# VE.Direct Protocol

## BlueSolar and SmartSolar MPPT chargers

victron energy
B L U E   P O W E R

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# 1  VE.Direct Protocol

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 | 0x51FA51FA51FA51FA51FA as payload will enable bootloader mode. |
| 1 | Ping | Check for presence, the response is an 'Rsp ping' containing version and firmware type. See the response ping message. |
| 3 | App version | 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. |
| 3 | Unknown | Unknown command, data is the unknown command. |
| 4 | Error | Frame error (payload=0xAAAA), unable to enter bootloader (payload=0). |
| 5 | Ping | The version number is directly interpreted from the hex representation, e.g. 0x0101 is version 1.01. The two most significant bits indicate the firmware type: <br> b00: bootloader <br> b01: application <br> b10: tester <br> b11: release candidate <br> In case of release candidate the lowest two bits of the highest nibble together with type indicate the release candidate number. E.g. 0xD101 represents release candidate D of version 1.01. <br> Note that there can only be 4 release candidates per version. |
| 7 | Get | uint16 — id: of the value being returned <br> uint8 — flags: defined below <br> type depends on id — value |
| 8 | Set | uint16 — id of the value which was set <br> uint8 — flags: defined below <br> type depends on id — value |

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 | Charger | Load output | Remark (*1) |
|---|---|---|---|---|
| 0x0300 | BlueSolar MPPT 70\|15 (*2 *3) | 12..24V-15A | 15A | - |
| 0xA040 | BlueSolar MPPT 75\|50 (*3) | 12..24V-50A | - | pv only |
| 0xA041 | BlueSolar MPPT 150\|35 (*3) | 12..48V-35A | - | pv only |
| 0xA042 | BlueSolar MPPT 75\|15 | 12..24V-15A | 15A | - |
| 0xA043 | BlueSolar MPPT 100\|15 | 12..24V-15A | 15A | - |
| 0xA044 | BlueSolar MPPT 100\|30 (*3) | 12..24V-30A | - | pv only |
| 0xA045 | BlueSolar MPPT 100\|50 (*3) | 12..24V-50A | - | pv only |
| 0xA046 | BlueSolar MPPT 150\|70 | 12..48V-70A | - | - |
| 0xA047 | BlueSolar MPPT 150\|100 | 12..48V-100A | - | - |
| 0xA048 | BlueSolar MPPT 75\|50 rev2 (*3) | 12..24V-50A | - | - |
| 0xA049 | BlueSolar MPPT 100\|50 rev2 | 12..24V-50A | - | - |
| 0xA04A | BlueSolar MPPT 100\|30 rev2 | 12..24V-30A | - | - |
| 0xA04B | BlueSolar MPPT 150\|35 rev2 | 12..48V-35A | - | - |
| 0xA04C | BlueSolar MPPT 75\|10 | 12..24V-10A | 10A | - |
| 0xA04D | BlueSolar MPPT 150\|45 | 12..48V-45A | - | - |
| 0xA04E | BlueSolar MPPT 150\|60 | 12..48V-60A | - | - |
| 0xA04F | BlueSolar MPPT 150\|85 | 12..48V-85A | - | - |
| 0xA050 | SmartSolar MPPT 250\|100 | 12..48V-100A | - | ble |
| 0xA051 | SmartSolar MPPT 150\|100 (*3 *4) | 12..48V-100A | - | ble |
| 0xA052 | SmartSolar MPPT 150\|85 (*3 *4) | 12..48V-85A | - | ble |
| 0xA053 | SmartSolar MPPT 75\|15 | 12..24V-15A | 15A | ble net |
| 0xA054 | SmartSolar MPPT 75\|10 | 12..24V-10A | 10A | ble net |
| 0xA055 | SmartSolar MPPT 100\|15 | 12..24V-15A | 15A | ble net |
| 0xA056 | SmartSolar MPPT 100\|30 | 12..24V-30A | - | ble net |
| 0xA057 | SmartSolar MPPT 100\|50 | 12..24V-50A | - | ble net |

| Id | Name | Charger | Load output | Remark (*1) |
|---|---|---|---|---|
| 0xA058 | SmartSolar MPPT 150\|35 | 12..48V-35A | - | ble net |
| 0xA059 | SmartSolar MPPT 150\|100 rev2 | 12..48V-100A | - | ble net |
| 0xA05A | SmartSolar MPPT 150\|85 rev2 | 12..48V-85A | - | ble net |
| 0xA05B | SmartSolar MPPT 250\|70 | 12..48V-70A | - | ble net |
| 0xA05C | SmartSolar MPPT 250\|85 | 12..48V-85A | - | ble |
| 0xA05D | SmartSolar MPPT 250\|60 | 12..48V-60A | - | ble net |
| 0xA05E | SmartSolar MPPT 250\|45 | 12..48V-45A | - | ble net |
| 0xA05F | SmartSolar MPPT 100\|20 | 12..24V-20A | 20A | ble net |
| 0xA060 | SmartSolar MPPT 100\|20 48V | 12..48V-20A | 100mA | ble net |
| 0xA061 | SmartSolar MPPT 150\|45 | 12..48V-45A | - | ble net |
| 0xA062 | SmartSolar MPPT 150\|60 | 12..48V-60A | - | ble net |
| 0xA063 | SmartSolar MPPT 150\|70 | 12..48V-70A | - | ble net |
| 0xA064 | SmartSolar MPPT 250\|85 rev2 | 12..48V-85A | - | ble net |
| 0xA065 | SmartSolar MPPT 250\|100 rev2 | 12..48V-100A | - | ble net |
| 0xA066 | BlueSolar MPPT 100\|20 | 12..24V-20A | 20A | - |
| 0xA067 | BlueSolar MPPT 100\|20 48V | 12..48V-20A | 100mA | - |
| 0xA068 | SmartSolar MPPT 250\|60 rev2 | 12..48V-60A | - | ble net |
| 0xA069 | SmartSolar MPPT 250\|70 rev2 | 12..48V-70A | - | ble net |
| 0xA06A | SmartSolar MPPT 150\|45 rev2 | 12..48V-45A | - | ble net |
| 0xA06B | SmartSolar MPPT 150\|60 rev2 | 12..48V-60A | - | ble net |
| 0xA06C | SmartSolar MPPT 150\|70 rev2 | 12..48V-70A | - | ble net |
| 0xA06D | SmartSolar MPPT 150\|85 rev2 | 12..48V-85A | - | ble net |
| 0xA06E | SmartSolar MPPT 150\|100 rev3 | 12..48V-100A | - | ble net |
| 0xA06F | BlueSolar MPPT 150\|45 rev2 | 12..48V-45A | - | - |
| 0xA070 | BlueSolar MPPT 150\|60 rev2 | 12..48V-60A | - | - |
| 0xA071 | BlueSolar MPPT 150\|70 rev2 | 12..48V-70A | - | - |
| 0xA072 | BlueSolar MPPT 150\|45 rev3 | 12..48V-45A | - | - |
| 0xA073 | SmartSolar MPPT 150\|45 rev3 | 12..48V-45A | - | ble net |
| 0xA074 | SmartSolar MPPT 75\|10 rev2 | 12..24V-10A | 10A | ble net |
| 0xA075 | SmartSolar MPPT 75\|15 rev2 | 12..24V-15A | 15A | ble net |
| 0xA076 | BlueSolar MPPT 100\|30 rev3 | 12..24V-30A | - | - |
| 0xA077 | BlueSolar MPPT 100\|50 rev3 | 12..24V-50A | - | - |
| 0xA078 | BlueSolar MPPT 150\|35 rev2 | 12..48V-35A | - | - |
| 0xA079 | BlueSolar MPPT 75\|10 rev2 | 12..24V-10A | 10A | - |
| 0xA07A | BlueSolar MPPT 75\|15 rev2 | 12..24V-15A | 15A | - |
| 0xA07B | BlueSolar MPPT 100\|15 rev2 | 12..24V-15A | 15A | - |
| 0xA07C | BlueSolar MPPT 75/10 rev3 | 12..24V-10A | 10A | - |
| 0xA07D | BlueSolar MPPT 75/15 rev3 | 12..24V-15A | 15A | - |
| 0xA07E | SmartSolar Charger MPPT 100/30 | 12V-30A | - | ble net |
| 0xA102 | SmartSolar MPPT VE.Can 150\|70 | 12..48V-70A | - | ble net |
| 0xA103 | SmartSolar MPPT VE.Can 150\|45 | 12..48V-45A | - | ble net |
| 0xA104 | SmartSolar MPPT VE.Can 150\|60 | 12..48V-60A | - | ble net |
| 0xA105 | SmartSolar MPPT VE.Can 150\|85 | 12..48V-85A | - | ble net |
| 0xA106 | SmartSolar MPPT VE.Can 150\|100 | 12..48V-100A | - | ble net |
| 0xA107 | SmartSolar MPPT VE.Can 250\|45 | 12..48V-45A | - | ble net |
| 0xA108 | SmartSolar MPPT VE.Can 250\|60 | 12..48V-60A | - | ble net |
| 0xA109 | SmartSolar MPPT VE.Can 250\|70 | 12..48V-70A | - | ble net |
| 0xA10A | SmartSolar MPPT VE.Can 250\|85 | 12..48V-85A | - | ble net |
| 0xA10B | SmartSolar MPPT VE.Can 250\|100 | 12..48V-100A | - | ble net |
| 0xA10C | SmartSolar MPPT VE.Can 150\|70 rev2 | 12..48V-70A | - | ble net |
| 0xA10D | SmartSolar MPPT VE.Can 150\|85 rev2 | 12..48V-85A | - | ble net |
| 0xA10E | SmartSolar MPPT VE.Can 150\|100 rev2 | 12..48V-100A | - | ble net |
| 0xA10F | BlueSolar MPPT VE.Can 150\|100 | 12..48V-100A | - | - |
| 0xA110 | SmartSolar MPPT RS 450/100 | 48V-100A | - | 2 trackers |
| 0xA111 | SmartSolar MPPT RS 450/200 | 48V-200A | - | 4 trackers |
| 0xA112 | BlueSolar MPPT VE.Can 250\|70 | 12..48V-70A | - | - |

| Id | Name | Charger | Load output | Remark (*1) |
|---|---|---|---|---|
| 0xA113 | BlueSolar MPPT VE.Can 250\|100 | 12..48V-100A | - | - |
| 0xA114 | SmartSolar MPPT VE.Can 250\|70 rev2 | 12..48V-70A | - | ble net |
| 0xA115 | SmartSolar MPPT VE.Can 250\|100 rev2 | 12..48V-7100A | - | ble net |
| 0xA116 | SmartSolar MPPT VE.Can 250\|85 rev2 | 12..48V-85A | - | ble net |
| 0xA117 | BlueSolar MPPT VE.Can 150\|100 rev2 | 12..48V-100A | - | - |

Note 1: "pv only" indicates that the unit is only operational when the solar panel power is present, i.e. no communication is possible during the night. "ble" indicates that the unit has an internal Bluetooth low-energy module and can be monitored/configured using the VictronConnect app, additionally "net" indicates that the model supports Bluetooth VE.Smart Networking (remote sense/synchronized charging). "trackers" indicates that the unit has a certain amount of independent MPPT trackers.

Note 2: There is a discrepancy between the labelling on the housing and the actual product id for the 70|15 models. A MPPT 70|15 from year/week 1308 or later is fully identical to the MPPT 75|15. This means that it is capable of history logging and the street lighting functionality is available for these models.

Note 3: These models are phased out (no longer being made/sold).

Note 4: Bluetooth communication channel multiplexed with the VE.Direct port. Once the VE.Direct port is in use the internal Bluetooth low-energy module cannot be used anymore.

## 1.1 Get and Set items

**Product information registers**

| ID | Description | Scale | Type | Unit |
|---|---|---|---|---|
| 0x0100 | Product Id (*1) | - | un32 | - |
| 0x0104 | Group Id (*3) | - | un8 | - |
| 0x010A | Serial number (*1) | - | string | - |
| 0x010B | Model name (*1) | - | string | - |
| 0x0140 | Capabilities (*2) | - | un32 | - |

Note 1: Available since firmware version 1.12 (2-bytes). Since firmware version 1.30 (4-bytes)
Note 2: Available since firmware version 1.16
Note 3: Available since firmware version 1.17, used for synchronized charging operation

### 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).

### Capabilities (register 0x0140)

| 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) |

**Generic device control registers**

| ID | Description | Scale | Type | Unit |
|---|---|---|---|---|
| 0x0200 | Device mode | - | un8 | - |
| 0x0201 | Device state | - | un8 | - |
| 0x0202 | Remote control used | - | un32 | - |
| 0x0205 | Device off reason (*1) | - | un8 | - |
| 0x0207 | Device off reason (*2) | - | un32 | - |

Note 1: firmware versions 1.29 up to 1.43. Available on SmartSolar models.
Note 2: firmware version 1.44. Available on SmartSolar and MPPT RS models only.

### Device mode values (register 0x0200)

| Mode | Meaning |
|---|---|
| 0 or 4 | Charger off (*2) |
| 1 | Charger on |

Note 1: The charger will only respond to on/off commands when the remote on/off bit is set in the remote control mask (see register 0x0202).
Note 2: Firmware version 1.16 and lower report the "Charger off" state as 0, firmware version 1.17 and higher report the "Charger off" state as 4. All firmware versions will accept both 0 and 4 as a "Charger off" command. Furthermore firmware 1.16 and lower report the actual operation state of the unit (is actually charging or not). Firmware version 1.17 will report the condition of the soft on/off switch. To find out if the unit is operational or not check register 0x0201.

### 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 |
| 245 | WAKE-UP | The device is about to start (signal to external control) |
| 247 | AUTO EQUALISE | Voltage controlled with equalisation voltage set-point |
| 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 |

Note 1: batterysafe mode will be reported as state 3 (bulk), see register 0xEDD4 to determine if batterysafe mode is active, available until firmware version 1.13.
Note 2: automatic equalisation mode: firmware version 1.39 and lower report state 4 (absorption), see register 0xEDD4 to determine if automatic equalisation mode is active. Firmware version 1.42 and higher report state 247.
Note 3: manual equalisation mode reports as state 7. It can be started using the plug-in display (setup menu item 10) for models that support this, the MPPT control (setup menu item 25) or by using the VictronConnect app.

### Remote control used bit-mask (register 0x0202)

| Bit | Meaning |
|---|---|
| 0 | Reserved |
| 1 | Enable remote ON/OFF control |

| Bit | Meaning |
|---|---|
| 2..31 | Reserved |

Note 1: The mask value 0x00000002 needs to be sent at least once after power-up of the charger in order to enable remote ON/OFF control (when using register 0x0200).

Note 2: Bits can only be set to '1' in this register. The bits will only be cleared when the unit restarts. Setting reserved bits is allowed but has no effect.

Note 3: In firmware version 1.42 and up bit 1 is set by default, so the device mode command can be used directly.

### Device off reason bit-mask (registers 0x0205,0x0207)

| Bit | Meaning |
|---|---|
| 0 | No input power (solar panels) |
| 1 | Physical power switch (MPPT RS models only) |
| 2 | Soft power switch (device mode or pluggable display) |
| 3 | Remote input (either via VE.Direct RX pin alternate function or dedicated remote input) |
| 4 | Internal reason |
| 5 | Pay-as-you-go out of credit |
| 6 | BMS shutdown |
| 7..8 | Reserved |
| 9 | Battery temperature too low (charging not allowed) |

Only available on SmartSolar models.

## 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 (*1,*9) | - | un8 | 0=off, 1=on |
| 0xEDFE | Adaptive mode (*10) | - | un8 | 0=off, 1=on |
| 0xEDFD | Automatic equalisation mode (*2) | - | un8 | 0=off, 1..250 |
| 0xEDFC | Battery bulk time limit (*9) | 0.01 | un16 | hours |
| 0xEDFB | Battery absorption time limit | 0.01 | un16 | hours |
| 0xEDF7 | Battery absorption voltage (*5) | 0.01 | un16 | V |
| 0xEDF6 | Battery float voltage (*5) | 0.01 | un16 | V |
| 0xEDF4 | Battery equalisation voltage (*3,*5) | 0.01 | un16 | V |
| 0xEDF2 | Battery temp. compensation (*5) | 0.01 | sn16 | mV/K |
| 0xEDF1 | Battery type | 1 | un8 | 0xFF = user |
| 0xEDF0 | Battery maximum current | 0.1 | un16 | A |
| 0xEDEF | Battery voltage (*4) | 1 | un8 | V |
| 0xEDEC | Battery temperature (*8) | 0.01 | un16 | K, 0xFFFF=N/A |
| 0xEDEA | Battery voltage setting (*4, *7) | 1 | un8 | V |
| 0xEDE8 | BMS present (*6) | - | un8 | 0=no, 1=yes |
| 0xEDE7 | Tail current (*10) | 0.1 | un16 | |
| 0xEDE6 | Low temperature charge current (*8) | 0.1 | un16 | A, 0xFFFF=use max |
| 0xEDE5 | Auto equalise stop on voltage (*10) | - | un8 | 0=no, 1=yes |
| 0xEDE4 | Equalisation current level (*10) | 1 | un8 | % (of 0xEDF0) |
| 0xEDE3 | Equalisation duration (*10) | 0.01 | un16 | hours |
| 0xED2E | Re-bulk voltage offset (*10) | 0.01 | un16 | V |

| 0xEDE0 | Battery low temperature level (*8) | 0.01 | sn16 | °C |
|--------|-----------------------------------|------|------|-----|
| 0xEDCA | Voltage compensation (*10) | 0.01 | un16 | V |

Note 1: Safe mode has been permanently disabled since firmware version 1.13.

Note 2: Automatic equalisation mode can be set to the values 0 (=off), 1 (=every day), 2 (=every other day) up to 250. Introduced in firmware version 1.16.

Note 3: Introduced in firmware version 1.16.

Note 4: 0xEDEF can be written to force the system into a fixed battery voltage setting. Reading 0xEDEF will always reports the operational voltage. 0xEDEA can be used to check if the battery voltage is set to AUTO (0), register 0xEDEA has been added since firmware version 1.12.

Note 5: In order to change these parameters the battery type (register 0xEDF1) must be set to user defined (0xFF). The charger checks the validity of these parameters, for a 12V system the voltage settings must be between 8V and 17.4V and the temperature compensation must be between -21mV and +21mV. If these conditions are not met an error 119 is issued. This error can only be resolved by correcting the settings (e.g. reset to factory defaults) followed by a system reset (e.g. power cycle).

Note 6: Introduced in firmware version 1.17. Set to '1' automatically when a BMS is detected. This register can be used to clear the BMS present setting in order to return the unit to stand-alone operation.

Note 7: From firmware version 1.17 the battery voltage setting register (0xEDEA) can be written as well, a write to this register has the same effect as writing to the battery voltage register (0xEDEF).

Note 8: Introduced in firmware version 1.30.

Note 9: Removed in firmware version 1.42.

Note 10: Introduced in firmware version 1.42.

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

10A/15A/20A Chargers (without rotary switch and load output)

| Value | Name | Meaning |
|-------|------|---------|
| 1 | TYPE_2 | GEL Victron Deep discharge |
| 255 | USER | User defined |

30A/35A/45A/50A/65A/70A/85A/100A Chargers (with rotary switch)

| Value | Name | Meaning |
|-------|------|---------|
| 1 | TYPE_1 | GEL Victron Long Life (14.1V) |
| 2 | TYPE_2 | GEL Victron Deep discharge (14.3V) |
| 2 | TYPE_3 | GEL Victron Deep discharge (14.4V) |
| 3 | TYPE_4 | AGM Victron Deep discharge (14.7V) |
| 5 | TYPE_5 | Tubular plate cyclic mode 1 (14.9V) |
| 6 | TYPE_6 | Tubular plate cyclic mode 2 (15.1V) |
| 7 | TYPE_7 | Tubular plate cyclic mode 3 (15.3V) |
| 8 | TYPE_8 | LiFEPO4 (14.2V) |
| 255 | USER | User defined |

These chargers have a rotary switch to select the battery type. When the battery type is written it can be set to 255 (user) so the battery parameters can be set remotely. Writing a value different from 255 will revert back to the rotary setting. A read will either return the rotary type or 255 (user). Note that the labelling on the housing is numbered from 0..7

MPPT RS Chargers

| Value | Name | Meaning |
|-------|------|---------|
| 1 | AGM_NORMAL | GEL Victron Deep discharge (57.6V) |
| 2 | AGM_HIGH | AGM Victron Deep discharge (58.8V) |
| 3 | LITHIUM | LiFePO4 (56.8V) with 2-wire BMS |

| Value | Name | Meaning |
|---|---|---|
| 255 | USER | User defined |

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

| Value | Meaning |
|---|---|
| 0 | Auto detection at startup |
| 12 | 12V battery |
| 24 | 24V battery |
| 36 | 36V battery |
| 48 | 48V battery |

Note 1: For auto detection (setting 0) to work properly, the battery must be connected **before** the solar panel is connected. Reading the battery voltage register (0xEDEF) always returns the actual battery voltage setting (e.g. if the auto detection is active and the charger detected a 24V battery the read-back value will be 24). When this setting is written with a battery voltage (e.g. 12) the auto detection mechanism will be disabled. The 10A, 15A, 30A and 50A chargers can operate at 12 or 24V. The 35A, 45A, 60A, 70A, 85A and 100A chargers can operate at 12, 24, 36 and 48V. Note that 36V will never be auto detected, since these voltages overlap with the 24V and 48V battery range. For the charger to operate in 36V mode, it must be set to this voltage manually (e.g. by using the VictronConnect app).

Note 2: In firmware 1.26 and higher the automatic voltage detection only takes place at the first power-up. Once the voltage is detected the automatic voltage detection will be disabled. A voltage detection is considered to be successful when the battery voltage is > 7V at power-up. If the battery voltage is absent and only the panels are connected the charger will operate at 12V but auto detection remains active.

Note 3: The MPPT 100|20 48V operates at 48V by default, it will never perform an automatic voltage detection, it can be set manually to 12,24 or 36V.

Note 4: For fixed voltage models this register is read-only.

## 2-wire BMS input - MPPT RS models only

MPPT RS models only

| ID | Description | Scale | Type | Unit |
|---|---|---|---|---|
| 0xD0C0 | Remote input mode configuration | - | un8 | - |
| 0xD01F | 2-wire BMS input states | - | un8 | - |

### Remote input mode configuration values (register 0xD0C0) - MPPT RS models only

| Value | Meaning |
|---|---|
| 0 | Remote on/off |
| 1 | 2-wire BMS signals |

This determines the function of the REMOTE_L and REMOTE_H pins on the user I/O connector in the front panel. It is only writable when a user defined battery type is selected (register 0xEDF1).

### 2-wire BMS input states (registers 0xD01F) - MPPT RS models only

| Bit | Meaning |
|---|---|
| 0 | 2-wire BMS input enabled |
| 1 | allow to discharge active |
| 2 | allow to charge active |

This shows the actual state of the 2-wire BMS input.

**Charger data registers**

| ID | Description | Scale | Type | Unit |
|---|---|---|---|---|
| 0xEDEC | Battery temperature (*7) | 0.01 | un16 | K |
| 0xEDDF | Charger maximum current (*1) | 0.1 | un16 | A |
| 0xEDDD | System yield (*2) | 0.01 | un32 | kWh |
| 0xEDDC | User yield (resettable) (*2) | 0.01 | un32 | kWh |
| 0xEDDB | Charger internal temperature | 0.01 | sn16 | °C |
| 0xEDDA | Charger error code | - | un8 | - |
| 0xEDD7 | Charger current (*3) | 0.1 | un16 | A |
| 0xEDD5 | Charger voltage (*3) | 0.01 | un16 | V |
| 0xEDD4 | Additional charger state info | - | un8 | - |
| 0xEDD3 | Yield today (*2) | 0.01 | (*4) | kWh |
| 0xEDD2 | Maximum power today (*2) | 1 | un16 | W |
| 0xEDD1 | Yield yesterday (*2) | 0.01 | (*4) | kWh |
| 0xEDD0 | Maximum power yesterday (*2) | 1 | un16 | W |
| 0xEDCE | Voltage settings range (*5) | - | un16 | - |
| 0xEDCD | History version (*1) | - | un8 | - |
| 0xEDCC | Streetlight version (*1) | - | un8 | - |
| 0xEDC7 | Equalise current maximum (*8) | 1 | un8 | % |
| 0xEDC6 | Equalise voltage maximum (*8) | 0.01 | un16 | V |
| 0x2211 | Adjustable voltage minimum (*6) | 0.01 | un16 | V |
| 0x2212 | Adjustable voltage maximum (*6) | 0.01 | un16 | V |

Note 1: Available in firmware version 1.16 and higher.
Note 2: Historical data is available on all models except the BlueSolar MPPT 70|15 charger (product id 0x0300)
Note 3: The charger voltage is the voltage across the battery terminals of the charger. The charger current is the sum of the current flowing to the battery and the load output. To report the battery current the load current (0xEDAD) must be subtracted manually.
Note 4: The type is an un32 up to and including v1.12, in higher versions it is an un16.
Note 5: The low-byte is the minimum system voltage and the high byte is maximum system voltage (both in 1V units). Available in firmware version 1.16 and higher.
Note 6: Available in firmware version 1.30. These indicate the allowed voltage adjustment range for absorption, float and equalisation settings.
Note 7: Available in firmware version 1.42. This shows the battery temperature if a BMV or a Smart Battery Sense is connected via VE.Smart networking.
Note 8: MPPT RS models only.

**Additional charger state info bit-mask (register 0xEDD4)**

| Bit | Meaning |
|---|---|
| 0 | Safe mode active (*1,*3) |
| 1 | Automatic equalisation active (*2,*3) |
| 4 | Temperature dimming active |
| 6 | Input current dimming active |

Note 1: Safe mode has been permanently disabled since firmware version 1.13.
Note 2: Automatic equalisation is introduced in firmware version 1.16.
Note 3: Since firmware version 1.42 this information is moved to register 0x0201, these bits are no longer used.

**Charger error code values (register 0xEDDA)**

| Error | Meaning |
|-------|---------|
| 0 | No error |
| 2 | Battery voltage too high |
| 3..5 | Battery temperature sensor issue |
| 6..8 | Battery voltage sensor issue |
| 14 | Battery temperature too low (charging not allowed) |
| 17 | Charger internal temperature too high |
| 18 | Charger excessive output current |
| 19 | Charger current polarity reversed |
| 20 | Charger bulk time expired (when 10 hour bulk time protection active) |
| 21 | Charger current sensor issue (bias not within expected limits during off state) |
| 22,23 | Charger internal temperature sensor issue |
| 26 | Charger terminals overheated |
| 27 | Charger short-circuit |
| 28 | Converter issue (dual converter models, one of the converters is not working) |
| 29 | Battery over-charge protection |
| 33 | Input voltage too high |
| 34 | Input excessive current |
| 38 | Input shutdown (due to excessive battery voltage) |
| 39 | Input shutdown (current flowing while the converter is switched off) |
| 66 | Incompatible device in the network (for synchronized charging) |
| 67 | BMS connection lost |
| 68 | Network misconfigured (e.g. combining ESS with ve.smart networking) |
| 116 | Calibration data lost |
| 117 | Incompatible firmware (i.e. not for this model) |
| 119 | Settings data invalid / corrupted (use restore to defaults and reset to recover) |

Notes: Error 19 is disabled since firmware version 1.15, it can be safely ignored in older versions. Error 21 can occur at start-up/shutdown it can be ignored for 5 minutes, this is resolved in firmware version 1.16. Errors 26 and 38 are added in firmware version 1.16. Error 34 is removed in firmware version 1.29. Error 116 also occurs if the firmware on a SmartSolar unit is downgraded from v1.40 or higher to v1.39 or lower.

**DC channel registers - MPPT RS models only**

| ID | Description | Scale | Type | Unit |
|--------|-------------|-------|------|------|
| 0xED8B | Battery ripple voltage | 0.01 | un16 | V |
| 0xED8D | Battery voltage (replaces 0xEDD5) | 0.01 | sn16 | V |
| 0xED8F | Battery current (replaces 0xEDD7) | 0.1 | sn16 | A |

**Solar panel data registers**

| ID | Description | Scale | Type | Unit |
|---|---|---|---|---|
| 0x0244 | Number of MPPT trackers (*4) | - | un8 | - |
| 0xEDBF | Panel maximum current (*4) | 0.1 | un16 | A |
| 0xEDBC | Panel power | 0.01 | un32 | W |
| 0xEDBB | Panel voltage | 0.01 | un16 | V |
| 0xEDBD | Panel current (*1) | 0.1 | un16 | A |
| 0xEDB8 | Panel maximum voltage (*2) | 0.01 | un16 | V |
| 0xEDB3 | Tracker mode (*3) | - | un8 | - |
| 0xEDB2 | Panel starting voltage (*4) | 0.01 | un16 | V |
| 0xEDB1 | Panel input resistance (*4) | 1 | un32 | Ohm |

Note 1: The panel current is not available in the 10A/15A/20A chargers.
Note 2: The maximum allowed panel voltage is added in firmware version 1.16.
Note 3: Added in firmware version 1.42. 0 = off, 1 = voltage/current limited, 2 = MPP tracker.
Note 4: MPPT RS models only.

**Solar panel data individual MPPT trackers registers - MPPT RS models only**

The MPPT RS has multiple trackers. You can access the individual tracker information using the following registers. The panel power register (0xEDBC) gives the combined power for the entire unit.

| Description | Tracker1 | Tracker2 | Tracker3 | Tracker4 |
|---|---|---|---|---|
| Panel power (see 0xEDBC) | 0xECCC | 0xECDC | 0xECEC | 0xECFC |
| Panel voltage (see 0xEDBB) | 0xECCB | 0xECDB | 0xECEB | 0xECFB |
| Panel current (see 0xEDBD) | 0xECCD | 0xECDD | 0xECED | 0xECFD |
| Tracker mode (see 0xEDB3) | 0xECC3 | 0xECD3 | 0xECE3 | 0xECF3 |

Use register 0x0244 to determine how many trackers the connected MPPT RS supports.

**Load output data/settings registers**
These registers are only available on the models that have a load output (10A/15A/20A models).

| ID | Description | Scale | Type | Unit |
|---|---|---|---|---|
| 0xEDAD | Load current | 0.1 | un16 | A |
| 0xEDAC | Load offset voltage | 0.01 | un8 | V |
| 0xEDAB | Load output control | - | un8 | - |
| 0xEDA9 | Load output voltage (*1) | 0.01 | un16 | V |
| 0xEDA8 | Load output state | - | un8 | - |
| 0xED9D | Load switch high level (*2) | 0.01 | un16 | V |
| 0xED9C | Load switch low level (*2) | 0.01 | un16 | V |
| 0xED91 | Load output off reason (*3) | - | un8 | - |
| 0xED90 | Load AES timer (*4) | 1 | un16 | minute |

Note 1: The load output voltage is only available on smart solar 10A/15A/20A chargers.
Note 2: The user defined load switch mode is introduced in firmware version 1.15. Note that this function does not work in combination with 24V operation, please use firmware version 1.16 if this functionality is required. The user defined load switch is not available on the MPPT 70|15.
Note 3: Added in firmware version 1.20. Available on SmartSolar models.
Note 4: Added in firmware version 1.26. Available on SmartSolar models with a load output.

*Load output state values (register 0xEDA8)*

| State | Name | Meaning |
|---|---|---|
| 0 | OFF | Load output is off |
| 1 | ON | Load output is on |

*Load output control values (register 0xEDAB)*

| Value | Name | Meaning |
|---|---|---|
| 0 | OFF | Load output off |
| 1 | AUTO | Automatic control / batterylife (default) |
| 2 | ALT1 | Alternative control 1 (off<11.1V, on>13.1V) |
| 3 | ALT2 | Alternative control 2 (off<11.8V, on>14.0V) |
| 4 | ON | Load output on (use with caution, no discharge guard) |
| 5 | USER1 | User defined settings 1 (off<Vlow, on>Vhigh) (*2) |
| 6 | USER2 | User defined settings 2 (off<Vlow<on<Vhigh<off) (*2) |
| 7 | AES | Automatic Energy Selector (*3) |

| Bit | Description |
|---|---|
| 7 | Lighting controller timer (1=active) |

Note 1: Make sure to mask the lower 4 bits when using the load output control values, the upper 4 bits are reserved for other purposes.
Note 2: The user defined settings make use of the load switch high and low level registers. This feature is introduced in firmware version 1.15.
Note 3: The automatic energy selector can be customized by the load switch high (switch on level), load switch low level (switch off level) and AES timer (on duration when between the on and off levels) registers. This feature is introduced in firmware version 1.26 and is available on SmartSolar models with a load output.

### Load output off reason bit-mask (register 0xED91)

| Bit | Meaning |
|---|---|
| 0 | Battery low |
| 1 | Short circuit |
| 2 | Timer program |
| 3 | Remote input (VE.Direct RX pin alternate function) |
| 4 | Pay-as-you-go out of credit |
| 5 | Reserved |
| 6 | Reserved |
| 7 | Device starting up |

Note: added in firmware version 1.20. Available on SmartSolar models.

## Relay settings registers

These registers are only available on the models that have a relay output.

| ID | Description | Scale | Type | Unit |
|---|---|---|---|---|
| 0xEDD9 | Relay operation mode | - | un8 | - |
| 0x0350 | Relay battery low voltage set | 0.01 | un16 | V |
| 0x0351 | Relay battery low voltage clear | 0.01 | un16 | V |
| 0x0352 | Relay battery high voltage set | 0.01 | un16 | V |
| 0x0353 | Relay battery high voltage clear | 0.01 | un16 | V |
| 0xEDBA | Relay panel high voltage set | 0.01 | un16 | V |
| 0xEDB9 | Relay panel high voltage clear | 0.01 | un16 | V |
| 0x100A | Relay minimum enabled time | 1 | un16 | minute |

### Relay operation modes (register 0xEDD9)

| Value | Description |
|---|---|
| 0 | Relay always off |
| 1 | Panel voltage high (uses 0xEDBA,0xEDB9) |
| 2 | Internal temperature high (> 85°C / 185F) |
| 3 | Battery voltage too low (uses 0x0350,0x0351) |
| 4 | Equalisation active |
| 5 | Error condition present |
| 6 | Internal temperature low (< -20°C / -4F) |
| 7 | Battery voltage too high (uses 0x0352,0x0353) |
| 8 | Charger in float or storage |
| 9 | Day detection (panels irradiated) |
| 10 | Load control (relay switches according to the load control mode) |

**Lighting controller timer**

The lighting controller (timer) functionality is available from firmware version 1.15 and higher on the 10/15/20A models with a load output, except the BlueSolar MPPT 70|15 charger (product id 0x0300).

| ID | Description | Scale | Type | Unit |
|---|---|---|---|---|
| 0xEDA0 ... 0xEDA5 | Timer events 0..5 | - | un32 | - |
| 0xEDA7 | Mid-point shift (*1) | 1 | sn16 | min |
| 0xED9B | Gradual dim speed (*2) | 1 | un8 | s |
| 0xED9A | Panel voltage night (*3) | 0.01 | un16 | V |
| 0xED99 | Panel voltage day (*3) | 0.01 | un16 | V |
| 0xED96 | Sunset delay (*4) | 1 | un16 | min |
| 0xED97 | Sunrise delay (*4) | 1 | un16 | min |
| 0xED90 | AES Timer | 1 | un16 | min |
| 0x2030 | Solar activity | - | un8 | 0=dark, 1=light |
| 0x2031 | Time-of-day (*5) | 1 | un16 | min, 0=mid-night |

Note 1: The mid-point shift can be used to compensate the difference between the solar mid-night (halfway between sunset and sunrise) and the actual mid-night (clock wise).

Note 2: The gradual dimming option can be used to mask differences in day/night detection between individual units that are located in each other's proximity. A value of 0 (=default) means that gradual dimming is disabled, i.e. immediate response. Another value is interpreted as 1% change per x seconds, e.g. when using a value of 9 it takes 15 minutes to dim from 0 to 100%. Introduced in firmware version 1.16.

Note 3: The day/night panel voltage settings can be useful to tweak the behaviour of the system, so it matches with the actual panel configuration. The day detection voltage must be higher than the night detection voltage level. The lowest detectable voltage is 11.4V. Set this option to 0 to use the built-in defaults. Introduced in firmware version 1.16. Since firmware version 1.26 it is possible to use voltage settings below 11.4V.

Note 4: The sunset and sunrise delays can be used to make the system less sensitive for clouds passing over the solar panels. Introduced in firmware version 1.26.

Note 5: The time-of-day can be read to verify the synchronization of the solar clock. It can also be written with the current time (the charger will use this time for 5 days before falling back to the solar activity). The value is the number of minutes since mid-night. A value of 0xFFFF indicates that the time is unknown (e.g. when the charger is not yet synchronized).

**Timer events (registers 0xEDA0..0xEDA5)**

A timer event consists of a 32-bit word with the following content

| Bits | Description | Scale | Type | Unit |
|---|---|---|---|---|
| 0..15 | Time offset | 1 | sn16 | min |
| 16..23 | Anchor point | - | un8 | - |
| 24..31 | Dim action (0..100) | 1 | un8 | % |

**Anchor points (bits 16..23 in registers 0xEDA0..0xEDA5)**

| Value | Description |
|---|---|
| 1 | Sunset |
| 2 | Mid-night |
| 3 | Sunrise |

Note: The sunset and sunrise moments are absolute; using the mid-night point requires synchronization of the charger with the solar activity.

**VE.Direct port functions**

| ID | Description | Scale | Type | Unit |
|---|---|---|---|---|
| 0xED9E | TX Port operation mode | - | un8 | - |
| 0xED98 | RX Port operation mode (*1) | - | un8 | - |

Note 1: The RX Port operation mode is only available on the 10A/15A/20A models since firmware version 1.17.

**VE.Direct TX Port operation modes (register 0xED9E)**

| Value | Description |
|---|---|
| 0 | Normal VE.Direct communication (default) |
| 1 | Pulse for every 0.01kWh harvested (100ms low) |
| 2 | Lighting control pwm normal (f=160Hz, 0%=0V) (*2) |
| 3 | Lighting control pwm inverted (f=160Hz, 0%=5V) (*2) |
| 4 | Virtual load output (*3) |

Note 1: Any mode other than 0 effectively disables communication. In these modes the TEXT protocol broadcasts will be disabled. When the charger receives a valid HEX frame, it will send a response before falling back to mode as defined by this register.
Note 2: Modes 2 and 3 are only available in combination with the lighting controller timer.
Note 3: Mode 4 is only available on selected models without a real load output (typically product id 0xA046 and higher). A VE.Direct TX digital output cable can be used to connect to a Battery Protect or DC/DC solid state relay. Available since firmware version 1.17.

**VE.Direct RX Port operation modes (register 0xED98)**

| Value | Description |
|---|---|
| 0 | Remote on/off (*2) |
| 1 | Load output configuration (*2) |
| 2 | Load output on/off remote control (inverted) |
| 3 | Load output on/off remote control (normal) (*1) |

Note 1: Added in firmware version 1.26.
Note 2: "Load output configuration" is the default behaviour for models with a load output. "Remote on/off" is the default behaviour for models without a load output.

**Restore factory defaults**

| ID | Description |
|---|---|
| 0x0004 | Restore default |

When a write message is addressed to register Id 0x0004, all settings of the device, with the exception of 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 except the BlueSolar MPPT 70|15 charger (product id 0x0300). The history registers are introduced in firmware version 1.16.

| ID | Description |
|---|---|
| 0x1030 | Clear history |
| 0x104F | Total history |
| 0x1050 ... 0x106E | Daily history (0x1050=today, 0x1051=yesterday, ...) (*1) |
| 0x10A0 ... 0x10BE | Daily MPPT history (0x10A0=today, 0x10A1=yesterday, ...) (*1, *2) |

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.
Note 2: Only available on units that have multiple MPPT trackers like the MPPT RS models.

*History total record (register 0x104F) - firmware version 1.16 - 19 bytes payload*

| Bytes | Description | Scale | Type | Unit |
|---|---|---|---|---|
| 0 | Reserved (=0) | - | un8 | - |
| 1 | Error database (=0) | - | un8 | - |
| 2 | Error 0 (most recent) (*1) | - | un8 | - |
| 3 | Error 1 (*1) | - | un8 | - |
| 4 | Error 2 (*1) | - | un8 | - |
| 5 | Error 3 (oldest) (*1) | - | un8 | - |
| 6 | Total yield (user resettable) | 0.01 | un32 | kWh |
| 10 | Total yield (system) | 0.01 | un32 | kWh |
| 14 | Panel voltage maximum | 0.01 | un16 | V |
| 16 | Battery voltage maximum | 0.01 | un16 | V |
| 18 | Number of days available (*2) | - | un8 | - |

Note 1: For the error meanings see the description of register 0xEDDA.
Note 2: When the charger starts for the first time or after a history reset the 30 day backlog buffer will be empty. This field can be used to know in advance how many days of history are available without having to query all the individual daily registers.

*History total record (register 0x104F) - firmware version 1.17 and higher - 34 bytes payload*

| Bytes | Description | Scale | Type | Unit |
|---|---|---|---|---|
| 0 | Reserved (=1) | - | un8 | - |
| 1..18 | See table above (*1) | | | |
| 19 | Battery voltage minimum | 0.01 | un16 | V |
| 21 | 13 reserved bytes (=0xFF) | - | un8 | - |

Note 1: Bytes 1 to 18 are identical to firmware 1.16.

### History day record (registers 0x1050..0x106E) - 34 bytes payload

| Bytes | Description | Scale | Type | Unit |
|---|---|---|---|---|
| 0 | Reserved (=0) | - | un8 | - |
| 1 | Yield | 0.01 | un32 | kWh |
| 5 | Consumed (*1) | 0.01 | un32 | kWh |
| 9 | Battery voltage maximum | 0.01 | un16 | V |
| 11 | Battery voltage minimum | 0.01 | un16 | V |
| 13 | Error database (=0) | - | un8 | - |
| 14 | Error 0 (most recent) (*2) | - | un8 | - |
| 15 | Error 1 (*2) | - | un8 | - |
| 16 | Error 2 (*2) | - | un8 | - |
| 17 | Error 3 (oldest) (*2) | - | un8 | - |
| 18 | Time bulk | 1 | un16 | min |
| 20 | Time absorption | 1 | un16 | min |
| 22 | Time float | 1 | un16 | min |
| 24 | Power maximum | 1 | un32 | W |
| 28 | Battery current maximum | 0.1 | un16 | A |
| 30 | Panel voltage maximum | 0.01 | un16 | V |
| 32 | Day sequence number (*3) | - | un16 | - |

Note 1: Consumed is not available on models without load output (reads as 0xFFFFFFFF).
Note 2: For the error meanings see the description of register 0xEDDA.
Note 3: The sequence number can be used to uniquely identify a day. This number will stay the same while data traverses through the 30 day backlog buffer. For each new day added the sequence number will be increased by 1, at the count of 365 it will be wrapped to 0.

### History MPPT day record (registers 0x10A0..0x10BD)

The MPPT RS have multiple trackers. You can access the individual tracker history data using these registers. The 'regular' history day records give the combined data for the entire unit.

| Bytes | Description | Scale | Type | Unit |
|---|---|---|---|---|
| 0 | Reserved (=0) | - | un8 | - |
| 1 | Day sequence number | - | un16 | - |
| 3 | Energy tracker #1 | 0.01 | un16 | kWh |
| 5 | Energy tracker #2 | 0.01 | un16 | kWh |
| 7 | Energy tracker #3 | 0.01 | un16 | kWh |
| 9 | Energy tracker #4 | 0.01 | un16 | kWh |
| 11 | Peak power tracker #1 | 1 | un16 | W |
| 13 | Peak power tracker #2 | 1 | un16 | W |
| 15 | Peak power tracker #3 | 1 | un16 | W |
| 17 | Peak power tracker #4 | 1 | un16 | W |
| 19 | Voc max tracker #1 | 0.01 | un16 | V |
| 21 | Voc max tracker #2 | 0.01 | un16 | V |
| 23 | Voc max tracker #3 | 0.01 | un16 | V |
| 25 | Voc max tracker #4 | 0.01 | un16 | V |
| 27 | 9 reserved bytes (=0xFF) | - | un8 | - |

Use register 0x0244 to determine how many trackers the connected MPPT RS supports. Fields that are not present in the given unit report as 0xFFFF.

**Pluggable display settings**

Only available on models with the pluggable LCD display.

| ID | Description | Type |
|---|---|---|
| 0x0400 | Display backlight mode (0 = keypress, 1 = on,  2 = auto) | un8 |
| 0x0401 | Display backlight intensity (0 = always off, 1 = on) | un8 |
| 0x0402 | Display scroll text speed (1 = slow, 5 = fast) | un8 |
| 0x0403 | Display setup lock (0 = unlocked, 1 = locked) (*2) | un8 |
| 0x0404 | Display temperature unit (0 = Celsius, 1 = Fahrenheit) (*2) | un8 |

Note 1: These registers are primarily intended for settings migration to be used by the firmware updater.
Note 2: Since firmware v1.30.


**Internal display settings**

Only applies to the MPPT RS models.

| ID | Description | Type |
|---|---|---|
| 0x0401 | Display backlight intensity (0 = always off, 1 = on) | un8 |
| 0x0402 | Display scroll text speed (1 = slow, 5 = fast) | un8 |
| 0x0404 | Display temperature unit (0 = Celsius, 1 = Fahrenheit) | un8 |
| 0x0406 | Display contrast (*1) | un8 |
| 0x0408 | Display backlight mode (0 = off, 1 = on,  2 = auto) | un8 |

Note 1: only for certain models, does not apply to the rectangular LCD display with white characters on the dark blue background as this display lacks hardware support for contrast adjustment.

**Remote control registers - firmware v1.29 or higher (v1.02 or higher for VE.Can MPPTs)**

Note: the remote control registers were already present since firmware version 1.17 for experimental purposes. Remote control is officially supported since firmware version 1.29 (v1.02 for VE.Can MPPTs). Synchronized charging is available for firmware version 1.44 or higher (v1.02 or higher for VE.Can MPPTs) on SmartSolar chargers with an integrated Bluetooth device that is VE.Smart network capable (see the product id table page 5, look for 'ble net').

| ID | Description | Scale | Type | Unit |
|---|---|---|---|---|
| 0x2000 | Charge algorithm version (*1,*8) | - | un8 | - |
| 0x2001 | Charge voltage set-point (*2) | 0.01 | un16 | V |
| 0x2002 | Battery voltage sense (*3) | 0.01 | un16 | V |
| 0x2003 | Battery temperature sense (*3) | 0.01 | sn16 | °C |
| 0x2004 | Remote command | - | un8 | - |
| 0x2007 | Charge state elapsed time (*4, *8) | 1 | un32 | ms |
| 0x2008 | Absorption time (*4, *8) | 0.01 | un16 | hours |
| 0x2009 | Error code (*8) | - | un8 | - |
| 0x200A | Battery charge current (*8) | 0.001 | sn32 | A |
| 0x200B | Battery idle voltage (*8) | 0.01 | un16 | V |
| 0x200C | Device state (*8) | - | un8 | - |
| 0x200D | Network info (*7) | - | un8 | - |
| 0x200E | Network mode | - | un8 | - |
| 0x200F | Network status register | - | un8 | - |
| 0x2013 | Total charge current (*8) | 0.001 | sn32 | A |
| 0x2014 | Charge current percentage (*5) | 1 | un8 | % |
| 0x2015 | Charge current limit (*6) | 0.1 | un16 | A |
| 0x2018 | Manual equalisation pending (*8) | - | un8 | - |
| 0x2027 | Total DC input power (*8) | 0.01 | un32 | W |

Note 1: The charge algorithm version in combination with register 0x0104 is used for identification and grouping of chargers specifically intended for synchronized charging.
Note 2: 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 3: 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.
Note 4: The time data must be copied from the master unit to the slave units. This ensures that the slaves have the information required to take over the master role if needed (e.g. when the master is switched off).
Note 5: Deprecated, replaced by 0x2015 (was present in firmware version 1.17 only).
Note 6: Firmware version 1.19 and higher (v1.02 or higher on VE.Can MPPTs). See network mode register 0x200E.
Note 7: Added in firmware version 1.42 (v1.02 on VE.Can MPPTs).
Note 8: Implemented in firmware version 1.44 or higher (v1.02 or higher on VE.Can MPPTs) only on SmartSolar models that support synchronised charging.

**Remote commands (register 0x2004)**

| Value | Description |
|---|---|
| 1 | Start equalise (*1) |

| Value | Description |
|---|---|
| 2 | Stop equalise (*1) |
| 3 | Synchronize user interface (*2) |
| 4 | Synchronize day event (*3) |

Note 1: Only available on models that support manual equalisation (check register 0x0140).

Note 2: Synchronize blinking leds / icons (on a display), not used on VE.Direct.

Note 3: First unit to detect a new day sends this message so all grouped units will update their daily history at the same time, not used on VE.Direct.

### 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 behavior, charger uses internal charge profile |
| Charge master | Set 0x200E to b0100001, charger uses internal charge profile |
| Slave mode | Set 0x200E to b0000011, write to registers 0x0201 and 0x200x |
| 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..

Slave mode

Use this mode when the charger is to be a slave of another charger. In this mode, provide the following values to the charger:

- Charge voltage set-point     0x2001
- Charge state (bulk/abs/...)     0x200C
- Charge state elapsed time     0x2007
- Absorption time     0x2008
- Battery idle voltage     0x200B
- Battery charge current     0x200A

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

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).

Firmware versions up to and including 1.39: when in this mode, the device state always reports as EXTERNAL CONTROL (252). It is not showing Bulk, Absorption or anything else.
Firmware versions 1.42 and higher: 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).

<u>BMS Controlled</u>

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.

<u>Charge master mode</u>
When a unit is set to charge instance master mode it will periodically send the registers 0x2001, 0x2007, 0x2008 and 0x200B using asynchronous hex-messages (:A). These messages must be forwarded to the slave chargers. The internal charge profile remains active in the instance master mode.
The group master role is only present for compatibility with the VE.Can chargers. The VE.Direct chargers are unable to perform data gathering (i.e. reporting the condition of the complete charger group).

<u>Remote sensor data (voltage and/or temperature)</u>
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 has to be within ±5V with respect to the voltage on the charger terminals. The charger can adapt its charging voltage up to ±2V to compensate for cable losses.

<u>Adding nodes to the network</u>
When a node is about to start it reports state 245 (wake-up) briefly before starting, this is the trigger for the network master to determine the role of the new unit. If the network master needs time to gather data, it can force the unit into standby by setting bit 6 in register 0x200E. The network master can preset link data into the unit before clearing bit 6 and allowing the unit to start-up.

***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 behavior) |

| 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 |

Note: bits 6+7 are added in firmware version 1.26, bits 4+5 in firmware version 1.44.

### 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 |

| State | Name | Meaning |
|-------|------|---------|
| 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.

### Absorption time (register 0x2008)

Firmware versions up to and including 1.39: use the available absorption time (updated when the unit starts or when the unit switches from absorption to float).
Firmware versions 1.42 and higher: use the time spent in absorption (counting up when the unit is in absorption), the available absorption time is determined by the user configuration (adaptive mode, maximum absorption time). The time spent is reset if the unit is off for more than 1 hour or if the configuration is changed (different battery type).

### Battery idle voltage (register 0x200B)

The battery voltage measured before the charge process starts, in a networked environment, this should only be measured by the first device that is about to start. Units that start later should use the information from the first unit.

### Battery charge current (register 0x200A)

The actual battery current: used to check if the tail current condition is met (switch from absorption to float). This comes from a battery monitor (e.g. BMV).

### 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 to summing up all the known DC battery currents in the system.

### Error code (register 0x2009)

The network master uses this register to inject an error code into a unit. Example: if the network master determines that there is a configuration issue, it can inject error code 66, so the error code will be visible on the pluggable display and in VictronConnect.

### Total DC input power (register 0x2027)

The total dc input power produced by the synchronized charging system. This is determined by to summing up all the known DC input power in the system. The network master needs to take care of this, on VE.CAN the MPPT chargers do this themselves, on the ve.direct interface the external network master needs to do this by summing up all the individual powers by reading VE_REG_DC_INPUT_POWER (0xEDBC) and write the sum to register 0x2027 on all the units. This information is used by VictronConnect and/or Venus devices so they can show a power indication in the device list.

### 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.

## 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. The table below shows the MPPT firmware versions and the support of asynchronous messages.

| Firmware | Asynchronous messages |
|---|---|
| 1.15 and lower | Not supported |
| 1.16 | Only the history messages for totals and today (0x104F/0x1050) are sent asynchronously when their contents are changed. |
| 1.17 | Like 1.16 the history messages are always sent asynchronously. Furthermore when hex messages are detected by the charger it will send most registers asynchronously when their contents change. If no incoming hex messages are detected for 2 minutes it will cease to send these messages. |
| 1.26 | Added the following registers to be transmitted asynchronously: <br> - register 0xEDD5 (charger output voltage) <br> - register 0x2030 (solar rtc state) <br> - register 0x2002 (vsense): transmit 0xFFFF @ timeout <br> - register 0x2003 (tsense): transmit 0x7FFF @ timeout |
| 1.53 | Text messages not suppressed/delayed anymore due to hex requests. Now the text messages will always be sent every 2 seconds. Furthermore, a response to a hex message will always wait until the text message finishes to be sent (will not be interrupted in the middle of it as it was before). |

## 1.3 Message examples

\n at the end of the message is implied.

**Ping**
:154
:51641F9
0x4116 = talking to application version 1.16

**Application version**
:352
:11641FD
Like ping, application version 1.16

**Product Id**
:451
:1000351
0x300 = BlueSolar MPPT 70|15

**Restart**
:64F
No response, restarted

**Get Battery Maximum Current**
:7F0ED0071
:7F0ED009600DB
Value = 0x0096 = 15.0A

**Set Battery Maximum Current**
Set to 10.0A = 0x0064
:8F0ED0064000C
:8F0ED0064000C
Acknowledged with the new value returned.

**Unsupported command**
:253
:3020050
Unknown response

**Invalid frame (checksum wrong)**
:452
:4AAAAFD
Error response

**Asynchronous message**
:A0102000543
The unit reports register 0x0201 (device state) with value 0x05 (float).

# 2  Text Protocol

For firmware version v1.52 and below, when no VE.Direct queries are sent to the device, the charger periodically sends human readable (TEXT) data to the serial port. For firmware versions v1.53 and above, 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.

Changes:

**12-09-2012**
Added text protocol description

**02-01-2013**
Updated chapter 2.1 (register overview)
Name change HEX protocol => VE.Direct protocol

**04-06-2013**
Updated product id overview (added new types)
Updated the battery table for the 50A/35A chargers

**27-11-2013**
Updated product id overview (added new types)
Updated description regarding the battery voltages (about 35A charger and register 0xEDEA)
TEXT protocol part now refers to a separate document

**01-08-2014**
Split document into 3 parts: bootloader, private and public protocol parts

**22-09-2014**
Added Async message in the hex protocol definition
Updated document to match with firmware version 1.15 (new load output related features)

**24-09-2014**
Updated history section, added descriptions for the history totals and daily records

**29-09-2014**
Fixed panel current (wrong register number). Daily history changed yield/consumed un16->un32.

**14-10-2014**
vreg 0x0100 (product id): updated comment and set type to un16
vregs 0xEDD3/0xEDD1 (yield today/yesterday): update types (depends on firmware version)

**22-10-2014**
vreg 0xEDDB charger *internal* temperature
moved day sequence number from the total record to the day record

**23-10-2014**
Updated product id overview (added new type 85A MINI)

**7-11-2014**
Updated notes (error 21) in the charger error codes section

**13-02-2015**
Updated product id overview (added new types rev2 devices and the 75|10)
Updated history total record: added number of days field

**23-03-2015**
Updated street lighting related registers (gradual dim and panel voltage tweaks)
Added automatic equalisation registers

**14-04-2015**
Added remark: the user defined load switch modes are introduced in firmware version 1.15

**21-04-2015**
Product id 0xA047 changed from 85A to 100A charge current
Added capability query registers (useful for tooling/displays)

**1-05-2015**
Battery settings registers: added note 5 explaining parameter validity checks.

**6-05-2015**
Added new mppt types 150/45 and 150/60

**20-05-2015**
History total record, added new frame definition to include the minimum battery voltage

**29-05-2015**
Register 0x0201 (device state), added notes about the special modes batterysafe and automatic equalisation
Removed product id 0xA048, the MPPT 75/50 is replaced by the MPPT 100/50

**12-06-2015**
Updated response code description

**08-09-2015**
Product id register (0x0100): added recommendation to use the :4 hex command instead
Capabilities register (0x0140): added BMS/HUB-1 and synchronized charging definitions

**03-11-2015**
Added product id 0xA04F: MPPT 150/85

**08-01-2016 – rev 4**
Updated product id table, added new models
Capabilities register (0x0140): added alarm relay and alternate rx pin definitions
Added register (0xED98): RX port configuration

**26-02-2016**
Update examples (replaced BMV examples)
Updated description of register 0x0200  and 0x0202
Timer event description bit order fixed (vregs 0xEDA0..0xEDA5)
Added virtual load output to register 0xED9E
Capabilities register (0x0140): added virtual load output and virtual relay
Added remote control registers section
Added asynchronous message section

**25-03-2016**
Updated description of register 0x0200: v1.17 will report the on/off switch condition
Added 'error response' description, updated message examples
Added 10A to the relevant sections that were applicable to the 15A only.

**29-03-2016**
Added remark in the battery parameters section: these parameters can only be written when the user defined battery type is selected.

**08-04-2016 – rev 5**
Change in register (0xEDEA): in firmware v1.17 this register is writeable; a write has the same effect as writing to register (0xEDEF).

**12-05-2016**
BMS current setting changed from percentage to absolute current value; vreg 0x2014 (firmware v1.17) will be replaced by vreg 0x2015 (firmware v1.19).

**21-06-2016**
HUB-1 operation: dropped the requirement to set the state remotely in firmware v1.19. Added state 252 (HUB-1) to vreg 0x0201, this state will be reported when the charger operates in HUB-1 mode.

**22-07-2016**
Updated product id table (added new SmartSolar models)

**10-08-2016**
Added register 0x200F (network status)

**31-10-2016**
Updated load output section (add load output voltage for the SmartSolar models)
Updated product id table (added new SmartSolar models)

**12-12-2016**
Update load output section (add load output off reason, update in rx operation modes)

**15-12-2016**
Updated product id table (added new SmartSolar models)

**21-06-2017 – rev 6**
Updated registers 0xEDEF and 0xEDEA: automatic voltage detection mechanism changed
Updated register 0x0140 (capabilities): added new values 21 and 25
Add registers 0xED96 and 0xED97 (sunrise/sunset delays)
Add register 0xED91 (load output off reason)
Add register 0xED90 (aes timer)
Updated register 0xEDAB (load output control): added option 7
Updated register 0xED98 (rx port): added option 3
Updated register 0x200F (network status): added tsense/vsense feedback
Updated register 0x0201 (device state): added manual equalisation.
Updated description of asynchronous items: added changes in firmware version 1.26

**30-06-2017**
Updated product id table (added new SmartSolar model 100/20 rev2)

**06-12-2017**
Updated section about remote controlling the charger (BMS/ESS)
Add register 0x0205 (device off reason)
Updated product id table

**19-02-2018 – rev 7**
Update document to match with firmware 1.30
Rename HUB-1 to ESS
Updated product id table

**13-09-2018**
Replaced device id with product id
Update description of the product id vreg (0x0100)

**11-09-2019**
Update document to match with firmware versions 1.42 and 1.44
Rename ESS to External control
Add registers for the charger algorithm (more customization options)
Add/update registers for the synchronized charger operation

**03-10-2019 – rev8**
Add SmartSolar VE.Can models to the product id values table
Update the remote control registers table (update data formats and add 0x2027)
Update description of Error code (register 0x2009)

**02-12-2019 – rev9**
Add Link Device state (register 0x200C) description

**03-12-2019 – rev10**
Add scale, type and unit for the Adaptive mode register (0xEDFE) on the battery settings registers table.

**15-06-2020 – rev11**
Fixed standby and instance master bits in network mode use cases .

**16-06-2020 – rev12**
Added VE_REG_LINK_BATTERY_IDLE_VOLTAGE (0x200B) and VE_REG_LINK_DEVICE_STATE (0x200C) on the list of VREGs that are periodically sent by the charge master.

**17-06-2020 – rev13**
Remove VE_REG_LINK_DEVICE_STATE (0x200C) on the list of VREGs that are periodically sent by the charge master.

**08-10-2020 – rev14**
Update asynchronous items table with the new changes to the text messages done on v1.53 fw.

**01-02-2021 – rev15**
Update text protocol short description.

**01-03-2021 – rev16**
Fix Load offset voltage (0xEDAC) data type, from un16 to un8.
Fix Charger maximum current (0xEDDF) data scale, from 0.01 to 0.1.

**05-11-2021 – rev17**
Add description to the charge current limit register (0x2015).
Add warning to the battery settings to inform user that those should not be changed too often.
Update product id list (add products 0xA066 to 0xA07B and 0xA10C to 0xA117).
Changed references to "parallel charging" to "synchronized charging".

**15-11-2021 – rev18**
Updated product id table.
Add MPPT RS specific register information.