

Manual

SmartSolar charge controllers

MPPT 75/10

MPPT 75/15

MPPT 100/15

MPPT 100/20

MPPT 100/20-48V

1 General Description

1.1 Bluetooth Smart built-in: dongle not needed

The wireless solution to set-up, monitor and update the controller using Apple and Android smartphones, tablets or other devices.

1.2 VE.Direct

For a wired data connection to a Color Control panel, PC or other devices

1.3 Ultra fast MPPT tracking

Especially in case of a clouded sky, when light intensity is changing continuously, a fast MPPT algorithm will improve energy harvest by up to 30% compared to PWM charge controllers and by up to 10% compared to slower MPPT controllers.

1.4 Load output

Deep discharge of the battery can be prevented by connecting all loads to the load output. The load output will disconnect the load when the battery has been discharged to a pre-set voltage.

Alternatively, an intelligent battery management algorithm can be chosen: see Battery Life.

The load output is short circuit proof.

Some loads with high inrush current can best be connected directly to the battery. If equipped with a remote on-off input, these loads can be controlled by connecting the load output of the controller this remote on-off input. A special interface cable may be needed, please see section 3.7.

Alternatively, a BatteryProtect may be used to control the load. Please see our website for specifications.

1.5 Battery Life: intelligent battery management

When a solar charge controller is not able to recharge the battery to its full capacity within one day, the result is often that the battery will continually be cycled between a 'partially charged' state and the 'end of discharge' state. This mode of operation (no regular full recharge) will destroy a lead-acid battery within weeks or months.

The Battery Life algorithm will monitor the state of charge of the battery and, if needed, day by day slightly increase the load disconnect level (i.e. disconnect the load earlier) until the harvested solar energy is sufficient to recharge the battery to nearly the full 100%. From that point onwards the load disconnect level will be modulated so that a nearly 100% recharge is achieved about once every week.

1.6 Internal temperature sensor

Compensates absorption and float charge voltages for temperature. (range 6°C to 40°C)

1.7 Optional external voltage and temperature sensor

(range -20°C to 50°C)

The **Smart Battery Sense** is a wireless battery voltage-and-temperature sensor for Victron MPPT Solar Chargers. The Solar Charger uses these measurements to optimize its charge parameters. The accuracy of the data it transmits will improve battery charging efficiency, and prolong battery life.

Alternatively, Bluetooth communication can be set up between a **BMV-712 battery monitor** with battery temperature sensor and the solar charge controller

For more detail please enter *smart networking* in the search box on our website.

1.8 Automatic battery voltage recognition

The controller will automatically adjust itself to a 12V or a 24V system **one time only**. If a different system voltage is required at a later stage, it must be changed manually, for example with the Bluetooth app see section 1.9.

1.9 Adaptive three step charging

The controller is configured for a three step charging process: Bulk – Absorption - Float. See section 3.8 and section 5 for default settings.

See section 1.9 for user defined stings

1.9.1. Bulk

During this stage the controller delivers as much charge current as possible to rapidly recharge the batteries.

1.9.2. Absorption

When the battery voltage reaches the absorption voltage, the controller switches to constant voltage mode.

When only shallow discharges occur, the absorption time is kept short in order to prevent overcharging of the battery. After a deep discharge the absorption time is automatically increased to make sure that the battery is completely recharged.

Additionally, the absorption period is also ended when the charge current decreases to less than 1A.

1.9.3. Float

During this stage, float voltage is applied to the battery to maintain a fully charged state. When the battery voltage drops below float voltage during at least 1 minute a new charge cycle will be triggered.

1.9.4. Equalization

See section 3.8.1

1.10 Configuring and monitoring

Configure the solar charge controller with the VictronConnect app. Available for iOS & Android devices; as well as macOS and Windows computers. An accessory might be required; enter *victronconnect* in the search box on our website and see the VictronConnect download page for details.

For simple monitoring, use the MPPT Control; a panel mounted simple yet effective display that shows all operational parameters. Full system monitoring including logging to our online portal, VRM, is done using the GX Product range



MPPT Control



Color Control



Venus GX

2. IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS - This manual contains important instructions that shall be followed during installation and maintenance.



Danger of explosion from sparking

Danger of electric shock

- It is advised to read this manual carefully before the product is installed and put into use.
- This product is designed and tested in accordance with international standards. The equipment should be used for the designated application only.
- Install the product in a heatproof environment. Ensure therefore that there are no chemicals, plastic parts, curtains or other textiles, etc. in the immediate vicinity of the equipment.
- The product is not allowed to be mounted in a user accessible area.
- Ensure that the equipment is used under the correct operating conditions. Never operate it in a wet environment.
- Never use the product at sites where gas or dust explosions could occur.
- Ensure that there is always sufficient free space around the product for ventilation.
- Refer to the specifications provided by the manufacturer of the battery to ensure that the battery is suitable for use with this product. The battery manufacturer's safety instructions should always be observed.
- Protect the solar modules from incident light during installation, e.g. cover them.
- Never touch uninsulated cable ends.
- Use only insulated tools.
- Connections must always be made in the sequence described in section 3.5.
- The installer of the product must provide a means for cable strain relief to prevent the transmission of stress to the connections.
- In addition to this manual, the system operation or service manual must include a battery maintenance manual applicable to the type of batteries used.

3. Installation

WARNING: DC (PV) INPUT NOT ISOLATED FROM BATTERY CIRCUIT.

CAUTION: FOR PROPER TEMPERATURE COMPENSATION THE AMBIENT CONDITION FOR CHARGER AND BATTERY MUST BE WITHIN 5°C, or the optional Smart Battery Sense dongle must be used.

3.1. General

- Mount vertically on a non-flammable substrate, with the power terminals facing downwards. Observe a minimum clearance of 10 cm under and above the product for optimal cooling.
- Mount close to the battery, but never directly above the battery (in order to prevent damage due to gassing of the battery).
- Improper internal temperature compensation (e.g. ambient condition battery and charger not within 5°C) can lead to reduced battery lifetime.

We recommend using a direct battery voltage sense source (BMV, Smart Battery Sense or GX device shared voltage sense) if larger temperature differences or extreme ambient temperature conditions are expected

- Battery installation must be done in accordance with the storage battery rules of the Canadian Electrical Code, Part I.
- The battery and PV connections must be guarded against inadvertent contact (e.g. install in an enclosure or install the optional WireBox).

3.2 Grounding

- *Battery grounding*: the charger can be installed in a positive or negative grounded system.

Note: apply a single ground connection (preferably close to the battery) to prevent malfunctioning of the system.

- *Chassis grounding*: A separate earth path for the chassis ground is permitted because it is isolated from the positive and negative terminal.
- The USA National Electrical Code (NEC) requires the use of an external ground fault protection device (GFPD). These MPPT chargers do not have internal ground fault protection. The system electrical negative should be bonded through a GFPD to earth ground at one (and only one) location.
- The charger must not be connected with grounded PV arrays (one ground connection only)
- The plus and minus of the PV array should not be grounded. Ground the frame of the PV panels to reduce the impact of lightning.

WARNING: WHEN A GROUND FAULT IS INDICATED, BATTERY TERMINALS AND CONNECTED CIRCUITS MAY BE UNGROUNDED AND HAZARDOUS.

3.3. PV configuration (also see the MPPT Excel sheet on our website)

- Provide a means to disconnect all current-carrying conductors of a photovoltaic power source from all other conductors in a building or other structure.
- A switch, circuit breaker, or other device, either ac or dc, shall not be installed in a grounded conductor if operation of that switch, circuit breaker, or other device leaves the grounded conductor in an ungrounded state while the system remains energized.

- The controller will operate only if the PV voltage exceeds battery voltage (Vbat).
- PV voltage must exceed Vbat + 5V for the controller to start. Thereafter minimum PV voltage is Vbat + 1V.
- Maximum open circuit PV voltage: 75V respectively 100V

For example:

12V battery and mono- or polycrystalline panels connected to a 75V controller

- Minimum number of cells in series: 36 (12V panel).
- Recommended number of cells for highest controller efficiency: 72 (2x 12V panel in series or 1x 24V panel).
- Maximum: 108 cells (3x 12V panel in series).

24V battery and mono- or polycrystalline panels connected to a 100V controller

- Minimum number of cells in series: 72 (2x 12V panel in series or 1x 24V panel).
- Maximum: 144 cells (4x 12V panel in series).

Remark: at low temperature the open circuit voltage of a 108 cell array may exceed 75V and the open circuit voltage of a 144 cell solar array may exceed 100V, depending on local conditions and cell specifications. In that case the number of cells in series must be reduced.

3.4 Cable connection sequence (see figure 4 at the end of this manual)

First: connect the cables to the load, but ensure that all loads are switched off.

Second: connect the battery (this will allow the controller to recognize system voltage).

Third: connect the solar array (when connected with reverse polarity, the controller will heat up but will not charge the battery).

Torque: 1 Nm

The system is now ready for use.

3.5. Configuration of the controller (see figure 1 and 2 at the end of this manual)

If a Bluetooth device or other means of communication is not available, the VE.Direct communication port (see section 1.10) can be used to configure the load output as follows:

3.6 The load output

The load out output can be configured with Bluetooth or via VE.Direct.

Alternatively, a jumper can be used to to configure the load output as follows:

3.6.1. **No jumper:** BatteryLife algorithm (see 1.5.)

3.6.2. **Jumper between pin 1 and pin 2:** conventional

Low voltage load disconnect: 11,1V or 22,2V

Automatic load reconnect: 13,1V or 26,2V

3.6.3. **Jumper between pin 2 and pin 3:** conventional

Low voltage load disconnect: 11,8V or 23,6V

Automatic load reconnect: 14V or 28V

Note: remove the jumper when using Bluetooth to configure the controller

Some loads with high inrush current can best be connected directly to the battery. If equipped with a remote on-off input, these loads can be controlled by connecting the load output of the controller to this remote on-off input. A special interface cable may be needed.

Alternatively, a BatteryProtect may be used to control the load. Please see our website for specifications.

Low power inverters, such as the **Phoenix VE.Direct inverters** up to 375VA, can be powered by the load output, but the maximum output power will be limited by the current limit of the load output.

Phoenix VE.Direct inverters can be controlled by connecting the left side connection of the remote control to the load output.

The bridge on the remote control between left and right must be removed.

The Victron inverters model Phoenix 12/800, 24/800, 12/1200 and 24/1200 can be controlled by connecting the right side connection of the inverter remote control directly to the load output (see figure 4 at the end of this manual).

For the Victron inverters model Phoenix 12/180, 24/180, 12/350, 24/350, the Phoenix Inverter Compact models and the MultiPlus Compact models an interface cable is needed: the Inverting remote on-off cable, article number ASS030550100, see figure 5 at the end of this manual.

3.7 LEDs

LED indication:

- permanent on
- ◎ blinking
- off

Regular operation

| | LEDs | Bulk | Absorption | Float |
|------------------------|------|------|------------|-------|
| Not charging (*1) | | ◎ | ○ | ○ |
| Bulk | | ● | ○ | ○ |
| Absorption | | ○ | ● | ○ |
| Automatic equalisation | | ○ | ● | ● |
| Float | | ○ | ○ | ● |

Note (*1): The bulk LED will blink briefly every 3 seconds when the system is powered but there is insufficient power to start charging.

Fault situations

| | LEDs | Bulk | Absorption | Float |
|-------------------------------|------|------|------------|-------|
| Charger temperature too high | | ○ | ○ | ◎ |
| Charger over-current | | ◎ | ○ | ◎ |
| Charger or panel over-voltage | | ○ | ◎ | ◎ |
| Internal error (*2) | | ◎ | ◎ | ○ |

Note (*2): E.g. calibration and/or settings data lost, current sensor issue.

3.8 Battery charging information

The charge controller starts a new charge cycle every morning, when the sun starts shining.

User defined algorithm:

The default settings can be modified with Bluetooth or via VE.Direct.

Lead-acid batteries: default method to determine length and end of absorption

The charging algorithm behaviour of MPPTs differs from AC connected battery chargers. Please read this section of the manual carefully to understand MPPT behaviour, and always follow the recommendations of your battery manufacturer.

By default, the absorption time is determined on idle battery voltage at the start of each day based on the following table:

| Battery voltage Vb (@start-up) | Multiplier | Maximum absorption time |
|--------------------------------|------------|-------------------------|
| Vb < 11,9V | x 1 | 6h |
| 11,9V < Vb < 12,2V | x 2/3 | 4h |
| 12,2V < Vb < 12,6V | x 1/3 | 2h |
| Vb > 12,6V | x 1/6 | 1h |

(12V values, adjust for 24V))

Default absorption voltage: 14,4V

Default float voltage: 13,8V

The absorption time counter starts once switched from bulk to absorption.

The MPPT Solar Chargers will also end absorption and switch to float when the battery current drops below a low current threshold limit, the 'tail current'.

The default tail current value value is 1A.

For models with a load output the current on the battery terminals is used; and for the larger models; the current on the output terminals is used.

The default settings (voltages, absorption time multiplier and tail current) can be modified with the Victronconnect app via or via VE.Direct.

There are two exceptions to normal operation:

1. When used in an ESS system; the solar charger algorithm is disabled; and instead it follows the curve as mandated by the inverter/charger.
2. For CAN-bus Lithium batteries, like BYD, the battery tells the system, including the solar charger, what charge voltage to use. This Charge Voltage Limit (CVL) is for some batteries even dynamic; changes over time; based on for example maximum cell voltage in the pack and other parameters.

Variations to expected behaviour

1. Pausing of the absorption time counter

The absorption time counter starts when the configured absorption voltage is reached and pauses when the output voltage is below the configured absorption voltage.

An example of when this voltage drop could occur is when PV power (due to clouds, trees, bridges) is insufficient to charge the battery and to power the loads.

When the absorption timer is paused, the absorption LED will flash very slowly.

2. Restarting the charge process

The charging algorithm will reset if charging has stopped for an hour. This may occur when the PV voltage drops below the battery voltage due to bad weather, shade or similar.

3. Battery being charged or discharged before solar charging begins

The automatic absorption time is based on the start-up battery voltage (see table). This

absorption time estimation can be incorrect if there is an additional charge source (eg alternator) or load on the batteries.

This is an inherent issue in the default algorithm. However, in most cases it is still better than a fixed absorption time regardless of other charge sources or battery state.

It is possible to override the default absorption time algorithm by setting a fixed absorption time when programming the solar charge controller. Be aware this can result in overcharging your batteries. Please see your battery manufacturer for recommended settings.

4. Absorption time determined by tail current

In some applications it may be preferable to terminate absorption time based on tail current only. This can be achieved by increasing the default absorption time multiplier.

(warning: the tail current of lead-acid batteries does not decrease to zero when the batteries are fully charged, and this “remaining” tail current can increase substantially when the batteries age)

Default setting, LiFePO4 batteries

LiFePO4 batteries do not need to be fully charged to prevent premature failure.

The default absorption voltage setting is 14,2V (28,4V).

And the default absorption time setting is 2 hours.

Default float setting: 13,2V (26,4V).

These settings are adjustable.

Reset of the charge algorithm:

The default setting for restarting the charge cycle is $V_{batt} < (V_{float} - 0,4V)$ for lead-acid, and $V_{batt} < (V_{float} - 0,1V)$ for LiFePO4 batteries, during 1 minute.

(values for 12V batteries, multiply by two for 24V)

3.9 Automatic equalization

Automatic equalization is default set to 'OFF'. With the Victron Connect app (see sect 1.9) this setting can be configured with a number between 1 (every day) and 250 (once every 250 days).

When automatic equalization is active, the absorption charge will be followed by a voltage limited constant current period. The current is limited to 8% or 25% of the bulk current. The bulk current is the rated charger current unless a lower maximum current setting has been chosen.

When using a setting with 8% current limit, automatic equalization ends when the voltage limit has been reached, or after 1 hour, whichever comes first.

Other settings: automatic equalization ends after 4 hours.

When automatic equalization is not completely finished within one day, it will not resume the next day, the next equalization session will take place as determined by the day interval.

3.10 VE.Direct communication port

See section 1.10 and 3.5.

4. Troubleshooting

| Problem | Possible cause | Solution |
|------------------------------------|--|--|
| Charger does not function | Reversed PV connection | Connect PV correctly |
| | No fuse inserted | Insert 20A fuse (models 75/10, 75/15, 100/15) or 25A fuse (model 100/20) |
| Blown fuse | Reversed battery connection | 1. Connect battery correctly 2. Replace fuse |
| The battery is not fully charged | A bad battery connection | Check battery connection |
| | Cable losses too high | Use cables with larger cross section |
| | Large ambient temperature difference between charger and battery ($T_{\text{ambient_chrg}} > T_{\text{ambient_batt}}$) | Make sure that ambient conditions are equal for charger and battery |
| | <i>Only for a 24V system:</i> wrong system voltage chosen (12V instead of 24V) by the charge controller | Set the controller manually to the required system voltage (see section 1.9) |
| The battery is being overcharged | A battery cell is defect | Replace battery |
| | Large ambient temperature difference between charger and battery ($T_{\text{ambient_chrg}} < T_{\text{ambient_batt}}$) | Make sure that ambient conditions are equal for charger and battery |
| Load output does not become active | Maximum current limit exceeded | Make sure that the output current does not exceed 15A |
| | DC load in combination with capacitive load (e.g. inverter) applied | Disconnect DC load during start-up of the capacitive load Disconnect AC load from the inverter, or connect inverter as explained in section 3.6 |
| | Short-circuit | Check for short-circuit in the load connection |

5 Specifications, 75V models

| SmartSolar charge controller | MPPT 75/10 | MPPT 75/15 |
|---|--|------------|
| Battery voltage | 12/24V Auto Select | |
| Maximum battery current | 10A | 15A |
| Nominal PV power, 12V 1a,b) | 145W | 220W |
| Nominal PV power, 24V 1a,b) | 290W | 440W |
| Max. PV short circuit current 2) | 13A | 15A |
| Automatic load disconnect | Yes, maximum load 15A | |
| Maximum PV open circuit voltage | 75V | |
| Peak efficiency | 98% | |
| Self consumption | 12V: 25 mA 24V: 15 mA | |
| Charge voltage 'absorption' | 14,4V / 28,8V (adjustable) | |
| Charge voltage 'equalization' | 16,2V / 32,4V (adjustable) | |
| Charge voltage 'float' | 13,8V / 27,6V (adjustable) | |
| Charge algorithm | multi-stage adaptive or user defined algorithm | |
| Temperature compensation | -16mV / °C resp. -32mV / °C | |
| Continuous load current | 15A | |
| Low voltage load disconnect | 11,1V / 22,2V or 11,8V / 23,6V or BatteryLife algorithm | |
| Low voltage load reconnect | 13,1V / 26,2V or 14V / 28V or BatteryLife algorithm | |
| Protection | Battery reverse polarity (fuse) Output short circuit / Over temperature | |
| Operating temperature | -30 to +60°C (full rated output up to 40°C) | |
| Humidity | 100%, non-condensing | |
| Maximum altitude | 5000m (full rated output up to 2000m) | |
| Environmental condition | Indoor type 1, unconditioned | |
| Pollution degree | PD3 | |
| Data communication | VE.Direct port or Bluetooth See the data communication white paper on our website | |
| ENCLOSURE | | |
| Colour | Blue (RAL 5012) | |
| Power terminals | 6mm ² / AWG10 | |
| Protection category | IP43 (electronic components) IP22 (connection area) | |
| Weight | 0,5kg | |
| Dimensions (h x w x d) | 100 x 113 x 40mm | |
| STANDARDS | | |
| Safety | EN/IEC 62109-1, UL 1741, CSA C22.2 | |
| 1a) If more PV power is connected, the controller will limit input power 1b) The PV voltage must exceed Vbat + 5V for the controller to start. Thereafter the minimum PV voltage is Vbat + 1V. 2) A higher short circuit current may damage the controller in case of reverse polarity connection of the PV array. | | |



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Specifications, 100V models

| SmartSolar charge controller | MPPT 100/15 | MPPT 100/20 |
|---|--|-------------------|
| Battery voltage | 12/24V Auto Select | |
| Maximum battery current | 15A | 20A |
| Nominal PV power, 12V 1a,b) | 220W | 290W |
| Nominal PV power, 24V 1a,b) | 440W | 580W |
| Max. PV short circuit current 2) | 15A | 20A |
| Automatic load disconnect | Yes, maximum load 15A resp. 20A | |
| Maximum PV open circuit voltage | 100V | |
| Peak efficiency | 98% | |
| Self consumption | 12V: 25 mA 24V: 15 mA | |
| Charge voltage 'absorption' | 14,4V / 28,8V (adjustable) | |
| Charge voltage 'equalization' | 16,2V / 32,4V (adjustable) | |
| Charge voltage 'float' | 13,8V / 27,6V (adjustable) | |
| Charge algorithm | multi-stage adaptive | |
| Temperature compensation | -16mV / °C resp. -32mV / °C | |
| Continuous load current | 15A | 20A |
| Low voltage load disconnect | 11,1V / 22,2V or 11,8V / 23,6V or BatteryLife algorithm | |
| Low voltage load reconnect | 13,1V / 26,2V or 14V / 28V or BatteryLife algorithm | |
| Protection | Battery reverse polarity (fuse) Output short circuit / Over temperature | |
| Operating temperature | -30 to +60°C (full rated output up to 40°C) | |
| Humidity | 100%, non-condensing | |
| Maximum altitude | 5000m (full rated output up to 2000m) | |
| Environmental condition | Indoor type 1, unconditioned | |
| Pollution degree | PD3 | |
| Data communication port | VE.Direct See the data communication white paper on our website | |
| ENCLOSURE | | |
| Colour | Blue (RAL 5012) | |
| Power terminals | 6mm ² / AWG10 | |
| Protection category | IP43 (electronic components) IP22 (connection area) | |
| Weight | 0,6 kg | 0,65 kg |
| Dimensions (h x w x d) | 100 x 113 x 50 mm | 100 x 113 x 60 mm |
| STANDARDS | | |
| Safety | EN/IEC 62109-1, UL 1741, CSA C22.2 | |
| 1a) If more PV power is connected, the controller will limit input power 1b) The PV voltage must exceed Vbat + 5V for the controller to start. Thereafter the minimum PV voltage is Vbat + 1V. 2) A higher short circuit current may damage the controller in case of reverse polarity connection of the PV array. | | |

| SmartSolar charge controller | MPPT 100/20-48V |
|--|--|
| Battery voltage | 12/24/48V Auto Select |
| Maximum battery current | 20A |
| Nominal PV power, 48V 1a,b) | 1160W (290W / 580W / 870W) |
| Max. PV short circuit current 2) | 20A |
| Automatic load disconnect | Yes, maximum load 20A(12/24V) & 0,1A(36/48V) |
| Maximum PV open circuit voltage | 100V |
| Peak efficiency | 98% |
| Self consumption | 15mA |
| Charge voltage 'absorption' | 14,4V / 28,8V / 43,2V / 57,6V (adjustable) |
| Charge voltage 'equalization' | 16,2V / 32,4V / 48,6V / 64,8V (adjustable) |
| Charge voltage 'float' | 13,8V / 27,6V / 41,4V / 55,2V (adjustable) |
| Charge algorithm | multi-stage adaptive |
| Temperature compensation | -16mV/ °C / -32mV/ °C / -48mV/ °C / -64mV/ °C |
| Continuous load current, 12/24V | 20A |
| Continuous load current, 36/48V | 1A |
| Low voltage load disconnect | 11,1 / 22,2 / 33,3 / 44,4V or 11,8 / 23,6 / 35,4 / 47,2V or BatteryLife algorithm |
| Low voltage load reconnect | 13,1 / 26,2 / 39,3 / 52,4V or 14 / 28 / 42 / 56V or BatteryLife algorithm |
| Protection | Output short circuit / Over temperature |
| Operating temperature | -30 to +60°C (full rated output up to 40°C) |
| Humidity | 100%, non-condensing |
| Maximum altitude | 5000m (full rated output up to 2000m) |
| Environmental condition | Indoor type 1, unconditioned |
| Pollution degree | PD3 |
| Data communication port | VE.Direct See the data communication white paper on our website |
| ENCLOSURE | |
| Colour | Blue (RAL 5012) |
| Power terminals | 6mm ² / AWG10 |
| Protection category | IP43 (electronic components) IP22 (connection area) |
| Weight | 0,65 kg |
| Dimensions (h x w x d) | 100 x 113 x 60 mm |
| STANDARDS | |
| Safety | EN/IEC 62109-1, UL 1741, CSA C22.2 |
| 1a) If more PV power is connected, the controller will limit input power | |
| 1b) The PV voltage must exceed Vbat + 5V for the controller to start. Thereafter the minimum PV voltage is Vbat + 1V. | |
| 2) A higher short circuit current may damage the controller in case of reverse polarity connection of the PV array. | |



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Figure 1a: configuration pins of the VE.Direct communication port, 75V models

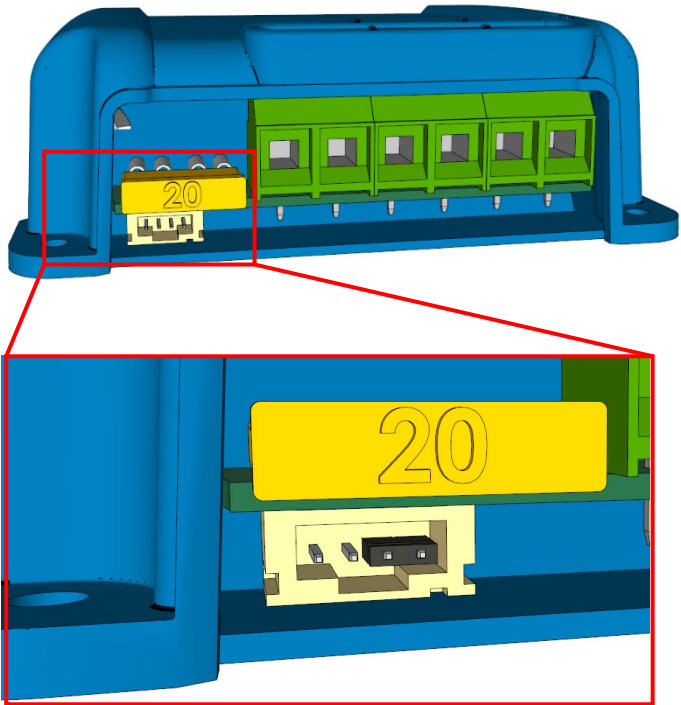


Figure 1b: pin numbering of the VE.Direct communication port, 75V models

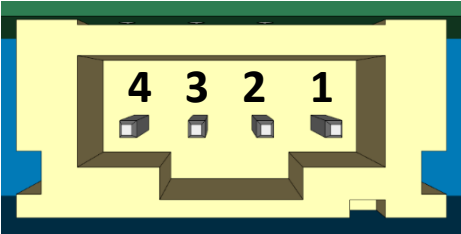


Figure 2a: configuration pins of the VE.Direct communication port, 100V models

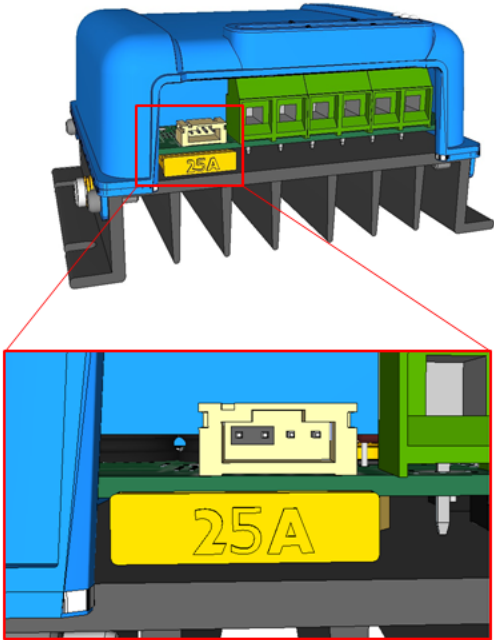


Figure 2b: pin numbering of the VE.Direct communication port, 100V models

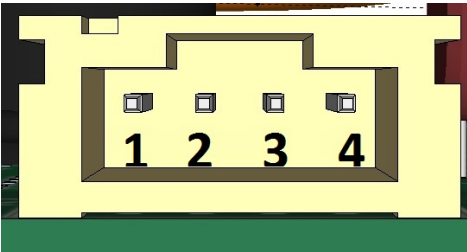


Figure 3: Battery management options

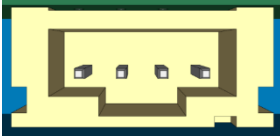
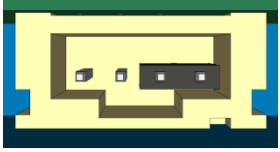
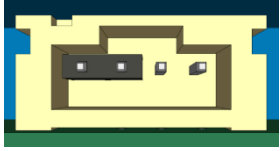
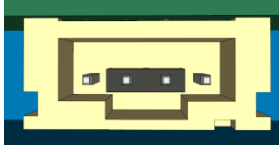
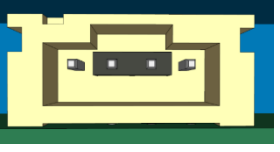
| | |
|---|--|
| <p><u>EN: No bridge</u>: BatteryLife algorithm</p> |  |
| <p><u>EN: Bridge between pin 1 and 2</u>: Low voltage disconnect: 11.1V or 22.2V Automatic load reconnect: 13.1V or 26.2V</p> | <p>75V models</p>  <p>100V models</p>  |
| <p><u>EN: Bridge between pin 2 and 3</u>: Low voltage disconnect: 11.8V or 23.6V Automatic load reconnect: 14.0V or 28.0V</p> | <p>75V models</p>  <p>100V models</p>  |

Figure 4: Power connections



Figure 5: The Victron inverters model Phoenix 12/800, 24/800, 12/1200 and 24/1200 can be controlled by connecting the right side connection (1) of the inverter remote control directly to the solar charger load output. Similarly, all **Phoenix VE.Direct** inverters can be controlled by connecting to the left side connection of the remote control

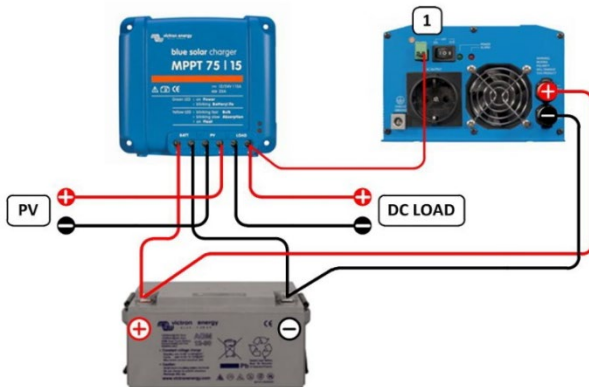
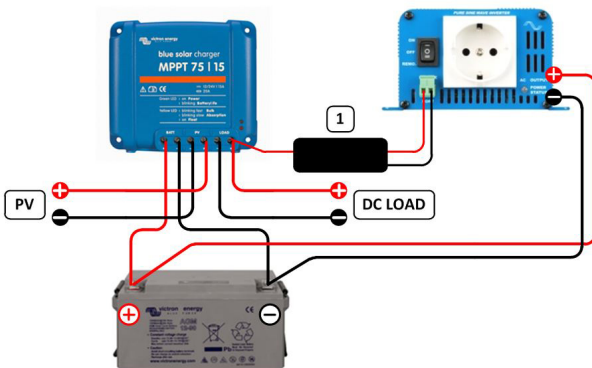


Figure 6: For the Victron inverters model Phoenix 12/180, 24/180, 12/350, 24/350, the Phoenix Inverter C models and the MultiPlus C models an interface cable (1) is needed: the **Inverting remote on-off cable** (article number ASS030550100)



VictronConnect - MPPT Solar Charge Controllers

1. Introduction

Thank you for using VictronConnect. This guide will help you get the most out of your MPPT Solar Charge Controller. The information available here applies to all BlueSolar and SmartSolar MPPT Charge Controllers which are compatible with VictronConnect.

More general information about the VictronConnect App - how to install it; how to pair it with your device; and how to update firmware, for example - can be found by referring to the overall VictronConnect manual.

Note: Where battery voltage is referred to in these instructions, a 12V battery is assumed. Please multiply the given values by 2, 3 or 4 to arrive at settings for an installation configured for 24V, 36V or 48V respectively.

2. STATUS - Live Data Information



- **MPPT [Model Number]** confirms the connected device. A custom name can also be set if desired.
 - **Solar 'Gauge' icon** shows the dynamic real-time power output from the solar array. With regard to the Solar Panel voltage, note that the Solar charger will only operate once the Panel voltage has risen more than 5V above battery voltage.
 - **Battery - Voltage** The voltage measurement is taken at the battery terminals of the Solar
-

charger.

- **Battery - Current** This reading shows the current flowing-to, or drawn-from the battery terminals of the Solar charger. Note that in the case of the 100/20 Solar chargers and smaller - which have a dedicated load output - a Positive notation alongside the current reading means that current is flowing to the battery; whereas a Negative notation means that current is being drawn from the battery.
- **Battery - State:**
 - Bulk: During this stage the Controller delivers as much charge current as possible to rapidly charge the batteries. When the battery voltage reaches the Absorption voltage setting, the Controller activates the Absorption stage.
 - Absorption: During this stage the Controller switches to the constant voltage mode, where a pre-set absorption voltage, suitable to the battery type (See section 4.1 Battery Settings below), is applied. When the charge current decreases below the Tail current and/or the pre-set Absorption time has elapsed, the battery is fully charged. The Controller switches to the Float stage. The Tail current is 1A for models 100/20 and smaller; and 2A for larger models. (When an automatic equalisation is being performed this will also be reported as 'Absorption'.)
 - Float: During this stage the float voltage is applied to the battery to maintain a fully-charged state. When the battery voltage drops below float voltage during at least 1 minute, a new charge cycle will be triggered.
 - Equalization: This is shown when 'Start equalization now' is pressed in the battery settings. The charger applies the equalization voltage to the battery as long as the current level stays below 8% (Gel or AGM) or 25% (tubular plate) of the bulk current.

*** Menu items only available on models with load output (100/20 and smaller.)**

- **Load output on/off** The function of the load output switch is to disconnect the load when the battery is low on power in order to avoid damaging it. See the configuration section (4.2 below) for available load switching algorithms.
- **Load current** This shows the current being drawn by electronic devices, lights, fridge, etc.

Note that for the load output reading to be reliable, all loads must be wired directly to the load output ...including their negative terminals. See manual or consult your installer for details.

Note that some loads (especially inverters) are best connected directly to the battery. In such cases the load output does not show a reliable reading - the current drawn by the inverter, for example, will not be included. Consider adding a BMV battery monitor which will measure all current going to - or being drawn from the battery, *including* loads connected directly to the battery ...not just the load output terminals of the charge controller.

Is my battery being charged?

The battery will be charged whenever the power available from the PV panels exceeds the power being drawn by the loads (lights, fridge, inverter, etc.).

You can only tell if that is the case with Charge Controllers which have all loads connected to the load output terminals. Remember: any loads connected directly to the battery can't be monitored by the Solar Charger.

3. HISTORY - Thirty-day Graphic



(The fragmented square icon (top left) allows you to toggle between 'portrait' and 'landscape' screen presentations.)

A summary of activity for the last 30 days is presented graphically. Swipe the bar left or right to show any of the previous 30 days.

The daily log shows:

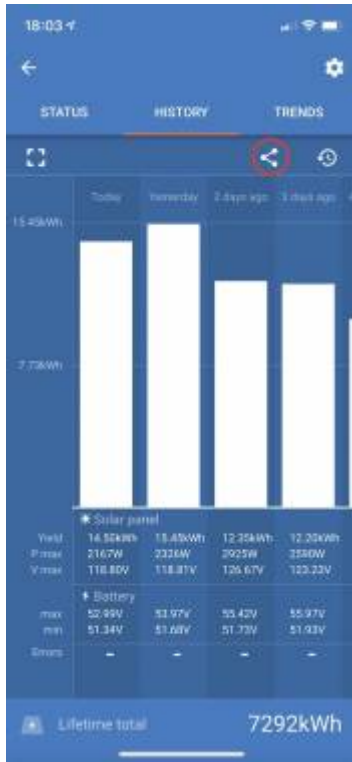
- **Yield:** The energy converted for that day.
- **P max:** The maximum power recorded during the day.
- **V max:** The highest voltage from the PV array during the day.

Clicking on any day/bar in the graph will expand the information to show charge-status times - both as hrs/m; and also as a percentage of the 'charge' day. This graphic provides an at-a-glance representation of how much time your charger is spending in each of three modes: Bulk / Absorption / Float.

Tip! You can use the charge times to see if the PV array is properly sized for your requirements. A system which never reaches 'Float' may need more panels; or perhaps the load could be reduced?

(If you are operating an ESS (Energy Storage System) the charge time for this will be included in the 'Bulk' reading.)

It is possible to export the history as a comma separated file (.csv) by clicking the three connected dots at the top right of the history screen:



This is an example of the exported data for 3 of 30 days:

| Days ago | Yield(Wh) | Max. PV power(W) | Max. PV voltage(V) | Min. battery voltage(V) | Max. battery voltage(V) | Time in bulk(m) | Time in absorption(m) | Time in float(m) | Last error | 2nd last error | 3rd last error | 4th last error |
|----------|-----------|------------------|--------------------|-------------------------|-------------------------|-----------------|-----------------------|------------------|------------|----------------|----------------|----------------|
| 0 | 14500 | 2167 | 118.80 | 51.34 | 52.99 | 748 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 15450 | 2326 | 118.81 | 51.68 | 53.97 | 869 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 12350 | 2925 | 126.67 | 51.73 | 55.42 | 872 | 0 | 0 | 0 | 0 | 0 | 0 |

Battery Voltage

The first figure shows the maximum battery voltage for the day ...the figure below is the minimum battery voltage.

Consumption (only on 100/20 models and smaller)

Shows the energy consumed by loads connected to the load output terminal.

Errors

Shows the number of errors (if any) for the day, to see the error codes click on the orange point. See MPPT Solar Charger Error Codes.

(You may need to slide the display on your device up to see the errors.)

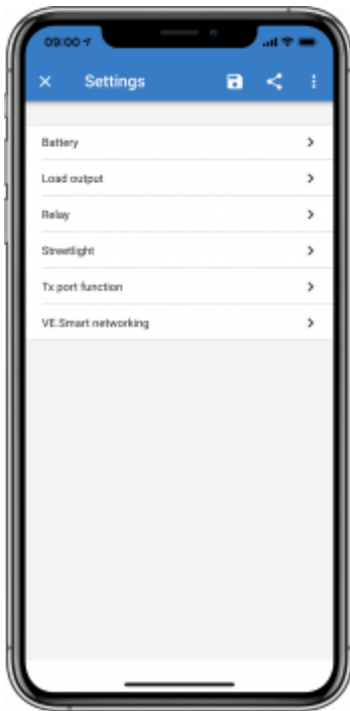
Total

This shows the total energy converted by the installation and is not re-settable.

Since Cleared

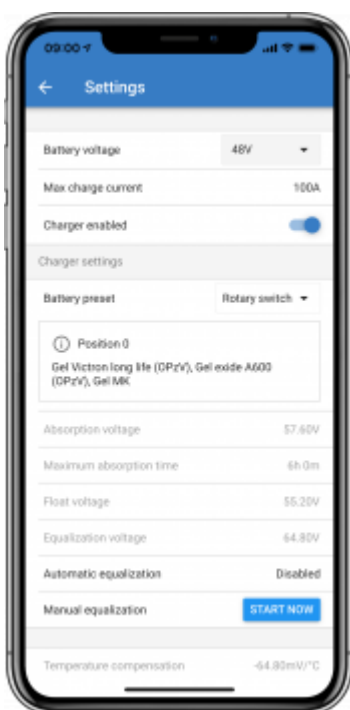
This shows how much energy has been converted by the installation since the last reset.

4. Settings



The settings page is accessed by clicking on the Cog icon at the top right of the Home page. The settings page provides access to view or change the settings of the Battery; Load; Streetlight; and Port functions. From this page you can also view Product information such as the Firmware versions installed on the MPPT Solar Charger.

4.1 Battery settings



For small MPPT Solar Charger models there is only one preset. Larger models feature a rotary switch, the battery page shows the setting of the rotary switch.

We recommend using the rotary switch to select one of the pre-programmed charge algorithms.

Battery voltage

Set the battery voltage to a fixed voltage (12, 24, 36, 48).

The battery voltage is automatically selected at the very first power-up of the charger. The detected figure is stored, and further automatic detection is disabled. If, however, the battery voltage is absent (or below 7 volts) the unit operates as a 12V model and automatic detection is rescheduled for the next power-up.

Note that 36 and 48 volt operation is only available on models which support these voltages - such as the MPPT 150/35. Note also that 36 volts cannot be detected automatically. Systems operating at this voltage must always be set manually.

Hint: if you just want to update the firmware of a device while still keeping the automatic voltage detection active (e.g. before shipping a unit to the end customer), update the firmware as you normally would do. When the firmware update is complete, at the "Live Data Information" page select to cog wheel in the upper right corner, next the three vertical dots in the upper right corner and make sure to choose "Reset to defaults" from the drop-down menu. Now power down the unit, when the unit is powered up the next time it will perform an automatic voltage detection.

Max charge current

Allows the user to set a lower maximum charge current.

Charger enabled

Toggling this setting turns the Solar Charger off. The batteries will not be charged. This setting is intended only for use when carrying-out work on the installation.

Charger settings - Battery preset

Battery preset allows you to select the battery type; accept factory defaults; or enter your own preset values to be used for the battery charge algorithm. The Absorption voltage, Absorption time, Float voltage, Equalisation voltage and Temperature compensation settings are all configured to a preset value - but can be user-defined.

User-defined presets will be stored in the preset library - in this way installers will not have to define all the values each time they are configuring a new installation.

By selecting *Edit Presets*, or on the Settings screen (with expert mode on or not), custom parameters can be set as follows:

Absorption voltage

Set the absorption voltage.

Adaptive absorption time

Select with adaptive absorption time or fixed absorption time will be used. Both are better explained below:

Fixed absorption time: The same length of absorption is applied every day (when there is enough solar power) by using the maximum absorption time setting. Be aware that this option can result in overcharging your batteries, especially for lead batteries and system with shallow daily discharges. See your battery manufacturer for recommended settings.

Adaptive absorption time: The charge algorithm can use an adaptive absorption time: it automatically adapts to the state of charge in the morning. The maximum duration of the absorption period for the day is determined by the battery voltage as measured just before the solar charger begins operation each morning (12V battery assumed):

| Battery voltage Vb (@start-up) | Multiplier | Maximum absorption times |
|--------------------------------|------------|--------------------------|
| Vb < 11.9V | x 1 | 06:00 hours |
| > 11.9V Vb < 12.2V | x 2/3 | 04:00 hours |
| > 12.2V Vb < 12.6V | x 1/3 | 02:00 hours |
| Vb > 12.6V | x 1/6 | 01:00 hours |

The multiplier is applied to the maximum absorption time setting and this results in the maximum duration of the absorption period used by the charger. The maximum absorption times shown in the last column of the table are based on the default maximum absorption time setting of 6 hours.

Maximum absorption time (hh:mm)

Set the absorption time limit. Only available when using a custom charge profile.

Enter the time value in the notation hh:mm, where hours are between 0 and 12; and minutes are between 0 and 59.

Float voltage

Set the float voltage.

Re-bulk voltage offset

Set the voltage offset that will be used over the float voltage setting that will determine the threshold that the charge cycle will restart.

E.g.: For a Re-bulk voltage offset off 0.1V and a float voltage setting of 13.8V, the voltage threshold that will be use to restart the charge cycle will be 13.7V. In other words, if the battery voltage drops below 13.7V for one minute, the charge cycle will restart.

Equalization voltage

Set the equalization voltage.

Equalization current percentage

Set the percentage of the Max charge current setting that will be used when equalisation is performed.

Automatic Equalization

Set-up the frequency of the auto equalize function. Available options are between 1 and 250 days:

- 1 = daily
- 2 = every other day
- ...
- 250 = every 250 days

Equalization is typically used to balance the cells in a lead battery, and also to prevent stratification of the electrolyte in flooded batteries. Whether (automatic) equalization is necessary, or not, depends on the type of batteries, and their usage. Consult your battery supplier for guidelines.

When the Automatic equalization cycle has initiated, the charger applies an equalization voltage to the battery as long as the current level stays below the equalization current percentage setting of the bulk current.

Duration of the Automatic equalization cycle

In the case of all VRLA batteries and some flooded batteries (algorithm number 0, 1, 2 and 3) automatic equalization ends when the voltage limit (maxV) has been reached, or after a period equal to (absorption time/8) - whichever comes first.

For all tubular plate batteries (algorithm numbers 4, 5 & 6); and also for the user-defined battery type, automatic equalization will end after a period equal to (absorption time/2).

For the Lithium battery type (algorithm number 7), equalization is not available.

When an automatic equalization cycle is not completed in one day, it will not resume the next day. The next equalization session will take place according to the interval set in the 'Auto Equalization' option.

For units without a rotary switch (75/10; 75/15; 100/15 & 100/20) the default battery type is a VRLA battery and any user-defined battery will behave as a tubular plate battery with regard to equalization.

Equalisation stop mode

Set how the equalisation will end. There are two possibilities, first is if the battery voltage reaches the

equalisation voltage and the second is on fixed time, where the maximum equalisation duration is used.

Maximum equalisation duration

Set the maximum time that the equalisation phase will last.

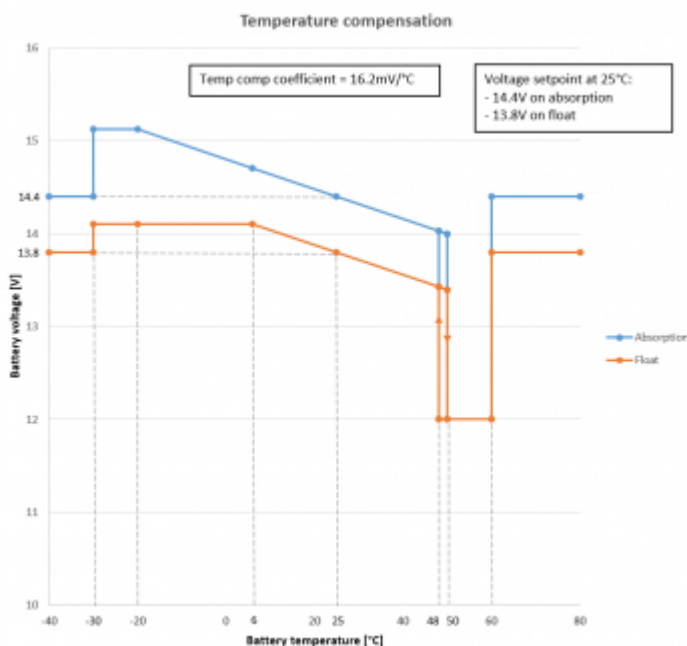
Tail current

Set the current threshold that will be used to finish absorption phase before the maximum absorption time expires. When the battery current gets below the tail current for one minute, the absorption phase will end. This setting can be disabled by setting it to zero.

Temperature compensation

Many types of battery require a lower charge voltage in warm operating conditions, and a higher charge voltage in cold operating conditions.

The configured coefficient is in mV per degree Celsius for the whole battery bank, not per cell. The base temperature for the compensation is 25°C (77°F), as shown in the chart below.



With a Smart Battery Sense is installed; the actual battery temperature will be used for compensation; throughout the day.

In case there is no external source for battery temperature; charger uses its internal temperature for battery temperature compensation. The temperature reading is taken in the morning; when the charger has been idle for at least one hour, i.e. when the charger is not actively charging a battery or supplying a load.

Low temperature cut-off

This setting is available when a VE.Smart network is set-up and the battery temperature is available (e.g. by for example using a Smart Battery Sense or a Smart BMV with the optional temperature sensor). It can be used to disable charging at low temperatures as required by Lithium batteries.

For Lithium Iron Phosphate batteries this setting is preset at 5 degrees Celsius, for the other battery types it is disabled. When creating a user defined battery the cut-off temperature level can be adjusted manually.

See the VE.Smart Network manual for details on what devices are capable of transmitting temperature.

Manual Equalization - Start now

Selecting 'Start now' on 'Manual equalisation' allows manual initiation of an Equalization cycle. To allow the charger to equalize the battery properly use the manual equalize option only during absorption and float periods, and when there is sufficient sunlight. Current and voltage limits are identical to the automatic equalize function. The duration of the equalisation cycle is limited to a maximum of 1 hour when triggered manually. Manual equalization can be stopped at any time by selecting 'Stop Equalize'.

4.2 Load output

This section applies to all products. These settings are typically used on the smaller models which have a dedicated load output (75/10, 75/15, 100/15 and 100/20).

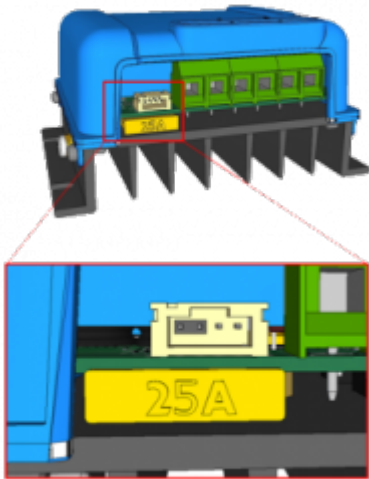
For larger models without a load output, the load settings can be used to drive the TX pin in the VE.Direct port, which can then be used to drive a BatteryProtect relay or other load-shedding device. See chapter 4.4 Tx port function, option 5: Virtual Load output, for more information.



The available programs are:

1. **Always off**
2. **BatteryLife algorithm:** Self adapting algorithm to maximize life of the battery. See manual for details.
3. **Conventional algorithm 1:** Off when $V_{batt} < 11.10V$. And On when $V_{batt} > 13.10V$. (12V battery assumed)
4. **Conventional algorithm 2:** Off when $V_{batt} < 11.80V$. And On when $V_{batt} > 14.00V$.
5. **Always on**
6. **User defined algorithm 1:** Off when $V_{batt} < V_{low}$. And On when $V_{batt} > V_{high}$.
7. **User defined algorithm 2:** Off when $V_{batt} < V_{low}$ or $V_{batt} > V_{high}$. And On when V_{batt} between V_{low} and V_{high} .
8. **Automatic Energy Selector:** Off when $V_{batt} < V_{low}$. And On when $V_{batt} > V_{high}$. When conditions are met Load will be on for a pre-selected time. Note; This mode is only available on SmartSolar Models.

Note that, by default, the models with a load output have their algorithm selected with a jumper in the VE.Direct port. This can be disabled using the VE.Direct Rx pin configuration (see **4.5** below). Or remove the jumper from the VE.Direct port when using VictronConnect to configure the load output operation mode, the drawing below shows where the jumper is located.



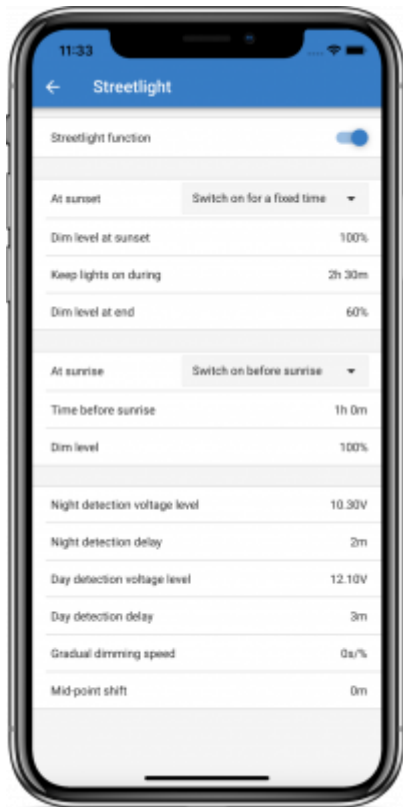
Keep in mind that modes 1 (always off) and 5 (always on) will respond immediately. The other modes, sensing the battery voltage, have a delay of 2 minutes before the load output changes. This is so that the charger does not respond too quickly when, for example, an inrush current briefly lowers the battery voltage below the threshold.

Larger models offer a 'Streetlighting Algorithm' (see **4.3** below); this too will be 'controlled' by the Load Output settings in order to protect the battery from being too deeply drained: Streetlight settings will be overridden if the battery voltage falls below a chosen value. When the battery voltage is restored to chosen parameters, the Streetlighting function will resume. In this way the two functions work together.

The load output (on the smaller MPPT models) always acts as a switch - off when load output is off or streetlight dimming is at 0%; and on when load output is on and streetlight dimming is between 1 and 100% (see **4.3** below: *Gradual Dimming speed*).

Use the optional VE.Direct TX digital output cable, ASS030550500, accessory.

4.3 Streetlight settings



Introduction

The Streetlight function allows you to automatically control night lighting - its duration, and brilliance. When the Streetlight function is enabled a timer program can be created whereby Sunset, Sunrise as well as Midnight can be used as the anchor points for the timer program. These anchor points will automatically adjust itself to the duration of night-time as it changes with the seasons.

Streetlight, TX Pin, Relay as well as the Load output configuration

For our smaller chargers, that have a set of dedicated load output terminals, the light can be powered from those terminals. For larger chargers, the TX can be used, as a 'virtual load output'. Or, for models having a relay, also the relay can be used. See TX Pin and Relay chapters for details.

Note that, both for the real load output, and TX pin or Relay as 'virtual load output' the streetlight algorithm is applied in conjunction with the settings as configured in the Load output menu:

If streetlight is disabled, then the (virtual) load output is controlled only by the configuration as made in the load output menu.

If streetlight is enabled, then its an AND function: the load output will be on when both the condition made in the Load output menu are satisfied as well as the streetlight settings. Otherwise, its off.

Therefore, in a streetlight application, the load output setting is typically set to either Always on, or to Battery life. Its is never configured to Always off as that will result in the light to be always off. For more configurable voltage levels to force the light off, the other load output options (conv alg., user alg.) can be used.

Setting the Sunset action

At sunset you can choose from the following actions:

- Keep the lights off
- Switch on for a fixed time. This option will turn the light on at sunset, and then off after a configurable interval. When the dimming feature is enabled ⁽¹⁾, two dim-levels can be entered: one for the “on” period; and a second for the “off” period. A typical use case for these options is to get a strong light during high traffic hours (right after sunset), and lower intensity during the low hours, to save the battery. Set the second dim level to 0% to switch the light completely off during that second section.
- Switch on till midnight. This option turns the light on at sunset, and then off at midnight. When the dimming feature is enabled ⁽¹⁾, two dim-levels can be entered: one for the “on” period (up to midnight) and a second dim-level for the “off” period after midnight. Set the second dim level to 0% to switch the light completely off during that second section.
- Switch on till sunrise. This options turns the light on at sunset, and then off at sunrise. When this option is selected; there is no need to also select an action at sunrise, and therefore the sunrise control option will be hidden. When the dimming feature is enabled ⁽¹⁾, one dim level be configured, Dim level at sunset.

¹⁾ the dimming feature requires the TX Port function to be configured to PWM. The dim level inputs are only available when the TX Port is configured accordingly. See chapter 4.4 below for details.

Setting the Sunrise action

At sunrise you can choose to:

- Switch off: Turns the light off at sunrise.
- Switch on before sunrise: This option switches the light on at a configurable time interval before sunrise; and then switches the light off at sunrise. In case the dimming feature is enabled ⁽¹⁾, this feature allows to configure a more intense light interval during early morning rush hours. Together with the Sunset action, you can now configure three dim levels: one at sunset rush hour, one during the low traffic hours, and the third on during the early morning rush hours.

Midnight is Solar midnight, and not 12 o' clock

The charger has no real time clock, and does not know when it is 12 o' clock at night. All references to midnight refer to what we call solar midnight: the mid-point between sunset and sunrise.

Midnight and Sunrise synchronisation

The (solar-) midnight and sunrise anchor points in the timer program need the charger to have its internal clock synchronised with the cycle of the sun.

After making your settings and powering up the charger, the charger will start unsynchronised: it assumes that midnight is 6 hours after sunset, and assumes that the full night is 12 hours.

During synchronisation, the charger checks the time between each detected sunrise. After three full day/night cycles, where the detected time is approximately 24 hours (one hour of deviation is allowed), it will start using its internal clock; instead of the fixed 6 and 12 hour timing.

Note that a loss of power will make the charger lose its synchronisation; it will take 5 days again to properly synchronise. Configuration settings are (ofcourse) stored and not lost, just like any other settings are always maintained during a loss of power.

Sunset and sunrise detection

The Sunset and Sunrise detection voltage settings can be used to adjust the detection to match the panel configuration. The Sunrise detection voltage must be 0.5V higher than the Sunset detection level. The lowest detectable voltage is 11.4V. Set this option to 0 to use the built-in defaults, which are:

- Sunset = $V_{\text{panel}} < 11.4\text{V}$
- Sunrise = $V_{\text{panel}} > 11.9\text{V}$

The default setting is 0, which uses built-in default voltages.

Use the 'Delay' periods to avoid the system making an accidental switch when clouds pass over the panels. The valid range is between 0...60 minutes. These delays are disabled by default (0).

Gradual dimming speed

The gradual dimming option can be used to slow down the response of the timer program. This is useful when multiple streetlights are used in a row, and helps to mask the fact that each timer uses its own detection and the transition moment which will vary from unit to unit.

The dimming settings can be adjusted. You can input the number of seconds required to achieve each percentage-point of change (x seconds/per 1% of dimming). The available setting parameters are 0 ...99

* 0 = immediate response (gradual dimming disabled)

- A setting of '0' will achieve an immediate response - so the gradual dimming option is disabled.

* 9 = dim from 0 to 100% in 15 minutes.

- Setting the dimming speed to 9, for example, slows down the dimming speed to 15 minutes (9 seconds for each percentage point of dimming x 100 percentage points = 900 seconds or 15 minutes).

Note: Make sure the TX port function is set to Light dimming mode (as described in the next chapter) and connect a VE.Direct TX digital output cable to the PWM dim input of your LED driver.

Mid-point shift

The time of midnight is estimated based on solar activity, and depends on your geographical location. Remember, too, that daylight saving times cause a further deviation between 'solar' and 'clock' midnight. By using the Mid-point shift function this can be compensated for. (Note that this setting is only relevant when your timer program uses 'Midnight' as a switching moment ...as in option 3 above). Use 0 to disable the shift (default).

Calculation Example:

For calculation we use a 1440-minute day.

Where Sunset is at 19:00 (1140 minutes); and Sunrise is at 6:25 (385 minutes)

- Night duration in minutes is: $1440m^{(\text{min/day})} - 1140m^{(\text{time to sunset})} + 385m^{(\text{time to sunrise})} = 685m$
- Degree of shift = time of sunset (in minutes) + half the duration of night (in minutes) - length of day (in minutes) = $1140m + 342m - 1440m = 42 \text{ minutes}$

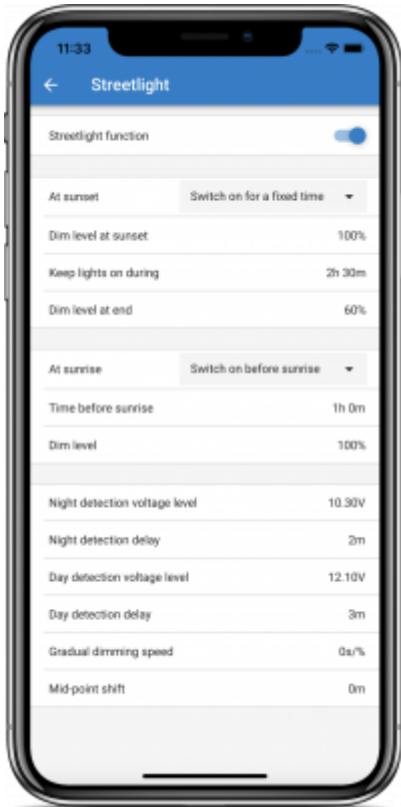
Example configuration

The selections which have been made on below screen image (click to enlarge) result in this program:

- *At sunset* - the light will be switched on for a fixed time
- *Dim level at sunset* - at Full brilliance (100%)
- *Keep lights on during* - the duration has been set to 1h 0m
- *Dim level at end* - at the end of one hour the brilliance will be reduced to half (50%)

Also;

- *At sunrise* - the lighting will be adjusted before sunrise
 - *Time before sunrise* - at 1h 0m before sunrise, the following adjustment will be made:
 - *Dim level* - full brilliance will be restored (100%)
-



4.4 Tx port function

This setting defines the function of the Tx pin located inside the VE.Direct connector. Use the VE.Direct TX digital output cable, ASS030550500 to access - and therefore receive signals from - the pin.



Available options:

1. **Normal communication (default)**. Use this when connecting to a Color Control GX, a
-

VE.Direct Bluetooth Smart dongle, or any other device that needs to communicate with the MPPT.

2. **Pulse every 0.01 kWh.** Selecting this option causes a pulse to be emitted for every 0.01kWh of energy harvested, the TX port is normally high and will be driven low for approximately 250ms for every 0.01kWh harvested. This function is useful in combination with an energy meter.
3. **Light dimming (pwm normal).** Use this function in combination with the Streetlight algorithm. PWM will be at 100% duty cycle when full light intensity is required.
4. **Light dimming (pwm inverted).** Use this function in combination with the Streetlight algorithm. PWM signal will be 0% duty cycle when full light intensity is required.
5. **Virtual load output.** The TX pin will switch in harmony with the load output port. The purpose of this is to use the BatteryLife algorithm, or Streetlight algorithm, on the larger models which do not have a dedicated load output. Connect the VE.Direct TX digital output cable to a [BatteryProtect module](#) or a solid state relay.

Notes:

- The PWM signal output (when using options 3 and 4) operates at a fixed frequency of 160Hz and has a fixed voltage level of 5V.
- Using options 2 through to 5 does not disable the ability of the unit to communicate - what happens is that the unit will automatically detect incoming data, and whilst that data is being received it will resume normal communication (as in option 1) for the duration of that data-reception. When the unit detects that the data-reception has been completed, it will automatically resume whichever option (2 -5) has been manually selected.

4.5 Rx port function



The Rx pin on the VE.Direct connector can be used for other functions. This functionality was introduced in firmware version 1.17. Available options:

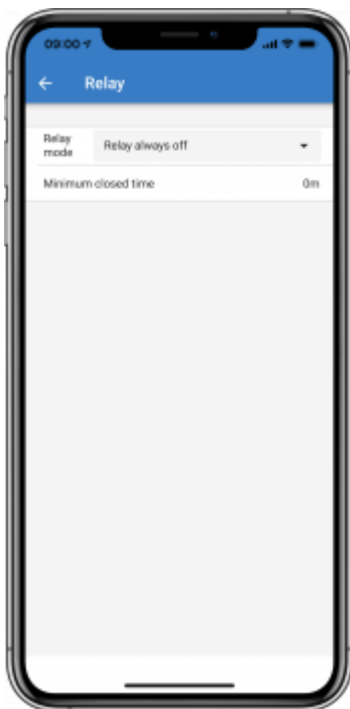
1. **Remote on/off (This is the default setting on all larger models).** This setting allows remote on/off control: (0V = switch charger off, +5V (or a signal sent via VE.Direct communication) = switch charger on). An example of this operation is when the unit is connected to a VE.BUS BMS (using a VE.Direct non inverting remote on-off cable,

ASS030550300).

2. **Load output configuration (This is the default setting on the following models: 75/10, 75/15, 100/15 and 100/20).** The Tx pin can be used to place a jumper to select load output operation. See Load output chapter (4.2 above) for details. This only applies to the 10A, 15A and 20A chargers with a load output.
3. **Load output on/off inverted** This setting reverses the load output on/off control: (0V = switch load output on, +5V = switch load output off)
4. **Load output on/off normal** This setting allows load output on/off control: (0V = switch load output off, +5V = switch load output on)

Note: These settings work in a similar way to a remote on/off switch, but instead they control the load output.

5. Programmable relay



A programmable relay switch is available on some SmartSolar models. The datasheet for your model will tell you whether or not it is available.

The relay offers three connections:

1. NO (Normally Open)
2. C (Common)
3. NC (Normally Closed)

| Relay state | Connection between |
|--------------|--------------------|
| Switched ON | C and NO |
| Switched OFF | C and NC |

The conditions for switching the relay depend on the relay mode setting, note that the conditions for switching over must be present for at least 10 seconds before the relay will change position.

Relay mode

1. **Relay always off.** This option switches the relay OFF. It will disable the other relay options. Use this option if you do not plan to use the relay function.
2. **Panel voltage high.** This option switches the relay ON when the panel voltage becomes too high. See *Panel voltage high mode settings* below.
3. **High temperature (Dimming).** This option switches the relay ON when the charger output current is reduced due to high temperatures. Use this option to for example switch an external fan.
4. **Battery voltage Low.** This option switches the relay in ON when the battery voltage falls too low, see *Battery voltage Low settings* below. This is the default setting when the relay function is active.
5. **Equalization active.** This option switches the relay ON when the manual equalization mode is active.
6. **Error state.** This option switches the relay ON when there is an error.
7. **Defrost option (Temp < -20?).** This option switches the relay ON when the Charger temperature falls below -20 degrees Centigrade.
8. **Battery voltage high.** This option switches the relay ON when the battery voltage is too high, see *Battery voltage High settings* below.
9. **Float or Storage state.** This option switches the relay ON when the charger is in the float state.
10. **Day detection (Panels irradiated).** This option switches the relay ON whilst the solar panels are providing energy (Day/Night detection).
11. **Load output.** This option switches the relay ON and OFF according to the settings chosen in 'Load Output' (4.2 above): Load on = Relay switched ON. Load off = Relay switched OFF. The purpose of this is to use the BatteryLife algorithm, or Streetlight algorithm, on the larger models which do not have a dedicated load output.

Panel voltage High settings

1. Panel high voltage. (User-defined Voltage)
2. Clear panel high voltage. (User-defined Voltage)

This option switches the relay ON when the panel voltage rises above the chosen “Panel high voltage” setting, and switches the relay OFF when the panel voltage falls below the chosen “Clear panel high voltage” setting. Ensure, of course, that the “Panel high voltage” setting is greater than the “Clear panel high voltage” setting. These settings must never exceed the maximum voltage-rating allowed by your MPPT charger.

Battery voltage Low settings

1. Battery low-voltage relay. (The default setting for this is 10.00V) (12V battery assumed)
2. Clear battery low-voltage relay. (The default setting for this is 10.50V)

These settings, which can be user-defined, will cause the relay to switch ON when the battery voltage falls below the chosen “Battery low-voltage” setting; and will cause the relay to switch OFF when the battery voltage once again rises above the “Clear battery low-voltage” setting. Ensure, of course, that the “Battery low-voltage relay” setting is lower than the “Clear battery low-voltage relay” setting.

An application for this feature, for example, is to automatically disconnect a load in order to prevent a battery from becoming too deeply discharged.

Battery voltage High settings

1. Battery high-voltage relay. (The default setting for this is 16.50V) (12V battery assumed)
2. Clear battery high-voltage relay. (The default setting for this is 16.00V)

These settings, which can be user-defined, will cause the relay to switch ON when the battery voltage rises above the “Battery high-voltage relay” setting; and will cause the relay to switch OFF when the battery voltage drops below the “Clear battery high-voltage relay” setting. Ensure, of course, that the “Battery high-voltage relay” setting is greater than the “Clear battery high-voltage relay” setting.

An application for this feature, for example, is to disconnect a load in order to protect it from an over-voltage.

General settings

1. Minimum closed time. (The default setting for this is 0 minutes)

This option sets a minimum-time for the ON condition to prevail once the relay has been switched ON.

An application for this feature, for example, is to set a minimum generator run-time.

6. VE.Smart Networking

This option is only available when the connection between the charger and VictronConnect is done over Bluetooth. This menu offers the possibility for the user to create or join an existing VE.Smart Network. By doing that, the user allow data to be exchanged between chargers and sensors. Please, refer to the VE.Smart Networking manual for more information about the possibilities over that feature.

DISQUS

[View the discussion thread.](#)

MPPT Solar Charger Error Codes

Solar Chargers indicate an error with their LEDs. See the Toolkit App for the LED codes.

Detailed error codes can be read with a remote panel, such as the Color Control GX or the MPPT Control.

Error Codes

Err 2 - Battery voltage too high

This error will auto-reset after the battery voltage has dropped. This error can be due to other charging equipment connected to the battery or a fault in the charge controller. This error can also occur if the battery voltage (12, 24 48V) is set to a lower voltage than the connected battery.

Err 3, Err 4 - Remote temperature sensor failure

Check if the T-sense connector is properly connected to a remote temperature sensor. Most likely cause: the remote T-sense connector is connected to the BAT+ or BAT- terminal. This error will auto-reset after proper connection.

Err 5 - Remote temperature sensor failure (connection lost)

Check if the T-sense connector is properly connected to a remote temperature sensor. This error will not auto-reset.

Err 6, Err 7 - Remote battery voltage sense failure

Check if the V-sense connector is properly connected to the battery terminals. Most likely cause: the remote V-sense connector is connected in reverse polarity to the BAT+ or BAT- terminals.

Err 8 - Remote battery voltage sense failure (connection lost)

Check if the V-sense connector is properly connected to the battery terminals.

Err 17 - Controller overheated despite reduced output current

This error will auto-reset after charger has cooled down. Check the ambient temperature and check for obstructions near the heatsink.

Err 18 - Controller over-current

This error will auto-reset. If the error does not auto-reset disconnect the charge controller from all power-sources, wait 3 minutes, and power up again. If the error persists the charge controller is probably faulty. A cause for this error can be switching on a very large load on the battery side.

Err 20 - Maximum Bulk-time exceeded

Solar Chargers

The maximum bulk time protection is a feature that was in the chargers when they were just released (2015 or earlier) and later the feature was removed.

If you do see this error, then update to the latest firmware.

If you then still have the error, perform a reset to factory defaults of the configuration, and reconfigure the solar charger.

AC Chargers

This protection is default enabled on the Skylla-i and the Skylla IP44.

This error is generated when the battery-absorption-voltage is not reached after 10 hours of charging.

The feature of this safety protection is to detect a shorted cell; and stop charging.

Err 21 - Current sensor issue

This error will not auto-reset.

Disconnect all wires, and then reconnect all wires. Also, make sure the minus on the MPPT charge controller (PV minus/Battery minus) is not bypassing the charge controller.

If the error remains, please contact the dealer, there might be a hardware defect.

Err 26 - Terminal overheated

Power terminals overheated, check wiring, including the wiring type and type of strands, and/or fasten bolts if possible.

This error will auto-reset.

Err 28 - Power stage issue

This error will not auto-reset.

Disconnect all wires, and then reconnect all wires. If the error persists the charge controller is probably faulty.

Note that this error was introduced in v1.36. So when doing an update, it might look like the firmware update caused this issue; but it doesn't. The Solar charger was then already not performing 100% before the update; updating to v1.36 or later merely made the issue more visible. The unit needs to be replaced.

Err 33 - PV over-voltage

This error will auto-reset after PV-voltage has dropped to safe limit. This error is an indication that the PV-array configuration with regard to open-circuit voltage is critical for this charger. Check configuration, and if required, re-organise panels.

Err 34 - PV over-current

The current from the solar-panel array has exceeded 75A. This error could be generated due to an internal system fault. Disconnect the charger from all power-sources, wait 3 minutes, and power-up again. If the error persists the controller is probably faulty, contact your dealer.

Err 38, Err 39 - PV Input shutdown

To protect the battery from over-charging the panel input is shorted.

Possible reasons for this error to occur:

- The Battery voltage (12/24/48V) is set, or auto-detected, incorrectly. Use VictronConnect to disable auto-detect and set the Battery Voltage to a fixed voltage.
- There is another device connected to the battery, which is configured to a higher voltage. For example a MultiPlus, configured to equalise at 17 Volts, while in the MPPT this is not configured.
- The battery is disconnected using a manual switch. Ideally the charger should be switched off before disconnecting the battery, this avoids a voltage overshoot on the charger output. If necessary the voltage trip-level for the PV Short protection can be increased by raising the Equalization voltage set-point (note: equalization does not have to be enabled in this case).
- The battery is disconnected using a Lithium charge relay connected to the "allow-to-charge" output of a BMS. Consider wiring this signal to the Remote terminal of the charger instead. This shuts down the charger gracefully without creating a voltage overshoot.

Error recovery:

- Error 38: First disconnect the solar panels and disconnect the battery. Wait for 3 minutes, then reconnect the battery first and next the panels.
 - Error 39: The charger will automatically resume operation once the battery voltage drops below its maximum voltage setting (normally Equalisation or Absorption voltages), for 250V versions or float voltage for the other units. It can also takes a minute to reset the fault.
-

If the error persists the charge controller is probably faulty.

Err 40 - PV Input failed to shutdown

If the charger is unable to turn off the PV input, it will go into a safe mode in order to protect the battery from over-charging or having a high voltage on the battery terminals. In order to do that, the charger will stop charging and disconnect its own output. The charger will become faulty.

Information 65 - Communication warning

Communication with one of the paralleled controllers was lost. To clear the warning, switch the controller off and back on

Information 66 - Incompatible device

The controller is being paralleled to another controller that has different settings and/or a different charge algorithm.

Make sure all settings are the same and update firmware on all chargers to the latest version

Err 67 - BMS Connection lost

The charger is configured to be controlled by a BMS, but it does not receive any control messages from a BMS. The charger stopped charging, as a safety precaution.

Check the connection between the charger and the BMS.

How to reset the charger, to de-couple it from the BMS

When the charger needs to operate in stand-alone mode again, not controlled by a BMS, it needs to be reset:

- VE.Can solar chargers, go into the setup menu, and change setting 'BMS' from 'Y' to 'N' (setup item 31).
- VE.Direct solar chargers, reset the charger to factory defaults with VictronConnect, and then reconfigure it.

Note that (solar-)chargers automatically configure themselves to be BMS-controlled when they are connected to one; either direct or via a Color Control GX or Venus GX.

Err 68 - Network misconfigured

The charger detects multiple conflicting network sources trying to take control of the charger.

Applies to SmartSolar MPPTs and SmartSolar MPPTs VE.Can.

The typical reason for the error to show is that the charger is configured to operate in parallel using our wireless VE.Smart protocol; and at the same time it is part of an Energy Storage System (ESS). Or its used in an installation with an intelligent battery. In all those cases, the charger is being externally controlled (by ESS and/or intelligent battery), and should therefore not at the same time be configured for parallel operation.

The error might be intermittent as the charger will always try to reset the fault. There is a 10 seconds delay to retry resetting the error in order for the error to be seen and broadcast to the interfaces.

Resolution: disable the parallel operation by connecting VictronConnect, going to settings, then "VE.Smart networking" and choose "Leave network".

For SmartSolar MPPT VE.Can only, also make sure its not connected to a GX Device via both VE.Can and VE.Direct. Either disconnect the VE.CAN cable or the VE.Direct cable.

Once the conflict is resolved the error will disappear and the charger will resume normal operation, within a minute.

Err 114 - CPU temperature too high

This error will reset after the CPU has cooled down. If the error persists, check the ambient temperature and check for obstructions near the air inlet and outlet holes of the charger cabinet. Check manual for mounting instructions with regard to cooling. If error persists the controller is probably faulty.

Err 116 - Calibration data lost

If the unit does not work and error 116 pops up as the active error the unit is faulty, contact your dealer for a replacement.

If the error is only present in the history data and the unit operates normally this error can be ignored safely. Explanation: when the units power up for the very first time in the factory, it does not have calibration data and an error 116 is logged. Obviously this should have been cleared, but in the beginning units left the factory with this message still in the history data.

SmartSolar models (not the BlueSolar models): upgrading to v1.4x firmware is a one-way trip, you cannot go back to an older firmware version once you upgrade to v1.4x. Reverting to older firmware gives error 116 (calibration data lost), this can be fixed by re-installing the v1.4x firmware.

Err 119 - Settings data lost

The charger cannot read its configuration, and stopped.

This error will not auto-reset. To get it working again:

1. First, restore it to factory defaults. (top right in Victron Connect, click on the three dots)
 2. Disconnect the charge controller from all power-sources
 3. wait 3 minutes, and power up again.
 4. Reconfigure the charger.
-

VE.Smart Networking

1. Introduction

A VE.Smart Network is a wireless network which allows a number of Victron products to exchange information. It is a wireless technology using Bluetooth Smart.

Use VE.Smart to add remote voltage, temperature and/or current sensing to your Victron MPPT Solar Chargers. Connect either a BMV battery monitor - or the new Smart Battery Sense, to a Solar Charger. The Solar Charger will receive the available information from the battery, like battery voltage and temperature (depending on the sensor) information, and use that data to optimize its charge parameters. This will improve charging-efficiency and prolong battery life.



Video

Use also now the VE.Smart Networking to synchronise the charger algorithms from Solar Chargers and improve even further the charge-efficiency and battery life. This feature is only available on SmartSolars with firmware version equal or higher than v1.47 (Ve.Direct SmartSolars) and v1.04 (Ve.Can SmartSolars).

2. Voltage, temperature and current sense - further details

The battery voltage data is used to compensate for voltage-drop over the battery cables. This ensures that the battery is charged with the exact voltage as configured in the charger - instead of a lower voltage due to resistance in the wiring.

The battery temperature data is used to adjust the charge voltages. When cold, a lead/acid battery typically needs a higher charge-voltage ...and a lower charge-voltage when it's hot.

For lithium batteries the charge-voltages remain the same at all temperatures, as long as it's not *too* cold. Its better to not charge Lithium batteries below 5C, to prevent them from being damaged and degraded.

The battery current is used to allow the tail current setting (see the Solar Charger Manual for more details) to be used more precisely as, by having the actual battery current, the Solar Charger can decide better if absorption phase should stop and go to equalisation/float phase.

3. Specifications

3.1 VE.Smart Networking products compatibility

| Product range | Compatible | Function |
|---|--|---|
| BMV-700 | Yes (requires dongle accessory) ⁽²⁾ | Transmit voltage-sense and current-sense |
| BMV-702 | Yes (requires dongle accessory) ⁽²⁾ | Transmit voltage-sense, current-sense, and (optionally) temperature ⁽¹⁾ |
| BMV-712 | Yes | Transmit voltage-sense, current-sense, and (optionally) temperature ⁽¹⁾ |
| SmartSolar MPPTs | Yes ⁽²⁾ | Uses received sense data to optimize charging and synchronise charging process ⁽³⁾ |
| BlueSolar MPPTs | Yes (requires dongle accessory) ⁽²⁾ | Uses received sense data to optimize charging |
| Phoenix Smart IP43 Charger | No | Not yet supported, may be compatible in the future |
| Orion-Tr Smart DC-DC Charger Isolated | No | Not yet supported, may be compatible in the future |
| Blue Smart Chargers IP22, IP65 and IP67 | No | Not yet supported, may be compatible in the future |

1. To measure battery temperature, the BMV series temperature sensor is required.
2. Check the table below to see which models are incompatible with this feature.
3. Synchronised charging is available on the SmartSolar on version v1.47 or higher except for the models listed on the table below

First production batches of SmartSolar MPPTs do not support VE.Smart Networking

All currently shipping SmartSolar MPPTs support VE.Smart Networking. However some older versions of those models do **not** support VE.Smart Networking. Those devices will also not become compatible later with a firmware update: the incompatibility is due to a hardware limitation in those devices. There is a work around: connect a VE.Direct Bluetooth Smart dongle. This **enables** VE.Smart Networking support. Both Voltage and Temperature sense will work. In such scenario the internal Bluetooth interface of the SmartSolar should not be used anymore as communication errors may occur - instead the VE.Direct Bluetooth Smart dongle is to be used when connecting by phone or tablet. This is the list of the older *incompatible* products and part-numbers - together with the part numbers of their compatible successors:

| Product | Old Incompatible Part-number | New Compatible Part-number |
|----------------------------------|------------------------------|----------------------------|
| VE.Direct Bluetooth Smart dongle | ASS030536010 | ASS030536011 |
| SmartSolar MPPT 150/85 Tr | SCC010085210 | SCC115085211 |
| SmartSolar MPPT 150/85 MC4 | SCC010085310 | SCC115085311 |
| SmartSolar MPPT 150/100 Tr | SCC010100210 | SCC115110211 |
| SmartSolar MPPT 150/100 MC4 | SCC010100310 | SCC115110311 |

| Product | Old Incompatible Part-number | New Compatible Part-number |
|-------------------------|--|--|
| SmartSolar MPPT 250/85 | SCC125085210 (before s/n HQ1811) SCC125085310 (before s/n HQ1811) | SCC125085210 (after s/n HQ1811) SCC125085310 (after s/n HQ1811) |
| SmartSolar MPPT 250/100 | SCC125110210 (before s/n HQ1811) SCC125110310 (before s/n HQ1811) | SCC125110210 (after s/n HQ1811) SCC125110310 (after s/n HQ1811) |

3.2 Limitations

- The maximum number of devices which can be connected on one network is 10.
- VE.Smart Networking is designed for small systems which do not have a GX device - such as a Color Control GX or Venus GX. In systems which have a GX device, do not use VE.Smart Networking - See FAQ 6.
- The transmitter range will be found to be the same as the Bluetooth range - as experienced when connecting a device to *VictronConnect*.
- VE.Smart Networking is not allowed to be created with the charger that already has a CAN network that is also being used to synchronise the charger algorithm with other chargers or if an ESS or an intelligent battery is used on the CAN network or Ve.Direct. Error 68 will be shown when the network is misconfigured. Please see the MPPT error list to find more information about troubleshooting.

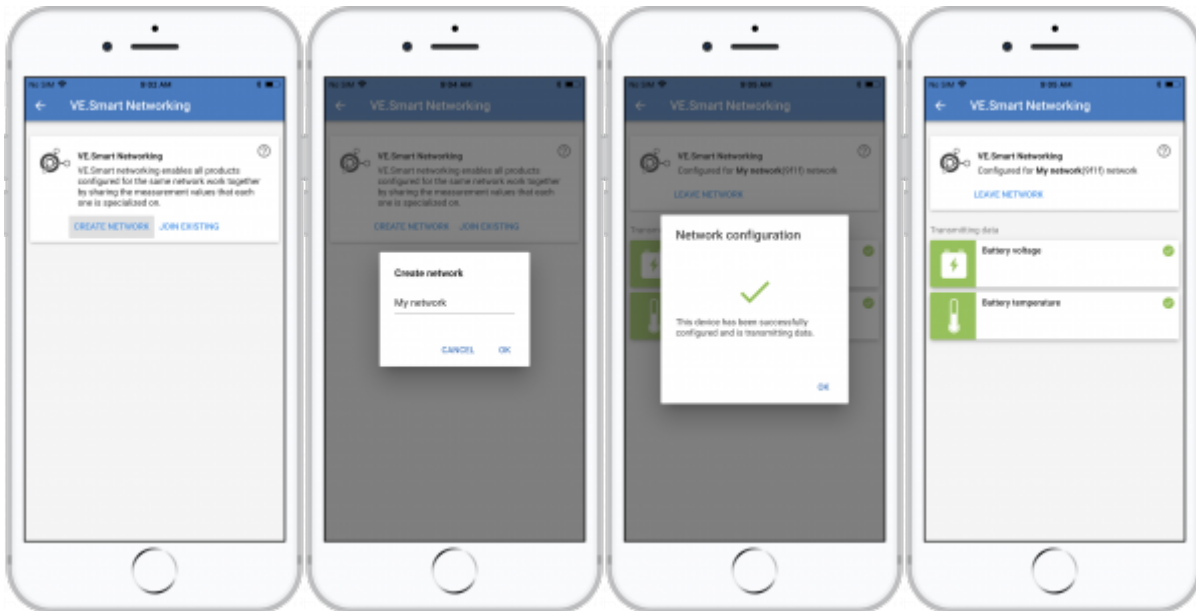
4. Step by step instructions

We recommend you configure the Smart Battery Sense, or BMV first ...and *then* add one or more solar chargers to that network. You can read the Smart Battery Sense manual [here](#).

4.1 Setup the Smart Battery Sense or BMV

Open *VictronConnect*, connect the device, and then navigate to *Settings* and select *VE.Smart Networking*.

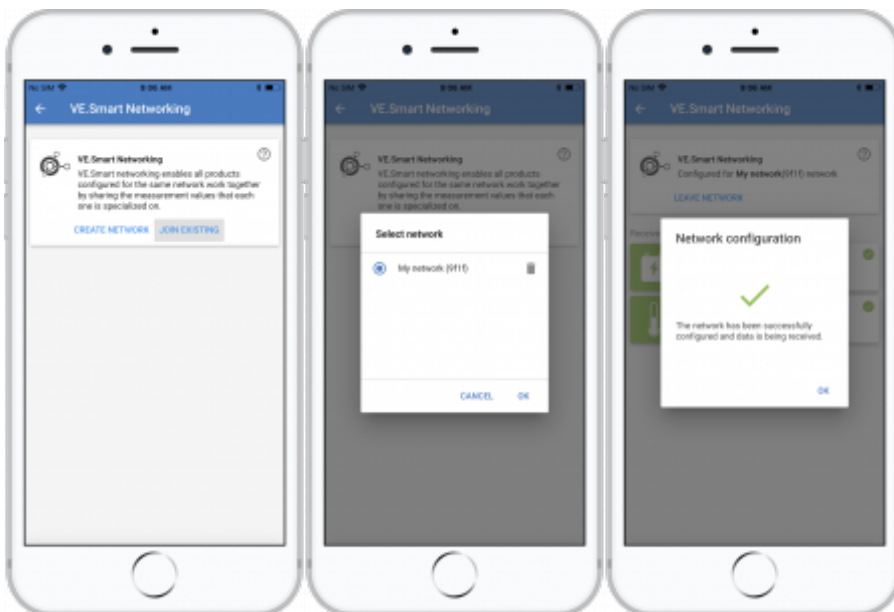
Click *Create Network*, enter a name. Click *Save* and wait for the 'OK' to show up.



4.2 Join the Solar Chargers to the network

Go back and navigate to the *Solar charger*, then click *Settings* followed by *VE.Smart Networking* followed by *Join Existing*. Now select the network which you created at the previous step.


Wait for the 'OK' to show.



4.3 Verify operation

When everything is working OK, you will be able to see that the VE.Smart Networking page of the Solar Charger is receiving data:



Also the network icon  will be shown on the main page:



Clicking on that icon will show the network status.

5. FAQ

Q1: Can several MPPTs be paired to one Smart Battery Sense or BMV?

Yes. If SmartSolars are connected to the same network, they will also synchronize their charger algorithms.

Q2: Is VE.Smart Networking disrupted if I connect a smartphone to it at the same time?

Not at all. It is possible to connect with a smart phone, computer or tablet, at the same time.

Q3: Will you add the same functionality to the BlueSmart Charger product range?

Yes we will - though the exact functionality, and the models to be included has yet to be determined.

Q4: Can Smart Battery Sense be used as a standalone product?

Yes. In this instance it will simply act as a voltage- and temperature-measuring device. Note that the functionality is limited in that it does not (yet) show the graphs or other data which would normally be generated from these measurements.

Q5: Can I use Smart Battery Sense in systems already controlled by a GX device (eg CCGX/VenusGX)?

No. The GX device already has voltage sensing (soon they will have temperature sensing too). Adding Smart Battery Sense to the installation will confuse the voltage-sensing data. For further information please see: CCGX/Distributed Voltage and Current Control.

DISQUS

[View the discussion thread.](#)