1. General Description

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.

VE.Direct port
For a wired data connection to a Color Control GX or other GX device, PC or other devices.

VE.Can port
For a wired data connection to a Color Control GX or other GX device.
The VE.CAN port is the preferred solution to synchronise several charge controllers

Remote on-off input
On/off control by a VE.Bus BMS when charging Li-ion batteries.

Programmable relay
Can be programmed (a.o. with a smartphone) to trip on an alarm, or other events.

Optional: pluggable LCD display
Simply remove the rubber seal that protects the plug on the front of the controller and plug-in the display.

Ultra-fast Maximum Power Point Tracking (MPPT)
Especially in case of a clouded sky, when light intensity is changing continuously, an ultra fast MPPT controller will improve energy harvest by up to 30% compared to PWM charge controllers and by up to 10% compared to slower MPPT controllers.

Advanced Maximum Power Point Detection in case of partial shading conditions
If partial shading occurs, two or more maximum power points may be present on the power-voltage curve.
Conventional MPPTs tend to lock to a local MPP, which may not be the optimum MPP.
The innovative SmartSolar algorithm will always maximize energy harvest by locking to the optimum MPP.

Outstanding conversion efficiency
No cooling fan. Maximum efficiency exceeds 98%. Full output current up to 40°C (104°F).

Extensive electronic protection
Over-temperature protection and power derating when temperature is high.
PV reverse polarity protection.

Internal temperature sensor
Compensates absorption and float charge voltages for temperature.

Automatic battery voltage recognition
The controllers will automatically adjust to a 12V, 24V or a 48V 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 or the optionel LCD display. Similarly, manual setting is required in case of 36V system.

Flexible charge algorithm
Fully programmable charge algorithm, and eight preprogrammed algorithms, selectable with a rotary switch.

Adaptive three step charging
The SmartSolar MPPT Charge Controller is configured for a three step charging process: Bulk – Absorption – Float.
A regular equalization charge can also be programmed: see section 3.12 of this manual.
Bulk
During this stage the controller delivers as much charge current as possible to rapidly recharge the batteries.
Absorption
When the battery voltage reaches the absorption voltage setting, 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 2A.
Float
During this stage, float voltage is applied to the battery to maintain it in 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
See section 3.12

Configuring and monitoring

- Bluetooth Smart built-in: the wireless solution to set-up, monitor and update the controller using Apple and Android smartphones, tablets or other devices.
- Use the VE.Direct to USB cable (ASS030530000) to connect to a PC, a smartphone with Android and USB On-The-Go support (requires additional USB OTG cable).
- Use the VE.Direct port and a VE.Direct to VE.Direct cable to connect to a MPPT Control, a Color Control GX or other GX device.
- Or use the VE.Can ports and a RJ45 UTP cable to daisy-chain several units and connect to a GX device.

Several parameters can be customized with the VictronConnect app.
The VictronConnect app can be downloaded from
http://www.victronenergy.nl/support-and-downloads/software/
Use the manual – VictronConnect - MPPT Solar Charge Controllers – to get the most out of the VictronConnect App when it's connected to a MPPT Solar Charge Controller:
http://www.victronenergy.com/live/victronconnect:mppt-solarchargers

MPPT Control

Color Control GX

Venus GX

2. 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

- Please 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 maximum working voltage for the charge controller is considered unsafe. Voltage carrying parts are not allowed to be operator accessible. Without a wire box (see section 3.15) 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 3.4.
- Without a wire box 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.

- Use flexible multistranded copper cable for the battery and PV connections.
  The maximum diameter of the individual strands is 0,4mm/0,125mm² (0.016 inch/AWG26).

A 25mm² cable, for example, should have at least 196 strands (class 5 or higher stranding according to VDE 0295, IEC 60228 and BS6360).
An AWG2 gauge cable should have at least 259/26 stranding (259 strands of AWG26).
Maximum operating temperature: ≥ 90°C.
Example of suitable cable: class 5 “Tri-rated” cable (it has three approvals: American (UL), Canadian (CSA) and British (BS))
In case of thicker strands the contact area will be too small and the resulting high contact resistance will cause severe overheating, eventually resulting in fire.



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.

3.1 General

● Mount vertically on a non-flammable surface, 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 installing the Smart Battery Sense option 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 connections (and for Tr version also PV connections) must be guarded against inadvertent contact (e.g. install in an enclosure or install the optional WireBox).

Tr models: use flexible multistranded copper cable for the battery and PV connections: see safety instructions.

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)

- The controllers 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: 150V or 250V, depending on model.

For example:

24V battery, mono- or polycristalline panels, max PV voltage 150V:

- Minimum number of cells in series: 72 (2x 12V panel in series or one 24V panel).
- Recommended number of cells for highest controller efficiency: 144 cells (4x 12V panel or 2x 24V panel in series).
- Maximum: 216 cells (6x 12V or 3x 24V panel in series).

48V battery, mono- or polycristalline panels, max PV voltage 250V:

- Minimum number of cells in series: 144 (4x 12V panel or 2x 24V panel in series).
- Maximum: 360 cells (10x 12V or 5x 24 panel in series).

Remark: at low temperature the open circuit voltage of a 216 cell solar array may exceed 150V, and the open cicuit voltage of a 360 cell array may exceed 250V, 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 1)

First: connect the battery.
Second: if required, connect the remote on-off, CAN interface and programmable relay
Third: connect the solar array (when connected with reverse polarity, the controller will heat up but will not charge the battery).

3.5 Remote on-off

H-pin on level: >3V
L-pin on level: <5V
On-level impedance between L-H pins: <500kΩ
Voltage tolerance L & H pin: +/-70V_{DC}
The recommended use of the remote on-off is:
a. A switch wired between the L-H pins
b. A switch wired between battery plus and the H-pin.
c) A switch between the L-pin and the charge disconnect terminal of a VE.Bus BMS

3.6 CAN bus interface

The charger is equipped with two CAN bus RJ45 sockets.

The CAN bus on this charger is not galvanically isolated. The CAN bus is referenced to the minus battery connection.

The CAN bus interface will be referenced to ground if the minus pole of the battery is grounded. In case of a positive grounded system, a CAN isolation module will be needed to reference the CAN bus interface to ground.
The end of a CAN cable should have a bus terminator. This is achieved by inserting a bus terminator in one of the two RJ45 connectors and the CAN

cable in the other. In case of a node (two CAN cables, one in each RJ45 connector), no termination is needed.

Supply voltage (V+ supply): 9V-70V
Maximum supply current: 500mA
Data rate: 250 kbps
CANH/CANL voltage tolerance: +/-70V_{DC}
CAN transceiver ISO specification: ISO 11898-2:2016

To provide maximum flexibility, the battery voltage is used for the V+ supply line of VE.CAN. This means that all equipment connected to VE.CAN are a permanent load to the battery.

3.7 Synchronised parallel operation

Several charge controllers can be synchronised with the CAN interface. This is achieved by simply interconnecting the chargers with RJ45 UTP cables (bus terminators needed, see section 3.6).
The paralleled charge contollers must have identical settings (e.g. charge algorithm). The CAN communication ensures that the controllers will switch simultaneously from one charge state to another (from bulk charge to absorption for example). **Each unit will (and should) regulate its own output current,** depending a.o. on the output of each PV array and cable resistance.

In case of synchronized parallel operation, the network icon will blink every 3 seconds on all paralleled units.

The PV inputs should not be connected in parallel. Each charge controller must be connected to its own PV array.

3.8 Energy Storage System (ESS)

An Energy Storage System (ESS) is a specific type of power system that integrates a power grid connection with a Victron Inverter/Charger, GX-device and battery system. It stores solar energy into your battery during the day, for use later on when the sun stops shining.

Please refer to the following manual how to setup an ESS:
https://www.victronenergy.com/live/ess:start

3.9 Configuration of the controller with the rotary switch

Fully programmable charge algorithm (see the software page on our website) and eight preprogrammed charge algorithms, selectable with a rotary switch:

Pos	Suggested battery type	Absor-ption V	Float V	Equa-lize V @%I_{nom}	dV/dT mV/° C
0	**Gel Victron long life (OPzV)** **Gel exide A600 (OPzV)** **Gel MK**	28,2	27,6	31,8 @8%	-32
1	**Gel Victron deep discharge** **Gel Exide A200** **AGM Victron deep discharge** **Stationary tubular plate (OPzS)**	28,6	27,6	32,2 @8%	-32
2	**Default setting** **Gel Victron deep discharge** **Gel Exide A200** **AGM Victron deep discharge** **Stationary tubular plate (OPzS)**	28,8	27,6	32,4 @8%	-32
3	**AGM spiral cell** **Stationary tubular plate (OPzS)** **Rolls AGM**	29,4	27,6	33,0 @8%	-32
4	**PzS tubular plate traction batteries or OPzS batteries**	29,8	27,6	33,4 @25%	-32
5	**PzS tubular plate traction batteries or OPzS batteries**	30,2	27,6	33,8 @25%	-32
6	**PzS tubular plate traction batteries or OPzS batteries**	30,6	27,6	34,2 @25%	-32
7	**Lithium Iron Phosphate ($LiFePo_4$) batteries**	28,4	27,0	n.a.	0

Note 1: divide all values by two in case of a 12V system and multiply by two in case of a 48V system.
Note 2: equalize normally off, see sect. 3.9 to activate
(do not equalize VRLA Gel and AGM batteries)
Note 3: any setting change performed with the pluggable LCD display or via Bluetooth will override the rotary switch setting. Turning the rotary switch will override prior settings made with the pluggable LCD display or via Bluetooth.

A binary LED code helps determining the position of the rotary switch. After changing the position of the rotary switch, the LEDs will blink during 4 seconds as follows:

Switch position	LED Bulk	LED Abs	LED Float	Blink frequency
0	1	1	1	Fast
1	0	0	1	Slow
2	0	1	0	Slow
3	0	1	1	Slow
4	1	0	0	Slow
5	1	0	1	Slow
6	1	1	0	Slow
7	1	1	1	Slow

Thereafter, normal indication resumes, as described in the LEDs section.

3.10 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.

3.11 Battery charging information

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

Default setting:

The maximum duration of the absorption period is determined by the battery voltage measured just before the solar charger starts up in the morning:

Battery voltage Vb (@start-up)	Maximum absorption time
Vb < 23,8V	6h
23,8V < Vb < 24,4V	4h
24,4V < Vb < 25,2V	2h
Vb > 25,2V	1h

(divide voltages by 2 for a 12V system and multiply by two in case of a 48V system)

If the absorption period is interrupted due to a cloud or due to a power hungry load, the absorption process will resume when absorption voltage is reached again later on the day, until the absorption period has been completed.

The absorption period also ends when the output current of the solar charger drops to less than 2Amps, not because of low solar array output but because the battery is fully charged (tail current cut off).

This algorithm prevents over charge of the battery due to daily absorption charging when the system operates without load or with a small load.

User defined algorithm:

Any setting change performed with the pluggable LCD display or via Bluetooth will override the rotary switch setting. Turning the rotary switch will override prior settings made with the pluggable LCD display or via Bluetooth.

3.12 Automatic equalization

Automatic equalization is default set to 'OFF'. With the VictronConnect app or the pluggable LCD display 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 (see table in section 3.5). The current is limited to 8% of the bulk current for all VRLA (Gel or AGM) batteries and some flooded batteries, and to 25% of the bulk current for all tubular plate batteries and the user defined battery type. The bulk current is the rated charger current unless a lower maximum current setting has been chosen.

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

For all tubular plate batteries and the user defined battery type automatic equalization ends after t = (absorption time)/2.

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

3.13 Pluggable LCD display - Live data

Remove the rubber seal that protects the plug on the front of the controller and plug-in the display module. The display is hot-swappable; this means that the charger may be operational while the display is plugged in.

The following information will be displayed if the "-" button is pressed (in order of appearance):

Displayed info	Icons	Segments	Units
Battery voltage and charge current		28.8 50	A
Battery charge current		50.0	A
Battery voltage		28.80	V
Battery charge power		1420.0	W
Battery temperature [1]		25.0,---,Err	°C/°F
Charger temperature [1]		25.0,---,Err	°C/°F
Panel current		8.6	A
Panel voltage		85.0	V
Panel power		1435.0	W
Warning message [2]		!nF 65	
Error message [2]		Err 2	
REMOTE operation [2]		rE:0tE	
BMS operation [2]		b:S	

Notes:
1) A valid temperature is shown, --- = no sensor information or Err = invalid sensor data.
2) These items are only visible when relevant.

Pressing the "-" button or the "+"button for 4 seconds activates the auto-scroll-mode. Now all LCD-screens will pop-up one by one with short intervals. The auto-scroll-mode can be stopped by pressing the "-" or the "+" button shortly.

3.14 Pluggable LCD display - History data

The charge controller tracks several parameters regarding the energy harvest. Enter history data by pressing the SELECT button when in monitor mode, a scrolling text will be visible. Press + or – to browse the various parameters as shown in the table below, press SELECT to stop scrolling and show the corresponding value. Press + or – to browse the various values. For the daily items it is possible to scroll back to 30 days ago (data becomes available over time), a brief popup shows the day number. Press SELECT to leave the historical menu and go back to the monitor mode, alternatively press SETUP to return to the scrolling text.

Scrolling text	Icons [1]	Segments	Units	Displayed info
YIELd tOtAL		258.0	kWh	Total yield
LASt ErrOr		E0 2		Total error 0 (most recent)
		E1 0		Total error 1 (shown when available)
		E2 0		Total error 2 (shown when available)
		E3 0		Total error 3 (shown when available)
PAnEL vOLtAGE MAXIMUM		U 95.0	V	Total panel voltage maximum
bAttEry vOLtAGE MAXIMUM		H 28.8	V	Total battery voltage maximum
YIELd		y 8.6	Day kWh	Daily yield
bAttEry vOLtAGE MAXIMUM		H 28.8	Day V	Daily battery voltage maximum
bAttEry vOLtAGE MINIMUM		L 25.0	Day V	Daily battery voltage minimum
LASt ErrOr		E0 2	Day	Daily error 0 (most recent)
		E1 0	Day	Daily error 1 (shown when available)
		E2 0	Day	Daily error 2 (shown when available)
		E3 0	Day	Daily error 3 (shown when available)
tIME bULK		tb 60	Day	Daily time spent in bulk or ESS (minutes)
tIME AbSOrPtIOn		tA 30	Day	Daily time spent in absorption (minutes)
tIME FLOAt		tF 630	Day	Daily time spent in float (minutes)
MAX MAXIMUM POWEr		P 135	Day W	Daily power maximum
bAttEry CUrrEnt MAXIMUM		C 50.0	Day A	Daily battery current maximum
PAnEL vOLtAGE MAXIMUM		U 95.0	Day V	Daily panel voltage maximum

Note:
When the charger is not active (night time) the bulk, absorption and float icons will be shown as in the table above.
When the charger is active only one icon will be shown: the icon corresponding to the actual charge state.

3.15 Pluggable LCD display - Setup menu

a. To enter the SETUP Menu, press and hold the SETUP-button during 3 seconds. The “Menu” icon will light up and a scrolling text is visible.
b. Press the "-" or "+" button to scroll through the parameters.
c. The table below lists, in order of appearance, all parameters which can be adjusted by pressing the "-" button.
d. Press SELECT: the parameter to change will now blink.
e. Use the "-" or "+" button to chose the desired value.
f. Press SELECT to confirm the change, the value will stop blinking, and the change is made final.
g. Press SETUP to return to the parameters menu. With the "-" or "+" button it is now possible to scroll to another parameter that needs change.
h. To return to normal mode, press SETUP during 3 seconds.

Scrolling text	Icons	Segments	Units	Function or parameter
01 POWER On OFF	Menu Charging	On,OFF		On/off switch
02 MAX MAIN CHARGE CURRENT	Menu	1.0- 100.0	A	Maximum charge current
03 BATTERY VOLTAGE	Menu	12-48	V	System voltage
04 CHARGE ALGORITHM	Menu	0,1-USER	Type	Charge algorithm (1)
05 ABSORPTION VOLTAGE	Menu	16.0-28.8-34.8	V	Absorption voltage (2)
06 FLOAT VOLTAGE	Menu	16.0-27.6-34.8	V	Float voltage (2)
08 EQUALIZATION VOLTAGE	Menu Equalize	16.0-32.4-34.8	V	Equalization voltage (2)
09 AUTO EQUALIZE	Menu Equalize	OFF,AUTO		Automatic equalization (3)
10 MANUAL EQUALIZE	Menu Equalize	START,STOP		Manual equalization (4)
11 RELAY MODE	Menu	REL. OFF, 1-3- 10		Relay function (5)
12 RELAY LOW VOLTAGE	Menu	LB 16.0-20.0-34.8	V	Low battery voltage alarm set
13 RELAY CLEAR LOW VOLTAGE	Menu	LBC 16.0-2 1.0-34.8	V	Low battery voltage alarm clear
14 RELAY HIGH VOLTAGE	Menu	HB 16.0-33.0-34.8	V	High battery voltage alarm set
15 RELAY CLEAR HIGH VOLTAGE	Menu	HBC 16.0-32.0-34.8	V	High battery voltage alarm clear
16 RELAY HIGH PANEL VOLTAGE	Menu	U 1.0- 150.0	V	High panel voltage alarm set
17 RELAY CLEAR HIGH PANEL VOLTAGE	Menu	UC 1.0- 149.0- 150.0	V	High panel voltage alarm clear
18 RELAY MINIMAL MAIN CLOSED TIME	Menu	r.mC 0-500		Relay minimum closed time (minutes)
20 TEMPERATURE COMP ENSATION	Menu	-5.0- -2.7-0.0	°C mV	Battery temperature compensation per cell (2)
23 MAX ABSORPTION TIME	Menu	1.0-6.0-24.0	h	Absorption time
29 LOW TEMPERATURE CHARGE CURRENT	Menu	0.0- 100.0	A	Charge current below the low temperature level (item 30)
30 LOW TEMPERATURE LEVEL	Menu	- 10.0-5- 10.0	°C	Low temperature level (for item 29)
31 BMS PRESENT	Menu	bMS Y,n		BMS Present (6)
35 LOAD MODE	Menu	LOAD 0- 1-6		Load control (7)
36 LOAD LOW VOLTAGE	Menu	LL 16.0-20.0-34.8		Load user defined low voltage
37 LOAD HIGH VOLTAGE	Menu	LH 16.0-28.0-34.8		Load user defined high voltage
49 BACKLIGHT INTENSITY	Menu	0- 1		Backlight intensity
50 BACKLIGHT ALWAYS On	Menu	OFF,On,AUTO		Backlight automatic turn off after 60s (8)
51 SCROLL SPEED	Menu	1-3-5		Text scroll speed
57 VE MODE	Menu	VE 0-3		VE.Direct port RX pin mode (9)
58 VE MODE	Menu	VE 0-4		VE.Direct port TX pin mode (10)
59 CAN Address	Menu	NA 0-255		VE.Can network address
60 CAN DEVICE INSTANCE	Menu	DI 0-255		VE.Can device instance
61 SOFTWARE VERSION	Menu	1.17		Software version
62 RESET TO DEFAULTS	Menu	RESET		Reset to default settings (11)
63 CLEAR HISTORY	Menu	CLEAR		History data reset (12)
64 LOCK SETUP	Menu	LOCK Y,n		Lock settings
67 TEMPERATURE Unit	Menu	CELC,FAhr		Temperature unit °C/°F

Notes:
1) The factory defined battery type can be selected with the rotary switch next to VE.Direct connector. The selected type will be shown here. The setting can alter between a factory defined type and "USER".
2) These values can ONLY be changed for the battery type "USER". The values in the table are for a 24V-battery.
3) Automatic equalisation can be set to “OFF” (default) or a number between 1 (every day) and 250 (once every 250 days). See section 3.8 for more details about automatic equalisation.
4) To allow the charger to equalise the battery properly, use the manual equalise option only during absorbtion and float periods, and when there is sufficient sunlight. Press SELECT: the text “StArt” will blink, press SELECT again to start equalisation. To terminate the equalisation mode prematurely, enter the setup menu and navigate to setup item 10, press SELECT: the text “StOP” will blink, press SELECT again to stop equalisation. The manual equalise duration is 1 hour.
5) Relay function (setting 11):

Value	Description
0	Relay always off
1	Panel voltage high (setup items 16 and 17)
2	Internal temperature high (>85°C)
3	Battery voltage too low (setup items 12 and 13, default setting)
4	Equalization active
5	Error condition present
6	Internal temperature low (<-20°C)
7	Battery voltage too high (setup items 14 and 15)
8	Charger in float or storage
9	Day detection (panels irradiated)
10	Load control (relay switches according to load control mode, see setting 35 and note 7)

6) The parameter BMS present will be set to 'Y'es internally when a compatible BMS is detected. Setting 31 can be used to revert the charger to normal operation (i.e. without BMS) by setting it manually to 'N'o. (for example if the charger is moved to another location were a BMS is not needed), it cannot be set the 'Y'es manually.
7) Load control mode (setting 35).
To use the relay (setting 11, value 10), or the VE.Direct port (setting 58, value 4) to control a load according the options below:

Value	Description
0	Load output always off
1	Batterylife algorithm (default)
2	Conventional algorithm 1 (off<22.2V, on>26.2V)
3	Conventional algorithm 2 (off<23.6V, on>28.0V)
4	Load output always on
5	User defined algorithm 1 (off<20.0V, on>28.0V)
6	User defined algorithm 2 (off<20.0V<on<28.0V<off)

8) Backlight automatic turn-off has the following options: OFF=backlight remains lit all the time, ON=the backlight will dim 60s after the last keypress, AUTO=when charging the backlight is lit, otherwise it will dim.

9) VE.Direct port RX pin mode (setting 57)

Value	Description
0	Remote on/off (default). Can be used for on-off control by a VE.Bus BMS (instead of connecting the BMS to the remote on-off port. VE.Direct non-inverting remote on/off cable needed. (ASS030550310)
1	No function.
2 3	The RX pin can de-energize the relay (relay off), if relay function 10 of setting 11 has been set (see note 5, value 10). The load control options (setting 35) remain valid. In other words, a AND function is created: both the load control and the RX pin must be high (value=2) or low (value=3) to energize the relay.

10) VE.Direct port TX pin mode (setting 58)

Value	Description
0	Normal VE.Direct communication (default) For example to communicate with a Color Control panel (VE.Direct cable needed)
1	Pulse every 0.01kWh
2	Light dimming control (pwm normal) TX digital output cable needed (ASS0305505500)
3	Light dimming control (pwm inverted) TX digital output cable needed (ASS0305505500)
4	Load control mode: theTX pin switches according to load control mode, see note 7. TX digital output cable (ASS0305505500) needed to interface to a logic level load control port.

11) Press SELECT: the text "rESEt" will blink, press SELECT again to reset to original factory settings. The charger will re-boot. The history data will not be affected (kWh counter, etc).
12) Press SELECT: the text "CLEAr" will blink, press SELECT again to erase the history data (kWh-counter, etc). Note that this takes a few seconds to complete.

Note: any setting change performed with the pluggable LCD display or via Bluetooth will override the rotary switch setting. Turning the rotary switch will override prior settings made with the pluggable LCD display or via Bluetooth.

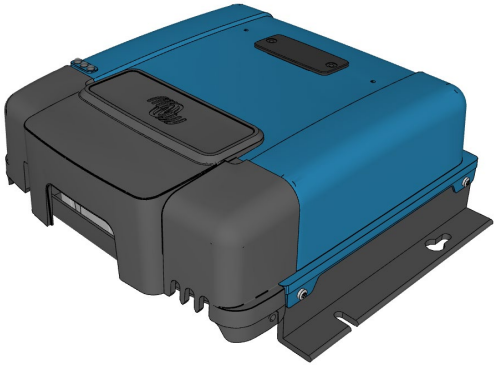
Warning: Some battery manufacturers do recommend a constant current equalization period, and others do not. Do not use constant current equalization unless recommend by the battery supplier.

3.16 Wirebox

The maximum working voltage for the charge controller is considered unsafe. Voltage carrying parts are not allowed to be operator accessible. To comply with the requirement for protection; the charge controller must be placed in an enclosure *or* fitted with a wirebox.

The wirebox also provides strain relief for the power connections.

Please enter *wirebox* in the in the search box on our website for more information



4. Troubleshooting

Problem	Possible cause	Solution
Charger does not function	Reversed PV connection	Connect PV correctly
	Reverse battery connection	Non replacable fuse blown. Return to VE for repair
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 ($T_{ambient\_chrg} > T_{ambient\_batt}$)	Make sure that ambient conditions are equal for charger and battery
	Only for a 24V or 48V system: wrong system voltage chosen (e.g. 12V instead of 24V) by the charge controller	Set the controller manually to the required system voltage
The battery is being overcharged	A battery cell is defect	Replace battery
	Large ambient temperature difference between charger and battery ($T_{ambient\_chrg} < T_{ambient\_batt}$)	Make sure that ambient conditions are equal for charger and battery

Using the pluggable LCD display or VictronConnect and the procedures below, most errors can be quickly identified. If an error cannot be resolved, please refer to your Victron Energy supplier.

Error nr.	Problem	Cause / Solution
n. a.	The LCD does not light up (no backlight, no display)	The internal power supply used for powering the converter and the backlight is derived from either the solar-array or the battery. If PV and battery voltage are both below 6V the LCD will not light up. Make sure that the LCD display is properly inserted into the socket.
n. a.	The LCD does not light up (backlight works, no display, charger seems to work)	This may be due to low ambient temperature. If the ambient temperature is below -10ºC (14ºF) the LCD-segments can become vague. Below -20ºC (-4ºF) the LCD-segments can become invisible. During charging the LCD-display will warm up, and the screen will become visible.
n. a.	The charge controller does not charge the battery	The LCD-display indicates that the charge-current is 0 Amps. Check the polarity of the solar-panels. Check the battery breaker Check if there is an error indication on the LCD Check if the charger is set to "ON" in the menu. Check if the Remote input is connected. Check if the right system voltage has been selected
n. a.	High temperature: the thermometer icon blinks	This error will auto-reset after temperature has dropped. Reduced output current due to high temperature. Check the ambient temperature and check for obstructions near the heatsink.
Err 2	Battery voltage too high (>76,8V)	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.
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. 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.
Err 20	Maximum Bulk-time exceeded	This error can only occur when the maximun bulk-time protection is active. This error will not auto-reset. This error is generated when the battery-absorption-voltage is not reached after 10 hours of charging. For normal solar installations it is advised not to use the maximum bulk-time protection.
Err 21	Current sensor issue	The charge controller is probably faulty. This error will not auto-reset.

Error nr.	Problem	Cause / Solution
Err 26	Terminal overheated	Power terminals overheated, check wiring and fasten bolts if possible. This error will auto-reset.
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. This error will auto-reset.
Err 38	Input shutdown due to battery over-voltage	To protect the battery from over-charging the panel input is shut down. To recover from this condition first disconnect the solar panels and disconnect the battery. Wait for 3 minutes reconnect the battery first and next the panels. If the error persists the charge controller is probably faulty.
Inf 65	Communication warning	Communication with one of the paralleled controllers was lost. To clear the warning, switch the controller off and back on.
Inf 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	Connection to the BMS lost, check the connection (Cabling / Bluetooth link). When the charger needs to operate in stand-alone mode again, change to setup menu setting 'BMS' from 'Y' to 'N' (setup item 31).
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	This error will not auto-reset.
Err 119	Settings data lost	This error will not auto-reset. Restore defaults in the setup menu (setup item 62). Disconnect the charge controller from all power-sources, wait 3 minutes, and power up again.

For further questions see FAQ:
https://www.victronenergy.com/live/drafts:mppt_faq

5. Specifications, 150/70

SmartSolar charge controller	MPPT 150/70
Battery voltage	12/24/48V Auto Select (36V: manual)
Maximum battery current	70A
Nominal PV power, 12V 1a,b)	1000W
Nominal PV power, 24V 1a,b)	2000W
Nominal PV power, 36V 1a,b)	3000W
Nominal PV power, 48V 1a,b)	4000W
Max. PV short circuit current 2)	50A
Maximum PV open circuit voltage	150V absolute maximum coldest conditions 145V start-up and operating maximum
Peak efficiency	98%
Self consumption	Less than 35mA @ 12V / 20mA @ 48V
Charge voltage 'absorption'	Default setting: 14,4V / 28,8V / 43,2V / 57,6V (adjustable)
Charge voltage 'float'	Default setting: 13,8V / 27,6V / 41,4V / 55,2V (adjustable)
Charge voltage 'equalization'	Default setting: 16,2V / 32,4V / 48,6V / 64,8V (adjustable)
Charge algorithm	multi-stage adaptive (eight preprogrammed algorithms) or user defined algrithm
Temperature compensation	-16mV/°C / -32mV/°C / -64mV/°C
Protection	Battery reverse polarity (fuse, not user accessible) PV reverse polarity / Output short circuit / Over temperature
Operating temperature	-30 to +60°C (full rated output up to 40°C)
Humidity	95%, non-condensing
Maximum altitude	5000m (full rated output up to 2000m)
Environmental condition	Indoor, unconditioned
Pollution degree	PD3
Data communication port	CAN, VE.Direct or Bluetooth
Remote on/off	Yes (2 pole connector)
Relay (programmable)	DPST AC rating: 240VAC / 4A DC rating: 4A up to 35VDC, 1A up to 60VDC
Parallel operation	Yes
ENCLOSURE	
Colour	Blue (RAL 5012)
PV terminals	35 mm² / AWG2 (Tr models)
Battery terminals	35 mm² / AWG2
Protection category	IP43 (electronic components) IP22 (connection area)
Weight	3 kg
Dimensions (h x w x d)	185 x 250 x 95 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 sort circuit current may damage the controller in case of reverse polarity connection of the PV array.

Specifications, 150V models continued

SmartSolar charge controller	MPPT 150/85	MPPT 150/100
Battery voltage	12/24/48V Auto Select (36V: manual)	
Maximum battery current	85A	100A
Nominal PV power, 12V 1a,b)	1200W	1450W
Nominal PV power, 24V 1a,b)	2400W	2900W
Nominal PV power, 36V 1a,b)	3600W	4350W
Nominal PV power, 48V 1a,b)	4900W	5800W
Max. PV short circuit current	70A	
Maximum PV open circuit voltage	150V absolute maximum coldest conditions 145V start-up and operating maximum	
Peak efficiency	98%	
Self consumption	Less than 35mA @ 12V / 20mA @ 48V	
Charge voltage 'absorption'	Default setting: 14,4V / 28,8V / 43,2V / 57,6V (adjustable)	
Charge voltage 'float'	Default setting: 13,8V / 27,6V / 41,4V / 55,2V (adjustable)	
Charge voltage 'equalization'	Default setting: 16,2V / 32,4V / 48,6V / 64,8V (adjustable)	
Charge algorithm	multi-stage adaptive (eight preprogrammed algorithms) or user defined algorithm	
Temperature compensation	-16mV/°C / -32mV/°C / -64mV/°C	
Protection	Battery reverse polarity (fuse, not user accessible) PV reverse polarity / Output short circuit / Over temperature	
Operating temperature	-30 to +60°C (full rated output up to 40°C)	
Humidity	95%, non-condensing	
Maximum altitude	5000m (full rated output up to 2000m)	
Environmental condition	Indoor, unconditioned	
Pollution degree	PD3	
Data communication port	CAN, VE.Direct or Bluetooth	
Remote on/off	Yes (2 pole connector)	
Relay (programmable)	DPST AC rating: 240VAC/4A DC rating: 4A up to 35VDC, 1A up to 60VDC	
Parallel operation	Yes	
ENCLOSURE		
Colour	Blue (RAL 5012)	
PV terminals	35mm² / AWG2 (Tr models), or three pairs of MC4 connectors (MC4 models)	
Battery terminals	35mm² / AWG2	
Protection category	IP43 (electronic components) IP22 (connection area)	
Weight	4,5kg	
Dimensions (h x w x d)	Tr models: 216 x 295 x 103mm MC4 models: 246 x 295 x 103mm	
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 sort circuit current may damage the controller in case of reverse polarity connection of the PV array.

6. Specifications, 250V models

SmartSolar charge controller	MPPT 250/70	MPPT 250/85	MPPT 250/100
Battery voltage	12/24/48V Auto Select (36V: manual)		
Maximum battery current	70A	85A	100A
Nominal PV power, 12V 1a,b)	1000W	1200W	1450W
Nominal PV power, 24V 1a,b)	2000W	2400W	2900W
Nominal PV power, 36V 1a,b)	3000W	3600W	4350W
Nominal PV power, 48V 1a,b)	4000W	4900W	5800W
Max. PV short circuit current 2)	35A (max 30A per MC4	70A (max 30A per MC4	
Maximum PV open circuit voltage	250V absolute maximum coldest conditions 245V start-up and operating maximum		
Peak efficiency	99%		
Self consumption	Less than 35mA @ 12V / 20mA @ 48V		
Charge voltage 'absorption'	Default setting: 14,4V / 28,8V / 43,2V / 57,6V (adjustable)		
Charge voltage 'float'	Default setting: 13,8V / 27,6V / 41,4V / 55,2V (adjustable)		
Charge voltage 'equalization'	Default setting: 16,2V / 32,4V / 48,6V / 64,8V (adjustable)		
Charge algorithm	multi-stage adaptive (eight preprogrammed algorithms) or user defined algorithm		
Temperature compensation	-16mV/°C / -32mV/°C / -64mV/°C		
Protection	Battery reverse polarity (fuse, not user accessible) PV reverse polarity / Output short circuit / Over temperature		
Operating temperature	-30 to +60°C (full rated output up to 40°C)		
Humidity	95%, non-condensing		
Maximum altitude	5000m (full rated output up to 2000m)		
Environmental condition	Indoor, unconditioned		
Pollution degree	PD3		
Data communication port	CAN, VE.Direct or Bluetooth		
Remote on/off	Yes (2 pole connector)		
Relay (programmable)	DPST AC rating: 240VAC / 4A DC rating: 4A up to 35VDC, 1A up to 60VDC		
Parallel operation	Yes (not synchronized)		
ENCLOSURE			
Colour	Blue (RAL 5012)		
PV terminals 3)	35 mm² / AWG2 (Tr models) Two pairs of MC4 connectors (MC4 model 250/70) Three pairs of MC4 connectors (MC4 models 250/85 and 250/100)		
Battery terminals	35 mm² / AWG2		
Protection category	IP43 (electronic components)	IP22 (connection area)	
Weight	3 kg	4,5 kg	
Dimensions (h x w x d)	Tr model: 185 x 250 x 95 mm MC4 model: 215 x 250 x 95 mm	Tr models: 216 x 295 x 103 mm MC4 models: 246 x 295 x 103 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 sort circuit current may damage the controller in case of reverse polarity connection of the PV array.
3) Default setting: OFF
4) MC4 models: several splitter pairs may be needed to parallel the strings of solar panels