

BlueSolar charge controllers

MPPT 75/10

MPPT 75/15

MPPT 100/15

MPPT 100/20

MPPT 100/20-48V

1 General Description

1.1 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.

1.2 VE.Direct

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

1.3 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 (especially inverters) can best be connected directly to the battery, and the inverter remote control connected to the load output. A special interface cable may be needed, please see section 3.6.

1.4 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.

1.5 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 1.8 for user defined settings

1.5.1. Bulk

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

1.5.2. 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 1A.

1.5.3. Float

During this stage, float voltage is applied to the battery to maintain a fully charged state.

1.5.4. Equalization

See section 3.9

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 (VE.Direct Bluetooth Smart dongle needed).

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

(VE.Direct Bluetooth Smart dongle needed). For more detail please enter *smart networking* in the search box on our website.

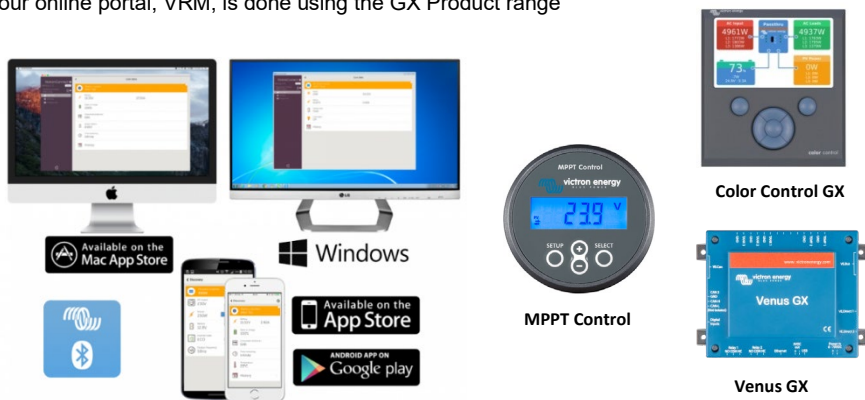
1.8 Automatic battery voltage recognition

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 3.8.

1.9 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



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.

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 S).

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 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 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 (V_{bat}).
- PV voltage must exceed $V_{bat} + 5V$ for the controller to start. Thereafter minimum PV voltage is $V_{bat} + 1V$.
- 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 3)

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: 0,75 Nm

The system is now ready for use.

3.5 Configuration of the controller

The VE.Direct communication port (see sect. 1.9) can be used to configure the controller. (dongle needed when using the Bluetooth app)

3.6 The load output (see figure 1 and 2 at the end of the manual)

The VE.Direct communication port (see sect. 1.8) can be used to configure the load output. (dongle needed when using the Bluetooth app)

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

- **No jumper:** BatteryLife algorithm (see 1.4)
- **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
- **Jumper between pin 2 and pin 3:** conventional
Low voltage load disconnect: 11,8V or 23,6V
Automatic load reconnect: 14V or 28V

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 directly 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 also 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

Green LED: indicates which load output control algorithm has been chosen.

On: one of the two conventional load output control algorithms (see Fig 2)

Blinking: BatteryLife load output control algorithm (see Fig 2)

Yellow LED: signals charge sequence

Off: no power from PV array (or PV array connected with reverse polarity)

Blinking fast: bulk charge (battery in partially charged state)

Blinking slow: absorption charge (battery charged to 80% or more)

On: float charge (battery fully charged)

3.8 Battery charging information

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

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

The charging algorithm behavior of MPPTs differs from AC connected battery chargers. Please read this section of the manual carefully to understand MPPT behavior, 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 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 Bluetooth (VE.Direct Bluetooth Smart dongle needed) 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 1.9 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
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 1.8)
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

BlueSolar 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: 20 mA	24V: 10 mA
Charge voltage 'absorption'	14,4V / 28,8V (adjustable)	
Charge voltage 'equalization' 3)	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	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	0,5kg	
Dimensions (h x w x d)	100 x 113 x 40mm	
STANDARDS		
Safety	EN/IEC 62109-1 / UL 1741 / CSA C22.2 NO.107.1-16	
<p>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.</p> <p>2) A higher short circuit current may damage the controller in case of reverse polarity connection of the PV array.</p> <p>3) Default setting: OFF</p>		

Specifications 100V models

BlueSolar 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: 20 mA 24V: 10 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	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	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	
<p>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.</p> <p>2) A higher short circuit current may damage the controller in case of reverse polarity connection of the PV array.</p>		

BlueSolar 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	25 / 15 / 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 or user defined algorithm
Temperature compensation	-16mV/ °C / -32mV/ °C / -48mV/ °C / -64mV/ °C
Continuous load current, 12/24V	20A
Continuous load current, 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
<p>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.</p>	

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

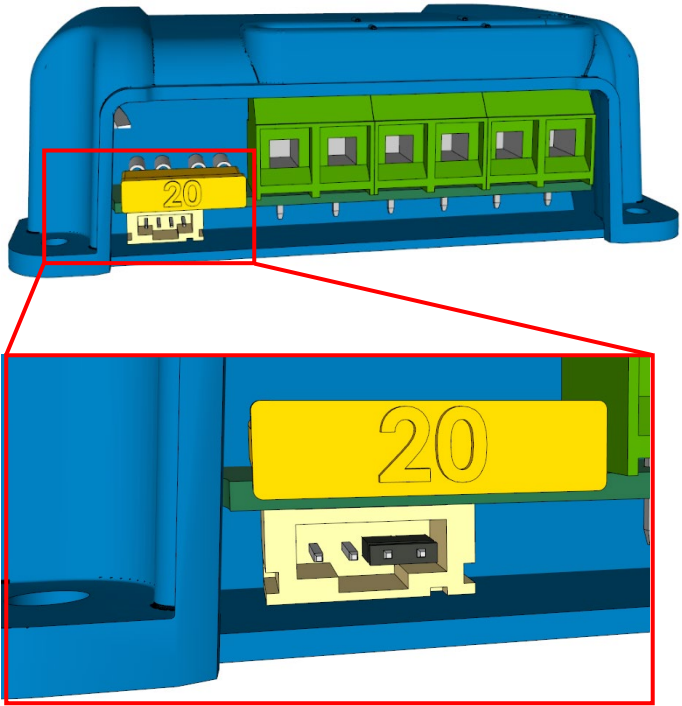


Figure 1b: pin numbering of the VE.Direct communication port.

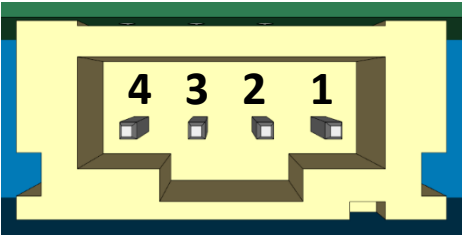


Figure 2a: configuration pins of the VE.Direct communication port, 100V model

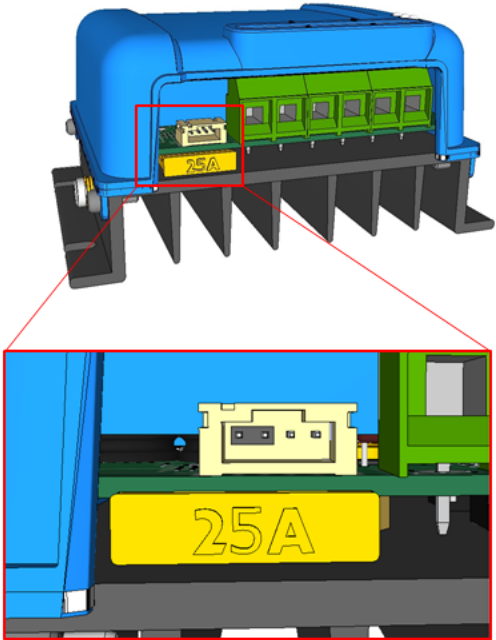


Figure 2b: pin numbering of the VE.Direct communication port, 100V model

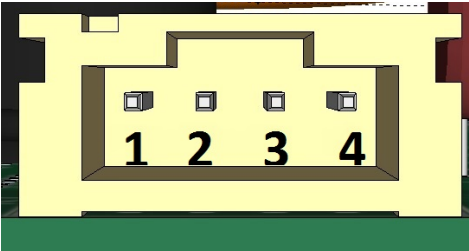


Figure 3: Battery management options

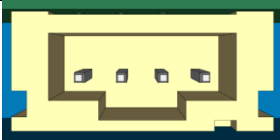


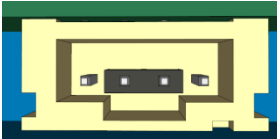

<p><u>EN:</u> No bridge: BatteryLife algorithm</p>	
<p><u>EN:</u> Bridge between pin 1 and 2: Low voltage disconnect: 11.1V or 22.2V Automatic load reconnect: 13.1V or 26.2V</p>	<p>75V models</p>  <p>100V models</p> 
<p><u>EN:</u> Bridge between pin 2 and 3: Low voltage disconnect: 11.8V or 23.6V Automatic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

Figure 4: Power connections

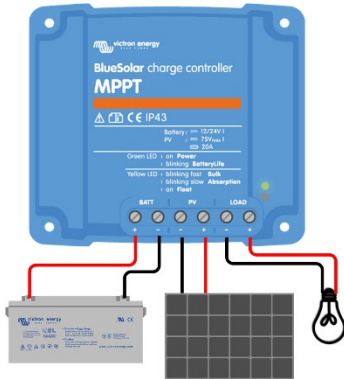
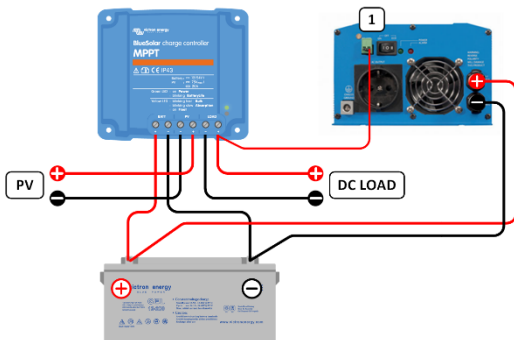


Figure 5: The Victron inverters model Phoenix 12/800, 24/800, 12/1200 and 24/1200 can be controlled by connecting the right side connection (1) of the inverter remote control directly to the solar charger load output.



Similarly, all **Phoenix VE.Direct** inverters can be controlled by connecting to the left side connection of the remote control

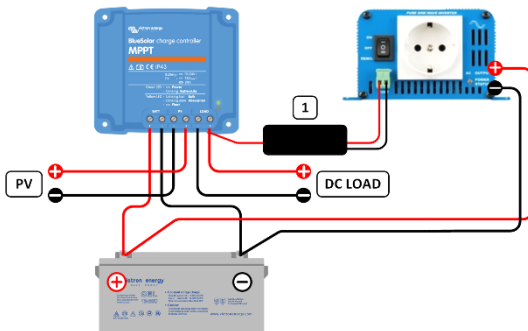


Figure 6: For the Victron inverters model Phoenix 12/180, 24/180, 12/350, 24/350, the Phoenix Inverter C models and the MultiPlus C models an interface cable (1) is needed: the **Inverting remote on-off cable** (article number ASS030550100)



Manual

BlueSolar charge controller MPPT 100/15

1 General Description

1.1 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.

1.2 Load output

Over-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 (especially inverters) can best be connected directly to the battery, and the inverter remote control connected to the load output. A special interface cable may be needed, please see section 3.6.

1.3 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.

1.4 Internal temperature sensor

Compensates absorption and float charge voltages for temperature.

1.5 Automatic battery voltage recognition

The MPPT 100/15 will automatically adjust itself to a 12V or a 24V system.

1.6 Three step charging

The BlueSolar MPPT Charge Controller is configured for a three step charging process:
Bulk – Absorption – Float.

1.6.1. Bulk stage

During this stage the Controller delivers as much charge current as possible to rapidly recharge the batteries. When the battery voltage reaches the absorption voltage setting, the Controller activates the next stage (absorption).

1.6.2. Absorption stage

During this stage, the Controller switches to the constant voltage mode, where the absorption voltage is applied to the battery. When the charge current decreases to the float transition current setting, the battery is fully charged and the Controller switches to the float stage.

1.6.3. Float stage

During this stage, the float voltage is applied to the battery to maintain it in a fully charged state. When battery voltage drops below 13,2 Volt during at least 1 minute a new charge cycle will be triggered.

1.6.4. Equalization

See section 3.8.1

1.7 Monitoring and configuring options

1.7.1 The VictronConnect app

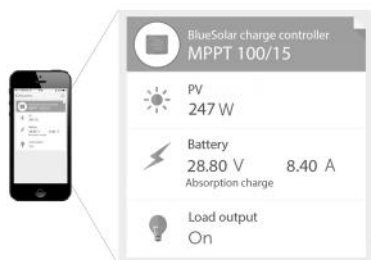
Several parameters can be customized with the VictronConnect app.

- Bluetooth dongle needed when using Bluetooth Smart.
- VE.Direct to USB cable needed when using a computer.

See the data communication white paper on our website.

1.7.2 Monitoring

The ColorControl panel or the MPPT control, VE.Direct cable needed



MPPT Control



Color Control

2. IMPORTANT SAFETY INSTRUCTIONS

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



WARNING

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 direct 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 3.6.
- 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 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 substrate, with the power terminals facing downwards.
- 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.
- 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).

3.2 Grounding

- *Battery grounding configuration*: the charger can be configured as a positive- or negative-ground system.

Note: apply a single ground connection 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.
- 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.

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 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 (V_{bat}).
- PV voltage must exceed $V_{bat} + 5V$ for the controller to start. Thereafter minimum PV voltage is $V_{bat} + 1V$.
- Maximum open circuit PV voltage: 100V.

The controller can be used with any PV configuration that satisfies the three above mentioned conditions.

For example:

12V battery and mono- or polycrystalline panels

- 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: 144 cells 4x 12V panel in series).

24V battery and mono- or polycrystalline panels

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

Note: at low temperatures 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. Configuration of the controller (see figure 1 and 2)

There is a 4-pin connector available to select one of the three battery control options:

- **No bridge:** BatteryLife algorithm (see 1.2.2.)
- **Bridge between pin 1 and pin 2:** conventional (see 1.2.1.)
Low voltage load disconnect: 11,1V or 22,2V
Automatic load reconnect: 13,1V or 26,2V
- **Bridge between pin 2 and pin 3:** conventional (see 1.2.1.)
Low voltage load disconnect: 11,8V or 23,6V
Automatic load reconnect: 14V or 28V

3.5 LEDs

Green LED: indicates which load output control algorithm has been chosen.

On: one of the two conventional load output control algorithms (see Fig 2)

Blinking: BatteryLife load output control algorithm (see Fig 2)

Yellow LED: signals charge sequence

Off: no power from PV array (or PV array connected with reverse polarity)

Blinking fast: bulk charge (battery in partially charged state)

Blinking slow: absorption charge (battery charged to 80% or more)

On: float charge (battery fully charged)

3.6 Cable connection sequence (see figure 3)

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).

The system is now ready for use.

3.7 Connecting an inverter

The load output can be used to supply DC loads and simultaneously to control an inverter.

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

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 is needed (MPPT 70/15 to inverter remote on-off cable, article number ASS030550100, see figure 5).

3.8 Battery charging information

The charge controller starts a new charge cycle every morning, when the sun starts shining. 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 V_b (@start-up)	Maximum absorption time
$V_b < 23,8V$	6h
$23,8V < V_b < 24,4V$	4h
$24,4V < V_b < 25,2V$	2h
$V_b > 25,2V$	1h

(divide voltages by 2 for a 12V 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 that 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 1 Amp, 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.

3.8.1. Automatic equalization

Automatic equalization is default set to 'OFF'. With the Victron Connect app (see sect 3.8) 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% of the bulk current for the factory default battery type, and to 25% of the bulk current for a user defined battery type. The bulk current is the rated charger current unless a lower maximum current setting has been chosen.

When using the factory default battery type, automatic equalization ends when the voltage limit 16.2V / 32.4V has been reached, or after $t = (\text{absorption time})/8$, whichever comes first. For the user defined battery type automatic equalization ends after $t = (\text{absorption time})/2$.

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.

3.9 VE.Direct communication port

See section 1.7

4. Troubleshooting

Problem	Possible cause	Solution
Charger does not function	Reversed PV connection	Connect PV correctly
	No fuse inserted	Insert 20A fuse
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	Disconnect PV and battery, after making sure that the battery voltage is at least >19V, reconnect properly
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

BlueSolar charge controller	MPPT 100/15
Battery voltage	12/24 V Auto Select
Maximum battery current	15A
Nominal PV power, 12V 1a,b)	220W
Nominal PV power, 24V 1a,b)	440W
Max. PV short circuit current 2)	20A
Automatic load disconnect	Yes, maximum load 15A
Maximum PV open circuit voltage	100V
Peak efficiency	98%
Self consumption	10mA
Charge voltage 'absorption'	14,4V / 28,8V (adjustable)
Charge voltage 'float'	13,8V / 27,6V (adjustable)
Charge algorithm	multi-stage adaptive
Temperature compensation	-16mV / °C resp. -32mV / °C
Continuous/peak load current	15A / 50A
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 <small>See the data communication white paper on our website</small>
ENCLOSURE	
Colour	Blue (RAL 5012)
Power terminals	6mm ² / AWG10
Protection category	IP43 (electronic components) IP22 (connection area)
Weight	0,4kg
Dimensions (h x w x d)	100 x 113 x 47mm
STANDARDS	
Safety	EN/IEC 62109
<p>1a) If more PV power is connected, the controller will limit input power 1b) PV voltage must exceed Vbat + 5V for the controller to start. Thereafter minimum PV voltage is Vbat + 1V.</p> <p>2) A PV array with a higher short circuit current may damage the controller.</p>	

Figure 1a: configuration pins

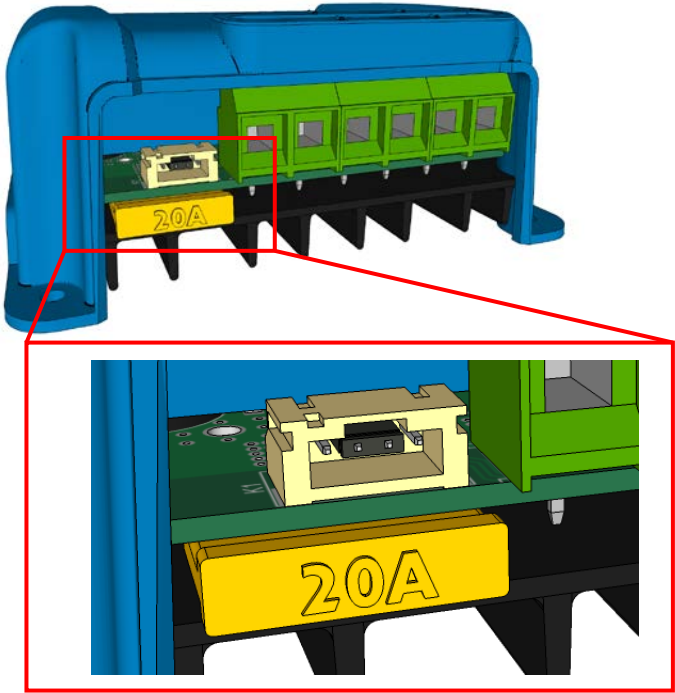


Figure 1b: pin numbering

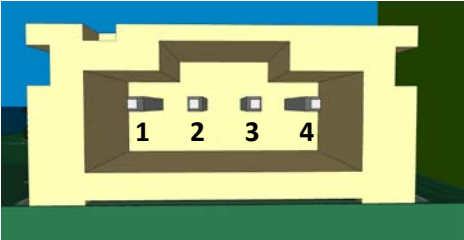


Figure 2: Battery management options

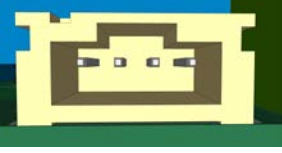

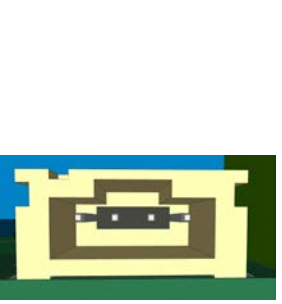
<p>EN: No bridge: BatteryLife algorithm NL: Geen brug: BatteryLife algoritme FR: Pas de pont : Algorithme BatteryLife DE: Keine Überbrückung: BatteryLife Algorithmus ES: Ningún puente: algoritmo BatteryLife SE: Ingen brygga: BatteryLife-algorithm</p>	
<p>EN: Bridge between pin 1 and 2: Low voltage disconnect: 11.1V or 22.2V Automatic load reconnect: 13.1V or 26.2V</p> <p>NL: Brug tussen pin 1 en 2: Belastingsontkoppeling bij lage spanning: 11,1V of 22,2V Automatische belastingsherkoppeling: 13,1V of 26,2V</p> <p>FR: Pont entre broche 1 et 2 : Déconnexion en cas de tension réduite : 11,1 V ou 22,2 V Reconnexion automatique de la charge : 13,1 V ou 26,2 V</p> <p>DE: Überbrückung zwischen Pol 1 und Pol 2: Unterbrechung bei geringer Spannung: 1.1V oder 22.2V Automatisches Wiederanschießen: 3,1V oder 26,2V</p> <p>ES: Puente entre pines 1 y 2: Desconexión por baja tensión: 11,1V o 22,2V Reconexión automática de la carga: 13,1V ó 26,2V</p> <p>SE: Brygga mellan stift 1 och 2: Frånkoppling låg spänning: 11,1V eller 22,2V Automatiskt omkoppling av belastning: 13,1V eller 26,2V</p>	
<p>EN: Bridge between pin 2 and 3: Low voltage disconnect: 11.8V or 23.6V Automatic load reconnect: 14.0V or 28.0V</p> <p>NL: Brug tussen pin 2 en 3: Belastingsontkoppeling bij lage spanning: 11,8V of 23,6V Automatische belastingsherkoppeling: 14,0V of 28,0V</p> <p>FR: Pont entre broche 2 et 3 : Déconnexion en cas de tension réduite : 11,8 V ou 23,6 V Reconnexion automatique de la charge : 14,0 V ou 28,0 V</p> <p>DE: Überbrückung zwischen Pol 2 und Pol 3: Unterbrechung bei geringer Spannungs: 12,0V oder 24,0V Automatisches Wiederanschießen: 14,0V oder 28,0V</p> <p>ES: Puente entre pines 2 y 3: Desconexión por baja tensión: 11,8V ó 23,6V Reconexión automática de la carga: 14,0V ó 28,0V</p> <p>SE: Brygga mellan stift 2 och 3: Frånkoppling låg spänning: 11,8V eller 23,6V Automatiskt omkoppling av belastning: 14,0V eller 28,0V</p>	

Figure 3: Power connections



Figure 4: 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

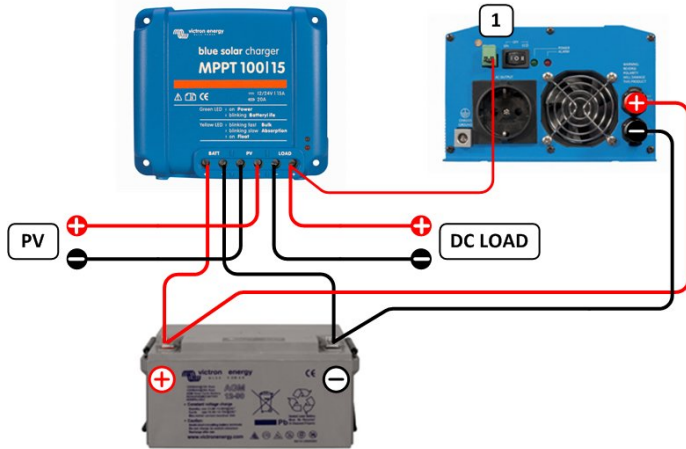


Figure 5: For the Victron inverters model Phoenix 12/180, 24/180, 12/350, 24/350, the Phoenix Inverter C models and the MultiPlus C models an interface cable (1) is needed (MPPT 70/15 to inverter remote on-off cable, article number ASS030550100)

