The solar system does not work – possible causes

Problem	Possible cause	Solution
Red LED on the battery output is illuminated.	battery is reverse-connected	Release terminals on battery output and connect correctly.
Green LED on PV module input is not illuminated, although solar module is connected and functioning.	Solar module is reverse-connected	Release terminals on PV output and connect correctly.
When connecting the DC load the green LED on the load output lights up only shortly or not at all.	Short circuit on the load output.	Remove short circuit. If failure continues, the internal safety fuse must be replaced. (see paragraph "Changing the internal fuse")
The solar module does not provide power in the operating mode. DC load output is supplied over battery only.	MPPT solar charge controller is overheated internally and has switched off the solar input.	Provide appropriate cooling for the device and, if necessary, disconnect the loads not required at present. The solar input is re-connected automatically, if the internal operating temperature has dropped to an appropriate level.
Load was switched off automatically, the LED on the DC load output is not illuminated.	MPPT solar charge controller makes sure that the battery will not reach a deep-discharged status therefore it switched off the DC output.	Wait until the battery is recharged. Then the DC load output will automatically be switched back on again.
Gas production is detected within the battery despite overcharge protection.	Failure of external temperature probe.	Check the external temperature probe on mechanical damage. Connect the external temperature probe directly to the battery body.

Technical specifications

Battery nominal voltage:	12 / 24 V DC
Solar module voltage:	5 - 70Vdc
Max. module current (Usolar > Ubatt):	10 / 20 /30 A (type MPPT10 / MPPT20 / MPPT30)
Max. module current (Usolar < Ubatt):	3 A
Max. DC load current:	10 / 20 /30 A (type MPPT10 / MPPT20 / MPPT30)
Typ. consumption in active status:	100-110 mA
Typ. consumption in standby status:	< 1mA
Reverse polarity protection (PV and DC load):	Fully electronic
Over-current protection at PV and DC load:	Fully electronic, current limiting
Battery charging characteristics:	3 stage (1. constant current; 2. constant voltage: 14.2V for 5 min.; 3. constant voltage: 13.8V; rated at 25C and 12V battery, calculate double values at 24V battery
Battery DDP voltage – DC load disconnect:	10.5V
Battery DDP voltage – DC load reconnect:	12.5V
Temperature range:	-25°C … +60°C
Protection type:	IP20
Dimensions:	190 x 112 x 59 mm
Weight:	780 / 870 / 890 g (type MPPT10 / MPPT20 / MPPT30)

Environmental protection notice
At the end of its useful life, this product must not be disposed of together with normal household waste, but has to be dropped off at a collection centre for the recycling of electrical and electronic devices. This is indicated by the symbol on the product, on the instruction manual or on the packaging. The materials of which this product is made are recyclable pursuant to their labelling. With the reuse, the recycling of the materials or other forms of scrap usage you are making an important contribution to the protection of the environment. Please ask your local administration office for the appropriate disposal centre.

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Panelectron

OPERATING INSTRUCTIONS

MPPT10, MPPT20, MPPT30 - solar charge controller
10 – 20 – 30A

CE

- MPPT (Max Power Point Tracking) charging algorithm
- Automatic system voltage recognition 12/24V
- Wide solar input voltage range from 5V to 70V
- Battery deep-discharge protection, over-charge protection, over-voltage protection
- Desulphating mode (battery conditioning)
- Temperature dependent charge parameter correction
- Over-temperature protection, over-current protection, fully electronic reverse-polarity protection
- DC load manual ON/OFF switch
- Option: Logging possibility on SD memory card
- Option: Remote control with display

Dear Customer,
Thank you for buying our product. You have bought one of the most powerful, compact and reliable units of its class. Please read the operating instructions carefully before use.

WARNING!!! Safety Instructions!!!

- Do not use the unit:
  In places, which are dusty, damp, in a high-humidity area (over 80% rel. humidity), at temperatures above 50°C, in areas containing inflammable materials (liquids/solvents, gas). Do not immerse in water.
- Use only in closed, dry areas.
- Should the unit fail to operate, or show signs of not operating properly unplug immediately and make sure that the unit is not put into further operation. Do not use the unit when visible signs of damage - due to transport or inadequate storage are noticeable.
- To prevent the risk of explosion by overcharging, install the battery in a well-ventilated place.
- To prevent a short-circuit between solar charger unit and battery, install a fuse on the positive battery pole.
- Equipment which must stay connected all the time and must not be disconnected by the load disconnect function (e.g. navigation lights), must be connected directly to the battery and fused.
- Follow installation instructions strictly when connecting the unit!
- The unit should be disconnected in reverse order (see installation procedures).

What is MPPT (Maximum Power Point Tracking)?
In order to charge a battery (increase its voltage), the PV module must apply a voltage that is higher than that of the battery. If the PV module's Vpp is just slightly below the battery voltage, then the current drops nearly to zero. So, to play it safe, typical PV modules are made with a Vpp of around 17V when measured at a cell temperature of 25°C. They do that because it will drop to around 15V on a very hot day. However, on a very cold day, it can rise to 18V! Every solar panel is only able to render its maximum power (Vpp) at a certain voltage (dependent of temperature and illumination). What happens when the Vpp is much higher than the voltage of the battery? With traditional charge controllers without MPPT function the module voltage is dragged down to a lower-than-ideal voltage. An MPPT solar regulator makes the best possible connection of the module's voltage and the battery's voltage by keeping the solar module voltage at an ideal level, independent from the battery voltage. By doing so, it will put the maximum AMPS available from the module into the battery (it is Amps into the battery that counts). Most modern MPPT's are around 92-97% efficient in the conversion. You typically get a 20 to 45% power gain in winter and 10-15% in summer. Actual gain can vary widely depending weather, temperature, battery state of charge, and other factors.

MPPT's are most effective under these conditions:

- Winter, and/or cloudy or hazy days - when the extra power is needed the most.
- Cold weather - solar panels work better at cold temperatures, but without a MPPT you are losing most of that. Cold weather is most likely in winter - the time when sun hours are low and you need the power to recharge batteries the most.
- Low battery charge - the lower the state of charge in your battery, the more current a MPPT puts into them - another time when the extra power is needed the most. You can have both of these conditions at the same time.

An Example:
The Kyocera KC-120 is rated at 7.1 amps at 16.9 volts - 7.1 amps times 16.9 volts = 120 watts. So what happens when you hook up this 120 watt solar panel to your battery? Unfortunately, what happens is not 120 watts. Your panel puts out 7.1 amps. Your battery is setting at 12 volts under charge: 7.1 amps × 12 volts = 85 watts. You lost 35 watts. That 35 watts is not going anywhere, it just is not being produced because there is a poor match between the panel and the battery. With a very low battery, say 10.5 volts, it's even worse - you could be losing as much as 35% (10.5 volts x 7.1 amps = 75 watts. You lost 45 watts. Here is where the optimization, or maximum power point tracking comes in. Assume your battery is low, at around 11.5 volts. A MPPT takes that 16.9 volts at 7.1 amps and converts it, so that what the battery gets is no longer 7.1 amps, but 9.6 amps. Now you still have almost all available watts, and everyone is happy.

Description of operation
The MPPT (Maximum Power Point Tracking) charging algorithm enables you to make maximum usage of the solar power of your solar modules. The most efficient working point of the solar modules is modified by various factors, such as module temperature, irradiation, module type, etc. This working point is permanently monitored by the internal microcontroller and, if required, is controlled in such a way that the optimum performance of the solar module is available and your batteries are charged with the highest available current. The solar charger is suited for all applications with negative mass potential (-), as the load is disconnected in the positive line (+). Photovoltaic systems are usually run with lead-acid, maintenance-free lead-acid, lead-gel and lead-vlies batteries for storing the energy. Lead batteries must be protected against deep discharging and overcharging. The MPPT solar charge controller fulfils both requirements. The batteries are also perfectly maintained by an intelligent desulphating mode. The internal microcontroller precisely controls the switching thresholds for overcharging / deep-discharging, load disconnection and voltage reset (with temperature compensation).

Deep discharge protection
Lead batteries must be protected against deep discharging, as the cells may be damaged otherwise. The MPPT solar charge controller offers reliable protection for the batteries against deep discharging by disconnecting the load automatically as soon as the battery deep-discharge voltage (10.5V or 21V) has been reached. Faulty battery condition also generates load disconnection. As soon as the battery has sufficiently been recharged by the solar module, the load output will be switched on again (at 12.5V or 25V). Between the two voltage thresholds manual DC load reconnection is possible by pressing the DC LOAD ON/OFF button twice.

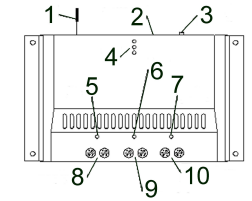
Overcharge protection
When the battery charging voltage is too high, the battery begins to produce gas. Intensive gas production results in the loss of electrolyte in the battery, besides the generated hydrogen makes up a highly explosive compound by mixing with oxygen from the air. If parts of the battery plates are not covered with electrolyte due to the loss of liquid, the battery may be damaged. If intensive gas production can be observed, find the cause (see troubleshooting table) and check the acid level. The generation of gas within the batteries is temperature-dependent. The external temperature sensor adjusts the max. charging voltage automatically according to the ambient temperature. If the max. charging voltage has been reached, the MPPT solar charge controller turns into desulphating mode if the DC load output is inactive (switched off manually by the DC LOAD ON/OFF button).

Desulphating mode
90% of the battery faults are owed to the lead-sulphate layer on the battery plates set over the years preventing proper electron transfer between the plates and the electrolyte. The MPPT solar regulator uses a well-known charging technique which is called "impulse-charging". The desulphating impulses (100 µs – 60V spikes) come in every 3 second period only when the DC load output is manually switched off (by DC LOAD ON/OFF switch). This is to make sure that these impulses could not cause interference with any sensitive dc load connected to the solar charger unit. It is recommended to disconnect periodically your DC loads and do a regenerative charging using the desulphating mode. Thanks to this charging method the existing lead-sulphate layer will be removed from the battery plates of your valuable solar batteries, the charging impulses also prevent new sulphate formation in the future. In addition to a guaranty of maximum capacity, this also means extremely long durability and lifetime of your batteries, ensures the protection of the environment and your wallet.

Temperature compensation
The external temperature sensor adjusts and regulates the battery charging voltage and helps to prevent gas-formation within the batteries. For that reason the charge controller should be mounted in the same room as the batteries and the external probe should be attached to the battery case. An additional protective feature is also added against high external temperature: the unit allows maximum charging current up to 40 Celsius, between 40-60C it will be reduced to 66%.

Optional remote control panel with logging function
With the help of the optional control panel (for further info please check item: MPPT REMOTE) you can read off the most important system parameters from an LCD, wake up the unit from standby mode or log the Voltage and Amps parameters of the solar module and battery stored on an SD memory card for later evaluation (these values can be used for calculating the generated power in Watt-hour, for instance).

Connection and operating elements



1) External temperature probe
2) Remote control connection
3) DC LOAD ON/OFF button
4) BATTERY Status LEDs
5) Status LED – PV MODULE input
6) Status LED – DC LOAD output
7) Status LED – BATTERY input/output
8) PV MODULE input (+ -)
9) DC LOAD output (- +)
10) BATTERY input/output (- +)

Warning: Should the terminals be reverse polarity connected to the load output, can even fused units be completely damaged. Each system component must be individually fused. The solar charger unit should be placed in close proximity to the battery and be sufficiently protected against the weather. Take care to place the battery in a well-ventilated place. To enable the unit to cool properly, the electrical connections should face downwards in order to allow free air ventilation along the rear side. The charge controller must not be installed above a heat-source. Minimum 100 mm free space must be allowed above and beneath the unit.

Installation
Warning: Take care of the right polarity! To guarantee that the unit functions properly it must be connected to the solar generator, the lead-battery and the load. Each part of the system - solar generator, lead battery, load and solar charger unit should correspond in voltage and current rating with one another. Please check this before installations, when in doubt contact your local dealer! Pay careful attention to the following order of installation instructions:

1. Connect the battery to the corresponding terminals on the Solar Charger Unit. To avoid voltage drop in the cable and the related heat development, please chose a sufficient cable diameter. The screw terminals are capable of receiving cables with cross-sections up to 16 mm². The required minimum cross sections are: up to 10A: 1.5 mm², up to 20A: 2.5 mm², up to 30A: 4.0 mm².
   → Attention: In case of reverse battery connection the red LED illuminates above the BATTERY input/output. Always fuse the battery + terminal according to safety regulations. Both the solar regulator and the battery must be installed in the same room in a small distance from each other. The external temperature probe must be affixed directly onto the battery case.
2. Connect the solar module to the corresponding screw-terminals on the MPPT solar charge controller.
   → Green input LED illuminates
3. Connect the loads to the corresponding screw-terminals of the MPPT solar regulator, please observe the max. current rating. Perform the connection according to the + and - symbols on the regulator. → As the final step of the installation, press DC LOAD ON/OFF button to wake up the unit if it went into sleep mode and switch on the DC load output. If the load output is active, the green output LED illuminates. If the MPPT charger is in standby mode, the first push of the DC LOAD ON/OFF button will wake up the unit, the second push will switch the DC output on.

Standby-operation
In order to be more efficient and energy-saving, the MPPT solar regulator goes into sleep mode if the solar module does not provide at least that much energy which is required for the operation of the solar charger itself. This means that in cloudy weather or at night, when the operation of the solar regulator would be supplied only from the battery, there will be no unnecessary power consumption. The standby mode is only activated when the dc load output is not active (no DC load is connected or it is disconnected). The microprocessor periodically measures and compares the outputted energy from the PV module with the self energy consumption of the solar regulator and shuts down the charger if the former is lower than the latter. The LED indication lights are also switched off during standby operation. A "wakeup" is generated, if the PV input power exceeds the power required for the operation of the solar charger OR the DC LOAD ON/OFF button has been pushed either on the solar regulator or on the REMOTE control.

Changing the internal fuse
The MPPT charge controller has an internal fuse. In case the fuse has burnt, the top cover of the unit must be removed for fuse replacement. To remove cover, all connected cables and the four screws from sides must be removed. After the removal of cover the fuse can be accessed. Caution! Please take care while taking off and placing back the cover that the wire of the external temperature probe and the LED's guide is well in place and that no cable is squeezed in.

Battery status display

Red LED	The battery deep-discharge voltage has been reached. DC load output has been disconnected.
Yellow LED	Battery is being charged.
Green LED	Battery is fully charged. Desulphating mode is activated if DC load output is switched off manually.