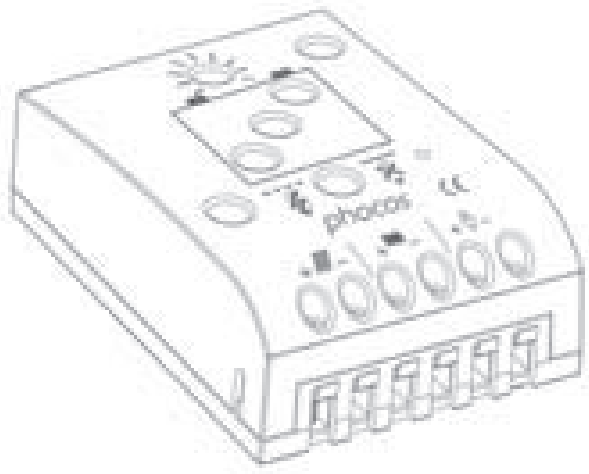
Phocos CML-V2

Solar charge controller

User Manual (English)



Dear customer,

Thank you very much for buying this Phocos product. Please read the instructions carefully and thoroughly before using the product.

Your new CML controller is a state-of-the art device which was developed in accordance with the latest available technical standards. It comes with a number of outstanding features, such as:

- Clear, readable display of the state of charge
- Acoustic signal when the state of charge changes
- Low voltage disconnect regulated by state of charge or voltage
- 16 mm^2 connector clamps
- Complete electronic protection

Please read this manual carefully taking special note of the safety and usage recommendations at the end. The manual gives important recommendations for installing, using and programming as well as a troubleshooting guide for potential problems with the controller.

Description of Functions

- The charge controller protects the battery from being overcharged by the solar array and from being deep discharged by the loads. The charging characteristics include several stages which include automatic adaptation to the ambient temperature.
- The charge controller adjusts itself automatically to 12V or 24V system voltage.
- The charge controller has a number of safety and display functions.

Mounting and Connecting

The controller is intended for indoor use only. Protect it from direct sunlight and place it in a dry environment. Never install it in humid rooms (like bathrooms). The controller measures the ambient temperature to determine the charging voltage. Controller and battery must be installed in the same room.

The controller warms up during operation, and should therefore be installed on a non flammable surface only.

***REMARK**: Connect the controller by following the steps described below to avoid installation faults.*

①

Mount the controller to the wall with screws that fit to the wall material. Use screws with 4 mm shaft and max. 8 mm head diameter, no counter sink. Mind that the screws have to carry also the force applied by the wiring.

Make sure that the ventilator slits on the sides are unobstructed.

A DIN Rail mounting plate is available as an accessory (CX-DR2). This allows mounting the controller on a standard 35mm DIN rail. Remove the screws at the backside of the controller and screw the mounting plate with the (long) fastening screw onto the backside of the controller.

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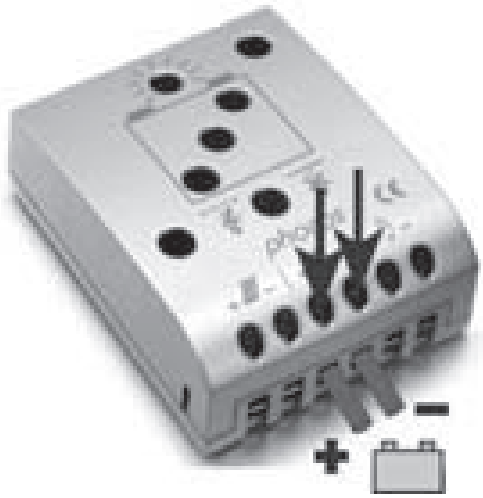
②



Connect the wires leading to the battery with correct polarity. To avoid any voltage on the wires, first connect the controller, then the battery. Mind the recommended wire length (min 30 cm to max approx. 100 cm) and the wire size:

CML05: min 2.5 mm^2
CML08: min 4 mm^2
CML10: min 6 mm^2
CML15, CML20: min 10 mm^2

Wrong polarity will cause a permanent warning sound.

***WARNING**: If the battery is connected with reverse polarity, the load terminals will also have the wrong polarity. Never connect loads during this condition!*

REMARK: *Mind the recommendations of your battery manufacturer. We strongly recommend connecting a fuse directly to the battery to protect any short circuit at the battery wiring. The fuse must take the charge controller nominal current:*

CML05: 20A, CML08: 20A, CML10: 30A,
CML15: 30A, CML20: 40A

③

Connect the wires leading to the solar array with correct polarity. To avoid any voltage on the wires, first connect the controller, then the solar array. Mind the recommended wire size:

CML05: min 2.5 mm^2
CML08: min 4 mm^2
CML10: min 6 mm^2
CML15, CML20: min 10 mm^2

REMARK: *Place positive and negative wire close to each other to minimize electromagnetic effects.*

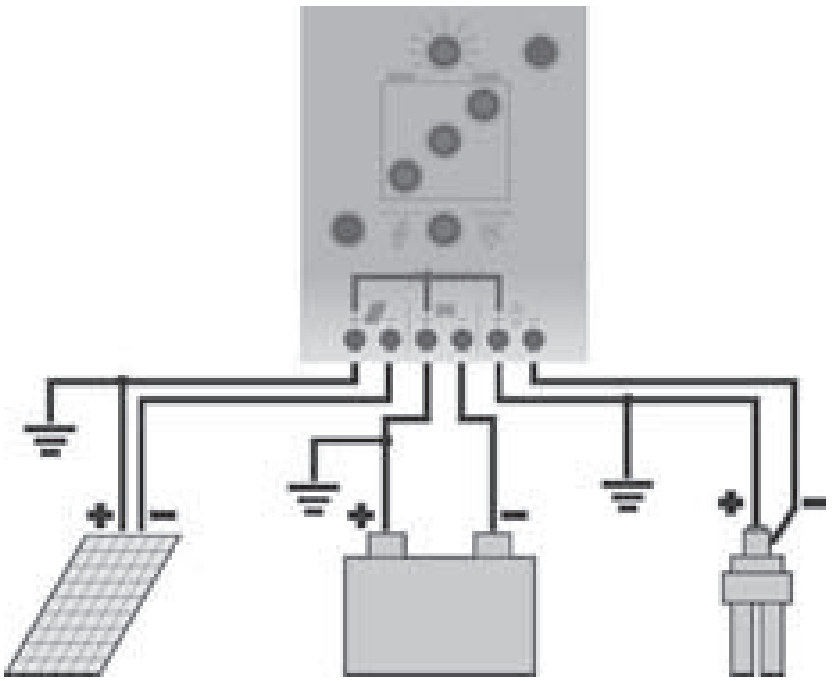
REMARK: *Solar panels provide voltage as soon as exposed to sun light. Mind the solar panel manufacturer's recommendations in any case.*

④

Connect the wires leading to the loads with correct polarity. To avoid any voltage on the wires, first connect the wire to the load, then to the controller. Mind the recommended wire size:

CML05: min 2.5 mm^2
CML08: min 4 mm^2
CML10: min 6 mm^2
CML15, CML20: min 10 mm^2

Grounding the Solar System



Be aware that the positive terminals of the CML controller are connected internally and therefore have the same electrical potential. If any grounding is required, always do this on the positive wires.

REMARK: *If the device is used in a vehicle which has the battery negative on the chassis, loads connected to the regulator must not have an electric connection to the car body. Otherwise the Low Voltage Disconnect function and the electronic fuse function of the controller are short circuited.*

Starting up the Controller

Self Test

As soon as the controller is supplied with power either from the battery or the solar array, it starts a self test routine. Then the display changes to normal operation.

System Voltage

The controller adjusts itself automatically to 12 V or 24 V system voltage. As soon as the voltage at the time of start-up exceeds 20.0 V, the controller implies a 24 V system. If the battery voltage is not within the normal operation range (ca. 12 to 15.5 V or ca. 24 to 31 V) at start-up, a status display according to the section **ERROR DESCRIPTION** occurs.

Battery Type

The controller is preset to operate with lead acid batteries with liquid electrolyte. If you intend to use a lead-acid battery with solid electrolyte ('gel' type or 'fleece' type) you can adjust the charging characteristics (see "Settings"). The equalization charge is deactivated then. In case of any doubts consult your dealer.

Recommendations for Use

The controller warms up during normal operation.

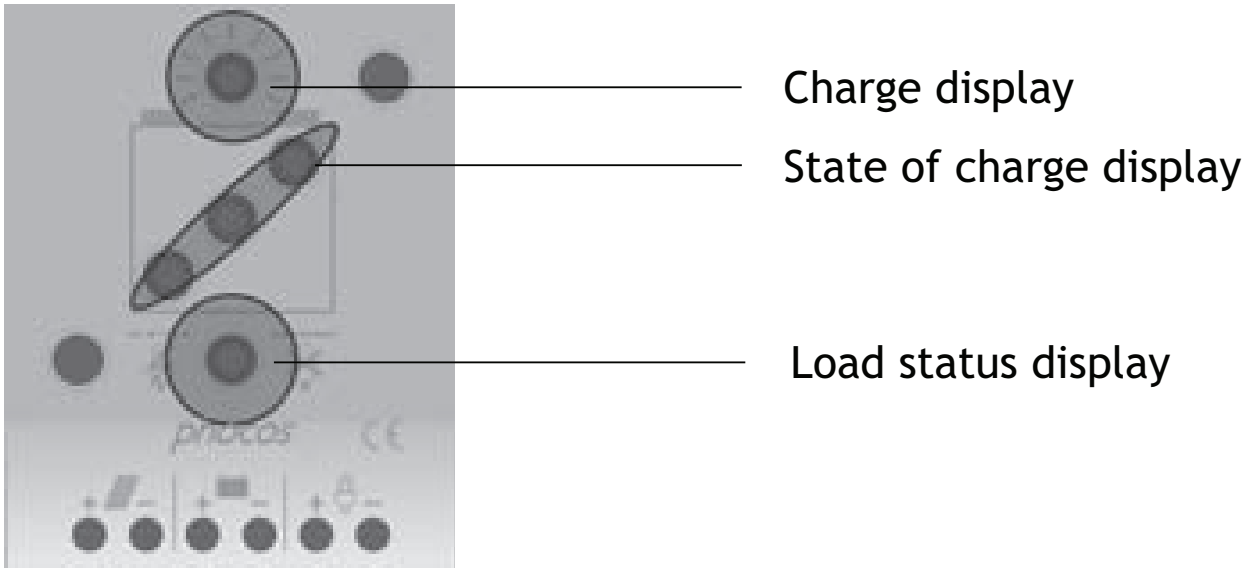
The controller does not need any maintenance or service. Remove dust with a dry tissue.

It is important that the battery gets fully charged frequently (at least monthly). Otherwise the battery will be permanently damaged.

A battery can only be fully charged if not too much energy is drawn during charging. Keep that in mind, especially if you install additional loads.

Display Functions in normal operation

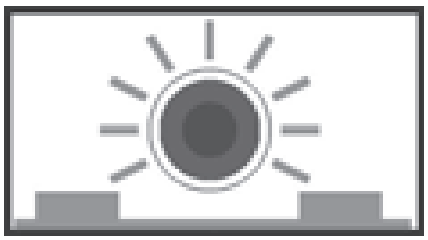
The controller is equipped with 5 LEDs and an acoustic warning signal.



In normal operation, the controller shows the state of charge of the battery and the charge from the solar panels. Any change of the state of charge (SOC) to a lower status is additionally signaled acoustically.

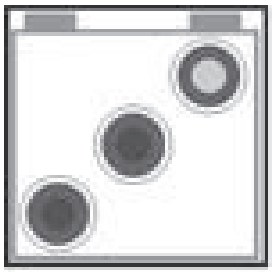
Charge display

Solar array supplies electricity (LED on)



Solar array does not supply electricity (LED off)

State of charge display



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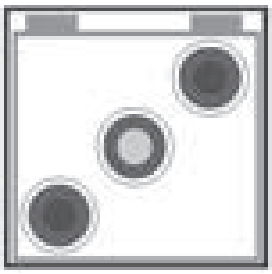

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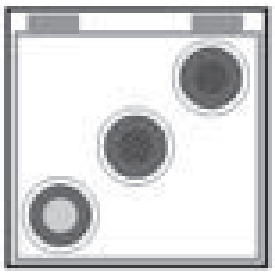

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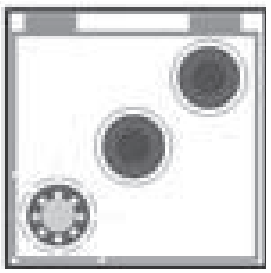
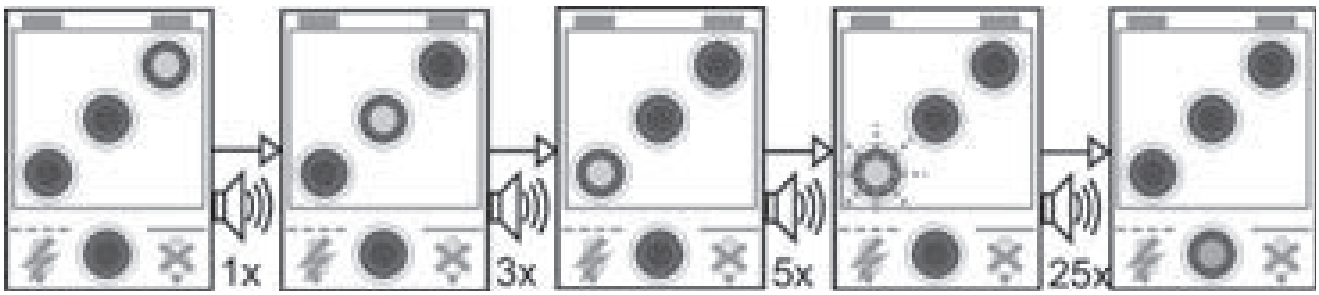


flashes: <10%

The percentage corresponds to the available energy until Low Voltage Disconnect in relation to a fully charged battery.

Acoustic signals

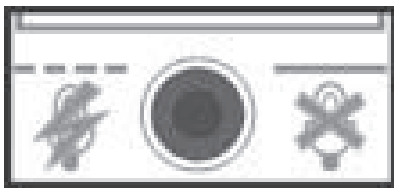
A change in the state of charge (SOC) to a lower status is indicated by an acoustic signal.



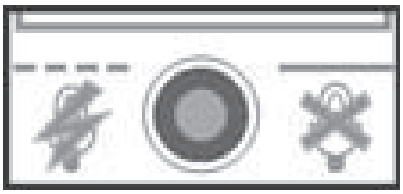
The loads are disconnected approx. 1 minute after a series of 25 signals.

Load status display

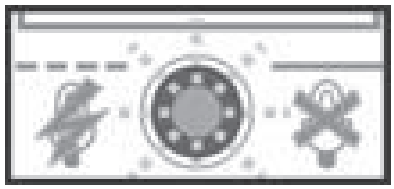
In case of deep discharge or overload/short-circuit of load, the load output is switched off. This is indicated by:



Normal operation (LED off)



Low voltage disconnect (LED on)



Overload or Short-circuit of load (LED flashing)

Low Voltage Disconnect Function (LVD)

The controller has 2 different modes to protect the battery from being deeply discharged:

1. State of charge controlled: Disconnect at 11.4 V (at nominal load current) up to 11.9 V (at no load current). Normal operation mode for good battery protection.

2. Voltage controlled: Disconnect at 11.0 V fixed setting. Appropriate if bypass loads draw current directly from the battery.

The controller is preset to Mode 1 from the factory. Changing the mode setting is described below.

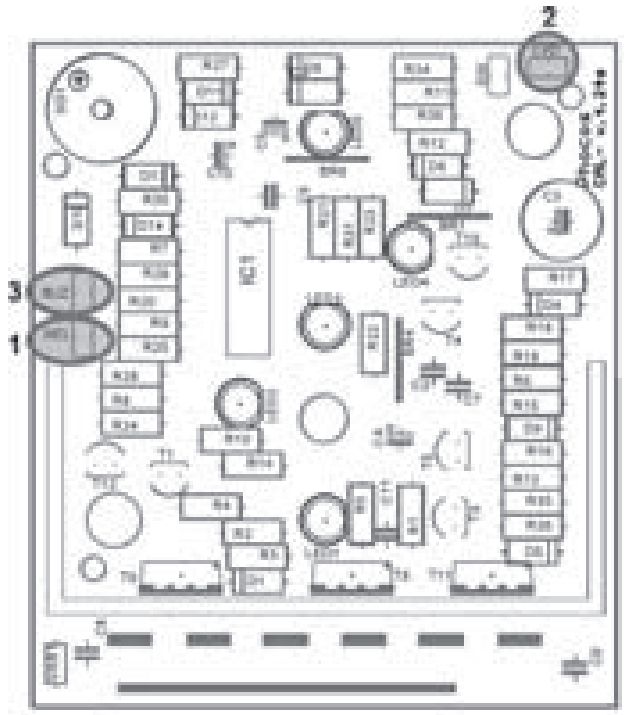
In case of doubts which mode to choose, consult your dealer because this has to be evaluated depending on the battery used.

Settings

The controller can be configured for special operation. For this purpose, open the cover of the controller by removing the screws on the back side.

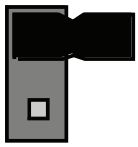
> ***WARNING:*** *The controller should not be opened while connected and in operation!*

When the controller is opened, there are 3 jumpers on the electronic board:



For changing, put the jumper either on both contact pins or only on one contact pin:

Closed jumper



Open jumper

With these jumpers, the following settings can be configured:

Jumper	GEL (1)	LVD (2)	BUZ (3)
Function	Battery type	Function of low voltage disconnect	Acoustic alarm signal
Setting jumper open	Liquid electrolyte	State of charge controlled	Alarm off
Setting jumper closed	GEL (VRLA battery)	Voltage controlled	Alarm on
Factory setting	Jumper open (liquid electrolyte)	Jumper open state-ofcharge controlled	Jumper closed Alarm on

After completing the setting, replace the cover and tighten it with the screws.

Safety Features

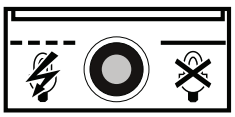
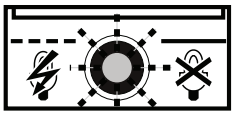
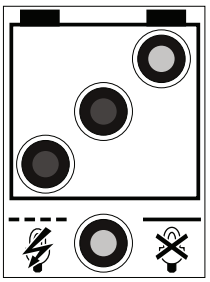
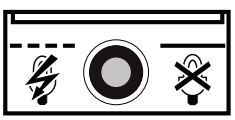
The controller is protected against improper installation or use:

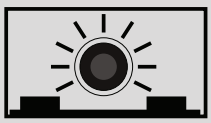
	At the solar terminal	At the battery terminal	At the load terminal
Battery connected with correct polarity	Unrestricted	Normal operation	Unrestricted
Battery connected with wrong polarity	Unrestricted	Unrestricted. Acoustic Warning	Unrestricted
Reverse polarity	Yes, not at 24V system voltage	Yes, if only the battery is connected. Acoustic Warning	Load output is protected, but loads might be damaged.
Short circuit	Unrestricted	Unrestricted. **CAUTION:** Battery must be protected by fuse.	Unrestricted
Overcurrent	No protection	-------	Controller switches off load terminal.
Thermal overload	No protection	-------	Controller switches off load terminal.

	At the solar terminal	At the battery terminal	At the load terminal
No connection	Unrestricted	Unrestricted	Unrestricted
Reverse current	Unrestricted	-------	-------
Overvoltage	Varistor 56 V, 2.3 J	Max. 40 V	Controller switches off load terminal.
Undervoltage	Normal operation	Controller switches off load terminal.	Controller switches off load terminal.

WARNING: *The combination of different error conditions may cause damage to the controller. Always remove the error before you continue connecting the controller!*

Error Description

Error	Display	Reason	Remedy
Loads are not supplied		Battery is low (Red LED on)	Load will reconnect as soon as battery is recharged.
		Overcurrent/ Short circuit of loads (Red LED flashing)	Switch off all loads. Remove short circuit. Controller will switch on load automatically after max 1 minute.
		Battery voltage too high (>15.5 / 31.0 V)	Check if other sources overcharge the battery. If not, controller is damaged.
		Battery wires or battery fuse damaged, battery has high resistance	Check battery wires, fuses and battery.
Battery is empty after a short time		Battery has low capacity (Red LED on)	Change battery

Error	Display	Reason	Remedy
Battery is not being charged during the day		Solar array faulty or wrong polarity (Green LED off)	Remove faulty connection / reverse polarity
Battery wrong polarity	Permanent sound	Battery is connected with reverse polarity	Remove reverse polarity

General Safety and Usage Recommendations

Intended Use

The charge controller is intended exclusively for use in photovoltaic systems with 12 V or 24 V nominal voltage and in conjunction with vented or sealed (VRLA) lead acid batteries only.

Safety Recommendations

- Batteries store a large amount of energy. Never short circuit a battery under all circumstances. We recommend connecting a fuse (slow acting type, according to the nominal controller current) directly to the battery terminal.
- Batteries can produce flammable gases. Avoid making sparks, using fire or any naked flame. Make sure that the battery room is ventilated.
- Avoid touching or short circuiting wires or terminals. Be aware that the voltages on specific terminals or wires can be up to double

the battery voltage. Use isolated tools, stand on dry ground and keep your hands dry.

- Keep children away from batteries and the charge controller.
- Please observe the safety recommendations of the battery manufacturer. If in doubt, consult your dealer or installer.

Liability Exclusion

The manufacturer shall not be liable for damages, especially on the battery, caused by use other than as intended or as mentioned in this manual or if the recommendations of the battery manufacturer are neglected. The manufacturer shall not be liable if there has been service or repair carried out by any unauthorized person, unusual use, wrong installation, or bad system design.

Technical Data

Nominal voltage	12 / 24 V, automatic recognition
Boost voltage	14.5 / 29.0 V (25°C),2h
Equalization voltage	14.8 / 29.6 V (25°C),2h
Float voltage	13.7 / 27.4 V (25°C)
Low Voltage Disconnect Function	11.4 - 11.9 / 22.8-23.8 V controlled by state of charge 11.0 / 22.0 V controlled by voltage
Load reconnect voltage	12.8 / 25.6 V
Temperature compensation	-4 mV/cell*K
Max. solar panel current	5 / 8 / 10 / 15 / 20 A according to model number @ 50°C
Max. load current	5 / 8 / 10 / 15 / 20 A according to model number @ 50°C
Dimensions	80 x 100 x 32 mm (w x h x d)
Weight	180gr
Max. wire size	16 mm^2 (AWG #6)
Self consumption	4 mA
Ambient temperature range	-40 to + 50°C
Case protection	IP 22

Subject to change without notice.
Version: 20090103
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