Solar Charge Controller
10A/15A/20A
Instructions Manual
Please read the instruction Manual carefully before using
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# 8. Technical Data

The technical data is subject to alteration by the manufacturer.

<table>
<thead>
<tr>
<th>Solar charge controller</th>
<th>PCS10-24C</th>
<th>PCS15-24C</th>
<th>PCS20-24C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>System Voltage</strong></td>
<td>12V/24V</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Max charge current</strong></td>
<td>10A</td>
<td>15A</td>
<td>20A</td>
</tr>
<tr>
<td><strong>Max load current</strong></td>
<td>10A</td>
<td>15A</td>
<td>20A</td>
</tr>
<tr>
<td><strong>Max consumption current</strong></td>
<td></td>
<td>12mA</td>
<td></td>
</tr>
<tr>
<td><strong>Final charging voltage (Floating charge)</strong></td>
<td>Liquid 13.9V/27.8V</td>
<td>Gel 14.1V/28.2V</td>
<td></td>
</tr>
<tr>
<td><strong>Fastest charge voltage</strong></td>
<td>14.4V/28.8V (2:00h)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Even charge(except gel batter)</strong></td>
<td>14.7V/29.4V (2:00h)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DOD recovery value(SOC/LVR)</strong></td>
<td>&gt;50% SOC (12.6V/25.2V)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DOD protecting value(SOC/LCD)</strong></td>
<td>&lt;30% SOC (11.1V/22.2V)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Environment temperature</strong></td>
<td>-10℃...+50℃</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Installation</strong></td>
<td>Wall installation</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Temperature compensation</strong></td>
<td>Optional function -5mV/℃</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Protection type</strong></td>
<td>IP 22</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>350g</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Dimensions(LxWxH)</strong></td>
<td>187x96x44mm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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# 1. Safety Instructions

1.1 The safety instructions are marked as follows

⚠️ In this manual, safety instructions for personal protection are marked with this symbol. The relevant operational safety notes of the system and controller are marked in bold.

1.2 General Safety Instructions

⚠️ Observe the following while installing the controller and handing the battery:
- Danger of explosion due to improper handling of batteries!
- Corrosive hazard by leaking battery acid!
- Keep children away from batteries and acid! Smoking fire and naked lights are prohibited when handing batteries. Prevent sparking and wear eye protection gear during installation.

⚠️ Observe and follow the handling instructions in the user manual and on the battery.

⚠️ Solar modules generate power from light incidence. Even by low light incidence solar modules carry the full voltage. Therefore, work cautiously and avoid sparking during all work. Observe the corresponding safety precautions.

⚠️ During installation and electrical installation the photovoltaic system’s DC circuit may carry twice its system voltage value (in the 12V system up to 24V, 24V system up to 48V). Use only well-isolated tools!

⚠️ Do not use any technical and measuring equipment that you know is damaged or defective!

⚠️ When installing the power line ensure that no fire safety measures are damaged. The controller may not be installed and operated in moist rooms (e.g. restrooms), or rooms, in which easily flammable gasoline mixtures may be present, such as by gas bottles, paint, lacquer, solvents etc. Do not store any of the mentioned mixtures in the room, in which the solar controller is installed!

⚠️ If the controller is operated in a manner not specified by the manufacturer, the controller’s constructive protective measures can deteriorate.

⚠️ The factory signs and marking may not be modified, removed or made unrecognizable. All work must be performed in conformity with the national electrical specifications and related local regulations!
When installing the controller in foreign countries, information concerning regulations and protective measures must be obtained from the relevant institutions/authorities.

Do not begin the installation until you are sure that you have technically understood the manual and perform the work only in the order provided in this manual!

The manual must be available during all work performed on the system, third parties included.

This manual is a component of the system controller and must be included with the controller when given to a third person.

1.3 Scope of Application

This manual describes the function and installation of a controller for photovoltaic(PV) systems for charging 12V or 24V or 48V lead batteries for recreational, residential, business, commercial areas and small businesses.

The charge controller is only suitable for regulating photovoltaic solar modules. Never connect another charging source to the charge controller. This can destroy the controller and/or source. Consult your specialized dealer or installer if other charging sources should be used and observe the “5.1. SOC Calculation” item in this manual.

The controller is only suitable for the following chargeable 12V or 24V battery types:
- Lead storage batteries with liquid electrolytes
- Sealed lead storage batteries; AGM,GEL
The respective battery type must be set on the controller, see 6.3. Battery Type Gel/Li.

Observe the manufacturer's instructions before connecting the battery.

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**Display** | **Meaning** | **Cause Remedy**
---|---|---
| Battery voltage too low. Voltage <10.5 V or >40.2 V | Check installation. Check battery voltage, possibly recharge battery manually. Consumer connected directly to the battery can deep-discharge the battery. |
| Battery voltage too high. Voltage >15.5 V or >62.0 V | Check installation. Check battery voltage, possibly check additional charge sources. |
| Load current too high. The controller’s permitted consumer current has been exceeded, the load output has therefore been disconnected. | Reduce the load current using the consumer output. Perhaps current spikes are occurring through the consumer. Try reconnecting the load. |
| Module current too high. The controller’s permitted input current as been exceeded. | Reduce the load current or module power. |
| Short-circuiting at the load output. | Remove short-circuit, disconnect consumer and try to reconnect |
| If there is a short circuit in The module, the moon symbol appears during the day. | The module input is protected by an internal electronic fuse. |
| No battery connected or connection interrupted. | Supply only by solar module. Connect battery to controller and check battery fuse. |
| Storage battery connected with reverse polarity. | Disconnect battery and connect to controller with correct polarity. |
7. Error Messages

Caution! Please do not open the controller or attempt to replace components when troubleshooting. Improper maintenance can be hazardous to the user and the system.

If the controller detects errors or unauthorized operating states, it flashes error codes on the display. Error codes can generally be differentiated, whether there is a temporary malfunction, e.g. controller overload or a more serious system error that can be remedied by appropriate external measures. Since not all errors can be simultaneously displayed, the error with the highest error number (priority) is displayed. If several errors are present, the second error code is displayed after remedying the more significant error.

The following meaning is assigned to the different error codes:

<table>
<thead>
<tr>
<th>Display</th>
<th>Meaning</th>
<th>Cause/Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="387x46" alt="Image" /></td>
<td>Communication error with the internal memory (EEPROM).</td>
<td>Disconnect consumer, solar module and battery. Reinstall the device. If the error reoccurs, please contact your specialized dealer.</td>
</tr>
<tr>
<td><img src="402x148" alt="Image" /></td>
<td>Communication error on the external bus (6-pole edge connector).</td>
<td>Check the 6-pole plug-in connection on the edge connector, power supply and function of the external extension. If the error reoccurs, please contact your specialized dealer.</td>
</tr>
<tr>
<td><img src="489x70" alt="Image" /></td>
<td>Short-circuit at the external temperature sensor</td>
<td>Check the contact of the 2-pole edge connector, remove short-circuit. Check sensor.</td>
</tr>
<tr>
<td><img src="477x184" alt="Image" /></td>
<td>Excessive temperature controller turned off the consumer due to internal over heating.</td>
<td>Let controller cool. Check the cause for overheating (installation site, other heat sources). Possible reduce charge or load current. Ensure the controller has proper ventilation.</td>
</tr>
<tr>
<td><img src="489x70" alt="Image" /></td>
<td>No solar module connected. (Detection lasts approx. 15 minutes)</td>
<td>Check module connection. Module connected with reverse polarity, perhaps the module feed wire is disrupted.</td>
</tr>
</tbody>
</table>

2. Installation

2.1 Installation Site

Only install the controller near the battery on a suitable surface. This surface should be solid, stable, even, dry and nonflamable. The battery cable should be as short as possible (1-2m) and have a suitable cable diameter size to minimize loss, e.g. use 2.5mm² at 10A and 2m length; 4mm² at 20A and 2m length; 6mm² at 30A and 2m length.

The controller and battery should have same temperature ratio for the temperature compensation function of the charging voltage. When the battery is placed far away from the controller, an external temperature sensor is available as an accessory unit.

Do not assemble the charge controller outdoors. The controller must be installed so that it is protected against humidity, dripping, splashing and rain water as well as direct and indirect warming e.g. Sunlight.

The controller also generates heat during normal operation. The installation or assembly into another housing may not obstruct the rear vents necessary for cooling the device. To ensure the air circulation for cooling the controller, an area of 15cm on each side of the controller must be kept free. The temperature at the installation site may never fall below or exceed the maximal permitted ambient temperature.

15cm 15cm

The integrated LC display should be protected against UV rays (e.g. sunlight). Chronic exposure to UV rays can permanently discolor the LCD.

2.2 Connecting the Controller

![Diagram]
Connect the individual components to the symbols provided. Observe the following connection sequence during commissioning:
1. Connect the battery to the charge controller-plus and minus
2. Connect the photovoltaic module to the charge controller-plus and minus
3. Connect the consumer to the charge controller-plus and minus

The reverse order applies when deinstalling!
Please observe that the automatic adjustment to 12V/24V systems does not function properly, if this sequence order is not followed. An improper sequence order can damage the battery!

2.3 Grounding
Grounding the controller is not technically required when installing a standalone solar system. Observe, however, the corresponding applicable national regulations. One ground is possible for all positive connections; however, only one connection is possible for a negative ground. Observe that there is no common connection, e.g. Across a ground connection, the minus module connections, battery minus and load minus. Non-observance can damage the controller!

3. Protective functions of the controller
The controller is equipped with various devices to protect its electronics, battery and load. If the controller's maximal permitted data are exceeded, the controller can break down despite the protective functions. Never improperly connect more than one component to the controller! Error messages (Point7. Error messages) display any protective devices triggered. The protective function is automatically reset after remedying the error.

- **Protection against reverse polarity of solar modules**
  The solar module's power may not exceed the controller's nominal power!
- **Protection against reverse polarity of the connected consumer at the load output**
  Protects the controller, not the consumer.
- **Protection against reverse polarity of connected battery**
  Charging and discharging the battery is prevented.
- **Short-circuiting at the module input**
- **Short-circuiting at the load output**
- **Protection against overcharging**
  Controller disconnects the connection to the battery and turns off the consumer.

This function controls the load output only when it is dark (at night). During daylight the consumer output remains off. The connected solar module records information on the light intensity. The load is activated once the solar module detects that it is dark. Once it becomes light, the controller deactivates the consumer output regardless which illumination duration has been selected. Due to different properties of various modules, the twilight threshold cannot be specified accurately. An activation delay cannot be set when twilight sets in.

6.5 Default Setting (Presetting) Activation
Calling up the default settings (PRE) deletes the previous settings and resets the charge controller to the factory settings.
The default setting is: SOC Control/Gel Storage Battery/Night Light OFF

6.6 Auto-test
The auto-test can determine whether the charge controller is fully operational and localize all possible windows simultaneously. The following preparations must be met before you can start the test using the menu item. Non-compliance can lead to incorrect test results.

A) Disconnect the solar module from the charge controller (both connections). The battery must be connected.
B) Connect a small functional DC consumer, e.g. an energy-saving lamp, to the load output.
C) Press the right button to manually disconnect the load.
D) Press the right button. The display begins to flash.
E) Start the auto-test with the left button. The test expires quickly and automatically.
F) If there is no error, this window is displayed shortly (1 sec.) Afterwards, all LCD segments fade in and out for 1 second. Then the auto-test window reappears in the display.
G) If there is an error, an error code is displayed.

Note the code your local distributor can help you find the error with this information. After 30 seconds the display returns to the auto-test window. During this the display flashes.
H) In the flashing auto-test window, press the left button again to repeat the test or the right button to end the test.
Press the left button for at least 3 seconds to open the first setting window (control type). Press the left button again to call up the various windows. Press the right button to modify settings. The display begins to flash. Now, with the left button select the settings options. The setting must be saved with the right button. The display then stops flashing.

The normal window reappears after a 30 seconds waiting period or pressing the left button for 3 seconds. This applies to all windows.

6.2 SOC Setting/Voltage Control
The SOC control is the factory setting. This way, the charging procedure and the deep discharging protection are controlled by the calculated SOC value for ideal battery usage.

Only fixed voltage thresholds are used and the SOC bar display is faded out in all windows during voltage-guided control UoL.

6.3 Gel/Liquid Battery Type Setting
The standard setting is “Li”. The setting of the battery type influences the cutoff voltage of the controller. If you use a Gel or AGM battery, you have to change the battery type to GEL.

Caution! An incorrect battery type setting can damage the battery!

6.4 Night Light Function Setting
This setting provides three options in the following order:
• OFF: The function is deactivated (default).
• Operating time-choice of 1 to 8 hours.
• ON: The consumer output remains on for the entire night.

4. Operating the system controller

The display shows a variety of system data by symbols and digits. Both buttons control all settings and display windows

4.1 Display and Operation Elements

Display window for system information and messages
Button for switching display windows or calling up the setting 
Manual load switch, or confirmation button in program mode

4.2 Display Window
Change the display windows with the left button.
After switching windows, the window selected remains. To return to the beginning, simply press the left button until the SOC window appears. The bar display shows the actual battery level (SOC = state of charge) of the battery in each window. If the controller is set to voltage control, the SOC bar display does not appear and the battery voltage value replaces the SOC percentage value! Please observe that the accuracy of the controller's display is not comparable to that of a measuring device.

4.2.1 SOC Window
Displays the charge level, day/night level and consumer on/off. Instead of the SOC value, the battery voltage is displayed during voltage control.

4.2.2 Voltage window
Displays the battery voltage measured by the controller.

4.2.3 Module current
Displays the actual produced solar module's current output.

4.2.4 Charging current
Displays the charging current flowing into battery from the solar module.

4.2.5 Load current
Displays the current drawn by the load output.

4.2.6 Ah Battery charging meter
Displays the accumulative sum of recharged Ah since the initial installation or reset. Press both buttons for 3 seconds to reset the meter to 0. Even when the battery is disconnected the value remains. When 99.9KAh are reached, it will switch back to 0 Ah.

4.2.7 Ah Battery discharging meter
Displays the accumulative sum of Ah drawn by load since the initial installation or reset. Press both buttons for 3 seconds to reset the meter to 0. When 99.9KAh are reached, it will switch back to 0 Ah.

4.2.8 Warning deep discharge protection
As an early warning, the SOC bar or the voltage value flashes. The face still looks friendly!

4.2.9 Load disconnection
If the deep discharging protection has been activated the SOC bar or the voltage value flashes. The face looks sad until the reconnection set point is reached.

5. Function Overview

This charging controller has basic functions for specifying the charging state (SOC), charging specification and deep discharge protection that are described in the following section. Additional functions that can be activated such as the settings, night light function, auto-test, presetting and serial number query are explained under the corresponding menu items in chapter 6.

5.1 SOC Calculation
During operation, the controller monitors various parameters (U, I) of the battery and from that calculates the battery's charge level (SOC = state of charge). The charge level is the energy level still available in the battery. Modifications in the system, e.g., the battery's aging process are automatically taken into consideration by the system's continuous learning process.

Using this SOC information, you always have an accurate overview on the actual battery level. Using the SOC, the controller also controls the selection of the charging procedure and the deep discharging protection in order to ideally maintain the battery. If one of the parameters cannot be recorded because for example, a consumer or charging source is directly connected to the battery, the SOC calculation is invalid. The controller can then be set to a more simplified voltage-guided control, see chapter 6.2.

The SOC calculation is restarted each time the controller is reinstalled.

5.2 PWM Charge Control
The controller applies a constant voltage charging to the battery. The entire available electricity provided by the charging source is used for charging the battery until the final voltage is reached. A pulse width modulator (PWM) regulates the charging current by briefly closing the module input (shunt charge controller) in the charge control area.

5.3 Deep Discharging Protection
The controller protects the connected battery against an excessive discharging. If the battery falls below a specified charge level (during SOC control) or battery voltage (during the voltage-controlled function), the load output is disconnected and the discharge of the battery is prevented. The display shows the early warning and disconnection during deep discharging. The set points of the deep discharging protection are predefined and cannot be reset.

6. Controller Settings

The battery type, control type and night light function can be set in the controller. Points for the auto-test and the serial number query are also located within the menu. The settings remain when the battery is disconnected.

6.1 Calling up and Modifying the Settings