4 Solar Powered Series

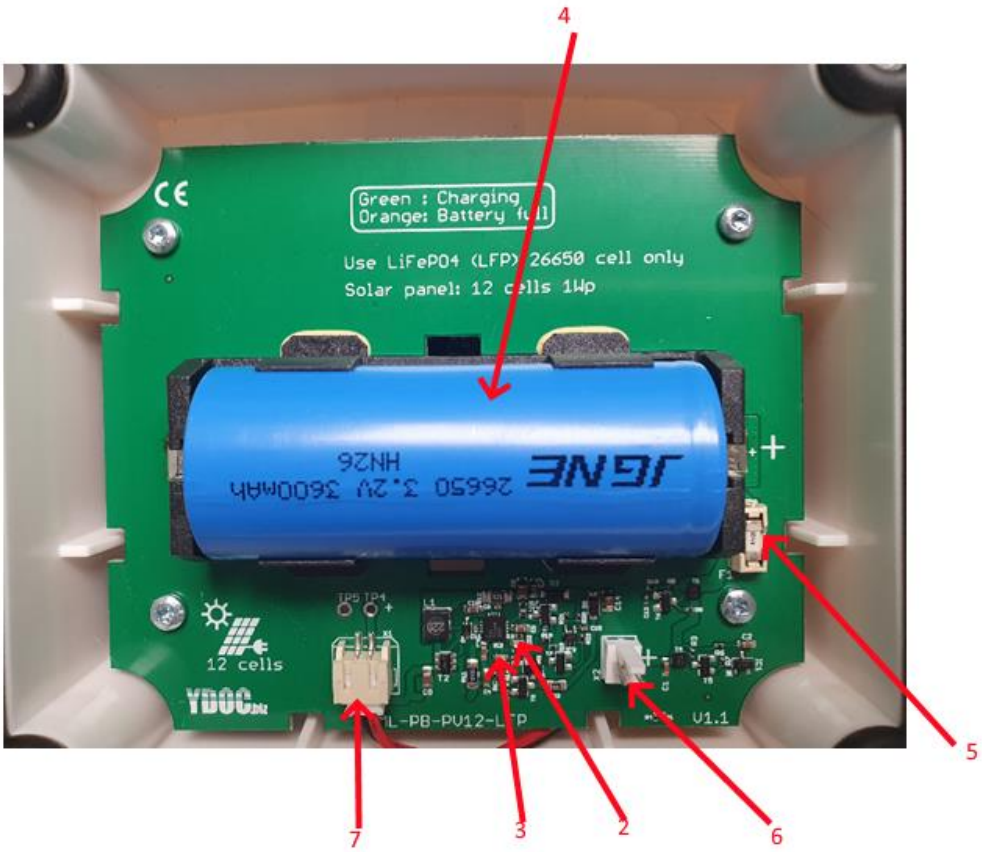
4.1 ML-PB-PV12-LFP

The YDOC ML-PB-PV12-LFP Charger-Power Board is an accessory for the type ML-xxx low power Data Logger. It is designed to power the ML-xxx Data Logger from an 12 cells 1Wp solar cell. It must be used together with a 26650 LiFePiO4 battery and a solar panel. Features:

- Designed for operation with solar cell 1Wp 12 Cells (4 Volts nom.)
- Power output 3.2 V nominal (Cell voltage)
- LiFePO4 26650 battery
- RoHs Compliant
- CE Compliant

4.1.1 Overview of the ML-PB-PV12-LFP Power Board

Underneath, a picture is shown of a ML-PB-PV12-LFP Power Board.



2) battery full indicator LED (orange)
3) charge indicator LED (Green)
4) battery holder for 26650 cells
5) Battery Fuse (4 A)
6) 3.2 Volts nom. output connector for Data Logger (Unregulated, directly from cells)

7) Input connector (solar panel)

4.1.2 General

The ML-PB-PV12-LFP Battery Charger is a, charger for 3.2 Volts, 26650 type, LFP Battery (or LiFe-PO4). It consists of a single PCB, to be mounted in a ML-COVER-PV-type Casing

4.1.3 Charger

The charger is optimized for solar power (12 cells, Vnom 4V Voc 7V). It automatically searches for the maximum power point of the solar panel, for high efficiency. The charge current is limited to 200 mA.

4.1.4 Protection

The charger has different protection features to enable a high reliable, user-friendly and safe operation.

Battery undervoltage protection

It has a Battery low detection which is triggered when the battery voltage gets below 2.5 Volts. When this happens, the battery will be disconnected from the output (from the Data Logger), so, the battery won't be damaged due to total discharge. There is a hysteresis which prevents the system from "flipping" on and of all the time. (see technical specification)
The battery is re-connected to the power output when the battery-voltage gets above the threshold + hysteresis. So, the Data Logger will work again. The battery is switched off @ 2.5 V and switched back on @ 2.95 V.

Due to this hysteresis, the system will not start, when connecting a battery with a voltage <2.95V. Normally, a unloaded, fully charged battery will have a voltage of > 3.6 V. An unloaded battery with a voltage < 2.95 V is pretty empty. After the solar panel has charged the battery above 2.95V it will work.

Overtemperature protection

The system is protected against too high temperature, in two levels. The first level is using an NTC resistor on the board, and is located on a "cool" zone of the PCB The overtemperature. Protection is set to 60 degrees Celsius. If this level is reached, it will shut down, and resume, when cooled under 50 Degrees. A second level is activated, if the first, somehow fails. This happens @ 145 degrees Celsius, it will shut down. This temperature is measured inside the charge controller, which is connected to the gnd plane of the PCB.
So, if the batteries are overheated, the PCB will conduct this heat and the charger will stop.
Also, when the environment temperature is very high, and the cells are charged with much current, it can sometimes happen that the overtemperature protection gets activated once in a while.

Wrong polarity protection

The battery is protected for wrong polarity by means of an electronic circuit. If the cell is installed backwards, it just doesn't work, but will not cause damage.

Operation
The ML-PB-PV12-LFP is used to charge a 26650 type LiFe-PO4 battery. You can build a solar system with just this Power board, inside the ML-COVER-PV , 26650-LFP battery. The Power board also has a power output for the Data Logger.
The ML-PB-PV12-LFP is optimized, and only intended for solar power. (12 Cells 1Wp)

The ML-PB-PV12-LFP power board manages the energy system stand alone. There are no jumpers, no settings are needed. It just works straight from the box. There are 2 indicators that are useful for the user.

4.1.5 Charge indicator

This is the green LED.
When this LED is lid, the battery is charged. The charge current is defined by the internal management system and may vary upon, state of charge of the battery and the available power from the solar panel.

4.1.6 Battery Full indicator

This is the orange LED. When this LED is lid, the charge process is terminated, and the battery is fully charged. To prevent the device form “flipping” the system has a hysteresis. The battery will be charged again when the battery voltage drops below this hysteresis.

4.1.7 Maximum Power Point (MPP)

The device searches for the maximum power point of the solar panel. This fixed point lies at 5.5 Volts. (The MPP is related to the Voc of the panel, and that is a fixed property) When the charger needs more current than the solar panel can provide, it limits the current at this point.
A bypass circuit will continue to work, in low light conditions, where the conditions of the MPP are not met.

4.1.8 Connector Pin Configuration

Connector	Pin	Function	Description	Value	Comments
X1	1	- Solar (GND)	Black wire	0V	Solar Panel
X1	2	+Solar	Red wire	4V nom	Solar Panel
X2	1	Data Logger Power +		3.6V	Data Logger
X2	2	Data Logger Power -		0V	Data Logger

4.1.9 Specifications ML-PB-PV12-LFP

Power Supply	
Protection	Internal fuse for Battery
Input Power	Solar Panel
Type of Power	Solar Panel 12 Cells (Voc 7 Volts, Vnom 4 Volts)
Charger Circuit	
Discharge protection	Yes, @ 2.5 Volts
Charging Current	200 mA max
Battery Full Level	3.8 V
Battery Level Hysteresis	0.45 V (back on @ 2.95 V)
Battery Low Level	2.5 V
Temperature	Operating: -0 ~ + 60 °C (limited to battery spec) Storage -40 ~ +85 °C
Humidity	5 ~ 100 % RH
Electrical	
Type of charger	Solar optimized charger with MPP tracking
Switch Frequency	1 Mhz typical
Quiesent Current	<100 uA (output available, but not loaded)
3.6 V output	
Output current	4A RMS
Connector	Molex 22-27-2021
Galvanic Isolation	No
Overload Protection	Yes, by means of fuse
CE Compliant	Yes
Rohs Compliant	Yes
Dimensions	
W X D x H	106 mm X 82 mm X 15 mm
Weight	
Netto Weight	110 Grams

Spareparts:

- Battery fuse (F2): 4A Slow Blow Littlefuse 0454004.