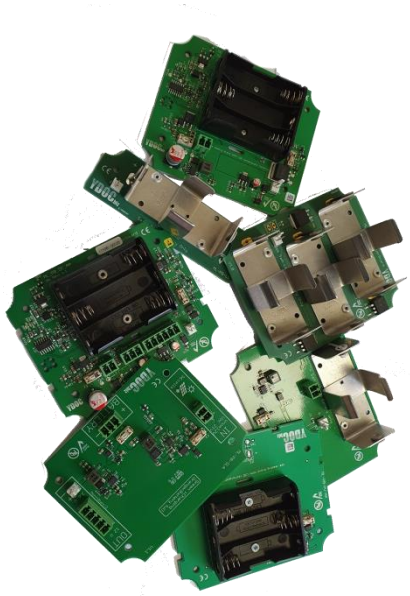
Your Data Our Care

Type ML-PB-XX
(Power Board Series)



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WARNING

THE FOLLOWING OPERATING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID DAMAGE OR MALFUNCTION, DO NOT PERFORM ANY OPERATING OTHER THAN THAT CONTAINED IN THIS MANUAL. ANY OPERATOR SHOULD BE SKILLED WITH A TECHNCAL BACKGROUND BEFORE OPERATING THE DEVICE.

1 User Manual ML-PB-XX (Power Board Series)

Warranty

All YDOC instruments are warranted against defective materials and workmanship. Any questions with respect to the warranty mentioned above should be taken up with your YDOC Distributor.

Check Available Editions.

2 Battery and DC Powered Series

2.1 ML-PB-DC-LI

The ML-PB-DC-LI -Power Board is a multifunctional, high efficiency, low noise, power supply. It consists of a single PCB, to be mounted in YDOC ML-type Data Logger (It is delivered with a cover)

A D-Size 3.6V Lithium battery powered is best suitable for monitoring with longer log intervals >=1h and transfer intervals >=4h.

Equipped with D-size holders to host up to 3 Lithium SAFT LSH20 batteries safely, with a combined lossless capacity of 39000mAh.

Properties:

1) 8 - 28 Volts DC auxiliary input power option
2) Lithium Battery option

2.1.1 8- 28 Volts DC auxiliary input power (Lithium Power Backup)

The power supply is converting the input source to a, stable and clean, output voltage.
A special super-low-loss diode is mounted, for isolation of the batteries. I.E., that no current is drawn, accidentally, from the batteries, into the attached power supply. The output voltage of the power supply is slightly higher than the unloaded voltage of the lithium battery, so no current is taken from the battery, when the board has input power.
A green LED indicates the presence of the input power.

So:

1) When both, (lithium)battery and auxiliary power are connected, the power will be taken from the auxiliary power only, and thus saving the battery.
2) When the power board is connected, but NOT powered, the ML- Data Logger will still continue to work, and draw it's current from the Lithium battery. No extra current is wasted into the power supply, by means of the diode.

So to increase the availability of your system it is advised to use both battery and Auxiliary power.

Protection

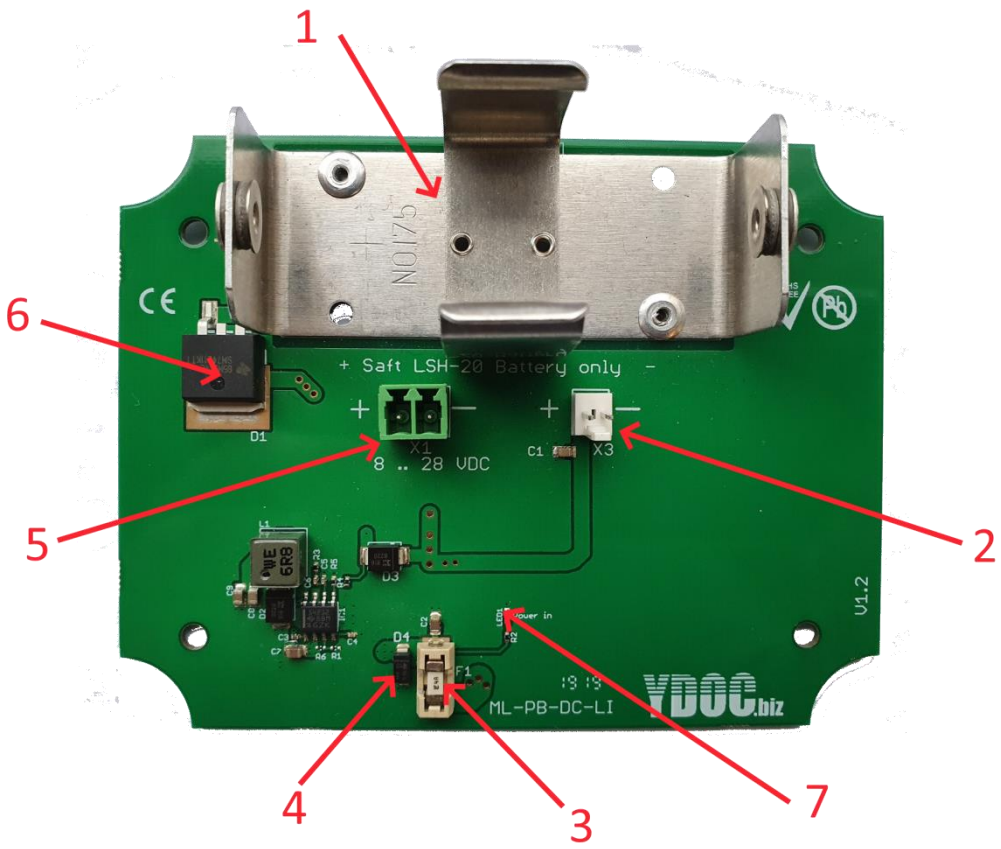
The power board input circuit is equipped with a transzorp of 30 Volts, and a fuse of 4 Amp. This protects the connected Data Logger from high input voltages.

Beware of exposing power board to high voltages, as it will damage the fuse. Also, when the polarity of the input-source is wrong, the fuse will blow. But your connected Data Logger is protected in both cases.

Normally the fuse will never blow, during the lifetime of the instrument.

2.1.2 Overview ML-PB-DC-AA (Lithium and Auxiliary) Power Board

Underneath, a picture is shown of a ML-PB-DC-AA Power Board with Lithium Battery and auxiliary DC power option.



1) Battery holder for Lithium Battery (Saft LSH-20)
2) Power output for powering Data Logger
3) Main fuse
4) Transzorp for protection
5) 8 - 28 VDC auxiliary power input connector
6) Super low loss diode
7) Input power LED

Spare parts:

- Input fuse (F1): 2A Fast Acting Littlefuse 0453002.

2.1.3 Specifications ML-PB-DC-LI

Power Supply	
Protection	Fuse 4A
Input Power	8 - 28 VDC
Power out	1 Amp (Rms)
General Enviroment	
Temperature	Operating: -30 ~ + 85 °C; Storage -40 ~ +85 °C
Humidity	5 ~ 100 % RH
Electrical	
Switch Frequency	1 Mhz typical
Quiesent Current	<1 mA @12V (3.6 Volts power supply active)
3.6 V output	
Output current	2 Amp Rms
Connector	Molex 22-27-2021
Galvanic Isolation	No
Ripple & Noise	5% pk-pk, 20 MHz bandwidth
Overload Protection	Yes, by means of fuse
CE Complient	Yes
Rohs Complient	Yes
Dimensions	
W X D x H	106 mm X 82 mm X 40 mm
Weight	
Netto Weight	110 Grams

2.2 ML-PB-DC-NIMH (End of Life)

The ML-PB-DC-NIMH NiMH Charger is a multifunctional ,high efficiency, low noise, power supply and charger for AA type Rechargeable Batteries. It consists of a single PCB, to be mounted in a ML-xxx-type Data Logger

2.2.1 Charger

The charger is used to charge the rechargeable AA type batteries, and outputs the battery voltage.
It is converting the input power into the batteries. The Charger is developed to operate with various power sources, especially solar panels. It is very versatile and adapts automatically to the power source used. When there is very little power available, it will automatically reduce the charging current.
It can be used with 8 - 30 Volts solar panels or DC sources.

2.2.2 Protection

The charger has different protection features to enable a high reliable, user-friendly and safe operation. The features are implemented in both soft- and hardware to increase reliability.

Battery undervoltage protection

It has a Battery low detection which is triggered when the battery voltage gets below 2.9 Volts. When this happens, the batteries will be disconnected from the output (from the Data Logger), so, the batteries won't be damaged due to total discharge. There is a hysteresis which prevents the system from "flipping" on and of all the time.
The batteries are re-connected to the power output when the battery-voltage gets above the threshold + hysteresis. So, the Data Logger will work again.

Overtemperature protection

The temperature of the batteries is measured and if too high, the charging process is terminated.

Overvoltage protection

Both input and output are protected against too high voltage. The output protections ensures that the voltage of the output never exceeds 5.5 Volts, to guard your Data Logger. The input voltage is monitored, and in case of overvoltage, the charging-process is terminated. When the input voltage is above 43 Volts, the fuse will blow.

Battery out detection

This mechanism detects whether batteries are installed or not. If not, the charging process is terminated. This feature prevents the output voltage to rise above spec.

2.2.3 LED indicators

Overtemperature (RED)

When the temperature of the batteries reaches 45 degrees Celsius, this (red) LED will be flashing. The charging process is terminated, until the temperature is normal again. This can happen when the enclosure is subjected to direct sunlight.

Overvoltage Input (RED/Flashing)

When the input voltage is higher than the spec of the device (>36 Volts) this (red) LED will lit (solid). The fuse will be blown when the input voltage reaches 30 Volts. The frequency of flashing is twice per second.

Battery Out (Orange)

The device detects if batteries are installed or not, and in case of no batteries present it lit the (orange) battery out LED, and terminates the charging process. This prevents the output voltage to rise to a out-of-spec value.

Charging (green)

A green LED indicates the correct charging of the batteries. It shows different stages:

- Solid : Normal charging (200 mA)
- Flash: High speed charging (800 mA)
- Off: No charging (<200 mA or no charge)

When the LED is off, it shows that the batteries are NOT or WEAK charging. This can indicate:

- Batteries are fully charged
- There is no input power available to charge with.
- The input power is not sufficient to charge @ normal speed

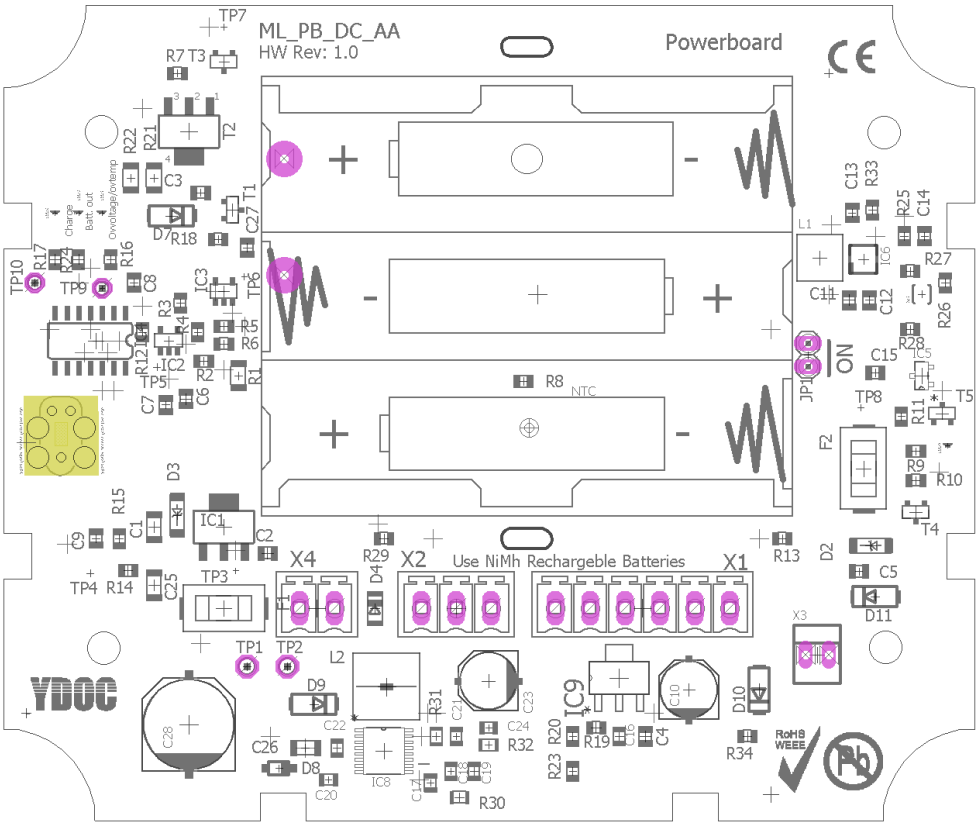
Indication LEDs	
LED	**Color**
Battery Out	Orange
Overvoltage/ Overtermperature	Red/flash
Charge	Green/Flash

2.2.4 Overview of the ML-PB-DC-NIMH Power Board

1) Charge indicator LED
2) Battery out detection LED
3) Overvoltage /Overtemperature indicator LED
4) Battery holder, Use good Quality NiMH batteries only
5) Battery protection fuse
6) Output connector to Data Logger
7) Input Power connector (8 - 30 Volts DC)
8) main fuse

2.2.5 Connector Pin Configuration

Connector	Pin	Function	Description	Value	Comments
X3	1	Power Supply +	Power output for powering MLxxxx series Data Logger	3.6 V	Molex connector
X3	2	Power Supply -		0V	
X1	1	Power Input +	Auxilary power input	8 - 30 V	
X1	2	Power Input -		0V	



Spareparts:

- Input fuse (F1): 2A Fast Acting Littlefuse 0453002.
- Battery fuse (F2) 4A Slow Blow Littlefuse 0454004.

2.2.6 Specifications ML-PB-DC-NIMH

Power Supply	
Protection	Internal fuse
Input Power	Solar Panel
Type of Power	Solar Panel 36 Cells (Voc 21 Volts, Vnom 12 Volts)
Power	Output: 3,6 Volt, 1 Amp, 3,6 Watt
Auxilary Output	
Protection	Yes, by fuse
Output Voltage	12 Volts unregulated (battery voltage)
Output Current	4 A max.
Charger Circuit	
Discharge protection	Yes, @ 10.8 Volts
Charging Current	1 A max
Battery Full Level	14.4 V
Battery Full Hysteresis	1.8 V (back on @ 12.6 V)
Battery Low Level	10.8 V
Battery Low Hysteresis	1.2 V (back on 12.0 V)
General Enviroment	
Temperature	Operating: -30 ~ + 85 °C; 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	1 mA (3.6 Volts power supply active)
Quiesent Current	500 uA (SLA Battery low) (3.6 volts power supply not active)
3.6 V output	
Output current	2A rms
Connector	Molex 22-27-2021
Galvanic Isolation	No
Ripple & Noise	5% pk-pk, 20 MHz bandwidth
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 20 mm
Weight	
Netto Weight	110 Grams

2.3 ML-PB-LFP

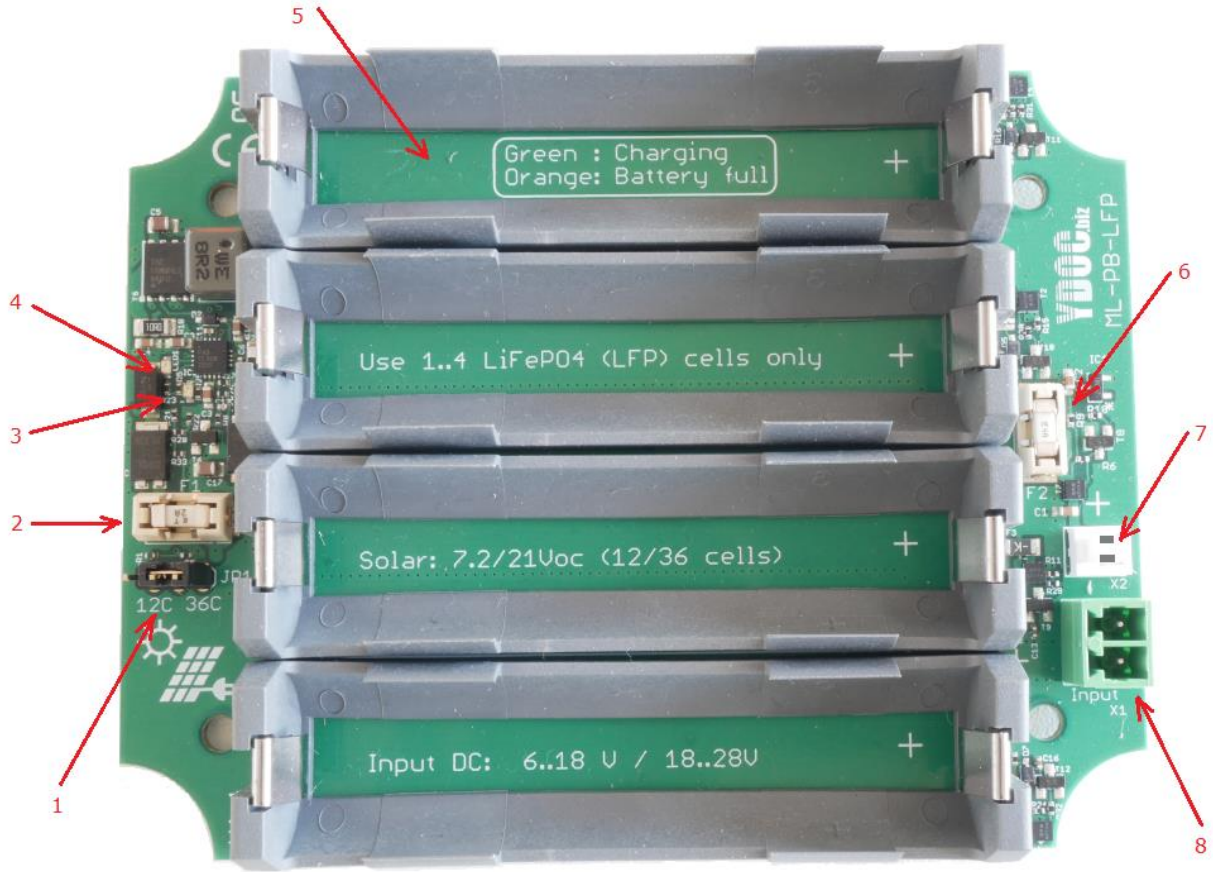
The YDOC ML-PB-LFP Charger-Power Board is an accessory for the type ML-xxx low power Data Logger. It is designed to power the ML-xxx Data Logger from an auxiliary Solar or DC power source. It can be used with a external DC Power source, the batteries are used as backup when DC power fails. It must be used in combination with 1 to 4 18650 LiFePO4 cells.

Features:

- Designed for operation with solar system 12 or 36 Cells (12 Volts nom.) or a 6 - 28 V DC power supply
- Power output 3.2 V nominal (cell voltage)
- Supports 1 - 4 LiFePO4 18650 batteries
- RoHs Compliant
- CE Compliant

2.3.1 Overview of the ML-PB-LFP Power Board

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



1) Solar Panel Type (12 /36 cells) or DC Input Voltage Selector (6 - 18V /18 - 28V)
2) Main fuse (2A fast acting)
3) Battery full indicator LED (Orange)
4) Charge indicator LED (Green)
5) Battery holder, up to 4 18650 cells

6) Battery Fuse (4 A fast acting)
7) 3.2 Volts nom. output connector for Data Logger (Unregulated, directly from cells)
8) Input connector (From Solar Panel)

2.3.2 General

The ML-PB-LFP Battery Charger is a, charger for 3.2 Volts, 18650 type, LFP Batteries (or LiFePO4). Batteries are charged by 12 /36 Solar Panel or can be used as a backup for a 6 - 28V external DC power supply. It is a single PCB, to be mounted in a ML-xxxx-type Casing.

2.3.3 Charger

The charger is optimized for solar power (36 cells, Vnom 12V Voc 21V). It automatically searches for the maximum power point of the solar panel, for high efficiency. The charge current is limited to 3.3 Amp.

2.3.4 Protection

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

Battery undervoltage protection (SLA)

It has a Battery low detection which is triggered when the battery voltage gets below 2.5 Volts. When this happens, the batteries will be disconnected from the output (from the Data Logger), so, the batteries 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 batteries are 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.

Over temperature 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 firs, 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.

Overvoltage protection

The input is protected against too high voltage When the input voltage is above 34 Volts, the (main) fuse will blow. The battery is protected against overvoltage (overcharge) by the management chip.

Wrong polarity protection

The input is protected against wrong polarity. The main input fuse will blow if a source with enough power is connected wrongly. (a solar panel must drive more than 2 A to blow the fuse)
The batteries are protected for wrong polarity by means of an electronic circuit. If one or more cells are installed wrongly, it just doesn't work, but will not cause damage.

Operation

The ML-PB-LFP is used to charge 18650 type LiFePO4 batteries. You can build a system with just this Power board , a solar panel and a 18650-LFP battery. The Power board is optimized for solar power and has also a power output for the Data Logger.
The ML-PB-LFP power board manages the energy system stand alone. Two types of solar panels or DC power supplies are supported: 12 or 36 cells (7.2 - 21 Voc) or DC input 6 - 18 or 18 - 28V.
Selection is made by JP1.

2.3.5 Charge indicator

When the green LED is lit, 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.

2.3.6 Battery Full indicator

When the orange LED is lit, 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.

2.3.7 Maximum Power Point (MPP)

The device searches for the maximum power point of the solar panel. This point depends on the connected solar panel (The mpp is related to the Voc of the panel, and that is a fixed property of 18 Volts) When the charger needs more current than the solar panel can provide, it limits the current at this point. Of course, when a very big solar panel is connected, the maximum power point can't be reached because of the overcurrent limit of 3.3 A. So, the maximum power point tracking only works when the solar panel is properly dimensioned to the charger. (i.e., a 12 V 15 Watt Panel). With the 36 cell panel, the MPP won't be reached, this works by designed.

Because of the MPP tracking, which is fixed to 18 Volts, connecting a DC power source will only charge the batteries, when the voltage of this source is set to >= 18 volts. This is because the electronics will reduce charging current when the input voltage is lower than the MPP setpoint. So, when the ML-PB-LFP is powered with a voltage of less than 18 volts, it will not charge. When using a solar panel, of course, the drop in charge current will cause the input voltage to rise (above 18 Volts), so it will charge correctly.

Connector Pin Configuration

Connector	Pin	Function	Description	Value	Comments
X1	1	Solar +		12 V nom	Solar Panel
X1	2	Solar - (GND)		0V	Solar Panel
X2	1	Data Logger Power +		3.6V	Data Logger
X2	2	Data Logger Power -		0V	Data Logger

JP1: Voltage range or Solar panel type selector.

2.3.8 Specifications ML-PB-LFP

Power Supply	
Protection	Internal fuse for Battery and main input
Input Power	Solar Panel or external DC power supply
Type of Power	Solar Panel 12 or 36 Cells (Voc 21 Volts, Vnom 12 Volts)
Charger Circuit	
Discharge protection	yes, @ 2.5 Volts
Charging Current	1.6 A max.
Battery Full Level	4.2 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	50 uA (3.6 Volts power supply active)
3.6 V output	
Output current	4 Amp Rms
Connector	Molex 22-27-2021
Galvanic Isolation	No
Overload Protection	Yes, by means of fuse
CE Complient	Yes
Rohs Complient	Yes
Dimensions	
W X D x H	106 mm X 82 mm X 15 mm
Weight	
Netto Weight	110 Grams

Spareparts:

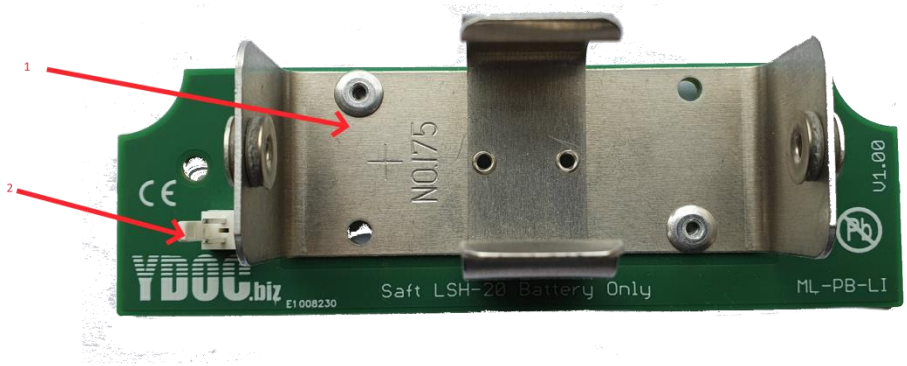
- Input fuse (F1): 2A Fast Acting Littlefuse 0453002.
- Battery fuse (F2): 4A Slow Blow Littlefuse 0454004.

3 Battery Powered Series

3.1 ML-PB-LI

The ML-PB-LI Power Board is a board to facilitate the housing of 1 single D-cell Li battery (Saft LSH-20)

3.1.1 Overview of the ML-PB-LI Power Board



1) Battery holder
2) Output 3.6 Volt Power connector (to Data Logger)

3.1.2 Specifications ML-PB-LI

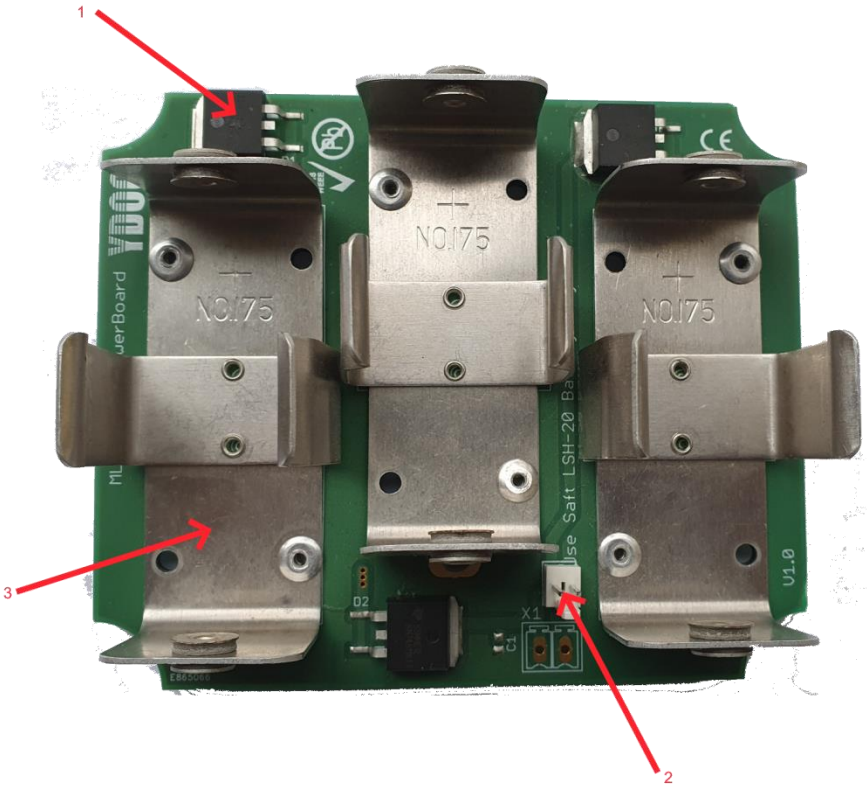
Power Supply	
Protection	None /Fuse inside battery
Input Power	none
General Enviroment	
Temperature	Operating: -30 ~ + 85 °C; Storage -40 ~ +85 °C
Humidity	5 ~ 100 % RH
Electrical	
Galvanic Isolation	No
Overload Protection	Yes, by means of fuse in battery
CE Compliant	Yes
Rohs Compliant	Yes
Dimensions	
W X D x H	106 mm X 33 mm X 40 mm
Weight	
Netto Weight	110 Grams

3.2 ML-PB-3LI

The ML-PB-3LI Power Board is a board to facilitate the housing of 3 D-cell Li batteries (Saft LSH-20) Combined the board holds 39 Ah @ 3.6 Volts.

3.3 Overview of the ML-PB-3LI power Board

The board has triple good quality battery holders to hold the LSH-20 cells. The circuit is very straightforward: In series with each battery is a super low loss diode, which prevents the cells against revers current (which could be an issue when cells of different state of depletion are installed, or even minor differences in production) There is NO fuse on the board, because the battery itself is equipped with an internal fuse.



1) Super - Low Loss Diode (Smart diode)
2) Output 3.6 Volt Power connector (to Data Logger)
3) Battery holder

3.3.1 Specifications ML-PB-3LI

Power Supply	
Protection	None /Fuse inside battery
Input Power	none
General Enviroment	
Temperature	Operating: -30 ~ + 85 °C; Storage -40 ~ +85 °C
Humidity	5 ~ 100 % RH
Electrical	
Galvanic Isolation	No
Overload Protection	Yes, by means of fuse in battery
CE Complient	Yes
Rohs Complient	Yes
Dimensions	
W X D x H	106 mm X 82 mm X 40mm
Weight	
Netto Weight	110 Grams

4 Solar Powered Series

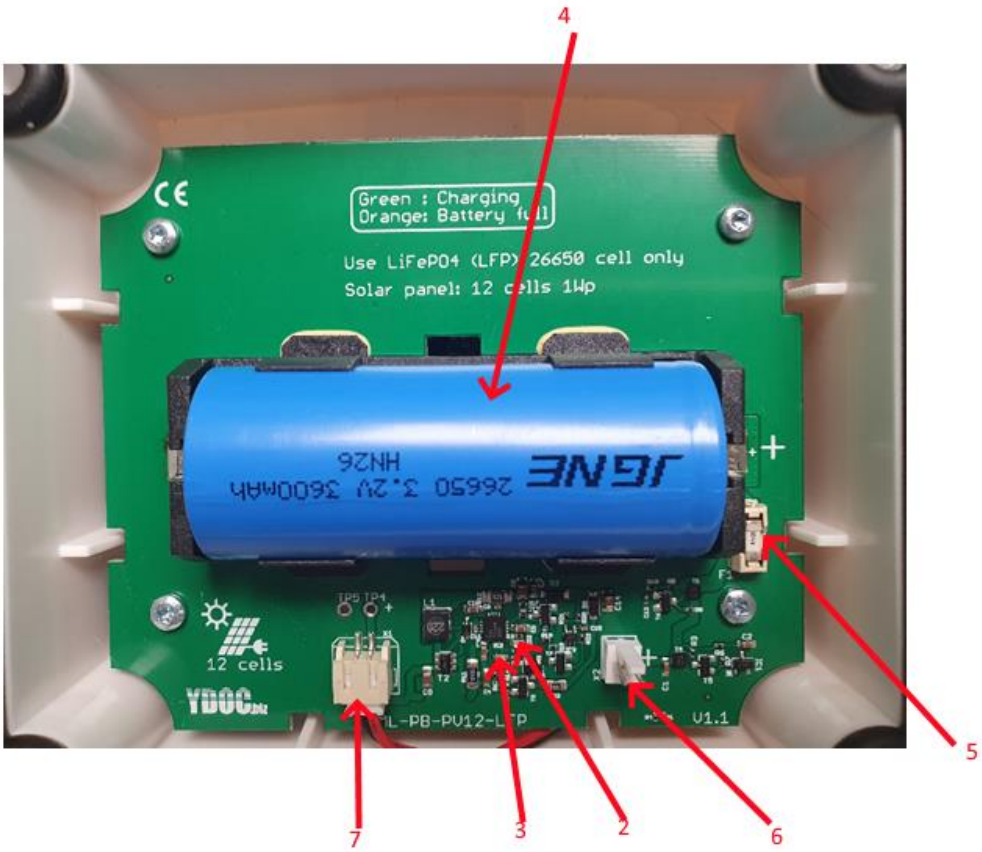
4.1 ML-PB-PV12-LFP

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 26650 LiFePO4 battery charged from a 12 cells 1Wp 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 LiFePO4). 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 LiFePO4 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.

4.2 ML-PB-PV-AA (End of Life)

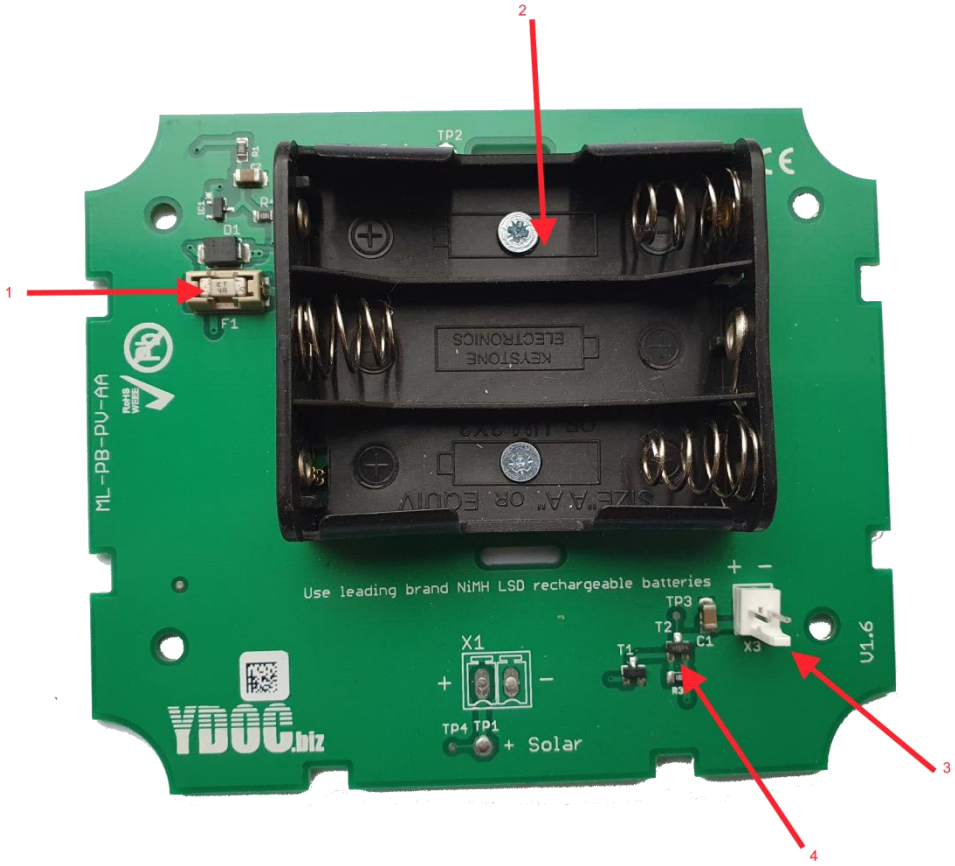
The ML-PB-PV-AA Power Board is a power board for solar charging of 3 NiMH -AA cells. It has to be mounted in an YDOC cover with 10 cell integrated solar panel.

It provides overload protection-by dimensioning and battery discharge protection.

4.2.1 Solar Charging of NiMH batteries (AA -type)

The design is very straightforward: a 1 Wp solar panel, that is mounted in the special cover, is directly charging the batteries. The output is switched off when the batteries are depleted (@2.9 Volts). A diode prevents the batteries to drawn via the solar panel at night.
A 4 Amp fuse protects the batteries/device in case of a short-circuit.

4.2.2 Overview of the ML-PB-PV-AA Power Board



1) 4 Amp Battery fuse
2) Battery holder for 3 AA type NIMH LSD cells (low self-discharge)
3) Output connector (to Data Logger)
4) Undervoltage protection

Spare parts:

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

4.2.3 Specifications ML-PB-PV-AA

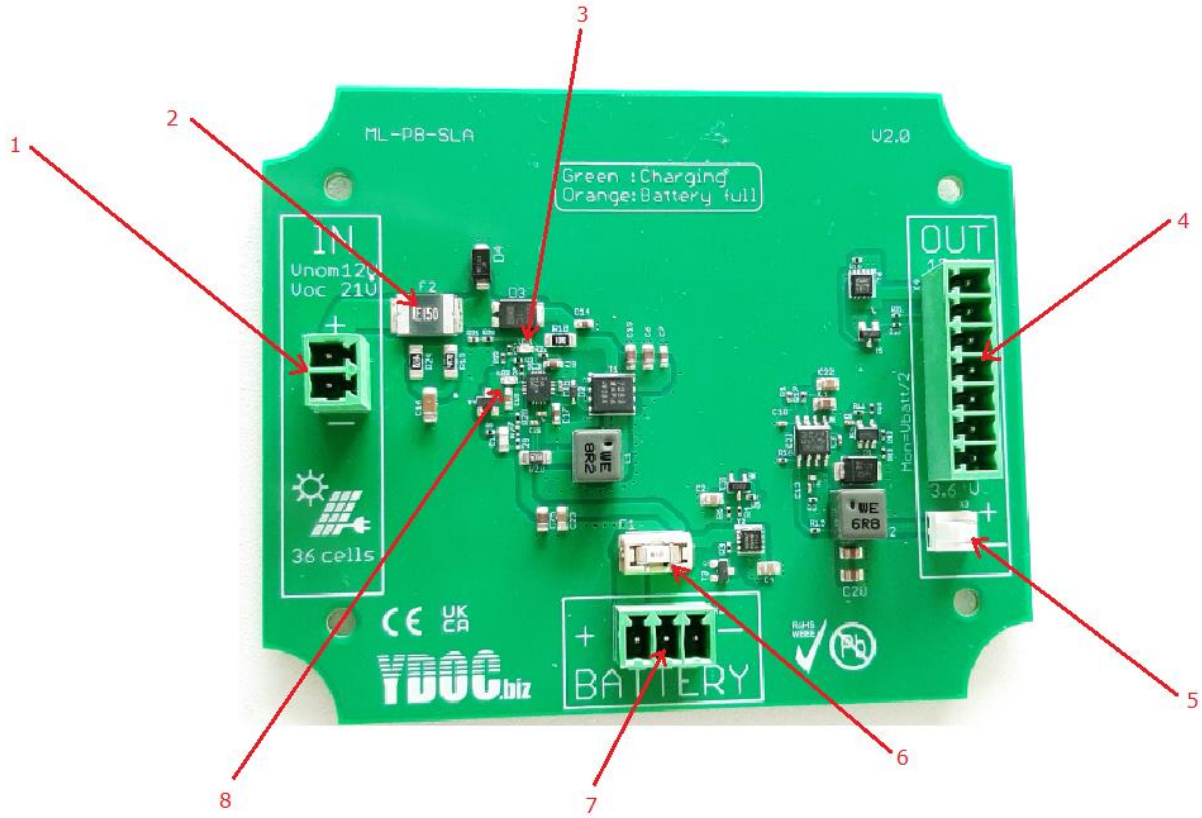
Power Supply	
Protection	Fuse
Input Power	Solar Panel
Type of Power	YDOC Solar Panel (10 cells 1 Watt)
Charger Circuit	
Discharge protection	Yes, @ 2.9 Volts
Charging Current	200 mA max
Battery Empty Level	2.9 V
Battery Empty Hysteresis	0.45 V (back on @ 3.35 V)
General Enviroment	
Temperature	Operating: -30 ~ + 85 °C; Storage -40 ~ +85 °C
Humidity	5 ~ 100 % RH
Electrical	
Type of charger	Solar
Switch Frequency	DC
Quiesent Current	Not applicable
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 20 mm
Weight	
Netto Weight	110 Grams

4.3 ML-PB-SLA V2.0

The YDOC ML-PB-SLA V2.0 SLA Charger-Power Board is an accessory for the type ML-xx low power Data Logger. It is designed to power the ML-xx Data Logger from an auxiliary solar power source. It must be used together with a 12 V Sealed Lead Acid Battery (SLA) or en LiFePO4 battery and a solar panel or DC power supply Features:

- Solar system 36 Cells (12 Volts nom.)
- Power output 12V /0 - 4A max.
- Switchable output 12V /0 - 4A max.
- 12 V Power output and switched output can deliver 4A max. (together)
- Power output 3.6 Volt (Regulated power for Data Logger main board)
- SLA Charger
- RoHs Compliant
- CE Compliant

4.3.1 Overview of the ML-PB-SLA V2.0 Board



1) Solar power in. Use 36 cells solar panel
2) Automatic main fuse (Non replaceable)
3) Charge indicator LED (Green)
4) 12V Output connector:
   Battery monitor output pin
   +12V (unregulated) from battery
   Gnd
   Switch input pin (0 - 12V)
   Switched 12V output, unregulated from battery

5) 3.6 Volt power connector for Data Logger (Regulated)
6) Battery Fuse (4 A fast acting)
7) Battery connector
8) Battery full indicator LED (Orange)

Spareparts:

- Battery fuse (F1): 4A Slow Blow or fast acting Littlefuse 0454004.

4.3.2 General

The ML-PB-SLA Sealed Lead Acid Battery Charger is a, high efficiency, low noise, power supply and charger for 12 Volts type SLA Batteries (or LiFePO4). It consists of a single PCB, to be mounted in a ML-xxxx-type Casing

4.3.3 Charger

The charger is optimized for solar power (36 cells, Vnom 12V /Voc 21V). It automatically searches for the maximum power point of the solar panel, for high efficiency. The charge current is limited to 1.6 Amp, for small battery-support.

4.3.4 Protection

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

Battery undervoltage protection (SLA)

It has a Battery low detection which is triggered when the battery voltage gets below 10.8 Volts. When this happens, the batteries will be disconnected from the output (from the Data Logger), so, the batteries 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 batteries are re-connected to the power output when the battery-voltage gets above the threshold + hysteresis. So, the Data Logger will work again. Because of the chemistry of a battery, the hysteresis is relatively high. The battery is switched off @ 10.8V and switched back on @ 12.0V.

Due to this hysteresis, the system will not start, when connecting a battery with a voltage <12 V. Normally, a unloaded charged battery will have a voltage of > 12 V. An unloaded battery with a voltage < 12 V is pretty empty. After the solar panel has charged the battery above 12V it will work.

Overtemperature protection

The system is protected against Too high temperature (>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 Because the batteries are charged externally, the battery temperature is NOT measured

Overvoltage protection

The input is protected against too high voltage When the input voltage is above 34 Volts, the (main) fuse will blow. The battery is protected against overvoltage (overcharge) by the management chip.

Wrong polarity protection

The input is protected against wrong polarity. Nothing will happen if the polarity is wrong, but the system won't work.
The battery in/output is protected by means of a fuse. If connected wrong, the fuse will blow. Although the electronics are not damaged by this, it is NOT favorable to do.

4.3.5 Operation

The ML-PB-SLA is used to charge SLA & LiFePO4 batteries. You can build a system with just this Power board , a solar panel and a battery. The Power board also has a power output for the Data Logger. This way, the user won't have to buy a separate solar charger, and 3.6 volts power supply.The ML-PB-SLA is optimized for solar power. It is not practical to use it as a power adapter for 12 ->3.6 Volt conversion. Use other products, like ML-PC-DC instead. The ML-PB-SLA 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. 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.

4.3.6 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 "flippering" the system has a hysteresis. The battery will be charged again when the battery voltage drops below this hysteresis.

4.3.1 Battery Monitor output

This output enables the monitoring of the battery voltage. It outputs half of the real battery voltage. This is convenient, because it enables the user to connect it to a standard analog (voltage) 0 - 10V input. By multiplying the measurement by 2, it shows the real battery value. This output is buffered by an OpAmp, so the user doesn't have to worry about input impedance.

4.3.2 Maximum Power Point (MPP)

The device searches for the maximum power point of the solar panel. This fixed point lies at 18 Volts. (The MMP 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.
Of course, when a very big solar panel is connected, the maximum power point can't be reached because of the overcurrent limit of 1 A. So, the maximum power point tracking only works when the solar panel is properly dimensioned to the charger. (i.e., a 12 Volt 15-Watt Panel). A bigger panel is supported also, only the MPP won't be reached. (The user will not notice, because it will operate perfectly)

4.3.3 Connector Pin Configuration

Connector	Pin	Function	Description	Value	Comments
X1	1	+ Solar		12 V nom	Solar Panel
X1	2	- Solar (GND)		0V	Solar Panel
X2	3	+ Battery		12V nom	Battery
X2	4	Not connected			
X2	5	- Battery (GND)		0V	Battery
X3	1	Data Logger Power +		3.6V	Data Logger
X3	2	Data Logger Power -		0V	Data Logger
X4	1	Monitor output	Monitors battery voltage	Vbat/2	To analog input
X4	2	+12 V		12V nom	Aux equipment (continue)
X4	3	+12 V		12V nom	Aux equipment (continue)
X4	4	GND		0 V	Aux equipment
X4	5	GND		0 V	Aux equipment
X4	6	Switch input pin	Input to activate switch	12V	Input pin
X4	7	+12V switched output		12V nom	Aux equipment (switched)

4.3.4 Specifications ML-PB-SLA V2.0

Power Supply	
Protection	Internal fuse
Input Power	Solar Panel
Type of Power	Solar Panel 36 Cells (Voc 21 Volts, Vnom 12 Volts)
Auxilary Output	
Protection	Yes, by fuse
Output Voltage	12 Volts unregulated (Battery voltage)
Output Current	4 A max. (Continue and Switched together)
Charger Circuit	
Discharge protection	Yes, @ 10.8 Volt
Charging Current	1 Amp max.
Battery Full Level	14.4 Volt
Battery Full Hysteresis	1.8 V (Back on @ 12.6 V)
Battery Low Level	10.8 Volt
Battery Low hysteresis	1.2 V (Back on 12.0 V)
General Environment	
Temperature	Operating: -30 ~ + 85 °C; Storage -40 ~ +85 °C
Humidity	5 ~ 100 % RH
Electrical	
Type of charger	Solar optimized charger with MPP tracking
Switch Frequency	1 Mhz topicaal
Quiesent Current	1 mA (3.6 Volts power supply active)
Quiesent Current	500 uA (SLA Battery low) (3.6 volts power supply not active)
3.6 V output	
Output current	2A Rms
Connector	Molex 22-27-2021
Galvanic Isolation	No
Ripple & Noise	5% pk-pk, 20 MHz bandwidth
Overload Protection	Yes, by means of fuse
CE Complient	Yes
Rohs Complient	Yes
Dimensions	
W X D x H	106 mm X 82 mm X 15 mm
Weight	
Netto Weight	110 Grams

5 DC Powered Board

5.1 ML-PB-DC

The ML-PB-DC power board is a high efficiency, low noise, power supply. It consists of a single PCB, to be mounted in YDOC ML-type Data Logger (it comes with a cover

Properties:

1) 8 - 28 Volts DC auxiliary input power option
2) power output for Data Logger

5.1.1 8 - 28 Volts DC auxiliary input power

The power supply is converting the input source to a, stable and clean, output voltage.
A green LED indicates the presence of the input power.

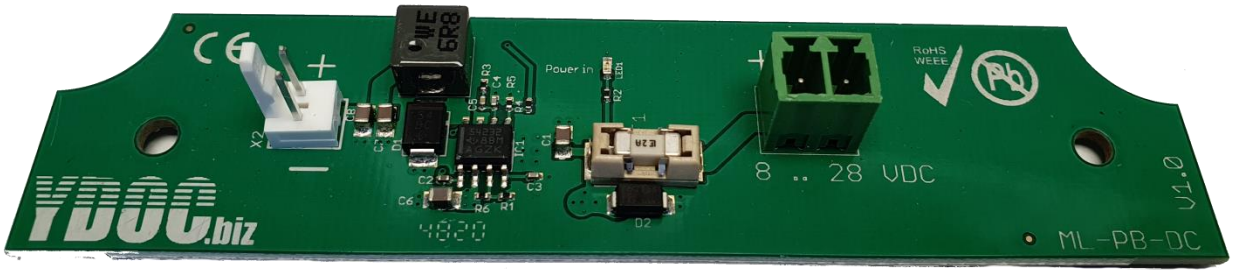
Protection

The power board input circuit is equipped with a tranzorp of 30 Volts, and a fuse of 4A. This protects the connected Data Logger from high input voltages.

Beware of exposing power board to high voltages, as it will damage the fuse. Also, when the polarity of the input-source is wrong, the fuse will blow. But, your connected Data Logger is protected in both cases.

Normally the fuse will never blow, during the lifetime of the instrument.

5.1.2 Overview of the ML-PB-DC power Board



Spare parts:

- Input fuse (F1): 2A Fast Acting Littlefuse 0453002.

5.1.3 Specifications ML-PB-DC

Power Supply	
Protection	Fuse 2A
Input Power	8 - 28 V (DC)
Power out	4V, 1 Amp (Rms), 3A (Peak)
General Enviroment	
Temperature	Operating: -30 ~ + 85 °C; Storage -40 ~ +85 °C
Humidity	5 ~ 100 % RH
Electrical	
Switch Frequency	1 Mhz typical
Quiesent Current	<1 mA @12V (3.6 Volts power supply active)
3.6 V output	
Output current	2 Amp Rms
Connector	Molex 22-27-2021
Galvanic Isolation	No
Ripple & Noise	2% pk-pk, 20 MHz bandwidth
Overload Protection	Yes, by means of fuse
CE Complient	Yes
Rohs Complient	Yes
Dimensions	
W X D x H	106 mm X 82 mm X 40 mm
Weight	
Netto Weight	50 Grams

6 LiFePO4 Battery Empty Voltage

According to manufacturer discharge curves the state of charge at 3.1 V of a LiFePo4 cell is about 15%, but this is always with a high load. With low loads like with our data loggers, a battery can maintain a higher voltage much longer, which means that the capacity left at 3.1 V is way lower and about 5%. However, with 5% of 3600 mAh is still 180 mAh left and enough to keep data logging going on for weeks. (3.1V is the level at which we will seize Swarm communication.) Please find below a realistic discharge curve base on a typical Data Logger load.