Your Data Our Care

Type ML-PB-XX
(Power Board Series)

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Author : Remco Kleine

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.

User Manual ML-PB-XX (Power Board)

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.

1 ML-PB-DC-AA

1.1 General

The ML-PB-DC-AA 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-xx-type datalogger

1.1.1 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 .. 36 Volts solar panels or DC sources.

1.1.2 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 undervolts 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 datalogger), so, the batteries won't be damaged due to total discharge. There is a hysteresis which prevents the system from "flipping" on and off all the time.
The batteries are re-connected to the power output when the battery-voltage gets above the threshold + hysteresis. So, the datalogger will work again.

Overtemp 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 datalogger. 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.

1.1.3 LED indicators

Overtemp (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 43 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	**Colour**
Battery Out	Orange
Overvoltage/ Overtemp	Red/flash
Charge	Green/Flash

1.1.4 Overview Power Board

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

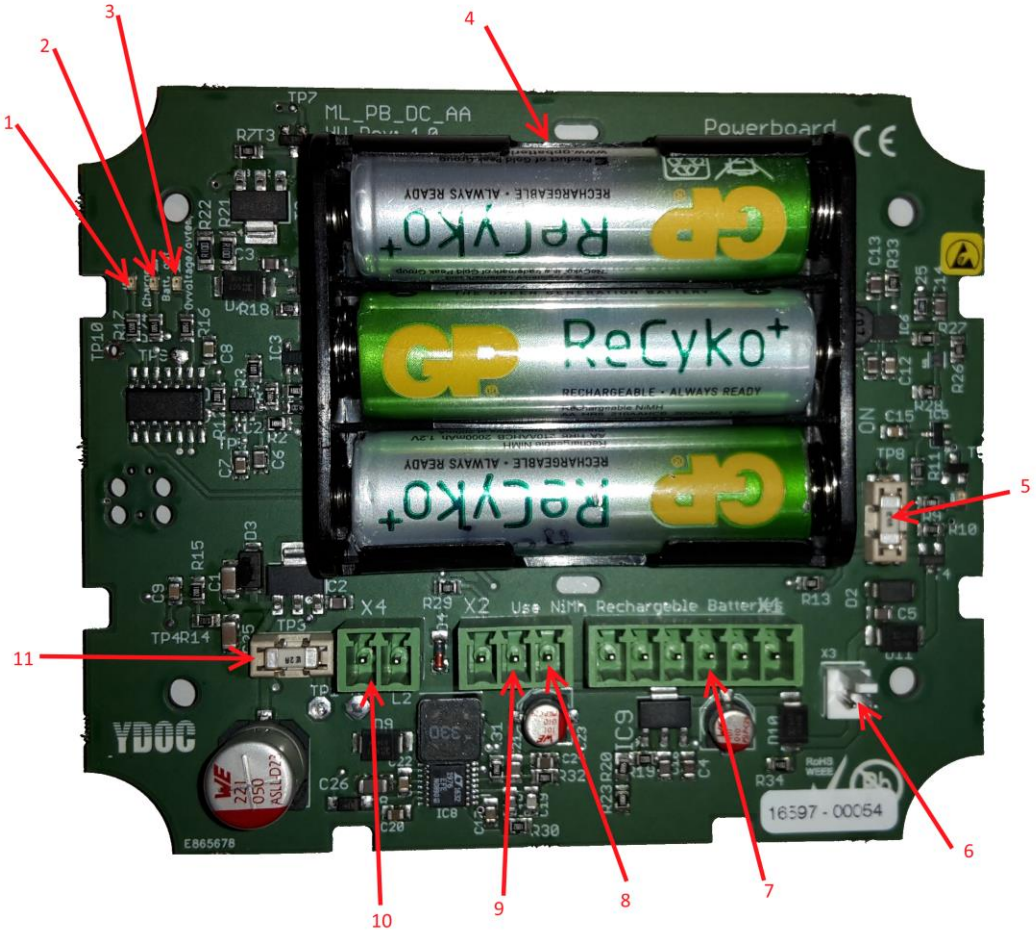


Figure 1: Board Overview

1) Charge indicator LED
2) Battery out detection LED
3) Overvoltage / Overtemp indicator LED
4) Battery holder, Use good Quality NiMH batteries only
5) Battery protection fuse
6) Output connector to datalogger
7) Power Booster Connector
8) Aux power available status pin
9) Power Booster trigger pin
10) Input Power connector (8 .. 36 Volts DC)
11) main fuse

Spare parts:

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

1.1.5 Power Booster

This is used to “boost” the power switch signal from the datalogger. It is used for powering very high power demanding sensors. It also provides in two , user selectable, output voltages. The system can boost the normal 12 Volts /100mA power switch signal from the datalogger into a high power 12 Volts/200 mA or 24 Volts / 90 mA. The user can select his output voltage by using a solder jumper. Default your Power board is factory set to 12 volts. The booster is triggered by its sensor power input, an input voltage of 3..12 volts. Connect the sensor power signal from your datalogger to this input.
If continuous operation of the booster is required, you may use jumper JP1. This option is , of course, NOT low power.

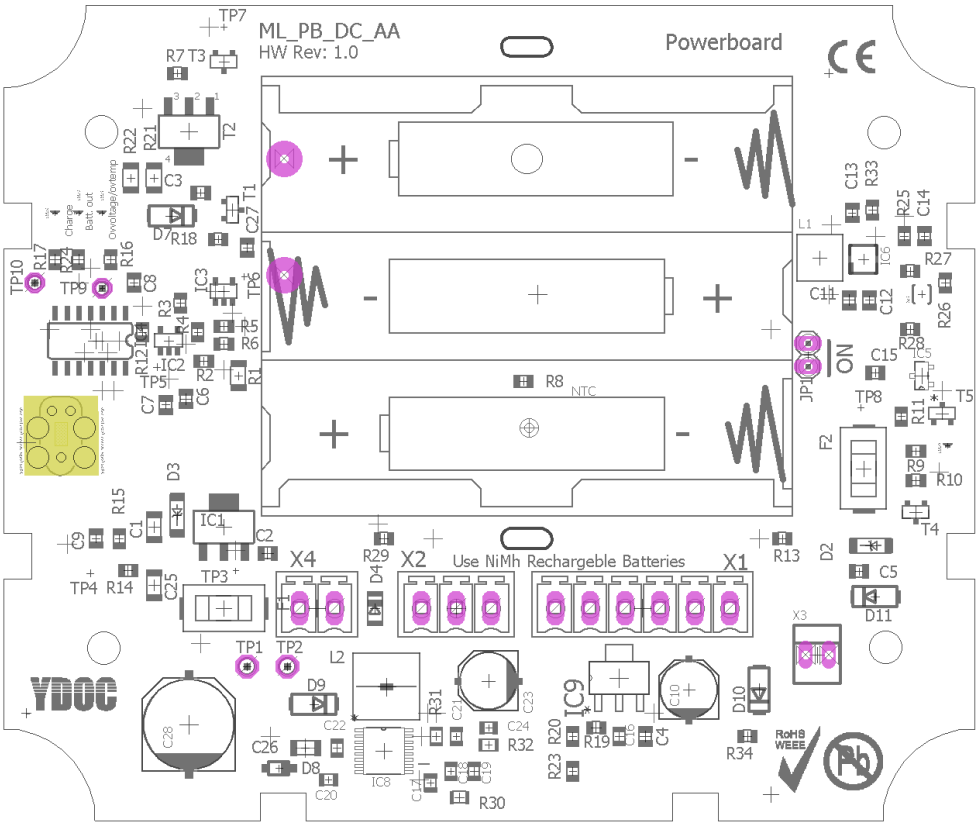
Output Voltage Configuration	
SJ1	**Voltage**
Open	12 V
Closed	24 V

1) Solder jumper SJ1

2) Jumper JP1 for continuous power boost operation

Connector Pin Configuration

Connector	Pin	Function	Description	Value	Comments
X1	1	GND	Sensor Power signal to power 12 Volts or 24 Volts sensors, multiple terminals for connecting multiple wires	0V	
X1	2	GND		0V	
X1	3	GND		0V	
X1	4	Power_Out		12V / 24V	
X1	5	Power_Out		12V / 24V	
X1	6	Power_Out		12V / 24V	
X2	1	Sensor Power Input	Sensor Power input , must be connected to Sensor Power output of datalogger	12 V Switched	
X2	2	GND		0V	
X2	3	Aux power Present		5.0 V / 500 mA	
X3	1	Power Supply +	Power output for powering ML-xx series datalogger	3.6 V	Molex connector
X3	2	Power Supply -		0V	
X4	1	Power Input +	Auxiliary power input	8 .. 30 V	
X4	2	Power Input -		0V	



Specifications ML-PB-DC-AA

Power Supply			
Protection	Internal fuse 4A		
Input Range	8 ~ 30 Vdc| Solar |optional use of 3 NimH batteries		
Type of Power	External DC | NiMH battery/Solar Panel		
Power	Output Voltage	Output Current	Output power
	3.6 V	1000 mA	3.6 W
Power Switch Output			
Protection			
Output Voltage	12 Volts / 24 Volts selectable by solderjumper		
Output Current	200 mA / 90 mA		
Charger Circuit			
Discharge protection	yes, @ 2.9 Volts		
Bypass Diode	yes		
General Enviroment			
Temperature	Operating: -30 ~ + 65 °C; Storage -40 ~ +75 °C		
Humidity	5 ~ 100 % RH		
Electrical			
SMPS	yes		
Switch Frequency	200 kHz		
Quiescent Current	100 uA		
Peak Current	1.8 A		
Max. Input Voltage	30 V		
Min. Input Voltage	5 V		
Connector	Molex 22-27-2021		
Galvanic Isolation	No		
Ripple & Noise	1% pk-pk, 20 MHz bandwidth		
Overload Protection	Yes, by means of fuse		
CE Compliant	Yes		
Rohs Compliant	Yes		

Dimensions	
W X D x H	107 mm X 109 mm X 40 mm
Weight	
Netto Weight	110 Grams

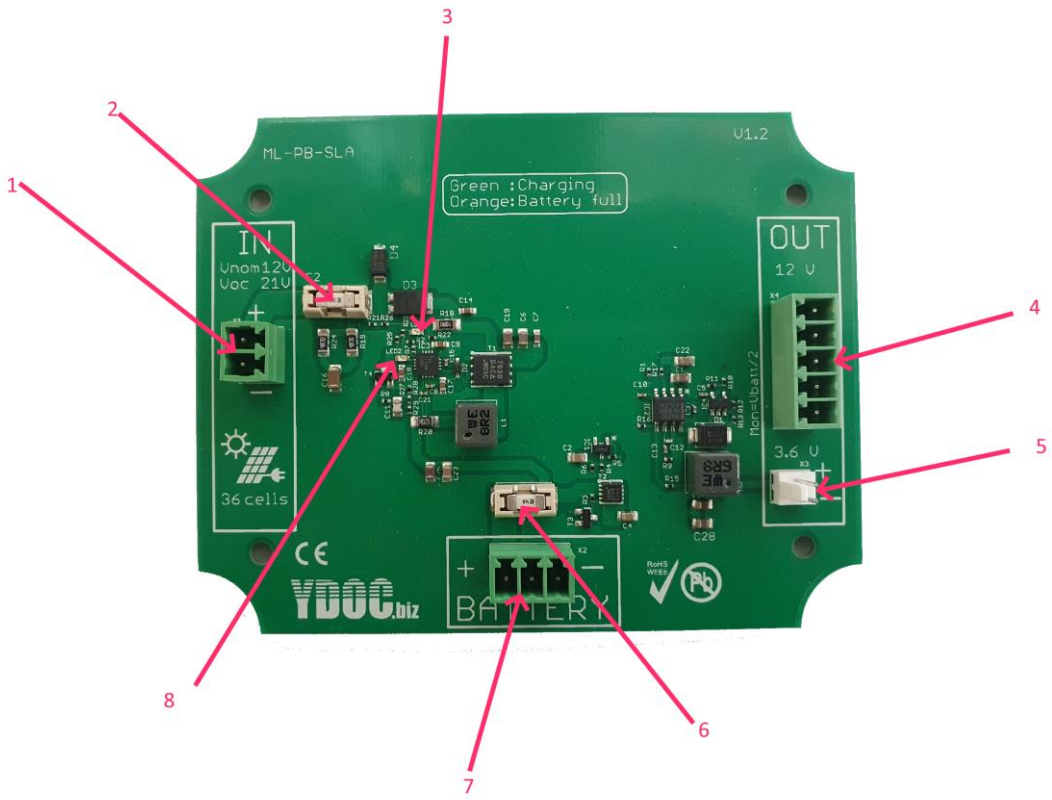
2 ML-PB-SLA

The YDOC ML-PB-SLA SLA Charger/Power board is an accessory for the type ML-xx low power datalogger. It is designed to power the ML-xx datalogger from an auxiliary solar power source. It must be used together with a 12 V Sealed Lead Acid Battery (SLA) or an LiFe-PO4 battery and a solar panel or DC power supply Features:

- Solar system 36 Cells (12 Volts nom.)
- Power output 12 V
- Power output 3.6 V (for datalogger
- SLA Charger
- RoHs Compliant
- CE Compliant

2.1.1 Overview Power Board

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



1) Solar power in. Use 36 cells solar panel
2) main fuse (2A fast acting)
3) Charge indicator LED (Green)
4) 12 V Output connector (unregulated battery voltage)+ Battery monitor output pin
5) 3.6 Volts output connector for datalogger (Regulated)
6) Battery Fuse (4 A fast acting)
7) Battery connector
8) Battery full indicator LED (Orange)

Spare parts:

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

2.2 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 LiFe-PO4). It consists of a single PCB, to be mounted in a ML-xx-type Casing

2.2.1 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.

2.2.2 Protection

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

Battery undervolts 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 datalogger), 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 datalogger will work again. Because of the chemistry of a battery, the hysteresis is relatively high. The battery is switched off @ 10.8 V and switched back on @ 12.0 V.

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.

Overtemp 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 ground plane of the PCB Because the batteries are charged externally, the battery temp 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 favourable for do.

2.3 operation

The ML-PB-SLA is used to charge SLA & LiFe-PO4 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 datalogger. 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 Volts 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.

2.3.1 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" on/off the system has a hysteresis. The battery will be charged again when the battery voltage drops below this hysteresis.

2.3.1 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.

2.4 Maximum Power Point (MPP)

The device searches for the maximum power point of the solar panel. This fixed point lies at 18 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.
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 V 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)

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	Datalogger Power +		3.6V	Datalogger
X3	2	Datalogger Power -		0V	Datalogger
X4	1	Monitor output	Monitors battery voltage	Vbat/2	To analog input
X4	2	+12 V		12V nom	Datalogger
X4	3	+12 V		12V nom	Datalogger
X4	4	GND		0 V	
X4	5	GND	Power output for powering Auxilary equipment	0 V	Aux equipment

Specifications ML-PB-SLA

Power Supply	
Protection	Internal fuse
Input Power	Solar Panel
Type of Power	Solar Panel 36 Cells (Voc 21 Volts, Vnom 12 Volts)
Power	
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
Quiescent Current	1 mA (3.6 Volts power supply active)
Quiescent 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 15 mm
Weight	
Netto Weight	110 Grams

3 ML-PB-DC-NIMH

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-xx-type datalogger

3.1.1 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.

3.1.2 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 undervolts 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 datalogger), so, the batteries won't be damaged due to total discharge. There is a hysteresis which prevents the system from "flipping" on/off all the time. The batteries are re-connected to the power output when the battery-voltage gets above the threshold + hysteresis. So, the datalogger will work again.

Overtemp 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 datalogger. 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.

3.1.3 LED indicators

Overtemp (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	**Colour**
Battery Out	Orange
Overvoltage/ Overtemp	Red/flash
Charge	Green/Flash

3.1.4 Overview Power Board

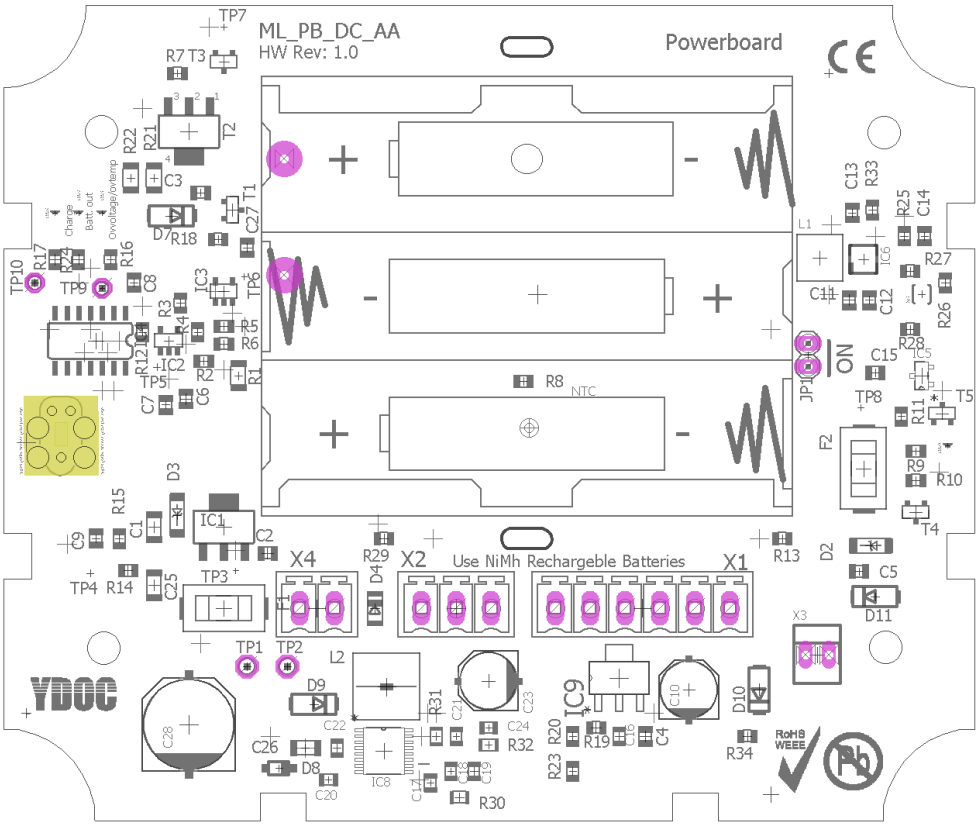
Underneath, a picture is shown of a ML-PB-DC-NIMH Power Board.

Figure 2: Board Overview

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

Connector Pin Configuration

Connector	Pin	Function	Description	Value	Comments
X3	1	Power Supply +	Power output for powering ML-xx series datalogger	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	



Spare parts:

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

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	
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
Quiescent Current	1 mA (3.6 Volts power supply active)
Quiescent 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

4 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 datalogger (it comes with a cover

Properties:

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

4.1.1 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- datalogger 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

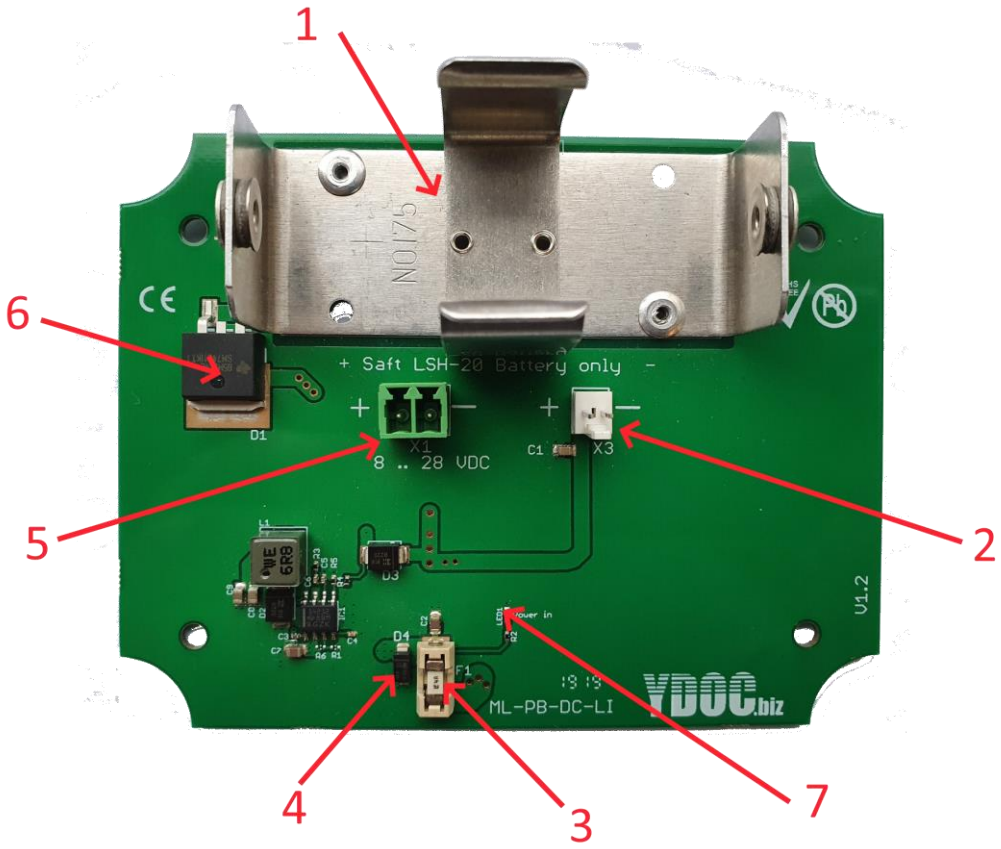
The power board input circuit is equipped with a transorp of 30 Volts, and a fuse of 4A. This protects the connected datalogger from high input voltages.

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 datalogger is protected in both cases.

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

4.1.2 Overview Power PCB option Lithium Auxiliary Power

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 datalogger
3) Main fuse
4) Transorp 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 Little fuse 0453002.

Specifications ML-PB-DC-LI

Power Supply	
Protection	Fuse 4A
Input Power	8 .. 28 VDC
Power out	1 A (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	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 40 mm
Weight	
Netto Weight	110 Grams

5 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 datalogger (it comes with a cover

Properties:

1) 8 ..28 Volts DC auxiliary input power option
2) power output for datalogger

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

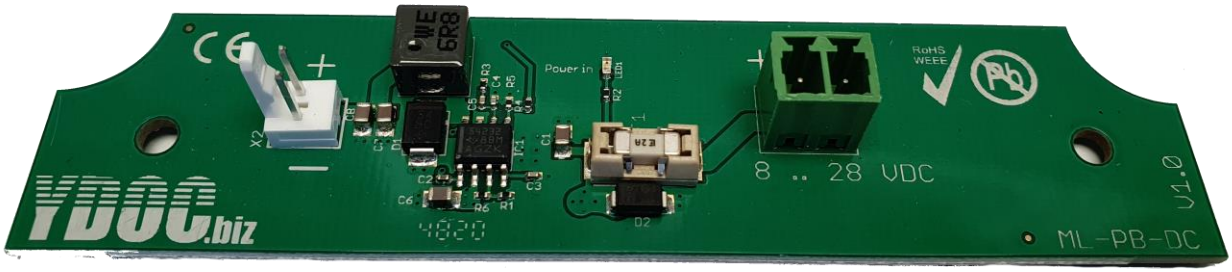
The power board input circuit is equipped with a transorp of 30 Volts, and a fuse of 4A. This protects the connected datalogger from high input voltages.

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 datalogger is protected in both cases.

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

5.1.2 Overview Power PCB option Lithium Auxiliary Power

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



Spare parts:

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

Specifications ML-PB-DC

Power Supply	
Protection	Fuse 2A
Input Power	8 .. 28 VDC
Power out	4V, 1 A (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	2A 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 Compliant	Yes
Rohs Compliant	Yes

Dimensions	
W X D x H	106 mm X 82 mm X 40 mm
Weight	
Netto Weight	50 Grams

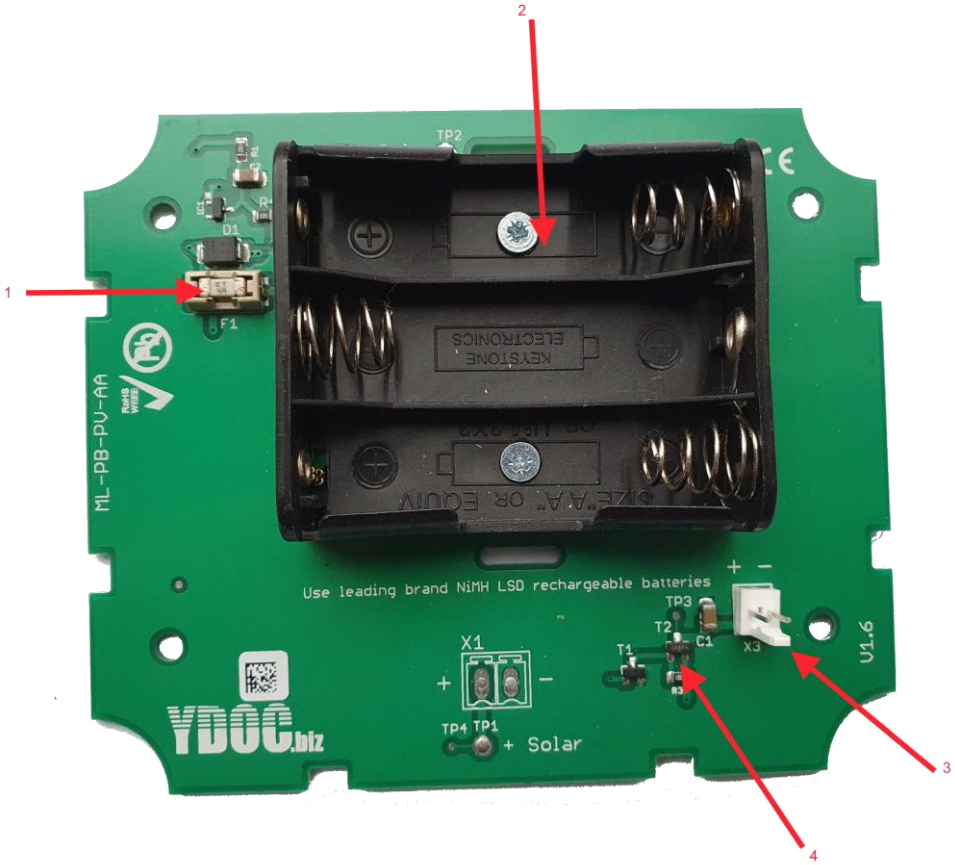
6 ML-PB-PV-AA

The ML-PB-PV-AA Power Board is a power board for solar charging of 3 NiMH -AA cells . It is to be mounted in a special solar cover from ydoc.

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

6.1 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 4A fuse protects the batteries/device in case of a short circuit.



1) 4A Battery fuse
2) Battery holder for 3 AA type NINH LSD cells (low self-discharge)
3) Output connector (to datalogger)
4) Undervolts protection

Spare parts:

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

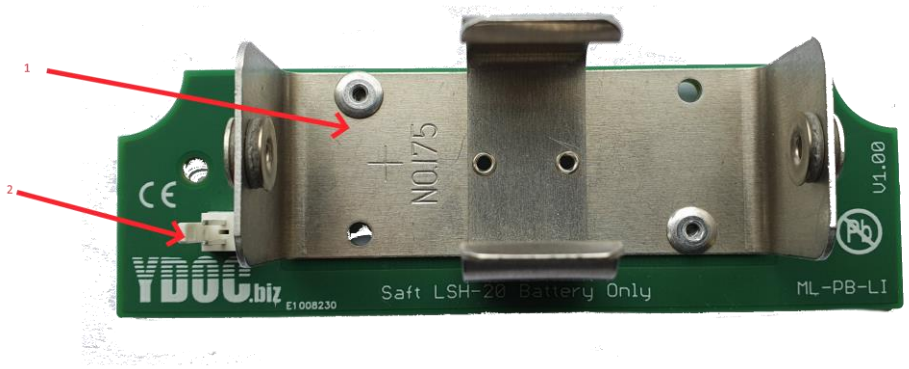
Specifications ML-PB-PV-AA

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 EmptyHysteresis	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

7 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)



1) Battery holder
2) Output connector (to datalogger)

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

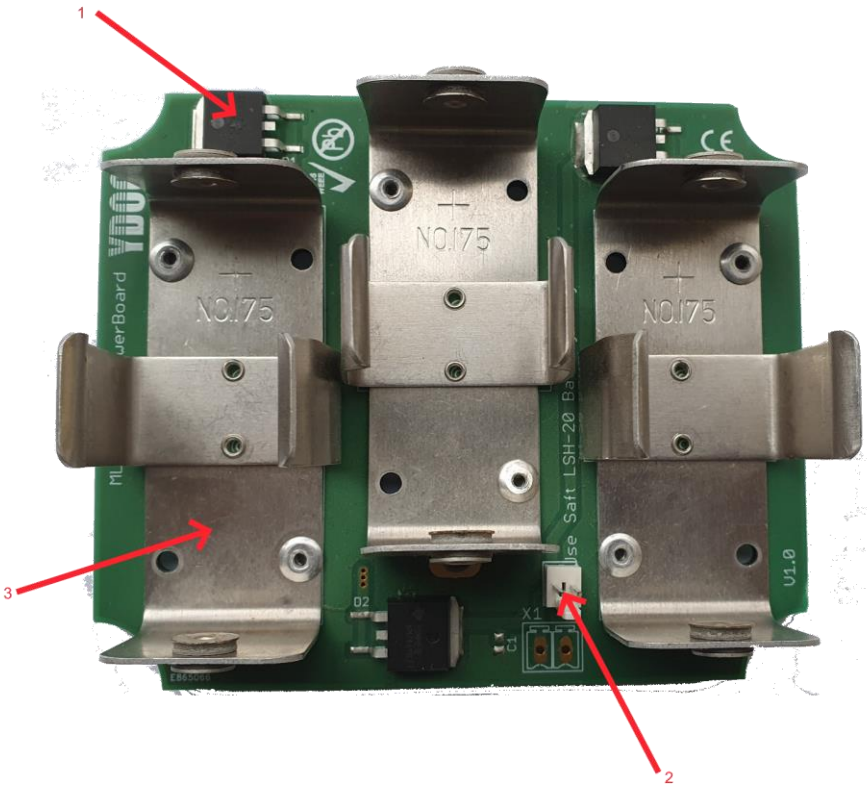
Dimensions	
W X D x H	106 mm X 33 mm X 40 mm
Weight	
Netto Weight	110 Grams

8 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.

8.1 Triple Lithium battery holder

The board has 3 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 has an internal fuse already.



1) Super – low loss diode (Smart diode)
2) Output connector (to datalogger)
3) Battery holder

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 Compliant	Yes
Rohs Compliant	Yes

Dimensions	
W X D x H	106 mm X 82 mm X 40mm
Weight	
Netto Weight	110 Grams

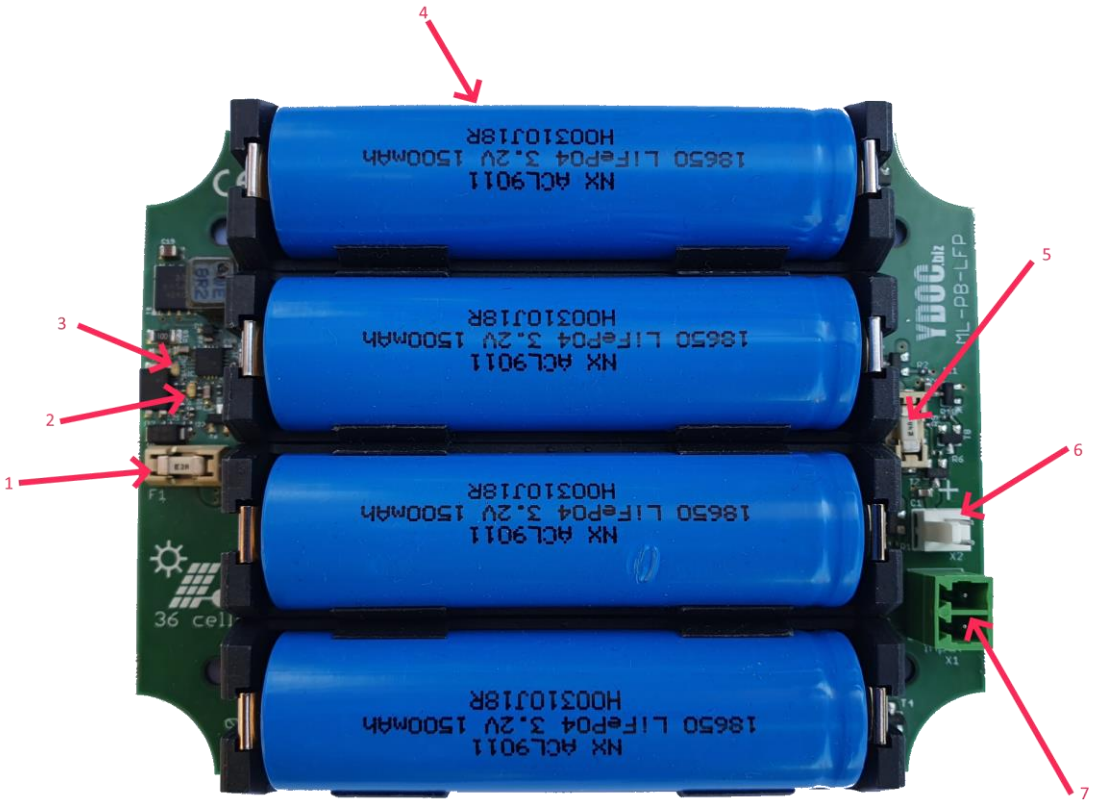
9 ML-PB-LFP

The YDOC ML-PB-LFP Charger-Power Board is an accessory for the type ML-xx low power datalogger. It is designed to power the ML-xx datalogger from an auxiliary solar power source. It must be used together with 1 to 4 18650 LiFePO4 cells battery and a solar panel or DC power supply Features:

- Designed for operation with solar system 36 Cells (12 Volts nom.)
- Power output 3.2 V nominal (cell voltage)
- LiFePO4 18650 batteries
- RoHs Compliant
- CE Compliant

9.1.1 Overview Power Board

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



1) main fuse (2A fast acting)
2) battery full indicator LED (orange)
3) charge indicator LED (Green)
4) battery holder for up to 4 18650 cells
5) Battery Fuse (4 A fast acting)
6) 3.2 Volts nom. output connector for datalogger (Unregulated, directly from cells)
7) Input connector (solar panel)

9.2 General

The ML-PB-LFP Battery Charger is a, charger for 3.2 Volts , 18650 type, LFP Batteries (or LiFe-PO4). It consists of a single PCB, to be mounted in a ML-xx-type Casing

9.2.1 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.

9.2.2 Protection

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

Battery undervolts 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 datalogger), 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 datalogger 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.

Overtemp 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 overtempt. 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 overtempt 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 don't work, but will not cause damage.

operation
The ML-PB-LFP is used to charge 18650 type LiFe-PO4 batteries. You can build a system with just this Power board , a solar panel and a 18650-LFP battery. The Power board also has a power output for the datalogger.
The ML-PB-LFP is optimized for solar power.

The ML-PB-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.

9.2.3 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.

9.2.4 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.

9.3 Maximum Power Point (MPP)

The device searches for the maximum power point of the solar panel. This fixed point lies at 18 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.
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). A bigger panel is supported also, only the MPP won’t be reached. (the user will not notice, because it will operate perfectly)

As a consequence 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	Datalogger Power +		3.6V	Datalogger
X2	2	Datalogger Power -		0V	Datalogger

Specifications ML-PB-LFP

Power Supply	
Protection	Internal fuse for Battery and main input
Input Power	Solar Panel
Type of Power	Solar Panel 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	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

Spare parts:

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

10 ML-PB-PV12-LFP

The YDOC ML-PB-PV12-LFP Charger-Power Board is an accessory for the type ML-xx low power datalogger. It is designed to power the ML-xx datalogger from an 12 cells 1Wp solar panel. It must be used together with a 26650LiFePiO4 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

10.1.1 Overview 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 cell
5) Battery Fuse (4 A)
6) 3.2 Volts nom. output connector for datalogger (Unregulated, directly from cells)
7) Input connector (solar panel)

10.2 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

10.2.1 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.

10.2.2 Protection

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

Battery undervolts 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 datalogger), 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 datalogger 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.

Overtemp 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 overtempt. 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 ground 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 overtempt 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 don'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 datalogger.
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.

10.2.3 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.

10.2.4 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.

10.3 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.

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	Datalogger Power +		3.6V	Datalogger
X2	2	Datalogger Power -		0V	Datalogger

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

Spare parts:

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

11 Battery Empty voltage

According to manufacturer discharge curves the state of charge at 3.1V 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 3.1V is way lower and about 5%. However 5% of 3600mAh is still 180 mAh left and enough to keep data logging going for several days.

Please find below a realistic discharge curve base on a typical datalogger load.