

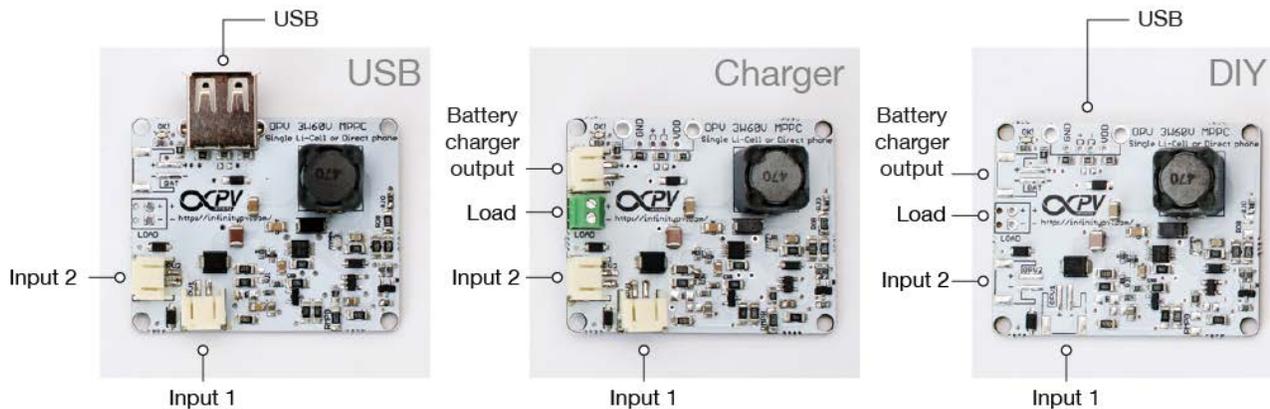
# OPV3W60V MPPC

## Application Notes

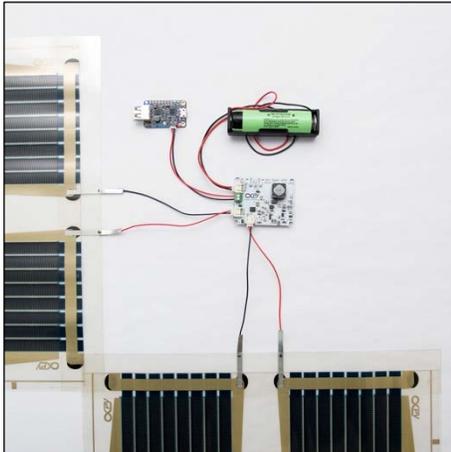
(Rev 1.1 - 10/2017)

The OPV3W60V is custom made DCDC converter for high-voltage photovoltaic devices with low power, in particular serial connected organic solar cells (OPV). It can operate as solar battery charger or as direct 5V USB output. The OPV3W60V board has two solar PV inputs and it fits perfectly with infinityPV Solar Tapes or any other infinityPV OPV solar foils, where the power is in the range from 0.5-3W and voltages up to 60V. This range of power is perfect for Internet of Things (IoT) devices or energy harvesting applications, sensors, small gadgets, charging small devices (iPod, small smartphones).

In order to maximize the power extraction from your solar device, the OPV3W60V includes a Maximum Power Point Control (MPPC). This is important because all PV devices have an ideal working voltage where the extraction of solar power is at its maximum. The OPV3W60V control keeps the PV device at a reference input voltage ( $V_{mpp}$ ) in order to be as close as possible to the maximum power point (MPP).

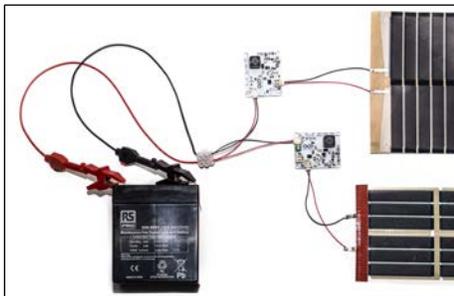


### Lithium Battery Charger configuration



The OPV3W60V will charge safely your LiPo or Lilon battery (not included) until 4.2V and limits the current to zero, when the battery is fully charged. A LED will indicate the full charge. It includes a connector in parallel with the battery, so you can easily connect your load to it. (Battery and load not included)

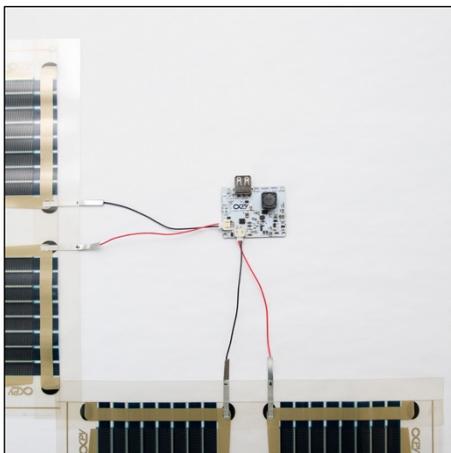
### Pb-Acid Battery Charger configuration



The OPV3W60V will charge safely your Pb-Acid battery (not included) until 14V and limits the current to zero, when the battery is fully charged. The full charge LED is disabled by default but it can be enable replacing some resistors (check FAQ).

Pictures shows two OPV3W60V converters with their outputs connected in parallel and charging the same Pb-Acid battery simultaneously.

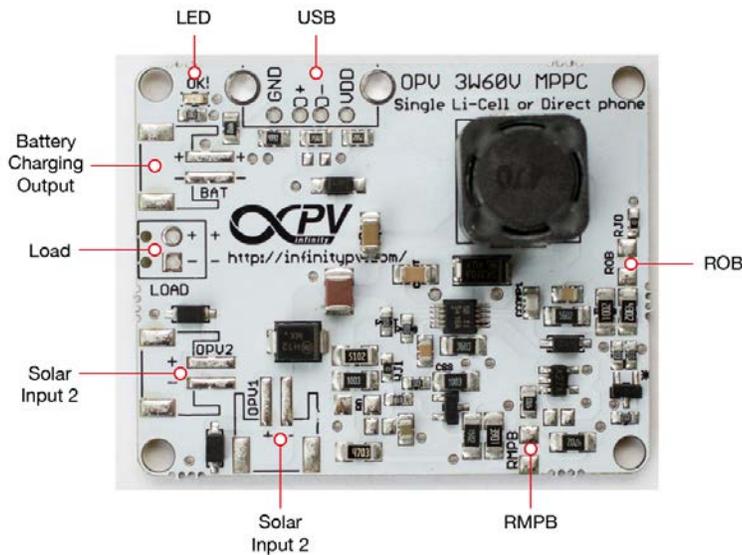
### USB configuration



The USB configuration is not compatible with a buffer battery. The USB load is therefore powered intermittently depending on the solar irradiance. The OPV3W60V in USB configuration is configured to provide an output of approx. 5V to the USB compatible load (e.g. a smartphone or a power bank).

In case your OPV solar device is very small or the sun is not fully shining the OPV3W60V will not be able to stabilize the output (i.e. the charge of the smartphone or USB power bank will be intermittent). It is recommended to use OPV solar devices with at least 2.5Wp for direct charging of mobile devices.

### DIY configuration



The OPV<sub>3</sub>W60V in DIY configuration is the bare board without connectors and needs further configuration by the user. Is it ideal for electronic hobbyists, researchers and makers who want to experiment with organic solar cells. The DIY board requires soldering experience and additional electronic equipment (connectors, resistors).

infinityPV OPV solar foils or OPV Solar Tapes can be tailored to any length and therefore output voltage. The OPV<sub>3</sub>W60V can be configured to choose also the  $V_{mpp}$  appropriate to your OPV device by changing a 1206 SMD resistor on the board.

The OPV<sub>3</sub>W60V has 2 inputs for 2 different OPV foils. They are connected in parallel and the MPPC will act exactly on both, so both OPV lines should have similar voltage range (similar length). More than 2 OPV foils in parallel need to be connected externally.

Table 1: Technical Data OPV<sub>3</sub>W60V MPPC

DC input voltage range ( $V_{oc}$ )	8 - 66
DC MPP voltage range ( $V_{mpp}$ )	8 - 42
No. of parallel inputs	2
Maximum output current (A)	1.5
Rated output power (W)	3
Maximum output voltage (V)- Li Battery charger mode	4.2
Maximum output voltage (V)- Pb-Acid Battery charger mode	13.9
Maximum output voltage (V)- USB mode	5.2

The OPV<sub>3</sub>W60V has 2 outputs mode: 1) as battery charger and 2) as USB output. Because you can choose different lengths of your OPV foils, it is also possible to configure the OPV<sub>3</sub>W60V to perfectly match its input control to your selected OPV foil.



### Configuring the output mode:

The mode is defined by the value of the resistor ROB:

- Li Battery (1 cell) charger mode: ROB=2k
- Lead-Acid Battery charger mode: ROB=120k
- USB output mode: ROB=13k

### Configuring the input voltage reference or $V_{mpp}$ :

First you need to know the best input voltage ( $V_{mpp}$ ) for you OPV solar foil. As rule of thumb, we recommend to select it at around 63% of the maximum voltage (or open voltage circuit  $V_{oc}$ ) in nominal conditions of your foil.

For example, if your OPV foil has maximum voltage of  $V_{oc}=60V$ , we recommend to configure the OPV3W60V for a  $V_{mpp}=38V$ .

The reference  $V_{mpp}$  is configured by the resistor RMPB and it can be configured from 8V to 40V. Table 2 shows the reference  $V_{mpp}$  you will obtain with common resistors (type 1206 SMD).

Table 2: Configuring the input voltage reference: Reference  $V_{mpp}$  for different values of RMPB

RMPB ( $\Omega$ )	$V_{mpp}$ (V)
30k	37.5
20k	30.4
7.5k	17.5
2k	10.6
1k	9.05
680	8.5



## FAQ

### ***Which kind of battery can I use with the OPV3W60V?***

The OPV3W60V can be configured to stop the charging process at any desired output voltage, (lower than the input of course). So it can be configured for charging any rechargeable battery. However, some battery packs are made of several battery cells and some technologies, especially Li-based batteries, need a cell-balancing system during charging.

We recommend the OPV3W60V for charging typical Pb-Acid batteries or single-cell Li batteries (see configuring the output mode), but you can always contact us if your battery pack does not fit to these options.

When you choose your battery, it is quite important to keep in mind that batteries must not be charged at higher current than their capacity rating.

Example: A battery has a capacity of 450mAh. The recommended maximum charge rate should be at 450mA and we can consider 3.7V as nominal voltage in a single-cell LiPo battery. The maximum power in your OPV solar device should be  $3.7V \times 450mA = 1.66W$ . There will always be some losses at the converter, but this will give you an extra safety margin.

### ***Which kind of connectors or cables can I use with the OPV3W60V?***

We have prepared the board for attaching 2-pin JST connectors for the battery and the 2 OPV solar inputs. The DIY version comes without the connectors, so you can directly solder your own cables or connectors. If you do that, please take care of the polarity.

### ***Can you provide batteries for the OPV3W60V?***

Rechargeable batteries are not included. We recommend to buy them from your local (or nearest) supplier since transporting batteries has a lot of restrictions. You can also order from big suppliers such as

<https://www.sparkfun.com>

<http://www.hobbyking.com>

<http://seedstudio.com>

### ***Can I use the battery output and the USB output at the same time?***

No, you cannot. The OPV3W60V has only 1 output, which can be configured to charge a battery OR to provide an USB compatible output. The configuration is set by changing the ROB resistor on the board.

### ***I want to charge my phone using the OPV3W60V, is it possible?***

Yes, you can charge your phone or any other device with an USB compatible 5V input. You have two options:

Charge it without battery only when full Sun is present. You need to configure the OPV3W60V as USB compatible output and we recommend an OPV device with at least 2.5Wp of power.

Charge it with a battery at any time you need (no Sun is needed while you are charging). The OPV3W60V must be configured as battery charger. You will need a battery and a small extra converter (not included) to regulate the voltage from the battery to a stable 5V output. A compatible converter is the "PowerBoost 1000 Charger - Rechargeable 5V Lipo USB Boost @ 1A" available from Adafruit:

<https://www.adafruit.com/products/2465>

### ***I want to run my Raspberry or Arduino from Solar energy using the OPV3W60V, is it possible?***

Yes, it is. We recommend to do it charging a Li battery with OPV3W60V and then running the Raspberry or Arduino from the battery. Without the battery the supply will be intermittent as the sun radiation and your application will be resetting from time to time.

infinityPV is offering now LiBAT5V2A which is a battery shield, which provides a stable 5V output with up to 2A from Li-based batteries to supply safely your preferred DIY programming platform. The shield is supplied with connectors for Raspberry, Arduino or Photon and it has an extra option for monitoring voltage/currents on board through the I2C bus. Check LiBAT5V2A at [infinitypv.com](http://infinitypv.com).

**Is the OPV3W60V in USB mode Apple compatible?**

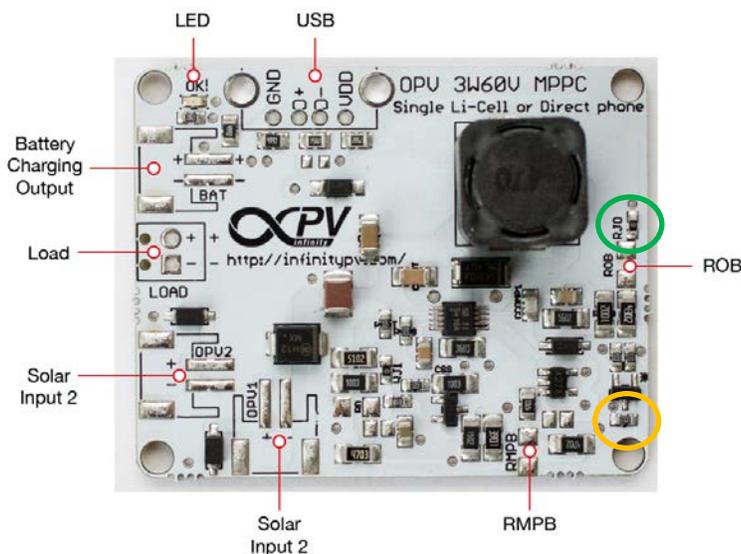
Yes, it is compatible with all the smartphone we have tested, including several Apple iPhones. In some models, when the OPV3W60V is charging the phone directly during fluctuating sunlight, you will see a message on your screen like “the device might be not compatible”, but it still continues charging.

**Can I use OPV3W60V with other PV technologies?**

Yes, you can, while you are respecting the Technical Data (Table 1).

**How can I re-enable the full charge “OK!” LED for charger mode with Pb-Acid battery?**

There is a small resistor (0603 size) that needs to be replaced to adjust the “ON value” for the full charge LED to indicate full charge at 14V. In the following picture this resistor is highlighted with an orange circle, it needs to be replaced by a 10k resistor. Also the jumper RJO (green circled), needs to be placed, you can use a zero ohm 0603 resistor or just simply a big drop of tin or a small piece of cable.



**Can I use several OPV3W60V converters in parallel to charge the same battery?**

Yes, they can be used with their outputs in parallel for charging the same battery, but please be careful to not exceed the maximum charging current for your battery.