

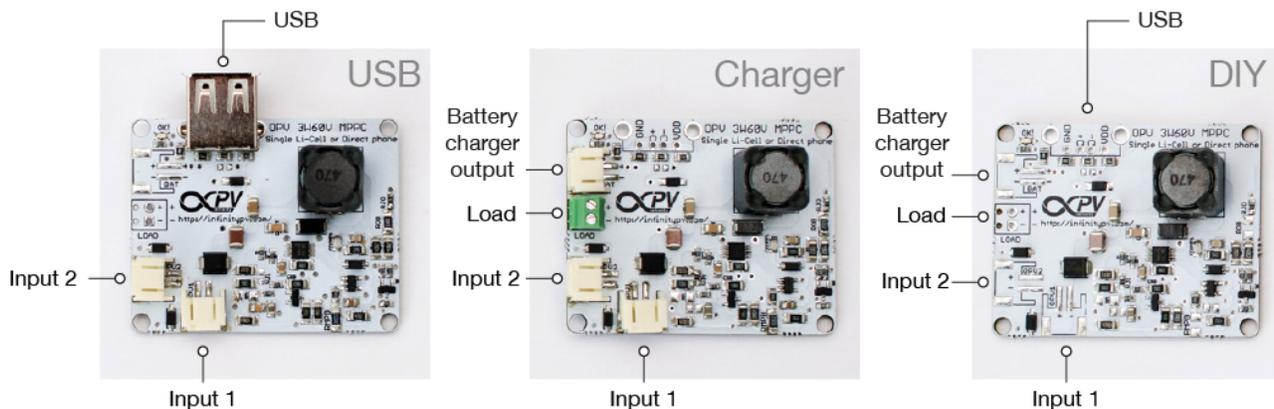
OPV3W60V MPPC

Application Notes

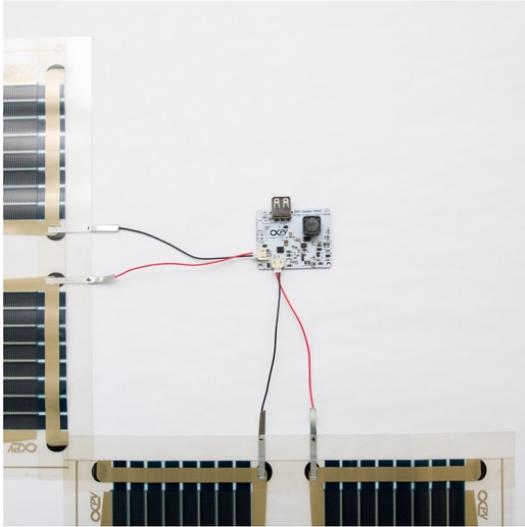
(Rev 1.00 - 07/2016)

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 charger for single-cell lithium ion and lithium polymer (LiPo) batteries 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).



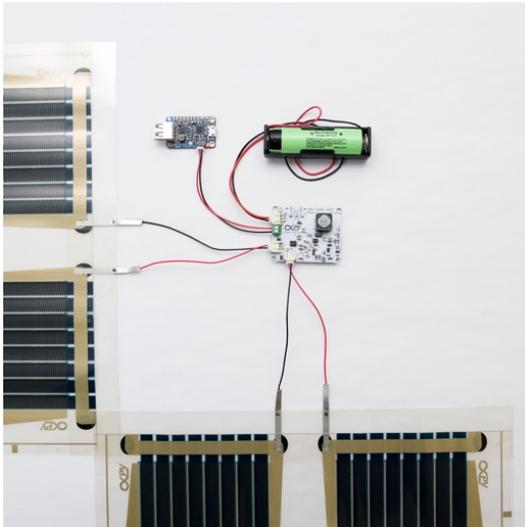
USB configuration



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 ca. 5V to the USB compatible load (e.g. a smartphone or a power bank). The standard OPV3W60V is set to 60 V maximum input voltage.

In case your OPV solar device is very small or the illumination of the solar foil is poor (i.e. low sun or overcast conditions) the OPV3W60V will not be able to stabilize the output (e.g. the charging of the smartphone or USB power bank will be intermittent). It is recommended to use OPV solar devices with at least $2.5W_{\text{peak}}$ for direct charging of mobile devices.

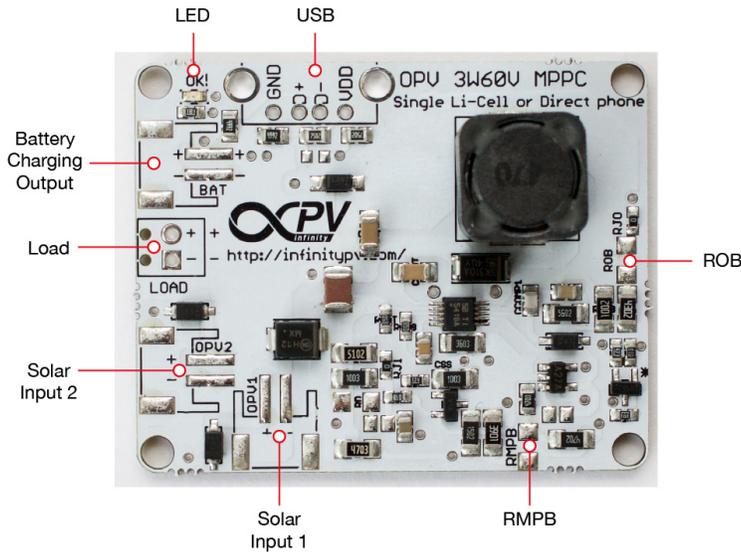
Battery Charger configuration



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

The standard OPV3W60V is set to 60 V maximum input voltage.

DIY configuration



The OPV3W60V in DIY configuration is the bare board without connectors and needs further configuration by the user. It is 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 OPV3W60V can be configured to choose also the V_{mpp} appropriate to your OPV device by changing a SMD resistor (1206 case style) on the board.

The OPV3W60V has 2 inputs for 2 different OPV foils. They are connected in parallel and the MPPC will act equally on both, so both OPV lines should have similar voltage range (similar length). If you need more than 2 OPV foils in parallel these need to be connected externally.

Table 1: Technical Data OPV3W60V 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)- Battery charger mode	4.2
Maximum output voltage (V)- USB mode	5.2
Weight (g)	15
Dimensions board, excl. USB port (mm)	50 x 40 x 12

The OPV3W60V has 2 output modes: 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 OPV3W60V 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:

- Battery charger mode: ROB=2k
- USB output mode: ROB=13k

A simultaneous configuration of both modes is not possible.

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 (Ω)	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?

You can use any kind of single-cell LiPo battery but it is recommended that batteries not be charged higher than their rated capacity.

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 specified on the board.

What types of batteries will work?

The OPV3W60V in charger configuration is able to charge any LiPo 1S battery but be aware that very small capacity batteries i.e. < 30 mAh will be charge relatively quickly whereas very large capacity batteries i.e. > 2000 mAh will charge slowly.

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 international 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 under full Sun. You need to configure the OPV3W60V as USB compatible output and we recommend an OPV device with at least $2W_{peak}$ 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>

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).