

## 1. What's B0B?

B0B is a very simple way to fly your Mavic Mini without the DJI genuine battery but with the telemetry of voltage available on the RC. B0B is not a battery, it's rather a cheap platform to experiment with any battery you wish.

B0B is able to communicate with the ESC board of the drone giving it just enough information to be accepted at boot and to monitor the voltage during the flight.

B0B does not work with DJI mini2.

Let's start by a video to see B0B running: <https://youtu.be/pL0dGoH2AC4>

To use B0B, the Mavic Mini firmware version shall be **1.0.0400 or below**. Should you want to keep the advantages of the 1.0.0500 firmware with manual settings of the camera in video, just search for "DJI firmware module mixing" or watch this video: [https://youtu.be/96oaoMC\\_Zkw](https://youtu.be/96oaoMC_Zkw)

The battery type inside the firmware shall be set to **type 2 or 3 (which means just a warning on the screen and a beep in case of low batt and no RTH)**. (you are just warned). Type 0 works too without any warning. When left in Batt-Type = 1; the drone won't boot (error: "not genuine battery")

## 2. What does it do?

Obviously there is some electronics behind this.

A PIC12F1840 microcontroller will emulate the I2C traffic needed by the ESC board of the Mavic mini to start the drone and to collect telemetry information.

The voltage of the cells is acquired by B0B via a resistor bridge.

With DJI fly up to 1.1.15, the total voltage of the batt is displayed into the Mavic Mini temperature field. This is done on purpose just to remember you flight with B0B and not genuine battery.

The voltage is displayed like this:

**804,7 °C ==> means 8,047 V**

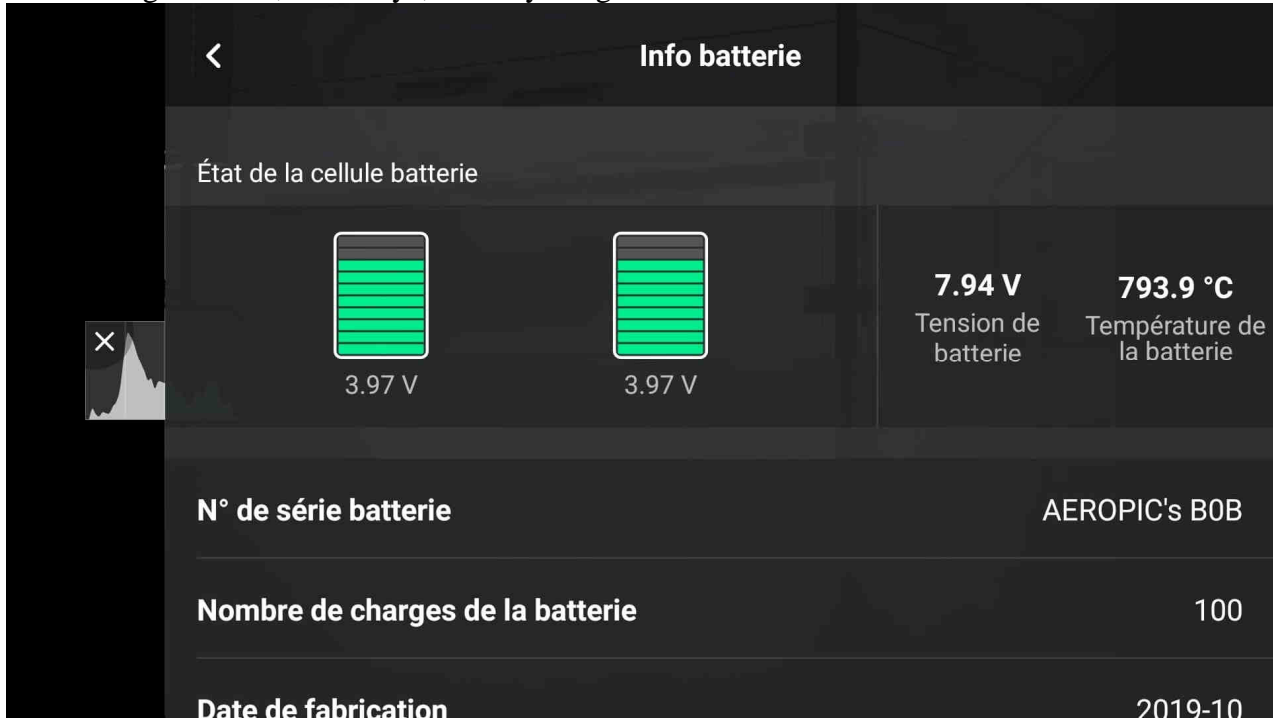


This value is then divided by 2 and displayed into each cell gauge

The battery remaining capacity is estimated based on the total voltage and displayed on the screen.

The **estimation is NOT accurate and is clamped to a minimum value around 10%**. Just enough to trigger the low batt warning ;-).

The latest version DJI Fly 1.1.6 and above does not display anymore the voltage on the main screen. You've to go to "...", "security", "battery" to get it:



You'll have to fly "with tension" reading the total voltage of the batt. **Don't go under 6.5V or the batt can be damaged** (and the drone may lose power and eventually crash).

To be clear, as its name means B0B is a battery with no BMS.

**You cannot use it to charge the batt from the DJI charger nor from the USB plug from the drone.** B0B is "stupid". It just fools the DJI firmware giving it just enough information to start the drone and display voltage. That is!

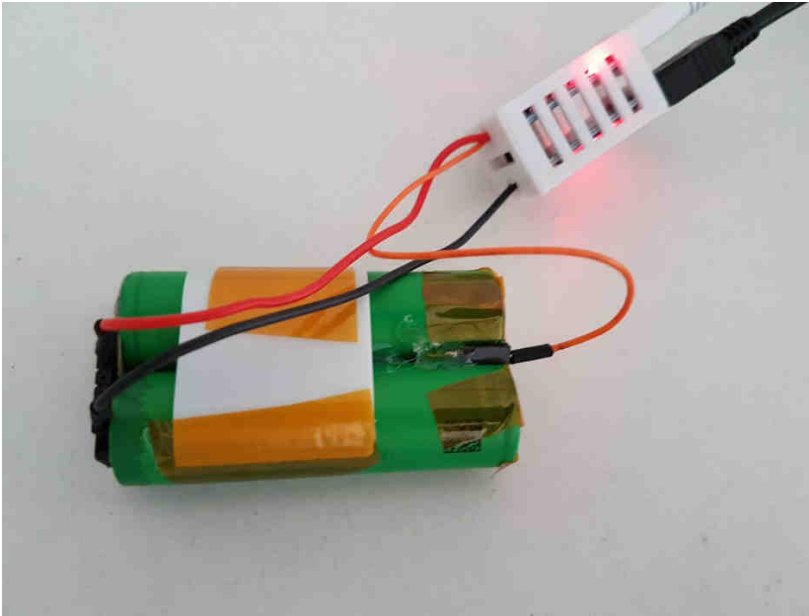
### 3. Which battery?

Any 18650 cell with a discharge rate of 15A continuous and 20 A peak should do the job.



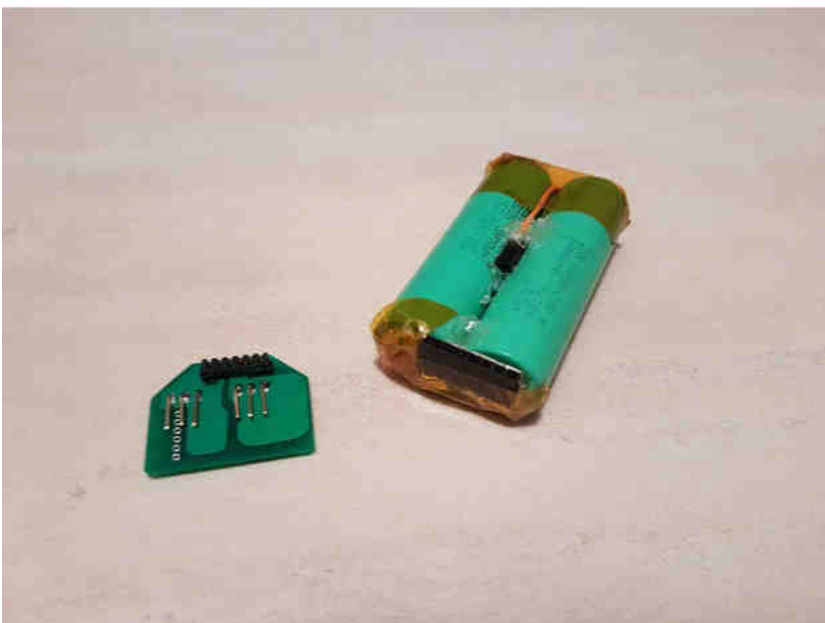
If you want to fly with the genuine cells, buy two Samsung 2500mAh INR18650 cells. They can be found for 10€ on ebay ;-)

The Sony VTC6 3000mAh are an excellent candidate too. They are few grams heavier than the SAMSUNG but they end at 101.4 grams (all included B0B, cells, 3D printed parts...) which keeps the Mini right under the 250 grams' limit! 30 minutes of flight time can be achieved with those cells.



The battery is attached to B0B with a "sliding" 2x3pins connector. You can use a single B0B and own as many batteries you like.

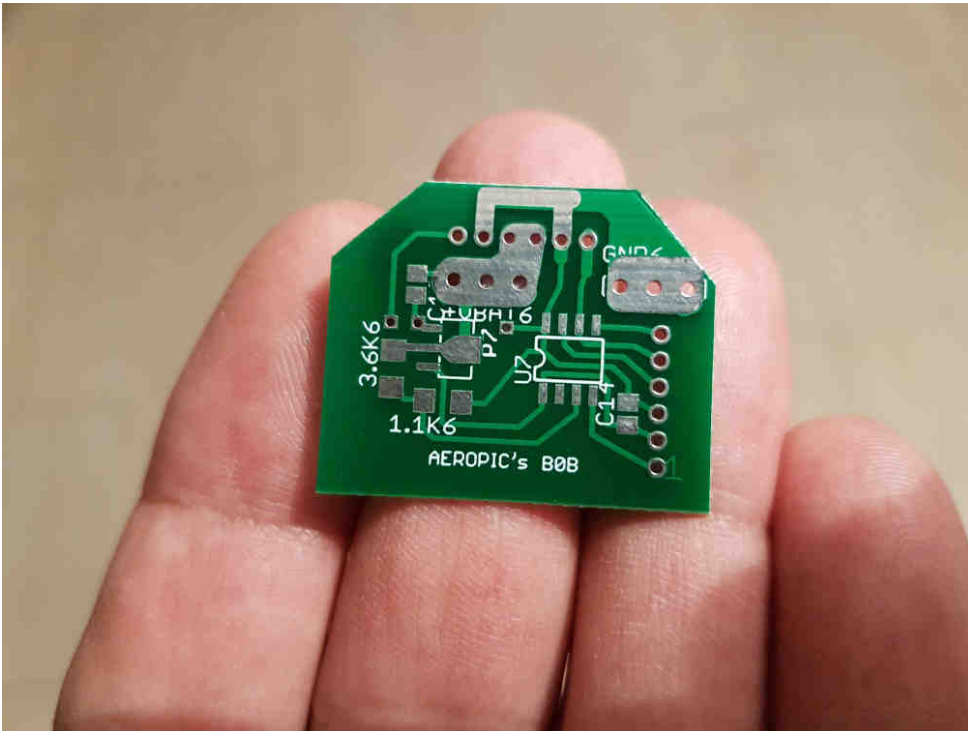
the battery can be un attached and charged from an external charger using the same connector B0B is attached to it + the middle point to balance it... The charger you see on the picture above is a very cheap way to charge your cells. It is described here: <https://www.thingiverse.com/thing:4550431>





## 5. Preparing the PCB

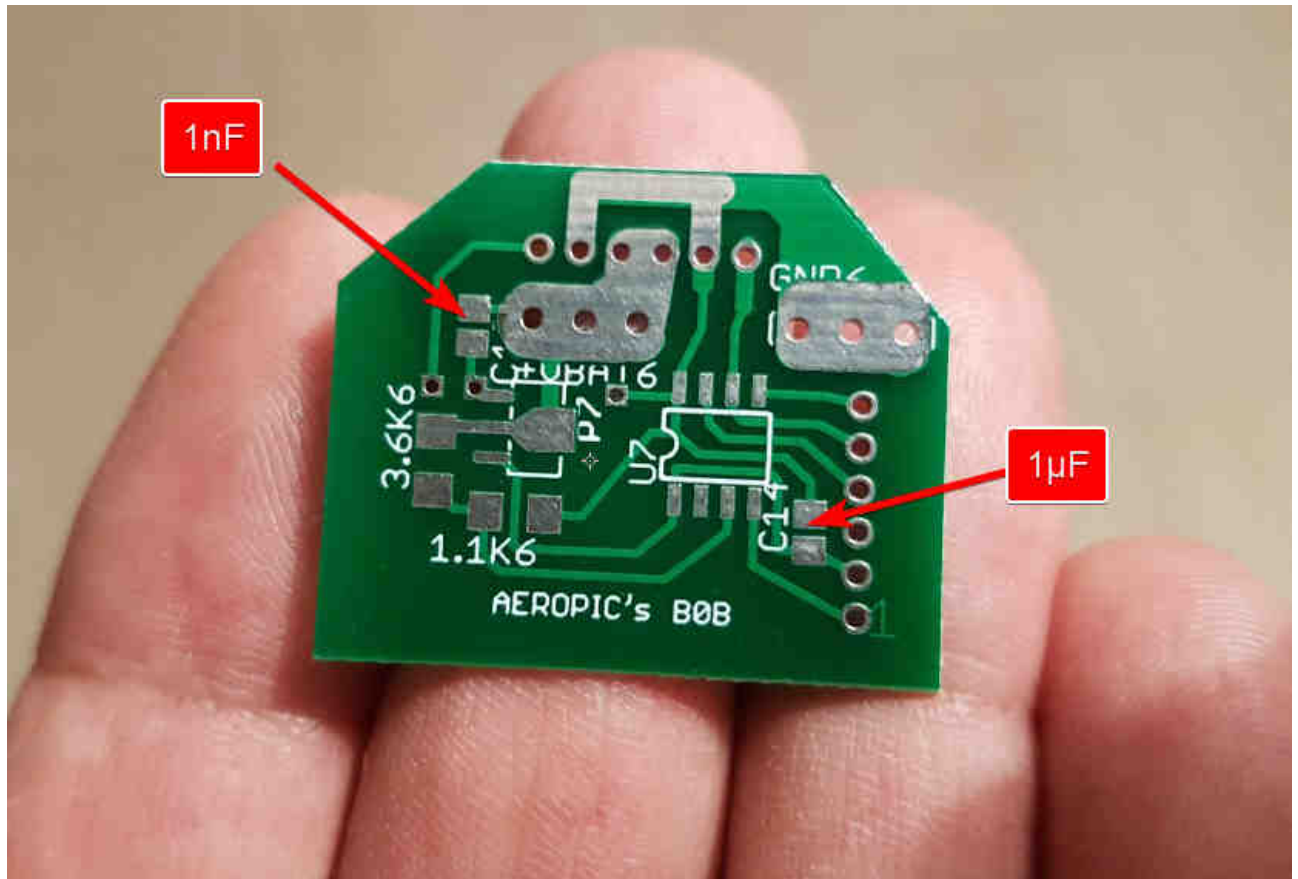
The PCB is ready to use.



Soldering is done on the PCB in the following sequence:

- 1- solder the tiny ceramic capacitor (on the left on the PCB)

- 2- a second capacitor (1 $\mu$ F or so) shall be soldered (on the right C1x on the PCB) between +3.3V and GND



- 3- solder the LDO regulator (P7 on the PCB)
- 4- solder the two resistors don't cross them. The 1.1 kOhm one is marked [1001] on the component, the 3.6 kOhm is marked [362] on the component



At that stage you can perform a first test:

- connect B0B to a source of tension between 5V and 9V (8V in the example).  
I had not marked on the PCB the polarity. Seen from component side, + 8V is the left connector (JP1x) and GND the right one (JP1x+2). Do not cross the battery otherwise ==> magic smoke!

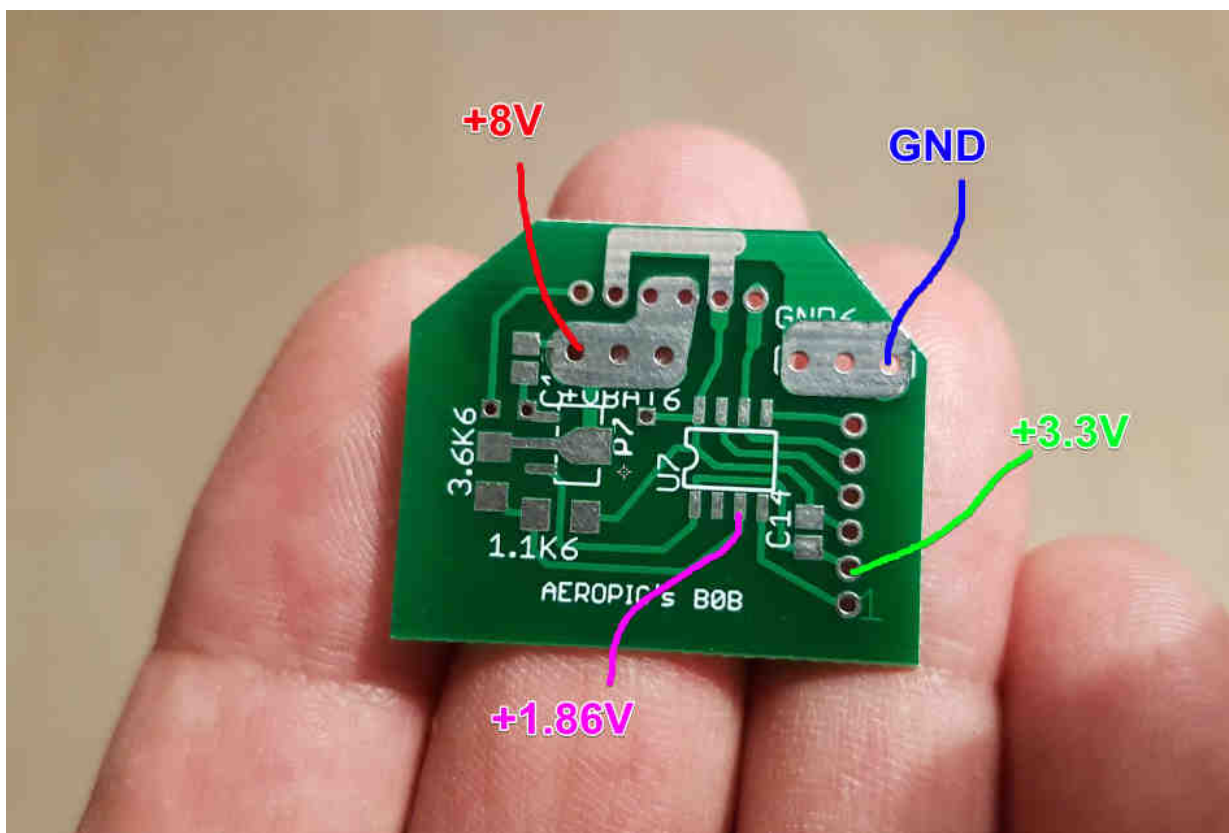
- measure some tensions between GND and the following test points:

- on the vertical connector on the right. You shall find 3.3V

- on pin3 of the PIC's footprint you should find a voltage close to

$V_{bat} \cdot 0.234$ .

Here 1.86V if  $V_{bat} = 8V$ .



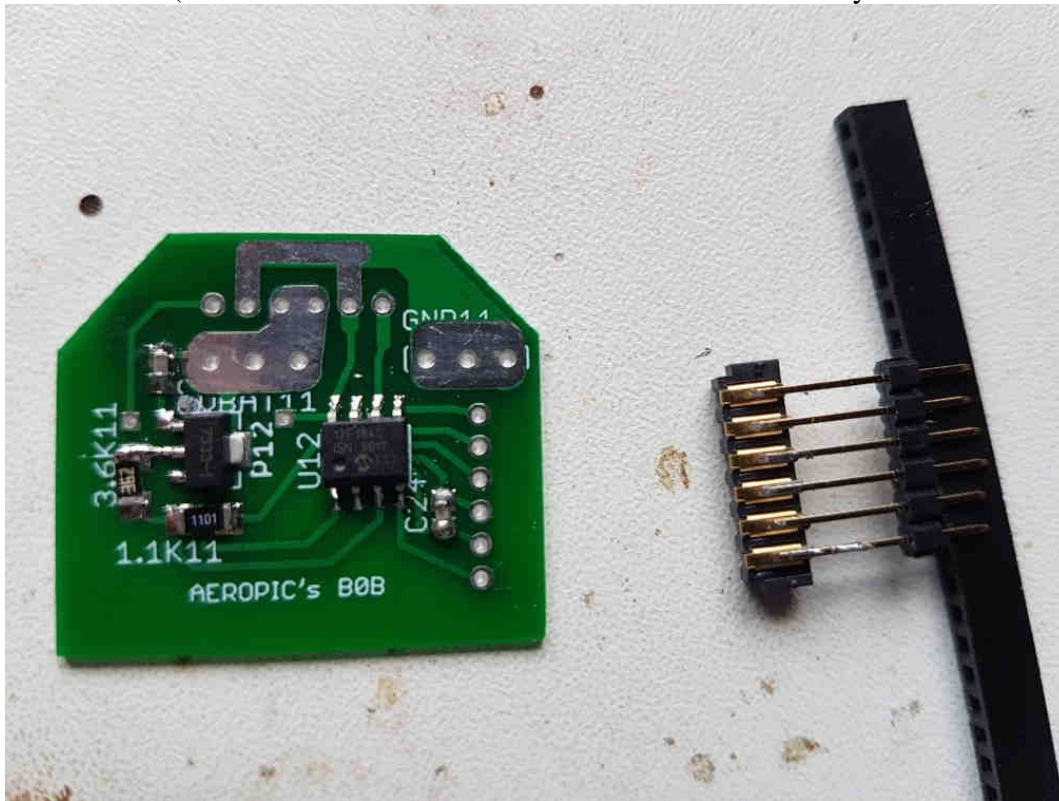
- It is time now to solder the microcontroller. The dot shall be placed to the left like on the template on the PCB

## 6. Soldering the battery connector

### 6.1. TO INSTALL THE SMD CONNECTOR JUST FOLLOW THOSE STEPS:

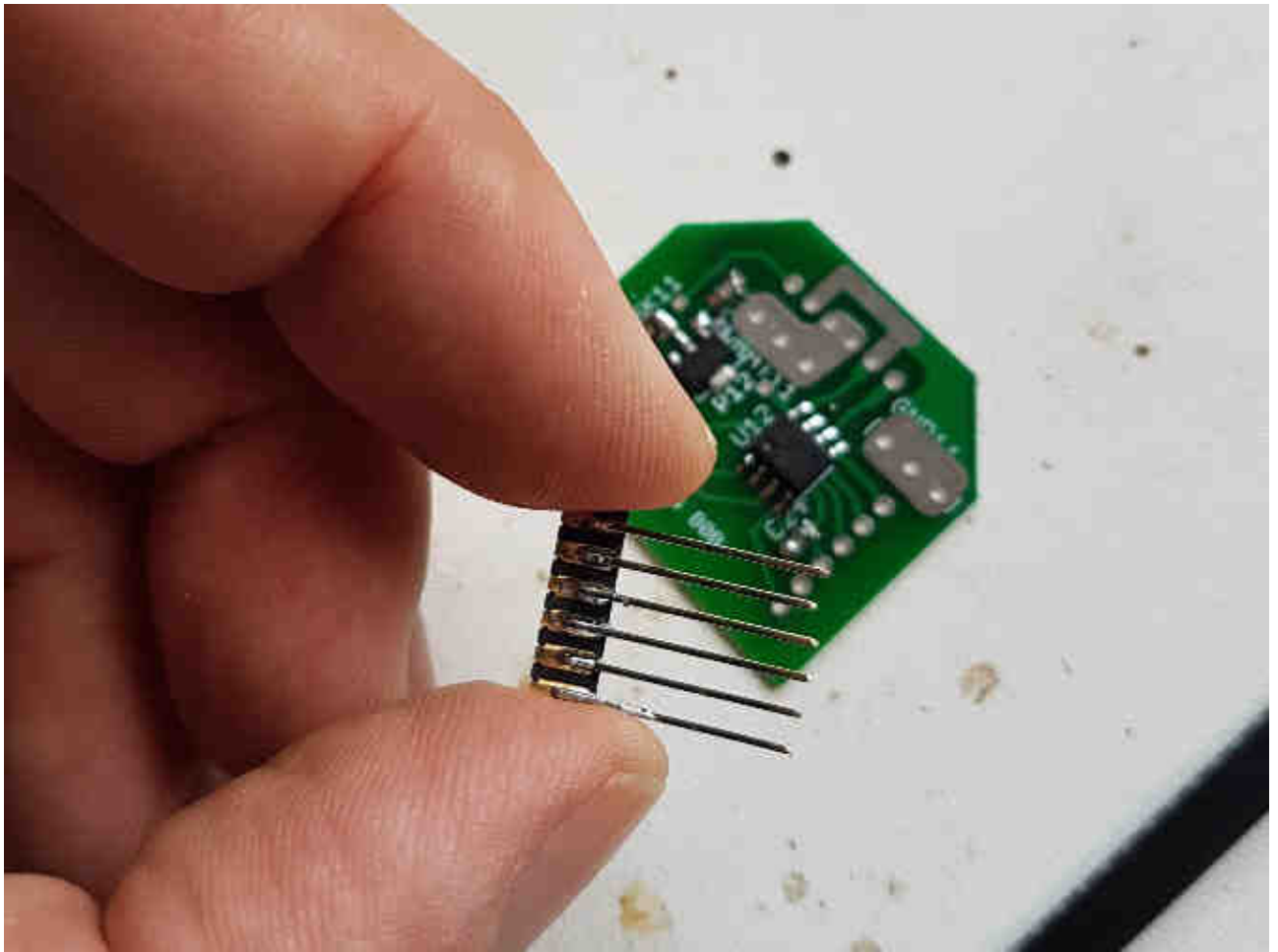
- 1- Solder the 6 pins male 2mm connector on the SMD connector

Set it flat on a table. Don't let more than 1/2-2/3 connector's height like on the picture and solder the pins don't put too much solder or you will fill the lyres and destroy the connector... (take care to the orientation of the connector: the entry is on the left here)

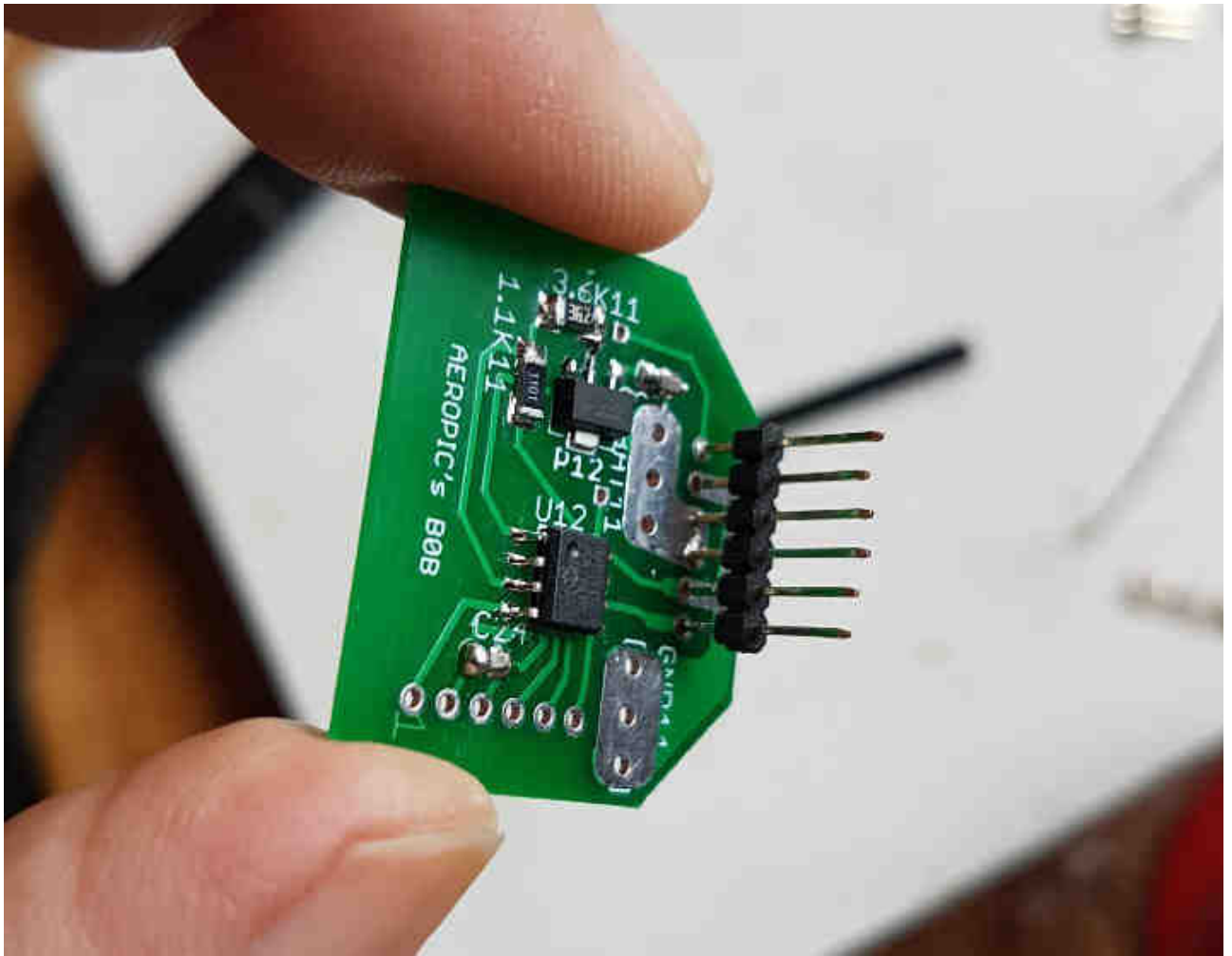


2- Remove the black piece of plastic

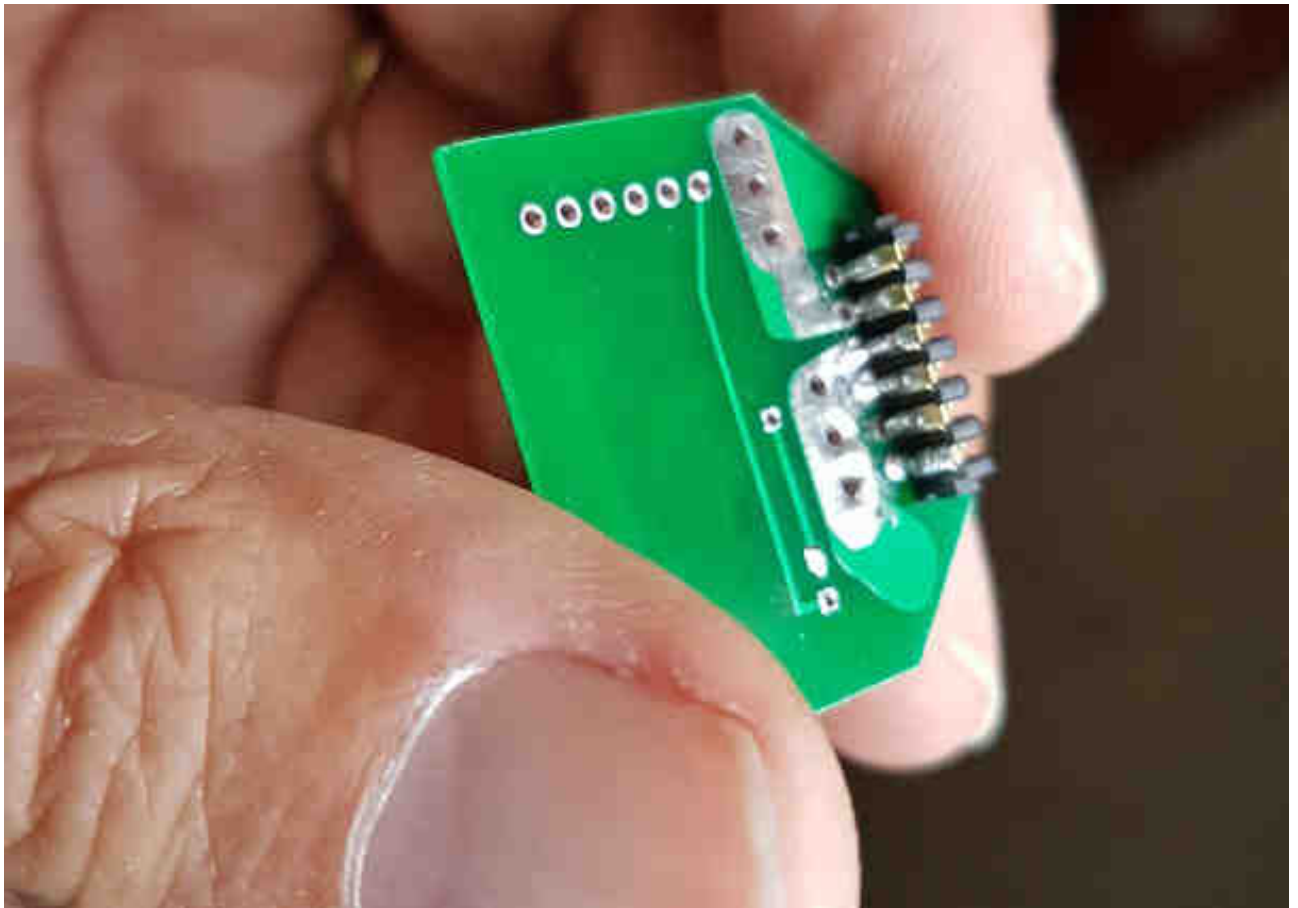




- 3- Insert the pins into the PCB and replace the black piece of plastic  
You can push it up to the surface of the PCB (more than on the picture) and you'll start soldering by the back of the PCB.



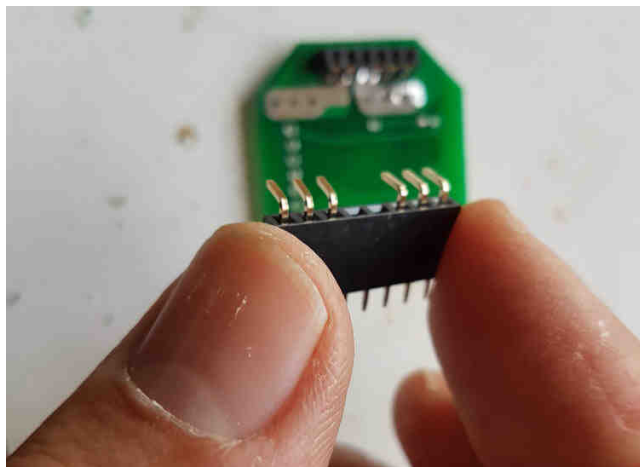
4- Here we are

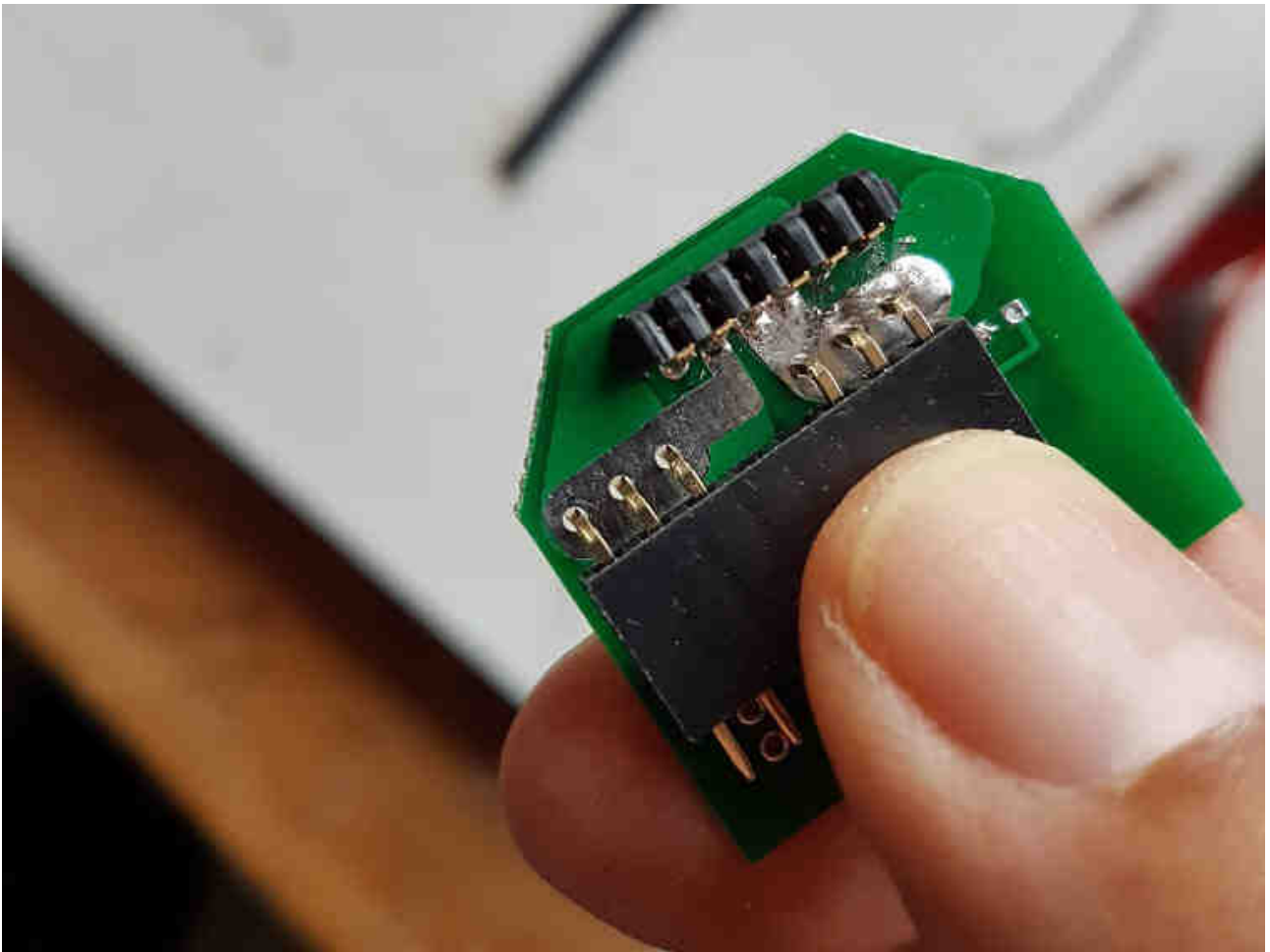


- 5- You can now pull the black plastic support but keep it to the tip of the pins. Then solder the second side . Cut the extra length

## 6.2. TIME TO PLACE THE MALE CONNECTOR

- cut 2x 3pins male 2.54 connector and bend the pins at 90°. Remove the plastic part. Insert the 6 pins into the female connector (the 2 middles pins are free). Then, from behind the PCB insert the connectors into the 2x3 holes (pins looking towards the bottom) and solder them **flat with the female connector fully in contact the PCB**. (It is very important not to leave room here if you want to be able to shut the Mini's door).





You have to solder the pins from **both sides** of the PCB.

## 7. DIY a battery connector

First install and solder the male 6 pins connector.(see 6.2)



The most difficult part to source is the battery connector. If you don't get the DJI genuine one nor the SMD one, I found a way to DIY a female battery connector.

The genuine lyre of DJI battery connector offers 4 contacts to the male pin. The DIY battery connector will offer also 4 contacts per pin.

I simply extracted some female lyres from a 2mm pitch square pins connector and placed them two by two inside a 3D printed case.

The lyres shall be inserted as deep as possible into the 3D printed case. This is very important to avoid the battery pops out in flight. **The tip of the lyres shall be as close as possible to the surface of the connector (0 to 0.3mm)**

It's a pain to solder in place and the best way is to use a male connector or at least a male pin to keep the pair of females in place while soldering.

Be patient, the result is excellent; we get the same four contacts to the male pin. Insertion into the male connector requires a lower but good enough amount of force than with the genuine one.

If the MM draws 10 A, this gives 5 A per pin as Vdd and GND are duplicated which turns into 2.5A per lyre and 1.25A per contact... It should do the job!

Be cool while inserting B0B to the male connector of the drone. Do not force, this might destroy the lyres. If a lyre is bent or misaligned, just place it into position using a needle.

## 8. Making the battery

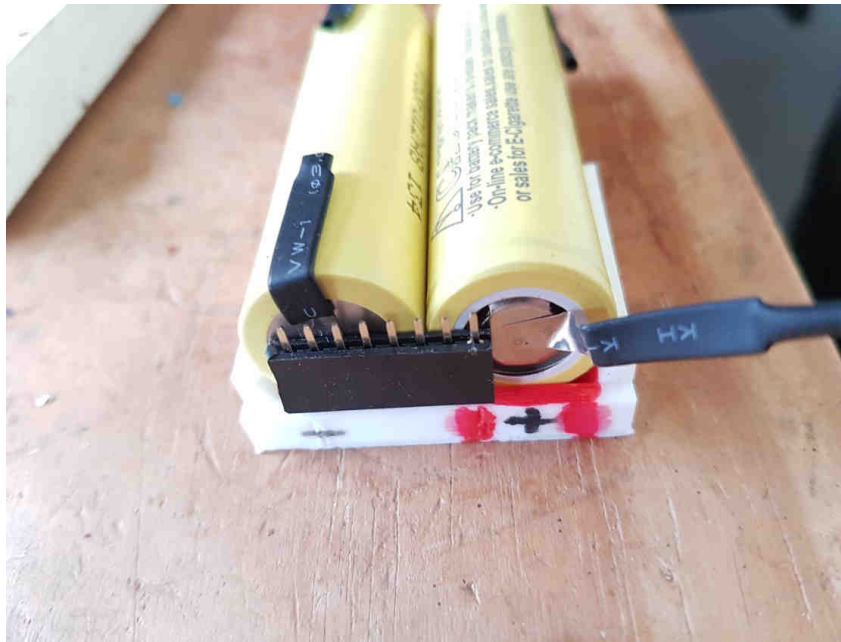
To make simple the battery soldering, use the 3D printed template. Print it and glue 2 pins inside the holes. Mark the polarities on the template to avoid any dramatic mistake.



Insert the female 8 pins connector, and put the cells in contact of the connector







Hot glue the 2 cells together and attach the connector to the cells with some strong double sided tape. You can now solder your cells to the connector. Only 3 pins from both sides. The two middle pins shall be removed.

Don't forget to solder the other side in serial and to add a one pin dupond connector to charge and balance the cells.

You can 3D print in spiral vase the B0B\_center\_batt thing. Just glue it under the cells, it will help centering correctly the battery inside the Mavic Mini hole. The conic slot is to be set at the opposite of the connector.



For those who don't get a 3D printer the right position of the connector is :

- Top (side of the holes) at 4 mm from the level of the cells
- 3<sup>rd</sup> pin aligned to the axis of the battery

It is of utmost importance to keep the battery plus soldering's:

- **as short as possible**. For this the connection at the rear in serial between both cells shall be done with a flat large wire like a desoldering braid,
- the batt shall remain **'flat and level'** no soldering shall protrude under the cells.

**If you don't not respect this you get the risk the connector pops out and does a power loss which means crash of the drone. TAKE CARE !**

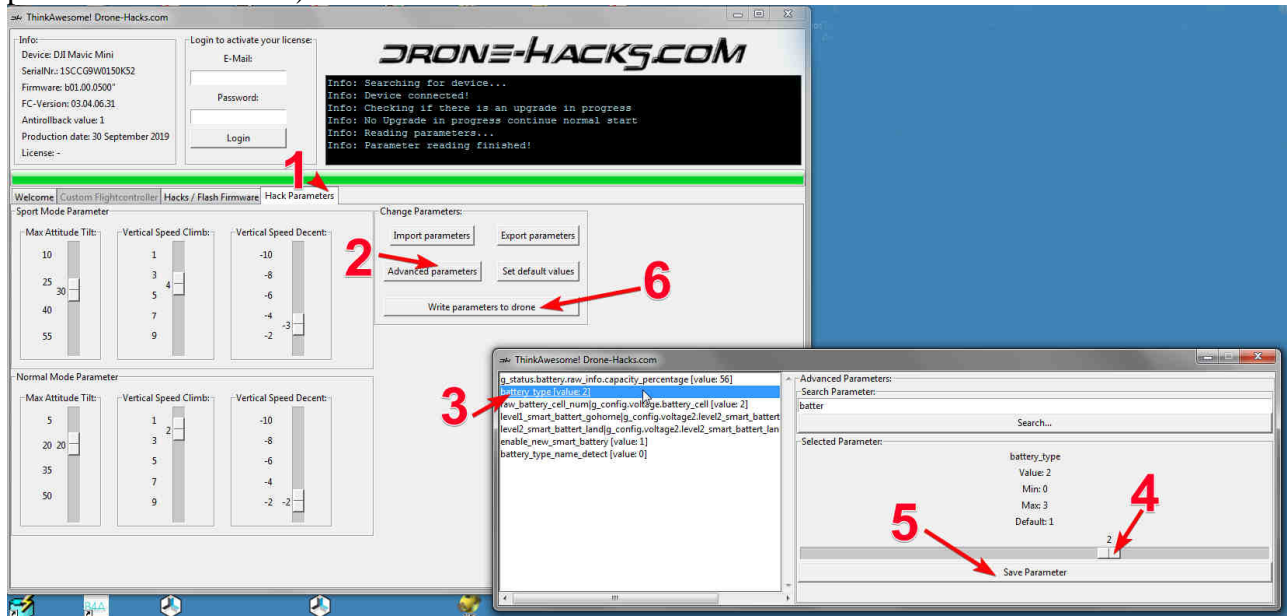
## 9. Which battery type?

Drone Hacks software allows patching the battery type (firmware  $\leq$  1.0.0400).

<https://drone-hacks.com/>

Those operations shall be done with a genuine battery installed in the drone.

To patch the battery type follow the 6 steps : (don't forget the last one to permanently write the parameter to the drone)



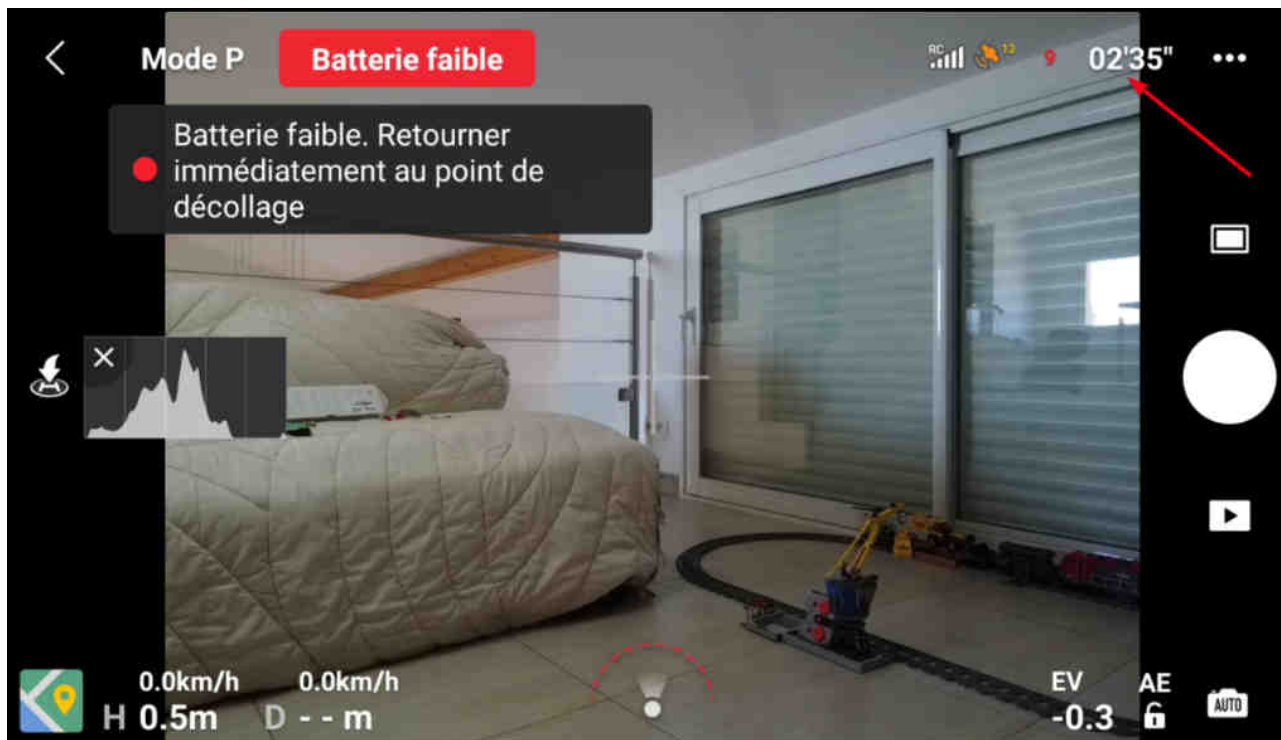
Batt type can be set at a value from 0 to 3. B0B needs the BATT-TYPE to be set at either 0, 2 or 3. From what I could experiment playing with batteries and SMBus data my first understanding of the different values is:

- type 1 : it is the default value where the ESC firmware is waiting for a genuine DJI batt including authentication.  
In this mode everything is checked by the firmware and the low batt (15%) and extreme low batt (5%) monitoring are performed. When too low an emergency landing is forced by the firmware. (The latest 1.0.500 firmware is limited to type 1 only)

This type 1 cannot be used with B0B

- type 0 : is the most basic monitoring of the battery. No red warning in case of low batt, no emergency landing.
- type 2 and 3 perform a less basic monitoring of the battery. Both will display in red the % of charge when it comes under the low batt value. And an annoying but useful two tones bip is played
- type 2, in addition to type 3, will ask the battery BMS for an estimated remaining capacity and based on the full charge capacity will display an estimated remaining flight time on the top right corner of the screen.

Versions  $\geq$  100 of B0B's firmware are now able to display a poor estimation of remaining flight time (but do not trust it !)



## 10. In flight testing

Before connecting B0B to the battery, just **connect the PCB board without battery to the Mavic Mini** and check that the connector connects smoothly. If not you might get a misalignment of one lyre. Do not push hard or you will damage the lyres. At the opposite, with a magnifier check that the lyre are well oriented. If not with a pin, place them in correct position.

Connect B0B to the battery. You can perform a voltage check (see above) at least to check that the 3.3V is still valid!

It's time to connect B0B and its battery to the Mini. **Take care to keep the connector well centered when inserting the battery into the Mini otherwise with a shift of 1mm you may generate a shortcut and damage your battery or the connectors or both!**

**In flight, it is mandatory to secure the battery to the drone.** Use the 3D printed lock that will prevent the battery to slide back and self-disconnect... (with a crash of the



drone).

Boot your RC, boot your mini. The LEDs under the Mini shall start with only one LED, then after few seconds display a correct voltage (all LEDs ON for a fully charged battery).

When the Mini will be recognized by the DJI fly application, the camera view shall display the % of charge and after a tap on the **screen the "temperature" of 820 °C or so for a fully charged battery!**

**If the "temperature" shows a permanent value of 923°C, this means that you crossed the resistors...**

If everything is OK at that stage you can try a first take off and hover during around 1 minute. Land the bird, switch it out and check the temperature of the board and the battery with your hand. If you feel an hot spot on the connector, your solderings must be reviewed...

If the battery is too hot, this means the cells are not adapted to the current drawn by the Mini. A 15A continuous discharge rate is mandatory...

## 11. Voltage calibration

From version 202, the voltage measurement can be calibrated to get a better accuracy.

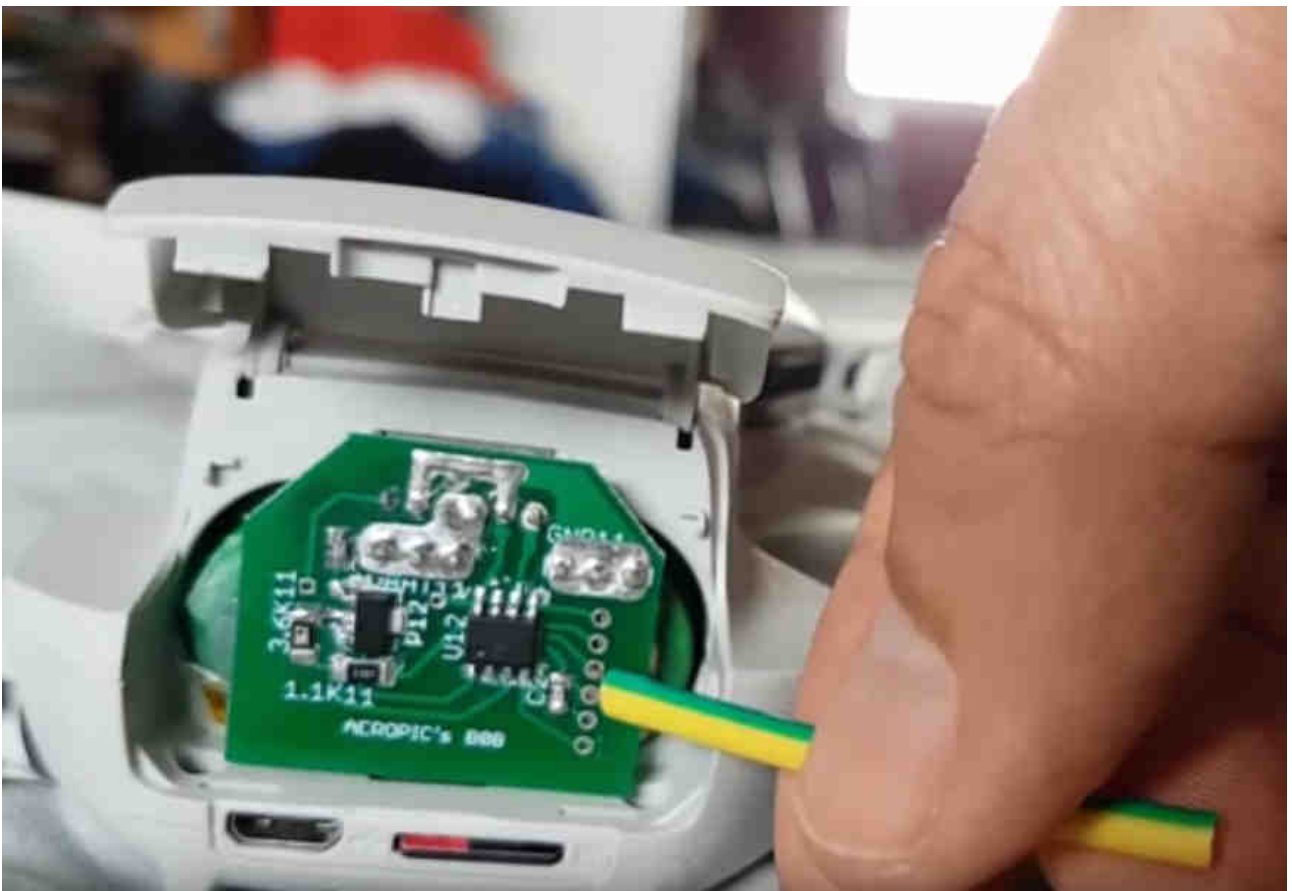
Just have a look to this video :

<https://youtu.be/O1Grdi4CUhM>

Prepare a tool from a spare connector's lyre (it will be needed to short the two middle pins of the vertical holes connector).



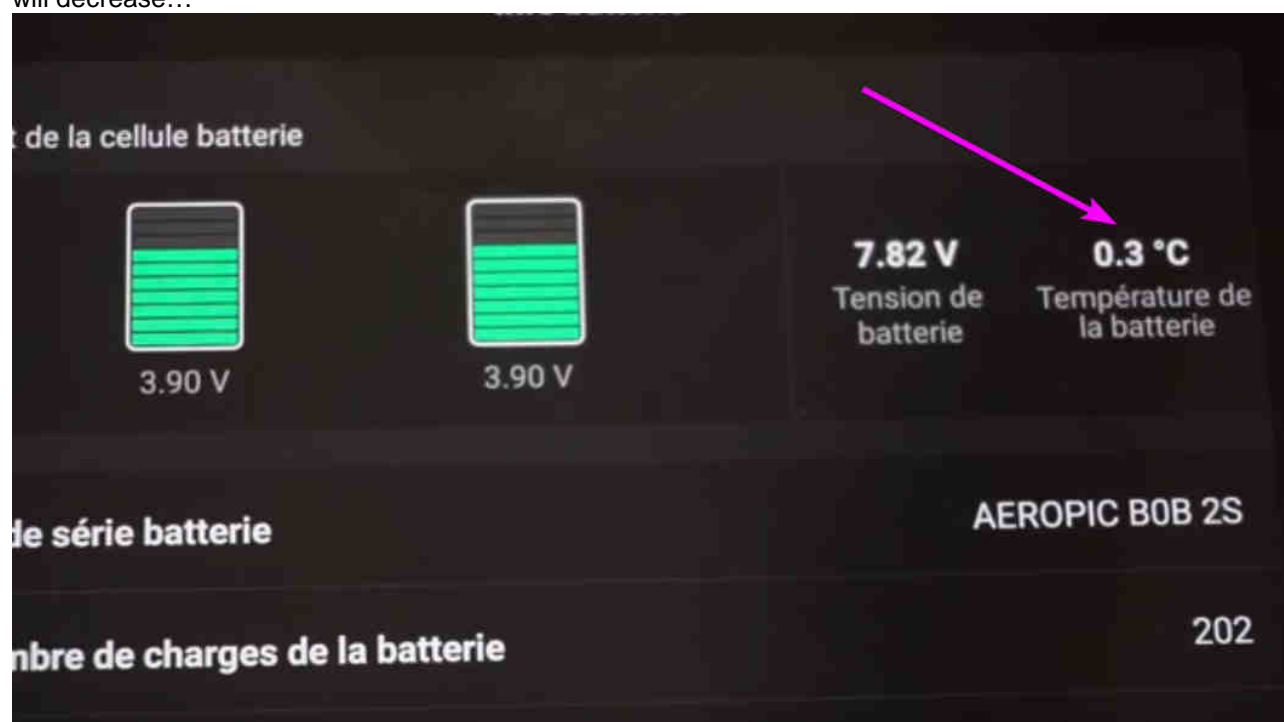
Boot the mini with B0B and its battery and start the DJI fly application.  
Measure the voltage between the two battery's tabs.  
Short the two middle holes :



And you will see the temperature field displaying incrementing or decrementing values. Here 0.3°C. This value is the amount of correction applied to the voltage measurement (0.3 means 0.3% added to the voltage)



When disconnecting the shortcut and doing it again the amount of correction will reverse. If it was climbing it will decrease...



When the voltage is OK. Just remove the tool and B0B will memorize the adjustment value !



## 12. Conclusion

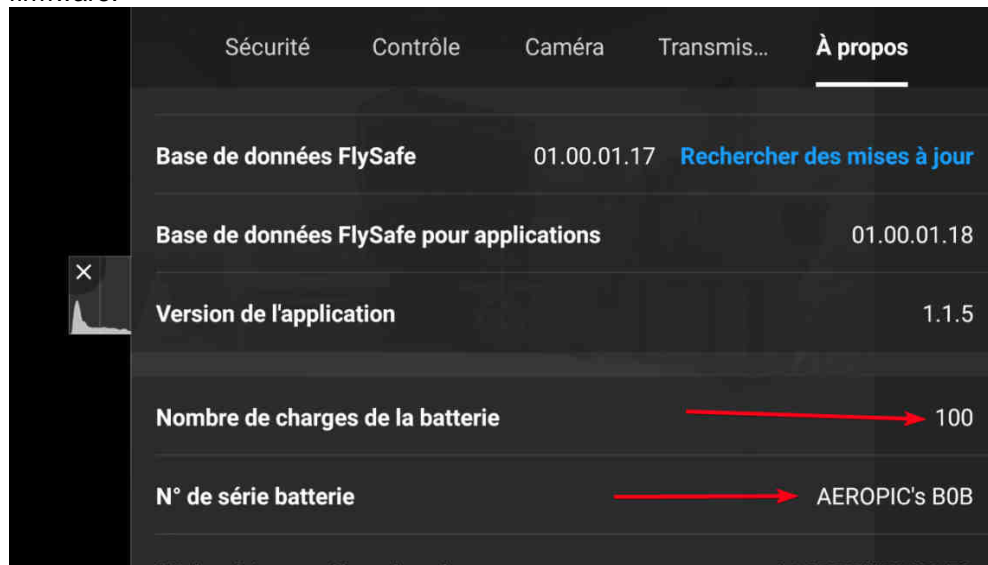
I hope you will like doing this little project and experiment with batteries on your mini.

Be careful when manipulating the battery, do not short the tabs...

It could be wise to carefully insulate all exposed parts...

Use cleverly your B0B, do not go to low in terms of voltage and use B0B at your own risk respecting the regulations, **I cannot be taken for responsible if you damage your drone nor if you create an accident.** With this in mind, should you want to get a B0B or the programmed PIC, please send me a mail at [aeropic\(at\)free.fr](mailto:aeropic(at)free.fr) replace (at) by @ and please put [B0B] into the title so that my antispam software does not trash your email...

Last but not least, if you go to the “about” menu of DJI fly you could see this with the latest versions of firmware:



Number of charges displays the B0B's firmware version...