

Build the spectrometer AS7341

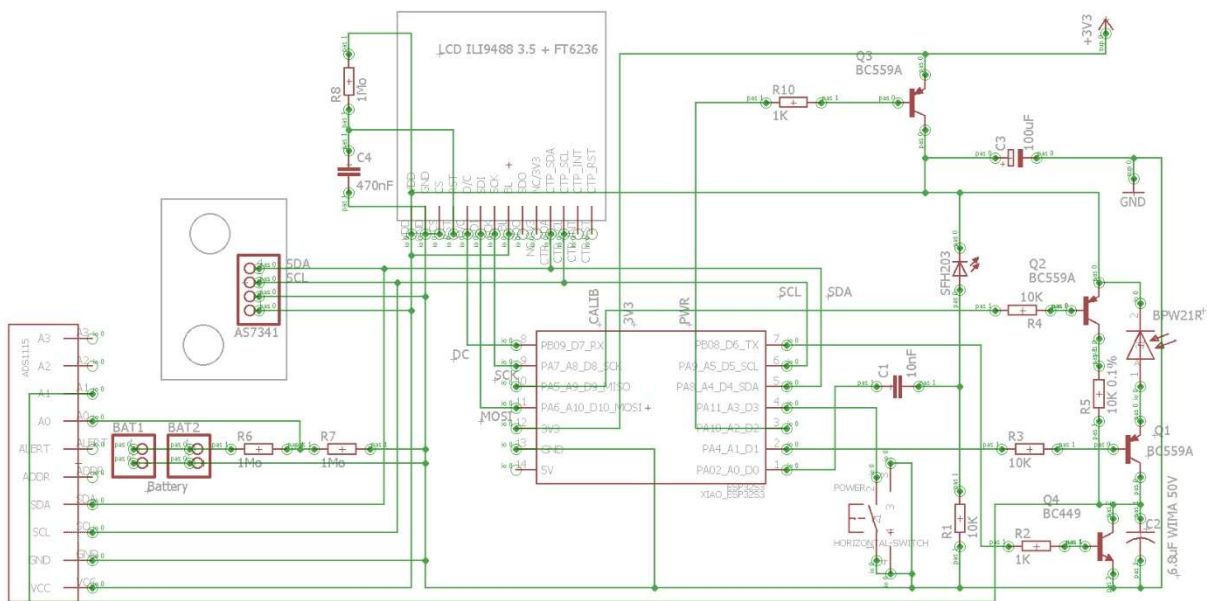
First thing, the printed circuit. I have it manufactured at JLCPCB (<https://jlcpcb.com/>).

They are not expensive and especially in the ZIP, there is a file called "JLCPCB gerber file.ZIP",

You can directly drop it on their website to start manufacturing, it is the ready-made file so no knowledge is required, they have an "Add gerber file" button.

But if you want to have the PCB manufactured elsewhere, I provide the eagle files of the project (board and diagram).

By the way, here is the diagram in the form of an image:



That's it, you have bought and gathered all the components.

Now we will move on to the realization.

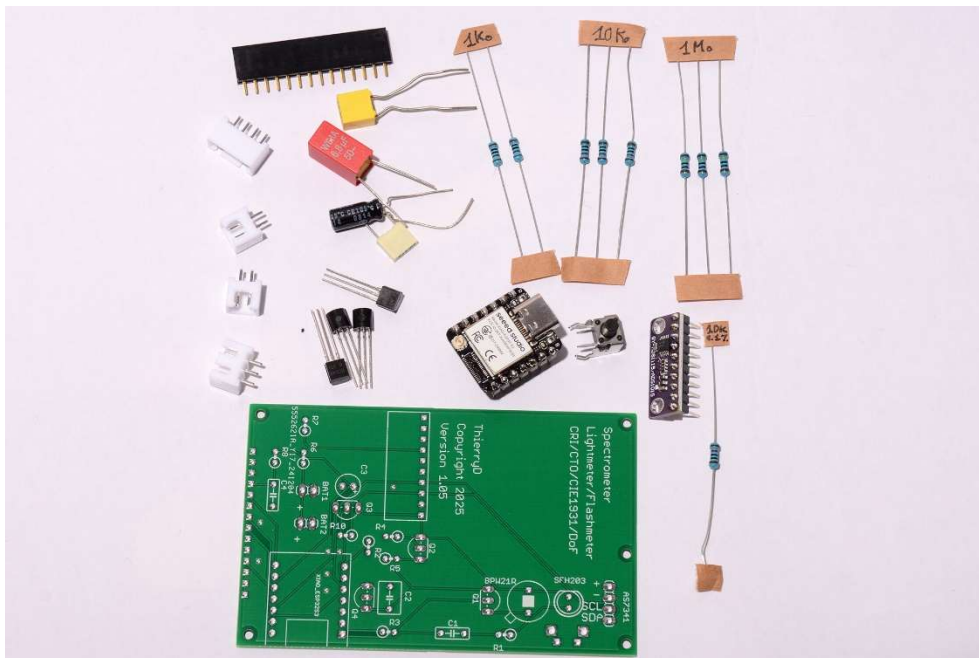
Just one piece of advice, it is very important!!! Take your time.

Check, recheck what you are doing. If you make a mistake, it will be hard to go back once a component is soldered.

Take your time, you are not at two days to make it.

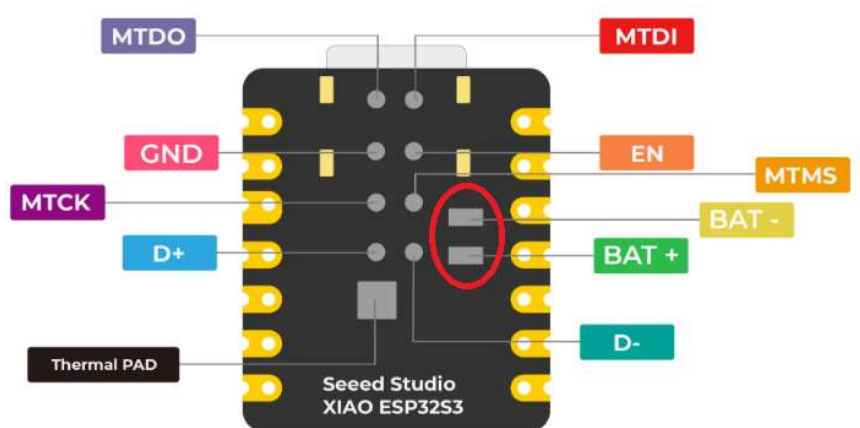
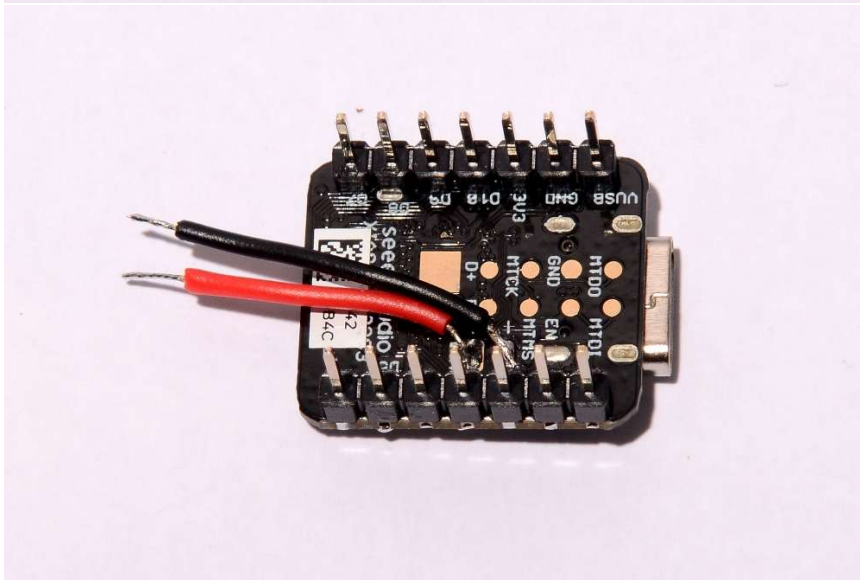
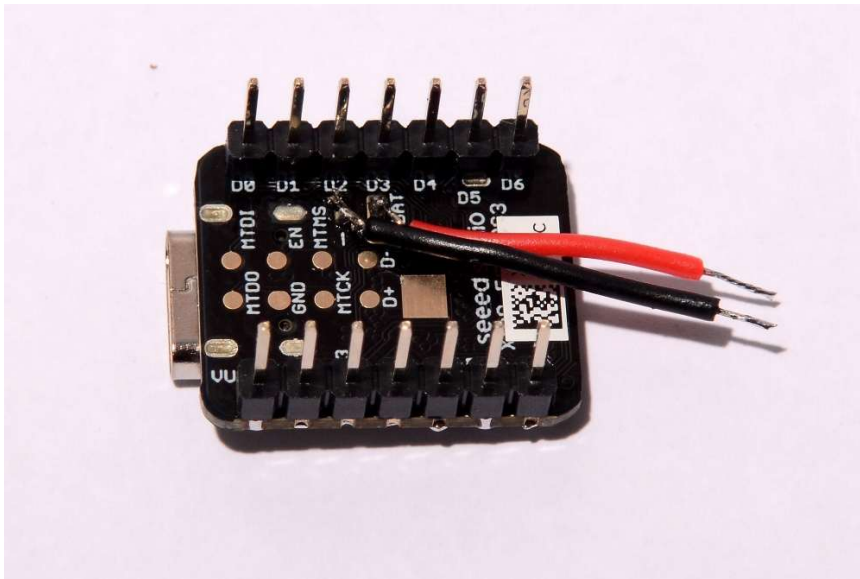
Better two or three days to make it, than fifteen days to find the problem.

So, here are the components gathered:



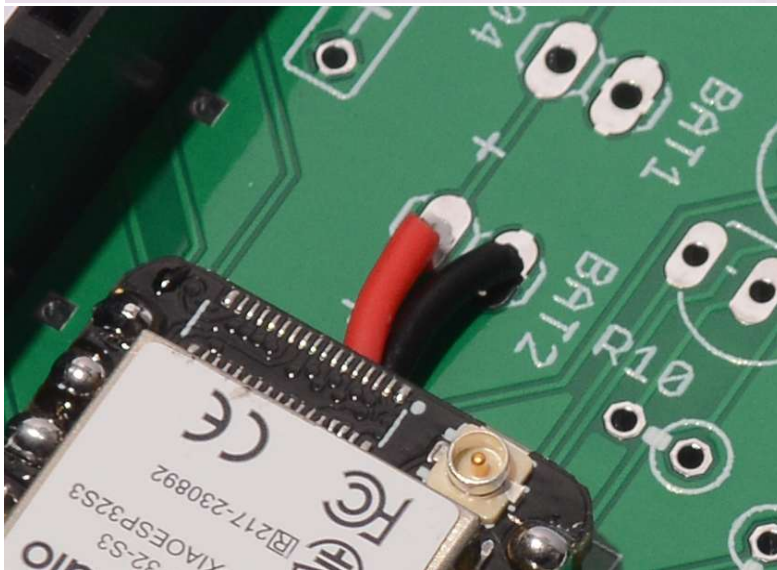
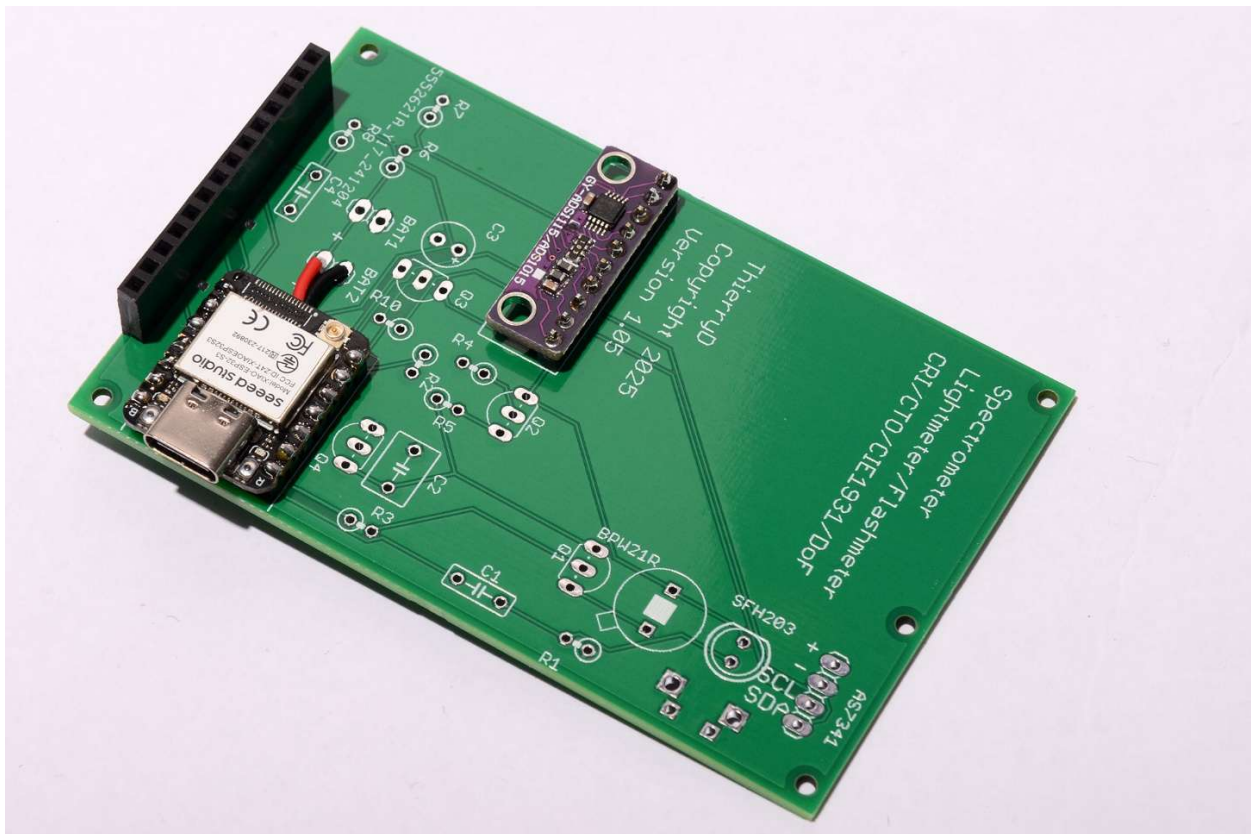
In the photo, I put only the components that must be soldered. So we do not see the two Photodiodes, the AS7341 and the battery.

I remind you that the white XH2.54 connectors that we see on the left in the photo are not mandatory.



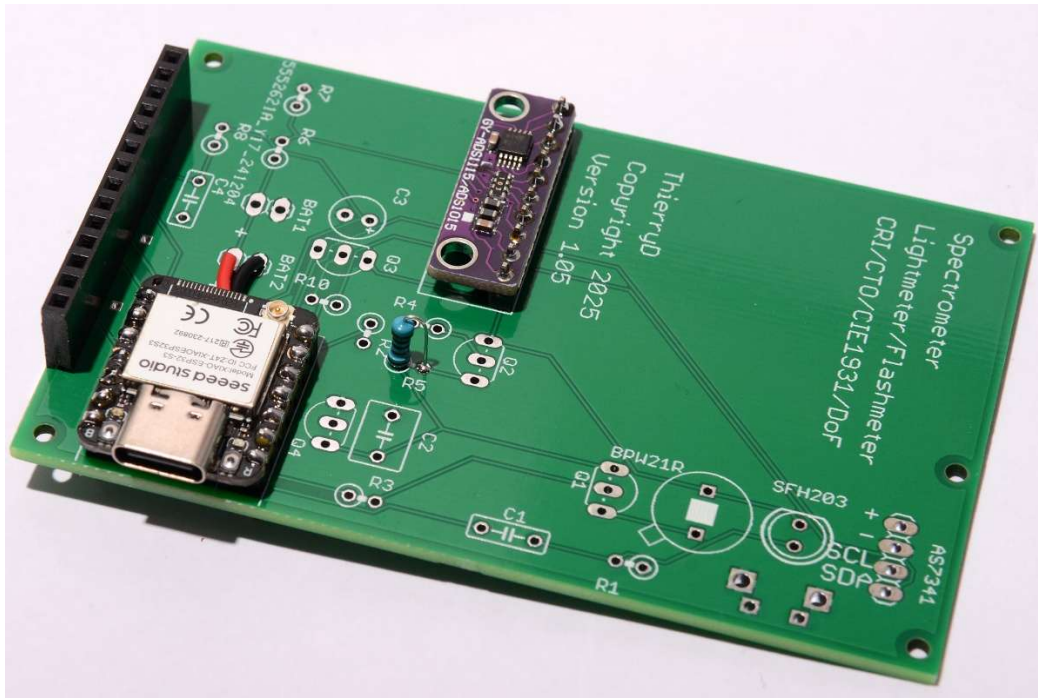
The first thing to do!!!

Very important! You have to solder two wires below the XIAO ESP32S3. These two wires will allow you to charge and use the battery. You won't be able to do it later! You have to do it now. I advise you to put two wires of different colors to identify them well, I put red for the + and black for the -.



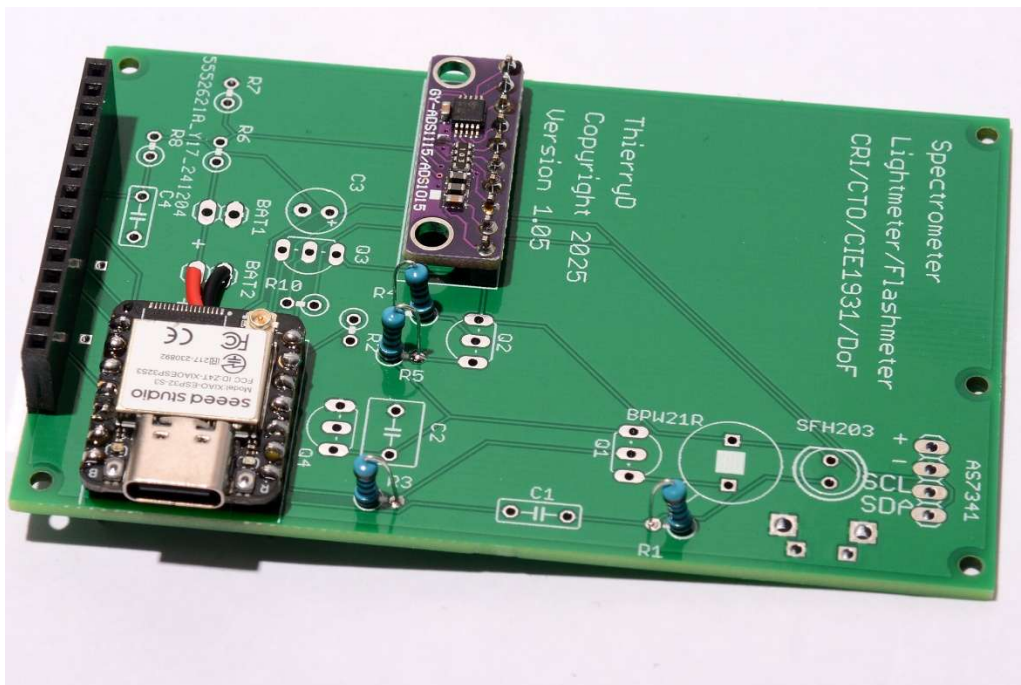
You can now solder the XIAO ESP32S3 on the PCB, solder the two wires of the battery (a small + sign is silkscreened on the PCB). Also solder the ADS1115 converter.

Also solder the black JST 2.54 mm female connector. By default this connector has 40 pins, it will have to be cut because we only need 12 pins.

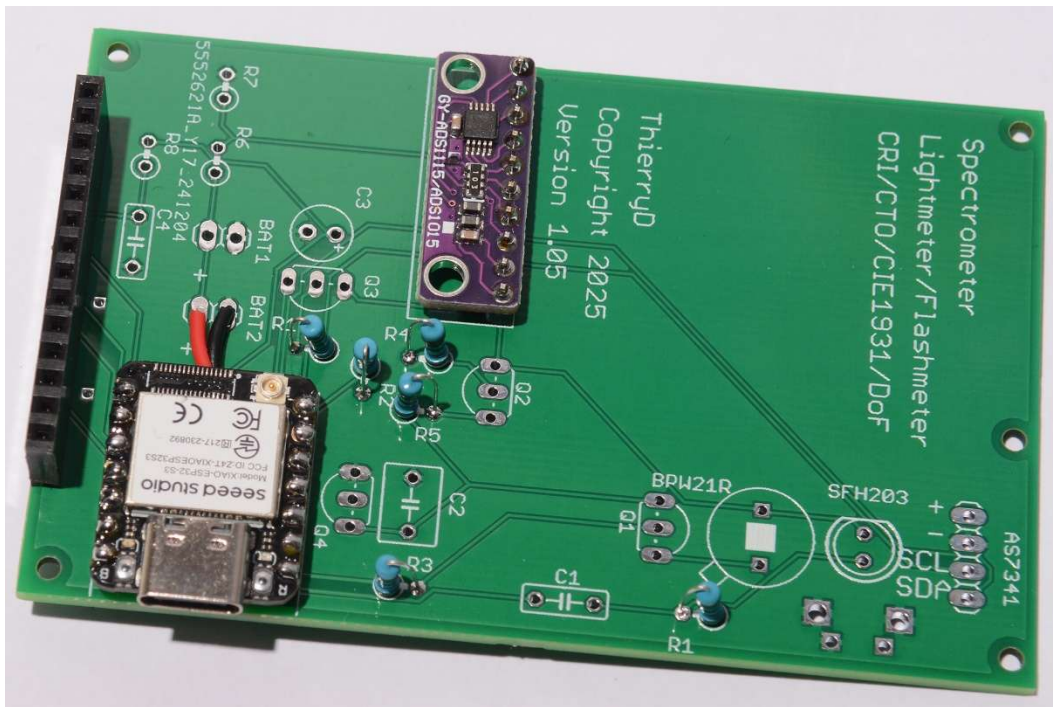


Start by soldering the resistor R5, it is the 10Ko 0.1% resistor.

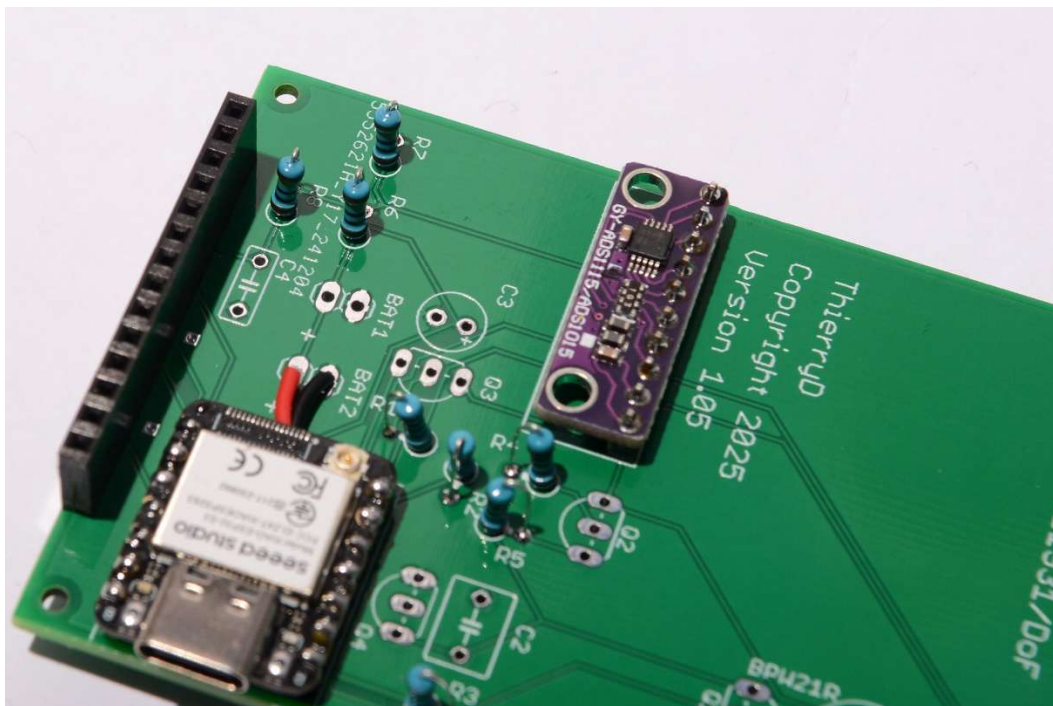
If you bought only 10Ko 0.1% resistors then you can solder them all now, but in case you only have one, start with that one so you don't make a mistake.



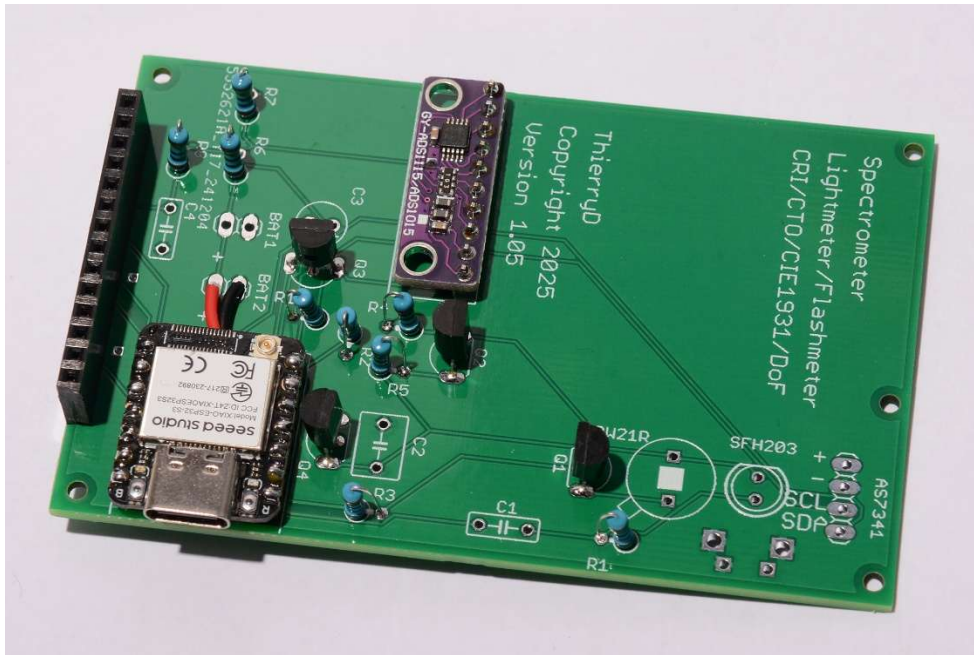
Now solder the other 10K resistors: R1, R3 and R4



Now solder the 1K resistors: R2 and R10

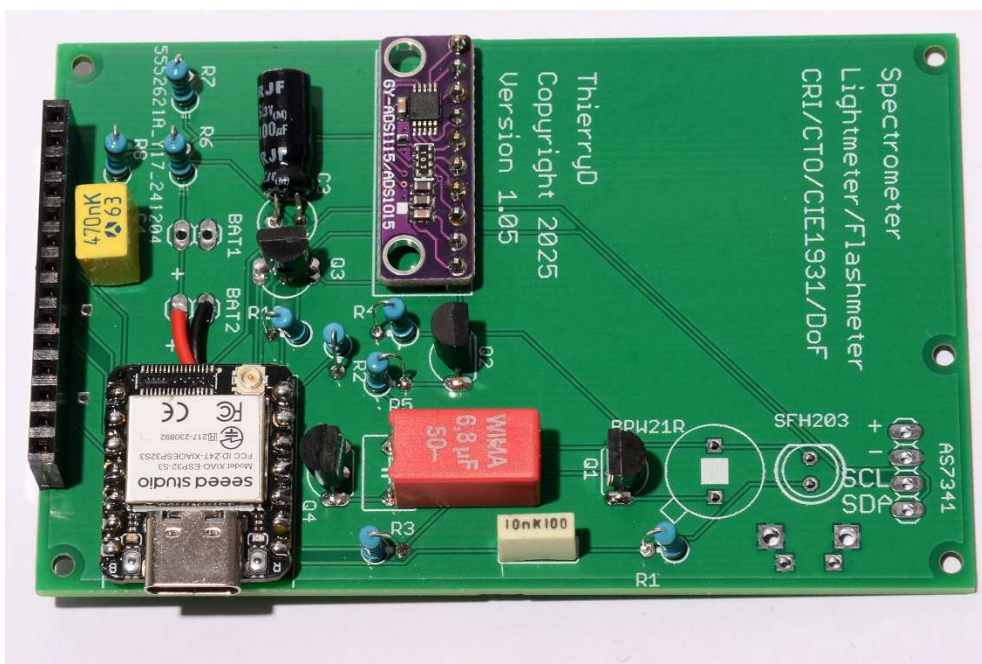


Solder the three 1MB resistors: R6, R7 and R8



Solder the 4 transistors.

Q4 is the BC549 transistor (bottom left in the photo above), Q1, Q2 and Q3 are the 3 BC559 transistors



Solder the 4 capacitors. C1 is the 10nF capacitor, C2 the red WIMA of 6.8 uF, C4 the 470 nF capacitor.

Be careful for C3 the 100 uF capacitor!!! It is a polarized capacitor, this means that there is a direction, a + and a -. This capacitor has a white stripe on one side with a - to identify the - of the +.

Manufacturing of the case

In the ZIP file, I provide a folder (STL 3D printer\Spectrometer) with all the STL files for 3D printing. The files have the STL extension.

There are the files of the case but also the STL files of the calibration supports that I used (STL 3D printer\bracket calibration).

IMPORTANT !!!!! Very important !!!!!

The diffuser must be made of 100% material (100% filling in your 3D printer slicer).

For the rest of the case you can choose a less important filling, but for the solidity of the case and especially the rotating head, I advise you to do everything in 100%.

For the diffuser, it is mandatory to do it in 100%, because otherwise the empty spaces inside risk making light diffraction zones and more or less dense zones.

If you do not have a 3D printer or the possibility in your entourage, there are companies on the internet that can do the prints for you but it will cost a little money.

For manufacturing, I recommend PETG or ABS rather than PLA for resistance to outdoor temperatures.

And yes, if you use this case outdoors and it stays in the sun, its temperature can reach 60 degrees, or even a little more, and PLA does not like heat. PLA starts to deform around 60 degrees. So, my advice is no PLA if you want to use it outdoors and/or the case risks staying in the sun in broad daylight.

The diffuser must be white, it is imperative. Moreover, if you change your filament, remember to really purge the nozzle well to avoid having a white mixed with another color (if for example you had black filament before, you risk having a light gray instead of white). You must therefore purge the nozzle well.

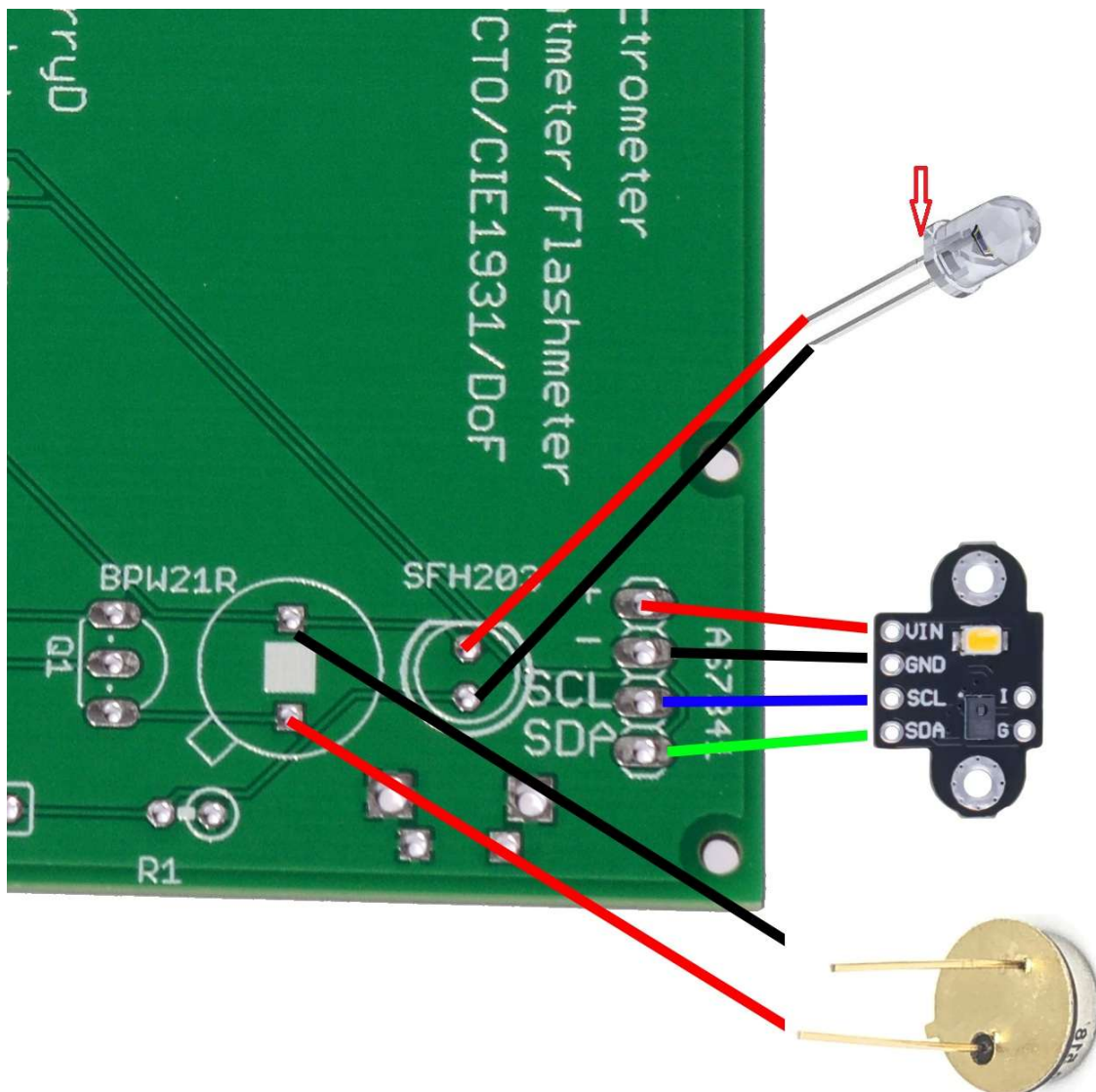
For the rest of the case, it's up to you, you can make an original blue case if you want. Except for the rotating head. The rotating head must be black, otherwise you risk, during the measurement, bringing components of another color, which will necessarily distort the results.

There is a difference in density and therefore transparency between PLA, PETG and ABS. This is why I provide several diffusers of different thicknesses in the ZIP file. To know if your diffuser is good, when you look at the sun through it, you should not discern it, you only need to see that the diffuser has a homogeneous distribution of sunlight. By doing different tests, the 1 mm diffuser is good for PLA, for PETG choose the 1.1 mm diffuser (Head filter XXX mm.stl file).

You will need to solder wires to the two photodiodes and the AS7341. I advise you to use wires of different colors to identify them well.

For my part, I used the wire from an old mouse that no longer worked. There are 4 wires inside a mouse cable and they are all different colors. They also have the advantage of being flexible because you must not forget that the head is rotating so the wires will be subject to twisting.

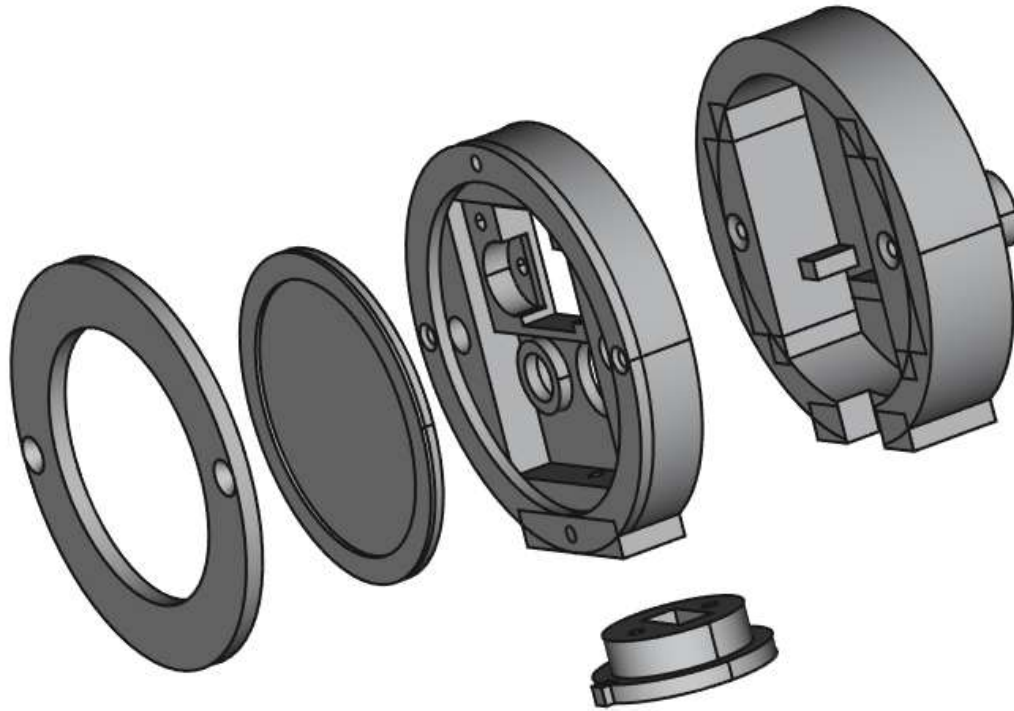
Here is how you should connect the photodiodes and the AS7341 to the PCB:



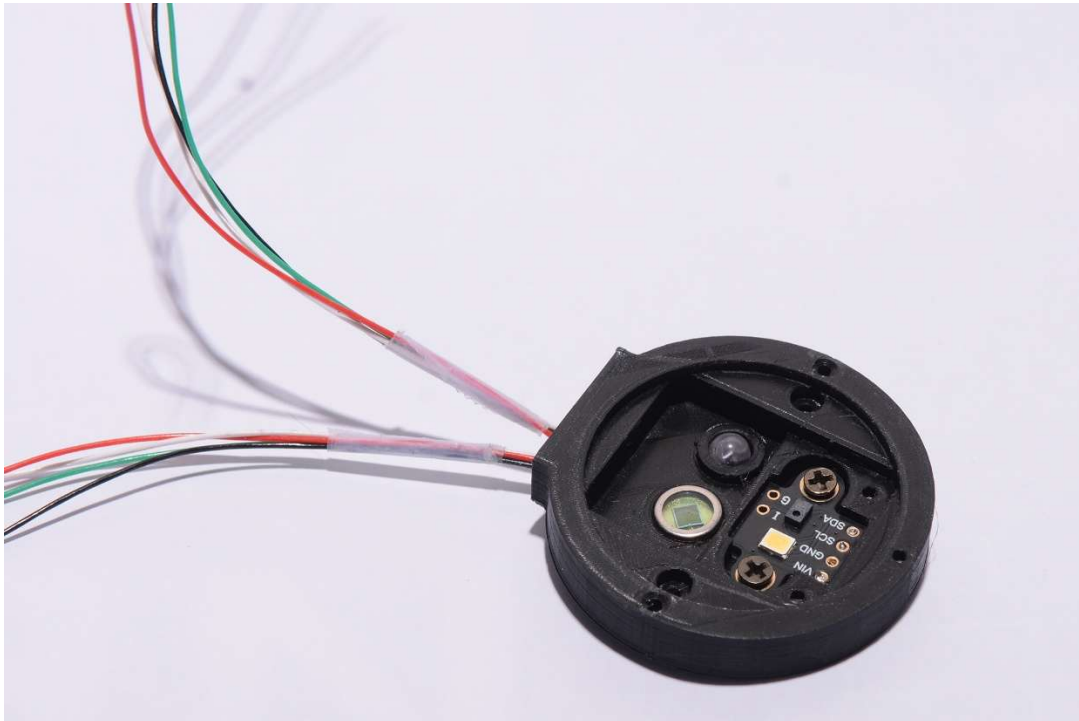


That's it, you have printed or had printed the different parts of the spectrometer, it is time to start the final assembly.

We will start with the assembly of the rotating head.

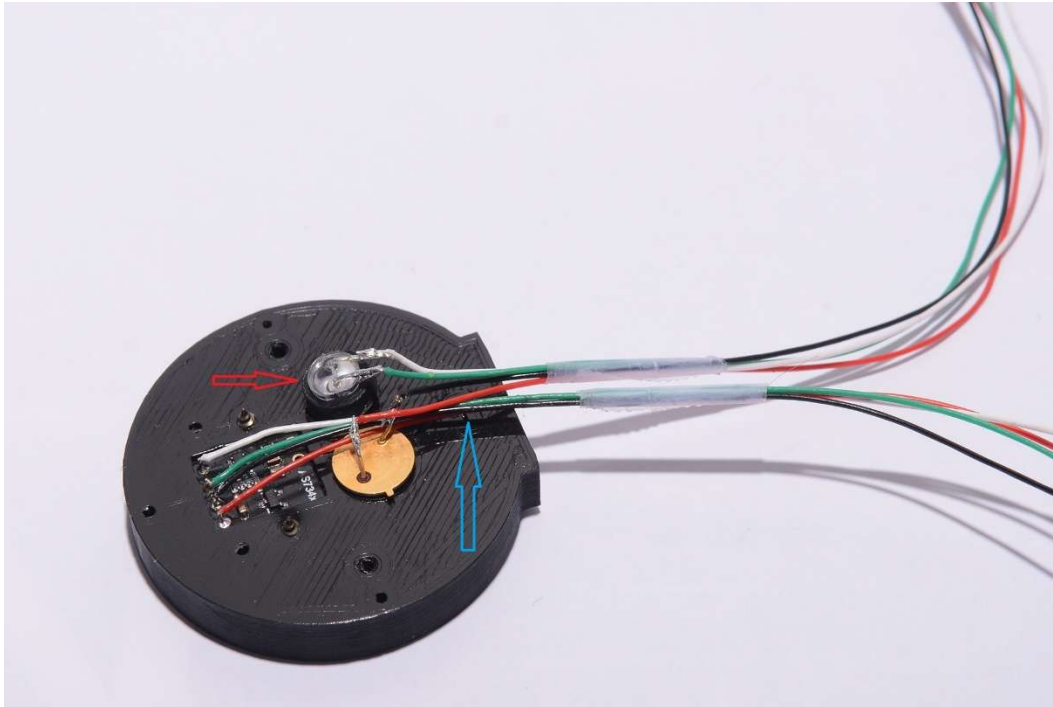


Here is a view of the 5 parts that make up the head. In order, the diffuser retaining disc, the diffuser, the upper part, below the retaining base and finally, on the right, the rear part.

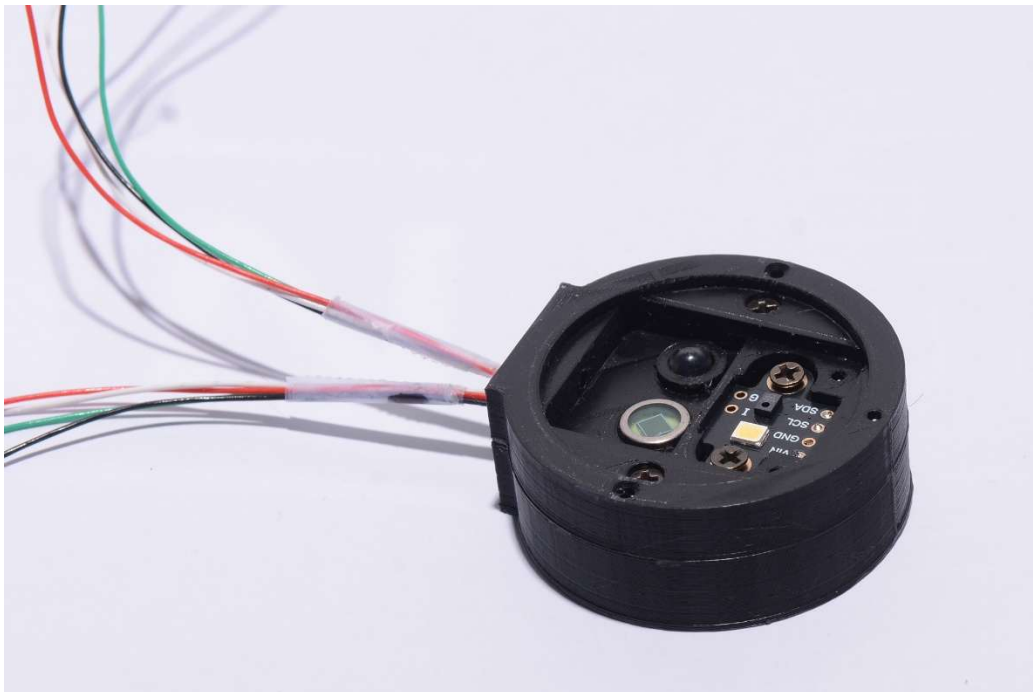


The first thing is to insert the BPW21r photodiode, the SFH203 photodiode and the AS7341 in the upper part of the head (head front.stl).

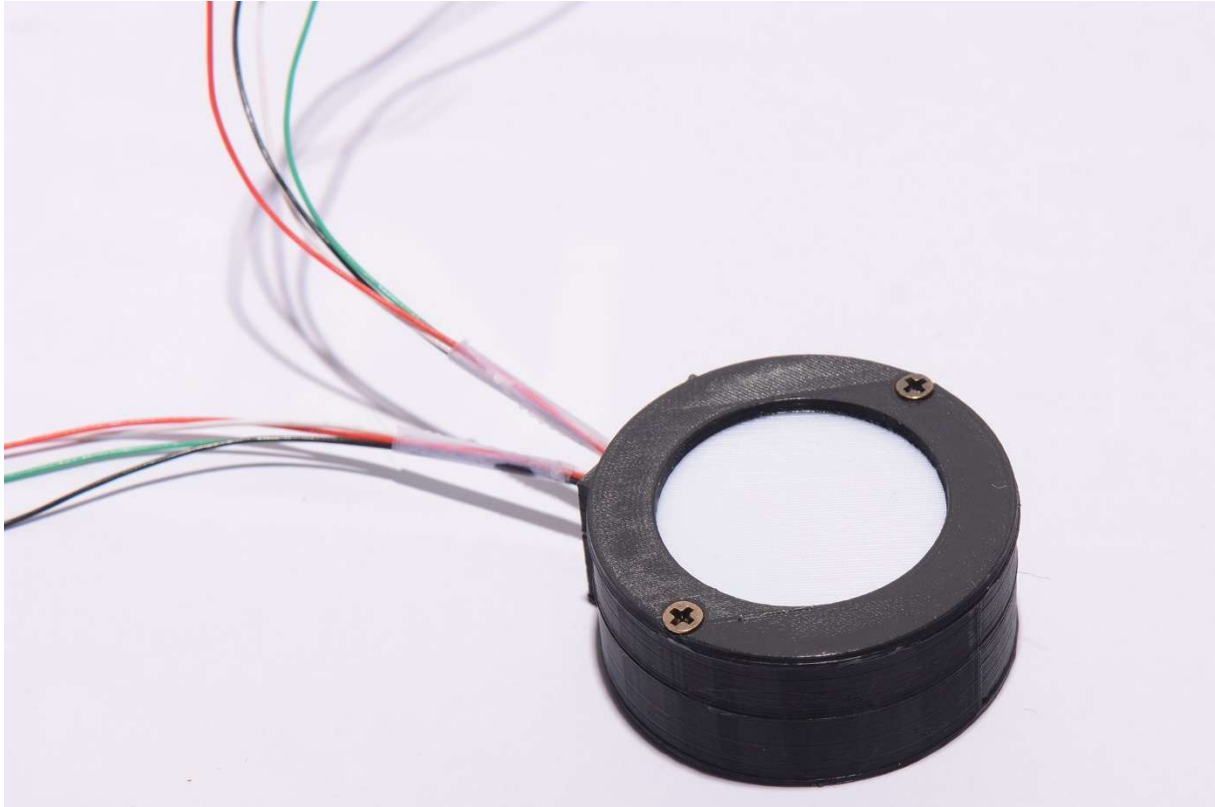
The BPW21r photodiode is just inserted by force, if necessary, slightly enlarge the hole with a cutter. The AS7341 is screwed with small M2 screws. For the SFH203 photodiode it is a little particular due to its length.



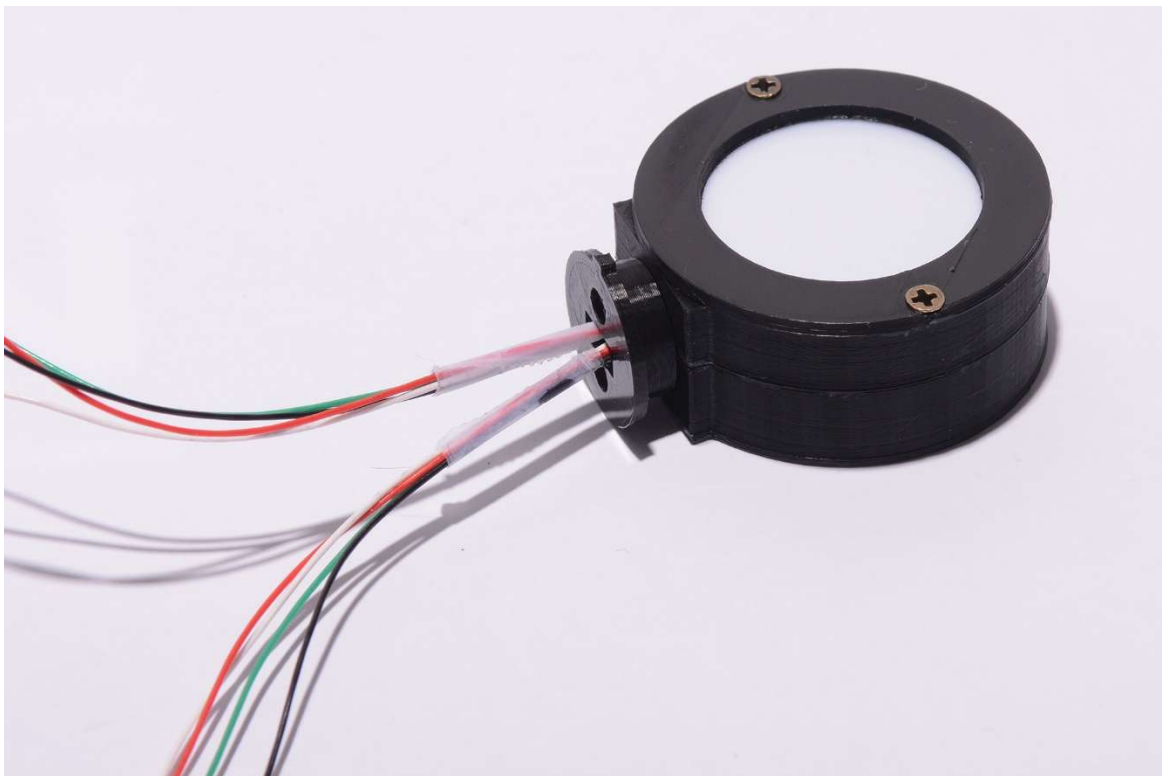
For the SFH203, you need to put a small adapter represented by the red arrow (head SFH203.stl), otherwise you will not be able to put the diffuser. Before putting the back cover of the head, I advise you to glue the wires to the place of the blue arrow, because the head is rotating and over time this risks cutting the wires at the level of the welds that you made on the photodiodes and the AS7341.



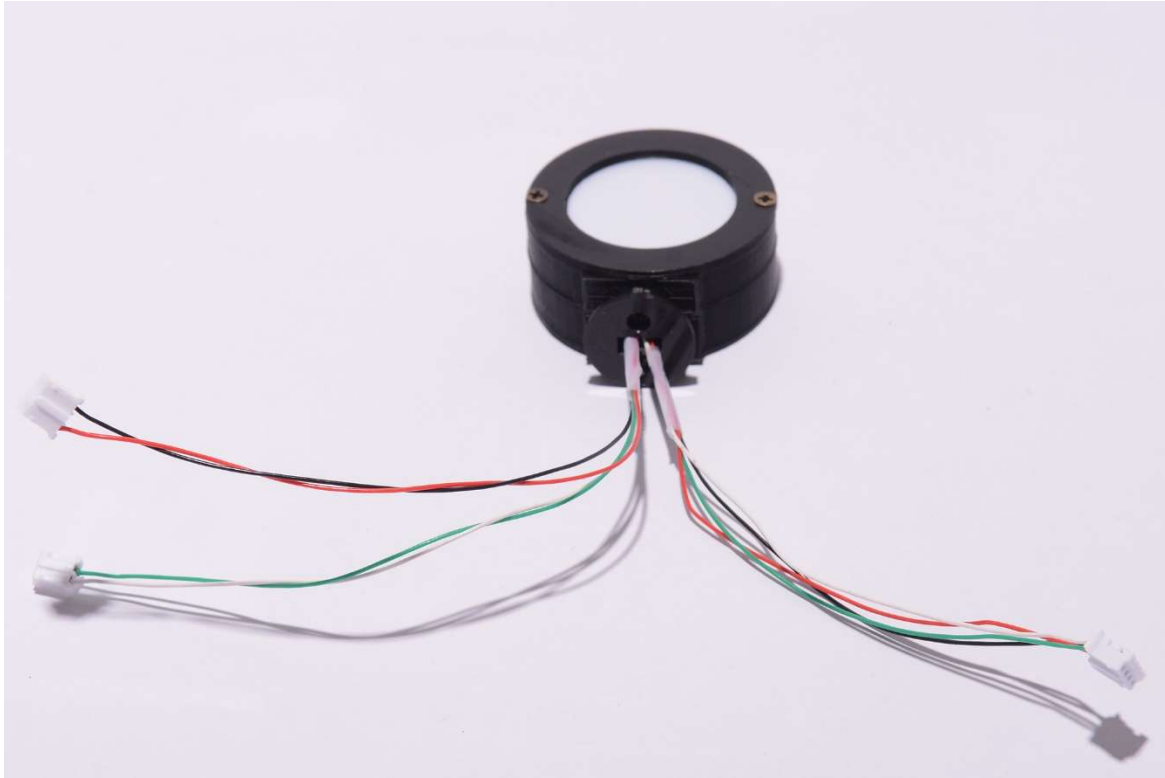
Now you can fix the back of the head with M2 screws (Head back.stl).



Insert the white diffuser and close the head with the diffuser retaining disk which is fixed with two M2 screws (head filter cover.stl).



Now and before putting the white connectors (if you have chosen to use them), you must put the base for holding the head and the case (head shoe.stl). It is also fixed with M2 screws.

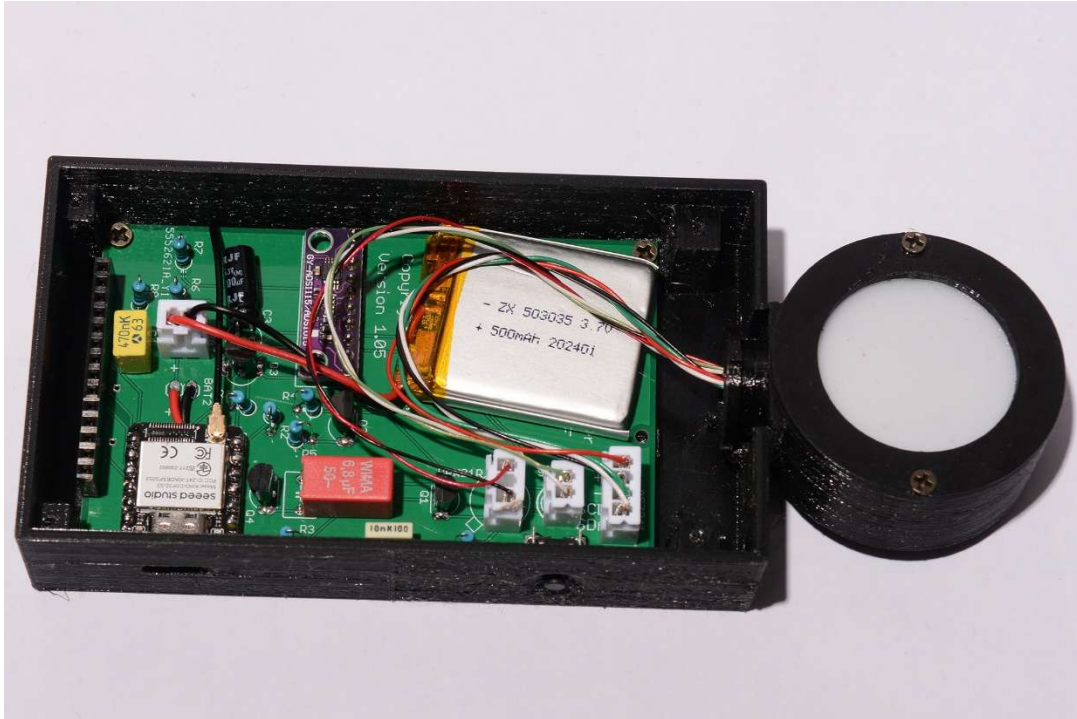


Finally, if you have chosen to use white connectors, you can put them in. Before closing the head, take care to identify your wires!



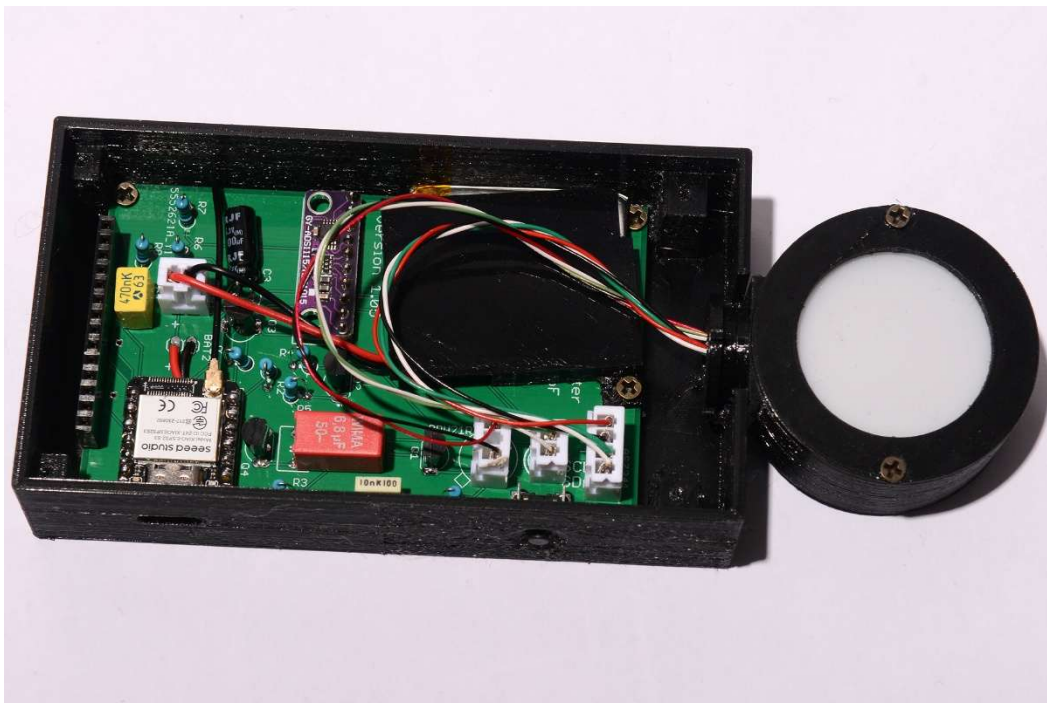
You can now connect the head to the PCB via the connectors (or if you did not use a connector, solder the wires on the PCB).

You will also need to connect the battery, respecting the + and -.



Now you can insert the PCB into the main case and screw it with M2 screws.

There are 4 screws to put in each hole of each corner of the PCB.



Now we will fix the battery cover with an M2 screw.

It does not matter if it is not very straight. The purpose of this battery cover is just to keep the battery in place and that it does not touch the LCD screen that will be on it.



Now you can finally insert the LCD. The pins of the LCD fit into the black connector.



And there you have it! Your spectrometer is ready, well almost...

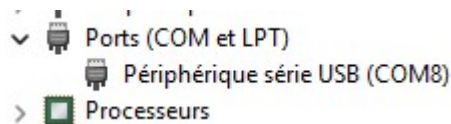
Programming XIAO ESP32S3

Programming the ESP32S3 is done only under Windows. I created a downloader only for Windows. It must be programmed on a computer equipped with Windows 10 or higher.

Now it remains to put the firmware in the XIAO ESP32S3 microcontroller, because for the moment it can not do anything, it has no program (firmware).

Connect the spectrometer to your computer (Windows) and let your computer detect the XIAO ESP32S3 for a few seconds.

If you want to check that the XIAO ESP32S3 has been detected by Windows, launch the Windows "device manager", you should see a COM port appear as below:



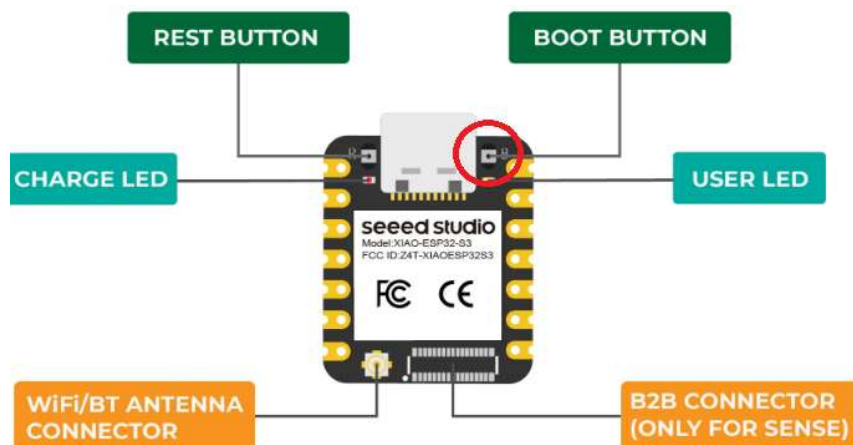
In this example, the ESP32S3 is detected on COM8.

If the ESP32S3 is not detected, you can force it to enter "Boot mode".

To put the XIAO ESP32S3 into "boot mode", unplug the USB cable,

Press the "Boot button" on the ESP32S3 and hold it down.

With the "Boot Button" button pressed, plug the USB cable back in. The XIAO ESP32S3 COM port should now appear in the Windows Device Manager.



If this method does not work, you will have to disconnect the battery, disconnect the USB.

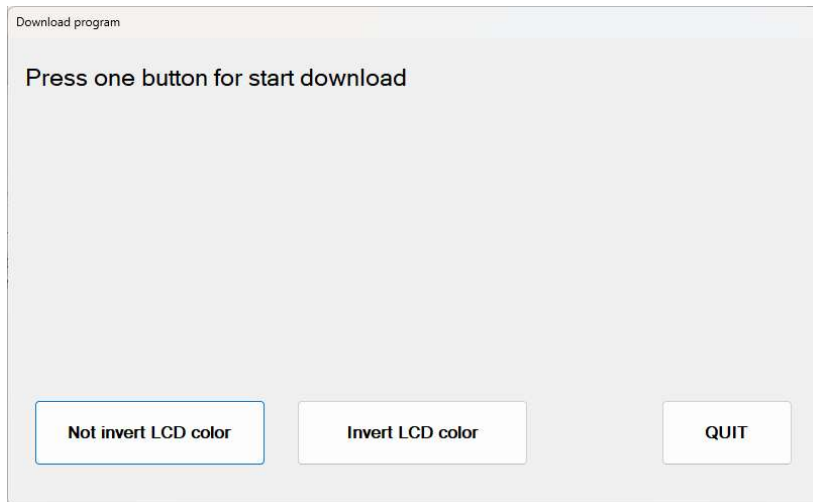
Reconnect the USB, then press "Boot Button" and at the same time "Reset Button".

Release "Reset button" but keep "Boot Button" pressed for one more second.

In the ZIP file, there is a folder "Downloader program", in this folder you will find a file "Downloader.exe".

Run this program "Downloader.exe".

NB: This program does not have any virus, it was made by me and I do not like viruses. Viruses make you sick and you can't use antibiotics to cure yourself (LOL).



There are two buttons to program the XIAO ESP32S3.

I noticed that some manufacturers invert the colors of the LCD display, that is, reds are blues and blues are reds.

So by default, program the XIAO Esp32S3 by clicking on the "Not Invert LCD color" button,

But if when starting the spectrometer, you notice that the display is on a white background, then you can immediately reprogram it by clicking on the "Invert LCD color" button.

For information:

If you want to reprogram the spectrometer, it must be turned on.

If the LCD screen has been correctly detected, the spectrometer has started normally, the standby mode is triggered after 5 minutes, so you have 5 minutes to program it.

If not, please use the "Boot button" method described above.

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