









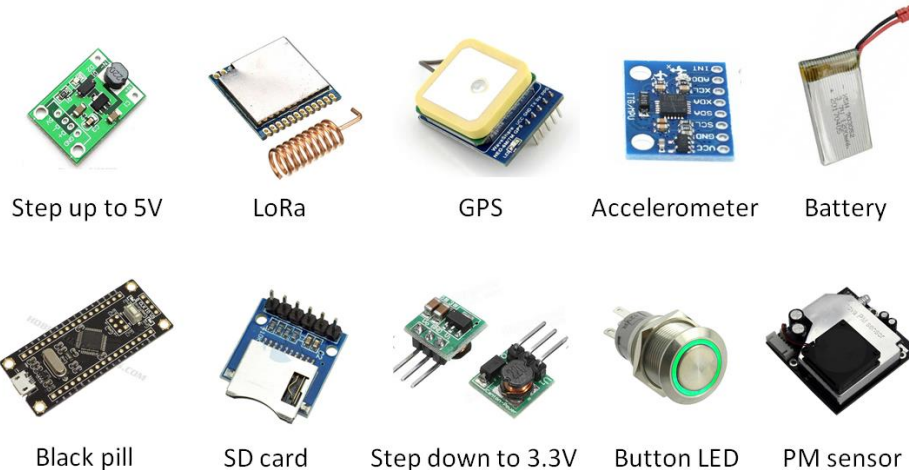


# Assemble your CamBike Sensor hub

## Main components

Below you can find the proposed main components to build the CamBike Sensor hub. They are all off-the-shelf components that can be bought from diverse suppliers. You can find the links of the exact ones we used in our sensor hub in each entry. Feel free to get alternative ones if you prefer!

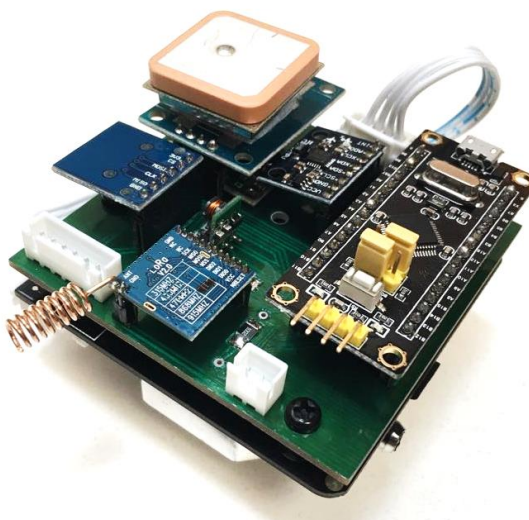
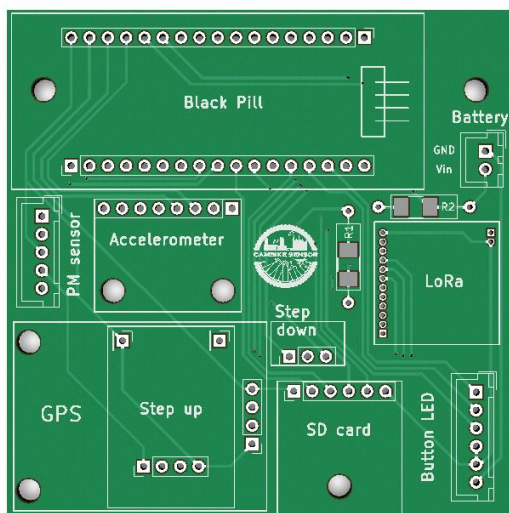
-  **Microcontroller:**  
[STM32F103C8T6](#), also known as STM32 Black Pill.
-  **GPS:**  
[NEO-6M V2 GPS](#), for geo-localisation.
-  **Particulate Matter (PM) sensor:**  
[SDS011](#), which measures PM10 and PM2.5. If you are interested in knowing more about why it is important to measure particulate matter and about how this sensor works, have a look to the Particulate Matter section!
-  **Accelerometer and Gyroscope:**  
Arduino 6-axis [GY-521](#), to infer road quality.
-  **SD card module:**  
Arduino-compatible [SD card module](#) to record all the data.
-  **LoRaWAN radio:**  
[NiceRF Lora1276](#), for low-power wireless transmission of data. If you would like to know more about LoRaWAN and Low-Power Wide-Area Networks (LPWAN) check out this section!
-  **Battery:**  
Lithium polymer flat 3.7V 1200 mAh [battery](#) with protective circuits against over-charge, over-discharge, short-circuit and over-current.
-  **Step-up voltage regulator:**  
[Boost from 1-5 V to 5 V](#), to increase the battery voltage from 3.7 V to 5 V. It is needed to power some of the components, such as the PM sensor.
-  **Step-down voltage regulator:**  
[Buck from 6-3.3 V to 3.3 V](#), to decrease the battery voltage from 3.7 V to 3.3 V and to power most of the components.
-  **Button LED:**  
[RGB LED self-latching push button](#), to be used as a status LED and master switch of the hub.



Most components include pin headers to be soldered in order to plug and use them. Some of them might come with the pins already soldered and some might come without pins. Therefore, be aware that you will probably need to have access to a soldering station and have some spare pin headers to work with.

## Soldering of the Printed Circuit Board (PCB)

We have designed a plug-and-play printed circuit board (PCB) that integrates all the components and fits on the top of the SDS011 PM sensor. The KiCAD files can be found in the PCB folder of our [GitHub repository](#). You can get it printed yourself or get one of our assembly kits!

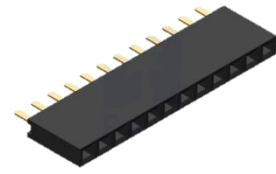


To mount the PCB, you will need a few more components, mainly connectors to plug the previously listed components and screws to hold the hub together. If you decided to buy an already assembled kit from us, you can skip this section.

For one PCB, you need:

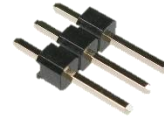
🔌 Female pin headers (pin sockets), with a pitch of 2,54 mm:

- 🔌 2x 17, for the Black Pill
- 🔌 1x 4, for the GPS
- 🔌 1x 8, for the accelerometer
- 🔌 1x 6, for the SD card module



🔌 Male pin headers, with a pitch of 2,54 mm:

- 🔌 4x 1, for the step-up regulator

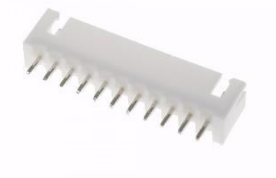


🔌 Female pins with a pitch of 1,27 mm:

- 🔌 1x 12
- 🔌 1x 2, for the LoRa radio

🔌 JST-XH connectors:

- 🔌 1x 2, for the battery
- 🔌 1x 5, for the PM sensor
- 🔌 1x 6, for the RGB button LED



🔌 Resistors:

- 🔌 2x 10 kΩ

**Note:** As long as both are of the same value, any resistor in the order of tens of kΩ works. They can be mounted on the surface ([SMD, 1206](#)) or be conventional ones (through hole resistors).



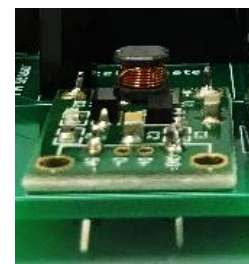
🔌 Mounting hardware M3:

- 🔌 3x hexagonal 6 mm with screw
- 🔌 3x hexagonal 10 mm with screw
- 🔌 1x hexagonal 20 mm with screw
- 🔌 4x screws 6 mm
- 🔌 5x nuts

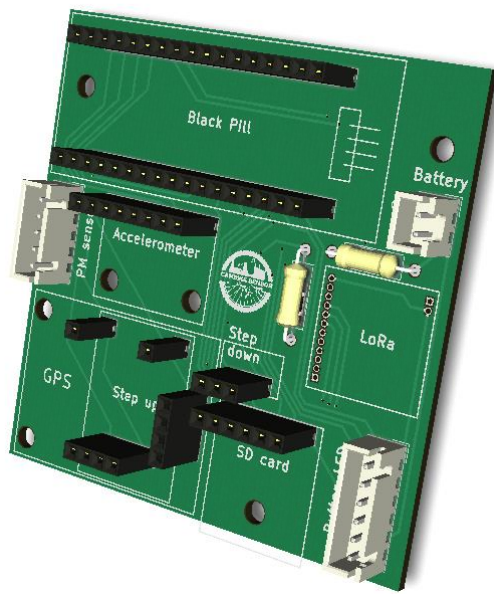


The text on the PCB will guide you on where to solder the pins correspondent to each of the components and where to plug them later on. As a recommendation, you can start with the resistors, and then continue with the pin headers. Make sure that you solder the pins completely perpendicular to the board, otherwise the components won't fit later on!

In order to solder the step up, we recommend soldering it directly to the board using male pins. Introduce the male pin with the plastic bit below the PCB, so it does not add extra height to the step up and allows it to fit underneath the GPS module. Then solder the step up to the pin as it can be seen in the picture. Use for this the four individual male pins.



Once finished, it should look like the picture below.



## Mounting the PCB

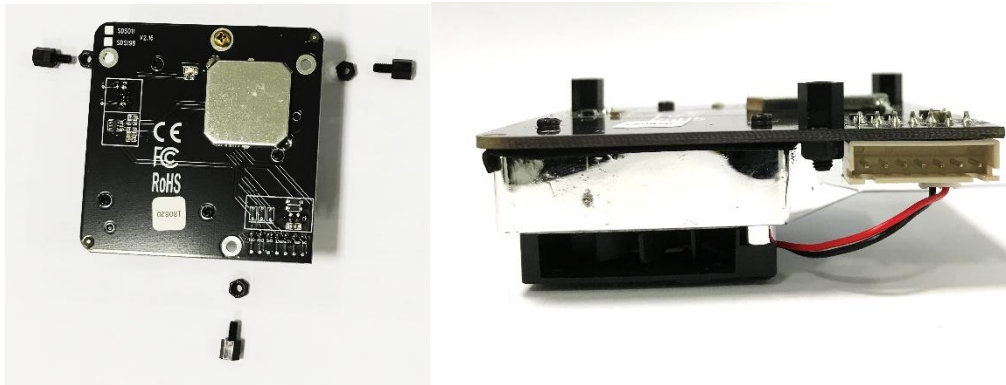


The PCB is mounted on the SDS011 PM sensor using three screws. As it can be seen on the picture, the PM sensor comes with an extra piece of electronics. It is a TTL Serial to USB adaptor, meant to be used to communicate the sensor with a computer by directly plugging it via an USB port. You won't need it to plug the sensor to the PCB, but you do need the cable that comes with it. The converter will be useful later on to flash the code into the microcontroller.

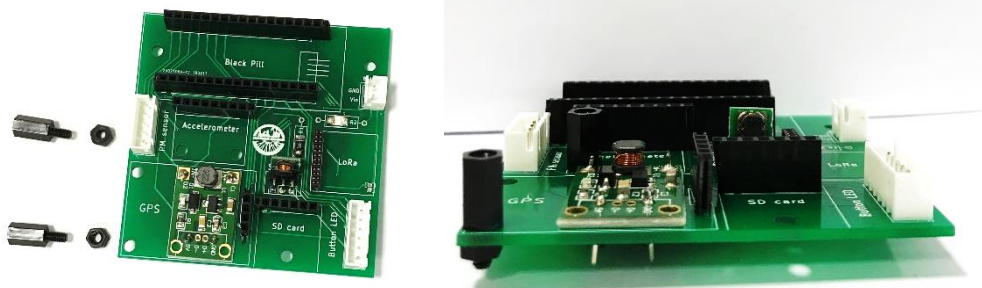




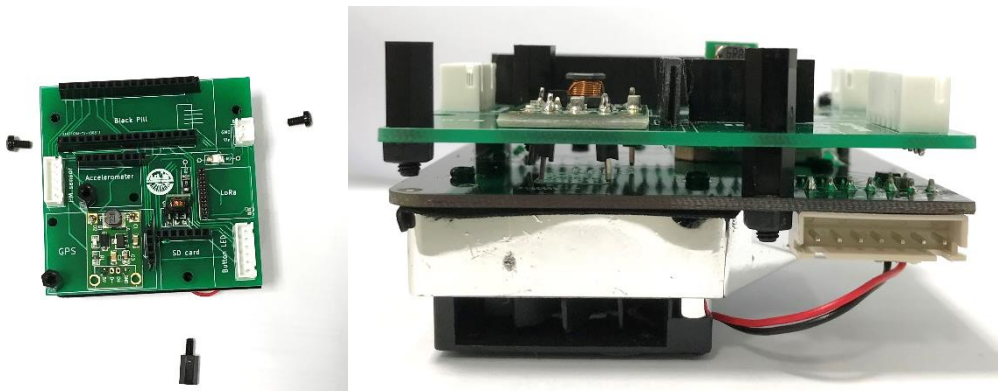
1. Start placing the 3x hexagonal 6mm screws on the PM sensor:



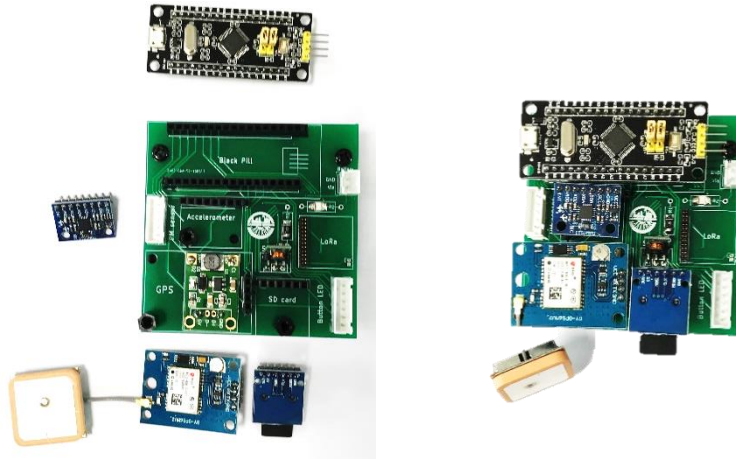
2. Then place the 2x hexagonal 10 mm screws on the PCB, to hold the GPS and accelerometer in place.



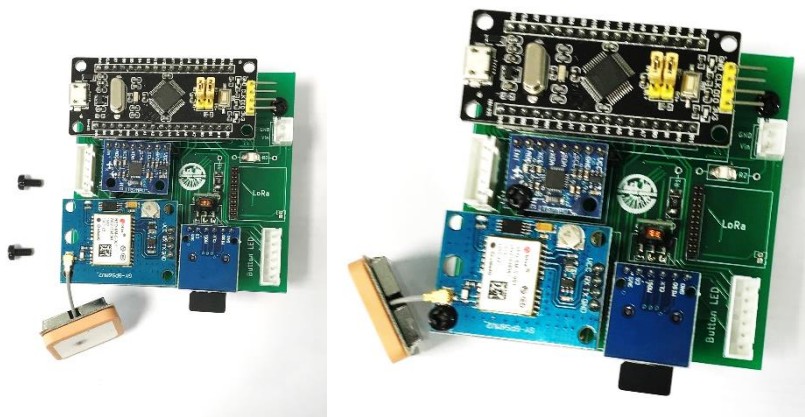
3. Now you can mount the PCB on the PM sensor and screw them together using 2x 6 mm screws for the upper two holes, and 1x hexagonal 10 mm screw for the bottom hole (in the SD card zone). The later will be used as a support for the SD card module.



4. The next step is to plug all the components! Follow the text on the PCB to know where each of them should be placed. Don't forget to plug the GPS antenna with the receiver facing up (as in the picture below). You can also hold the PM sensor cable as we proposed in the pictures, to obtain a more compact hub!



5. Finally, add the 2x 6 mm screws to fix the GPS and the accelerometer.



Once you have your electronics assembled, you can run the first tests to check if it works!

## Checking the sensor hub

You can now plug the battery in its connector. Make sure you are plugging the red cable in Vin and the black one in GND!

There are some LEDs you need to check:



**Microcontroller:**

It has 2 LEDs (either 2 red LEDs, either one blue and one red, depending on the version of the microcontroller). One is permanently on, so that is the first test required. If no lights are on, there is a problem with the connections and you should disconnect the battery and check that everything is correctly plugged. The second LED blinks every time data is read from the PM sensor and saved to the SD card. It takes about 30 s for the sensor hub to initialise, so you need to wait a bit to see if it's working correctly. Once it starts blinking, it blinks every 3s. Sometimes it's on for a very short time, sometimes it stays on longer. Don't worry, it's normal behaviour. The reason is that it waits for the PM sensor to send data and this time is variable!



**Accelerometer:**

It has a green LED that should be permanently on.



#### GPS:

It has a blue LED that blinks when there is connection to the satellites. To check that GPS is working correctly, you need to be outdoors. It takes about a minute for the GPS to lock to the satellites and then it starts blinking. If after a few minutes it still doesn't blink, check the connection of the antenna, or move it around in case there are interferences. If it doesn't improve, then try changing the module.



#### Step-up:

You also should be able to see a red light coming from below the GPS module. It's the step-up regulator, and it should be permanently on.

Once you have checked all the lights, you can remove the SD card and see the data in your computer!

If you have any question about the mounting or functioning, don't doubt to drop us an email at: [info@cambikesensor.net](mailto:info@cambikesensor.net).

## The case

We have designed a laser-cut case made of wood and with a transparent lid, so you can see what's going on with the electronics! You can find the files in the casing folder of our [GitHub repository](#). There is a specific entry about its mounting in the wiki.