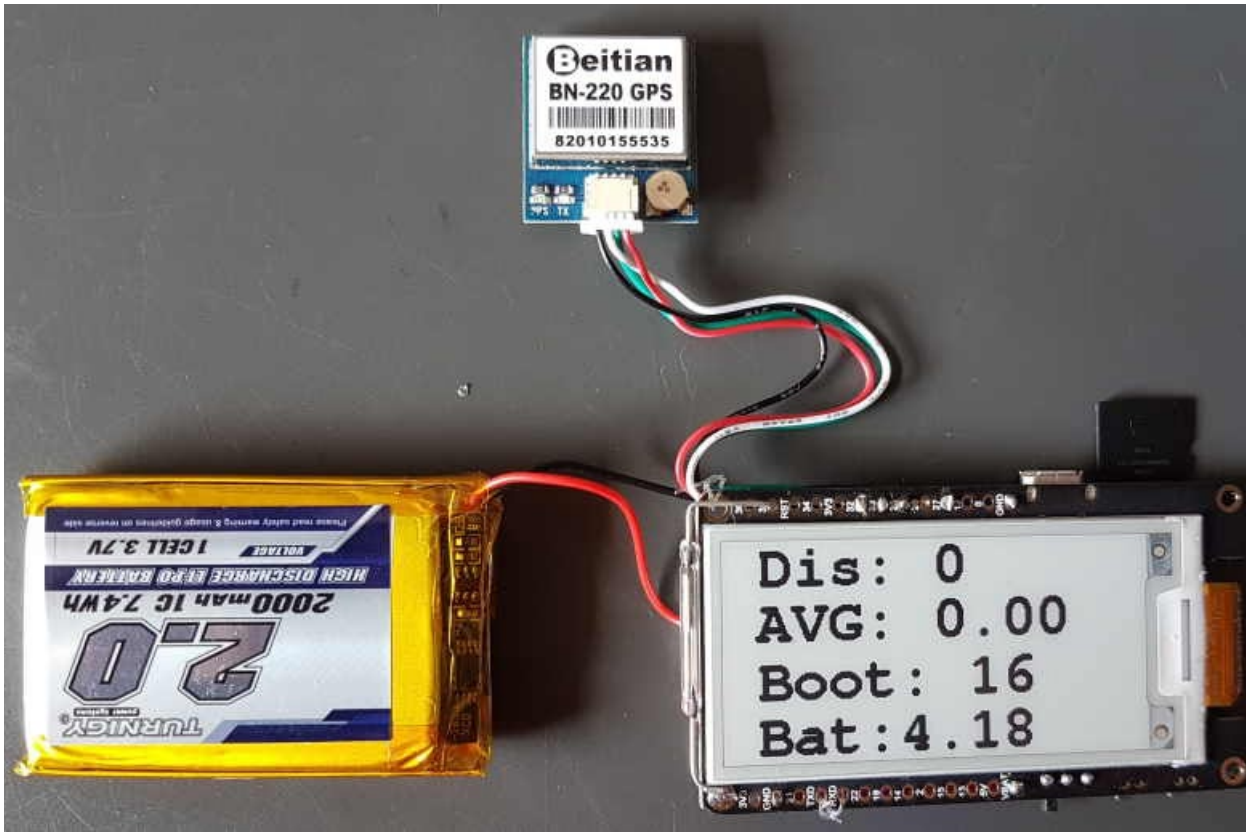


Make your own GPS-logger

This is a guide for making the electrical connections and the mechanical assembly. Before assembly, the T5 board has to be flashed once over the micro USB. Next software updates can be done with the WiFi function ("Over The Air" update).

Part list :

All parts were ordered in China, Banggood or Aliexpress. As links never last that long, I will give here some search terms :

T5-board : **Lilygo TTGO T5**

Micro SD card **: A 16GB micro sd class 10** should be fine.

GPS-module : **Beitain BN220 / BN280** or other Ublox M8N gps

Lipo 2000 mAh with build in protection : **Lipo 103450**

Reed switch

Wireless charging : **DIY wireless charging receiver**

Electrical box : **Clear Transparent/ White Waterproof Plastic Electronic Instrument Project Cover Box Enclosure Case 85x58x33mm**

Alternative **: GoPro casing Hero7/8 or Hero 9/10 !!**

Software

All software is now open source and available on github :

https://github.com/RP6conrad/ESP-GPS-Logger

Necessary toolings

Standard electronic tools are usable :

- Soldering iron with a fine tip.
- Standard solder wire (with lead, 60/40) with resin core. Leadfree solder could also be used, but is more tricky to solder.
- Pliers, stripping tools

Connection cable gps-module to T5-screen

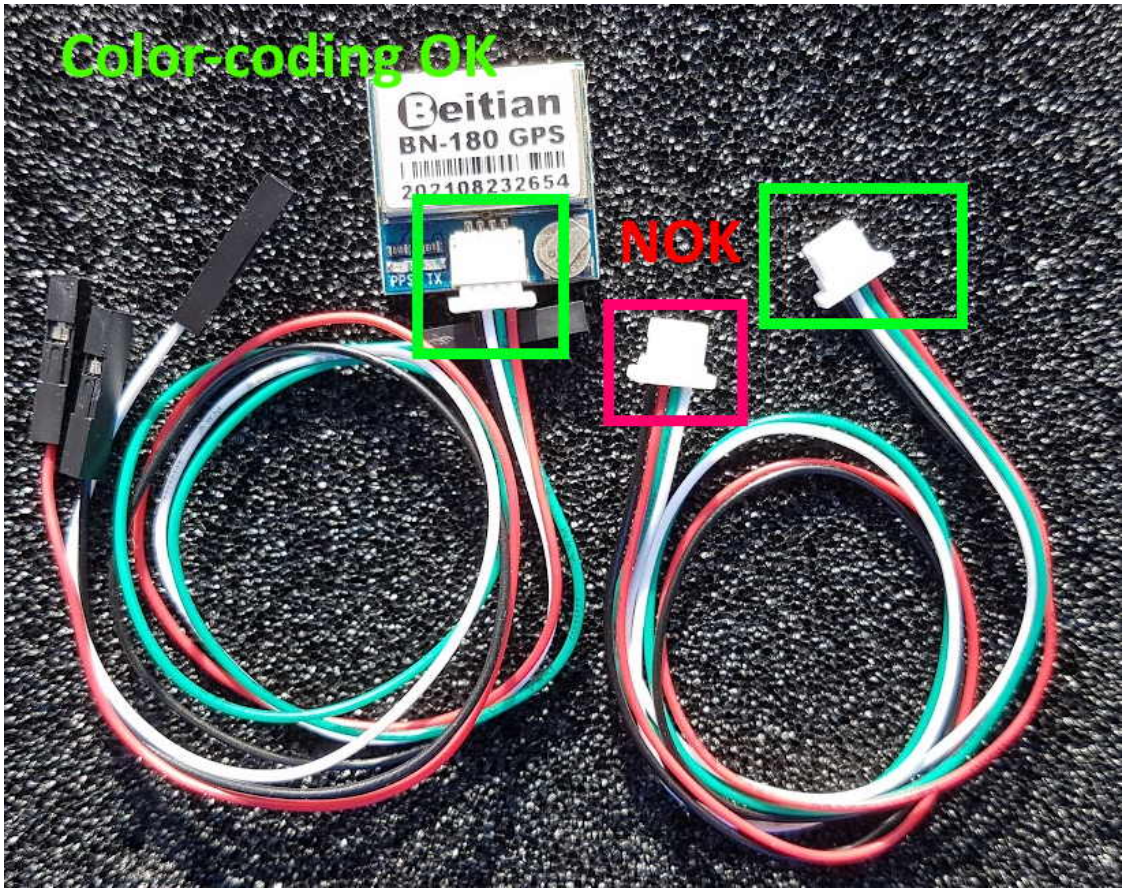
1. The Beitian BN280 has a connector with 6 wires :
    a. V+ (Vcc), this is the positive power supply, RED
    b. GND, this is the negative power supply, BLACK
    c. Tx, Serial Transmit, WHITE
    d. Rx, Serial Receive, GREEN
    e. SDA, not used, can be removed, GREY
    f. SCL, not used, can be removed, YELLOW
2. The Beitian BN220 has a connector with 4 wires :
    a. V+ (Vcc), this is the positive power supply, RED
    b. GND, this is the negative power supply, BLACK
    c. Tx, Serial Transmit, WHITE
    d. Rx, Serial Receive, GREEN

The wires that are not used can be removed by lifting the locking tap on the connector with a very small screwdriver, or you can cut them with a sharp plier. With my modules, the end of the wires were already stripped and tinned.

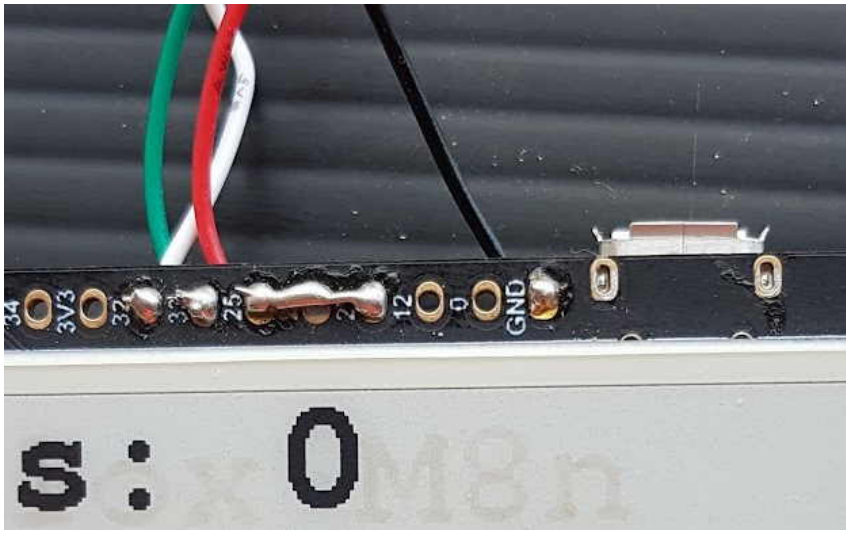
The wires must be stripped over 3mm to 5mm. Here you see the stripped wires in the correct position :

- WHITE goes to 32
- GREEN goes to 33
- RED goes to 25, 26 and 27 (has to be connected with a solder bridge)
- BLACK goes to GND
- YELLOW and GREY are removed from the connector, are not used.

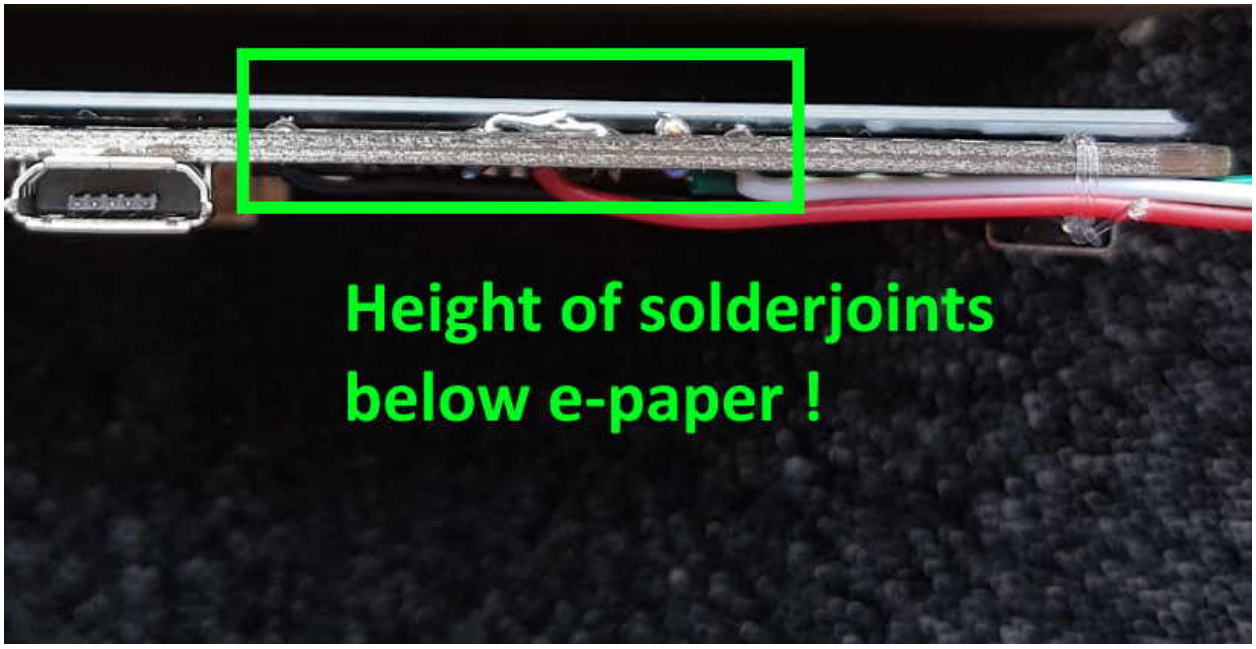
- Check the color coding on the GPS-side ! The connectors are not identical on boths sides !



The soldering is done on the other side :

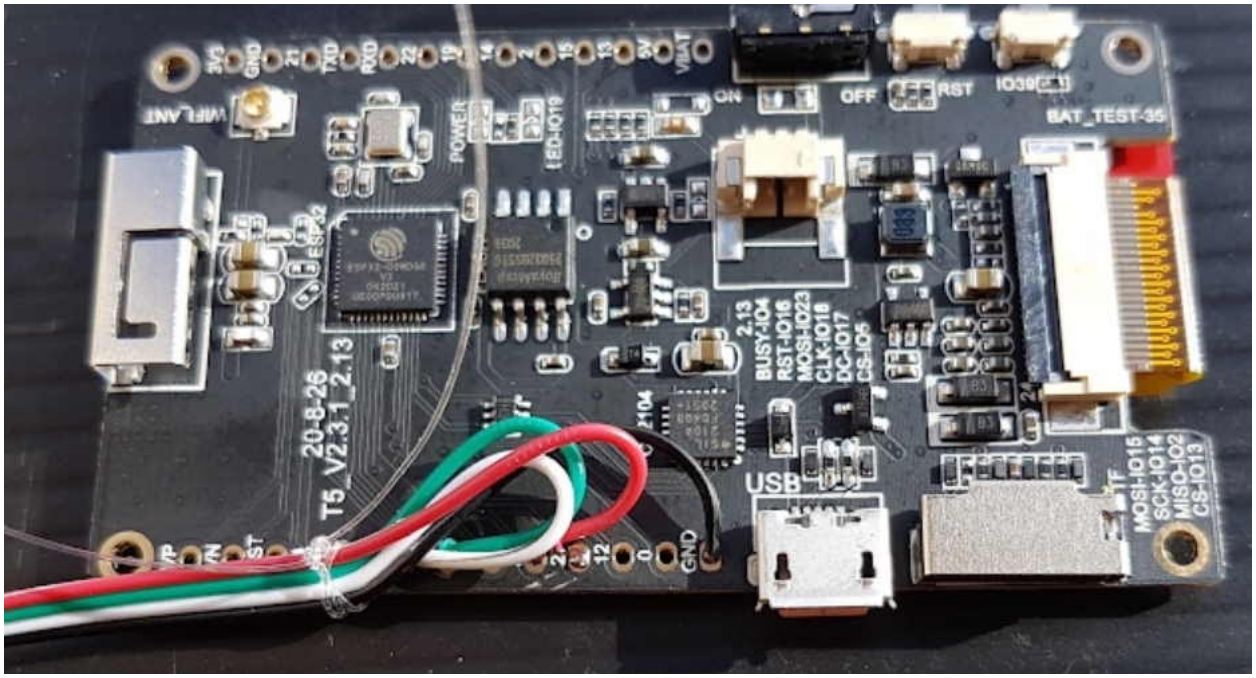


After soldering, check the heigth of the protruding wires, if necessary cut them shorter (the screen has to be in flat contact with the case).



Securing the wires :

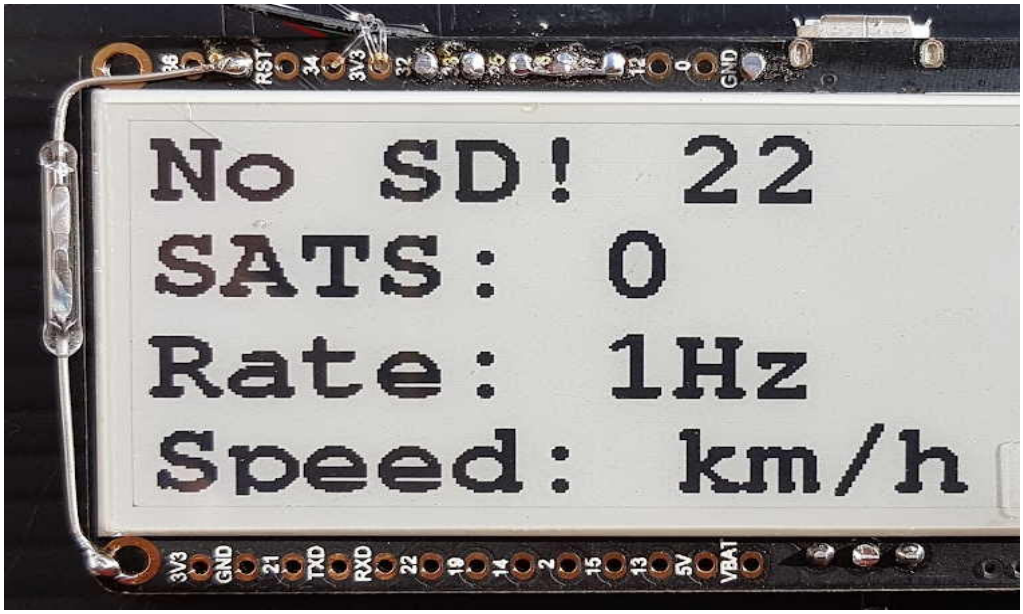
The soldered wires are fragile at the solderjoint, so I advice to secure them with some nylon string :



Soldering the reed switch

The reed switch must be connected between GPIO39 (S_VN) and GND. The mounting holes are all grounded, so you can use these as GND. The upper mounting hole should not touch the metal wire of the reed switch, so bend it away or use some insulation.

A second(optional) reed switch can be connected between GPIO12 and GND. With this switch, configurable statistic screens can be chosen.



Connect the lipo battery to the T5-connector

The lipo battery comes with a standard JST connector, but the T5 board has a smaller connector. I just cut the standard connector of the lipo and solder the T5-connector on the wires. Carefull, never cut the red and black wire from the lipo together (short circuit) !!

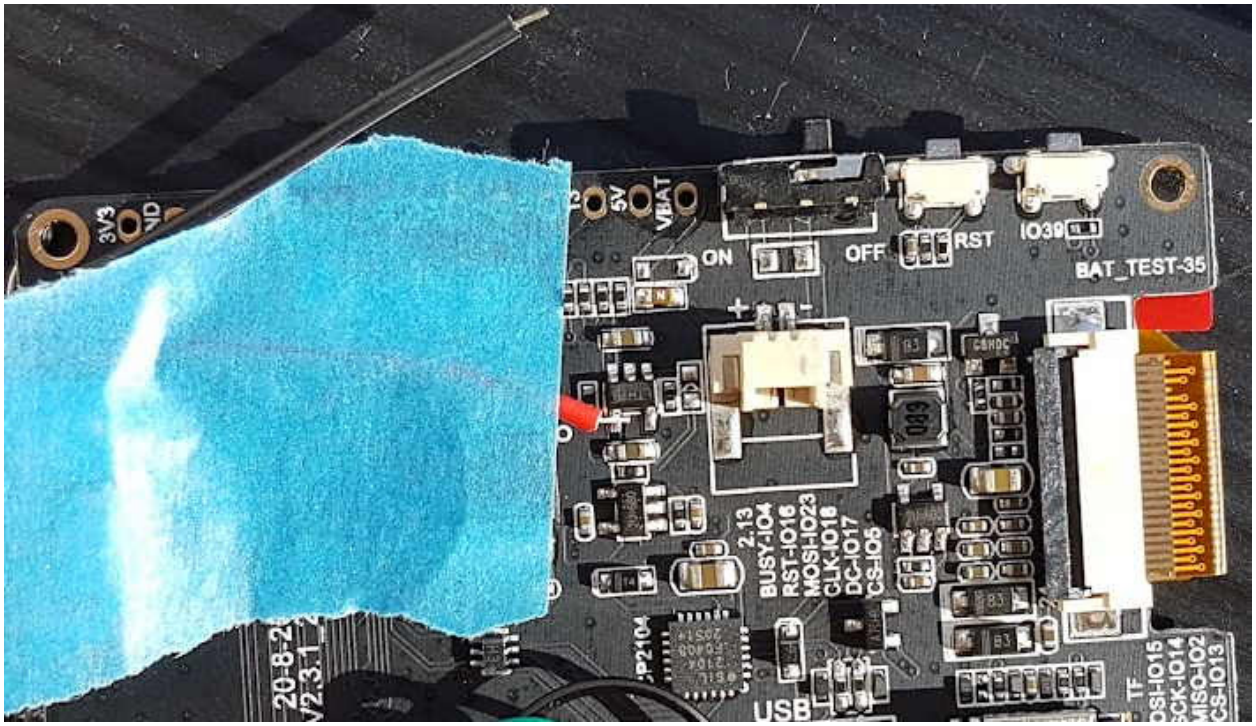
Here you see the soldered connection. With some heat shrink tubing, they can be isolated (very important, danger of short circuit).

It is also possible to solder the lipo wires directly to the T5-board, RED wire to VBAT and BLACK wire to GND. Unfortunately, the lipo wires are too short, so you need an extension anyway.

Connect the wireless charging PCB to the T5-board

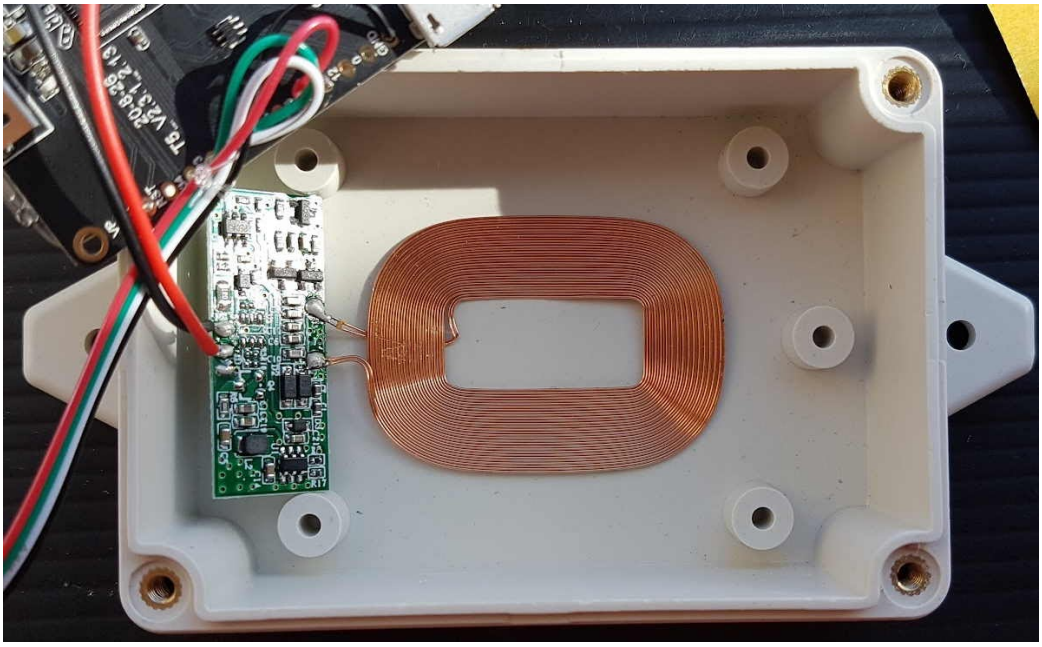
The T5 has a lipo charge controller which is only connected to the Vcc of the micro USB connection. This means that you have to solder the RED wire from the charging PCB directly to the charge controller itself ! The BLACK wire from the charge controller can be soldered to a GND connection.

I advice to use some tape as fixture for the RED wire, and a small solder tip ! The BLACK wire can be soldered to the free GND (on the picture upper side, next to the 3V3).

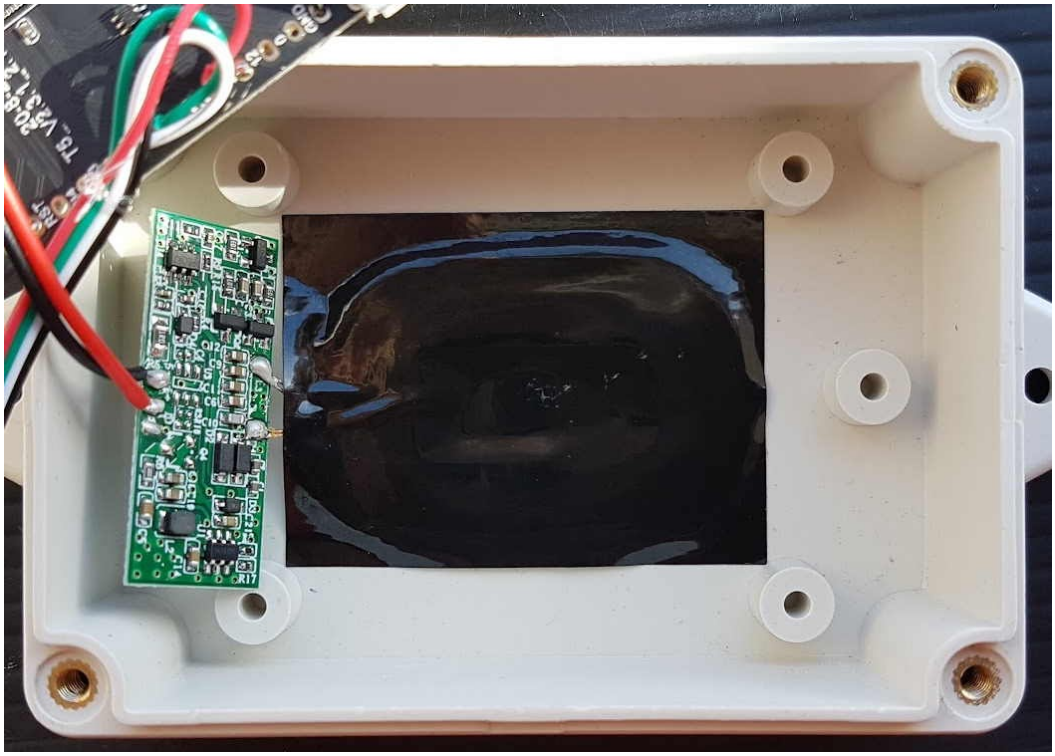


Assembly of the logger

The coil of the wireless charger comes on the bottom of the box :



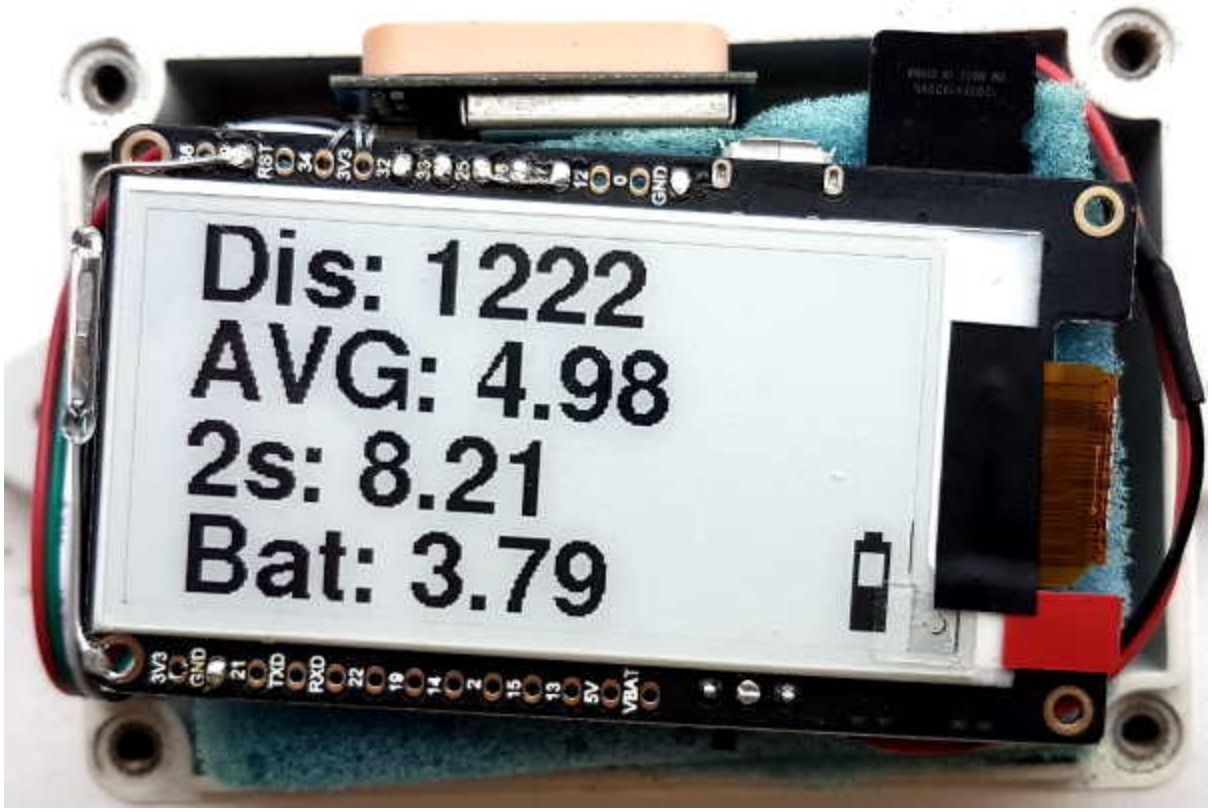
On top of the coil, the ferrite tape is placed. This is also a fixture for the coil. I noticed that the quality and thickness ot these ferrite tape can differ a lot ! The thicker ferrite is normally the better, as the function is to have a better inductive coupling. The thin ferrite has a bad efficiency, and the charger will switch off when the temperature goes to high, so charging takes a lot longer.



After the ferrite tape is attached, you can create a temperature insulation with 5 mm foam. This shall protect the battery from the generated heat of the charging coil. The battery is then placed on top of the foam.

Protecting the e-paper controller against light !

There is a small controller on the flex connection between e-paper and PCB. This controller is sensitive to light ! In bright sunshine, it will ruin the contrast of the e-paper. So, be sure to protect this controller from the light with some black tape.



Now we need some foam to keep everything in place ! dont forget to put the SD card in the slot. The GPS is placed on its side, the ceramic antenna to the side of the box. The LEDS of the GPS must be visible, so this side of the GPS must be on the upperside.

Now the foam is stacked on the lipo, and then the T5-board is stacked on the foam. Now you can close the lid carefully, check that the wires are not interfering.

The T5 board with the SD-card has a narrow fit, so be very carefull when you do the final assembly !

The screws which are delivered with the box will corrode rather fast, so better replace them with stainless screws ! (the black tape is still missing here !)

The sealing from the box is not perfect, I advice to seal it permanent with silicone or another glue.

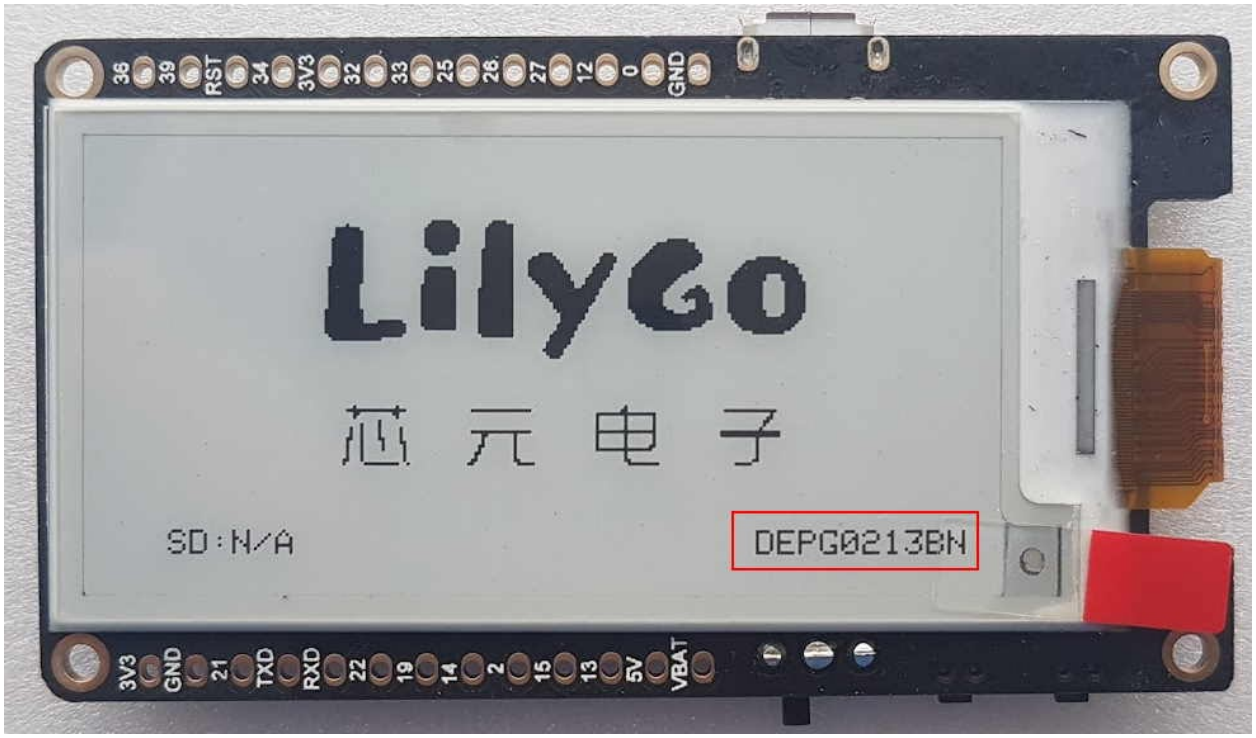
A alternative casing is a GoPro housing for Hero 7..10. They come cheap (10€), and they seal well. Charging over usb is easy, and access to the components is secured.

There is a 3D-print design available, which will fit al the components in a GoPro 7 housing, but with a 1100 mAh lipo.


AV: 0.00
R1: 0.00
R2: 0.00
R3: 0.00
R4: 0.00
R5: 0.00
2sec: 0.00
Dist: 0.00
Alp : 0.00
500m: 0.00
Mile: 0.00
Bat : 3.96
speed in km/h
0:0 0-1-1900
CALL +32 001 002 003
3V3
GND
GND

How to load the Software for the first time

The T5 board is delivered with a standard firmware. Normally, a brand new T5 will show next information :



On the bottom left side, you see information about the SD-slot, here the last run was without a sd-card (SD:N/A). On the bottom right side, you see the type of e-paper that is used (DEPG0213BN). This is important, as the different types need a different software.

Another difference is at the backside, the older types do have two LEDs. A blue LED which is on if the ESP32 is running, or in deepsleep. So for the logger, this means it is always on. The red LED is on when the battery is charging. The deep-sleep current with the blue LED is around 1.5 mA.(DEPG0213B73)

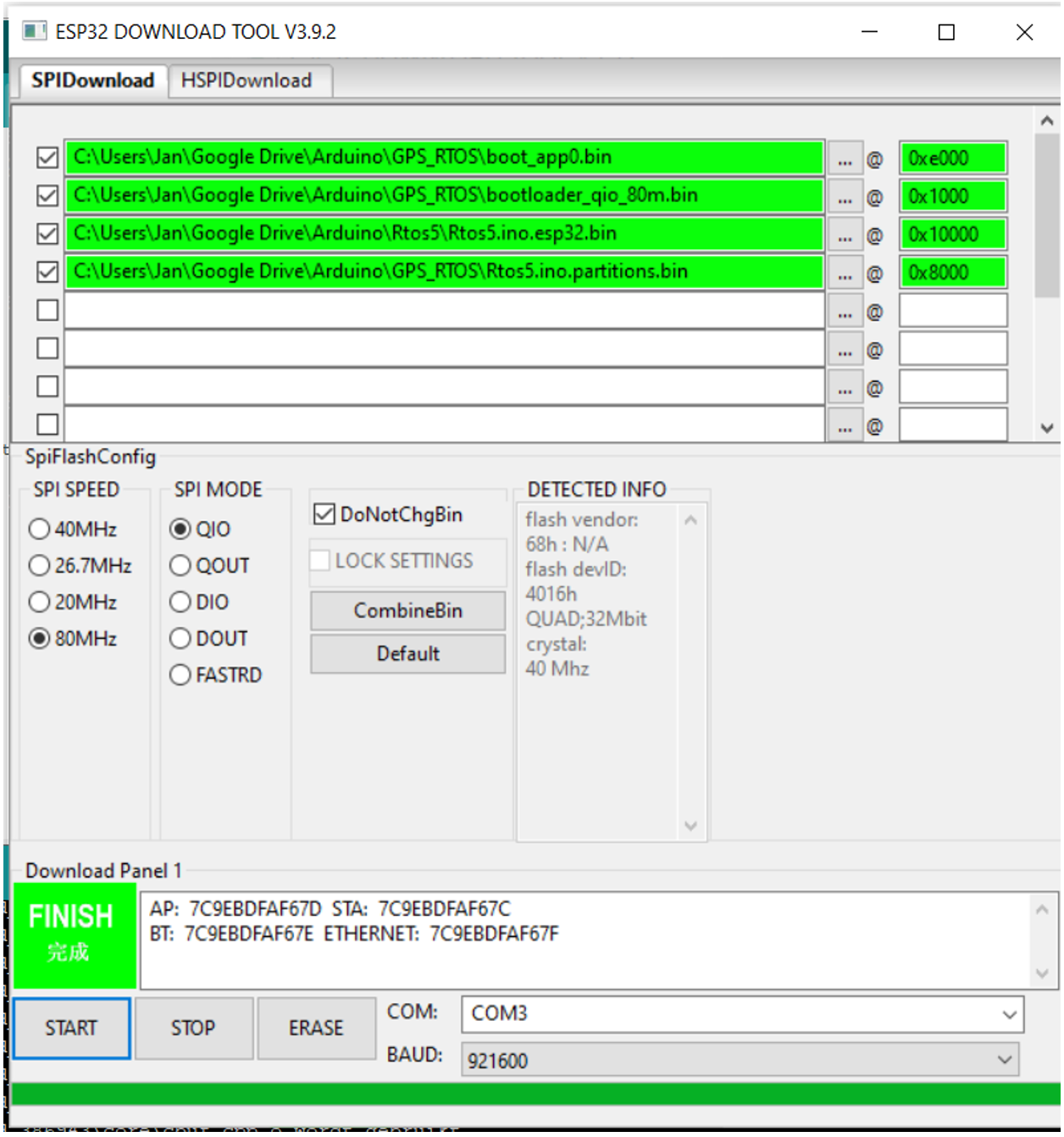
The more recent type does not have the LEDs on the board. Here, the deep-sleep current is around 0.5 mA (DEPG0213BN)

When you connect the micro usb with your computer, the T5 board will boot and will read the sd-card slot. **The switch has to be in the ON position !** If you plugged in a sd-card, the T5 will show the free memory of the sd. After that, you will see some screens with rectangles and demo of different fonts.

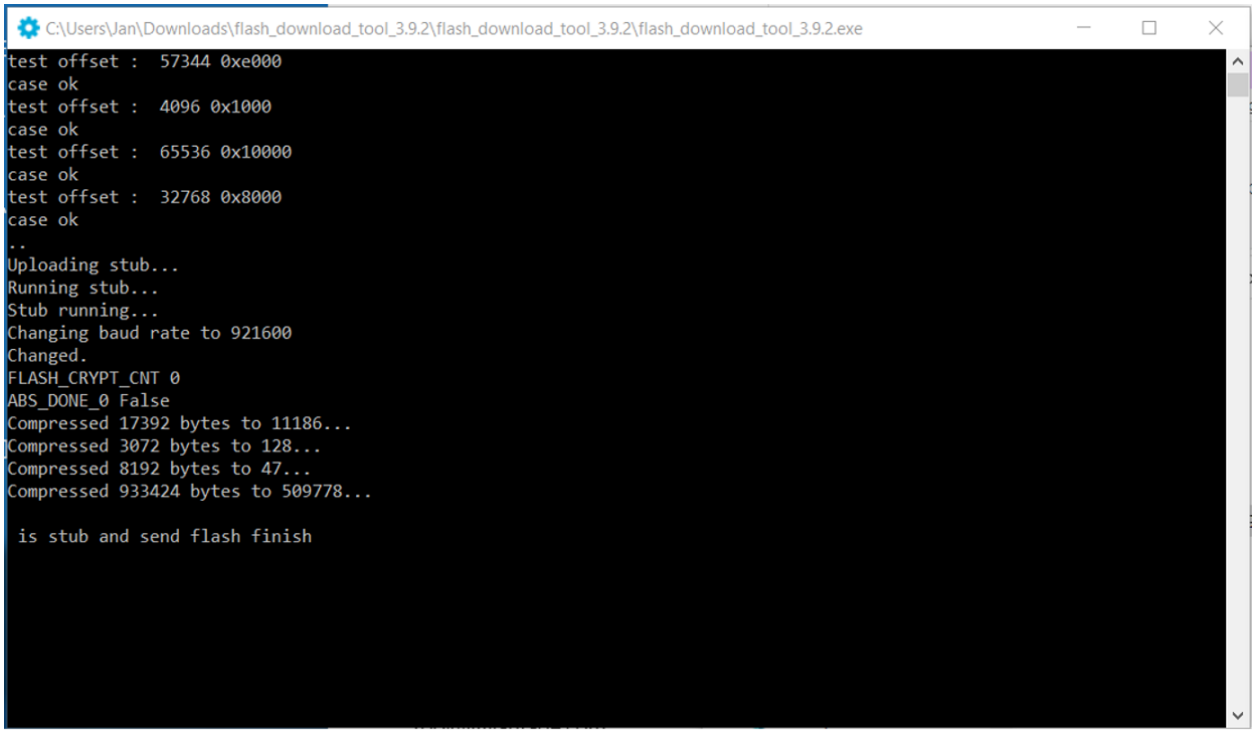
On your computer, you should have now a “virtual com port”. The usb to serial converter is a CP2104 or CH9102F. If the com port is not appearing on your pc, you need to install the usb drivers for one of these converters. On Windows 7, this can be a issue. With Windows 10, the drivers are loaded and installed plug@play.

The first flash of the T5-board must be done over the virtual serial port (usb connection). **The switch has to be in the ON position !** Then you need the download tool from espressif (only for Windows !) :
https://www.espressif.com/en/support/download/other-tools

Install it, and choose the “esp32” option. In the next screen, you have to set the files and the adresses and some other stuff (send me a pm for the bin files). Choose the right com-port, and press start. There is also a monitor window, so you can see what happens. If the download succeeded, you can use OTA for the next updates !



The monitor window :

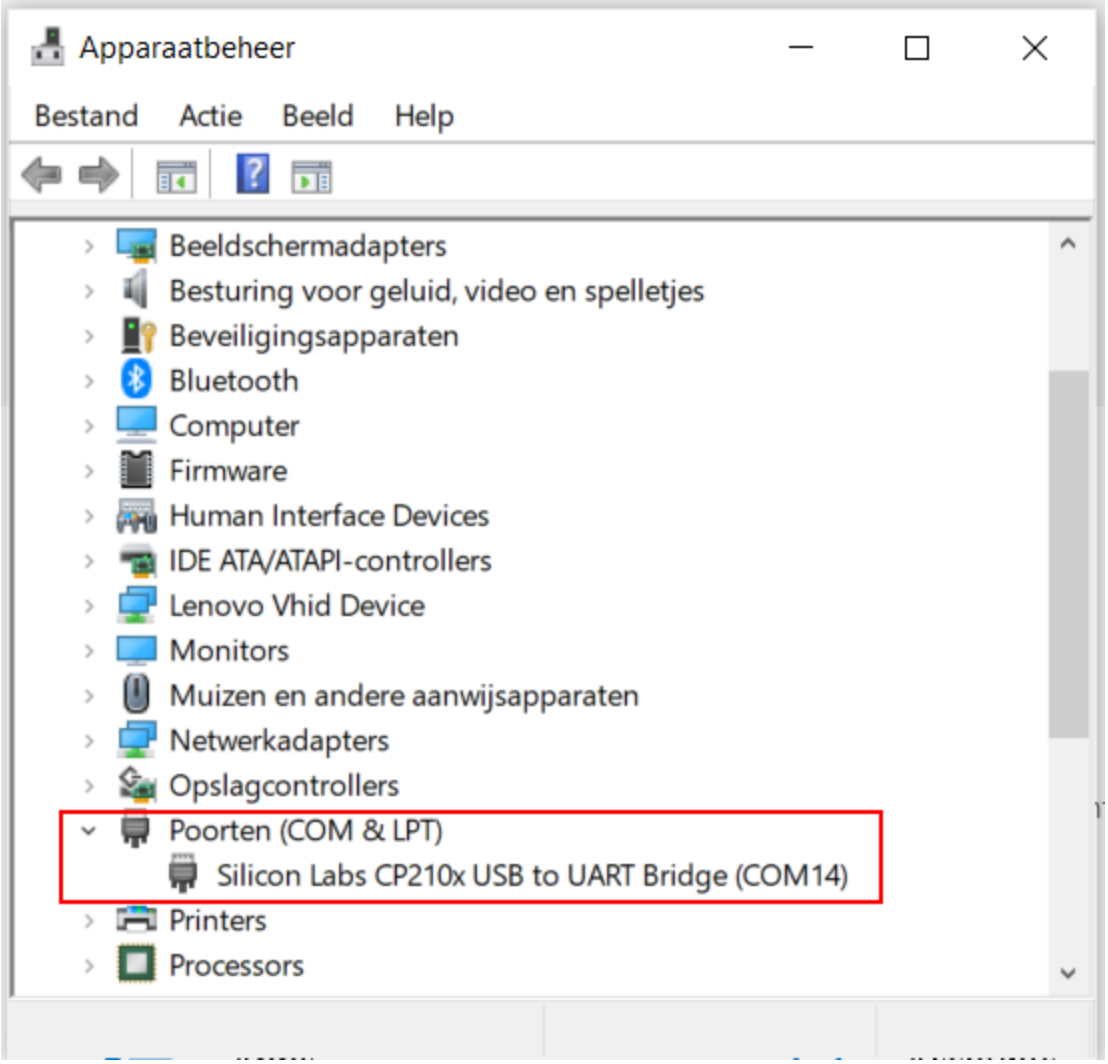


USB to Serial converter, Windows 10

When connecting the T5 board over micro-usb to a Windows machine, there should appear a “com port” on your computer. You can check this in the “device manager”. In the printscreen, you see a T5 board with a CP210x usb to serial converter. If there is no “virtual” serial port, you need to install the correct driver. Some versions of the T5 board come with a CH340 usb to serial converter, so check for the correct driver.

https://www.silabs.com/developers/usb-to-uart-bridge-vcp-drivers

https://learn.sparkfun.com/tutorials/how-to-install-ch340-drivers/all



For IOS, you have next option :

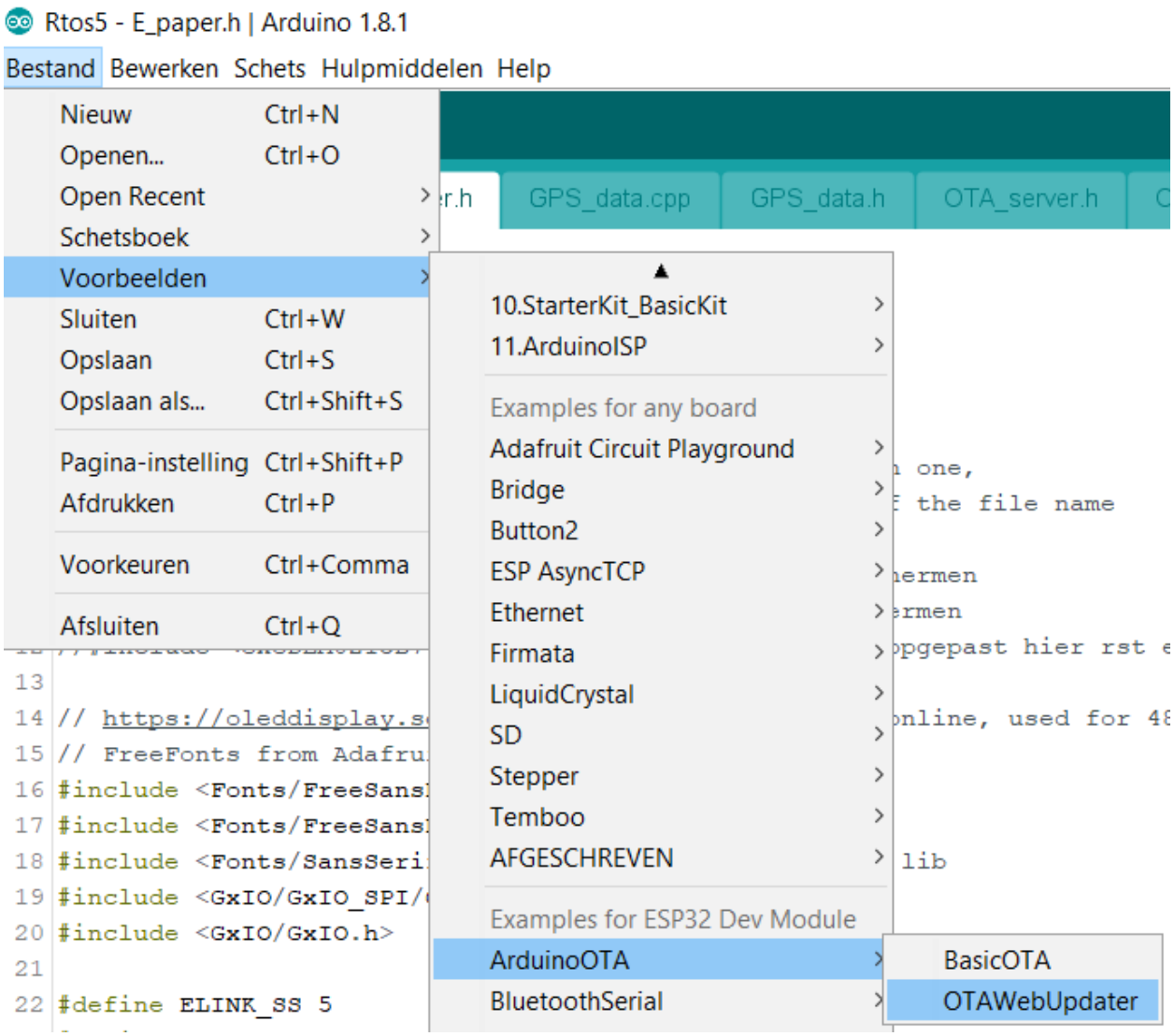
IOS : Use the Arduino IDE !

First, you have to install the Arduino IDE on your IOS :
https://www.arduino.cc/en/Guide/macOS

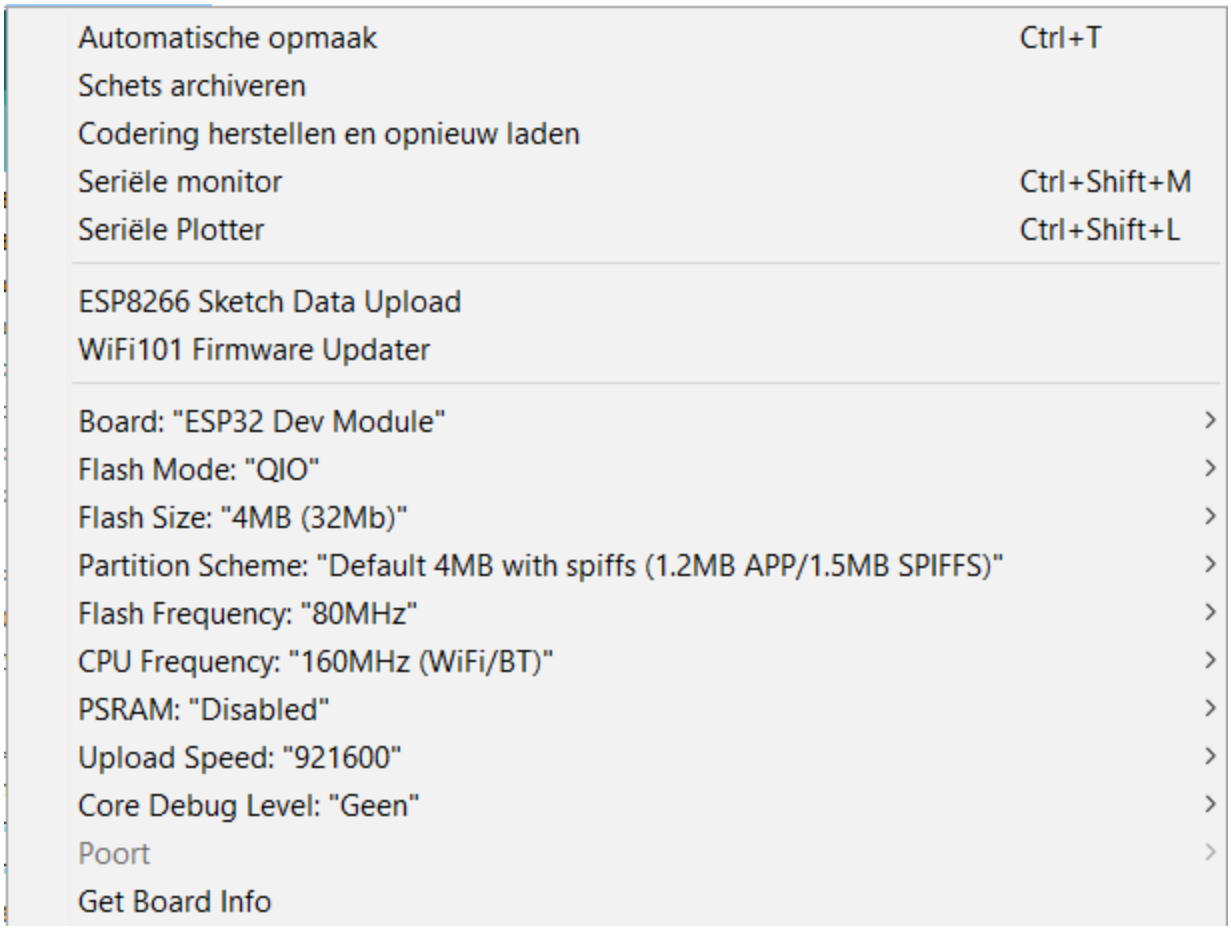
Then, you need to install the ESP32 board manager :
https://randomnerdtutorials.com/installing-the-esp32-board-in-arduino-ide-windows-instructions/

When connecting the T5 board over USB, there should appear a virtual serial port on your system. If not, you need to install the correct drivers.

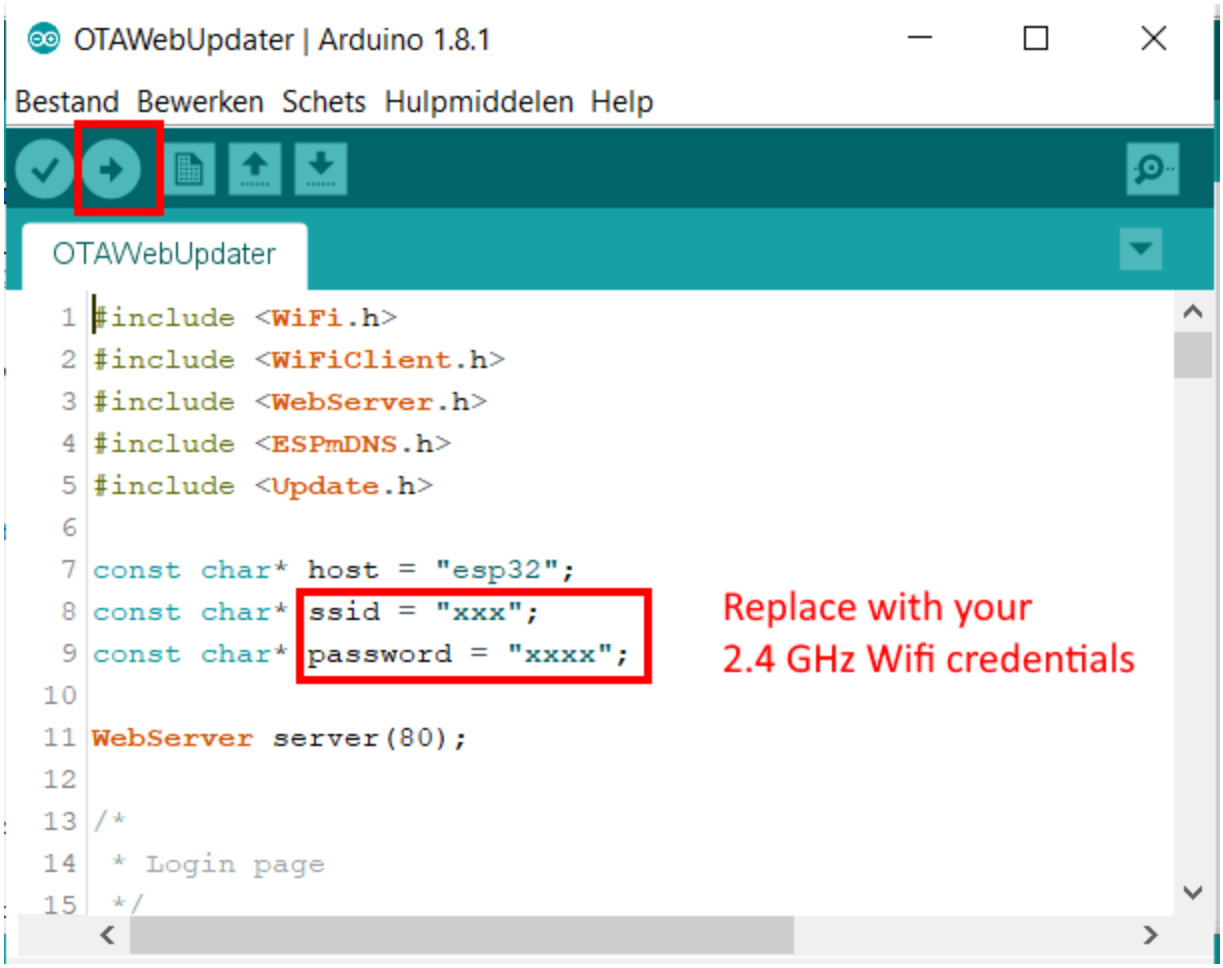
Start the Arduino, and open the OTA example for ESP32 :



Arduino settings for the ESP32 :



In the sketch, you have to set your Wifi credentials, SSID and password (2.4 GHz). Then, you must compile the sketch and transfer it to the T5 board.



After compiling and downloading the sketch to your T5 board, the ESP32 will boot and try to connect to your local wifi. You can follow this process over your Arduino “Serial Monitor”. The assigned IP-adress is also visible in the Serial Monitor. The e-paper will not work, as this sketch is only for the OTA functionality !

Now you can use your browser to access the webserver on the T5 : just use the IP address. To download another bin file to the ESP32, you need to log in with the account “admin” , password “admin”.

Some more usefull information : https://www.youtube.com/watch?v=av-w0U8UZEs&t=131s

FTP functionality with IOS

With the FTP Manager app on my Iphone, I could access the files on the T5 : https://apps.apple.com/us/app/ftpmanager-ftp-sftp-client/id525959186