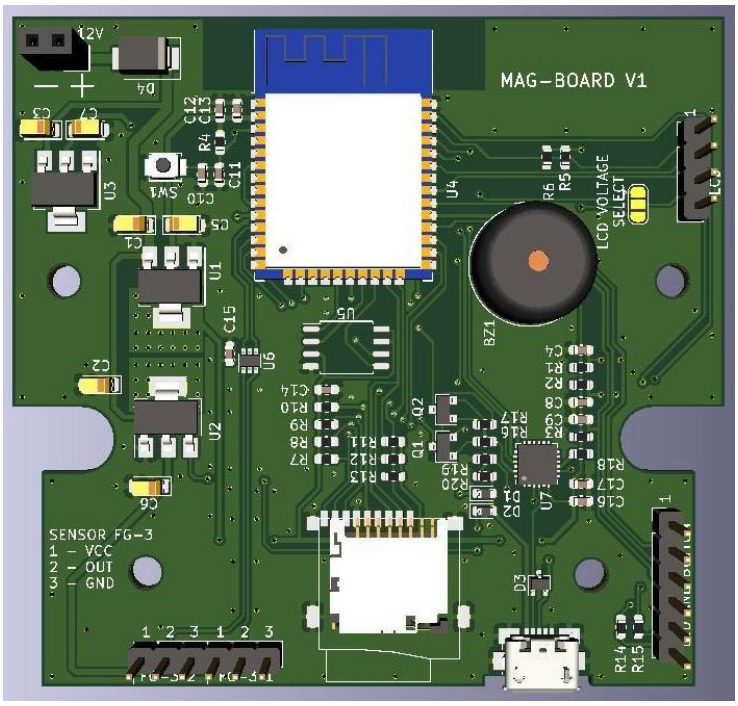
Instructions for assembling the MAG-BOARD and build MAGRA gradiometer

Version 1.1



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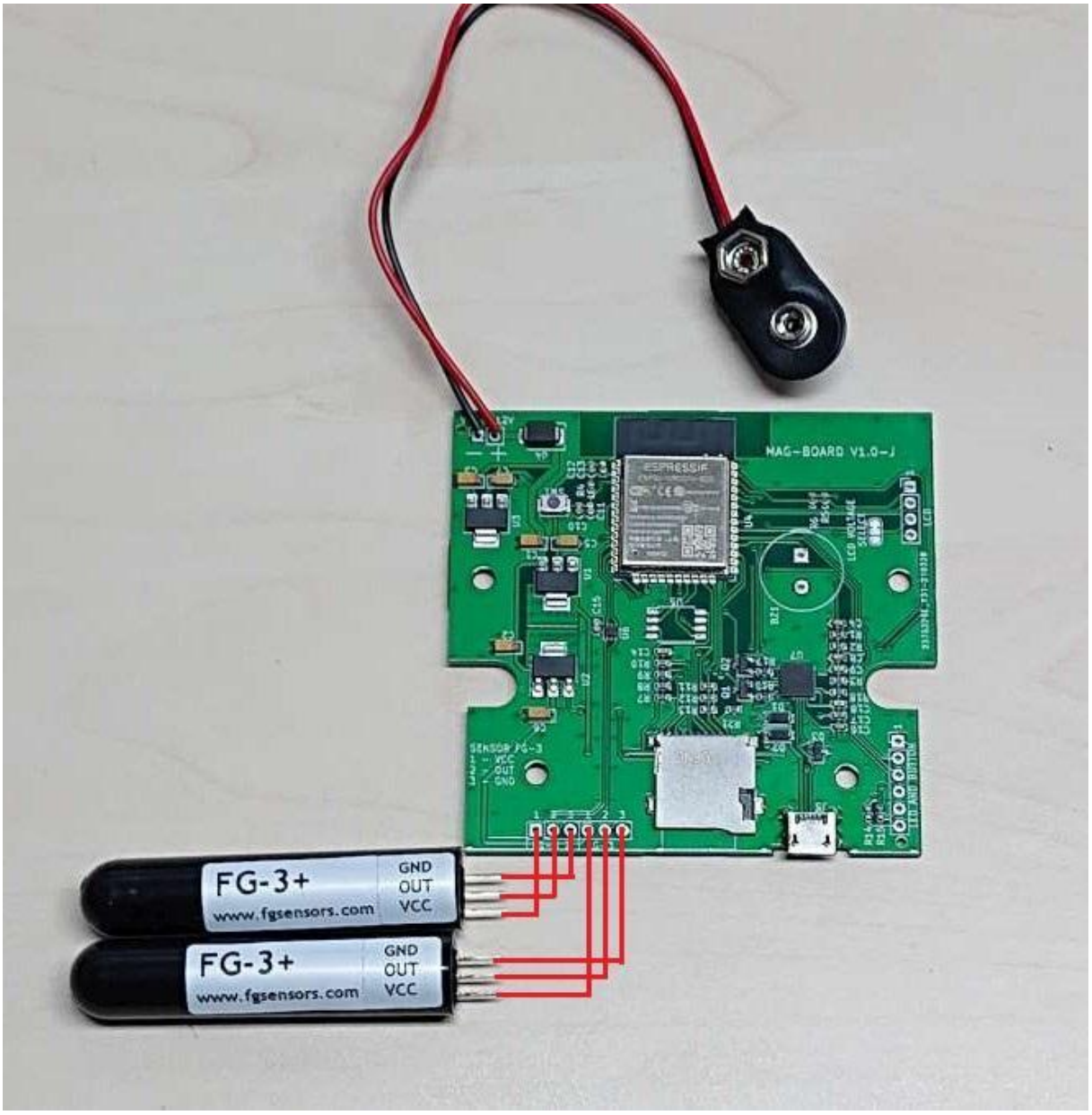
Slovenia
2. oct. 2021

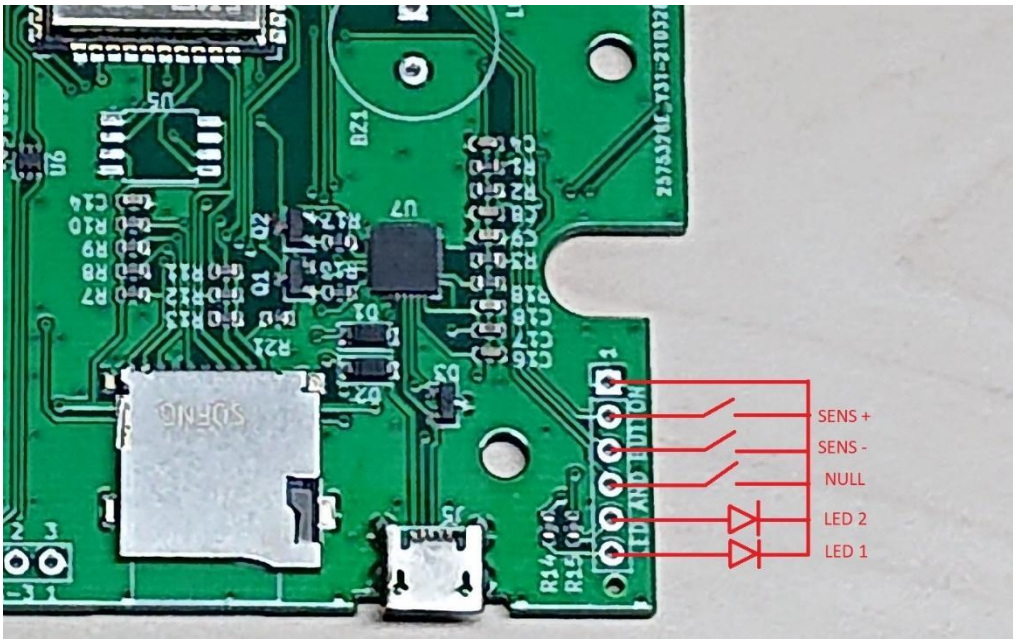
WWW.FGSENSORS.COM

Assembling the MAG-BOARD

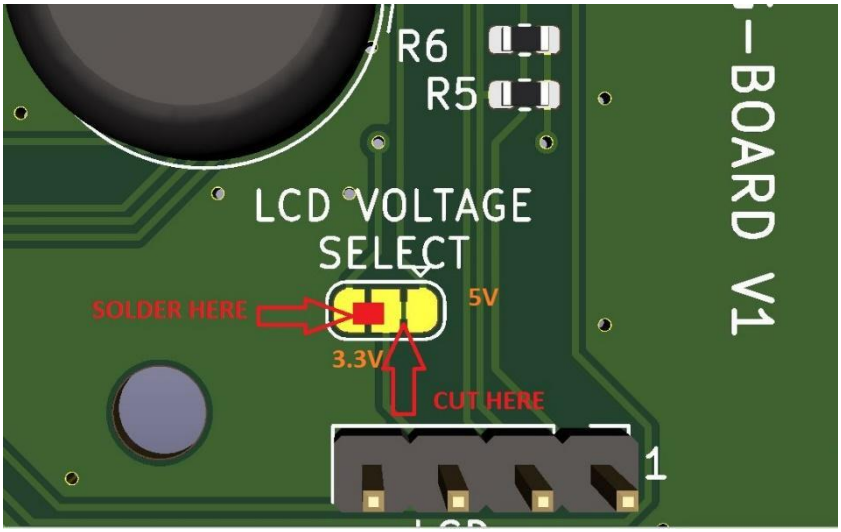
If you have already purchased the assembled MAG-BOARD, you can skip this chapter.
Although most of the components are already soldered to your MAG-BOARD, you still need to solder the power cord, connectors and the buzzer.
It is very important not to mix the colors of the power cord - black cable must be on the left »-«, red cable on the right »+« side.
The cables on the sensors must be routed correctly. See captions



You can connect up to 3 buttons and 2 LEDs onto your MAG-BOARD. The current program version has the NULLing button, »+« and »-« for sensitivity. Connect them as follows



LCD VOLTAGE SELECT:
If you buy LCD with MAG-BORD, you do not have to do anything. If using a 3.3V LCD screen, you have to cut the jumper and make contact with a drop of tin on the 3.3V voltage side.



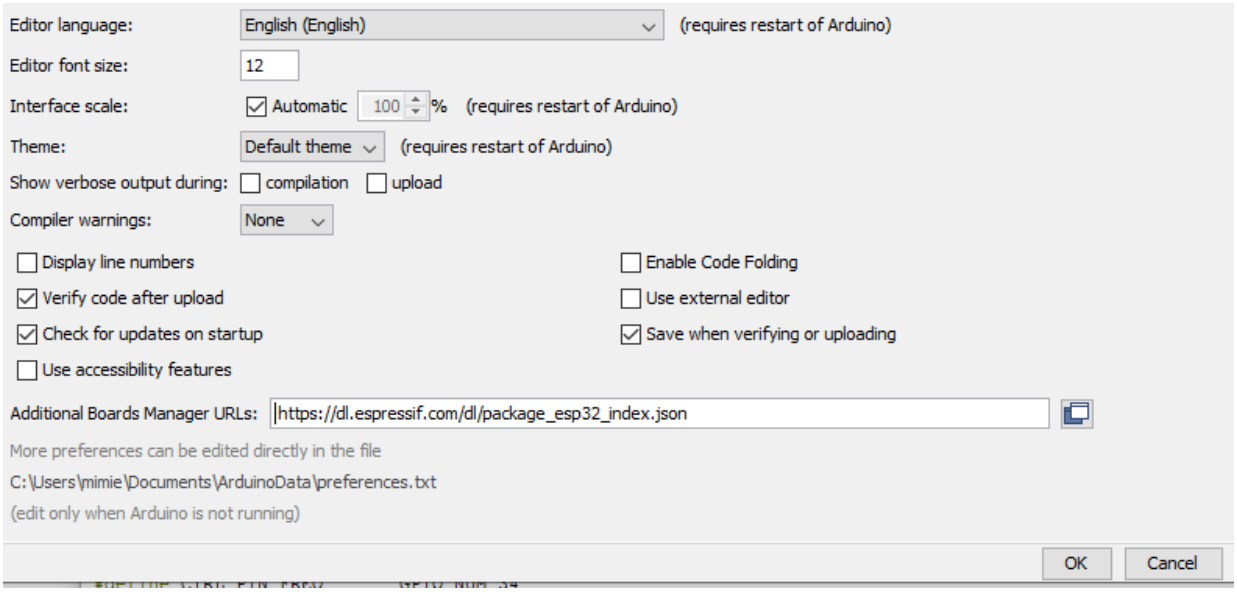
EXTERNAL FLASH
MAG-BOARD has an option of storing data to an external flash drive, which the user has to tin by himself. W25Q32JVSS is suggested, but others may also be used.

Programming

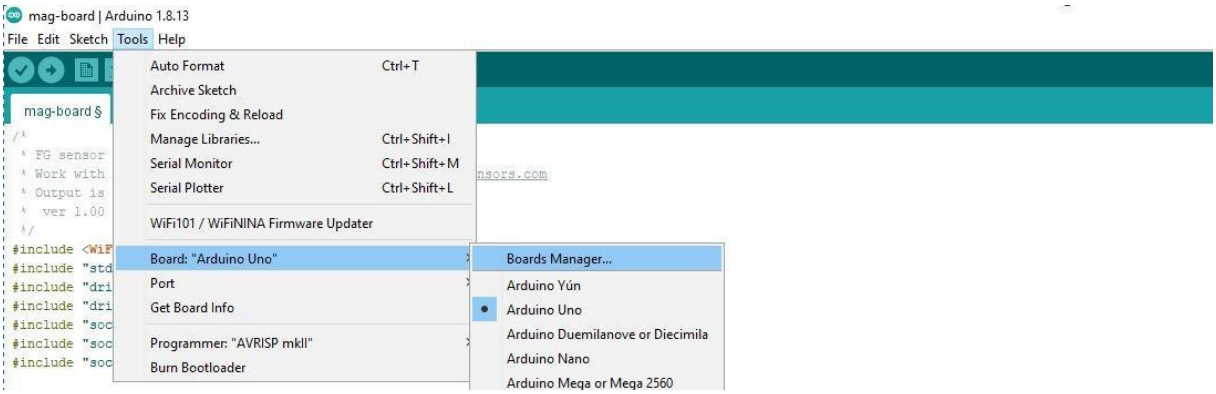
MAG-BOARD is already equipped with a preloaded program for the gradiometer. If you do not need to create your own program, this chapter can be skipped.

In case you wish to adapt the program according to your needs, use the source code for the arduino, which is available at www.fgsensors.com. **Attention! Open-source program for the gradiometer on the website does not support connection to the »FG sensors app« android application!**

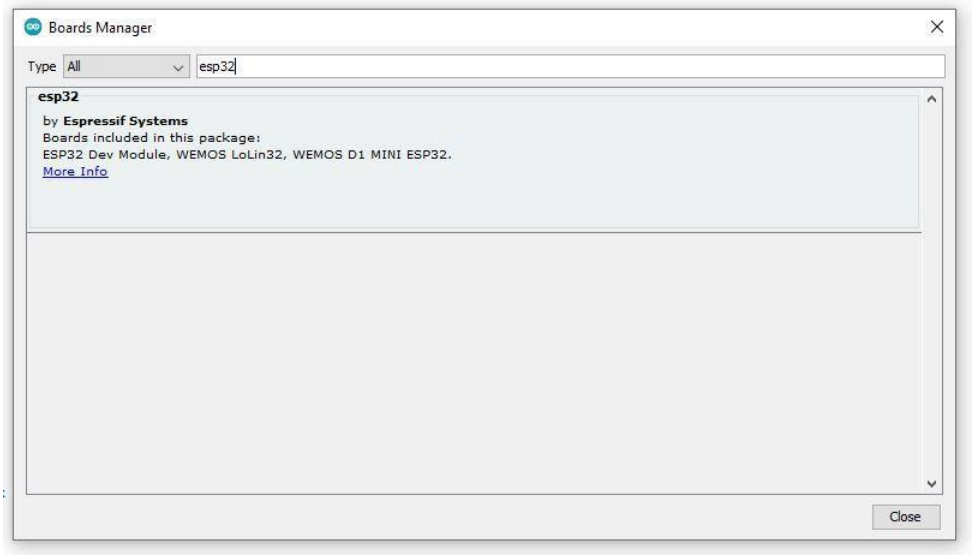
MicroUSB cable and Arduino IDE program is required for programming process (www.arduino.cc/en/software)
For installing you will need to download a package for ESP32. To do this, input https://dl.espressif.com/dl/package_esp32_index.json in the field Additional Boards Manager URLs under File -> Preferences tab



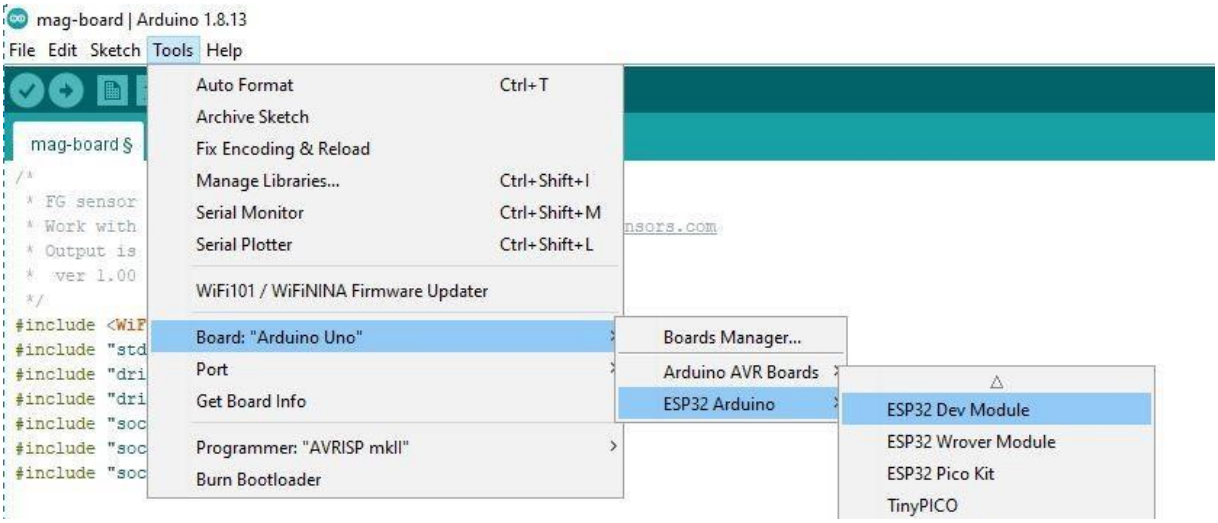
Install the board by selecting the menu Tools -> Board -> Board Manager…



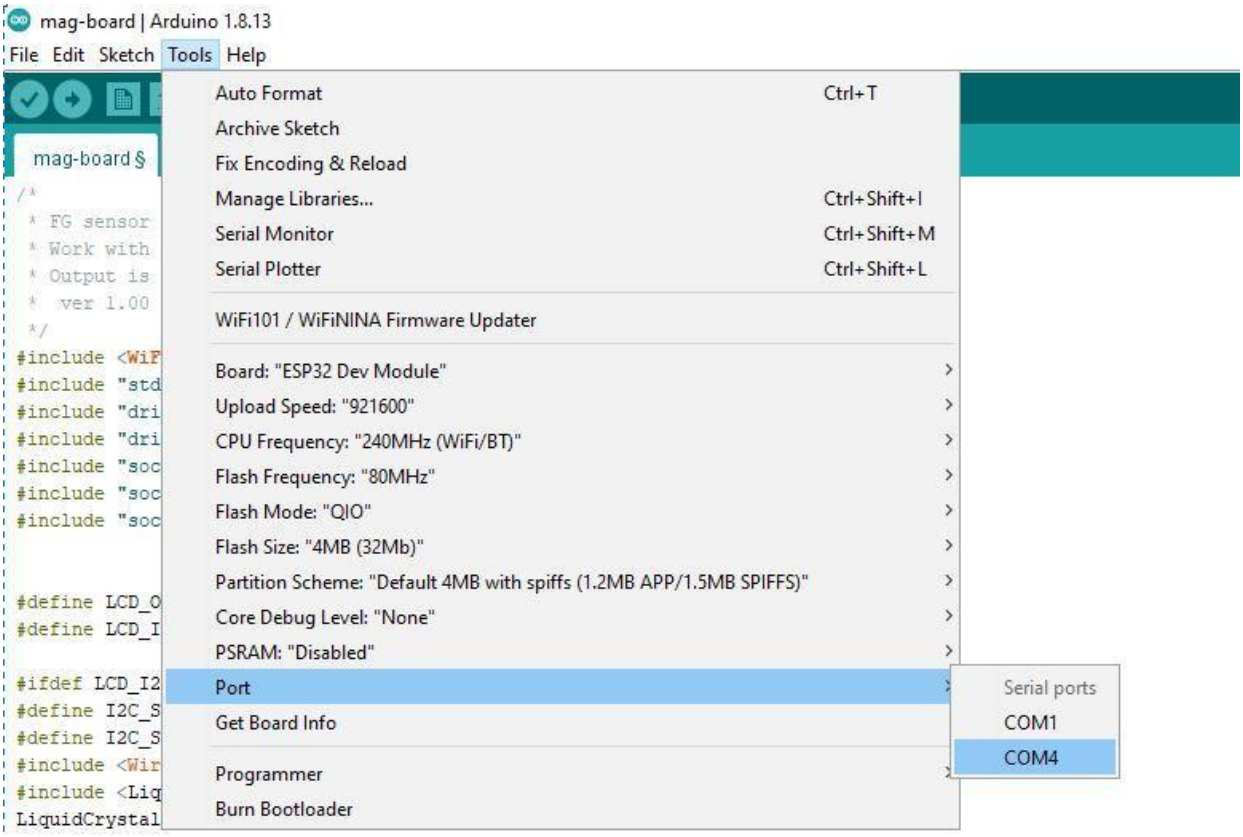
Input »esp32« and install it



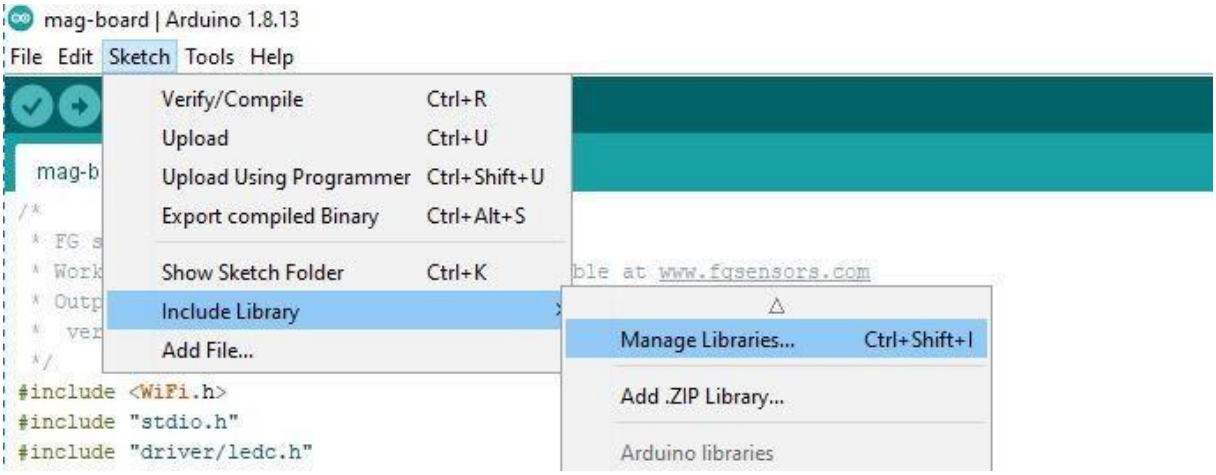
Next, click on the installed board. Select Tools -> Board: -> ESP32 Arduino choose ESP32 Dev Module



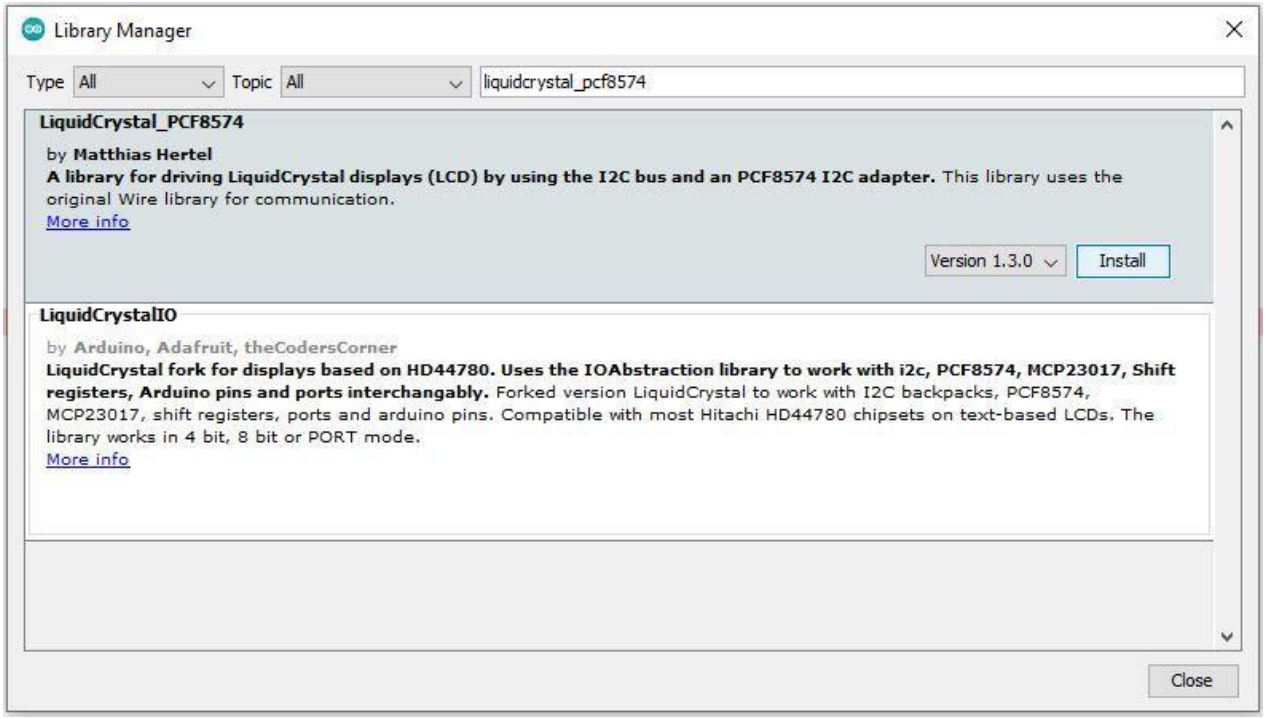
After selecting the board, click on Tools and select Port. Which port you choose, depends on your PC. I will choose COM4.



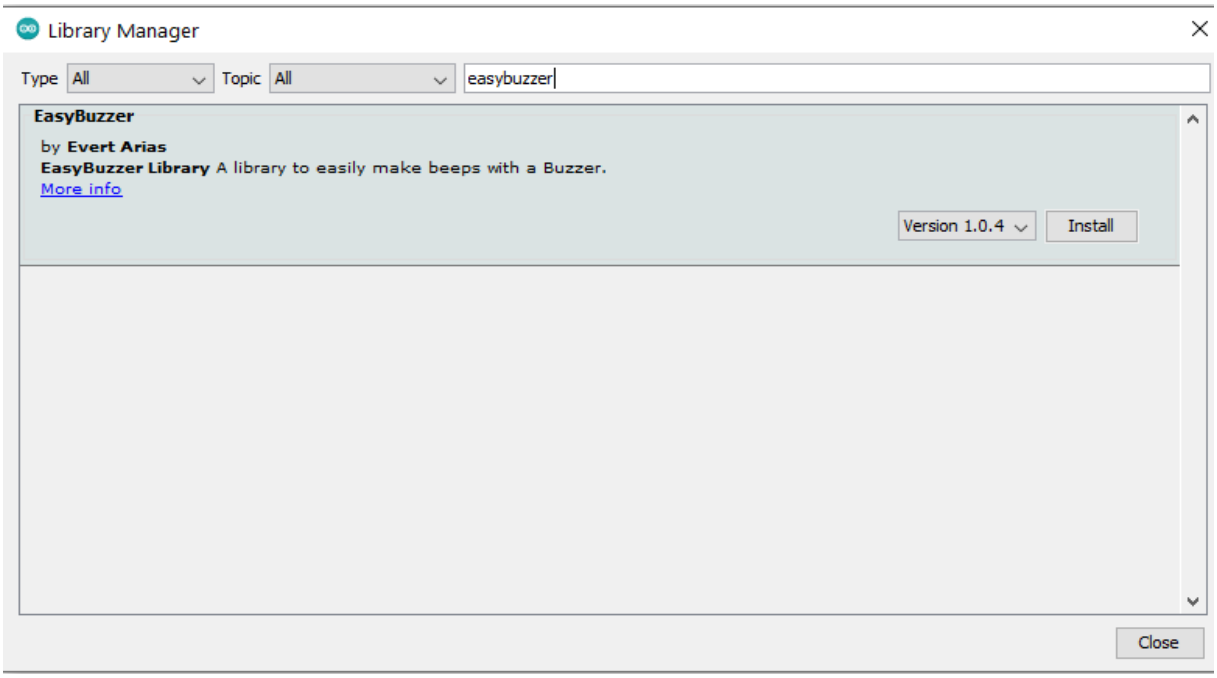
Now you have to install a library for the I2C LCD and buzzer. To do this, select menu Sketch ->Include Library -> Manage Libraries…



input »liquidcrystal_pcf8574« and install it



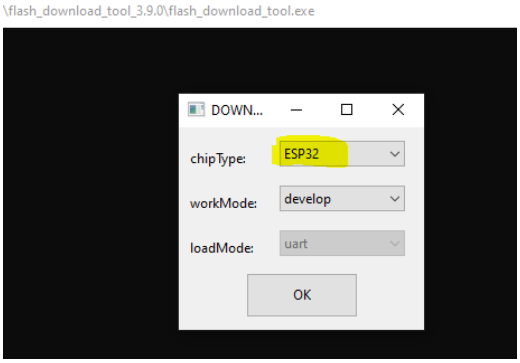
Afterwards search for »easybuzzer« and install it



This is all there is to it. For uploading simply press the »upload« key.

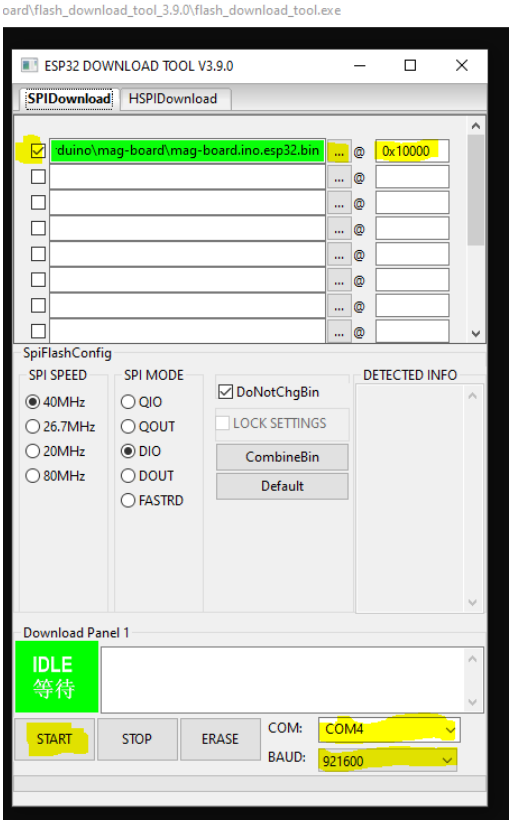
Programming with BIN file

To download the official codes (new FW), the process is simple.
First download »Offical Firmware(BIN)« from our webpage. For upload it you need free tool »**flash downolad tool**« downloaded from site:
https://www.espressif.com/en/support/download/other-tools
After run select chipType »ESP32« and click OK



After this:

1. Click where »…« are and select downloaded mag-board bineary file
2. Mark »√« to comform this line
3. Put address at 0x10000
4. Select COM port (in my case is COM4 you may have some other!)
5. Select BAUD to 921600
6. Click to START



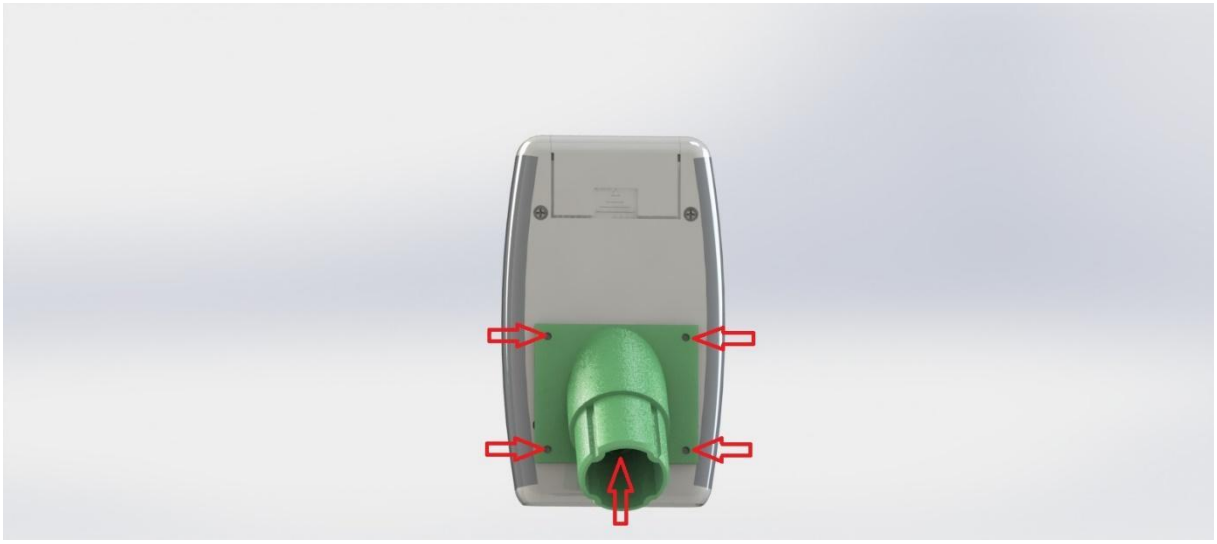
Assembling the MAGRA gradiometer

To assemble the MAGRA you need:

- MAGRA kit, which can be ordered here: www.fgsensors.com. Or you can print the parts on a 3D printer from the STL file, available on our website.
- Waste water tube of 30mm diameter and 1m length (or longer if needed)
- Tube cap of 30mm diameter
- Drills of Ø3mm, Ø6.5mm, Ø10mm and drilling machine

ATTACHING THE CONTROL UNIT

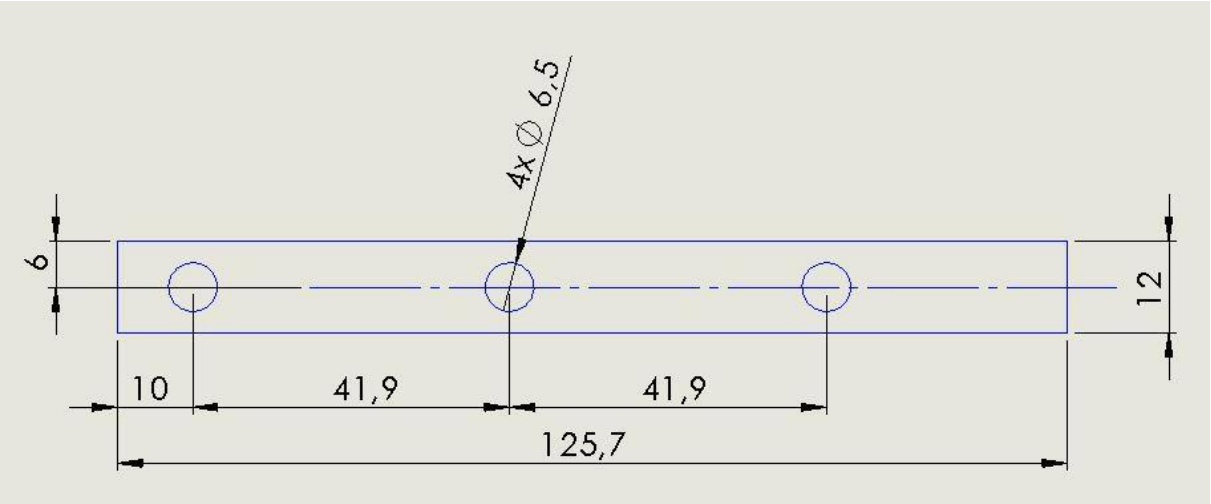
First, attach the electronics housing onto the bracket. Holes for Ø3mm screws and Ø10mm cables must be drilled in the housing. The easiest way to do this is to set the bracket onto the housing and mark the holes.

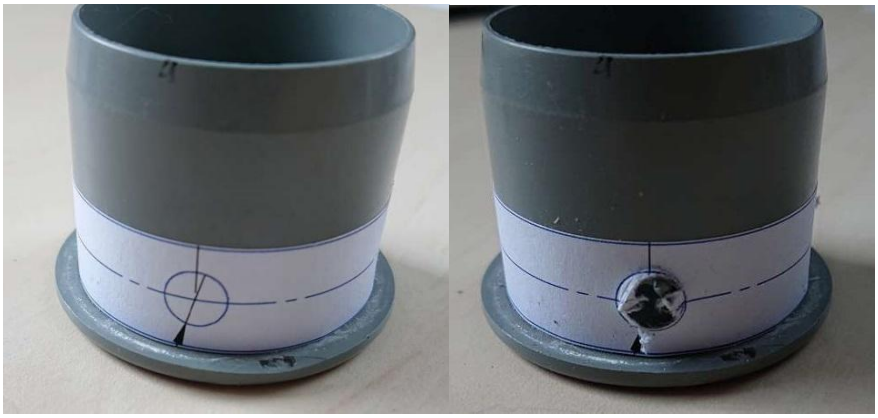


Take the holder of the upper sensor and push the sensor into it to the point where it passes the latch.

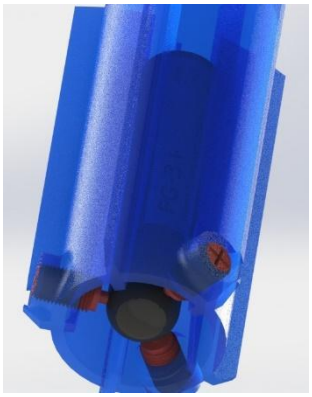
Then connect the sensor with a shorter cable supplied and secure it with some hot glue.

Drill 3 holes in the plug of approx. Ø 6.5 -7 mm in diameter, to allow rotation of the sensor adapter screws. You can also use a gadget printed on a piece of paper (PDF in 1:1 scale can be found on our website)



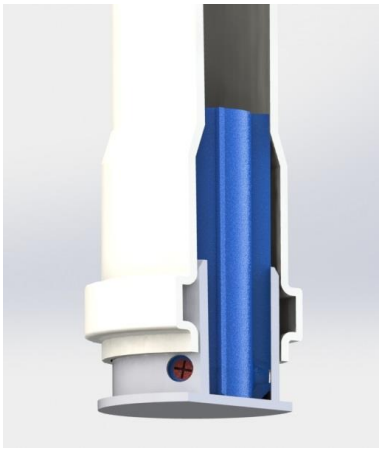


Insert the sensor into the holder. Put the supplied screws through the holes and tighten them so that the sensor is fixed in the center. Put the assembly onto the plug, allowing access through drilled holes and fix the bracket with some hot glue.



Connect the lower sensor with a longer cable supplied and secure it with some hot glue. Pull the cable through the tube and insert the upper sensor from the top side, approximately 10cm below the top and secure it with hot glue, so the sensor does not move. Both sensors must be oriented in same way. Upside down!

When the glue is dried, insert the lower sensor into the tube to the extent, which still allows the screws to be turned. Lubricate the seal on the tube beforehand with liquid soap or hand cream for easy insertion and turning.



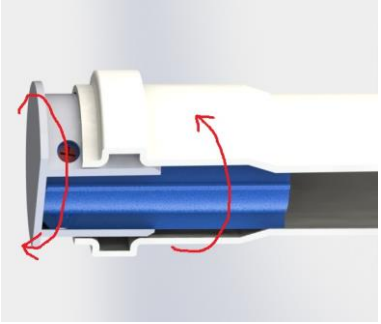
Calibration of MAGRA gradiometer

For calibration of the gradiometer you need a plastic or other non-metallic screwdriver, assembled and working MAG-BOARD and a non-metallic bracket (V-block) allowing rotation of the gradiometer without moving. The bracket can be printed (STL files available on our site) or bought in our webshop.
ATTENTION! The calibration process must be performed in a room with no electromagnetic (electrical wiring, transformers, speakers, etc.) sources, iron and magnetic objects nearby.

Place the V-blocks horizontally onto the level surface in the east-west position and put the gradiometer on it. Connect the LCD and the sensors and turn the MAG-BOARD on. If everything is OK, a 5-6 digit number will appear on the screen next to the »U«(upper sensor) and »L« (lower sensor). If the screen is blank, use the screwdriver to turn the blue element on the black board next to the LCD to left/right. This is a potentiometer for adjusting the screen contrast.

1. Rotate the tube around its axis and observe both numbers. Numbers are increasing and decreasing.

2. By only turning the cap you need to achieve both numbers (»L« and »U«) to increase and decrease simultaneously.



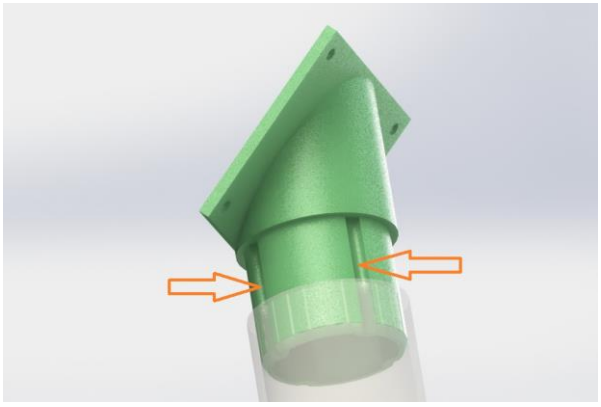
After finishing this phase, you are ready to perform fine tuning.

3. Press the NULL button on the electronic part (or android app) and observe the number under letter »D« on the screen while rotating the tube around its axis.
4. When the highest value is reached, loosen the bottom screw and tighten the upper screw (if there is no bottom screw, loosen two of the closest ones). All screws must always be slightly tightened. When making last corrections, you do not have to loosen the bottom screws, but only tighten the upper one.
5. Repeat the steps from the 3rd point onwards, until you reach the slightest change in the value »D« per revolution
6. If the value below 1000 can not be reached, slightly rotate the cap as in the 2nd point and repeat the tuning process as explained in the 3rd point.

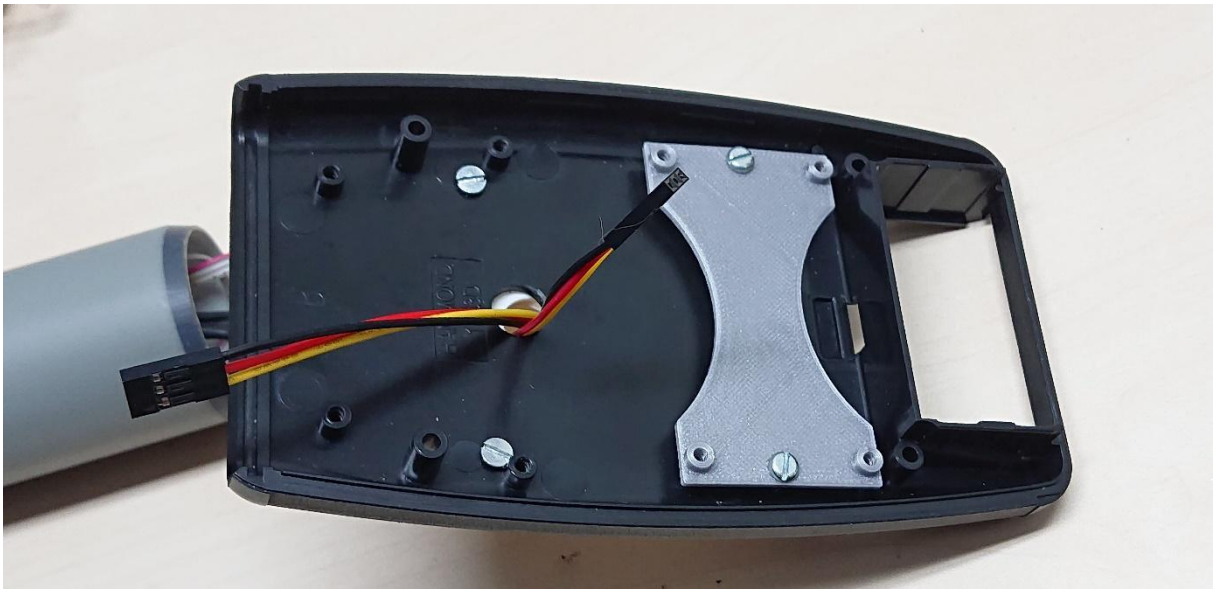
This step is very time consuming, but very important for proper functioning.

After successfully finishing the tuning process, check if any screw protrude the cap. If yes, please remove the protruding part. Attention! This can put the gradiometer out of tune. We suggest the protruding part to be sanded off and not cut off with a knife or saw! Then pour the hot glue over the screws and push it all the way into the tube.

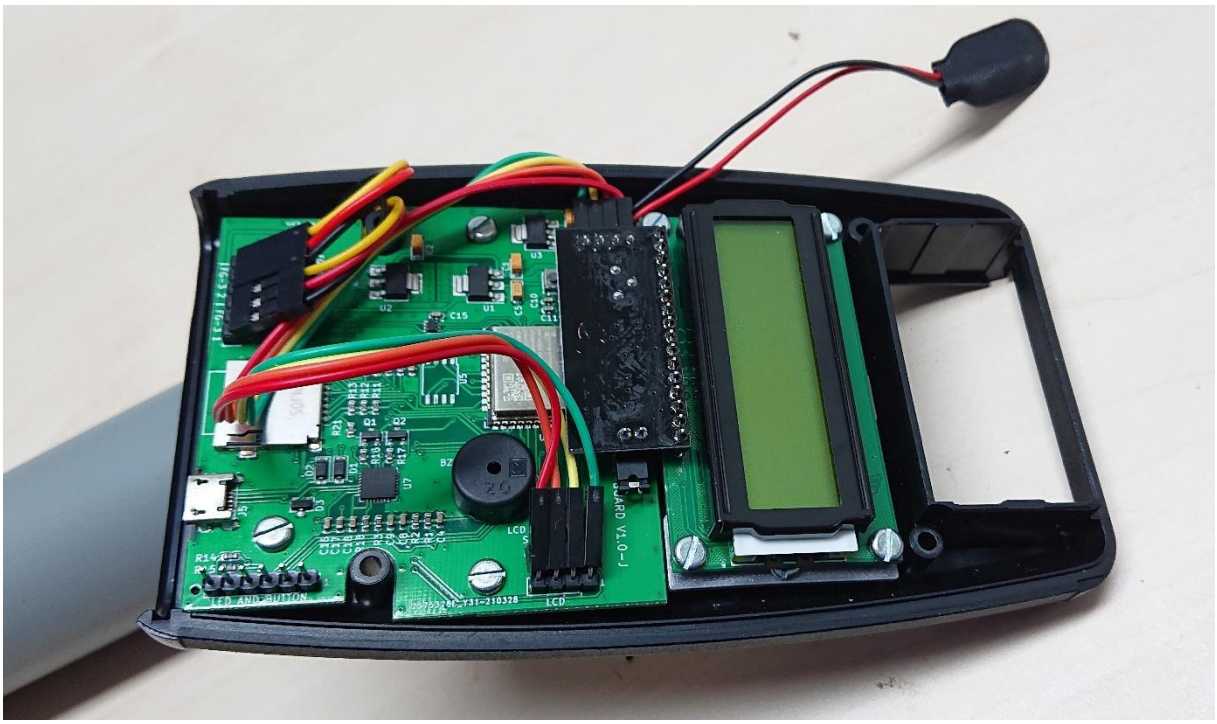
Next is the installation of electronics onto the tube. You need to add hot glue to the dedicated channels and push it into the tube.



Screw the housing onto the bracket. Attach the LCD holder to the housing, and pull the sensor wires through the hole.



Attach the circuit and LCD and connect it with cables. Pay attention to how the cables are turned. Your cables may deviate in color. The important thing is that the beginning and the end are in the same position.



NOTE:

Given that it is left to the self-builder to handle the components, which can lead to their destruction or malfunction of the board, no guarantee can be given for the correct function of the assembled MAG-BOARD/MAGRA. However, online assembly assistance will be provided and any justified complaints will be carefully treated.

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