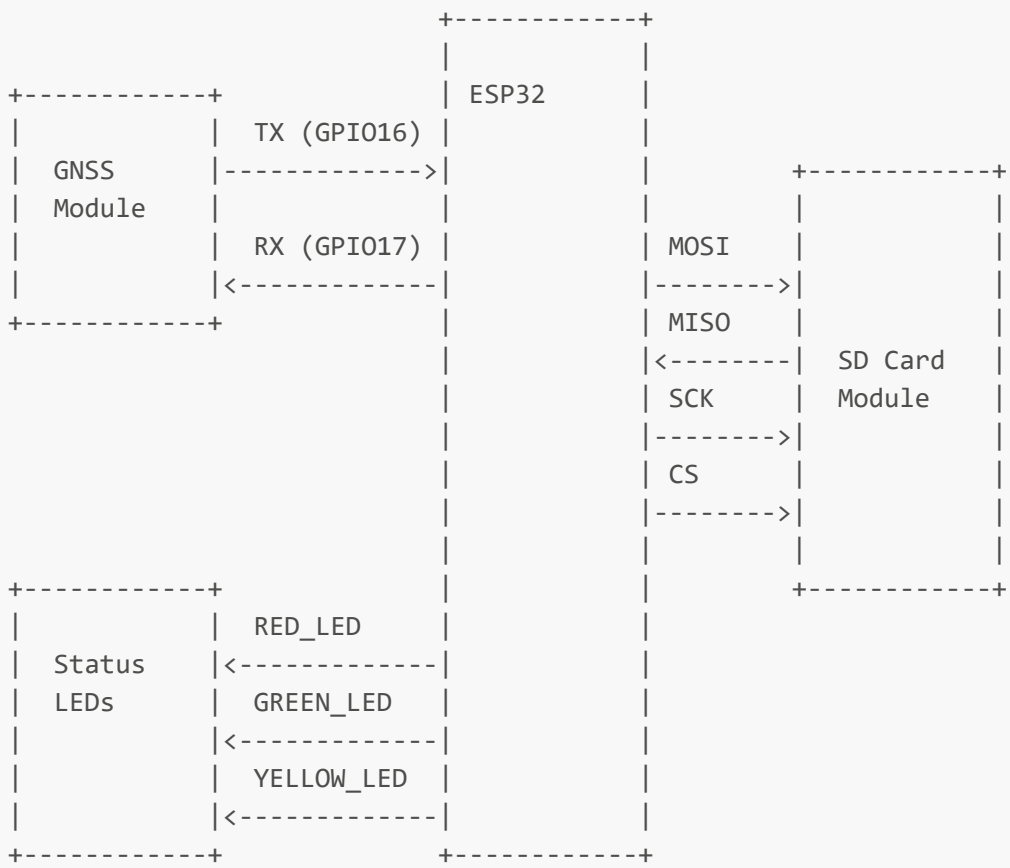
Technical Documentation: Hardware Schematics

GNSS Sensor Schematic



Connection Table GNSS Sensor

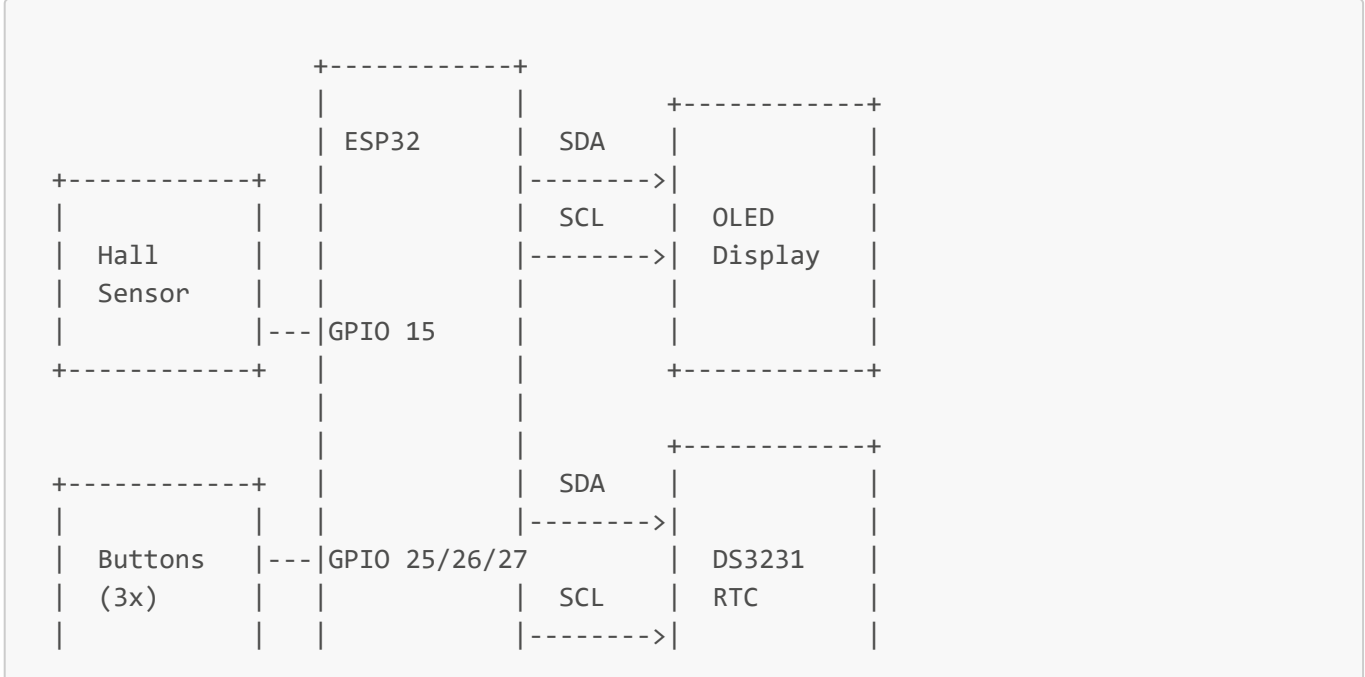
ESP32 Pin	Connected to	Function
GPIO 16	GNSS TX	UART Data Reception
GPIO 17	GNSS RX	UART Data Transmission
GPIO 23	SD MOSI	SPI Master Out Slave In
GPIO 19	SD MISO	SPI Master In Slave Out
GPIO 18	SD SCK	SPI Clock
GPIO 5	SD CS	SD Chip Select
RED_LED	Red LED	Error Indication
GREEN_LED	Green LED	Operation Indication
YELLOW_LED	Yellow LED	SD Card Access
5V	Power Supply	Operating Voltage

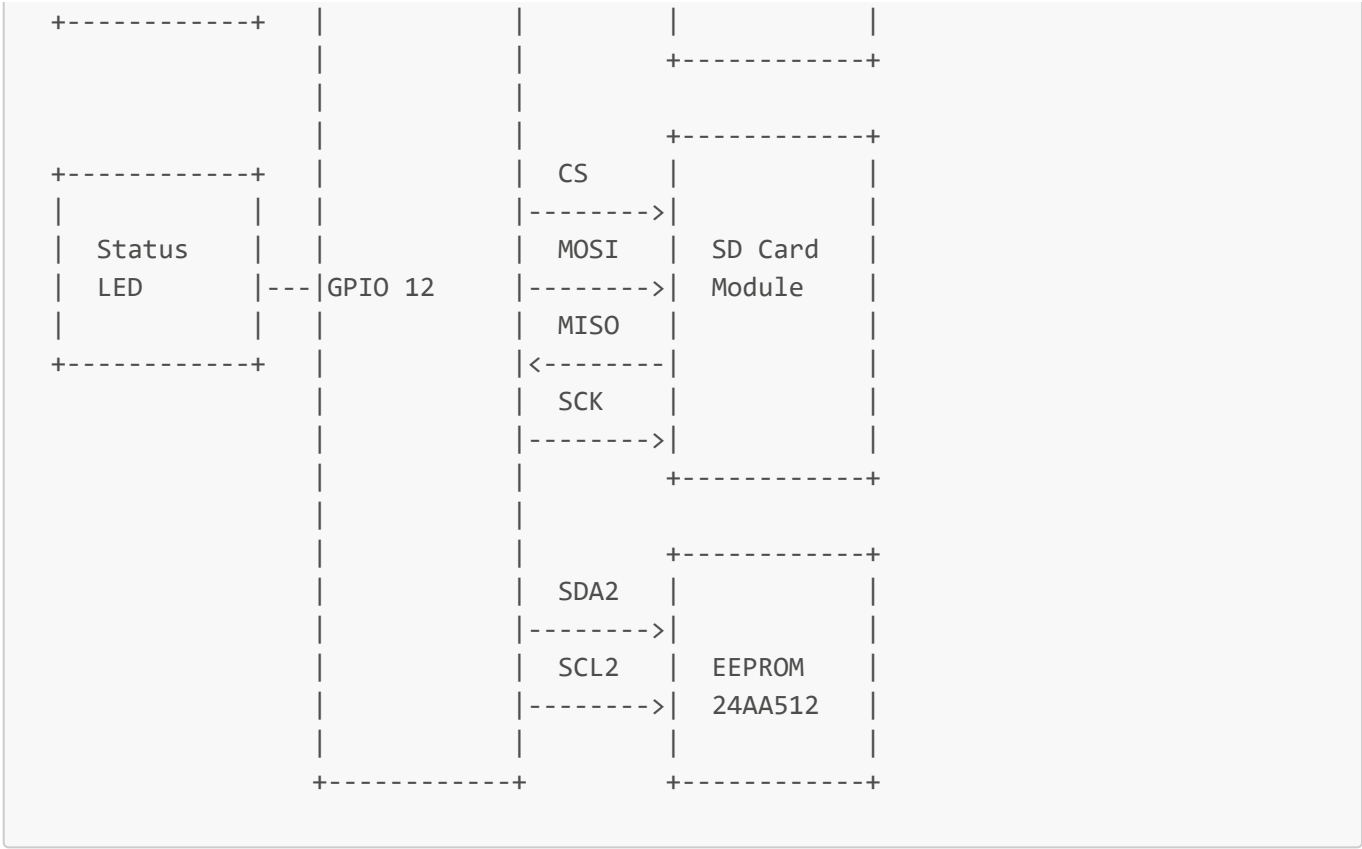
ESP32 Pin	Connected to	Function
GND	Ground	Common Ground Point

Component Specifications

1. **ESP32-WROOM-32**
    - Operating voltage: 3.3V (5V via USB)
    - CPU: Dual-Core Xtensa LX6, up to 240 MHz
    - Flash memory: 4 MB
    - RAM: 520 KB
2. **GNSS Module**
    - Operating voltage: 3.3V
    - Current consumption: approx. 30-50 mA
    - Receiver: GPS, GLONASS, BeiDou, Galileo
    - Update rate: 1 Hz (standard)
3. **SD Card Module**
    - Operating voltage: 3.3V
    - Supports SD and SDHC cards
    - Communication: SPI
4. **Status LEDs**
    - Operating voltage: 3.3V
    - Series resistor: 220 Ohm per LED
    - Colors: Red, Green, Yellow

RPM Sensor Schematic





Connection Table RPM Sensor

ESP32 Pin	Connected to	Function
GPIO 15	Hall Sensor	Pulse Signal
GPIO 21	SDA (I2C-1)	I2C Data Line for OLED and RTC
GPIO 22	SCL (I2C-1)	I2C Clock Line for OLED and RTC
GPIO 16	SDA (I2C-2)	I2C Data Line for EEPROM
GPIO 17	SCL (I2C-2)	I2C Clock Line for EEPROM
GPIO 25	PLUS Button	Value Increase (blue)
GPIO 26	MINUS Button	Value Decrease (white)
GPIO 27	SET Button	Confirmation/Setting (yellow)
GPIO 12	Status LED	Operation Indication
GPIO 5	SD CS	SD Chip Select
MOSI	SD MOSI	SPI Master Out Slave In
MISO	SD MISO	SPI Master In Slave Out
SCK	SD SCK	SPI Clock
5V	Power Supply	Operating Voltage
GND	Ground	Common Ground Point

Component Specifications

1. **ESP32-WROOM-32**
    - Operating voltage: 3.3V (5V via USB)
    - CPU: Dual-Core Xtensa LX6, up to 240 MHz
    - Flash memory: 4 MB
    - RAM: 520 KB
2. **Hall Sensor**
    - Operating voltage: 3.3V-5V
    - Output: Digital (High/Low)
    - Sensitivity: Optimized for 1-3 mm distance to the magnet
3. **OLED Display**
    - Type: 128x64 pixels
    - Interface: I2C
    - Operating voltage: 3.3V
4. **DS3231 RTC**
    - High-precision real-time clock
    - I2C interface
    - Backup battery: CR2032
5. **SD Card Module**
    - Operating voltage: 3.3V
    - Supports SD and SDHC cards up to 16 GB
    - Communication: SPI
6. **24AA512-MIC EEPROM**
    - Capacity: 64 KB
    - I2C interface
    - Data retention: >100 years
    - Write/read cycle count: >1 million
7. **Buttons and LED**
    - 3 buttons with pull-up resistors (10 kOhm)
    - LED with series resistor (220 Ohm)

Mounting the Magnets

For the correct function of the RPM sensor, the proper mounting of the magnets is crucial:

General mounting of a Hall sensor: The number of magnets must be coordinated with the ESP32 program being used. In the case of this project, 4 magnets per revolution are measured.

- Use 4 magnets, evenly distributed around the circumference of the rotating part
- Distance between magnets and Hall sensor: max 18-20 mm since in this project's magnet sleeve, 4 strong neodymium magnets per position are used. (otherwise distance 1-3 mm)
- All magnets should be oriented with the same polarity towards the sensor
- Secure the magnets firmly to prevent them from coming loose during operation

Schematic Representation of the Magnets

```
      [Magnet 1]
     /           \
[Magnet 2]     [Magnet 4]
     \           /
      [Magnet 3]

       Rotating
          Part
```

GitHub Repositories

The complete source code, schematics, and 3D printing templates for both projects are available in the following GitHub repositories:

GNSS Sensor

Repository: github.com/hansratzinger/GnssSensor

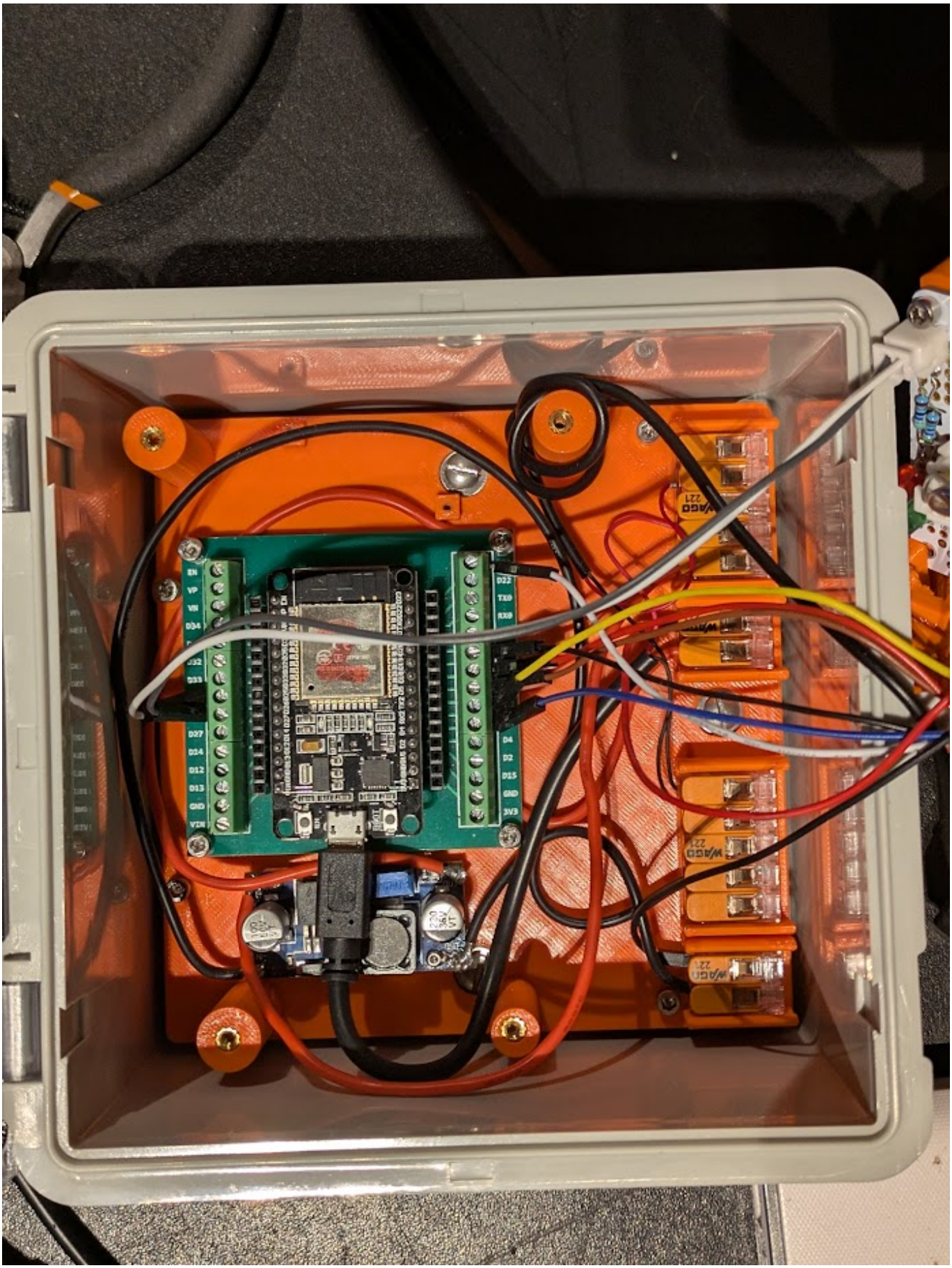
RPM Sensor

Repository: github.com/hansratzinger/RpmSensor

In the `/3d` folder of both repositories, you will find .3mf files for 3D printing all required housing parts, mounts, and other components.

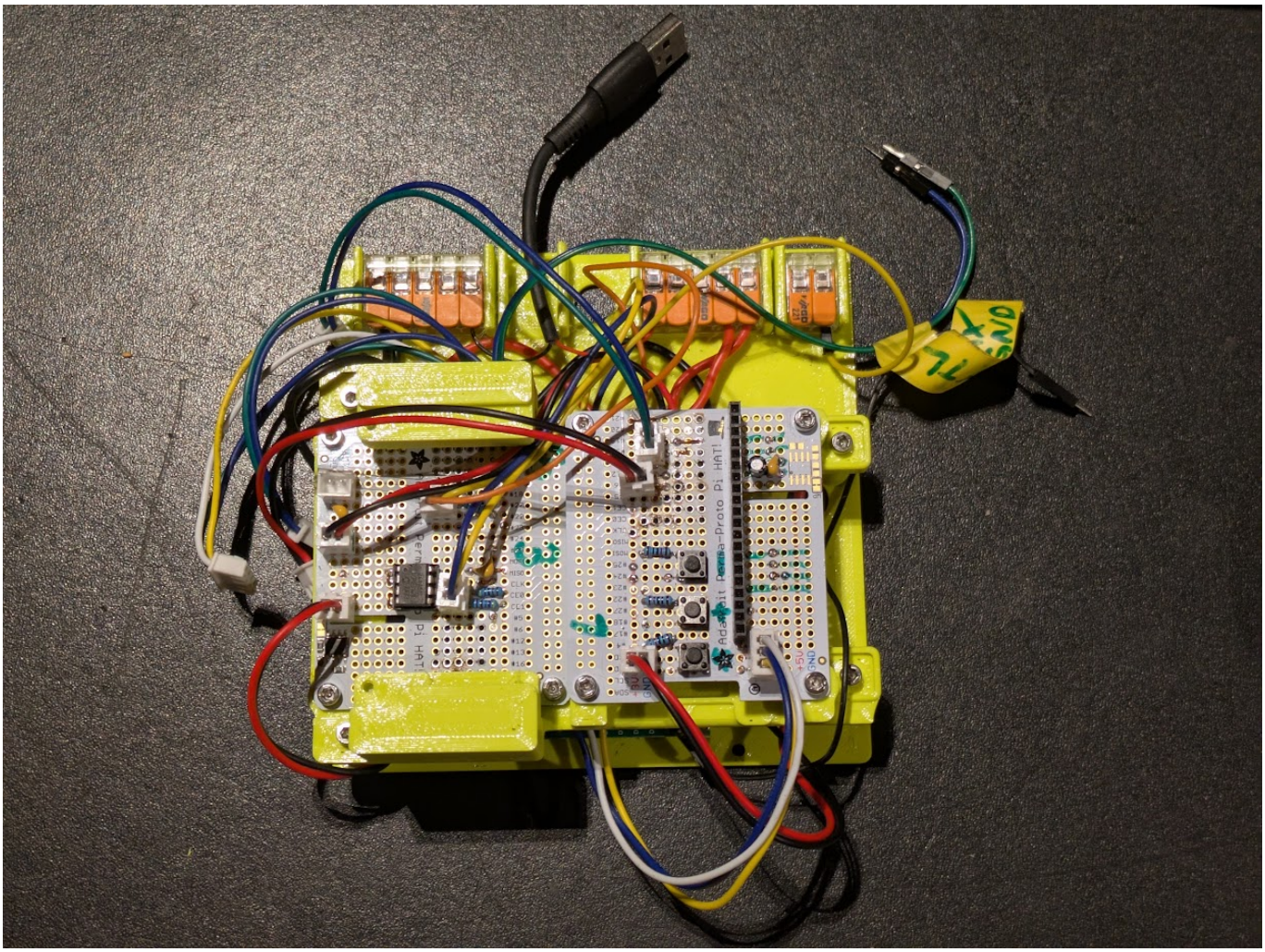
Appendix: Images

GNSS Sensor

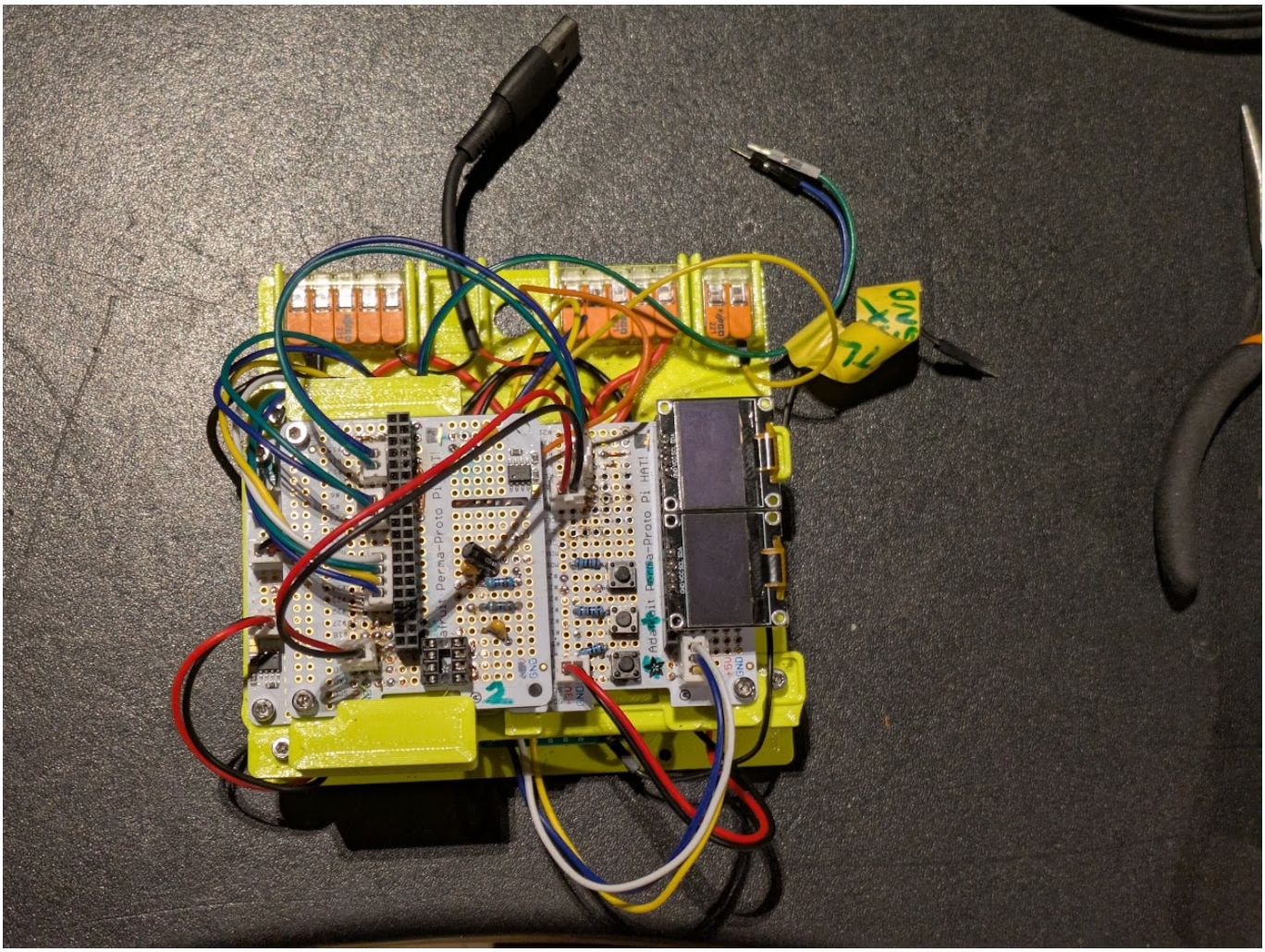


GNSS Sensor Base Board with Components

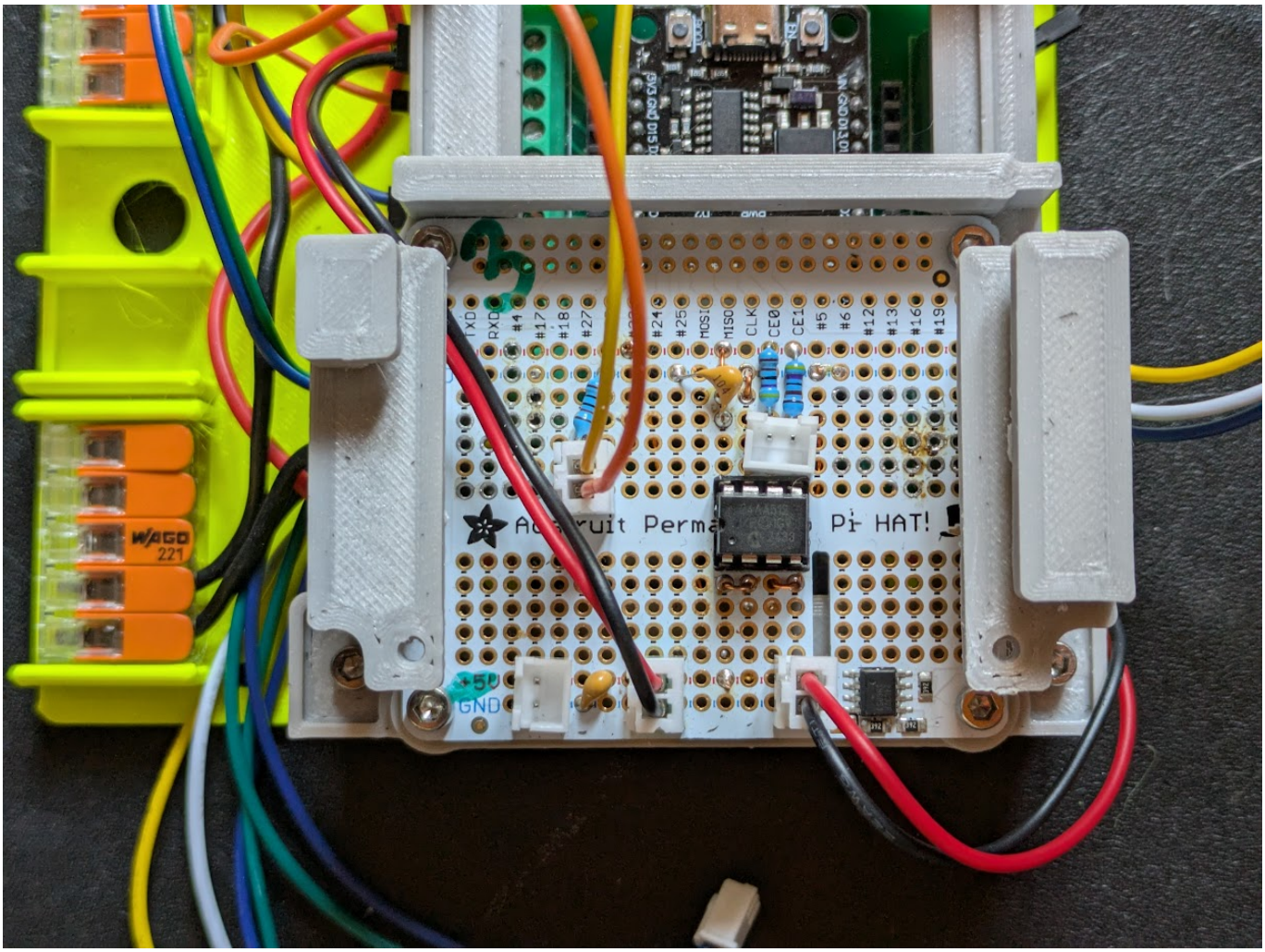
RPM Sensor



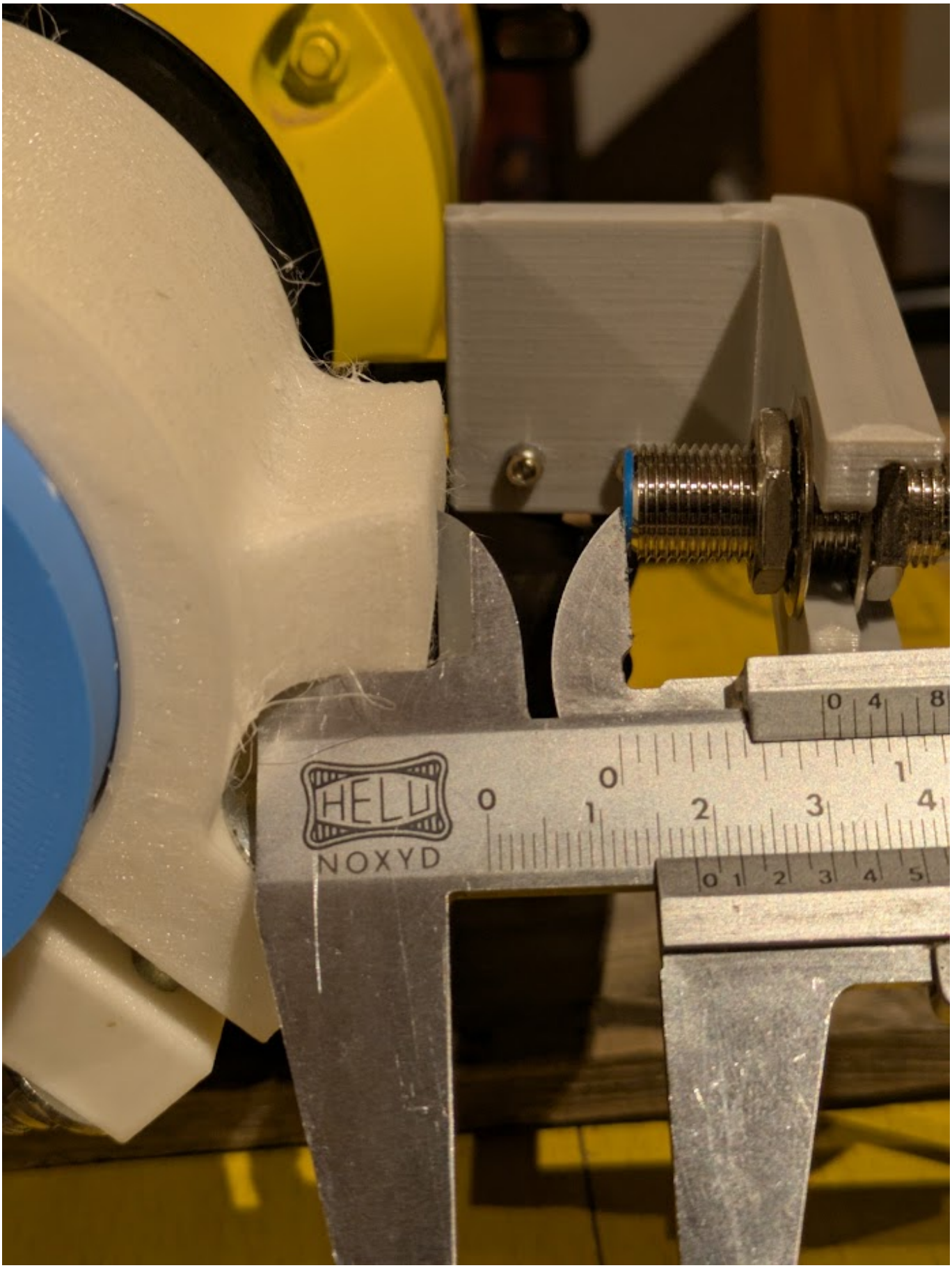
RPM Box Main Board (View 1)



RPM Box Main Board (View 2)



RPM Box Main Board with EEPROM



Mounting of the Hall Sensor

This technical documentation is part of the documentation of the RNLI project. Version 1.0, July 2025