RPM Sensor User Manual

Introduction

This manual describes the operation and maintenance of the RPM sensor developed for the RNLI project. The RPM sensor enables precise measurement of rotational speeds (revolutions per minute) and their storage in EEPROM as well as on an SD card.

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1. Overview

The RPM sensor is a compact device for continuous measurement of rotational speeds using a Hall sensor. It was specifically developed for use on sea rescue vessels and is robust against maritime conditions.

The system automatically stores the following data:

- Rotational speed (revolutions per minute)
- Date and time
- Temperature

The data is displayed on the OLED display as well as stored in the EEPROM and on the SD card.

2. Getting Started

2.1 Package Contents

- RPM sensor unit in weatherproof housing
- Power cable (5V)
- Hall sensor with connection cable
- Mounting materials
- SD card (pre-formatted)
- This documentation

2.2 Installation

1. **Mounting the main unit**: Attach the device at an easily accessible position protected from splash water.

2. **Mounting the Hall sensor**:
    - The Hall sensor is housed in a splash-proof box.
    - Attach the sensor box near the rotating component whose rotational speed is to be measured.
    - The magnet sleeve and the Hall sensor can have a distance of up to 18-20mm due to the strong neodymium magnets used.
    - The Hall sensor cable connection is made via WAGO terminals according to the following scheme:
        - Black → Orange (data line)
        - Brown → Red (5V)
        - Blue → Black (GND)
    - The shielding of the connecting cable is connected to GND only on one side in the RPM box.
3. **Mounting the magnet sleeve**:
    - The flexible sleeve made of TPU is placed around the shaft to be measured.
    - Secure the sleeve with the provided screws.
    - The sleeve contains 4 sets of magnets, each consisting of 4 strong neodymium magnets, allowing for a greater distance between the sensor and the rotating part.
    - Ensure that the sleeve is securely attached and cannot come loose during operation.
4. **Connect power supply**: Connect the power cable to a 5V power source. The device switches on automatically.
5. **Initial setup**: After switching on, the display shows the current values. On first startup, date and time must be set (see Section 5).

3. Daily Use

The RPM sensor works largely automatically. After switching on, the device immediately begins measuring and displaying the rotational speed and storing the data.

3.1 Switching On and Off

- **Switching on**: Connect the device to the power supply.
- **Switching off**: Disconnect the device from the power supply.

It is recommended to keep the device switched on during the entire operation time to ensure continuous data acquisition.

3.2 Normal Operating States

In normal operation, the display continuously shows the following information:

- Current rotational speed (RPM)
- Current date and time
- Current temperature

The measured data is automatically stored in the EEPROM and at regular intervals on the SD card.

4. Display Indicators and Functions

The OLED display is divided into different areas showing different information:

- **Upper area**: Current rotational speed in RPM
- **Middle area**: Date and time
- **Lower area**: Temperature and status information

For devices with two OLED displays, the second display shows additional information, such as historical data or graphical representations of the rotational speed development.

5. Setting Date and Time

To set date and time:

1. Press the SET button (yellow button) for about 2 seconds.
2. The display now shows the setting mode, starting with the year.
3. Use the PLUS (blue button) and MINUS buttons (white button) to change the displayed value.
4. Press the SET button again to move to the next value (year → month → day → hour → minute → second).
5. After setting the seconds, the new values are stored in the RTC and the normal operating mode is reactivated.

If no button is pressed for 30 seconds, the device exits the setting mode without saving the changes.

6. Data Retrieval and Management

6.1 Accessing Stored Data

To access the recorded data:

1. Switch off the device (disconnect power supply).
2. Carefully open the housing (pay attention to waterproofing).
3. Remove the SD card.
4. Read the SD card with a computer.
5. Re-insert the SD card and carefully close the housing.

The data stored in the EEPROM serves as a backup and can be read out if needed. To do this:

1. Connect a USB-TTL converter to the TX/RX connections of the device (see photo in the appendix).
2. Open the Serial Monitor on your PC (e.g., in Arduino IDE or VS Code).
3. Set the baud rate to 115200.
4. Enter the command "Download" and send it.
5. The device then outputs all data stored in the EEPROM in CSV format.

Note: The crossing of the TX/RX lines is already taken into account and should not be done again.

6.2 Data Format

The data is stored on the SD card in CSV files. The file name follows the format `rpm_log_YYYY-MM-DD_HH-MM-SS.csv`, where the date and time indicate the time of the first recording in the file.

Each line in the CSV file contains the following entry:

```
YYYY-MM-DD,HH:MM:SS,RPM,Temperature
```

Example:

```
2025-07-30,14:35:22,1240,22.5
```

6.3 Recommended Data Backup

It is recommended to back up the data regularly (e.g., weekly) from the SD card. This can be done by copying the CSV files to a computer or another storage medium.

7. Troubleshooting

7.1 Common Problems and Solutions

Problem	**Possible Cause**	**Solution**
No or incorrect RPM display	Incorrect distance between sensor and magnets	Adjust distance (up to 18-20 mm with the project's neodymium magnets)
	Incorrect alignment of the magnets	Correct position of the magnets
	Cable break	Check cable and connections
No display on the screen	Power supply problem	Check power supply
	Display error	Turn the device off and on again
SD card error	Wrong SD card	Use 8 GB SD card
	SD card not formatted	Format SD card in FAT32 format
Incorrect time/date	RTC battery empty	Send device for maintenance
	Incorrect setting	Reset time and date

7.2 Restarting the Device

In case of unusual behavior, a restart of the device can help:

1. Disconnect the power supply.
2. Wait 30 seconds.
3. Reconnect the power supply.

8. Maintenance and Care

8.1 Regular Inspection

- Regularly check the water tightness of the housing.
- Check the mounting of the device and the Hall sensor.
- Clean the device with a damp cloth if necessary (no aggressive cleaning agents).

8.2 SD Card

The SD card has a limited lifespan. It is recommended to:

- Replace the SD card every 6-12 months.
- Use only high-quality SD cards with a maximum of 16 GB (preferably 8 GB).
- Regularly check the SD card for errors.

8.3 Hall Sensor and Magnet Sleeve

- Regularly check the position and distance of the Hall sensor to the magnets.
- Make sure the sensor and magnets are free from dirt and corrosion.
- Regularly check the attachment of the magnet sleeve and tighten the screws if necessary.
- Check the Hall sensor's connecting cable for damage or corrosion at the WAGO terminals.

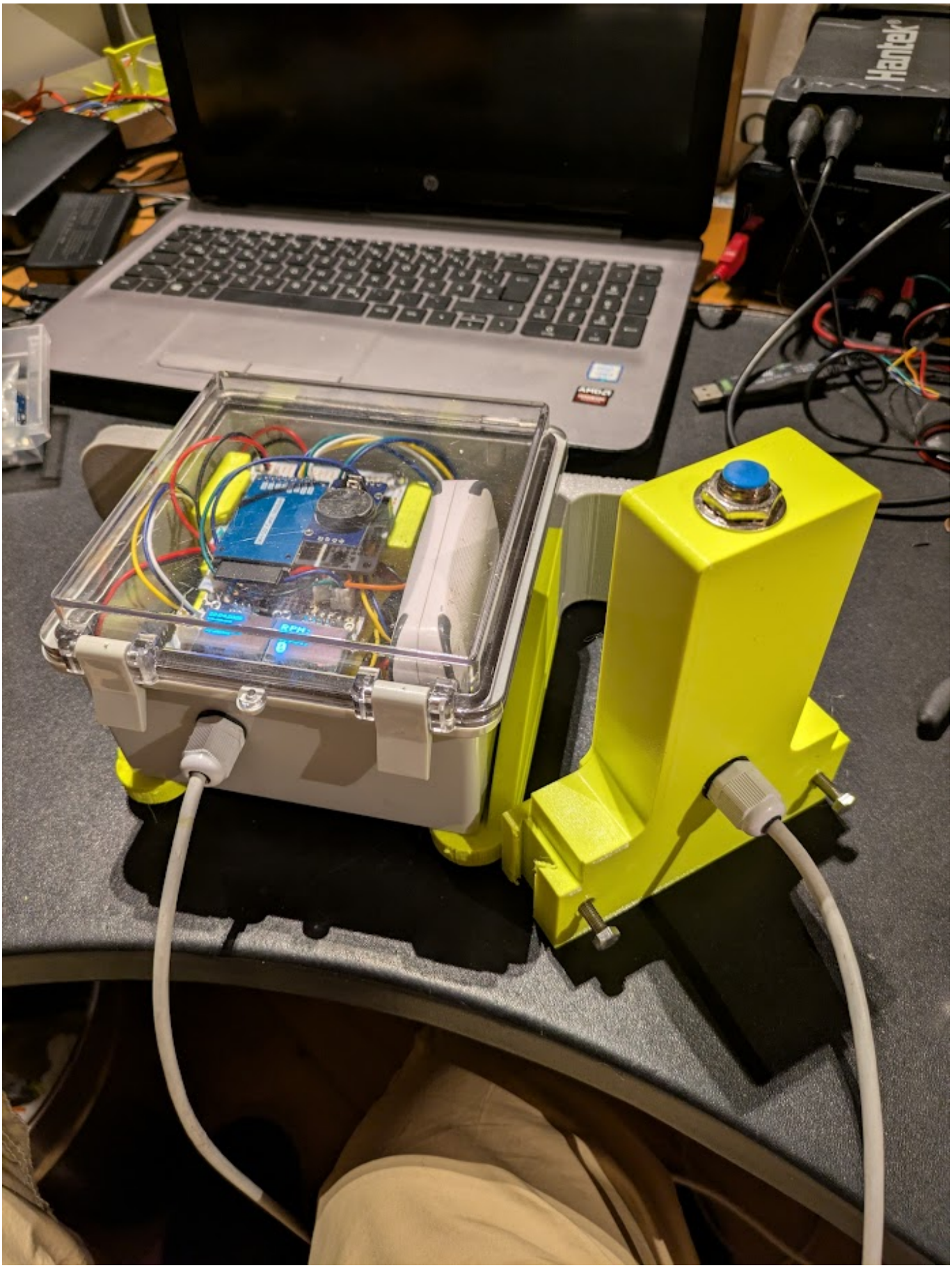
9. Technical Specifications

- **Power supply**:
  - Input: 5V DC
  - Internal: Two separate Buck Step Down Converters to 3.3V:
    - Converter 1: Supply for ESP32 and EEPROM
    - Converter 2: Supply for OLED displays and SD card
- **Power consumption**: max. 200mA
- **Operating temperature**: -10°C to +50°C
- **Protection class**: IP65
- **Measurement range**: 10-10,000 RPM
- **Accuracy**: ±1%
- **Number of trigger points per revolution**: 4
- **Data recording interval**: Continuous, storage every 5 seconds
- **Display**: OLED, 128x64 pixels
- **SD card**: FAT32 format, recommended size 8 GB
- **EEPROM**: 24AA512-MIC (64 KB)
- **Dimensions**: According to housing
- **Weight**: According to configuration

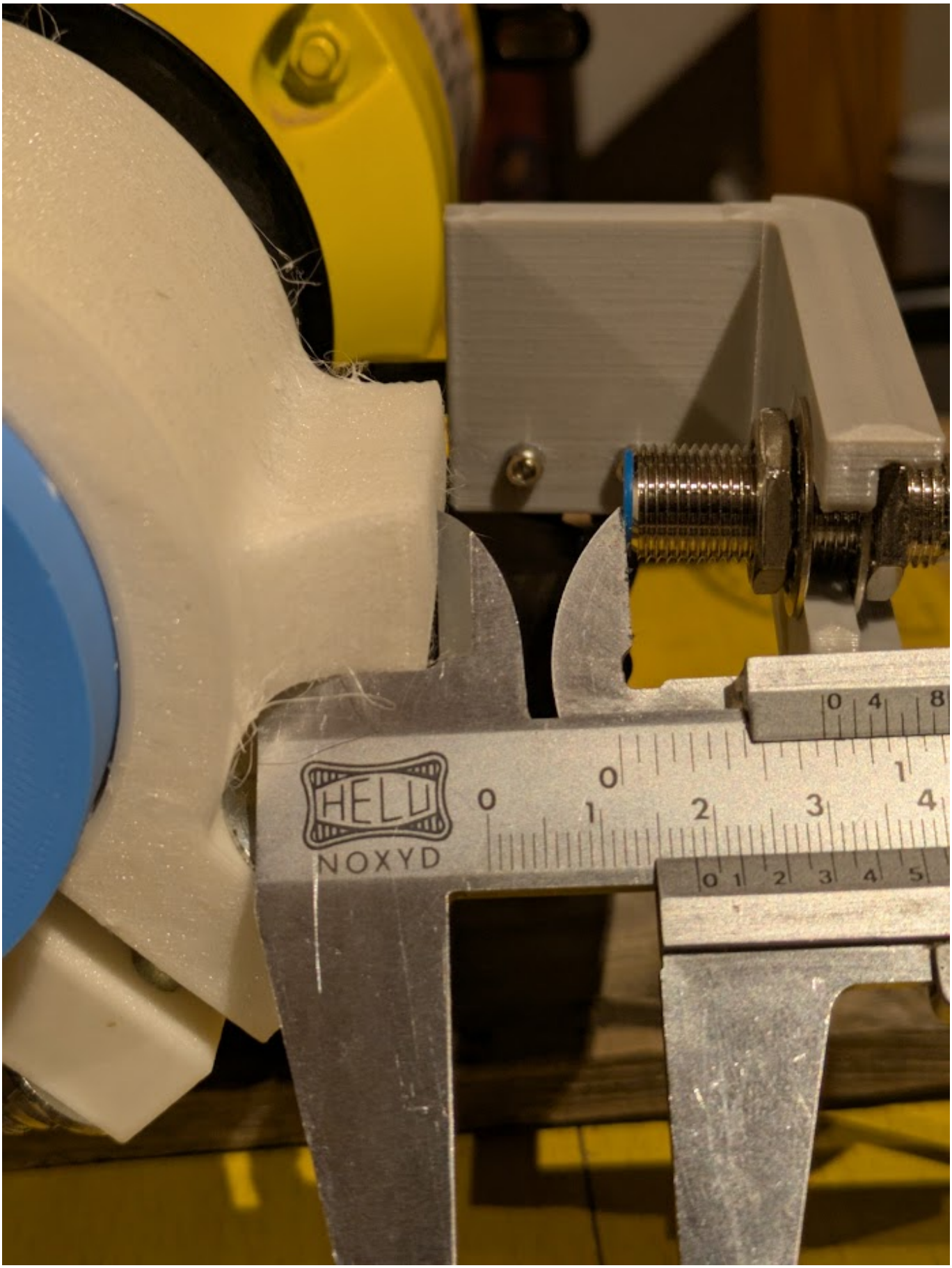
Appendix

Photos and Diagrams

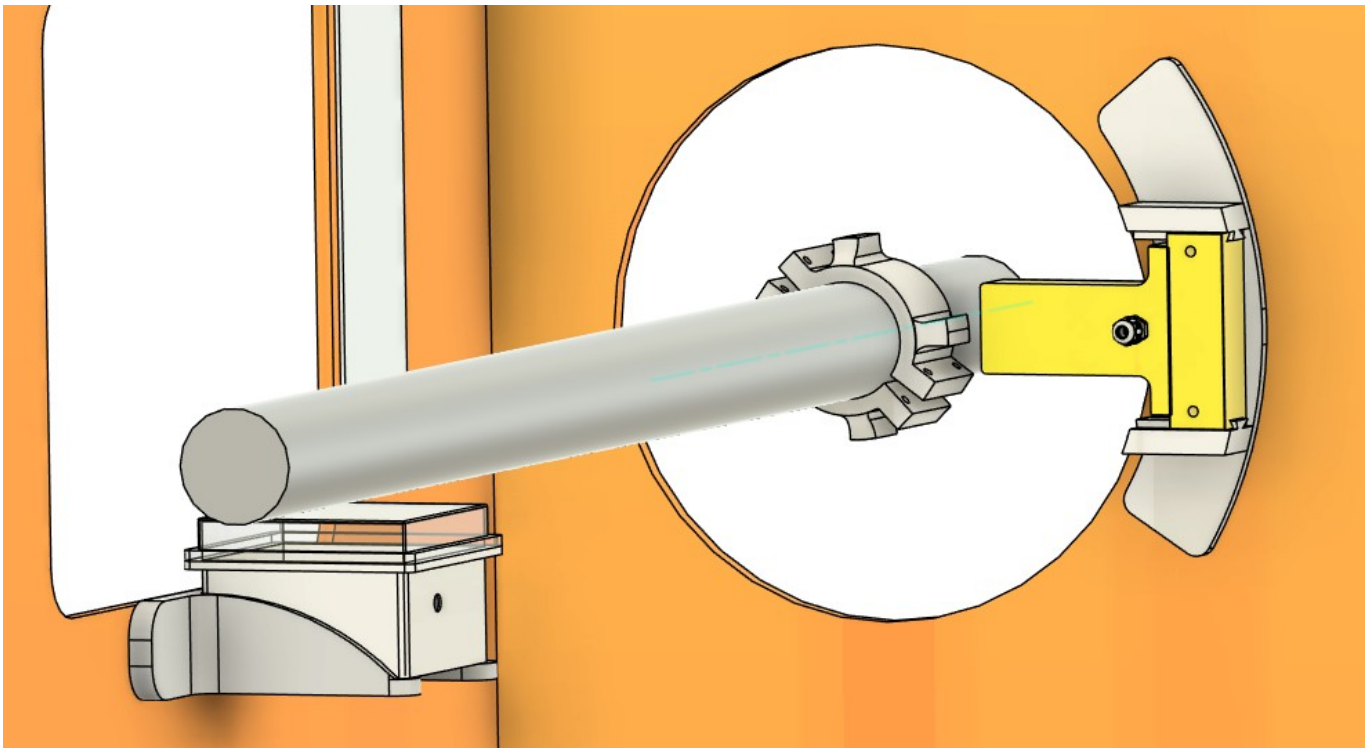
Components and Mounting



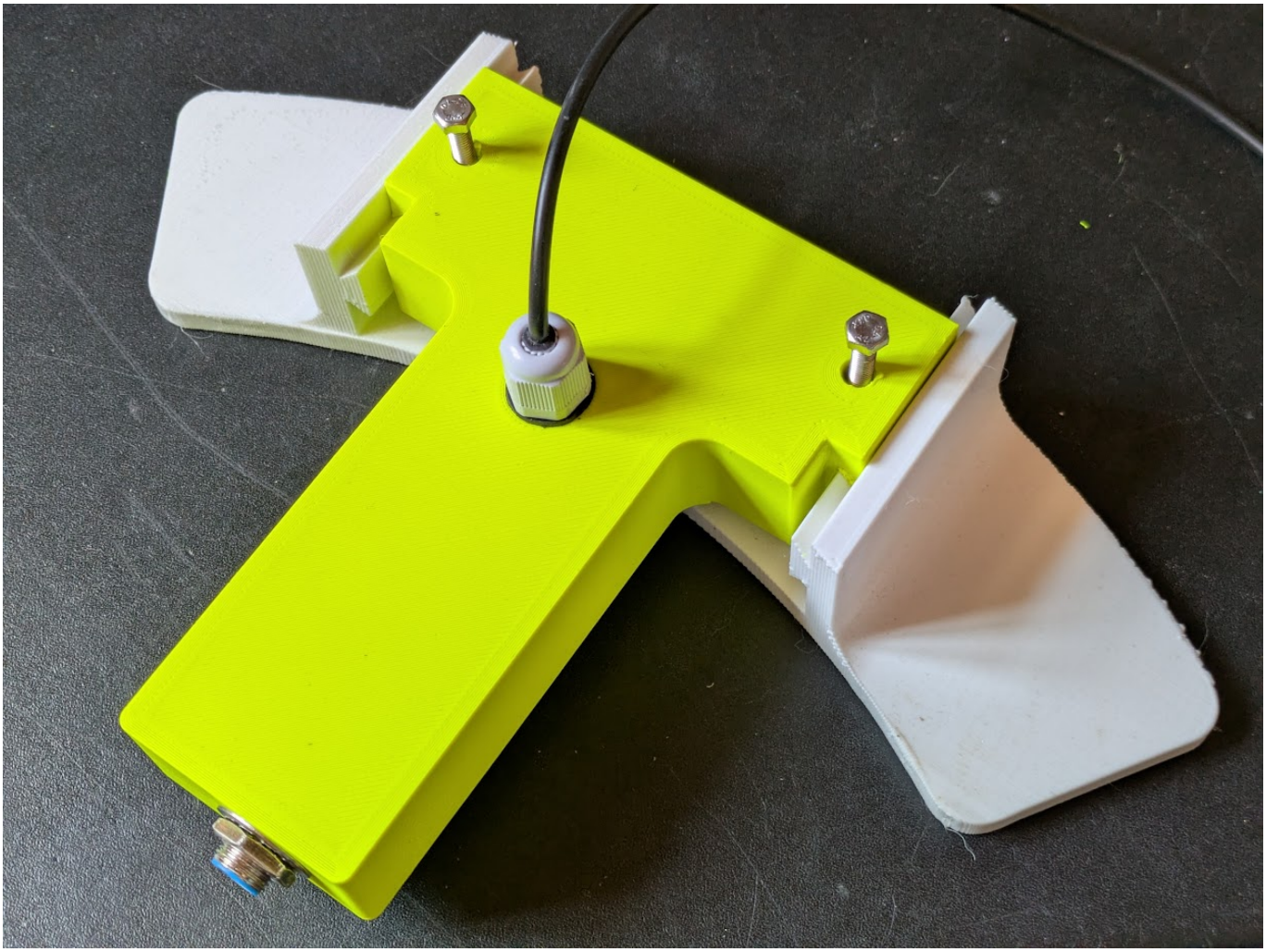
RPM Box with connected HALL sensor box



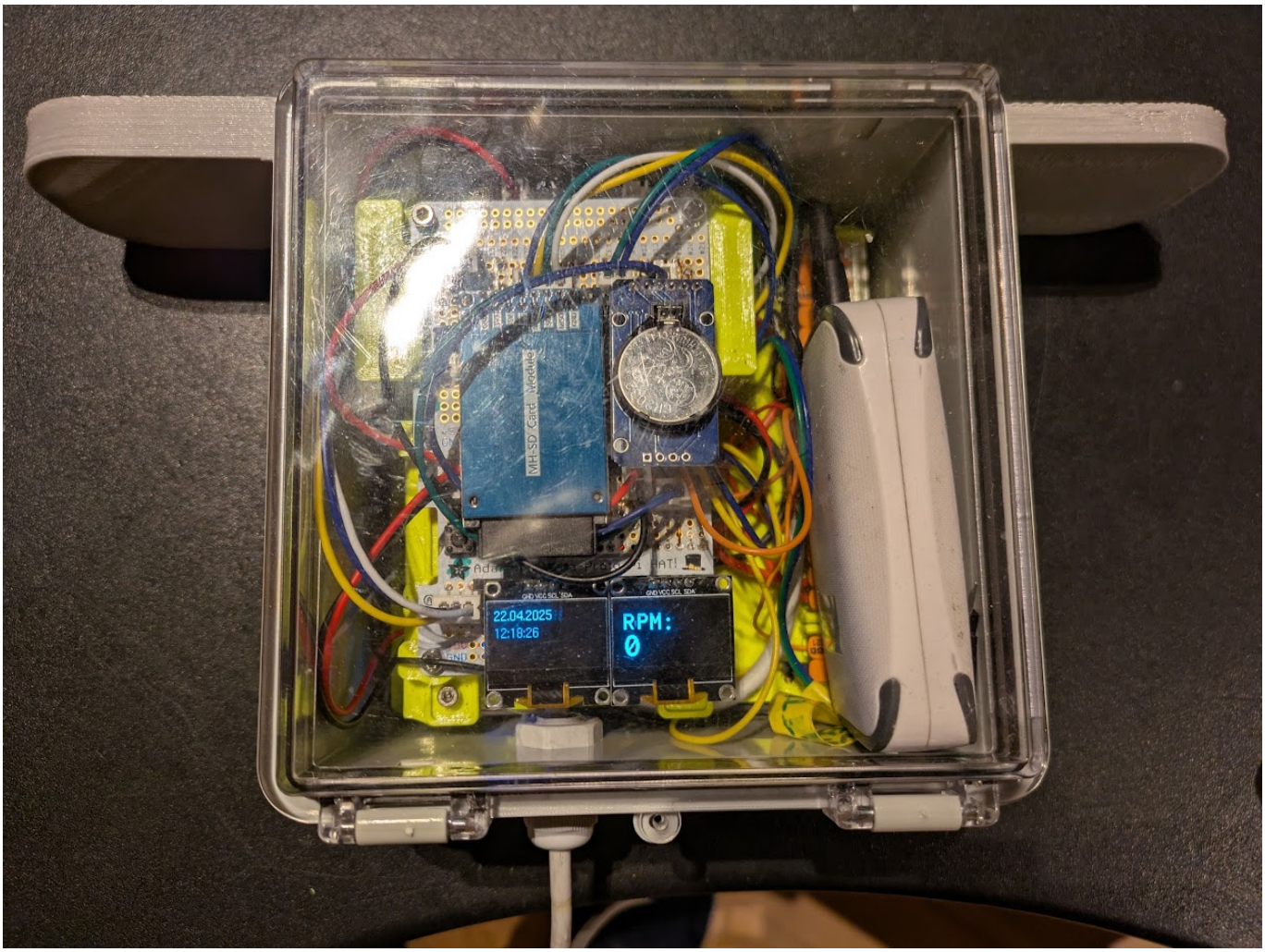
Mounting of the Hall sensor on the component to be measured



Mounting of the RPM sensor and the sensor box

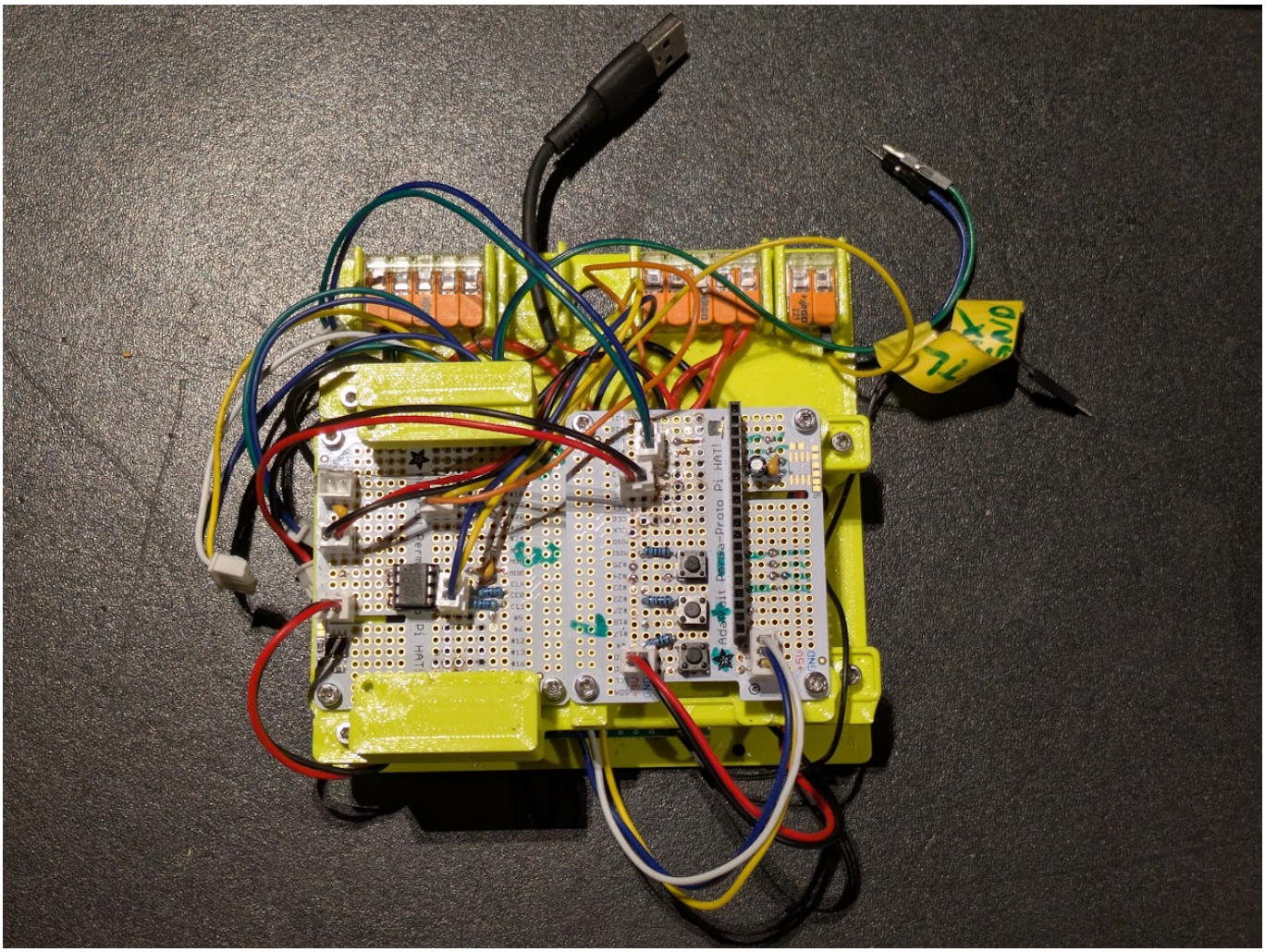


RPM sensor box with mount for attachment

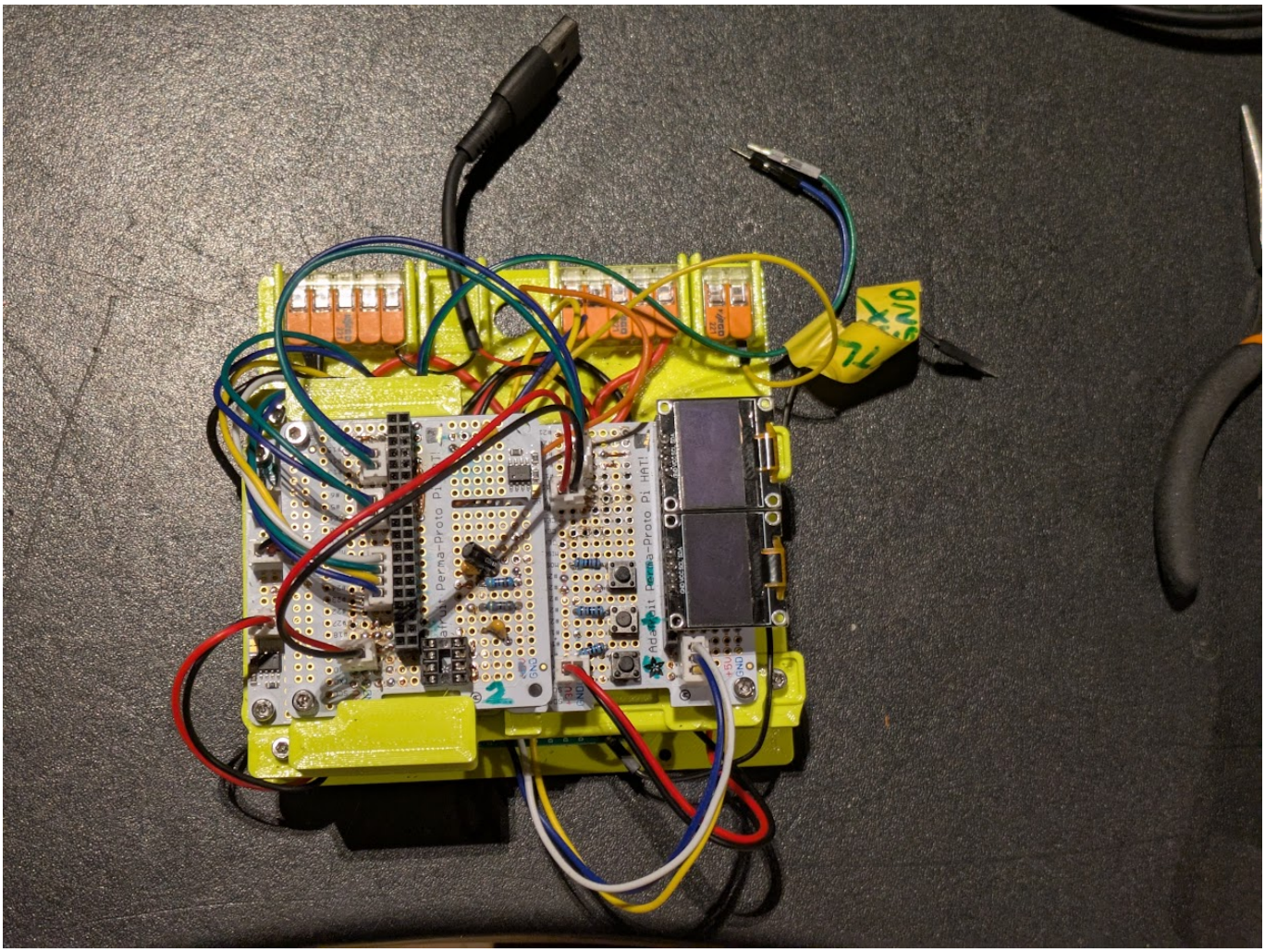


The RPM box with mounted bracket

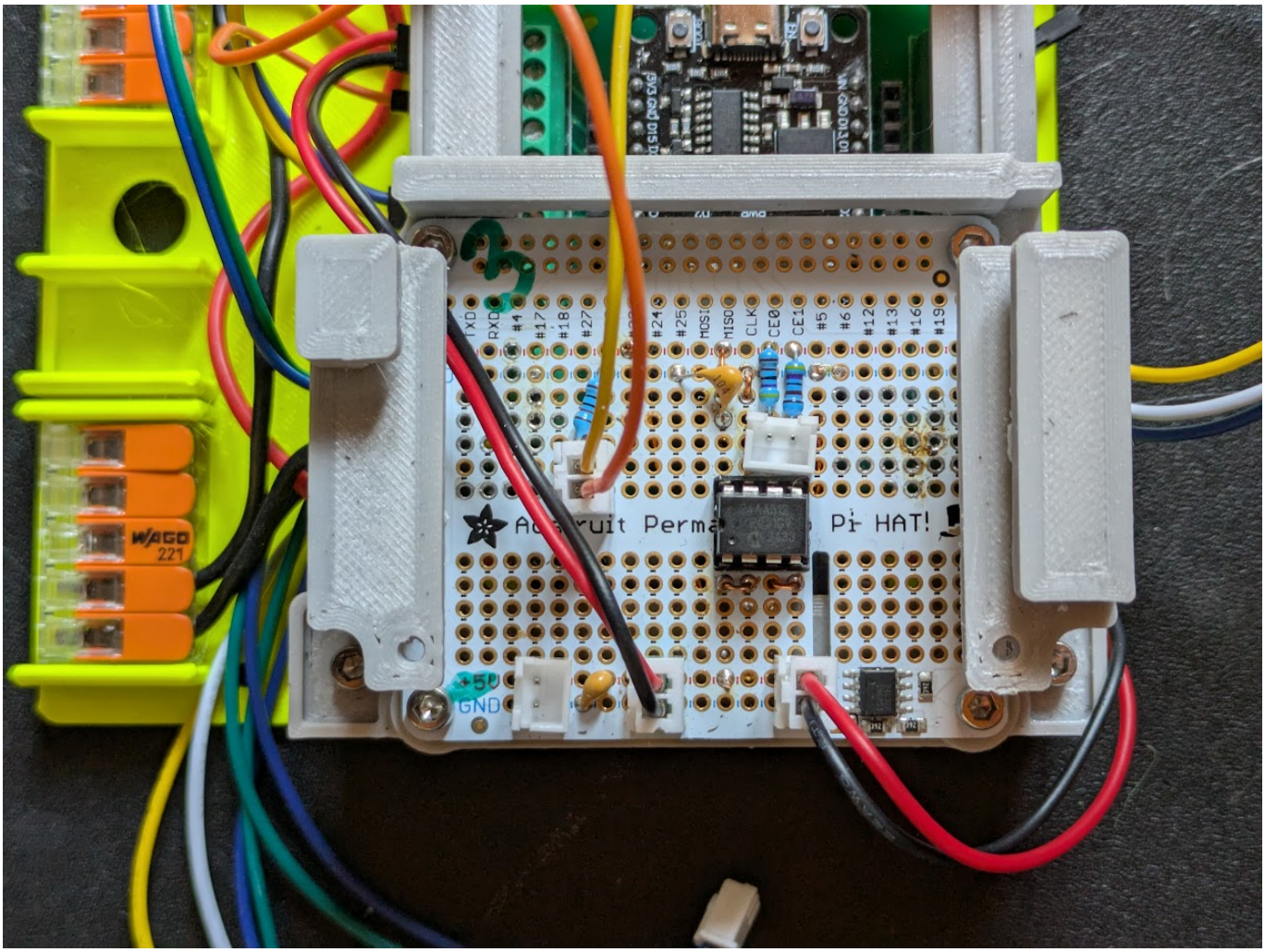
Boards and Electronics



RPM box main board without mounted OLED displays

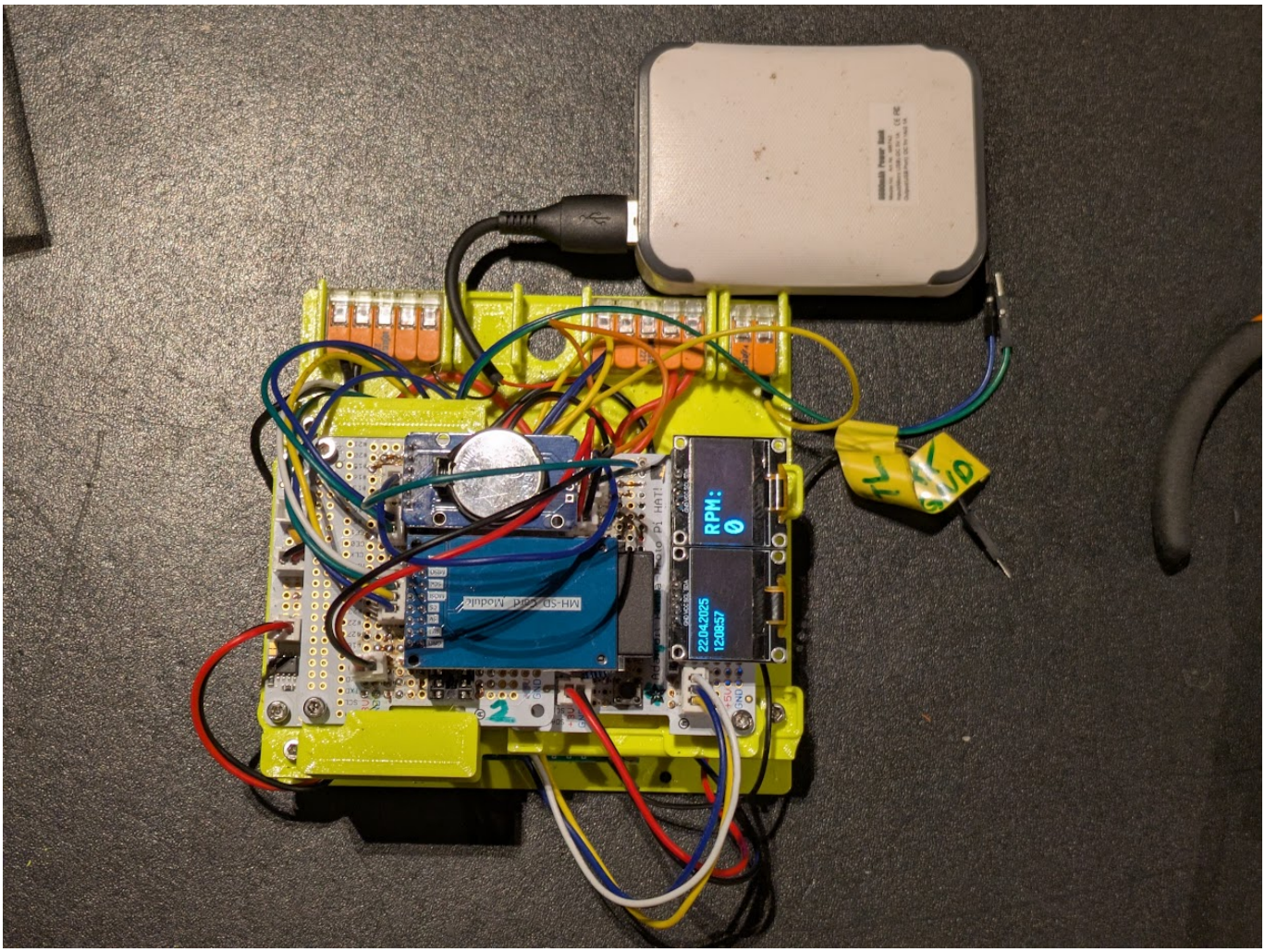


RPM box board without SD card and RTC module



RPM box board with EEPROM storage module

Operation



RPM box in operation mode with activated displays

Source Code and 3D Print Templates

The complete source code and all associated files for this project are available in the GitHub repository:

GitHub Repository: github.com/hansratzinger/RpmSensor

The repository contains:

- The complete source code of the project
- Configuration files
- 3D printing templates (.3mf files) in the `/3d` folder for all required components:
  - Housing parts for the RPM box
  - Mounts for installation
  - TPU magnet sleeves in different sizes
  - Splash-proof Hall sensor box

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