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# 1x PDI Calibration

*Release 6.8.69*

**Embention**

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# | PDI CALIBRATION

1x PDI Calibration setups calibration parameters for 1x autopilots. It also allows the user to calibrate sensors and configure the radio module.



## QUICK START

1x PDI Calibration is the application tool that allows the user to perform certain **calibrations** of a Veronte Autopilot 1x and **trim stick inputs**. The calibrations that can be performed from this app are as follows:

- Sensors Calibration: **IMUs** and **Magnetometers**
- Calibration of **Servos**

In addition, it also includes a **Terminal Manager** that can be used, for example, to configure the **Microhard internal radio** (Veronte Autopilot 1x with hardware version 4.5 internal radio).

Once 1x autopilot has been detected on [Veronte Link](#), install **1x PDI Calibration**.

### 1.1 Download

Once the **Veronte Autopilot 1x** has been purchased, a GitHub release should be created for the customer with the application.

To access to the release and download the software, read the [Releases section](#) of the **Joint Collaboration Framework** manual.

## 1.2 Installation

To install 1x PDI Calibration on Windows just execute “1xVerontePDICalibration.exe” and follow the indications.

1. Click on Next:

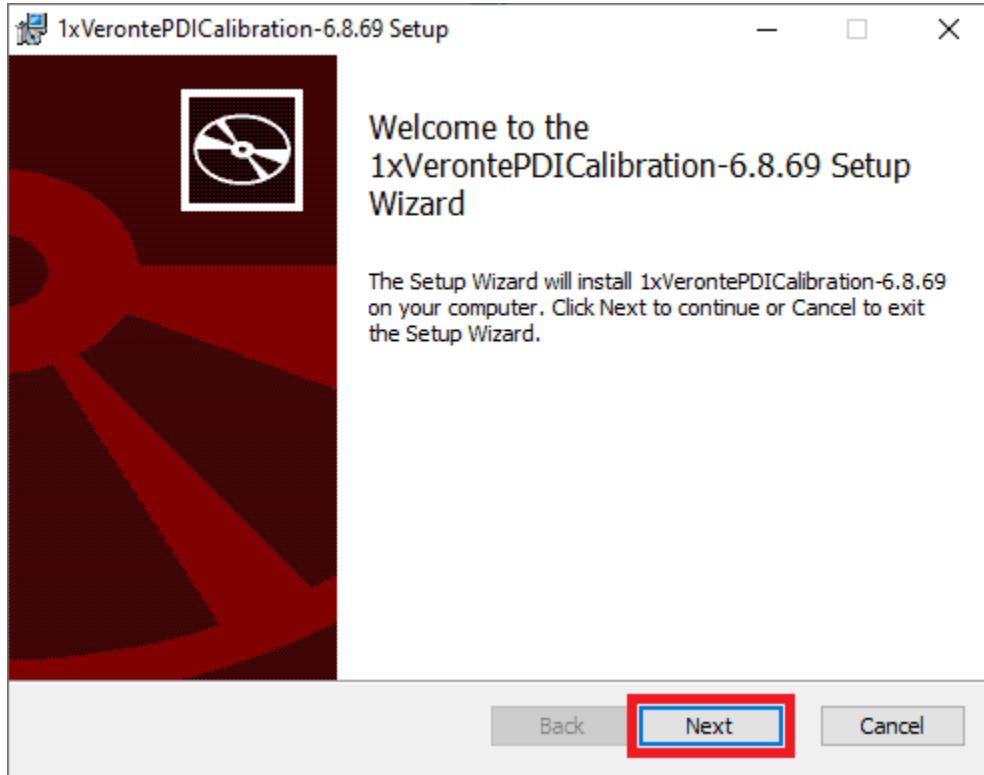


Fig. 1: Windows Installation - Step 1

2. Read and accept the EULA (End-User License Agreement):



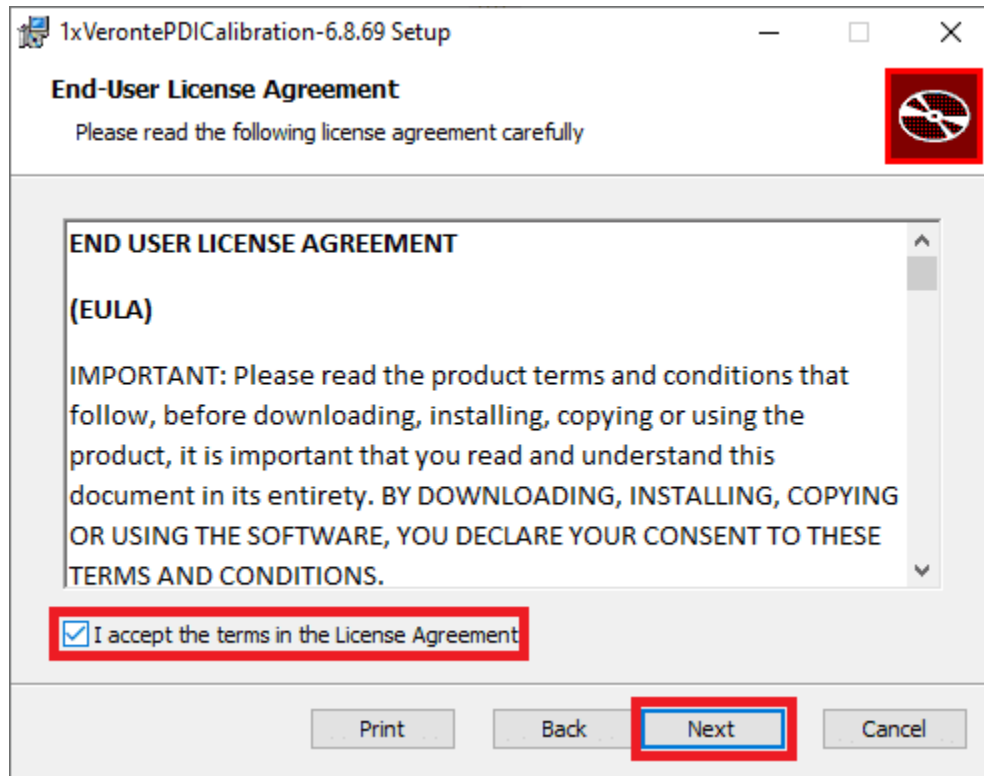


Fig. 2: Windows Installation - Step 2

3. Select the desired directory where the software will be installed and click on next.

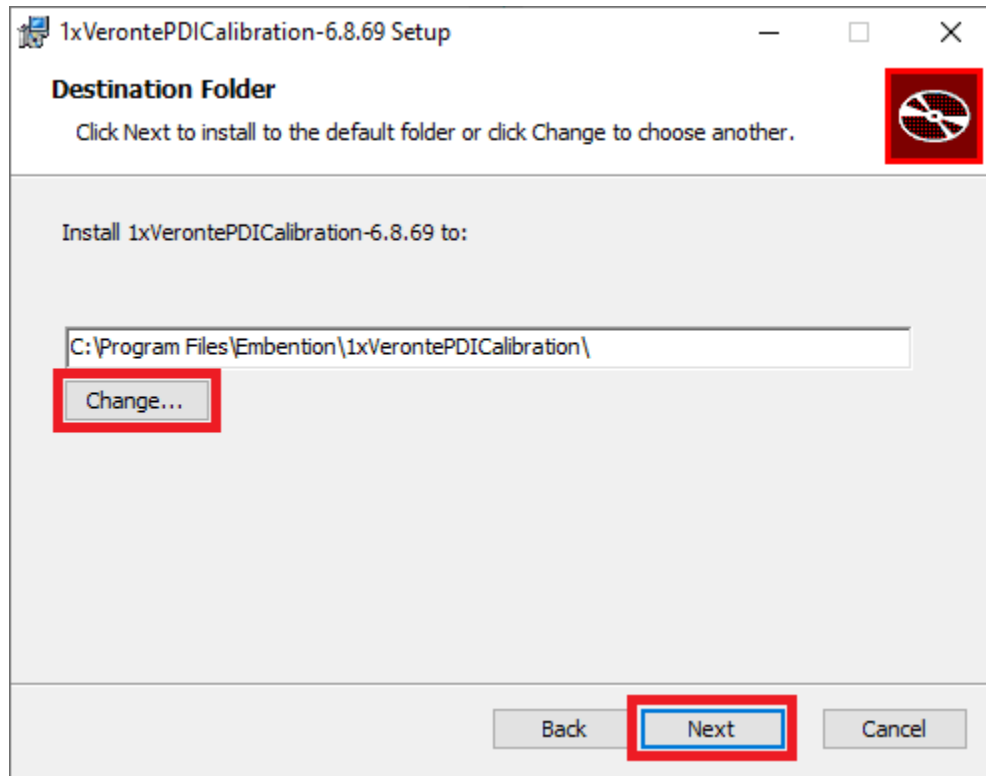


Fig. 3: Windows Installation - Step 3

4. Finally, click on **Install** (administrator rights are needed):

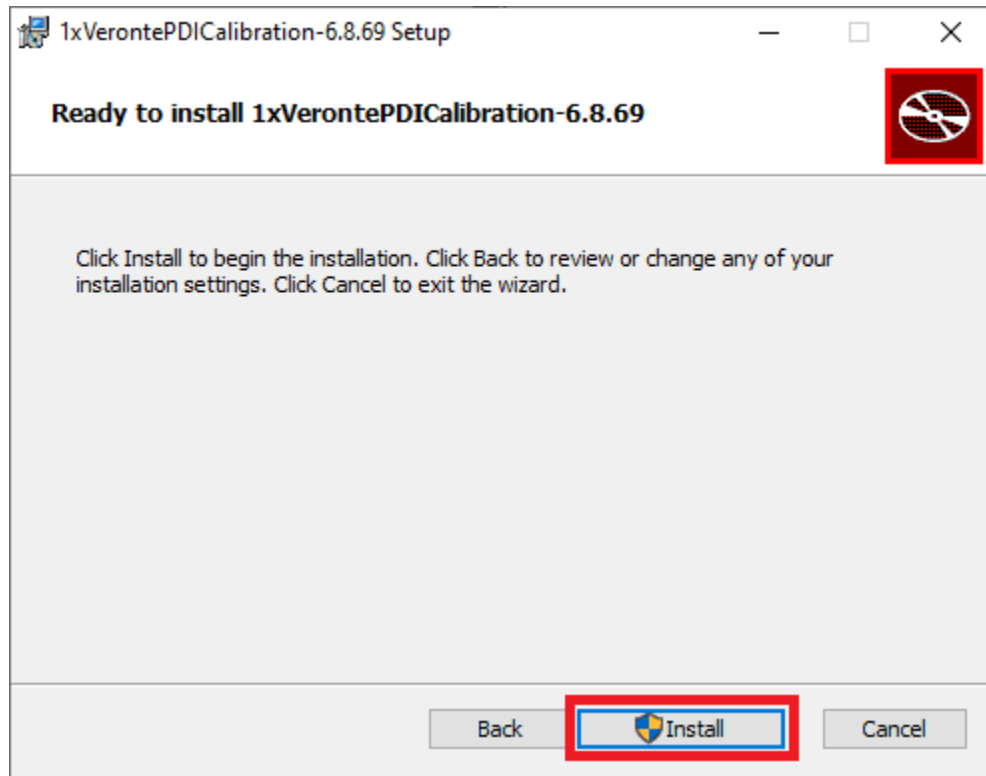


Fig. 4: Windows Installation - Step 4

5. After a few seconds, the following window will appear indicating the process was successful. Click on **Finish**:

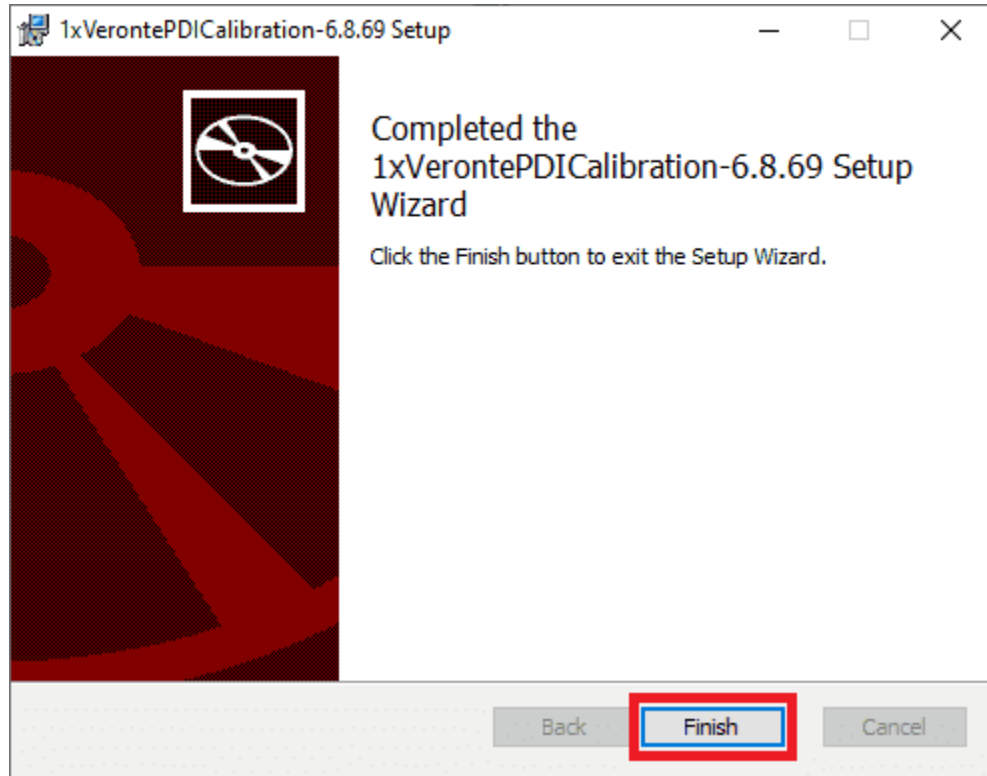


Fig. 5: Windows Installation - Step 5

**Warning:** If users have any problems with the installation, please disable the antivirus and the Windows firewall. Disabling the antivirus depends on the antivirus software.

To disable the firewall, go to "Control Panel" → "System and Security" → "Windows Defender Firewall" and then, click on "Turn windows Defender Firewall on or off".

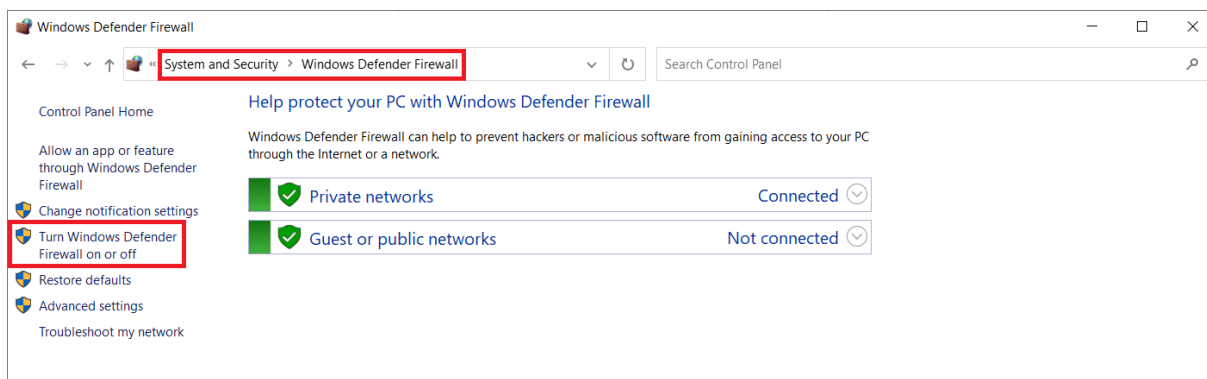


Fig. 6: Windows Defender Firewall

## OPERATION

Once the installation is finished, open 1x PDI Calibration and select the unit.

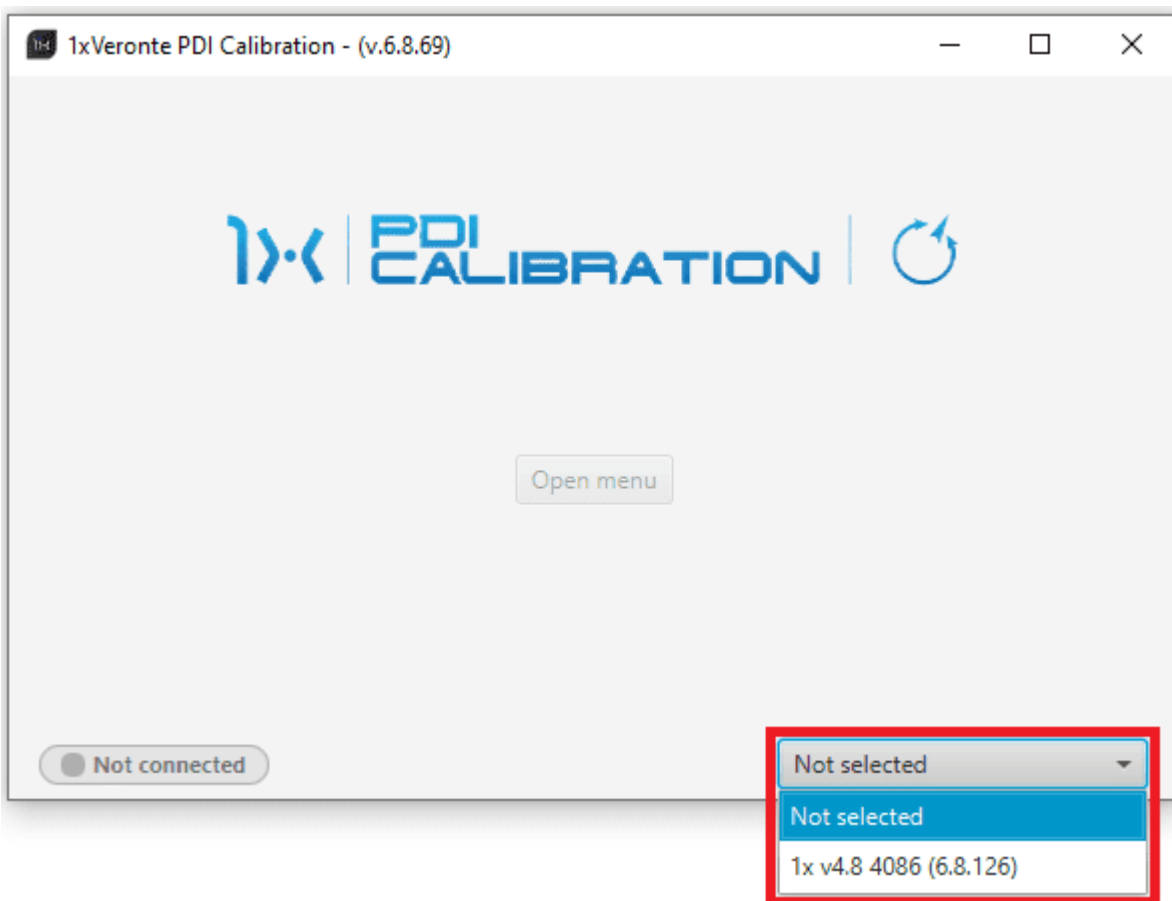


Fig. 1: Select device

**Warning:** If no unit is connected, e.g. when working offline, it is not possible to access the menus of the 1x PDI Calibration software.

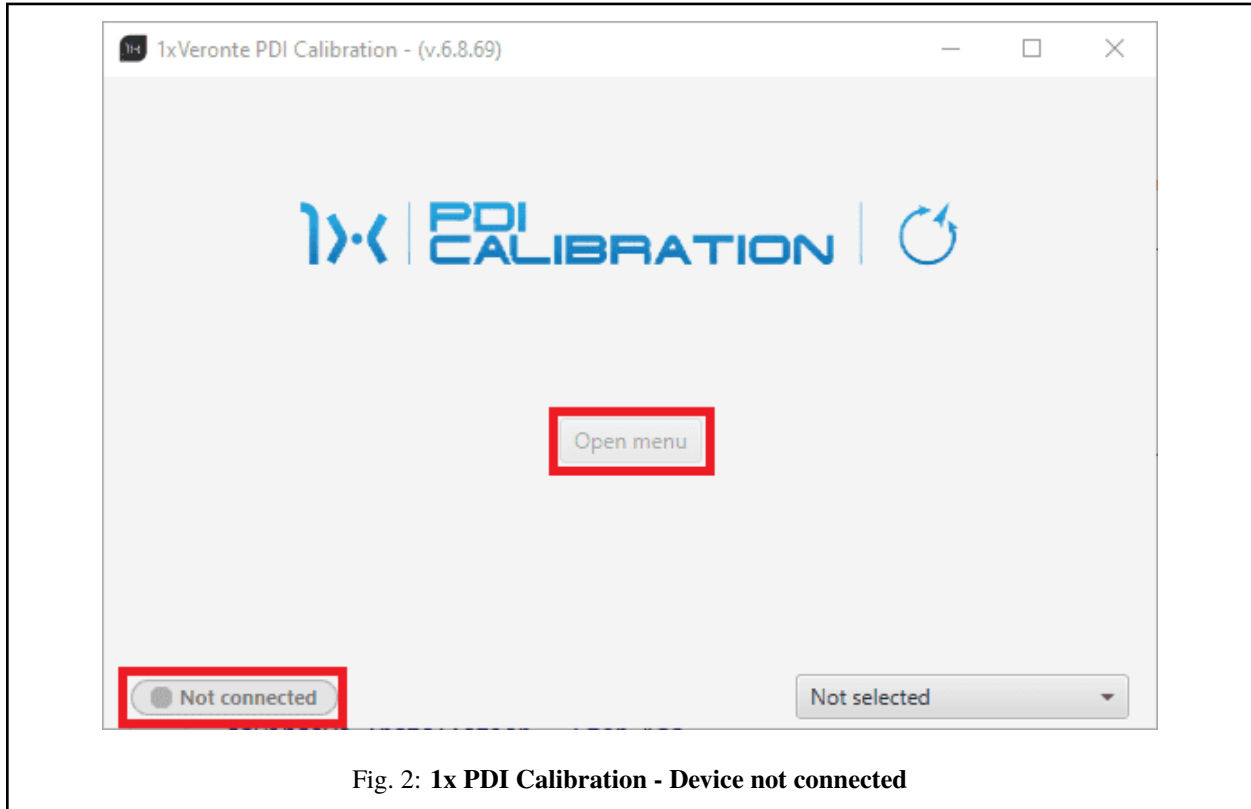


Fig. 2: 1x PDI Calibration - Device not connected

If it is correctly connected, it should appear in **Normal mode** as shown in the following figure.

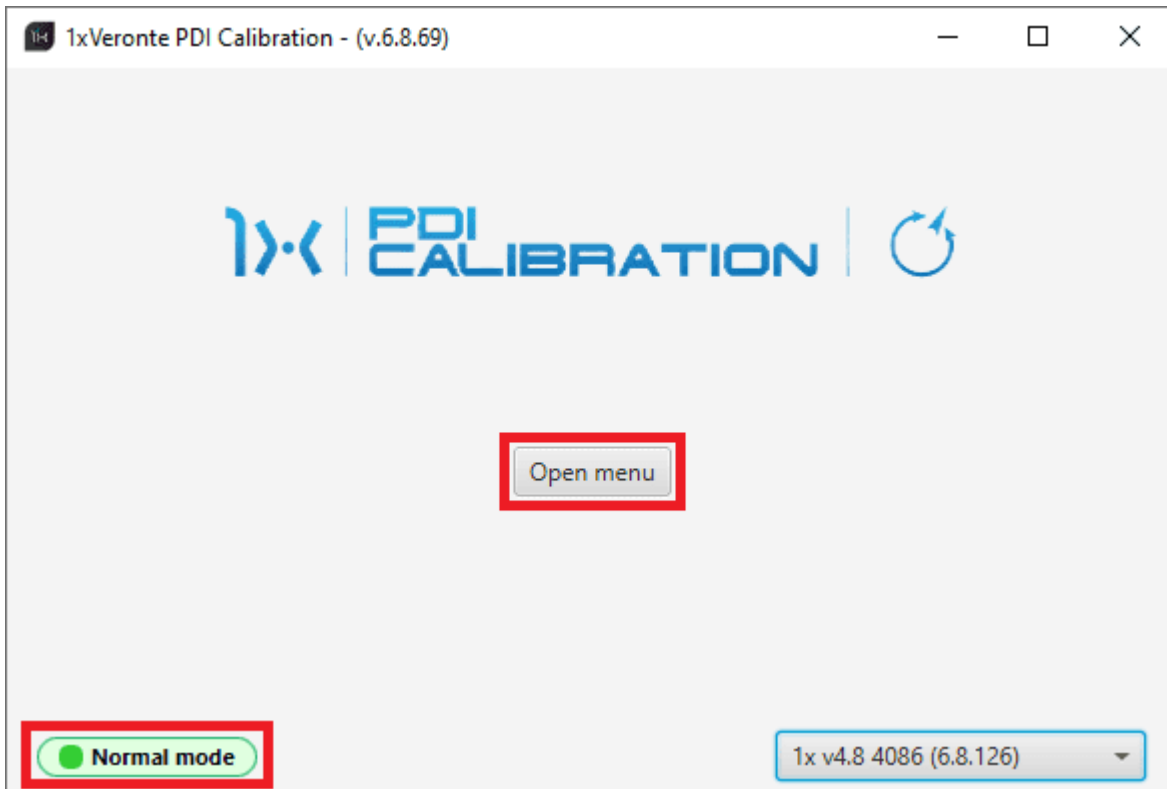


Fig. 3: 1x PDI Calibration

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**Note:**

- 1x unit can also appear as: Maintenance mode, Maintenance mode (loaded with errors) or Normal mode - Disconnected.
  - **Maintenance mode (loaded with errors)** appears when something is wrong in the configuration.
- 

The user can now access the software by clicking on '**Open menu**'. Then, the following window will be displayed:

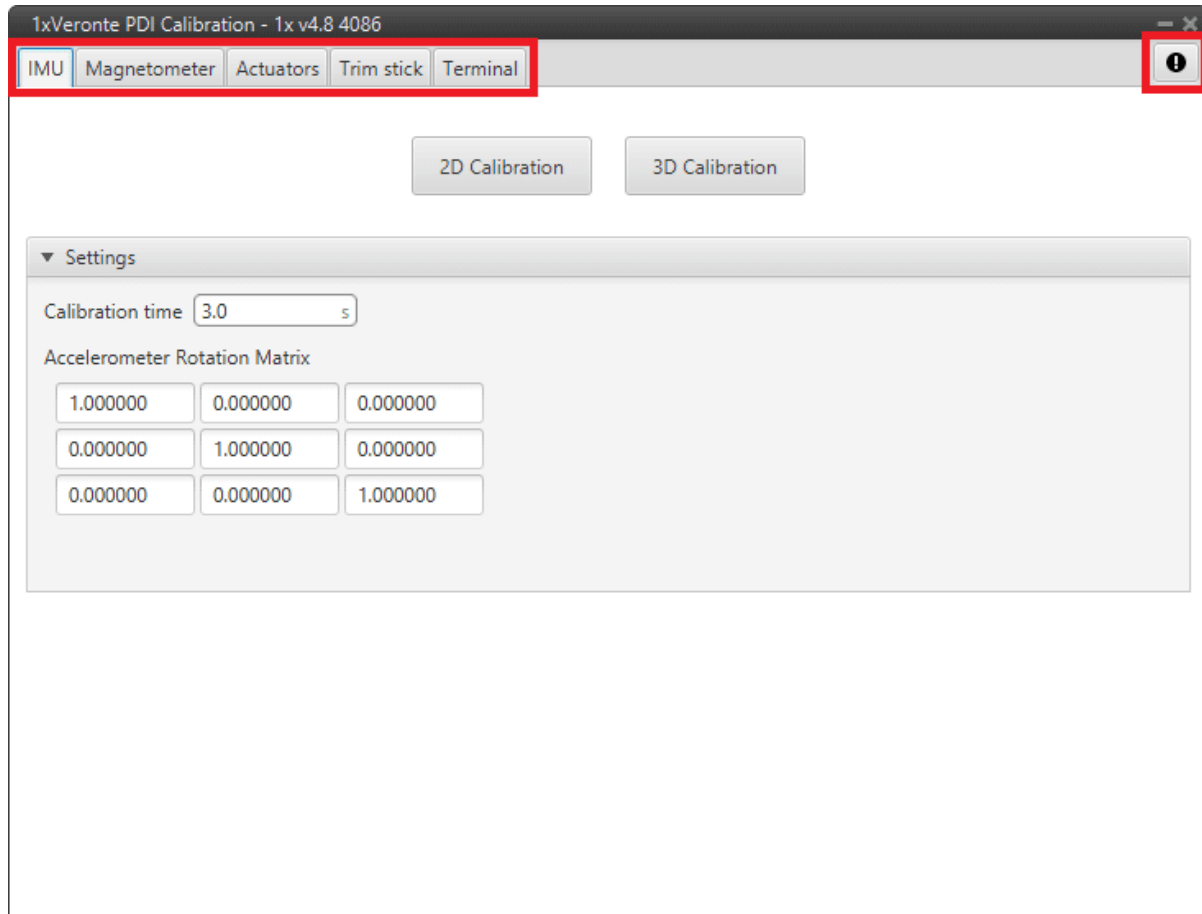



Fig. 4: Initial menu

-  **Feedback button:** Users can report a problem they have encountered by **creating an issue in their own ‘Joint Collaboration Framework’**.

The ‘**Download**’ button downloads a zipped folder with the current 1x configuration and more information needed for Embention to resolve the issue. It is advisable to attach this folder when creating the issue.

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**Note:** The user’s ‘Joint Collaboration Framework’ is simply a **own Github repository for each customer**.

If the user has any questions about this Joint Collaboration Framework, please see the [Joint Collaboration Framework user manual](#) or contact [sales@embention.com](mailto:sales@embention.com).

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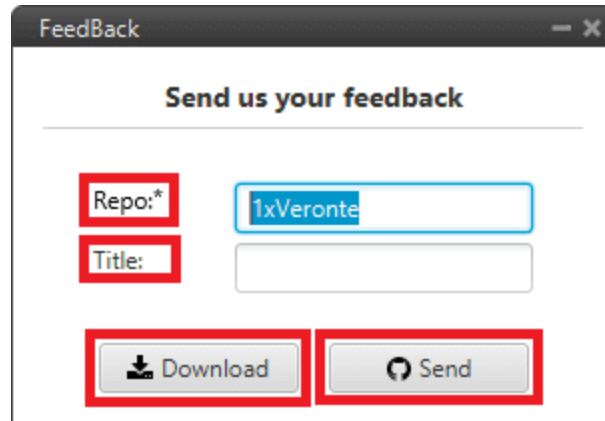



Fig. 5: Feedback

- The 5 different tabs that can be seen in the figure above are explained in detail in the following sections:
  - *IMU*: Calibration of the current IMU (selected in the **1x PDI Builder** software).
  - *Magnetometer*: Calibration of all magnetometers sensors.
  - *Actuators*: Calibration of actuators.
  - *Trim stick*: Trimming the neutral position of channels.
  - *Terminal*: Terminal Manager.

When **exiting** from the 1x PDI Calibration software menus (by clicking on ) , the following message will appear asking to save/export the current configuration:

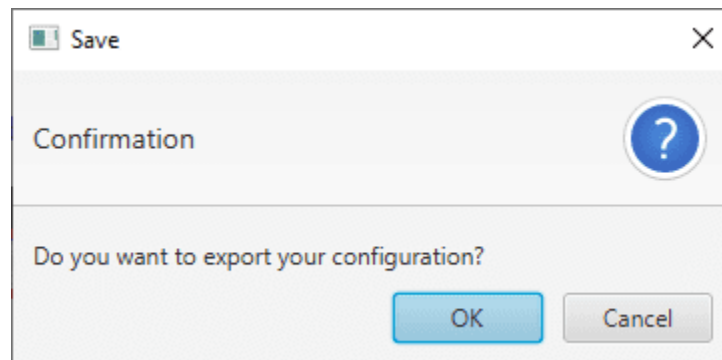


Fig. 6: Export configuration

This will save a folder with the current configuration (**PDI files** including the **production** folder) saved in Veronte Autopilot 1x.

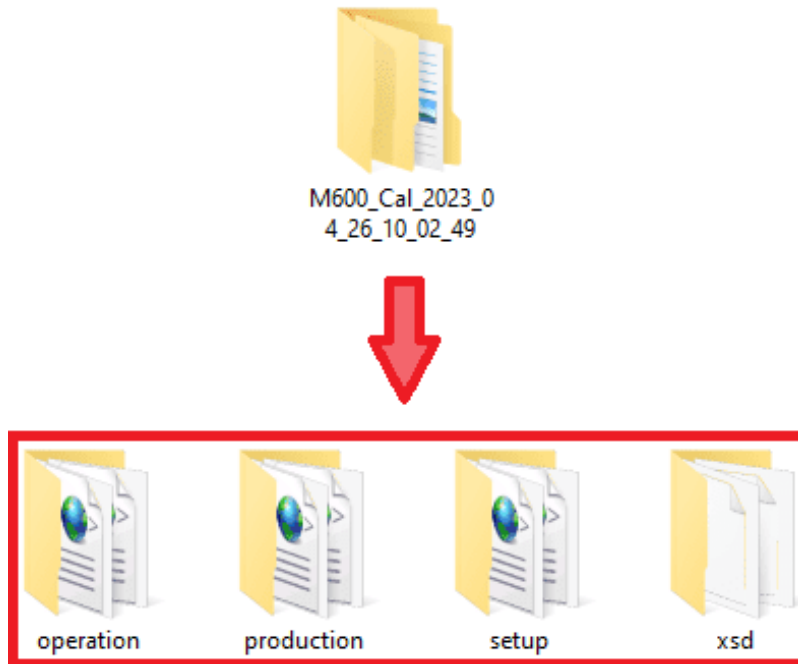


Fig. 7: Exported configuration - PDI files

For more information on the folders containing the **PDI files**, see the [initial menu of the Configuration section of the 1x PDI Builder user manual](#).

## 2.1 IMU

This menu allows the user to recalibrate the IMU, as they are factory calibrated, to correct any bias in the IMU calibration, including mounting offsets.

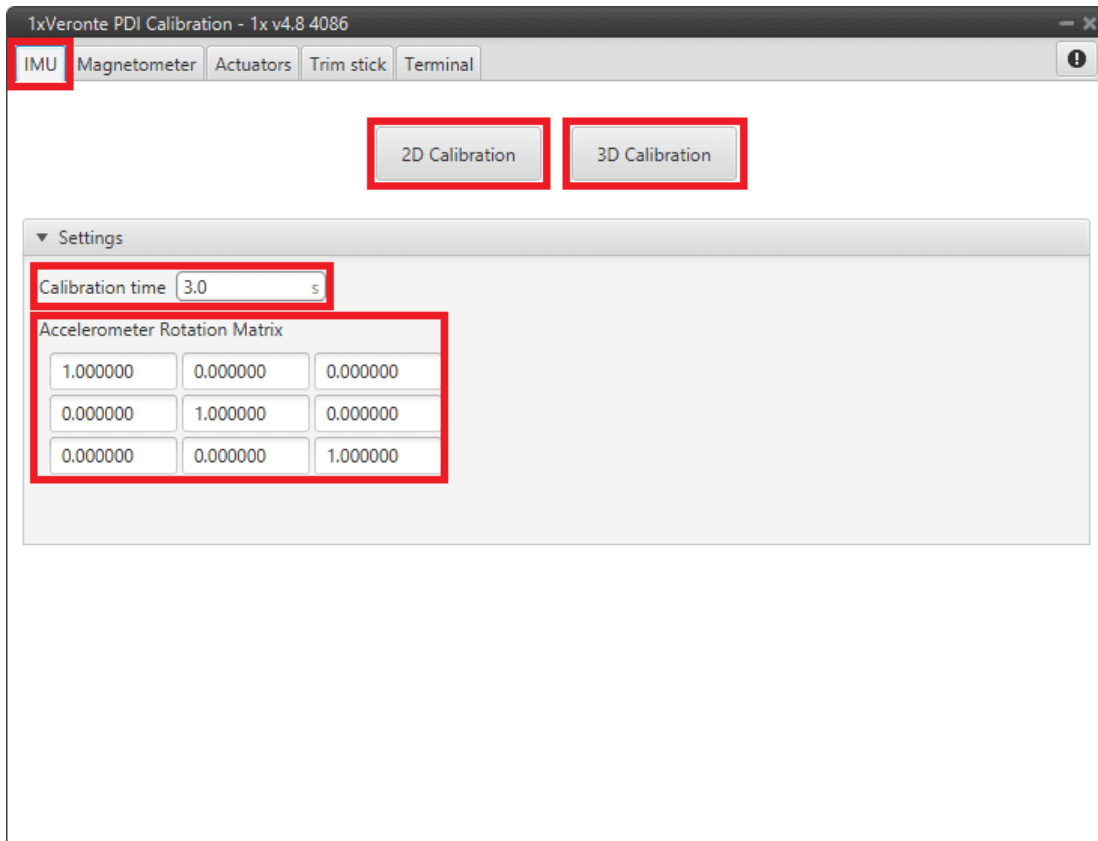


Fig. 8: IMU Calibration menu

There are 2 calibration options available:

- **2D Calibration:** Only calibrates **pitch** and **roll angles**. The autopilot must be **horizontal** during the calibration process:

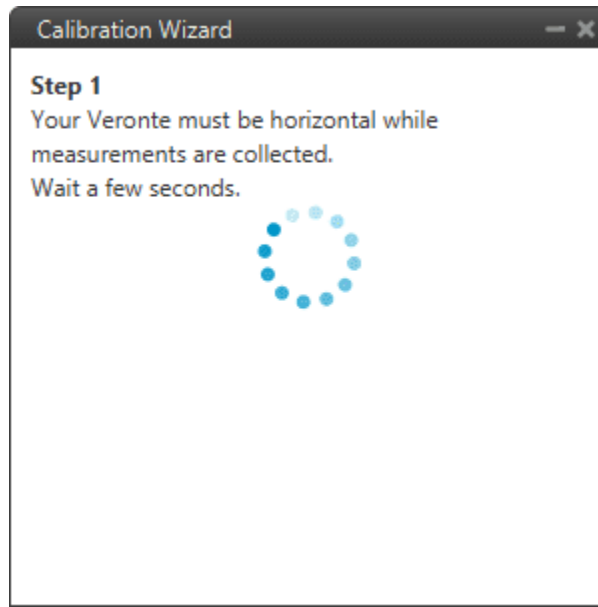


Fig. 9: 2D Calibration

- **3D Calibration:** Calibrates **pitch, roll and yaw angles** and it needs to take measurements in **two orientations**.
  - During the first measurement the autopilot must be horizontal:

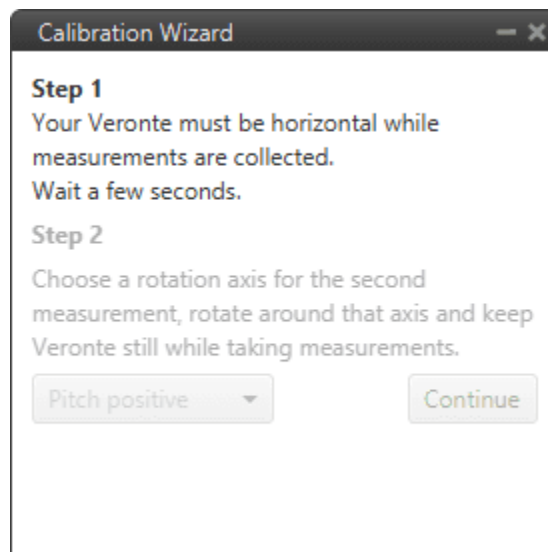


Fig. 10: 3D Calibration - First measurement

- The second measurement requires to **rotate the autopilot around the selected axis**.  
The options are: *Pitch positive*, *Pitch negative*, *Roll positive* or *Roll negative*.

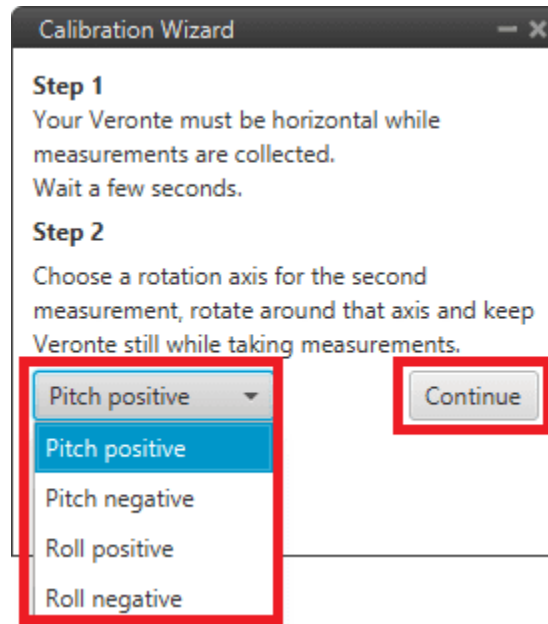


Fig. 11: 3D Calibration - Second measurement options

Once the rotation axis has been selected, click on '**Continue**' to perform this second measurement:

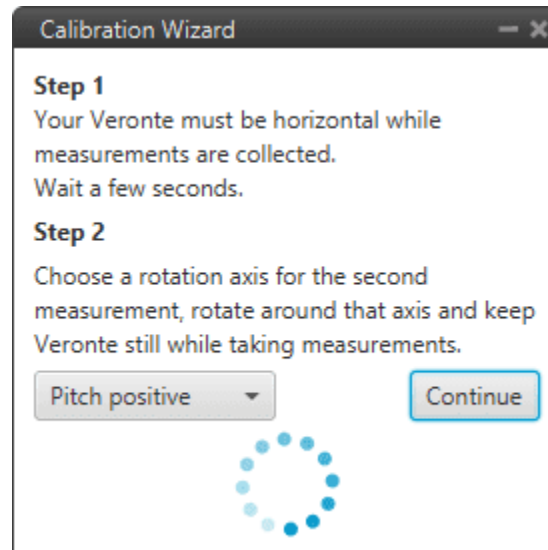


Fig. 12: 3D Calibration - Second measurement

**Warning:** The autopilot must be **turned more than 10 degrees** in the selected axis. Otherwise, the calibration will not be performed and the following message will appear to reset the calibration:

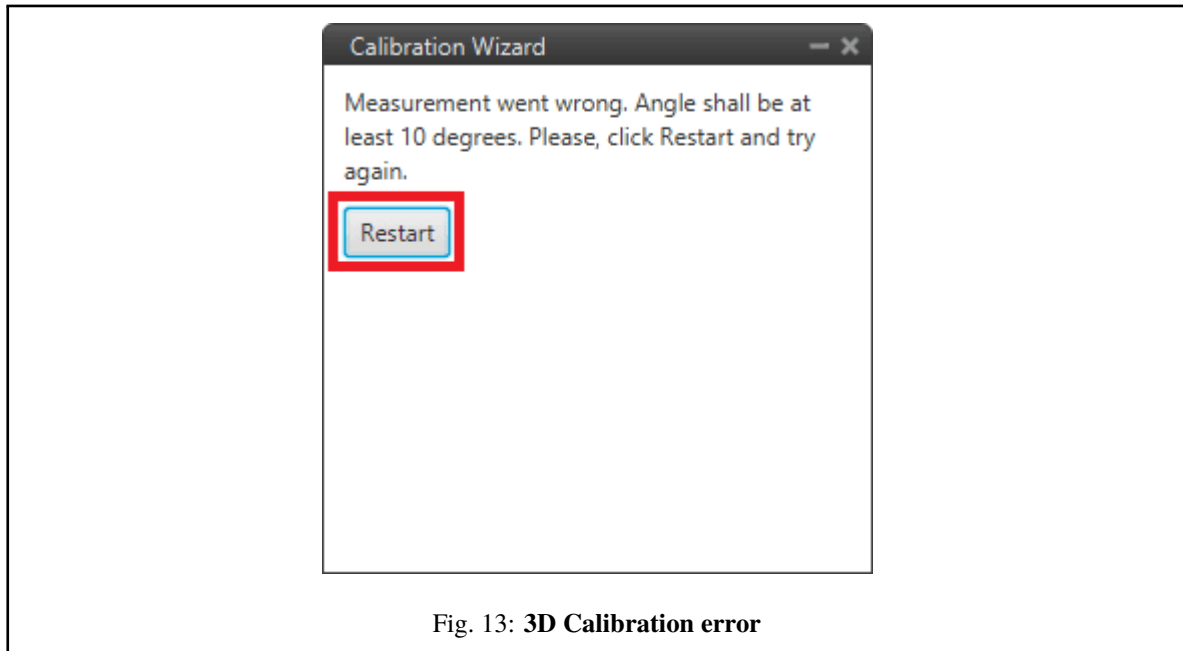


Fig. 13: 3D Calibration error

- **Settings:**

- **Calibration time:** Users can modify the time during which the software is requesting values from the autopilot 1x for calibration.
- **Accelerometer Rotation Matrix:** This rotation matrix is the result of the calibration performed. **Cannot be modified by the user.**

## 2.2 Magnetometer

Magnetometer calibration should be performed once Veronte Autopilot 1x has been installed on the platform, so that the magnetic field during operation is similar to that measured during calibration.

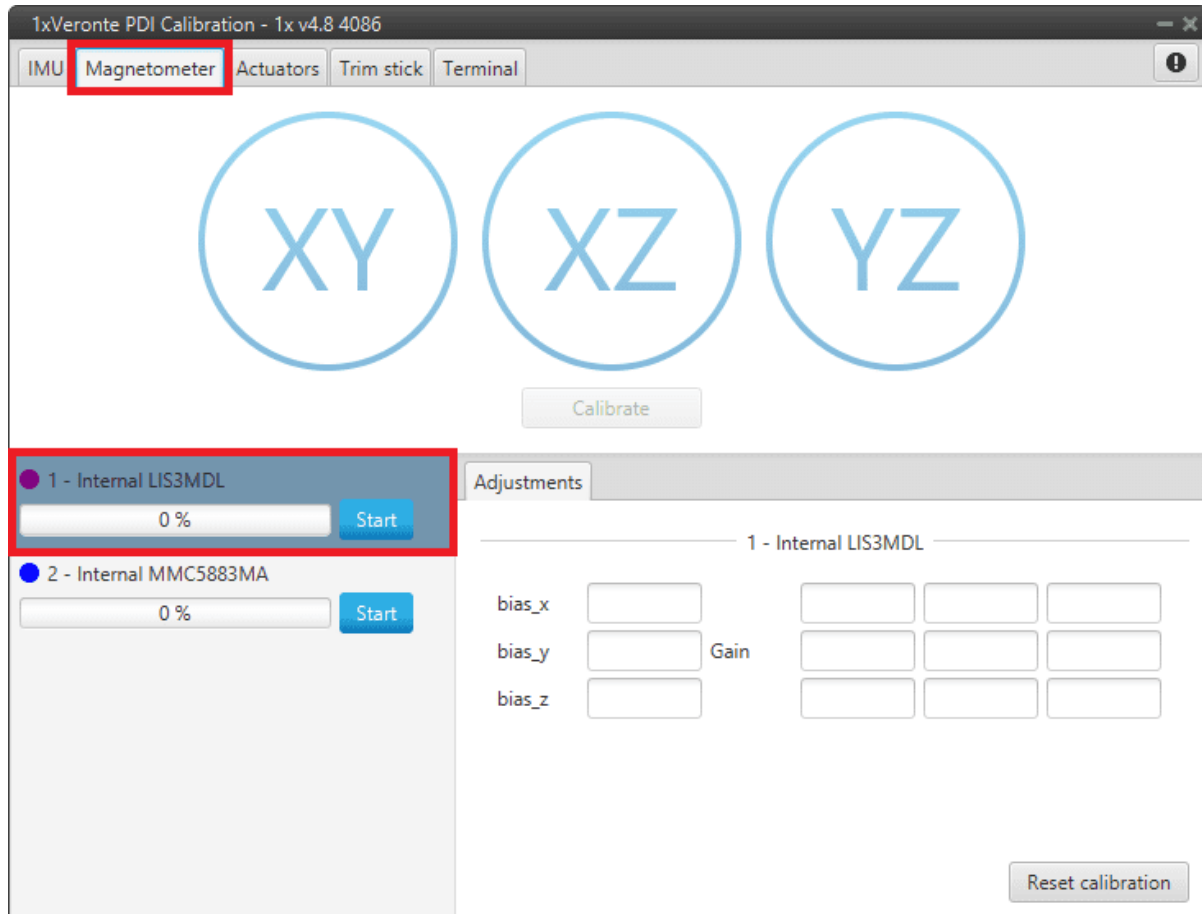


Fig. 14: Magnetometer Calibration menu

To start the calibration, press the **Start** button of the magnetometer sensor to be calibrated, so that the system can capture the data from the magnetometer.

During calibration, the system must be rotated around all 3 axes, *X*, *Y* and *Z*, in order to capture sufficient data. It is important to have approximately the same number of samples for each axis of rotation, so rotate it around a different axis every 33% approximately.

The calibration procedure should be performed as follows:

1. Rotate 1x autopilot around the *Z*-axis (*XY* plane) until the progress bar reaches approximately **33%**.
2. Repeat the same process for the *Y*-axis (*XZ* plane) until the progress bar reaches approximately **66%**.
3. Finish the calibration by repeating this process for the *X*-axis (*YZ* plane) until **100%** is reached.

**Note:** The order in which the user rotates the autopilot about each of the axes does not affect the calibration, this is just an example of how to do it. So the user can first rotate on the *Y*-axis, then on the *X*-axis and finally on the *Z*-axis.

These different rotations to which Veronte Autopilot 1x must be subjected can be seen in the figures below:



Fig. 15: Calibration procedure

Fig. 16: Calibration procedure

The progress bar will increase according to the number of samples measured, and these samples will be drawn in each circle (one circle for each plane of rotation):

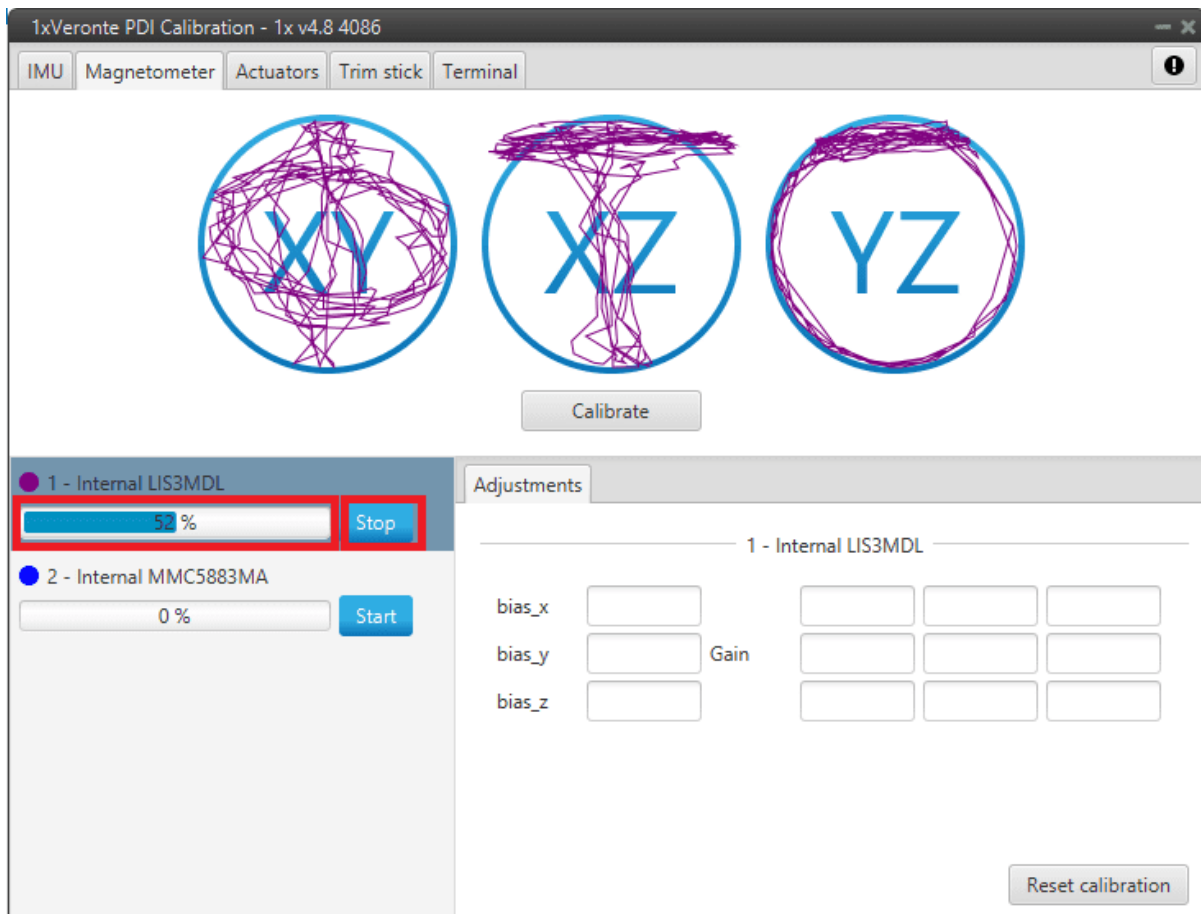


Fig. 17: Calibration process



**Note:** If the user wishes to interrupt the calibration, simply click on the ‘**Stop**’ button.

Once 3 circles have been drawn on the screen and the progress bar reaches the 100%, the calibration process is complete. The following image shows an example of the calibration:

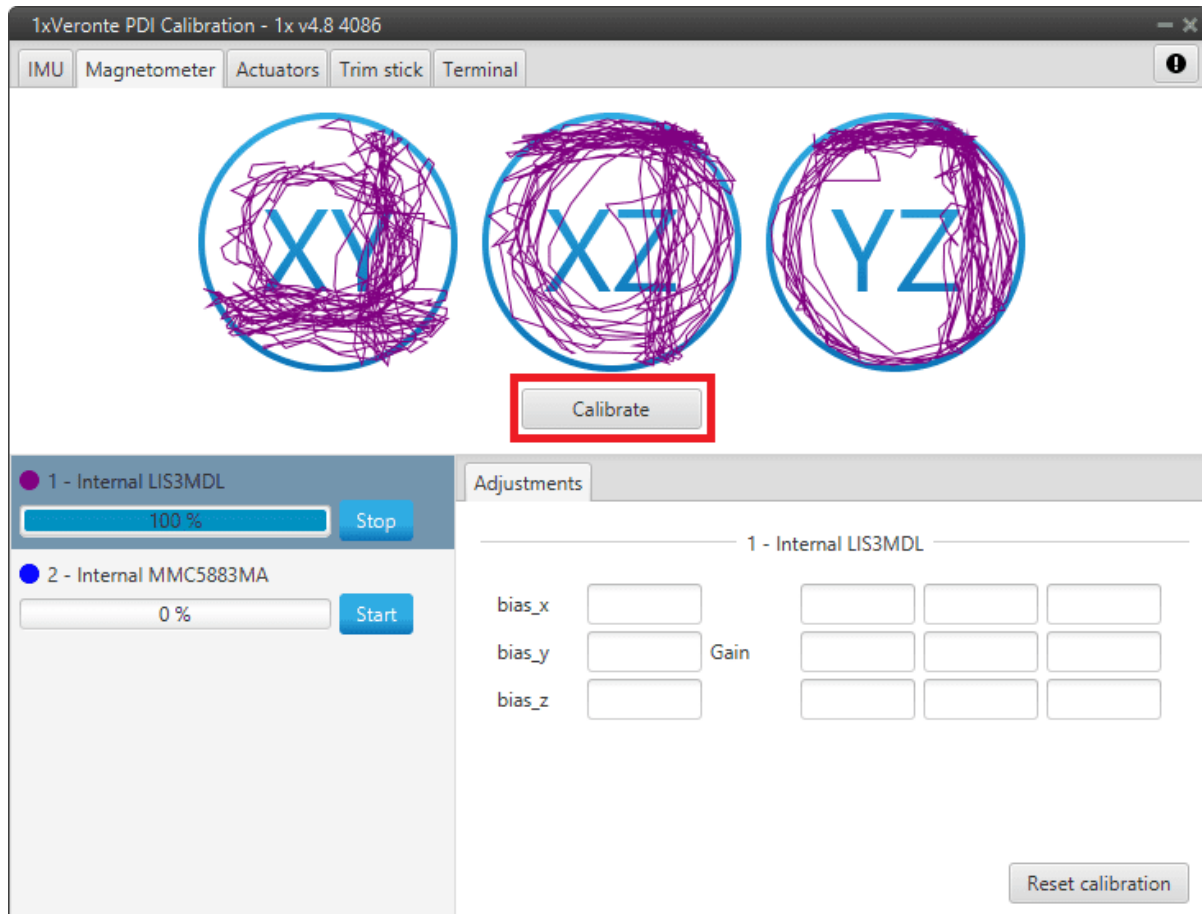


Fig. 18: **Calibrate**

Then press the ‘**Calibrate**’ button to save the calibration in 1x autopilot, and the following success message will appear:

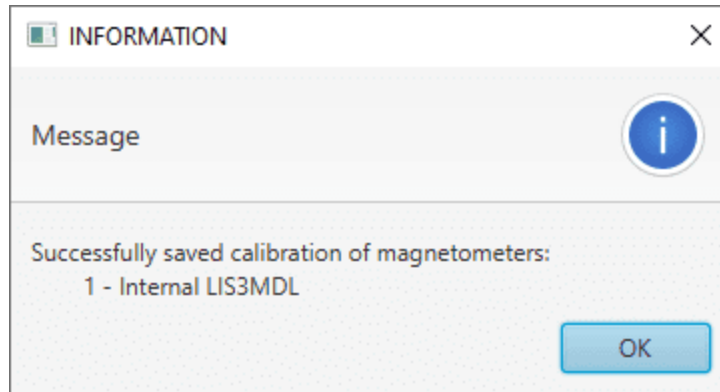


Fig. 19: Calibrate success message

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**Note:** If not enough samples have been collected in the calibration process, the following message will appear after pressing 'Calibrate':

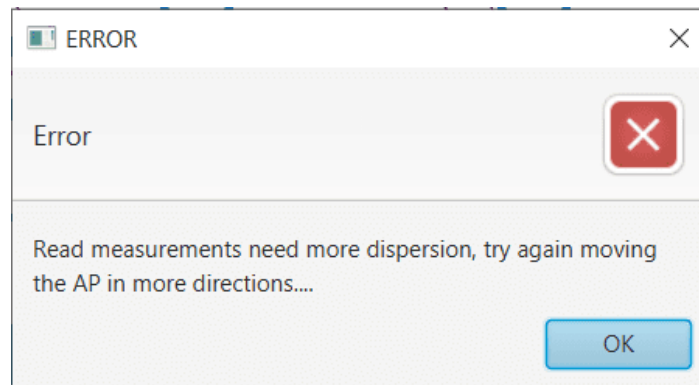


Fig. 20: Calibrate error message

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Then, it will appear:

- A colored percentage indicating the quality of the calibration measurements:
  - **Red (0-39%)**: Repeating calibration is recommended.
  - **Orange (40-79%)**: Acceptable.
  - **Green (80-100%)**: Optimal.
- The calibration results, **bias x/y/z** and **Gains** measurements, are displayed in the **Adjustments** tab.

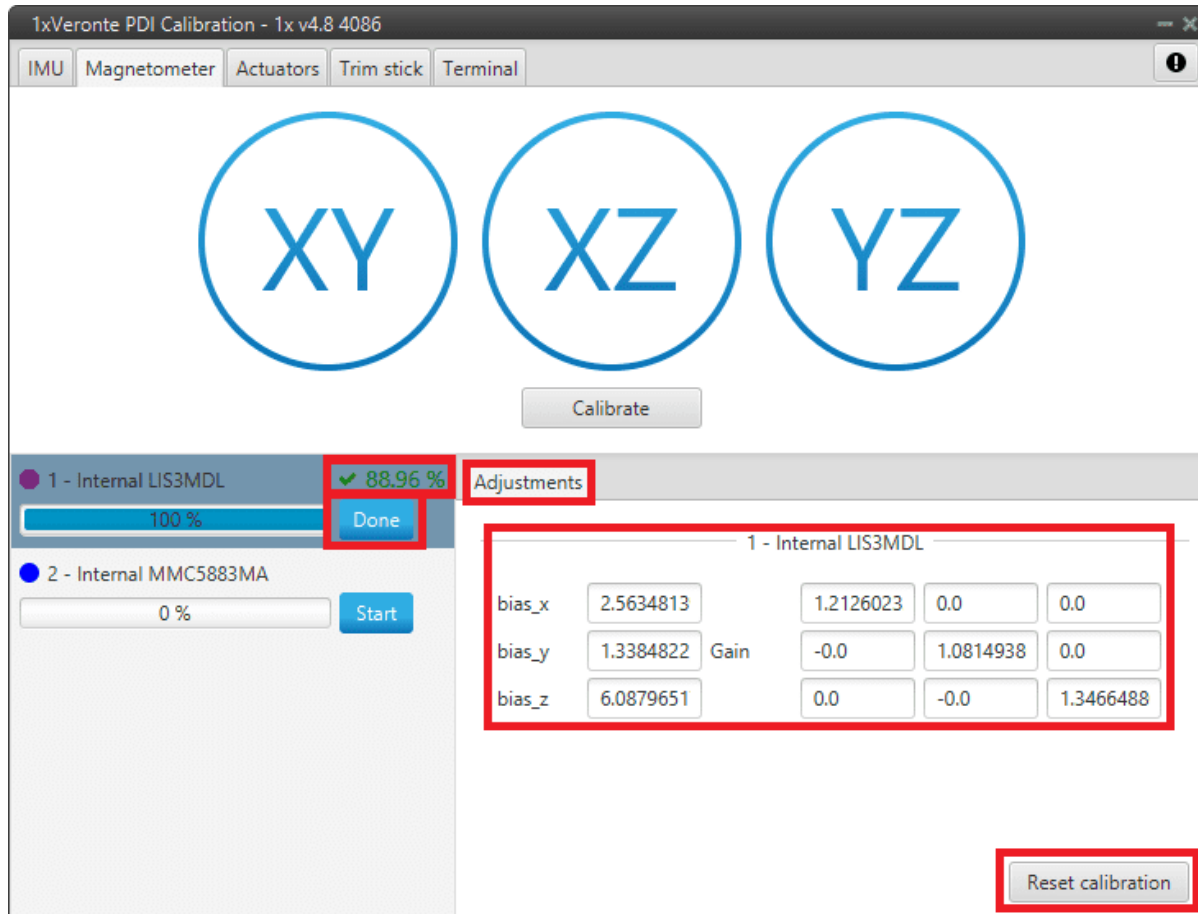


Fig. 21: Calibration done

If the calibration is good enough, click 'Done'. Otherwise, if the calibration is not satisfying, click 'Reset calibration' to calibrate again.

**Note:** Reset calibration will delete the current calibration on the connected 1x autopilot.

## 2.3 Actuators

Actuators tab displays the [Actuator blocks](#) as created and configured in **Block Programs** of **1x PDI Builder**.

This menu allows the calibration of all the connected actuators that control the attitude of the aircraft. It is possible to set actuator position for each control signal/output, allowing to configure the maximum and minimum values and its custom performance.

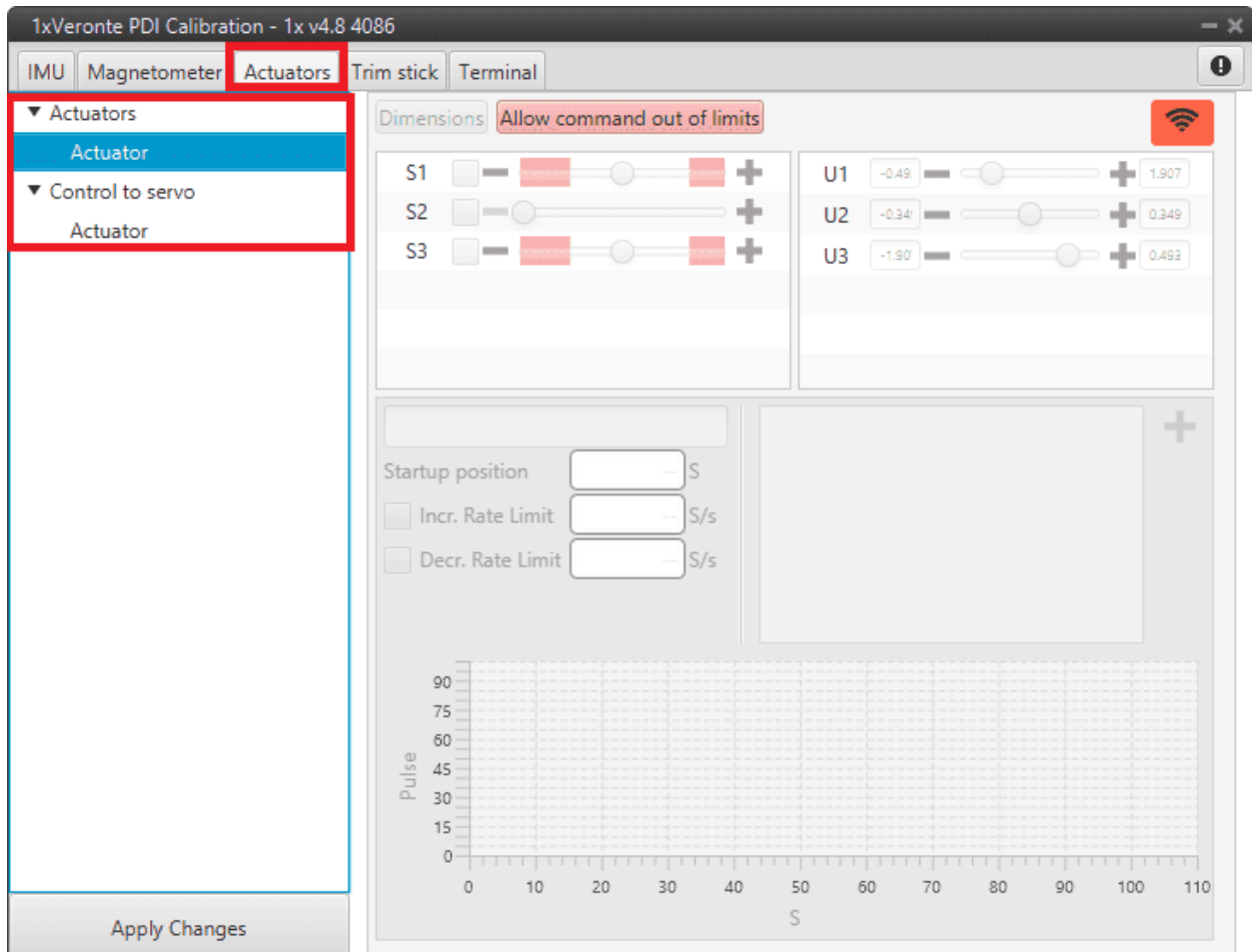


Fig. 22: Actuators Calibration menu

The options of this calibration menu are presented below:

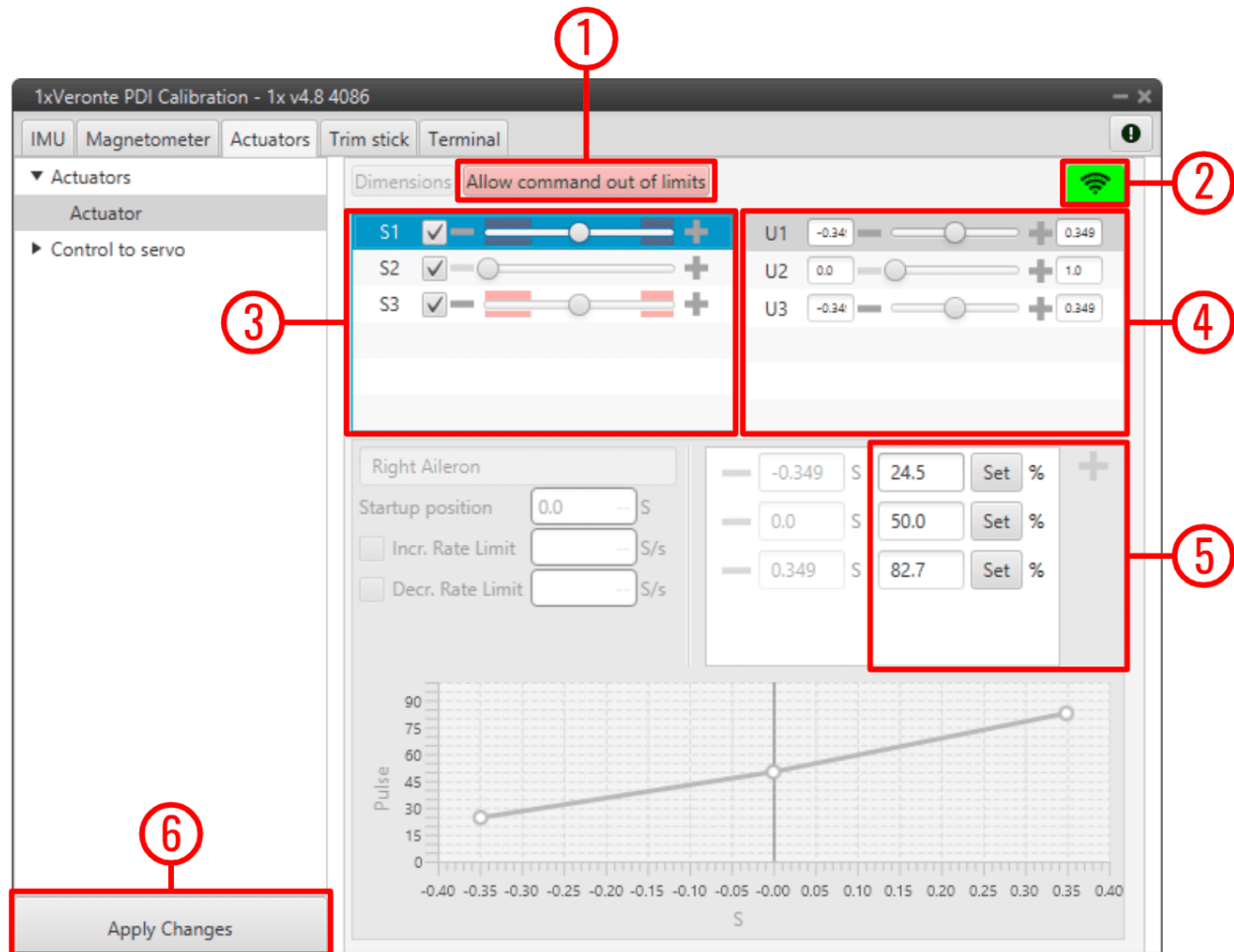


Fig. 23: Actuators Calibration parameters

**Important:** Only the parameters that can be modified in this menu are explained. Therefore, those that are disabled, cannot be modified here, this is because they must be configured in the corresponding **Actuator block** of the **1x PDI Builder** software.

1. **Allow command out of limits:** Allows out-of-limits motion for the selected actuator.

**Tip:** When the user is in the **trimming process**, it is possible that the desired servo position is in the **Out of range** zone (red zone), so by pressing this button it is possible to move the actuator completely and find the correct position.

2. **Enable/Disable command:** Enables/Disables commands to move the servos. It is enabled when the icon is **green** and disabled when it is **red**.
3. **Servos (actuators):** This menu contains the servos of the aircraft.

Moving the scrolling bar will change the servo position, but the signal to the system will only be sent if the checkbox next to the servo number (S1, S2, ...) is marked.

**Error:** The **manual movement of the servos** can **only** be performed in the “**Initial**” phase (when there is no phase selected in the **Veronte Panel** of **Veronte Ops**).

4. **Control Signals:** This menu contains the variables representing the control signals/outputs  $U$  generated by the system.

Considering that the above example is for a flying wing, the controls are pitching (U1), thrusting (U2) and rolling (U3), so there are 3 different controls in total.

When moving the scroll bar of one of the control channels, the corresponding movement in the servos will also be represented.

5. **Servo Position - PWM:** This option is used to set the transformation **from a control position  $S$  to PWM signal**.

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**Note:** Only the PWM percentage can be changed.

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For example, in the figure above, a 20° degrees deflection (0.349 rad) of the right aileron corresponds to an 82.7% pulse to be sent to the corresponding servo.

For more information on the **PWM percentage**, refer to the [PWM section](#) of the **1x PDI Builder** user manual.

6. **Apply Changes:** After making the necessary customizations, the user should click on this button to save the changes.

As this action will restart the device, the following confirmation message will appear when clicked:

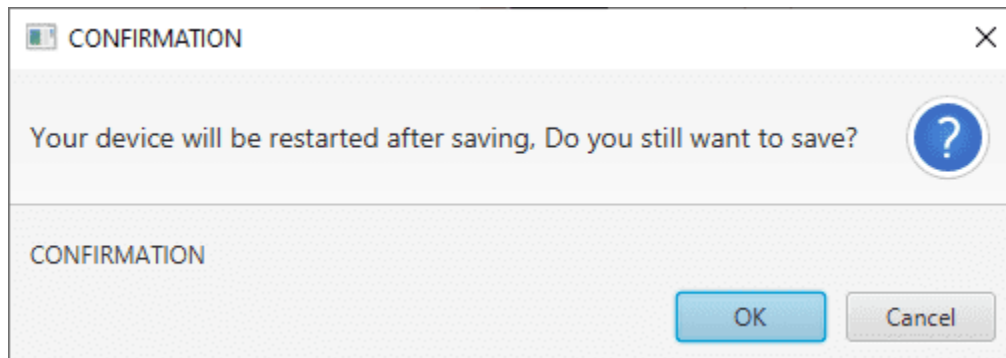


Fig. 24: Actuators Calibration - Apply Changes confirmation message

Consequently, the device has to enter maintenance mode before restarting, so a confirmation message to enter maintenance mode will also appear:

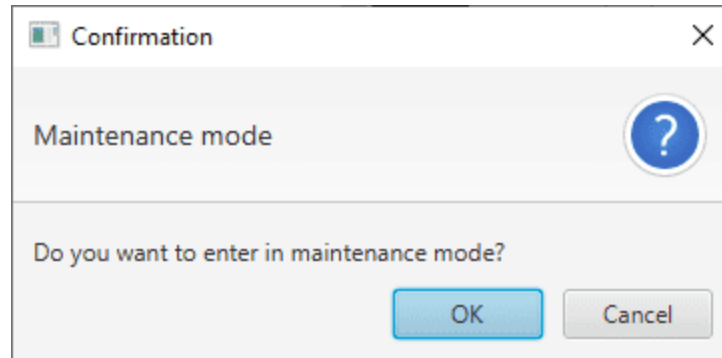


Fig. 25: Actuators Calibration - Maintenance mode confirmation message

### 2.3.1 Trimming

Trimming can be performed by **moving the servos in three different positions**: zero position, minimum and maximum deflection angle (angles are usually physically limited). These positions must be entered and saved in the software by clicking on '**Apply Changes**' when the actuator is in the desired position. Otherwise, the position can be entered manually.

The *figure above* shows the setting of the right aileron:

- **Minimum**: -0.349 [rad] deflection  $\Rightarrow$  24.5% PWM output.
- **Zero position**: 0 [rad] deflection  $\Rightarrow$  50% PWM output.
- **Maximum**: 0.349 [rad] deflection  $\Rightarrow$  82.7% PWM output.

## 2.4 Trim stick

In this menu it is possible to trim the neutral position of the channels of the selected stick.

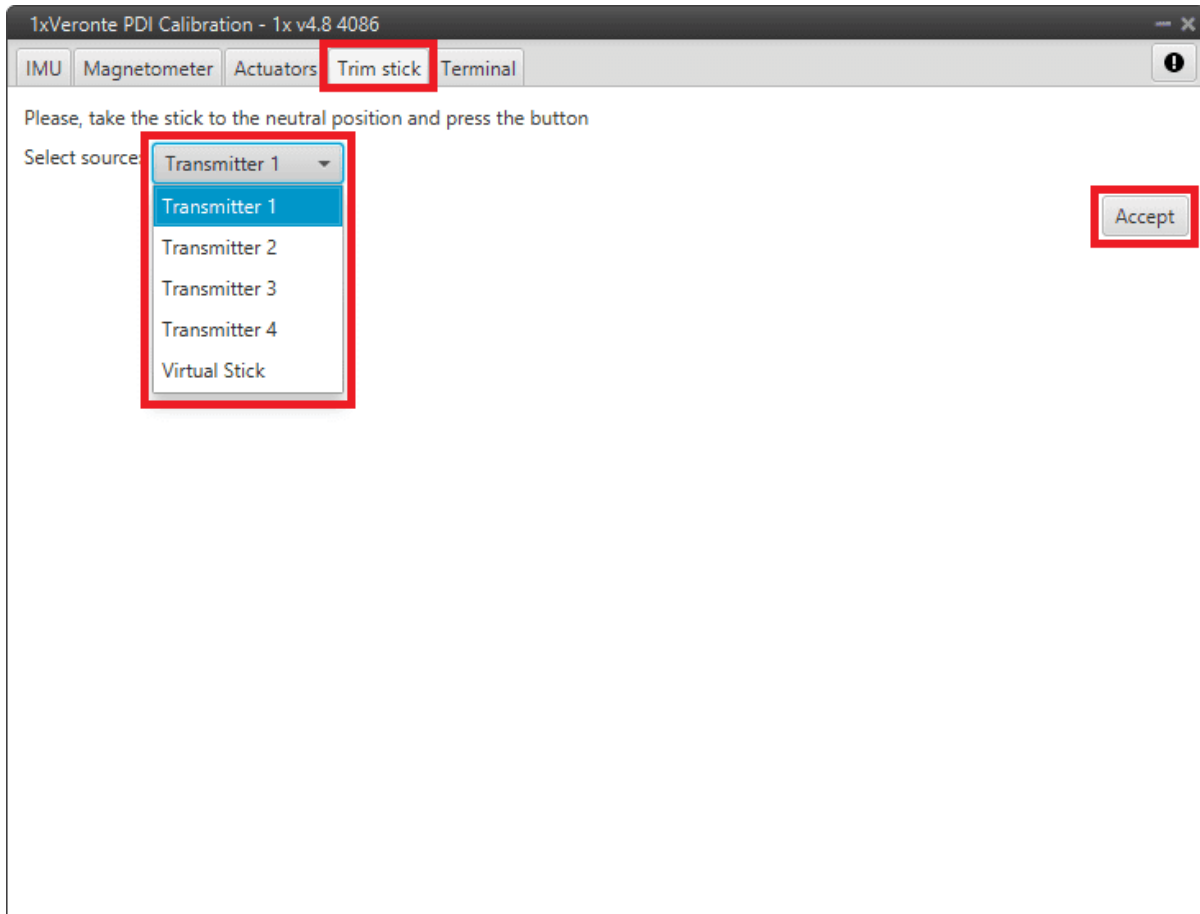


Fig. 26: Trim Stick menu

The user simply selects the desired stick and the clicks 'Accept'.

## 2.5 Terminal

The Terminal Manager allows the user to access a **Tunnel Console**.

This allows the user to see the information/data coming into a certain port (e.g. a serial port) where the device is connected.

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### Example

If the device is connected to a **RS-232** port, in the **1x PDI Builder** software the **RS232 producer** must be bidirectionally connected to a **Tunnel consumer** and vice versa:



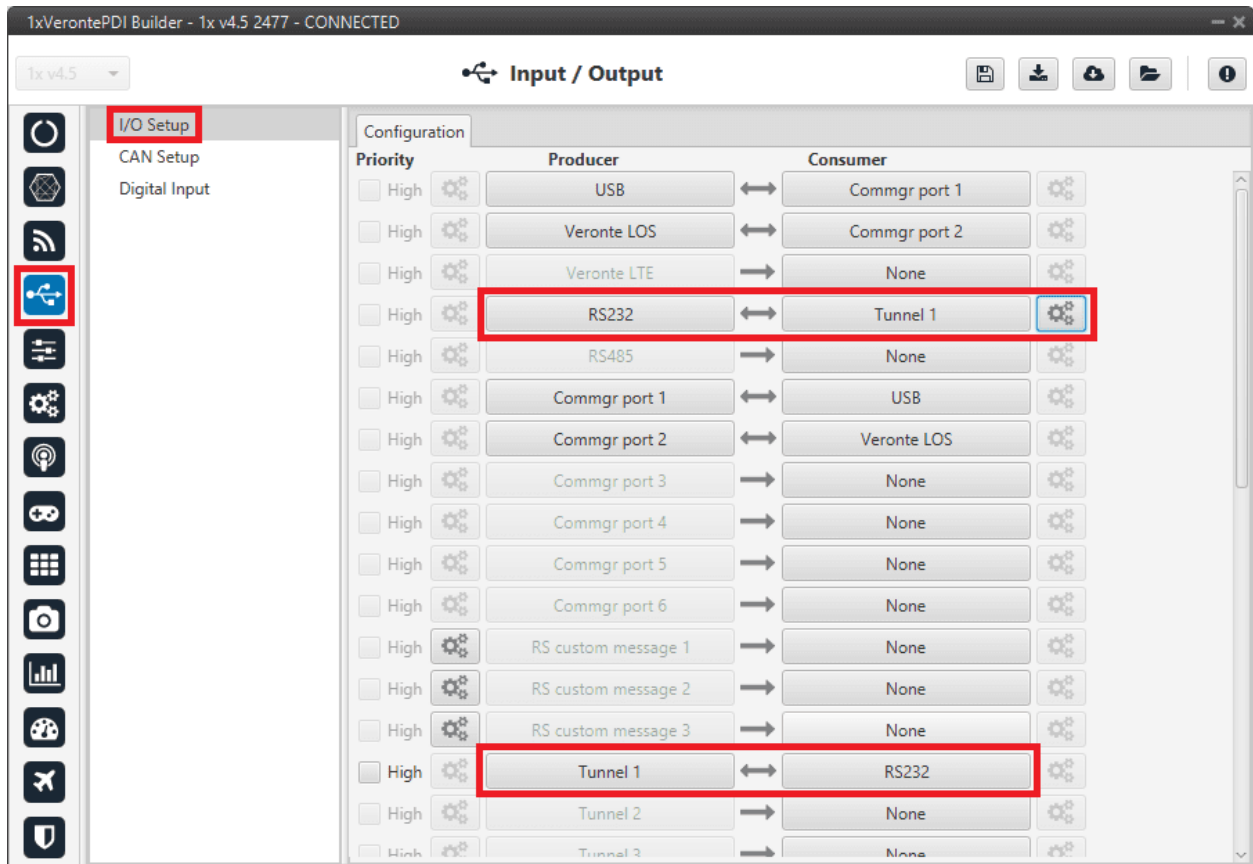


Fig. 27: 1x PDI Builder - RS232 ↔ Tunnel 1

In the case of Veronte Autopilot 1x v4.5, it is integrated with the **Microhard Pico Series internal radio** module and its configuration can be modified by using the *Microhard setup helper*.

First, the user must agree the information about the process:

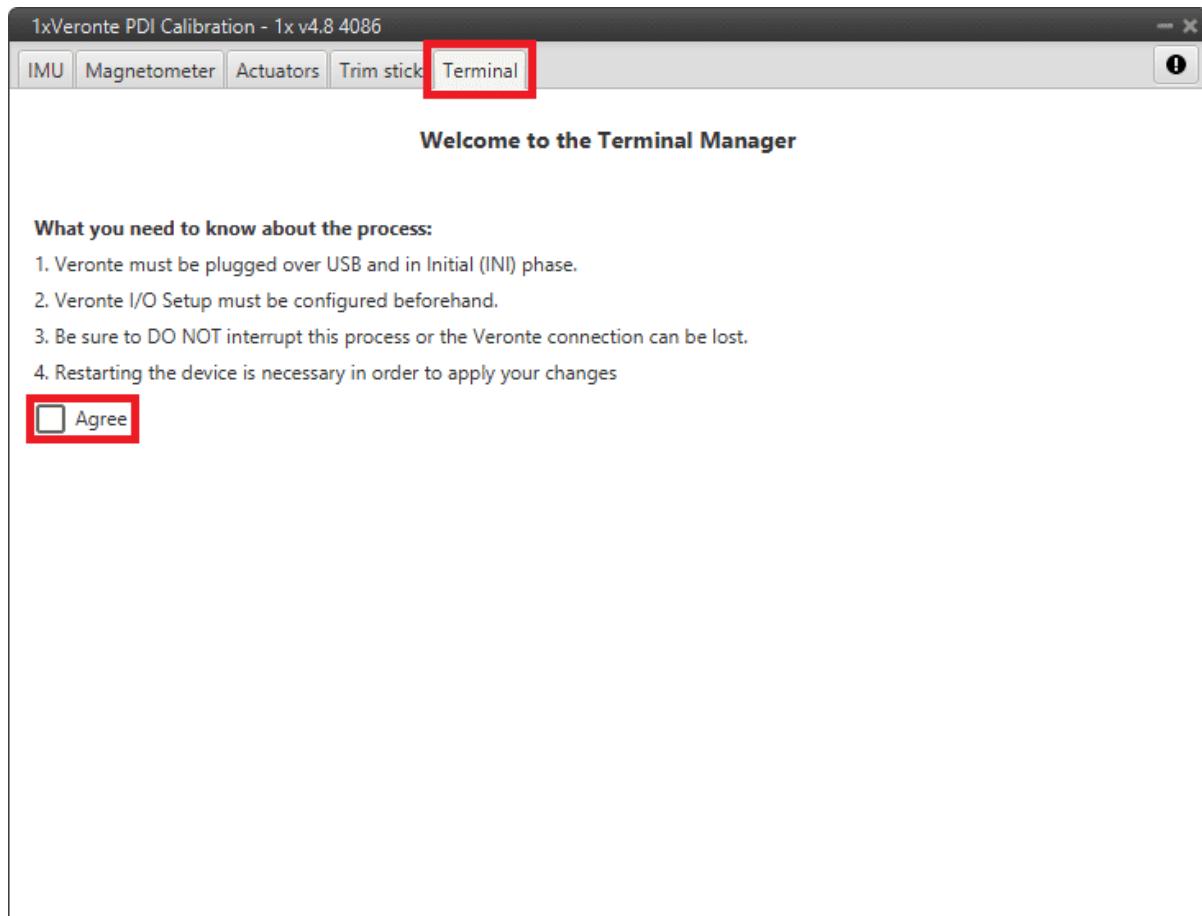


Fig. 28: Terminal Manager menu

It is then possible to select the **Tunnel** (*Tunnel 1,2 or 3*) that the user has configured and needs.

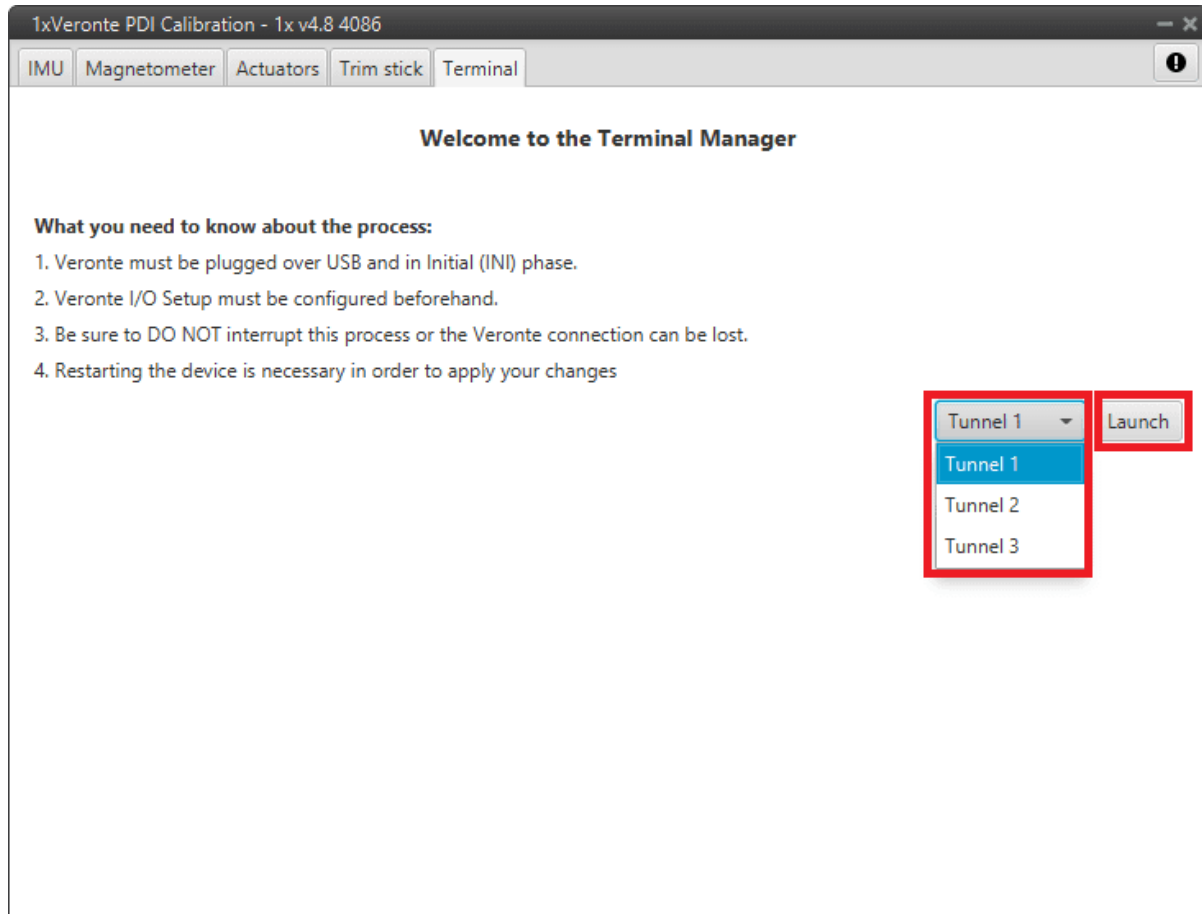


Fig. 29: Terminal Manager menu

Once the process is launched (just click on '**Launch**'), everything is correctly configured, the **Tunnel Console** appears.

**Note:** If something has gone wrong, the Tunnel Console will not open and, instead, the panel will report of the error occurred and how to fix it:

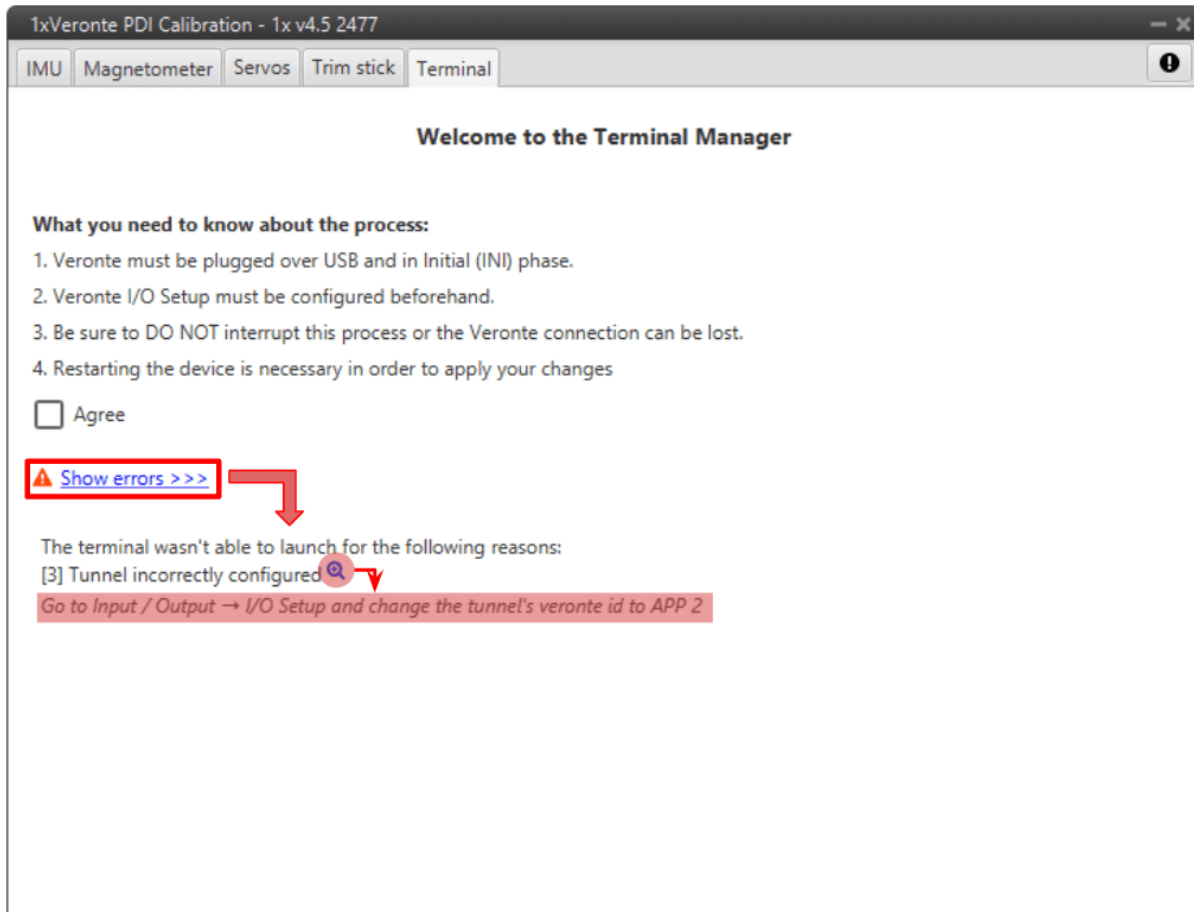


Fig. 30: Terminal - Launch failed

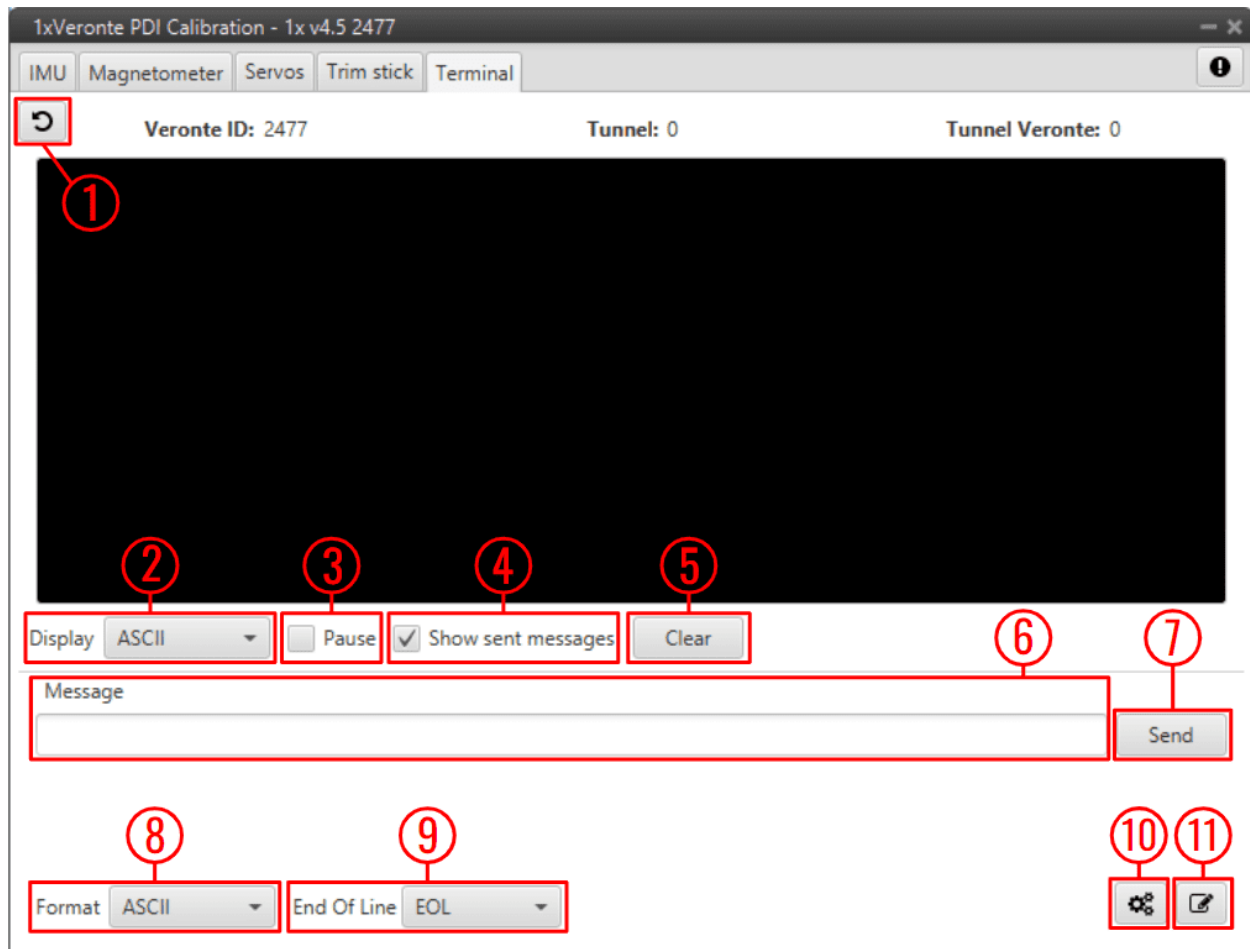


Fig. 31: Tunnel Console

1. **Back to Terminal:** Click here to return to the initial terminal menu.
2. **Display:** Data can be **displayed** in **ASCII** or **Hexa** format.
3. **Pause:** When the data stream is running, it is possible to pause it by enable this option.
4. **Show sent message:** If enabled, the sent messages are shown in the console.
5. **Clear:** Clears the last console data.
6. **Message:** Message content.
7. **Send:** When clicked, the current message is sent.
8. **Format:** Data can be **sent** in **ASCII** or **Hexa** format.
9. **End Of Line:** Message “End of line” configuration. The available ‘characters’ are *EOL* (actually it is the combination of *CR* and *LF*), *CR*, *LF* or *None*.
10. **Microhard Wizard:** See related [subsection](#) below.
11. **Edit:** By clicking here, it is possible to construct larger text messages, as well as copy and paste.

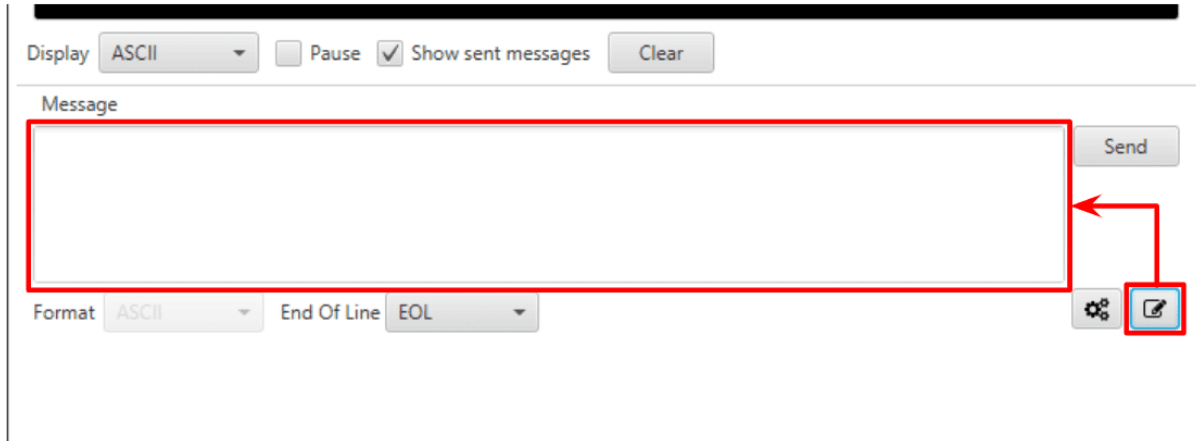


Fig. 32: Tunnel Console - Edit message

### 2.5.1 Microhard setup helper

The **Microhard setup helper** can be used to easily **configure the Microhard internal modules** (Veronte Autopilot 1x with hardware version 4.5 internal radio). To do this, the user must click on the dedicated button and the Wizard will automatically start the radio searching.

Once the radio is found, its model and the **configured parameters** are displayed on the console:

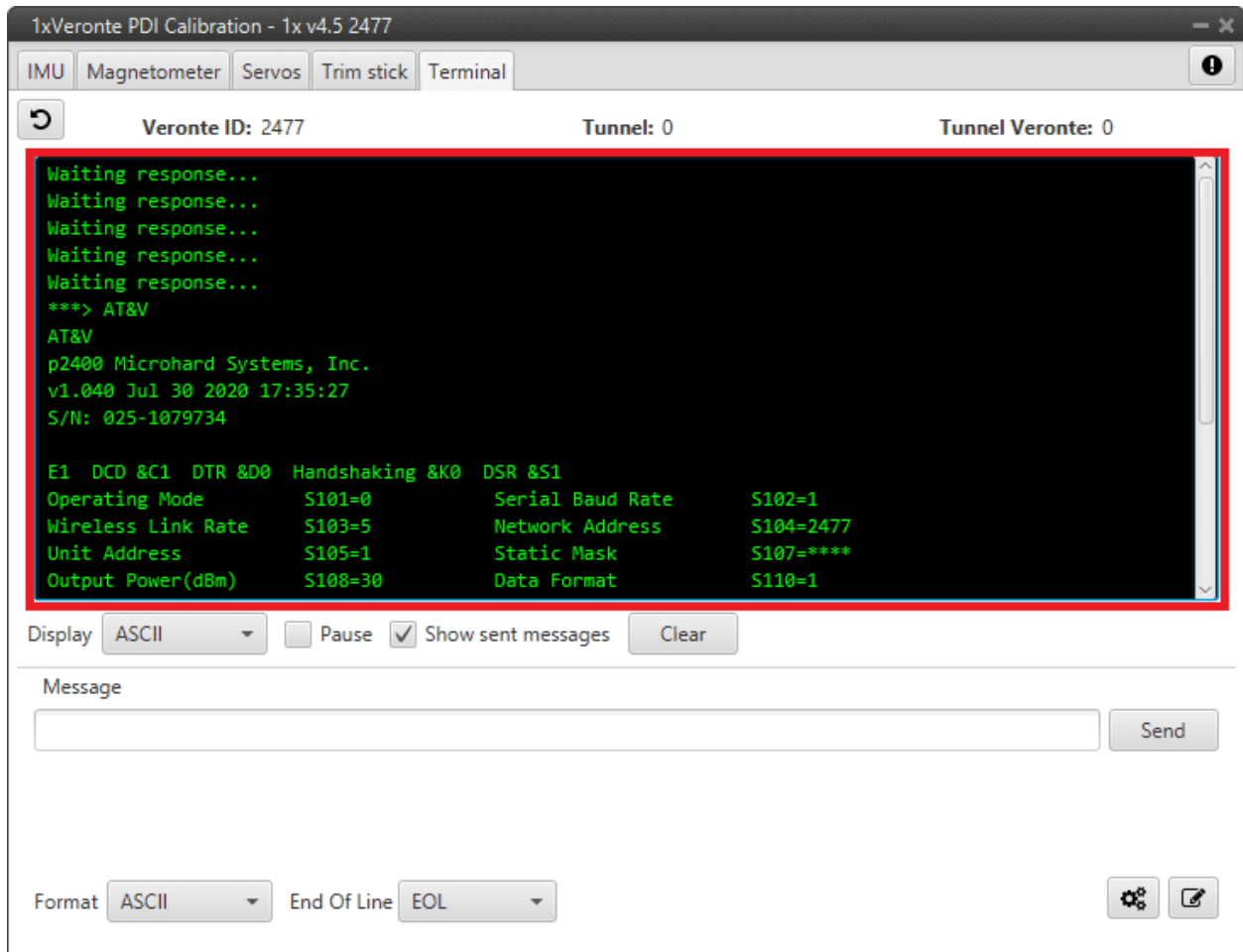


Fig. 33: Microhard Wizard - Tunnel Console

The following **Wizard menu** is displayed:

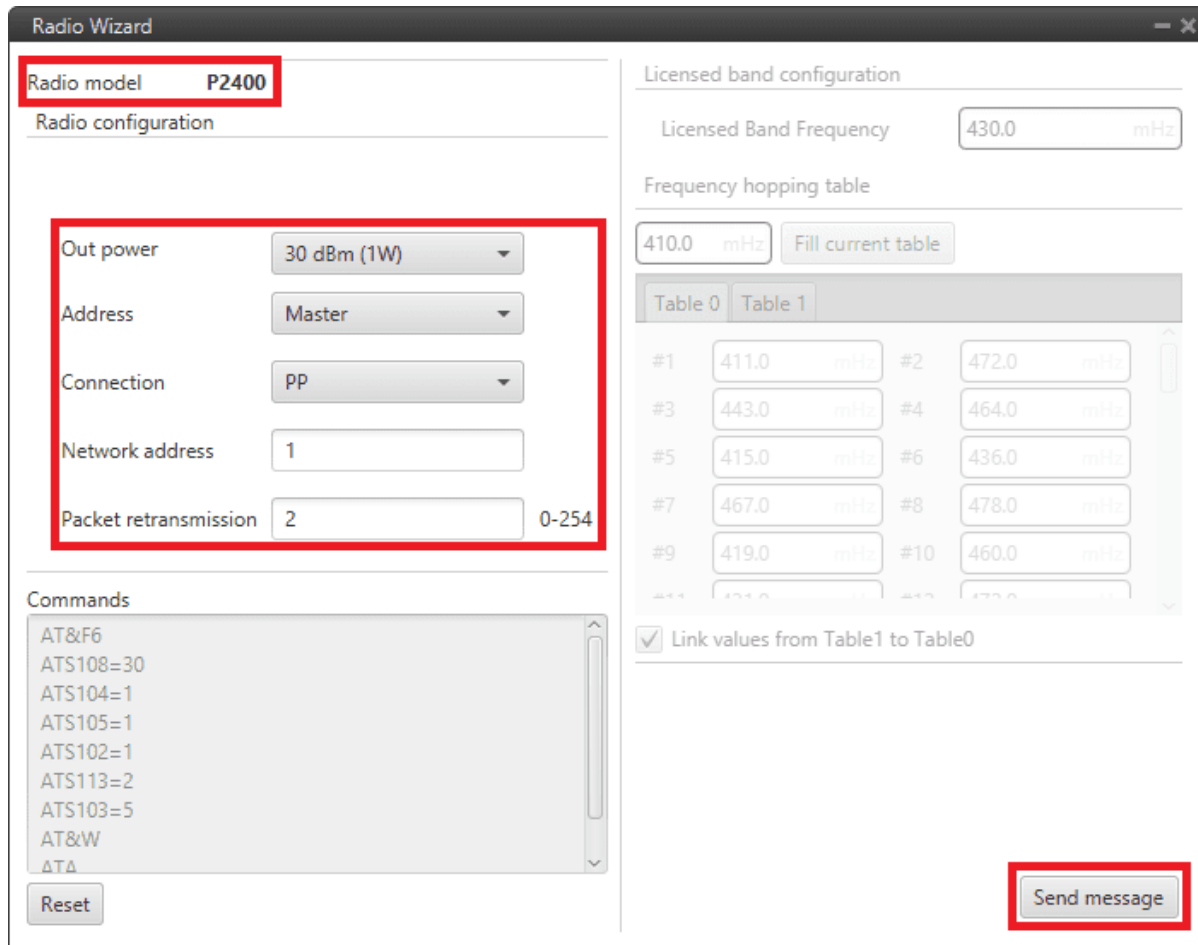


Fig. 34: Microhard Wizard menu

**Warning:** The parameters shown in this wizard menu are **not** those configured in the radio module.

The **default wizard parameters** are shown **here**, the ones configured in the radio module are shown in the tunnel console as shown in the figure *Microhard Wizard - Tunnel Console*.

These parameters have to be configured according to the radio module installed in the Veronte Autopilot 1x.

- **Radio model:** Each 1x Autopilot has only one of the following radio modules **P400**, **P900** and **P2400**.
- **Output power:** Sets the available output power.
- **Address:** Select the role for each autopilot 1x by selectig **Master** or **Slave**.  
By default, **Air units** are defined as **Slave** and **Ground units** are defined as **Master**.
- **Connection:** **PP** (*Point to Point*) or **PMP** (*Point Multi Point*) connections.  
By default all units are paired with **PP connection**.
- **Network address:** This is the address of the network to which the autopilot with this radio module installed belongs. **This number must be the same for all Veronte Autopilots 1x on the same network.**



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**Tip:** Usually, the address of the ground unit is set as the network address for easy recall.

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- **Packet retransmission:** Each data packet is sent as many times as defined here. It is recommended to leave the default value.

By pressing ‘Send message’, the user is able to **send all these parameters to the Microhard module**.

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**Note:** The **commands** can also be **sent manually**. For **advanced Microhard configuration**, please refer to the User Manual of the specific radio module: [Microhard - Pico series](#).

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Once the configuration is sent, the radio wizard menu closes and the tunnel console should appear as shown in the figure below:

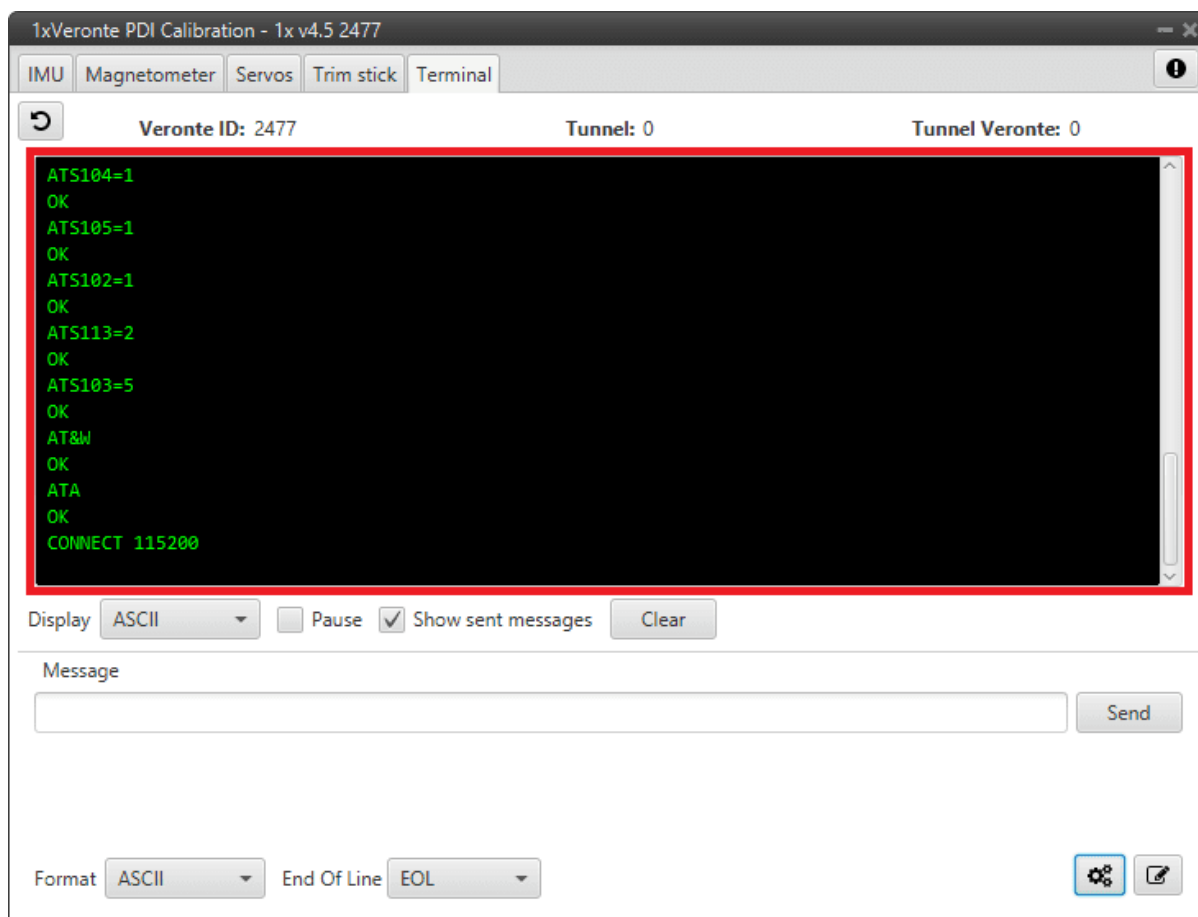


Fig. 35: Tunnel Console - Radio module configured

The Microhard radio module is now configured.

Finally, the **Microhard radio module must be restarted** so, the user must **restart the Veronte Autopilot 1x**.