

# UCO DWM-DEV Documentation

An open-source, standalone GUI for control, processing and data recording of the  
DWM1001-DEV development boards developed by Qorvo company

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## Objectives of the application

The main reason of the development of this application is to provide a software that implements multiple tools that allows the connection, control, data visualization and processing of the development board **DWM1001-DEV** developed by *Qorvo Company*.

To support in the use of this device, multiple tools like the next examples have been developed:

- Communication manager.
- Command line interpreter.
- Data visualization.
- Data recording.
- Estimation of statistics.
- Media filter for received data.
- GPIO control.
- Device configuration.

These functionalities provide an easy way to operate the device and allow further analysis of the UWB technology implemented in the DWM1001-DEV development board through a USB serial port connection.

## Resources

### Source code

The source code of the developed GUI is available in the following GitHub repository:

<https://github.com/AntonioRuizR/UCO-DWM1001-DEV>

To test and build, download [Qt for open source development](#). Qt Creator and Qt v6.6.1 are requested.

### Release

Ready to use executable files for Windows OS are available in the following GitHub repository:

<https://github.com/AntonioRuizR/UCO-DWM1001-DEV/releases>

## Application structure

Every functionality developed is executed in the main window of the application shown in Figure 1.

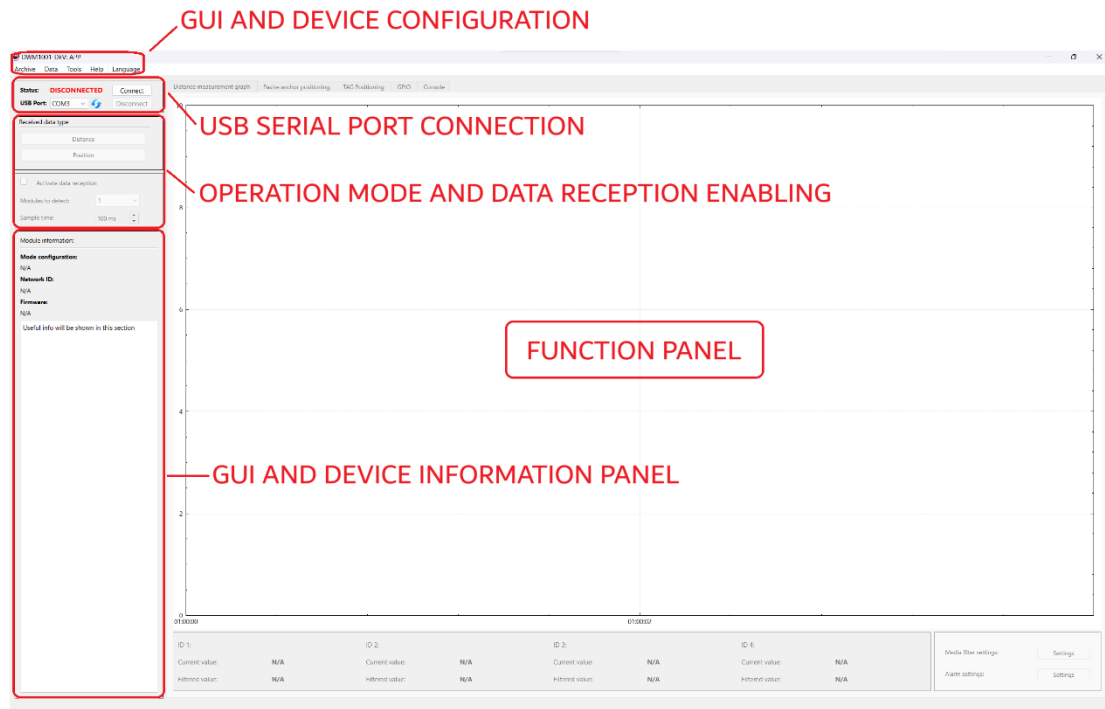


Figure 1: DWM1001-DEV App main window

## GUI and device configuration

In this section, user is able to select and establish a new USB serial port connection with the device, choosing the USB port in which the development board is connected.



Figure 2: Connection panel

## GUI operation mode and data reception enabling panel

This panel provides the user the required elements to modify the sample rate of the received data and to specify if the data requested by the user is distance or position information. In distance mode, the connected device must be configured as a TAG and distance to the four nearest anchors will be obtained. In position mode, there are two different functioning options:

- **TAG**: Tag connected to user's PC Will start receiving position data which will appear in 'TAG positioning' tab.

- **Passive anchor:** Passive anchor connected to user's PC will receive the TAG position in the same UWB network which will appear in 'Passive anchor positioning' tab.

Figure 3: GUI operation mode and data reception panel

## GUI and device information panel

When a new connection is established with a device, the application automatically request information from the module and shows the current operation mode of the module (anchor, passive anchor, initiator anchor or tag), network id and firmware version.

In the panel below, useful data will be provided to the user depending on the last operations and actions realized and also leaving a record of the most recent actions performed. An example of the text displayed is shown in Figure 4.

This panel is cleared when a new connection is set.

Figure 4: Information panel

## Function Panel

The function panel is the main section of this Application. In this panel each tab contains a main feature.

### Distance measurement graph

In this tab, distance data will be graphically represented up to four ranging anchors in the same network. In the information panel below the graph, current distance to each anchor (and its ID in the network) is shown. If the media filter associated to this measures is enabled, its value is also displayed. Also, a small panel is provided to configure the media filter and the alarm.



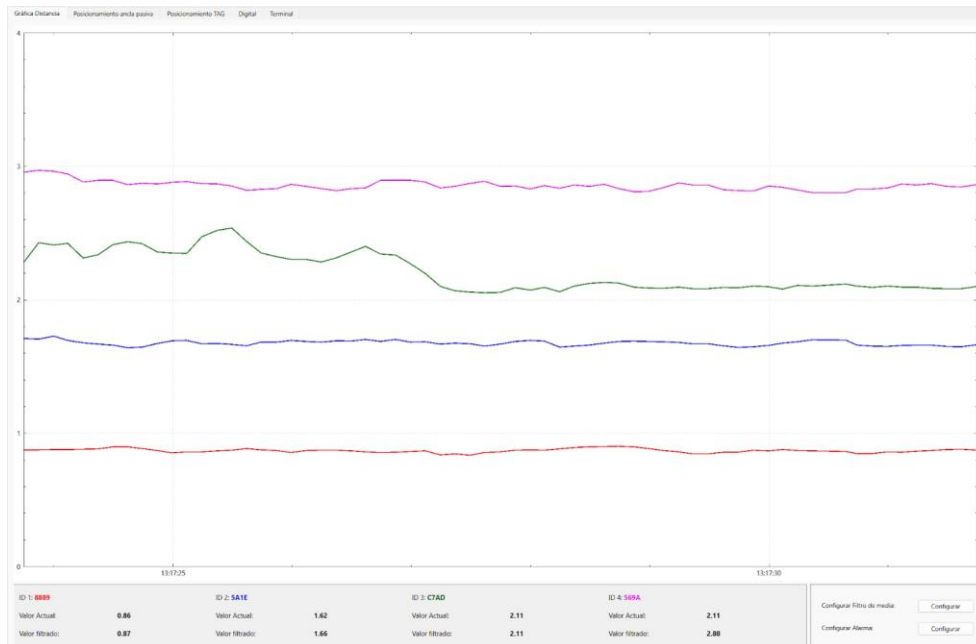


Figure 5: Example of distance reception for 4 anchors.

## Passive anchor positioning and TAG positioning

In both tabs, position of a TAG in a network with at least three anchors (one initiator) is graphically represented. Axis and coordinates of the fixed anchors in the networks can be configured as well as the use of a media filter and a alarm associated with the current position of the TAG. The operation of each mode is briefly explained below.

- **Passive anchor:** Device must be configured as a passive anchor (positioning graph settings). If a TAG in the network is detected, its position will be graphically represented in the corresponding tab. If the position of the TAG can not be estimated, the last valid value is considered.
- **TAG:** The position of the TAG connected to the PC is graphically represented in the TAG positioning tab.

For both options, position data mode must be enabled.

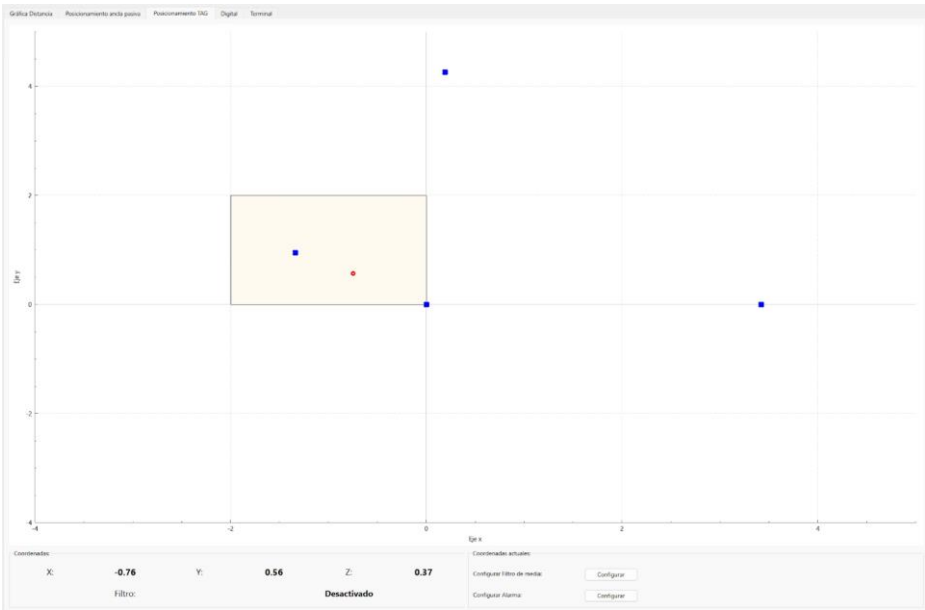


Figure 6: Positioning of a TAG example

GPIO operation tab

In this tab, user is able to test the activation and deactivation of a chosen GPIO from the development board. If requested, activation and deactivation of this GPIO can be linked with a timer.

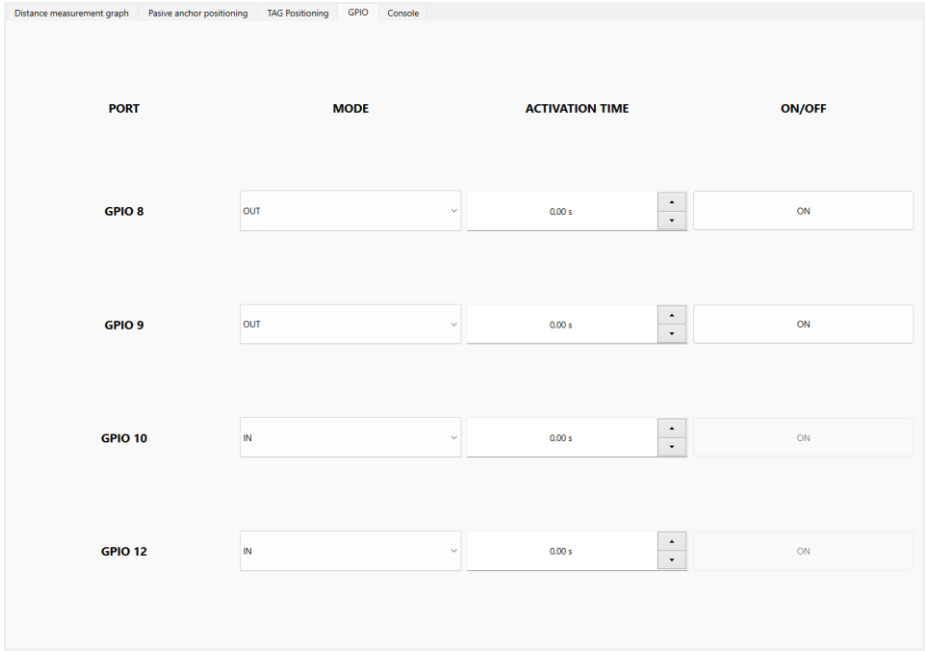
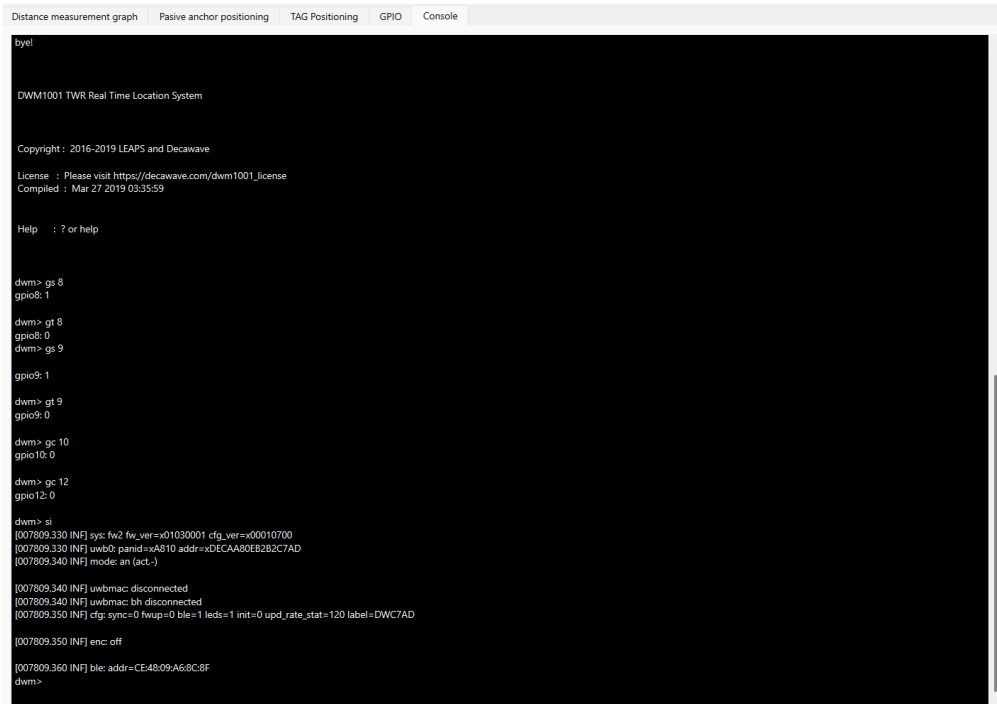


Figure 7: GPIO operation tab

## Terminal

The last tab of the main function panel is a terminal emulator which provides the user a direct communication with the device. With this tool, user can manually send commands to the development board and check the communication flow between this GUI and the DWM1001-DEV development board. While main functions are in progress, manually command sending is disabled (Data representation a.e.).



```

byel

DWM1001 TWR Real Time Location System

Copyright : 2016-2019 LEAPS and Decawave

License : Please visit https://decawave.com/dwm1001_license
Compiled : Mar 27 2019 03:35:59

Help : ? or help

dwm> gs 8
gpio8: 1

dwm> gt 8
gpio8: 0
dwm> gs 9
gpio9: 1

dwm> gt 9
gpio9: 0

dwm> gc 10
gpio10: 0

dwm> gc 12
gpio12: 0

dwm> si
[007809.330 INF] sys: fw_ver=x01030001 cfg_ver=x00010700
[007809.330 INF] uwb0: panid=xA810 addr=xDECAA80EB282C7AD
[007809.340 INF] mode: an (act-)

[007809.340 INF] uwbmac: disconnected
[007809.340 INF] uwbmac: bh disconnected
[007809.350 INF] cfg: sync=0 fwup=0 ble=1 leds=1 init=0 upd_rate=120 label=DWC7AD

[007809.350 INF] enc: off

[007809.360 INF] ble: addr=CE48:09:A6:8C:8F
dwm>

```

Figure 8: Terminal emulator

## GUI and device configuration tabs

Several tabs are provided in the upper part of the window that allow the user to configure various interface and development board options. The options available in this sections are:

- File:
  - Factory reset: Clears saved data in the DWM1001-DEV and restarts the device.
  - Reset: Restarts the DWM1001-DEV development board.
  - Exit: Close the application.
- Data:
  - Data history representation: Graphical representation of all received data in an external window. Distance or position retrieved since the beginning of the test is available in this feature. In distance mode some calculations are available selecting a range in a graph.

- Advanced statistics: When data reception is enabled, this window estimates statistics of the received data.
  - Save data settings: This option allows the user configure the name and folder in which the csv file that registers received data is stored.
  - Start data saving: When clicked, data recording begins.
  - Stop data saving: When clicked, data recording ends.
- Tools:
  - Distance graph settings: A window in which the user can configure the distance mode graph.
  - Positioning graph settings: A window in which the user can configure the position mode graph and to set up the development board as a passive anchor.
  - DWM1001-DEV settings: This option allows the user to configure the operation mode and network id of the development board.
- Help:
  - About: Information about the developed software.
  - User guide.
- Language: Provides translations of the application. In order to facilitate new translations, program automatically searches for new translation files (.qm) in 'languages' folder, avoiding to rebuild the source code to add new translations.

## Examples of operation

### Connection

1. Open the application.
2. Connect the device to an USB port available.
3. If not detected, refresh the available USB port list.
4. Choose the correct USB port and click in 'Connect' button.



Figure 9: Connection panel

### DWM1001-DEV configuration

Once the device is connected:

1. Click in Tools > DWM1001-DEV settings.

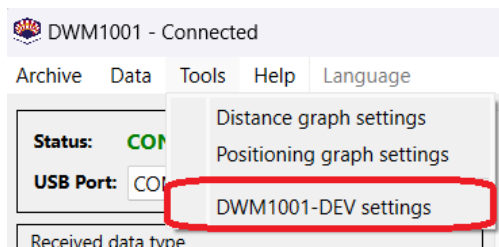


Figure 10: Tools tab

2. Choose the operation mode and the network ID desired.

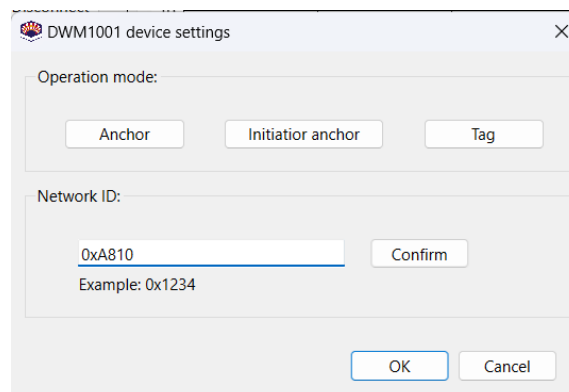


Figure 11: Device settings window

- Click 'Ok' and wait until the device is restarted.

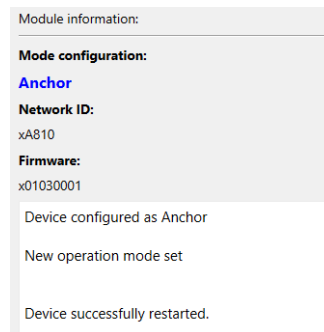


Figure 12: GUI Information panel

- (Optional) If the desired operation mode is passive anchor, this option is available at 'Positioning graph settings'.

## Distance data reception

Once the connection with the device is established:

- Select distance mode in the application.

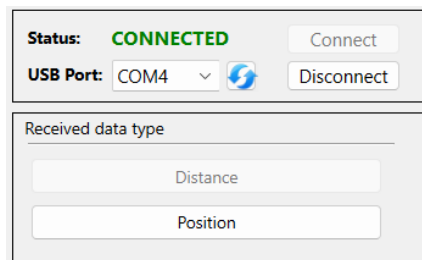


Figure 13: Connection and functioning mode panels

- Choose TAG as device operation mode.
- Change data reception sample time if desired.
- Enable data reception.

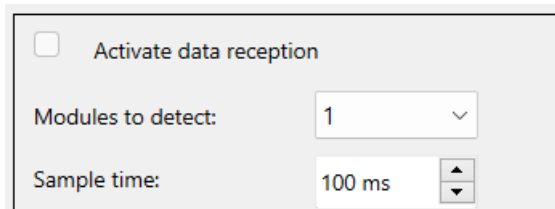


Figure 14: Data reception panel

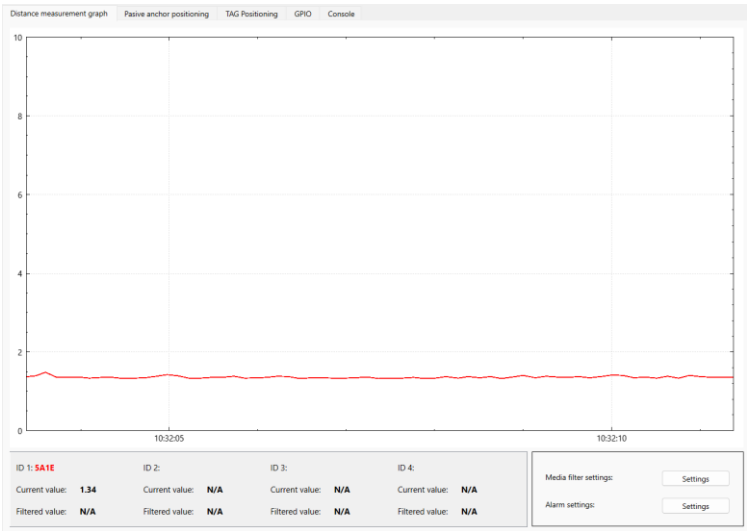


Figure 15: Distance mode panel example

5. (Optional) Configure distance graph.

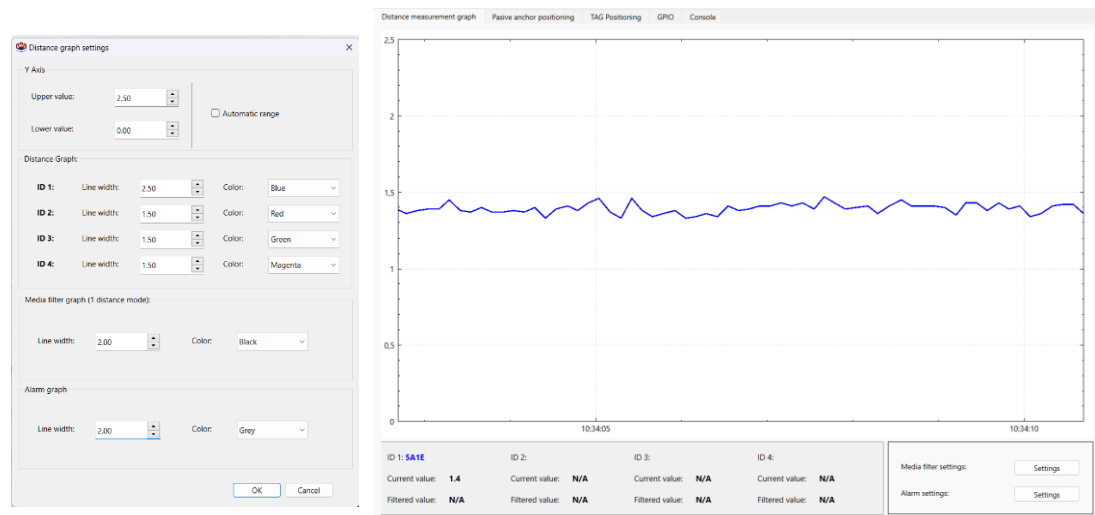


Figure 16: Distance graph configuration example

The application automatically detects available ranging anchors and plots the measured distance in each graph.

Enable media filter or Alarm: Distance mode

Media filter

- 1. Click 'Media filter settings' button.

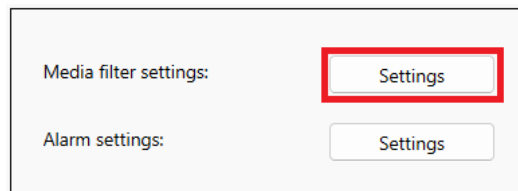


Figure 17: Media filter and alarm configuration panel

2. Indicate the media buffer size

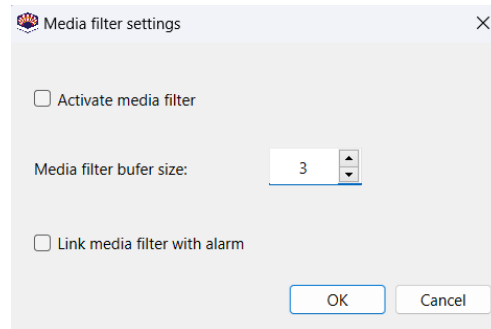


Figure 18: Media filter settings window

3. (Optional) If desired, to activate the enabled alarm with the media filter value, check 'Link media filter with alarm'.

If only one distance is retrieved, media filter will be displayed as an independent graph. For all other measures, media filter replaces each distance graph.

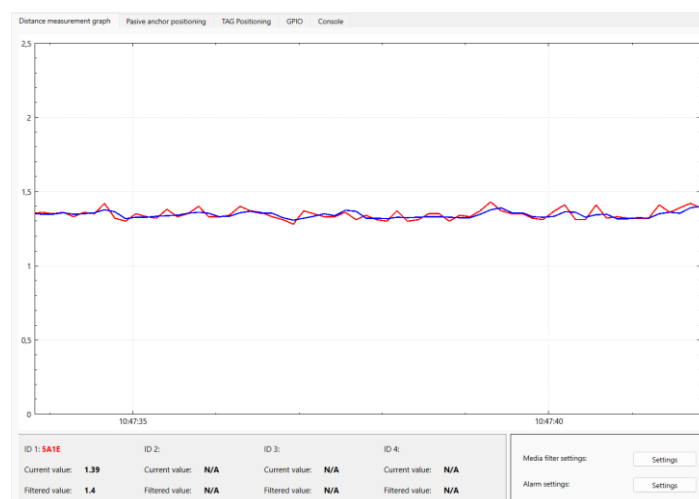


Figure 19: Distance mode with media filter activated for one distance retrieved



## Alarm: Distance

This application provides the establishment of an alarm based on the last distance data obtained. An upper and lower value must be selected.

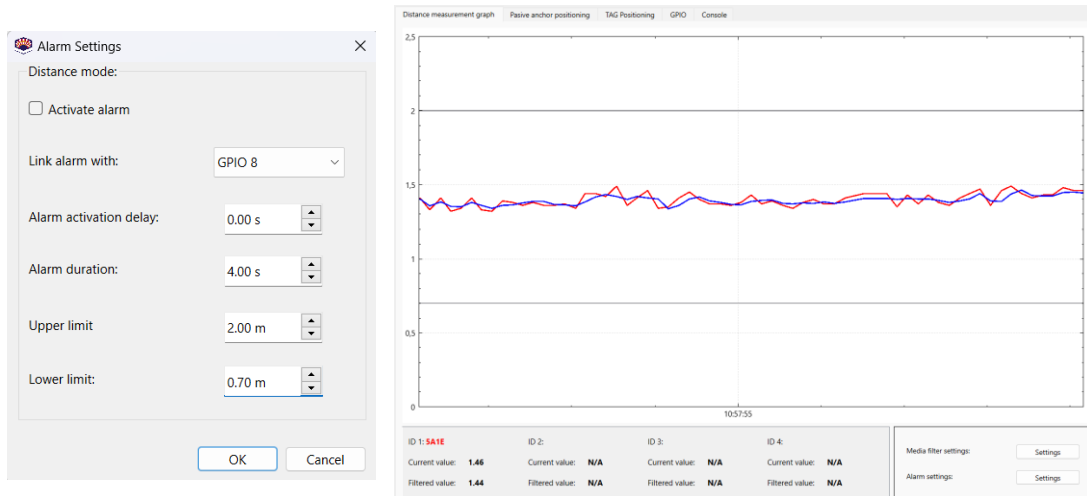


Figure 20: Distance mode with media filter and alarm enabled

If the distance retrieved is greater than the chosen upper value or less than the lower value, the selected GPIO is turned on during the specified time.



Figure 21: Alarm activation example

## Position data reception

Once the connection with the device is established.

1. Configure the device as TAG if position is retrieved directly from this device or as Passive anchor if distance is received from a TAG in the network.
2. Select 'Position' Mode.

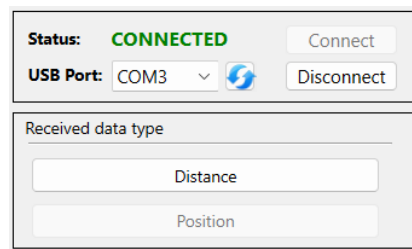


Figure 22: Connection and operation mode panels.

3. (Optional) Configure the position graph if desired in Tools > Positioning graph settings.
4. Select the correct tab according to the chosen operating mode.
5. If the network has been initialized correctly, the coordinates obtained from the device are graphically represented.

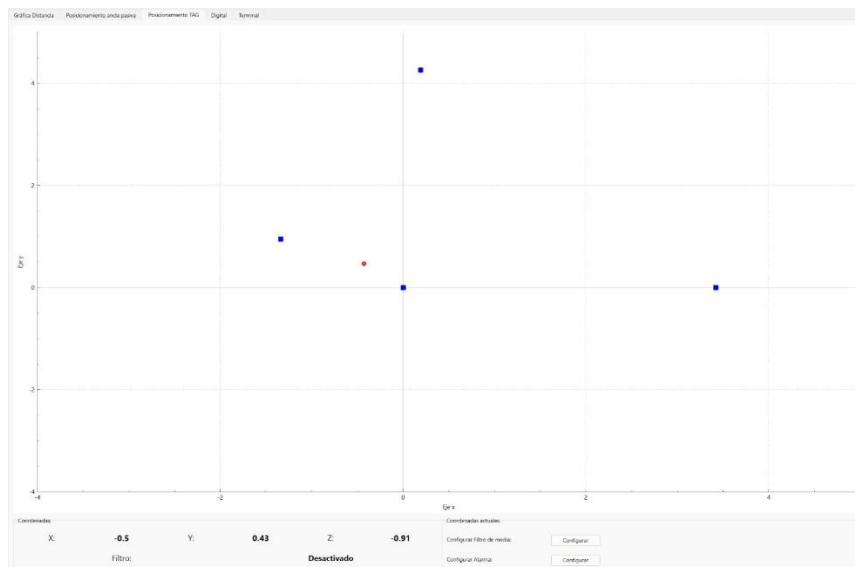


Figure 23: Position mode example

## Enable media filter or Alarm: Position mode

### Media filter

1. Click 'Media filter settings' button.

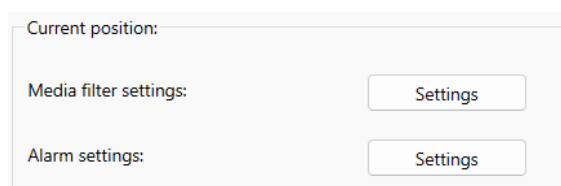


Figure 24: Media filter and alarm settings for positioning mode

## 2. Indicate the media buffer size

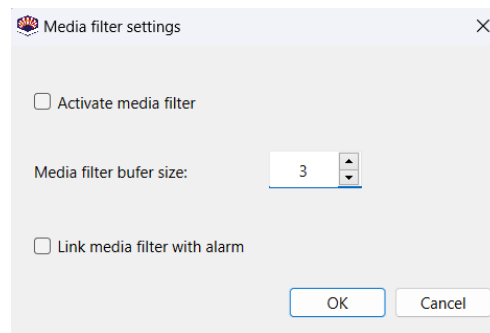


Figure 25: Media filter settings

- (Optional) If desired, to activate the enabled alarm with the media filter value, check 'Link media filter with alarm'.

## Alarm: Position

This application provides the establishment of an alarm based on the last position data obtained. User can assign alarm to an upper and lower value for each axis, being able to create a 'safe zone'. If tag exits these limits, alarm would turn on the chosen GPIO.

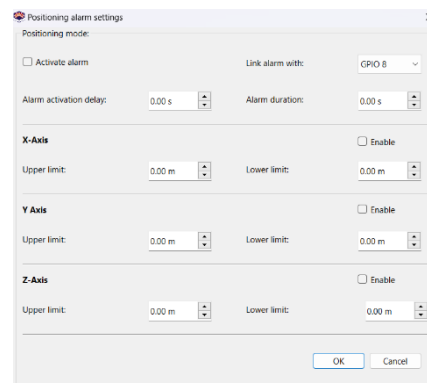


Figure 26: Alarm settings for positioning mode

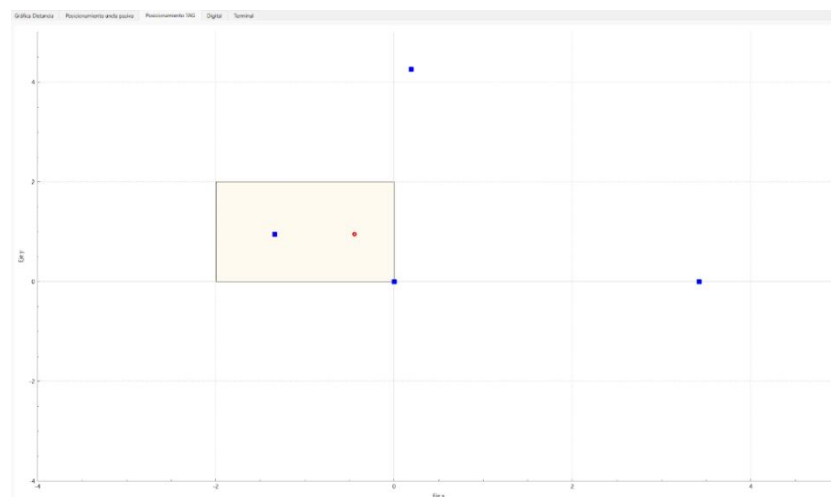


Figure 27: Positioning example with alarm enabled

## Data recording as a csv file

In order to be able to perform a subsequent analysis, this application provides the user a functionality to save all the data received in an external file. At any point in the operation of the application, this option can be enabled.

1. Connect the device with the application.
2. Enter 'Save data settings' to specify the created file name and folder.

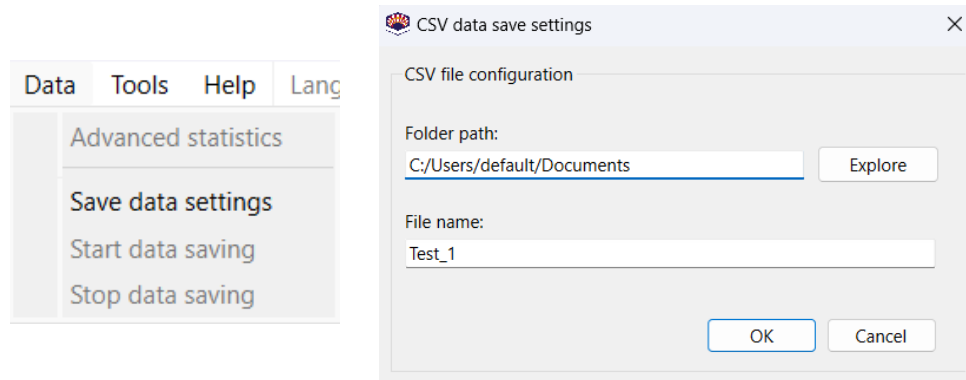


Figure 28: CSV file settings window

3. Click in 'Start data saving'. From this moment, every data received will be written into the created csv file.
4. To stop data recording, click on 'Stop data saving' option.

## Distance csv example

The following data, separated by commas, will be stored in the created file:

- Value index.
- Date and time.
- ID 1 distance.
- (Optional) ID 1 distance media filter value.
- (Optional) ID 2 distance.
- (Optional) ID 2 distance media filter value.
- (Optional) ID 3 distance.
- (Optional) ID 3 distance media filter value.
- (Optional) ID 4 distance.
- (Optional) ID 4 distance media filter value.
- GPIO status.

An example for the measurement of the distance to four anchors without media filter is displayed in the line below:

65,27/02/2024 9:50:26.408,0.92,1.18,3.93,4.19,0

## Position csv example

The following data, separated by commas, will be stored in the created file:

- Value index.
- Date and time.
- Last obtained X axis coordinate.
- Last obtained Y axis coordinate.
- Last obtained Z axis coordinate.
- GPIO status.

An example for the measurement of the position of a TAG without media filter is displayed in the line below:

1,27/02/2024 11:57:56.452,-0.76,0.55,0.38,0

## Statistics

A statistical calculation window has been implemented to provide a basic evaluation of test results without the need for post-processing through other software. The window displays the following calculations: mean, mode, standard deviation, maximum, minimum, range, and percentiles. The necessary data to perform statistical calculations is stored and the calculations are performed when the statistical values are requested. Statistics window is shown in Figure 29.

Advanced statistics							
Distance to ID: <b>CTAD</b>		Samples:	1964	Distance to ID: <b>8889</b>		Samples:	1968
Mean:	1.19	Mode:	1.16	Mean:	1.1	Mode:	1.2
Standard deviation:	0.189	Range:	1.09	Standard deviation:	0.14	Range:	0.72
Maximum:	1.62	Minimum:	0.53	Maximum:	1.42	Minimum:	0.7
Percentile 25%:	1.1	Percentile 75%:	1.27	Percentile 25%:	0.93	Percentile 75%:	1.2
Distance to ID: <b>SA1E</b>		Samples:	1968	Distance to ID: <b>569A</b>		Samples:	1966
Mean:	3.75	Mode:	3.64	Mean:	3.63	Mode:	3.79
Standard deviation:	0.368	Range:	1.6	Standard deviation:	0.255	Range:	1.22
Maximum:	4.76	Minimum:	3.16	Maximum:	4.33	Minimum:	3.11
Percentile 25%:	3.52	Percentile 75%:	3.81	Percentile 25%:	3.43	Percentile 75%:	3.8
Positioning:							
Z-axis mean value:	N/A	X-axis STD:	N/A	X-axis maximum:	N/A	X-axis minimum:	N/A
Y-axis mean value:	N/A	Y-axis STD:	N/A	Y-axis maximum:	N/A	Y-axis minimum:	N/A
Z-axis mean value:	N/A	Z-axis STD:	N/A	Z-axis maximum:	N/A	Z-axis minimum:	N/A
X-axis mode:	N/A	X-axis range:	N/A	Percentile 25% X:	N/A	Percentile 75% X:	N/A
Y-axis mode:	N/A	Y-axis range:	N/A	Percentile 25% Y:	N/A	Percentile 75% Y:	N/A
Z-axis mode:	N/A	Z-axis range:	N/A	Percentile 25% Z:	N/A	Percentile 75% Z:	N/A
Save statistics		Reset statistics		OK		Cancel	

Figure 29. Statistics window

## Data history representation

The GUI provides a window in which all received distance or position data is displayed. In this way the user can observe the history of the received data, select a graph and a range within the performed measurements and obtain some calculations on the chosen range. This feature with the distance representation of three devices is shown in Figure

30. When an alarm is set, to avoid an issue with the retrieved distance, data history and statistics do not process received data (Data recording in a csv file is not affected when the alarm is set). To select a range of data measurement, click in the initial and end points while holding *Ctrl* key.

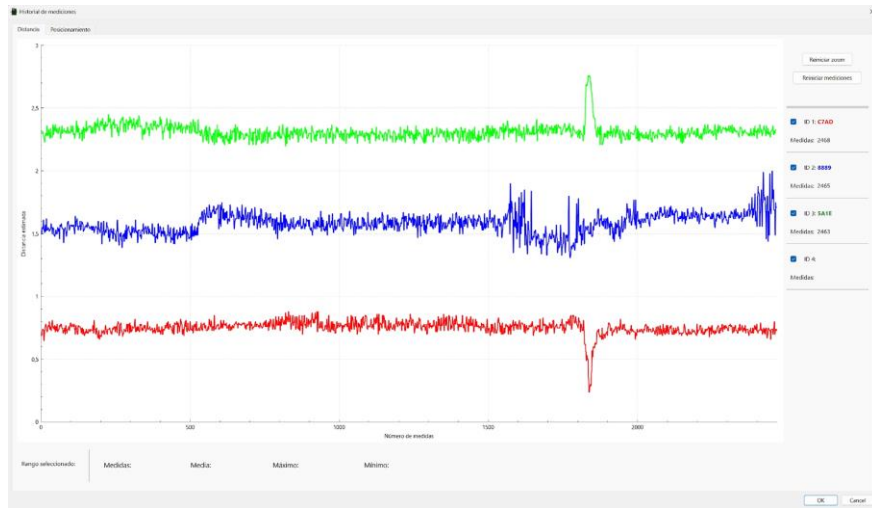


Figure 30. Data history representation window

## License and contributions

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