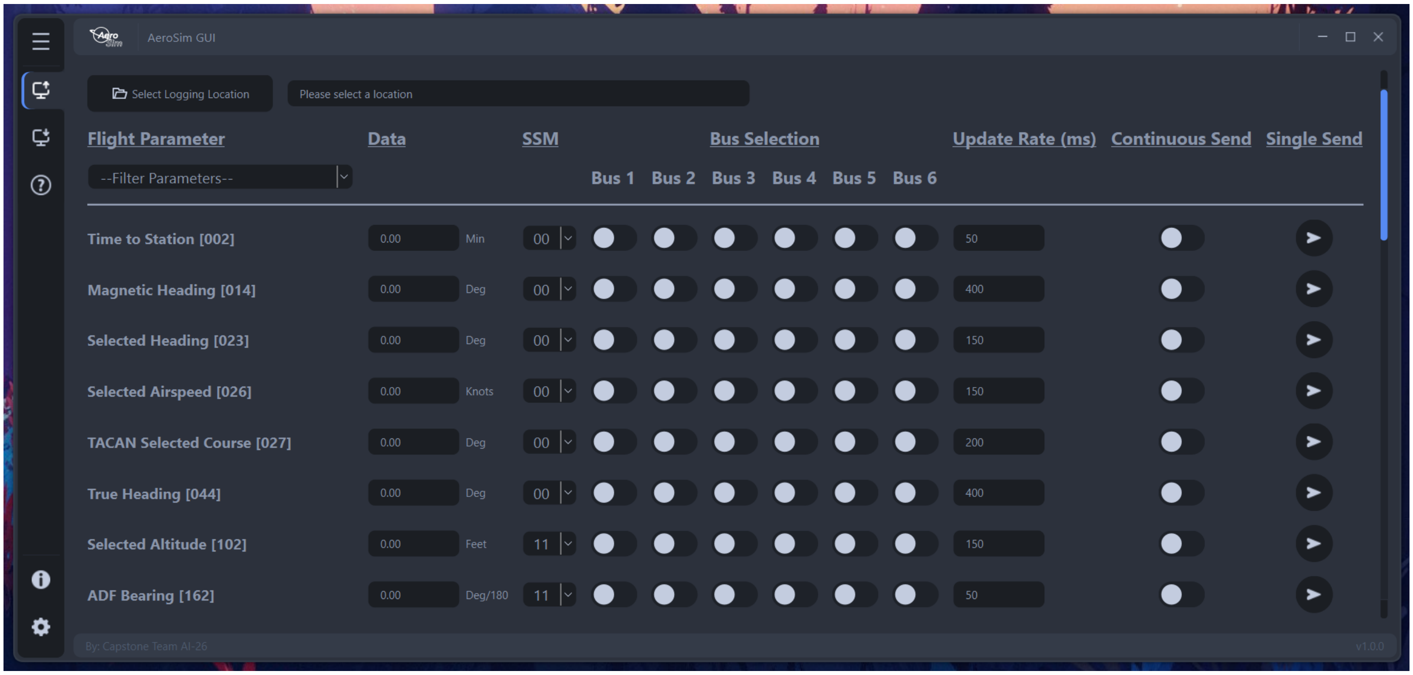
AeroSim GUI Application

Table of Contents

Usage Guide

TX Menu



Please select a location

Flight Parameter	Data		SSM	Bus Selection						Update Rate (ms)	Continuous Send	Single Send
--Filter Parameters--				Bus 1	Bus 2	Bus 3	Bus 4	Bus 5	Bus 6			
Time to Station [002]	0.00	Min	00	○	○	○	○	○	○	50	○	➤
Magnetic Heading [014]	0.00	Deg	00	○	○	○	○	○	○	400	○	➤
Selected Heading [023]	0.00	Deg	00	○	○	○	○	○	○	150	○	➤
Selected Airspeed [026]	0.00	Knots	00	○	○	○	○	○	○	150	○	➤
TACAN Selected Course [027]	0.00	Deg	00	○	○	○	○	○	○	200	○	➤
True Heading [044]	0.00	Deg	00	○	○	○	○	○	○	400	○	➤
Selected Altitude [102]	0.00	Feet	11	○	○	○	○	○	○	150	○	➤
ADF Bearing [162]	0.00	Deg/180	11	○	○	○	○	○	○	50	○	➤

By: Capstone Team AI-26

v1.0.0

Elements On Screen

> **Select Logging Location:** A button that opens a directory selection dialog for the user to select where they would like to store a logging file. This button is **disabled** (pressing it will do nothing) while **LOGGING ON/OFF** is `ON`.

> **Logging Path Display:** A text field that displays the currently selected directory to generate a log file in. This field updates whenever you select a new logging location by pressing the **Select Logging Location** button.

> **Flight Parameter:** These are the ARINC-429 parameters that are currently available for user configuration.

> **Data:** The numerical data corresponding to each parameter. The exact allowed ranges for each parameter can be found in the `param_settings.json` file. This entry box allows the entry of DECIMAL values.

> **SSM Selector:** A dropdown menu that allows users to specify the Sign Status Matrix (SSM) in the ARINC-429 message for the corresponding parameter.

> **Bus Selection (1-6):** Toggles to select which buses to output each parameter on. Refer to the attached pinout of the D-Sub connector to determine the physical bus connection.

> **Update Rate:** The rate at which each parameter will be sent out, in periods of milliseconds. Only INTEGERS are allowed to be entered in any **Update Rate** entry box. By DEFAULT, the update rate corresponding to each parameter has been pre-configured to a number within the range specified for that parameter in the ARINC-429 standard.

> **Continuous Send:** A toggle to turn `ON` or `OFF` continuous periodic transmission of a flight parameter (the periodic rate used is the number specified in the **Update Rate** entry box).

> **Single Send:** A toggle to turn `ON` or `OFF` a singular transmission of a flight parameter.

> **Parameter Filter:** A dropdown menu that allows users to filter each row of flight parameters shown on screen. Users can check the boxes beside each parameter in the dropdown to show the parameter or uncheck them to hide the parameter. Users can also type in the name (or label) of the parameter they wish to find in the editable field of the dropdown to quickly find any parameters they wish to filter.

> **Discrete Outputs:** Toggles to turn ON or OFF discrete outputs available on the AeroSim hardware.
>
> - 4x Open/Ground outputs
> - 2x Open/28V outputs

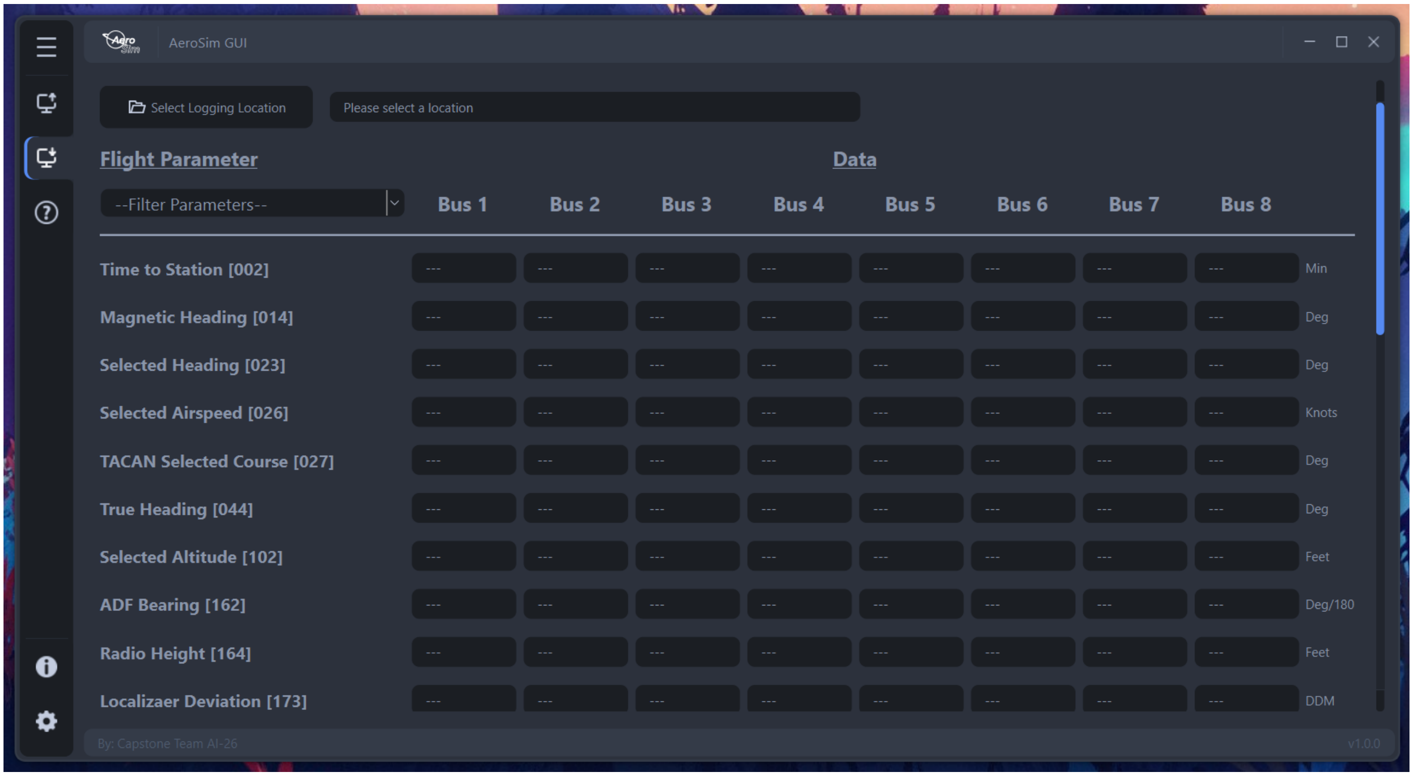
Usage Notes

- Please note that any changes to the values of **Data**, **SSM Selector**, and **Update Rate** while **Continuous Send** is `ON` will NOT result in new values being output to the hardware.
- To update any of the aforementioned settings, you will need to toggle **Continuous Send** or any of the **Bus Selection (1-6)** toggles that you wish to send the updated parameter on.

Example TX Testing Procedure

1. Select the COM port of the connected AeroSim device in the **COM Port Selector** dropdown on the ***Global Settings*** menu (i.e `COM3`).
2. Set **Bus 1 Bitrate** on the ***TX Settings*** menu to `100 kbps`
3. Turn `ON` the **TX ON/OFF** toggle
4. For the **Magnetic Heading [014]** parameter:
    1. Set the **Data** entry box to a value of `90`
    2. Turn `ON` the **Bus 1** toggle
    3. Turn `ON` the **Continuous Send** toggle

RX Menu



AeroSim GUI

Select Logging Location | Please select a location

Flight Parameter — Data

--Filter Parameters--	Bus 1	Bus 2	Bus 3	Bus 4	Bus 5	Bus 6	Bus 7	Bus 8	
Time to Station [002]	---	---	---	---	---	---	---	---	Min
Magnetic Heading [014]	---	---	---	---	---	---	---	---	Deg
Selected Heading [023]	---	---	---	---	---	---	---	---	Deg
Selected Airspeed [026]	---	---	---	---	---	---	---	---	Knots
TACAN Selected Course [027]	---	---	---	---	---	---	---	---	Deg
True Heading [044]	---	---	---	---	---	---	---	---	Deg
Selected Altitude [102]	---	---	---	---	---	---	---	---	Feet
ADF Bearing [162]	---	---	---	---	---	---	---	---	Deg/180
Radio Height [164]	---	---	---	---	---	---	---	---	Feet
Localizaer Deviation [173]	---	---	---	---	---	---	---	---	DDM

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Elements On Screen

> **Select Logging Location:** A button that opens a directory selection dialog for the user to select where they would like to store a logging file. This button is **disabled** (pressing it will do nothing) while **LOGGING ON/OFF** is `ON`.

> **Logging Path Display:** A text field that displays the currently selected directory to generate a log file in. This field updates whenever you select a new logging location by pressing the **Select Logging Location** button.

> **Flight Parameter:** These are the ARINC-429 parameters that are currently available for user configuration.

> **Data:** The numerical data corresponding to each parameter. When no data is detected the display defaults to `---`, and when data is received the field corresponding to the parameter and the bus it was received on

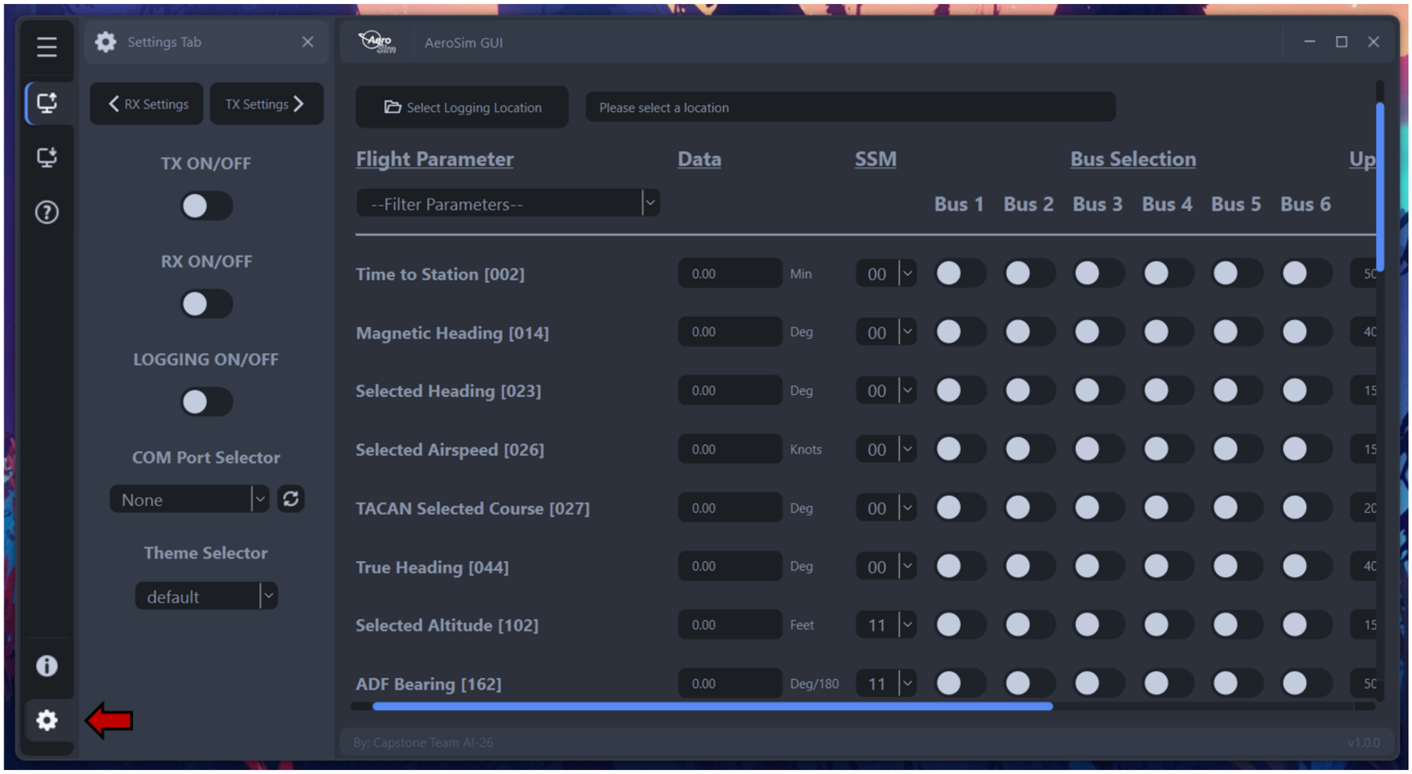
> is populated.
>
> The data column for each bus is hidden by default when the application is started since all of the **Bus Status** dropdowns on the ***RX Settings*** menu are set to `OFF` intially. Each data bus column can be shown by setting its corresponding **Bus Status** dropdown to `ON` in the ***RX Settings*** menu.

> **Parameter Filter:** A dropdown menu that allows users to filter each row of flight parameters shown on screen. Users can check the boxes beside each parameter in the dropdown to show the parameter or uncheck them to hide the parameter. Users can also type in the name (or label) of the parameter they wish to find in the editable field of the dropdown to quickly find any parameters they wish to filter.

Example RX Testing Procedure

1. Select the COM port of the connected AeroSim device in the **COM Port Selector** dropdown on the ***Global Settings*** menu (i.e `COM3`).
2. Set **Bus 1 Status** on the ***RX Settings*** menu to `ON`
3. Connect a device that outputs the **Altitude (1013.25 mb) [203]** parameter to **Bus 1** (check physical pinout of the D-SUB to locate the **Bus 1** connector)
4. Turn `ON` the **RX ON/OFF** toggle
5. Check the data field beside the **Altitude (1013.25 mb) [203]** parameter under the **Bus 1 Data** column to see the real time data being output by the device

Global Settings



TX ON/OFF ○

RX ON/OFF ○

LOGGING ON/OFF ○

COM Port Selector: None

Theme Selector: default

Flight Parameter	Data		SSM	Bus 1	Bus 2	Bus 3	Bus 4	Bus 5	Bus 6	Up
Time to Station [002]	0.00	Min	00	○	○	○	○	○	○	5C
Magnetic Heading [014]	0.00	Deg	00	○	○	○	○	○	○	4C
Selected Heading [023]	0.00	Deg	00	○	○	○	○	○	○	15
Selected Airspeed [026]	0.00	Knots	00	○	○	○	○	○	○	15
TACAN Selected Course [027]	0.00	Deg	00	○	○	○	○	○	○	2C
True Heading [044]	0.00	Deg	00	○	○	○	○	○	○	4C
Selected Altitude [102]	0.00	Feet	11	○	○	○	○	○	○	15
ADF Bearing [162]	0.00	Deg/180	11	○	○	○	○	○	○	5C

The Global Settings menu can be accessed by clicking the gear icon on the side bar indicated by the red arrow in the picture above.

Elements On Screen

> **TX ON/OFF Toggle:** A toggle that enables/disables overall transmission of data from the application to the AeroSim hardware.

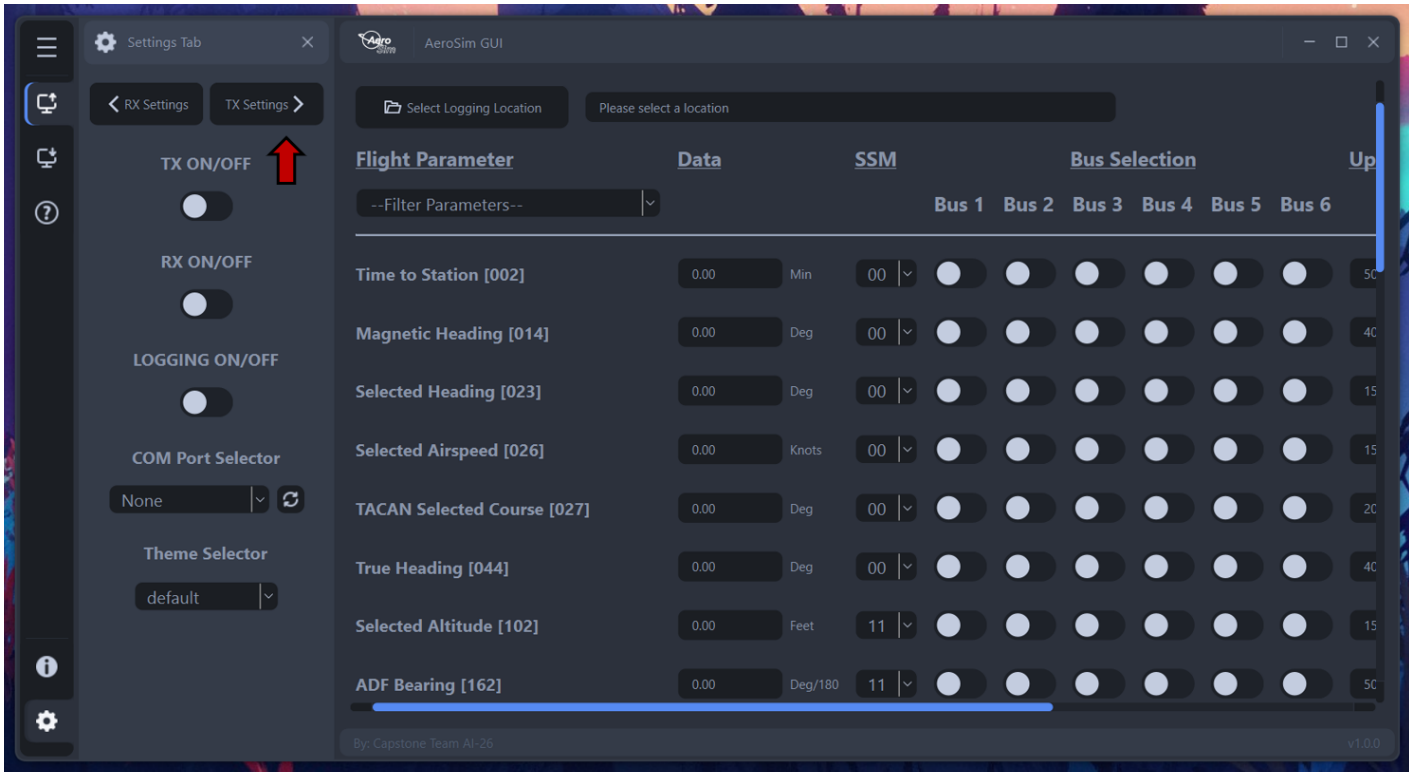
> **RX ON/OFF Toggle:** A toggle that enables/disables overall reception of data from the AeroSim hardware to the application.

> **LOGGING ON/OFF Toggle:** A toggle to turn `ON` or `OFF` logging to a *CSV* file. Both TX and RX ARINC-429 messages will be logged. Files will be generated at the location displayed in the **Logging Path Display** field, and they will be generated with a default name in the following format: `AeroSim_Logfile_YYYY-MM-DD_hh-mm-ss.csv`
>
> *Note:* You can view the generated *CSV* file using Microsoft Excel to view the data in a tabular format, or you can open it using any text editor program such as Notepad or Visual Studio Code to view it in its raw form.
>
> **Limitations:**
>
> - The maximum number of lines in a file is currently limited to **10 million (10,000,000) lines**. A new logging file will be automatically generated upon reaching that limit and all new data sent or received will be put into the new log file.
> - The application will ONLY log a TX message when the user updates it either by toggling the bus selection or activating continuous send/single send. RX messages are logged each time they are received.

> **COM Port Selector:** A dropdown menu that allows the user to connect to the AeroSim hardware by selecting its assigned COM port. This COM port is automatically assigned by Windows and can vary from device to device (i.e. `COM#`). You can click the **refresh button** next to the dropdown to refresh the list of currently detected COM ports if you have connected/disconnected the AeroSim hardware device after starting up the application.

> **Theme Selector:** A dropdown menu that allows users to switch the application color scheme. There are currently three themes available: `default`, `bright_theme`, and `dracula`. Note that changing themes will restart the application and you will lose all configurations you have made in the current instance of the application, so it is advised to pick a theme before configuring any menus for a test.

TX Settings



TX ON/OFF

RX ON/OFF

LOGGING ON/OFF

COM Port Selector: None

Theme Selector: default

Please select a location

--Filter Parameters--

Flight Parameter	Data		SSM	Bus 1	Bus 2	Bus 3	Bus 4	Bus 5	Bus 6	Up
Time to Station [002]	0.00	Min	00	○	○	○	○	○	○	50
Magnetic Heading [014]	0.00	Deg	00	○	○	○	○	○	○	40
Selected Heading [023]	0.00	Deg	00	○	○	○	○	○	○	15
Selected Airspeed [026]	0.00	Knots	00	○	○	○	○	○	○	15
TACAN Selected Course [027]	0.00	Deg	00	○	○	○	○	○	○	20
True Heading [044]	0.00	Deg	00	○	○	○	○	○	○	40
Selected Altitude [102]	0.00	Feet	11	○	○	○	○	○	○	15
ADF Bearing [162]	0.00	Deg/180	11	○	○	○	○	○	○	50

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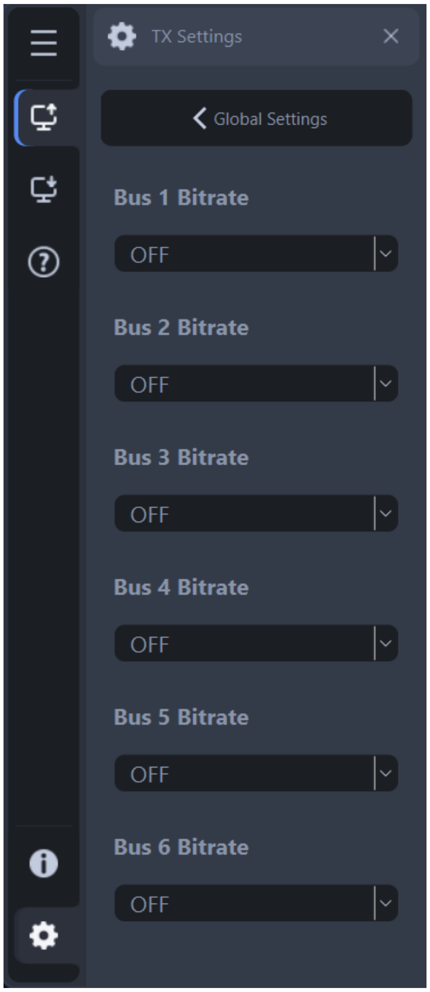
The TX Settings menu can be accessed by clicking the button at the top of the **Global Settings** menu indicated by the red arrow in the picture above.



Bus 1 Bitrate: OFF

Bus 2 Bitrate: OFF

Bus 3 Bitrate: OFF

Bus 4 Bitrate: OFF

Bus 5 Bitrate: OFF

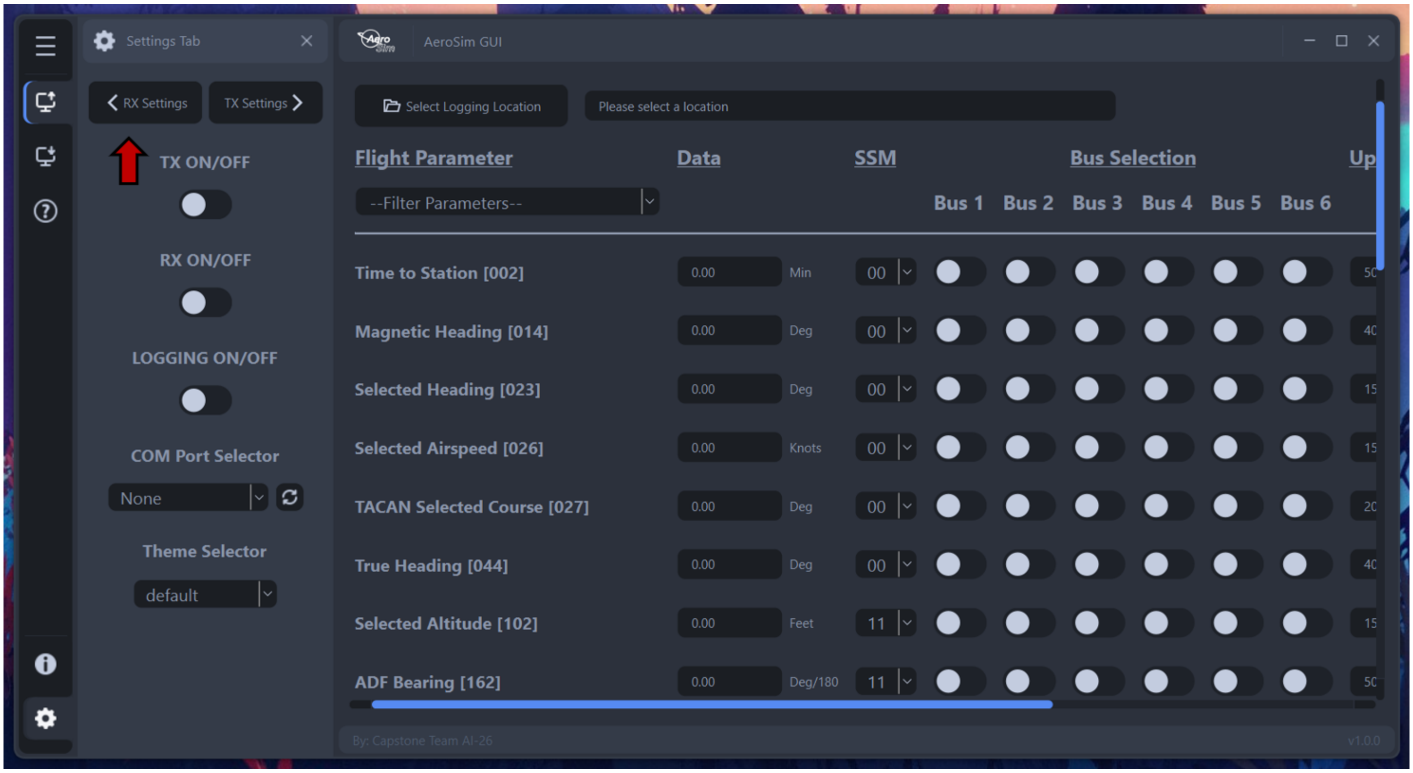
Bus 6 Bitrate: OFF

You can click the **Global Settings** button at the top of the menu to return to the **Global Settings** menu.

Elements On Screen

> **Bus Bitrates (1-6):** Dropdown menus that allow the user to select which bitrate to output the ARINC words at to conform to different equipment specifications. There are 3 options available: `OFF`, `12.5 kbps`, and `100 kbps`.
>
> - Selecting the `OFF` option disables transmission of any data on that bus.
> - Selecting either the `12.5 kbps` or `100 kbps` options sets the bitrate on that bus to the value selected, but no message transmission will occur until the global **TX ON/OFF Toggle** is turned `ON`.

RX Settings



TX ON/OFF ○

RX ON/OFF ○

LOGGING ON/OFF ○

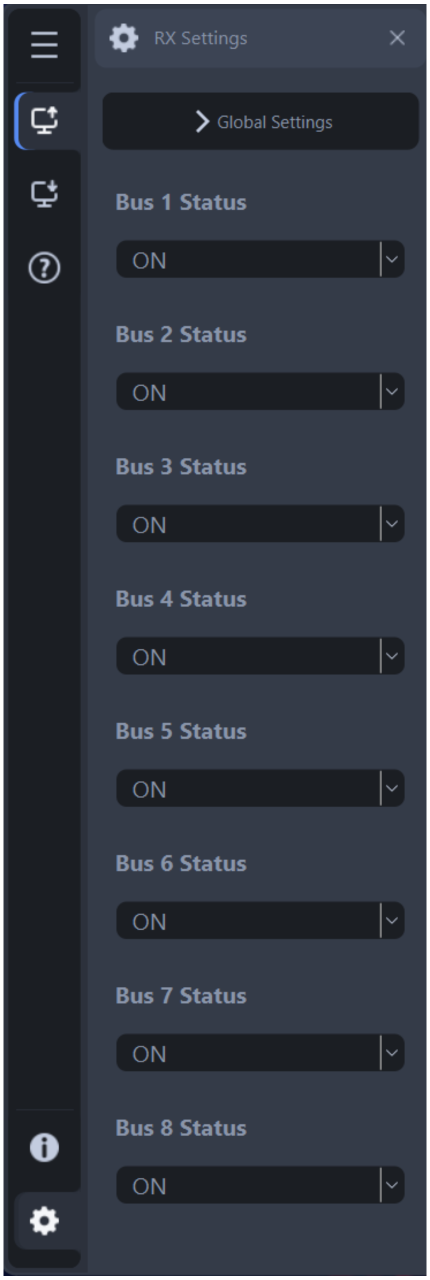
COM Port Selector: None

Theme Selector: default

Please select a location

Flight Parameter	Data		SSM	Bus Selection						Up
--Filter Parameters--				Bus 1	Bus 2	Bus 3	Bus 4	Bus 5	Bus 6	
Time to Station [002]	0.00	Min	00	○	○	○	○	○	○	50
Magnetic Heading [014]	0.00	Deg	00	○	○	○	○	○	○	40
Selected Heading [023]	0.00	Deg	00	○	○	○	○	○	○	15
Selected Airspeed [026]	0.00	Knots	00	○	○	○	○	○	○	15
TACAN Selected Course [027]	0.00	Deg	00	○	○	○	○	○	○	20
True Heading [044]	0.00	Deg	00	○	○	○	○	○	○	40
Selected Altitude [102]	0.00	Feet	11	○	○	○	○	○	○	15
ADF Bearing [162]	0.00	Deg/180	11	○	○	○	○	○	○	50

The RX Settings menu can be accessed by clicking the button at the top of the **Global Settings** menu indicated by the red arrow in the picture above.



Bus 1 Status: ON

Bus 2 Status: ON

Bus 3 Status: ON

Bus 4 Status: ON

Bus 5 Status: ON

Bus 6 Status: ON

Bus 7 Status: ON

Bus 8 Status: ON

You can click the **Global Settings** button at the top of the menu to return to the **Global Settings** menu.

Elements On Screen

> **Bus Statuses (1-8):** Dropdown menus that allow the user to enable or disable reception of data on that bus. There are two options available: `ON` and `OFF`.
>
> - Selecting the `ON` option displays the corresponding bus column underneath the **Data** header on the ***RX Menu*** and enables reception of data on that bus. However, no data will be received until the global **RX ON/OFF Toggle** is turned `ON`.
> - Selecting the `OFF` option hides the corresponding bus column underneath the **Data** header on the ***RX Menu*** and disables reception of data on that bus.

Dev Notes:

> **Warning**: this project was created using PySide6 and Python 3.9, using previous versions can cause compatibility problems.

- The Qt Designer application comes with the PySide6 package and the executable can be found at the following library installation directory:

  `.\Lib\site-packages\PySide6\designer.exe`

  Important: You will need to copy paste the **Qt6Core.dll** found in the `.\PySide6` directory into the `.\PySide6\bin` directory in order for the "View Python Code..." function in Qt Designer to work when you want to generate Python code from your .ui design file.

- NOTE: PyUSB is not used in the current code but this note is left here in case this knowledge becomes useful in the future.

  The PyUSB library requires the libusb library to also be installed, and the packaged **libusb-1.0.dll** found at `venv\Lib\site-packages\libusb\_platform\_windows\x64\libusb-1.0.dll` MUST be copied over to the ``C:\Windows\System3`` folder for the PyUSB library to work. Otherwise you will get a `` Backend not found` error.

  Sources for info on this here:

  https://github.com/pyusb/pyusb/blob/master/docs/faq.rst

  https://stackoverflow.com/questions/13773132/pyusb-on-windows-no-backend-available

  SUGGESTED FIX FOR PACKAGED APPLICATION: Install the `libusb-1.0.dll` into the client's `C:\Windows\System32` folder upon application installation.

- The PyARINC429 library will need to be manually installed via `git clone https://github.com/aeroneous/PyARINC429` into `.\Lib\site-packages` since there is no PyPI pip install package available.

- To quickly generate a new **requirements.txt** file simply run the following commands in your virtual env (while it is activated):

  - `pip install pipreqs` (this will install Pipreqs ONLY in your virtual env)
  - `python -m pipreqs.pipreqs --force`
  - Note the `--force` command is used to override an existing `requirements.txt` file

- NOTE: A 10ms delay is added in `receive_arinc.py` after reading from serial port to prevent PySerial from dropping received ARINC429 messages. This is a temporary fix and may significantly delay the reception of messages from avionics equipment. This may result in preventing the interface device from handling a full load of receiving RX messages from 8 flight instruments at once, depending on the rate of messages received.

Build Instructions

We can use the **PyInstaller** library to build the AeroSim application into a standalone package that can be used on any Windows machine (Windows 8 and newer), regardless of whether they have Python installed or not. Check out the PyInstaller manual for more details on how the library works.

To build the application, simply run the following commands in your virtual env (while it is activated):

- `pip install pyinstaller` (this will install PyInstaller ONLY in your virtual env)
- `.\run_PyInstaller.bat` (this batch file runs PyInstaller with some preset input arguments that are required for the application to be built properly)

After the previous steps you should see a `dist` folder generated in your local repository. The `AeroSim` folder inside contains your portable AeroSim application! To distribute this package simply compress the folder with your favourite zipping tool (to reduce the file size for the transfer) and hand it to your user. They can then decompress it and run the `AeroSim.exe` executable inside the `AeroSim` folder to start the application.

External Resources:

This GUI was created using the open-source PyOneDark project by Wanderson-Magalhaes as a code base for the color scheme and widget designs. You can view his Youtube videos in the linked repository to find out how some of his custom widgets work.