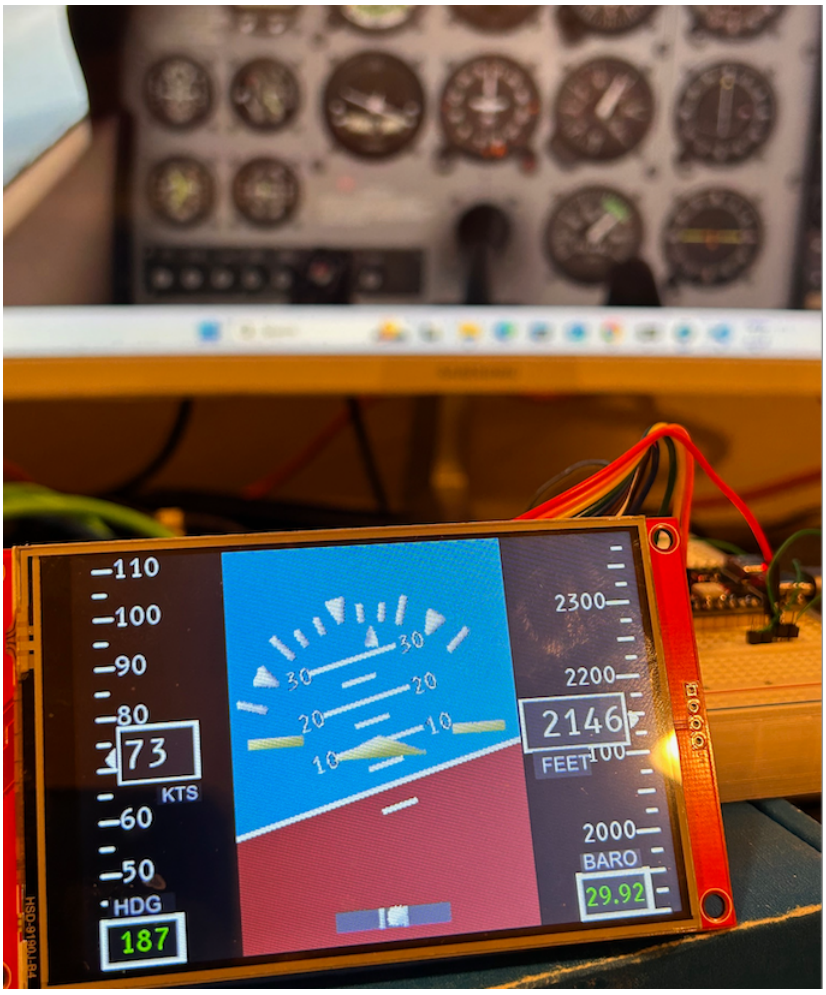
Standby Attitude Module on a 3.5-inch LCD screen and ESP32 S3 Microcontroller (Implemented as a Mobiflight Community Device)



1. Introduction:

This is a Standby Attitude Module (SAM) for use with Flight Simulation. It is an original implementation inspired by the MD302 and Garmin G5. Of course, it does not have all the functionality of those devices, as this was just developed for fun!

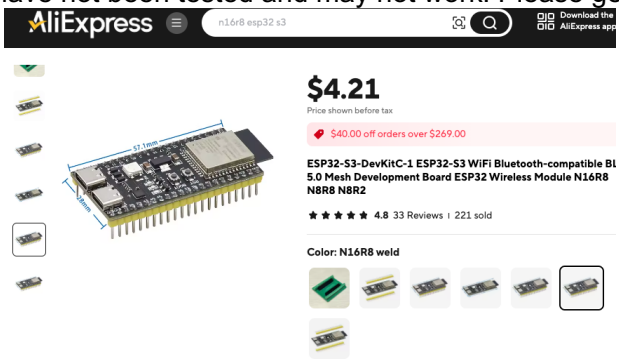
The motivation for this is to have a realistic SAM that can be placed anywhere in the sim panel for home cockpit builders and hobbyists without breaking the bank. This is implemented as a Mobiflight community device using an ESP32 S3, so it can be used with flight simulators that are supported by Mobiflight (MSFS2020, X Plane) and can be integrated easily.

For questions, please join the Mobiflight Discord server and go to the “custom-devices “ channel.

Most important of all, have fun, and…. Mobiflight rocks!!!

2. Hardware:

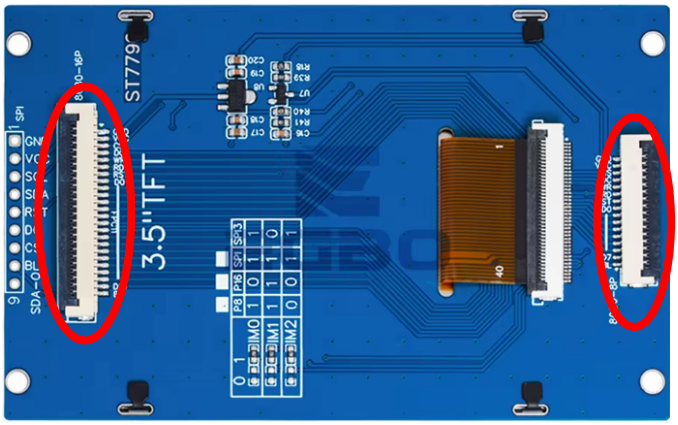
- **ESP32 S3 N16R8 variant**
  Note: Other variants have not been tested and may not work. Please get this specific variant



  For example:
  - https://tinyurl.com/at2ubb9a
  - https://tinyurl.com/46rwnp9p

- **3.5-inch LCD screen with the ST7796 or ST7796S driver**
  Note: Other LCD screens with a different driver will not work!
  For example:
  - https://tinyurl.com/3z6y7kcu
  - https://tinyurl.com/3aac2f63

  Currently, this device uses the serial SPI interface, but it is highly recommended to get a 3.5-inch LCD screen that also has a parallel interface option, as this might be implemented in the future. See example below:

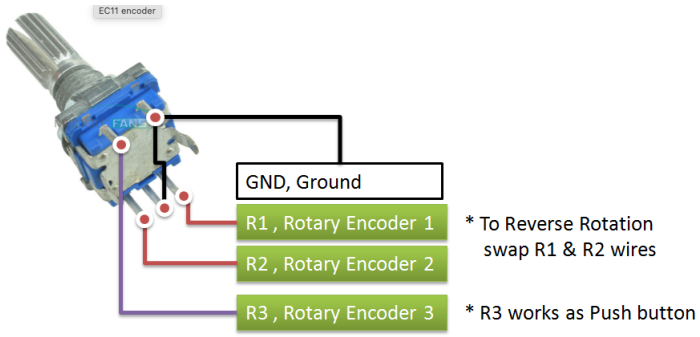


- **Other hardware**
  - EC11 Rotary Encoder
  - Wires, USB connectors, etc.

- **ESP32 S3 and LCD Screen (ST7796/ST7796S) PIN connections**
  Connect the 3.5-inch LCD display pins to the corresponding ESP32 S3 GPIO pins according to the table below:

ESP32 S3 GPIO Pin	3.5-in LCD (ST7796/ST7796S) Pin
3V3	VCC
GND	GND
7	CS
6	RESET
15	DC/RS
17	SDI(MOSI)
18	SCK
13	LED

- **Rotary Encoder (EC11) connections**



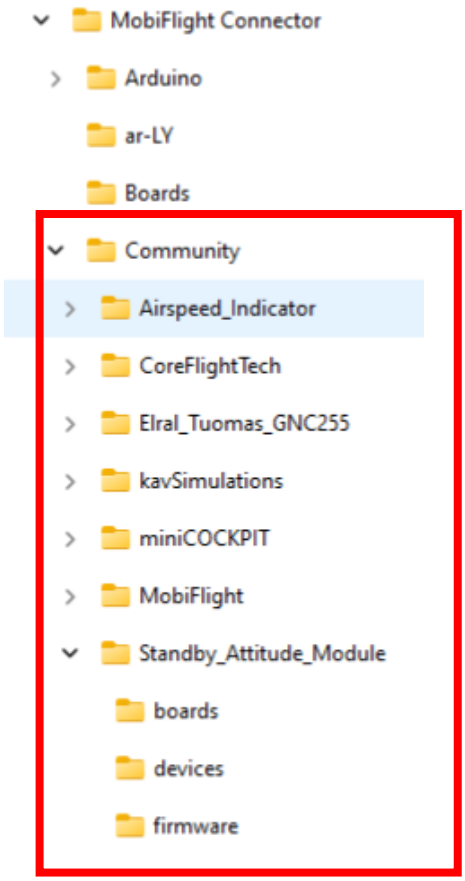
Credits to Dronebots Workshop for the image.

ESP32 S3 GPIO Pin	Rotary Encoder (EC11)
GND	GND
10	R1, Rotary Encoder 1
11	R2, Rotary Encoder 2
12	R2, Rotary Encoder 3 (pushbutton)

3. Software:

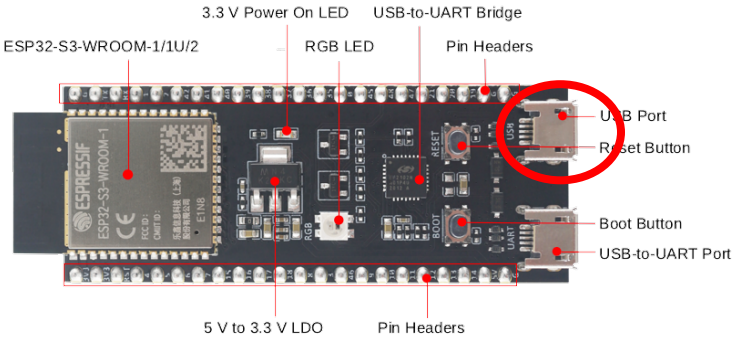
- **Mobiflight**
  - https://www.mobiflight.com/en/index.html
- **Mobiflight Standby Attitude Module custom firmware**
  - See the instructions below for downloading and installing the custom firmware

4. Downloading the Mobiflight Standby Attitude Module custom firmware:

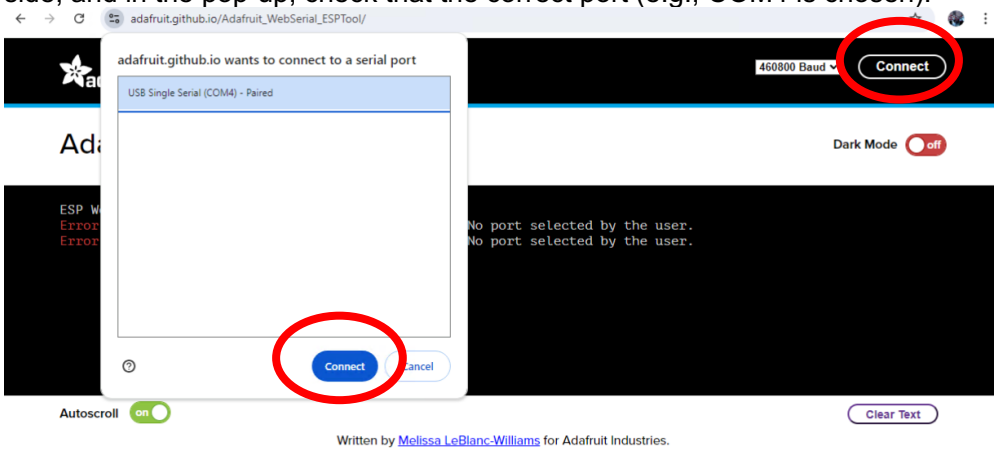
- Download the Mobiflight Standby Attitude Module custom firmware from the link below:
  https://github.com/savesabanal01/Mobiflight-StandbyAttitudeModule-ESP32-S3/tree/StandbyAttitudeModule-release
  Go to the folder “firmware” and download Standby Attitude Module_2.5.2.zip
- Open you Windows Explorer, using Win+E
- In the file path window, paste %LocalAppData%\MobiFlight\MobiFlight Connector\Community
- Extract the Standby Attitude Module_2.5.2.zip to this folder. The file structure should look like the one below (make sure that the “Standby_Attitude_Module” folder is directly under “Community”:
- 

5. Flashing the Mobiflight Standby Attitude Module custom firmware to the ESP32 S3:

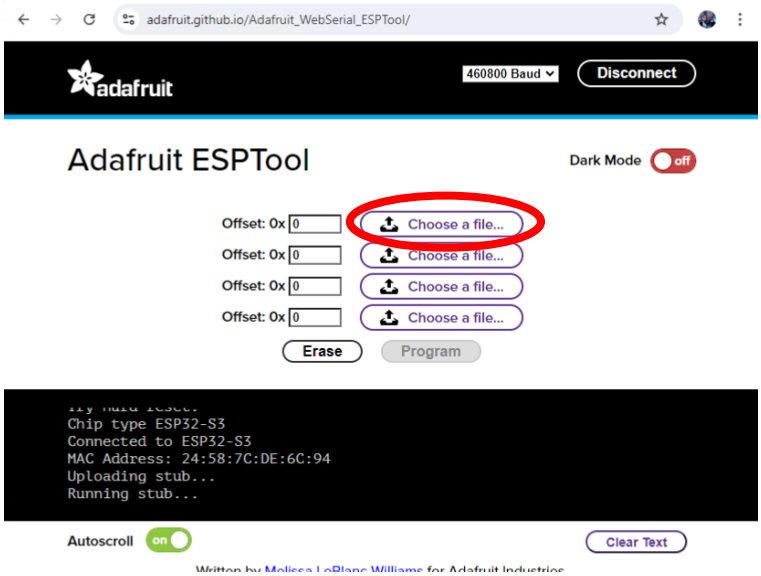
- The easy (and slow) method:
  Connect the ESP32 S3 to your PC using the USB port in the picture below:



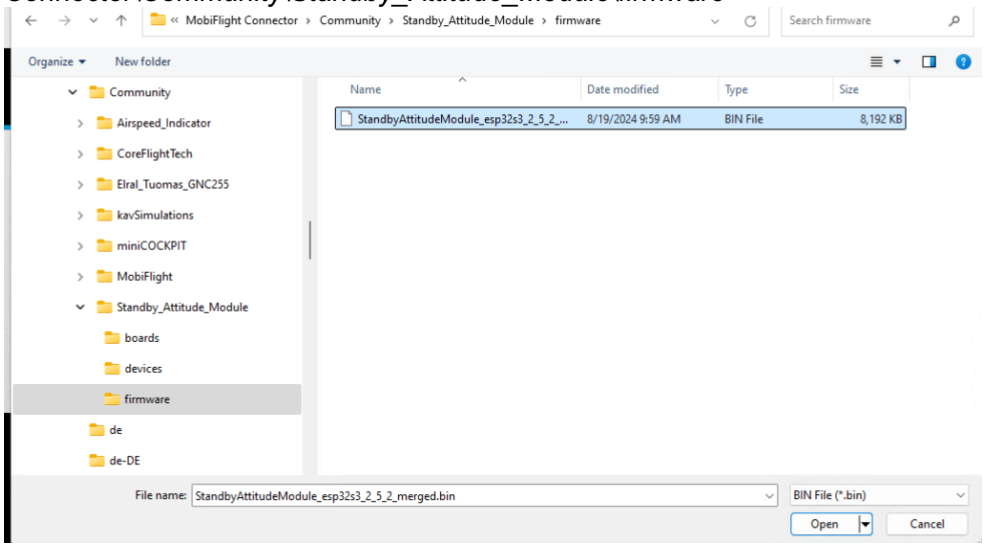
- Open the following URL: https://adafruit.github.io/Adafruit_WebSerial_ESPTool/
- When the webpage is opened, click on the “Connect” button on the upper right-hand side, and in the pop-up, check that the correct port (e.g., COM4 is chosen).



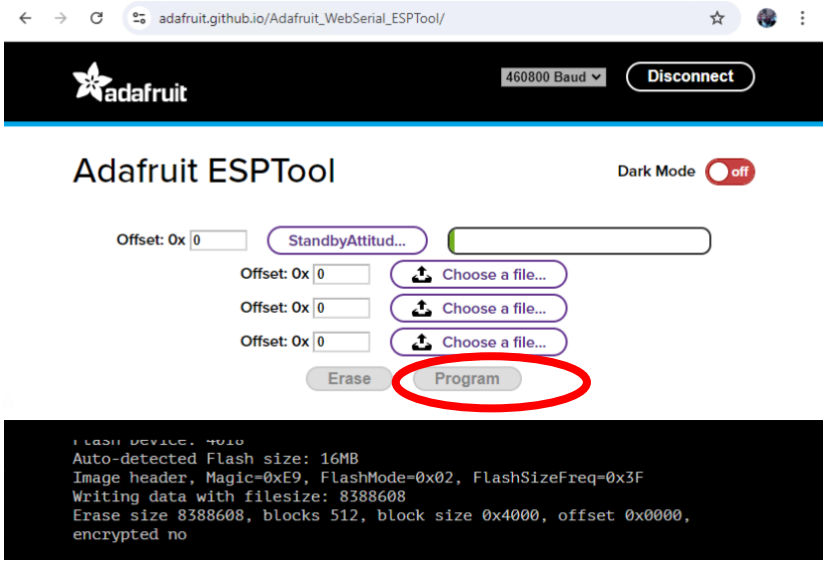
- Click on the correct port and click the “Connect” button in the pop-up
- On the next page, click the first “Choose a file…” button



- When Windows Explorer opens, select the “StandbyAttitudeModule_esp32s3_2_5_2_merged.bin” file, which is in the “Standby_Attitude_Module” -> “firmware" folder that you extracted previously. ***Hint:*** *It is under: C:\Users\<username>\AppData\Local\MobiFlight\MobiFlight Connector\Community\Standby_Attitude_Module\firmware*



- Click on “Program” and wait for the firmware flashing to complete



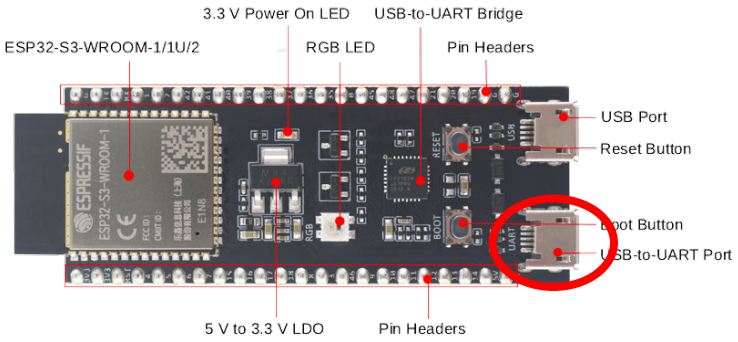
- **For advanced users,** the faster method is to use the esptool.py. You need to install Python and the esptool.py tool. Please see this link for details: https://github.com/espressif/esptool

The syntax to use the esptool.py to flash the firmware is, assuming that “StandbyAttitudeModule_esp32s3_2_5_2_merged.bin” is in your current directoyr:

python -m esptool --chip esp32s3 --port=<port No> --baud 460800 --before default_reset --after hard_reset write_flash -z --flash_mode dio --flash_freq 80m --flash_size 16MB 0x00 .\StandbyAttitudeModule_esp32s3_2_5_2_merged.bin

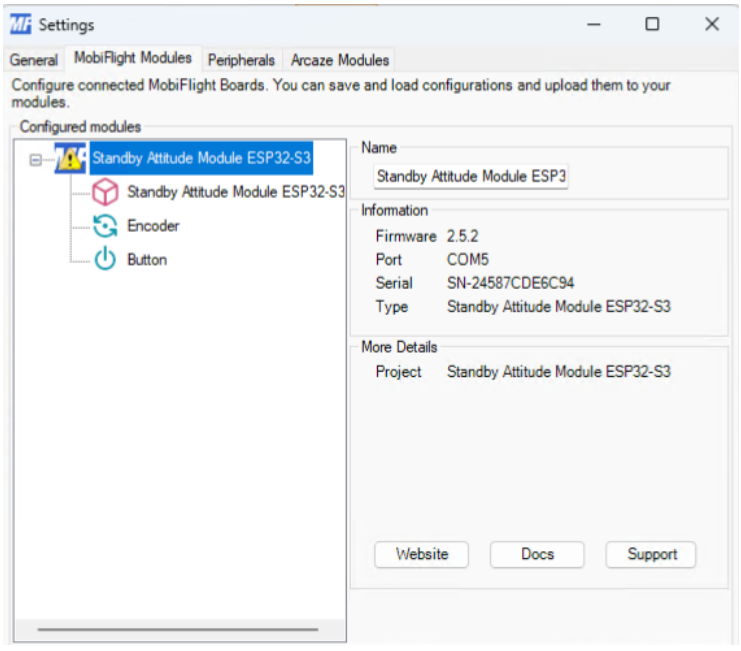
E.g., *python -m esptool --chip esp32s3 --port=COM5 --baud 460800 --before default_reset --after hard_reset write_flash -z --flash_mode dio --flash_freq 80m --flash_size 16MB 0x00 .\StandbyAttitudeModule_esp32s3_2_5_2_merged.bin*

- Once the firmware flashing is completed, reconnect the ESP32 S3 board to your PC using the USB-to-UART port (see below) and restart Mobiflight.

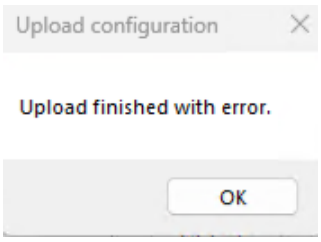


6. Uploading the Mobiflight profiles

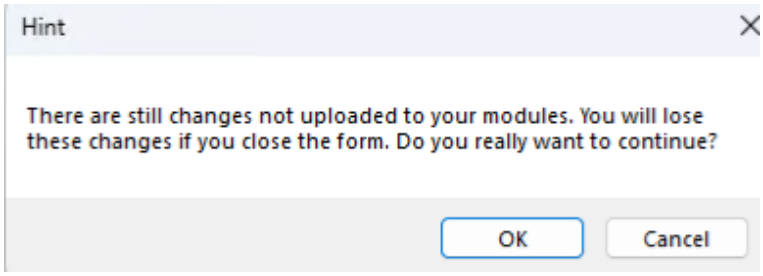
- Download the Mobiflight profiles and save them to your local PC. The profiles can be downloaded from: https://github.com/savesabanal01/Mobiflight-StandbyAttitudeModule-ESP32-S3/tree/StandbyAttitudeModule-release/profiles
  The files are Standby Attitude Module ESP32-S3.mfmc and Standby Attitude Module XPlane.mcc
- Start Mobiflight, open “Mobiflight Modules” and upload the Standby Attitude Module ESP32-S3.mfmc file to the “Standby Attitude Module ESP32-S3” device (see below):



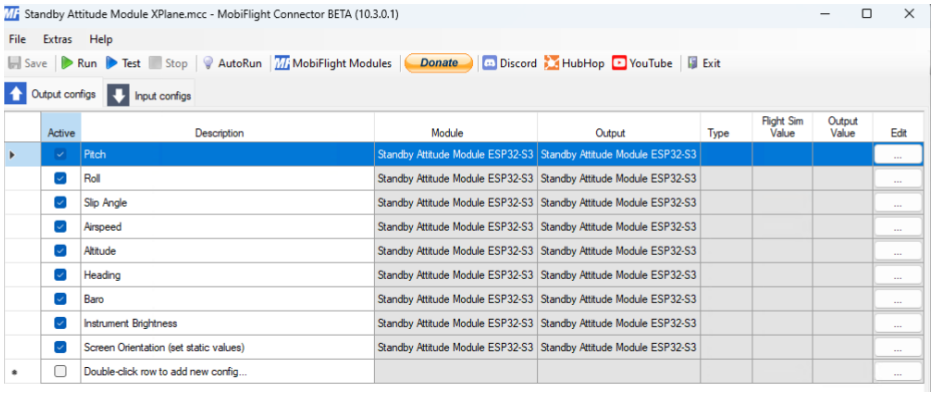
- Now, click “Upload config” and wait for it to finish uploading. You will get and “Upload finished with error” pop-up, but this is fine. Just hit “OK”.



- Now close the Mobiflight Settings pop-up and you will get the error pop-out below, but this is also ok. Just hit “OK”.



- From the Mobiflight main screen, go to Files -> Open, and open the downloaded Standby Attitude Module XPlane.mcc file. You should get the settings for X Plane as shown below:

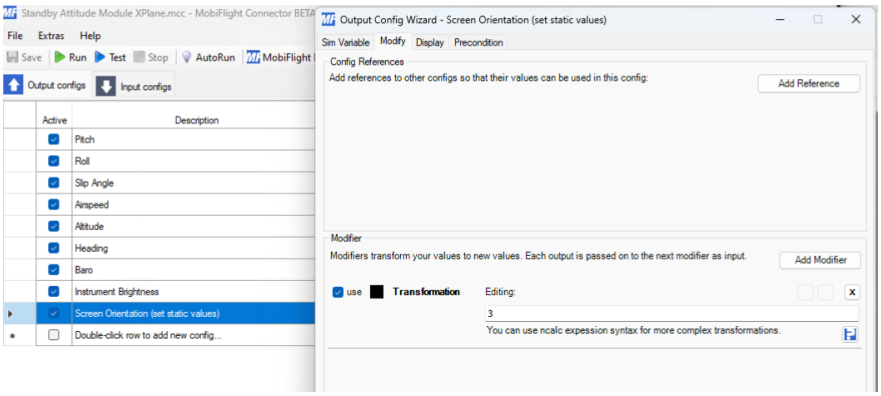


Important Note: *I only have X Plane so I have not prepared configurations for MSFS2020, but the X Plane datarefs can be replaced by MSFS 2020 variables that correspond to them. Please try it!*

- Now, start your flight simulator, start Mobiflight and have fun!!!

7. Important Notes and Future Directions:

- You can use the other open pins in the ESP32 S3 for buttons, encoders, etc. Just make sure not to use pins 19, 20, 35, 36, and 37 (they have some limitations).
- To change the LCD screen orientation, edit the “Screen Orientation (set static values”)” config -> Modify – Transformation, and change the value from “3” to “1”. This will flip the screen (see below)



- These are the following improvements I plan in the future:
  - Implement the airspeed limitations (V-speeds) and the vertical climb trend
  - 8-bit parallel interfacing between the ESP32 S3 and the LCD screen
  - Maybe a fancier number scrolling like in the real MD302 or Garmin G5 device?