MD302 ASI ALT on a 2.4-inch LCD screen and ESP32 S3 Microcontroller (Implemented as a Mobiflight Community Device)

1. Introduction:

This is an Airspeed Indicator (ASI) and Altimeter (ALT) inspired by the MD302 for use in Flight Simulation displayed on a 3.5-inch LCD screen implemented as a Mobiflight community device for easy integration with flight simulators such as MSFS 2020 and X Plane. It uses an ESP32 S3 N16R8 microcontroller to drive the graphics and the firmware:

The motivations for implementing this device:

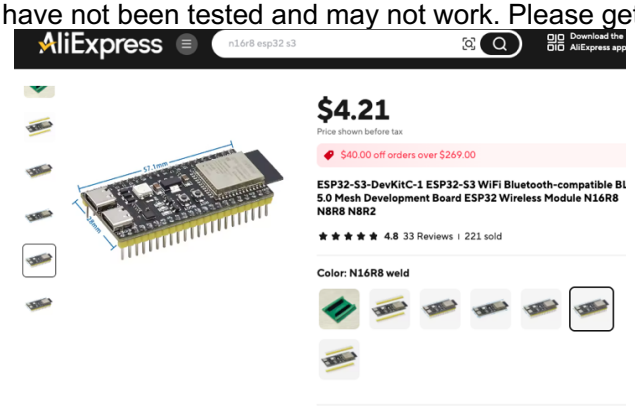
- Low cost and easy to build while providing an awesome flight simulator experience
- Minimal mechanical components (quiet operation)
- Minimal components and skills required (just wiring and uploading of firmware, and maybe 3D printing design if you want to design your own case/panel).
- Can be placed anywhere in the panel without the constraints of a large monitor
- Most of all, to have fun, and… Mobiflight rocks!!

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



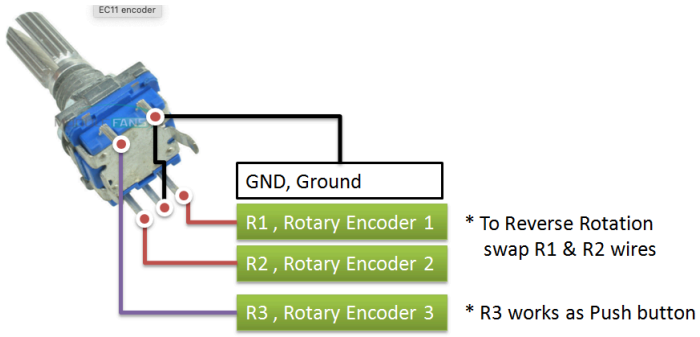
  For example, you can order the ESP32 S3 N16R8 variant from the following:
  - https://tinyurl.com/at2ubb9a
  - https://tinyurl.com/46rwnp9p

- **2.4-inch LCD screen with the ILI9341 driver (touch functionality is not required)**
  Note: Other LCD screens with a different driver will not work!
  For example, you can order the LCD screens from the following:
  - https://tinyurl.com/24vbnup4
  - https://tinyurl.com/4hhfuwtz
- **Other hardware**
  - Wires, USB connectors, etc.
  - EC311 Rotary Encoder (for adjusting the Baro value)

- **ESP32 S3 and LCD Screen (ILI9341) PIN connections**
  Connect the 2.4-inch LCD display pins to the corresponding ESP32 S3 GPIO pins according to the table below:

ESP32 S3 GPIO Pin	2.4-in LCD (ILI9341) 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	R3, Rotary Encoder 3 (pushbutton)

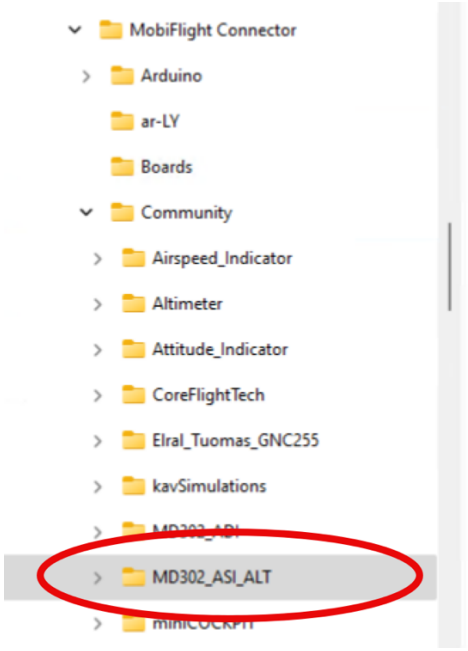
3. Software:

- **Mobiflight**
  - https://www.mobiflight.com/en/index.html

- **Mobiflight MD302 ASI ALT custom firmware**
  - See the instructions below for downloading and installing the custom firmware

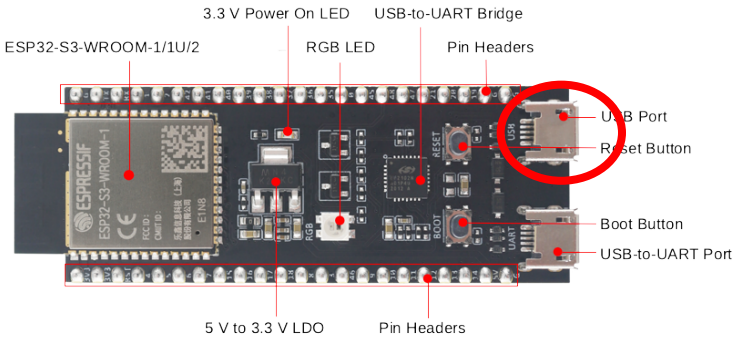
4. Downloading the Mobiflight MD302 ASI ALT custom firmware:

- Download the Mobiflight MD302 ASI ALT custom firmware from the link below: https://github.com/savesabanal01/Mobiflight-MD302-ASI-ALT-ESP32-S3/tree/MD302_ASI_ALT
  Go to the folder “firmware” and download MD302_ASI_ALT_2.5.2.zip
- Open your Windows Explorer, using Win+E
- In the file path window, paste %LocalAppData%\MobiFlight\MobiFlight Connector\Community
- Extract the MD302_ASI_ALT_2.5.2.zip to this folder. The file structure should look like the one below (make sure that the “MD302_ASI_ALT” folder is directly under “Community”):

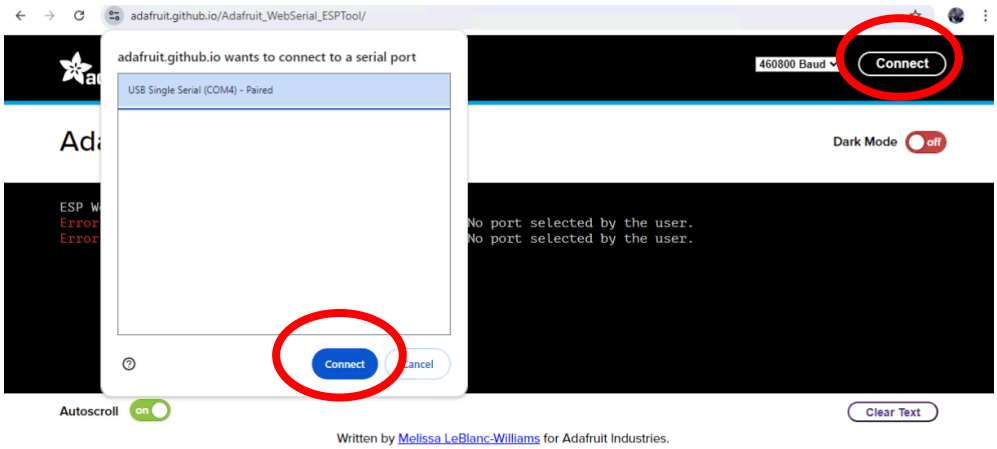


5. Flashing the Mobiflight MD302 ASI ALT custom firmware to the ESP32 S3:

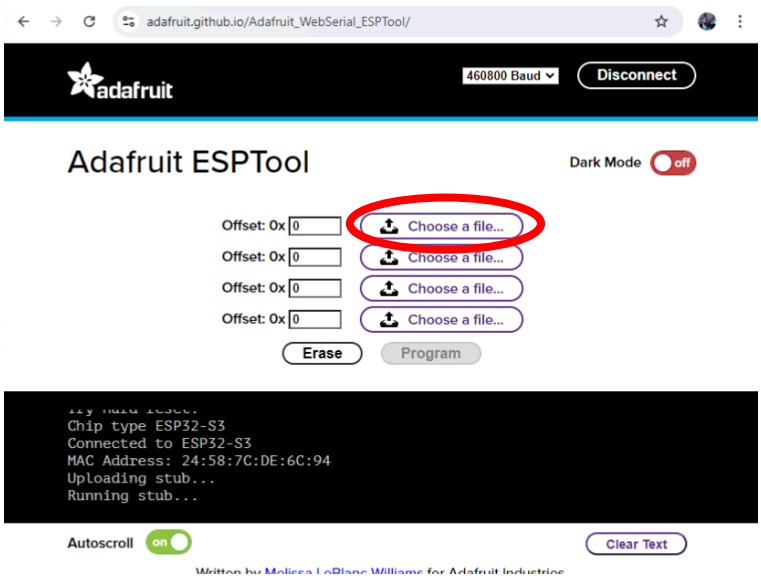
- *Important Note! Please make sure that Mobiflight is shut down.*
- The easy (and slow) method:
  Connect the ESP32 S3 to your PC using the USB port in (highlighted in red) in the picture below:



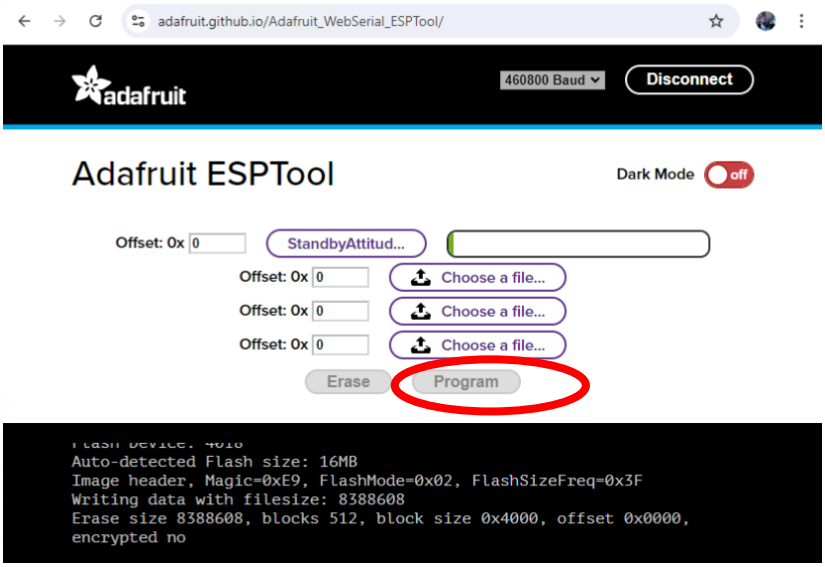
- Open the following URL: https://adafruit.github.io/Adafruit_WebSerial_ESPTool/
- When the webpage is opened, click on the “Connect” button on the upper right-hand side. In the pop-up, check that the correct port (e.g., COM5) is chosen.



- 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 “MD302_ASI_ALT_esp32s3_2_5_2_merged.bin” file, which is in the “MD302_ASI_ALT” -> “firmware" folder that you extracted previously.
  Hint: *It is under: C:\Users\<username>\AppData\Local\MobiFlight\MobiFlight Connector\Community\MD302_ASI_ALT\firmware*
- Click on “Program” and wait for the firmware flashing to complete



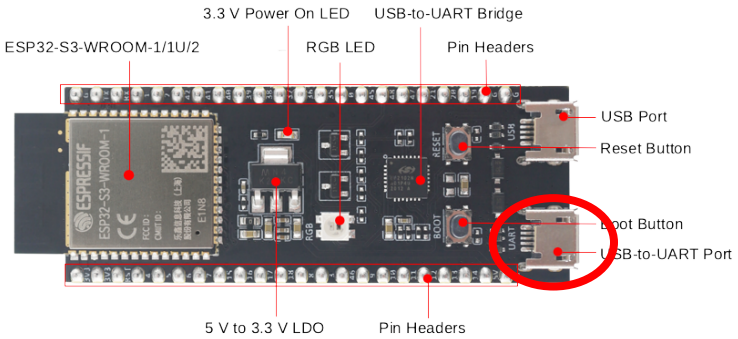
- **For advanced users,** the faster method is to use the esptool.py tool. You need to install Python and the esptool.py tool. Please see this link for details: https://github.com/espressif/esptool
  The syntax to use the esptool.py to flash the firmware is:

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 <directory where firmware is stored>\MD302_ASI_ALT_esp32s3_2_5_2_merged.bin

E.g., if the "MD302_ASI_ALT_esp32s3_2_5_2_merged.bin" file is in your current folder:

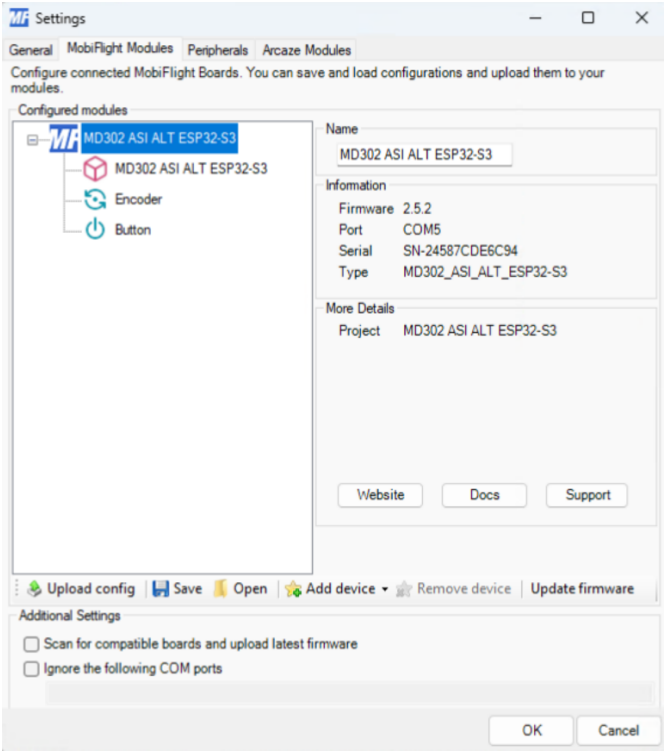
python -m esptool --chip esp32s3 --port=COM5 --baud 460800 --before default_reset --after hard_reset write_flash -z --flash_mode dio --flash_freq 80m --flash_size 16MB 0x00 .\MD302_ASI_ALT_esp32s3_2_5_2_merged.bin

- **Important!** Once the firmware flashing is completed, reconnect the ESP32 S3 board to your PC using the USB-to-UART port (encircled in red below) and restart Mobiflight.

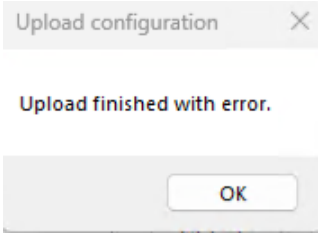


6. Uploading the Mobiflight profiles

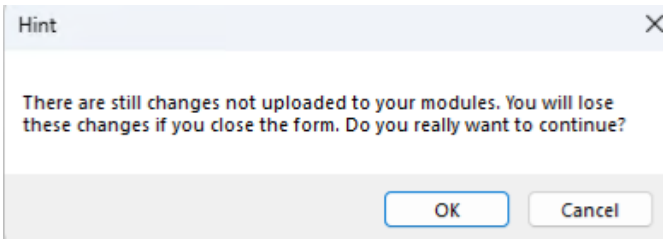
- Download the Mobiflight profiles and save them to your local PC. The profiles can be downloaded from: https://github.com/savesabanal01/Mobiflight-MD302-ASI-ALT-ESP32-S3/tree/MD302_ASI_ALT/profiles
- The files are MD302 ASI ALT ESP32-S3.mfmc and MD302_ASI_ALT_XPlane.mcc
- Start Mobiflight, open “Mobiflight Modules”, click “Open” and MD302 ASI ALT ESP32-S3.mfmc file to the “MD302 ASI ALT ESP32-S3” device (see below):



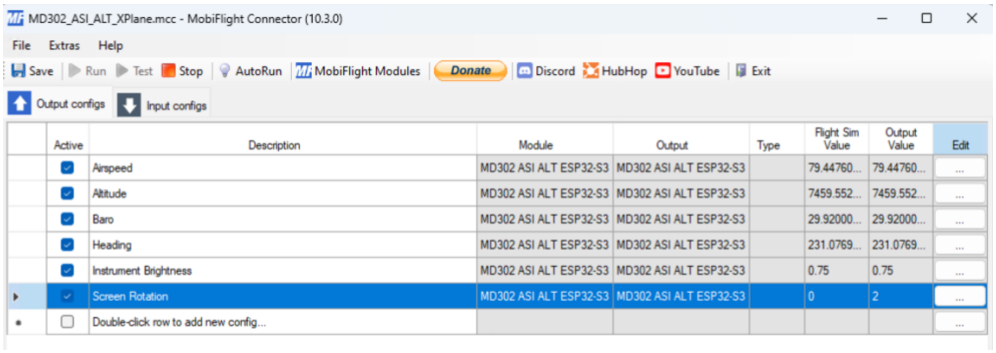
- Now, click “Upload config” and wait for it to finish uploading. You will get an “Upload finished with error” pop-up, but this is fine. Just hit “OK”.



- 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 MD302_ASI_ALT_XPlane.mcc. 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:

- The EC11 Rotary Encoder will change the Baro settings up or down
- The EC11 pushbutton will set the Baro to the default 29.29 inHg.
- 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” output config, go to Modify –>Transformation, and change the value from “2” to “0”. This will flip the screen (see below)