INAV Setup for X Tailed NEPTUNE

Control architecture for the X Tailed Neptune.

My reasons for using a frsky R9mm ota 900 mHz receiver paired to a SpeedyBee F405 flight controller using INAV:

My objective is to optimize the receiver antenna location in order to maximize reception.

I am not qualified to go down the “antenna theory” rabbit hole, so suffice it to say: don’t mess with the antenna and mount it vertically with a minimum of surrounding obstructions.

First, the frsky R9mm ota.

1. Long Range: according to Frsky, it has an operating range of 10 km.
2. Compact form factor: 10 x 16 mm
3. 16 channels available via F. Port.

The SpeedyBee F405 Wing APP

1. Low cost, great value
2. 12 pwm outputs
3. Stability control
4. Telemetry

INAV:

Admittedly, using a flight controller is overkill. However, its value is in allowing optimal locations for the receiver antenna and stability hardware (accelerometers and gyros). I also prefer a computer user interface to that of a Transmitter for setup.

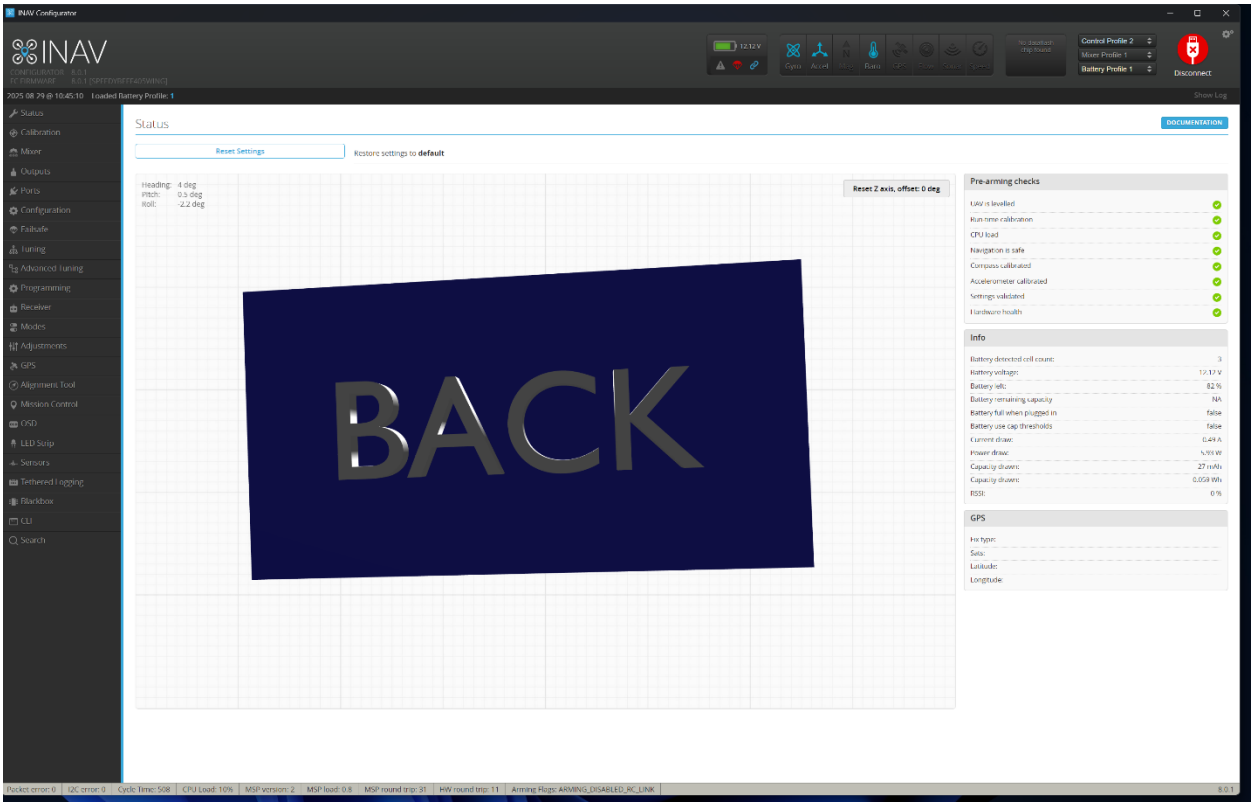
Also, having all those channels allows for customization by using INAV programming and transmitter switches. One example is three bow plane operation modes: independent, synchronized and opposed to the x tail. The left slider on the Frsky Tx operates the bow planes independently. Switch SA low works the bow plane and x tail in tandem. This would raise or lower the boat with minimum pitching. Switch SA high operates the bow planes opposed to the x tail. This would provide maximum pitch control.

More details on “how to”…

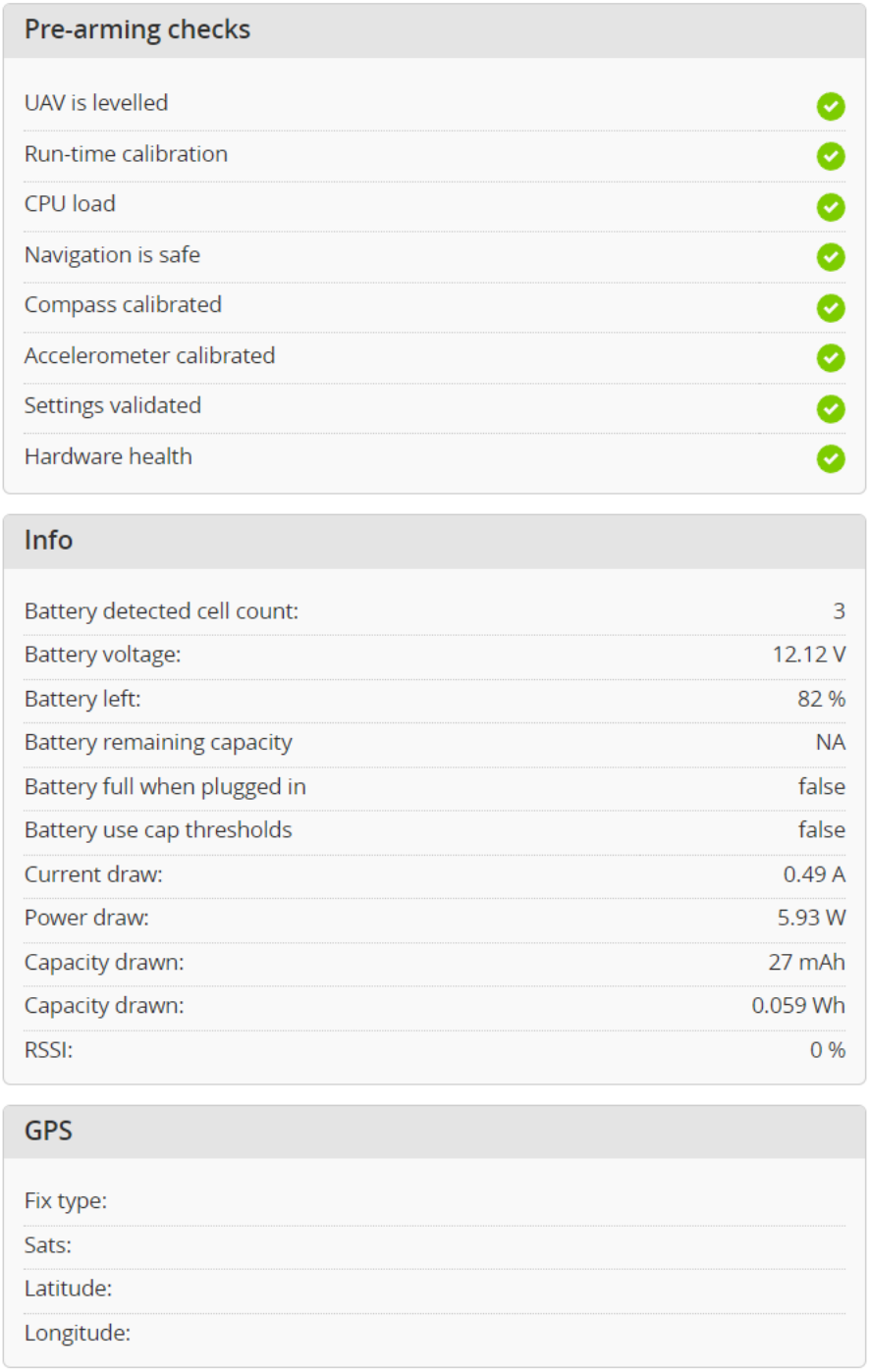
- Update Frsky Tx and Rx to Ethos 1.6.3
- Install INAV 8.0 on WINDOWS OS.
- Install SpeedyBee Driver on WINDOWS OS using ZADIG.
- R9MM: solder wire leads to V_in, GND & Inverted S.Port.
- SpeedyBee: Rx power and ground go to respective SBUS pins. The Rx ‘Inverted S.Port” connects to a Tx pad on any free UART. I used “Tx5” on UART5.
- Follow the SpeedyBee manual to connect ESC and servos. Make sure to NOT connect the ESC power wire.
- The Rx must be paired to the Tx while connected to the SpeedyBee. Otherwise, Fport won’t work.
- INAV values to follow (probably a word doc)

- Useful references: GitHub, You Tube channels: Painless360, Joshua Bardwell, FPV University, FrSky Rc and Mr.D – Falling with style.

INAV Setting:

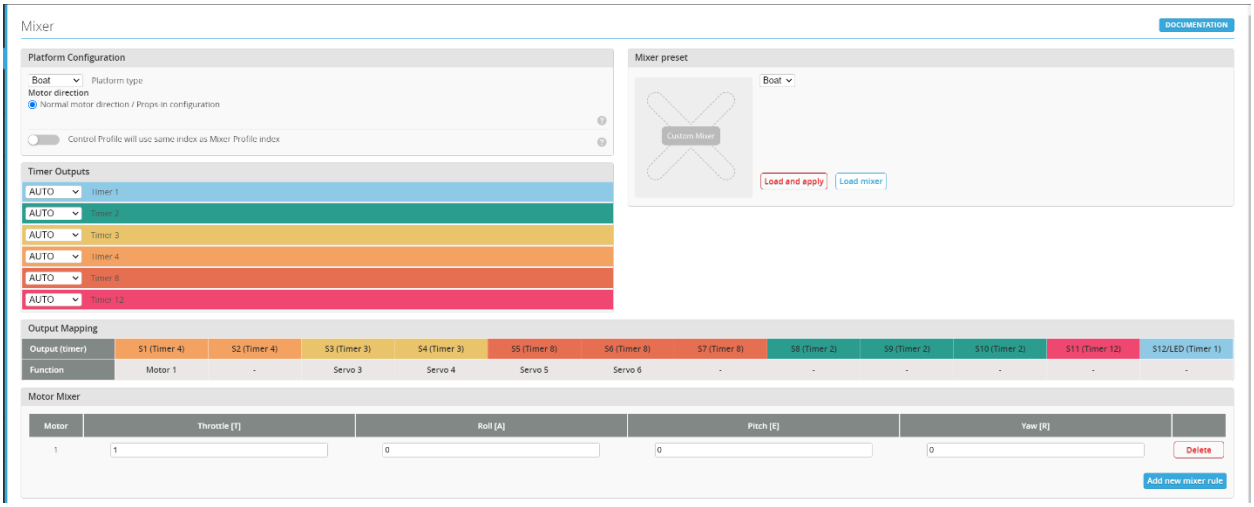


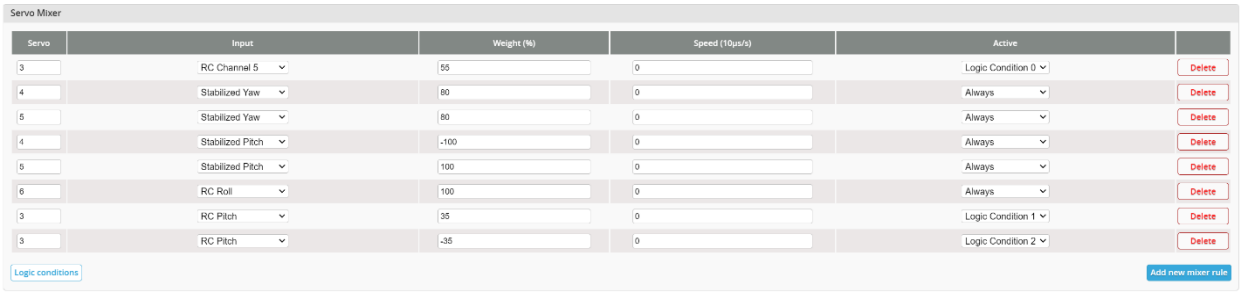
This is the “Settings” Page. The BACK picture represents the orientation of the flight controller. I changed the orientation in the “Adjustments” view to match the physical orientation in the boat.



Here you see that all pre-arming checks are green meaning that the FC can be armed.

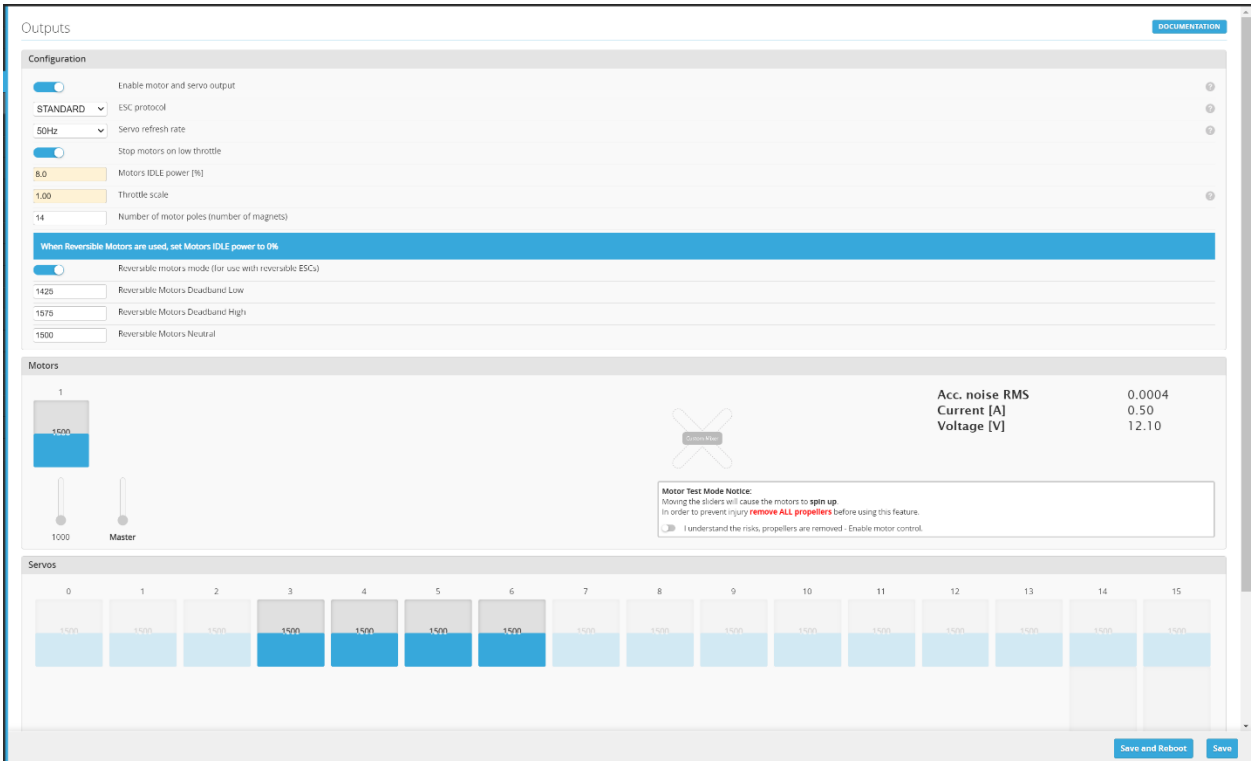
MIXER PAGE:





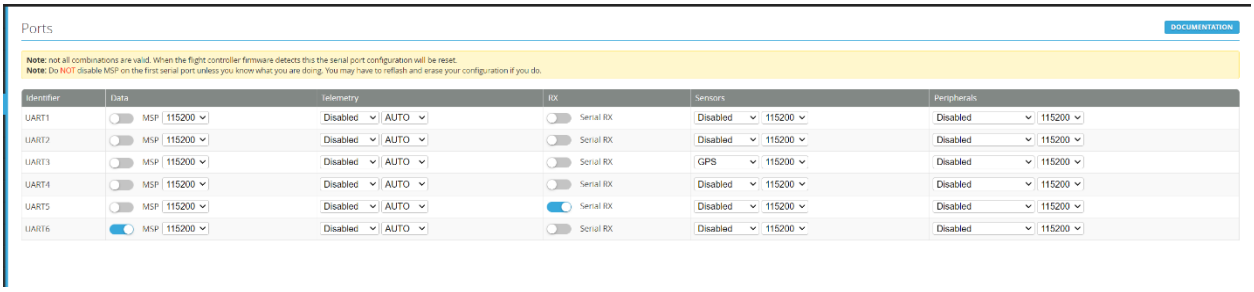
Servos 4 & 5 are used to control the “X” tail. They are used for both PITCH and YAW and are stabilized. The weighted values were derived empirically. Servo 3 is matched to “RC Channel 5” conditionally set by Logic condition 0 (defined in Programming). Servo 3 is also matched to “RC Pitch” in order to work with the X Tail Pitch movements. Servo 6 controls the Ballast Pump.

OUTPUTS PAGE:



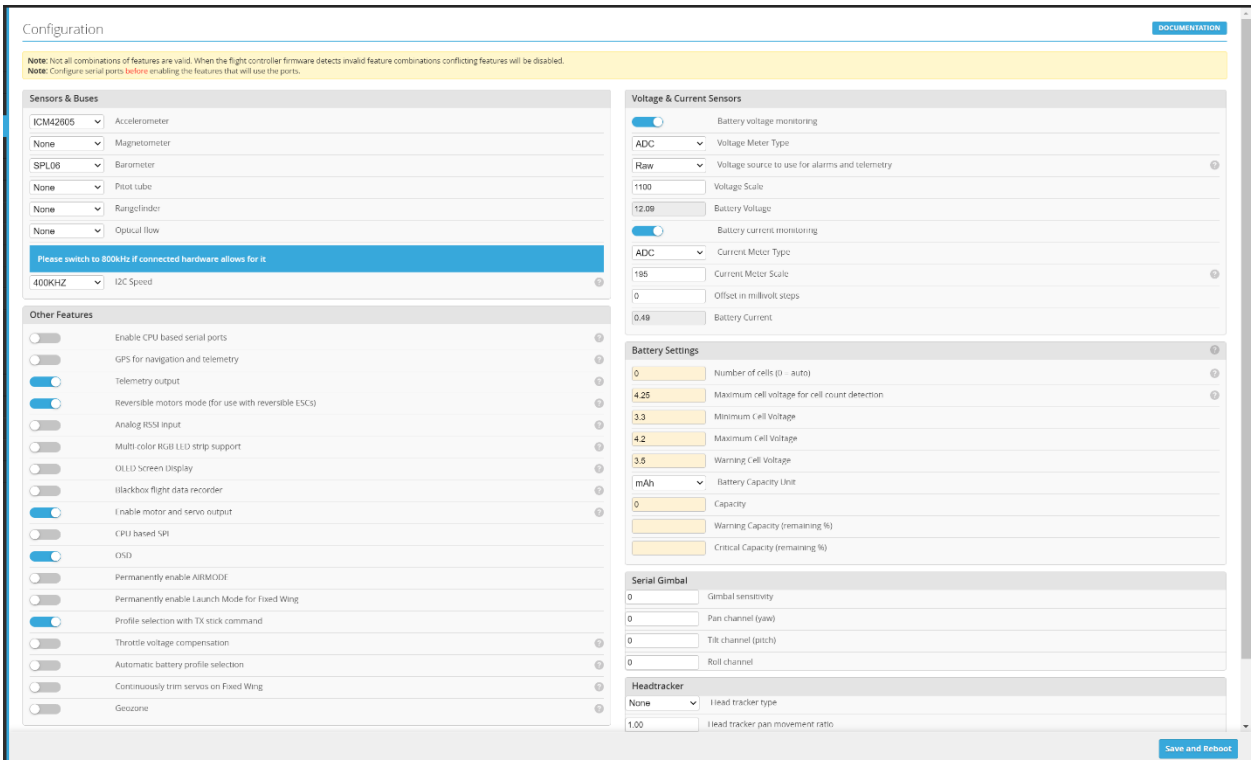
Here are the motor configuration values for the brushed ESC. I won't go into set up detail here, but there are You Tube Video tutorials (see references on page 2) for ESC testing. Servo 6 controls the Peristaltic pump.

PORTS PAGE:



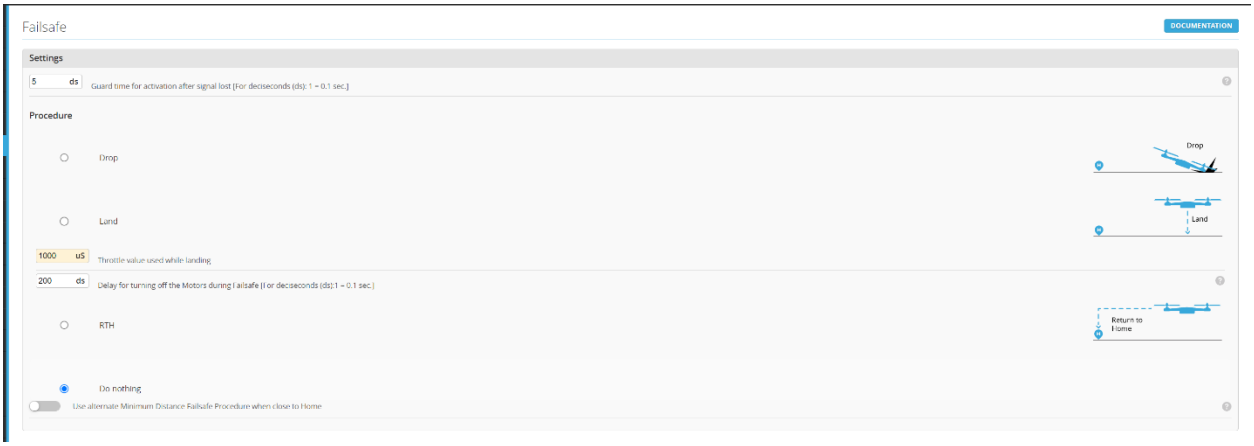
This is where you program the FrSky inverted S.Bus connection to the SpeedyBee UART. As mentioned in the beginning, you must connect the inverted S.Bus output of the Rx to an unused UART Tx pad. I used UART 5 so Serial Rx is turned on at UART 5.

CONFIGURATION PAGE:



To keep it simple, just match the switch settings displayed here. Battery Setup is self-explanatory.

FAILSAFE PAGE:

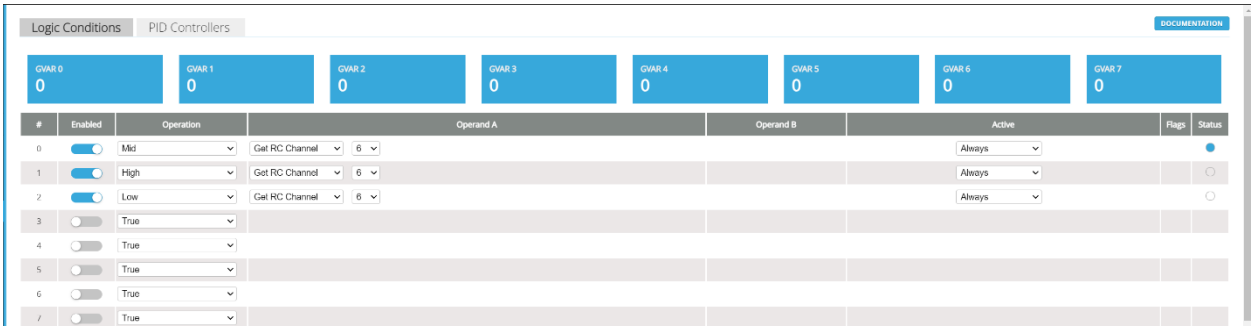


I had to peel back the onion here. I don't use the INAV FAILSAFE feature. I set the Failsafe in the FrSky Tx to no output. That way the native Neptune board acts as the failsafe.

TUNING PAGE (PID):

Here are the preliminary PID values set on the bench. Fine tuning will occur when the boat is launched. There is a SpeedyBee Android APP and Bluetooth connection for WIFi interface but I have yet to play with it.

PROGRAMMING PAGE:



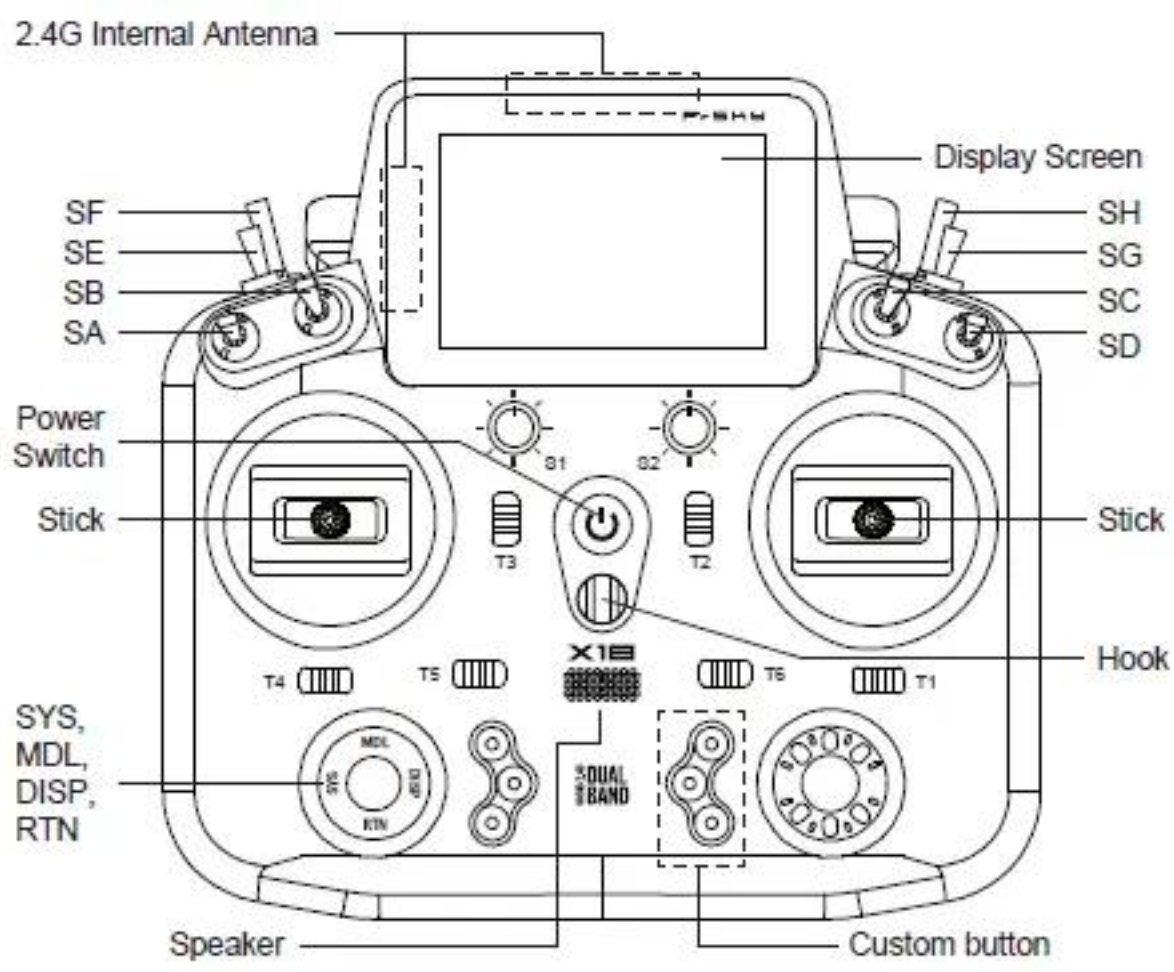
This is the set up for Dive Plane Mode. **Note:** Nomenclature is everything. Things can get confusing.

Servo numbers are the domain of INAV and channel numbers are the domain of the Tx.

For example: the INAV Servo 6 is matched to channel 1 in the Tx which is used for Ballast control. INAV names the Tx channel 1, “RC Roll”.

So RC Channel 6 in INAV is not the Ballast control. Channel 6 in the Tx is matched to switch SA.

Here is a layout of the Tx:



SD HIGH (down) = ARM FLIGHT CONTROLLER

SA MID = ENABLE LEFT SLIDER [INDEPENDENT BOW PLANE]

SA LOW = SYNCED BOW AND STERN PLANES

SA HIGH = OPPOSED BOW AND STERN PLANES

SE LOW = EMPTY BALLAST BLADDER

SE HIGH = FILL BALLAST BLADDER

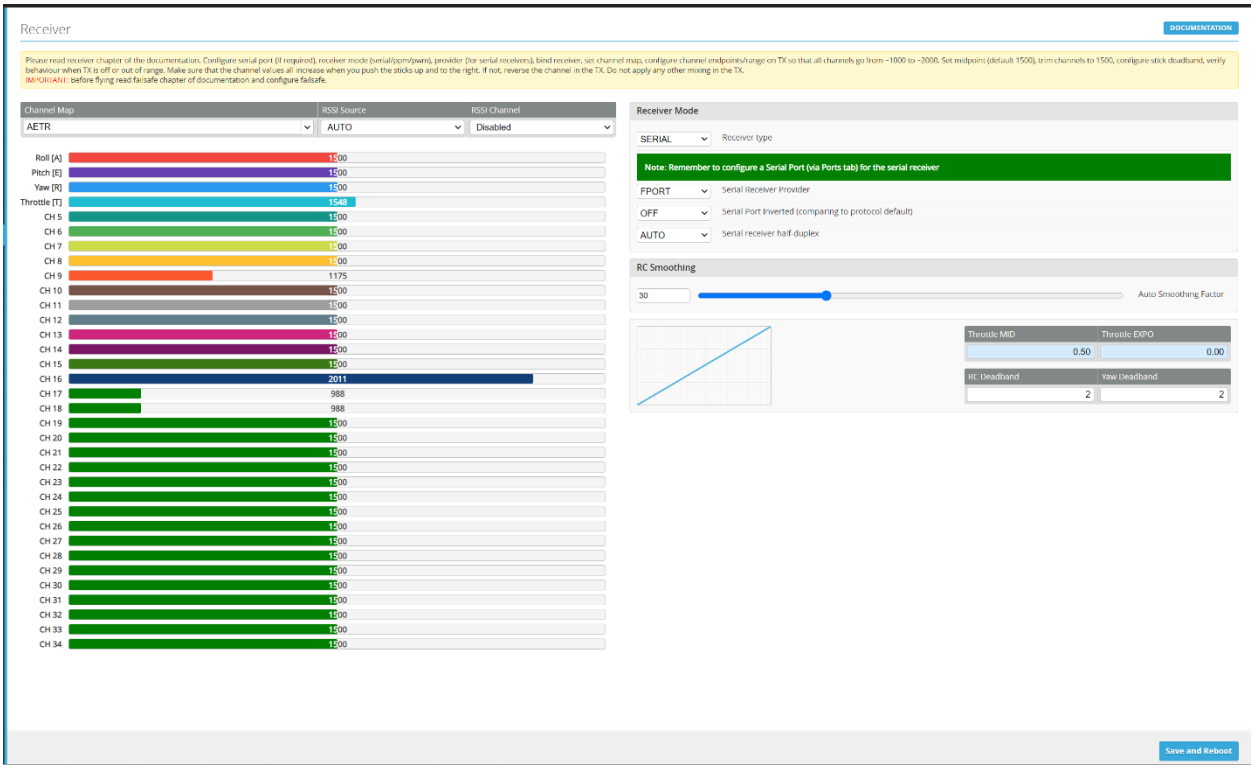
VERTICAL RIGHT STICK = PITCH

HORIZONTAL RIGHT STICK = YAW

VERTICAL LEFT STICK = THROTTLE

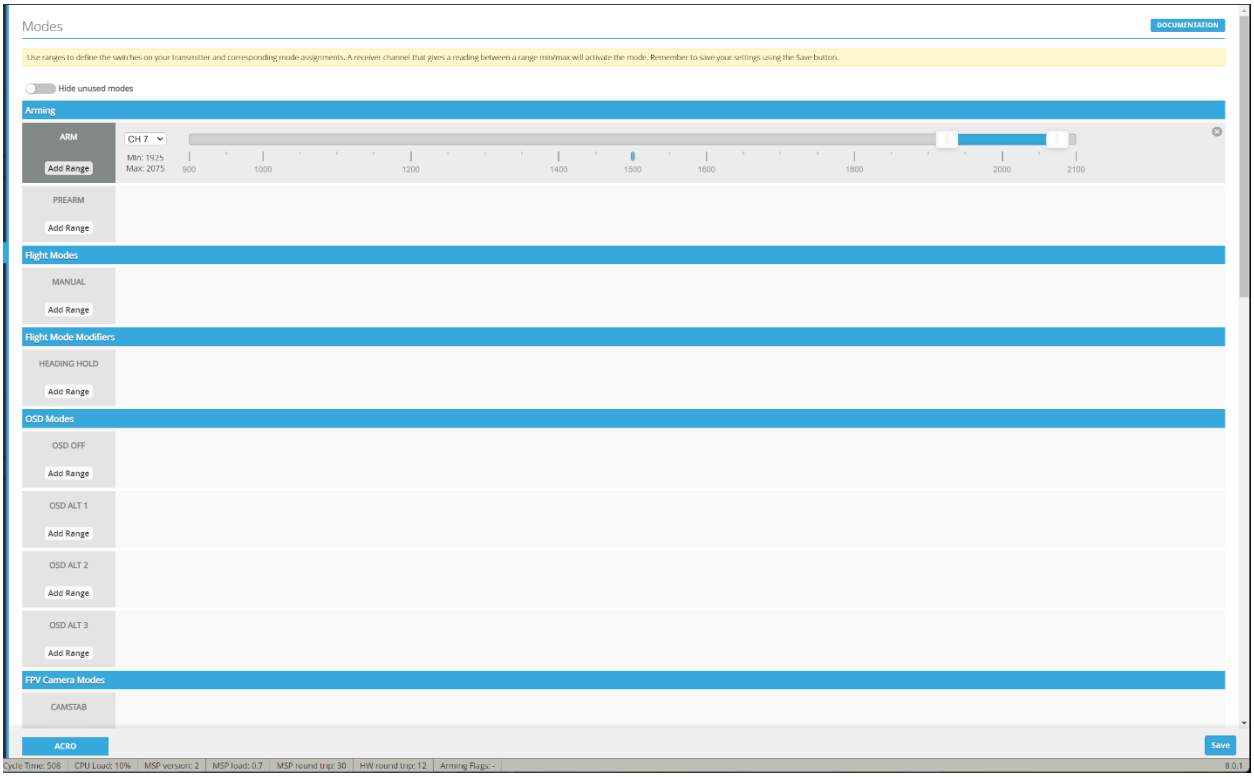
HORIZONTAL LEFT STICK = N/A

RECEIVER PAGE:



This page graphically displays the output values of the Tx. This is very useful for setup and debugging.

MODES PAGE:



This page sets the Arming switch. This is a Quadcopter and airplane safety feature. I couldn't figure out a work around. The problems with arming were caused by a glitchy Tx switch. I now have a bit more confidence in this feature.

I will cover the Tx set up in a future document. Is isn't complicated, all the work is performed by the Flight Controller. Just remember to have the Rx actively connected to the SpeedyBee before binding the Rx to the Tx. This is the only way F.Port will work.