Quick Build Guide

Synerduino STM

VERSIONS: F405, F411, H743

For more Information:
www.synerflight.com

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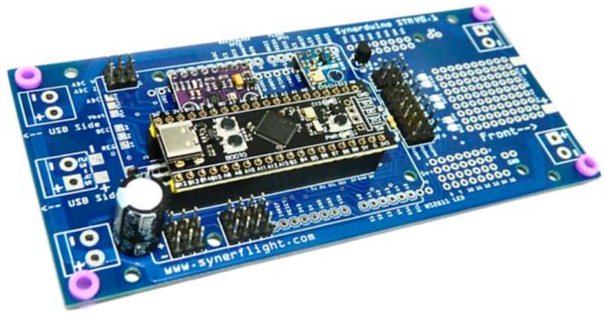
STM VERSIONS THROUGHOUT THE YEARS

F411



SYNERDUINO
STM F411

1

F405

SYNERDUINO
STM F405

2

H743

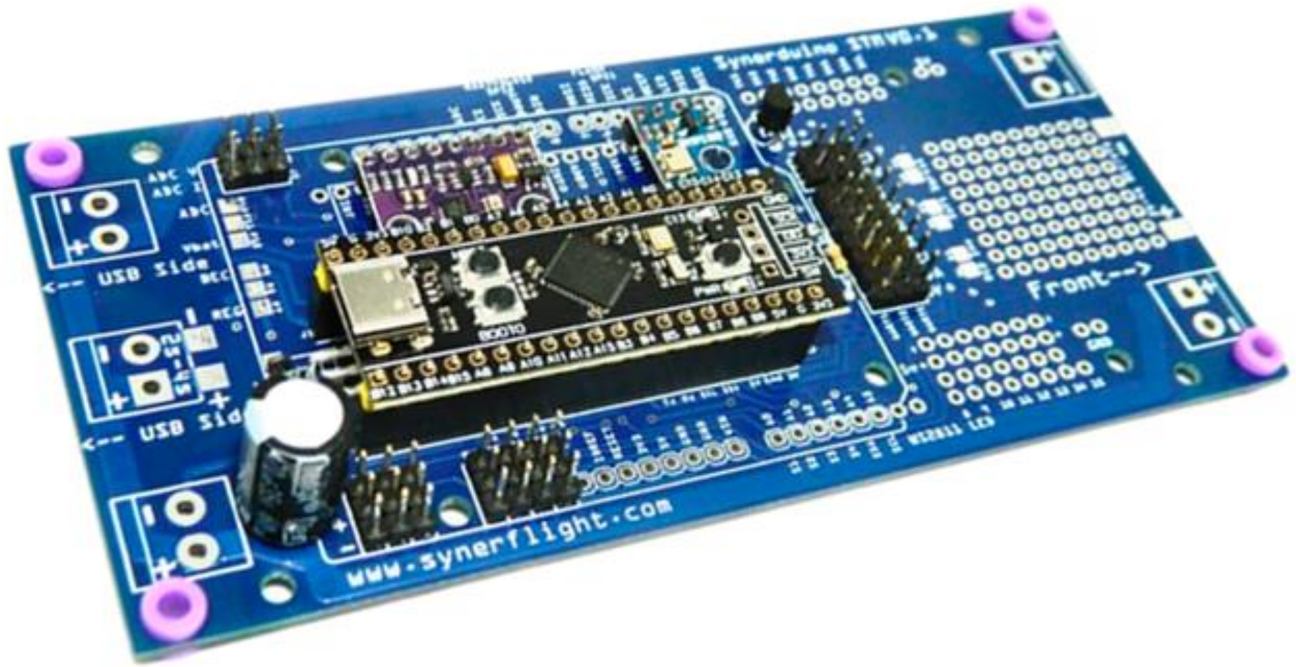
SYNERDUINO
STM H743

3

INTRODUCTION

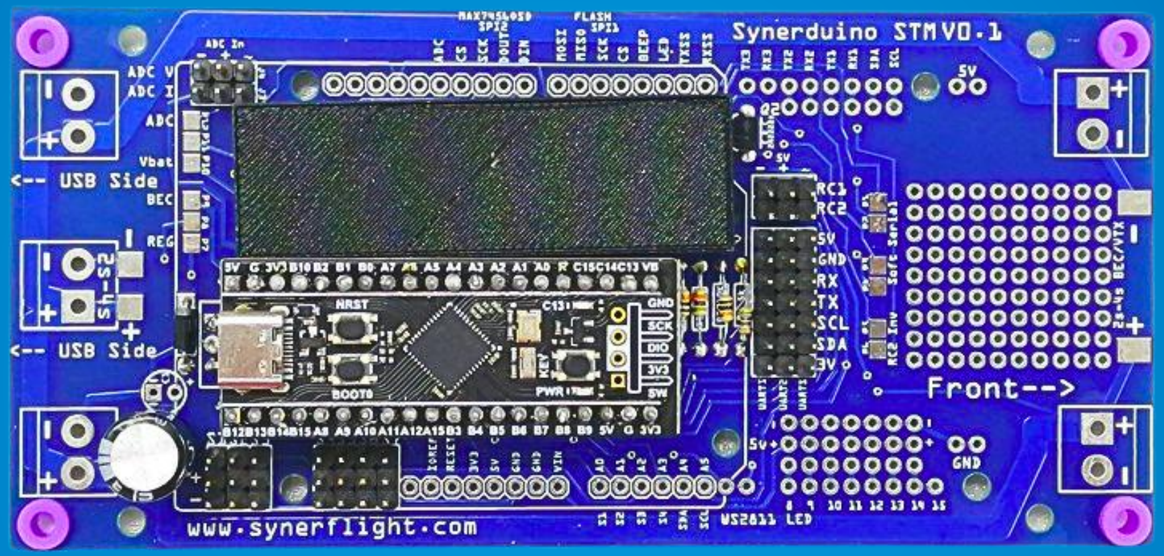
The Synerduino STM is a 32-bit version of the Synerduino shield family, designed to enhance the performance of your drone applications, making it an ideal tool for research developers in robotics and drone technology.

More details will be shared as they become available. The Synerduino STM shield is built on an STM32-based platform, offering advanced functionality for your drone projects while maintaining the classic Arduino form factor, ensuring compatibility with existing Arduino prototyping boards.



SYNERDUINO STM F411

ABOUT THE BOARD



Power

- WS2811 LED Power 5V 1.5A
- Serial Power Rail 5V 1.5A
- PWM Power Rail Regulated – 5V 1.5A
- Drone Power Input Voltage – 12.6V (3S) or 16.8V (4S)
- Power Distribution Lines – 12.6V-25.2V 80A

Properties

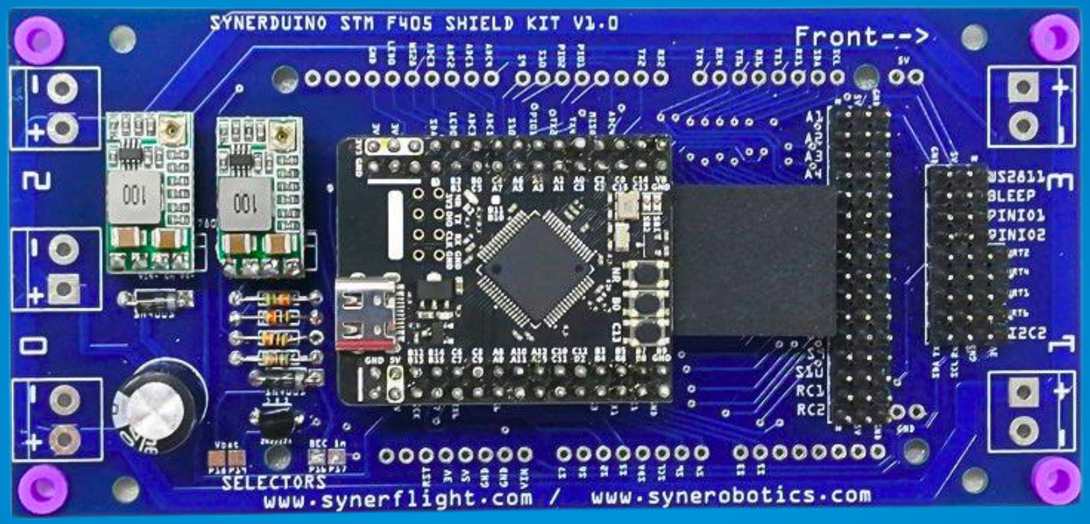
- Dimensions: 128 x 62 x 28 mm LWH / (V1.1)135mm x 62mm x 28mm
- Weight: 46.1g
- Arduino Prototyping Shield Footprint
- 4 Solder Pad set s for 4 ESCs and Motors
- DIY section for component addons
- 7 3-Pin PWM Headers S1-S7
- 2 3-Pin RC Headers w/ Sbus inverter
- 3 7-Pin Serial Headers
- 2 3pin ADC in (Voltage and Current)
- 2 RC Serial input Pin
- WS2811 LED output

Compatibility

- GYRO/ACC: BMI160 (Align CW 0)
- MAG: HMC5883/QMC5883 (Align CW 180)
- BARO: BMP180/280

SYNERDUINO STM F405

ABOUT THE BOARD



Power

- WS2811 LED Power 5V 3A
- Serial Power Rail – 3.3V 3A
- PWM Power Rail Regulated – 5V 3A
- Drone Power Input Voltage – 12.6V (3S) or 25.2V (6S)
- Power Distribution Lines – 12.6V-25.2V 80A

Properties

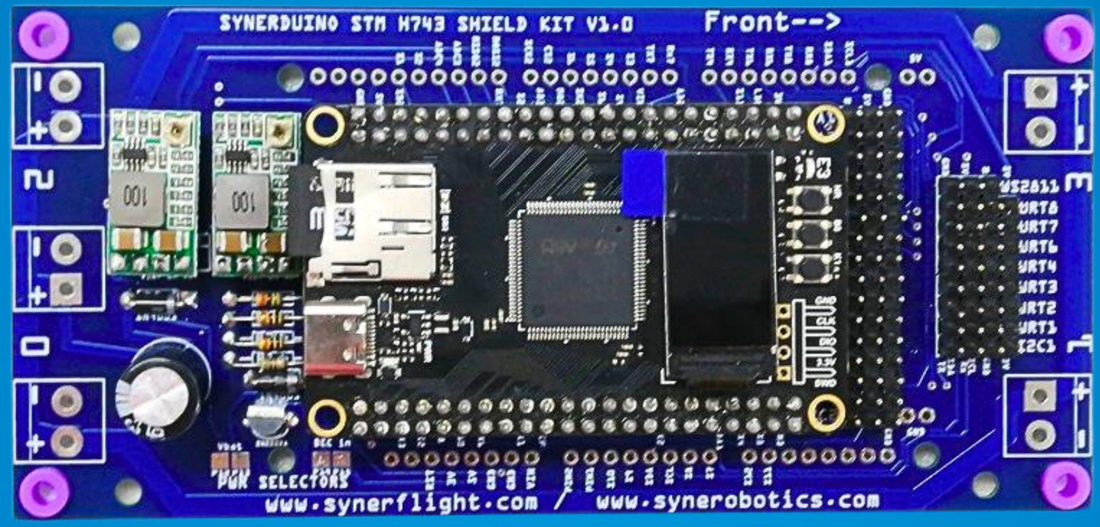
- Dimensions: 128 x 62 x 28 mm LWH / (V1.1)135mm x 62mm x 28mm
- Weight: 46.1g
- Arduino Prototyping Shield Footprint
- 4 Solder Pad set s for 4 ESCs and Motors
- DIY section for component addons
- 10 3-Pin PWM Headers S1-S10
- 2 3-Pin RC Headers w/ Sbus inverter
- 4 4-Pin Serial Headers
- 4 3pin ADC in (Voltage and Current)
- 2 RC Serial input Pin
- 1 WS2811 LED output
- 2 PIN IO (User Action)

Compatibility

- GYRO/ACC: BMI160 (Align CW 0)
- MAG: HMC5883/QMC5883 (Align CW 180)
- BARO: BMP180/280

SYNERDUINO STM H743

ABOUT THE BOARD



Power

- WS2811 LED Power 5V 3A
- Serial Power Rail – 3.3V 3A
- PWM Power Rail Regulated – 5V 3A
- Drone Power Input Voltage – 12.6V (3S) or 25.2V (6S)
- Power Distribution Lines – 12.6V-25.2V 80A
- Note: 8S – 12S Use External UBEC 5V to the main power input and external ESC Power distribution

Properties

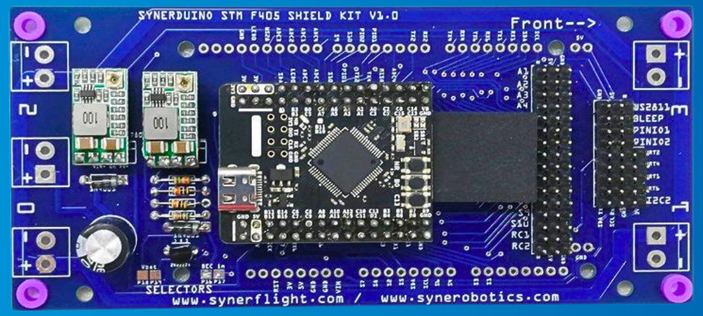
- Dimensions: 128 x 62 x 28 mm LWH / (V1.1)135mm x 62mm x 28mm
- Weight: 46.1g
- Arduino Prototyping Shield Footprint
- 4 Solder Pad set s for 4 ESCs and Motors
- DIY section for component addons
- 10 3-Pin PWM Headers S1-S10
- 2 Aux PWM Headers S11-S12
- 2 3-Pin RC Headers w/ Sbus inverter
- 7 4-Pin Serial Headers
- 4 3pin ADC in (Voltage and Current)
- 2 RC Serial input Pin
- 1 WS2811 LED output
- 2 Pin IO (User Action)

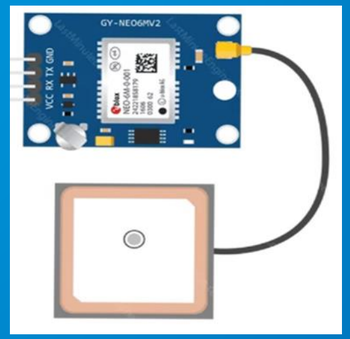
Compatibility

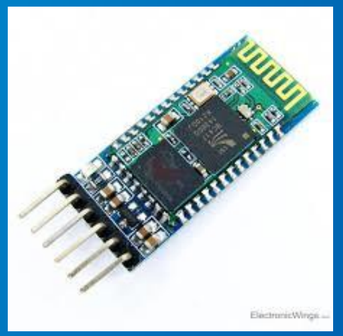
- GYRO/ACC: BMI160 (Align CW 0)
- MAG: HMC5883/QMC5883 (Align CW 180)
- BARO: BMP180/280

SYNERDUINO KIT COMPONENTS

Drone Kit + Synerduino Board







ASSEMBLY

TOOLS AND MATERIALS

PLIERS

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TAPES

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SOLDERING SET

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HEX DRIVER SET

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Mauris quam sapien, aliquam

CUTTER

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ZIP TIES

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TOOLS AND MATERIALS

LI-PO BATTERY

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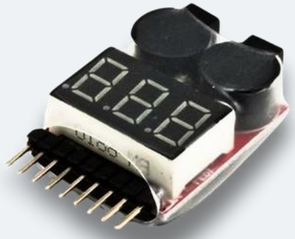

BATTERY ALARM CHECKER

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LI-PO BATTERY CHARGER

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Mauris quam sapien, aliquam

PVC GLUE

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THREAD LOCKER PURPLE

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ASSEMBLING PROCESS

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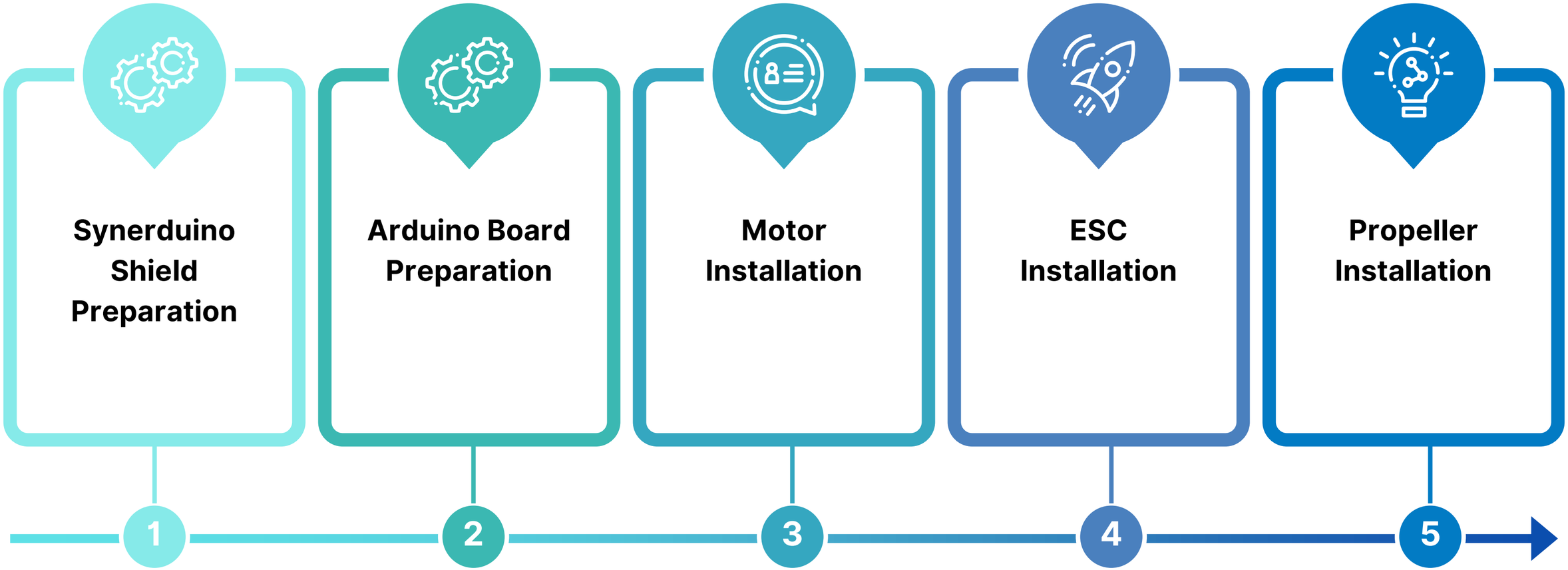
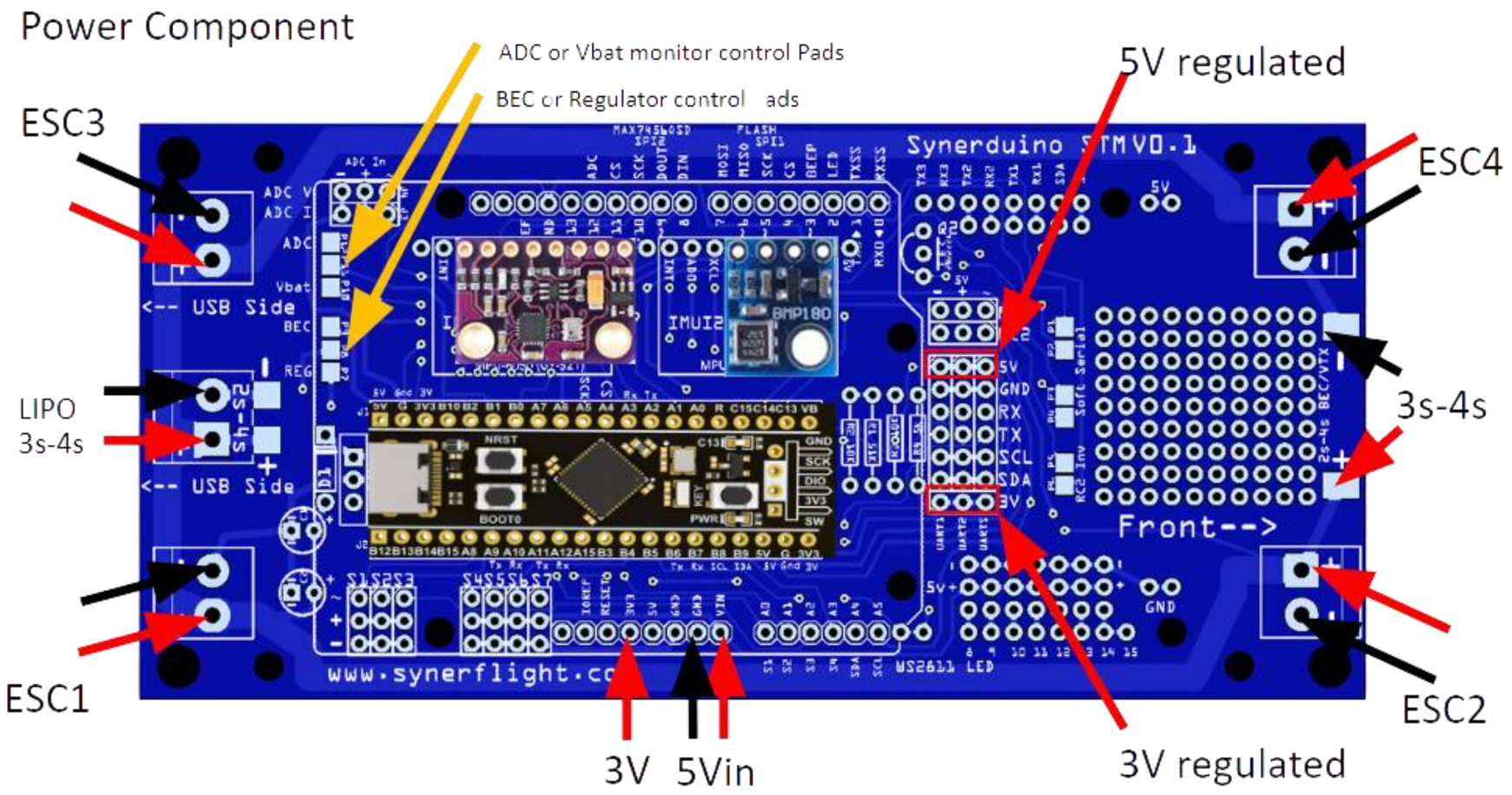
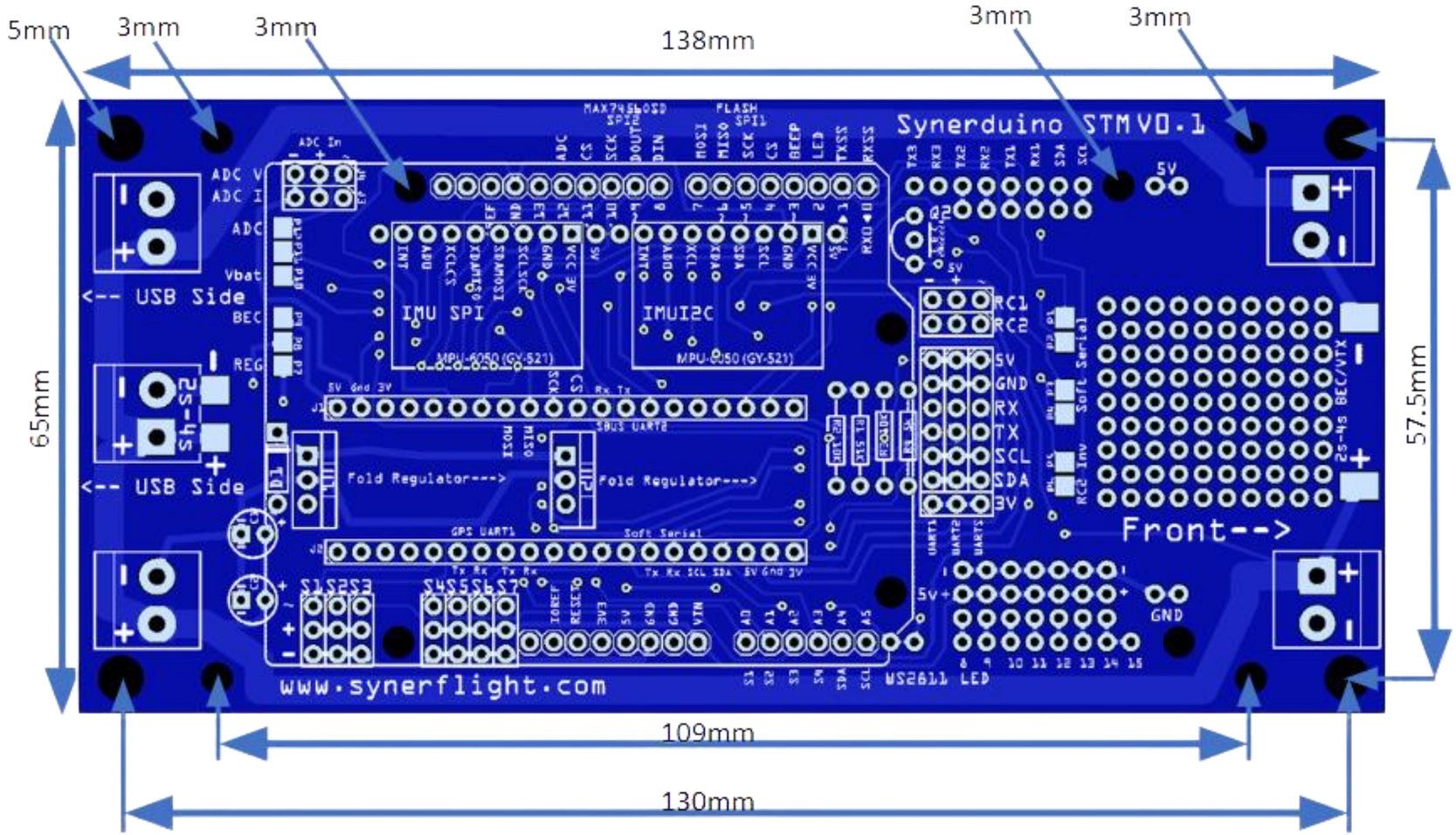


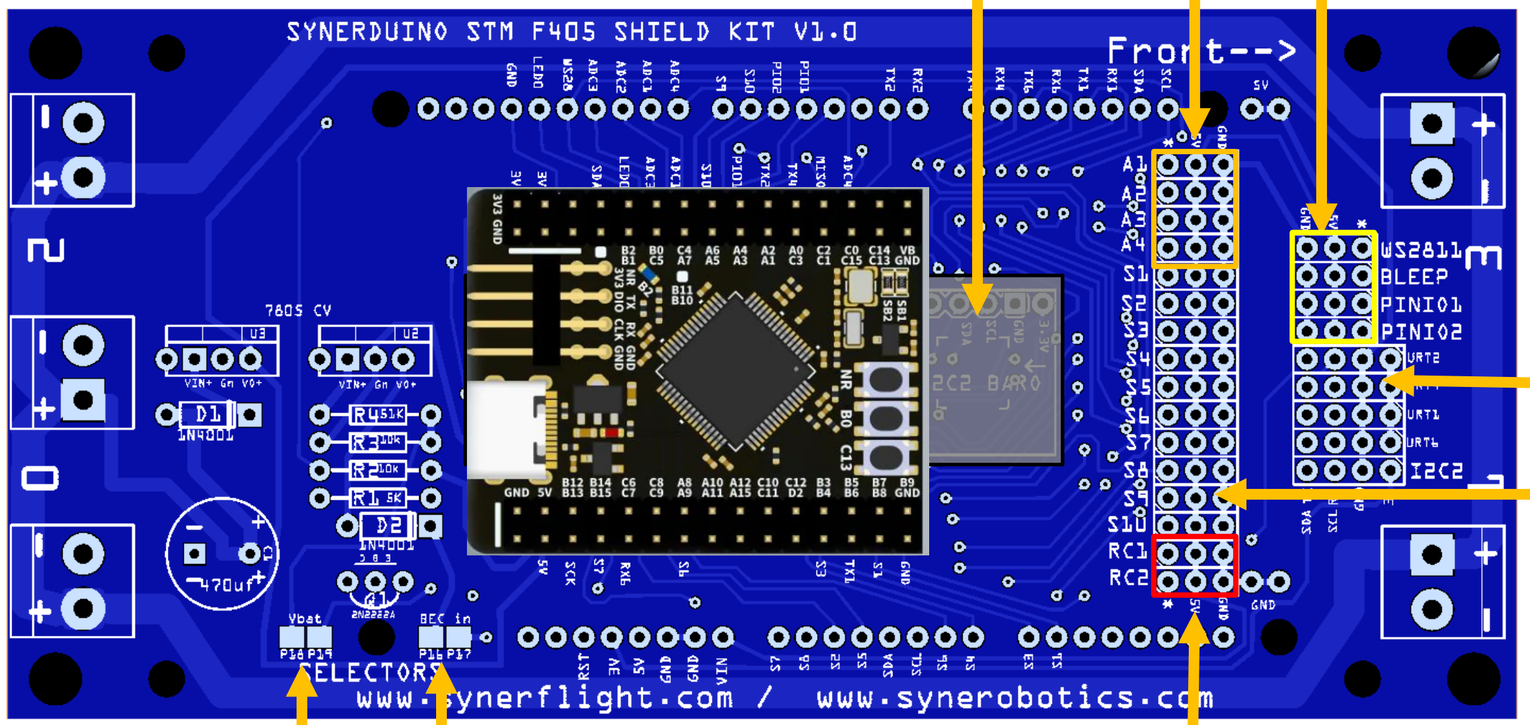
SYNERDUINO STM F411 SHIELD



SYNERDUINO STM F411 SHIELD



SYNERDUINO STM F405 SHIELD



Sensors must be covered with the provided housing glued into place using PVA white glue

ADC input headers

WS2811 & I/O

UART headers

PWM output headers

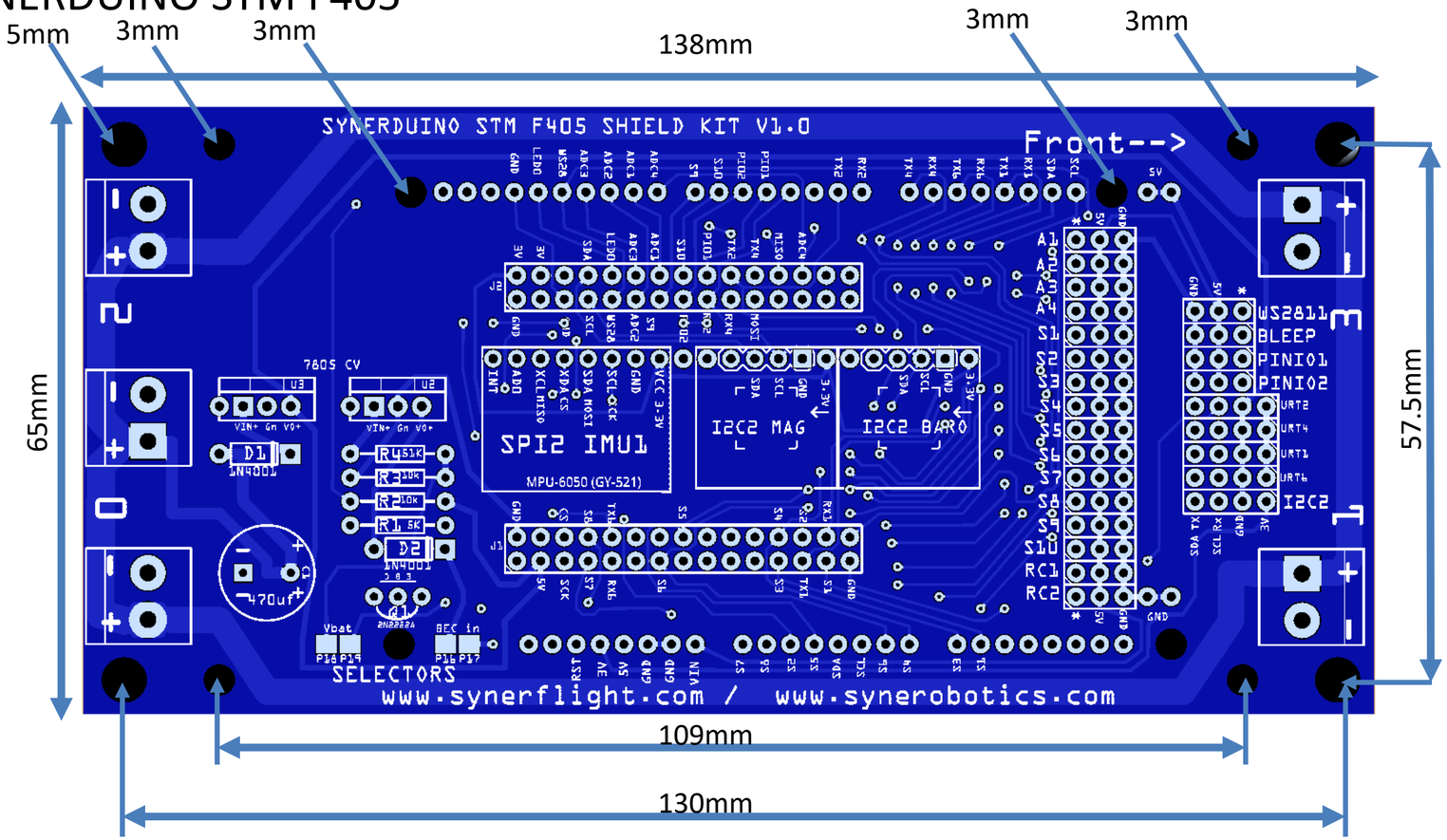
RC1 & RC2

UBEC /Regulator Selection Pads

ADC and Battery Monitoring

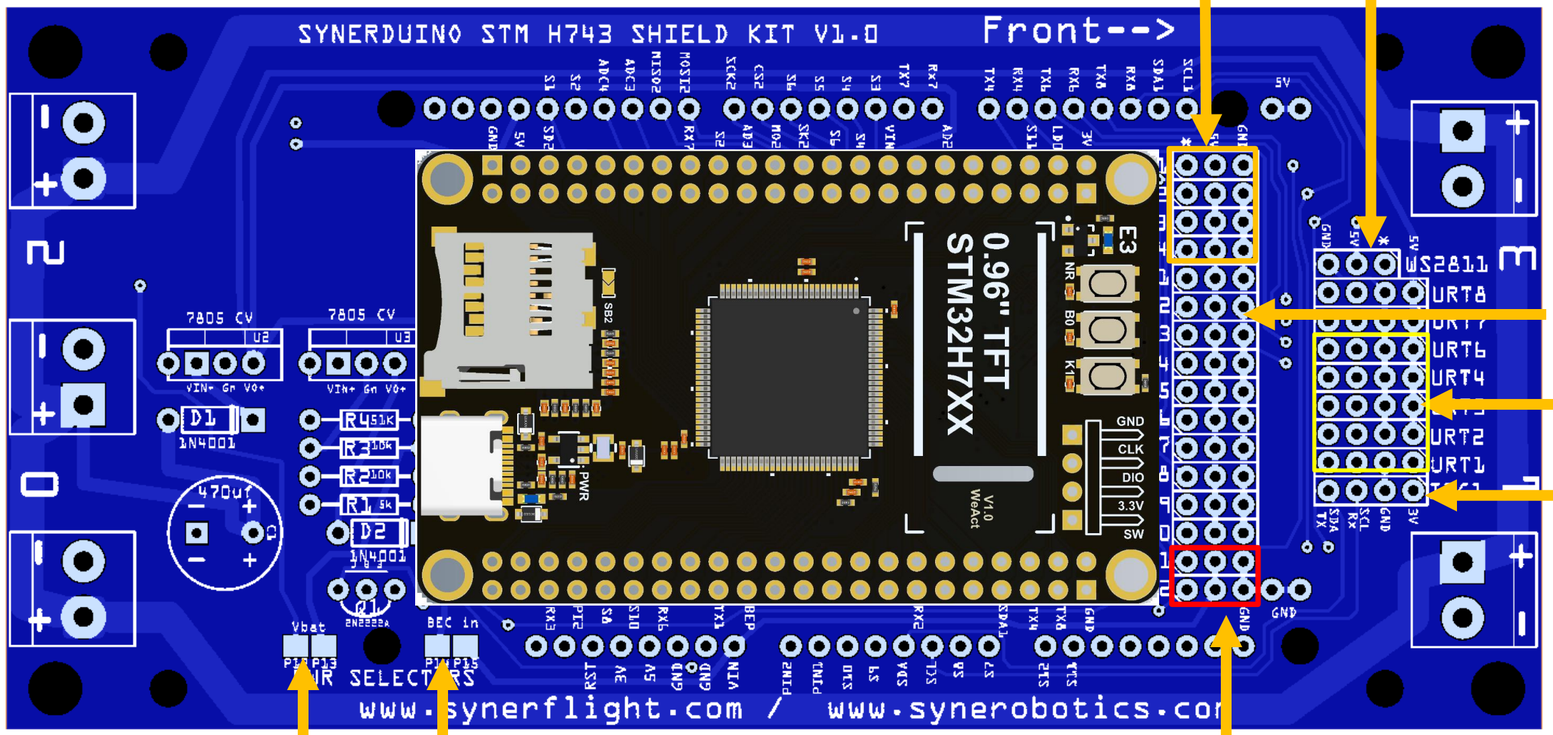
SYNERDUINO STM F405 SHIELD

SYNERDUINO STM F405



SYNERDUINO STM H743 SHIELD

Sensors must be covered with the provided housing glued into place using PVA white glue



ADC input headers

WS2811

PWM output headers

UART headers

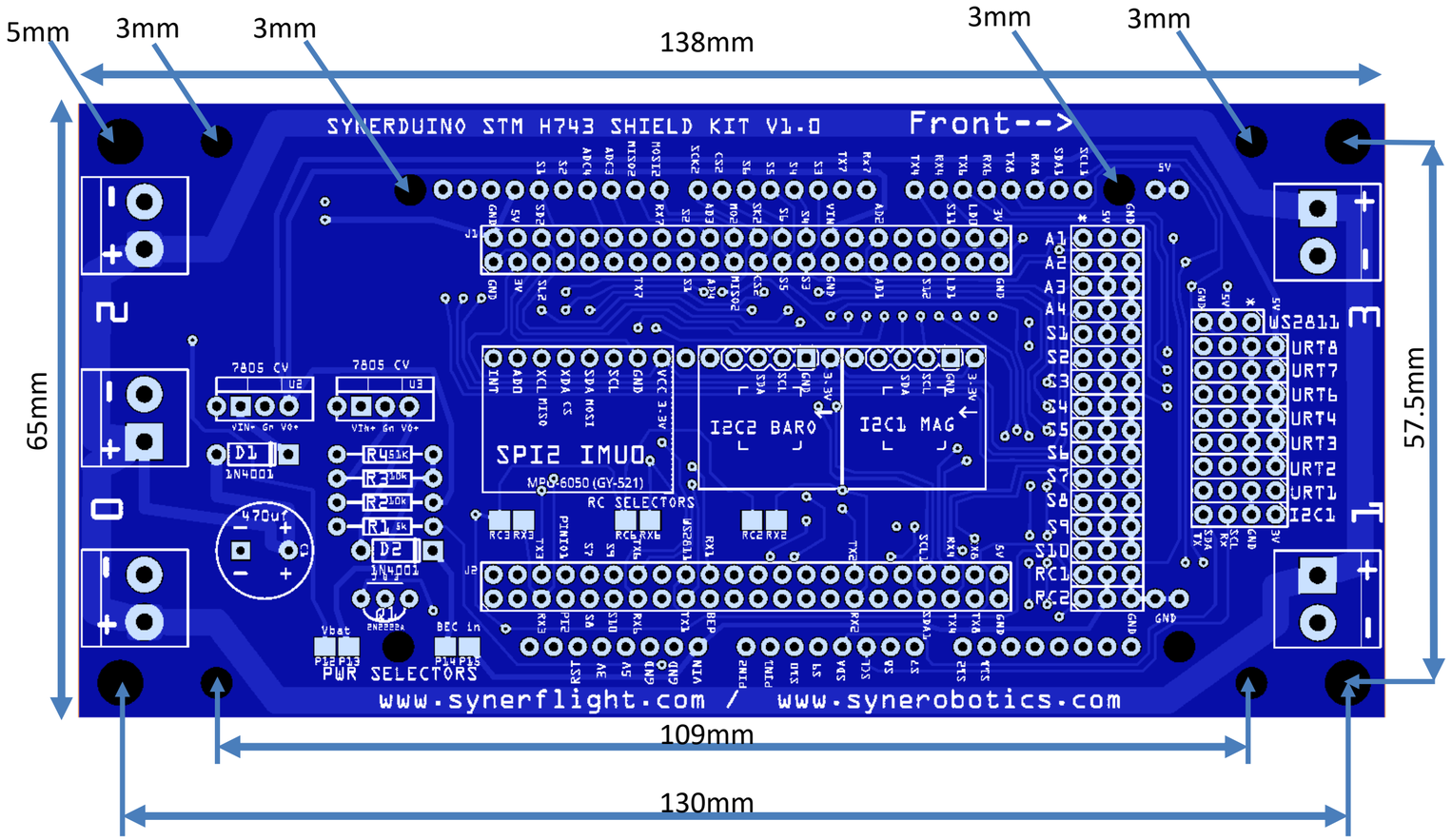
i2C Headers

UBEC /Regulator Selection Pads

RC1 & RC2

ADC and Battery Monitoring

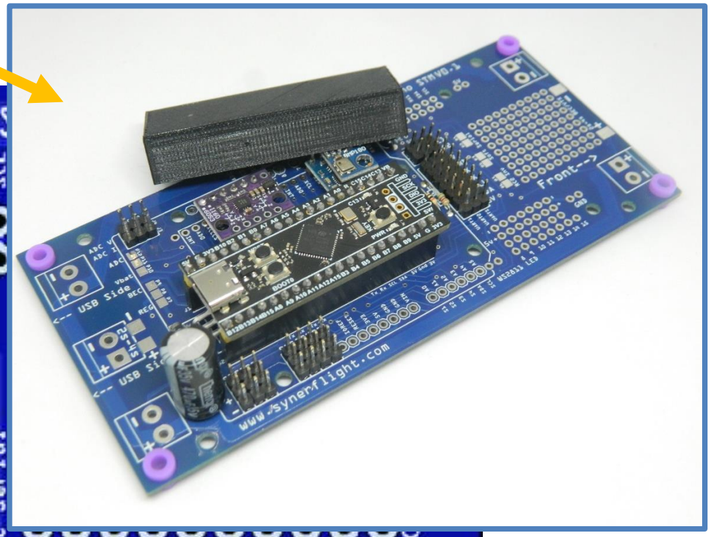
SYNERDUINO STM H743 SHIELD



Board Preparations

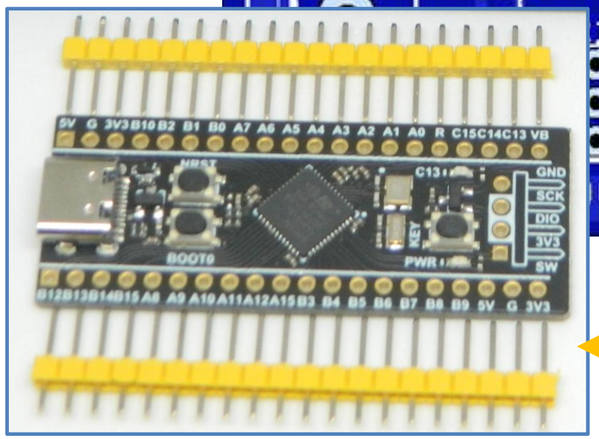
ADC and Battery Monitoring

Sensors must be covered with the provided housing glued into place using PVA white glue



UBEC /Regulator Selection Pads

USB facing this side



Pins have to be solder on before installation

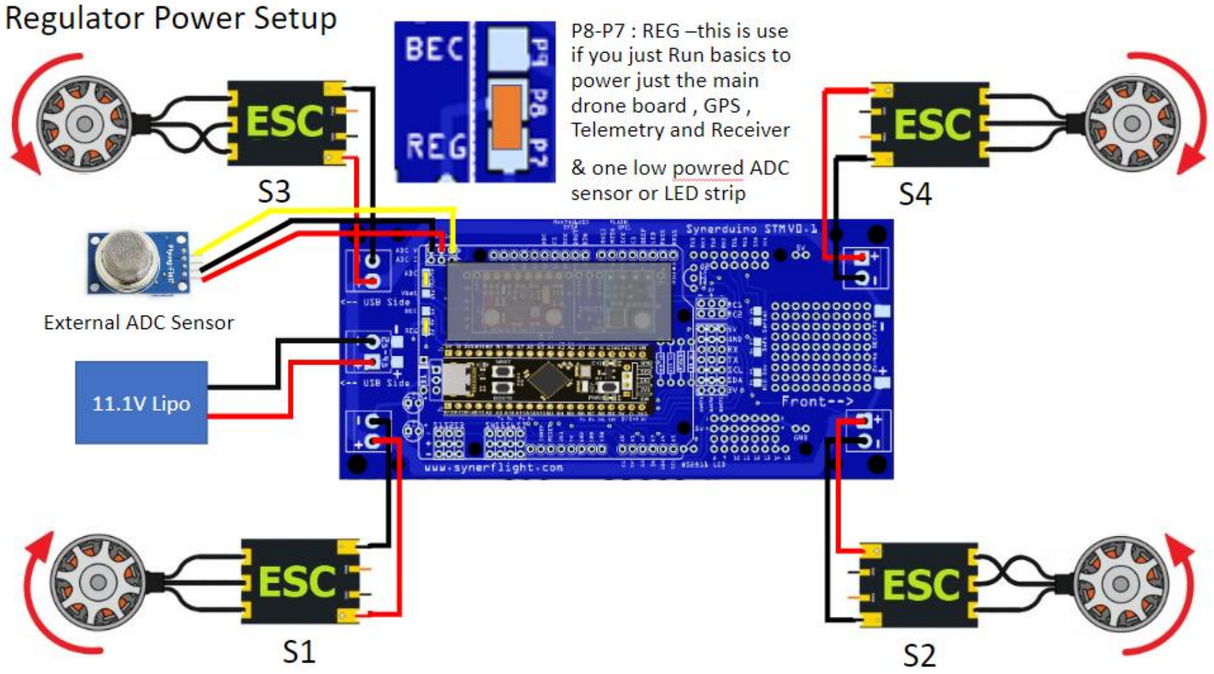
8-9 WS2811 LED out

RC2 inverted Sbus signal

For those using PWMto SBUS converter

F411 POWER LAYOUT

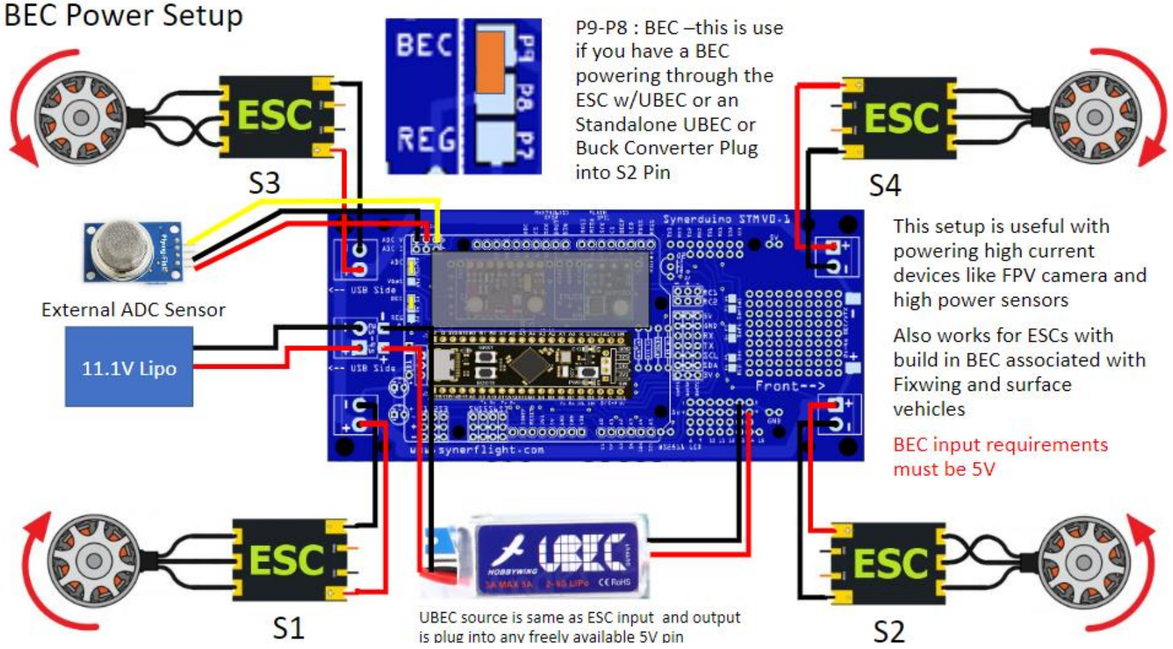
Regulator Power Setup



P8-P7 : REG –this is use if you just Run basics to power just the main drone board , GPS , Telemetry and Receiver

& one low powred ADC sensor or LED strip

BEC Power Setup



P9-P8 : BEC –this is use if you have a BEC powering through the ESC w/UBEC or an Standalone UBEC or Buck Converter Plug into S2 Pin

This setup is useful with powering high current devices like FPV camera and high power sensors

Also works for ESCs with build in BEC associated with Fixwing and surface vehicles

BEC input requirements must be 5V

UBEC source is same as ESC input and output is plug into any freely available 5V pin

F411 RC RECEIVER & UARTS

UART Serial Devices

AS if INAV5 and INAV6 its Required Receiver supports SBUS Serial

Receiver : Connect to RC1 / UART2

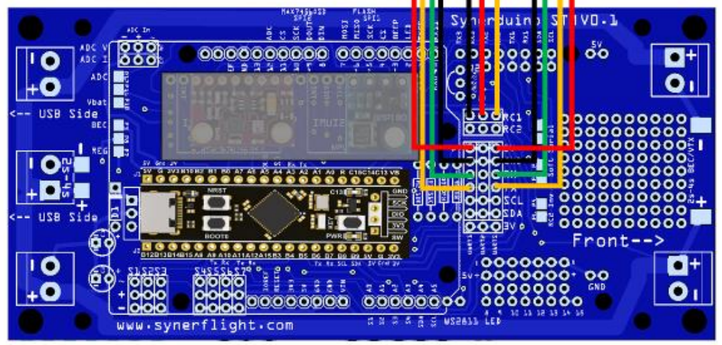
Flysky FS-i6X Receiver

GPS

UARTS

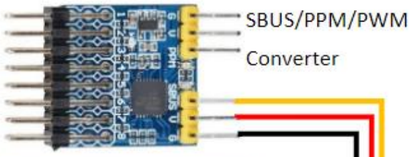
Bluetooth/Serial Radio

UART1



UART Serial Devices

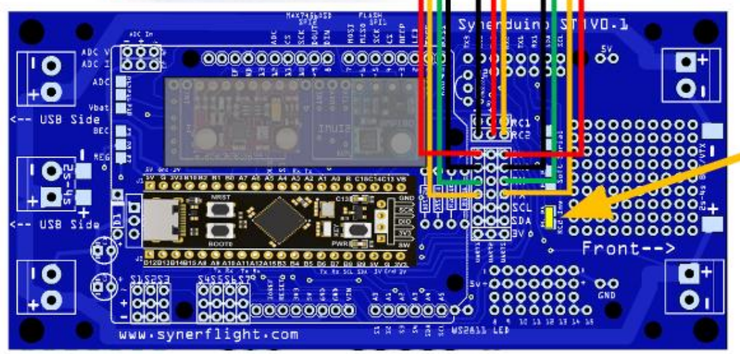
For those who Uses PWM or PPM Receiver Require to add an Additional PWM/PPM/SBUS Converter to RC2/UART2



SBUS/PPM/PWM Converter

GPS

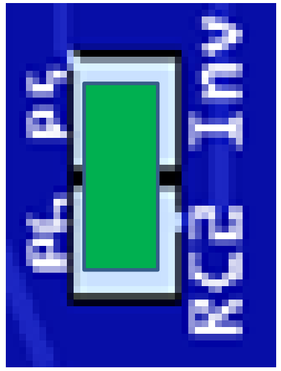
Bluetooth/Serial Radio



USE RC2 INV to invert the SBUS for Some Signal Converter

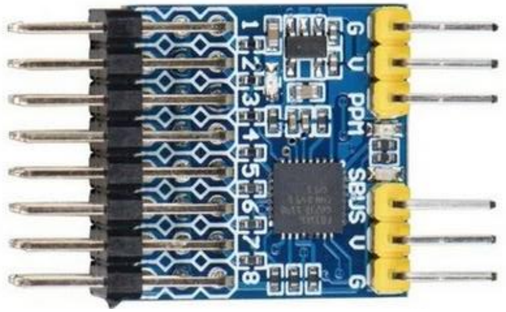
RECEIVER TYPES

PPM AND PWM RECEIVER



The Invert Pads are only Present in the F411 boards .

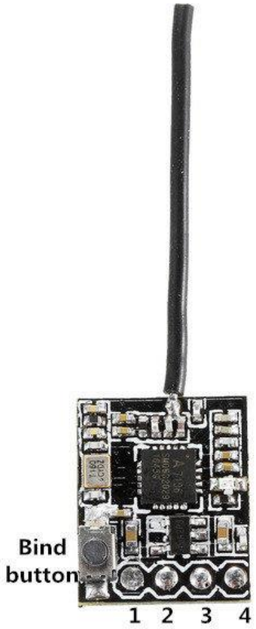
F405 and H743 boards does a way with this



PWM/PPM/SBUS CONVERTER

For those who Uses PWM or PPM Receiver Require to add an Additional PWM/PPM/SBUS Converter and connect it to RC2 to SBus

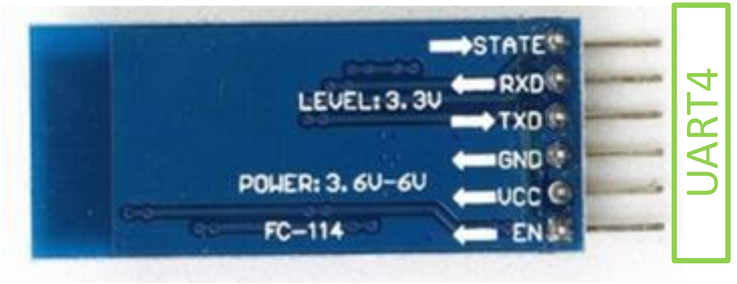
SERIAL RECEIVER



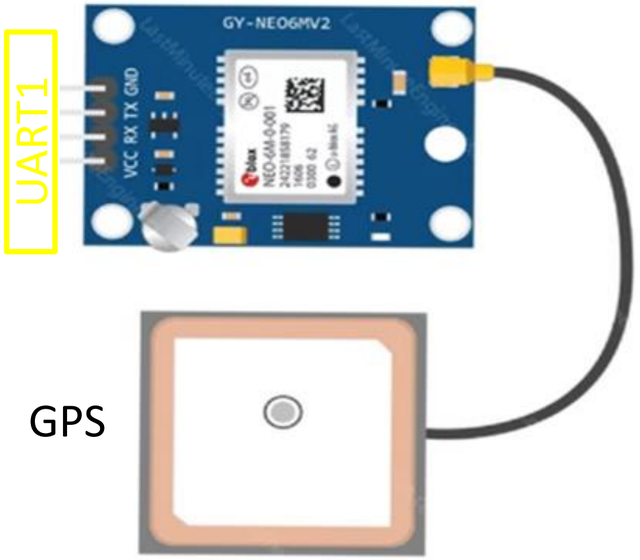
1:GND
2:VCC
3:PPM
4:IBUS

F405 RC RECEIVER & UARTS

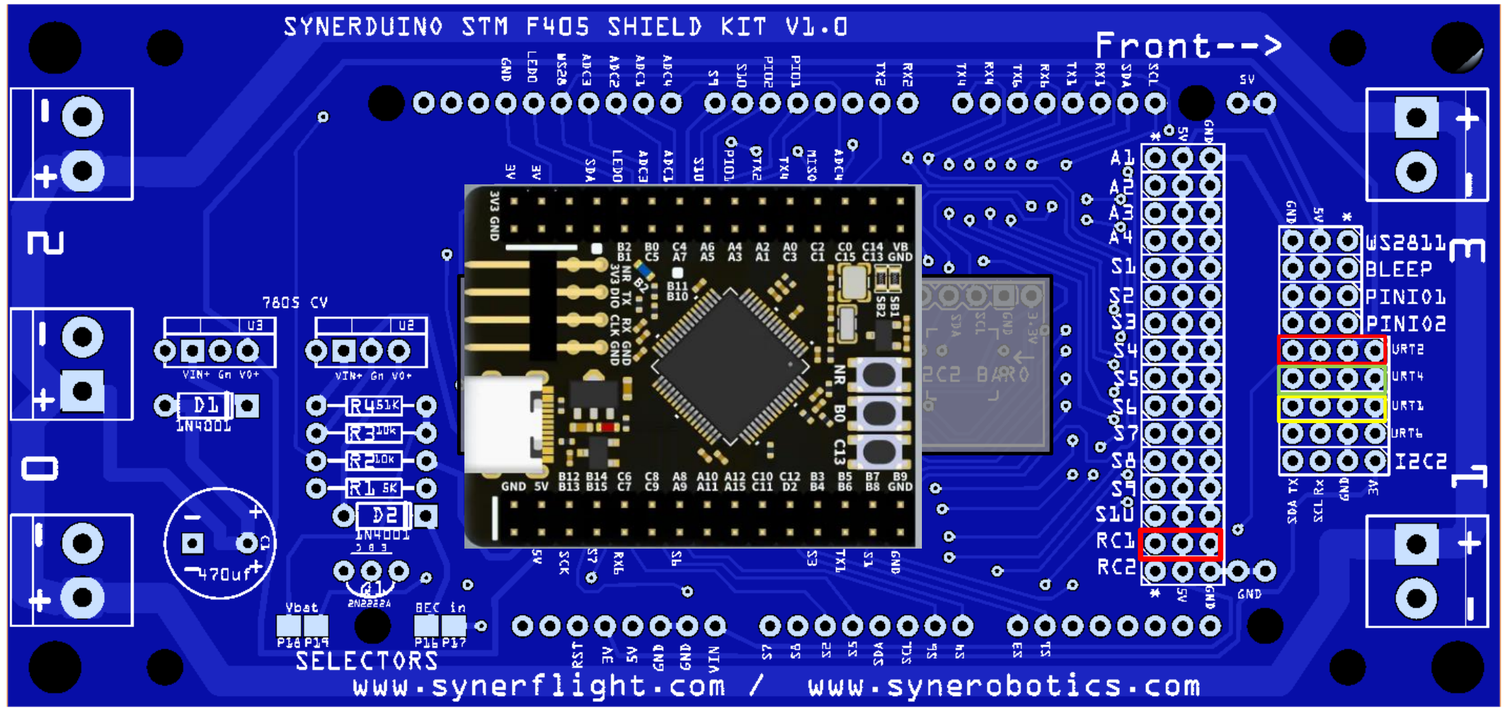
Receiver : Connect to RC1 / UART2



Bluetooth/Serial Radio

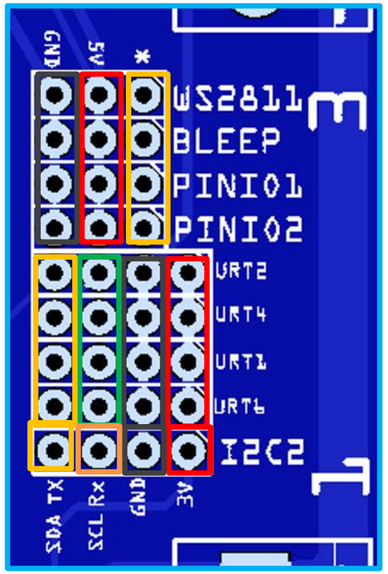


GPS



STMF405

V+ Gn Dat



TX RX Gn V+

Check connection Polarity

H743 RC RECEIVER & UARTS

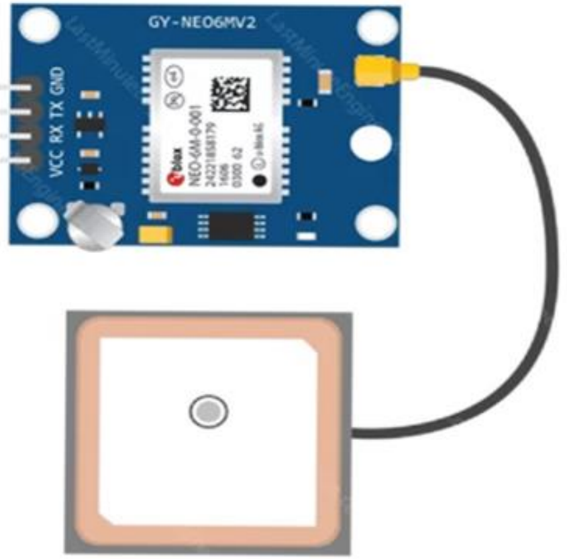
RC1

Receiver : Connect to RC1 / UART2

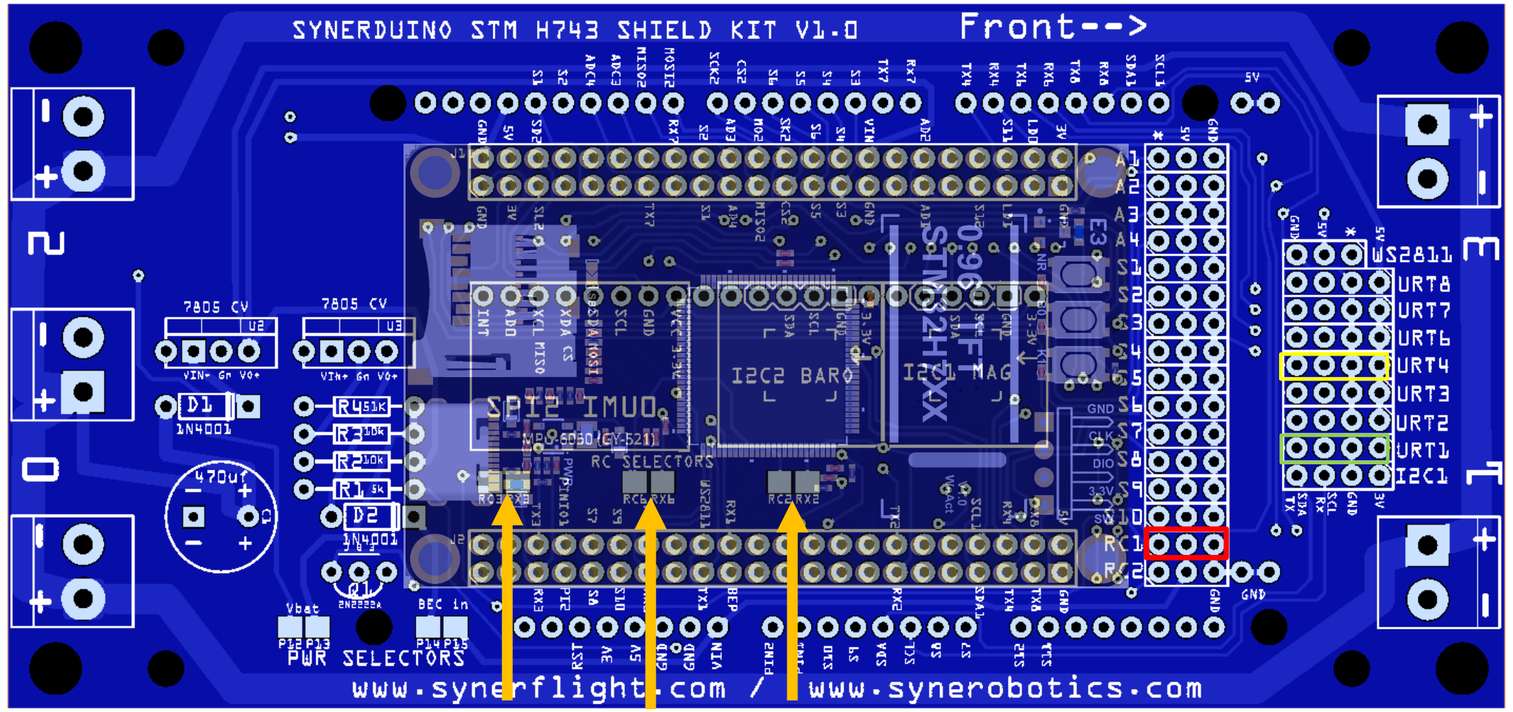
UART4

Bluetooth/Serial Radio

UART1

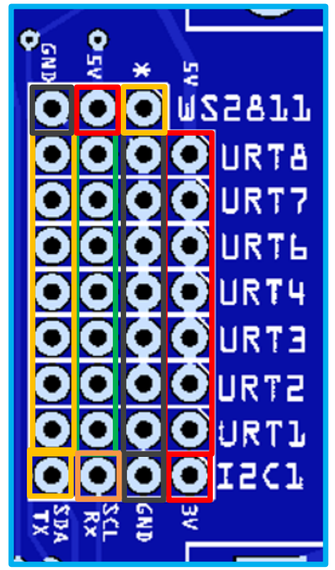


GPS



STMH743

V+ Gn Dat



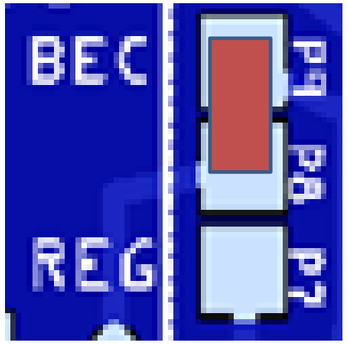
TX RX Gn V+

Check connection Polarity

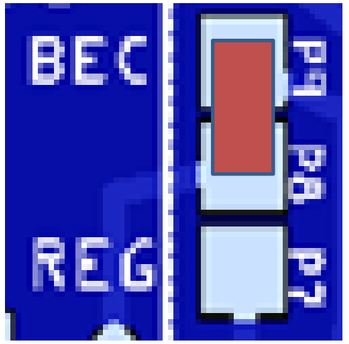
RC UART selector you have 3 option where your RC receiver can be connected

F411 SELECTOR SELECTOR PADS

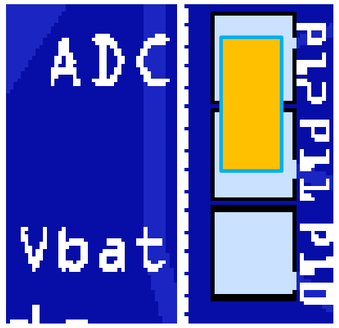
To Select two adjacent pads must be shorted with a solder blob



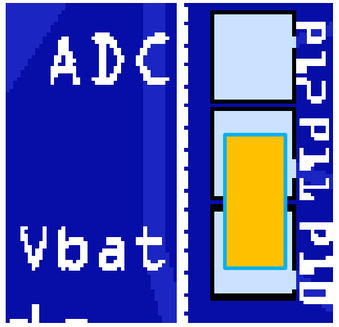
P9-P8 : BEC –this is use if you have a BEC powering through the ESC w/UBEC or an Standalone UBEC or Buck Converter Plug into S2 Pin BEC input is 5V



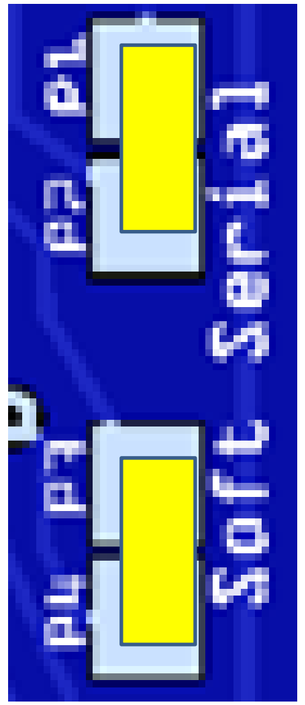
P8-P7 : REG –this is use if you just Run basics to power just the main drone board , GPS , Telemetry and Receiver



P12-P11 ADC Sensor Input



P11-P10 ADC Voltage Monitoring input



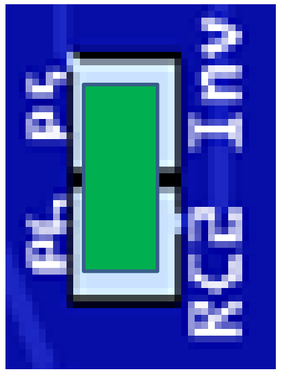
P1-P2 P3-P4 Softserial activates the TXSS and RXSS connection to the expansion pins for Prototyping board serial

Connection

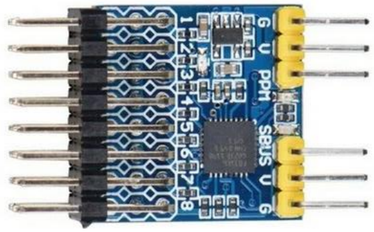
Synerduino

Note: the power rails would support upto 4s safely

For 6s setup this would require an external UBEC to supply 5V

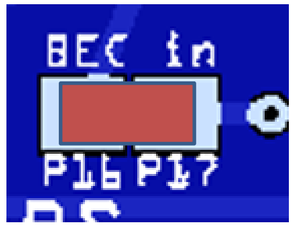


P5-P6 RC2 Inv : inverts the Sbus signals which activates the RC2 Sbus pin input to the UART2



Primary use for PWM to SBUS Converters

F405 & H743 SELECTOR PADS



P16-P17 : BEC –this is use if you have a BEC powering through the ESC w/UBEC or an Standalone UBEC or Buck Converter Plug into S2 Pin BEC input is 5V

Default ADC1 input

P18-P19 ADC activate Battery monitoring

Synerduino

Note: the power rails would support upto 4s safely

For 6s setup this would require an external UBEC to supply 5V

For ESCs with UBEC ensure it outputs 5V

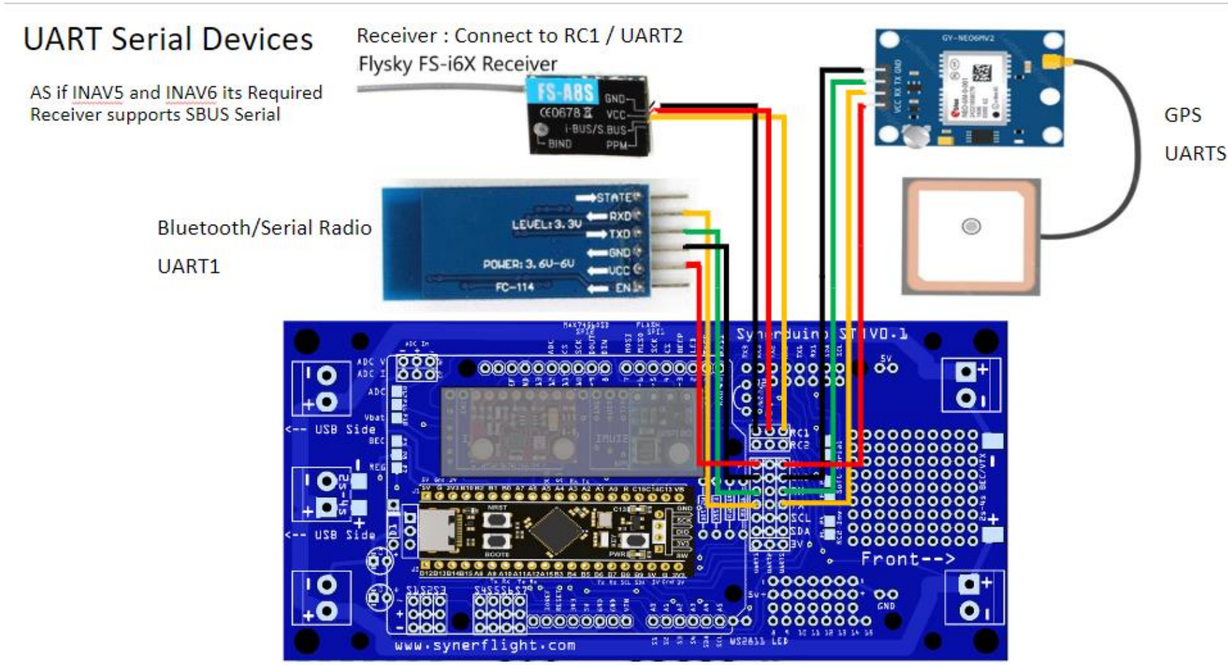
Default Onboard Regulator

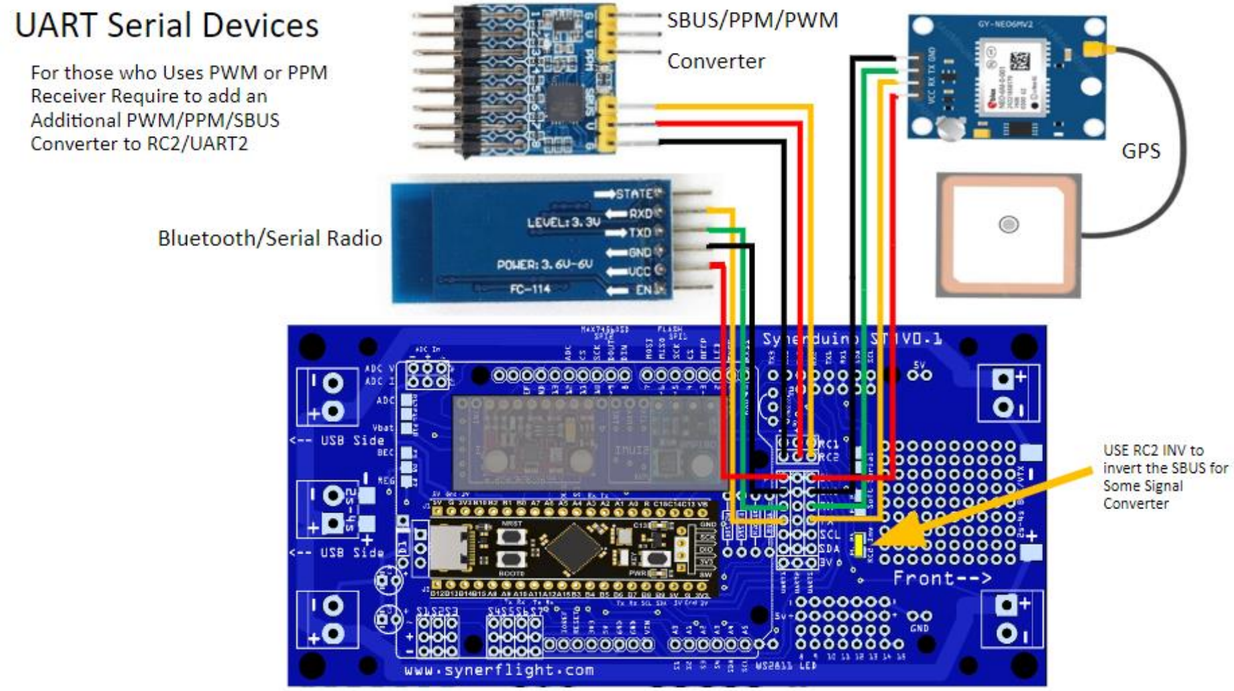
(H743 Boards) Selectable UART for RC2 RX

RC2-RX2 is Default

To Select two adjacent pads must be shorted with a solder blob

UART CONNECTIONS





F411 SPI CONNECTIONS

SPI2 Devices

These are optional addons

All Addon SPI devices can Access SPI2 Pins

CS - CS

DIN – MOSI

DOUT - MISO

SCK – SCK

Power can be tap into any freely available 3V or 5V pin

SD Card is Active Default for Synerduino STM firmwares:

Synerduino STM.HEX

Synerduino STM VS.HEX

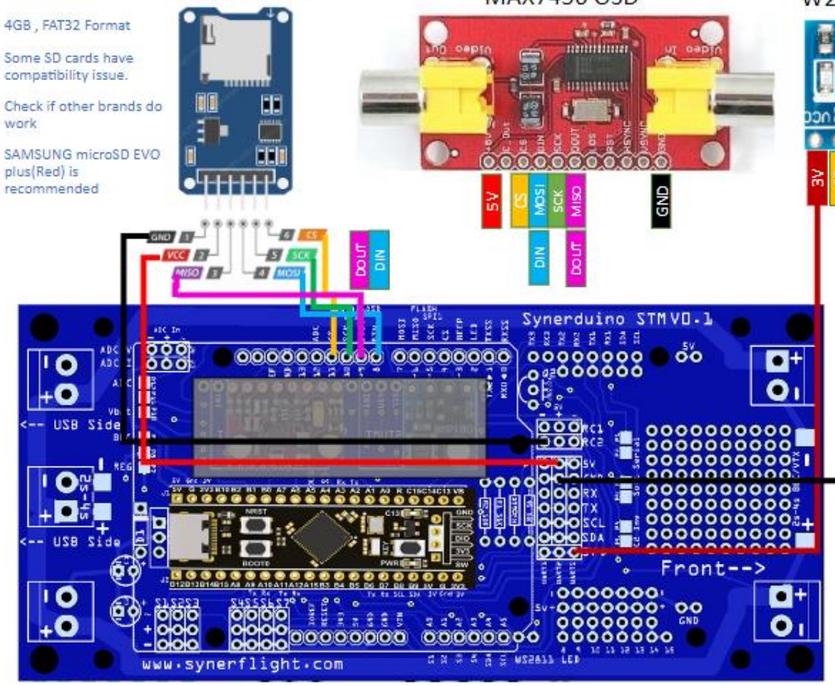
SD Card Reader

4GB , FAT32 Format

Some SD cards have compatibility issue.

Check if other brands do work

SAMSUNG microSD EVO plus(Red) is recommended



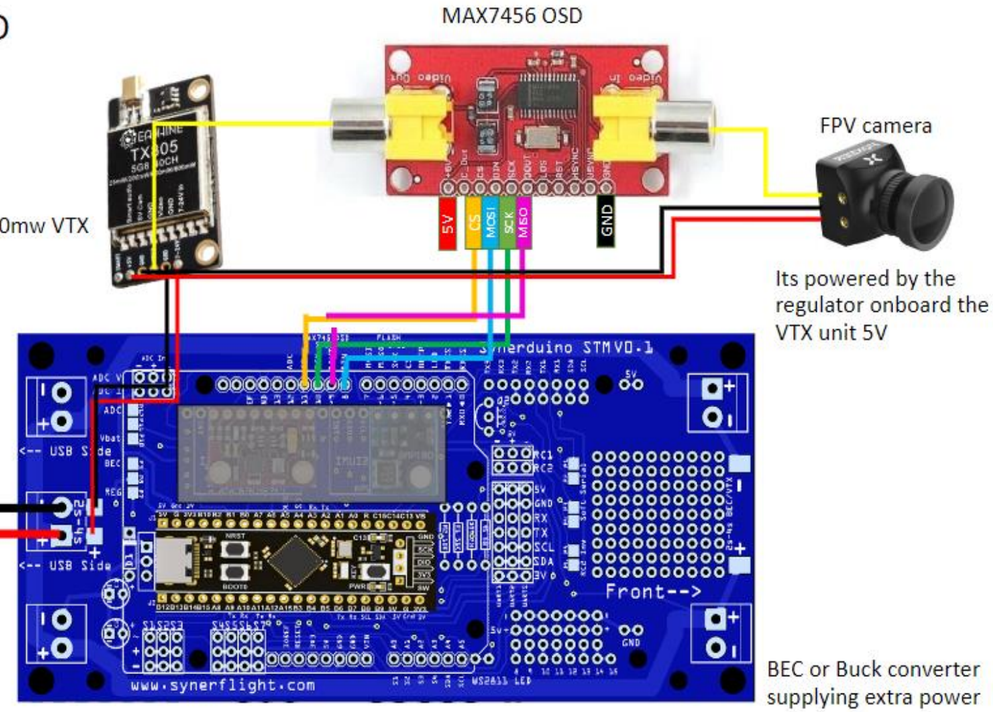
FPV with SPI OSD

The Telemetry can also use the SPI OSD module

Split VTX camera Setup

600mw to 800mw VTX

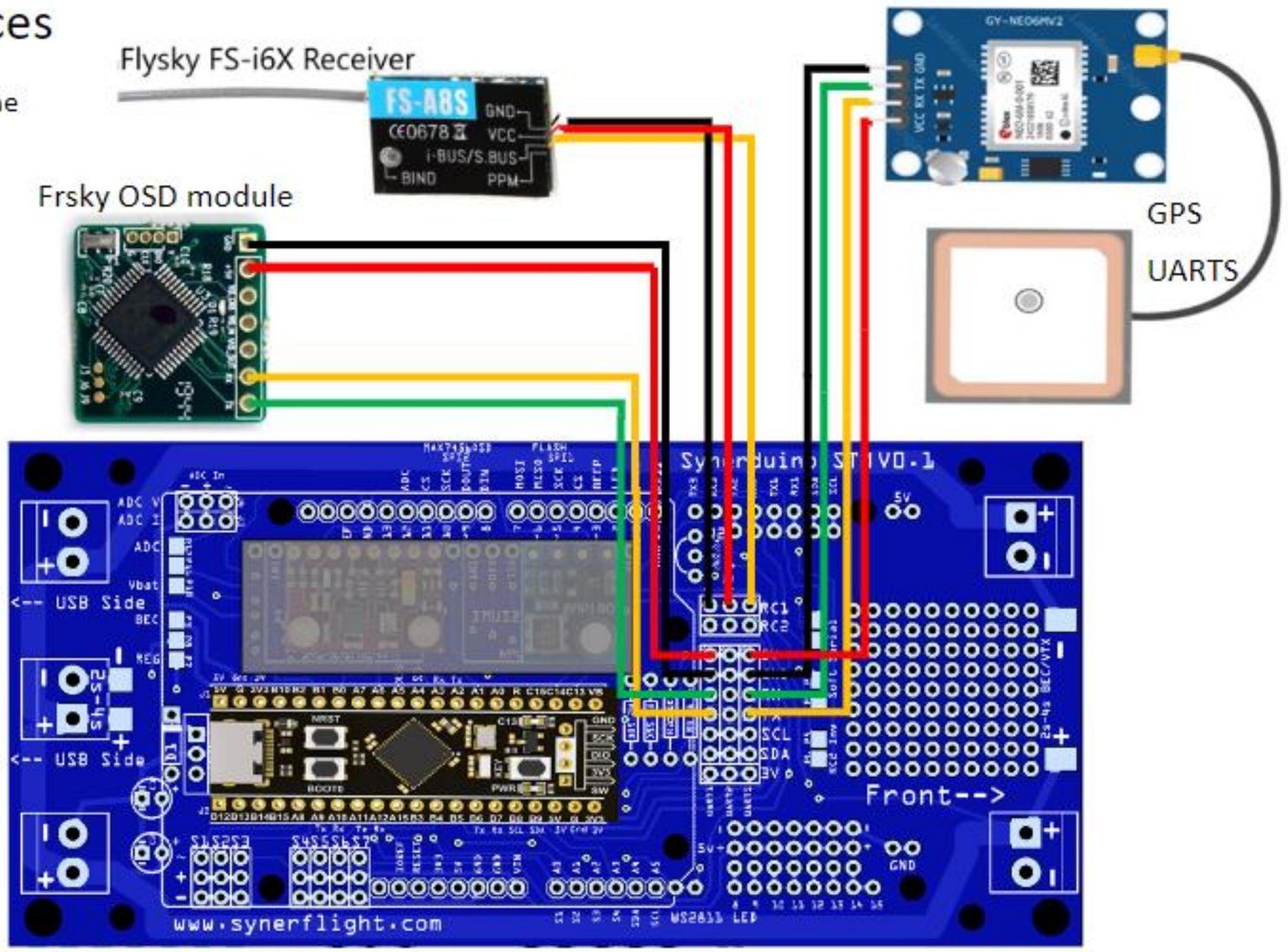
Battery 3s or 4s



F411 UART CONNECTIONS

UART Serial Devices

The Telemetry can also use the Serial OSD module



F411 FPV UART SETUP

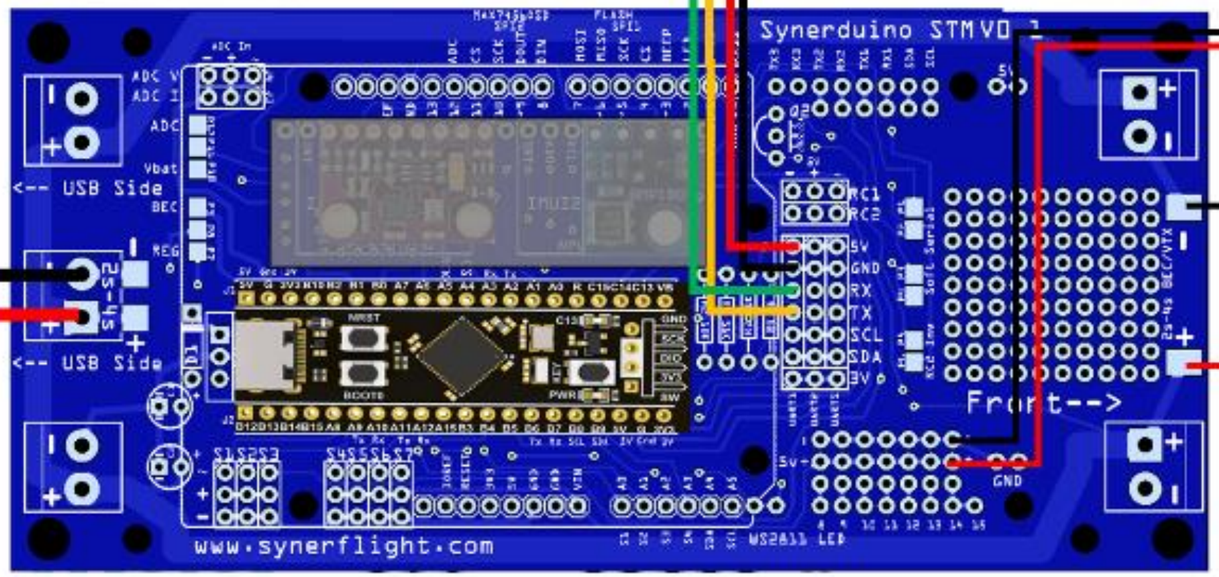
FPV with SERIAL OSD

The Telemetry can also use the Serial OSD module

Power Pads is selected to BEC to use external BEC

Frsky OSD module

FPV camera 25mw Standalone

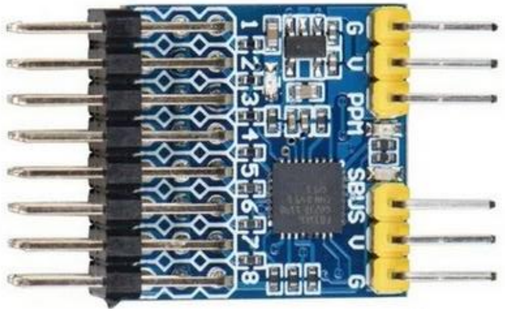


Battery 3s or 4s

UART 1 needs to be configure in Ports to OSD flysky serial

BEC or Buck converter supplying extra power

F405 FPV UART SETUP



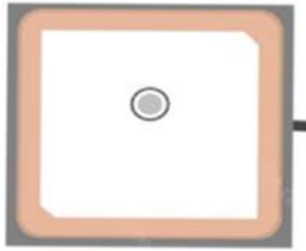
RC2

UART1

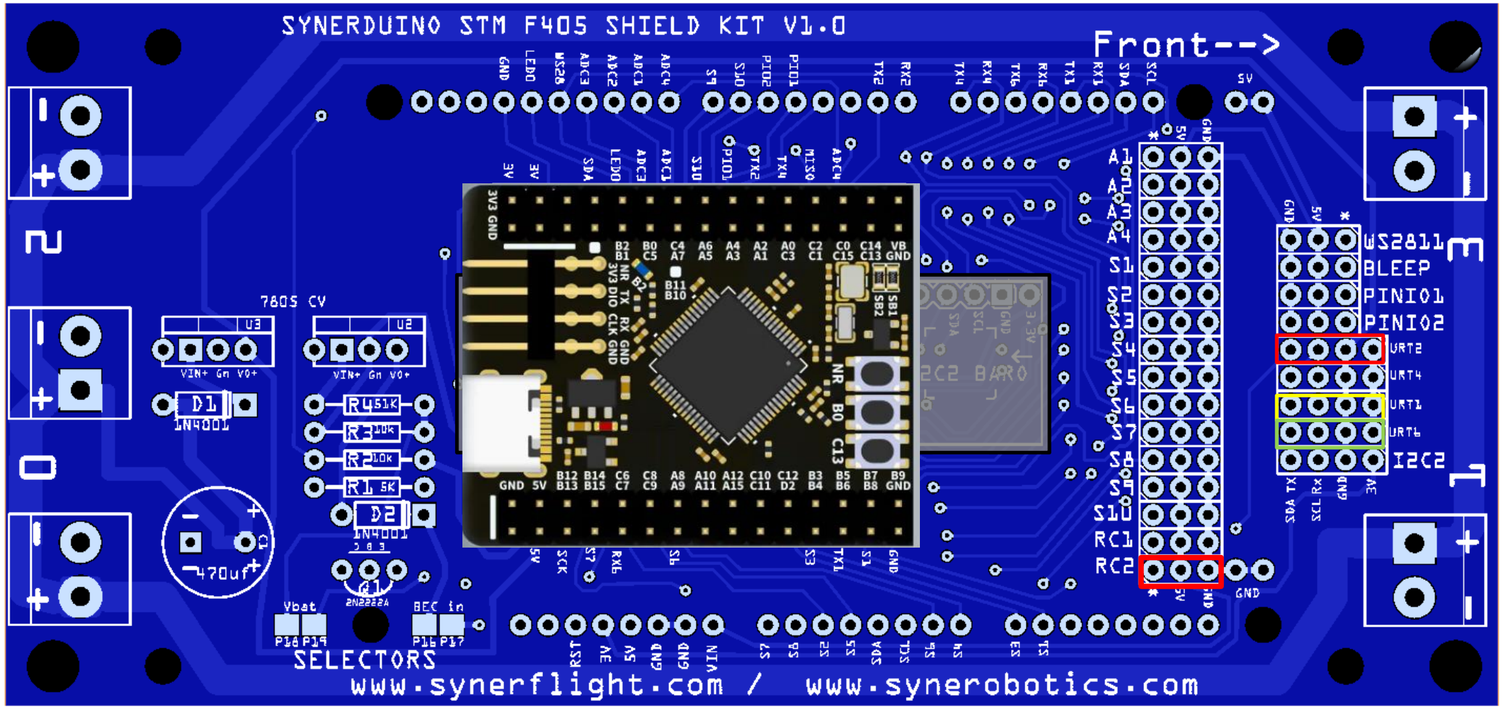
Frsky OSD module

UART6

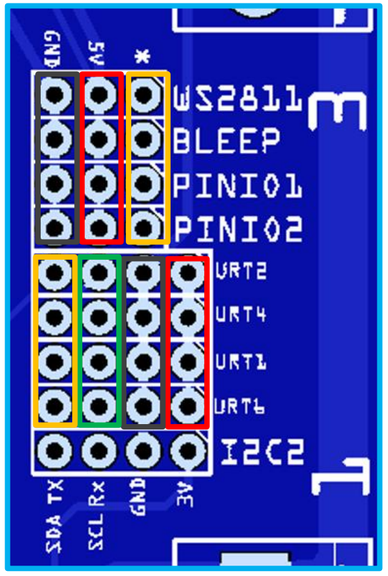
GPS



Mavlink OSD module



V+ Gn Dat

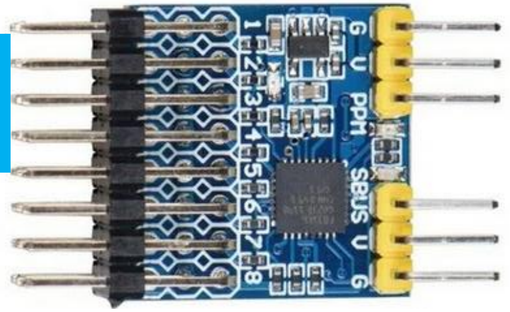


Check connection Polarity

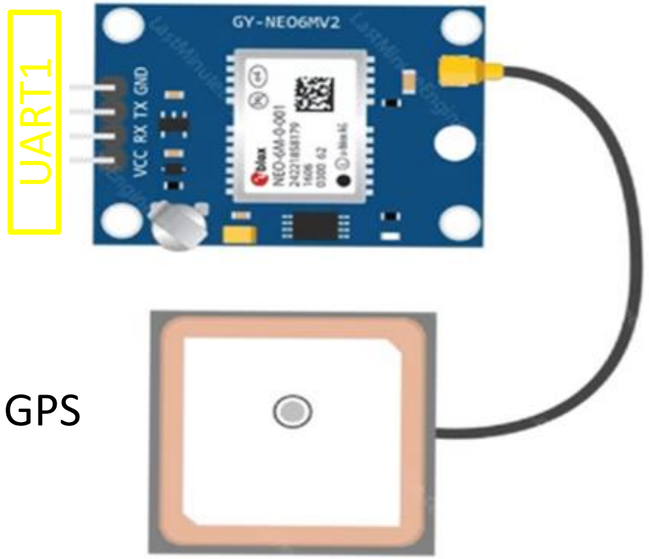
TX RX Gn V+

STMF405

H743 FPV UART SETUP

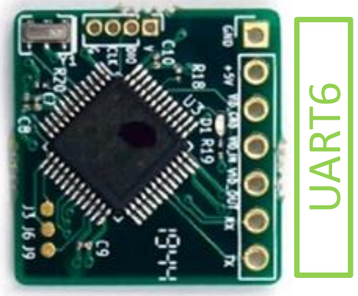


RC2



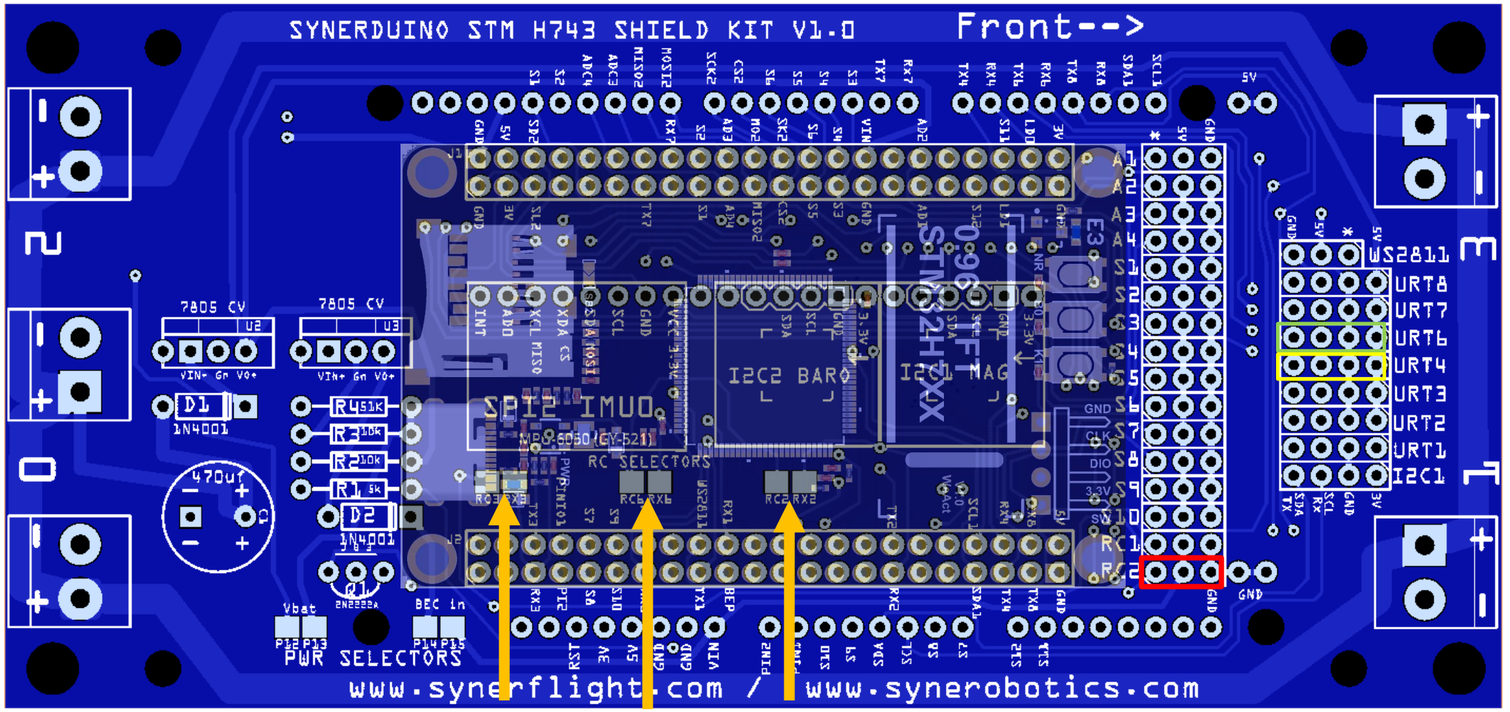
GPS

Frsky OSD module

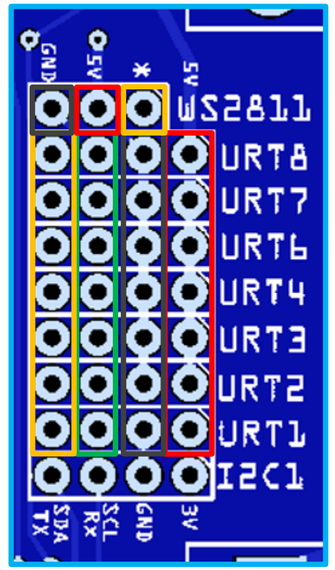


UART6

Mavlink OSD module



V+ Gn Dat



TX RX Gn V+

Check connection Polarity

STMH743

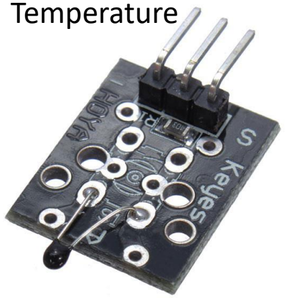
RC UART selector you have 3 option where your RC receiver can be connected

F411 ADC SENSOR

ADC External Sensor

MQ Gas sensor

Temperature

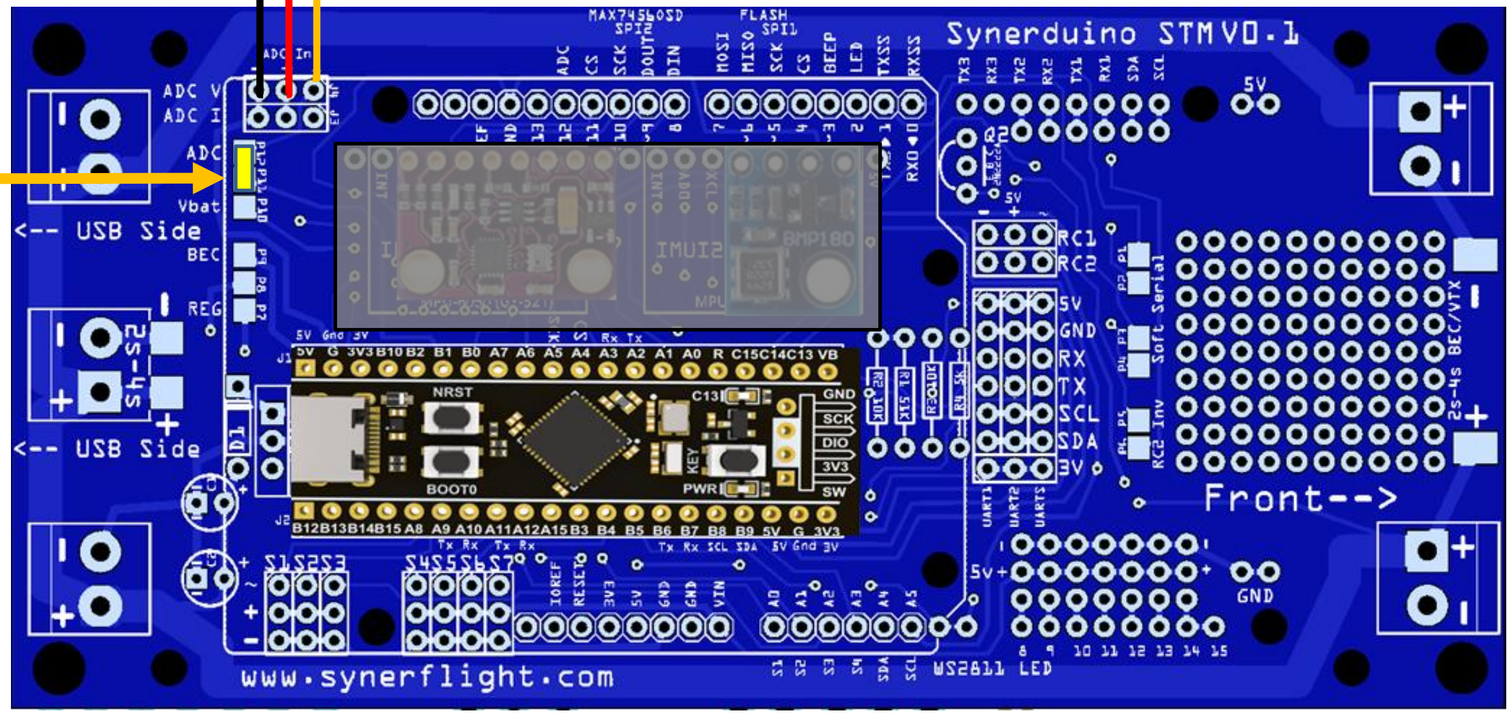


Current sensor

Here you can switch to ADC sensor input or VBAT for Battery monitoring

ADC V – Voltage 0-5V

ADC I – Current 0-5V



F405 ADC SENSOR

Here you can switch to ADC sensor input or VBAT for Battery monitoring

A1 ADC V – Voltage 0-5V

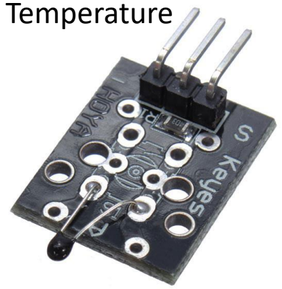
A2 ADC I – Current 0-5V

A3 ADC T – RSSI 0-5V

A4 ADC A – AIRSPEED 0-5V

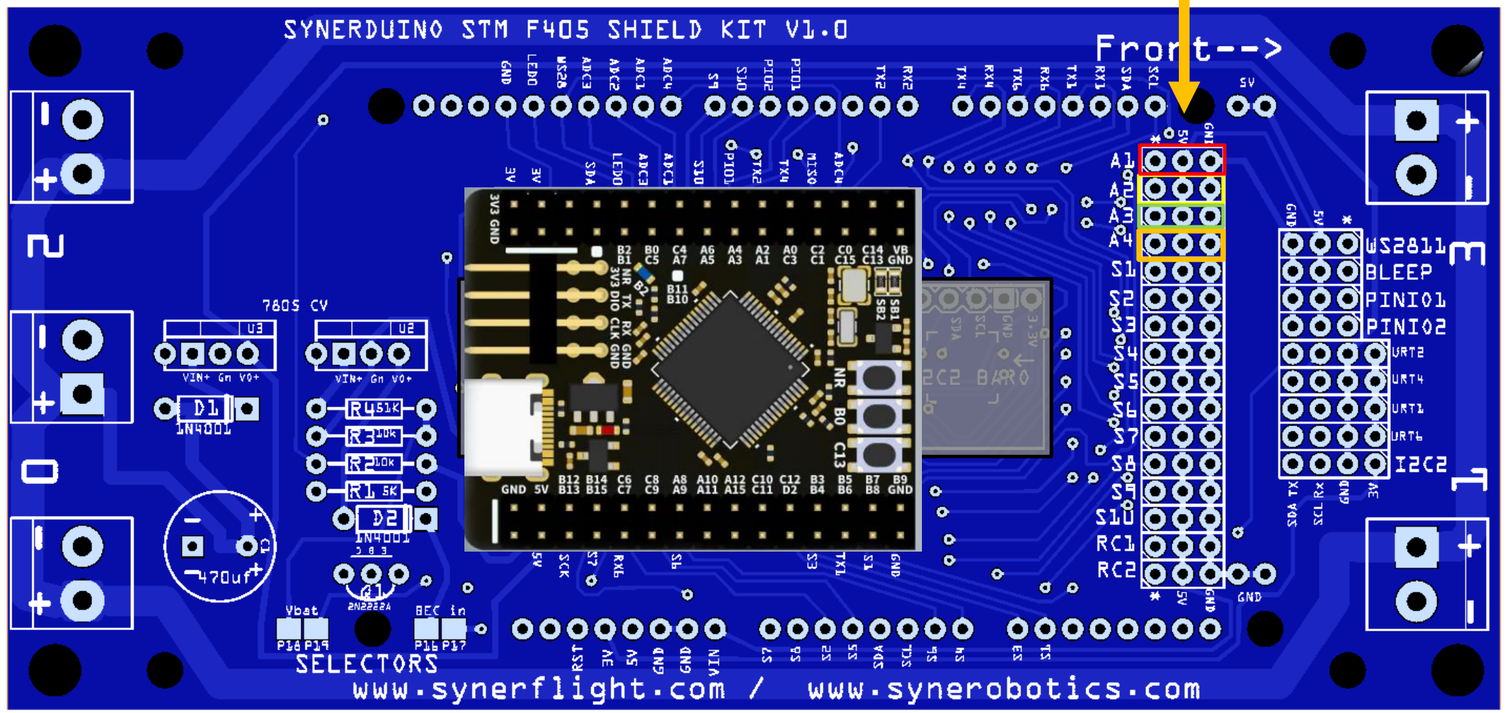
PH sensor

Temperature



MQ Gas sensor

ASPD 7002 Analog Airspeed



PWM to Analog RSSI

Current sensor

STMF405

H743 ADC SENSOR

Here you can switch to ADC sensor input or VBAT for Battery monitoring

A1 ADC V – Voltage 0-5V

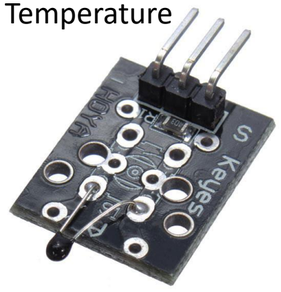
A2 ADC I – Current 0-5V

A3 ADC T – RSSI 0-5V

A4 ADC A – AIRSPEED 0-5V

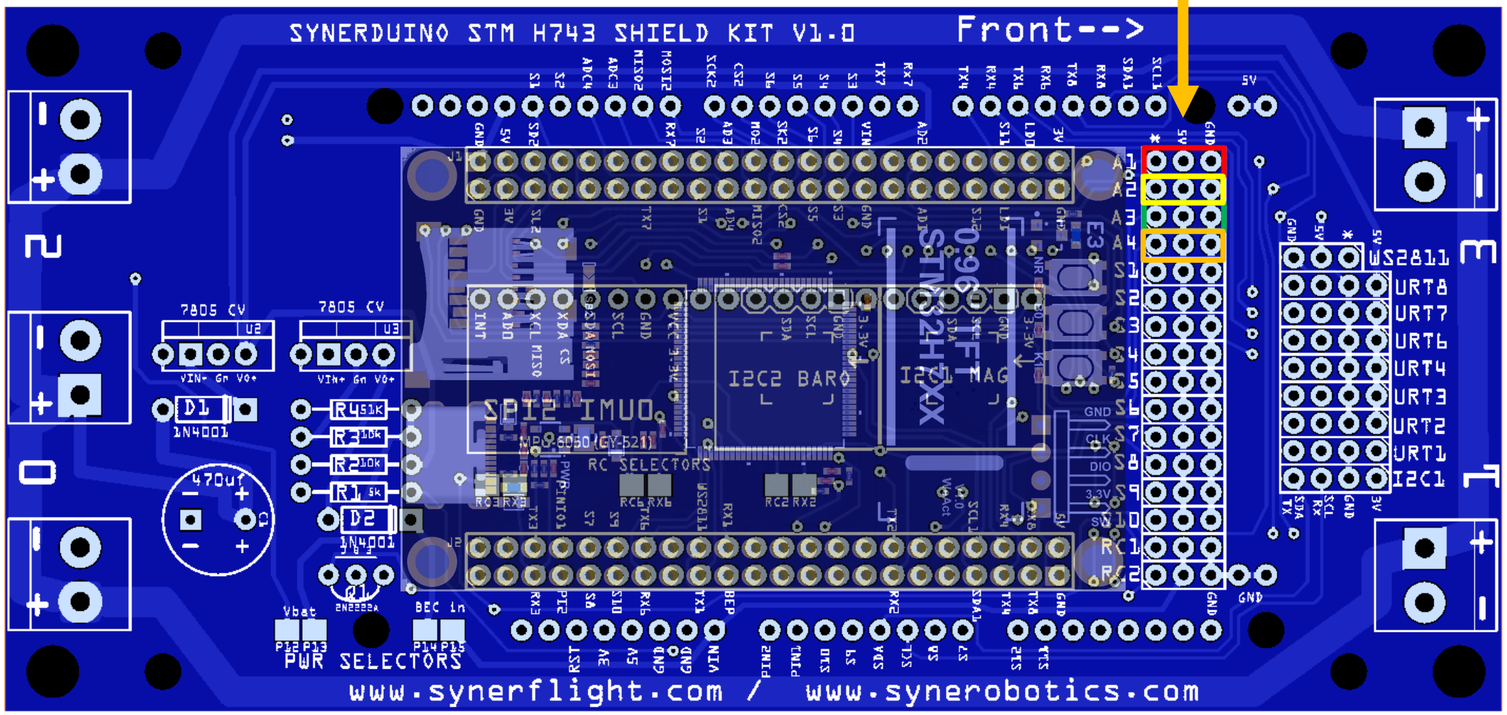
PH sensor

Temperature



MQ Gas sensor

ASPD 7002 Analog Airspeed



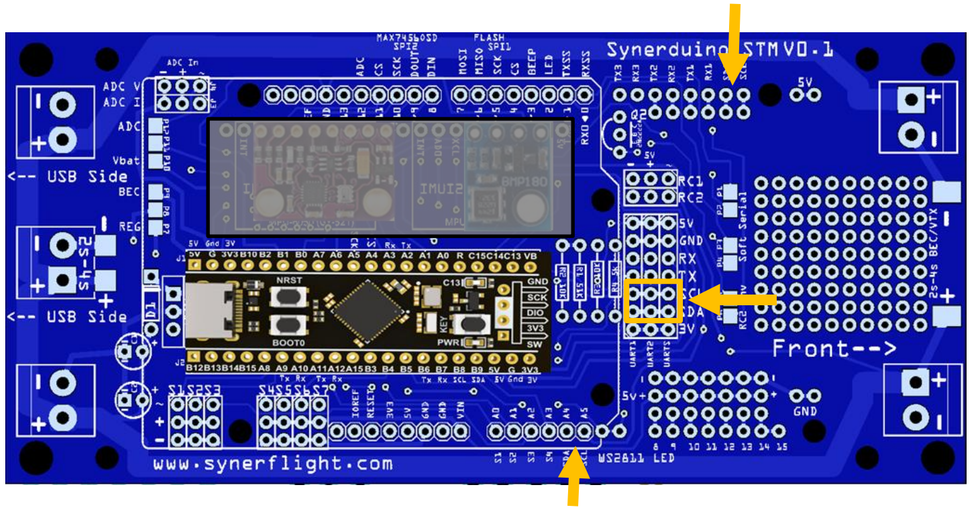
PWM to Analog RSSI

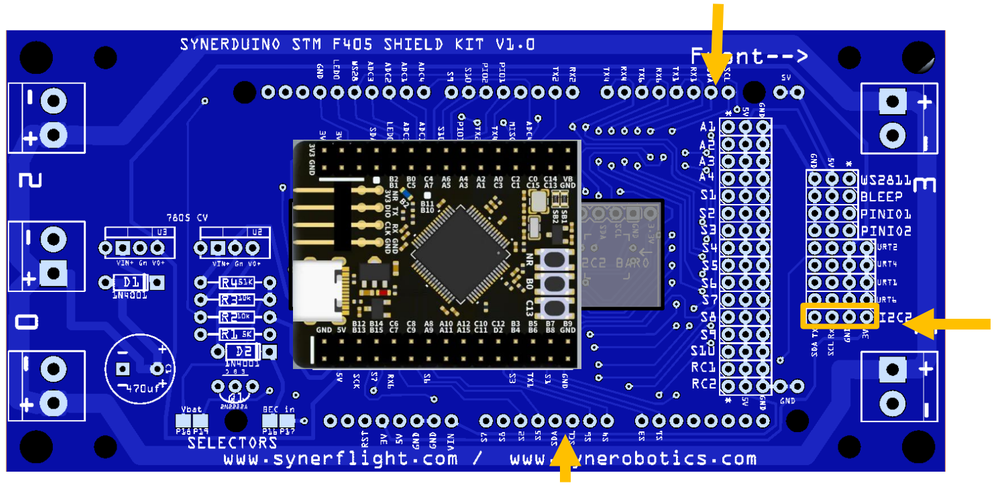
Current sensor

STMH743

I2C SENSORS

I2C digital sensors expansion allows you to add a host of external sensors to the current board via i2C pin (SLC SDA)





Range Finder

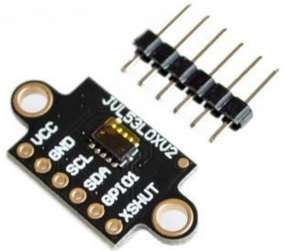
- **VL53L0X**
- **VL53L1X**
- **TOF10120**

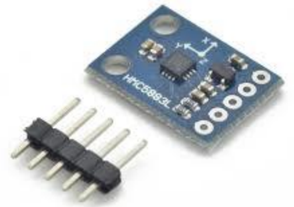
Airspeed sensor

- **MS4525**
- **ASPD-DLVR L10D**

Magnetometer

- HMC5883
- QMC5883
- IST8310
- MAG3110
- LIS3MDL
- MPU9250





F411 LED WS2811

LED Devices

These are optional addons

Serves as Status indicator or put up a heck of a light show

WS2811 or WS2812

DATA

5V

GND

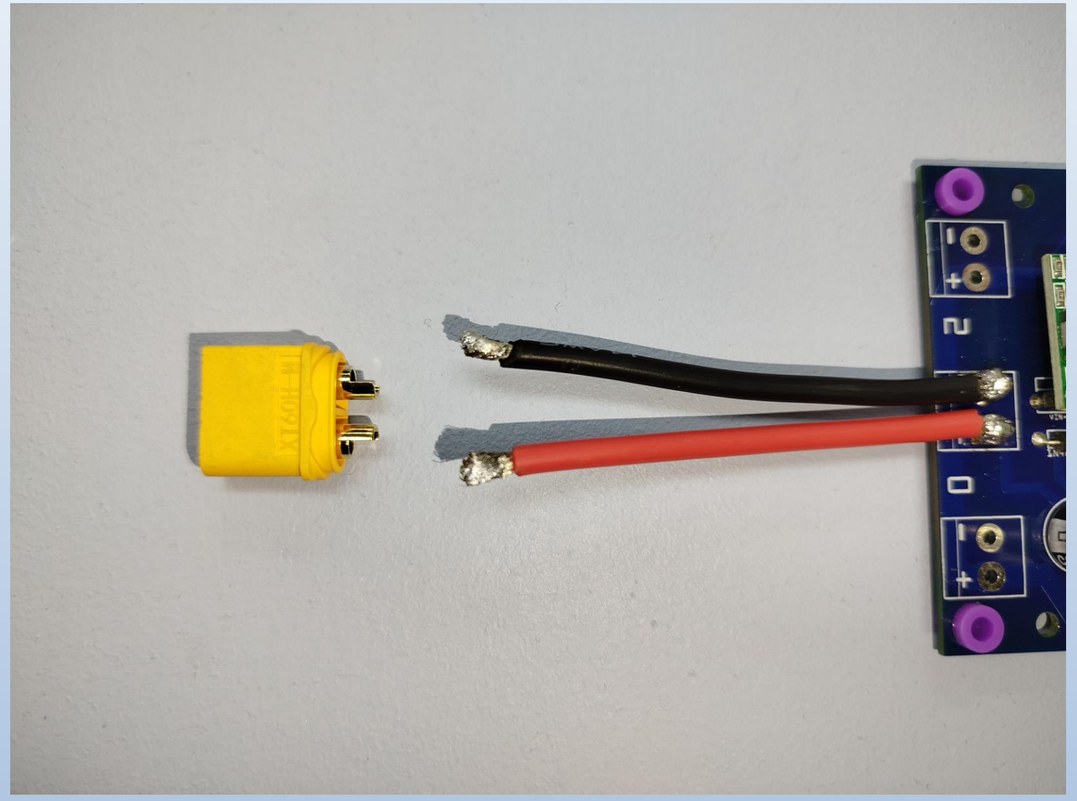
WS2811 LED allows you to add upto 32 LED strip or 5x5 Led Matrix

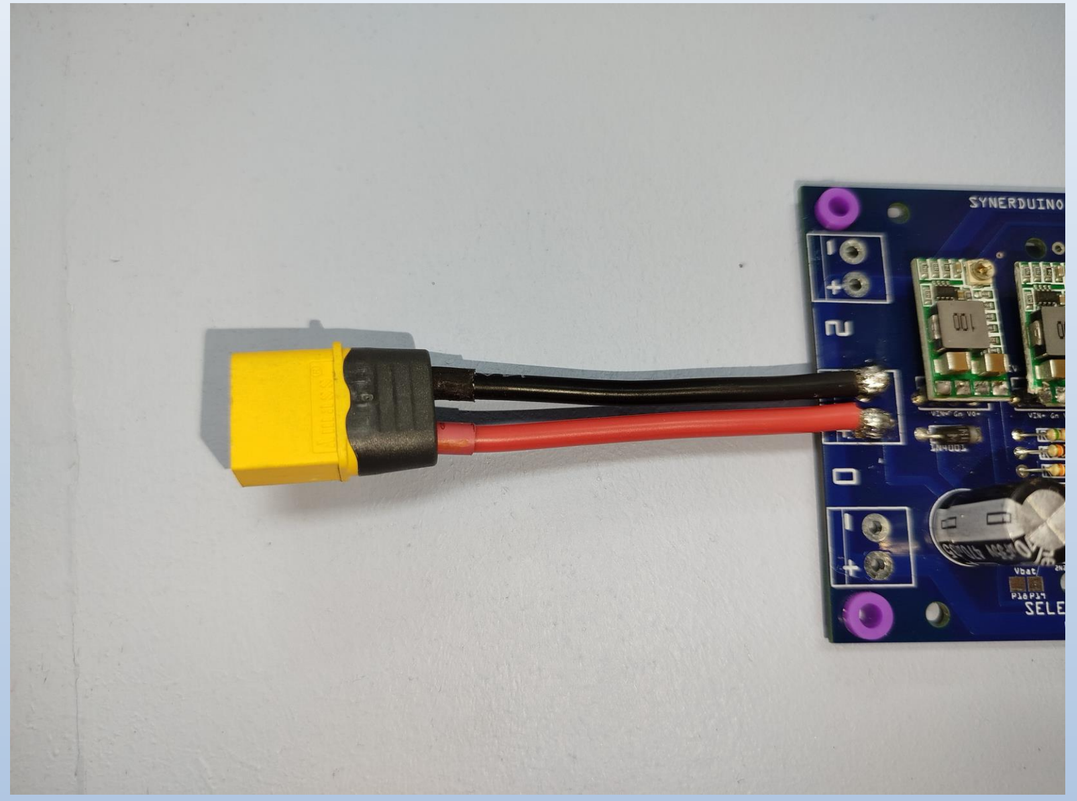
Accessible on Pin 8 & 9

This also requires 3 Timers

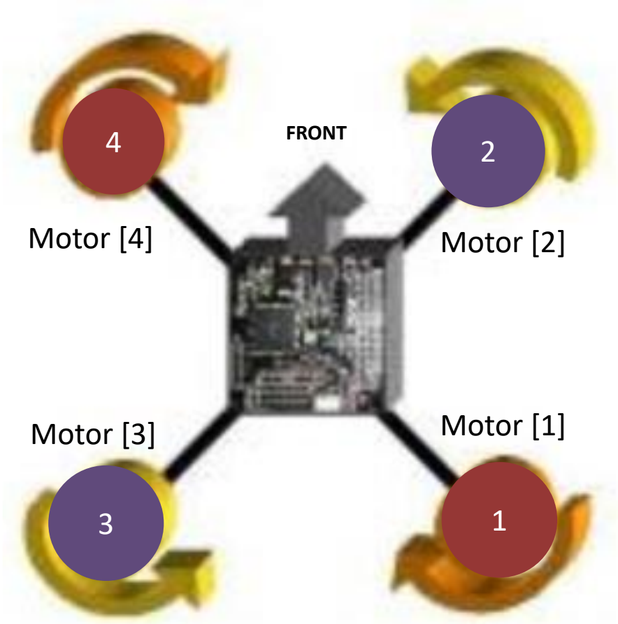
When activated only 5 PWM pins can be use for Motor/Servo

POWER



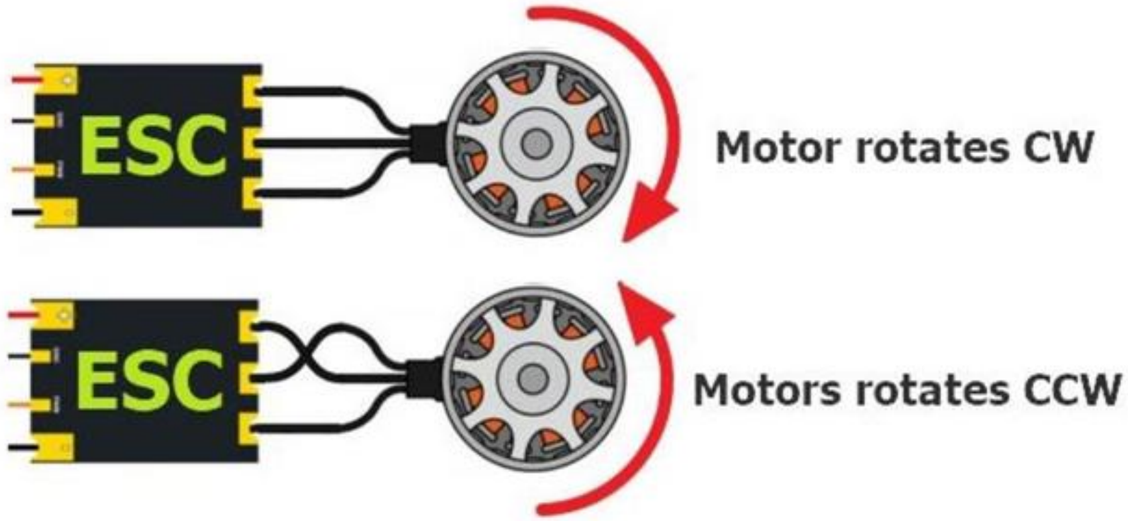


MOTOR, ESC, & PROPELLER INSTALLATION



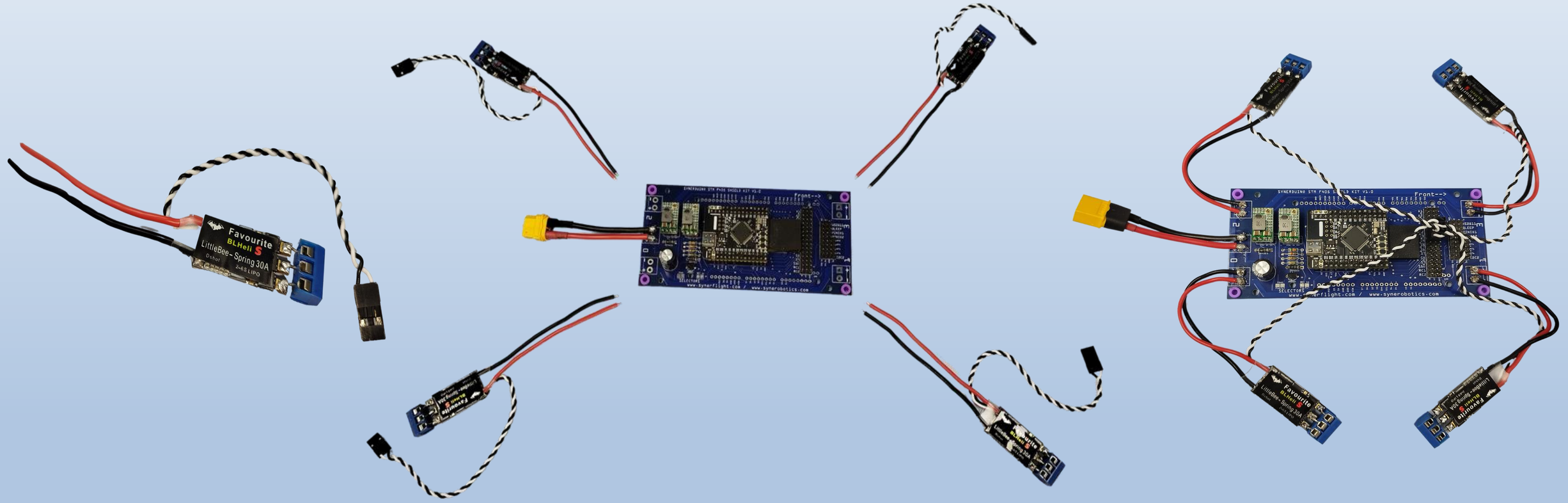
Note : you can pre solder the motor to the board and check for rotation before installing the propeller to ensure all motor rotations are correct

Electronic Speed Controller

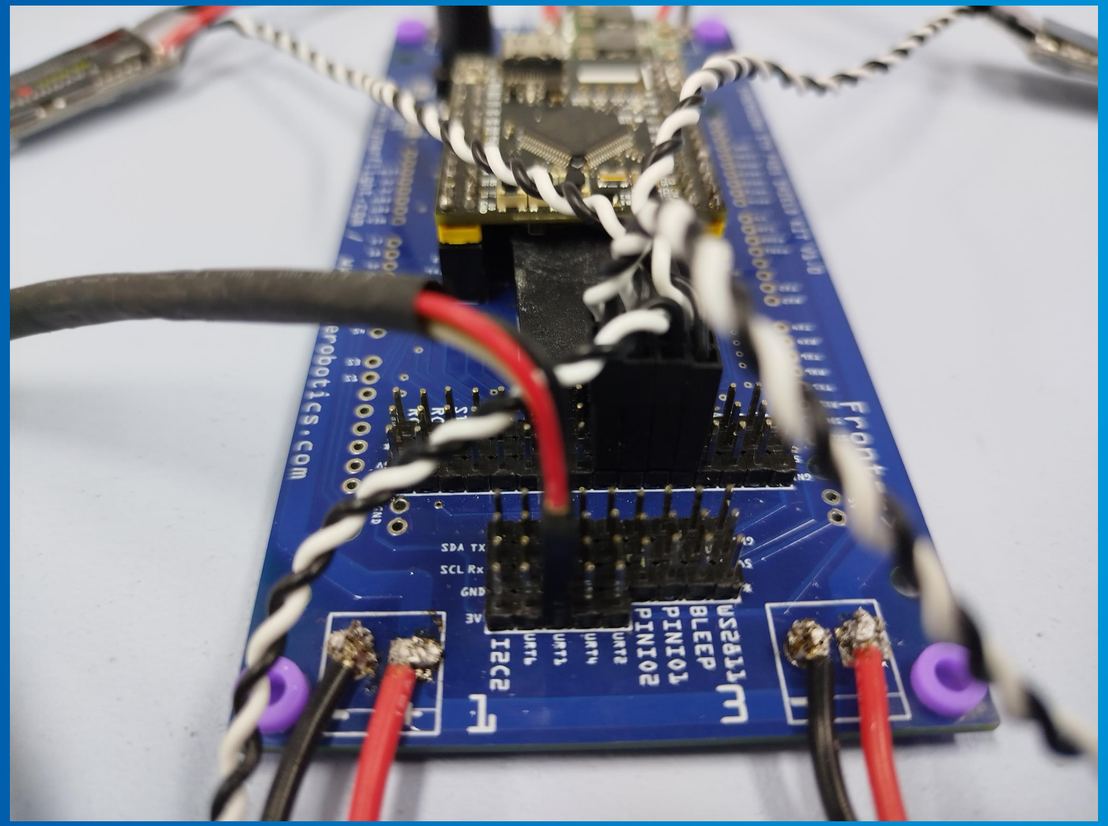


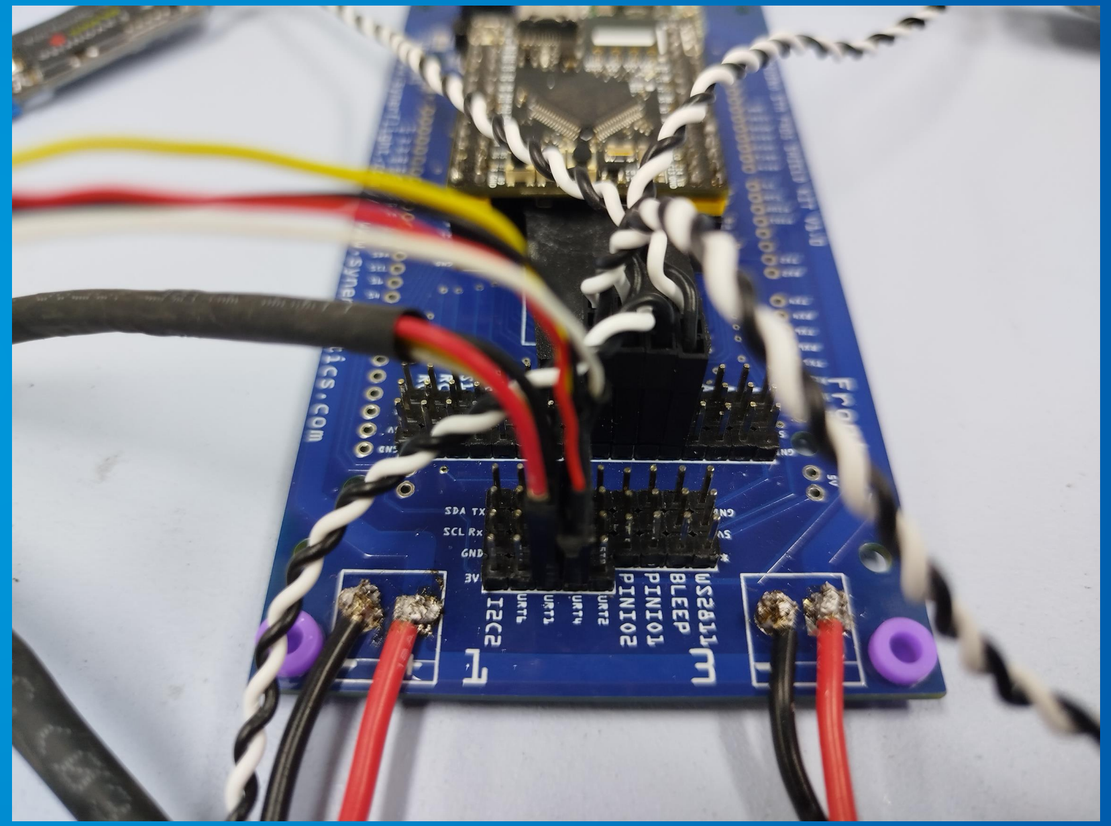
Note : on some brands of motor they may come in two different prop nuts color (Known as self tightening nuts)

ESC INSTALLATION

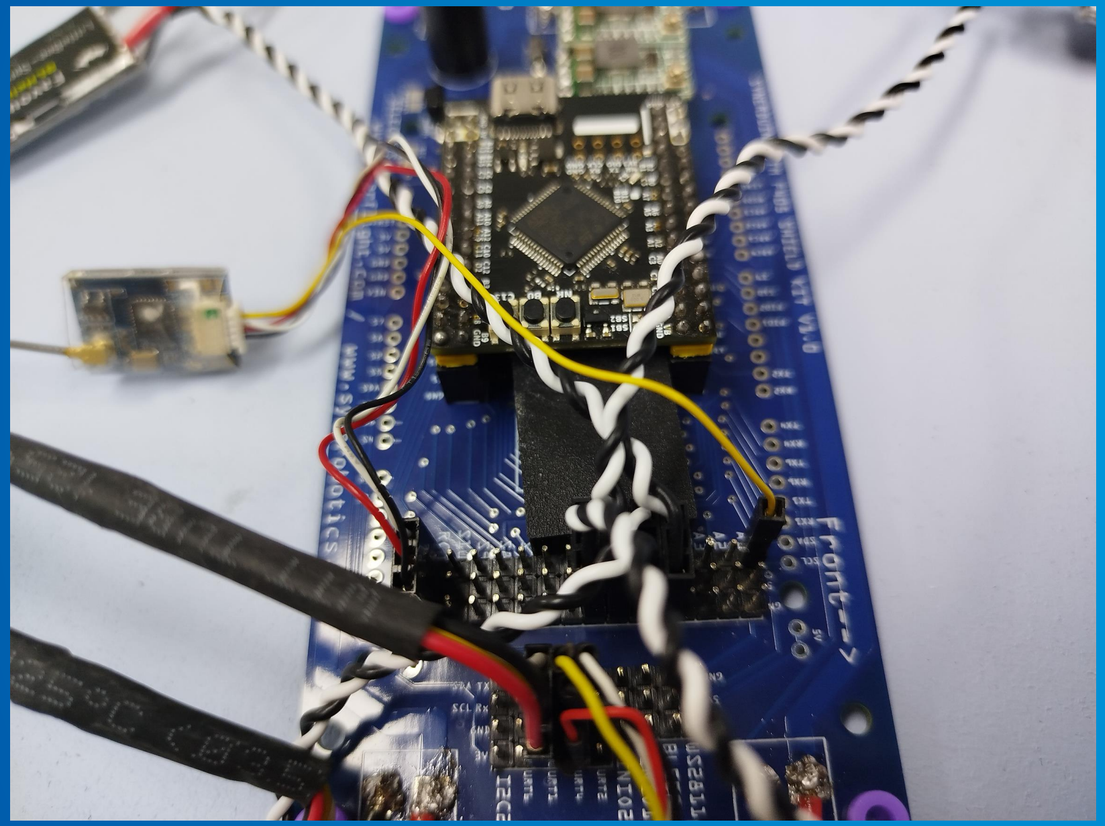


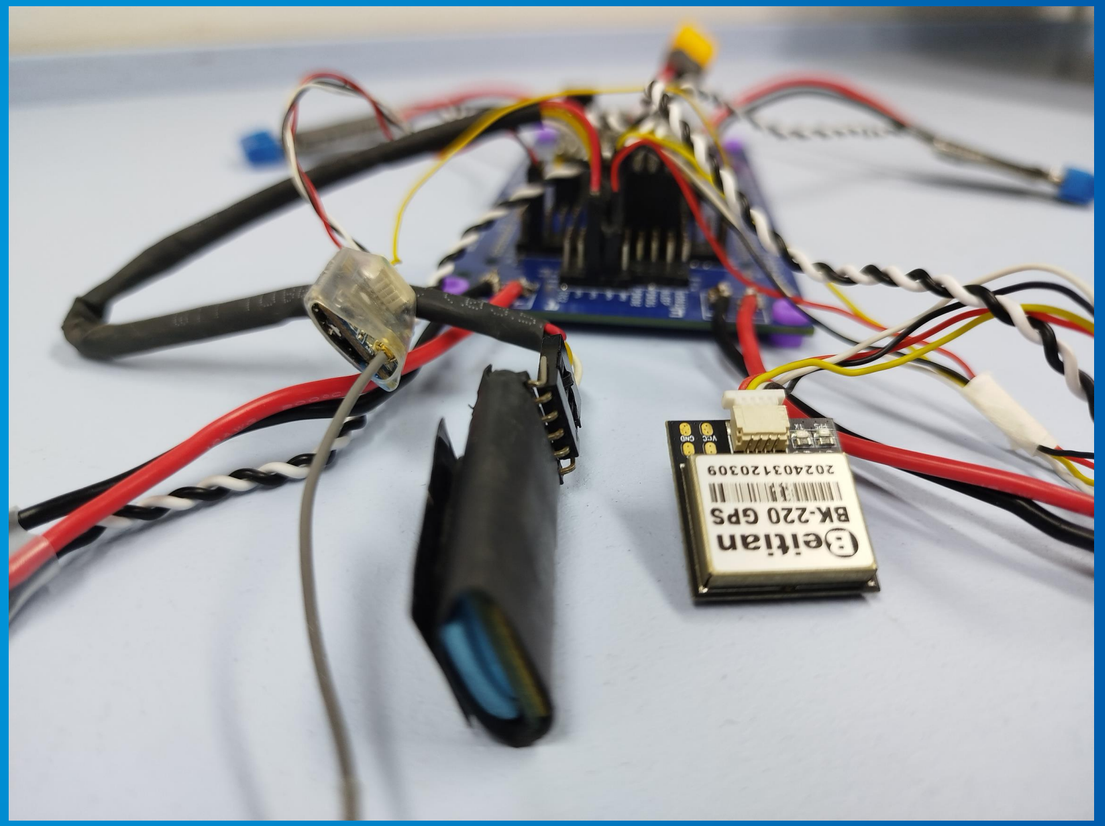
ASSEMBLY


SDA TX
SCL Rx
GND
3V
I2C2
WS2811
BLEEP
PINI01
PINI02


SDA TX
SCL Rx
GND
3V
I2C2
WS2811
BLEEP
PINI01
PINI02

ASSEMBLY





MOTOR, INSTALLATION

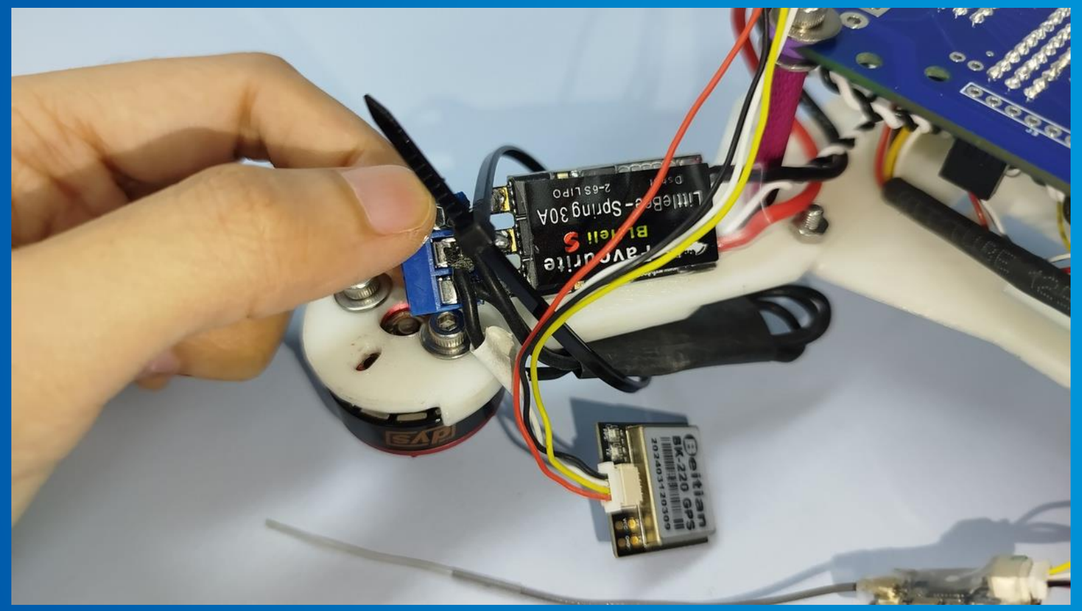
Motor is Held in by 4pcs of 6mm Bolts and Washer set

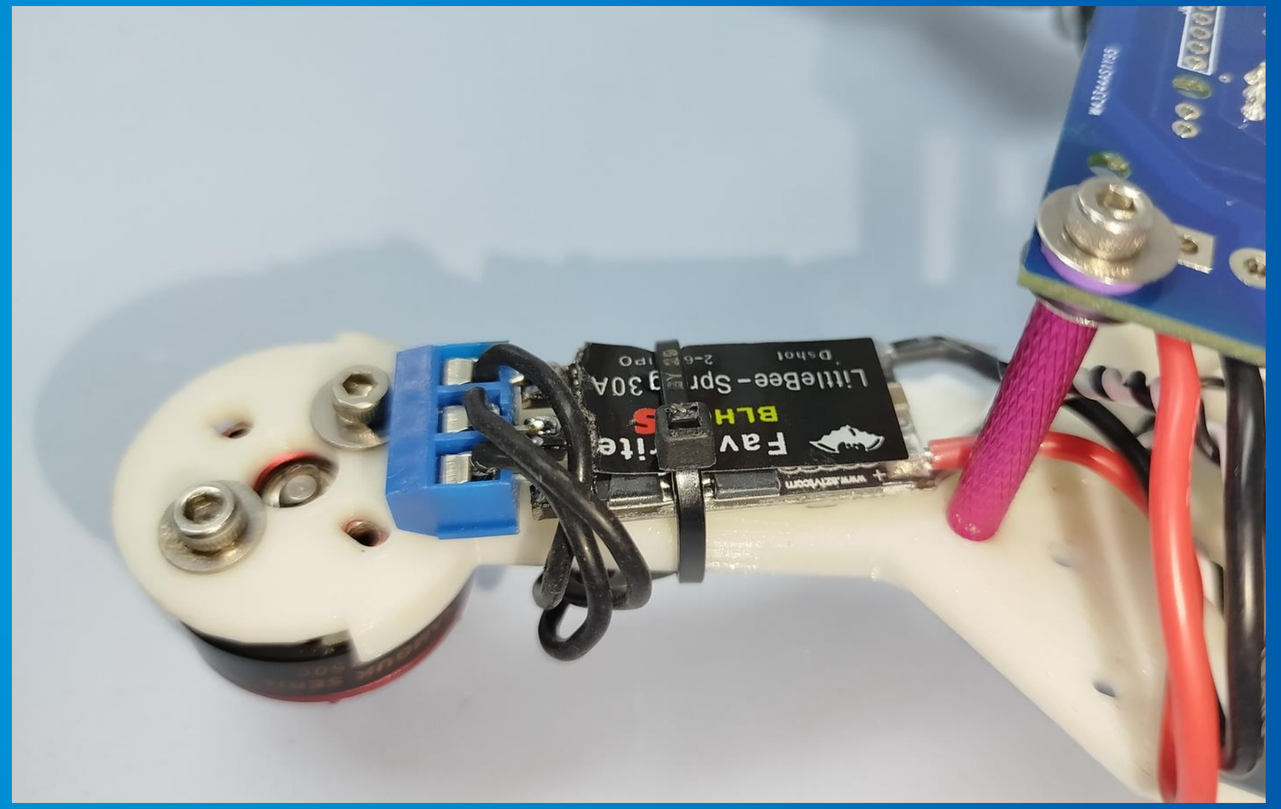
Bolt thread Must thread lock before installation to ensure it stay on

Thread Lock 242 blue or 222 Purple for light loads

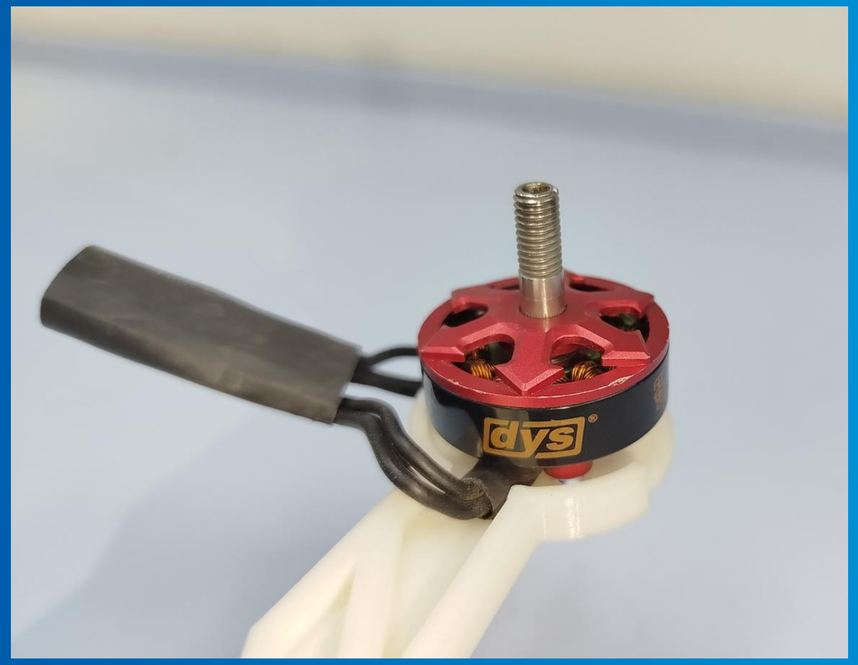
PVA White Glue

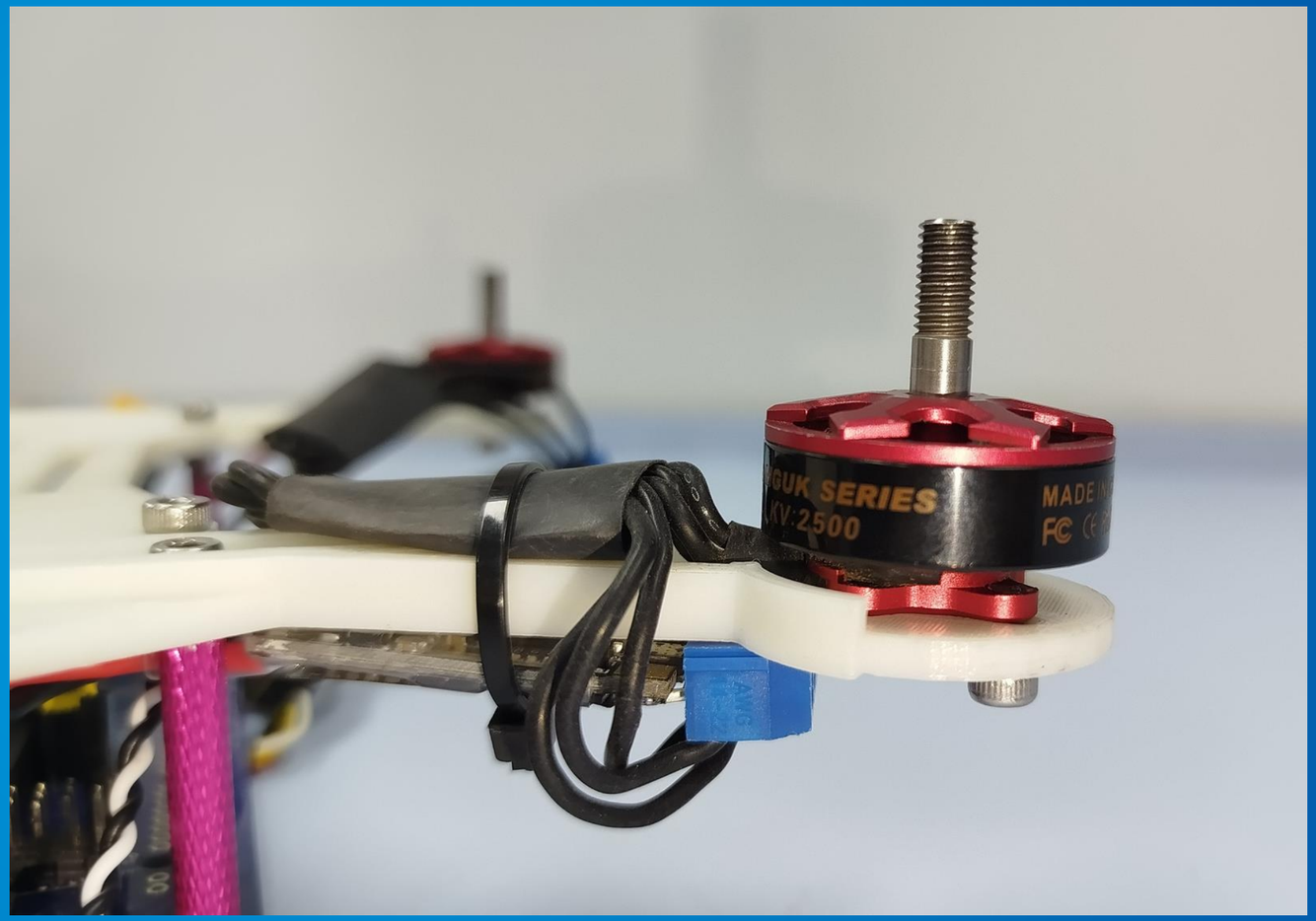
ASSEMBLY



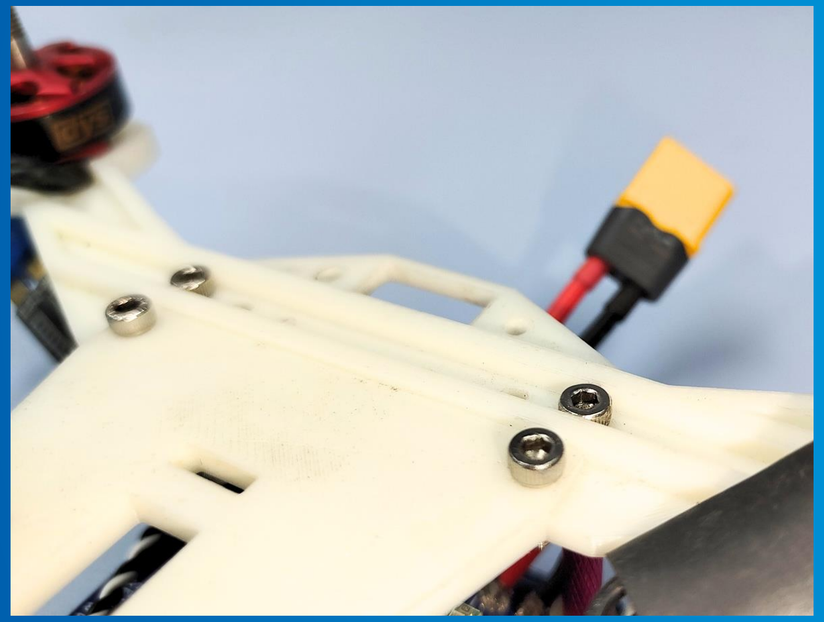


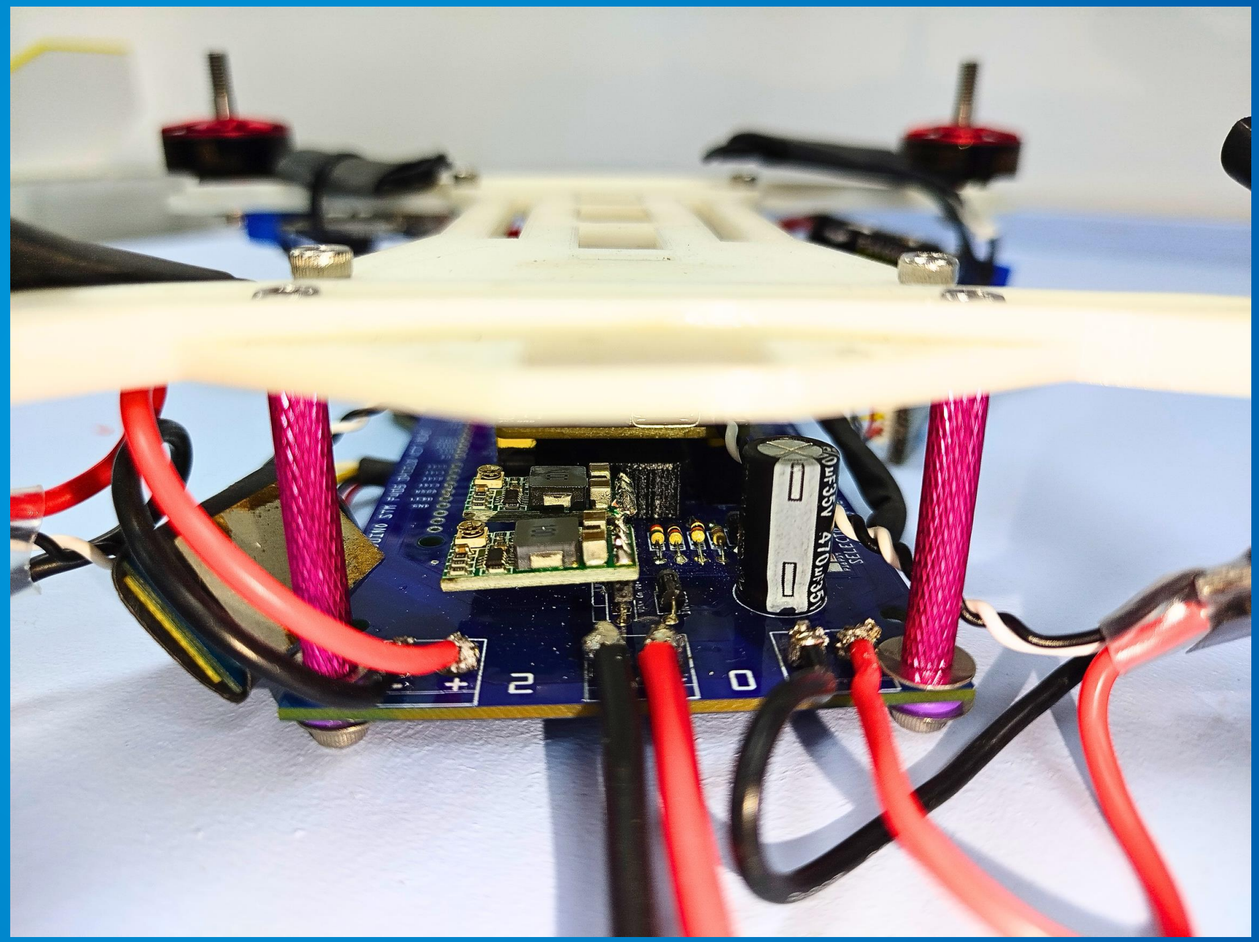
ASSEMBLY



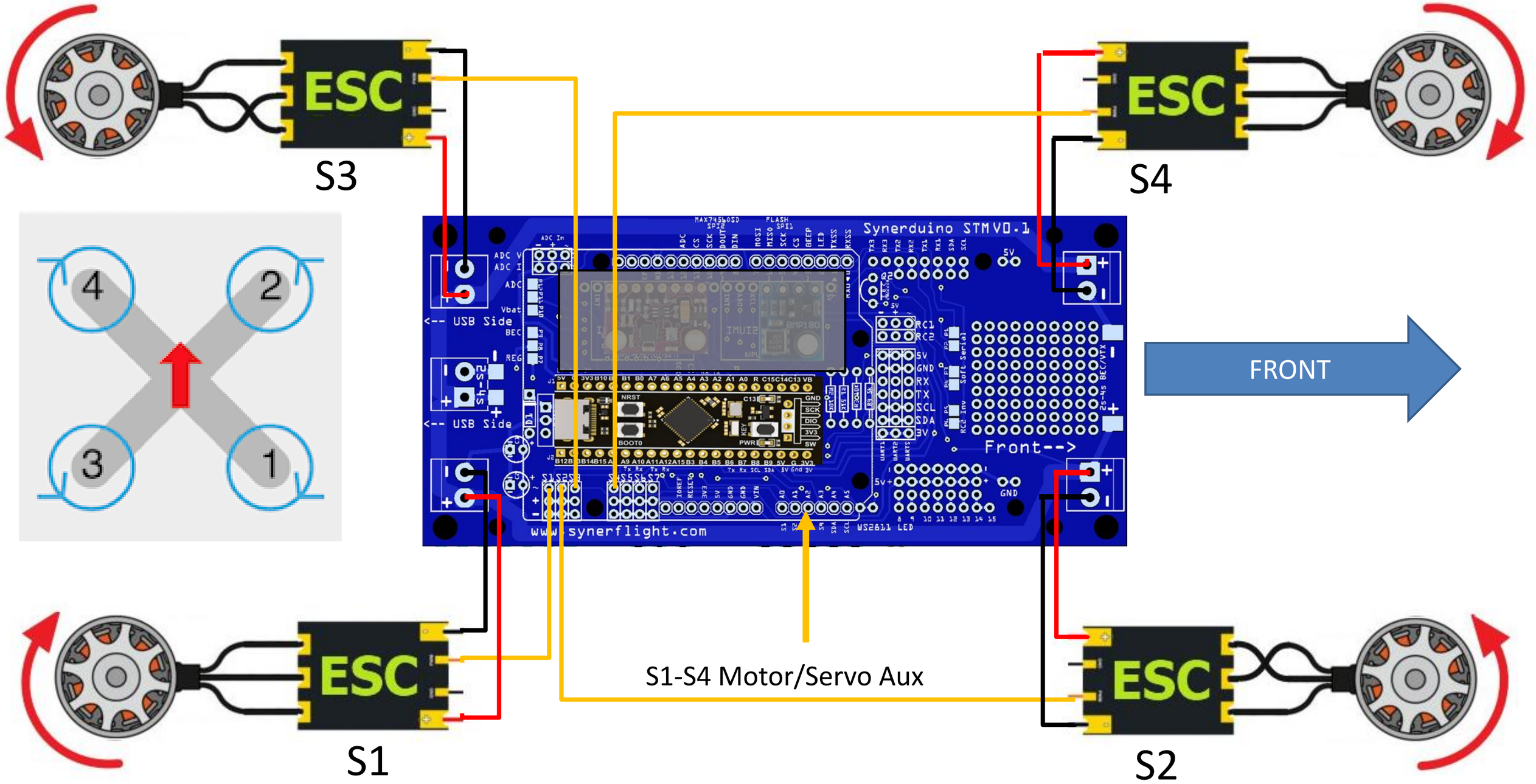


ASSEMBLY

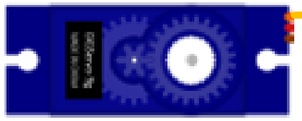




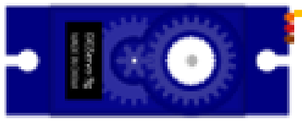
Multirotor Setup



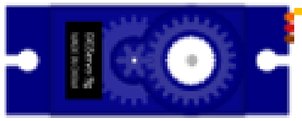
Fixwing Setup



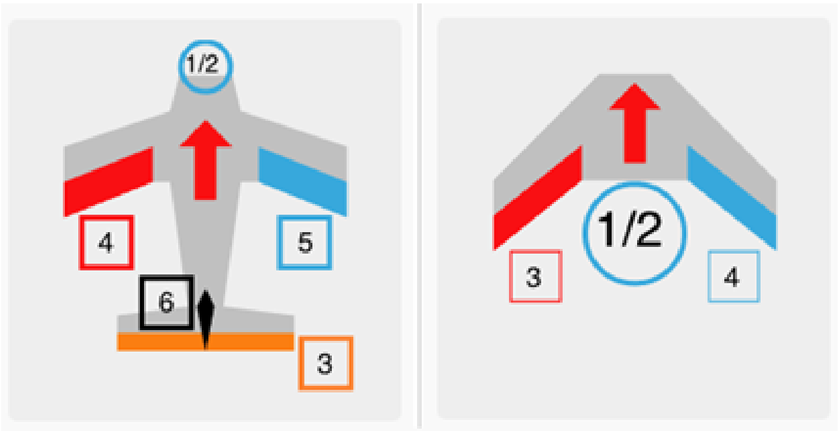
S5

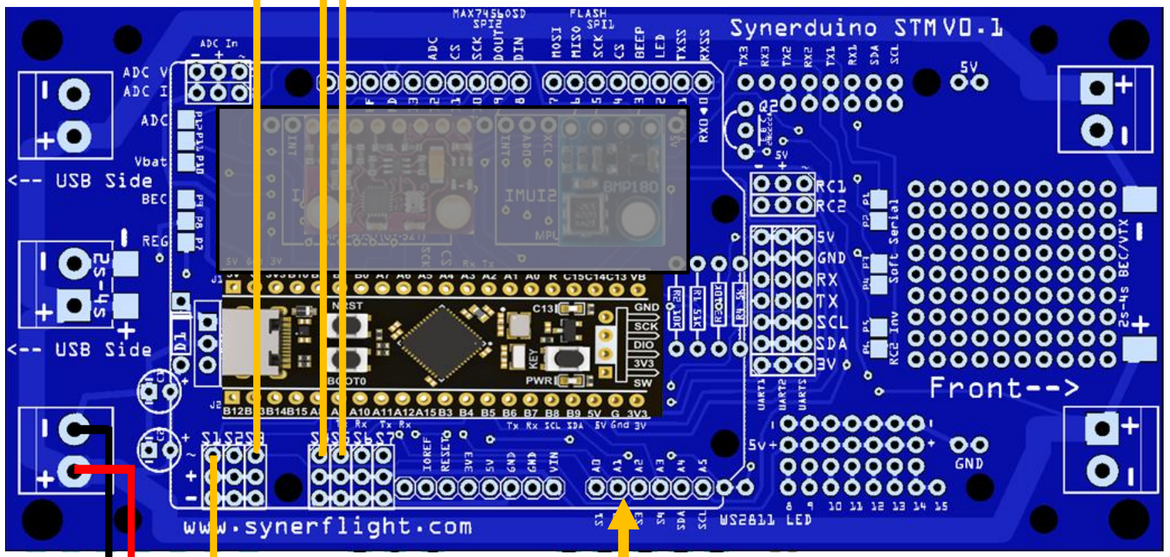


S4



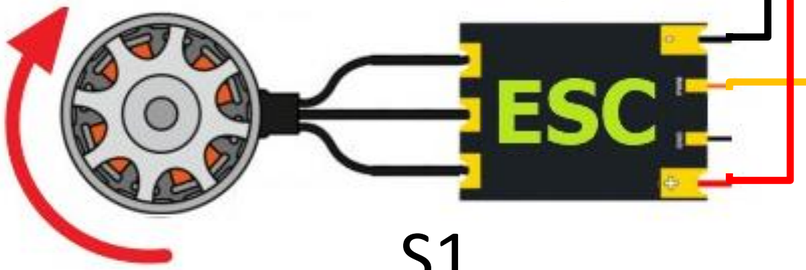
S3





FRONT

ESC W/ UBEC



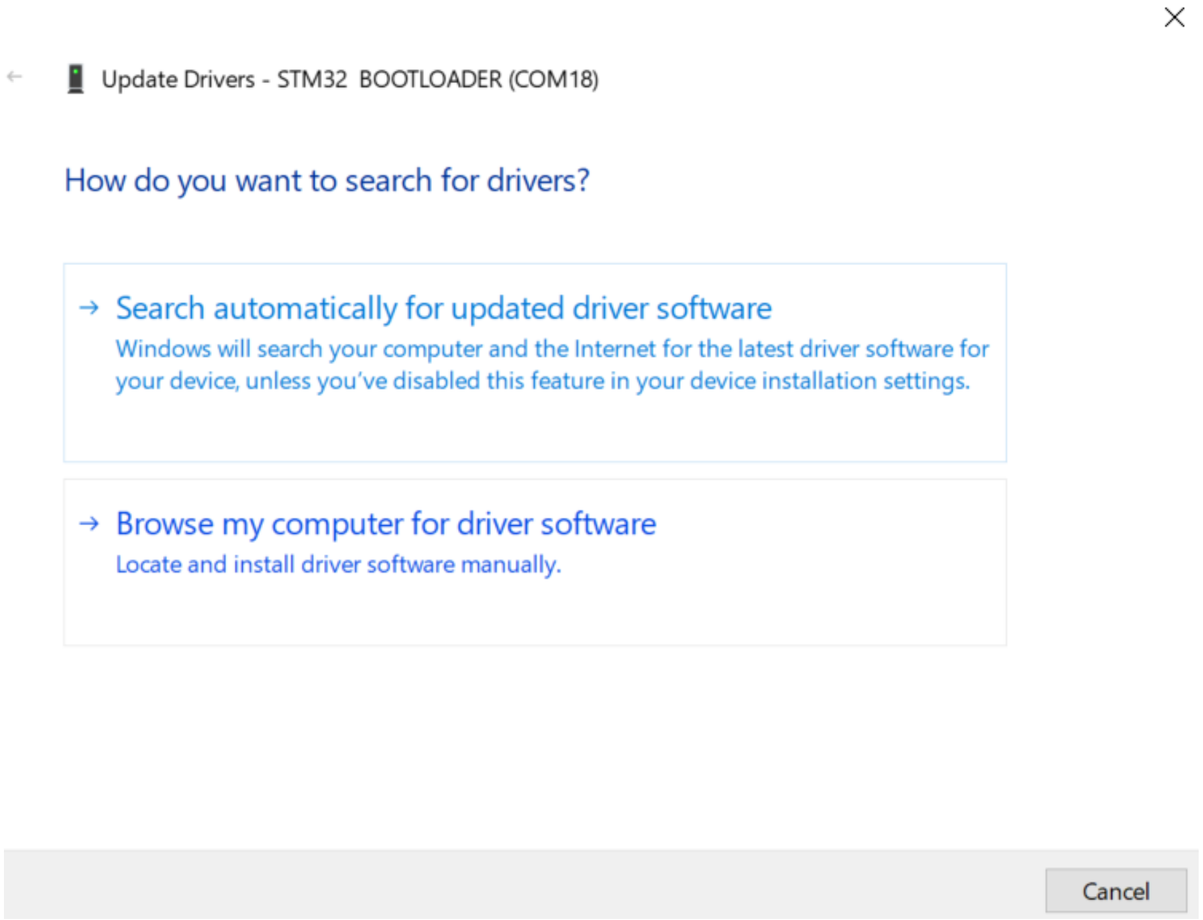
S1

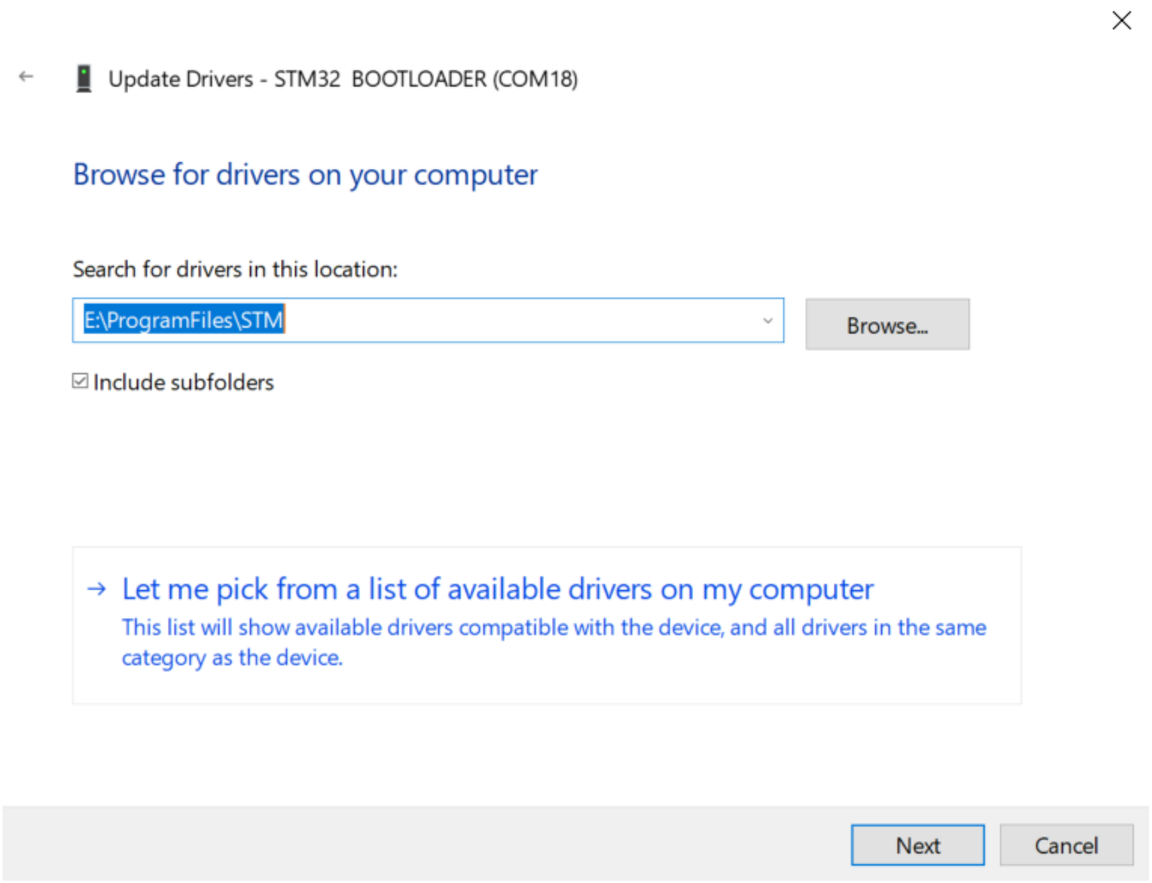
S1-S4 Motor/Servo Aux

SOFTWARE SETUP

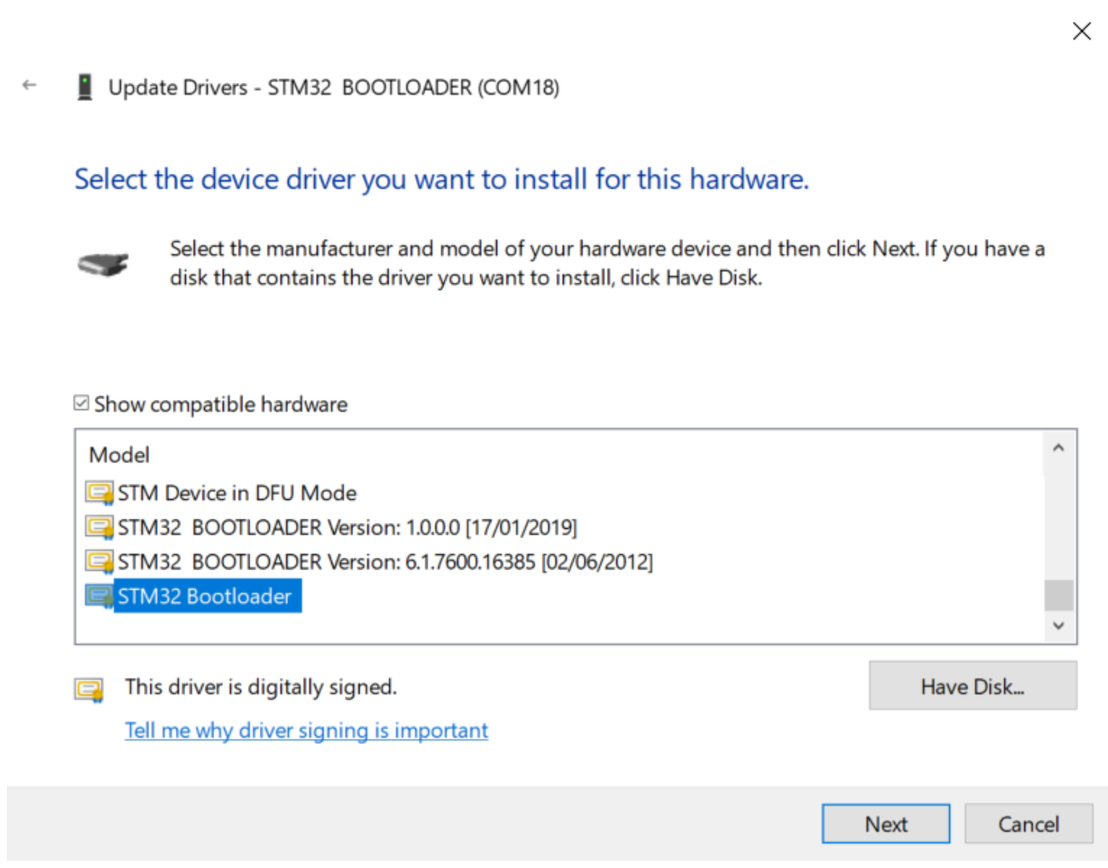
FIRMWARE INSTALLATION

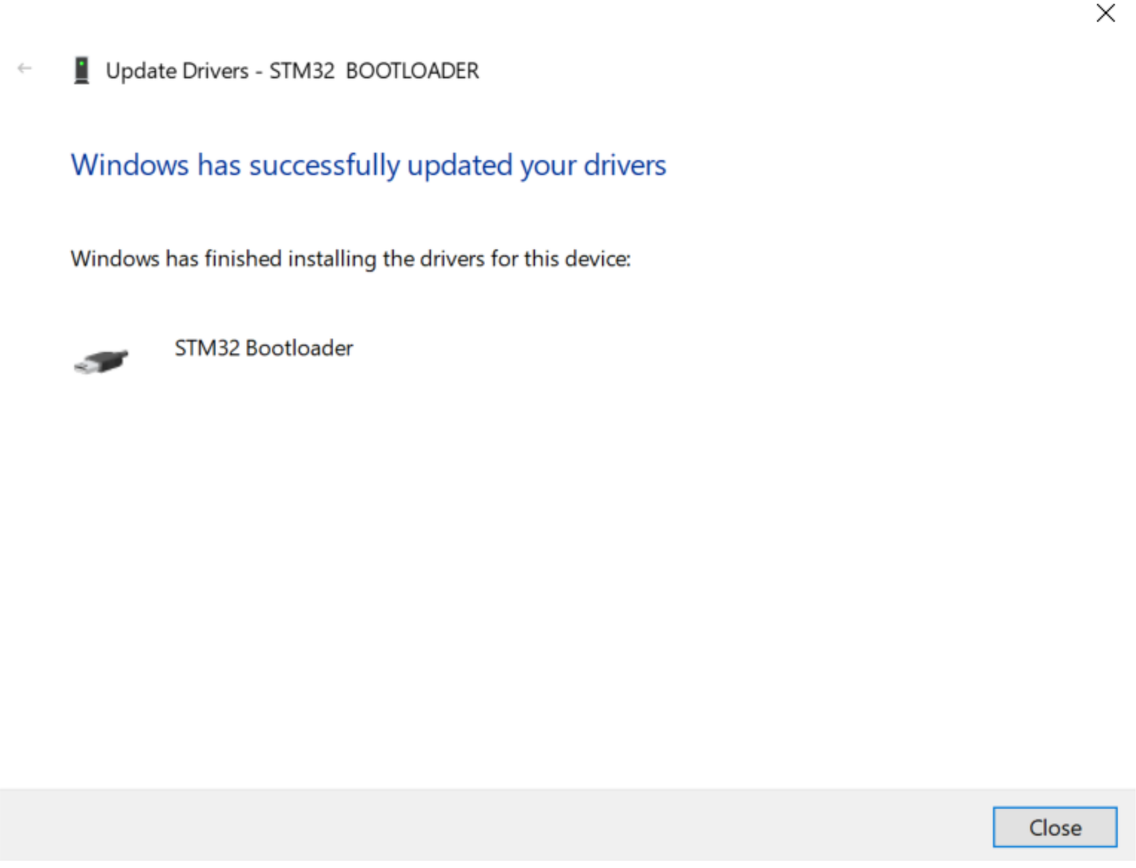
- Browse my Computer for Driver
- Let Me Pick from List





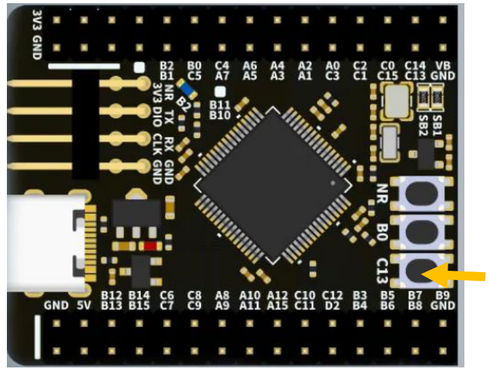
FIRMWARE INSTALLATION

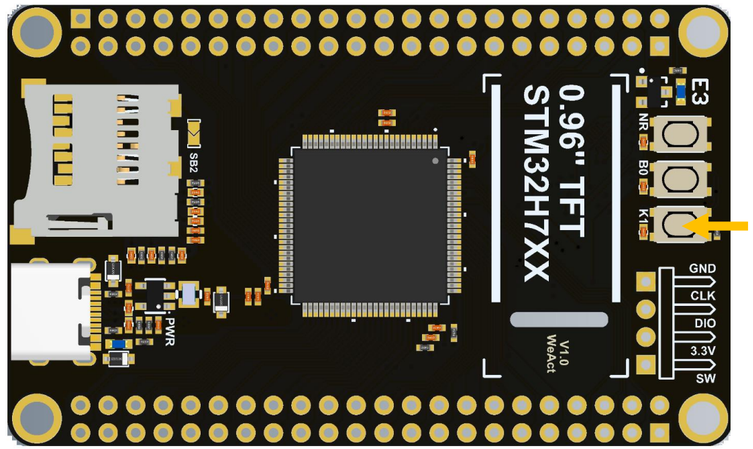


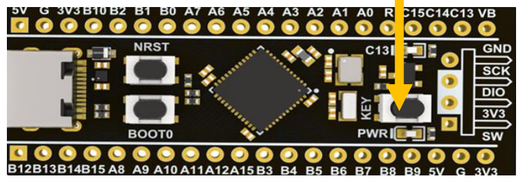


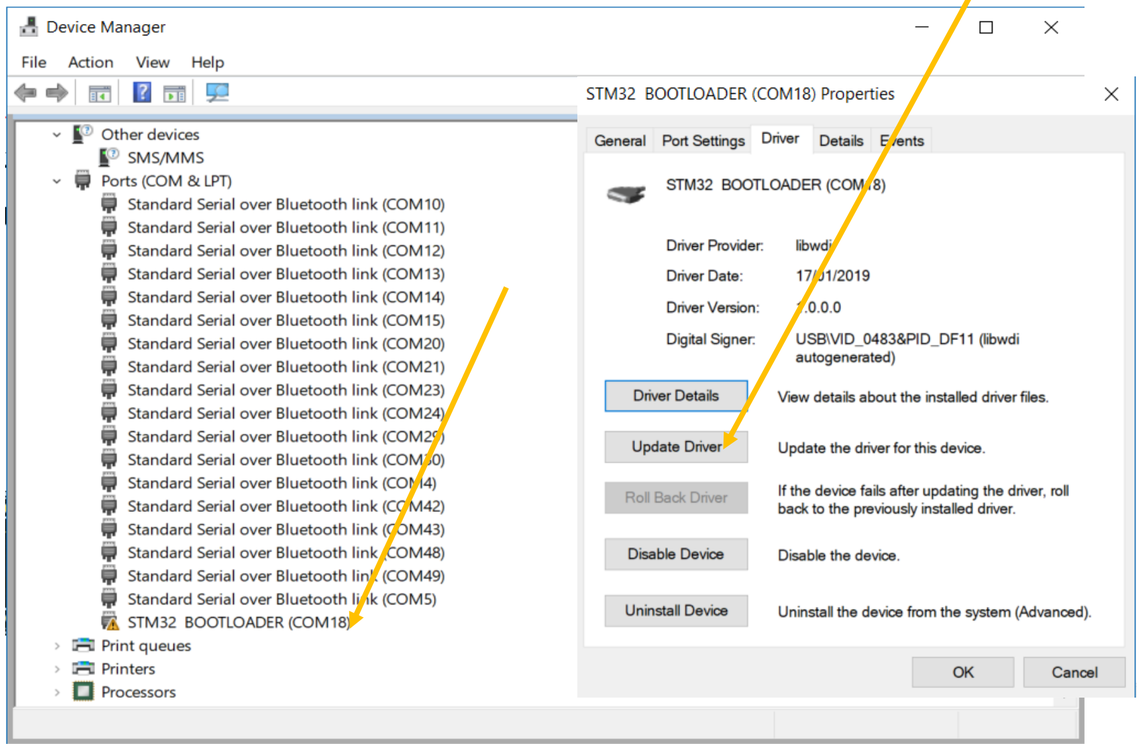
FIRMWARE INSTALLATION

- Plug in USB you see Blue Led fading in and out
- Hold the Key Button for 3seconds till the blue light flashes and goes out
- In device manager the STM32 Bootloader (Com should show up)
- Note : this is for Brand new boards that were not flash with firmware , skip this for Synerduino package kits as they are preflashed for your convenience

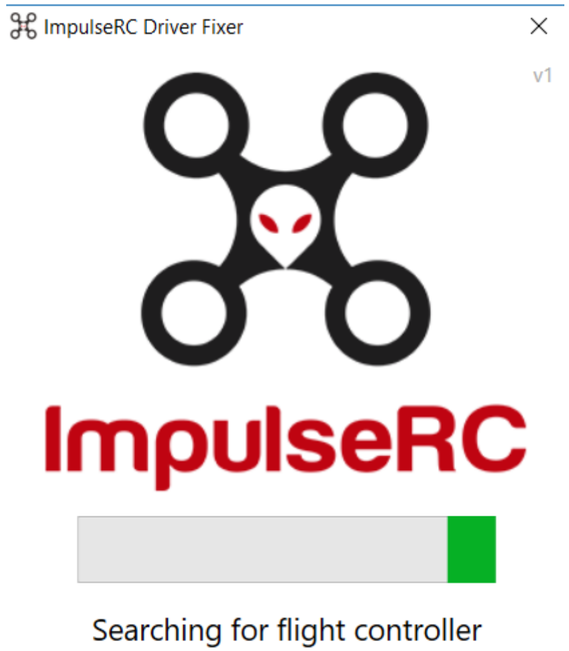








FIRMWARE INSTALLATION

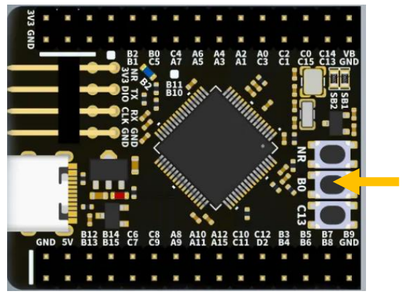


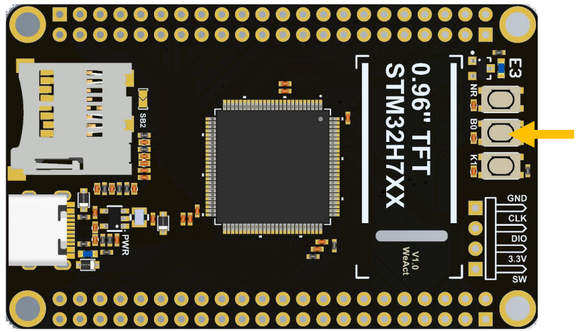
ImpulseRC Driver Fixer

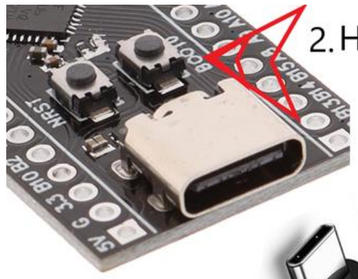
https://impulserc.blob.core.windows.net/utilities/ImpulseRC_Driver_Fixer.exe

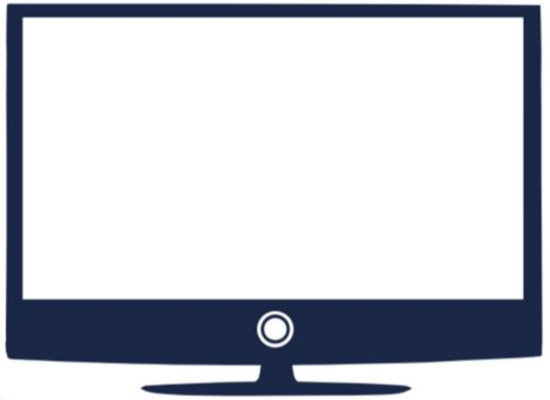
- Start ImpluseRC Driver Fixer
- Connect the FC USB to the PC While On DFU mode . (DO NOT power on FC via external 5V or Vbat)
- The ImpulseRC Driver Fixer should then see and load the proper driver

FIRMWARE INSTALLATION









After Flashed Processor setup

This can also be done by holding down the boot button while pressing the NRST button to reset the board . This is just like unplugging and plugging the USB
(only to be use on a pre flashed blackpill)

F411 DFU mode can sometimes take several attempts as Windows may not recognize the device mode
Its require to preheat heat the chip to 25c with your finger for some Reason.

Synerduino STMF411 board a preheat can be made by running the board with the battery for 1 min

FIRMWARE INSTALLATION

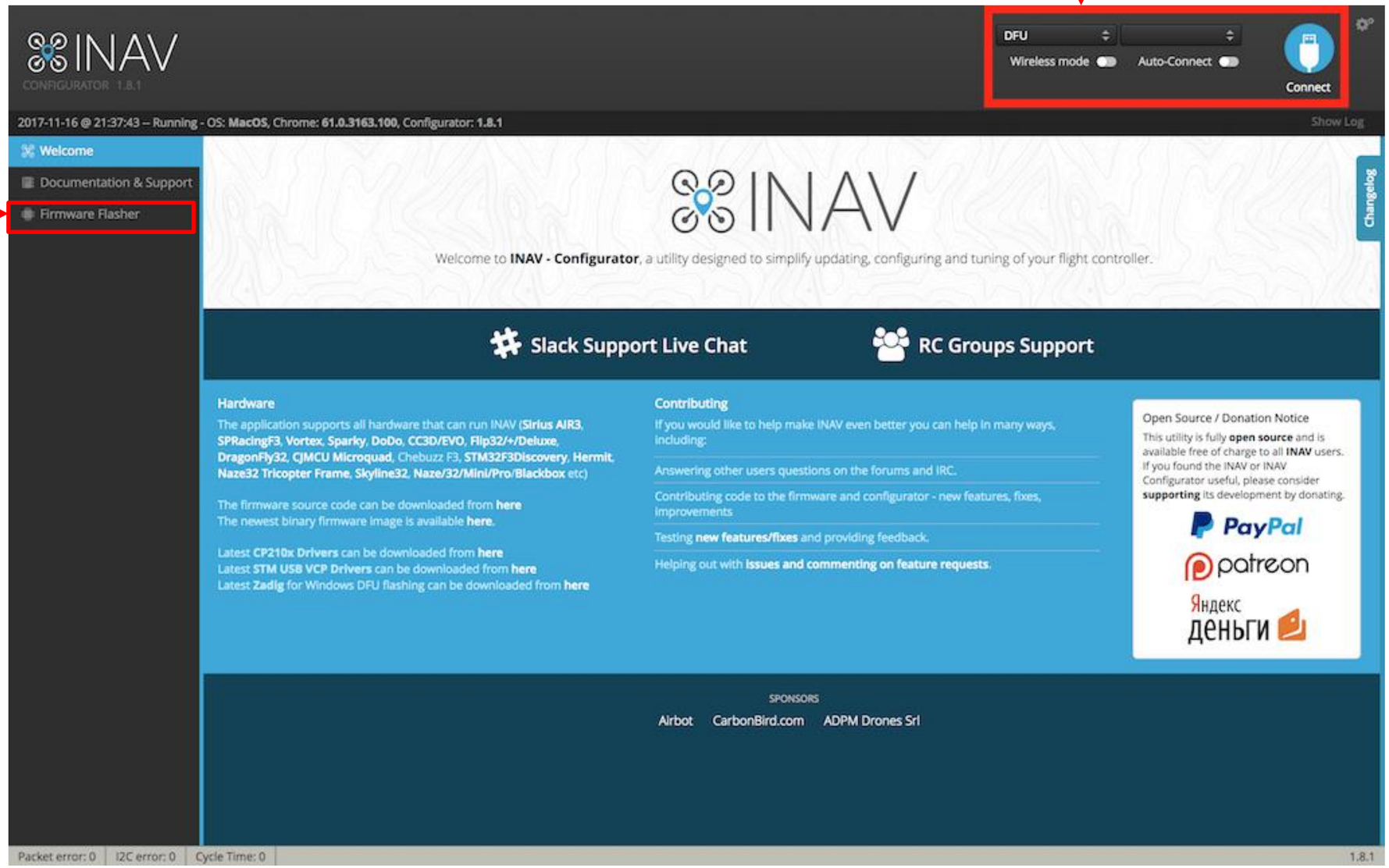
- Start INAV configurator
- Connect the FC USB to the PC while holding the boot button in.
- INAV configurator should show it’s connected in DFU mode in the top right corner (DO NOT click the CONNECT button)
- Choose the latest hex file for your FC and then “Load Firmware local”. Once loaded, click “Flash Firmware”.

Download Configurator for Windows platform (win32 or win64 is present) Extract ZIP archive Run INAV Configurator app from unpacked folder Configurator is not signed, so you have to allow Windows to run untrusted application. There might be a monit for it during first run

FIRMWARE INSTALLATION

When you've successfully connected, the Configurator will recognize a device in DFU mode – which will be reflected in the port selection tab at the top. (Do Not Connect at this point)

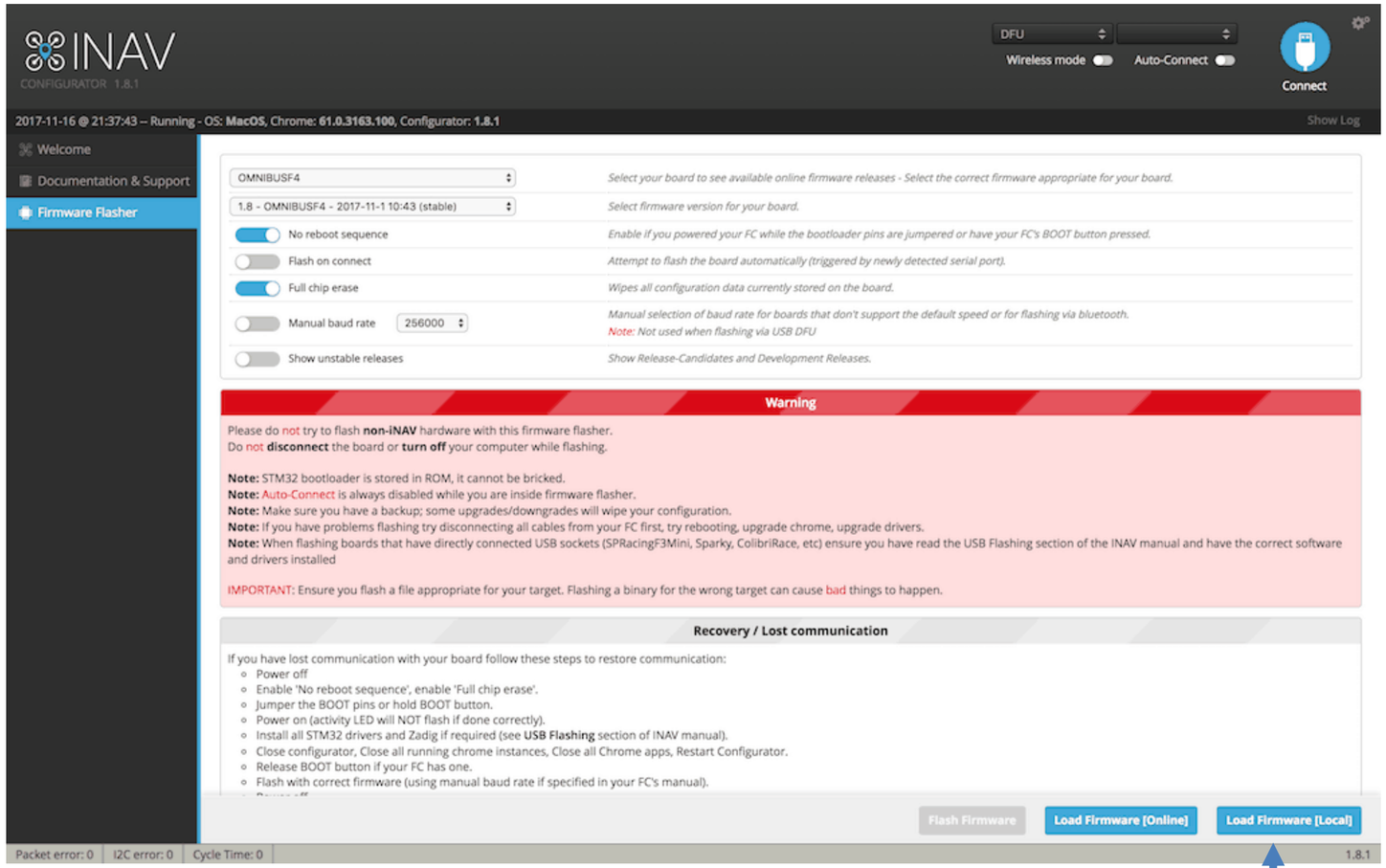
Next, click on the Firmware Flasher tab



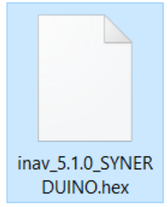
DFU (**Device Firmware Update**) mode is an incredibly useful feature on modern microcontrollers. It allows for quick and easy updates to a device's firmware without the need of extra piece of hardware.

Typical Boot Button or Jumper is required to turn on the microcontroller into DFU mode

FIRMWARE INSTALLATION



Synerduino STM Hex files are available at Downloads Tab



Next, click on the Firmware Flasher tab and select your correct board and the latest release of the firmware, make sure “Full Chip Erase” is selected and click Load Firmware Local and Select the hex File that matches the version of your configurator and Shield Board

Once this process is Done and Rebooted you can now select your Serial Com port and Connect to the Synerduino STM Shield

Load Firmware [Local]

Look for the

INAV 5.1.0 – INAV8.0.0
SynerduinoSTMF411.hex
SynerduinoSTMF405.hex
SynerduinoSTMH743.hex

SETTING UP YOUR DRONE

SETUP

After the Firmware installation you may connect normally to the board using the Com and baud assign to it (115600) default baud

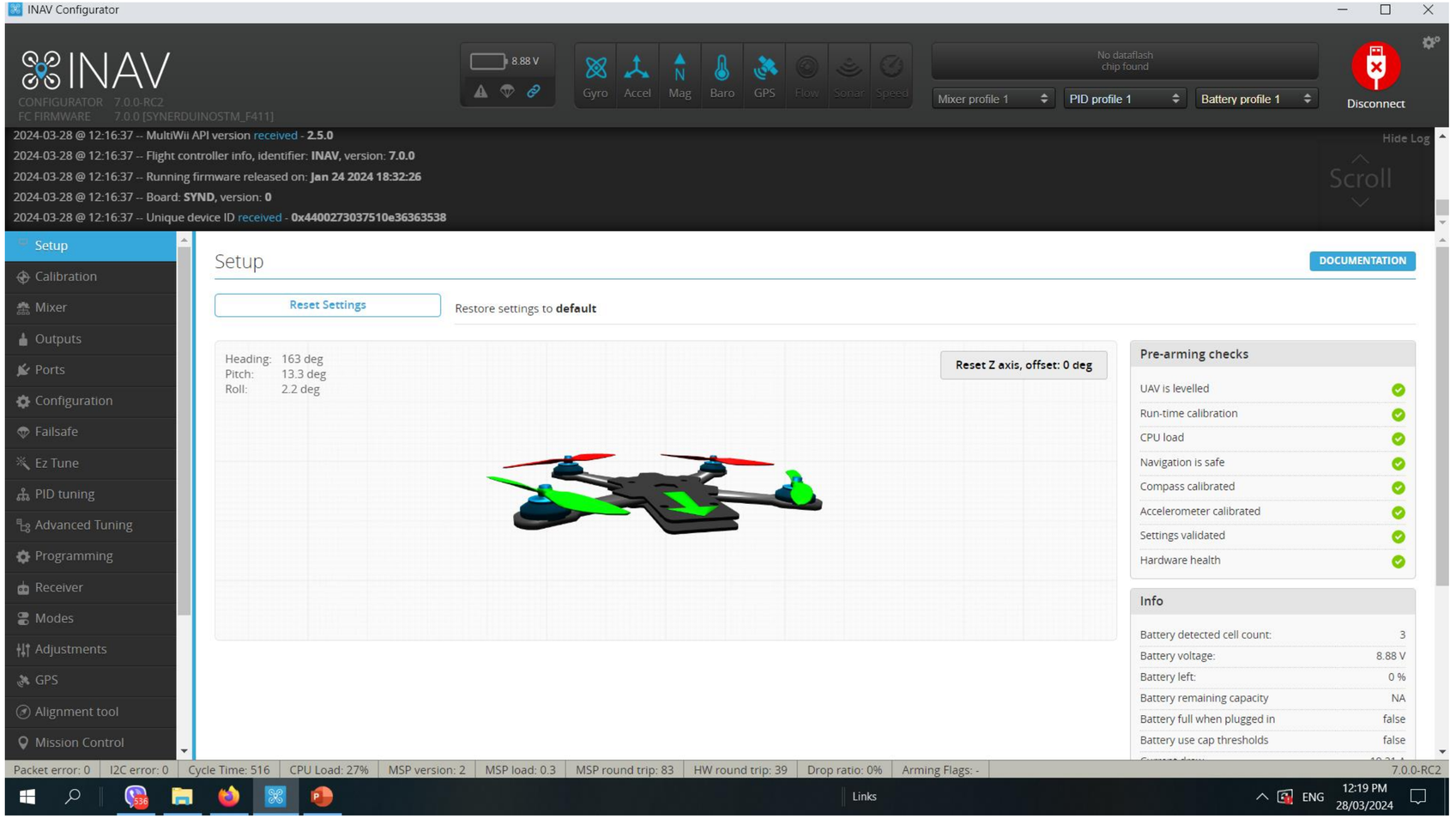
This is where you check the Status of your drone

Frame type ,orientation and other important information

Ensure all Pre-Arming checks are in the Green otherwise pls check the configuration or hardware of issue

The Tab on top indicates the Sensors and status

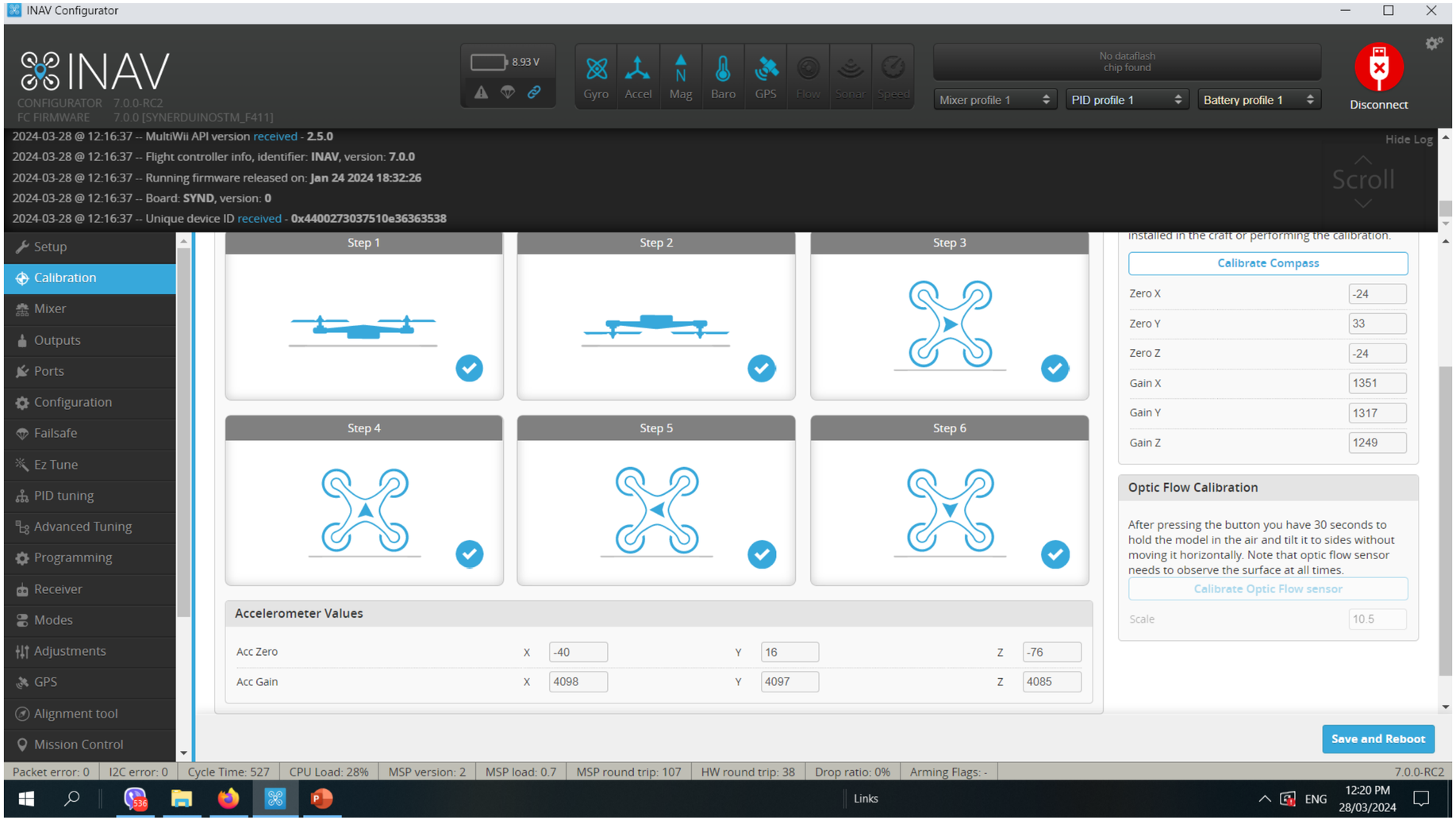
Red means it has issue
Blue is Active
Grey out is not available



SETTING UP YOUR DRONE

CALIBRATION

Before the controllers goes into the airframe it has to be first calibrated



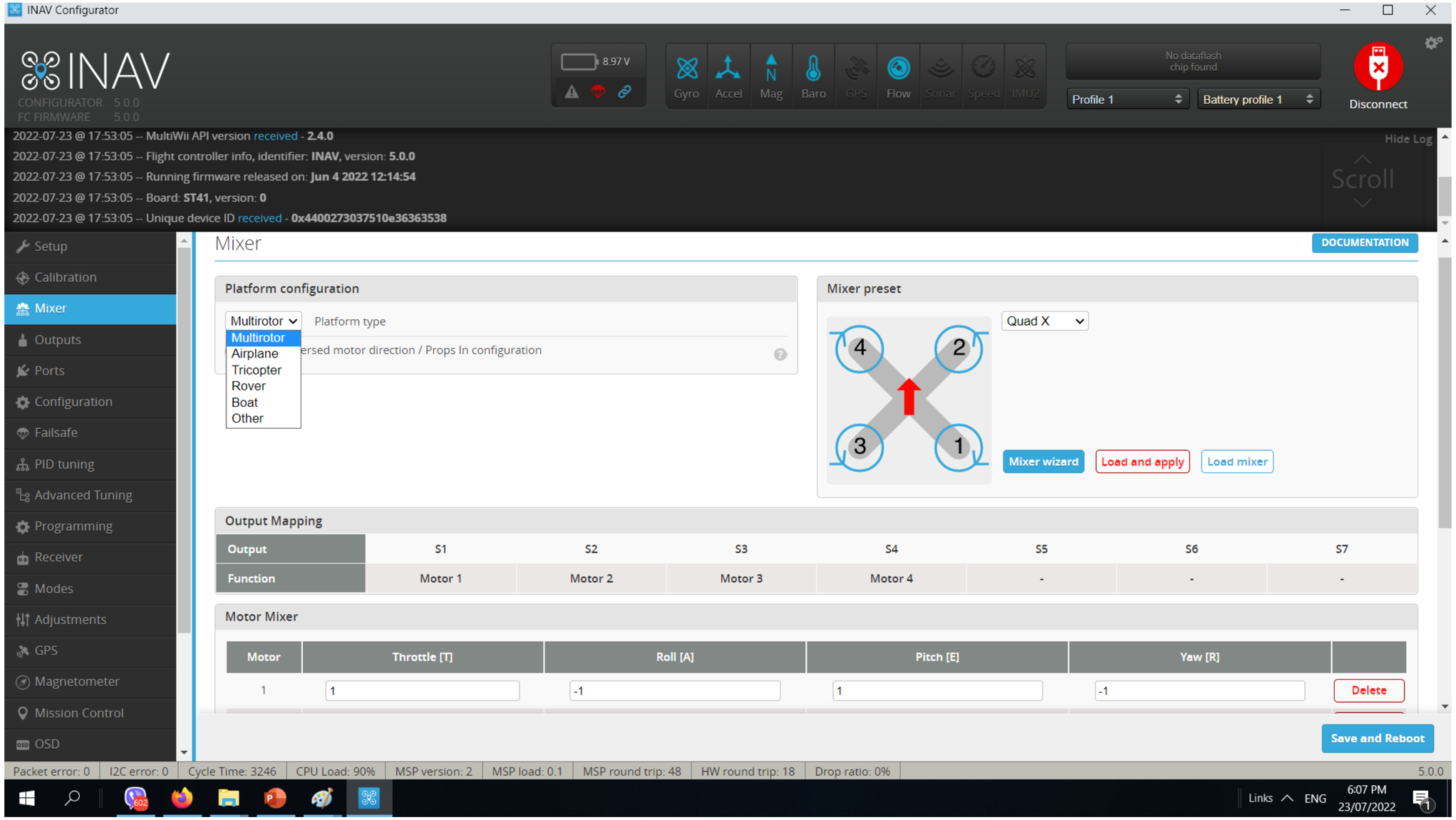
SETTING UP YOUR DRONE

MIXER (INAV5-6)

Airframe or Vehicle time Preset and mix selection

Load and apply when selected then Save Reboot

- Multirotor
- Airplane
- Tricopter
- Rover
- Boat
- Others



SETTING UP YOUR DRONE

MIXER Applicable for (INAV5-INAV6)

Note INAV5-INAV6 SynerduinoSTM has Two Firmware with different output arrangement for different vehicle types , (You can get creative in mixing for custom frame designs)

SYNERDUINOSTM.Hex (Default Loaded)

```
(TIM_USE_MC_MOTOR | TIM_USE_FW_MOTOR), // S1
(TIM_USE_MC_MOTOR | TIM_USE_FW_MOTOR), // S2
(TIM_USE_MC_MOTOR | TIM_USE_FW_SERVO), // S3
(TIM_USE_MC_MOTOR | TIM_USE_FW_SERVO), // S4
(TIM_USE_MC_MOTOR | TIM_USE_FW_SERVO), // S5
(TIM_USE_MC_MOTOR | TIM_USE_FW_SERVO), // S6
(TIM_USE_MC_SERVO | TIM_USE_FW_SERVO), // S7
```

Vehicle Preset Mix

```
QUAD X
QUAD +
QUAD A-Tail
Y4
Y6
Hex X
Hex +
Hex H
```

```
FlyingWing
Airplane
Airplane No Rudder
Airplane V-Tail 2 Aileron Servo
Airplane V-Tail 1 Aileron Servo
Other Stuff
```

SYNERDUINOSTMSV.Hex

```
(TIM_USE_MC_MOTOR | TIM_USE_FW_MOTOR), // S1
(TIM_USE_MC_MOTOR | TIM_USE_FW_MOTOR), // S2
(TIM_USE_MC_MOTOR | TIM_USE_FW_MOTOR), // S3
(TIM_USE_MC_MOTOR | TIM_USE_FW_MOTOR), // S4
(TIM_USE_MC_SERVO | TIM_USE_FW_SERVO), // S5
(TIM_USE_MC_SERVO | TIM_USE_FW_SERVO), // S6
(TIM_USE_MC_SERVO | TIM_USE_FW_SERVO), // S7
```

Vehicle Preset Mix

```
Quad X W/ Gimbal
Quad + W/ Gimbal
Single Copter
Bi-Copter
Tricopter
Rover
Boat
Camera Gimbal
```

```
FlyingWing Differential thrust
Airplane Differential Thrust
Airplane V-Tail Differential Thrust
Other Stuff
```

SETTING UP YOUR DRONE

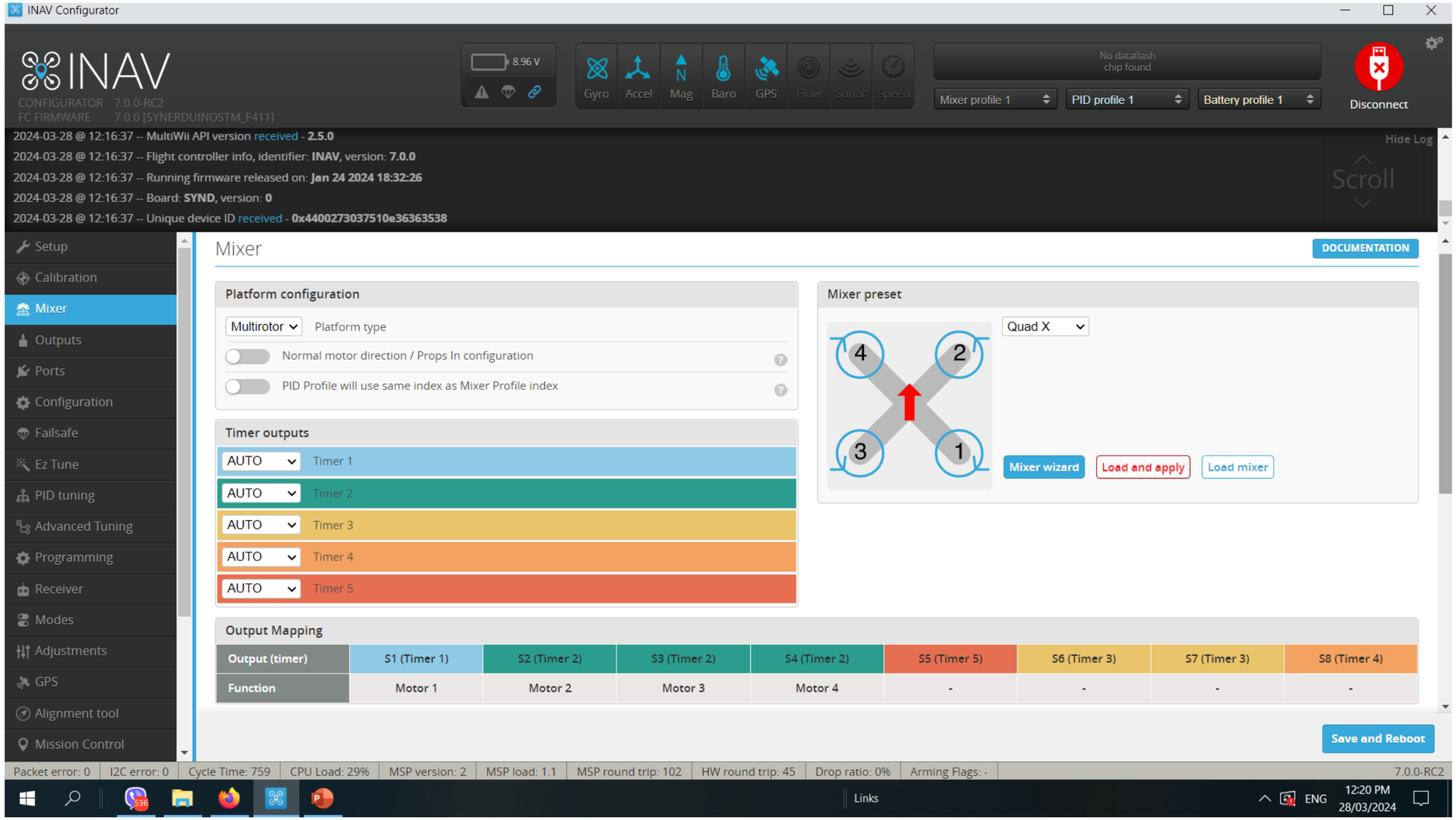
MIXER (INAV7-8)

Airframe or Vehicle time Preset and mix selection

Load and apply when selected then Save Reboot

- Multirotor
- Airplane
- Tricopter
- Rover
- Boat
- Others

Mixing is now color coded to timer availability



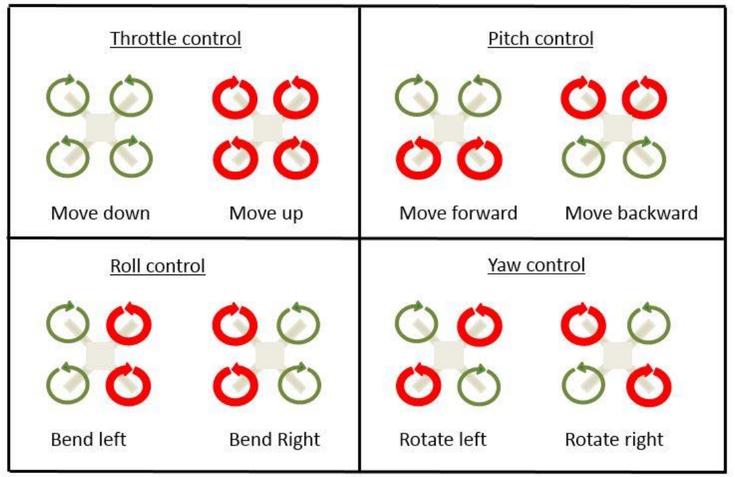
This allows you to assign motor and servo function to your custom drone frame or payload requirement this eliminates the need to recompile a new firmware for custom frame types

SETTING UP YOUR DRONE

MOTOR MIX FOR QUAD X (INAV 5-6)

THROTTLE – SPOOL UP
AILERON - ROLL RIGHT
ELEVATOR - PITCH FORWARD
RUDDER - YAW RIGHT

(-) REDUCE RPM
(+) INCREASE RPM



Normal Speed
High Speed

Output	S1	S2	S3	S4	S5	S6	S7
Function	Motor 1	Motor 2	Motor 3	Motor 4	Servo 1	-	-

Motor Mixer

Motor	Throttle [T]	Roll [A]	Pitch [E]	Yaw [R]	
1	1	-1	1	-1	Delete
2	1	-1	-1	1	Delete
3	1	1	1	1	Delete
4	1	1	-1	-1	Delete

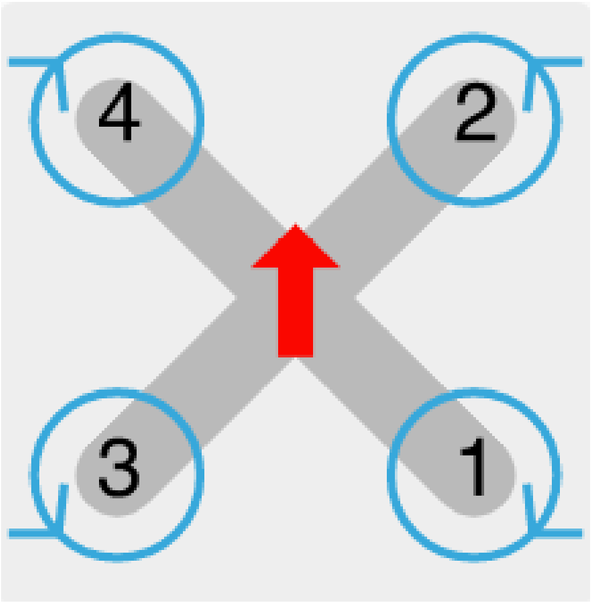
Add new mixer rule

Servo mixer

Servo	Input	Weight (%)	Speed (10µs/s)	Active	
1	RC Channel 6	100	0	Always	Delete

Logic conditions

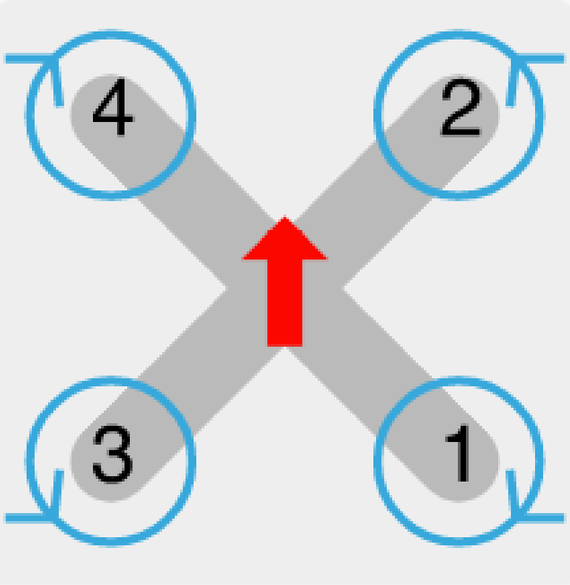
Add new mixer rule

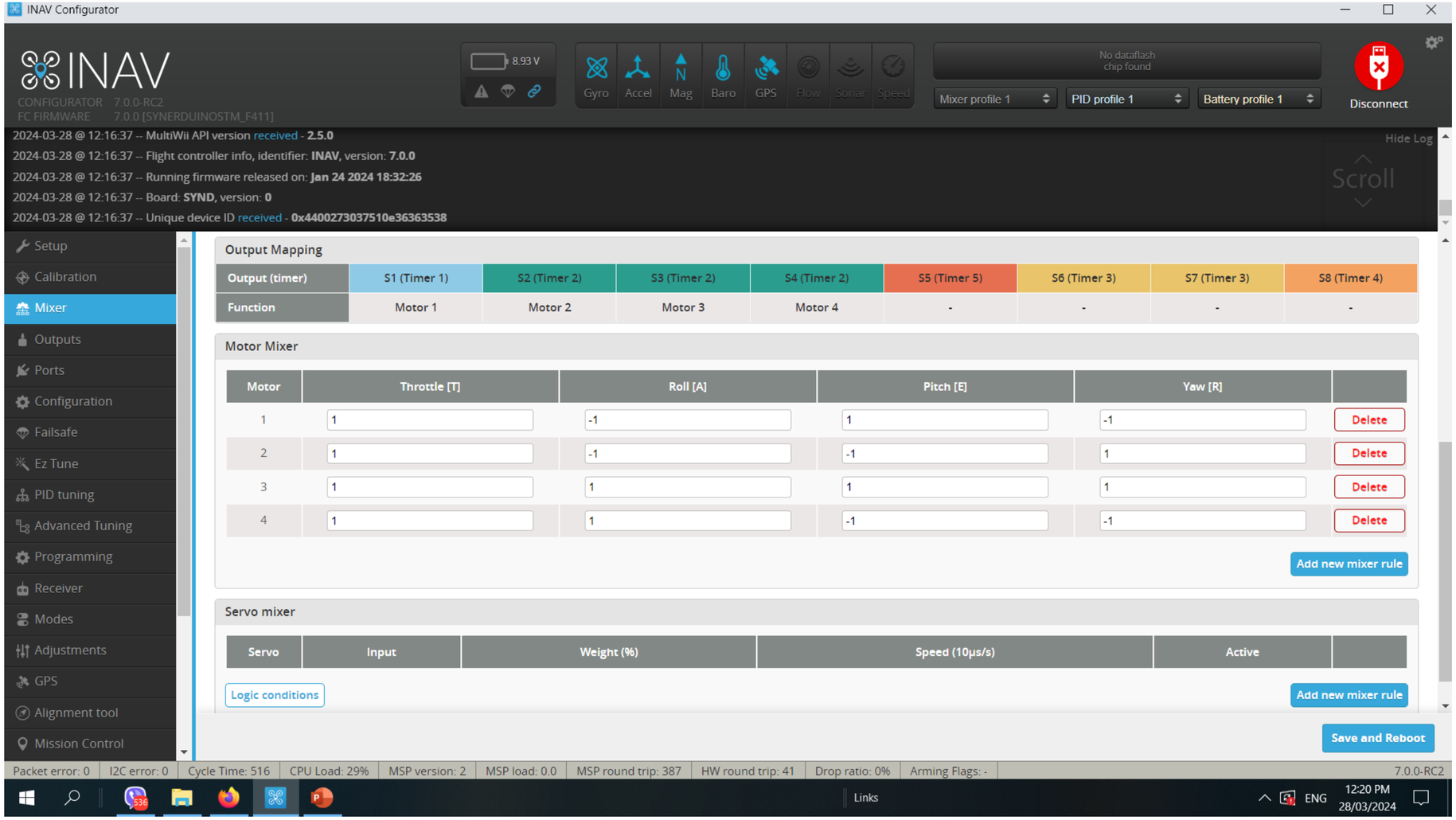


SETTING UP YOUR DRONE

MOTOR MIX FOR QUAD X (INAV 7-8)

THROTTLE – SPOOL UP
AILERON - ROLL RIGHT
ELEVATOR - PITCH FORWARD
RUDDER - YAW RIGHT



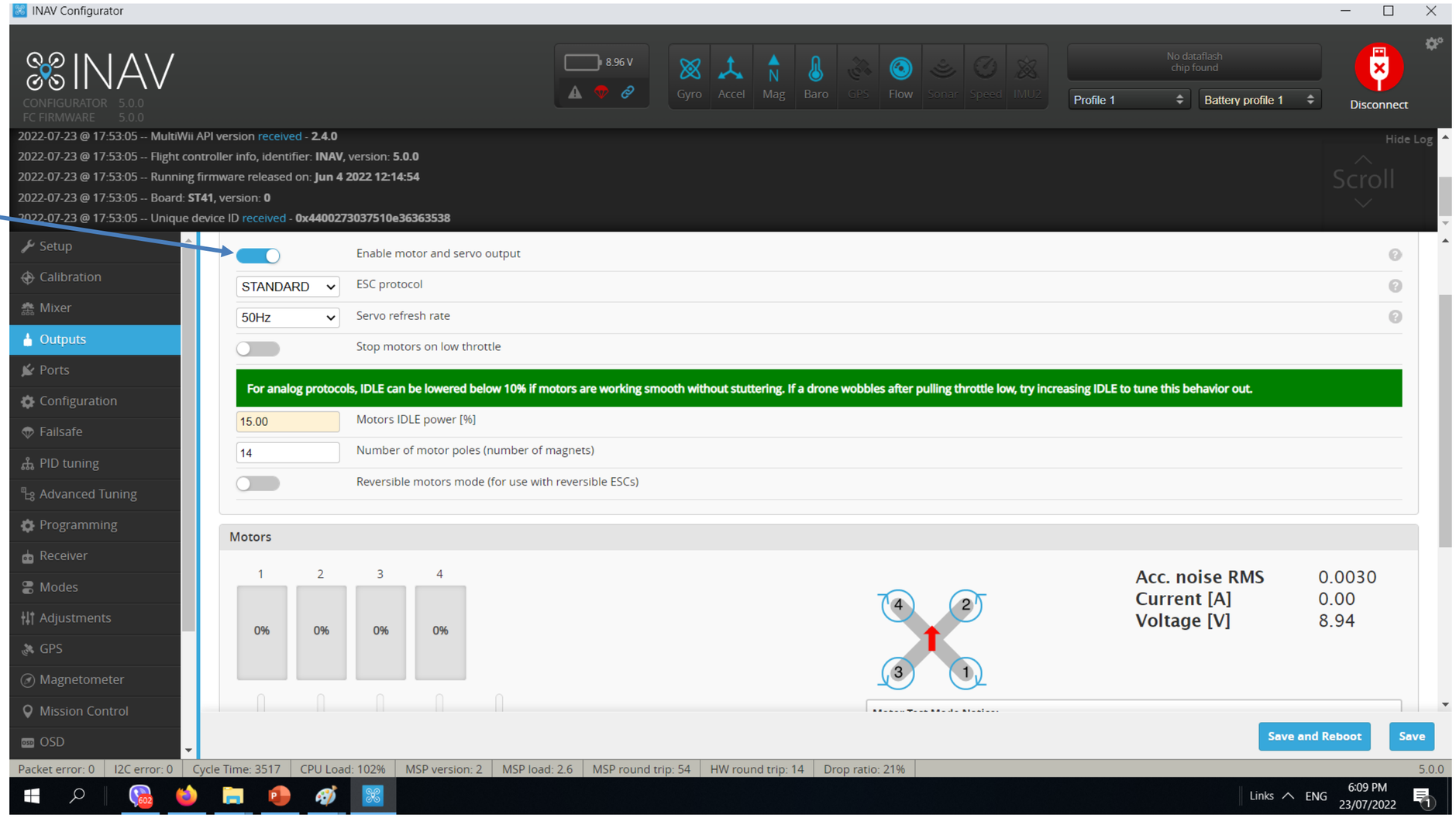


SETTING UP YOUR DRONE

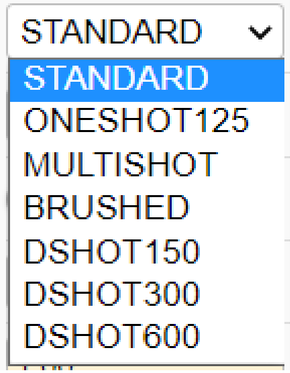
OUTPUT

This Tab is use to calibrate and Test ESC, Motors and Servos assignment

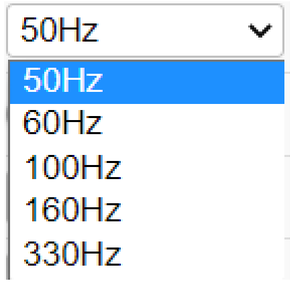
Enable Motor and Servo Output must be on



ESC Protocol



Servo Refresh rate



SETTING UP YOUR DRONE

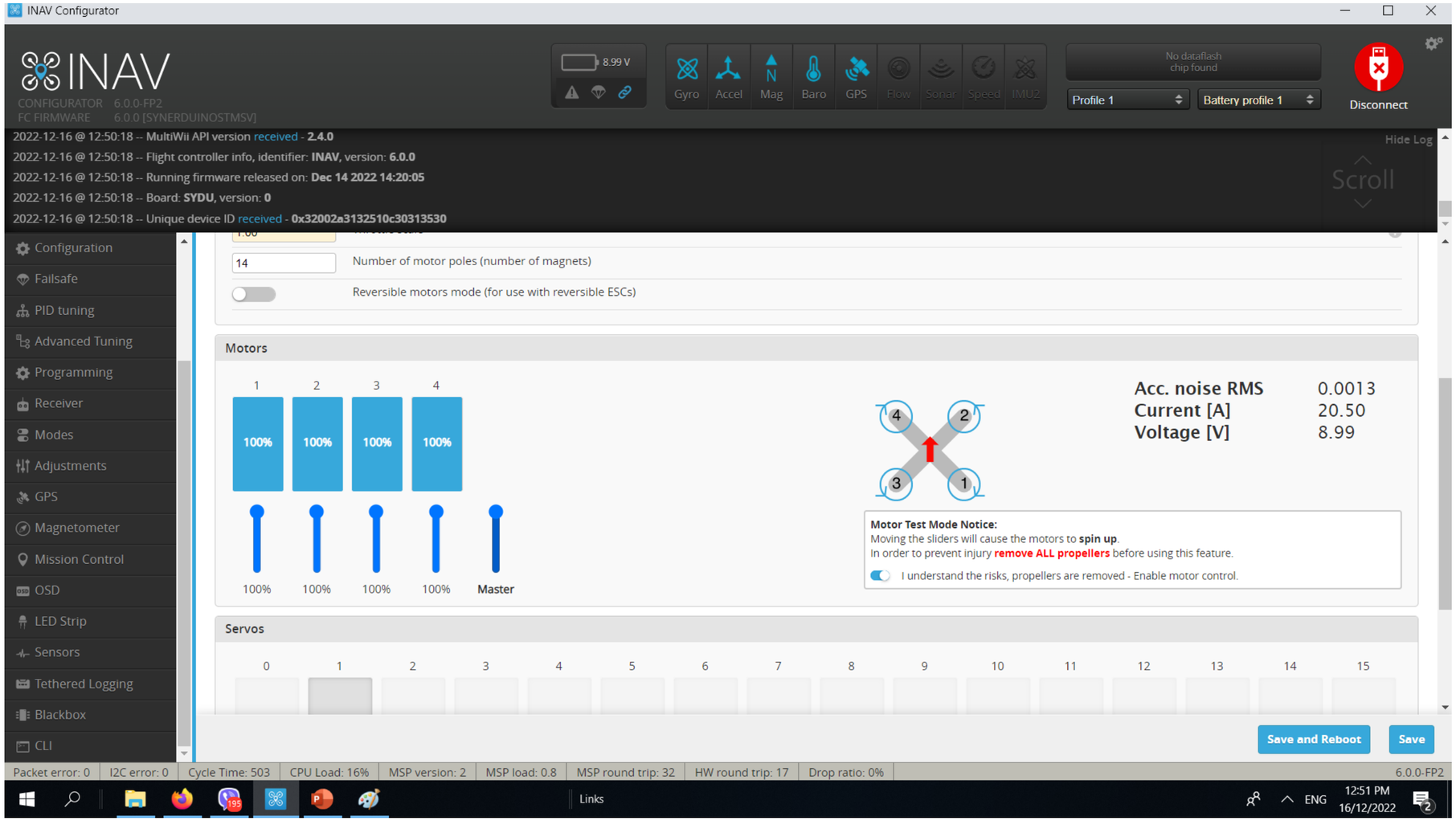
OUTPUT

This Tab is use to calibrate and Test ESC, Motors and Servos assignment

Calibrate ESC:

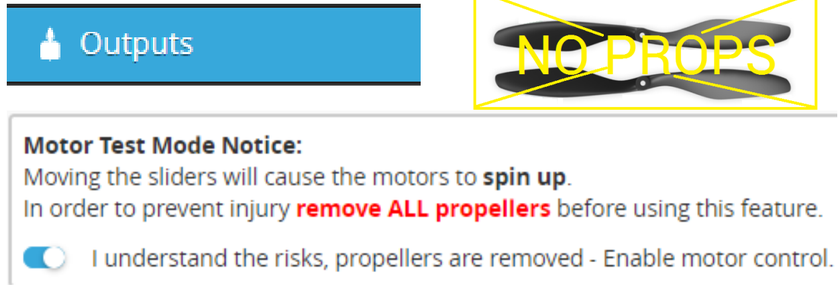
Remove all props

1. Activate motor Test mode
2. Master throttle up 100%
3. Plug in Battery and wait for the calibration Tune
4. Master throttle down 0%
5. Deactivate motor Test mode
6. Test the motor again by reactivating test motor test mode after the boot up tune start slowly throttling up



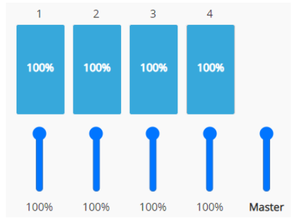
SETTING UP YOUR DRONE

Electronic Speed Controller CALIBRATION

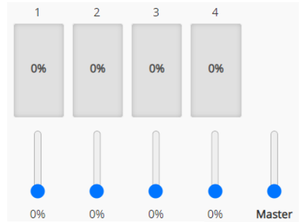


Its required that all speed controllers must be calibrated in order the motors to spool up at the same RPM and improve stability of the vehicle and the ease of tuning.

1. Plug Synerduino in with USB and Connect INAV Configurator
2. Go to Output Tab
3. Activate motor Test mode (Remove Props)
4. move Master throttle up 100%
5. Plug in Battery and wait for the calibration Tune
6. After the Program tune completed move Master throttle down 0%
7. Allow ESC to exit Programming mode with a Bleep
8. Test the motor again to ensure all motors start running at the same time and speed
9. Then Deactivate Motor Test mode an Disconnect Battery
10. Calibration complete



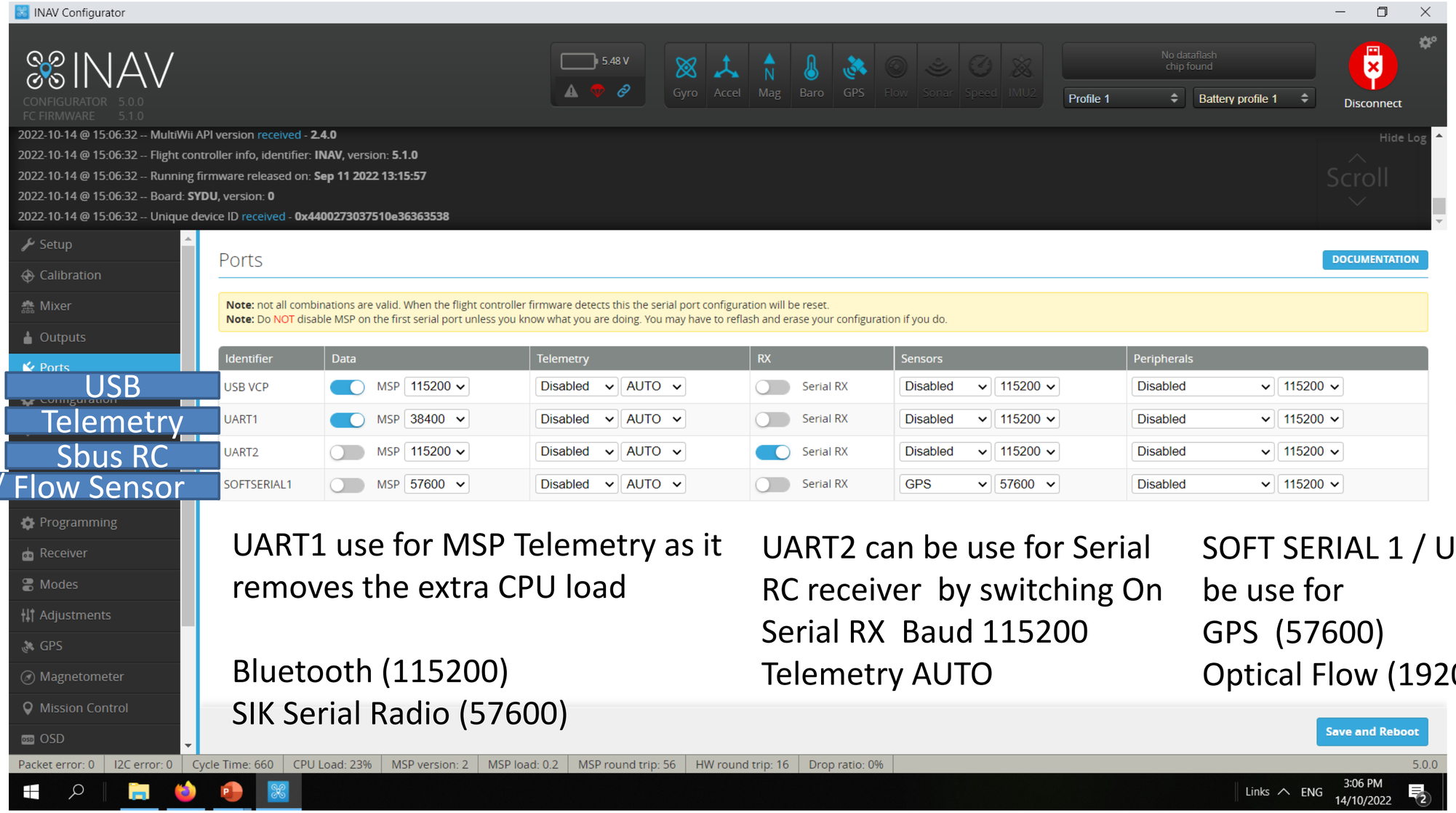
Connect battery to power module.



Disconnect battery.

SETTING UP YOUR DRONE

PORTS



USB

Telemetry

Sbus RC

GPS / Flow Sensor

The Number of Ports is relation to the specification of the Synerduino Board. Pls see data sheet

Dont Touch USB VCP connection for the STM board . Leave MSP On 115200
(changing this would disconnect the Board and Require Reflashing firmware to fix)

UART1 use for MSP Telemetry as it removes the extra CPU load

Bluetooth (115200)
SIK Serial Radio (57600)

UART2 can be use for Serial RC receiver by switching On Serial RX Baud 115200 Telemetry AUTO

SOFT SERIAL 1 / UART3 can be use for
GPS (57600)
Optical Flow (19200)

BN 880 GPS / Baud 57600

CXFO Optical Flow / Baud 19200

Bluetooth / Baud 115200

SIK Radio / Baud 75600

SETTING UP YOUR DRONE

CONFIGURATION

Sensors would depend on the board installation
Synerduino support the following

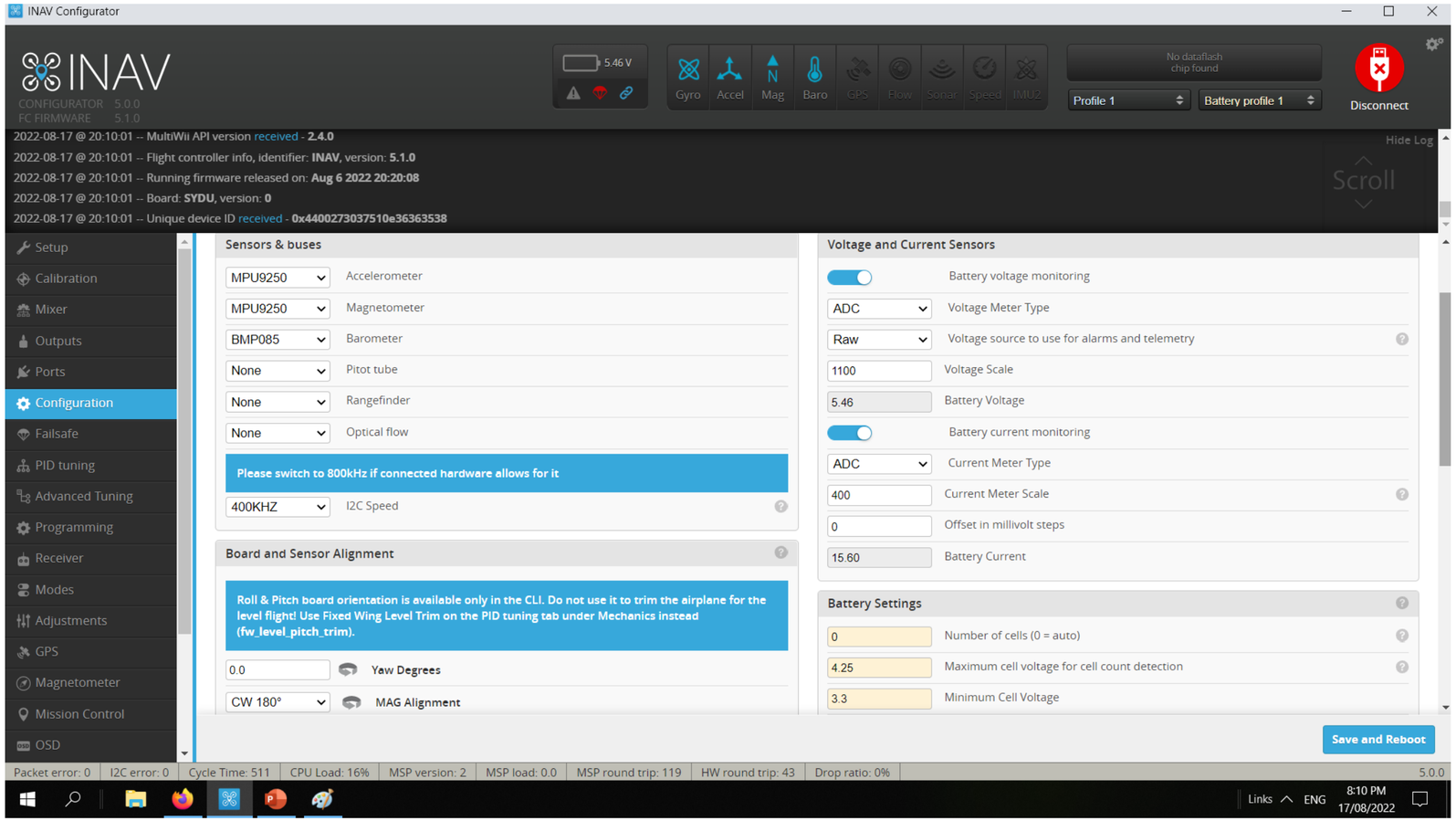
ACC – MPU9250 or BMI160
MAG – MPU9250 , HMC5883 or QMC5883
BARO – BMP180 or BMP280
PitotTube – AirSpeed sensor both ADC and i2C
RangeFinder – Ultrasonic and Lidar
Optical Flow - Option installation CXFO Sensor

I2C speed 400hz

Board and Sensor alignment
0.0 Yaw Degrees
CW180 Mag Alignment

Features (Synerduino STM)
Enable CPU based serial ports
GPS for navigation and telemetry
Telemetry output
Multi-color RGB LED strip support
Enable motor and servo output

This also Contains the Multiplier setting for the Battery Voltage and Current and can be utilize for External ADC sensors applications

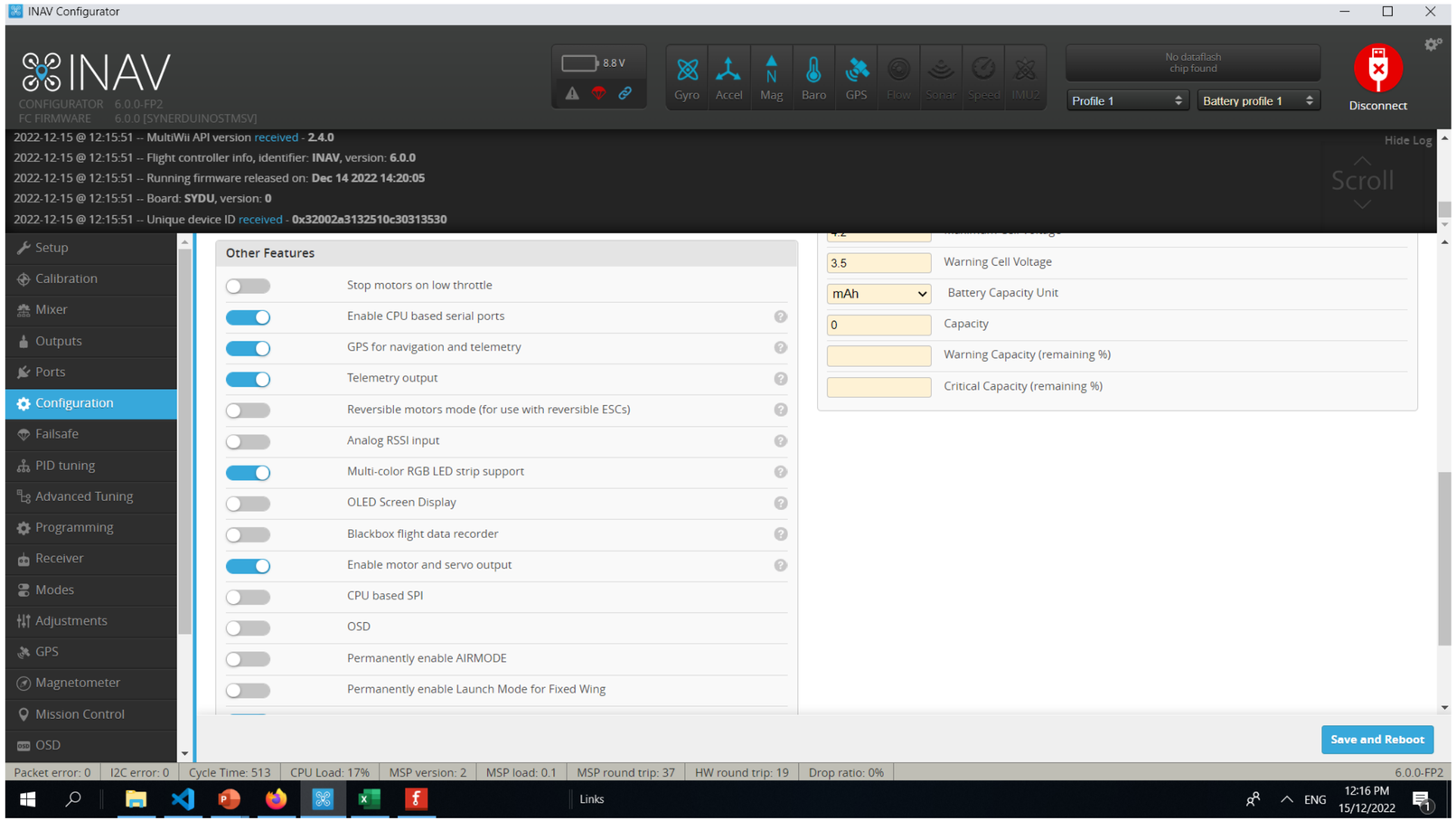


SETTING UP YOUR DRONE

CONFIGURATION

OTHER FEATURES

- **Stop motors on low throttle** – no Idle speed motor is shut off on throttle down
- **Enable CPU based serial ports –** Activate Serial 1 , 2 , Soft serial
- **GPS for navigation and telemetry** – Activate GPS navigation function
- **Telemetry output** – activate MSP protocol for Telemetry use
- **Reversible motors mode** - for use with reversible ESCs)
- **Analog RSSI input** – signal strength of your radio
- **Multi-color RGB LED strip support –** support for WS2811 LED Note : it would reduce useable PWM output to 5
- **OLED Screen Display –** small screen support
- **Blackbox flight data recorder** - use with Flash or SD Card SPI to save log flight and sensor data
- **Enable motor and servo output** – activate all PWM pins (Required)
- **CPU based SPI –** to use the CPU to added extra processing to ISP
- **OSD –** Screen Display
- **Permanently enable AIRMODE - allows motor idle to control the aircraft (Multirotor)**
- **Permanently enable Launch Mode for Fixed Wing –** allows to Autolaunch
- **Profile selection with TX stick command –** Stick command profile
- **Throttle voltage compensation –** throttle compensator to power fluctuation
- **Automatic battery profile selection –** Battery Profile setup
- **Continuously trim servos on Fixed Wing –** Automatic Trim to the aircraft Level flight



SETTING UP YOUR DRONE

CONFIGURATION

Voltage and Current sensors

Battery Voltage monitoring (Vbat)

RAW = ADC V – Voltage 0-5V

Voltage scale= this is adjusted to calibate your actual battery voltage to the GUI as identify by the Battery voltage indicator

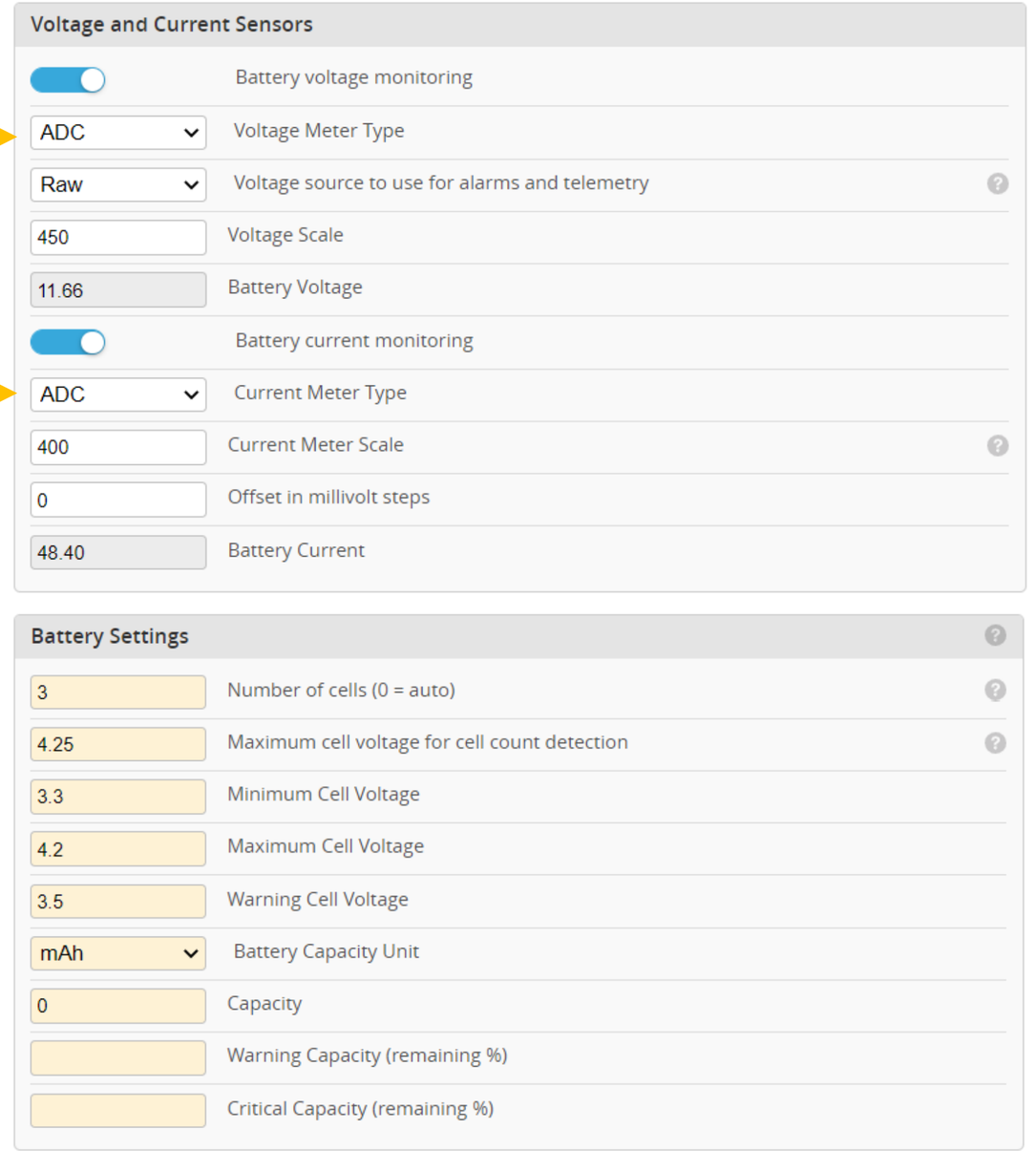
Battery Current Monitoring (Current)

RAW = ADC I – Current 0-5V

Current meter scale this is adjusted to calibate your actual battery Current to the GUI as identify by the Battery Current indicator

Battery Settings

This is the base battery parameters it should match the specs of your battery



SETTING UP YOUR DRONE

PID Tuning

Synerduino Mini Kwad

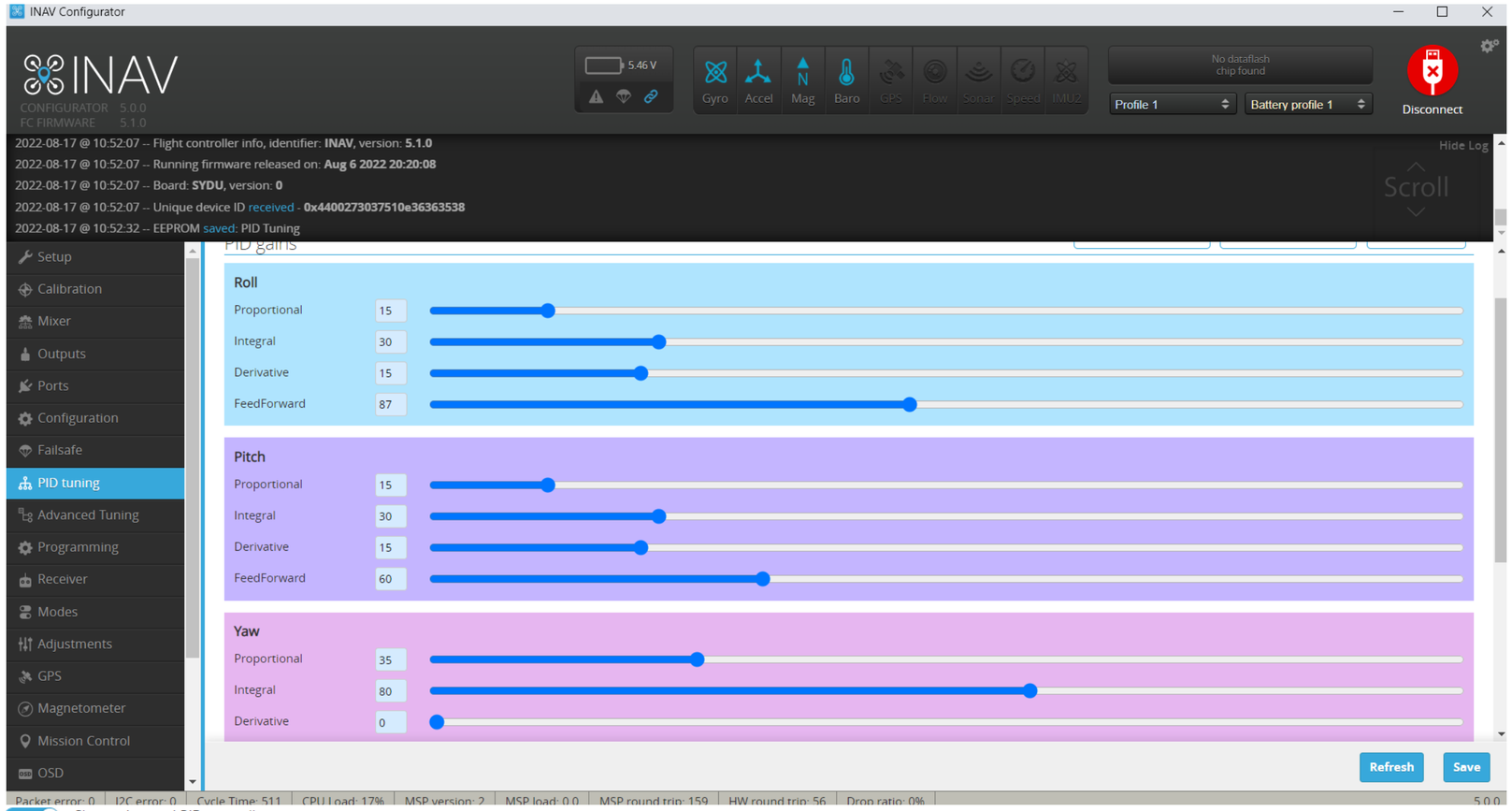
Proportion Integral Derivative tuning section to tune your drone stability in different flight mode and sensor feedback loop

PITCH
Proportion 15
Integral 30
Derivative 15
Feedforward 87

ROLL
Proportion 15
Integral 30
Derivative 15
Feedforward 60

YAW
Proportion 35
Integral 80
Derivative 0

ANGLE/HORIZON
Strength 40
LPF Cutoff (Hz) 10
Transition (Horizc



Show advanced PID controllers

Name	Proportional	Integral	Derivative	FeedForward
Barometer & Sonar/Altitude				
Position Z	50	0	0	
Velocity Z	100	50	10	
Magnometer/Heading				
Heading Hold	60			
Nav Heading	0	0	0	

Angle/Horizon	Strength	LPF cutoff (Hz)	Transition (Horizon)
Level	40	10	75

SETTING UP YOUR DRONE

ADVANCE PID CONTROLLERS

Synerduino Mini KWAD PID

Show advanced PID controllers

Name	Proportional	Integral	Derivative	FeedForward
Barometer & Sonar/Altitude				
Position Z	50	0	0	
Velocity Z	100	50	10	
Magnometer/Heading				
Heading Hold	60			
Nav Heading	0	0	0	
GPS Navigation				
Position XY	46			
Velocity XY	40	15	100	40
Surface	0	0	0	

Angle/Horizon	Strength	LPF cutoff (Hz)	Transition (Horizon)
Level	25	15	75

This is the Main Flight mode tuning

Barometer & Sonar / Altitude

- Position -Vertical tuning strength
- Velocity - how much responds and the duration of that respond to hold an altitude

Magnetometer / Heading

- Heading hold
- Nav Heading

GPS Navigation

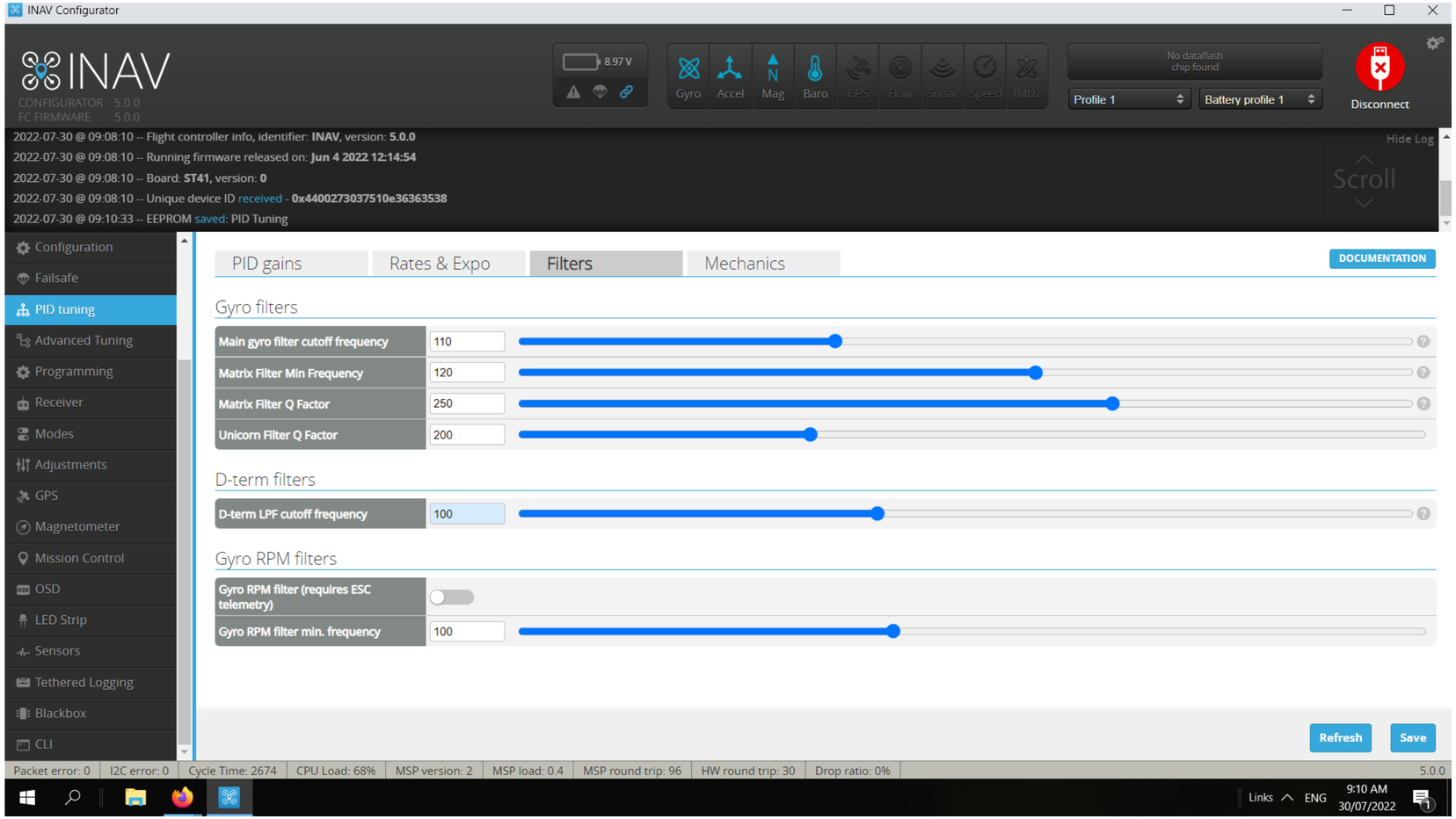
- Position XY – this is the streght of the responds to hold position (too thigh it would over correct , too low it would under responds)
- Velocity XY – how fast it would respond to the deviation
- Surface XY – works with optical sensor

Angle / horizon

- Level – how quick the drone returns to level flight

SETTING UP YOUR DRONE

Filters adjustment for Sensor respond rate



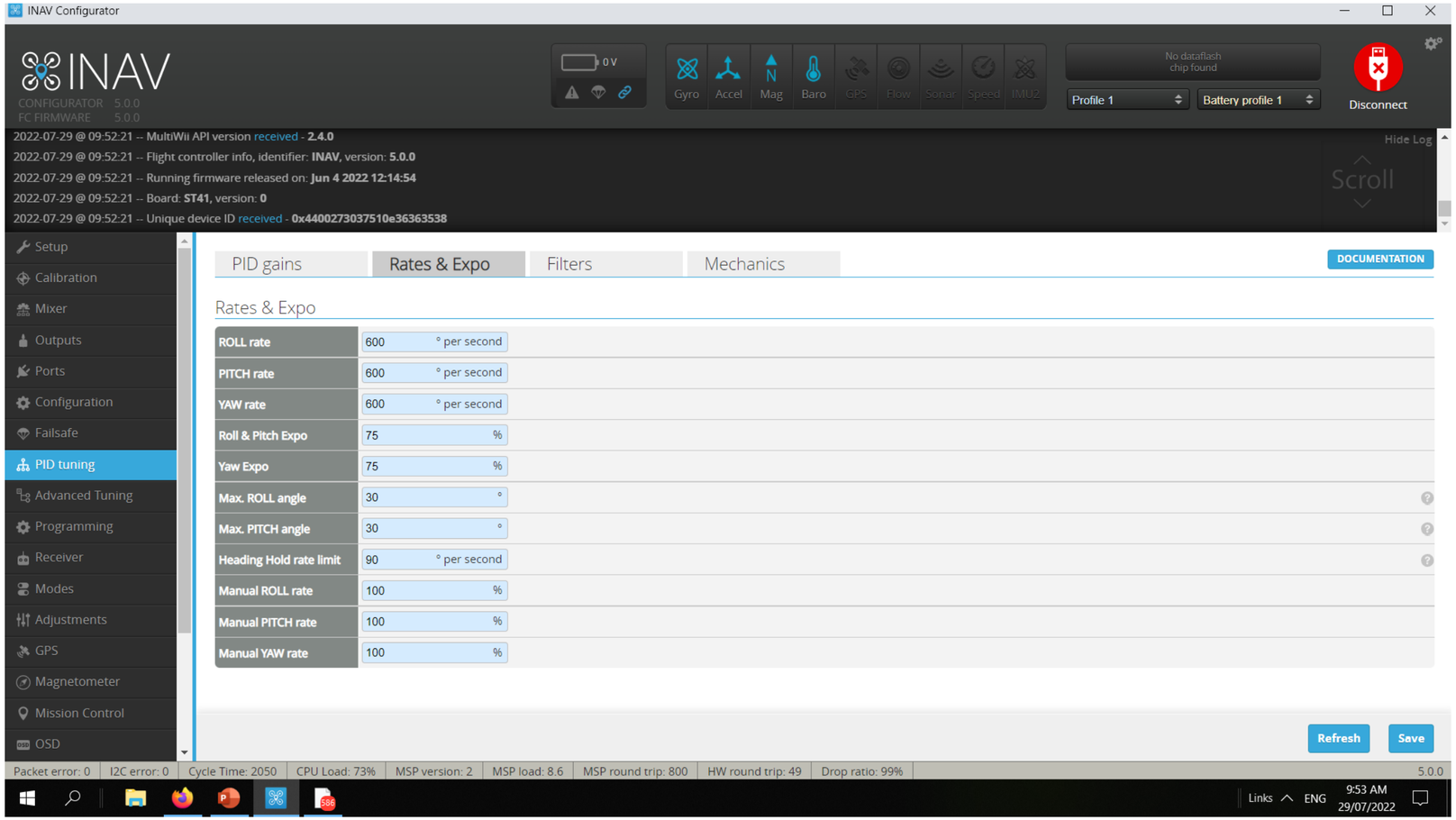
SETTING UP YOUR DRONE

Rate and Expo pertain to the sensitivity on each behavior and limits set on each flight modes

This can set for Aggressive for sport flying

Or

Relax for beginner training to mission-oriented flight



Roll, Pitch, Yaw Rate = Horizon mode on how fast the drone rotate on its axis (can cause drone to flip mid flight if set too high)
Roll,Pitch,Yaw Manual = this is much basic stabilize mode (none self leveling)
Roll,Pitch,Yaw Angle = in Angle mode sets the max limit on the drone Tilt from level axis (self leveling)

SETTING UP YOUR DRONE

EZ PID Tuning

Synerduino Mini KWAD PID

Introduce in INAV7 allows easier configuration of your PID and Filter function

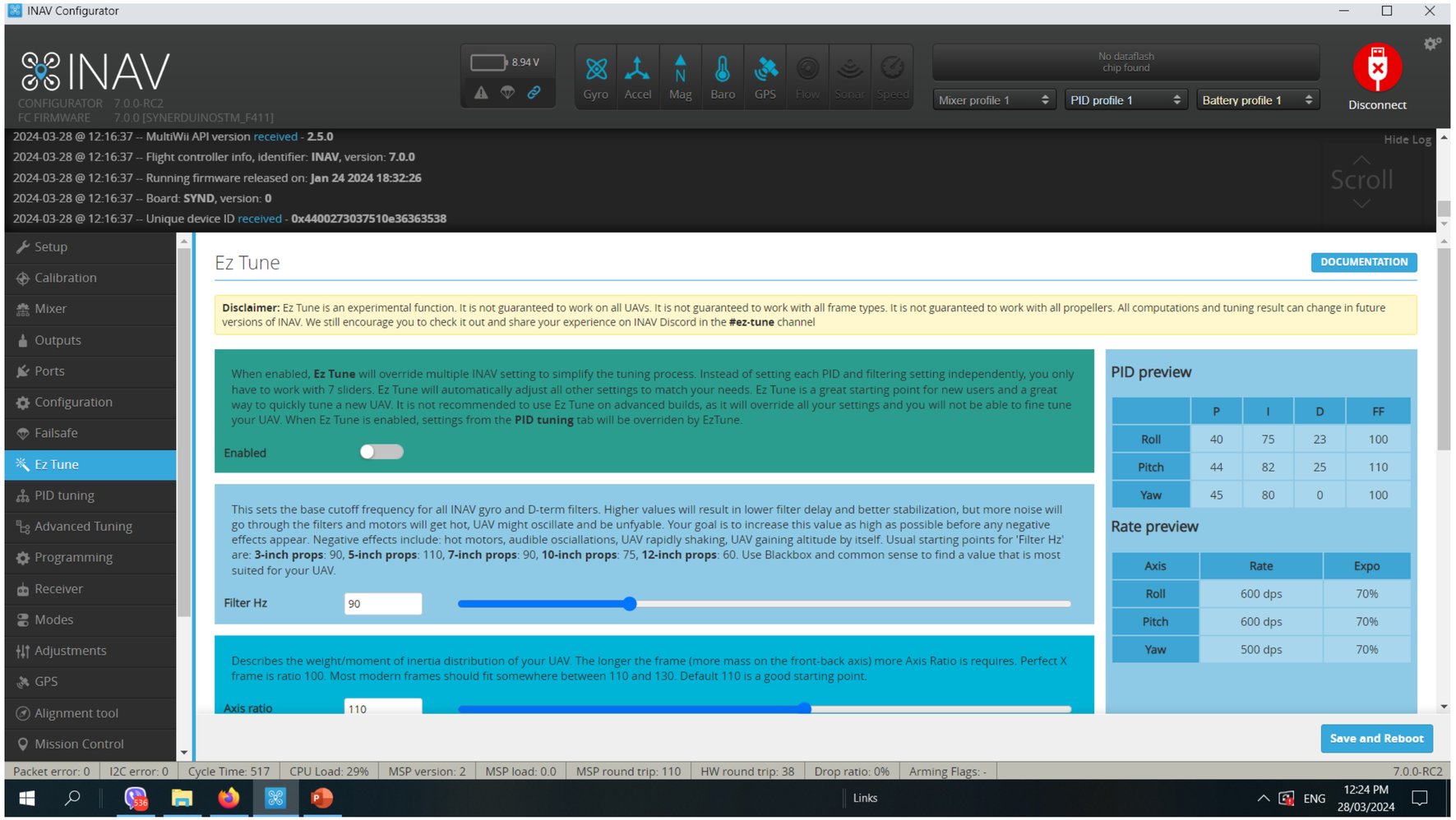
When Enable it automatically override the standard PID process associated to the older INAV 5 and 6

Descriptions are listed

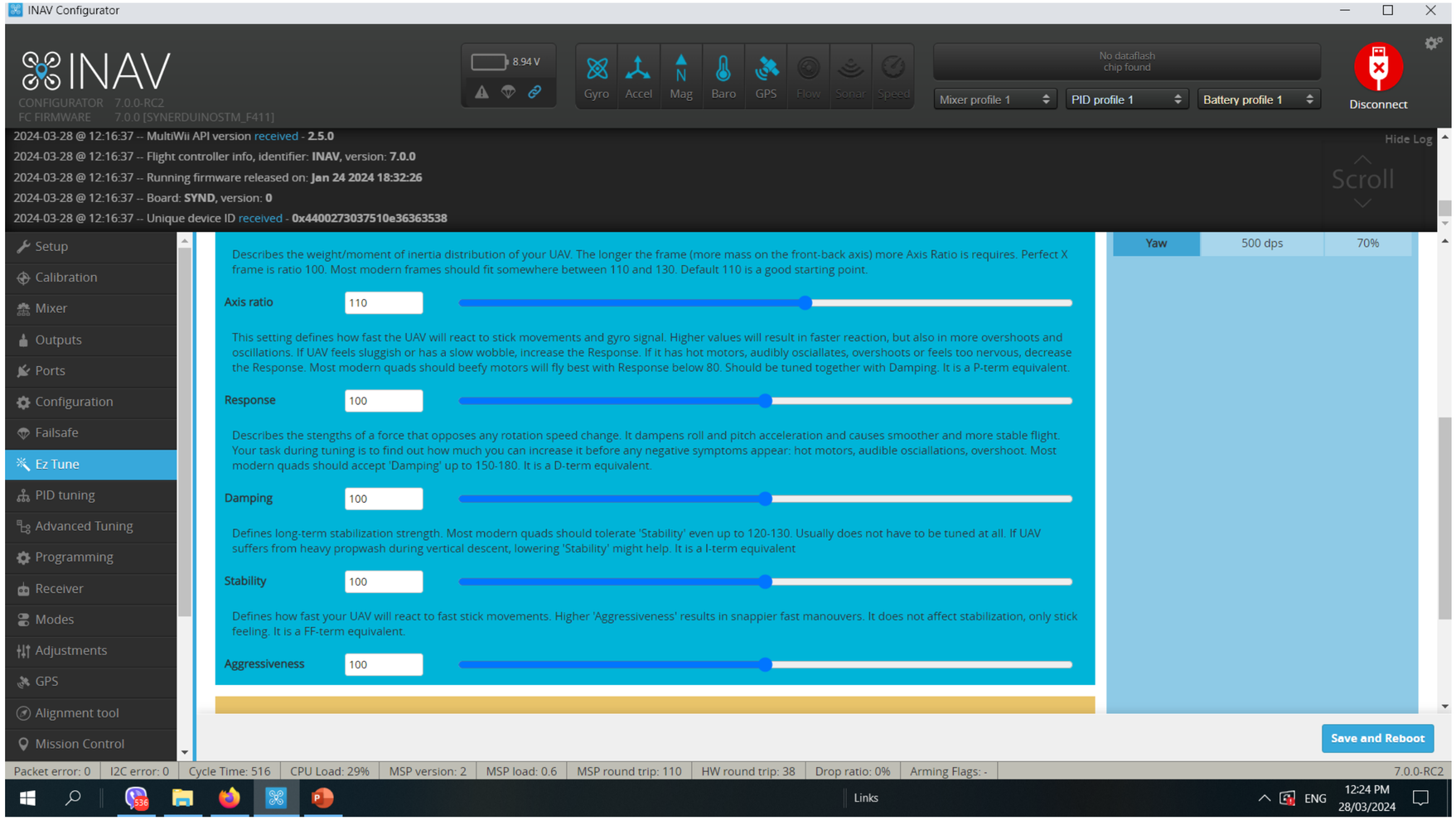
However this is still a work in progress it works well for small drones

Large drones may or may not tune correctly with this , due to wildly varied inertias and weight.

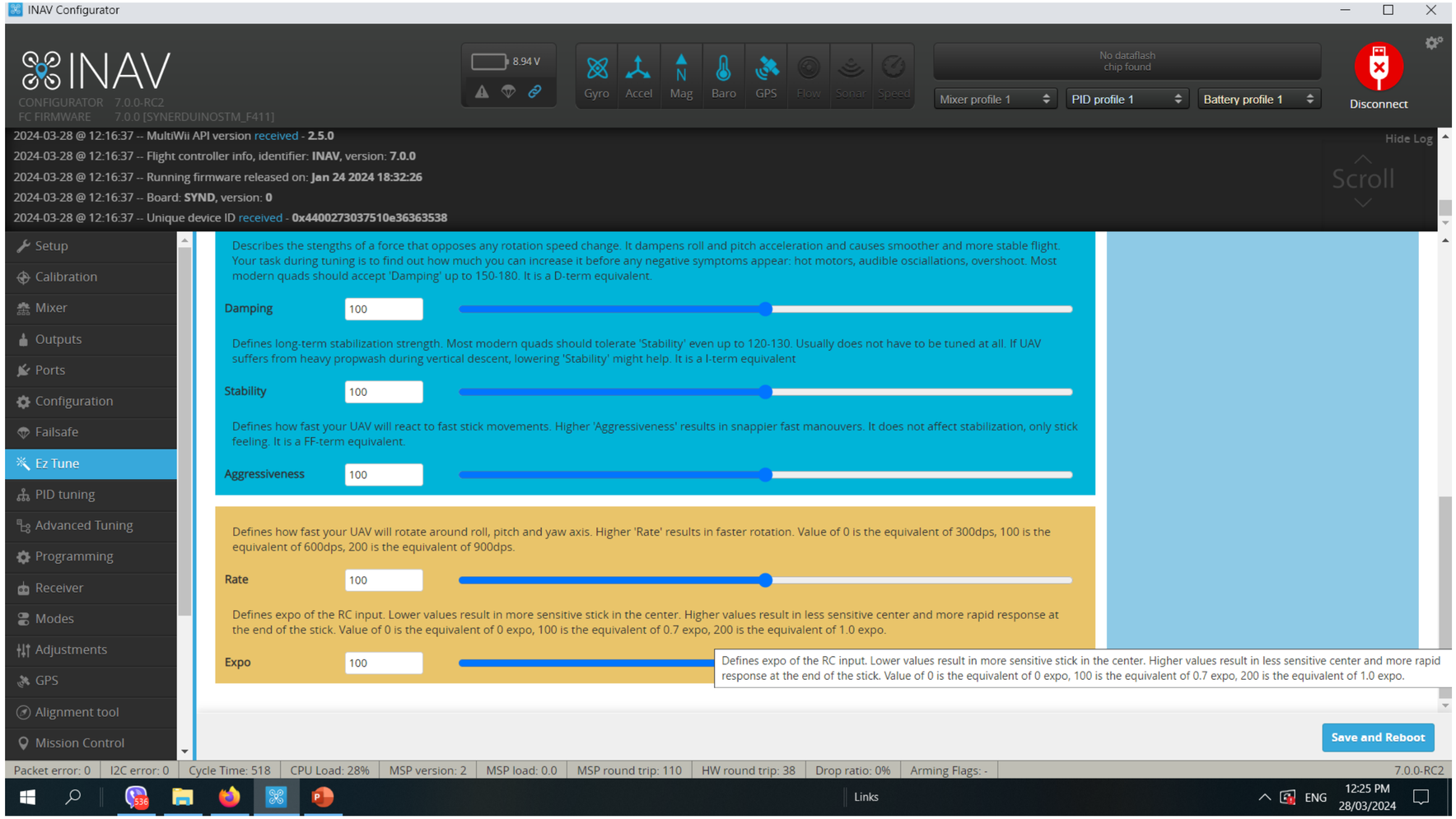
Recommend to use conventional PID tuning method



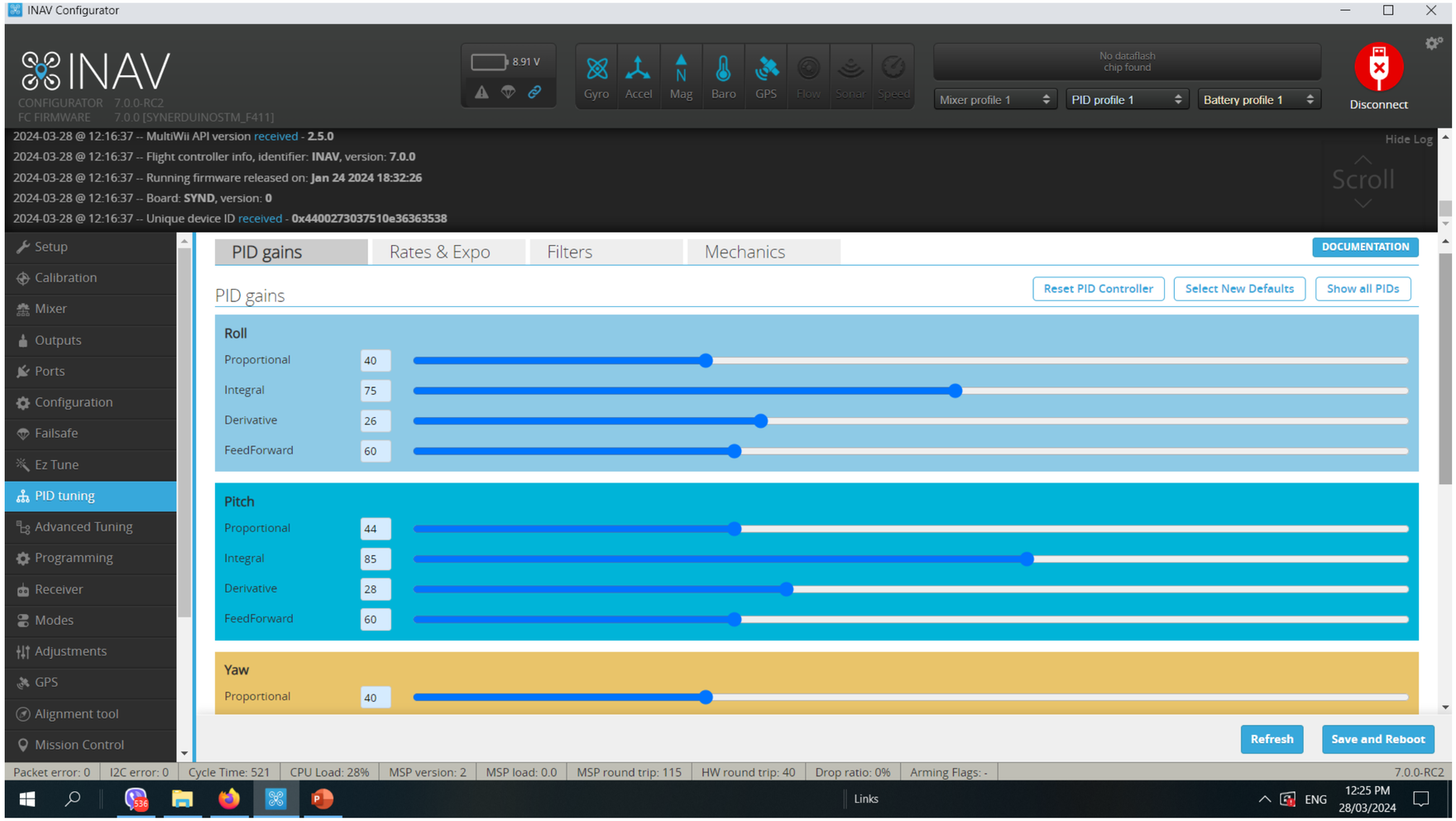
SETTING UP YOUR DRONE



SETTING UP YOUR DRONE



SETTING UP YOUR DRONE



SETTING UP YOUR DRONE

ADVANCE TUNING

Advance tuning for all navigational settings

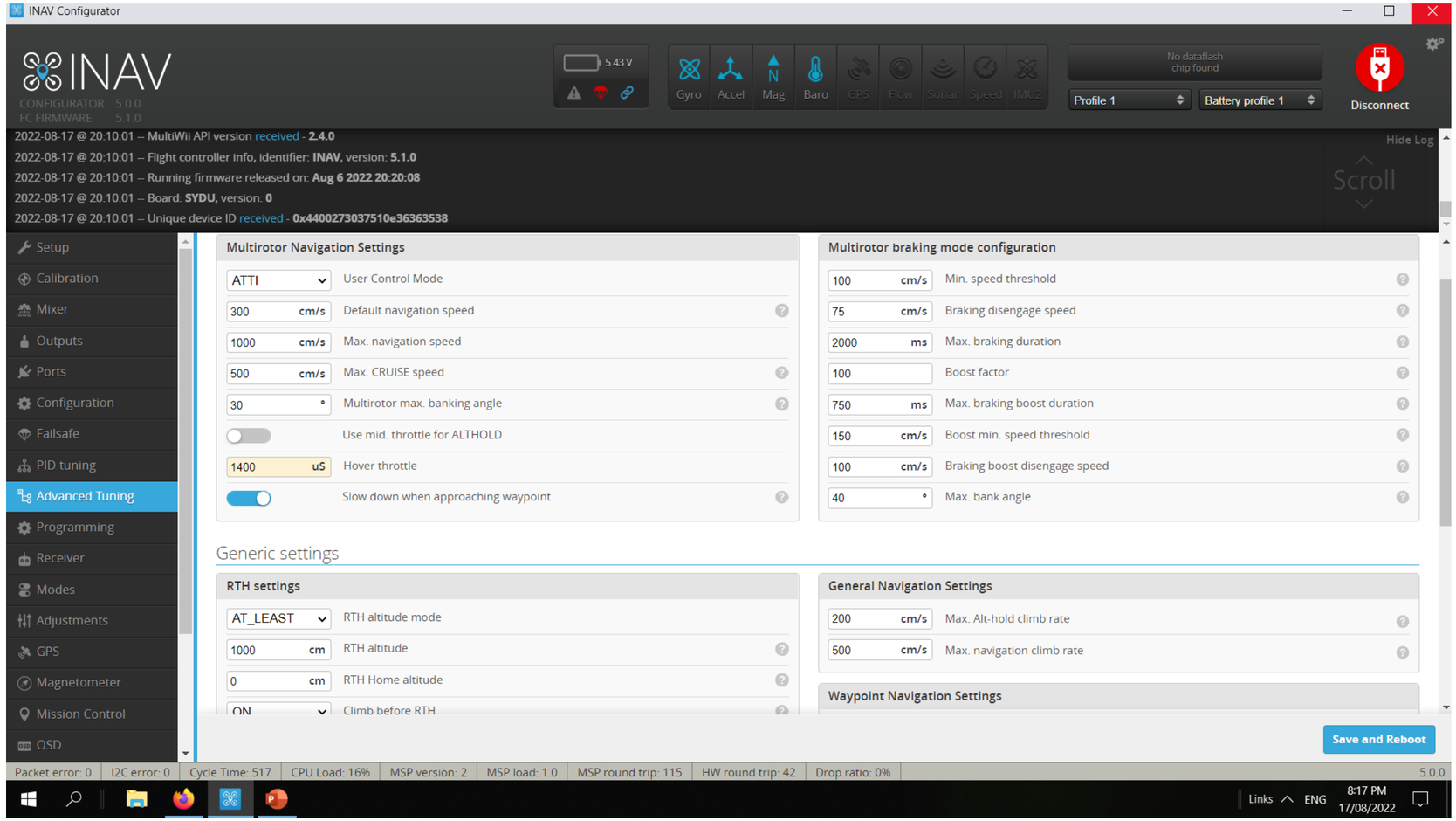
Recommended changes for Synerduino 250mm Quad

300cm/s Nav speed
1000cm/s Max Nav speed
500cm/s Max Cruise Speed
30 Degree Max bank Angle MC

Mid throttle Alt hold only use if you intend to use a mid stick throttle radio , pls set Null point on your radio.

1400us Hover Throttle (Althold mode)

Slow down when approaching Waypoint



SETTING UP YOUR DRONE

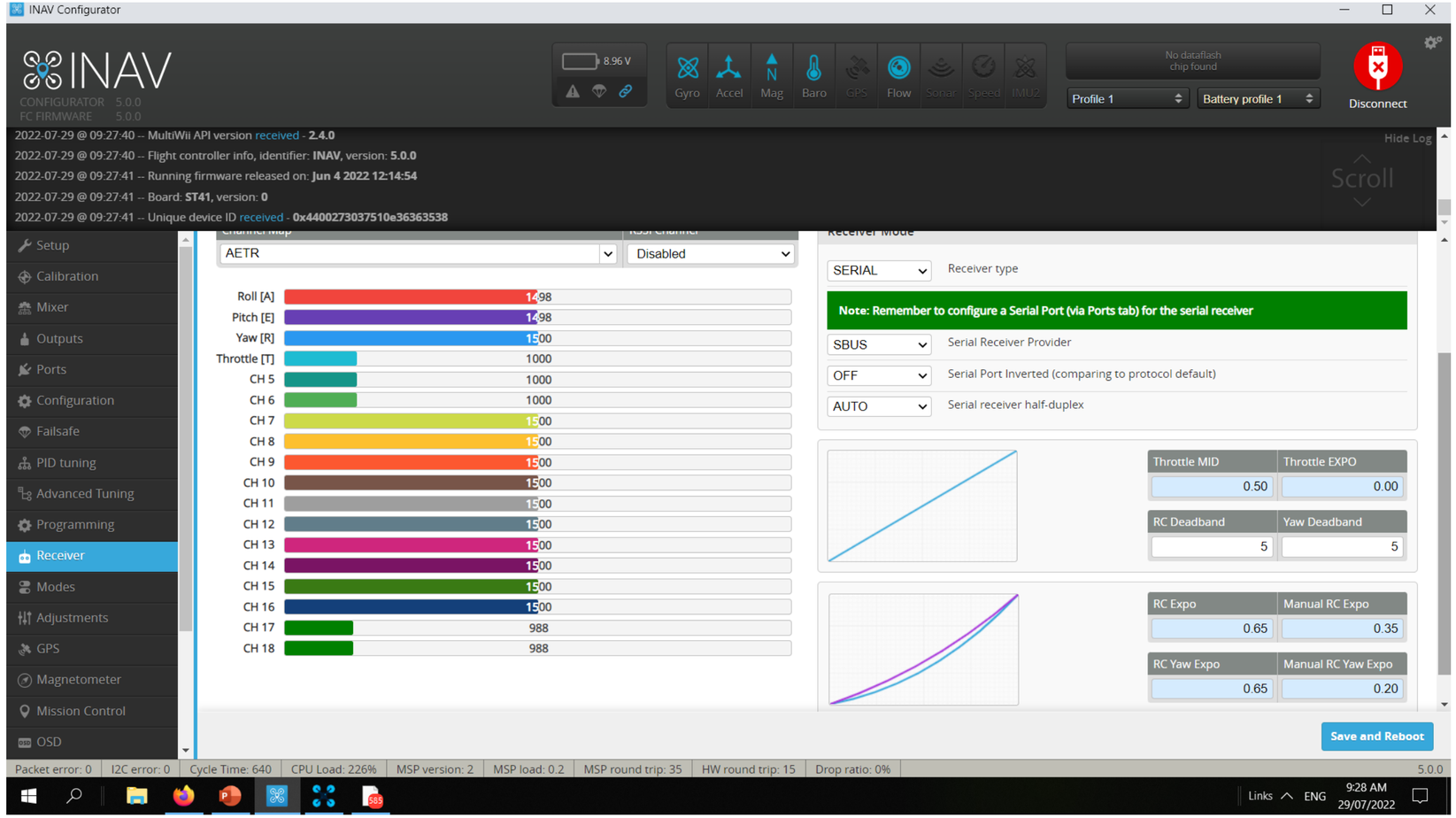
RECEIVER

Serial Receiver as SBUS

Be aware of your radio format
AETR = Futaba format
TAER = JR format
EATR = Walkera Format

This is to check if there is signal coming from the receiver

Also to adjust the Expo rate of your RC controls



RECEIVER FORMAT

INAV like most modern Flight controllers now Supports Sbus to reduce the number of wires in build its advice to use Sbus Receiver for Synerduino STM as well

RX > SBUS input	Futaba Format (AETR)	JR Format (TAER)	Walkera Format (EATR)
Throttle	Ch3	Ch1	Ch3
Aileron	Ch1	Ch2	Ch2
Elevator	Ch2	Ch3	Ch1
Rudder	Ch4	Ch4	Ch4
Aux1	Ch5	Ch5	Ch5
Aux2	Ch6	Ch6	Ch6
Aux3	Ch7	Ch7	Ch7
Aux4	Ch8	Ch8	Ch8

SBUS/PPM/PWM

Converter may be required if your receiver don’t support SBUS

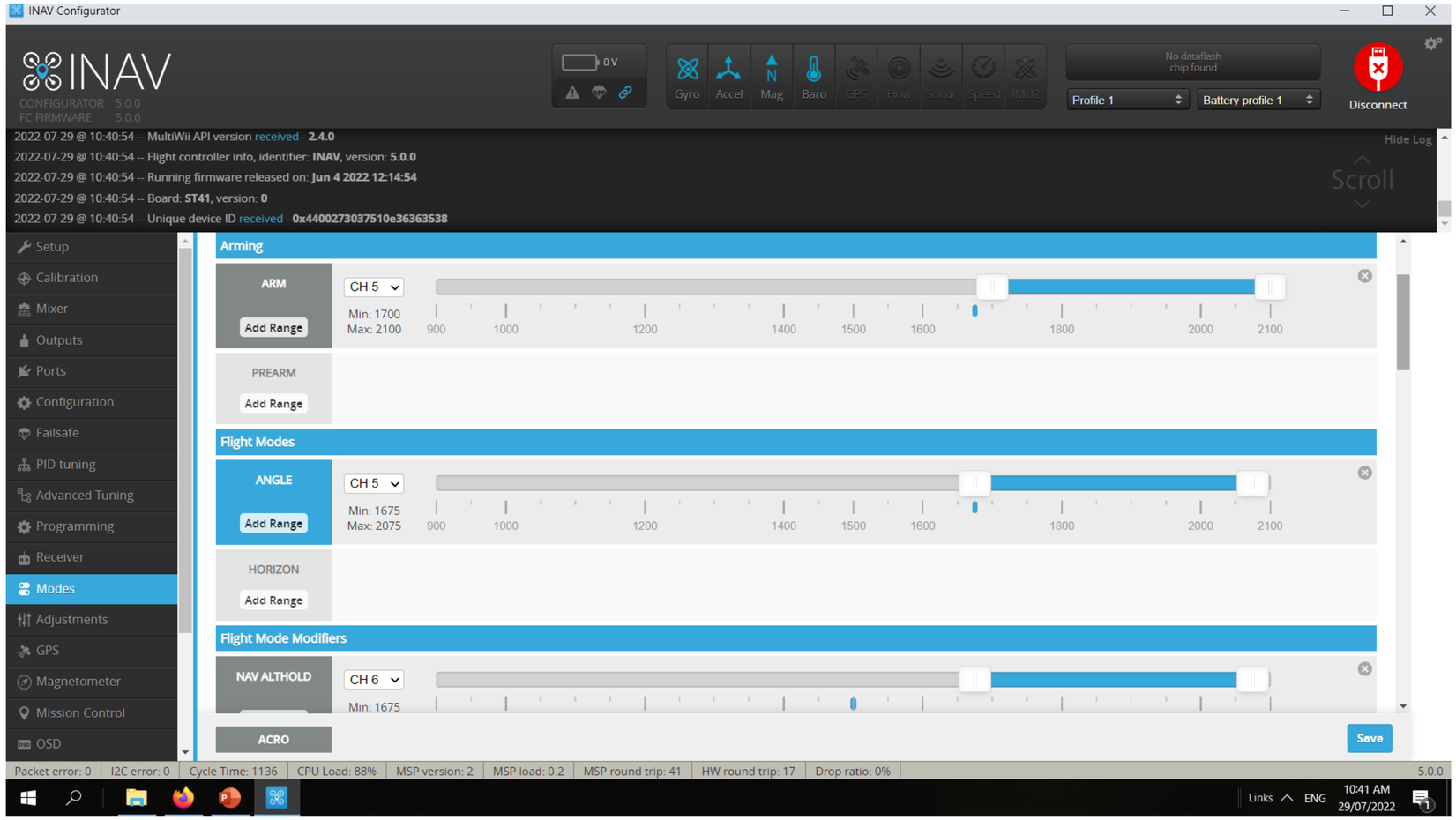
Pls Check the output pin from your Radio Rx manual

SETTING UP YOUR DRONE

MODES

Flight modes
This is where you set the Aux switch on your transmitter commands

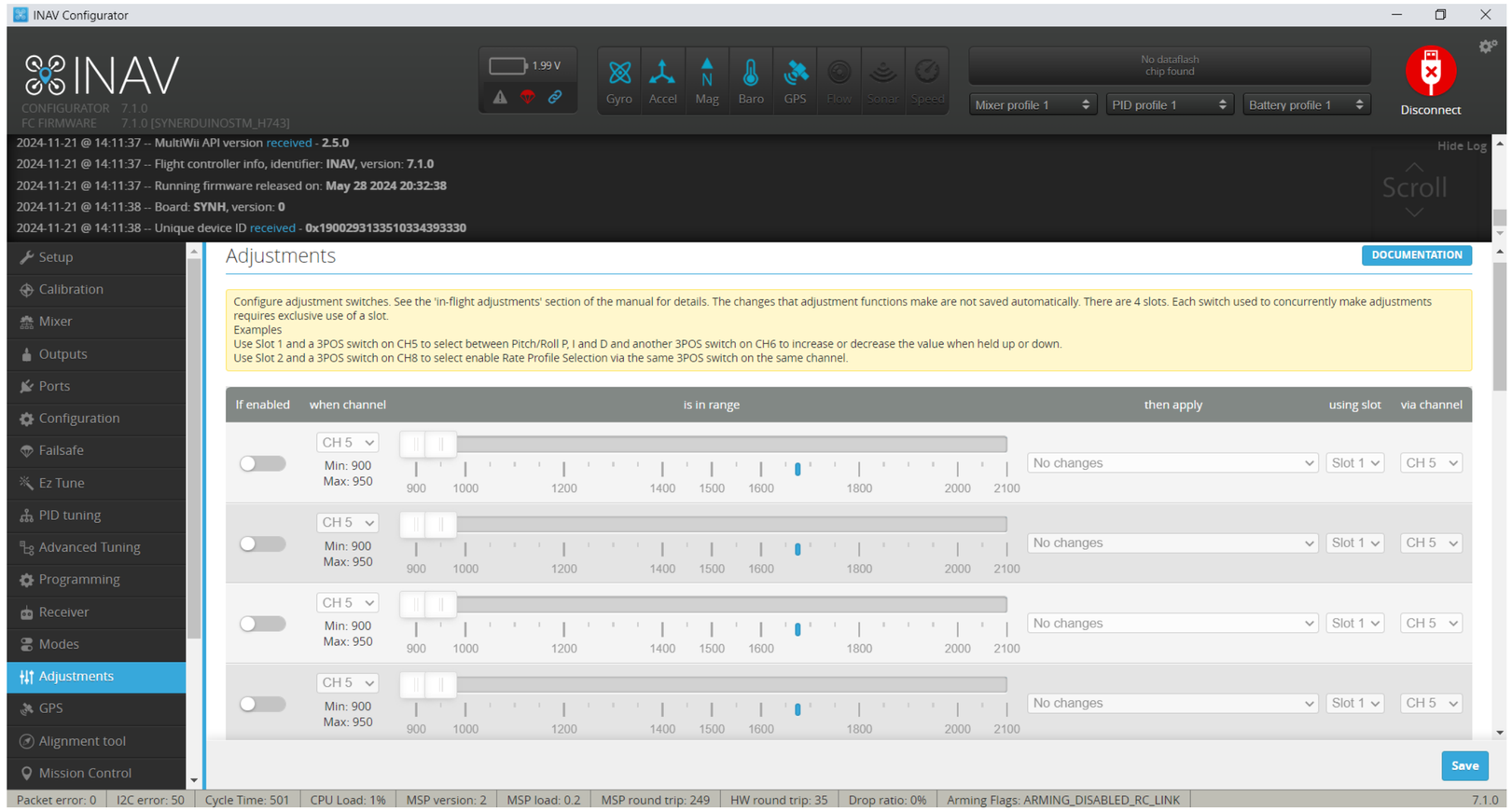
For Beginners we advice to have Turn ANGLE Flight Mode on



- NAV ALTHOLD - Altitude hold
- NAV POSHOLD - Horizontal position hold
- NAV COURSE HOLD - Fixed Wing Heading Hold
- NAV CRUISE - Fixed Wing Heading + Altitude Hold
- NAV RTH - Return to home
- NAV WP - Autonomous waypoint mission
- WP PLANNER - On the fly waypoint mission planner
- GCS NAV - Ground control station

ADJUESTMENTS

Configure adjustment switches. See the 'in-flight adjustments' section of the manual for details. The changes that adjustment functions make are not saved automatically. There are 4 slots. Each switch used to concurrently make adjustments requires exclusive use of a slot.
Examples
•Use Slot 1 and a 3POS switch on CH5 to select between Pitch/Roll P, I and D and another 3POS switch on CH6 to increase or decrease the value when held up or down.
•Use Slot 2 and a 3POS switch on CH8 to select enable Rate Profile Selection via the same 3POS switch on the same channel.



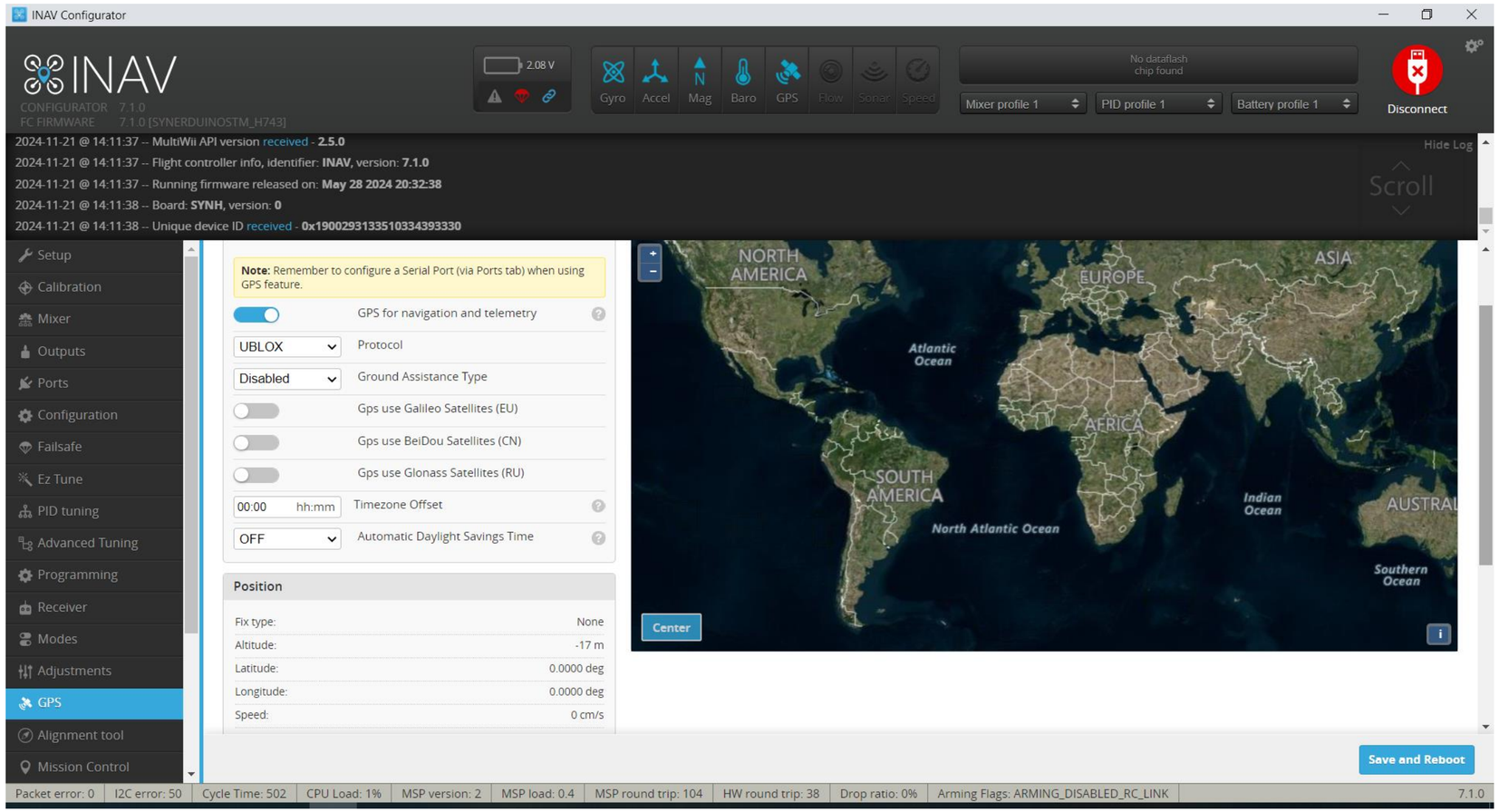
GPS

GPS settings

Note: Remember to configure a Serial Port (via Ports tab) when using GPS feature

Here is where you setup your GPS base off the GPS module function.

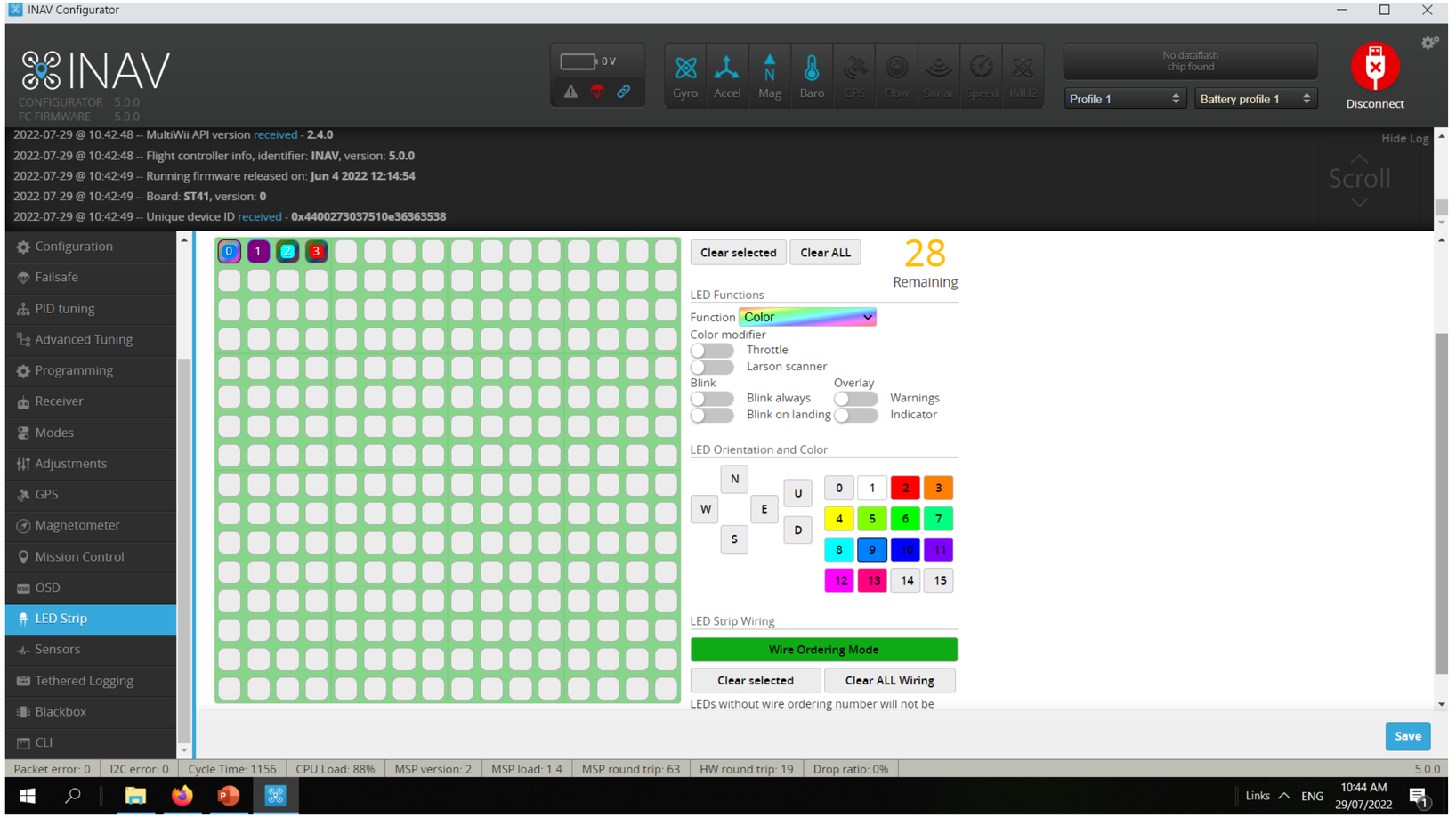
Its also to check if GPS is working correctly



SETTING UP YOUR DRONE

LED STRIP

WS2811/WS2812 – Led strip programming upto 32 LEDS



WS2811 – Led strip this needs to be activated on the Configure Tab before you can use this function

Note: this will reduce the PWM availability to just 5 Pins removes S6 and S7 (this is because it requires 2 Timers to run the WS2811)

SETTING UP YOUR DRONE

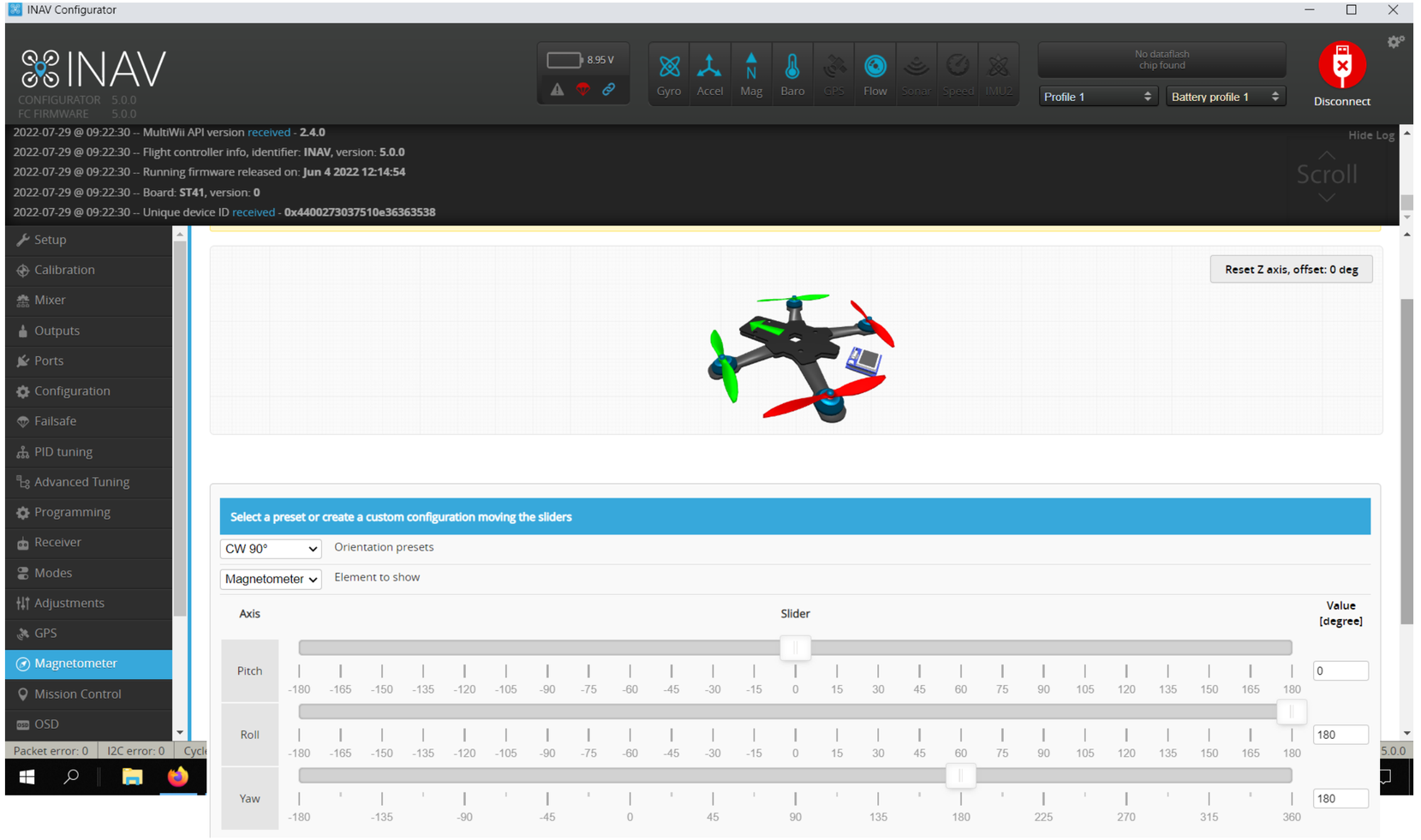
MAGNETOMETER (INAV5-6)

This is where you set the orientation of your Mag sensor , should you use the GPS with a build in MAG

Also the Mag orientation Can vari from Flight controller to Flight controller. Pls be aware of this

This can be verified From the setup Tab look at heading it should follow when the Drone is pointing toward a heading

0 Degrees = North
90 Degrees = East
180 Degrees = South
270 Degrees = West



Synerduino STM V0.1 uses the HMC5883 orientation is Pitch 0 ,Roll 180 ,Yaw 180

SETTING UP YOUR DRONE

ALIGNMENT TOOL (INAV7-8)

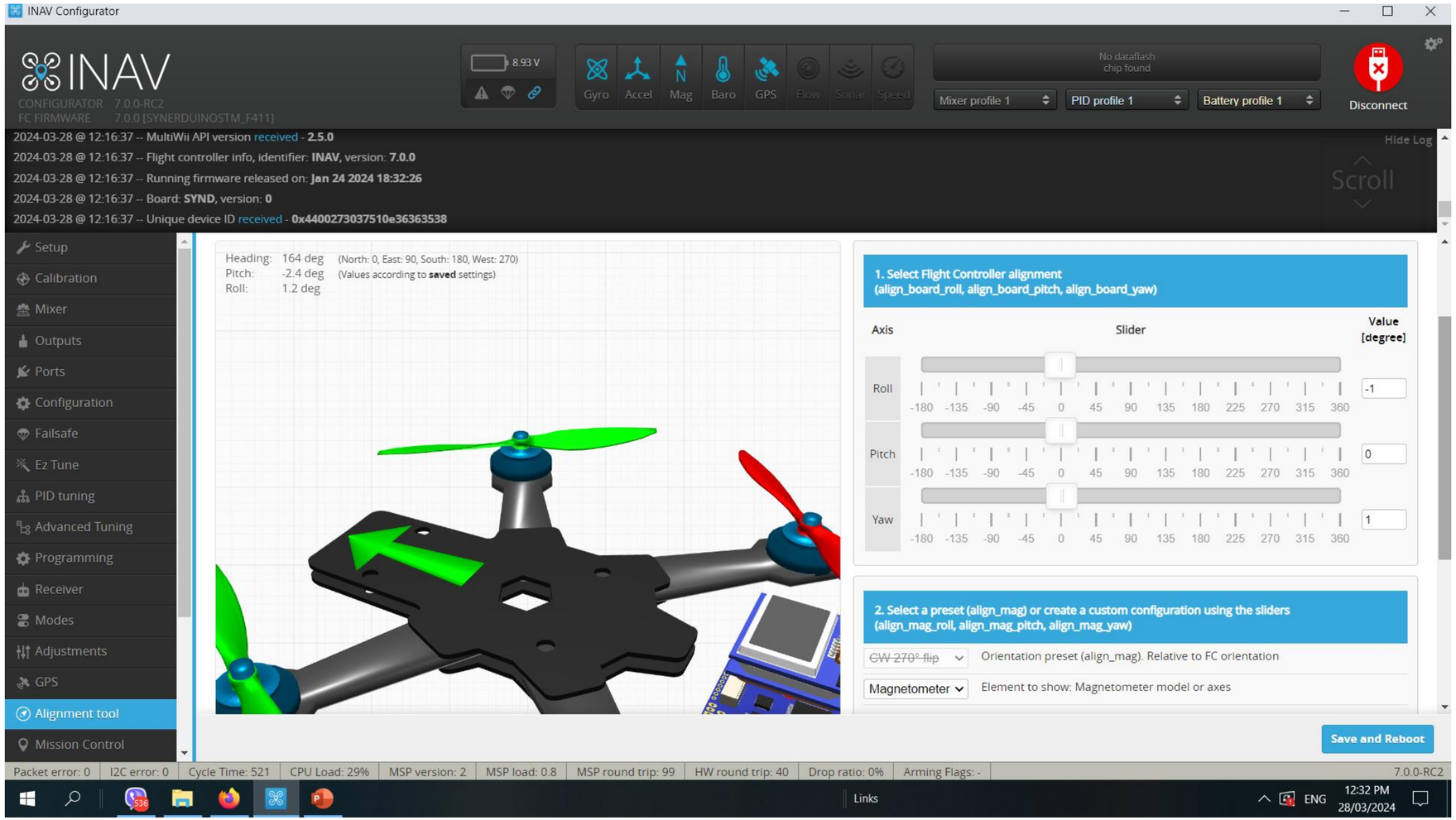
This replaces the old magnetometer Tab with the addition of Board Orientation

In an situation you needed to Reorientation of the Flight controller to fit your vehicle

This can be verified From the setup Tab look at heading it should follow when the Drone is pointing toward a heading

Mag relationship

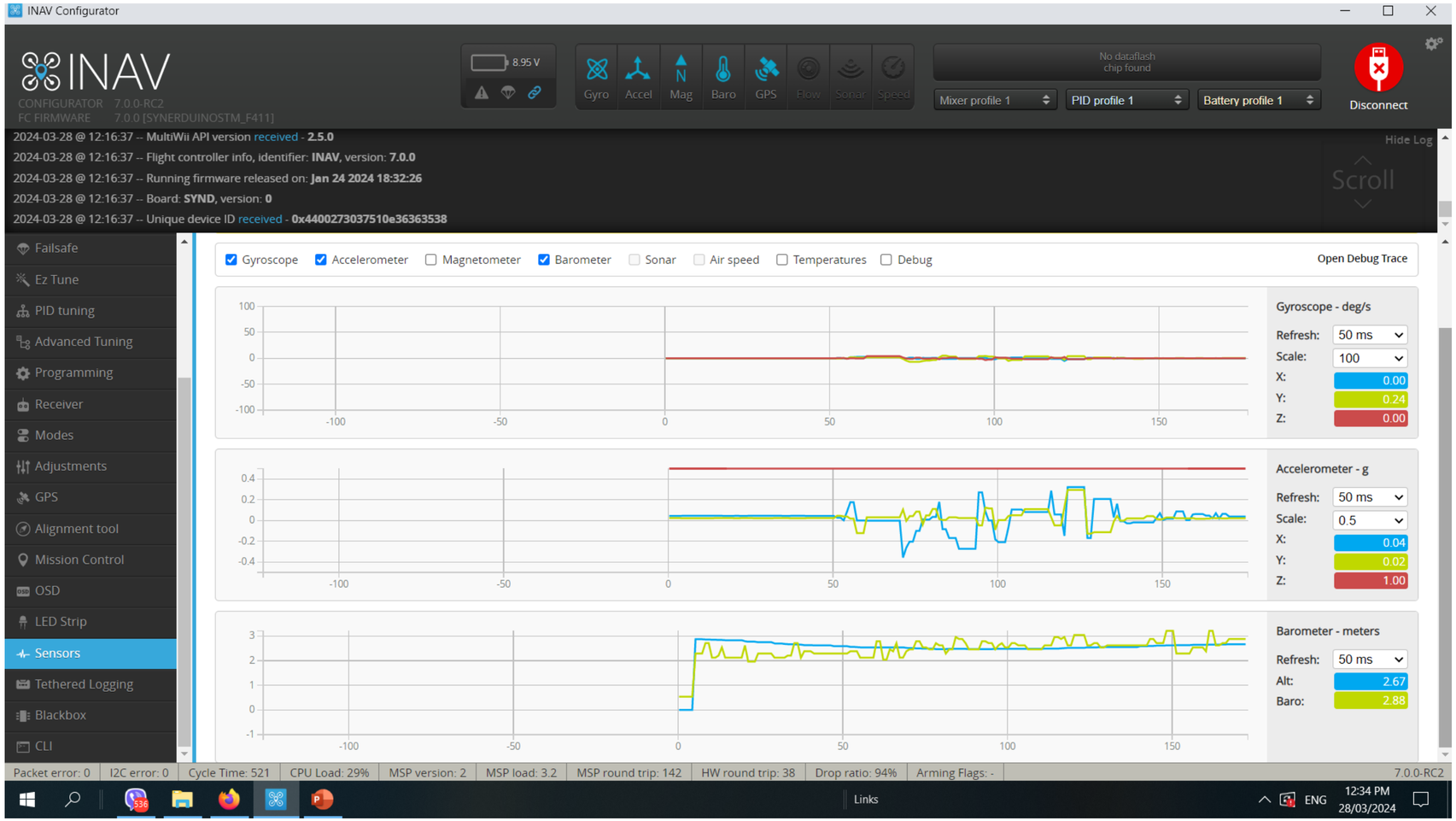
0 Degrees = North
90 Degrees = East
180 Degrees = South
270 Degrees = West



SETTING UP YOUR DRONE

SENSORS

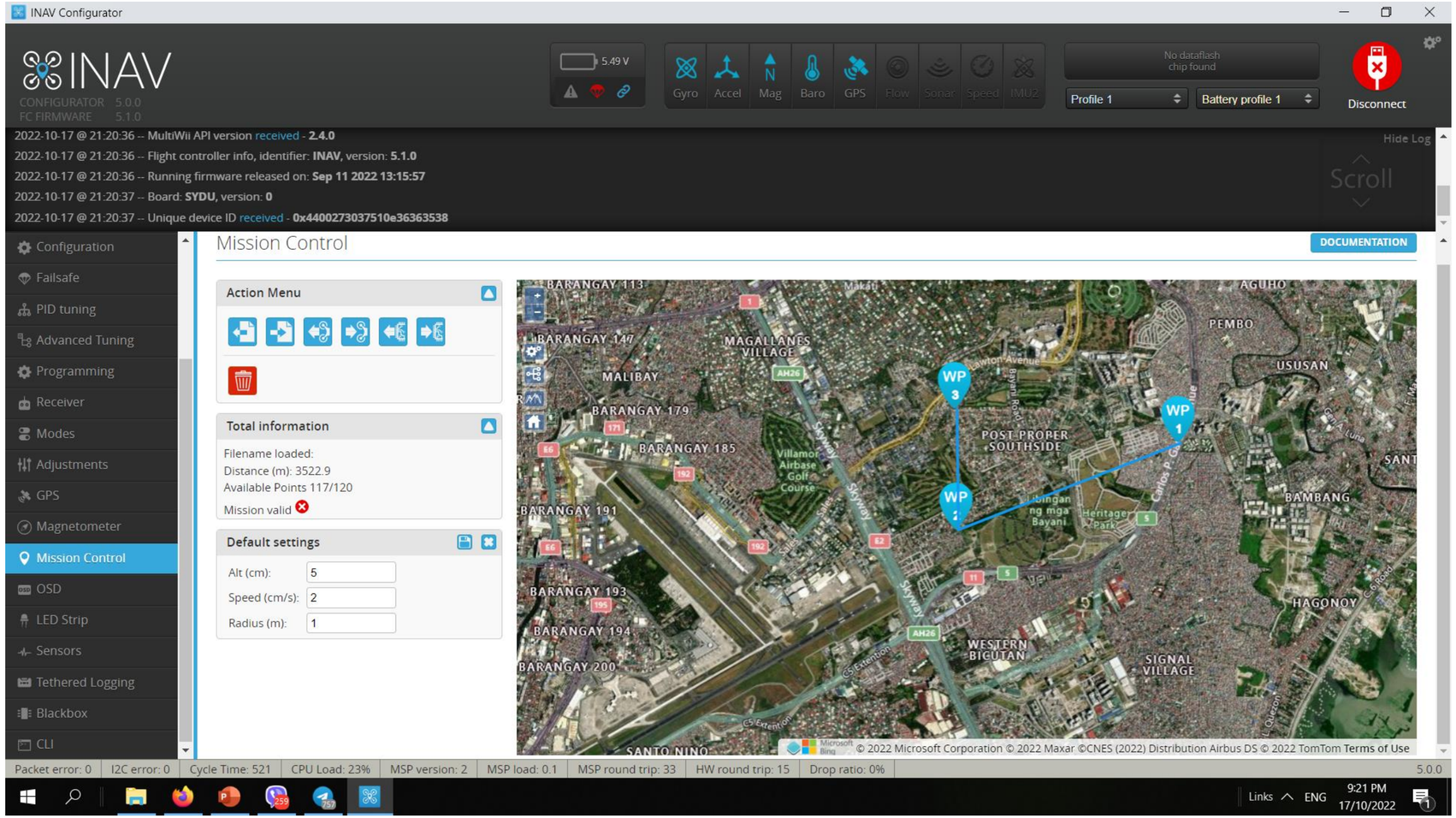
This is to visualize your Sensors input and aid for orientation



SETTING UP YOUR DRONE

MISSION CONTROL

NAV Configurator allows to choose between OpenStreetMap, Bing Maps, and MapProxy map providers. INAV Configurator is shipped **WITHOUT** API key for Bing Maps. That means: every user who wants to use Bing Maps has to create own account, agree to all *Terms and Conditions* required by Bing Maps and configure INAV Configuerator by himself.



SETTING UP YOUR DRONE

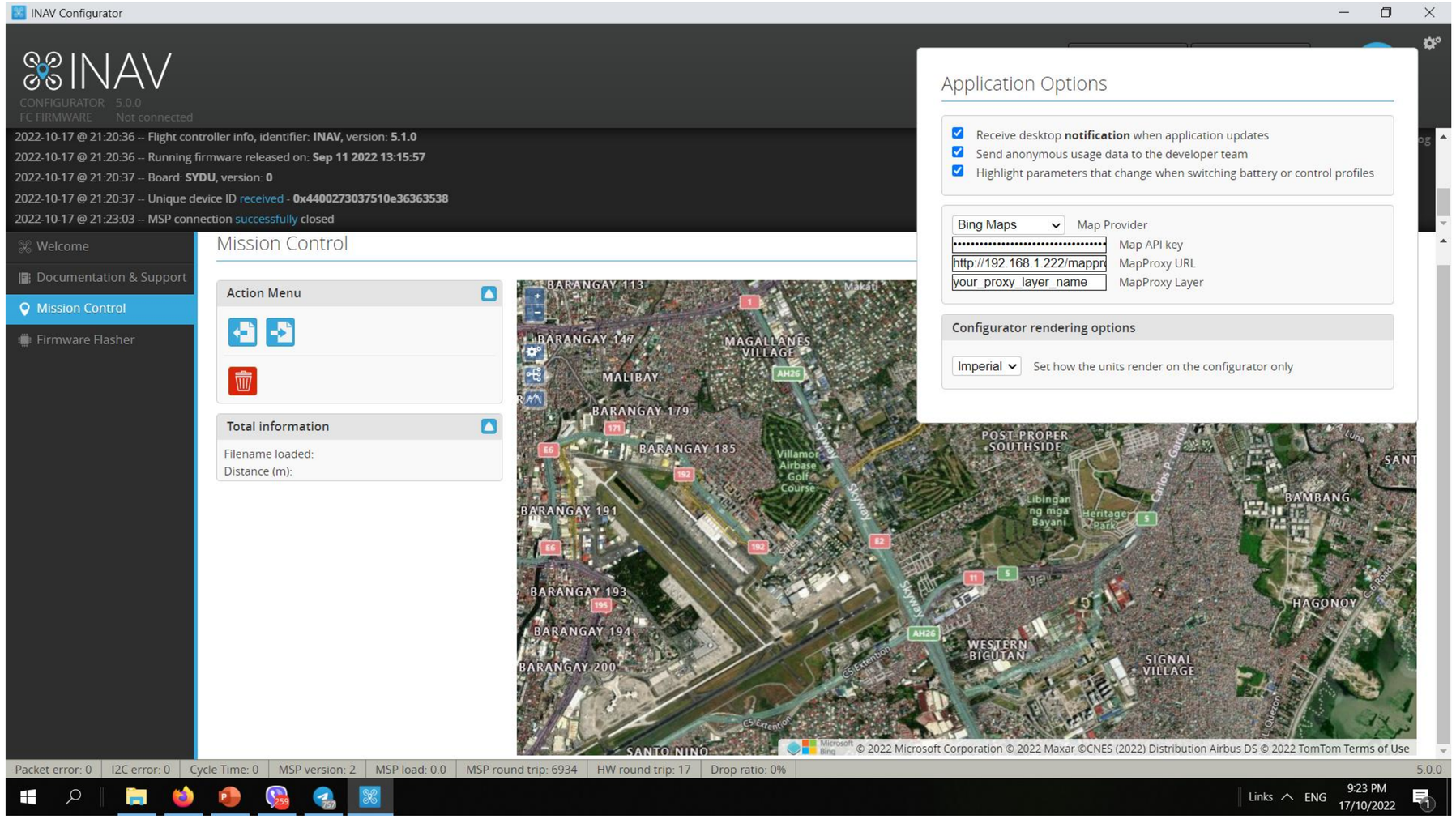
How to choose Map provider

1.Click **Settings** icon in the top-right corner of INAV Configurator

2.Choose provider: OpenStreetMap, Bing, or MapProxy

3.In the case of Bing Maps, you have to provide your own, personal, generated by you, Bing Maps API key

4.For MapProxy, you need to provide a server URL and layer name to be used



How to get Bing Maps API key

1.Go to the Bing Maps Dev Center at https://www.bingmapsportal.com/.

1. If you have a Bing Maps account, sign in with the Microsoft account that you used to create the account or create a new one. For new accounts, follow the instructions in Creating a Bing Maps Account.

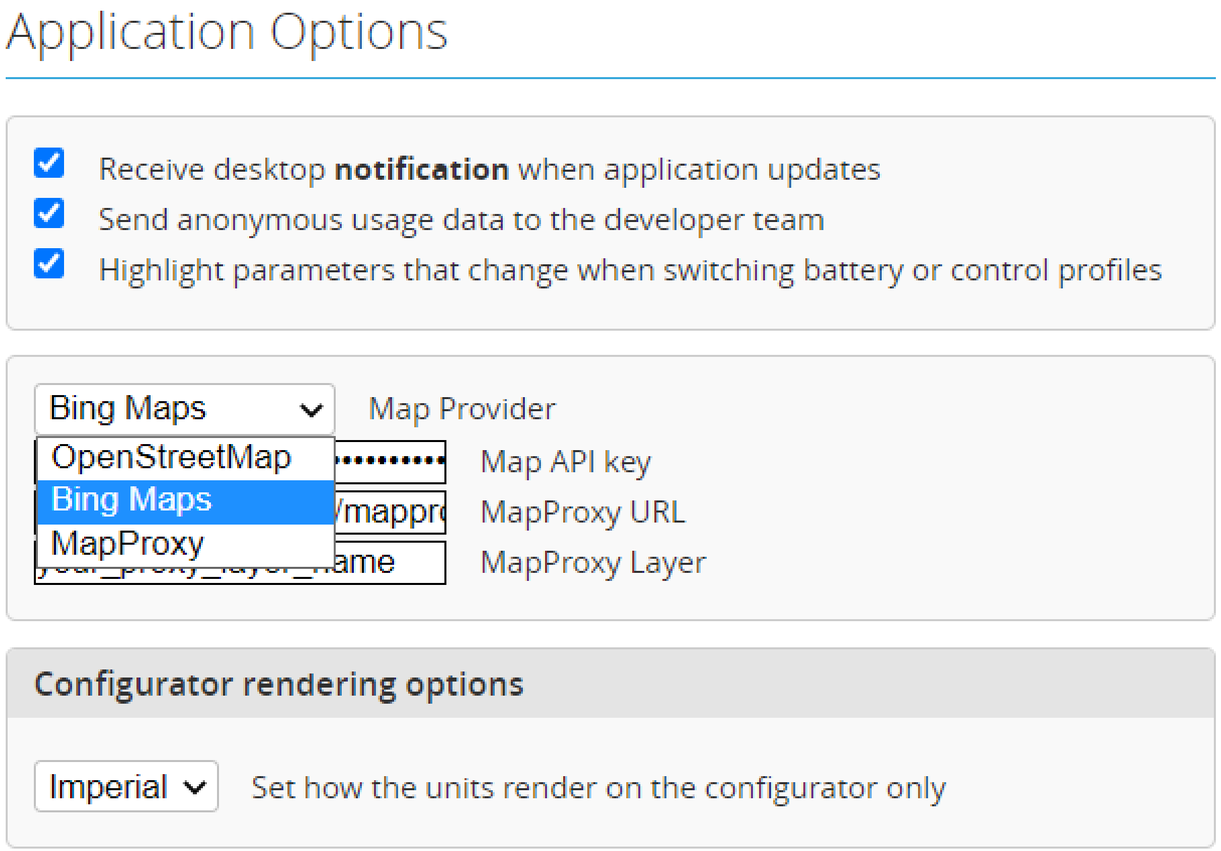
2.Select **My keys** under **My Account**.

3.Select the option to create a new key.

4.Provide the following information to create a key:

1. Application name: Required. The name of the application.
2. Application URL: The URL of the application. This is an optional field which is useful in helping you remember the purpose of that key in the future.
3. Key type: Required. Select the key type that you want to create. You can find descriptions of key and application types here.
4. Application type: Required. Select the application type that best represents the application that will use this key. You can find descriptions of key and application types here.

5.Click the **Create** button. The new key displays in the list of available keys. Use this key to authenticate your Bing Maps application as described in the documentation for the Bing Maps API you are using.

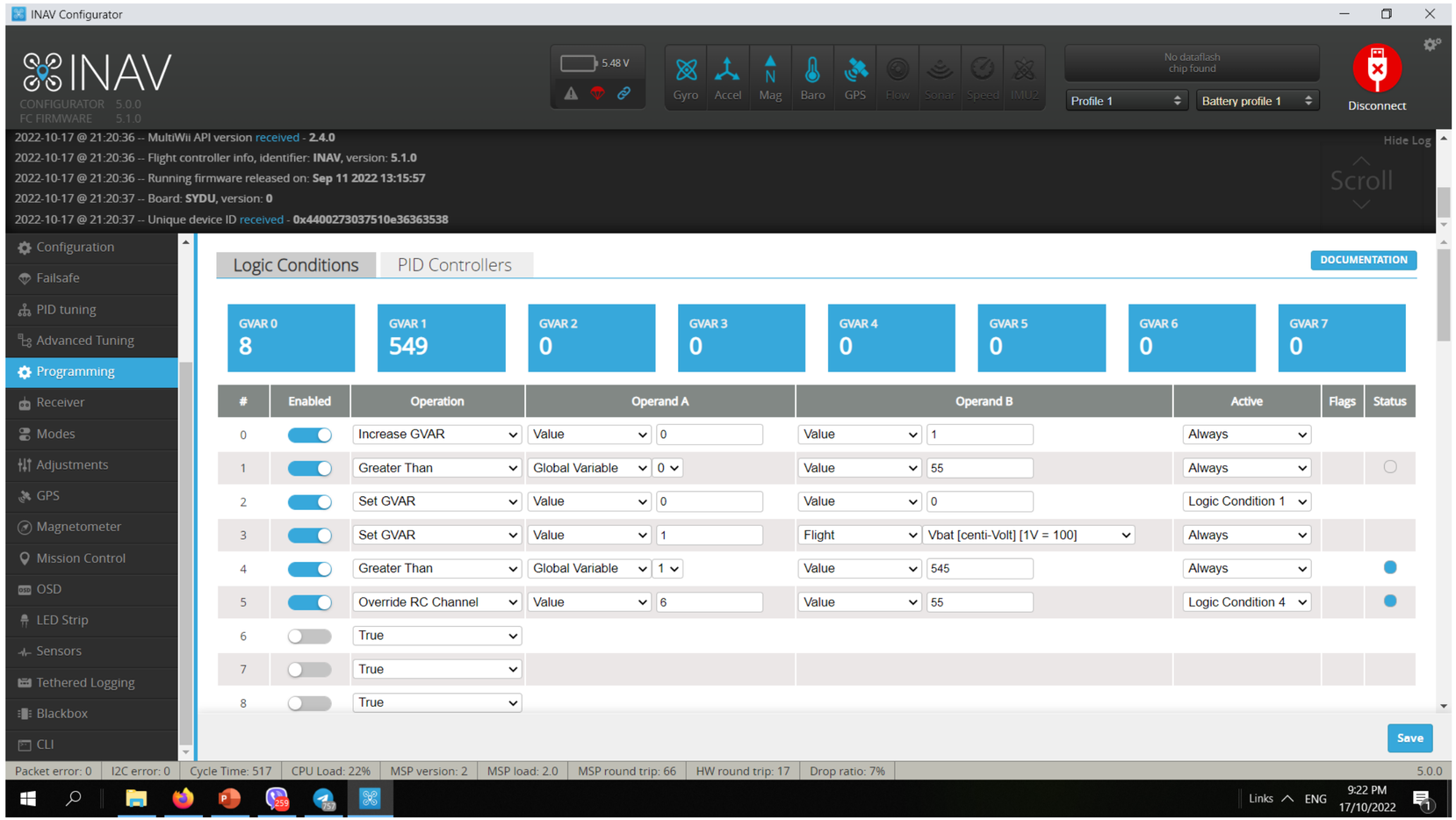


SETTING UP YOUR DRONE

Programming

This is the definitive feature of INAV combine with the Synerduino Shield .

This PLC function allows you to program upto 8 GVAR and instructions from timer to sensor conditions to trigger a Flight mode action or control action of your Drone



SETTING UP YOUR DRONE

CLI Command Line – Aircraft Status

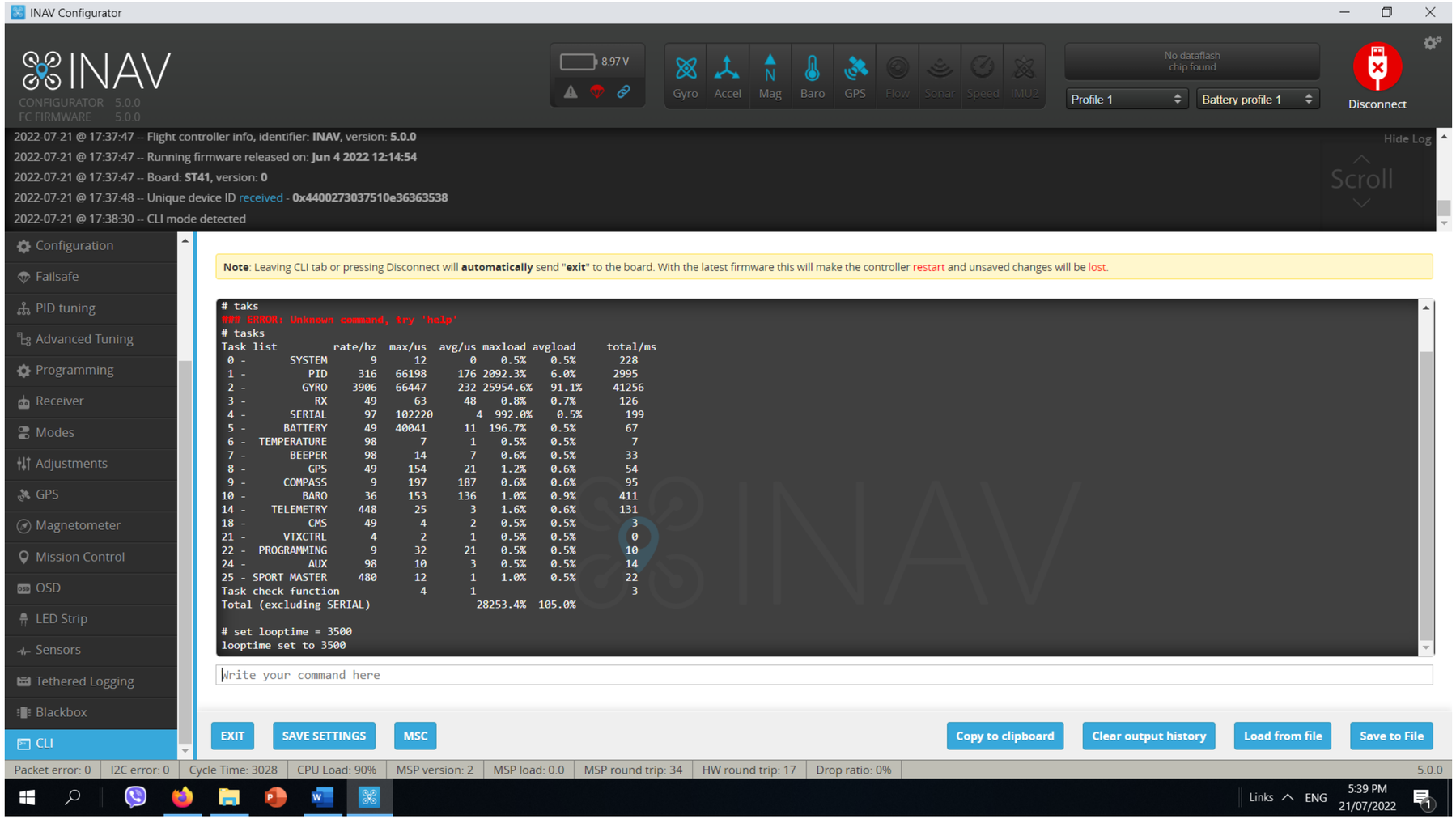
This is where you can import PID setting , check status or Adjust parameters

Open the CLI command line. Enter the command below.

Tasks – check if everything is with in CPU load should be with in 70%

Status – Check if all systems are active , Gyro/ACC/MAG/BARO/GPS or Flow

And to identify errors



Reason (CLI Mnemonic)	Bit Mask (Hex)	Explanation
FS	00000080	The RX is not recognised as providing a valid signal
ANGLE	00000100	The vehicle is not level as defined by the CLI small_angle setting
CAL	00000200	The pre-arm sensor calibration has not completed. The barometer is somewhat susceptible to lengthy calibration, which may be mitigated by the CLI setting baro_cal_tolerance, e.g. set baro_cal_tolerance = 500 (find a suitable value by experimentation).
OVRLD	00000400	The CPU load is excessive. May be caused by too an aggressive loop time setting.
NAV	00000800	Where the CLI setting nav_extra_arming_safety = ON is used, this may be caused by reasons shown in the table below
COMPASS	00001000	The compass is not calibrated. Perform the calibration procedure
ACC	00002000	The accelerometer is not calibrated. Perform the 6 point calibration procedure
ARMSW	00004000	The arm switch was engaged as the FC booted
HWFAIL	00008000	A required hardware device has failed / is not recognised (e.g. GPS, Compass, Baro)
BOXFS	00010000	A failsafe switch is engaged
KILLSW	00020000	A kill switch is engaged
RX	00040000	The RC link is not detected (RX not detected)
THR	00080000	The throttle setting is not a minimum
CLI	00100000	The CLI is active (note: you will always /unavoidably see this when in the CLI)
CMS	00200000	The CMS menu is active
OSD	00400000	The OSD menu is active
ROLL/PITCH	00800000	Roll and/or pitch is not centred
AUTOTRIM	01000000	Servo autotrim is engaged
OOM	02000000	The FC is out of memory
SETTINGFAIL	04000000	A CLI setting is out of range. The erroneous setting should be indicated in a CLI dump. If you can't then reset the offending setting, reflash with full chip erase and reapplying settings from scratch may help.
PWMOUT	08000000	PWM output error. Motor or servo output initialization failed. (cause by insufficient timers available : turn off unused function like LED strip or SPI device)
NOPREARM	10000000	PREARM is enabled and timed out

- INAV will refuse to arm for the following reasons (e.g. from cli status**):**
- **Type Status on the CLI to find the cause**

SETTING UP YOUR DRONE

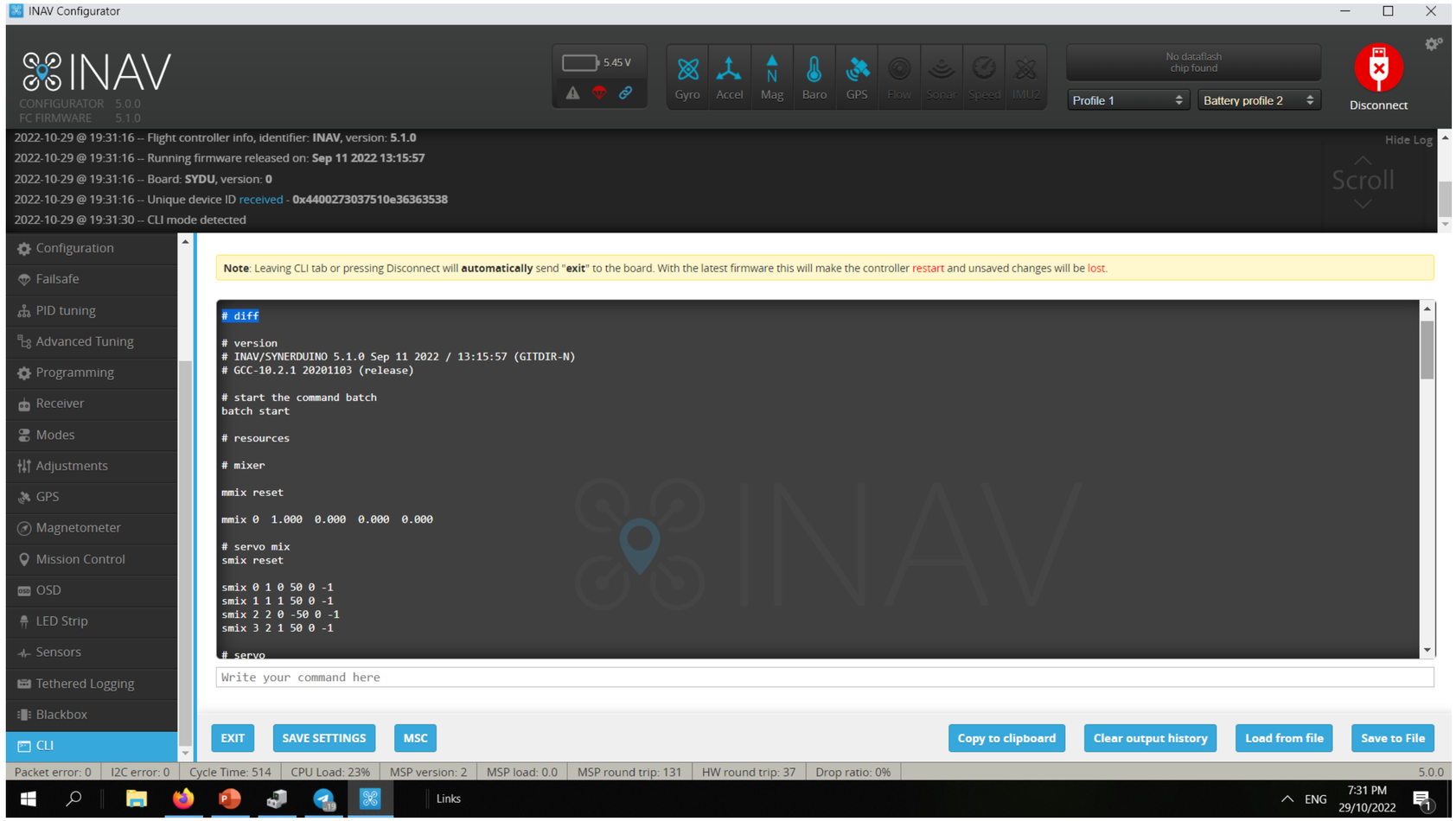
CLI Command Line Saving and Loading Parameters

You can download the Preset DIFF for the Synerduino STM Synerduino STM page

- DIFF - command to dump only those settings that differ from their default values (those that have been changed).
- DUMP – CLI Dump configuration

Then save the output on a notepad

The same output can be paste on the CLI and press ENTER to upload the Configuration , Save Settings then Reboot



Note: that we offer the Synerduino STM Diff .txt file available for those who wanted to use the pre-set for the 250mm synerduino drone

SETTING UP YOUR DRONE

Sometimes no matter how well you calibrate

Your aircraft may drift when your on neutral sticks

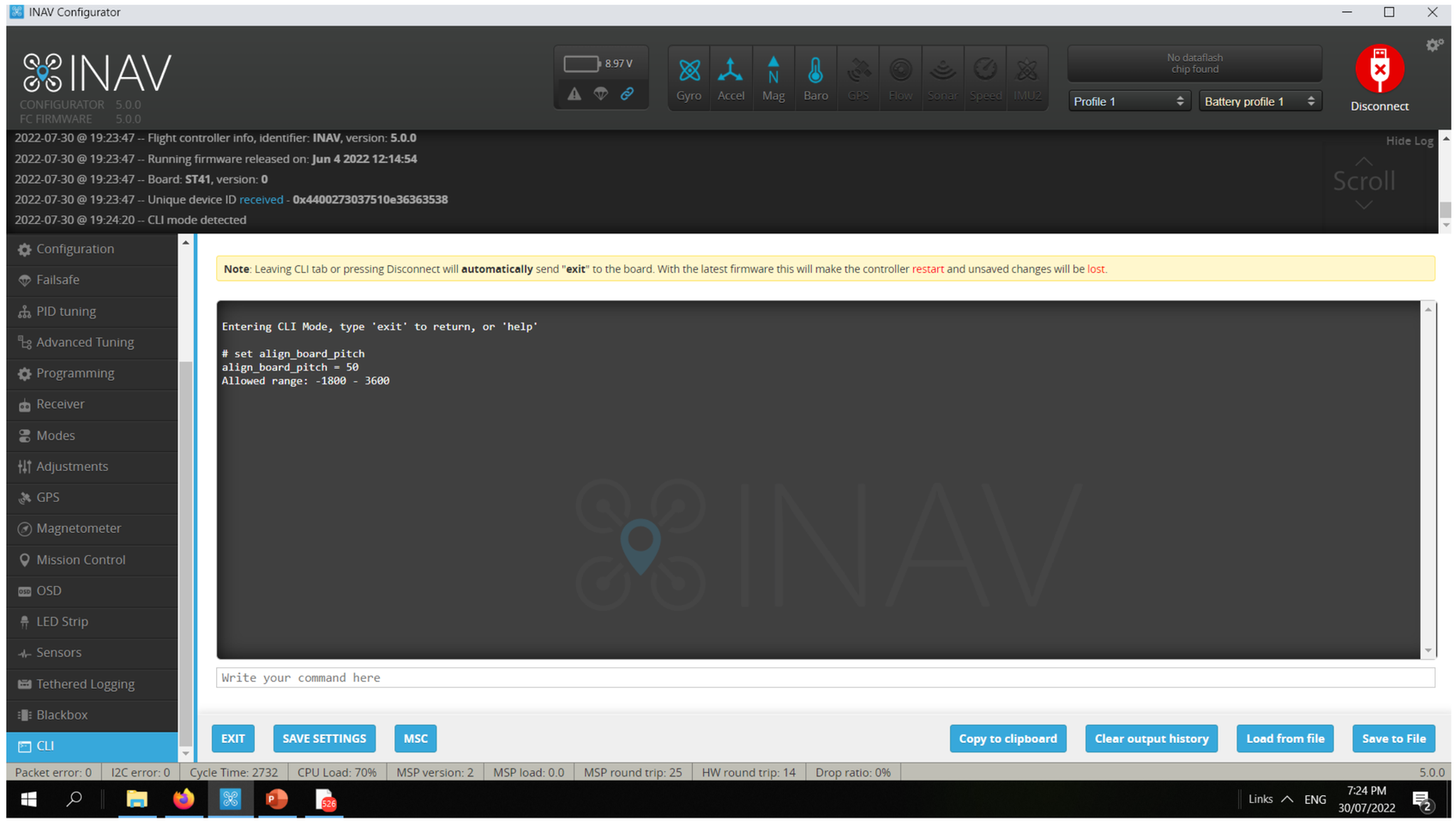
your ACC its not always perfect . You may need to trim your board for a good stability in flight

set align_board_pitch
set align_board_pitch = #
Allowed range: -1800 – 3600

set align_board_roll
set align_board_roll = #
Allowed range: -1800 – 3600

Pitch + # is Trim to the Back
Pitch – # is Trim to the Forward
Roll + # is Trim Left
Roll - # is Trim Right

CLI Command Line Trimming the Roll and Pitch Alignment



SETTING UP YOUR DRONE

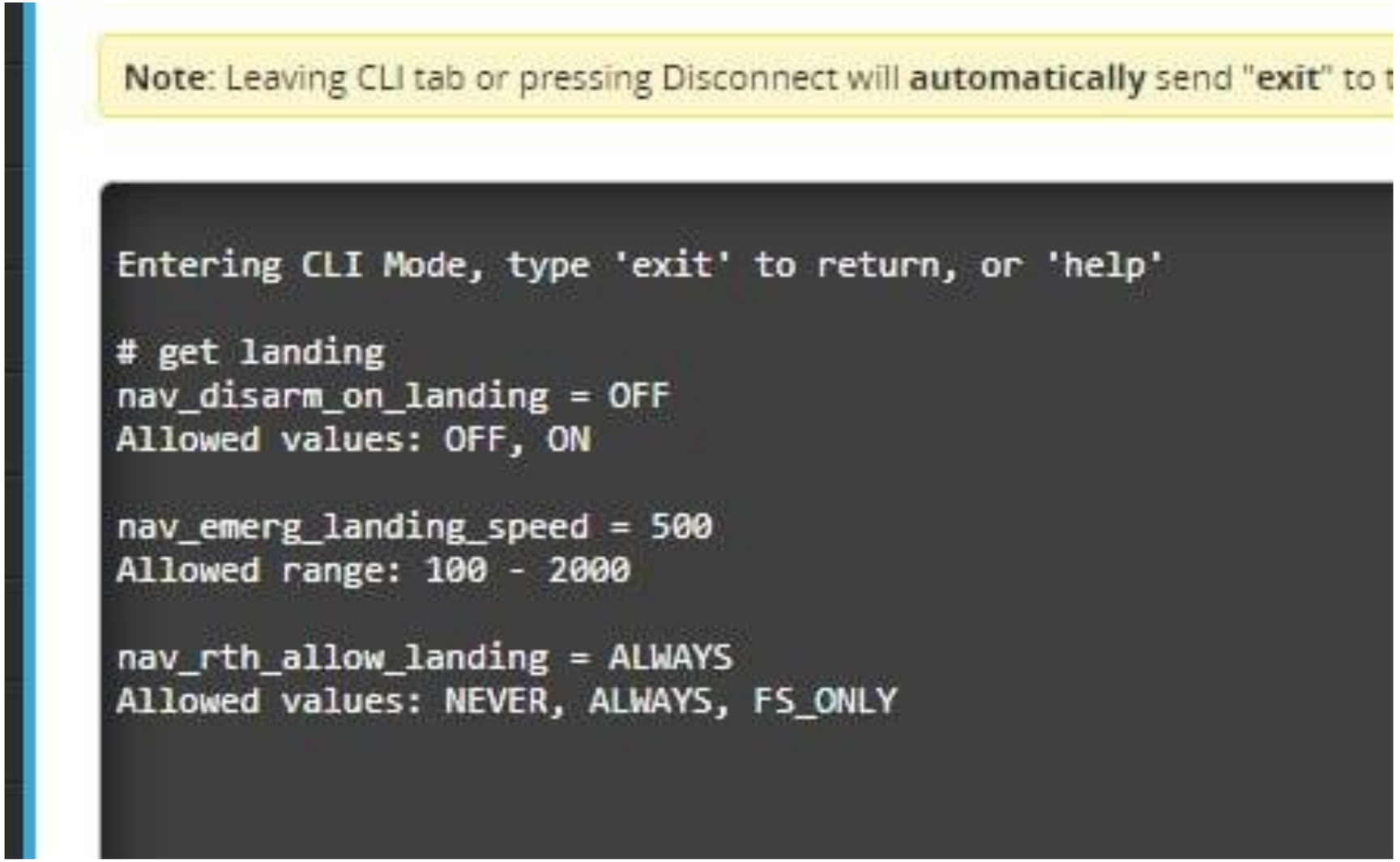
CLI Command Line Landing setting

What your drone would do when Landing or RTH command is present

nav_disarm_landing
This shuts off the motor after touch down or contact solid . Means drone has no movment for 3 seconds or what ever you set it to

nav_ emerg_landing_speed
The speed it descends on emergency

nav_rth_allow_landing
Should the drone land after reaching RTH



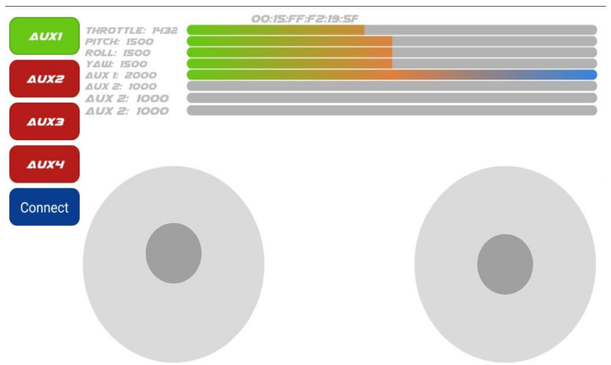
SETTING UP YOUR DRONE

set rx_min_usec = 790

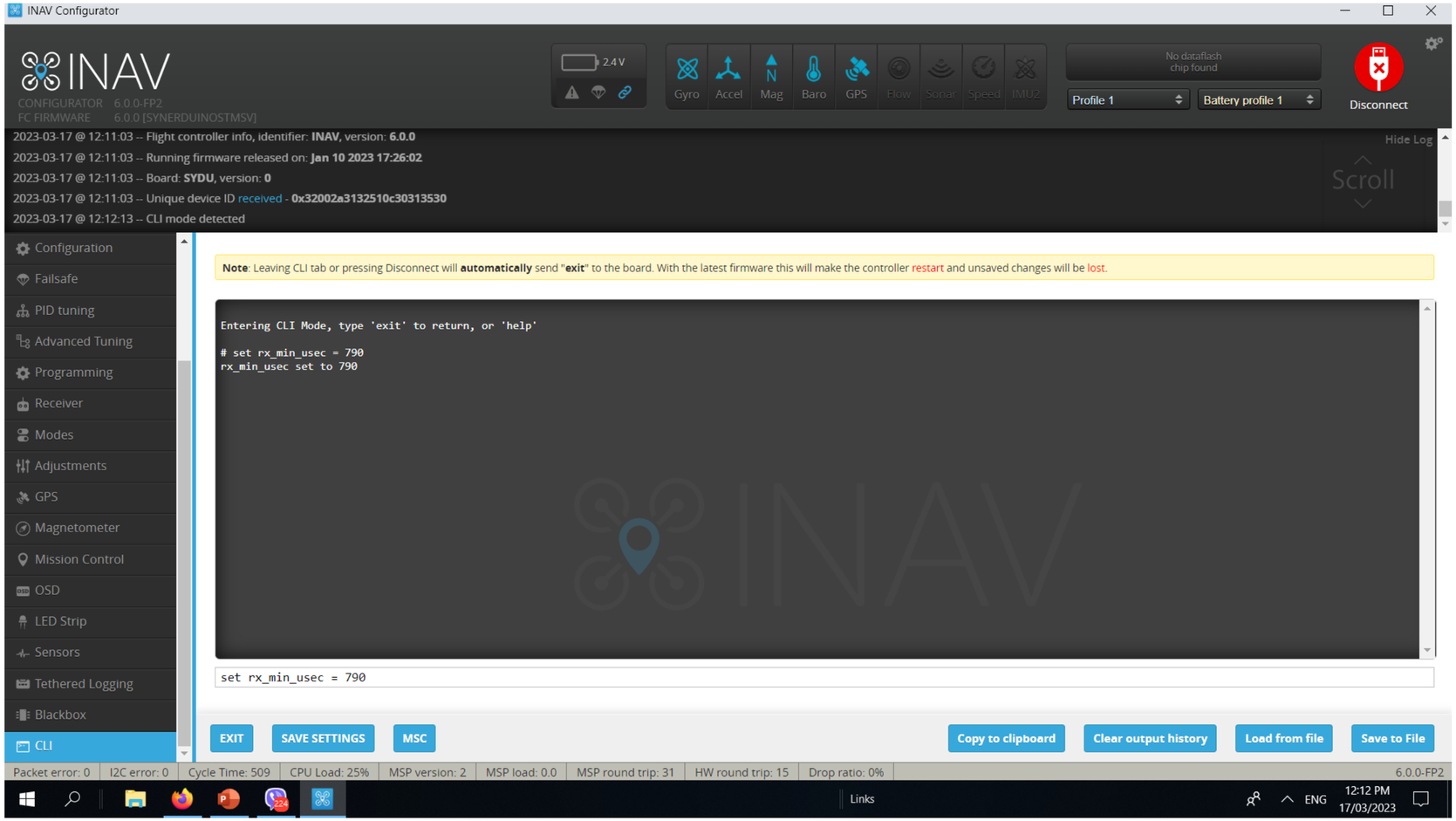
Because the Synerduino App sets RX min as 800 to accommodate Multiwii Serial RC switching

The INAV equivalent is to reduce the RC min to 790 to accommodate this buttons

This allows the use of the AUX buttons on the Left



For users who wish to control this drone using the Synerduino APP



SETTING UP YOUR DRONE

Its important to set this correctly to ensure proper GPS flights

CLI Command Line GPS setting

Set ahrs_gps_yaw_windcomp = ON

Set gps_provider = UBLOX7
Allowed values: NMEA, UBLOX, UBLOX7, MSP

Set gps_sbas_mode = AUTO
Allowed values: AUTO, EGNOS, WAAS, MSAS, GAGAN, NONE

Set gps_dyn_model = PEDESTRIAN
PEDESTRIAN – multirotor hover or Slow Flg
AIR_1G – airplane slow to mid speed
AIR_4G – airplane fast speed

gps_auto_config = ON
Config GPS on bootup

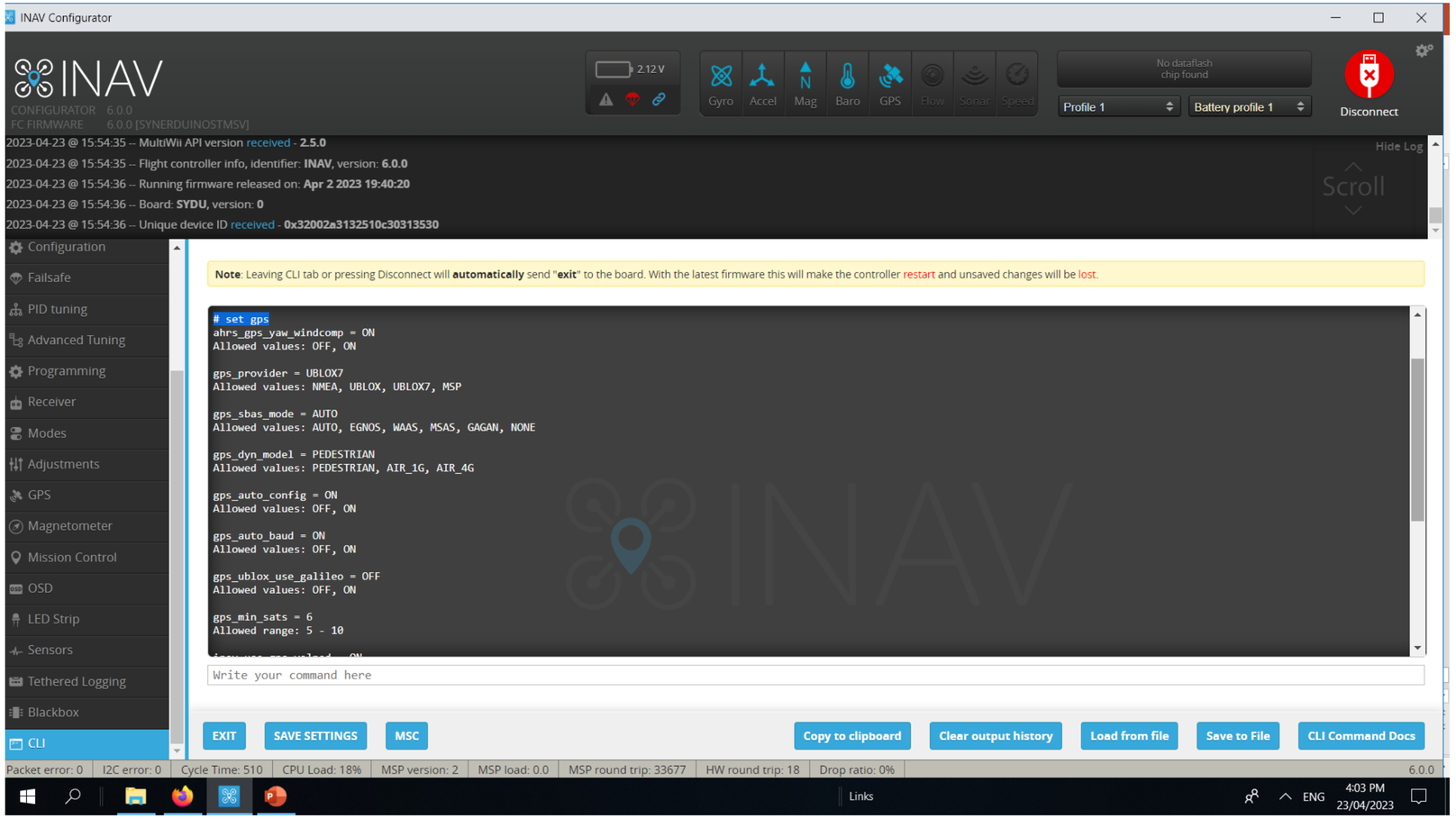
gps_auto_baud = ON

gps_ublox_use_galileo = OFF
turn on only if GPS supports Galileo in your area

gps_min_sats = 6
Minimum sats to arm gps flight mode

inav_use_gps_velned = ON

inav_use_gps_no_baro = OFF
turning this on would make your drone rely on GPS altitude instead of Baro – meaure above sea level instead relative to bootup

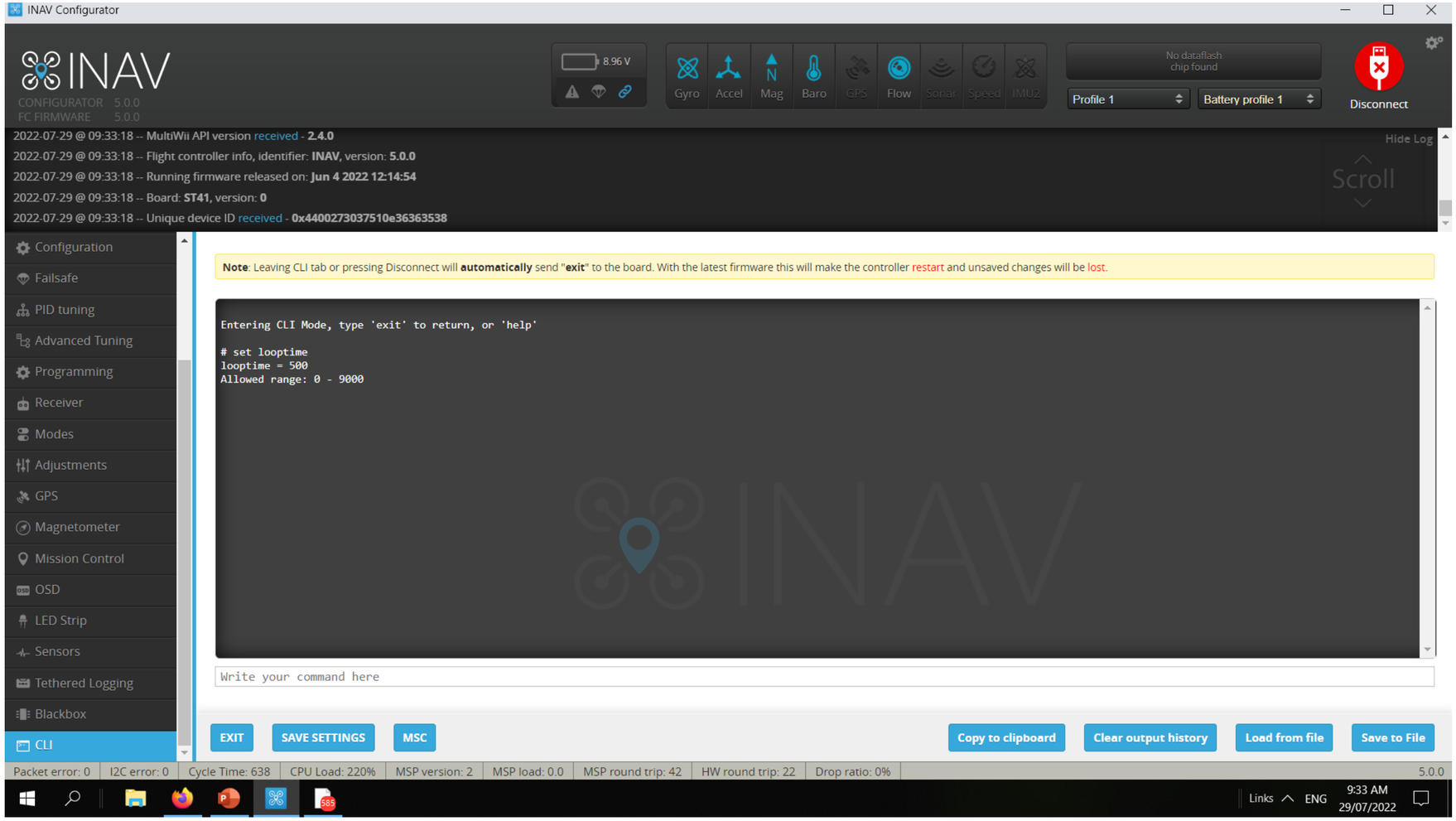


SETTING UP YOUR DRONE

CLI Command Line – Looptime and CPU Speed

LoopTime is the speed of processing allocation, this is adjusted depending on the sensors used or the number of peripherals

Looptime – Default 500 but you can get as slow as 2000 in worst case scenario

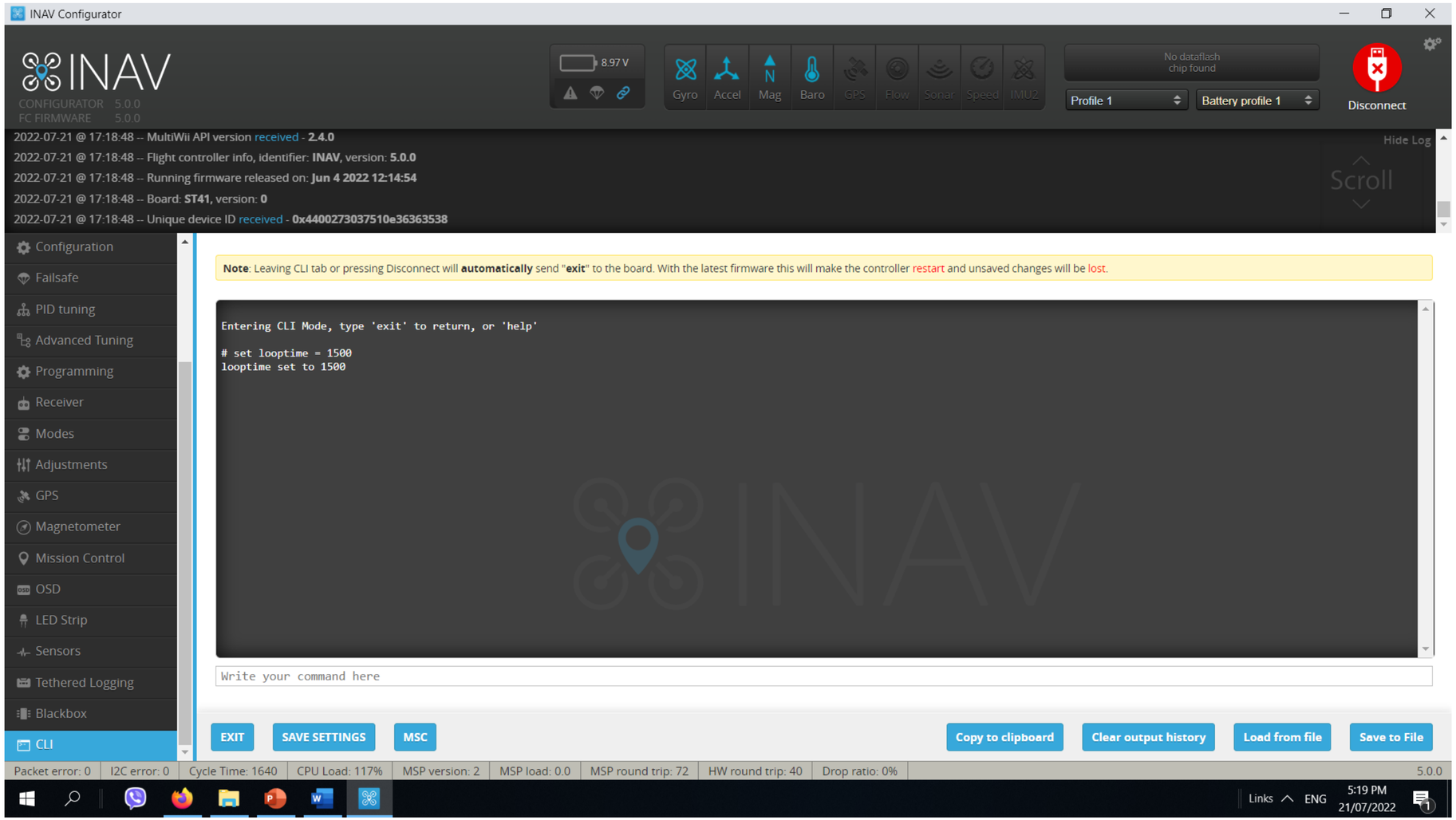


SETTING UP YOUR DRONE

CLI Command Line – Looptime and CPU speed

Open the CLI command line.
Enter the command below.
Default: set looptime = 500 or
Synerduino: set looptime = 2800 - 3500 this would slow down the refresh rate of the gyro to give it enough time for the cpu to load aswell as reduce the sensitivity of Gyros to Noise (Vibrations) that can cause the drone to flip
Then save it by typing the following command. save

This Adjust the sensor Refresh rate to better regulate the CPU Load Speed , If CPU is above 100% its overloaded and the failsafe would kick in . The drone will not Arm



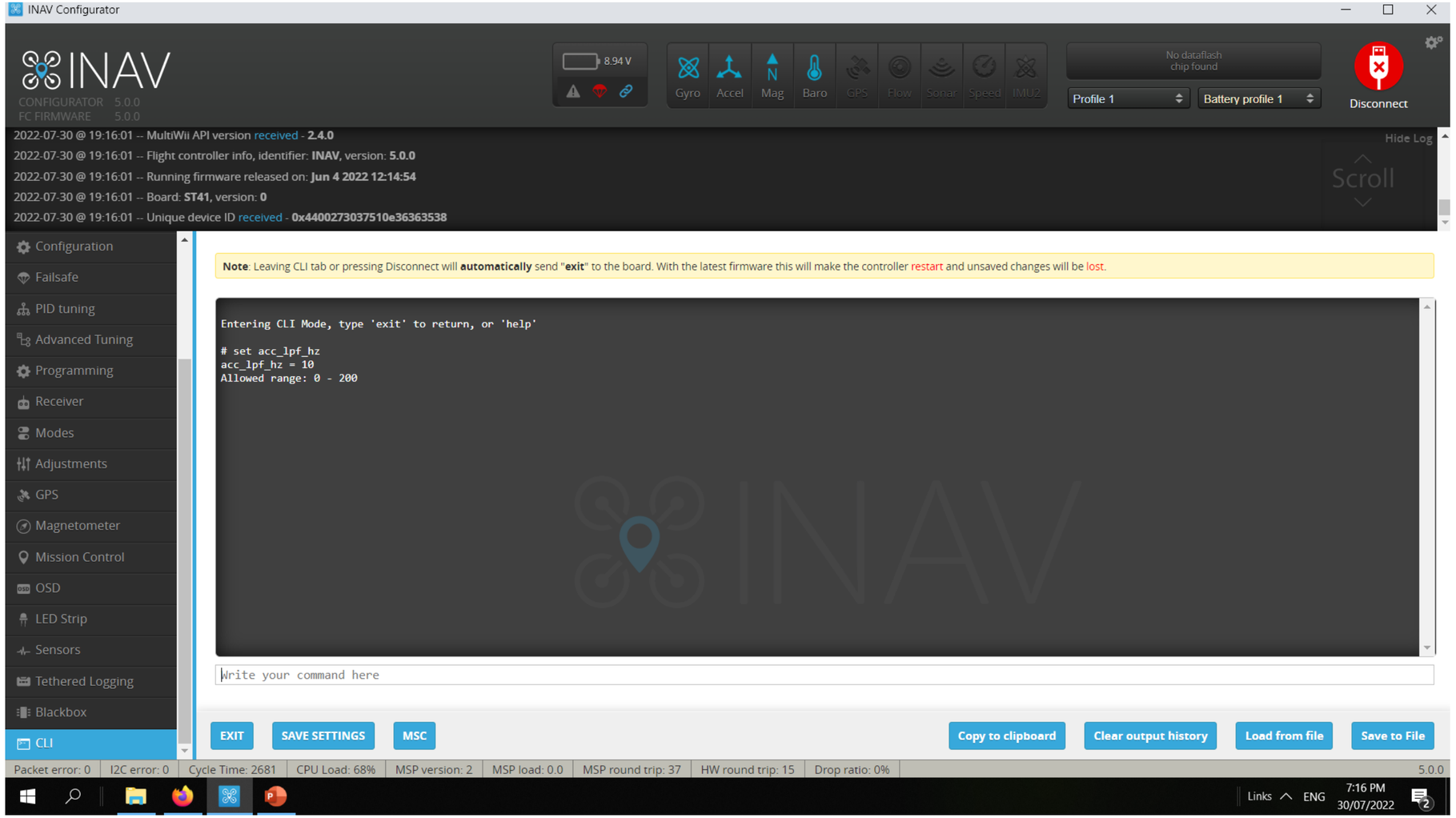
SETTING UP YOUR DRONE

CLI Command Line – Low Pass Filter

set acc_lpf_hz = 10 –

lower the number the less the sensitivity of the Acc to vibration cause by the motor , this may give a sluggish respond but it would settle the strange hiccups of INAV for Drifting Horizons

set acc_lpf_hz = 20 is Default



SETTING UP YOUR DRONE

Altitude hold

`Set nav_mc_althold_throttle = MID_STICK`
Allowed values: STICK, MID_STICK, HOVER

Sometimes users preference or Radio Transmitter would determine what constitute an Altitude hold

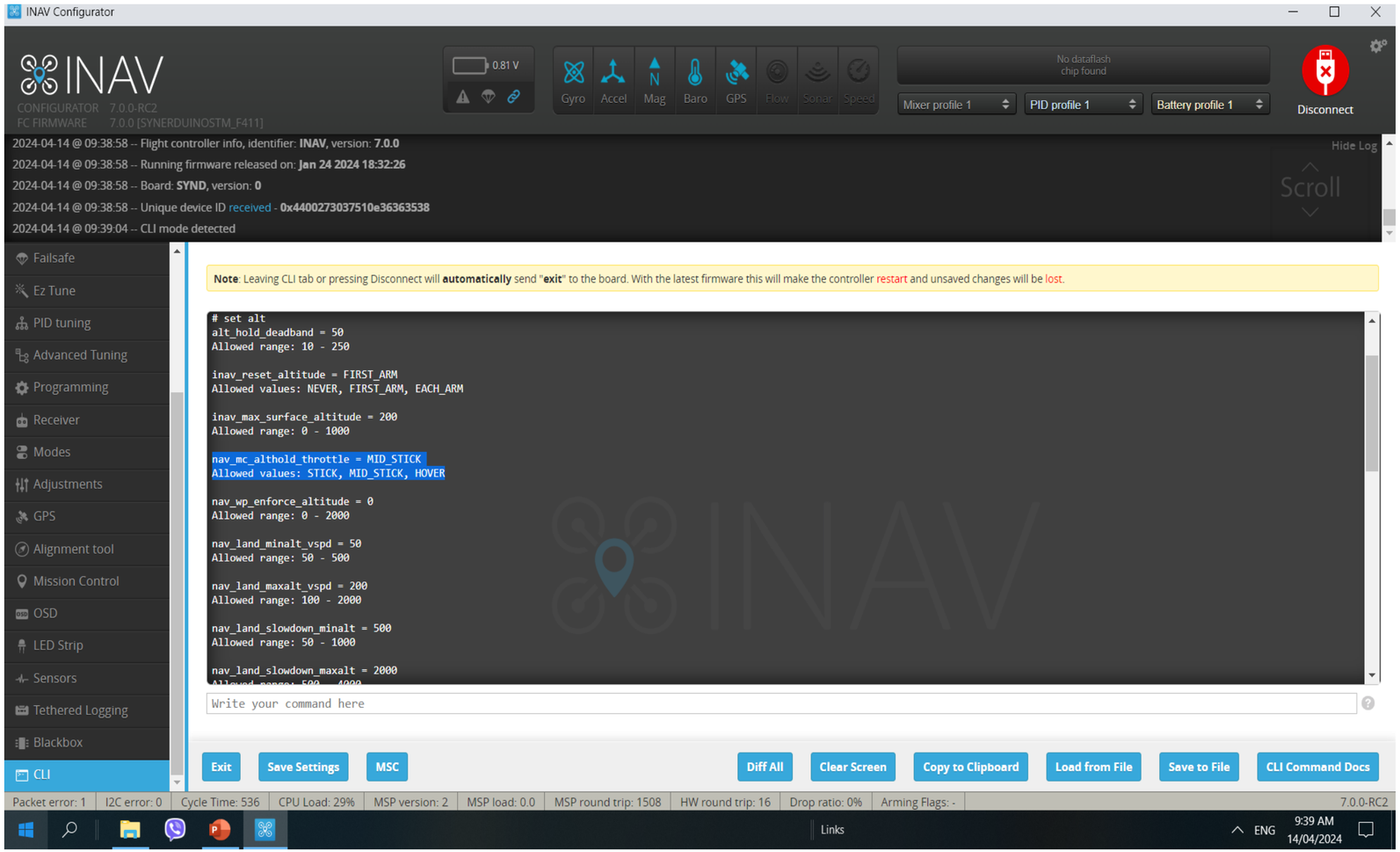
STICK = this would rely on the hover throttle as set in ADVANCE PID to determine the hover with dead band +/-

MID_STICK = this is common for Radios with throttle stick at center position with PWM 1500, means then throttle stick is at the center Altitude hold is active

HOVER = again is is Hover throttle Related

Set alt_hold_deadband = 50
Allowed range: 10 – 250

This is Dead band related it gives a deadregion in your throttle mid stick like 1450 to 1550 as MID stick position



https://github.com/iNavFlight/inav/discussions/8933

SETTING UP YOUR DRONE

Finishing Note:
Should you use the Preset DIFF in CLI
You may need to check again the following

- Calibration
- PID Tuning
- PORTS – if the correct port selected depending on your serial hardware
- Receiver - RC mapping to match your radio
- Modes – Flight modes switch
- Configuration - Sensor Orientation /Mag Orientation
- Magnetometer - Orientation
- GPS – configuration should it match your GPS type
- CLI – Task and Status to make sure you didn’t miss anything or having conflict
- INAV is a Active development and should be check for Updates from time to time

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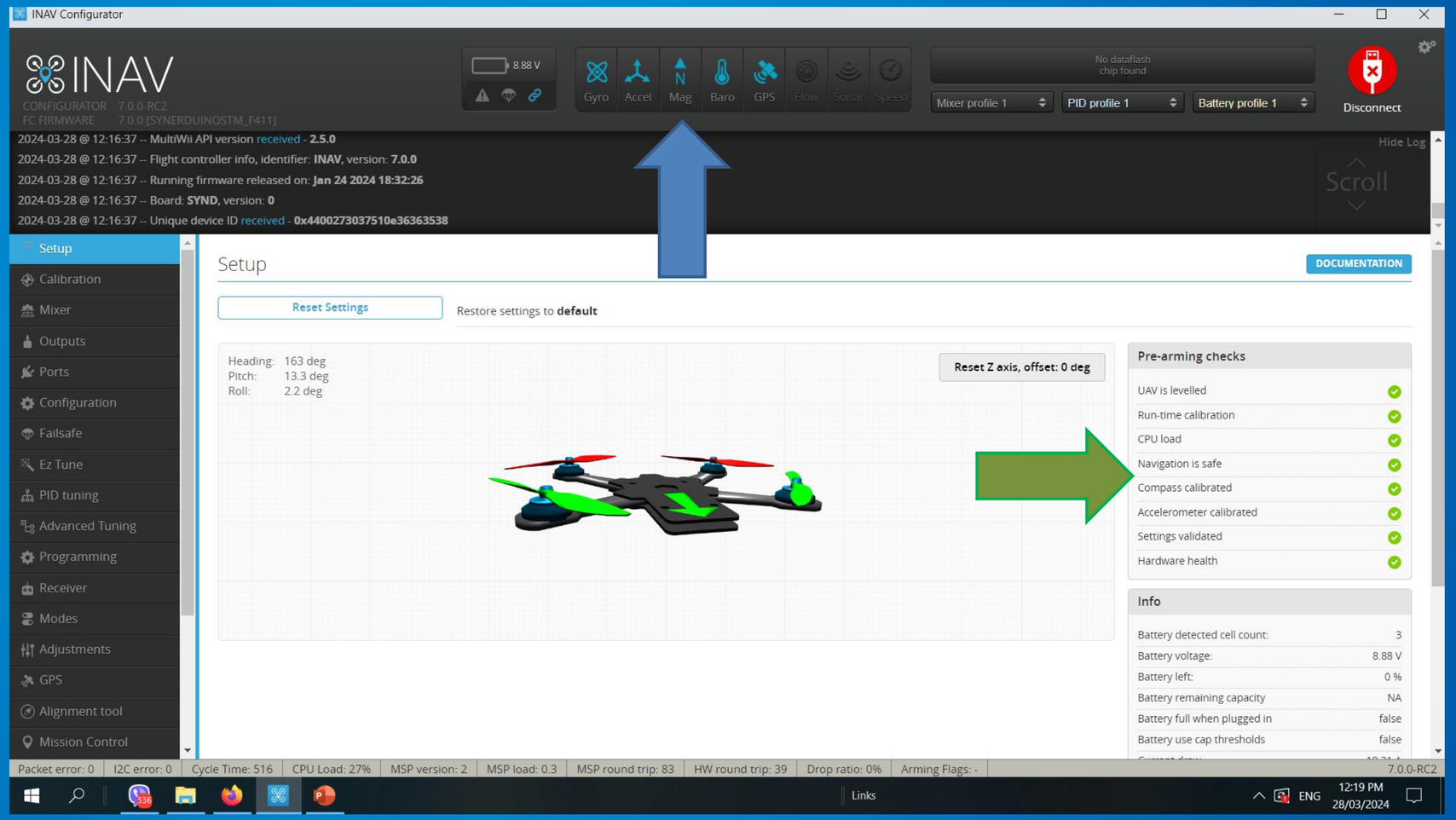
TESTING

SYSTEM CHECKS

NOTE:

- *Ensure all Pre-Arm checks are in the green*
- *Sensor Status are Blue*
- *Heading is Oriented correctly*
  0 North 90 East 180 South 270 West
- *Pitch and Roll at 0*
- *Any Error in this should check their Respective Menu*
- *CLI Terminal type STATUS should show if there are any misconfigurations*



PRE-FLIGHT

PREFLIGHT

NOTE:

- *Check Batteries fully Charge*
- *Motors and Connections in Good shape*
- *Radio Failsafe Active*
- *Communication with Ground station working*
- *Flight modes setup correctly*

QUICK BUILD GUIDE

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