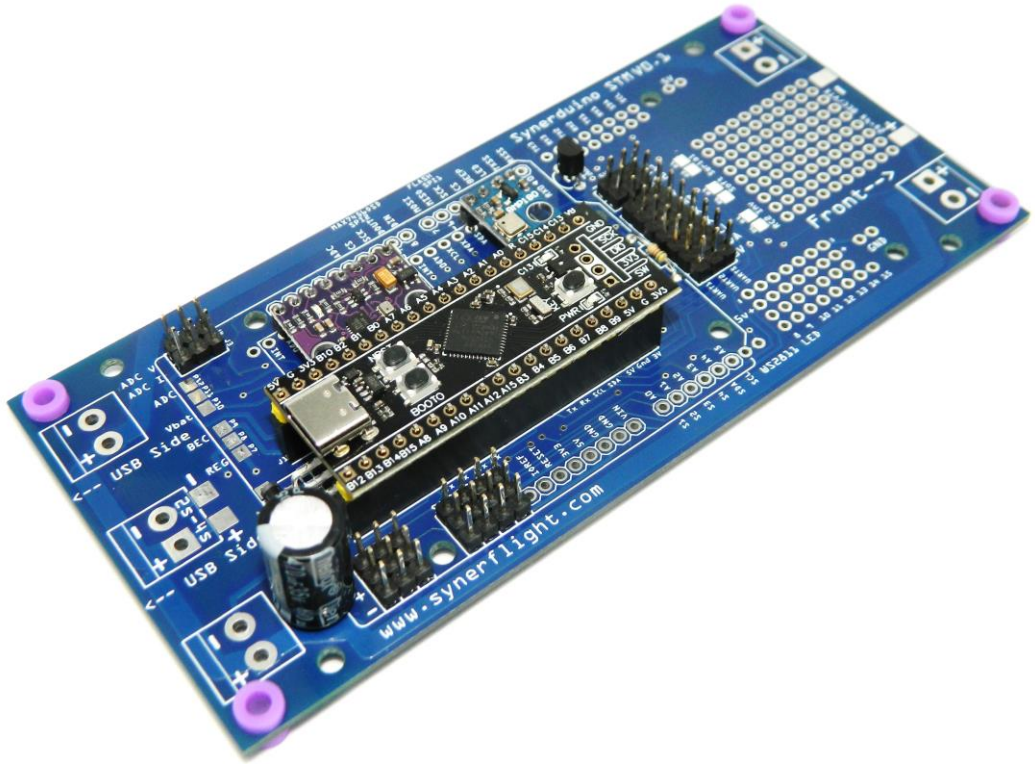
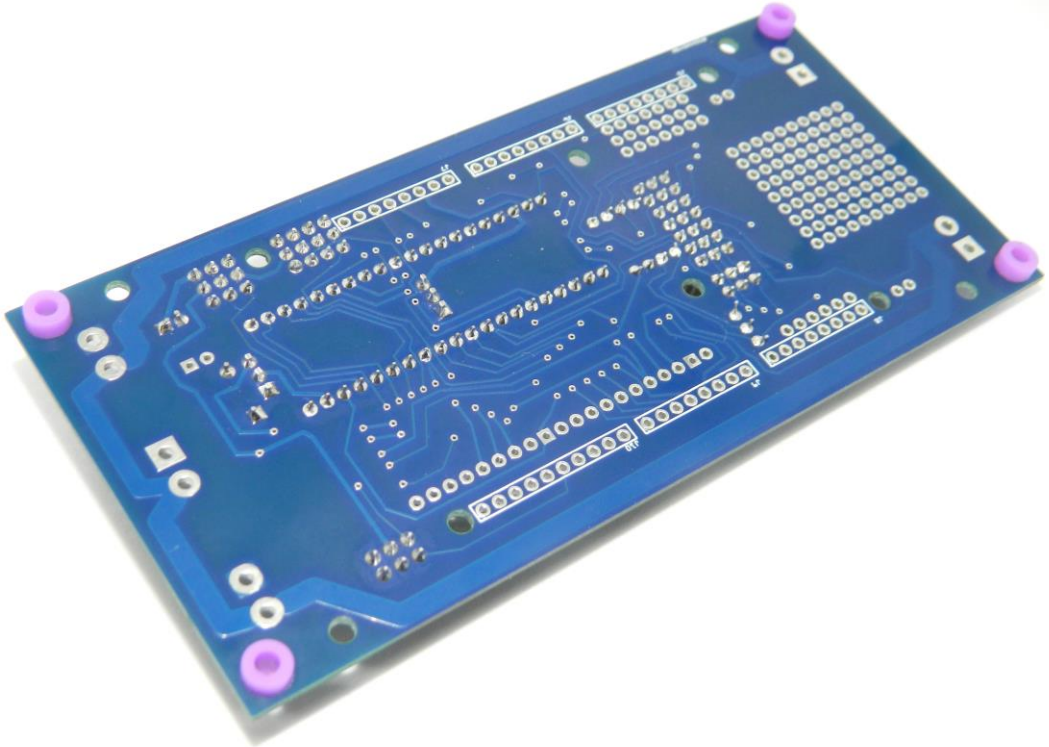
SYNERDUINO STM SHIELD

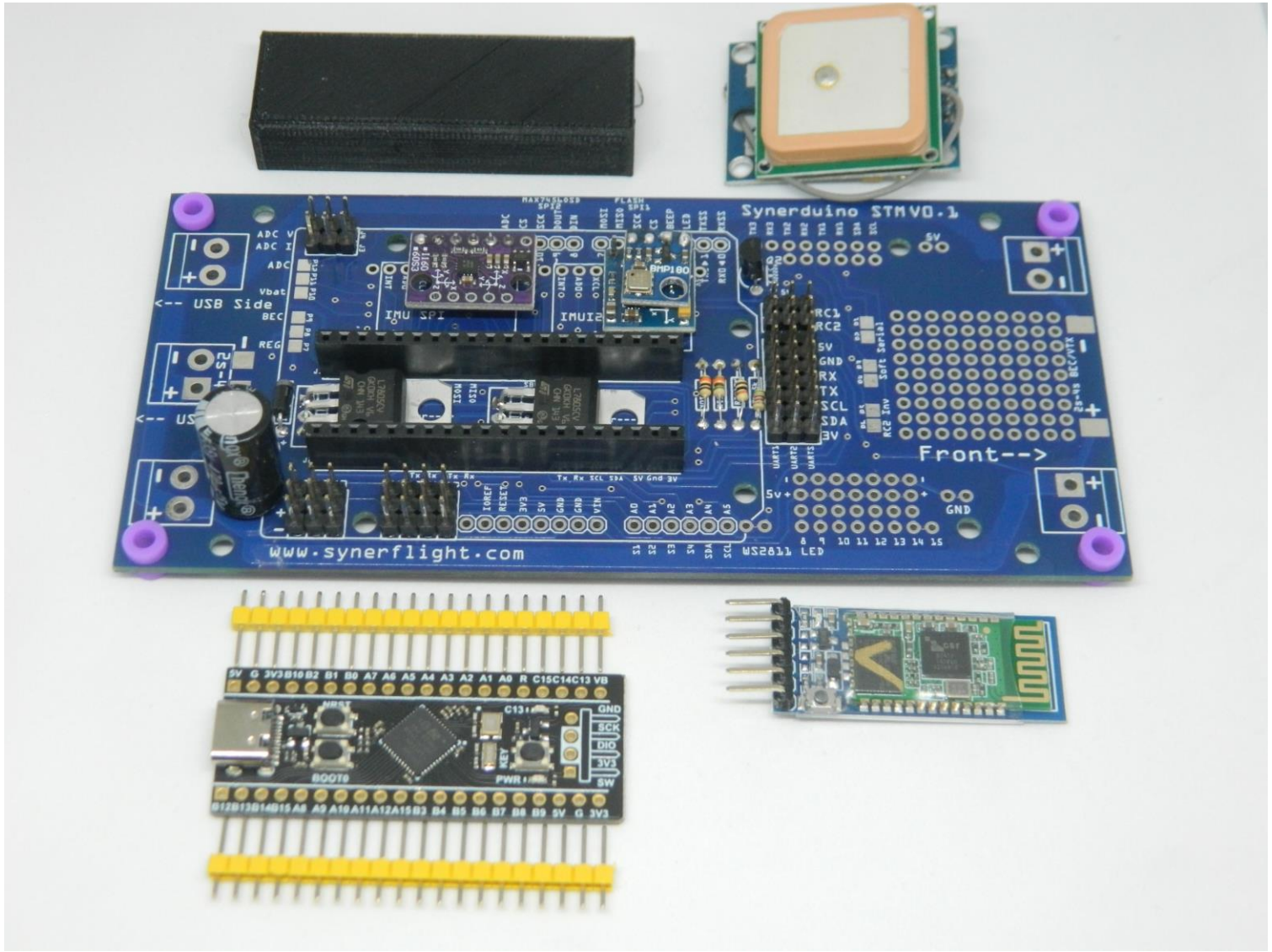
STM32F411 and Shield board Setup

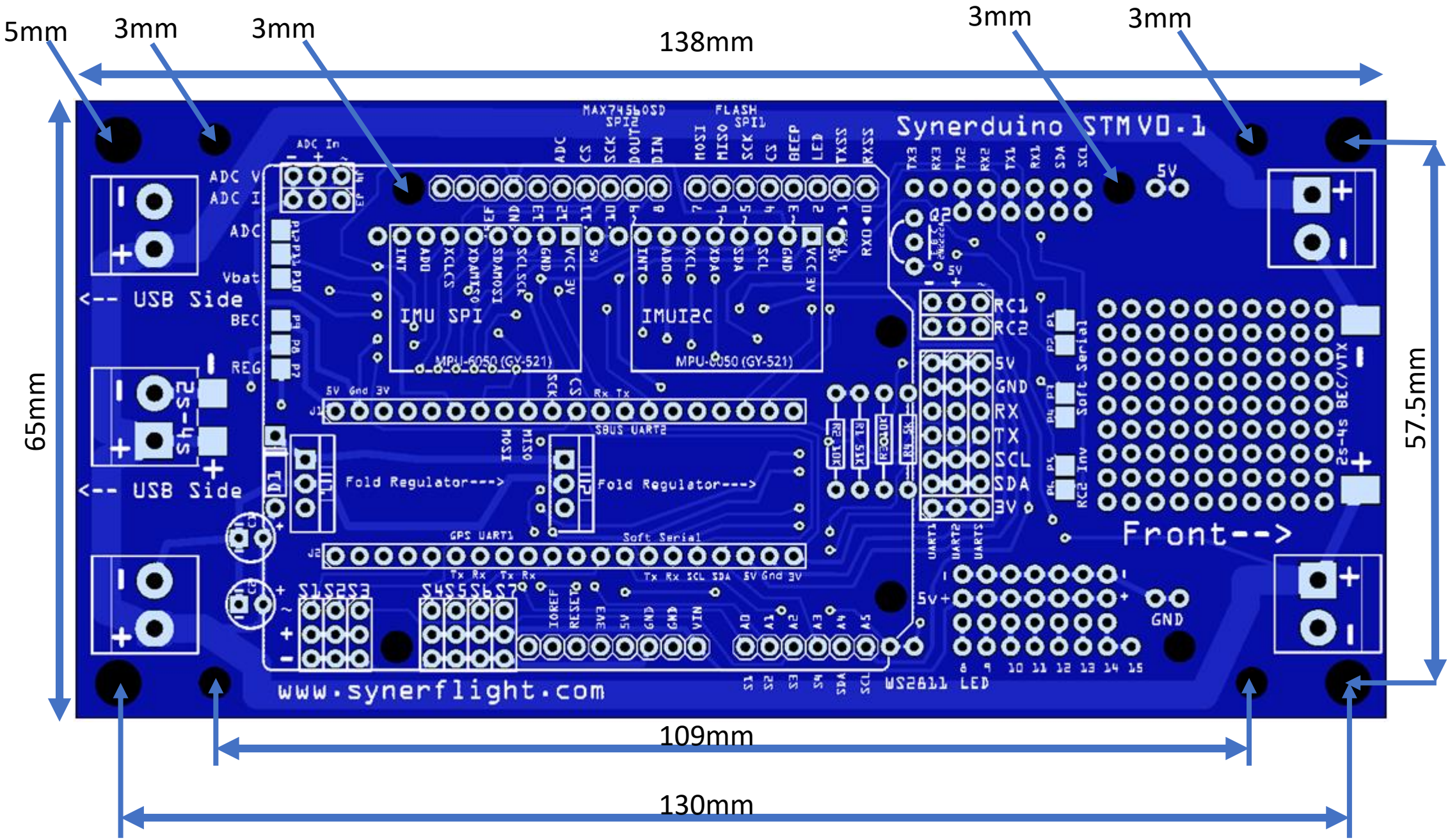
SYNERDUINO STM BlackPill
STM32F411CEU6



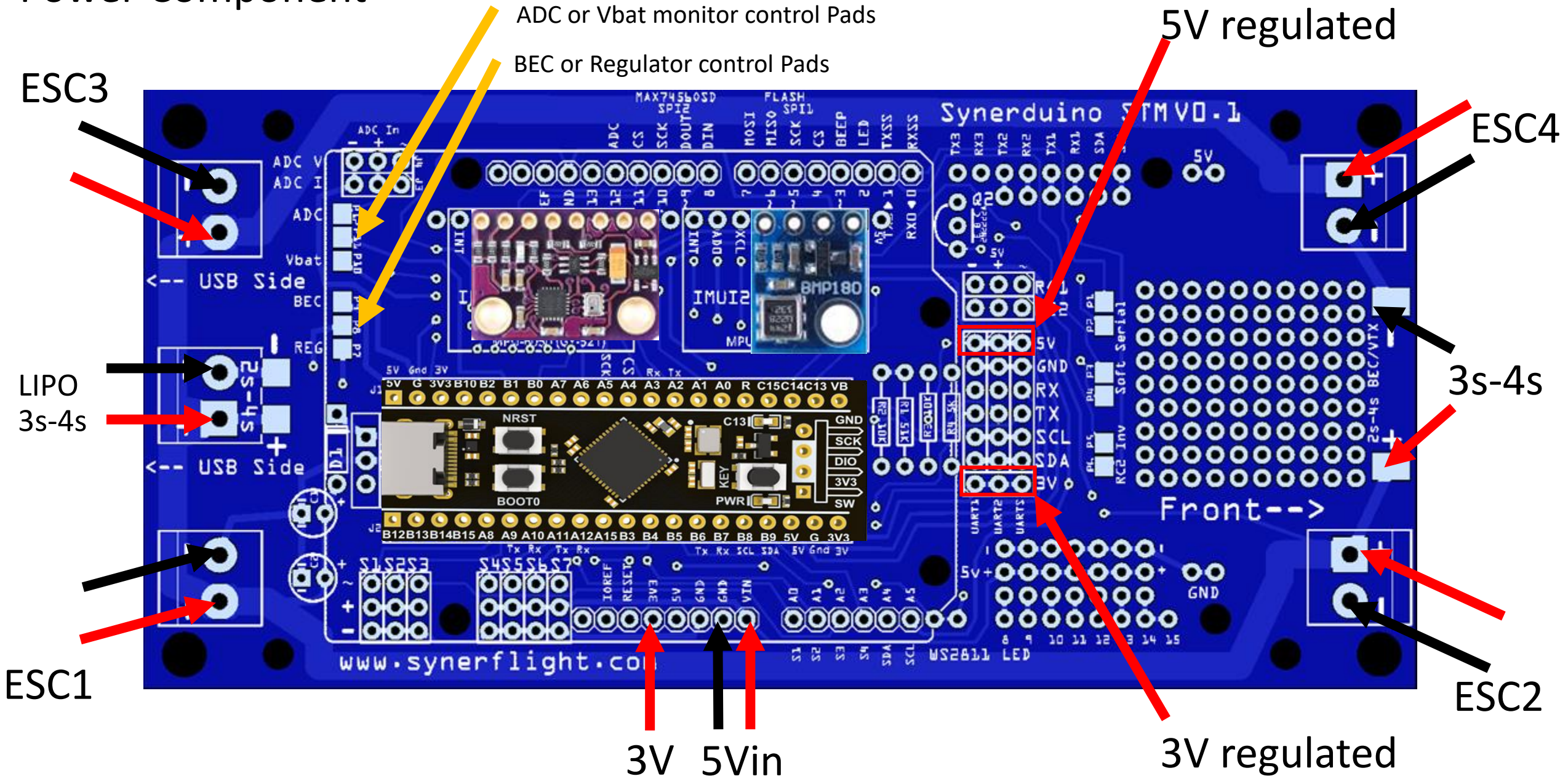


SYNERDUINO STM Kit



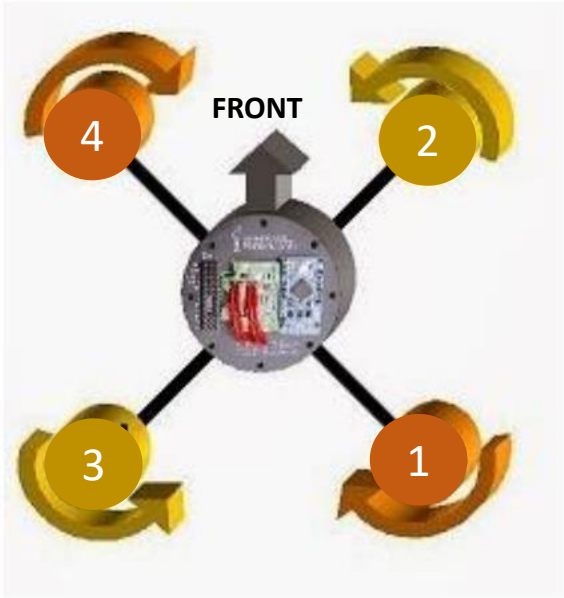

5mm
3mm
3mm
138mm
3mm
3mm
65mm
57.5mm
109mm
130mm
Synerduino STM V0.1
IMU SPI
IMUI2C
MPU-6050 (GY-521)
MPU-6050 (GY-521)
<-- USB Side
<-- USB Side
Fold Regulator--->
Fold Regulator--->
SBUS UART2
GPS UART1
Soft Serial
Front-->
www.synerflight.com
WS2811 LED
BEC/VTX
Soft Serial
RC2 Inv

Power Component



Electronic Speed Controller

Motor [4]



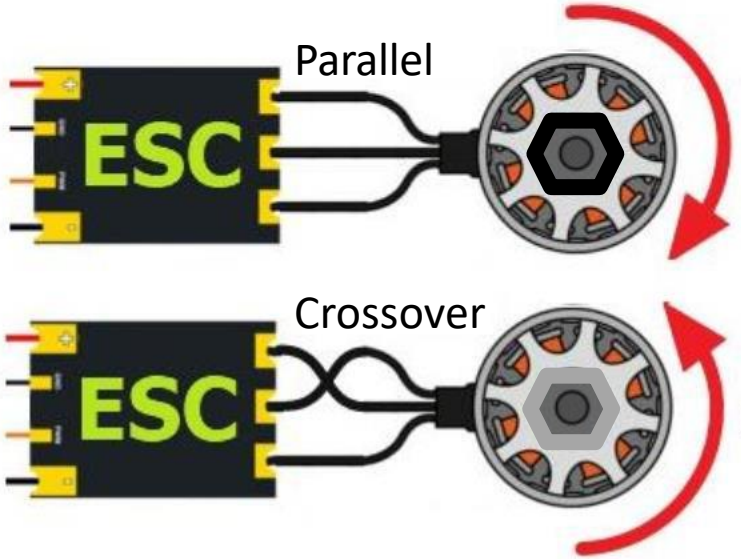
Motor [2]

Motor [3]

Motor [1]

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

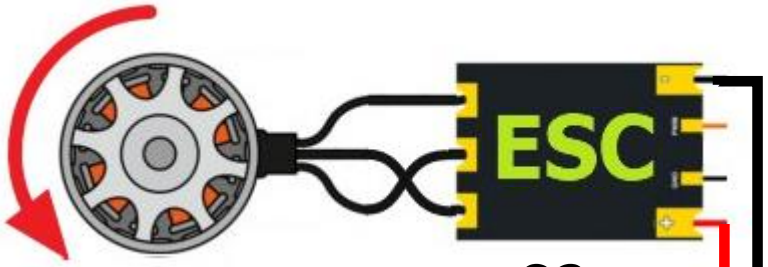
Note : on some brands of motor they may came in two different prop nuts color (Known as self tightening nuts)



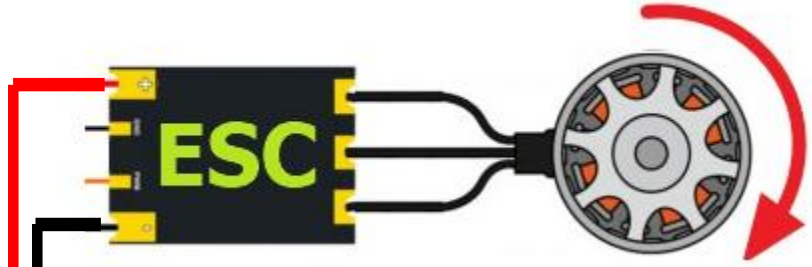
Regulator Power Setup

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



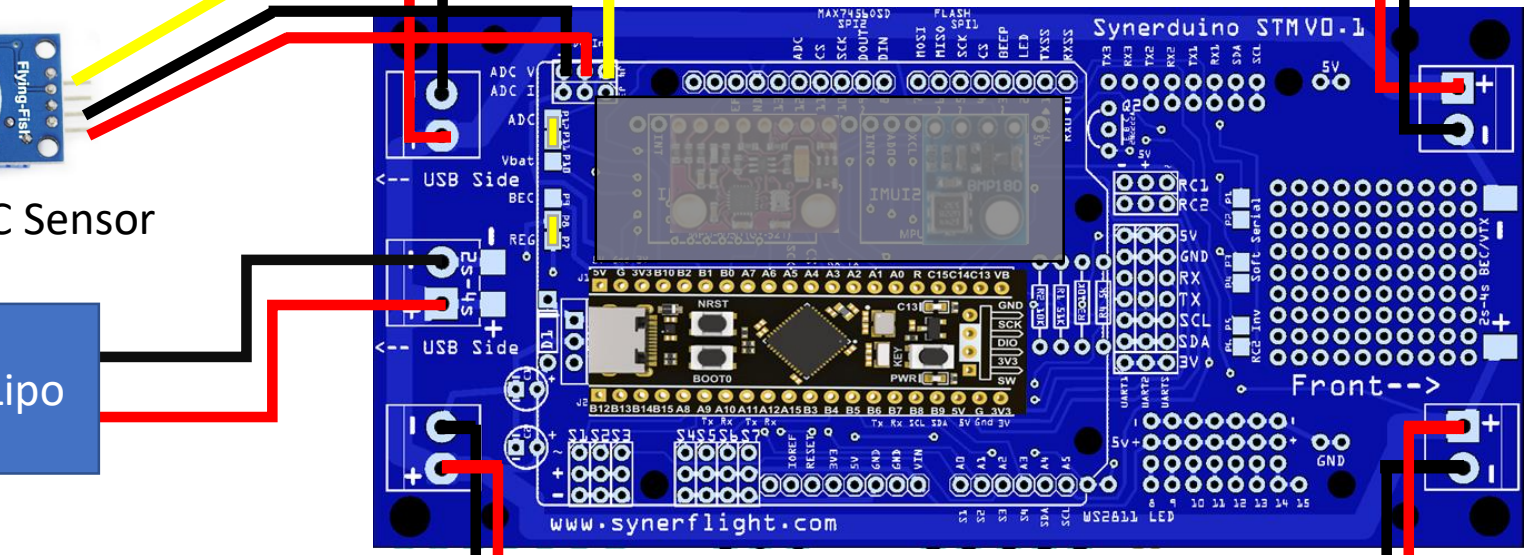
S3

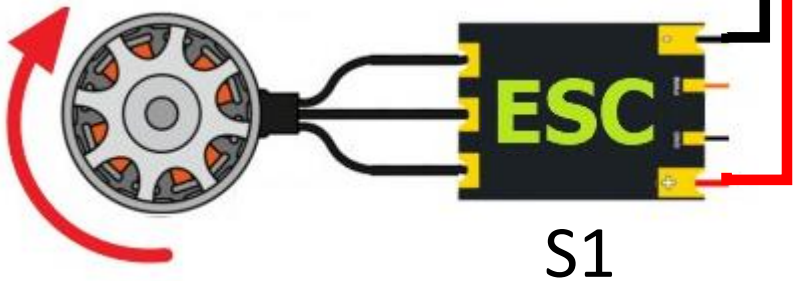


S4

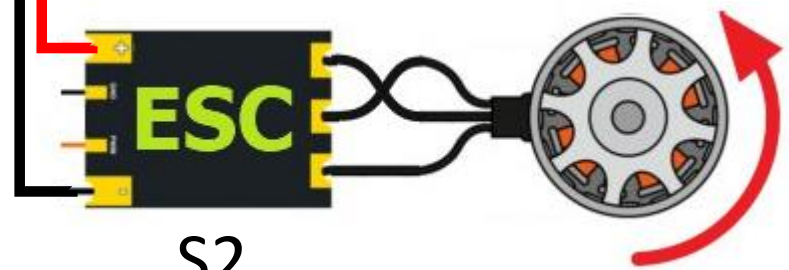
External ADC Sensor

11.1V Lipo





S1

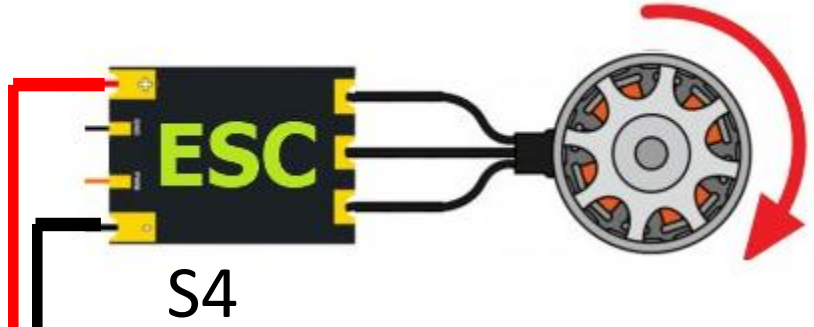


S2

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

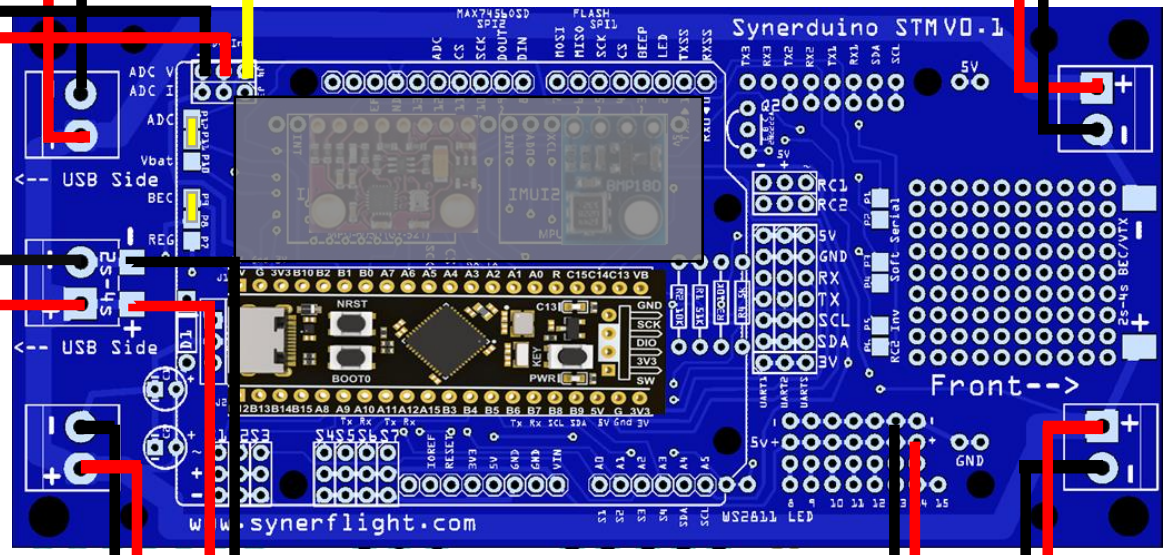
S3



S4

External ADC Sensor

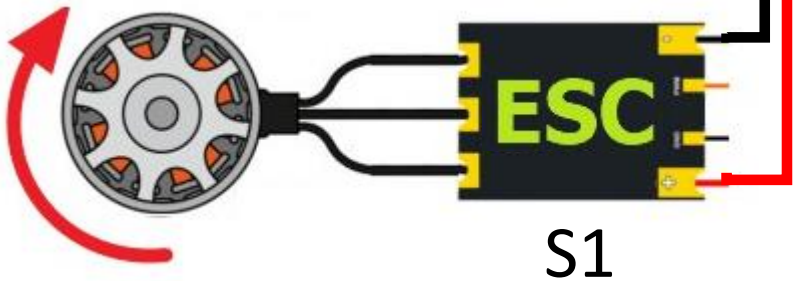
11.1V Lipo



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

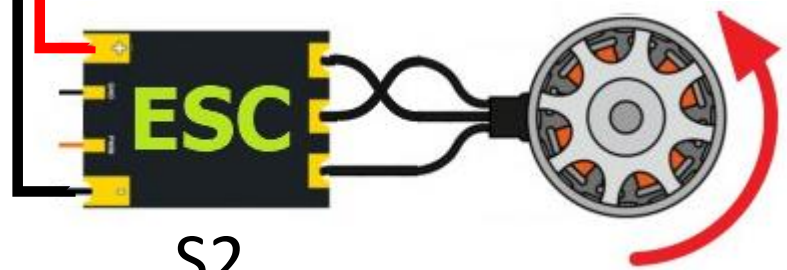
Also works for ESCs with build in BEC associated with Fixwing and surface vehicles

BEC input requirements must be 5V



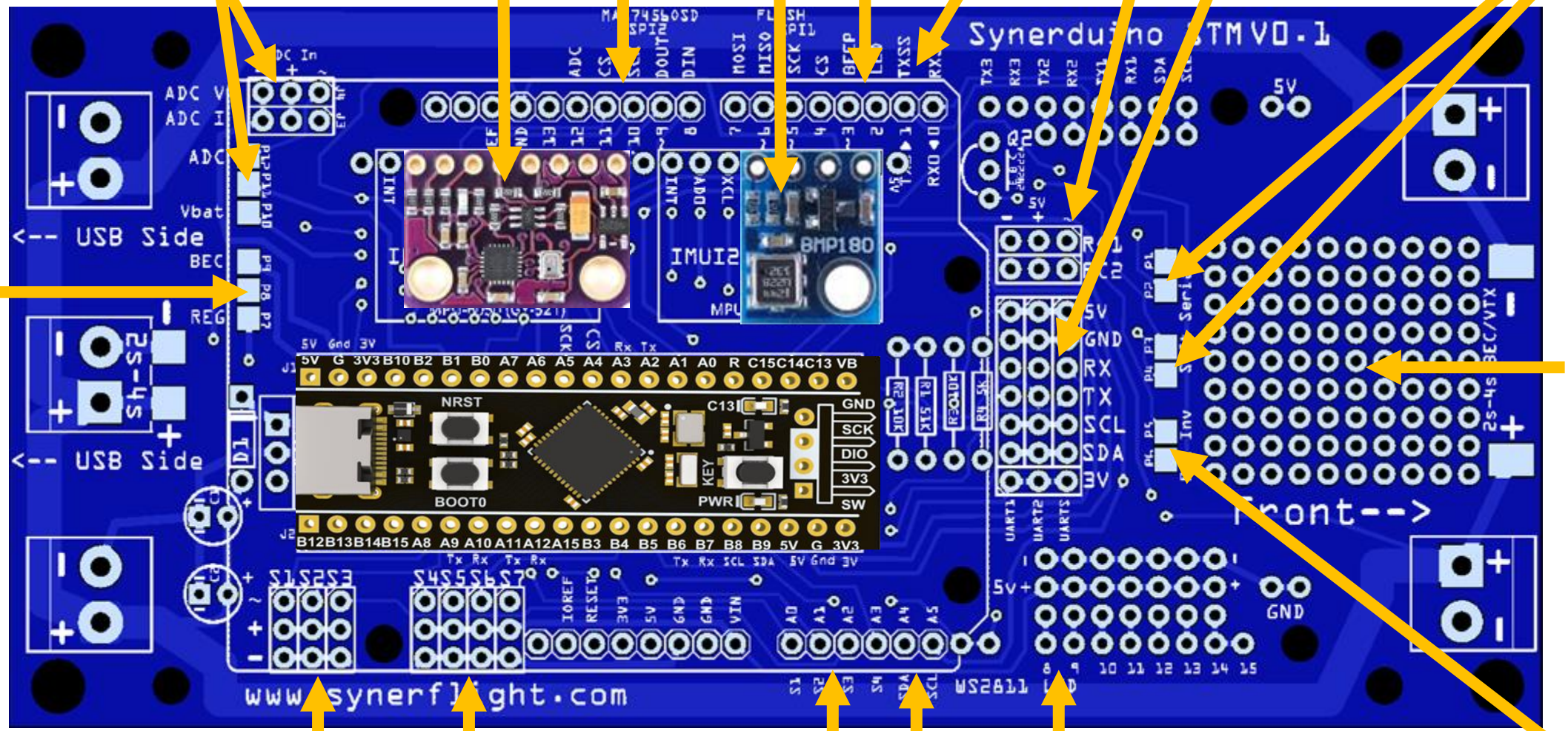
S1

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



S2

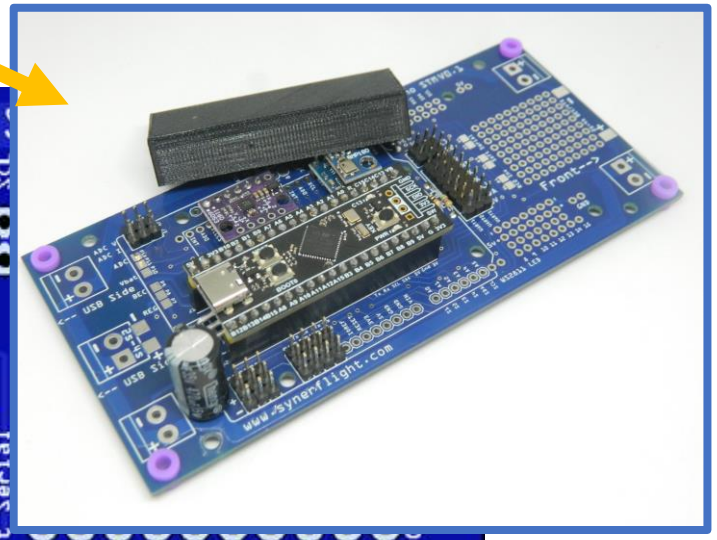
System Component



Board Preparations

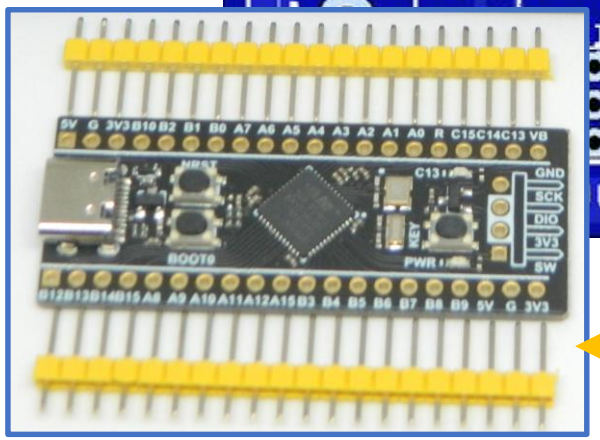
ADC and Battery Monitoring

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

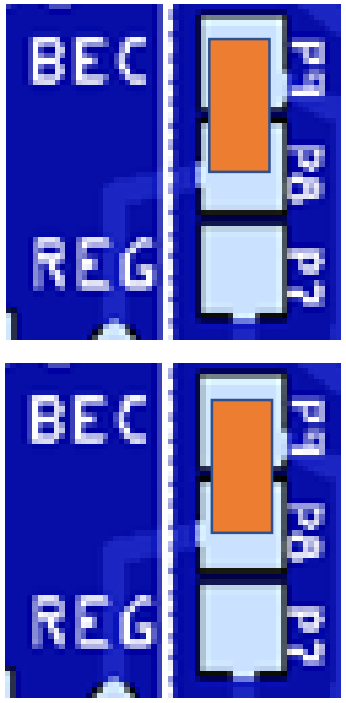
8-9 WS2811 LED out

RC2 inverted Sbus signal

For those using PWMto SBUS converter

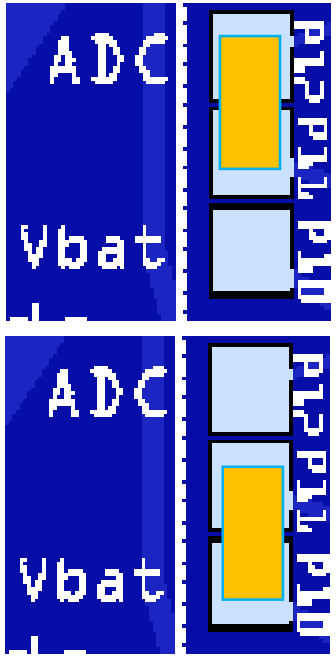
Selector Pads

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



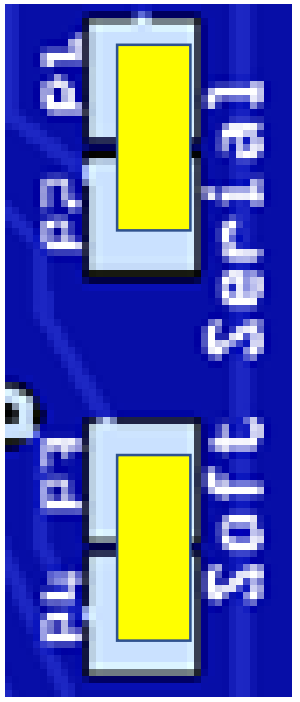
P9-P8 : BEC –this is use if you have a BEC powering through the ESC w/UBEC or an Standalone UBEC or Buck Converter Plug into S2 Pin BEC input is 5V

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



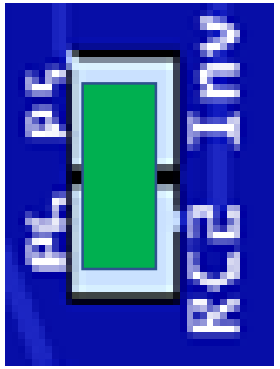
P1-P2 P3-P4 Softserial activates the TXSS and RXSS connection to the expansion pins for Prototyping board serial

Connection

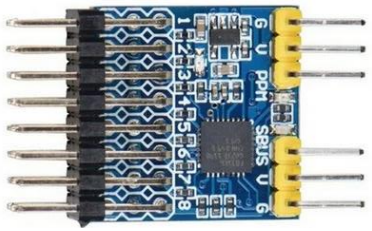
Synerduino

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

UART Serial Devices

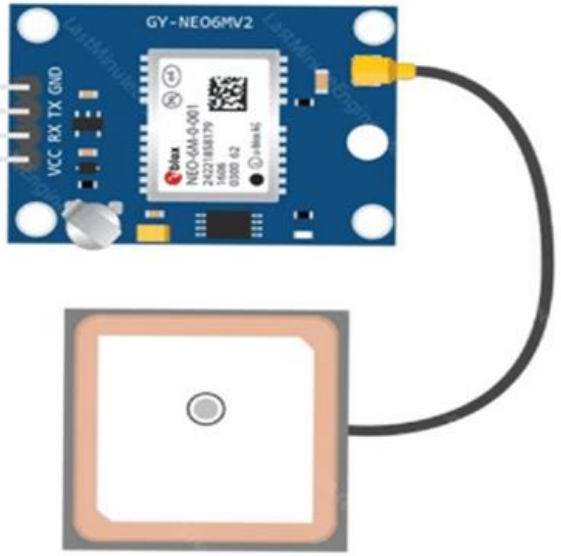
AS if INAV5 and INAV6 its Required
Receiver supports SBUS Serial

Receiver : Connect to RC1 / UART2

Flysky FS-i6X Receiver

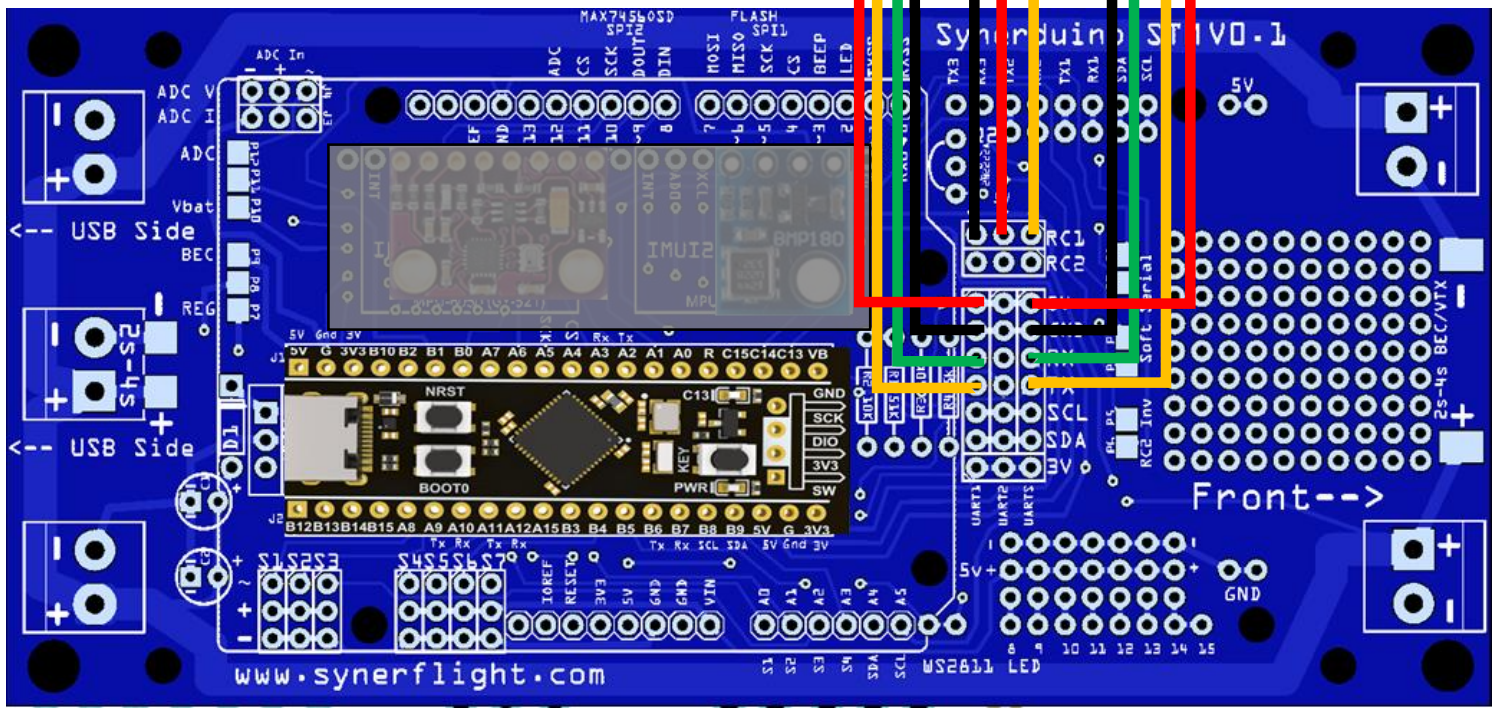
GPS

UARTS



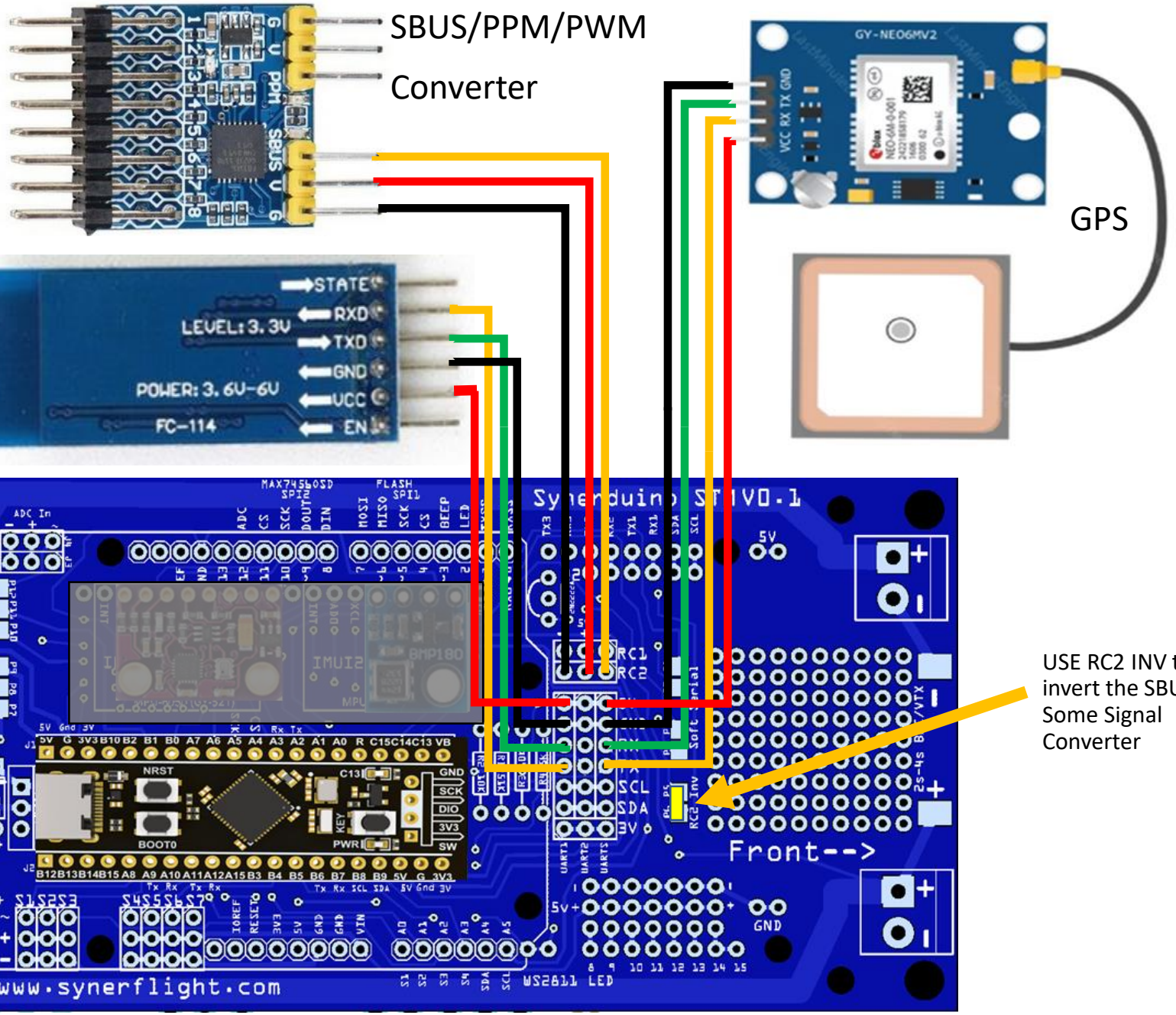
Bluetooth/Serial Radio

UART1



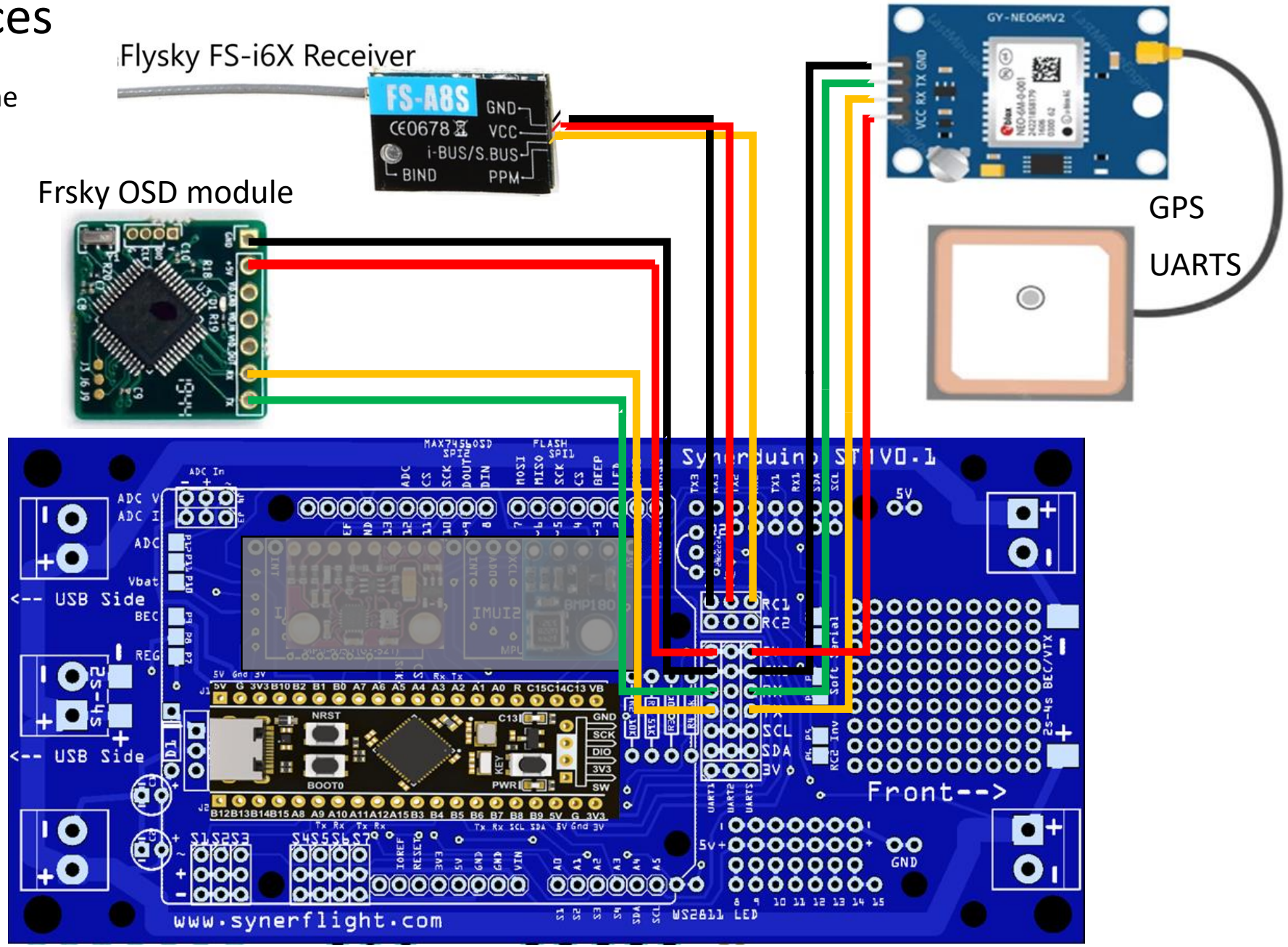
UART Serial Devices

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



UART Serial Devices

The Telemetry can also use the Serial OSD module



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

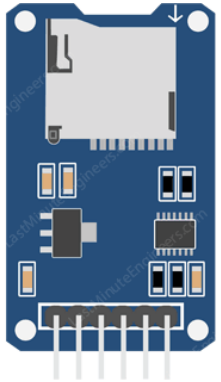
SD Card Reader

4GB , FAT32 Format

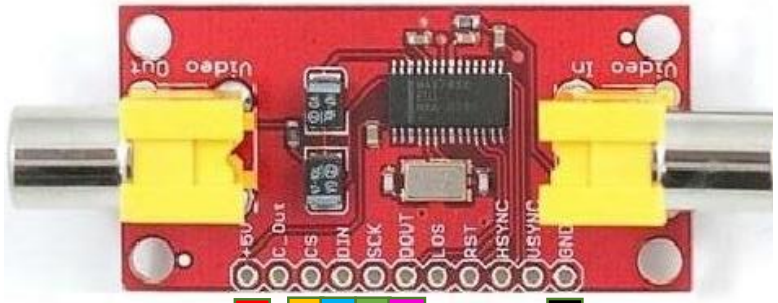
Some SD cards have compatibility issue.

Check if other brands do work

SAMSUNG microSD EVO plus(Red) is recommended



MAX7456 OSD



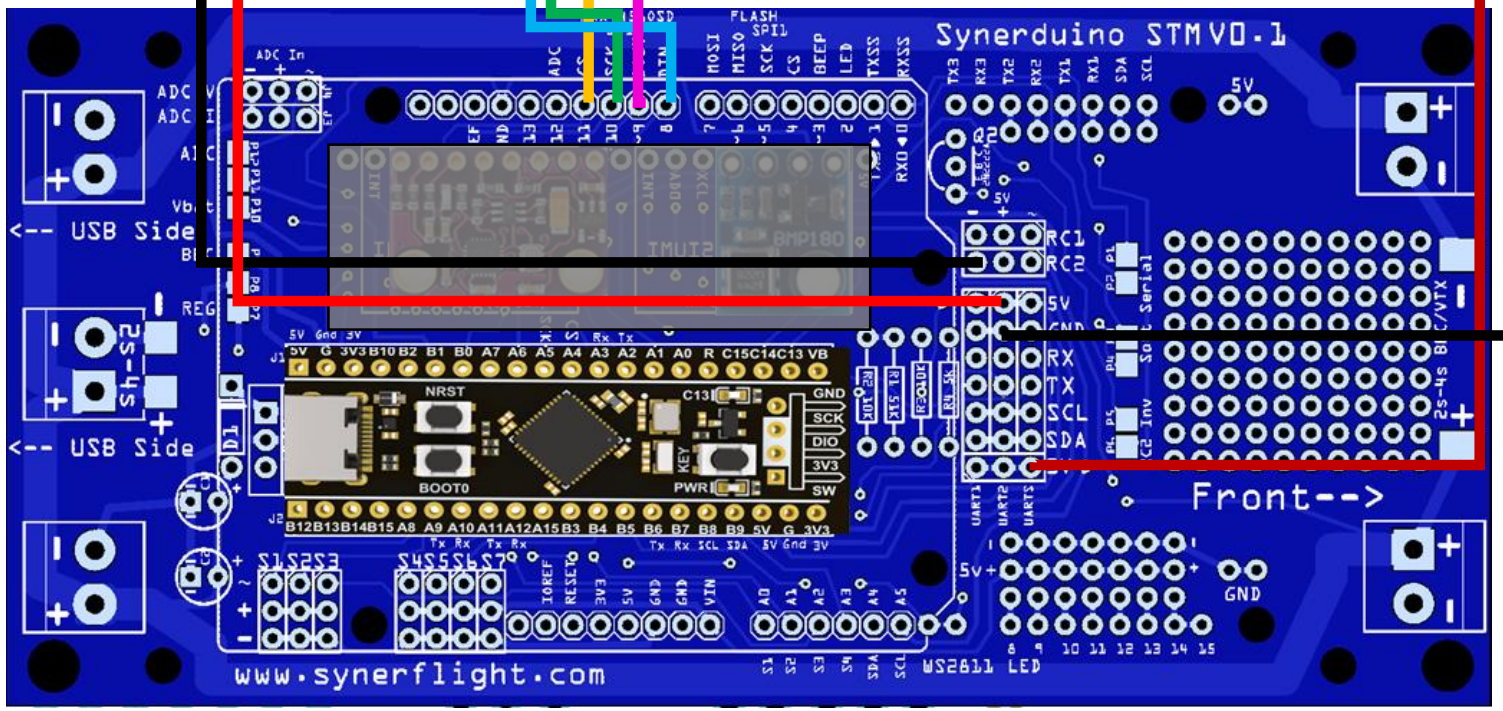
5V CS MOSI SCK MISO GND

DIN DOUT

W25QXX Flash

3V CS MISO GND SCK MOSI

DOUT DIN



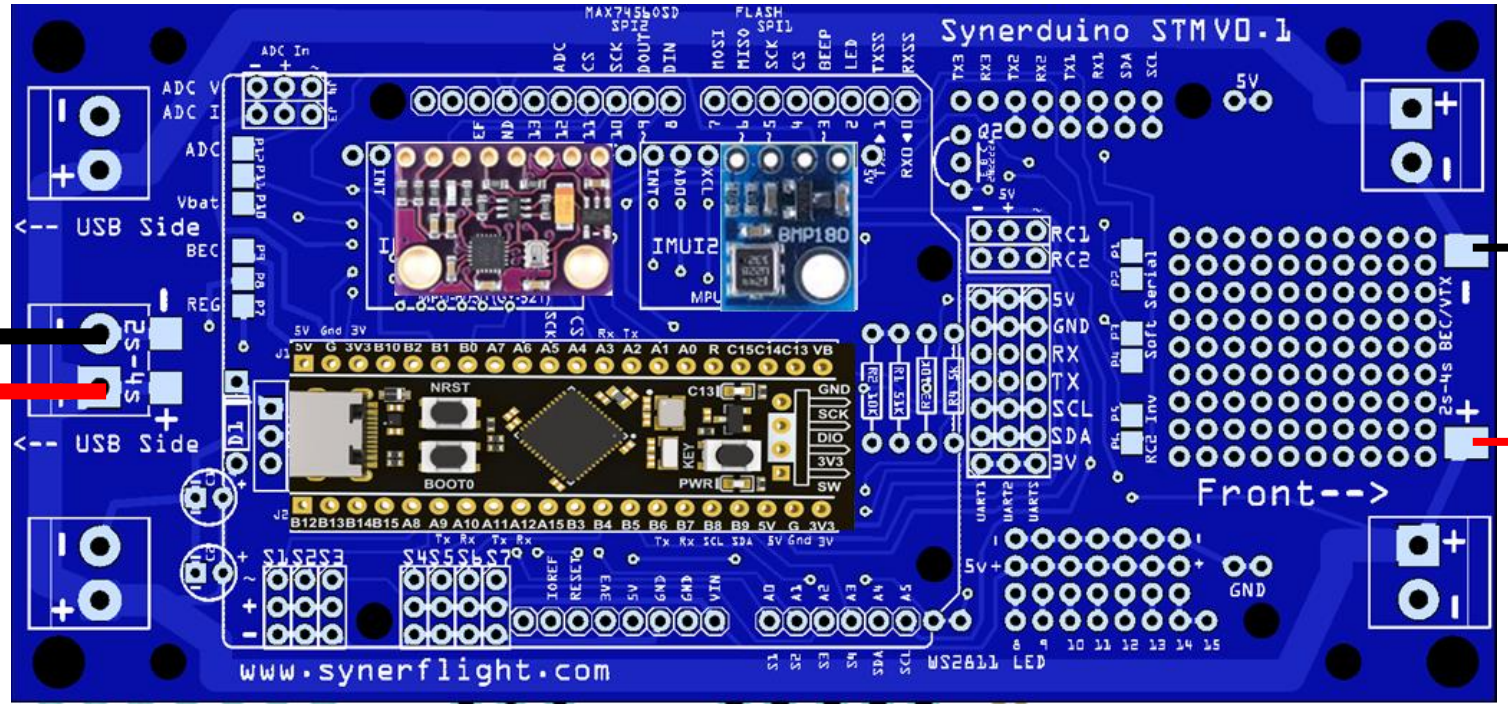
FPV Standalone

This requires no introduction as it uses a BEC to supply a standalone FPV25mw camera with integrated VTX

This also can be apply to split camera a VTX sets as well (some Standalone VTX can support 2s to 6s meaning they can directly hook up to the main batter Pads with requiring a BEC supplement)

FPV camera 25mw Standalone

Battery 3s or 4s



BEC or Buck converter supplying extra power

FPV with SPI OSD

The Telemetry can also use the SPI OSD module

Split VTX camera Setup

MAX7456 OSD

FPV camera

600mw to 800mw VTX

5V

CS

MOSI

SCK

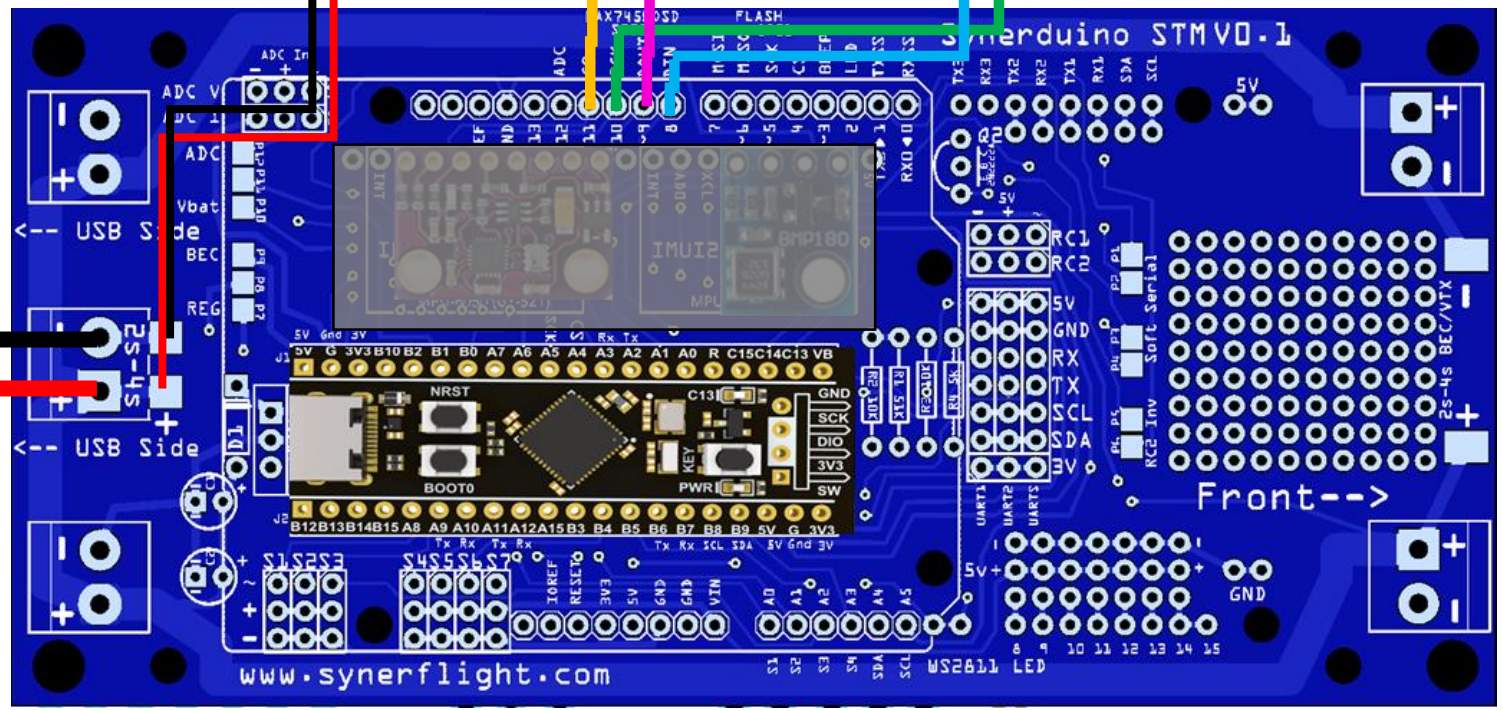
MISO

GND

Its powered by the regulator onboard the VTX unit 5V

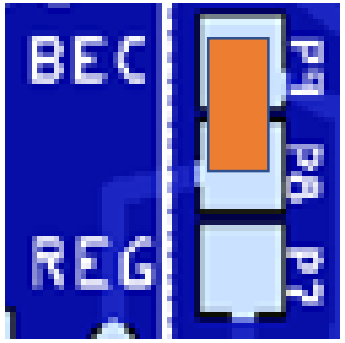
Battery 3s or 4s

BEC or Buck converter supplying extra power



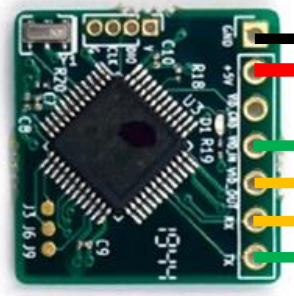
FPV with SERIAL OSD

The Telemetry can also use the Serial OSD module



Power Pads is selected to BEC to use external BEC

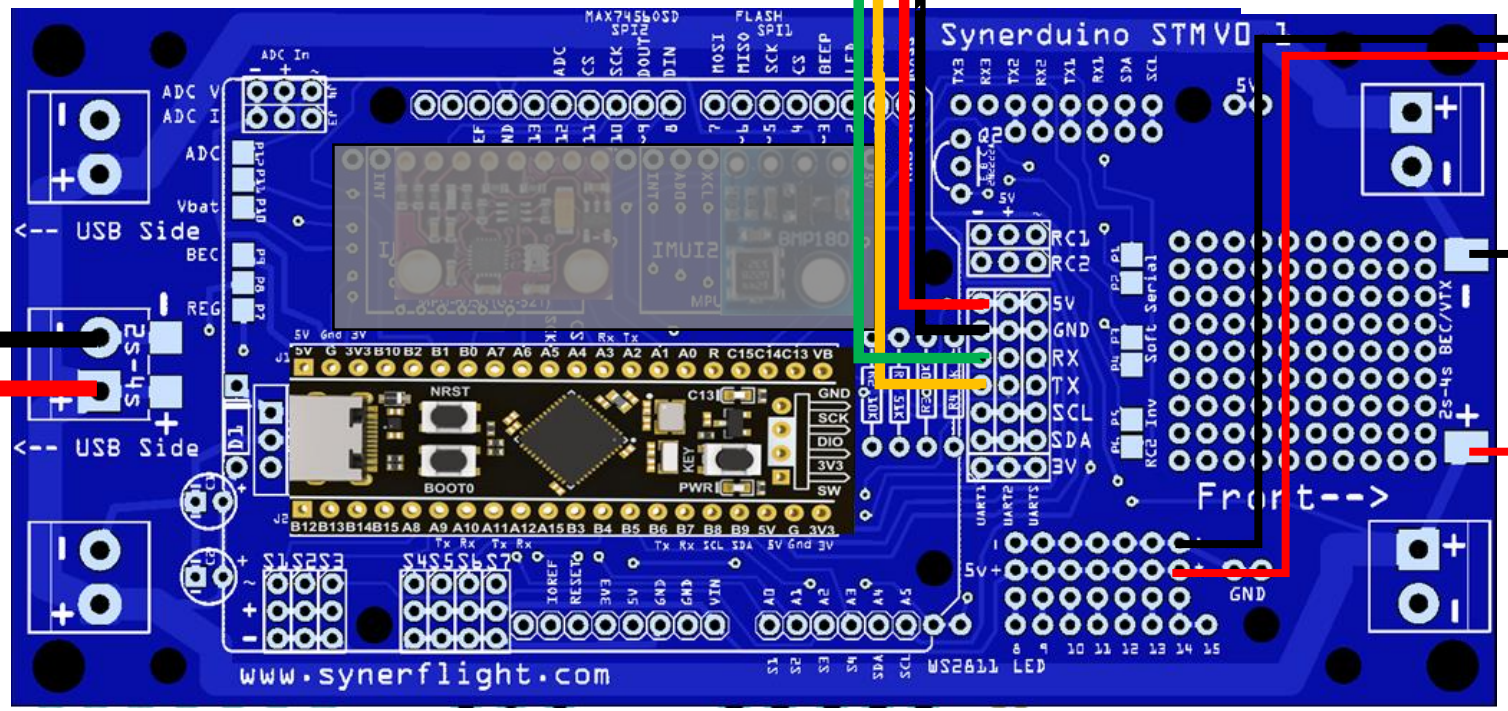
Frsky OSD module



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

LED Devices

These are optional addons

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

WS2811 or WS2812

DATA

5V

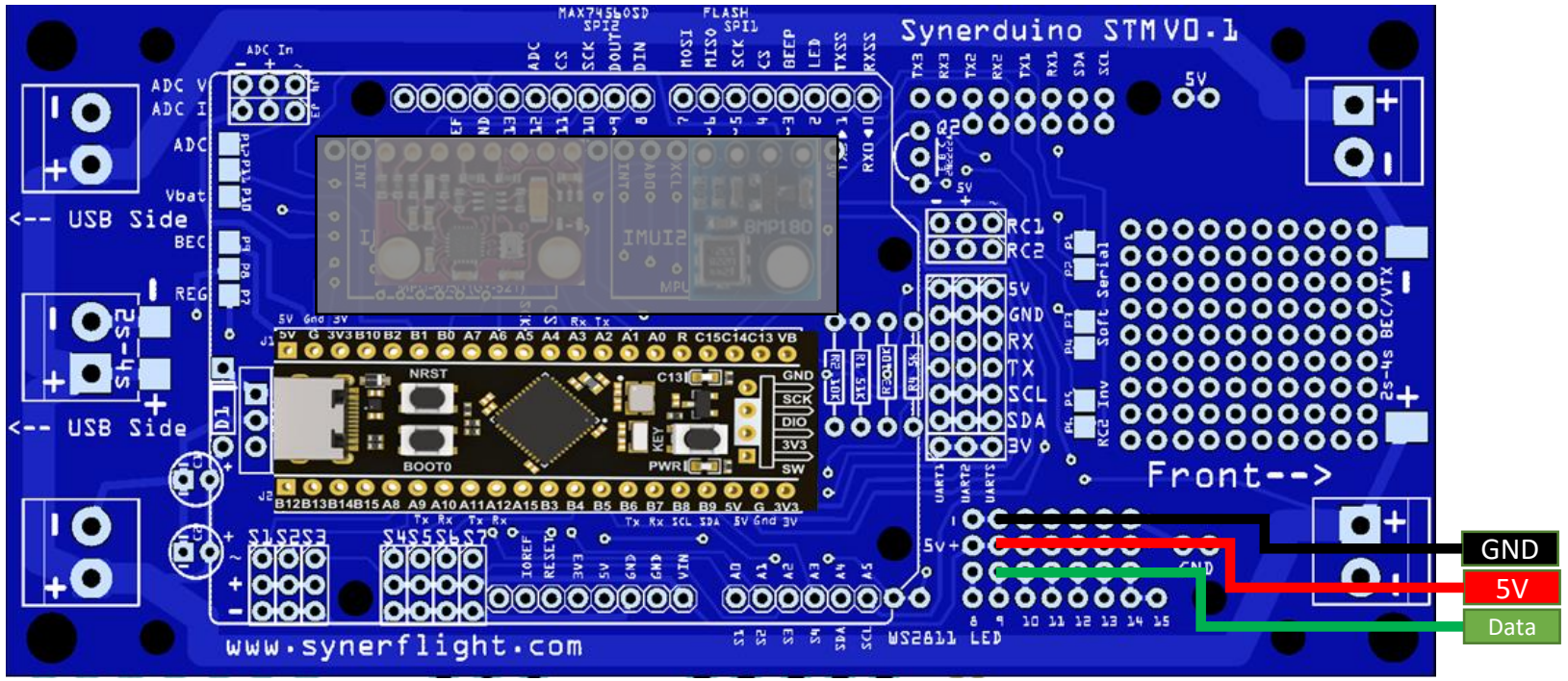
GND

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

Accessible on Pin 8 & 9

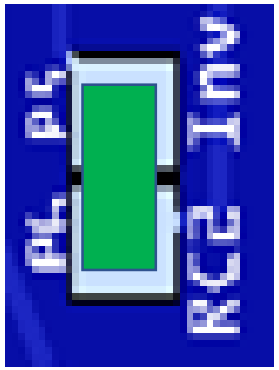
This also requires 3 Timers

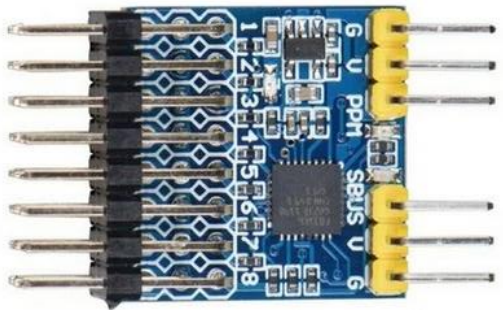
When activated only 5 PWM pins can be use for Motor/Servo



RECEIVER TYPES

PPM AND PWM RECEIVER

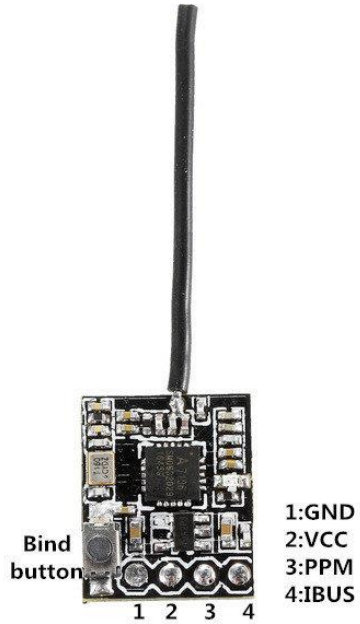




PWM/PPM/SBUS CONVERTER

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

SBUS RECEIVER



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)	SBUS/PPM/PWM Converter may be required if your receiver don't support SBUS Pls Check the output pin from your Radio Rx manual
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	

We all get confused sometimes we plug the receiver or PPM/PWM/SBUS Converter in and it suppose to work but it doesn't

SBUS inversion depending on the Brand of Receiver or the PPM/PWM/SBUS Converter you have the SBUS signal can come as Forward Signal or Reverse Signal . This is crucial in getting a Good Receiver connection to the Synerduino STM

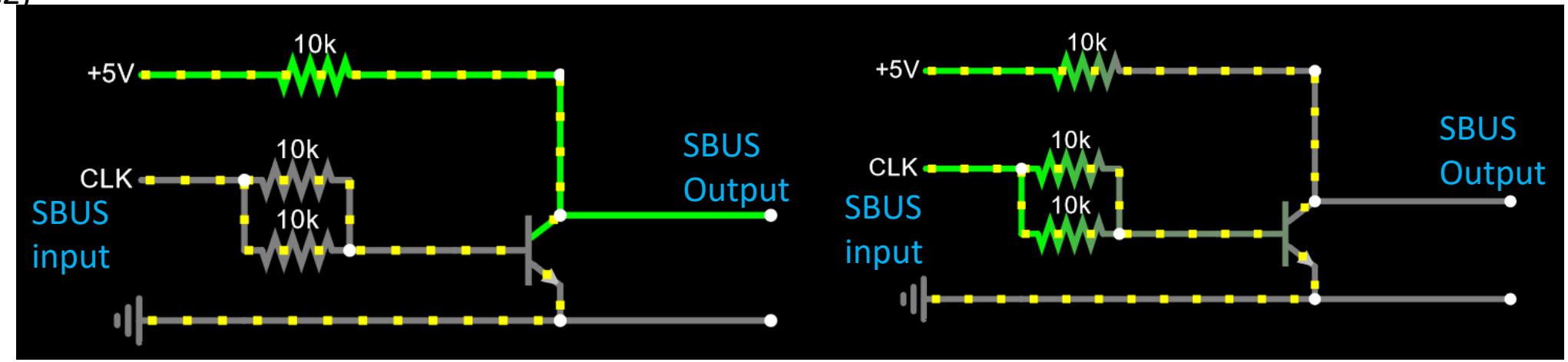
Fortunately Synerduino STM has a Reversing circuit you can depend on should this situation Arises. Via Solder Pads allows you to select Normal (RC1) or Inverted SBUS Signal (RC2)

Inverted SBUS

Normal SBUS

Y U No Read SBUS

Most modern Receivers now comes with Serial Protocol as they than the old PWM or PPM standard and its now the Modern de Receiver to Flight Control Board communication



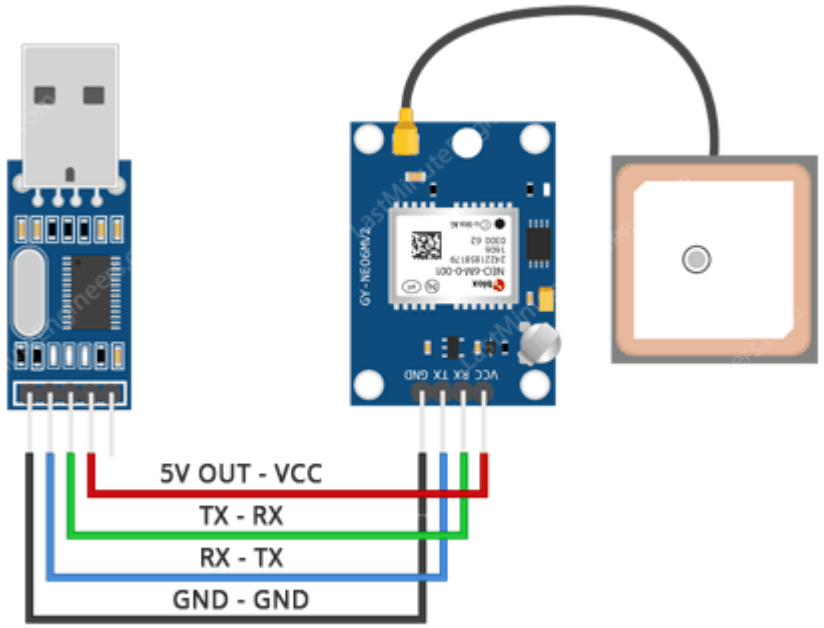
GPS

UBLOX Protocol

NMEA Protocol

NOTE: GPS CONFIGURING ONLY WORKS WHEN GPS MODULE COMES WITH EEPROM OR FLASH MEMORY. AS YOUR SELLER IF IT COMES WITH THOSE FUNCTIONS

GPS CONFIGURING



U BLOX NEO 6

PLUG IN TO SERIAL TX 2 RX 2

USB TTL TO PROGRAM THE GPS

THIS GOES SAME ON THE DRONE SHIELD

GPS CONFIGURING

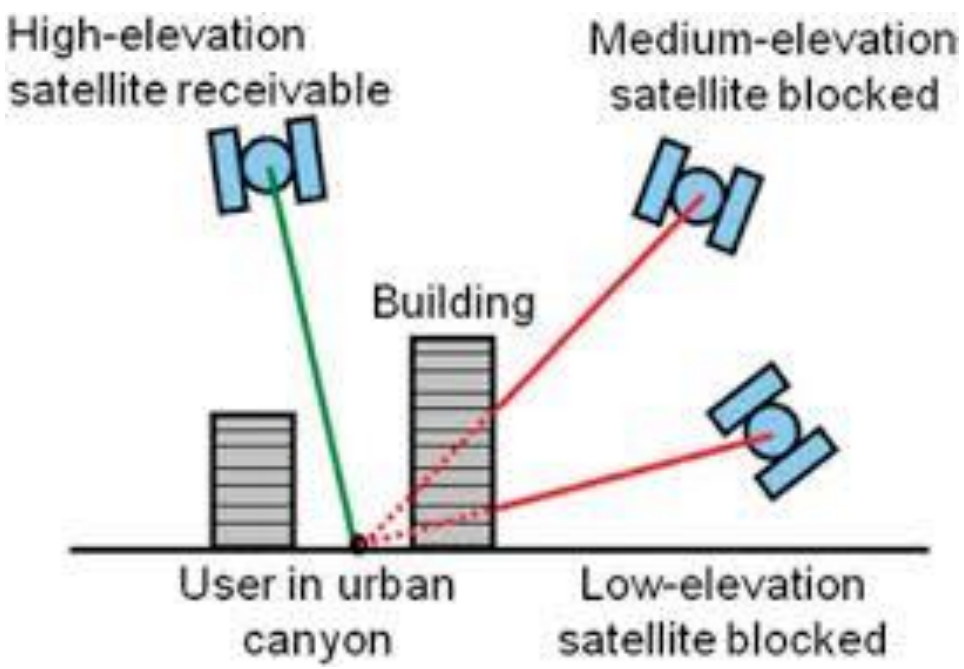
PIN	PIN Name	I/O	Description
1	GND	G	Ground
2	TX	O	Serial Data Output.
3	RX	I	Serial Data Input.
4	VCC	I	DC 3.0V - 5.5V supply input,Typical: 5.0V

Pin Description:

PIN	PIN Name	I/O	Description
1	SDA	O	Compass SDA
2	GND	G	Ground
3	TX	O	Serial Data Output.
4	RX	I	Serial Data input.
5	VCC	I	3.0V~ 5.5V supply input,Typical: 5.0V
6	SCL	I	Compass SCL

GPS ONLY MODELS & GPS WITH COMPASS MODEL

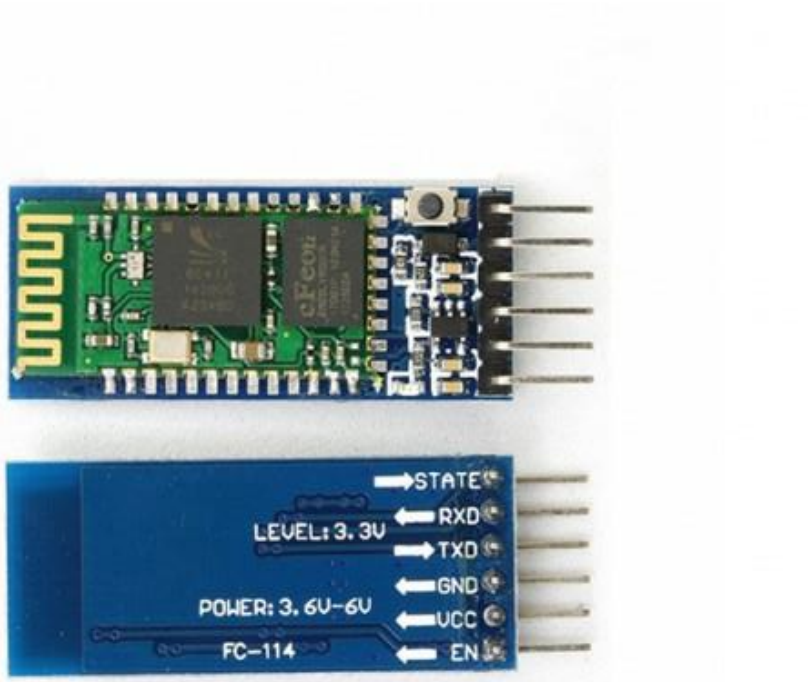
GPS



Note : GPS require a clear open area to get a proper fix and accuracy minimum 7 satellites but 10+ are Ideal

Flying next to a building can distort satellite signal deteriorating accuracy

Which in this case its better to not use GPS modes and fly Manual

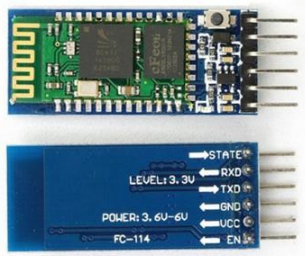


BLUETOOTH

Bluetooth setup with the USB TTL and Arduino IDE

Arduino IDE>Tools>Serial Monitor (Push Button Before Connecting the USB) Set (Baud 38400) (Both NL & C

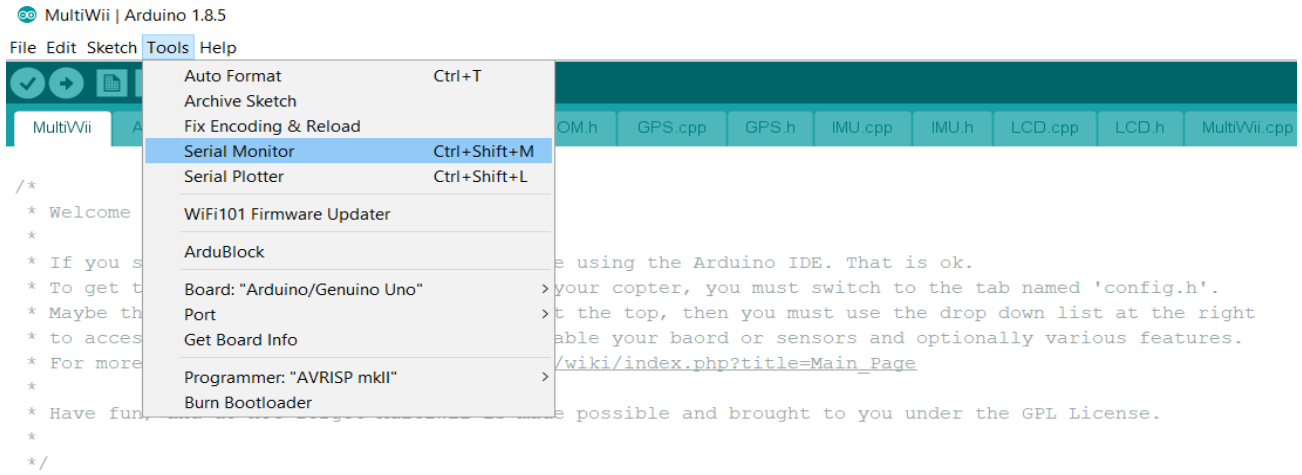
AT : check the connection
AT+VERSION : Check Version

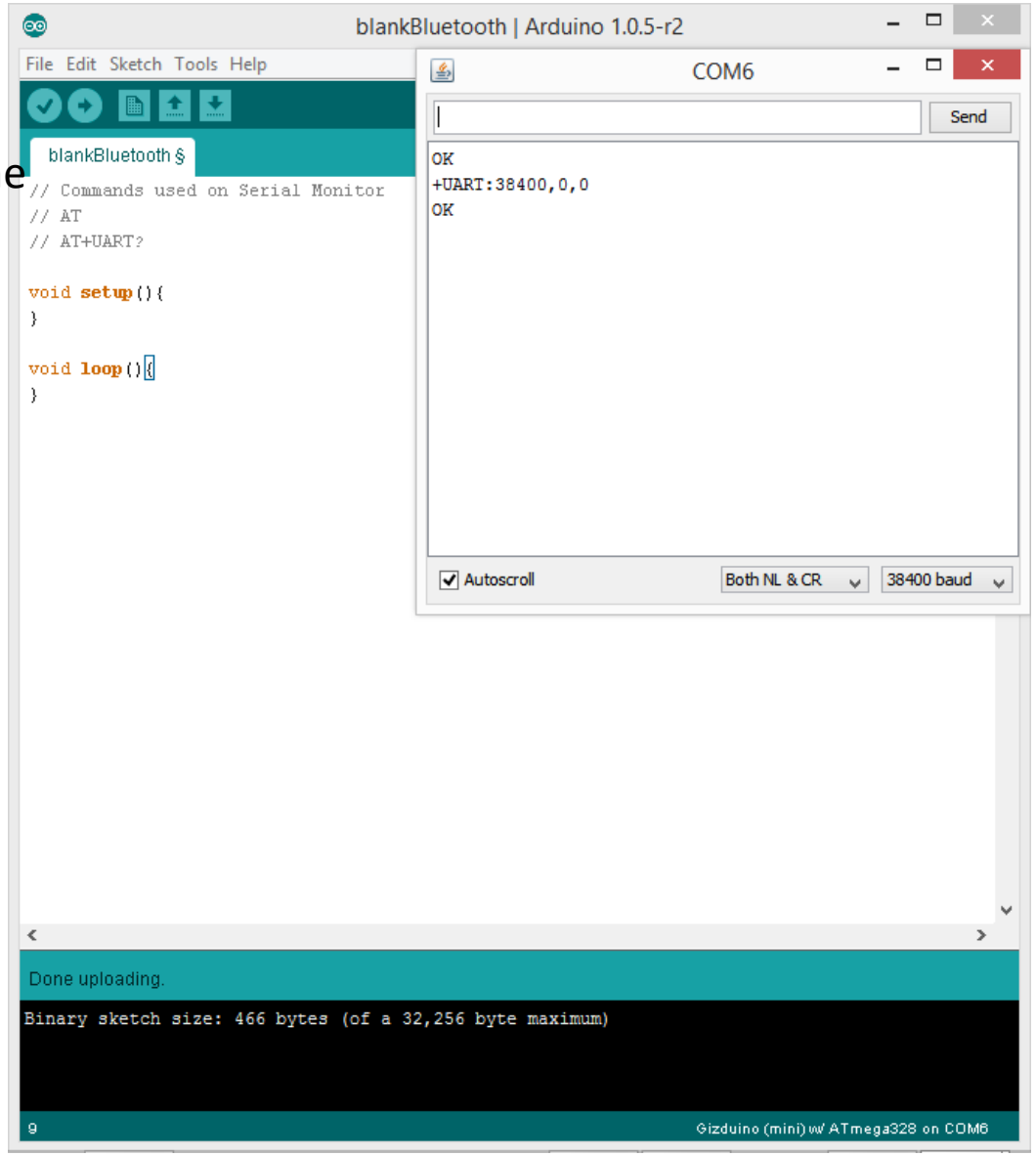


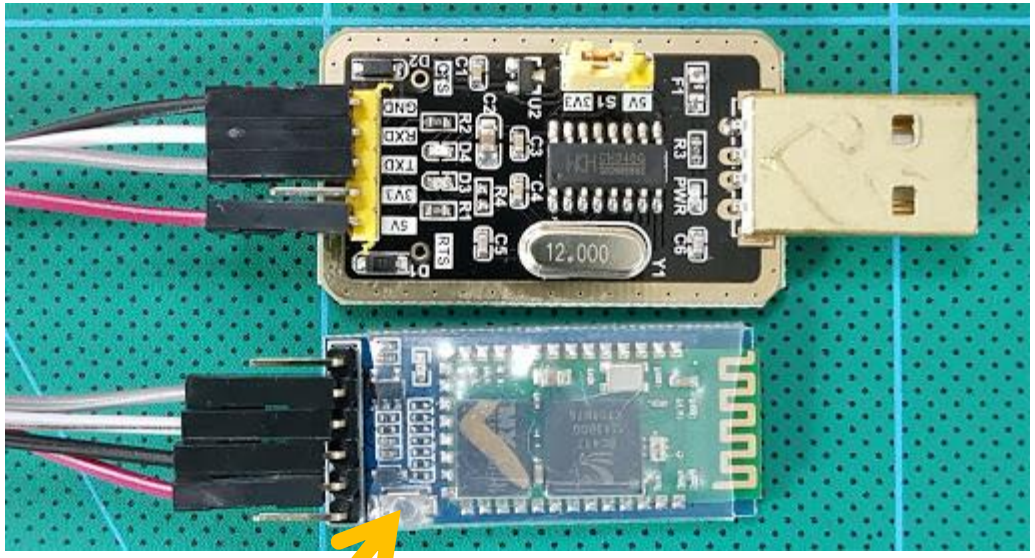
HC-05 (Recommended)

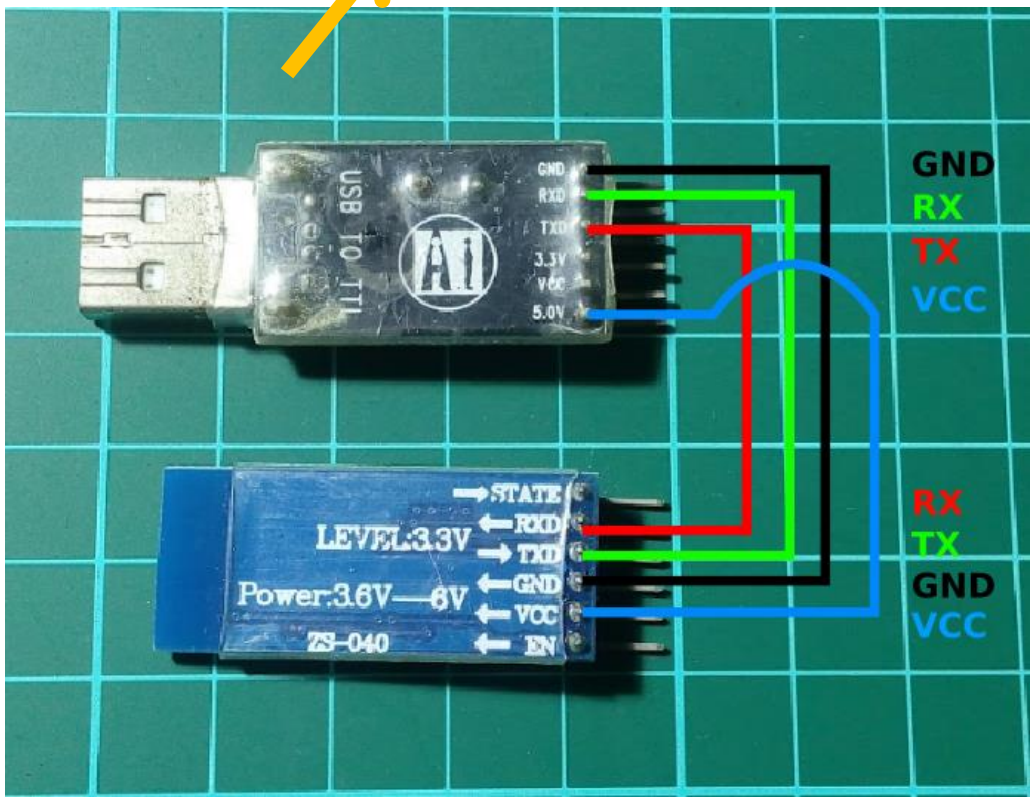
AT+NAME=ArduinoDrone
AT+PSWD=1234 (Version 2)
AT+PSWD="1234" (Version 3)
AT+UART=115200,1,0

HC-05 (Recommended)









Bluetooth setup with the USB TTL and Arduino IDE

Arduino IDE>Tools>Serial Monitor (hold the Button while Plugging USB) to go programming mode Set (Baud 38400) (Both NL & CR)

Hold Press when sending AT command (Version 5)

AT : check the connection
AT+VERSION : Check Version

HC-05 (Recommended)

AT+NAME=Change name (Synerduino)
AT+PSWD=1234 (Version 2)
AT+PSWD="1234" (Version 3) (Possibly works on Version 5)
AT+UART=115200,1,0

(115200 FOR BLUETOOTH)

HC-06

AT+NAME: Change name
AT+PIN: change pin, xxxx is the pin, again, no space.
AT+BAUDX, where X=1 to 9
1 set to 1200bps, 2 set to 2400bps, 3 set to 4800bps
4 set to 9600bps (Default)
5 set to 19200bps,6 set to 38400bps, 7 set to 57600bps
8 set to 115200bps

AT+UART=115200,1,0

Param1: Baud rate:
4800 -> 4800 bits/s
9600 -> 9600 bits/s
19200 -> 19200 bits/s
38400 -> 38400 bits/s
57600 -> 57600 bits/s
115200 -> 115200 bits/s
230400 -> 230400 bits/s
460800 -> 460800 bits/s
921600 -> 921600 bits/s
1382400 -> 1382400 bits/s
Param2: Stop bit:
0 -> 1 bit
1 -> 2 bits
Param3: Parity bit:
0 -> None
1 -> Odd parity
2 -> Even parity

AT+BAUD

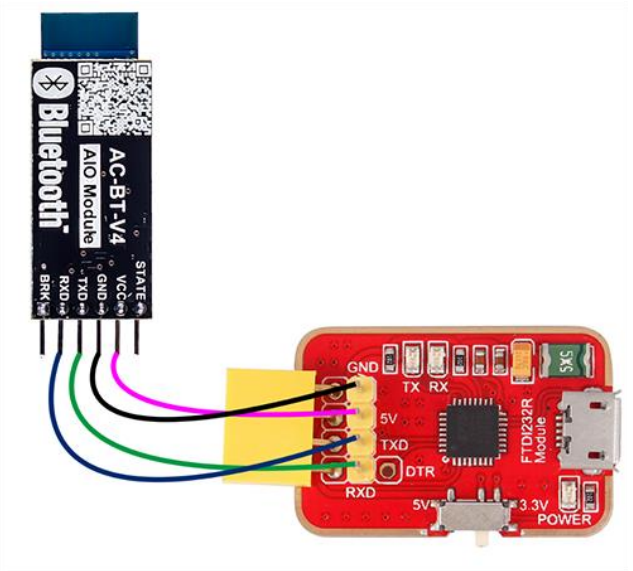
1 set to 1200bps,
2 set to 2400bps,
3 set to 4800bps
4 set to 9600bps (Default)
5 set to 19200bps,
6 set to 38400bps,
7 set to 57600bps
8 set to 115200bps

AT+STOP **Get/Set UART stop bit**
0: One stop bit
1: Two stop bit
Default: 0 (One stop bit)
AT+PARI **Get/Set UART parity bit**
0:None
1:EVEN
2:ODD
Default: 0 (None)

HM-10 Bluetooth

Setup with FTDI + Arduino Serial Monitor + AT Command

AT+NAME? (Query name)
AT+ADDR? ((Query Mac address)



First you will need to Query the native MAC address using AT Command **AT+ADDR?**
You will get something like this 20C38FF61DA1, each BLE has a unique MAC address.

Use **AT+CON[param1]** and **AT+ROLE[param1]** to pair to another device.

Example
BLE A has Mac Address 11C11FF11DA1, I used **AT+ADDR?** to figure it out BLE B has Mac Address 22C22FF22DA2, I used **AT+ADDR?** to figure it out
Send **AT+CON**22C22FF22DA2 to BLE A Send **AT+CON**11C11FF11DA1 to BLE B (Send the B address to A, A address to B)
Send **AT+ROLE0** to BLE ASend **AT+ROLE1** to BLE B (Doesn't matter which one)
Now it's ready to use on you ATMEGA 328P, Arduino or Attiny. **The red light will stay solid after the connection has been made on both BLE. This should take less than a second.**

HM-10 (Original)

AT (Check if new configuration is working)

AT+NAME (Query name)

AT+ADDR (Query Mac address)

AT+BAUD (Query Baud)

AT+PASS (Query current Pincode)

AT+PIN **(Query current Pincode on some BL module)**

AT+TYPE (Query authentication mode)

AT+ROLE (Query Peripheral (Slave) or Central (Master) mode)

AT+TYPE

0:Not need PIN Code

1:Auth not need PIN

2:Auth with PIN

3:Auth and bond

AT+BAUD

0 – 9600:

1 – 19200

2 – 38400

3 – 57600 (Some BL its 4800)

4 – 115200

5 – 4800

6 – 2400

7 – 1200

8 – 230400 (Some BL its 115200)

AT+NAMEArduinoDrone

AT+BAUD4 set baud to 115200 (we want this for high speed)

AT+BAUD8 set baud to 115200 (on some BL module)

AT+PASS123456 Set password to 123456

AT+PIN123456 Set password to 123456 (on some BL module)

AT+ROLE

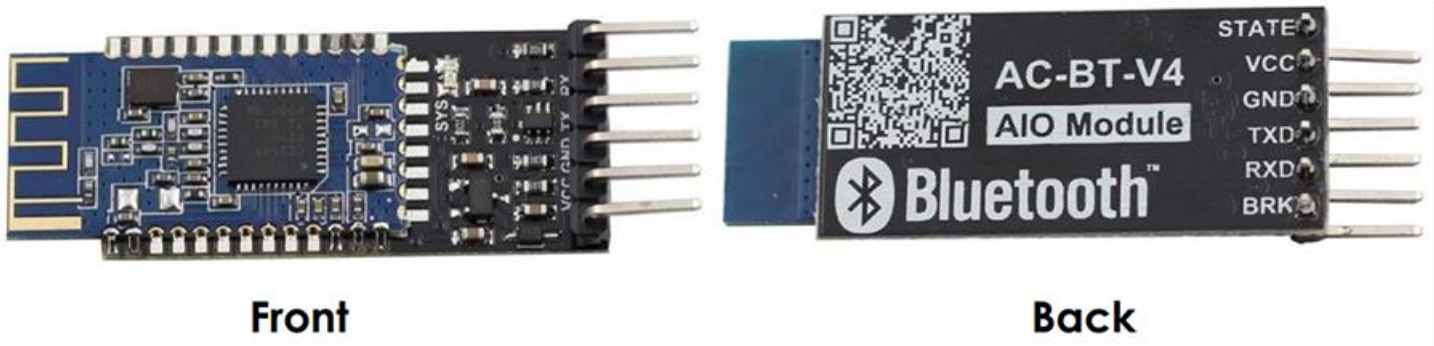
0 = Slave or Peripheral

1 = Master or Central.

AT+TYPE2

AT+TYPE1 (on Some BL modules)

AT+ROLE0



Front Back

Note : there are several clones of this type in the market that can be very difficult to setup

BT05 V5.3

AT (Check if new configuration is working)

AT+NAME (Query name)

AT+ADDR (Query Mac address)

AT+BAUD (Query Baud)

AT+PASS (Query current Pincode)

AT+PIN (Query current Pincode on some BL module)

AT+TYPE (Query authentication mode)

AT+ROLE (Query Peripheral (0 Slave) or Central (1 Master) mode)

AT+PARI **Get/Set UART parity bit.** 0:None 1:EVEN 2:ODD Default: 0 (None)

AT+STOP **Get/Set UART stop bit.** 0: One stop bit 1: Two stop bit

AT+NAMEArduinoDrone

AT+BAUD8 set baud to 115200 (on some BL module)

AT+PASS123456 Set password to 123456

AT+PIN123456 Set password to 123456 (on some BL module)

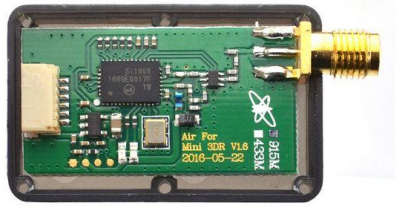
AT+STOP0

AT+PARI0

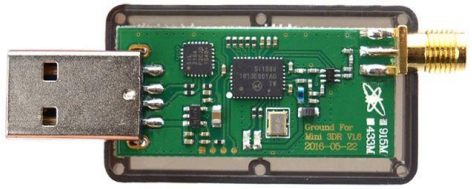
AT+ROLE0

SIK SERIAL RADIO

38400 OR 57600 FOR SIK RADIO DEPENDING IF USES 433MHZ OR 900MHZ

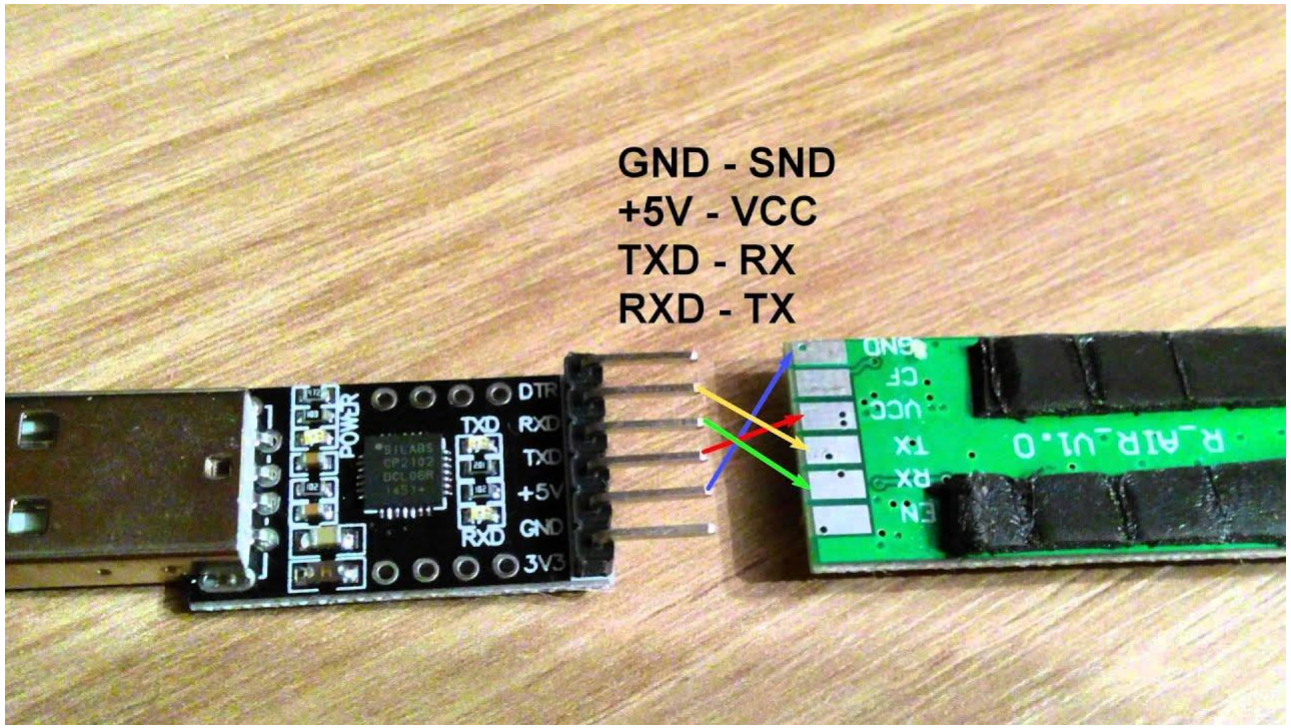


RadioTelemetry Air Module



RadioTelemetry Ground Module

Again to setup you require an USB-TTL module to connect to the serial port to configure both the module how ever most likely you only need to do this for the vehicle unit as the ground unit has an USB build into



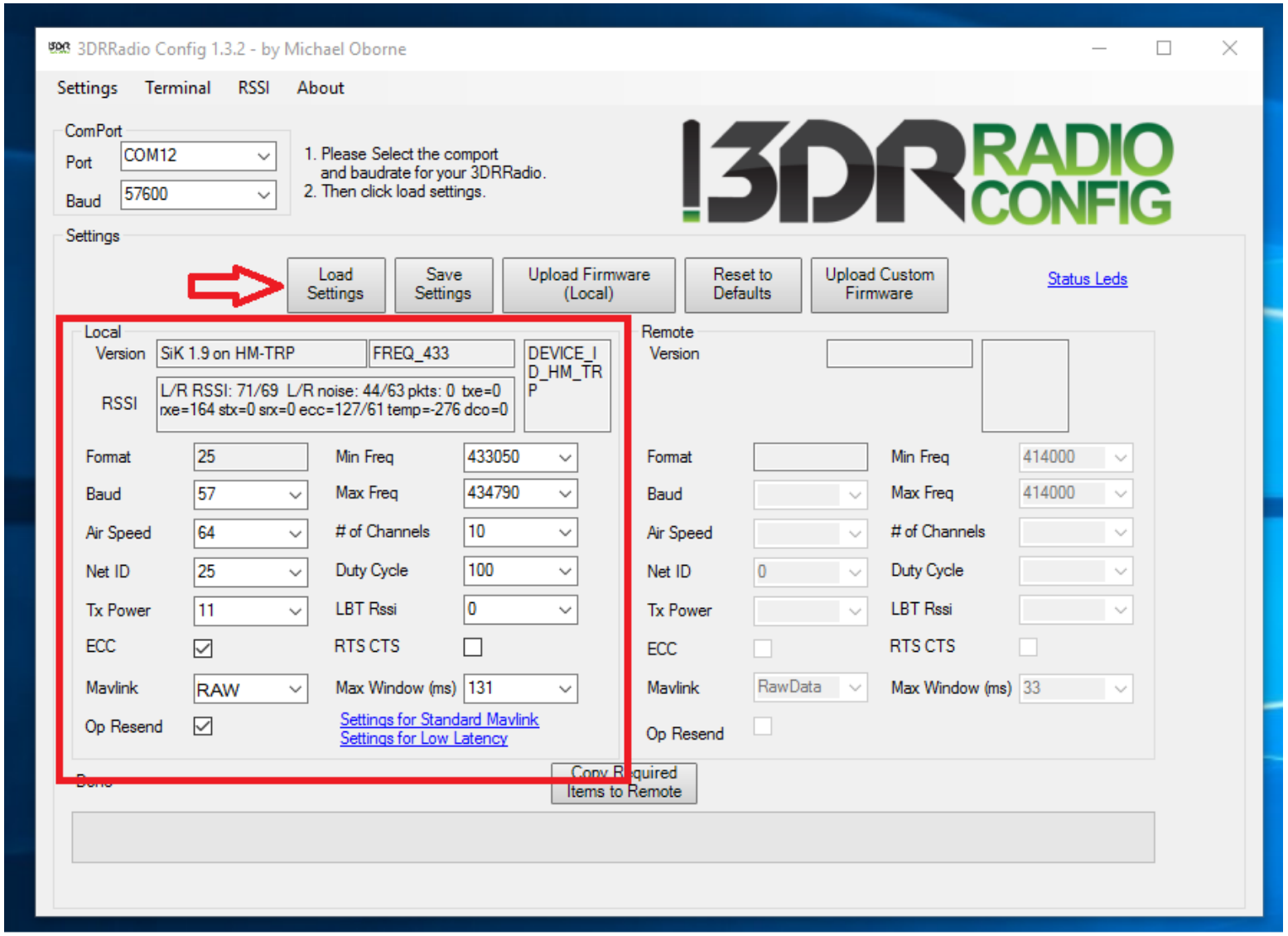
Manually configuring the telemetry kit for Synerduino uses the 3DR radio Config

http://vps.oborne.me/3drradioconfig.zip

Also available in the synerduino page

Both Vehicle and Ground station unit must have similar in the following

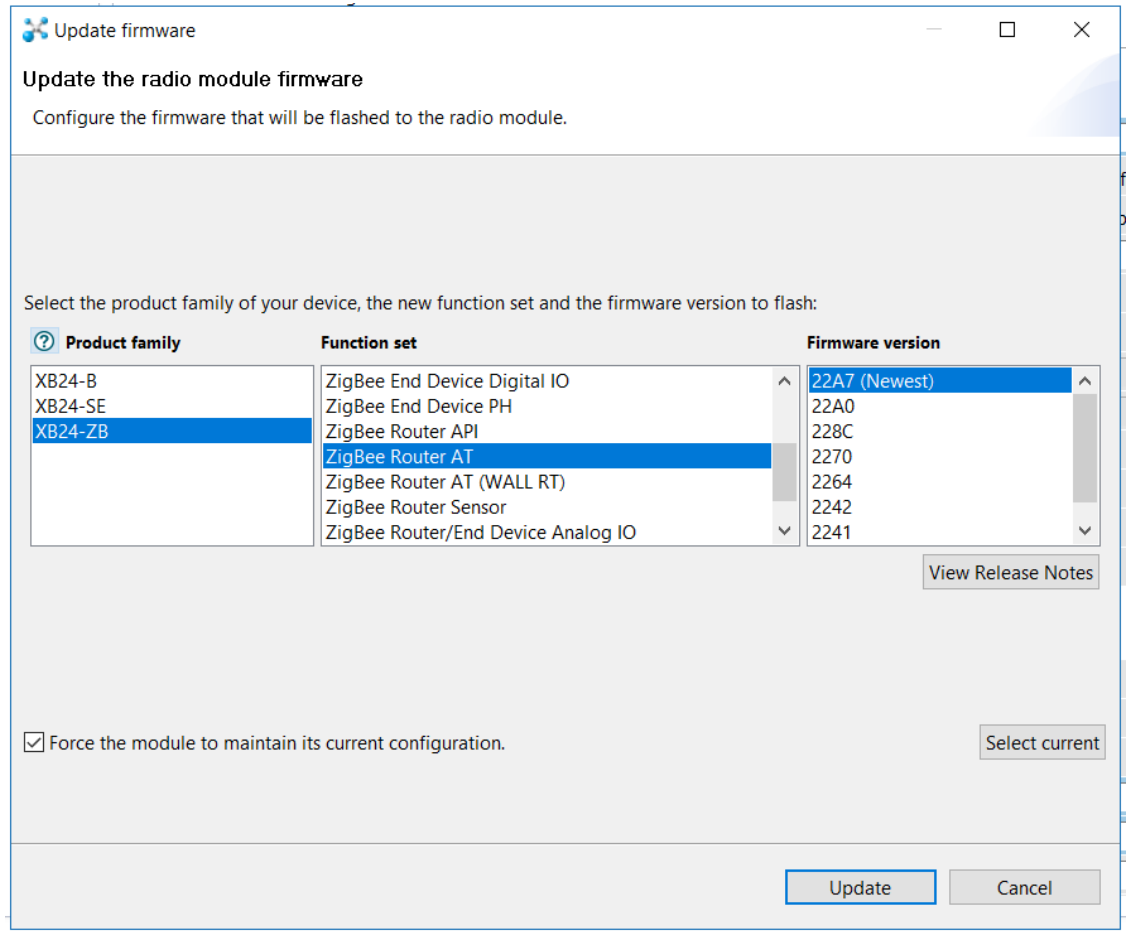
- Versions
- Frequency
- Baud (38400 or 57600 ensure)
- Airspeed
- Net ID (in cases you need to assign multiple drones each having their own ID)
- Tx power
- Mavlink (RAW –Synerduino STM uses Format)

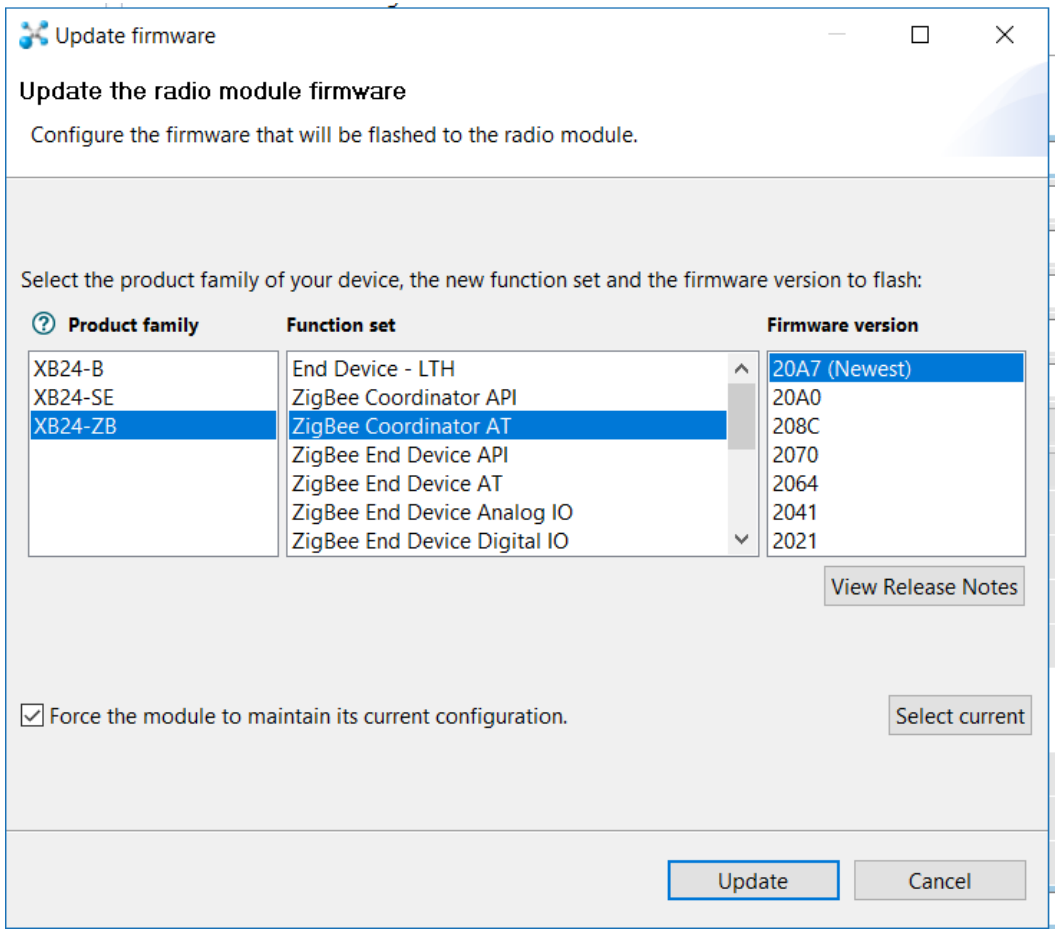


XBEE RADIO

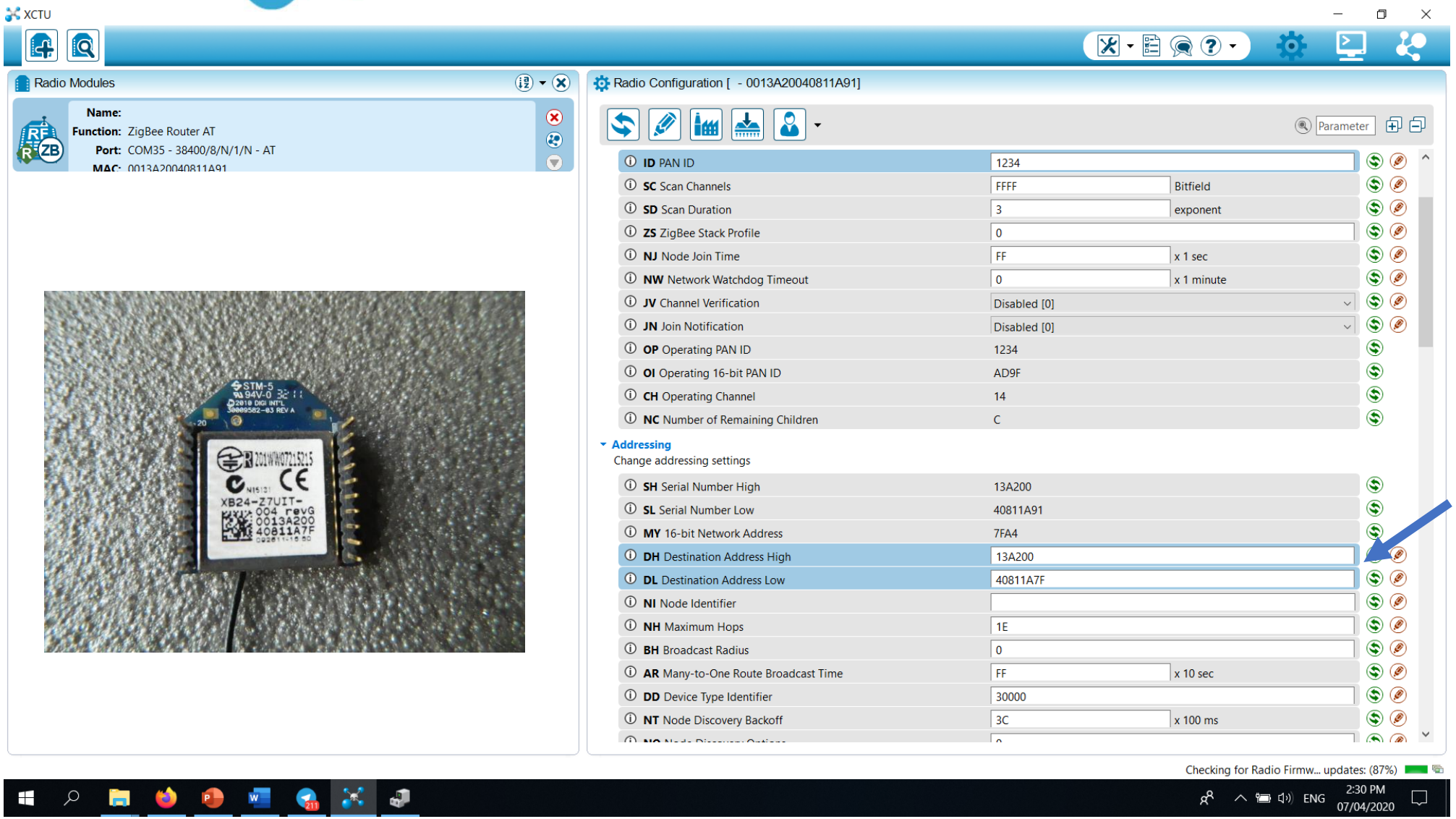
GROUND STATION ROUTER
38400 8/N/1/N - AT

AIRCRAFT COORDINATOR 38400 8/N/1/N - AT





GROUND STATION



GROUND STATION

XCTU

Radio Modules

Name:
Function: ZigBee Router AT
Port: COM35 - 38400/8/N/1/N - AT
MAC: 0013A20040811A91

Radio Configuration [- 0013A20040811A91]

Parameter

Security
Change security parameters

EE Encryption Enable	Disabled [0]	
EO Encryption Options	0	Bitfield
KY Encryption Key		

Serial Interfacing
Change modem interfacing options

BD Baud Rate	38400 [5]	
NB Parity	No Parity [0]	
SB Stop Bits	One stop bit [0]	
RO Packetization Timeout	3	x character times
D7 DIO7 Configuration	CTS flow control [1]	
D6 DIO6 Configuration	Disable [0]	

AT Command Options
Change AT command mode behavior

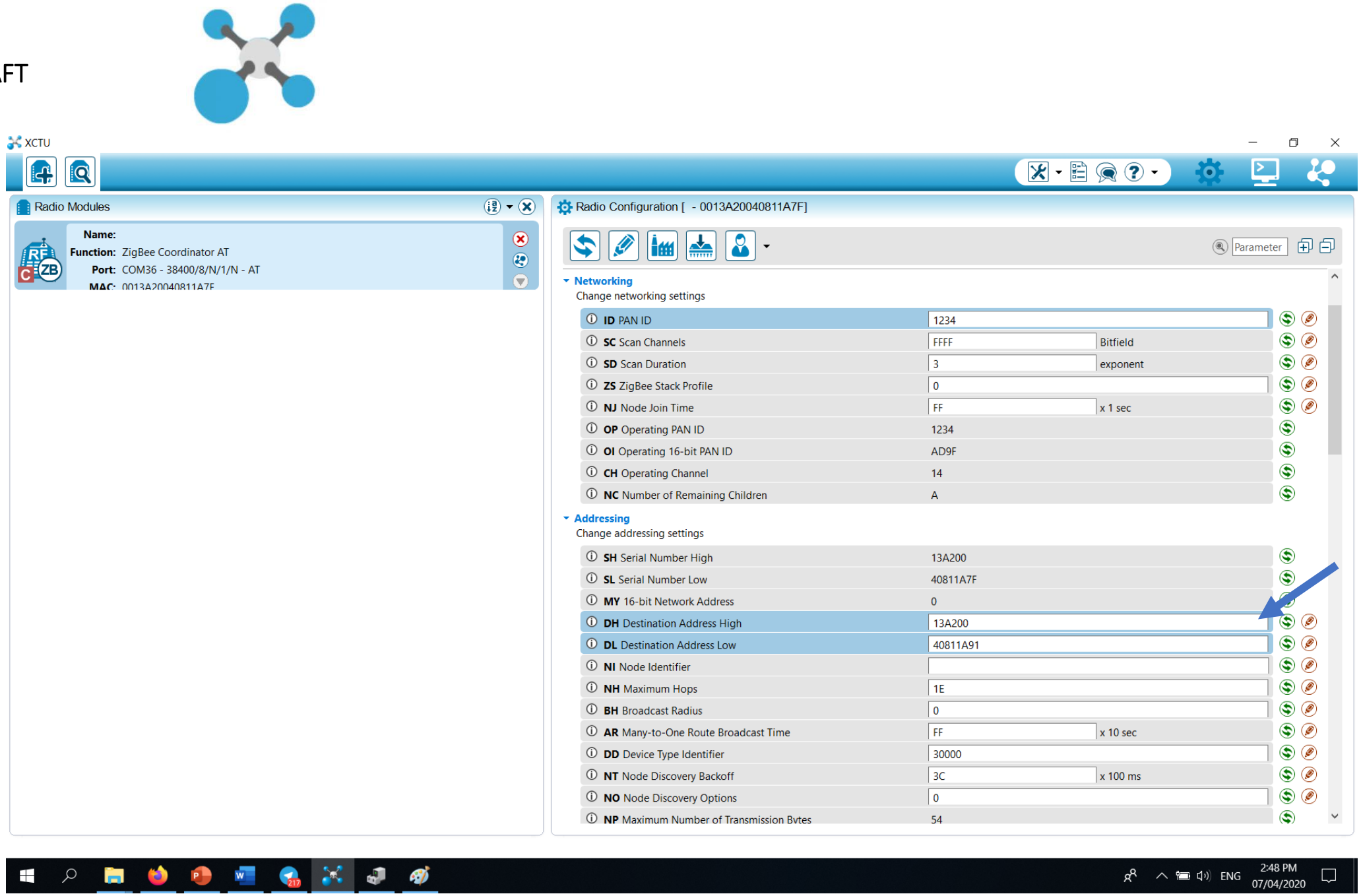
CT AT Command Mode Timeout	64	x 100ms
GT Guard Times	3E8	x 1ms
CC Command Sequence Character	2B	Recommended: 0x20-0x7F (ASCII)

Sleep Modes
Configure low power options to support end device children

SM Sleep Mode	No Sleep (Router) [0]	
SN Number of Cyclic Sleep Periods	1	
SO Sleep Options	0	
SP Cyclic Sleep Period	20	x 10 ms
ST Time before Sleep	1388	x 1 ms

ENG 2:36 PM 07/04/2020

AIRCRAFT


XCTU
Radio Modules
Name:
Function: ZigBee Coordinator AT
Port: COM36 - 38400/8/N/1/N - AT
MAC: 0013A20040811A7F
Radio Configuration [- 0013A20040811A7F]
Parameter
Networking
Change networking settings
ID PAN ID 1234
SC Scan Channels FFFF Bitfield
SD Scan Duration 3 exponent
ZS ZigBee Stack Profile 0
NJ Node Join Time FF x 1 sec
OP Operating PAN ID 1234
OI Operating 16-bit PAN ID AD9F
CH Operating Channel 14
NC Number of Remaining Children A
Addressing
Change addressing settings
SH Serial Number High 13A200
SL Serial Number Low 40811A7F
MY 16-bit Network Address 0
DH Destination Address High 13A200
DL Destination Address Low 40811A91
NI Node Identifier
NH Maximum Hops 1E
BH Broadcast Radius 0
AR Many-to-One Route Broadcast Time FF x 10 sec
DD Device Type Identifier 30000
NT Node Discovery Backoff 3C x 100 ms
NO Node Discovery Options 0
NP Maximum Number of Transmission Bytes 54
ENG
2:48 PM
07/04/2020

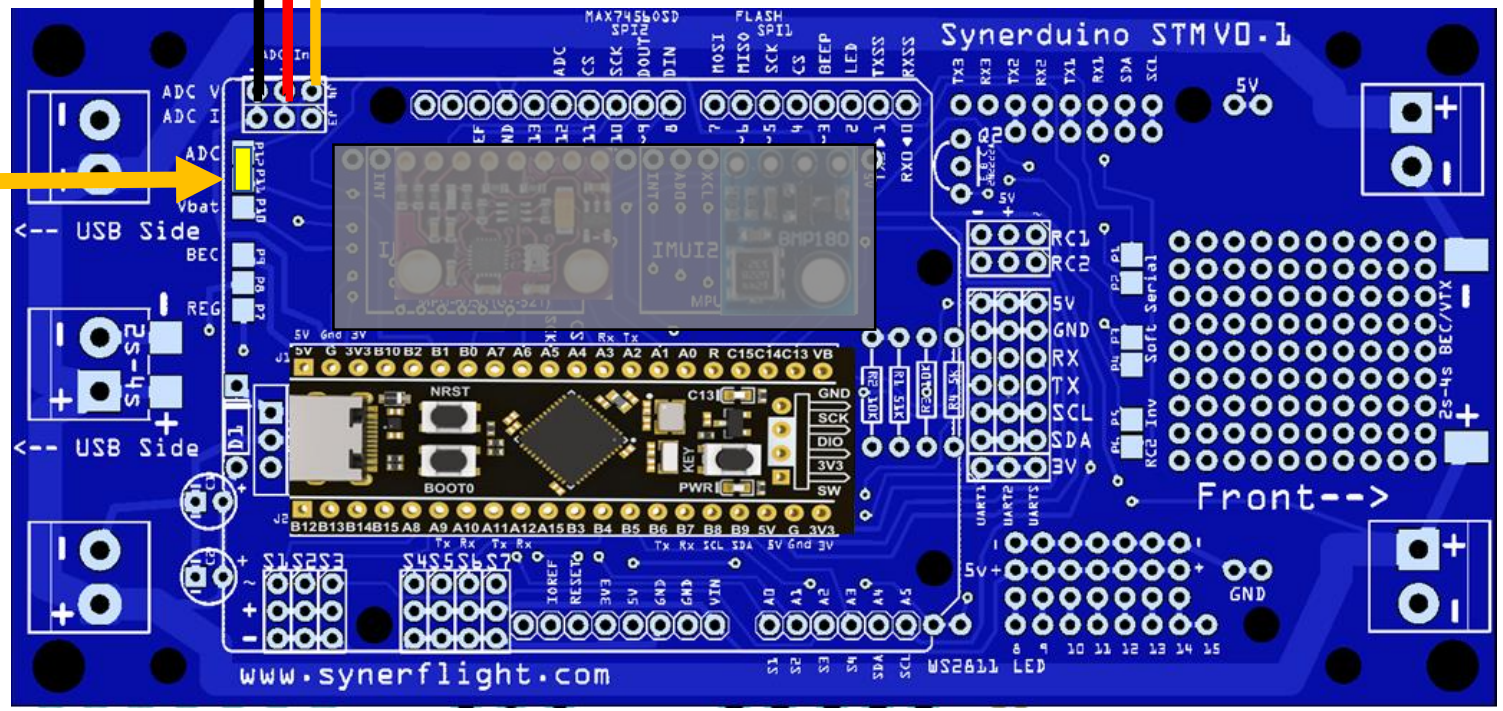
Batter Monitoring or ADC Sensor Devices

ADC External Sensor

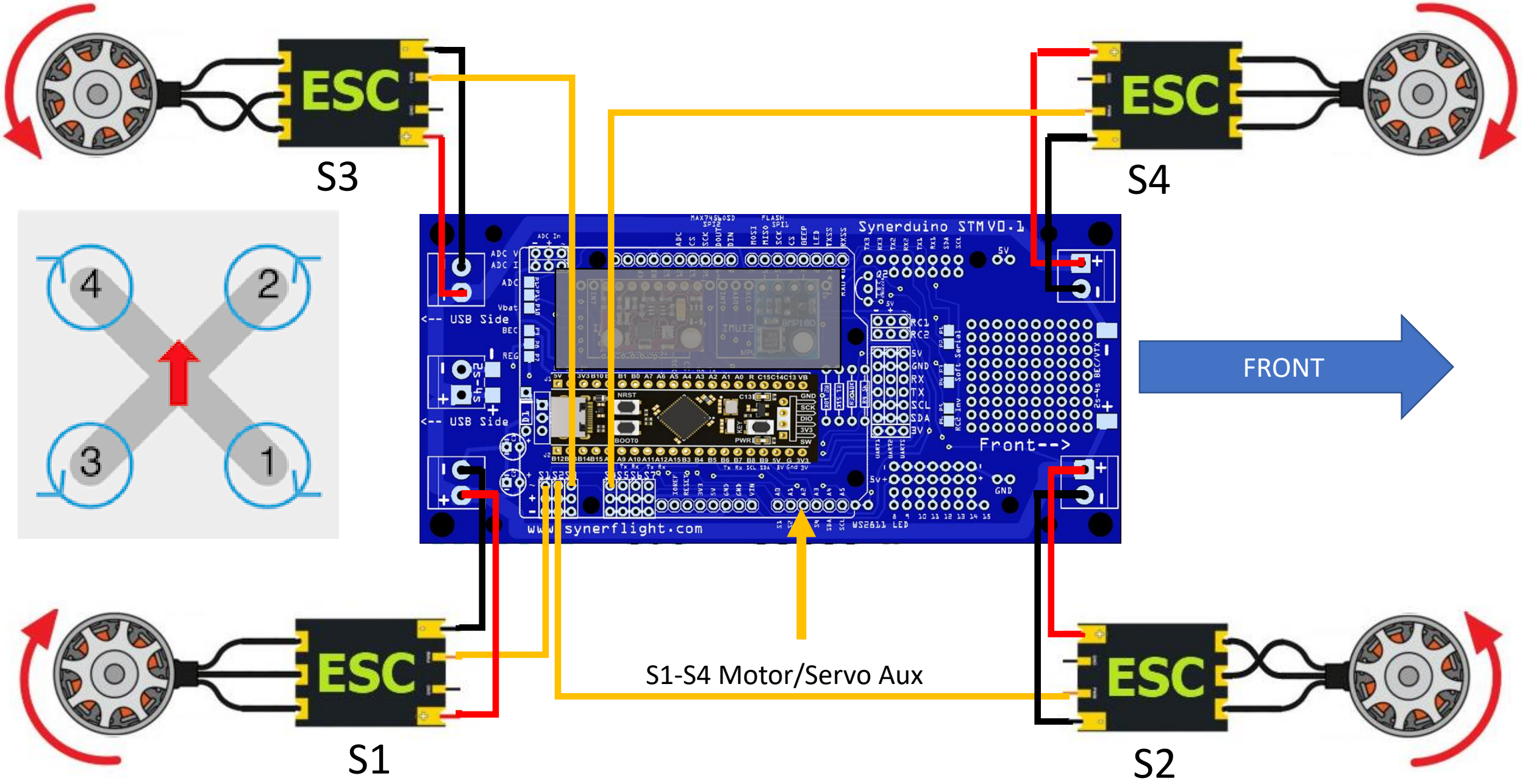
Here you can switch to ADC sensor input or VBAT for Battery monitoring

ADC V – Voltage 0-5V

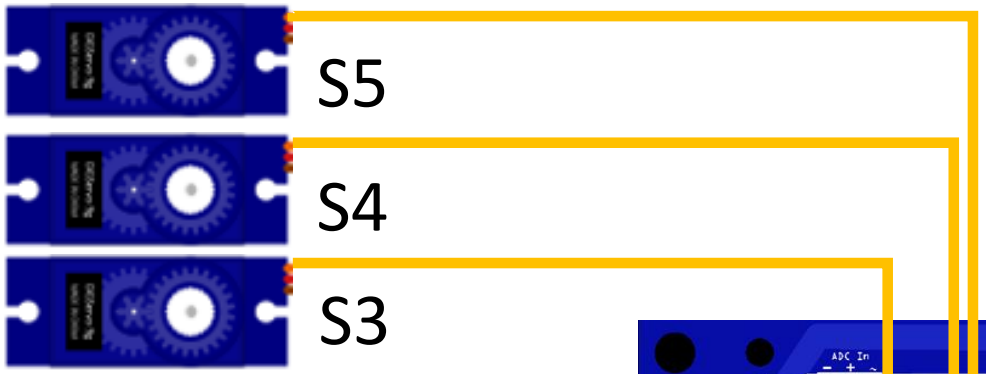
ADC I – Current 0-5V

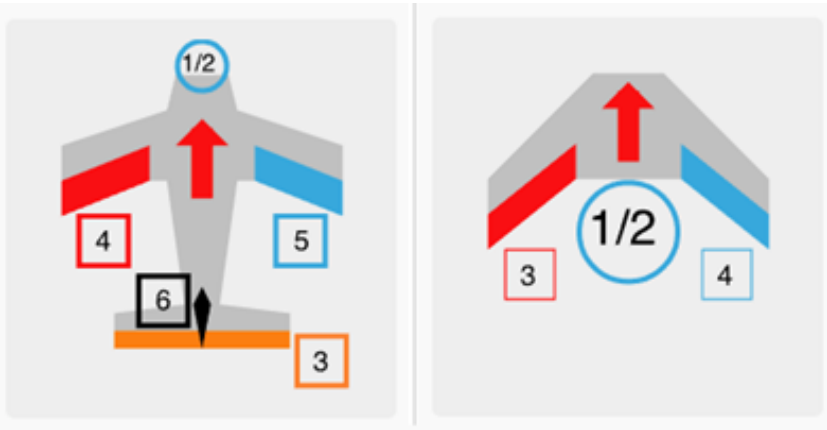


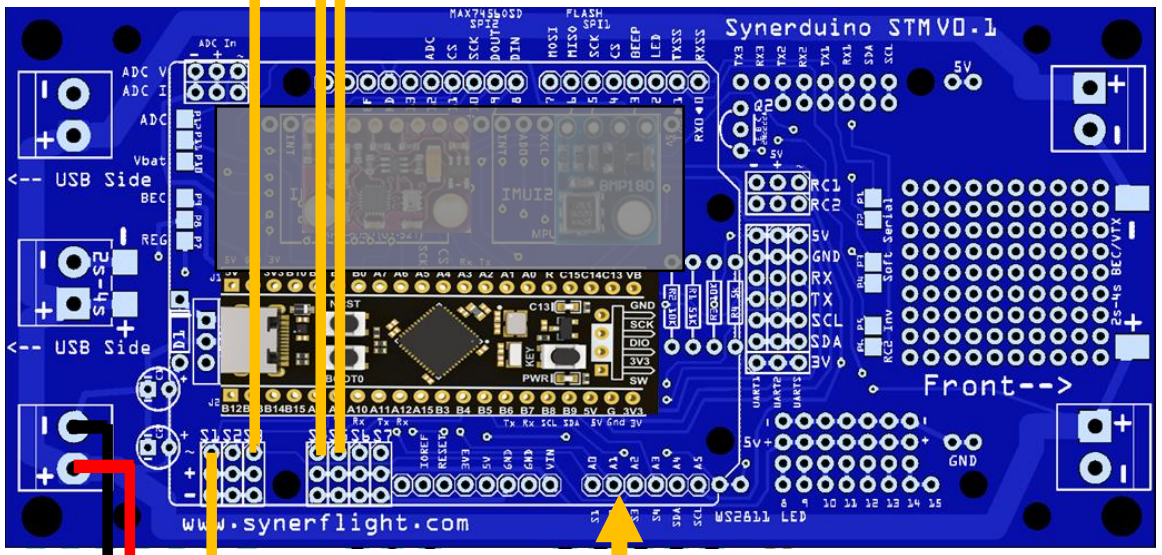
Multirotor Setup



Fixwing Setup

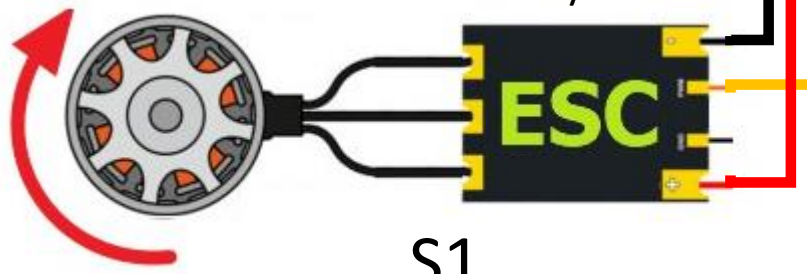






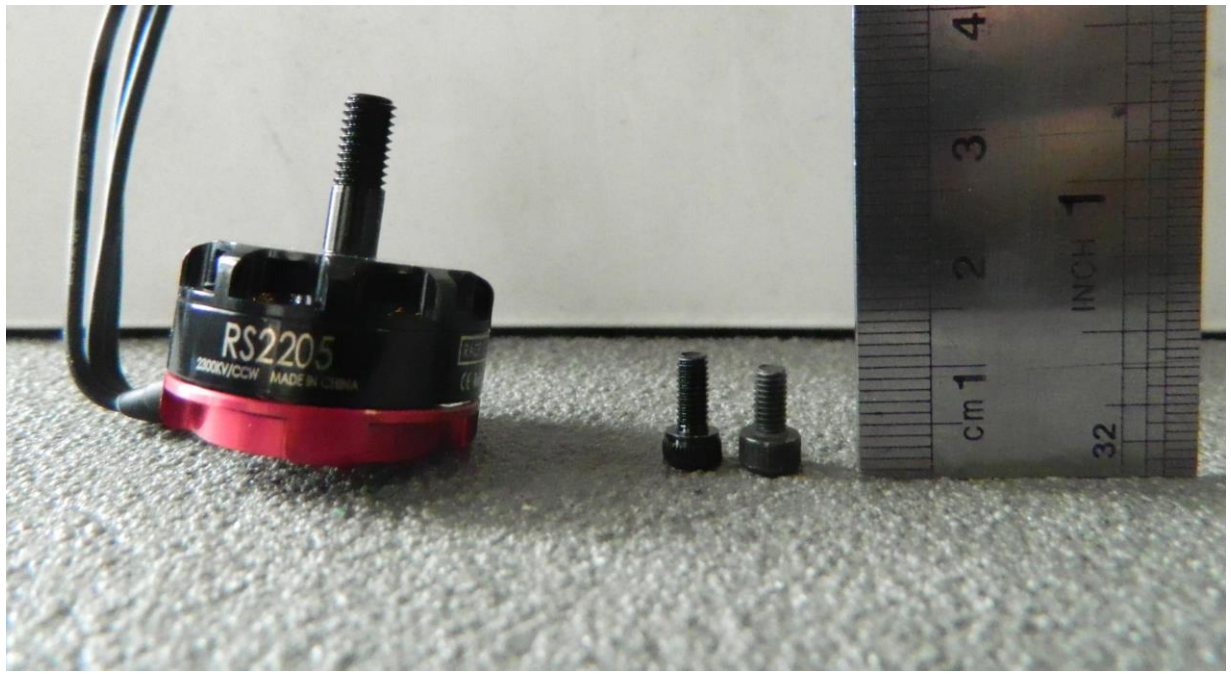
FRONT

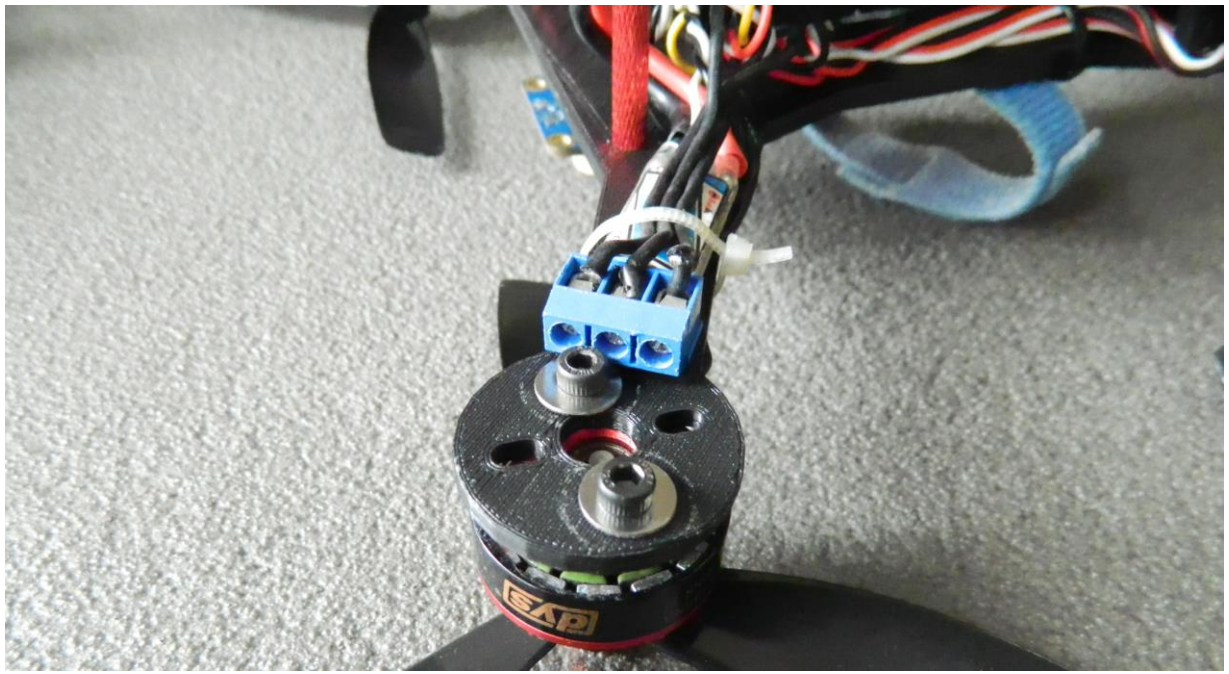
ESC W/ UBEC



S1

S1-S4 Motor/Servo Aux





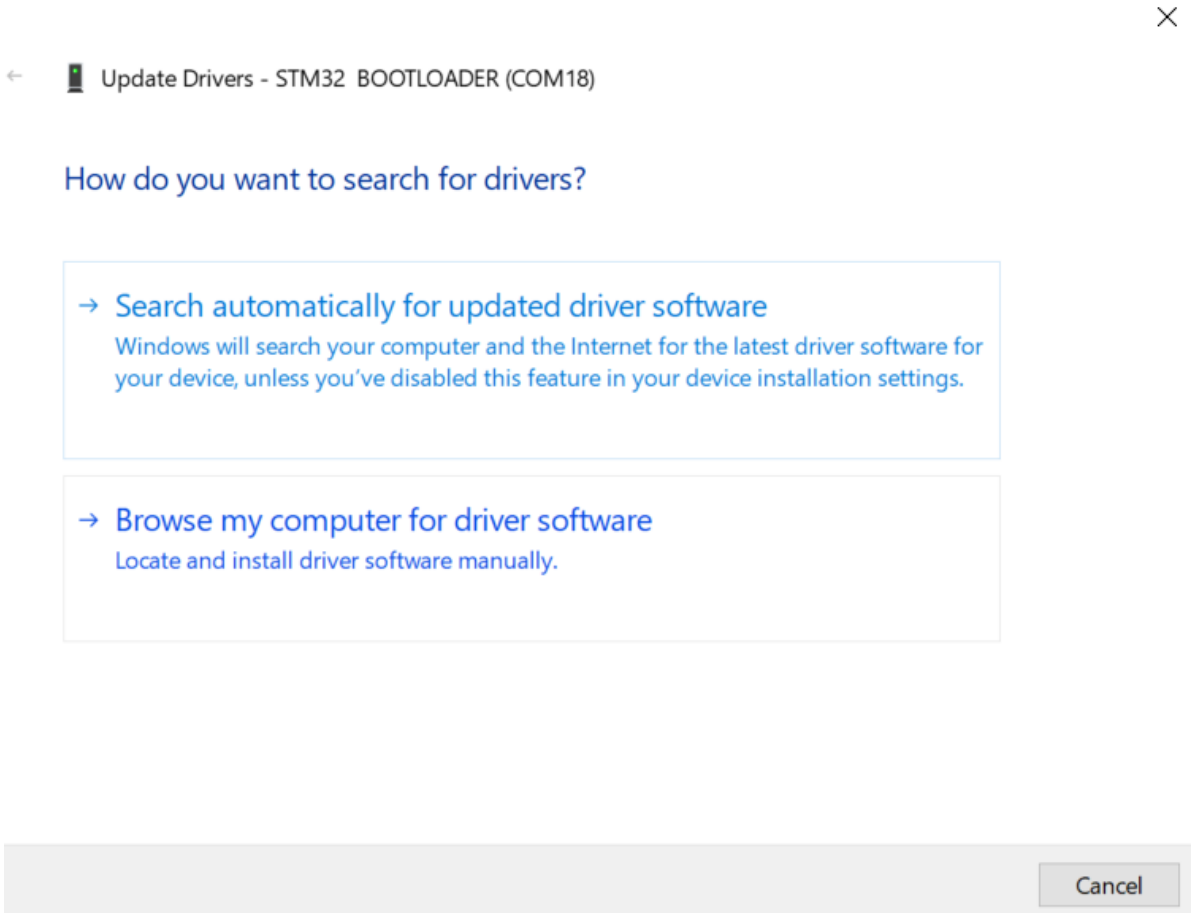
Frames are design to use the 6mm M3 Bolt for motor and must be thread lock with PVA glue in place to prevent it from going loose

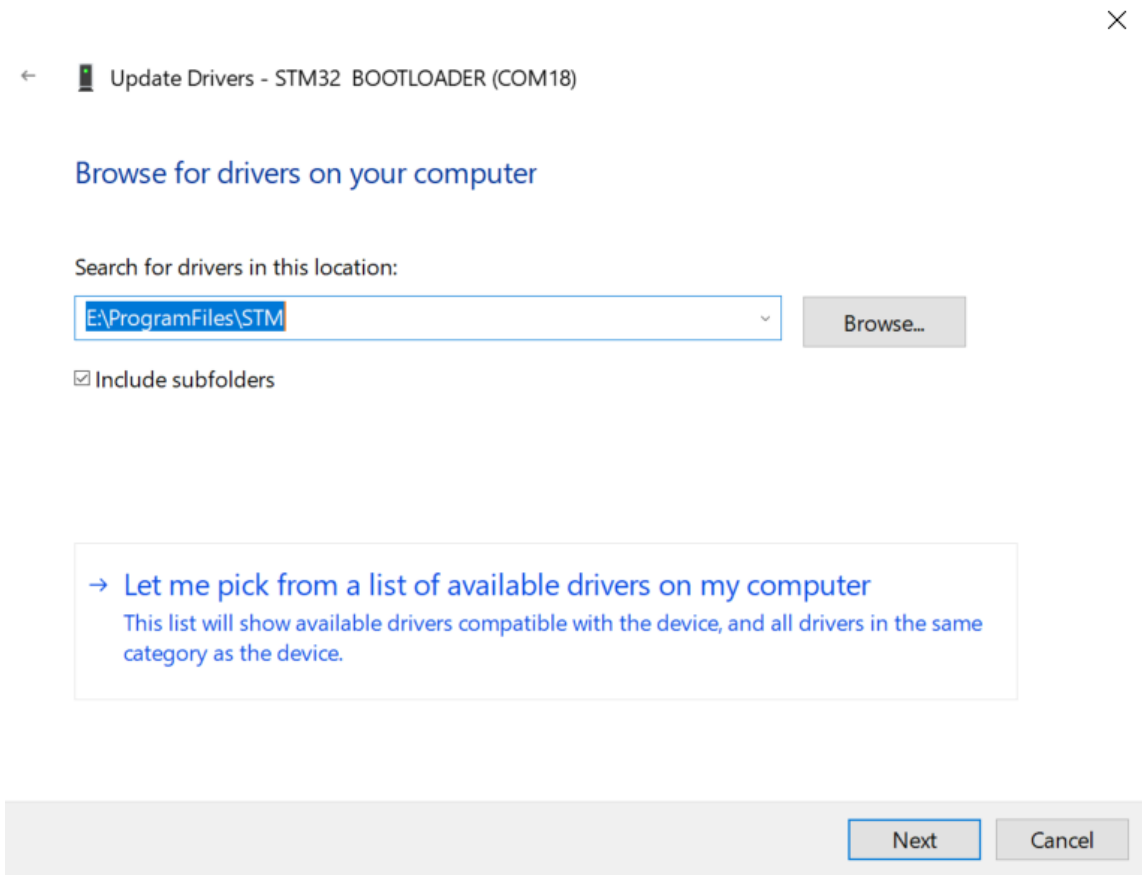
SYNERDUINO STM SHIELD

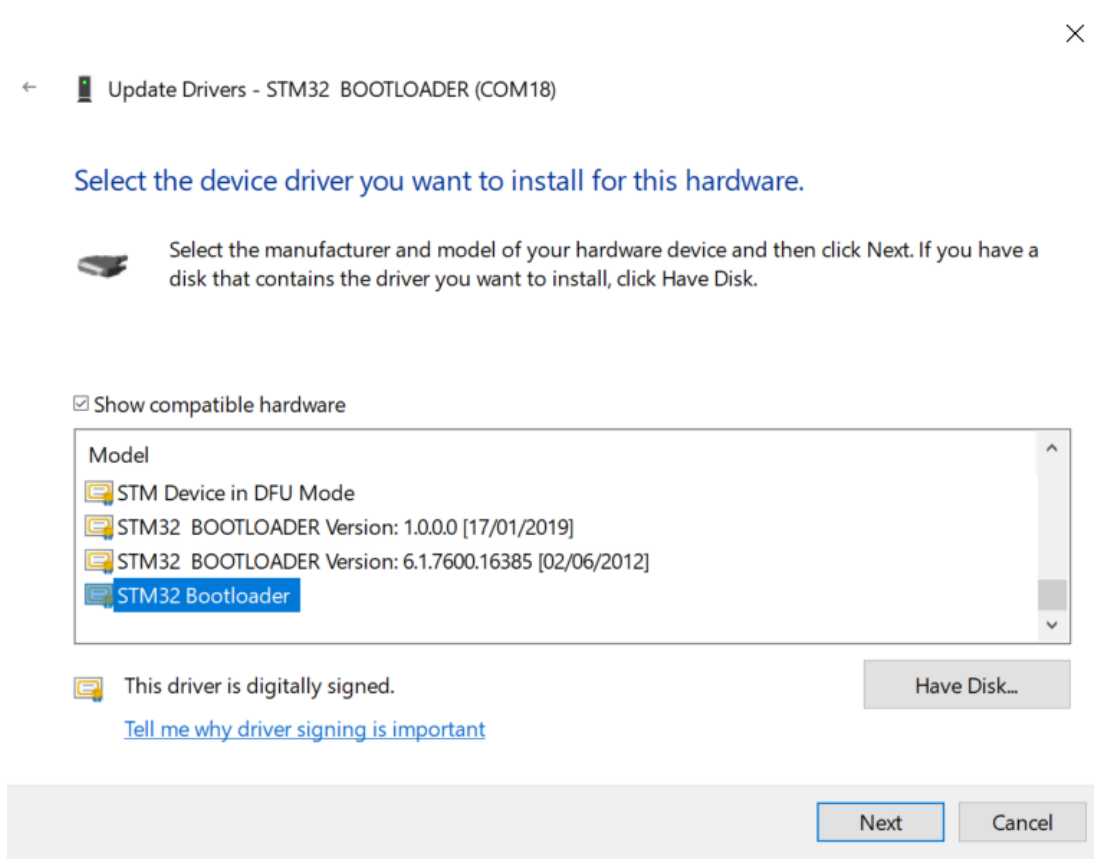
INAV Flash firmware installation and Synerduino Setup

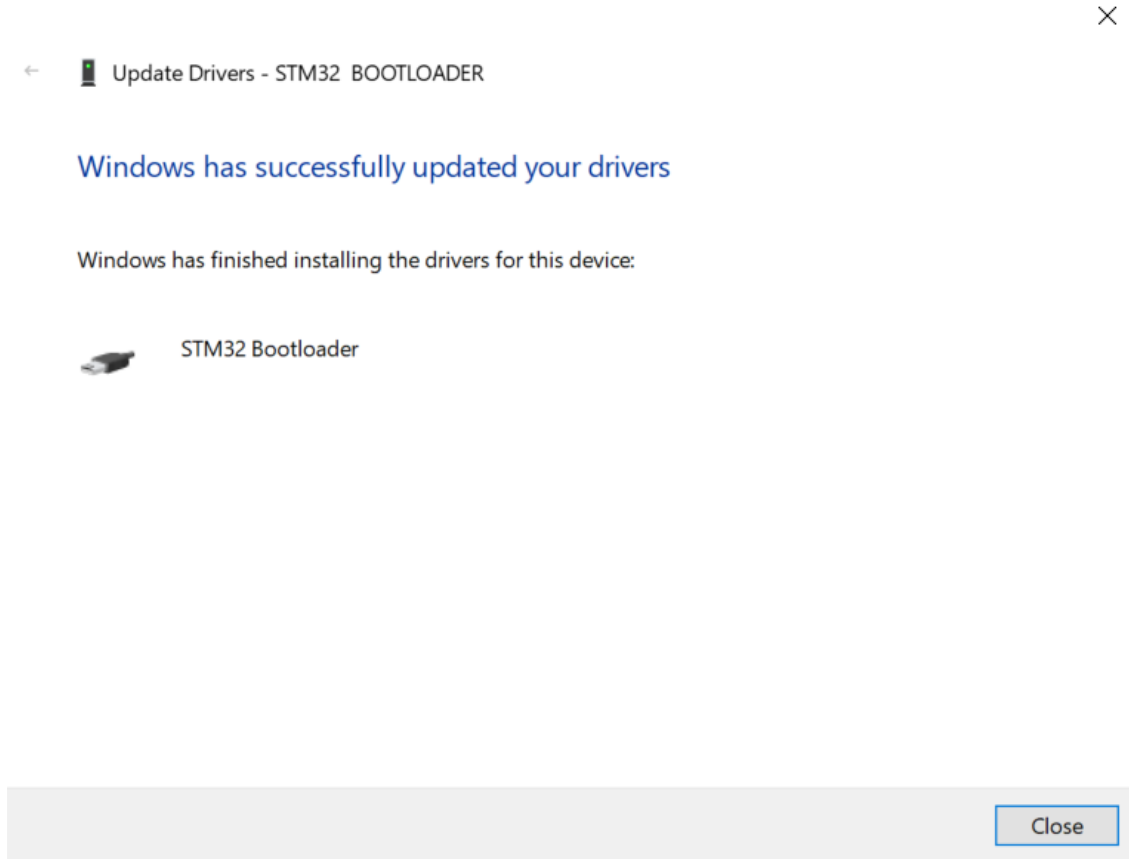
(you may skip the firmware Flash if you wish to use the default preloaded on to the board 6.0.0)

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



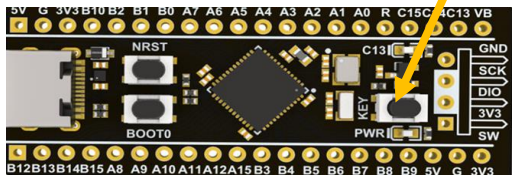


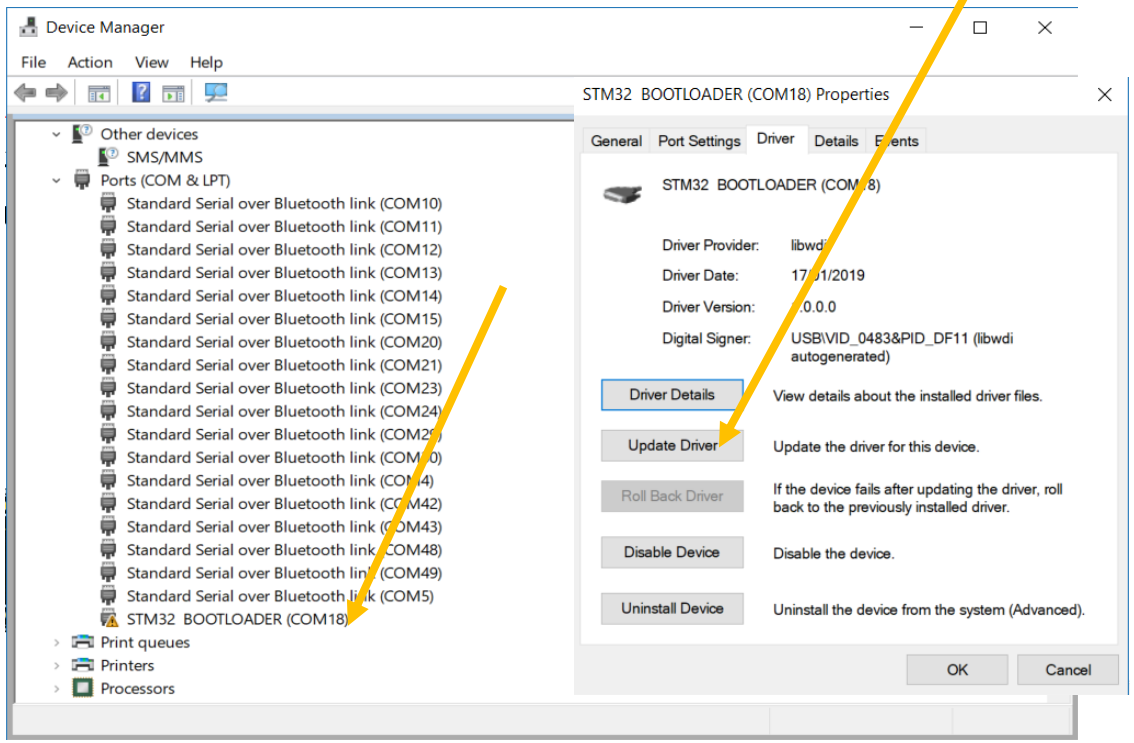

Update Drivers - STM32 BOOTLOADER (COM18)
Select the device driver you want to install for this hardware.
Select the manufacturer and model of your hardware device and then click Next. If you have a disk that contains the driver you want to install, click Have Disk.
Show compatible hardware
Model
STM Device in DFU Mode
STM32 BOOTLOADER Version: 1.0.0.0 [17/01/2019]
STM32 BOOTLOADER Version: 6.1.7600.16385 [02/06/2012]
STM32 Bootloader
This driver is digitally signed.
Have Disk...
Tell me why driver signing is important
Next
Cancel

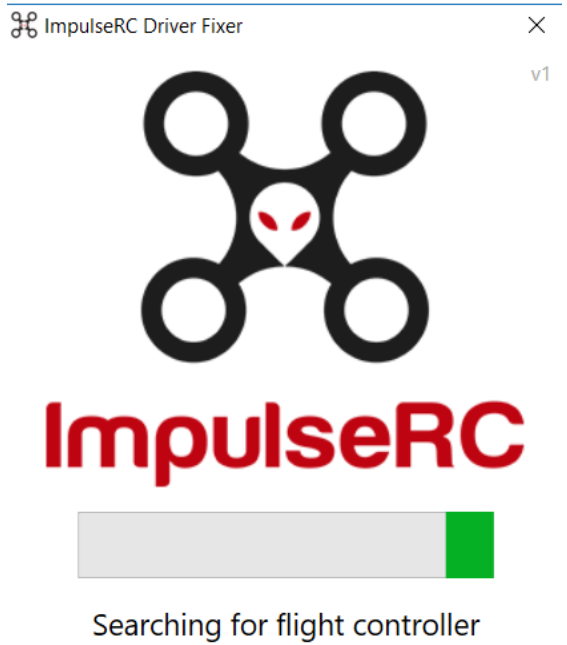

Update Drivers - STM32 BOOTLOADER
Windows has successfully updated your drivers
Windows has finished installing the drivers for this device:
STM32 Bootloader
Close

Brand new Blackpill STM32F411 setup

- 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





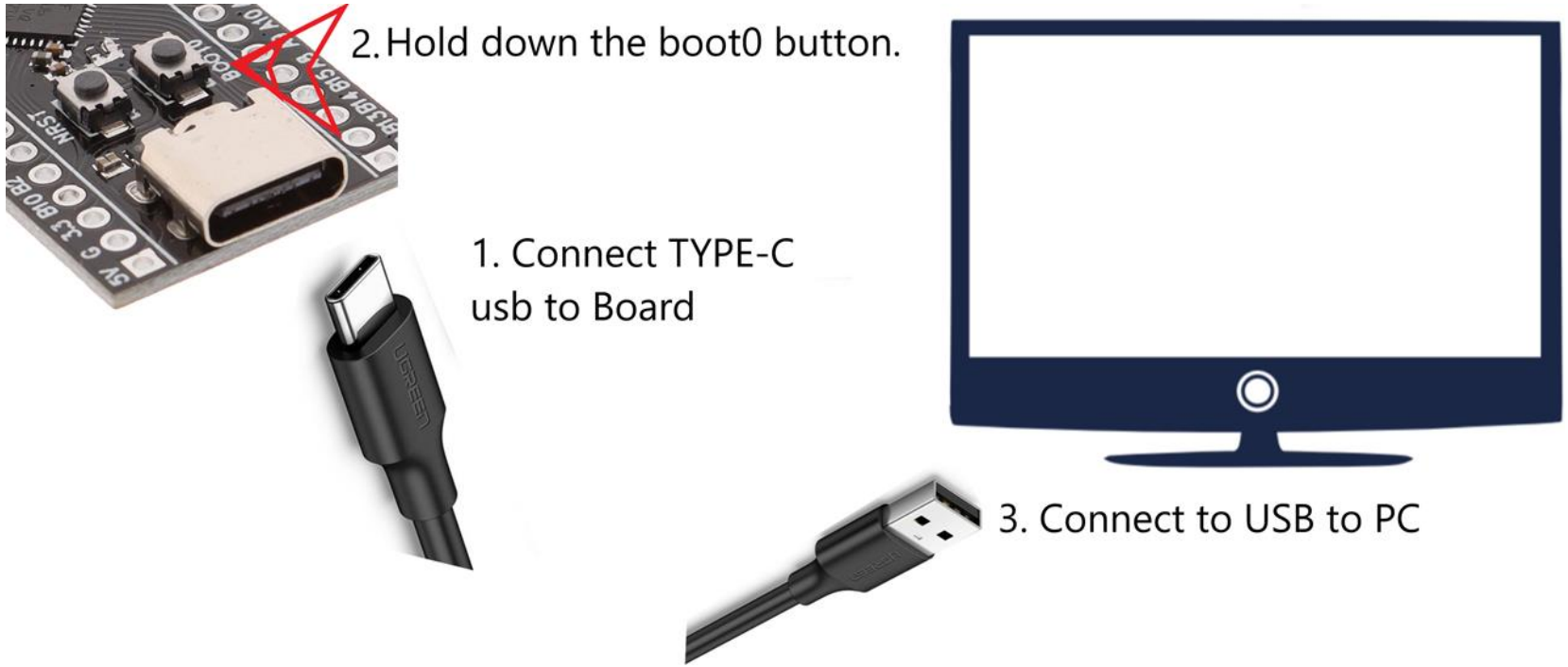


ImpulseRC Driver Fixer

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

After Flashed Blackpill STM32F411 setup



In the Black pill 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)

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.

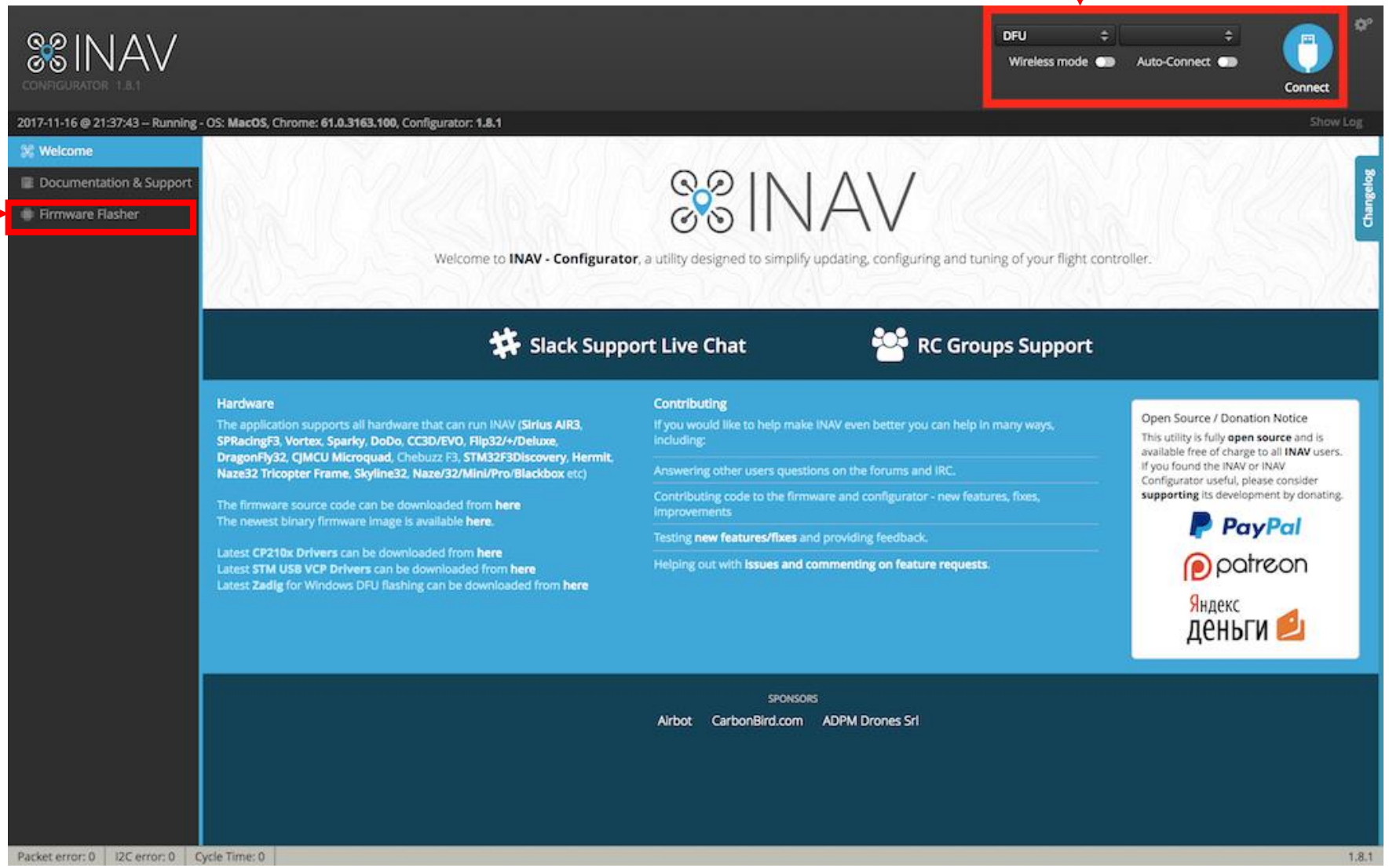
If the Blackpill is plug into the Synerduino board a preheat can be made by running the board with the battery for 1 min

- 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

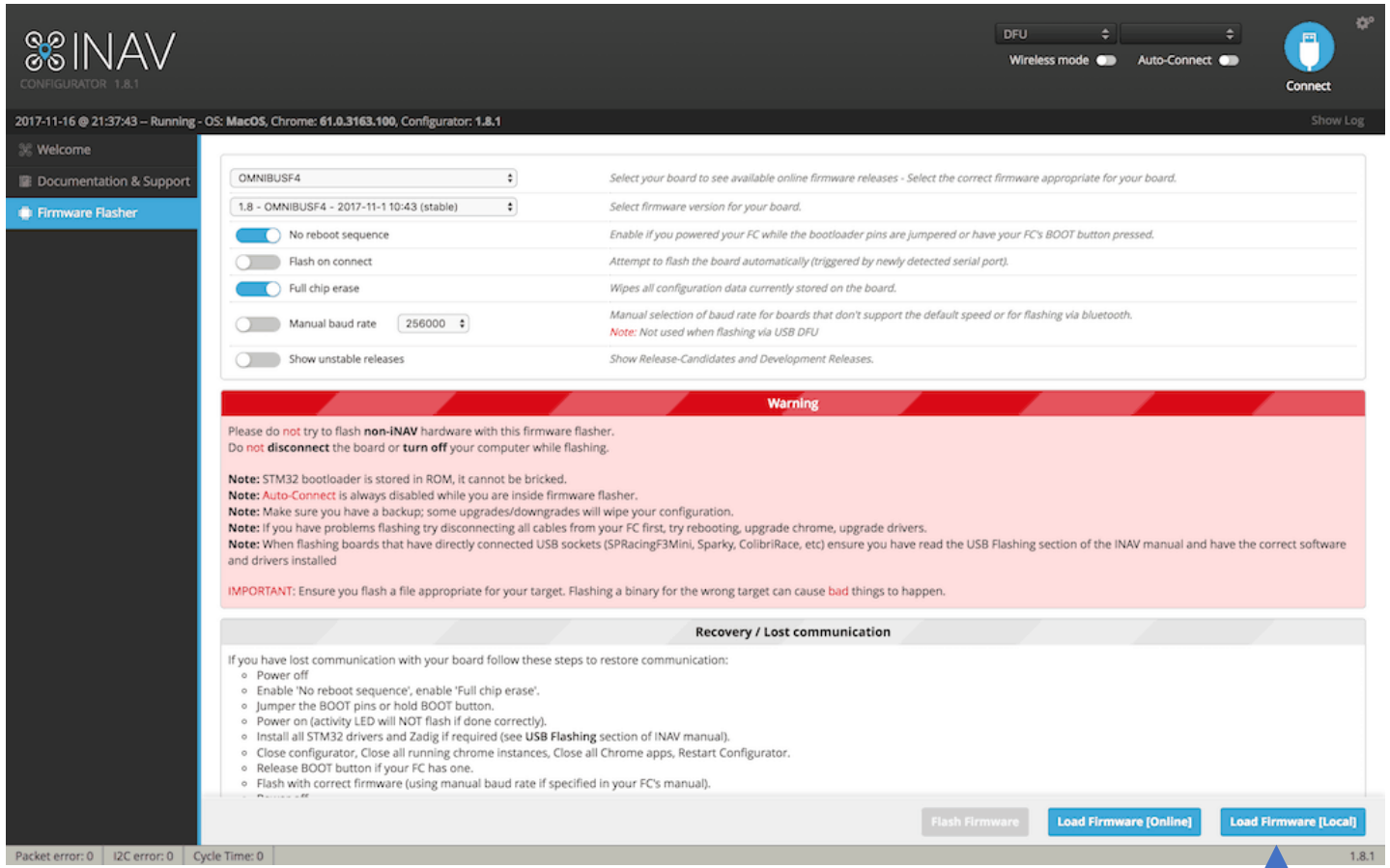
When you've successfully connected, the Configurator will recognize a device in DFU mode – which will be reflected in the port selection tab at the top. (Do Not Connect at this point)

Next, click on the Firmware Flasher tab

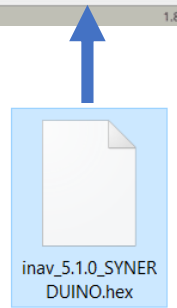


DFU (**Device Firmware Update**) mode is an incredibly useful feature on modern microcontrollers. It allows for quick and easy updates to a device's firmware without the need of extra piece of hardware.

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



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 STM32F411CE.hex that matches the version of your configurator

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 / INAV6.0.0 Synerduino.hex
Synerduino2.hex

SETUP

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

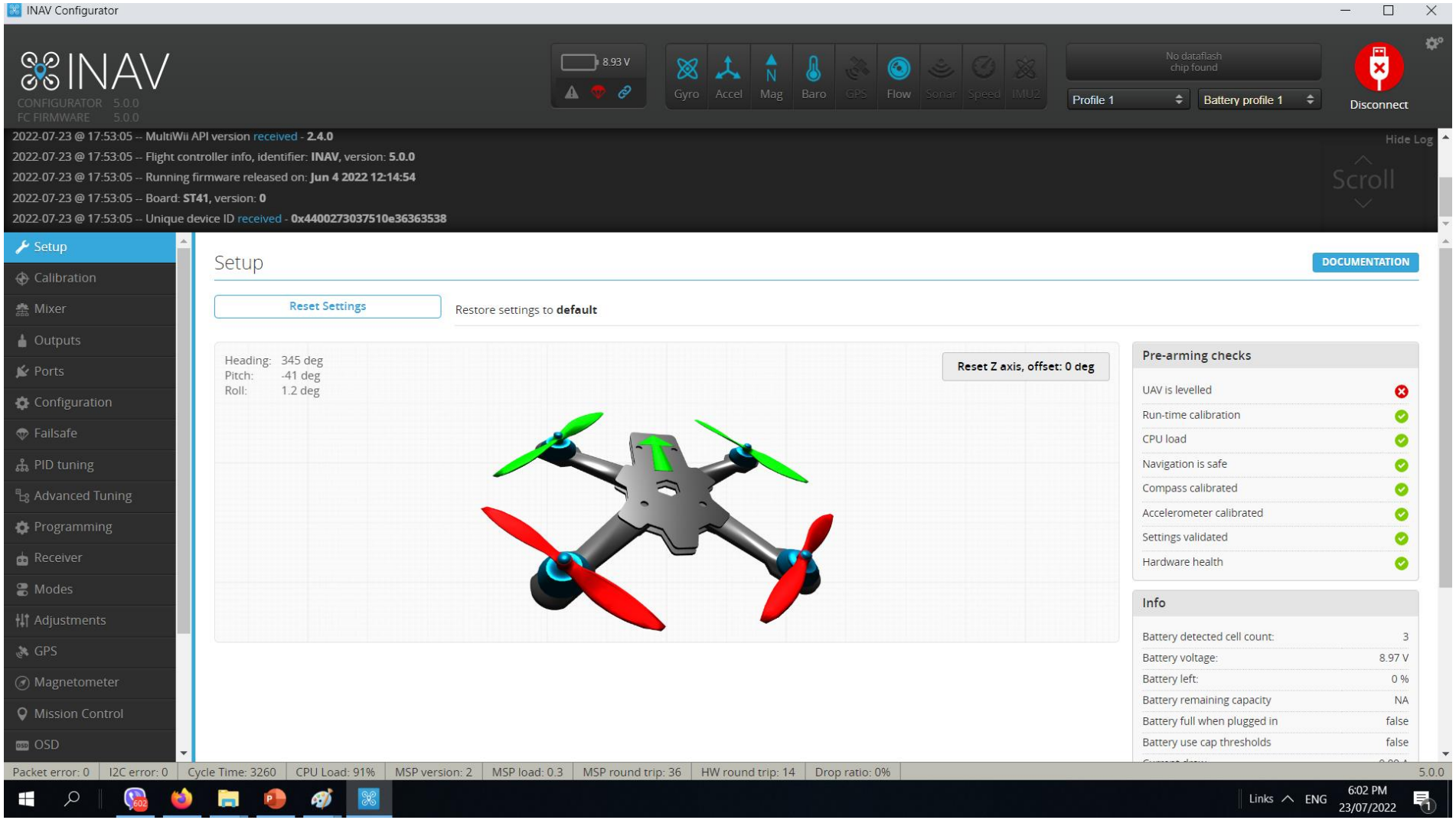
This is where you check the Status of your drone

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

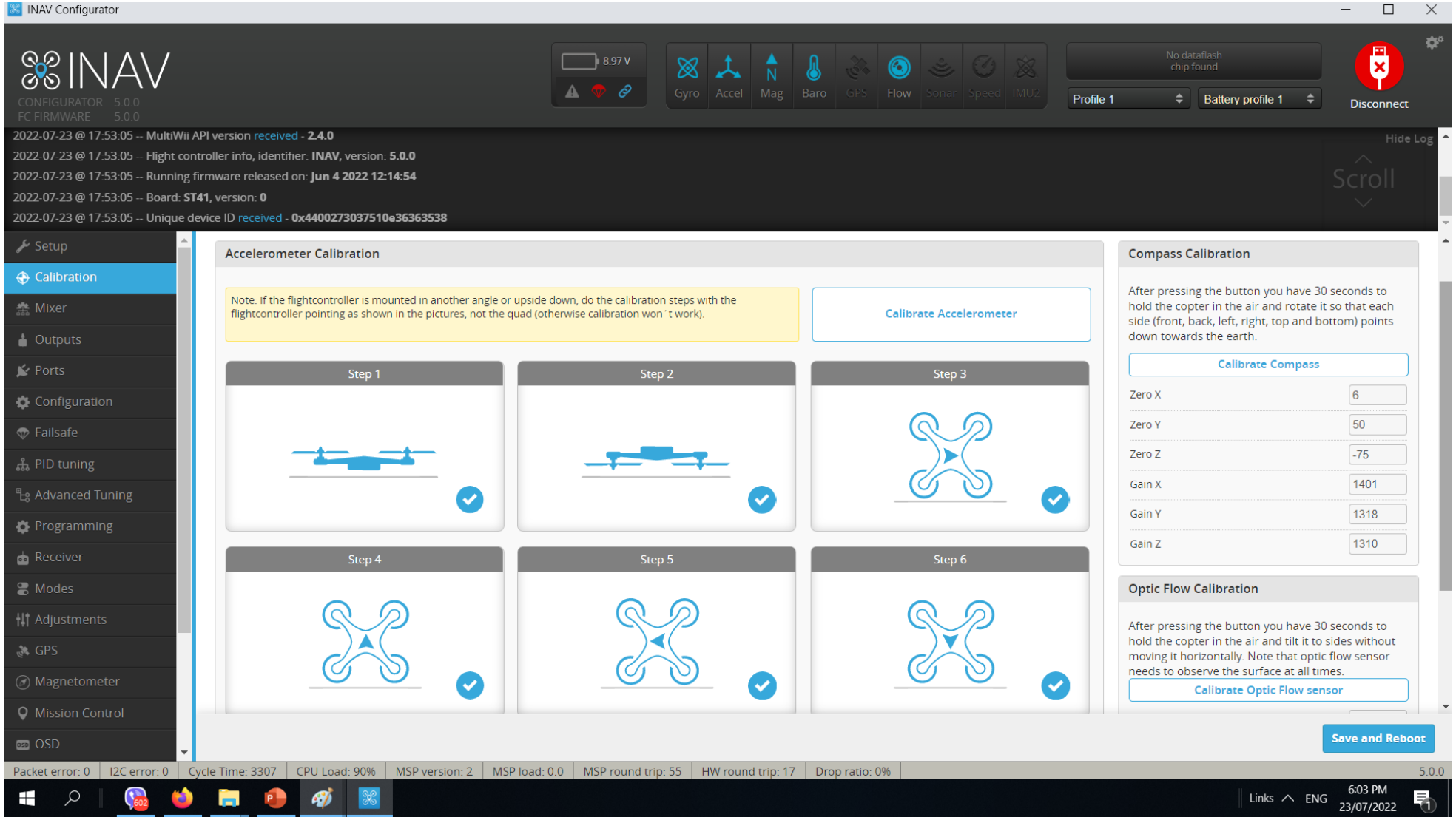
The Tab on top indicates the Sensors and status

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



CALIBRATION

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

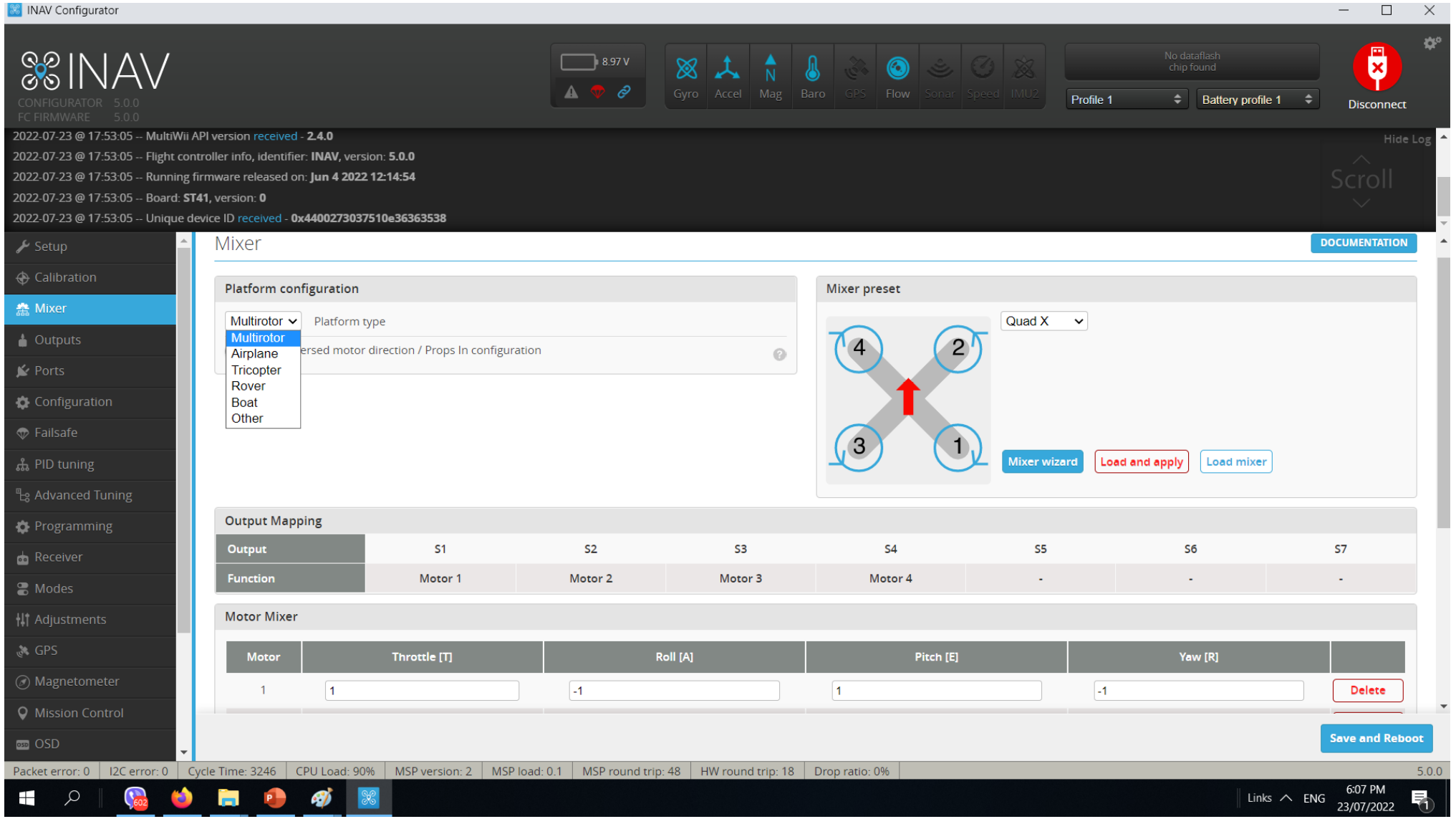


MIXER

Airframe or Vehicle time Preset and mix selection

Load and apply when selected then Save Reboot

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



MIXER

Note 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

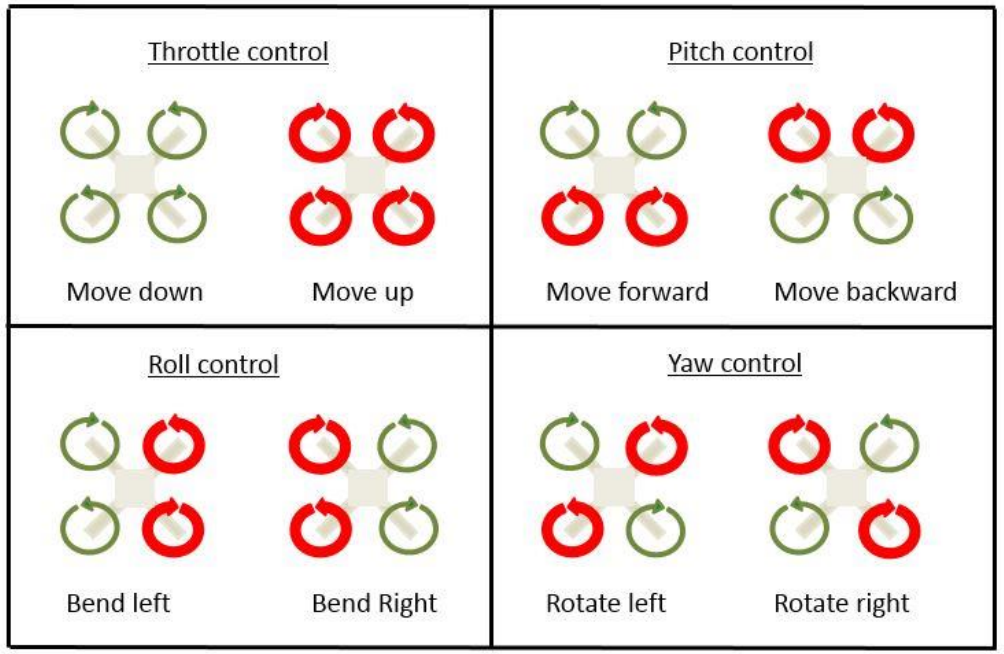
```
Quad X W/ Gimbal
Quad + W/ Gimbal
Single Copter
Bi-Copter
Tricopter
Rover
Boat
Camera Gimbal
```

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

MOTOR MIX FOR QUAD X

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

(-) REDUCE RPM
(+) INCREASE RPM



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

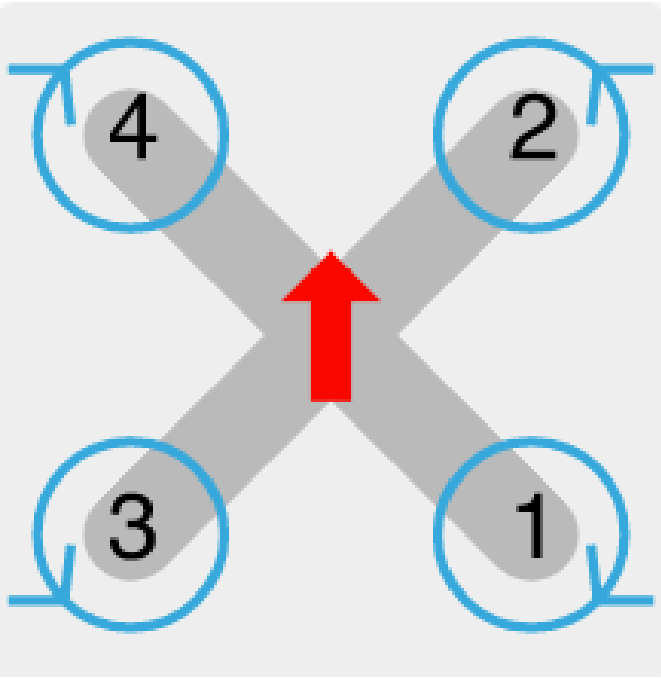
Add new mixer rule

Servo mixer

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

Logic conditions

Add new mixer rule

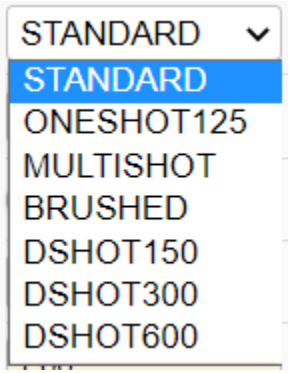


OUTPUT

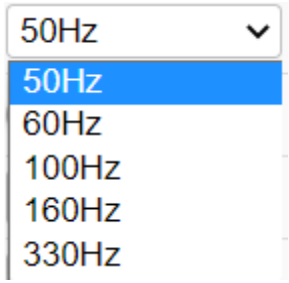
This Tab is use to calibrate and Test ESC, Motors and Servos assignment

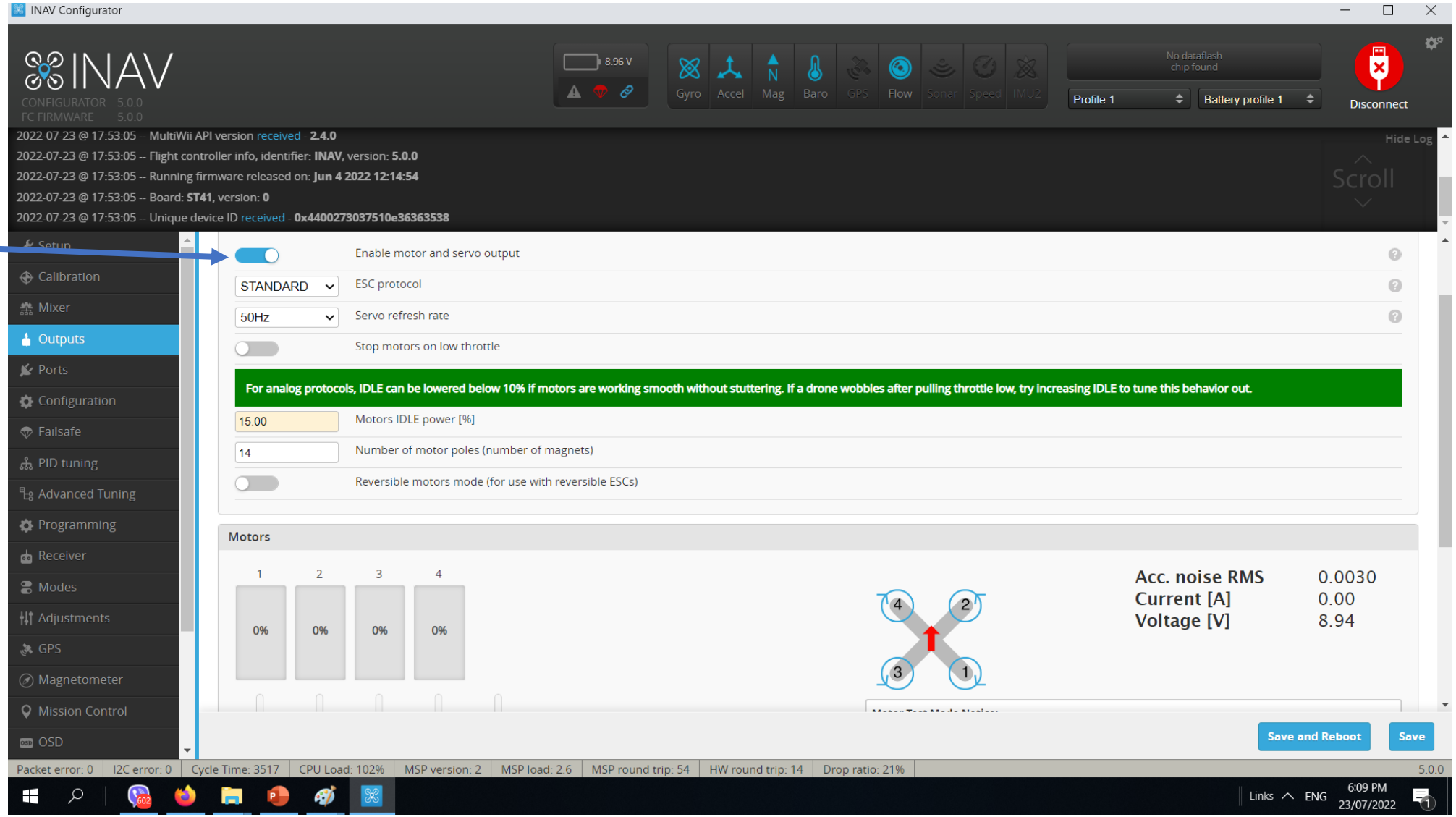
Enable Motor and Servo Output must be on

ESC Protocol



Servo Refresh rate



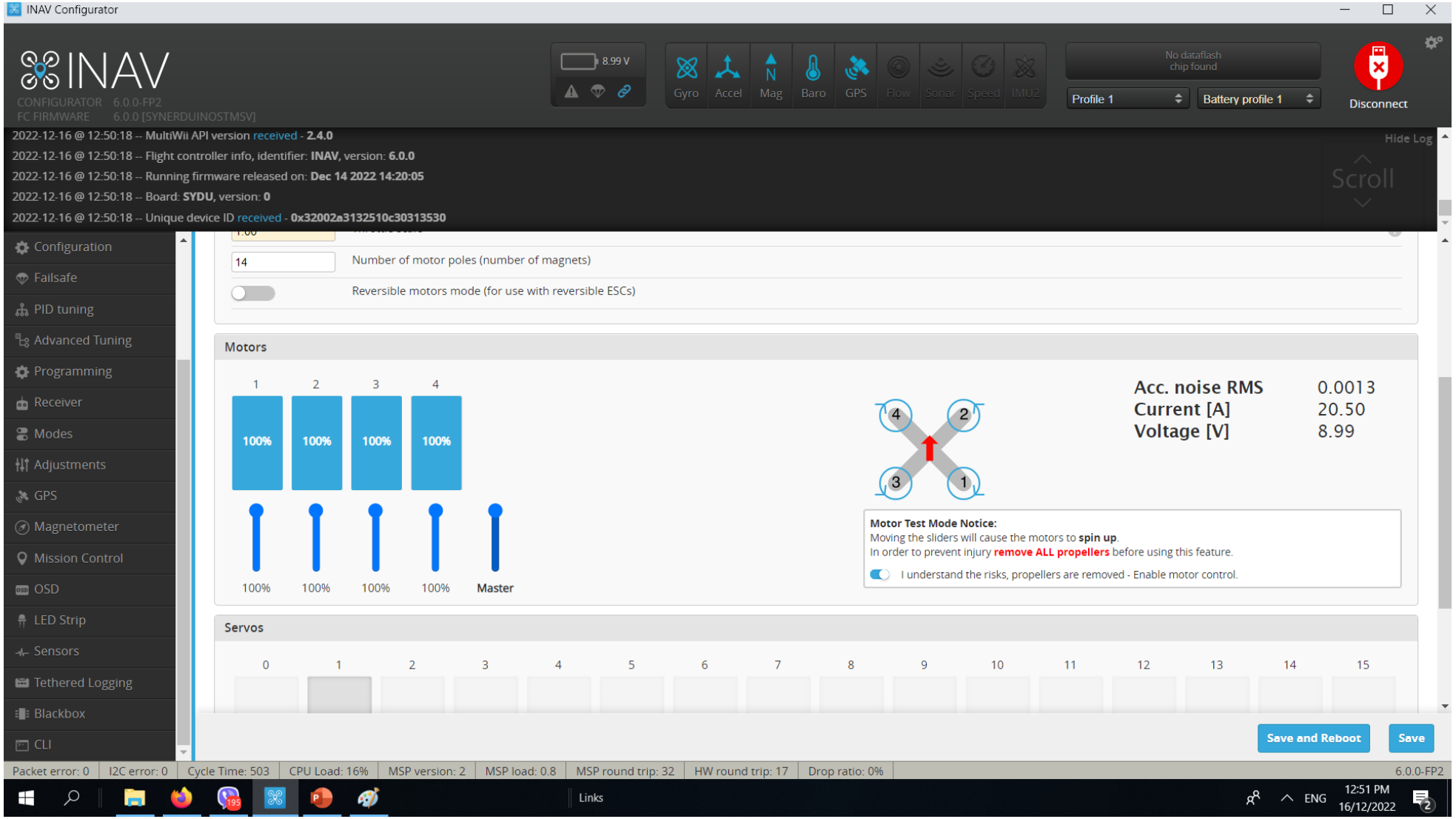


This Tab is use to calibrate and Test ESC, Motors and Servos assignment

Calibrate ESC:

Remove all props

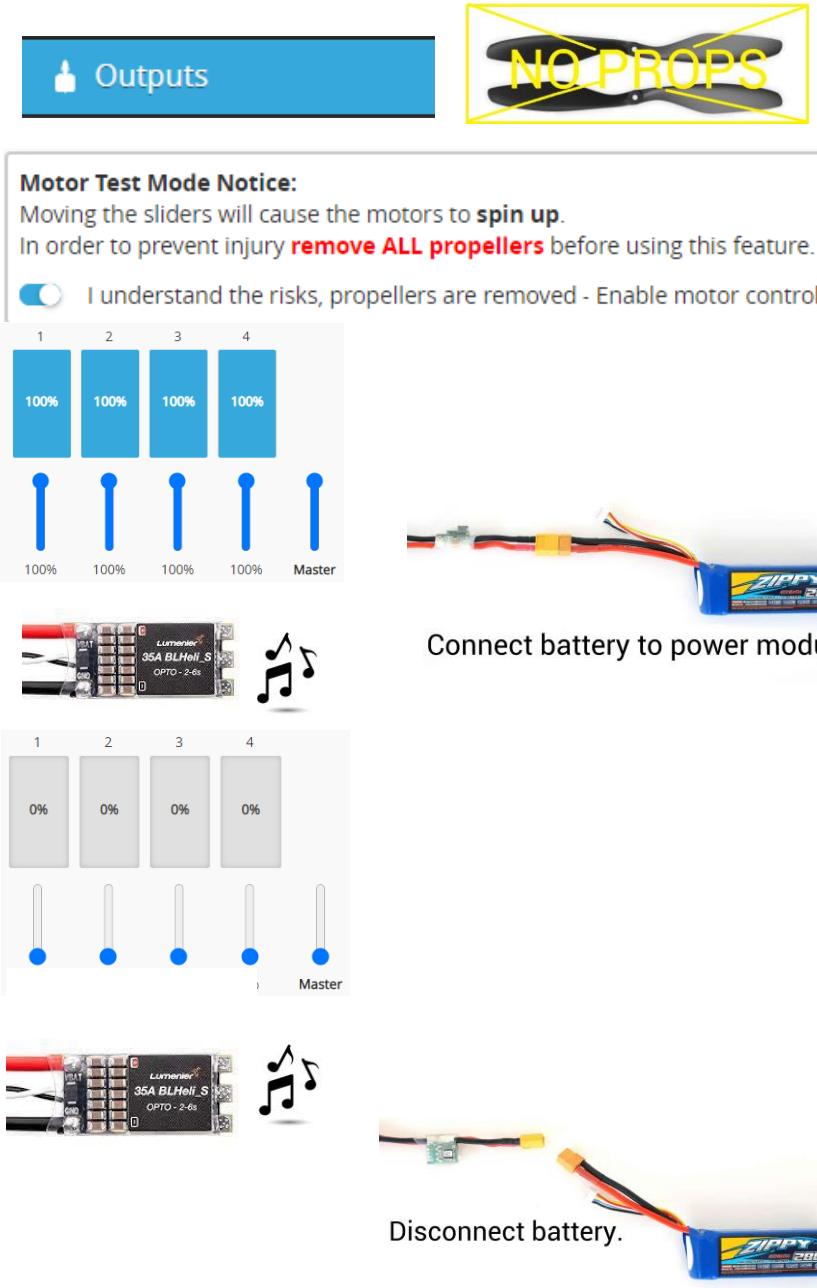
1. Activate motor Test mode
2. Master throttle up 100%
3. Plug in Battery and wait for the calibration Tune
4. Master throttle down 0%
5. Deactivate motor Test mode
6. Test the motor again by reactivating test motor test mode after the boot up tune start slowly throttling up



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



PORTS

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)

INAV Configurator

INAV
CONFIGURATOR 5.0.0
FC FIRMWARE 5.1.0

5.48 V

Gyro Accel Mag Baro GPS Flow Sonar Speed IMU2

No dataflash chip found

Profile 1 Battery prof

2022-10-14 @ 15:06:32 -- MultiWii API version received - **2.4.0**
2022-10-14 @ 15:06:32 -- Flight controller info, identifier: **INAV**, version: **5.1.0**
2022-10-14 @ 15:06:32 -- Running firmware released on: **Sep 11 2022 13:15:57**
2022-10-14 @ 15:06:32 -- Board: **SYDU**, version: **0**
2022-10-14 @ 15:06:32 -- Unique device ID received - **0x4400273037510e36363538**

Scroll

- Setup
- Calibration
- Mixer
- Outputs
- Ports
- Programming
- Receiver
- Modes
- Adjustments
- GPS
- Magnetometer
- Mission Control
- OSD

Ports

DOCUMENTATION

Note: not all combinations are valid. When the flight controller firmware detects this the serial port configuration will be reset.
Note: Do NOT disable MSP on the first serial port unless you know what you are doing. You may have to reflash and erase your configuration if you do.

Identifier	Data	Telemetry	RX	Sensors	Peripherals
USB VCP	MSP 115200	Disabled AUTO	Serial RX	Disabled 115200	Disabled 115200
UART1	MSP 38400	Disabled AUTO	Serial RX	Disabled 115200	Disabled 115200
UART2	MSP 115200	Disabled AUTO	Serial RX	Disabled 115200	Disabled 115200
SOFTSERIAL1	MSP 57600	Disabled AUTO	Serial RX	GPS 57600	Disabled 115200

USB

Telemetry

Sbus RC

GPS / Flow Sensor

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 can be use for GPS (57600)
Optical Flow (19200)

Save and Reboot

Packet error: 0 | I2C error: 0 | Cycle Time: 660 | CPU Load: 23% | MSP version: 2 | MSP load: 0.2 | MSP round trip: 56 | HW round trip: 16 | Drop ratio: 0% | 5.0.0

BN 880 GPS / Baud 57600 | CXFO Optical Flow / Baud 19200 | Bluetooth / Baud 115200 | SIK Radio / Baud 75600

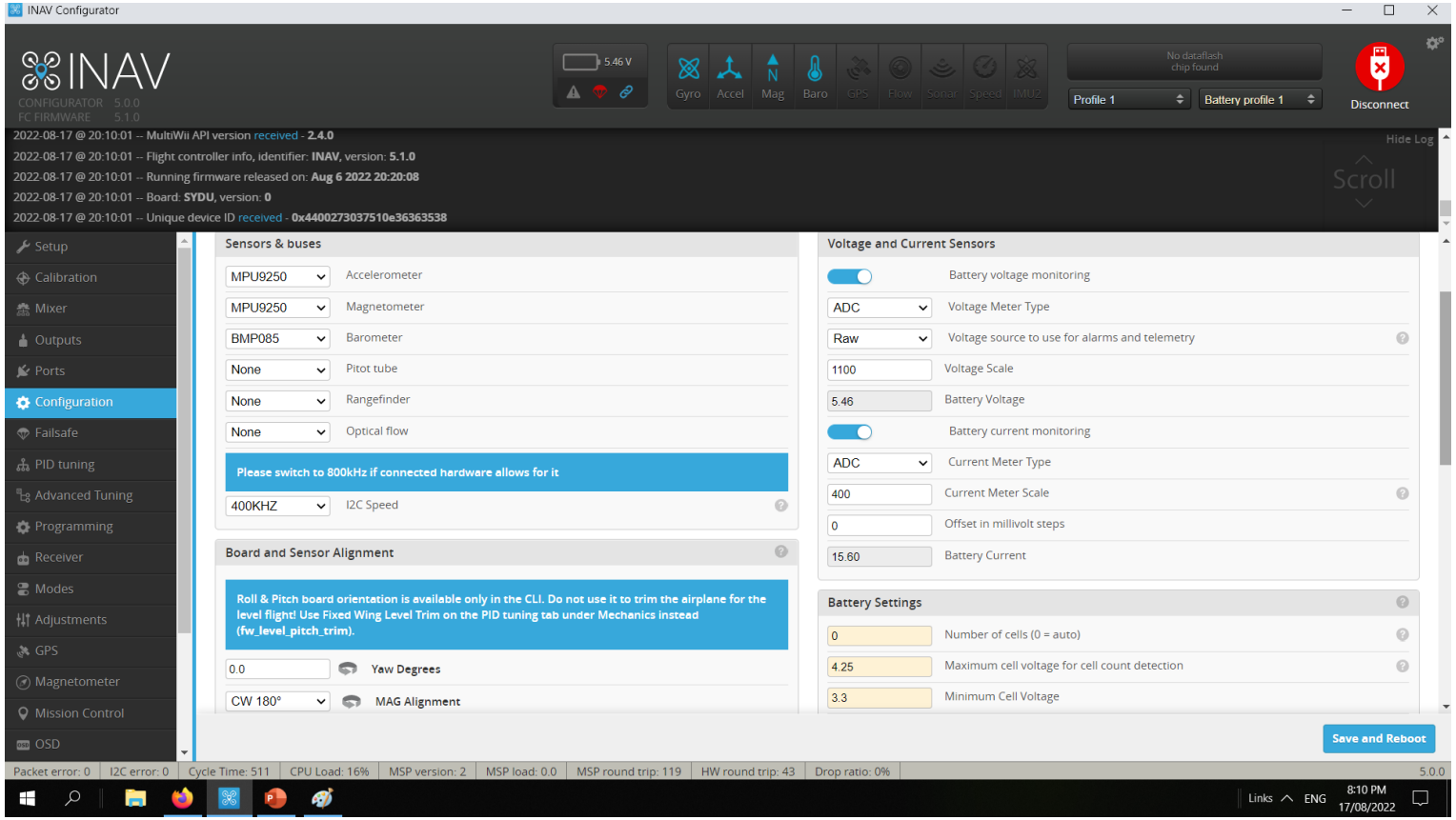
CONFIGURATION

Sensors would depend on the board installation
Synerduino support the following
ACC – MPU9250 or BMI160
MAG – MPU9250 , HMC5883 or QMC5883
BARO – BMP180 or BMP280
Optional Optical Flow installation CXFO

I2C speed 400hz

Board and Sensor alignment
0.0 Yaw Degrees
CW180 Mag Alignment

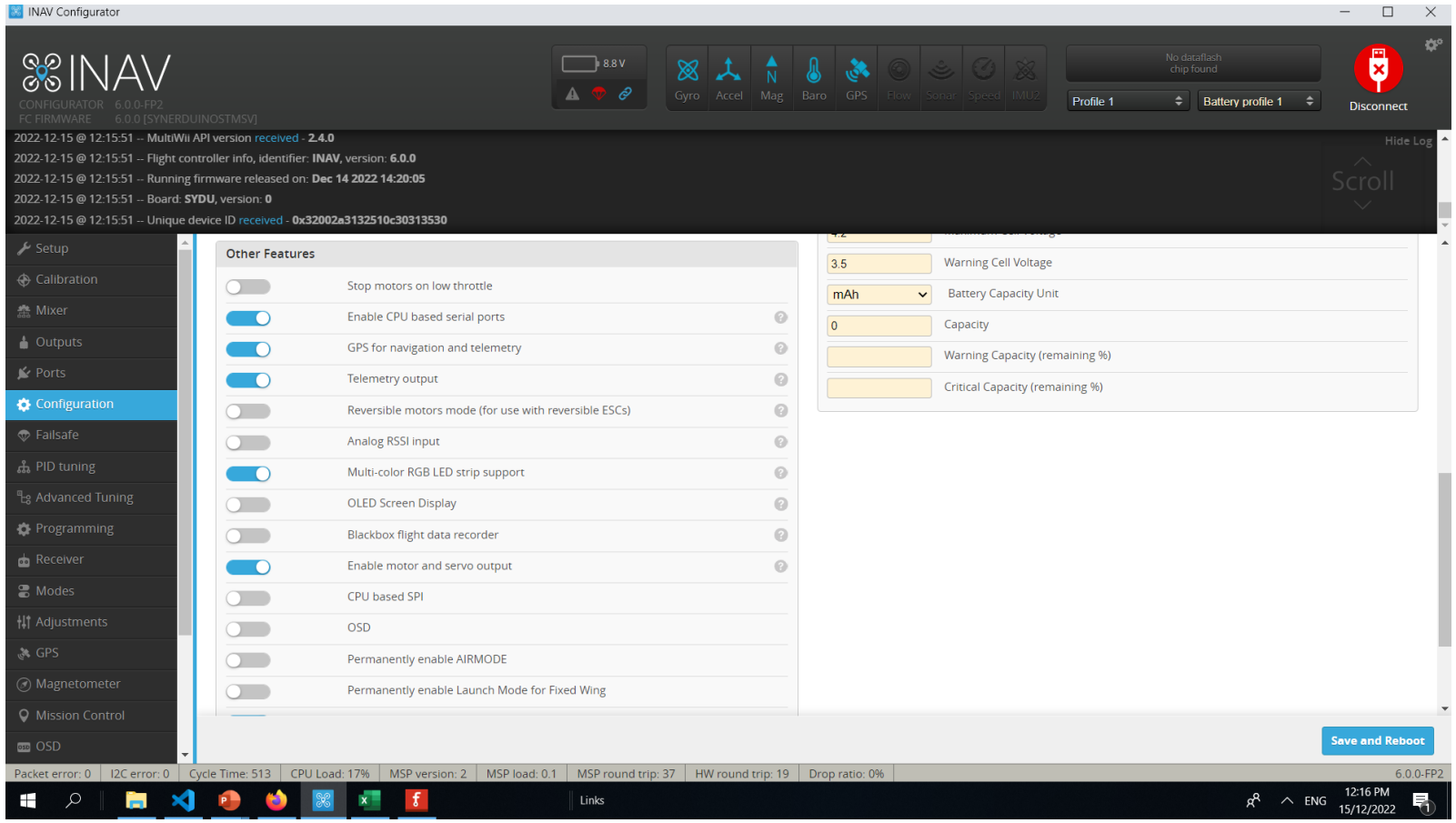
Features (Synerduino STM BlackPill)
Enable CPU based serial ports
GPS for navigation and telemetry
Telemetry output
Multi-color RGB LED strip support
Enable motor and servo output
Profile selection with TX stick command



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



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

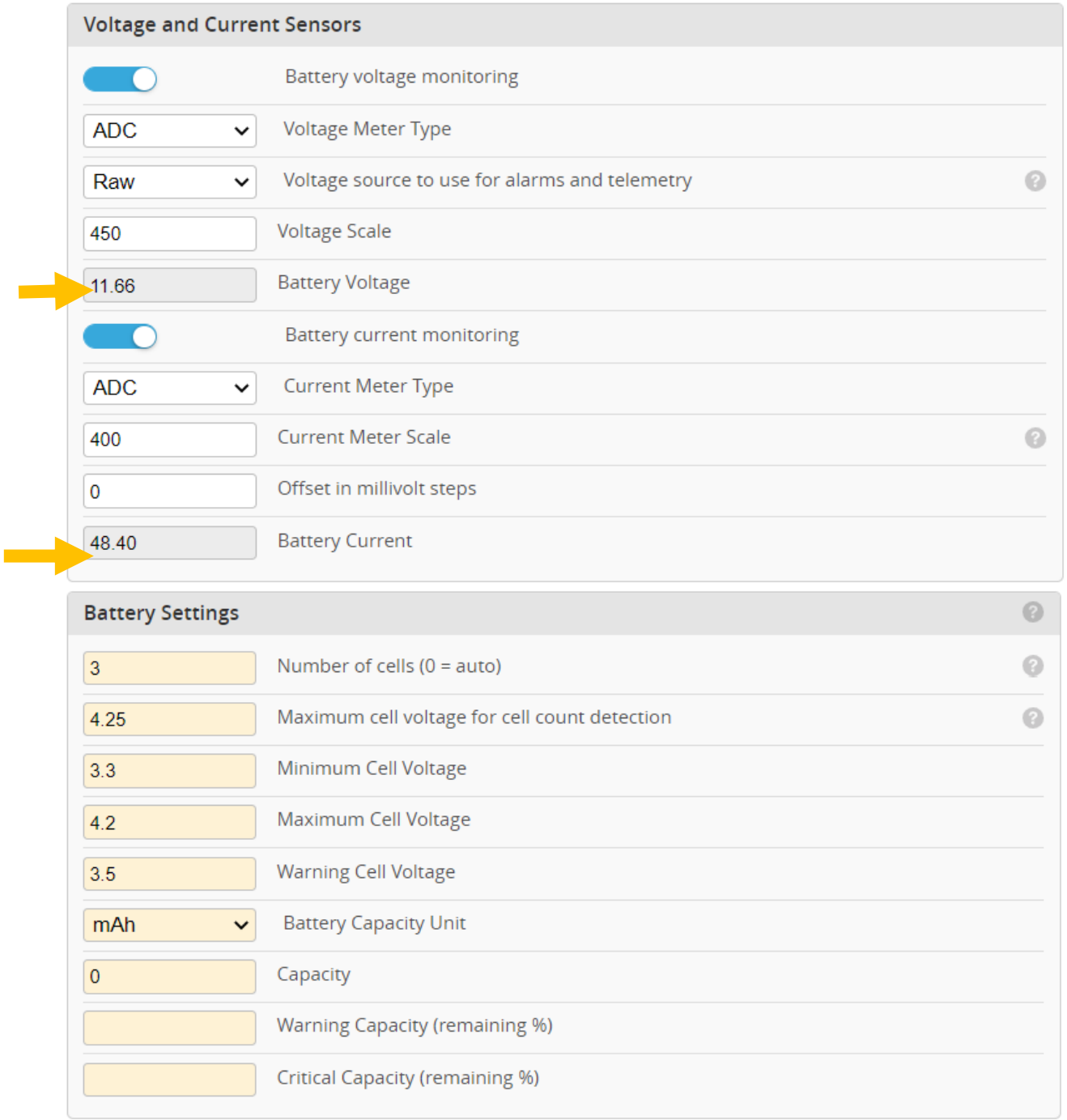
Battery Current Monitoring (Current)

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



INERTIAL MEASURING UNIT MEASURING UNIT

Pls see the Board Specs Data sheets for the installed IMUs onboard

Magnetometer

Barometer

This is the heart of every flight controller AKA the Main 4 ,

Gyro – stabilization on Roll Pitch Yaw Axis
Acc - Horizontal and Vertical stabilization XYZ
Baro – Altitude hold control
Mag – Heading and Compass

Accelerometer

Gyroscope

Each sensor has a corresponding address registry set by manufacturer

You can find it on sensors.ccp tab

PID Tuning

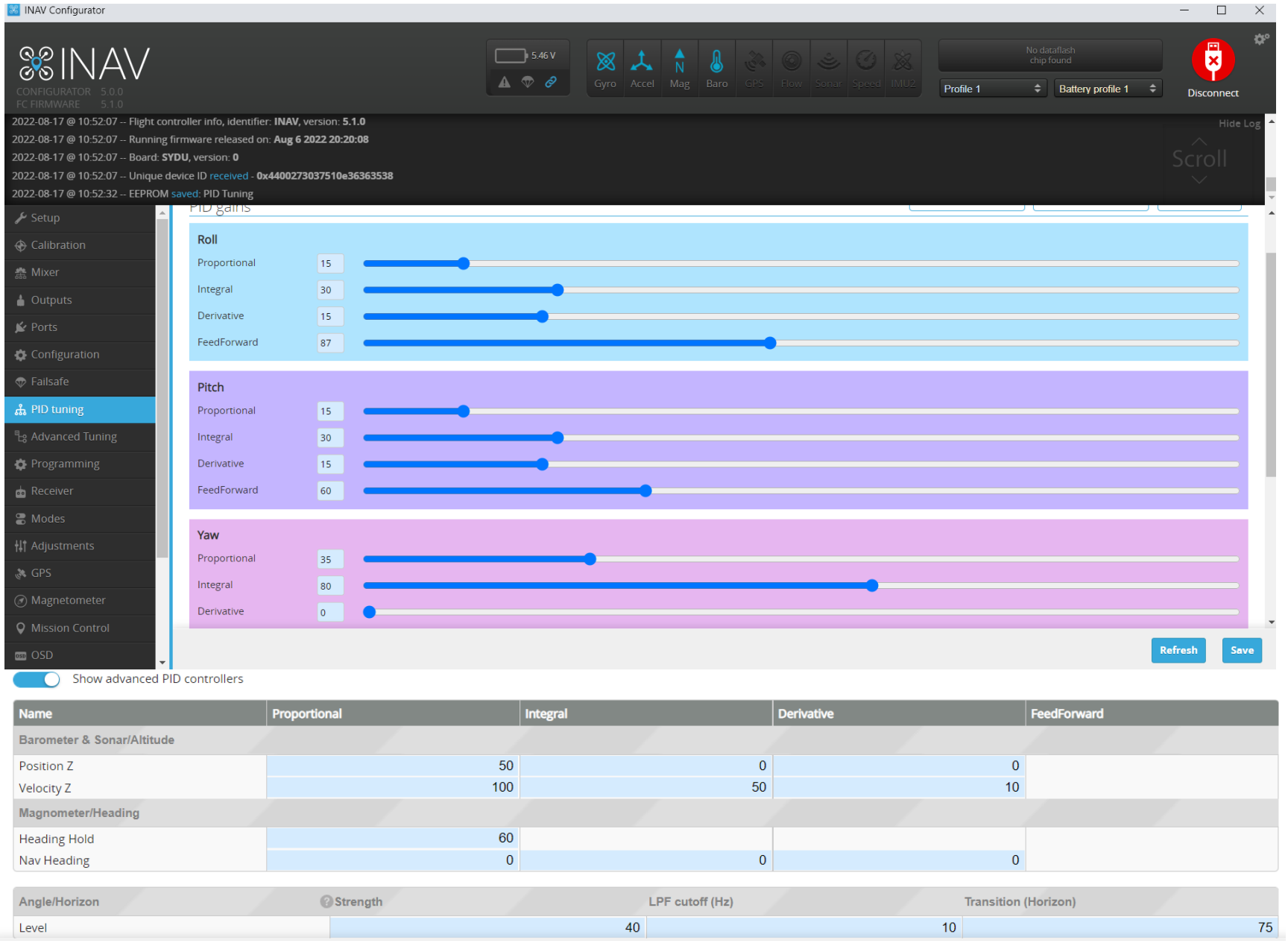
Synerduino Mini KWAD PID

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

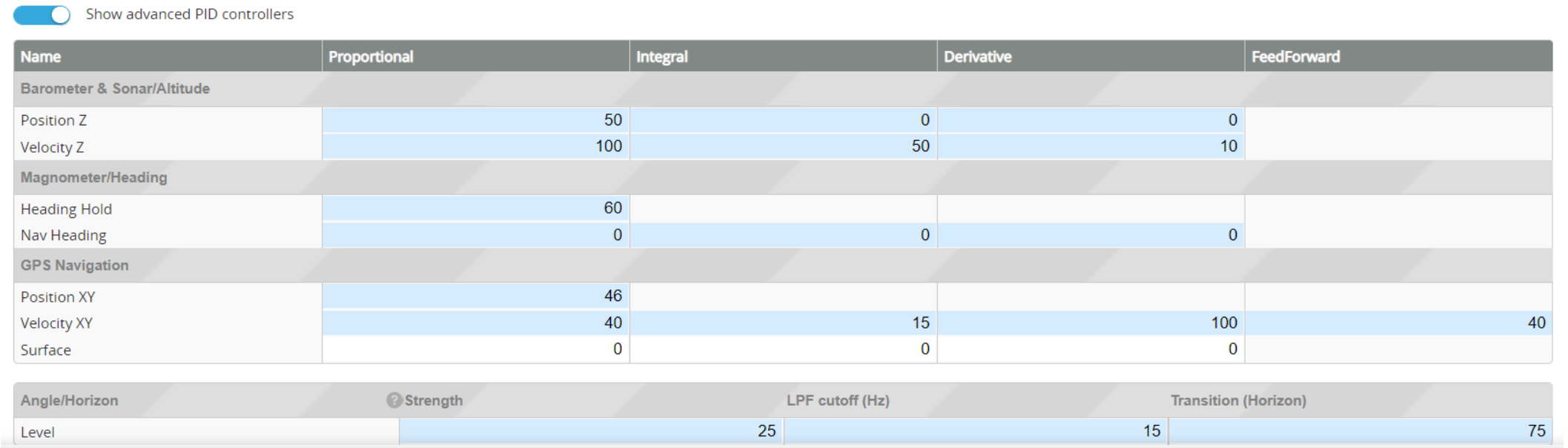
ANGLE/HORIZON
Strength 40
LPF Cutoff (Hz) 10
Transition (Horizon) 75



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

ADVANCE PID CONTROLLERS

Synerduino Mini KWAD PID



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

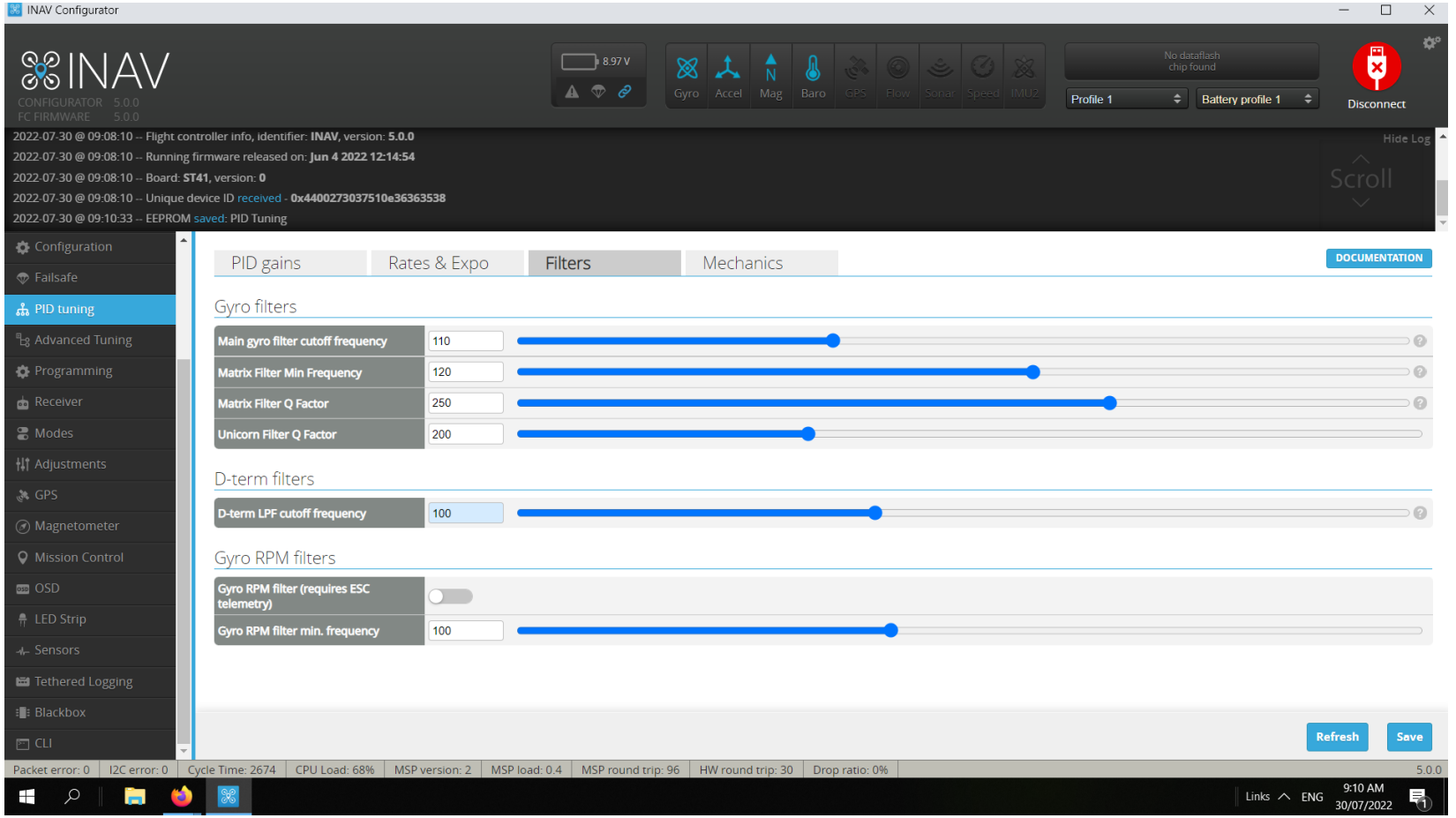
- Position XY – this is the streght of the responds to hold position (too thigh it would over correct , too low it would under responds)
- Velocity XY – how fast it would respond to the deviation
- Surface XY – works with optical sensor

Angle / horizon

- Level – how quick the drone returns to level flight

PID TUNING

Filters adjustment for Sensor respond rate



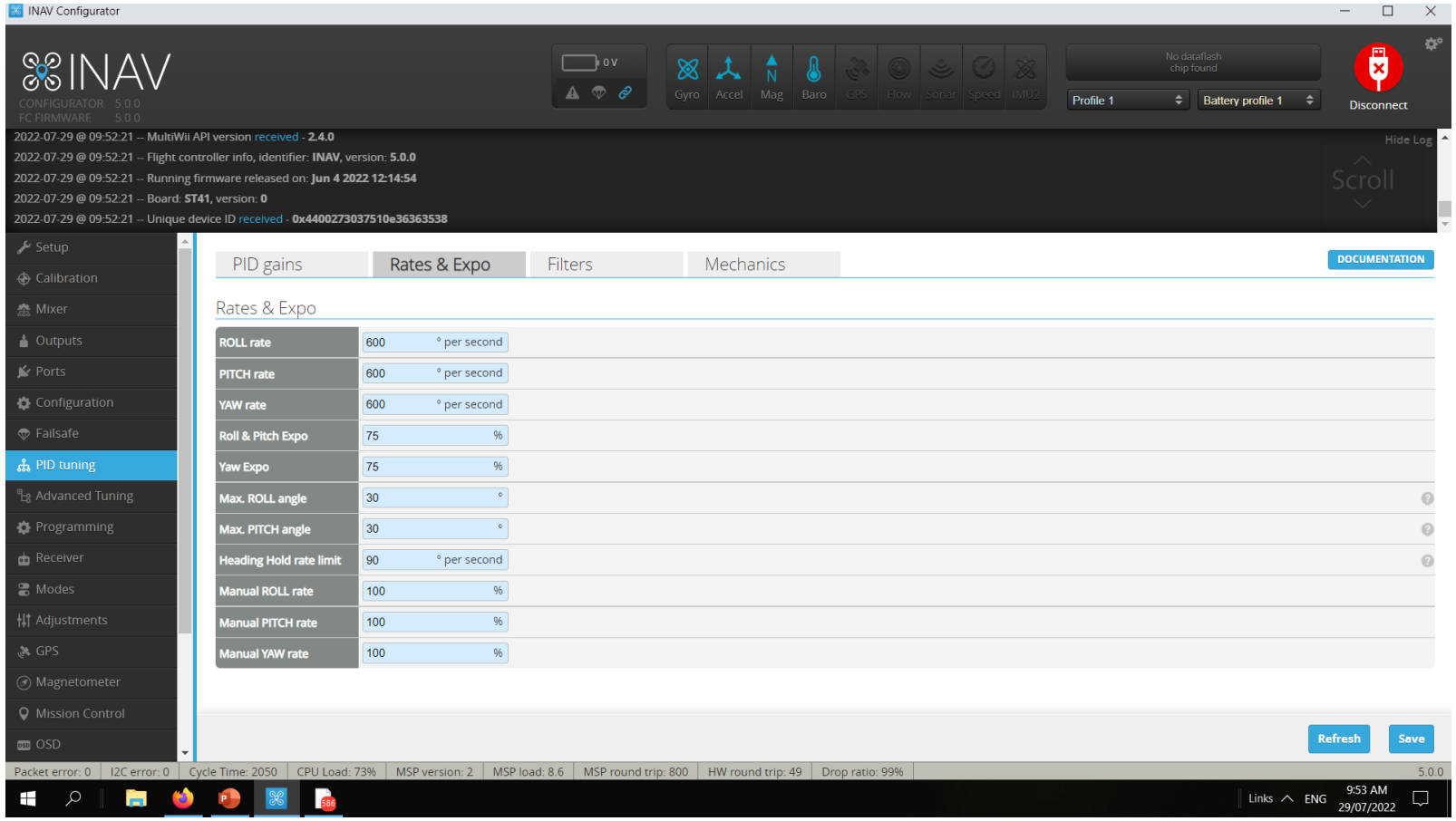
PID TUNING

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)

ADVANCE TUNING

Advance tuning for all navigational settings

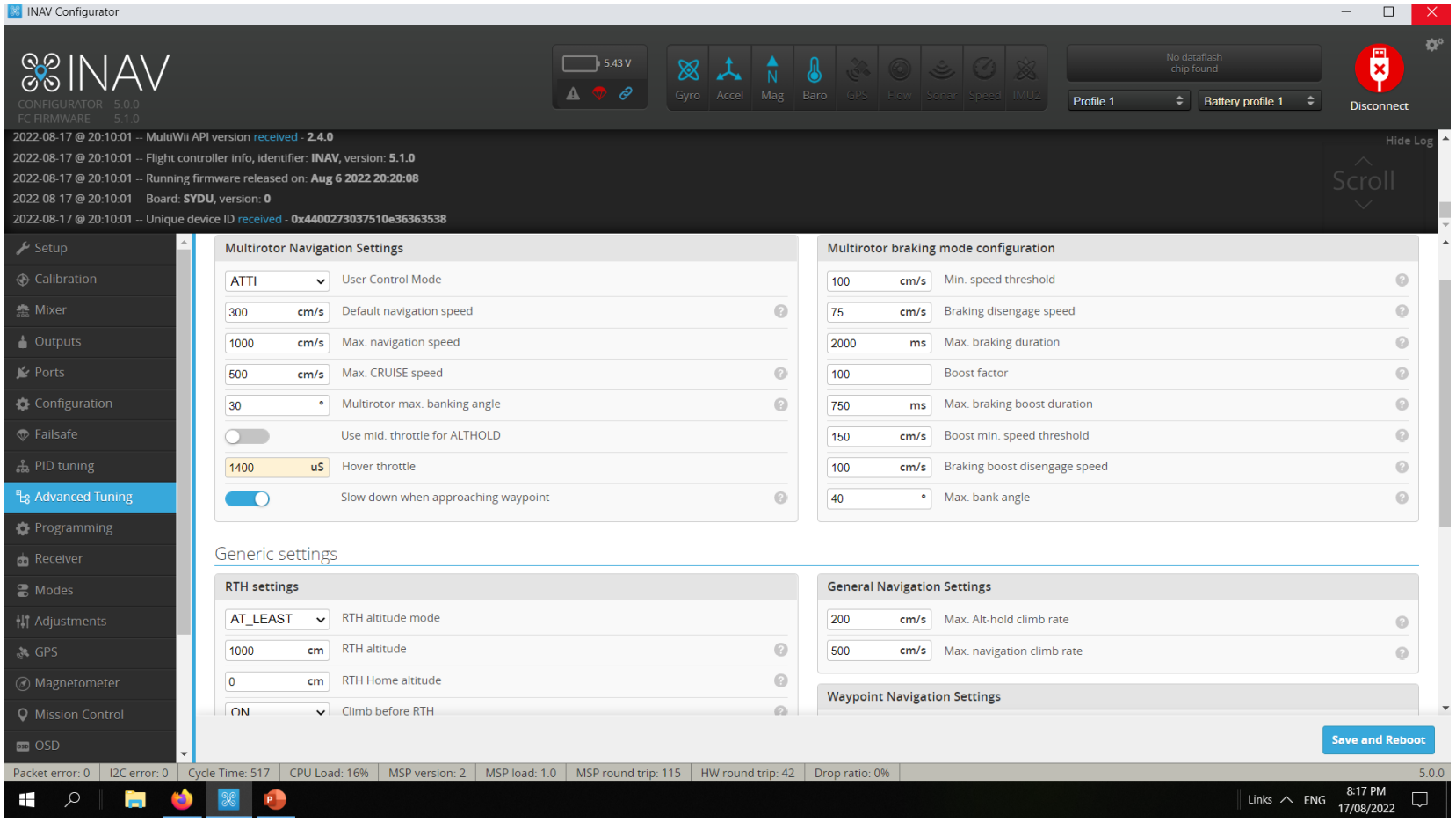
Recommended changes for Synerduino 250mm Quad

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



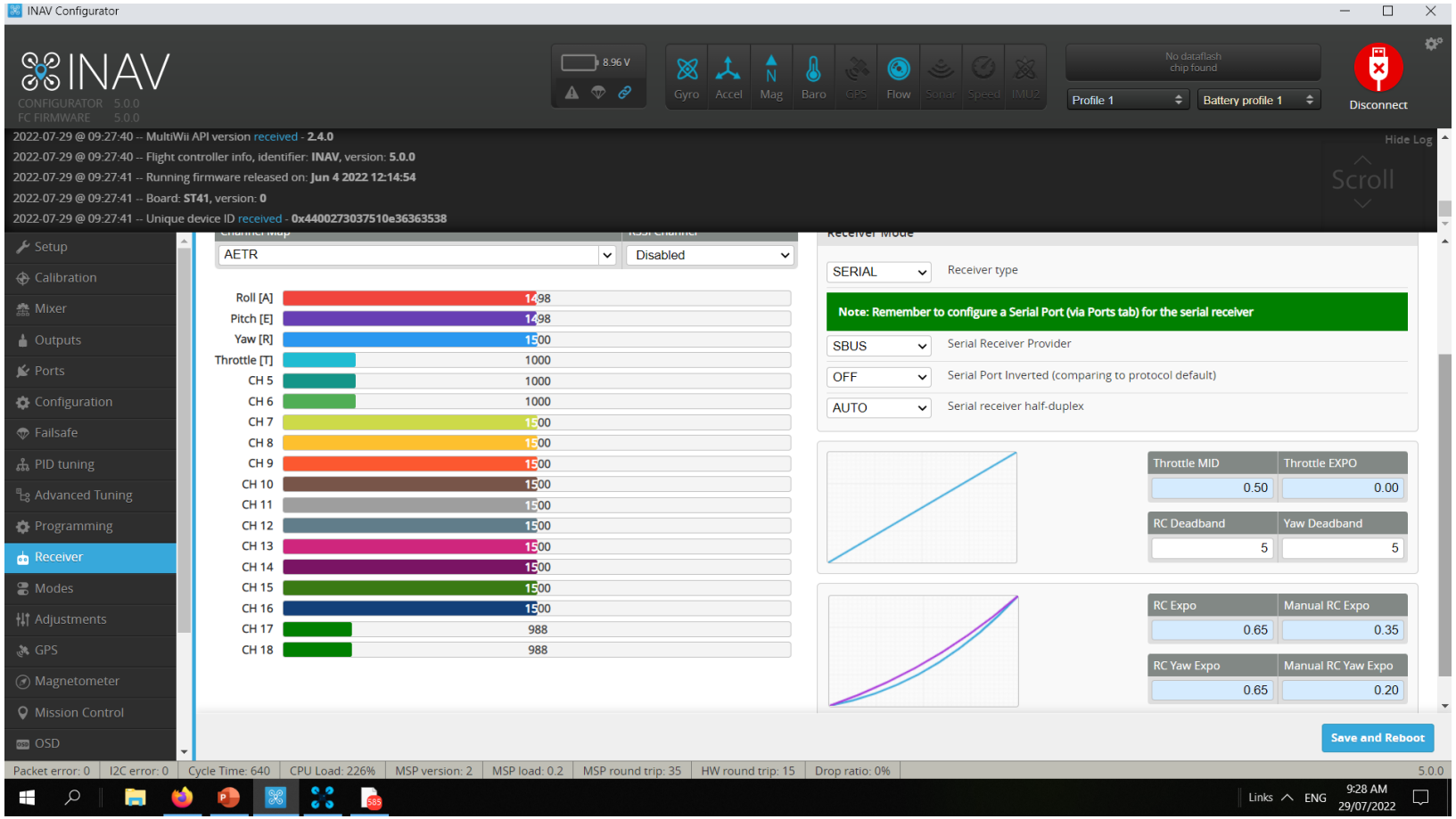
RECEIVER

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

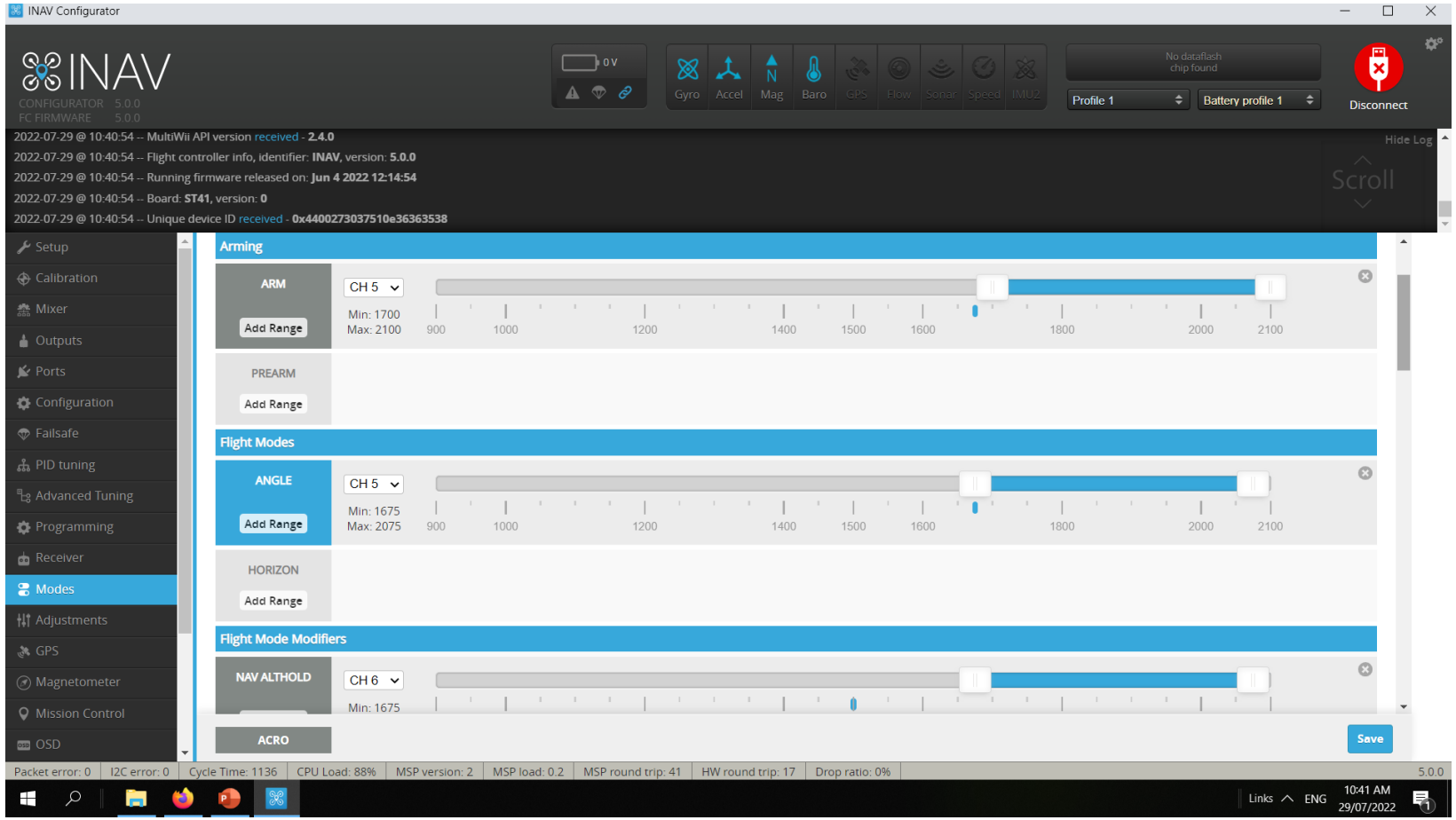
Also to adjust the Expo rate of your RC controls



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

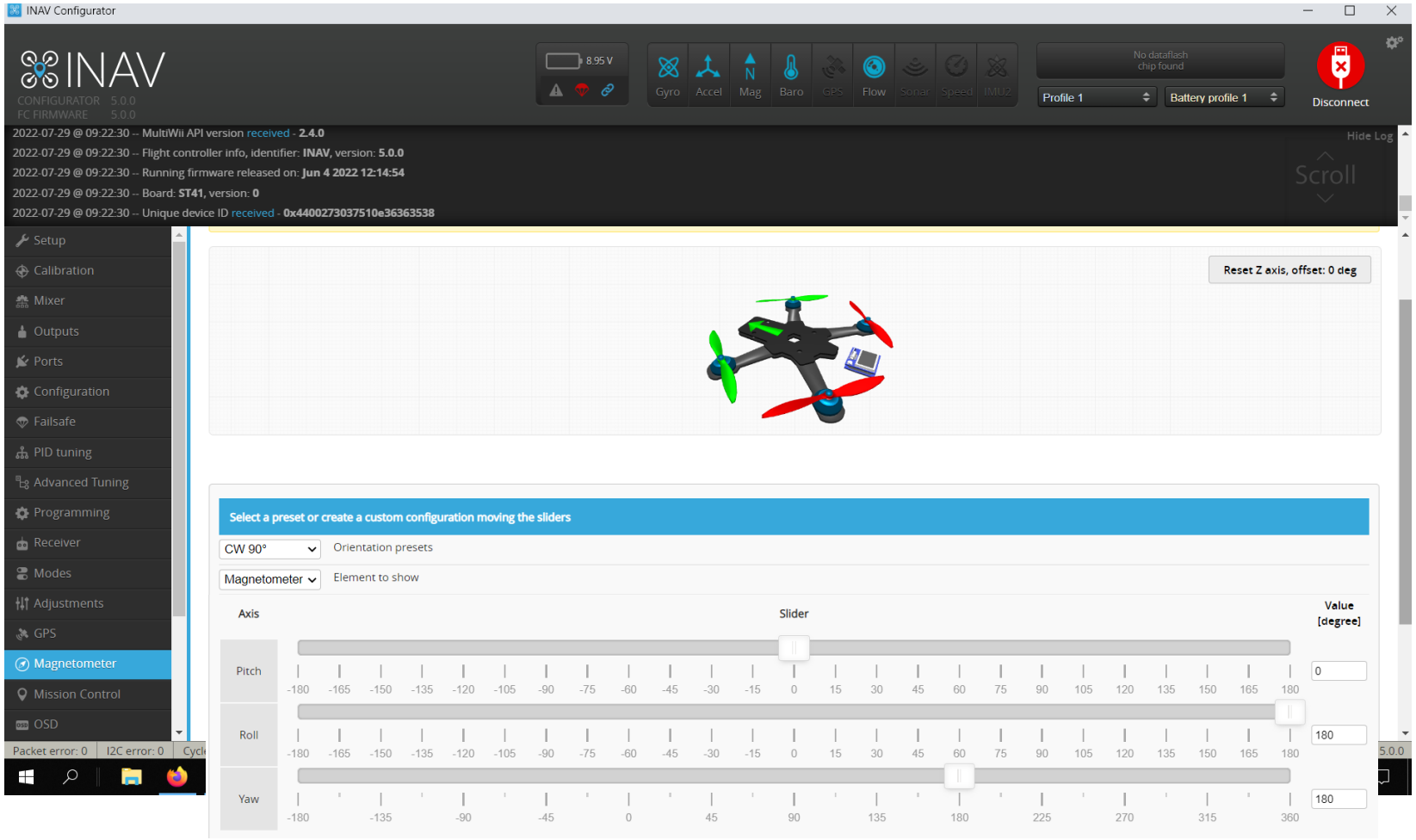
MAGNETOMETER

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

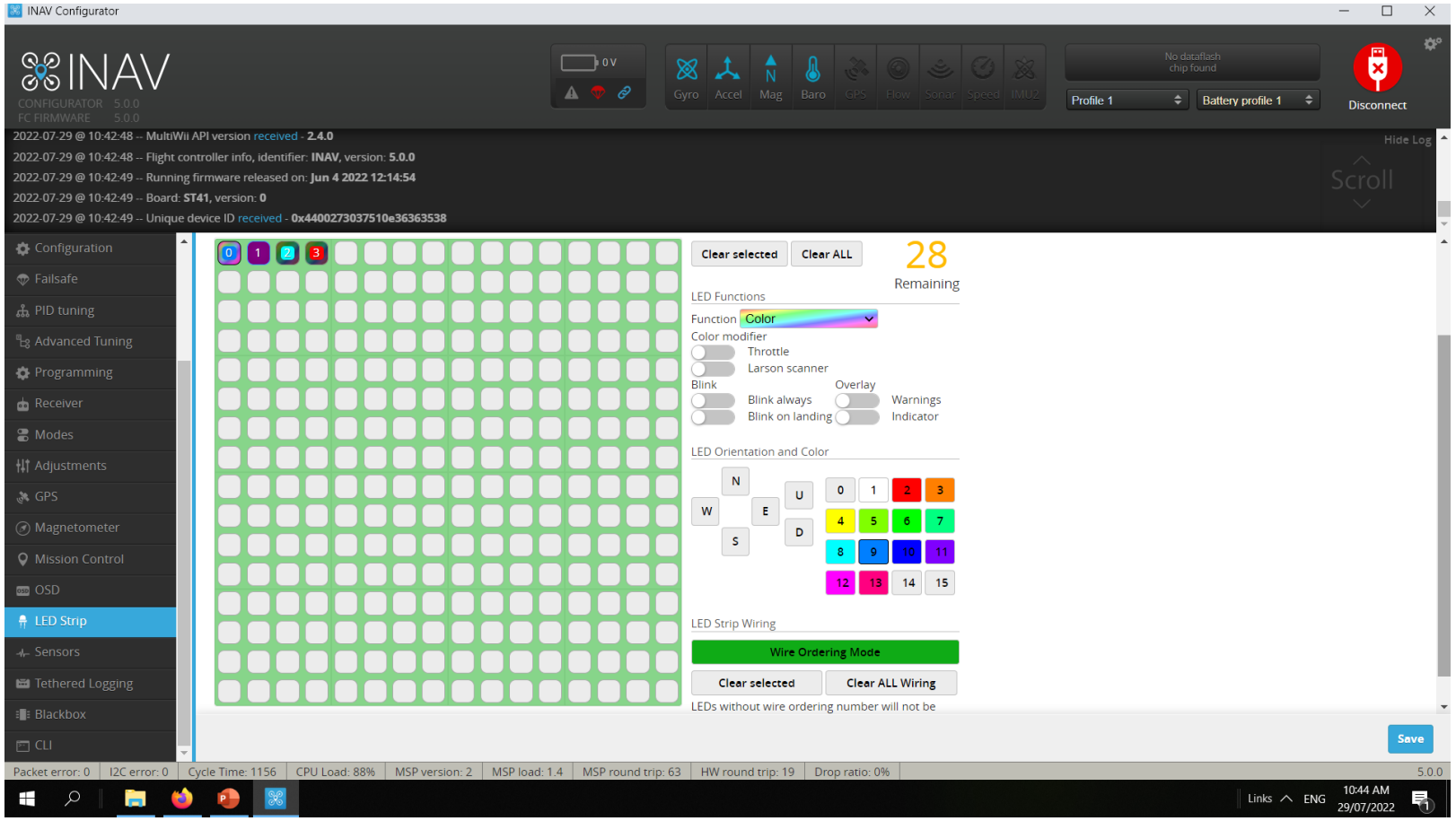
0 Degrees = North
90 Degrees = East
180 Degrees = South
270 Degrees = West



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

LED STRIP

WS2811/WS2812 – Led strip programming upto 32 LEDS

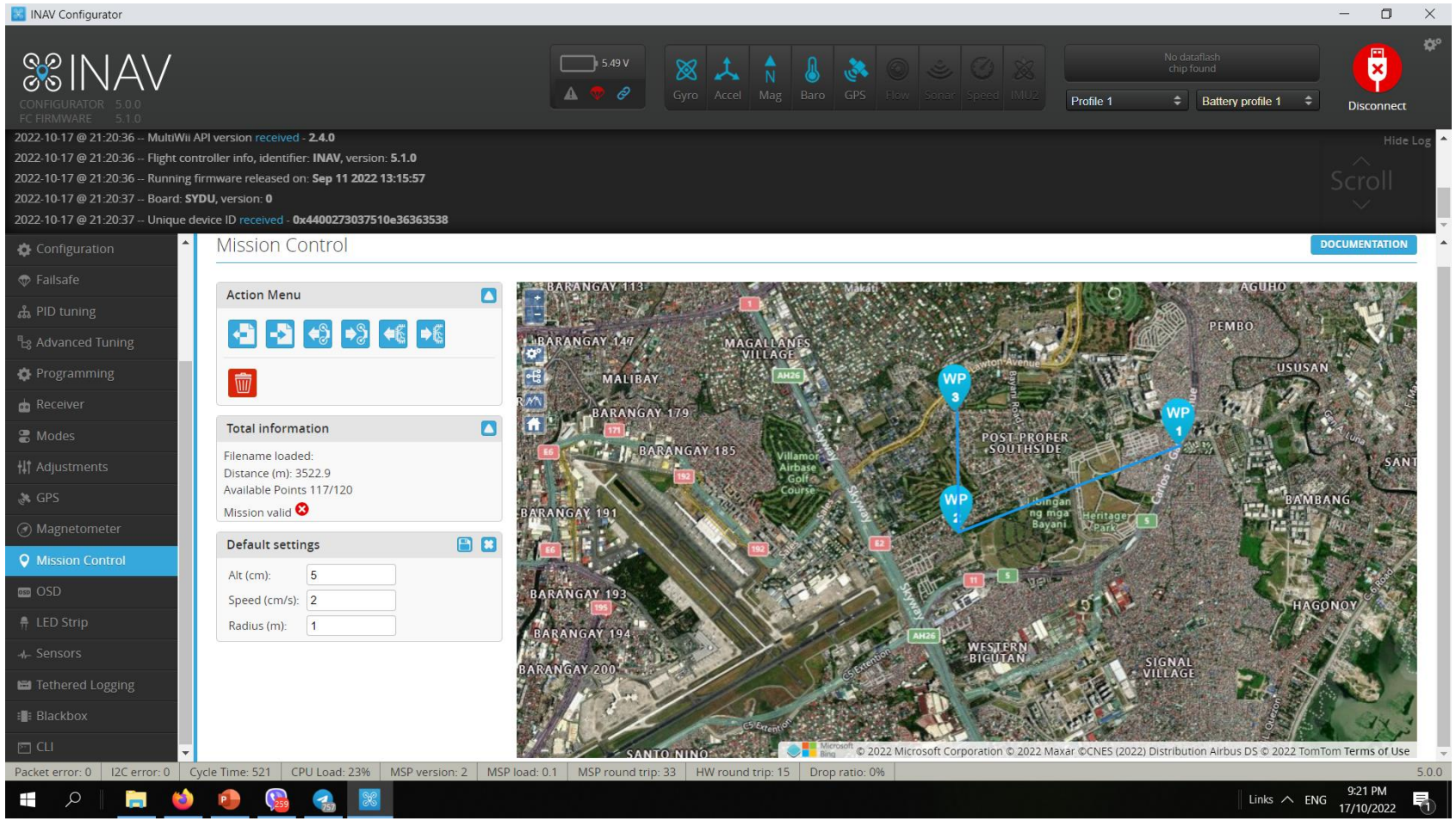


WS2811 – Led strip this needs to be activated on the Configure Tab before you can use this function

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)

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.



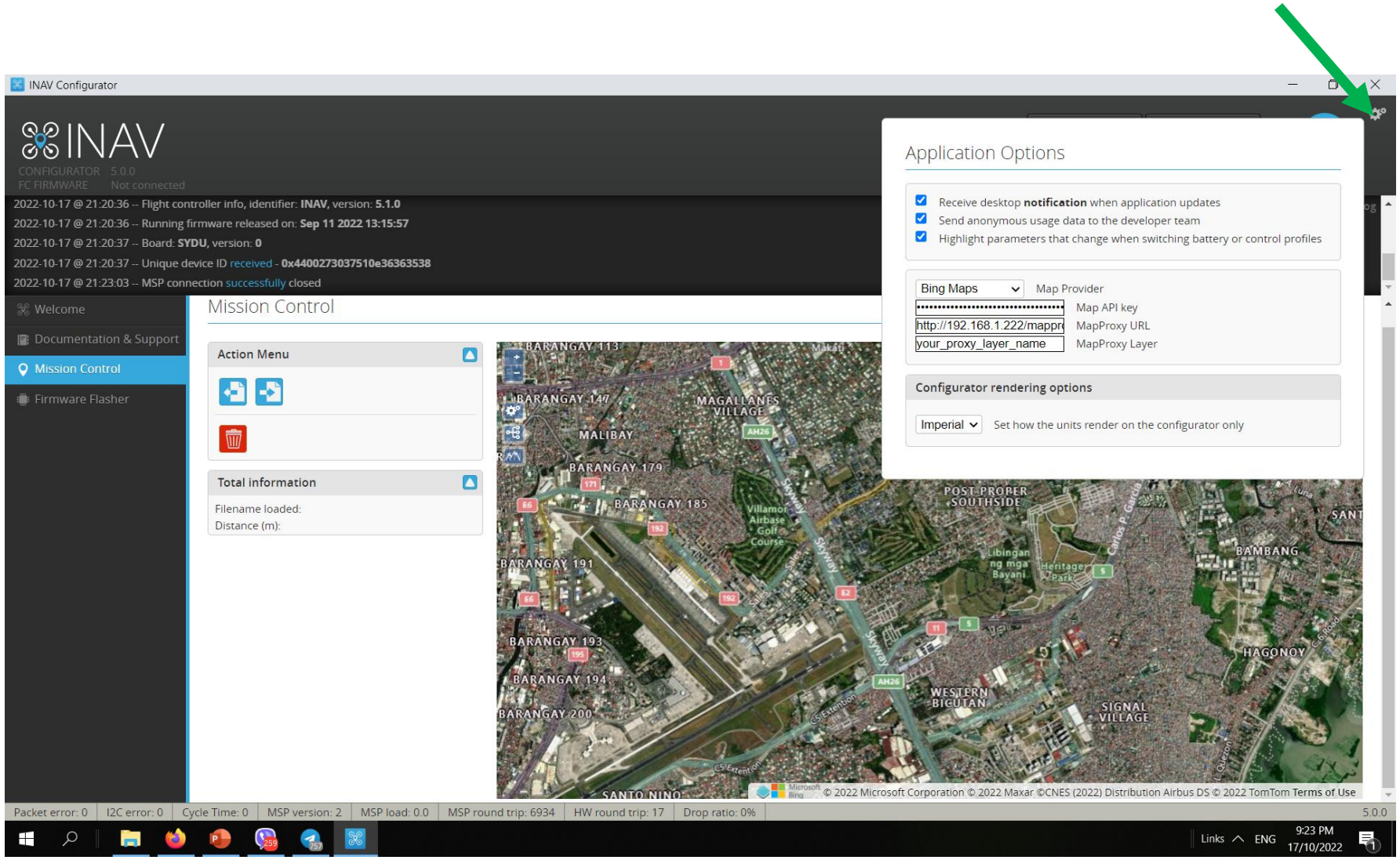
How to choose Map provider

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.

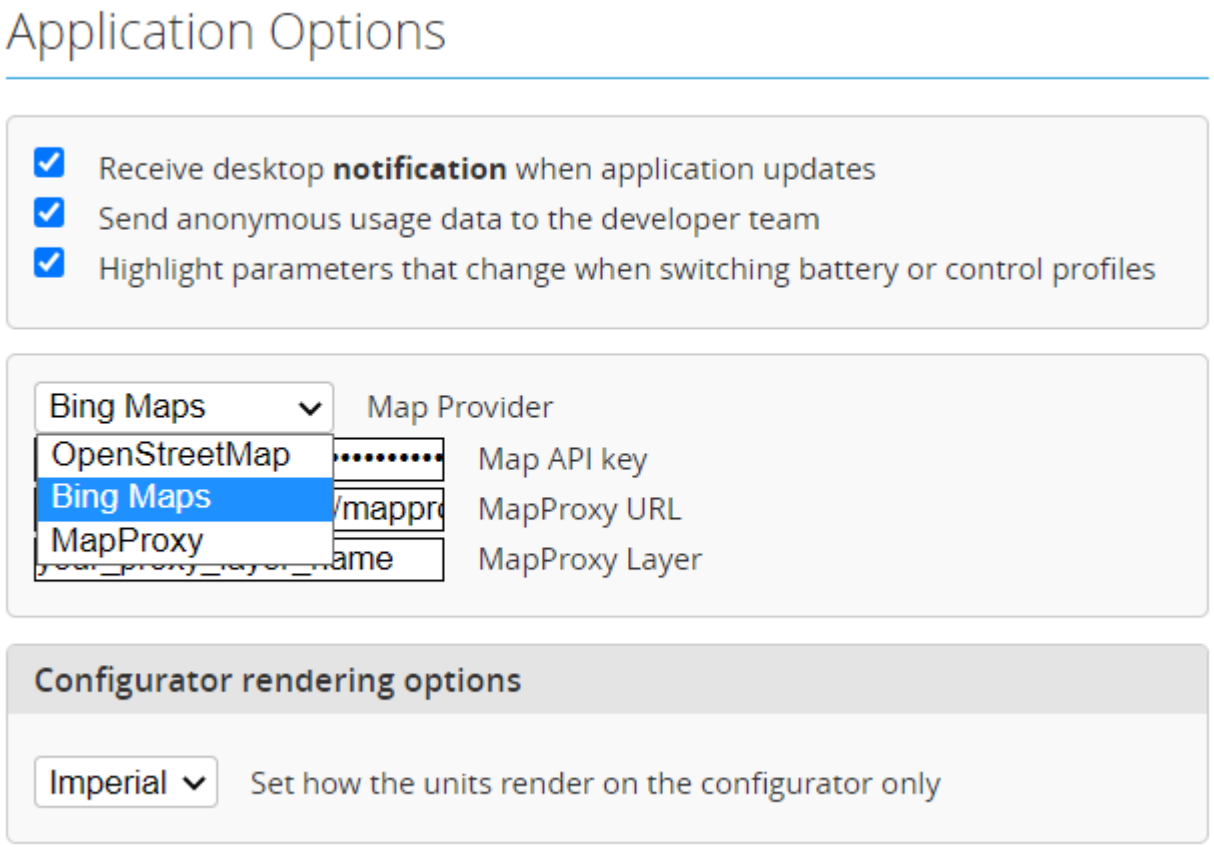
2.Select **My keys** under **My Account**.

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.

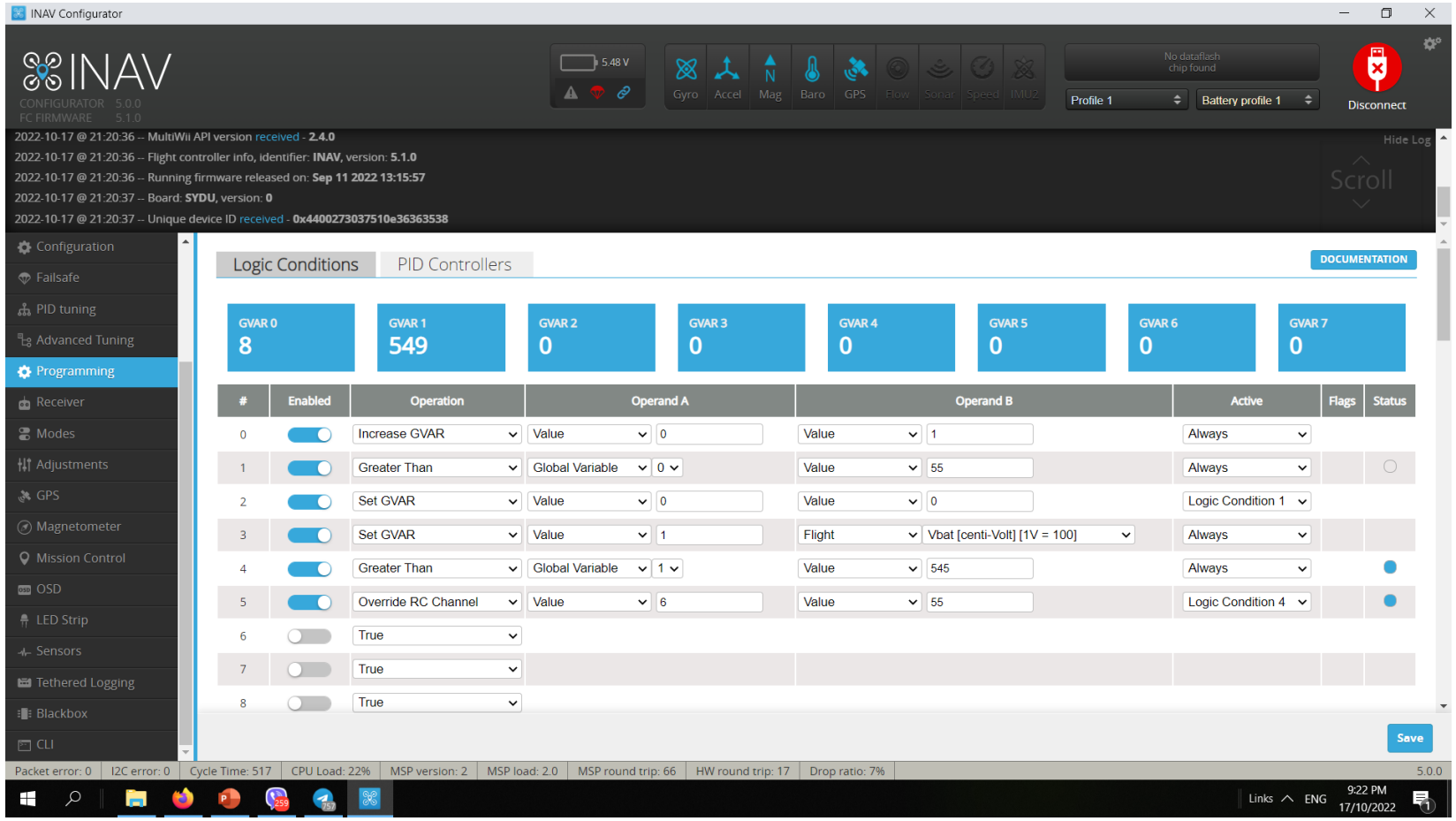
5.Click the **Create** button. The new key displays in the list of available keys. Use this key to authenticate your Bing Maps application as described in the documentation for the Bing Maps API you are using.



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



CLI Command Line – Aircraft Status

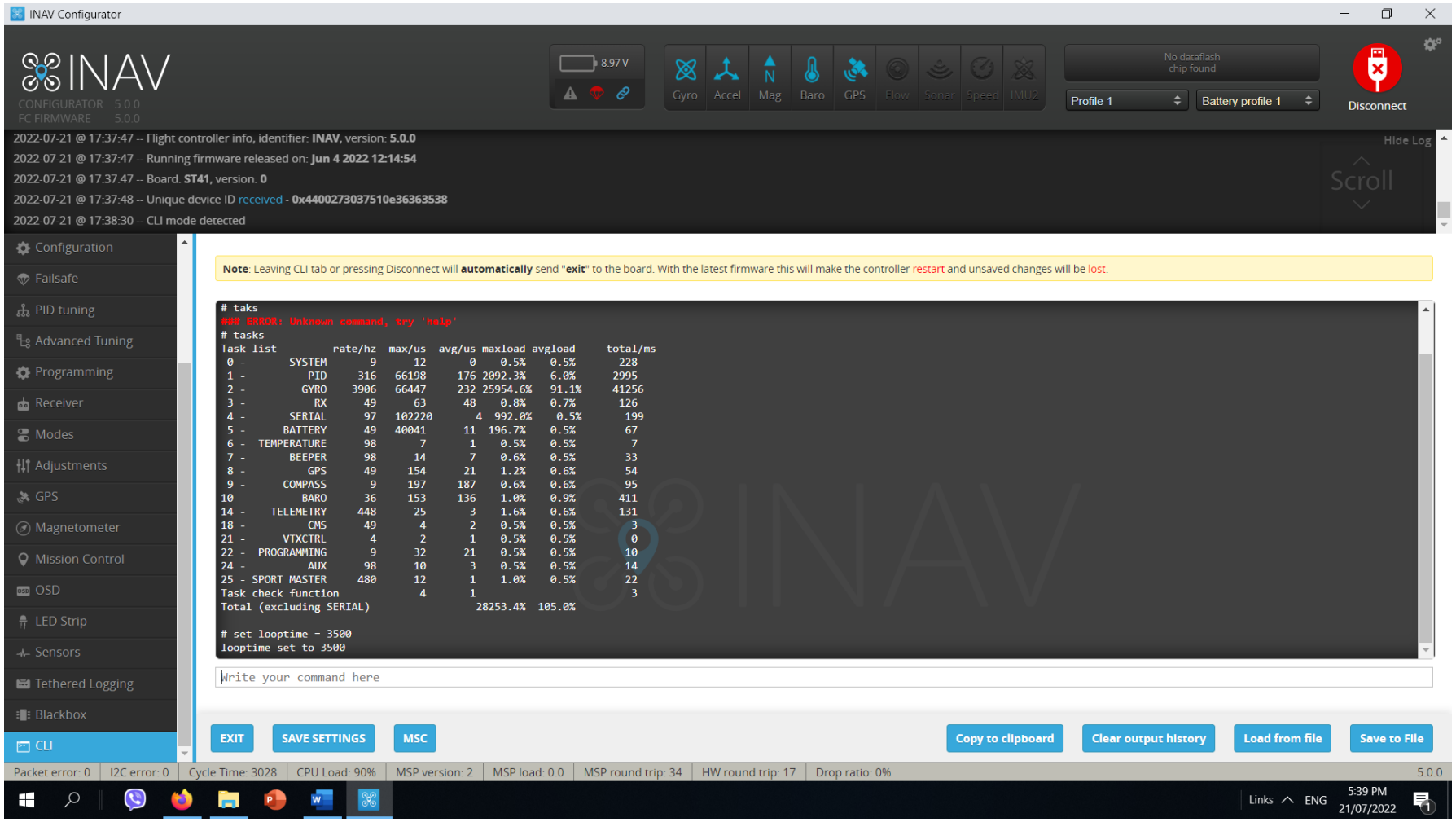
This is where you can import PID setting , check status or Adjust parameters

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
DSHOTBEEPER	20000000	DSHOTBEEPER is enabled and is active

INAV will refuse to arm for the following reasons (e.g. from cli status**):**

Type Status on the CLI to find the cause

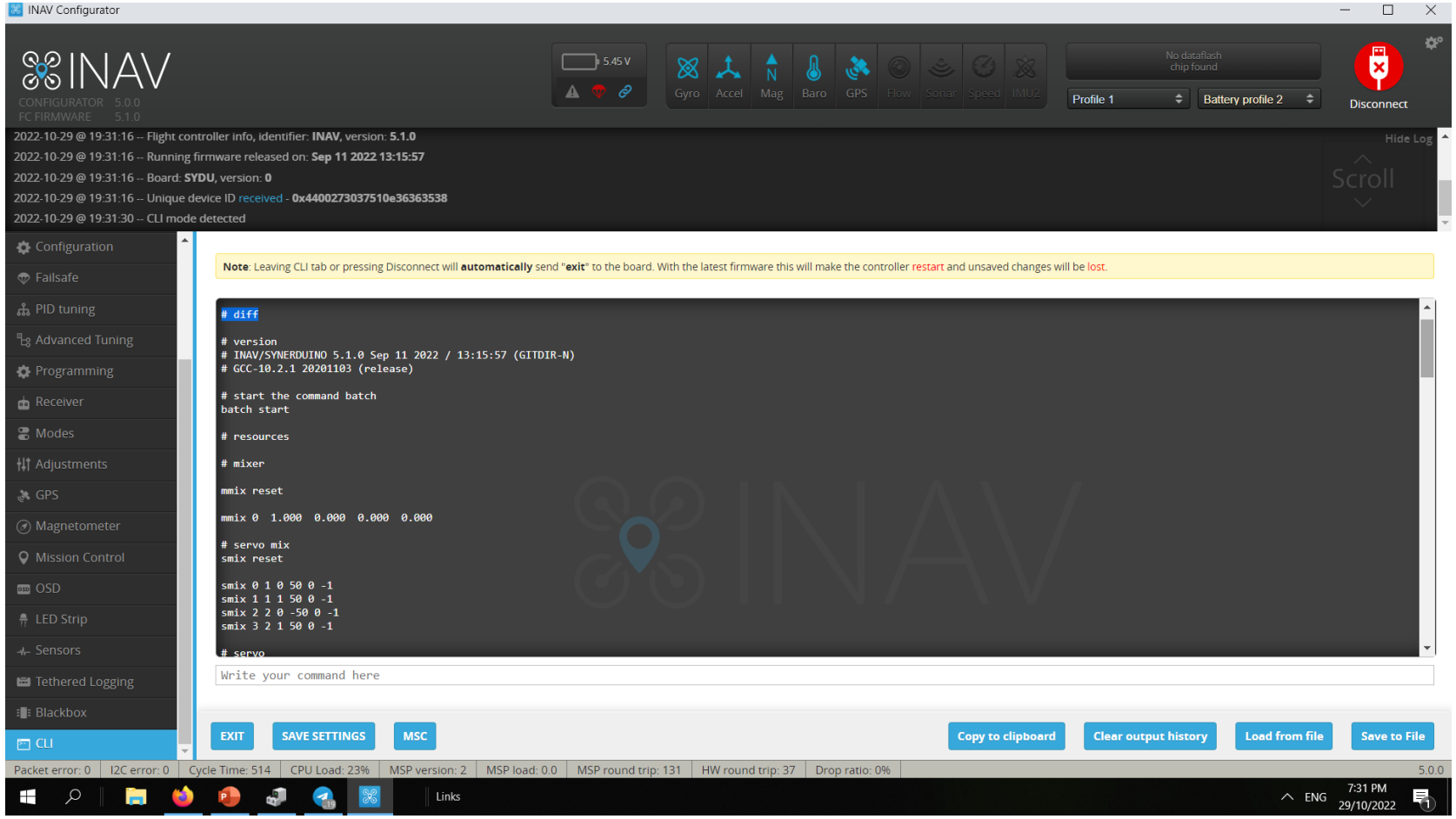
CLI Command Line Saving and Loading Parameters

You can download the Preset DIFF for the Synerduino STM Synerduino STM page [Synerduino DIFF 6.0.0] [Synerduino diff all-5.1.0]

- 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

CLI Command Line Trimming the Roll and Pitch Alignment

Sometimes no matter how well you calibrate

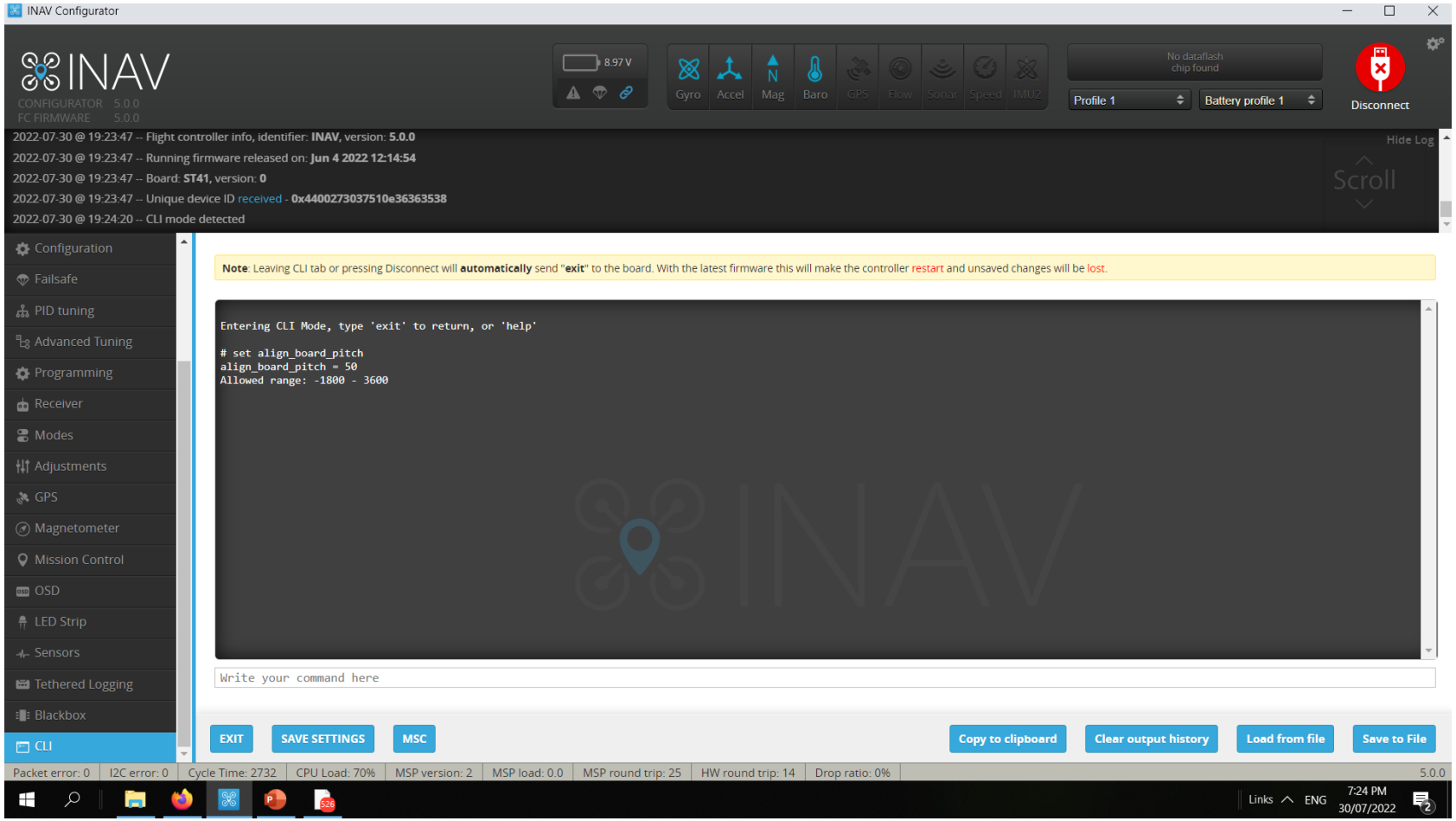
Your aircraft may drift when your on neutral sticks

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



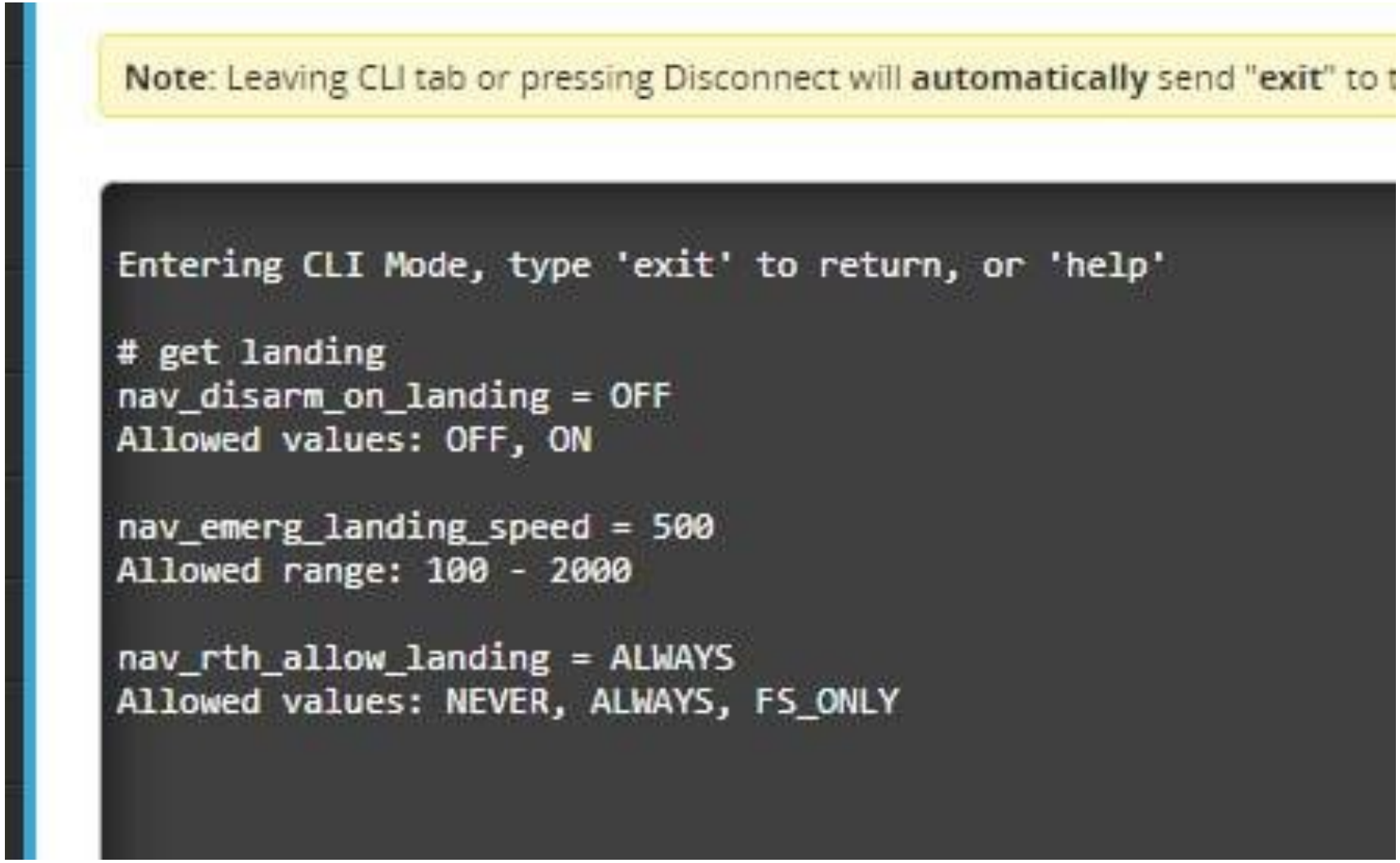
CLI Command Line Landing setting

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



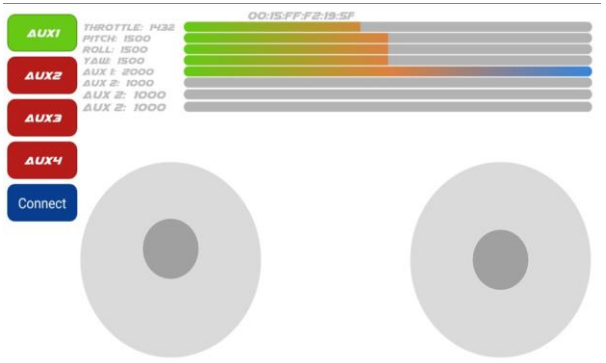
For users who wish to control this drone using the Synerduino APP

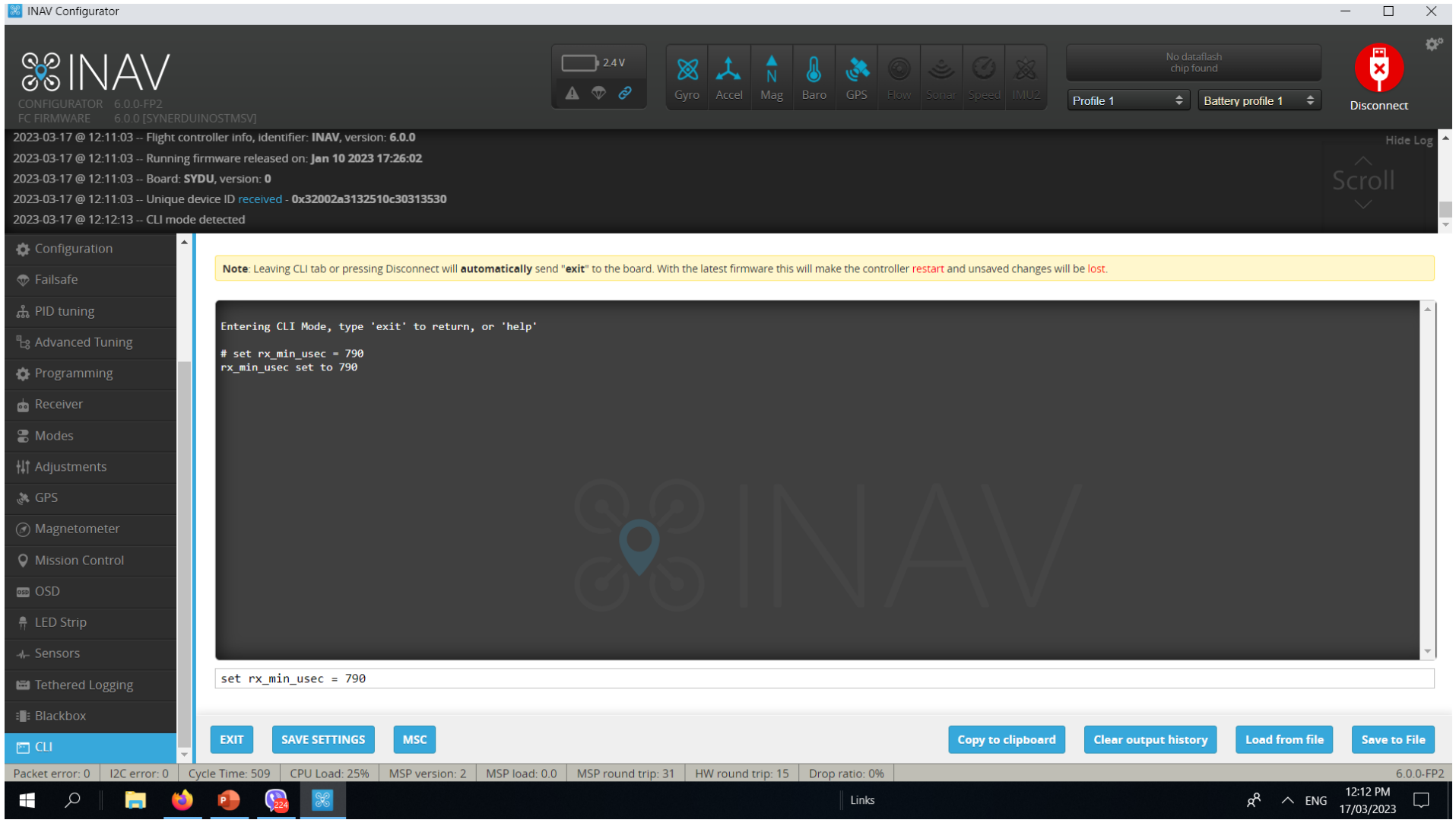
set rx_min_usec = 790

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





CLI Command Line GPS setting

Its important to set this correctly to ensure proper GPS flights

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

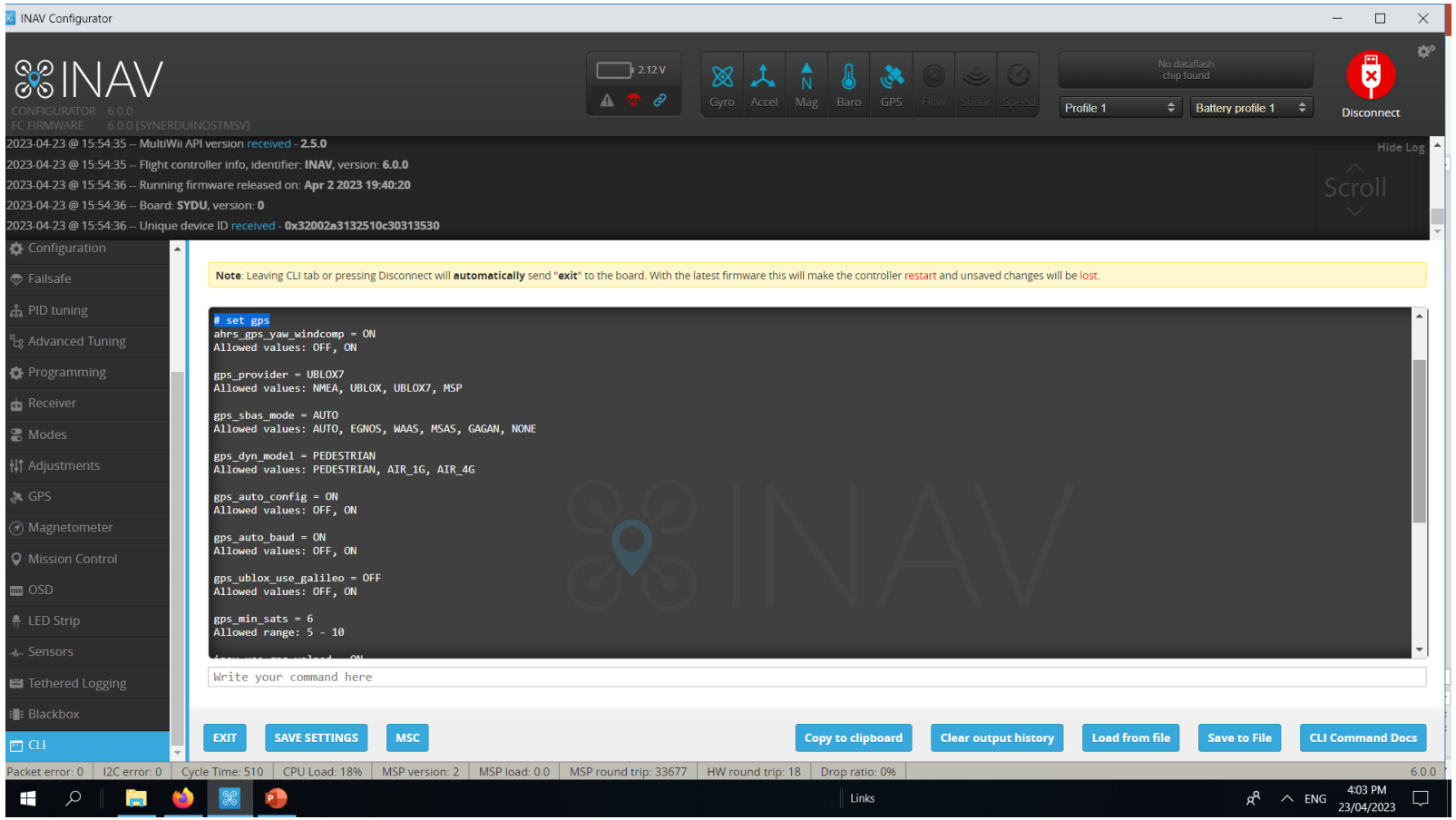
gps_auto_baud = ON

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

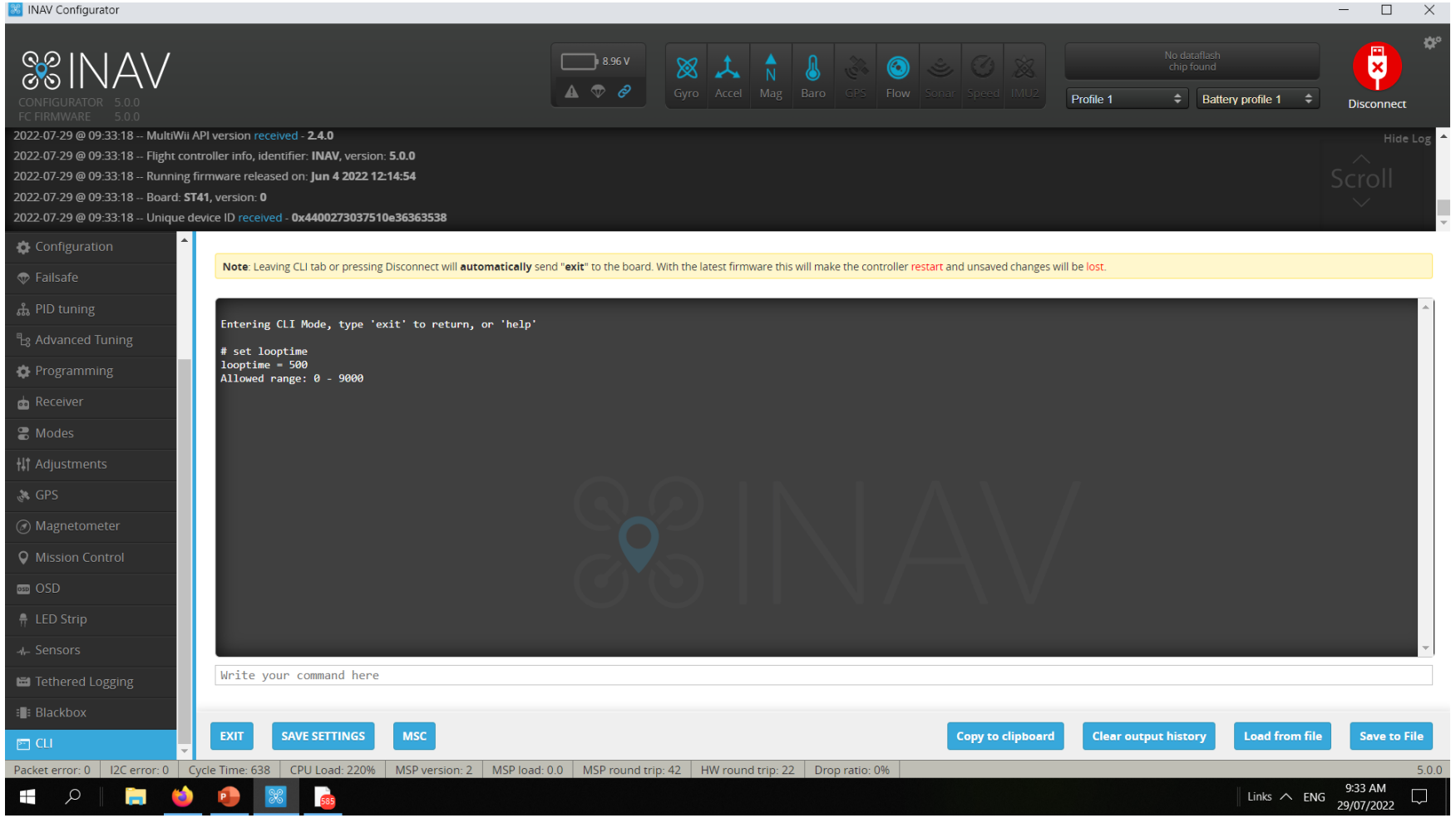
inav_use_gps_no_baro = OFF
turning this on would make your drone rely on GPS altitude instead of Baro – meaure above sea level instead relative to bootup



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

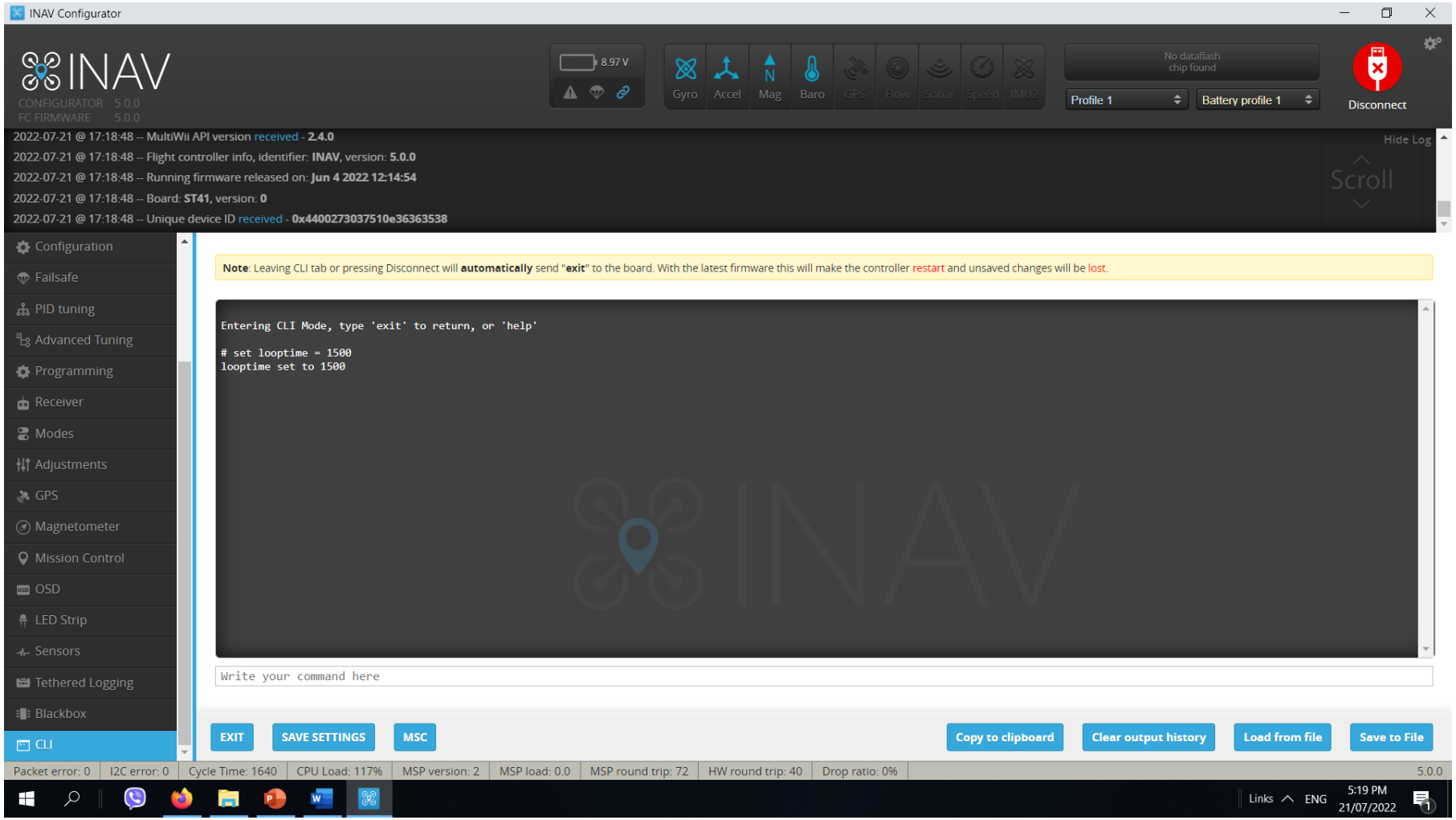
Looptime – Default 500 but you can get as slow as 2000 in worst case scenario



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

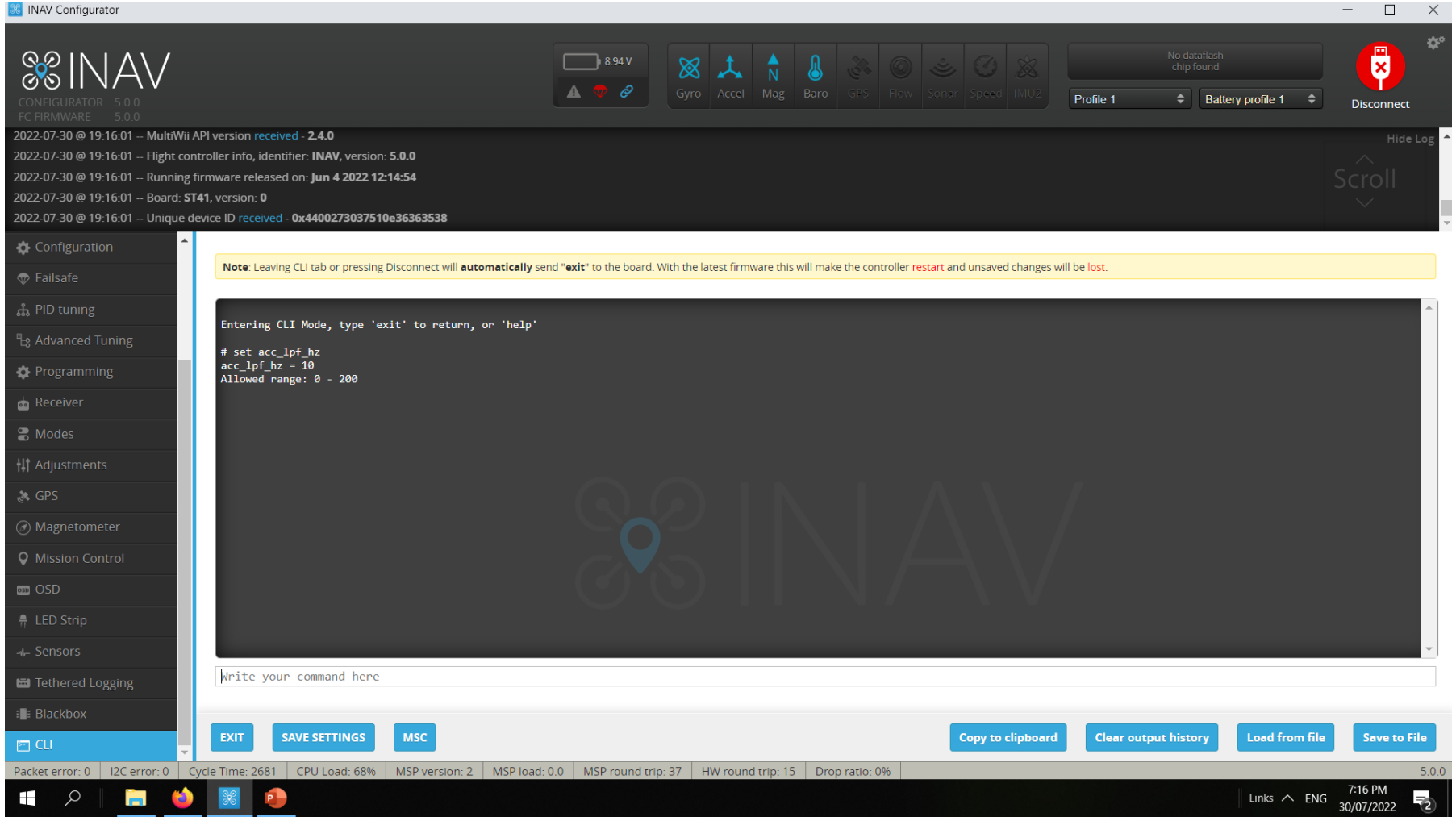


CLI Command Line – Low Pass Filter

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



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