General Build Guide

Synerduino Ardu 2560

Fixwing

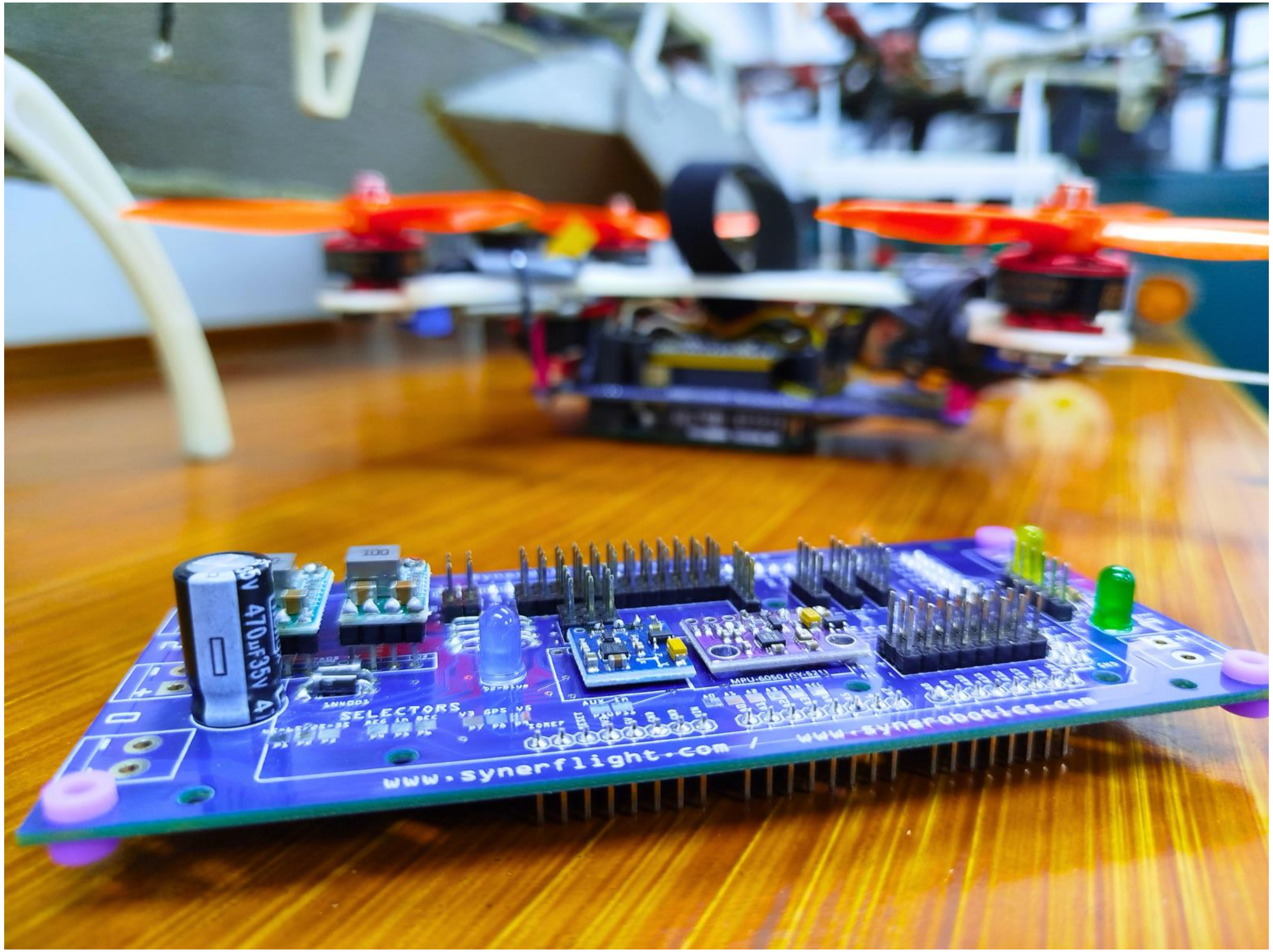
Latest Version - 2024

For more Information:
www.synerflight.com

TABLE OF CONTENTS

INTRODUCTION

Synerduino Ardu 2560 brings back the classic feel of Arduino, reminiscent of the 2012-2014 era. With its compatibility with the iconic 2560 board and the Arduino IDE, configuring your projects through Sketch .ino files has never been more straightforward. Built on top of the widely used Arduino boards, Synerduino Ardu 2560 is designed with the academic environment in mind, making it a perfect choice for educational and hobbyist projects alike.



SYNERDUINO ARDU 2560

ABOUT THE BOARD

Power

- Input Voltage from Arduino Board: 3.3-5V
- PWM Power Rail Regulated – 5V at 1.5A
- Drone Power Input Voltage – 12.6V (3S) or 25.2V (6S)
- Power Distribution Lines – 80A

Properties

- Dimensions: 128 x 62 x 28 mm LWH / (V1.1)135mm x 62mm x 28mm
- Weight: 46.1g
- 4 Solder Pads for 4 ESCs and Motors
- 15 3-Pin Digital Headers
- 8 3-Pin Analog Headers
- 5 4-Pin Serial Headers

Sensors

- Gyroscope + Accelerometer: MPU6050
- Magnetometer: QMC5883 / HMC5883
- Barometer: BMP280

BOARD VERSIONS

Synerduino Arduino Shield V2 -2024

- **MPU9250**
- **QMC5883**
- **BMP 280**

Synerduino Kwad Shield V1 -2021

- **MPU9250**
- **MAG 9250**
- **BMP 180**

Synerduino Kwad Shield Beta -2020

- **L3G4200D**
- **ADXL345**
- **BMP 180**
- **MMC5883**

PIN LAYOUT

Aux ADC in

Description: Auxiliary input for connecting additional sensors or components that output analog signals, allowing the board to read and process external analog data.

Note: *Input Voltage: 3.3-5V*

ESC / Servo PWM Out

Description: These are 36 PWM (Pulse Width Modulation) output pins used to control the motors through ESCs (Electronic Speed Controllers) or servos.

Serial Pins

Description: These are 12 serial pins for communication with external devices or modules like GPS or telemetry systems using a UART interface.

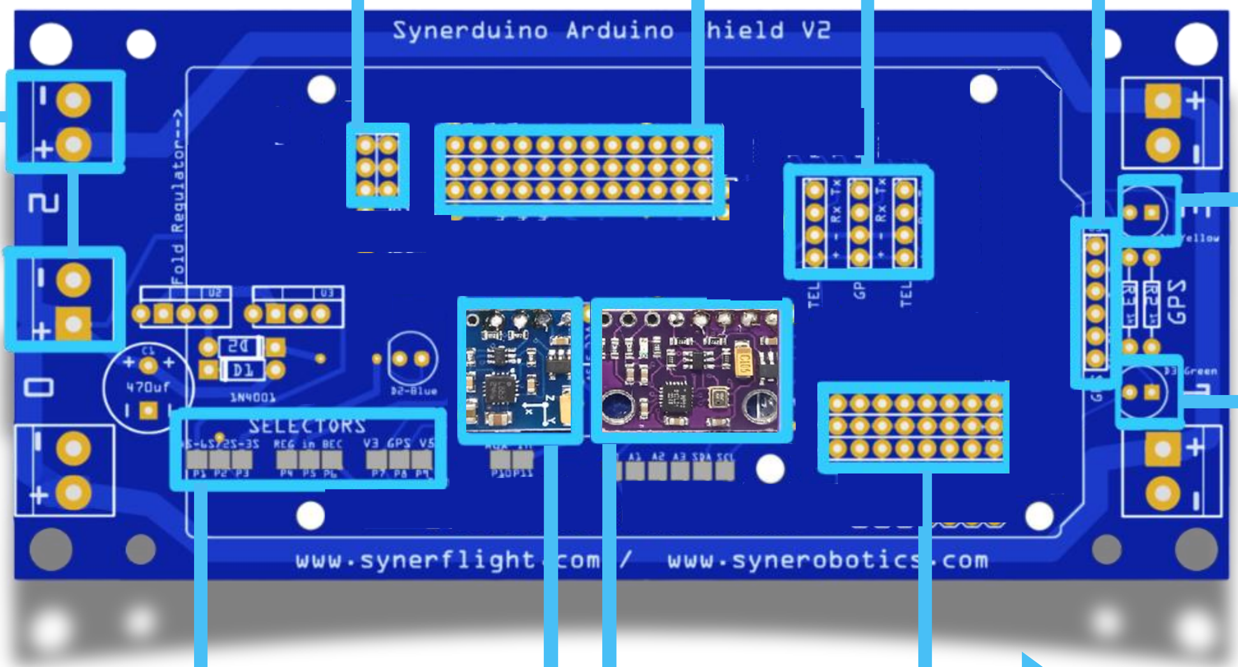
GPS Serial Pins

Description: These are 6 dedicated pins for connecting a GPS module's TX and RX (Transmit and Receive) lines for serial communication.

Power Input

Description: This is the main power input for the board, designed for a 3-cell (3S) - 4-cell (4S) LiPo battery - 11.1V and 14.8V respectively. It powers the ESCs, servos, and other components on the board.

Soldering Note: ESCs should only be soldered on the top side of the board, ensuring the solder joints do not penetrate through to the bottom.



GPS LED

Description: This LED blinks or stays lit depending on whether the GPS is locked (has found satellites) or is searching for a signal.

Status LED

Description: A general-purpose status indicator for the board. It could be used to indicate power, initialization, or operational status.

Jumper Pads Selector Zone

Description: These are PWM (Pulse Width Modulation) output pins used to control the motors through ESCs (Electronic Speed Controllers) or servos.

MAG 5883

IMU MPU-9250

Note: *These modules may vary depending on the manufacturer or version. Some versions might use different sensor combinations that could exclude certain components, like the magnetometer.*

RC PWM In

Description: These are 24 pins which accept PWM signals from an RC (radio control) receiver, allowing manual control via an RC transmitter.

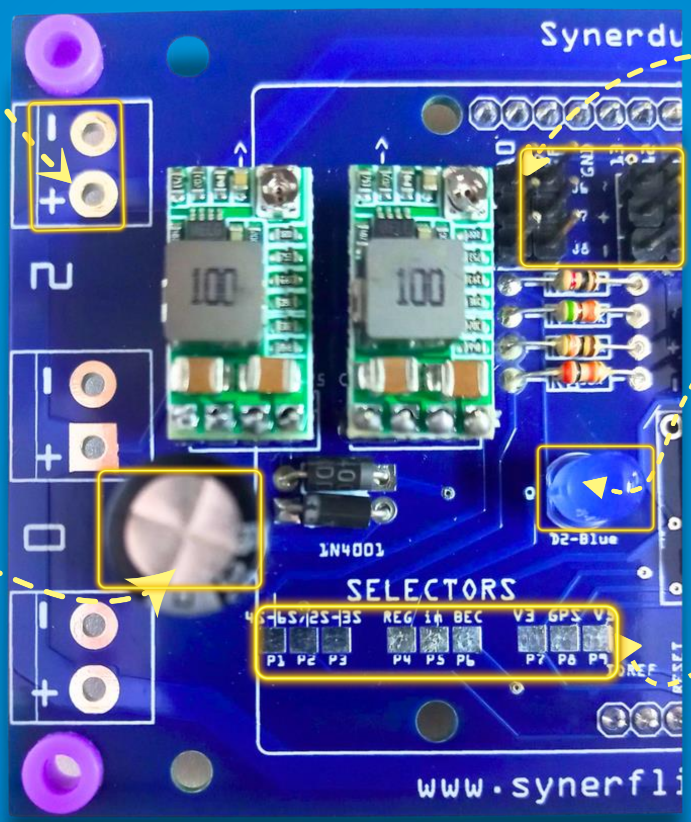
KEY FEATURES OF THE BOARD

Power Terminals (+ and -)

These terminals supply the voltage needed for the entire drone system, ensuring that the right amount of power is distributed across the board and connected components.

Capacitor

Ensures that power distributed to pins and components remains stable, reducing the risk of erratic behavior during flight due to power fluctuations.



GPIO and I/O Headers

Each pin corresponds to a specific function, such as reading throttle, aileron, elevator, and rudder signals from the receiver, processing sensor data, or controlling motors, making them critical for the drone's operation.

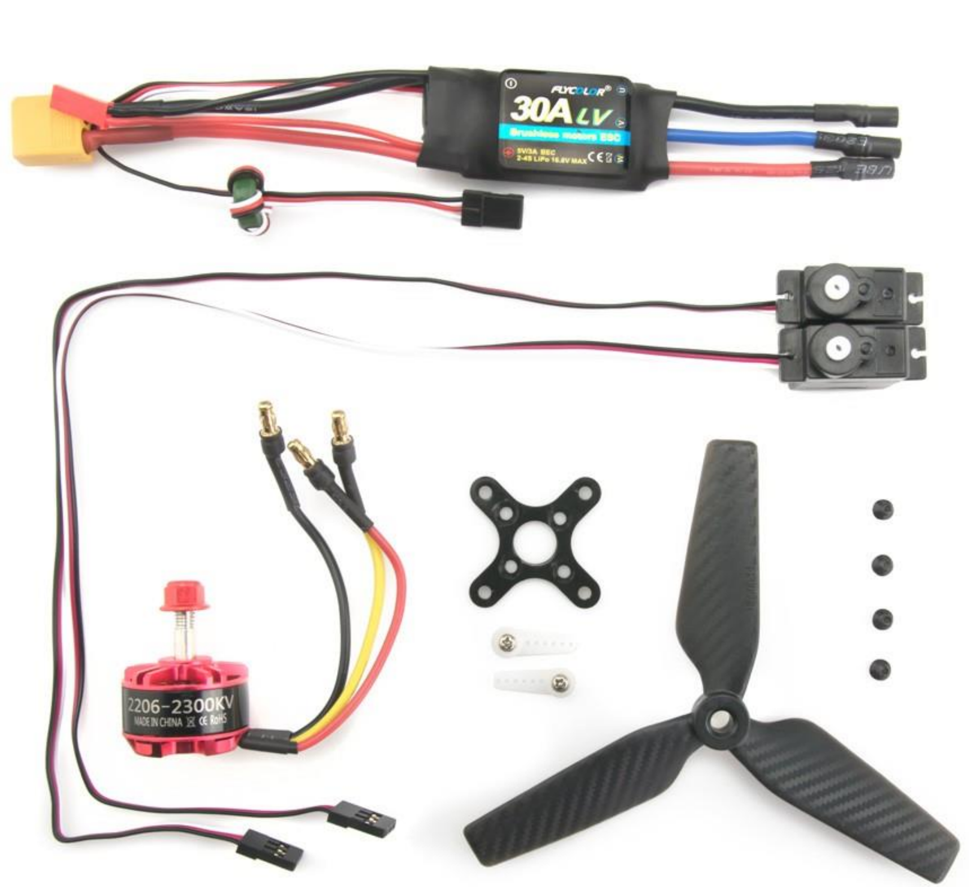
LED Indicator

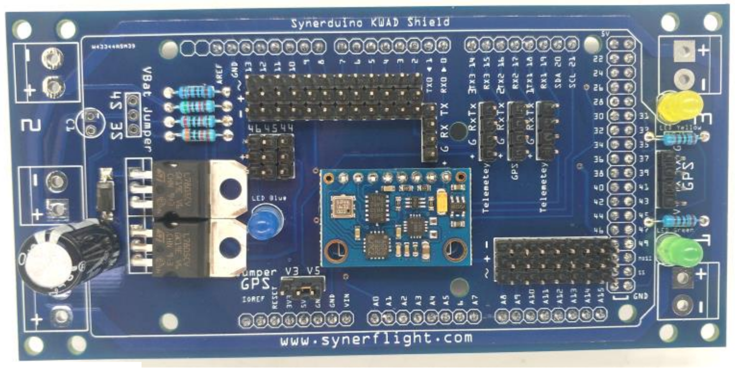
Provides a quick visual confirmation that the board and connected pins are functioning correctly, which is particularly useful during pre-flight checks.

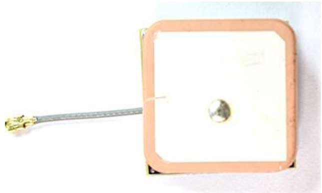
Selector Pins

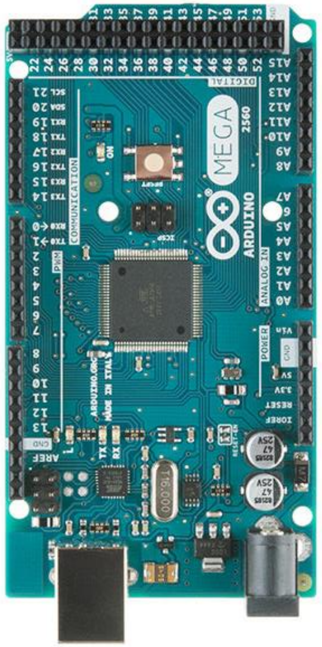
Selector pins customize the board's power management, allowing you to configure ESCs, GPS modules, and sensors according to flight needs.

SYNERDUINO KIT COMPONENTS









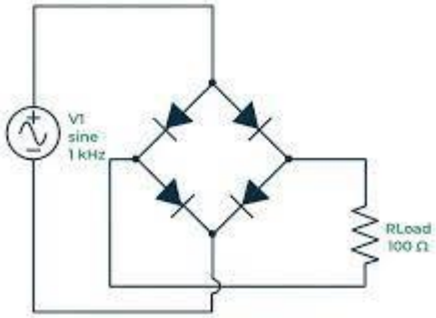
Legacy Plane Types – Support Single ESC, motor setup and upto 4 Servos

Special Plane Types – Support Dual ESC, motor setup and upto 3 Servos

HIGH POWER HARDWARE

For those running additional sensors , servos and other 5V or 6V components Please use an standalone BEC to power extra hardware

Rectifiers are useful as reverse polarity protection at source. Can be place before the ESC,Servo,Synerduino board rating must be higher than the combine current off all the electronics and motor current draw

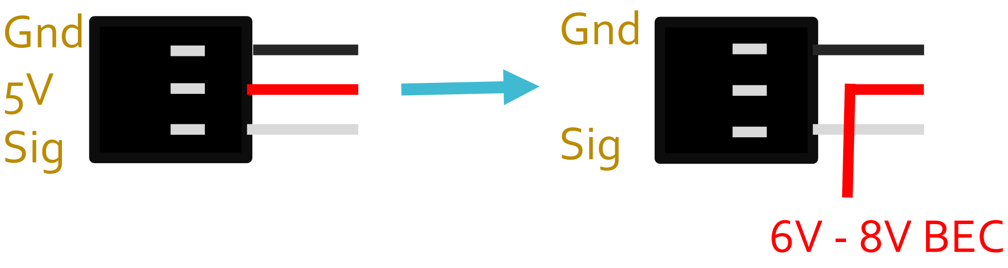


For ESCs that have 6V – 8V BEC , to prevent damage to Synerduino PWM Power Rail its recommended that the PWM Power wire is disconnected

High power servos that required 6V-12V

Its required you use an External BEC or Power supply to power Large servos

Disconnect the Red PWM servo wire to



this can be redirected to the power input rail or high power servo input

SYNERDUINO KIT COMPONENTS

Hardware

- Synerduino shield
- Arduino2560 MEGA / Uno 328
- Fixwing (Airplane) Synerduino Plane Airframe
- (1x Legacy) (2x Special) Brushless Motor 1500kv - 2300kv
- (1x Legacy) (2x Special) ESCs 30A 2s-4s
- (1x Legacy) (2x Special) Props 5045 or 8045 depending on setup
- (4xLegacy) (3x Special) 9g Micro Servos and control Rod & horn set
- GPS
- Bluetooth

SYNERDUINO KIT COMPONENTS

Features:

- Compatible with MultiWii (open source RC multi rotor flying platform)
- Compatible with Arduino Mega 2560 and Uno
- Ground Station with Flywii GUI or Synerflight App
- IMU 10DOF
- Supports 3S/4S Batteries
- 4 Output ESC Pads
- Mode Selection Pads (V1.1)
- ADC sensor input (V1.1)
- Highly customizable

Technical Specifications:

- Physical Dimensions: 128 x 62 x 28 mm LWH
- Weight: 46.1g
- 4 Solder Pads for 4 ESCs and Motors
- 15 3-Pin Digital Headers
- 8 3-Pin Analog Headers
- 5 4-Pin Serial Headers

ASSEMBLY

TOOLS AND MATERIALS

PLIERS

Used for gripping, bending, and cutting wires or components during the assembly process.

TAPES

Electrical and double-sided tapes used for securing wires and insulating electrical connections.

SOLDERING SET

Essential for soldering components and making secure connections between wires and circuit boards.

HEX DRIVER SET

Utilized for tightening or loosening hex screws commonly found in drone frames and components.

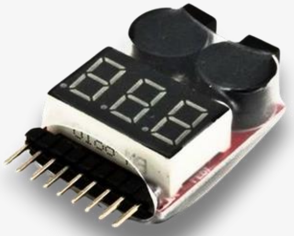
CUTTER

Handy for cutting zip ties, wires, or other materials to the desired length during assembly.

ZIP TIES

Used for bundling and securing wires, ensuring neat and organized cabling inside the drone.

TOOLS AND MATERIALS



BATTERY ALARM CHECKER

Monitors battery voltage, providing warnings when the battery is low to prevent damage or crashes.

LI-PO BATTERY CHARGER

Safely recharges Li-Po batteries, ensuring optimal battery health and longevity.

PVC GLUE

Used for assembling or reinforcing non-electrical parts of the drone frame and components.

THREAD LOCKER PURPLE

Secures screws and fasteners in place, preventing them from loosening due to vibration during flight.

ASSEMBLING PROCESS

This section outlines the essential steps for assembling your Synerduino Drone Kit. Begin by gathering the necessary tools and materials, then prepare the Synerduino shield and the Arduino board. Finally, install the motor, Electronic Speed Controller (ESC), and propeller. Follow these steps carefully to ensure a successful assembly and get your drone ready for flight!

1. **Synerduino Shield Preparation**
2. **Arduino Board Preparation**
3. **Pad Connections**
4. **Battery, Motor, ESC, and Propeller Installation**
5. **GPS and Bluetooth Configuration**

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SYNERDUINO BOARD PREPARATION

Aux ADC in

Usage: These pins are used to connect external sensors or devices that output analog signals, such as temperature, pressure, or current sensors.

ESC / Servo PWM Out

Usage: ESCs should be connected to these pins for motor control in a drone or robot.

Serial Pins

Usage: You can use these for connecting devices that need to send/receive serial data.

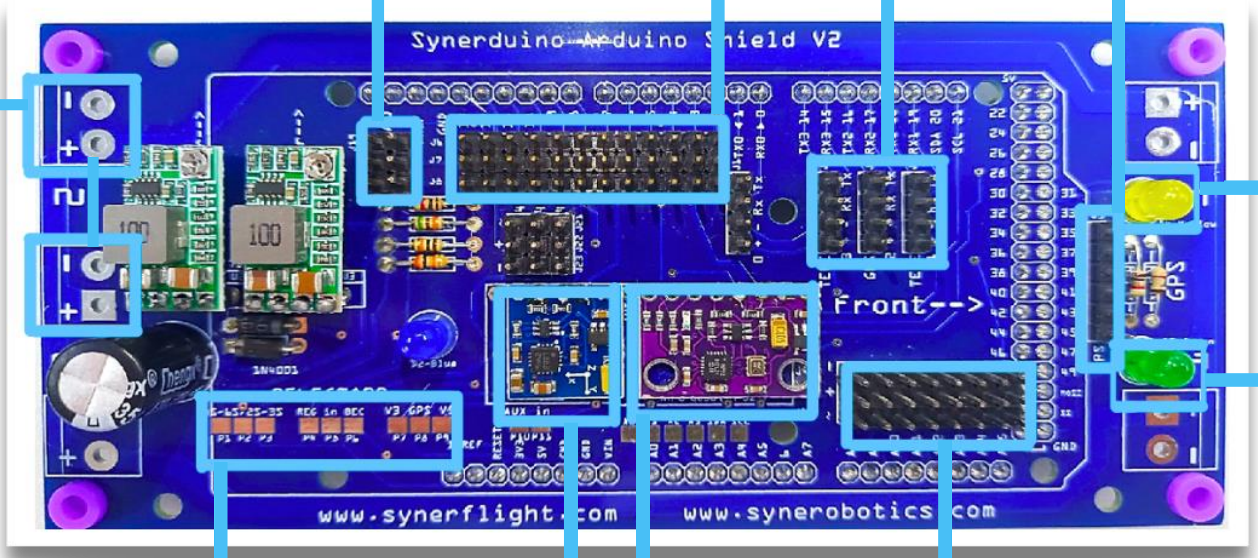
GPS Serial Pins

Usage: You will connect the GPS module's TX to the RX pin on the board and vice versa, ensuring the correct serial data exchange between the GPS and the microcontroller.

Power Input

Usage: Connect a 3S LiPo battery to this input. Make sure to match the polarity of the battery with the input terminals to avoid damaging the board.

Soldering Note: ESCs should only be soldered on the top side of the board, ensuring the solder joints do not penetrate through to the bottom.



GPS LED

Usage: When the GPS module is properly connected, this LED will inform you of its status. A blinking or steady light usually indicates good GPS reception.

Status LED

Usage: The microcontroller on the board controls this LED, which will light up to signal that the board is functioning correctly.

Jumper Pads Selector Zone

Usage: By soldering the appropriate jumper pads, you can select between different power sources or set the board for the correct number of battery cells.

MAG 5883

IMU : MPU-9250

RC PWM In

Usage: Connect the output pins from your RC receiver to these PWM input pins. The signals will then be processed by the microcontroller, which can send commands to the motors through the ESC.

IMU : MPU-9250 Mag QMC5883/QMC5883P & BMP280

Synerduino Kwad Shield BETA GY801

Note : surface mount your solder ESC wire make sure it doesn't penetrate to the bottom of the board

ESC is Solder on Top side only

ESC / Servo PWM Out

Serial Pins

ESC is Solder on Top side only

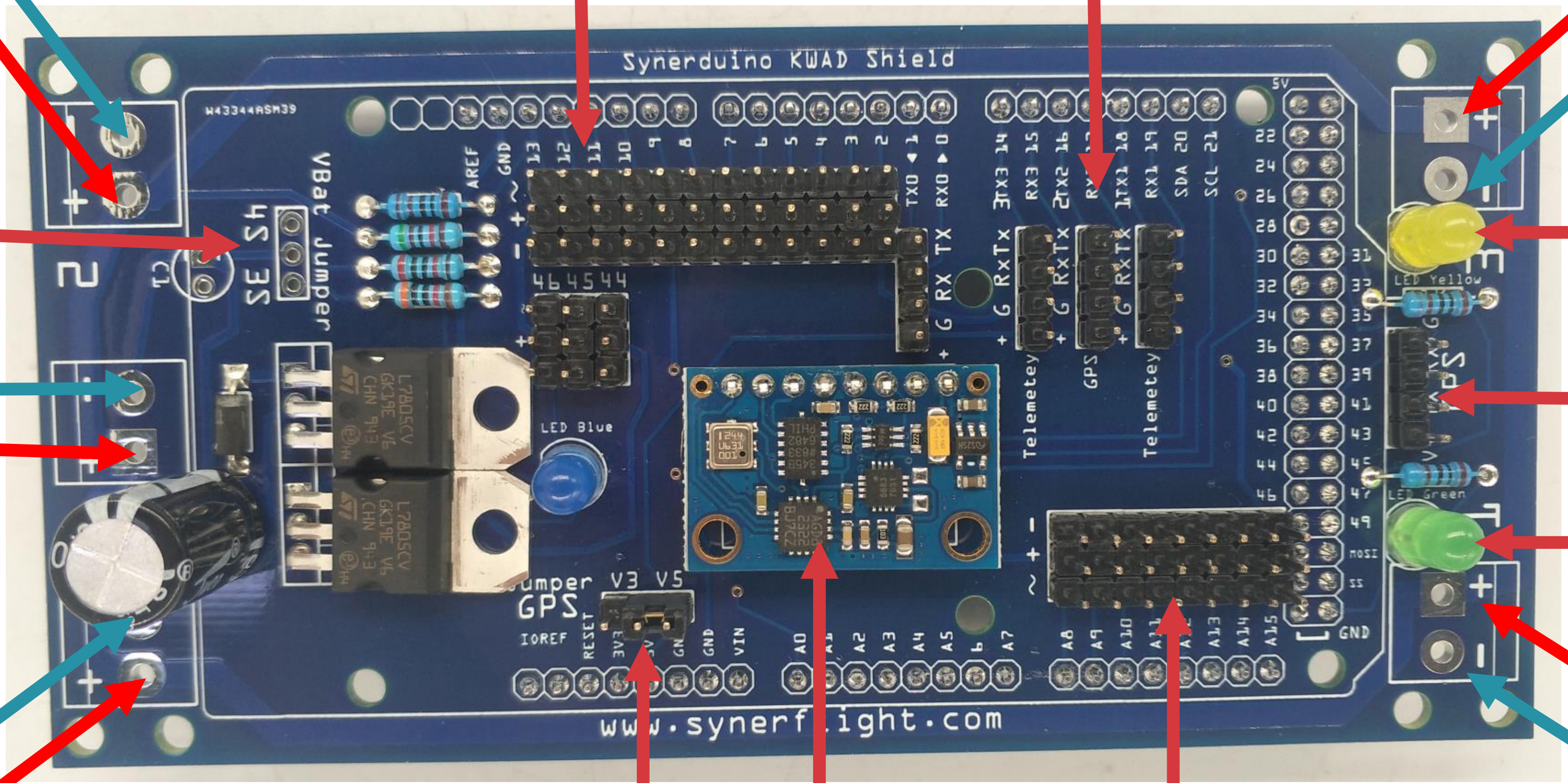
Set jumper to the Battery Cell count (Solded) 3s – 4s

GPS LED

Power input
3s 11.1V
4s 14.8V

GPS Serial Pins

Status LED



ESC is Solder on Top side only

GPS Voltage Jumper

RC PWM in

ESC is Solder on Top side only

For improve performance IMU must be protected from the Environment

IMU : L3G4200D Gyro / ADXL345 Accelerometer / BMP180 – 85 Baro / MMC5883 Mag

Synerduino Kwad Shield V1.1 GY91

Note : surface mount your solder ESC wire make sure it doesn't penetrate to the bottom of the board

ESC is Solder on Top side only

Aux ADC in

ESC / Servo PWM Out

Serial Pins

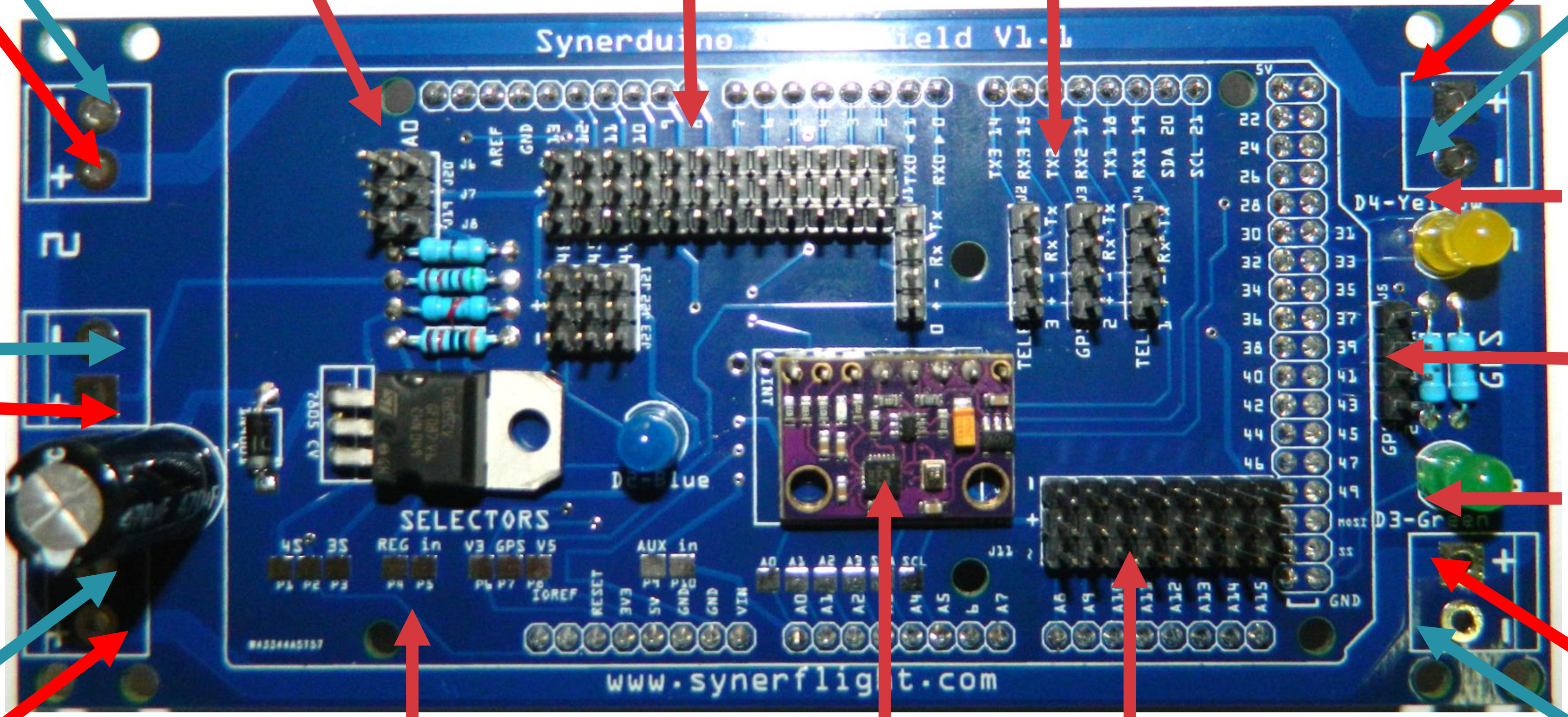
ESC is Solder on Top side only

GPS LED

Power input 3s 11.1V

GPS Serial Pins

Status LED



ESC is Solder on Top side only

Jumper Pads Selector Zone

RC PWM in

ESC is Solder on Top side only

For improve performance IMU must be protected from the Environment

IMU : MPU-9250 Mag HMC/QMC5883 & BMP280

ASSEMBLING PROCESS

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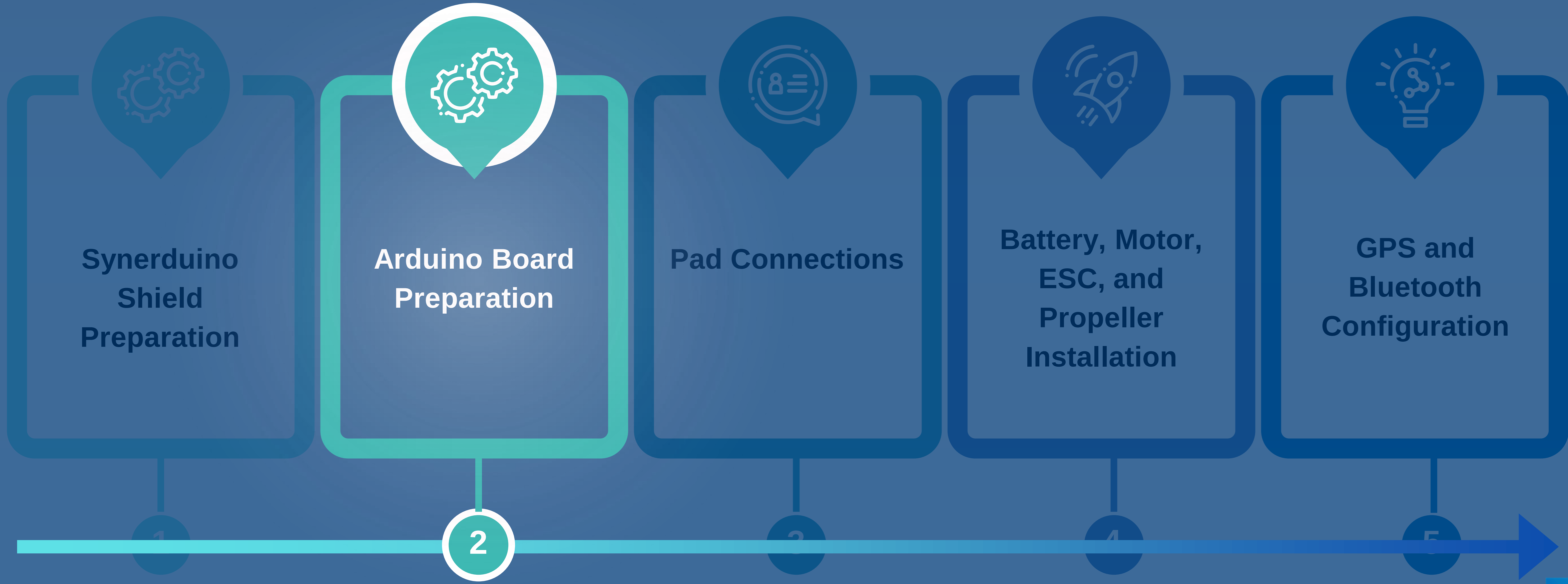
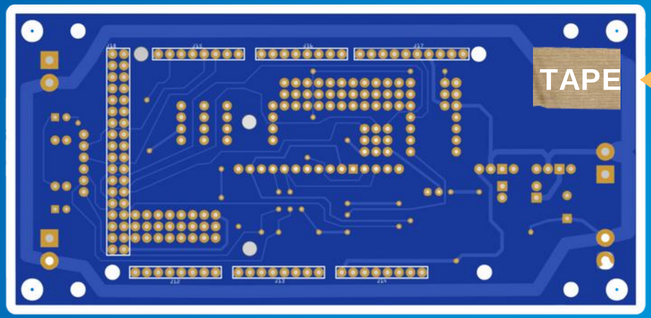


BOARD PREPARATION

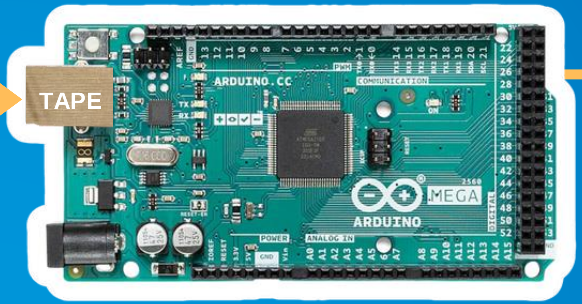
Step 1:

Add tape to these areas to ensure insulation from the Arduino board.

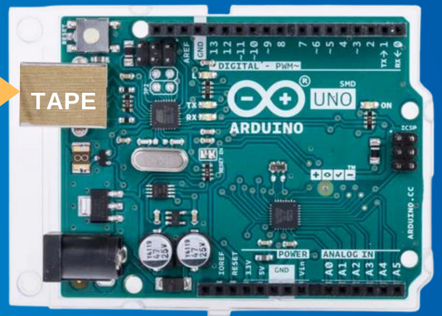


Add tape to the top right side corner at the back of the Synerduino board.

2560 MEGA



UNO 328

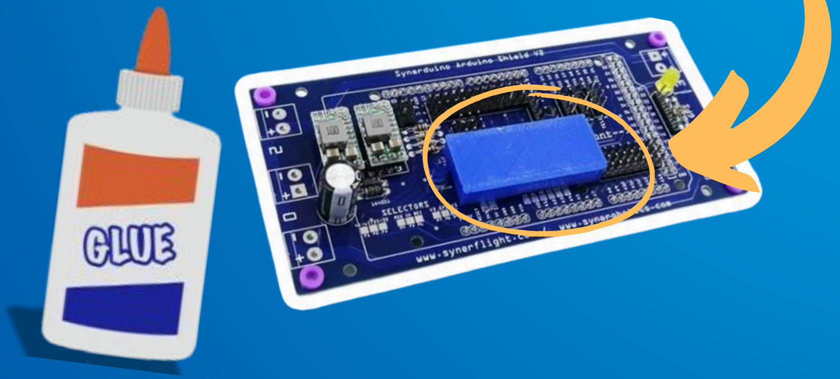


Add tape to the top-left side of the Arduino 2560 MEGA/UNO 328 board to cover the metal part.

Note: The exposed metal areas may come into contact with the Synerduino kit components, potentially causing a short circuit.

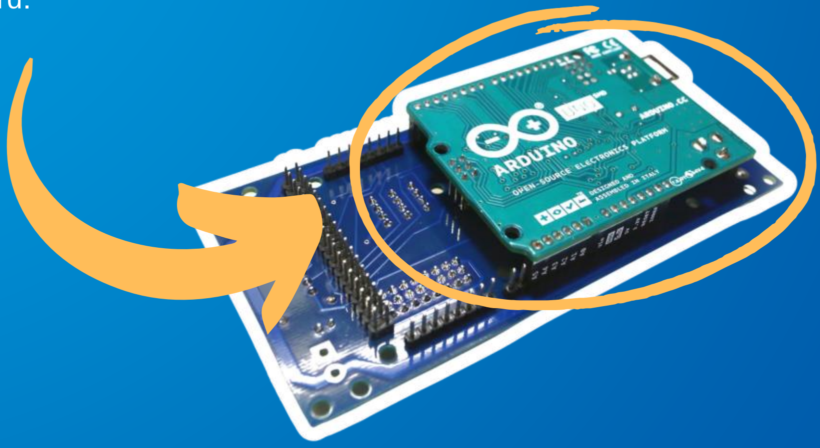
Step 2:

Make sure to seal the cover onto the sensor using PVA glue, and allow it to fully dry before proceeding.



Step 3:

Now, connect the Arduino Uno Shield to the back of the Synerduino board.



ASSEMBLING PROCESS

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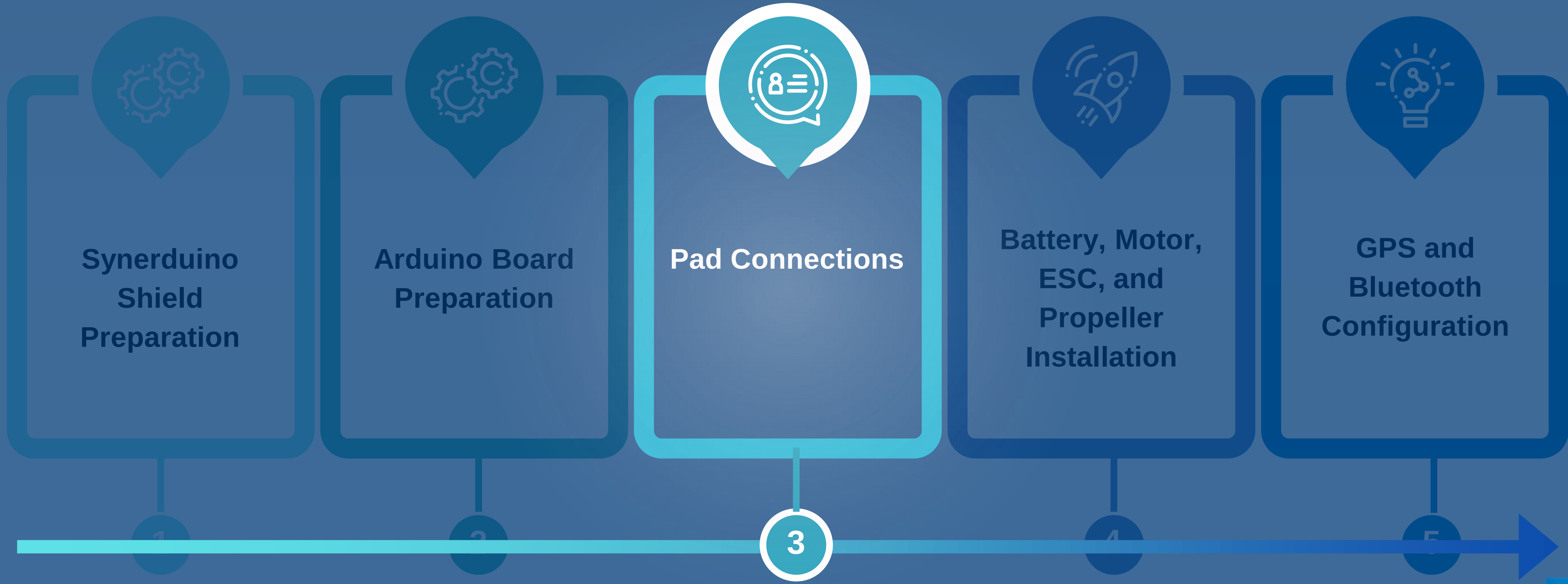
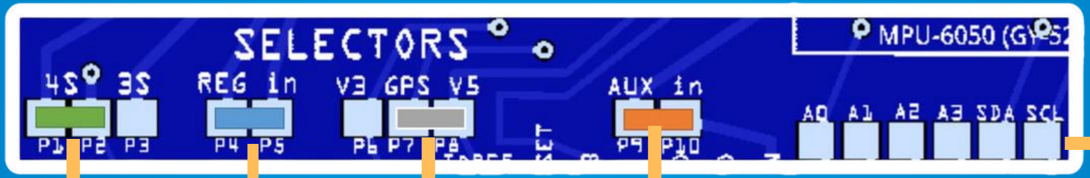


Step 4:

Power Selector Jumper Pads are directly added to the main board, enabling users to choose the desired power source through a simple soldering step:

Apply a **small blob of solder** to bridge the specific pads corresponding to your preferred power option.

This approach provides a secure connection, giving you the flexibility to configure power supply without additional components, all in a compact and reliable manner.



External i2C A4 and A4

For External Sensors not supported by the Board

Battery cell monitoring 4s or 3s

To use the onboard battery monitoring with Aux In:

- Set to 3S if you're using a 1S-3S battery.
- Set to 4S if you're using a 4S battery.
- Leave it open when using Aux In as external sensors or when using 5S-6S batteries.

5V Regulator from battery

- For Reg In, short the pads to use the regulator to power both the Synerduino and Arduino board, along with the built-in power distributor.

GPS Pins V+ voltage in front of the board

The 2nd GPS pin comes with a voltage selector:

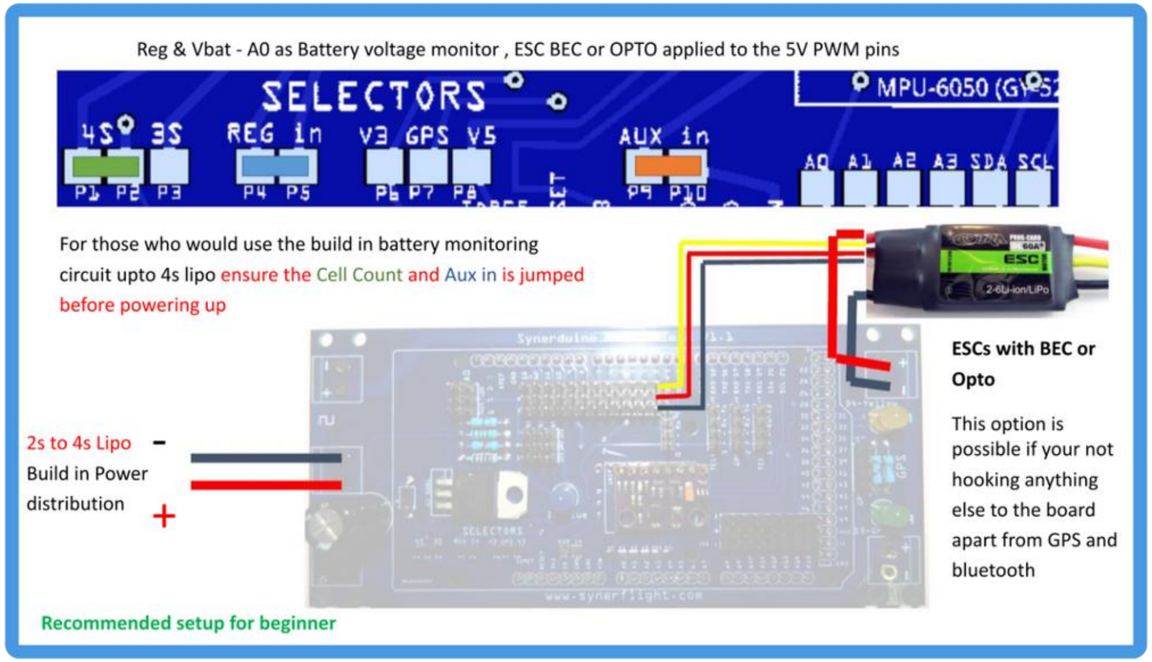
- Set to 5V for a regular GPS.
- Set to 3V for an external I2C sensor, such as a magnetometer.

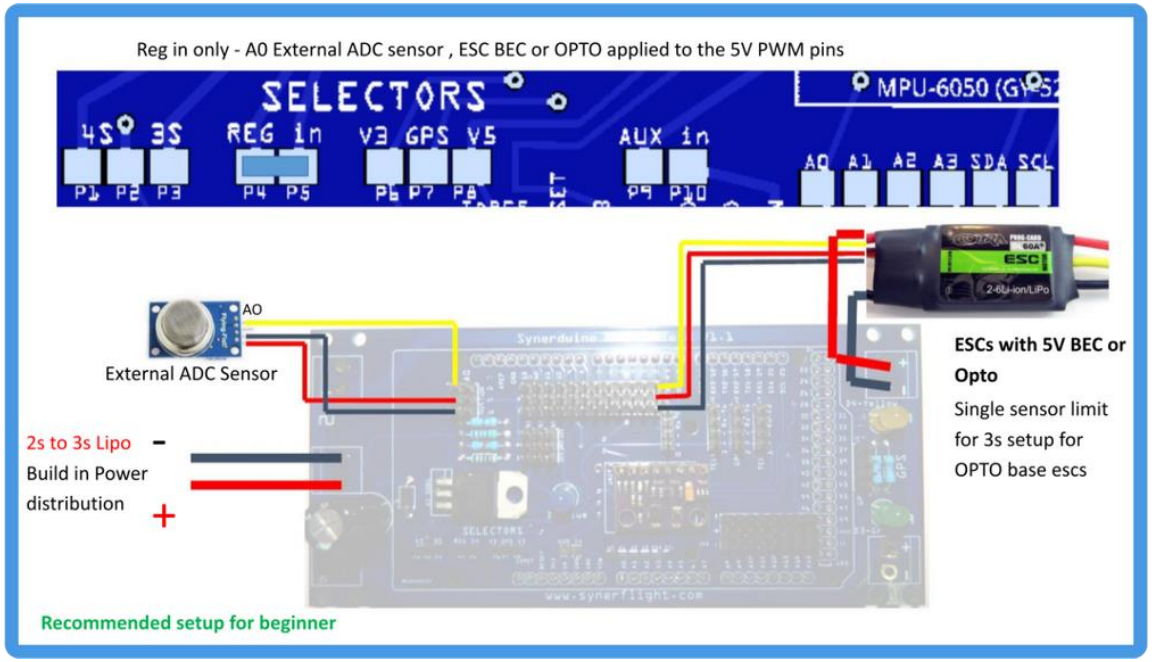
Analog 0 pin Auxin / Battery monitor

For Aux In:

- Leave it open to utilize the A0 pins for external ADC sensors.
- Short the pads to use the built-in battery monitoring. Ensure the Cell Selector is set to 3S or 4S, depending on the battery configuration.

SYNERDUINO KWAD SHIELD V1 BOARD





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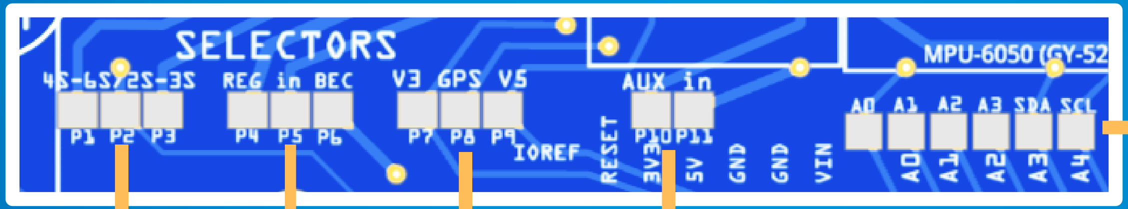

External i2C A4 and A4

For External Sensors not supported by the Board

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- Set to 4S if you're using a 4S battery.
- Leave it open when using Aux In as external sensors or when using 5S-6S batteries.

5V Regulator from battery

- For Reg In, short the pads to use the regulator to power both the Synerduino and Arduino board, along with the built-in power distributor.
- Bec to Used ESC's BeC to power the Synerduino shield and Arduino Board

GPS Pins V+ voltage in front of the board

The 2nd GPS pin comes with a voltage selector:

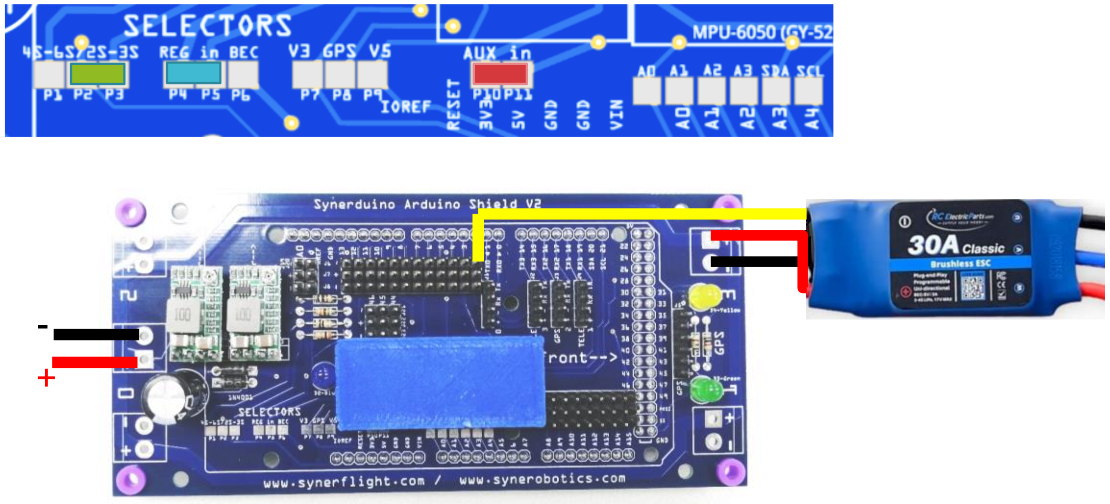
- Set to 5V for a regular GPS.
- Set to 3V for an external I2C sensor, such as a magnetometer.

Analog 0 pin Auxin / Battery monitor

For Aux In:

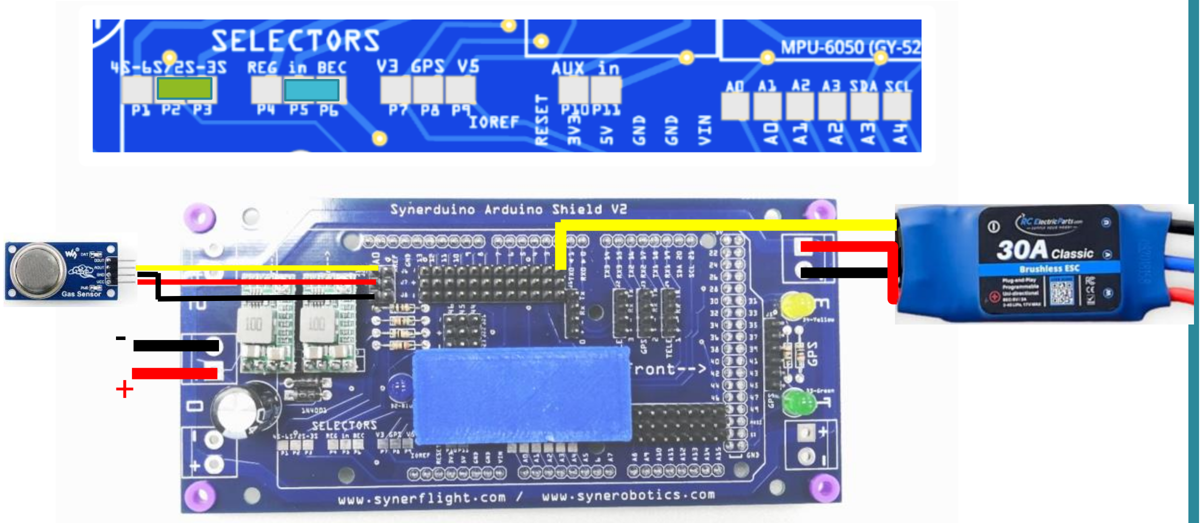
- Leave it open to utilize the A0 pins for external ADC sensors.
- Short the pads to use the built-in battery monitoring. Ensure the Cell Selector is set to 3S or 4S, depending on the battery configuration.

PAD CONNECTIONS SYNERDUINO ARDUINO SHIELD V2 BOARD



Reg in – to use the onboard power supply to run the board up to 3A

Aux in – to Read the Battert Voltage assign by the 4s-6s or 2s-3s pads



BEC in – if your using External BEC or ESC Bec to provide much needed Power to run Servos and External sensors and Companion Hardware

ASSEMBLING PROCESS

This section outlines the essential steps for assembling your Synerduino Drone Kit. Follow these steps carefully to ensure a successful assembly and get your drone ready for flight!

Synerduino Shield Preparation

Arduino Board Preparation

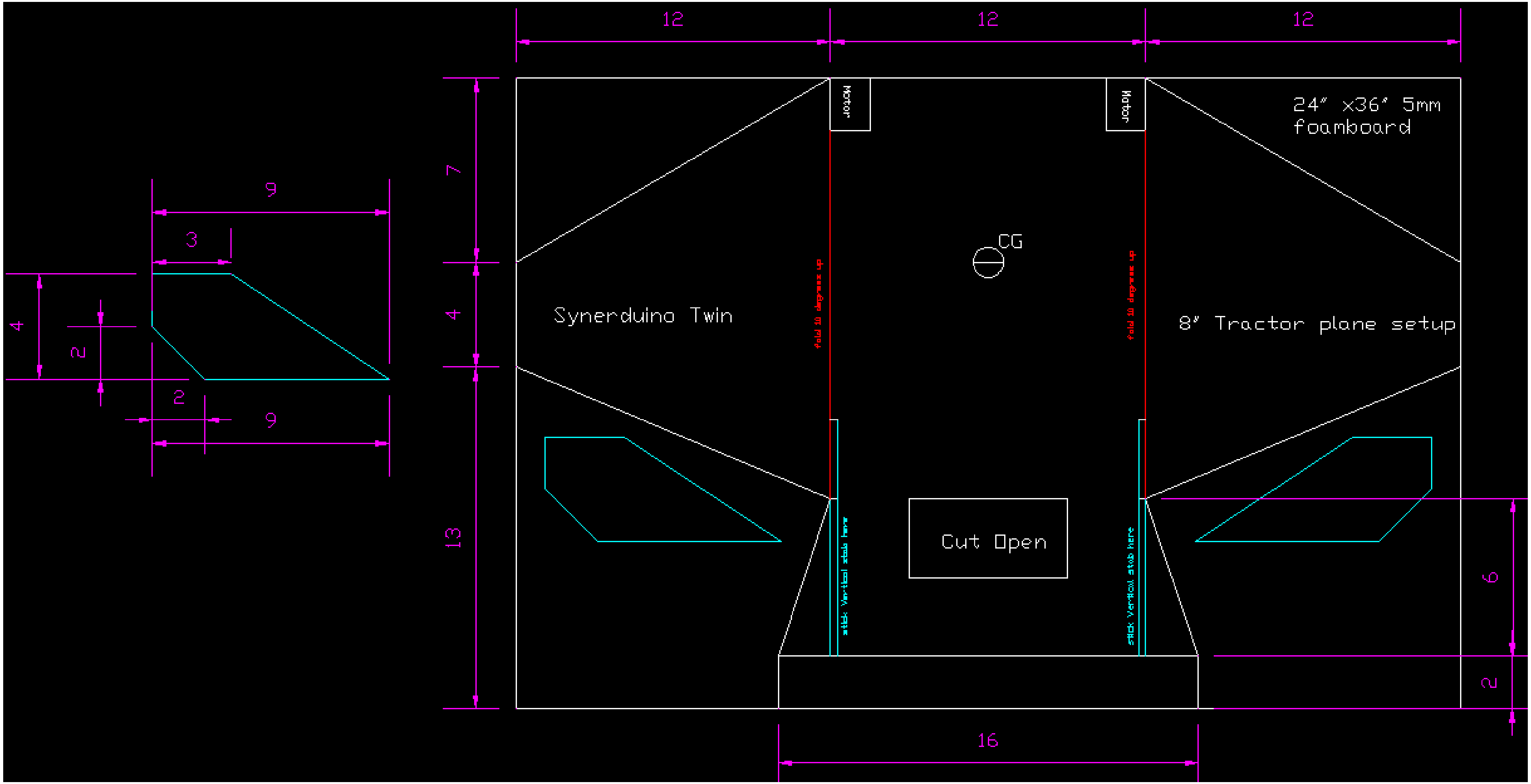
Pad Connections

Battery, Motor, ESC, and Propeller Installation

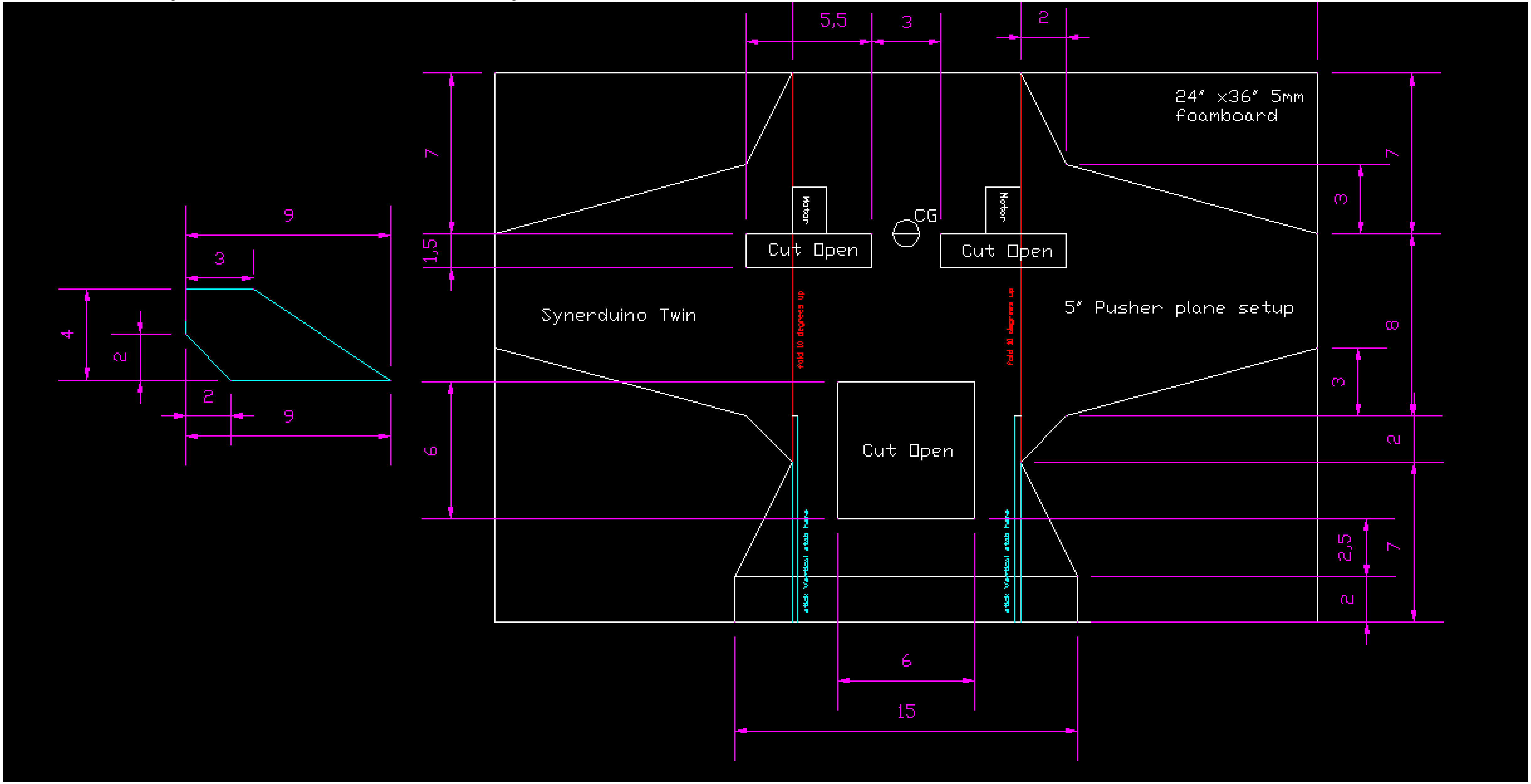
GPS and Bluetooth Configuration

4

Synerduino Dart Design is base of the FT Flyer require 5mm 24”x36” foam board
Wings have a dihedral of 15-20 degrees at most (Special plane)



Hole in slot Wings is possible with such design as required pusher (Special plane)

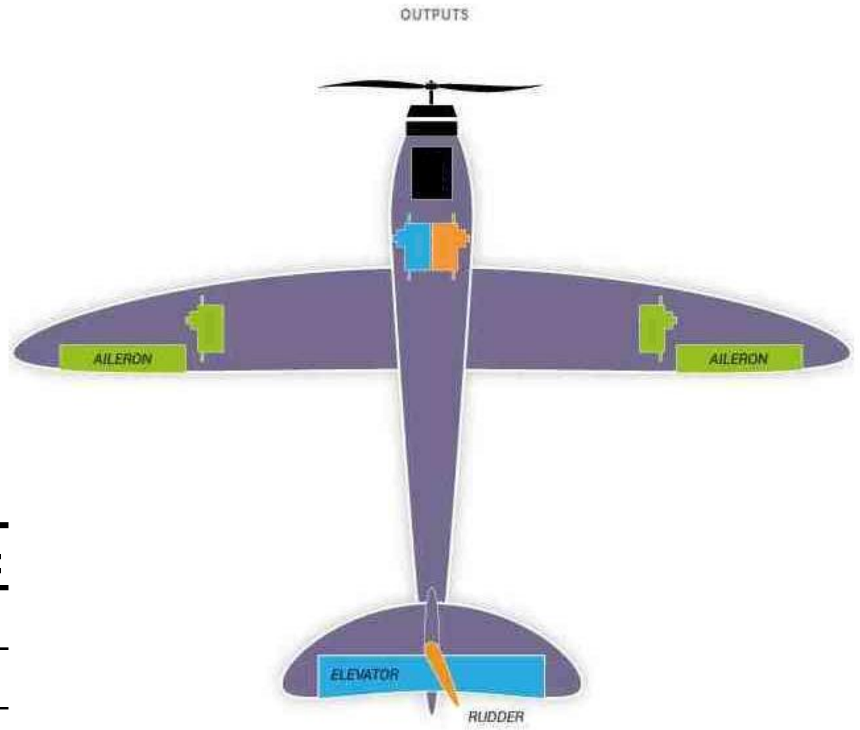


PWM Pins arrangement PWM Output Legacy Airplane Types

[(Arduino 1.8.18)SynerduinoPlane4-GY91GY801-1.8.18Download]()

[(Arduino 1.8.5) SynerduinoPlanes4-GY91-GY801Download]()

[(PatrikE codes with updated sensors) MultiWii_FW_synerduinoDownload]()

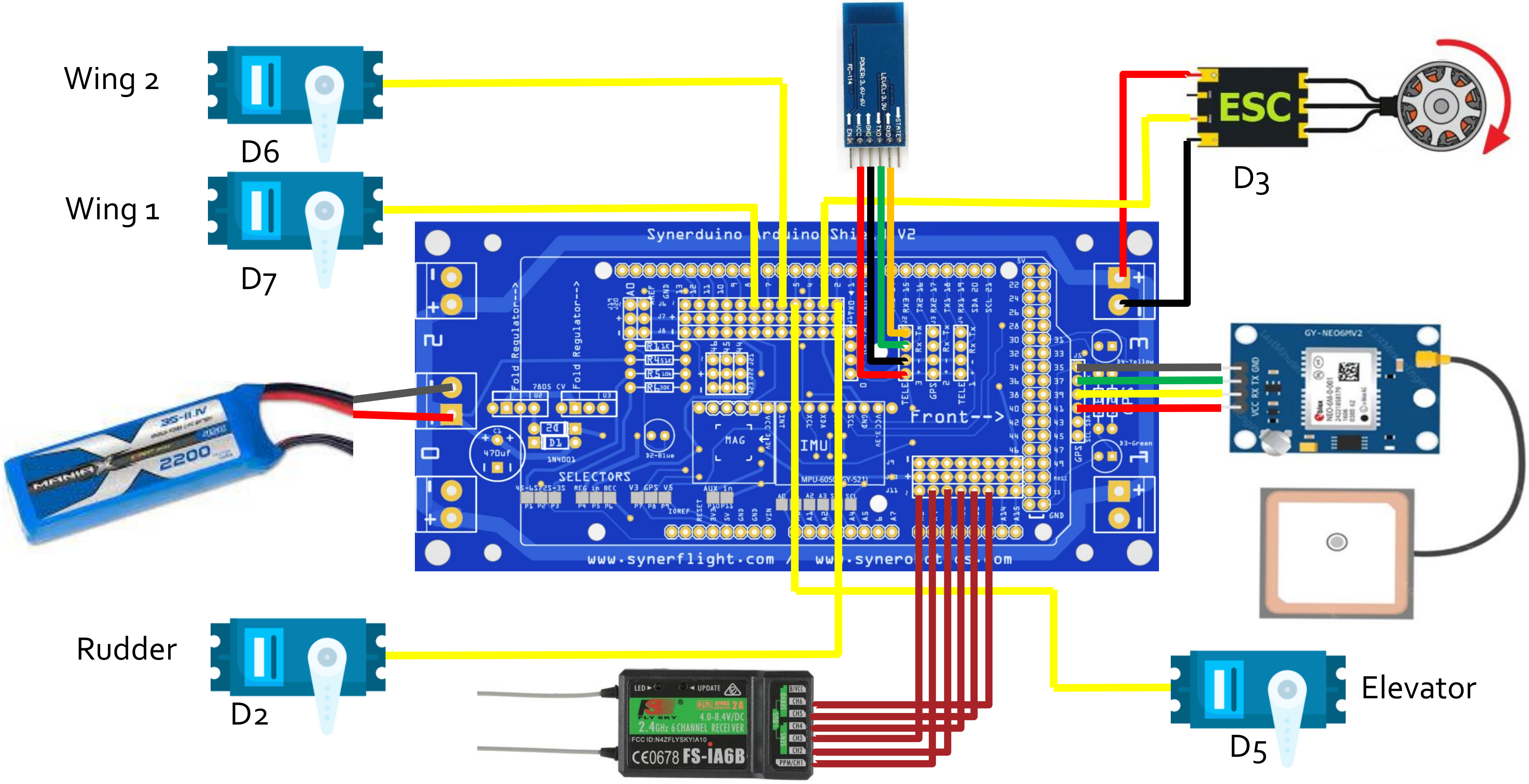


	MINI	MEGA	AirPlane	Heli-90	Heli-120	Engine nr:
servo[0] =	A0	D34/44	-	-	-	
servo[1] =	A1	D35/45	-	-	-	
servo[2] =	A2	D33/46	-	-	-	
servo[3] =	D12	D7/D37	Wing:1	Nckservo	Nckservo	
servo[4] =	D11	D6	Wing:2	Roll	Left	motor[3]
servo[5] =	D3	D2	Rudder	Tail	Tail	motor[2]
servo[6] =	D10	D5	Elev	Coll	Right	motor[1]
servo[7] =	D9	D3	Engine	Engine	Engine	motor[0]

Note: Servo 3 can also serves as conventional Flaps

See the Aircraft Settings Config.h

BATTERY, MOTOR, ESC, & PROPELLER INSTALLATION



PWM Pins arrangement PWM Output **use special airplane ino file** for this setup utilizing Bi copter special Plane types

Differential Thrust Wing

Arduino Mega Diff Thrust Plane

Elevator	Rudder	Aileron	Throttle
D6	D2	D7	D3 Left motor D5 Right motor

Arduino Uno Diff Thrust Plane

Elevator	Rudder	Aileron	Throttle
D11	D3	D12	D9 Left motor D10 Right motor

Arduino Mega Wing

Elevon	Elevon	Rudder	Throttle
D6 L	D2 R	D7	D3 Left motor D5 Right motor

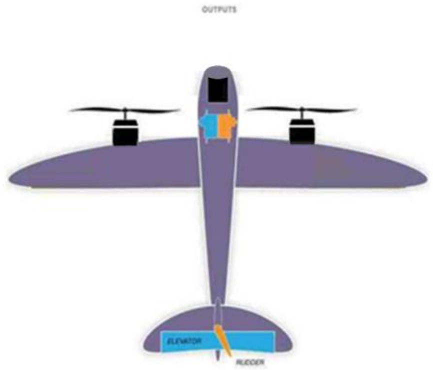
Arduino Uno Wing

Elevon	Elevon	Rudder	Throttle
D11 L	D3 R	D12	D9 Left motor D10 Right motor

Special Airplane Firmware .ino (RET ,4Ch , Differential Thrust)

Synerduino_Special_Airplane-2-GY91-1.8.16Download

Synerduino special airplane3 GY91-1.8.16Download



Synerduino Firmware .ino (Flying wings)

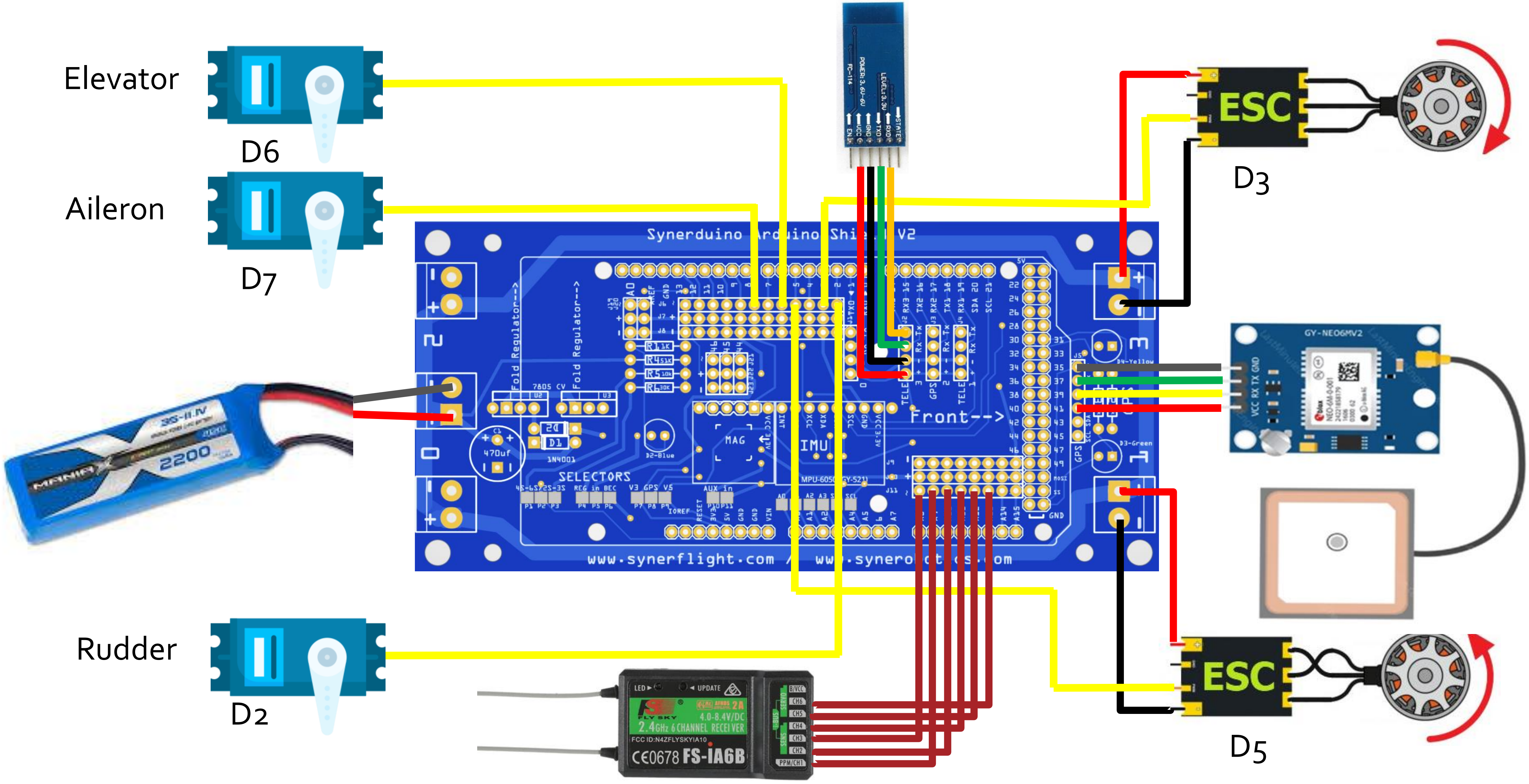
SynerduinoWingPlane3-GY801Download

Synerduino-Firmware-AirplaneDownload

Note: check if your RC servo needs reversing on FC config or on your Transmitter to ensure out put of differential respond correctly

Some models of transmitter may need RC output reversing to operate correctly

BATTERY, MOTOR, ESC, & PROPELLER INSTALLATION



PWM Pins arrangement PWM Output **use special airplane ino file** for this setup utilizing Bi copter special Plane types

Arduino Mega Airplane

Elevator	Rudder	Aileron	Throttle
D6	D2	D7	D3 D5 motor

Arduino Uno Airplane

Elevator	Rudder	Aileron	Throttle
D11	D3	D12	D9 D10 motor

Arduino Mega Wing

Elevon	Elevon	Aileron	Throttle
D6 L	D2 R	D7	D3 D5 motor

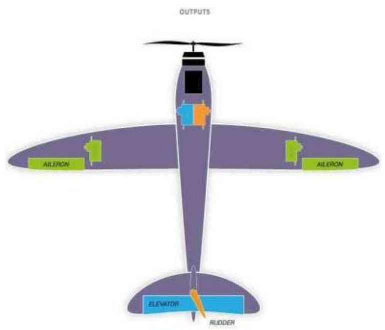
Arduino Uno Wing

Elevon	Elevon	Rudder	Throttle
D11 L	D3 R	D12	D9 D10 motor

Special Airplane Firmware .ino (RET ,4Ch , Differential Thrust)

Synerduino_Special_Airplane-2-GY91-1.8.16Download

Synerduino special airplane3 GY91-1.8.16Download



Synerduino Firmware .ino (Flying wings)

SynerduinoWingPlane3-GY801Download

Synerduino-Firmware-AirplaneDownload

Note: check if your RC servo needs reversing on FC config or on your Transmitter to ensure out put of differential respond correctly
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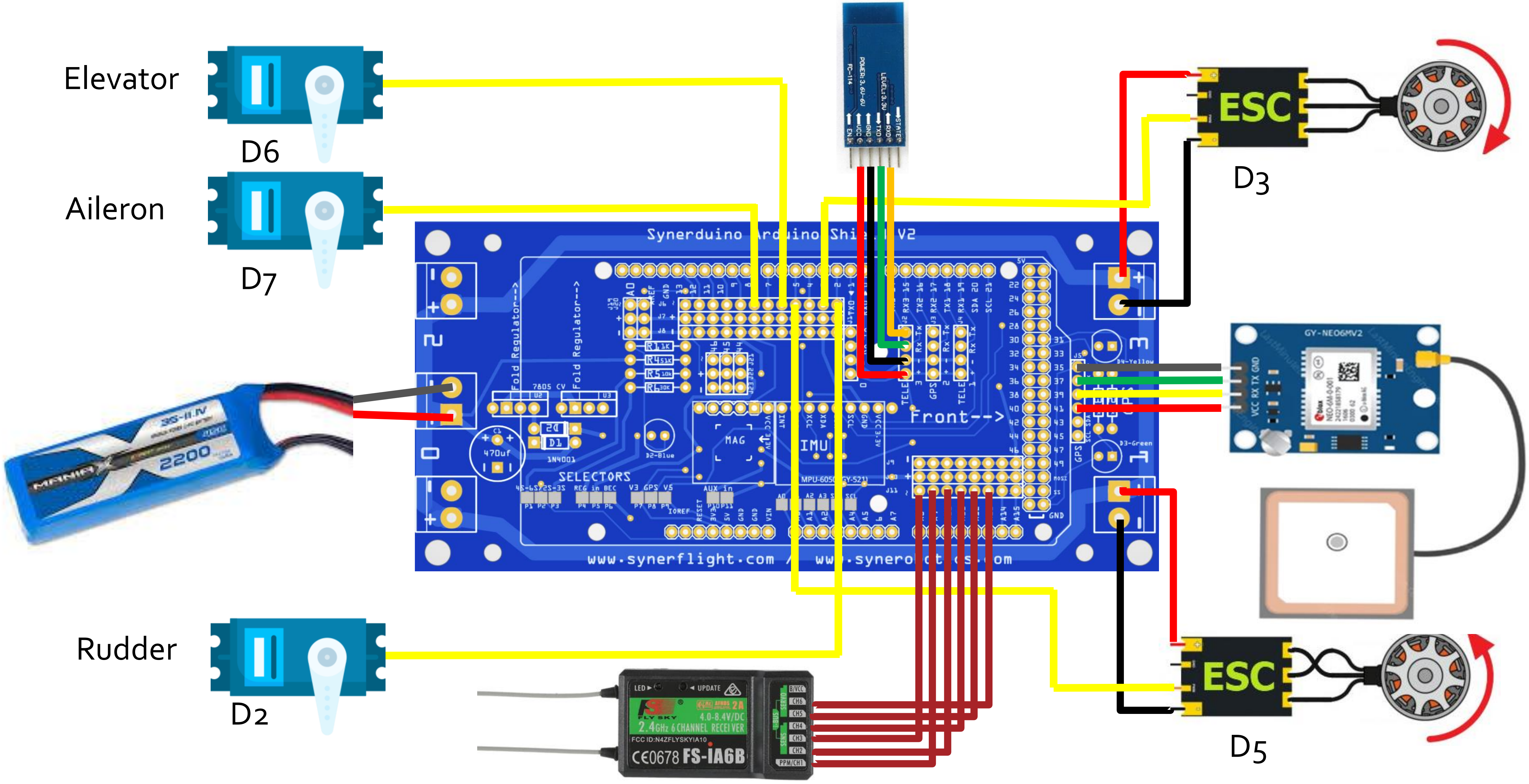
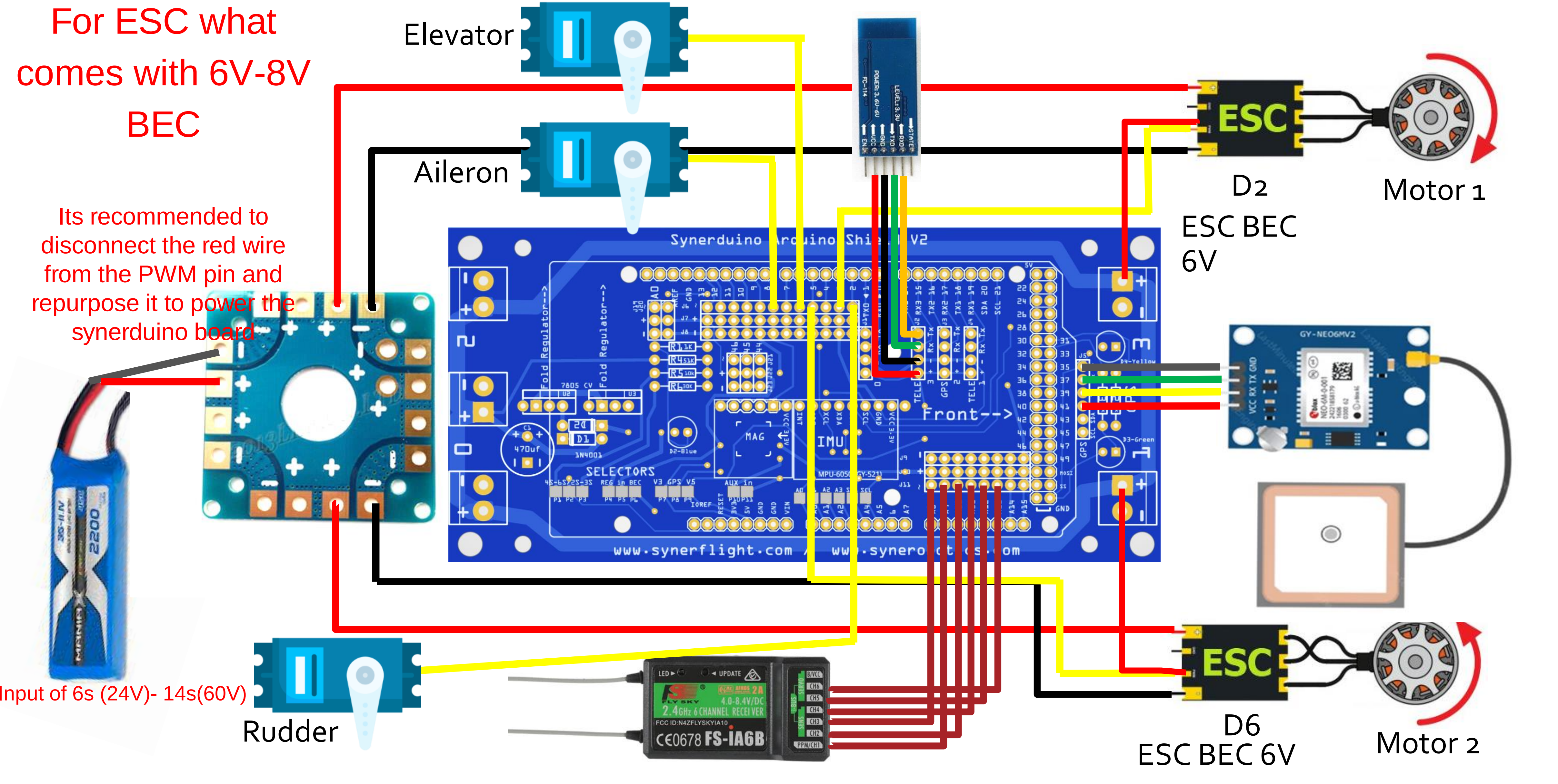
BATTERY, MOTOR, ESC, & PROPELLER INSTALLATION



High Voltage BEC (5V- 12V) and High Current (40A-300A) DIFFERENTIAL INSTALLATION

For ESC what comes with 6V-8V BEC

Its recommended to disconnect the red wire from the PWM pin and repurpose it to power the synerduino board



ASSEMBLING PROCESS

This section outlines the essential steps for assembling your Synerduino Drone Kit. Follow these steps carefully to ensure a successful assembly and get your drone ready for flight!

Synerduino Shield Preparation

Arduino Board Preparation

Pad Connections

Battery, Motor, ESC, and Propeller Installation

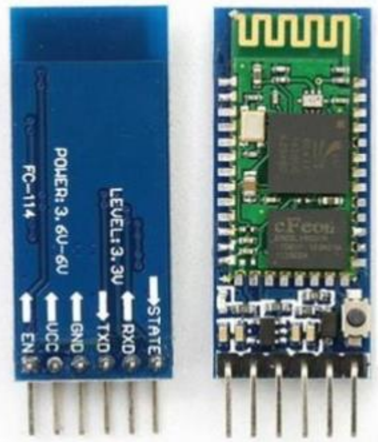
GPS and Bluetooth Configuration

5

TELEMETRY

38400 OR 57600 FOR SIK RADIO DEPENDING IF USES 433MHZ OR 900MHZ (63kbps)

38400 FOR XBEE RADIO



115200 FOR BLUETOOTH HC-05

STANDARD FOR ALL DRONES TO USE SERIAL LINK AS TELEMETRY MAINLY ON YOUR TX RX SERIAL PORTS , NOTE: THE LOWER THE FREQUENCY OF THE RADIO THE LOWER THE BAUD IS NEEDED ,

MOST DRONES REQUIRE MINIMUM 63kbps AIRSPEED TO COMMUNICATE PROPERLY

PROTOCOL IS MSP RAW OR MAVLINK

BLUETOOTH CONFIGURATION

TO CONNECT THE **BLUETOOTH HC-05 MODULE** TO THE BOARD, ENSURE THE HEADERS ARE ARRANGED CORRECTLY. FOLLOW THIS WIRING CONFIGURATION:

VCC (Bluetooth) connects to **+** (Board)

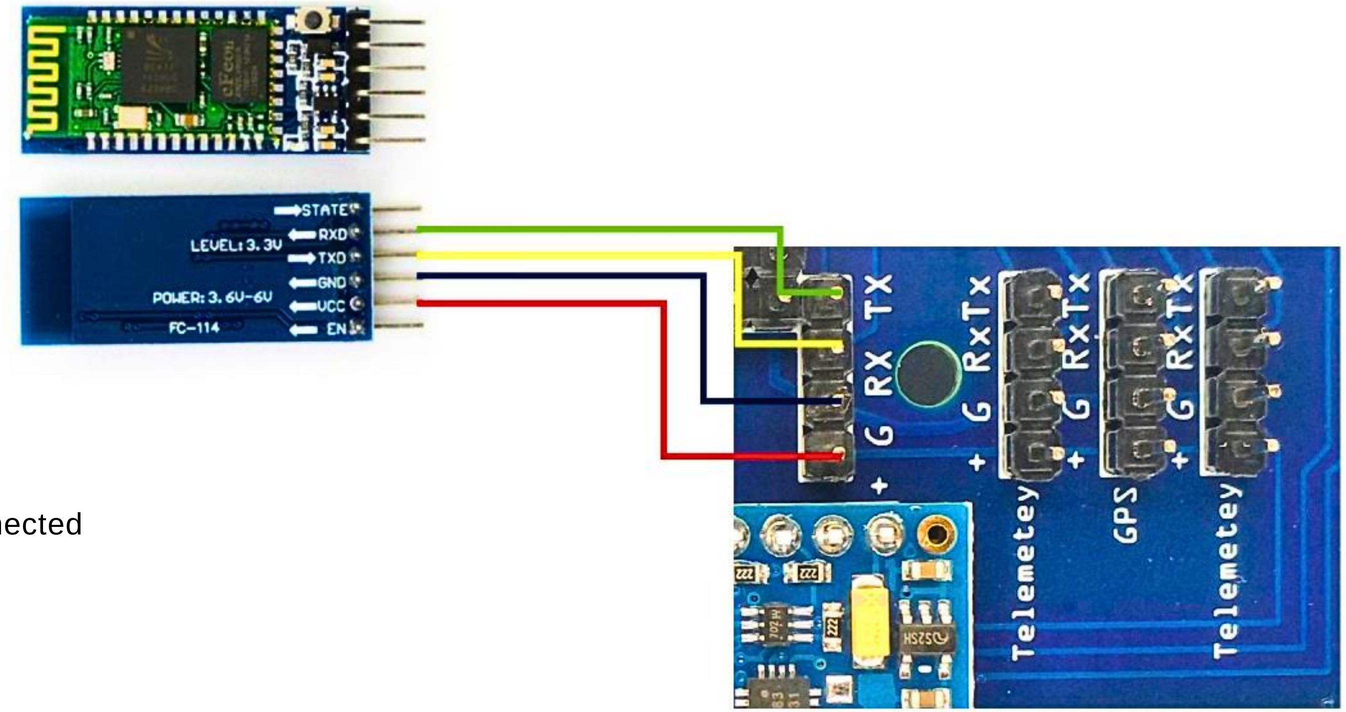
GND (Bluetooth) connects to **G** (Board)

TX (Bluetooth) connects to **RX** (Board)

RX (Bluetooth) connects to **TX** (Board)

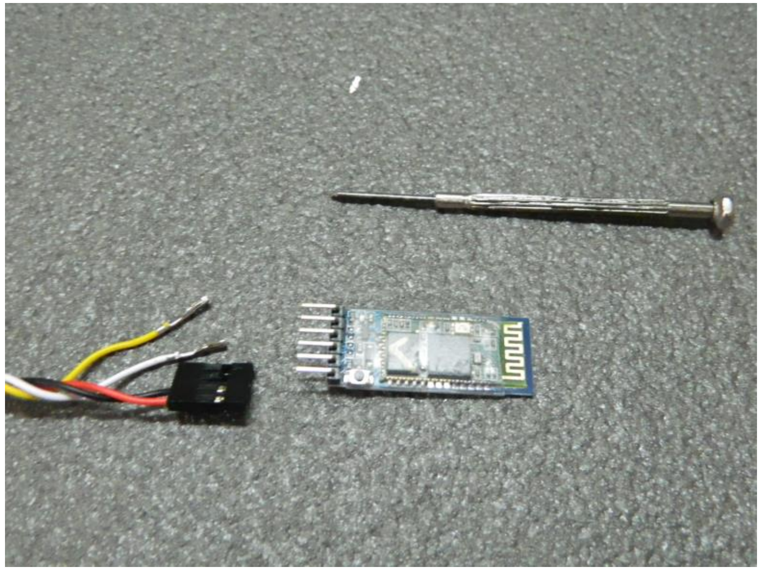
Any Serial Radio can be configured to run on Serial 0, 1, or Serial 3. with the matching Baud

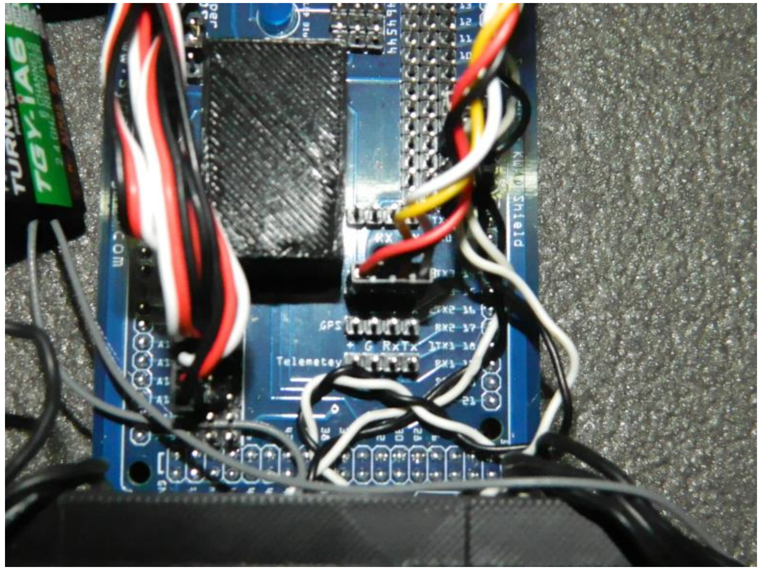
Serial 0 can be used for telemetry only if the USB is disconnected



NOTE: DOUBLE-CHECK THAT THE WIRE COLORS MATCH THESE MARKINGS. INCORRECT INSTALLATION OR POLARITY MAY DAMAGE THE ARDUINO BOARD. THE BLUETOOTH MODULE IS PRESET TO A BAUD RATE OF 115200 FOR YOUR CONVENIENCE, BUT YOU MAY CHANGE THE SETTINGS IF NEEDED.

Bluetooth





BLUETOOTH PLUG INTO SERIAL 1 OR SERIAL 3

115200 FOR BLUETOOTH HC-05

ATTENTION:

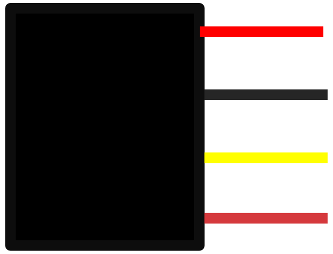
YOU MAY NEED TO REARRANGE THE HEADERS TO CONNECT THE BLUETOOTH MODULE TO THE SHIELD BOARD ACCORDINGLY

VCC >> +

GND >> G

TX >> RX

RX >>TX



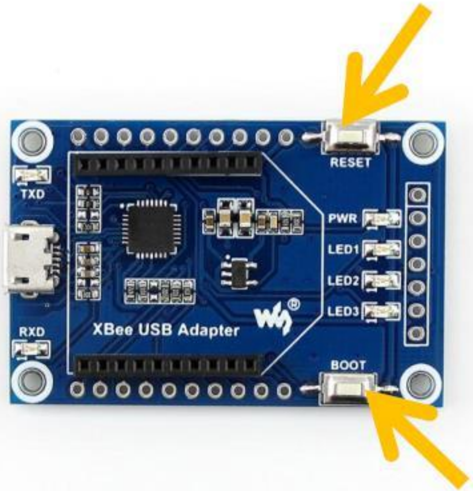
SEE TO IT THE WIRES COLOR CODE MATCHES THE MARKINGS

IMPROPER INSTALLATION MAY CAUSE DAMAGE TO THE ARDUINO BOARD AND SHIELD DUE TO REVERSE POLARITY

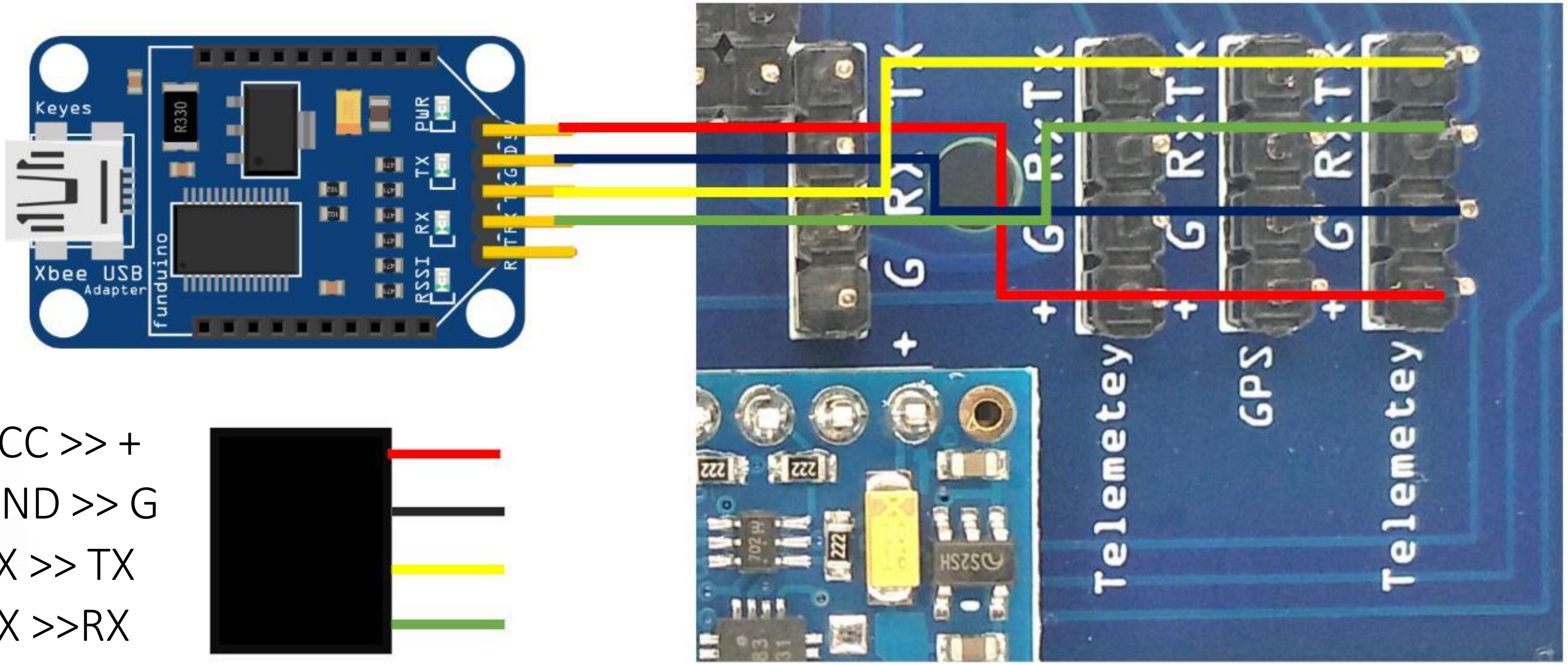
NOTE: WE PRESET THE BLUETOOTH FOR YOUR CONVENIENCE TO THE PROPER SETUP BUT SHOULD YOU WISH TO CHANGE THE SETTING ON YOUR DIGRESSION

SERIAL RADIO CONFIGURATION

38400 FOR XBEE RADIO



GET THE USB MODULE WITH BOOT AND RESET BUTTON AS YOU MAY NEED TO RESET THE XBEE WHEN UPDATING FIRMWARE



VCC >> +

GND >> G

TX >> TX

RX >>RX

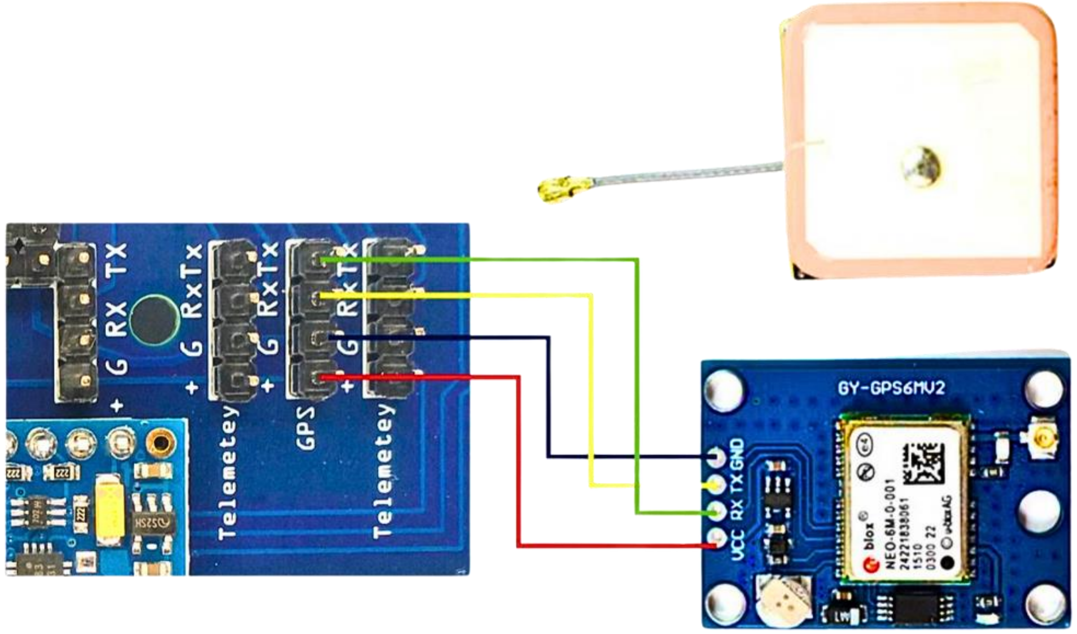
GPS CONFIGURATION

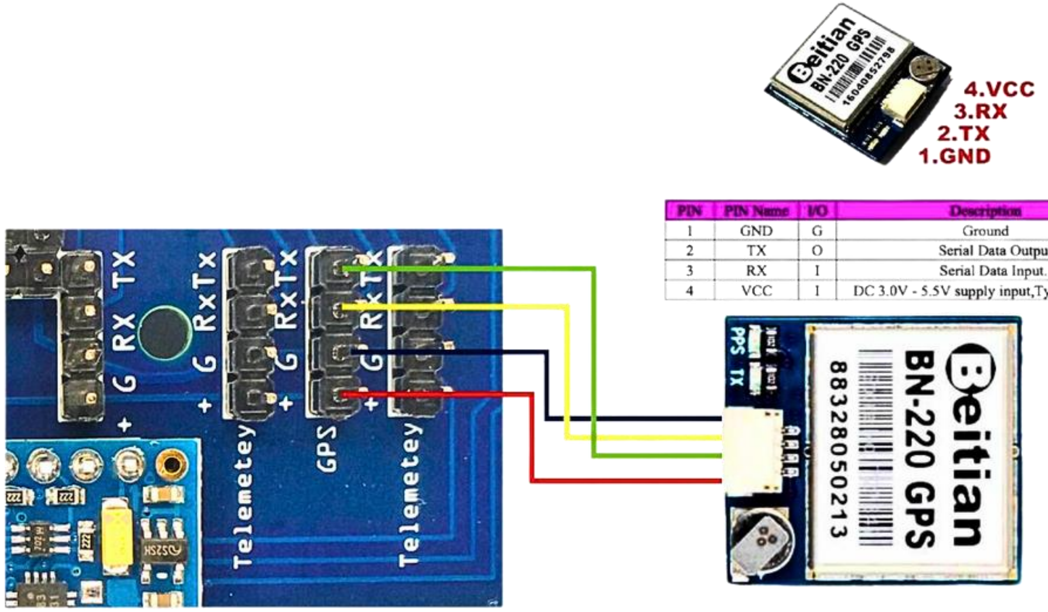
THE **TELEMETRY MODULE** INCLUDES PINS LABELED RX, TX, GND, AND VCC, WHICH CORRESPOND TO THE GPS MODULE'S MATCHING PINS.

TO CONNECT THESE COMPONENTS, COLOR-CODED WIRES CLARIFY THESE CONNECTIONS, WITH **YELLOW** INDICATING **RX TO TX**, **GREEN** FOR **TX TO RX**, **BLACK** FOR **GROUND (GND)**, AND **RED** FOR **POWER (VCC).**

THE **BEITIAN BN-220 GPS MODULE** SHOWS A SPECIFIC PINOUT TABLE THAT DESCRIBES EACH PIN’S FUNCTION:

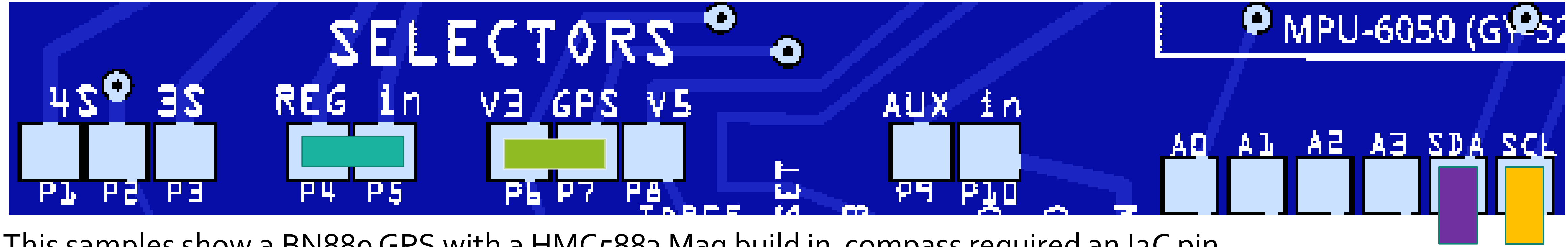
PIN 1 IS **GND (GROUND)**
PIN 2 IS **TX** (DATA OUTPUT)
PIN 3 IS **RX** (DATA INPUT)
PIN 4 IS **VCC** (POWER SUPPLY RANGES FROM 3.3V TO 5.0V)



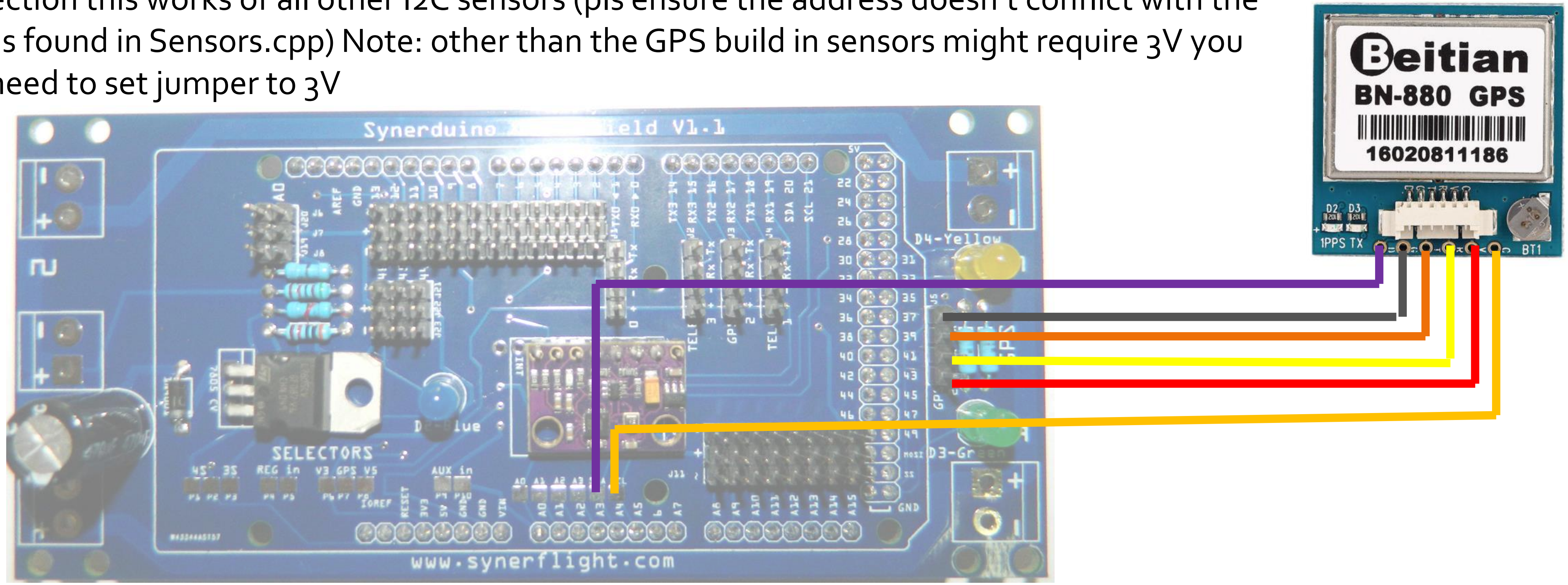


PIN	PIN Name	I/O	Description
1	GND	G	Ground
2	TX	O	Serial Data Output.
3	RX	I	Serial Data Input.
4	VCC	I	DC 3.0V - 5.5V supply input,Typical: 5.0V

External Sensors



This samples show a BN880 GPS with a HMC5883 Mag build in compass required an I2C pin connection this works of all other I2C sensors (pls ensure the address doesn't conflict with the IMU as found in Sensors.cpp) Note: other than the GPS build in sensors might require 3V you may need to set jumper to 3V



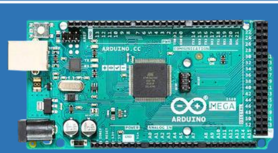
RECEIVER TYPES PrOTOCOL

PPM RECEIVER

SERIALRECEIVER

PWM RECEIVER

RECEIVER TYPE CONFIGURATIONS

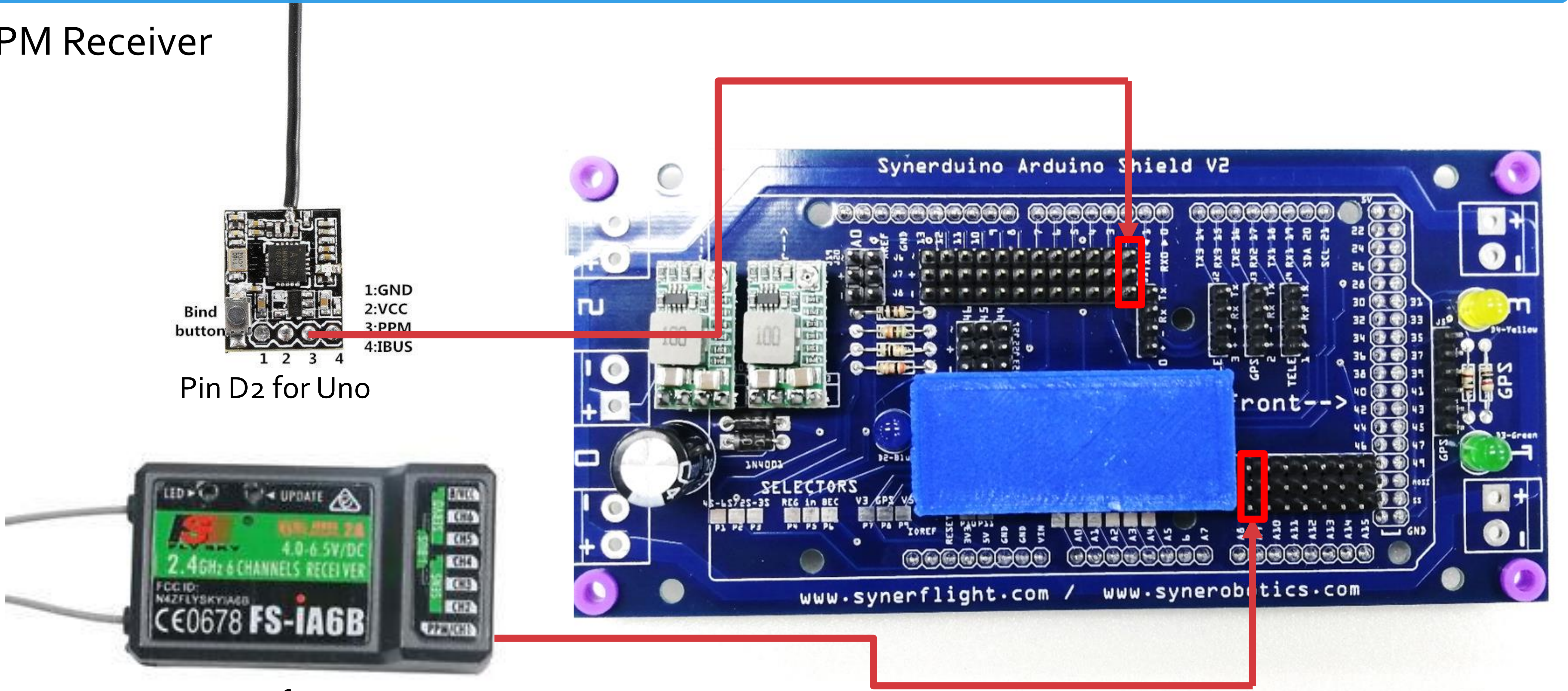
RX > SBUS INPUT	FUTABA FORMAT	JR FORMAT	WALKERA FORMAT	GRAUPNER FORMAT	MEGA 2560
	AETR	TAER	EATR	ERTA	INPUT
					
THROTTLE	CH3	CH1	CH3	CH3	A8
AILERON	CH1	CH2	CH2	CH4	A9
ELEVATOR	CH2	CH3	CH1	CH1	A10
RUDDER	CH4	CH4	CH4	CH2	A11
AUX 1	CH5	CH5	CH5	CH5	A12
AUX 2	CH6	CH6	CH6	CH6	A13
AUX 3	CH7	CH7	CH7	CH7	A14
AUX 4	CH8	CH8	CH8	CH8	A15

RECEIVER TYPE CONFIGURATIONS

RX > SBUS INPUT	FUTABA FORMAT	JR FORMAT	WALKERA FORMAT	GRAUPNER FORMAT	UNO
	AETR	TAER	EATR	ERTA	INPUT
					
THROTTLE	CH3	CH1	CH3	CH3	D2
AILERON	CH1	CH2	CH2	CH4	D4
ELEVATOR	CH2	CH3	CH1	CH1	D5
RUDDER	CH4	CH4	CH4	CH2	D6
AUX 1	CH5	CH5	CH5	CH5	D7
AUX 2	CH6	CH6	CH6	CH6	D8
AUX 3	CH7	CH7	CH7	CH7	N/A
AUX 4	CH8	CH8	CH8	CH8	N/A

OTHER RECEIVER TYPE

PPM Receiver

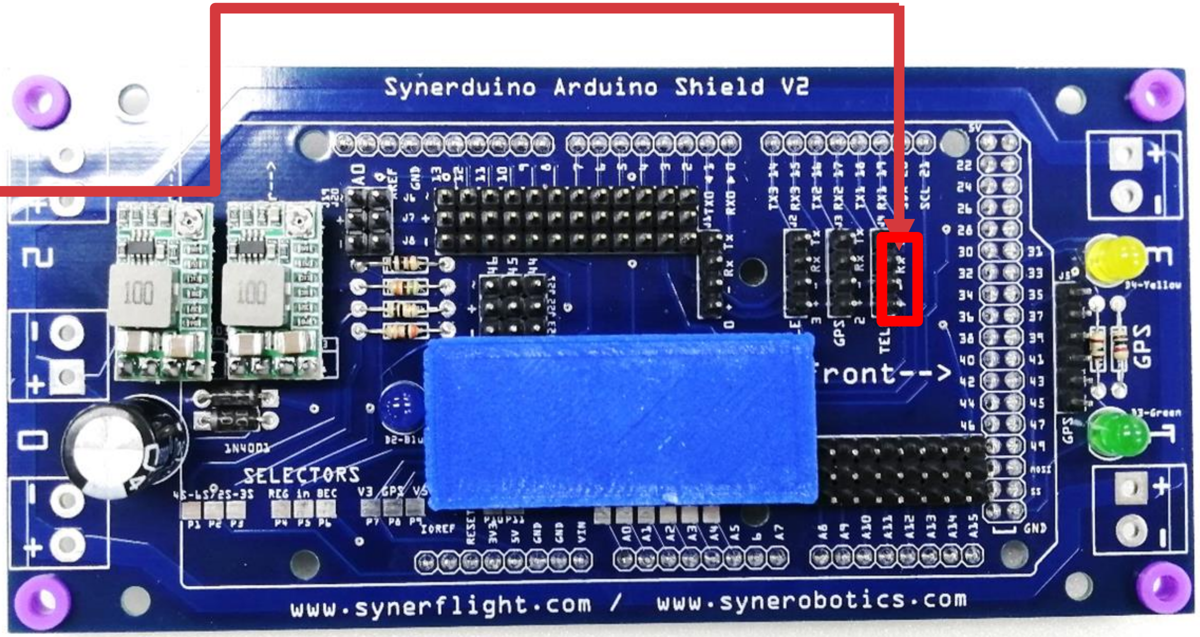


Pin A8 for Mega

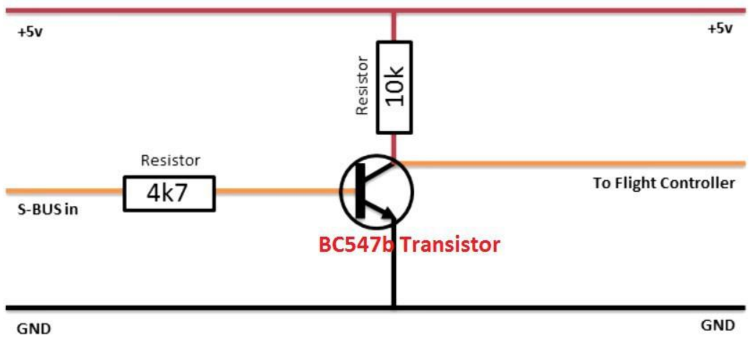
OTHER RECEIVER TYPE

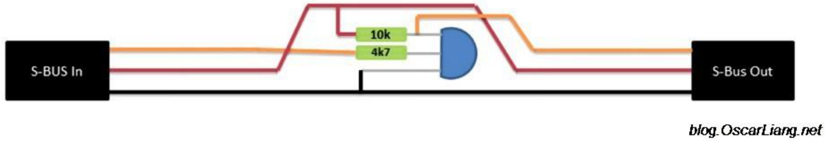
SBUS Receiver

RX 1 Telemetry



The SBUS system uses Futaba protocol and should be compatible with Most SBUS Receivers





SBUS Inverter

Should there be issues in Signal Inversion an SBUS inverter may be use

You can tell if the RC control is not being read

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

SOFTWARE SETUP

AIRCRAFT SELECTION FOR FIXWINGS

Synerfight has 2 Selection for Fixwings on the Download tab

Legacy – support single motor Fixwings (Airplane and Flying Wing)

- Legacy Plane (Single Motor Classic FixWing)
- Synerduino Firmware .ino (Flying wings)

Special – Support Diff thrust and Special Mode Fixwings

- Special Airplane (Support M9 – M10 NMEA , M7-M8 UBX.Home Reset) (2024)
- Legacy Special Airplane (Support M5 – M6 NMEA , M7-M8 UBX) (2023)

AIRCRAFT SELECTION FOR FIXWINGS

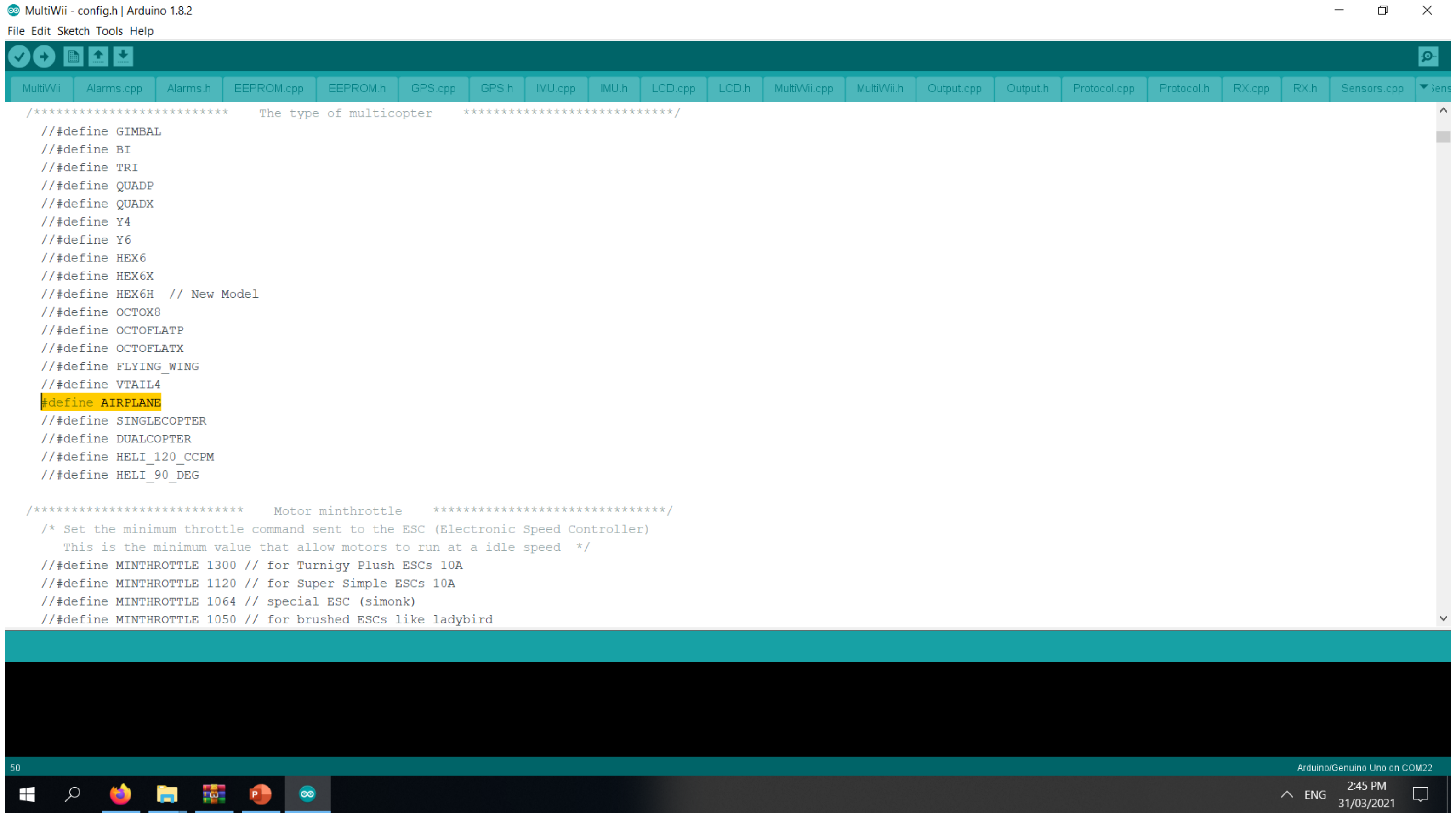
Legacy Airplane

- Uncomment #Define AIRPLANE

- This puts the vehicle into
- Conventional Airplane mode

- Uncomment #Define FLYIMGWING

- This puts the vehicle into
- Conventional Flying Wing mode



AIRCRAFT SELECTION FOR FIXWINGS

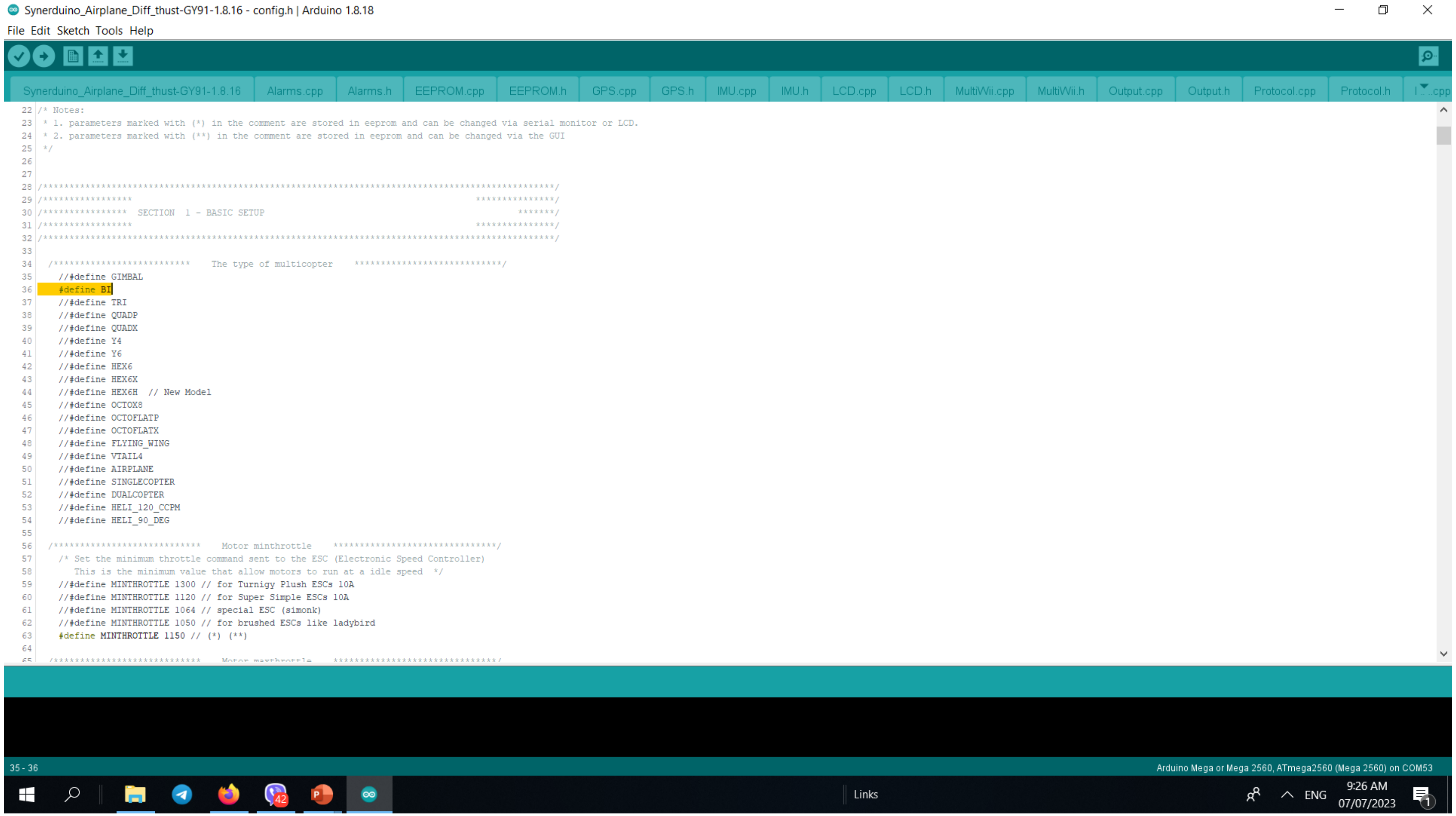
Special Airplane

Config.h

- Uncomment Define Bi

- This puts the vehicle into
- Bi diff thrust mode Spacial plane mode

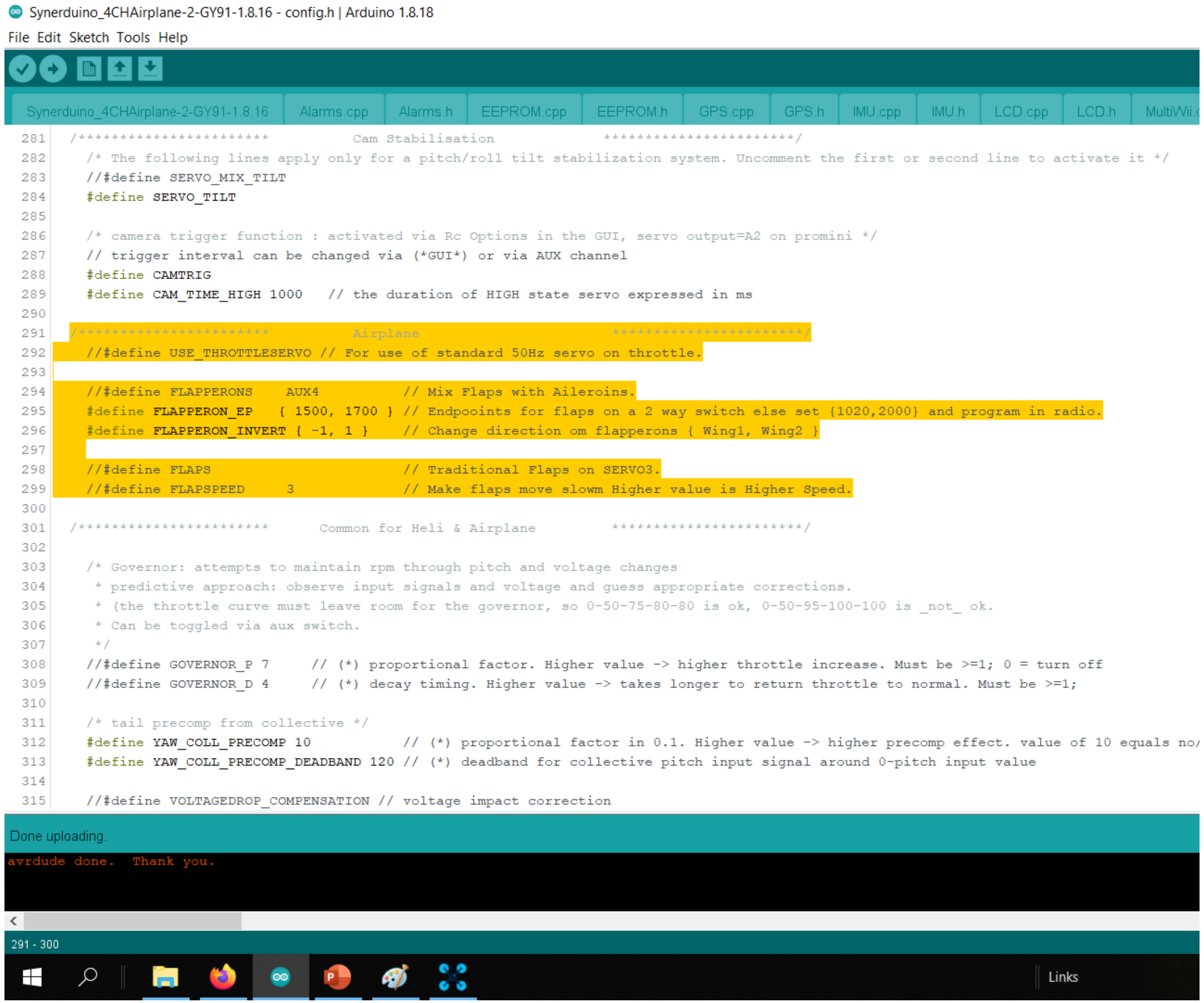
- Only applicable on special Airplane ino skech



AIRCRAFT SELECTION FOR FIXWINGS

CONFIG.H

IF FIXWING USES FLAPPERON OR CONVENTIONAL FLAPS



MOTOR MIN THROTTLE

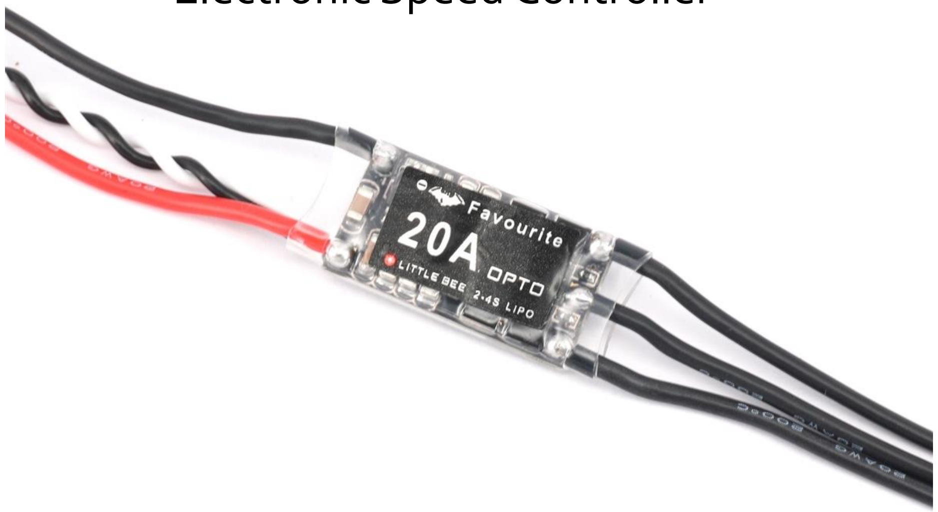
CONFIG.H

#define MAXTHROTTLE 2000

Because you want Full Power sometimes!

MOTOR MIN THROTTLE

Electronic Speed Controller



Brushless Motor

1500

Idle Speed

MINTHROTTLE 1150

PWM Frequency

MAXTHROTTLE 1850

MINCOMMAND 800 - 1100

1900 – 2000

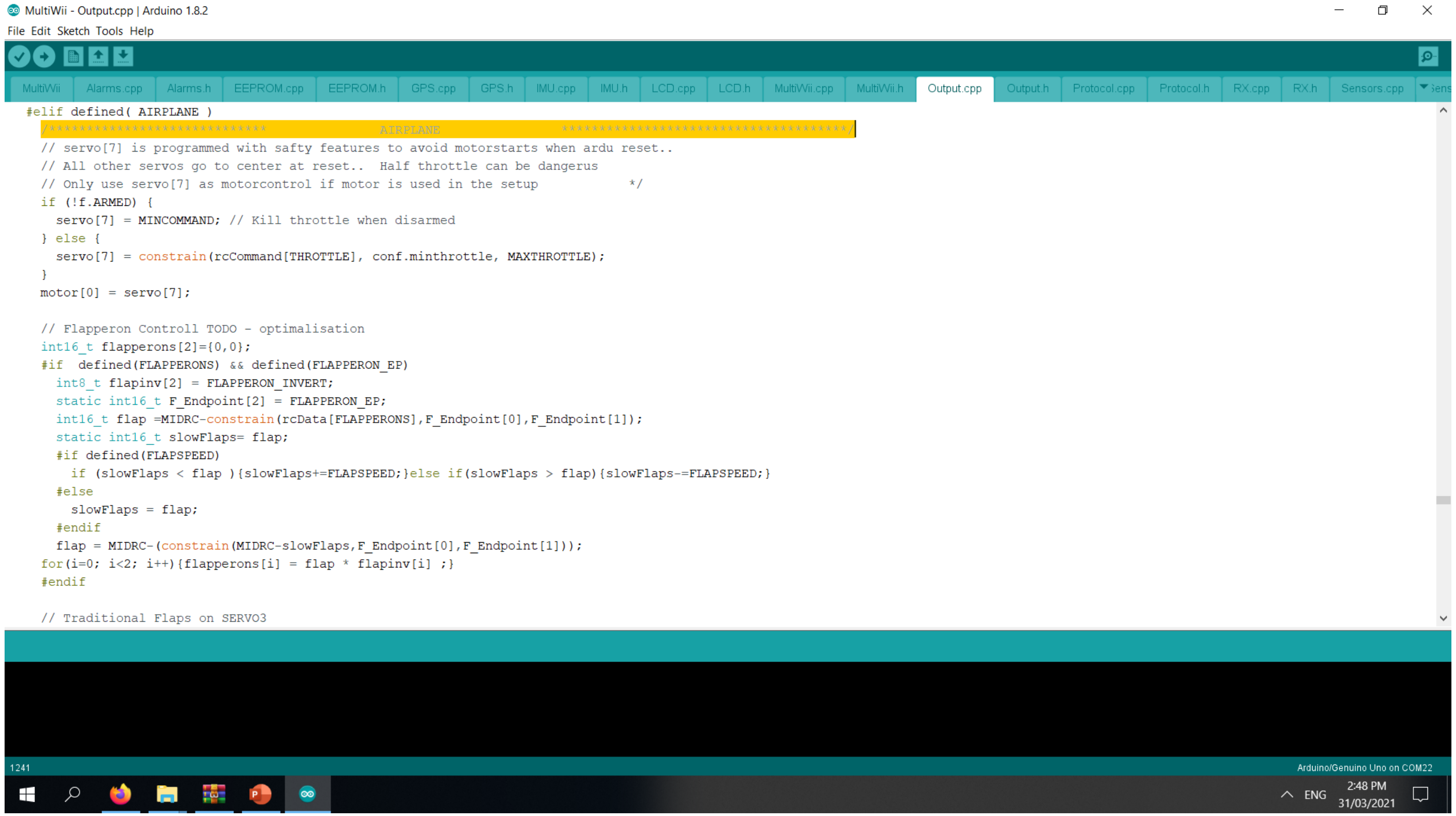
LEGACY AIRPLANE

Legacy Airplane

- Servo reversing is done thru here apart those on the flywii GUI

- This also covers flaps and flapperons

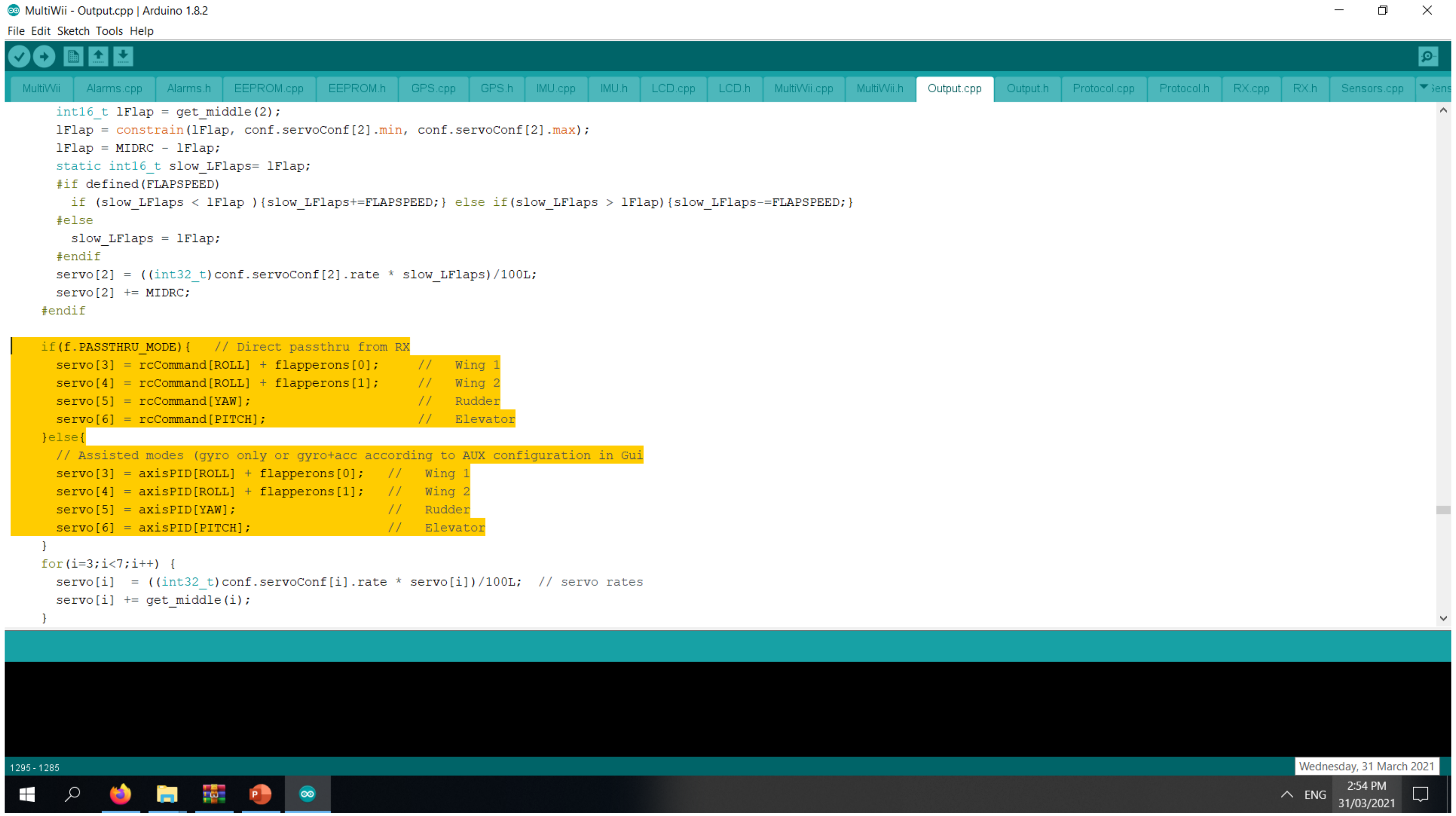
- Flying wing / Vtail modes are also set in this area



LEGACY AIRPLANE

Legacy Airplane

- Servo reversing is done thru here apart those on the flywii GUI
- This also covers flaps and flapperons
- Flying wing / Vtail modes are also set in this area



Output.cpp

SPECIAL AIRPLANE

Main Mix table should you need to custom mix your plane (Define {Bi}) Special Airplane

Synerduino_Airplane_Diff_thust-GY91-1.8.16 - Output.cpp | Arduino 1.8.18

```
#if defined( MY_PRIVATE_MIXING )
  #include MY_PRIVATE_MIXING
#elif defined( BI )
  //motor[0] = PIDMIX(+1, 0, 0); //LEFT
  //motor[1] = PIDMIX(-1, 0, 0); //RIGHT
  //servo[4] = (SERVODIR(4,2) * axisPID[YAW]) + (SERVODIR(4,1) * axisPID[PITCH]) + get_middle(4); //LEFT
  //servo[5] = (SERVODIR(5,2) * axisPID[YAW]) + (SERVODIR(5,1) * axisPID[PITCH]) + get_middle(5); //RIGHT
/****************          BI Airplane Elevator Ailron            ******************/
  motor[0] = PIDMIX(0, 0, +1); //LEFT
  motor[1] = PIDMIX(0, 0, -1); //RIGHT
  servo[4] = (SERVODIR(4,2) * axisPID[PITCH]) + get_middle(4); //ELEVATOR
  servo[5] = (SERVODIR(5,2) * axisPID[ROLL]) + get_middle(5);//AILERON
  /****************          BI Wing Elevon            ******************/
  //motor[0] = PIDMIX(0, 0, +1); //LEFT
  //motor[1] = PIDMIX(0, 0, -1); //RIGHT
  //servo[4] = (SERVODIR(4,2) * axisPID[ROLL]) + (SERVODIR(4,1) * axisPID[PITCH]) + get_middle(4); //LEFT
  //servo[5] = (SERVODIR(5,2) * axisPID[ROLL]) + (SERVODIR(5,1) * axisPID[PITCH]) + get_middle(5); //RIGHT

#elif defined( TRI )
  motor[0] = PIDMIX( 0,+4/3, 0); //REAR
  motor[1] = PIDMIX(-1,-2/3, 0); //RIGHT
  motor[2] = PIDMIX(+1,-2/3, 0); //LEFT
  servo[5] = (SERVODIR(5, 1) * axisPID[YAW]) + get_middle(5); //REAR
#elif defined( QUADP )
  motor[0] = PIDMIX( 0,+1,-1); //REAR
  motor[1] = PIDMIX(-1, 0,+1); //RIGHT
  motor[2] = PIDMIX(+1, 0,+1); //LEFT
  motor[3] = PIDMIX( 0,-1,-1); //FRONT
#elif defined( QUADX )
  motor[0] = PIDMIX(-1,+1,-1); //REAR_R
  motor[1] = PIDMIX(-1,-1,+1); //FRONT_R
  motor[2] = PIDMIX(+1,+1,+1); //REAR_L
  motor[3] = PIDMIX(+1,-1,-1); //FRONT_L
#elif defined( Y4 )
  motor[0] = PIDMIX(+0,+1,-1);   //REAR_1 CW
  motor[1] = PIDMIX(-1,-1, 0); //FRONT_R CCW
  motor[2] = PIDMIX(+0,+1,+1);   //REAR_2 CCW
  motor[3] = PIDMIX(+1,-1, 0); //FRONT_L CW
#elif defined( Y6 )
  motor[0] = PIDMIX(+0,+4/3,+1); //REAR
  motor[1] = PIDMIX(-1,-2/3,-1); //RIGHT
  motor[2] = PIDMIX(+1,-2/3,-1); //LEFT
  motor[3] = PIDMIX(+0,+4/3,-1); //UNDER_REAR
  motor[4] = PIDMIX(-1,-2/3,+1); //UNDER_RIGHT
```

1147 - 1144

Arduino Mega or Mega 2560, ATmega2560 (Mega 2560) on COM53

Output.cpp

SPECIAL AIRPLANE

Main Mix table should you need to custom mix your plane (Define {Bi})

Special Airplane

Synerduino_3CHAirplane-GY91-1.8.16 | Alarms.cpp | Alarms.h | EEPROM.cpp | EEPROM.h | GPS.cpp | GPS.h | IMU.cpp | IMU.h | LCD.cpp | LCD.h | MultiWii.cpp | MultiWii.h | Output.cpp

```
#if defined(DYNBALANCE)
  return;
#endif
#define PIDMIX(X,Y,Z) rcCommand[THROTTLE] + axisPID[ROLL]*X + axisPID[PITCH]*Y + YAW_DIRECTION * axisPID[YAW]*Z
#define SERVODIR(n,b) ((conf.servoConf[n].rate & b) ? -1 : 1)

  /****************                   main Mix Table                ******************/
#if defined( MY_PRIVATE_MIXING )
#include MY_PRIVATE_MIXING
#elif defined( BI )
  //motor[0] = PIDMIX(+1, 0, 0); //LEFT
  //motor[1] = PIDMIX(-1, 0, 0); //RIGHT
  //servo[4] = (SERVODIR(4,2) * axisPID[YAW]) + (SERVODIR(4,1) * axisPID[PITCH]) + get_middle(4); //LEFT
  //servo[5] = (SERVODIR(5,2) * axisPID[YAW]) + (SERVODIR(5,1) * axisPID[PITCH]) + get_middle(5); //RIGHT
  /****************                   3ch Airplane Throttle Elevator Rudder              ******************/
  motor[0] = PIDMIX(0, 0, 0); //LEFT
  motor[1] = PIDMIX(0, 0, 0); //RIGHT
  servo[4] = (SERVODIR(4, 1) * axisPID[YAW]) + get_middle(4); //RUDDER
  servo[5] = (SERVODIR(5, 1) * axisPID[PITCH]) + get_middle(5); //ELEVATOR
  /****************                   BI Airplane Elevator Ailron              ******************/
  //motor[0] = PIDMIX(0, 0, +1); //LEFT
  //motor[1] = PIDMIX(0, 0, -1); //RIGHT
  //servo[4] = (SERVODIR(4,1) * axisPID[ROLL]) + get_middle(4); //AILERON
  //servo[5] = (SERVODIR(5,1) * axisPID[PITCH]) + get_middle(5);//ELEVATOR
  /****************                   BI Wing Elevon              ******************/
  //motor[0] = PIDMIX(0, 0, +1); //LEFT
  //motor[1] = PIDMIX(0, 0, -1); //RIGHT
  //servo[4] = (SERVODIR(4,2) * axisPID[ROLL]) + (SERVODIR(4,1) * axisPID[PITCH]) + get_middle(4); //LEFT
  //servo[5] = (SERVODIR(5,2) * axisPID[ROLL]) + (SERVODIR(5,1) * axisPID[PITCH]) + get_middle(5); //RIGHT
```

Def.h

SPECIAL AIRPLANE

Special Airplane

Define custom selection of servo timers

/************************* all the Mega types ********************************/

Synerduino_4CHAirplane-2-GY91-1.8.16 | Alarms.cpp | Alarms.h | EEPROM.cpp | EEPROM.h | GPS.cpp | GPS.h | IMU.cpp | IMU.h | LCD.cpp | LCD.h | MultiWii.cpp | MultiWii.h | Output.cpp | Output.h | Protocol.cpp | Protocol.h | RX.c

```
#define AUX2PIN                  5  //PIN 67 =  PIN A13
#define AUX3PIN                  6  //PIN 68 =  PIN A14
#define AUX4PIN                  7  //PIN 69 =  PIN A15
#define V_BATPIN                 A0    // Analog PIN 0
#define PSENSORPIN               A2    // Analog PIN 2
#define PCINT_PIN_COUNT          8
#define PCINT_RX_BITS            (1<<2),(1<<4),(1<<5),(1<<6),(1<<7),(1<<0),(1<<1),(1<<3)
#define PCINT_RX_PORT            PORTK
#define PCINT_RX_MASK            PCMSK2
#define PCIR_PORT_BIT            (1<<2)
#define RX_PC_INTERRUPT          PCINT2_vect
#define RX_PCINT_PIN_PORT        PINK

#define SERVO_1_PINMODE          pinMode(34,OUTPUT);pinMode(44,OUTPUT); // TILT_PITCH - WING left
#define SERVO_1_PIN_HIGH         PORTC |= 1<<3;PORTL |= 1<<5;
#define SERVO_1_PIN_LOW          PORTC &= ~(1<<3);PORTL &= ~(1<<5);
#define SERVO_2_PINMODE          pinMode(35,OUTPUT);pinMode(45,OUTPUT); // TILT_ROLL  - WING right
#define SERVO_2_PIN_HIGH         PORTC |= 1<<2;PORTL |= 1<<4;
#define SERVO_2_PIN_LOW          PORTC &= ~(1<<2);PORTL &= ~(1<<4);
#define SERVO_3_PINMODE          pinMode(33,OUTPUT); pinMode(46,OUTPUT); // CAM TRIG  - alt TILT_PITCH
#define SERVO_3_PIN_HIGH         PORTC |= 1<<4;PORTL |= 1<<3;
#define SERVO_3_PIN_LOW          PORTC &= ~(1<<4);PORTL &= ~(1<<3);
#define SERVO_4_PINMODE          pinMode (37, OUTPUT);pinMode(7,OUTPUT); // // Spare output      - alt TILT_ROLL
#define SERVO_4_PIN_HIGH         PORTC |= 1<<0; PORTH |= 1<<4;
#define SERVO_4_PIN_LOW          PORTC &= ~(1<<0);PORTH &= ~(1<<4);

#define SERVO_5_PINMODE          pinMode(6,OUTPUT);                      // BI LEFT
#define SERVO_5_PIN_HIGH         PORTH |= 1<<3;
#define SERVO_5_PIN_LOW          PORTH &= ~(1<<3);
#define SERVO_6_PINMODE          pinMode(2,OUTPUT);                      // TRI REAR - BI RIGHT
#define SERVO_6_PIN_HIGH         PORTE |= 1<<4;
#define SERVO_6_PIN_LOW          PORTE &= ~(1<<4);
#define SERVO_7_PINMODE          pinMode(5,OUTPUT);                      // new
#define SERVO_7_PIN_HIGH         PORTE |= 1<<3;
```

Arduino Version: 1.8.18

INERTIAL MEASURING UNIT MEASURING UNIT

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

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

Each sensor has a corresponding address registry set by manufacturer

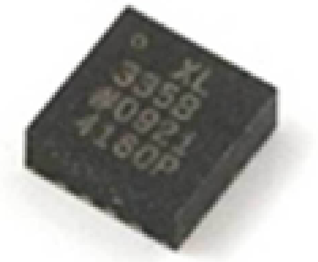
You can find it on sensors.ccp tab

Sensors work best if mounted as close to CG as possible.

Magnetometer

Barometer

Accelerometer



Gyroscope

INERTIAL MEASURING UNIT MEASURING UNIT

Config.h

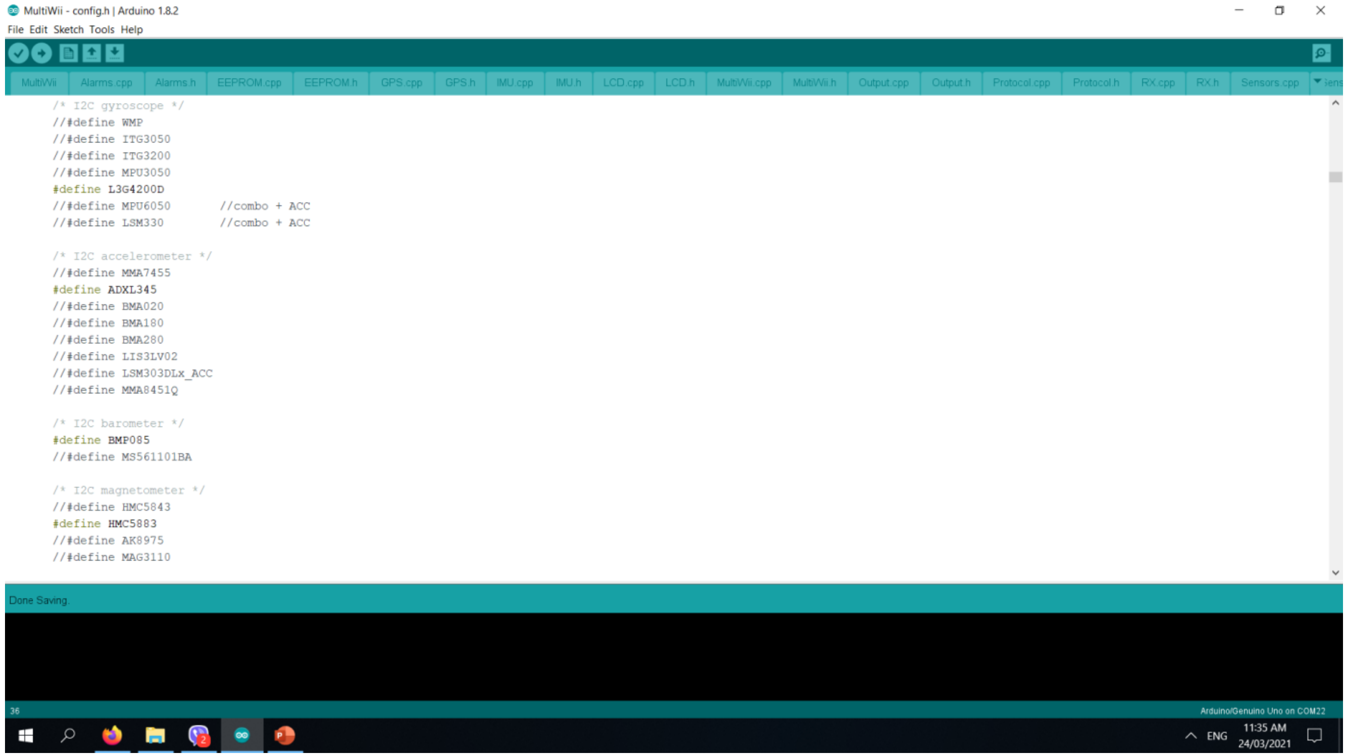
Sensors

#define L3G4200D

#define ADXL345

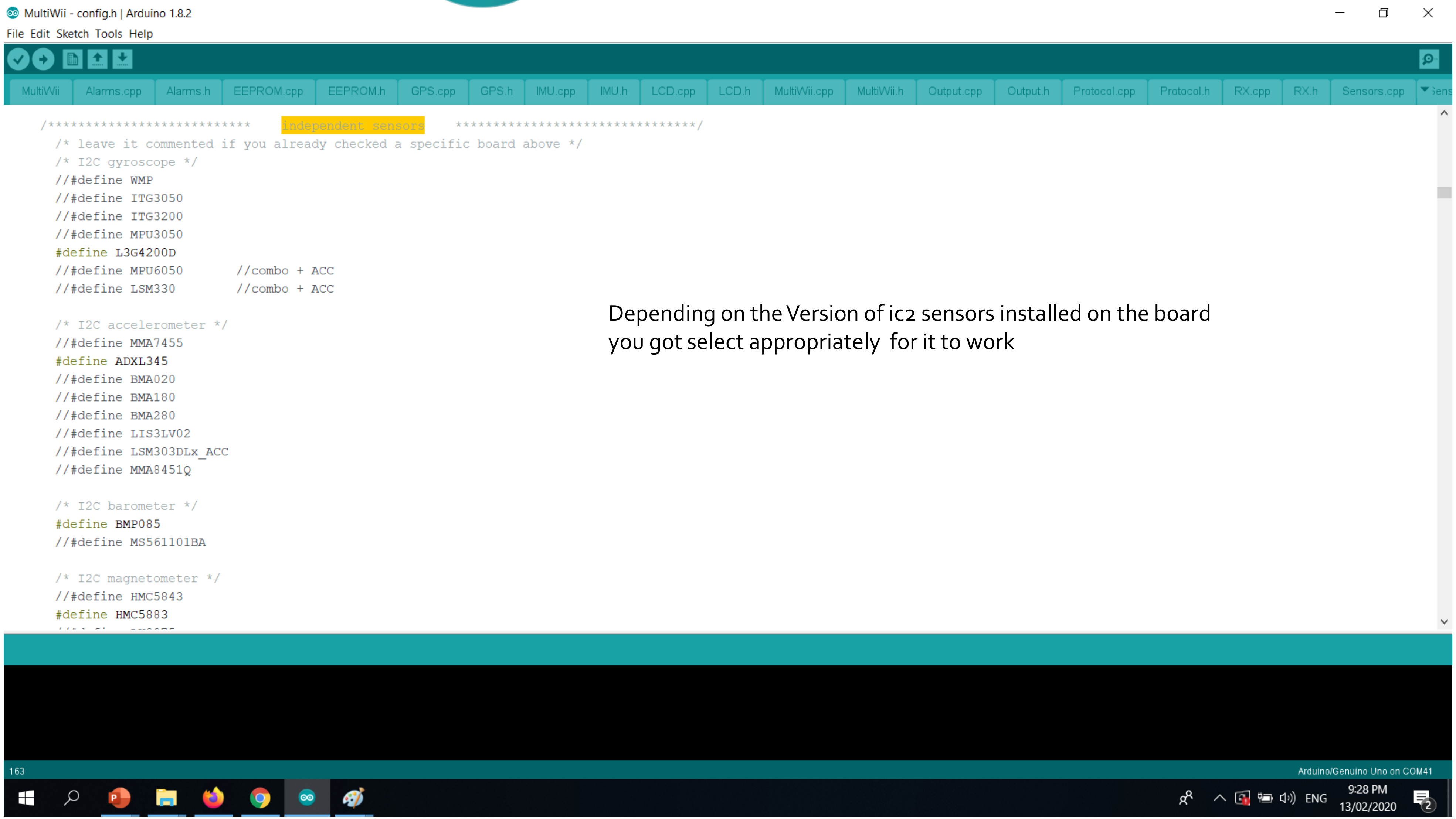
#define BMP085

#define MMC5883



CONFIG.H

INERTIAL MEASURING UNIT MEASURING UNIT



Depending on the Version of ic2 sensors installed on the board you got select appropriately for it to work

SENSORS.CCP

INERTIAL MEASURING UNIT MEASURING UNIT

MultiWii - Sensors.cpp | Arduino 1.8.2

File Edit Sketch Tools Help

MultiWii | Alarms.h | EEPROM.cpp | EEPROM.h | GPS.cpp | GPS.h | IMU.cpp | IMU.h | LCD.cpp | LCD.h | MultiWii.cpp | MultiWii.h | Output.cpp | Output.h | Protocol.cpp | Protocol.h | RX.cpp | RX.h | Sensors.cpp

```
#endif

// ************************************************************************************************************
// I2C Gyroscope L3G4200D
// ************************************************************************************************************
#if defined(L3G4200D)
#define L3G4200D_ADDRESS 0x69
void Gyro_init() {
  delay(100);
  i2c_writeReg(L3G4200D_ADDRESS ,0x20 ,0x8F ); // CTRL_REG1   400Hz ODR, 20hz filter, run!
  delay(5);
  i2c_writeReg(L3G4200D_ADDRESS ,0x24 ,0x02 ); // CTRL_REG5   low pass filter enable
  delay(5);
  i2c_writeReg(L3G4200D_ADDRESS ,0x23 ,0x30); // CTRL_REG4 Select 2000dps
}

void Gyro_getADC () {
  i2c_getSixRawADC(L3G4200D_ADDRESS,0x80|0x28);

  GYRO_ORIENTATION( ((rawADC[1]<<8) | rawADC[0])>>2  ,
                    ((rawADC[3]<<8) | rawADC[2])>>2  ,
                    ((rawADC[5]<<8) | rawADC[4])>>2  );
  GYRO_Common();
}
#endif

// ************************************************************************************************************
// I2C Gyroscope ITG3200 / ITG3205 / ITG3050 / MPU3050
```

851   Arduino/Genuino Uno on COM41

9:37 PM 13/02/2020

SENSORS.CCP

INERTIAL MEASURING UNIT MEASURING UNIT

MultiWii - Sensors.cpp | Arduino 1.8.2

```
// I2C Accelerometer ADXL345
// ************************************************************************************************************
// I2C adress: 0x3A (8bit)    0x1D (7bit)
// Resolution: 10bit (Full range - 14bit, but this is autoscaling 10bit ADC to the range +- 16g)
// principle:
//  1) CS PIN must be linked to VCC to select the I2C mode
//  2) SD0 PIN must be linked to VCC to select the right I2C adress
//  3) bit  b00000100 must be set on register 0x2D to read data (only once at the initialization)
//  4) bits b00001011 must be set on register 0x31 to select the data format (only once at the initialization)
// ************************************************************************************************************
#if defined(ADXL345)
#if !defined(ADXL345_ADDRESS)
  //#define ADXL345_ADDRESS 0x1D
  #define ADXL345_ADDRESS 0x53   //WARNING: Conflicts with a Wii Motion plus!
#endif

void ACC_init () {
  delay(10);
  i2c_writeReg(ADXL345_ADDRESS,0x2D,1<<3); //  register: Power CTRL  -- value: Set measure bit 3 on
  i2c_writeReg(ADXL345_ADDRESS,0x31,0x0B); //  register: DATA_FORMAT -- value: Set bits 3(full range) and 1 0 on (+/- 16g-range)
  i2c_writeReg(ADXL345_ADDRESS,0x2C,0x09); //  register: BW_RATE     -- value: rate=50hz, bw=20hz
}

void ACC_getADC () {
  i2c_getSixRawADC(ADXL345_ADDRESS,0x32);

  ACC_ORIENTATION( ((rawADC[1]<<8) | rawADC[0]) ,
                   ((rawADC[3]<<8) | rawADC[2]) ,
```

642

Arduino/Genuino Uno on COM41

SENSORS.CCP

INERTIAL MEASURING UNIT MEASURING UNIT

MultiWii - Sensors.cpp | Arduino 1.8.2

File Edit Sketch Tools Help

MultiWii | Alarms.h | EEPROM.cpp | EEPROM.h | GPS.cpp | GPS.h | IMU.cpp | IMU.h | LCD.cpp | LCD.h | MultiWii.cpp | MultiWii.h | Output.cpp | Output.h | Protocol.cpp | Protocol.h | RX.cpp | RX.h | Sensors.cpp

```
// ************************************************************************************************************
// I2C Barometer BOSCH BMP085
// ************************************************************************************************************
// I2C adress: 0x77 (7bit)
// principle:
//  1) read the calibration register (only once at the initialization)
//  2) read uncompensated temperature (not mandatory at every cycle)
//  3) read uncompensated pressure
//  4) raw temp + raw pressure => calculation of the adjusted pressure
//  the following code uses the maximum precision setting (oversampling setting 3)
// ************************************************************************************************************

#if defined(BMP085)
#define BMP085_ADDRESS 0x77

static struct {
  // sensor registers from the BOSCH BMP085 datasheet
  int16_t  ac1, ac2, ac3;
  uint16_t ac4, ac5, ac6;
  int16_t  b1, b2, mb, mc, md;
  union {uint16_t val; uint8_t raw[2]; } ut; //uncompensated T
  union {uint32_t val; uint8_t raw[4]; } up; //uncompensated P
  uint8_t  state;
  uint32_t deadline;
} bmp085_ctx;
#define OSS 3

/* transform a series of bytes from big endian to little
```

331

Arduino/Genuino Uno on COM41

ENG 9:40 PM 13/02/2020

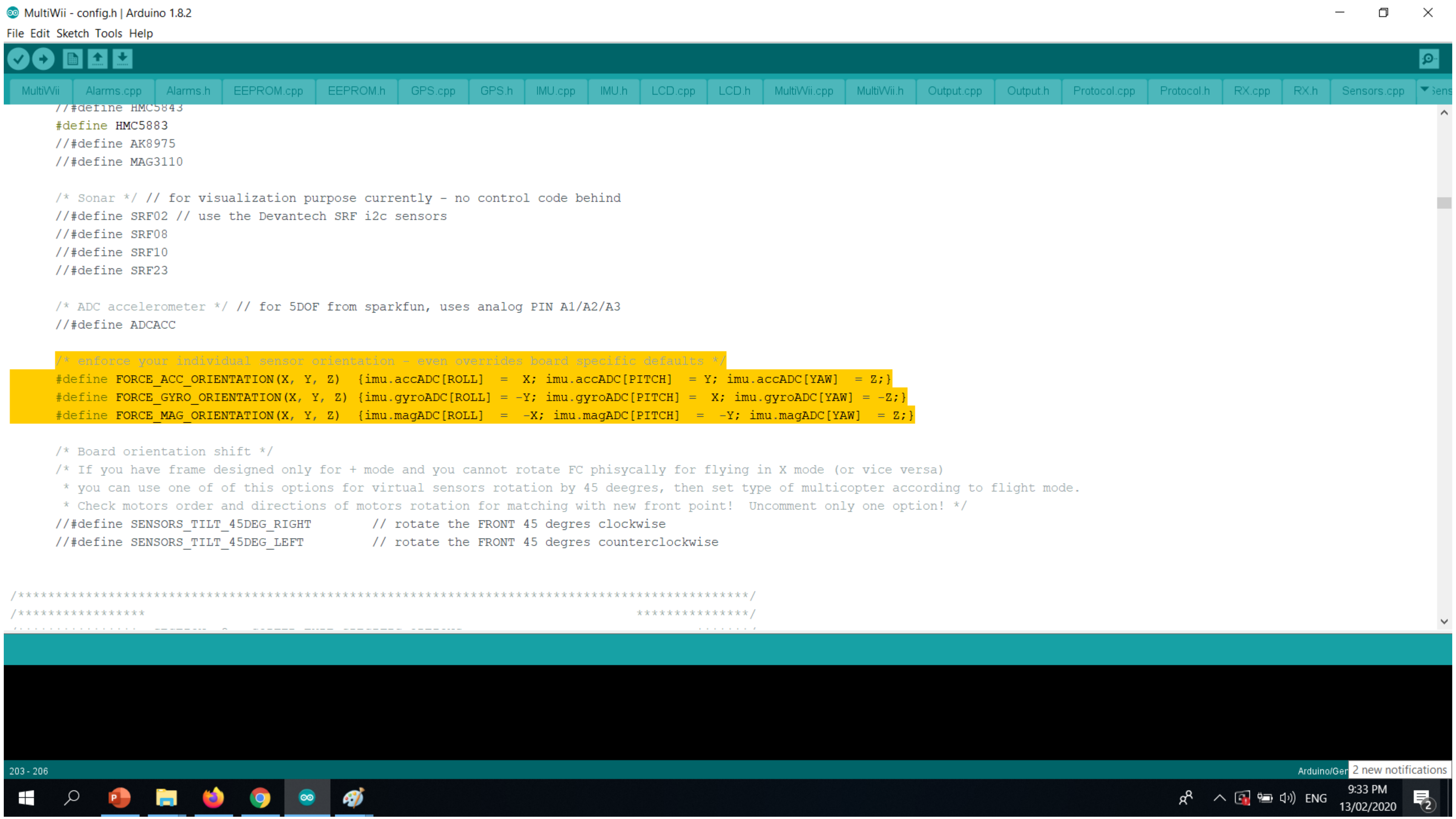
SENSORS.CPP

INERTIAL MEASURING UNIT MEASURING UNIT

MultiWii - Sensors.cpp | Arduino 1.8.2

```
// I2C Compass MMC5883
// ******************************************************************************************
// I2C adress: 0x30 (8bit)   0x00 (7bit)
// ******************************************************************************************

#if defined(MMC5883)

#define MAG_ADDRESS 0x30
#define MAG_DATA_REGISTER 0x00 //Read register address
//REG CONTROL
#define MMC5883MA_OUT 0x00
#define MMC5883MA_XOUT 0x00
#define MMC5883MA_XOUT_LOW 0x00
#define MMC5883MA_XOUT_HIGH 0x01
#define MMC5883MA_YOUT 0x02
#define MMC5883MA_YOUT_LOW 0x02
#define MMC5883MA_YOUT_HIGH 0x03
#define MMC5883MA_ZOUT 0x04
#define MMC5883MA_ZOUT_LOW 0x04
#define MMC5883MA_ZOUT_HIGH 0x05
#define MMC5883MA_TEMPERATURE 0x06
#define MMC5883MA_STATUS 0x07
#define MMC5883MA_INTERNAL_CONTROL_0 0x08
#define MMC5883MA_INTERNAL_CONTROL_1 0x09
#define MMC5883MA_INTERNAL_CONTROL_2 0x0A
#define MMC5883MA_X_THRESHOLD 0x0B
#define MMC5883MA_Y_THRESHOLD 0x0C
#define MMC5883MA_Z_THRESHOLD 0x0D
```

SENSOR ORIENTATION CONFIG.H



SENSORS IMU ORIENTATION IS IMPORTANT SEE TO IT THE ACC GYRO AND MAG ALL COMPLIMENT EACH OTHER

RECEIVER TYPES PROTOCOL

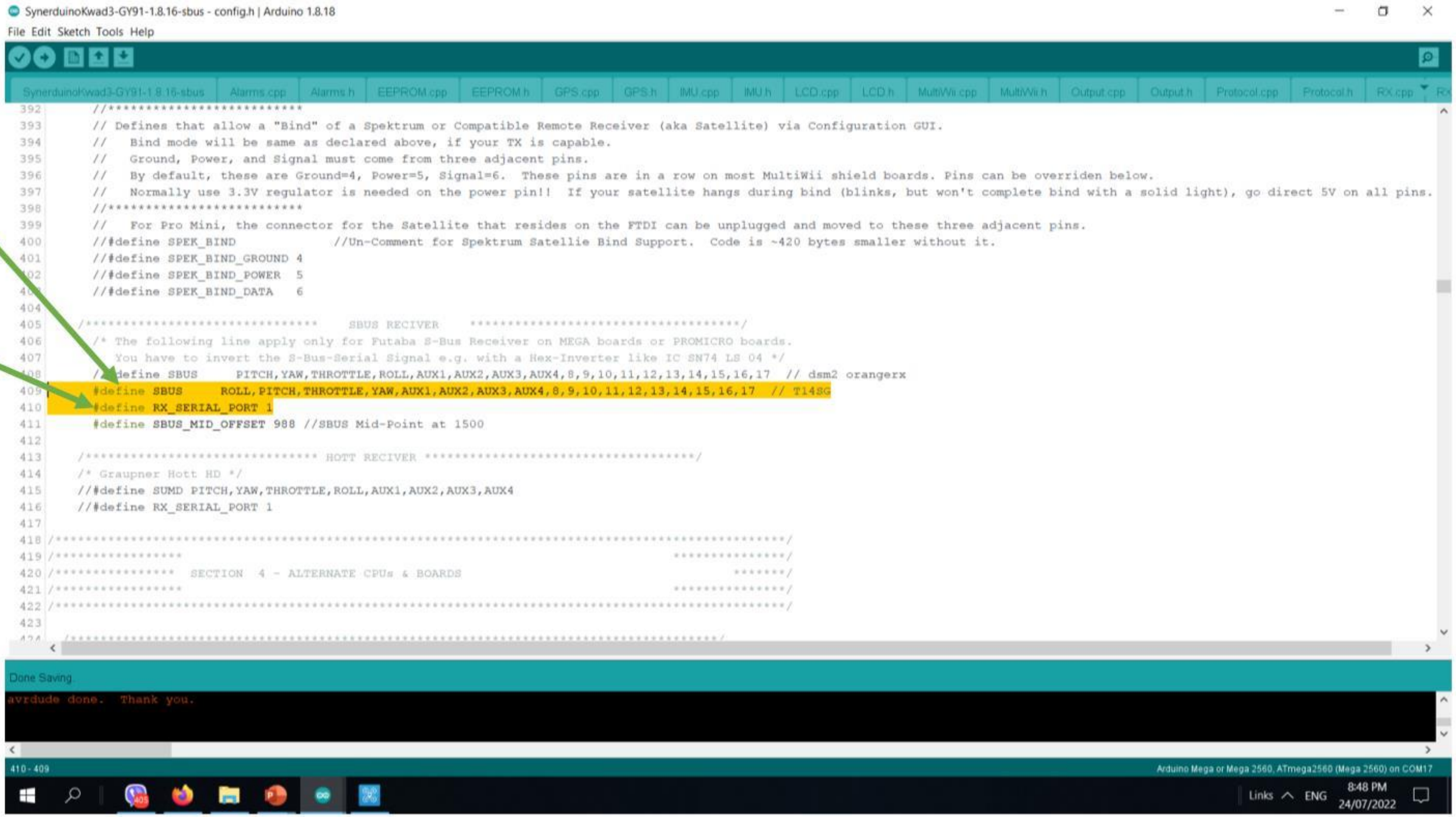
CONFIG.H

For SBUS Receiver

Channel Mapping

Uncomment SBUS on RX Serial Port 1 (Telemetry 1)

You may need to uncomment and change the ordering of your channel depending on your Transmitter's model and specification

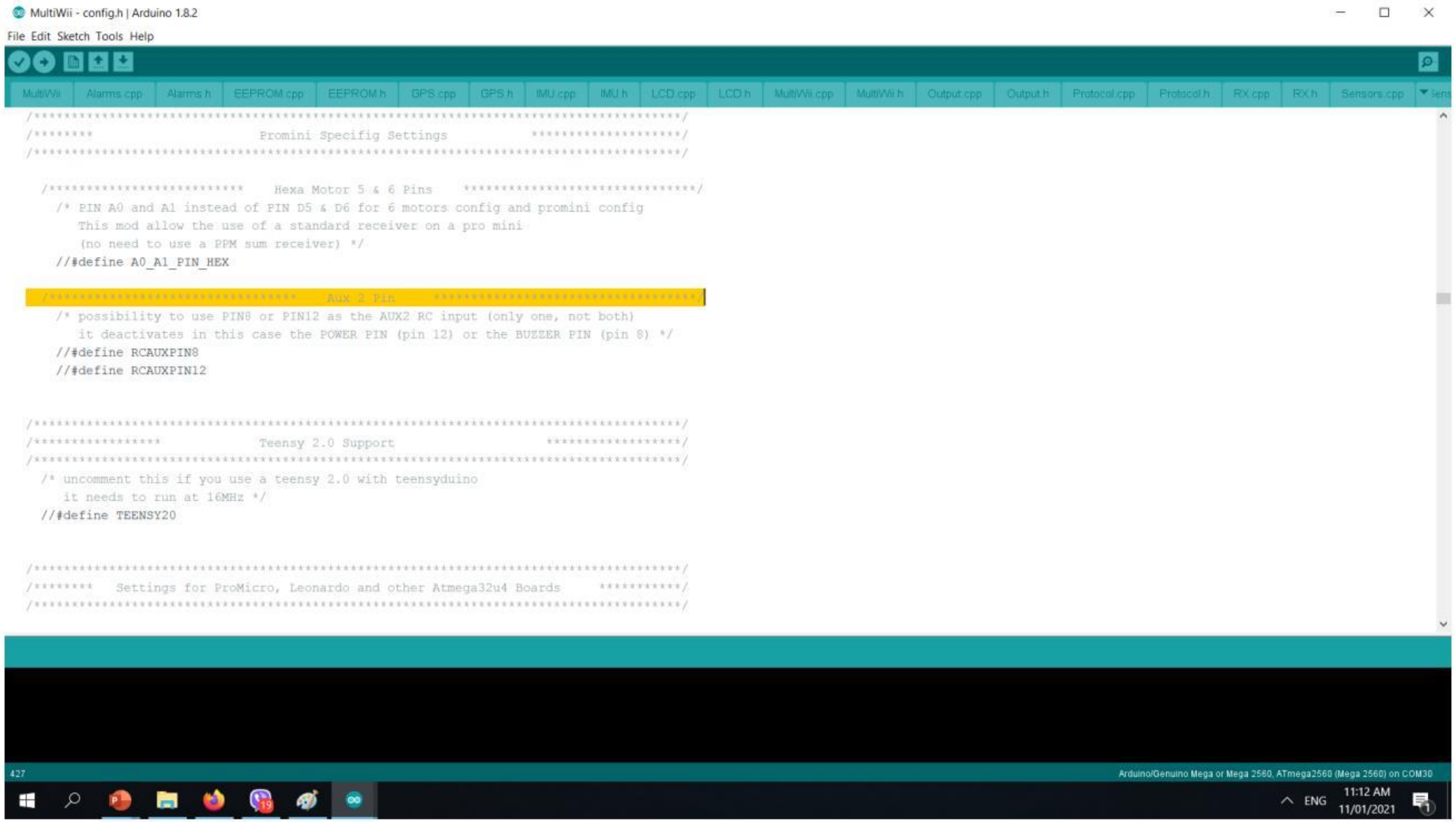


RECEIVER TYPES PROTOCOL

CONFIG.H

AUX PIN

For UNO you need to define your PPM Aux 2 Pin



TELEMETRY COM SPEED

CONFIG.H

SERIAL BAUD RATE

WILL DEPEND ON WHAT BAUD YOUR TELEMETRY MODULE ARE SET INTO YOU CAN CHANGE IT TO SUITE THE PORT YOUR DEVICE IS CONNECTED TO.

SERIAL 0 CAN BE USE FOR TELEMETRY GIVEN NOTHING IS CONNECTED TO THE USB AT THIS POINT. AND FIRMWARE MUST BE FLISH PRIOR TO HOOKING UP ANYTHING TO THIS PINS

SERIAL 1 , 3 IS RESERVE FOR TELEMETRY

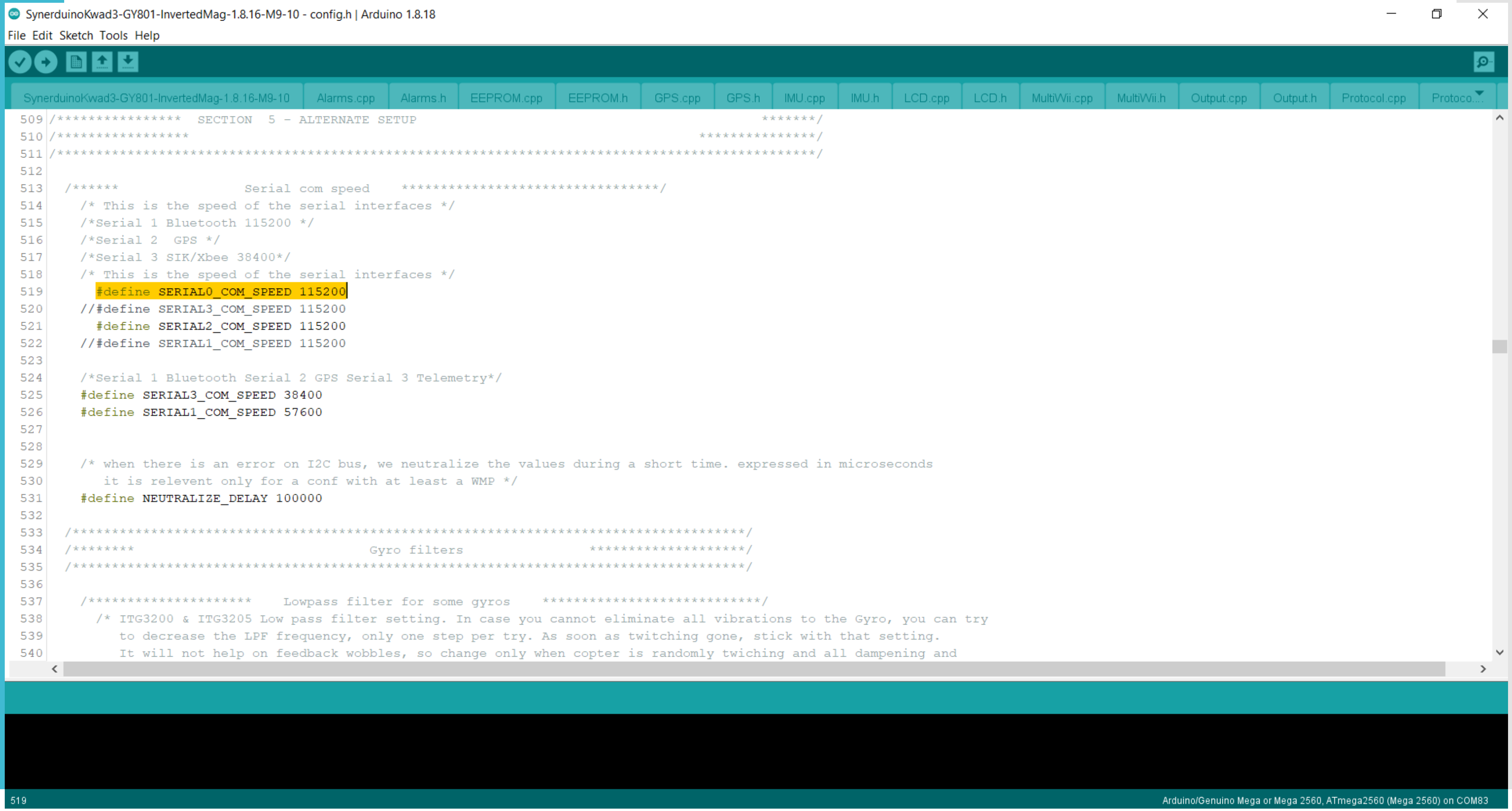
115200 FOR BLUETOOTH HC-05

38400 FOR XBEE RADIO

57600 for SIK RADIO

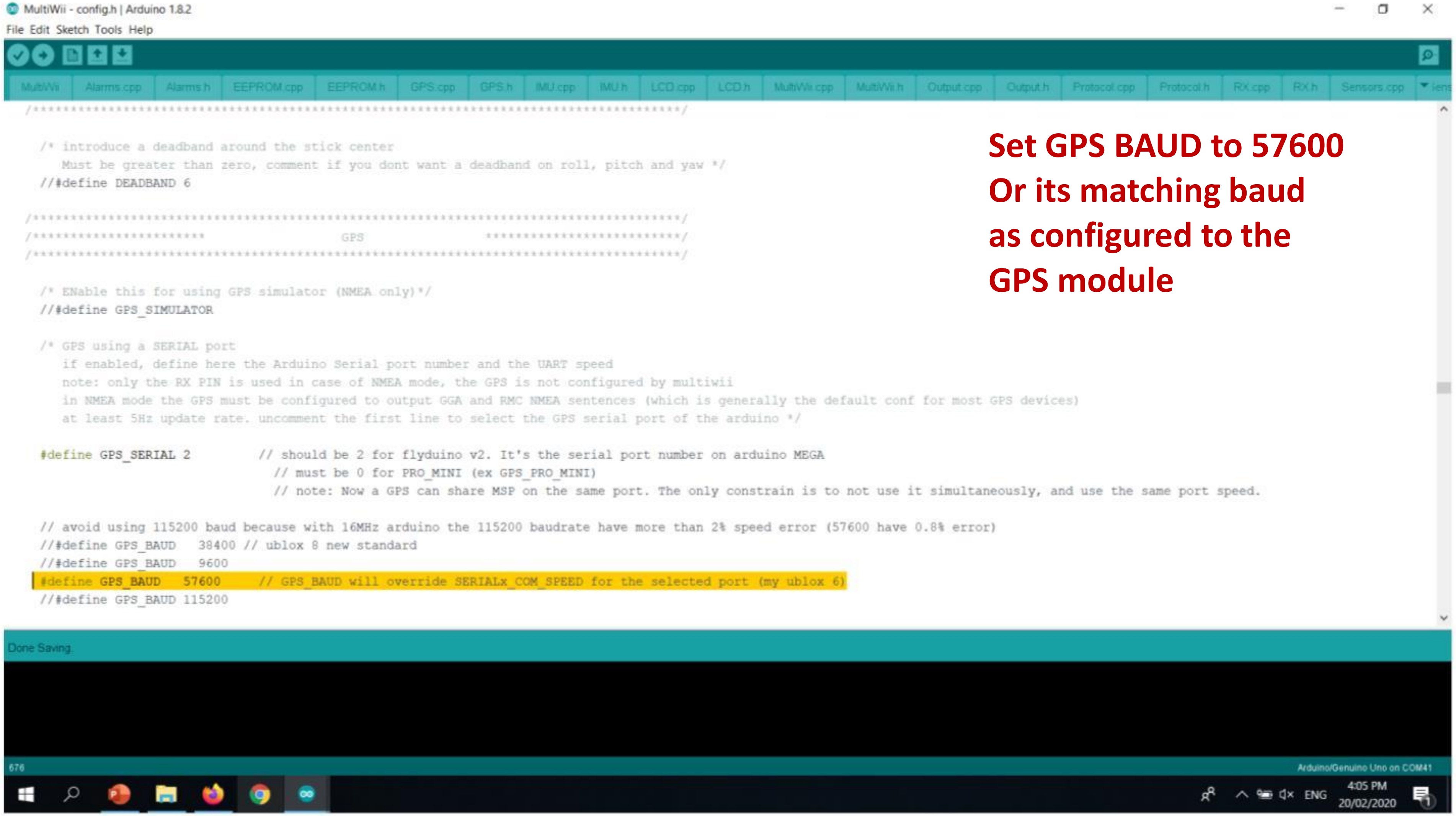
SERIAL 2 IS RESERVE FOR GPS

NMEA Baud 57600




```
/****************  SECTION  5 - ALTERNATE SETUP                                   *******/
/*****************                                                         ***************/
/*****************************************************************************************/

  /******               Serial com speed    *********************************/
    /* This is the speed of the serial interfaces */
    /*Serial 1 Bluetooth 115200 */
    /*Serial 2  GPS */
    /*Serial 3 SIK/Xbee 38400*/
    /* This is the speed of the serial interfaces */
      #define SERIAL0_COM_SPEED 115200
    //#define SERIAL3_COM_SPEED 115200
      #define SERIAL2_COM_SPEED 115200
    //#define SERIAL1_COM_SPEED 115200

    /*Serial 1 Bluetooth Serial 2 GPS Serial 3 Telemetry*/
    #define SERIAL3_COM_SPEED 38400
    #define SERIAL1_COM_SPEED 57600


    /* when there is an error on I2C bus, we neutralize the values during a short time. expressed in microseconds
       it is relevent only for a conf with at least a WMP */
    #define NEUTRALIZE_DELAY 100000

  /************************************************************************************/
  /********                               Gyro filters                *******************/
  /************************************************************************************/

    /*********************     Lowpass filter for some gyros    ****************************/
      /* ITG3200 & ITG3205 Low pass filter setting. In case you cannot eliminate all vibrations to the Gyro, you can try
         to decrease the LPF frequency, only one step per try. As soon as twitching gone, stick with that setting.
         It will not help on feedback wobbles, so change only when copter is randomly twiching and all dampening and
```

GPS CONFIG.H



MultiWii - config.h | Arduino 1.8.2

File Edit Sketch Tools Help

```
/*****************************************************************************************************/

  /* introduce a deadband around the stick center
     Must be greater than zero, comment if you dont want a deadband on roll, pitch and yaw */
  //#define DEADBAND 6

/*****************************************************************************************************/
/************************                    GPS                  ***************************/
/*****************************************************************************************************/

  /* ENable this for using GPS simulator (NMEA only)*/
  //#define GPS_SIMULATOR

  /* GPS using a SERIAL port
     if enabled, define here the Arduino Serial port number and the UART speed
     note: only the RX PIN is used in case of NMEA mode, the GPS is not configured by multiwii
     in NMEA mode the GPS must be configured to output GGA and RMC NMEA sentences (which is generally the default conf for most GPS devices)
     at least 5Hz update rate. uncomment the first line to select the GPS serial port of the arduino */

  #define GPS_SERIAL 2         // should be 2 for flyduino v2. It's the serial port number on arduino MEGA
                                 // must be 0 for PRO_MINI (ex GPS_PRO_MINI)
                                 // note: Now a GPS can share MSP on the same port. The only constrain is to not use it simultaneously, and use the same port speed.

  // avoid using 115200 baud because with 16MHz arduino the 115200 baudrate have more than 2% speed error (57600 have 0.8% error)
  //#define GPS_BAUD   38400 // ublox 8 new standard
  //#define GPS_BAUD   9600
  #define GPS_BAUD   57600      // GPS_BAUD will override SERIALx_COM_SPEED for the selected port (my ublox 6)
  //#define GPS_BAUD 115200
```

Done Saving.

Set GPS BAUD to 57600
Or its matching baud
as configured to the
GPS module

GPS

CONFIG.H

SynerduinoKwad3-GY91-1.8.16-M9-10 - config.h | Arduino 1.8.18

File Edit Sketch Tools Help

SynerduinoKwad3-GY91-1.8.16-M9-10 | Alarms.cpp | Alarms.h | EEPROM.cpp | EEPROM.h | GPS.cpp | GPS.h | IMU.cpp | IMU.h | LCD.cpp | LCD.h | MultiWii.cpp | MultiWii.h | Output.cpp | Output.h | Protocol.cpp | Protocol.h | RX.cpp

```
                          // must be 0 for PRO_MINI / UNO (ex GPS_PRO_MINI) - GPS must be disconnected when using USB Serial
                          // note: Now a GPS can share MSP on the same port. The only constrain is to not use it simultaneo

  // avoid using 115200 baud because with 16MHz arduino the 115200 baudrate have more than 2% speed error (57600 have 0.8% error)
  //#define GPS_BAUD 9600    // GPS default
  //#define GPS_BAUD 38400
  #define GPS_BAUD  57600     // GPS_BAUD will override SERIALx_COM_SPEED for the selected port
  //#define GPS_BAUD 115200

 /* GPS protocol
     NMEA  - Standard NMEA protocol GGA, GSA and RMC  sentences are needed
     UBLOX - U-Blox binary protocol, use the ublox config file (u-blox-config.ublox.txt) from the source tree
     MTK_BINARY16 and MTK_BINARY19 - MTK3329 chipset based GPS with DIYDrones binary firmware (v1.6 or v1.9)
     With UBLOX and MTK_BINARY you don't have to use GPS_FILTERING in multiwii code !!!

     SEE UCENTER https://www.u-blox.com/en/product/u-center */


  //#define NMEA                //for Ublox NMEA GPS - NMEA Protocol Pls. sea GPS.h M5-M6 Protocol M8-M10 Protocol uncomment
  #define UBLOX             //for Beitian GPS - UBLX Protocol
  //#define MTK_BINARY16
  //#define MTK_BINARY19
  //#define INIT_MTK_GPS       // initialize MTK GPS for using selected speed, 5Hz update rate and GGA & RMC sentence o


  /* I2C GPS device made with an independant arduino + GPS device
     including some navigation functions
     contribution from EOSBandi   http://code.google.com/p/i2c-gps-nav/
     You have to use at least I2CGpsNav code r33 */
  /* all functionnalities allowed by SERIAL_GPS are now available for I2C_GPS: all relevant navigation computations are gathered in the main FC */

  //#define I2C_GPS
```

711 | Arduino/Genuino Mega or Mega 2560, ATmega2560 (Mega 2560) on COM83

Depending on the GPS Version

Older formats uses NMEA protocol

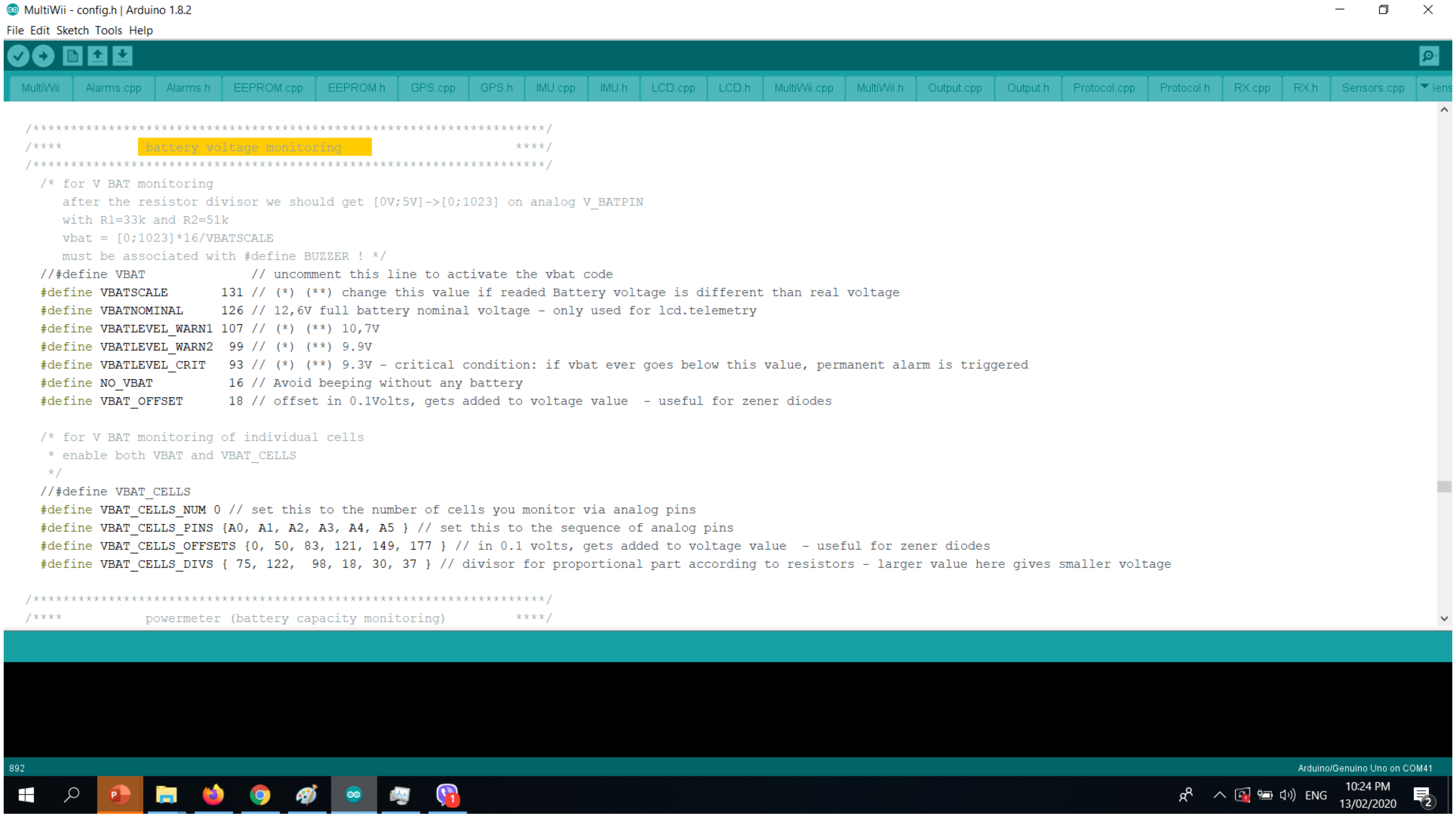
Newer GPS uses UBLOX UBX Protocol

Support:

M6-M8 UBLOX

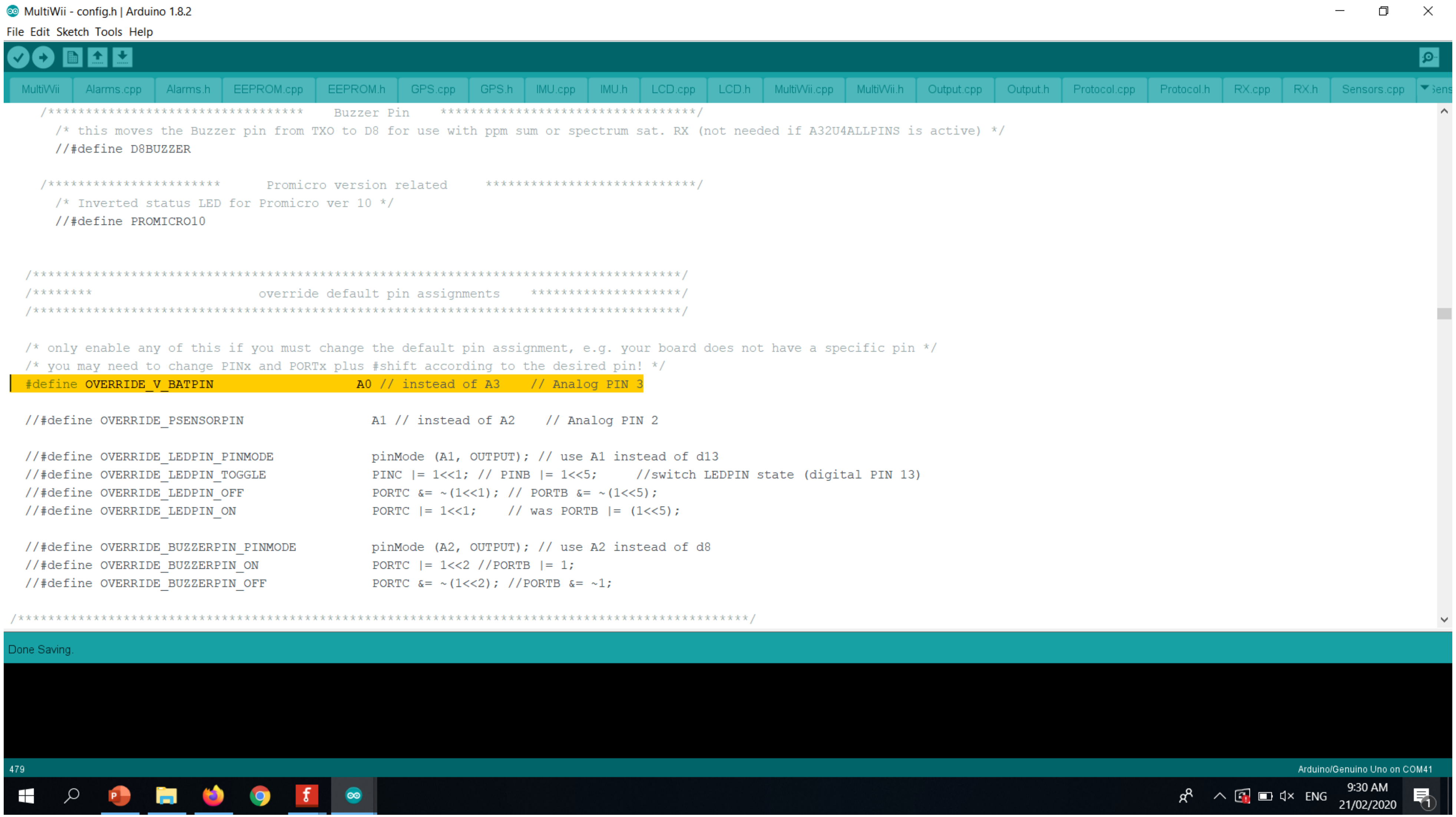
M8-M10 NMEA (Flash Required)

BATTERY MONITORING CONFIG.H




```
/********************************************************************/
/****           battery voltage monitoring                      ****/
/********************************************************************/
  /* for V BAT monitoring
     after the resistor divisor we should get [0V;5V]->[0;1023] on analog V_BATPIN
     with R1=33k and R2=51k
     vbat = [0;1023]*16/VBATSCALE
     must be associated with #define BUZZER ! */
  //#define VBAT              // uncomment this line to activate the vbat code
  #define VBATSCALE       131 // (*) (**) change this value if readed Battery voltage is different than real voltage
  #define VBATNOMINAL     126 // 12,6V full battery nominal voltage - only used for lcd.telemetry
  #define VBATLEVEL_WARN1 107 // (*) (**) 10,7V
  #define VBATLEVEL_WARN2  99 // (*) (**) 9.9V
  #define VBATLEVEL_CRIT   93 // (*) (**) 9.3V - critical condition: if vbat ever goes below this value, permanent alarm is triggered
  #define NO_VBAT          16 // Avoid beeping without any battery
  #define VBAT_OFFSET      18 // offset in 0.1Volts, gets added to voltage value  - useful for zener diodes

  /* for V BAT monitoring of individual cells
   * enable both VBAT and VBAT_CELLS
   */
  //#define VBAT_CELLS
  #define VBAT_CELLS_NUM 0 // set this to the number of cells you monitor via analog pins
  #define VBAT_CELLS_PINS {A0, A1, A2, A3, A4, A5 } // set this to the sequence of analog pins
  #define VBAT_CELLS_OFFSETS {0, 50, 83, 121, 149, 177 } // in 0.1 volts, gets added to voltage value  - useful for zener diodes
  #define VBAT_CELLS_DIVS { 75, 122,  98, 18, 30, 37 } // divisor for proportional part according to resistors - larger value here gives smaller voltage

/********************************************************************/
/****           powermeter (battery capacity monitoring)        ****/
```

PIN ASSIGNMENTS CONFIG.H



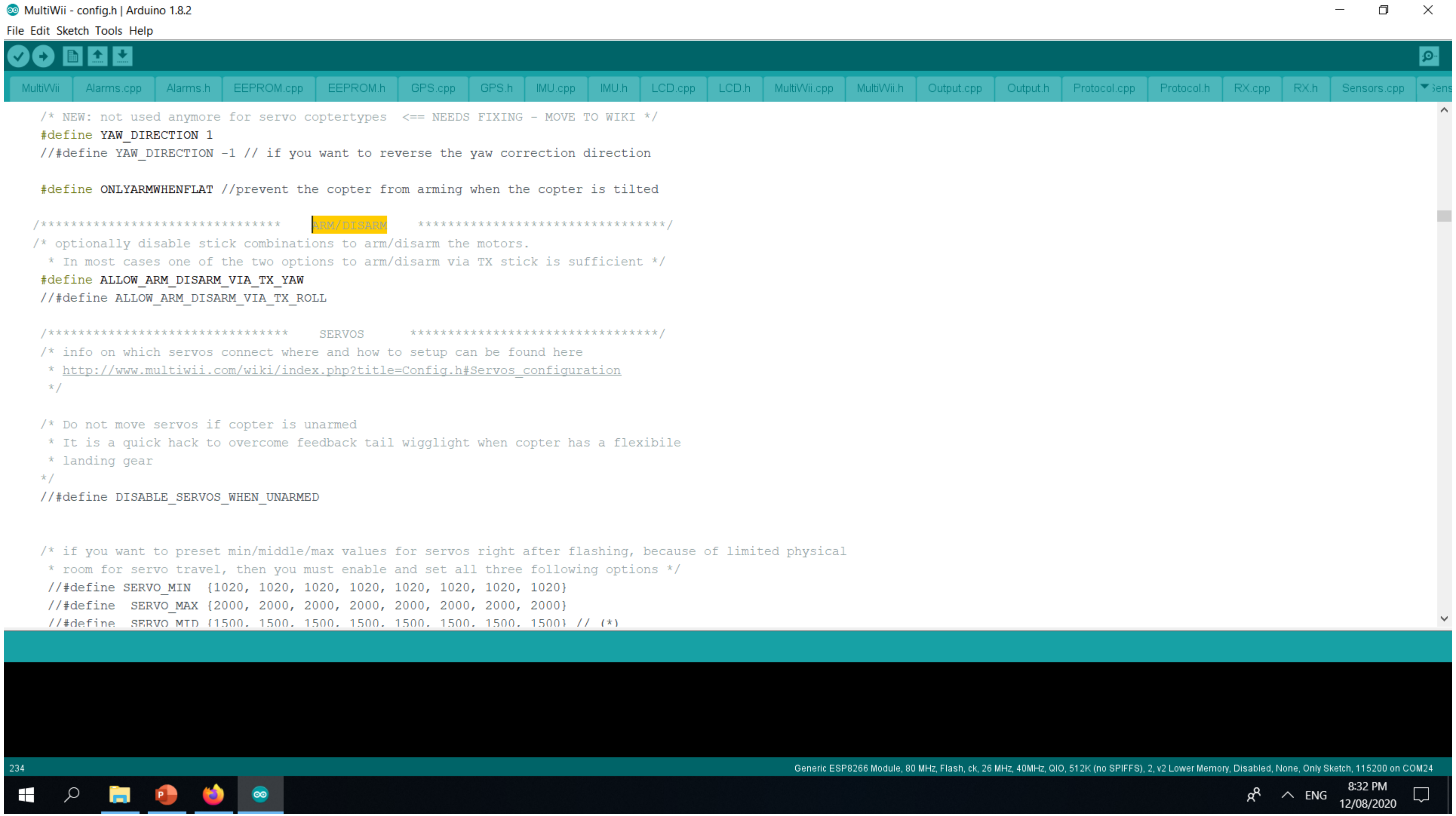

```
  /*********************************    Buzzer Pin    *********************************/
    /* this moves the Buzzer pin from TXO to D8 for use with ppm sum or spectrum sat. RX (not needed if A32U4ALLPINS is active) */
    //#define D8BUZZER

  /***********************      Promicro version related     ****************************/
    /* Inverted status LED for Promicro ver 10 */
    //#define PROMICRO10


/**************************************************************************************/
/********                      override default pin assignments    ********************/
/**************************************************************************************/

/* only enable any of this if you must change the default pin assignment, e.g. your board does not have a specific pin */
/* you may need to change PINx and PORTx plus #shift according to the desired pin! */
#define OVERRIDE_V_BATPIN                   A0 // instead of A3    // Analog PIN 3

//#define OVERRIDE_PSENSORPIN                A1 // instead of A2    // Analog PIN 2

//#define OVERRIDE_LEDPIN_PINMODE            pinMode (A1, OUTPUT); // use A1 instead of d13
//#define OVERRIDE_LEDPIN_TOGGLE             PINC |= 1<<1; // PINB |= 1<<5;     //switch LEDPIN state (digital PIN 13)
//#define OVERRIDE_LEDPIN_OFF                PORTC &= ~(1<<1); // PORTB &= ~(1<<5);
//#define OVERRIDE_LEDPIN_ON                 PORTC |= 1<<1;    // was PORTB |= (1<<5);

//#define OVERRIDE_BUZZERPIN_PINMODE         pinMode (A2, OUTPUT); // use A2 instead of d8
//#define OVERRIDE_BUZZERPIN_ON              PORTC |= 1<<2 //PORTB |= 1;
//#define OVERRIDE_BUZZERPIN_OFF             PORTC &= ~(1<<2); //PORTB &= ~1;

/*************************************************************************************************/
```

CONFIG.H

Arm/DisArm

Option for combination stick command to start and stop the drone

Note: Combination stick only works on some vehicles configuration . Others uses Aux Arm switch



Works for Multirotor Example : Rudder Stick Left to Rudder Arm Stick Right to Disarm
Note: motors will spool up to Idle Speed

Arm Only When Flat

Is a safety option not to arm when the drone is not level prevent starting up when on a slope or when moving

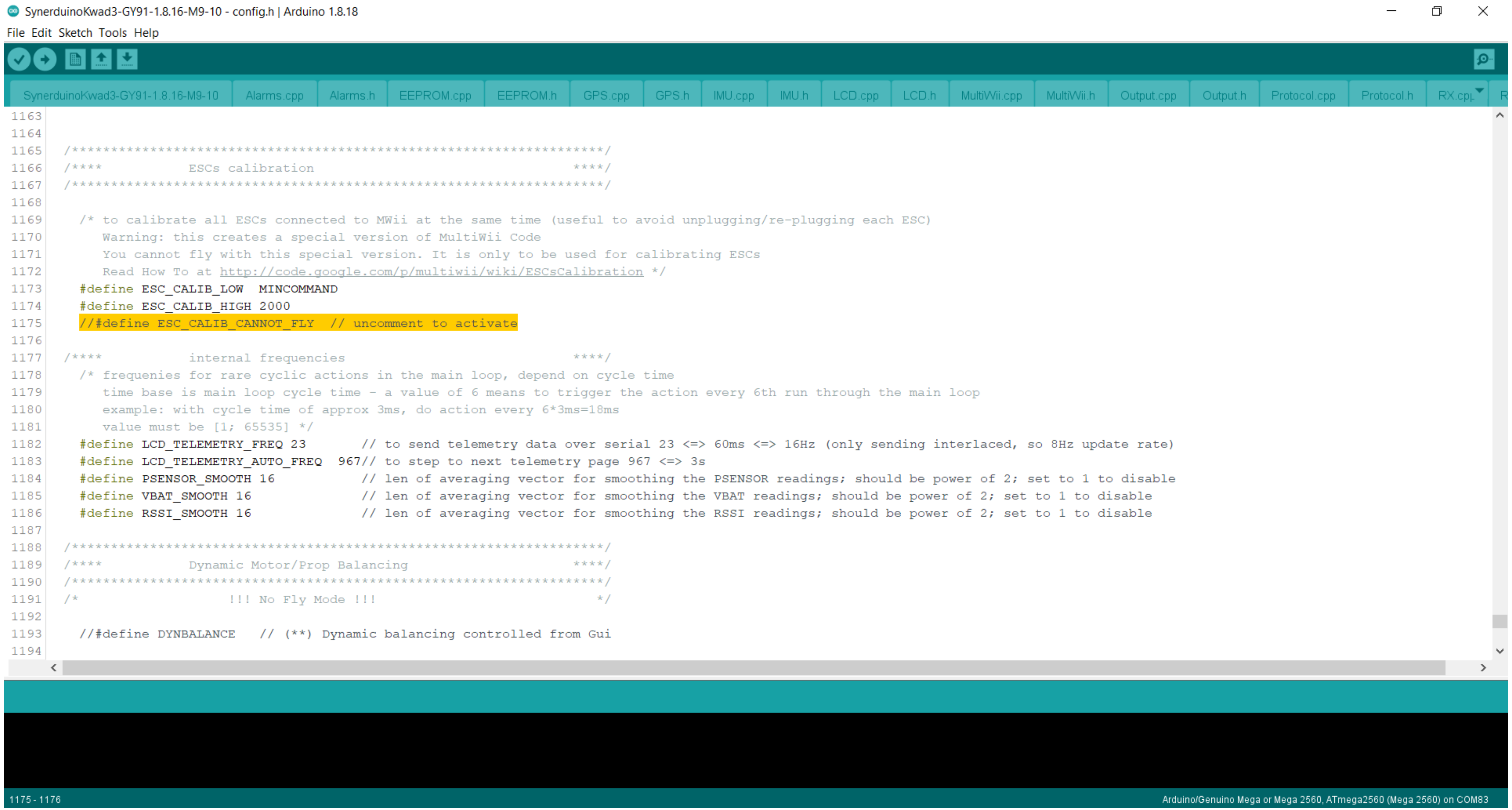
CONFIG.H

THROTTLE FAILSAFE –WHAT THE THROTTLE INPUT WOULD BE IF SIGNAL IS LOST BETWEEN THE SYNERDUINO BOARD , RECEIVER AND TRANSMITTER

ESC CALIBRATION

To ensure a proper tune stable flight

All ESCs must be Calibrated



ESC CALIBRATION

CONFIG.H

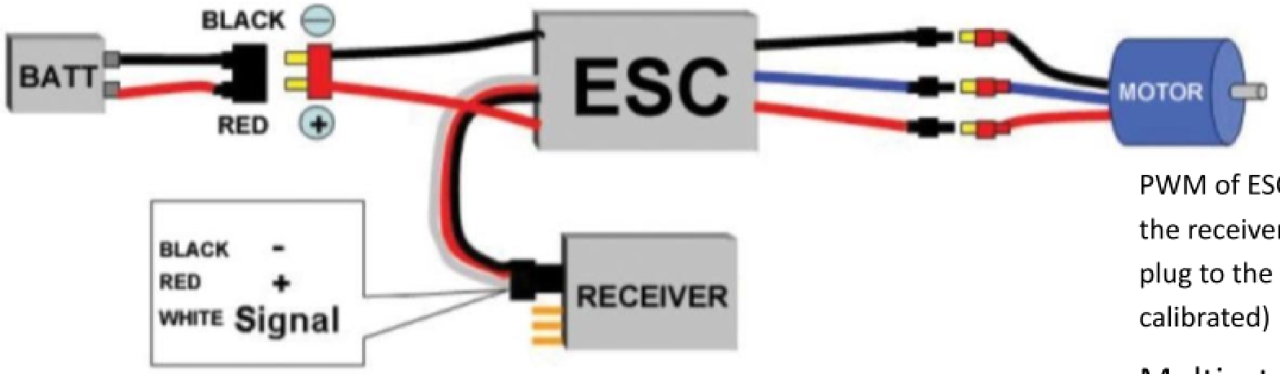
STE

1

XLoader Download

Electronic Speed Controller CALIBRATION

Propellers are removed during this process



PWM of ESC is directly hook up to the receiver Throttle pin . Ensure the receiver is getting power thru the Aux PWM pin which remains plug to the synerduino board (process is repeated till all ESCs are calibrated)

Multirotors must have all ESCs calibrated similarly to ensure reliable operations

Motor must be plug in at this point w/o the propeller. As it will serve several purpose

- An Speaker to listen to calibration tone of the ESC
- Identify motor rotation should it needs to be corrected
- Test full speed range

ESC calibration will vary based on what brand of ESC you are using, so always refer to the documentation for the brand of ESC you are using for specific information (such as tones). "All at once" calibration works well for most ESCs, so it is good idea to attempt it first and if that fails try the "Manual ESC-by-ESC" method.

If your ESC happens to be an OPTO. The Synerduino board can provide as power supply for both RC Receiver and ESCs when soldered in . Get the PWM Pin of the ESC you want to calibrate and plug it into the Throttle Channel of your Receiver

STE

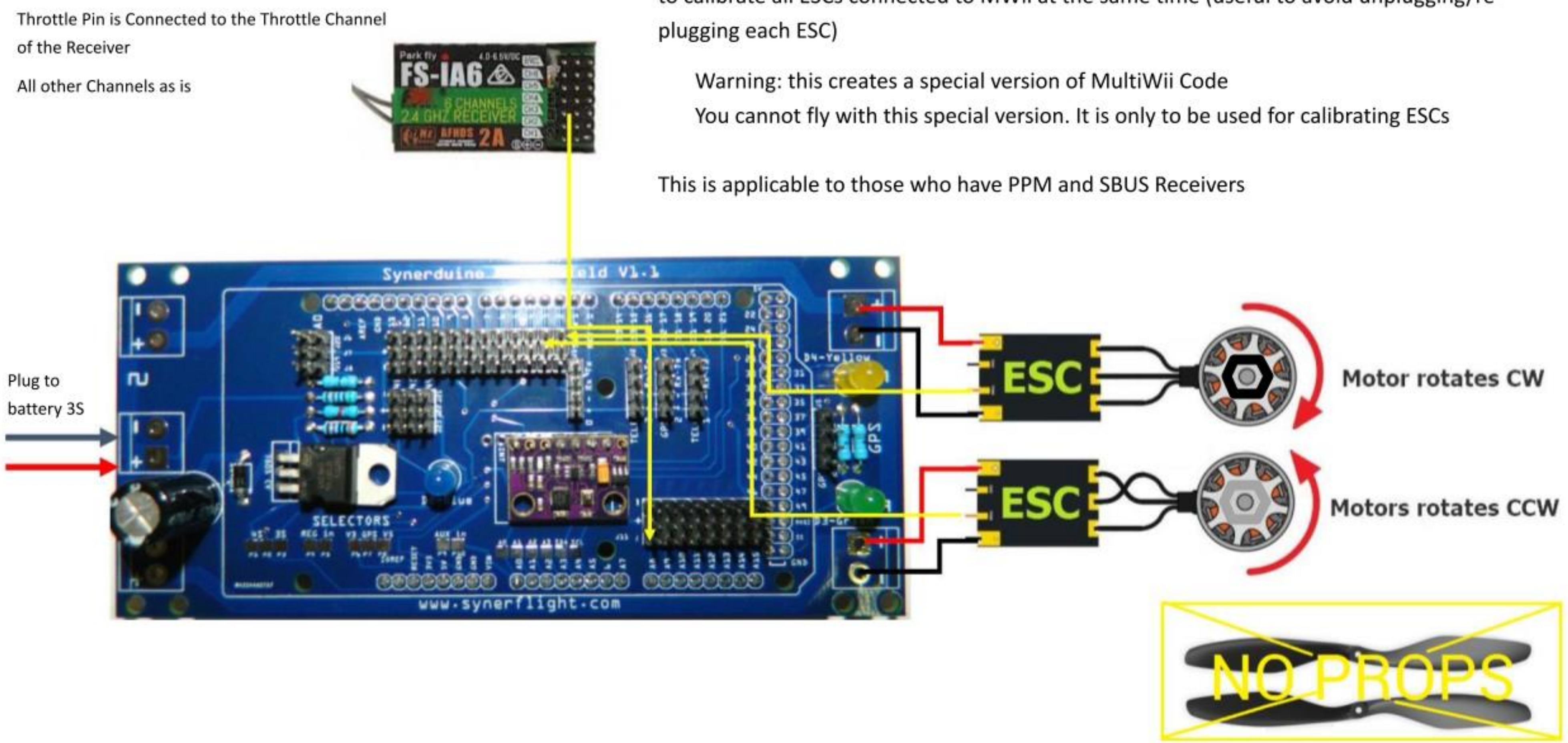
2

Synerduino Multiwii ESC calibration method , for All ESC at Once

to calibrate all ESCs connected to MWii at the same time (useful to avoid unplugging/re-plugging each ESC)

Warning: this creates a special version of MultiWii Code
You cannot fly with this special version. It is only to be used for calibrating ESCs

This is applicable to those who have PPM and SBUS Receivers



ESC CALIBRATION

CONFIG.H

STE

4

- Remove props or tie the copter down.
- Plug in USB.
- Uncomment #define ESC_CALIB_CANNOT_FLY // uncomment to activate
- Flash firmware to Synerduino
- Disconnect the USB.
- Plug in the battery. The copter will not fly and will use ESC Tone/LEDs to indicate finished calibration (after approx. 5-10 seconds).
- Disconnect the battery.
- Plug in USB and Comment #define ESC_CALIB_CANNOT_FLY // uncomment to activate
- You can test carefully with your ESCs calibrated.

FLYWIIGUI INSTALLATION

STEP 1

Download the FlyWiiGUI groundstation and open FlywiiGUI.exe

Name	Date modified	Type	Size
210130-0301	30/04/2021 3:01 PM	File	3 KB
210814-0408	14/09/2021 4:08 PM	File	3 KB
212812-0428	12/06/2021 4:28 PM	File	3 KB
214012-0340	12/06/2021 3:40 PM	File	3 KB
AForge.Controls.dll	25/01/2015 1:15 PM	Application extens...	44 KB
AForge.dll	25/01/2015 1:15 PM	Application extens...	17 KB
AForge.Imaging.dll	25/01/2015 1:15 PM	Application extens...	248 KB
AForge.Math.dll	25/01/2015 1:15 PM	Application extens...	67 KB
AForge.Video.DirectShow.dll	25/01/2015 1:15 PM	Application extens...	52 KB
AForge.Video.dll	25/01/2015 1:15 PM	Application extens...	19 KB
AForge.Video.FFMPEG.dll	25/01/2015 1:15 PM	Application extens...	60 KB
avcodec-53.dll	25/01/2015 1:15 PM	Application extens...	13,181 KB
avdevice-53.dll	25/01/2015 1:15 PM	Application extens...	342 KB
avfilter-2.dll	25/01/2015 1:15 PM	Application extens...	870 KB
avformat-53.dll	25/01/2015 1:15 PM	Application extens...	2,405 KB
avutil-51.dll	25/01/2015 1:15 PM	Application extens...	135 KB
FlyWiiGUI.exe	30/10/2021 11:41 ...	Application	6,945 KB
FlyWiiGUI.exe.config	28/02/2017 5:31 PM	CONFIG File	1 KB
FlyWiiGUI.exe.manifest	30/10/2021 11:41 ...	MANIFEST File	30 KB

The FlyWii GUI is a free updated version of the MultiWii WinGUI. It serves as the ground control station for the MultiWii 2.4 controller software.

FlyWii GUI is currently only supported for Windows 7/8/10

Download

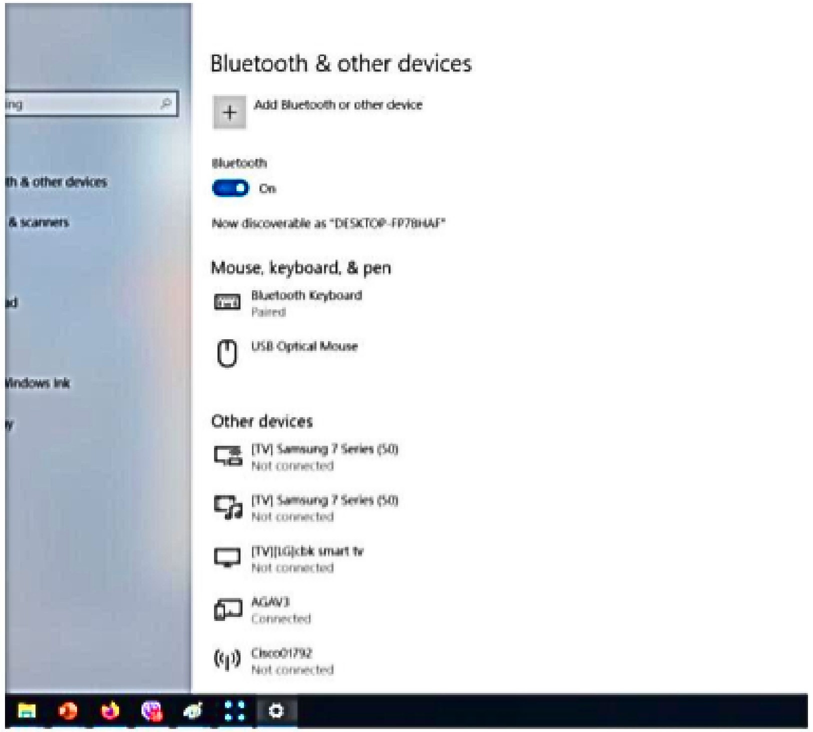
Latest Release

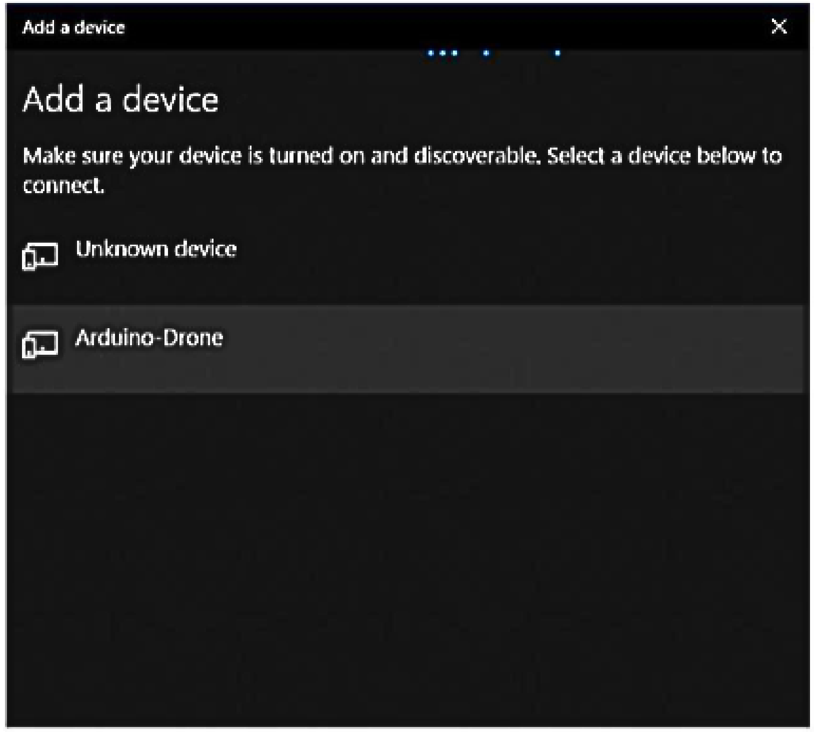
FlwiiGUI Ground Station Software .EXE*

FlyWiiGUI20 Download

STE

2





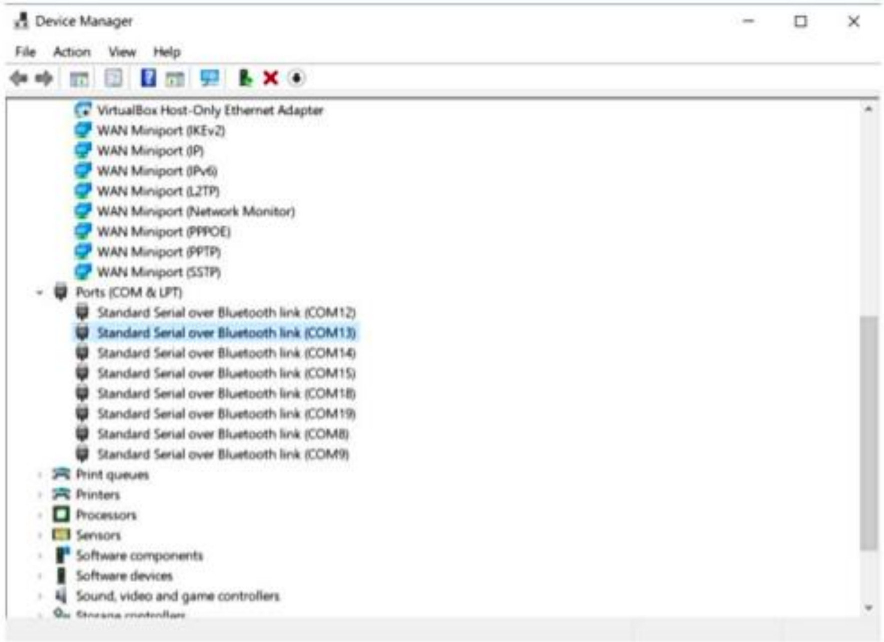
Adding Bluetooth on Windows Device Manager look for Arduino-Drone BT device

Take note on which Serial Com port its added to in Device Manager

FLYWIIGUI INSTALLATION

STE

3



In Device Manager Located in COM & LPT

FLYWIIGUI INSTALLATION

STE

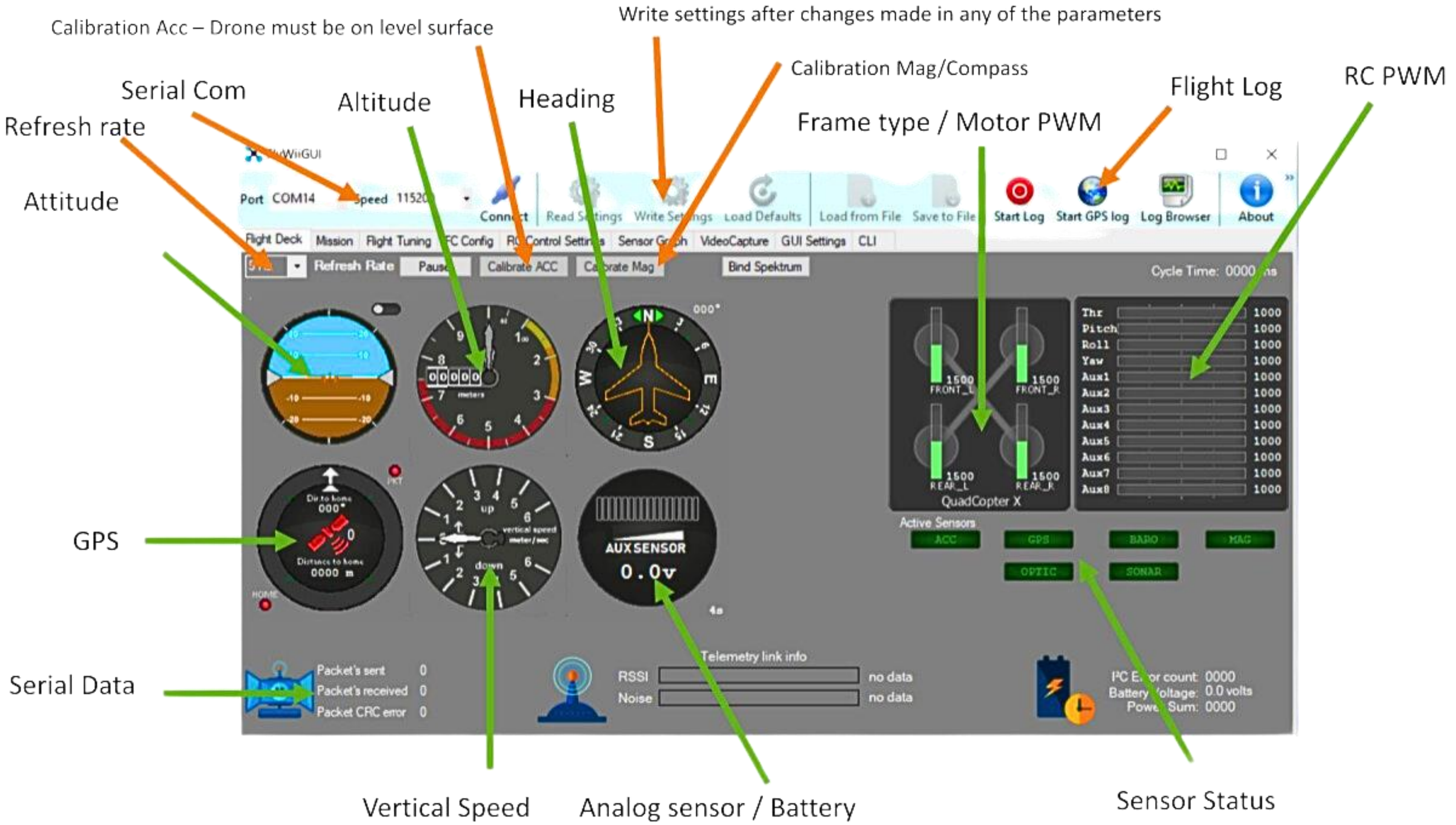
4

Select the com port your Bluetooth is connected to .

At this point Disconnect your Physical USB and your drone should be running on batteries using only the Bluetooth to communicate

Connect to the Drone with the associated COM port and Baud as found in your device manager

FLYWIIGUI INSTALLATION



FLIGHT TUNING

FLIGHT DECK – IF THIS DOESN'T LOOK RIGHT CHECK YOUR SENSORS ORIENTATION AGAIN USING THE SENSOR GRAPH

TELEMETRY CONNECTION SEE YOUR CHECK YOUR BLUETOOTH RADIO OR USB ON WHERE IS THE VIRTUAL COM PORT IS

COMPASS (MAG AND GYRO)

SAVE CONFIG

PWM OUTPUT INDICATOR

FLIGHT & GPS LOGS

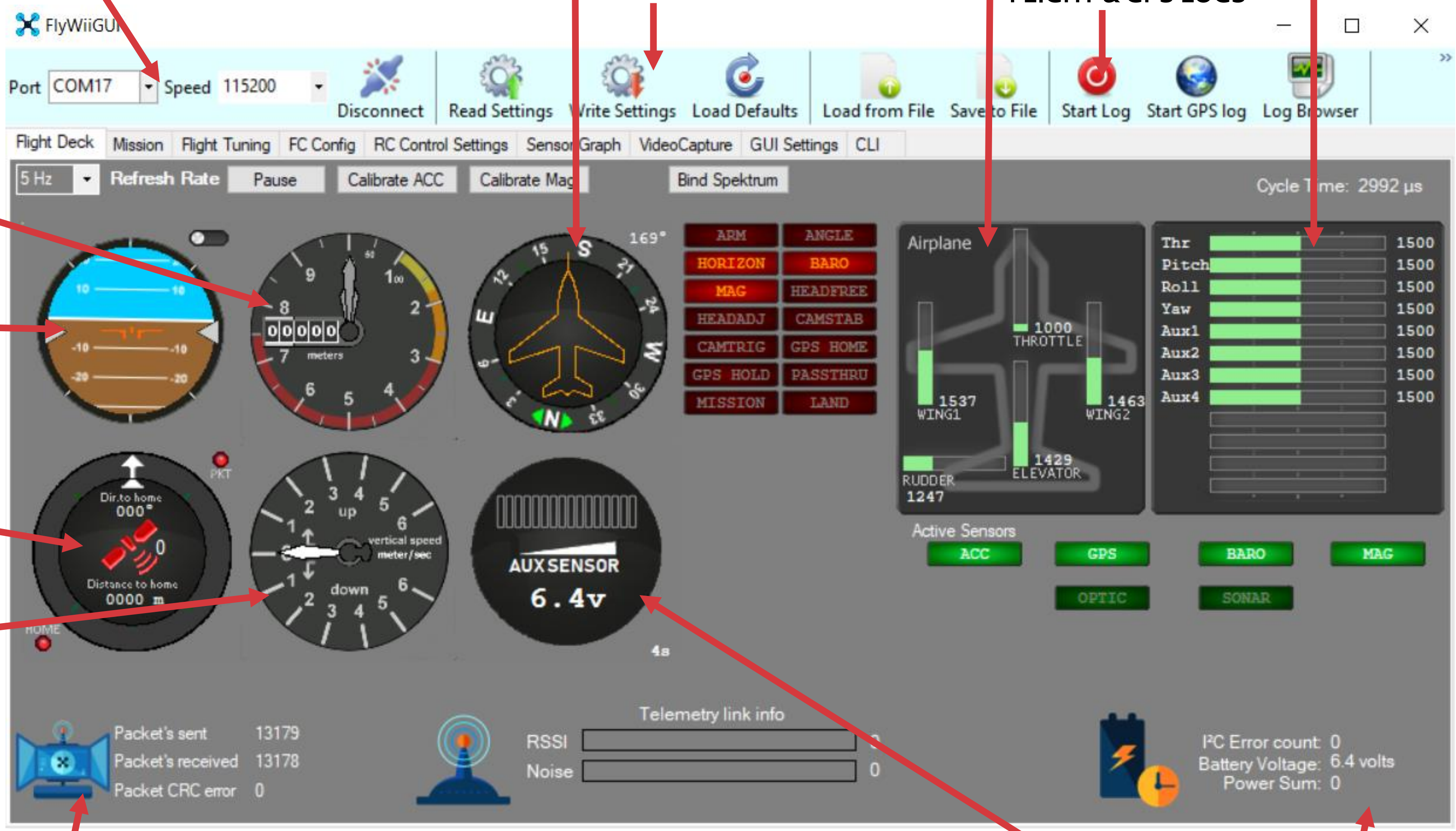
PWM INPUT INDICATOR

ALTITUDE (BARO)

ATTITUDE (ARTIFICIAL HORIZON)
(GYRO XYZ AND ACC XYZ)

GPS SATELLITE COUNT
(4 SATS FOR 3D FIX – IDEAL 7 SATS)

VERTICAL SPEED INDICATOR
(ACC Z AXIS)

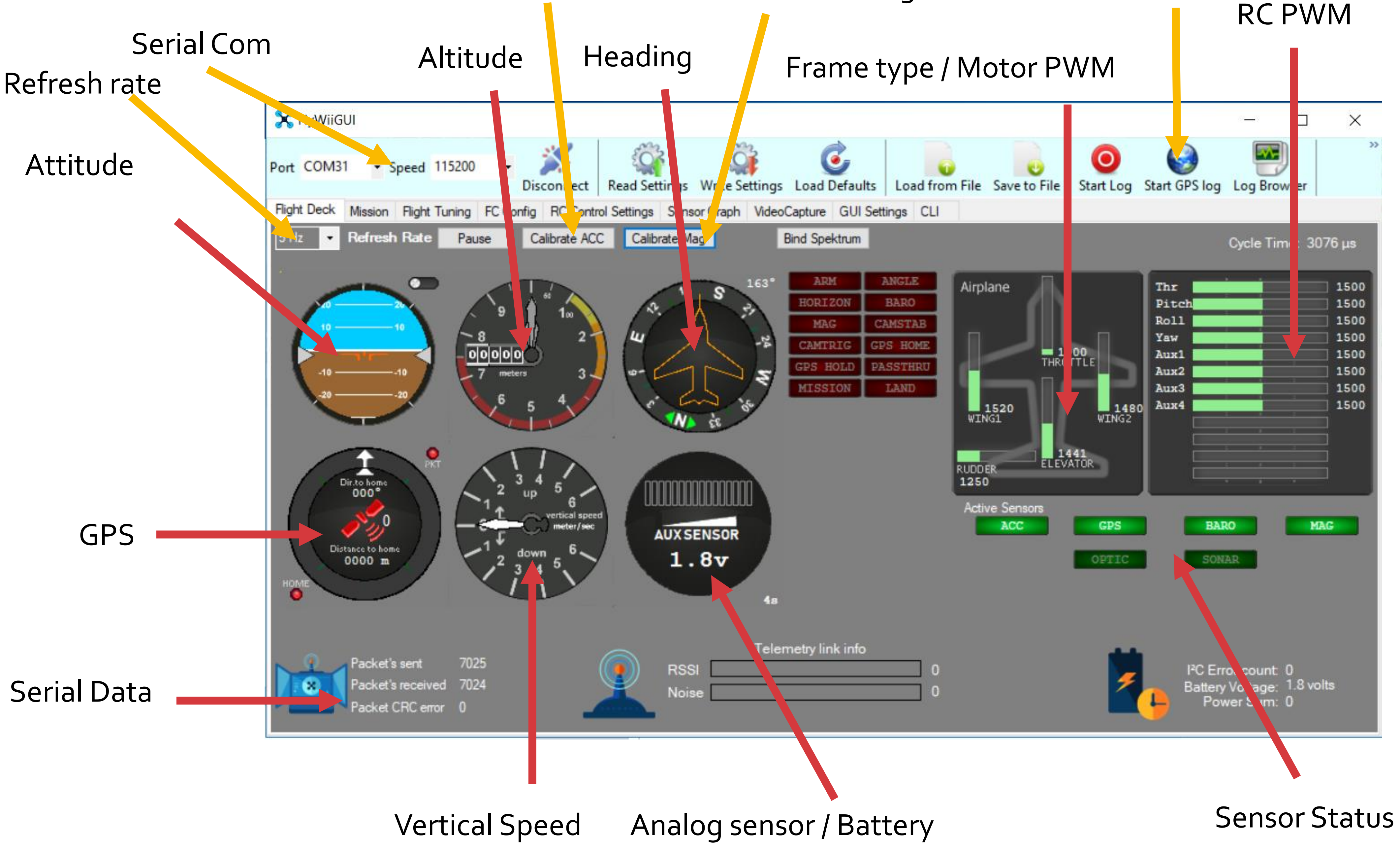


PACKETS STATUS

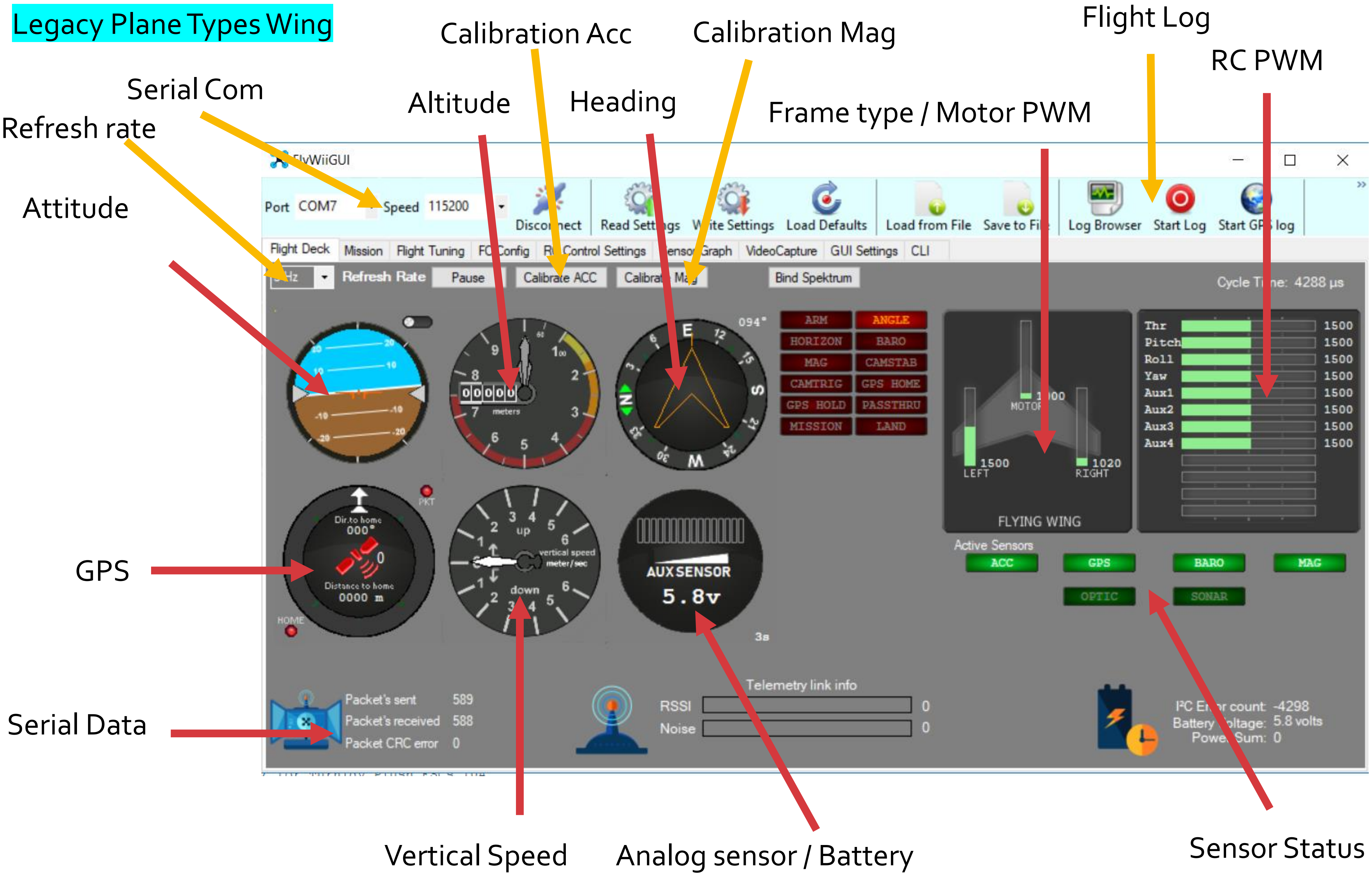
(IF THE ERROR NUMBERS ARE HIGH PLS CHECK YOUR TELEMETRY CONFIG)

POWER STATUS / AUX SENSOR
ALSO KNOWN AS FUEL GAUGE
(VBAT)

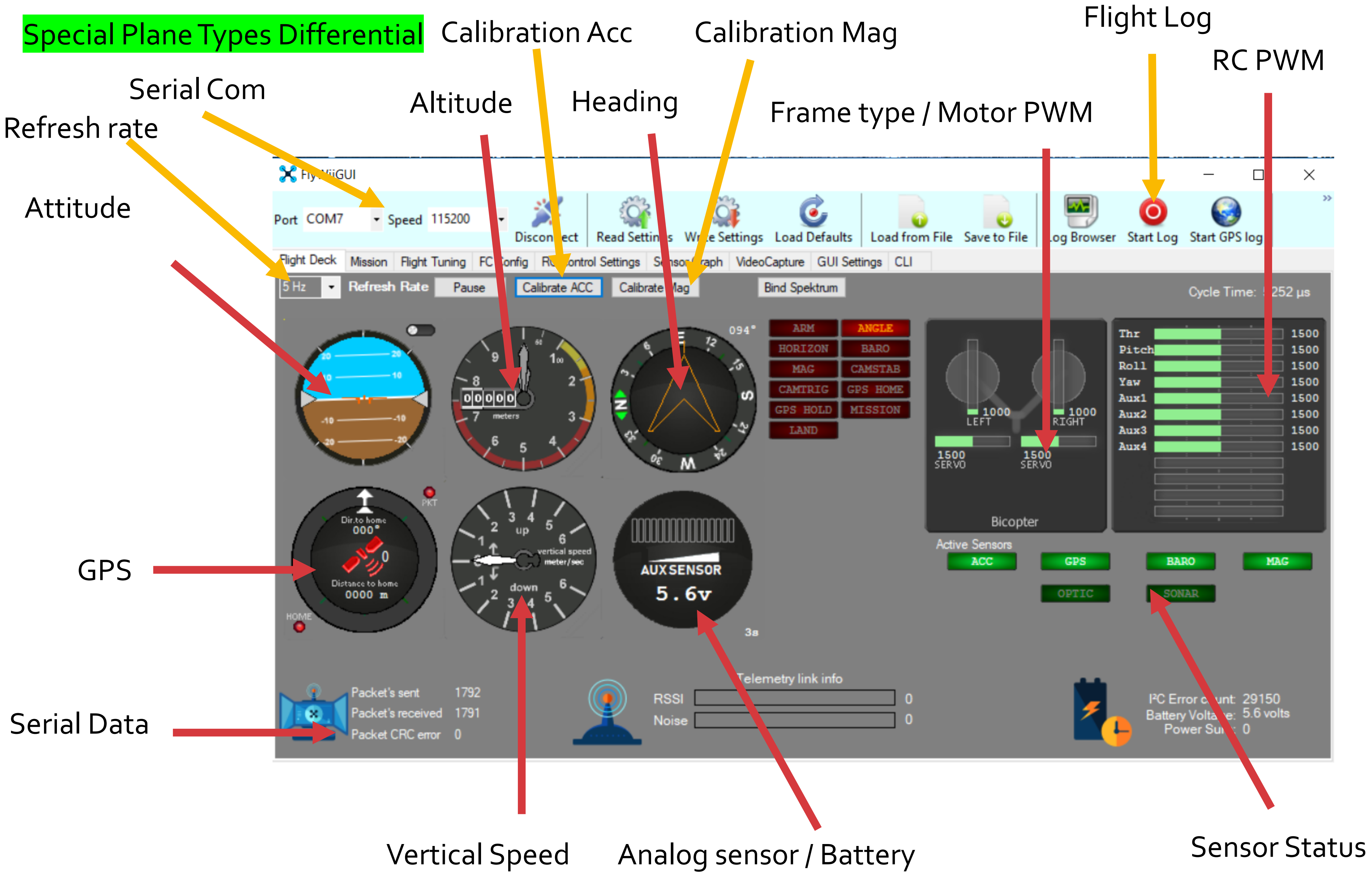
Legacy Plane Types Conventional



Legacy Plane Types Wing



Special Plane Types Differential



Calibration Mag

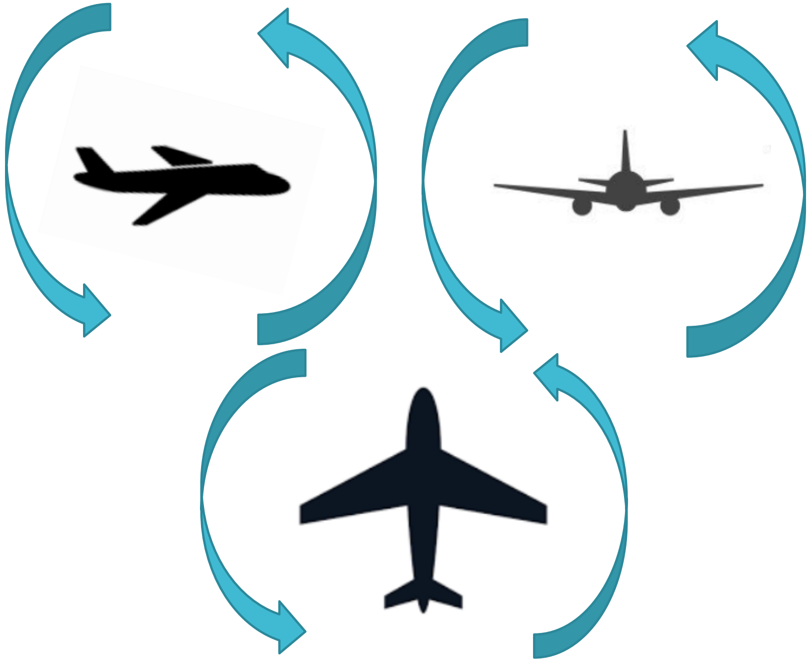
Refresh Rate . Telemetry update speed

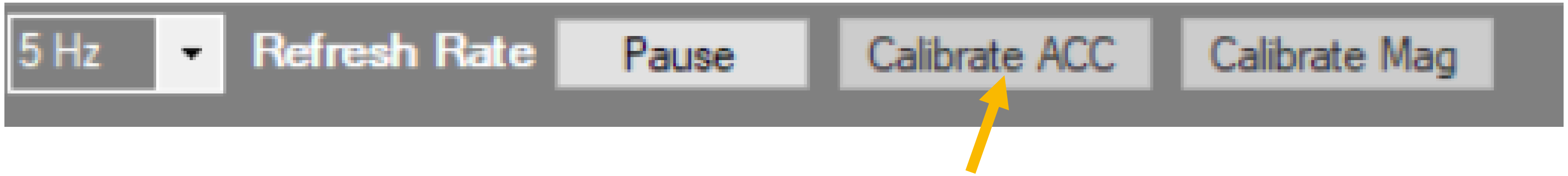
Acc Calibration . Set the Plane down on a level surface . Away from any metal objects for 10 secs.

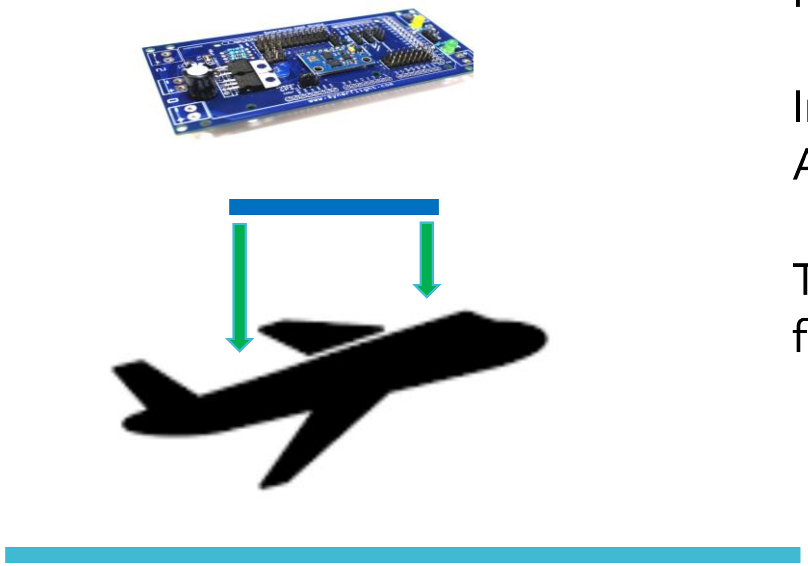
Mag Calibration . rotate the aircraft 360 degrees in all axis within 1 min. while the blue Led flashes

Mag Calibration must be perform when launching your drone in a new location for the first time. Pls verified the Compass if the drone heading matches your compass app in your phone.

These Calibration must be perform after Parameter updates after Flashing the firmware
Blue LED would flash during these calibration processes





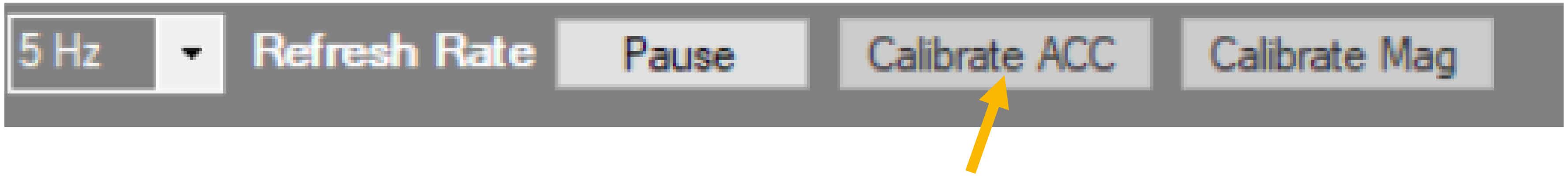


Flight controller Mounting in relation to Angle of Attack

In Neutral AOA – the Flight controller (Synerduino) can be set into a Neutral AOA to the airframe as being Level

This Hold true for any Fixwing that uses Flat plate airfoil wings to compensate for the lack of neutral lift unlike NACA or Cambered Airfoil

Calibration ACC



Due to the Nature of Flat wing Aircraft like the Synerduino Dart / FT Flyer an **Neutral Angle of Attack** must be identify and establish
The Synerduino Dart/FT flyer is set as 45 degrees AOA

Acc Calibration ,set the Aircraft on its neutral Angle of attack for 10 secs.

Max Speed AOA – this is when the aircraft is in its maximum Waypoint cruise speed as set by **Max Nav Banking** angle on Flight tuning tab Navigation settings

Neutral AOA – this is where the Aircraft AOA is settle on Horizon mode

Stall AOA – this is when the aircraft is slowing down also set by **Max Nav Banking** angle on **Flight tuning tab Navigation settings** . Happends when the mission is set to hold the aircraft tries to slow down or when on landing

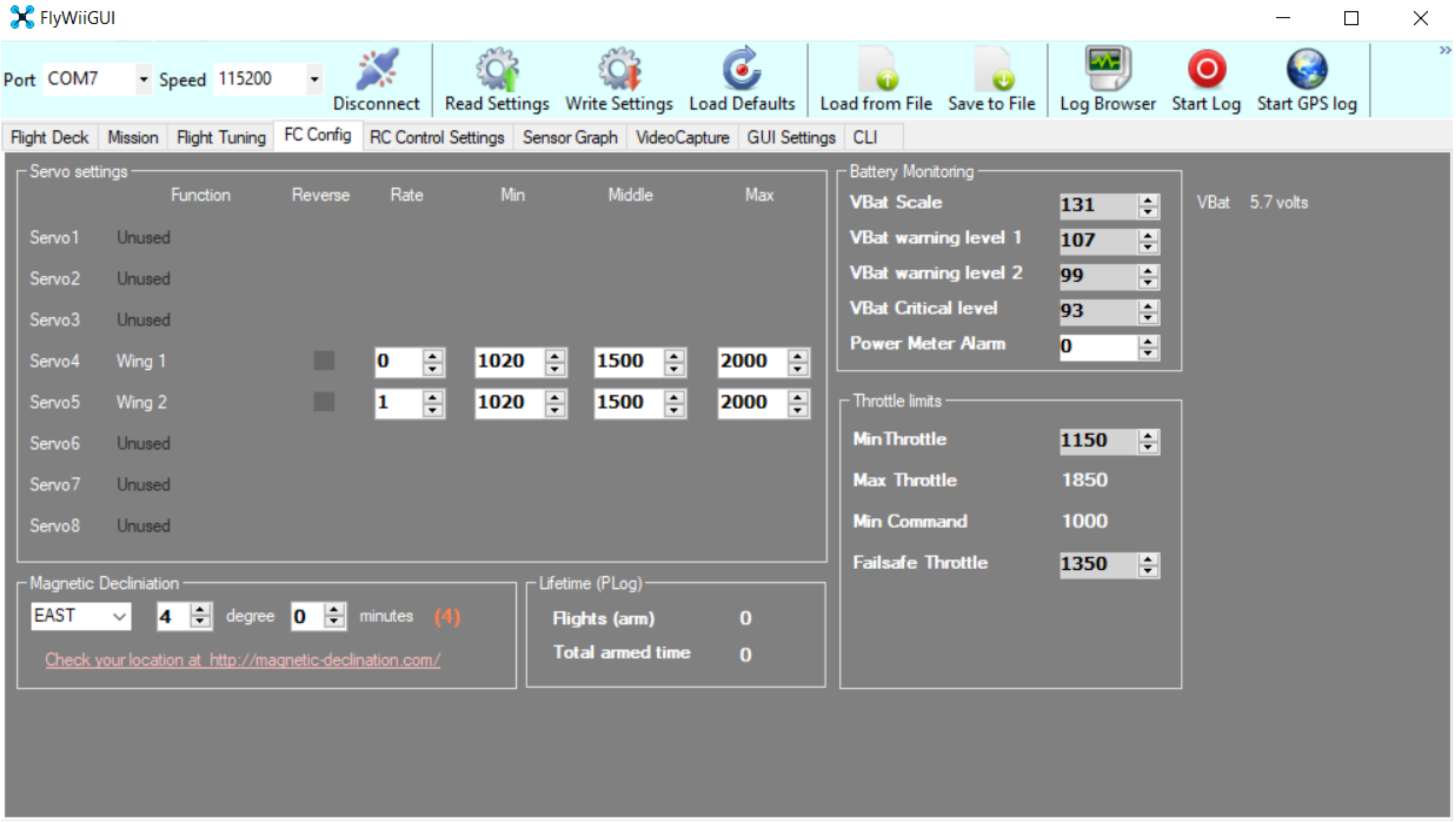
Legacy Plane Types Wing

This is for control Surface Augmentation for the 2 servos
Wing1 elevon & Wing 2 Elevon

- ***FC Config***
- ***Gyro or Acc assisted Mode.***
- Check if Gyro move servos in right directions.
- Lift a wingtip and Aileron goes up.
- Lift the tail and Elevator goes up.
- Rudder moves in same direction as the tail.
-

Use the Servo Tab in Gui to Change Servo directions.

- Rate 1-norm or 2-rev



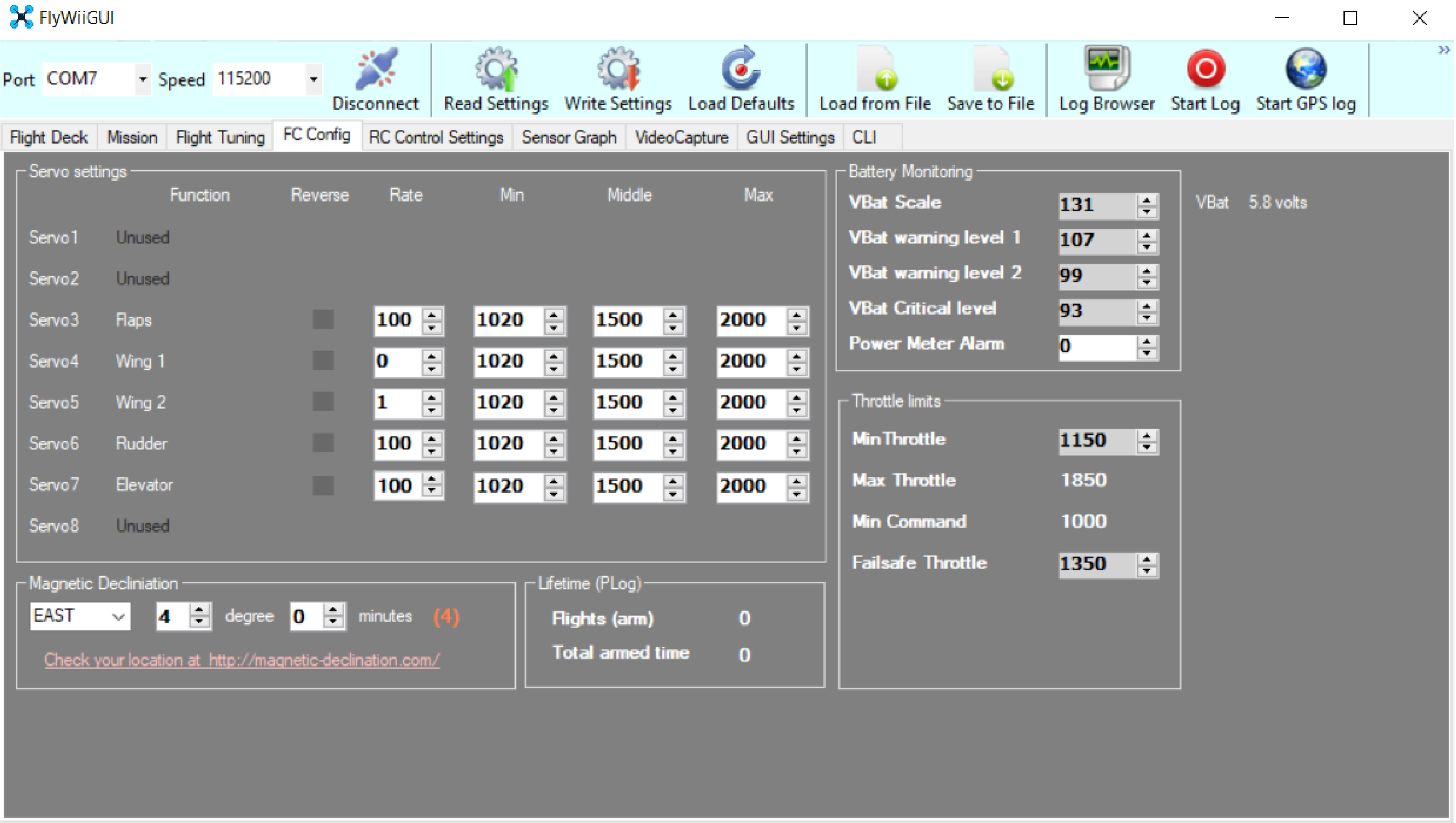
Legacy Plane Types Conventional

This is for control Surface Augmentation for Surface types shows the 5 servos Elevator ,Rudder ,Flaps and Aileron

- ***FC Config***
- ***Gyro or Acc assisted Mode.***
- Check if Gyro move servos in right directions.
- Lift a wingtip and Aileron goes up.
- Lift the tail and Elevator goes up.
- Rudder moves in same direction as the tail.
-

Use the Servo Tab in Gui to Change Servo directions.

- Rate 1-norm or 2-rev



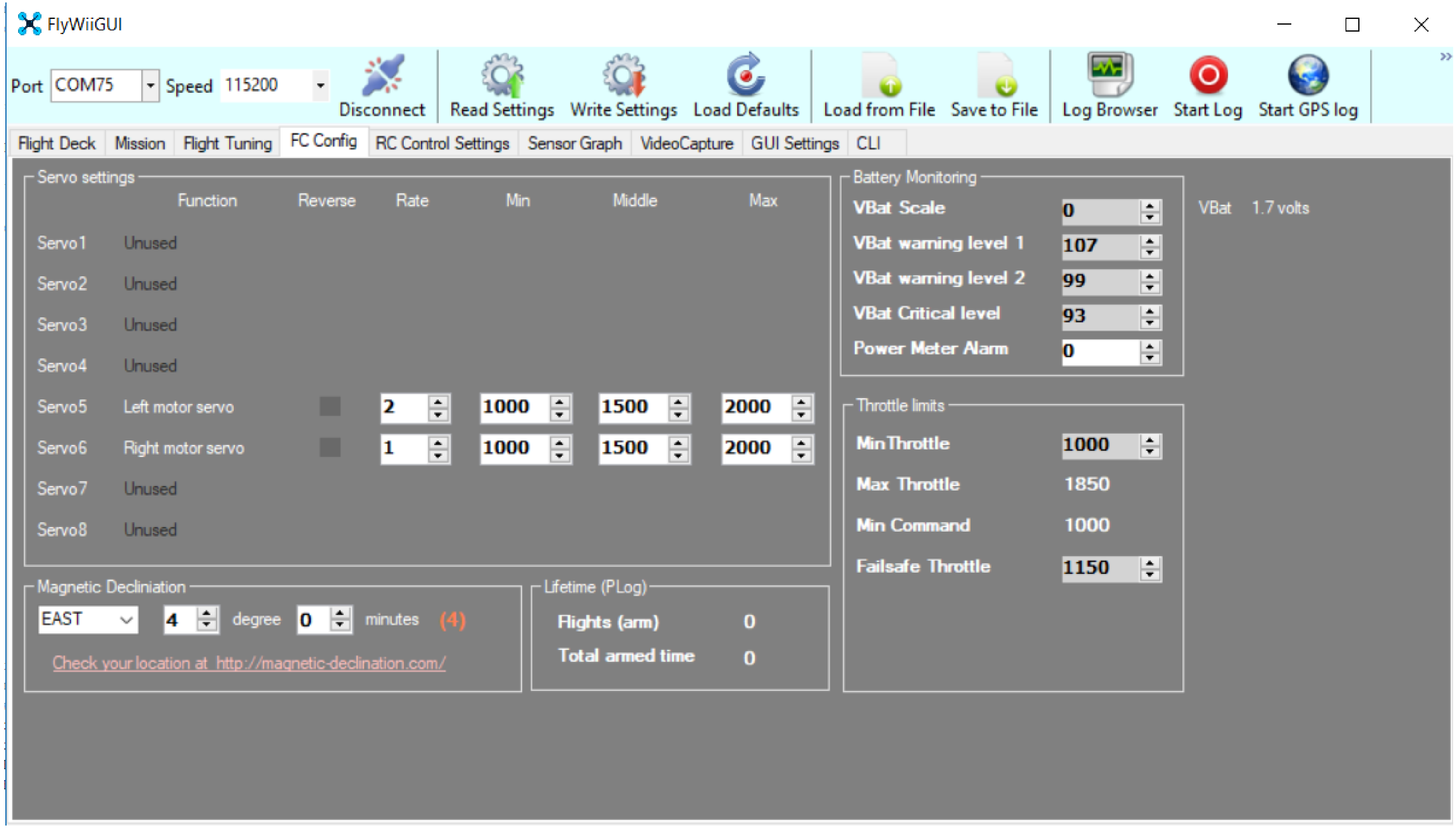
Special Plane Types Diff thrust or Special

This is for control Surface Augmentation for shows the 2 servos Elevator and Aileron on Special Types

- ***FC Config***
- ***Gyro or Acc assisted Mode.***
- Check if Gyro move servos in right directions.
- Lift a wingtip and Aileron goes up.
- Lift the tail and Elevator goes up.
- Rudder moves in same direction as the tail.
-

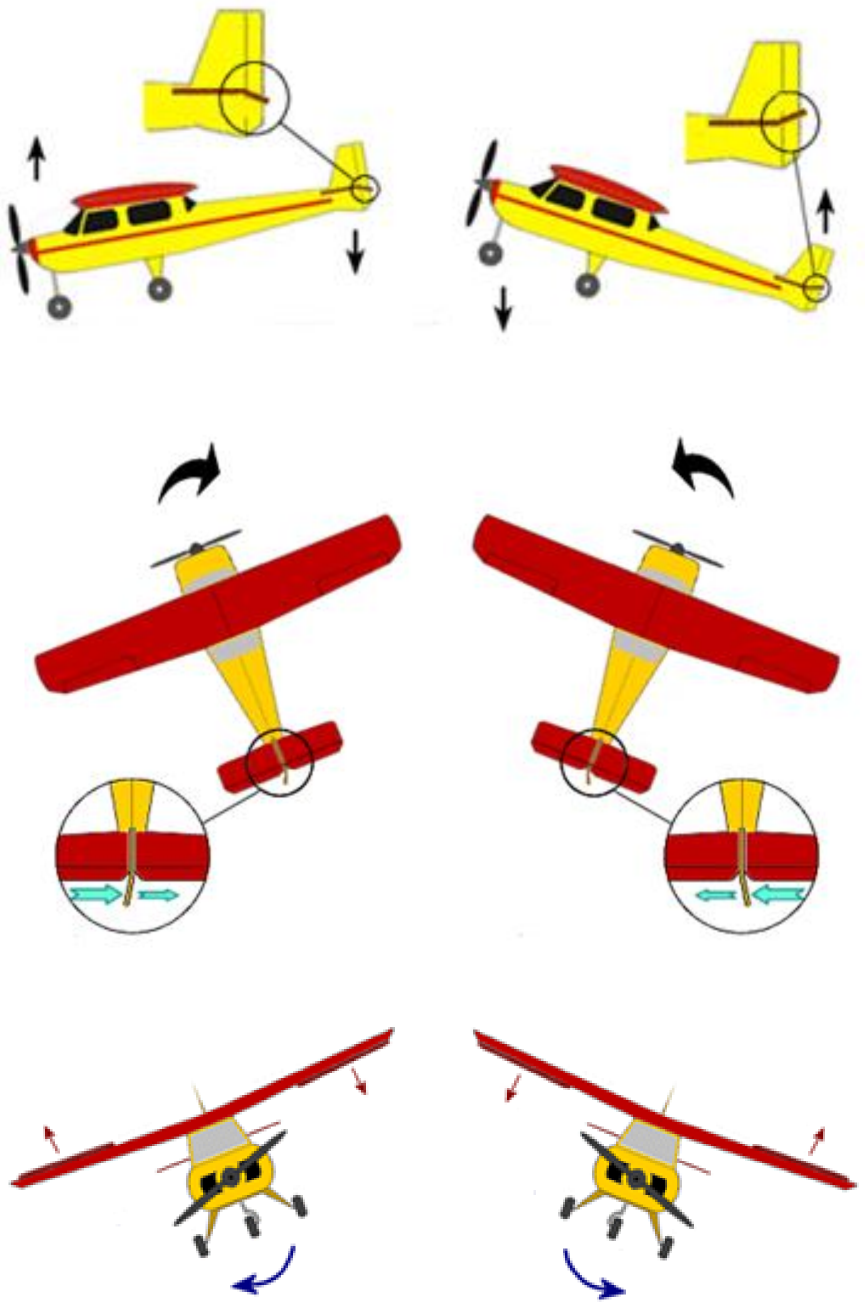
Use the Servo Tab in Gui to Change Servo directions.

- Rate 1-norm or 2-rev



This is for surface control Augmentation

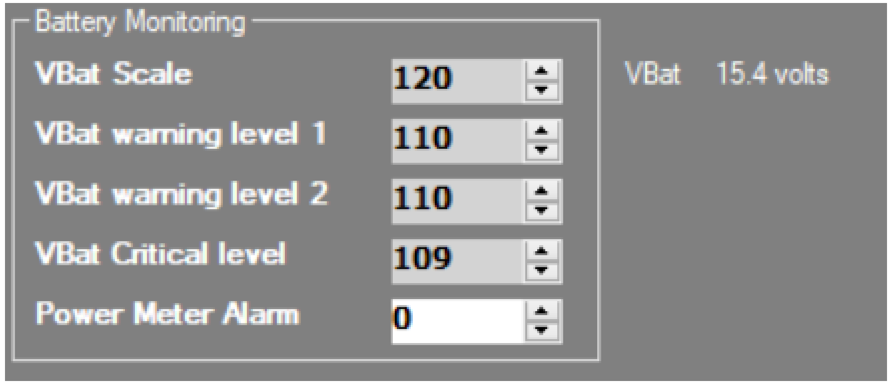
- ***Servos Settings***
- ***Gyro or Acc assisted Mode.***
- Check if Gyro move servos in right directions.
- Lift a Right wingtip and Right Aileron goes up.
- Lift the tail and Elevator goes up.
- Rudder moves in same direction as the tail.
- Use the Servo Tab in Gui to Change Servo directions.
- The Aircraft should give the correct proportion for control attitude correction
- Control surfaces should oppose the disturbance applied to the aircraft

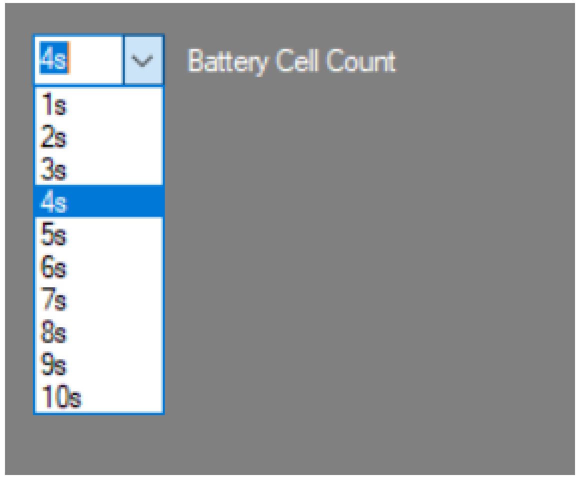


The arrow represent an external force acting on the aircraft opposite to it the control surface counter it with the opposite force

The Gyro and Accelerometer would always counter the force opposite to it .

FLYWII GUI





(FC CONFIG TAB)

BATTERY MONITORING

VBAT SCALE - ADJUST THIS TO MATCH THE BATTERY VOLTAGE OUTPUT USING THE VOLTAGE ALARM INDICATOR

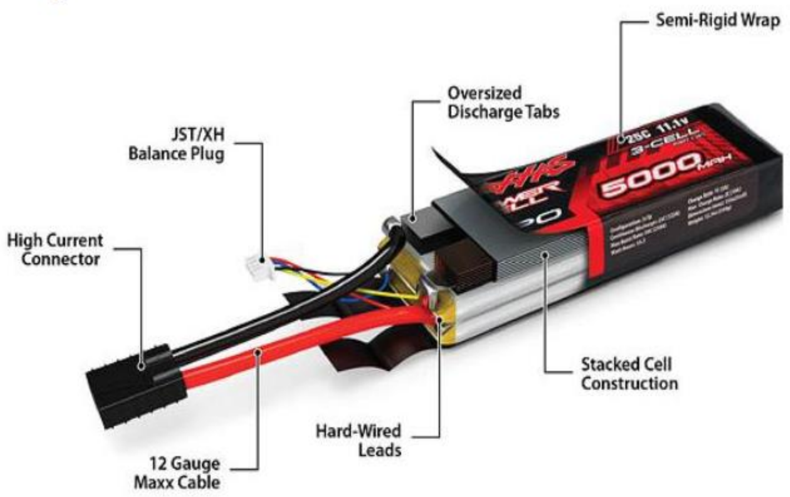
VBAT WARNING LEVEL – IDENTIFY THE NOTICE WHEN THE BATTERY DROPS TO THIS VOLTAGE

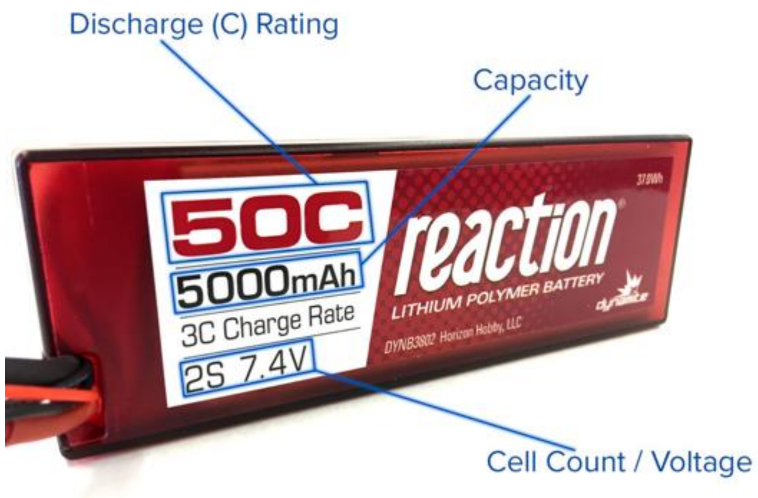
(GUI SETTINGS TAB)

BATTERY CELL COUNT- ADJUST THIS DEPENDING ON THE NUMBER OF CELLS

THIS BOARD SUPPORTS 2S-4S BATTERY

BATTERY MONITORING

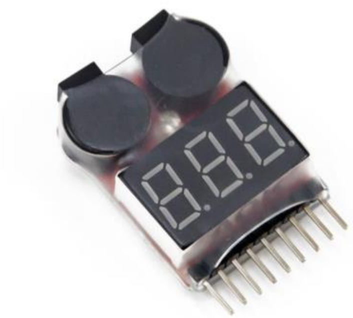




BATTERY CARE – ONLY CHARGE AT 1C OR THE RECOMMENDED THE CHARGE RATE ON THE LABEL

USE BALANCE CHARGER TO SET THE CURRENT IN THE SAMPLE IS 5A

BATTERY



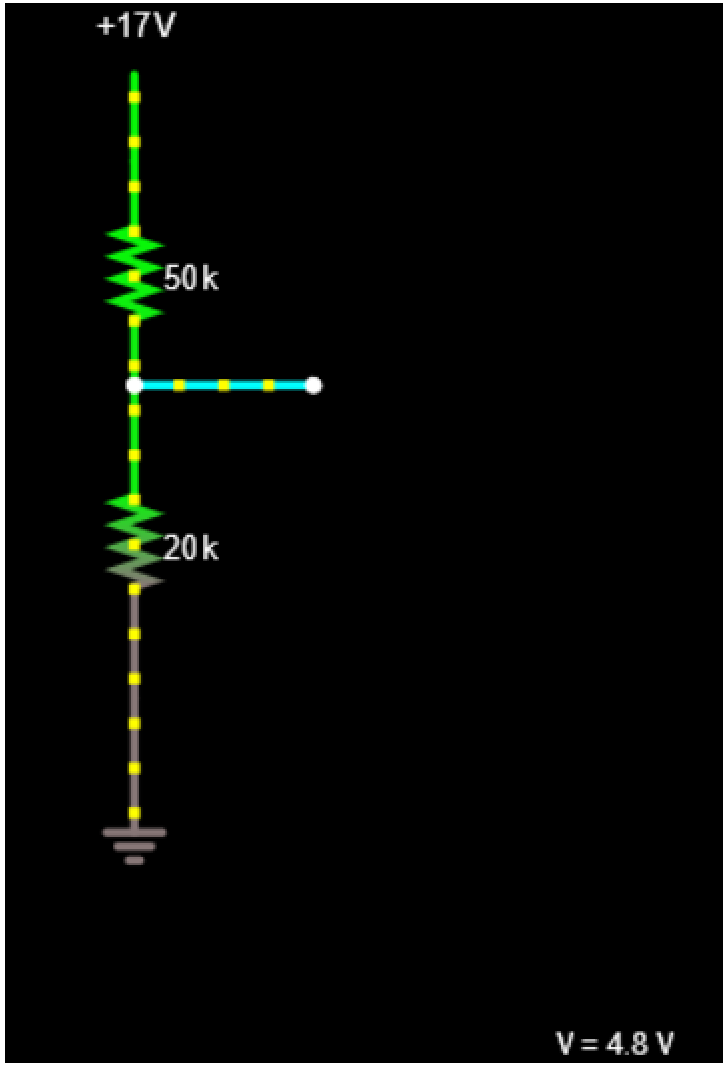
BATTERY STORAGE MODE IS 3.8V PER CELL

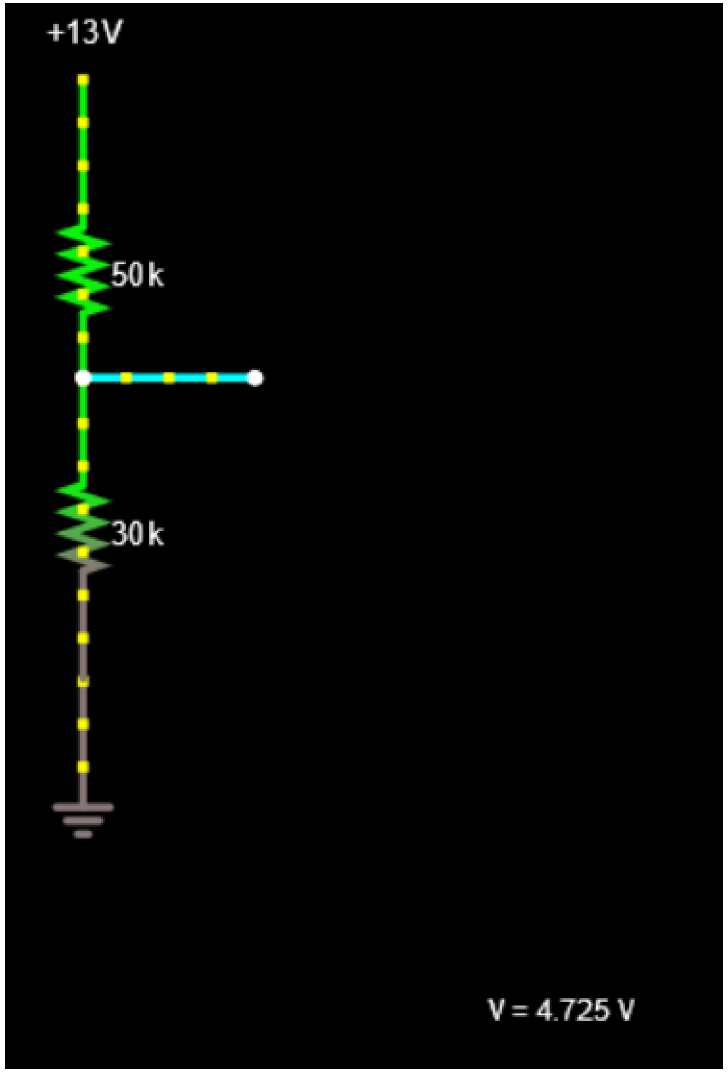
BATTERY DISCHARGE IS 3.6V PER CELL

BATTERY FULL CHARGE IS 4.2V PER CELL

ITS RECOMMEND TO USE THE VOLTAGE ALARM TO MONITOR THE BATTERY VOLTAGE WHILE IN USE

4S 16.8V 3S 12.6V





VOLTAGE READING

HOW MUCH POWER IN YOUR BATTERY

VOLTAGE DIVIDER

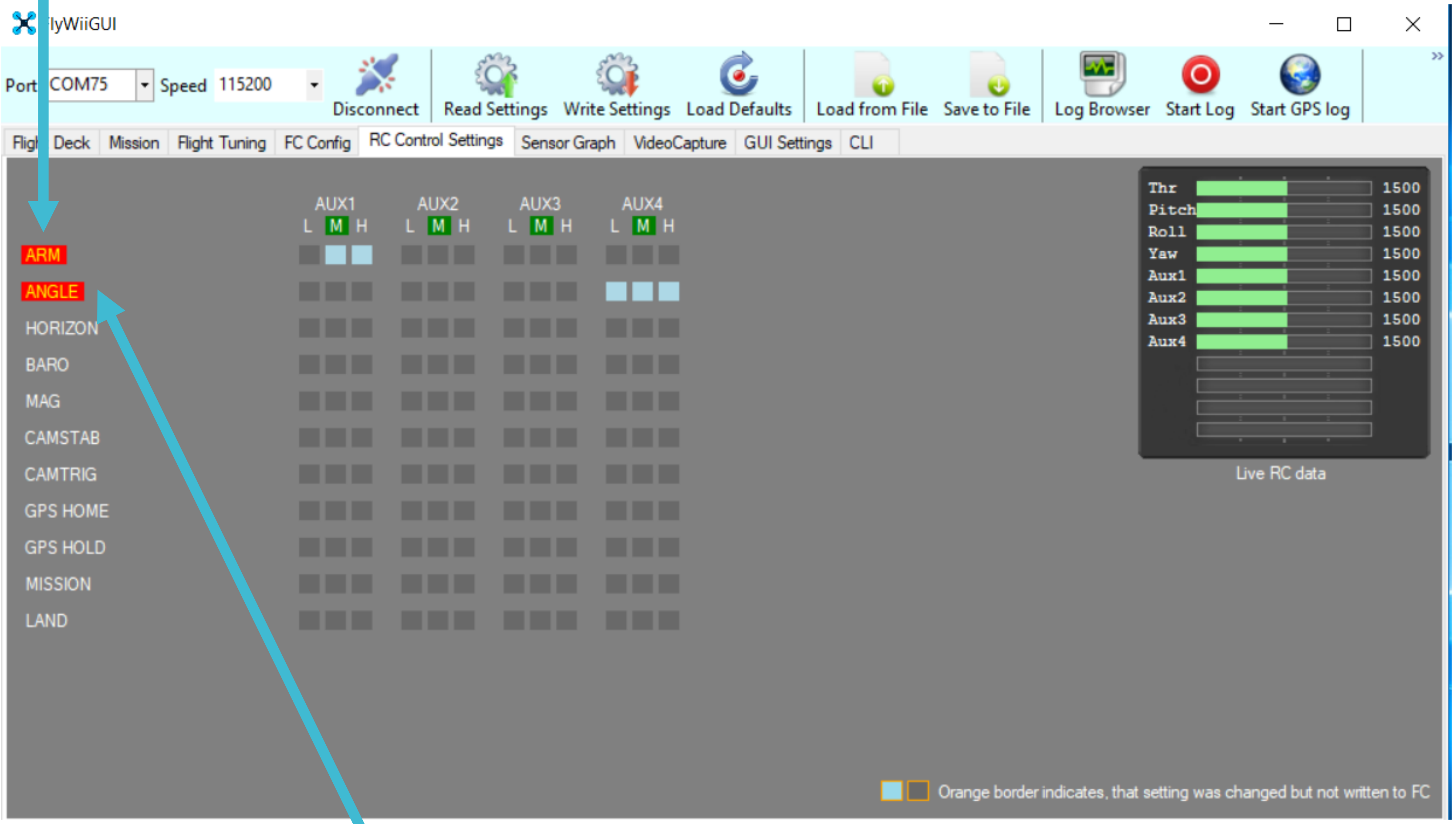
THIS ALLOWS THE 3V-5V TO BE INPUTTED TO THE A0 ANALOG PIN OF THE ARDUINO TO READ THE BATTERY VOLTAGE

SWITCH THE VBAT JUMPER ACCORDINGLY TO THE BATTER CELLS YOUR USING

3S OR 4S

- The Diff thrust plane of Synerduino is rather unique
- It behaves like a Bi-copter as also a plane
- ARM — to activate the Aircraft
- ANGLE - this is mostly use to keep the plane Level
- HORIZON - this also may work for certain Leveling application
- BARO — Altitude hold by throttle control
- MAG — Heading hold
- CAM TRIG — Payload Trigger
- GPS HOME — RTH
- MISSION — Perform Waypoint
- LAND — this allows the Aircraft to Land after RTH , must use in conjunction to GPS Home

ARM – Arms the main motor of the aircraft



Use Angle mode for stabilization

- **Acc Calibration**
- Place the plane on a stable surface.
- Wings Level with nose in expected Attack angle for level flight.
- Normally a few degrees up.
- Memorize the planes attitude in flight this should be Level for Acc.
-

- ***Passthru***
- Sends Rc commands direct to servos.

No influence from sensors.

- ***Gyro Mode*** *(Acro)*
- This is "Normal" mode when nothing else is selected.
- The plane should compensate for movements. (Wind Gusts etc)
- The plane feels stable and locked in but still able to loop & roll.
- Stall speed is lower and it can be necessary to "Push" it down in landings.

- ***Stable Modes***
- With the sticks centered the plane will self stabilize.
  Returning to level flight from almost any situation.
- Provided there's enough Altitude for recovery.
-

- **Horizon Mode** Allows rolls and loops. Levels with centered sticks
  This is a comfortable flight mode for FPV.

- **Angle Mode** also limits how much the plane can tilt.
  Gives a Stiff feeling and is only recommended for beginners.

Graphs and Sensors

Upload the sketch to the Arduino attach to the drone shield and open the FlywiiGUI sensor Graphs tab and hit connect to the appropriate COM your drone is connected to

the correct orientation

Roll Right + no#
Pitch nose down + No#
Z up + No#

Roll Right + no#
Pitch nose down + No#
Yaw Right +No#

Mag & HEAD degrees corresponds to the compass

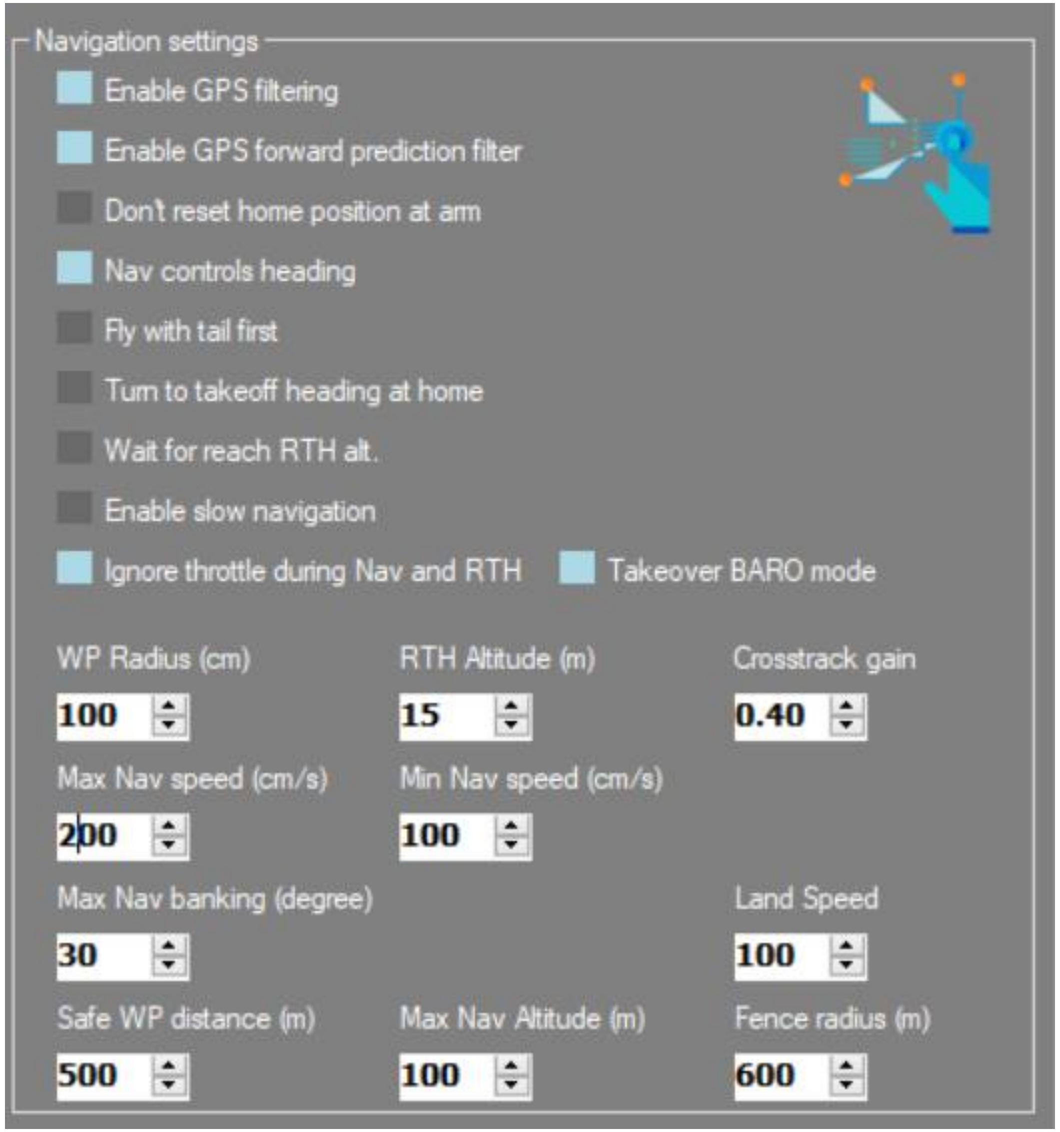
(0 degrees = North)

Alt up +no#

Example : if roll the drone to the right the Accelerometer and Gyroscope graphs would show positive numbers and to the Left Negative numbers

If Lift the drone up Vertically the accelerometer Z axis should shows positive numbers and altitude should show a climb in meters

Other Navigation Functions



WP Radius – the radius of the area the Pos PID with trigger it has reach the waypoint

Max Nav Speed – Maximum speed the drone travel between waypoints (too fast and you likely over shoot your target) ***for first mission flight test Nav speed of 100cm/s with ("Enable Slow Navigation "Active)***

Min Nav Speed – the speed the drone travel when with in the WP Radius 200cm/s for starters

RTH Altitude – Altitude the drone will climb to when its below the altitude in relation to its home point when the RTH is trigger set this to 0 to RTH at current altitude

Max Nav Banking – the max allowable pitch and roll the drone will be set too while traveling between waypoints (tune this along with Max Nav Speed to take account with Environment conditions)

Max Nav Altitude – Max altitude the drone is cap to fly at

Land Speed – speed of descending for Landing cm/s

Safe WP Distance – max distance between waypoint before its null out

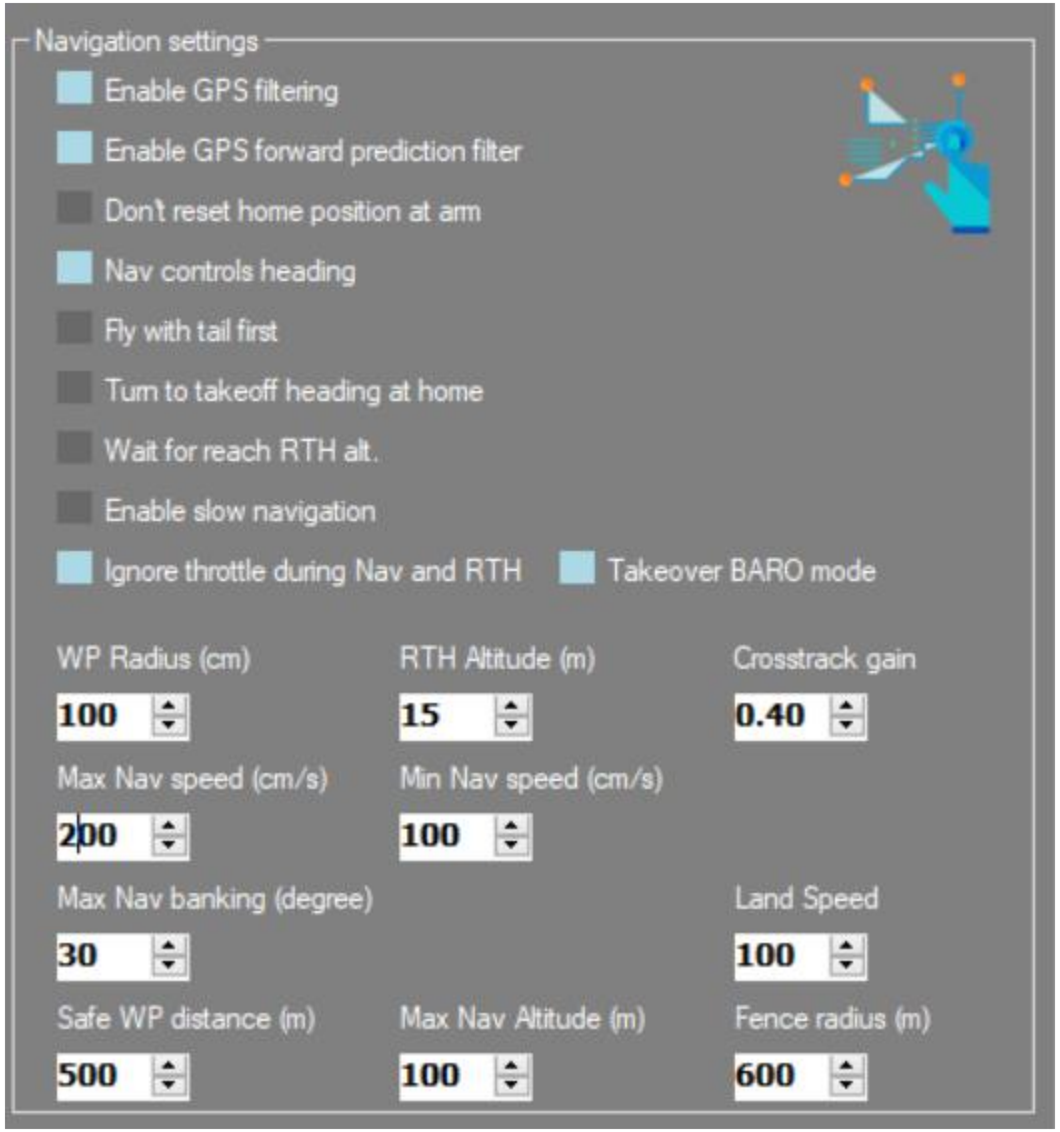
Fence Radius – Geo Fence to keep the drone with in the perimeter in relation to home position

CrossTrack gain - this tune the GPS and Nav sensitivity

GPS Filtering – use to enhance GPS accuracy

GPS Forward Prediction Filter – predicting the drones location and to compensate for lag . (optional) – not necessary for most application

Other Navigation Functions



Don't Reset Home position at Arm – this retains the home position where you first plug power on your drone

Nav Controls Heading – this points the drone to its next waypoint Important to fixwings

Fly tail first – Not applicable in fixwings

Turn take off heading at Home – when drone arrives at home position it orientates to its heading right after arming

Wait to reach RTH - this works with RTH altitude command which the drone would climb to the said altitude before initiating the flight to home position

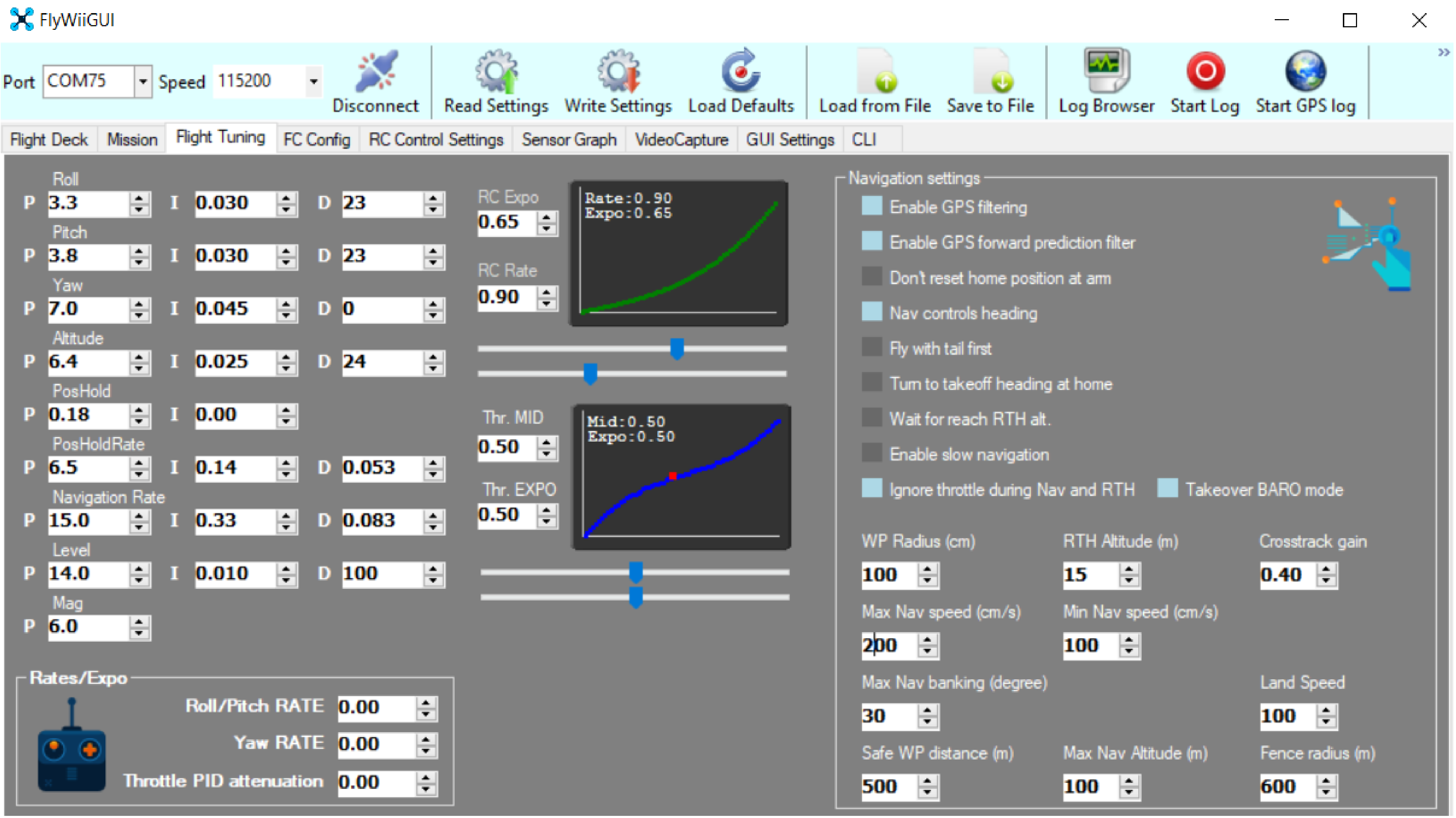
Enable slow navigation – this works with keeping the drone to its **Min Nav speed**

Ignore throttle and Take over Baro – as the name suggest disable throttle stick command from the controller when the drone is on mission mode

Important Navigation Settings for Fixwing

- Enable GPS Filtering ON
- Nav Control Heading ON
- Flywith Tail First OFF
- Turn Takeoff Heading OFF
- Wait for Reach RTH alt OFF
- Enable slow navigation OFF

- Flight Tuning



Stability	Roll,Pitch,Yaw Gyro	PID : Level of your Gyro
Horizon / Level Mode	X,Y Accelerometer	PID : X ,Y Axis Level of your Accelerometer
Heading Lock	Compass/Mag	PID : heading of your magnetometer Calibration
Altitude Hold	Barometer / Z	PID : Barometer and Z accelerometer
Position Hold	GPS Pos	PID : sensitivity of GPS position reaction
Navigation Rate	GPS Nav	

Understanding impact of P, I and D

P : this is the amount of corrective force applied to return the Aircraft back to its initial position

The amount of force is proportional to a combination of the the deviation from initial position minus any command to change direction from the controller input. A higher P value will create a stronger force to resist any attempts to change it's position. If the P value is too high, on the return to initial position, it will overshoot and then opposite force is needed to compensate. This creates an oscillating effect until stability is eventually reached or in severe cases becomes completely destabilized.

I : this is the time period for which the angular change is sampled and averaged

The amount of force applied to return to initial position is increased by the I factor the longer the deviation exists until a maximum force value is reached. A higher I will increase the angular hold capability.

D : this is the speed at which the Aircraft is returned to its original position

Increasing value for D: Improves the speed at which deviations are recovered

With fast recovery speed comes a higher probability of overshooting and oscillations
Will also increase the effect of P

P – proportional

P provides a proportional amount of corrective force based upon the angle of error from desired position. The larger the deviation, the larger the corrective force.

A higher P value will create a stronger force to return to desired position. If the P value is too high, on the return to initial position, it will overshoot and then opposite force is needed to compensate. This creates an oscillating effect until stability is eventually reached or in severe cases, the overshoot becomes amplified and the multi-rotor becomes completely destabilized.

Increasing value for P :It will become more solid/stable until P is too high where it starts to oscillate and lose control. You will notice a very strong resistive force to any attempts to move the Multi-Rotor

Decreasing value for P: It will start to drift in control until P is too low when it becomes very unstable. Will be less resistive to any attempts to change orientation

Aerobatic flight: Requires a slightly higher P

Gentle smooth flight: Requires a slightly lower P

I – Integral

“I” gain provides a variable amount of corrective force based upon the angle of error from desired position.

The larger the deviation and / or the longer the deviation exists, the larger the corrective force. It is limited to prevent becoming excessively high.

A higher I will increase the heading hold capability

Increasing value for I: Increase the ability to hold overall position, reduce drift due to unbalanced frames etc

Decreasing value for I:Will improve reaction to changes, but increase drift and reduce ability to hold position

D- Divide / Derivative

This moderates the speed at which the Aircraft is returned to its original position.

A lower D will mean the Multi-Rotor will snap back to its initial position very quickly

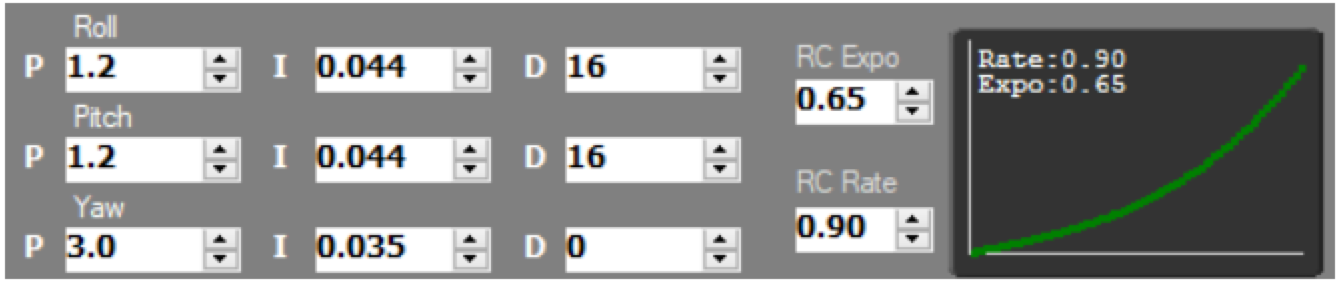
Increasing value for D: Dampens changes. Slower to react to fast changes

Decreasing value for D: Less dampening to changes. Reacts faster to changes

Aerobatic flight: Lower D

Gentle smooth flight: Increase D

Basic PID Tuning – on the ground



Click on Write settings after changes made in any of the parameters to save

1 - Set PID to the designers default recommended settings.

2 - Hold the Aircraft securely and safely in the air.

3 - Increase throttle to the hover point where it starts to feel light.

4 - Try to lean the Aircraft down onto each motor axis. You should feel a reaction against your pressure for each axis.

5 - Change P until it is difficult to move against the reaction. Without stabilization you will feel it allow you to move over a period of time. That is OK

6 - Now try rocking the aircraft. Increase P until it starts to oscillate and then reduce a touch.

7 - Repeat for Yaw Axis. Your settings should now be suitable for flight tuning.

You will have to accept a compromise of optimal settings for stable hover and your typical mode of flying.

Obviously factor it towards your most common style.

Other factors affecting PID Taking known good PID values from an identical configuration will get you close, but bear in mind no two Aircraft will have the same flying characteristics and the following items will have an impact on actual PID values:

1 - Frame weight /size / material / stiffness
2 - Motors - power / torque /momentum
3 - Position - Motor-->motor distance (I.E. frame size)
4 -ESC / TX - power curves
5 - Prop - diameter / pitch / material
6 - BALANCING
7 - Pilot skills

Advanced Tuning - practical implementation

For Aerobatic flying: Increase value for P until oscillations start, then back of slightly

Change value for I until wobble is unacceptable, then decrease slightly

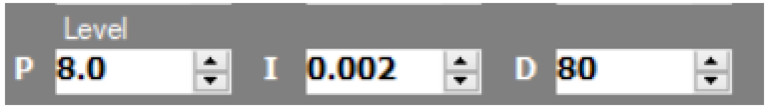
Decrease value for D until recovery from dramatic control changes results in unacceptable recovery oscillations, then increase D slightly Repeat above steps

For stable flying (RC): Increase value for P until oscillations start, then back of quite a bit

Decrease value for I until it feels too loose /unstable then increase slightly
Increase value for D

Click on Write settings after changes made in any of the parameters to save

PID : Level



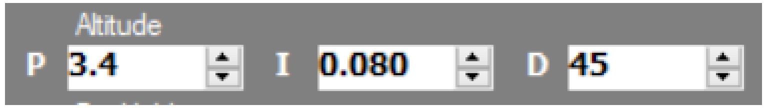
This will influence the flight characteristic with an accelerometer : this is Level Mode

P is the dominant part of autolevel mode.
I will tell how much force must be applied when the mesured angle error persit
D is used to clamp the maximum correction for autolevel mode

Increase value for P will make the autolevel mode stronger

For smooth operation the sum of P axis + P level should stay near the default value : if you decrease P for Roll and Pitch axis you can increase P Level

ALT Hold



Click on Write settings after changes made in any of the parameters to save

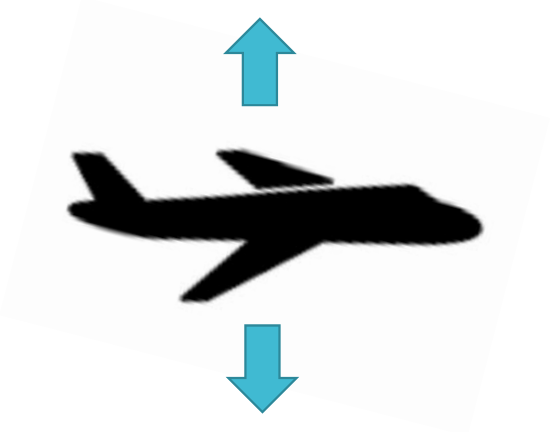
The Barometer sensor is used to detect the altitude of your aircraft and is used for altitude hold mode. As the barometer sensor is not very precise and is quite noisy, detection of small up and down movements is impossible.

So small up and down movements are detected by the accelerometer Z axis.
Combination of these two sensors gives good altitude hold.
PID settings for ALT works like this:

P - Is how much the Aircraft should rely on the barometer sensor. The higher the value is the stronger the multirotor relies on the Barometer reading.

I - Is used to compensate for drift caused by battery voltage drop during the flight. The higher the value is more the multirotor will react to voltage drops (or other varying factors over time).

D - Is how strong the Aircraft should react to data from the accelerometer Z axis. It is used to react to small up and down movements that the barometer cannot accurately sense. The higher the value is the stronger the Aircraft will react to small altitude changes.



1. So set the P and I to 0

2. Start to play with D value only. To high D may cause yoyo effect (up and down oscillations). With to low D copter will be not able to react strong/fast enough to hold altitude. Your goal here is to set D to the value when copter don';t oscillate up and down and also holds altitude quite well for a not very long period of time. Aircraft will not hold altitude perfectly at this point during long periods. It will slowly drift up or down, but altitude should be quite stable in short periods.

3. Start to increase P to the point where Aircraft holds altitude over long time period. If the value is to small the copter will drift slowly up and down. If the value is to high yoyo effect may appear. Goal here is to set it to the point where copter holds altitude for quite some time. Aircraft will still go slowly down due to battery voltage drop over time.

4. "I" is used to compensate the voltage drop. So start to increase the "I" value slowly until you get a perfect position hold during a very long time.
Now your altitude hold should be good enough.

- **For Mega 2560 + GPS Pos Rate PID controller & Pos Rate PID Tuning**

- Pos Rate PID controller
- Pos Rate PID Tuning

- The Pos Rate PID controller takes the commanded speed output from the Pos PI controller and commands an attitude in order to maintain the position hold location. This PID controller should be tuned before adjusting the Pos PI controller.

- The Pos Rate PID settings control how the attitude of the Vehicle is changed in order to move towards the desired hold location.

- The speed of movement is controlled by the Pos PI controller, while the attitude of the Aircraft is controlled by Pos Rate.

- When the Aircraft is within the defined distance of the hold location or waypoint (set by GPS_WP_RADIUS in config.h) the Pos Rate PID is used, when further away from the location the Nav Rate PID is used to return to within the defined waypoint radius.

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- To tune the Pos Rate PID, initially set P, I and D values to 0.
- Gradually increase P until the Aircraft begins to position hold with some drift.
- Gradually increase D until the Aircraft responds more quickly to undesired changes in attitude caused by the wind. If this value is set too high you will see oscillations or sudden jerking in pitch and roll motion.
- If needed, gradually increase I value to allow the PID controller to compensate for long lasting error, ie if it is being blown by the wind.

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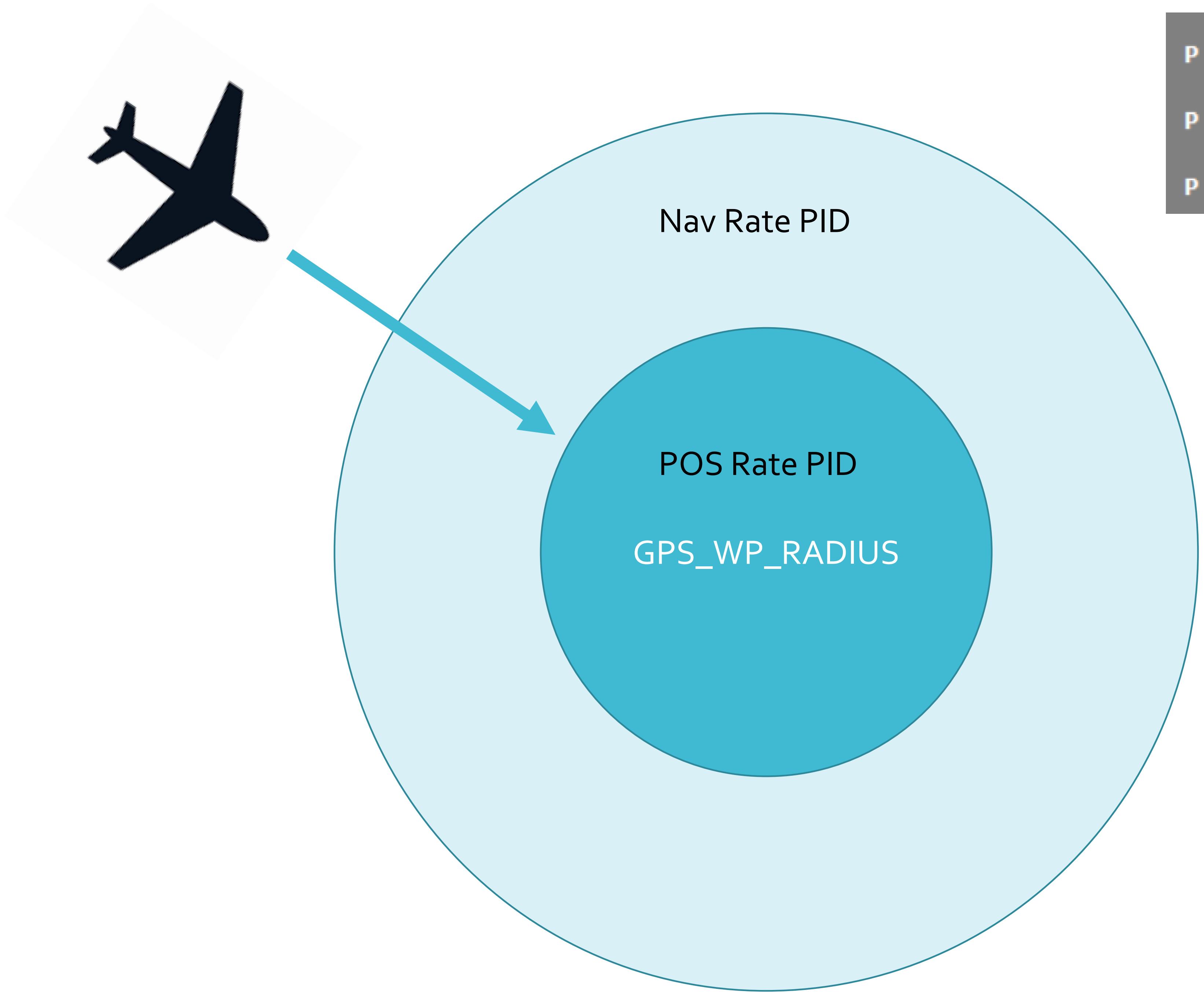
PosHold					
P	0.15	I	0.00		
PosHoldRate					
P	3.4	I	0.14	D	0.053
Navigation Rate					
P	2.5	I	0.33	D	0.083



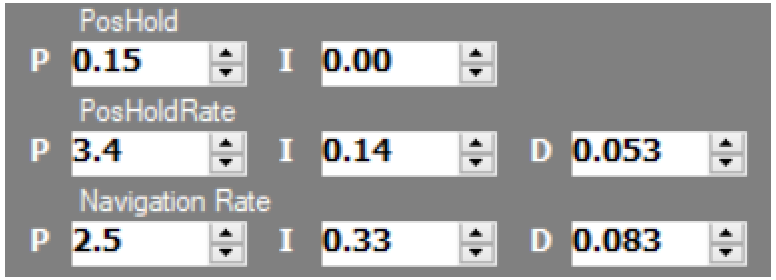
The Aircraft suppose to heading towards the waypoint

When the aircraft goes pass the waypoint

Mission – fly to next waypoint

GPS Hold – Aircraft would orbit the Waypoint

Enter loiter orbit mode



To tune the Pos Rate PID, initially set P, I and D values to 0.

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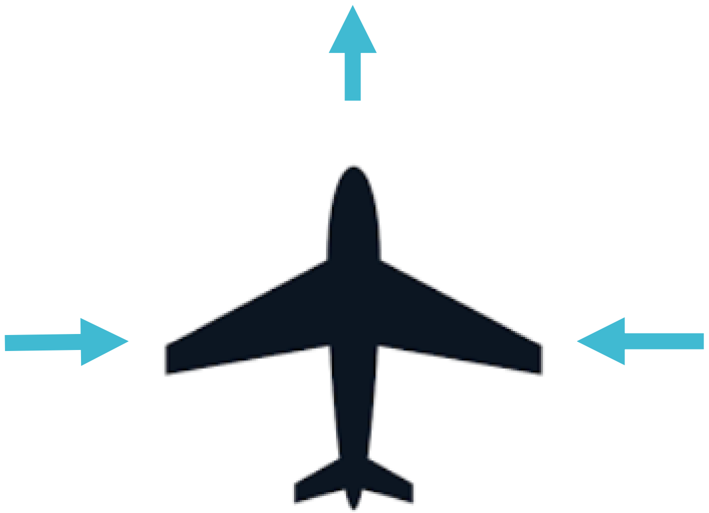
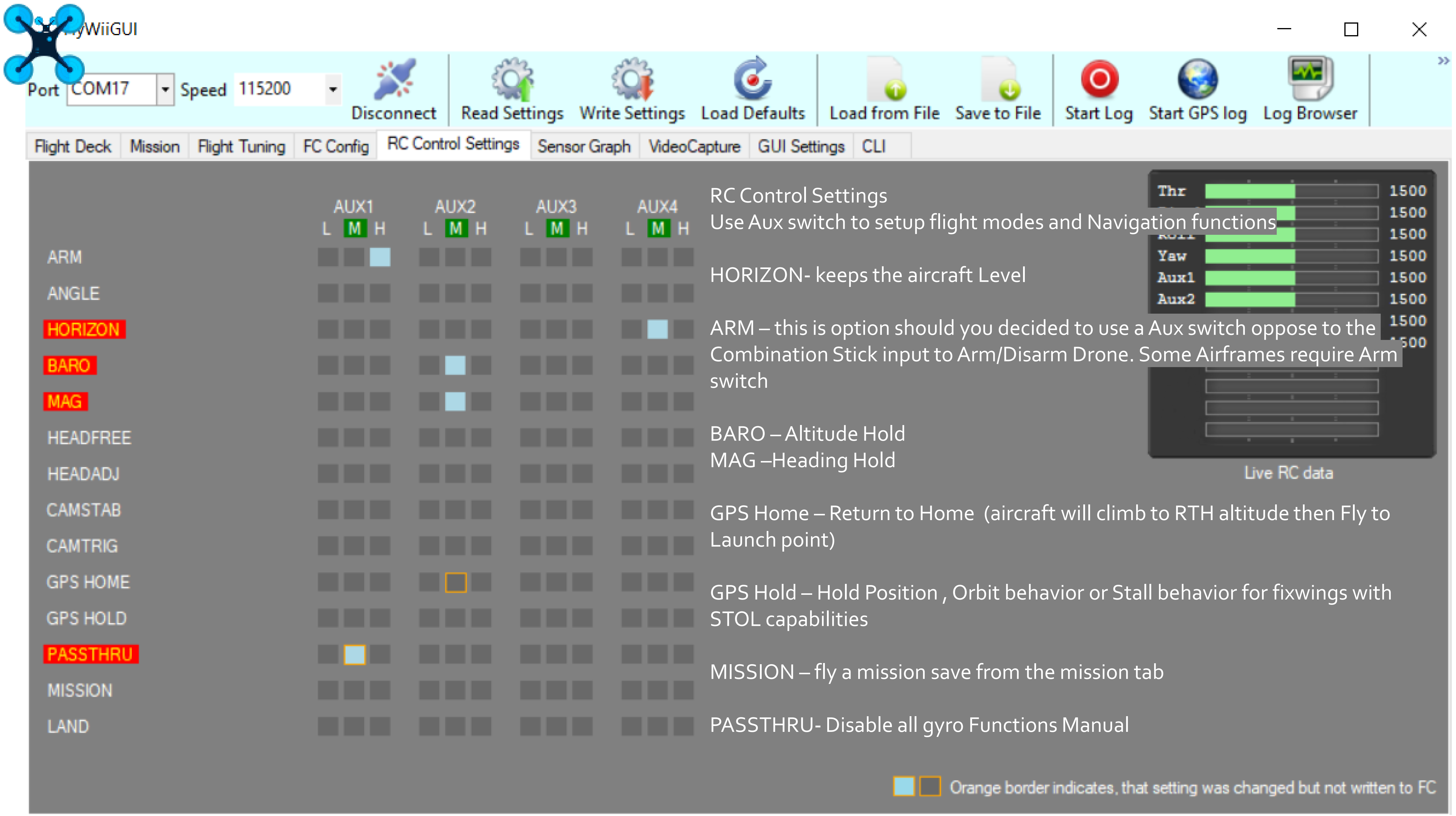



MultiWiiGUI
Port COM17
Speed 115200
Disconnect
Read Settings
Write Settings
Load Defaults
Load from File
Save to File
Start Log
Start GPS log
Log Browser
Flight Deck
Mission
Flight Tuning
FC Config
RC Control Settings
Sensor Graph
VideoCapture
GUI Settings
CLI
AUX1
AUX2
AUX3
AUX4
L M H
ARM
ANGLE
HORIZON
BARO
MAG
HEADFREE
HEADADJ
CAMSTAB
CAMTRIG
GPS HOME
GPS HOLD
PASSTHRU
MISSION
LAND
RC Control Settings
Use Aux switch to setup flight modes and Navigation functions
HORIZON- keeps the aircraft Level
ARM – this is option should you decided to use a Aux switch oppose to the Combination Stick input to Arm/Disarm Drone. Some Airframes require Arm switch
BARO – Altitude Hold
MAG –Heading Hold
GPS Home – Return to Home (aircraft will climb to RTH altitude then Fly to Launch point)
GPS Hold – Hold Position , Orbit behavior or Stall behavior for fixwings with STOL capabilities
MISSION – fly a mission save from the mission tab
PASSTHRU- Disable all gyro Functions Manual
Thr 1500
1500
1500
Yaw 1500
Aux1 1500
Aux2 1500
1500
Live RC data
Orange border indicates, that setting was changed but not written to FC

MODES and AUX Setting

- Preferably to reserve 1 Aux channel as Arm switch as combination stick could make the vehicle move prematurely
- Then the alternative Aux for the Mission or RTH mode

MODES and AUX Setting

Passthru
Sends Rc commands direct to servos.
No influence from sensors.

Gyro Mode *(Acro)*
This is "Normal" mode when nothing else is selected.
The plane should compensate for movements. (Wind Gusts etc)
The plane feels stable and locked in but still able to loop & roll.
Stall speed is lower and it can be necessary to "Push" it down in landings.

Stable Modes
With the sticks centered the plane will self stabilize.
Returning to level flight from almost any situation.
Provided there's enough Altitude for recovery.

Horizon Mode Allows rolls and loops. Levels with centered sticks
This is a comfortable flight mode for FPV.

Angle Mode also limits how much the plane can tilt.
Gives a Stiff feeling and is only recommended for beginners.

MODES and AUX Setting

GPS Flight Modes

Missions

Puts the aircraft into waypoint mode set Aux switch to Mission & Horizon or Angle mode

GPS-Hold

Can only be enabled With AUX switch.
Check both Angle mode and GPS Hold in Gui.
When GPS-Hold is activated The position is saved in a 3D Waypoint.
The plane will Navigate and try to "hit" the WP continuously and maintaining altitude.
No pattern is programmed and the plane fly the shortest way back.
Often in a circle or figure eight.

MODES and AUX Setting

RTH (Return to home)
Can be enabled With AUX switch or by Failsafe.
Check both Angle mode and RTH in Gui.

When RTH is activated the plane will start Climb to reach safe Altitude.
If RTH is enabled Higher than set altitude it will start navigation and keep that altitude.
If altitude is safe the plane will start to Navigate to home Position.

Only use Angle/Horizon + Gps Home/Hold together.
Do **NOT** Activate BARO Or MAG for navigation.
It will interfere with the navigation code.

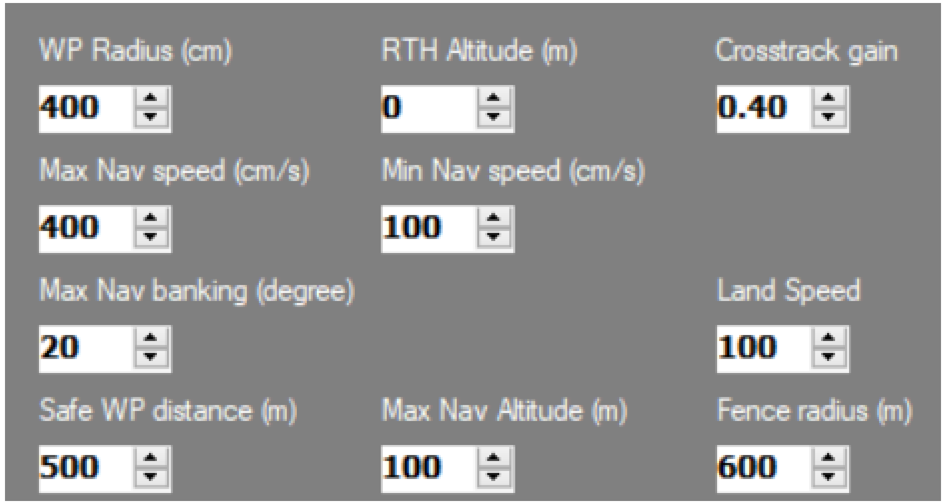
When the plane reaches **SAFE_DECSCEND_ZONE** the plane will begin descending to correct altitude.
The plane will keep flying in hold mode and continuously pass home.

If Failsafe is active at return The plane will Disarm motor and descend to a "Landing"

PID Settings

PID settings is made in Gui.
ALT & NavR.

Return Altitude can be set with
RTH Altitude
Scale is in Meters
15m is set as default.



Missions

Note: Only functional for Mega 2560 Boards with GPS

Waypoint – the drone with travel between those points

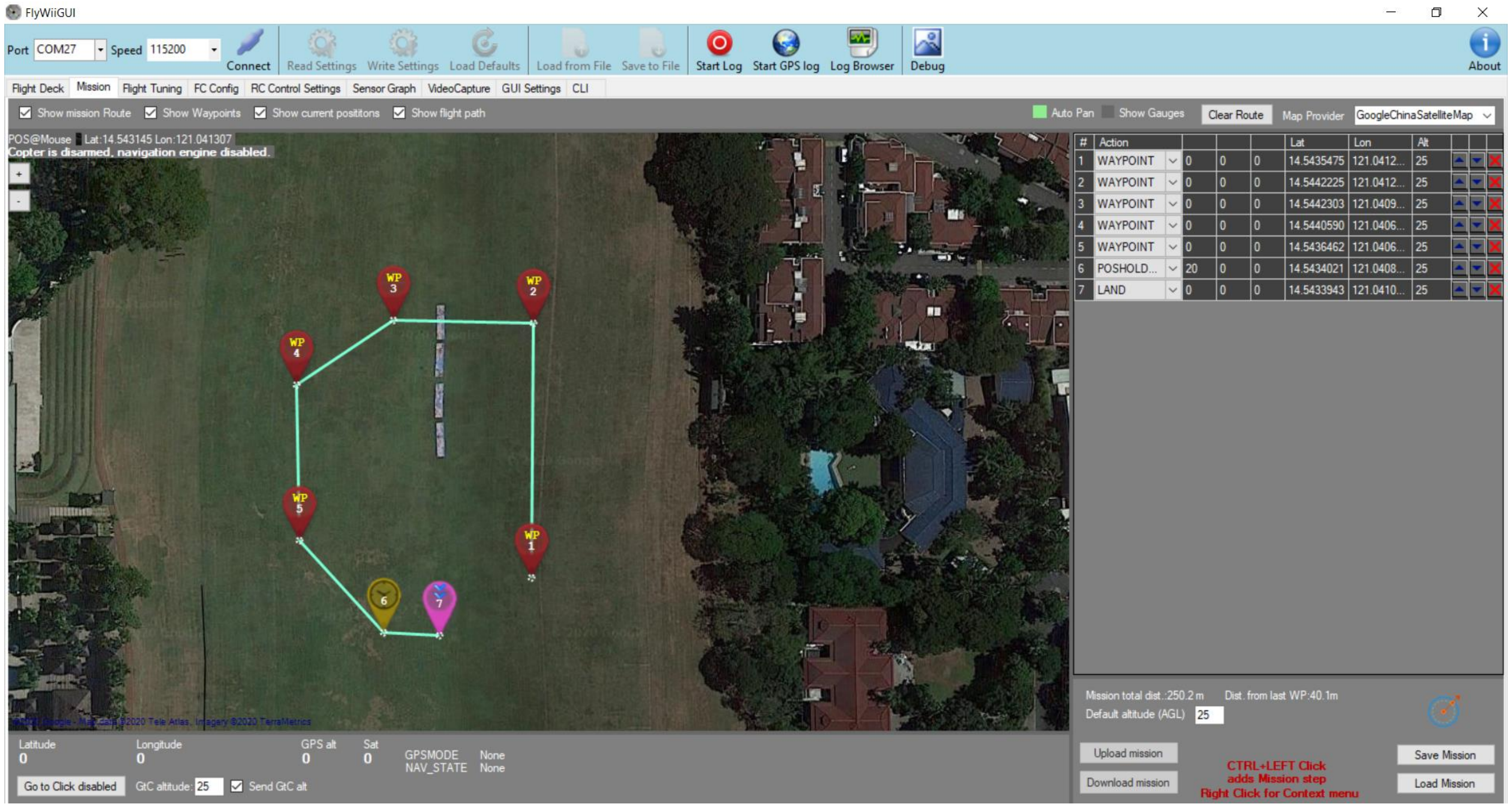
Time PosHold – Drone will wait X number of 00:00:00 then move to the next waypoint (limited for fixwing)

Unlimited PosHold – once the plane reach this point it will attempt to STOL Wait till you switch out of Mission mode

Land – the drone will land once it has reach this point (Must be place at the end of the mission)

RTH – the Drone will fly back to home position (Must be place at the end of the mission)

Default Alt – Altitude in meters (for first Mission test waypoint with altitude 2m-3m Above Ground Level) And set missions with 2m-3m altitude with Nav speed of 100cm/s .



RC Control Setting Tab – activate Baro , Mag , Mission

To start mission takeoff aircraft in stabilize mode up to 1-2meter altitude then switch the aux switch to mission mode .

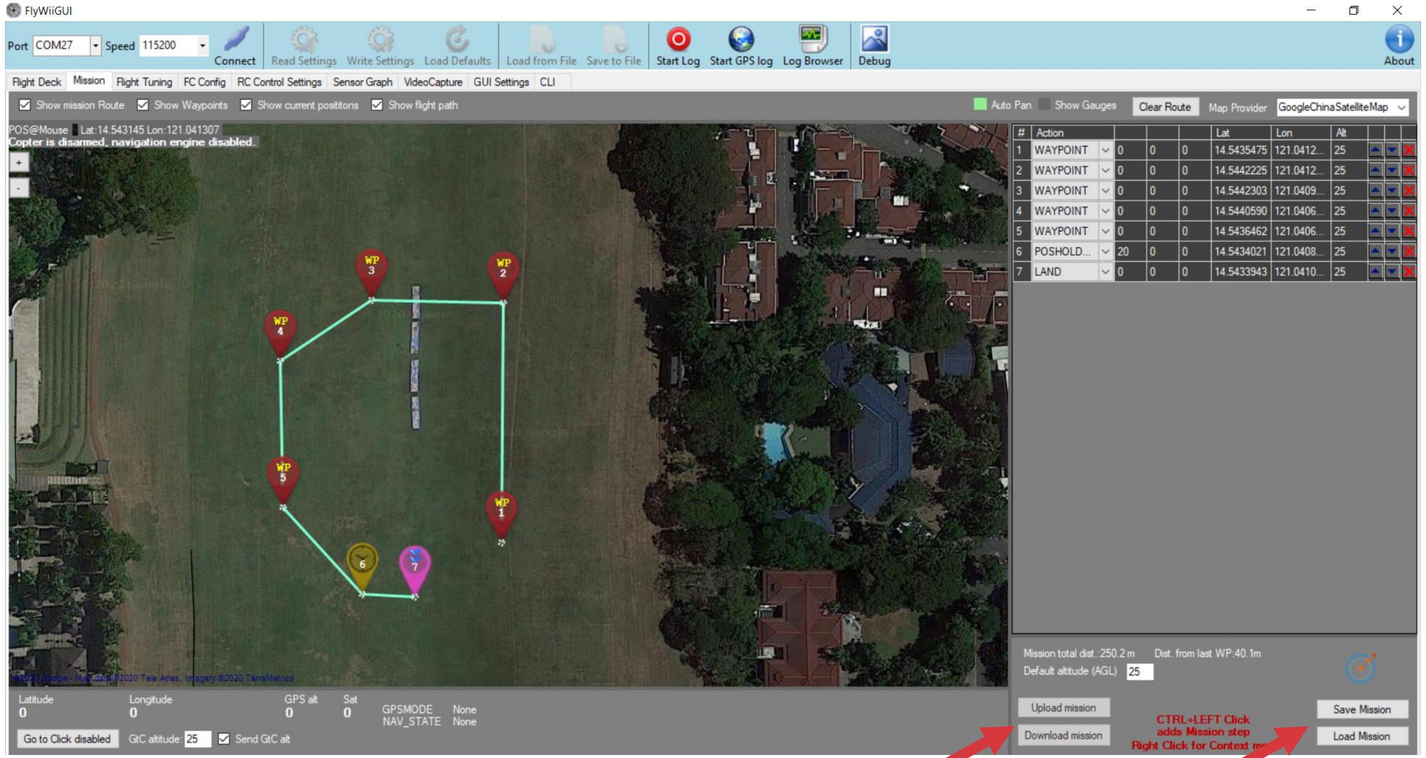
Any time you can switch out of it on hold or stabilize mode

Missions

Prerequisite and process for a good mission , Points to test before performing a mission

1. Plane is flying stable in horizon and Alt hold mode , holding altitude consistently less than 1m variation over 1 minute period . Tune PID and altitude PID when necessary. Return to passthru for manual control

2. RTH – set RTH Altitude to 0 , Max Nav speed to 100cm/s , set aux switch to RTH ,Horizon/Angle and write settings ,Fly the drone 5 Meters away from the Launch site and activate the RTH Aux switch ,see if the drone returns back to home position and holds position when arrive . Tune Navigation Rate PID when necessary

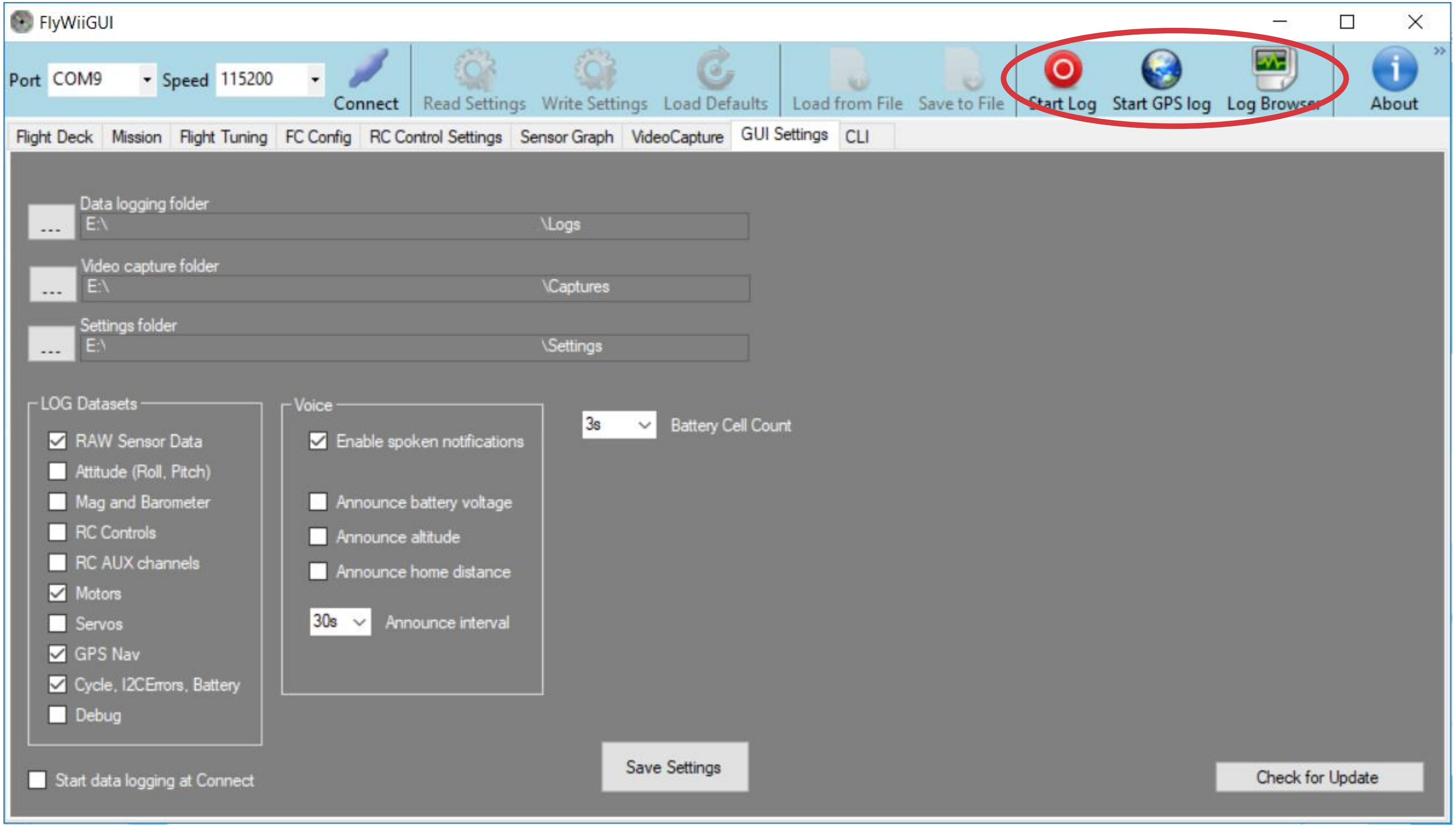


Mission upload to /download from plane

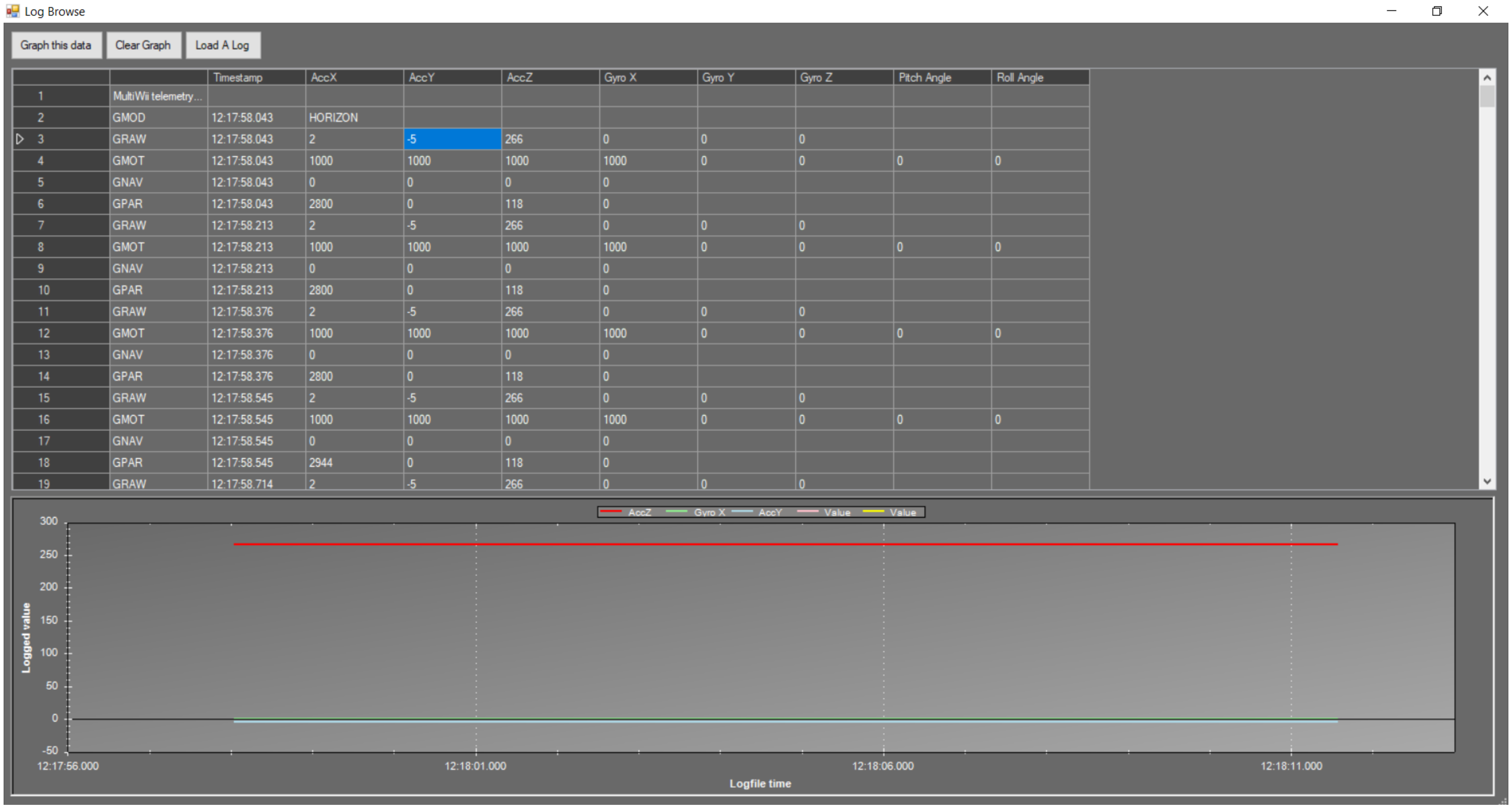
Mission Save to /Open from File

Graphs and Data Logging

GUI Settings (where you save your PID ,Flight Logs and Video Logs)



Log Browser



		Timestamp	AccX	AccY	AccZ	Gyro X	Gyro Y	Gyro Z	Pitch Angle	Roll Angle
1	MultiWii telemetry...									
2	GMOD	12:17:58.043	HORIZON							
3	GRAW	12:17:58.043	2	-5	266	0	0	0		
4	GMOT	12:17:58.043	1000	1000	1000	1000	0	0	0	0
5	GNAV	12:17:58.043	0	0	0	0				
6	GPAR	12:17:58.043	2800	0	118	0				
7	GRAW	12:17:58.213	2	-5	266	0	0	0		
8	GMOT	12:17:58.213	1000	1000	1000	1000	0	0	0	0
9	GNAV	12:17:58.213	0	0	0	0				
10	GPAR	12:17:58.213	2800	0	118	0				
11	GRAW	12:17:58.376	2	-5	266	0	0	0		
12	GMOT	12:17:58.376	1000	1000	1000	1000	0	0	0	0
13	GNAV	12:17:58.376	0	0	0	0				
14	GPAR	12:17:58.376	2800	0	118	0				
15	GRAW	12:17:58.545	2	-5	266	0	0	0		
16	GMOT	12:17:58.545	1000	1000	1000	1000	0	0	0	0
17	GNAV	12:17:58.545	0	0	0	0				
18	GPAR	12:17:58.545	2944	0	118	0				
19	GRAW	12:17:58.714	2	-5	266	0	0	0		

PRE-FLIGHT

Preflight setup
After you have changed the servo Rates
you can set Dual rates and Expos in the Transmitter.
Engine must be *Armed* to prevent motor start by accident..
It can be Armed from AUX-channel if it's setup in the gui . (recommended)
Or with stick combination min throttle & max rudder.

First Flight.
Take of in Passthru.
Switch mode on safe height.
Activate Assisted modes (Horizon /Angle) and feel the difference.

Level-P value will Reduce the maximum throw in Level-Mode.

And your much Done on your setup

Cannot Arm Motors

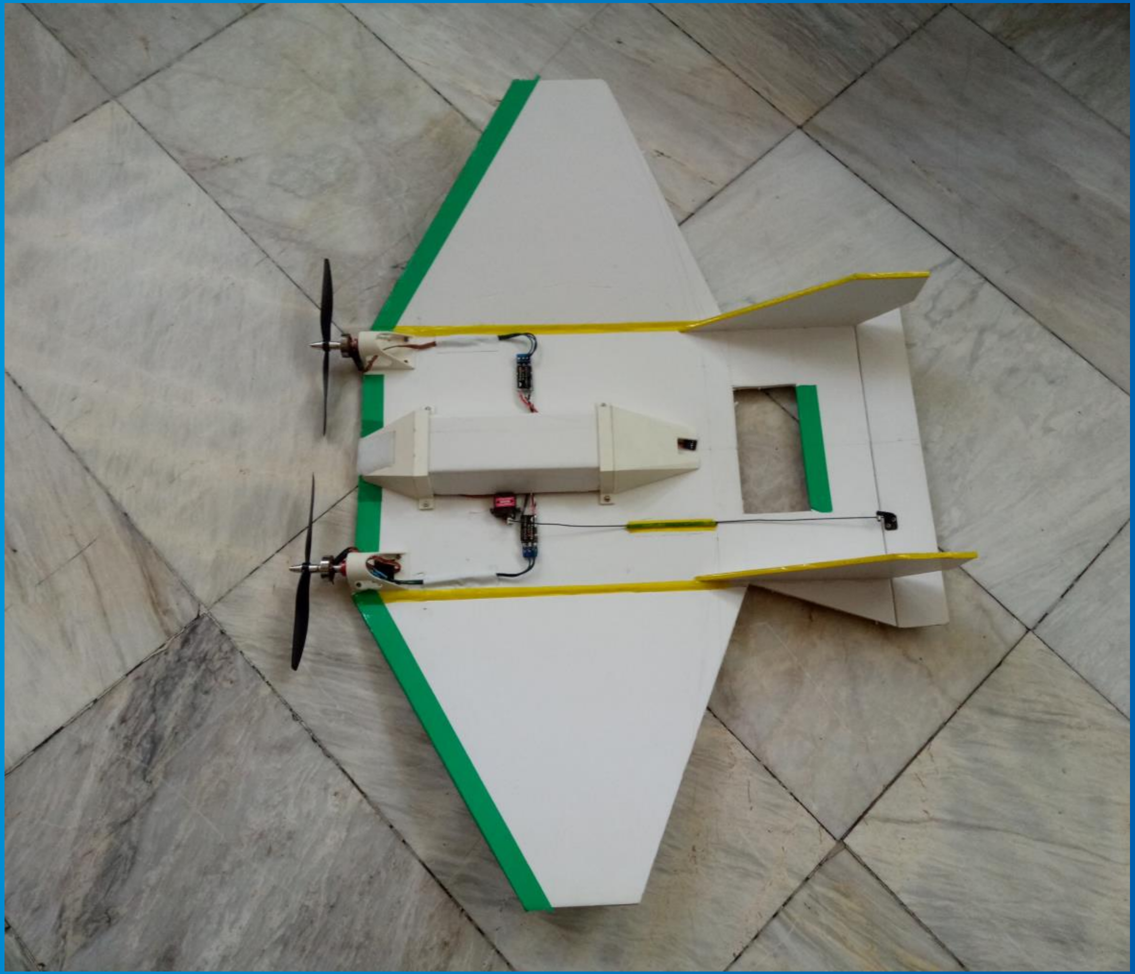
when on GPS Home , GPS Hold , Mission Flight modes & when USB is plugged in . (pls use Bluetooth telemetry)

Tests motor with Props off

Baro and Mag preferably switch off when Arming

Pls calibrate ACC and Mag in the FlyWii GUI Dashboard

Ensure the compass is facing the correct orientation



Preflight setup

After you have changed the servo Rates you can set Dual rates and Expos in the Transmitter.

Engine must be *Armed* to prevent motorstart by accident..

It can be Armed from AXU-channel if it's setup in the gui . (recommended)

Or with stick combination min throttle & max rudder.

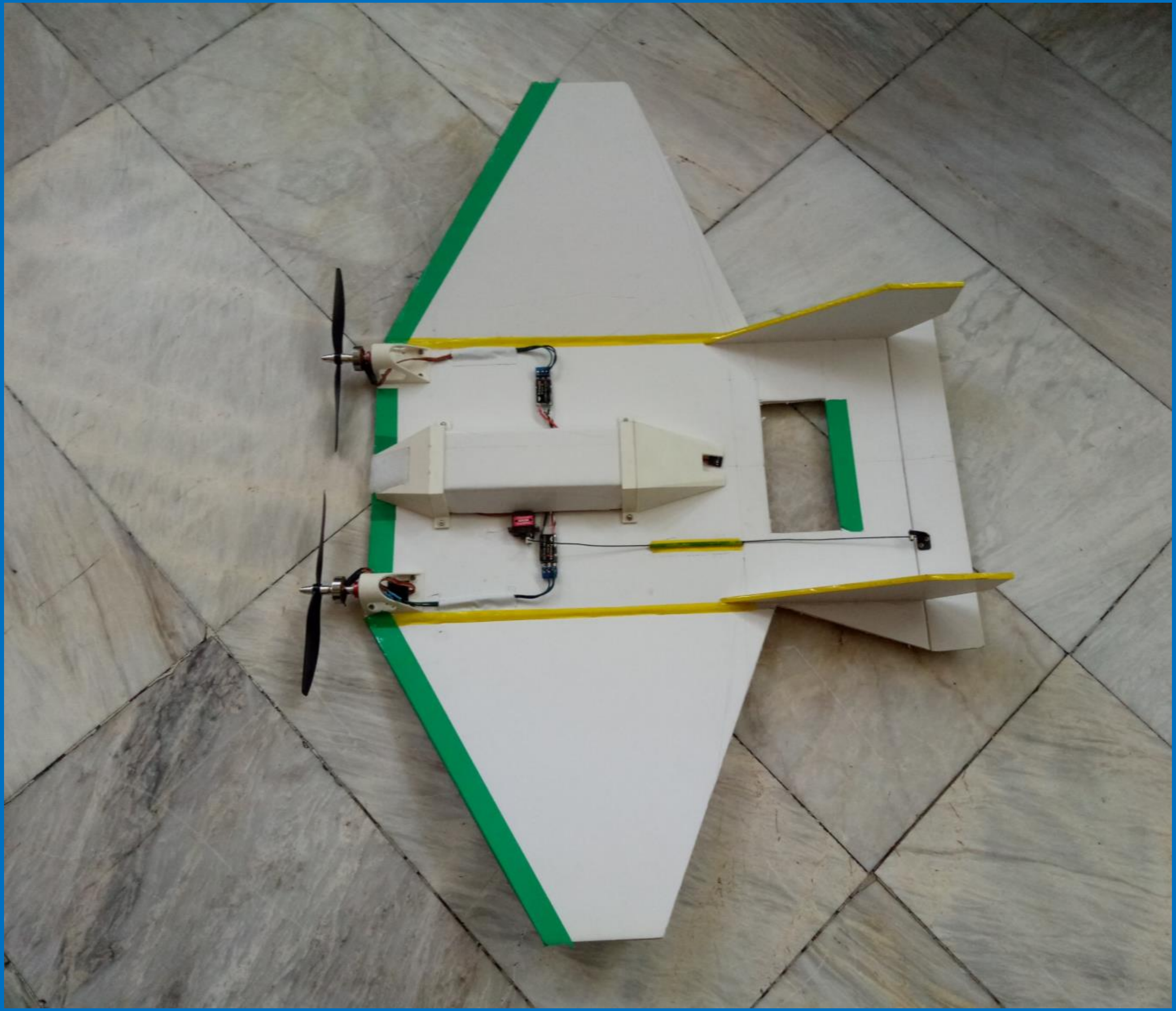
In RC control Setting set Aux 1 as Arm

First Flight.

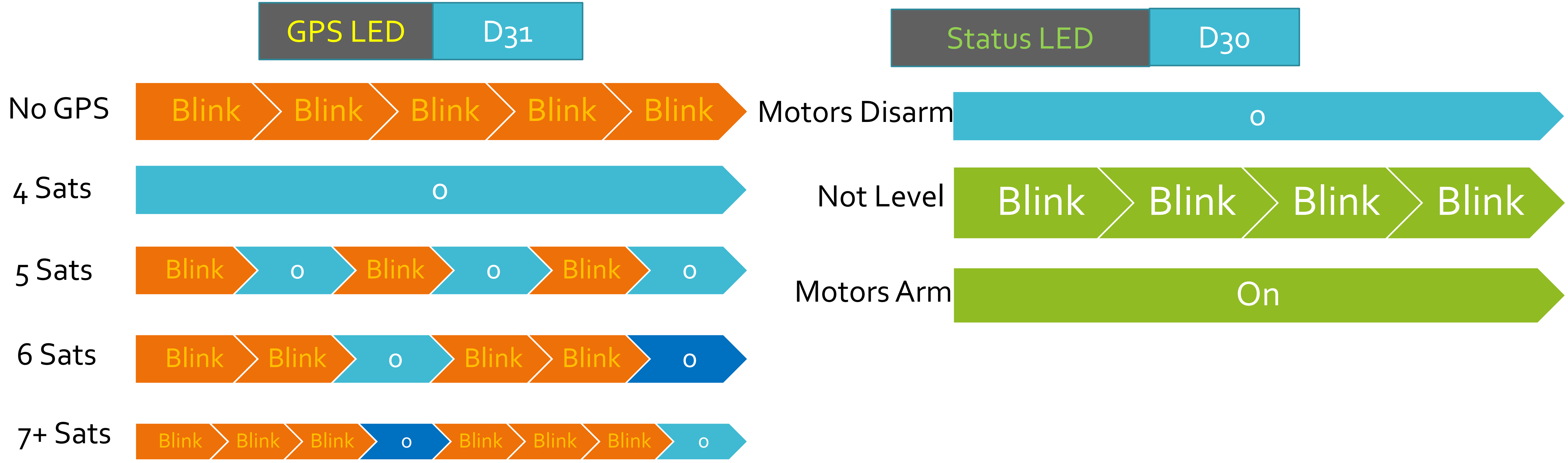
Take of in Passthru.

Switch mode on safe height.

Activate Assisted modes and feel the difference.



LED INDICATOR



indicate a valid GPS fix by flashing the LED

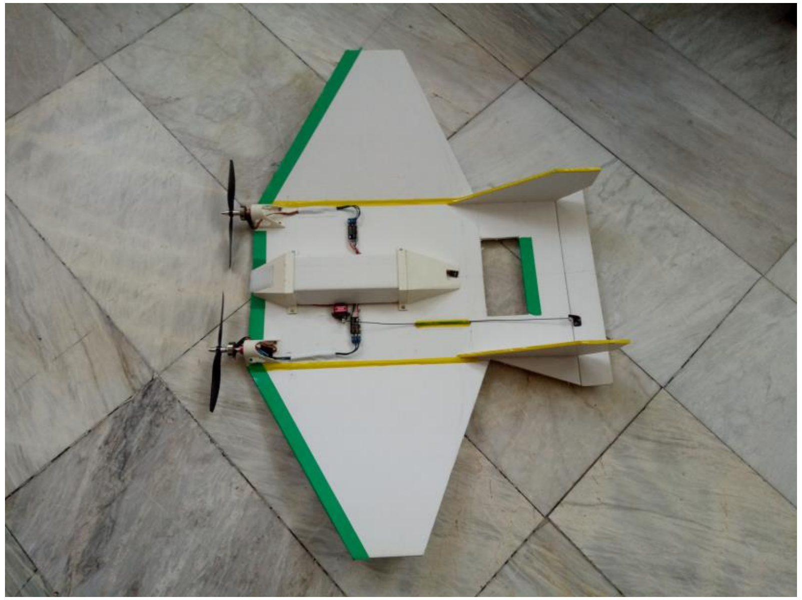
- led work as sat number indicator
- No GPS FIX -> LED blinks constant speed
- Fix and sat no. below 5 -> LED off
- Fix and sat no. >= 5 -> LED blinks, one blink for 5 sat, two blinks for 6 sat, three for 7 +

SYNERFLIGHT

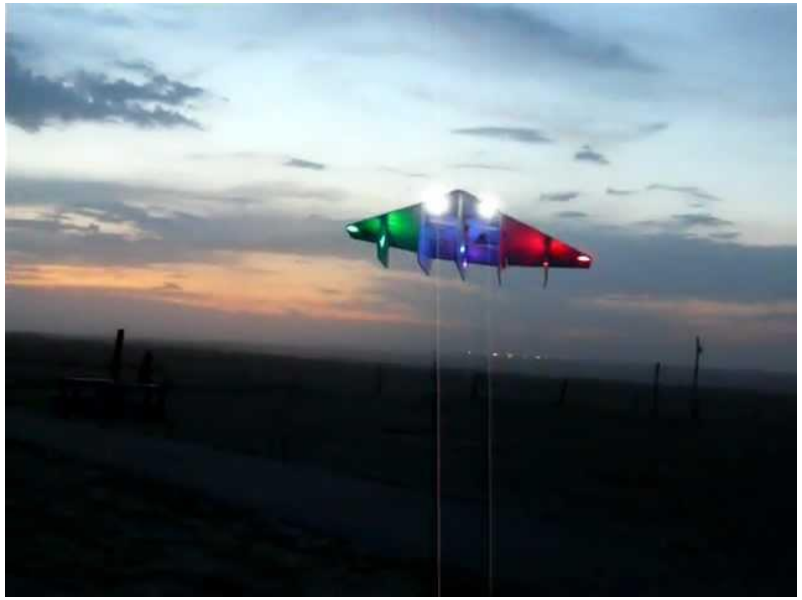
SYNERDUINO ARDU 2560

Conventional 4Ch AETR

Conventional 3Ch RET



Differential Thrust 3Ch RET



Flying Wing 3Ch

First timer for Autonomous RC Aircraft

We recommend that you choose a sizeable slow flying plane. Your comfortable flying

Either build from scratch or an available kit

Large enough to fit all your equipment and slow enough

To fly comfortably

This way its easy to tune and flown manually should needed