

# ADC Sensors

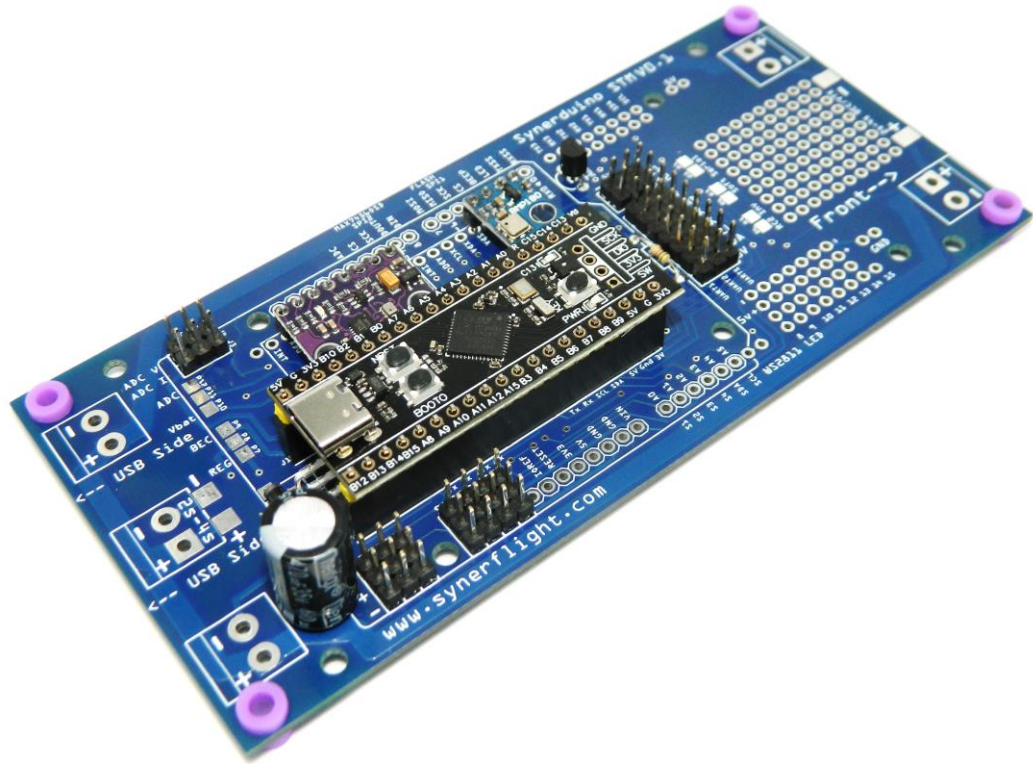
Synerduino STM

**VERSIONS: F405, F411, H743**

For more Information:  
[www.synerflight.com](http://www.synerflight.com)



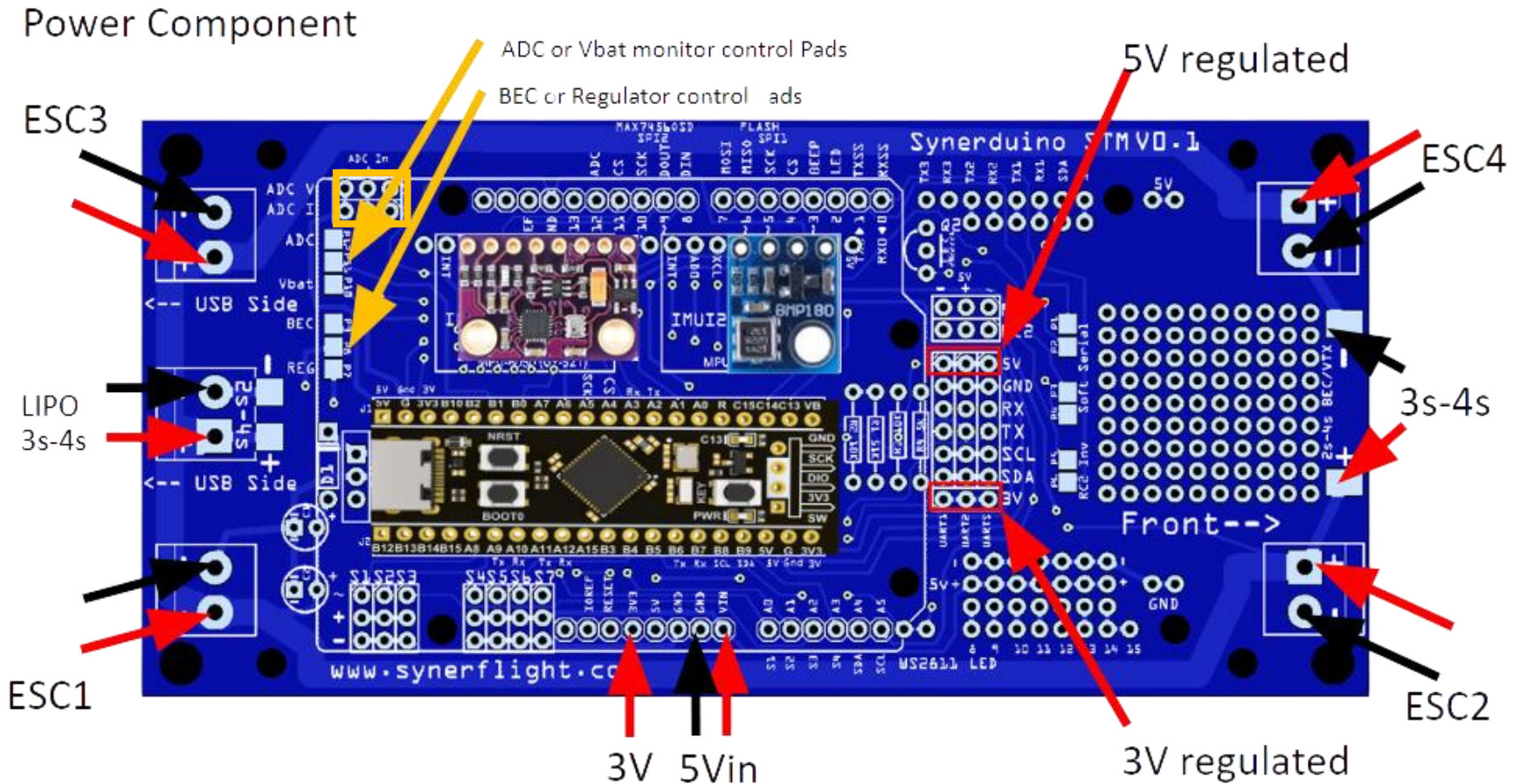
# INTRODUCTION



One of the highlighted feature both hardware and software is its flexibility into adding new function to a Drone the combination of Synerduino hardware and INAV software makes this possible

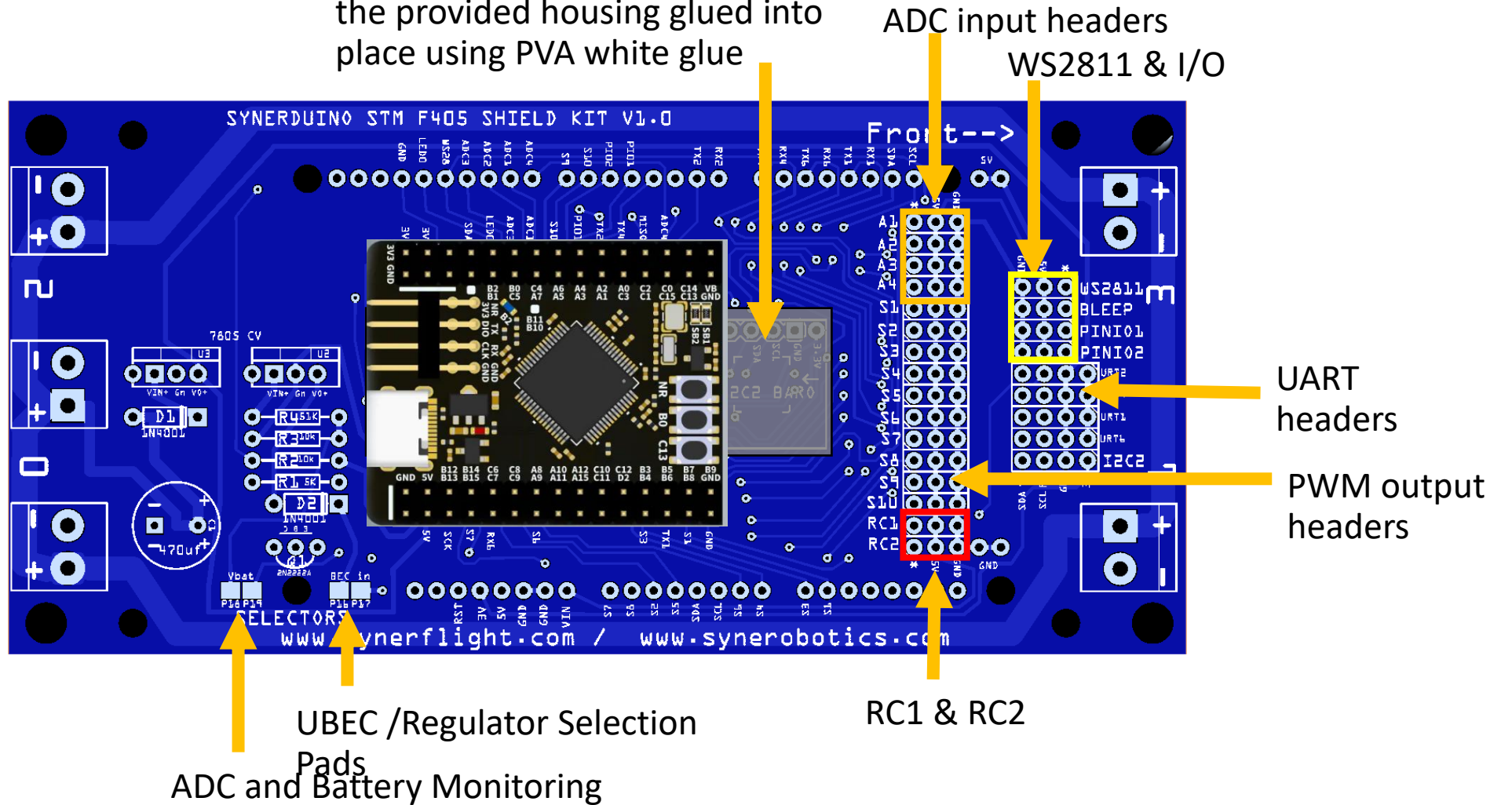
ADC Sensor and Data Logging is not only useful in diagnosing drone internal condition but also external environment as well

# SYNERDUINO STM F411 SHIELD



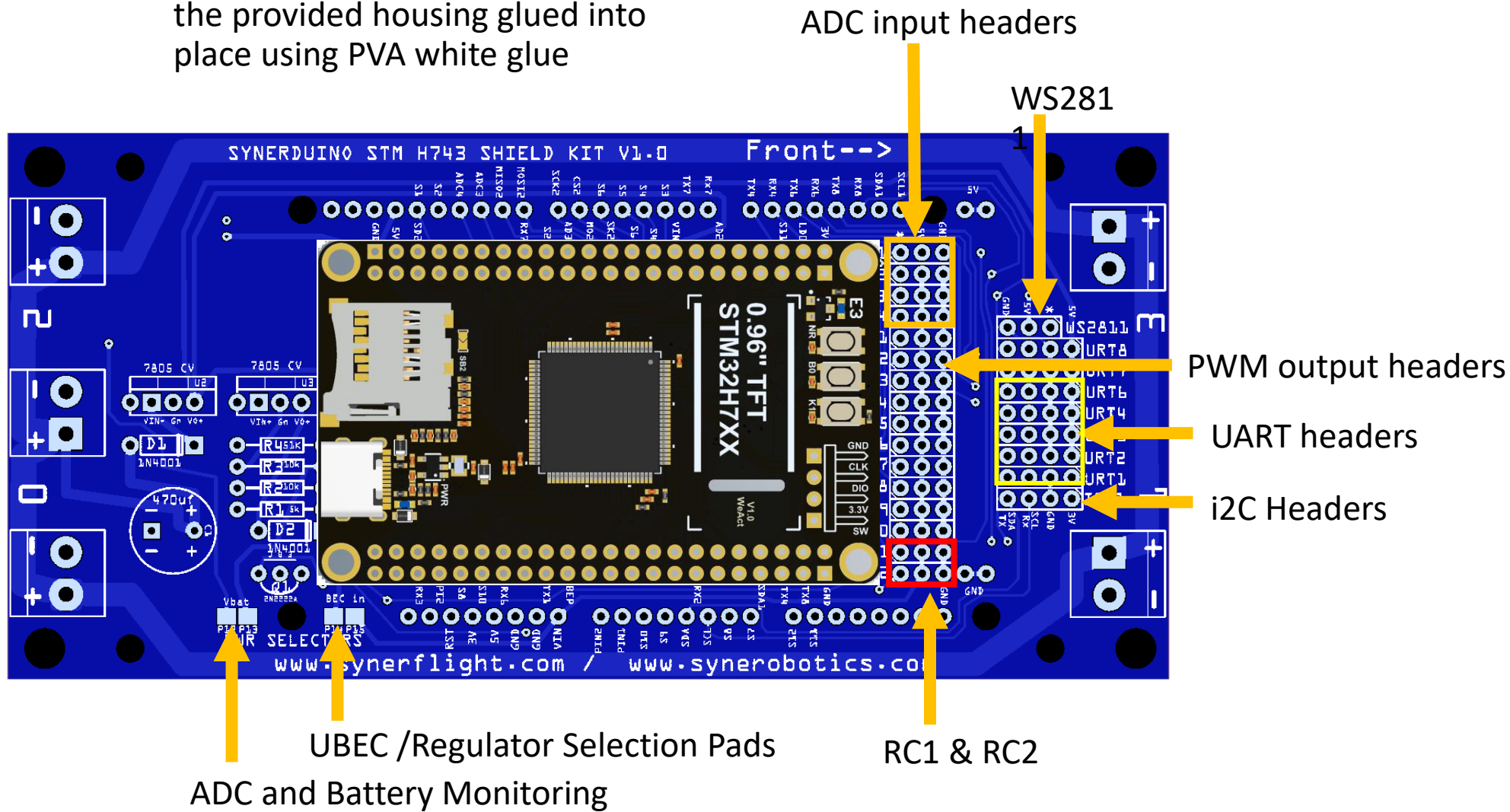
# SYNERDUINO STM F405 SHIELD

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



# SYNERDUINO STM H743 SHIELD

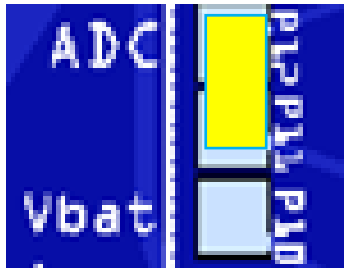
Sensors must be covered with the provided housing glued into place using PVA white glue



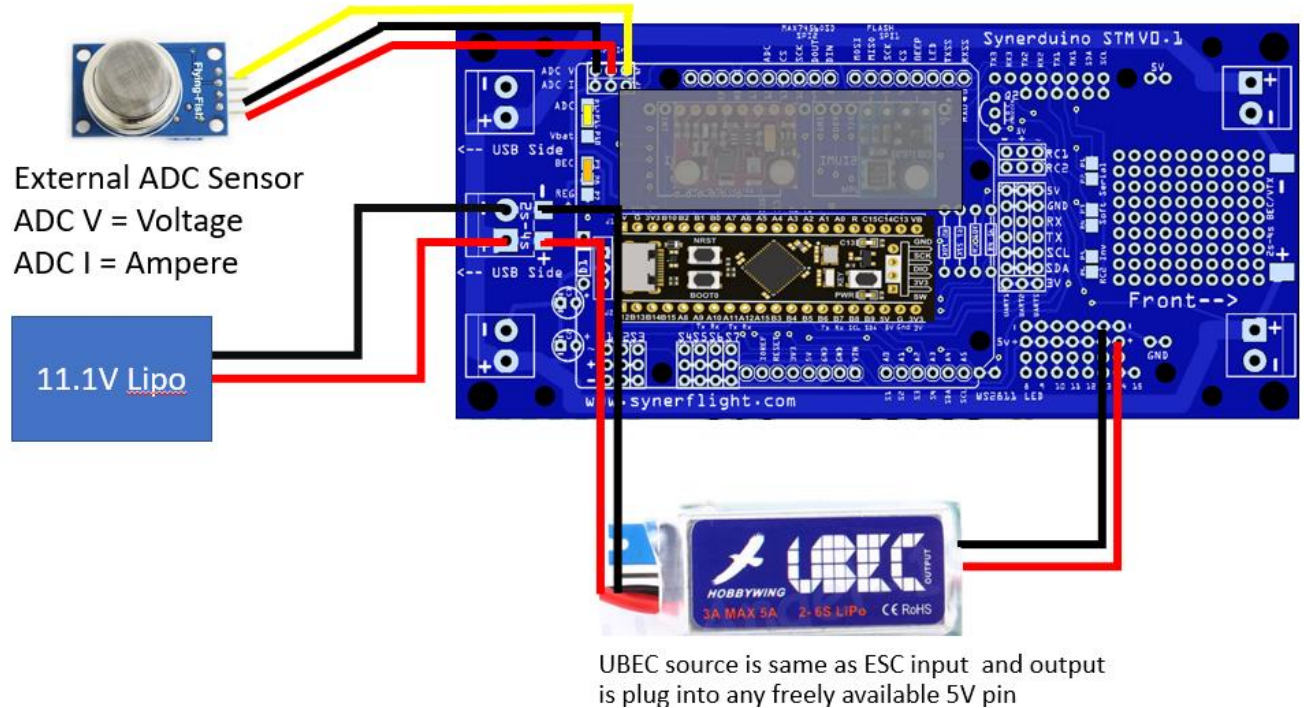
# Data Analytic Intervention

As the name suggest if you know what you're looking for and you want the drone to intervene /Do something when it met a condition. doing the mission whether is triggering a payload or instrument when a potential positive value is match

For this sample we Hook up a sensor into the ADC V or ADC I



P12-P11 : ADC –this is use for having an external Analog sensor installed as it reads 0V-5V for Synerduino to convert to a Global Variable

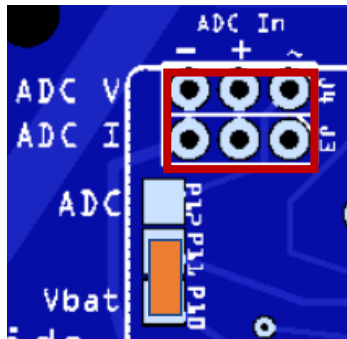


UBEC source is same as ESC input and output is plug into any freely available 5V pin



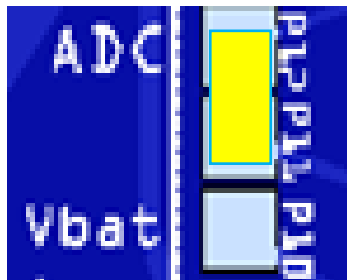
P9-P8 : BEC –this is use if you have a BEC powering through the ESC w/UBEC or an Standalone UBEC or Buck Converter Plug into S2 Pin

Note: when running external devices and sensors may sometimes require the use of external UBEC and a means to provide extra current to what your running



P11 – P10 Vbat = Provides battery status data of voltage which can function as a form of failsafe or other battery function

P11- P12 ADC = Provides an option to add External ADC sensors to the Board for Environmental Data Analytics or signaling application



ADC V = Voltage  
ADC I = Amperage

# Data Analytic Intervention

Primary with 4 ADC pins

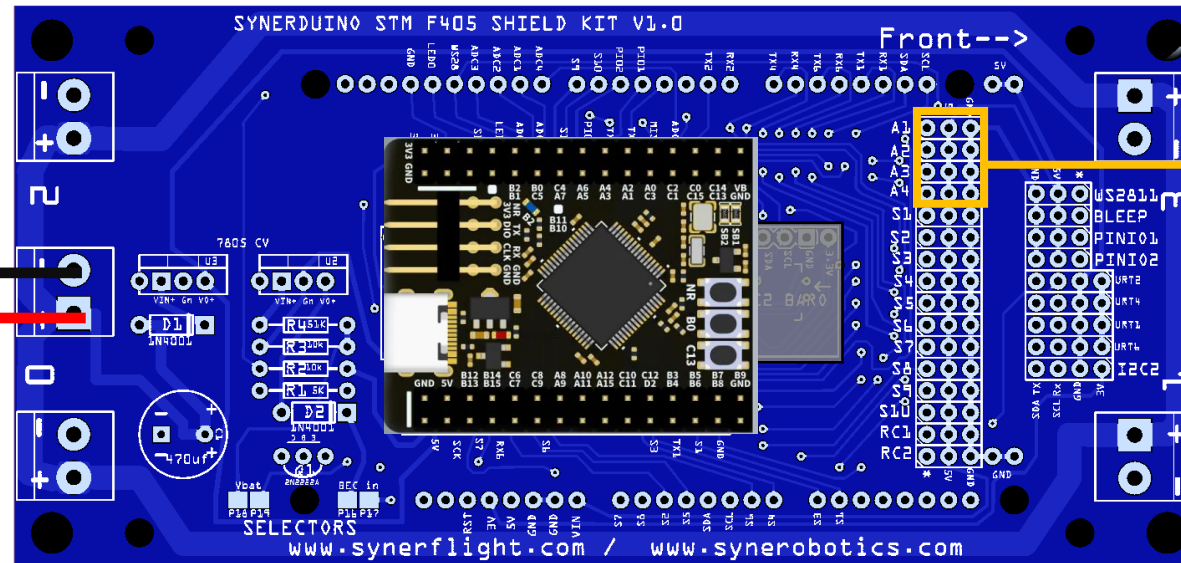
- Voltage
- Current
- RSSI
- Airspeed

UBEC is Required for High current applications if it exceeded more than

- 3A for STM405 and H743
- 1.5A for F411 of use when driving servos

**BEC input requirements must be 5V**

External ADC Sensor



This can be reassign for any Analog sensors outputting 0V -5V



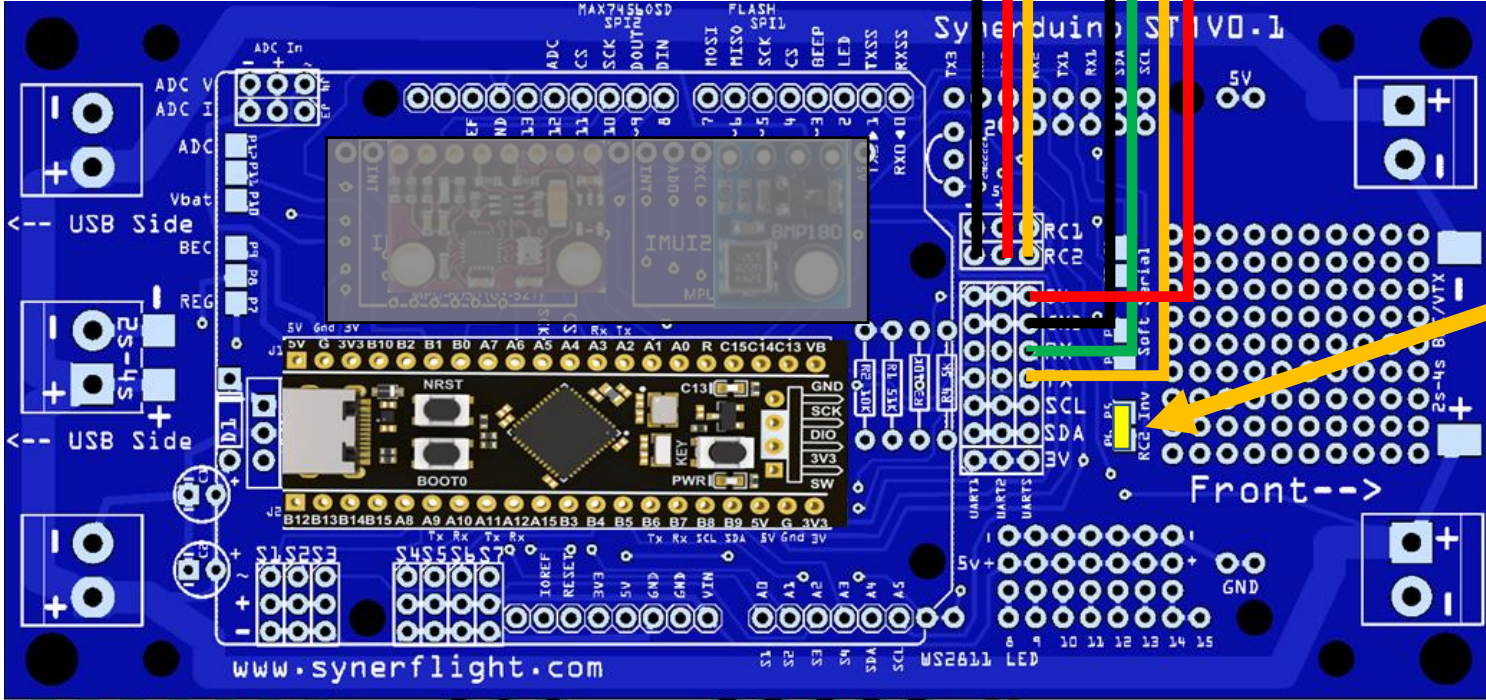
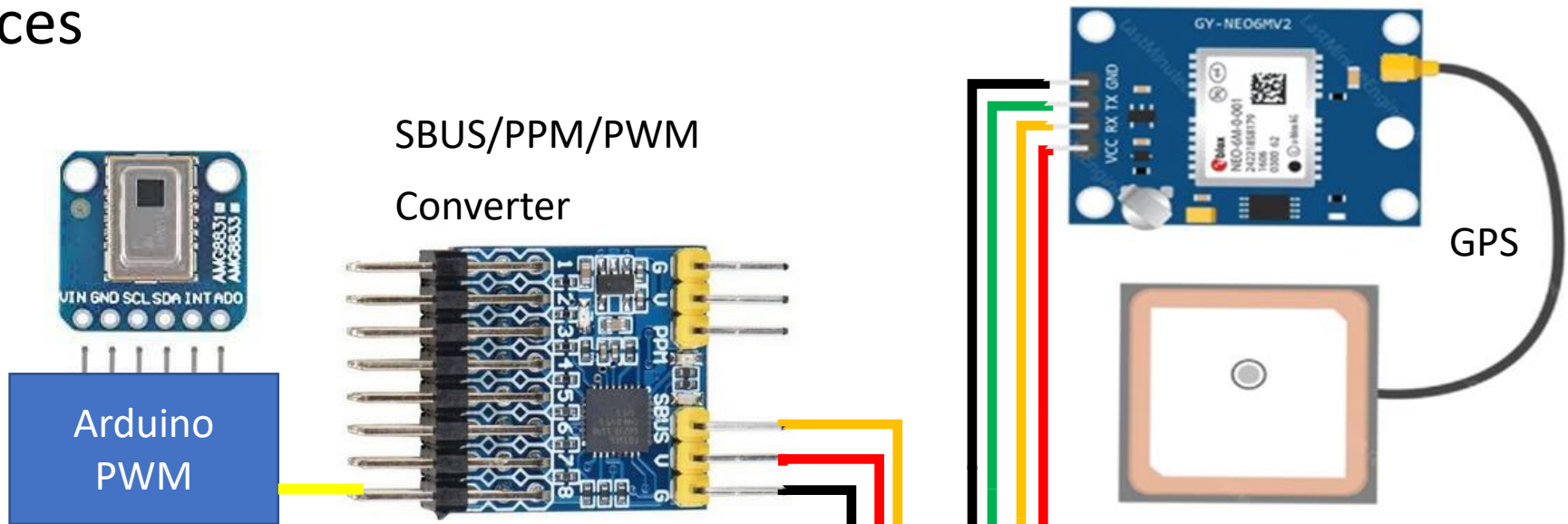
# Digital Sensor Devices

An SBUS/PPM/PWM converter can also take advantage on extra PWM input when building self constrain platform.

Utilizing an Arduino board as a companion controller to process sensor data into PWM

This is useful when you need to convert digital sensor data into PWM for synerduino to Read , process and transmit

With those function available in Arduino projects

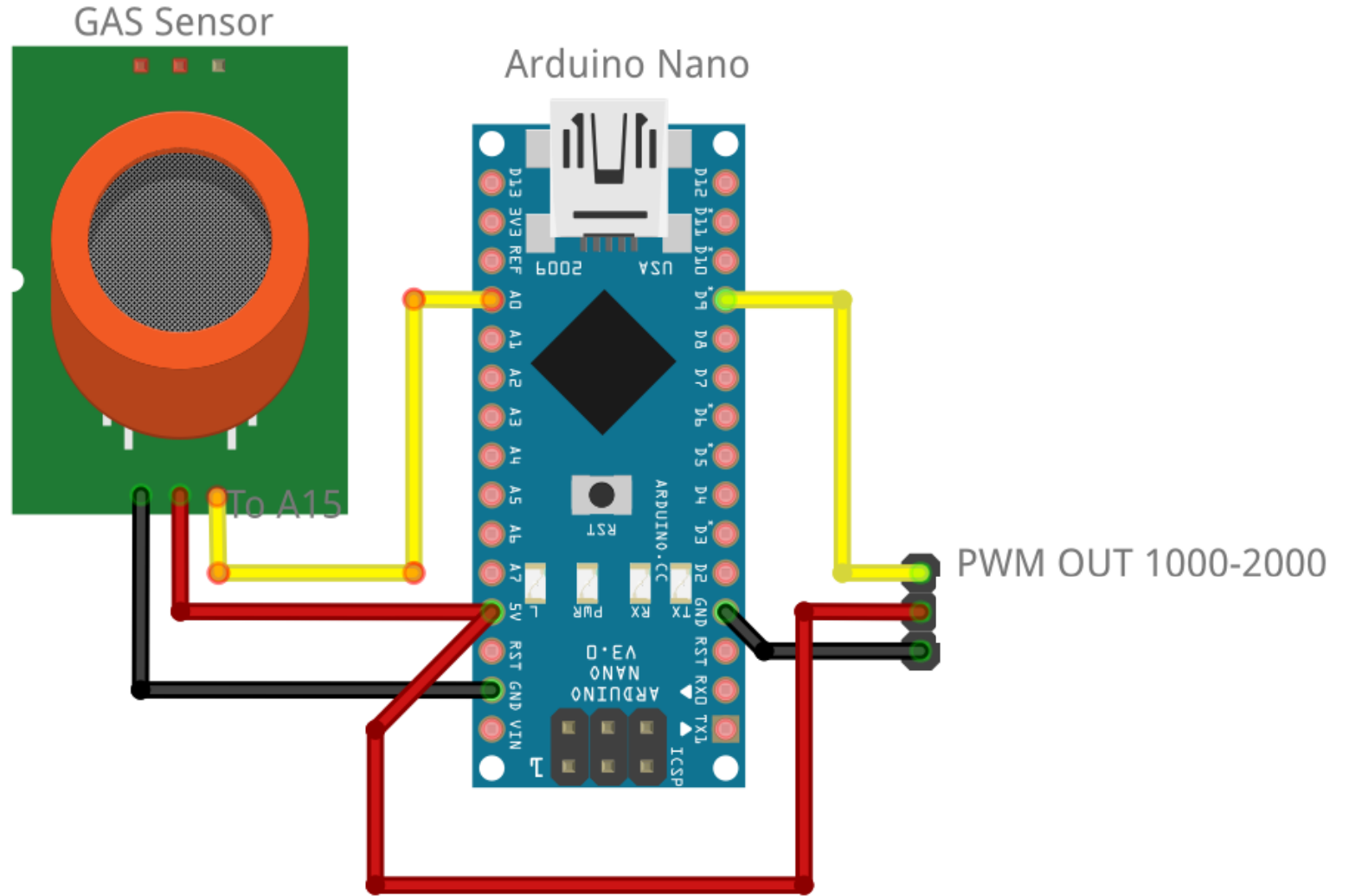


USE RC2 INV to invert the SBUS for Some Signal Converter

# Digital Sensor Devices

An Arduino can also be used as a Companion board to this application utilizing any unused PWM input by the Converter as an AUX

This can work for both digital and analog sensors as well



# Data Logging

## These are optional addons

All Addon SPI devices can Access SPI2 Pins

CS - CS

DIN - MOSI

DOUT - MISO

SCK - SCK

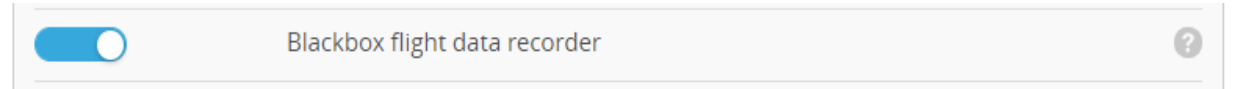
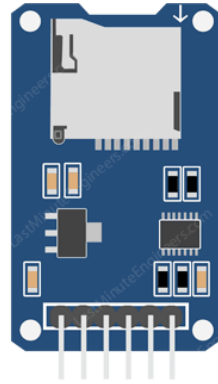
Power can be tap into any freely available 3V or 5V pin

SD Card is Active Default for Synerduino STM firmwares:

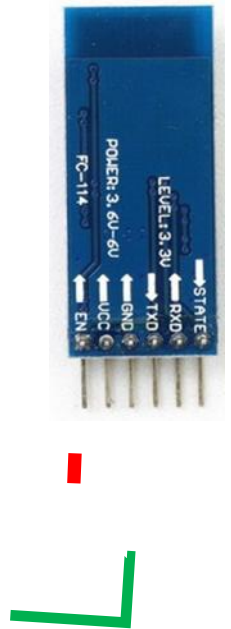
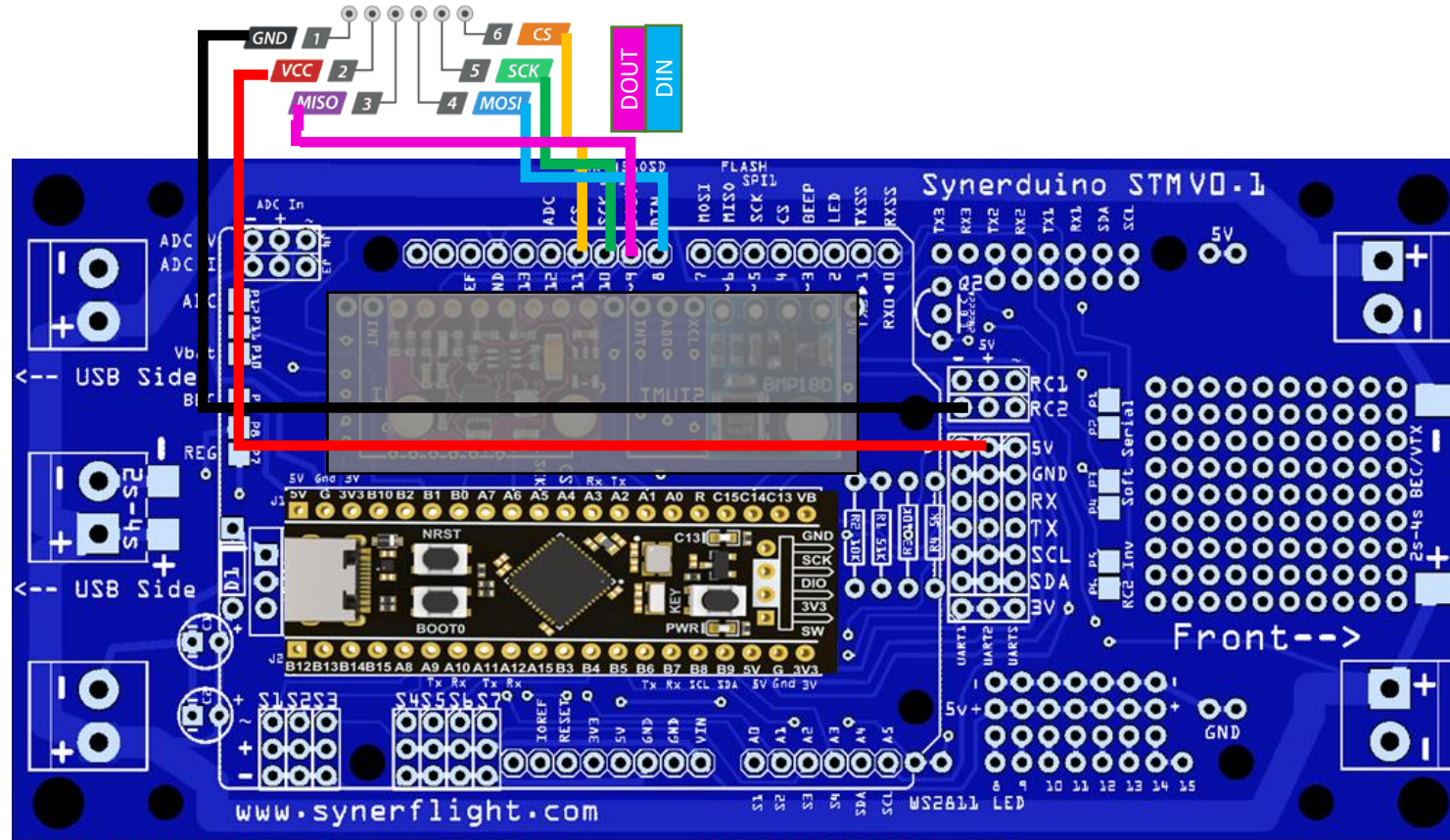
Synerduino STM.HEX

Synerduino STM VS.HEX

## SD Card Reader



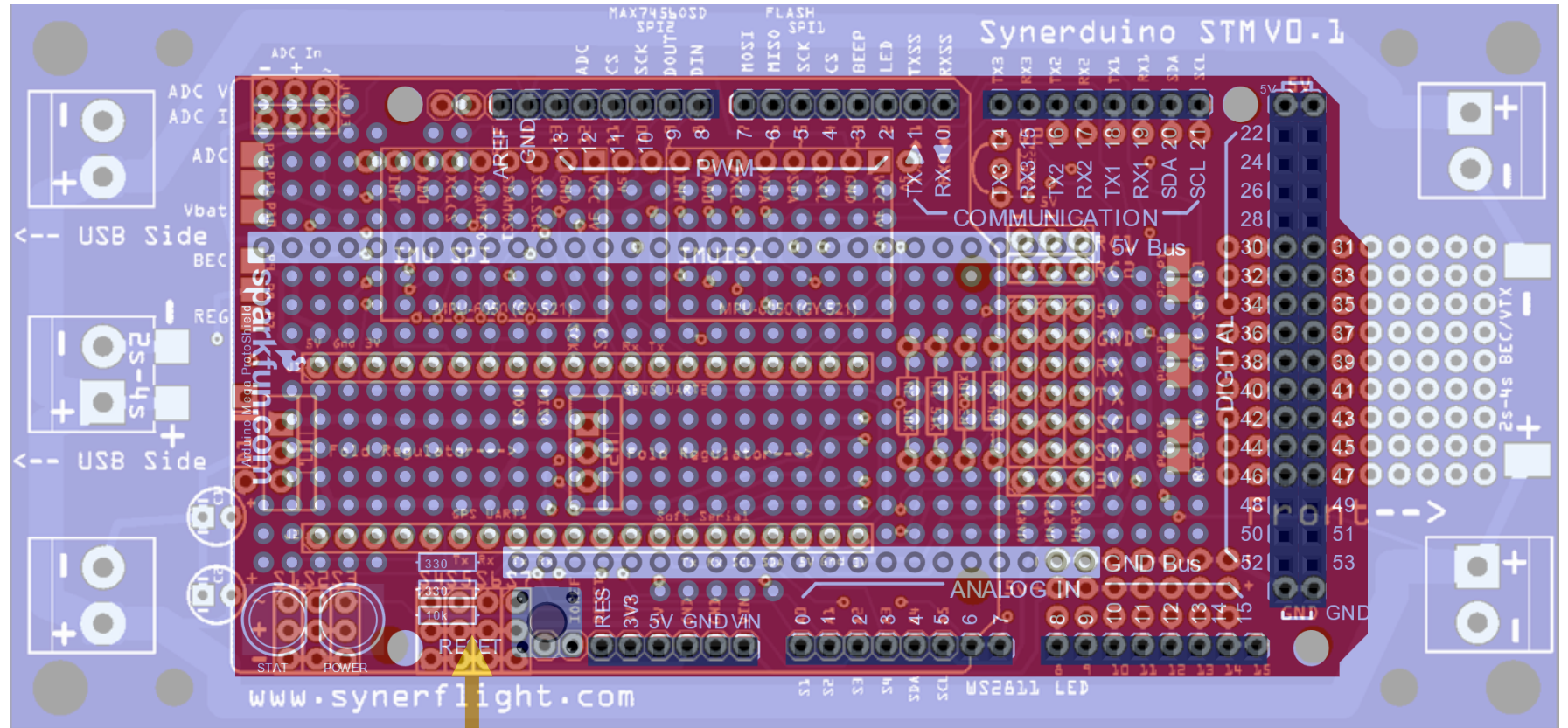
In Configuration Blackbox Flight data recorder can be set active should you have the SD card installed



# SYNERDUINO STM and PROTOTYPING BOARDS

Since Synerduino is design as a shield board with an Arduino footprint its self means its compatible with a wide range of other shield prototyping board as well making it easy to fit custom or add on hardware reducing the need of additional wires and connectors

Male Headers are installed on the bottom of the board as required.



Prototyping Shield are to be place on the under side of the board

# Setting up INAV for ADC and Battery Monitoring

In configuration we have voltage and current sensors. This is the ADC configuration which you can adjust the Voltage and Current Scaling as well as offset adjustments

This works for battery monitoring and ADC sensor calibration methods

The screenshot displays the INAV Configurator software interface. The top status bar shows a battery level of 31.19 V and various sensor icons (Gyro, Accel, Mag, Baro, GPS, Flow, Sonar, Speed, IMU2). The main configuration area is divided into several sections:

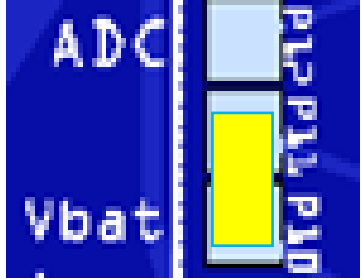
- Sensors & buses:** Lists sensors like BMI160 (Accelerometer), HMC5883 (Magnetometer), BMP085 (Barometer), and I2C Speed set to 400KHZ.
- Voltage and Current Sensors:** Includes settings for Battery voltage monitoring (enabled), Voltage Meter Type (ADC), Voltage source (Raw), Voltage Scale (1200), Battery Voltage (31.17), Battery current monitoring (enabled), Current Meter Type (ADC), Current Meter Scale (400), Offset in millivolt steps (0), and Battery Current (48.52).
- Battery Settings:** Shows Number of cells (0) and Maximum cell voltage for cell count detection (4.25).

The bottom status bar provides system metrics: Packet error: 0, I2C error: 0, Cycle Time: 507, CPU Load: 15%, MSP version: 2, MSP load: 0.1, MSP round trip: 39, HW round trip: 14, Drop ratio: 0%. The system version is 6.0.0-FP2. The Windows taskbar at the bottom shows the time as 11:14 AM on 03/01/2023.

# Setting up INAV for ADC and Battery Monitoring

## Having an Active monitoring

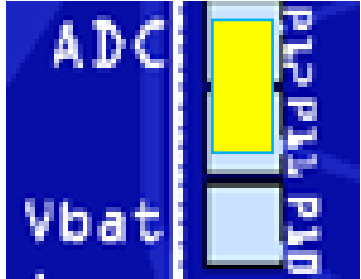
Serves two purpose interchangeably as ADC we can monitor power loading in two distinct ways



### VBAT

P11 – P10 Vbat = Provides battery status data of voltage which can function as a form of Battery failsafe or other battery function

You can Adjust battery settings to the required configuration to match your battery output voltage and Cell count (this will also affect the Battery fail safe mode)



### ADC

P11- P12 ADC = Provides an option to add External ADC sensors to the Board for Environmental Data Analytics or signaling application

ADC V = Voltage

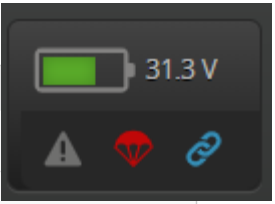
ADC I = Amperage

### Sensors needs to be calibrated and Adjusted

Voltage Scale = adjust to V ADC input

Current Meter Scale = adjust to I ADC input

Offser in Millivolt = offset the I ADC output



#### Voltage and Current Sensors

Battery voltage monitoring

ADC Voltage Meter Type

Raw Voltage source to use for alarms and telemetry

1200 Voltage Scale

31.24 Battery Voltage

Battery current monitoring

ADC Current Meter Type

400 Current Meter Scale

0 Offset in millivolt steps

48.74 Battery Current

#### Battery Settings

0 Number of cells (0 = auto)

4.25 Maximum cell voltage for cell count detection

3.3 Minimum Cell Voltage

4.2 Maximum Cell Voltage

3.5 Warning Cell Voltage

mAh Battery Capacity Unit

0 Capacity

Warning Capacity (remaining %)

Critical Capacity (remaining %)

# Tethered Logging

Tethered logging support works for Telemetry function how ever this tab has to keep active for the duration of the flight for it to work

This can work as a supplement to live data logging

1. You can do an initial mission to monitor the drone prior to switching to Log mode on the 2<sup>nd</sup> flight

2. Use an OTG cable to hook the USB-C to a companion computer

MSP\_RAW\_GPS

GPS coordinates

MSP\_ANALOG

ADC data

MSP\_RC

PWM data

MSP\_Motor

Motor Outputs

The screenshot shows the INAV Configurator interface. The top bar displays system status: battery at 31.36 V, and various sensor icons (Gyro, Accel, Mag, Baro, GPS, Flow, Sonar, Speed, IMU2). A 'No dataflash chip found' warning is present. The main panel is titled 'Tethered Logging' and contains a yellow warning box: 'Data will be logged in this tab only, leaving the tab will cancel logging and application will return to its normal "configurator" state. You are free to select the global update period, data will be written into the log file every 1 second for performance reasons.' Below this, there is a list of logging options:

- MSP\_RAW\_IMU: 9 columns (accel[x, y, z], gyro[x, y, z], mag[x, y, z])
- MSP\_ATTITUDE: 3 columns (x, y, z)
- MSP\_ALTITUDE: one column
- MSP\_RAW\_GPS: 7 columns
- MSP\_ANALOG: 4 columns
- MSP\_RC: 8 columns by default
- MSP\_MOTOR: 8 columns by default
- MSP\_DEBUG: 4 columns

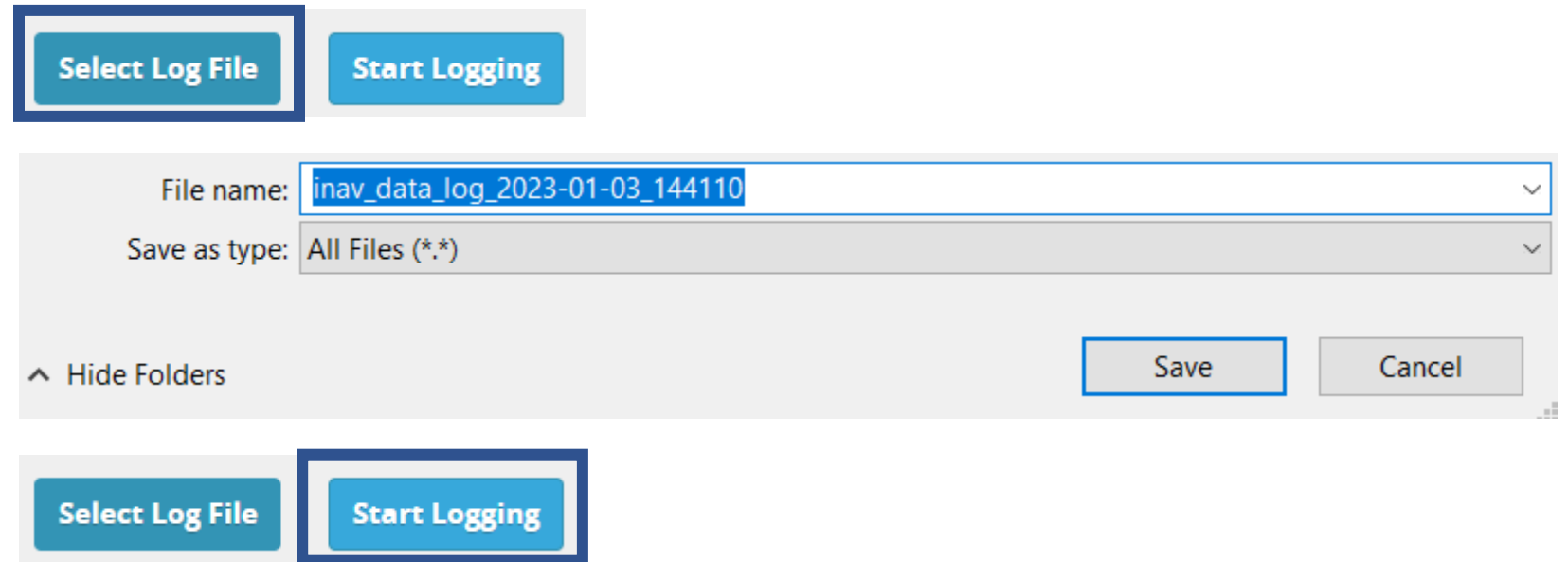
A dropdown menu is set to '100 ms'. The status shows 'Samples Saved: 0' and 'Log Size: 0 Bytes'. At the bottom, there are 'Select Log File' and 'Start Logging' buttons. The status bar at the very bottom shows system metrics: Packet error: 0, I2C error: 0, Cycle Time: 502, CPU Load: 14%, MSP version: 2, MSP load: 0.0, MSP round trip: 40, HW round trip: 15, Drop ratio: 0%, and version 6.0.0-FP2. The system clock shows 11:22 AM on 03/01/2023.

# Tethered Logging

Data will be logged in this tab **only**, leaving the tab will **cancel** logging and application will return to its normal "configurator" state.

You are free to select the global update period, data will be written into the log file every 1 second for performance reasons.

An file needs to be created in order to save the logs onto it





# Black Box

Black Box function support for SD card add on

SD card slot is on SPI2 as indicated on the hardware setup page

The Black Box Field indicate the figures you wish to Log

The SD card can also be extracted for later logging

The screenshot shows the INAV Configurator interface. At the top, there's a status bar with a battery level of 31.21 V and various sensor icons (Gyro, Accel, Mag, Baro, GPS, Flow, Sonar, Speed, IMU2). Below this, a log shows system messages: "MultiWii API version received - 2.4.0", "Flight controller info, identifier: INAV, version: 6.0.0", "Running firmware released on: Dec 14 2022 14:20:05", "Board: SYDU, version: 0", and "Unique device ID received - 0x32002a3132510c30313530".

The main content area is titled "Blackbox" and contains two sections:

- Blackbox configuration:** A toggle switch for "Blackbox flight data recorder" is turned on. Below it, a dropdown menu for "Blackbox logging device" is open, showing "On-board SD card slot" selected. A text field below the dropdown is labeled "Portion of flight loop iterations to log (logging rate)".
- Blackbox fields:** A list of checkboxes for data to be logged. The following fields are checked: "Navigation position estimation", "Navigation PID", "Magnetometer", "Accelerometer", "Attitude", "RC data", "RC command", and "Motors output". The following fields are unchecked: "Navigation accelerometer", "Gyro RAW (no filtering)", "Gyro Noise peak freq. Roll", and "Gyro Noise peak freq. Pitch".

At the bottom of the interface, there's a "Save and reboot" button and a status bar showing system metrics: "Packet error: 0", "I2C error: 0", "Cycle Time: 508", "CPU Load: 15%", "MSP version: 2", "MSP load: 0.1", "MSP round trip: 36", "HW round trip: 17", "Drop ratio: 0%", and "6.0.0-FP2". The Windows taskbar at the very bottom shows the time as 12:25 PM on 03/01/2023.

# Black Box

In MODES

The Black Box function is active in a switch

Every activation of this generates a new file in the SD card

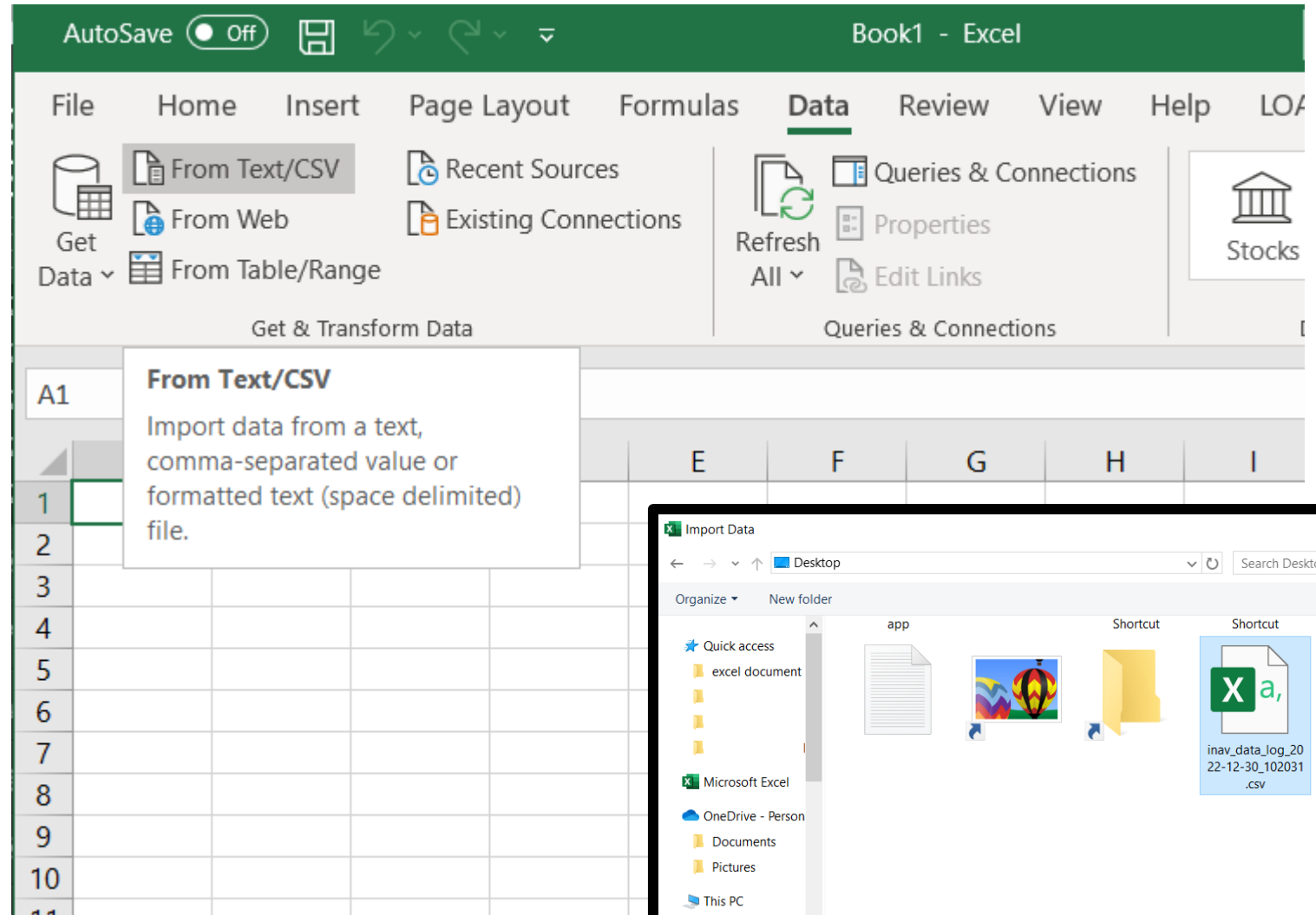
The screenshot displays the INAV Configurator software interface. The top status bar shows a battery level of 31.36 V and various sensor icons (Gyro, Accel, Mag, Baro, GPS, Flow, Sonar, Speed, IMU2). The main content area is titled "Modes" and lists several functions: Configuration, Failsafe, PID tuning, Advanced Tuning, Programming, Receiver, Modes (highlighted), Adjustments, GPS, Magnetometer, Mission Control, OSD, LED Strip, Sensors, Tethered Logging, Blackbox, and CLI. The "BLACKBOX" function is currently selected and active, indicated by a blue bar and a "CH 5" dropdown menu. Below the function name is a range slider with a minimum value of 1300 and a maximum value of 1700. The slider is set to a value of approximately 1650. The bottom status bar shows system metrics: Packet error: 0, I2C error: 0, Cycle Time: 509, CPU Load: 16%, MSP version: 2, MSP load: 0.2, MSP round trip: 34, HW round trip: 17, Drop ratio: 0%, and the firmware version 6.0.0-FP2. The Windows taskbar at the bottom shows the time as 2:47 PM on 03/01/2023.

# Exporting to Excel

Excel

In the Data Tab go to Text/CSV

And open the Inav\_data file as CSV (this can be rename as well if extension doesn't exist)



# Exporting to Excel



inav\_data\_log\_2022-12-30\_102031.csv

File Origin: 1252: Western European (Windows) | Delimiter: Comma | Data Type Detection: Based on first 200 rows

timestamp	gpsFix	gpsNumSat	gpsLat	gpsLon	gpsAlt	gpsSpeed	gpsGroundCourse	voltage	amperage	mAhdrawn	r
1.67237E+12	0	0	0	0	-17	0	0	25.5	42.72	6203	
1.67237E+12	0	0	0	0	-17	0	0	25.5	42.74	6203	
1.67237E+12	0	0	0	0	-17	0	0	25.5	42.78	6205	
1.67237E+12	0	0	0	0	-17	0	0	25.5	42.9	6206	
1.67237E+12	0	0	0	0	-17	0	0	25.5	42.92	6207	
1.67237E+12	0	0	0	0	-17	0	0	25.5	42.76	6208	
1.67237E+12	0	0	0	0	-17	0	0	25.5	42.69	6209	
1.67237E+12	0	0	0	0	-17	0	0	25.5	42.62	6210	
1.67237E+12	0	0	0	0	-17	0	0	25.5	42.68	6212	
1.67237E+12	0	0	0	0	-17	0	0	25.5	42.7	6213	
1.67237E+12	0	0	0	0	-17	0	0	25.5	42.72	6214	
1.67237E+12	0	0	0	0	-17	0	0	25.5	42.75	6216	
1.67237E+12	0	0	0	0	-17	0	0	25.5	42.87	6216	
1.67237E+12	0	0	0	0	-17	0	0	25.5	42.91	6218	
1.67237E+12	0	0	0	0	-17	0	0	25.5	42.74	6219	
1.67237E+12	0	0	0	0	-17	0	0	25.5	42.67	6220	
1.67237E+12	0	0	0	0	-17	0	0	25.5	42.5	6221	
1.67237E+12	0	0	0	0	-17	0	0	25.5	42.57	6223	
1.67237E+12	0	0	0	0	-17	0	0	25.5	42.62	6223	
1.67237E+12	0	0	0	0	-17	0	0	25.5	42.68	6225	

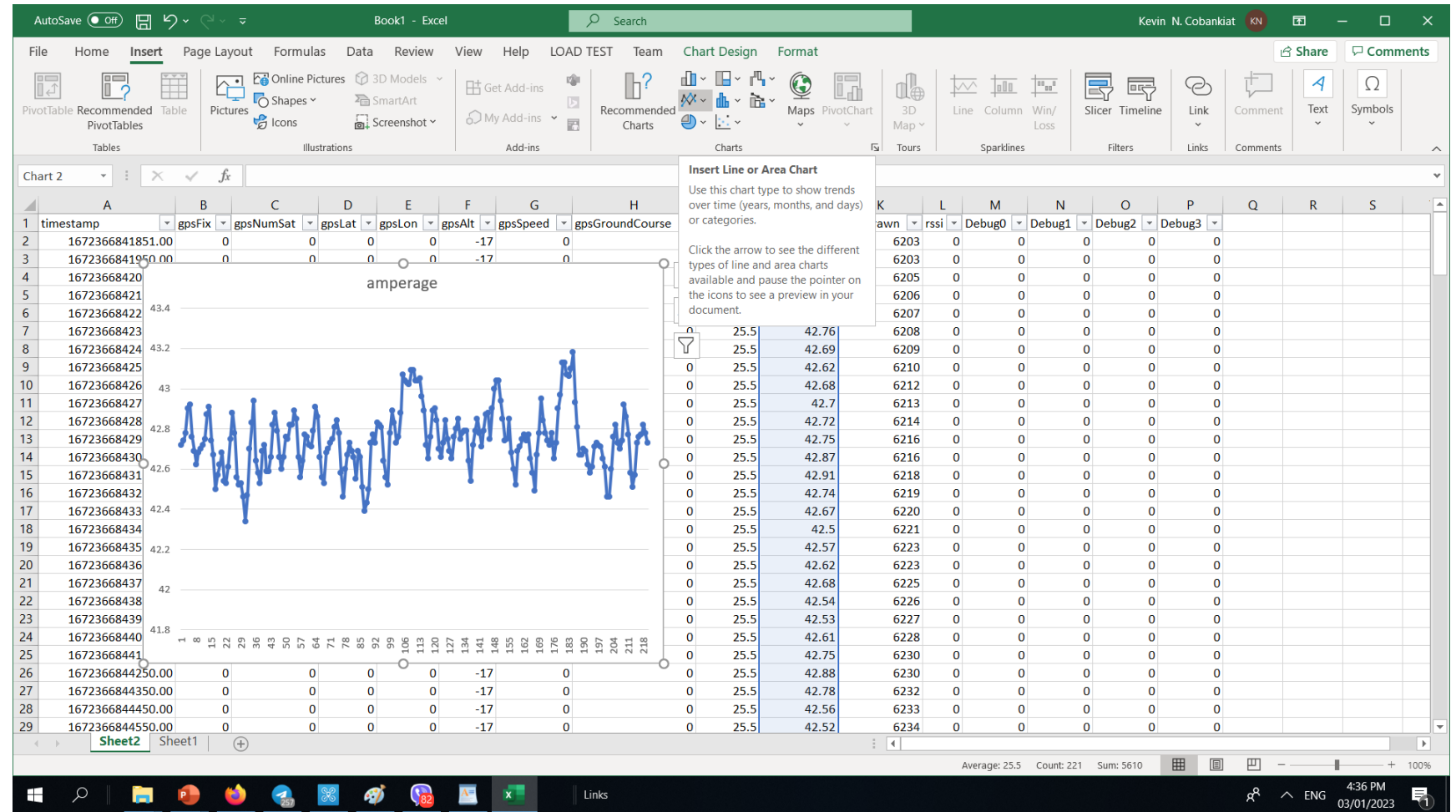
Once your happy with the results click the Load button to load the data into excel

Load | Transform Data | Cancel

# Exporting to Excel

From the Insert Tab Charts and Graphs can be created for Data Analytics off the Drone.

Feel free to configure both the sensor ,chart and drone system to suite your data requirements



# Thank you

