Teachers take flight workshop

Welcome & introductions

KVVF

TEXAS A&M UNIVERSITY COMMERCE

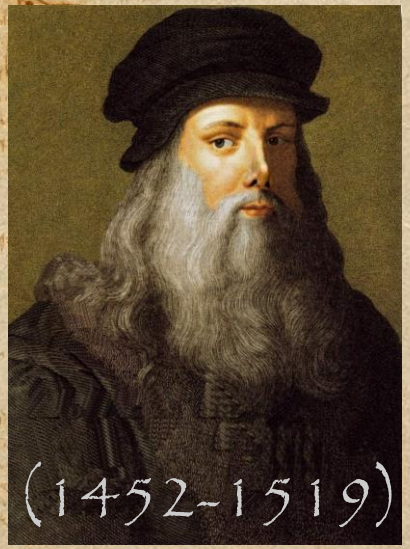
DALLAS INDEPENDENT SCHOOL DISTRICT

Teachers take flight workshop objectives

- Complete assembly of drone.
- Integrate and program flight controller.
- Calibrate GPS/compass.
- Document build in engineering log book with sketches and instructions.
- Learn Mission Planner software.
- Research and present on Flying Creature aerodynamics.
- Fly drone using Transmitter.
- Monitor flights on Mission Planner software while your partner fly's the drone with the Transmitter.
- Plan and execute autonomous flight mission.

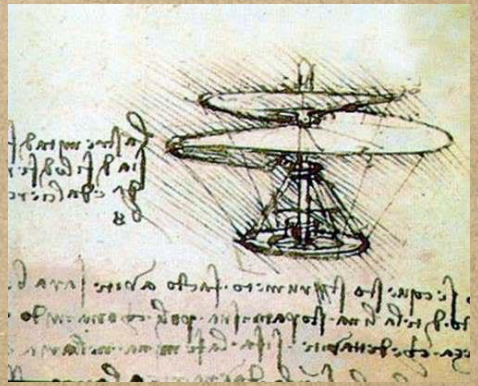
The Leonardo da Vinci method of teaching design & function

Presenter: Princess Aliyah, KWF



Leonardo Da Vinci

- Born in Vinci, Italy
- Artist, Chemist, Engineer, Inventor, & Scientist
- Learned through observation, development & application
- Integrated art, science and engineering to create new capabilities



Cycle

Wildlife Conservation UAV Challenge

2013

DaVinci Challenge: Build a Drone Workshop

2014

MiSHELL Drones

2015

Teachers Take Flight Workshop

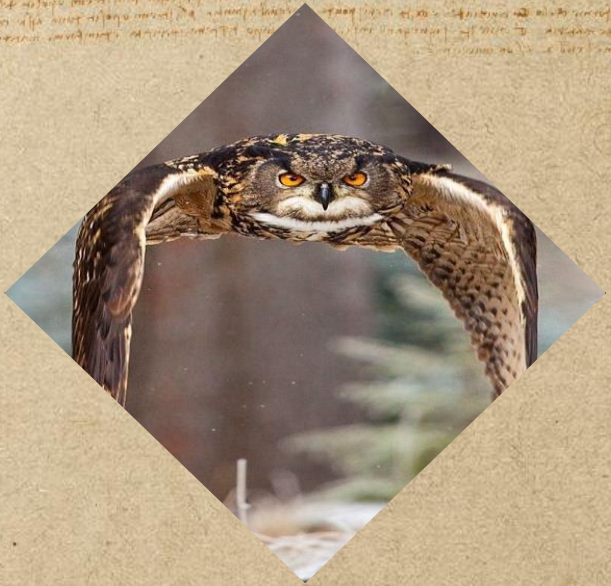
2016

Fly for Conservation Workshop

2016

FLYING CREATURES

Flying Creatures Help Teach Aerodynamics & Embedded Sensors



Flying creature

Owls fly like a Fixed Wing

Watch a video on my stealth flight

Flying creatures

Bats have the most complex flight abilities

Watch a video on my flight capabilities

Hammerhead Bat

Peregrine Falcon

Monarch Butterfly

Flying Fish

Choose your Flying creature to research

1. *Location – what is their environment like? Coastal, mountains, tundra, desert, etc.*
2. *Wing spa, weight, speed*
3. *Type of flight – like a fixed wing, multicopter, or even more advance?*
4. *Maximum distance covered in one flight?*
5. *What makes your flying creatures flight so interesting?*

Existing & future drone applications
F.A.A. regulations

Presenter: dr. burchan aydin, TaMUC

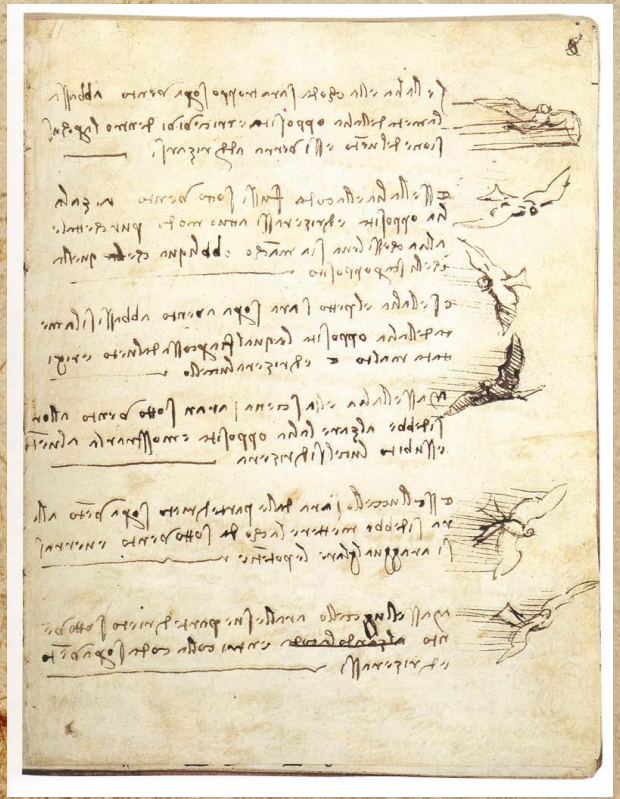
Drones as a Tool in Teaching Robotic Sciences

Presenter: dr. Ronald pandolfi, kwf

MODULES

- Drone Components I
- Frame Assembly II
- Propulsion & Power System Integration III
- Avionics Integration IV
- Wifi Module Integration V
- RC Transmitter Integration VI
- Mission Planner Overivew VII
- Mission Planner Setup VIII
- Motor Spin Test IX
- Pre-Flight Check X

YOUR FLIGHT JOURNEY



"For once you have tasted flight you will walk the earth with your eyes turned skywards, for there you have been and there you will long to return." -Leonardo da Vinci

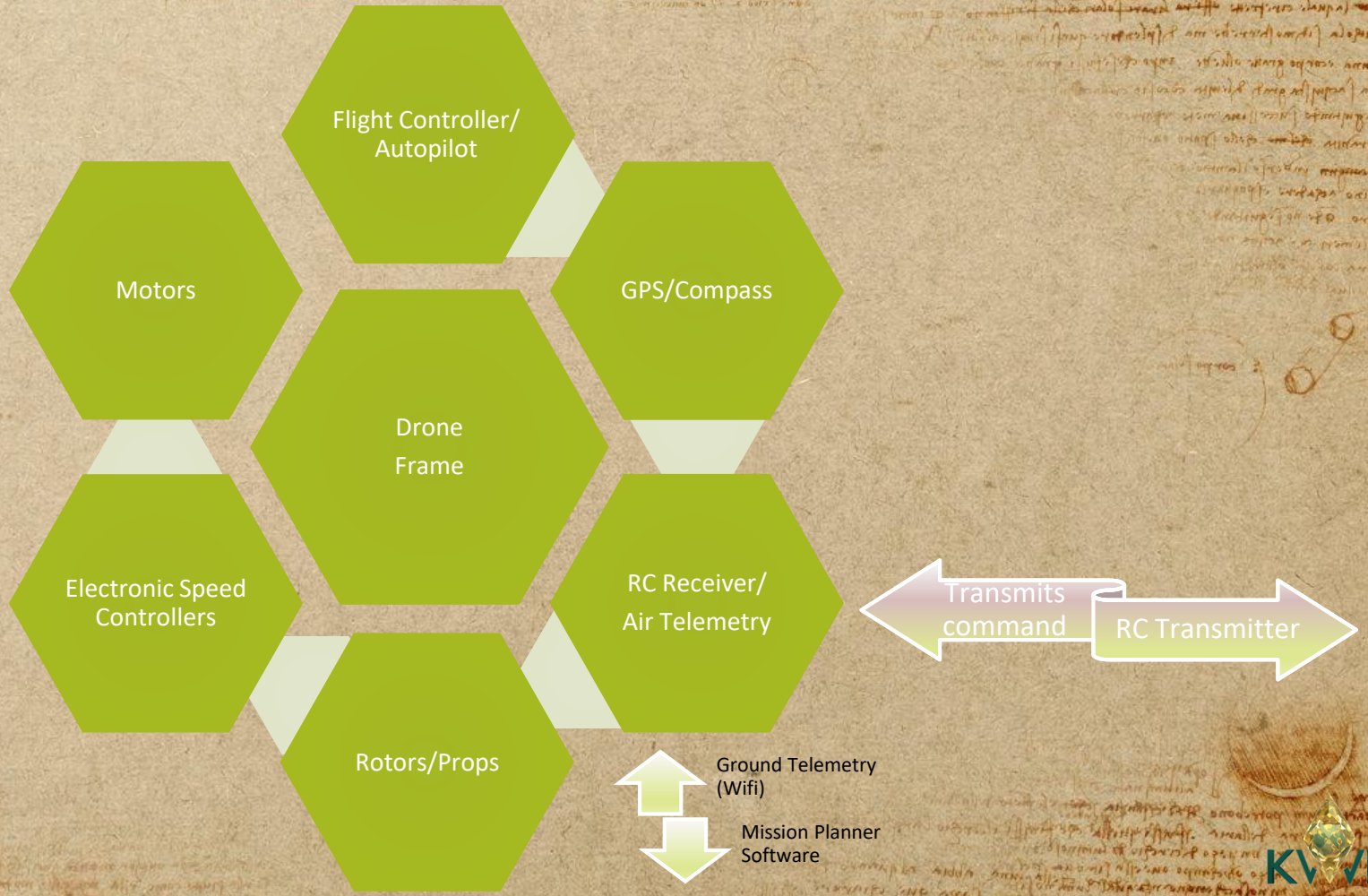
DOCUMENT YOUR JOURNEY

In your build log, include:

- Description of each step
- Sketch or photo
- Written observation

"Codex on the flight of birds" – Circa 1505

UNMANNED/DRONE SYSTEM



I.

Drone Components

Drone kit components

Frame

GPS,
Compass
& Mount

Flight Controller
Wifi Adapter
Safety Buzzer & Switch
Micro SD Card &
Reader

Battery

Charger

RC Transmitter

Wifi Adapter

RC Receiver

Motors

Electronic Speed
Controllers (ESCs)

Power Module

Power Distribution Cable

DuPont Cables

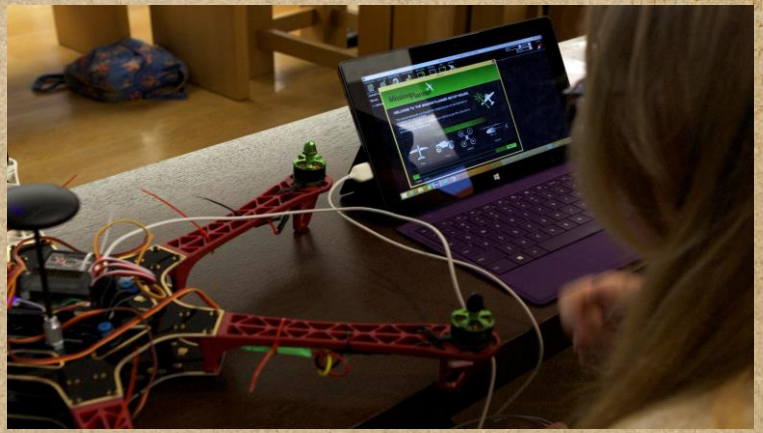
Rotors

Tools Needed

Metric Allen Wrenches

Cable Ties

Velcro Dots

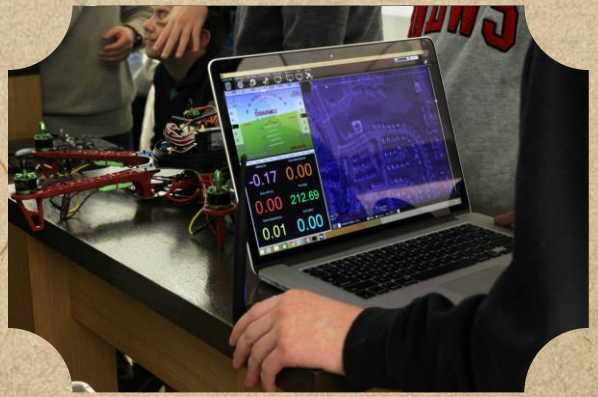


Ground Station, Laptop or Windows Tablet

Micro USB Cable

AA Batteries

Software needed



You will need to download Mission Planner or APM Planner. It is the Ground Control System (GCS) used for your autonomous flights.

MP is Only compatible with Windows.
Download here:
http://ardupilot.org/planner/docs/common-install-mission-planner.html

Are you ready to
assemble your drone?
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Build Log

Document all your build steps with a description, sketch/photo and written observations for future reference and trouble shooting.

II.
FRAME ASSEMBLY

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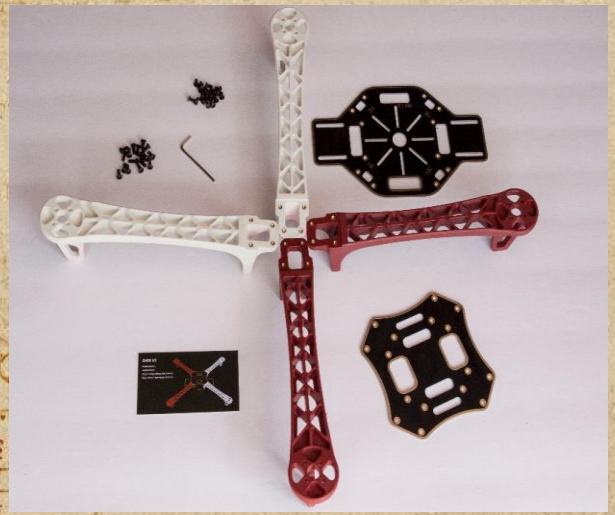
Frame Assembly



Arrange legs and plates

Red – Front & White – Back

Allen wrench: 2mm

Frame screws: M2.5 (24)

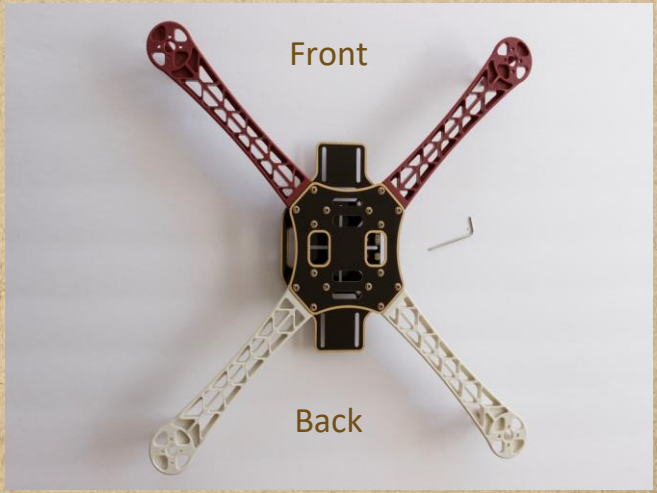
Motor screws: M3.0 (16)

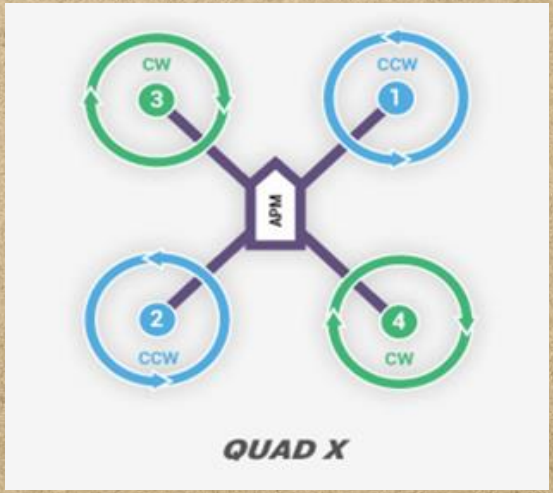
Bottom plate screws: M2.5 (8)

Top plate: M2.5 (16)

- Legs are made of glass filled nylon
- Plates are made of glass reinforced epoxy laminate with metal layers
- Red arms will be the front of drone
- White arms will be the back of the drone

Label Frame Arms with “X” Configuration





III.

Integrate Power & Propulsion

Brushless motors

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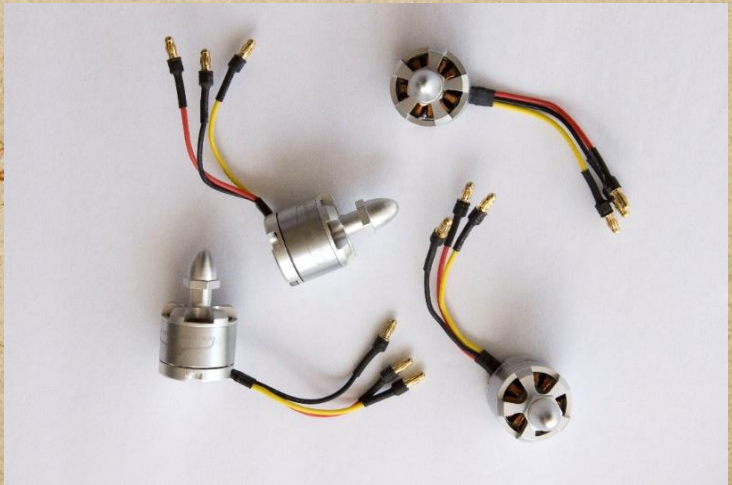
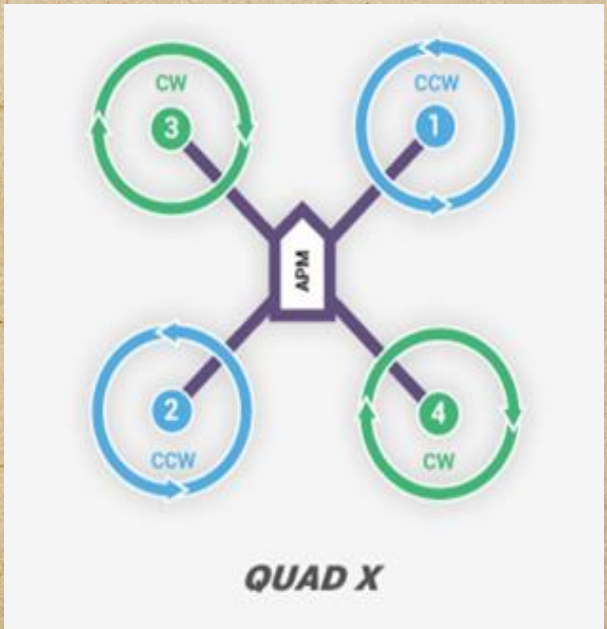
Brushless Motors

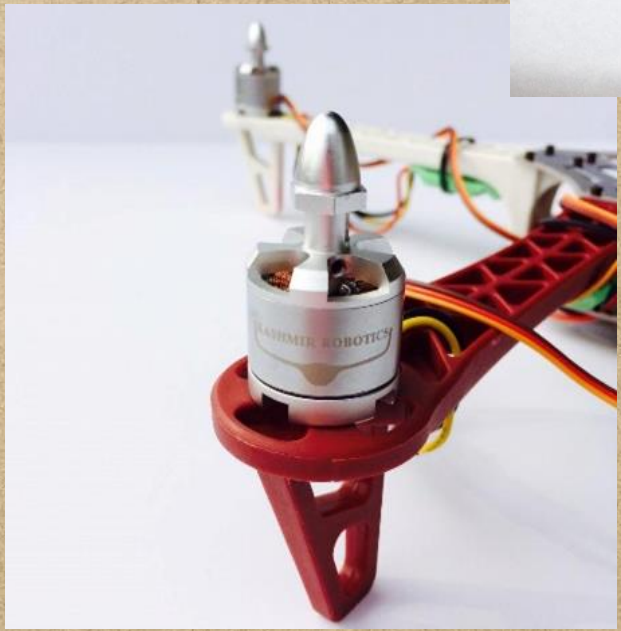
Check for Clockwise (CW) & Counter Clockwise (CCW) Motors

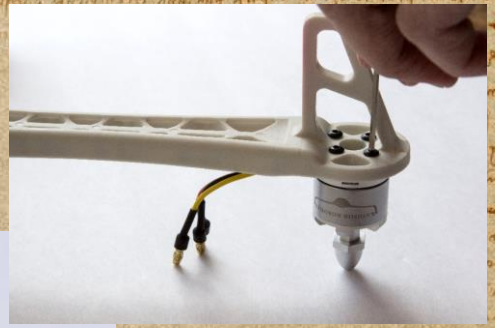


- 2212/920KV
- Magnets are 22 mm in diameter & 12 mm in length;
- Motors turn 920 revolutions per minute per volt
- Motors operate on 3S LiPo battery voltage
- High pole count for less noise and smoother response

Brushless Motors – Mount







Motor Screws: M3.0 (16)

Electronic speed controllers (ESCs)

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Electronic Speed Controllers (ECSs)

To reduce radio interference braid your esc cables before connecting to the motors.

- Brushless ESCs
- 20 AMP continuous draw
- No Battery Eliminator Circuit (BEC)
- Voltage ranges from 2-6s LiPo
- 1KHz input frequency
- Preinstalled Simon K firmware
- 16AWG/Female 3.5 mm motor connectors

Connect ESCs to motors and thread the cables through the opening of the drone to connect with power distribution cable and flight controller. Cable tie ESCs to drone arms.

Electronic speed controller (ESC)

Connect red cable to red power distribution cables
and black to black power distribution cables

Connect all three cables
to motors

Power distribution cable

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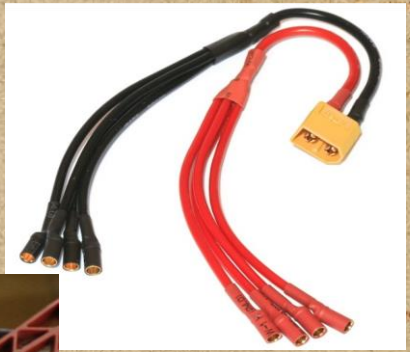
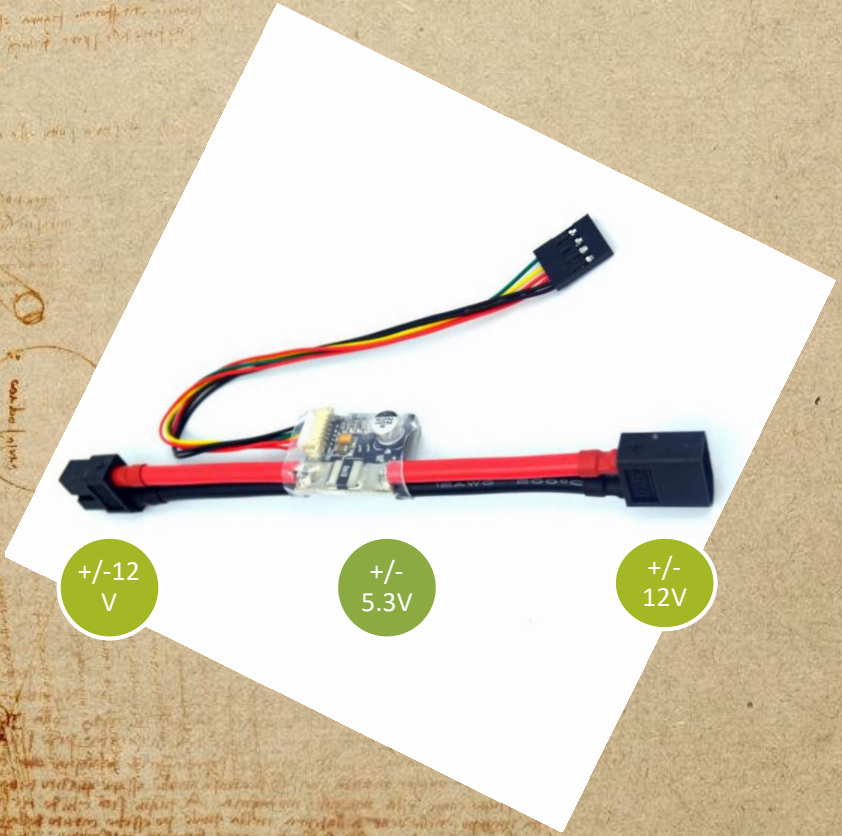
Power Distribution Cable



- Battery Input via: **XT60 Female**
- ESC output via: 3.5mm Gold Connector
- ESC Quantity: 6
- Wire Gauge: 14/18 AWG
- Length: 220mm
- Weight: 35 grams

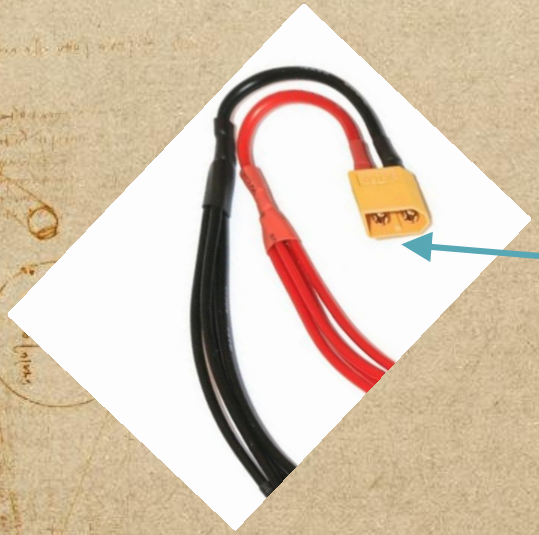
Power Module

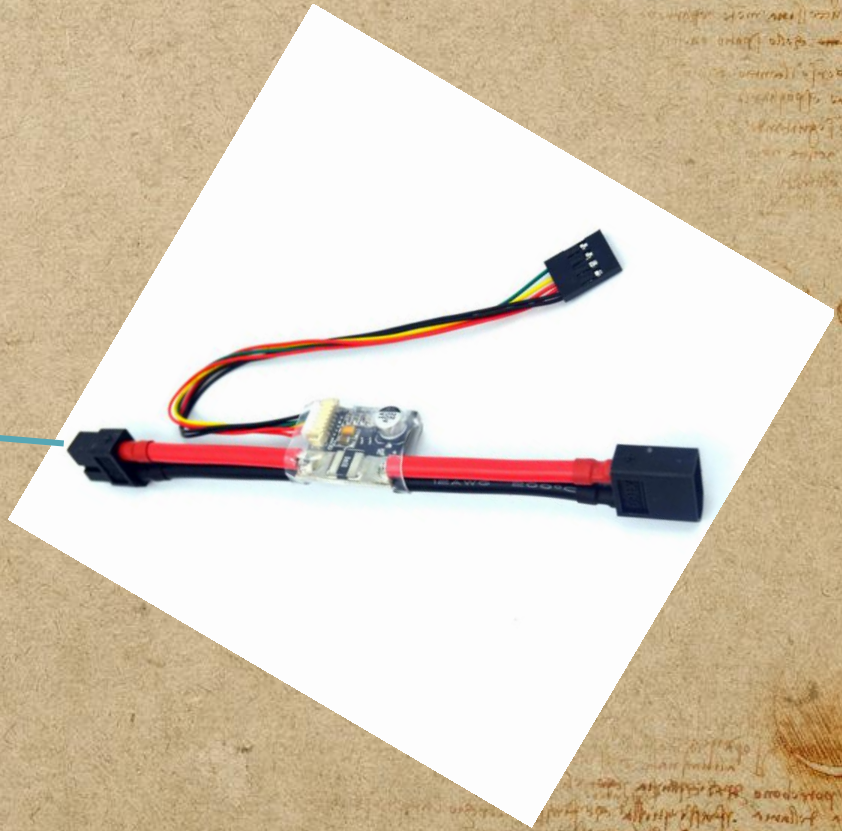
Power Module



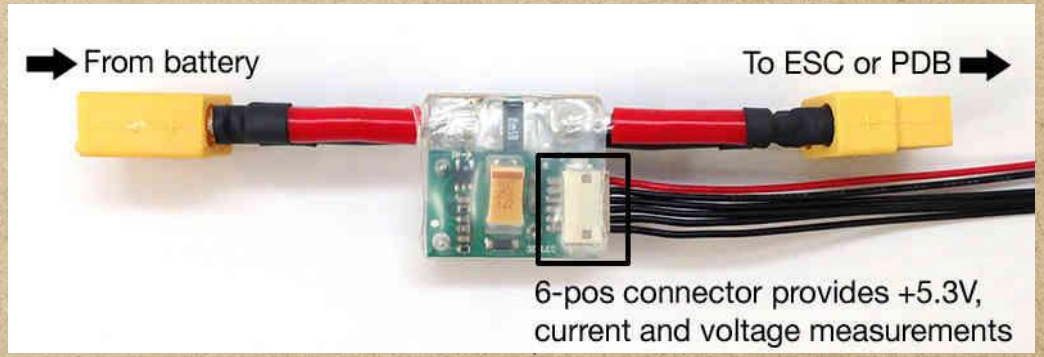
- Connects to
  - Power Distribution Cable
  - Flight Controller
  - Battery
- Provides power to ESCs and Flight Controller
- Provides Flight Controller with information on battery voltage

Connect Power Module to Power Distribution Cable





Power Module Connections



Mission Planner

Mission Planner is a full-featured ground station application for the open source flight controller. You can plan and execute autonomous missions.

IV

AVIONICS INTEGRATION

AVIONICS

Flight Controller

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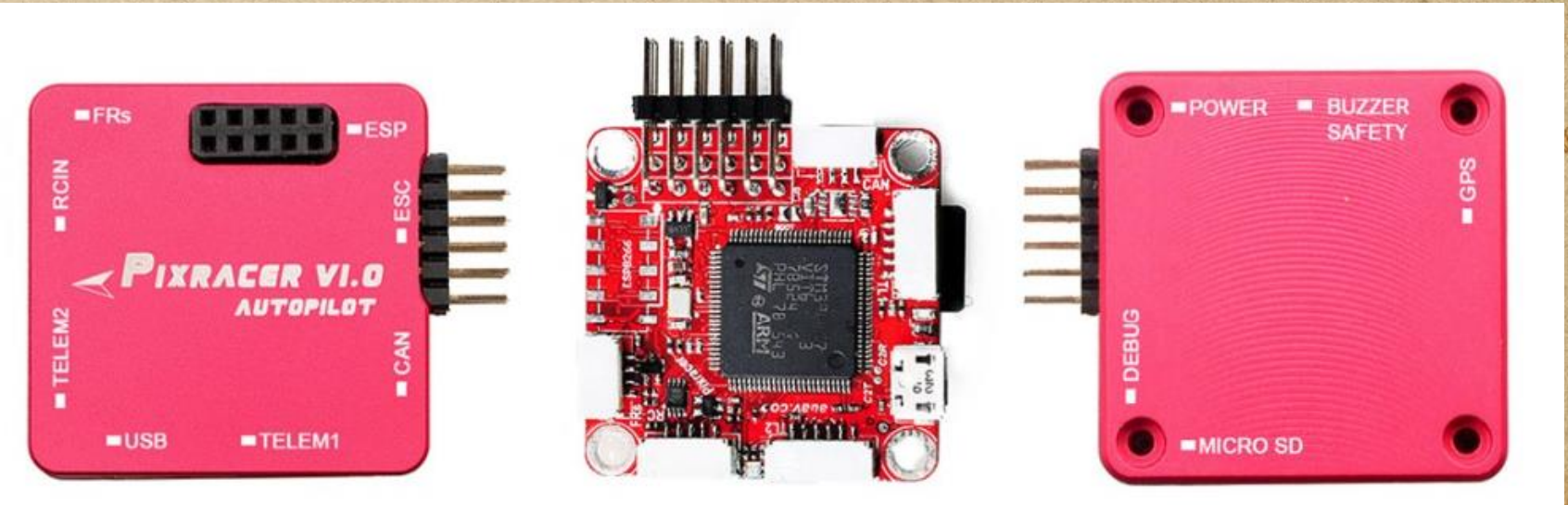
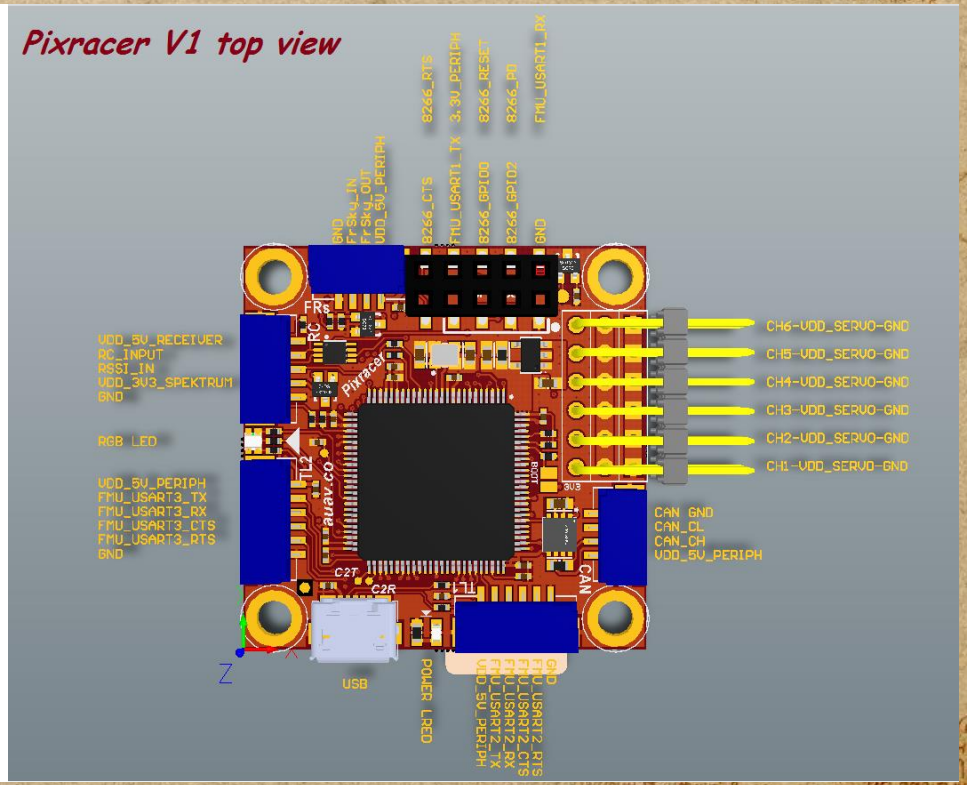
Flight Controller – PIXRACER

- Open source flight controller/autopilot
- “Brain” of the unit
- Flight Controller combines the following:
  - Accelerometer - Measures liner acceleration on up to three axes (X, Y, and Z)
  - Barometric pressure sensor - measures atmospheric pressure and altitude
  - Gyroscope - Detects angular changes on up to three angular axes
  - Compass – gravitates towards the earth’s magnetic field
  - GPS – Global Positioning System

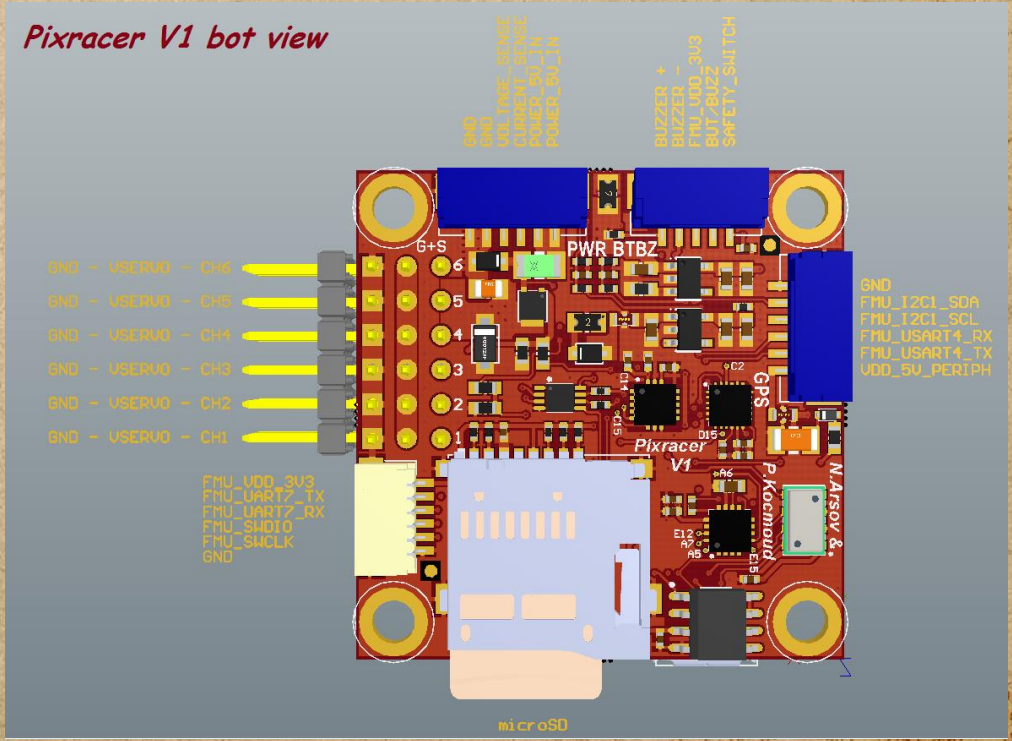
Overview Cable Connections to Flight Controller



Flight Controller top view

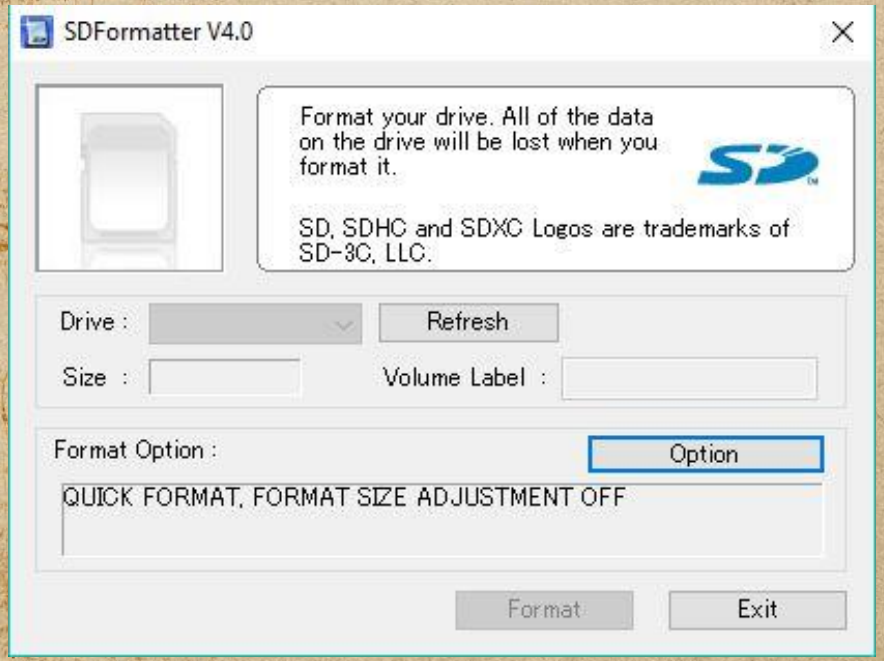


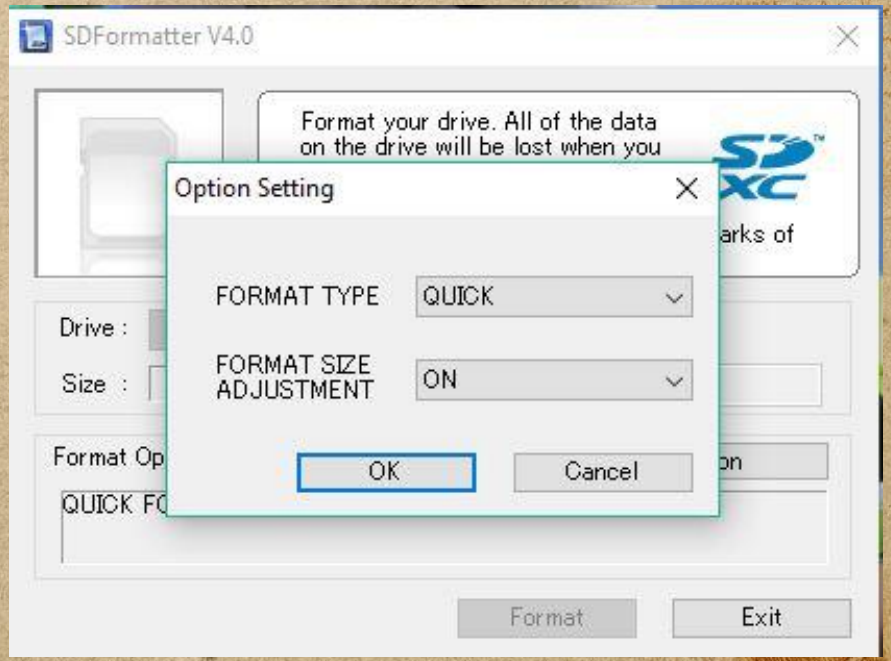
Flight Controller Bottom view



FORMAT SD CARD

FORMAT SD CARD & GIVE NAME IN VOLUME LABEL



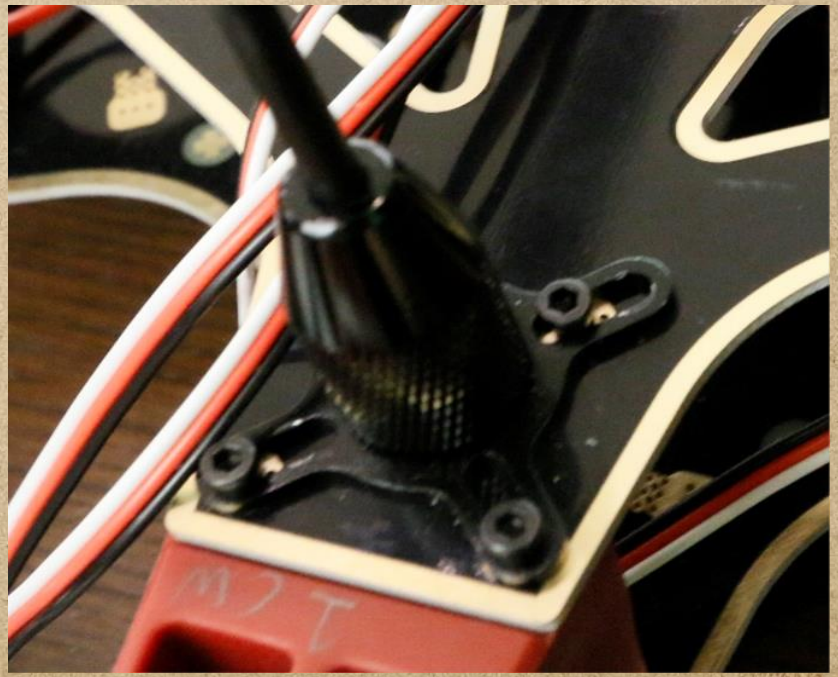


GPS/Compass

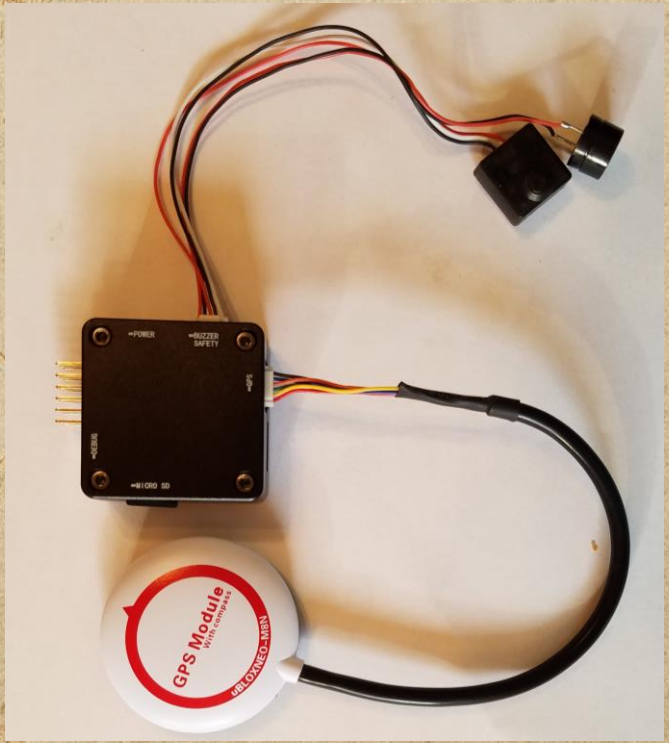
GPS & Compass Features

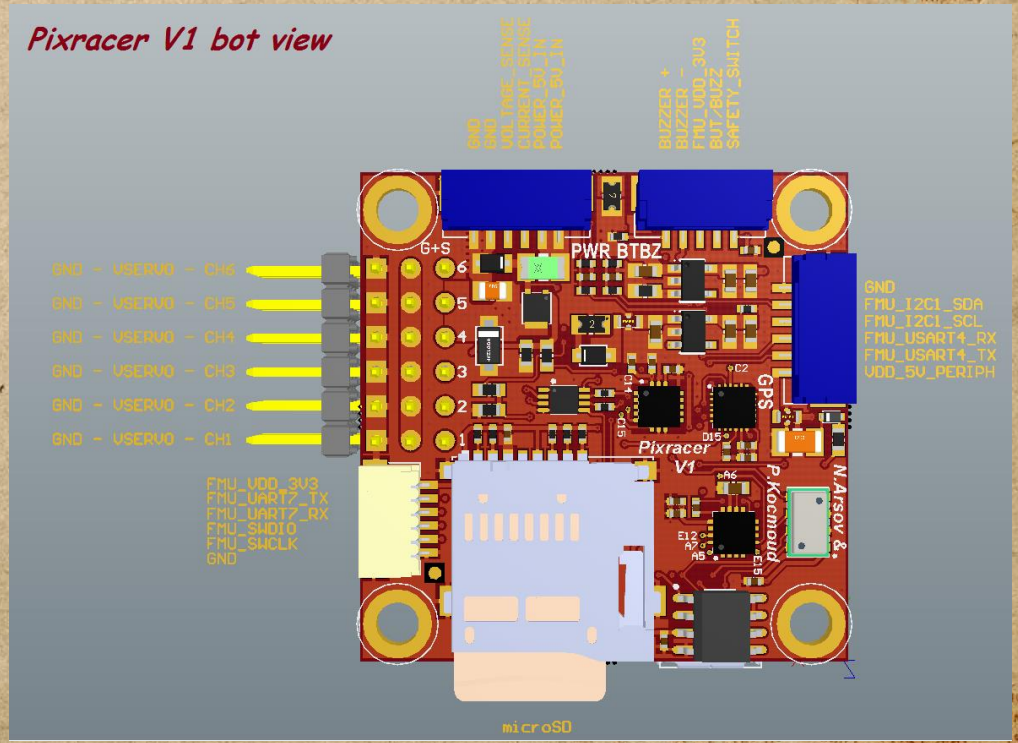
- Neo-8M module
- 56-channel
- GPS L1 C/A, GLONASS L1 FDMA
- QZSS L1 C/A
- Galileo E1B/C
- SBAS: WAAS, EGNOS, MSAS
- 10Hz update rate
- 25x25x2 Ceramic patch antenna
- Rechargeable 3V Backup battery
- Low noise 3.3V regulator
- I2C EEPROM storage
- Power and fix LED's
- Pre-configured 38,400 Baud and prams
- Connection: Compass 4 pin/ GPS 6 pin (Pixhawk/PX4 compatible)

Mount GPS on the Front Right Arm



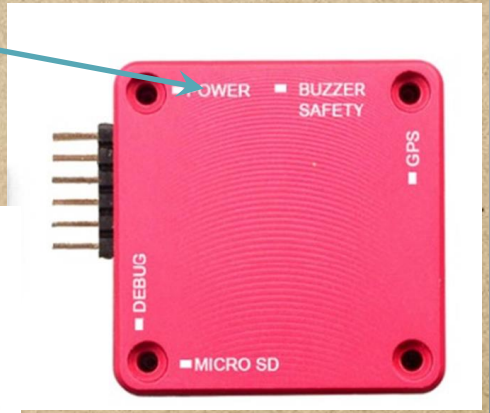
CONNECT GPS & COMPASS TO FLIGHT CONTROLLER

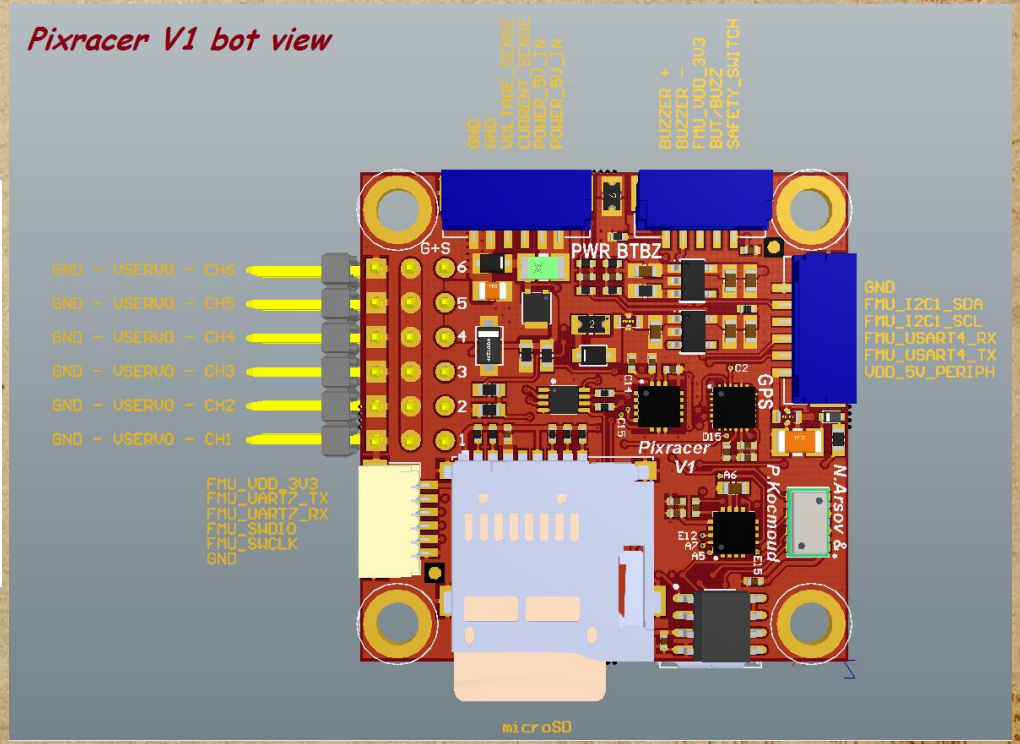




Power module

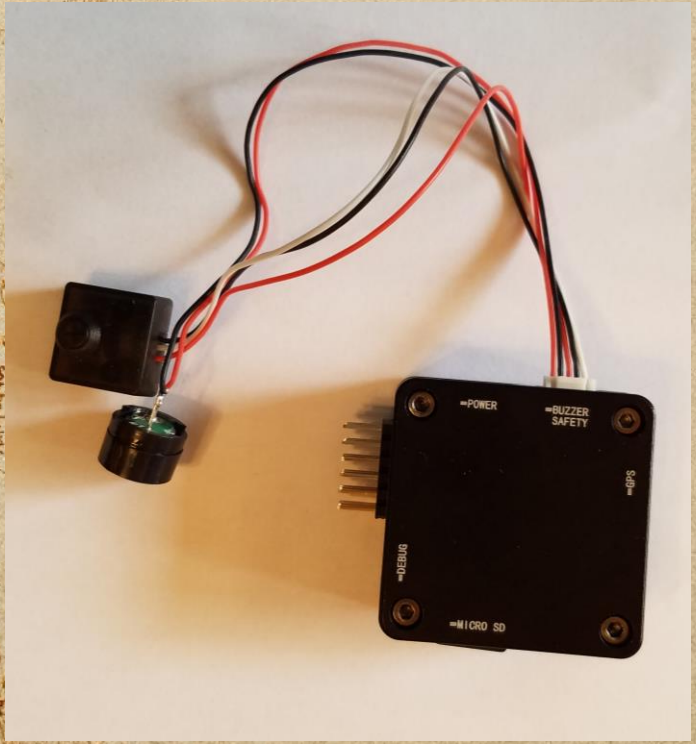
Connect Power Module to Flight Controller

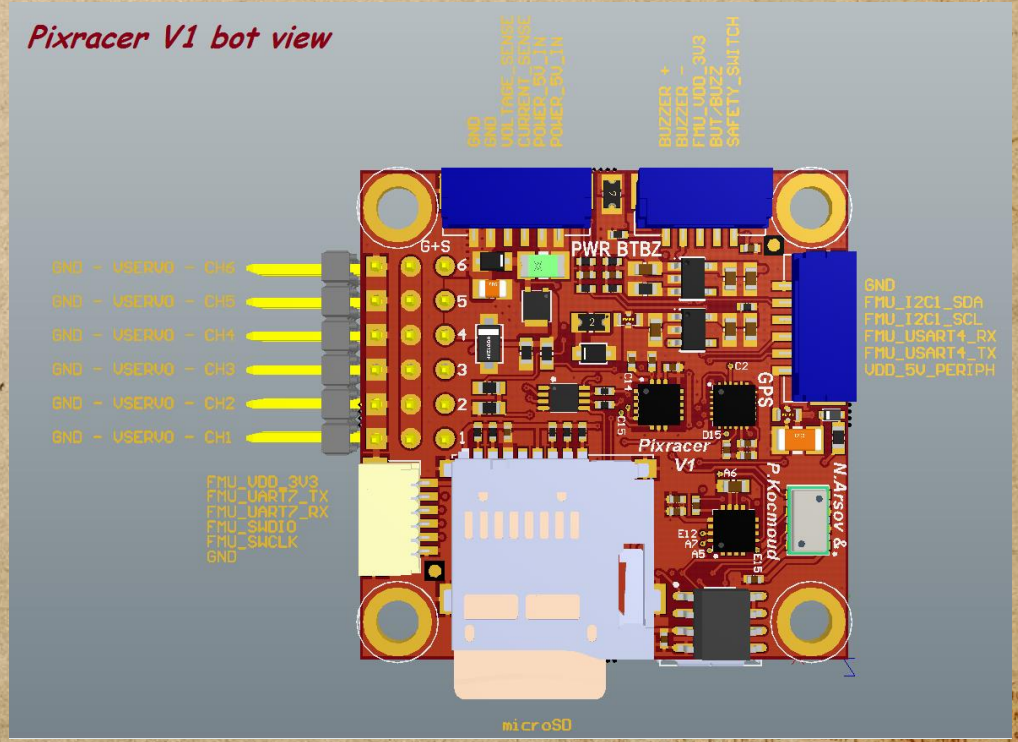




SAFETY SWITCH & BUZZER

CONNECT SAFETY SWITCH & BUZZER





WIFI ADAPTER INTEGRATION

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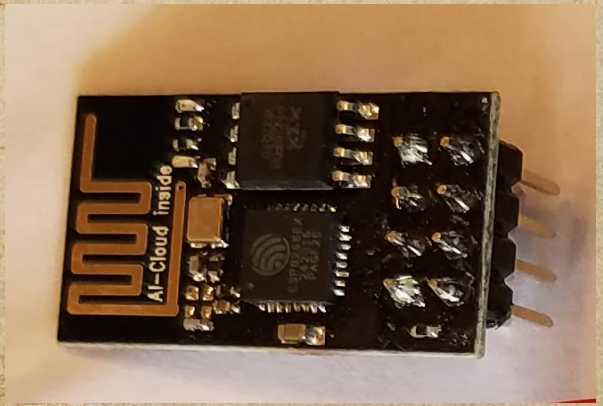
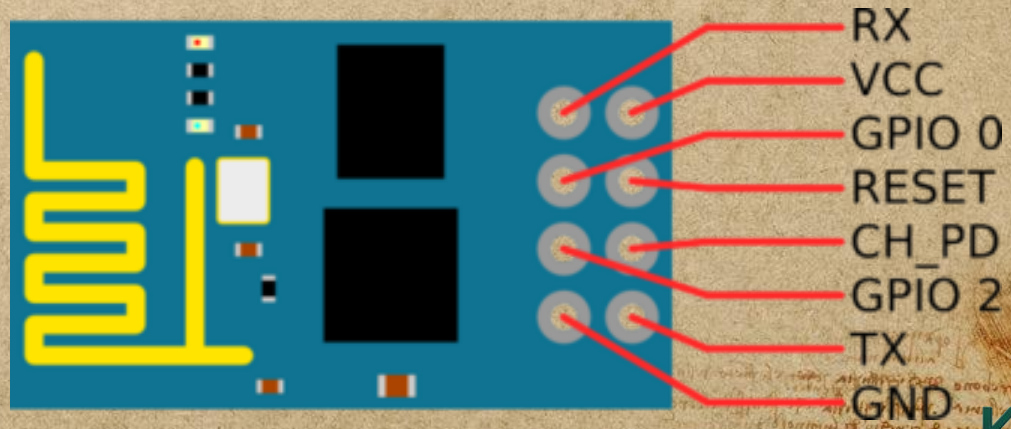
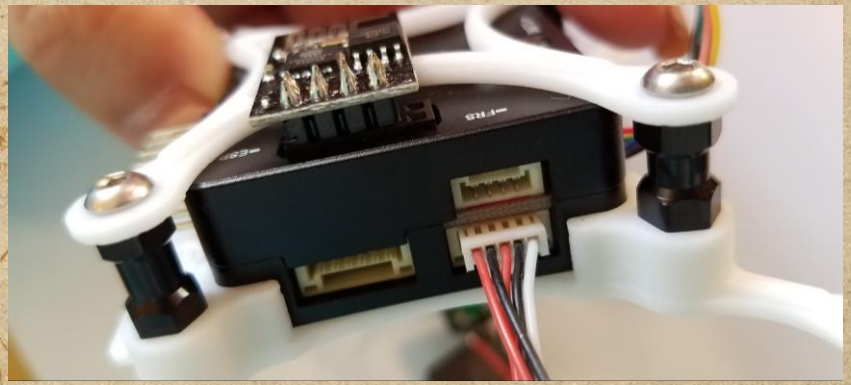
WIFI MODULE ESP8266

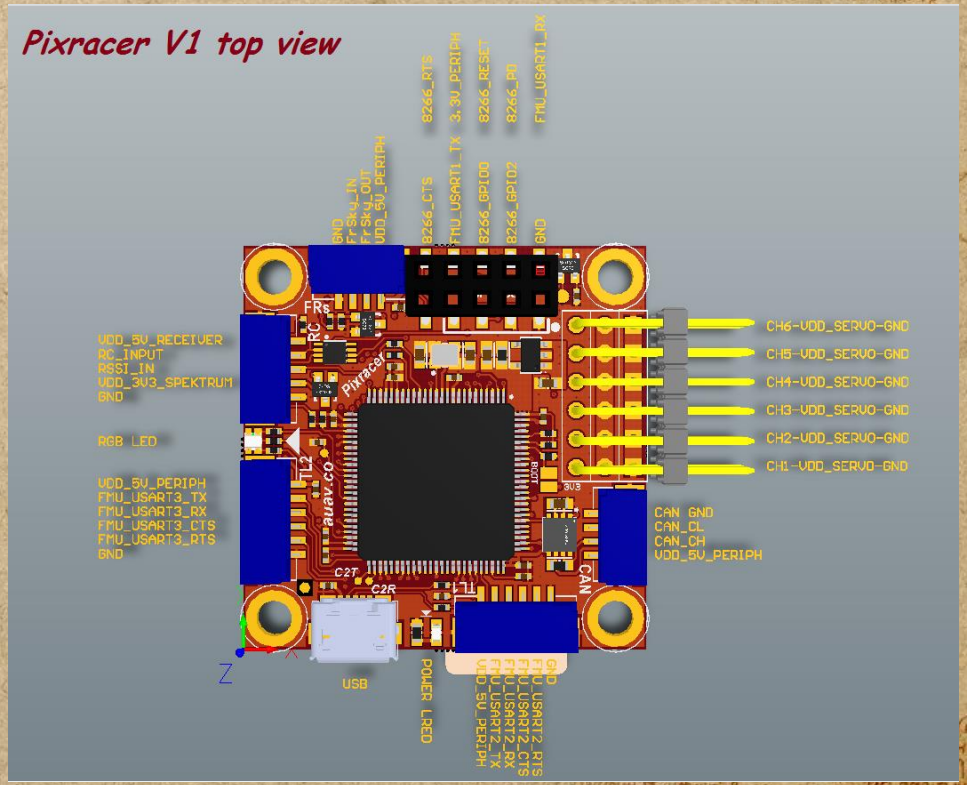
- Communicates between ground station and Flight Controller
- Low power consumption 32 bit CPU
- Wi-Fi Direct (P2P), soft-AP
- Built-in TCP / IP protocol stack
- Built-in temperature sensor





CONNECT WIFI MODULE



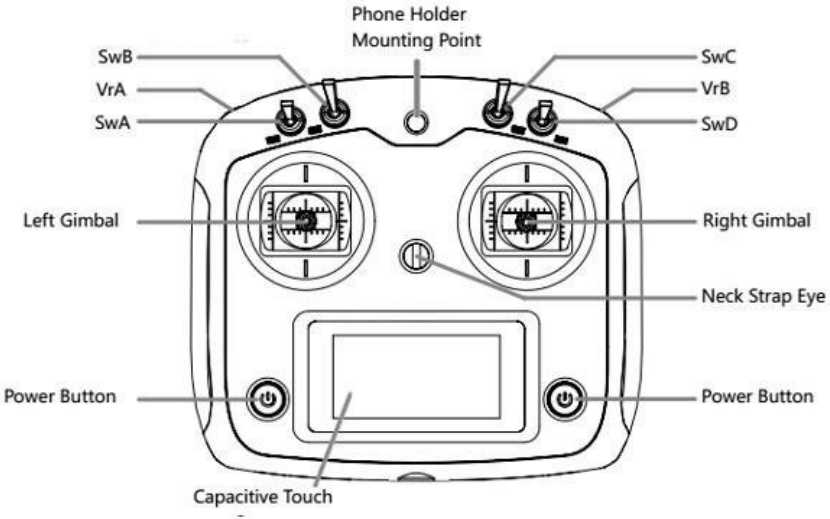


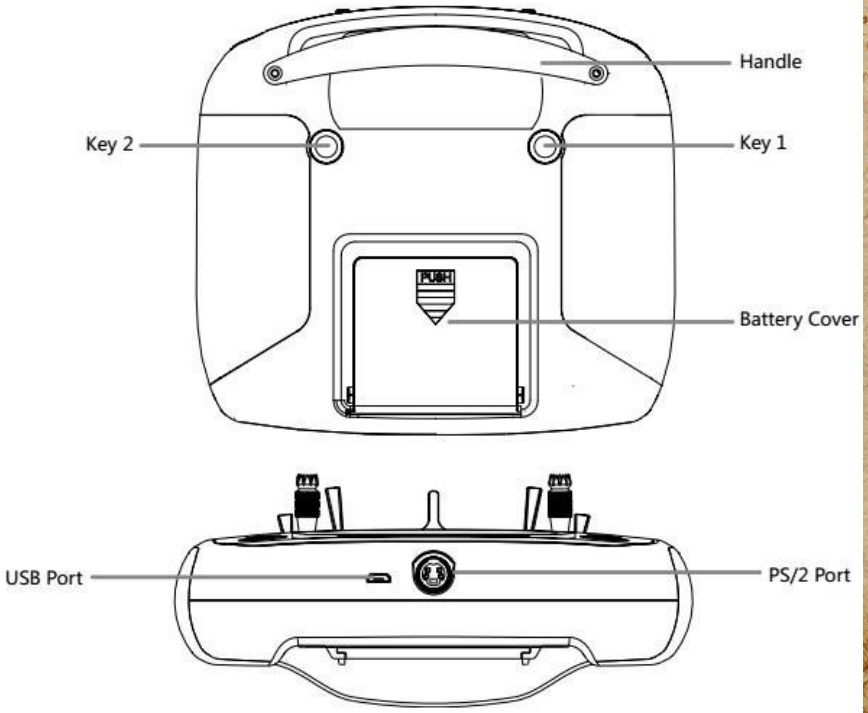
V

RC Transmitter

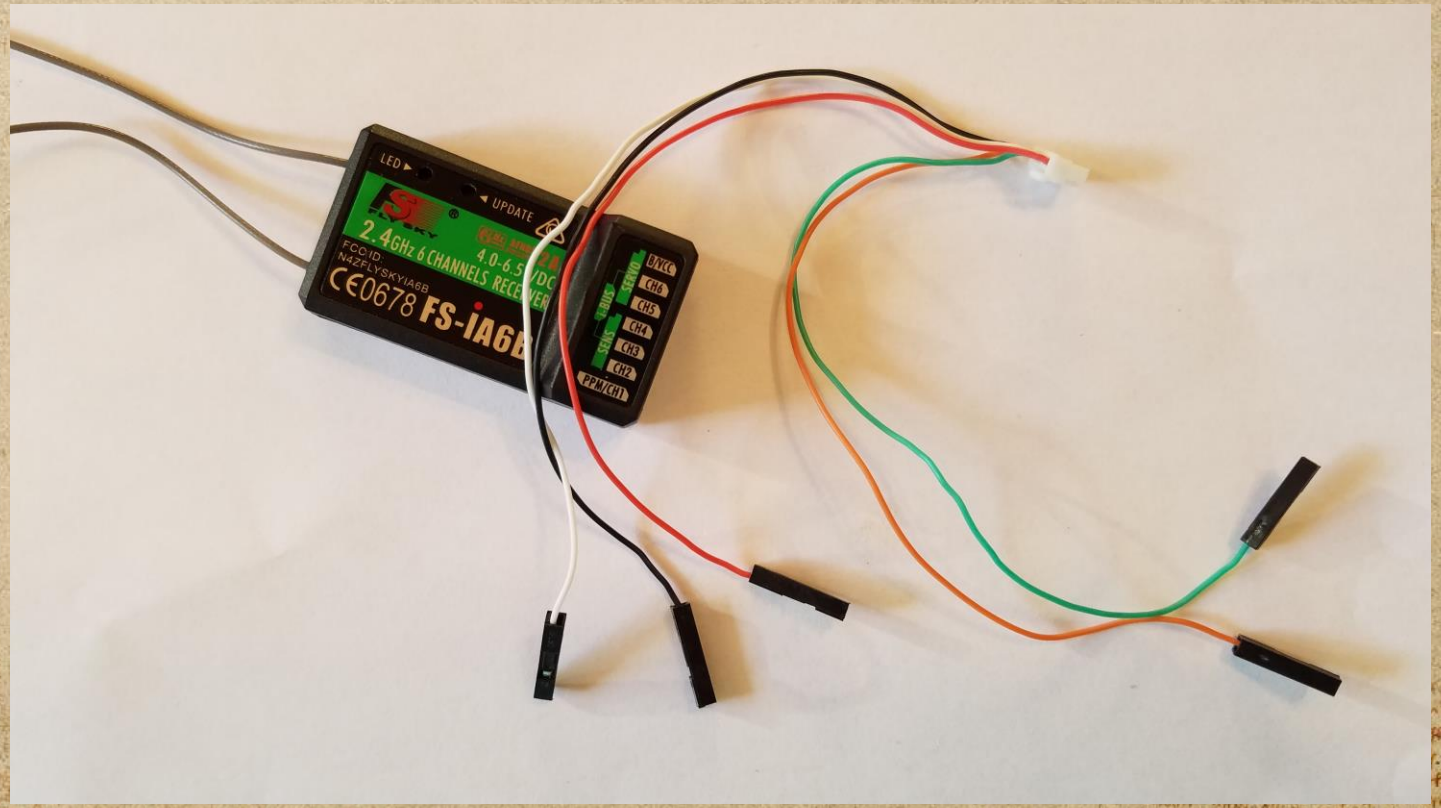
Transmitter – 10 channel 2.4ghz Digital computerized radio control (RC) system

RC transmitter buttons

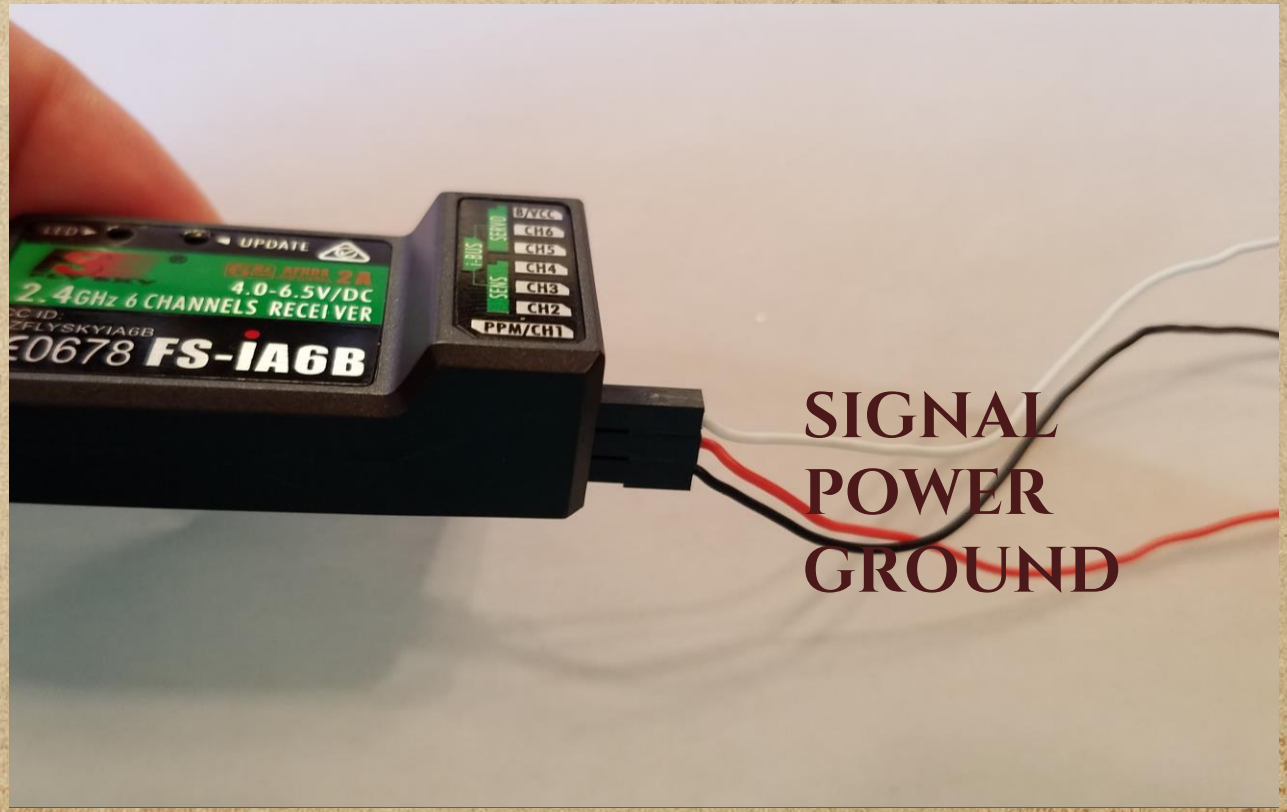




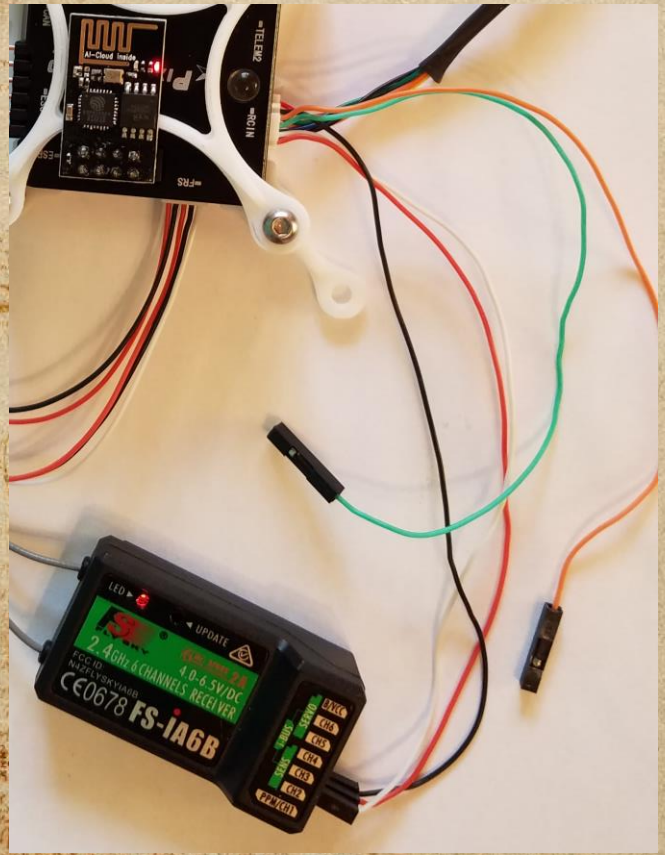
RC RECEIVER CABLES FOR PPM MODE

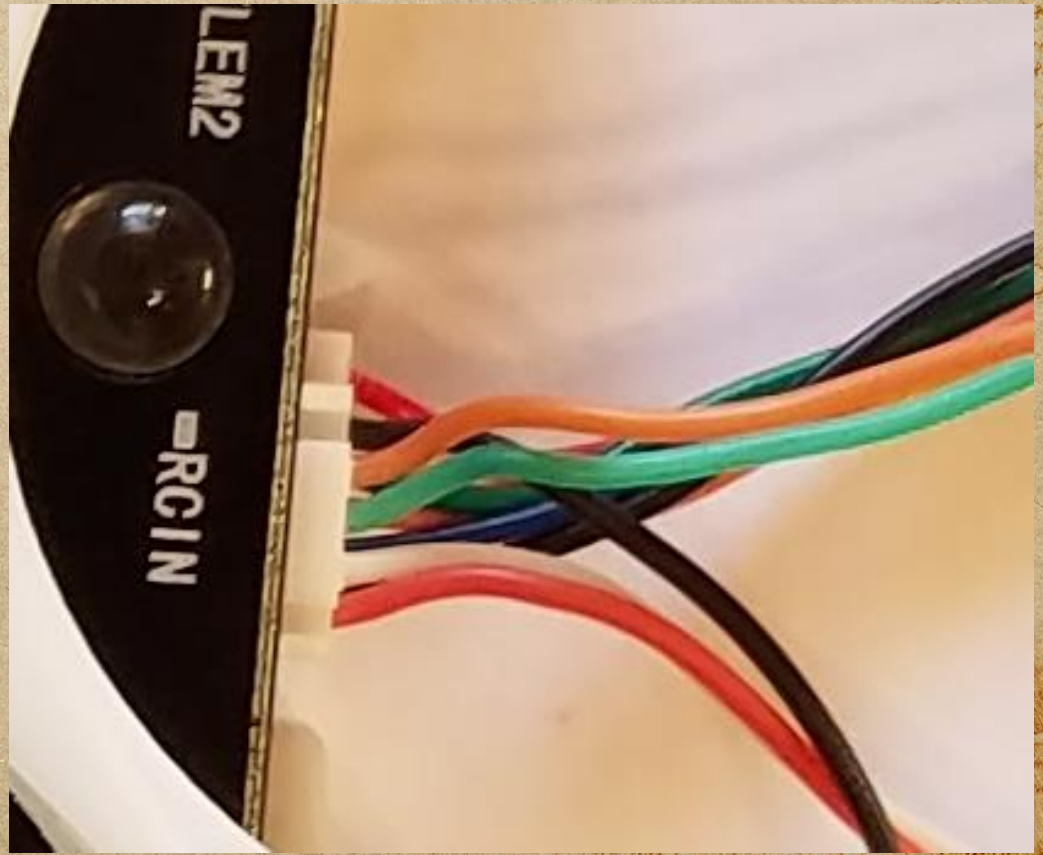


CONNECT DUPONT CABLE TO RC RECEIVER IN PPM MODE



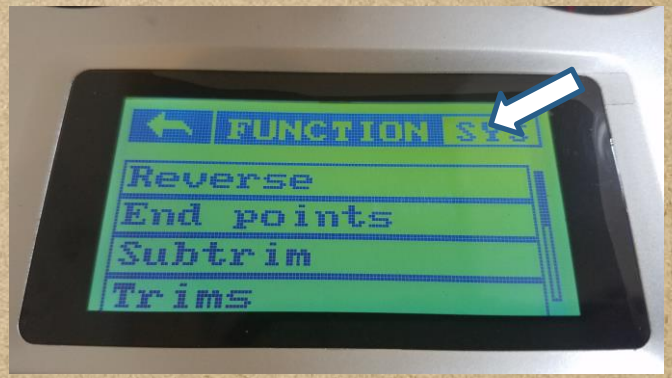
connect rc receiver DuPont cable to flight controller rcin

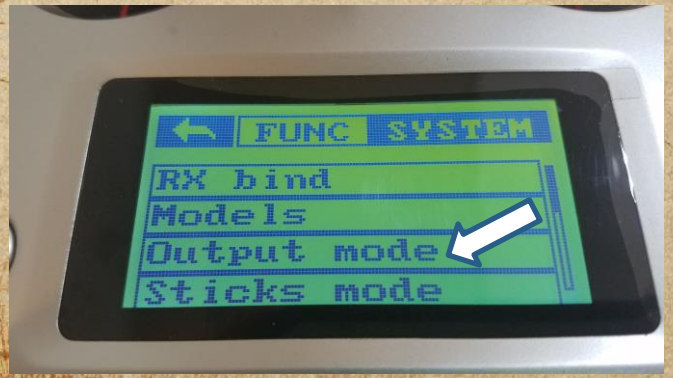


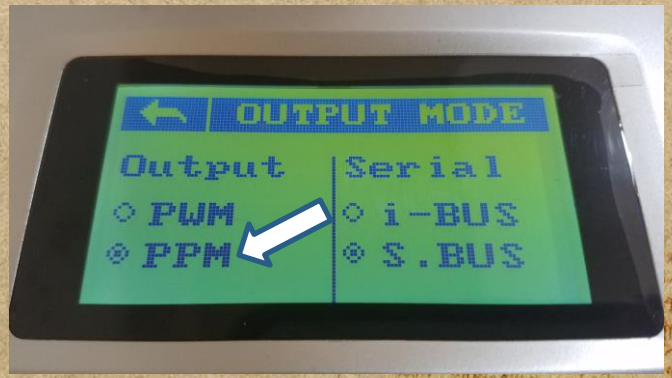


Set transmitter to PPM mode

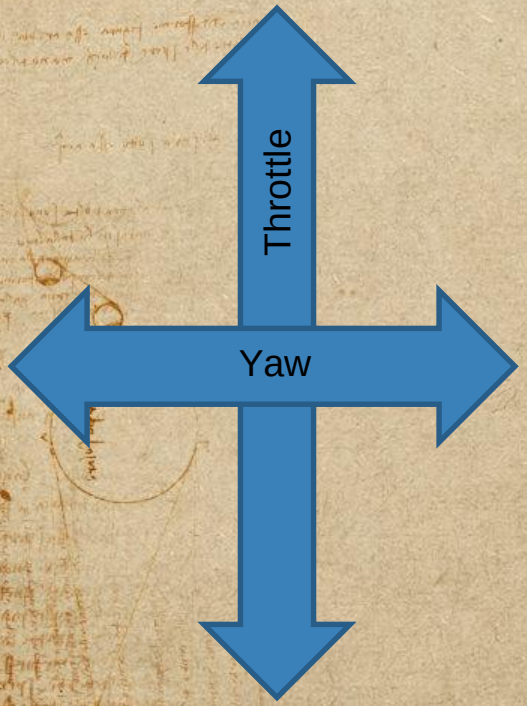
(hold both bottoms to turn on)

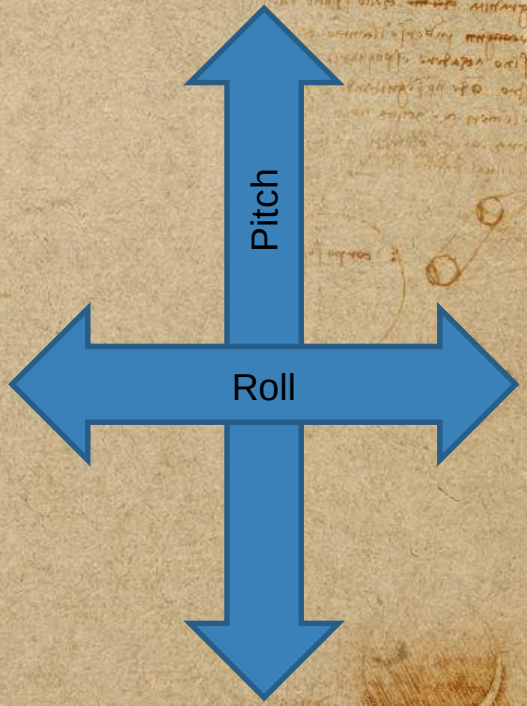






RC Transmitter Buttons

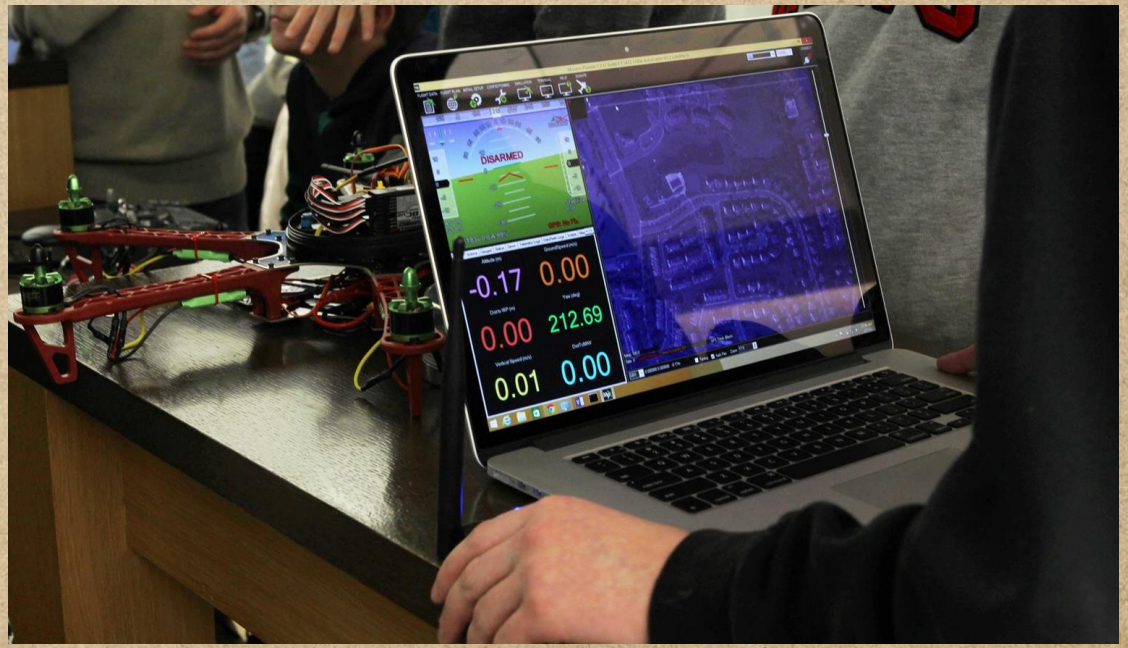




XI

Mission planner overview

Download Mission planner software



[Download here: http://ardupilot.org/planner/docs/common-install-mission-planner.html](http://ardupilot.org/planner/docs/common-install-mission-planner.html)

Mission Planner 1.3.41 build 1.1.6110.31287

FLIGHT DATA | FLIGHT PLAN | INITIAL SETUP | CONFIG/TUNING | SIMULATION | TERMINAL | HELP | DONATE

COM3 | 57600 | CONNECT

NW 330 345 0 15 30 NE

00:00:00

DISARMED

AS 0.0
GS 0.0

Unknown
0>0

EKF Vibe GPS: No GPS

Quick | Actions | PreFlight | Gauges | Status | Servo | Telemetry Logs | DataFlash Logs | Scripts | Messages

Altitude (m)	GroundSpeed (m/s)
0.00	0.00
Dist to WP (m)	Yaw (deg)
0.00	0.00
Vertical Speed (m/s)	DistToMAV
0.00	0.00

Sats: 0 | Current Heading | Direct to current WP | Target Heading | GPS Track (Black)

GEO 0.000000 0.000000 0.00m | Tuning | Auto Pan | Zoom 8.0

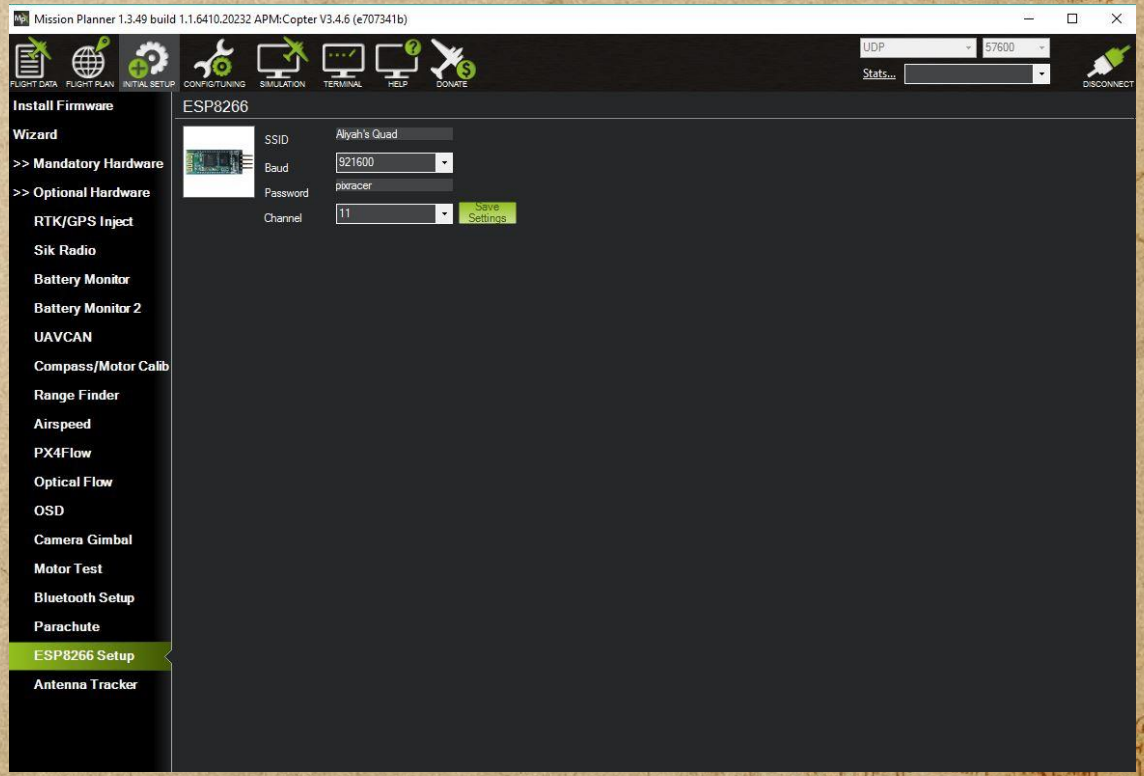
XII

MISSION PLANNER SETUP

Change wifi network name

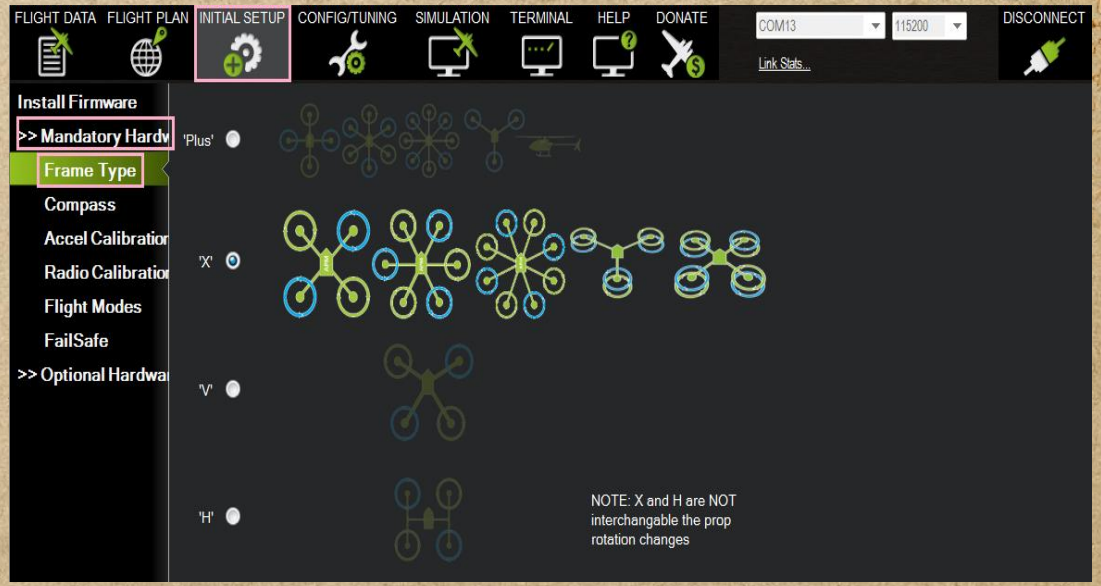
Must change name of wifi connection one drone at a time

- Select Initial Setup
- Optional Hardware
- ESP8266 Setup
- Change SSID: Select Name
- Save Settings



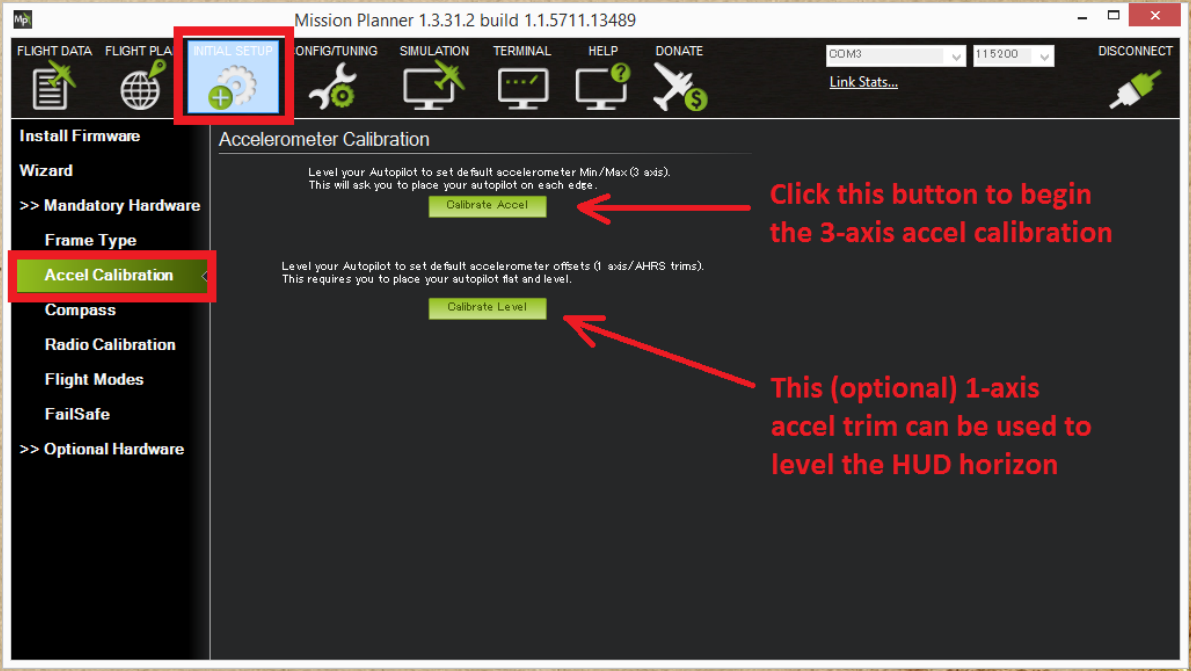
Mandatory hardware - Frame type

- Connect using USB cord with Baud Rate 115200
- Click Mandatory Hardware
- Select Frame Type
- Quadcopter – Configuration “X”



Mandatory hardware - Accelerometer Calibration

- Select Accelerometer Calibration
- Click Calibrate Accelerometer
- Follow instructions on screen



Install Firmware

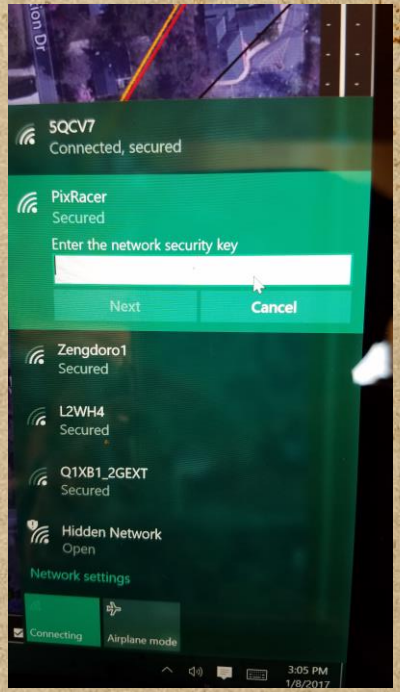
- Plug Micro USB cable into Flight Controller
- Connect Micro USB cable with ground station
- Verify COM Port
- Set Baud Rate to 115200
- DO NOT CONNECT YET
- Click Initial Set Up Tab
- Install Firmware
- Select Your Multicopter

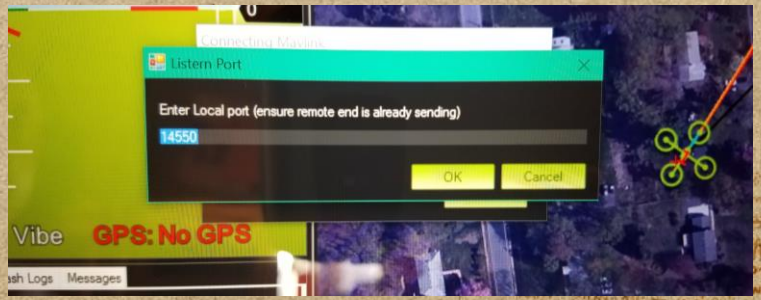
The **baud rate** is the **rate** at which information is transferred in a communication channel. In the serial port context, "9600 **baud**" means that the serial port is capable of transferring a maximum of 9600 bits per second.

Connect WIFI Module

Must change name of wifi connection one drone at a time

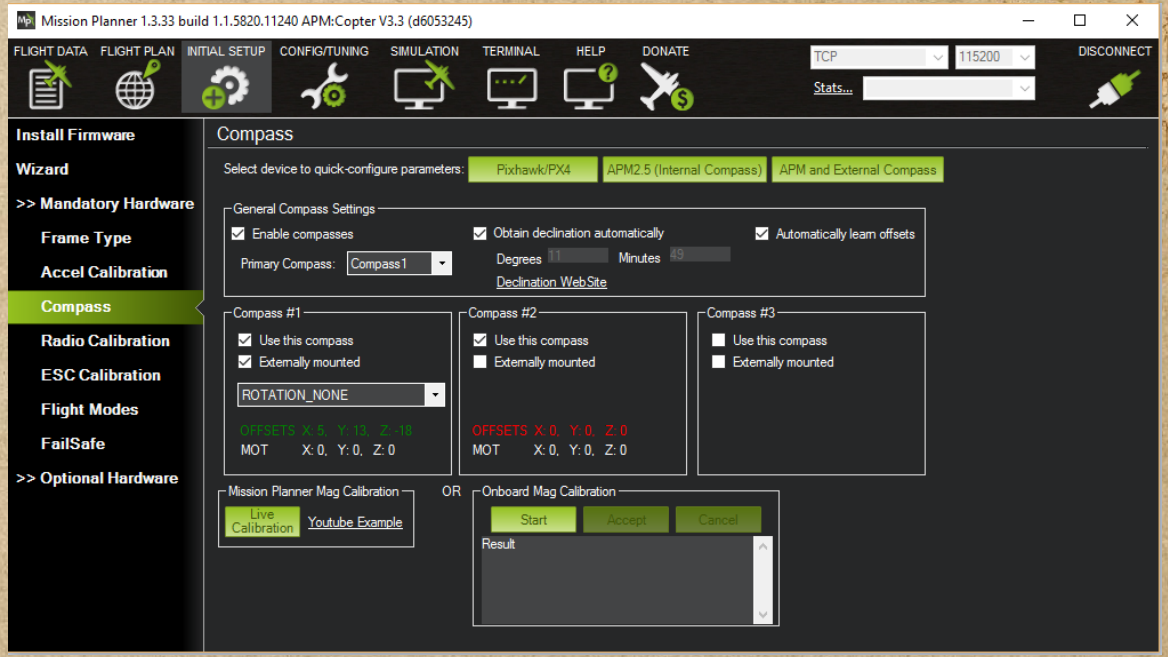
- Power via Micro USB cable
- Connect to Wifi: PixRacer
- Password: pixracer
- Set baud rate to UDP**
- Connect in Mission Planner
- Local Port: 14550





Mandatory hardware - Compass Calibration

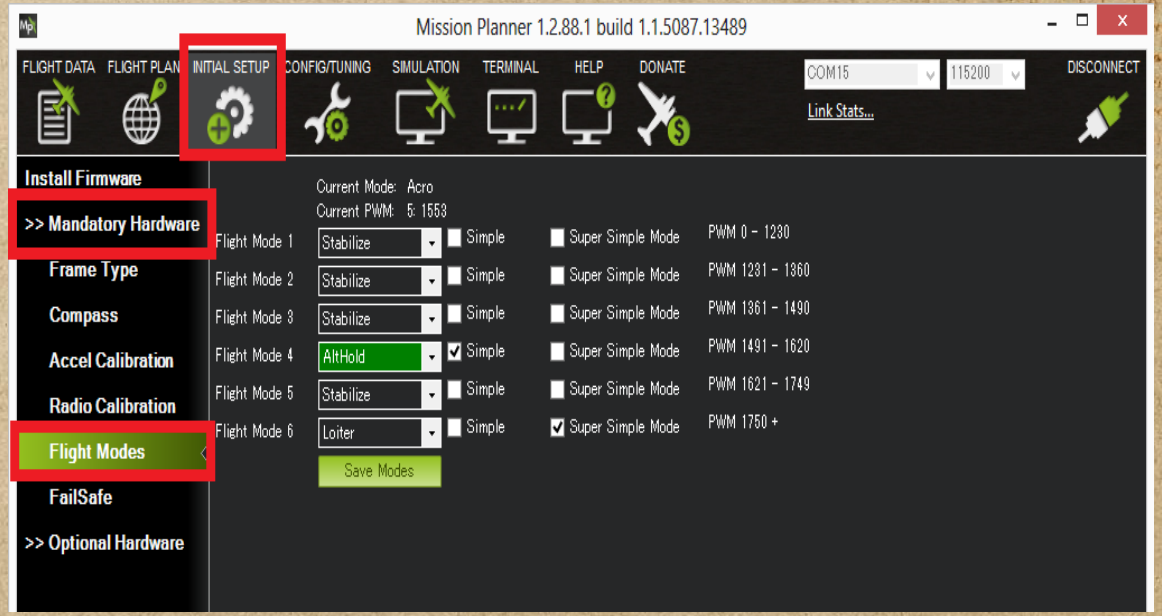
- Compass #1 check both boxes
- Set to “ROTATION_NONE”
- Compass #2 check top box only
- Click “Onboard Mag Calibration”
- Rotate the drone on all axis holding each position for 2 seconds
- Compass OFFSETS should be less then 500, turn off any compass with offsets in RED



Mandatory hardware - Radio Calibration

Mandatory hardware - Flight Mode Setup

- Stabilize – You are in full control
- Althold – Altitude Hold
- Poshold – Position Hold
- RTL – Return to Launch

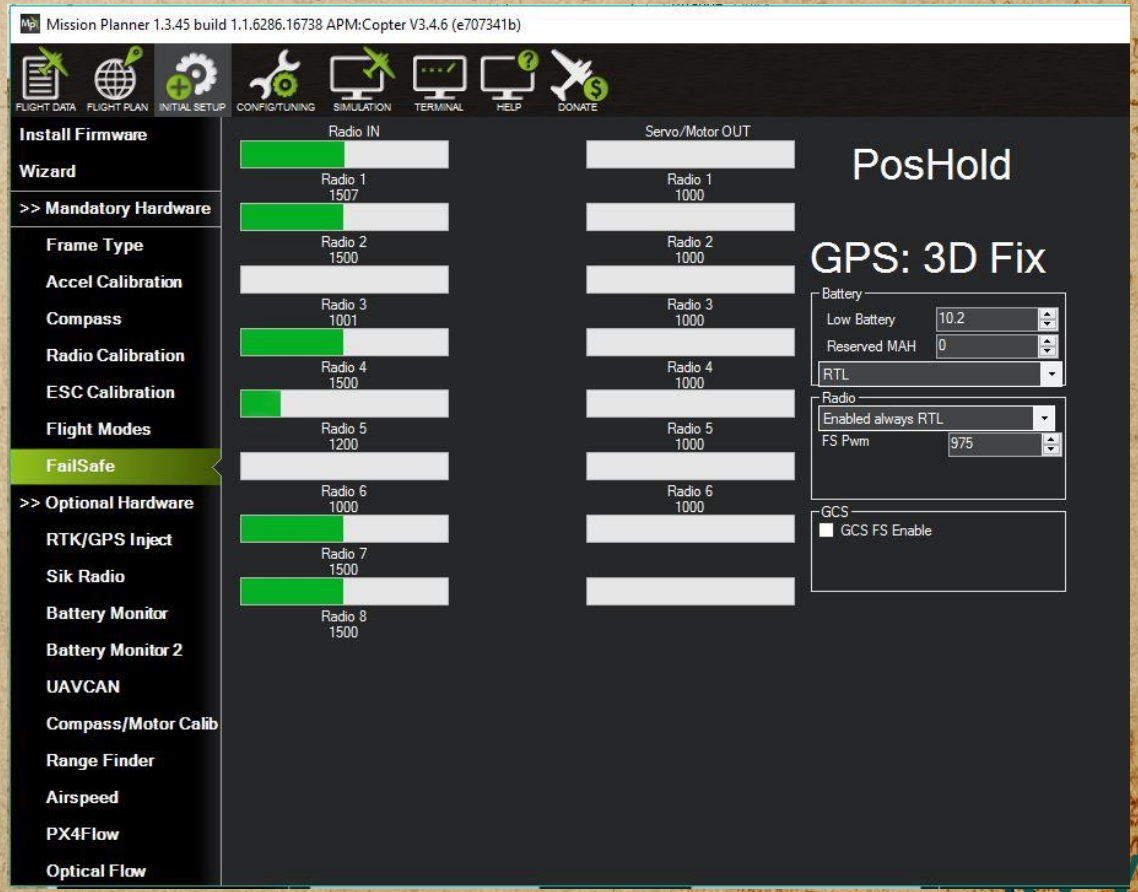


Mandatory hardware - Failsafe Setup

- Low Battery: 10.15
- Disabled

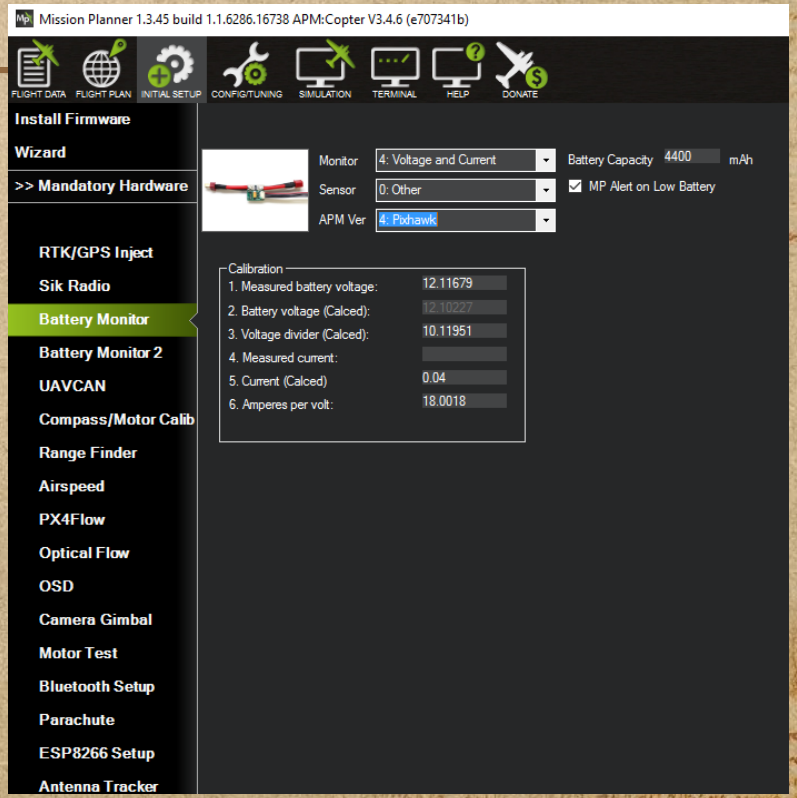
- Radio
- Enabled RTL

- Do Not Enable GCS



Optional hardware - Battery Monitor

- Monitor: Voltage & Current
- Sensor: Other
- APM Ver: PixRacer
- Battery Capacity: 2200 mAH or 4400 mAH

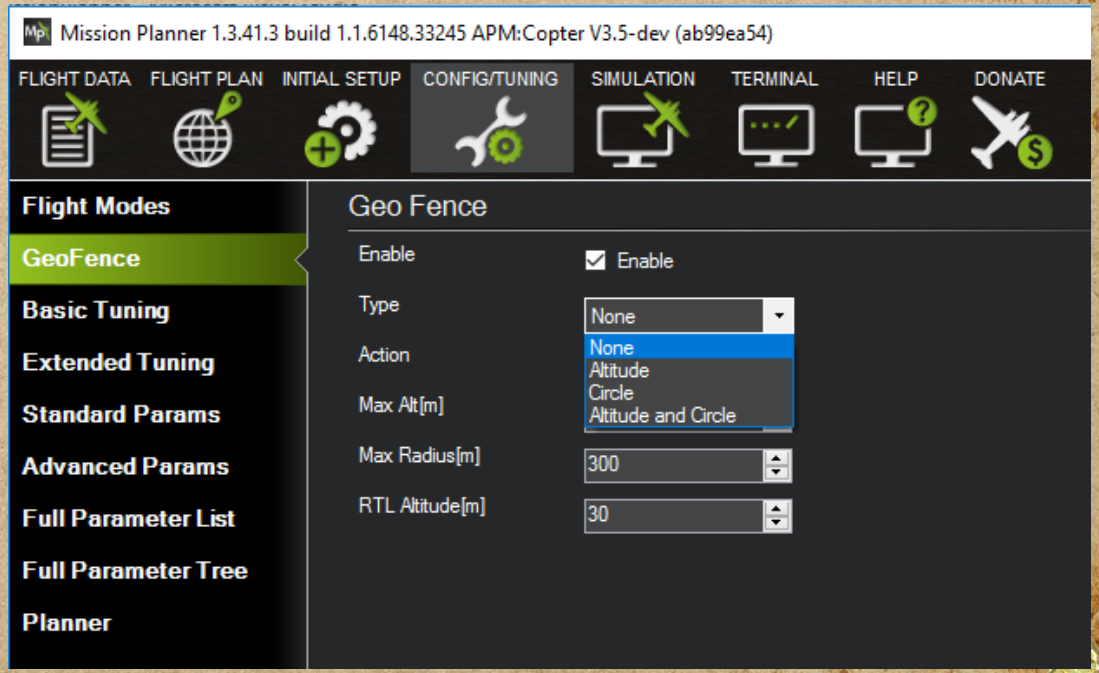


Calibration

1. Measured battery voltage: Set prior to flight, check battery with monitor and update voltage

Config/tuning - Geo fence Setup

- Enable
- Type: Altitude and Circle
- Action: RTL or Land
- Max Alt: 30
- Max Radius: 80



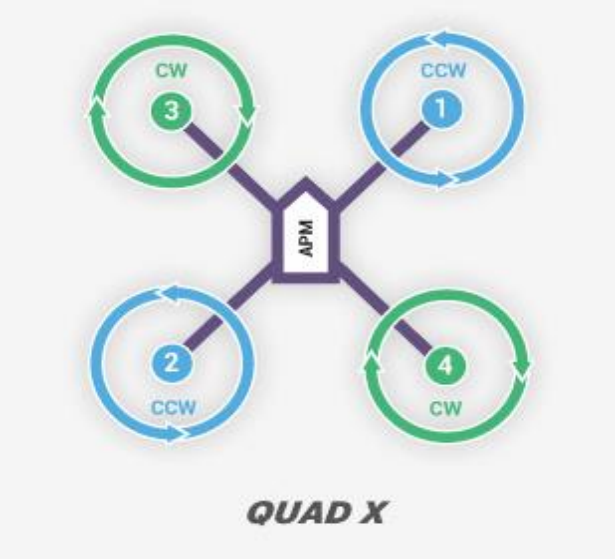
XIII

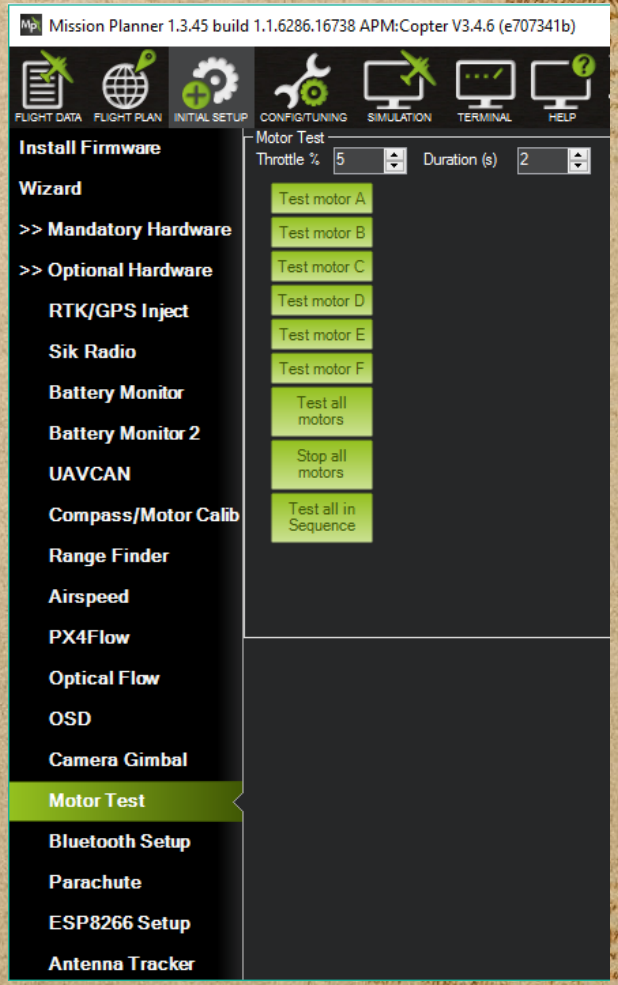
MOTOR SPIN TEST

Motor Spin Test

Set Throttle 7 %

- Test motor order is correct
- Test spin direction is correct





XIV.

Pre-Flight Check

DRONE SAFETY & REGULATIONS

KWVF

DRONE SAFETY & REGULATIONS

- Have visual sight of your aircraft
- Remain under 400 Feet Above Ground Level (AGL)
- Respect privacy and safety of others
- Keep your aircraft out of airport flight paths (5 mile radius) and restricted airspace areas, and obey any FAA Temporary Flight Restrictions (TFRs).

JOIN THE ACADEMY OF MODEL AERONAUTICS (AMA)

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  - http://www.modelaircraft.org
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  - YES Grants Available
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- Model Aviation Student Club (MASC)
- AMA Flight School
  - http://www.amaflightschool.org

Pre-Flight

Follow pre-flight check instructions