THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF ELECTRONIC & COMPUTER ENGINEERING

Introduction to Aerial Robotics
Lab Tutorial 1

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Introduction

Logistics of Lab Tutorials

- Lab tutorial 1 (08&09 March): Drone assembling and manual flight
- Lab tutorial 2 (15&16 March): Development environment and fly in API mode with OptiTrack
- Lab tutorial 3 (26&27 April): State estimation and trajectory planning by your own

Today's Objective

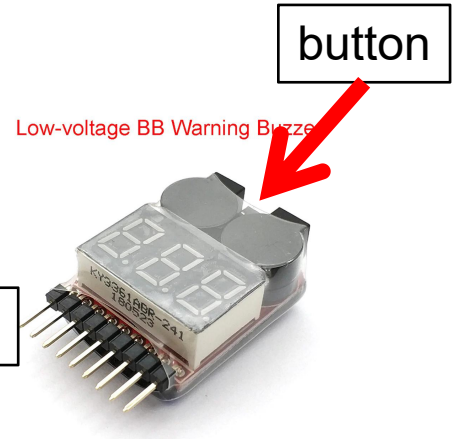
- Assemble your quadrotor
- Let TA check your quadrotor
- Fly the quadrotor under manual control (ATTI Mode)

Prerequisite Knowledge

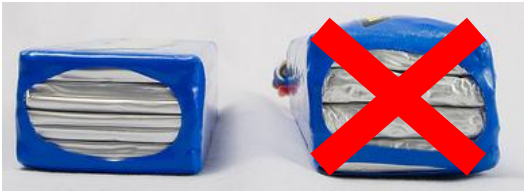
- Common sense of mechanical assembly
  - Types of screws
  - Properly tightening screws
- Soldering

Safety Reminder

Safety Reminder



- Battery
  - Use BB Buzzer to check battery every time before flight
    - !!! At least 15.8V before flight, duration should be less than 5 minutes
    - !!! Stop use the battery immediately when the buzzer starts “b~b~b~b~”
  - Do not charge it by youself if you are not familiar with Li-Po
    - !!! Improper battery charging will burn Robotics Institute
  - !!! Do not use swollen batteries for flight
  - Put used batteries into the “Used Battery” box
  - Try not to make it less than 14.8V



Safety Reminder

- Soldering
  - !!! Do not touch the working soldering iron (400 °C)
  - !!! Do not touch the soldering joint immediately after soldering
  - Put idle soldering iron in stand
  - Turn soldering iron off immediately when you finish your work
- Hot-melt adhesive
  - !!! Do not touch the iron head
  - !!! Do not touch the adhesive that is melt

Safety Reminder

- Electric Tools
  - Do not use electric tools if you have no experience
    - !!! Wrong way to use electric tools may cause a wrist sprain
- Propellers
  - Do not install any propellers until TA checks your UAV
    - !!! Spining propellers can cause severe damage
  - Also beware of rotors spining under high speed even without propellers

Assembled Quadrotor (Reference)

Quadrotor BOM

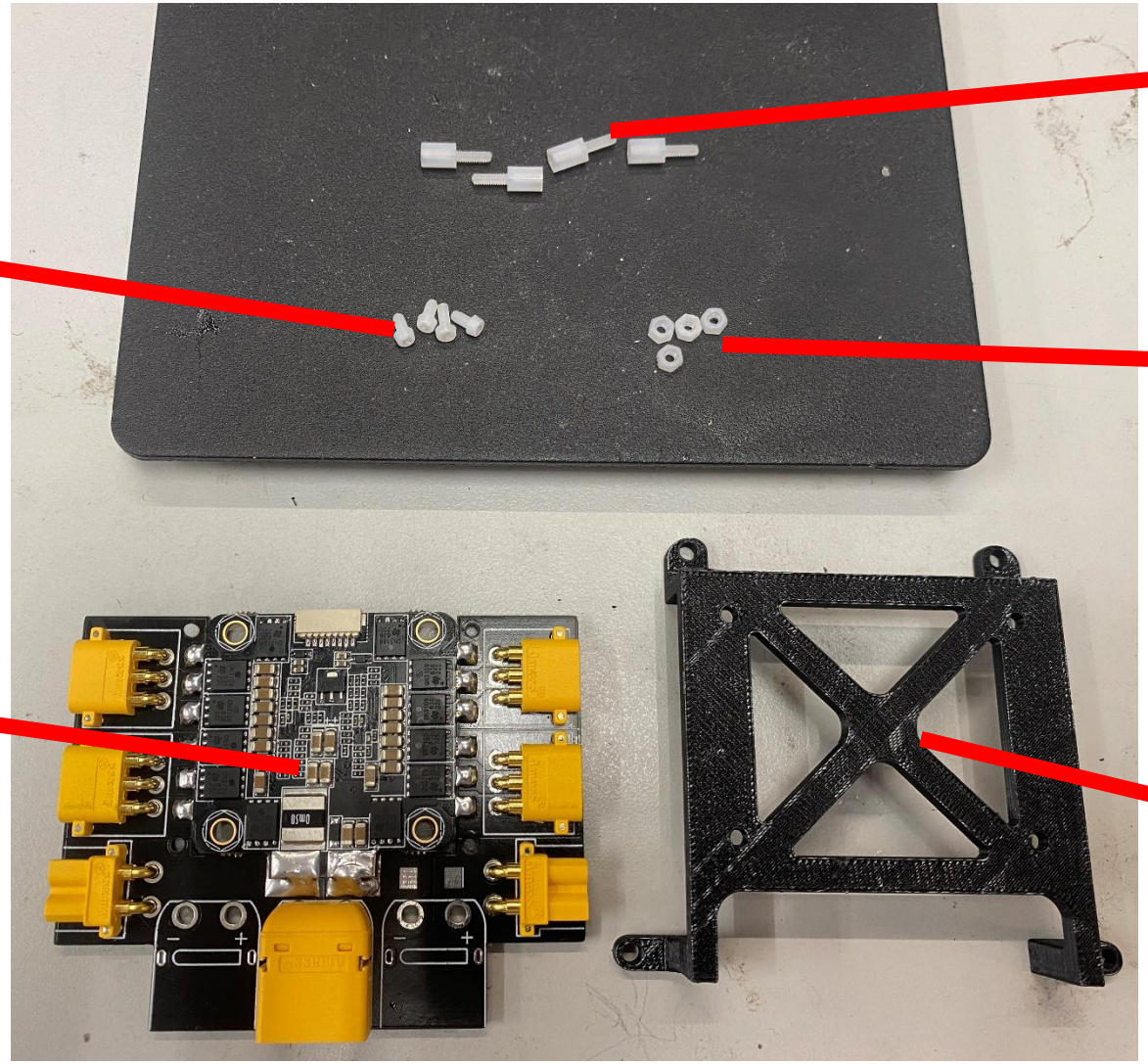
- Provided in equipment box, also uploaded to Canvas
- Be careful during your experiments, as the total cost of your quadrotor is more than HKD 25,000!
- Please check your equipment with the BOM list first. Contact TAs if you find any part missing.

Part 1

Quadrotor Assembly Part 1

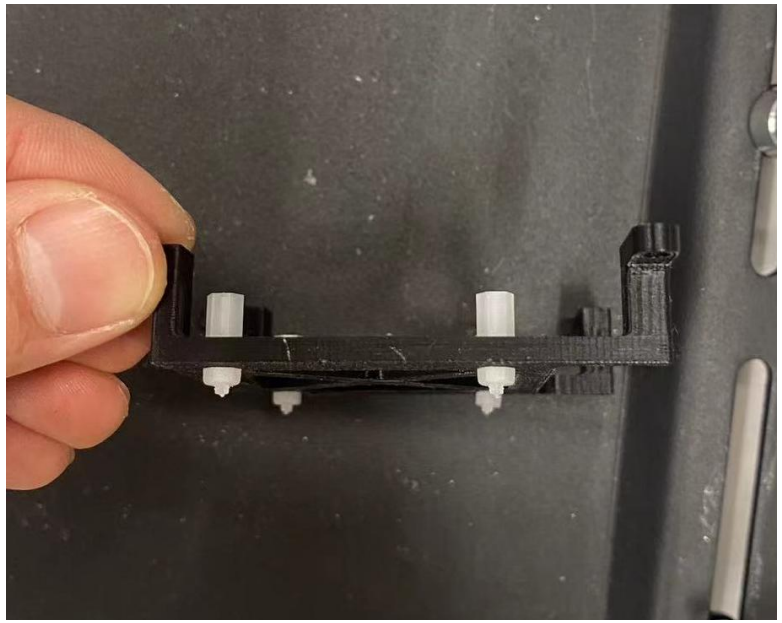
- Equipment List:

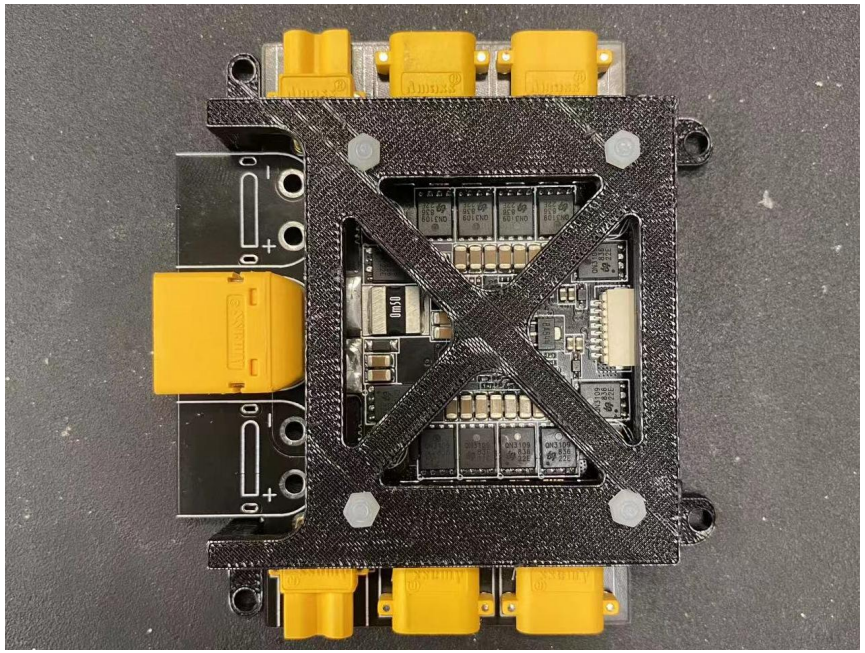
Item	Quant.
ESC Cover	1
4 in 1 ESC	1
M2 * 6 Nylon Screw	4
M2 * 6-6 Nylon Stud	4
M2 Nylon Hex Nut	4

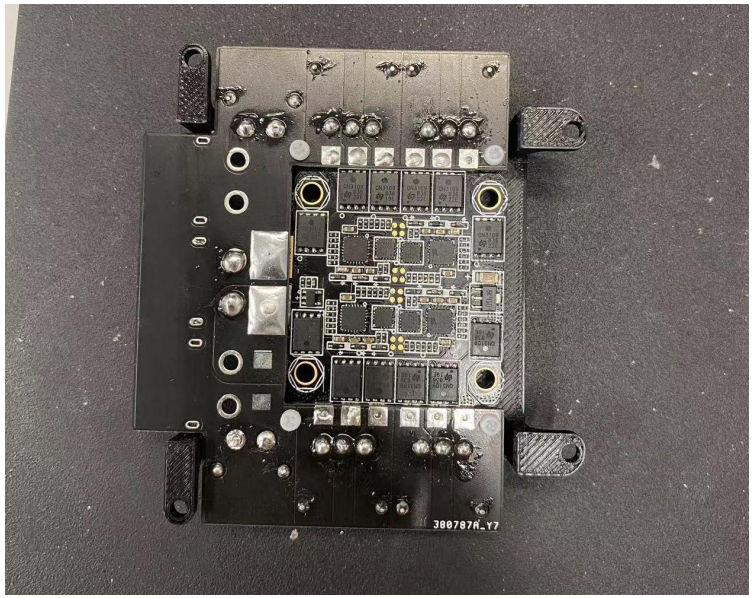

M2 * 6-6 Nylon Stud
M2 * 6 Nylon Screw
M2 Nylon Hex Nut
4-in-1 ESC
ESC Cover

Quadrotor Assembly Part 1

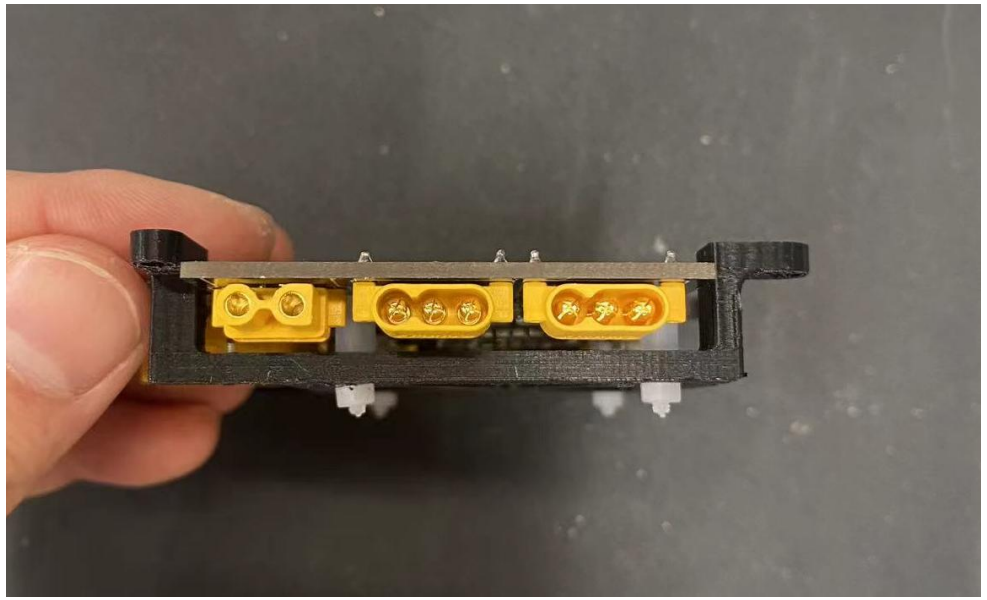
- **Part 1**: Baseboard (power distribution & ESC)







Quadrotor Assembly Part 1



Part 2

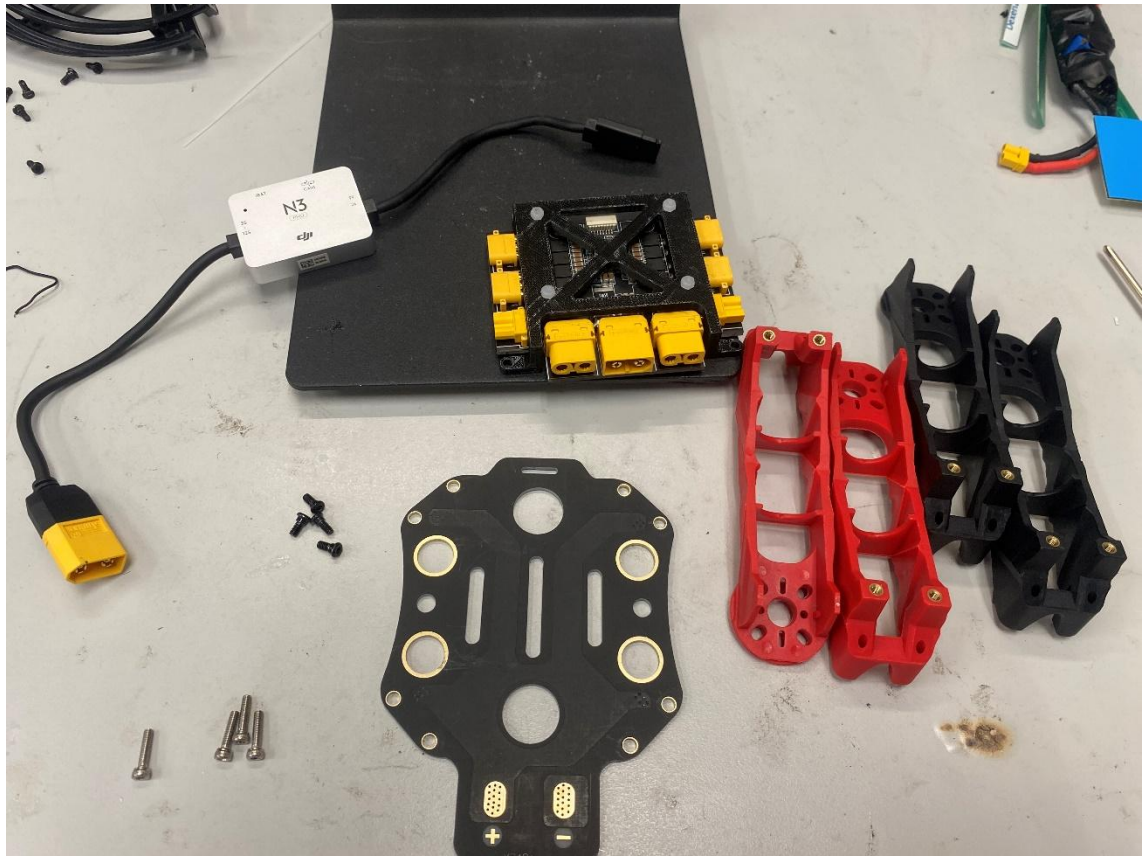
Quadrotor Assembly Part 2

- Equipment List:

Item	Quant.
Q250 Arm	4
Baseboard	1
N3 PMU	1
M2.5 * 4 Step Screw	4
M2.5 * 10	4
Part1	1

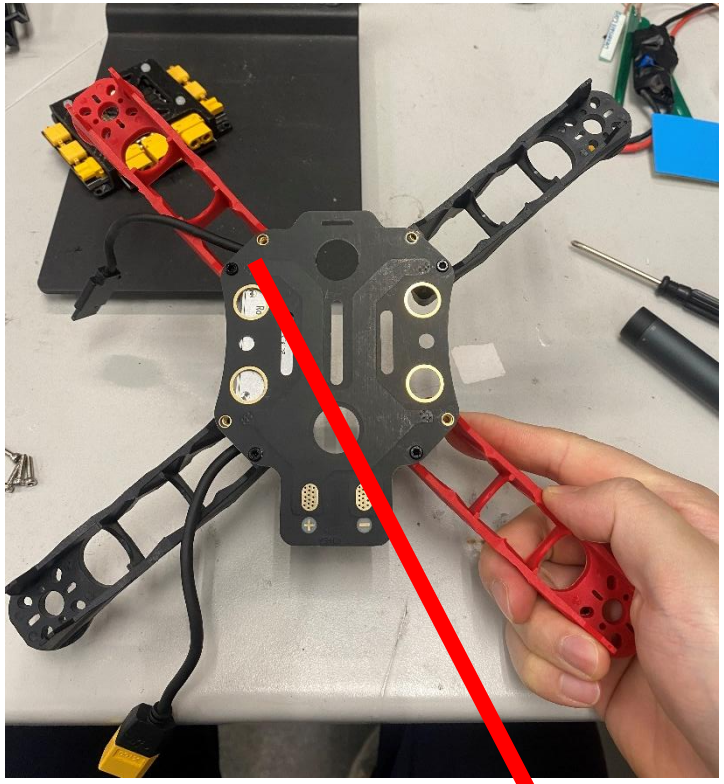
Quadrotor Assembly Part 2

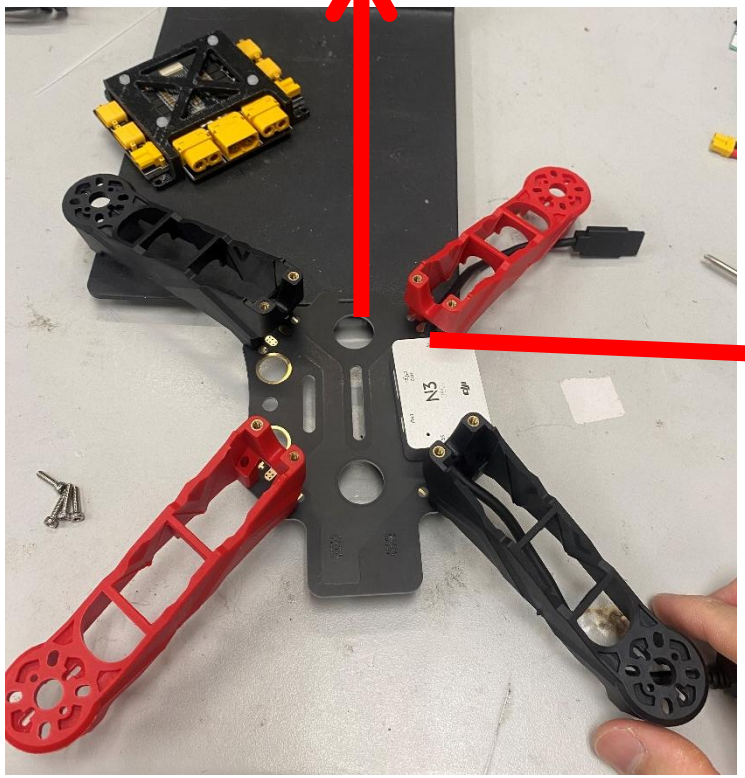
- **Part 2**: Assemble the base frame



Quadrotor Assembly Part 2

Head

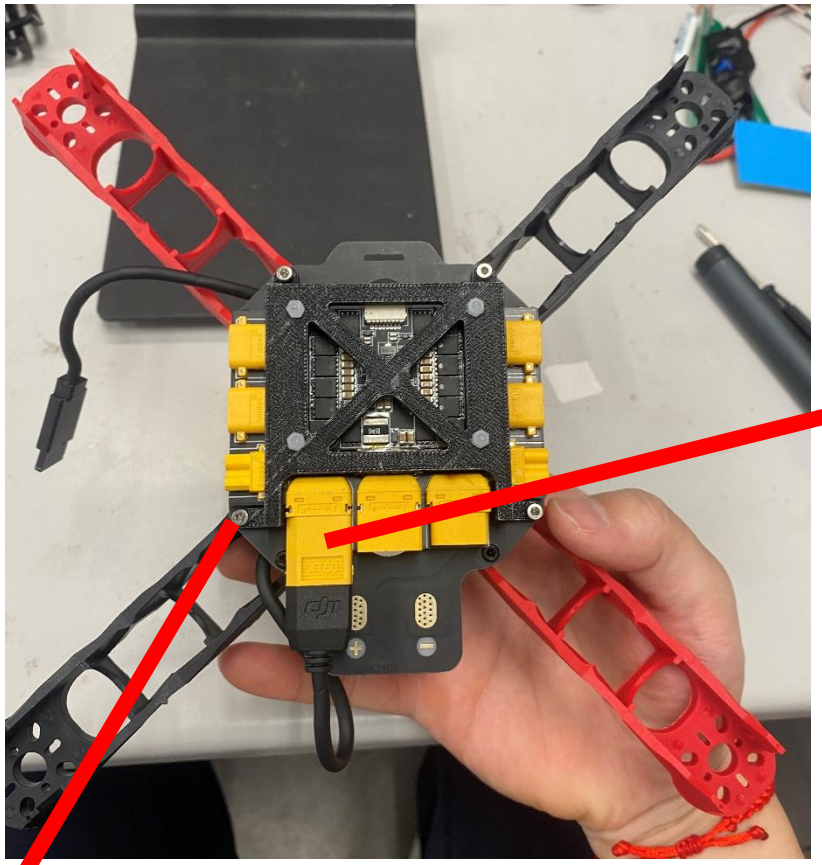




N3 PMU wires should be installed inside the arms.
Be careful with N3's install position. It should be on the right side

Be careful with M2.5 *4 screws' position and direction

Quadrotor Assembly Part 2



Plug in PMU XT60 socket

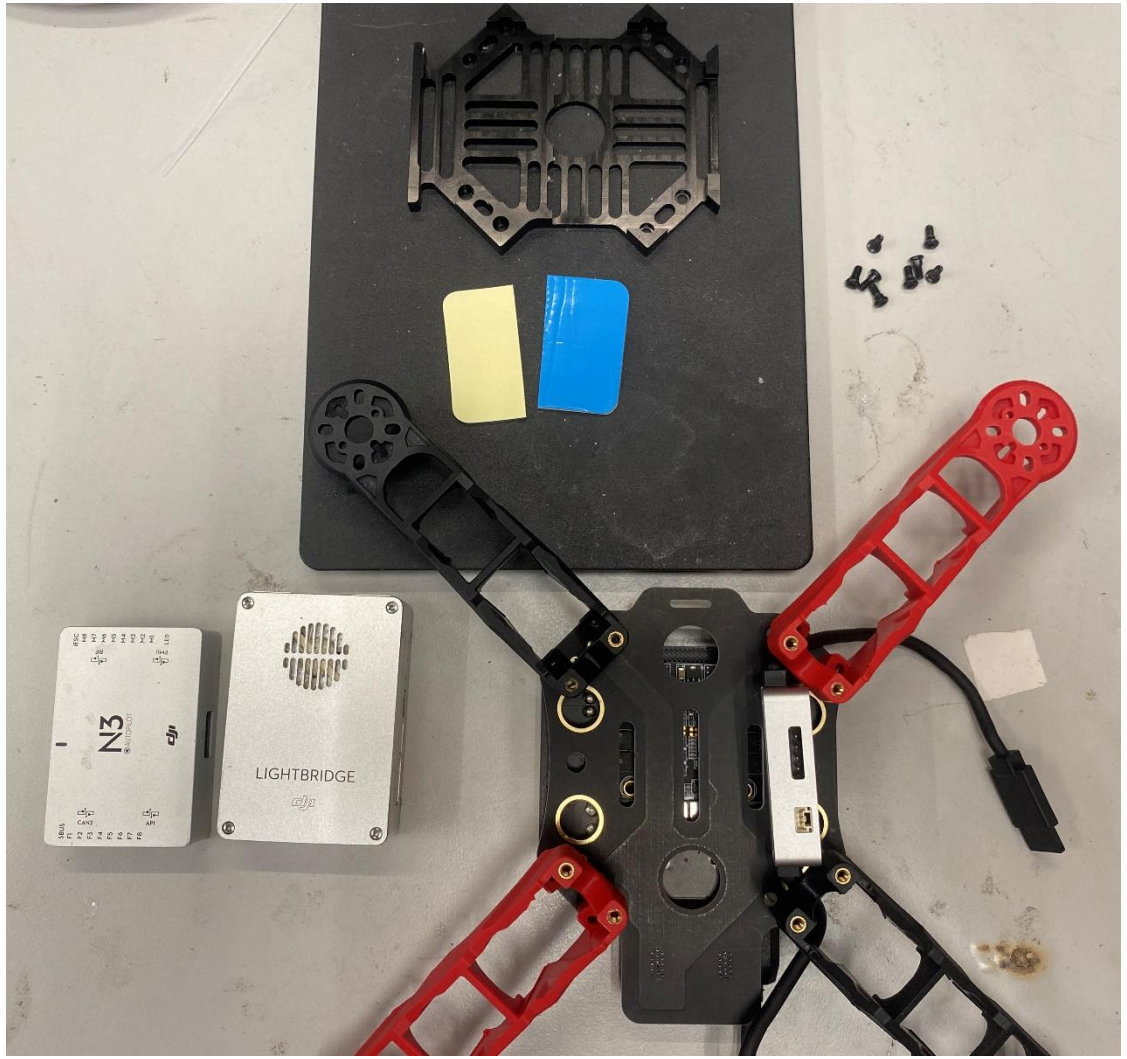
Be careful with M2.5 *10 screws' position and direction

Quadrotor Assembly Part 3

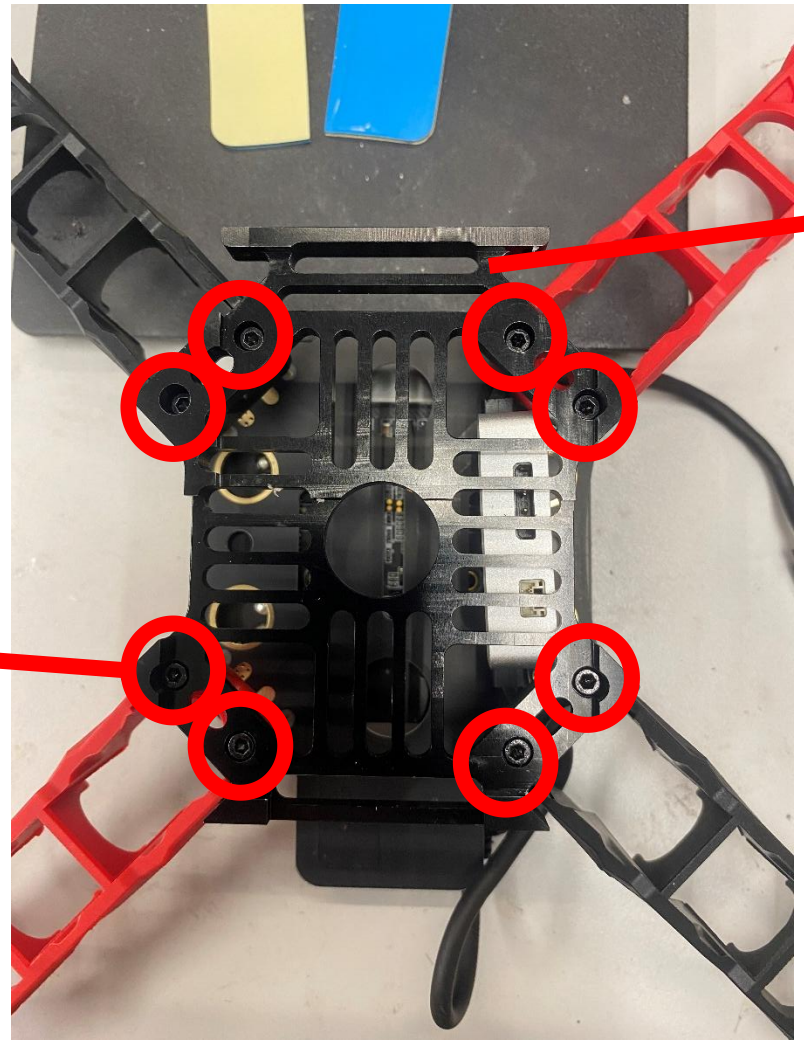
- Equipment List:

Item	Quant.
3M Double Coated Tissue Tape	2
N3/BL2 Carrier	1
N3 Autopilot	1
LightBridge 2	1
M2.5 * 4 Step Screw	8
Part2	1

Quadrotor Assembly Part 3



Quadrotor Assembly Part 3



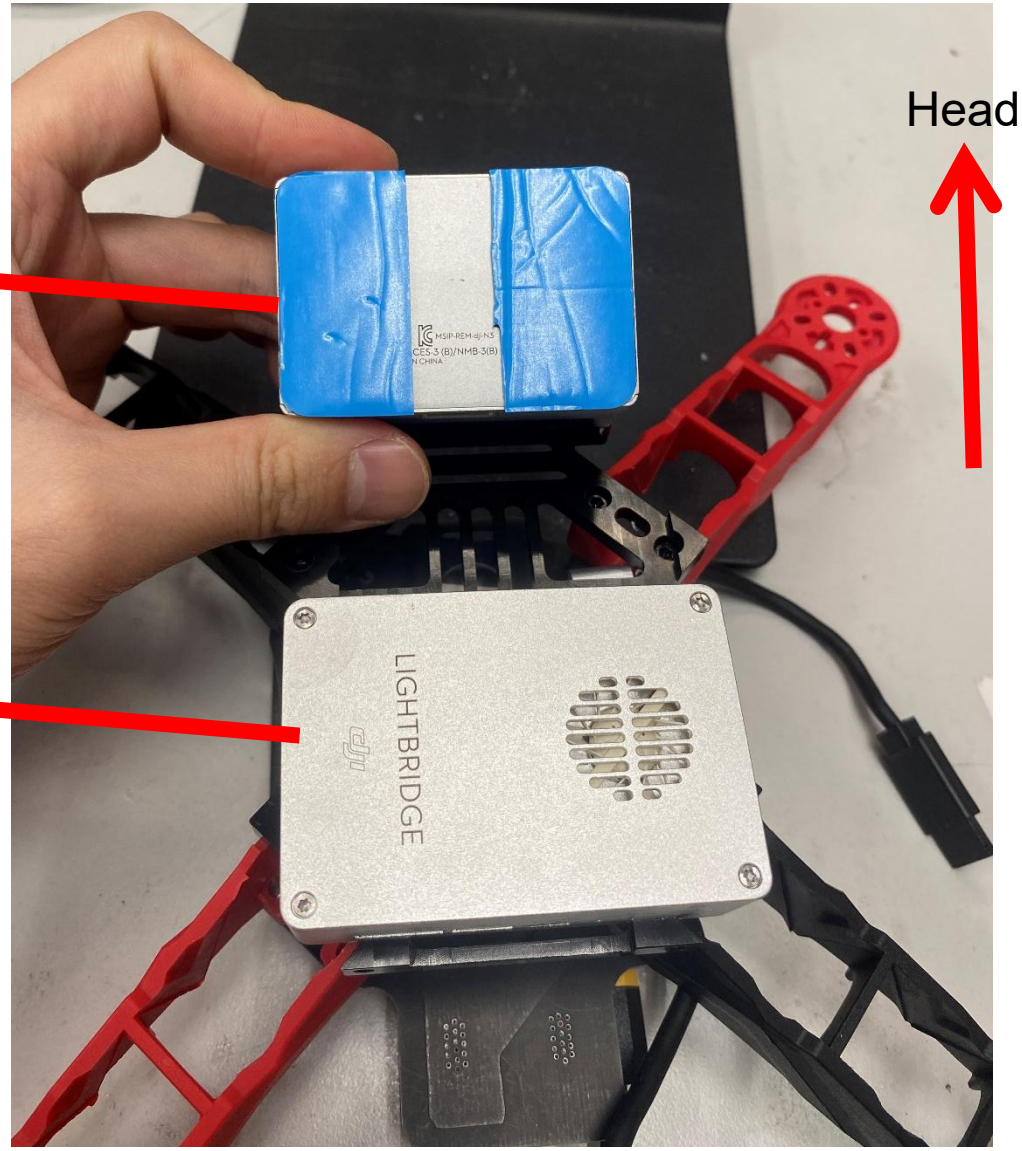
Be careful with N3/LB2 carrier direction. Longer part toward to head.

Be careful with M2.5 *4 screws' position

Quadrotor Assembly Part 3

Paste M3 Double Coated Tissue Tape in advance.

Install LB2 receiver



Quadrotor Assembly Part 3

Head

N3 and LB2 receivers should just fit the carrier

Quadrotor Assembly Part 4

- Equipment List:

Item	Quant.
Linear Bar Connector	4
Manifold-2G	1
Manifold carrier	1
M2.5 * 4 Step Screw	10
Part3	1

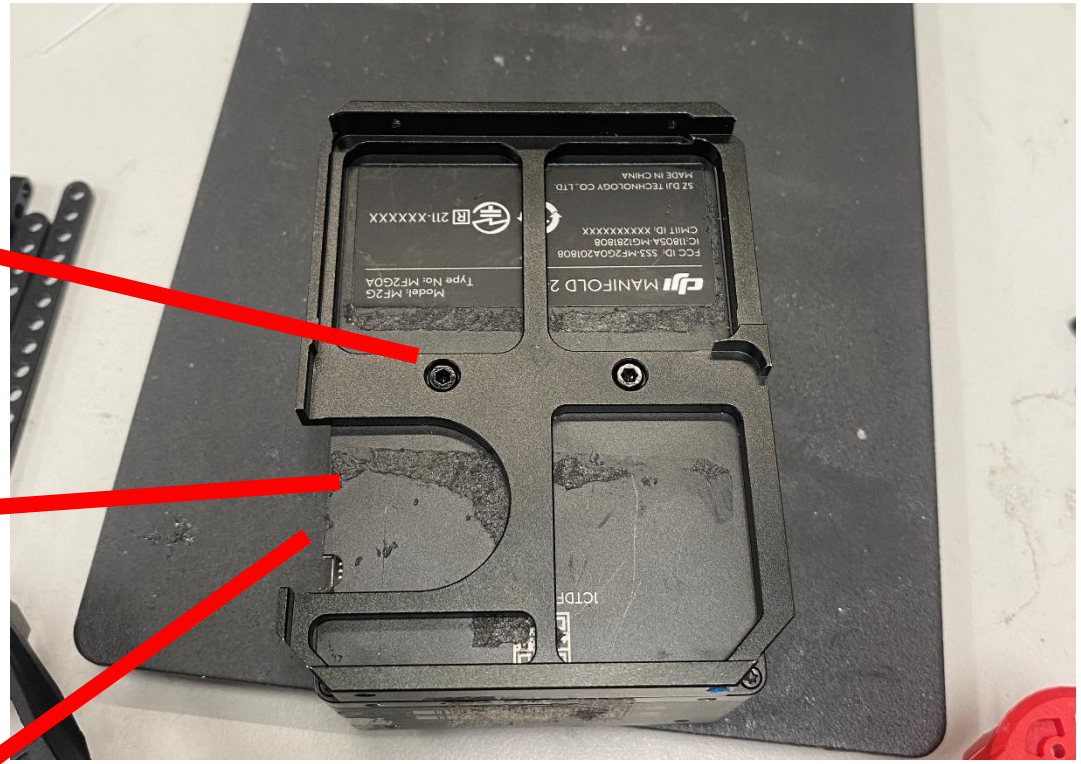
Quadrotor Assembly Part 4

Quadrotor Assembly Part 4

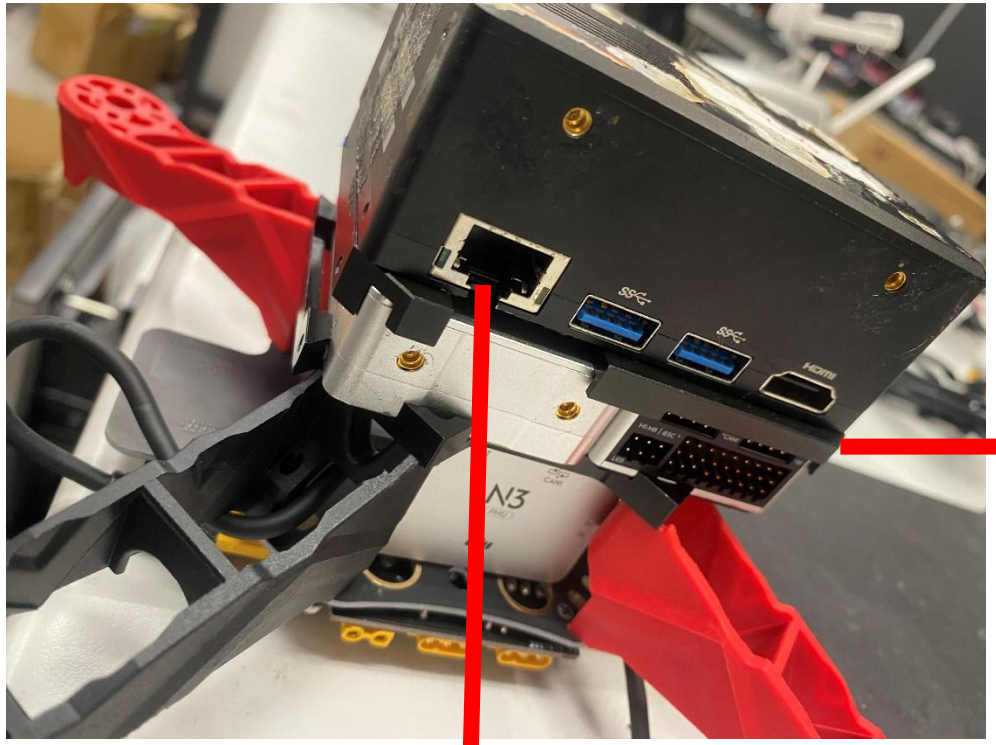
M2.5 * 4 Step Screw

Be careful with carrier install direction

Manifold’s RJ45 socket



Quadrotor Assembly Part 4



Right side view

Head

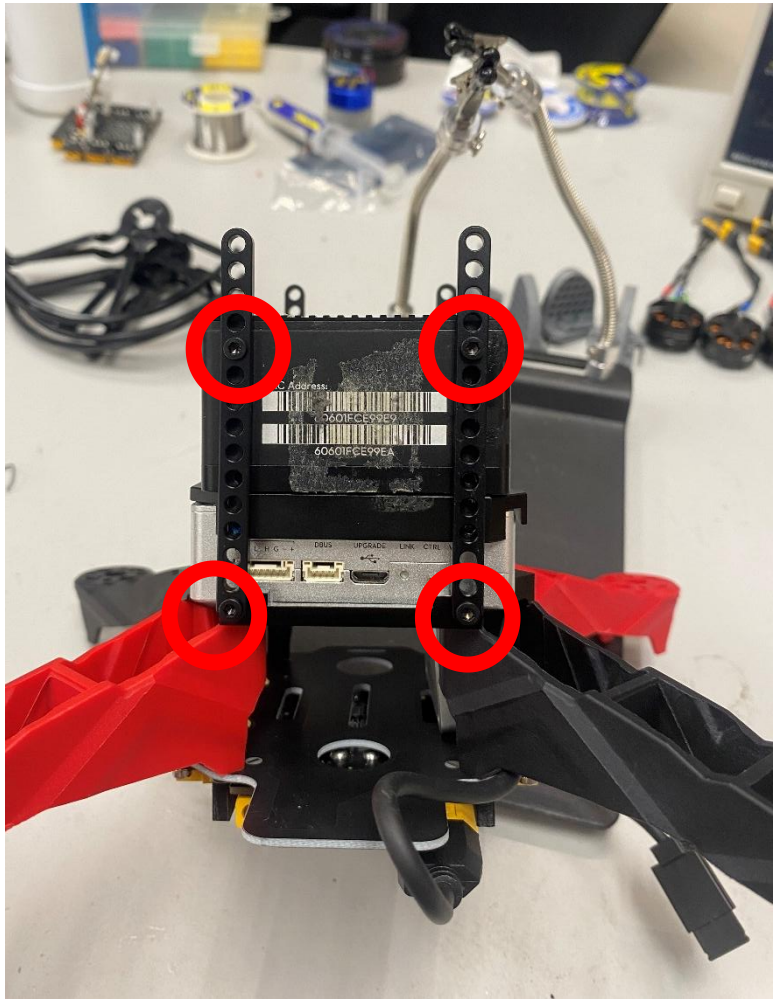
Left side view

Manifold’s RJ45 socket

Quadrotor Assembly Part 4

Be care with M2.5 * 4 Step Screws' position

Head view



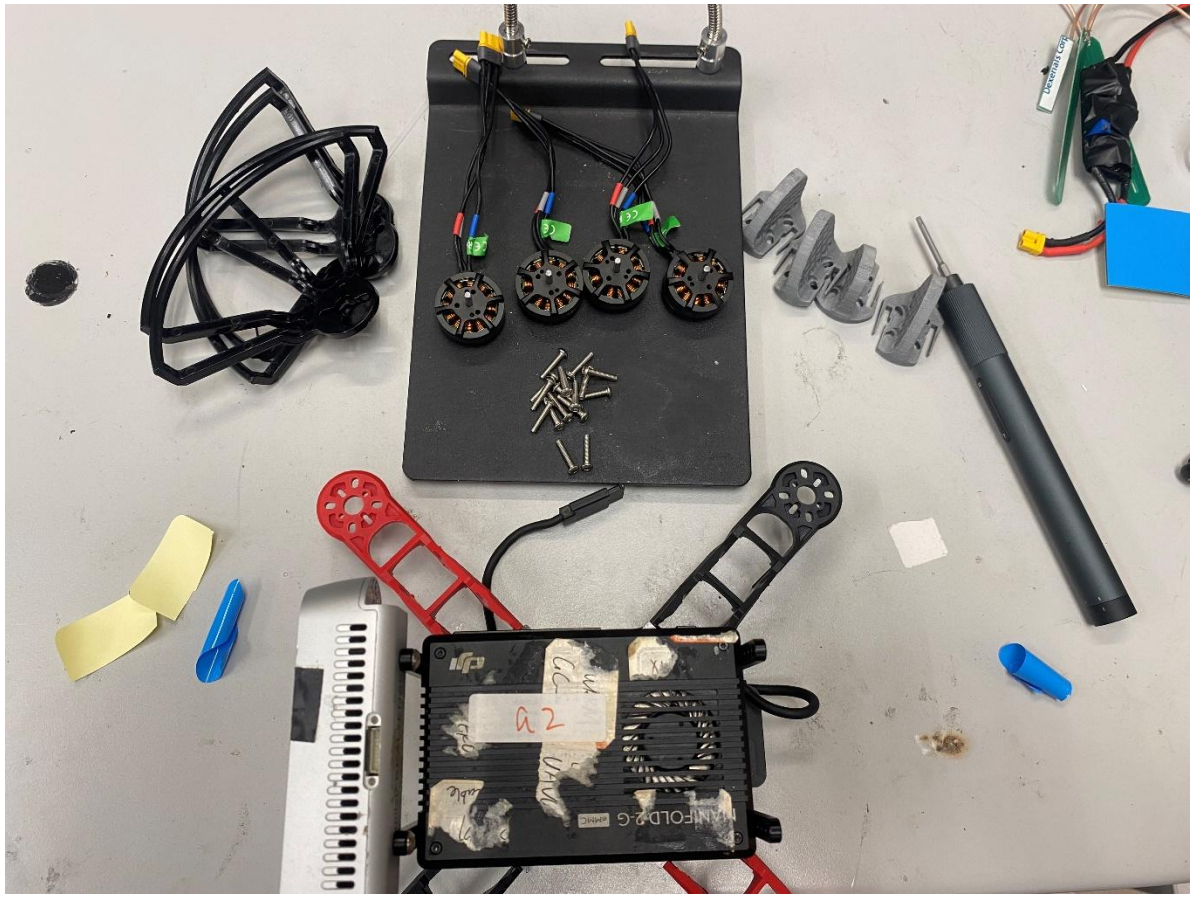
Tail view

Quadrotor Assembly Part 5

- Equipment List:

Item	Quant.
Real-sense	1
Motors	4
Propeller protector	4
Landing Gear	4
M3*6 screws	2
M3*14 round head	16

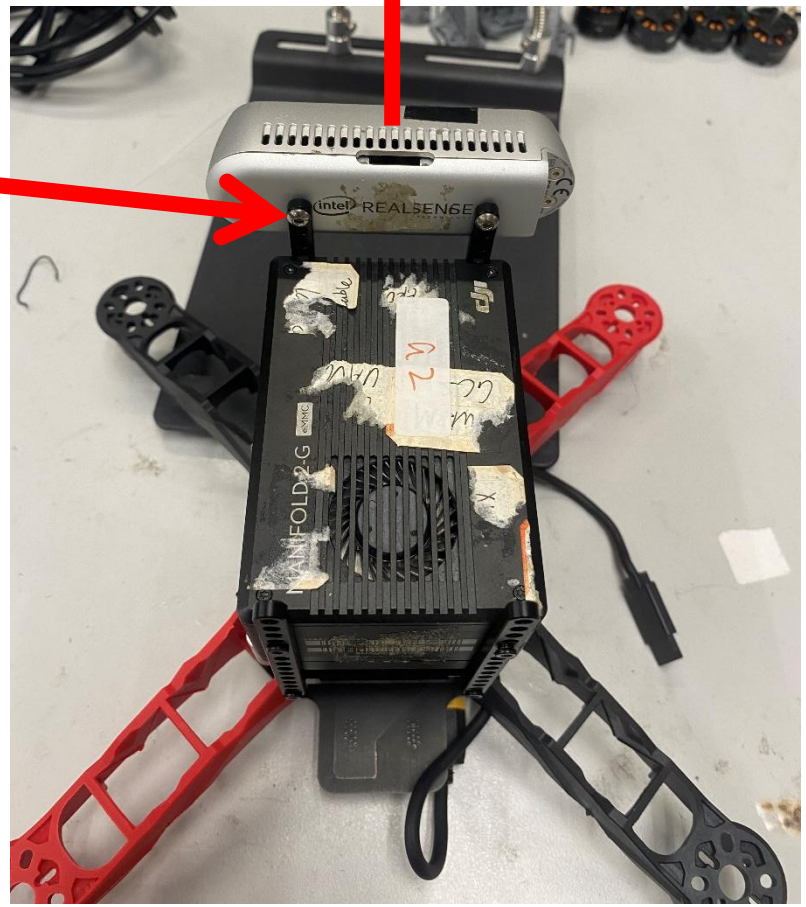
Quadrotor Assembly Part 5



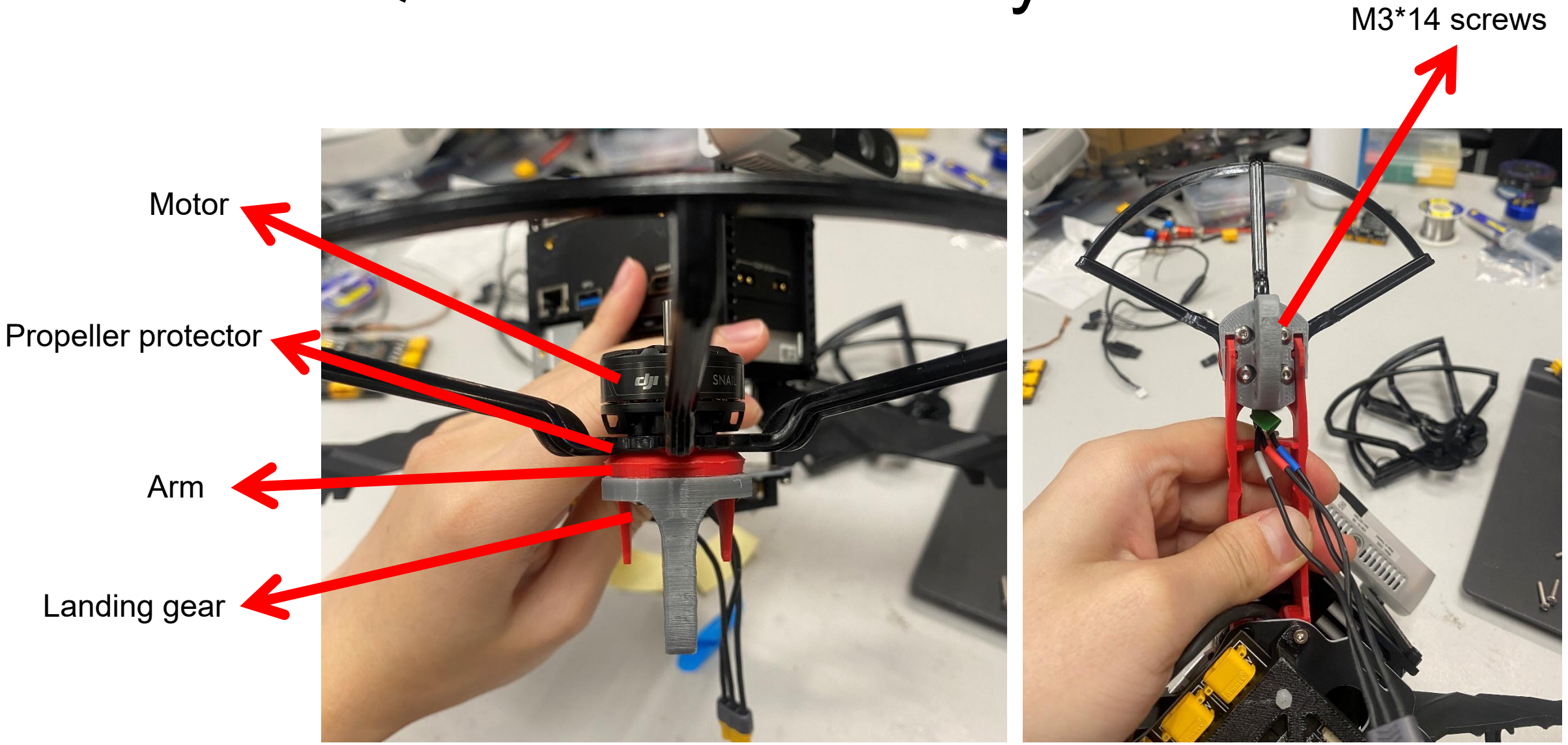
Quadrotor Assembly Part 5

Head

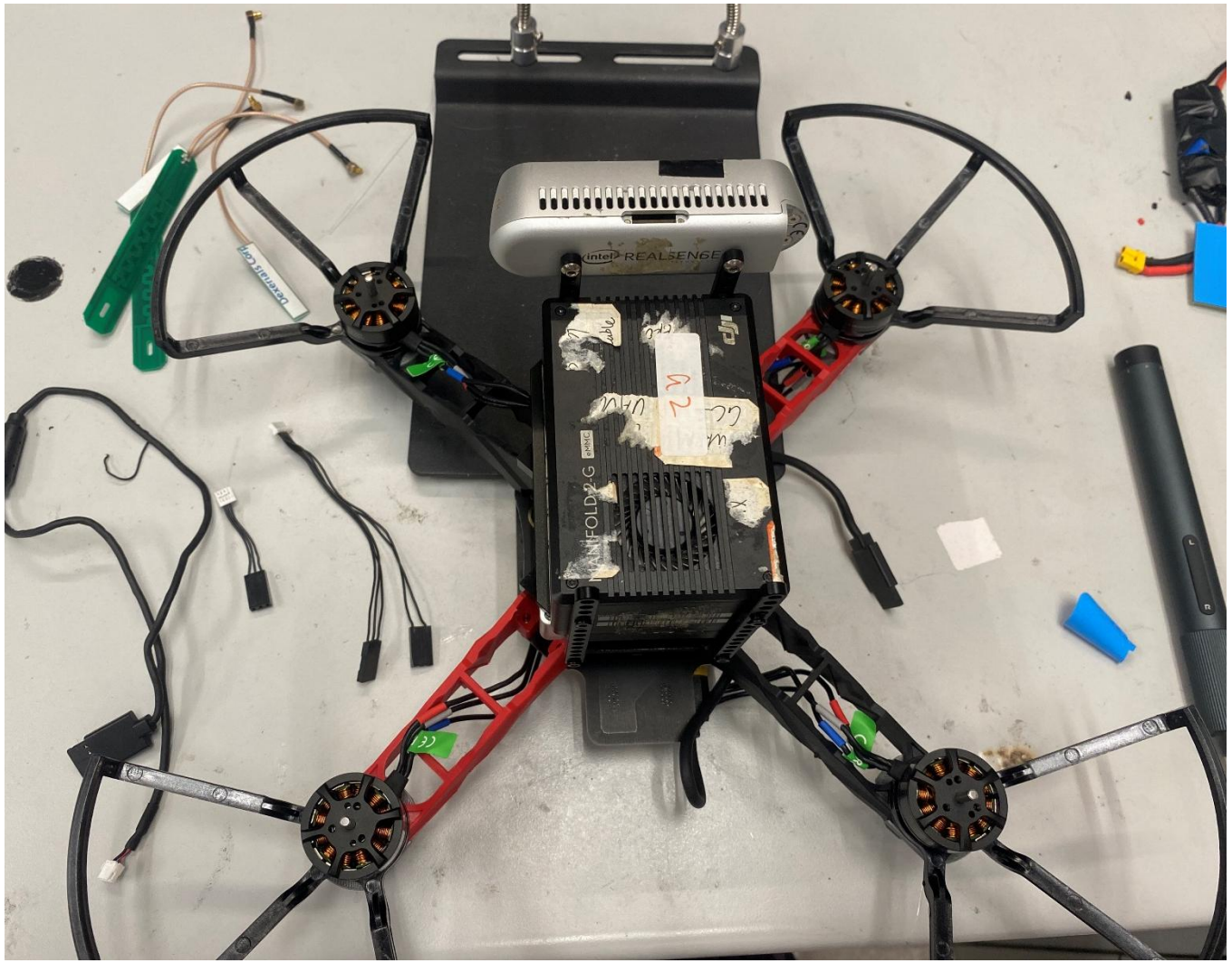
M3*6 screws



Quadrotor Assembly Part 5



Quadrotor Assembly Part 5



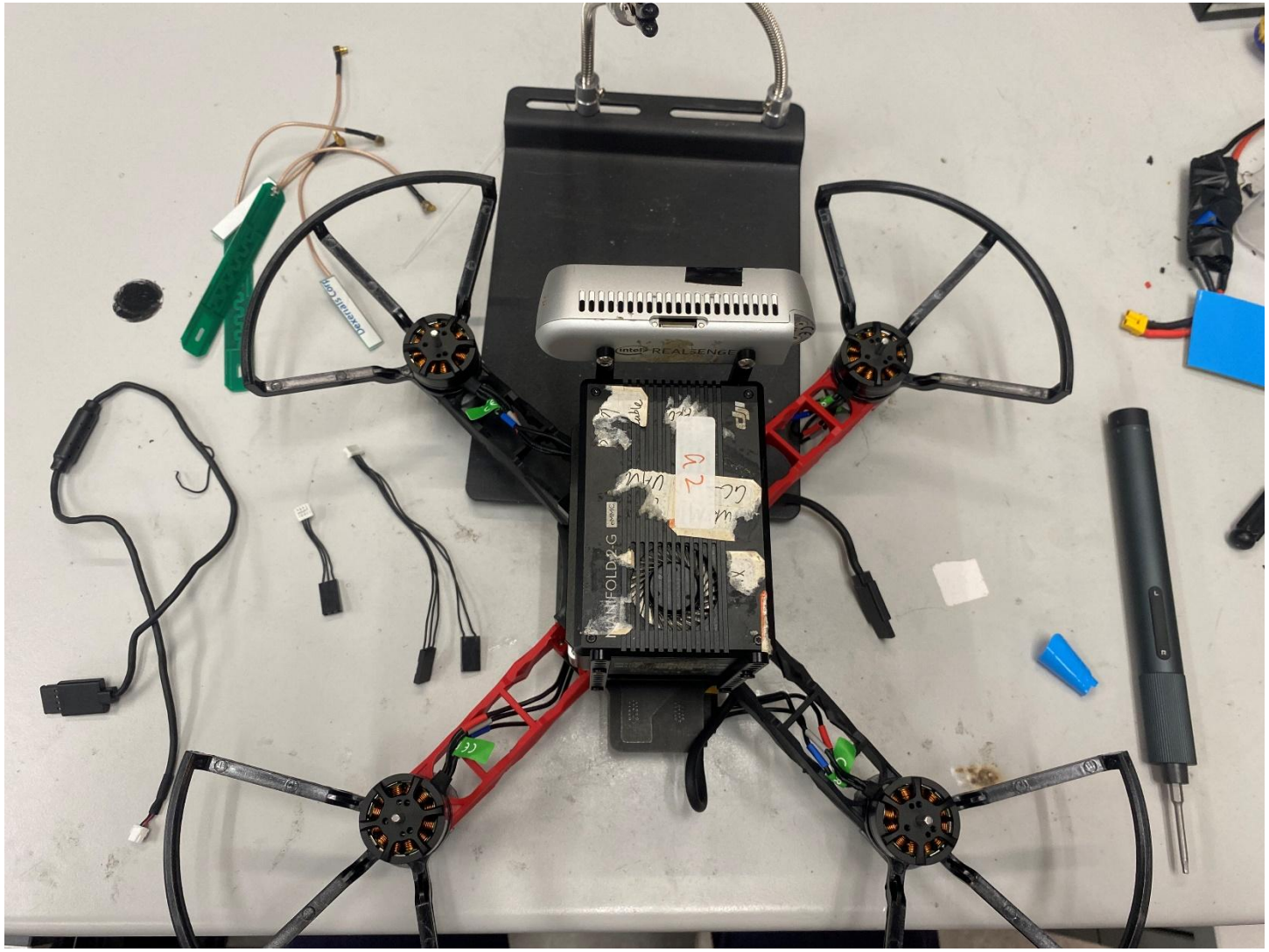
Almost done!

Quadrotor Assembly Part 6

- Equipment List:

Item	Quant.
USB Type-C Cable	1
Dupont 4-pin to GH1.25 4-pin	1
SH 8-pin to Dupont 3-pin * 2	1
Dupont 3-pin to GH1.25 3-pin	1
Manifold Antenna	2
LB2 Antenna	2
Voltage Regulator	1
XT30 Power Cable	2

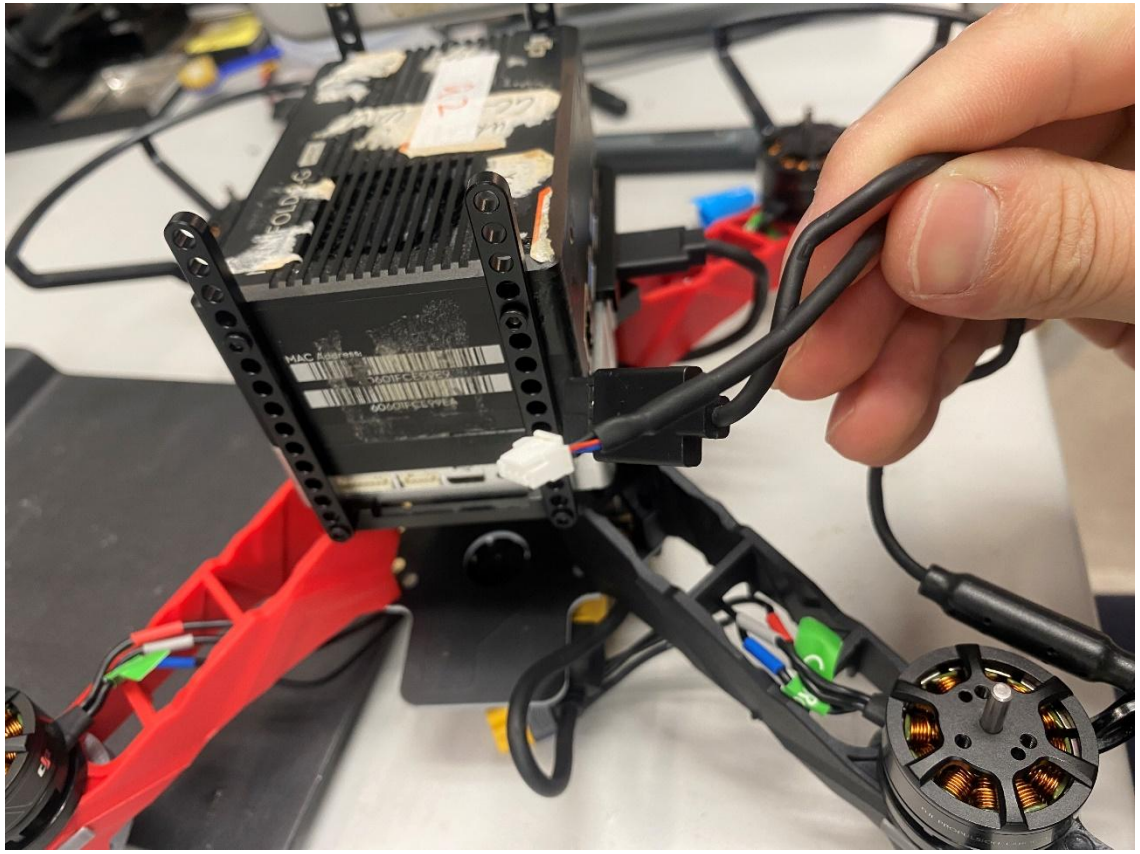
Quadrotor Assembly Part 6



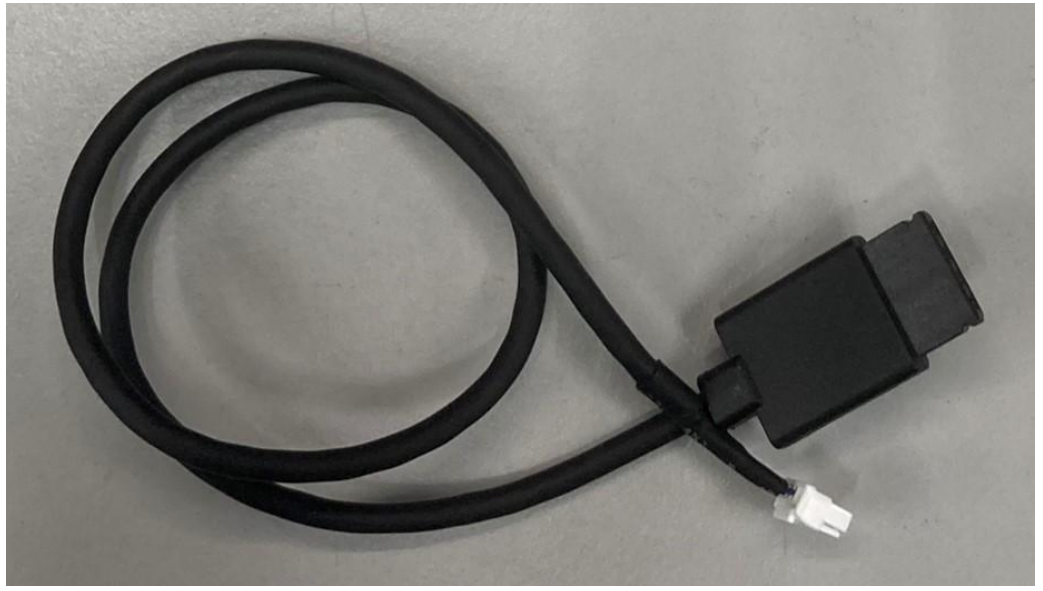
Quadrotor Assembly Part 6

Connect PMU to N3 (CAN port)

Quadrotor Assembly Part 6



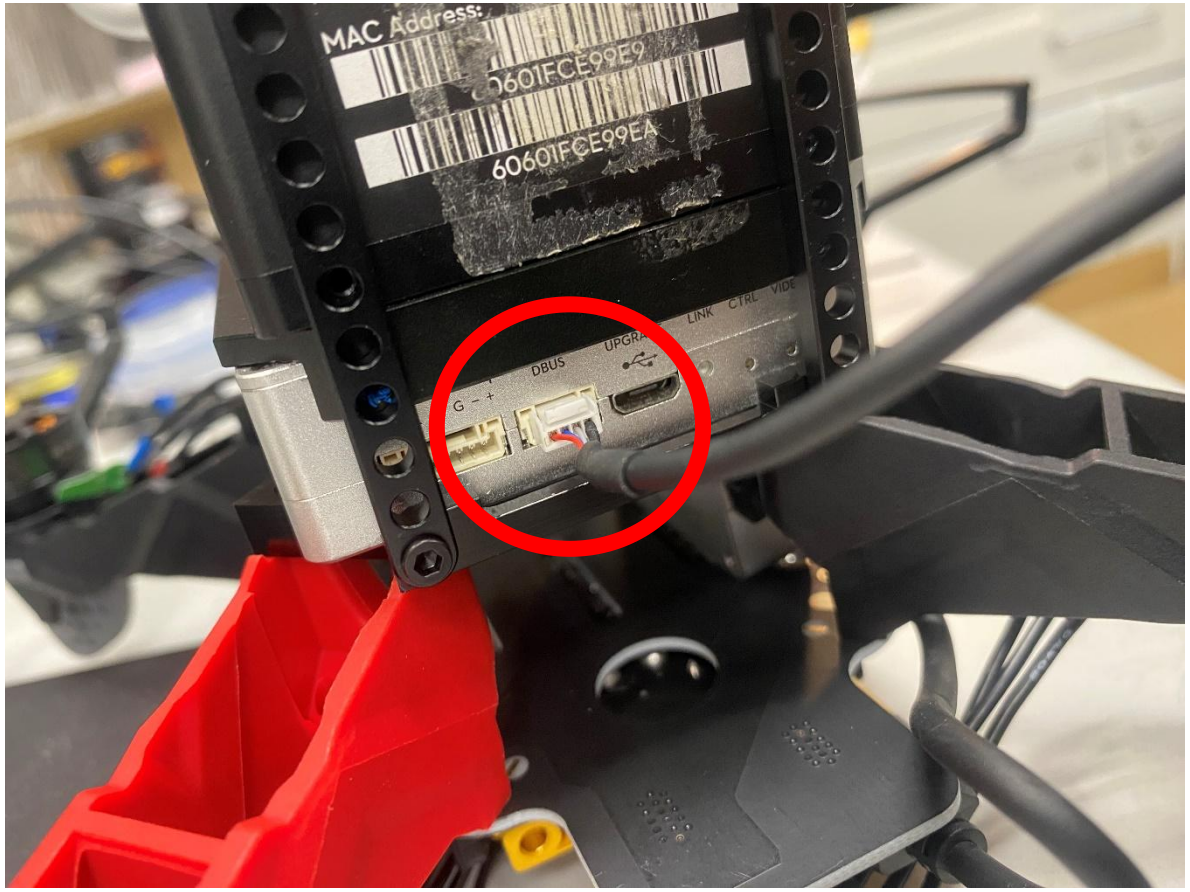
Connect N3 with LB2 receiver with Dupont 4-pin to GH1.25 4-pin



Quadrotor Assembly Part 6

Connect N3 with LB2 receiver with
Dupont 4-pin to GH1.25 4-pin

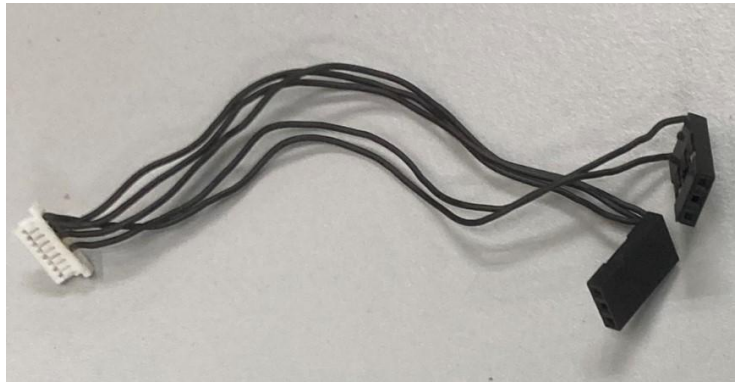
LB2 DBUS Port



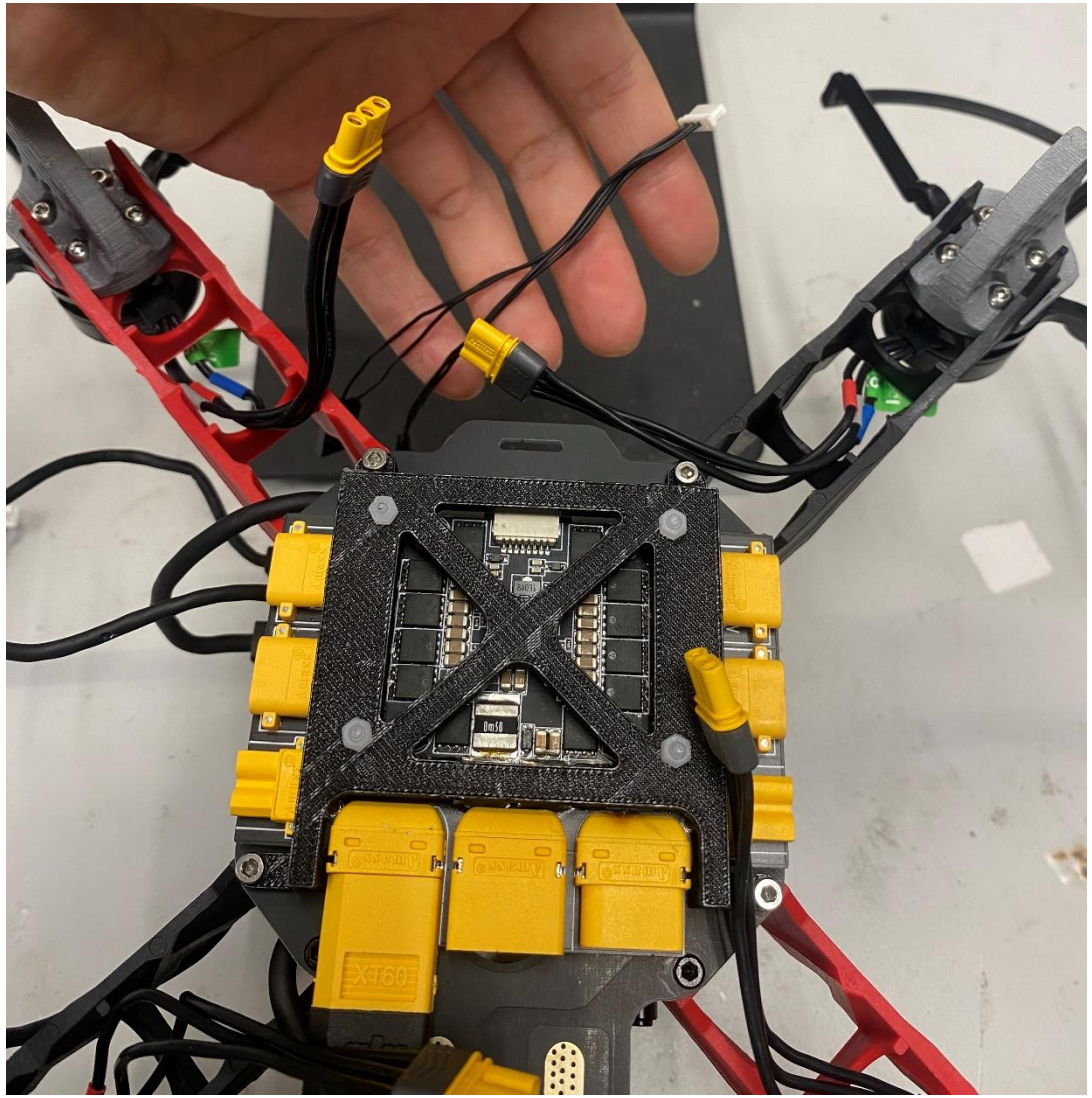
N3 RF Port

Quadrotor Assembly Part 6

Connect ESC and N3 with:
SH 8-pin to Dupont 3-pin * 2

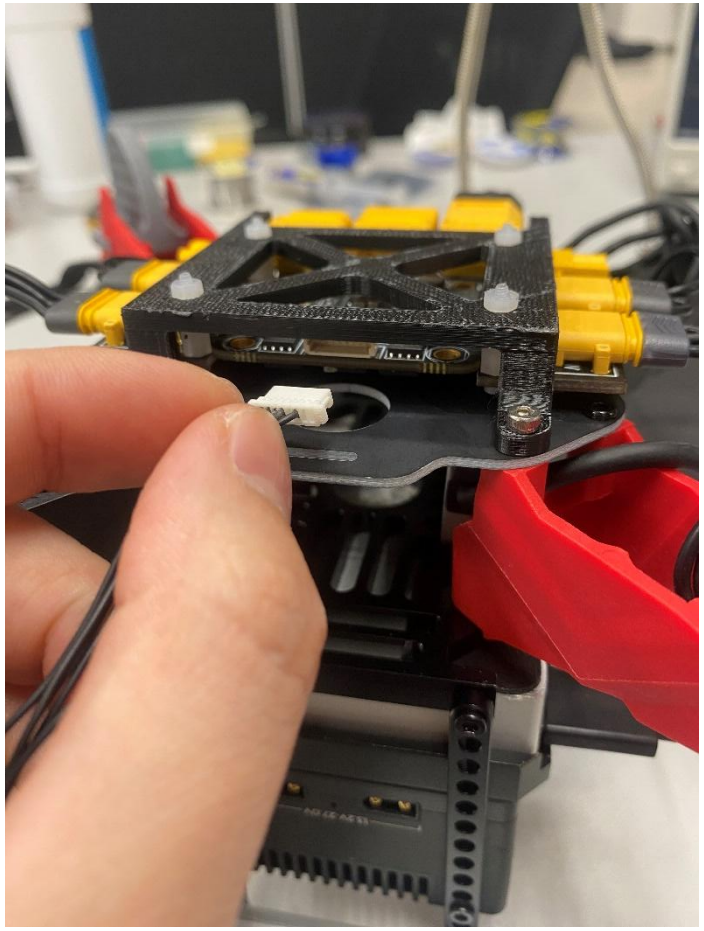


Connect motors with ESC



Quadrotor Assembly Part 6

Connect ESC and N3 with:
SH 8-pin to Dupont 3-pin * 2



2-wire Dupont connector
You can see iron connectors from this direction.

Quadrotor Assembly Part 6

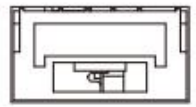
Connect Manifold and N3 with
Dupont 3-pin to GH1.25 3-pin

DO NOT connect to Pin 1.
Please double-check the connection!
The wrong connection will damage N3!!!

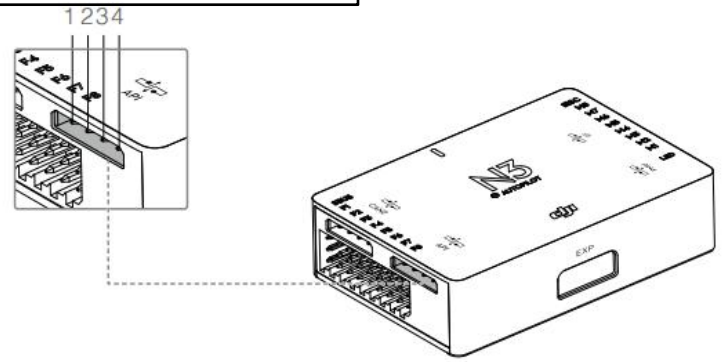
1

GND	RXD	TXD	N/A

UART 0



DO NOT connect to Pin 1



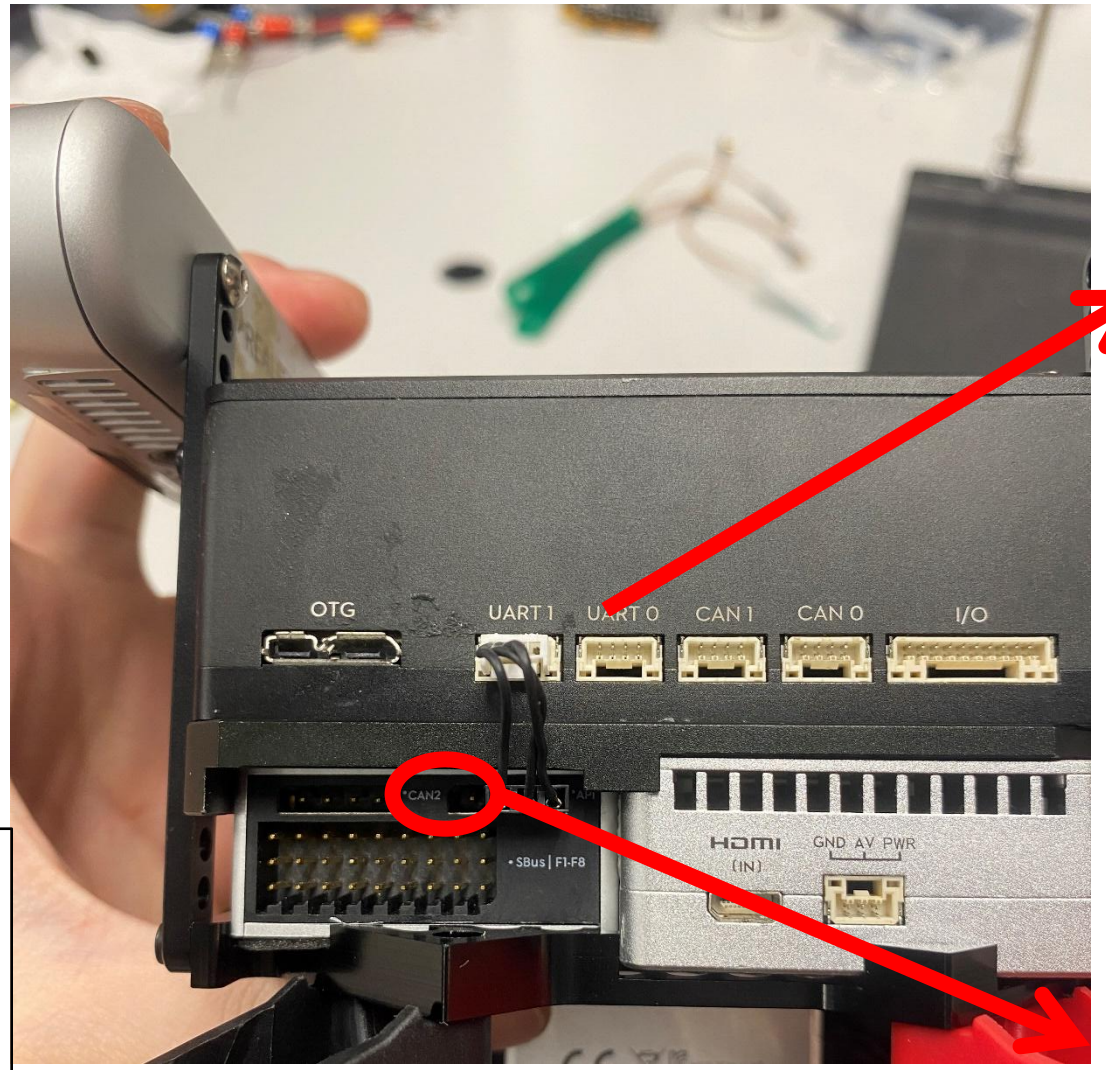
API Pin Descriptions

1. Power pin: Supply voltage of 9 V and power consumption of 9 W. If the API device does not satisfy the above voltage and consumption requirements, provide an alternate power supply.
2. GND pin: Connects to the API device's GND (ground) pin.
3. UART-TXD pin: Serial signal pin with voltage level of 3.3 V, should be connected to the API device's RXD pin.
4. UART-RXD pin: Serial signal pin with voltage level of 3.3 V, should be connected to the API device's TXD pin.

Quadrotor Assembly Part 6

Connect Manifold and N3 with Dupont 3-pin to GH1.25 3-pin

DO NOT connect to Pin 1.
Please double-check the connection!
The wrong connection will damage N3!!!

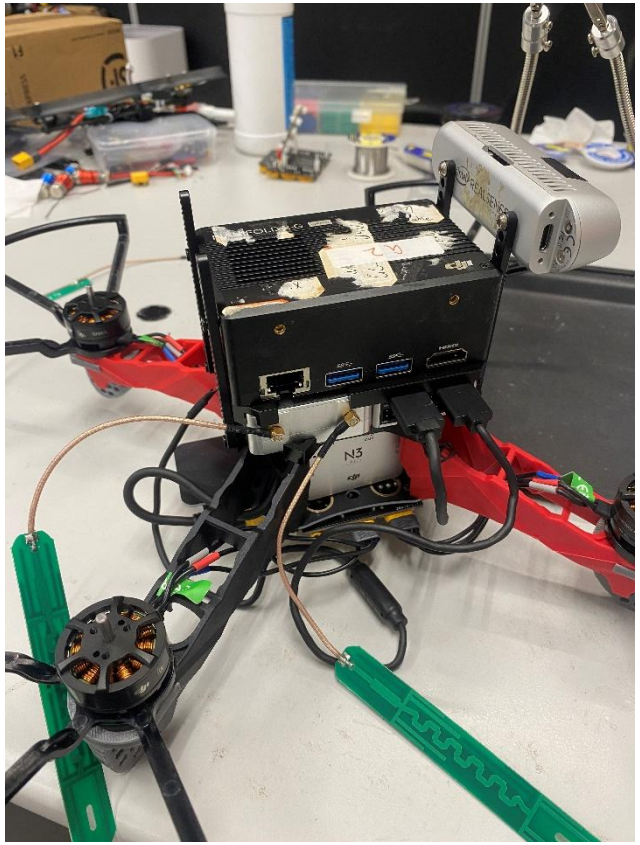


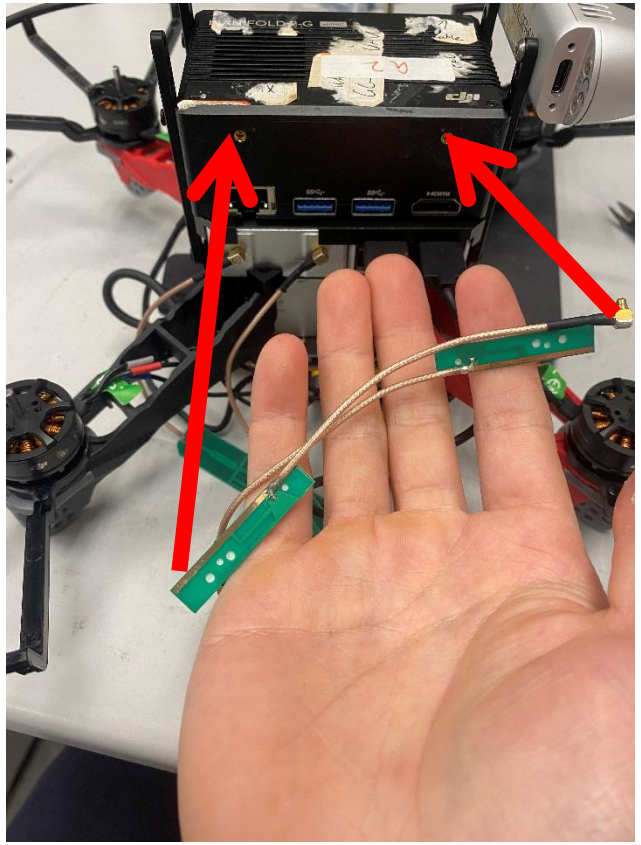
Three cables should not intersect with each other

Left pin should not be connected

Quadrotor Assembly Part 6

Connect LB2 Antenna and Manifold-2G Antenna



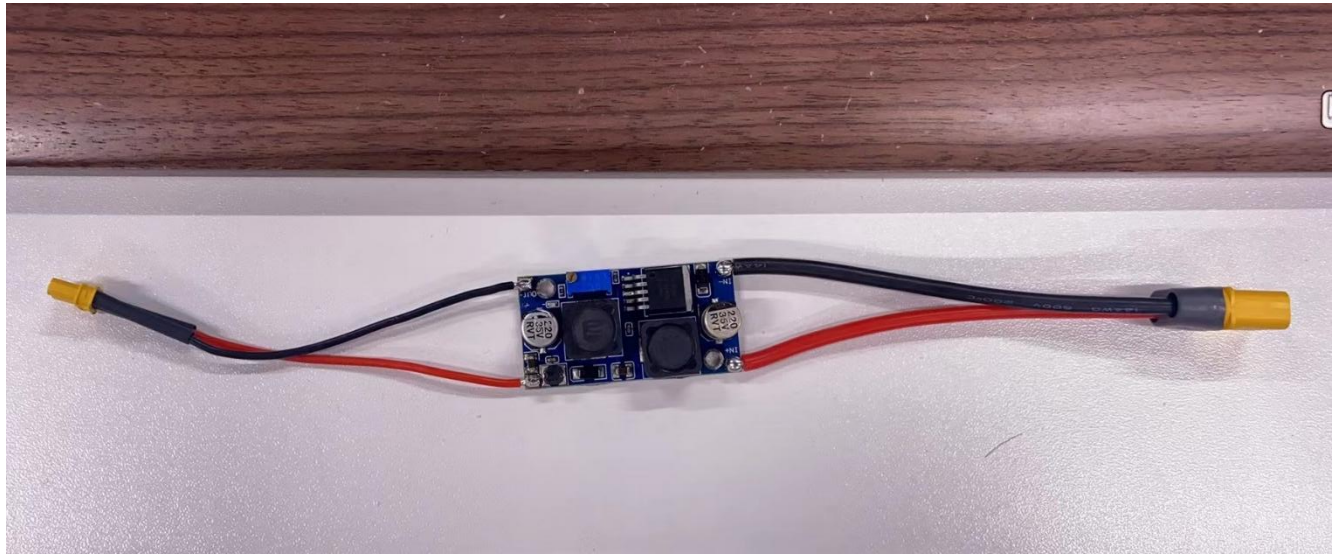


Quadrotor Assembly Part 6

Connect realsense and manifold-2G with typeC-usb cable.

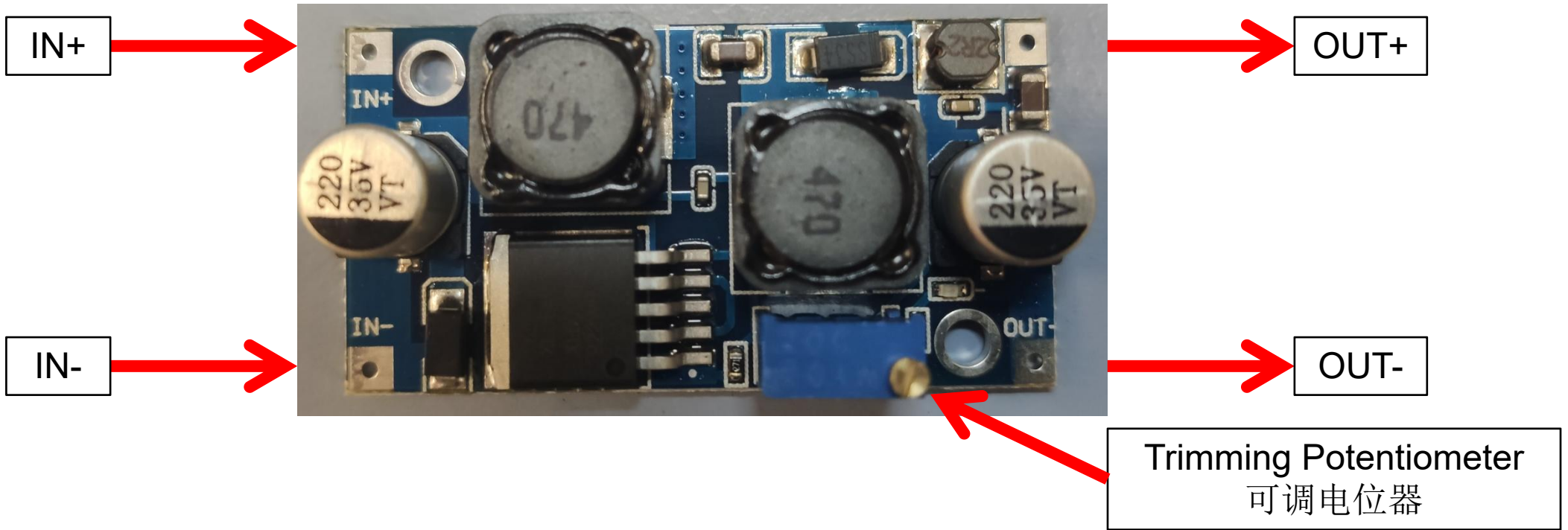
Quadrotor Assembly Part 6

Connect manifold and ESC with Voltage Regulator



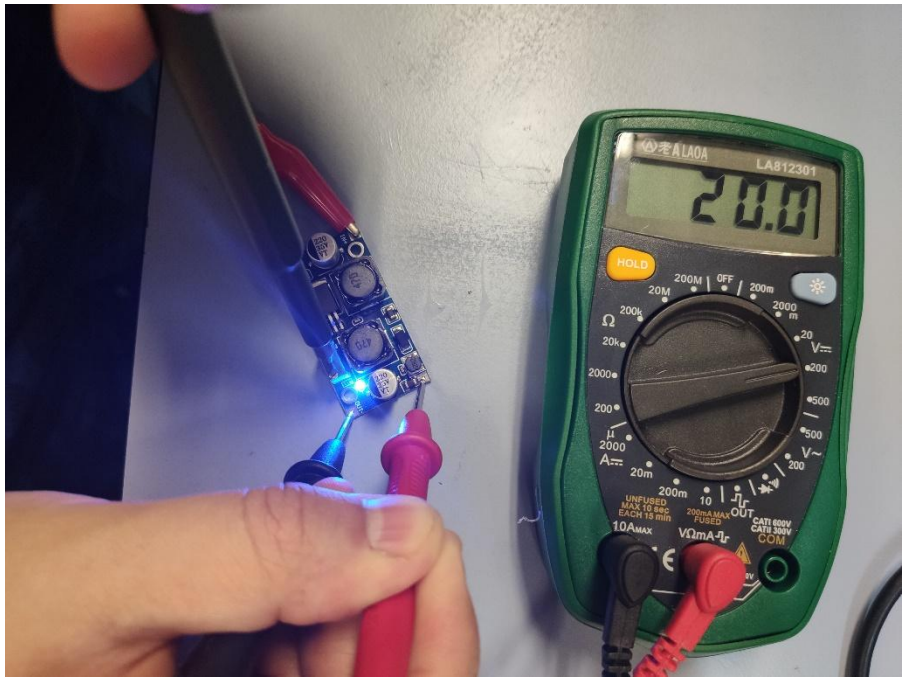
Install Voltage Stabilizer for Manifold 2-G

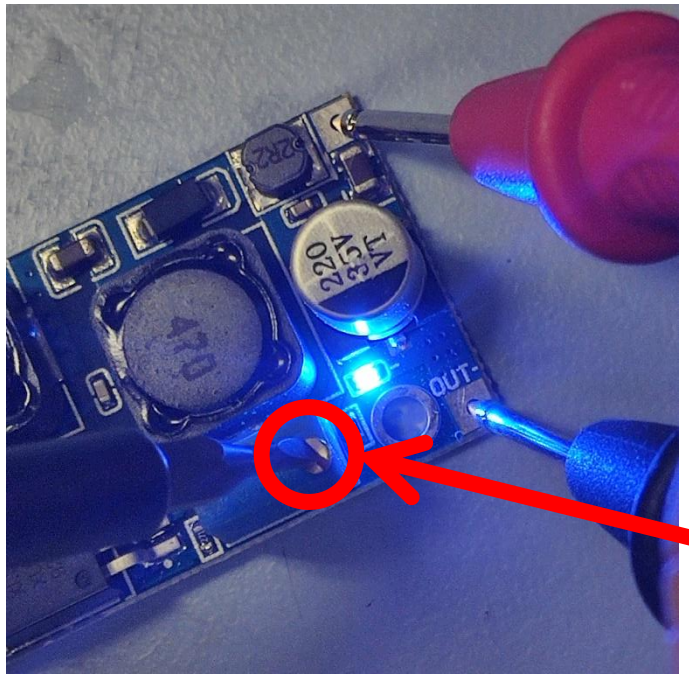
- XL6009 buck-boost converter
- Without it, your Manifold 2-G may suffer from unexpected shutdown and reboot during flight



Install Voltage Stabilizer for Manifold 2-G

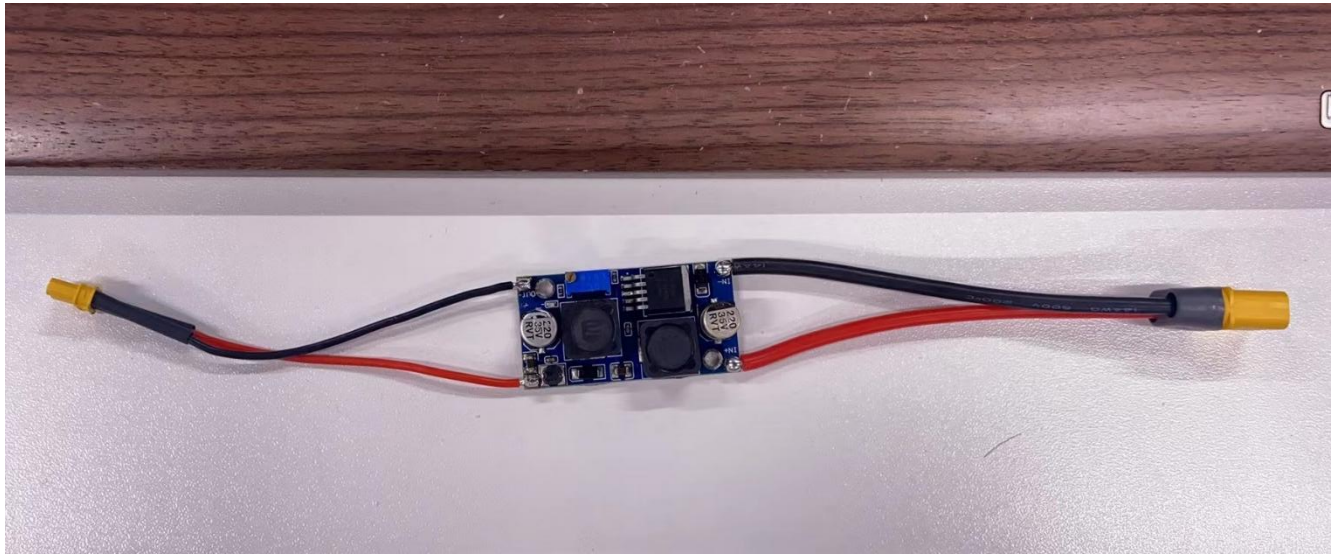
- Connect to the power supply (IN) and adjust output voltage to around 20V by a flat-blade screwdriver





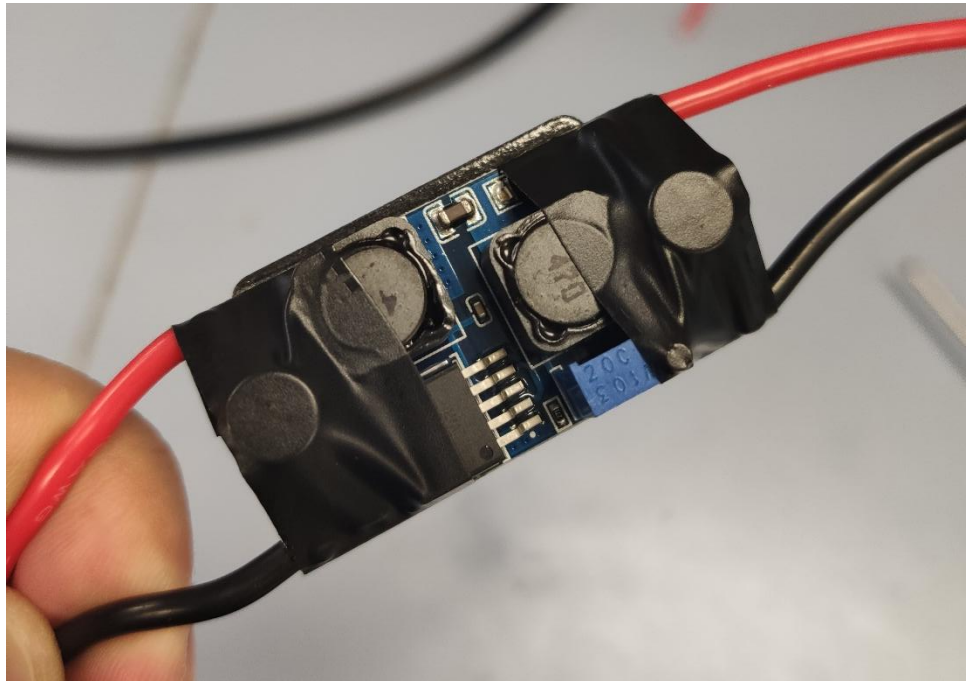
Install Voltage Stabilizer for Manifold 2-G

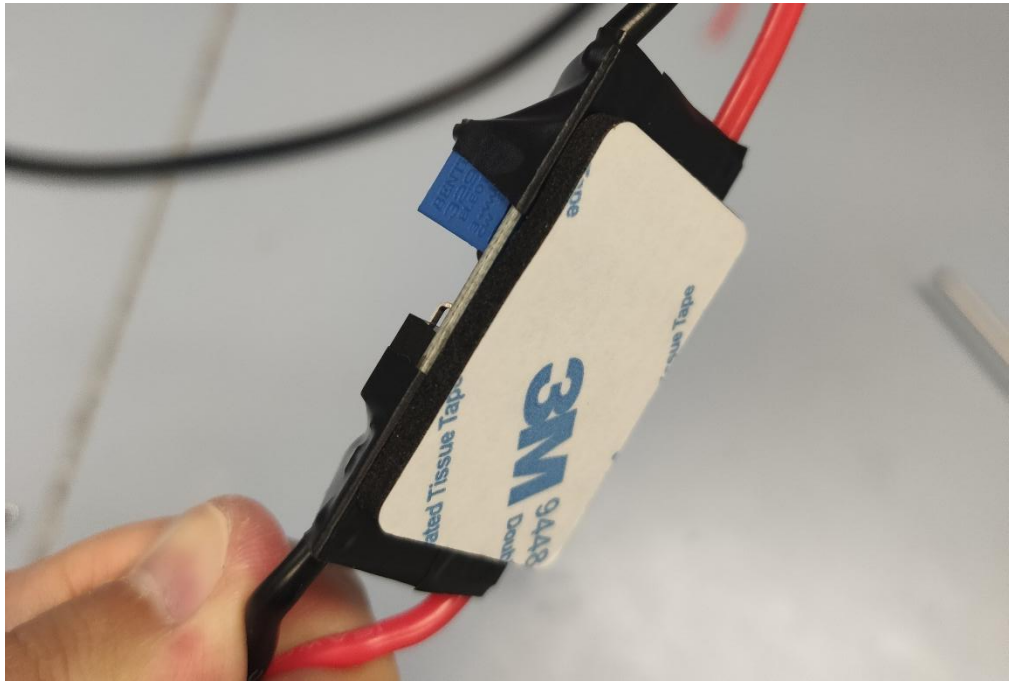
- Soldering power cable at each side



Install Voltage Stabilizer for Manifold 2-G

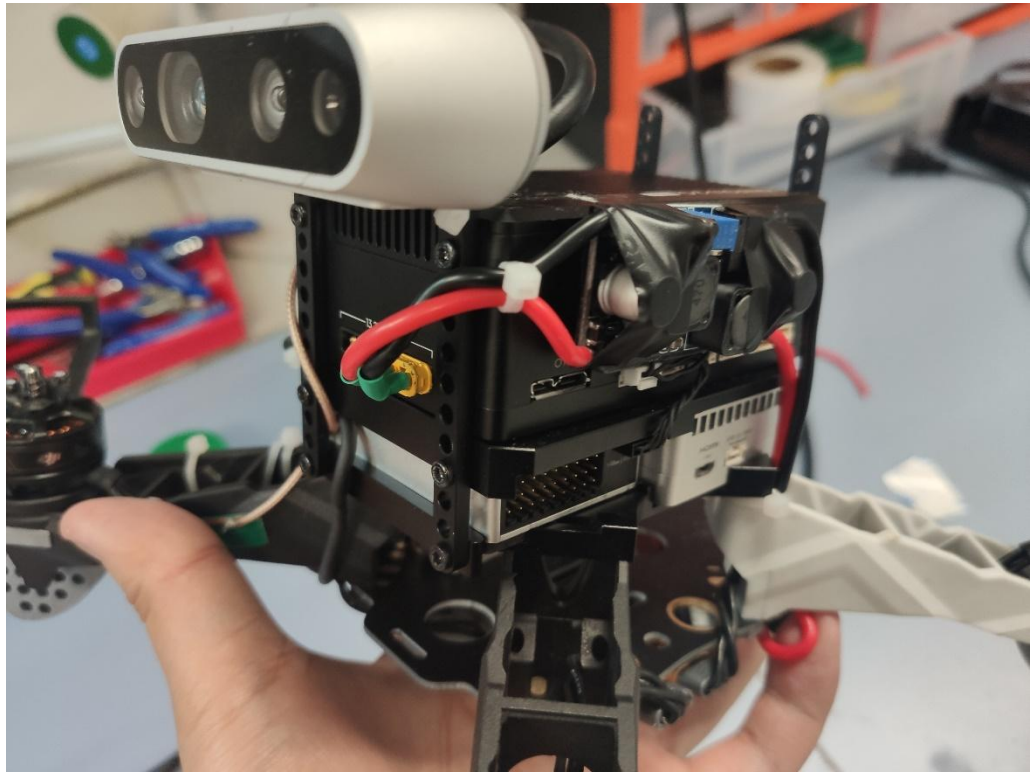
- Protect soldering joints by electrical tape
- Stick a double-sided tape at backside





Install Voltage Stabilizer for Manifold 2-G

- Fix it on your drone and wire the cables carefully



Quadrotor Assembly Part 6

Well done! Organize your cables and make your drone looks more compact!!!

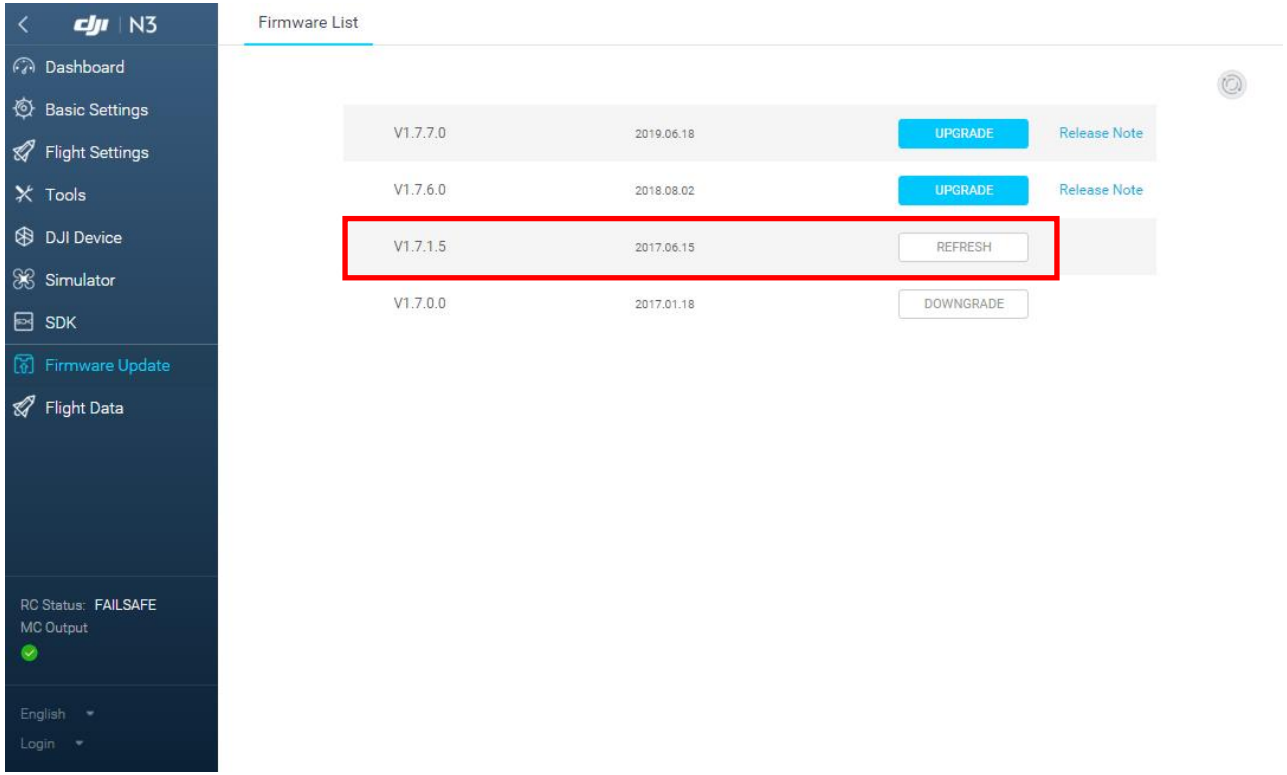
Part 7 Settings

Part 7: N3 Autopilot Set-up

- Install DJI Assistant 2 for Autopilot (Win & Mac)
  - https://www.dji.com/hk-en/downloads/softwares/assistant-dji-2-for-autopilot
- Or you can use the computer in the flying testing field
- Connect N3 autopilot to computer using N3 LED & a micro-USB cable

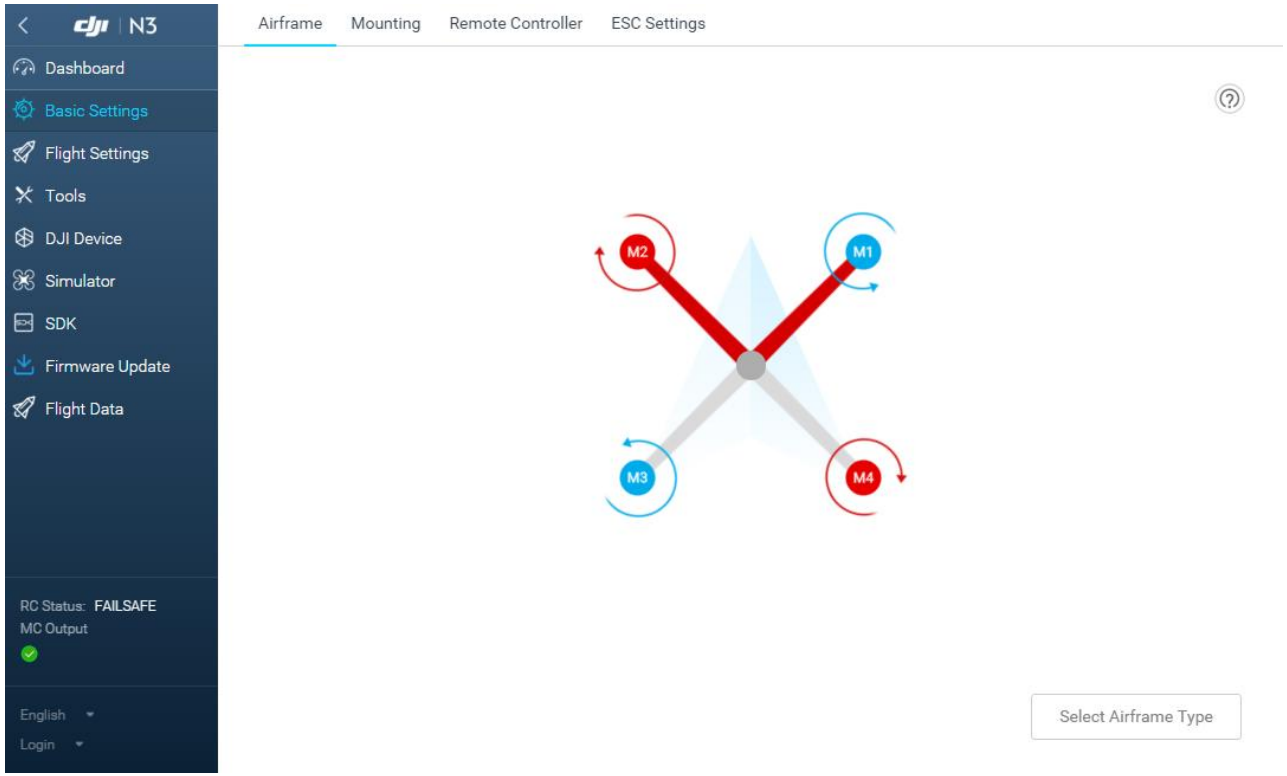
Part 7: N3 Autopilot Set-up

- Check firmware (Must be V1.7.1.5)



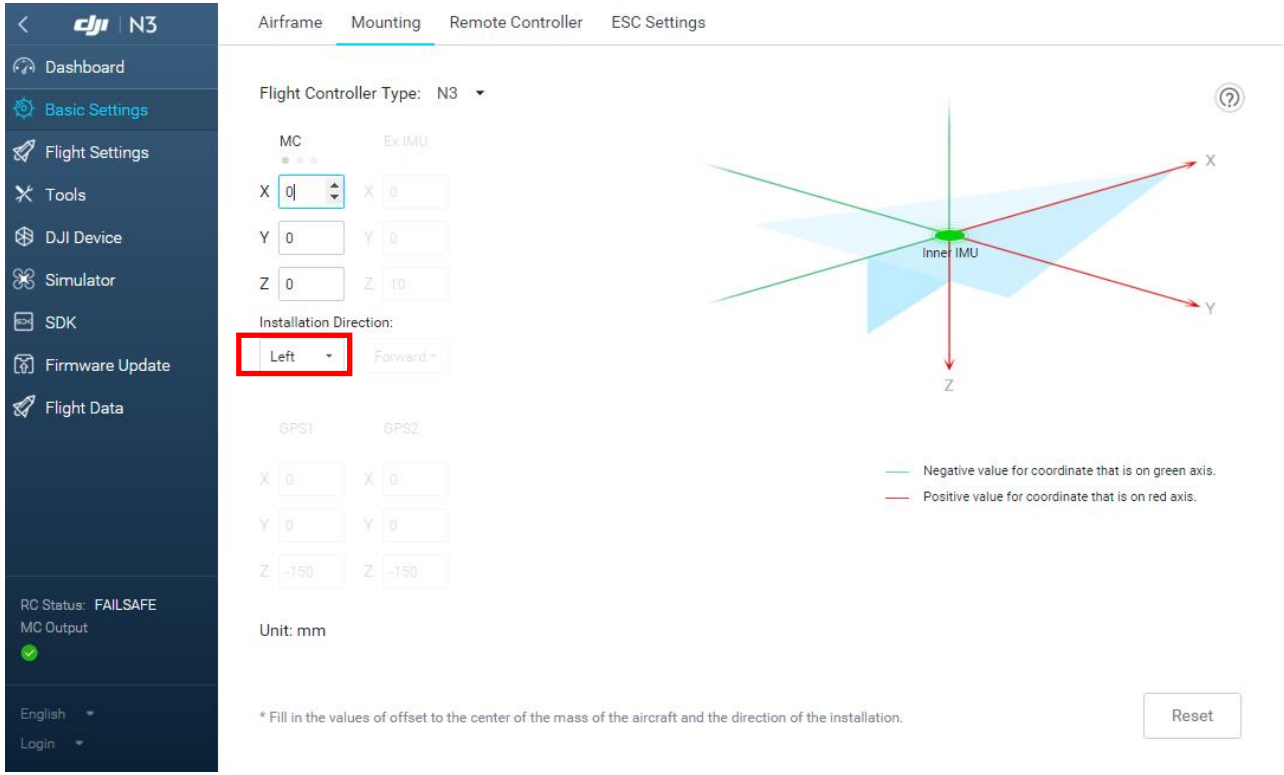
Part 7: N3 Autopilot Set-up

- Check airfram type
  - Quad X, Battery 4S (Low: 14.8V, 3.7V/cell)



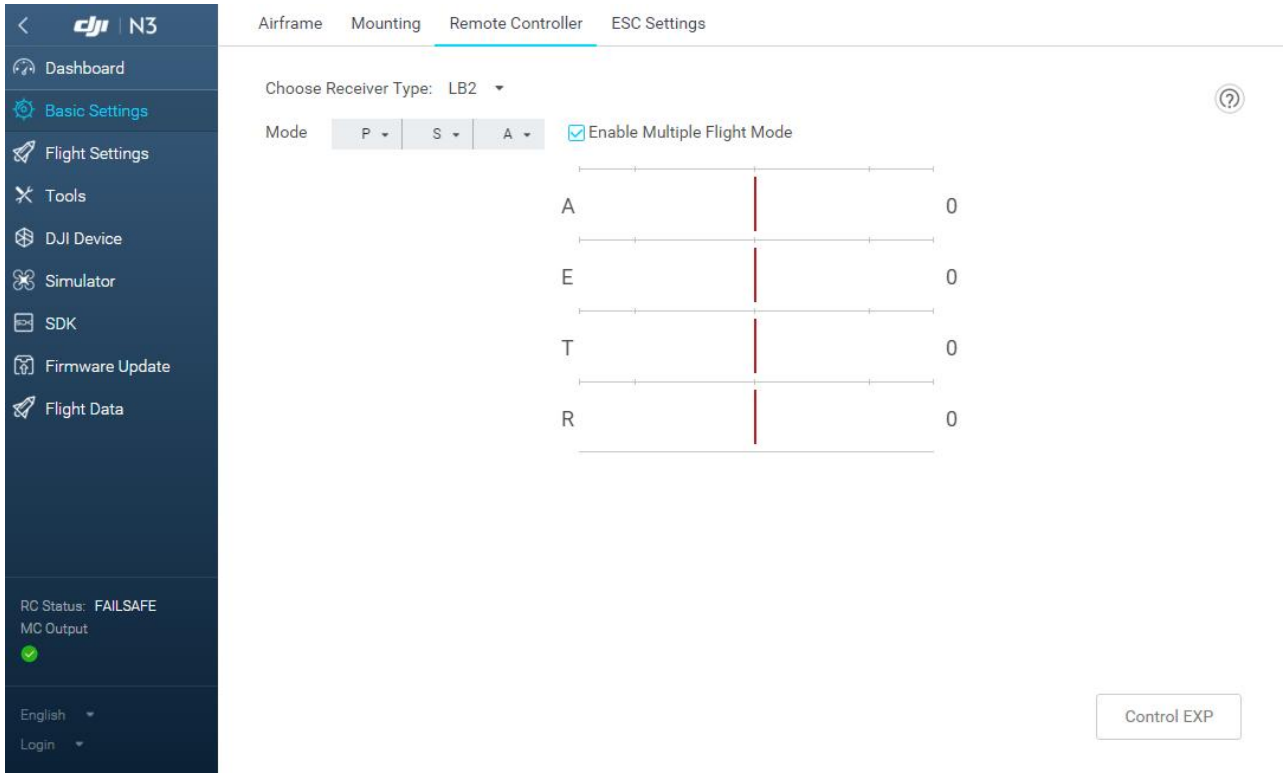
Part 7: N3 Autopilot Set-up

- Check mounting



Part 7: N3 Autopilot Set-up

- Check LightBridge 2 remote controller
  - Pairing first / Check channels

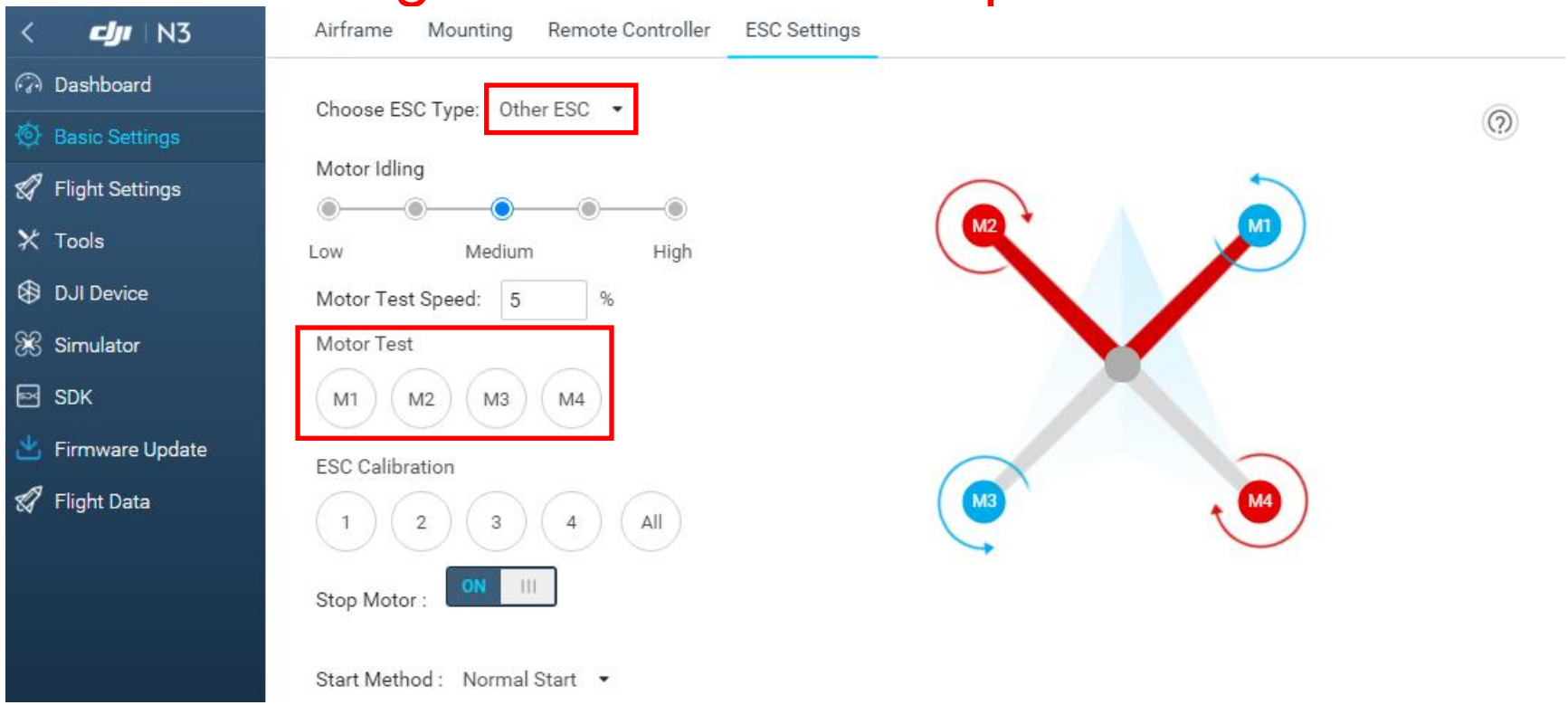


Part 7: N3 Autopilot Set-up

- Check LightBridge 2 remote controller
  - Check channels
    - A: Aileron/Roll
    - E: Elevator/Pitch
    - T: Throttle
    - R: Rudder/Yaw

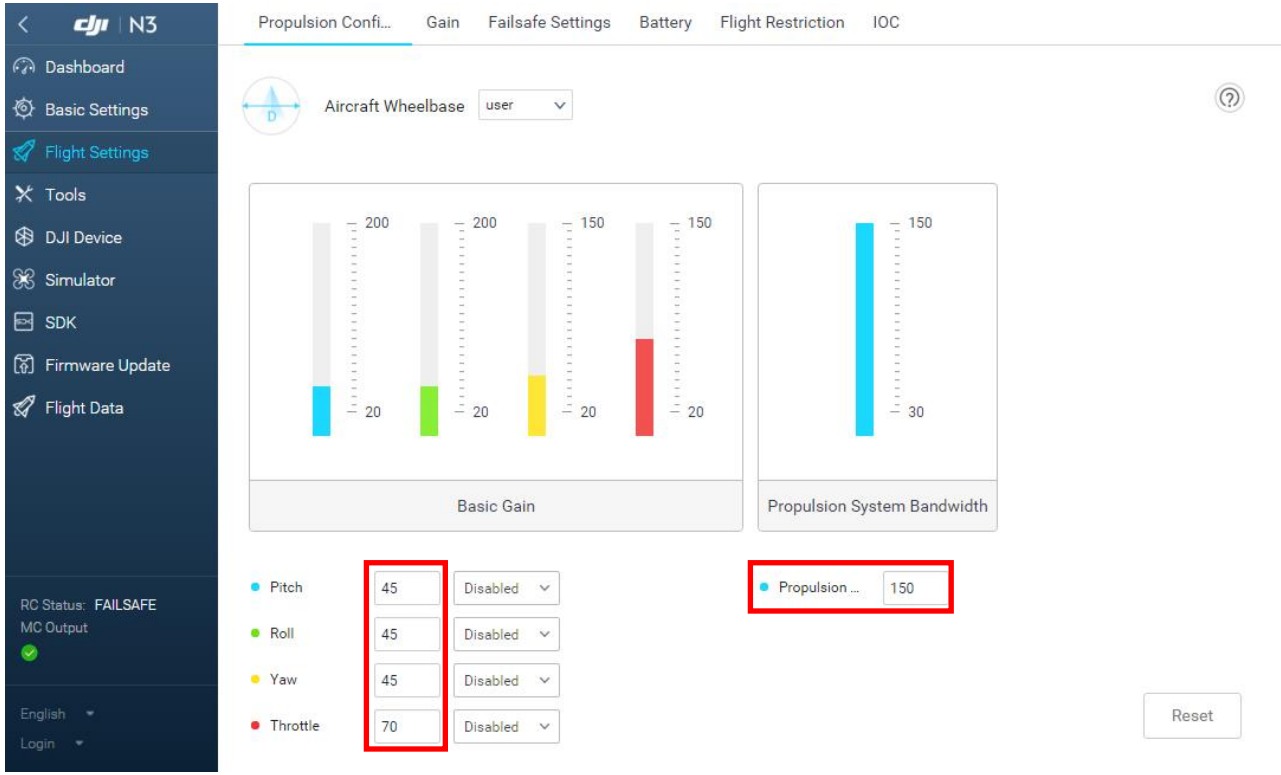
Part 7: N3 Autopilot Set-up

- Check motors and ESC, use Motor Test
  - Check motor direction and sequence (ALL must be correct !!!)
  - !!! Do not install propellers
  - If you need to change motors'direction please contact TA



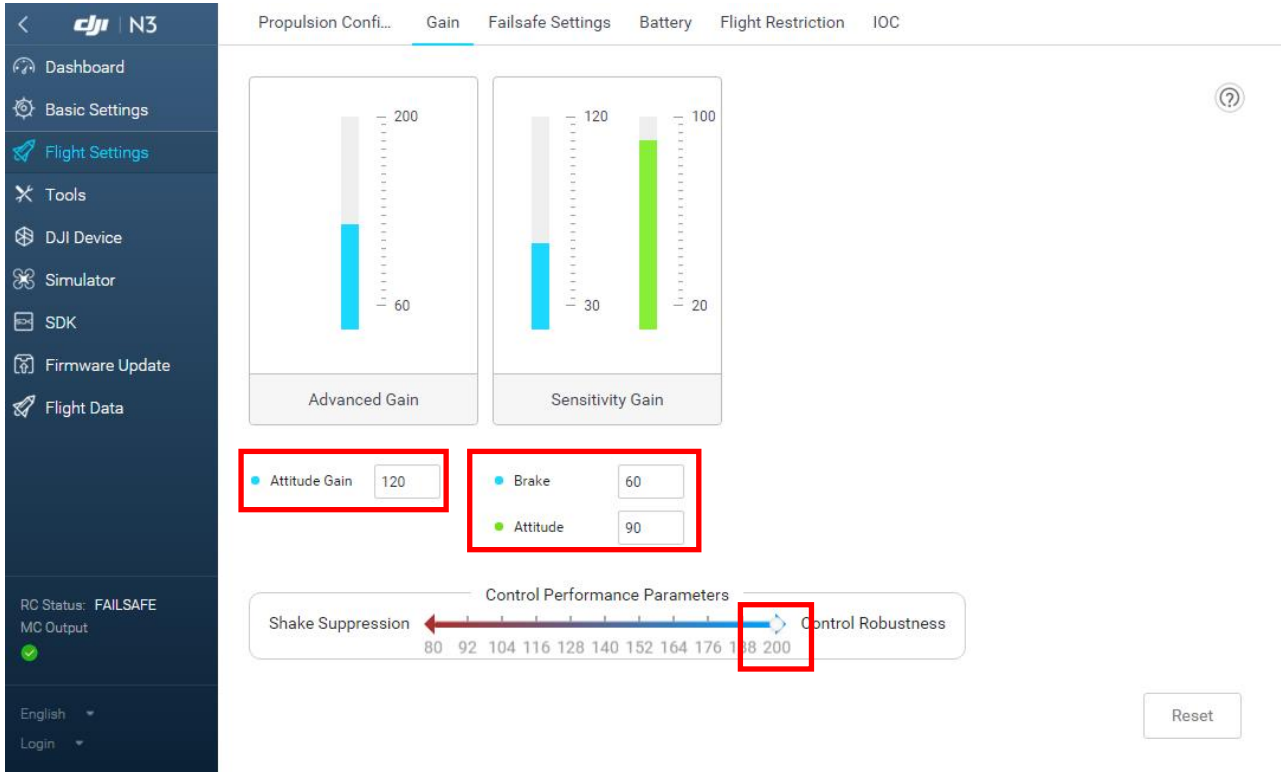
Part 7: N3 Autopilot Set-up

- Check controller parameters



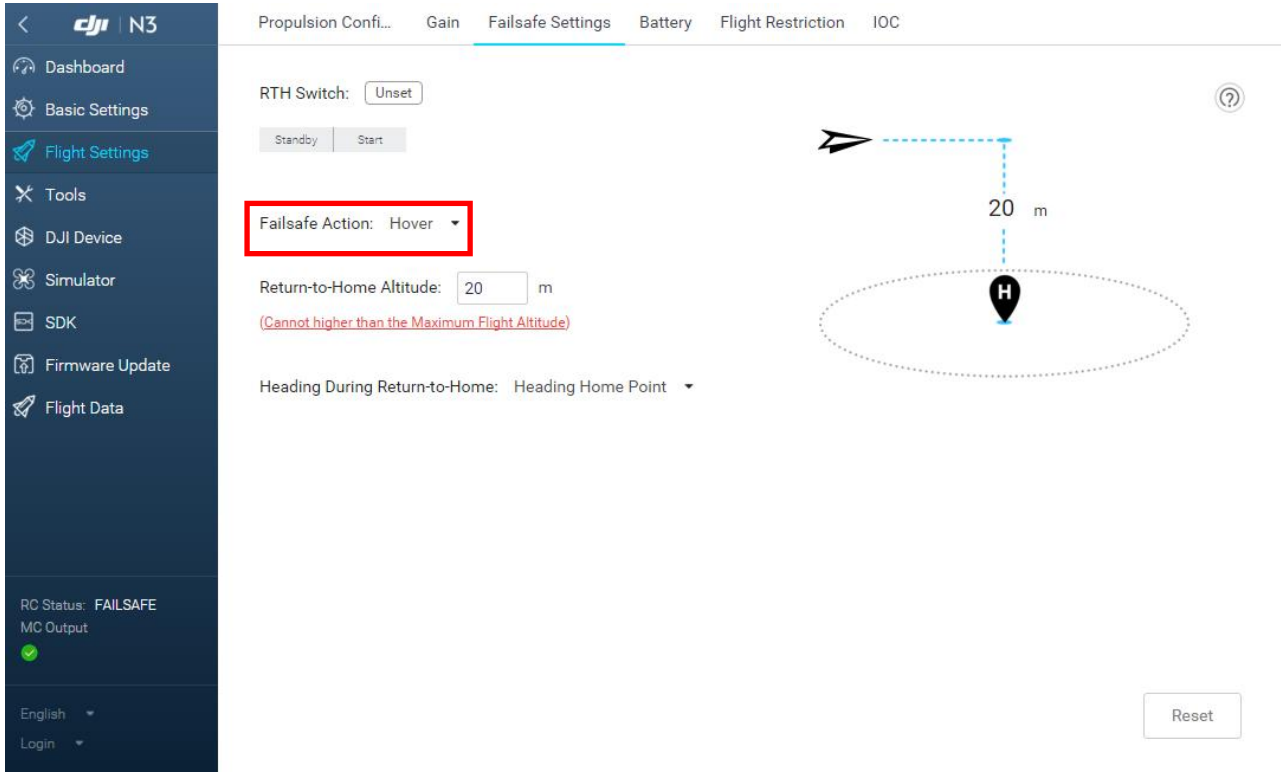
Part 7: N3 Autopilot Set-up

- Check controller parameters



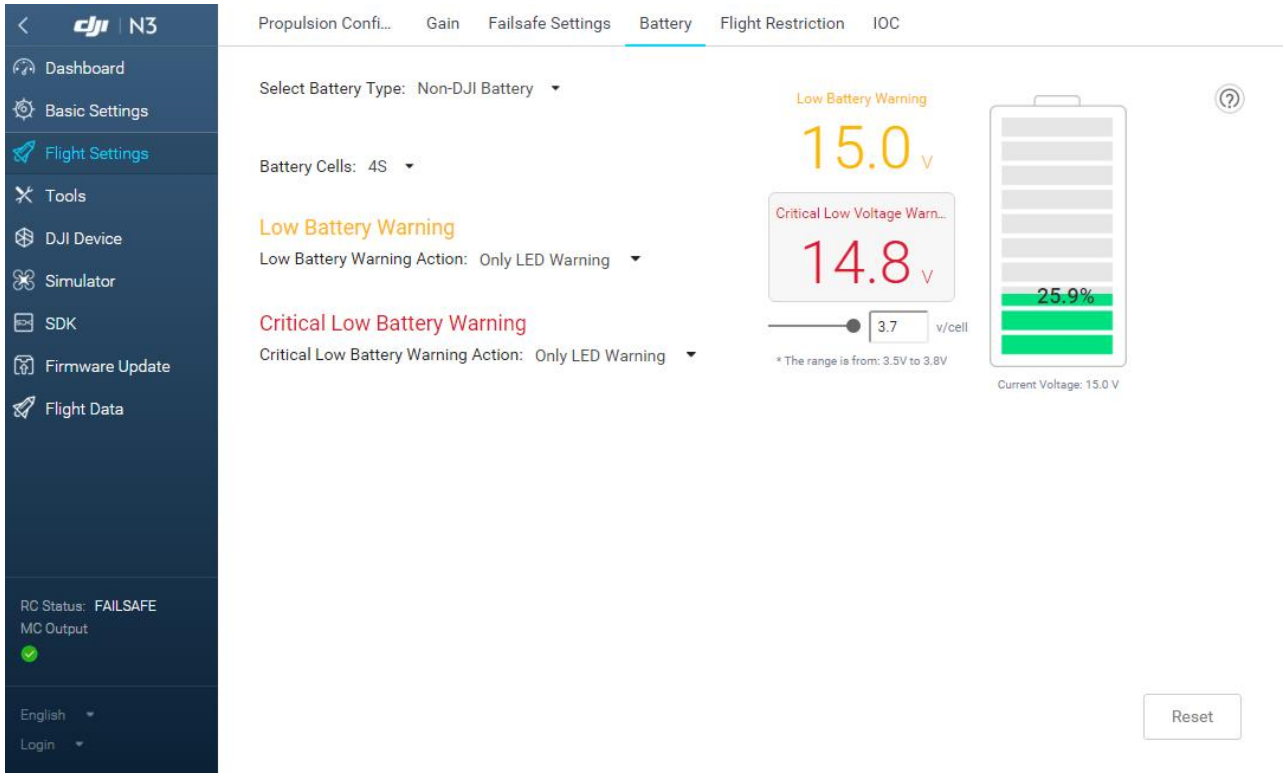
Part 7: N3 Autopilot Set-up

- Failsafe Setting



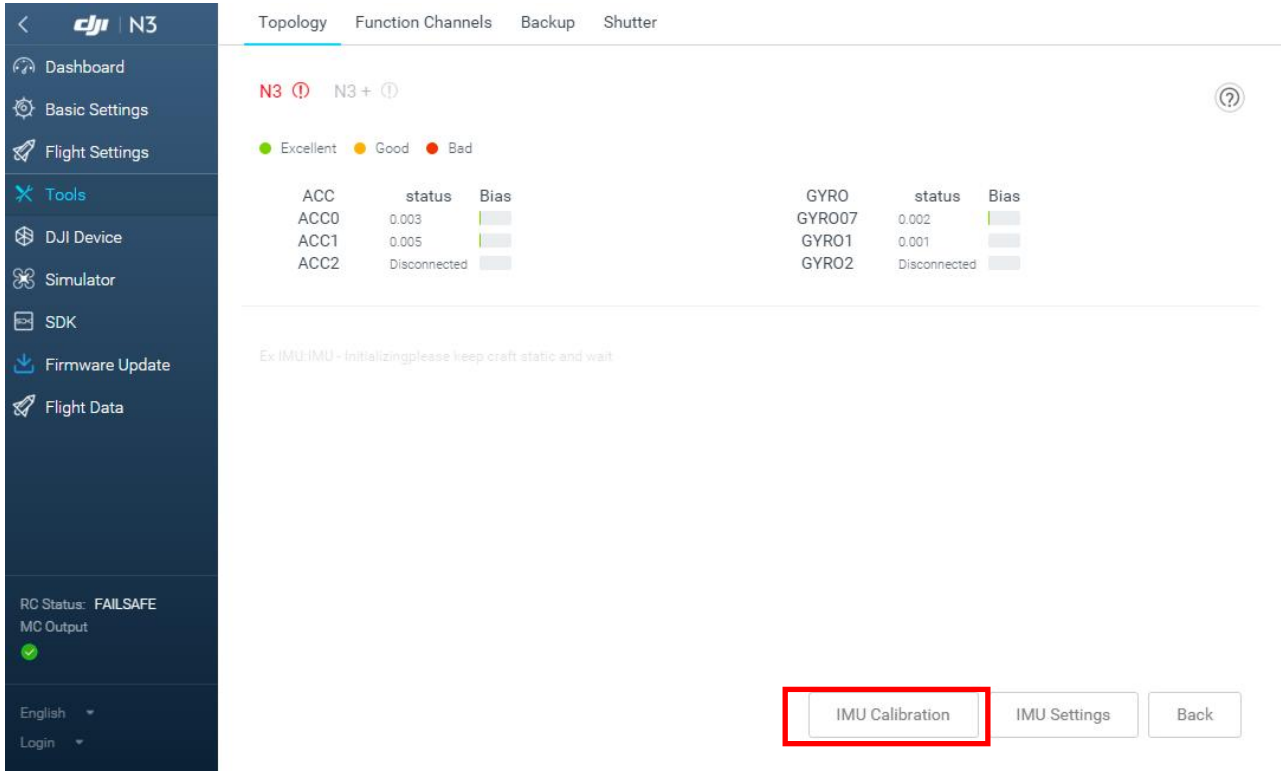
Part 7: N3 Autopilot Set-up

- Check battery settings
  - Battery 4S (Low: 14.8V, 3.7V/cell)



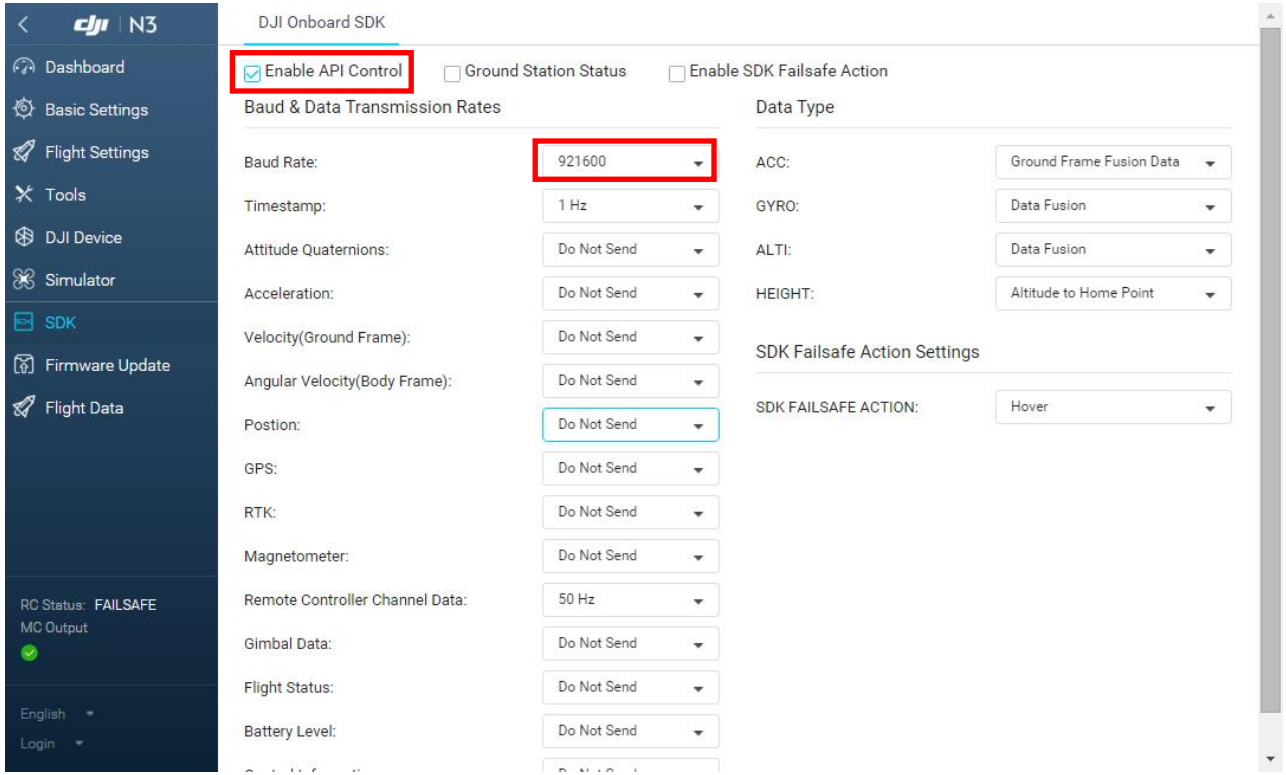
Part 7: N3 Autopilot Set-up

- Check IMU state, calibrate if bias is large
  - Press N3 Autopilot under Tools/Topology



Part 7: N3 Autopilot Set-up

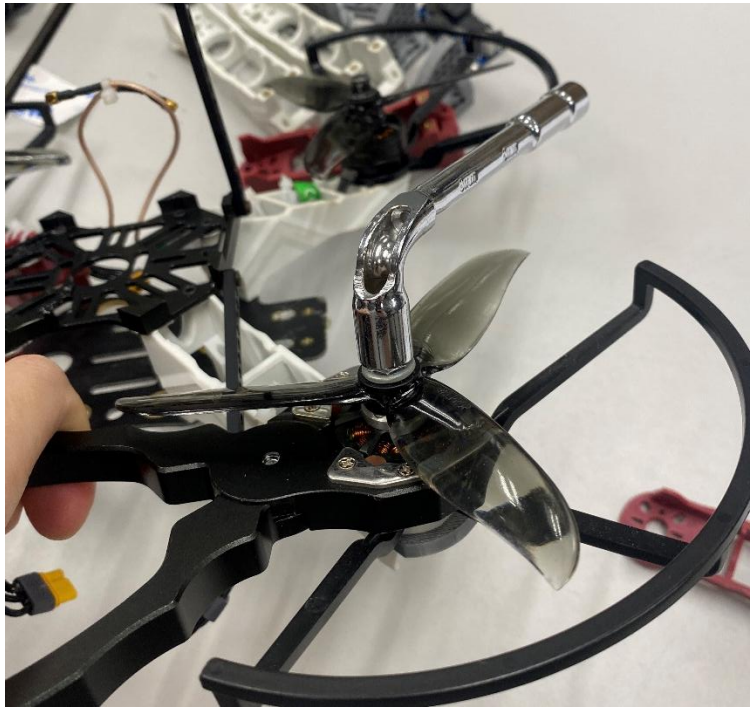
- Check SDK settings



Before Flight

- Make sure ALL your work is correct
  - Any mistake will be very likely to cause drone crash
- !!! Let TA check your work before flight
- Acquire propellers from TA
- Install propellers (Next page)

- Assembling the propellers
    1. Make sure you have tightened the nut !!!!!
    2. To remove the propeller, use the plier hold motor first, and then remove the nut with the spanner




READY FOR TAKEOFF