# RV Jet Operating Procedure Manual

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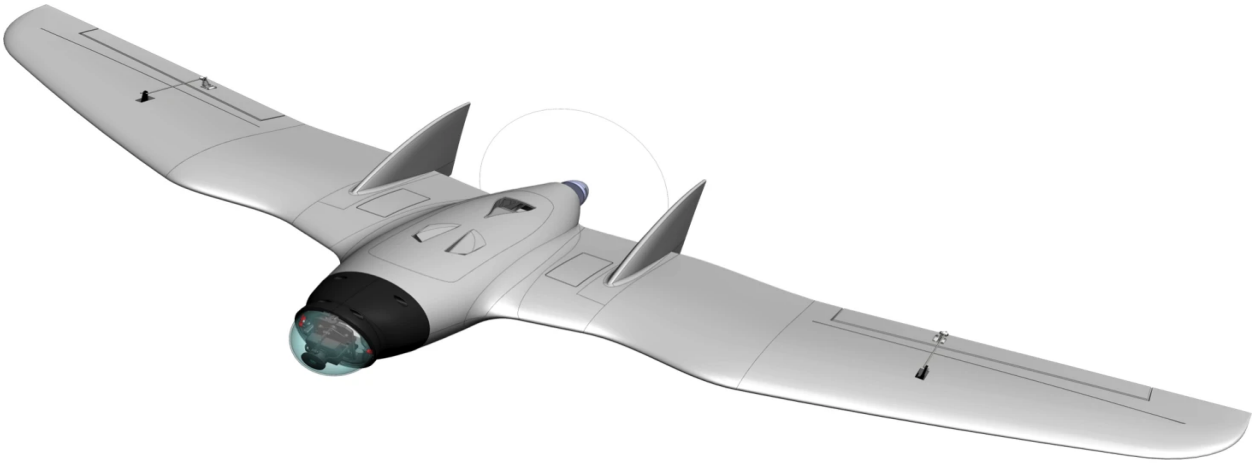

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# I. Reminders

1. **Before building airframe!**

- Please read through the complete instructions prior to assembly and follow them
- Test fit each part before applying glue
- Make sure you know how and where you intend to install electronics before gluing parts together
- Brushless motor rotation direction must be confirmed
- The servo must be centred and the servo horn must be attached before it is glued into the wing
- Ensure that the skid and motor mount is properly glued to the fuselage
- The use of thick or medium CA glue with activator is recommended
- This guide is for the LONG wing version of the RV Jet only!

2. **Before flying!**

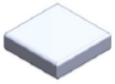
- Before launch make sure you have correctly set reflex and throws and that the elevons move correctly
- Check that all foam hinges are undamaged
- We recommend usage of the foam nose during the first flights to protect the PnT from unnecessary damage
- Before flying the long wing configuration, learn and memorize how to exit the turning dive (ref: Q&A)
- Do not exceed VNE of 100kph when flying the long wing configuration

# II. RV Jet Parts List

1. RV Jet part list. This details out every part that should come with your RV Jet. Please make sure that every piece is accounted for in order to assemble this. If a part is missing you will have to look online in order to get another part. Be careful not to damage anything while taking it out of the box either.

1x
POWER PACKAGE

1x
BATTERY TRAY



4x
MAGNETS
(10x10x2MM)

## 2. Electric Device

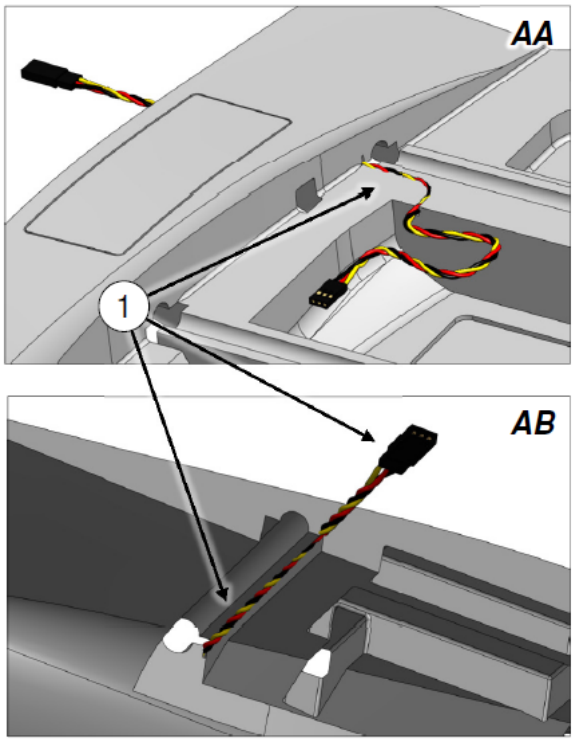
a. PIX Hawk Cube 2.0 Pack x1
b. GPS Pack x1
c. Pitot Tube Pack x1
d. Skydroid T12 Controller x1
e. Skydroid T12 Transceiver x1
f. Skydroid T12 Mini Camera x1
g. Laser Altimeter x1
h. BEC x1
i. Li-Po Battery (4s 4200mAh) x1
j. Power Sensor (Ampere meter) x1

# III. Fuselage Assembly

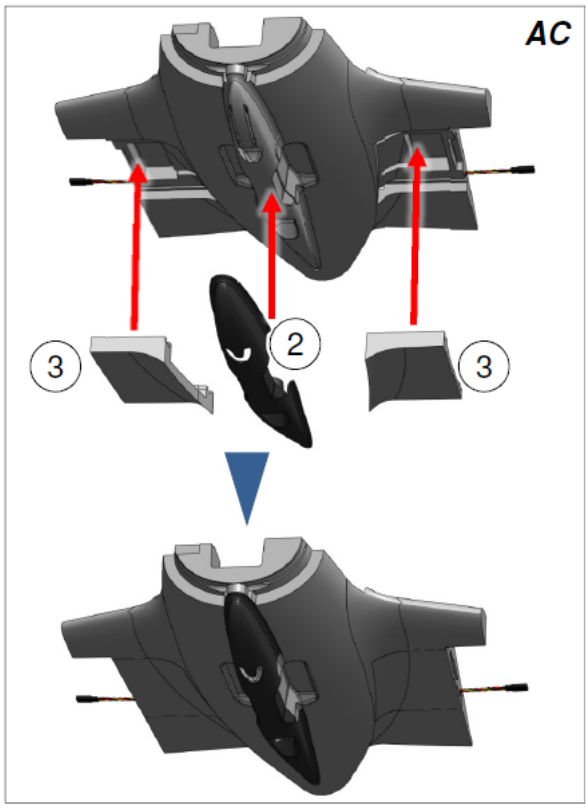
1. **Fuselage**

**Before assembly:**

- Please follow the number to construct
- Demount the propeller from the motor
- Make sure the parts are on the right spot before gluing

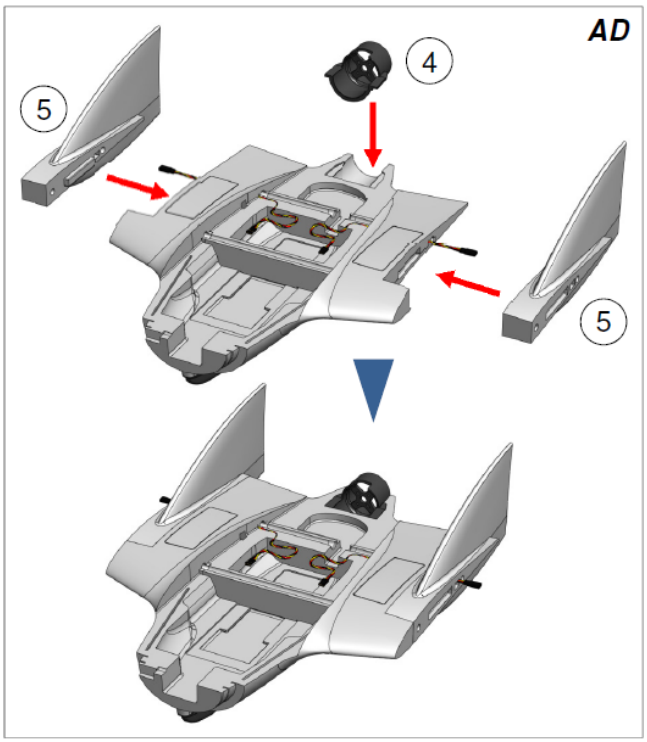



*1. Route servo cables from the inside of the bottom fuselage to the wings*
*! The cable is thicker than the slot in the foam requiring the cable to be pressed into the slot*
*! Ensure there is enough cable inside to reach the RVOSD*
*! Test mount the fins and make sure the connectors reaches through the holes in the fins*



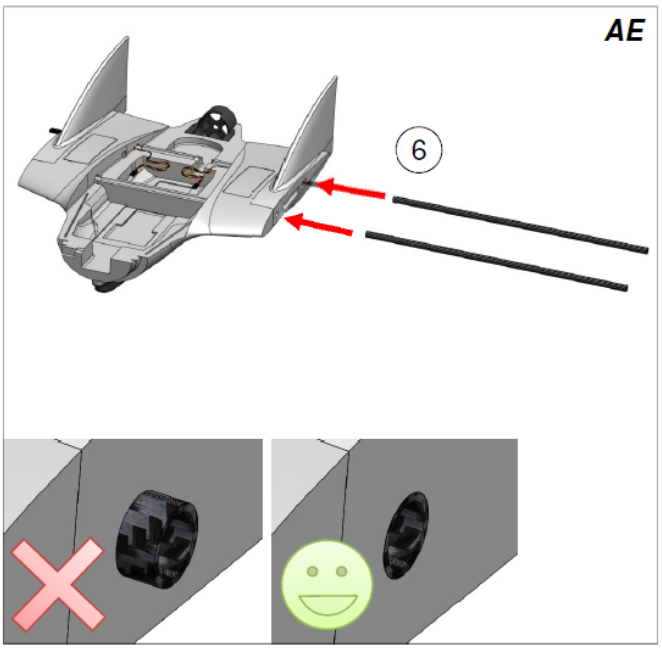

*2. Glue the skid to the bottom fuselage*
*! Make sure the whole surface between the parts is glued*

*3. Glue the left and right covers to the bottom fuselage*
*! The internal pockets can be used for VTx/RCRx or other electronics (ref: Setup)*

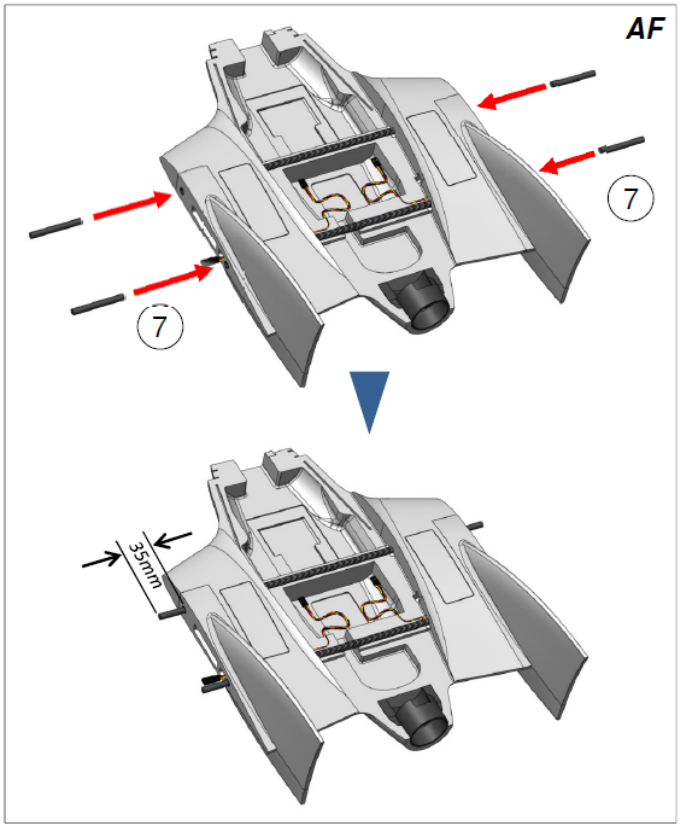



4. Glue the motor mount to the bottom fuselage
! Make sure the whole surface between the parts is glued

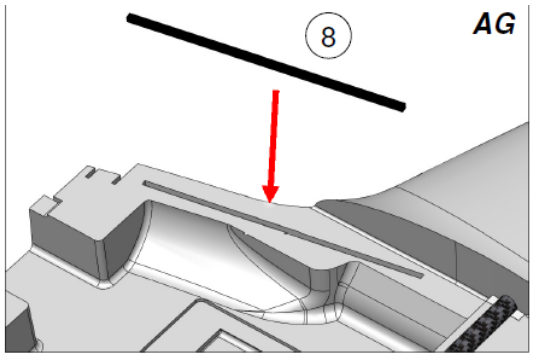
5. Glue the left and right fins to the bottom fuselage
! Ensure the servo cables exits through the square holes



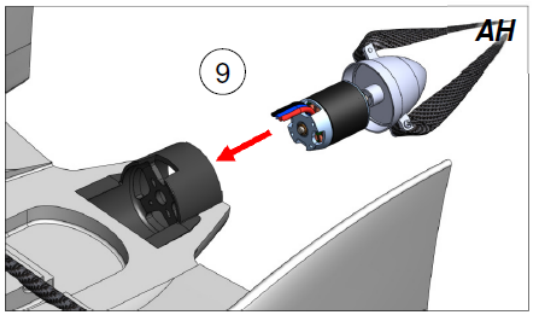

6. Glue the CF-tubes to the fuselage
! Make sure the tube does not stick out on the sides



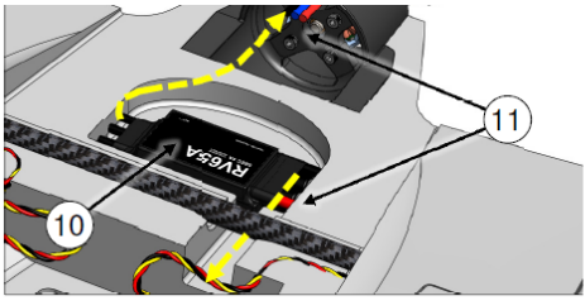

7. Glue the CF-rods 35mm (1.4in) into each side of the fuselage CF-tubes
! Some sanding might be required on the rods

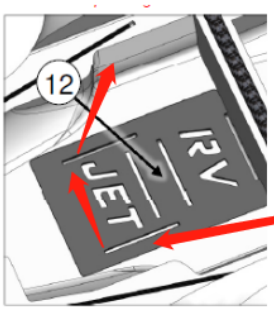



8. Glue the square CF-tube into the recess in the front of the bottom fuselage (repeat for the other side)




9. Install the motor on the motor mount
! Any adjustments to the thrust angle are easiest to do now
! Hex screws are recommended for easier access to motor
! The motor cables should go through the upper hole of the motor mount

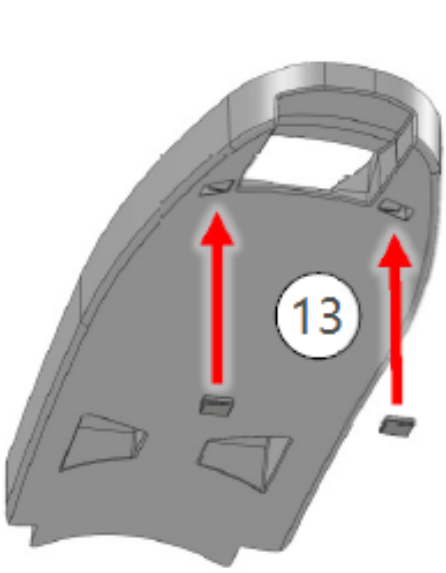


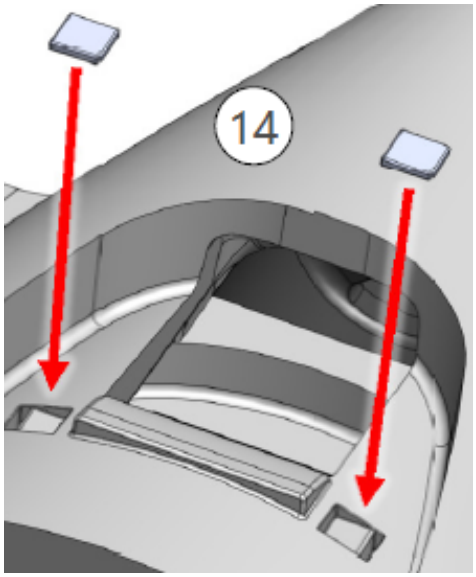



*10. Install the ESC between the CF-tube and motor mount*

*11. Connect the ESC to the motor, route power and signal cable*

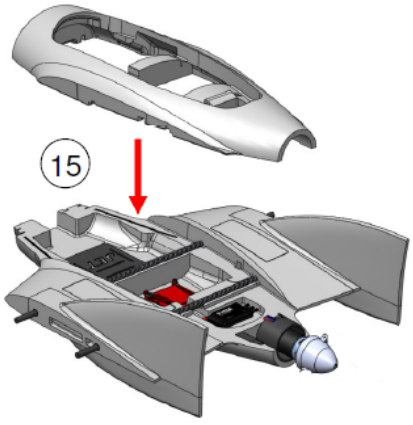
*12. Push the velcro battery security strap on the battery tray, a loop with the fury surface facing outside of the loop should be formed. Install the battery tray in the large recess (front compartment)*

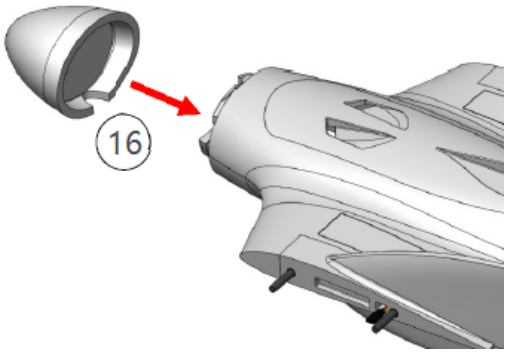



*13. Glue two magnets in the square holes on the fuselage top hatch*

*14. Glue two magnets in the square holes on the top fuselage. Make sure the magnets are facing right.*

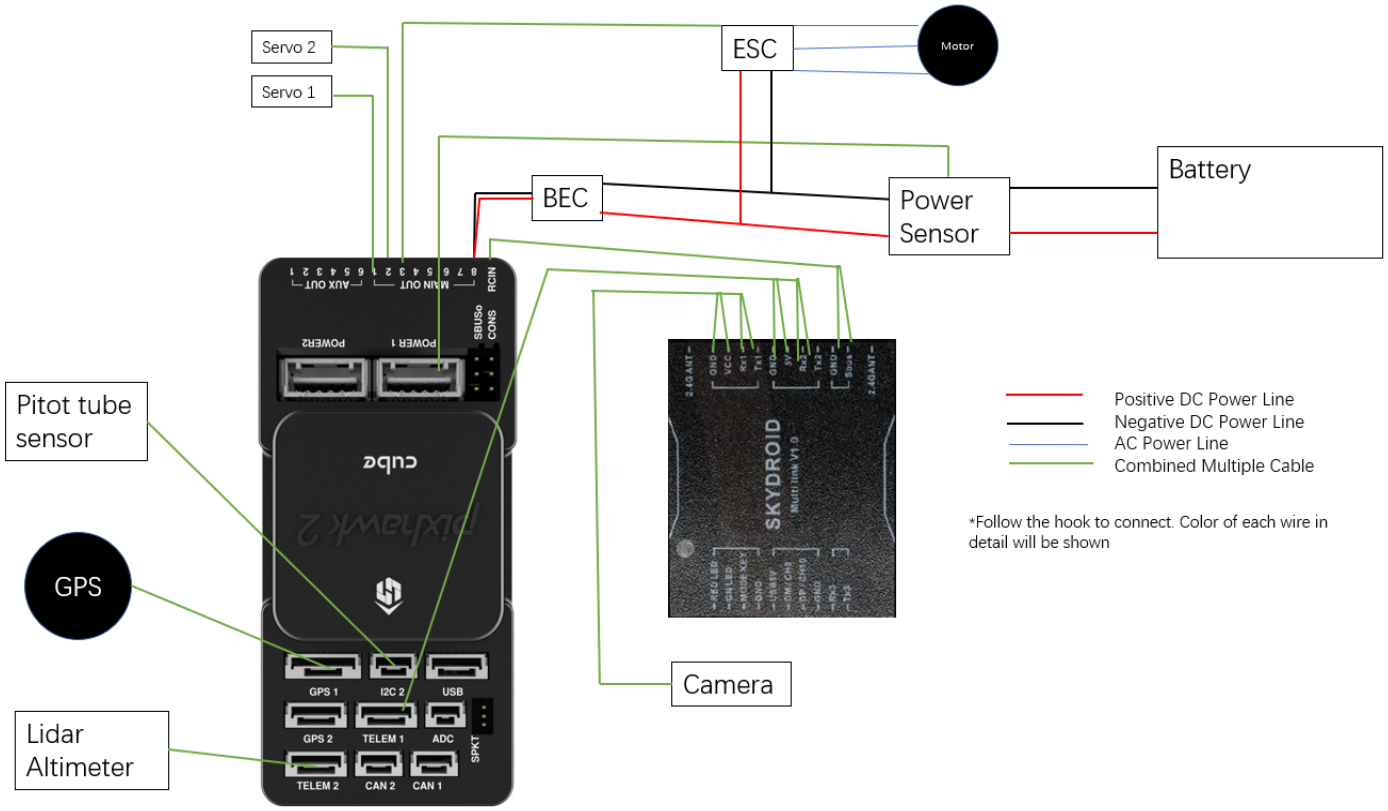



***15, 16. WARNING: you can only glue the top fuselage and the nose after all electric devices pass the test***

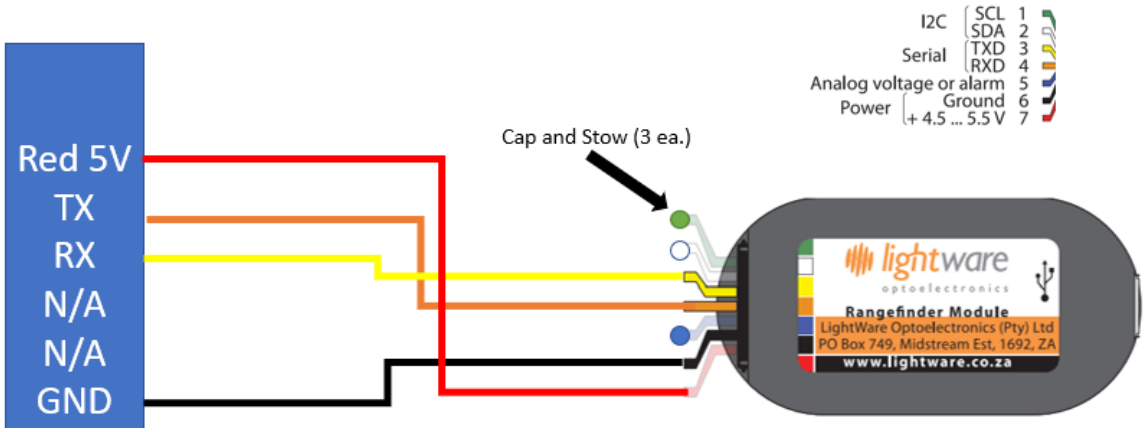
## 2. Electric Device Connection

**a.** This diagram details out how your Pixhawk2 Autopilot would be hooked up with the Pitot Static sensor, Lidar altimeter, BEC, both servos's, and your transceiver. It is important to make sure all connections are secure and in place when setting up your Pixhawk.



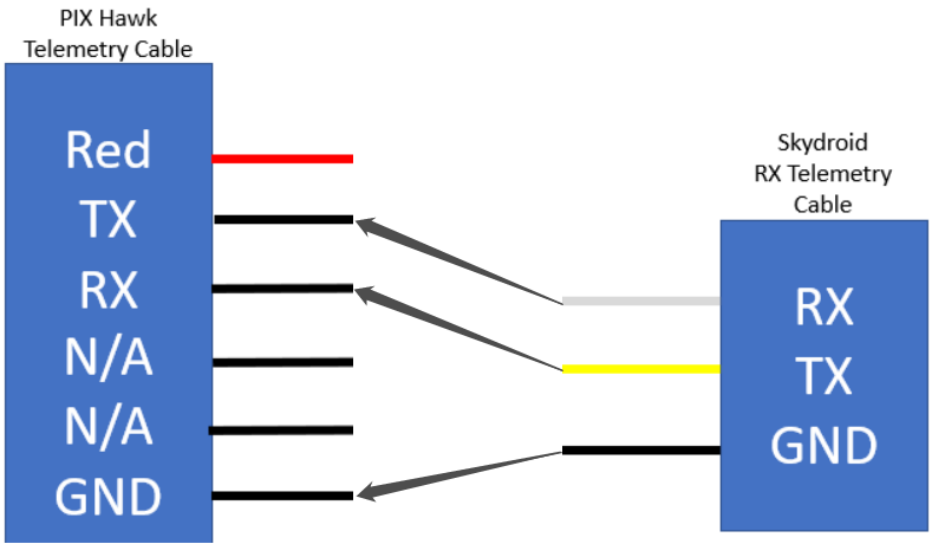

**b. Lidar to Pixhawk2**

In order to set up The SF11 Lidar sensor to the Pixhawk2 you are required to make some soldering modifications. Below is a diagram that illustrates which color wire should be connected from the SF11 Lidar altimeter to the pixhawk2 autopilot. Make sure you cut the correct wire and match it up according to the diagram below.

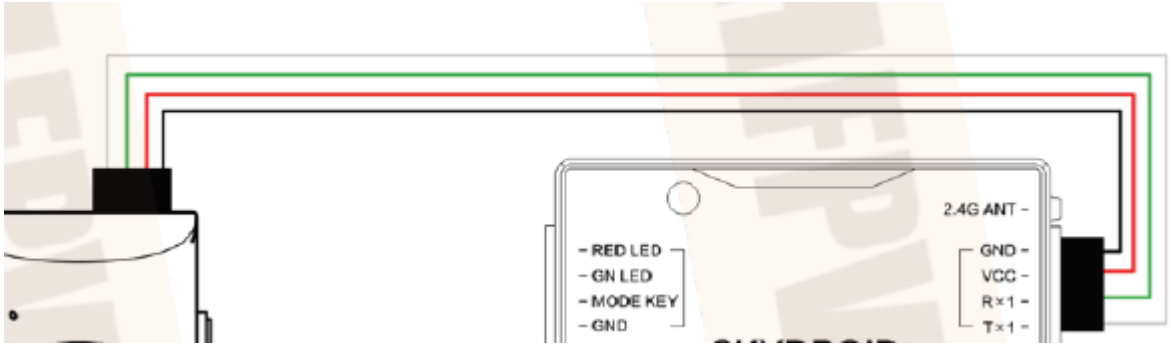


**c. Transceiver to PIX Hawk**

The SF11 Lidar Altimeter isn't the only soldering modification that needs to be completed. The next Soldering modification that should be conducted is connecting the T12 Skydroid transceiver to the Pixhawk2 autopilot. Below illustrates a detailed diagram of showing where to make the soldering modifications. Please be careful when conducting solder modification to not connect the wrong wires.



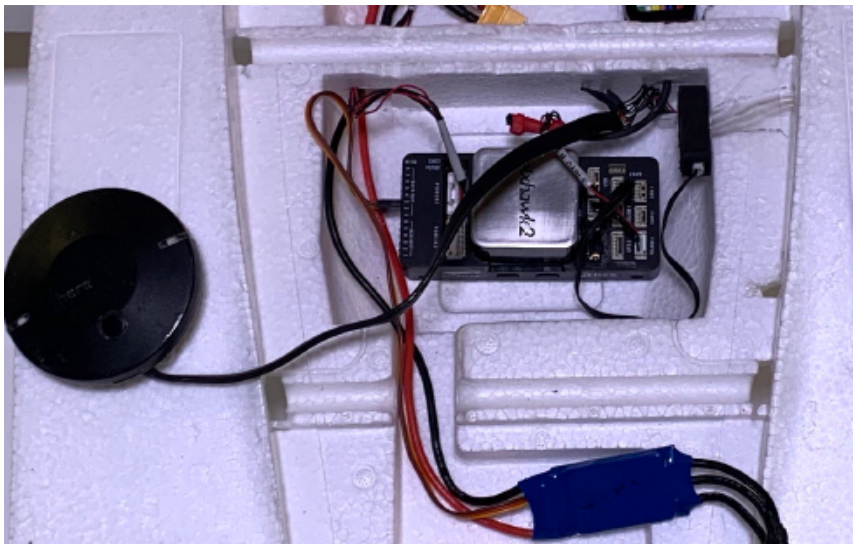

**c. Transceiver to Camera**



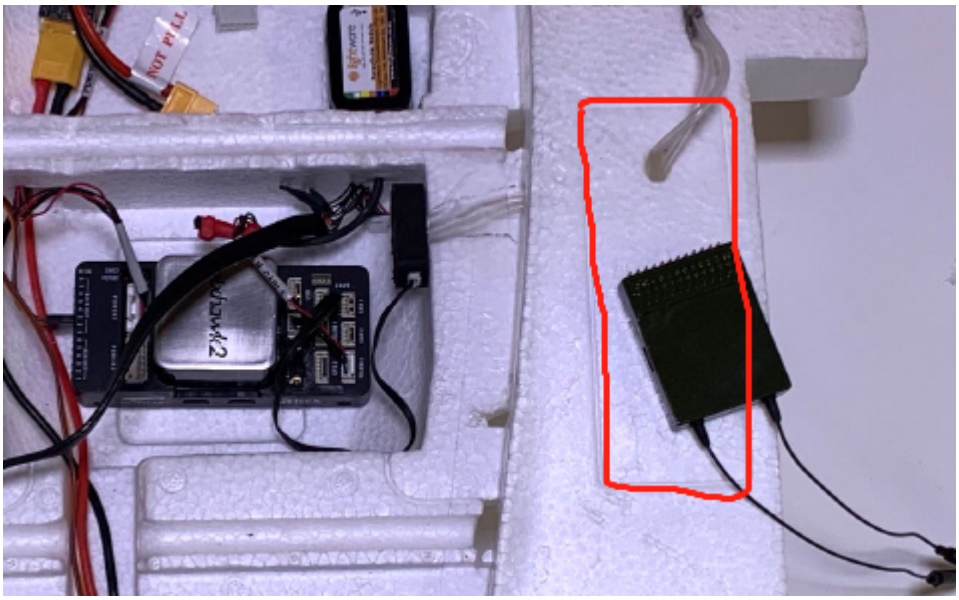

**2.**

3. **Electric Device Assembly**
    a. **PIX Hawk Cube and GPS installation**

The Pixhawk2 Autopilot should be centered in the middle of the fuselage. Secured down with velcro strips on the back of the Pixhawk2 and the styrofoam where the pixhawk will sit. After completion of the pixhawk then make sure to cut a perfect circle to fit the Here GPS on the RV Jet. The circular incision should be made on the right wing fuselage. The GPS should sit flush with the styrofoam. Be sure to connect to Pixhawk2 Autopilot, and then securely glue in place.

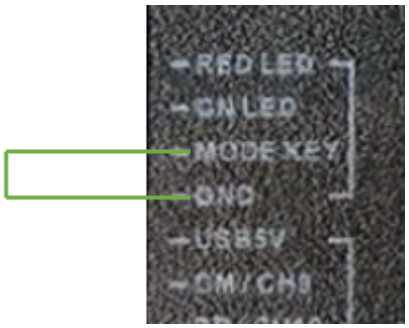


### b. Skydroid T12 Transceiver and Binding with Controller



Follow the red line to cut, there is space for the transceiver to place. Do not let the antennas cross.

**Binding with Controller**




Short-circuit MODE KEY and GND to enter the frequency pairing mode, the green light flashes quickly on the remote controller and it will complete the frequency pairing. The green light is always on after binding successful. (DO NOT TRY THIS)

TRY THIS: use a bread board and a power supply (MAKE SURE SET THE CURRENT LIMIT SO YOU DON'T BURN IT ACCIDENTLY). Every time the receiver is powered up, it will self-check. If the self-check passed, it will flash red and then green very quickly. Power up the receiver five times quickly, make sure not too fast, so it will pass the self-check five times. At the 6th power up, hold it and it will flash green light quickly. Then power up the receiver. So the time line is: (power up, self-check, unplug power)x 5 times, and power up, hold it.

E:CH5

G: CH6

F: CH8

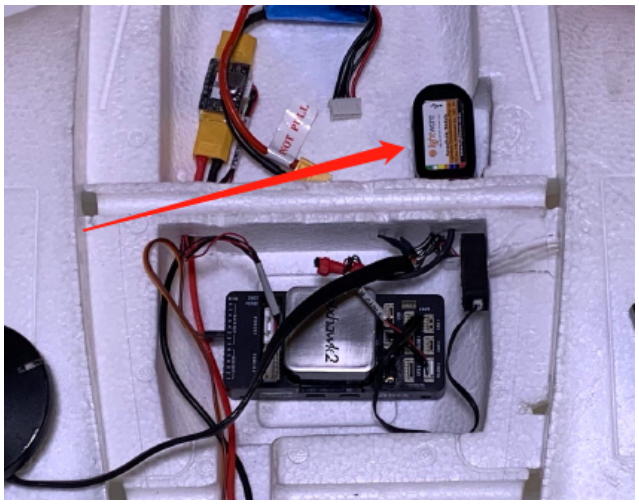
H: CH7

### c. Camera

Dig a hole on the top middle of the foam front nose so that the lens of the camera can fit in.

**d.**

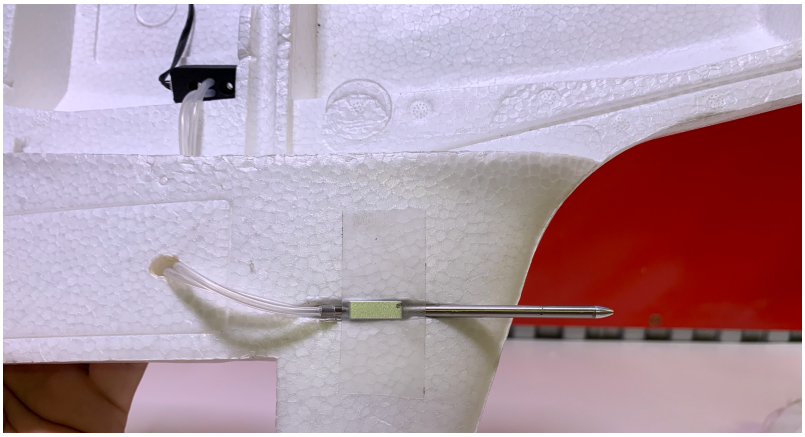
### e. Lidar Altimeter



Dig a hole near the battery tray so that the Lidar Altimeter can fit in.

### f. Pitot Tube

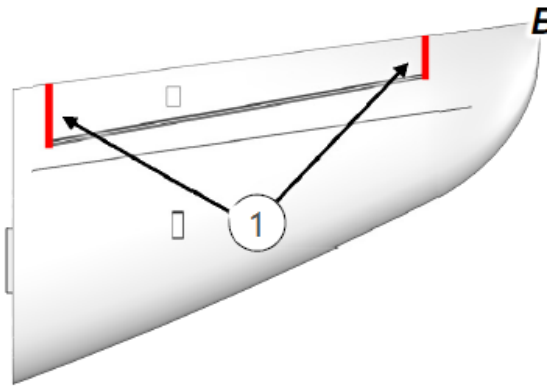
This will be installed by the transceiver where the antennas will go as well. Make sure rubber tubes are properly installed on the sensor for accurate readings. Also be sure that this is also plugged into the Pixhawk Autopilot in proper spot as illustrated above.



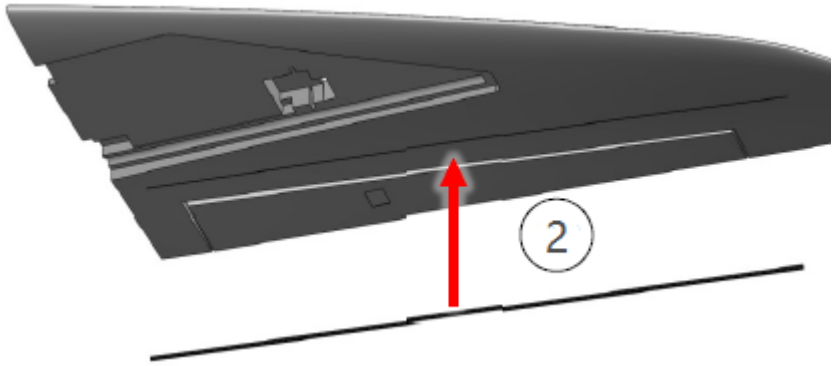
# IV. Long Wing Assembly

Please follow these step by step images on how to assemble your long wing RV Jet. This also shows you how to install and set up both servos. Be sure all parts fit and are seated properly before laying glue!

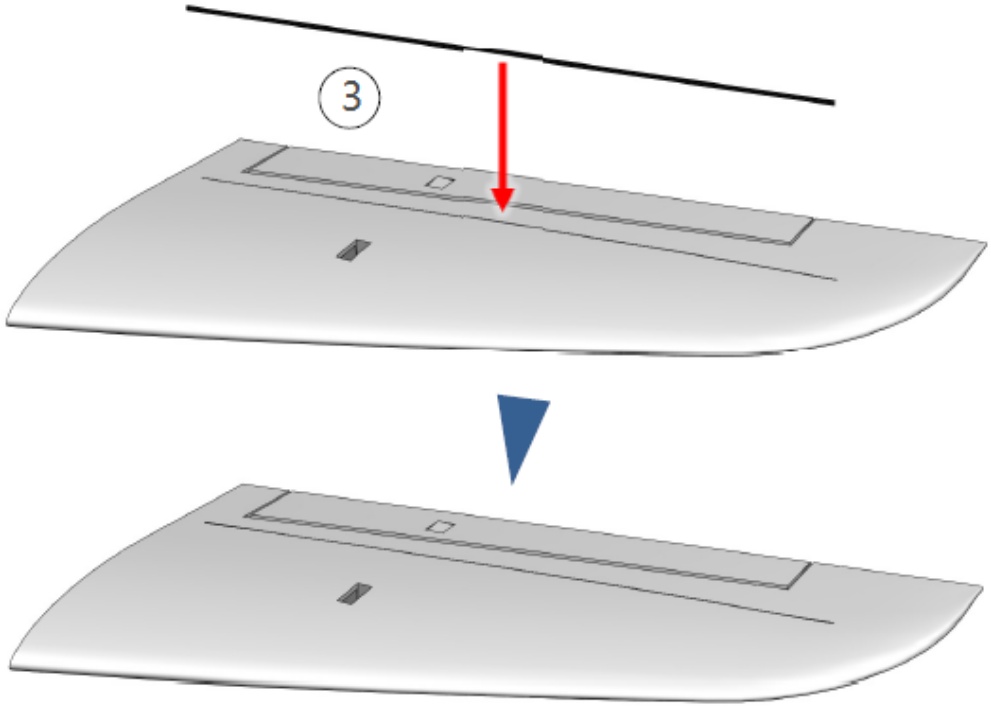
1. *Remove the foam on the sides of the elevons*



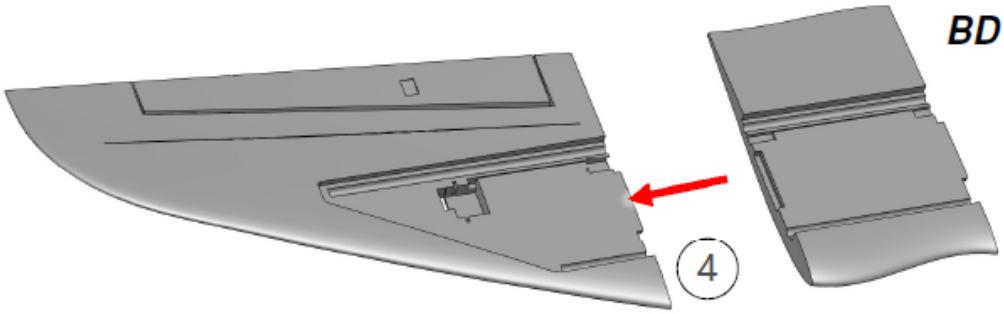

2. *Glue CF-strip in the bottom slot of the wing. Ensure that the strip fits fully before applying glue Ensure that the strip is flush to the surface of the wing*



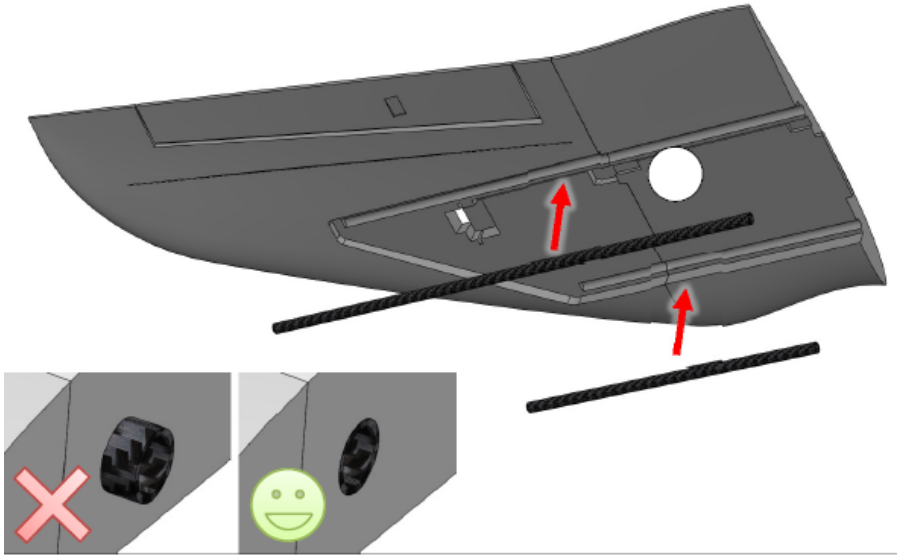

3. *Glue CF-strip in the top slot of the wing. Ensure that the strip fits fully before applying glue Ensure that the strip is flush to the surface of the wing*



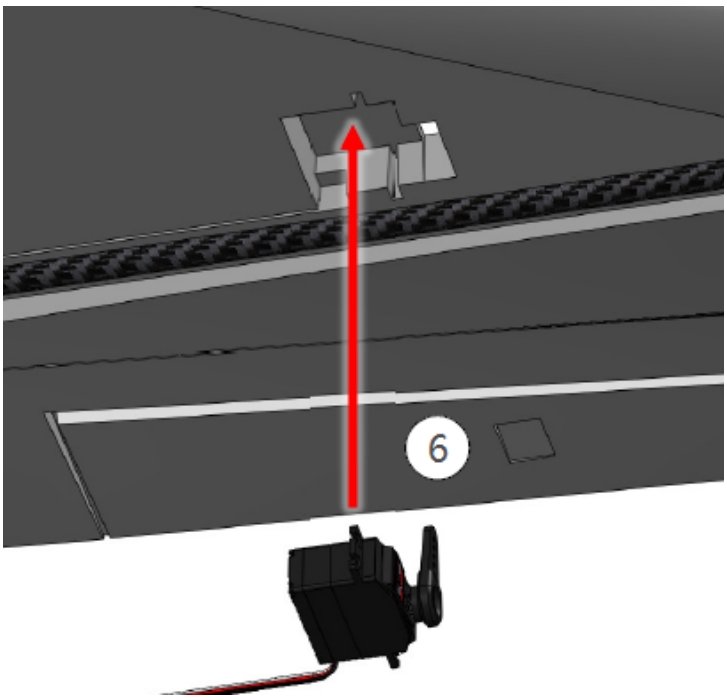

4. *Glue wing extension to wing*



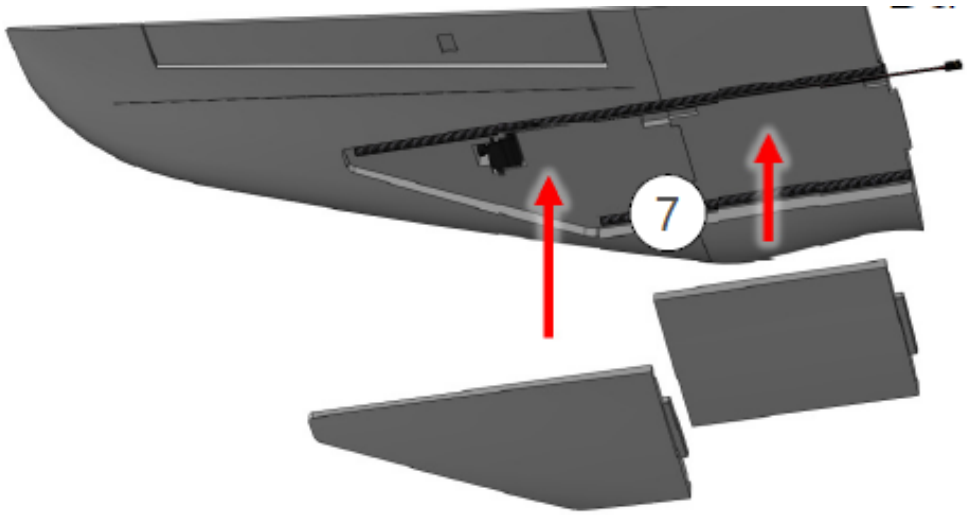

5. *Glue the wing CF-tubes to the fuselage. Make sure the tube does not stick out on the sides*



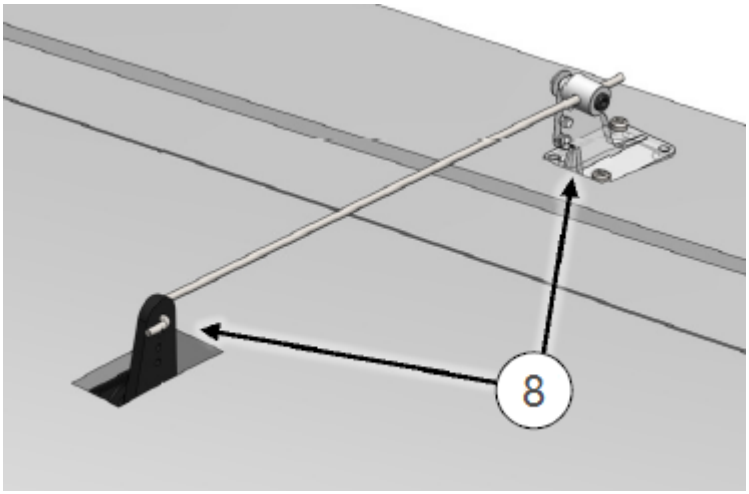
6. *Install servo in servo tray. Make sure the servo is centred and the control arm installed*




7. *Glue covers onto wing and wing extension*




8. *Install control horn and pushrod*



# V. Laminating

Cut the film a little larger than the size of the wing. Set the iron to low, and heating from the middle. Cut the side of film into many small sections so they can fold over the wing. Do both sides of both wings.

If you still need help, please visit [https://www.youtube.com/watch?v=FOqkUmWkrmI](https://www.youtube.com/watch?v=FOqkUmWkrmI)

# VI. PIX Hawk Setting Up

1. **Connecting**

   Please have Mission Planner installed on your PC or laptop.

   Link to download: https://ardupilot.org/planner/docs/mission-planner-overview.html

   Use the USB cord from the pixhawk box.

   Connect directly to the cube, do not use the extension/expansion cable.

## 2.Install Firmware

### Installing Firmware

- Change to the initial setup tab
- The firmware to use is arduplane
- Make Sure the board is disconnected in the top right of the screen, but the cable is connected to the computer
- Some questions it will ask you, answer these as follows, the cube is black, do not upload chiba os

## 3. Load Parameter

### Load Parameters from Manufacture

- Load the Param file in the configuration tab under full parameters, then on the right side below the connect button
- Once the file is loaded, click write to transfer the settings to the board
- Refresh the Parameters
- Check to see if the settings are correct by going to the initial setup tab under mandatory hardware and comparing the servo functions
- If the functions match the lower image, they were successfully updated

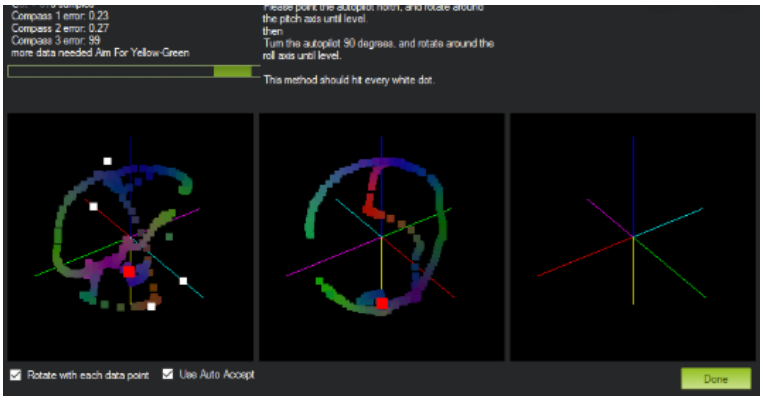
## 4. Calibrations

### a. Accelerometer

- Under the initial setup tab select the accel calibration
- Maker sure everything is attached to the UAV and follow the steps on the screen
- After that is done, calibrate level
- Verify that it is correct using the artificial horizon in the flight data tab

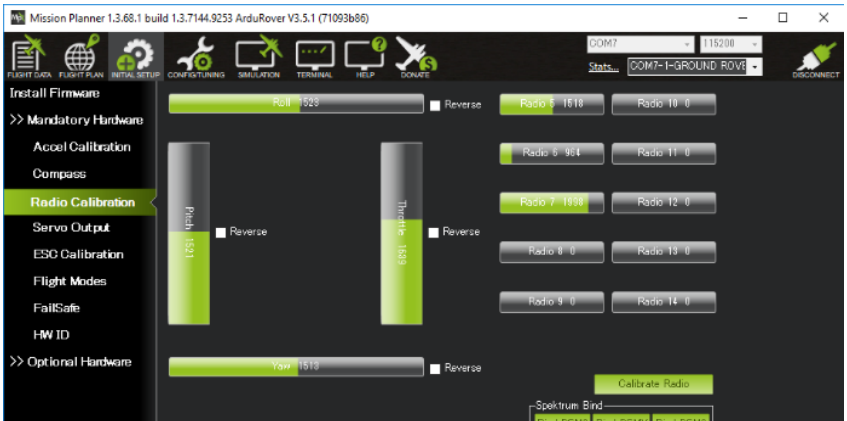
### b. Compass

- Under the initial setup tab select the compass window
- Do a compass calibration, move The craft around all axes in all orientations, be careful to not unplug the usb rom the aircraft or the computer while you are doing this process
- Go to the flight data tab and verify accuracy of the compass heading




### b. Radio

- Under the initial setup tab select the Radio Calibration window
- Fallow the onscreen instructions
- Ensure to move the gimbals to their Max's in both axis, and flip all the switches and push all the buttons



# VII. Skydroid Controller T-12

This works as the ground control station for the long wing RV Jet. This also supports the FPV camera as well as the transceiver that is installed in the RV Jet.

1. Dual-Antenna.
2. Internal Integrated digital radio
3. Use the mobile APP assistant software to set the parameters.
4. Bluetooth, USB connection.
5. Built-in 4000MAH lithium-ion battery for more than 24 hours.
6. Supports FPV camera

**Weight:** 490(g) controller, 26(g) transceiver, 15.6(g) FPV camera
**Channel:** 12
**Working Voltage:** 3.7V
**Working Current:** 170mA
**Battery Capacity:** 4000mAh
**Endurance:** 25hours
**Frequency:**2.4Ghz-2.4833Ghz
**Communication technology:** FHSS
**Transmission Distance:** 10km
**Signal Output:** SBUS,PWM,I2C

# VIII. RV Jet Performance

The performance specifications detailed below regard the Long Wing style RV Jet **ONLY!** With the long wing attached the RV Jet is able to fly longer and equips the Jet with more endurance. Be sure to look online to find specifications if you wish to ever build the short wing RV Jet version!

**Wing Span:** 76.7 in
**Max Speed:** 62 Mph
**Max RPM:** 74,000RPM
**Battery Type:** Lipo Battery 6100mAh. 14.8V
**Max Endurance:** 30-45 mins
**Max Distance:** 6.2 Miles
**Max Weight:** 452.5(g) w/battery
**Motor:** 1200kV 3550
**Operating Temp:** 32-95 degrees Fahrenheit
**Flight Distance:** 10km with T12 Controller

# IX. Internal Hardware Specifications

## 1. Pixhawk2 Cube

a. This serves as the autopilot for this RV Jet. As shown in the schematics aboved, when putting this together the GPS, Pitot Tube, LiDAR, and other main components plug into it.
b. Triple redundant Imu system
c. Isolated and dampened IMU
d. Modular Flight Controller
e. Weights: 39(g)

## 2. SF11 Laser Altimeter

a. This tells the RV Jet how close or far away from the Ground it is. Very lightweight, and easy to set up with the autopilot.
b. **Range:** 50 meters
c. **Resolution:**1 cm
d. **Update rate**: 40 readings per second
e. **Power Voltage:** 5.0V
f. **Power Current:** 200mA
g. **Weight:** 35(g)
h. **Laser power:** 20 W
i. **Operating Temp:** 40 degrees ©

## 3. Here (GPS/Compass)

a. This serves as the GPS and compass for the RV Jet. This one is advised when using the Pixhawk.
b. **Weight:** (49g)
c. **Operating temp:** -40 to 85 degrees celsius
d. **Navigation Update Rate:** 10HZ

# X. Weight and Balance

Prepared by: Patrick Lamb, Dingming Lu, Michael Montgomery

**Make**: RV Jet **Model**: Group 4

**Serial**: 4 **Date**: 3/31/20

| Items | Weight(g) | Arm(cm) | Wing Line(cm) | WaterMark(cm) | Moment |
|---|---|---|---|---|---|
| **Camera** | 15.6 | +5 | 0 | 9.5 | 78 |
| **Battery Holder** | 35 | +10 | 0 | 5.5 | 350 |
| **LiDar** | 35 | +28 | 7 | 7 | 980 |
| **Pitot Tube** | 15 | +27 | 16 | 9.5 | 405 |
| **Transceiver** | 26 | +33.5 | 16 | 8.5 | 871 |
| **GPS** | 49 | +31 | -14 | 10 | 1519 |
| **Power Sensor** | 16 | +26.5 | -6 | 7.5 | 424 |
| **BEC** | 18 | +31 | 0 | 7 | 558 |
| **PixHawk** | 39 | +38.5 | 0 | 7 | 1501.5 |
| **Right servo** | 25 | +42 | -59 | 10 | 1050 |
| **Left Servo** | 25 | +42 | -59 | 10 | 1050 |
| **Motor** | 80 | +59 | 0 | 7 | 4720 |
| **ESC** | 18 | +44 | -2 | 5 | 792 |
| | | | | | |
| **Weighting point** | Weight(g) | Tare(g) | Net Weight(g) | Arm(cm) | Moment |
| **Nose** | 184.39 | 0 | 184.3 | +1.5 | 276.45 |
| **Left** | 770.9 | 66.73 | 704.2 | +47 | 33097.4 |
| **Right** | 719.1 | 63.32 | 655.7 | +47.5 | 31145 |
| **Total(EW)& CG** | N/A | N/A | 1544 | +41.8 | 64519 |

| | | | | | |
|---|---|---|---|---|---|
| **w/ Battery** | 452.5 | 0 | 452.5 | +16.27 | 7362 |
| **Total Bat&CG** | N/A | N/A | 1996.7 | +36 | 71881 |

Notes:

1. Arm datum is from the nose.
2. Looking from the motor to the camera, the left side is the direction where the RV Jet turn left, which is negative, vice versa. The right side is positive.
3. Negative values have negative signs. Positive signs are omitted.

# XI. RV Jet Preflight Checklist

**Pre-Mission**

1. Check for the type of airspace above and around operating area
2. If necessary contact proper ATC or other authority and inquire about permission to operate in mission area
3. Ensure permission to fly as well as clearing any legality issues
4. Check weather for ceiling, visibility, wind and any other significant information using official aviation sources
5. Night before ensure all equipment is packed and ready to go as well as batteries are being properly charged for all vehicle, personal and GCS batteries. Sleep a healthy amount of time.

**Day Of Mission**

1. Properly move all non-packed or charging equipment into automobile and drive to the mission site
2. Check weather recuringly to stay informed on any forming fronts

## Before Flight

1. When arrived visually scan the area to check for obstructions including trees, buildings, towers and guy wires.
2. Check for Wi-Fi availability or if mobile data is pres
3. Take out fuselage, wings, and rubber band from the box

## Assembly and Checks

1. Install the wings to the fuselage
2. Open the fuselage
3. Check the wires are connected properly
4. Check the voltage of the battery
5. Install the battery to the fuselage
6. Turn on the controller and ground control station, connect them together
7. Check the batteries of controller and ground control station
8. Pull the third channel (thrust) to the bottom
9. Connect the battery to the BEC and ESC
10. After turning on GCS check for any updates to firmware or software
11. Check if the ground control station has reaction when rotating the RVJet
12. Check if the altimeter, airspeed indicator, GPS, and the compass works properly
13. Check if the camera works properly, if the right location is shown on the ground control station.
14. Check if the voltage of the battery of the RVJet through the ground control station
15. Hold the RVJet from the front
16. Push the stick of the third channel (thrust) on the controller, check if the RV Jet move forward
17. Move left and right the stick of the first channel, check if the servos work properly
18. Push and pull the stick of the second channel (elevator), check if the servos work properly
19. Close the fuselage

## Launch

1. Hold the RVJet by using two fingers on the CG line to check the balance.
2. Install the rubber band to the ground
3. Hook the RVJet to the rubber band and pull back about 30 feet
4. During operation check weather recuringly to be knowledgeable of any front

# XII. Emergency Procedures

In the event that you find yourself in an emergency it is always important to have a plan. Make sure where you are operating is always in an open area that has little air traffic and ground traffic. If you lose signal make sure you try to establish a clear connection with the Ground control station and the RV Jet. Avoid areas with large obstruction in the way as they can block your signal to the RV Jet. Once connection is established land in an open area right away. It is important as the PIC to have contingency plans.

# XIII. Battery Operations

Using Lipo batteries can be very dangerous. Make sure that you store your batteries in a proper container that can keep the batteries at room temp and also keep the batteries from suffering any kind of physical damage. Do not place the batteries in any trailers, truck bed, or any place that does regulate temperature correctly. These batteries can deplete at a very fast rate if not stored properly. Make sure the battery is always stored at the proper storage setting as well.