GENERAL MANUAL

INTERNATIONAL ARMOUR TM

www.armour.gr

HARK VTOL DRONE

FIREFLY VTOL DRONE

1. Symbols in the Manual

Prohibitions

Important / Caution

Prompt / Skills

Annotations

Tips

2. Safety Instructions

2.1 Acknowledgement

This product is a professional aviation tool, where wrong operations may lead to damage to the goods or casualties.

User must bear the corresponding criminal responsibility caused by this product.

For proper usage and your safety, please read the instructions carefully before using or consult the manufacturer.

2.2 Precautions

2.2.1 Air Traffic Control

Subject to the country that you will use the FF VTOL, appropriate approval of the Air Traffic Management Bureau (ATMB) of Civil Aviation Administration must be obtained and strictly to abide by national laws and regulations.

2.2.2 Flight Area

(1) If the use of the FF VTOL is for Civilian proposes, and subject to the country laws, It is prohibited to fly over the no-fly zone delineated by the public security department, including airports, railways, flammable and explosive materials storages (factories), dangerous goods stores (factories), power stations, high voltage lines, military facilities, personnel-intensive areas, and public security departments.

(2) If any important protection or ambiguous target exists in the intended flight area, it is necessary to report to the local authorities for approval.

2.2.3 Geographic Environment

(1) The flight area must be surveyed to ensure that the flight path is out of obstructions.

(2) Flights in mountain or between buildings are prohibited since the product may experience strongly change the shear wind.

2.2.4 Personnel Situation

(1) All staffs and operators must be in good condition, with energy and concentration. Operators with sickness, emotional or fatigue state are not allowed to operate the unmanned aircraft.

(2) From the night before the flight until the end of the flight, all operators are prohibited from alcohol.

3. Overview

FIREFLY (FF) & SHARK UAVs are a composite vertical take-off and landing UAVs design and manufacturing by International Armour and Partners, applies fixed wing combined with the quad rotor complex fix wing layout, which solves the problem of vertical take-off and landing in a simple and reliable way.

Along with its advantages of long endurance, high speed, and long distance.

An industrial-grade flight control and navigation system is specially developed for the UAVs, ensure that the UAV could complete the whole flight, cruise, flight state transition, vertical take-off and landing and other flight stages without operator intervention.

The UAVs does not require any runway, take-off and airspace, which ensure it can operate smoothly in complex terrain and building-intensive areas such as mountains, hills and jungles.

This advantage has greatly expand the UAV application range, which makes the UAVs ideal for many applications.

3.1 Features

- Layout ： Simple and reliable structure from the application of conventional fixed-wing and quad rotor combination as the layout pattern。

- Practical and Efficient: Fixed wing UAV with long endurance, high speed, long distance, and heavy payload

- Vertical Take-off and Landing: Equip with a vertical take-off and landing features can significantly reduce requirements on landing space.

- Low Cost of use: Do not require any complex cumbersome launch and recovery equipment. Additional recovery sensors are also not necessary for this UAV. Vertical take-off and landing can minimize the possibility of damage to the fuselage and equipment on board.

- Easy to Operate: Applying integrated dedicated flight control and navigation system, achieving fully autonomous flight.
Operators without professional training and operational experience could also operate the UAV by simply sending flight plans.

- Compact System: Do not require any complex auxiliary equipment. Along with simple transportation, expansion, maintenance, and withdrawal.

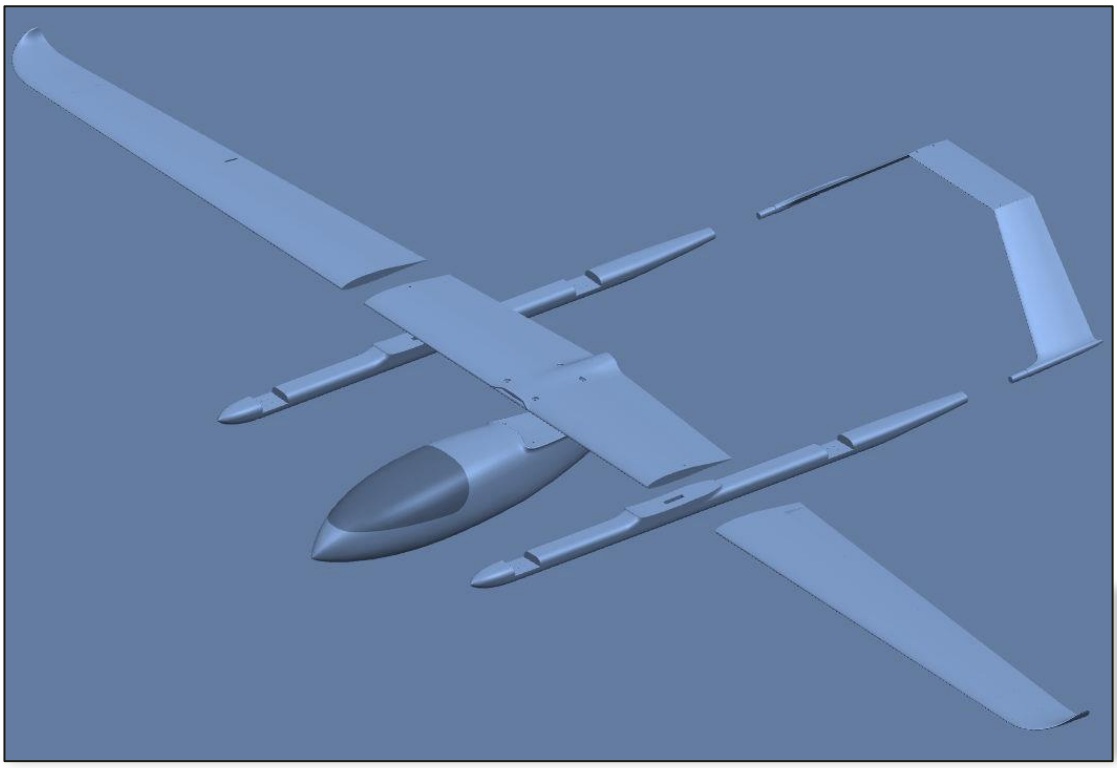
3.2. Basic Performance Parameter

Total Flight Weight: <18Kg
Payload: 1.5Kg
Cruising Speed: 24-25m/s
Maximum Flight Speed: 31m/s
Stall Speed: 14m/s, (wind speed < 3m/s)
Flight Time: < 2.0 hours (Pure electrical)
Wing Span: 3.5m to 4m
Wing speed level: <14m/s
Practical Ceiling: 3900m (Pure electrical)

3.3. UAV Composition

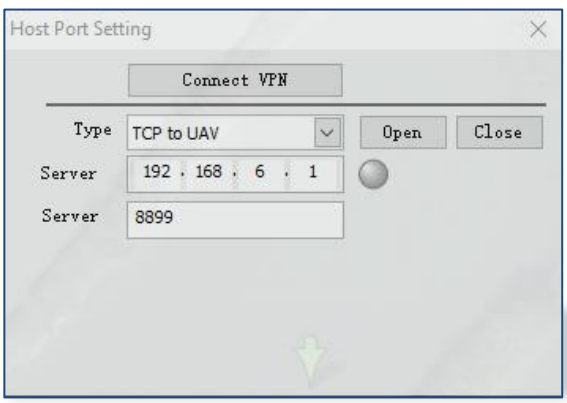
QTY	Description
1	FF VTOL bundle - Quad motor system installed - Main motor installed - Servo installed - Avionics installed
1	Flight controller support VTOL
1	Standard Fysky radio control - 18 channels - Used for ground setting
1	Service Autopilot
2	8S 10000mAh Li-po for FF (1 Set as spare part)
2	42000mAh (18650, Li-ion) battery (6s, 25.2v) Weight 3.6kg For FF fix wing (1 Set as spare part)
1	Dual output charger 6-12S x 2 1200w
1	Telemetry 900mMhz - Range 30-50km - Built in battery 6000mAh for 6 hours - Sbus x 1, Serial x 1 - Wifi, Bluetooth
1	1.8m fiberglass antenna, 2 section 10db, 902 - 928 MHz
1	Nose FPV camera, AV output
1	Analog video link with AV input, Range 10km Receiver & Antenna
1	Compact carrying case 1270 x 360 x 460mm, 5kg

3.3.1 UAV airframe composition



3.3.2 Ground Station

Ground station for FF UAV is shown below, where it is easy to carry and applicable with any laptop with Window 10 system.



Ground station telemetry transfer rate: 115200bps

Com port number: Simply plug-in USB to your laptop, which will automatically set up required software, then launch the GCS40 software after the set up.

Or use WiFi connect, select **WIFI "D04_Radio", Password：88888888.** Launch GCS software, select **TCP to UAV,** enter Telemetry IP address **192.168.6.1,** port number 8899, then click open.

4. UAV Operation

4.1 Preparation

4.1.1 Fuel （applicable for Gasoline engine only）

Gasoline：93#(Country IV) or 92#(Country V)

Lubrication Oil: FD Level 2 Stroke Oil

Gasoline/Oil mixing ratio: 30：1

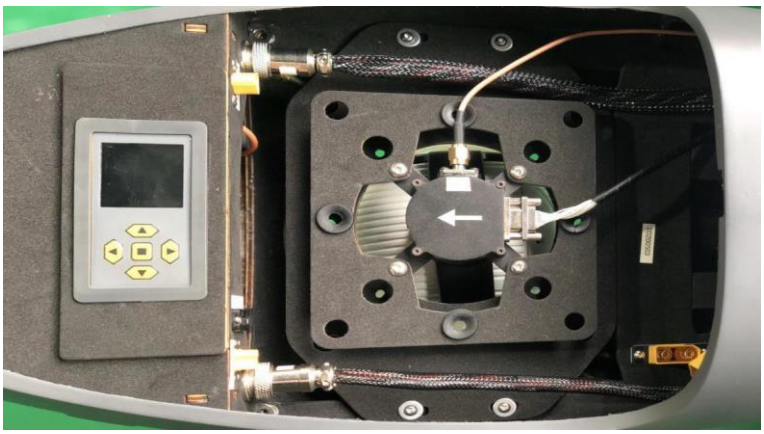
4.1.2 Battery

Make sure all batteries, including battery equipped with avionics (autopilot instrument, control servo, etc.) power supply battery, power system battery, hover system battery, and ground station power supply battery are well-prepared and fully charged.

4.1.3 Mission Equipment Installation Mission equipment could be changed based on actual needs of the mission.

All mission equipment must be installed in specified area of the fuselage, where they should not exceed the nominal load range.

Corresponding shock treatments are also necessary to protect those Mission Equipment.



It is strictly forbidden to change the position of the fuselage and exceed the nominal load.

4.1.4 Mission Planning

Flight plan could be planned in the ground station according to the mission requirement.

UAV can perform variety of actions as indicated by the flight plan at certain coordinate.

Operators can amend the flight plan based on the actual situation.

4.1.5 Contingency Plans

Reasonable contingency plans should be planned near the ground station, where its altitude ought to be the same with the normal operation altitude.

When the UAV is out of service, like its data link is interrupted, the engine is accidentally turned off, or the GPS could not receive any satellite signal, then UAV can return to a safe location.

Carefully survey the landing site, determine the appropriate direction for landing from measurement, such as conditions permit.

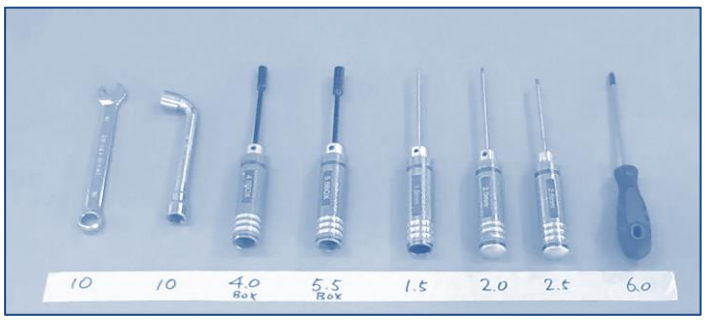
Also, operators should allocate 2 to 3 spare landing point, once the landing conditions change, select the most appropriate landing point for landing according to the actual situation

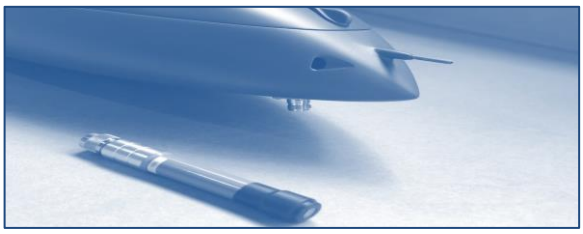
4.2 UAV Assembly

FF UAV structure is simple, do not require any complex auxiliary equipment, along with its easy start up, convenient transportation, maintenance, and withdrawal.

During daily storage and transportation, the UAV can be stored in a box/case, which can be assembled for flight.

4.2.1 Body – Centre Wing Assembly





4.2.2 Hover Arm

Hover Arm is the most important component on achieving vertical Take-off and landing.

The following components and tools are necessary for installation.

Hover Arm (Install the screws)

Corresponding Side Wing (Hex Wrench（M6）)

Installation Procedures

(1) Properly install the quad motor propeller.

Due to the limitation of the external packaging volume, the quad motor is not installed on the hover motor when the UAV is shipped.

User must follow the instructions shown below for proper installation.

Propeller： APC 18 x 5.5

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Propeller： APC 18 x 8e

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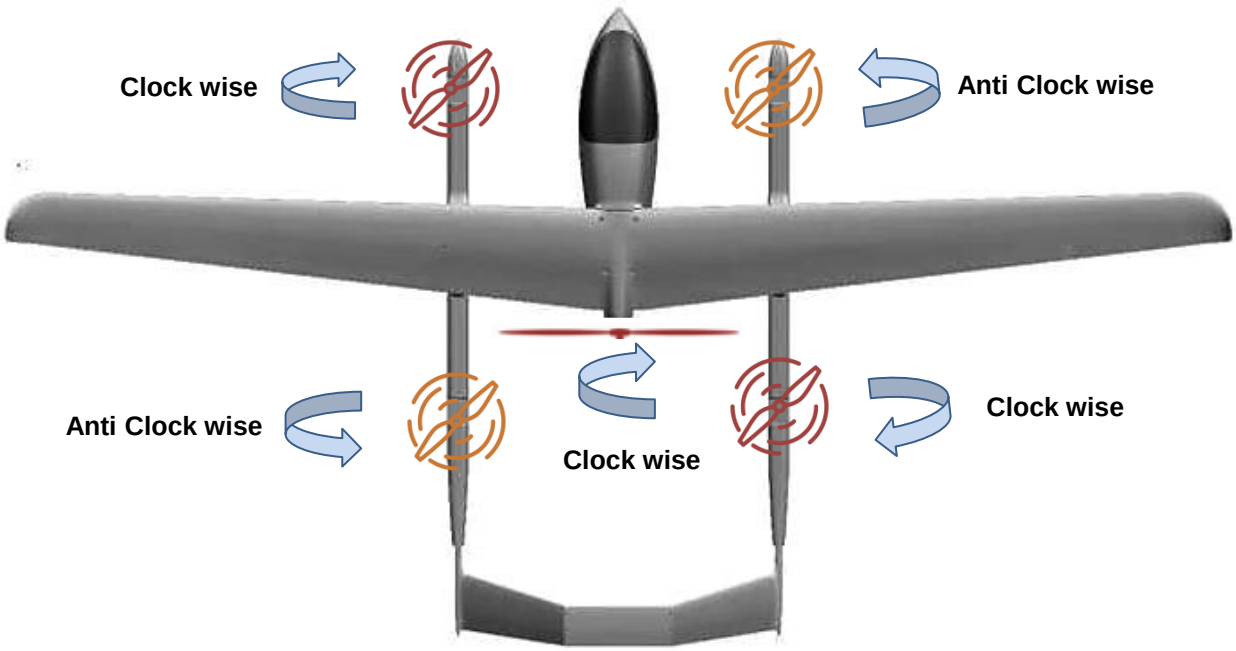

2) Install the hovering arm to the centre wing

Make sure the hovering arm is in the right side.
Check the rotation direction of each quad motor to install the arm to the right side.

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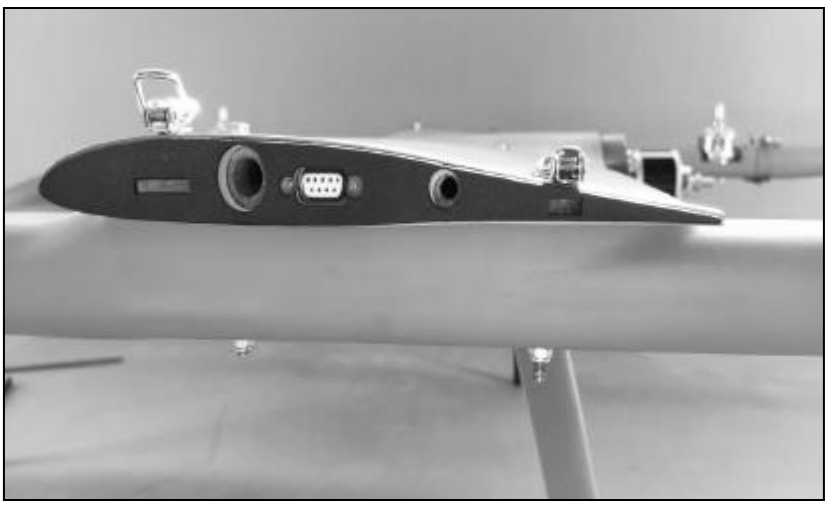
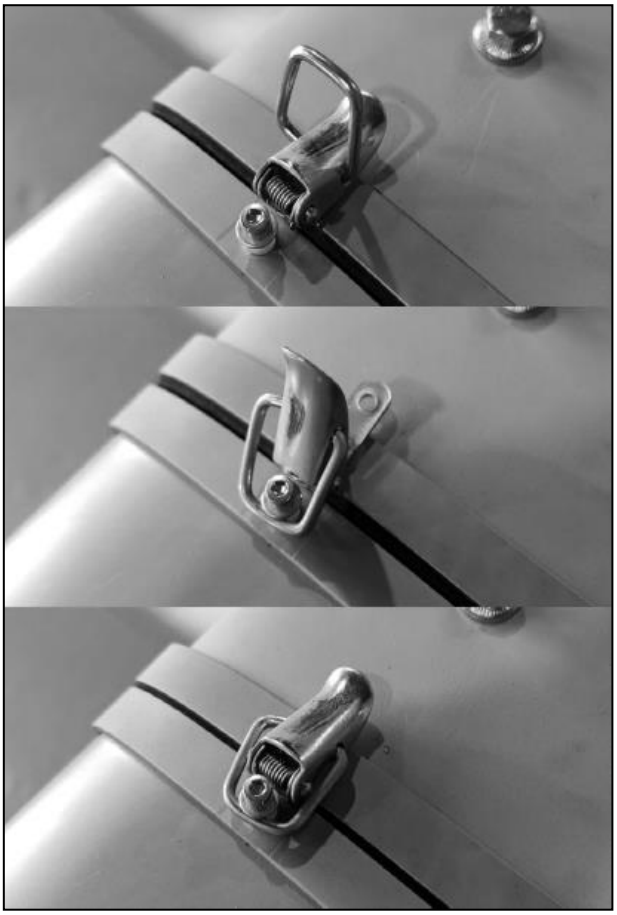


3) Wing Assembly

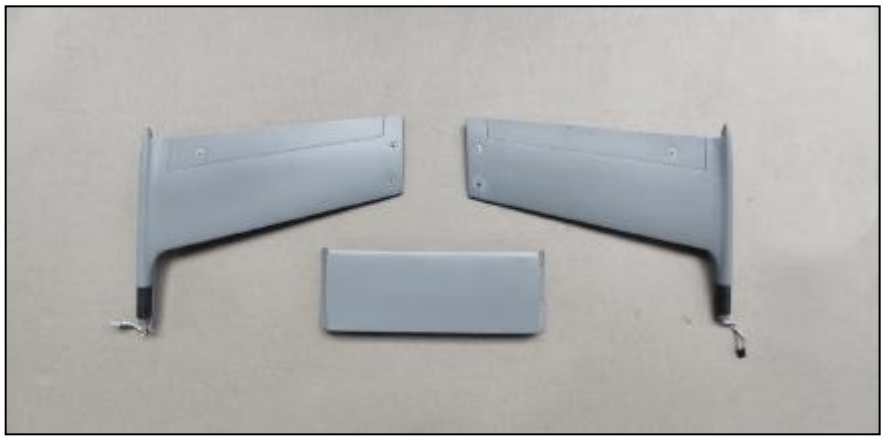


Make sure the lock pin are firmly locked.

4.2.3 Tail plane Assembly

1) Connecting the DuPont connector of the elevator to the DuPont plug on the hovering arm.

2) Make sure they are plugged in the correct polarity and locked.



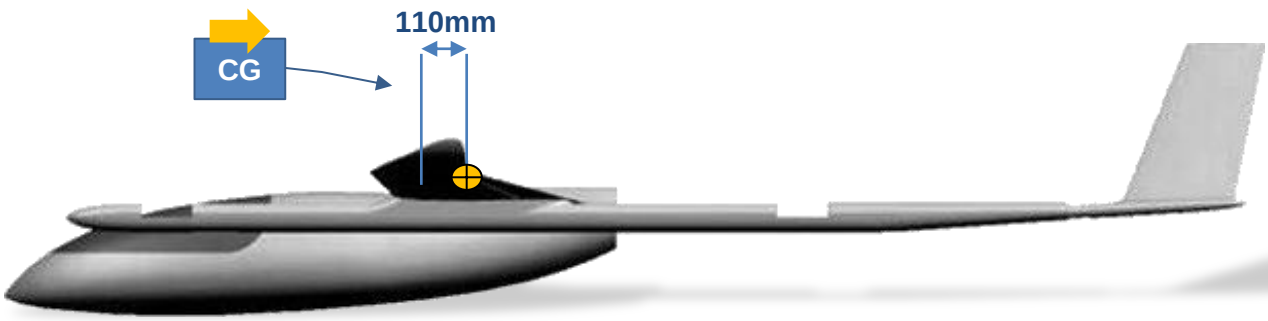
Make sure the DuPont connector are firmly plug in

Make sure all screws are firmly installed.

3) Centre of Gravity

Before each flight, or equipped, replaced the mission equipment, the user need to manually measure the current centre of gravity of the UAV from the design.

If the current centre of gravity deviation is too large (more than 3 mm deviation from factory marked position), user need to move the mission equipment installation location, make sure it comply with factory UAV design requirement.



Do not squeeze the folded DuPont cable during installation, user must use the screws provided along with the product.
Also, be ensure that they are firmly installed and prevent any connection screw from loosening situation.

4.2.4 Electrical Connection

FF UAV electrical connection is simple and reliable.
The electrical interface is mainly concentrated on both sides of the wing.
As shown below, from top to bottom, they were airspeed interface, control signal interface and power interface respectively.

Connect the two side wing cable plugs to the specified cable side connector on the corresponding side of the fuselage with the correct polarity.

Installed the battery in the appropriate installation position, and firmly fixed, where they cannot experience any loosening situation. Also, the user can connect the batteries according to their situations.

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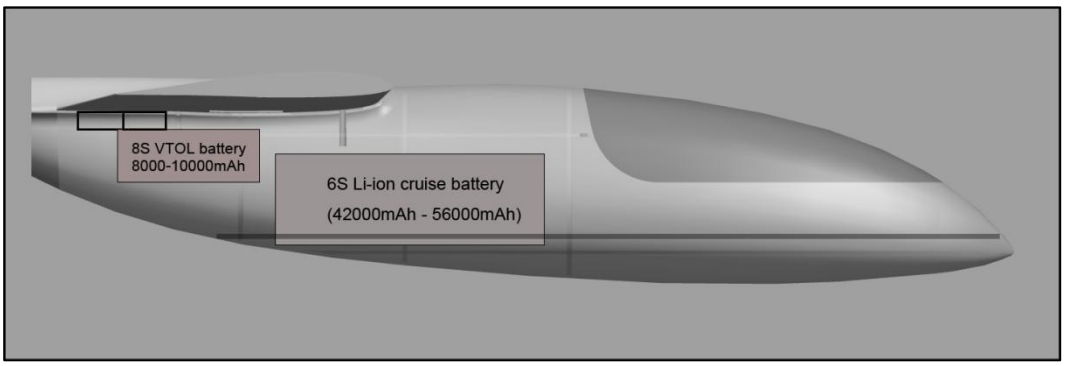
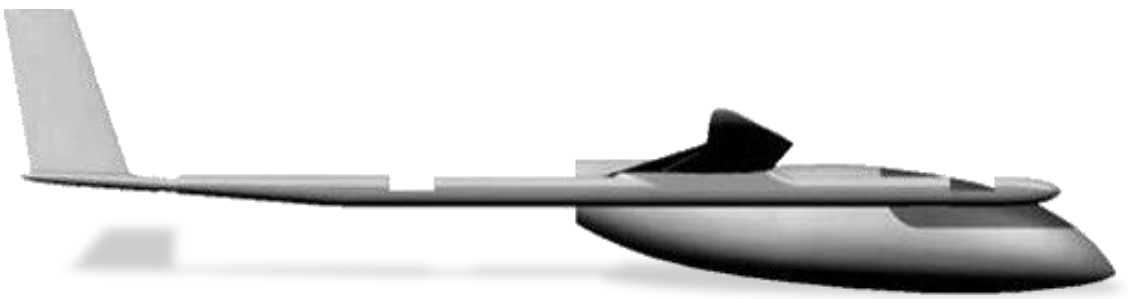
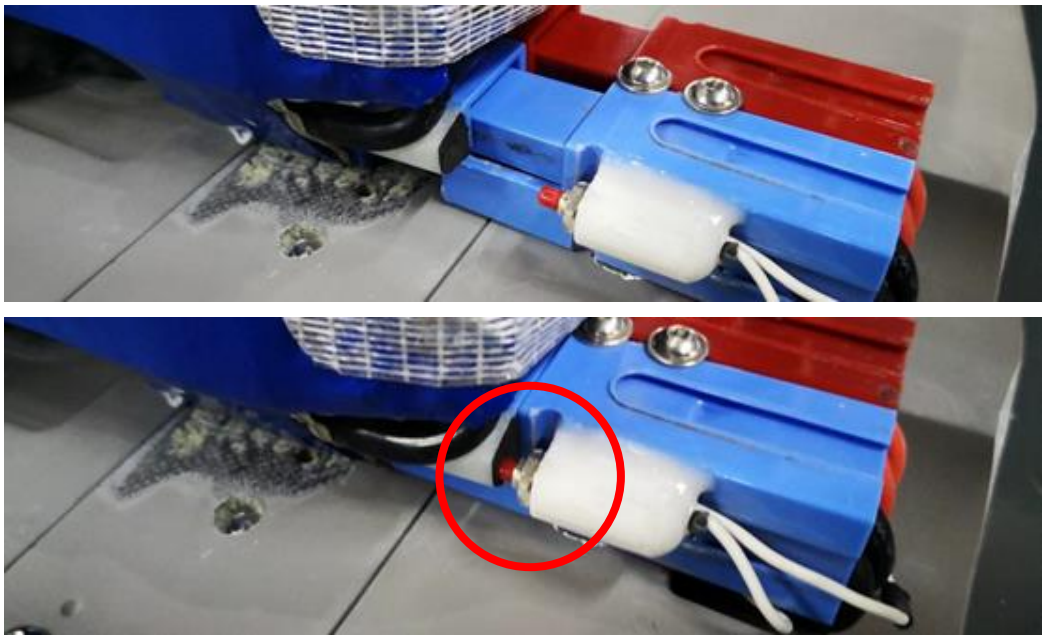




VTOL battery installation

VTOL battery installation



The VTOL battery sensor switch will detect the battery plugin firmly or not. If the battery does not plugs in firmly then the voltage display on software will be “0”.

Each device is recommended to use the specified type of batteries provided by factory.

4.3 Pre-flight Inspection

4.3.1 Connection/installation Inspection

(1) Check the entire UAV cable connection is intact and ensure that each connector is tightly plugged.
(2) Check the engine propeller installation is loose or not, it is necessary to ensure that it is firmly installed. Otherwise, flight should be prohibited.
(3) Check the airspeed tube is intact, without any vandalism.

(4) Connect to the ground station power supply, self-pilot instrument power, steering gear power, the engine starting power one by one.

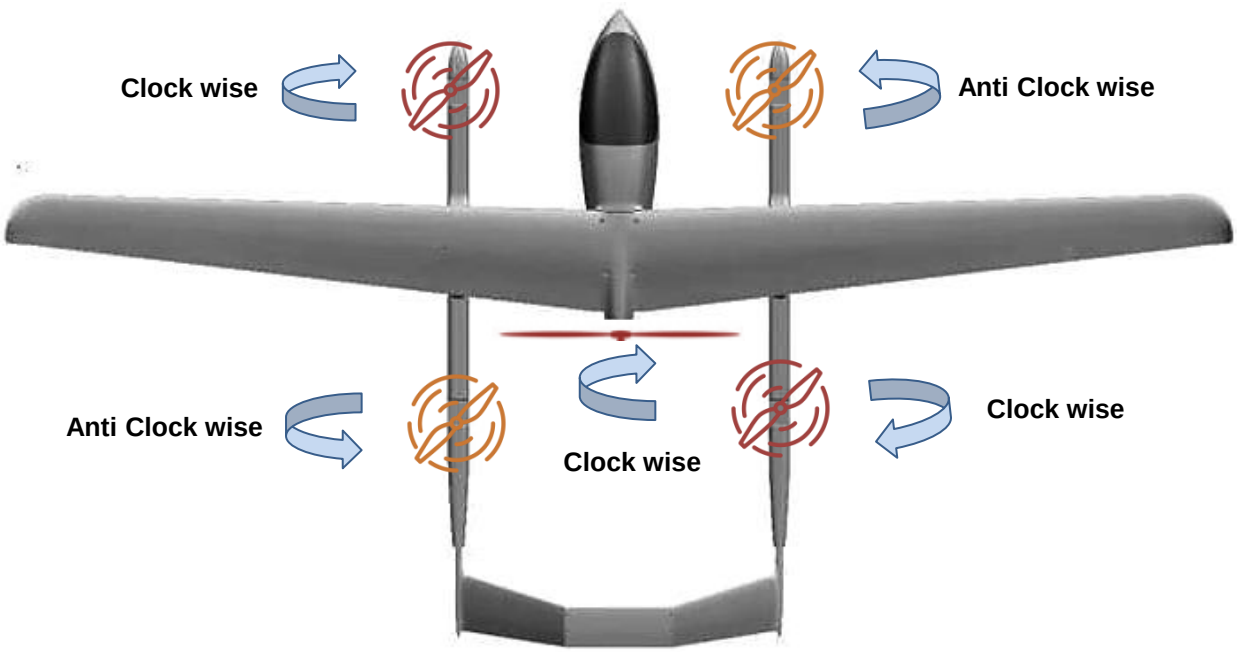
Note: After connecting to power supply, open the ground station software.
Once the connection is completed, then proceed the ground station inspection.

4.3.2 Engine/motor Inspection

(1) Check the forward engine/motor propeller is installed correctly.
(2) Check the rotor motor propeller is installed correctly.

The rotation direction of the forward engine is in clockwise (observe from the nose to the tail).
It should be consistent with the rotation direction of the propeller.

The top left and bottom right rotor motor are in clockwise.
The top right and bottom left rotor motor are in anti-clockwise (Observe from the top of the fuselage, see diagram below for detail explanations)



4.3.3 Ground Station Inspection

For your safety, please unplug all power source or supply when proceeding ground station software inspection.

This is due to parts of the inspection criteria may drive the motor or the engine.

(1) **Remote Control Checking:** This checking mainly confirms the remote control corresponding to the joystick and the plane system is consistent.

The user shaking the ailerons, elevators, throttle, steering, and the hand switching function to joysticks and switches are also the criteria of this checking.

Besides, the operator is responsible to the inspector the pre-flight check page long with its corresponding channel status, which ensures the actual action of the remote control is consistent with the inspection page.

Otherwise, corresponding adjustments need to be made on the remote control

(2) **Posture Checking:** Manually changing the posture of the UAV, compare with the direction indicated by horizon instrument whether consistent or not.

(3) **Magnetic Compass Calibration:** Accuracy of the magnetic compass will directly affect the flight quality of the UAV. If the difference of the magnetic compass is greater than 30°, system re-boot or re-calibration is required.

(4) **Flight Plan Inspection:** Request the long-range flight plan of the UAV to confirm whether the task route is reasonable or not. And to confirm whether the landing route is set and reasonable.

After completing those inspections listed above, the operator can now connect the power supply to proceed with follow-up inspections.

(5) **Proceed** avionics equipment power, power supply, GPS status checking.
Also, check the main power of the avionics equipment, steering gear power and power supply are appropriate or not.

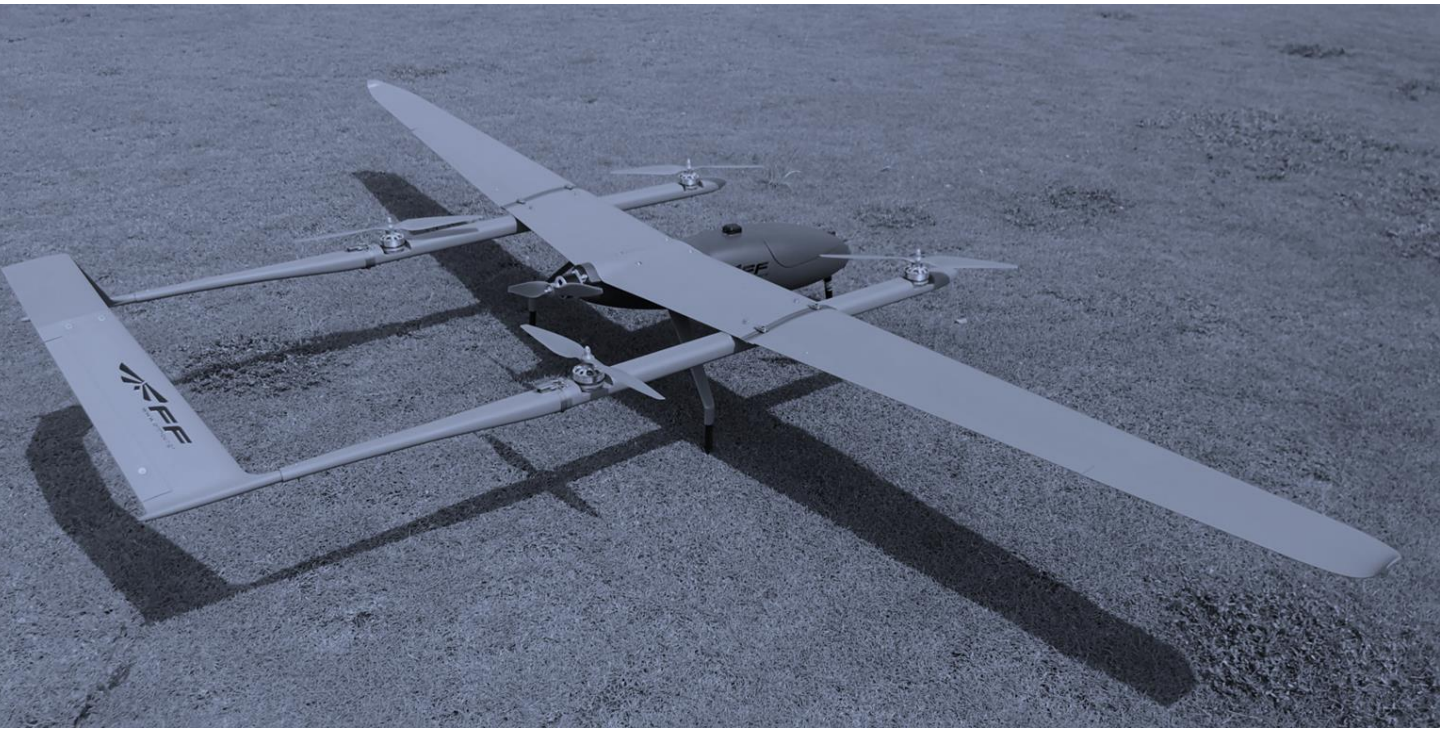
(6) **Servo Control Surface Inspection:** Give instructions through the ground station to check the aileron, elevator and rudder surface deflection and whether the rotation direction of the rotor is consistent with the instructions.
If they are the same, then proceed to the next inspection; if not, the operator needs to re-examine the cable connection.

(7) **Airspeed sensor Inspection:** Accuracy of dynamic pressure is directly related to the safety of the UAV, which should be treated seriously.

a) Check the pitot tube is smooth or not: check whether a rapid increase in dynamic pressure (generally should be greater than 15Pa) through a thumb press to the airspeed tube. Once released, the dynamic pressure is reduced to/near 0, or near wind speed if under windy conditions.

b) Blow the pitot tube directly with the mouth is strictly forbidden, since the water vapour may condense into the airspeed tube, which will block the pitot tube. Besides, blowing the airspeed tube with the mouth will generate a huge pressure, which may damage the dynamometer.

Proceed the pre-flight checking in Appendix 1 before every flight



4.4 The First Flight

After completing the UAV assembly and pre-flight inspections, your UAV is ready for its first flight.

4.5 Daily Maintenance

(1) The operator must clean the UAV body after every flight, ensure that the UAV body is without any material residue which prevents the UAV structure from chemical corrosion.

(2) The Engine intake and exhaust tube should be closed after every flight, to avoid debris destructing the engine structure.

(3) The UAV storage environment should be dry in all time, since the humid environment may affect the autopilot instrument sensor measurements.

(4) The pitot tube must be covered by the hood after every flight and usual storage, to avoid debris blocking the pitot tube, resulting in error in airspeed measurements.

4.6 Engine Maintenance (Gasoline engine Only)

(1) Please use clean 93# gasoline, where the mix ratio with oil should be 30:1.

(2) Make sure the pipeline between fuel tank to carburettor does not experience leaks at any time.

(3) Clean the fuel filter located in the carburettor on a regular basis otherwise, it will cause the failure of oil needle adjustment, and the engine will become unstable.

Mixing and using lubricating oil from different manufacturers or grades are strictly prohibited. Otherwise the carburettor will be seriously blocked.

4.7 Battery Maintenance

(1) The lithium / Li-ion battery should be charged to 3.8~3.9V while in storage.

(2) When operating in winter or high-altitude area, the operator should pay attention to the battery insulation treatments, since low temperature may affect the performance of the battery.

5. DISCLAIMER

Before using this product, please read this statement carefully.

Once this product is being used, the user is treated as recognized and accepted the contents of the statement.
During use, the user is responsible for his own actions and all the consequences arising from it.

Also, the user undertakes to use the product for legitimate purposes only and agrees to comply with these terms and regulations.

5.1 Prohibited Behavior

The following acts are strictly prohibited, where the manufacturer does not bear the responsibility for after-sales service.

(1) Unauthorized modification on the main structure of the aircraft (excluding the mission equipment cabin), adjust the location of equipment, flights beyond the scope of gravity.

(2) Replacement of different types of equipment and accessories

(3) Unauthorized changes, adjustments on the flight control system and the parameters of the Electronic Speed Control (ESC).

4) Crack or changes in the ground station system.

5.2 Violation of security

(1) Flying in airspace without permission from the air traffic control departments, or the flight plan is not reported.
Also, subject to the end-user authorization, the flights are prohibited in military restricted areas, clearance areas, occupied airspace, population, and building-intensive areas.

(2) Flight operations beyond the flight performance parameter of this product.
Those performance parameters including the ceiling, the maximum speed, Cruise seed, the minimum level of flight speed, the maximum wind resistance level, the maximum hover time, the maximum lifetime, and the maximum control distance.

(3) Flight behavior in inclement weather or very low ambient temperature (≤-20°C)

(4) Route planning does not meet the safety regulations of flight behavior。

(5) Did not perform the preflight inspection, or perform reckless flight behavior.

(6) Flight beyond the safe life of the product behavior.

APPENDIX 1

Pre-flight Checking List

Ground Station _____ Maintenance _____ Flight Date _____

Flight Environment			
Weather_____	□	Wind Speed_____ Wind Direction_____	□ □
UAV Inspection			
Are the connecting screws secure?	□	Is the wing locking pin secure?	□
Hover motor/propeller is good?	□	Is the motor mount secure?	□
Are the servo control surfaces being intact?	□	Is cruise fly propeller intact?	□
Is the centre of gravity normal?	□	Oil Level _____	□
Ground Station Inspection（without power）			
Whether the output of the remote control correct?	□	Whether the posture is correct?	□
Magnetic compass calibrated?	□	Whether the flight plan is correct?	□
Magnetic Compass Inspection：_ 、_ 、_ 、_ 。			□
Ground Station Inspection（with power）			
Main Power_____V Autopilot Power_____V Hovering Power Supply_____V			□
No. of GPS satellite:_____	□		
Whether the manual radio control command correct?	□	Whether the hovering propeller and motor is oriented in the correct?	□
		Will the airspeed increase when pressing the pitot tube?	□
	□		□
	□		□

SHARK
VTOL DRONE

FIREFLY
VTOL DRONE

PRE-FLIGHT PREPARATION

PRE-FLIGHT PREPARATION

I-Balance Control Technology Ltd.

1) Power up avionics, keep steady for 30 secs until the self-diagnostic success.
   - Speech warning from Ground Control System

2) Power up VTOL battery and auto starter battery.

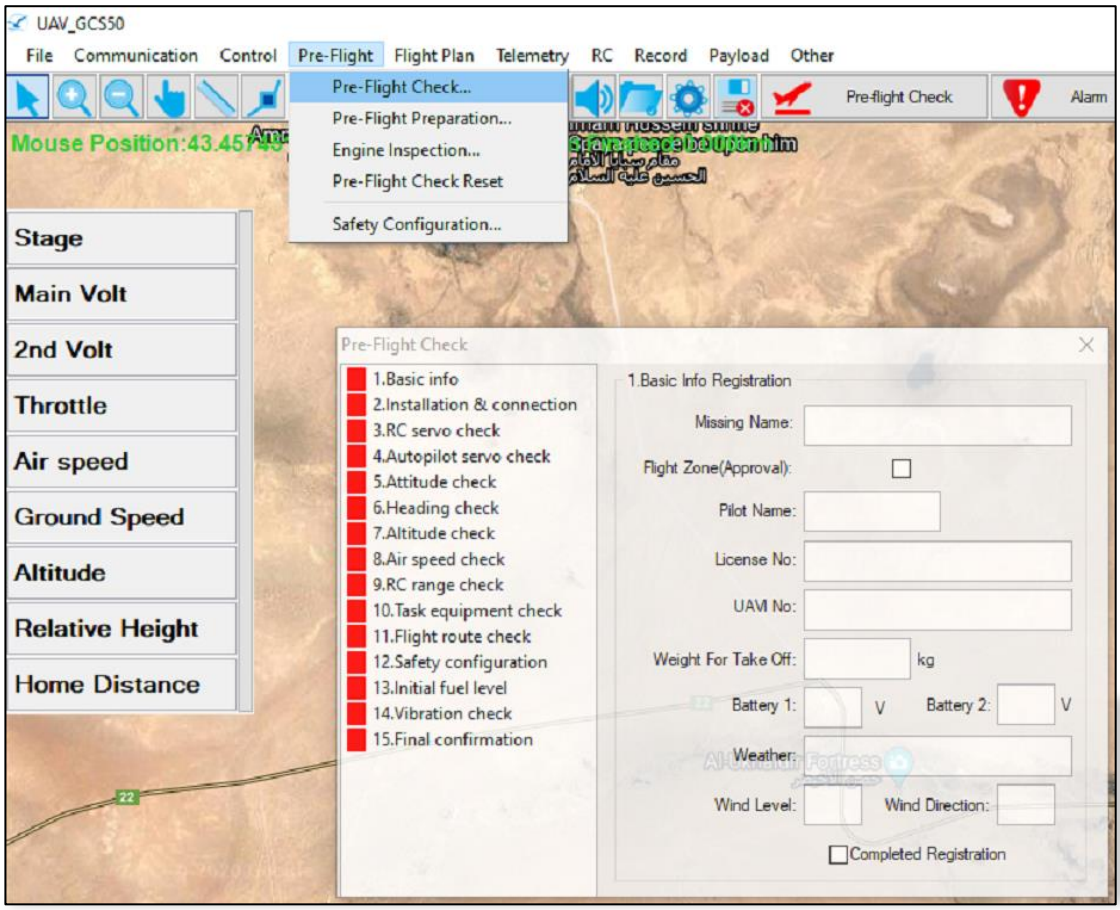
3) Setup all antenna before power up ground control station
- **Warning** : the telemetry will burn within 30 seconds without antenna installed.

4) Launch GCS.

5) Confirm the telemetry linked properly.

6) Read parameters from GCS and confirm all figures identical to factory recommendation.

7) Carefully go through the [Preflight] check list one by one.



8) Double confirm the bearing angle reading from GCS against the aircraft is consistence and stable not changing.

- Use the smart phone as the tools to have the current heading angle value reading.

- The both heading angle reading deviation should less than 30º and reading value stable.

- If not, move the drone to new position to avoid the magnetic interference from environment such as the power cable underground.

9) Set the Radio Control to manual mode, Quad motor mode, Throttle cut normal

10) Unlock the drone by both control stick keep inward and bottom for 5 sec.

11) Manual take off the VTOL drone as normal quad motor drone. Keep altitude at 3m is enough. Pilot should report the feeling of the control is comfortable or not.

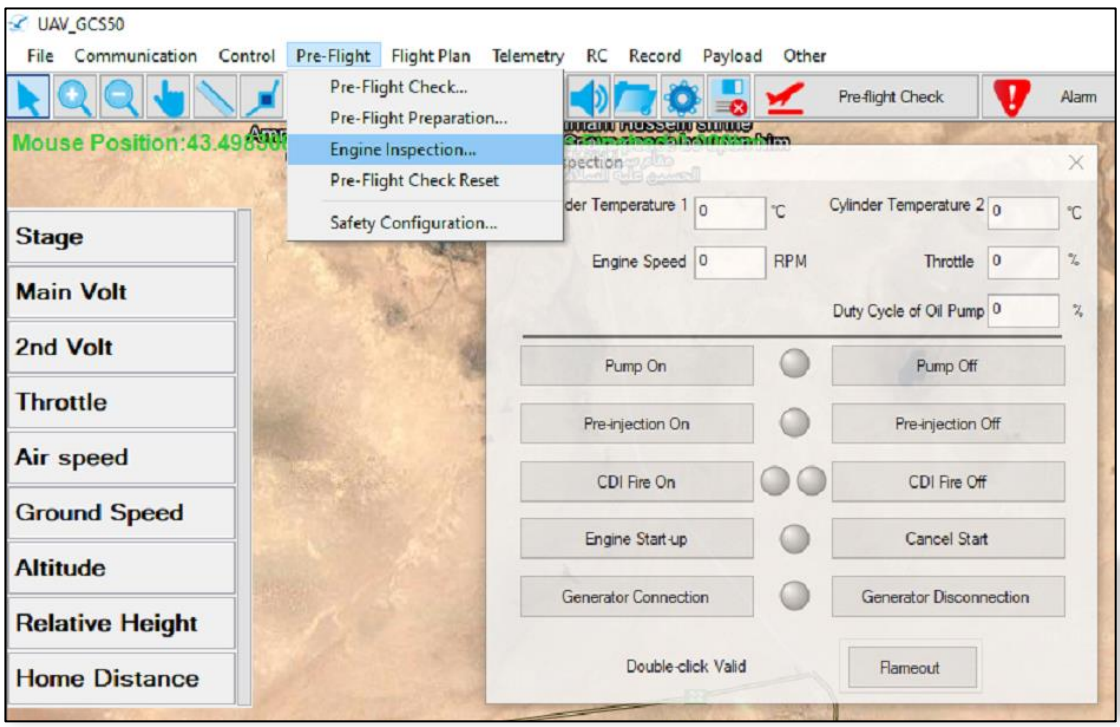
This will help to confirm the propeller installation properly and the flight controller work normally. (If no RC pilot available then the step possible to bypass)

12) Land the VTOL drones as normal quad motor drone.

13) Set flight mode to Fix wing

14) Start engine from Radio Control by switch SWH.

- If the EFI system installed and click the Engine Inspection menu for the engine operation.



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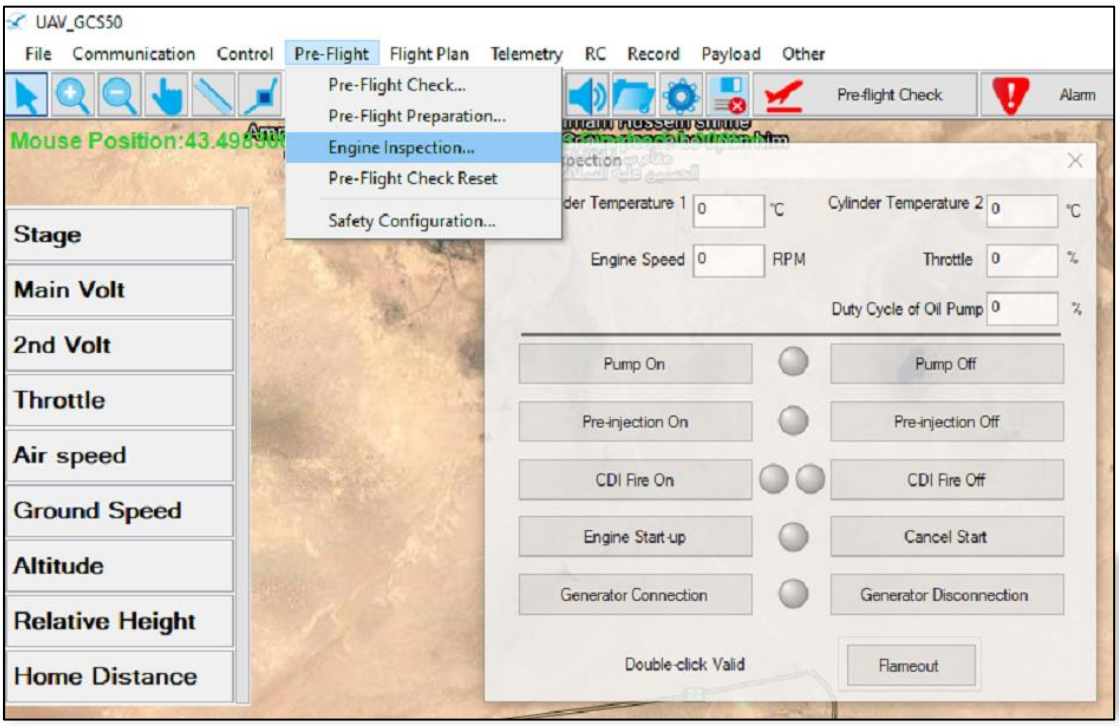
- If NO EFI installed and skip the above step.



15) Monitor the vibration from step (7) [item 14] of the value within the requirement comply to the specification.

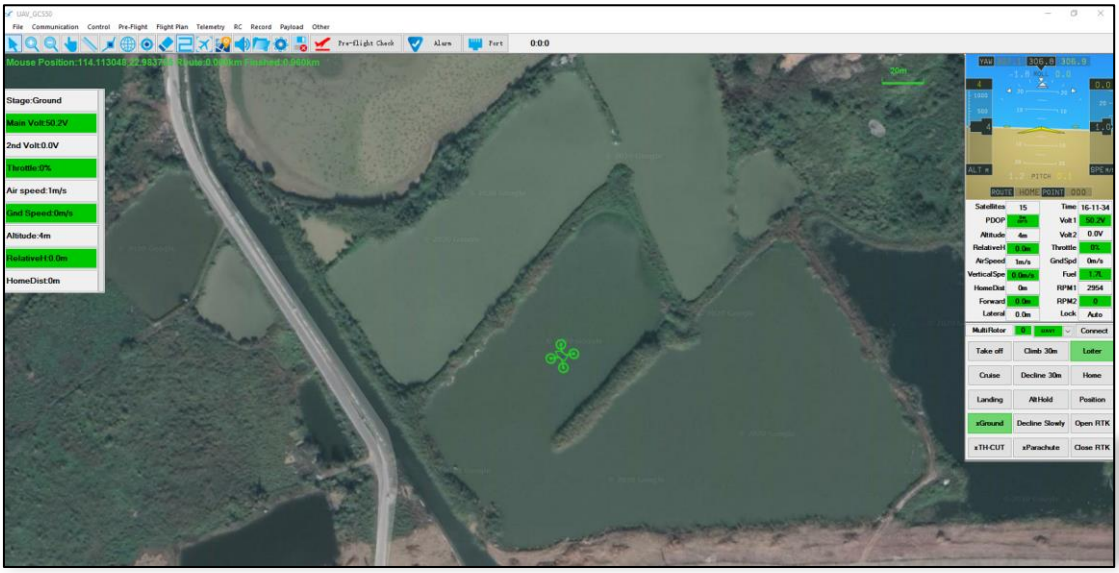
16) Radio control set the throttle cut switch **[SWD]** to **[Throttle Cut]**

17) Radio controller set the control to **[QUAD]** mode , **[Full Auto]** mode, Throttle cut **[SWD] Normal**, leave throttle stick at middle.

18) Start engine from GCS or switch **[SWH]** from Radio control.

19) Confirm the following screen as shown.

Note: The screen should **NOT have any RED** color value and warning. Check the value inside the circle is normal.



20) Double Click **[Take off]** button, the drone will take off and stay at 3m altitude hovering. Once you feel everything normal then Double Click **[Cruise]** button, the drone will climb up to 50m then accelerate by throttle up of the main engine. Once the air speed up to 20m/s and the quad motor will cut out automatically and means transition success.

Note: The pilot possible to click **[Home**] anytime to abort the mission. It will force the drone fly back home for landing automatically.

The quad motor will activate once the drone fly back away home point 130m. (For example of the current altitude above 80m, it will fly back home and descent at the same time)

21) If the transition success then the drone will keep circle at fix wing mode at adius 300m around home point.

22) Click the **[Alarm]** menu and verify the Elevator value.

Note: It should be –10 ~ 20 % range is normal. Perfect value is 0%.

If the value exceeds the above range means the Centre of Gravity (CG) is incorrect. Pilot should land the drone ASAP and balance the drone again before next flight.

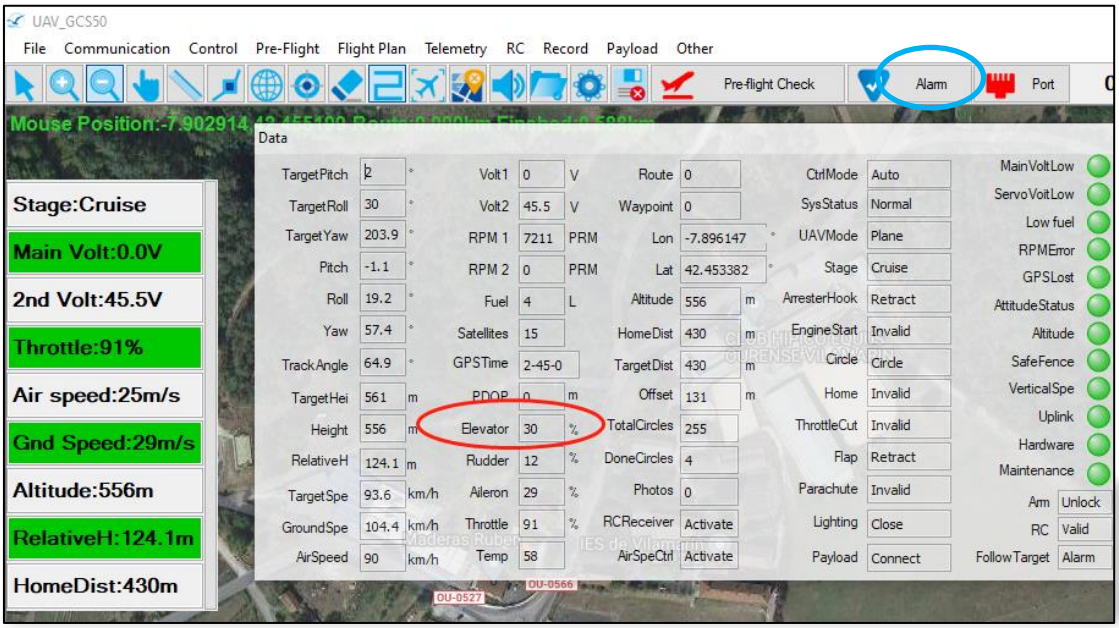
The value show below is 30% which is exceed the range and means the nose is too heavy.

You should add weight on tail (in this case may be add 200g) or reduce the weight on nose.

Means the CG position require to be adjusted.

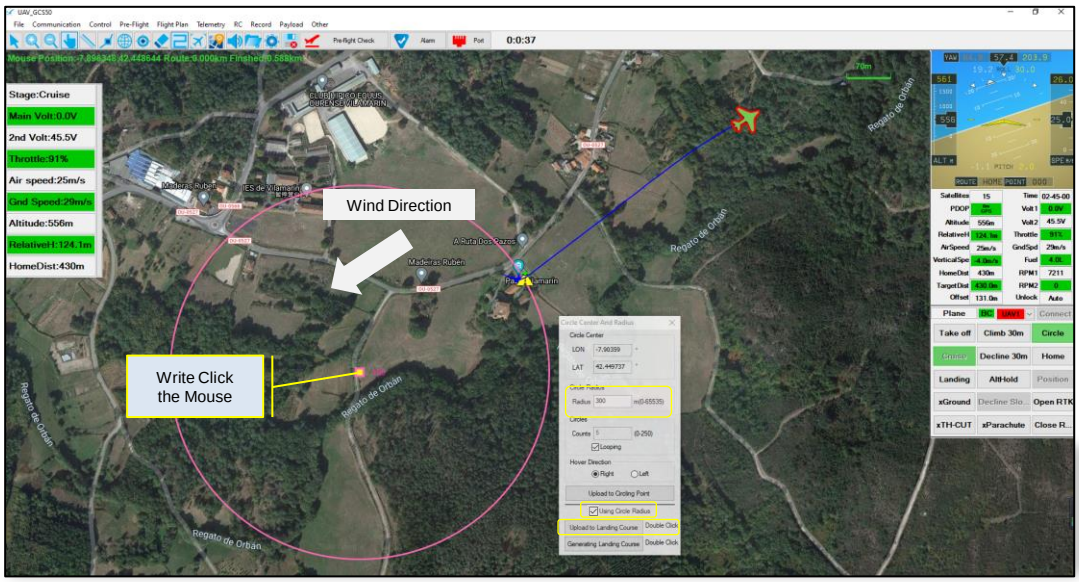
The CG position of every drone will vary a little bit and should find the right position with couple test flight by verifying the Elevator value % achieve the perfect value or within the range.

Once the Elevator value satisfy and remark the new CG position and use it for the ongoing flight.



23) To land the drone just simply upload the landing circle point heading to home point by right click mouse on the screen.
Suggest the circle center away from home point >300m.
Then the drone will execute the landing procedure automatically.

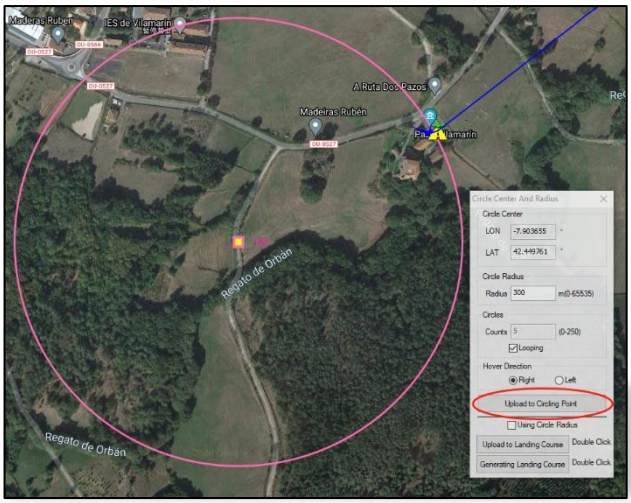
- Switching to the way point at any time always should be in smooth flight path.
- **NEVER** turning the drone with sharp angle.
- Click **[Upload]** to Landing Course once you satisfy the landing path, the drone will fly to the circle path and decent until the safety altitude, the drone will head to the home point until 130m ahead and activate the quad system for vertical landing.
- Straight away to click the [Home] will force the drone fly back for home point landing immediately.
  The operation is not recommended except in emergency happen and no time to define the landing path.
  Since this operation will not aware of the wind direction and landing may not in perfect and sometime will cause the problem of landing such as cross wind or tail wind situation.



<u>Switch to fly circling continually</u>.

Note: This operation also used for instruct the drone fly to point where you Right click for circle during the mission. Right click mouse at any mission way point will resume original flight path. Each operation will be prompted for confirmation.

Click the **[Upload to circle point]** to do it.



Mission planning

1) Pilot are possible to design the mission and upload to flight controller before takeoff or even during the mission.

2) Once mission uploaded and right click the waypoint then press execute then it will take effect immediately.

3) After uploaded the mission and please erase it from GCS and download again to confirm it successfully stored at flight controller.

Suggest for the first flight test:

1) Take off the drone to circle around home point as normal procedure

2) Climb up to 200m by 6 times operation (every time climb up 30m) to prevent the over loading of the engine.

3) Design the mission-2 with range 500m. Verify the flight altitude (in Sea level). Upload the mission-2 and switch to any way point (Right click mouse) in smooth transition while drone flying in circling.

4) Land the drone as usual.

5) Replace VTOL battery.

6) Repeat step (1) – (2) for takeoff.

7) Upload new mission with 10km range at altitude 200m.

8) Switch to new mission while circling.

9) Monitor the telemetry connection from GCS during the mission confirm the link stable.

10) Monitor the video link during the whole mission.

11) Land the drone as usual.