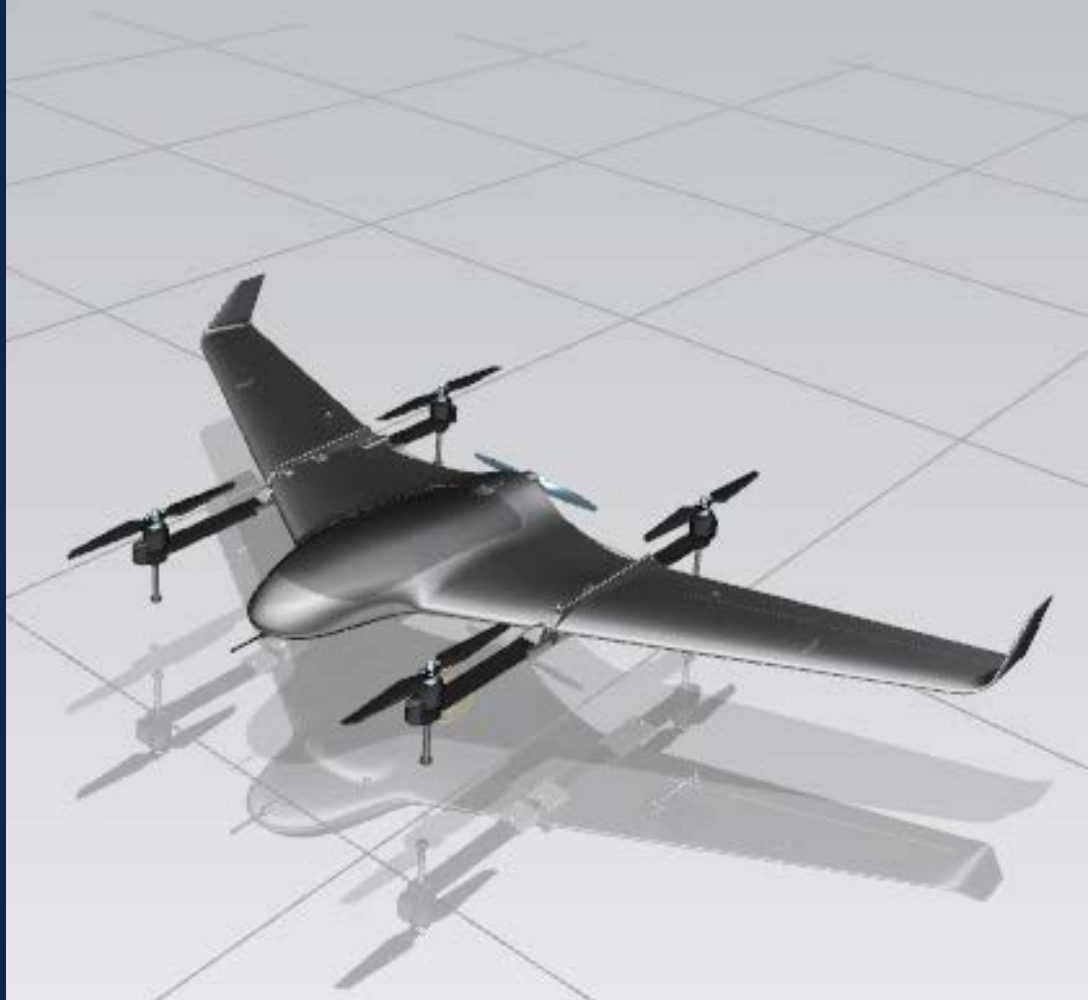
GENERAL MANUAL

SparkleTech

Model no : S2010

SuperBird



www.sparkletech.hk
www.sparkleuav.com
www.drones-mart.com

Designed and manufactured by Sparkle Tech Ltd.

1. Safety Instructions

1.1 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.

1.2 Precautions

1.2.1 Air Traffic Control

Subject to the country that you will use the SuperBird, 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.

1.2.2 Flight Area

(1) If the use of the SuperBird 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.

1.2.3 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.

1.2.4 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.

2. Overview

SuperBird is a composite vertical take-off and landing VTOL design UAV and designed and manufacturing by Sparkle Tech profession team, applies fixed wing combined with the quad-rotor complex fixed wing layout, which solves the problem of vertical take-off and landing in a simple and reliable way.

Its superior aerodynamic characteristics have been refined and evolved by birds for thousands of years. Sparkle Tech started development of the flying wing design back in 2012 and the successful test flight happened in 2014. So Sparkle Tech have a lot more experience on flying wings than others.

The VTOL solution successfully implement to the flying wing platform since 2016.

This is due to the four electric motor driven rotors like those of ordinary drones you see all the time. We all know that today there are millions of quad-rotor drones in use all over the world. So this design is fully mature and its reliability is beyond doubt.

2.1 Features

- Layout : Simple and reliable composite structure from the application of conventional flying wing and quad-rotor combination as the layout pattern**.**

- Practical and Efficient: Flying wing UAV with long endurance, high speed, long distance, and durable in structural.

- 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 controller 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. System Component

3.1 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.

3.2 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, 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.

3.3 UAV Assembly

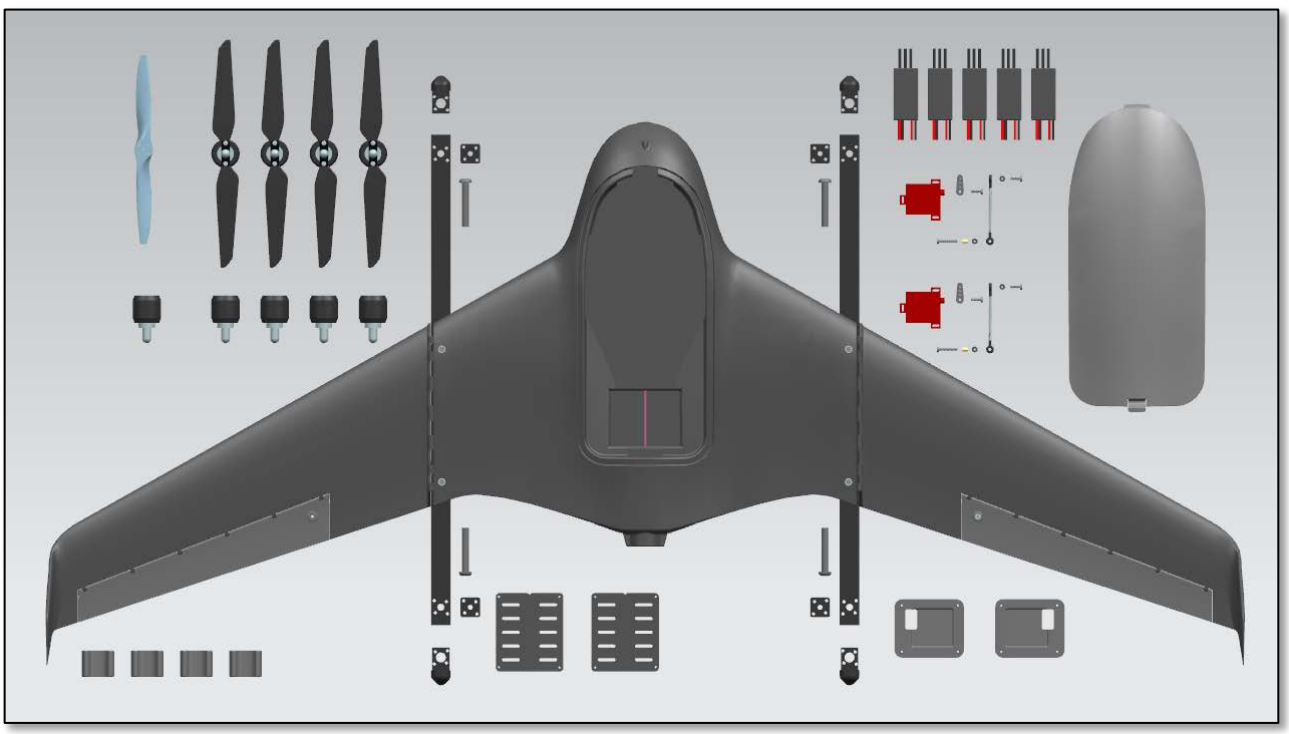
SuperBird structure is simple and durable, do not require any complex auxiliary equipment, along with its easy set up, convenient transportation, maintenance, and withdrawal.

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

3.4 Flight Parameters

SuperBird Technical Data	
Item	Data
Takeoff weight	2600 g
Beaufort wind scale	<7.9 m/s
Max Endurance	70 min
Hovering time(VTOL)	130 s
Max speed	25 m/s
Distance of fixed wing to Quad motor while RTL	30 m
Transition time to fixed wing	5 s
Min loiter radius	90 m
Max rolling angle	25 °
Max climbing angle	15 °
Max decending angle	-15 °
Max climbing speed	3 m/s
Min air speed	17 m/s
Cruise speed	18 m/s
Max air speed	23 m/s
Stall speed	< 16 m/s
Optimal cruise speed	18 m/s
Fully charged voltage (4S)	16.8 V
Low voltage RTL	12.4 V

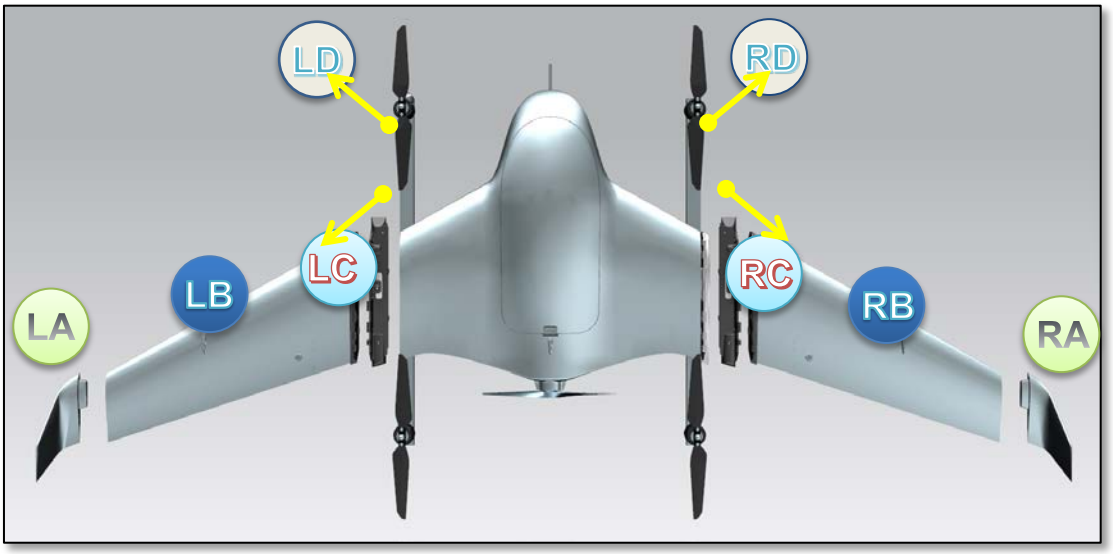
3.5 Airframe components



3.5.1 Installation instruction

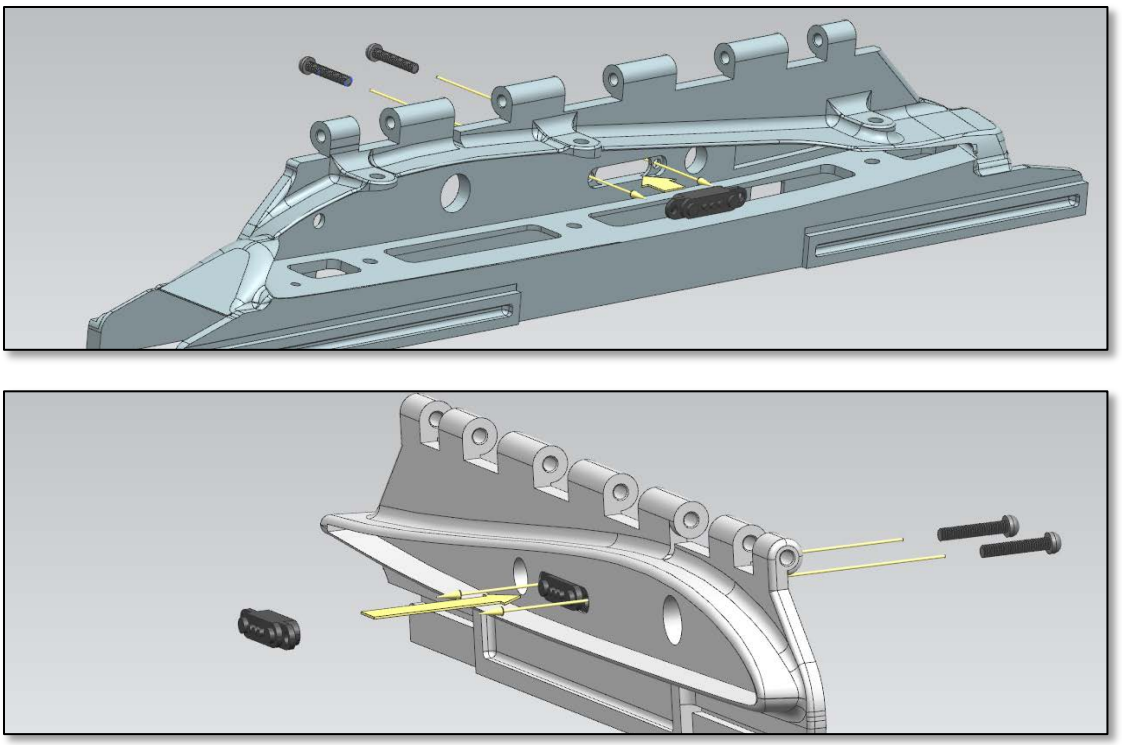
Note : “L” and “R” is the Symmetrical parts

Glue “LA” to “LB” as the figure 1-1



1-1

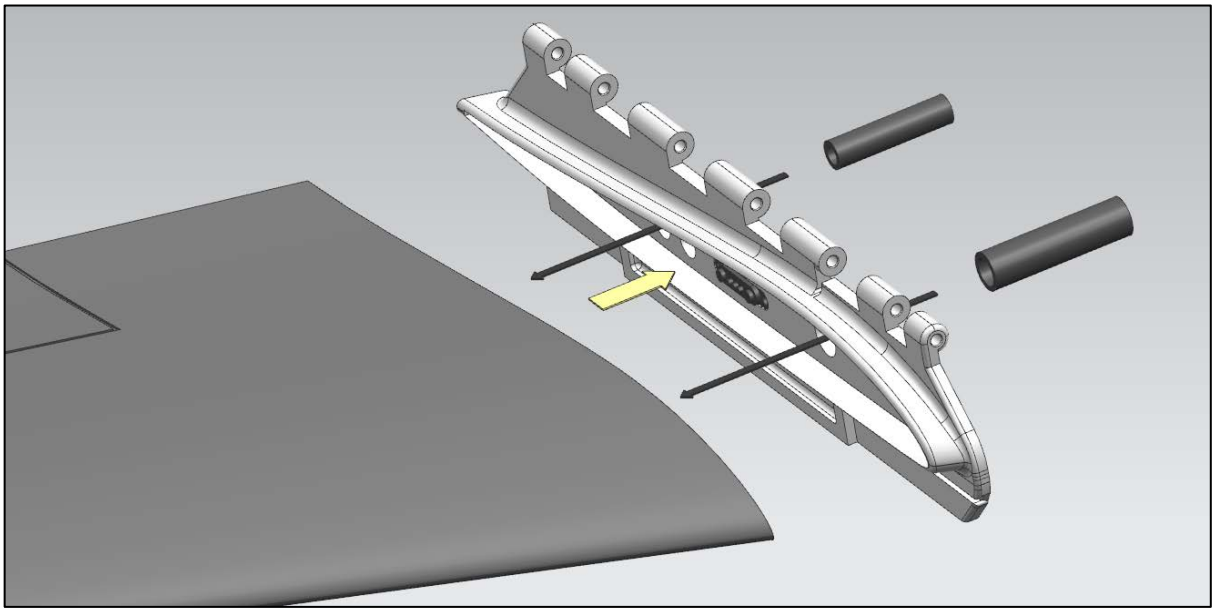
Install 3-Pins magnetic connector for the aileron servo connection (Fig 1-2)



1-2

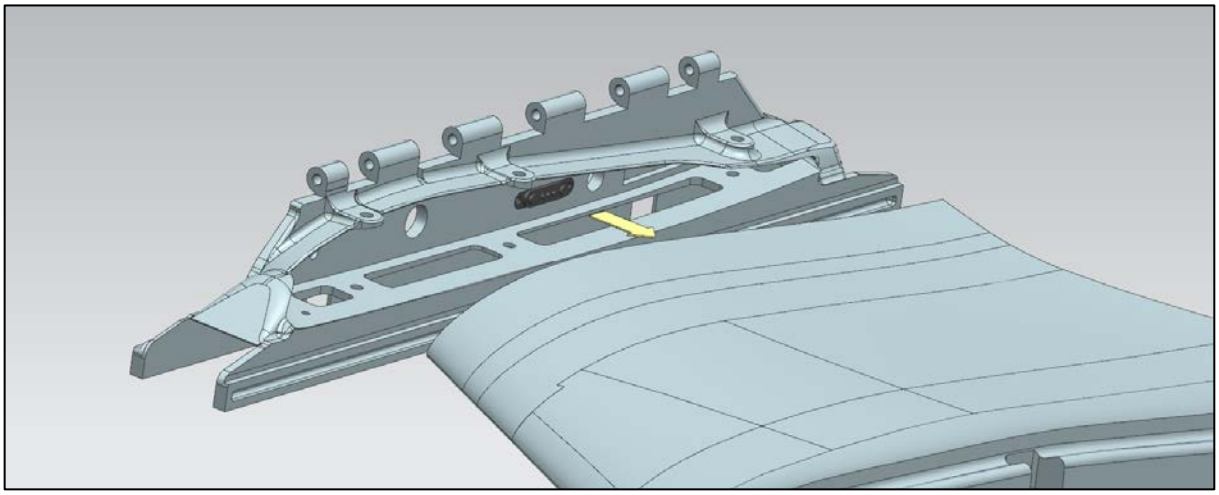
Installing hinges

- Soldering the servo cable. Glue the wing panel to hinge permanently. Glue the 8mm and 6mm carbon tube inside the wing panel.(Fig 1-3)



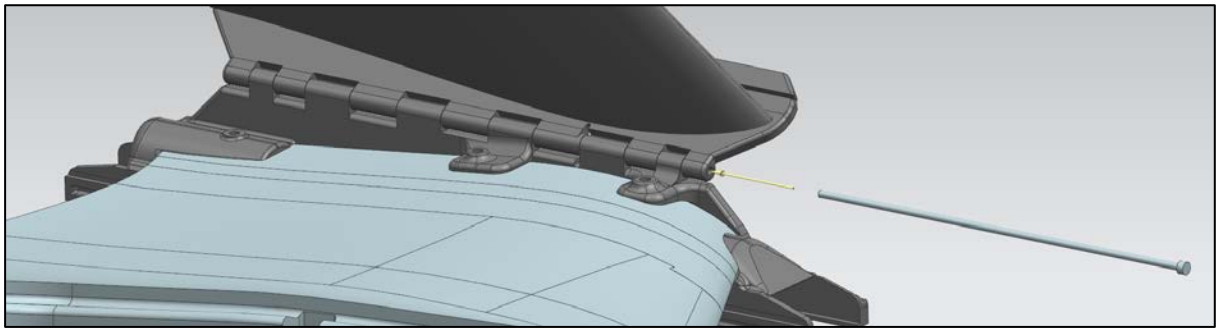
1-3

- Glue the hinge part to the fuselage permanently. (Fig 1-3-1)



1-3-1

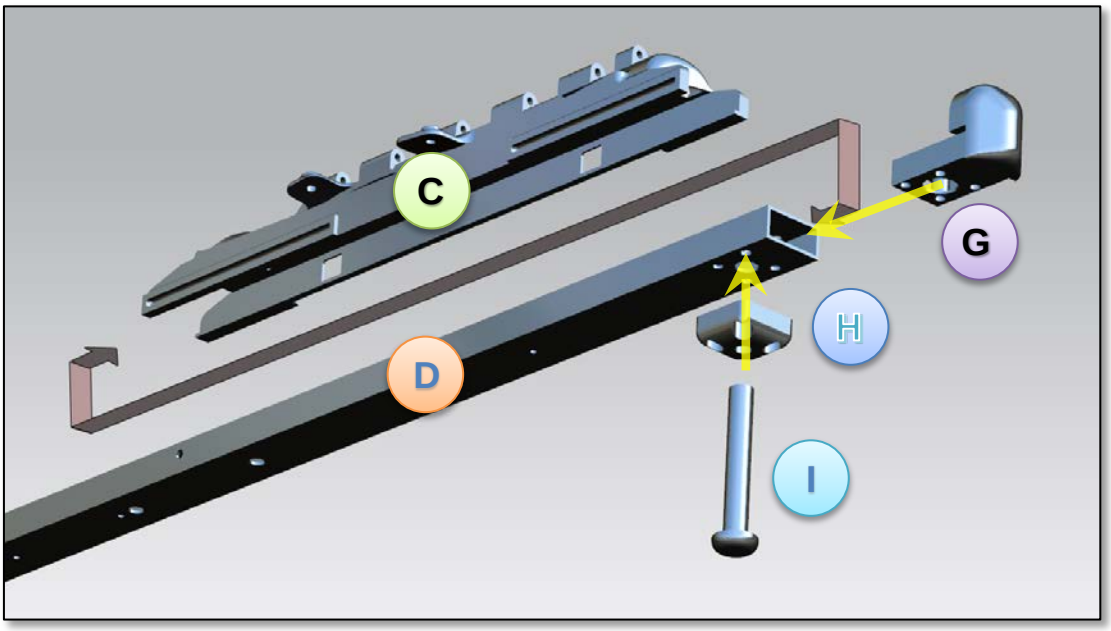
- Plug in the 2mm hinge pin and make it turn freely.(Fig 1-3-2)



1-3-2

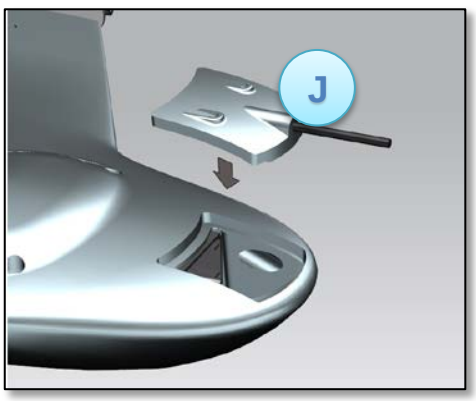
Installing airframe

- Plug in the “C” to “D”.(Figure 1-3)
- Install the motors , and part “I” – “H” – “D” . Route the motor cables from the center of “C” to fuselage. (Figure 1-3)
- Connect the ESC and fit inside the ESC compartment of fuselage

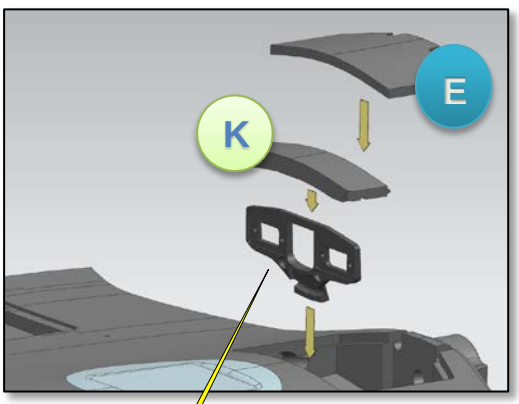


1-3

- Connect the pitot tube from part “J”. Glue the cover permanently whenever the cable well installed inside or make it removable for future maintenance in need. (Figure 1-4)
- Glue “K” to fuselage permanently. (Figure 1-5)
- Glue “E” to fuselage whenever the ESC installed and cable well connected inside or make it removable for future maintenance in need. (Figure 1-5)

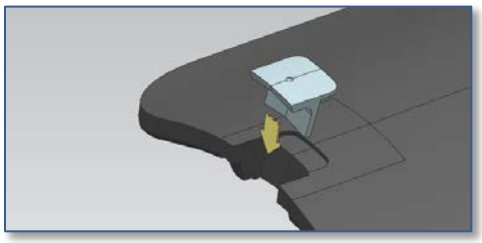


1-4



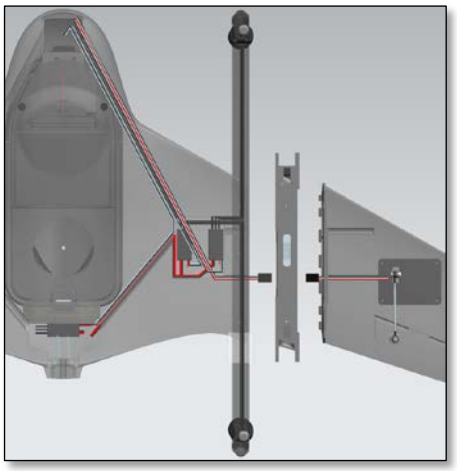
1-5

- Glue the plastic part to canopy (Fig1-6)

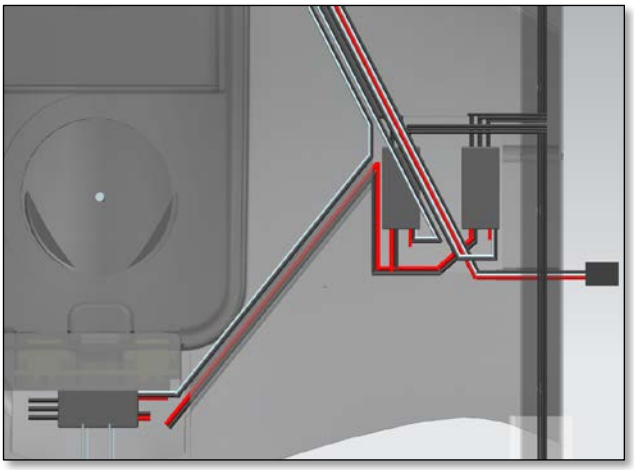


1-6

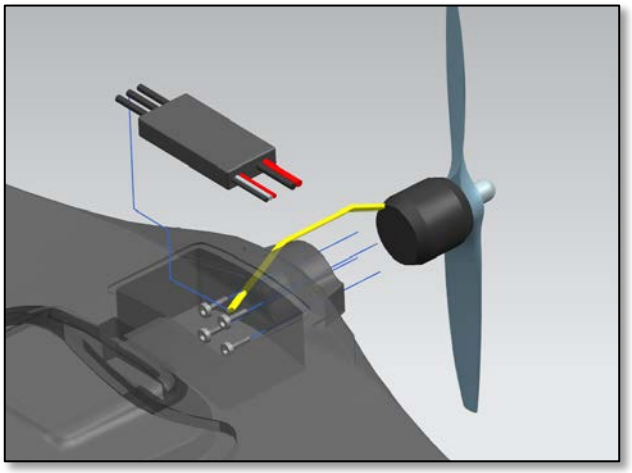
Avionics installation



2-2

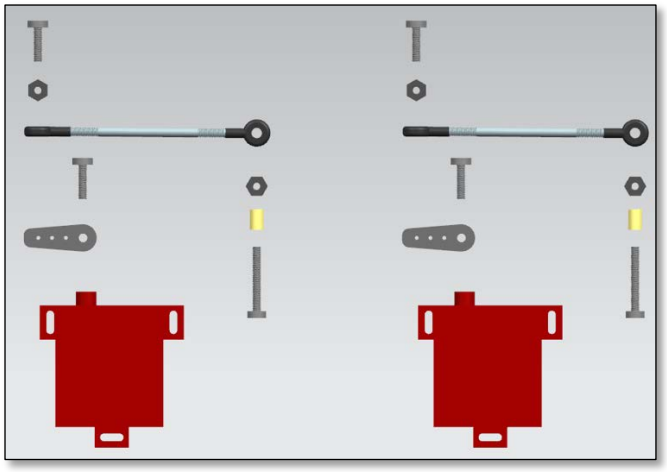


2-3

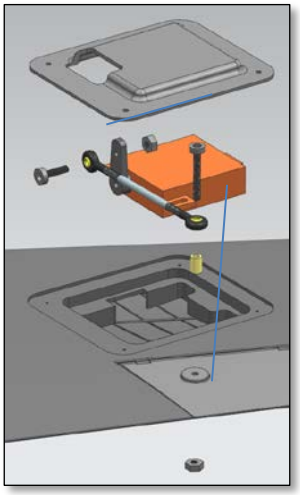


2-4

Servo installation



2-5

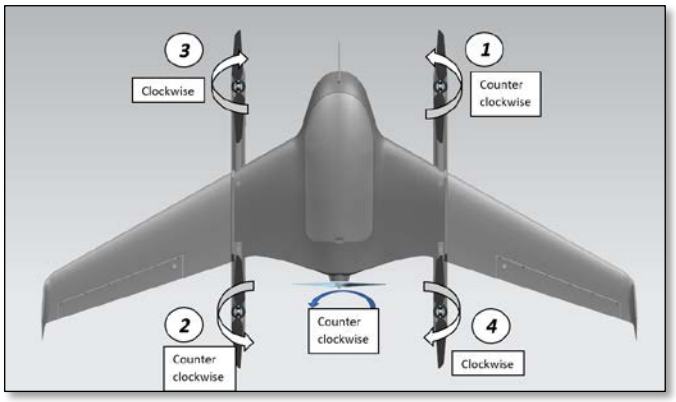


2-6

Propellers installation

Properly install the quad motor propeller. Please bear in mind the difference rotating direction.

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



Propulsion Propeller : 8 x 4e

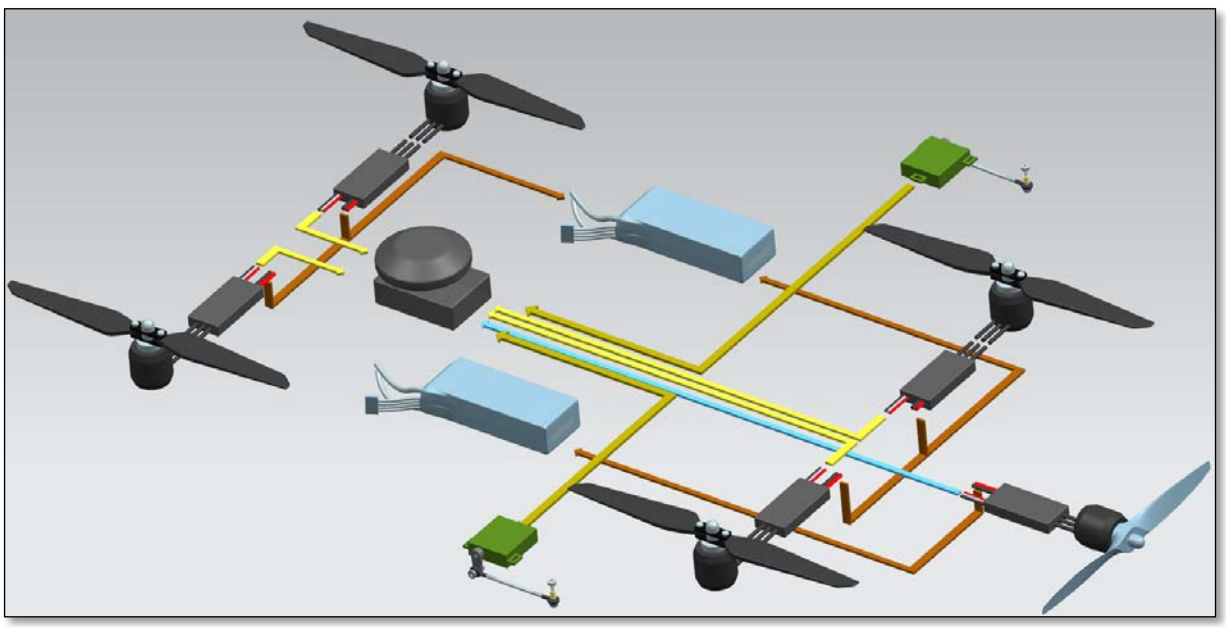
Propeller 1 : 8.5 x 7

Propeller 2 : 8.5 x 7

Propeller 3 : 8.5 x 7

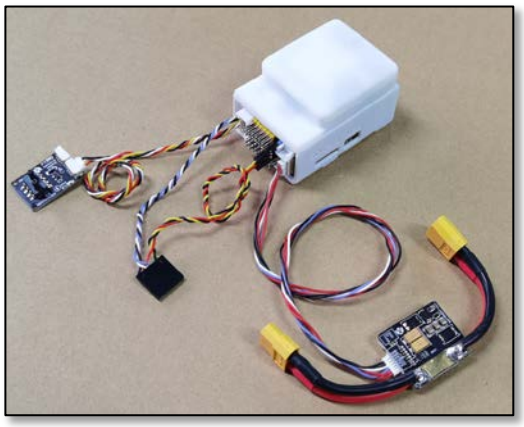
Propeller 4 : 8.5 x 7

Avionics block diagram

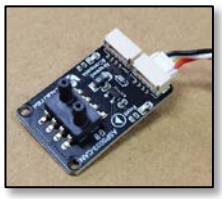


3.6 Flight controller

The RP-02 is an internal vibration dampened autopilot with GPS antenna module integrated for ruggedness. It features fully redundant sensors, an expanded number of outputs, temperature-controlled IMUs, and is the first high-performance autopilot with an integrated AT7456E OSD chip.



Air speed sensor and external digital compass device install at the nose. It will keep away the interference source from battery and onboard electronics.



3.7 Ground control system

Ground control station has undergone a lot of optimization based on QGC, a better interactive interface, a larger controllable map field of viewing, the aircraft implements intelligent waypoint planning, automatic mission execution, automatic follow-up, and one-click home, highly provides working effectiveness in professional fields.

4. Hardware

4.1 Preparation

4.1.1 Battery for propulsion

Standard Li-ion battery 18650 x 8 pcs (4S 7000mAh) should be used for propulsion power.

Recommend total capacity should be 6000 ~ 7000mAh.

4.1.2 Battery for VTOL

Common Li-Po battery to be used for VTOL quad motor system.

Recommend Li-Po battery with 4S (14.8v) 1500mAh and above 60C discharge rate to be used.

4.1.3 Battery Charger

(1) Propulsion battery :

Li-Po battery, 4S 1P(1500mAh)
Fully charged voltage is 16.5 ~ 16.6V

(2) VTOL battery :

Li-Ion battery, 4S, 2P(7000mAh)
Fully charged voltage is 16.8V

Always install the fully charged battery for every flight.

4.2.1 Flight controller

Most of the open source flight controller available in market will work well. The preinstalled flight controller customized for the best performance and uploaded the parameters.

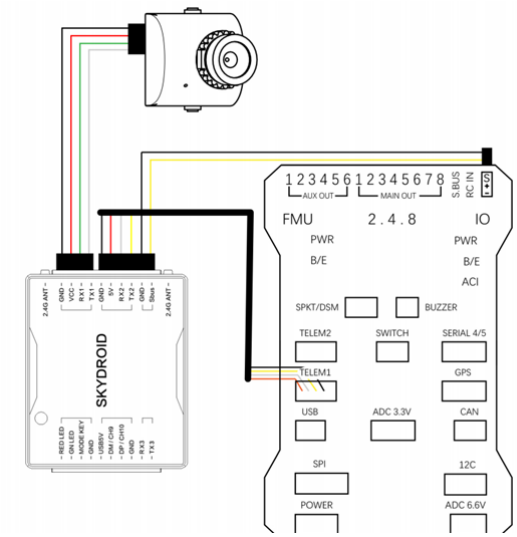
4.2.2 FPV camera

2-axis stabilized camera provide the excellent FPV features as well as surveillance application. Video captured in SD card with 1920x1080 HD quality.

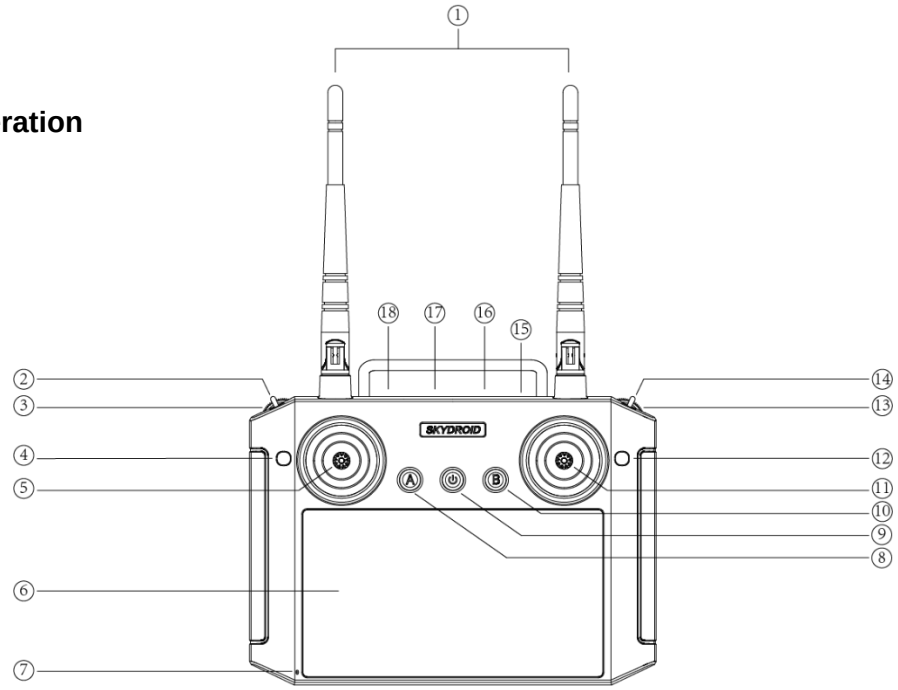
Camera controlled from the H12 controller control roller.

4.2.3 Telemetry & video link

R12 receiver provide the 5 ~ 10 km control range depends on the environment as well as the radio condition of the flying zone.



4.3 H12 operation

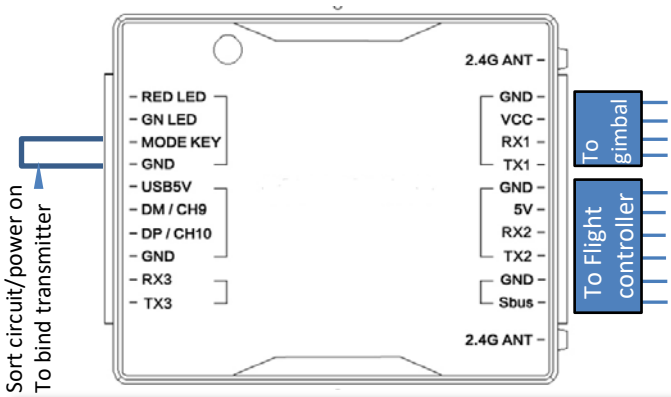


No	Functions	No	Functions
1	2.4G , 3dB Antenna	10	Return to Home (channel 8)
2	Mode switch : Auto – Loitor – Quad hovering	11	Control stick (Channel 1 & 2)
3	Channel 11 (Dial G)	12	Channel 10 (Button D)
4	Channel 9 (Button C)	13	Gimbal moving Up & Down (Channel 12)
5	Control stick (Channel 3 & 4)	14	Channel 6 (3 position switch)
6	5.5” LCD screen	15	Speaker
7	Microphone	16	SIM card slot
8	Fixed wing cruise (Channel 7)	17	Charging port (Type C)
9	Power Switch	18	USB cable connect to PC (PPM output)

Power On the H12 and slide up screen
To unlock the system.

4.4 H12 operation

4.5 Receiver R12



LED indicator	Receiver status
Green LED steady on	Normal
Green LED slow blinking	Disconnect with RC
Green LED fast blinking	Frequency matching
Red LED steady on	C.BUS mode
Red LED slow blinking	Upgrade in processing
Red LED fast blinking	Hardware failure

Label	Functions	Label	Functions
RED LED	Red light	2.4 ANT	Antenna
GN LED	Green light	GND	Camera connector
MODE KEY	Mode setting	VCC	
GND	Ground	RX1	
USB 5V	USB upgrade port	TX1	
DM/CH9		GND	Telemetry/ CBUS
DP/CH10		5V	
GND		RX2	
RX3	Expansion port	TX2	
TX3		GND	SBUS to flight controller
		SBUS	
		2.4 ANT	Antenna

Receiver specification	
Model	R12
Operating voltage	4.5 ~ 5.5v
Channel	12
Power consumption	140mA@5V
Measurement	51x41x13mm
Weight	14g

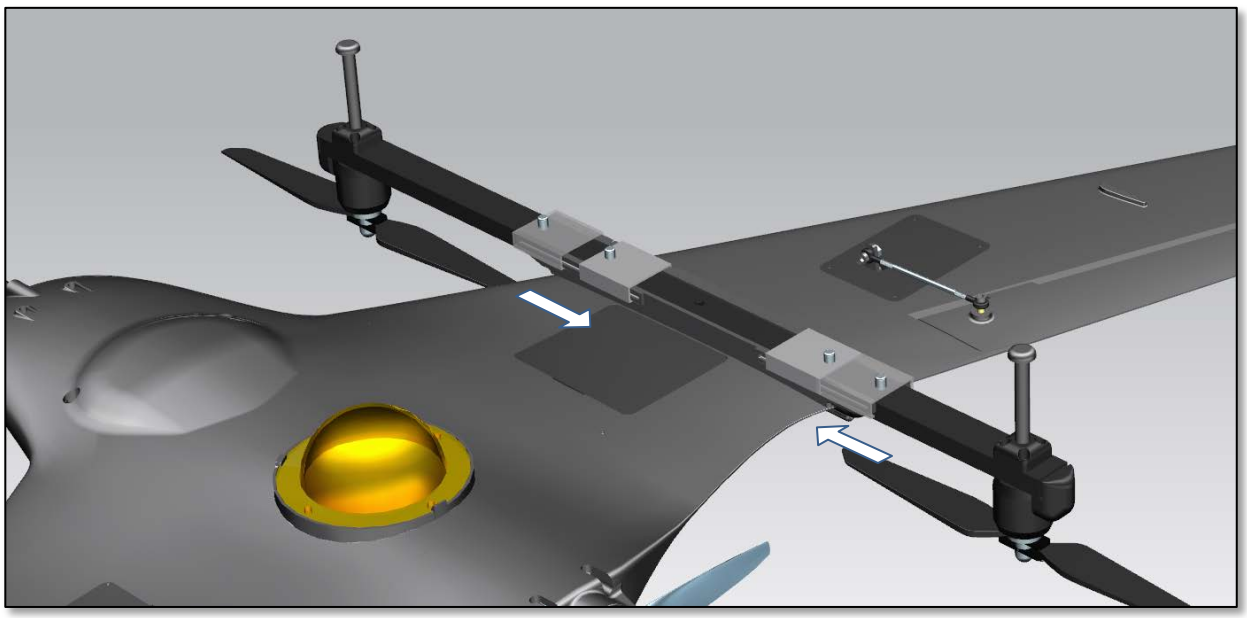
5. Prepare the flight

5.1 Airframe

Fold the wing panel to level.

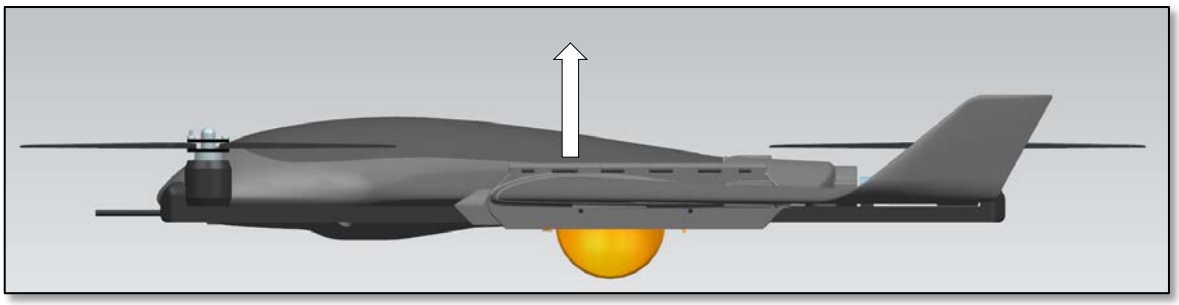
5.2 Lock the wing

Slide the aluminum “U” locker to secure the wing panel. No any tools need to lock the wing panel.



5.3 Center of Gravity

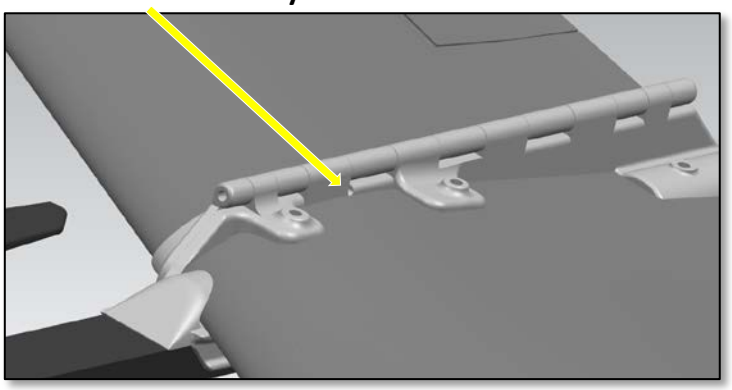
Before each flight, or equipped, replaced the mission equipment, the user need to manually measure the centre of gravity of the UAV.

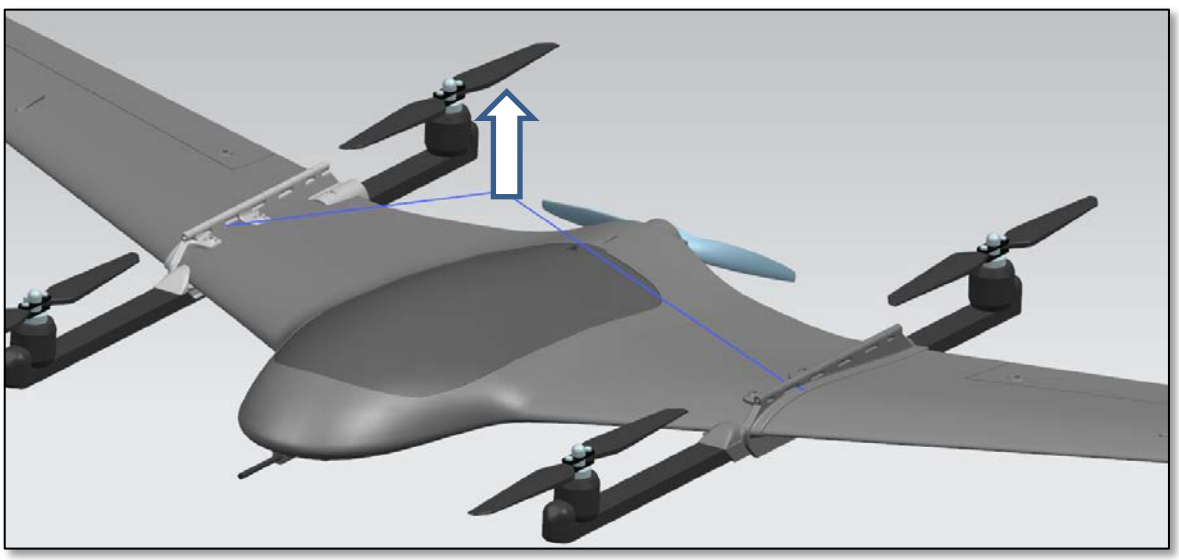


Point to measure the Center of Gravity

Use wire go through the hole on both side. Hanging up from the center of the wire to confirm the balance is correct.

If the balance is incorrect, add weight on nose/tail or relocate the battery to achieve the proper balance.





5.7 Quad propeller

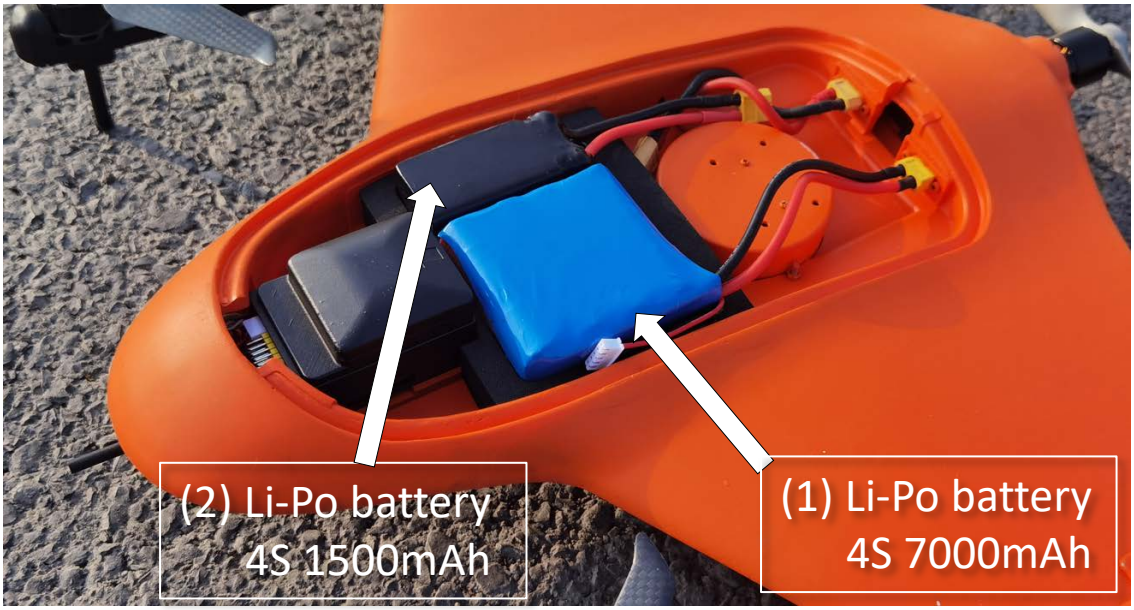
Extend the propellers to straight in line.
Confirm all the screw well tighten.

5.8 Install battery

Install the dual battery pack at the right position.

(1) Cruise & Avionics power : Li-ion battery 4S, 7000mAh x 1
(2) VTOL : Li-po battery 4S, 1500mAh x 1

Remark : Connect battery (1) first, following by battery (2).



6. Flight controller & GCS

6.1 initializing

The flight controller being well tune and calibrated before shipped from factory. The proper parameters have been saved inside the flight controller. We are not recommend that the user modify the parameters.

Any incorrect flight control parameters value will lead the drone crash in second.

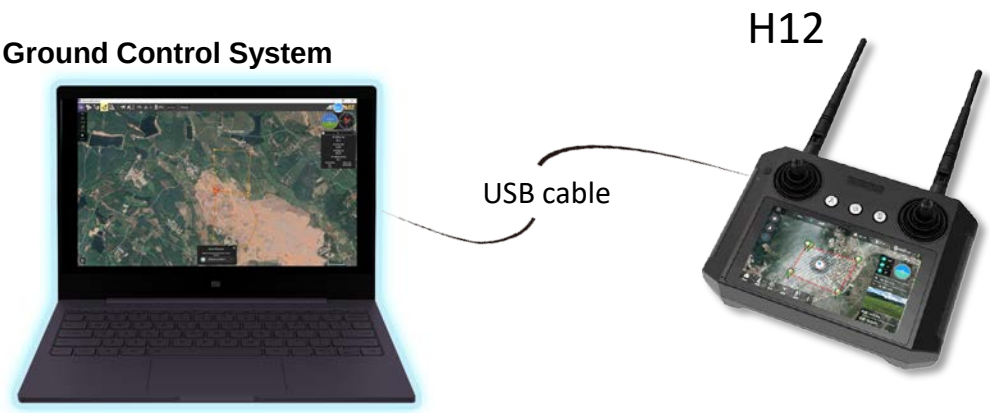
The drone operating area may far away from the factory while calibrating the compass. The user should go through the calibration process before operate the drone from the mission area.

If the compass report failure and the calibration process should be carried out.

Refer to the official website to proceed the calibration.

https://ardupilot.org/copter/docs/common-compass-calibration-in-mission-planner.html?highlight=compass%20calibration

6.2 Ground Control System



Any Laptop computer running Window10 support to work with H12.

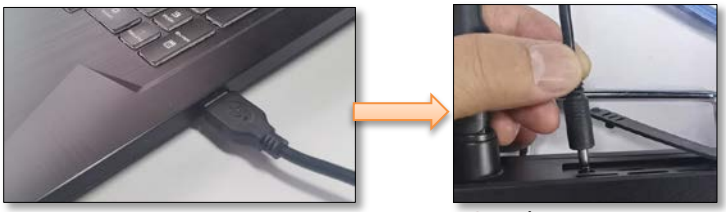
Download the Mission Planner software from the official website.
https://firmware.ardupilot.org/Tools/MissionPlanner/

Sparkle Tech Ltd is the official partner of Ardupilot.

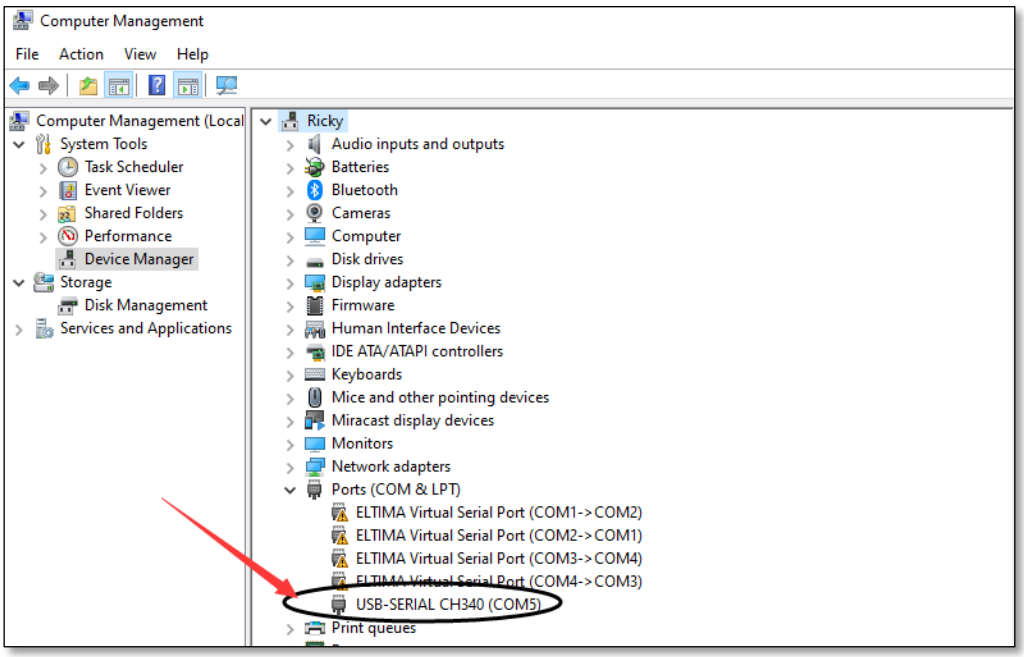
6. Flight controller & GCS

6.3 Connect H12 to Mission Planner

Connect USB cable between H12 and Window system, find the corresponding COM port and use it for Mission Planner.

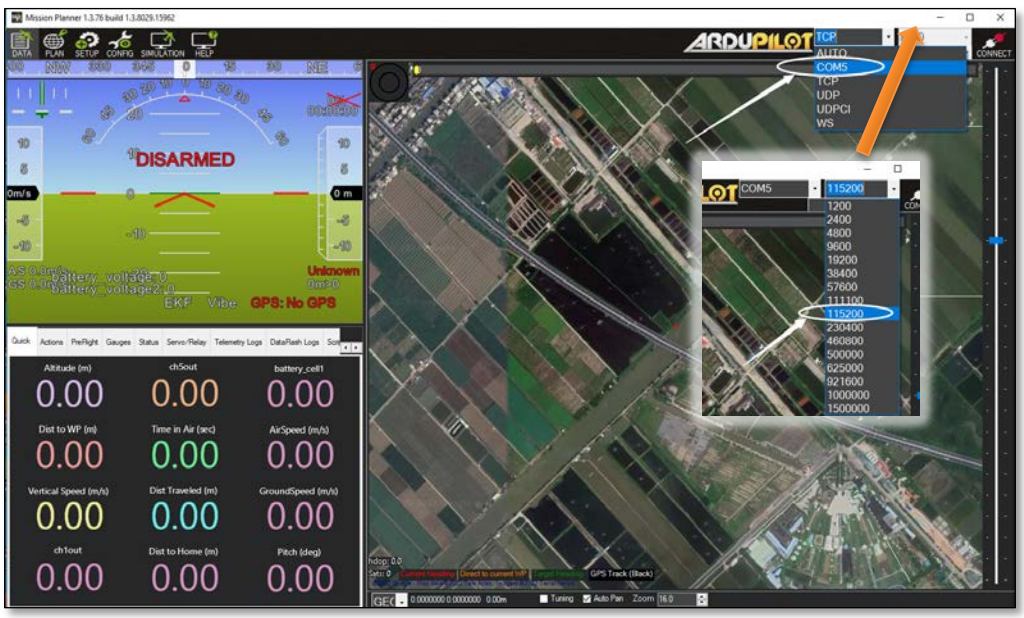


Plug in connector firmly to H12



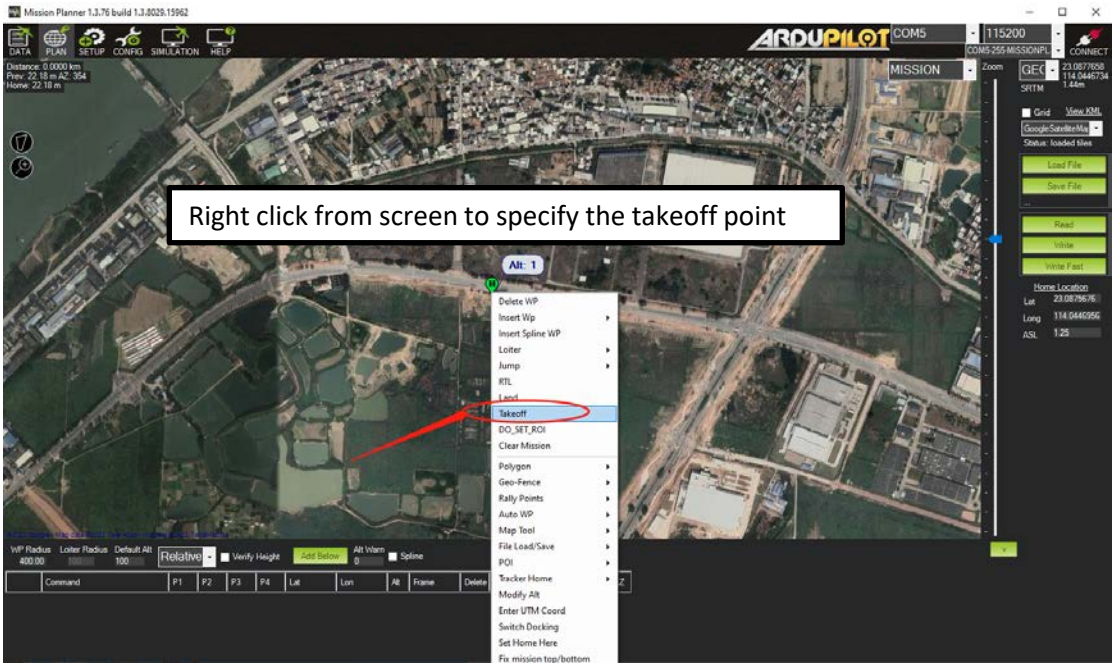
Select the COM port and baud rate of 115200. Click “CONNECT” 

button to connect the H12 , Mission Planner and the flight controller.



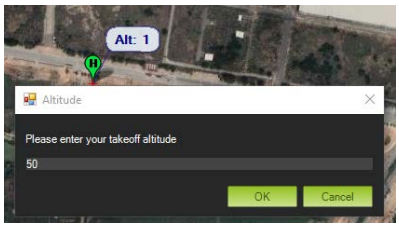
6. Flight controller & GCS

Right click from screen to specify the takeoff point.



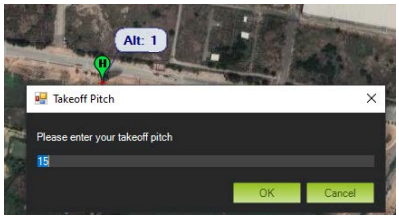
Key in takeoff altitude value 50. The value recommend from 50 ~ 100m.

Low altitude value may be dangerous for surrounding object.
Higher value may lead to insufficient power for landing.

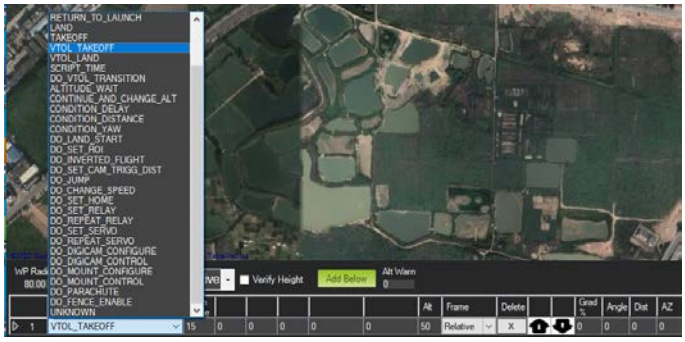


Leave the default value no change.

Takeoff pitch only apply for normal takeoff method.
Which is meaningless for VTOL takeoff method.



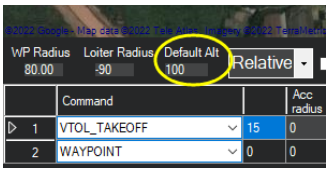
Select VTOL Takeoff

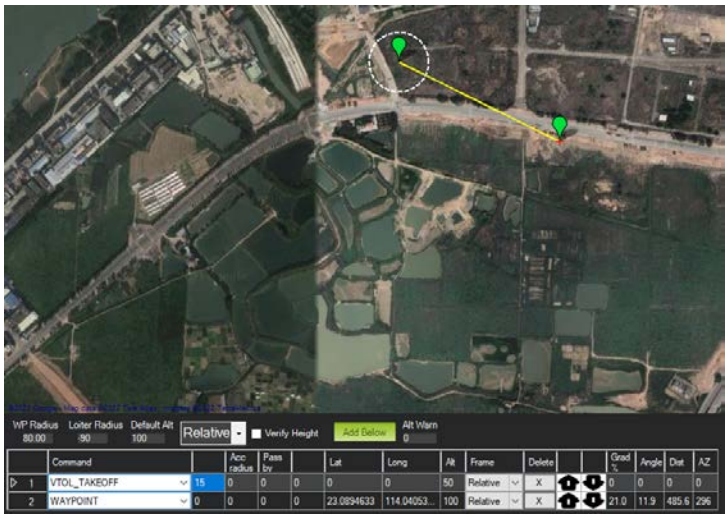


6. Flight controller & GCS

Right click on the map to specify the first way point.

Key in the default altitude

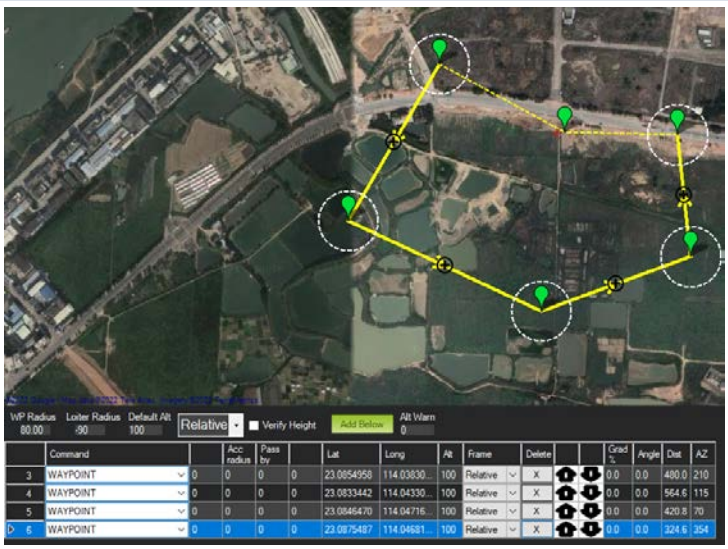




Repeat the procedure to specify the other way points one by one.

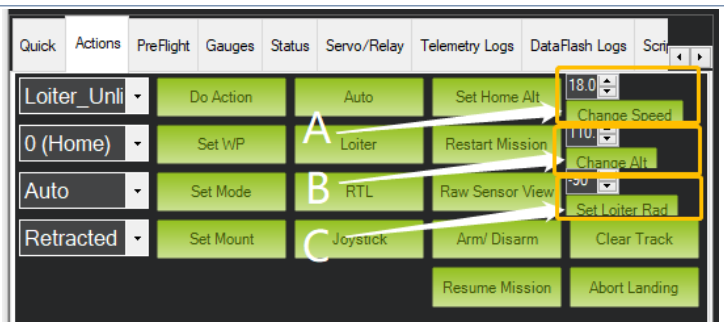
Bear in mind that never make the sharp turn of flight path between every way points.

Recommend the turning angle should not less than 80° . Otherwise the side wind may cause the drone stall.



A – Airspeed
Default is 18m/s, change value and press button execute immediately for whole mission

B – Altitude
Change value and press button execute immediately for the current route only. Next way point will resume preset altitude.



C – Loiter Radius
Default is anticlockwise 90m(-90). Change to + for clockwise. Actual rolling angle will limited by the default rolling angle of <25° .

6. Flight controller & GCS

Landing

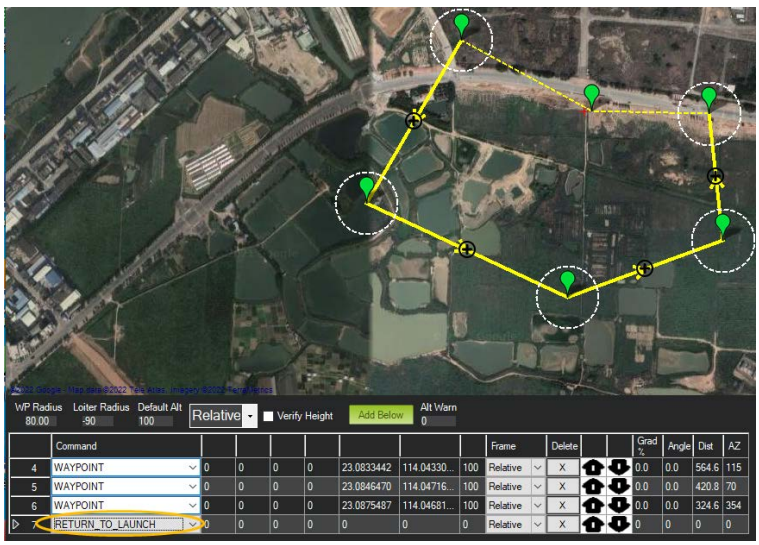
Right click anywhere on map to pop up the menu.

Select RTL (Return to Launch).

If telemetry link disconnect for 60 secs while mission, RTL command will automatic send immediately.

RETURN_TO_LAUNCH action added automatically to the last command.

Recommend to add one way point before the home point with altitude 60m. It will prevent the VTOL function activated at high altitude for landing. It also save the power consuming of the VTOL battery.



Note for landing procedure.

1. If the last command is “RTL”, the drone will automatically execute the VTOL command land to home point.
2. If no “RTL” command set, the drone will loiter at the last way point continually. The pilot should manually send “RTL” command from Mission Planner or press “RTL” button from H12 controller.

For more detail tutorial of the controlling the drone, please visit the official Ardupilot website.

https://ardupilot.org/plane/docs/common-mission-planning.html

Press “Write” to save mission plan to flight controller.

7. Prepare to takeoff

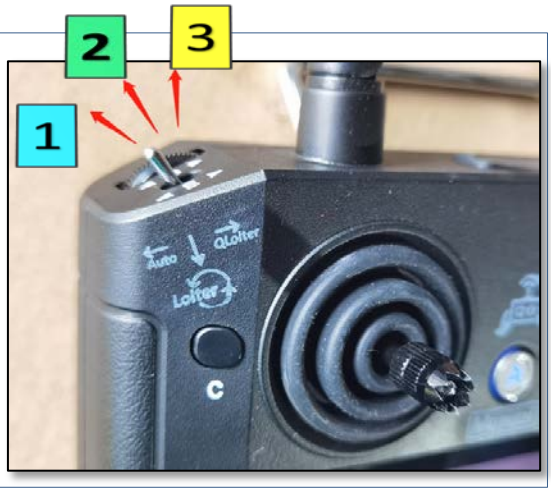
Familiar the functions of switch from the H12 controller. Pilot able to take the right response immediately while in flight.

Download the H12 operation manual
http://drones-mart.com/lfupload/storage/uploads/files/shares/H12%20user%20manual.pdf

1 Auto

2 Loiter (Fixed wing)

3 QLoiter (Quad)



4 Cruise (Semi-Auto)
(Effective at Fixed wing mode)

Drone will maintain current altitude, airspeed, flight direction. Pilot use control stick to control rolling and pitch manually.

Flight altitude should > 30m. Quad motor protection will activate automatically while flight altitude < 30m.

5 RTL (Return to Land)

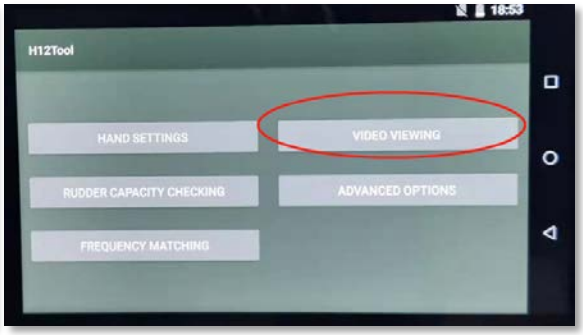
More details of the switch assignment for flight mode.
https://ardupilot.org/plane/docs/flight-modes.html

6 Gimbal control

7. Prepare to takeoff

Launch the H12Tools software from H12. Press  start video recording on SD card.

Press  to take photo save on SD card.



7

Start/Stop video recording on SD card

8

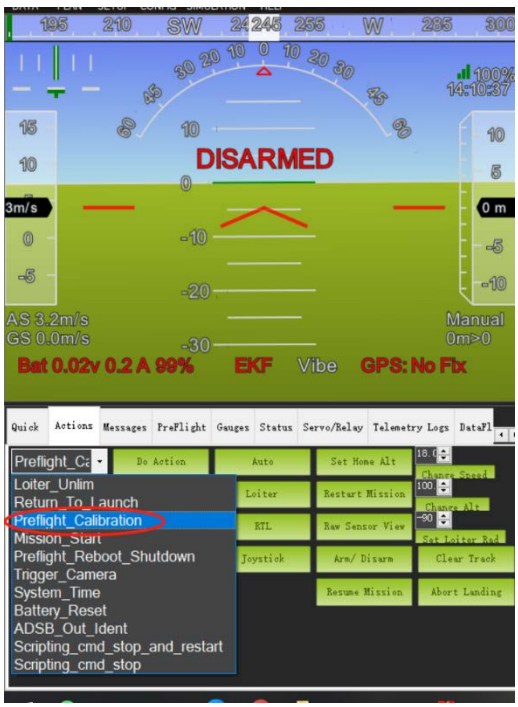
Take photo on SD card

Proceed to takeoff

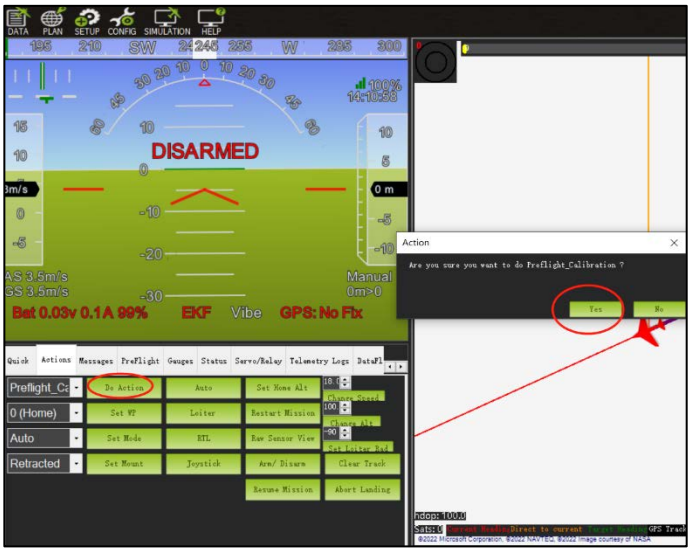
WARNING

The Air Speed data is critical information for the drone keep flying normally. Therefore, the pilot must to calibrate the air speed sensor before EVERY takeoff mission.

Following the procedure to do the air speed sensor calibration.



7. Prepare to takeoff

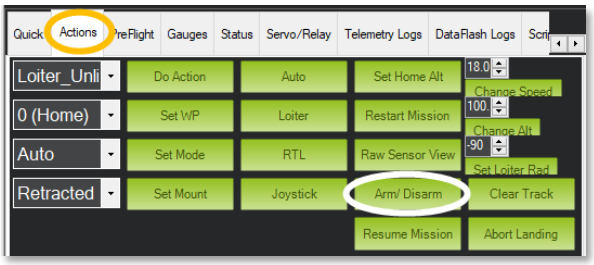


Press confirmation the **Preflight_Calibration** to Yes

The AS value should changing up and down of 0~1 means the air speed sensor well calibrated.

Arm the drone to takeoff

ARM the flight controller to takeoff



Method 1 (From Mission Planner)

Click Arm/ Disarm on control panel

Note : Any failure of system status will prompt the warning. Pilot possible force to ARM but have to take the responsibilities.

OR

Method 2 (From H12)

Launch SKYDROID Apps From H12.

Hold left control stick to right lower corner for 5 seconds.

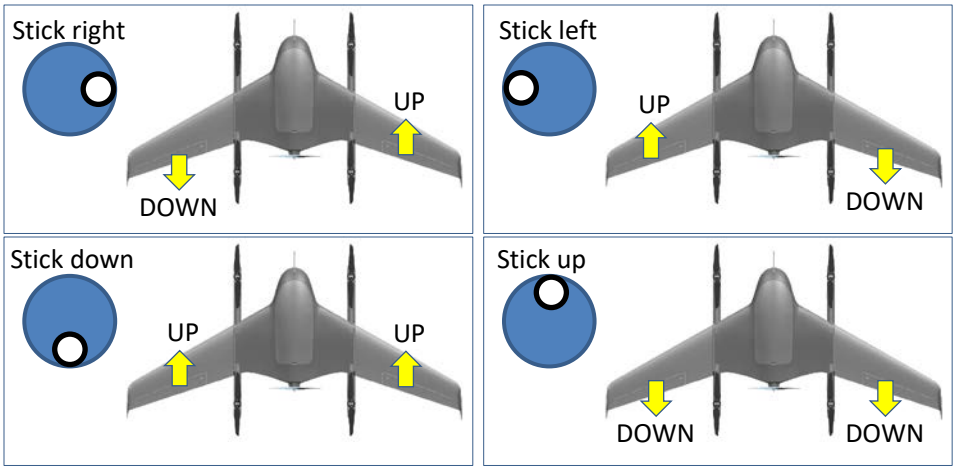
Note : Any failure of system status and the ARM action will be rejected.

WARNING Quad motor start to spin once ARM, keep away from the Drone

8. Preflight check procedure

Strictly recommend to go through the following steps for every flight.

1. Monitoring the VTOL battery and propulsion battery level normally.
2. Secure all screw and no any moving component.
3. No any warning message prompt from H12 and Mission Planner.
4. Check the Aileron & Elevator reaction corresponding to the control stick movement.



5. Execute Preflight calibration of Air speed sensor. AS value display should around 0 ~ 1m/s.
6. Upload the mission path.
7. Check the gimbal control working normally.
8. Activate the video recording on H12.
9. Flight mode switch to Auto
10. Hold left control stick to right lower corner for 5 seconds.

    OR

11. Click Arm/ Disarm from Mission Planner.

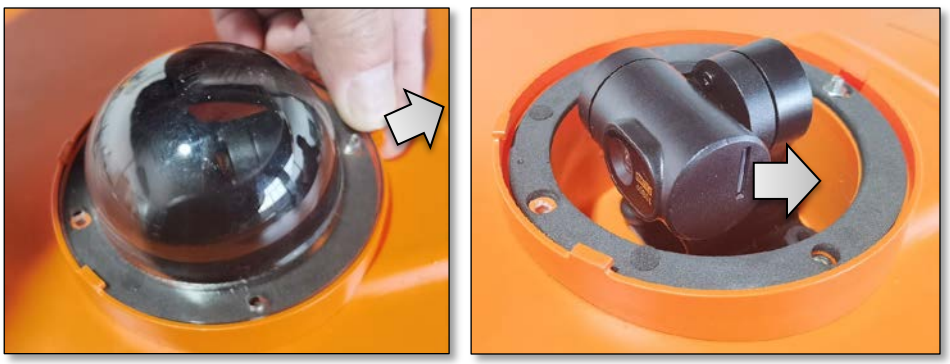
    NOTE : If no mission path uploaded to flight controller, the **Arm** operation will be rejected.

12. Quad motor will start spinning and takeoff.
13. In case of emergency or attempt for landing. Press  RTL button from H12 will force the drone land to home immediately.

14. Hold left control stick to left lower corner for 5 second to DISARM the drone.

15. Remove the dome cover and take out the SD card to download the video.

- Gently bend the buckle prevent to break it.
- The SD card should be formated as NTFS format.



9. CAUTION OF BATTERY

The drone system require 2 pack of battery for every flight. Every flight should installed with the set of fully charged battery.

Lack of battery capacity will lead to the drone shorten endurance and dangerous for landing.

VTOL battery

- Fully charged is 16.8 V.
- Lower voltage level is 13 V
- Maximum hovering time is 150 seconds

Propulsion battery

- Fully charged is 16.5 V ~ 16.6 V
- Lower voltage level is 12.2 V
- Battery low level trigger “Return to home” have set to 12.4 V

Pilot should keep monitoring the propulsion battery all the time. If the drone away home more than 5km, or the windy situation. The pilot should reserve reasonable battery capacity for the drone fly back home.

In the case of the battery level drop to 13.5 V, pilot should prevent to climb up and turning aggressively to save the battery power. Make the smooth and gently landing path to save battery power.

10. CAUTION OF SAFETY

Connection/installation/Inspection

(1) Check the entire UAV cable connection is intact and ensure that each connector is tightly plugged.
(2) Check the 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.

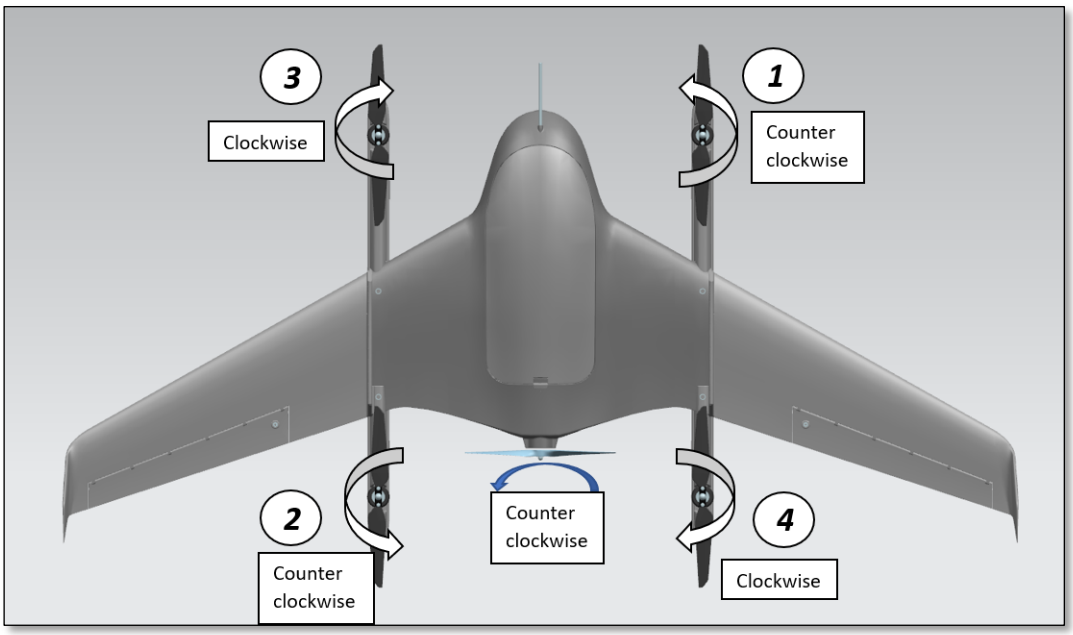
Note: After connecting to power supply, launch the ground station software.
Once the connection is completed, then proceed the preflight check procedure.

Motor Inspection

(1) Check the forward 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)



10. CAUTION OF SAFETY

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 controller.

(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.

10. CAUTION OF SAFETY

(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 before every flight

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.

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.

11. 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.

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.

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.