

GENERAL MANUAL

SparkleTech





SparkleTech

1. Symbols in the Manual



Prohibitions



Important



Prompt



Annotations

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) UAV is a composite vertical take-off and landing UAV 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 FF UAV, 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 FF UAV 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 FF UAV 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.

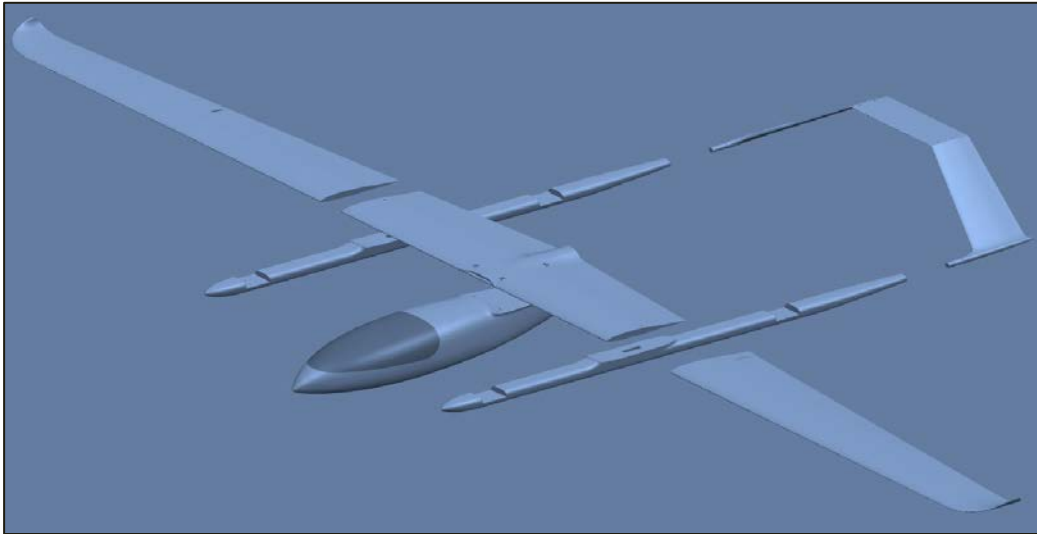
3.2. Basic Performance Parameter

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
 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 900MHz - 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



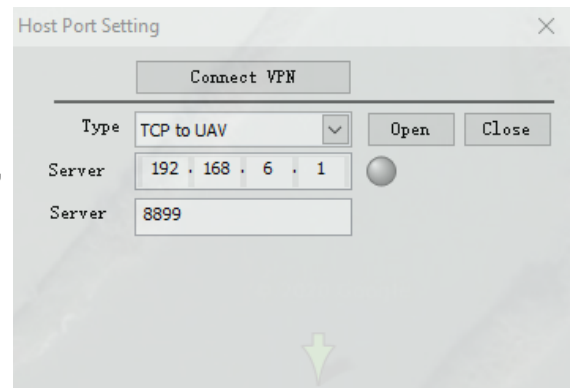
3.3.2 Ground Station

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

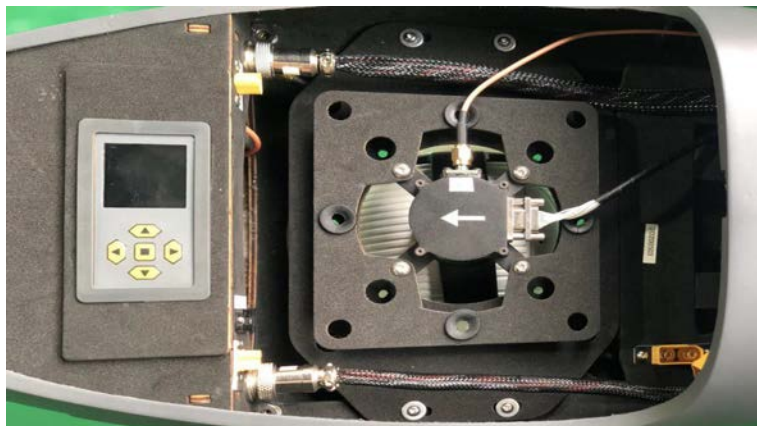
Make sure all batteries, including battery equipped with avionics (autopilot instrument, control servo, etc.) power supply battery, power system battery, hover system battery, and ground station power supply battery are well-prepared and fully charged.

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.

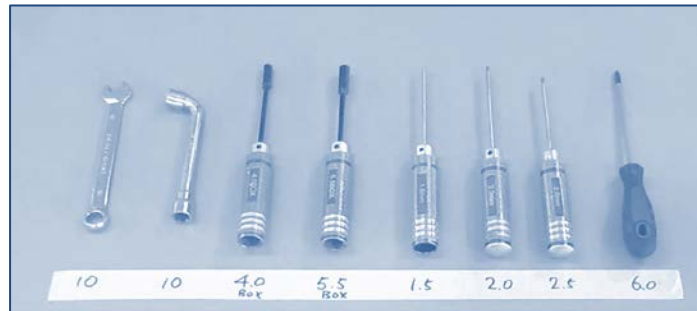
Also, operators should allocate 2 to 3 spare landing point, once the landing conditions change, select the most appropriate landing point for landing according to the actual situation

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

Propeller: APC 18 x 5.5



Propeller: APC 18 x 5.5

Propeller: APC 18 x 5.5



Propeller: APC 18 x 8e

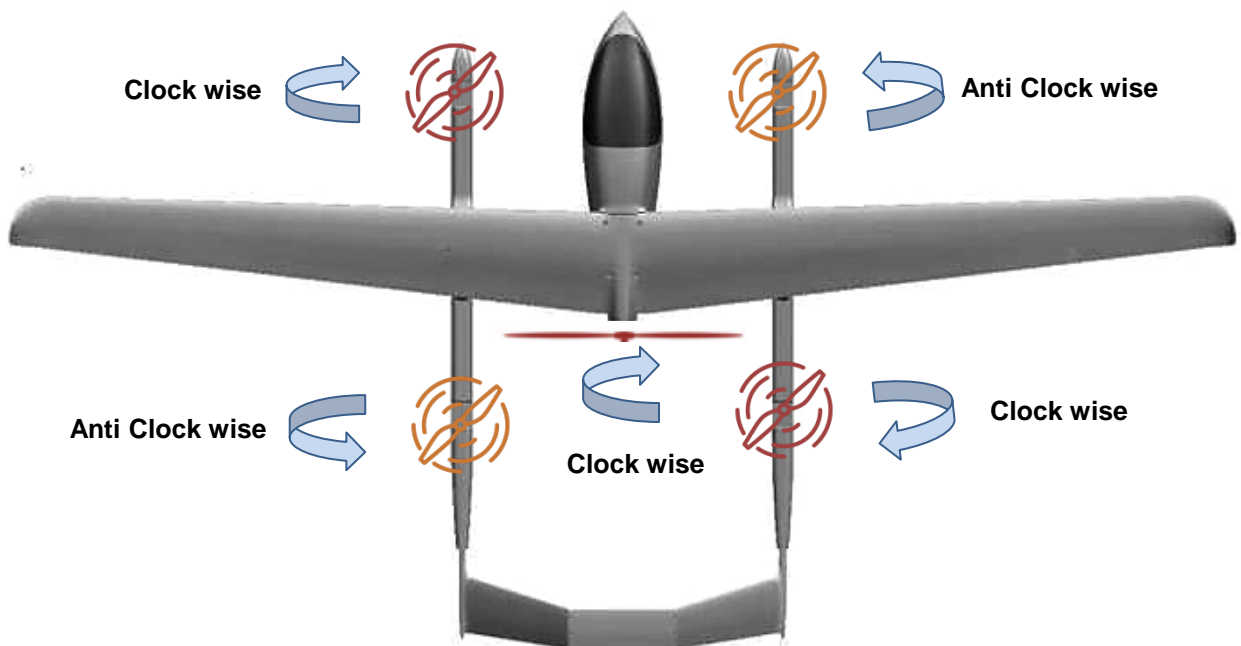
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2) Install the hovering arm to the centre wing

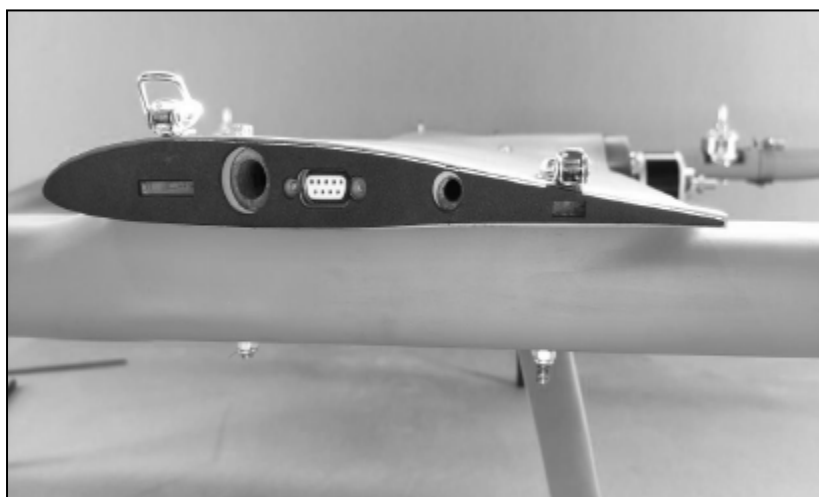
Make sure the hovering arm is in the right side.
Check the rotation direction of each quad motor to install the arm to the right side.



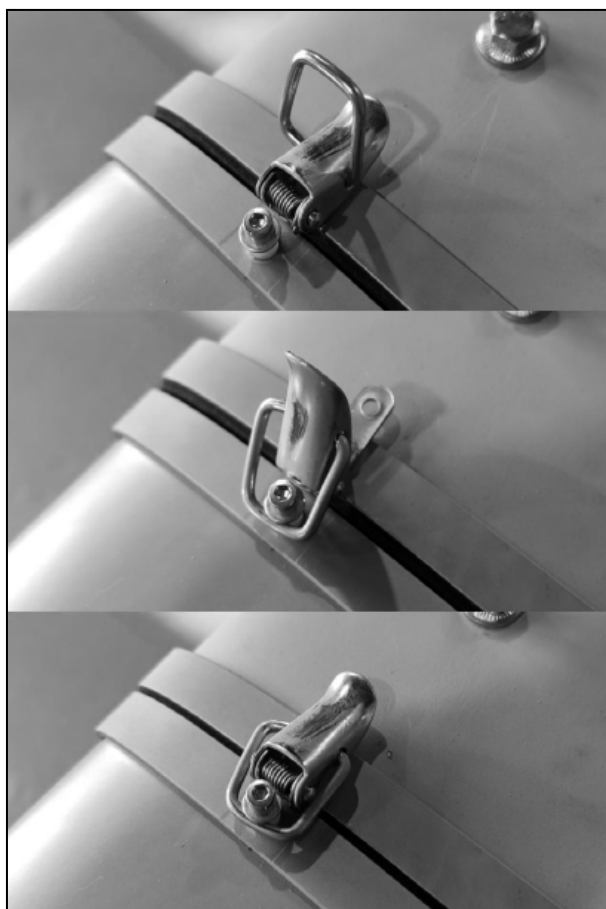
2) Install the hovering arm to the centre wing

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.



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

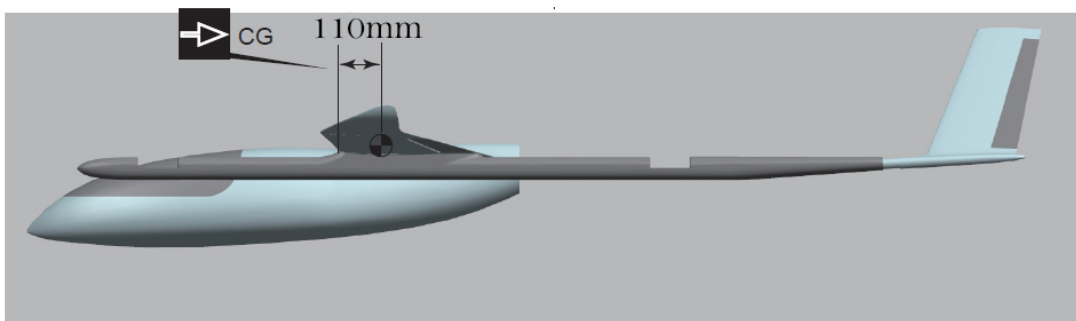


Make sure all screws are firmly installed.

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.

4.2.4 Electrical Connection

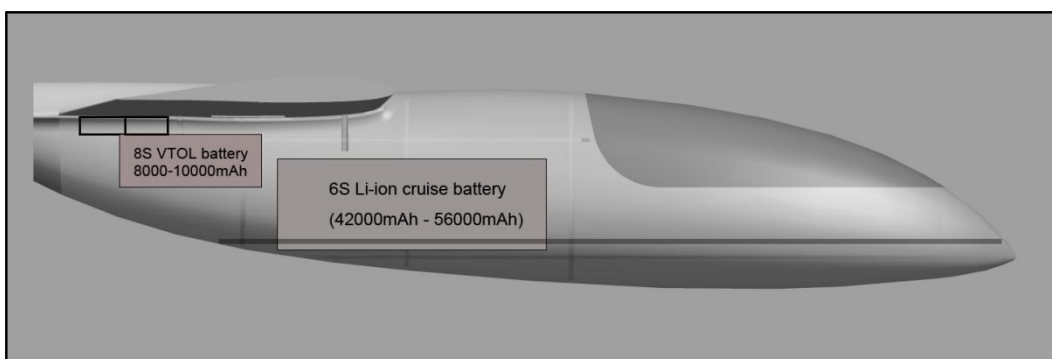
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4.3 Pre-flight Inspection

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.



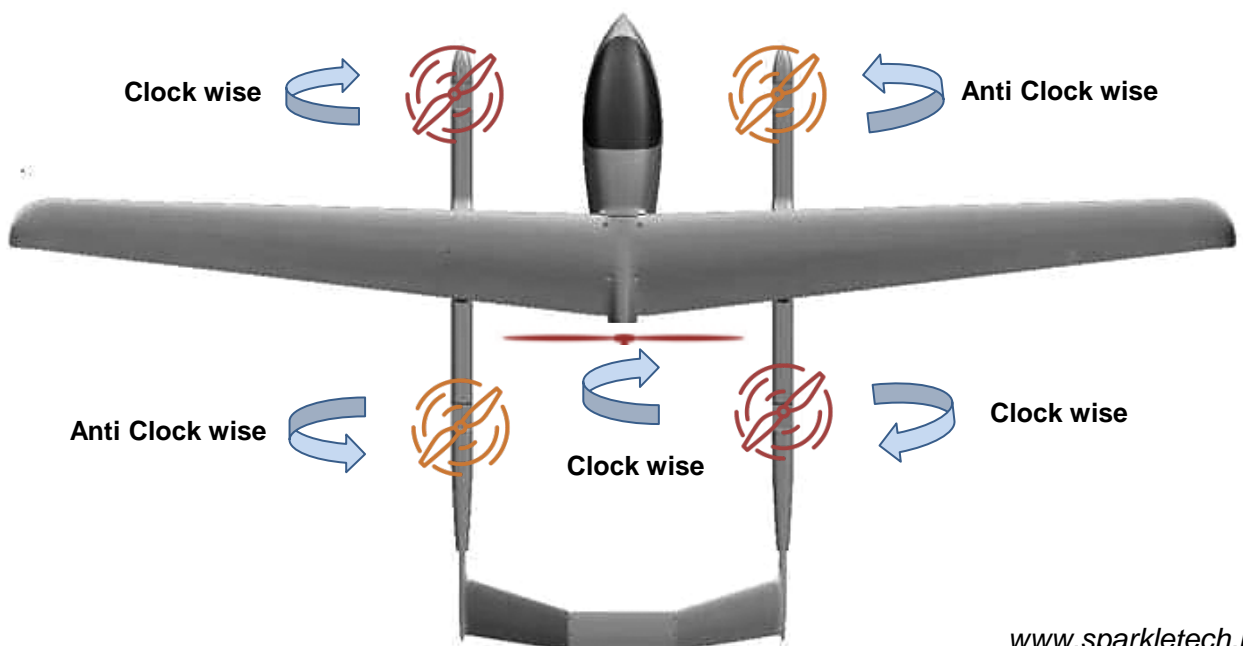
The rotation direction of the forward engine is in clockwise (observe from the nose to the tail).

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 speed, 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 ($\leq -20^{\circ}\text{C}$)

(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 _____	<input type="checkbox"/>	Wind Speed _____	<input type="checkbox"/>
		Wind Direction _____	<input type="checkbox"/>
UAV Inspection			
Are the connecting screws secure?	<input type="checkbox"/>	Is the wing locking pin secure?	<input type="checkbox"/>
Hover motor/propeller is good?	<input type="checkbox"/>	Is the motor mount secure?	<input type="checkbox"/>
Are the servo control surfaces being intact?	<input type="checkbox"/>	Is cruise fly propeller intact?	<input type="checkbox"/>
Is the centre of gravity normal?	<input type="checkbox"/>	Oil Level _____	<input type="checkbox"/>
Ground Station Inspection (without power)			
Whether the output of the remote control correct?	<input type="checkbox"/>	Whether the posture is correct?	<input type="checkbox"/>
Magnetic compass calibrated?	<input type="checkbox"/>	Whether the flight plan is correct?	<input type="checkbox"/>
Magnetic Inspection: _ , _ , _ , _ .			Compass <input type="checkbox"/>
Ground Station Inspection (with power)			
Main Power _____ V		Autopilot Power _____ V	<input type="checkbox"/>
Hovering Power Supply _____ V			
No. of GPS satellite: _____	<input type="checkbox"/>		
Whether the manual radio control command correct?	<input type="checkbox"/>	Whether the hovering propeller and motor is oriented in the correct?	<input type="checkbox"/>
		Will the airspeed increase when pressing the pitot tube?	<input type="checkbox"/>
	<input type="checkbox"/>		<input type="checkbox"/>
	<input type="checkbox"/>		<input type="checkbox"/>

