U.S. Department
of Transportation
**Federal Aviation
Administration**

800 Independence Ave., S.W.
Washington, D.C. 20591

July 22, 2015

Exemption No. 12114
Regulatory Docket No. FAA–2015–1064

Mr. David Pinkerton
President
AgriImage, LLC
91 A Milan Highway
Milan, TN 38358

Dear Mr. Pinkerton:

This letter is to inform you that we have granted your request for exemption. It transmits our decision, explains its basis, and gives you the conditions and limitations of the exemption, including the date it ends.

By letter dated April 9, 2015, you petitioned the Federal Aviation Administration (FAA) on behalf of AgriImage, LLC (hereinafter petitioner or operator) for an exemption. The petitioner requested to operate an unmanned aircraft system (UAS) to conduct precision agriculture operations.

See Appendix A for the petition submitted to the FAA describing the proposed operations and the regulations that the petitioner seeks an exemption.

The FAA has determined that good cause exists for not publishing a summary of the petition in the Federal Register because the requested exemption would not set a precedent, and any delay in acting on this petition would be detrimental to the petitioner.

Airworthiness Certification

The UAS proposed by the petitioner are the AgScout and AgScout Mini.

The petitioner requested relief from 14 CFR part 21, *Certification procedures for products and parts, Subpart H—Airworthiness Certificates*. In accordance with the statutory criteria provided in Section 333 of Public Law 112−95 in reference to 49 U.S.C. § 44704, and in

consideration of the size, weight, speed, and limited operating area associated with the aircraft and its operation, the Secretary of Transportation has determined that this aircraft meets the conditions of Section 333. Therefore, the FAA finds that the requested relief from 14 CFR part 21, *Certification procedures for products and parts, Subpart H—Airworthiness Certificates*, and any associated noise certification and testing requirements of part 36, is not necessary.

The Basis for Our Decision

You have requested to use a UAS for aerial data collection[1]. The FAA has issued grants of exemption in circumstances similar in all material respects to those presented in your petition. In Grants of Exemption Nos. 11062 to Astraeus Aerial (*see* Docket No. FAA−2014−0352), 11109 to Clayco, Inc. (*see* Docket No. FAA−2014−0507), 11112 to VDOS Global, LLC (*see* Docket No. FAA−2014−0382), and 11213 to Aeryon Labs, Inc. (*see* Docket No. FAA−2014−0642), the FAA found that the enhanced safety achieved using an unmanned aircraft (UA) with the specifications described by the petitioner and carrying no passengers or crew, rather than a manned aircraft of significantly greater proportions, carrying crew in addition to flammable fuel, gives the FAA good cause to find that the UAS operation enabled by this exemption is in the public interest.

Having reviewed your reasons for requesting an exemption, I find that—

- They are similar in all material respects to relief previously requested in Grant of Exemption Nos. 11062, 11109, 11112, and 11213;
- The reasons stated by the FAA for granting Exemption Nos. 11062, 11109, 11112, and 11213 also apply to the situation you present; and
- A grant of exemption is in the public interest.

Our Decision

In consideration of the foregoing, I find that a grant of exemption is in the public interest. Therefore, pursuant to the authority contained in 49 U.S.C. 106(f), 40113, and 44701, delegated to me by the Administrator, AgriImage, LLC is granted an exemption from 14 CFR §§ 61.23(a) and (c), 61.101(e)(4) and (5), 61.113(a), 61.315(a), 91.7(a), 91.119(c), 91.121, 91.151(a)(1), 91.405(a), 91.407(a)(1), 91.409(a)(1) and (2), and 91.417(a) and (b), to the extent necessary to allow the petitioner to operate a UAS to perform aerial data collection. This exemption is subject to the conditions and limitations listed below.

[1] Aerial data collection includes any remote sensing and measuring by an instrument(s) aboard the UA. Examples include imagery (photography, video, infrared, etc.), electronic measurement (precision surveying, RF analysis, etc.), chemical measurement (particulate measurement, etc.), or any other gathering of data by instruments aboard the UA.

Conditions and Limitations

In this grant of exemption, AgriImage, LLC is hereafter referred to as the operator.

Failure to comply with any of the conditions and limitations of this grant of exemption will be grounds for the immediate suspension or rescission of this exemption.

1. Operations authorized by this grant of exemption are limited to the AgScout and AgScout Mini when weighing less than 55 pounds including payload. Proposed operations of any other aircraft will require a new petition or a petition to amend this exemption.

2. Operations for the purpose of closed-set motion picture and television filming are not permitted.

3. The UA may not be operated at a speed exceeding 87 knots (100 miles per hour). The exemption holder may use either groundspeed or calibrated airspeed to determine compliance with the 87 knot speed restriction. In no case will the UA be operated at airspeeds greater than the maximum UA operating airspeed recommended by the aircraft manufacturer.

4. The UA must be operated at an altitude of no more than 400 feet above ground level (AGL). Altitude must be reported in feet AGL.

5. The UA must be operated within visual line of sight (VLOS) of the PIC at all times. This requires the PIC to be able to use human vision unaided by any device other than corrective lenses, as specified on the PIC's FAA-issued airman medical certificate or U.S. driver's license.

6. All operations must utilize a visual observer (VO). The UA must be operated within the visual line of sight (VLOS) of the PIC and VO at all times. The VO may be used to satisfy the VLOS requirement as long as the PIC always maintains VLOS capability. The VO and PIC must be able to communicate verbally at all times; electronic messaging or texting is not permitted during flight operations. The PIC must be designated before the flight and cannot transfer his or her designation for the duration of the flight. The PIC must ensure that the VO can perform the duties required of the VO.

7. This exemption and all documents needed to operate the UAS and conduct its operations in accordance with the conditions and limitations stated in this grant of exemption, are hereinafter referred to as the operating documents. The operating documents must be accessible during UAS operations and made available to the Administrator upon request. If a discrepancy exists between the conditions and limitations in this exemption and the procedures outlined in the operating documents,

the conditions and limitations herein take precedence and must be followed. Otherwise, the operator must follow the procedures as outlined in its operating documents. The operator may update or revise its operating documents. It is the operator's responsibility to track such revisions and present updated and revised documents to the Administrator or any law enforcement official upon request. The operator must also present updated and revised documents if it petitions for extension or amendment to this grant of exemption. If the operator determines that any update or revision would affect the basis upon which the FAA granted this exemption, then the operator must petition for an amendment to its grant of exemption. The FAA's UAS Integration Office (AFS−80) may be contacted if questions arise regarding updates or revisions to the operating documents.

8. Any UAS that has undergone maintenance or alterations that affect the UAS operation or flight characteristics, e.g., replacement of a flight critical component, must undergo a functional test flight prior to conducting further operations under this exemption. Functional test flights may only be conducted by a PIC with a VO and must remain at least 500 feet from other people. The functional test flight must be conducted in such a manner so as to not pose an undue hazard to persons and property.

9. The operator is responsible for maintaining and inspecting the UAS to ensure that it is in a condition for safe operation.

10. Prior to each flight, the PIC must conduct a pre-flight inspection and determine the UAS is in a condition for safe flight. The pre-flight inspection must account for all potential discrepancies, e.g., inoperable components, items, or equipment. If the inspection reveals a condition that affects the safe operation of the UAS, the aircraft is prohibited from operating until the necessary maintenance has been performed and the UAS is found to be in a condition for safe flight.

11. The operator must follow the UAS manufacturer's maintenance, overhaul, replacement, inspection, and life limit requirements for the aircraft and aircraft components.

12. Each UAS operated under this exemption must comply with all manufacturer safety bulletins.

13. Under this grant of exemption, a PIC must hold either an airline transport, commercial, private, recreational, or sport pilot certificate. The PIC must also hold a current FAA airman medical certificate or a valid U.S. driver's license issued by a state, the District of Columbia, Puerto Rico, a territory, a possession, or the Federal government. The PIC must also meet the flight review requirements specified in 14 CFR § 61.56 in an aircraft in which the PIC is rated on his or her pilot certificate.

14. The operator may not permit any PIC to operate unless the PIC demonstrates the ability to safely operate the UAS in a manner consistent with how the UAS will be operated under this exemption, including evasive and emergency maneuvers and maintaining appropriate distances from persons, vessels, vehicles and structures. PIC qualification flight hours and currency must be logged in a manner consistent with 14 CFR § 61.51(b). Flights for the purposes of training the operator's PICs and VOs (training, proficiency, and experience-building) and determining the PIC's ability to safely operate the UAS in a manner consistent with how the UAS will be operated under this exemption are permitted under the terms of this exemption. However, training operations may only be conducted during dedicated training sessions. During training, proficiency, and experience-building flights, all persons not essential for flight operations are considered nonparticipants, and the PIC must operate the UA with appropriate distance from nonparticipants in accordance with 14 CFR § 91.119.

15. UAS operations may not be conducted during night, as defined in 14 CFR § 1.1. All operations must be conducted under visual meteorological conditions (VMC). Flights under special visual flight rules (SVFR) are not authorized.

16. The UA may not operate within 5 nautical miles of an airport reference point (ARP) as denoted in the current FAA Airport/Facility Directory (AFD) or for airports not denoted with an ARP, the center of the airport symbol as denoted on the current FAA-published aeronautical chart, unless a letter of agreement with that airport's management is obtained or otherwise permitted by a COA issued to the exemption holder. The letter of agreement with the airport management must be made available to the Administrator or any law enforcement official upon request.

17. The UA may not be operated less than 500 feet below or less than 2,000 feet horizontally from a cloud or when visibility is less than 3 statute miles from the PIC.

18. If the UAS loses communications or loses its GPS signal, the UA must return to a pre-determined location within the private or controlled-access property.

19. The PIC must abort the flight in the event of unpredicted obstacles or emergencies.

20. The PIC is prohibited from beginning a flight unless (considering wind and forecast weather conditions) there is enough available power for the UA to conduct the intended operation and to operate after that for at least five minutes or with the reserve power recommended by the manufacturer if greater.

21. Air Traffic Organization (ATO) Certificate of Waiver or Authorization (COA). All operations shall be conducted in accordance with an ATO-issued COA. The exemption holder may apply for a new or amended COA if it intends to conduct operations that cannot be conducted under the terms of the attached COA.

22. All aircraft operated in accordance with this exemption must be identified by serial number, registered in accordance with 14 CFR part 47, and have identification (N−Number) markings in accordance with 14 CFR part 45, Subpart C. Markings must be as large as practicable.

23. Documents used by the operator to ensure the safe operation and flight of the UAS and any documents required under 14 CFR §§ 91.9 and 91.203 must be available to the PIC at the Ground Control Station of the UAS any time the aircraft is operating. These documents must be made available to the Administrator or any law enforcement official upon request.

24. The UA must remain clear and give way to all manned aviation operations and activities at all times.

25. The UAS may not be operated by the PIC from any moving device or vehicle.

26. All Flight operations must be conducted at least 500 feet from all nonparticipating persons, vessels, vehicles, and structures unless:
    a. Barriers or structures are present that sufficiently protect nonparticipating persons from the UA and/or debris in the event of an accident. The operator must ensure that nonparticipating persons remain under such protection. If a situation arises where nonparticipating persons leave such protection and are within 500 feet of the UA, flight operations must cease immediately in a manner ensuring the safety of nonparticipating persons; and
    b. The owner/controller of any vessels, vehicles or structures has granted permission for operating closer to those objects and the PIC has made a safety assessment of the risk of operating closer to those objects and determined that it does not present an undue hazard.

    The PIC, VO, operator trainees or essential persons are not considered nonparticipating persons under this exemption.

27. All operations shall be conducted over private or controlled-access property with permission from the property owner/controller or authorized representative. Permission from property owner/controller or authorized representative will be obtained for each flight to be conducted.

28. Any incident, accident, or flight operation that transgresses the lateral or vertical boundaries of the operational area as defined by the applicable COA must be reported to the FAA's UAS Integration Office (AFS−80) within 24 hours. Accidents must be reported to the National Transportation Safety Board (NTSB) per instructions contained on the NTSB Web site: www.ntsb.gov.

If this exemption permits operations for the purpose of closed-set motion picture and television filming and production, the following additional conditions and limitations apply.

29. The operator must have a motion picture and television operations manual (MPTOM) as documented in this grant of exemption.

30. At least 3 days before aerial filming, the operator of the UAS affected by this exemption must submit a written Plan of Activities to the local Flight Standards District Office (FSDO) with jurisdiction over the area of proposed filming. The 3-day notification may be waived with the concurrence of the FSDO. The plan of activities must include at least the following:
    a. Dates and times for all flights;
    b. Name and phone number of the operator for the UAS aerial filming conducted under this grant of exemption;
    c. Name and phone number of the person responsible for the on-scene operation of the UAS;
    d. Make, model, and serial or N−Number of UAS to be used;
    e. Name and certificate number of UAS PICs involved in the aerial filming;
    f. A statement that the operator has obtained permission from property owners and/or local officials to conduct the filming production event; the list of those who gave permission must be made available to the inspector upon request;
    g. Signature of exemption holder or representative; and
    h. A description of the flight activity, including maps or diagrams of any area, city, town, county, and/or state over which filming will be conducted and the altitudes essential to accomplish the operation.

31. Flight operations may be conducted closer than 500 feet from participating persons consenting to be involved and necessary for the filming production, as specified in the exemption holder's MPTOM.

Unless otherwise specified in this grant of exemption, the UAS, the UAS PIC, and the UAS operations must comply with all applicable parts of 14 CFR including, but not limited to, parts 45, 47, 61, and 91.

This exemption terminates on July 31, 2017, unless sooner superseded or rescinded.

Sincerely,

/s/
John S. Duncan
Director, Flight Standards Service

Enclosures

April 9, 2015
U.S. Department of Transportation
Docket Management System
1200 New Jersey Ave, SE
Washington, DC 20590

AgriImage, LLC
91 A Milan Hwy.
Milan, TN 38358
731-613-7850

RE: Request for Exemption under Section 333 of the FAA Modernization and Reform Act of 2012 and Part 11 of the Federal Aviation Regulations from 14 C.F.R 21(h); 14 C.F.R. 45.23(b), 14 C.F.R 61.113(a) and (b), 14 C.F.R 91.7(a), 14 C.F.R 91.9(b)(2), 14 C.F.R 91.103(b)(2), 14 C.F.R. 91.105, 14 C.F.R 91.109, 14 C.F.R 91.119, 14 C.F.R 91.121, 14 C.F.R 91.151(a), 14 C.F.R 91.203(a) and (b), 14 C.F.R 91.405(a), 14 C.F.R 91.407(a)(1), C.F.R 91.409(a) (2), and C.F.R 91.417(a) and (b).

Dear Sir or Madam:

Pursuant to Section 333 of the FFA Modernization and Reform Act of 2012 (the Reform Act) and C.F.R. Part 11, AgriImage, LLC, an operator of Small Unmanned Aerial Systems ("sUAS") equipped to record and take images of farmland for members of the agriculture industry, applies for exemption from the listed Federal Aviation Regulations ("FARs") to allow the commercial operation of its sUASs, so long as such operations are conducted within and under all the conditions outlined herein or as may be established by the FAA as required by Section 333.

The approval of exemptions for AgriImage will allow commercial operations of the AgScout and AgScout Mini UAVs for precision agriculture. This will help farmers, agronomists, crop consultants, and other agriculture industry professionals locate problem areas in their field. Once a problem area is detected, the individual can use the data in order to write chemical and fertilizer subscriptions. The contemplated applications involve aerial surveys of agricultural areas (including but not limited to farm fields), using a variety of sensors and technologies (including but not limited to infrared photography, thermal imagery, optical zoom camera, photogrammetry, and high resolution imagery) to collect data to make more informed decisions. The pilot in command (PIC) has flown numerous practice flights in field locations as a hobbyist in order to prepare for future commercial use. The practice flights have increased AgriImage's knowledge of its sUAS performance under different temperature and weather conditions. This request should be granted because operation of the proposed small UASs conducted in the conditions outlined below, will provide an equivalent level of safety while still allowing commercial operations. The AgScout and AgScout Mini, both lightweight aircrafts, covered by the exemption are safer than operations piloted with helicopters and fixed-wing aircraft weighing thousands of pounds containing pilot and crew members operating in close proximity to the ground and people below. Congress directed the FAA to consider the following seven factors when approving Section 33 exemption petitions: size, weight, speed, operational capability, proximity to airports, proximity to populated areas, and operation within visual line of sight (VLOS). These factors are supported in this petition. The sUASs that AgriImage use are small, operate at slow speeds, stay below 400 feet, will not operate within 5 miles of an airport, and are not flown in populated areas.

If we can provide any additional information to better assist your understanding of this petition, please do not hesitate to contact us at 731-613-7850 or by email at david@agriimage.com.

Thank you,

David Pinkerton 4-9-15

David Pinkerton

President of AgriImage, LLC

Table of Contents

I. Petitioner's Contact Information:

AgriImage, LLC
91 A Milan Hwy
Milan, TN 38358
Office: 731-613-7850
Email: david@agriimage.com
President: David Pinkerton

II. AgriImage LLC's Operations:

A. sUASs

The requested exemption will permit the operation of two small, unmanned multirotor aircraft, the AgScout and the AgScout Mini.

1. The AgScout

The AgScout is a small, unmanned multirotor aircraft, weighing 11 lbs., inclusive of batteries and technical payload. The AgScout can operate at a speed of 26 knots (30 mph).

The sUAS will have the following specifications or equivalent:
Airframe: Skyhero Spyder
Control System: Wookong
Tx: ImmersionRC EZUHF JR transmitter
Rx: ImmersionRC EZUHF 8ch receiver
Motors: Tiger RC U5 400KV brushless motors
Propellers: Tiger RC 15" Carbon Fiber
Autonomous flight system: DJI 2.4GHz Data Link
OSD: iOSD mini
Gimbal: Tarot 2D gimbal
Cameras: ReadyMadeRC flight camera, GoPro Hero 3 Silver edition, Tetracam ADC micro multispectral camera, Flir Tau 2 Thermal camera
Batteries: Pulse 10000mAh 6-cell Lithium Polymer Ion batteries with XT-60 main power connection

Please refer to Exhibits 5-10, attached to this petition, for further information about the Airframe, Control System, Tx, RX, Autonomous flight system, and the OSD respectively.

FAA has previously granted Exemption No. 11138, allowing commercial flight of a for a DJI sUAS system. Exhibit 1.

2. The AgScout Mini

The AgScout Mini is a small, unmanned multirotor aircraft, weighing 5lbs., inclusive of batteries and technical payloads. The AgScout Mini can operate at a speed of 26 knots (30 mph).

The sUAS will have the following specifications or equivalent:

Airframe: Skyhero Spyder

Control System: Naza v2
Tx: ImmersionRC EZUHF JR transmitter
Rx: ImmersionRC EZUHF 8chlite receiver
Motors: Skyhero SKH04-002 950KV brushless motors
Propellers: Gymfan 10"Carbon Fiber
Autonomous flight system: DJI 2.4GHz Data Link
OSD: iOSD mini
Gimbal: Zenmuse H3D gimbal
Cameras: ReadyMadeRC flight camera, GoPro Hero 3 Silver edition
Batteries: Pulse 5000mAh 4-cell Lithium Polymer ion batteries with XT-60 main power connection

Please refer to Exhibits 11, 12,7,13,9, and 10 attached to this petition, for further information about the Airframe, Control System, Tx, Rx, Autonomous flight system, and the OSD respectively.

B. Flight Conditions

The sUAS will be flown in airspace under 400 feet above ground level ("AGL") and under controlled conditions in rural areas. The majority of flights will take place in rural, remote areas and will avoid congested and densely populated areas. These flights occur over farmland that is usually located in very rural areas. AgriImage will abide by visual meteorological conditions (VMC), which is no less than 500 feet below and no less than 2,000 feet horizontally from a cloud or when visibility is at least 3 statute miles from the PIC. The flight crew will always conduct preflight checklists, and will only operate when it is determined that no undue dangers are present.

C. Flight Operations

AgriImage requires that the Pilot in Command (PIC) always keep the sUAS in the line of sight of both the PIC and visual observers (VOs). Flights will remain at altitudes below 400 feet AGL, and at speeds less than 20 knots.

The PIC, and the VO, have over 5 years of experience with RC aircraft, and have numerous hours flying sUAS as hobbyist. A pilot license could be helpful, but a pilot license will not ensure remote control piloting skills. The operation of AgriImage's sUAS are far less the risks than the risk levels inherent in the commercial activities outlined in 14 CFR part 61.113. An exemption was granted to File No. 11138 in regards to an exemption under Section 333 of the FAA Modernization and Reform Act of 2012 and Part 11 of the Federal Aviation Regulations, and this individual did not have a pilot license. Exhibit 1.

The week of an operation, the flight crew will carefully review the flight location to determine if it is a safe area to fly, based on the following criteria: at least 5 miles away from airports, away from populated areas, and any obstructions. If there are any individuals who live close to the area in which the flight crew will fly, the flight crew will contact these individuals and make them aware of the flight. The sUAS will only fly over land of which it has permission from the landowner or landowner's agent. If a notification is necessary to members who live close by, the flight crew will provide them with the following: time, place, and type of UAS operation being conducted. If the flight crew is unable to reach individuals who own property close by, they will leave letters in mailboxes and/or front doors in order to inform the individuals of the panned sUAS operation. The flight crew will also brief the property owners on their safety guidelines.

Flights will take place on rural farmland that will vary in size. The PIC will remain in visual line of sight (VLOS) at all times. For larger fields, the PIC will break the fields into sections in order to remain in visual line of sight. Operation will not take place in congested or densely populated areas, and the PIC will abide by local and federal laws and restrictions. The flight crew will monitor weather data information prior to every flight, and conduct a preflight checklist as found in the Wookong or Naza V2 user guides. Refer to exhibits 6 and 12 for the respective user guides.

AgriImage will abide by the following operating conditions under this exemption:

- AgriImage will only operate its sUASs in Visual Line of Sight (VLOS) of the pilot or observer; operating within 1,500 feet will ensure the UAS stays within visual line of sight (VLOS);
- The sUASs will be restricted to an altitude of 400 feet above ground level (AGL);
- Will not operate the sUASs within 5 miles of an airport. If flight is to be conducted within 5 miles of an airport, AgriImage will contact respective airports to request permission to fly, providing the respective airport with: estimated flight time, flight duration, elevation of flight and other relevant flight information;
- Will obtain permission from land owner/controller prior to the beginning of every flight;
- All operations will avoid congested or populated areas;
- Use the UAS' global positioning system (GPS) failsafe feature in which the unit returns to its original take-off spot if communication with remote control pilot is lost. This failsafe systems also monitors battery life of the UAS, and will return the unit home if battery levels get too low (refer to Exhibit 3 for a detailed description of the failsafe safety features);
- Operations will occur during daylight hours;
- Will not fly the UAS unless it has the maximum amount of satellites as specified in the user manual;
- Operate the UAS following all safety precautions, conducting a pre-flight checklist before every flight, and will actively monitor flight data and other sources of information in order to enhance safety protocols.

The ground station software for the AgScout and AgScout Mini have "no fly zones" programmed into them, which will prevent the PIC from placing waypoints in no fly zones. A no fly zone is defined as a 5 mile circular area covering all major airports. Refer to exhibit 4 for a comprehensive list of no fly zones. AgriImage will take every precaution to avoid flying in airspace other than class G airspace, and the "no fly zones" will add an additional level of safety to flight operations.

The sUAS has been tested by the PIC and VO in a variety of weather conditions. The AgScout is capable of flying in winds up to 30 mph (26 knots), while the AgScout mini can fly in winds up to 15 mph (13 knots). Due to the potential for water damage to the sUAS, AgriImage will not fly in rainstorms. Rainstorms also decrease the visibility of the unit, therefore it would not be safe to operate the unit in such conditions. The PIC and VO have also practiced failsafe features in case an emergency bailout is necessary. This feature allows the PIC to flip the failsafe switch, which makes the sUAS return to home. Another safety feature, if an emergency occurs, allows the PIC to release the joysticks. Releasing the joysticks will make the sUAS hover in place and maintain its position and altitude.

When operating the sUAS, the PIC and the VO will stand next to each other, always communicating while viewing the ground station monitor. The VO will observe the telemetry data and images from the camera on the ground station monitor. If the PIC wishes to capture a different angle on the camera, the VO will direct the PIC.

III. Privacy

Proposed flights will not invade privacy because all flights will occur over rural property with the property owner's prior knowledge and consent. Property to be filmed will have requested and hired AgriImage for the purpose of filming and photographing the property with the sUAS.

IV. Aircraft and Equivalent Level of Safety

AgriImage proposes that the exemption requested herein apply to civil aircraft that have the characteristics and that operate within the limitations listed herein. These limitations provide for at least an equivalent or higher level of safety to operate under the current regulatory structure.

These limitations and conditions to which AgriImage agrees to be bound when conducting commercial operations under an FAA issued exemption include:

1. The sUASs will weigh significantly less than (50) lbs. The AgScout weighs 11 lbs., inclusive of battery and payload. The AgScout Mini weighs 5 lbs., inclusive of battery and payload.

2. Flights will not exceed an altitude of 400 feet AGL.

3. Flights will be operated within visual line of sight (VLOS) of the PIC and VO.

4. Crew for each operation will consist of the sUAS PIC and VO.

5. Each flight will have a maximum total flight time of 75% of battery life. Flights will be terminated once battery level reaches 25% level. The PIC and VO will have access to this information via the telemetry data submitted to the ground station monitor and transmitter. If for some reason the PIC and VO do not notice battery level getting low, the sUAS will enter into failsafe mode.

6. Prior to each flight, the flight crew will review the desired flight patterns and conduct the preflight checklist.

7. The operator will obtain a FAA UAS Civil COA prior to conducting any operations under this grant of exemption.

8. The PIC and VOs will at all times be able to communicate with each other.

9. Flight data will be actively analyzed, along with other sources of information to constantly update and enhance safety protocols.

10. Procedures will be set in place to abort flights in the event of safety breaches or potential danger. Both the AgScout and AgScout Mini will have the capability to abort flight in case of unexpected obstacles or emergencies.

11. All local and federal laws and regulations will be followed.

12. The PIC has accumulated numerous flight hours that easily exceed over 100 hours. PIC has 5 years the experience with RC aircraft, and has numerous hours flying sUAS as a hobbyist.

V. Public Interest and Safety

AgriImage's safety protocols provide a level of safety equal to or exceeding existing rules. Airplanes are currently the means of aerial video and photography for agricultural images. While the safety record of such airplanes is astonishing, there have been accident that involves the loss of life as well as extensive property damage; it is far safer to operate battery-powered sUAS.

The sUAS does not carry people and it operates in specific rural areas away from mass populations, therefore the loss of life is diminished. There is no fuel on board the sUAS, which reduces the risk for fire or explosions. The limited weight of the AgScout and AgScout Mini significantly reduces the potential for harm to participating and nonparticipating individuals or property in the event of an incident or accident. Both sUASs can fly at lower altitudes the manned aircraft and requires less room for takeoff and landing, allowing for flights to take place over smaller areas.

The AgScout and AgScout Mini's small size, weight, speed, and limited operating area associated with the aircraft and its operation meet the statutory considerations of Section 333.

VI. Regulations from Which Exemption is Requested

A. 14 C.F.R. 21 (h) and 14 C.F.R. 91.203(a)(1): Airworthiness Certificates, Manuals and the Like.

AgriImage, LLC requests an exemption from 14 C.F.R. 21 (h), which "prescribes requirements for the issue of airworthiness certificates" in relation to FAR C.F.R. 91.203(a)(1). The size, weight and enclosed operational area of the sUASs meets an equivalent level of safety pursuant to Section 333 of the Reform Act. The FAA is authorized to exempt aircraft from the airworthiness certificate requirement under both the Act (49 U.S.C. Section (f)) and Section 333 of the Reform Act. These pieces of legislation permit the FAA to exempt sUAS's from the airworthiness certificate requirement in consideration to weight, size, speed, maneuverability and proximity to areas such as airports or highly populated areas.

Equivalent level of safety: AgriImage's proposed exemption meets the requirements for an equivalent level of safety of this section, pursuant to Section 333, based upon the following factor:

- Small Size:
  - AgScout: The AgScout's external dimensions can be found in Exhibit 5.
  - AgScout Mini: The AgScout Mini's external dimensions can be found in Exhibit 11.
- Light weight:
  - AgScout: 11 lbs. inclusive of battery and technical payload.
  - AgScout Mini: 5 lbs. inclusive of battery and technical payload.
- Operate at relatively slow speed:

    - AgScout and AgScout Mini: while the AgScout and AgScout Mini are capable of operating at speeds up to 30 mph (26 knots), flights will be limited to the slower speed of 20 mph (17 knots).
- Operational capacity:
    - AgScout and AgScout Mini: the low battery failsafe is triggered in both of these units, as found in exhibit 3, when battery level is depleted to 84%.
- Operating near airports: AgriImage will only operate in class G airspace, and will not operate within 5 miles of an airport. If operation within 5 miles must take place, AgriImage will contact necessary officials at the airport to obtain permission to operate its unit.
- Visual line of sight (VLOS): the PIC will always fly the sUAS within his line of sight.
- Altitude: AgriImage will always operate no more than 400 feet AGL.
- Operating near populated areas: AgriImage will only operate in Class G airspace in rural, natural areas. Due to the industry in which AgriImage serves, flights take place over rural farmland. These areas are typically far away from heavily populated areas.
- Area in which the sUAS will be operated: The aircraft will operate in the area in which AgriImage has permission to operate within. The flight crew will watch for individuals and other aircraft entering the area. Flights will be aborted if flight crew notices any individuals or aircraft entering the area.

B. 14 C.F.R. 45.23(b): Marking of the Aircraft.

This regulation states the following:

When marks include only the Roman capital letter "N" and the registration number is displayed on limited, restricted or light-sport category aircraft or experimental or provisionally certified aircraft, the operator must also display on that aircraft near each entrance to the cabin, cockpit, or pilot station, in letters not less than 2 inches nor more than 6 inches high, the words "limited," "restricted," "light-sport," "experimental," or "provisional," as applicable.

AgriImage seeks exemption from 14 C.F.R. 45.23(b) due to the fact the AgScout does not have a cabin, cockpit, or pilot station on which the word "experimental" can be placed. The 2-inch lettering would not fit due to the size of the aircraft. However, in order to comply with 14 C.F.R. Section 45.29(f), AgriImage will mark the fuselage with the word "Experimental." AgriImage will also mark one or more of the "arms" of the sUAS. The size of the marking will be determined by the size of the "arm" being used and may be less than 1 inch in size.

Equivalent level of safety: Marking the fuselage as required by 14 C.F.R. 45.29(f) will meet the equivalent level of safety. It will allow the PIC, VO and others working with the sUAS will see the identification of the UAS as "Experimental." This request is consistent with the following exemptions to this regulation that the FAA has issued: Exemption Nos. 10700, 8738, 10167 and 10167A.

C. 14 C.F.R. 61.113 (a)(b): Private Pilot Privileges and Limitations: Pilot in Command.

AgriImage requests an exemption from 14 C.F.R. 61.113. The PIC of the sUAS does not possess either a private or commercial license. However, both sUASs are essentially model aircrafts. The AgScout weighs 11 lbs. inclusive of battery and technical payload, and the AgScout Mini weighs 5 lbs. inclusive of battery and technical payload. AgriImage's sUASs will not carry any pilot or passengers, the area of operation is controlled and restricted, all flights will be planned in advance, and the maximum altitude will not exceed 400 feet AGL. A pilot license could be helpful, but a pilot license

will not ensure remote control piloting skills. The operation of AgriImage's sUAS are far less the risks than the risk levels inherent in the commercial activities outlined in 14 CFR part 61.113.

The FAA previously granted exemption for this section for File No. 11138 (Exhibit 1). AgriImage requests the same determination to be made for this Petition.

Equivalent level of safety: The sUASs do not carry pilot or passengers and will operate in controlled areas. Flights will not exceed 400 feet AGL. The sUASs are very light in weight, and they both contain failsafe features (Exhibit 3). The PIC, and the VO, have over 5 years of experience with RC aircraft, and have numerous hours flying sUAS as hobbyist. The flight crew are familiar with the unit and have knowledge of its operations.

D. **14 C.F.R. 91.7(a): Civil aircraft worthiness.**

AgriImage, LLC requests exemption from Section 91.7(a). As no such certificate will be applicable in the form contemplated by the FARs, this Regulation is inapplicable.

Equivalent level of safety: The PIC and VO assemble the sUAS from start to finish, which makes them the most qualified to confirm that the copters is in an airworthy mechanical and electrical condition. Thus, this exemption provides an equivalent level of safety to 14 C.F.R. 91.7(a) because the PIC and VO contain knowledge of the aircraft, which will enable them to make the determination as to the airworthy condition.

E. 14 C.F.R. 91.9 (b)(2): Civil aircraft flight manual, marking, and placard requirements.

The FAA previously stated that no exemption is required for this section, Exhibit 1. AgriImage requests the same determination to be made for this Petition.

Alternatively, AgriImage requests exemption from Section 91.9(b) (2) because the UAS does not contain any pilots or passenger on board, and due to the size of the UAS it is impossible to place an aircraft flight manual inside of the aircraft. To provide an equivalent level of safety, AgriImage will maintain a safety flight manual with the UAS ground station, Exhibit 2.

F. 14 C.F.R. 91.103(b)(2): Preflight action.

AgriImage, LLC requests exemption from Section 91.103(b)(2) because the UAS will not be operated at airports or require a runway for takeoff. To provide an equivalent level of safety, AgriImage, LLC will make sure that all pre-flight safety instructions are followed. AgriImage, LLC will ensure that the landing and take-off area of the UAS is clear of any obstructions, and that the user or observer is at least 15 feet away from the UAS at takeoff and landing.

G. 14 C.F.R. 91.105: Flight crewmembers at stations.

AgriImage requests an exemption for 14 C.F.R. 91.105 due to the fact that the sUAS carries no flight crewmembers.

Equivalent Level of Safety: AgriImage will achieve an equivalent level of safety by ensuring that someone is at the controls at all times. The flight crew will consist of the PIC and the VOs. These individuals will remain at their stations at all times during flight. These stations will be on the ground, not in the air.

H. 14 C.F.R. 91.109(a): Flight Instruction

These regulations provide that no person may operate a civil aircraft (except a manned free balloon) that is being used for flight instruction unless that aircraft has fully functioning dual controls.

The AgScout and AgScout Mini are remotely piloted aircraft and by design, does not have fully functional dual controls. Flight control is accomplished through the use of a control box that communicates with the aircraft via radio communications. If needed during flight, the observer can easily gain control of the aircraft by commandeering the UAS' control unit. This serves as an equivalent level of safety for fully functioning dual controls. The FAA has approved exemptions for flight training without fully functional dual controls for number of aircraft and for flight instruction in experimental aircraft (See Exemption Nos. 5778k & 9862A). AgriImage requests the same determination be made for this Petition.

I. 14 C.F.R. 91.119: Minimum Safe Altitudes.

This Section establishes safe altitudes for operation of civil aircraft. 91.119(c) states the following:

"Except when necessary for takeoff or landing, no person may operate an aircraft below the following altitudes.....

(c) Over other than congested areas. An altitude of 500 feet above the surface, except over open water or sparsely populated areas. In those cases, the aircraft may not be operated closer than 500 feet to any person, vessel, vehicle, or structure."

The AgScout and AgScout Mini will never operate at higher than 400 feet AGL. They will, however, be operated to avoid congested or populated area. Because aerial survey work must be accomplished at relatively low altitudes and at altitudes less than 500 feet AGL, an exemption from Section 91,119(c) is needed. The equivalent level of safety will be achieved given the size, weight, speed, and material with which the sUASs are built. AgriImage will operate the UAS under the following, self-imposed restrictions:

- the UAS will not be operated over congested or populated areas, and will stay away from power lines, elevated lights, airports, and other relevant obstructions;
- if flight is to be conducted within 5 miles of an airport, AgriImage will contact respective airports and advise them of estimated flight time, flight duration, elevation of flight and other relevant flight information;
- AgriImage will seek permission from land owner/controller prior to the beginning of every flight;
- All operations will occur over private or controlled access property.

AgriImage, will be flying over private agricultural land. These areas are secluded and are not considered to be congested or populated areas. AgriImage will also follow all safety requirements as mentioned in the user manual. AgriImage will not fly in congested and highly populated areas. Therefore, emergency landings can be performed without causing hazard to persons or property on the surface. The failsafe mechanism built into the UAS also ensures that safe landings will be performed.

J. 14 C.F.R. 91.121: Altimeter Settings

AgriImage requests exemption from 14 C.F.R. 91.121. The AgScout and AgScout Mini's flight controller both have an internal measurement unit ("IMU"). This is a built-in internal sensor and barometric altimeter that measures both attitude and altitude, Exhibit 2. AgriImage is not requesting a general exemption from the requirement that its sUAS have an Altimeter. However, AgriImage requests an exemption from the requirement to set its altimeter to a station along the route, or out of an airport, because the AgScout and AgScout Mini will not be traveling from point-to-point and it has to remain in the VLOS of the PIC. AgriImage will also not operate within 5 miles of an airport.

Equivalent Level of Safety: AgriImage will never exceed an altitude of 400 feet AGL and will not exceed the speed of 20 knots. The PIC and VO will be able to observe and control the maximum height of the sUAS through telemetry features of the transmitter and on the ground station monitor. Both the

AgScout and AgScout Mini, through the use of telemetry features, provide altitude information from the ground station monitor. The PIC will always keep the sUAS in VLOS. Therefore, AgriImage will meet the equivalent level of safety provided by Section 91.121. The FAA has previously granted this exemption. Exhibit 2.

K. 14 C.F.R. 91.151: Fuel Requirements for flight in VFR conditions.

The AgScout and AgScout Mini are powered by lithium polymer batteries that currently have a flight time of no more than 30 minutes. Due to the limitations of the batteries, it is currently impossible to comply with 14 C.F.R. 91.151. During the flight, the PIC will keep the sUAS in VLOS while the VO observes the battery life via the telemetry display on the ground station monitor.

Equivalent Level of Safety: The failsafe mechanisms is triggered in both of these units, as found in exhibit 3, when battery level is depleted to 84%. This meets an equivalent level of safety to 14 C.F.R. 91.151(a) due to limitations on AgriImage's proposed operations and locations of the operations, a reduced minimum power reserve for flight in daylight VFR conditions is reasonable.

L. 14 C.F.R. 91.405 (a); 407 (a)(1); 409 (a) (2); 417 (a) (b): Maintenance Inspections.

The regulations cited above require aircraft owners and operators to "have the aircraft inspected as prescribed in subpart E of this part and shall between required inspections, except as provided in paragraph (c) of this section, have discrepancies repaired as prescribed in part 43....."

The aforementioned regulations only apply to aircraft with an airworthiness certificate. Therefore, these regulations do not apply to AgriImage's sUASs.

Equivalent Level of Safety: This exemption will meet an equivalent level of safety to 14 C.F.R. 91.405 (a); 407 (a)(1); 409 (a)(2); and 417 (a)&(b) because AgriImage will repair and maintain the AgScout and AgScout Mini by following the manufacturer's specifications. Exhibit 5 and Exhibit 11. AgriImage will also conduct preflight inspections to ensure the sUAS is ready to fly. AgriImage will keep detailed maintenance record on every part as it is replaced, including but not limited to motors, propellers, batteries, and electrical components.

VII. Exhibit List

A. Exhibit 1: Douglas Trudeau, Docket No. FAA-2014-0481, Grant of Exemption (Jan. 6, 2015)

Exemption No. 11138

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
WASHINGTON, DC 20591

In the matter of the petition of

DOUGLAS TRUDEAU, REALTOR®

for an exemption from Part 21; and §§ 45.23(b); 61.113(a) & (b); 91.7(a); 91.9(b)(2); 91.103(b); 91.109; 91.119; 91.121, 91.151(a); 91.203(a) & (b); 91.405(a); 91.407(a)(1); 91.409(a)(2); and 91.417(a) & (b) of Title 14, Code of Federal Regulations

Regulatory Docket No. FAA-2014-0481

GRANT OF EXEMPTION

By letter dated July 12, 2014, Mr. Douglas Trudeau, Realtor®, of Tierra Antigua Realty (Trudeau), 1650 E River Road, Suite 202, Tucson, AZ 85718 petitioned the Federal Aviation Administration (FAA) for an exemption from part 21, subpart H; and Sections 45.23(b), 61.113(a) and (b), 91.7(a), 91.9(b)(2), 91.103(b), 91.109, 91.119, 91.121, 91.151(a), 91.203(a) and (b), 91.405(a), 91.407(a)(1), 91.409(a)(2), and 91.417(a) and (b) of Title 14, Code of Federal Regulations (14 CFR). The proposed exemption would allow Trudeau to operate the PHANTOM 2 Vision+ quad-copter unmanned aircraft system (UAS) to conduct aerial videography and cinematography to enhance academic community awareness for those individuals and companies unfamiliar with the geographical layout of the metro Tucson area and augment real estate listing videos.

The petitioner requests relief from the following regulations:

Part 21 prescribes the procedural requirements for issuing and changing design approvals, productions approvals, airworthiness certificates, and airworthiness approvals.

Section 45.23(b) prescribes that when marks include only the Roman capital letter "N" and the registration number is displayed on limited, restricted or light-sport category aircraft or experimental or provisionally certificated aircraft, the

operator must also display on that aircraft near each entrance to the cabin, cockpit, or pilot station, in letters not less than 2 inches nor more than 6 inches high, the words "limited," "restricted," "light-sport," "experimental," or "provisional," as applicable. Section 61.113(a) and (b) prescribes that—

(a) no person who holds a private pilot certificate may act as a pilot in command of an aircraft that is carrying passengers or property for compensation or hire; nor may that person, for compensation or hire, act as pilot in command of an aircraft.

(b) a private pilot may, for compensation or hire, act as pilot in command of an aircraft in connection with any business or employment if:

(1) The flight is only incidental to that business or employment; and

(2) The aircraft does not carry passengers or property for compensation or hire.

Section 91.7(a) prescribes that no person may operate a civil aircraft unless it is in an airworthy condition.

Section 91.7(b) prescribes that the pilot in command of a civil aircraft is responsible for determining whether that aircraft is in condition for safe flight and that the PIC shall discontinue the flight when unairworthy mechanical, electrical, or structural conditions occur.

Section 91.9(b)(2) prohibits operation of U.S.-registered civil aircraft unless there is available in the aircraft a current approved Airplane or Rotorcraft Flight Manual, approved manual material, markings, and placards, or any combination thereof.

Section 91.103(b) prescribes that a pilot shall for any flight, become familiar with runway lengths at airports of intended use, and takeoff and landing distance information.

Section 91.109(a) prescribes, in pertinent part, that no person may operate a civil aircraft (except a manned free balloon) that is being used for flight instruction unless that aircraft has fully functioning dual controls.

Section 91.119 prescribes that, except when necessary for takeoff or landing, no person may operate an aircraft below the following altitudes:

(a) Anywhere. An altitude allowing, if a power unit fails, an emergency landing without undue hazard to persons or property on the surface.

(b) Over congested areas. Over any congested area of a city, town, or settlement, or over any open air assembly of persons, an altitude of 1,000 feet above the highest obstacle within a horizontal radius of 2,000 feet of the aircraft.

(c) Over other than congested areas. An altitude of 500 feet above the surface, except over open water or sparsely populated areas. In those cases, the aircraft may not be operated closer than 500 feet to any person, vessel, vehicle, or structure.

(d) Helicopters, powered parachutes, and weight-shift-control aircraft. If the operation is conducted without hazard to persons or property on the surface—

(1) A helicopter may be operated at less than the minimums prescribed in paragraph (b) or (c) of this section, provided each person operating the helicopter complies with any routes or altitudes specifically prescribed for helicopters by the FAA; and

(2) A powered parachute or weight-shift-control aircraft may be operated at less than the minimums prescribed in paragraph (c) of this section.

Section 91.121 requires, in pertinent part, each person operating an aircraft to maintain cruising altitude by reference to an altimeter that is set "...to the elevation of the departure airport or an appropriate altimeter setting available before departure."

Section 91.151(a) prescribes that no person may begin a flight in an airplane under VFR conditions unless (considering wind and forecast weather conditions) there is enough fuel to fly to the first point of intended landing and, assuming normal cruising speed, (1) during the day, to fly after that for at least 30 minutes [emphasis added].

Section 91.203(a) prohibits, in pertinent part, any person from operating a civil aircraft unless it has within it (1) an appropriate and current airworthiness certificate; and (2) an effective U.S. registration certificate issued to its owner or, for operation within the United States, the second copy of the Aircraft registration Application as provided for in § 47.31(c).

Section 91.203(b) prescribes, in pertinent part, that no person may operate a civil aircraft unless the airworthiness certificate or a special flight authorization issued under § 91.715 is displayed at the cabin or cockpit entrance so that it is legible to passengers or crew.

Section 91.405(a) requires, in pertinent part, that an aircraft operator or owner shall have that aircraft inspected as prescribed in subpart E of the same part and shall, between required inspections, except as provided in paragraph (c) of the same section, have discrepancies repaired as prescribed in part 43 of the chapter.

Section 91.407(a)(1) prohibits, in pertinent part, any person from operating an aircraft that has undergone maintenance, preventive maintenance, rebuilding, or alteration unless it has been approved for return to service by a person authorized under § 43.7 of the same chapter.

Section 91.409(a)(2) prescribes, in pertinent part, that no person may operate an aircraft unless, within the preceding 12 calendar months, it has had an inspection for the issuance of an airworthiness certificate in accordance with part 21 of this chapter.

Section 91.417(a) and (b) prescribes, in pertinent part, that—

(a) Each registered owner or operator shall keep the following records for the periods specified in paragraph (b) of this section:

(1) Records of the maintenance, preventive maintenance, and alteration and records of the 100-hour, annual, progressive, and other required or approved inspections, as appropriate, for each aircraft (including the airframe) and each engine, propeller, rotor, and appliance of an aircraft. The records must include—

(i) A description (or reference to data acceptable to the Administrator) of the work performed; and

(ii) The date of completion of the work performed; and

(iii) The signature, and certificate number of the person approving the aircraft for return to service.

(2) Records containing the following information:

(i) The total time in service of the airframe, each engine, each propeller, and each rotor.

(ii) The current status of life-limited parts of each airframe, engine, propeller, rotor, and appliance.

(iii) The time since last overhaul of all items installed on the aircraft which are required to be overhauled on a specified time basis.

(iv)The current inspection status of the aircraft, including the time since the last inspection required by the inspection program under which the aircraft and its appliances are maintained.

(v) The current status of applicable airworthiness directives (AD) and safety directives including, for each, the method of compliance, the AD or safety directive number and revision date. If the AD or safety directive involves recurring action, the time and date when the next action is required.

(vi)Copies of the forms prescribed by § 43.9(d) of this chapter for each major alteration to the airframe and currently installed engines, rotors, propellers, and appliances.

(b) The owner or operator shall retain the following records for the periods prescribed:

(1) The records specified in paragraph (a)(1) of this section shall be retained until the work is repeated or superseded by other work or for 1 year after the work is performed.

(2) The records specified in paragraph (a)(2) of this section shall be retained and transferred with the aircraft at the time the aircraft is sold.

(3) A list of defects furnished to a registered owner or operator under § 43.11 of this chapter shall be retained until the defects are repaired and the aircraft is approved for return to service.

The petitioner supports his request with the following information:

The petitioner has provided the following information – contained in his petition and supporting documentation including: 1) Supplemental Response for Petition, 2) PHANTOM Flying Flow Chart V1.0 (Simplified Version), PHANTOM Quick Start Manual v1.7, PHANTOM Advanced Manual v.1.4, 3) PHANTOM 2 Vision+ User Manual 4) restricted areas map, 5) personal protocols and controls, and 6) Safety/Flight Manual (all hereinafter referred to as operating documents).

The FAA has organized the petitioner's information into four sections: 1) the unmanned aircraft system (UAS), 2) the UAS Pilot In Command (PIC), 3) the UAS operating parameters and 4) Public Interest.

Unmanned Aircraft System

The petitioner states he plans to operate a UAS, the PHANTOM 2 Vision+, which is comprised of an unmanned aircraft (UA or PHANTOM) and a transportable ground station. The PHANTOM is referred to as a quad-copter with a maximum gross weight of about 3 pounds. It is equipped with four rotors that are driven by electric motors powered by batteries.

The UA has a maximum airspeed of 30 knots. Petitioner plans to attach a small ultralightweight GoPro 3+ camera to his UA and operate the UA over various areas near Tucson, Arizona to enhance academic community awareness and augment real estate listing videos. Petitioner makes the following representations of operational enhancements which he proposes to abide by to ensure this exemption will provide a level of safety at least equal to existing rules:

- He will only operate in reasonably safe environments that are strictly controlled, are away from power lines, elevated lights, airports and actively populated areas; and
- He will conduct extensive preflight inspections and protocols, during which safety carries primary importance.

The petitioner states that given the size, weight, speed, and limited operating area associated with the aircraft to be utilized by him, an exemption from 14 CFR part 21, Subpart H (Airworthiness Certificates) and § 91.203 (a) and (b) (Certifications required), subject to certain conditions and limitations, is warranted and meets the requirements for an equivalent level of safety under 14 CFR part 11 and Section 333 of P.L. 112-95 (Section 333).

Petitioner requests an exemption from § 45.23 *Marking of the aircraft* because his UA will not have a cabin, cockpit or pilot station on which to mark certain words or phrases. Further, he states that two-inch lettering is difficult to place on such a small aircraft with dimensions smaller than the minimal lettering requirement. Regardless of this, petitioner states that he will mark his UAS in the largest possible lettering by placing the word "Experimental" on its fuselage as required by § 45.29(f) so that he or anyone assisting him as a spotter will see the markings.

The petitioner states that an exemption from §§ 91.405(a), 91.407(a)(1), 91.409(a)(2) and 91.417(a) and (b) *Maintenance inspections* may be required and should be granted since they only apply to aircraft with an airworthiness certificate. However, the petitioner states as a safety precaution he will perform a preflight inspection of his UAS before each flight as outlined in his operating documents.

UAS Pilot in Command (PIC)

The petitioner asserts that under § 61.113 (a) and (b) private pilots are limited to noncommercial operations, however he can achieve an equivalent level of safety as achieved by current regulations because his UAS does not carry any pilots or passengers. Further, he states that, while helpful, a pilot license will not ensure remote control piloting skills. He further indicates that the risks of operating a UAS are far less than the risk levels inherent in the commercial activities outlined in 14 CFR part 61, et seq., thus he requests an exemption from § 61.113 *Private Pilot Privileges and Limitations: Pilot in command.*

Regarding UAS operational training, the petitioner states he has flown numerous practice flights in remote areas as a hobbyist simulating flights for future commercial use to gain familiarization with the characteristics of his UAS' performance under different temperature and weather conditions. He further states that he practices computerized simulated flights to maintain adequate skills and response reflex time.

In a supplemental request to the FAA, the petitioner requests consideration of a 120 day temporary airman certificate in accordance with § 63.13, to allow him time to obtain a private pilot certificate or to allow the FAA time to establish minimum UAS airman certification standards.

UAS Operating Parameters

The petitioner states that he will abide by the following additional operating conditions under this exemption:

- operate his UAS below 300 feet and within a radius distance of 1000 feet from the controller to both aid in direct line of sight visual observation;[1]
- operate the UAS for 3-7 minutes per flight;
- land his UAS prior to the manufacturer's recommended minimum level of battery power;
- operate his UAS only within visual line of sight (VLOS);

[1] As specified in Douglas Trudeau Supplementary Information No. 2

- use the UAS' global positioning system (GPS) flight safety feature whereby it hovers and then slowly lands if communication with the remote control pilot is lost;
- conduct all operations under his own personal and flight safety protocols (including posting a warning sign reading: "Attention Aerial Photography in Progress – Remain Back 150 feet") contained in the operating documents and will actively analyze flight data and other sources of information to constantly update and enhance his safety protocols;
- contact respective airports if operations will be within 5 miles to advise them of his estimated flight time, flight duration, elevation of flight and other pertinent information;
- always obtain all necessary permissions prior to operation; and
- have procedures in place to abort flights in the event of safety breaches or potential danger.

Petitioner states that § 91.7(a) prohibits the operation of an aircraft without an airworthiness certificate. The petitioner asserts that since there is currently no certificate applicable to his operation, this regulation is inapplicable.

Petitioner states that § 91.9(b)(2) requires an aircraft flight manual in the aircraft, however since there are no pilots or passengers on board his aircraft and given its size, this regulation is inapplicable. He further indicates an equivalent level of safety will be achieved by maintaining a safety/flight manual with the UAS ground station.

Although petitioner requests an exemption from § 91.103(b) *Preflight action*, he provides no information supporting his request.

Similarly, the petitioner requests an exemption from § 91.109 *Flight instruction; simulated instrument flight and certain flight test,* and provides no information indicating how safety will be maintained if an exemption to this section is granted.

Petitioner states that § 91.119 prescribes safe altitudes for the operation of civil aircraft, but that it allows helicopters to be operated at lower altitudes in certain conditions. Petitioner states he will not operate his UAS above the altitude of 300 feet above ground level (AGL) and will also only operate in safe areas away from the public and traffic, thus "providing a level of safety at least equivalent to or below those in relation to minimum safe altitudes." The petitioner asserts that given the size, weight, maneuverability, and speed of his UAS, an equivalent or higher level of safety will be achieved.

Petitioner indicates that § 91.121 *Altimeter settings* is inapplicable since he UAS utilizes electronic GPS with a barometric sensor.

While petitioner requests an exemption from § 91.151(a) *Fuel requirements for flight in VFR conditions*, he provides no information supporting his request for this exemption.

Public Interest

The petitioner states that aerial videography for geographical awareness and for real estate marketing has been around for a long time through manned fixed wing aircraft and helicopters, but for small business owners, its expense has been cost-prohibitive. Granting this exemption to the petitioner would allow him to provide this service at a much lower cost. Further, the petitioner indicates his small UAS will pose no threat to the public given its small size and lack of combustible fuel when compared to larger manned aircraft. The petitioner also states that the operation of his UAS will minimize ecological damage and promote economic growth by providing information to companies looking to relocate or build in the Tucson metro area.

Discussion of Public Comments:

A summary of the petition was published in the Federal Register on August 8, 2014 (79 FR 46500). The petition received five comments. During the comment period, the petitioner submitted supplemental information in response to several of the comments.

Of the five comments received, including four from trade organizations and one submitted by an individual, three raised concerns with the petition and one was specifically opposed. The other two supported the petition. Three trade organizations submitted letters expressing various concerns with the petition for exemption, including the Air Line Pilots Association International (ALPA), the National Agricultural Aviation Association (NAAA), and the United States Hang Gliding & Paragliding Association (USHPA).

ALPA expressed concern regarding certain conditions outlined in Trudeau's petition. ALPA noted that the proposed operations will be for "compensation or hire," and believes the UAS pilot must hold at least a current FAA Commercial Pilot Certificate with an appropriate category and class rating for the type of aircraft being flown and a current second-class airman medical certificate. ALPA also noted that this is the requirement for compensation or hire operations in the National Airspace System (NAS) today. NAAA and USHPA raised similar concerns on pilot qualification. NAAA and USHPA asserted that the operator should hold a pilot certificate and be thoroughly familiar with the limitations of manned aircraft flight. NAAA further stated that requirements for UAS pilot licensing should be developed along with other rigorous rules and qualifications to ensure safe integration of the unmanned aircraft into the NAS. The Small UAV Coalition (Coalition) disagreed with ALPA, NAAA and USHPA, asserting that a pilot certification should not be required for small unmanned operations such as the petitioner's.

The FAA has carefully reviewed the concerns expressed in these comments and the discussion regarding knowledge, training, and medical certification required by holders of both private and commercial pilot certificates. Additional details are available in the ensuing analysis of this issue with regard to 14 CFR part 61.

ALPA stated that the petitioner asserts that although he plans to fly below 300 feet above the surface and will generally not operate near populated areas, he also states he plans to survey real estate development which ALPA believes are by definition populated areas. ALPA also stated that the petitioner's area of operations as outlined in his exhibits show he would be within the airport traffic area of both Tucson International Airport and Davis-Monthan AFB. ALPA also raised concerns about whether the petitioner's UAS' barometric sensor will enable him to accurately address his altitude restrictions. ALPA also asserted that processes or mitigations, such as redundant control capability, fail-safe systems, and backups, and specific, validated procedures for system and equipment failures, must be in place to ensure the aircraft and its control system(s) operate to the same level of safety as other aircraft operated commercially in the NAS. NAAA stated commercial UAS should have to receive airworthiness certification by the FAA to ensure they can safely operate in the NAS without posing a hazard to persons or property.

ALPA commented that command and control (C2) link failures are one of the most common failures on a UAS, and that lost link mitigations should require safe modes to prevent UA fly-away or other scenarios. If lost-link occurs, mitigations like auto-hover, auto-land, returnto-home and geo-fencing boundary protection must be incorporated into the navigation and control systems for the UAS to safely land or re-establish C2.

The FAA agrees and carefully examined the proposed operation to ensure that the vehicle design and the petitioner's supporting documentation addressed potential hazards related to C2 failure. The FAA finds that the UAS to be operated by Trudeau has sufficient design features to address these hazards. Further detail is contained in the analysis of the UAS below.

Regarding use of the NAS, ALPA noted there must be means to ensure the UA remains within the defined airspace and to ensure the hazard of other aircraft intruding on the operation is mitigated. ALPA stated given the absence of an onboard pilot, the means to meet the requirements to "see and avoid" must be specified. ALPA also expressed concern, stating that "because the waiver request is not for a specific operation but rather for all operations of the same general type, the FAA's

oversight task is considerably increased." Per the conditions and limitations below, the FAA has prescribed operator, pilot and notification requirements to ensure that appropriate oversight can occur.

The FAA agrees and has required specific conditions and limitations outlined below related to the use of a visual observer, that the pilot be a current FAA certificated private pilot and that a notice-to-airmen (NOTAM) be issued prior to operations.

NAAA stated that it represents the interests of small business owners and pilots licensed as commercial applicators and ensuring safe low-level airspace includes minimizing obstructions which are difficult to be seen and identified by the pilots. NAAA members operate in lowlevel airspace, and clear low-level airspace is vital to the safety of these operators. NAAA stated that seeing and avoiding other aircraft and hazardous obstructions is the backbone for agricultural safety, and agricultural pilots depend on pilots of other aircraft to perform their see and avoid functions needed to prevent collisions. NAAA believes that UA operations at low altitudes will increase the potential of collision hazards with agricultural aircraft. NAAA requested that operators of UAS develop ways of making the presence of UAS known to VFR air traffic if they are to be integrated into the NAS and, for areas with less UAS activity, recommended a procedure for issuing NOTAMs when they are present.

The FAA agrees and has incorporated this into the conditions and limitations of this exemption. NAAA's notification concerns are also addressed by the conditions and limitations that will require an Air Traffic Organization issued Certificate of Waiver or Authorization (COA) to address airspace requirements and notification. Further detail is contained in the analysis of the UAS operating parameters below.

NAAA proposed UAS comply with 13 measures similar to those presented by the North Dakota Agricultural Aviation Association to the North Dakota Department of Commerce, the organization awarded the North Dakota UAS test site.

The FAA believes the limitations under which the petitioner will operate (i.e. VLOS and at or below 300 feet AGL) and the UAS emergency procedures as outlined in the petitioner's supplemental documentation are sufficient mitigations to this risk so that the operations will not adversely affect safety. Further, the FAA addressed additional concerns raised by NAAA by adding operating conditions and limitations regarding operations in the proximity of airports, stand-off distance from clouds, altitude restrictions, and operating distance from nonparticipating persons. Further detail is contained in the analysis of the UAS operating parameters below.

The USHPA also raised concerns about the identification marking regulations as well as the petitioner's need to coordinate his operations with airports and comply with local and state notification regulations associated with his type of activity.

Commenter James Lee wrote in support of Trudeau's petition, so long as he does not fly higher than 200 feet within a quarter mile from an airport or any flight path or flight operation and never flies above 400 feet AGL.

The FAA considered USHPA's and Mr. Lee's concerns and included conditions and limitations to address these issues as outlined below.

Lastly, the Small UAV Coalition submitted extensive comments supporting the petition. These included suggestions that the FAA: apply regulations differently to small UAVs versus those in the air transport category, not require all seven factors outlined in Section 333 as a prerequisite for every exemption (i.e. beyond visual line of sight (VLOS); weight; size, altitude, airspace, geographic area, and proposed technology), and consider Trudeau's safety protocols including his posting of signs warning of flights as sufficient to enable operations in populated areas. Regarding use in the NAS, the Small UAV Coalition

stated, in part, that the FAA's safety evaluation of UAV operations should not hinge on the type of operation (i.e. public, commercial, recreational or philanthropic) rather operational risks and steps that can be taken to eliminate or reduce such risks. The Small UAV Coalition also commended the petitioner for developing a "Personal Protocols and Controls" document that details how he will contact any airport within a 5 mile radius in advance of his proposed UAV operation.

The FAA's analysis is as follows:

Unmanned aircraft system (UAS)

The petitioner requested relief from 14 CFR part 21, *Certification procedures for products and parts.* In accordance with the statutory criteria provided in Section 333 of P.L. 112-95 in reference to 49 USC § 44704, and in consideration of the size, weight, speed, and limited operating area associated with the aircraft and its operation, the Secretary of Transportation has determined that this aircraft meets the conditions of Section 333. Therefore, the FAA finds that the requested relief from 14 CFR part 21, and any associated noise certification and testing requirements of part 36, is not necessary.

Manned aircraft conducting aerial filming and photography can weigh 5,000 lbs. or more, are operated by an onboard pilot and may carry other onboard crewmembers, as well as 100 gallons or more of fuel. The petitioner's UA weighs less than 3 lbs. The pilot and crew will be remotely located from the aircraft. The limited weight reduces the potential for harm to persons or damage to property in the event of an incident or accident. The risk to an onboard pilot and crew during an incident or accident is eliminated with the use of a UAS for the proposed operation.

Manned aircraft are at risk of fuel spillage and fire in the event of an incident or accident. The Phantom 2 Vision+ carries no fuel, and therefore the risk of fire following an incident or accident due to fuel spillage is eliminated.

This exemption does not require an electronic means to monitor and communicate with other aircraft, such as transponders or sense and avoid technology. Rather the FAA is mitigating the risk of these operations by placing limits on altitude, requiring stand-off distance from clouds, permitting daytime operations only, and requiring that the UA be operated within VLOS and yield right of way to all manned operations. Additionally, the exemption provides that the operator will request a notice to airmen (NOTAM) prior to operations to alert other users of the NAS. These mitigations address concerns raised by NAAA and ALPA regarding awareness of UAS operations occurring in the airspace

The petitioner's UAS has the capability to operate safely after experiencing certain in-flight contingencies or failures and uses an auto-pilot system to maintain UAS stability and control. The UAS is also able to respond to a loss of GPS or a lost-link event with pre-coordinated automated flight maneuvers. These safety features provide an equivalent level of safety compared to a manned aircraft holding a restricted airworthiness certificate performing a similar operation and address concerns raised by ALPA and NAAA.

Regarding the petitioner's requested relief from 14 CFR 45.23(b), *Display of marks,* the petitioner requests this relief under the assumption that marking with the word "experimental" will be required as a condition of a grant of exemption. However, this marking is reserved for aircraft that are issued experimental certificates under 14 CFR 21.191. The petitioner's UAS will not be certificated under § 21.191, and therefore the "experimental" marking is not required. Since the petitioner's UAS will not be certificated under § 21.191, a grant of exemption for § 45.23(b) is not necessary.

Regarding the petitioner's requested relief from 14 CFR 91.405(a), *Maintenance required,*

91.407(a)(1), *Operation after maintenance, preventive maintenance, rebuilding, or alteration,* 91.409(a)(2), *Inspections,* and 91.417(a) and (b), *Maintenance records,* the FAA has determined that relief from § 91.409(a)(1) is also necessary because it

is an alternate inspection requirement of § 91.409(a)(2). The petitioner proposes to inspect and ensure that the UAS is in a condition for safe flight.

Therefore, the FAA finds that adherence to the petitioner's operating documents and the conditions and limitations below, describing the requirements for maintenance, inspection, and recordkeeping, are sufficient to ensure that safety is not adversely affected. Accordingly, the FAA finds that exemption from 14 CFR 91.405(a), 91.407(a)(1), 91.409(a)(1) and (2), and 91.417(a) and (b) is warranted.

Pilot In Command (PIC) of the UAS

Regarding the petitioner's requested relief from 14 CFR 61.113(a) and (b), *Private pilot privileges and limitations,* the petitioner requested regulatory relief to operate his UAS without an FAA-certificated pilot. In support of his request, the petitioner states that "while helpful, a pilot license will not ensure remote control piloting skills." However, the FAA does not possess the authority to exempt the petitioner from the statutory requirement to hold an airman certificate, as prescribed in 49 USC § 44711.[2] Although Section 333 provides limited statutory flexibility relative to 49 USC § 44704 for the purposes of airworthiness certification, it does not provide similar flexibility relative to other sections of Title 49.

Unlike operations pursuant to public COAs, the FAA is also requiring a pilot certificate for UAS operations for two reasons, the first of which is to satisfy the statutory requirements as stated above. The second is because pilots holding an FAA issued private or commercial pilot certificate are subject to the security screening by the Department of Homeland Security that certificated airmen undergo. As previously determined by the Secretary of Transportation, the requirement to have an airman certificate ameliorates security concerns over civil UAS operations conducted in accordance with Section 333.

Given these grounds, the FAA must determine the appropriate level of pilot certification for the petitioner's proposed operation.

Under current regulations, civil operations for compensation or hire require a PIC holding a commercial pilot certificate per 14 CFR part 61. Based on the private pilot limitations in accordance with pertinent parts of 14 CFR 61.113(a) and (b), a pilot holding a private pilot certificate cannot act as a PIC of an aircraft for compensation or hire unless the flight is only incidental to a business or employment. However, in Grant of Exemption No. 11062 to Astraeus Aerial (Astraeus), the FAA determined that a PIC with a private pilot certificate operating the Astraeus UAS would not adversely affect operations in the NAS or present a hazard to persons or property on the ground.

As discussed above, the petition received three comments registering concern about pilot certification. ALPA stated its opposition to the proposed operation by a non-certificated pilot without a required medical certificate. ALPA believes that the operation should be conducted by a PIC holding a current FAA commercial pilot certificate with an appropriate category and class rating for the type of aircraft being flown and a current second-class airman medical certificate. NAAA stated that the UAS pilot should be a commercial pilot or have similar training and can demonstrate knowledge of aviation safety and communication procedures. USHPA stated that since the petitioner has not indicated any restriction to location of his operations, nor his knowledge of airspace rules, and because his operations would constitute commercial operations, he should be required to meet that level of certification.

[2] 49 USC § 44711 prohibits a person from serving "in any capacity as an airman with respect to a civil aircraft, aircraft engine, propeller, or appliance used, or intended for use, in air commerce...without an airman certificate authorizing the airman to serve in the capacity for which the certificate was issued . . . .".

The FAA has analyzed the petitioner's proposed operation, considered the comments above, and determined it does not differ significantly from the situation described in Grant of Exemption No. 11062 (Astraeus). The petitioner plans to operate in the NAS over private property while also limiting access to the property at times he is operating the UA. Given: 1) the similar nature of the petitioner's proposed operating environment to that of Astraeus, 2) the parallel nature of private pilot aeronautical knowledge requirements to those of commercial requirements [ref: Exemption No. 11062], and 3) the airmanship skills necessary to operate the UAS, the FAA finds that the additional manned airmanship experience of a commercially certificated pilot would not correlate to the airmanship skills necessary for the petitioner's proposed operations. Therefore, the FAA finds that a PIC holding a private pilot certificate and a third-class airman medical certificate is appropriate for the proposed operations.

With regard to the airmanship skills necessary to operate the UAS, the petitioner has provided no training program, minimum flight time hours, or test standards to demonstrate his capability to meet some of the conditions and limitations below including avoiding hazards, reacting to emergencies, or maintaining specific distances from persons or property. The petitioner indicates he avoids risks that may cause a crash and that he has flown numerous practice flights in remote areas as a hobbyist simulating flights for future commercial use to gain familiarization with the characteristics and performance of this UAS under different temperature and wind conditions. He also mentions his computerized simulated flights to maintain adequate skills and response reflex time.

Since the petitioner provides no information regarding a training program, minimum flight

time hours, or test standards to demonstrate his capability to operate safely, and in response to concerns raised by ALPA, NAAA, and USHPA, the FAA reviewed the minimum requirements for providing a waiver to manned operations under 14 CFR 91.119. While this process applies to an operator seeking a waiver rather than an exemption, the exemption process is similar. Manned operations that require relief from 14 CFR 91.119 in the form of a waiver have established minimum requirements for pilot personnel (PIC).[3]

1) at least 500 hours logged as the PIC and at least 20 hours logged as the PIC in the aircraft type;
2) a minimum of 25 hours (or 100 hours in the case of motion picture operations) in the same category and class of aircraft to be used; and
3) a minimum of 5 hours in the make and model aircraft to be used under the waiver.

However, given the relative size, weight, speed and operating parameters of the proposed UAS operations and its accompanying reduction in risk to persons and property when compared to manned operations, these minimum requirements should be reduced, but not eliminated. UAS operators still need to establish airmanship skills in order to meet the conditions and limitations listed below such as the ability to maneuver near but maintain specific distances from persons and property, respond to unexpected emergencies, or avoid objects as well as the ability to avoid potential conflicts with manned aircraft. In consideration of the above, the FAA must determine the appropriate level of pilot flight hours necessary to qualify the PIC for the petitioner's proposed operations. The FAA has considered minimum skills and associated flight-hours necessary to practice and build proficiency in these skills. The petitioner is responsible for assessing its operations and identifying any additional skills required to operate safely under normal and abnormal conditions. Normal condition skills may include the ability to maintain altitude, maintain VLOS, and navigational skills. Abnormal condition skills may include the ability to avoid obstacles, avoid air traffic, and respond to loss of link.

In making its determination the FAA considered the requirements proposed by Astraeus in Exemption No. 11062. The FAA notes that the petitioner's proposed operation is similar to that authorized in Exemption No. 11062 because both include

[3] FAA Order 8900.1, Volume 3, Chapter 7, Section 1 *Issue a Certificate of Waiver or Authorization: § 91.119(b) and/or (c) (Minimum Safe Altitudes)* and FAA Order 8900.1, Volume 3, Chapter 8, Section 1, *Issue a Certificate of Waiver for Motion Picture and Television Filming.*

operations closer than 500 feet from persons, vessels, vehicles, and structures. In Exemption No. 11062, the FAA required that prior to conducting operations for the purpose of motion picture filming (or similar operations), the PIC must have accumulated and logged, in a manner consistent with 14 CFR 61.51(b), 25 hours of total time as a UAS rotorcraft pilot including at least 10 hours logged as a UAS pilot with a multi-rotor UAS. Prior to operations under Exemption No. 11062, the PIC must also have accumulated and logged a minimum of 5 hours as a UAS pilot operating the same make and model of UAS to be used for operations under the exemption. For clarification, the FAA considers these minimum hour requirements to be inclusive rather than additive; i.e. 5 hours make and model time may be included in the 10 hours of multirotor time and the 10 hours may be included in the total 25 hours of UAS rotorcraft time. In addition to the hour requirements, the PIC must accomplish 3 take-offs and landings in the preceding 90 days (for currency purposes). The FAA finds that at a minimum, the flight-hour requirements in Exemption No. 11062 are appropriate to practice and build proficiency in the skills necessary to safely conduct the petitioner's proposed operations. The FAA also finds that prior documented flight experience that was obtained in compliance with applicable regulations would satisfy this requirement. Training, proficiency, and experience-building flights can also be conducted under the grant of exemption to accomplish the required flight time. During training, proficiency, and experience-building flights the PIC is required to operate the UA with appropriate distances in accordance with 14 CFR 91.119.

The flight-hours above are considered appropriate given the circumstances of the proposed operation and the description provided by the petitioner of the preparations he has undertaken to conduct the UAS operation safely. The petitioner may determine through its safety assessment that additional hours are necessary to address all potential flight hazards and requisite airmanship skills. Consequently, the FAA has included in the conditions and limitations below that the petitioner may not permit any PIC to operate unless that PIC is able to safely operate the UAS in a manner consistent with how the UAS will be operated under this exemption, including evasive and emergency maneuvers and maintaining appropriate distances from persons, vessels, vehicles and structures.

In conclusion, the FAA finds that prior to operations the PIC must, at a minimum, hold a private pilot certificate, a third-class airman medical certificate, and completed the minimum flight hour and currency requirements as stated in the conditions and limitations below. Thus, the FAA finds relief from 14 CFR 61.113(a) and (b) is warranted.

In a supplemental request to the FAA, the petitioner requests consideration of a 120 day temporary airman certificate in accordance with 14 CFR 63.13, to allow him time to obtain a private pilot certificate. The requested relief is not applicable to pilot certificates because, 14 CFR 63.1, *Applicability*, states this part prescribes the requirements for issuing flight engineer and flight navigator certificates and the general operating rules for holders of those certificates, only. Thus, 14 CFR 63.13 does not provide a basis from which to issue a temporary pilot certificate as requested by the petitioner and the requested relief is denied.

The petitioner has also indicated he will supplement his proposed operation(s) with a spotter, hereafter referred to as a visual observer (VO). The conditions and limitations below stipulate that the PIC must ensure that the VO can perform the functions prescribed in the operating documents. Additionally, as discussed in Exemption No. 11109 to Clayco, Inc., there are no regulatory requirements for visual observer medical certificates. Although a medical certificate is not required for a VO, the UA must never be operated beyond the actual visual capabilities of the VO, and the VO and PIC must have the ability to maintain visual line of sight (VLOS) with the UA at all times. It is the responsibility of the PIC to be aware of the VO's visual limitations and limit operations of the UA to distances within the visual capabilities of both the PIC and VO. Moreover, the VO will not be operating the aircraft. Therefore, as in Grant of Exemption No. 11062 to Astraeus, the FAA does not consider a medical certificate necessary for the VO.

Operating parameters of the UAS

Regarding the petitioner's requested relief from 14 CFR 91.7(a) *Civil aircraft airworthiness,* petitioner's request is based on his belief that since no FAA regulatory standard exists for determining airworthiness of the UAS, the regulation is inapplicable. While the petitioner's UAS will not require an airworthiness certificate in accordance with 14 CFR part 21, Subpart H, the FAA considers the petitioner's compliance with his operating documents to be sufficient means for determining an airworthy condition. Therefore, relief from § 91.7(a) is granted. The petitioner is still required to ensure that his aircraft is in an airworthy condition – based on compliance with the operating documents prior to every flight, and as stated in the conditions and limitations below.

Additionally, in accordance with 14 CFR 91.7(b), the PIC of the UAS is responsible for determining whether the aircraft is in a condition for safe flight. The FAA finds that the PIC can comply with this requirement, therefore relief from § 91.7(b) is not necessary.

Regarding the petitioner's requested relief from 14 CFR 91.9 *Civil aircraft flight manual, marking, and placard requirements* and 14 CFR 91.203(a) and (b) *Civil aircraft:*

Certifications required, the FAA has previously determined that relief from these sections is not necessary. Relevant materials may be kept in a location accessible to the PIC in compliance with the regulations.

Regarding the petitioner's requested relief from 14 CFR 91.103, *Preflight Action,* the petitioner requires each PIC to take certain actions before flight to ensure the safety of the flight. The exemption is needed because the pilot will take separate preflight actions as referenced in the operating documents. Although there will be no approved Airplane or Rotorcraft Flight Manual available, the FAA believes that the petitioner can comply with the other applicable requirements in 14 CFR 91.103(b)(2). The procedures outlined in the operating documents address the FAA's concerns regarding compliance with § 91.103(b). The PIC will take all actions including reviewing weather, flight battery requirements, landings, and takeoff distances and aircraft performance data before initiation of flight. The FAA has imposed stricter requirements with regard to visibility and distance from clouds; this is to both keep the UA from departing the VLOS and to preclude the UA from operating in the NAS. The FAA also notes the risks associated with sun glare; the FAA believes that the PIC's and VO's ability to still see other air traffic, combined with the PIC's ability to initiate a return-to-home sequence, are sufficient mitigations in this respect. The PIC will also account for all relevant site-specific conditions in his or her preflight procedures. Therefore, the FAA finds that exemption from 14 CFR 91.103 is not necessary.

Regarding the petitioner's requested relief from 14 CFR 91.109(a), *Flight instruction; Simulated instrument flight and certain flight tests,* the petitioner did not describe training scenarios in which a dual set of controls would be utilized or required, i.e. dual flight instruction, provided by a flight instructor or other company-designated individual, that would require that individual to have fully functioning dual controls. Rather, the petitioner refers to his "numerous practice flights in remote areas as a hobbyist." But, as outlined above, the FAA is requiring that the petitioner's PIC possess at least a private pilot's certificate. Also, the currency requirements expressed in the conditions and limitations below will help ensure that a PIC training on the UAS has the authority to operate the UAS during training flights as PIC in accordance with § 61.31(l). The FAA will impose a limitation that those training operations are only conducted during dedicated training sessions. As such, the FAA finds that the petitioner can conduct his operations without the requested relief from § 91.109.

The petitioner's requested relief from 14 CFR 91.119, *Minimum safe altitudes,* relief from § 91.119(a), which requires operating at an altitude that allows a safe emergency landing if a power unit fails, is not granted. The FAA expects the petitioner to be able to perform an emergency landing without undue hazard to persons or property on the surface if a power unit fails. Relief from § 91.119(b), operation over congested areas, is not granted, because, as discussed below, operations over congested areas will not be permitted under this exemption.

Relief from § 91.119(c) is necessary because the aircraft will be operated at altitudes below 300 feet AGL. Section 91.119(c) states that no person may operate an aircraft below the following altitudes: *over other than congested areas,* an altitude of 500 feet above the surface, except over open water or sparsely populated areas. In those cases, the aircraft may not be

operated closer than 500 feet to any person, vessel, vehicle, or structure. The petitioner states that he will operate pursuant to the following, self-imposed restrictions related to § 91.119:

- operate in reasonably safe environment that are strictly controlled, are away from power lines, elevated lights, airports and actively populated areas away from public and traffic;
- conduct all operations under his own personal safety protocols (including posting a warning sign reading: "Attention Aerial Photography in Progress – Remain Back 150 Feet") contained in the operating documents and will actively analyze flight data and other sources of information to constantly update and enhance his safety protocols;
- contact respective airports if operations will be within 5 miles to advise them of his estimated flight time, flight duration, elevation of flight and other pertinent information; and
- always obtain all necessary permissions prior to operation.

The petitioner proposes to avoid "actively populated areas" but does not explain how these areas are determined. As in Exemption No. 11110 (Trimble Navigation, Ltd.), the FAA notes that avoidance of areas which are depicted in "yellow" on VFR charts is a practicable step in assuring that operations are not conducted over congested or densely populated areas. However, using these "yellow" areas solely to make this determination is not sufficient. Pilots may obtain information regarding congested areas from the local Flight Standards District Office (FSDO). Therefore, operations over congested or densely populated areas are prohibited as stated in the conditions and limitations below.

The petitioner did not describe stand-off distances from persons, vessels, vehicles and structures. Section 91.119(c) requires that aircraft operate no closer than 500 feet to these persons or objects. As discussed in Exemption No. 11109 (Clayco, Inc.), operations conducted closer than 500 feet to the ground may require that the UA be operated closer than 500 feet to essential persons, or objects that would not be possible without additional relief. Therefore, the FAA is requiring that prior to conducting UAS operations, all persons not essential to flight operations (nonparticipating persons) must remain at appropriate distances. In open areas, this requires the UA to remain 500 feet from all persons other than essential flight personnel (i.e. PIC, VO, operator trainees or essential persons). The FAA has also considered the UA's maximum gross weight of approximately 3 pounds. If barriers or structures are present that can sufficiently protect nonparticipating persons from the UA or debris in the event of an accident, then the UA may operate closer than 500 feet to persons afforded such protection. The operator must also ensure that nonparticipating persons remain under such protection. If a situation arises where nonparticipating persons leave such protection and are within 500 feet of the UA, flight operations must cease immediately. When considering how to immediately cease operations, the primary concern is the safety of those nonparticipating persons. In addition, the FAA finds that operations may be conducted closer than 500 feet to vessels, vehicles and structures when the owner/controller of any such vessels, vehicles or structures grants permission for the operation and the PIC makes a safety assessment of the risk of operating closer to those objects and determines that it does not present an undue hazard.

Thus, the FAA finds that relief from § 91.119(c) is warranted provided adherence to the procedures in the operating documents and the FAA's additional conditions and limitations outlined below. Relief from § 91.119(a) is unwarranted as the FAA expects the petitioner to be able to perform an emergency landing without undue hazard to persons or property on the surface. Relief from §§ 91.119(b) is not granted and 91.119(d) is not applicable.

Regarding the petitioner's requested relief from 14 CFR 91.121 *Altimeter Settings*, the petitioner has a barometric altimeter and GPS derived altitude capabilities. However, as stated in the conditions and limitations below, the FAA requires any altitude reported to ATC to be in feet AGL. The petitioner may choose to set the altimeter to zero feet AGL rather than local barometric pressure or field altitude before flight. Considering the limited altitude of the proposed operations, relief from 14 CFR 91.121 is granted to the extent necessary to comply with the applicable conditions and limitations stated below.

Regarding the petitioner's requested relief from § 91.151 (a) *Fuel requirements for flight in VFR conditions*, prior relief has been granted for manned aircraft to operate at less than prescribed minimums, including Exemption Nos. 2689, 5745, and 10650. In addition, similar UAS-specific relief has been granted in Exemption Nos. 8811, 10808, and 10673 for daytime, VFR

conditions. The petitioner's only reference to this section is his commitment to land the UAS prior to the manufacturer's recommended minimum level of battery power. The operating documents indicate that two low-voltage (low battery) alerts are issued - warning that the first alert should be followed (30% - low battery level warning). Further, the petitioner has indicated his flights will last only 3-7 minutes each. Also, the UAS has an automated function which results in immediate landing when a low battery is detected. These factors provide the FAA with sufficient reason to grant the relief from 14 CFR 91.151(a) as requested in accordance with the conditions and limitations below, that prohibit the PIC from beginning a flight unless (considering wind and forecast weather conditions) there is enough power to fly to the first point of intended landing and, assuming normal cruising speed, land the UA with 30% battery power remaining.

Regarding an Air Traffic Organization (ATO) issued Certificate of Waiver or Authorization (COA), the majority of current UAS operations occurring in the NAS are being coordinated through Air Traffic Control (ATC) by the issuance of a COA. This is an existing process that not only makes local ATC facilities aware of UAS operations, but also provides ATC the ability to consider airspace issues that are unique to UAS operations. The COA will require the operator to request a NOTAM, which is the mechanism for alerting other users of the NAS to the UAS activities being conducted. The conditions and limitations below prescribe the requirement for the petitioner to obtain an ATO-issued COA.

Public Interest

The FAA finds that a grant of exemption is in the public interest. The enhanced safety and reduced environmental impact achieved using a UA with the specifications described by the petitioner and carrying no passengers or crew, rather than a manned aircraft of significantly greater proportions, carrying crew in addition to flammable fuel, gives the FAA good cause to find that the UAS operation enabled by this exemption is in the public interest. The following table summarizes the FAA's determinations regarding the relief sought by the petitioner:

Relief considered (14 CFR)	FAA determination (14 CFR)
Part 21	Relief not necessary
45.23(b)	Relief not necessary
61.113(a) and (b)	Relief granted with conditions and limitations
63.13	Relief not granted
91.7(a)	Relief granted with conditions and limitations
91.9(b)(2)	Relief not necessary
91.103(b)	Relief not necessary
91.109	Relief not necessary
91.119	Paragraph (c) granted with conditions and limitations
91.121	Relief granted with conditions and limitations
91.151(a)	Paragraph 91.151(a)(1), day, granted with conditions and limitations
91.203(a) and (b)	Relief not necessary
91.405(a)	Relief granted with conditions and
Relief considered (14 CFR)	FAA determination (14 CFR)
	limitations
91.407(a)(1)	Relief granted with conditions and limitations

91.409(a)(1) and (2)	Relief granted with conditions and limitations
91.417(a) and (b)	Relief granted with conditions and limitations

The FAA's Decision

In consideration of the foregoing, I find that a grant of exemption is in the public interest. Therefore, pursuant to the authority contained in 49 U.S.C. 106(f), 40113, and 44701, delegated to me by the Administrator, Mr. Douglas Trudeau, Realtor®, of Tierra Antigua Realty, is granted an exemption from 14 CFR 61.113(a) and (b), 91.7(a), 91.119(c), 91.121, 91.151(a)(1), 91.405(a), 91.407(a)(1), 91.409(a)(1) and (2), and 91.417(a) and (b) to the extent necessary to allow petitioner to operate an unmanned aircraft systems (UAS) for the purpose of aerial videography/cinematography and augment real estate listing videos. This exemption is subject to the conditions and limitations listed below.

Conditions and Limitations

Relative to this grant of exemption, Trudeau is hereafter referred to as the operator.

The following documents provided by the operator in its petition, 1) Supplemental Response for Petition, 2) PHANTOM Flying Flow Chart V1.0 (Simplified Version), PHANTOM Quick

Start Manual v1.7, PHANTOM Advanced Manual v.1.4, 3) PHANTOM 2 Vision+ User Manual 4) restricted areas map, 5) personal protocols and controls, and 6) Safety/Flight Manual, are hereinafter referred to as operating documents.

Failure to comply with any of the conditions and limitations of this grant of exemption will be grounds for the immediate suspension or rescission of this exemption.

1) Operations authorized by this grant of exemption are limited to the following aircraft described in the operating documents which is a quad-rotor aircraft weighing less than 3 pounds: PHANTOM 2 Vision+ Unmanned Aircraft System. Proposed operations of any other aircraft will require a new petition or a petition to amend this grant.

2) The UA may not be flown at an indicated airspeed exceeding 30 knots.

3) The UA must be operated at an altitude of no more than 300 feet above ground level (AGL), as indicated by the procedures specified in the operating documents. All altitudes reported to ATC must be in feet AGL.

4) The UA must be operated within visual line of sight (VLOS) of the Pilot In Command (PIC) at all times. This requires the PIC to be able to use human vision unaided by any device other than corrective lenses, as specified on the PIC's FAA-issued airman medical certificate.

5) All operations must utilize a visual observer (VO). The UA must be operated within the visual line of sight (VLOS) of the VO at all times. The VO may be used to satisfy the VLOS requirement as long as the PIC always maintains VLOS capability. The VO and PIC must be able to communicate verbally at all times. The PIC must be designated before the flight and cannot transfer his or her designation for the duration of the flight. The PIC must ensure that the VO can perform the functions prescribed in the operating documents.

6) The operating documents and this grant of exemption must be accessible during UAS operations and made available to the Administrator upon request. If a discrepancy exists between the conditions and limitations in this exemption and the procedures outlined in the operating documents, the conditions and limitations herein take precedence and must be followed. Otherwise, the operator must follow the procedures as outlined in its operating documents. The operator may update or revise its operating documents. It is the operator's responsibility to track such revisions and present updated and revised documents to the Administrator upon request. The operator must also present updated and revised documents if he petitions for extension or amendment to this grant of exemption. If the operator determines that any update or revision would affect the basis upon which the FAA granted this exemption, then the operator must petition for amendment to its grant of exemption. The FAA's UAS

Integration Office (AFS-80) may be contacted if questions arise regarding updates or revisions to the operating documents.

7) Prior to each flight, the PIC must inspect the UAS to ensure it is in a condition for safe flight. If the inspection reveals a condition that affects the safe operation of the UAS, the UAS is prohibited from operating until the necessary maintenance has been performed and the UAS is found to be in a condition for safe flight. The Ground Control Station must be included in the preflight inspection. All maintenance and alterations must be properly documented in the aircraft records.

8) Any UAS maintenance or alterations that affect the UAS operation or flight characteristics, e.g. replacement of a flight critical component, must undergo a functional test flight. The PIC who conducts the functional test flight must make an entry in the aircraft records.

9) The pre-flight inspection section in the operating documents must account for all discrepancies, i.e. inoperable components, items, or equipment, not already covered in the relevant sections of the operating documents.

10) The operator must follow the UAS manufacturer's aircraft/component, maintenance, overhaul, replacement, inspection, and life limit requirements.

11) The operator must carry out its maintenance, inspections, and record keeping requirements, in accordance with the operating documents. Maintenance, inspection, and alterations must be noted in the aircraft records, including total flight hours, description of work accomplished, and the signature of the authorized person returning the UAS to service.

12) Each UAS operated under this exemption must comply with all manufacturer Safety Bulletins.

13) The authorized person must make an entry in the aircraft record of the corrective action taken against discrepancies discovered between inspections.

14) UAS operations must be conducted by a PIC possessing at least a private pilot certificate and at least a current third-class medical certificate. The PIC must also meet the flight review requirements specified in 14 CFR 61.56 in an aircraft in which the PIC is rated on his or her pilot certificate.

15) Prior to operations conducted for the purpose of aerial videography/cinematography and augmenting real estate listing videos (or similar operations), the PIC must have accumulated and logged, in a manner consistent with 14 CFR 61.51(b), a minimum of

25 hours of total time as a UAS rotorcraft pilot including at least 10 hours logged as a UAS pilot with a multi-rotor UAS. Prior documented flight experience that was obtained in compliance with applicable regulations may satisfy this requirement. Training, proficiency, and experience-building flights can also be conducted under this grant of exemption to accomplish the required flight time. However, said training operations may only be conducted during dedicated training sessions. During training, proficiency, and experience-building flights the PIC is required to operate the UA with appropriate distances in accordance with 14 CFR 91.119.

16) Prior to operations conducted for the purpose of aerial videography/cinematography and augmenting real estate listing videos (or similar operations), the PIC must have accumulated and logged, in a manner consistent with 14 CFR 61.51(b), a minimum of 5 hours as UAS pilot operating the make and model of the UAS to be used in operations under the exemption; 5 hours make and model time may be included in the 10 hours of multi-rotor time prescribed above. The PIC must accomplish 3 take-offs and landings in the preceding 90 days (for currency purposes). Training, proficiency, experience-building, and take-off and landing currency flights can be conducted under this grant of exemption to accomplish the required flight time and 90 day currency. However, said training

operations may only be conducted during dedicated training sessions. During training, proficiency, and experience-building flights the
PIC is required to operate the UA with appropriate distances in accordance with 14 CFR 91.119.

17)The operator may not permit the PIC to operate the UAS for the purpose of aerial videography/cinematography and augmenting real estate listing videos (or similar operations), unless the PIC has demonstrated and logged in a manner consistent with 14 CFR 61.51(b), the ability to safely operate the UAS in a manner consistent with how the UAS will be operated under this exemption, including evasive and emergency maneuvers and maintaining appropriate distances from people, vessels, vehicles and structures.

18)UAS operations may not be conducted during night, as defined in 14 CFR 1.1. All operations must be conducted under visual meteorological conditions (VMC).

19)The UA may not operate within 5 nautical miles of an airport reference point as denoted on a current FAA-published aeronautical chart.

20)The UA may not be operated less than 500 feet below or less than 2,000 feet horizontally from a cloud or when visibility is less than 3 statute miles from the PIC.

21)If the UA loses communications or loses its GPS signal, it must return to a predetermined location within the planned operating area and land or be recovered in accordance with the operating documents.

22)The PIC must abort the flight in the event of unpredicted obstacles or emergencies in accordance with the operating documents.

23)The PIC is prohibited from beginning a flight unless (considering wind and forecast weather conditions) there is enough power to fly at normal cruising speed to the intended landing point and land the UA with 30% battery power remaining.

24)The operator must obtain an Air Traffic Organization (ATO) issued Certificate of Waiver or Authorization (COA) prior to conducting any operations under this grant of exemption. This COA will also require the operator to request a Notice to Airman (NOTAM) not more than 72 hours in advance, but not less than 48 hours prior to the operation.

25)All aircraft operated in accordance with this exemption must be identified by serial number, registered in accordance with 14 CFR part 47, and have identification (NNumber) markings in accordance with 14 CFR part 45, Subpart C. Markings must be as large as practicable.

26)Before conducting operations, the radio frequency spectrum used for operation and control of the UA must comply with the Federal Communications Commission (FCC) or other appropriate government oversight agency requirements.

27)The documents required under 14 CFR 91.9 and 91.203 must be available to the PIC at the Ground Control Station of the UAS any time the UAS is operating. These documents must be made available to the Administrator or any law enforcement official upon request.

28)The UA must remain clear and yield the right of way to all manned aviation operations and activities at all times.

29)The UAS may not be operated by the PIC from any moving device or vehicle.

30)The UA may not be operated over congested or densely populated areas.

31)Flight operations must be conducted at least 500 feet from all nonparticipating persons, vessels, vehicles, and structures unless:

a. Barriers or structures are present that sufficiently protect nonparticipating persons from the UA and/or debris in the event of an accident. The operator must ensure that nonparticipating persons remain under such protection. If a situation arises where nonparticipating persons leave such protection and are within 500 feet of the UA, flight operations must cease immediately and/or;
b. The aircraft is operated near vessels, vehicles or structures where the owner/controller of such vessels, vehicles or structures has granted permission and the PIC has made a safety assessment of the risk of operating closer to those objects and determined that it does not present an undue hazard, and;
c. Operations nearer to the PIC, VO, operator trainees or essential persons do not present an undue hazard to those persons per § 91.119(a).

32)All operations shall be conducted over private or controlled-access property with permission from the land owner/controller or authorized representative. Permission from land owner/controller or authorized representative will be obtained for each flight to be conducted.

33)Any incident, accident, or flight operation that transgresses the lateral or vertical boundaries of the operational area as defined by the applicable COA must be reported to the FAA's UAS Integration Office (AFS-80) within 24 hours. Accidents must be reported to the National Transportation Safety Board (NTSB) per instructions contained on the NTSB Web site: www.ntsb.gov.

Unless otherwise specified in this grant of exemption, the UAS, the UAS PIC, and the UAS operations must comply with all applicable parts of 14 CFR including, but not limited to, parts 45, 47, 61, and 91.

This exemption terminates on January 31, 2017, unless sooner superseded or rescinded.

Issued in Washington, DC, on January 5, 2015.

/s/
John S. Duncan
Director, Flight Standards Service

B. Exhibit 2: User Manuals

1. AgScout User Manual:

AgScout Unmanned Aerial System User Manual

1. Disclaimer and Warning

Please read this declaimer before using any products from AgriImage, LLC. By using this product, you hereby agree to this disclaimer and signify that you have read them fully. **THIS PRODUCT IS NOT A TOY. IT IS NOT SUITABLE FOR PEOPLE UNDER THE AGE OF 18.**

AgriImage, LLC products, which include UAVs/Drones and other products, ARE NOT TOYS. The safety instructions, along with mandatory training, are intended not only for the protection of the products but also for the safety of the user and others. If the Purchaser fails to follow safety instructions, it can cause serious injury and/or property damage. If the Purchaser does not follow safety guidelines and improperly uses the UAV/Drone, LIPO battery, or any other products, it can be dangerous. AgriImage, LLC DOES NOT GURANTEEE error-free behavior of the electronics, software, LIPO batteries, or other products we sell, manufacture, or market.

Use at own risk. Purchaser agrees to use any and all of our products we sell at his/her own risk. This also applies to any software that are within our products.

Comply with all federal and local laws. Purchaser agrees to comply with local, federal and international or government rules, especially when flying or operating any of our products near airports, schools, and crowded areas.

Safe Flying. Purchaser agrees to use his/her best judgment and always follow safety guidelines when flying/operating our units.

Safety of others. Purchaser agrees to refrain from using any of our products in heavily congested areas, keep away from children, large gathering areas such as a park, pets or property that could be damaged.

Maintenance. Purchaser agrees to conduct periodic maintenance on any product as instructed.

Untrained/Inexperienced User/s. AgriImage, LLC is NOT responsible for untrained and/or inexperienced operators. AgriImage, LLC UAVs and other products involve complex technologies that presupposes a base knowledge of mechanics, computer and RC (radio control) systems. The Purchaser agrees to have a full understanding of how to operate all products purchased. If the Purchaser does not understand; the Purchaser agrees to seek further assistance.

Liability for damages. Purchaser/s or user/s assumes all liability for damages to persons or property caused by any equipment purchased from AgriImage, LLC.

Liability for improper use. Purchaser/s or user/s assumes liability for improper use for any products purchased from AgriImage, LLC.

Purchasing Insurance. AgriImage, LLC recommends that the Purchaser/s or user/s not fly any products without purchasing liability insurance. This will ensure that in case of an accident, the Purchaser/s or user/s will have help in covering costs that are related to injury of persons or damaged properties with the use of our products. AgriImage, LLC will provide the user with information regarding insurance at the Purchaser/s or user/s request.

Liability for modifications AgriImage, LLC products are set with proper modifications and calibrations prior to shipping or delivery. The Purchaser/s or user/s agree not to change or modify the unit at any time, unless directed otherwise by an AgriImage, LLC technician or authorized dealer. If modifications to any systems are made, the Purchaser/s or user/s are responsible for any damage to property or any persons caused by the product.

Assumption of risk. Purchaser/s or user/s assume all risk of the product/s for his or her intended use. Damaged property or the injury of any person/s by the product/s is the sole responsibility of the Purchaser/s or user/s.

Responsibility. AgriImage, LLC is not responsible, under any circumstance, for any incidental, indirect, or consequential damages linked to the use of any products sold. The Purchaser/s or user/s assumes all responsibility for any incidental, indirect, or consequential damages linked to the use of any product/s purchased.

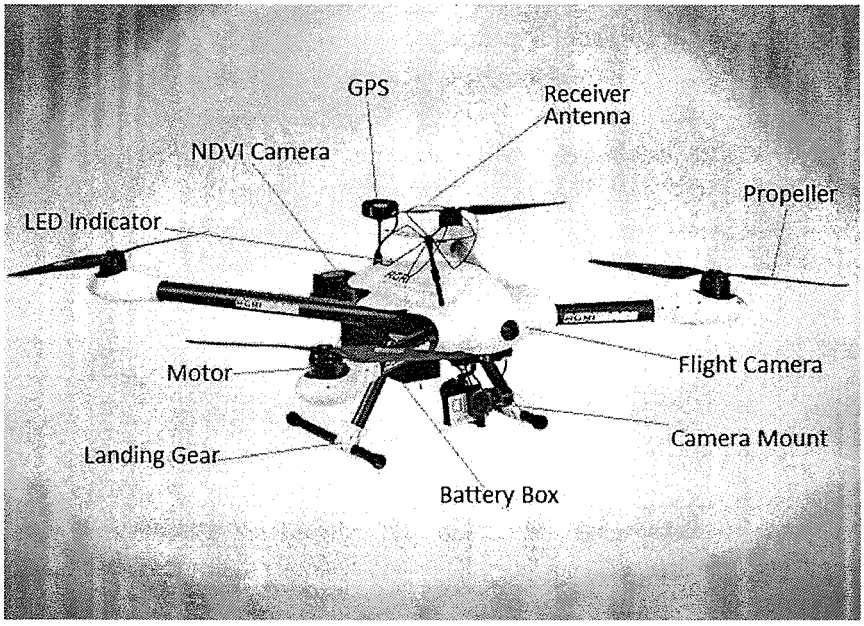
Cautions for Product Use

1. Before flying the unit, user must complete and pass flight training.
2. Make sure that batteries are fully charged, for both remote and unit, and make sure that batteries are strapped in securely before flight.
3. Always turn on remote control before plugging battery into the unit.
4. After completing a flight, always unplug battery from unit before powering off remote.
5. Before powering on the unit, make sure there are no persons close to the unit. The rotating propellers are very dangerous and could cause serious injury.

6. Keep the unit out of reach from children at all times. This unit is not toy and could cause serious damage to unexperienced users.
7. Make sure that you never turn on the WiFi function on the GoPro Camera; if the WiFi is turned on, it could interfere with the transmitter.
8. Make sure you fly responsibly. Do not fly the unit in crowded areas, near voltage lines, near any obstacles, etc.
9. Make sure that all propellers are tightened before flight.
10. Check and make sure that all cameras are secured and correctly attached before flight.

Trademarks

1. AgScout Aircraft



1.1 Built-in flight control system:

The built-in flight control system is used to control the entire aircraft's functions in flight such as Pitch (forwards and backwards), Roll (left and right), Elevator (up and down) and Yaw (turn left or right). The flight controllercontains the MC (Main Controller), IMU, GPS, compass, receiver.

The IMU (Inertial Measurement Unit) has a built-in inertial sensor and a barometric altimeter that measures both attitude and altitude. The compass reads geomagnetic information which assists the GPS (Global Position System) to accurately calculate the aircrafts position and height in order to lock the aircraft in a stable hover. The receiver is used to communicate with the remote controller and the MC acts as the brains of the complete flight control system connecting and controlling all the modules together.

1.2 Built-in video system:

The built-in video system transmits a live video feed from all the cameras on board the AgScout. The user is also able to remotely switch between desired video feeds from each camera. The video system consists of the components:

1. Dedicated flight camera and any combination of a high definition GoPro camera, Multispectral camera, or Thermal imaging camera
2. Over Screen Display that overlays real-time flight information on the flight camera feed

3. Remote controlled switch to switch between each cameras live video feed
4. Video transmitter to transmit the selected video feed

1.3 Led indicator:

The led light indicator mounted on the canopy of the AgScout conveys specific information during the pre-flight, flight, and post flight phase. A legend for each code is detailed below:

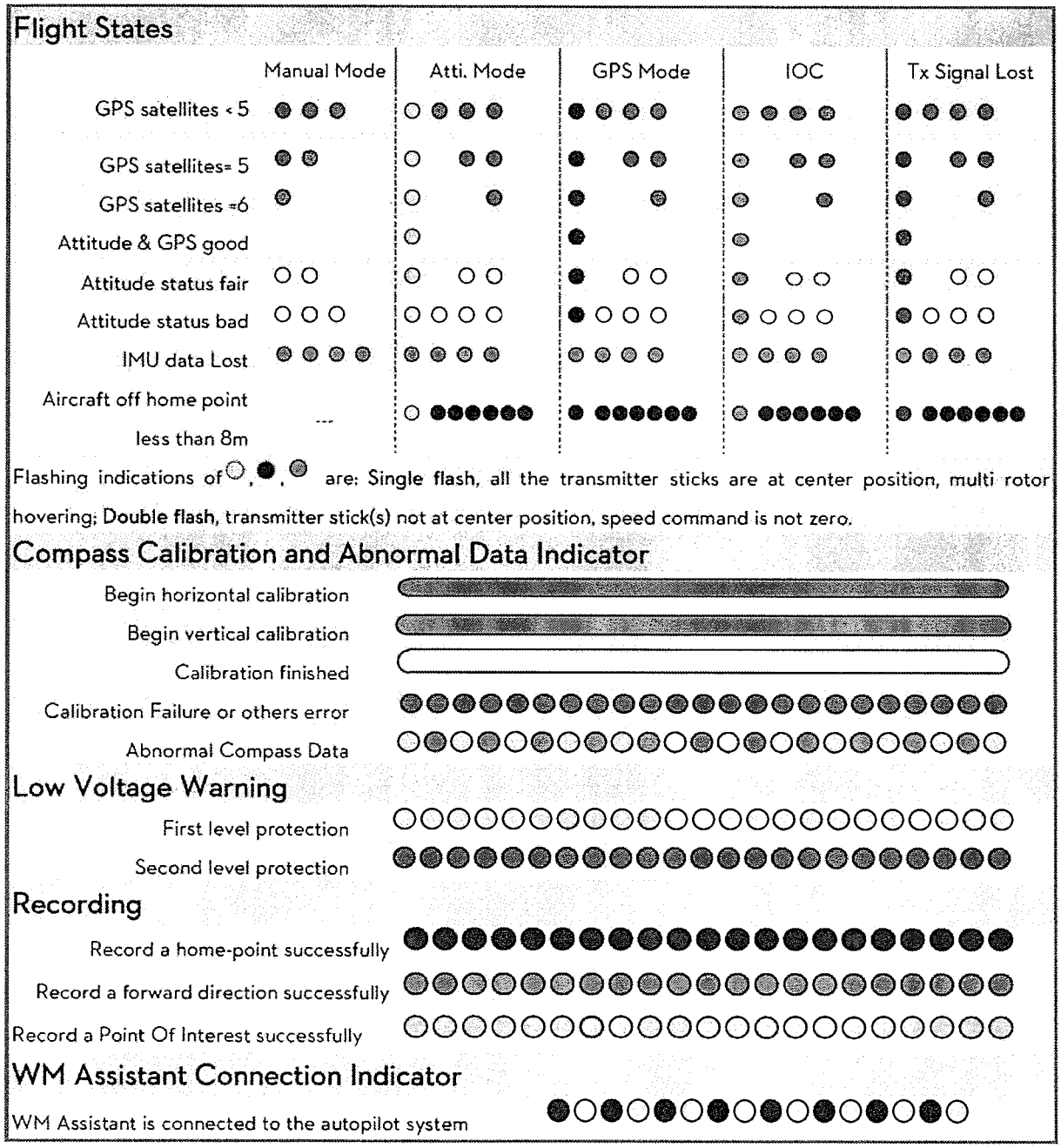


Fig 1

2. Propellers

2.1 Installation:

In order for the aircraft to fly, the carbon fiber propellers need to be installed correctly. Starting from the top right-hand corner of the nose of the aircraft and continuing in a counter-clockwise sequence, the propellers direction alternates between a counter clockwise to clockwise orientation. Starting with the counter clockwise propeller on the top right-hand of the nose of the aircraft, install the propeller by placing the propeller guard plate over the propeller while ensuring the two holes in the plate match with the two holes on the propeller. Using the two provided bolts, bolt the propeller onto the motor by running a bolt through the propeller guard plate first and then the propeller. "Hand-tighten" each bolt. Refer to the following figure to determine the orientation of the propeller:

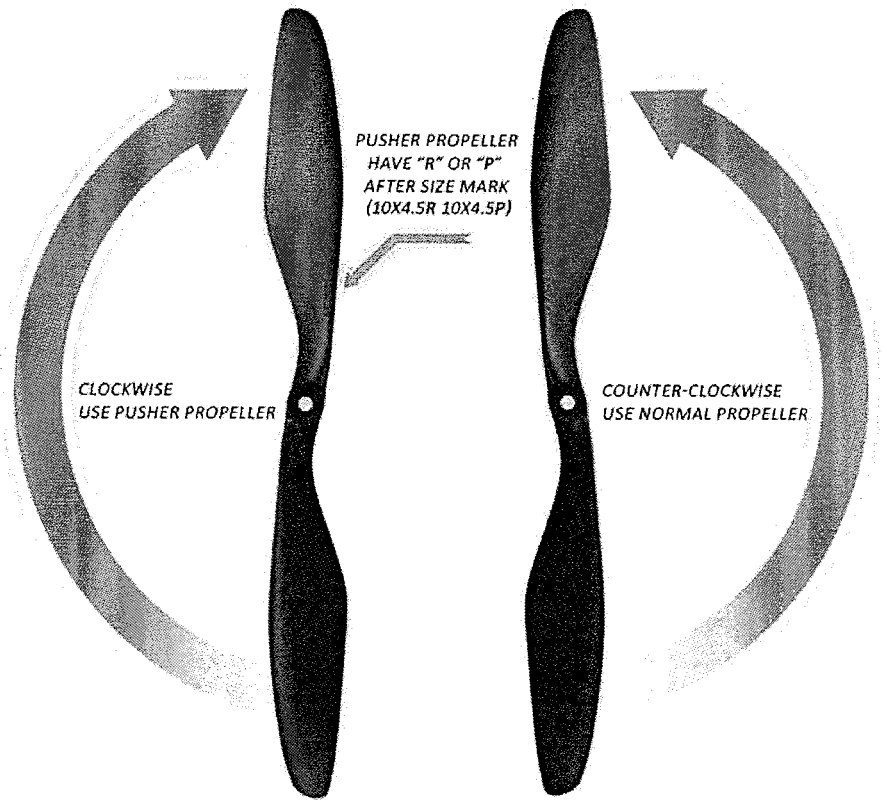


Fig 2

2.2 Disassebly

To disassemble the propellers, simply unscrew the bolts in the propellers and replace the propeller guard plate onto the motor to avoid losing either the propeller guard plate or the bolts.

3. Remoter controller

The Remote controller is used to remotely steer the aircraft.

3.1 Installing the antenna

It is imperative that the removable antenna is installed on the controller before turning on the controller. Failure to do so will damage the controller's radio. To install the antenna, simply screw the antenna onto the antenna port located on the back of the controller

3.2 Remote control operation:

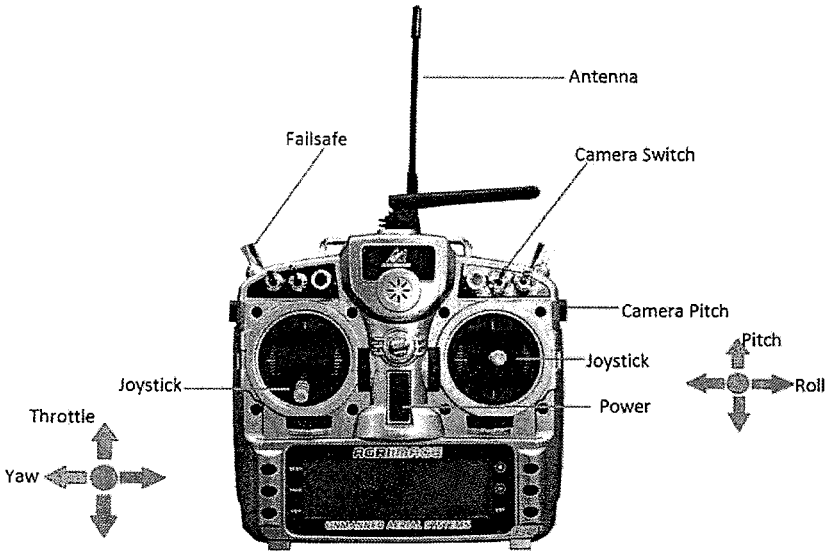
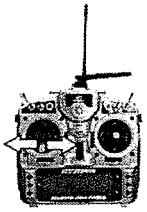
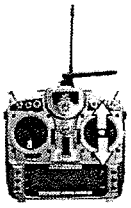
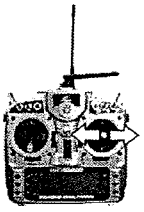


Fig 3

	**Throttle up and down** Throttle stick controls up and down movement of the aircraft. If you place the stick in the center, the aircraft will hold its position. Pushing the sitck up will cause the aircraft to move up. Pushing the stick down will cause the aircraft to move down.
	**Yaw Left and Yaw Right** Pushing yaw stick to the left will cause the aircraft rotate to the left. Pushing the yaw stick to the right will cause the aircraft to rotate to the right.
	**Pitch Up and Pitch Down** The pitch stick is for front and backward movent. Pushing the pitch stick up causes the aircraft to move forward. Pushing the pitch stick down causes the aircraft to move backward.
	**Roll Left and Roll Right** The roll stick is for left and right movement. Pushing the stick to the left will cause the aircraft to bank left. Pushing the stick to the right will cause the unit to bank right.

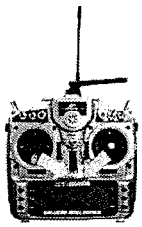
	**Power On and Off** **Pushing the sticks diagonally inward will turn the aircraft on and off. Note: you must push the sticks inward simutaneously.**

Table 1

4. Ground station

The groundsation consists of the monitor, the video receiver antenna, and the DataLink for autonomous flight.

4.1 Setting up The Ground station

The following steps describes the setup and operation of the ground station:

1. Set up the tripod by fully extending the legs.
2. Mount the monitor onto the tripod
3. Adjust the angle of the monitor for desired angle
4. Slide the ground station battery into the battery holder
5. Power on the ground station by plugging in the battery connector

4.2 Antenna orientation

For optimal video quality, the face of the antenna should be pointed in the direction of the aircraft at all times. Flying the aircraft behind the antenna may result in loss of video feed.

5. Battery

5.1 Charging procedure

To charge the battery, first determine the specifications of the battery about to be charged. The table below lists the specifications for each battery used in the system:

Battery	Voltage	Charge Current
AgScout (Pulse)	22.2V (6s)	10A
Ground station (TBS)	11.1V (3s)	2.5A
Remote Controller (Turnigy)	11.1V (3s)	2.5A

Table 2

Once the battery's specifications has been determined, follow the steps outlines below to operate the charger:

1. Turn on the charger

2. Plug the yellow, XT-60 battery lead into the charging port located on the side of the charger.
3. Plug the balance chord into the appropriate port of the charger.
4. Use the navigation buttons to select "Lipo Balance" option on the charger.
5. Press Enter once to enter the voltage selection
6. Use the navigation buttons to select the appropriate voltage based on table 2
7. Press Enter to enter the current selection
8. Use the navigation buttons to select the appropriate current based on table 2
9. Once the user is satisfied with the voltage and current settings, Long pressing the Enter button will begin the battery verification process
10. Once the Battery has been successfully verified, the user will be prompted to press the Enter button to begin charging.

5.2 Installing the battery

Install the AgScout battery by sliding the battery into the battery box located on the bottom of the aircraft. Ensure correct orientation by observing that the battery lead wires are facing up. Push the battery in all the way and fold the leads down such that they emerge from the bottom of the box. Fold in the balance port and close the battery box's door. Fasten the door by running the provided o-ring through the hooks on the side of the box and the face of the door.

5.3 Battery Safety and Warnings

General Guidelines and Warnings

1. Use specific battery charger as specified by AgriImage, LLC. Failure to do so may cause a fire, which may result in personal injury and/or property damage.
2. Never charge batteries unattended. You should always be present when charging Li-Po batteries in order to react to potential problems that may occur.
3. It is your responsibility solely to assure that your charger you purchased works properly. Always monitor the charging process to ensure that batteries are being charged properly. Failure to do so may result in a fire.
4. If battery begins to balloon or swell up, discontinue charging process immediately. Disconnect the battery and observe it in a safe place away from all people. If you continue to charge a swelling battery, it will result in a fire. Never use a battery that is ballooned or swollen upon purchase.
5. If battery is damaged, it is best to observe the battery as a safety precaution. Observation of the battery should occur away from buildings, people, vehicles, and any combustible material
6. If you accidentally short the wires, the battery must be placed in a safe area for observation. Wire lead shorts can cause a fire. If a short occurs and contact is made with metal, severe injuries may occur due to the conductibility of electric current.
7. If you were to crash your unit, you must remove the battery for observation and place it in an open area away from buildings, people, vehicles, and any combustible material.
8. Never store or charge your battery pack in extreme temperatures. This could cause a fire.
9. Only use the correctly specified batteries.
10. Keep batteries out of reach from children at all times.
11. Never hit or throw the battery. If battery is punctured, it could cause serious damage, injury, and/or could start a fire.
12. Do not drain the battery or leave the battery plugged into the unit when not being used. When low voltage alert is given, land the unit to avoid damage to the battery and others.

Before Charging Batteries

1. Make sure you inspect the battery pack. Look for damaged leads, connectors, ballooned or swollen cells, broken heat shrink, etc. If you find any of the following irregularities DO NOT use the battery pack.
2. If any damage to the pack or leads are found, do not attempt to charge or fly with the battery pack. Contact AgriImage, LLC as soon as you discover the issue.

Charging Process

1. Never charge batteries unattended.

2. Charge away from other flammable materials in an isolated area.
3. Do not charge battery packs in series. Never "Daisy Chain" or charge battery packs in series. Failure to do so may result in overcharging and/or cause a fire.
4. When selecting voltage or cell counts for battery charging, select the voltage and cell counts as it appears on the battery. If you do not follow the voltage and cell counts as labeled on the battery, it can cause a fire. To ensure your safety, and the safety of others, double check the voltage and cell requirements before charging.

6. Auto Pilot Usage

The following pages are an excerpt from the auto pilot manufacturer's manual. Following the usage and best practices for flying detailed below will ensure competency and safety while flying.

Compass Calibration

Without GPS module, please skip this step. If you use with GPS module, follow step-by-step for calibration.

- DO NOT calibrate your compass where there is strong magnetic interference, such as magnetite, car park, and steel reinforcement under the ground.
- DO NOT carry ferromagnetic materials with you during calibration, such as keys or cell phones.
- Compass module CANNOT work in the polar circle.

Calibration Procedures

1. Quickly switch the control mode switch from GPS Mode to Manual Mode and back to GPS Mode for 6 to

   10 times. The LED indicator will turn on solid BLUE.
2. Rotate your Multi-rotor around the horizontal axis (about 360°) until the LED changes to solid GREEN,

   and then go to the next step.
3. Hold your Multi-rotor vertically and rotate it (its nose MUST be downward) around the vertical axis (about

   360°) until the LED turns off, meaning the calibration is finished.

4. The LED indicator will show whether the calibration is successful or not.
   - If the LED keeps WHITE for 3 seconds, meaning the calibration is successful, and then calibration

     mode will exit automatically.
   - If the LED keeps flashing quickly RED, the calibration has failed. Switch the control mode switch

     one time to cancel the calibration, and then re-start from step 1.

1. You don't need to rotate your multi-rotor on a precise horizontal or vertical surface, but keep at least 45° difference between horizontal and vertical calibration.
2. If you keep having calibration failure, it might suggest that there is very strong magnetic interference around the GPS & Compass module, please avoid flying in this area.
3. When to do re-calibration.
   - The flight field is changed.
   - The multi-rotor mechanical setup has changed, including the following situations:
     a) If the GPS & Compass module is re-positioned.
     b) Electronic devices added, removed or re-positioned (Main Controller, servos, batteries, etc).
     c) When the mechanical structure of the multi-rotor is changed.
   - If the flight direction appears shifting (meaning the multi-rotor doesn't "fly straight").
   - The LED indicator often indicates abnormality blinking when the multi-rotor spins. But it is normal for this to happen only occasionally.
   - LED blinks yellow and green ( ) continually, indicating that the compass data is abnormal.

Basic Flying Test

Step1 About the Control Mode Switch

The autopilot system can work in Manual Mode and ATTI. Mode without a GPS module. After connecting to the GPS module, GPS Mode is available. Follow the bellow steps to enter the different control modes.

1. Use a 3-position switch on the transmitter as mode control switch.
2. Make sure to take off the aircraft in ATTI. Mode in every flight.
3. Hover the Aircraft. Release all joysticks and then flip the control mode switch to the GPS Mode or Manual Mode (NOT RECOMMENDED).

Step2 Start & Stop Motor

Star Motor：Pushing throttle stick before takeoff will not start motors. You have to execute any one of following four Combination Stick Commands (CSC) to start motors

Stop Motor：The default setting of stop motor is Immediately. For the immediately mode, in any control mode, once motors start and throttle stick is over 10%, motors will stop immediately when throttle stick is back under 10% again. In this case, if you push the throttle stick over 10% within 5s after motors stop, motors will re-start, CSC is not needed. If you don't push throttle stick after motors start within 3s, motors will stop automatically.

Please refer to the instructions of A1 and A2 in the Advanced Functions section, to learn more about the Control Mode and Stop Motor details.

Setp3 Checking List before Flying

- Make sure you have assembled your multi-rotor correctly.
- Make sure you have done the configuration procedure correctly.
- Make sure all connections are in good condition.
- Make sure batteries are fully charged for your transmitter, autopilot system and all devices.
- Any of the following mistakes will lead to a dangerous accident, double check all these items: Rotation direction of motor is opposite / Propeller installation mistake / Main controller installation mistake / Wrong connection between the main controller and ESC.
- Always switch on the transmitter first, then power on multi-rotor! (Power off multi-rotor first, then switch off the transmitter after landing!)
- Make sure the GPS signal is good, only one Red LED blinking or without Red LED blinking.

  Otherwise multi-rotor will drift without stick commands.

- When system is powered on, you MUST NOT move your multi-rotor or sticks on transmitter until the system initialization is finished (about 5 second).
- Please AVOID using the autopilot system in areas of urban area with crowded buildings, tunnels and under bridges, where GPS signal will be blocked most likely.

- In ATTI Mode, throttle stick center position is for 0m/s along the vertical direction. You should keep the position of throttle stick higher than 10% from cut-throttle during the flight!
- Please do the fly test and gain tuning with ATTI. Mode in the open air without heavy wind!
- Refer to the indication in the software: Basic->Gain for more details.

Step4 Flying Procedures

1. If in GPS Mode, place the aircraft in an open space without buildings or trees. Take off the aircraft after 6 or more GPS satellites are found (RED LED blinks once or no blinking). If in Manual Mode or ATTI. Mode, you can skip this step.
2. Place the aircraft three meters away from you and others (especially child), to avoid accidental injury.
3. Start-up
   - ✓ Switch on the transmitter, and then power on autopilot system! You MUST NOT move your multi-rotor or sticks on transmitter until the system initialization is finished (about 5 second).
   - ✓ Push both sticks of transmitter to the left bottom or right bottom to start the motors.
   - ✓ Release the yaw, roll and pitch sticks and keep them at the neutral position, avoiding the aircraft to tilt to one side. At the same time raise the throttle stick from the bottom quickly. The motors will stop if you do not push the throttle stick from the bottom within 3s and you will need to execute the start-up procedure again. When the aircraft is on the point of leaving the ground, continue to push the throttle stick upwards to take off from the ground, pay attention not to push the stick excessively.
   - ✓ Pay attention to the aircraft movement at any time when flying, and use the sticks to adjust the aircraft's position. Keep the yaw, roll, pitch and throttle sticks at the neutral position to hover the aircraft at the desired height.
4. Lower the aircraft slowly. Pull the throttle stick to the bottom and then push the sticks to the left bottom or right bottom to stop the motors after landing. (Also, with throttle stick under 10%, and after landing 3s the motors will stop automatically)
5. Power off the autopilot system, and then switch off the transmitter after landing.

- DO NOT fly near to any ferromagnetic substances, to avoid strong magnetic interference with the GPS. Otherwise, it may cause the aircraft to FailSafe, crack or even fly away.
- If abnormal compass data occurs during flying, LED will blink Yellow and Green alternatively ( ). If in ATTI and Manual Mode, it is free from influence. In any other control mode, the autopilot system will enter into ATTI. Mode automatically; once the compass data

	goes back to normal, the autopilot system will regain the original control mode.
	• If the LED flashes quickly YELLOW then this indicates battery voltage is low, land ASAP. It is recommended to land the aircraft slowly, to prevent the • aircraft from damage. • If the transmitter indicates low-battery alarm, please land ASAP. In this condition the transmitter may cause the aircraft to go out of control or even crash. • The LED will blink White to indicate huge cumulative yaw errors caused by spinning the craft continuously. In this case, you can stop or slow down the spinning, and continue flying after the White blinking has stopped, so as to have better flight performance.
	If Low-Voltage Alarm is set, the aircraft will act according to the • configuration of the Assistant Software once Low-Voltage Alarm is triggered. • If Fail-Safe function is set, the aircraft will act according to the configuration of the Assistant Software once Fail-Safe is triggered.
	• Refer to the LED Indicator Description in the Appendix.

2. AgScout Mini User Manual:

AgScout Mini Unmanned Aerial System User Manual

2. Disclaimer and Warning

Please read this declaimer before using any products from AgriImage, LLC. By using this product, you hereby agree to this disclaimer and signify that you have read them fully. **THIS PRODUCT IS NOT A TOY. IT IS NOT SUITABLE FOR PEOPLE UNDER THE AGE OF 18.**

AgriImage, LLC products, which include UAVs/Drones and other products, ARE NOT TOYS. The safety instructions, along with mandatory training, are intended not only for the protection of the products but also for the safety of the user and others. If the Purchaser fails to follow safety instructions, it can cause serious injury and/or property damage. If the Purchaser does not follow safety guidelines and improperly uses the UAV/Drone, LIPO battery, or any other products, it can be dangerous. AgriImage, LLC DOES NOT GURANTEEE error-free behavior of the electronics, software, LIPO batteries, or other products we sell, manufacture, or market.

Use at own risk. Purchaser agrees to use any and all of our products we sell at his/her own risk. This also applies to any software that are within our products.

Comply with all federal and local laws. Purchaser agrees to comply with local, federal and international or government rules, especially when flying or operating any of our products near airports, schools, and crowded areas.

Safe Flying. Purchaser agrees to use his/her best judgment and always follow safety guidelines when flying/operating our units.

Safety of others. Purchaser agrees to refrain from using any of our products in heavily congested areas, keep away from children, large gathering areas such as a park, pets or property that could be damaged.

Maintenance. Purchaser agrees to conduct periodic maintenance on any product as instructed.

Untrained/Inexperienced User/s. AgriImage, LLC is NOT responsible for untrained and/or inexperienced operators. AgriImage, LLC UAVs and other products involve complex technologies that presupposes a base knowledge of mechanics, computer and RC (radio control) systems. The Purchaser agrees to have a full understanding of how to operate all products purchased. If the Purchaser does not understand; the Purchaser agrees to seek further assistance.

Liability for damages. Purchaser/s or user/s assumes all liability for damages to persons or property caused by any equipment purchased from AgriImage, LLC.

Liability for improper use. Purchaser/s or user/s assumes liability for improper use for any products purchased from AgriImage, LLC.

Purchasing Insurance. AgriImage, LLC recommends that the Purchaser/s or user/s not fly any products without purchasing liability insurance. This will ensure that in case of an accident, the Purchaser/s or user/s will have help in covering costs that are related to injury of persons or damaged properties with the use of our products. AgriImage, LLC will provide the user with information regarding insurance at the Purchaser/s or user/s request.

Liability for modifications AgriImage, LLC products are set with proper modifications and calibrations prior to shipping or delivery. The Purchaser/s or user/s agree not to change or modify the unit at any time, unless directed otherwise by an AgriImage, LLC technician or authorized dealer. If modifications to any systems are made, the Purchaser/s or user/s are responsible for any damage to property or any persons caused by the product.

Assumption of risk. Purchaser/s or user/s assume all risk of the product/s for his or her intended use. Damaged property or the injury of any person/s by the product/s is the sole responsibility of the Purchaser/s or user/s.

Responsibility. AgriImage, LLC is not responsible, under any circumstance, for any incidental, indirect, or consequential damages linked to the use of any products sold. The Purchaser/s or user/s assumes all responsibility for any incidental, indirect, or consequential damages linked to the use of any product/s purchased.

Cautions for Product Use

11. Before flying the unit, user must complete and pass flight training.
12. Make sure that batteries are fully charged, for both remote and unit, and make sure that batteries are strapped in securely before flight.
13. Always turn on remote control before plugging battery into the unit.
14. After completing a flight, always unplug battery from unit before powering off remote.
15. Before powering on the unit, make sure there are no persons close to the unit. The rotating propellers are very dangerous and could cause serious injury.
16. Keep the unit out of reach from children at all times. This unit is not toy and could cause serious damage to unexperienced users.
17. Make sure that you never turn on the WiFi function on the GoPro Camera; if the WiFi is turned on, it could interfere with the transmitter.

18. Make sure you fly responsibly. Do not fly the unit in crowded areas, near voltage lines, near any obstacles, etc.
19. Make sure that all propellers are tightened before flight.
20. Check and make sure that all cameras are secured and correctly attached before flight.

Trademarks

3. AgScout Mini Aircraft

1.1 Built-in flight control system:

The built-in flight control system is used to control the entire aircraft's functions in flight such as Pitch (forwards and backwards), Roll (left and right), Elevator (up and down) and Yaw (turn left or right). The flight controllercontains the MC (Main Controller), IMU, GPS, compass, receiver.

The IMU (Inertial Measurement Unit) has a built-in inertial sensor and a barometric altimeter that measures both attitude and altitude. The compass reads geomagnetic information which assists the GPS (Global Position System) to accurately calculate the aircrafts position and height in order to lock the aircraft in a stable hover. The receiver is used to communicate with the remote controller and the MC acts as the brains of the complete flight control system connecting and controlling all the modules together.

1.2 Built-in video system:

The built-in video system transmits a live video feed from all the cameras on board the AgScout Mini. The user is also able to remotely switch between desired video feeds from each camera. The video system consists of the components:

5. Dedicated flight camera and any combination of a high definition GoPro camera, Multispectral camera, or Thermal imaging camera
6. Over Screen Display that overlays real-time flight information on the flight camera feed
7. Remote controlled switch to switch between each cameras live video feed
8. Video transmitter to transmit the selected video feed

1.3 Led indicator:

The led light indicator mounted on the canopy of the AgScout Mini conveys specific information during the pre-flight, flight, and post flight phase. A legend for each code is detailed below:

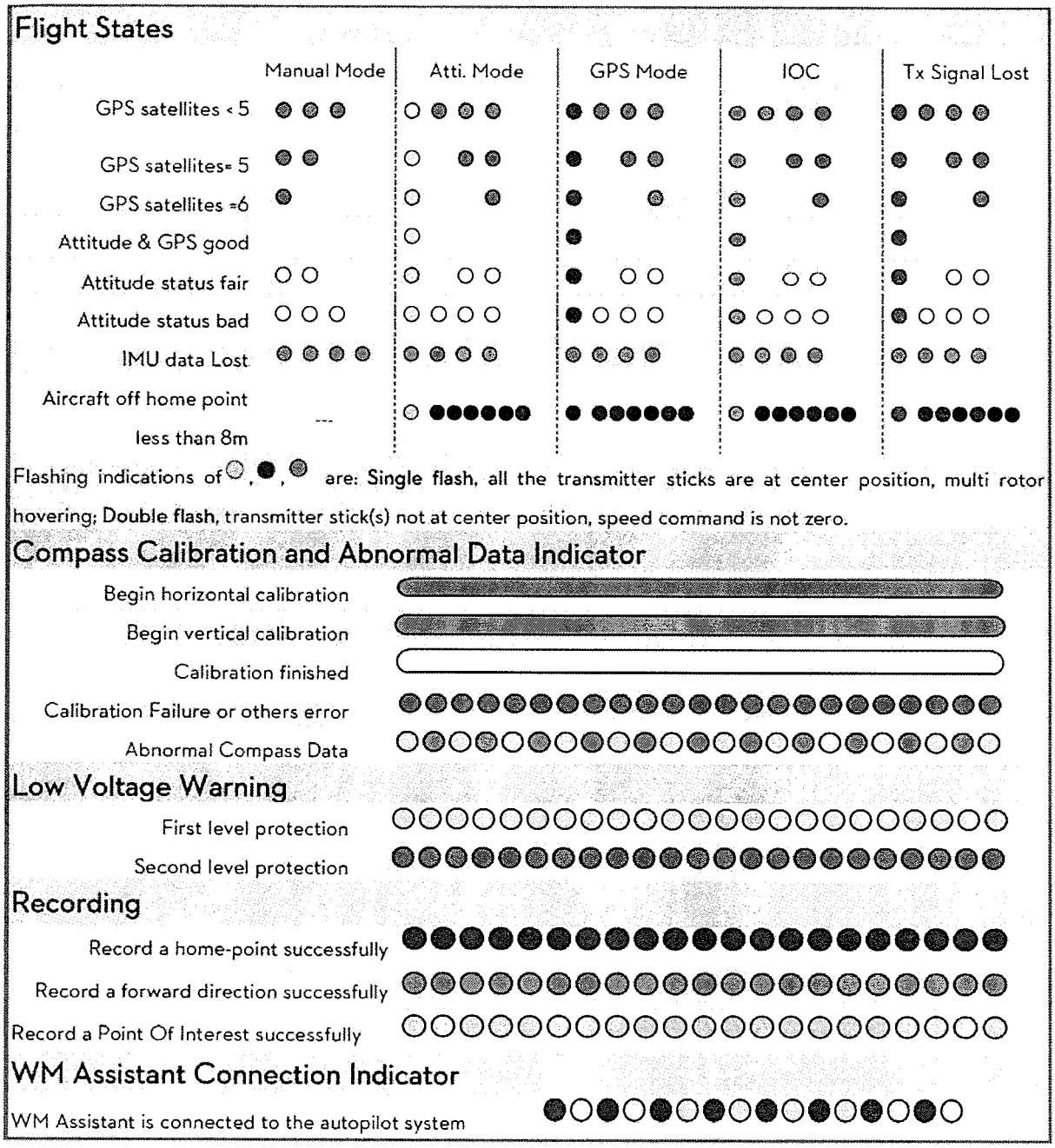


Fig 1

2. Propellers

2.1 Installation:

In order for the aircraft to fly, the carbon fiber propellers need to be installed correctly. Starting from the top right-hand corner of the nose of the aircraft and continuing in a counter-clockwise sequence, the propellers direction alternates between a counter clockwise to clockwise orientation. Starting with the counter clockwise propeller on the top right-hand of the nose of the aircraft, install the propeller by placing the propeller guard plate over the propeller while ensuring the two holes in the plate match with the two holes on the propeller. Using the two provided bolts, bolt the propeller onto the motor by running a bolt through the propeller guard plate first and then the propeller. "Hand-tighten" each bolt. Refer to the following figure to determine the orientation of the propeller:

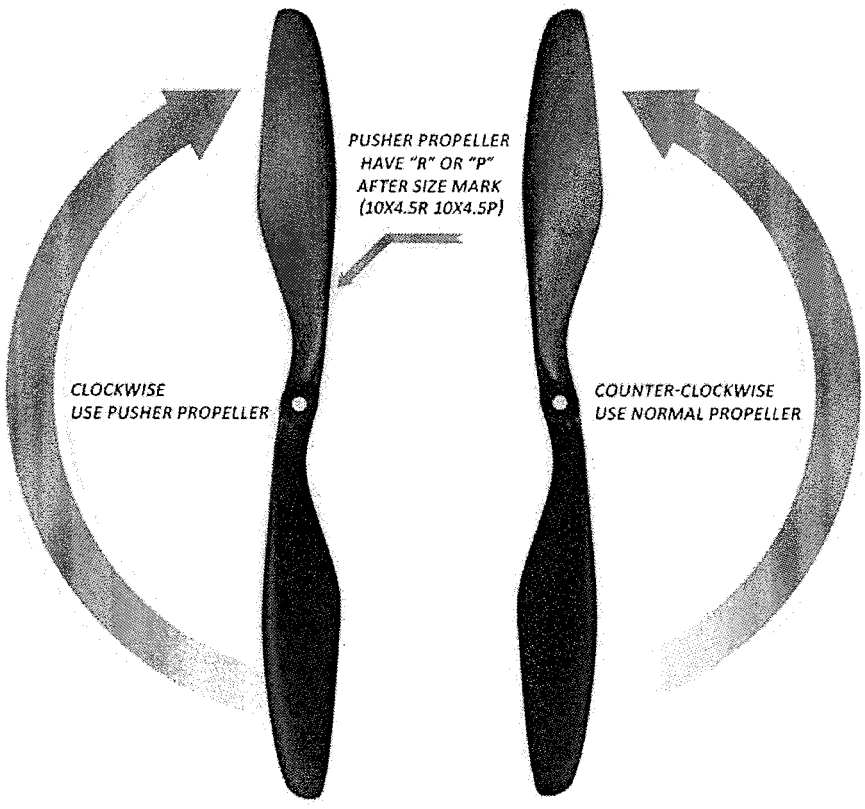


Fig 2

2.2 Disassembly

To disassemble the propellers, simply unscrew the bolts in the propellers and replace the propeller guard plate onto the motor to avoid losing either the propeller guard plate or the bolts.

3. Remoter controller

The Remote controller is used to remotely steer the aircraft.

3.1 Installing the antenna

It is imperative that the removable antenna is installed on the controller before turning on the controller. Failure to do so will damage the controller's radio. To install the antenna, simply screw the antenna onto the antenna port located on the back of the controller

3.2 Remote control operation:

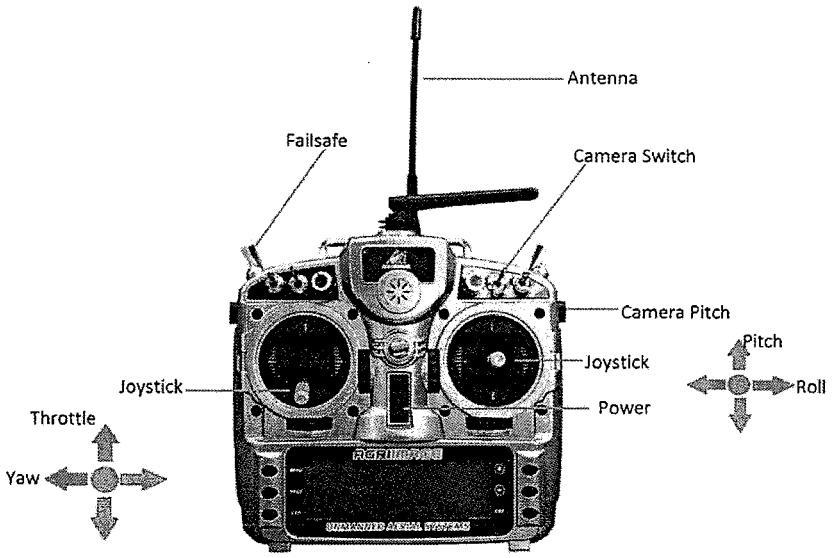
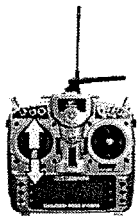
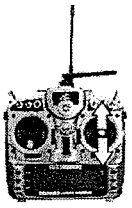


Fig 3

	**Throttle up and down** Throttle stick controls up and down movement of the aircraft. If you place the stick in the center, the aircraft will hold its position. Pushing the sitck up will cause the aircraft to move up. Pushing the stick down will cause the aircraft to move down.
	**Yaw Left and Yaw Right** Pushing yaw stick to the left will cause the aircraft rotate to the left. Pushing the yaw stick to the right will cause the aircraft to rotate to the right.
	**Pitch Up and Pitch Down** The pitch stick is for front and backward movent. Pushing the pitch stick up causes the aircraft to move forward. Pushing the pitch stick down causes the aircraft to move backward.
	**Roll Left and Roll Right** The roll stick is for left and right movement. Pushing the stick to the left will cause the aircraft to bank left. Pushing the stick to the right will cause the unit to bank right.

	**Power On and Off** **Pushing the sticks diagonally inward will turn the aircraft on and off. Note: you must push the sticks inward simutaneously.**

Table 1

4. Ground station

The ground station consists of the monitor, the video receiver antenna, and the DataLink for autonomous flight.

4.1 Setting up The Ground station

The following steps describes the setup and operation of the ground station:

6. Set up the tripod by fully extending the legs.
7. Mount the monitor onto the tripod
8. Adjust the angle of the monitor for desired angle
9. Slide the ground station battery into the battery holder
10. Power on the ground station by plugging in the battery connector

4.2 Antenna orientation

For optimal video quality, the face of the antenna should be pointed in the direction of the aircraft at all times. Flying the aircraft behind the antenna may result in loss of video feed.

5. Battery

5.1 Charging procedure

To charge the battery, first determine the specifications of the battery about to be charged. The table below lists the specifications for each battery used in the system:

Battery	Voltage	Charge Current
AgScout Mini (Pulse)	14.8V (4s)	10A
Ground station (TBS)	11.1V (3s)	2.5A
Remote Controller (Turnigy)	11.1V (3s)	2.5A

Table 2

Once the battery's specifications has been determined, follow the steps outlines below to operate the charger:

11. Turn on the charger

12. Plug the yellow, XT-60 battery lead into the charging port located on the side of the charger.
13. Plug the balance chord into the appropriate port of the charger.
14. Use the navigation buttons to select "Lipo Balance" option on the charger.
15. Press Enter once to enter the voltage selection
16. Use the navigation buttons to select the appropriate voltage based on table 2
17. Press Enter to enter the current selection
18. Use the navigation buttons to select the appropriate current based on table 2
19. Once the user is satisfied with the voltage and current settings, Long pressing the Enter button will begin the battery verification process
20. Once the Battery has been successfully verified, the user will be prompted to press the Enter button to begin charging.

5.2 Installing the battery

Install the AgScout Mini battery by sliding the battery into the battery box located on the bottom of the aircraft. Ensure correct orientation by observing that the battery lead wires are facing up. Push the battery in all the way and fold the leads down such that they emerge from the bottom of the box. Fold in the balance port and close the battery box's door. Fasten the door by running the provided o-ring through the hooks on the side of the box and the face of the door.

5.3 Battery Safety and Warnings

General Guidelines and Warnings

13. Use specific battery charger as specified by AgriImage, LLC. Failure to do so may cause a fire, which may result in personal injury and/or property damage.
14. Never charge batteries unattended. You should always be present when charging Li-Po batteries in order to react to potential problems that may occur.
15. It is your responsibility solely to assure that your charger you purchased works properly. Always monitor the charging process to ensure that batteries are being charged properly. Failure to do so may result in a fire.
16. If battery begins to balloon or swell up, discontinue charging process immediately. Disconnect the battery and observe it in a safe place away from all people. If you continue to charge a swelling battery, it will result in a fire. Never use a battery that is ballooned or swollen upon purchase.
17. If battery is damaged, it is best to observe the battery as a safety precaution. Observation of the battery should occur away from buildings, people, vehicles, and any combustible material
18. If you accidentally short the wires, the battery must be placed in a safe area for observation. Wire lead shorts can cause a fire. If a short occurs and contact is made with metal, severe injuries may occur due to the conductibility of electric current.
19. If you were to crash your unit, you must remove the battery for observation and place it in an open area away from buildings, people, vehicles, and any combustible material.
20. Never store or charge your battery pack in extreme temperatures. This could cause a fire.
21. Only use the correctly specified batteries.
22. Keep batteries out of reach from children at all times.
23. Never hit or throw the battery. If battery is punctured, it could cause serious damage, injury, and/or could start a fire.
24. Do not drain the battery or leave the battery plugged into the unit when not being used. When low voltage alert is given, land the unit to avoid damage to the battery and others.

Before Charging Batteries

4. Make sure you inspect the battery pack. Look for damaged leads, connectors, ballooned or swollen cells, broken heat shrink, etc. If you find any of the following irregularities DO NOT use the battery pack.
5. If any damage to the pack or leads are found, do not attempt to charge or fly with the battery pack. Contact AgriImage, LLC as soon as you discover the issue.

Charging Process

5. Never charge batteries unattended.
6. Charge away from other flammable materials in an isolated area.
7. Do not charge battery packs in series. Never "Daisy Chain" or charge battery packs in series. Failure to do so may result in overcharging and/or cause a fire.
8. When selecting voltage or cell counts for battery charging, select the voltage and cell counts as it appears on the battery. If you do not follow the voltage and cell counts as labeled on the battery, it can cause a fire. To ensure your safety, and the safety of others, double check the voltage and cell requirements before charging.

6. Auto Pilot Usage

The following pages are an excerpt from the auto pilot manufacturer's manual. Following the usage and best practices for flying detailed below will ensure competency and safety while flying.

Basic Flying

Control Mode Knowledge

Please read the Control Mode Knowledge clearly before usage, to know how to control the aircraft.

Different control modes will give you different flight performances. Please make sure you understand the features and differences of the three control modes.

	GPS ATTI. Mode (With GPS Module)	ATTI. Mode	Manual Mode
Rudder Angular Velocity	Maximum rudder angular velocity is 150°/s		
Command Linearity	YES		
Command Stick Meaning	Multi attitude control; Stick center position for 0° attitude, its endpoint is 35°.		Max-angular velocity is 150°/s. No attitude angle limitation and vertical velocity locking.
Altitude Lock	Maintain the altitude best above 1 meter from ground.		NO
Stick Released	Lock position if GPS signal is adequate.	Only attitude stabilizing.	NOT Recommend
GPS Lost	When GPS signal has been lost for 3s, system enters ATTI. Mode automatically.	Only performing attitude stabilizing without position lock.	---
Safety	Attitude & speed control ensures		Depends on

	mixture stability		experience.
	Enhanced Fail-Safe(Position lock when hovering)	Auto Level Fail-Safe (Attitude stabilizing)	
	With GPS/Compass and the failsafe module requirement Mode (including GPS, ATTI. Mode, Manual Mode and IOC Mode), the Mode enter the failsafe Mode.		s are satisfied, in each Control aircraft will
Applications	AP work	Sports flying.	---

Start & Stop Motor Knowledge

(1) Both Immediately Mode and Intelligent Mode are available in the Assistant Software:

Advanced->Motor->Stop Type.

(2) Stop Motor method is defaulted to Immediately Mode.

Please get to know well about this section before flying.

1 Start Motor: Pushing throttle stick before takeoff will not start the motors. You have to execute any one of following four Combination Stick Commands (CSC) to start the motors:

2 Stop Motor: We provide two options to stop motors in the assistant software: Immediately and Intelligent. (1) Immediately Mode: If you select this mode, in any control mode, once motors start and throttle stick is over 10%, motors will not stop immediately only when throttle stick is back under 10% the motors will stop. In this case, if you push the throttle stick over 10% within 5 seconds after motors stop, motors will re-start, CSC is not needed. If you don't push throttle stick after motors start in three seconds, motors will stop automatically.

(2) Intelligent Mode: By using this mode, different control mode has different way of stopping motors. In Manual Mode, only executing CSC can stop motors. In ATTI. Mode or GPS ATTI. Mode, any one of following four cases will stop motors:

a) You don't push throttle stick after motors start within three seconds;

b) Executing CSC;

c) Throttle stick under 10%, and after landing for more than 3 seconds.

d) If the angle of multi-rotor is over 70°, and throttle stick under 10%.

Notes of Intelligent Mode

(1) In ATTI. / GPS ATTI. Mode, it has landing judgment, which will stop

motors.

(2) Start motors in ATTI. / GPS ATTI. Mode, you have to execute CSC and then push throttle stick over 10% in 3 seconds, otherwise motors will stop after 3 seconds.

(3) During normal flight, only pull throttle stick under 10% will not stop motors in any control mode.

(4) For safety reason, when the slope angle of multi-rotor is over 70° during the flight in ATTI. / GPS ATTI. Mode (may be caused by collision, motor and ESC error or propeller broken down), and throttle stick is under 10%, motors will stop automatically.

Notes of Intelligent Mode & Immediately Mode

(1) If you choose the Immediately Mode, you should not pull throttle stick under 10% during flight, because it will stop motors. If you do it accidentally, you should push the throttle stick over 10% in 5s to re-start motors.

(2) DO NOT execute the CSC during normal flight without any reason, or it will stop motors at once.

(1) If you choose the Intelligent mode, and the throttle stick is under 10%, this will trigger the landing Procedure, in any control mode. In this judgment, pitch, roll and yaw controls are denied except the throttle, but multi-rotor will still auto level.

(2) In any control mode, DO NOT pull throttle stick under 10% during normal flight without any reason.

(1) Any of these two cut off types will only work properly if TX calibration is correct done.

(2) In failed-safe, CSC is denied by the main controller, motors will hold their state.

Step 1 Compass Calibration

Without GPS module, please skip this step. If you use with GPS module, follow step-by-step for calibration.

(1) DO NOT calibrate your compass where there is magnetic interference, such as magnetite, car park, and steel reinforcement under the ground.

(2) DO NOT carry ferromagnetic materials with you during calibration, such as keys or cell phones.

(3) Compass module CANNOT work in the polar circle.

(4) Compass Calibration is very important, otherwise the system will work abnormal.

Calibration Procedures

1. Switch on the transmitter, and then power on autopilot system!
2. Quickly switch the control mode switch from GPS Mode to Manual Mode and back to GPS Mode (or from GPS Mode to ATTI. Mode and back to GPS Mode) for more than 5 times, The LED indicator will turn on constantly yellow so that the aircraft is ready for the calibration.

3. (Fig.1) Hold your Multi-rotor horizontal and rotate it around the gravitational force line (about 360°) until

   the LED changes to constant green, and then go to the next step.

4. (Fig.2)Hold your Multi-rotor vertically and rotate it (its nose is downward) around the gravitational force

   line (about 360°) until the LED turns off, meaning the calibration is finished.

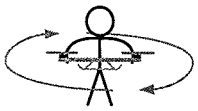


Fig.1

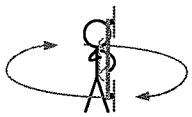


Fig.2

5. If the calibration was successful, calibration mode will exit automatically. If the LED keeps flashing quickly Red, the calibration has failed. Switch the control mode switch one time to cancel the calibration, and then re-start from step 2.

1. When the GPS is abnormal, the Main controller will tell you by the LED blinking Red and Yellow alternately (▬▬), disable the GPS Module, and automatically enter the aircraft into the ATTI. Mode.
2. You don't need to rotate your multi-rotor on a precise horizontal or vertical surface, but keep at least 45° difference between horizontal and vertical calibration.
3. If you keep having calibration failure, it might suggest that there is very strong magnetic interference around the GPS /Compass module, please avoid flying in this area.
4. When to do re-calibration

(1) The flight field is changed.

(2) When the multi-rotor mechanical setup has changed:

a) If the GPS/Compass module is re-positioned.

b) If electronic devices are added/removed/ re-positioned (Main Controller, servos, batteries, etc.).

c) When the mechanical structure of the multi-rotor is changed.

(3) If the flight direction appears to be shifting (meaning the multi-rotor doesn't "fly straight").

(4) The LED indicator often indicates abnormality blinking when the multi-rotor spins. (It is normal for this to happen only occasionally)

Step2 Assembly Checking List

Please check each item, to make sure for safety.

Any of the following mistakes will lead to a dangerous accident, double check all these items:

(1) Rotation direction of motor is opposite

(2) Infirm connection between the motor and the ESC

(3) Wrong or infirm installation of Main controller

(4) Wrong or infirm connection between the main controller and ESC.

(5) Propeller installation mistake

(6) Magnetization of the compass

Make sure the following items are correct.

(1) Make sure you have assembled your multi-rotor correctly.

(2) Make sure you have done the configuration procedure correctly.

(3) Make sure all connections are in good condition.

(4) Make sure batteries are fully charged for your transmitter, autopilot system and all devices.

Step3 Before Flight

Carry out the following procedures (is based on Intelligent Mode of Motor Stop) to make sure all configurations are correct. Refer to the Appendix->LED Description for more LED details.

1. Always switch on the transmitter first, then power on multi-rotor!
2. Keep the aircraft stationary until the system start and self-check has finished (●●○●●○●●○○●●●●). After that, the LED may blink Yellow 4 times quickly (○○○○). Start motor is disable during LED blinking Yellow 4 times quickly (○○○○), as the system is warming up.
3. After the 4 times Yellow LED ○ ●●● disappears, toggle the control mode switch on your transmitter to make sure it is working properly. For example, LED blinks (), which means the system is in ATTI. Mode and the GPS signal is worst Check it with LED indicator to specify the current working mode for MC. See following table for details about LED indicator;

(1) There are Manual Mode and ATTI. Mode without a GPS/Compass module, no GPS signal status LED indicator.

(2) After connecting to the GPS/Compass module, GPS ATTI. Mode is available, and GPS signal status LED indicator is available.

Control Mode LED Indicator	GPS Signal Status LED Indicator

	Signal is best (GPS satellites > 6) : NO LED
Manual Mode: NO LED	Signal is well (GPS satellites = 6) :
ATTI. Mode: indicates that is stick(s) not at center)	Signal is bad(GPS satellites = 5) :
GPS Mode: (indicates that is s	Signal is worst (GPS satellites< 5) :

4. Keep the aircraft stationary, and then push both sticks to the left bottom or right bottom (shown as the following chart, defined as Combination Stick Commands (CSC)), to start the motors.

5. Release the yaw, roll and pitch sticks and keep them at the mid point, and the throttle stick under the mid point. Then check whether all propellers are rotating correctly.
6. Stop motors, power off the Multi-rotor.
7. Make sure all settings and configurations are correct and then you can take off you aircraft.

After power on, if abnormal LED Indicator occurs, please refer to the Abnormal LED instruction in the FAQ and aids troubleshooting.

Step4 Flying Test

1. Choose an open space without obstruction, tall buildings and crowds as flying filed. Place the aircraft 3 meters away from you and others, to avoid accidental injury.
2. If in GPS ATTI. Mode, place the aircraft in an open space without buildings or trees. Take off the aircraft after 6 or more GPS satellites are found (Red LED blinks once or no blinking). If in Manual Mode or ATTI.

   Mode, you can skip this step.
3. Start-up
   (1) Switch on the transmitter first, then power on multi-rotor! Keep the aircraft stationary until the

   system start and self-check has finished.

   (2) Please wait for the system to warm up gradually with the LED blinks Yellow 4 times quickly

   (oooo). You should not start the motors until the blinking disappears.

   (3) Keep the aircraft stationary, and execute the CSC to start the motors.

   (4) Release the yaw, roll and pitch sticks and keep them at the mid point, at the same time raise the

   throttle stick from the bottom. The motors will stop if you do not push the throttle stick from the bottom within 3 sec and you will need to re-start the motors.

   (5) Keep raising the throttle stick until all the rotors are working, push the throttle stick to the mid point

   and then take-off your multi-rotor gently, pay attention not to push the stick excessively.

   (6) Pay attention to the aircraft movement at any time when flying, and use the sticks to adjust the

   aircraft's position. Keep the yaw, roll, pitch and throttle sticks at the mid point to hover the aircraft at the desired height.
4. Lower the aircraft slowly. Pull the throttle stick to the bottom and then execute the CSC to stop the motors after landing.
5. Please always power off the Multi-rotor first, and then switch off the transmitter after landing.

FLYING NOTES(VERY IMPORTANT) ! ! !

(1) If the warm up waiting is longer than 2 minutes (the 4 times Yellow blink continues), please power off for 10 minutes, cold start, and then connect the assistant software, enter the "Tools" - > IMU calibration, carry out the Advanced calibration.

(2) If you enable the Immediately Mode of Motor Stop; you should not pull throttle stick under 10% during flight, because it will stop motors. If you do it accidentally, you should push the throttle stick over 10% in 5s to re-start motors.

(3) DO NOT execute the CSC during normal flight without any reason, or it will stop motors at once.

(4) Pay attention to the GPS satellite status LED indicator. Bad GPS signal may lead the aircraft to drift when hovering.

(5) DO NOT fly near to ferromagnetic substances, to avoid strong magnetic interference with the GPS.

(6) Please avoid using GPS ATTI. Mode in the areas, where GPS signal is most likely bad.

(7) If the LED flashes quickly Red then this indicates battery voltage is low, land ASAP.

(8) If the transmitter indicates low-battery alarm, please land ASAP. In this condition the transmitter may cause the aircraft to go out of control or even crash.

(9) In GPS ATTI. Mode, make sure that the home point is recorded when the GPS signal is well; otherwise the home point recording may be not so precise.

(1) In ATTI Mode, throttle stick center position is for 0m/s along the vertical direction. You should keep the position of throttle stick higher than 10% from cut-throttle during the flight! In any control mode, DO NOT pull throttle stick under 10% during normal flight without any reason.

(2) It is recommended to land the aircraft slowly, to prevent the aircraft from damage when landing.

(3) If Low-Voltage Alarm is set, the aircraft will act according to the configuration of the Assistant Software once Low-Voltage Alarm is triggered. Make sure you remember what you have set before.

(4) If Fail-Safe function is set, the aircraft will act according to the configuration of the Assistant Software once Fail-Safe is triggered. Make sure you remember what you have set before.

C. Exhibit 3: Failsafe Safety Features

Once in Failsafe mode, the aircraft will rise to an altitude of 200ft above ground level and fly in a straight line to the GPS coordinates of the last take off location. Once the aircraft is in a 5ft range of the takeoff location the aircraft will begin to land itself. Upon landing, the motors will automatically cut off. There are numerous ways in which failsafe may be triggered:

1. Low Battery:

   Once the battery level reaches 80% of full charge, the aircraft will enter into failsafe mode. If the battery drops to 75% of full charge, the aircraft will begin to land itself regardless of proximity to take off location to avoid a crash landing.

2. Failsafe Trigger Switch:

   The pilot in control always has the option to remotely trigger the failsafe to begin the failsafe procedure.

3. Controller Signal Loss:

   Failsafe will trigger in the event that the signal from the remote controller is lost due to the controller being either out of range, or turned off.

D. Exhibit 4: No Fly Zones

Below is a list of No fly zones that are preprogrammed into the Autonomous flight component of the sUAS:

State	No Fly Zone
Alabama	Birmingham-Shuttlesworth International Airport
Alabama	Huntsville International Airport
Alaska	Juneau International Airport
Alaska	Ted Stevens Anchorage International Airport
Alaska	Ketchikan International Airport
Alaska	Fairbanks International Airport
Arizona	Tucson International Airport
Arizona	Phoenix Sky Harbor International Airport
Arizona	Yuma International Airport
California	Mineta San José International Airport
California	LA/Ontario International Airport
California	Oakland International Airport
California	Meadows Field Airport
California	Calexico International Airport
California	San Francisco International Airport
California	Fresno Yosemite International Airport
California	San Diego International Airport
California	San Diego International/Lindbergh Field Airport
California	Palm Springs International Airport
California	Marine Corps Air Station Miramar
California	Los Angeles International Airport
California	John Wayne Airport
California	Sacramento International Airport
Colorado	Denver International Airport
Connecticut	Bradley International Airport

Florida	Fort Lauderdale-Hollywood International Airport
Florida	Miami International Airport
Florida	Orlando International Airport
Florida	Northwest Florida Beaches International Airport
Florida	Melbourne International Airport
Florida	Tampa International Airport
Florida	Pensacola International Airport
Florida	St. Petersburg-Clearwater International Airport
Florida	Jacksonville International Airport
Florida	Southwest Florida International Airport
Florida	Key West International Airport
Florida	Palm Beach International Airport
Florida	Daytona Beach International Airport
Florida	Sarasota-Bradenton International Airport
Georgia	Hartsfield-Jackson Atlanta International Airport
Georgia	Savannah/Hilton Head International Airport
Hawaii	Kona International Airport
Hawaii	Honolulu International Airport
Illinois	Chicago Midway International Airport
Illinois	Quad City International Airport
Illinois	Chicago O'Hare International Airport
Illinois	Chicago Rockford International Airport
Illinois	General Wayne A. Downing Peoria International Airport
Indiana	Fort Wayne International Airport
Indiana	Indianapolis International Airport
Iowa	Des Moines International Airport
Kentucky	Louisville International Airport
Kentucky	Cincinnati/Northern Kentucky International Airport
Louisiana	Louis Armstrong New Orleans International Airport

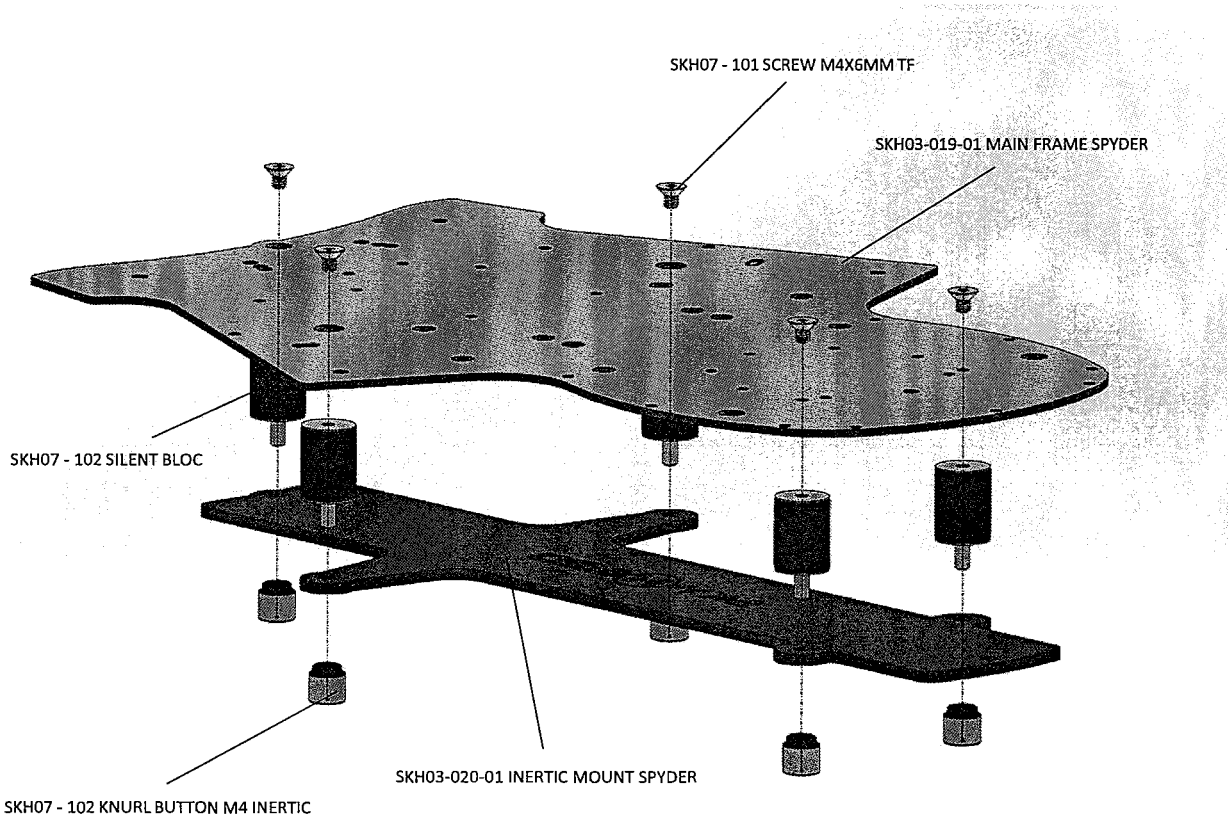
Louisiana	Alexandria International Airport
Louisiana	Chennault International Airport
Maine	Portland International Jetport
Maine	Houlton International Airport
Maryland	Baltimore/Washington International Thurgood Marshall Airport
Maryland	Andrews Air Force Base Airport
Massachusetts	Boston Logan International Airport
Michigan	Chippewa County International Airport
Michigan	Kalamazoo/Battle Creek International Airport
Michigan	Oakland County International Airport
Michigan	MBS International Airport
Michigan	Saint Clair County International Airport
Michigan	Gerald R. Ford International Airport
Michigan	Detroit Metropolitan Wayne County Airport
Michigan	Bishop International Airport
Michigan	Sawyer International Airport
Michigan	Capital Region International airport
Minnesota	Minneapolis–Saint Paul International Airport
Minnesota	Falls International Airport
Minnesota	Rochester International Airport
Minnesota	Duluth International Airport
Mississippi	Gulfport-Biloxi International Airport
Mississippi	Jackson-Medgar Wiley Evers International Airport
Missouri	Lambert–St. Louis International Airport
Missouri	Kansas City International Airport
Montana	Glacier Park International Airport
Montana	Glasgow Airport
Montana	Billings Logan International Airport
Montana	Great Falls International Airport

Montana	Del Bonita/Whetstone International Airport
Montana	Missoula International Airport
Nevada	Reno-Tahoe International Airport
Nevada	McCarran International Airport
New Hampshire	Portsmouth International Airport at Pease
New Jersey	Newark Liberty International Airport
New Jersey	Atlantic City International Airport
New Mexico	Las Cruces Airport
New Mexico	Albuquerque International Sunport
New York	LaGuardia Airport
New York	Albany International Airport
New York	Plattsburgh International Airport
New York	Ogdensburg International Airport
New York	Massena International Airport
New York	Watertown International Airport
New York	Stewart International Airport
New York	Greater Binghamton Airport
New York	John F. Kennedy International Airport
New York	Greater Rochester International Airport
New York	Niagara Falls International Airport
New York	Sullivan County International Airport
New York	Buffalo Niagara International Airport
North Carolina	Wilmington International Airport
North Carolina	Durham International Airport
North Carolina	Piedmont Triad International Airport
North Carolina	Charlotte Douglas International Airport
North Dakota	Hector International Airport
Ohio	Akron Fulton International
Ohio	Rickenbacker International Airport

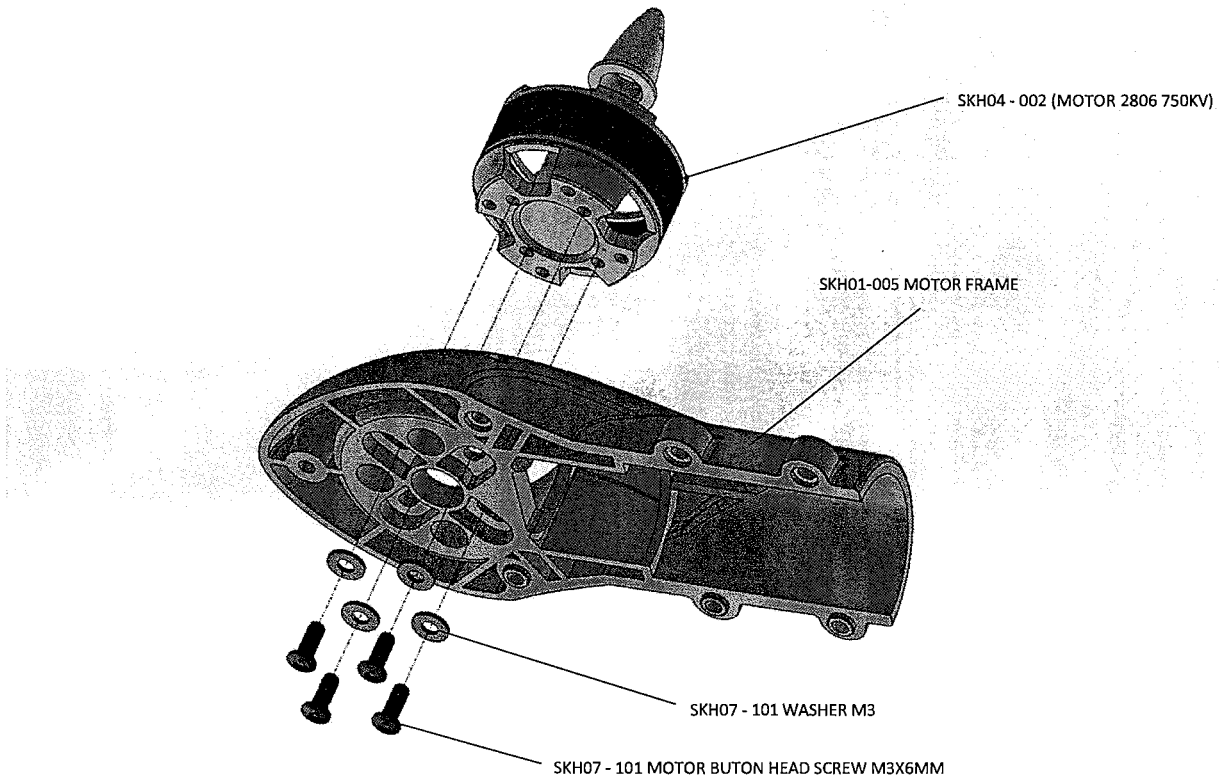
Ohio	Cleveland Hopkins International Airport
Ohio	Dayton International Airport
Ohio	Port Columbus International Airport
Ohio	Toledo Express Airport
Oklahoma	Tulsa International Airport
Oregon	Portland International Airport
Oregon	Rogue Valley International-Medford Airport
Pennsylvania	Erie International Airport
Pennsylvania	Philadelphia International Airport
Pennsylvania	Lehigh Valley International Airport
Pennsylvania	Wilkes-Barre/Scranton International Airport
Pennsylvania	Harrisburg International Airport
Pennsylvania	Pittsburgh International Airport
Rhode Island	T. F. Green Airport
South Carolina	Charleston International Airport
South Carolina	Myrtle Beach International Airport
South Carolina	Greenville-Spartanburg International Airport
Tennessee	Nashville International Airport
Tennessee	Memphis International Airport
Texas	McAllen International Airport
Texas	Laredo International Airport
Texas	El Paso International Airport
Texas	Alice International Airport
Texas	George Bush Intercontinental Airport
Texas	Corpus Christi International Airport
Texas	Houston–Hobby Airport
Texas	Dallas/Fort Worth International Airport
Texas	San Antonio International Airport
Texas	Meacham International Airport

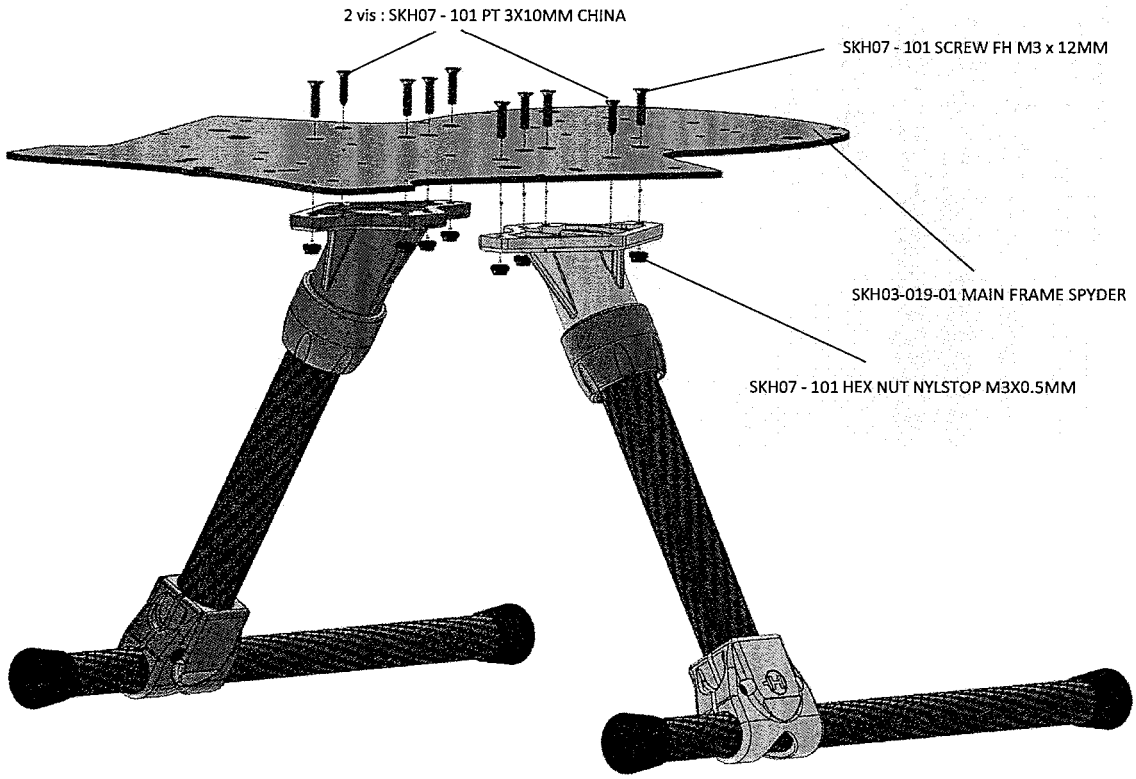
Texas	Del Rio International Airport
Texas	South Texas International Airport at Edinburg
Texas	Maverick County Memorial International Airport
Texas	Valley International Airport
Texas	Brownsville South Padre Island International Airport
Texas	Austin-Bergstrom International Airport
Texas	Preston Smith International Airport
Utah	Salt Lake City International Airport
Vermont	Burlington International Airport
Virginia	Dulles International Airport
Virginia	Norfolk International Airport
Virginia	Richmond International Airport
Virginia	Newport News/Williamsburg International Airport
Virginia	Ronald Reagan Washington National Airport
Washington	Jefferson County International Airport
Washington	Grant County International Airport
Washington	Seattle-Tacoma International Airport
Washington	Spokane International Airport
Washington	Bellingham International Airport
Washington	William R. Fairchild International Airport
Wisconsin	General Mitchell International Airport
Wisconsin	Austin Straubel International Airport
Wyoming	Casper–Natrona County International Airport

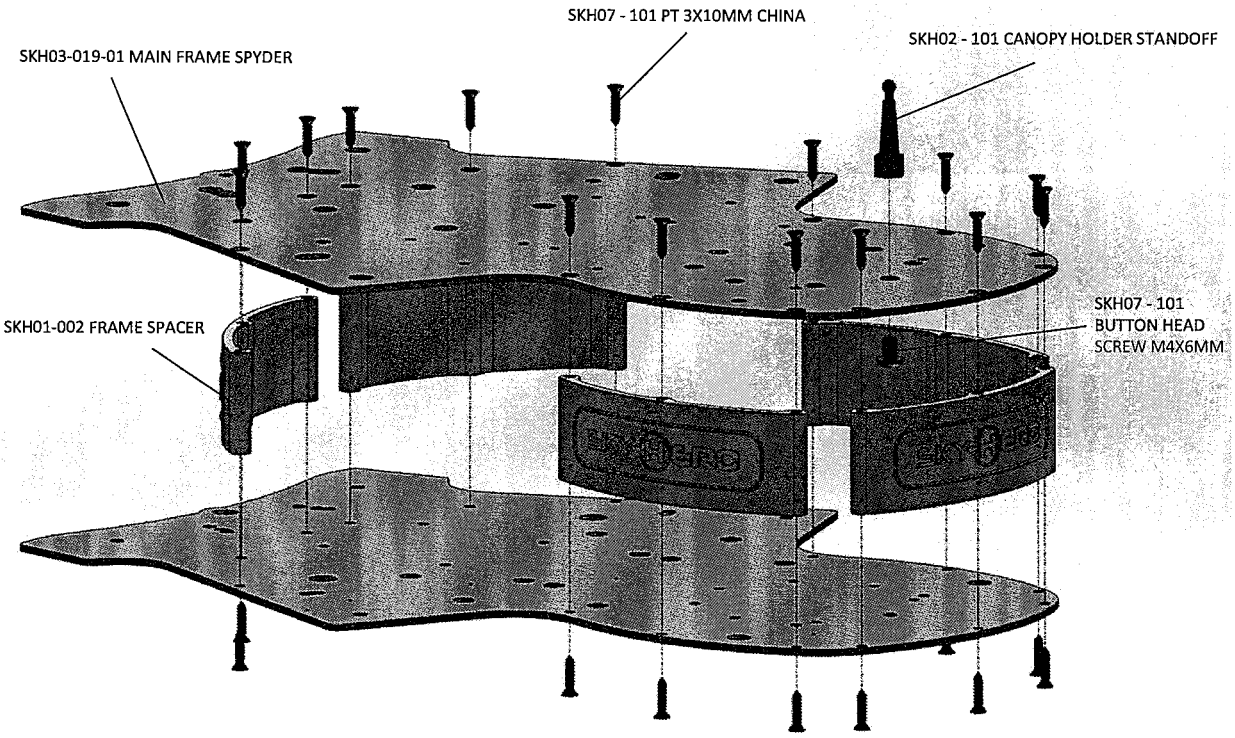
E. Exhibit 5: Sky Hero Spyder

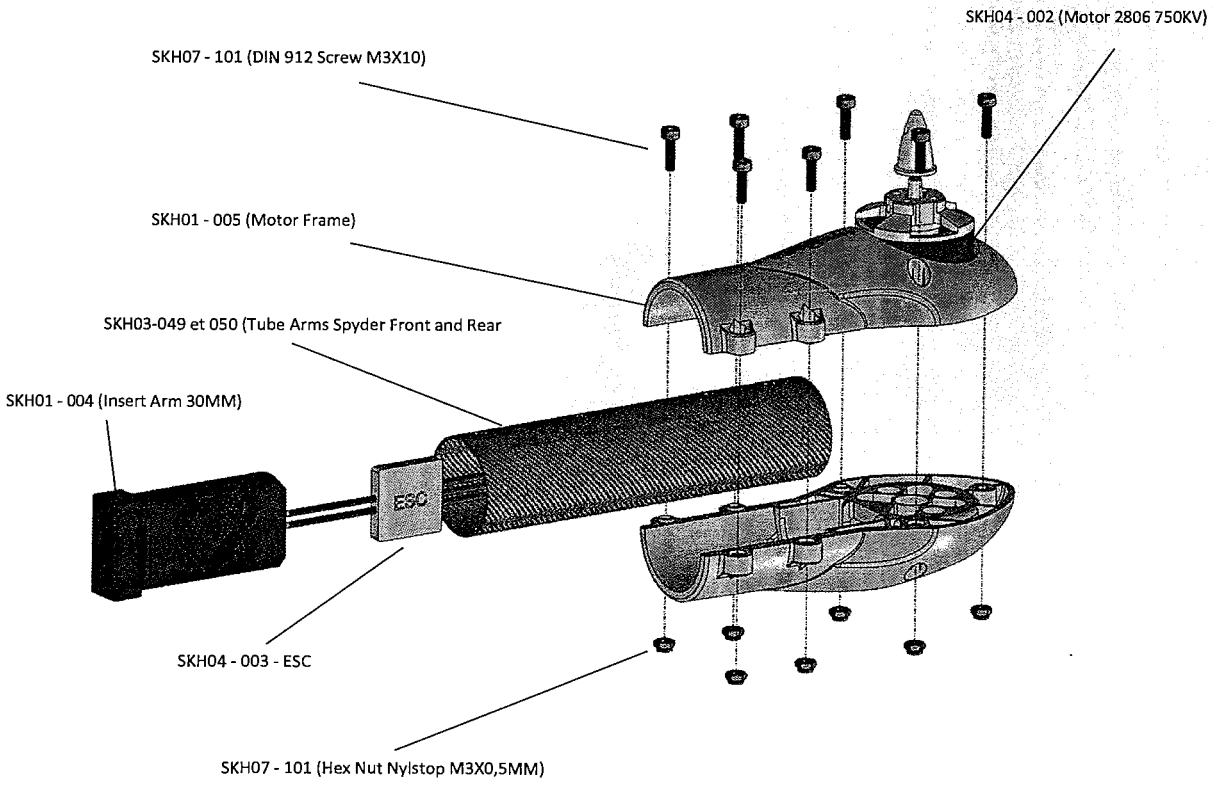


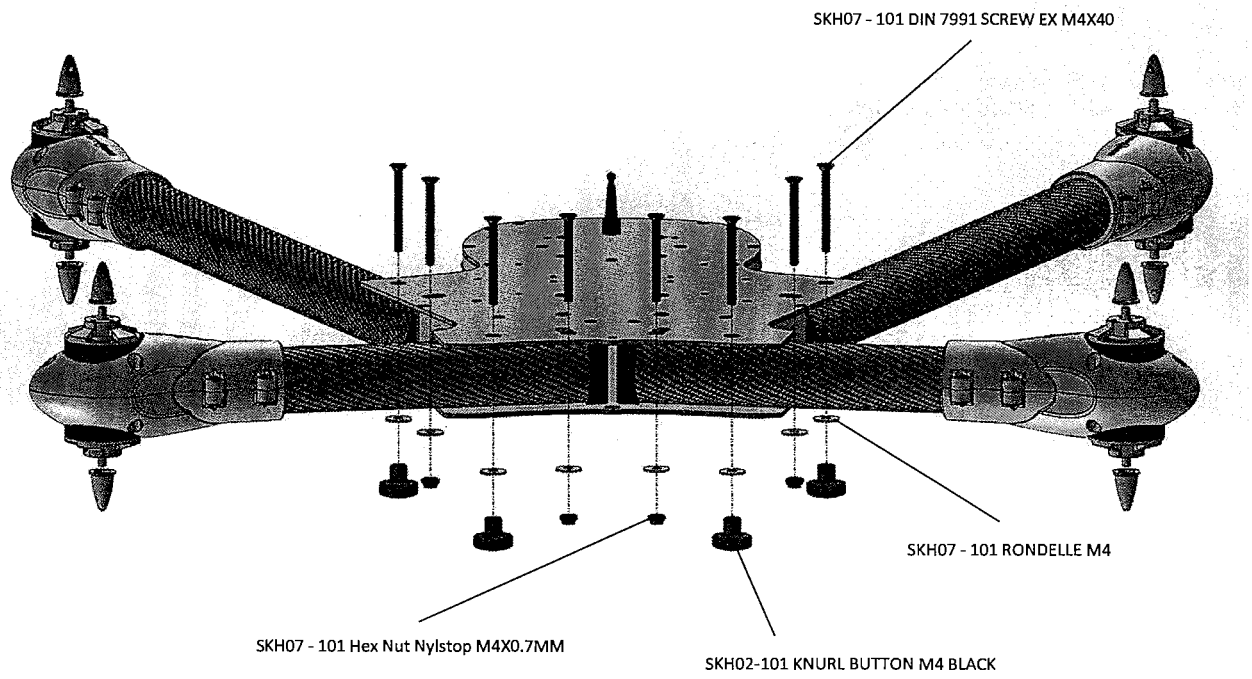
Exploded views Spyder / Kits [SKH00-401] [SKH00-402] [SKH00-403] /

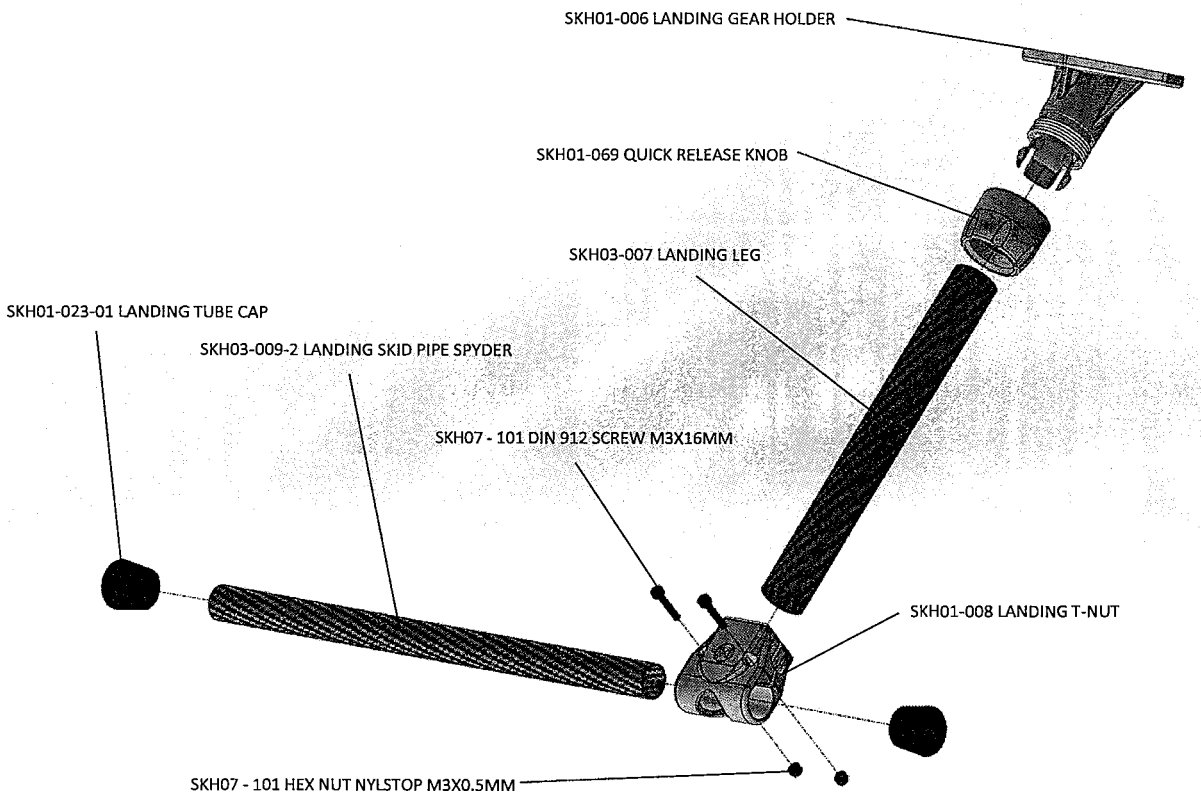

SKH04 - 002 (MOTOR 2806 750KV)
SKH01-005 MOTOR FRAME
SKH07 - 101 WASHER M3
SKH07 - 101 MOTOR BUTON HEAD SCREW M3X6MM

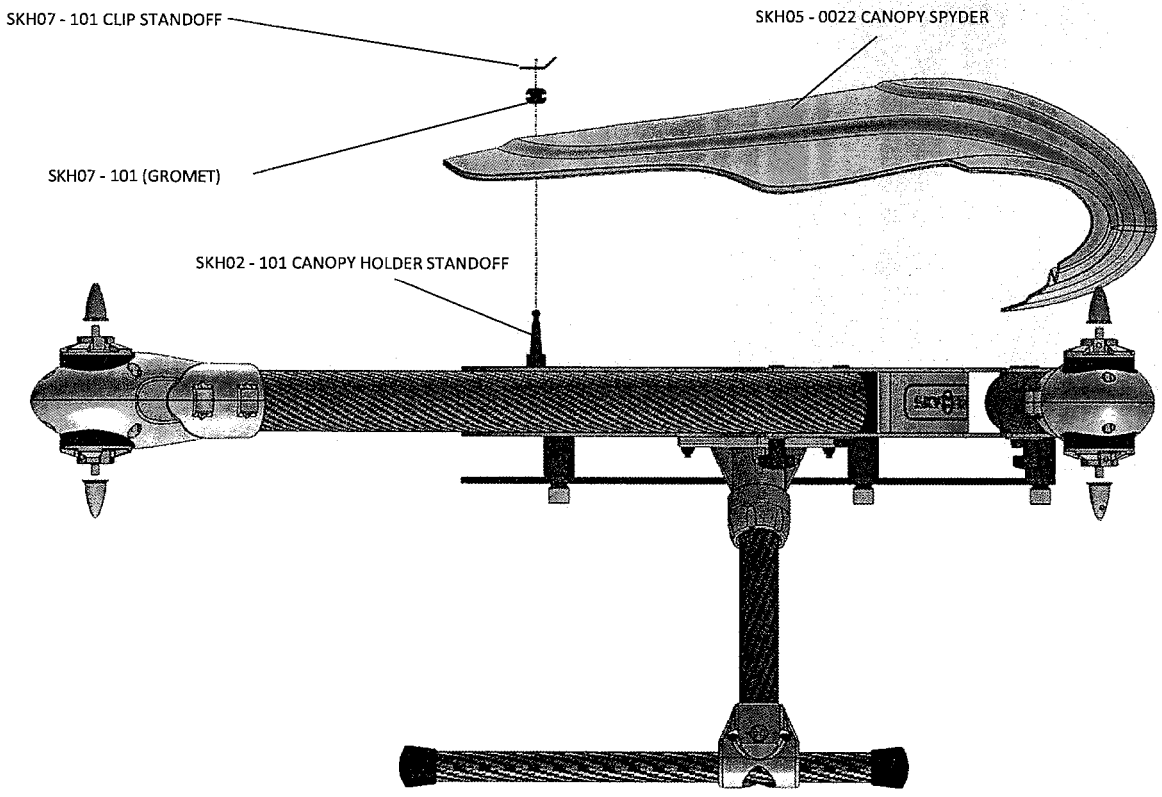

2 vis : SKH07 - 101 PT 3X10MM CHINA
SKH07 - 101 SCREW FH M3 x 12MM
SKH03-019-01 MAIN FRAME SPYDER
SKH07 - 101 HEX NUT NYLSTOP M3X0.5MM


SKH07 - 101 PT 3X10MM CHINA
SKH02 - 101 CANOPY HOLDER STANDOFF
SKH03-019-01 MAIN FRAME SPYDER
SKH01-002 FRAME SPACER
SKH07 - 101
BUTTON HEAD
SCREW M4X6MM


SKH04 - 002 (Motor 2806 750KV)
SKH07 - 101 (DIN 912 Screw M3X10)
SKH01 - 005 (Motor Frame)
SKH03-049 et 050 (Tube Arms Spyder Front and Rear
SKH01 - 004 (Insert Arm 30MM)
ESC
SKH04 - 003 - ESC
SKH07 - 101 (Hex Nut Nylstop M3X0,5MM)


SKH07 - 101 DIN 7991 SCREW EX M4X40
SKH07 - 101 RONDELLE M4
SKH07 - 101 Hex Nut Nylstop M4X0.7MM
SKH02-101 KNURL BUTTON M4 BLACK


SKH01-006 LANDING GEAR HOLDER
SKH01-069 QUICK RELEASE KNOB
SKH03-007 LANDING LEG
SKH01-023-01 LANDING TUBE CAP
SKH03-009-2 LANDING SKID PIPE SPYDER
SKH07 - 101 DIN 912 SCREW M3X16MM
SKH01-008 LANDING T-NUT
SKH07 - 101 HEX NUT NYLSTOP M3X0.5MM


SKH07 - 101 CLIP STANDOFF
SKH05 - 0022 CANOPY SPYDER
SKH07 - 101 (GROMET)
SKH02 - 101 CANOPY HOLDER STANDOFF

F. Exhibit 6: Wookong

WooKong-M Quick Start Guide

V 1.14

November 24, 2014 Revision

For Firmware Version V5.26

& PC Assistant Software V2.04

&WM Assistant V1.4.25

Please strictly follow these steps to mount and connect the autopilot system on your multi-rotor, as well as to install the Assistant Software on your computer or Mobile Device.

Thank you for purchasing this DJI product. Please regularly visit the WooKong-M web page at www.dji.com. This page is updated regularly. Any technical updates and manual corrections will be available on this web page. Due to unforeseen changes or product upgrades, the information contained in this manual is subject to change without notice.

This manual is only for basic assembly and configuration; you can obtain more details and advanced instructions when using the assistant software. To assure you have the latest information, please visit our website and download the latest manual and current software version.

Content

Trademark

Disclaimer & Warning

Please read this disclaimer carefully before using the product. By using this product, you hereby agree to this disclaimer and signify that you have read them fully.

THIS PRODUCT IS NOT SUITABLE FOR PEOPLE UNDER THE AGE OF 18.

WooKong-M is an autopilot system designed for serious multi-rotor enthusiasts providing excellent self-leveling and altitude holding, which completely takes the stress out of flying RC multi-rotors for both professional and hobby applications. Despite the product having a built-in autopilot system and our efforts in making the operation of the controller as safe as possible when the main power battery is connected, we strongly recommend users to remove all propellers when calibrating and setting parameters. Make sure all connections are good, and keep children and animals away during firmware upgrade, system calibration and parameter setup. DJI Innovations accepts no liability for damage(s) or injuries incurred directly or indirectly from the use of this product in the following conditions:

1. Damage(s) or injuries incurred when users are drunk, taking drugs, drug anesthesia, dizziness, fatigue, nausea and any other conditions no matter physically or mentally that could impair your ability.
2. Damage(s) or injuries caused by subjective intentional operations.
3. Any mental damage compensation caused by accident.
4. Failure to follow the guidance of the manual to assemble or operate.
5. Malfunctions caused by refit or replacement with non-DJI accessories and parts.
6. Damage(s) or injuries caused by using third party products or fake DJI products.
7. Damage(s) or injuries caused by mis-operation or subjective mis-judgment.
8. Damage(s) or injuries caused by mechanical failures due to erosion, aging.
9. Damage(s) or injuries caused by continued flying after low voltage protection alarm is triggered.
10. Damage(s) or injuries caused by knowingly flying the aircraft in abnormal condition (such as water, oil, soil, sand and other unknown material ingress into the aircraft or the assembly is not completed, the main components have obvious faults, obvious defect or missing accessories).
11. Damage(s) or injuries caused by flying in the following situations such as the aircraft in magnetic interference area, radio interference area, government regulated no-fly zones or the pilot is in backlight, blocked, fuzzy sight, and poor eyesight is not suitable for operating and other conditions not suitable for operating.

12. Damage(s) or injuries caused by using in bad weather, such as a rainy day or windy (more than moderate breeze), snow, hail, lightning, tornadoes, hurricanes etc.
13. Damage(s) or injuries caused when the aircraft is in the following situations: collision, fire, explosion, floods, tsunamis, subsidence, ice trapped, avalanche, debris flow, landslide, earthquake, etc.
14. Damage(s) or injuries caused by infringement such as any data, audio or video material recorded by the use of aircraft.
15. Damage(s) or injuries caused by the misuse of the battery, protection circuit, RC model and battery chargers. 16. Other losses that are not covered by the scope of DJI Innovations liability.

Certifications

This product is approved with quality standards such as CE, FCC and RoHS.

Symbol Instruction

Forbidden(Important) Cautions Tip Reference

Assembly &Configuration

Step1 Assembly

Install the autopilot system and receiver to the aircraft, and connect them according to the following diagram. Refer to the Port Description for more details.

R/C System

· These are example connections. Please setup Aileron, Elevator, Futaba Throttle, Rudder channels on S-Bus/S-Bus2 your TX first, and choose one 2 or 3 positions switch/channel as control mode switch, then connect your receiver to the right ports on MC.

R/C Receiver

PPM

Roll

GPS/COMPASS

· GPS/Compass is sensitive to magnetic interference, should be far away from any electronic devices.
· You should use epoxy resin AB glue to assemble the GPS bracket first as the figure showed in previous page.
· Mount the bracket on the center plate of craft first, then fix the GPS on the plate of the bracket (by 3M glue provided). The GPS is sensitive to vibration interference, so position the bracket at least 10 cm from any rotor.

The DJI logo marked on the GPS should face the sky, with the orientation arrow pointing directly forward. The GPS/Compass is packaged with a special indication line for mounting for the first time. If you are uncertain whether materials near the GPS/Compass module are magnetic or not, you can use a compass or magnet to check it. If you use your own mounting rod, make sure it is NOT magnetic!

IMU

· The IMU is best positioned near the multi rotor's center of gravity, where vibration is relatively low.
· Orient the IMU such that the arrow marked on the printed surface of the IMU faces the sky and points directly forward, backward, left or right.
· The sides of the IMU should be precisely parallel to the multi rotor body. Use double-sided foam tape for secured installation. DO NOT cover the ventilation holes, keep them unobstructed.

DO NOT mount the IMU upside-down.

Check the double faced adhesive regularly to ensure that the IMU is securely positioned.

The IMU module is NOT waterproof or oil-proof.

R/C Receiver

(JR) tape

Main Controller

PMU & Battery

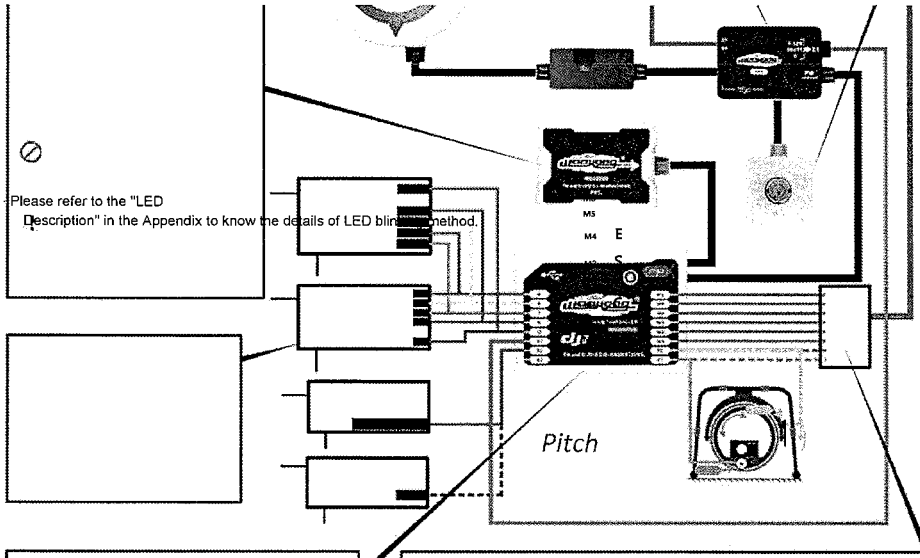
· There is no requirement for PMU mounting.
· Use our PMU Connecter (red line depicts in figure) to connect battery, PMU and ESCs.
· You can choose 2S-6S LiPo battery. For safety reason, please disconnect ESCs and battery connecter during the firmware upgrade and configuration procedure.

Sufficient air flow over the PMU is highly recommended.

ESC & Motor

LED Indicator

· Place The LED indicator at an appropriate location of craft body far away from the GPS. Do not mount it on other electronic devices.
· Make sure You can see the light during the flight. · You can connect LED to the CAN-Bus port on GPS connection wire.



. There is no orientation requirement for the Main · Please make sure you are using the ESCs and motors recommended by the Controller. Choose a mounting location where as manufacturer of your multi rotor first. We recommend you use DJI motors and ESCs. shorter ESC extension wires are needed as WKM output is 400Hz refresh frequency.
possible. Please make sure all ports are accessible · Connect all ESCs to MC by the motor numbering method introduced in ***Multi-Rotors*** when installing the MC so as to facilitate wiring and ***Supported***.
software configuration.

· If you use 3rd party ESCs, please make sure the ESCs travel midpoint is at 1520us.

. In three-pin ports, pins near the nicks are signal DO NOT use 700us travel midpoint ESC, as it may lead aircraft to fly away or cause pins. injury and damage. After connect ESCs, calibrate ESCs one by one through the receiver directly before connect them to your MC, Make sure program all of them into Governor off, Break off and Normal Start up to get best experience

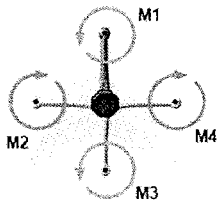
· If you use 3rd party ESCs, please cut the red wire (power wire) of your ESCs , as the

· After choosing a location to mount the MC, it is power from V-SEN on PMU is suitable to most of receivers and other electronic recommended that you DO NOT mount the MC devices.

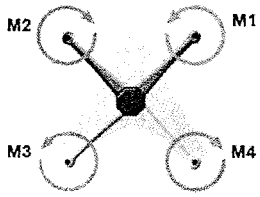
until all wirings and software configurations are completed.

. If you use extra BEC, please use a servo cable without power wire to connect V-SEN to X1. (Not recommend)

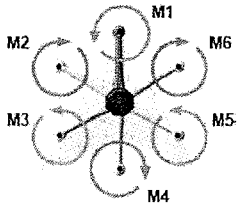
Multi-Rotors Supported



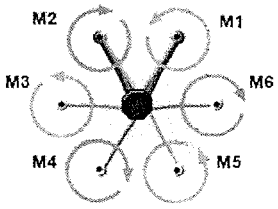
Quad-rotor I



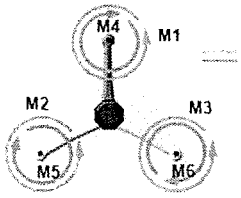
Quad-rotor X



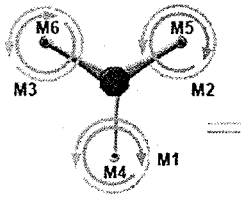
Hexa-rotor I



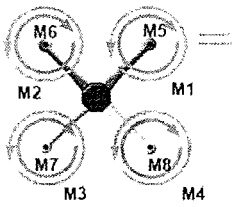
Hexa-rotor V

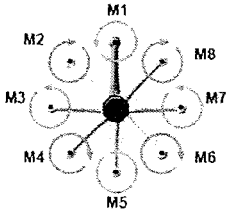


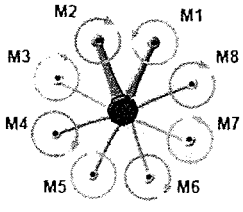
Hexa-rotor IY



Hexa-rotor Y







Octo-rotor X	Octo-rotor I	Octo-rotor V
	• To coaxial propellers: Blue propeller is at Top; Red propeller is at Bottom. Otherwise all propellers are at top.	
	• Please select the Mixer type in the assistant software according to your aircraft.	

Step2 Software and Driver Installation on a PC

1. Please download the drive installer and the assistant software from DJI website.
2. Connect the autopilot system and the PC via a USB cable, and power on the autopilot system.
3. Run the driver installer, and follow the instructions strictly to finish installation.
4. Run the assistant software installer, and follow the instructions strictly to finish installation.

Step3 Configuration by Assistant Software on a PC

1. Power on the PC. Make sure your computer is connected to the Internet for the first time you use.
2. Switch on the transmitter first, and then power on the autopilot system. Connect the autopilot system to the PC with a Micro-USB cable. DO NOT break the connection until setup is finished.
3. Run the Assistant Software.
4. Observe the indicators on the left bottom of the software. (connection communication indicator) If the connection indicator is communication indicator is blinking, that the software is ready, please go to next step.
5. Select the "Info" option. Check the software and the firmware version.
6. Select the "Basic" option. Please follow step-by-step for your first-time-configuration. Basic configuration is necessary, including Mixer Type, Mounting, RC, and Gain settings.
7. You can click the "Advanced" option for more parameter settings. Advanced setting is optional. There are settings of Motor, FailSafe, Intelligent Orientation Control (IOC), Gimbal, Low-Voltage Alert, and Flight Limits. Read the instruction in the assistant software to obtain more details.
8. Select the "Viewer" option and check all parameters.

!
- You may be required to fill register information for your first-time-usage.
- If the communication indicator is , please double check the connections.
- Basic configuration is necessary before you go to the "Basic Flying Test".

- If the software and the firmware upgrade are available, please upgrade the assistant software and the firmware by referring to the Appendix.
- This step is required to use together with the assistant software to obtain more details.

Recommended Settings for the users with F450/F550/S800/Z15.

Configuration Information	Basic	Attitude

	Motor	ESC	Propeller	Battery	Weight	Pitch	Roll	Yaw	Vertical	Pitch	Roll
F450	DJI-2212	DJI-30A	DJI-8 Inch	3S-2200	890 g	150	150	100	105	150	150
F550	DJI-2212	DJI-30A	DJI-8 Inch	4S-3300	1530 g	170	170	150	140	170	170
S800	DJI-4114	DJI-40A	DJI-15Inch	6S-15000	4770 g	200	200	195	175	190	190
5800+Z15	DJI-4114	DJI-40A	DJI-15Inch	6S-10000	6100 g	240	240	200	200	220	220
S800 EVO	DJI-4114 PRO	DJI-40A	DJI-15 Inch	6S-15000	6700 g	130	130	150	150	180	180

*S800 with damping kit can use the same values as 5800 EVO.

Step 4 Compass Calibration

Without GPS module, please skip this step. If you use with GPS module, follow step-by-step for calibration.

- DO NOT calibrate your compass where there is strong magnetic interference, such as magnetite, car park, and steel reinforcement under the ground.
- DO NOT carry ferromagnetic materials with you during calibration, such as keys or cell phones.
- Compass module CANNOT work in the polar circle.

Calibration Procedures

5. Quickly switch the control mode switch from GPS Mode to Manual Mode and back to GPS Mode for 6 to

   10 times. The LED indicator will turn on solid BLUE.

6. Rotate your Multi-rotor around the horizontal axis (about 360°) until the LED changes to solid GREEN,

   and then go to the next step.

7. Hold your Multi-rotor vertically and rotate it (its nose MUST be downward) around the vertical axis (about

   360°) until the LED turns off, meaning the calibration is finished.

8. The LED indicator will show whether the calibration is successful or not.
   - If the LED keeps WHITE for 3 seconds, meaning the calibration is successful, and then calibration mode will exit automatically.
   - If the LED keeps flashing quickly RED, the calibration has failed. Switch the control mode switch one time to cancel the calibration, and then re-start from step 1.

4. You don't need to rotate your multi-rotor on a precise horizontal or vertical surface, but keep at least 45° difference between horizontal and vertical calibration.

5. If you keep having calibration failure, it might suggest that there is very strong magnetic interference around the GPS & Compass module, please avoid flying in this area.

6. When to do re-calibration.

- The flight field is changed.
- The multi-rotor mechanical setup has changed, including the following situations:
  - d) If the GPS & Compass module is re-positioned.
  - e) Electronic devices added, removed or re-positioned (Main Controller, servos, batteries, etc).
  - f) When the mechanical structure of the multi-rotor is changed.
- If the flight direction appears shifting (meaning the multi-rotor doesn't "fly straight").
- The LED indicator often indicates abnormality blinking when the multi-rotor spins. But it is normal for this to happen only occasionally.
- LED blinks yellow and green ( ) continually, indicating that the compass data is abnormal.

Basic Flying Test

Step1 About the Control Mode Switch

The autopilot system can work in Manual Mode and ATTI. Mode without a GPS module. After connecting to the GPS module, GPS Mode is available. Follow the bellow steps to enter the different control modes.

4. Use a 3-position switch on the transmitter as mode control switch.
5. Make sure to take off the aircraft in ATTI. Mode in every flight.
6. Hover the Aircraft. Release all joysticks and then flip the control mode switch to the GPS Mode or Manual Mode (NOT RECOMMENDED).

Step2 Start & Stop Motor

Star Motor：Pushing throttle stick before takeoff will not start motors. You have to execute any one of following four Combination Stick Commands (CSC) to start motors

Stop Motor：The default setting of stop motor is Immediately. For the immediately mode, in any control mode, once motors start and throttle stick is over 10%, motors will stop immediately when throttle stick is back under 10% again. In this

case, if you push the throttle stick over 10% within 5s after motors stop, motors will re-start, CSC is not needed. If you don't push throttle stick after motors start within 3s, motors will stop automatically.

Please refer to the instructions of A1 and A2 in the Advanced Functions section, to learn more about the Control Mode and Stop Motor details.

Setp3 Checking List before Flying

- Make sure you have assembled your multi-rotor correctly.
- Make sure you have done the configuration procedure correctly.
- Make sure all connections are in good condition.
- Make sure batteries are fully charged for your transmitter, autopilot system and all devices.
- Any of the following mistakes will lead to a dangerous accident, double check all these items: Rotation direction of motor is opposite / Propeller installation mistake / Main controller installation mistake / Wrong connection between the main controller and ESC.
- Always switch on the transmitter first, then power on multi-rotor! (Power off multi-rotor first, then switch off the transmitter after landing!)
- Make sure the GPS signal is good, only one Red LED blinking or without Red LED blinking.

  Otherwise multi-rotor will drift without stick commands.

- When system is powered on, you MUST NOT move your multi-rotor or sticks on transmitter until the system initialization is finished (about 5 second).
- Please AVOID using the autopilot system in areas of urban area with crowded buildings, tunnels and under bridges, where GPS signal will be blocked most likely.

- In ATTI Mode, throttle stick center position is for 0m/s along the vertical direction. You should keep the position of throttle stick higher than 10% from cut-throttle during the flight!
- Please do the fly test and gain tuning with ATTI. Mode in the open air without heavy wind!
- Refer to the indication in the software: Basic->Gain for more details.

Step4 Flying Procedures

4. If in GPS Mode, place the aircraft in an open space without buildings or trees. Take off the aircraft after 6 or more GPS satellites are found (RED LED blinks once or no blinking). If in Manual Mode or ATTI. Mode, you can skip this step.
5. Place the aircraft three meters away from you and others (especially child), to avoid accidental injury.
6. Start-up
   - ✓ Switch on the transmitter, and then power on autopilot system! You MUST NOT move your multi-rotor or sticks on transmitter until the system initialization is finished (about 5 second).
   - ✓ Push both sticks of transmitter to the left bottom or right bottom to start the motors.
   - ✓ Release the yaw, roll and pitch sticks and keep them at the neutral position, avoiding the aircraft to tilt to one side. At the same time raise the throttle stick from the bottom quickly. The motors will stop if you do not push the throttle stick from the bottom within 3s and you will need to execute the start-up procedure again. When the aircraft is on the point of leaving the ground, continue to push the throttle stick upwards to take off from the ground, pay attention not to push the stick excessively.
   - ✓ Pay attention to the aircraft movement at any time when flying, and use the sticks to adjust the aircraft's position. Keep the yaw, roll, pitch and throttle sticks at the neutral position to hover the aircraft at the desired height.
6. Lower the aircraft slowly. Pull the throttle stick to the bottom and then push the sticks to the left bottom or right bottom to stop the motors after landing. (Also, with throttle stick under 10%, and after landing 3s the motors will stop automatically)
7. Power off the autopilot system, and then switch off the transmitter after landing.

- DO NOT fly near to any ferromagnetic substances, to avoid strong magnetic interference with the GPS. Otherwise, it may cause the aircraft to FailSafe, crack or even fly away.
- If abnormal compass data occurs during flying, LED will blink Yellow and Green alternatively ( ). If in ATTI and Manual Mode, it is free from influence. In any other control mode, the autopilot system will enter into ATTI. Mode automatically; once the compass data goes back to normal, the autopilot system will regain the original

control mode.
● If the LED flashes quickly YELLOW then this indicates battery voltage is low, land ASAP. ! It is recommended to land the aircraft slowly, to prevent the ● aircraft from damage. ● If the transmitter indicates low-battery alarm, please land ASAP. In this condition the transmitter may cause the aircraft to go out of control or even crash. ● The LED will blink White to indicate huge cumulative yaw errors caused by spinning the craft continuously. In this case, you can stop or slow down the spinning, and continue flying after the White blinking has stopped, so as to have better flight performance.
If Low-Voltage Alarm is set, the aircraft will act according to the ● configuration of the Assistant Software once Low-Voltage Alarm is triggered. ● If Fail-Safe function is set, the aircraft will act according to the configuration of the Assistant Software once Fail-Safe is triggered.
● Refer to the LED Indicator Description in the Appendix.

Advanced Functions

A1 Control Mode Knowledge

Please read the Control Mode Knowledge clearly before usage, to know how to control the aircraft.

Different control modes will give you different flight performances. Please make sure you understand the features and differences of the three control modes.

	GPS Mode (With GPS Module)	ATTI. Mode	Manual Mode
Rudder Angular Velocity	Maximum rudder angular velocity is 150°/s		
Command Linearity	YES		
Command Stick Meaning	Multi attitudetick center position control; Sfor 0° attitude, its endpoint is 35°.		Max-angular velocity is 150°/s. No attitude angle limitation and vertical velocity locking.
Altitude Lock	Maintain the best above 1 meter altitude from ground.		NO
Stick Released	Lock position if GPS signal is adequate.	Only attitude stabilizing.	NOT Recommend

GPS Lost	When GPS signal has been lost for 3s, system enters ATTI. Mode automatically.	Only performing attitude stabilizing without position lock.	---
Safety	Attitude & speedre control ensures mixtustability		Depends on experience.
	Enhanced Fail-Safe	Auto Level Fail-Safe	
Applications	AP work	Sports flying.	---

A2 Start & Stop Motor Knowledge

Both Immediately Mode and Intelligent Mode are available in the Assistant Software:

Advanced->Motor->Stop Type.

If necessary, please select the Intelligent Mode in the Assistant Software.

By using the Intelligent Mode, different control mode has different way of stopping motors.

- In Manual Mode, only executing CSC can stop motors.
- In ATTI. Mode or GPS Mode, any one of following four cases will stop motors:
  a) You don't push throttle stick after motors start within three seconds;
  b) Executing CSC;
  c) Throttle stick under 10%, and after landing 3 seconds.
  d) The slope angle of multi-rotor is over 70°, and throttle stick under 10%.

For Intelligent Mode

- In ATTI. / GPS Mode, it has landing judgment, which will stop motors.

- Start motors in ATTI. / GPS Mode, you have to execute CSC and then push throttle stick over 10% in 3 seconds, otherwise motors will stop after 3 seconds.
- During normal flight, only pull throttle stick under 10% will not stop motors in any control mode.
- For safety reason, when the slope angle of multi-rotor is over 70° during the flight in ATTI. / GPS Mode (may be caused by collision, motor and ESC error or propeller broken down), and throttle stick is under 10%, motors will stop automatically.

For Both Intelligent Mode & Immediately Mode

- If you choose the Immediately Mode, you SHOULD NOT pull throttle stick under 10% during flight, because it will stop motors. If you do it accidentally, you should push the throttle stick over 10% in 5s to re-start motors
- When transmitter commands are valid under any control modes, the motors will start or stop immediately when you execute CSC. It has nothing to do with the current throttle stick position. Please DO NOT executes CSC during flight without a good reason.

- If you choose Intelligent, throttle stick under 10% will trigger landing judgment in any control mode. In this judgment, pitch, roll and yaw controls are denied except throttle, but multi-rotor will still auto level.
- In any control mode, DO NOT pull throttle stick under 10% during normal flight without any reason.

- The two cut off types will only work correctly if the transmitter calibration is correct.
- In failed-safe, CSC is denied by the main controller, motors will hold their state.

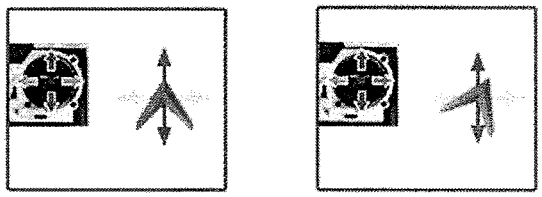
A3 Intelligent Orientation Control (IOC) Flight (with GPS module)

Definition of Forward Direction: Multi -rotor will fly along this direction when you push the elevator stick.

Graphic Description: ➡Forward direction Step1 Before You Start

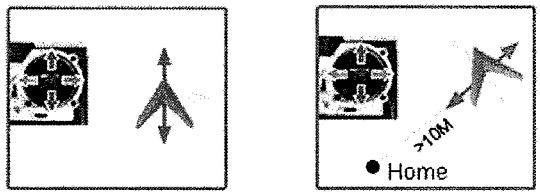
Usually, the forward direction of a flying multi-rotor is the same as the nose direction. By using IOC, wherever the nose points, the forward direction has nothing to do with nose direction. The red and blue arrows on the transmitter are corresponding to pitch and roll operations in the following diagram.

- In course lock flying, the forward direction is the same as a recorded nose direction.
- All the following requirements are met: the autopilot system is in ATTI. Mode or GPS Mode.



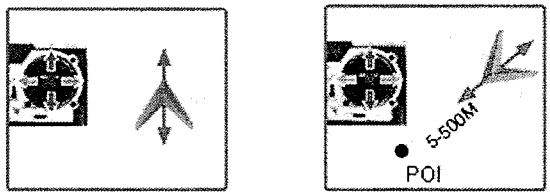
Normal flying Course Lock Flying

- In home lock flying, the forward direction is the same as the direction from home point to multi-rotor.
- All the following requirements are met: 6 or more GPS satellites are found, in GPS Mode, and the aircraft is further than 10m away from the home point.



Normal flying Home Lock Flying

- In POI (POI, Point Of Interest) flying, the roll channel controls the multi rotor circular flight speed around a fixed point, the pitch channel is used for controlling the diameter around the fixed point, the throttle is used to control the height around the fixed point.
- All the following requirements are met: 6 or more GPS satellites are found, in GPS Mode, and the aircraft is further than 5m (and less than 500m) away from the Point of Interest.



Normal flying POI Flying

Step2 IOC Switch Setting

Refer to the assistant software; click the "Advanced" to find the "IOC".

Before using the IOC function, you have to choose a 3-position switch on your transmitter as the IOC switch, which is also used for recording the orientation, home position or point of interest in corresponding modes. There are three IOC control mode options, and you should select one in the assistant software.

Step3 Method of Forward Direction, Home Point & POI Recording

If you use the IOC function, please be aware of the Forward Direction of Course Lock Flying, the home point of Home Lock Flying, and the Point of Interest of the POI Flying. There are two ways to record the forward direction and the home point: Manually and Automatically. You may choose any one record method.

> The above table is for example. The function of the switch position may be reversed since the normal/reversed setting of the switch channel. Toggle the switch and observe the slider position of channel X2 on the assistant software screen, the corresponding area should turn blue.

Switc Option	 Posit1	 Posit2	 Posit3
Control	OF	Course	Home
Control	OF	Course	PO
Control	OF	PO	Home

If the IOC switch is set as the above table; you can do the manual recording according to the following table.

	Manually
Course Lock	Control 1 : Toggle the switch from Positon-1 to Positon-2, and back to Positon-1 quickly 3 to 5 times. Control 2 : The same as above.
Home Lock	Before takeoff and after 6 or more GPS satellites have been found. Control 1 : Toggle the switch from Positon-2 to Positon-3, and back to Positon-2 quickly 3 to 5 times Control 3 : The same as above.
POI	Before takeoff and after 6 or more GPS satellites have been found. Control 2 : Toggle the switch from Positon-2 to Positon-3, and back to Positon-2 quickly 3 to 5 times. Control 3 : Toggle the switch from Positon-1 to Positon-2, and back to Positon-1 quickly 3 to 5 times.
	Automatically
Course Lock	30 seconds after you power on the autopilot system.
Home Lock	Before takeoff, the current position of the aircraft will be saved as home point when you push the throttle stick for the first time after 6 or more GPS satellites have been found.
POI	None

!
- LED will blink GREEN ◍ quickly if Forward Direction recording is successful.
- LED will blink PURPLE ● quickly if Home Point recording is

successful.

- LED will blink CYAN ◎ quickly if POI recording is successful.
- After Home Point is recorded successfully, LED will blink ●●●●●● continually under

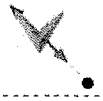
  below conditions. None of these conditions is omitted.

  1. GPS signal is well, the satellites number MC searched is more than 6.
  2. Distance between aircraft and the recorded home point is less than 8m.
  3. Current control mode is not Manual mode.
- DO NOT toggle the switch between Positon-1 to Positon-3, since it may change the recording of the Positon-2.

Step4 IOC Flying Test

Then you can do Course Lock, Home Lock, and POI flying test

Carry out an IOC flight by the following procedure. The Control Mode LED will blink GREEN to indicate the IOC mode only when the main controller is really to fly in Course Lock, Home Lock modes or POI.

During the same flight	STEP1: Record	STEP2: ON	STEP3: OFF	STEP4: ON again
Course Lock				
Switch Setting	Record the forward direction	Set Control Mode switch at GPS or ATTI. position, Toggle IOC switch from OFF to Course Lock position	Toggle IOC switch to OFF position	Toggle IOC switch from OFF to Course Lock position
Home Lock				
Switch Setting	Record the home point	Set Control Mode switch at GPS position, Toggle IOC switch from OFF to Home Lock position	Toggle IOC switch to OFF position	Toggle IOC switch from OFF to Home Lock position
POI				
Switch Setting	Record the POI	Set Control Mode switch at GPS position,	Toggle IOC switch to OFF position	Toggle IOC switch from OFF to POI position

		Toggle IOC switch from OFF		
		to POI position		

→ Aircraft moving direction when pull pitch stick ⇢ Aircraft moving direction when pull roll stick

- Home point ➢ Aircraft (the arrow is pointing to the direction of the aircraft nose)

IOC FLYING NOTES ! ! !

⊘	When Multi-rotor is flying by home lock far away from you and the home point, please DO NOT toggle the IOC switch many times quickly so as to avoid the change of home point without your attention.
!	• Home lock flying requires that 6 or more GPS satellites are found and the aircraft is further than 10m away from the home point. • In POI flying, avoid using POI in areas where the GPS signal might be lost or the transmitter /receiver signal might be lost (such as built up urban areas), to make sure 6 or more GPS satellites are found. And the multi-rotor is required to fly further than 5m (and less than 500m) away from the Point of Interest. • Continuously spinning will cause a yaw error. In this case, you can stop or slow down the spinning, so as to have better flight performance. • If the IOC flying requirement is not satisfied, the autopilot system will quit IOC control mode. Please be aware of the LED indicator, to know the current control mode of the autopilot system.
	• Before you do the home lock flight, you have to fly the aircraft out of the 10m range around home point, and then flip the IOC switch to Home Lock position to fly in home lock when all the requirements are met. If you have already toggled the IOC switch to Home Lock position when the aircraft is still in 10m range around home point, and this is the first time you are going to fly in home lock during the current flight, then if all the requirements are met, the main controller will change into home lock automatically when Multi-rotor flies out the 10m range around home point.. • When you are flying in home lock mode, if the aircraft is back into the 10m range around home point, or you switch into ATTI. Mode, or the GPS signal becomes weak, the autopilot system will fly in course lock by the current forward direction automatically. But this forward direction is NOT the recorded forward direction. If you open the course lock now, it will fly in course lock still by the earlier recorded forward direction.

- We suggest that you should know clearly that, by which lock method you are going to fly, and the locked forward direction or home point, before you switch on IOC mode during the flight.

- Refer to the LED Description in the Appendix for more details.

A4 FailSafe

FailSafe methods include Hover, Go-home, and Altitude Go-home. Choose one as your failsafe method, which will be triggered when the MC loses the control signal in one of the following situations:

1) Signal lost between transmitter and receiver, e.g. multi-rotor is out of the communication range, or transmitter has failed, etc.
2) One or more connections of A, E, T, R, U channels between the MC and receiver is lost. If this happens before take-off, the motors will not start if you raise the throttle stick. If this happens during the flight, the LED will flash blue to warn you, in addition to the fail-safe method. If Hovering fail-safe method is configured and U channel is disconnected, multi-rotor will auto land.

Also, you can select the Go-Home Switch item to start go-home (Go-home, and Altitude Go-home) by using a TX switch during the flight, when selected during flight the LED will flash purple instead of blue.

The multi-rotor position before takeoff, including reference longitude, reference latitude and reference altitude, is saved as home point by the MC automatically when you raise the throttle stick for the first time AND it has 6 or more GPS satellites acquired for more than 8 seconds (blinks once or no blinking >8secs)

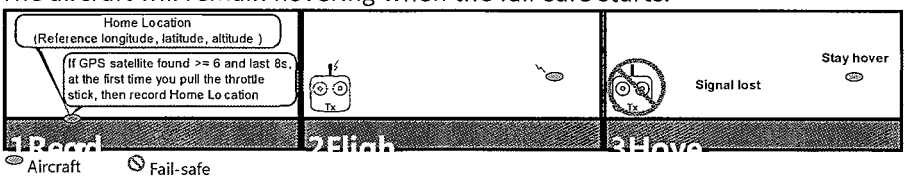
After taking off, every time the aircraft recorded a home-point successfully the LED will blink Cyan quickly for indicating.

THEREFORE: to use any form of Go-home (including failsafe return home), you must make sure 6 or more GPS satellites are acquired for more than 8 seconds (blinks once or no blinking >8secs) before take-off, this will assure correct recording of the Home position.

Go-Home Altitude: Determined by the reference altitude and the FailSafe method chosen. That is, the go-home altitude may be different due to fail-safe method chosen.

- Hover

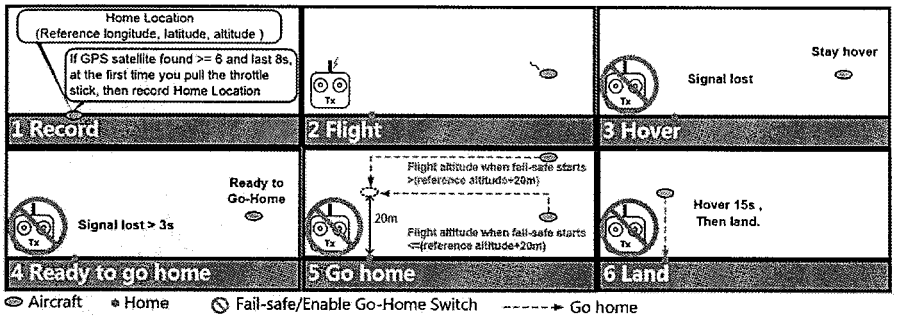
The aircraft will remain hovering when the fail-safe starts.



● Go-H (Go-home)

Flight altitude when fail-safe starts > (reference altitude+20m) , then go-home altitude = flight altitude when fail-safe starts

Flight altitude when fail-safe starts <= (reference altitude+20m) ,then go-home altitude = reference altitude +20m

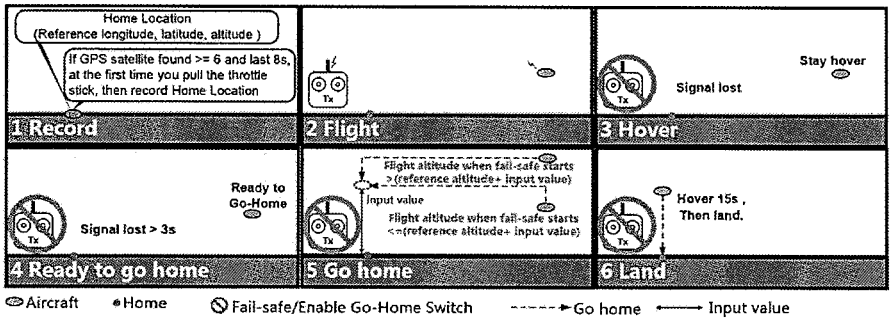


● Altitude Go-H (Altitude Go-home)

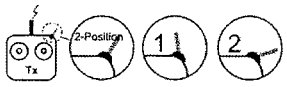
Flight altitude when fail-safe starts > (reference altitude + entered value) , then go-home altitude = flight altitude when fail-safe starts.

Flight altitude when fail-safe starts <= (reference altitude + entered value) , then go-home altitude = reference altitude + entered value.

Entered value: 20m~300m, the default value is 20m, and has an accuracy of 1m.



Go-Home Switch : Before using this function, you have to choose a 2-position switch on your transmitter as the Go-Home switch. Then connect



the correct channel of the receiver to the X3 port of the MC.

You should assign: Position-1 to Start; Position-2 to Standby; or reverse the assignment for Position-1 and Position-2. Move the Tx switch of the channel X3 and check that the corresponding area Start and Standby turns blue on the assistant software screen. If required adjust the Tx channel end points.

!
- Switching from Standby to Start will enable go-home during flight and you will no longer have flight control of the Multi rotor. If the multi-rotor is already in a failsafe condition, then the go-home switch will not work.
- If you switch to Manual Mode or Atti. Mode, (and the multi rotor is not in a fail-safe condition), then the go-home is cancelled and you regain control of the multi copter. Once GPS. Mode is re-selected you can once again use the go-home function.

- Use end-point fine tuning on your transmitter to adjust the X3 channel, to give the correct switch indication in the assistant software.
- The following example shows how to enable Go-home by the Tx Switch. Use position-1 to Start and Position-2 to Standby for example.

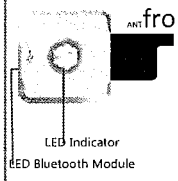
  Position -1→ Position -2→ Position -1, if the initial switch position is at Start (Position -1).

  Position -2→ Position -1, if the initial switch position is at Standby (Position -2).
- The home point of the ground station one key go-home is the same as the point set by user in the ground station software.
- If the home point is not set by the ground station, the home point of the ground station one key go-home function is the point recorded by the MC.
- If the Go-Home Switch cannot be selected in the assistant software, that may be due to the X3 channel been set for remote gain tuning, you should change this if required.

WM Assistant for Mobile Device

Step1 Assemble the LED Bluetooth Module

The LED Bluetooth Module is necessary if you are using the WM Assistant. This module is only for the iOS Device, not for android equipment. Its Operating Temperature range is from -5°C to +60°C. Please refer to the Assembly & Configuration -> Step1 Assembly to attach the module. This module has a USB interface for configuration and firmware upgrades when connecting to PC. The "LED Indicator" tells the status of autopilot system, and the "LED Bluetooth Module Status Indicator" tells whether the LED Bluetooth Module is working or not. The built-in Bluetooth is for wireless communication between the autopilot system and mobile equipment, with a maximum communication distance of 50m.



Step2 WM Assistant Installation

Please search the WM Assistant from the App Store by your iOS device, download and install it.

Step3 Parameter Configuration Procedures

1. Prepare an iOS Device that supports Bluetooth 4.0, and turn on the Bluetooth.
2. Switch on the transmitter first, power on the autopilot system. The LED Indicator blinks (.....) when self-check. After that, check the LED Bluetooth Module Status Indicator, if it is solid red on, then the LED Bluetooth Module is working normally.
3. Run the WM Assistant. The LED Indicator blinks Purple and Yellow alternately ( ) when the WM Assistant is connected to the autopilot system. Make sure your iOS device is connected to the Internet for the first time you use, to register account. And also you can login with the PC assistant account.
4. Run the WM Assistant. Set up the name and password for autopilot system according to the App start.
5. Observe the indicators on the left bottom of the software. (connecti communication indicator) On the WM Assistant, if the communication indicator is , please double check the connections and driver installation; otherwise if the indicator is blinking , go to next step.
6. Select the "Basic" option. Please follow step-by-step for your first-time-configuration. Basic configuration is necessary. Click the icon to get the configuration details.
7. You can click the "Advanced" option for more parameter settings. Advanced setting is optional. There are Motor, Enhanced Fail-Safe, Intelligent Orientation Control (IOC), Gimbal, Low-voltage Alarm, Flight Limits, etc.
8. Select Viewer and check all parameters.
9. Select "More" to obtain more details. Including: (Parameter)Import-Export, Restore Factory Settings, Account, Main Controller List, Information(including Hardware ID, IMU, Loader, Firmware, SN and Functions Activation Status), Rate WM Assistant, Feedback, About(Help Document, Disclaimer)

! If the LED Bluetooth Module Status Indicator does not be solid red on, then the LED Bluetooth Module works abnormally. There are following situations:

(1) The main controller firmware version is not matched, please upgrade the main controller.

(2) There is something wrong with the connection between the LED Bluetooth module and main controller, please check the connection.

(3) The LED Bluetooth module is damaged, please contact your dealer.

iOS Device List iPhone 4s, iPhone 5, iPod touch 5, iPad mini, iPad 3, iPad 4

Refer to the WM Assistant for more details.

The gain value displayed on Mobile Device and PC may be a little different, that is OK for use.

Step4 Flying Test Procedures

1. Get the aircraft ready, run the WM Assistant and make sure it is connected with the main controller. (The indicators on the WM Assistant are ○◉)
2. Start the motors.
3. The "View" page shows the relative parameters real-time when flying.
4. Go to the "Basic" and click into the "Gain" page to set the values of all gains real-time during flying.
5. Go to the "Advanced" and click into the "Gimbal" page to configure the gimbal real-time during flying.
6. Finish the flying and land your aircraft.

⚠ Only the parameter referred above can be changed during flying. Others can be configured after landing.

Forgot Main Controller Password

When connecting to the WooKong M flight control system to the WM Assistant using a mobile device for the first time, users will be asked to set a name and password for the WooKong M main controller. If the password is forgotten, users can connect the flight control system to Assistant software on a PC and click "Reset Bluetooth Info" in the Tools page to reset username and password. Once complete, set a new username and password as before.

How to Activate More Functions

In the Future you might be asked to fill in the new S/N in the future if you brought new function upgrades. Fill-in the S/N and then click Write button. If you filled in an invalid S/N over 30 times, your MC will be locked and you have to contact our customer support.

Appendix

Firmware & Assistant Software Upgrade

Please follow the procedure for software and firmware upgrade; otherwise the autopilot system might not work properly. For SAFETY REASONS, DO NOT use power battery during firmware upgrade.

1. Make sure your computer is connected to the Internet.
2. Please close all the other applications during the firmware upgrade, including anti-virus software and firewall.
3. Make sure the power supply is securely connected. DO NOT un-plug the power supply until firmware upgrade has finished.
4. Connect autopilot system to PC with USB cable, DO NOT break connection until firmware upgrade is finished.
5. Run Software and wait for connection.
6. Select Info→Software and Firmware.

7. DJI server will check your current software and firmware version, and get the latest software and firmware prepared for the unit.
8. If there is a software version more up-to-date than your current version, you will be able to click to download the new version. Please re-install the assistant software follow the prompts
9. If there is a firmware version more up-to-date than your current version, you will be able to click to update them.
10. Wait until Assistant software shows "finished".
11. Click OK and power cycle the unit after at least 5 seconds. Your unit is now up-to-date.

- After firmware upgrade, please re-configure the system using Assistant software.
- If the firmware upgrade failed, the autopilot system will enter waiting for firmware upgrade status automatically, please try again with the above procedures.

Port Description

Please remember the function of each port, which may help you to use the autopilot system efficiently.

Main Controller

A For roll control (left/right)

E For pitch control (front/back)

T For throttle control Or to gimbal roll servo

R For rudder control Or to gimbal pitch servo

U For Control Mode Switch

X1 For voltage monitor (Connect with PMU V-SEN port)

X2 For D-Bus (S-Bus/S-Bus2 compatible) Or for gain tuning Or for IOC switch

X3 For gimbal pitch control Or for gain tuning Or for switch go-home

M6 To #6 rotor

To #5 rotor

M4 To #4 rotor

To #3 rotor

M2 To #2 rotor

To #1 rotor

E2 To gimbal pitch servo Or to #8 rotor

E1 To gimbal roll servo Or to #7 rotor

Micro-B USB port: PC connection for configuration and firmware upgrades.

CAN-Bus port: MC uses CAN-Bus to power and communicate with other WKM modules.

(In three-pin ports, pins near the nicks are signal pins.)

Power Management Unit

V-SEN For monitoring battery voltage and supplying power to receiver and oth

(Connect with MC X1 port)

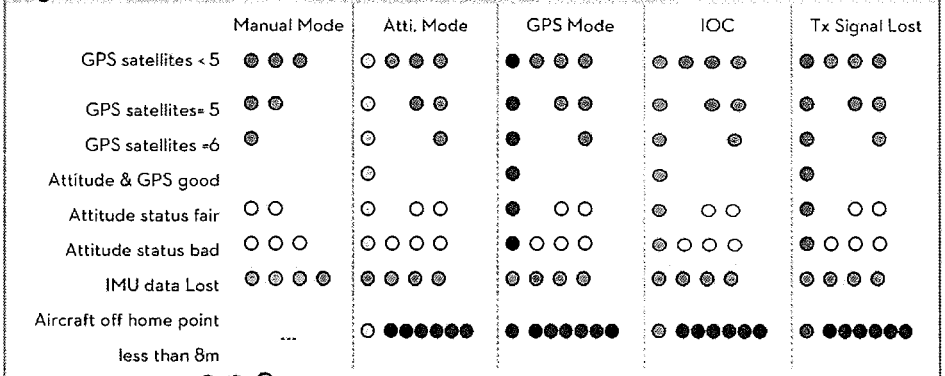
- Orange wire (signal wire) output: 0V ~ + 3.3V
- Red wire (power wire) output: 3A@5V

PW For supplying power to WKM system.

- Output: Max 2A@6V

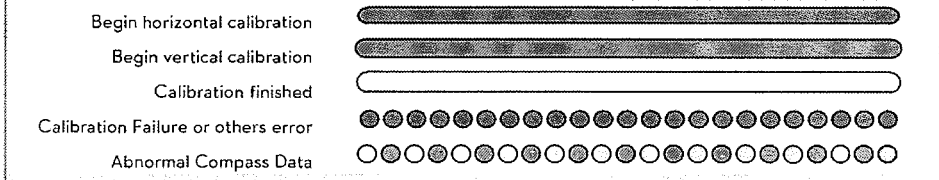
LED Description

Flight States

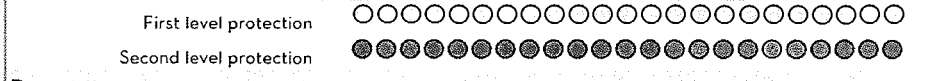


Flashing indications of ○, ●, ◎ are: Single flash, all the transmitter sticks are at center position, multi rotor hovering; Double flash, transmitter stick(s) not at center position, speed command is not zero.

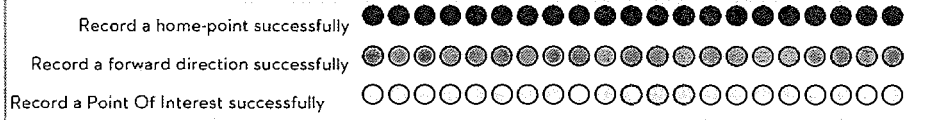
Compass Calibration and Abnormal Data Indicator



Low Voltage Warning



Recording



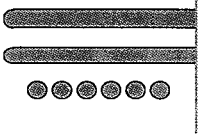
WM Assistant Connection Indicator

Main Controller LED

MC is functioning correctly.

Boot loader mode, MC is waiting for firmware upgrade.

Firmware upgrade has finished. MC is waiting for reboot.



Error occurred during firmware upgrade, MC reboot is required. or

PMU LED

PMU connection is correct.

Connection between PMU and battery is wrong (polarity error).

Specifications

General	
Built-In Functions	● Three Modes Autopilot ● S-Bus/S-Bus2 Receiver Supported ▯ PPM Receiver Supported ● Intelligent Orientation Control ▯ 2-axle Gimbal Support ● Multi Output Frequency Supported ▯ Enhanced Fail Safe ● Low Voltage Protection
Peripheral	
Supported Multi-rotor	● Quad-rotor: I4, X4; ● Hexa-rotor: I6, V6, Y6, IY6; ● Octo-rotor: X8, I8, V8.
Supported ESC output	400Hz refresh frequency.
Recommended Transmitter	Only PCM or 2.4GHz with minimum 7 channels and fail-safe function available on all channels.
Recommended Battery	2S ~ 6S LiPo
Assistant Software System Requirement	Windows XP SP3 / 7 /8
Electrical & Mechanical	
Power Consumption	MAX 5W (0.9A@5V, 0.7A@5.8V, 0.5A@7.4V, 0.4A@8V)
Operating Temperature	-5°C to +60°C
Total Weight	<= 118g (overall)
Dimensions	● MC: 51.2mm x 38.0mm x 15.3mm ▯ IMU: 41.4mm x 31.1mm x 27.8mm ▯ GPS & Compass: 50mm (diameter) x 9mm ▯ LED Indicator: 25mm x 25mm x 7mm ▯ PMU: 39.5mm×27.5mm×9.7mm
Flight Performance (can be effected by mechanical performance and payloads)	
Hovering Accuracy (GPS Mode)	● Vertical: ± 0.5m ● Horizontal: ± 2m
Maximum Wind Resistance	<8m/s (17.9mph / 28.8km/h)
Max Yaw Angular Velocity	150deg/s
Max Tilt Angle	35°

Ascent / Descent	±6m/s

FAQ

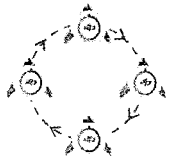
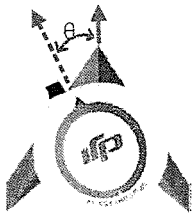
Fix the TBE (Toilet Bowl Effect) Problem

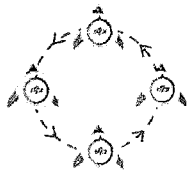
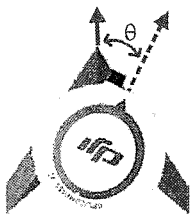
When flying in GPS Mode and the compass calibration has been done correctly, should you find the aircraft rotating (Toilet bowl effect), or drifting when hovering. Please check the GPS module mounting orientation and then re-do the compass calibration. Carry out the following procedure to re-mount the GPS module.

In the following diagram (view from the top), the aircraft can appear to be rotating in both clockwise and counter-clockwise direction, please re-mount the GPS module correspondingly.

 is the rotating direction of aircraft,  is the nose direction of aircraft,

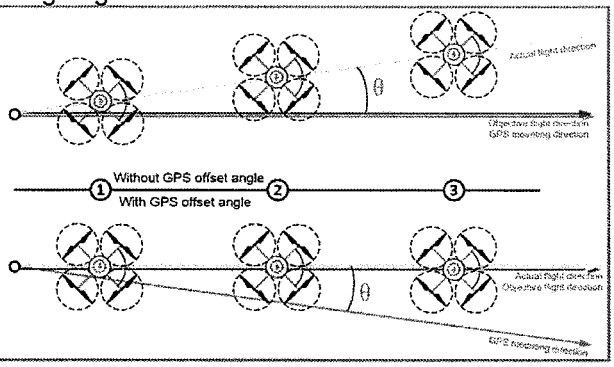
 is the arrow direction on the GPS module, θ is the offset angle for GPS re-mounting(about 10~30°)

Clockwise rotating	GPS re-mounting
	

Counter Clockwise rotating	GPS re-mounting
	

Reinstall the GPS in an Offsetting Angle

Should you find the multi-rotor does not track straight in forward flight, you might try re-mounting GPS in an offsetting angle as showed in right figure. Θ in the figure is the offsetting angle.



Attitude Controllable When One Motor Output is Failed

For Hexa-rotor, including Hexa-rotor I, Hexa-rotor V, Hexa-rotor IY and Hexa-rotor Y, aircraft is attitude controllable when one motor output is failed.

The WKM can still control the attitude of the Hexa-rotor for a safe landing when one motor output of the Hexa-rotor has failed, for example, one motor is stopped or one propeller is broken, etc.

The control mode of WKM should be in Atti. Mode or GPS Mode. The aircraft will rotate, due to an imbalance of torque; however, it can still be controlled by the Transmitter.

Select Course lock or home lock mode for flying the aircraft into a safe area to land when the aircraft is far away or the attitude can't be recognized. Even when the multi rotor is rotating, using Course lock or home lock mode will allow you to move the multi rotor in the corresponding Transmitter stick direction.

Flight Restriction in Specified Area Description

Flight Functions are restricted within the radius of 15Km from Tiananmen Square in Beijing, China.

In the restricted area, with GPS/Compass Module and GPS signal is good, you cannot take off the aircraft in any Control Mode.

In the restricted area, with GPS/Compass Module and GPS signal is bad, you can take off the aircraft, once the

GPS signal becomes good, you can only control the aircraft to land. Manual Mode is free form restriction.

Fly into the restricted area, you can only control the aircraft to land. Manual Mode is free form restriction.

Abnormal Cases in Motor Test

Below are abnormal cases and solutions for Motor Test in the Assistant software

(1) Tested motor does not rotate, there are two situations:

a) Connection issues: please check the connections first, such as whether MC and motors are power on, whether connection between MC and ESC is well, whether three cables of ESC are correctly connected to motor. If connections are well, then check whether motors or ESC are breakdown.

b) Please increase the Motor Idle Speed in the Advanced page of Assistant software.

(2) Tested motor rotates in wrong direction: please swap over any two wire connections of the motor.

(3) Rotating motor is not the tested motor (e.g. M2 motor rotates when click button"M1"): please ensure the cable of ESC is correct connected to the right port of MC.

Solution for LED yellow and green blinking

LED blinks yellow and green () alternatively means compass errors or interferences:

(1)Long time : in this case compass calibration is required.

(2)Temporary : e.g. LED blinks several times when the aircraft flying over some district and then no blinks; or take an calibrated aircraft from outside to inside of house, the may appear inside. In these cases the compass is ok and has no influences to flight. Compass calibration is not required.

When compass data become abnormal (LED blinks yellow and green) during flying, for safety reasons, the autopilot system will auto change the control mode. However in ATTI. and Manual Mode is free from influence. In any other control mode, the autopilot system will enter into ATTI. Mode automatically (the mode shown on status bar will be "Atti." if you connect the autopilot to the assistant software). Once the compass data go back to normal, the autopilot system will regain the original control mode.

Solutions for failed gain value adjustment in the Assistant software

If you fail to adjust the gain value in the Assistant software, please check the follow items to solve the problem.

(1) Make sure the MC has connected and communicated with the Assistant software successfully.

(2)Make sure the Receiver has connected to the MC successfully.

(3)Make sure you have selected the correct Receiver type in the Assistant software, and then you can try to adjust the gain value again.

CE Statement

Due to the used enclosure material, the devices shall only be connected to a USB.

Interface of version 2.0 or higher. The connection to so called power USB is prohibited.

Hereby, SZ DJI TECHNOLOGY CO. LTD declares that this device is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.

CE 0700

FCC Statement：

This equipment complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

NOTE: The manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications or changes to this equipment. Such modifications or changes could void the user's authority to operate the equipment.

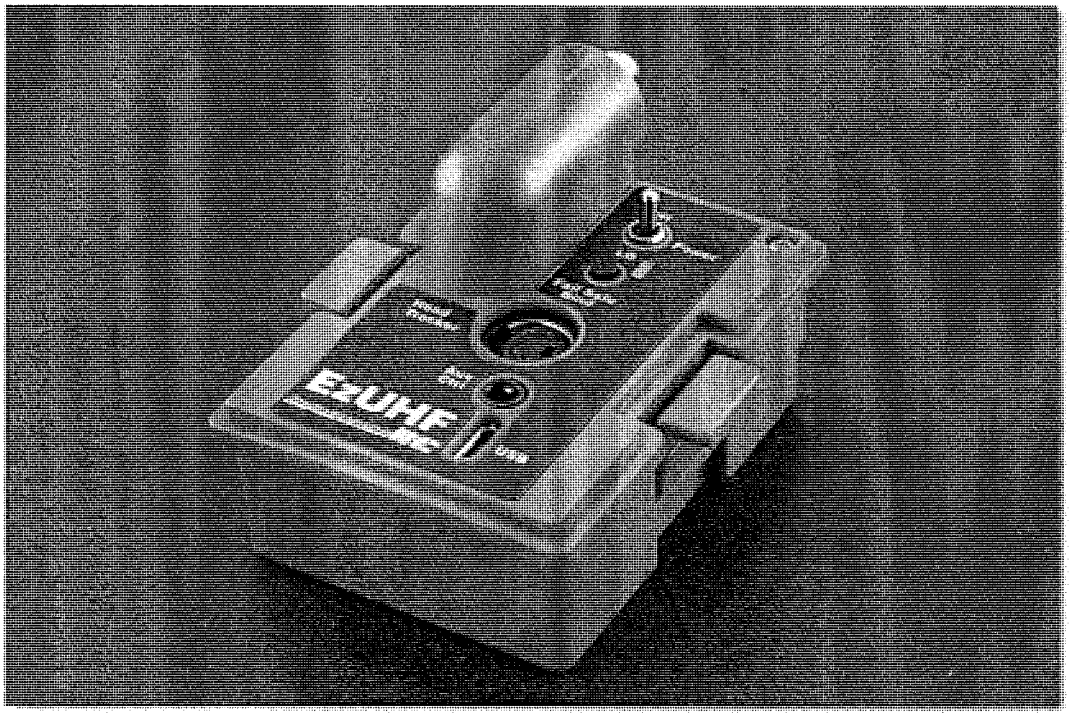
NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
-Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
-Consult the dealer or an experienced radio/TV technician for help.

G.JR Module

EzUHF JR Module Manual Supplement

January 2014



Introduction

Congratulations on your purchase of an ImmersionRC EzUHF 'JR' module transmitter.

This manual is a supplement to the general **EzUHF Control System, Overview & Operating Instructions** manual, which may be downloaded from the ImmersionRC Website, and gives more general information on the EzUHF system.

This module-based transmitter has a similar feature set to the standard 500mW EzUHF Transmitter, but with a more convenient form-factor, and much simpler cabling.

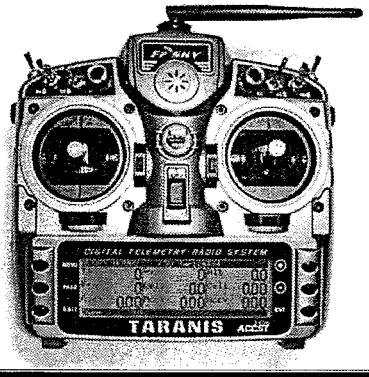
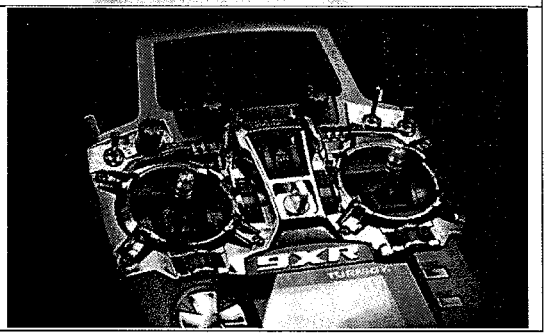
Specifications

Output Power	500mW (high), 200mW (low)
DC Power Input	6v – 13v
Current Consumption	250mA @ 12V in high power mode, 85mA @ 12V in low power
Head-tracker Power	Same as input voltage
Channel Count	Currently 12 Max. (16 planned)
Antenna Connector	Standard-Polarity SMA
Frequency Range	430MHz -> 440MHz, with a UK (459MHz option)
Frequency Bands	431-433, 433-435, 435-437, 436-438, 430-430 EH[1]
Spread Spectrum	FHSS, 20 slots from a possible 40, PRBS sequence

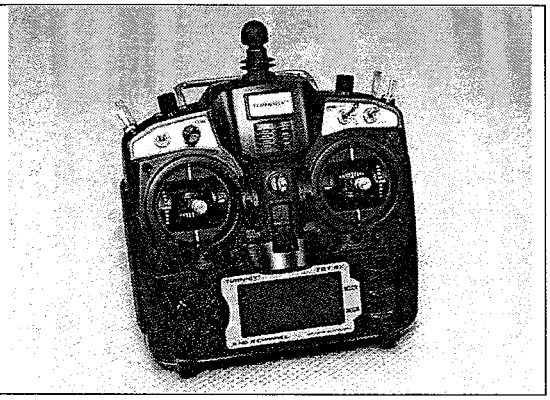
[1] EH = Extreme Hopping, more robust operation due to a 20MHz hopping range, instead of 2MHz.

Compatibility

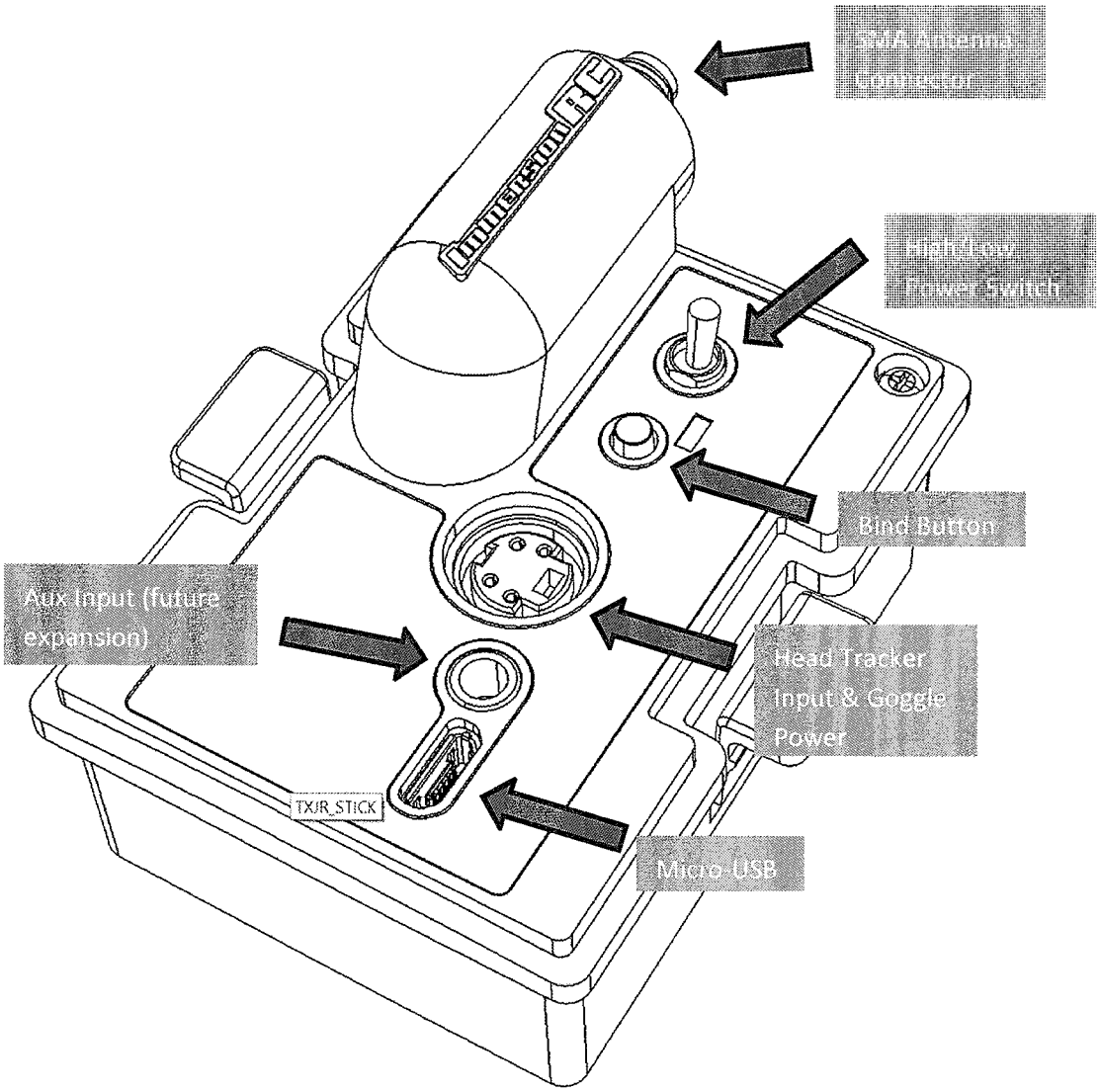
The EzUHF JR module is 'plug and play' compatible with the following radios:

Manufacturer	Model/Notes	Photo
FrSky	Taranis	
Turnigy	9xR	

The following radios can be made compatible after a simple modification procedure

Turnigy	9X Plastic part in the module bay needs removing in order to support the EzUHF JR module	

Connectors & Controls



Details of the Head Tracker connector pin-out may be found in the main EzUHF manual, mentioned earlier in this document.

Firmware Upgrade

As with all EzUHF equipment, it is important that compatible firmware is installed on both the transmitter, and the receiver.

The EzUHF JR module requires, at minimum, firmware version v1.48b. Receivers should be upgraded to v1.48, freely downloaded from the ImmersionRC.com website.

Note: A small batch of transmitter modules shipped with v1.48a, these should be upgraded to v1.48b before use.

To upgrade the firmware on the JR module, follow the below procedure:

1. Install the latest revision of ImmersionRC Tools on your Windows based PC
2. Remove the module from the radio
3. Switch the High/Low Power Switch to LO power mode
4. Hold down the failsafe/bind button, and connect the radio to a PC
5. Select the 'EzUHF: Tx, 500mW, 2W, JR' module from the list on the left
6. the 'Program' tab, and select 'Upgrade Firmware'
7. Select the upgrade file 'EzUHFFirmware_TxJRModule.fw', and follow the prompts.

Settings

There are several settings which may be set while the EzUHF JR Transmitter is connected to the PC.

These include:

Frequency Band

The EzUHF system hops over many frequencies within a pre-set band. Each set of stick positions sent to the model are sent on a different frequency, following a pseudo-random sequence. The default band is 433-435MHz as the units are shipped.

It is important that the band matches between the Transmitter and Receiver.

Band selections available are:

431-433MHz
433-435MHz
435-437MHz
436-438MHz
430-450MHz Extreme Hopping

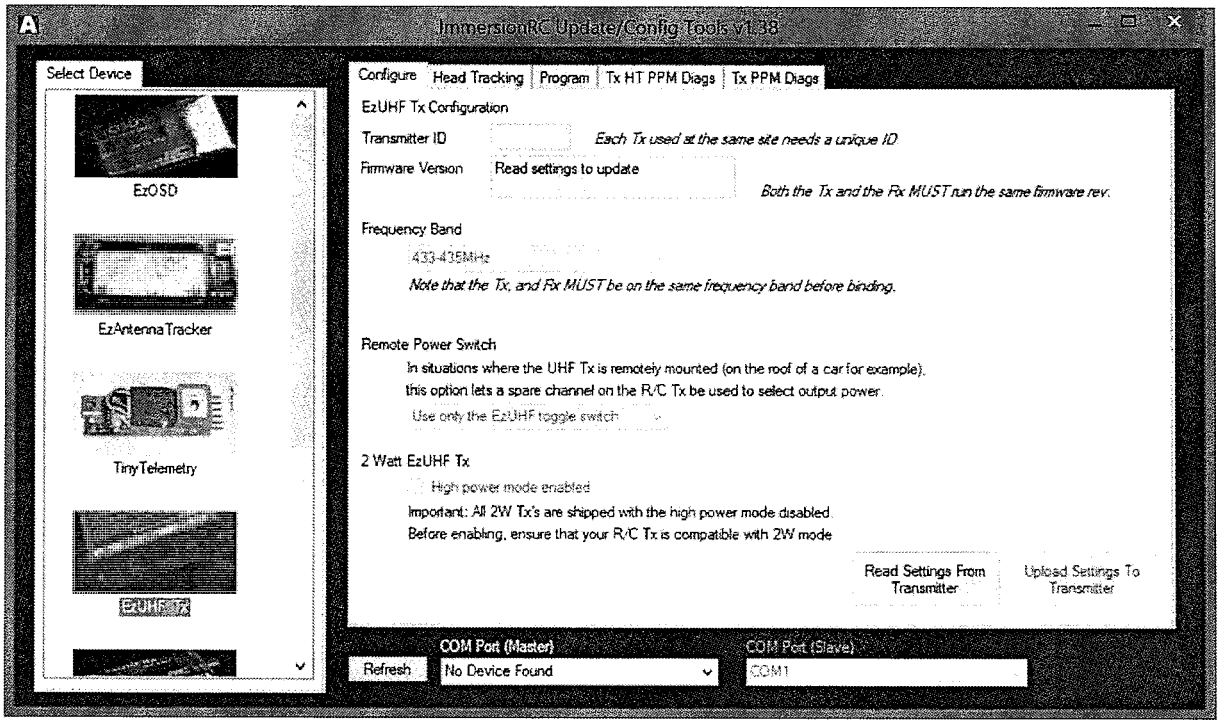
The UK version of the firmware doesn't have the frequency band selection, and will default to the hopping range legal within the UK, around 459MHz.

Typically, the band does not need to be changed from its default setting. Examples of when it should be changed are:
- When flying with other LRS users, to avoid the frequency band used by them
- When flying in RF-polluted areas, with strong interfering transmitters

Remote Power Switch

The Remote Power Switch allows a channel from the R/C transmitter to be used to change the output power level of the EzUHF transmitter.

Not commonly used, it is best left at its default setting, which uses the power switch on the back of the module to change between the two power levels.



Head Tracking

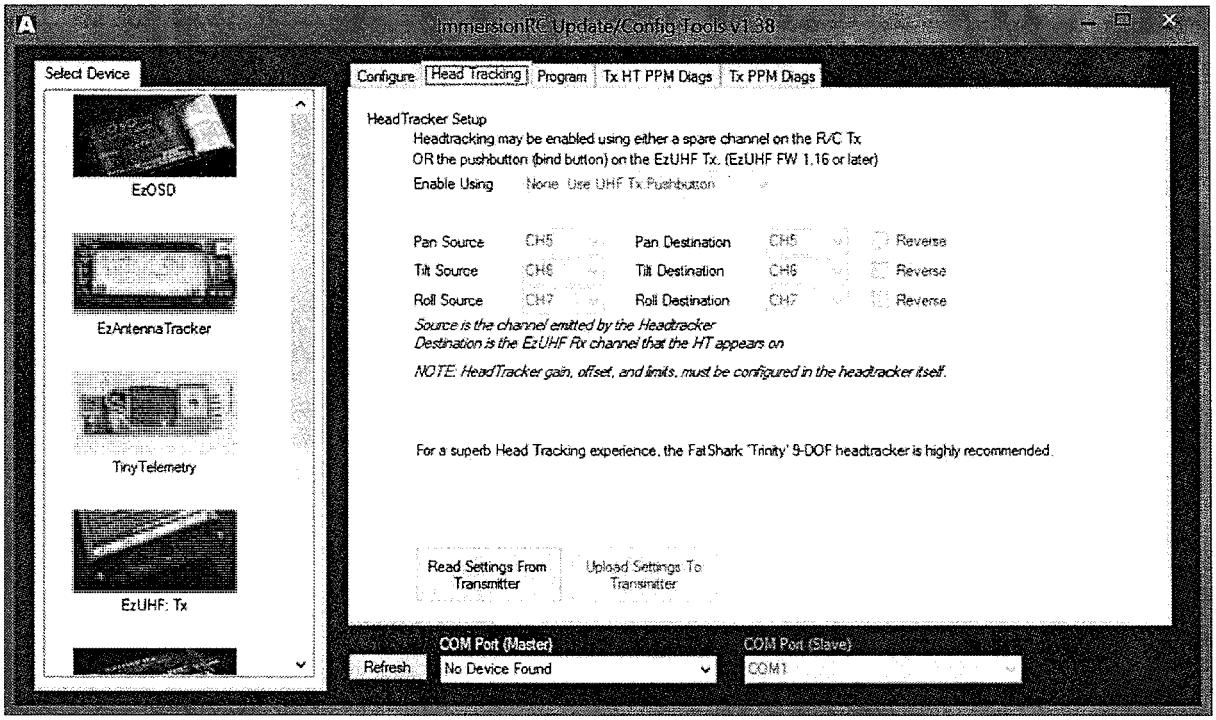
There are various settings which define the behavior of the head tracking support.

These allow mapping of source channels (channels on which the headtracker emits the pan/tilt/roll controls), and the destination channels (channels which are sent to the EzUHF Rx).

A switch also allows the headtracker to be optionally enabled/disabled with the bind button on the module.

The head-tracker port may also be used to power a set of FatShark goggles, eliminating the need for a separate battery.

Note that the FatShark 'Trinity' head tracker is highly recommended for use with the EzUHF system. This is really a best-in-class headtracker which uses sensors with 9 degrees of freedom, and absolutely zero drift.



Binding

Once the firmware revisions of the Tx and Rx have been verified, and upgrades performed, the transmitter may be bound to an EzUHF receiver.

To start the binding process, switch the power switch on the EzUHF JR module to Low power, while the radio is turned off.

Hold down the binding button, and turn on the radio. Keep the button held down until the radio starts beeping periodically. This indicates that the Tx is in bind mode.

Power up the receiver, and press the bind button on the receiver. The LED on the receiver will go out while binding is in progress, but then, assuming binding is successful, the LED will start 'breathing' indicating a successful bind.

A failed binding is indicated by 6 flashes of the LED on the Rx. If this occurs, ensure that the firmware versions match between Tx and Rx, and also ensure that the frequency band band matches.

Once bound successfully, cycle power to both the transmitter, and receiver, and ensure that the LED on the Rx is still 'breathing'.

Tip: We often get asked why the LED 'breathes' like this. Basically, an LED which fades on and off by varying the duty cycle is a better indicator of reception quality than a simple on/off LED. While range testing for example, signal quality can be

estimated by looking at 'stuttering' in the LED's fading.

Error/Beep Codes

When the EzUHF JR module detects a problem, it will beep in a sequence of long, and short beeps, which will indicate what is wrong.

_ .	Transmitter internal error, return for service (Xtal)
_ . .	Transmitter internal error, return for service (TxOvfl)
_ . . .	Detected PCM as opposed to PPM, change R/C Tx Mode to PPM
_	PPM not detected at power-up (Tx connected to HT input?)
. . .	PPM Timeout, connection problem between R/C Tx and EzUHF

Common problems are _ . . . which indicates that the R/C Tx is in PCM mode, instead of PPM. The EzUHF (and all other equivalent systems) require PPM as input, and not PCM.

Another common problem is _ . . . . which indicates that a PPM signal was not sensed, generally indicating that the R/C Tx is not configured to emit PPM to the module bay connector.
This error may also occur if the R/C transmitter is turned on, and stuck at the 'switch error' prompt for an extended period of time. During this time, the transmitter doesn't start emitting PPM.

H. Exhibit 8: EZUHF 8 Channel Receiver

PRODUCT SPECIFICATIONS

Initial Release Date: Dec 2012
R/C Channels: Maximum of 12 PPM, 8 servo outputs (future upgrade to 16 PPM channels)
RF Impedance: 50 ohms
Modulation: GFSK
Hopping: 20 of 40 slots, 2MHz, or 20MHz frequency spread (Extreme Hopping)
Frequency Band (Std. Firmware): 431-433MHz, 433-435MHz, 435-437MHz, 436-438MHz, 430-450MHz (Extreme Hopping)
Length: 70mm
Width: 30mm
Height: 17mm
Weight: 22g
Power Requirements: 4-6v DC

I. Exhibit 9: Datalink

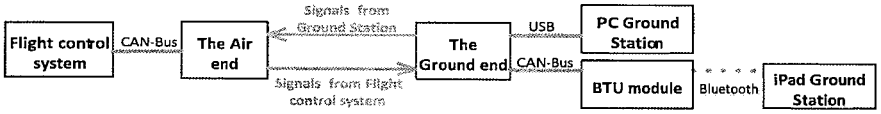
2.4G Bluetooth Datalink & iPad Ground Station User Guide V1.12

Thank you for purchasing DJI products. Please strictly follow this user guide to mount and connect the 2.4G Bluetooth Datalink, install the Assistant Software on your computer, as well as the App on your mobile device.

Note：The map of Mainland China download from Mainland China IP addresses has differences with the actual geographic environments. If users download the map of Mainland China from foreign IP addresses, which will be more accurate.

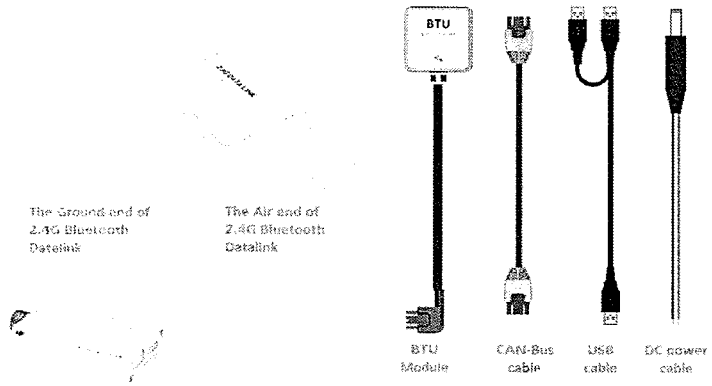
2.4G Bluetooth Datalink

The 2.4G Bluetooth Datalink consists of the Air end and the Ground end, which provides reliable and stable remote wireless transmissions for Ground Station based applications. The signal flow is as shown below.



Flight control systems that support the 2.4G Bluetooth Datalink
ACE ONE(Firmware V4.02 or above), WKM(Firmware V5.24 or above), NAZA-M, NAZA-M V2(Firmware V4.00 or above), A2(Firmware V2.0 or above)
Important: To make your Phantom 2 compatible with the 2.4G Bluetooth Datalink, please update the firmware of Phantom 2 and BTU module to the latest version.

1.1 In the box



Important：the firmware of BTU should be upgraded to version 1.0.1.2 or above to use with the 2.4G Bluetooth Datalink.

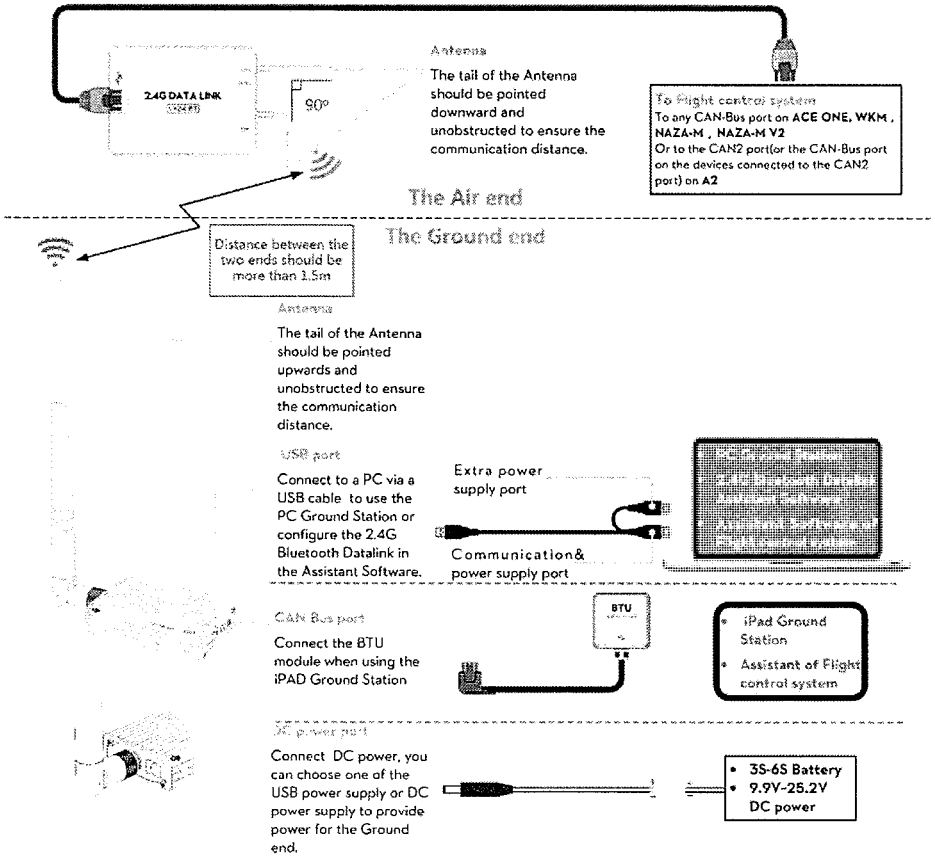
1.2 User supplied

To use the 2.4G Bluetooth Datalink and Ground Station, please prepare the Flight control system, the aircraft, batteries, PC or iPad etc.

1.3 Connections and use

(1) Please assemble the antenna of the Ground end first.

(2) For connections and use please refer to the diagram below.



Notes :

(1) You can configure the Flight control system using the Assistant software on a PC or iOS mobile Device wirelessly over the link of the 2.4G Bluetooth Datalink, however you cannot upgrade the firmware of the Flight control system using this communication route.

(2) When connecting a BTU module or a LED Bluetooth unit to the Flight control system to configure in the Assistant on mobile devices, as well as connecting a BTU module to the Ground end to use the iPad Ground station, the two Bluetooth communication links will not interfere with each other.

(3) If the Air end is changed to connect to a new Main controller, you should power cycle the Ground end.

(4) Make sure the LED indicator of BTU module is green after power on, for specific usage details please refer to the BTU Manual.

(5) For usage of the PC Ground Station please refer to the latest Ground

Station User Manual.

Important :

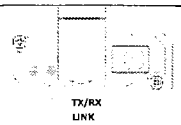
(1) If there are obstacles between the ground and air ends then the radio signal of the 2.4G Bluetooth Datalink will be weak; please make sure the antennas are always visibly unobstructed during the flight. Human body, trees, buildings or hills will disconnect the link between the Air end and the Ground end.

(2) Make sure the antenna of the Air end is pointing down, and the antenna of the Ground end is pointing upwards; it's better to put the Ground end at a high place to get further transmission distance.

(3) When using the ACE ONE Flight control system with the 2.4G Bluetooth Datalink, the Ground Station will connect to the Main controller 15s after power on.

1.4 LED Indicator descriptions

The LED Indicators of the 2.4G Bluetooth Datalink will work after power on, the descriptions are shown below.

	LED	TX/RX		LINK	
The Air end		Green blinks	Sending	Solid Green	The Air end links with the Ground end successfully
		Red blinks	Receiving	Solid Red	The Air end delinks with the Ground end
		Yellow blinks	Searching the Main controller		
The Ground end		Green blinks	Sending	Solid Green	The Air end links with the Ground end successfully
		Red blinks	Receiving	Solid Red	The Air end delinks with the Ground end

		Yellow blinks	Power voltage of the Ground end is less than 9.9V		

Notes :

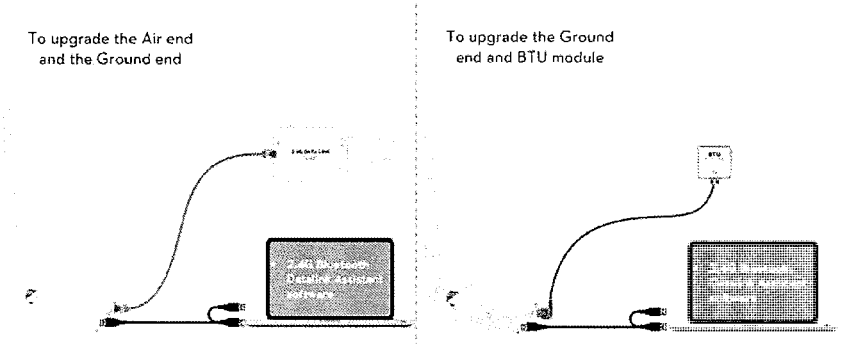
(1) LED Indicators on both ends will blink when powering on, then the TX/RX indicator of the Air end will blink when searching the Main controller.

(2) The LED Indicators of LINK on both ends should be solid green to indicate that the two ends have linked successfully.

(3) It's recommended to check the power voltage of the Ground end regularly when using batteries for power supply, in order to avoid over-discharging.

1.5 Upgrade

Use the 2.4G Bluetooth Datalink Assistant software to upgrade the 2.4G Bluetooth Datalink and BTU module. Please refer to the diagram below to connect when upgrading.



Important : POWER CYCLE the Flight control system and 2.4G Bluetooth Datalink after upgrade.

iPad Ground Station App

The iPad Ground Station is designed for remote flight control in applications of surveillance, aerial photography, etc., it should be used with the 2.4G Bluetooth Datalink to achieve auto flight after the setting of the routes. The application with easy usable design offers great portability and simple operation, which will provide users with an extraordinary flight experiences.

2.1 Introduction

Functions		
Map information display	Joystick mode	One key Take off/ Go Home
Flight display in real	Single waypoint	Auto Landing

time		
Flight simulator	Waypoints	Customized Waypoints
4 kinds of Route Template	Customized Route Template	Low voltage alert
Voice guidance function		

Flight control systems that support the iPad Ground Station
WKM(Firmware V5.24 or above), NAZA-M, NAZA-M V2(Firmware V4.00 or above) , A2(Firmware V2.0 or above).
Important: Phantom 2 supports iPad Ground Station V1.4.58. To use the iPad Ground Station with the Phantom 2, please update the main controller firmware to V2.00 or above, update the central board firmware to V1.0.1.24 or above while the BTU firmware should be updated to V1.0.1.3 or above.

iOS Devices that support the iPad Ground Station
iPad3 , iPad4 , iPad mini , iPad mini with Retina display , iPad Air (iOS 6.1 or above)

2.2 First Time Use

First time use		Tips and Notes
1. Open your iPad and search "DJI" in the App Store to download and install the Ground Station(GS) App.		
2. Open the Bluetooth function of your iPad.		There will have popups if you forget to enable the Bluetooth
3. Connect the 2.4G Bluetooth Datalink and BTU module to the Flight control system, power on.		Please refer to the Datalink part to connect
4. Run the GS App, create an account through the Internet and login.		PC account is available to login.
5. The GS will search your Main controller and named with "NEW" , you will be asked to set a new name and a password for the Main controller.		LED in GS indicates after the GS is connected with the Main controller
6. Please read the tips text carefully after login. Open the FisrtUse function to make use of the help text.		FisrtUse function can be opened and closed in "More " → "Settings "
7. Enable the Flight Simulator and try out the follow functions:		(1) Flight Simulator can be opened and closed in "More " → "Settings " (2) When using the GS the Flight control system will enter into GPS control mode and the aquired satellites shoule be more than 6. (3) In GPS control mode the GS control priorto the Transmitter, Users can toggle
Joystick	Use the sticks on the screen to control the aircraft	
Single waypoint	Edit a single waypoint and go	
Waypoints	Use the templates to set routes, ba waypoints and upload the routes, then	

	confirm and go	
Location	Use to locate the aircraft or the iPad	
Auto Landing	The aircraft will land slowly	
One key Go Home	Default Home point is the one recorded by the aircraft automatically after recording conditions are satisfied	the control mode switch to other mode and back to the GPS mode quickly to get the control by Transmitter.
8. Disable the Flight Simulator and power cycle the Flight control system to start real flights. Click on Joystick and you can use One key Take off to take off your aircraft		(1) Please view the map of fight fields via internet in the GS before outdoors flights, then the maps can be used off-line. (2) Please use the GS for real flights after you are familiar with its use and functions, Refer to all help text in the App.

2.3 Using Tips

1. Customized Route Template

   In Waypoints mode, users can set a route and click to save it as a template. Users can view all the customized route templates in the template menu, slip from right to left on a template and you can choose to detele it.

2. Capturing waypoints

   In Waypoints mode, click to capture the aircraft attitude (including longitude, latitude, height and nose pointing direction) properties to build a new waypoint during flight. This function is always available when the

   UAV is hovering or flying.

2.4 Flight Limit of Special Areas

All UAV operators should abide by all regulations from such organizations at ICAO (International Civil Aviation Organization) and per country airspace regulations. For safety reasons, key areas have been restricted, such as: a) Within the radius of 8Km from the airport.

Users will not be able to build waypoints or Home points in designated special areas and the waypoint routines go through these special areas are invalid, and the UAV will fail to cruise to those areas.

All the special areas have been restricted are specified on the DJI official website and please refer to Special Areas List (http://www.dji.com/fly-safe/category-gs) to obtain details.

Appendix

3.1 2.4G Bluetooth specifications (Deliveries passed FCC)

Performance	
RF Data Rate	1536 kbps
Indoor/Urban Range	≤ 350 m

Outdoor/RF Line-of-Sight Range	≤ 2 km
Transmit Power	≤ 125 mW
Receiver Sensitivity (1%PER)	-94 dBm
Power Consumption	The Ground end: ≤ 2.[5] W The Air end: ≤ 1.8 W

Features	
Frequency Band	2.4 G (2400 MHz ~ 2483 MHz)
Serial Data Rate	115200 bps
Antenna Options	SMA
Operating Temperature	-10°C ~ +60°C
Size (No Antenna)	The Ground end: 73 mm x 47.8 mm x 17.1 mm The Air end: 49.8 mm x 36.4 mm x 11.4 mm
Weight (with Antenna)	The Ground end: 93 g The Air end: 32 g

Power supply		
Supply Voltage	The Ground end: 9.9 V - 25.2 V	The Air end: 6 V
Current (Transmitting signal)	0.18 A @ 12.5 V	
Current (Receiving signal)	0.30 A @ 6 V	

Regulatory Approvals	
FCC (USA)	Yes

Performance	
RF Data Rate	1536 kbps
Indoor/Urban Range	≤ 200 m
Outdoor/RF Line-of-Sight Range	≤ 1.1 km
EIRP (Equivalent Isotropic Radiated Power)	≤ 100 mW
Receiver Sensitivity (1%PER)	-94 dBm
Power Consumption	The Ground end: ≤ 1.3 W The Air end: ≤ 0.9 W

Features	
Frequency Band	2.4 G (2400 MHz ~ 2483 MHz)

[5] .2 2.4G Bluetooth specifications (Deliveries passed CE)

Serial Data Rate	115200 bps
Antenna Options	SMA
Operating Temperature	-10°C ~ +60°C
Size (No Antenna)	The Ground end: 73 mm x 47.8 mm x 17.1 mm The Air end: 49.8 mm x 36.4 mm x 11.4 mm
Weight (with Antenna)	The Ground end: 93 g The Air end: 32 g

Power supply		
Supply Voltage	The Ground end: 9.9 V - 25.2 V	The Air end: 6 V
Current (Transmitting signal)	0.10 A @ 12.5 V	
Current (Receiving signal)	0.15 A @ 6 V	

Regulatory Approvals	
CE (European)	Yes

3.3 FAQ

2.4G Bluetooth Datalink Failure

The Ground Station fails to connect with the Main controller, please check the following items

- The distance between the two ends of the 2.4G Bluetooth Datalink should be more than 1.5 m.
- Make sure the Ground end is connected correctly and the LED indicator of BTU is green.

If above are ok please power cycle, while this problem continues after powering cycle, there may be hardware problems such as the Antenna is broken, please contact your authorized dealer.

Exhibit 10: iOSD

iOSD mini User Manual V1.06

Introduction

DJI iOSD mini is specially designed for DJI flight control system during the FPV flight or other aero-modeling activities. It displays real time video and OSD information, to bring users more involved flight experience.

Specified autopilot systems for the iOSD mini:

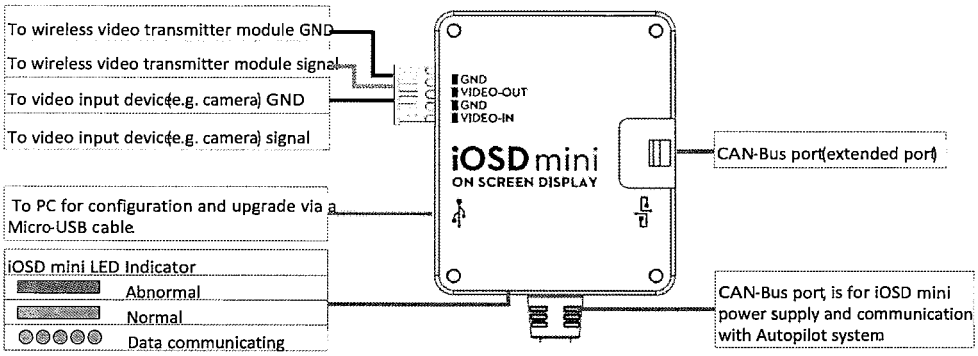
Autopilot System	Required Accessories	Firmware Version
NAZA-M series	NAZA PMU V2	4.02 or above
WooKong-M series	---	5.16 or above

Specifications

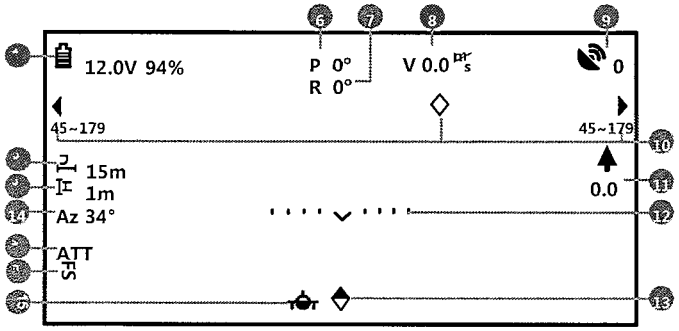
Voltage	6V	Working Current (Typical Value)	180mA@6V
Temperature	-20℃~60℃	Dimension	33.2mm x 28.2mm x 10.55mm
Weight	14g	Video Input/ Output Mode	PAL/NTSC (automatically recognize)

Assembly & Connection

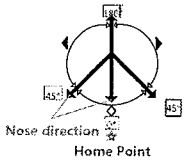
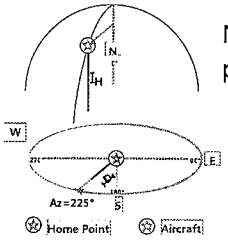
1. Prepare the iOSD mini、DJI autopilot system、video input source(e.g. camera)、wireless video transmitter module(including transmitter and receiver), monitor, and then assemble all these to aircraft.
2. Connect the iOSD mini according to the following diagram. Connect your wireless video receiver module and monitor correctly.



OSD Display Description



NO.	Function	Display	Description
1	Power voltage	blink	Real time battery voltage of the aircraft power, unit in V. (For PHANTOM 2 there will be current battery level percentage shown in addition.) Blink: first level low-voltage alert, the alert threshold is same to the protection voltage value set in the assistant software.
2	Distance between aircraft and home point	D (unit in m)	Show when the home point is successfully recorded
3	Height	H (unit in m)	Vertical height between the aircraft and the take-off point
4	Control mode	ATT, M, GPS	• ATT is Atti mode • GPS is GPS mode • M is Manual mode
5	FailSafe mode	FS, APT, GHome	• FS: FailSafe mode • APT: Ground station mode • GHome: Go home
6	Pitch attitude	P 0°	Positive value means the aircraft nose is pitching up; Negative value means the aircraft nose is pitching down.
7	Roll attitude	R 0°	Positive value means the aircraft is rolling to right. Negative value means the aircraft is rolling to left.

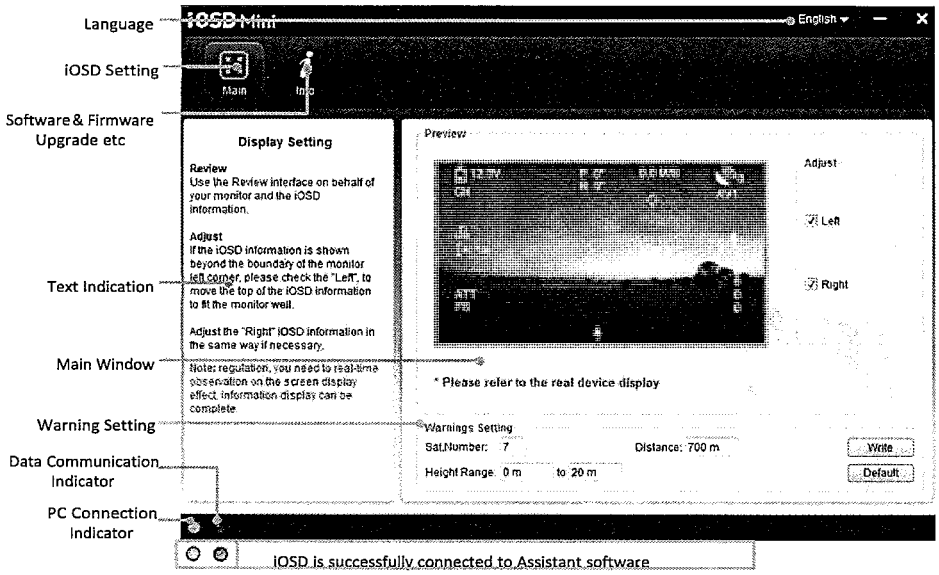
8	Flight velocity	0.0m/s	Horizontal speed of aircraft.
9	GPS satellite	0	Number of GPS satellites acquired.
10	Aircraft nose direction	◇ ◀ ▶	 Display the relative angle between the aircraft nose and home point. The aircraft nose is pointing to the home point when the icon ◇ is in the middle of monitor screen, which can help users to pull the aircraft back.
11	Vertical velocity	0.0 0.0	▲ : Upward speed in vertical direction ▼ : Downward speed in vertical direction
12	Attitude line		Use for aircraft attitude observation.
13	Compass error indicator	◆ blink	Blinking ◆ will appear when compass has errors, please calibrate your compass.
14	Azimuth angle	Az(0° ~360°)	 Azimuth angle is a horizontal angle measured clockwise from the North base line to the line goes through the home point and aircraft position. Users can locate the aircraft by calculating the aircraft position using **Az**, D, IH.
15	Airport alert	blink	Blinks when the aircraft enters a no-fly zone*. Disappears when the aircraft exits no-fly zone*.

Notes:
* For more information about the no-fly zones, visit www.dji.com and download the Phantom 2 User Manual.

Install Driver and Assistant Software

1. Please download the driver installer and assistant software from the iOSD mini page of DJI website (www.dji.com).
2. Connect the iOSD mini and the PC via a Micro-USB cable, and power on the iOSD mini system.
3. Run the driver installer, and follow the tips to finish installation.
4. Run the assistant software installer, and follow the tips to finish installation.

Assistant Software Usage



Trouble Shooting

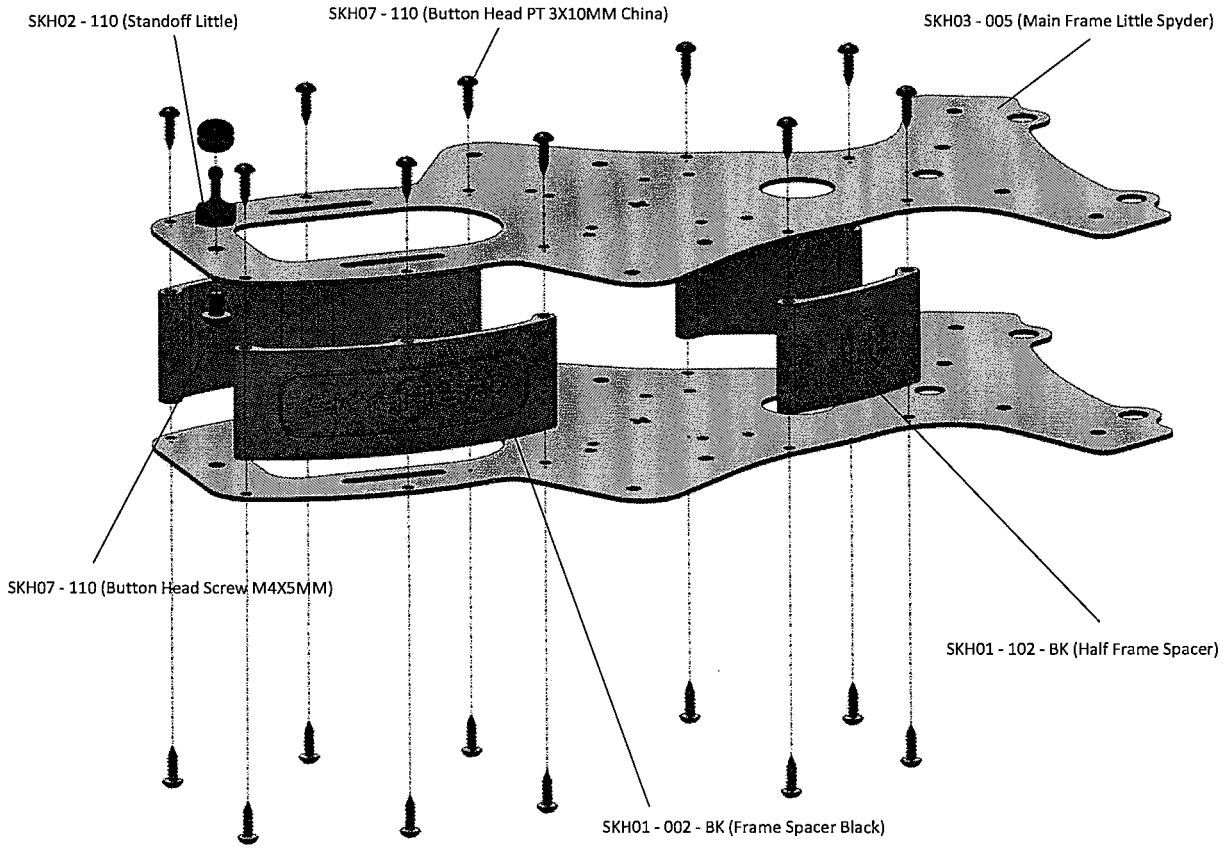
NO.	What	Why	How to
1	Only OSD information, video signal loss.	Video input error.	Ensure the connection between iOSD mini and video input port is OK.
2	Only video signal, OSD information loss.	Connection between iOSD mini and autopilot system error.	Ensure the connection between iOSD and DJI autopilot system is OK.
3	Both video signal and OSD information loss.	Signal transmission error.	Ensure the communication between the video transmitter and receiver is working correctly.
4	Both video signal and OSD information loss.	The video signal cable to monitor is unconnected or short circuit.	Ensure the connection of video signal cable is OK.

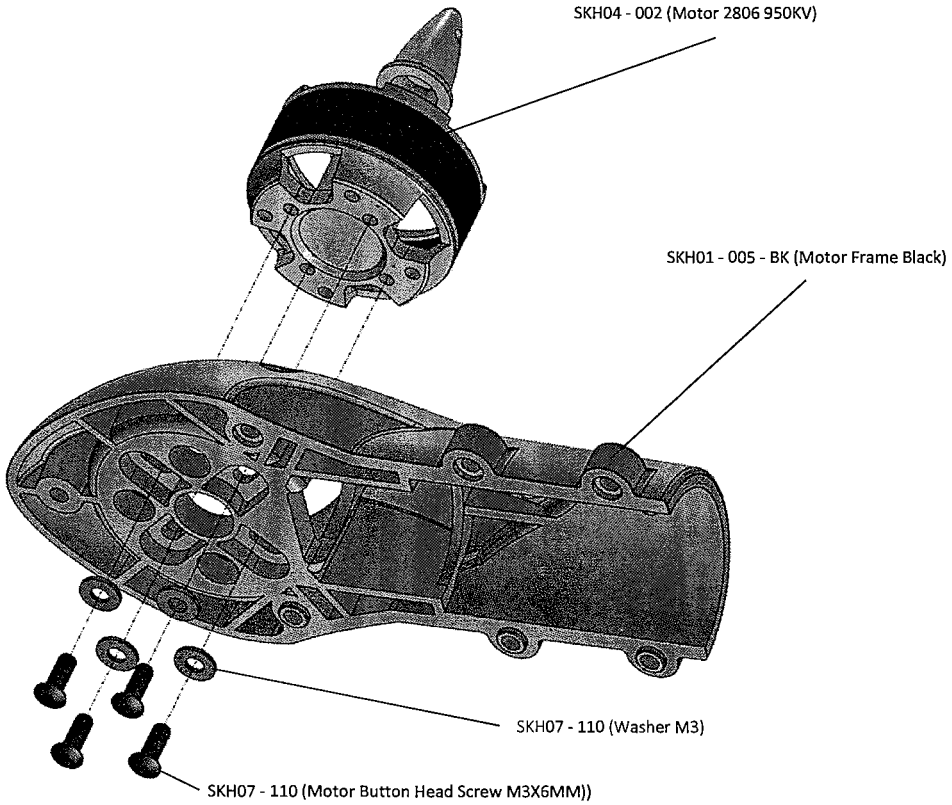
Disclaimer

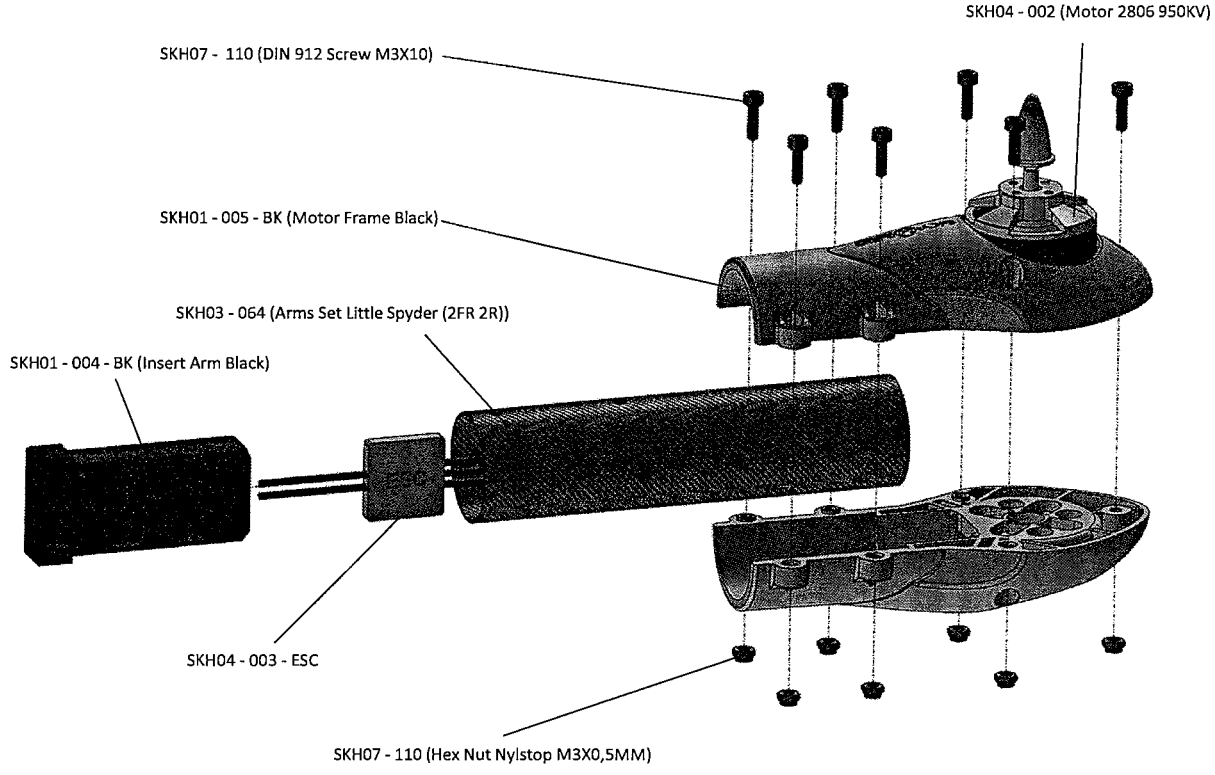
Thank you for purchasing product(s) from DJI Innovations. Please read the instructions carefully before installing the hardware and software for this product, this will ensure trouble free operation of your product. DJI Innovations accepts no liability for damage(s) or injured incurred directly or indirectly from the use of this product.

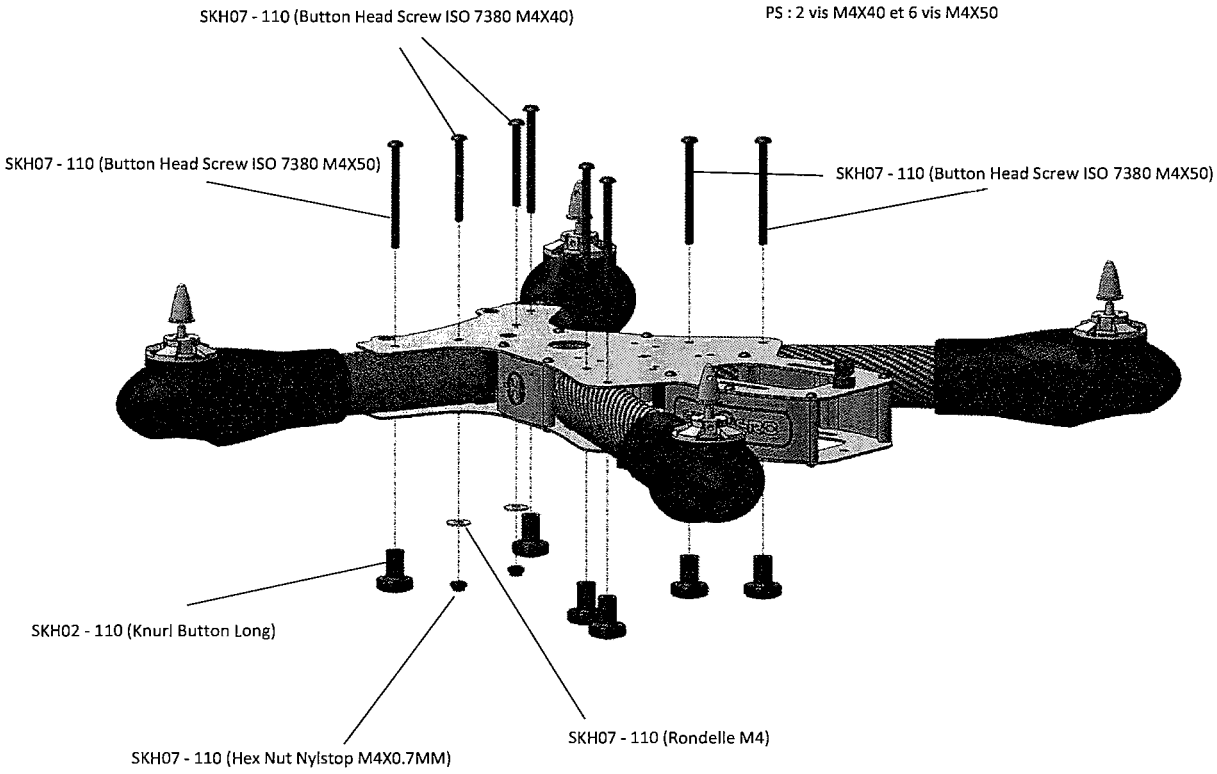
or authorization of DJI Innovations. No patent liability is assumed with respect to the use of the product or information contained herein.

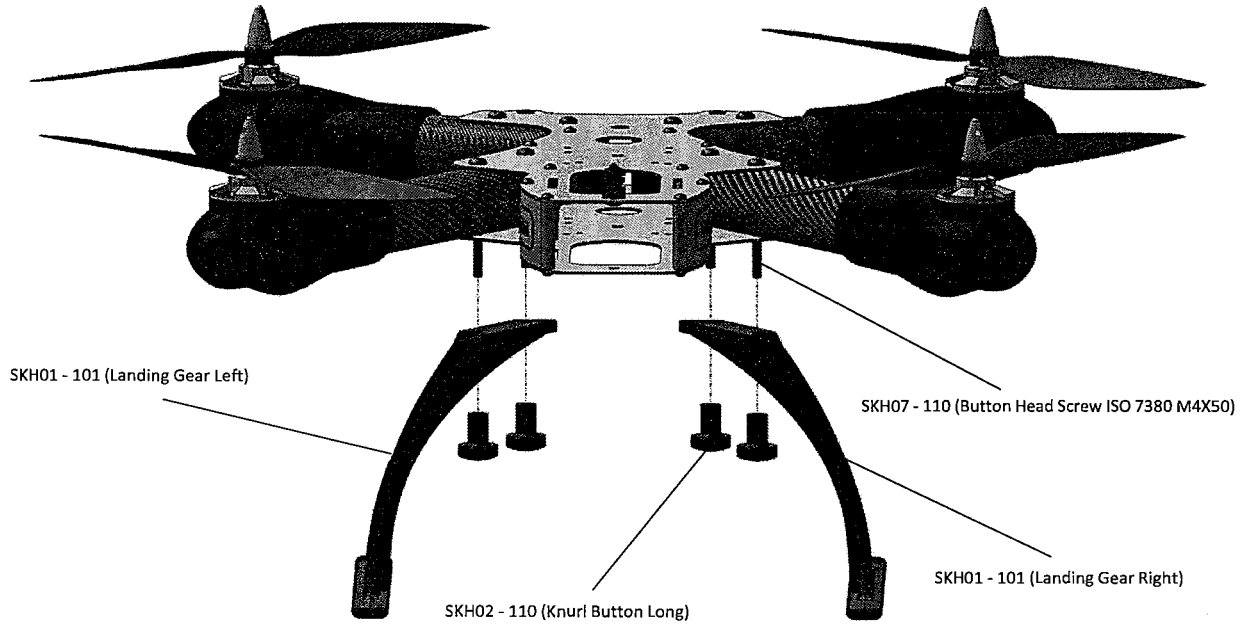
K. Exhibit 11: Skyhero Little Spyder




SKH04 - 002 (Motor 2806 950KV)
SKH01 - 005 - BK (Motor Frame Black)
SKH07 - 110 (Washer M3)
SKH07 - 110 (Motor Button Head Screw M3X6MM))


SKH04 - 002 (Motor 2806 950KV)
SKH07 - 110 (DIN 912 Screw M3X10)
SKH01 - 005 - BK (Motor Frame Black)
SKH03 - 064 (Arms Set Little Spyder (2FR 2R))
SKH01 - 004 - BK (Insert Arm Black)
SKH04 - 003 - ESC
SKH07 - 110 (Hex Nut Nylstop M3X0,5MM)


SKH07 - 110 (Button Head Screw ISO 7380 M4X40)
PS : 2 vis M4X40 et 6 vis M4X50
SKH07 - 110 (Button Head Screw ISO 7380 M4X50)
SKH07 - 110 (Button Head Screw ISO 7380 M4X50)
SKH02 - 110 (Knurl Button Long)
SKH07 - 110 (Hex Nut Nylstop M4X0.7MM)
SKH07 - 110 (Rondelle M4)


SKH01 - 101 (Landing Gear Left)
SKH07 - 110 (Button Head Screw ISO 7380 M4X50)
SKH01 - 101 (Landing Gear Right)
SKH02 - 110 (Knurl Button Long)

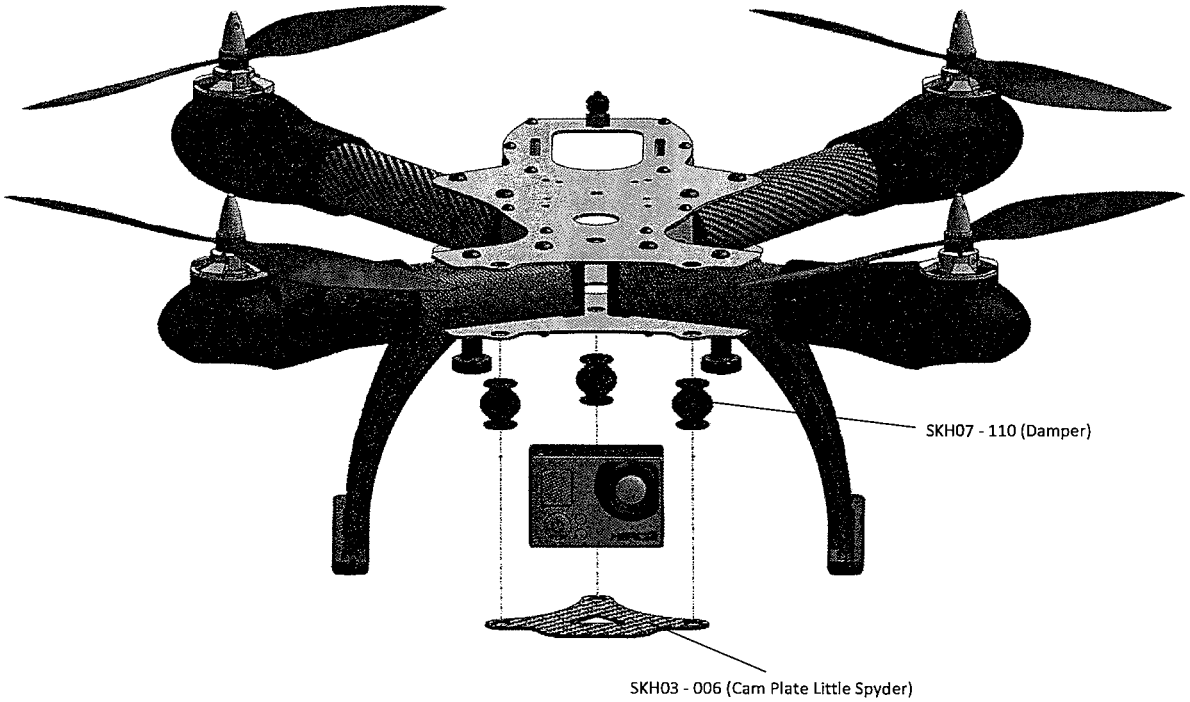

SKH07 - 110 (Damper)
SKH03 - 006 (Cam Plate Little Spyder)

Exhibit 12: Naza

Naza - M V2

Quick Start Guide V 1.26

2014.05.12 Revision

For Firmware Version V4.02 or above

& Assistant Software Version V2.20 or above

Thank you for purchasing this DJI product. Please strictly follow these steps to mount and connect this system on your aircraft, as well as to install the Assistant Software on your computer.

Please regularly check the web page of corresponding product* at our website www.dji.com, which is updated regularly. Product information, technical updates and manual corrections will be available on this web page. Due to unforeseen changes or product upgrades, the information contained in this manual is subject to change without notice.

* Important: Naza-M, Naza-M V2 and PHANTOM control system are different in hardware parts, but their configurations and functions are the same when using the same Assistant Software and Firmware Version, so they use the same Guide. Unless stated, the following instruction is basic on Naza-M V2. If you use the Naza-M, please make sure to read the "Instruction of V1 (also known as Naza-M)" section; if you use the PHANTOM, download the other corresponding manuals on the PHANTOM web page.

This manual is only for basic assembly and configuration; you can obtain more details and advanced instructions when using the assistant software. To assure you have the latest information, please visit our website and download the latest manual and current software version.

If you have any problem that you cannot solve during usage, please contact your authorized dealer.

Instruction

Disclaimer & Warning

Please read this disclaimer carefully before using the product. By using this product, you hereby agree to this disclaimer and signify that you have read them fully. THIS PRODUCT IS NOT SUITABLE FOR PEOPLE UNDER THE AGE OF 18.

This product is an autopilot system designed for serious multi-rotor enthusiasts providing excellent self-leveling and altitude holding, which completely takes the stress out of flying RC multi-rotors for both professional and hobby applications. Despite the system having a built-in autopilot system and our efforts in making the operation of the controller as safe as possible when the main power battery is connected, we strongly recommend users to remove all propellers when calibrating and setting parameters. Make sure all connections are good, and keep children and animals away during firmware upgrade, system calibration and parameter setup. DJI Innovations accepts no liability for damage(s) or injuries incurred directly or indirectly from the use of this product in the following conditions:

1. Damage(s) or injuries incurred when users are drunk, taking drugs, drug anesthesia, dizziness, fatigue, nausea and any other conditions no matter physically or mentally that could impair your ability.
2. Damage(s) or injuries caused by subjective intentional operations. Any mental damage compensation caused by accident.
3. Failure to follow the guidance of the manual to assemble or operate.
4. Malfunctions caused by refit or replacement with non-DJI accessories and parts.
5. Damage(s) or injuries caused by using third party products or fake DJI products.
6. Damage(s) or injuries caused by mis-operation or subjective mis-judgment.
7. Damage(s) or injuries caused by mechanical failures due to erosion, aging.
8. Damage(s) or injuries caused by continued flying after low voltage protection alarm is triggered.
9. Damage(s) or injuries caused by knowingly flying the aircraft in abnormal condition (such as water, oil, soil, sand and other unknown material ingress into the aircraft or the assembly is not completed, the main components have obvious faults, obvious defect or missing accessories).
10. Damage(s) or injuries caused by flying in the following situations such as the aircraft in magnetic interference area, radio interference area, government regulated no-fly zones or the pilot is in backlight, blocked, fuzzy sight, and poor eyesight is not suitable for operating and other conditions not suitable for operating.
11. Damage(s) or injuries caused by using in bad weather, such as a rainy day or windy (more than moderate breeze), snow, hail, lightning, tornadoes, hurricanes etc.
12. Damage(s) or injuries caused when the aircraft is in the following situations: collision, fire, explosion, floods, tsunamis, subsidence, ice trapped, avalanche, debris flow, landslide, earthquake, etc.

13. Damage(s) or injuries caused by infringement such as any data, audio or video material recorded by the use of aircraft.
14. Damage(s) or injuries caused by the misuse of the battery, protection circuit, RC model and battery chargers.
15. Other losses that are not covered by the scope of DJI Innovations liability.

Trademark

DJI and Naza-M are registered trademarks of DJI Innovations. Names of product, brand, etc., appearing in this manual are trademarks or registered trademarks of their respective owner companies.

Certifications

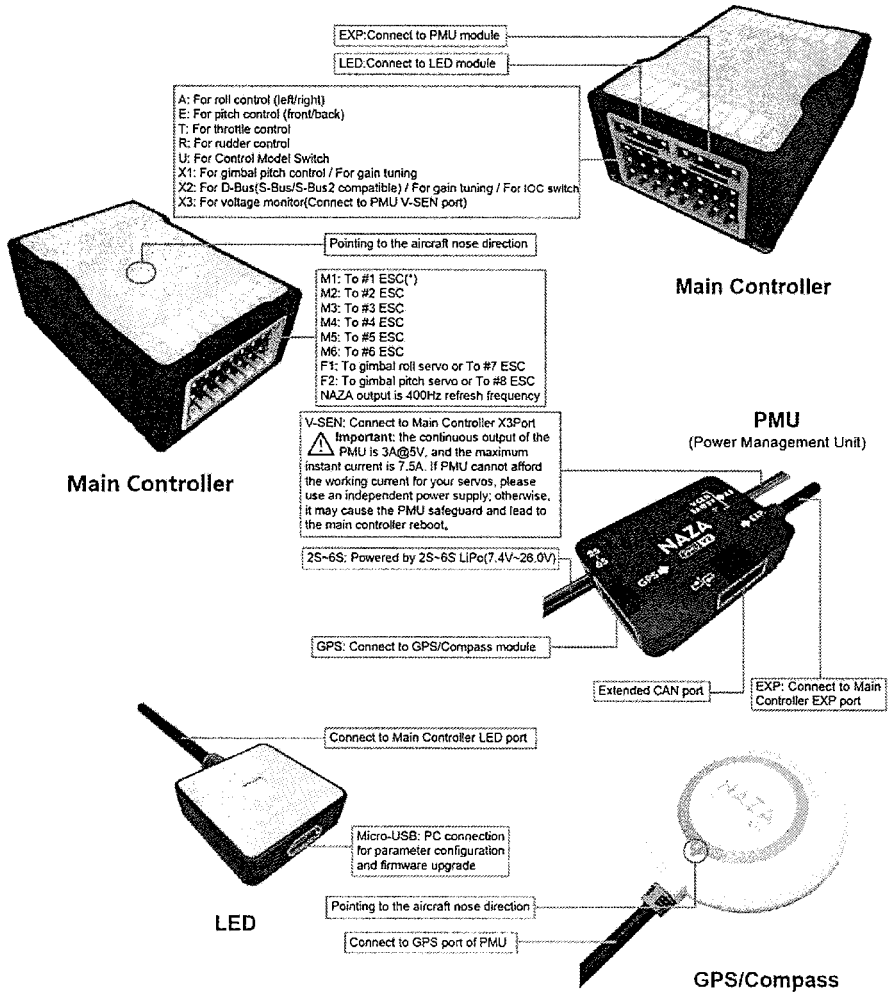
This product is approved with quality standards such as CE, FCC and RoHS.

Assembly & Connection

In the Box:

Main controller X1, PMU X1, GPS X1, GPS Bracket X1, LED X1, Servo Cable X8, Micro-USB Cable X1, 3M Adhesive Tape.

Step1 Port Description



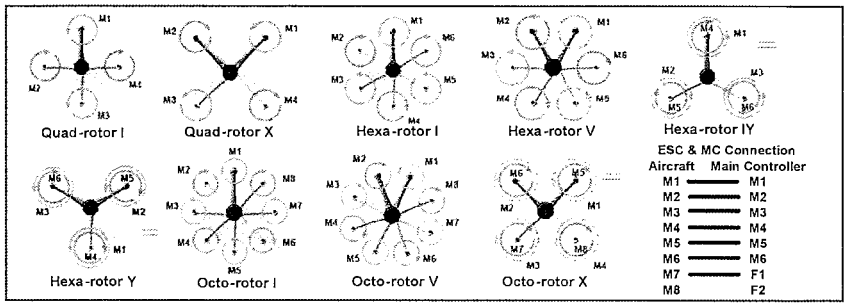
*ESC: Electronic Speed Controller

Step2 Assembly & Connection

Step1 Prepare an aircraft, supported the following **Mixed Types**.

The direction of the arrow in diagram indicates the rotation direction of the motor/propeller.

Important : To coaxial propellers: Blue propeller is at TOP; Red propeller is at Bottom. Otherwise all propellers are at top.



Note: The NAZA-M V2 flight control system doesn't support Gimbal function when used on the Octo-rotor aircraft.
For big aircraft that is larger than 650 or with heavy load, WKM is recommended.

Step2 Assembly and Connection

Main Controller(MC)

Mount : (1)The DJI logo should face the sky, DO NOT mount the MC upside-down. (2)The MC sides should be parallel to the aircraft body. (3)The arrow should point to the nose direction of aircraft. (4)he MC is best positioned near the aircraft's center of gravity. Make sure all ports are accessible.

Tip : It is recommended to fix the MC until all wirings and configurations are completed, using 3M gummed paper provided to fix the MC.

ESCs & Motors

Please use the ESCs and motors recommended by the manufacturer of your aircraft. We recommend you use DJI motors and ESCs (Refer to its manual for details). Connect all ESCs to MC by the motor numbering method introduced in mixed types Supported .

Important : If you use 3rd party ESCs, make sure the ESCs travel midpoint is at 1520us. DO NOT use 700us travel midpoint ESC, as it may lead aircraft to fly away or cause injury and damage. After ESCs connection , calibrate ESCs one by one through the receiver directly before connect them to your MC, Make sure program all of them into Governor off, Break off and Normal Start up to get best experience.

Step3 Double Check

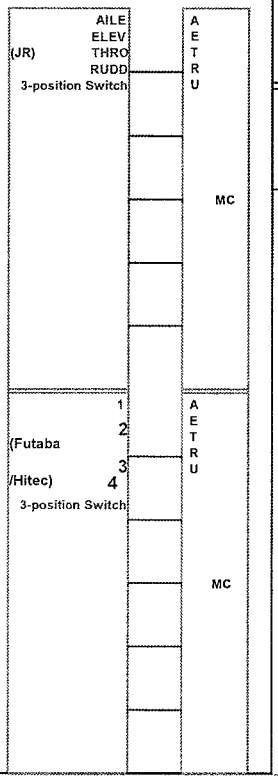
In this step, turn on the transmitter, connect the battery to the PMU, and then watch the LED, if you can see the LED blinks
( ), the system is working.

Assistant Software Installation and Configuration

Step1 Software and Driver Installation

Transmitter(TX) & Receiver(RX)

(1)Refer to you TX Manual, setup the Aileron, Elevator, Throttle, Rudder channels on your TX first, and choose a 3- position switch as control mode switch.
(2)Attach the matched RX to aircraft, then connect your RX to the right ports on MC. The following diagram shows the connection example for traditional RX.



PMU Module

Mount : DO NOT attach the PMU on other device. Sufficient air flow over the PMU is highly recommended.

Tip : If use with DJI multi-rotor, you can solder the power cable to power pads on frame bottom board. Please refer to DJI multi-rotor manual for details. If use with 3rd part aircraft, you can make a connecter by yourself to connect PMU and battery.

LED Module

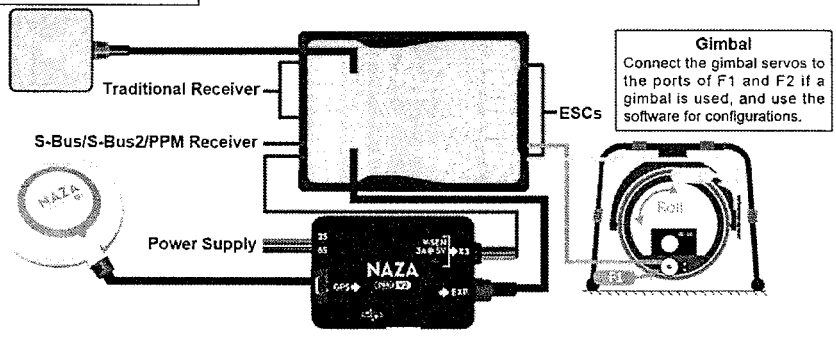
Mount : Make sure You can see the light during the flight. Leave the USB interface to be accessible. Use the 3M gummed paper provided to fix.

(Optional)GPS/Compass

Mount : GPS/Compass is sensitive to magnetic interference, should be far away from any electronic devices. If you use your own mounting rod, make sure it is NOT magnetic!

Procedures :

(1)You should use epoxy resin AB glue to assemble the GPS bracket first. Mount the bracket on the center plate of craft. Position the bracket at least 10 cm from any propeller. (2)The DJI logo marked on the GPS should face the sky, with the orientation arrow pointing directly forward. then fix the GPS on the plate of the bracket (by 3M glue provided). **Tip :** The GPS/Compass is packaged with a special indication line for mounting for the first time.



Gimbal

Connect the gimbal servos to the ports of F1 and F2 if a gimbal is used, and use the software for configurations.

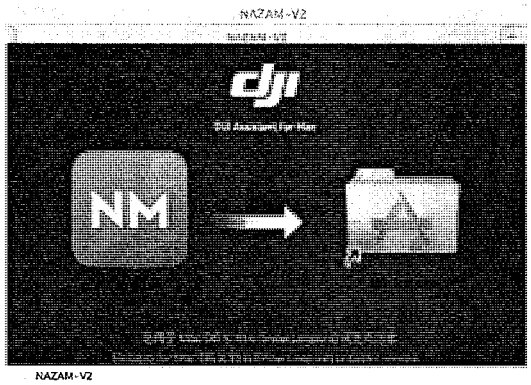
Installing and running on Windows

1. Please download the driver and the Assistant installation software in EXE format from www.dji.com.
2. Switch on the transmitter and then power on your autopilot system.
3. Connect your autopilot system and PC via a Micro-USB cable.
4. Open the driver installation software and follow the instructions to complete installation.
5. Run the Assistant installation software and follow the instructions to complete installation.

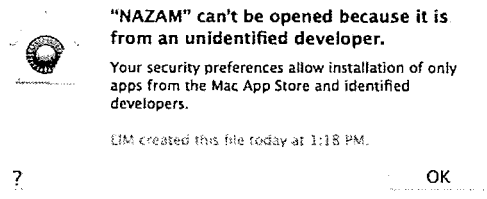
! The installer in EXE format is supported on Win XP, Win7, Win8 (32 or 64 bit).

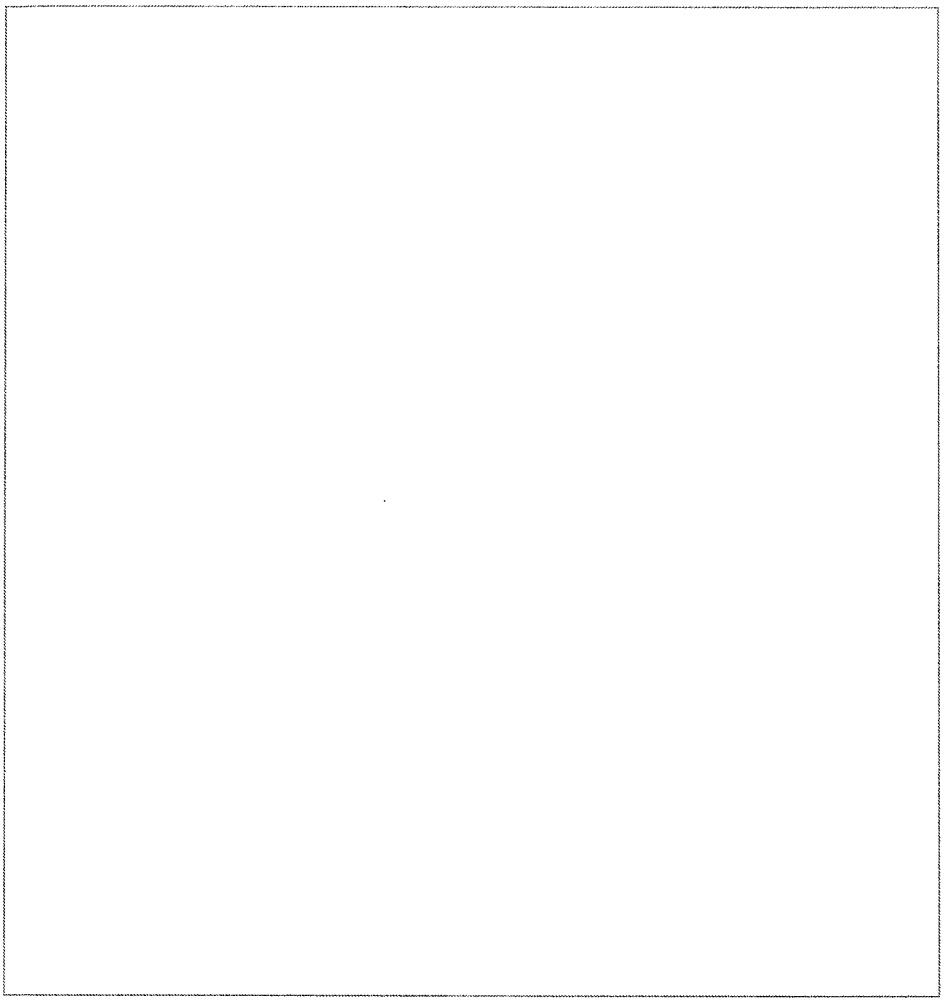
Installing and running on Mac OS X

1. Download the Assistant installer in DMG format from the download page of NAZA-M V2 on the DJI website.
2. Run the installation software and follow the prompts to finish installation.



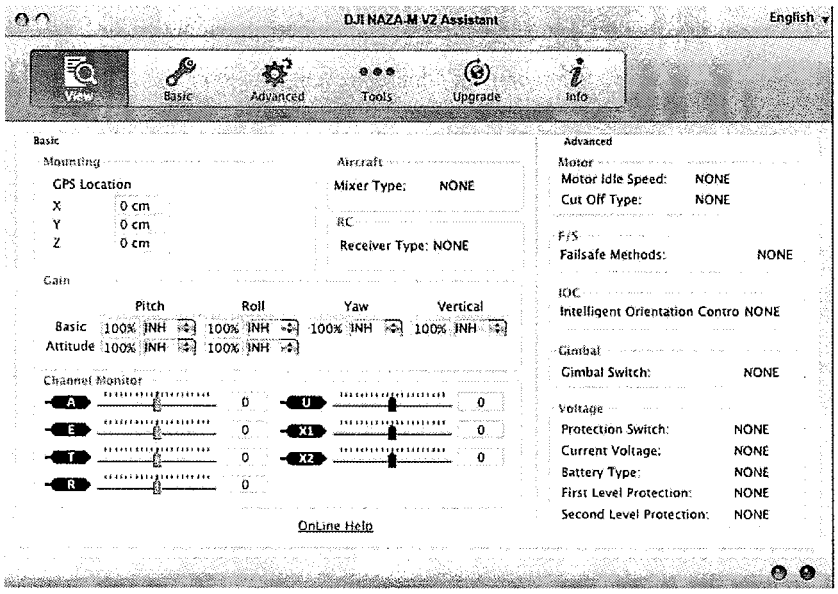
3. When launching for the first time if use Launchpad to run the NAZA-M V2 Assistant Software, Launchpad won't allow access because the software has not been reviewed by Mac App Store.





4 Locate the -MV icon in the Finder and open the file by Control or right clicking the selecting "Open" from the

5 After the first successful lau dickinge -MV icon in the Finder or using will open the



! Installer in DMG format is supported on Mac OS X 10.6 or above.

The NAZA-M V2 Assistant on Mac OS X and Windows are exactly the same. The Assistant appear in

other places of this manual is based on Windows version.

Step2 Configuration by Assistant on a PC

1. Power on the PC. Make sure your computer is connected to the Internet for the first time you use.
2. Switch on the transmitter first, and then power on the autopilot system. Connect the autopilot system to the PC with a Micro-USB cable. DO NOT break the connection until setup is finished.
3. Run the Assistant Software.
4. Observe the indicators on the left bottom of the software. (They are the connection indicator and communication indicator in order.) If the communication indicator is blinking, that the software is ready, please go to next step.
5. Select the "Info" option. Check the software firmware version. If the upgrade is available, you may update the assistant software.
6. Select the "Upgrade" option. Check the Main Controller, GPS and IMU

firmware version.

7. Select the "Basic" option. Please follow step-by-step for your first-time-configuration. Basic configuration is necessary, including Mixer Type, Mounting, RC, and Gain settings.
8. You can click the "Advanced" option for more parameter settings.

   Advanced setting is optional. There are settings of Motor, FailSafe,

   Intelligent Orientation Control (IOC), Gimbal, Low-Voltage Alert, and

   Flight

   Limits. Read the instruction in the assistant software to obtain more details.
9. Select the "Viewer" option to check all parameters.
10. Then break the Micro-USB cable, power off the aircraft. Finished.

(1) You may be required to fill register information for your first-time-usage.
(2) If the communication indicator is blue on, please double check the connections.
(Basic configuration is necessary before you go to the "Basic Flying
3) Test".
(4) Users are required to install a Windows system, since the software can only run on Windows system .

(1) If the firmware upgrade is available, please upgrade it by referring to the Firmware Upgrade in the Appendix.

(2) This step is required to use together with the assistant software to obtain more details.

Recommended Parameters

Recommended Settings for using F330/F450/F550

	Configuration Information					Basic Gain				Attitude Gain	
	Motor	ESC	Propeller	Battery	Weight	Pitch	Roll	Yaw	Vertical	Pitch	Roll
F330	DJI-2212	DJI-18A	DJI-8 Inch	3S-2200	790 g	140	140	100	110	140	140
F450	DJI-2212	DJI-30A	DJI-8 Inch	3S-2200	890 g	150	150	100	105	150	150
F550	DJI-2212	DJI-30A	DJI-8 Inch	4S-3300	1530 g	170	170	150	140	170	170

Basic Flying

Control Mode Knowledge

Please read the Control Mode Knowledge clearly before usage, to know how to control the aircraft.

Different control modes will give you different flight performances. Please make sure you understand the features and differences of the three control modes.

<table>
<tr><td></td><td>GPS ATTI. Mode (With GPS Module)</td><td>ATTI. Mode</td><td>Manual Mode</td></tr>
<tr><td>Rudder Angular Velocity</td><td colspan="3">Maximum rudder angular velocity is 150°/s</td></tr>
<tr><td>Command Linearity</td><td colspan="3">YES</td></tr>
<tr><td>Command Stick Meaning</td><td colspan="2">Multi attitude control; Stick center position for 0° attitude, its endpoint is 35°.</td><td>Max-angular velocity is 150°/s. No attitude angle limitation and vertical velocity locking.</td></tr>
<tr><td>Altitude Lock</td><td colspan="2">Maintain the altitude best above 1 meter from ground.</td><td>NO</td></tr>
<tr><td>Stick Released</td><td>Lock position if GPS signal is adequate.</td><td>Only attitude stabilizing.</td><td>NOT Recommend</td></tr>
<tr><td>GPS Lost</td><td>When GPS signal has been lost for 3s, system enters ATTI. Mode automatically.</td><td>Only performing attitude stabilizing without position lock.</td><td>---</td></tr>
<tr><td rowspan="3">Safety</td><td colspan="2">Attitude & speed control ensures mixture stability</td><td rowspan="2">Depends on experience.</td></tr>
<tr><td>Enhanced Fail-Safe(Position lock when hovering)</td><td>Auto Level Fail-Safe (Attitude stabilizing)</td></tr>
<tr><td colspan="3">With GPS/Compass and the failsafe modul equirement s are satisfied, in each Control Mode (including GPS, ATTI. Mode, nd IOC Mode), the Mode Manual Mode a aircraft will enter the failsafe Mode.</td></tr>
</table>

Applications	AP work	Sports flying.	---

Start & Stop Motor Knowledge

(1) Both Immediately Mode and Intelligent Mode are available in the Assistant Software:

Advanced->Motor->Stop Type.

(2) Stop Motor method is defaulted to Immediately Mode.

Please get to know well about this section before flying.

3 Start Motor: Pushing throttle stick before takeoff will not start the motors. You have to execute any one of following four Combination Stick Commands (CSC) to start the motors:

4 Stop Motor: We provide two options to stop motors in the assistant software: Immediately and Intelligent. (1) Immediately Mode: If you select this mode, in any control mode, once motors start and throttle stick is over 10%, motors will not stop immediately only when throttle stick is back under 10% the motors will stop. In this case, if you push the throttle stick over 10% within 5 seconds after motors stop, motors will re-start, CSC is not needed. If you don't push throttle stick after motors start in three seconds, motors will stop automatically.

(2) Intelligent Mode: By using this mode, different control mode has different way of stopping motors. In Manual Mode, only executing CSC can stop motors. In ATTI. Mode or GPS ATTI. Mode, any one of following four cases will stop motors:

a) You don't push throttle stick after motors start within three seconds;

b) Executing CSC;

c) Throttle stick under 10%, and after landing for more than 3 seconds.

d) If the angle of multi-rotor is over 70°, and throttle stick under 10%.

Notes of Intelligent Mode

(1) In ATTI. / GPS ATTI. Mode, it has landing judgment, which will stop motors.

(2) Start motors in ATTI. / GPS ATTI. Mode, you have to execute CSC and then push throttle stick over 10% in 3 seconds, otherwise motors will stop after 3 seconds.

(3) During normal flight, only pull throttle stick under 10% will not stop motors in any control mode.

(4) For safety reason, when the slope angle of multi-rotor is over 70° during the flight in ATTI. / GPS ATTI. Mode (may be caused by collision, motor and ESC error or propeller broken down), and throttle stick is under 10%, motors will stop automatically.

Notes of Intelligent Mode & Immediately Mode

(1) If you choose the Immediately Mode, you should not pull throttle stick under 10% during flight, because it will stop motors. If you do it accidentally, you should push the throttle stick over 10% in 5s to re-start motors.

(2) DO NOT execute the CSC during normal flight without any reason, or it will stop motors at once.

(1) If you choose the Intelligent mode, and the throttle stick is under 10%, this will trigger the landing Procedure, in any control mode. In this judgment, pitch, roll and yaw controls are denied except the throttle, but multi-rotor will still auto level.

(2) In any control mode, DO NOT pull throttle stick under 10% during normal flight without any reason.

(1) Any of these two cut off types will only work properly if TX calibration is correct done.

(2) In failed-safe, CSC is denied by the main controller, motors will hold their state.

Step 1 Compass Calibration

Without GPS module, please skip this step. If you use with GPS module, follow step-by-step for calibration.

(1) DO NOT calibrate your compass where there is magnetic interference, such as magnetite, car park, and steel reinforcement under the ground.

(2) DO NOT carry ferromagnetic materials with you during calibration, such as keys or cell phones.

(3) Compass module CANNOT work in the polar circle.

(4) Compass Calibration is very important, otherwise the system will work abnormal.

Calibration Procedures

1. Switch on the transmitter, and then power on autopilot system!
2. Quickly switch the control mode switch from GPS Mode to Manual Mode and back to GPS Mode (or from GPS Mode to ATTI. Mode and back to GPS Mode) for more than 5 times, The LED indicator will turn on constantly yellow so that the aircraft is ready for the calibration.
3. (Fig.1) Hold your Multi-rotor horizontal and rotate it around the gravitational force line (about 360°) until the LED changes to constant green, and then go to the next step.

4. (Fig.2)Hold your Multi-rotor vertically and rotate it (its nose is downward) around the gravitational force

   line (about 360°) until the LED turns off, meaning the calibration is finished.

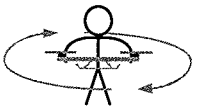


Fig.1

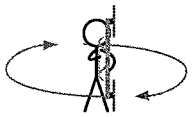


Fig.2

5. If the calibration was successful, calibration mode will exit automatically. If the LED keeps flashing quickly Red, the calibration has failed. Switch the control mode switch one time to cancel the calibration, and then re-start from step 2.

1. When the GPS is abnormal, the Main controller will tell you by the LED blinking Red and Yellow alternately (▬▬), disable the GPS Module, and automatically enter the aircraft into the ATTI. Mode.
2. You don't need to rotate your multi-rotor on a precise horizontal or vertical surface, but keep at least 45° difference between horizontal and vertical calibration.
3. If you keep having calibration failure, it might suggest that there is very strong magnetic interference around the GPS /Compass module, please avoid flying in this area.
4. When to do re-calibration

(1) The flight field is changed.

(2) When the multi-rotor mechanical setup has changed:

a) If the GPS/Compass module is re-positioned.

b) If electronic devices are added/removed/ re-positioned (Main Controller, servos, batteries, etc.).

c) When the mechanical structure of the multi-rotor is changed.

(3) If the flight direction appears to be shifting (meaning the multi-rotor doesn't "fly straight").

(4) The LED indicator often indicates abnormality blinking when the multi-rotor spins. (It is normal for this to happen only occasionally)

Step2 Assembly Checking List

Please check each item, to make sure for safety.

Any of the following mistakes will lead to a dangerous accident, double check all these items:

(7) Rotation direction of motor is opposite

(8) Infirm connection between the motor and the ESC

(9) Wrong or infirm installation of Main controller

(10) Wrong or infirm connection between the main controller and ESC.

(11) Propeller installation mistake

(12) Magnetization of the compass

Make sure the following items are correct.

(5) Make sure you have assembled your multi-rotor correctly.

(6) Make sure you have done the configuration procedure correctly.

(7) Make sure all connections are in good condition.

(8) Make sure batteries are fully charged for your transmitter, autopilot system and all devices.

Step3 Before Flight

Carry out the following procedures (is based on Intelligent Mode of Motor Stop) to make sure all configurations are correct. Refer to the Appendix->LED Description for more LED details.

8. Always switch on the transmitter first, then power on multi-rotor!
9. Keep the aircraft stationary until the system start and self-check has finished ( ). After that, the LED may blink Yellow 4 times quickly (oooo). Start motor is disable during LED blinking Yellow 4 times quickly (oooo), as the system is warming up.
10. After the 4 times Yellow LED disappears, toggle the control mode switch on your transmitter to make sure it is working properly. For example, LED blinks (), which means the system is in ATTI. Mode and the GPS signal is worst Check it with LED indicator to specify the current working mode for MC. See following table for details about LED indicator;

(1) There are Manual Mode and ATTI. Mode without a GPS/Compass module, no GPS signal status LED indicator.

(2) After connecting to the GPS/Compass module, GPS ATTI. Mode is available, and GPS signal status LED indicator is available.

Control Mode LED Indicator	GPS Signal Status LED Indicator
Manual Mode: NO LED ATTI. Mode: indicates that is stick(s) not at center) GPS Mode: (indicates that is s	Signal is best (GPS satellites > 6) : NO LED Signal is well (GPS satellites = 6) : Signal is bad(GPS satellites = 5) : Signal is worst (GPS satellites< 5) :

11. Keep the aircraft stationary, and then push both sticks to the left bottom or right bottom (shown as the following chart, defined as Combination Stick Commands (CSC)), to start the motors.

12. Release the yaw, roll and pitch sticks and keep them at the mid point, and the throttle stick under the mid point. Then check whether all propellers are rotating correctly.
13. Stop motors, power off the Multi-rotor.
14. Make sure all settings and configurations are correct and then you can take off you aircraft.

After power on, if abnormal LED Indicator occurs, please refer to the Abnormal LED instruction in the FAQ and aids troubleshooting.

Step4 Flying Test

6. Choose an open space without obstruction, tall buildings and crowds as flying filed. Place the aircraft 3 meters away from you and others, to avoid accidental injury.
7. If in GPS ATTI. Mode, place the aircraft in an open space without buildings or trees. Take off the aircraft after 6 or more GPS satellites are found (Red LED blinks once or no blinking). If in Manual Mode or ATTI.

   Mode, you can skip this step.
8. Start-up
   (1) Switch on the transmitter first, then power on multi-rotor! Keep the aircraft stationary until the

   system start and self-check has finished.

   (2) Please wait for the system to warm up gradually with the LED blinks Yellow 4 times quickly

   (oooo). You should not start the motors until the blinking disappears.

   (3) Keep the aircraft stationary, and execute the CSC to start the motors.

   (4) Release the yaw, roll and pitch sticks and keep them at the mid point, at the same time raise the

   throttle stick from the bottom. The motors will stop if you do not push the throttle stick from the bottom within 3 sec and you will need to re-start the motors.

   (5) Keep raising the throttle stick until all the rotors are working, push the throttle stick to the mid point

   and then take-off your multi-rotor gently, pay attention not to push the stick excessively.

   (6) Pay attention to the aircraft movement at any time when flying, and use the sticks to adjust the

   aircraft's position. Keep the yaw, roll, pitch and throttle sticks at the mid point to hover the aircraft at the desired height.
9. Lower the aircraft slowly. Pull the throttle stick to the bottom and then execute the CSC to stop the motors after landing.
10. Please always power off the Multi-rotor first, and then switch off the

transmitter after landing.

FLYING NOTES(VERY IMPORTANT) ! ! !

(1) If the warm up waiting is longer than 2 minutes (the 4 times Yellow blink continues), please power off for 10 minutes, cold start, and then connect the assistant software, enter the "Tools" - > IMU calibration, carry out the Advanced calibration.

(2) If you enable the Immediately Mode of Motor Stop; you should not pull throttle stick under 10% during flight, because it will stop motors. If you do it accidentally, you should push the throttle stick over 10% in 5s to re-start motors.

(3) DO NOT execute the CSC during normal flight without any reason, or it will stop motors at once.

(4) Pay attention to the GPS satellite status LED indicator. Bad GPS signal may lead the aircraft to drift when hovering.

(5) DO NOT fly near to ferromagnetic substances, to avoid strong magnetic interference with the GPS.

(6) Please avoid using GPS ATTI. Mode in the areas, where GPS signal is most likely bad.

(7) If the LED flashes quickly Red then this indicates battery voltage is

low, land ASAP.

(8) If the transmitter indicates low-battery alarm, please land ASAP. In this condition the transmitter may cause the aircraft to go out of control or even crash.

(9) In GPS ATTI. Mode, make sure that the home point is recorded when the GPS signal is well; otherwise the home point recording may be not so precise.

(1) In ATTI Mode, throttle stick center position is for 0m/s along the vertical direction. You should keep the position of throttle stick higher than 10% from cut-throttle during the flight! In any control mode, DO NOT pull throttle stick under 10% during normal flight without any reason.

(2) It is recommended to land the aircraft slowly, to prevent the aircraft from damage when landing.

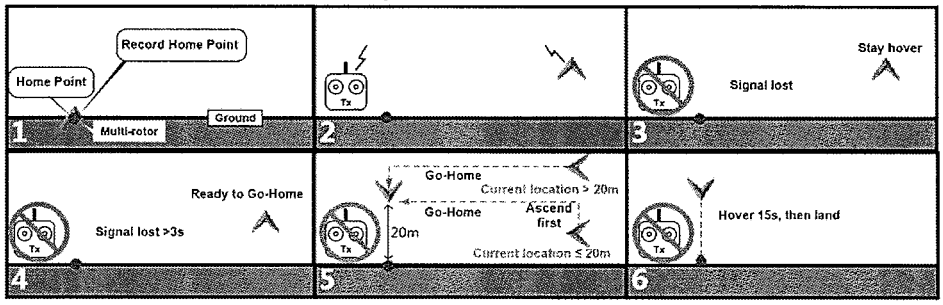
(3) If Low-Voltage Alarm is set, the aircraft will act according to the configuration of the Assistant Software once Low-Voltage Alarm is triggered. Make sure you remember what you have set before.

(4) If Fail-Safe function is set, the aircraft will act according to the configuration of the Assistant Software once Fail-Safe is triggered. Make sure you remember what you have set before.

Advanced Functions

A1 FailSafe

An introduction of Go-Home and Landing.



Home-point: Before takeoff, current position of multi-rotor will be saved as home-point by MC automatically when you start the motors for the first time after 6 or more GPS satellites are found (red light blinks once or no blinking) for 10 seconds.

! Note	1. Please make sure to record the home-point before takeoff, and clearly know where it is. 2. During go-home the nose direction of the aircraft is facing toward the home-point, the aircraft is flying directly from the current position to the home-point. 3. You can regain the control during the aircraft is hovering 15

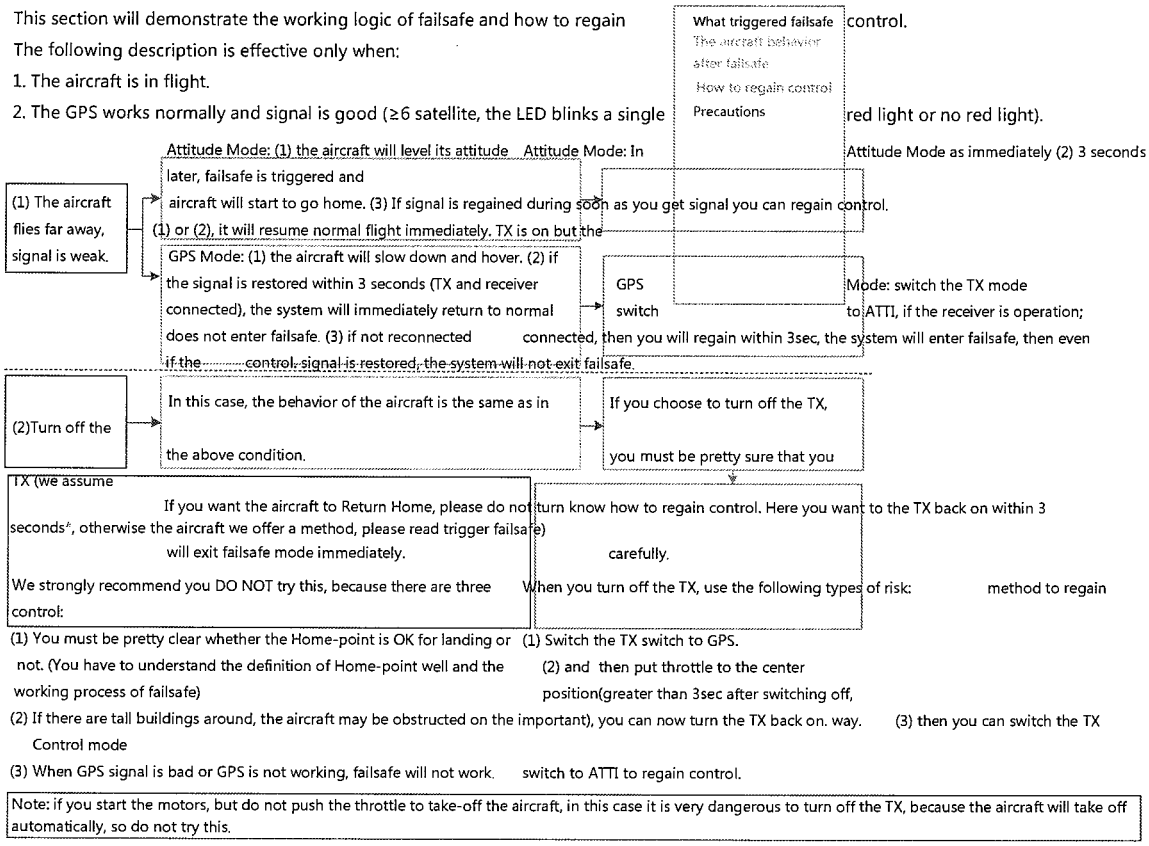
seconds.

The flowchart of failsafe and how to regain control

This section will demonstrate the working logic of failsafe and how to regain control.

The following description is effective only when:

1. The aircraft is in flight.
2. The GPS works normally and signal is good (≥6 satellite, the LED blinks a single red light or no red light).



* If signal lost for more than 3 seconds failsafe will be triggered, if signal regained within 3 seconds it will exit failsafe immediately.

A2 Low-Voltage Alert

In order to prevent your multi-rotor from a crash or other harmful consequences caused by low battery voltage, there are two levels of low voltage protection available to use. You can choose to use or not to use them; however we strongly recommend using the protections if available! Low-Voltage Alert is to indicate that the battery cannot provide enough power for the aircraft, in order to warn you to land the aircraft ASAP. You can configure this function in the assistant software, and please read the text in the software carefully before your flight. Make sure to carry out the Current Voltage Calibration.

There are both first level and second level protections. The first level protection has LED warning. During second level protection the aircraft will land automatically with LED warning. Meanwhile the

center point of throttle stick will move up slowly to 90% of endpoint, you should land ASAP to prevent your aircraft from crashing!

It is not for fun, you should land your aircraft ASAP to prevent your aircraft from crashing or other harmful consequences!!!

(1) Configure the FailSafe function in the assistant software -> "Advanced" -> "F/S" and read the instruction thoroughly and carefully.

(2) Configure the Low-Voltage Alert function in the assistant software -> "Advanced" -> "Voltage" and read the instruction thoroughly and carefully.

A3 Intelligent Orientation Control (IOC) Flight (with GPS module)

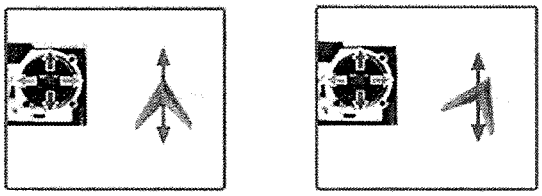
Definition of Forward Direction:

Multi -rotor will fly along this direction when you push the elevator stick (➡).

Step1 Before You Start

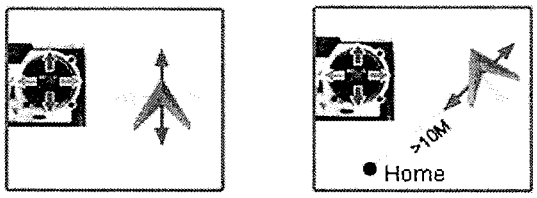
Usually, the forward direction of a flying multi-rotor is the same as the nose direction. By using IOC, wherever the nose points, the forward direction has nothing to do with nose direction. The red and blue arrows on the transmitter are corresponding to pitch and roll operations in the following diagram.

- In course lock flying, the forward direction is the same as a recorded nose direction. All the following requirements are met: the autopilot system is in ATTI. Mode or GPS ATTI. Mode.



Normal flying Course Lock Flying

- In home lock flying, the forward direction is the same as the direction from home point to multi-rotor. All the following requirements are met: 6 or more GPS satellites are found, in GPS ATTI. Mode, and the aircraft is further than 10m away from the home point.



Normal flying Home Lock Flying

Step2 IOC Switch Setting

Before using the IOC function, you have to choose a 3-position switch on your transmitter as the IOC switch, which is also used for recording the orientation, home position in corresponding modes. Refer to the assistant software; click the "Advanced" to find the "IOC".

IOC Switch			
IOC Function	OFF	Course Lock	Home Lock

The above table is for example. The function of the switch position may be reversed since the normal/reversed setting of the switch channel. Toggle the switch and observe the slider position of channel X2 on the assistant software screen, the corresponding area should turn blue.

Step3 Method of Forward Direction and Home Point Recording

If you use the IOC function, please be aware of the Forward Direction of Course Lock Flying, and the home point of Home Lock Flying. There are two ways to record the forward direction and the home point: Manually and Automatically. You may choose any one record method. The LED will blink Green quickly if successfully recorded.

	Course Lock	Home Lock
Automatically	30 seconds after you power on the autopilot system.	Before takeoff, the current position of the aircraft will be saved as home point when you start the motors for the first time after 6 or more GPS satellites have been found for 10 seconds.
Manually	30 seconds after you power on the autopilot system. Toggle the IOC switch from Off to Course Lock, and back to Off quickly 3 to 5 times.	After 6 or more GPS satellites have been found. And the aircraft can be hovering. Toggle the IOC switch from Course Lock to Home Lock, and back to Course Lock quickly 3 to 5 times.

! DO NOT toggle the switch between Off to Home Lock, since it may change the recording of the Forward Direction of Course Lock.

Step4 IOC Flying Test

Then you can do Course Lock and Home Lock flying test.

Carry out an IOC flight by the following procedure. The Control Mode LED will blink Yellow and Green alternatively () to indicate the IOC mode only when the main controller is really to fly in Course Lock, Home Lock modes.

During the same flight	STEP1: Record	STEP2: ON	STEP3: OFF	STEP4: ON again
Course Lock				
Switch Setting	Record the Forward Direction	Set Control Mode switch at GPS or ATTI. position, Toggle IOC switch from OFF to Course Lock position	Toggle IOC switch to OFF position	Toggle IOC switch from OFF to Course Lock position
Home Lock				
Switch Setting	Record the Home Point	Set Control Mode switch at GPS position, Toggle IOC switch from OFF to Home Lock position	Toggle IOC switch to OFF position	Toggle IOC switch from OFF to Home Lock position

⟶ Aircraft moving direction when pull pitch stick ⟶ Aircraft moving direction when pull roll stick

● Home point ➢ Aircraft (the arrow is pointing to the direction of the aircraft nose)

IOC FLYING NOTES ! ! !

⊘ (1) When Multi-rotor is flying by home lock far away from you and the home point, please DO NOT toggle the IOC switch many times quickly so as to avoid the change of home point without your attention.

(1) Home lock flying requires that 6 or more GPS satellites are found and the aircraft is further than 10m away from the home point.

(2) If the IOC flying requirement is not satisfied, the autopilot system will quit IOC control mode.

Please be aware of the LED indicator, to know the current control mode of the autopilot system.

(1) Blinking  are: indications of IOC

a) Before motors start: blink, all sticks (except throttle stick) return to center;
 blink, stick(s) (except throttle stick) not at center.

b) After motors start and throttle stick is over 10% in 3 seconds:  blink, all sticks return to center;  blink, stick(s) not at center.

(2) Before you do the home lock flight, you have to fly the aircraft out of the 10m range around home point, and then flip the IOC switch to Home Lock position to fly in home lock when all the requirements are met. If you have already toggled the IOC switch to Home Lock position when the aircraft is still in 10m range around home point, and this is the first time you are going to fly in home lock during the current flight, then if all the requirements are met, the main controller will change into home lock automatically when Multi-rotor flies out the 10m range around home point.

(1) When flying in Home Lock mode, if any of the following situations happen, then the system will quit Home Lock flying and automatically enter Course Lock flying. The aircraft will fly in Course Lock using the earlier forward direction.

a) The aircraft fly's within 10m range of the home point.

b) You toggle the control mode switch to the ATTI. Mode.

c) The GPS signal becomes bad (The GPS signal LED is blinking Red twice or three

times).

(2) We suggest that you should know clearly which flight lock method you are going to fly,

and you know the locked forward direction or home point, before you switch on IOC mode during the flight.

A4 Receiver Advanced Protection Function

You are asked to enable this function by connecting to the Assistant Software, please set it at the section of

Basic->R/C-> Receiver Advanced Protection.

If you choose enable it, the FailSafe will be triggered if the following situations occur during flight.

According to the difference of the aircraft height, there are two situations.

a) Lower than 100m, the A/E/R channel is not at the mid point.

b) Higher than 100m, the A/E/R channel is not at the mid point or the throttle stick is above the mid point. In the GPS Mode or ATTI. Mode, if the requirement a) or b) is satisfied, and the output data of four channels A/E/R/T have not changed for 20 seconds, then the aircraft will hover automatically. After that, if the output data of four channels A/E/R/T still do not any changes and last for 10 seconds, the autopilot system will think that the data from receiver is abnormal, and then enter the FailSafe Mode.

Brief introduction of how to quit the FailSafe Mode

If there is any command change from the receiver, the autopilot system thinks that the receiver is regained. In ATTI. Mode and Manual Mode, it will quit the FailSafe Mode automatically. In GPS Mode, please toggle the control mode switch to the ATTI. Mode and Manual Mode position to regain the control. Refer to the FailSafe section for more

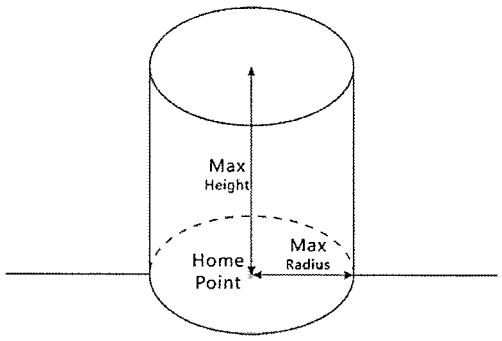
details.

A5 Flight Limits

The flight limits function is default enabled in the NAZA-M Flight control system, it's aimed to restrict the flying height and distance of the aircraft. The Max Height restricts the vertical distance between the aircraft and the Home point, the Max Radius restricts the horizontal distance between the aircraft and the Home point.

The default Max Height is 2000m and Max Radius is 2000m. Users can write the values of the Max Height and Max Radius in the Assistant software, the range of the Max Height is 10m-100000m, the

range of the Max Radius is the same. So that the aircraft will fly in the entered range, which is a cylinder space above the Home point.



(1) Height Limit works when the control mode is GPS or ATTI. Mode. Radius Limit works when the control mode is GPS and the satellite number ≥6.

(2) If the aircraft flies out of the limits, it's still controllable except flying further away.

(3) If the control mode is changed to GPS when the aircraft is out of Max Radius, the aircraft will fly back within the entered range.

(4) The Failsafe and the Ground Station operations are not restricted to the Flight Limits.

Appendix

Specifications

General	
Built-In Functions	(1) Three Modes of Autopilot (4)S-Bus/S-Bus2 Rece (2) Enhanced Fail Safe (5)PPM Receiver Support (3)Low Voltage Protection (6)2-axle Gimbal
Support Peripheral	
Supported Multi-rotor	● Quad-rotor I4, X4; Hexa-rotor I 6, X6, IY6, Y6. Octo- rotor I8, V8, X8
Supported ESC output	400Hz refresh frequency.

Recommended Transmitter PCM or 2.4GHz with a minimum 4 channels.	
Assistant Software System Requirement Windows XP SP3; Windows 7; Windows 8	
Electrical & Mechanical	
Working Voltage Range	● MC: 4.8V ~ 5.5 V ● PMU Input: 7.4V ~ 26.0 V (recommend 2S ~ 6S LiPo) Output(V-SEN port red wire): 3A@5V Output(V-SEN port red wire)burst current:7.5A
Power Consumption	● MAX: 1.5W(0.3A@5V) ● Normal: 0.6W(0.12A@5V)
Operating Temperature	-10°C ~ 50°C (14F ~122F)
Weight	• MC: 27g • GPS/Compass: 27g • PMU: 28g • LED: 13g
Dimensions	● MC: 45.5mm × 32.5mm × 18.5mm • GPS/Compass: 46mm (diameter) x 10mm • PMU：39.5mm × 27.5mm × 10.0mm • LED：25mm × 25mm × 7.0mm
Flight Performance (can be effected by mechanical performance and payloads)	
Hovering Accuracy (GPS Mode)	● Vertical: ±± 0.8m ● Horizontal: ±±2.5m
Max Yaw Angular Velocity	200°/s
Max Tilt Angle	35°
Max Ascent / Descent Speed	±Ascent : 6m/s, Descent: 4.5 m/s

MC/PMU Firmware Upgrade

Please follow the procedure for software and firmware upgrade; otherwise the system might not work properly. For SAFETY REASONS, DO NOT use power battery during firmware upgrade.

1. Make sure your computer is connected to the Internet.
2. Please close all the other applications during the firmware upgrade, including anti-virus software and firewall.

3. Make sure the power supply is securely connected. DO NOT un-plug the power supply until firmware upgrade has finished.
4. Connect system to PC with Micro-USB cable, DO NOT break connection until firmware upgrade is

   finished.
5. Run Software and wait for connection.
6. Select Upgrade option→Check the MC and PMU Firmware Version.
7. DJI server will check your current firmware version, and get the latest firmware prepared for the unit.
8. If there is a firmware version more up-to-date than your current version, you will be able to click to update them.
9. Wait until Assistant software shows "finished".
10. Click OK and power cycle the unit after at least 5 seconds.
11. Your unit is now up-to-date.

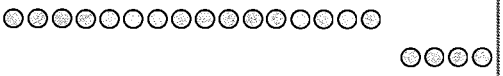
(1) After firmware upgrade, please re-configure the system using Assistant software.

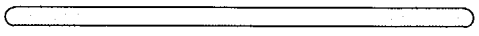
(2) If firmware upgrade failed, the system will enter waiting for firmware upgrade status automatically, please try again with the above procedures.

(3) Select Upgrade option→Check the GPS Firmware Version, online upgrade is disable.

LED Description

System Status	LED Flashing

System start and self-check	
IMU abnormal data or need advanced	
calibration*	
Warm up after power on	
The aircraft is moved or bias of sensors too big	
Compass error too big, need recalibration.	
Transmitter (TX) signal lost, enter the FailSafe.	
TX stick(s) mid point error too big	
Low voltage alert or other abnormal alert* (e.g. Configuration error, TX data error, Enable low voltage protection without PMU, SN error or Compass abnormal work.)	
Record forward direction or home point	
Control Mode Indictor	Manual Mode: None  ATTI. Mode: (stick(s) not at  center) GPS Mode: (stick(s) not at) center IOC Mode: (stick(s) not at) center
GPS Signal State Indicator (GPS/Compass Module is necessary)	GPS Signal is Best(GPS Satellite number > 6):  None GPS Signal is Well(GPS Satellite number = 6):  GPS Signal is Bad (GPS Satellite number = 5) :  GPS Signal is Worst (GPS Satellite number < 5):

Compass Calibration	LED Flashing
Begin horizontal calibration	

Begin vertical calibration	
Calibration or others error	

*You can figure out the error by connecting the autopilot system to the assistant software.

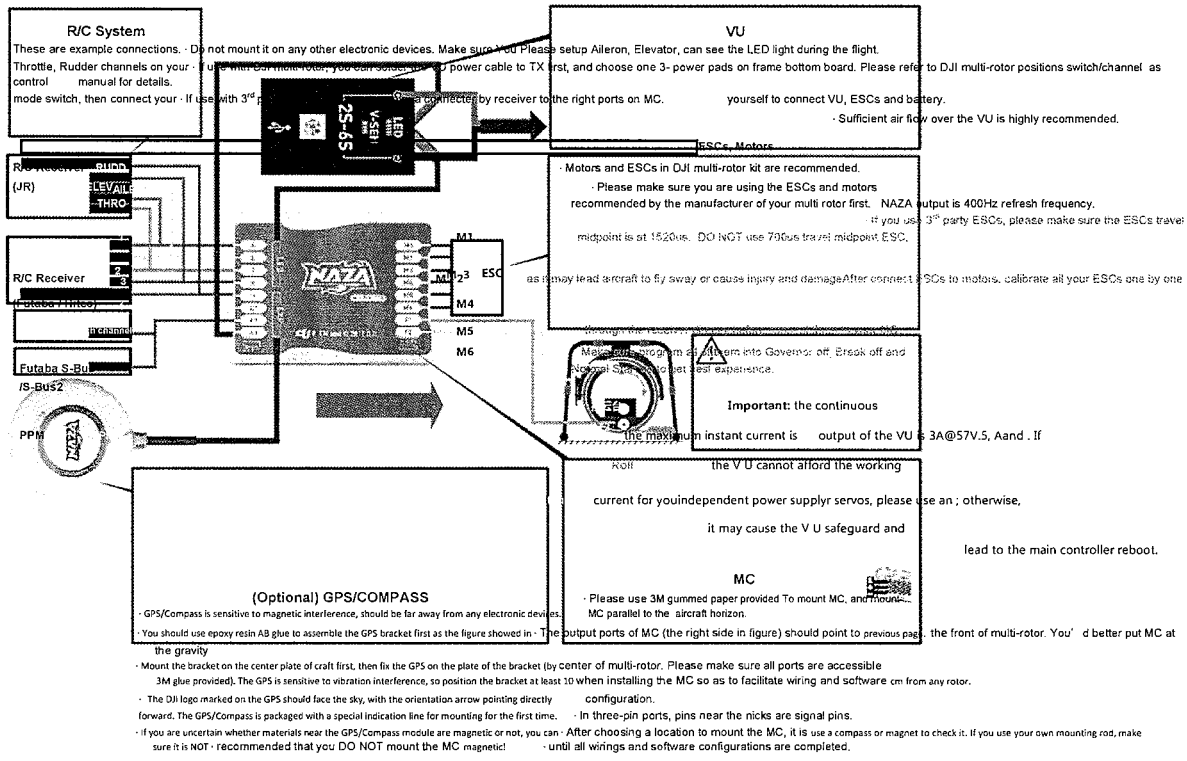
Instruction of V1 (also known as NAZA-M)

V1 (also known as NAZA-M) system is different from V2 system, if you are V1 system user, please read the following text carefully, and refer to the other text in this Guide for usage details (including Assistant Software Configuration,

Basic flying, Advanced Function Appendix and FAQ, etc.) .

V1 Assembly and Connection

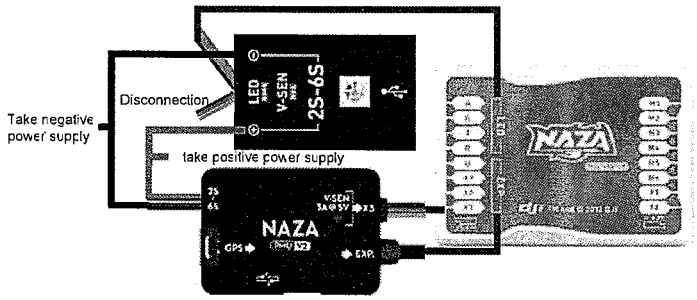
Connect the V1 system according to the following chart.



V1 is compatible with the PMU V2 (Accessory of Naza-M V2)

V1 system is compatible with the PMU V2 of V2 system; please carry out the following connection. The other modules connection is the same as before.

Important: You are asked to upgrade your Firmware version of V1 MC to V3.10 or above, as the PUM V2 can only work with the MC of version 3.10 or above.



V1 Port Description

Please remember the function of each port, which may help you to use the Naza-M efficiently.

Main Controller

A	For roll control (left/right)		
E	For pitch control (front/back)		
T	For throttle control		
R	For rudder control		
M	For Control Mode Switch		
X1	For gimbal pitch control	Or for gain tuning	
X2	For D-Bus (S-Bus/ S-Bus2 compatil	Or for gain tuning	Or for IOC switch
X3	For voltage monitor (Connect with VU V-SEN port)		
M1	To #1 rotor		
	To #2 rotor		
M2	To #3 rotor		
	To #4 rotor		
M3	To #5 rotor		
	To #6 rotor		
F1	To gimbal roll servo	Or to #7 rotor (Upgrade the MC Firmware to V3.10 or above)	
F2	To gimbal pitch	Or to #8 rotor (Upgrade the MC Firmware to	

servo | V3.10 or above)

LED port, for LED wire connection from Versatile Unit

EXP. GPS port, for GPS module wire connection.

(In three-pin ports, pins near the nicks are signal pins.)

Versatile Unit

V-SEN V-SEN port: To the X3 port of the main controller, for monitoring battery power

- Orange wire (signal wire) output: ±±3.3V
- Red wire (power wire) output: 3A@5V

LED LED wire, to LED port of the main controller.

USB port: PC connection for configuration and firmware upgrades.

GPS & Compass

Connect to the EXP. port.

V1 Specification

General	
Built-In Functions	• Three Modes of Autopilot • Enhanced Fail Safe • Low Voltage Protection • S-Bus/ S-Bus2 Receiver Support • PPM Receiver Support • 2-axle Gimbal Support
Peripheral	
Supported Multi-rotor	• Quad-rotor I4, X4; • Hexa-rotor I 6, X6, IY6, Y6. • Octo-rotor I8, V8, X8 (Upgrade the MC Firmware to V3.10 or above)
Supported ESC output	400Hz refresh frequency.

Recommended Transmitter	PCM or 2.4GHz with a minimum 4 channels.
Assistant Software System Requirement	Windows XP SP3; Windows 7
Electrical & Mechanical	
Working Voltage Range	• MC: 4.8V ~ 5.5 V • VU Input: 7.2V ~ 26.0 V (recommend 2S ~ 6S LiPo)
	Output(V-SEN port red wire): 3A@5V Output(V-SEN port red wire)burst current:7.5A
Power Consumption	● MAX: 1.5W(0.3A@5V) ● Normal: 0.6W(0.12A@5V)
Operating Temperature	-10°C ~ 50°C(14F ~122F)
Weight	• MC: 25g ● GPS: 21.3g • VU: 20g
Dimensions	• MC: 45.5mm × 31.5mm × 18.5mm ● GPS & Compass: 46mm (diameter) x 9mm • VU: 32.2mm × 21.1mm × 7.7mm
Flight Performance (can be effected by mechanical performance and payloads)	
Hovering Accuracy (GPS Mode)	● Vertical: ±± 0.8m ● Horizontal: ±± 2.5m
Max Yaw Angular Velocity	200°/s
Max Tilt Angle	45°
Max Ascent / Descent Speed	±6m/s

FAQ

Abnormal LED Indication List

During the Checking Procedure, if abnormal LED Indicator occurs or even the system cannot work normally, please refer to the following list and aids troubleshooting.

(1)	"System initializing and self-checking LED flashes" are not correct (●●○●●○●●○○○○○ Red LED appears in the last four green flashes). The autopilot system works abnormally. Please contact your dealer.

(2) LED blinks Yellow 4 times quickly (oooo). The system is warming up. You cannot start the motors until the 4 rapid yellow flashes disappear. If the warm up waiting is longer than 2 minutes, please power off for 5 minutes, cold start, and then connect the assistant software, enter the "Tools" - > IMU calibration, carry out the Advanced calibration.

(3) After the system start and self-checking has finished, if the LED blinks Red, Green and Yellow (ooo) continually. Sensor error is too big. Please connect the assistant software, enter the "Tools" - > IMU calibration, carry out calibration.

(4) At the first motors start, the system will check the sensors Bias and you are asked to keep the aircraft stationary (no need of horizontal level). If you cannot start the motors and the LED blinks Green 6 times quickly (oooooo), it means that the sensor error is too big. Please connect the assistant software,

enter the "Tools" - > IMU calibration, carry out basic calibration.

Note: after the first successful motors start, this checking will be disabled and it is no need any more to keep the aircraft stationary during starting motors.

(5) The system blinks Red LED quickly during flying. Low-voltage protection is triggered. Please land the aircraft ASAP.

(6) The system blinks Yellow LED quickly during flying. FailSafe Mode is triggered. Pay attention that there is no tall buildings and trees to block your aircraft during go-home.

(7) The LED blinks Red and Yellow alternately (▬▭). Compass error is too big.

a) There may be a ferromagnetic substance close to the Phantom. Lift the aircraft up about 1m from

the ground, if there is no Red and Yellow flashing, then it will not affect the flight.

b) Otherwise, re-calibrate the compass.

c) If re-calibration does not work, please connect to the Assistant Software, select the "Tools" and

follow the tips to carry out the required operation.

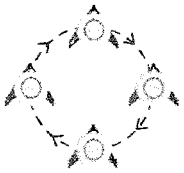
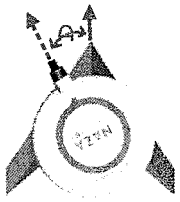
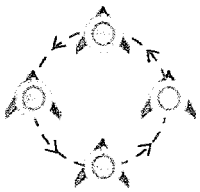
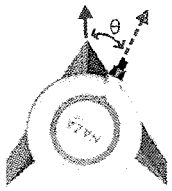
Fix the TBE (Toilet Bowl Effect) Problem

When flying in GPS ATTI. Mode and the compass calibration has been done correctly, should you find the aircraft rotating (Toilet bowl effect), or drifting when hovering. Please check the GPS module mounting orientation and then re-do the compass calibration. Carry out the following procedure to re-mount the GPS module.

In the following diagram (view from the top), the aircraft can appear to be rotating in both clockwise and counter-clockwise direction, please re-mount the GPS module correspondingly.

 is the rotating direction of aircraft,  is the nose direction of aircraft,

 is the arrow direction on the GPS module, θ is the offset angle for GPS re-mounting(about 10~30°)

Clockwise rotating	GPS re-mounting	Counter Clockwise rotating	GPS re-mounting
			

Should you find the multi-rotor does not track straight in forward flight.
Please carry out several more courses, the system will fix it automatically.

Motors Start failure caused by TX stick(s) mid point error too big

If the TX stick(s) mid point error is too big, Motors Start will fail when you execute the Combination Stick Commands (CSC) and lead to the aircraft will not takeoff.. And the LED will blink Red four times per second continually to warn you.

TX stick(s) mid point error too big can be caused by the following reasons:

(1) There is TX stick (except the throttle stick) not at center when power on the autopilot system.

(2) The TX sticks has been trimmed, which leads to the large deviation of mid point. For example, the

SUB-TRIM has been adjusted for Futaba transmitter.

(3) The TX stick(s) travel has larger asymmetry.

For the reason (1), please put all TX sticks at the mid point, and then power cycle the autopilot system to re-record the mid point. If the problem continues, that can be caused by the reason (2) or reason (3), yo u need to adjust the output range of your TX, and then use the Assistant Software to redo the TX cali bration. Please carry out the following procedures.

(1) Connect to the Assistant software, click Basic-> R/C-> Command Sticks Calibration, and push all TX sticks throughout their complete travel range to see if any stick cannot reach its largest position.

(2) Adjust the largest travel of TX stick until the cursor on the Assistant software can reach both end positions, according to your TX manual.

(3) Power cycle the autopilot system, note that power cycle is required.

(4) Redo the TX calibration according to the Assistant software.

Attitude Controllable When One Motor Output is Failed

For Hexa-rotor, including Hexa-rotor I, Hexa-rotor V, Hexa-rotor IY and Hexa-rotor Y, aircraft is attitude controllable when one motor output is failed.

The NAZA-M can still control the attitude of the Hexa-rotor for a safe landing when one motor output of the Hexa-rotor has failed, for example, one motor is stopped or one propeller is broken, etc.

The control mode of NAZA-M should be in Atti. Mode or GPS Atti. Mode. The aircraft will rotate, due to an imbalance of torque; however, it can still be controlled by the Transmitter.

Select Course lock or home lock mode for flying the aircraft into a safe area to land when the aircraft is far away or the attitude can't be recognized. Even when the multi rotor is rotating, using Course lock or home lock mode will allow you to move the multi rotor in the corresponding Transmitter stick direction.

When used with other DJI products

The NAZA-M system communicates with other DJI products (e.g. H3-2D gimbal, BTU module, iOSD mini and iOSD

Mark II) via the CAN-Bus port (⊏|⊐) of the NAZA PMU V2. You can plug new DJI products into any spare CAN-Bus port, since CAN-Bus ports on NAZA-M, CAN HUB, GCU, iOSD mini, iOSD Mark II and 2.4G Bluetooth Datalink are the same for the communications.

When there are not enough CAN-Bus ports for additional DJI products, then a DJI CAN HUB module is recommended. The following diagram is for your connection reference.

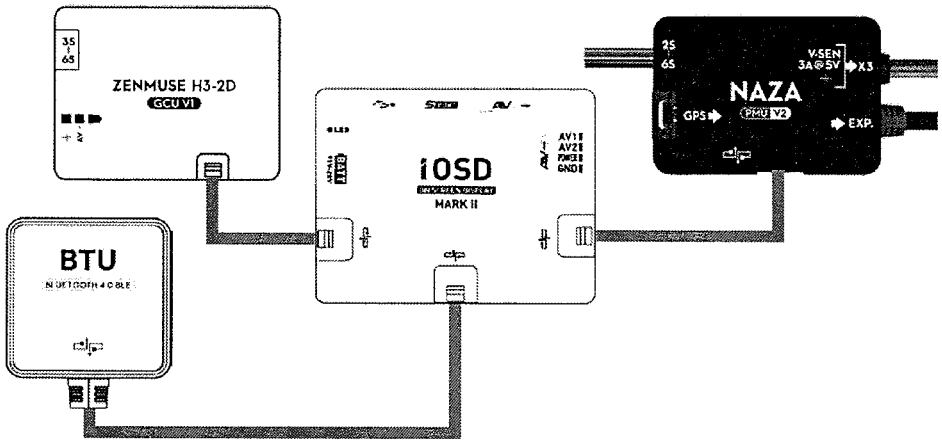


Fig.1 Used with iOSD

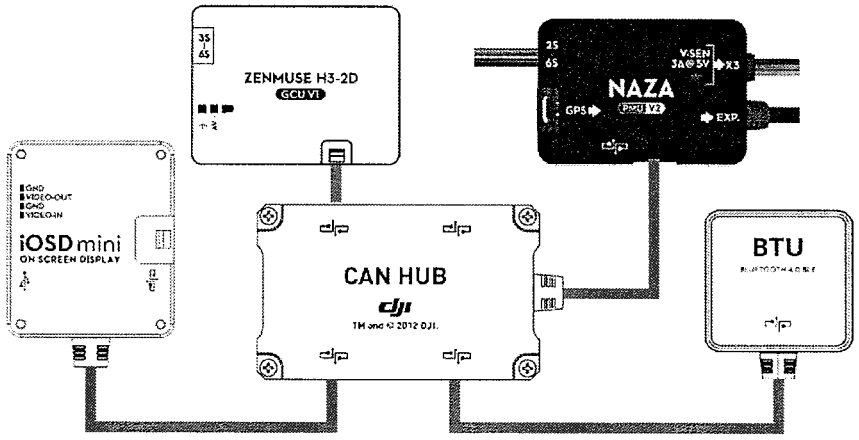


Fig.2 Used with CAN HUB

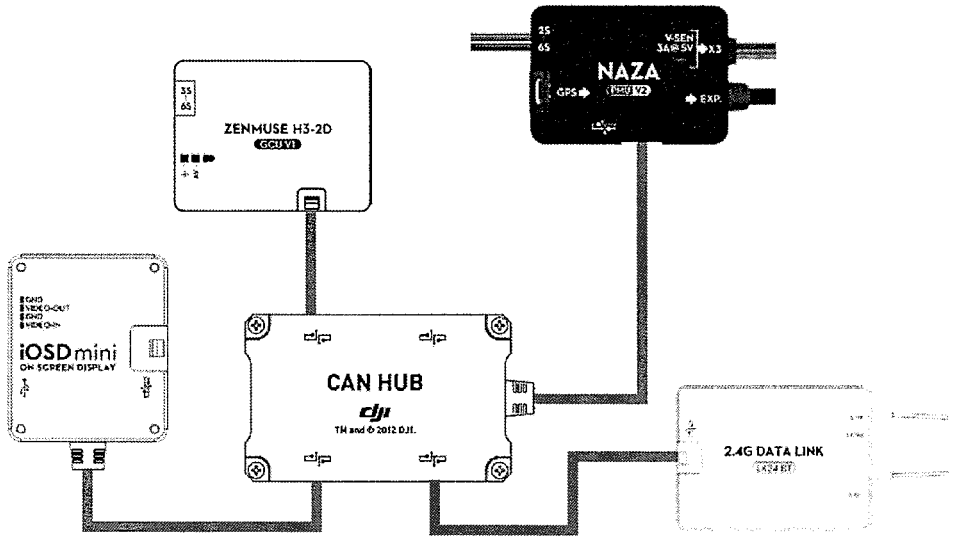


Fig.3 Use a CAN HUB to connect the 2.4G Bluetooth Datalink

(1) Users can use the NM Assistant on the mobile device when a BTU module is connecting with the Ground end of the2.4G Bluetooth Datalink (No need to connect another BTU module to the Flight control system).

M. Exhibit 8: EZUHF lite 8 Channel Receiver

PRODUCT SPECIFICATIONS

Initial Release Date: Dec 2012
R/C Channels: Maximum of 12 PPM, 8 servo outputs (future upgrade to 16 PPM channels)
RF Impedance: 50 ohms
Modulation: GFSK
Hopping: 20 of 40 slots, 2MHz, or 20MHz frequency spread (Extreme Hopping)
Frequency Band (Std. Firmware): 431-433MHz, 433-435MHz, 435-437MHz, 436-438MHz, 430-450MHz (Extreme Hopping)
Length: 70mm
Width: 30mm
Height: 17mm
Weight: 22g
Power Requirements: 4-6v DC