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

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

July 15, 2015

Exemption No. 12044
Regulatory Docket No. FAA–2015–1540

Mr. James Komsa
Shore Aerial Aviation Services, LLC
dba Shore Aerial Photography
990 Cedarbridge Avenue
Suite B7–157
Brick, NJ 08723

Dear Mr. Komsa:

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 24, 2015, you petitioned the Federal Aviation Administration (FAA) on behalf of Shore Aerial Aviation Services, LLC dba Shore Aerial Photography (hereinafter petitioner or operator) for an exemption. The petitioner requested to operate an unmanned aircraft system (UAS) to conduct aerial photography and videography.

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 is a DJI S-900.

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 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, Shore Aerial Aviation Services, LLC dba Shore Aerial Photography 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, Shore Aerial Aviation Services, LLC dba Shore Aerial Photography 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 DJI S-900 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

990 Cedarbridge Avenue
Suite B7-157
Brick, New Jersey 08723
1.800.292.8043

April 24, 2015

U.S. Department of Transportation
Docket Management System
1200 New Jersey Avenue, SE
Washington, DC 20590

Re: Exemption Request under Section 333 of the FAA Reform Act and Part 11 of the FAA Regulations and certain parts of the FARs.

Dear Sir or Madam:

INTRODUCTION AND INTERESTS OF PETITIONER

Pursuant to Section 333 of the FAA Modernization and Reform Act of 2012 (the "Reform Act") and 14 C.F.R. Part 11, Shore Aerial Aviation Services, LLC dba Shore Aerial Photography , an aerial photography company, hereby applies for an exemption from the listed Federal Aviation Administration ("FARs") to allow commercial operation of its Small Unmanned Aerial System (sUAS) for aerial imaging, so long as such operations are conducted within and under the conditions outlined herein or as may be established by the FAA as required by Section 333.

As detailed in this document and the attached proprietary Aircraft Information/Operators Manual, the requested exemption would permit the operation of sUAS under controlled conditions in airspace that is limited, predetermined, controlled as to access and would provide safety enhancements to the collection of aerial photography and videography.

Approval of this exemption would hereby enhance safety and fulfill the Secretary of Transportation's (the FAA Administrator's) responsibilities to "…establish requirements for the safe operation of such aircraft systems in the national airspace system." Section 333(c) of the Reform Act.

James Komsa is the owner and operator of Shore Aerial Photography and will serve as the PIC. He holds a private pilot certificate with an instrument rating. His associate and co-owner is Patricia Komsa and she will serve as the safety coordinator as well as the VLOS spotter.

NAME AND ADDRESS OF PETITIONER

The name and address of the applicant is:

Shore Aviation Services, LLC, dba Shore Aerial Photography
Attn: James Komsa
990 Cedarbridge Avenue
Suite B7-157
Brick, NJ 08723
800-292-8043
Email: jim@shoreaerial.com

SECTIONS OF 14 C.F.R. FROM WHICH SHORE AERIAL PHOTOGRAPHY SEEKS EXEMPTION

14 C.F.R. 91.7(a)
14 C.F.R. 91.119(c)
14 C.F.R. 91.121
14 C.F.R. 91.151(b)
14 C.F.R. 91.405(a)
14 C.F.R. 91.407(a)
14 C.F.R. 91.409(a)
14 C.F.R. 91.417(a)

EXTENT OF RELIEF AND REASON SHORE AERIAL PHOTOGRAPHY SEEKS RELIEF

14 C.F.R. 91.7(a) Civil aircraft airworthiness

An equivalent level of safety will be provided given the size of the aircraft and the requirements contained in the Aircraft Information/Owner's Manual for maintenance and use of safety checklists prior to each flight.

14 C.F.R. 91.119(c) Over other than congested areas

Operations of the aircraft will be conducted at distances less than 500 feet from participating persons, vessels, vehicles or structures that perform an essential function in connection with these special purpose operations.

14 C.F.R. 91.121 Altimeter settings

Altitude of the aircraft will be provided to the PIC via radio communications telemetry data link, which downlinks from the aircraft to the PIC for active monitoring of the aircraft's altitude.

14 C.F.R. 91.151(b) Fuel requirements for flight in VFR conditions

The sUAS will not begin flight unless (considering wind and forecast weather conditions) there is enough fuel (battery voltage) to fly to the first point of attending landing and, assuming normal cruising speed, to fly after that for at least two minutes.

14 C.F.R. 91.405(a) Maintenance requested, 14 C.F.R. 91.407(a) Operation after maintenance, preventative maintenance, rebuilding or alteration, 14 C.F.R. 91.409(a) Inspections, 14. C.F.R. 91.417(a), maintenance records

Shore Aerial Photography's aircraft Information/Operator's Manual contains daily, preflight, monthly and yearly checks for the aircraft. Adherence to this manual is sufficient to ensure that safety is not adversely affected

Shore Aerial Photography will carry out its maintenance, inspections and record keeping requirements in accordance with the Aircraft Information/Operators Manual. Maintenance , inspection and alterations will be noted in the aircraft logbook, including total flight hours, description of work accomplished and the signature of the authorized sUAS technician returning to service.

SHORE AERIAL PHOTOGRAPHY'S SUPPORT OF REQEUST; ORGANIZED INTO THREE SECTIONS

1. The unmanned aircraft system
2. The sUAS Pilot in Command (PIC)
3. The sUAS operating parameters

(1)The Unmanned Aircraft Systems

The unmanned aircraft system that Shore Aerial Photography intends to use is the DJI S-900.

The DJI S-900 is a radio controlled electric powered (battery) carbon fiber Hexacopter measuring 25 inches high by 18 inches wide. Its weights 13.5 pounds empty and 16 pounds with the camera and battery. The aircraft carries a Sony Nex 7 camera or similar device, stabilized by a three axis gimball. Communications between the PIC and sUAS will be accomplished using a standard hand held R/C transmitter on the ground and a receiver on the sUAS. The system operates on a frequency of 2.4Ghz which is permitted by the FCC. The transmitter/receiver uses telemetry to send certain data such as altitude and battery levels back to the PIC via transmitter. Further details of the use and maintenance can be found in the Aircraft Information/Operators Manual of the DJI S-900. The sUAS will not weigh more than 15 pounds when fully loaded, operates under normal conditions, at speeds no greater than 30 knots, carries no explosive materials or flammable liquid fuels, operates exclusively within a secure area detailed in this application with no pilots or passengers on board. In the event of a GPS or communication signal loss, the sUAS possesses the ability to return to a pre-determined location with the secured perimeter and land.

Shore Aerial Photography will perform maintenance by the following procedures outlined in the Aircraft Information/Operators manual. The Aircraft Information/Operators manual prescribes required maintenance and requires the operator to keep a log pertaining to each flight. Shore Aerial Photography notes that because of the aircraft's limited size, payload and operational constraints, immediate landings can be performed in case of mechanical issues.

Given the size and weight of the sUAS, the fact that it has a limited range (15 minutes max. battery), carries no flammable fuel, carries no crew or passengers and employs fail safe features, Shore Aerial Photography believes it can be operated within the NAS with minimal risk to persons and property in the air and on the ground.

(2)The sUAS Pilot in Command

Shore Aerial Photography proposes that, lacking any current sUAS PIC licensing procedures, the operator of its sUAS should hold at least a private pilot certificate with a valid third class medical certificate.

James Komsa is the owner and operator of Shore Aerial Photography and will serve as the PIC. He holds a private pilot certificate with an instrument rating. Additionally, he is actively training for his commercial pilot license and he has a valid third class medical certificate. James is also a police officer in the State of New Jersey. His associate and co-owner Patricia Komsa will serve as the safety coordinator as well as the VLOS spotter.

Anyone else that would be acting as PIC of Shore Aerial Photography's S900 would first have to demonstrate to James Komsa that he or she has met the qualifications outlines above and is capable to act as PIC of the sUAS.

(3) The sUAS Operating Parameters

Operations authorized by this grant of exemption would be limited to Shore Aerial Photography's sUAS, the DJI S-900 as described in the Aircraft Information/Operators Manual, which is included in this petition.

The sUAS will not be flown at an indicated airspeed of greater than 30 knots.

The sUAS will be operated at an altitude of no more than 400 feet above ground level (AGL), as indicated by the procedures specified in the Aircraft Information/Operators Manual. All altitudes reported to ATC will be in feet AGL.

The sUAS will be operated within the visual line of sight (VLOS) of the PIC at all times

All operations will utilize a visual observer (VO). The VO and PIC will be able to communicate verbally at all times. The PIC will be designated before flight and cannot transfer his/her designation for the duration of the flight. The PIC will ensure that the VO can perform the functions prescribed in the Aircraft Information/Operators manual.

Prior to each flight, the PIC will inspect the UAS to ensure it is in a condition of safe flight. It the inspection reveals a condition that affects the safe operation of the sUAS, the aircraft will be taken out of service until the necessary maintenance has been performed and the sUAS is found to be in a condition for safe flight. The ground control station will be included in the preflight inspection. All maintenance and alterations will be properly documented in the aircraft records.

If the sUAS has undergone maintenance or alterations that affect the sUAS operation of flight characteristics, it will undergo a functional test flight in accordance with the aircraft information/owner's manual. The PIC who conducts the functional test flight will make an entry in the sUAS records of flight.

Shore Aerial Photography will carry out its maintenance, inspections, and record keeping requirements in accordance with the aircraft Information/Operators Manual. Maintenance, inspection and alteration

will be noted in the aircraft logbook, including total flight hours, description of work accomplished and the signature of the authorized DJI technician returning the DJI S900 to service .

The PIC will possess at least an FAA Private Pilot's Certificate and at least a third class medical certificate.

If the sUAS loses communications or loses its GPS signal, the sUAS will return to a pre-determined location within the private or controlled-access property and land or be recovered.

The PIC will abort the flight in the event of unpredicted obstacles or emergencies in accordance with the Aircraft Information/Operators Manual.

The PIC will not begin flight unless (considering wind and forecast weather conditions) there is enough power (battery voltage) to fly to the first point of intended landing and, assuming normal cruising speed, to fly after that for at least two minutes.

Before conducting operations, the radio frequency spectrum used for operation and control of the sUAS will comply with the FCC or other appropriate government oversight agencies.

The documents required under 14 C.F.R. 91.9 and 91.203 will be available to the PIC at the ground control station of the sUAS any time the aircraft is operating. These documents will be made available to the Administrator or any law enforcement officer upon request.

The sUAS will remain clear of and yield the right of way to all other manned operations and activities at all times (included but not limited to ultra-light vehicles, parachute activities, parasailing activities, hand gliders, etc..).

sUAS operations will not be conducted during night as defined in 14 C.F.R. 1.1.

All operations will be conducted in Class G airspace.

During operations in Class G airspace, the SUAS will not operate within five nautical miles of the geographic center of an airport denoted on a current FAA-published aeronautical chart unless a letter of agreement with the airport's management is obtained and the operation is conducted in accordance with a NOTAM as required by the operator's COA. The letter of agreement with the airport management will be made available to the Administrator upon request.

The sUAS will not be operated over congested or densely populated areas.

Operation of the sUAS will be conducted at distances less than five hundred feet from participating persons, vessels, vehicles or structures that perform an essential function in connection with these special purpose operations.

Operations of the sUAS may be conducted as distances of less than five hundred feet from unoccupied vessels, vehicles or structures owned by the land owner/controller when the land owner/controller grants such permission and the PIC makes a safety assessment of the risk from operations closer to these objects.

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

REASONS WHY GRANTING SHORE AERIAL PHOTORAPHY'S REQUEST

WOULD BE IN THEH PUBLIC INTEREST

Shore Aerial Photography submits this Petition to perform commercial operations using its sUAS for aerial photography and videography.

Our clients will be inclusive of but not limited to commercial construction companies, land developers, real estate agents, marinas, solar farms and owners of cellular facility telephone towers.

With regard to cellular facility telephone towers, routine inspections of the towers frequently required to assess the integrity of the towers and/or to make a assessment as to the cause of a technical problem To accomplish this, owners of cellular telephone towers have to hire a team of climbers to make the assessment which is extremely risky to the climbers. According to the US Department of Labor, in 2013 alone, thirteen tower climbers were killed at communication tower worksites. See attached OSHA document.

As a result of the high risks associated with tower climbers, a portion of our clients will be owners of cellular telephone facilities. Our clients will reduce injury/death of tower climbers by having a sUAS take still images and provide live video feed to conduct visual inspections of these facilities. It should be noted that a traditional manned aircraft cannot safely or legally get low or close enough to a cellular telephone tower to obtain aerial images and/or video of a tower for inspection purposes. Additionally, there is a significant risk to life and property in the air and on the ground in attempting to use a manned aircraft for this type of operation.

The sUAS with its small size and weight, has less physical potential for collateral damage to life and property on the ground, and in the air, compared to manned aircraft. As a result, the risk associated with aerial photography and videoagraphy using a manned aircraft will be substantially reduced or completely eliminated.

In addition, these public and private clients who require aerial photography/videography will be able to be provided these services at a lower economic cost than using a manned aircraft.

REASONS WHY GRANTING EXEMPTION WOULD NOT ADVSERSELY EFFECT PUBLIC SAFETY

Many of the same reasons that this exemption would be in the public interest apply to why it would not adversely affect safety. As previously stated, the risk to life and property in the air and on the ground, which is usually associated with manned aircraft flight operations, will be substantially reduced or completely eliminated. Aside from the lack of aircrew members located on board the aircraft, the sUAS, with its small size and weight, has less physical potential for collateral damage to life and property on the ground, and in the air, compared to manned aircraft that typically conduct aerial photography and videography.

Properly using sUAS to perform the tasks outlined above would be safer than traditional methods.

SUMMARY THAT CAN BE PUBLISED IN THE FEDERAL REGISTRAR

Shore Aviation Services LLC, dab Shore Aerial Photography, an aerial photography company, seeks exemption from the requirements of 14 C.F.R. 91.7(a), 91.119(c), 91.121, 91.151(b), 91.405(a), 91.407(a), 91.409(a) and 91.417(a). This exemption would permit Shore Aerial Photography to operate its sUAS to safely collect various forms of aerial images and video for commercial use.

14 C.F.R. 91.7(a) civil aircraft airworthiness

An equivalent level of safety will be provided given the size of the aircraft and the requirements contained in the aircraft information/owner's manual for maintenance and use of safety checklists prior to each flight.

14 C.F.R. 91.119(c) over other than congested areas

Operations of the aircraft will be conducted at distances less than 500 feet from participating persons, vessels, vehicles or structures that perform an essential function in connection with these special purpose operations.

14 C.F.R. 91.121 Altimeter settings

Altitude of the aircraft will be provided to the PIC via radio communications telemetry data link, which downlinks from the aircraft to the PIC for active monitoring of the aircraft's altitude.

14 C.F.R. 91.151(b) Fuel requirements for flight in VFR conditions

The sUAS will not begin flight unless (considering wind and forecast weather conditions) there is enough fuel (battery voltage) to fly to the first point of attending landing and, assuming normal cruising speed, to fly after that for at least two minutes.

14 C.F.R. 91.405(a) Maintenance requested, 14 C.F.R. 91.407(a) Operation after maintenance, preventative maintenance, rebuilding or alteration, 14 C.F.R. 91.409(a) Inspections, 14. C.F.R. 91.417(a), maintenance records

Shore Aerial Photography's aircraft information/operator's manual contains daily, preflight, monthly and yearly checks for the aircraft. Adherence to this manual is sufficient to ensure that safety is not adversely affected

Shore Aerial Photography will carry out its maintenance, inspections and record keeping requirements in accordance with the aircraft information/operators manual. Maintenance , inspection and alterations will be noted in the aircraft logbook, including total flight hours, description of work accomplished and the signature of the authorized SUAS technetium returning to service.

CONCLUSION

As set forth above, Shore Aerial Photography seeks an exemption pursuant to 14 C.F.R. 11.61 and Section 333 of the FAA Modernization and Reform Act which will permit the safe operation of its sUAS commercially, for the special purpose of conducting aerial photography and videography along with aerial inspections of cellular facility towers. By granting the Petition, the FAA Administrator will be fulfilling the Congressional mandate of the FAA Modernization and Reform Act of 2012, while also advancing the interests of the public, by allowing Shore Aerial Photography to safely, efficiently and economically operate its sUAS commercially within the NAS.

Respectfully submitted,

James Komsa
Owner, Shore Aerial Photography

APPRENDICES

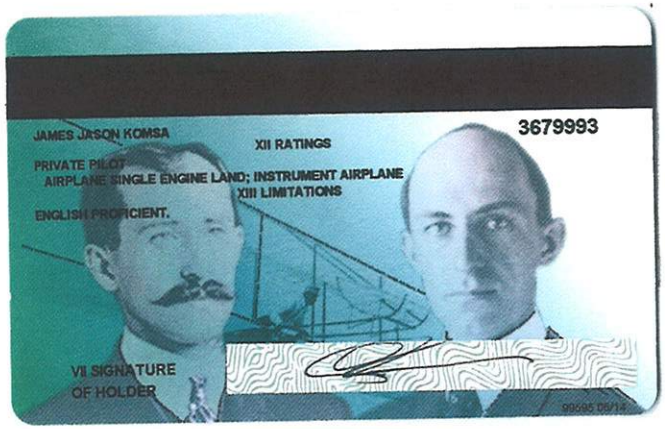
FAA Private Pilot Certificate

Third Class Medical

Aircraft Information/Operator's Manual for DJI S-900/Preflight checklist

OSHA Letter to Tower Industry Employers


I UNITED STATES OF AMERICA XI
DEPARTMENT OF TRANSPORTATION • FEDERAL AVIATION ADMINISTRATION
IV NAME
JAMES JASON KOMSA
V ADDRESS 109 SEAGOIN RD
BRICK NJ 08723-6736
VI NATIONALITY USA
SEX HEIGHT WEIGHT HAIR EYES
M 64 170 BROWN BROWN
Va D.O.B. 2 FEB 1977
IX HAS BEEN FOUND TO BE PROPERLY QUALIFIED TO EXERCISE THE PRIVILEGES OF
II PRIVATE PILOT
III CERTIFICATE NUMBER 3679993
X DATE OF ISSUE 24 SEP 2014
XIV
VIII ADMINISTRATOR


JAMES JASON KOMSA
3679993
XII RATINGS
PRIVATE PILOT
AIRPLANE SINGLE ENGINE LAND; INSTRUMENT AIRPLANE
XIII LIMITATIONS
ENGLISH PROFICIENT.
VII SIGNATURE
OF HOLDER

UNITED STATES OF AMERICA
Department of Transportation
Federal Aviation Administration

MEDICAL CERTIFICATE THIRD CLASS

This certifies that ***(Full name and address):***

JAMES Jason KOMSA
109 Seagoin Road
Brick NJ 08723 USA

Date of Birth	Height	Weight	Hair	Eyes	Sex
02/02/1977	64	167	BROWN	BROWN	M

has met the medical standards prescribed in part 67, Federal Aviation Regulations, for this class of Medical Certificate.

Limitations

Not valid for any class after 1/31/2016.

Date of Examination	Examiner's Designation No.
01/08/2015	12719

Examiner

Signature

Typed Name
JOSEPH R TORDELLA , DO

AIRMAN'S SIGNATURE

Applicant ID: 2001796530 Control No.: 200006740985

FAA Form 8500-9 (9-08) Supersedes Previous Edition NSN: 0052-00-670-7002

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CONDITIONS OF ISSUE

The holder of this certificate must:

- Have it in his or her personal possession at all times while exercising privileges of an airman certificate. (14CFR § 61.3)
- Understand that the issuance of a medical certificate by an Aviation Medical Examiner may be reversed by the FAA within 60 days. (14CFR § 67.407)
- Comply with validity standards specified for first-, second-, and third-class medical certificates. (14CFR § 61.23)
- Comply with any statement of functional, operational, and/or time limitation issued as a condition of certification. (14CFR § 67.401) (Note: A letter of authorization (or SODA) describing any such limitations must be kept with this certificate at all times while exercising the privileges of an airman certificate.)
- Comply with the standards relating to prohibitions on operation during medical deficiency. (14CFR §§ 61.53, 63.19, and 65.49)

For International Operations Only: Some holders may be affected by certain international medical standards. Consult the U.S. Aeronautical Information Publication for U.S. differences with ICAO Annex 1 medical standards.

Date :	August 4, 2014
S900 User Manual Version :	1.00
S900 ESC Firmware Version :	3.6

August 4, 2014 DJI Spreading Wings S900

S900 Overview

1. Safe and stable

(1) The S900's V-type mixer design provides large amounts of propulsion while improving power efficiency. Combined with DJI flight controllers like the A2, it is guaranteed to remain stable even with the loss of a rotor.

(2) A more reliable, safe, and simplified power wiring system is easy to setup, and eliminates the need for soldering. The main power cord uses an AS150 spark-proof plug and an XT150 plug, preventing creators from mixing up polarity when plugging in the battery, and also helping prevent short circuits.

(3) All frame arms and the retractable landing gear are made from carbon fiber, ensuring light weight and high structural stability.

2. Professional hexacopter

(1) Weighing approximately 3.3kg with a maximum takeoff weight of about 8.2kg, the S900 can easily carry equipment such as the Zenmuse gimbal systems and a set of shooting equipment. Used with a 6S 15000mAh battery it can fly for up to 18 minutes.

(2) The gimbal is mounted low on the frame on a specifically designed bracket. When combined with our retractable landing gear, you have very wide range of possible shooting angles.

(3) The gimbal and battery are mounted to the same bracket, with dampers placed between the bracket and the frame. This significantly reduces high-frequency vibrations and makes shots clearer and sharper. The battery tray's position also makes it more stable and convenient for mounting and dismounting.

(4) The S900 supports most of the Zenmuse series of gimbals. (The Z15-5D gimbal is not currently supported by the S900. Please use the S1000 platform when using the Z15-5D.)

3. Portable and easy to use

(1) All six arms can be folded down, and the 1552 folding propellers can be tucked away, minimizing the S900's size during transport.

(2) To fly, simply lift the frame arms up, lock them in place with the red clips, and power up the system. This greatly saves on pre-flight prep time and you can be ready to fly in less than 5 minutes.

(3) The upper center plate can be removed quickly, making it convenient and efficient to arrange or change the power system, control system, and other accessories.

4. Easy to control and fly

(1) Each frame arm is designed with an 8° inversion and a 3° inclination, making the aircraft more stable when rolling and pitching, and more flexible when rotating.

(2) Each frame arm has a built-in 40A electronic speed controller (ESC). When combined with the 4114 pro motor and high performance 1552 folding propellers, the S900 is capable of a maximum thrust of 2.5Kg.

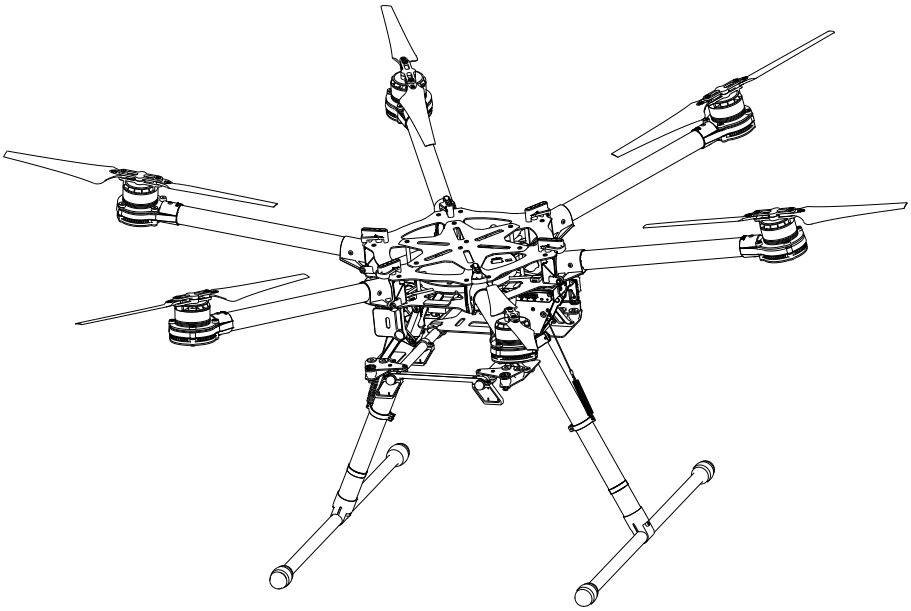
New Product Specification

Frame	
Diagonal Wheelbase	900mm
Frame Arm Length	358mm
Frame Arm Weight (with Motor, ESC, Propeller)	316g
Center Frame Diameter	272mm
Center Frame Weight (with Landing Gear Mounting Base, Servos)	1185g
Landing Gear Size	460mm(Length)×450mm(Width)×360mm(Height)
Motor	
Stator Size	41×14mm
kV	400rpm/V
Max Power	500W
Weight (with Cooling Fan)	158g
ESC	
Working Current	40A
Working Voltage	6S LiPo
Signal Frequency	30Hz ~ 450Hz
Drive PWM Frequency	8KHz
Weight (with Radiators)	35g
Foldable Propeller (1552/1552R)	
Material	High strength performance engineered plastics
Size	15×5.2 inch
Weight	13g
Flight Parameters	
Takeoff Weight	4.7Kg ~ 8.2Kg
Total Weight	3.3Kg
Power Battery	LiPo (6S, 10000mAh ~ 15000mAh, 15C(Min))
Max Power Consumption	3000W
Hovering Power Consumption	1000W (@6.8Kg Takeoff Weight)
Hovering Time	18min (@12000mAh & 6.8Kg Takeoff Weight)
Working Environment Temperature	-10°C ~ 40°C

Spreading Wings S900

User Manual V1.2

2014.12



Disclaimer

Thank you for purchasing the S900. Please visit the Spreading Wings S900 page on www.dji.com regularly to keep up to date with product information, technical updates and manual corrections. Information in this manual is subject to change without notice.

In using this product, you hereby agree to this disclaimer and signify that you have understood all points completely. When assembling this product, follow all instructions carefully. The manufacturer and seller assume no liability for any damage or injury arising from the use of this product.

This is a class A product of the FCC certification. In a domestic environment this product may cause radio interference, in which case the user may be required to take adequate measures.

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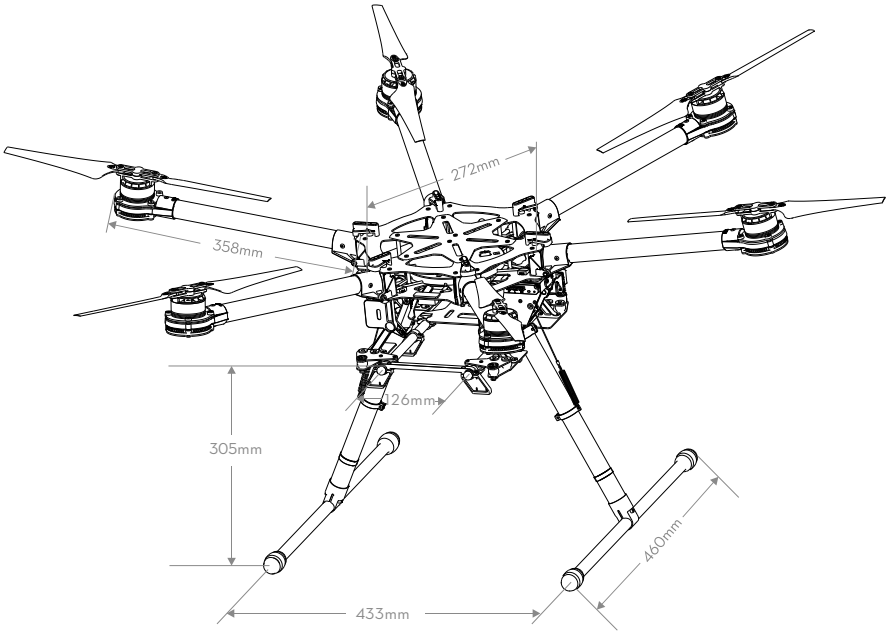
About

The S900 is designed for professional aerial photography and cinematography. It is user friendly, safe, stabilized and easy to fly while its integrated design makes assembly and configuration simple and fast. Retractable landing gear, vibration dampers, slightly angled arms and a minimalized gimbal mount allow for a clear 360 degree view from the camera. A patented power distribution board, built-in high-speed ESCs and motors with high efficiency propellers ensure dynamic stability and maximized power efficiency. Used with a professional DJI multi-rotor autopilot system, the S900 can hover and fly reliably making it ideal for photography and cinematography.



Contents

Cautions

When flying, the rotating propellers may cause serious damage and injury. Please fly safe at all times.

Assembly Cautions

1. Use a bracket to mount the GPS module on the center frame to avoid interference with the power board.
2. Ensure the IMU is mounted with the arrow pointing toward the nose of the aircraft.
3. If using a receiver, attach it under the bottom board of the center frame with the end of the antenna facing downwards and away from obstructions to avoid signal loss.
4. Ensure frame arms are mounted correctly.
   a) Motor mounts with CCW marks should be mounted to the center frame positions with the following marks: M1, M3 and M5.
   b) Motor mounts with CW marks should be mounted to the center frame positions with the following marks: M2, M4, and M6.
5. Do not remove any glued-in screws.
6. Screws that already have blue glue can be used once without thread locker. On other occasions, apply appropriate thread locker first.
7. The S900 should be lifted off the ground when testing landing gear or recalibrating servo travel.

Flight Cautions

1. ESCs are not water-proof, please do not fly in rain or snow.
2. Ensure all soft dampers and vibration absorbers are in good condition before every flight. If not, replace immediately. Otherwise, the flight performance of your aircraft will be adversely affected.
3. Ensure all parts are in good condition before each flight. Do not fly with worn or broken parts.
4. Ensure propellers and motors are installed correctly and propellers are unfolded before flying.
5. Ensure ESC signal connectors and power cable connectors are tight before every flight.
6. When flying, maintain a safe distance away from people, buildings, high-voltage lines, tall trees, water and other hazards.
7. Use only 6S LiPo batteries for the power supply.
8. Ensure all output signals from M1 to M6 are in proper working order when using the DJI A2 flight control system to avoid damage or injury.
9. Do not overload the system.
10. Do not get close to or touch motors or propellers when they are spinning as this can cause serious injury.
11. Disconnect the battery and remove the camera during transportation to avoid damage or injury.
12. We strongly recommend using as many DJI manufactured parts as possible.

Others

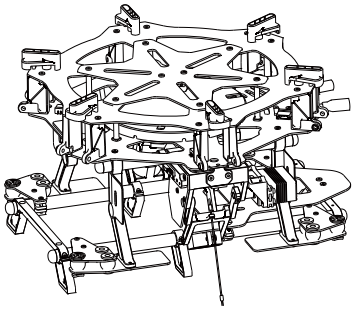
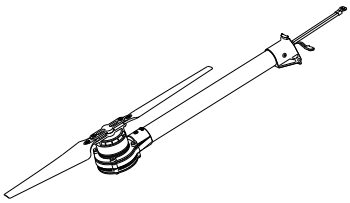
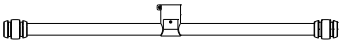
If you have any problems you cannot resolve, contact your dealer or DJI customer service.

Legend

Important

Hints and Tips

In The Box

Center Frame ×1	Frame Arms ×6
	
Landing Skid Tubes ×2 (with Silicone Rubber Dampers)	**Landing Gear Legs ×2**
	
GPS Collapsible Mount ×1	**Springs ×2**
	
Connection Cable	**Accessories Package ×1**
Connector Set ×1  or 3-PIN Connection Cables ×8 	CW propellers ×2 CCW propellers ×2 Magic tapes ×4 The red knobs ×6 Landing gear leg rings ×4 Soft dampers ×50
3-PIN Servo Cable ×1	**Screw Package ×1**
	For frame arms mount: M4×35 For landing gear mount: M3×8, M2.5×8 (socket cap), M3×22 (socket cap)

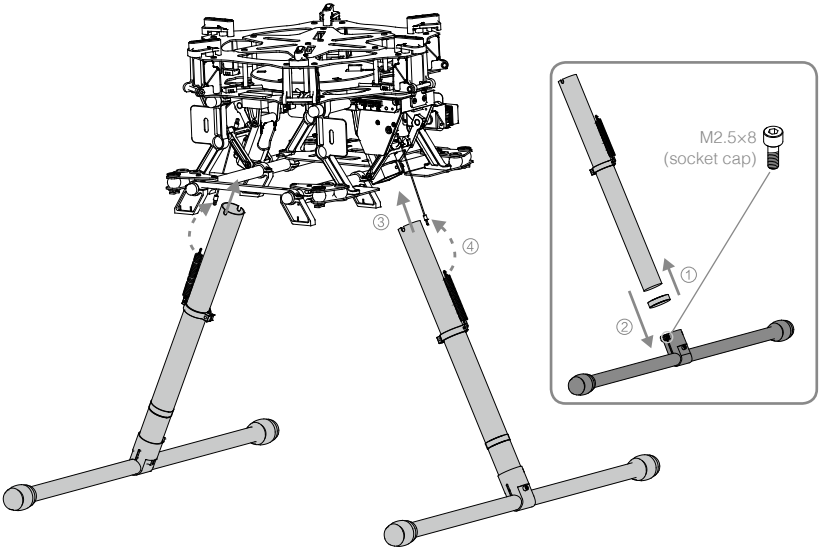
Tools Required

Tools	Usage
2.0mm Hex Wrench, 2.5mm Hex Wrench	Mounting screws.
Thread Locker	Fastening screws.
Nylon Cable Tie, Scissors, Cutting Pliers/Dykes	Binding devices and wires.
Foam Double Sided Adhesive Tape	Mounting receiver, controller and other modules.

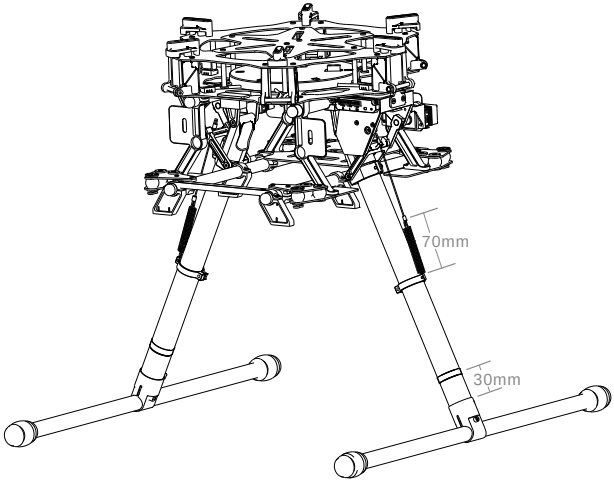
Mounting the Landing Gear

Instructions

1. Put one landing gear leg ring onto each landing gear leg.
2. Insert one landing gear leg into each landing skid tube and secure it in place by tightening the M2.5×8 (socket cap) screw. Ensure silicone rubber dampers are attached to each end.
3. Insert the landing gear leg into connection point on the center frame. Affix in place with M3×8 screws.
4. Connect both springs on the legs to the center frame.



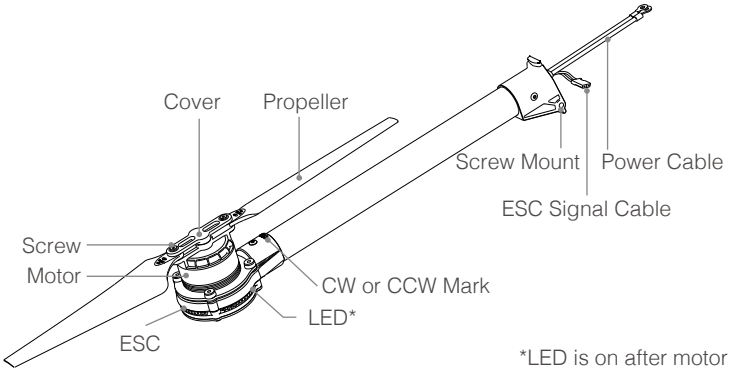
- Note the springs are 58.5mm before connecting to the center frame, and are stretched to 70mm when mounting is completed.
- It is recommended that the landing gear leg ring be placed about 30mm above the landing skid tube.



Mounting Frame Arms

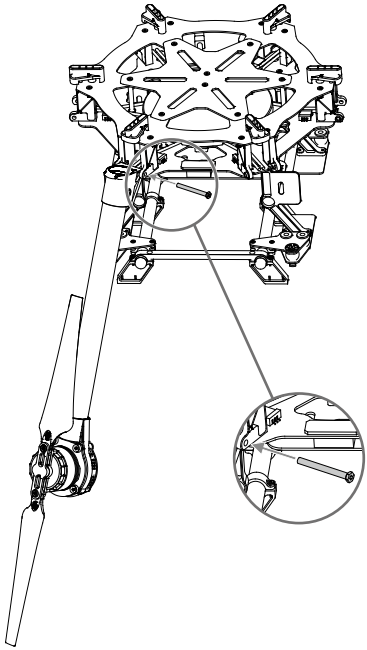
Instructions

1. Prepare the arms.
   (1) Check all propellers for cracks, then install and screw each propeller cover on tightly.
   (2) Ensure all motors are mounted firmly and rotate freely.
   (3) Mount all arms with red propeller covers to M1 and M2 to indicate the nose of the S900.
   (4) Identify the CW and CCW marks on the arms. Mount the arms with the CCW mark to the M1, M3 and M5 positions of the center frame. The arms with the CW mark should be mounted to the M2, M4 and M6 positions of the center frame.

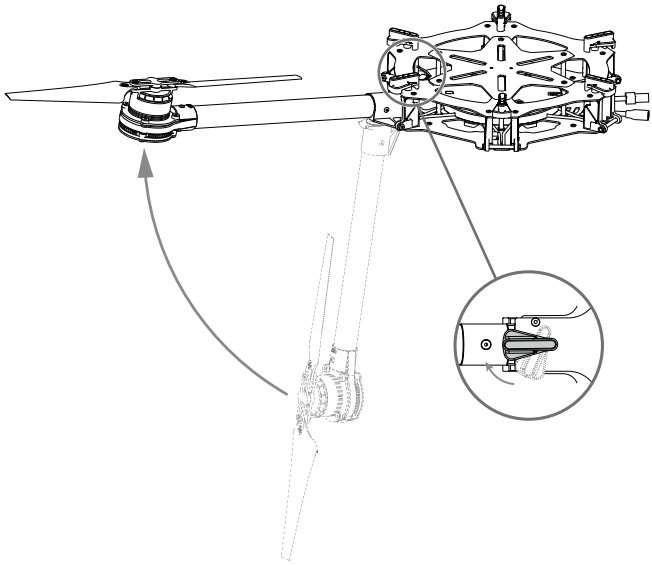


*LED is on after motor started.

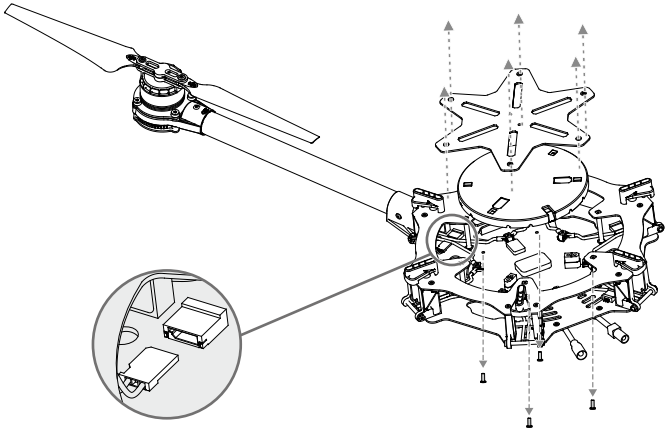
2. Insert each frame arm vertically into the mounting area on the center frame.
3. Line up the screw holes of the frame arm and center frame.
4. Insert the M4×35 screw from the right of the frame arm (the thread is located on the left of the screw mount). Tighten each screw correctly. Over tightening may lead to connector abrasion.



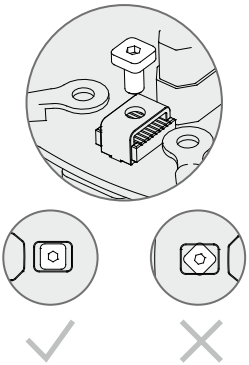
5. Gently lift the frame arm.
6. Twist the red knob to lock each arm in place. Be sure there is an audible click, which indicates a proper lock. Check the arm for movement. To store, untwist the knob and lower the frame arm.

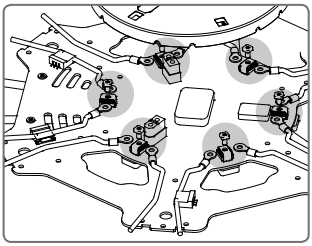


7. Now unscrew 6 screws (M2.5×8 cheese) on the upper plate of the center frame and remove the upper plate. Then unscrew the 4 screws (M3×8 self-tapping, found under the center frame) of the round cover and remove it to gain access to the ESC and power cable installation area.
8. Plug each ESC signal cable into the slot near each arm on the center frame.

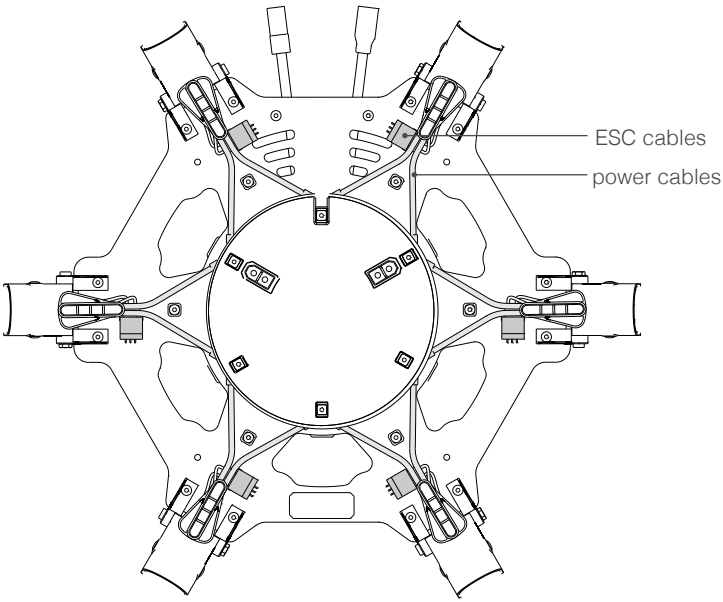


9. Connect the power cables to the center frame. Each cable must be screwed into a positive (+) or negative (-) gold bracket. Each bracket will have two cables of the same color screwed into it. Red cables are positive and black cables are negative.
10. To ensure a reliable connection, rotate the screw until it is both tight and parallel to the connecting bracket.

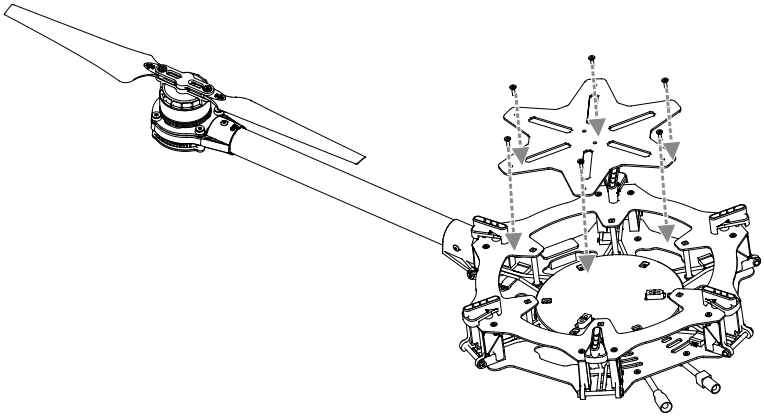




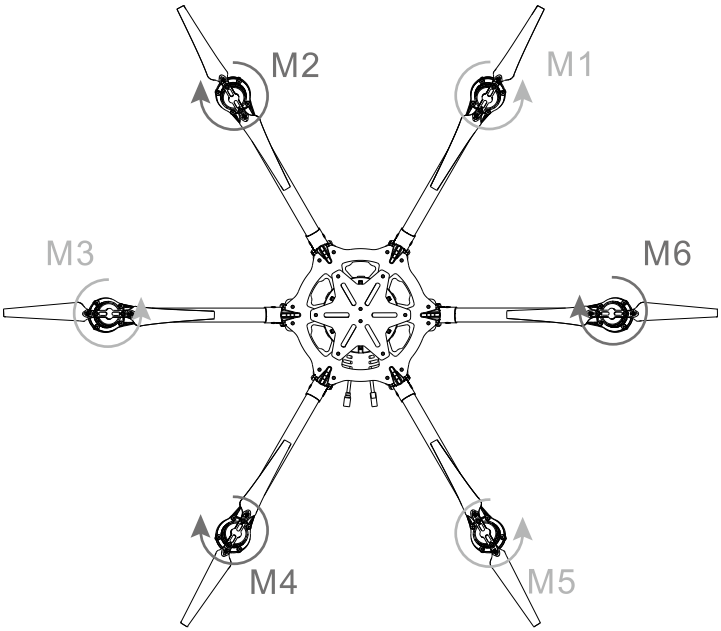
11. Ensure all ESC cables, and power cables are correctly installed onto the center frame.



12. Replace the round cover of the center plate, and re-tighten the 4 screws (M3×8 self-tapping). Then replace the upper plate of the center frame, and re-tighten the 6 screws (M2.5×8 cheese).



13. Double check all frame arms. Arms M1 and M2 are the forward facing (nose), arms M4 and M5 are the tail. Seen from the top, motors on arms M1, M3 and M5 rotate counter clockwise while those on arms M2, M4 and M6 rotate clockwise.

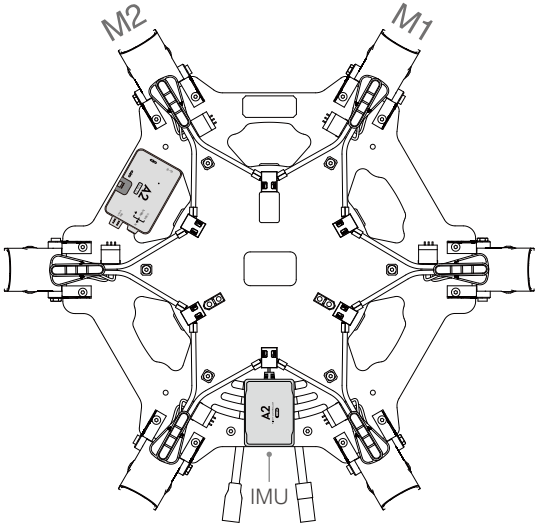


Mounting Electronics and Wiring

Eight positions are reserved for mounting a flight control system, wireless video transmission module, receiver, and other accessories. The DJI A2 flight control system has been used here as an example. If using an A2, follow mounting and wiring instructions found in the A2 flight control system user manual. If using the DJI WK-M flight control system, please refer to the WK-M user manual for connections. Also be sure the firmware on your DJI flight controller has been updated to the latest version.

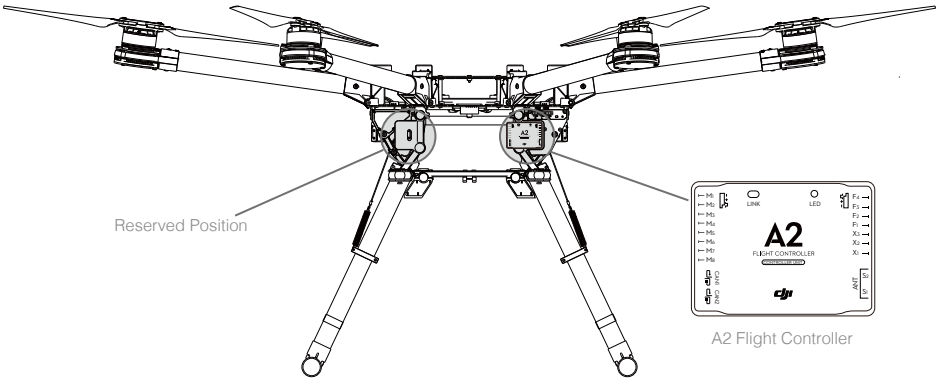
Instructions

1. Attach IMU module to the IMU area of the center frame. Ensure that it points toward the nose.
2. Attach the PMU module to the center frame.

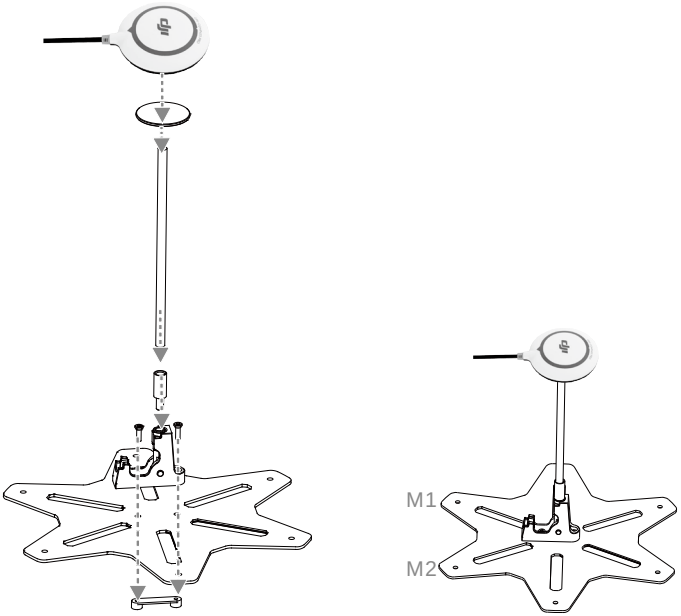


⚠ Only mount the IMU in the IMU position of the center frame.

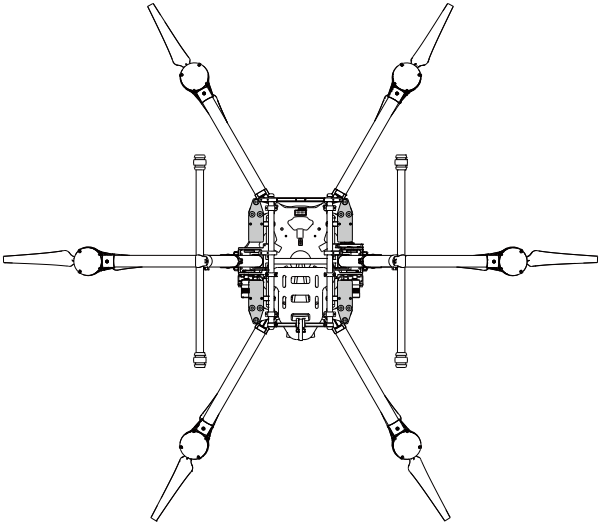
3. Mount the flight controller in the reserved position near the PMU module.



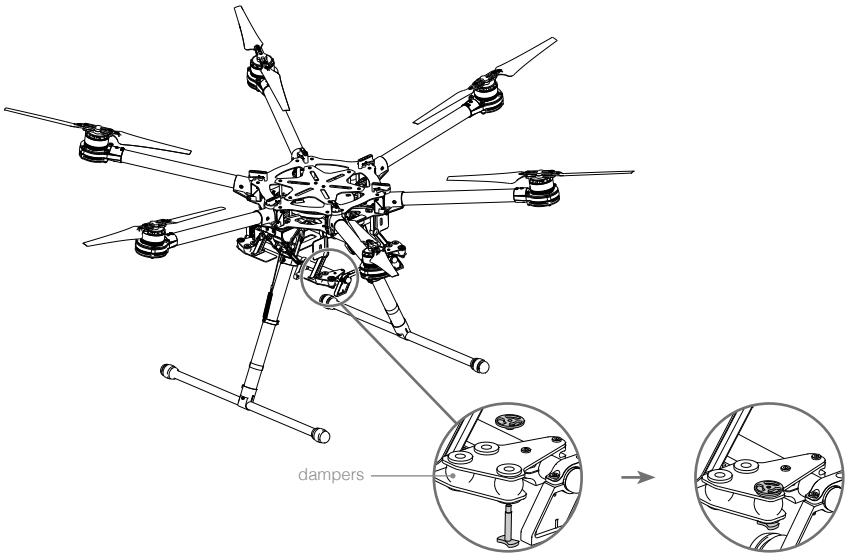
4. Attach the GPS collapsible mount to the center frame using M2.5×8 screws.
5. Mount a GPS module to the GPS mount with a bracket. Ensure the arrow points toward the nose and avoid catching your fingers in the bracket when folding for transportation.



6. The other reserved positions are indicated in the diagram below and can be used for mounting a receiver, LED flight indicator, iOSD module and wireless video transmission module.



7. Check that every anti-drop screw has been firmly installed in the reserved positions. Thread locker is recommended.
   (1) Remove the anti-drop screws to apply appropriate thread locker.
   (2) Replace and tighten.
8. Note that the dampers are 30° silicon rubber. If you use other dampers or vibration absorbing balls, the quality of your aerial photography may be affected.



⚠
- Mount the GPS with a bracket to avoid interference from the center frame power board.
- Use glue to install the GPS bracket. Ensure it is firm and stable before every flight.
- Always test motors using the Assistant Software after installation. Refer to your flight control system user manual for details.

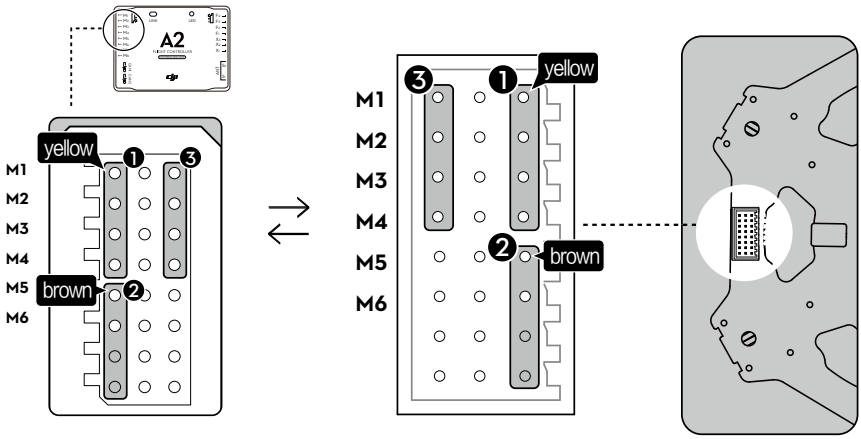
Connecting the flight controller to the center frame

1. Connect the flight control system according to your flight control system user manual.
2. Connect the flight controller to the center frame with the connection cables.
   There are two kinds of connection cables. Choose the corresponding connection mode according to the connection cable in the box.

Using the connector set: 

Plug in the connector set to the ESC signal outlet on the center frame. Then plug in the connector set to flight controller as shown below.

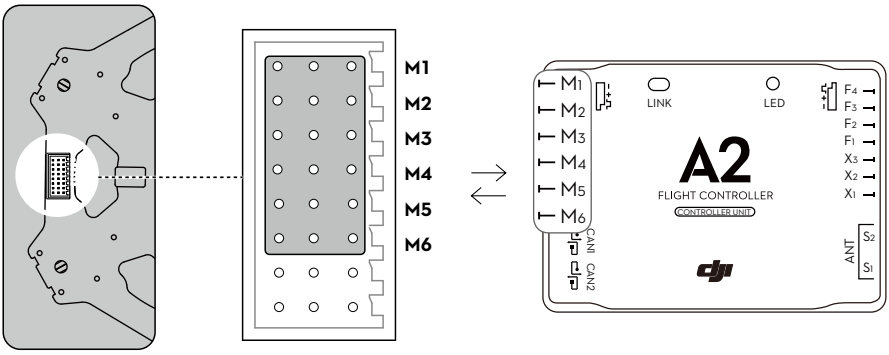
(1) Yellow 4-pin cables are for M1~ M4 connections. The yellow cable should be connected to M1.
(2) Brown 4-pin cables are for M5~ M6 connections. The brown cable should be connected to M5.
(3) Black 4-pin cables are for four continuous ground pins connections. M1~M4 are connected as the following diagram shows.



A2 Flight Controller　　the ESC Signal Outlet

Using the 3-pin connection cable: 

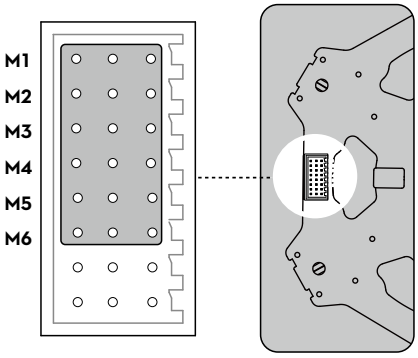
M1 through M6 correspond to each motor number.



the ESC Signal Outlet　　A2 Flight Controller

If using a DJI WK-M flight controller, you must use the wires that came with the WK-M. M1 through M6 correspond to each motor number.

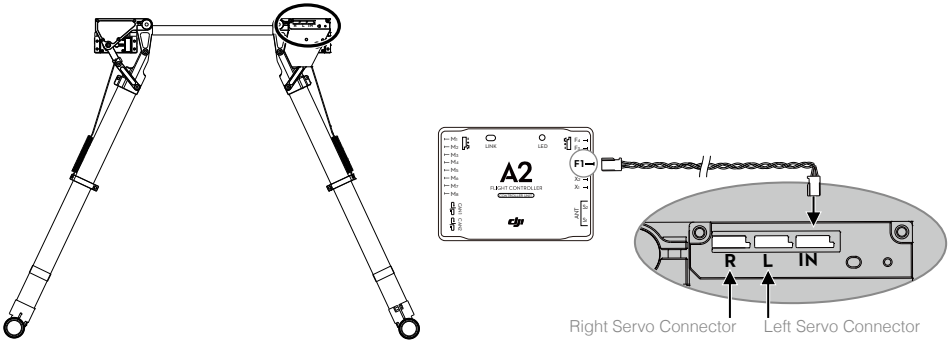
WKM Flight Controller



the ESC Signal Outlet

Connecting the flight controller and landing gear

1. Connect the left servo (between M3 and M4) cable to the “L” port of the landing gear control board.
2. Connect the right servo (between M5 and M6) cable to the “R” port of the landing gear control board.
3. For the A2 flight control system, connect the F1 port of the flight controller to the “IN” port of the landing gear control board. Other flight control systems connect a 2-position channel receiver to the “IN” port.



Right Servo Connector Left Servo Connector

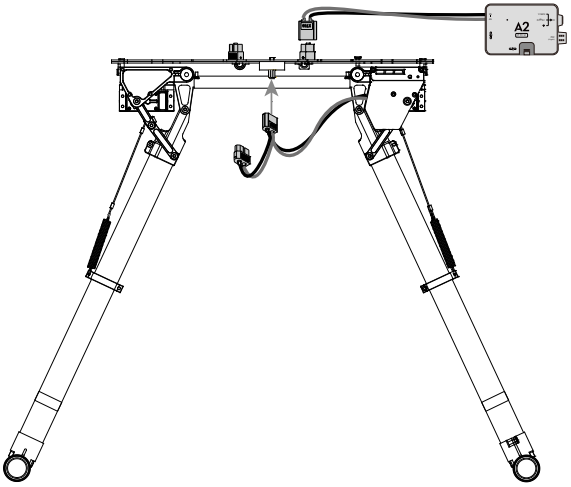
- If right and left servo cables are reversed, the landing gear will not function properly.
- Connect all wires carefully and neatly to avoid cable damage caused by frame edges.

Connecting XT60 Ports on the Center Frame

The bottom board is a power distribution board with three XT60 connectors for battery power.

Instructions

1. Connect the PMU power cable to the XT60 connector on top of the bottom board.
2. Connect the landing gear control board cable to the XT60 connector on the bottom of the bottom board.
3. Other connectors can supply power for other DJI devices, as required.

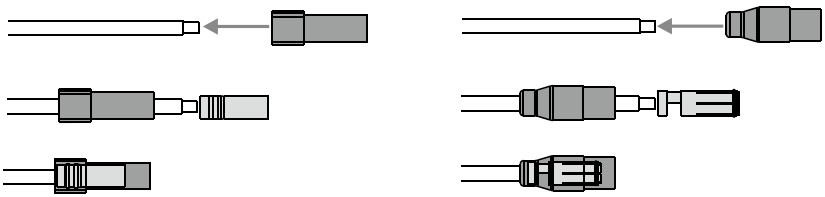


Installing Battery

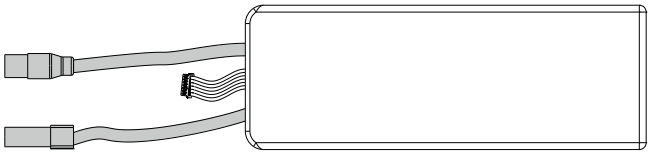
Soldering battery connectors

AS150 spark-proof connectors are used. They must be soldered to your battery power cables.

1. Remove the original battery connectors. Avoid cutting the power and ground cables at the same time, as this can cause a short circuit. We recommend wrapping unsoldered cables with insulating tape to prevent accidental connections.
2. Pass the black ground wire through the black housing. After passing the wire through, solder the female bullet connector to the ground wire. Wait for the soldered connection to cool, then pull the housing back over the bullet connector.
3. Screw and pass the red power wire through the red housing. After passing the wire through, solder the male bullet connector to the power wire. Wait for the soldered connection to cool, and then screw and pull the housing back over the bullet connector.



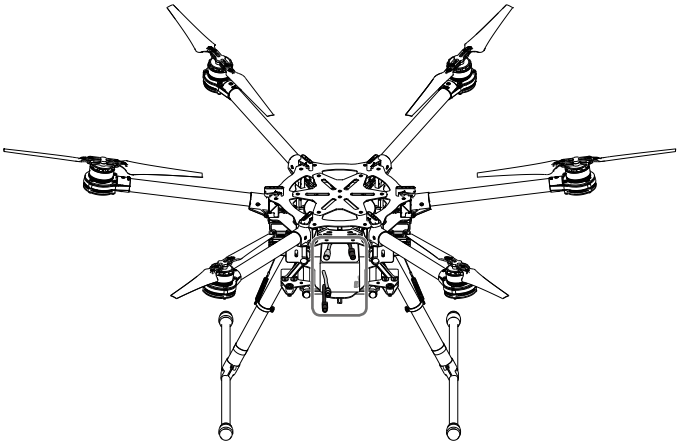
Connectors soldering diagram

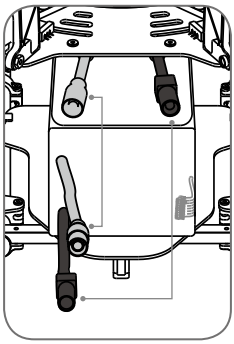


Connectors are soldered

Installing and connecting battery

1. Attach battery to battery tray. Do not use an oversized battery. Maximum installation dimension is 80mm X 120mm X 200mm.
2. Connect the black connector and then the red connector to power on. Disconnect the red connector then black connector to power off.



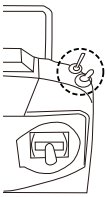


Setting Up the Landing Gear

Using a 2-position RC transmitter switch, landing gear retraction can be carried out remotely.

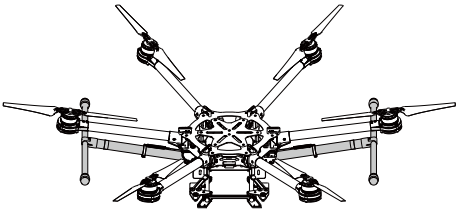
Setting up the transmitter

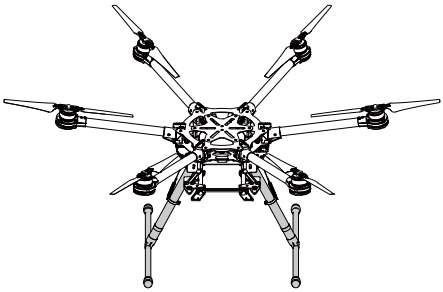
Select a 2-position switch (default setting is OK) as the control input for the landing gear. Ensure the corresponding receiver port is connected to the “IN” port on control board. For the A2 flight control system, connect the flight controller’s F1 port to “IN” port on control board.



Upper: Toggle the switch to this position to raise the landing gear.

Lower: Toggle the switch to this position to lower the landing gear.





- If the transmitter switch has a FailSafe function, set the FailSafe value to the [Lower] position. This ensures that the landing gear will lower automatically when the receiver enters FailSafe mode.
- To avoid accidental switch triggering, slide levers or other controls can be used for landing gear control.

Usage procedures

1. Ensure transmitter and receiver batteries are fully charged.
2. Toggle the switch to the [Lower] position, and then turn on the transmitter.
3. Ensure the “R”, “L” and “IN” connections are correct.
4. Ensure the landing gear is in the [Lower] position, then power on the system. If a solid green LED on the landing gear control board lights up, everything is normal. If it flashes green slowly, re-calibrate the system according to instructions in “Recalibrating Servo Travel”.
5. Toggle the switch to the [Upper] position ONLY AFTER takeoff.
6. Toggle the switch to the [Lower] position for landing.

- Servo power will shut off 3 seconds after the landing gear has reached its target position.
- When powering on the system, if the transmitter switch is in the [Upper] position, the LED will flash red quickly as a warning. Toggle the switch to the [Lower] position to continue.
- If there is an abnormal signal or no signal input into the “IN” port, the LED will slowly flash red. Check receiver and connections for problems.
- If servo power consumption is too high, the LED will light up red. If this lasts more than 4 seconds, the landing gear will lower and the LED will flash green slowly. Re-calibration is needed before flying.
- A2 flight control system users can use the A2 Assistant to set intelligent gear on the “Advanced” page. Refer to the “A2 user manual” for details.

LED Control Board Indicator

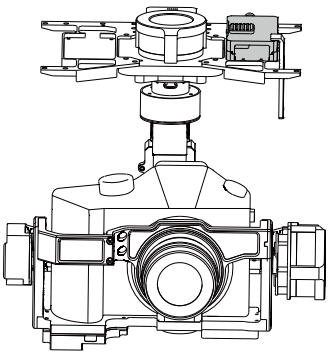
System normal	G —— Solid green.
Calibration required	G ····· Blinks rapid green.
Recalibration required	G ····· Blinks slow green.
Calibration failed	Y —— Solid yellow.
Enter calibration mode	Y ····· Blinks rapid yellow.
System calibrating	Y ····· Blinks slow yellow.
Motor stalled	R —— Solid red.
Unsafe startup alert	R ····· Blinks rapid red.
Input signal abnormal	R ····· Blinks slow green.

Landing Gear Specifications

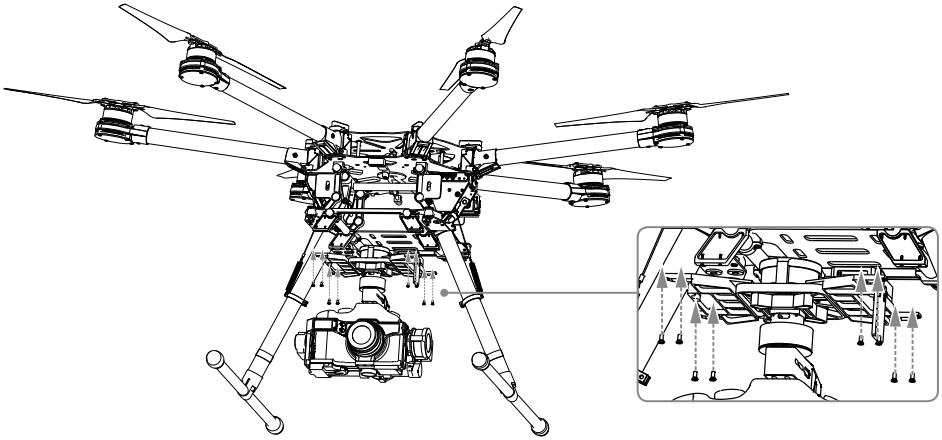
Parameter	Range	Parameter	Range
Working Voltage	3S~6S (LiPo)	Input Signal	PWM (High-Pulse Width 800us~2200us)
Working Current	Max 1A@6S	Output Signal	PWM (Mid Position is 1520us) in 90Hz
Working Temperature	-20~70° C	Output Voltage	6V
Total Weight	875g	Servo Travel	150° (Minimum 120°)

Mounting the Gimbal

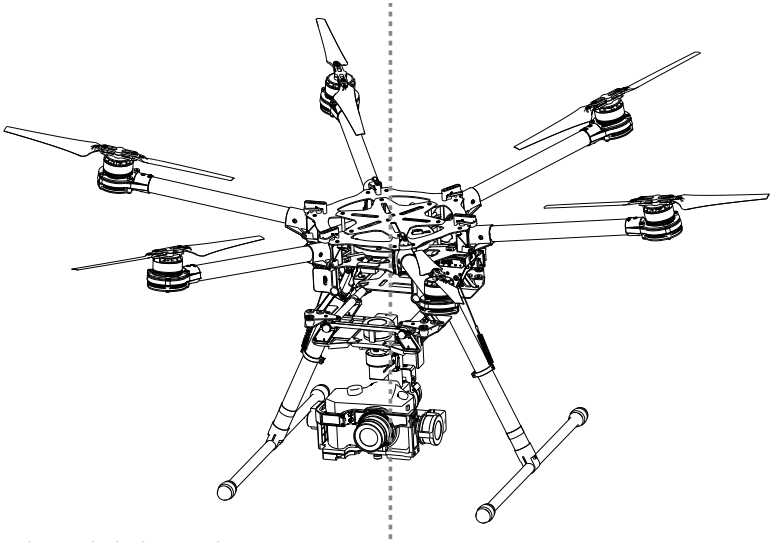
Before assembling the gimbal, install the GCU as shown below. Be sure to install on the side as shown below. A DJI Z15-GH4 (HD) gimbal has been used as an example in the following diagrams.



The connectors on gimbal should be removed for better performance, then the gimbal can be mounted to the lower connection points. Users of DJI Z15-5N / 7N gimbal, refer to the DJI Z15-5N / 7N Gimbal Mounting Notes (Page 21) for details.



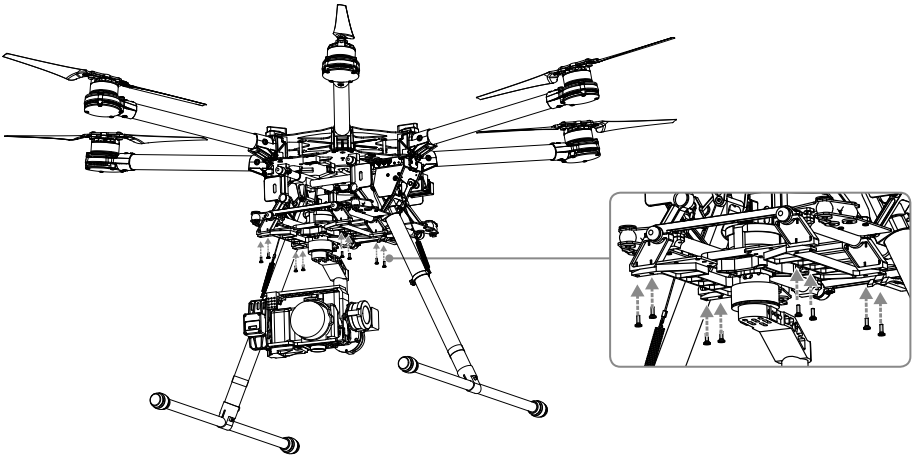
Check that the system's center of gravity is on the line as shown in the diagram below.



DJI Z15-5N / 7N Gimbal Mounting Notes

- Due to the size restriction of the Z15-5N / 7N gimbal, users should purchase extended landing gear legs (used with Z15-5N / 7N gimbal) to avoid damage and/or failure during the self-test. Refer to the Part List Package No.34 (Page 31) for details.
- Follow the Mounting the Landing Gear (Page 6) instructions to mount extended landing gear legs. Then the gimbal can be mounted as shown below.

Package No.34 is for users whose landing gear legs are 300mm. Users whose landing gear legs are 350mm have no need to purchase this part.



Appendix

ESC Sound

ESC State	Sound
Ready	♪1234567--B--B
Throttle stick is not at bottom	BBBBBB…
Input signal abnormal	B·····B·····B…
Input voltage abnormal	BB···BB···BB···BB…

ESC LED

ESC State	LED
Standby	Off
Motor rotating	Solid Red or Green On
Motor rotating at full throttle position	Solid Yellow On

⚠ DJI ESCs are specifically designed for multi-rotors. When used with DJI autopilot systems parameters and travel ranges do not have to be calibrated.

Specifications

Frame	
Diagonal Wheelbase	900mm
Frame Arm Length	358mm
Frame Arm Weight (with Motor, ESC, Propeller)	316g
Center Frame Diameter	272mm
Center Frame Weight (with Landing Gear Mounting Base, Servos)	1185g
Landing Gear Size	460mm(Length)×450mm(Width)×360mm(Height)
Motor	
Stator Size	41×14mm
KV	400rpm/V
Max Power	500W

Weight (with Cooling Fan)	158g
ESC	
Working Current	40A
Working Voltage	6S LiPo
Signal Frequency	30Hz ~ 450Hz
Drive PWM Frequency	8KHz
Weight (with Radiators)	35g
Foldable Propeller (1552/1552R)	
Material	High strength performance engineered plastics
Size	15×5.2 inch
Weight	13g
Flight Parameters	
Takeoff Weight	4.7Kg ~ 8.2Kg
Total Weight	3.3Kg
Power Battery	LiPo (6S,10000mAh~15000mAh,15C(Min))
Max Power Consumption	3000W
Hovering Power Consumption	1000W (@6.8Kg Takeoff Weight)
Hovering Time	18min (@12000mAh & 6.8Kg Takeoff Weight)
Working Environment Temperature	-10° C ~ 40° C

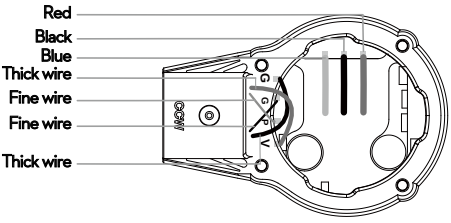
Gain Value Settings

Flight Control	Basic			Attitude		
	Pitch	Roll	Yaw	Pitch	Roll	Vertical
A2	110%	110%	120%	220%	220%	120%
WooKong-M	160%	160%	160%	190%	190%	100%

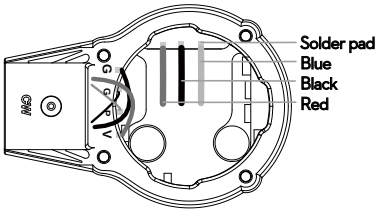
FAQ

Soldering the ESC

Be sure to solder the thick wires and fine wires correctly when soldering an ESC to the frame arm. Clockwise (CW) and counter clockwise (CCW) motors have a different arrangement of the colored wires.



CCW arms



CW arms

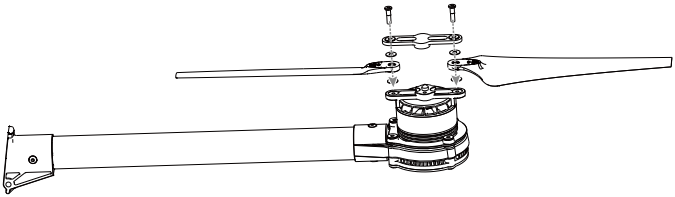
Remounting the Propellers

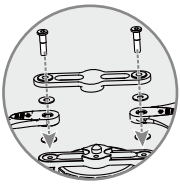
Instructions

1. Use two M3×12.3 screws and four washers to remount propellers.
2. Apply thread locker to the thread of the propellers mount first.
3. Affix screws with 4Kg · cm (0.4N · m) torque.

Refer to original screw tensions if you are unfamiliar with torque measurements. Applying thread locker to the propeller mount first avoids getting thread locker into the holes of the plastic propeller.

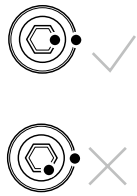
Loose screws cannot be securely locked with thread locker.

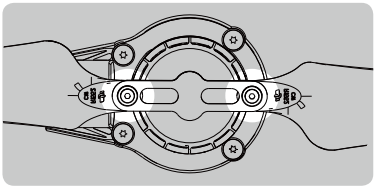




Propeller Precautions

Torque markers on the screws and propeller covers will give you a visual cue to check whether the propellers are loose. Check the torque markers before every flight.

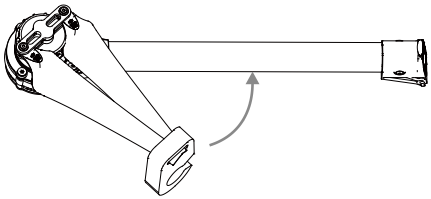




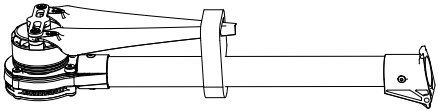
Using the Propeller Holder

Instructions

1. Insert the propeller blades into the propeller holder.

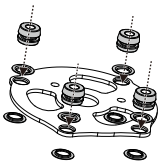


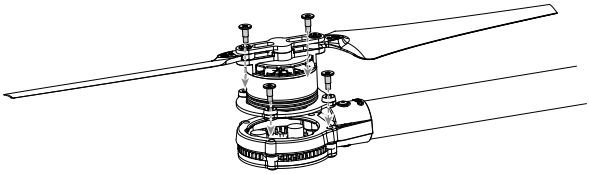
2. Attach the propeller holder to the frame arm.



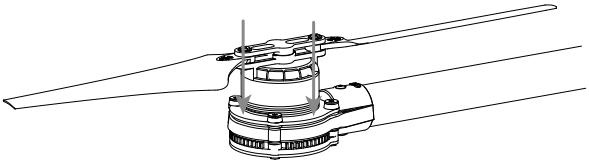
Assembling Motor Vibration Absorbers

A soft damper is part of the vibration absorber. Assemble soft dampers as shown below. Assembly is the same for CCW and CW propellers.





- Ensure all soft dampers and vibration absorbers are in good condition before every flight. If not, replace immediately. Otherwise, the flight performance of your aircraft will be adversely affected.
- Before installing the soft dampers, put the copper gaskets onto the four mounting holes on the carbon plate. Then put the soft dampers into the mounting holes.
- After tightening the screws, the vibration absorbers may be twisted. If this is the case, hold the motor with your thumbs under the base plate and fingers on the top carbon plate, and squeeze the plates together to make the vibration absorbers flat and parallel with the plates.

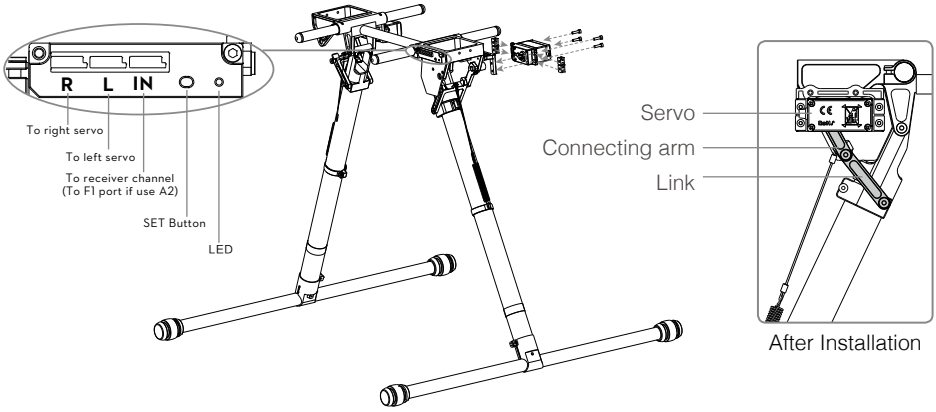


Remounting the Landing Gear Servo

Remounting servos is not recommended as they are pre-installed.

Instructions

1. Connect the left servo cable to the “L” port of the landing gear control board.
2. Connect the right servo cable to the “R” port of the landing gear control board.
3. Press and hold the SET button using a pin then power on. You will see a yellow LED beside the SET button flashing quickly. Wait as servos complete position initialization.
4. Make sure the arm connecting to the servo is parallel to the link as shown in the following diagram.
5. Assemble the left and right servos to the left (between M3, M4) and the right (between M5, M6) parts of the landing gear. Power off.



Recalibrating Servo Travel

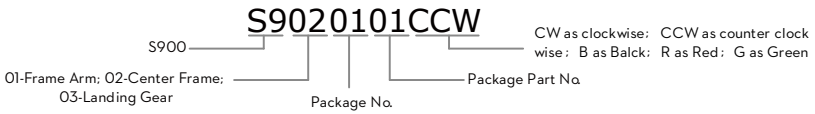
Instructions

1. Keep your hands away from all moving parts.
2. Ensure the “R”, “L” and “IN” connections are correct.
3. Keep the whole aircraft off of the ground during calibration, as landing gear will move.
4. Press and hold the SET button using a pin while powering on, then release. An LED will flash yellow quickly. Press the SET button again. Auto calibration will begin and the LED will flash yellow slowly. DO NOT obstruct any moving parts during auto calibration.
5. During calibration, the left landing gear will raise and lower, followed by the right landing gear.
6. After calibration, both the left and right landing gears will be lowered and the LED will display a solid green light. This indicates that the landing gear is working properly.

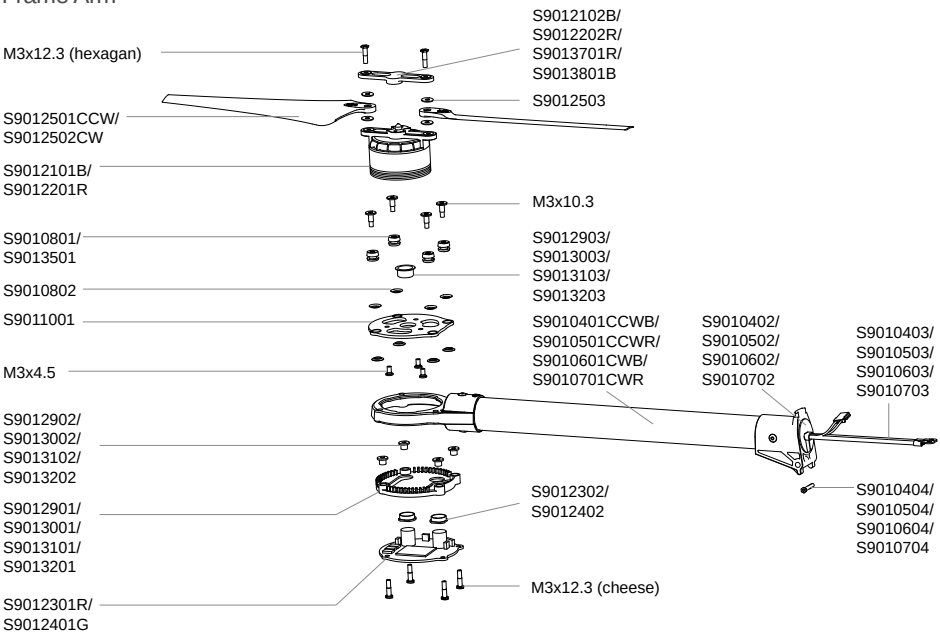
⚠
- If the LED is solid yellow after calibration, a problem has occurred. Carry out the instructions in “Remounting the Landing Gear Servo” then try again.
- Avoid obstructions during calibration. If the landing gear was obstructed, recalibration will be required, per the above steps.
- If the “R” and “L” servo cables are reversed, travel will not be measured correctly. Fix the connections and recalibrate the landing gear using the above steps.
- Landing gear travel has been pre-calibrated. Mechanical adjustment of the gear travel is not recommended.

Part List

If you require a replacement part, locate the part that you wish to replace in the following tables. Then order the package that comes with the specified part. The numbering of the part is defined as follow:



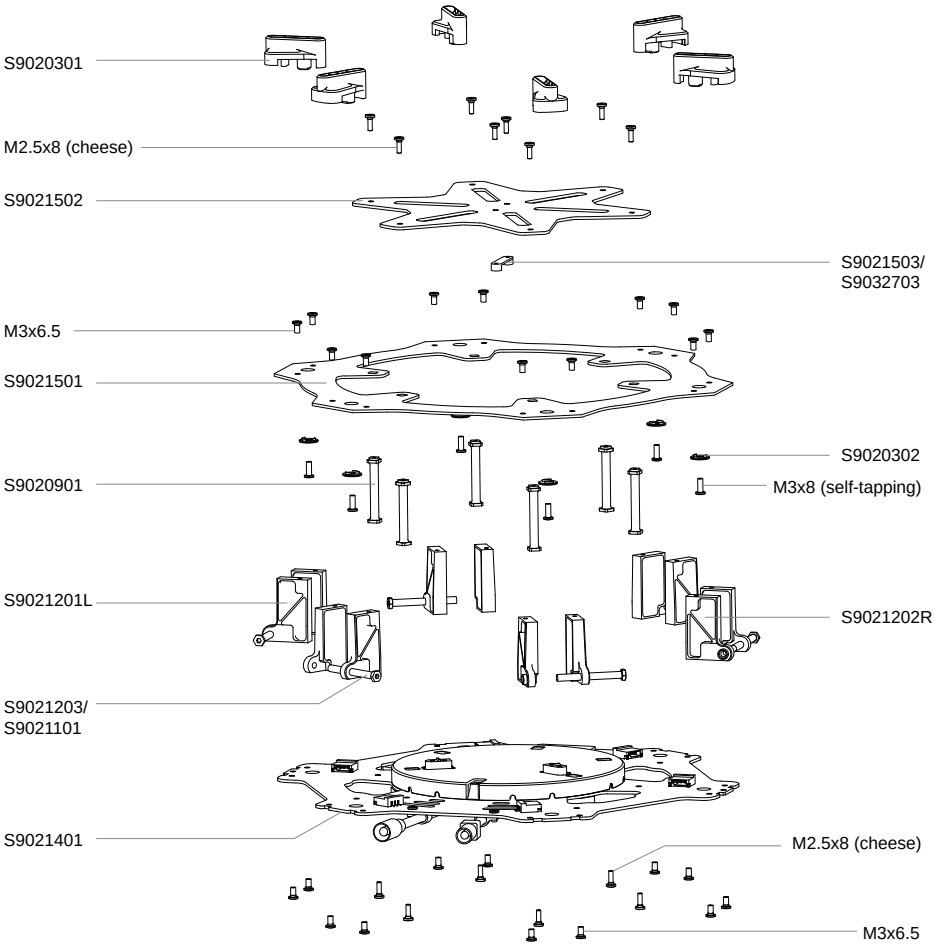
Frame Arm



Package No.	Name	Part No.
4	S900 Frame Arm CCW - Black	S9010401CCWB, S9010402, S9010403, S9010404, M3×12.3 (cheese)
5	S900 Frame Arm CCW - Red	S9010501CCWR, S9010502, S9010503, S9010504, M3×12.3 (cheese)
6	S900 Frame Arm CW - Black	S9010601CWB, S9010602, S9010603, S9010604, M3×12.3 (cheese)
7	S900 Frame Arm CW - Red	S9010701CWR, S9010702, S9010703, S9010704, M3×12.3 (cheese)
8	S900 Motor Damping Unit	S9010801, S9010802, M3×10.3
10	S900 Motor Mount Carbon Board	S9011001, M3×4.5

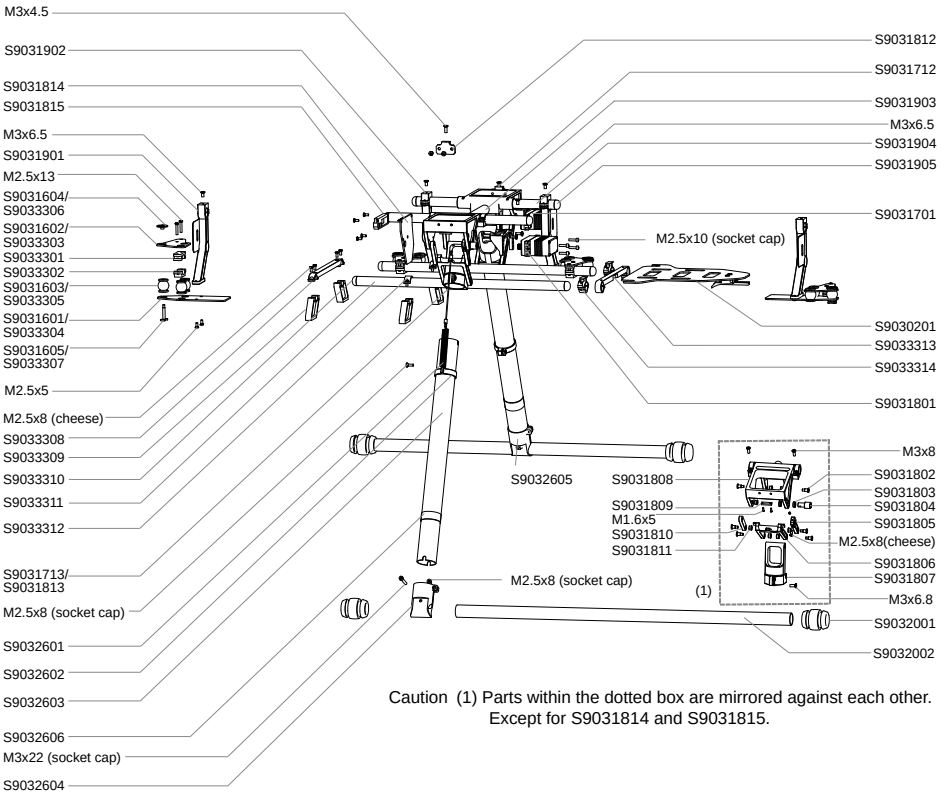
21	S900 4114 Motor with black Prop cover	S9012101B, S9012102B, M3×4.5
22	S900 4114 Motor with red Prop cover	S9012201R, S9012202R, M3×4.5
23	S900 ESC with Red LED	S9012301R, S9012302, M3×12.3 (cheese)
24	S900 ESC with Green LED	S9012401G, S9012402, M3×12.3 (cheese)
25	S900 Propeller Pack	S9012501CCW, S9012502CW, S9012503, M3×12.3 (hexagan)

Center Frame



Package No.	Name	Part No.
3	S900 Lock Knob	S9020301, S9020302, M3×8 (self-tapping)
9	S900 Center Frame Support Pillar	S9020901, M2.5×8 (cheese)
12	S900 Arm Mounting Bracket	S9021201L, S9021202R, S9021203, M3×6.5
14	S900 Center Frame Bottom Board	S9021401, M3×4.5 (cheese), M3×8 (self-tapping), M3×6.5, M3×5.5
15	S900 Center Frame Top Board	S9021501, S9021502, S9021503, M3×6.5, M2.5×8 (cheese)
11	S900 Frame Arm Mounting Steel Shaft	S9021101

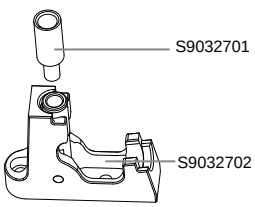
Landing Gear

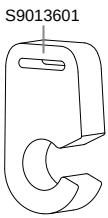


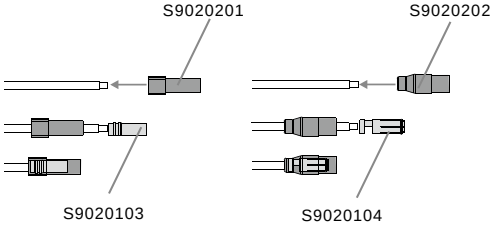
Caution (1) Parts within the dotted box are mirrored against each other. Except for S9031814 and S9031815.

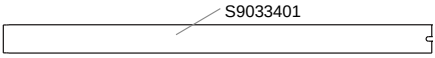
Package No.	Name	Part No.
16	S900 Gimbal Damping Bracket	S9031601, S9031602, S9031603, S9031604, S9031605, M2.5×5, M2.5×13
17	S900 Retractable Module (Right)	S9031701, S9031702, S9031703, S9031704, S9031705, S9031706, S9031707, S9031708, S9031709, S9031710, S9031711, S9031712, S0031713, M1.6×5, M2.5×10 (socket cap), M2.5×8 (cheese), M2.5×5, M3×8, M3×4.5, M3×6.8
18	S900 Retractable Module (Left)	S9031801, S9031802, S9031803, S9031804, S9031805, S9031806, S9031807, S9031808, S9031809, S9031810, S9031811, S9031812, S9031813, S9031814, S9031815, M1.6×5, M2.5×10 (socket cap), M2.5×8 (cheese), M2.5×5, M3×8, M3×4.5, M3×6.8
19	S900 Gimbal Damping Connecting Brackets	S9031901, S9031902, S9031903, S9031904, S9031905, M2.5×5, M3×6.5
20	S900 Landing Skid	S9032001, S9032002
26	S900 Landing Gear Leg	S9032601, S9032602, S9032603, S9032604, S9032605, S9032606, M2.5×8 (socket cap), M3×22 (socket cap)
2	S900 Battery Tray	S9030201
33	S900 Gimbal Mounting Accessories	S9033301, S9033302, S9033303, S9033304, S9033305, S9033306, S9033307, S9033308, S9033309, S9033310, S9033311, S9033312, S9033313, S9033314, M2.5×5, M2.5×13, M2.5×8 (cheese)

Miscellaneous









Caution: This part is used with Z15-5N / 7N gimbal.

Package No.	Name	Part No.
13	S900 Center Frame	Package 3, 9, 12, 14, 15
29	S900 Complete Arm [CW-RED]	Package 7, 8, 10, 11, 22, 23, 25, S9012901, S9012902, S9012903
30	S900 Complete Arm [CW-Green]	Package 6, 8, 10, 11, 21, 24, 25, S9013001, S9013002, S9013003
31	S900 Complete Arm [CCW-RED]	Package 5, 8, 10, 11, 22, 23, 25, S9013101, S9013102, S9013103
32	S900 Complete Arm [CCW-Green]	Package 4, 8, 10, 11, 21, 24, 25, S9013201, S9013202, S9013203
27	S900 GPS Holder	S9032701, S9032702, S9032703, M2.5×8 (cheese)
28	S900 Screw Pack	Assorted screws
1	S900 Power Cord Plug	S9020101, S9020102, S9020103, S9020104
34	S900 Extended Landing Gear Leg	S9033401
35	S900 Rubber Damper for 4114 Motor	S9013501, M3×10.3
36	S900 Propeller Holder	S9013601
37	S900 4114 Motor-Red Prop Cover	S9013701R, M3×12.3 (hexagan)
38	S900 4114 Motor-Black Prop Cover	S9013801B, M3×12.3 (hexagan)

FCC Statements

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

User manual is subject to change without prior notice.

You may visit DJI offical website to obtain the latest version of user manual.

http://www.dji.com/product/spreading-wings-s900

PILOT OPERATING HANDBOOK

DJI S-900/Zenmuse

Author: Gene Payson Revised: 9/02/2014

http://www.troybuiltmodels.com

PILOT OPERATION HANDBOOK
DJI S-900/Zenmuse

This book is offered in a format so that pilots can customize the checklists to their exact needs. Please print out this handbook, make notes while watching the video regarding the checklist, then change the wording and order to suit your needs. Then print out the revised form and laminate it in plastic. Use it every time you operate your aircraft. Keep the log books regarding the following:

1) Pilot flight time
2) Aircraft flight time
3) Aircraft maintenance and updates
4) Battery usage, date put into service, voltage, mah vs time

Print out and make readily available the error message legend of various flashing lights. Know what to do without hesitation should you observe warnings.

Insurance is a must! Not only will it be expensive to repair your aircraft in the event of an incident, if you injure bystanders or damage other people's property you are liable for damages which could run into the millions of dollars. One insurance company which currently writes policies on sUAS is www.Transportrisk.com

Errors & Omissions should be sent to customerservice@troybuiltmodels.com. We will promptly update the POH for everyone to have the latest updates available.

DJI S900 KEY PARAMETERS

Max Takeoff Weight: 18 lbs.
Approved Cameras: Sony Nex5/7, Panasonic GH3/4, Blackmagic Cinema

--- No Gimbal
13.5lbs = S900 NO Gimbal and TBM 21000
12.3lbs = S900 NO Gimbal and TBM 15000
--- Nex-7 Gimbal
17.2lbs = S900 with Nex-7 and TBM 21000
16lbs = S900 with Nex-7 and TBM 15000
--- GH3/GH4 Gimbal
17.68lbs = S900 with GH3/GH4 and TBM 21000
16.48lbs = S900 with GH3/GH4 and TBM 15000
--- BMPCC Gimbal
17.3lbs = S900 and TBM 21000
16.1lbs = S900 and TBM 15000
--- 5D Gimbal
22.5lbs = S900 and TBM 21000 - OVERWEIGHT!
21.3lbs = S900 and TBM 15000- OVERWEIGHT!

Flight Times using 90% of battery:

15,000 mah battery with gimbal and camera: 15+ min
21,000 mah battery with gimbal and camera: 20+ min

These times are averages in our tests. Individual flight times may differ based on weight and flying style.

DJI S-900/Zenmuse CHECKLISTS

- **DJI S-900 BENCH SET UP & TESTS**
  - All screws/bolts are tight
  - Timer alarm for flight time to not exceed 80% battery capacity set properly
  - Batteries are secure
  - Antennas are secure
  - Props balanced
  - Props aligned
  - Props not chipped
  - Check blades, arms, etc. for cracks/damage
  - Wiring Tight
  - No excessive flexing of motors or booms
  - Booms/motors will not twist
  - Center of gravity is correct
  - Warning lights set for low battery if used
  - Batteries charged. Replace any battery which cycles below 80% of rated capacity
    - Laptop Battery
    - Flight Battery
    - Handheld Rx Battery
    - RC Tx Battery
    - Video Rx Battery
    - Spare Laptop Battery

- **DJI S-900 INVENTORY CHECKLIST**
  - Load Flight plan
  - Aircraft
  - Camera with SD card
  - Spare parts/tools
  - Spare batteries
  - Two RC transmitters
  - Laptop
  - Battery Charger
  - Flight Controller Cable
  - Video monitor, stand, battery, antennas
  - Goggles
  - Datalink & cable
  - Battery Y-harness

- **DJI S-900 PREFLIGHT CHECKLIST**
  - Position: GCS, S900
  - Emergency LZ
  - Wind
  - Area secure
  - Antennas
  - GCS
  - Lens cap
  - Camera On
  - SD card
  - Flight battery: voltage – install - CG
  - C2 Tx: Switches – On - Model Selection - 5.4V+
  - Photo Tx – Switches – On - Model Selection - 5.4V+
  - Copter On
  - Calibrate? - Cycle
  - Copter Voltage on GCS
  - GPS Mode – Double Purple/Single Purple
  - Course Lock Mode - Green
  - Camera/Gimbal tests
  - Upload mission
  - Zero altitude

- **TAKEOFF CHECKLIST**
  - Timer
  - GPS mode (Course lock?)
  - Motor startup/checks
  - Takeoff
  - Landing Gear

- **LANDING CHECKLIST**
  - LZ clear
  - Landing Gear
  - Land
  - Flight Time
  - Copter/Camera Power down
  - Adjust Params
  - Power Down ____ batteries
  - Motor Temps
  - Logbooks

- **ERROR MESSAGES**
  - White flashes
    - IMU malfunction. Land and determine cause. Possibilities:
      - GPS/Compass not pointing forward
      - IMU not pointing forward
      - Set up of X, Y, Z for location of IMU and Compass is incorrect
  - Excessive rocking/instability possible causes:
    - Weak motor
    - Structure flexing from fatigue or cracks
      - Motor mount
      - Main frame
      - Booms
    - Loose Bolts causing flexing or misalignment
      - Props
      - Mounts
    - Props out of balance
    - Props misaligned
    - Excessive wind speeds or gusts
    - Excessive Gains
    - Excessive motor power. Max motor power must a little more than typical ascent power.
  - Red Flashes (1, 2 or 3 flashes with pauses) – GPS loss (3 is more serious). Land if loss lasts for more than 30 seconds. Possible causes:
    - Clouds
    - Structures
    - GPS mal-function
    - GPS too close to electrical components
    - GPS vibration

TABLE OF CONTENTS

SECTION 1
GENERAL

NOTE: In an effort to minimize costs and maximize spare parts availability, many COTS (commercial off the shelf) components have been utilized. Some may have slight modifications to better suit this application. Most COTS products have separate data sheets, assembly manuals and instruction manuals. They are reference in this document, with key factors being emphasized.

As with all high technology products utilizing constantly evolving software, it is important to periodically check for online upgrades to the COTS components, including hardware, firmware and software.

WARNING: Great care must be taken with the batteries. Much of this manual and supplemental information is devoted to the use and care of the batteries, especially the flight batteries. They are less volatile than gasoline, though they should be treated with the same respect. Become very familiar with proper techniques of their use.

- GENERAL CHARACTERISTICS
  - Primarily for ISR (Intelligence, Surveillance, and Reconnaissance)
  - Economical due to extensive use of COTS products
  - Low Visual Signature
  - Low Aural Signature
  - Quick Launch and Recovery
  - Short Training Period
  - Simple Operation
  - Waypoint Navigation
  - Backpackable
  - VTOL
  - Quick Repairs
  - Redundant Flight Systems
  - Safety Return to Home during lost link or low battery
  - High Degree of Mission Success
  - GPS navigation aid
  - Various sensors
  - 18 lb max takeoff weight
  - Operating Temp Range: -5°C to +60°C
  - Flight Modes: Manual and GPS aided waypoint navigation
  - Maximum Operating Altitude: 1000 meters
  - Maximum Operation Wind Conditions: 10 m/s
  - Propulsion System: LiPoly batteries
  - Takeoff: Manual or Automatic
  - Landing: Manual or Automatic
  - Takeoff/Recovery Area: 5m square

- IMPORTANT DIMENSIONS
  - Distance rotor to rotor across the center: 35”
  - Height with GPS/Compass folded down: 21”
  - Height with GPS/Compass up: 25”
  - Length of landing gear skids: 17”
  - Distance between landing gear skids: 18”
  - Collapsed size: 22” x 19”

- IMPORTANT WEIGHTS
  - --- No Gimbal
  - 13.5lbs = S900 NO Gimbal and TBM 21000
  - 12.3lbs = S900 NO Gimbal and TBM 15000
  - --- Nex-7 Gimbal
  - 17.2lbs = S900 with Nex-7 and TBM 21000
  - 16lbs = S900 with Nex-7 and TBM 15000
  - --- GH3/GH4 Gimbal
  - 17.68lbs = S900 with GH3/GH4 and TBM 21000
  - 16.48lbs = S900 with GH3/GH4 and TBM 15000
  - --- BMPCC Gimbal
  - 17.3lbs = S900 and TBM 21000
  - 16.1lbs = S900 and TBM 15000
  - --- 5D Gimbal
  - 22.5lbs = S900 and TBM 21000 - OVERWEIGHT!
  - 21.3lbs = S900 and TBM 15000- OVERWEIGHT!

- MOTORS
  - Manufacturer: DJI-Innovations
  - Number of motors: 8
  - Motor type: 41mm x 14mm
  - Motor Model Number: 4114-11
  - Motor KV/RPM: 400
  - Motor max @ 25.2V: 10,000 rpm
  - Motor Max Power: 500 Watts
  - Power rating: 3000 Watts maximum power consumption for all 6 motors
  - Current Max: 100 amps
  - Amp Draw Typical Average: 55 amps

- PROPELLERS
  - Manufacturer: DJI-Innovations
  - Material: Composite
  - Number of propellers: 6
  - Propeller model number: DJI 15 x 5.2
  - Number of blades: 2 - folding
  - Propeller Diameter: 15”
  - Propeller Pitch (fixed): 5.2”
  - Max rpm: 10,000 rpm

- ELECTRONIC SPEED CONTROLS
  - Manufacturer: DJI-Innovations
  - Number of speed controls: 6
  - Speed control model number: DJI 40A Opto
  - Rating in amps: 40 Amps continuous
  - Signal Frequency: 30 - 450 Hz
  - Drive PWM Frequency: 8 KHz

- AUTOPILOT
  - Manufacturer: DJI-Innovations
  - Autopilot Model Number: DJI A2
  - Components: GPS/Compass, IMU, Master Controller, Power Distribution System, LED Indicator Lighting System, Data Transceiver, GCS Software
  - Power Consumption: 5W
  - Operating Temp Range: -5°C to +60°C
  - Software Compatible: Windows XP sp3 / Windows 7
  - Hovering Accuracy: Vertical : ± 0.5m; Horizontal: ± 2m

- ANALOG WIRELESS LINKS
  - Distributor: DJI-Innovations
  - Frequencies:
    - 2.4 Ghz datalink with WiFi
    - 2.4 Ghz Command & Control
    - 5.8 Ghz Video
  - Power Consumption: <1 watt
  - Usable Range: <2 km.

- DIGITAL WIRELESS LINKS (Lightbridge)
  - Distributor: DJI-Innovations
  - Frequencies:
    - 2.4 Ghz (C2 & Video)
  - Power Consumption: <1 watt
  - Usable Range: <2 km.

- FLIGHT BATTERY
  - Manufacturers: Various COTS suppliers
  - Battery chemistry recommended: Lithium Polymer
  - Battery Capacity: up to 21,000 mah or greater depending on max gross weight
  - Battery cell count required: 6S (6 cells in series)
  - Battery Voltage: 21V minimum during hover, 22.2V nominal, 25.2V maximum
  - Battery Minimum Rated Discharge Rate: 20C minimum
  - Battery Minimum Charge Rate: 1C (3C preferable)
  - Battery Rest Time between discharging and charging: 0-30 minutes
  - Batteries used simultaneously: typically 1
  - Recommended Battery Discharge Amount: 80-90%

- FLIGHT PARAMETERS
  - Flight Time: 20+ minutes typical
  - Payload Max: 9.5 lbs for battery, sensor and gimbal

- ***WARNINGS***
  - Never power a video transmitter or receiver without an antenna connected or overload failure will occur.
  - Read all information regarding batteries contained in this manual and supplements.
  - Batteries are highly flammable and can explode, especially when fully charged. Improper charging, vibration, impact, high discharge, etc. can lead to explosion and fire. Batteries must be charged under constant supervision and using proper precautions.
  - Batteries fully charged must be handled with extreme care.
  - Batteries must not be stored above 60% charged state.
  - Store batteries between 20% - 60% charged state. Fully charge just before use.
  - Fully charged batteries which are not to be used within 24 hours should be discharged to 20% - 50% charged state.
  - Discharging LiPoly batteries in excess of 80% of their rated capacity can cause harm to the batteries.
  - Using more than one battery at a time requires the proper wiring harness so that the voltage is no more than 25.2V. Over voltage will cause serious damage to electrical equipment.
  - Using more than one battery at a time requires weight and balance checks. Proper CG is critical to performance. Airframe must not be overloaded.
  - GPS/Compass must be facing forward.
  - Do not use GPS Mode without GPS lock.
  - Use low strength thread locking compound on all screws.
  - Wireless Video and Data ranges vary considerably on many factors including weather, equipment, and obstructions. Be prepared for com failures.

SECTION 2
LIMITATIONS

- AIRSPEED LIMITATIONS
  - Vne – Velocity to Never Exceed: 15 m/s
  - Va – Typical Maneuvering Speed – 5 m/s

- POWER & POWERPLANT LIMITATIONS
  - 40 Amps max per motor
  - 40 Amps max per speed control
  - 320 Amps max total
  - Do not exceed 80-90% discharge of rated battery capacity
  - Do not charge batteries which are warmer than air temperature
  - Allow batteries to cool after use before charging
  - Leave an air gap between batteries when multiple batteries are used simultaneously

- WEIGHT LIMITS
  - Takeoff Weight Max: 18 lbs
    - Must be checked prior to takeoff if any change in equipment is made

- CENTER OF GRAVITY LIMITS
  - 3mm from the center of any of the three pairs of arms
    - Must be checked before every flight to ensure batteries were installed in the proper location.
    - Check all 4 pairs of arms before flight

- MANEUVER LIMITS
  - This aircraft is intended for non-aerobatic operations
  - G-loading maximum: 2G

- TEMPERATURE LIMITS
  - Operating Temp Range: -10°C to +40°C
  - In cold temperatures
    - Keep IMU at room temperature if possible before the flight
    - Keep Batteries above 5°C before flight
    - Do not fly with any frost or ice on the propellers
  - In warm temperatures
    - Batteries heat up when discharged
    - The higher the discharge rate the higher the temperature increase during use
    - At temperatures above 45°C, use of 2 or more batteries is required to lower the load on any one battery pack to keep it cooler.

- WEATHER LIMITS
  - Light dust and light rain require the use of a shield for the electronics in the center section.
  - Light dust and light rain are acceptable for the unshielded motor and ESC.

- RANGE LIMITS
  - FUEL
    - Fuel capacity is a primary limiting factor.
    - Flying into the wind will use more battery power to travel the same ground distance. Higher air speeds will be required to penetrate the wind which used more battery power. Take this into account when flying a mission.
    - Where possible, fly upwind at the start of a mission and downwind at the end to avoid depleting the battery before returning to base. Have alternative landing sites available in case of emergency landing.

  - WIRELESS LINK
    - Wireless links will be stable in LOS (line of sight) in most conditions
    - Wireless links are always susceptible to shorter ranges due to
      - Atmospheric conditions
      - Other transmission devices in the area
      - Jamming
      - Antennas not aligned properly
      - Improper voltage
      - Antenna blockage from AV in certain positions
      - Multipath – reflection off buildings or ground which cause multiple signals to arrive at different times and/or phase.

SECTION 3
EMERGENCY PROCEDURES

- MOTOR FAILURE
  - Operation is possible with one motor/ESC/propeller failure
    - The two adjacent motors/ESCs will be increased in thrust automatically by the flight controller to overcome the loss
    - In cases where the airframe is highly loaded the maximum rating of 40 amps may be exceeded by these two motors/ESCs
    - Operation should be terminated as soon as possible to reduce the possibility of damage to the remaining motors

- COMMUNICATION FAILURE
  - Video link failure
    - 5.8 Ghz being the shortest wavelength in general AV use has the least ability to penetrate. This link should be the first to be lost.
    - It is best to lose video first! It is the least likely to cause a crash when it fails.
    - 5.8 Ghz can lose link with little warning.
    - Ensure that the GCS station antennas are perpendicular to the AV. Do not point the antenna at the AV.
    - Yaw the AV to change the antenna position
    - Other links should still be good. Return back to the GCS until link is restored.
    - Transmitters produce heat when in operation. When overheated they may have thermal protection which interrupts use temporarily. Use of a heat sink or fan may be required especially with high ambient temperatures.
    - Higher gain antennas may be used, but do so with caution. High gain antennas are directional.
    - Multiple antennas using “diversity” can be used. Diversity is a device which determines the best signal, and uses that.
    - 5.8 Ghz even at high wattages theoretically has less range than lower frequencies. Changing to 1.3 Ghz is an option, though there are other issues to be considered.
  - RC link failure
    - 2.4 Ghz antennas can lose link with little warning.
    - Anything in between the two antennas can cause temporary signal loss especially a person.
    - Hold the transmitter up in the air and walk in the general direction of the AV (aerial vehicle).
    - Ensure that the antenna is vertical. Do not point the antenna at the AV.
    - The failsafes on the RC link should be set so that the AV returns to home. Should this require a heading change, the antenna may move into a more desirable position and link will be restored.
    - The onboard equipment may block the signal. Yaw the AV so that the antennas point towards the GCS.
    - A LRS (long range system) can be used as a permanent solution. This is higher in wattage and usually on 433 Mhz.
  - Data Link Failure
    - 900 Mhz do not lose link without some warning. When drop outs are noticed to increase in frequency that is the limit of the range.

        - If using 900 Mhz, this is on cell phone frequency. If a cell tower is nearby it can swamp the signal. 900 Mhz may not be usable in that area. Change to a different freq. or remain closer to the AV

- LOW BATTERY POWER
    - Fail-safes can be set such that in the event of low battery power, either due to a failure or too long of a flight, the warning light on the AV will constantly flash amber. This is the first level of warning.
    - The second warning level is red flashing lights
    - Auto landing will occur when battery power is low. It may land in a tree or a lake, so this is not desirable.
    - Landing with 80-90% of battery depleted is best. Therefore landing with 17,000 mah used and 3,000 mah remaining of a 20,000 mah battery is desirable. Batteries should be drawn down equally when in use if they are both charged equally and both in relatively the same condition/age.
    - Do not mix partially charged batteries. Only use completely charged batteries.
    - Over discharging a battery below 19.8V can permanently damage the battery.

- GCS FAILURE
    - Takeover by the external pilot should happen ASAP using the RC link.
    - Most often happens due to a low battery.
    - Keep a spare 3 cell LiPoly battery with the appropriate plug to plug into the charge jack for emergency use. Most chargers are 19V output which is roughly equivalent to a 4-cell battery. 3-cell batteries may work.

- COMPASS CALIBRATION ERROR
    - If the compass is out of calibration the warning light will flash red. This is the same signal as low voltage. If the voltage is correct, there is a calibration error.
    - Recalibrate the compass following the instruction manual

- FIRE
    - Fires can occur due to a short circuit or battery failure.
    - Disconnect the battery ASAP unless there is danger in doing so if there is any electrical issue.
    - It is not possible to put out a battery fire.
    - Do not attempt to put out a battery fire. Use a fire extinguisher to put out fires surrounding the battery. A CO2 fire extinguisher is better than the powder or chemical type. CO2 does not leave a residue. Water can be used though it may cause other electrical component failures.

- FORCED LANDINGS
    - If alternate emergency landing zones should be chosen ahead of time.
    - Be sure that the LZ is clear of people to avoid any incidents.
    - Land in the nearest LZ which is clear of people.
    - Announce your intentions of landing as loud as necessary to alert people of the incoming AV.

SECTION 4
SET UP SUGGESTIONS

- ELECTRONICS BURN IN
  - We recommend that you put weights onto the landing skids to keep the copter on the ground and run the copter at about 70% throttle for about 2 hours to burn in the electronics. Most electronic failures occur in the first 2 hours of operation.
- GPS/COMPASS MAST LENGTH
  - We found that the higher the mast, the better the GPS reception
- Nex5N vs. Nex7 vs. Panasonic GH3
  - These cameras are excellent for stills, and very good for video. The best for video is the Panasonic GH4 with 4k capabilities.
  - We found that the Nex 5N takes exceptional quality stills and video, though most professionals use the Nex 7.
  - Use the Panasonic GH4 if you primarily shoot video
- RADIO SET UP
  - Follow the instructions in the manual
  - We prefer the switch assignment as shown in the checklists above though feel free to modify to your liking
- COPTER COMMAND AND CONTROL
  - We recommend the use of a dual rate switch for main copter operation.
    - High rate – used to initialize the motors. The flight controller will not engage unless it sees full down throttle, full left rudder, full left cyclic and full back cyclic. However, these may be too high for normal flying. On high rate it is helpful to utilize fairly high exponential to make the stick feel soft around center. Adjust to your preference.
    - Low rate – used for typical flying. Set the end point adjustments such that full stick deflection offers the maximum speed required in normal flying. If conditions require higher flight speeds, switch to high rate. On low rate it is also helpful to utilize a small amount of exponential to make the stick feel soft around center. Adjust to your preference.
- ZENMUSE COMMAND AND CONTROL
  - We recommend the use of a dual rate switch for gimbal operation.
    - High rate – used to initialize the gimbal. The gimbal may not engage unless it sees full motion. However, these may be too high for shooting video smoothly. This is best for still photography so as to put the camera on target quickly. On high rate it is helpful to utilize fairly high exponential to make the stick feel soft around center. Adjust to your preference.
    - Low rate – used for videography. Set the end point adjustments such that full stick deflection offers the maximum speed required for videography. If conditions require higher gimbal speeds, switch to high rate. On low rate it is also helpful to utilize a small amount of exponential to make the stick feel soft around center. Adjust to your preference.
- TIMERS
  - Use of the countdown timer is a good backup method to ensure landing with battery power.
    - Set the timer for 20 minutes (or what you deem appropriate) and have it start when the throttle is over ¼. Then adjust the timer upwards until the amount of battery used is about 80-90% of the total available. If using 20,000 mah batteries, a total of 17,000 mah would be the target. Set the timer such that you have a minute or so to land after

the alarm sounds so that you have adequate time to return to base. Adjust to your preference.

- BATTERIES
  - Replace the transmitter standard battery with a Lipoly battery to extend use times to 8 hours. Supplied batteries often last about 2 hours.

NORMAL PROCEDURES

- PREFLIGHT CHECKLIST
  - Confirm all communication radios are operational
    - Radio with ATC
    - Radios with others in the group
  - Set a perimeter of 100 meters
    - Area must be clear of people to avoid collision
  - Check for overhead power lines and other obstacles to avoid
  - Check structural integrity
    - In event of prior crash, inspect all booms, props and motor mounts for excessive flex indicating structural fatigue/failure
  - Have a manual flight plan avoiding obstacles.
  - Load auto flight plan if using one
    - Be sure that the total flight time is under 10 minutes to avoid low battery
  - Clean lens
    - Remove lens cap
  - Ensure camera has SD card installed
    - Many flights have been wasted due to this!
  - Install batteries
    - Ensure that the straps are tight and the Velcro keeps the batteries from moving which will avoid a shift in the CG (Center of Gravity – or that it balances evenly)
  - Check CG (Center of Gravity)
    - Lift the copter on each of the 3 pairs of arms. The copter should balance properly. If not, do not fly. Rearrange the equipment such that the CG is
  - IMU pointing forward
    - The Inertial Measurement Unit is set so that it must face forward
  - GPS/Compass installed, limited free play, pointing forward
    - This device must be installed with a screw to hold it in place. It cannot vibrate easily. If it does not point forward, the corrections in ATTI and GPS mode will be incorrect and it will crash. The FC will provide a warning with constant flashing white lights.
  - Level copter using a bubble level with front pointing in correct direction for course lock – do not turn on
    - Keep in mind the best angle for pointing the landing gear in the direction that will keep the landing gear out of the shot when flying.
  - Turn on Pilot Tx
  - If using the rate gyro, set it at the correct position. This is usually a slider switch. Gains should have the range set from 200 – 350. Use the highest gain possible which does not cause oscillation.
  - Check Model Selection on Tx to be S900
  - Throttle on Tx Down
  - Return to Home switch Off
  - Adjust gain to correct position (if required)
  - Manual Flight Mode Switch to manual (not ATTI or GPS mode)
  - Flight Path Switch Off – Not Course or Home or POI
  - Check Tx battery voltage (above 7.5v)
    - These settings above are required to initialize the copter properly. If the switches are in the incorrect position, it will not initialize properly which may cause some of the functions like course lock or GPS mode to not operate properly.

        - If the copter does not function properly after takeoff, land immediately and disconnect the copter power. Then put all the switches in the proper position for initialization and turn the power back on to the copter.
    - Count down timer should be set correctly depending on battery capacity. This can be adjusted to your flying style. The timer should engage at ¼ throttle and trigger an alarm at the proper time. This is a backup alarm in case the indicator lights on the copter are not visible.
    - Turn on Photography Tx
    - Check Model Selection on Tx – should read Zenmuse
    - Check Tx battery voltage (above 5.4v for Futaba 14ch)
    - HDMI switch Off
    - Freestyle switch Off (FPV On)
        - These settings above are required to initialize the Zenmuse properly. If the switches are in the incorrect position, it will not initialize properly which may cause some of the functions like live video or gimbal operation to not operate properly.
        - If the camera or gimbal do not function properly, disconnect the copter power. Then put all the switches in the proper position for initialization and turn the power back on to the copter.
    - Engage power to copter
        - Plug in the 2 battery packs. Typically the battery packs use red T-style connectors in a parallel wire harness. This Y-harness has a yellow connector. It is preferable to connect the batteries to the Y-harness first, then plug in the yellow connector. This reduces (but does not eliminate) electrical arcing.
        - 6 quick chirps should be heard confirming 6S LiPoly batteries are recognized by the ESCs.
            - Hearing less than 6 chirps indicates fewer cell battery packs are being recognized which is incorrect. Check for improper or damaged batteries.
    - Do not move or vibrate the Squadcopter until 30 seconds after full GPS Lock
        - Initial 3 red blinks is normal meaning no GPS lock. No red flashes indicates full GPS lock.
        - Continue with checklist as you are waiting for full GPS lock, but do not move the copter.
        - If the GPS takes more than 5 minutes to lock, there is a problem with the area. It is not receiving the proper signals from the satellites. GPS signals are weak, so trees, people, buildings, terrain, weather, have an effect. Move the copter into a more open area where it can more easily see the satellites.
    - Check Copter Voltage from both Tx's (transmitters)
        - The transmitters receive a signal from the corresponding receivers. The voltages are regulated to about 5v. If the voltage is below 4.4v or above 6v do not fly. There may be power regulation issues. The receivers cannot work outside this voltage consistently. Also there is some issue if the voltage is outside that range which should be resolved before flying.
    - Engage Attitude Mode – Must achieve double amber flash
    - Engage GPS Mode – Must achieve double purple flash
    - Engage course cock mode – Must achieve double green flash
    - Disengage course lock mode. Must achieve double purple flash. Stay in this mode until just prior to takeoff, after takeoff at any time, or do not use.
    - Do not engage motors. Set throttle to center position. Must achieve single purple flash when in GPS mode.
        - To verify that the sticks are all centered properly:

        - With throttle in the center position, use the trim buttons on the transmitter to check that the sticks are centered. Trim the roll (the stick located on the right side of the transmitter when moved to the right and left) to the right, counting the number of clicks until a double flash occurs. Then center the trim. Then move the trim to the left, counting the number of clicks until a double flash occurs. An equal number of clicks should be counted each side of center.
        - Do this check for the 3 stick movements other than throttle.
        - Center the trim such that when the stick is in the neutral position that there are equal numbers of clicks in each direction. This ensures that when the sticks are neutralized that the flight controller will recognize this signal and engage GPS mode.
    - Calibrate GPS/Compass before the first flight each day or if receiving continuous red blinks or continuous white blinks.
        - Flip the GPS mode switch 7 times very quickly from manual to GPS. End with the switch in the manual position. The indicator light will be blue. Rotate the copter about 1.5 turns in a horizontal position. A green flashing light indicates that this is complete. Then hold the copter vertically and rotate about 1.5 turns. A white flashing light indicates that this is complete. Repeat if necessary until this is completed.
    - After calibration, reset the copter by cycling battery with copter pointed in the correct heading for course lock.
    - Engage Camera
    - HDMI switch On
        - This will stop video from playing on the back of the camera and will send the video signal to the video transmitter via the HDMI connection.
    - Freestyle switch On (FPV Off)
        - This allows the camera to be operated freely through the transmitter
    - Verify camera operation
        - Operate the shutter
        - Set the focus to auto or manual. Manual setting is usually set to infinity to stop constant focusing of the camera.
    - Verify data link if installed
        - Roll the copter about 45 degrees on its side by lifting one side of the copter and resting one side of the landing gear on the ground
        - A corresponding roll should be seen on the gauge.
        - If the copter is rolled to the right, it will appear on the gauge that the horizon rolls to the left – not the right because the view from inside the copter is that the horizon rolls the opposite direction of the copter.
    - Verify altitude is about 0 via gauge on computer
        - If it is not about 0, the altitude settings for the waypoints will be off by this amount. This could cause the copter to fly at 10 meters or 30 meters if the waypoint is set for 20 meters and the altitude is off by 10 meters one way or another. If the copter thinks it is at 10 meters when it is on the ground, then it will only rise 10 meters above the ground to achieve what it believes it to be 20 meters above the ground.
        - The altitude can be reset using the ground control software by going to altitude offset.
    - Alternate Emergency Landing Sites Established

- NORMAL TAKEOFF
    - Confirm clear for takeoff with ATC
        - Necessary if within 5 miles of an airport

        - ATC clearance is required days or weeks before flying.
    - Engage GPS mode – Double purple flash when the throttle is down.
    - Switch to Course Lock flight mode if required. Purple flashes are replaced with green flashes. Flying in course lock is not required, but helpful in many instances.
    - Announce loudly: "CLEAR PROP"
    - Move both of the sticks to the bottom left corners to engage the motors. Within 1 second move the throttle up 1/8 – 1/4. The copter should not lift off until about ½ stick is reached.
    - Verify data and video links before lifting off. If anything is not working properly, move the throttle stick to low to disengage the motors and determine a solution.
    - If all flight checks are passed, announce loudly: "TAKING OFF"
    - Advance throttle to about 3/4. Copter must jump off of the ground to avoid one skid coming up before the other skid, and the skid on the ground getting caught and flipping the copter over sideways.
    - Ascend to 3 meters. Then decrease throttle to ½ to engage the GPS hold.
    - Verify links, GPS, Attitude, etc. Should be single purple flash.
    - Verify that the copter is holding position within .5m in all directions.
    - Verify camera operation
    - Verify course lock is operational by rotating 90 degrees and pushing forward on stick.
    - Verify copter stability. If unstable, land and reset gains, recalibrate, or retest as necessary.
    - Proceed with manual mission or
    - For autopilot operation
        - Ascend to 10 meters
        - Command AVO to proceed with mission.
            - Pilot should say "It's yours"
            - Response from AVO "I have it"
    - Manual pilot/observer must monitor the informational LED and be ready to take over in manual mode when necessary.
        - White flashes indicates flight controller issue
        - Amber flashes indicates low battery
        - Red flashes indicate loss of GPS or severe battery condition
            - Quick decisions are required when red flashes are indicated
            - 10 seconds or more of loss of GPS signal will stop waypoint guidance and any GPS hold and put into manual mode.
            - Red indicator light battery warning requires immediate landing
    - Manual pilot to request copter flight battery voltage readout from AVO periodically.
        - Reset the first and second indicator lights as required for your set up.
        - When recharging the batteries, the goal is to put 4,000 mah into a 5,000 mah battery pack. Adjust the voltage warnings to your style of flying.
        - Also use the countdown timer on the transmitter. This gives a good indication of battery level because the current used is fairly constant from flight to flight.

- POST LANDING
    - Note flight time from transmitter. Write this down in the log book.
    - Note battery power used during the flight. Write this down in the log book.
    - ALWAYS disconnect the main power to the AV first, then turn off the transmitter.

- Check motor temperatures by touching them with your fingers. Any motors which are excessively hot should be further inspected and possibly replaced.
- Check battery temperatures by touching them with your fingers. Battery temperatures should not be hot to the touch. Battery temperatures should be slightly above ambient.
- Inspect all components especially the propellers for wear.
- Note in logbook which batteries were used to calculate life cycle.

- AIRCRAFT FLIGHT LOG BOOK (Can be purchased inexpensively)
  - Keep a log of all flights.
    - Date
    - Time of Day
    - Time in Operation (in hours)
    - Battery serial numbers
    - Mah used in flight
    - Location
    - Pilot, Observer, Sensor Operator Names
    - Flight Objective
    - Remarks

- AIRCRAFT MAINTENANCE LOG BOOK (Can be purchased inexpensively)
  - Keep a log of significant inspections, tests, repairs, alterations, equipment changes.
    - Date maintenance is performed
    - Accumulated hours of operation
    - Remarks

- PILOT LOG BOOK (Can be purchased inexpensively)
  - Keep a log of all flights. Include the following:
    - Aircraft flown
    - Aircraft serial number
    - Date
    - Time of Day
    - Time in Operation (in hours)
    - Location
    - Flight Objective
    - Remarks

SECTION 5
PERFORMANCE

- FLIGHT TIMES
  - The AV is designed to hover at high efficiency. Hovering is much less efficient than flying on a wing, thus flight times are low compared to fixed wing aircraft.
  - All the weight of the AV is supported by power from the batteries. As the batteries are used in a flight, the amount of power available decreases. Therefore the power reserve is constantly decreasing as the battery is being used. Thus loading a rotorcraft above its limit is not recommended. While the AV may have enough power to lift off initially on a full charge, the power reserve at partial charge may be too low to allow for maneuvering and will result in a crash.
  - High lateral speeds will add lift to slightly improve efficiency. The rotors act similar to fixed wings at higher speeds. This increase in efficiency may be negated by the increased power consumption of forward flight.
  - High winds or gusts decrease efficiency/flight time. The motors work harder to hold position.
  - As weight increases flight times decrease.

- WIRELESS TRANSMISSION
  - Refer to the specific manuals for performance ratings.
  - Wireless communications utilized provide acceptable communication for LOS.
  - In general:
    - LOS is required
    - The higher the GCS antennas, the better the range
    - Any freq. at may have severe degradation due to location to other admitters such as cell towers
    - RSSI (Received Signal Strength Indication) should be monitored for indication of communication drop out.

SECTION 6
WEIGHT AND BALANCE EQUIPMENT LIST

- CG
  - CG is critical to the efficient operation of any AV
  - When components are shifted, the CG will be altered.
  - The main components which are moved on a regular basis are the sensors and the batteries.
  - The sensors are typically in the front of the AV, and the batteries are located in the correct position to offset all the components on the AV.
  - The CG must be tested after any change to the components or their placement.
  - The CG should be tested by lifting the UV with fingers on the bottom of the arms. Check all 3 pairs of arms. The CG should be no more than 2mm off in any on the 3 checks. The closer the CG is to the centerlines of the arms the more efficient and the more stable the AV will be.
- WEIGHT
  - Weight is critical to the operation of any aircraft
  - Weight is especially critical to a rotor wing aircraft. At full throttle the motors have a finite amount of thrust. All the weight is lifted by the battery power, there is no wing to assist in providing lift.
  - As the batteries are operated, they lose power. At full charge they have about 25v. At 20% remaining capacity they have about 21v. This is a loss of 8% of the power available which is significant.
  - Do not overload the aircraft or there will not be sufficient reserve power to maneuver at low battery levels.

SECTION 7
AIR VEHICLE AND SYSTEMS DESCRIPTION

- FLIGHT BATTERY REQUIRED
  - Manufacturers: Various COTS suppliers
  - Battery chemistry recommended: Lithium Polymer
  - Battery Capacity: up to 21,000 mah or greater depending on max gross weight
  - Battery cell count required: 6S (6 cells in series)
  - Battery Voltage: 21V minimum during hover, 22.2V nominal, 25.2V maximum
  - Battery Minimum Rated Discharge Rate: 20C minimum
  - Battery Minimum Charge Rate: 1C (3C preferable)
  - Battery Rest Time between discharging and charging: 0-30 minutes
  - Batteries used simultaneously: typically 1
  - Recommended Battery Discharge Amount: 80-90%

- WERELESS COMMUNICATIONS
  - Refer to the specific manuals for performance ratings.
  - Never power a video transmitter or receiver without an antenna connected or overload failure will occur.
  - Wireless communications utilized provide acceptable communication for LOS.
  - In general:
  - LOS is required.
  - Lower frequencies penetrate objects such as trees better than higher freqs.
  - Lower freqs have longer range than high freqs
  - Higher freqs can transfer more data than lower freqs
  - Higher freqs use smaller/shorter antennas
  - The higher the GCS antennas, the better the range and reception
  - Any freq at may have severe degradation due to location to other admitters such as cell towers
  - Range must be constantly monitored.
  - Alternate antenna types may be utilized to improve link/range. Patch, helical, omni, etc. can be substituted. They must be verified before use.
  - Alternate freqs may be utilized to improve link/range.

SECTION 8
HANDLING, SERVICE AND MAINTENANCE

- PROPELLER CARE
  - Propellers must be checked each flight for nicks or cracks
  - Propellers are designed to last indefinitely if they do not impact dust, dirt or more.

- BATTERY CARE AND USE
  - Refer to instruction sheet included from the battery manufacturer. Typical information follows.
  - Batteries are highly flammable and can explode, especially when fully charged. Improper charging, vibration, impact, high discharge, etc. can lead to explosion and fire. Batteries must be charged under constant supervision and using proper precautions.
  - Batteries fully charged must be handled with extreme care.
  - Any battery which puffs up is considered damaged and must not be used. It is in a dangerous state. Never charge a puffed up battery.
  - Any battery which holds less than 80% of its rated capacity should be discarded.
  - Cycle test each battery after every 50 cycles or if a battery is suspected to have lost as significant amount of its capacity to determine the current capacity.
  - Properly dispose of batteries. First discharge the battery fully using a battery cycler. Bring to a recycler such as a home improvement store.
  - Always charge flight batteries under “balance” mode.
  - Flight Battery Recommended Charge Rate: 1C which takes approximately 1 hour to charge
  - Flight Battery Maximum Charge Rate: May exceed 5C. Charge rates higher than 1C will decrease life cycles. Maximum charge rating per the manufacturer will provide 300+ cycles. Use the lowest charge rate which is practical.
  - Battery Rest Time between discharging and charging: 30 minutes minimum, 1 hour maximum.
  - Do not charge if the battery is more than 2°C warmer than ambient, especially if the temperature is above 20°C. The outer surface is cooler than the inner core after use. Damage will occur when charging a warm battery.
  - Recommended Battery Discharge Amount: 80%. Using more of the capacity of the battery will decrease the life cycles
  - As battery temperature approaches freezing the capacity of Lithium Polymer batteries decrease. Keep warmer than 5°C before installing into the UV (unmanned vehicle).
  - Battery capacity decreases at higher discharge rates. Using more batteries decreases the discharge rate of each battery thereby extending individual battery capacity slightly.
  - Lower discharge rates improve the life cycles.
  - Batteries are rated at greater than 300 life cycles. 1,000+ life cycles are possible.
  - Batteries must not be stored above 60% charged state for extended periods.
  - Batteries should be stored below 25°C for extended periods
  - Store batteries between 40% - 60% charged state. Fully charge just before use.
  - Fully charged batteries which are not to be used within 24 hours should be discharged to 40% - 60% charged state using the battery discharger.
  - Using more than one battery at a time requires the proper wiring harness so that the voltage is no more than 25.2V. Over voltage will cause serious damage to electrical equipment.

- PREVENTATIVE MAINTENANCE
    - ANNUAL INSPECTION (SUGGESTED)
        - If the airframe has in excess of 300 hours in a one year period, an annual inspection must be completed by an approved technician.
        - An approved technician should disassemble the AV and inspect all components for wear and replace any components as required.
        - Test all batteries for capacity.
        - Upgrade firmware and software to latest revisions

    - 500 HOUR PM (SUGGESTED)
        - An approved technician should disassemble the AV and inspect all components for wear and replace any components as required.
        - Replace all motors.
        - Test all batteries for capacity.
        - Upgrade firmware and software to latest revisions.

SECTION 9
SUPPLEMENTS

COTS components have been utilized in the construction of this AV. All instruction manuals, operating handbooks, warning notices, and more are available as separate documents. Components which may have separate documentation follow. Links to these documents are available on the website. Print out the significant documents and keep in a notebook with the copter at all times.

AIRFRAME
AUTOPILOT SYSTEM
BATTERIES
BATTERY CHARGER
CAMERA MANUAL
CAMERA GCS
DATA WIRELESS LINK
GIMBAL CAMERA MOUNT
GIMBAL CAMERA MOUNT SERVOS
LAPTOP COMPUTER
MOTORS
ONBOARD REGULATOR
PROPELLERS
RC/MANUAL COMMAND & CONTROL SYSTEM
SPEED CONTROLS (ESCs)
VIDEO CAPTURE HARDWARE
VIDEO CAPTURE SOFTWARE
VIDEO WIRELESS LINK