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

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

July 20, 2015

Exemption No. 12083
Regulatory Docket No. FAA–2015–0357

Mr. Brent Rouse
Indiana Aerial Solutions, LLC
5112 East Range Road
Shelbyville, IN 46176

Dear Mr. Rouse:

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 February 10, 2015, you petitioned the Federal Aviation Administration (FAA) on behalf of Indiana Aerial Solutions, LLC (hereinafter petitioner or operator) for an exemption. The petitioner requested to operate an unmanned aircraft system (UAS) to conduct precision photogrammetry and crop scouting at the resolutions necessary for precision agriculture.

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 Precision Drone Pacesetter.

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

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

The Basis for Our Decision

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

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

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

Our Decision

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

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

Conditions and Limitations

In this grant of exemption, Indiana Aerial Solutions, LLC is hereafter referred to as the operator.

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

1. Operations authorized by this grant of exemption are limited to the Precision Drone Pacesetter 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

Indiana Aerial Solutions LLC
5112 East Range Road
Shelbyville, IN 46176

February 10, 2015
US Department of Transportation
1200 New Jersey Ave., SE
Washington, DC 20590

Dear Sir or Madam:

Pursuant to Section 333 of the FAA Modernization and Reform Act of 2012 (the "Reform Act") and 14 C.F.R Part 11, Indiana Aerial Solutions LLC (IAS) seeks an exemption from Federal Aviation Regulations ("FARs") detailed below for the Pacesetter Unmanned Aircraft System manufactured by Precision Drone.

The requested exemption would support an application for a commercial Certificate of Authorization to use the system to support agriculture. The Pacesetter system consists of a lightweight (6.2 lbs.) battery operated aircraft, a PC-based ground control station, and associated communications equipment. The aircraft carries an onboard geo-referenced still camera that allows it to conduct precision photogrammetry and crop scouting at the resolutions necessary for precision agriculture. This high resolution imagery can direct variable seeding rates as well as the precise application of fertilizer and chemicals reducing their use. This data helps farmers to identify and eliminate potential yield limiters while reducing their costs. By approving these exemptions, the FAA will create a benefit to agriculture and ultimately the farmers' ability to continue to feed a growing global population.

The aircraft will be operated in the field with both a Pilot in Command (PIC) and a ground based Visual Observer (VO) in accordance with FAA Policy N 8900.227 Section 14 "Operational Requirements for UAS" with the following restrictions:

- All operations will occur in Glass G airspace at no more than 400' AGL
- Operations will be operated over private property with the permission of the land owner
- All required permits will be obtained from state and local government prior to operation
- The aircraft WILL NOT be operated over urban or populated areas
- The aircraft WILL NOT be operated at air shows or over and open-air assembly of humans
- The aircraft WILL NOT be operated over heavily traveled roads
- The aircraft WILL NOT be operated within 5NM of an airport or heliport
- Operations will be limited to daytime hours in visual meteorological conditions
- Aircraft will remain within visual line of sight at no greater than ½ NM of the PIC
- While the aircraft is airborne, the VO will be positioned within voice distance of the PIC

The PIC and VO will meet the requirements outlined in FAA Policy N 8900.227 Section 16 Personnel Qualifications. Additionally, I personally will be acting as PIC of this aircraft and have in my possession and in good standing a FAA issued Commercial Pilot License (cert # 2787906) and have logged more than 1100 hours since obtaining my license in 2000. Furthermore, I also have in my possession and in good standing a FAA issued Certified Flight Instructor license (cert # 2787906CFI). The PIC and VO will also perform maintenance on the system and will complete a course of maintenance/operational instruction as part of their initial training. The PIC will also be attending and completing a 10 day SUAS rotorcraft safety course sponsored by Unmanned Experts in Denver, CO in February of 2015.

We submit that the combination of the aircraft's light weight, previously demonstrated flight performance, fully qualified flight crew, operations over rural agriculture areas, and strict operation under the guidelines established in 8900.227, the FAA can have full confidence that the operation will have an equivalent or greater level of safety of manned aircraft performing the same mission.

The name and contact information of the applicant is:

Indiana Aerial Solutions LLC
Attn: Brent Rouse
Phone: 317-512-1225
Email: brent@inaerialsolutions.com

The regulations from which the exemption is requested are as follows:

- 14 CFR Part 21
- 14 CFR 91.203
- 14 CFR 45.23, 45.29
- 14 CFR 91.9
- 14 CFR 61.133
- 14 CFR 91.119
- 14 CFR 91.121, 91.151
- 14 CFR Subpart E (91.401 – 91.417)
- FAA Policy 8900.227 Paragraph 16(c)(4) and Paragraph 16(e)(1)

We are willing and able to modify or amend any part of this request to satisfy the need for an equivalent level of safety. I personally look forward to working with your office. Please contact me at any time if you require additional information or clarification.

Sincerely,

Brent Rouse

Brent Rouse
Owner

Appendices Begin on Next Page

APPENDICES:

A. Exemption Request and Equivalent Level of Safety

B. Aircraft Description, Safety Features, & Operation

C. PIC Qualifications

D. User Manual and Flight Logs

EXEMPTION REQUESTS AND EQUIVALENT LEVEL OF SAFETY

Indiana Aerial Solutions requests an exemption from the following regulations as well as any additional regulations that may technically apply to the operation of the Precision Drone Pacesetter:

14 CFR Part 21, Subpart H: Airworthiness Certificates

This part establishes the procedures for the issuance of an airworthiness certificate. While the FAA continues to work to develop airworthiness standards for UAS, we request an experimental certificate be issued for the Precision Drone Pacesetter under either or both of the following provisions:

> 21.191 EXPERIMENTAL CERTIFICATES
> Experimental certificates are issued for the following purposes:
> (a) *Research and Development.* Testing new aircraft design concepts, new aircraft equipment, new aircraft installations, new aircraft operating techniques, or new uses for aircraft
> (b) *Showing compliance with Regulations.* Conducting flight tests and other operations to show compliance with their airworthiness regulations including flights to show compliance for issuance of type and supplemental type certificates, flight to substantiate major design changes, and flight to show compliance with the function and reliability requirements of the regulations.

Since the experimental certificate can be used for commercial purposes such as market surveys, sales demonstrations, and customer crew training, we would expect that an experimental certificate would permit our commercial purpose of precision agriculture as well.

The aircraft will not carry persons or property, will not carry fuel, and will only fly under strict operational requirements. Combined with the fact that the aircraft weighs only 6.2 pounds we propose that the Pacesetter will be at least as safe, if not safer, than a conventionally certified aircraft performing the same mission. If an experimental airworthiness certificate is not appropriate for this application, then we request an exemption of 14 CFR Part 21, Subpart H, and the requirements for airworthiness certificate in general.

14 CFR 91.203(a) & (b) Civil Aircraft; Certifications Required

The regulation provides that an airworthiness certificate, with the registration number assigned to the aircraft and a registration certificate must be aboard the aircraft. Additionally, subparagraph (b) provides that the airworthiness certificate be displayed at the cabin or cockpit entrance so that it is legible to passengers or crew. At 6.2 pounds the Pacesetter is too small to carry documentation, does not have an entrance to cockpit, and is not capable of carrying passengers or crew.

To obtain an equivalent level of safety and meet the intent of 91.203, we propose that those documents deemed appropriate for this aircraft by the FAA be located with the crew at the ground master command station and immediately available at all times upon request. In order to identify the aircraft, we propose that the information found on airworthiness and registration certificates be permanently affixed to the aircraft via a placard or sticker with the following information:

Manufacturer:
Model:
Serial Number:
Tail Number:
Registered To:
Registrants Address:
If Found Please Call:
We would also be willing to add any additional information to this placard that the FAA might require.

14 CFR 45.23 Display of Marks; general and 45.29 Size of Marks

These regulations provide that each aircraft must display 'N' and the aircraft's registration number in letters at least 3 inches high. Additionally, the aircraft must display the word 'EXPERIMENTAL' in letters at least 2 inches high near the entrance to the cabin, cockpit, or pilot station. The 6.2 pound Pacesetter is not large enough to meet this size of markings. We propose the word 'EXPERIMENTAL' the 'N' number of the aircraft be displayed on both the top and the bottom of the aircraft in 1 inch letters. It is our belief that this lettering along with the placard discussed in the previous paragraph will provide all of the necessary information for the aircraft

Additionally, if the FAA deems necessary, we are willing to display signage at our ground master command station designating it as such. This signage will be in bright 6 inch letters or larger. This will allow anyone that observes the aircraft and chooses to inquire as to where its point of origin is can do so.

14 CFR 91.9 Civil Aircraft Flight Manual, Marking, and Placard Requirements

This regulation provides that no person may operate an aircraft unless a current, approved flight manual is in the aircraft. We request an exemption to this requirement since the aircraft is not manned and is too small to carry documentation. To obtain an equivalent level of safety and meet the intent of 91.9, we propose that a current Aircraft Flight Manual (appendix D) be present and available to the crew at the ground master command station anytime the aircraft is in, or preparing for, flight.

14 CFR 61.133 Commercial Pilot Privileges and Limitations

This regulation provides that the person who holds a commercial pilot certificate may act as pilot in command of an aircraft for compensation or hire provided the person is qualified in accordance with the applicable parts of this chapter that apply to the operation. Since I personally will be acting as PIC of our aircraft and I have in my possession and in good standing a commercial pilot's license (certificate number 2787906), we propose that we will meet the requirements of this regulation.

14 CFR 91.119 Minimum Safe Altitudes: General

This regulation provides that over sparsely populated areas the aircraft cannot be operated closer than 500 feet to any person, vessel, vehicle, or structure. Since we will be operating the aircraft at a maximum altitude of 400' AGL, we cannot comply with this requirement.

To provide an equivalent level of safety we will only operate the aircraft over private property with the permission of the land owner. The land owner will be briefed of the expected route of flight and the associated risks to persons and property on the ground. We maintain that due to the small size of the Pacesetter, the hazard to persons, vessels, vehicles, and structures is not comparable to manned aircraft and should be considered in granting the exemption to this regulation.

The aircraft will not be operated over congested areas nor over any open air assembly of persons. The aircraft will be operated at an altitude allowing, if a power unit fails, an emergency landing can be made without undue hazard to persons or property on the surface.

14 CFR 91.121 Altimeter Settings

This regulation provides that aircraft shall maintain cruising altitudes by reference to an altimeter setting available within 100 nautical miles of the aircraft. Our aircraft will fly below 400' AGL and will not need to maintain hemispherical cruising altitudes in order to de-conflict with other aircraft. To provide an equivalent level of safety, we will set the altimeter to our aircraft to 0' AGL on the ground prior to every flight to ensure we can accurately ensure that the aircraft stays below 400' AGL at all times. Even if there were rapid changes in barometric pressure, it would have little effect on our operation since the aircraft stays airborne for only 30 minutes or less at a time.

14 CFR 91.151 Fuel Requirements for Flight in VFR Conditions

This regulation provides that no person may begin a flight in an airplane under day VFR conditions unless there is enough fuel to fly to the first point of intended landing and to fly thereafter for at least 30 minutes. The Pacesetter is a battery operated aircraft and the maximum duration of a flight with 2 fully charged batteries is 30 minutes. Additionally, since the aircraft will never fly more than 1/2 nm from point of launch, we feel that we would have adequate reserve "power" to make a safe landing at intended landing site. We request an exemption from this regulation.

14 CFR Subpart E (91.401 – 91.417) Maintenance, Preventative Maintenance, and Alterations

This regulation provides that the operator is primarily responsible for maintaining the aircraft in an airworthy condition, including compliance with part 39 and 43. Paragraphs 91.407 and 91.409 require that the aircraft be 'approved for return to service by a person authorized under 43.7' after maintenance and inspection. It is our intention that the PIC perform maintenance and inspection of the aircraft and be the 'authorized person to approve the aircraft for return to service'.

In the User Manual (appendix D) the PIC will ensure the aircraft is in airworthy condition by conducting a pre and post flight inspection after every single flight. Any maintenance performed by the PIC will be limited to repairing small cracks, replacing a propeller, tightening wire connections, and updating software and firmware. All other maintenance and repairs will be performed by the manufacturer. The PIC will document work performed in accordance with 91.417. We feel that due to the size, weight, and simplicity of the aircraft, the PIC can ensure an equivalent level of safety prior to launching the aircraft on each flight.

8900.227 Paragraph 16 (c)(4) PIC Medical & Paragraph 16 (e)(1) Observer Medical

This policy provides that both the PIC and VO must have a valid FAA issued second class medical certificate under part 67 in order act as PIC or VO. We feel requiring both crew members that are operating a 6.2 pound aircraft at less than 400' AGL meet the same medical requirements as a commercial pilot carrying passengers in a large manned aircraft are unnecessary.

We propose that the PIC will have and maintain a valid FAA issued second class medical, but that the medical requirements for the VO be lessened to having vision corrected to 20/20 and a valid, state-issued driver's license. We feel that if the VO is medically licensed to operate a vehicle on the road they then have the medical capability to perform their duties as a VO and assist the PIC with identifying and

avoiding other air traffic. In the very unlikely event that both the PIC and VO become medically incapacitated while the aircraft is in flight, the Pacesetter has a failsafe programmed that when battery levels reach 30% the aircraft autonomously returns to home point and land without any crew inputs.

AIRCRAFT GENERAL DESCRIPTION, SAFETY FEATURES, & OPERATION

General Description

The Precision Drone Pacesetter is a remotely controlled hexacopter that is capable of both manual and autonomous flight and weighs only 6.2 pounds. It will only be operated when sufficient GPS signal is available. More detailed information is included in the specification sheet in the User Manual (appendix D)

Safety Features

There are a number of safety features programmed into the aircraft that will be utilized on every flight. For example:

- If GPS signal is lost the aircraft will return to home point and land.
- If signal from the transmitter is lost the aircraft will return to home point and land.
- If battery power reaches 30% the aircraft will return to home point and land.

More detailed safety information is included in the User Manual (appendix D)

Intended Operations

This aircraft will be utilized by our company for the purpose of crop scouting and precision agriculture. The use of this aircraft in this industry is intended to allow grows to maximize yields to continue to feed a growing global population. In servicing this industry, the aircraft will only be used in private rural agriculture settings once requested by the grower and granted permission by the grower. As mentioned previously, operating in areas such as this will allow Indiana Aerial Solutions to eliminate public concern for (1) operating over urban or heavily populated areas and (2) personal privacy as we will be simply be flying over production agricultural farmland.

PIC QUALIFICATIONS

PIC Qualifications

As mentioned in previous pages, I personally will be the PIC of our company's aircraft. My aviation qualifications are as follows:

- Commercial Pilot License with Instrument Rating
  - Single Engine Land & Multi Engine Land
- Certified Flight Instructor
- Received Bachelors of Science Degree from Purdue University in 2005 majoring in Professional Flight Technology
- Previously employed as First Officer for Piedmont Airlines in 2005 and 2006
- Logged approximately 1100 flight hours and still actively fly manned aircraft
- Third Class Medical
- RC aircraft enthusiast and hobbyist for past 5 years operating fixed wing, rotorcraft, and multi-rotor aircraft

Along with these qualifications, I have a thorough knowledge and understanding of the National Airspace System (NAS) and the risks associated with safely incorporating "drones" into that system. I will go above and beyond meeting the current safety policies that exist with UAS as well as any and all polices that the FAA issues in the future. I will also be proactive in reporting any and all observed operations that are not in compliance with the current safety requirements to do my part in assisting with the successful transition of safely incorporating UAS into our NAS.

USER MANUAL & FLIGHT LOGS

(FOLLOWING 21 PAGES)

Precision Drone

User's Manual

Pacesetter Model
2015

Serial Number: DB000209

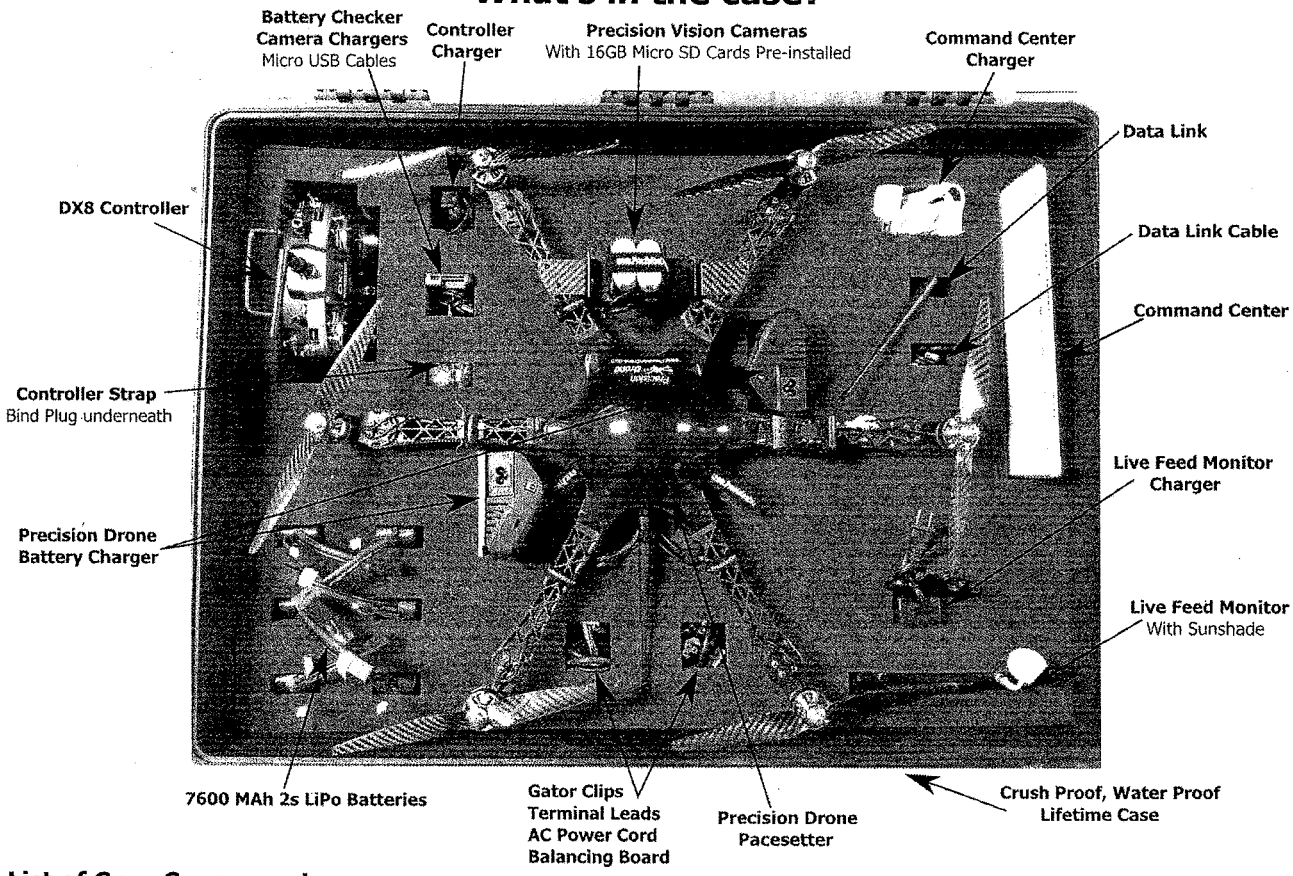
Version 1.12

WARNINGS

- Obey all federal, state, and local regulations
- Do not fly in rain or other harsh conditions
- Do not fly in wind more than 25mph
- Do not fly faster than 10 m/s (22.5mph)
- Operating in temperatures below 50° Fahrenheit (10° Celsius) will result in decreased flight times
- Operating in temperatures below 32° Fahrenheit (0° Celsius) and below the mechanical and electrical components run the chance of seizing, resulting in drone malfunction and ultimately property damage, injury, and/or death
- Always use the provided battery chargers
- The drone will return home when it reaches less than 14.5v
- The drone will land in place when it reaches less than 14.0v
- Keep away from spinning motors at ALL TIMES.
- Do not attempt to modify the drone
- Do not attempt to repair the drone
- NEVER allow minors to charge battery packs
- NEVER drop power supply or batteries
- NEVER attempt to charge damaged or swollen batteries
- NEVER let batteries fully discharge unless you are disposing of them
- NEVER attempt to charge a battery pack containing different types of batteries
- NEVER charge a battery if the cable has been pinched or shorted
- NEVER allow batteries to come into contact with moisture at any time
- NEVER charge batteries in extremely hot or cold places or in direct sunlight
- ALWAYS disconnect the battery after charging
- ALWAYS end the charging process if the charger or battery becomes too hot

*Failure to exercise caution while using this product and comply with the warnings above could result in product malfunction, electrical issues, excessive heat, fire, and ultimately injury, property damage, or death. Never allow use of this product by anyone without providing them with these instructions. You must read, understand, and follow all instructions and warnings for any product(s) to which this product is used in conjunction with or installed. The operator is choosing to use this product and does so at his or her own risk. Save these instructions with the product for use as a reference in the future

What's in the case?

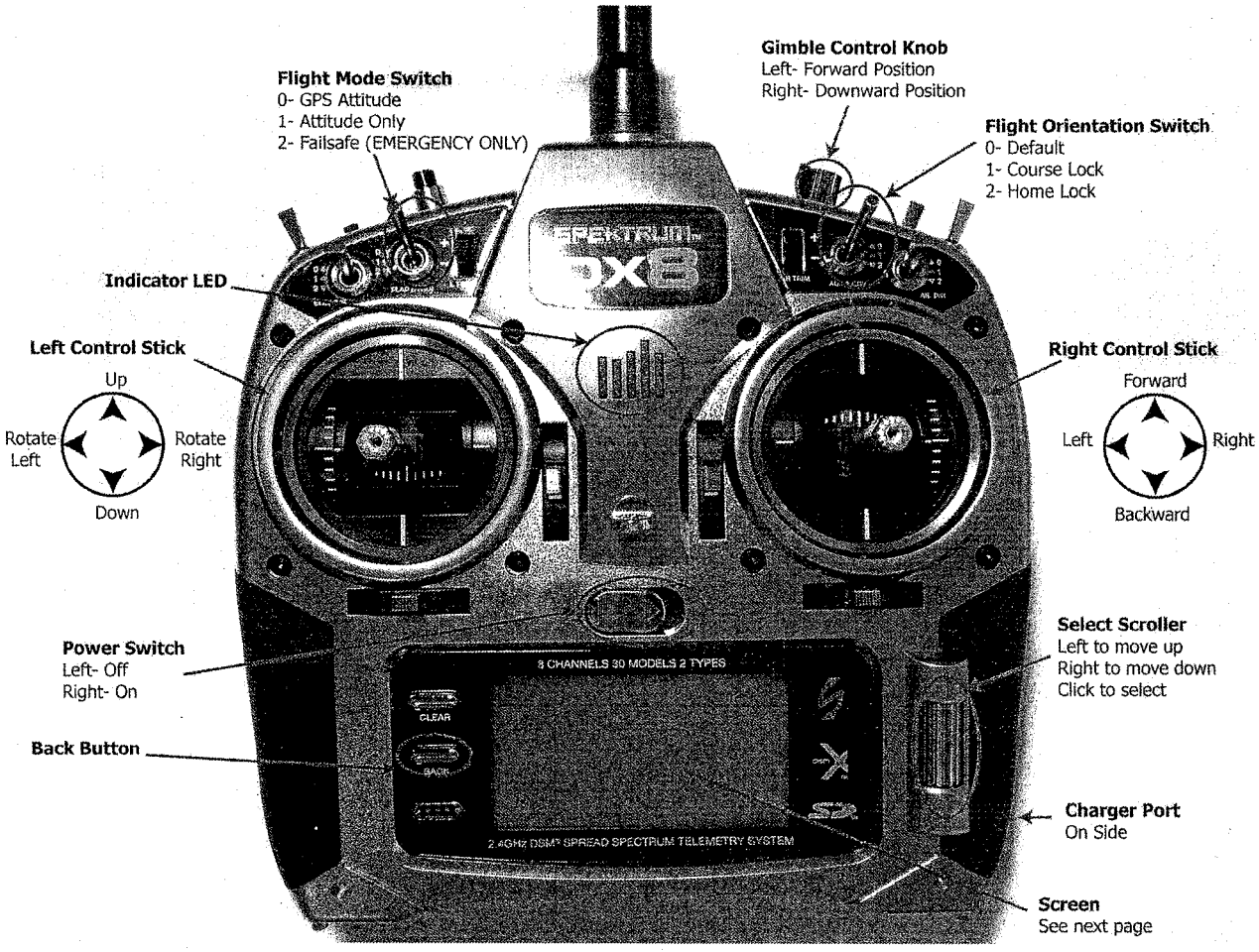


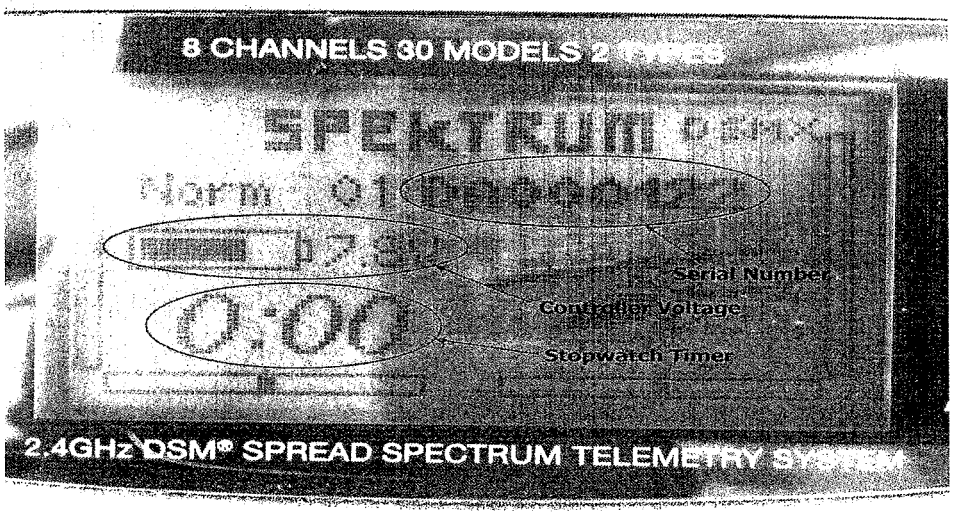
List of Case Components

1x Precision Drone Pacesetter
6x 7600mAh 2S LiPo Battery
1x Command Center Laptop
1x Command Center Charger
1x Live Feed Monitor
1x Live Feed Monitor Charger
1x Precision Vision Camera (NIR)
1x Precision Vision Camera (RGB)
2x Camera Charger Access Cable
1x DX8 Controller
1x Controller Charger
1x Controller Strap
1x Bind Plug
1x Data Link
1x Data Link Cable
2x Battery Charger
2x Balancing Board
2x Gator Clips
2x Charger Wall Plug
2x Charger Battery Plug
2x 16GB microSD card (pre-installed in cameras)
OEM Manuals (Located under first layer of foam)

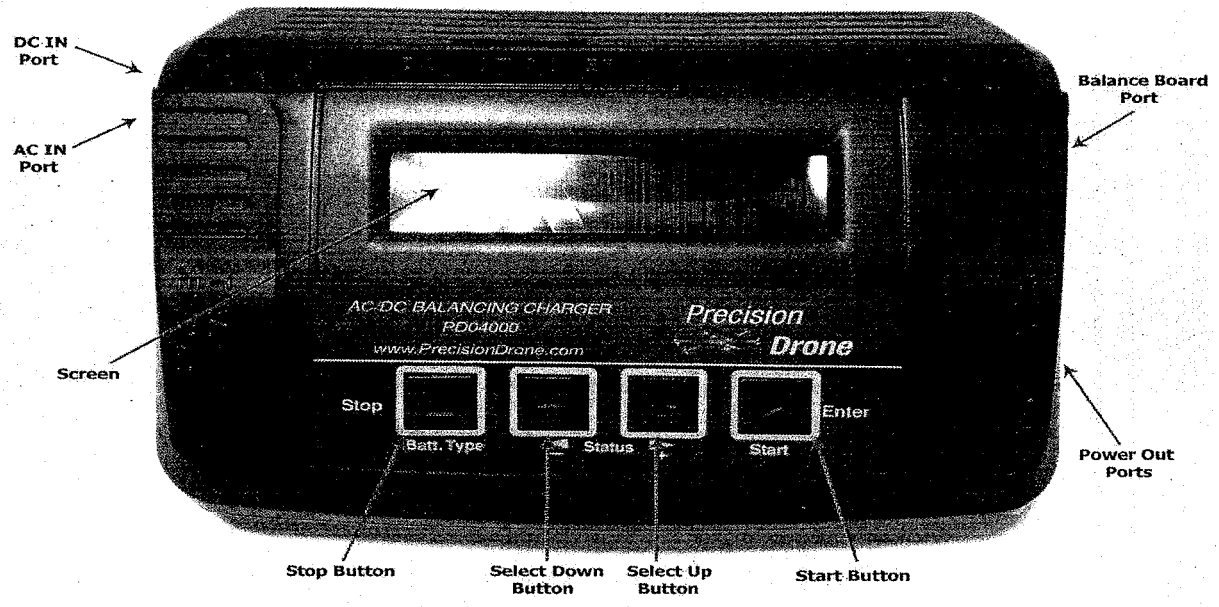
Components

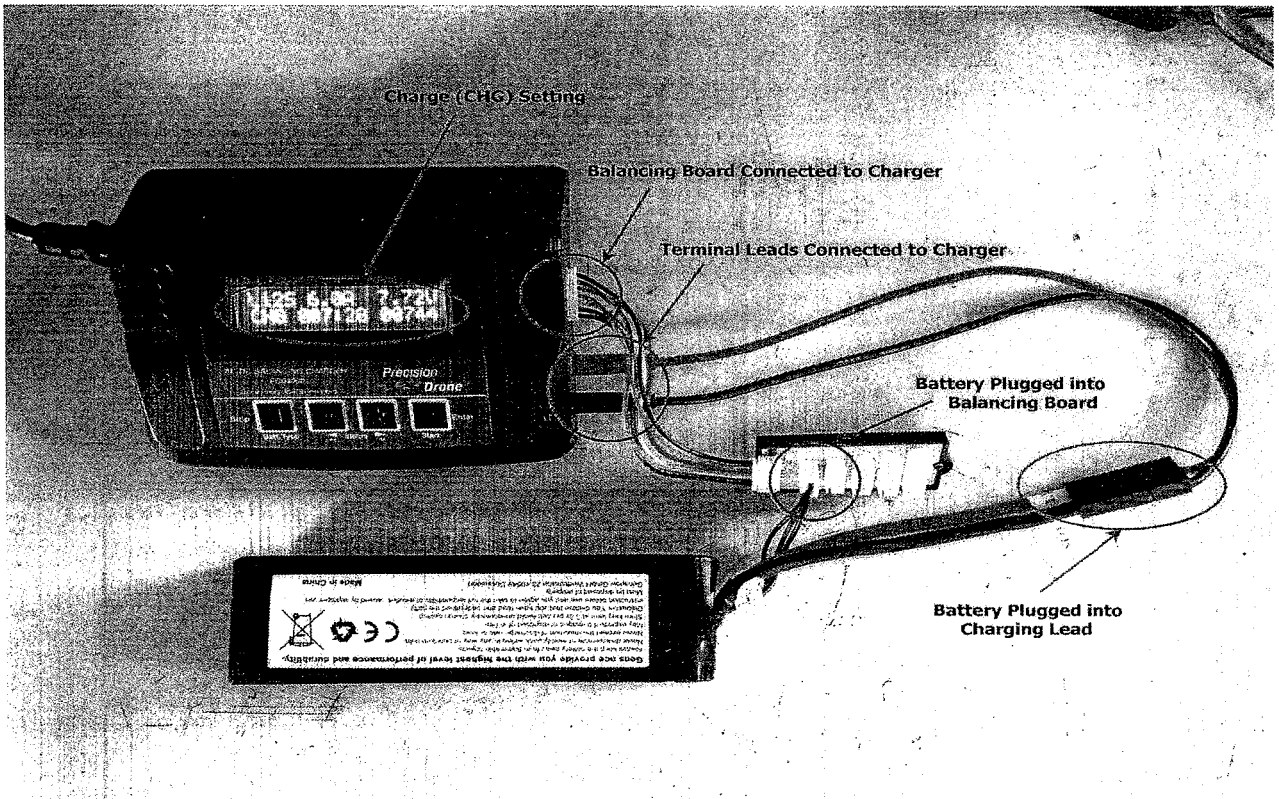
DX8 Controller:



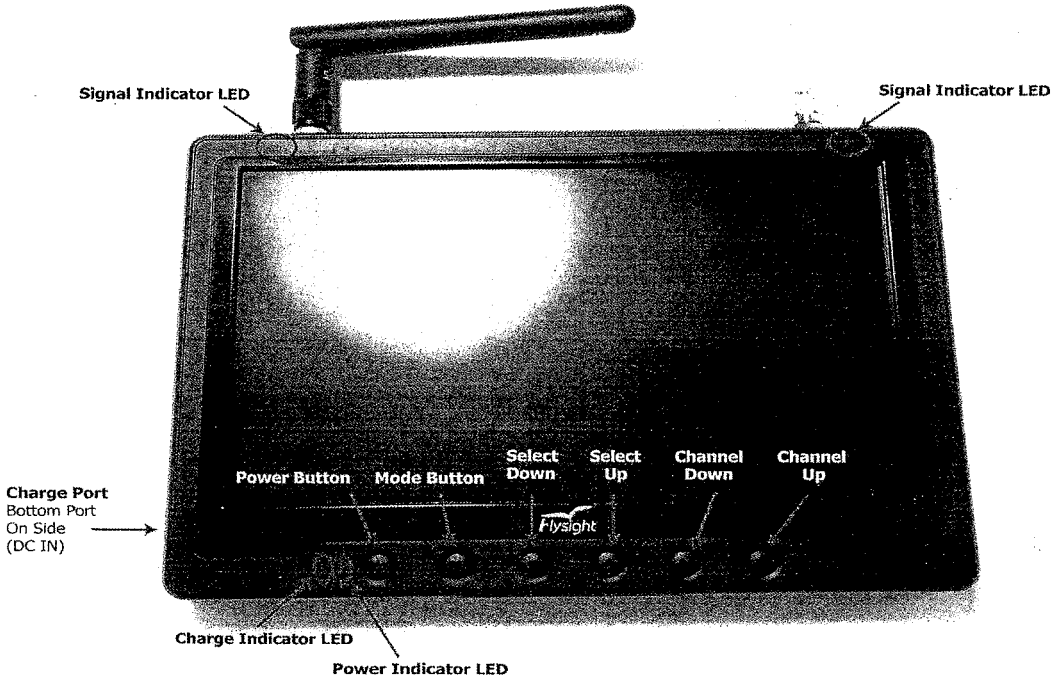


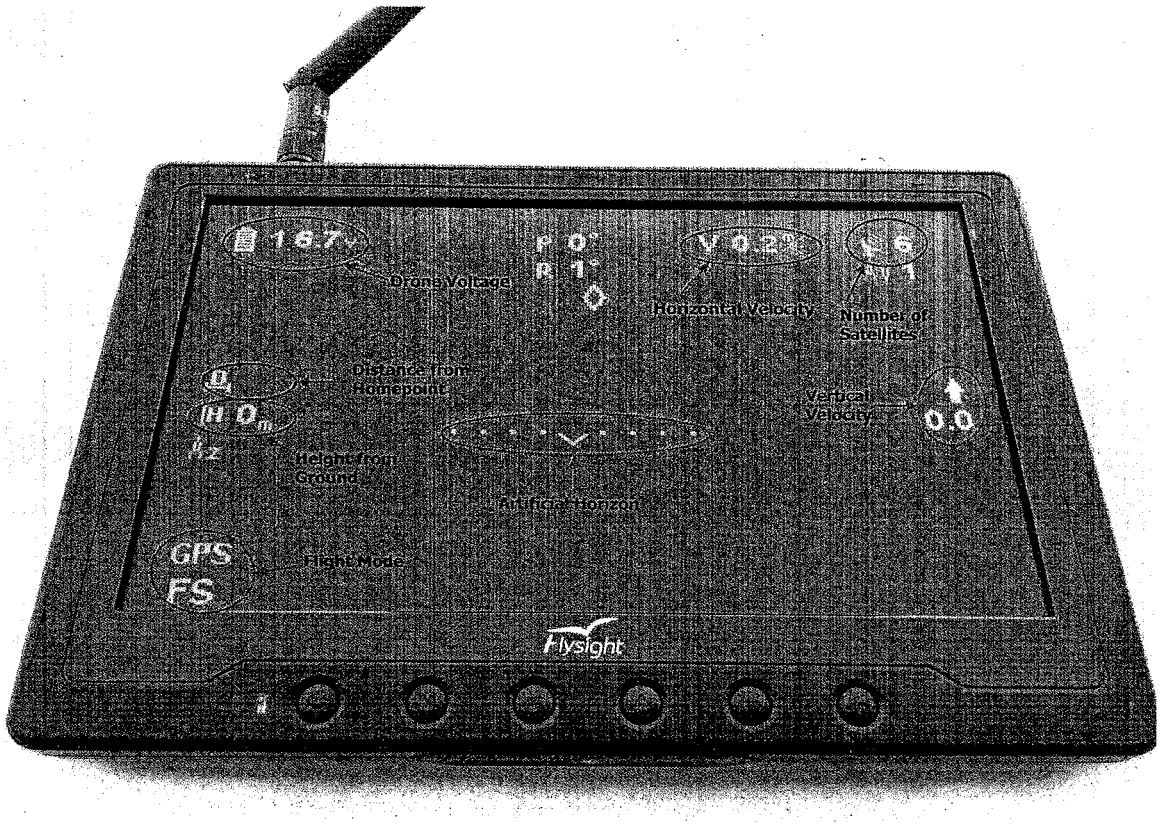
Battery Charger:





Live Feed Monitor:

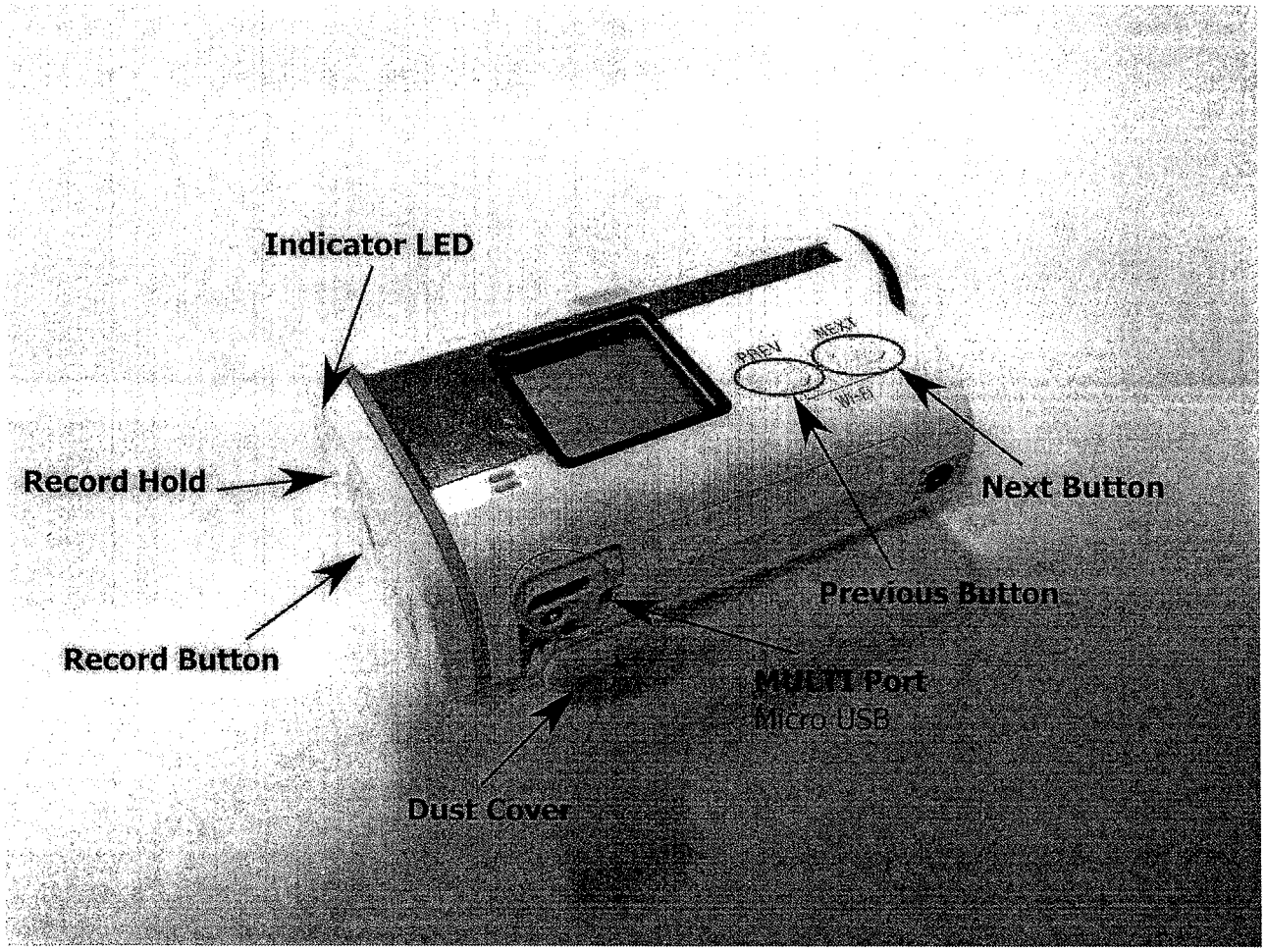




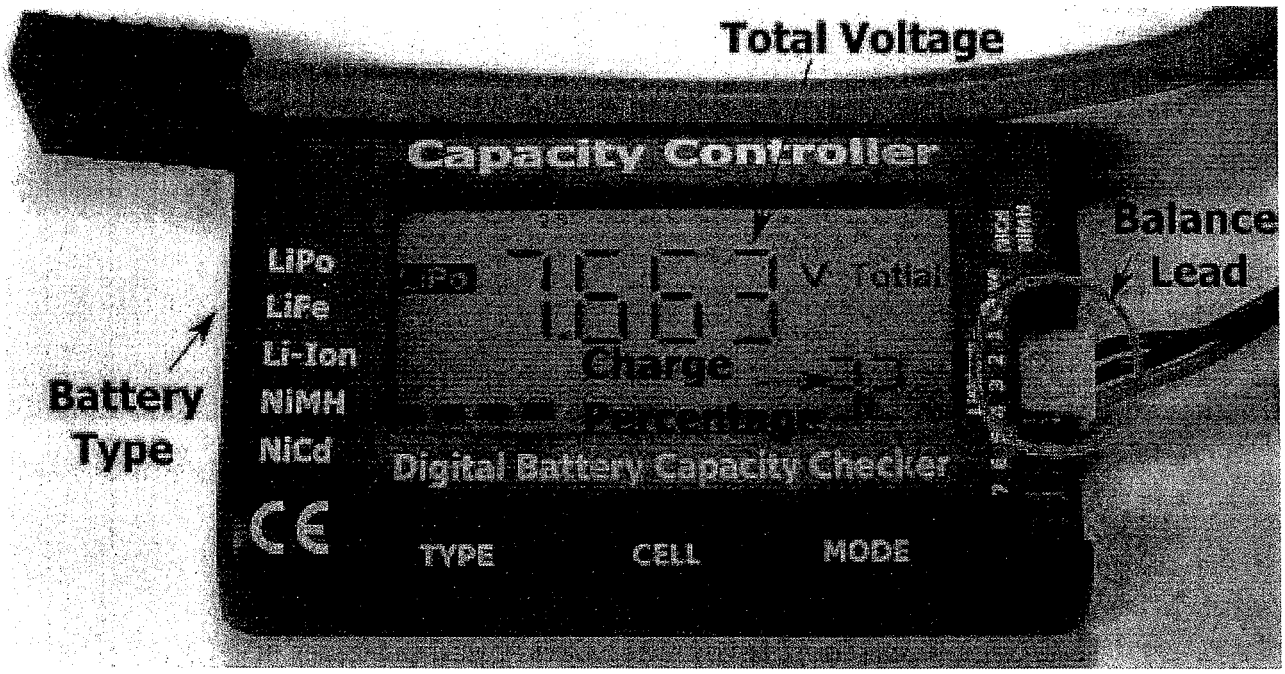
Notes on Live Feed Monitor:

1. All units are in metric as shown in picture above
2. You do not need to plug the live feed cable on the drone into a camera in order to see the telemetry on the live feed screen
3. Flight Modes:
   - GPS- GPS and Gyroscope correction
   - ATT- Gyroscope correction only
   - M- Manual. No GPS or Gyroscope correction. Never fly when the screen says this
   - GPS FS- Failsafe mode
   - Ghome- Go home mode. Drone will be flying in autopilot
   - WPT- Waypoint mode. Drone will be flying in autopilot
   - Landing- Drone is automatically landing itself in place
   - Pause- Drone is hovering in place after "Pause" button in Ground Station is hit

Precision Vision Camera:



Battery Voltage Checker



Notes on the Battery Checker

- To check the charge of a single battery, plug the balancing lead into the battery checker, using the three pins closest to the top as shown above. Make sure the red wire is towards the bottom.
- Make sure the checker is set for the correct battery type. As shown above, to the left of the total voltage, it should read "LiPo". If it does not, press the "Type" button until it does.
- Batteries will never read 100%. 99% is the highest reading, and a battery at 99% will have 8.4 total voltage

Getting Everything Charged

DX8 Controller: Turn the controller off. Plug one end of the charging cable into the charging port (see p. 5), and the other end into a power outlet. The controller indicator LED will glow blue indicating it is charging and turn off when fully charged.

Precision Vision Camera: Turn the camera off. Plug the micro USB cable into the MULTI port on the camera (see p. 9), and the other end into a generic USB port on a laptop or similar device connected to power. The Indicator LED will glow red when charging, and turn off when fully charged.

Live Feed Monitor: The monitor can remain powered on while charging. Plug one end of the charging cable into the bottom DC IN port on the monitor (see p. 7), and the other end into a power outlet. The charging indicator LED will glow red. It will turn green when finished.
IMPORTANT: *DO NOT leave it in prolonged exposure to sunlight while charging! DO NOT plug the adapter into the DC OUT port. This will ruin the battery.*

Command Center Laptop: The laptop can remain powered on while charging. Simply plug one end into the charging port on the laptop, and the other end into a power outlet. The charging indicator LED will glow red. It will turn green when finished. Laptop battery percentage can also be checked in Windows, in the lower right hand corner of the desktop.

Batteries: (see p. 6) Plug the battery charger into a power outlet using the power cable. Attach the red and black leads to their respective positions on the charger. Attach the balancing board to the balancing port on the charger. Now take the red/black leads and connect it to the battery. Connect the white balancing cable to the balancing board. Make sure everything is secure and snug. The charger should now be switched to "CHARGE" mode (it is already on by default). Now hold down the enter button for a few moments, then tap it again to confirm, it will now charge the battery. The charger will beep and flash "FULL" when finished. Hit "STOP".
IMPORTANT: *DO NOT disconnect the red/black terminals from the charger at all. Simply unplug the battery from its end. Failure to do so will create an arc in between the leads, this will damage the battery! The Pacesetter comes equipped with 7600 mAh 2s LiPo batteries. It is important that the batteries are charged with these settings. Failure to do so could result in machine under performance or damage to the battery.*
Note: Refer to the battery charging video for visual instruction.

GPS Recalibration

- If your drone "toilet bowls" when hovering, or "fish tails" when flying straight
- Once every 2 or 3 weeks depending on performance
- When moving from one region to another

1. Make sure your DX8, live feed screen, and one (1) set of batteries are all charged.
2. Turn on DX8 (see page 5 for locations of switches mentioned from here on) and live feed screen (see page 7 for locations mentioned from here on).
3. Place drone in an open outside area and plug batteries in.
4. On the DX8, hit the "select" button. Click on "Servo Setup". Scroll down to "Throttle" and click, then scroll right until you see "Gear". Click again, and scroll down so a % is highlighted. Put the Flight Mode switch in position 2. At this point, the percentage to the left should be highlighted (have a box around it). Click again, and bring it from 105% down to 83-85%. Check on the live feed screen that there is an "M" in the lower left hand corner now when that switch is in position 2. This step allows you to be able to calibrate the GPS.
5. Make sure you have AT LEAST 8 satellites before doing the next step. The more satellites acquired the better the chances of the calibration succeeding.
6. Starting in position 0 on the Flight Mode switch, cycle from 0, to 2, and back to 0. Repeat this "cycle" 11 times. The LED indicator on arm 4 of the drone will immediately turn a solid blue.
7. Grab the drone by arm 5, lift it straight up from the ground and hold above the waist
8. Rotate the drone 360 degrees clockwise around the drone's axis. (Imagine there is a pole running through the middle of the dome) When it is complete the LED will turn solid green.
9. Now turn the drone so the cameras point down, perpendicular to the ground.
10. Rotate the drone another 360 degrees clockwise, maintain its downward posture. Once a full rotation is complete the LED will turn solid purple. If it turns red instead of purple, set the drone down and repeat steps 6-10

(cont.)

11. Take drone up to roughly 20 feet. Take it through typical movements (forward, backward, left, right). If it "toilet bowls", or moves in a constant circular pattern land the drone and repeat steps 6-10. If it locks onto a position and does not wander, land the drone and continue. The GPS calibration was a success.
12. With the drone on the ground, go back to "Servo Setup" on the controller. Put the Flight Mode switch back into position 2, and set the left-hand % under "Gear" back to 105%. Double check what flight mode position 2 is set to by switching to it and looking on the bottom left-hand corner of the live feed monitor. If it says "GPS FS", you set your fail-safe correctly and can continue with flying. If it still says "M", repeat step 12. **THIS IS EXTREMELY IMPORTANT**: FAILURE TO RESET THE LEFT GEAR VALUE TO 105% MEANS THERE WILL BE NO FAIL-SAFE IF THE DRONE LOSES COMMUNICATION WITH THE CONTROLLER!
13. DO NOT FORGET STEP 12

GPS Declination

When first set, the drones are programmed for true north in relation to Indiana. If the drone does not fly straight where you are, you will need to adjust the declination. *NOTE: It is advised by the manufacturer that you have your authorized dealer perform this calibration. Once declination is set, it will not have to be set again if the drone stays in the same geographic location.*

1) Figure out which way it is rotated in relation to forward. Example: Is it pointing forward more with arm 1 or arm 2?
2) Land the drone, remove the dome and batteries.
3) Rotate the GPS puck away from the arm it is "favoring".
   Example: If it is flying and points forward more with arm 1, rotate the puck more towards arm 2. The foam under the puck can be rotated roughly 20 degrees without needing to be removed
4) Test the drone and repeat this process until proper flight orientation is achieved
5) The map on the following page will give you a rough idea on how far you will need to rotate it. Each line is 2 degrees, with negative being counter-clockwise (left towards arm 2), and positive being clockwise (right towards arm 1).

Pre-Flight Checklist

- Drone
- Controller
- Live Feed Monitor
- Batteries

1) Check the drone for any signs of damage or loose cables/straps
2) Make sure all components are fully charged.
3) Check that the propeller direction of rotation is correct. (See page 47)
4) Check that the propellers are tight and won't slip.
5) Make sure motor leads are fastened securely into the ESCs.
6) Make sure all switches on the controller are forward. Flight Mode Switch and Flight Orientation Switch should both be in position 0 (see page 5). Make sure the throttle is all the way down.
7) Turn on the controller.
8) Make sure batteries are strapped in and tight. → 98 or 99 '/.
9) Power on your live feed monitor and check that voltage is normal, it should be 16.8/16.9v. If voltage is higher, take the drone to your authorized dealer. If voltage is lower, check batteries with the provided battery checker.
10) Make sure the drone and its propellers are free of any and all obstructions before arming.
11) Start the motors and check that individual rotation is correct. To arm them, take both sticks and move them down and towards the center. Refer to the motor rotation diagram on page 47.

IMPORTANT: *Never take off with less than 8 satellites.*

Flight

Manual:

IMPORTANT: *If the drone has difficulty standing still while in hover, it will need a GPS recalibration, refer to pages 11-12 for the instructions*

1) Follow all of the steps under the Pre-Flight section first
2) Refer to the FAA guidelines for safe and proper drone operation

- To take off, bring the throttle stick up past 50%
- To hover in place, leave the throttle at 50%
- To descend, bring the throttle a little under 50%
- To rotate the camera, turn the Aux 3 knob on the controller

GPS Mode

- Position 0 (GPS): GPS is ON, Gyro active
- Position 1 (Att.): GPS is OFF, Gyro active
- Position 2 (FS): Failsafe (*For emergency use only!*)
  - NOTE: *If you had to recalibrate the GPS as described on pages 11-12, make sure you followed step 12*

Flight Mode Orientation

- Position 0: The default Flight Mode will make the drone move in relation to its own heading. Basically, its left will always be its left, forward is forward, back is back, etc.
- Position 1: The Course Lock mode will save the current heading as the forward orientation whenever. So no matter how you rotate the drone in flight forward/back/left/right always remain the same. A new course can be set with a flick of the switch during flight.

(cont.)

- Position 2: The Home Lock mode will lock the homepoint in so that the drone will always move relative to the homepoint. Moving backwards will always be towards the homepoint, forwards would be away from it, etc.

Autopilot:

IMPORTANT: *The drone will move straight to point 0 at the start of its route. Make sure there are no obstructions in between it and point 0, if needed, ascend the drone to a safe height first, then start the route from that altitude.*

1) Take the Data Link and plug it into the laptop with the data link cable, and attach to the hook-and-loop adhesive on the lid of the laptop.
2) Open Ground Station and click "Editor" at the top.
3) In the Editor window, click "Open" and load the desired route.
4) At this point you should perform the Pre-Flight checklist and make sure everything is okay with the drone.
    4a) Make sure the drone has acquired at least 8 satellites.
5) With the drone powered on now and ready to go, click "Connect" in Ground Station. A red "H" should now appear on the map right where the drone is located. The drone is connected.
6) Move point "0" to directly above the drone. Be aware of 3D view in Google Earth, and locate the pin for point "0" using the red line under it.
7) Under the Editor window, click "Upload". A box will come up displaying the route information, double check each waypoint altitude/speed. Click OK.
8) To start the autopilot, simply click the red "GO" button in the Editor window.
    - If at any time you would like the drone to come home, you can click the Go Home button in Ground Station, then click "Click to Go Home" at the bottom left corner of the screen.
        - IMPORTANT: *DO NOT use position 2 on the Flight Mode switch as a regular landing method!*

- If at any time you need to take control of the drone, for example to avoid an imminent collision, flip the Flight Mode switch down to position 1 then back up to position 0.

In the event that your Pacesetter hits failsafe in the middle of route, the route can be continued once the drone returns home and the batteries have been replaced. To do so, follow the steps below:

1) Remember the last waypoint that had been completed.
2) Clear the route that it had been on, and reload the same field.
3) In the Editor Window, select "Editing Mission". Set the last waypoint completed as the starting waypoint.
4) Go to the last waypoint completed and set its turning mode to "Stop and Turn"
5) Upload the route to the Pacesetter and launch it.
   5a) *Make sure to take off manually and get it to altitude when doing this. The drone will make a straight line to the continuation point and will hit any obstructions in its way.*

REMINDER: *The drone will hit its Failsafe Return to Home voltage when it reaches <14.5v. It will land in place once <14.0v has been reached. If you are flying manually when this happens, the drone will take control from you. To take back control, flip the Flight Mode Switch to position 1, then back to position 0. When failsafe is hit, the drone will ascend to 40 meters if it is flying lower then this altitude.*

Post-Flight

- Cameras
- Laptop

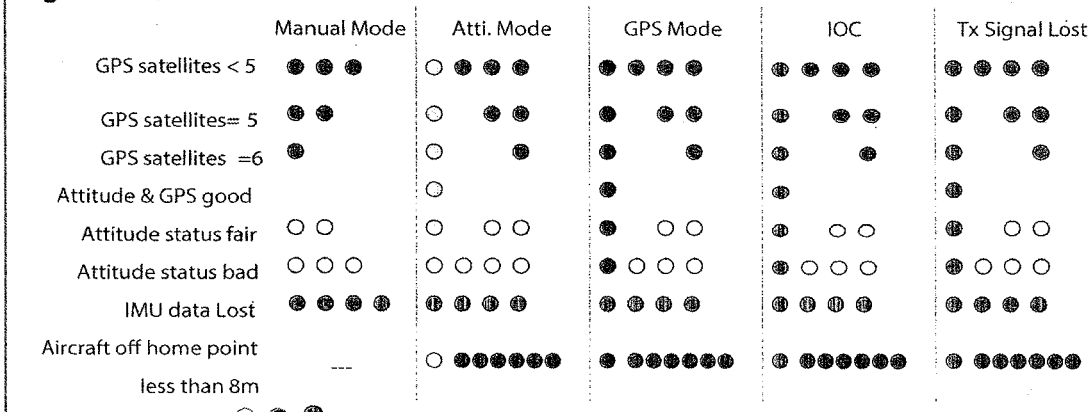
1) Remove the batteries from the drone.
2) Remove the cameras from the drone.
3) Using provided micro-USB cables, connect the cameras to the laptop using the MULTI port on the camera (see page 9), and hit the Record button to turn them on. They should say "USB" to indicate a connection.
4) They will come in as "Removable Disk(#:)" under This PC. The photos are located under in the DCIM folder.
5) Now create a place on the laptop to put your photos. Open the "Precision Vision" folder on your desktop, and create a new folder by right-clicking, highlighting "New" and click "Folder". Name it something you will remember.
6) Within that folder, create two more folders named "IR" and "RGB". This is so everything stays organized.
    6a) Remove the photos where the drone is taking off and landing as they come off the camera.
7) Now simply navigate to the photos that are still each camera (Removable Disk(#:)), and drag and drop or copy those photos to the respective folder, so IR photos from the IR camera will go in the "IR" folder and the RGB photos from the RGB camera will go in the "RGB" folder you just created.
8) Once the transfer is complete it is safe to disconnect the cameras from the laptop and you can now create a map using Agisoft Photoscan Pro.

Precision Drone

2014 MY Precision Drone Pacesetter
LED Guide

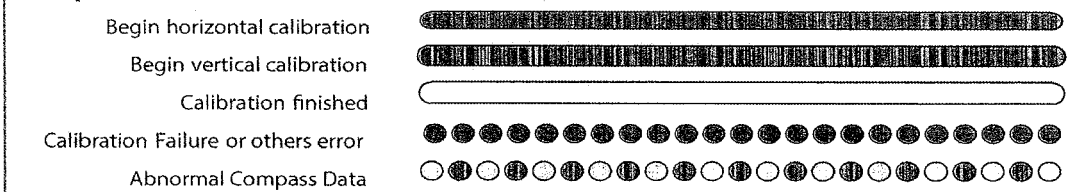
LED Description

Flight States

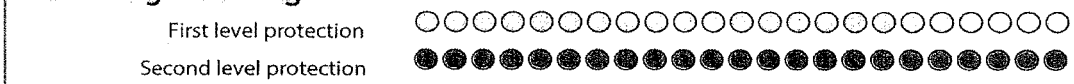


Flashing indications of ○, ●, ◍ are: **Single flash**, all the transmitter sticks are at center position, multi rotor hovering; **Double flash**, transmitter stick(s) not at center position, speed command is not zero.

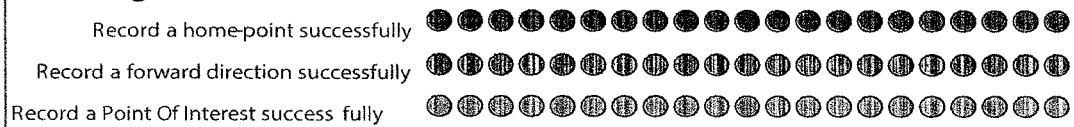
Compass Calibration and Abnormal Data Indicator



Low Voltage Warning



Recording



WM Assistant Connection Indicator

Technical Specifications

Battery Charger

Operating Voltage Range	DC11.0~180. Volt AC to DC adaptor (DC11.0~18.0V/5A)
Circuit Power	Max. charge power 80W Max. discharge power 10W
Charge current range:	0.1~6.0A
Discharge current range:	0.1~2.0A
Current drain for balancing Li-po:	300mAh/cell
NiCd/NiMH battery cell count:	1~15cell
Li-ion/Polymer cell count:	1~6 series
Pb battery voltage:	2V~20V
Weight:	490g(Net Weight)
Dimensions:	135x112x60.9mm

Live Feed Monitor

Display Screen	Diagonal	7 inch
	Resolution	1024x600
	Contrast	700:01:00
	Luminance	300 cd/m
Wireless Receiving	Working Frequency	ISM 5.8 GHz
	Sensitivity	-90dbm+-1dBm
	Channel	32 Channel (4 Band x 8 Channel)
	Antenna Port	2 x SMA, 50 ohm
	Diversity Receiving	Antenna diversity
	TV System	NTSC/PAL
	Video output level	1.0Vp-p Typ, 75 ohm
	Audio output level	1.0Vp-p Typ, 10Kohm
AV Port	RX1 AV OUT	Video, Audio output
	RX2 AV OUT	Video, Audio output
	DIV AV OUT	Diversity receiving, Video, Audio output
	AV IN	Video, Stereo Audio input
	HDMI IN(A Type)	Supports HDMI 1.3 Digital Input, Supports HDMI Audio in
	Built-in Microphone	8 Ohm/1W x 2
Power Supply	DC IN	7 ~ 28V/2A
	DC OUT	Output Voltage : DC IN or battery voltage Output Current : 1A
	Battery	11.1V/1000maH(3 series LiPo cells)
	Consumption	12V input:7.8W
Dimensions	Main Body	183x126x19.5mm(not including sun shadow)
	Battery	105x87.5x6.7mm(not including prominent part)
Weight	Main Body	350 g

Band	CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8
A	5865M	5845M	5825M	5805M	5785M	5765M	5745M	5725M
B	5733M	5752M	5771M	5790M	5809M	5828M	5847M	5866M
E	5705M	5685M	5665M	5645M	5885M	5905M	5925M	5945M
F	5740M	5760M	5780M	5800M	5820M	5840M	5860M	5880M

Date: _____ **Action**: Flight/Service (Circle one) **Duration**: _____
Name of Pilot/Technician: _____

Starting Voltage: _____ **Ending Voltage**: _____
Lowest Satellite Count: _____ **Highest Satellite Count**: _____
Total Flight Time: _____
Weather Conditions: _____
If flown within 5 miles of an airport:
Airport: _____
Date and Time of Notification: _____

Notes: _____

Signature: _____

Precision Drone