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

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

June 25, 2015

Exemption No. 11905
Regulatory Docket No. FAA–2015–1331

Mr. Jeffrey J. Antonelli
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Dear Mr. Antonelli:

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 Kovar & Associates LLC (hereinafter petitioner or operator) for an exemption. The petitioner requested to operate an unmanned aircraft system (UAS) to conduct remote sensing to support precision farming and other agriculture applications; asset management for utilities, government agencies, and private firms; construction and land management; disaster response and search and rescue; and conducting research flights to collect data and establish and refine forensic processes, procedures, and tools for investigation of accidents and crimes.

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. However, the FAA received one comment in support of the petition made to the docket.

Airworthiness Certification

The UAS proposed by the petitioner are theDJI Phantom 2 Vision+, Event38 E384, and PrecisionHawk Landcaster.

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.

[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.

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, Kovar & Associates 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.

Conditions and Limitations

In this grant of exemption, Kovar & Associates 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 DJI Phantom 2 Vision+, Event38 E384, and PrecisionHawk Landcaster 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

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U.S. Department of Transportation
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April 24, 2015

Re: Request for Exemption under Section 333 of the FAA Modernization and Reform Act of 2012 and Part 11 of the Federal Aviation Regulations from Certain Provisions of 14 C.F.R.

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, Antonelli Law files this petition for exemption on behalf of Kovar & Associates, LLC ("K&ALLC"), an operator of Small Unmanned Aircraft Systems ("UAs") used for remote sensing to support (i) precision farming and other agriculture applications; (ii) asset management for utilities, government agencies, and private firms; (iii) construction and land management; (iv) disaster response and search and rescue; and (v) conducting research flights to collect data and establish and refine forensic processes, procedures, and tools for investigation of accidents and crimes involving UAs. Specifically, petitioner seeks an exemption from the Federal Aviation Regulations ("FARs") listed in Appendix A to allow commercial operation of its UAs, so long as such operations are conducted within and under the conditions outlined herein or as may be established by the FAA in a grant of this petition. This request is substantially similar to other data collection petitions previously approved, and should be considered under the expedited summary grant procedure.

Approval of the exemption for petitioner will allow commercial operation of: (1) the DJI Phantom 2 Vision+, approved for commercial operations in Exemption Nos. 11138, 11189, and 11191; (2) the Event38 E384, approved for commercial operations in Exemption No. 11166; and (3) the PrecisionHawk Landcaster system, approved for commercial operations in Exemption No. 11345 in Class G airspace or as otherwise prescribed in an ATO issued COA nationwide. The UA operations contemplated by this petition are in the public interest because they clearly satisfy the "Four D's" of exemplary uses of UAs: to replace work that is Dangerous, Difficult, Dull, or Dirty, and at the same time provide an equivalent or greater level of safety than alternative manned aircraft operations. The UAs covered by this petition are small battery-powered craft, weighing no more than 6 lbs. (2.7 kg.), inclusive of battery and payload. Operation of the UAs under the strict conditions proposed below will provide an equivalent level of safety, as Congress intended, while still allowing commercial operations. Operations using these UAs are far safer than conventional operations conducted with helicopters and fixed-wing aircraft that weigh thousands of pounds, carry highly flammable fuel, and operate in close proximity to the ground, trees, infrastructure, and people.

Congress directed the FAA to consider seven factors in deciding whether to approve Section 333 exemption petitions - size, weight, speed, operational capability, proximity to airports, proximity to populated areas, and operation within visual line of sight. In this case, each factor supports the exemption request. In particular, the UA is small, and will operate at slow speeds and close to the ground. It will be able to more safely and efficiently conduct operations that would otherwise involve risk of injury or death. The substantial increase of safety and decrease of risk to human life and to property weighs heavily in favor of granting the exemption.

Pursuant to 14 C.F.R. §11.35, petitioner requests confidential treatment for certain information provided with this request for exemption. Specifically, petitioner is submitting its proprietary user manual, training syllabuses, emergency response letters of recommendation, and manuals for the E384 and PrecisionHawk under separate cover as Exhibits 1-4 and 13-14. It requests that the information contained in those exhibits not be made public because they are trade secrets whose disclosure would harm petitioner. They contain valuable commercial data this is not publicly available and are protected from release under the Freedom of Information Act, 5 U.S.C. §552(b)(4).

For your ease in reviewing this petition, please refer to the table of contents which begins on page 3. If we can provide any additional information to assist your understanding or review of this document, please do not hesitate to contact us at 312-201-8310 or via email at Jeffrey@Antonelli-Law.com.

Thank you,

Jeffrey J. Antonelli
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Table of Contents

Exhibit List

DJI Phantom 2 Vision+ Documents

Event38 E384 Documents

PrecisionHawk Lancaster Documents

Exhibits 1-4 and 13-14 have been submitted confidentially and are not available to the public.

I. Publishable Summary

Pursuant to 14 C.F.R. § 11, the following summary is provided for publication in the Federal Register, should it be determined that publication is needed:

Petitioner seeks an exemption from the following rules:

14 C.F.R 21(h); 14 C.F.R. 43.7; 14 C.F.R. 43.11; 14 C.F.R. 45.11; 14 C.F.R. 45.27; 14 C.F.R. 45.29; 14 C.F.R. 91.7(a); 14 C.F.R. 91.9(b)(2); 14 C.F.R. 91.9(c); 14 C.F.R. 91.103(b)(2); 14 C.F.R. 91.105; 14 C.F.R. 91.109; 14 C.F.R. 91.113(b); 14 C.F.R. 91.119 (c); 14 C.F.R. 91.121; 14 C.F.R. 91.151(a); 14 C.F.R. 91.203(a) and (b); 14 C.F.R. 215; 14 C.F.R. 91.403; 14 C.F.R. 91.405(a); 14 C.F.R. 91.407(a)(1); 14 C.F.R. 409(a)(1) and (2); and 14 C.F.R. 91.417(a) and (b) to operate commercially a small unmanned aircraft system (UA) (6 lbs. or less).

Approval of the exemption requested by petitioner will allow commercial operation of (1) the DJI Phantom 2 Vision+; (2) the Event 38 E384; and (3) the PrecisionHawk Lancaster system for remote sensing to support (i) precision farming and other agriculture applications; (ii) asset management for utilities, government agencies, and private firms; (iii) construction and land management; (iv) disaster response and search and rescue; as well as (v) conducting research flights to collect data and establish and refine forensic processes, procedures, and tools for investigation of accidents and crimes involving UAs in Class G airspace or as otherwise prescribed in an ATO issued COA nationwide. The requested exemption should be granted because operation of small UAs, weighing no more than 6 lbs. (2.7 kg.), inclusive of battery and payload, conducted in the strict conditions outlined below, will provide an equivalent level of safety, while still allowing commercial operations. The lightweight aircraft covered by the exemption are far safer than conventional operations conducted with helicopters and fixed-wing aircraft weighing thousands of pounds and carrying highly flammable fuel, and operating in close proximity to the ground and people. The seven factors Congress directed the FAA to consider when approving Section 333 exemption petitions - size, weight, speed, operational capability, proximity to airports, proximity to populated areas, and operation within visual line of sight – each support the request. In particular, the aircraft are small, and will operate at slow speeds, and close to the ground in order to more safely and efficiently conduct inspections that would otherwise involve a risk of death to the inspectors. The substantial increase of safety and decrease of risk to human life, coupled with the low risk use of UAs to conduct these operations, weigh heavily in favor of granting the exemption.

II. Petitioner's Contact Information

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III. Proposed Operations

A. The UAs

The requested exemption will permit petitioner to operate (1) the DJI Phantom 2 Vision+; (2) the Event38 E384; and (3) the PrecisionHawk Lancaster System. This petition and Exhibits 1-3, 5-6, and 10-17, are hereinafter referred to as the "operating documents." The specific conditions of the proposed exemption that relate to the characteristics of the UAs are numbers 1, 5, and 16-20 in Section V below. Each has been adopted or imposed by the FAA in numerous previous grants of Section 333 exemption petitions.

1. DJI Phantom 2 Vision+

The requested exemption will permit petitioner to operate the Phantom 2 Vision+, with a maximum weight of approximately 2.7 lbs. (1.2 kg), inclusive of batteries and technical payload. This rotorcraft operates at a speed of no more than 43 knots and has the capability to hover and move in the vertical and horizontal planes simultaneously.

Please refer to Exhibits 5-11 for further information about the airframe, control system and transmitter. The FAA has previously reviewed these documents and approved exemptions for commercial use of the DJI Phantom 2 Vision+ in Exemption Nos. 11138, 11189, and 11191.

The UA will have the following specifications or equivalent:

Airframe: DJI Phantom 2 Vision+
Dimensions: diagonal motor-motor distance 350 mm (approximately 13.78 in.)
Flight Control System: DJI Naza-M V2, which includes the GPS and Compass and the internal measurement unit (IMU), containing a built-in internal sensor and a barometric altimeter that measures both altitude and attitude.
Transmitter (Tx): 5.728GHz-5.85 GHz DJI Remote Control
Receiver (Rx): 5.8G receiver built in to the DJI Phantom 2 Vision+
Motor: electric DJI 2312 CCW
Data Link: 2.4 GHz USB ground modem
Video Link: 5.8 GHz
OSD: DJI Vision app, open on a dedicated mobile device, which allows live telemetry to be displayed to the visual observer, including the battery level and altitude
Batteries: Lithium Polymer batteries with capacity of 5200mAh

2. Event38 E384

The requested exemption will permit petitioner to operate the Event 38 E384, with a maximum weight of 5.9 lbs. (2.7 kg.), inclusive of batteries and technical payload. This fixed-wing aircraft operates at a speed of no more than 26 knots.

Please refer to 13-16 for further information about the airframe, control system and transmitter. The FAA has previously approved the E384 for commercial flight in Exemption No. 11166.

The UA will have the following specifications or equivalent:

Airframe: E384
Control System: ArduPilot Mega 2.6 autopilot, which includes the Main Controller (MC), Internal Measurement Unit (IMU) with a built-in internal sensor, barometric altimeter (which measures attitude and altitude), compass, GPS, and radio receiver (Rx).
Tx: Spektrum DX5E
Rx: AR 610 Receiver
Motors: Tiger T-Motor 3515-9
Data Link: 3DR 433mhz radio
OSD: Mission Planner software, visible on a dedicated ground station laptop, which allows live telemetry to be displayed to the visual observer, including the battery level and altitude.
Batteries: Lithium Polymer batteries with capacity of 5000 mAh

3. PrecisionHawk Lancaster System

The requested exemption will permit petitioner to operate the PrecisionHawk Lancaster System. Please refer to Exhibits 15-16 and 18-20 for information about the airframe and control system, including the UA specifications, which are proprietary business information. The FAA has previously approved the PrecisionHawk for commercial flights in Exemption No. 11345.

B. The Crew

The crew will consist of a pilot in command (PIC) and a visual observer (VO). The PIC will have, at minimum, a sport pilot's license and a third class medical certificate or a U.S. driver's license.

The PIC and VO will have been trained in operation of UAs generally and received up-to-date information on the UAs to be operated pursuant to this grant.

The PIC will have completed, at a minimum, 25 hours of UA flight training with the specific UAs prior to operations, and will be required to participate in annual training thereafter. The PIC will have completed the training programs provided by DJI, Event 38, and PrecisionHawk. The training syllabuses for DJI and Event 38 have been submitted as Exhibits 7 and 9.

The VO will have completed the training set forth in Exhibit 1: V.G.2: Operational Control: Training: VOs and Exhibit 3 prior to operations.

The specific conditions of the proposed exemption that relate to the training and

characteristics of the crew are numbers 3 and 6-9 in Section V below. Each has been adopted or imposed by the FAA in numerous previous grants of Section 333 exemption petitions.

C. Flight Conditions

The UAs will be used for remote sensing to support (i) precision farming and other agriculture applications; (ii) asset management for utilities, government agencies, and private firms; (iii) construction and land management; (iv) disaster response and search and rescue; and (v) conducting research flights to collect data and establish and refine forensic processes, procedures, and tools for investigation of accidents and crimes involving UAs. All flights will be in Class G airspace or as otherwise prescribed in an ATO issued COA under 400 feet above ground level ("AGL") and under controlled conditions. Petitioner will work with the local FSDO when planning operations. Petitioner will only operate its UAs in visual meteorological conditions (VMC). The UA will at all times be no less than 500 feet below and no less than 2,000 feet horizontally from a cloud, and petitioner will not conduct operations unless visibility is at least 3 statute miles from the PIC. The flight crew will always make a safety assessment of the risk of every operation, and will only operate when it is determined that no hazards are present. Flights will only be conducted away from any major population and never at public events or other areas where petitioner cannot control the area and observe the operational area.

Please refer to the following sections of Exhibit 1 for more information about the flight conditions:

- Section IV, Organization, Part G, Operating Limitations and Conditions
- Section VI, Operating Procedures, Part A, Flight Planning/Preparation, Number 2, Risk Assessment
- Section VI, Operating Procedures, Part A, Flight Planning/Preparation, Number 8, Weather Checks
- Appendix A: Risk Management

The specific conditions of the proposed exemption that relate to the flight conditions in which the UA will be operated are numbers 2, 4, 16, and 28-29 in Section V below. Each has been adopted or imposed by the FAA in numerous previous grants of Section 333 exemption petitions.

D. Flight Operations

The purpose of every UA flight will be to safely, accurately, and efficiently support: (i) precision farming and other agriculture applications; (ii) asset management for utilities, government agencies, and private firms; (iii) construction and land management; (iv) disaster response and search and rescue; as well as (v) research flights to develop processes, procedures, and tools for accident and crime investigations of UAs. Every UA flight will use at minimum a two person flight crew: a PIC and a VO. The standard operational procedures that they will follow are set out in the operating documents, specifically Exhibit 1. Please refer to the following sections of Exhibit 1 for information pertaining to operations:

V: Operational Control
VI: Operating Procedures
Appendix A: Risk Management

Petitioner will keep records of operations as indicated in Exhibit 2.

The specific conditions of the proposed exemption that relate to flight operations are numbers 11-12, 17-25, and 32-35 in Section V below. Each has been accepted or imposed by the FAA in numerous previous grants of Section 333 exemption petitions.

IV. Aircraft and Equivalent Level of Safety

Petitioner proposes that the exemption apply to UAs that have the characteristics and that operate with the limitations proposed herein. These limitations provide for a level of safety at least an equivalent to or higher than manned aircraft operations under the current regulatory structure. Section V below identifies the limitations and conditions to which petitioner agrees to be bound when conducting commercial operations under a grant of this petition. Appendix A contains matrix connecting (i) the specific proposed condition with (ii) the FAR provision for which it provides equivalent level of safety and (iii) one or more recent Section 333 exemption grants in which the FAA recognized this equivalent level of safety.

Approval of the commercial operations outlined in this petition presents no national security issue. The PIC will possess, at minimum, a sport pilot's certificate, so he or she will have been subject to security screenings by the Department of Homeland Security.

V. Proposed Conditions of the Exemption

1. The UAs will weigh no more than 6 lbs. (2.7 kg.), inclusive of battery and payload.

2. UA operations under this exemption will be limited to conducting operations for the purpose of providing (i) precision farming and other agriculture applications; (ii) asset management for utilities, government agencies, and private firms; (iii) construction and land management; (iv) disaster response and search and rescue; and (v) conducting research flights to collect data and establish and refine forensic processes, procedures, and tools for investigation of accidents and crimes involving UAs in Class G airspace nationwide, unless otherwise prescribed in an ATO-issued COA.

3. Flights will be operated within line of sight of a pilot and visual observer.

4. Flights will be operated at an altitude of no more than 400 feet AGL, as indicated by the procedures specified in the operating documents. All altitudes reported to ATC must be in feet AGL.

5. The UA will not be flown at an indicated airspeed exceeding 87 knots (100 mph).

6. Minimum flight crew for each operation will consist of the UA pilot in command (PIC) and a visual observer (VO).

7. The PIC will have, at minimum, a sport pilot license and a third class medical certificate or a U.S. driver's license.

8. The petitioner will not permit any PIC to operate unless the PIC meets its qualification criteria and demonstrates the ability to safely operate the UA in a manner consistent with

how the UA 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 will be logged in a manner consistent with 14 CFR § 61.51(b). A record of the PIC training will be documented and made available upon request by the Administrator. Training operations will only be conducted during dedicated training sessions. During training, proficiency, and experience-building flights, all persons not essential for flight operations will be considered nonparticipants, and the PIC will operate the UA with appropriate distance from nonparticipants in accordance with 14 CFR § 91.119.

9. The VO will not perform any other duties beyond assisting the PIC with seeing and avoiding other air traffic and other ground based obstacles/obstructions, and will not be permitted to operate the camera or other instruments.

10. The PIC will be designated before the flight and will not be allowed to transfer his or her designation for the duration of the flight. The PIC will ensure that the VO can perform the functions prescribed in these conditions and the operating documents.

11. A briefing will be conducted in regard to the planned UA operations prior to each day's activities. It will be mandatory that all personnel who will be performing duties in connection with the operations be present for this briefing.

12. Prior to each flight, the PIC will inspect the UA, including the Ground Control Station, to ensure it is in a condition for safe flight. If the inspection reveals a condition that affects the safe operation of the UA, the PIC will not operate the UA until the necessary maintenance has been performed and the UA is found to be in a condition for safe flight. All maintenance and alterations will be properly documented in the aircraft records.

13. Petitioner will conduct a functional flight test on any UA that has undergone maintenance or alterations that affect the UA operation or flight characteristics, e.g. replacement of a flight critical component. The PIC who conducts the functional test flight will make an entry in the aircraft records.

14. The petitioner will carry out its maintenance, inspections, and record keeping requirements, in accordance with the UA manufacturer's aircraft/component, maintenance, overhaul, replacement, inspection, and life limit requirements set forth in the operating documents. Maintenance, inspection, alterations, and status of replacement/overhaul component parts will be noted in the aircraft records, including total time in service, description of work accomplished, and the signature of the authorized person returning the UA to service. The authorized person will make an entry in the aircraft record of the corrective action taken against discrepancies discovered between inspections.

15. The UA will be operated within visual line of sight (VLOS) of the PIC and VO at all times. This requires the PIC to be able to use human vision unaided by any device other than corrective lenses. PIC and VO will at all times be able to communicate verbally. They will not be permitted to use electronic messaging or texting to communicate during flight operations.

16. The PIC will not begin a flight unless (considering wind and forecast weather conditions)

there is enough power to fly at normal cruising speed to the intended landing point and prepare to land each UA with 20% battery life remaining.

17. Actual total flight time for each operational flight will result in no less than a 20% battery reserve.

18. The UA will have the capability to abort a flight in case of unexpected obstacles or emergencies.

19. The UA will be programmed so that if it loses communications or loses its GPS signal, it will return to a pre-determined location within the planned operating area and land or be recovered in accordance with the operating documents

20. If the UA and its radio control link disconnect during flight, the system's failsafe protection will be triggered and the multirotor will return to home and land automatically, rather than flying off uncontrollably or landing at an unknown location.

21. The operating documents required under 14 CFR §§ 91.9 and 91.203 will be maintained and available to the PIC at the Ground Control Station of the UA any time the UA is operating. These documents will be made available to the Administrator or any law enforcement official upon request. If a discrepancy exists between the conditions and limitations in the exemption grant and the procedures outlined in the operating documents, the grant conditions and limitations will take precedence and will be followed. Otherwise, the petitioner will follow the procedures outlined in its operating documents. If it updates or revises its operating documents, it will present updated and revised documents to the Administrator upon request. If the petitioner determines that any update or revision would affect the basis upon which the FAA granted the exemption, then the Petitioner will petition for an amendment to the grant of exemption.

22. Petitioner will obtain written and/or oral permission from the landowners/authorized agents of the landowners over which flights will be conducted.

23. Petitioner will obtain all required permissions and permits from territorial, state, county or city jurisdictions, including local law enforcement, fire, or other appropriate governmental agencies.

24. UA operations will not be conducted during night, as defined in 14 CFR § 1.1. All operations will be conducted under visual meteorological conditions (VMC). Flights will not be conducted under special visual flight rules (SVFR).

25. The petitioner will obtain an Air Traffic Organization (ATO) issued Certificate of Waiver or Authorization (COA) prior to conducting any operations under the grant of exemption. Petitioner will request a Notice to Airman (NOTAM) not more than 72 hours in advance, but not less than 48 hours prior to the operation. All operations will be conducted in accordance with airspace requirements in the ATO issued COA, including class of airspace, altitude level and potential transponder requirements.

26. The UA will not be operated within 5 nautical miles of an airport reference point as denoted on a current FAA-published aeronautical chart unless a letter of agreement with that airport's

management has been obtained, and the operation is conducted in accordance with a NOTAM as required by the operator's COA. Any letter of agreement with the airport management will be made available to the Administrator upon request.

27. The UA will 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.

28. All operations shall be conducted in Class G airspace or as otherwise prescribed in an ATO issued COA.

29. All aircraft operated in accordance with this exemption will 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 will be as large as practicable.

30. Before conducting operations, petitioner will ensure that the radio frequency spectrum used for operation and control of the UA complies with the Federal Communications Commission (FCC) or other appropriate government oversight agency requirements.

31. The UA will remain clear and yield the right of way to all manned aviation operations and activities at all times.

32. The UA will not be operated by the PIC from any moving device or vehicle.

33. Petitioner will conduct all flight operations at least 500 feet from all nonparticipating persons, vessels, vehicles, and structures unless one of the following three conditions is met:

    a. Barriers or structures are present that sufficiently protect nonparticipating persons from the UA and/or debris in the event of an accident. The petitioner will 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, the PIC will ensure that flight operations cease immediately.

    b. The aircraft is operated near vessels, vehicles or structures where the owner/controller of such vessels, vehicles or structures has granted permission and the PIC has made a safety assessment of the risk of operating closer to those objects and determined that it does not present an undue hazard.

    c. Operations nearer to the PIC, VO, operator trainees or essential persons do not present an undue hazard to those persons per § 91.119(a).

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

VI. Privacy

K&ALLC will follow the Association of Unmanned Vehicles Systems International's

Code of Conduct, available at http://www.auvsi.org/conduct. When conducting search and rescue operations, the images received will be turned over to the incident commander (the individual in charge of the disaster or search) and the GIS staff on hand, who are almost always law enforcement personnel. This is a similar privacy protocol to when taking pictures on the ground for disaster response and search and rescue operations.

Please refer to Exhibit 1, Section VII: Privacy for more information regarding Petitioner's privacy policy.

VII. Public Interest and Safety

The planned UA use will increase ground safety for (i) precision farming and other agriculture applications; (ii) asset management for utilities, government agencies, and private firms; (iii) construction and land management; (iv) disaster response and search and rescue; and (v) conducting research flights to collect data and establish and refine forensic processes, procedures, and tools for investigation of accidents and crimes involving UAs. The enhanced safety and reduced environmental impact achieved using a UA with the specifications described by the petitioner and carrying no passengers or crew, rather than a manned aircraft of significantly greater proportions, carrying crew in addition to flammable fuel, gives the FAA good cause to find that the UA operation enabled by this exemption is in the public interest.

Satisfaction of the criteria provided in Section 333 of the Reform Act of 2012 – size, weight, speed, operating capabilities, proximity to airports and populated areas and operation within visual line of sight and national security – provide more than adequate justification for the grant of the requested exemption allowing commercial operation of petitioner's UAs, pursuant to K&ALLC's rules of operation.

A. Precision Farming and Agriculture Applications

The planned UA use will increase ground safety in the precision agriculture industry. The enhanced safety and reduced environmental impact achieved using a UA with the specifications described by the petitioner and carrying no passengers or crew, rather than a manned aircraft of significantly greater proportions, carrying crew in addition to flammable fuel, gives the FAA good cause to find that the UA operation enabled by this exemption is in the public interest.

Satisfaction of the criteria provided in Section 333 of the Reform Act of 2012 – size, weight, speed, operating capabilities, proximity to airports and populated areas and operation within visual line of sight and national security – provide more than adequate justification for the grant of the requested exemption allowing commercial operation of petitioner's UA for precision agriculture operations, pursuant to petitioner's rules of operation.

Use of UA technology to assist in precision agriculture is a benefit not only to farmers, but to the public as a whole, and to the environment. Farmers will have greater analytical tools at their disposal for managing crops, leading to decreased use of resources. This will result in both reduction of cost and increase in quality – benefits that will be passed on to the public. Additionally, using less water and chemicals during commercial farming operations will reduce the impact that the operation has on the environment.

As Jeff Vanderwerff testified on behalf of the American Farm Bureau Federation before

members of the Senate Committee on Commerce, Science, & Transportation on March 24, 2015:

> [The benefit of UA comes from] their ability to provide detailed scouting information on weed emergence, insect infestations and potential nutrient shortages. This valuable information allows the farmer to catch these threats before they develop into significant and catastrophic problems. By addressing threats quickly, the farmer has a greater likelihood of being able to respond appropriately so as to optimize yields.
>
> The imagery from UAS also allows the farmer to spot-treat sections of the fields as opposed to watering or spraying the entire field. The quicker a farmer can discover a potential threat, the quicker the farmer can address the issue. Images from UAS allow the farmer to identify the specific location where a specific treatment – be it fertilizer, water, pesticides, or herbicides is necessary; in doing so, the farmer can eliminate the need to use these applications more broadly across the entire field. ***By spot-treating threats to the crop, the farmer not only lowers the cost of treatment but also has the potential of lowering the environmental impact by minimizing application."*** (emphasis added)[1]

The FAA has previously determined that commercial UA use for the precision farming industry is within the public interest. It has approved the E384 for precision farming and agriculture applications in Exemption No. 11166.

Additionally, the FAA has previously approved a variety of other UAs for commercial precision farming and agriculture applications in Exemption Nos.:

11110 (precision aerial surveys);
11136 (photogrammetry and crop scouting in order to perform precision agriculture);
11167 (high-resolution aerial imagery in support of biomass analysis and estimation, yield monitoring, leaf area indexing and reporting of geographical data and overall crop health to a domestic agricultural seed company);
11170 (precision agriculture operations);
11177 (commercial precision agriculture surveys);
11192 (aerial photography and 3D mapping for the agriculture industry);
11193 (precision photogrammetry and crop scouting for precision agriculture);
11195 (aerial photography for agriculture);
11222 (collect high quality, actionable data for use by agronomists, crop consultants, and forestry professionals);
11223 (precision agriculture survey and inspection operations);
11226 (precision aerial surveys);
11228 (aerial acquisition and research in support of the agriculture industry); and
11229 (aerial acquisition and research in support of the agriculture industry).

[1] *Unmanned Aircraft Systems: Key Considerations Regarding Safety, Innovation, Economic Impact, and Privacy Before the S. Comm. On Commerce, Science, & Transportation*, 114th Cong. 1 (2015) (written statement of Jeff Vanderwerff on behalf of the American Farm Bureau Federation).

B. Asset Management Applications

Petitioner proposes utilizing its UAs for asset management applications including wind farm, power transmission system, and pipeline inspections.

Currently, many wind farm inspections are conducted by people in harnesses, dangling from each individual tower, and power transmission system and pipeline inspections are conducted by individuals in manned aircraft. Both wind farm and power transmission systems inspections involve a serious risk of falls. Wind farm inspectors often conduct inspections of towers and blades from the structure and are at risk of falling, sometimes over 100 feet or more.[2]

Similarly, inspectors of power transmission systems have a similar risk of falling, which is augmented by the danger of being near electrical wires. There have been several instances in recent years in which inspectors and crew members lost their lives performing these inspections. Three people were killed in an accident in Silt, Colorado in January 2014. The helicopter struck the power line and crashed, quickly killing all those on board.[3] Two people lost their lives in a similar situation in August 2014 in Alabama.[4] In Texas, in 2013, two transmission line inspectors that were suspended from the helicopter by large cables were killed when the cables struck the power line and snapped.[5] Moreover, especially in populated areas, the use of manned helicopters to conduct these inspections creates a substantial risk of injury or death for individuals on the ground.

Additionally, people involved in pipeline inspection must walk along the pipeline with sensor equipment. This can be time consuming, due to the length of pipelines. Inspectors may also have to traverse lengths of the pipeline in adverse weather and geographic conditions. Furthermore, inspectors may be exposed to hazardous materials, such as crude oil and natural gas. According to the U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHMSA), in 2014, there were 29 serious pipeline incidents, and an additional 268 significant pipeline incidents, with 19 fatalities and 96 injuries.[6]

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[2] United States Department of Energy, Occupational Safety & Hazard Administration, *Green Job Hazards: Wind Energy – Falls*, https://www.osha.gov/dep/greenjobs/windenergy_falls.html.

[3] Brian Hernandez, *3 Killed in Crash When Helicopter Hits Power Lines Near Silt in Western Colorado*, ABC7 NEWS DENVER Jan. 27, 2014, http://www.thedenverchannel.com/news/local-news/3-killed-in-helicopter-crash-near-silt01272014

[4] *Power-line-inspection Copter Crashes in Alabama; 2 Killed*, COLUMBUS DISPATCH, Aug. 20, 2014, http://www.dispatch.com/content/stories/national_world/2014/08/20/power-line-inspection-copter-crashes-2-killed.html

[5] Sabra Stafford, *Turlock Man Killed in Power Line Accident*, TURLOCK JOURNAL (Texas), Aug. 8, 2013, http://www.turlockjournal.com/archives/21204/

[6] The PHMSA defines "serious incidents" as those including a fatality or injury requiring in-patient hospitalization, but this data excludes first far incidents, which are gas distribution incidents with a cause of "other outside force damages" and sub-cause of "nearby fire/explosion" as the primary cause of incident. "Significant incidents" include any of the following conditions, excluding first fire incidents: (1) fatality or injury requiring in-patient hospitalization; (2) $50,000 or more in total costs, measured in 1984 dollars; (3) highly volatile liquid releases of 5 barrels or more or other liquid releases of 50 barrels or more; or (4) liquid releases resulting in an unintentional fire or explosion.

Conversely, all three types of asset management inspection can be easily, quickly, and much more safely, conducted by operators controlling UAs from the ground. Human inspectors will not be at risk of falls from great heights or onto electrical wires, and will not be subjected to the risks associated with manned flight.

The FAA has previously determined that commercial UA use for asset management is within the public interest. It has approved commercial UA asset management applications in Exemption Nos.:

11184 (inspection of towers and structures);
11185 (electric transmission and distribution utility system monitoring, inspections, and damage assessments);
11217 (aerial inspections of wind turbine blades and towers);
11224 (inspections of energy infrastructure);
11225 (safety inspections and aerial surveying);
11228 (research in support of Government entities, utility companies, local infrastructure)
11229 (research in support of Government entities, utility companies, local infrastructure)
11230 (tower inspections and mapping operations to an existing tower structure);
11238 (aerial inspections of electric and gas facilities); and
11239 (utility, power line inspections).

C. Construction and Land Management Applications

Use of a UA for construction and land management applications will provide a greater level of safety than what is currently available. The construction industry has traditionally been very dangerous for workers, both based on the working conditions and equipment used, including helicopters and cranes. Currently, aerial inspections are not done on many construction projects. Instead, inspections are conducted from the ground, or from within the structure being constructed, giving a limited view of the project. OSHA reports that in 2013, 20.3% of worker fatalities in private industry were related to construction, and the leading cause of those fatalities were falls, with 294 out of the 796 total fatalities.[7] This limits the capabilities of architects and construction crews examining the work that has been done, and could lead to misidentification or failure to identify flaws in the construction. Those projects that do incorporate aerial inspections must rely upon manned helicopters or other types of aircraft, devices that can pose a great risk to those piloting and those on the ground below, without providing the most accurate results. Similarly, land management applications are limited to either expensive and dangerous manned flights, or ground-level inspections that do not capture the full wealth of knowledge available.

Alternatively, using a UA to videotape and photograph these areas will allow the construction crew to gain a better vantage point of the structure. Safety concerns can be better identified and fixed, and the inspectors will be able to gain a more thorough understanding of construction progress. This UA will be able to provide a quick and cost effective aerial inspection of an entire jobsite, something that is much more difficult to perform without this technology. The device can be used to check the progress of the project and provide visual information on hard-to-reach areas that may not be adequately inspected otherwise without putting people in danger. UAs can be equipped with specialized cameras and sensors that provide enhanced detection of other concerns, such as gas leaks and lack of structural integrity.

[7] United States Department of labor, Occupational Safety & Health Administration *Commonly Used Statistics*, https://www.osha.gov/oshstats/commonstats.html

The FAA has previously determined that using a UA will provide an equivalent or greater level of safety than manned flight when inspecting construction sites and has approved Exemption Nos. 11109 (monitor and ensure safety of construction sites), 11204 (aerial photography for the architectural, engineering, and construction industry sites), and 11286 (aerial imaging of construction sites).

D. Disaster Response and Search and Rescue

Petitioner wishes to use its UAs when conducting disaster response and search and rescue operations. Although petitioner will not be conducting this sort of operation for profit, because petitioner is a commercial UA operator in other respects, petitioner has included this sort of operation in this petition. Petitioner wishes to conduct these operations under the auspices of the FAA. The president of K&ALLC, Mr. Kovar, is an experienced actor in disaster response and search and rescue operations. For reference letters regarding Mr. Kovar's previous experience and expertise in this area, please refer to Exhibit 4. Mr. Kovar wishes to expand his capabilities to assist where assistance is needed by using UAs as an aid.

The major benefit to conducting disaster response and search and rescue operations with a UA rather than a manned aircraft is cost. Government agencies across the country have turned to UAs as a possible source for assistance during emergency situations. The Washington State Department of Transportation has conducted research on using UAs and determined that they would be useful for both search and rescue and disaster response operations, including avalanche response. The department has previously paid $800 an hour for manned helicopters for search and response operations.[8] The Mesa County, Colorado Sherriff's Office uses a UA equipped with infrared sensors for search and rescue operations, and has projected that a UA costs $25 an hour to operate, compared with manned aircraft, which cost between $400 and $1,200 an hour to operate.[9] The Henry County, Indiana Office of Emergency Management ("HCOEM") determined that owning an emergency response manned aircraft could cost $800,000, not including personnel costs, compared to the one-time purchase price of $1,700 to purchase their UA, and concluded that investing in a manned aircraft for emergency management would not happen:

> "**The cost to Henry County to use manned aerial services is something that has and most likely will not be budgeted for**."[10] (emphasis added).

Additionally, operators of UAs are able respond much more quickly in an emergency than the pilot of a manned aircraft. They can be launched from an area close to the scene of an emergency, compared to a manned aircraft which would depart from an airport, potentially

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[8] Edward D. McCormack, *Use of Small Unmanned Aircraft by the Washington State Department of Transportation*, 14 (June, 2008) *available at* http://www.wsdot.wa.gov/research/reports/fullreports/703.1.pdf.

[9] Sheriff Rebecca Spiess, MSCO Unmanned Aircraft Systems Team, *Frequently Asked Questions*, *available at* http://sheriff.mesacounty.us/uav.

[10] Henry CountyOffice of Emergency Management, *Standard Operating Procedures and Standard Operating Guidelines for Unmanned Aircraft Systems (UAS)*, 8 (December 4, 2014), *available at*: http://www.henrycoema.org/forms/HCOEM%20Aerial%20Equipment%20Standard%20Operating%20Procedures%20and%20Guidlines%20Ver%201-3.pdf.

several miles away from the area of concern. Additionally, pilots of manned aircraft are subject to significantly more risks by being in the air, while UA operators are able to monitor the situation safely from the ground.

The FAA has previously approved disaster response operations in Exemption No. 11283 and search and rescue operations in Exemption No. 11282.

E. Research Flights to Develop Processes, Procedures, and Tools for Accident and Crime Investigations of UAs.

Finally, the petitioner wishes to conduct commercial UA operations for the purpose of conducting research flights to collect data and establish and refine forensic processes, procedures, and tools for investigation of accidents and crimes involving UAs. Petitioner wishes to fly UAs in order to collect flight data and the ground control station and then using forensic analysis to determine what the UA was doing, where it had been, and other information regarding that flight.

Unfortunately, the past year in manned aviation has demonstrated the importance of having a wealth of information regarding airplane disappearances and crashes. The National Transportation and Safety Board (NTSB) has a database covering civil manned aviation accidents that dates back to 1962. No such record exists for UAs, where the technology is rapidly developing. It is imperative for the safe integration of UAs into the NAS that this type of research occur.

VIII. Regulations from Which Exemption is Requested

A. Appendix A: FARs as to which K&ALLC wishes the same determination to be made as has been made previously.

FAR Provision	Applicable condition(s) in Section 5 of petition	FAA Exemption Decision
21(h)	1, 2, 3, 4, 5, 15, 24, 27, 28, 33	Nos. 11062, 11063, 11064, 11065, 11066, 11067, 11080, 11109, 11111, 11110, 11114, 11136, 11138, 11150, 11153, 11156, 11157, 11166, 11167, 11170, 11171, 11172, 11174, 11176, 11177, 11178, 11184, 11185, 11188, 11189, 11191, 11192, 11193, 11195
43.7	13, 14	No. 11208
43.11	12	No. 11208
45.11	29	No. 11208
45.27	29	No. 11188
45.29	29	Nos. 11136, 11157, 11170, 11185, 11193
91.7(a)	12	Nos. 11062, 11063, 11064, 11065, 11066, 11067, 11080, 11109, 11110, 11136, 11138, 11150, 11153, 11156, 11157, 11158, 11160, 11161, 11166, 11167, 11170, 11171, 11172, 11174, 11177, 11178, 11184, 11185, 11188, 11189, 11191, 11192, 11193, 11195, 11204
91.9(b)(2)	22	Nos. 11062, 11063, 11064, 11065, 11066, 11067, 11080, 11109, 11110, 11111, 11112, 11114, 11136, 11138, 11150, 11153, 11156, 11157, 11062, 11063, 11064, 11065, 11066, 11067, 11080, 11109, 11110, 11111, 11112, 11114, 11136, 11138, 11150, 11153, 11156, 11157, 11174, 11177, 11178, 11184, 11185, 11189, 11192, 11193, 11195
91.9(c)	30	Nos. 11136, 11170, 11171, 11174, 11185
91.103(b)(2)	3, 9, 15, 16, 17, 18, 19, 20, 27	No. 11062, 11063, 11064, 11065, 11066, 11067, 11080, 11109, 11138, 11150, 11153, 11156, 11158, 11160, 11161, 11166, 11167, 11171, 11172, 11176, 11177, 11178, 11184, 11185, 11188, 11188, 11189, 11191, 11192, 11193, 11195, 11204
91.105	6	No. 11185
91.109	7, 8	Nos. 11062, 11063, 11064, 11065, 11066, 11067, 11080, 11109, 11110, 11112, 11136, 11138, 11150, 11153, 11156, 11157, 11166, 11167, 11170, 11171, 11174, 11177, 11184, 11185, 11189, 11191, 11192, 11193, 11194, 11195, 11206, 11208
91.113(b)	3, 31	No. 11238

FAR Provision	Applicable condition(s) in Section 5 of petition	FAA Exemption Decision
91.119(c)	4, 33	Nos. 11162, 11163, 11164, 11165, 11166, 111080, 111109, 11110, 11111, 11112, 11114, 11136, 11138, 11150, 11153, 11156, 11160 11161, 11166, 11167, 11170, 11171, 11172, 11174, 11176, 11178, 11185, 11188, 11189, 11190, 11193
91.121	4	Nos. 11162, 11163, 11164, 11165, 11166, 111080, 111109, 11136, 11138, 11150, 11153, 11156, 11160 11161, 11166, 11167, 11170, 11171, 11174, 11176, 11178, 11185, 11188, 11189, 11190, 11193
91.151(a)	16, 17	Nos. 11110, 11153, 11156, 11161; 111109, 11110, 11112, 11136, 11138, 11150, 11153, 11156, 11160 11161, 11166, 11167, 11170, 11171, 11172, 11174, 11176, 11178, 11185, 11188, 11189, 11190, 11193
91.203 (a) and (b)	21	Nos. 11062, 11063, 11064, 11065, 11066, 11067, 11080, 11109, 11110, 11111, 11112, 11114, 11136, 11138, 11150, 11153, 11156, 11157, 11170, 11171, 11172, 11174, 11176, 11177, 11178, 11184, 11185, 11188, 11188, 11189, 11191, 11192, 11193, 11195
91.215	25, 26	Nos. 11185, 11195
91.403	12, 13, 14	No. 11185
91.405(a)	12, 13, 14	Nos. 11062, 11063, 11064, 11065, 11066, 11067, 11080, 11109, 11110, 11111, 11112, 11114, 11136, 11138, 11150, 11153, 11156, 11157, 11158, 11160, 11161, 11166, 11167, 11170, 11171, 11172, 11174, 11176, 11177, 11178, 11184, 11185, 11188, 11188, 11189, 11191, 11192, 11193, 11195, 11204
91.407(a)(1)	14	Nos. 11062, 11063, 11064, 11065, 11066, 11067, 11080, 11109, 11110, 11111, 11112, 11114, 11136, 11138, 11150, 11153, 11156, 11157, 11158, 11160, 11161, 11166, 11167, 11170, 11171, 11172, 11174, 11176, 11177, 11178, 11184, 11185, 11188, 11188, 11189, 11191, 11192, 11193, 11195, 11204
91.409(a)(1)	12, 13, 14	Nos. 11062, 11063, 11064, 11065, 11066, 11067, 11080, 11109, 11110, 11111, 11112, 11114, 11136, 11138, 11150, 11153, 11156, 11157, 11158, 11160, 11161, 11166, 11167, 11170, 11171, 11172, 11174, 11176, 11177, 11178, 11184, 11185, 11188, 11188, 11189, 11191, 11192, 11193, 11195, 11204

FAR Provision	Applicable condition(s) in Section 5 of petition	FAA Exemption Decision
91.409(a)(2)	12, 13, 14	Nos. 11062, 11063, 11064, 11065, 11066, 11067, 11080, 11109, 11110, 11111, 11112, 11114, 11136, 11138, 11150, 11153, 11156, 11157, 11158, 11160, 11161, 11166, 11167, 11170, 11171, 11172, 11174, 11176, 11177, 11178, 11184, 11185, 11188, 11188, 11189, 11191, 11192, 11193, 11195, 11204
91.417(a)	12, 13, 14	Nos. 11062, 11063, 11064, 11065, 11066, 11067, 11080, 11109, 11110, 11111, 11112, 11114, 11136, 11138, 11150, 11153, 11156, 11157, 11158, 11160, 11161, 11166, 11167, 11170, 11171, 11172, 11174, 11176, 11177, 11178, 11184, 11185, 11188, 11188, 11189, 11191, 11192, 11193, 11195, 11204
91.417(b)	12, 13, 14	Nos. 11062, 11063, 11064, 11065, 11066, 11067, 11080, 11109, 11110, 11111, 11112, 11114, 11136, 11138, 11150, 11153, 11156, 11157, 11158, 11160, 11161, 11166, 11167, 11170, 11171, 11172, 11174, 11176, 11177, 11178, 11184, 11185, 11188, 11188, 11189, 11191, 11192, 11193, 11195, 11204

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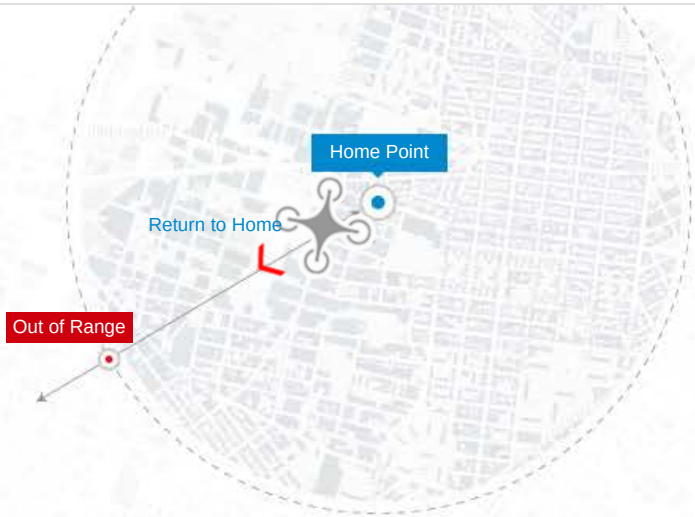
RADAR POSITIONING & RETURN HOME

- The flight radar displays the current position of the Phantom 2 Vision+ in relation to the pilot.
- Exceeding the control range of the remote control will trigger ‘Return-to-Home’, meaning the Phantom 2 Vision+ will automatically fly back to its takeoff point and land safely.



Max flight time

25 Mins

ONSCREEN REAL-TIME FLIGHT PARAMETERS

Keep track of current flight telemetry and see what your Phantom sees on your mobile device.

Radar positioning | Flight parameters | Return home

HIGH PERFORMANCE CAMERA

The Phantom 2 Vision+ carries an extremely high quality camera and a removable 4GB micro SD card. It shoots full HD video at 1080p/30fps and 720p/60fps, giving you crystal clear video and the option for slow motion shots. Photos are shot at 14 megapixels.

View actual photos taken with the Phantom 2 Vision+ □

CAMERA TILT CONTROL

Tilt the camera as you fly, creating unique angles and amazing shots.

GREATER CONTROL

The upgraded remote control comes with many new features. A gimbal control dial, trainer port, built-in rechargeable LiPo battery with a capacity of 2000mAh, battery level LED indicators and throttle locking feature that holds the throttle stick in place when descending are all included. The new remote control is compatible with the

Gimbal Control

Phantom 2 Vision+ and Phantom 2.

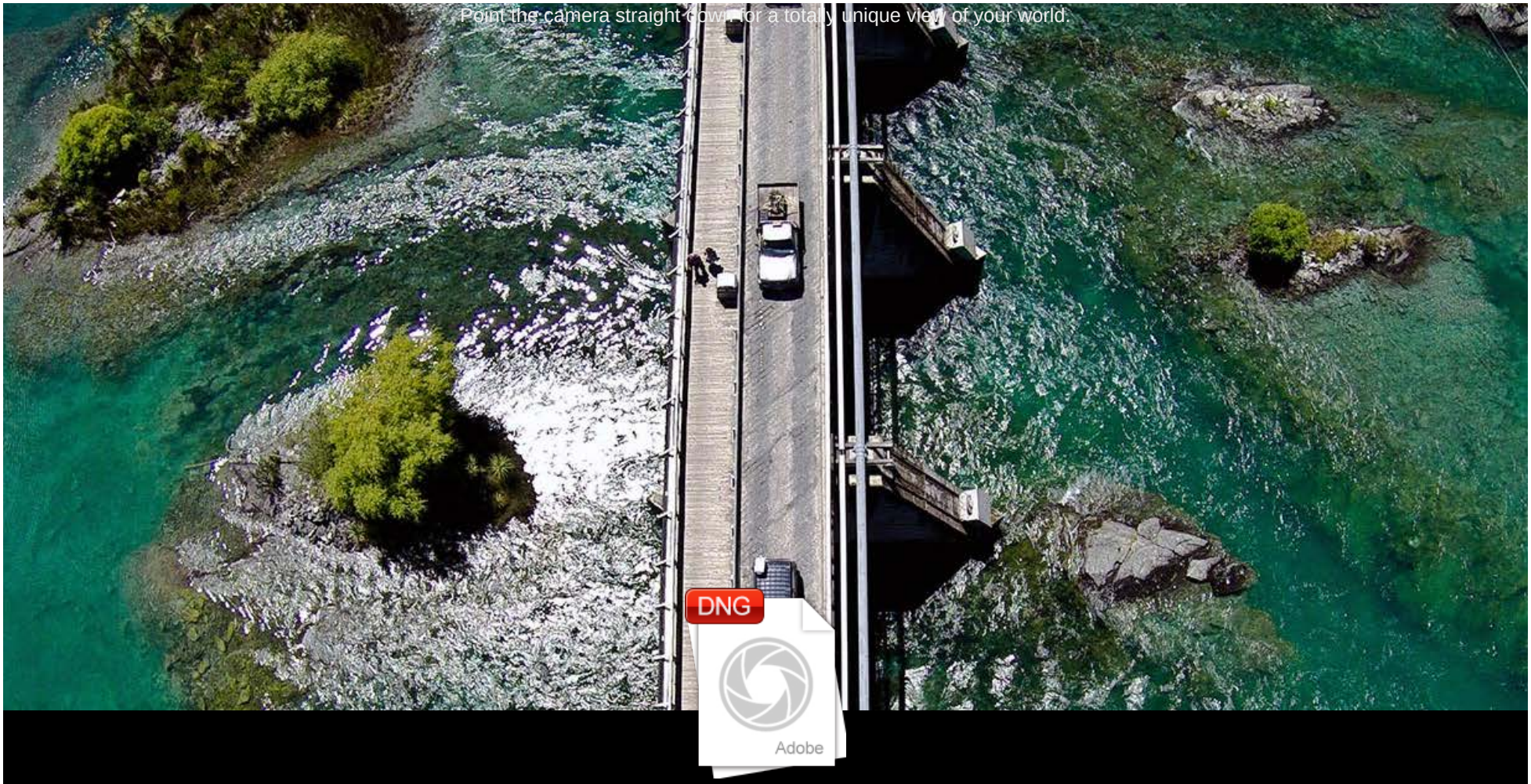
Use DJI Lightbridge to control your aircraft or connect the remote control to your computer via the trainer port to run a simulation application and practice your flying skills.

IMPROVED POWER

New motors, propellers, and ESCs combine to give you greater thrust and control than ever before. You can load more equipment on your Phantom, and achieve up to 200g/arm of extra thrust when using a 3S LiPo battery with this completely new system.

NEW COMPASS

A new, anti-static compass has been developed, with a protective shell to help
shield it in any flight conditions.



SUPPORTS ADOBE DNG RAW

DNG RAW photo capture means all original image information is retained for powerful post processing.

Adobe
PARTNER

ADOBE LENS PROFILE SUPPORT

An Adobe lens profile for barrel distortion removal is available for the DJI Phantom 2 Vision+ camera.

* Available as standard in the latest versions of Adobe Lightroom, Adobe Camera Raw for Photoshop and Adobe Premiere.

Before

After

CAMERA PARAMETER SETTINGS

Camera settings including Picture Quality, ISO, Exposure Compensation, White Balance, and capture Format can be adjusted through the VISION app.

ALBUM

SYNCHRONIZATION

Beam photos and videos from the Vision+ straight to your phone using Wi-Fi. No computer required.

NO FLY ZONES FEATURE

In order to increase flight safety and prevent accidental flights in restricted areas, the new firmware for the Phantom 2 series includes a No Fly Zone feature.

These zones have been divided into two categories: A and B. For a full explanation of the difference between the categories and to view a complete list of places included, please click here.

COMPARE PHANTOMS

Compare Now

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HELP AND SUPPORT

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Aircraft	Supported Battery	DJI 5200mAh LiPo Battery
	Weight (Battery & Propellers Included)	1242g
	Hover Accuracy (Ready To Fly)	Vertical: 0.8m; Horizontal: 2.5m
	Max Yaw Angular Velocity	200°/s
	Max Tiltable Angle	35°
	Max Ascent / Descent Speed	Ascent: 6m/s; Descent: 2m/s
	Max Flight Speed	15m/s (Not Recommended)
	Diagonal Motor-Motor Distance	350mm
Gimbal	Working Current	Static : 750mA; Dynamic : 900mA
	Control Accuracy	±0.03°
	Controllable Range	Pitch : -90° 0°
	Maximum Angular Speed	Pitch : 90°/s
Camera	Operating Environment Temperature	0 -40
	Sensor Size	1/2.3"

	Effective Pixels	14 Megapixels
	Resolution	4384×3288
	HD Recording	1080p30 & 720p
	Recording FOV	110° / 85°
Remote Control	**Operating Frequency**	5.728 GHz 5.85 GHz
	Communication Distance (Open Area)	CE Compliance: 400m; FCC Compliance: 800m
	Receiver Sensitivity (1%PER)	-93dBm
	Transmitter Power	CE Compliance: 25mW; FCC Compliance: 100mW
	Working Voltage	120 mA@3.7V
	Built-In LiPo Battery Working Current/Capacity	3.7V, 2000mAh
Range Extender	**Operating Frequency**	2412-2462MHz
	Communication Distance (Open Area)	500-700m
	Transmitter Power	20dBm
	Power Consumption	2W
DJI VISION App	**System Requirement Of Mobile Device**	iOS version 6.1 or above/ Android system version 4.0 or above
	Mobile Device Support	• iOS recommended: iPhone 4s, iPhone 5, iPhone 5s, iPhone 6, iPhone 6 Plus, iPod touch 5 (available but not recommended: iPad 3, iPad 4, iPad mini) • Android recommended: Samsung Galaxy S3, S4, Note 2, Note 3 or phones of similar configuration

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SMART FLIGHT BATTERY
Safety Guidelines

SMART FLIGHT BATTERIE
Nutzungshinweise

BATTERIES INTELLIGENTES
Guide d'Utilisation

飞行器智能电池
安全使用指引

マルチコプター電池
安全使用ガイド

V1.0 2014.07

English

Battery Use

- **Never use non-DJI batteries.** Go to www.DJI.com to purchase new batteries. DJI takes no responsibility for any accidents caused by non-DJI batteries.
- Never use or charge a swollen, leaky or damaged battery. If so, contact DJI or its designated dealers for further assistance.
- Do NOT install the battery into the battery compartment on the Phantom when turned on. Turn off the battery before installing it or removing it from the Phantom. **Never install or remove the battery from the Phantom when it is turned on.**
- The battery should be used in temperatures from -20°C to 40°C. Use of the battery above 50°C can lead to a fire or explosion. Use of battery below -20°C can lead to permanent damage.
- Do not use the battery in strong electrostatic or electromagnetic environments. Otherwise, the battery control board may malfunction and a **serious accident may happen during flight.**
- Never disassemble or pierce the battery in any way, or the battery may catch fire or explode.
- Electrolytes in the battery are **highly corrosive.** If any electrolytes splash onto your skin or eyes, immediately wash the affected area with fresh running water for at least 15 minutes then see a doctor immediately.
- Check the condition of the battery if it falls out of the Phantom. Make sure the battery is **NOT damaged or leaking** before putting it back to the Phantom.
- Land the Phantom immediately when the low battery level warning activates in the DJI VISION App.
- **Do not drop the battery into water.** If the inside of the battery comes into contact with water, chemical decomposition may occur, potentially resulting the battery catching on fire, and may even lead to an explosion. If the battery falls into water with the Phantom during flight, take it out immediately and put it in a safe and open area. Maintain a far distance from the battery until it is completely dry. **Never use the battery again, and dispose of the battery properly as described in Battery Disposal below.**
- Put out any battery fire using sand or a dry powder fire extinguisher. Never use water to put out a battery fire.

Charging the Battery

- Batteries **must be charged using a DJI approved adapter.** DJI takes no responsibility if the battery is charged using a non-DJI charger. Never leave the battery unattended during charging. Do not charge the battery near flammable materials or on flammable surfaces such as carpet or wood.
- Do not charge battery immediately after flight, because the battery temperature may be too high. Do not charge the battery until it cools down to near room temperature. Charging battery outside of the temperature range of 0°C-40°C may lead to leakage, overheating, or battery damage.
- Charge and discharge the battery completely once every 20 charge/discharge cycles. Discharge the battery until there is less than 8% power or until it can no longer be turned on, then recharge it to the maximum capacity. This power cycling procedure will optimize the battery life.

Battery Storage

- Do not leave the battery near heat sources such as a furnace or heater. The ideal storage temperature is 0°C-21°C.
- Keep the battery dry. Never drop the battery into water.
- Do not drop, strike, impale, or manually short-circuit the battery.
- Keep the battery away from metal objects such as necklaces and hairpins.
- Discharge the battery to 30%-50% of the battery level if it will not be used for 7 days or more. This can greatly extend the battery life.

Battery Disposal

- Dispose of the battery into specific recycling boxes only after a complete discharge. Do not place the battery into regular rubbish bins. Strictly follow your local disposal and recycling regulations of batteries.
- If the power on/off button of the smart battery is disabled and the battery cannot be fully discharged, please contact a professional battery disposal/recycling agent for further assistance.

Deutsch

Batterienutzung

- Benutzen Sie ausschließlich originale DJI

Batterien. Gehen Sie auf www.DJI.com, um neue Batterien zu erwerben. Für Schäden, die durch die Verwendung von Nicht-Originalteilen und Zubehör entstehen, ist jedwede Haftung des Herstellers ausgeschlossen.

- Benutzen oder Laden Sie niemals eine angeschwollene, undichte oder beschädigte Batterie. Kontaktieren Sie gegebenenfalls DJI oder unsere ausgewiesenen Händler für weitere Informationen.
- Setzen Sie NIEMALS die Batterie in das Batteriefach des Phantom ein, während die Batterie eingeschaltet ist. Schalten Sie die Batterie aus, bevor Sie diese in das Batteriefach einsetzen oder vom Phantom entfernen. **Setzen Sie niemals die Batterie ins Batteriefach ein oder entfernen sie, wenn diese eingeschaltet ist.**
- Die Batterie sollte nur in einem Temperaturbereich von -20°C bis 40°C benutzt werden. Der Gebrauch der Batterie bei über 50°C kann zu Feuer oder einer Explosion führen. Die Verwendung bei unter -20°C kann zu dauerhaften Schäden führen.
- Verwenden Sie die Batterie nie in starken elektrostatischen oder elektromagnetischen Umfelden. Das Batterie Control Board könnte versagen und **ein schwerer Unfall während des Fluges passieren.**
- Bauen Sie die Batterie niemals auseinander oder durchbohren Sie diese, die Batterie könnte Feuer fangen oder explodieren.
- Die Akkumulatorsäure in der Batterie ist **stark korrosiv**. Säurespritzer im Auge oder auf der Haut sofort unter frischem, laufenden Wasser aus- bzw. abspülen und anschließend sofort einen Arzt aufsuchen.
- Überprüfen Sie den Zustand der Batterie, falls diese aus dem Phantom herausfällt. Stellen Sie sicher, dass die Batterie **NICHT beschädigt ist oder ausläuft**, bevor Sie diese zurück in den Phantom stecken.
- Landen Sie den Phantom umgehend, sobald die Batteriewarnung in Ihrer DJI VISION App erscheint.
- **Lassen Sie die Batterie niemals in Wasser fallen.** Wenn das Innere der Batterie mit Wasser in Kontakt kommt, könnte eine chemische Zersetzung ausgelöst werden, durch die die Batterie möglicherweise Feuer fängt oder sogar explodiert. Falls die Batterie während des Fluges mit dem Phantom in Wasser fällt, entfernen Sie diese unverzüglich aus dem Fluggerät und legen diese in eine sichere und offene Umgebung. Halten Sie großen Abstand zu der Batterie bis diese komplett getrocknet ist. **Benutzen Sie die Batterie niemals erneut und entsorgen Sie die Batterie sachgerecht, wie unten in dem Kapitel Entsorgen der Flugbatterie beschrieben.**
- Löschen Sie jeden Batteriebrand mit Hilfe von Sand oder einem Pulverlöscher. Löschen Sie einen Batteriebrand niemals mit Wasser.

Aufladen der Flugbatterie

- Batterien **müssen mit einem von DJI zugelassenen Adapter geladen werden.** DJI übernimmt keine Haftung für Batterien, die mit einem nicht von DJI autorisierten Ladegerät geladen wurden. Lassen Sie die Batterie während des Ladevorgangs niemals unbeaufsichtigt. Laden Sie die Batterie nicht in der Nähe von entflammbaren Materialien oder Oberflächen wie Teppich oder Holz.
- Laden Sie die Batterie nicht direkt nach dem Flug, die Temperatur der Batterie könnte zu hoch sein. Laden Sie die Batterie erst, sobald sie auf mindestens Raumtemperatur abgekühlt ist. Das Laden der Batterie außerhalb des Temperaturbereichs von 0°C - 40°C kann zu Auslaufen, Überhitzen oder einem Schaden an der Batterie führen.
- Laden und Entladen Sie die Batterie einmal vollständig alle 20 Lade-/Entladevorgänge. Entladen Sie die Batterie bis auf unter 8% bis sie nicht mehr eingeschaltet werden kann, dann laden Sie diese bis zum Maximum ihrer Kapazität auf. Das beschriebene Verfahren optimiert die Lebensdauer Ihrer Batterie.

Lagerung der Flugbatterie

- Lassen Sie die Batterie nicht in der Nähe von Hitzequellen wie einem Ofen oder Heizkörper. Die ideale Lagerungstemperatur liegt zwischen 0°C - 21°C.
- Die Batterie ist sauber und trocken zu lagern. Lassen Sie die Batterie niemals in Wasser fallen.
- Lassen Sie die Batterie nicht fallen, spießen Sie diese nicht auf, schließen Sie sie nicht manuell kurz und wirken Sie nicht mit Gewalt auf die Batterie ein.
- Halten Sie die Batterie fern von Metallobjekten wie Ketten und Haarnadeln.
- Entladen Sie die Batterie bis auf 30% - 50%, falls Sie diese für 7 Tage oder länger nicht benutzen.

Dies kann die Lebensdauer Ihrer Batterie stark verlängern.

Entsorgung der Flugbatterie

- Entsorgen Sie die Battterie, nur nachdem Sie komplett entladen wurde, in speziellen Recycling Tonnen. Werfen Sie die Batterie nicht in die normale Mülltonne. Beachten und befolgen Sie unbedingt die kommunalen Entsorgungs- und Recyclingvorschriften für Batterien.
- Falls der On/Off Knopf der Batterie nicht funktioniert und die Batterie nicht vollständig entladen werden kann, kontaktieren Sie bitte eine professionelle Entsorgungs-/ Recyclingfirma.

Français

Utilisation de la Batterie

- N'utilisez jamais de batterie autre que d'origine. Rendez-vous sur www.DJI.com pour acheter de nouvelles batteries. La responsabilité de DJI ne pourrait être engagée pour tout accident résultant de l'utilisation de batteries non-DJI.
- N'utilisez ni ne chargez jamais de batterie déformée, qui suinte ou qui est endommagée. Si vous constatez un problème contactez DJI ou ses revendeurs agréés pour recevoir l'assistance nécessaire.
- N'installez PAS la batterie dans le compartiment du Phantom si elle est allumée. Eteignez la batterie avant de l'installer ou de la retirer du Phantom. N'installez ou ne retirez jamais la batterie du Phantom lorsqu'il est allumé.
- La batterie peut être utilisée sous des températures allant de -20°C à 40°C. Utiliser la batterie au-delà de 50°C peut causer un incendie ou une explosion. L'utiliser en deçà de -20°C peut causer un dommage irréparable à la batterie.
- N'utilisez pas la batterie dans un environnement électrostatique ou électromagnétique important. Sinon, l'unité de contrôle de la batterie pourrait mal fonctionner et un sérieux accident pourrait survenir pendant le vol.
- Ne désassemblez ou ne percez jamais la batterie d'aucune manière, ou celle-ci pourrait prendre feu ou exploser.
- L'électrolyte dans la batterie est très corrosif. Si de l'électrolyte éclabousse votre peau ou vos yeux, rincez immédiatement la zone affectée à l'eau fraiche courante pendant au moins 15 minutes puis consultez immédiatement un docteur.
- Vérifiez l'état de la batterie si elle tombe du Phantom. Vérifiez que la batterie n'est PAS endommagée ou suintante avant de la remettre dans le Phantom.
- Faites atterrir le Phantom immédiatement dès que l'alerte de faible batterie se déclenche dans l'App DJI VISION.
- N'immergez pas la batterie. Si l'intérieur de la batterie entre en contact avec de l'eau une réaction chimique peut se produire, résultant potentiellement en un incendie ou même en l'explosion de la batterie. Si la batterie tombe à l'eau avec le Phantom lors d'un vol retirez-la immédiatement et mettez-la à l'abri dans un endroit sécurisé et ouvert. Restez à bonne distance de la batterie jusqu'à ce qu'elle soit entièrement sèche. Ne la réutilisez jamais et déposez-la correctement comme décrit plus bas dans le paragraphe sur le Recyclage des Batteries. Eteignez une batterie en flammes en utilisant du sable ou un extincteur à poudre sèche. N'utilisez jamais d'eau pour éteindre une batterie en feu.

Charge de la Batterie

- Les batteries doivent être chargées à l'aide d'un chargeur approuvé par DJI. La responsabilité de DJI ne peut être engagée si la batterie est chargée avec un autre chargeur que celui proposé par DJI. Ne laissez jamais la batterie sans surveillance durant la charge. Ne chargez pas la batterie près d'une source de chaleur, d'un matériau inflammable ou sur une surface inflammable comme un tapis ou du parquet.
- Ne chargez pas votre batterie immédiatement après un vol car la température pourrait être trop élevée. Ne chargez la batterie que lorsque celle-ci aura atteint la température ambiante. Charger la batterie hors de la plage de température comprise entre 0°C et 0°C peut entrainer une fuite, une surchauffe ou une panne de la batterie.
- Chargez et déchargez complètement la batterie tous les cycles de 20 charges/décharges. Déchargez la batterie jusqu'à ce qu'il reste moins de 8% de charge ou jusqu'à ce que la batterie ne puisse plus être allumée puis rechargez-la jusqu'à sa capacité maximale.

Cette procédure de charge cyclique optimisera la durée de vie de votre batterie.

Stockage des Batteries

- Ne laissez jamais la batterie près d'une source de chaleur comme un radiateur ou un poêle. La température idéale de stockage est de 0°C -21°C.
- Maintenez la batterie bien sèche. Ne l'immergez jamais dans un liquide.
- Ne faites pas tomber ni ne cognez la batterie, ne la percez pas, ne provoquez pas volontairement de court-circuit sur la batterie.
- Gardez la batterie éloignée de petits objets métalliques tels que des épingles à cheveux, des trombones, des petits bijoux.
- Déchargez la batterie aux alentours de 30%-50% de son niveau de charge si vous ne l'utilisez pas pendant une semaine ou plus. Ceci augmentera de manière conséquente la durée de vie de votre batterie.

Recyclage des Batteries

- Mettez votre batterie dans une boite de recyclage adaptée uniquement après l'avoir complètement déchargée. Ne mettez pas votre batterie avec les ordures ménagères. Suivez scrupuleusement les consignes locales précises en matière de recyclage des piles et batteries.
- Si le bouton ON/OFF de la batterie intelligente est inopérant et que la batterie ne peut être complètement déchargée, veuillez s'il vous plait contacter un Professionnel du recyclage afin d'obtenir l'assistance nécessaire.

中 文

使 用

- **严禁使用非大疆官方提供的电池。**如需更换，请到大疆官网查询。因使用非大疆官方提供的电池而引发的电池事故、飞行故障，大疆概不负责。
- **严禁使用鼓包的、漏液的、包装破损的电池。**如有以上情况发生，请联系大疆或者其指定代理商做进一步处理。
- 在将电池安装或者拔出于飞行器之前，请保持电池的电源关闭。**请勿在电池电源打开的状态下，拔插电池。**
- 电池应在室温为 -20℃至 40℃之间使用。**温度过高，会引起电池着火，甚至爆炸。**温度过低，电池寿命会受到严重损害。
- 禁止在强静电或者磁场环境中使用电池。否则，**电池保护板会失灵，导致飞行器发生严重故障。**
- 禁止以任何方式拆解或用尖利物体刺破电池。否则，会引起电池着火甚至爆炸。
- 电池内部液体有**强腐蚀性**。如有泄露，请远离。如有溅射到人体皮肤或者眼睛里，请立即用清水冲洗至少 15 分钟，并立即就医。
- 若电池从飞行器中摔落，再次使用前，务必确保电池外观**无损，无破损、无漏液**等问题。
- 若飞机进入电量低报警模式，**应尽快降落并停止飞行**，更换新电池或者对电池进行充电。
- **请勿将电池浸入水中或将其弄湿。**电池内部接触到水后可能会发生分解反应，引发电池自燃，甚至可能引发爆炸。如果电池在 Phantom 飞行过程中或其它情况下意外坠入水中，请立即拔出电池并将其置于安全的开阔区域，这时应远离电池直至电池完全晾干。**晾干的电池不得再次使用，应该按照本文的废弃方法妥善处理。**
- 若电池发生起火，应立即采用“窒息灭火法”，如使用沙子或固体或干粉灭火器进行灭火。**严禁用水来灭火。**

充 电

- 智能电池**必须使用 DJI 官方提供的专用充电器**或车载充电器进行充电。对于使用非 DJI 官方提供的充电器进行充电所造成的一切后果，DJI 将不予负责。
- 请留意充电过程以防发生意外。充电时请将电池和充电器放置在水泥地面等周围**无易燃、可燃物**的地面。
- **禁止在飞行器飞行结束后，立刻对电池进行充电。**此时，电池处于高温状态，强制充电会对电池寿命造成严重损害。建议待电池降至室温，再对电池进行充电。理想的充电环境（0-40℃）可大幅度延长电池的使用寿命。
- 电池每经过约 20 次充放电后，需要进行一次完整的放电和充电过程（将电池充满电，然后放电至电量为 8% 以下或电池自动关闭，再充满电）以保证电池工作在最佳状态。

储 存

- 禁止将电池放在靠近热源的地方，比如火源或加热炉。智能电池的理想的保存温度为 0-21℃。
- 存放电池的环境应保持干燥。请勿将电池置于水中或者可能会漏水的地方。
- 禁止机械撞击电池、碾压、坠落、人为短路、刺穿电池。
- 禁止将电池与金属项链、发夹或者其他金属物体一起贮存或运输。
- 超过 7 天不使用电池，请将电池放电至 30%-50% 电量存放，可大大延长电池的使用寿命。

废 弃

- **务必将电池彻底放完电后，才将电池置于指定的电池回收箱中。**电池是危险化学品，**严禁废置于普通垃圾箱。**相关细节，请遵循当地电池回收和弃置的法律法规。
- 如电池因为电源开关失灵而无法完成彻底放电，请勿将电池直接弃置于电池回收箱，应联系专业电池回收公司做进一步的处理。

日本語

使 用

- 非 DJI 社製の電池を使用することによって発生する事故は DJI 社一切の責任を負いません。
- 包装破損、傷づいた電池を使用することが禁じます。上記したものが発生した場合、DJI 社或いは購入先の代理店までご連絡ください。
- 電池の取り付けや取り外しの前は、必ず電源をオフにしてください。電源をオンにしたまま、操作しないでください。
- 電池は温度－ 20℃から 40℃の間で使用してください。温度が高くなると、火事を引き起こします。低くなると、電池の寿命が短縮します。
- 強い静電気または磁気が起こる環境での電池の使用を禁止します。バッテリー保護基板の機能が失い、飛行器の故障につながる可能性があります。
- いかなる方法で電池を解体することは禁じます。火事や爆発事故が発生する原因とみられます。
- 電池内部の液体は腐食性が強いです。液体が漏れると、離れてください。皮膚や目に入った場合、すぐに 15 分以上水で洗い流し、速やかに医師の診察を受けてください。
- 飛行中に電池が墜落したら、再使用する前に電池の外観が破損したかどうかを確認してください。
- 飛行中に低電量アラームがなりましたら、すぐ安全地に着陸して、電池を交換するか充電してください。
- 電池を水に入れないでください。電池内部は水が入ると化学反応が起こり、自然発火して爆発する可能性があります。飛行中、機体が水に落ちた場合、直ちに電池を外して安全地で乾燥してください。乾燥した電池を再利用することは禁じます。本章の廃棄方法で処理してください。
- 電池が発火したら、砂や消火器で消火してください。水での消火を避けてください。

充電について

- 必ず DJI 社の充電器或いはカーチャージャで充電してください。非 DJI 社提供した充電器を使用することで起こった事故など、DJI 社は一切の責任を負いません。
- 充電中の充電状況を常に確認してください。充電時、可燃物の上に置かないでください。
- 飛行が終わった後、電池はまだ高温状態の為、充電してはいけません。電池の寿命が短縮します。推奨の充電温度は 0 ～ 40 度です。
- 電池のベスト状況を確保する為、20 回充電した後、一回完全放電してください。

保管について

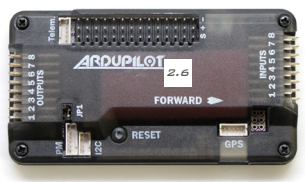
- 発熱源の近くで使用したり、保管したりしないでください。0 － 21℃の環境での保管を推奨します。
- 乾燥した環境での保管してください。水中や水漏れの場所に置かないでください。
- バッテリーに衝撃加えたり、墜落させたり、人為的にショートさせてたりしないでください。
- 金属物体或いは金属アクセサリーと一緒に保管したり運送したりしないでください。
- 使用しない期間は 7 日間を超える場合はバッテリー残量を３０%－５０%の状態にすることでバッテリーの寿命を延ばすことが可能です。

破棄について

- バッテリーは化学品の為、破棄するときは火災の原因とならないように、完全に放電を行ってから破棄してください。破棄方法は各エリアの条例を守ってください。
- バッテリーの電源の故障による放電できない場合は回収箱に入れずに、業者に連絡のうえ正しく処理を行ってください。

3D Robotics
UAV TECHNOLOGY

APM 2.6

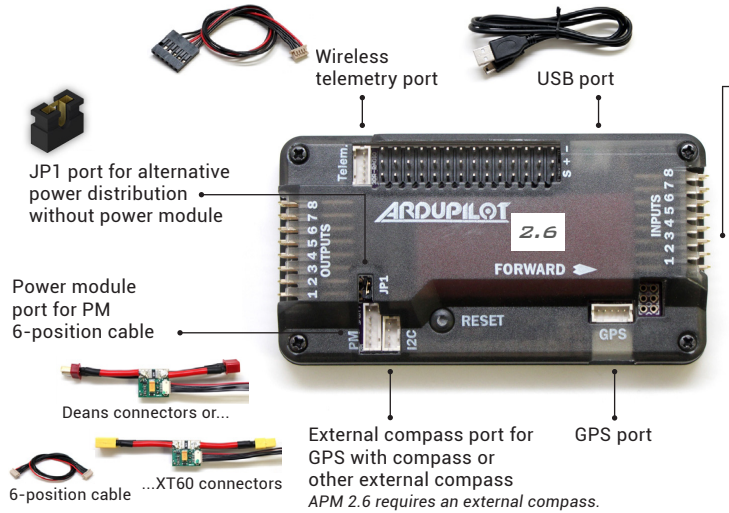


ARDUPILOT
MULTIPLATFORM AUTOPILOT
ARDUPILOT.COM

APM 2.6

FOR EXTERNAL MAGNETOMETER

Providing the same advanced, multiplatform capabilities as APM 2.5, the 2.6 revision of the award-winning APM autopilot is designed for an external magnetometer. This improves flight performance by allowing the compass module (or combined GPS with compass) to be placed further away from sources of potential magnetic interference.



APM 2.6 requires an external compass.

CONTENTS

We recommend:

3DR GPS uBlox with Compass

Featuring active circuitry for ceramic patch antenna, rechargeable backup battery for warm starts, I²C EEPROM for configuration storage, and a digital compass.

Available from
Store.3DRobotics.com

PLANE

To set up your APM 2.6 board using the APM:Plane firmware please visit:
PLANE.ARDUPILOT.COM

COPTER

To set up your APM 2.6 board using the APM:Copter firmware, please visit:
COPTER.ARDUPILOT.COM

ROVER

To set up your APM 2.6 board using the APM:Rover firmware, please visit:
ROVER.ARDUPILOT.COM

3DR

APM 2.5 and 2.6 Overview

Contents

APM 2.5

The APM 2.5 board requires no assembly, and is ready for firmware. You have a choice of side or top

entry pin configuration, in order to accommodate a variety of installations. You'll see this option when you order.

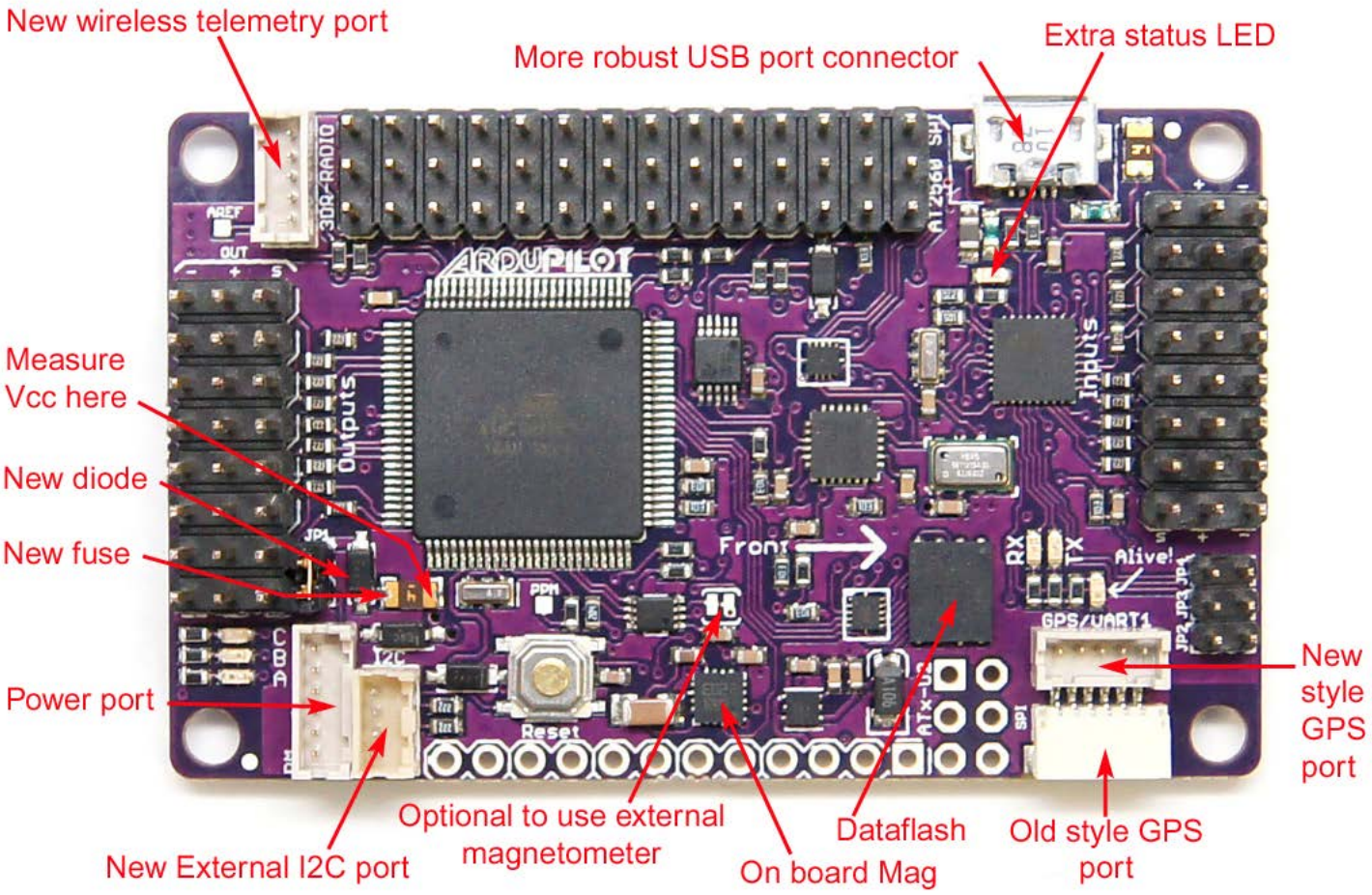
*****Click and drag the image above to spin it!**

This page gives you a look under the hood, and goes into more detail about the design of this board.

The APM 2.5 has some improvements over the APM 2.0, but they both have a very similar layout and function.

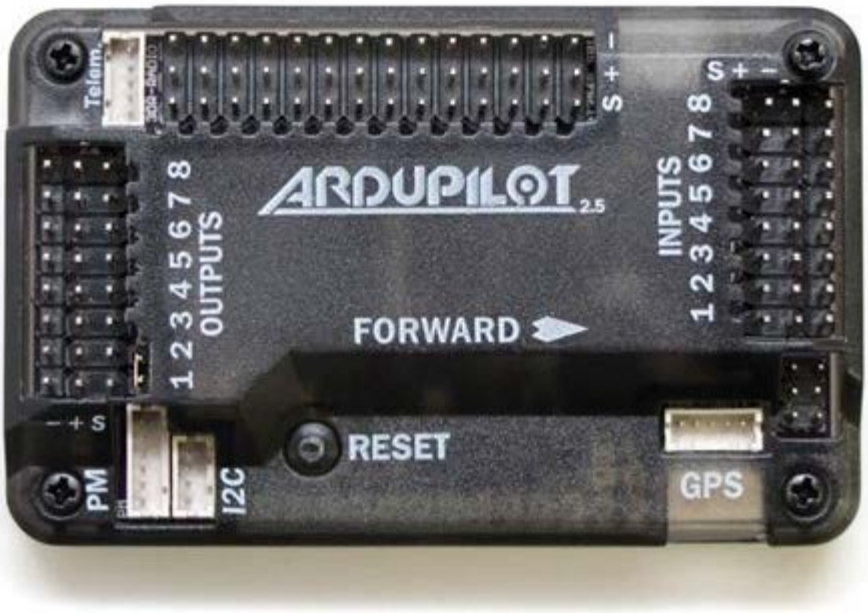
APM 2.6

- **APM 2.6** is a revision of the APM that makes use of an external magnetometer (compass).
- The APM 2.6 has no on board compass, and is optimized for vehicles where the compass should be placed as far from power and motor sources as possible to avoid magnetic interference.
- APM 2.6 is designed to be used with the 3DR GPS uBlox LEA-6 with Compass module.
- The GPS/Compass module may be mounted further from noise sources than the APM itself.
- APM 2.6 requires a GPS unit with an on board compass for full autonomy.
- For information on installing a 3DR GPS uBlox LEA-6 with Compass, visit .



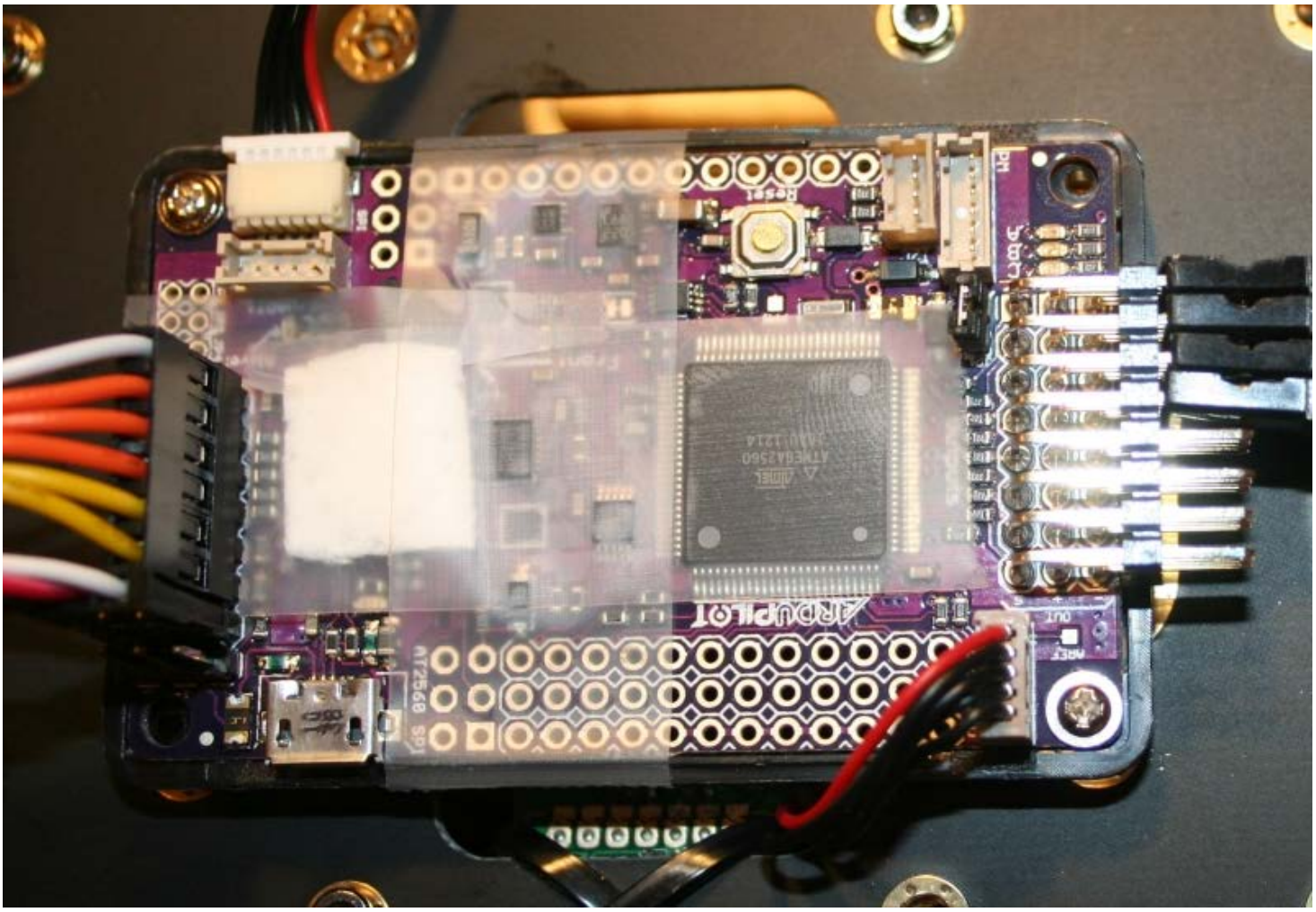
Using the APM 2.5/2.6 Enclosure

The APM 2.5/2.6 board is shipped in an enclosure with foam protecting the barometric pressure sensor, as shown here.



Or Not

If you aren’t using the enclosure, make sure to cover the barometric sensor with some open cell foam, cotton padding or tissue to protect it from prop wash, wind and turbulence. Also, the barometric sensor is sensitive to light and readings can change by several meters from direct sunlight to shade. Some type of light shield (on top of the foam) will minimize the effects of light changes.



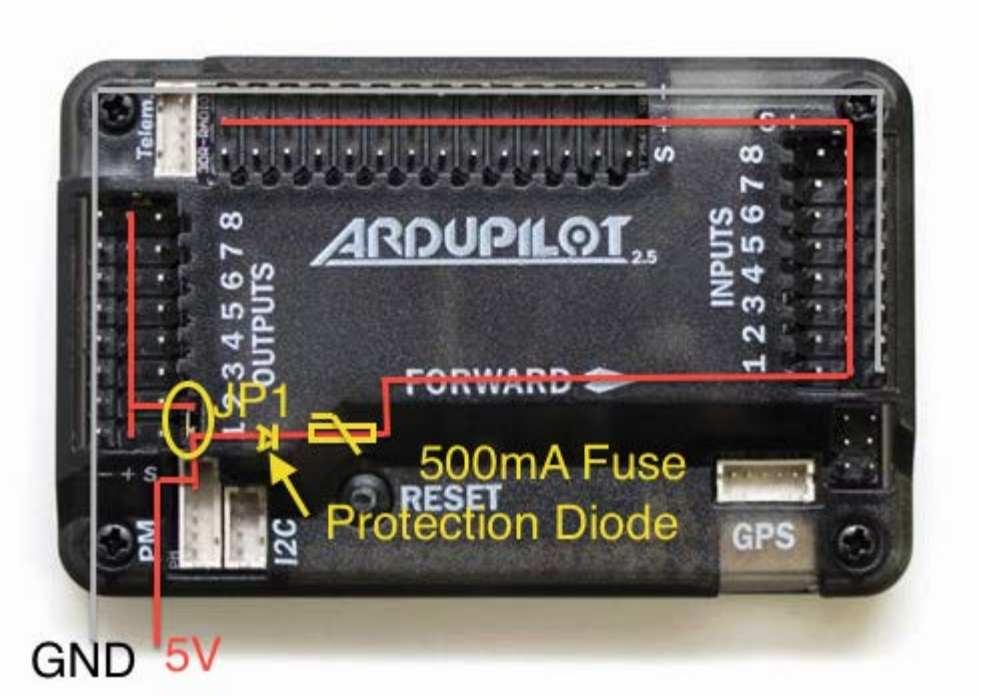
Powering the APM 2.5/2.6 Board

Like any computer, the APM needs a power supply with a steady clean voltage and sufficient current.

3DR provides an APM power module that supplies 2.25A at 5.37V. The module is designed to convert power from the main flight battery (18 volt maximum). That module will supply sufficient power for your APM, and low power radios including your RC receiver (without servos). Your RC receiver can be powered from any APM Input (+5V and ground). This is normally done by connecting a 2 or 3 wire cable between an APM Input and one of the output channels on the RC radio.

If you are using any servos such as are required with a traditional helicopter or a camera gimbal, you will need to provide an additional dedicated power supply for the servos. The APM is intended to **control** servos, not power them.

In order to design a power supply for your APM, or provide additional power, you'll need a basic understanding of the power circuit in the APM.



There are two “sides” to the positive circuit in the board. Each side has positive-rails available for inputing power or distributing it to peripheral devices. The center row of pins in the three groups of pins (Outputs, Inputs, Analog) labeled “+” are referred to as a “positive-rail”. This means that the base of all the + pins are connected so they represent a single electrical path. The positive-rails of the Input and Analog group are connected together. So we have two separate positive circuits, one in the Outputs and the other made up of the Input/Analog.

All of the components on the board take power from various points on these rails, so it is necessary for both “sides” to be receiving +5V (within the specs below) for the board to function.

These positive-rails can be joined together by placing JP1 in it’s position on the board. This connects all the positive-rails ands provides power to both sides of the board, so that low-level power can be distributed to peripheral sensors and devices: 3DR Radios, sonar, RC Rx, etc. via the power-rails.

When using the power module, the circuit path is as follows:

From the power module connection the negative wire is connected to a negative-rail shared by the entire board regardless of JP1.

Positive voltage comes in to a T-junction. to the left is a path through the JP1 to the positive-rail of the Outputs. To the right it flows through an over-voltage, over-current, reverse-polarity protection(500mA fuse and 6V Zener diode). A side effect of passing through the Zener diode is a .37V loss, therefore input voltage should be bumped up by .37V to account for this. From here the positive voltage runs to the positive-rails of the Inputs and Analog. Inputs should not be used to power anything except your RC receiver.

Higher current loads such as servos should be powered from the power-rails (positive-negative) of the Output side. You must use an adequate voltage-regulator to provide power directly to the Output power-rails, all servo power leads will attach to these same rails (the signal wires can connect on the Analog “S” pins in the case of a camera gimbal). Since JP1 is removed in this scenario, the other “side” of the board will need power provided to it’s power-rails directly.

Alternative ways to power your board

3DR Power Module

If you are using the 3DR Power Module please find instructions here: Using the 3DR Power Module

- **Warning!** Under no circumstances should you ever attempt to draw servo power from the analog input connector.
- **Warning:** You may “control” servos from A9, A10 and A11 from the A0 – A11 I/O connector, but you must run servo power separately.
  - The A0 – A11 I/O connector cannot supply sufficient power for servos.
  - A9, A10 and A11 of the I/O connector come pre-wired to correct digital out for use as servo control lines.
  - For servo use, it is imperative that they have not been reassigned to analog use with the pads on the back of the APM board.

A Non technical Description of the Power Supply Requirements

The description below simply supplements and provides an alternate view of the information above.

1. The APM 2.5/2.6 board has two separate power circuits which make it very easy to power by a variety of methods.
   1. A fused power circuit provides primary board and general I/O power: (It cannot provide power for servos).
   2. The Other power circuit is for the OUTPUT connector power rail: (it can provide power for servos).
2. The jumper JP 1 determines whether the two power circuits are connected or separate.
   1. If JP1 is removed, the power rail on the OUTPUT connector “Floats” and may be used to distribute power.
   2. Although if JP1 is removed the OUTPUT connector cannot be used to supply power to the APM board.

3. It is possible to power the APM board from the Power Module connector or the OUTPUT or INPUT connectors.
4. Normally the APM 2.5/2.6 “Power Module” is used to provide primary APM 2.5 board and general I/O power.
5. Alternatively primary board power can be supplied by a BEC either from one of the ESCs or from an external BEC.
6. If servos are used, supplementary power is required.
    1. Generally one power supply is provided for the board and one or more additional power supplies for the servos.
    2. But if a sufficiently large external BEC is used it can supply power for both via the OUTPUT connector.
7. Only the OUTPUT connector can provide power for servos as the other circuit is fused.
    1. The address connector is sometimes used provide servo signals, but the servos power must come from elsewhere.
8. How you are powering your APM board and or servos determines whether JP1 is installed or not.
    1. (Whether the two power circuits are separated or connected).
    2. All possible configurations are detailed Below.
9. The type of use will determine which options are available.
    1. APM:Copter can power the APM from a power module or a UBEC or a BEC from one of the ESCs and can power servos from a UBEC or from the other ESC’s BECs.
    2. APM:Plane can power the APM from the power module, the BEC from the flight motors ESC or a separate UBEC and can power servos from a separate UBEC or the flight motors BEC if it is large enough.
    3. APM:Rover can power the APM from the power module, the BEC from the drive motor’s ESC or a separate UBEC and can power the steering servo from a separate UBEC or the drive motors BEC if it is large enough.

Power Supply Rails Connected Requirements (JP1 Installed)

Warning: Do not exceed Abs MAX input voltages when connecting the power supply or you will damage your board.

Warning: Connecting USB when you have input voltages at the high end of the range (near Abs Max) can damage the board. Disconnect battery before connecting USB or test input voltages so they are within the specified range.

Power Options	Nominal	Abs MAX	JP1 status
Power on Output PWM connector	5.37V +-0.5	6V	JP1 connected

Power on Input PWM connector	5.00V +-0.25	5.5V	JP1 connected

No Power Module and No Servos and Power provided by BEC from ESC

- If you do not have a power module and you are not using servos.
- Ensure JP1 is installed and provide the necessary power via the BEC from one of your ESC's.
- Connect one ESC's BEC power and ground wires to one pair of the APM OUTPUT connectors power and ground pins.
- Clip the BEC power leads on the remaining 3 wire connectors.
- Ensure that the ESC's signal wires are connected to the appropriate APM OUTPUT connector signal pins.
- You must ensure that your ESC's BEC has a sufficient power capability (at least 2 amps).
  - Most 20 amp or higher ESCs have 2 amp BECs.

No Power Module but using Servos and a high power External BEC

- If you do not have a power module and are using servos you can use a high power external BEC.
- Ensure JP1 is installed and provide the necessary power via a high power external BEC (5 to 10 amps or more).
- The BEC power **must** be provided to one pair of the APM OUTPUT connector pins.
- **Warning!** Clip all power leads on the ESC's BECs (they would conflict with the external BEC).
- Your servos will determine the size of the BEC required.
- You should allow at least 2 or 3 amps extra to power the APM, receiver and to prevent (brown outs).
- All of the positive power for driving each servo must come from the OUTPUT connector.
  - This is true even if the servo(s) signal wires are connected to the ADDRESS connector.
- This option requires you to take responsibility for providing sufficient power to prevent brownout.

No Power Module but using Servos and multiple BECs from ESC's (A BEC for each Servo)

- If you do not have a power module and are using servos you can use multiple BECs from your ESC's.
- Ensure JP1 is installed and plug one of your ESC's signal cables with power leads into the OUTPUT connector.
- Remove the power and ground leads from the remaining ESCs signal cable connectors.
- Plug the signal wire connector from each ESC onto the appropriate pin on the OUTPUT connector.
  - You can heat shrink these or plug them into a multi-wire connector appropriate for your copter.
- Connect one pair of each of the remaining BEC power and ground lines to the power and ground of

each individual servo.

- Clip or heat shrink any remaining excess BEC power and ground leads.
- The BEC power from one ESC **must** be provided to one pair of the APM output connector pins.
- Plug only the signal input wire from your servos into the appropriate OUTPUT or ADDRESS connector pin.
- Your ESC's BECs should be at least 2 amps.
- The ESC's BEC grounds are in common with battery and internal signal ground so grounding the servos this way is OK.

Power Supply Rails Not Connected Requirements (JP1 Not Installed)

Warning: Do not exceed Abs MAX input voltages when connecting the power supply or you will damage your board.

Warning: Connecting USB when you have input voltages at the high end of the range (near Abs Max) can damage the board. Disconnect battery before connecting USB or test input voltages so they are within the specified range.

Power Options	Nominal	Abs MAX	JP1 status
Power on Output PWM connector	5.00V +-0.5	6V	JP1 open
Power on Input PWM connector	5.00V +-0.25	5.5V	JP1 open

Power Module and No Servos

- If you have a power module and you are not using servos.
- Ensure JP1 is not installed.
- Provide the necessary power via the power module connected to the APM's power module connector.
- When connecting your ESCs to the OUTPUT connector clip the BEC power leads on each ESC's 3 wire connector.
  - Or connect only the ESC's signal wires to the OUTPUT connector.

Power Module and using Servos with External BEC power

- If you have a power module and an external BEC and you are using servos.
- Ensure JP1 is Not installed
- Provide APM board and receiver power via the power module connected to the power module connector.

- Connect an external BEC with sufficient power for your servos to one pair of the OUTPUT connector power pins.
- When connecting your ESCs to the OUTPUT connector clip the BEC power leads on each ESC's 3 wire connector.
  - Or connect only the ESC signal wires to the OUTPUT connector.

Power Module and using Servos with BEC power from one ESC

- If you have a power module and you are using servos Remove JP1.
- Provide APM and receiver power via the power module connected to the APM's power module connector.
- The BEC of a single ESC must provide sufficient power for all your servos.
- When connecting your ESCs to the OUTPUT connector clip the BEC power leads on all but one of the ESC's connectors.
- Or connect only the ESC signal wires to the OUTPUT connector for all except one ESC.
  - And on that ESC connect all 3 wires to the OUTPUT connector.

No Power Module and using Servos with BEC power from two ESCs

- If you do not have a power module and you are using servos remove JP1.
- Provide APM and receiver power via 1 pair of ESC-BEC power wires connected to the APM INPUT connector power pins.
- Also connect another of the ESCs power wire pair to the OUTPUT connector.
- The BEC of a single ESC must provide sufficient power for all your servos.
- Clip the signal power leads on your remaining ESC's.
- Connect all ESC signal wires to the appropriate OUTPUT connector pins.

APM Power Wiring Example

Warning: Do not exceed Abs MAX input voltages when connecting power supply or you will damage your board.

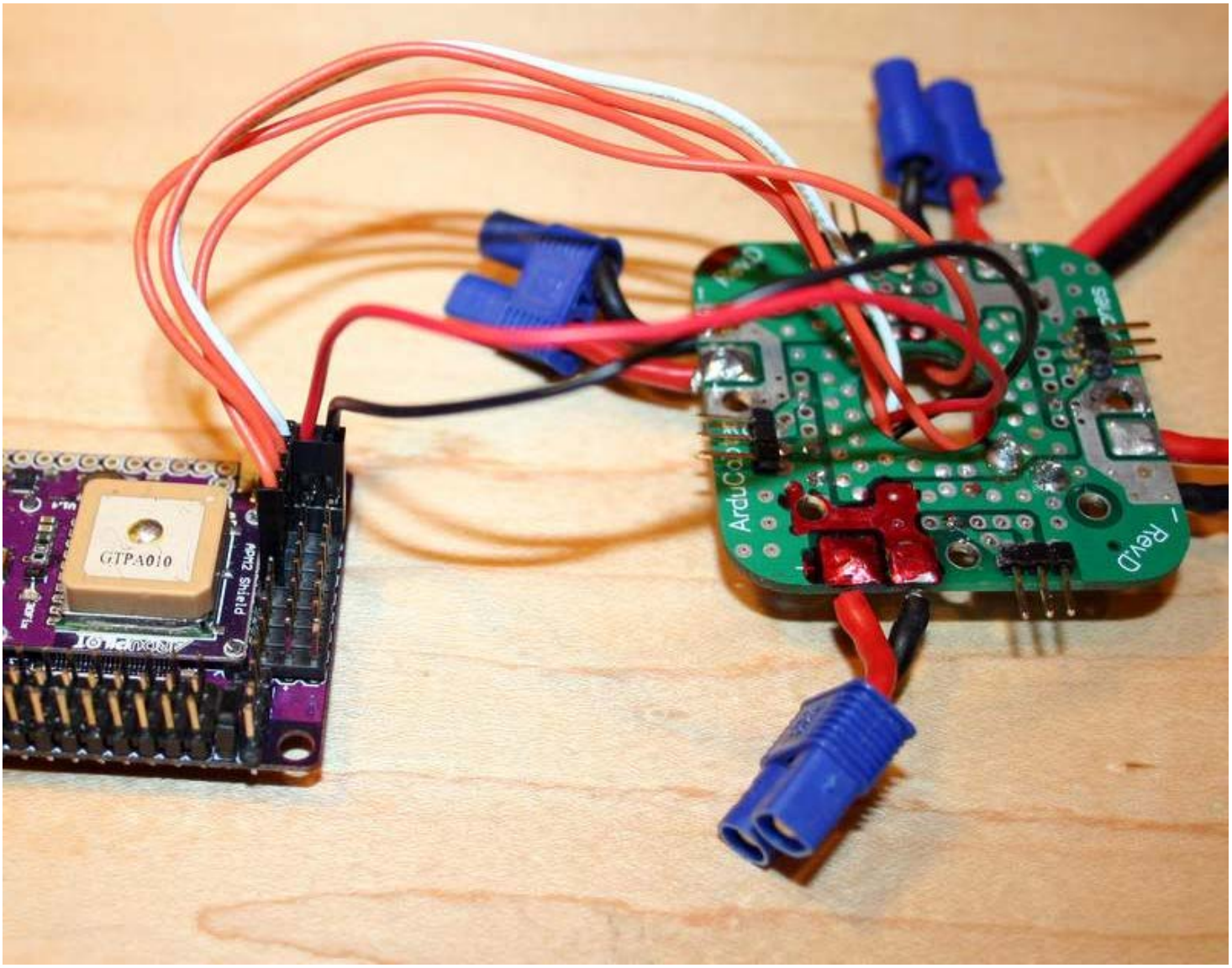
Warning: Connecting USB when you have input voltages at the high end of the range (near Abs Max) can damage the board. Disconnect battery before connecting USB or test input voltages so they are within the specified range.

On the bench, you'll probably be powering the board via your USB cable while you set it up and test it. But in your aircraft, you'll need to power it with your on board power system, which is usually your LiPo battery going through an ESC or the Power Module. In the case of a multicopter, this can come through your Power Distribution Board (PDB), which will break out the 5V output from the one of the

electronic speed controls (ESCs) or the Power module which is wored directly to the battery.

In the picture below, the red and black wires are the 5b m hV power cable coming from a PDB. You can plug them into any two pins along the 5V and Ground (middle and outer) rows of pins on APM 2.5's Output side. The other cable, which in this case is a four-wire cable with orange and white wires for a quadcopter, is the signal cable to the PDB, which are the wires that APM 2.5 will use to command each of the ESCs.

The picture below is of APM 2; but the concept is applicable to APM 2.5.



It's also possible to power APM 2.5 from two separate sources, one powering the RC system on the input side, and the other powering the output side (servos or ESCs). This is determined by a jumper on the JP1 pins (see below). If the jumper is on, which is the factory default, the board is powered from the OUTPUT rail or the USB. If the jumper is off, the board is powered from the INPUT rail, but the OUTPUT rail will need its own power source. This configuration is used if you want to have two

separate power sources in your aircraft, one powering the servos and the other powering the electronics. The ideal input voltage is 5.37v +/-0.0v and may not be provided by a typical ESC.

Warning: Do not exceed Abs MAX input voltages when connecting power supply or you will damage your board.

In some cases it may be a good idea to set the input voltage slightly above the median (but below the maximum) to account for possible voltage drops during momentary high current events.

The APM2.5 by itself draws relatively little current (200ma range) and a power source capable of providing 300 – 500ma will provide plenty of margin. However, if servos or other power consuming devices are being driven by the same power source you must consider the power requirements for those devices as well and provide plenty of margin to prevent disastrous “brown-outs”. For instance, a single digital servo can easily draw 1-5 amps depending on it’s size and performance. (Note: ESCs do not consume power from the APM) If you experience spurious resets or other odd behavior it is most likely due to noisy or insufficient power to the APM. As with all logic boards, electrical noise from the motors, servos, or other high current devices on the power source can cause unpredictable behavior.

It is recommend that a power filter be used in such conditions.

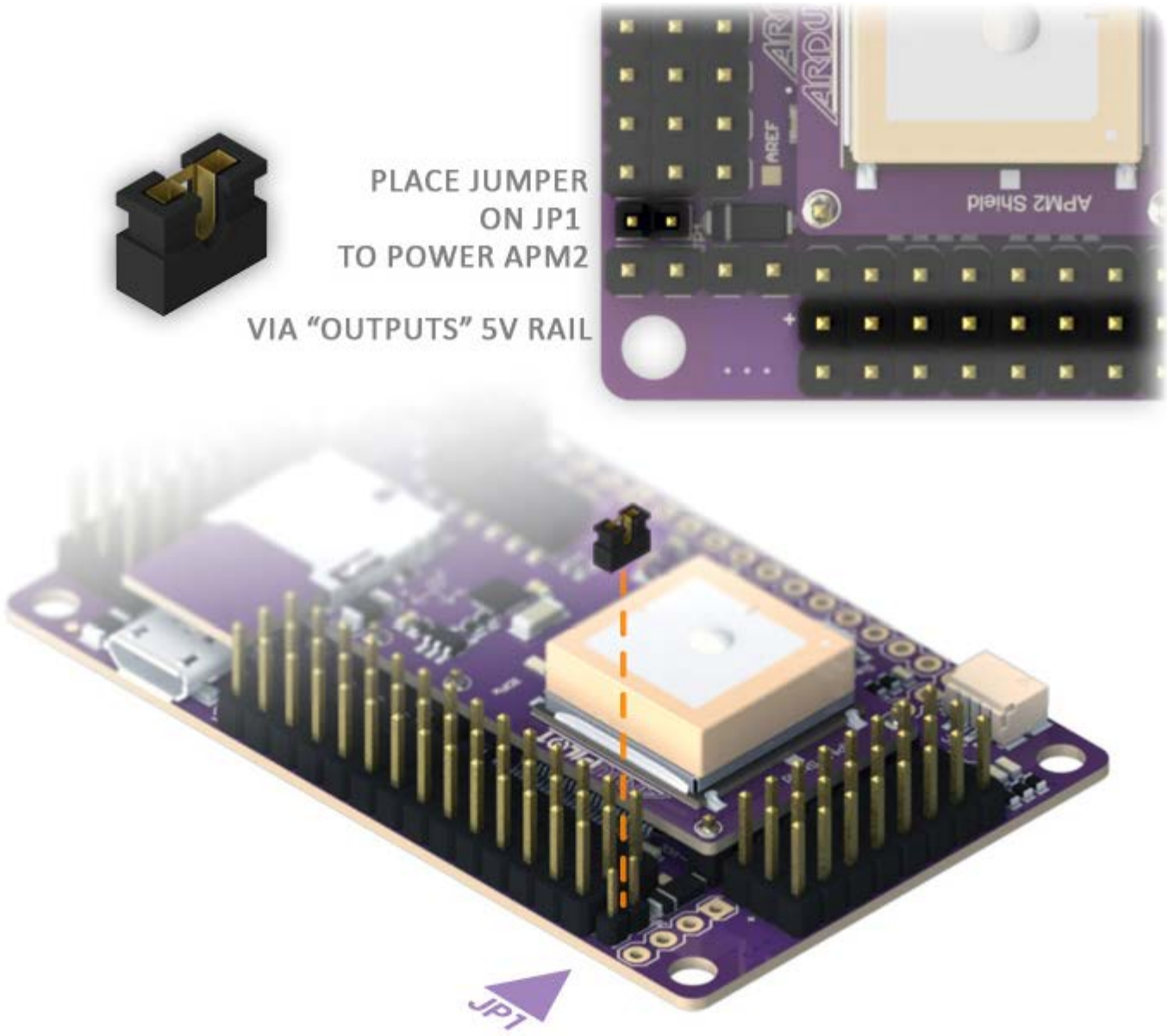
Too short or long power wires, bad or old connectors, or insufficient current capability of the APM power source can result in a “brown-out” situation resulting in unpredictable operation. This is particularly true in traditional helicopters where the collective servos can draw 3-20 amps in short bursts. The power source must be able to accommodate this without voltage droop or voltage spikes. A quality switching type BEC such as one of
these

or one of
these

can be a solution depending on overall current requirements. Many of these type of regulators are programmable so remember to program them with in the safe operating range of the APM2. Linear voltage regulators are not recommended as they are inefficient and prone to overheating and heat induced failures. APM2 should never be connected directly to a battery of any type.

Power source problems are common and can be insidious and frustrating. Be meticulous. Any autopilot or flight controller is useless and potentially dangerous without good clean power source.

The picture below is of APM 2; but the concept is applicable to APM 2.5/2.6.

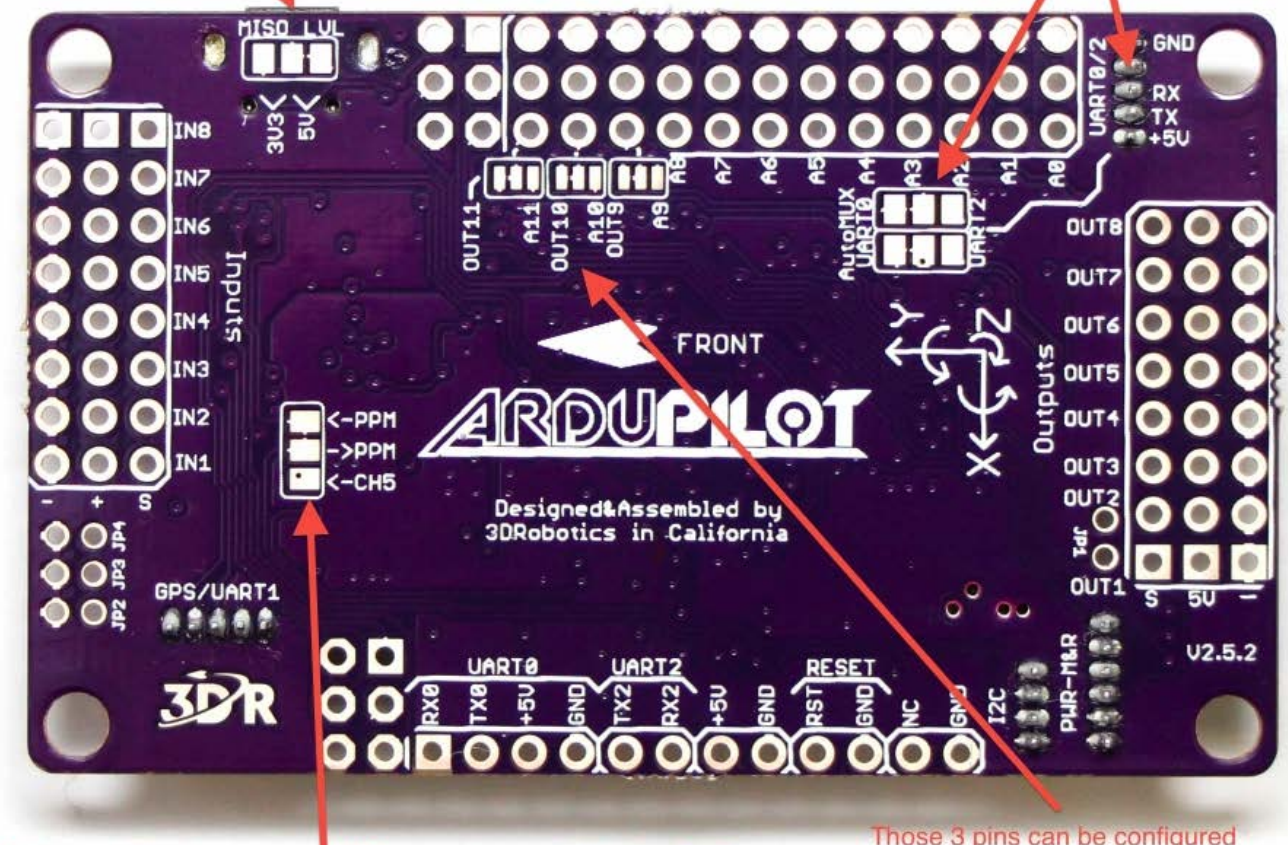


Explanation of solder jumper options on the bottom of the board

Sets the MISO (output) signal level to 3.3V or 5V
-5V is the (default mode).
-3.3V is required by some SPI devices like the optical flow

Note, both solder jumpers have to be set together in one side.
-If set to "AutoMux UART0" (default), the system will automatically route the UART0 between the "Modem port" and the "USB-to-Serial (AT32-U2)".

-When set to UART 2, the "radio modem" will be always routed to the UART2.

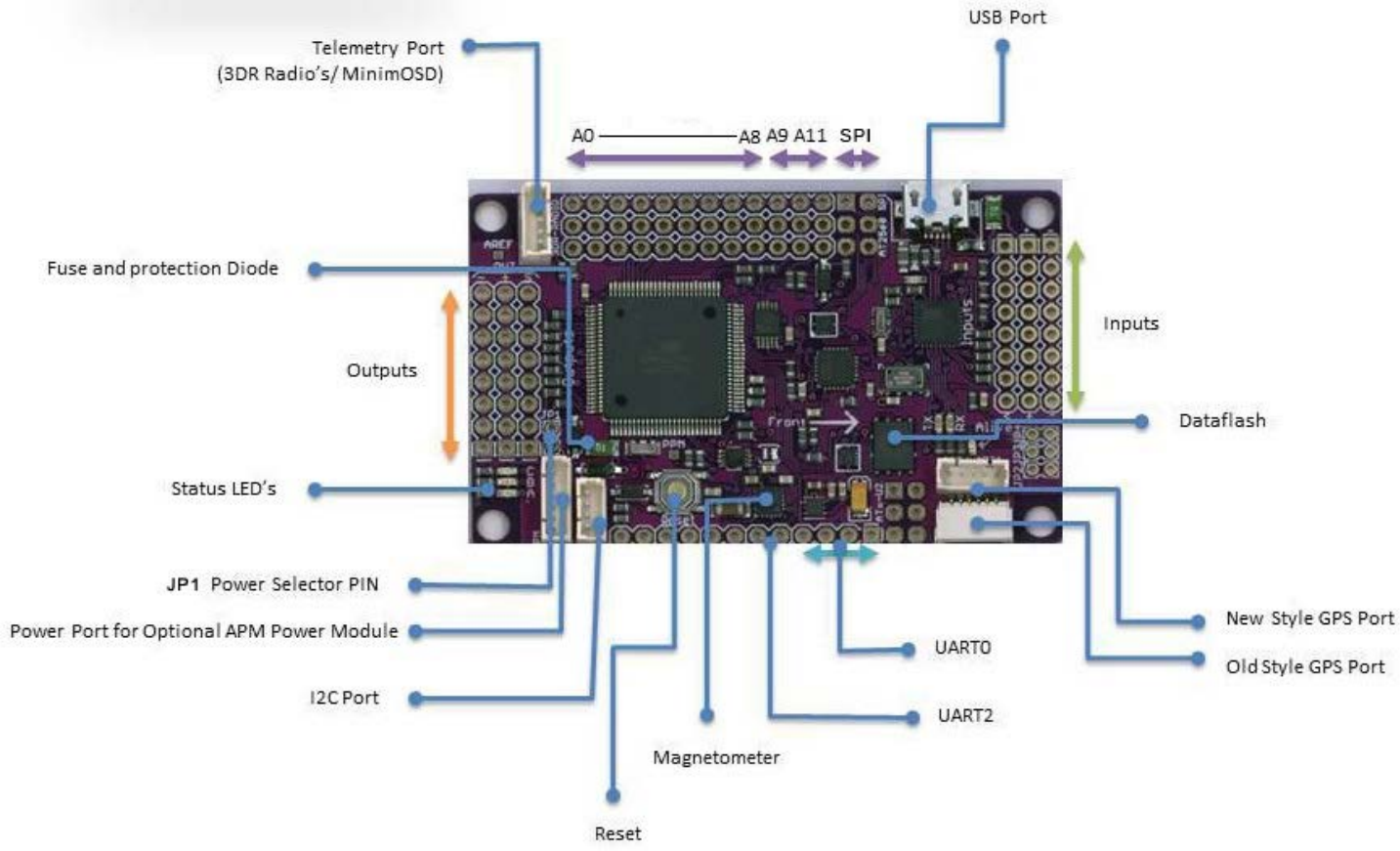


Not needed/used anymore. PPM encoder can do it internally for you. Just put a jumper on RC input 2&3 and connect your PPM to 1
-If "->PPM" and "<-PPM" are set it will route the PPM out from AT32-U2 to the PPM input of the AT2560 (Default).

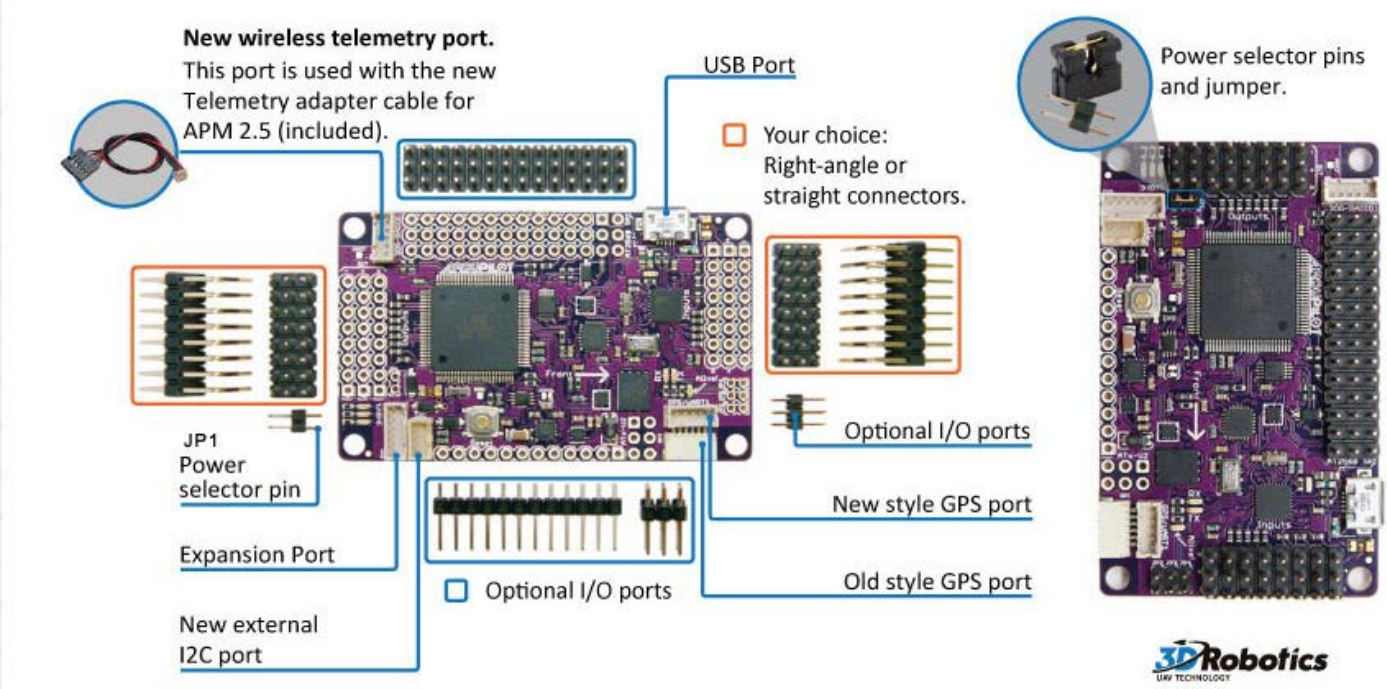
-If "->PPM" and "<-CH5" is set, the input channel 5 will be routedto the PPM input of the AT2560 (enabling you to use an external PPM signal).

Those 3 pins can be configured independently.
-If set to "OUTxx" will route the PWM output to the corresponding pin pointed by the label.
-If set to "Axx" will route the Analog input signal to the pin pointed by the label.

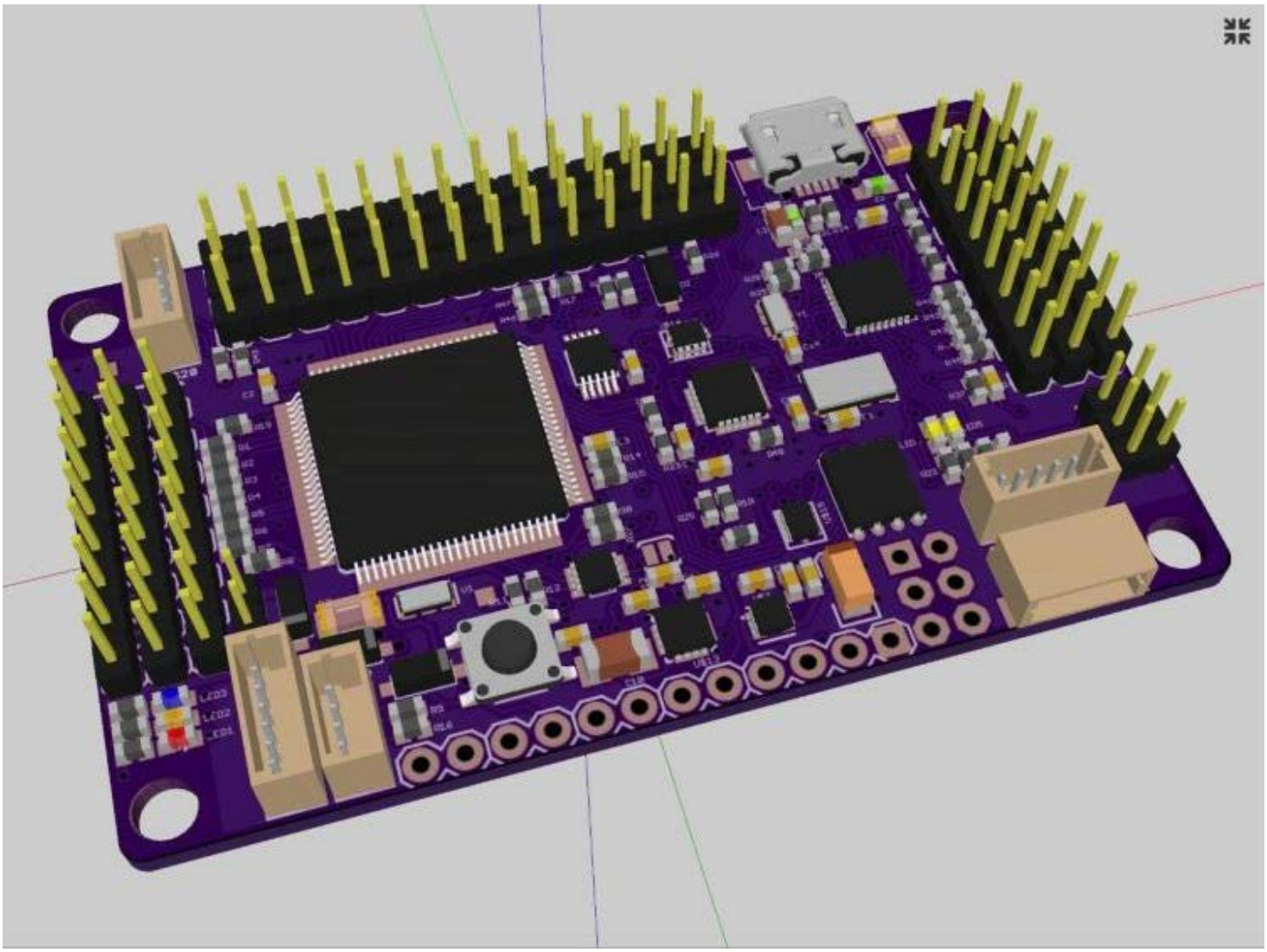
APM 2.5 Board Features



APM 2.5 Board Assembly Options



- Quadzimodo has produced a really nice editable 3D model of the APM 2.5 board in SketchUp 8: **APM 2.5 Google Sketchup File**



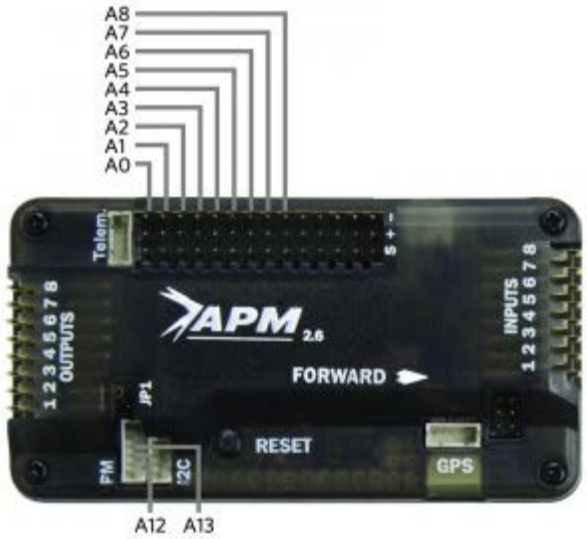
Analog input pins

Pin 0 to 8: The APM2 has a row of analog input pins down one side, labelled A0 to A8 on the underside of the board. These are available as pin numbers 0 to 8 inclusive in PIN variables.

All these pins can take up to 5V and may be used for any general analog input. They are commonly used for airspeed and sonar inputs.

Pin 12: power management connector current pin, accepts up to 5V, usually attached to 3DR power brick with 17:1 scaling

Pin 13: power management connector voltage pin, accepts up to 5V, usually attached to 3DR power brick with 10.1:1 scaling



Digital output pins

The APM2 uses the same set of 9 analog input pins as digital output pins. They are configured as digital output pins automatically when you start to use them as digital outputs.

Pin 54 to 62: You need to add 54 to the pin number to convert from an analog pin number to a digital pin number. So pin 54 is digital output pin on the A0 connector. Pin 58 is A4 etc.

These pins are usually used with the RELAY_PIN to RELAY_PIN4 parameters, allowing you to control things like camera shutter, bottle drop etc. They are also used as sonar “stop” pins allowing you to have multiple sonars and not have them interfere with each other.

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