



# AgEagle RAPID User Manual

Rev. 1.1 (8/29/2015)











# Using this Manual

## Legend



## Disclaimer

**READ THE ENTIRE USER MANUAL BEFORE FIRST FLIGHT!!**  
 Operator Assumes All Responsibility for Safe Operation

-  Never fly within 5 miles of any airport or airstrip.
-  Never fly where aerial spray planes (crop dusters) are operating.
-  Never fly over populated areas or busy roadways.
-  Never fly over or near wind turbines.
-  Never allow RAPID to fly beyond line of sight.
-  Keep children away from aircraft launcher.
-  Never stand near or to the side of rotating propeller.
-  Never leave launcher armed without the safety pin installed.

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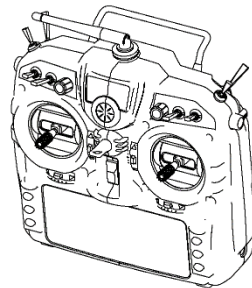
# Product Overview

## Included in the Box

**RAPID Flying Wing**



**Taranis RC Radio**



**Aircraft Launcher**



**Sony QX1 Camera**



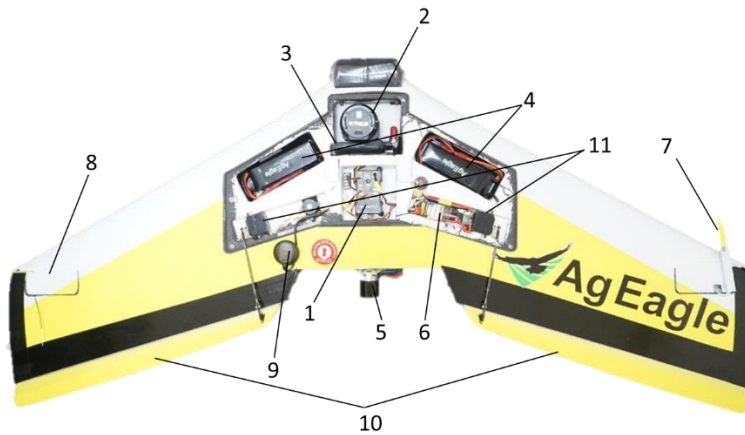
**Ground Support Equipment**

## Key Features

- Strong Carbon Fiber Reinforcement
  - Carbon fiber infused and incased airframe.
  - This provides the end user with a more rugged and durable system.
- Automatic Flight
  - There is no need for prior RC piloting experience because the RAPID system will fly itself. From launching to landing, the entire time the aircraft is in the air there is no need for pilot control inputs!
- Easy-to-Use Flight Planning
  - Simply click around the field your wish to fly and the scan pattern is automatically created. You can adjust for altitude, path width and other details quickly and easily.
  - Another simple way to create a scan pattern is to just upload your existing shape file, and the appropriate scan pattern will be automatically generated.
- In-Flight Image Processing
  - Save valuable time with the AgEagle Rapid's ability to stitch images on the fly. Within minutes, you'll have NIR/NDVI preview images so you can investigate crop conditions immediately. This speed can prove to be invaluable when adverse weather conditions and/or time crunches are on the horizon. Save time, save money.

# Aircraft

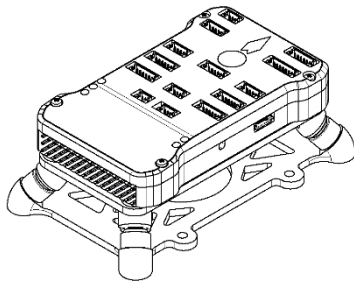
## Overview



AgEagle RAPID Components	
1	Autopilot
2	QX1 Camera
3	DroneDeploy Module
4	Li-Po Batteries
5	Motor
6	Elec. Speed Controller (ESC)
7	Airspeed Indicator (Pitot Tube)
8	RC Receiver
9	GPS Receiver
10	Elevons
11	Servos

## Hardware

### Autopilot



- Advanced autopilot system based on the PX4 open-hardware project.
- Stores flight information in “.bin” file located on removable SD card.

### Sony QX1 Camera



- Modified in house to allow infrared photos to be taken.
- Provides a stable photography platform and high quality images.

### Servos



- Actuates the control surfaces to control aircraft.
- Top quality servos to ensure reliability and longevity.

**Electronic Speed Controller (ESC)**



- Used to control how much power is sent to the motor.
- Talks to the autopilot system to accurately control propeller RPMs.

**GPS Receiver**



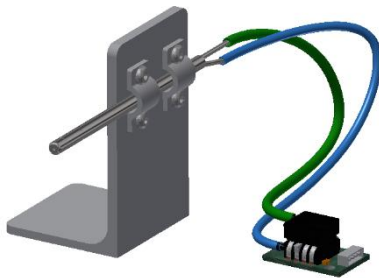
- High accuracy GPS antenna.
- Provides location based signal to the autopilot to ensure that the mission plan is being correctly followed.

**DroneDeploy Module**



- System used to talk to DroneDeploy servers through the Verizon modem.

**Airspeed Indicator**



- Provides autopilot with airspeed readings.
- Critical component for accurate autopilot tracking and flight.

**2 x Batteries**

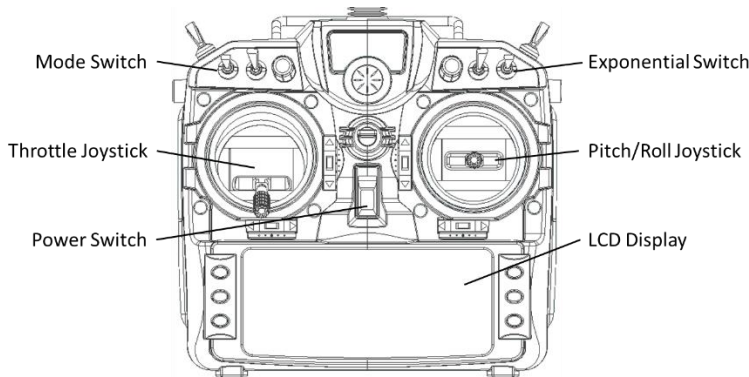


- 3300 mAh capacity
- 14.8V 25C
- Four Cell


# Handheld Flight Controller

## Overview

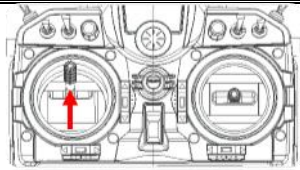
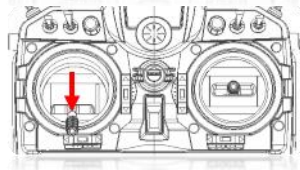
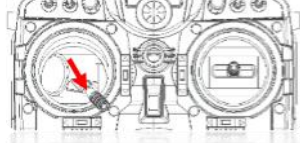
The FrSky Taranis X9D is a radio transmitter used to control the aircraft. The primary purpose is to set up the aircraft and provide a means for manual control if needed. The majority of flying is done from the autopilot and will only require active use of the radio during set-up and takeoff.



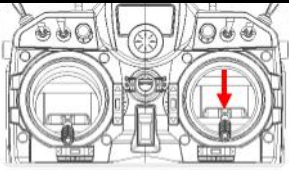
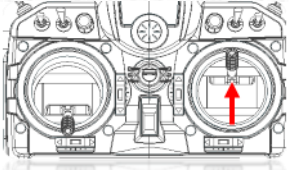

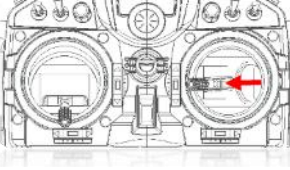
Please make note of the neutral positions of the joysticks. The throttle (left) joystick is zeroed at the lowest centered position. While the pitch/roll (right) joystick is zeroed at the center position.

 *The throttle joystick does not automatically reset the forward/backward position while the pitch/roll joystick will automatically center.*

## Controls and Operation

Left Stick Operation		
Movement Direction	Input	Aircraft Response
	Throttle 100%	Propeller Rotates
	Throttle 0%	Propeller Stops
	Fully Arming Position	Long Tone *if successful

## Right Stick Operation

Movement Direction	Input	Aircraft Response
	Pitch Up	Both Elevons Up
	Pitch Down	Both Elevons Down
	Roll Right	Right Elevon Up Left Elevon Down
	Roll Left	Right Elevon Down Left Elevon Up

Switch Operation		
Switch Position	Mode Switch	Exponential Switch
<b>Forward</b>	Manual (FBWA)	High Control Response
<b>Middle</b>	RTL	Moderate Control Response
<b>Back</b>	Auto	Mild Control Response

## Flight

### Operational Flying Conditions

- Avoid flying in adverse weather conditions including rain, sleet, snow, fog and wind conditions exceeding 30 mph.
- Only fly in open areas with no obstacles or obstructions.
- Avoid flying near large structures, large metal buildings may have an adverse effect on the onboard compass.
- Never fly over populated areas or busy roadways.
- Avoid flying close to electromagnetic producing devices (i.e. radio towers, cell towers, etc.).

### Flight Limits and No Fly Zone

RAPID operators should follow all regulations set forth by aviation regulation organizations such as the Federal Aviation Administration (FAA), International Civil Aviation Organization, Transport Canada and local aviation authorities. Please research local laws and/or regulations to ensure you are flying legally.

### Pre-flight Procedures & Checklist

- Check that launching grommets are not damaged.
- Check pitot tube for any obstructions.
- Pull servo control rods to ensure good connection to servo and elevon.
- Install winglets.
- Inspect camera lens for scratches and install if not damaged.
- Confirm that batteries are fully charged and install.
- Check that covers are properly secured.
- Turn on Taranis flight controller, place in manual mode with throttle down.
- Place aircraft on elevated, level surface and turn on.
- Open DroneDeploy on PC/Tablet and select the correct aircraft.
- Confirm GPS reception through DroneDeploy.
- Gently** blow towards pitot tube to ensure airspeed is reading correctly.
- Confirm battery voltage on DroneDeploy reads 16.8V.
- Set up DroneDeploy mission plan.
- Ensure that the landing location is clear of obstacles and loiter area is downwind.
- Write the mission plan from DroneDeploy to the aircraft.
- Arm the aircraft, then immediately disarm using the pre-arm button.
- Place aircraft on launcher (facing into the wind).
- Launch the aircraft.

## Initial Setup & Calibration

### Pre-Arming Sequences

1. Unload launcher and aim into the wind, lock the trolley into the launch position and install the safety pin.



*The amount of bungee cords needed for launch may vary depending on wind speed. On average, 6-8 should be sufficient while **higher** wind speeds may require **fewer** bungees.*



*The bungee cords may lose some strength over time due to heat and sunlight degradation.*

2. Place aircraft on an elevated, level surface. Leave the aircraft in this position until the Takeoff section is reached.



*A vehicle hood and/or pickup tailgate will work. But a small table or pedestal is recommended.*



*Do not place the aircraft on launcher at this time!*

3. Turn on the aircraft using the battery plug. This will start the calibration procedures, it's important that the aircraft is not disturbed during this process.



*Do not disturb aircraft during calibration process! Wait at least **30 seconds** before pre-arming the aircraft.*

4. Press and hold the pre-arm button until it shows a solid red light.



*When all pre-arming conditions are met, you should hear a "happy" tone from the autopilot.*

### Pre-Arming Conditions

- Barometer Calibrated
- Compass Calibrated
- GPS Lock
- INS Calibration Complete
- Parameter Checks
- Airspeed Sensor Functioning

5. Immediately after the "happy" tone is heard, move the left control stick of the flight controller to the lower right corner.



***NEVER** allow the left stick to be pushed forward during the pre-arming sequences. This can cause the propeller to start spinning unknowingly.*





*Wait until a long solid tone is emitted from the PixHawk. This will indicate that the aircraft is **FULLY ARMED**.*

6. As soon as the long solid tone is emitted press and hold the pre-arm button until it starts flashing, this will indicate that the aircraft is calibrated but disarmed.

7. Toggle the mode switch from autopilot mode to manual mode.




*Keeping the aircraft in manual mode will prevent the propeller from spinning unknowingly while moving the aircraft.*

8.  Observe the cellular data link antenna to ensure the aircraft has a data connection.
9.  Inspect the Sony QX1 camera lens and clean if necessary. Check the battery level and make sure the Wi-Fi is functioning.

## Mission Planning

*\*More details for mission planning are located in the Drone Deploy section*




10. Open the DroneDeploy website and/or application.
11. Select Agriculture → Your Aircraft ID → Camera Type → Start Planning
12. Confirm GPS reception through DroneDeploy.
13. Create flight plan and confirm that the aircraft will make its way upwind throughout the flight and for landing.
14.  Ensure that the desired landing zone is clear of any obstacles.
15. Move the “L” to the desired landing location.
16. Move the loiter circle DOWNWIND of the “L”, make sure that there are no obstacles within the loiter circle or the path from the loiter circle to the landing location.



*Always make sure that the aircraft will be flying INTO the wind when landing!*


17. Click “Prepare Flight” button.


## Sensor Calibration

18.  Inspect the pitot tube for any obstructions/mud or pinched/damaged tubing.  
 *NEVER blow into the pitot tube to clear obstructions! This can damage the sensor beyond repair and result in aircraft failure.*
19. Cup hand around the pitot tube without touching the tube itself, and click the gear next to the airspeed check.
20.  Make sure shown airspeed is fluctuating between 0-5 mph after calibration.
21. Click the “Prepare for Flight” button and observe the DroneDeploy checks.




*DO NOT fly if any DroneDeploy checks failed.*

22.  Check that the camera is connected and working properly.

 *The camera should automatically connect to the autopilot and capture a test image.*


23. Install the white covers back onto the aircraft.

 *Make sure that the mode switch is still in the manual position prior to moving the aircraft.*


## Takeoff & Flight

### Final Checks & Takeoff

24. Place the RAPID onto the launcher making sure that all four arms are properly fit into the holes in the bottom of the aircraft.

 *DO NOT allow anybody to walk in front of the armed launcher. Accidental launches can happen and may cause serious injury to anybody in front of the launcher!*

25. Approach the aircraft from behind the launcher and arm the aircraft by pressing the pre-arm button until it is illuminated solid red.

 *At this point the aircraft is fully armed and ready to fly. Treat the aircraft very carefully and DO NOT allow anybody to get close to or stand to the side of the propeller!*

26. Make sure that the elevons deflect down when armed, this will indicate that the aircraft is still in manual mode.


27. Check for proper aircraft operation using the flight controller.

27.1. Move the right stick down and observe that the elevons deflect up.


27.2. Move the right stick up and observe that the elevons deflect down.

27.3. Move the right stick left and observe that the left elevon deflects up.

27.4. Move the right stick right and observe that the right elevon deflects up.

 *Inspect the push rods to make sure nothing is loose or broken, also make sure the elevons move smoothly and don't jerk or jump around. This could indicate that a servo has become damaged.*

28. Make sure nobody is near or to the side of the propeller and announce to any bystanders "**Motor test, clear prop!**" Slowly move the left stick up to about ¼ throttle and hold for 3-4 seconds. The propeller should spin and you should feel airflow behind the aircraft.

 *Inspect the propeller and make sure that it is not loose or showing excessive vibration during this test.*

 *NEVER fly the aircraft if any component is loose, missing or damaged!*

29. Move the mode switch down to the autopilot position.



*Check that both elevons deflect UP by the same amount, about 18 degrees. This will indicate that the aircraft is ready to fly with autopilot.*

30. Remove the launcher safety pin and announce to bystanders, “**Launcher is armed!**”



*Keep the safety pin on your person after removal, do not place on the ground.*

31. Do another final check that both elevons are deflected up and that the airspeed is not exceeding 5 mph.

32. Hold the right stick of the flight controller straight back and observe that the elevons deflect up slightly higher.

33. While holding the right stick back, approach the launcher and depress the foot pedal to launch the aircraft.



*Keep the right stick back until the aircraft is airborne for at least 5 seconds.*

### **Mission Flight & Landing**

34. Keep an eye on the aircraft at all times during the flight.

35. Make sure the handheld radio is within arm’s reach at all times during flight.

36. Allow the aircraft to fly the mission and automatically land.

37. After landing use the radio to put the aircraft into manual mode.



*Putting the aircraft into manual mode will prevent the prop from spinning when locating the plane..*

### **Post-Flight**

38. Locate the aircraft and unplug the power connector.

39. Remove the propeller from the aircraft.

40. Check that all the photos were uploaded to DroneDeploy.

41. If all photos were not uploaded, power the aircraft back up to allow it to finish uploading photos.

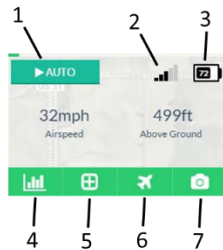
# Drone Deploy

DroneDeploy can be accessed by using a web browser or a mobile app. If a web browser is used, Google Chrome is the suggested program.



*AgEagle does not recommend using DroneDeploy's mobile application! Some important features available through a web browser are not available in the mobile app.*

## User Interface



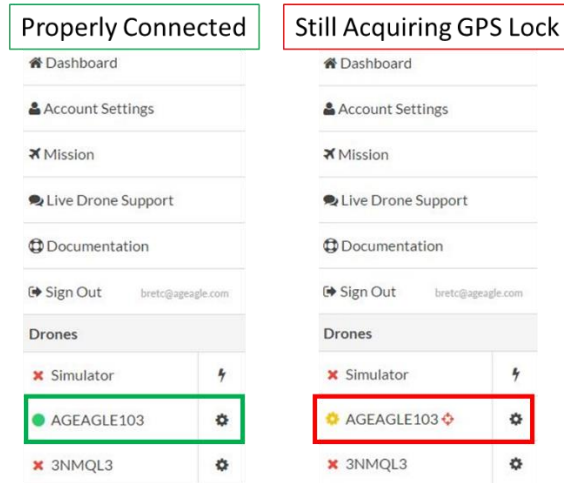
DroneDeploy UI Components	
1	Aircraft Mode (Auto, Manual, RTL)
2	Cellular Data Signal
3	Battery Life
4	Airspeed & Altitude View
5	Artificial Horizon View
6	Aircraft Data Page
7	Camera View

## Flight Planning

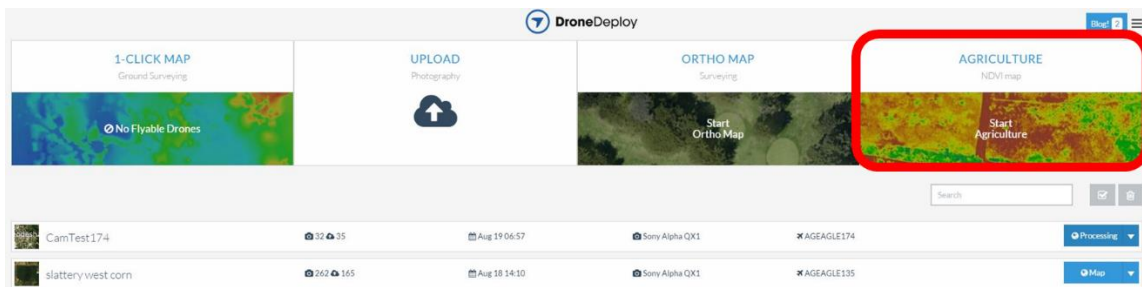
1. Log into your DroneDeploy account.



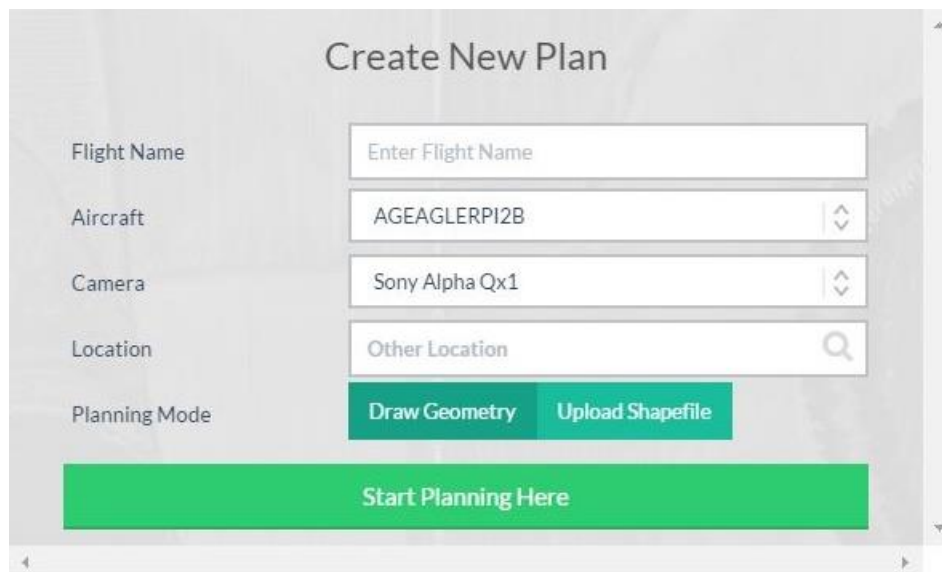
2. Make sure that your aircraft is properly connected to the DroneDeploy servers.



3. Click the “Agriculture” button to start planning your mission.



4. Name the mission and ensure that the correct aircraft is selected.



- Outline the area you are wanting to survey by adding points along the perimeter.

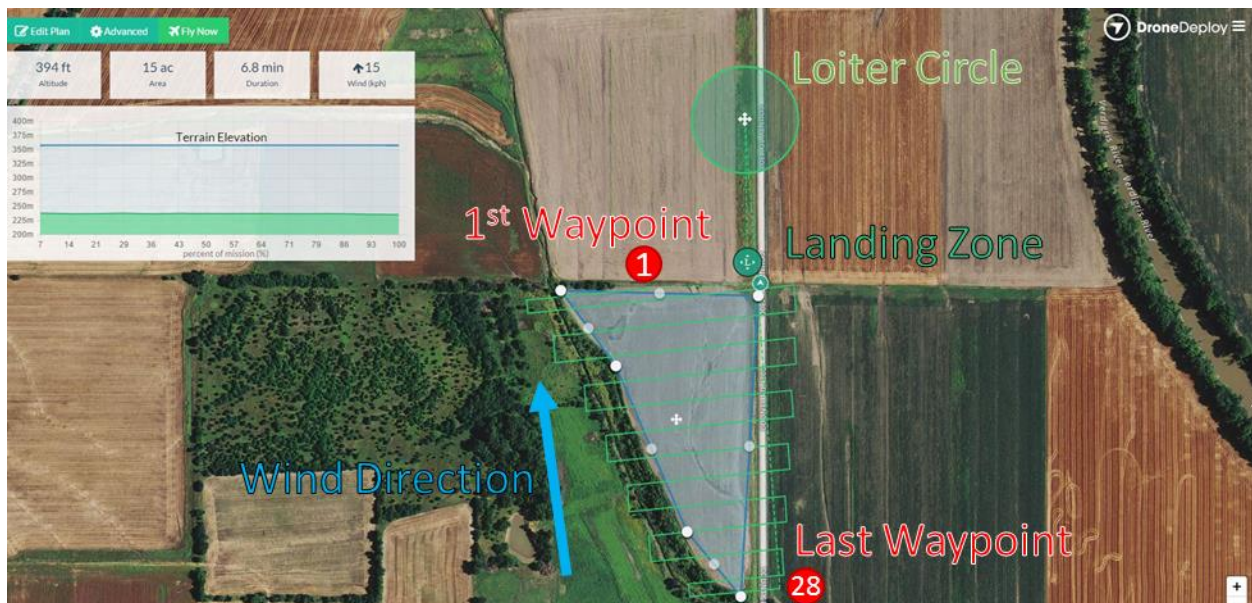


- Once the whole area is shaded, click the “Finish” button.

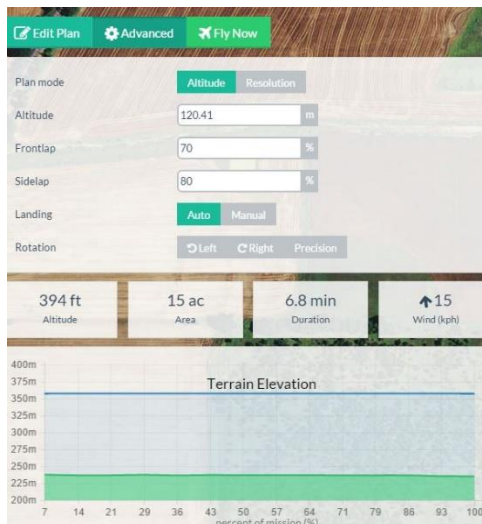


- Ensure that the aircraft will be flying into the wind while turning.


**!** Do NOT always trust the wind direction and/or speed DroneDeploy provides.



- If needed, edit the flight plan. This is done by clicking the advanced tab, bringing up the options shown below.

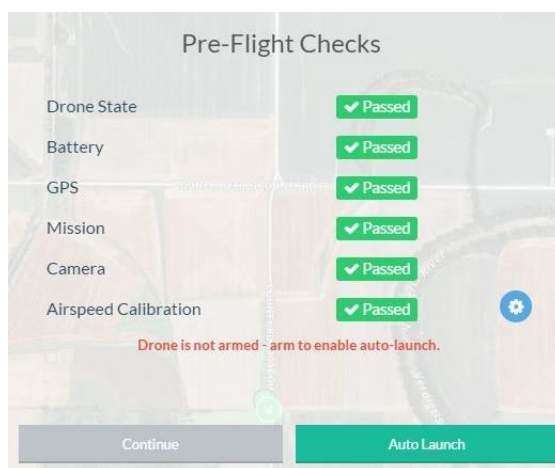


- Select a landing zone, making sure that there are no obstacles/obstructions within a 100 yard radius.
- Click and drag the loiter area to be DOWNWIND of the landing zone. This will cause the aircraft to land into the wind.
- Once the mission is complete and confirmed to be correct, click the “Fly Now” button.
- Calibrate the airspeed sensor by clicking the gear icon.

 *To calibrate, cover the pitot tube **WITHOUT** touching the tube itself. This prevents any wind from entering the tube and affecting the calibration.*



- Ensure that all the Pre-Flight Checks have passed.



14. Click the “Auto Launch” button.
15. Toggle the mode switch back a forth and put the aircraft into manual mode.



*If the aircraft is in auto mode and is moved, the propeller can spin unknowingly.*

### Mobile Hotspot Flight Planning

If you plan on flying in an area where the DroneDeploy’s Verizon network doesn’t get good service, an alternative method can be used to plan missions.



*A data connection is still required in order to use this method.*

This will allow you to use a cell phone, tablet, laptop or other device with a data connection to do mission planning. The aircraft will then upload photos to DroneDeploy when it has a good connection or this can be done post-flight.

1. Create a Wi-Fi hotspot from your mobile device with the name and password shown below.
  - Wi-Fi Name (SSID – Case Sensitive): **DroneDeploy safetynet**
  - Wi-Fi Password (Case Sensitive): **flyingrobots**



*For Apple products, the device name will need to be changed to the Wi-Fi Name in order to properly use this method. (<http://www.imore.com/change-device-iphone-ipad-overtheair-ota>)*

2. Call Manu Sharma from DroneDeploy to update plane, (386) 383-7694. (*This is a **one-time step** and will not need to be done for each flight*)
3. Make sure the camera is off.
4. Turn on Wi-Fi hotspot.
5. Make sure the drone appears online through DroneDeploy.
6. Create mission plan and start pre-flight checks. (User should be notified that the drone is connected to a hotspot)
7. Turn off the hotspot
8. Turn on the camera.
9. The camera should then trigger, this will notify the user that it is properly connected to the DroneDeploy module.
10. Fly the mission as you normally would.
11. Once the mission has completed, the aircraft can then be taken to an area where better cell reception is available to upload the data.
12. Once cell reception is established, plug the power the aircraft up to allow the DroneDeploy module to upload the data.

## FAQ

### Q. Why do I have to make sure my aircraft travels into the wind throughout the mission?

- A. If the aircraft isn't flying into the wind during turns it will overshoot the next flight path. This can cause missing images at the turns throughout the mission and could result in inaccurate maps and/or missing data on maps.

### Q. Why do I have to launch into the wind?

- A. When launching the aircraft it has to get up to flight speed in a very short amount of time. In order to make this achievable faster the aircraft must be launched into the wind to maximize airspeed. If launched with the wind, airspeed would be launch speed minus the wind speed, and most likely resulting in a failed launch.

### Q. How do I locate a downed aircraft?

- A. There are two main methods for locating an aircraft if it doesn't land where you intended.
- *Using GPS coordinates from PC/Tablet.*
    - It's important that you do not turn off the PC/Tablet in case the aircraft is damaged or has lost signal and is not able to report its location.
    - Using the last reported position from DroneDeploy and/or PC start heading towards the aircraft. Make note of the last known altitude and speed as the aircraft could glide farther from the last GPS location if still airborne.
  - *Using the Taranis Flight Controller RSS (Radio Signal Strength).*
    - The flight controller can be used as a radio beacon detector

### Q. What happens if my flight controller loses power during flight?

- A. If flying in close proximity of any obstacles we recommend that you immediately cancel the flight. Without the ability to take manual control of the aircraft it can present a dangerous situation if something should go wrong. If no risks are present, the flight can be allowed to finish on autopilot mode.
- Emergency landing from PC/Tablet.



*AgEagle does not recommend using DroneDeploy's mobile application! Some important features available through a web browser are not available in the mobile app.*

- In the upper left corner of the DroneDeploy screen click on the blue box with an arrow and AUTO next to it. This should bring up another menu and the option for Emergency Actions. Select the "Skip to Landing" option, this will cause the aircraft to abort the mission and go directly into the landing sequence.

### Q. What happens if my PC/Tablet loses power during flight?

- A. If no risks are present the flight can be allowed to finish in autopilot mode. If a problem occurs during flight, use the flight controller to put the aircraft into RTL mode. This should land the aircraft, if not, the aircraft must be landed manually.



*This is why it's important to plan flights within the aircrafts endurance (battery life). It is also important to be able to take manual control at any time during the flight.*

**Q. What do I do if I forgot to set my landing position before launching?**

- A. If the landing position is not in the correct location to land INTO the wind, you will need to add another waypoint for the aircraft to loiter. Do this by double clicking/tapping in an area clear of obstacles and enough room to land. Let the aircraft circle and when it is approaching the right direction to land into the wind, flip the mode switch into manual mode.

**Q. What happens if my camera lens gets scratched?**

- A. If your camera lens is scratched it could interfere with the imaging process and cause inaccurate mapping results. The lens should be replaced before anymore missions are flown.

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