

GAIA 160AG

Agricultural Spraying Drone

User Manual

V2.0

2020.10



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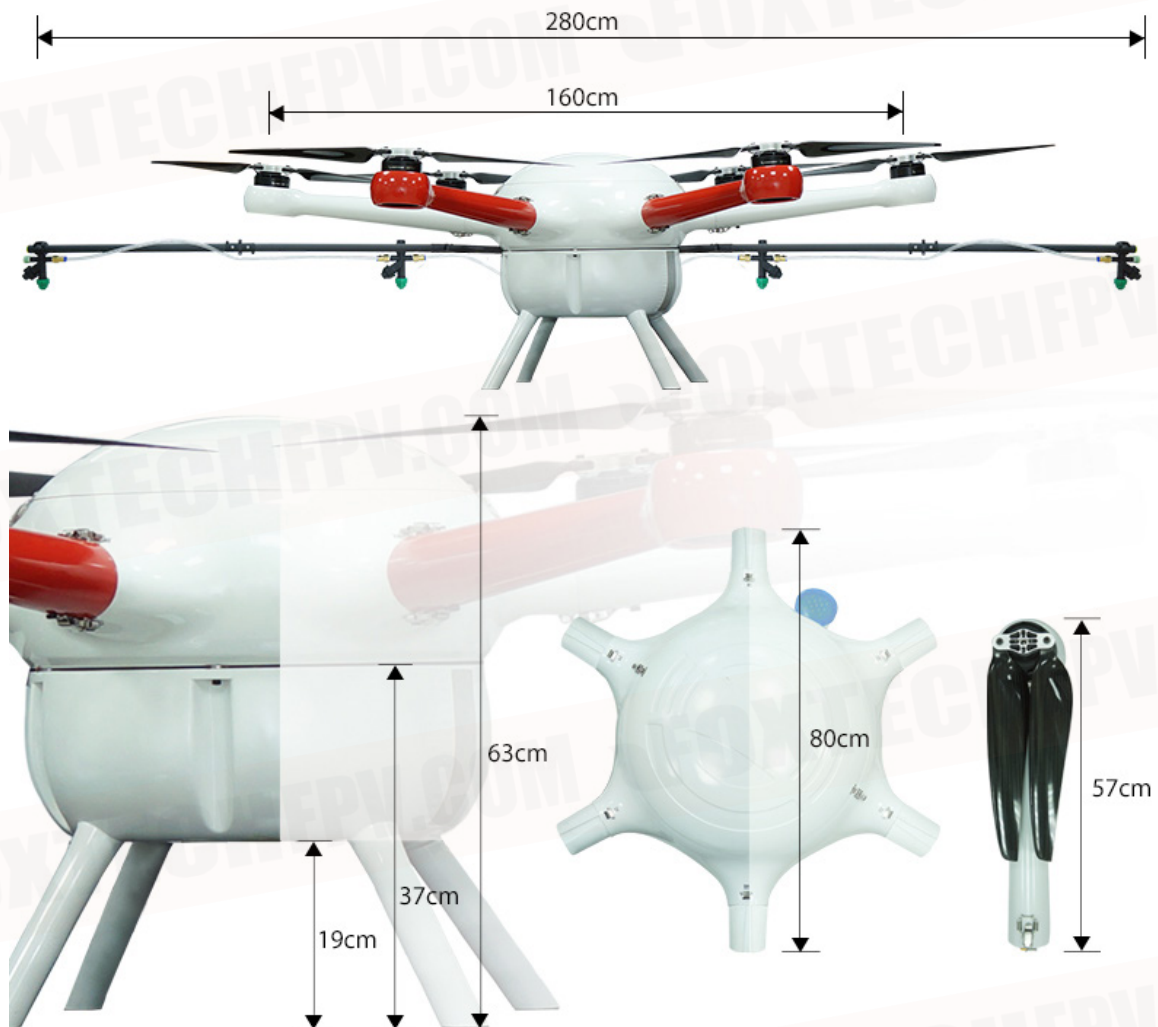
Specifications

Aircraft

Structure

Item Name	GAIA 160AG-Agricultural Spraying Drone
Material	Carbon Fiber
Shipping Dimension	1260x440x460mm
Shipping Weight	35kg
Wheelbase	1600mm
Max. Take-off Weight	46.5kg
No-load Weight	24kg
Load Pesticides	22.5L
Flying-time	18min(4x 6s 16000mah)
The Altitude of Spraying	1-5m
Spraying Swath	>5m
Spraying speed	2-6m/s
Operation Efficiency	10ha/h(max)
Suggested Battery	Foxttech 6s 16000mah x4
Flight Controller	PALADIN Flight Controller
Remote Controller	DA16S+

Dimension



Basic Theory

GAIA 160AG agriculture spraying drone is a high performance aircraft capable of offering comprehensive solutions for agricultural care. GAIA 160AG is made of carbon fiber material which features light weight and high strength, the top cover of the fuselage and the tank are made of glass fiber. The frame weight is about 7.25kg. The arm of GAIA160 series hexacopter is pluggable, both the cover and arms can be locked with the quick locking hooks.

The big fuselage of GAIA 160AG makes it possible to install many equipments eg. battery, Gps, flight control system. And all the wires are built into the fuselage. The closed fuselage structure can protect the GAIA 160AG hexacopter from the rain and dust, and also protect other load equipments.

This GAIA 160AG is equipped with a 2.8 meter long tube with four nozzles. The new water-saving nozzles could save the pesticide and improve the efficiency of spraying at the same time. This GAIA 160AG has a grid pesticide container which can prevent the liquids sloshing in the flight. The capacity of pesticide tank is 22.5L, so do not need to add pesticide frequently. The propeller vortex can help the GAIA 160AG evenly spraying the pesticide on the front and back of the plant leaves.

The GAIA 160AG is equipped with powerful motor and high efficiency 30 inch folding propeller, the max lift of one rotor can reach 13kg. The total thrust is over 70kg. The GAIA 160AG supports both manual and automatic flight, it can achieve automatic spraying by the planned flight paths. The motor and ESC use the water-resistant design, and can be applied in different weather conditions. Because of the large liquids load the efficiency of GAIA 160AG is twice as much as other aircraft with 10L payload.

Equipped with PALADIN flight controller set, GAIA 160AG can take off and land easily with one button. Adopting reliable algorithm, PALADIN flight controller ensures stable flight attitude of the drone. The microwave radar module can provide high-precision altitude information, so that GAIA 160AG will fly above the crops at a constant spraying distance to ensure uniformity of the pesticide spraying. GAIA 160AG is able to spray precisely by using flowmeter. The radio controller is DA16S+ with datalink and radiolink built inside, reaching up to 8km transmission distance. All these make pesticide spraying work more efficiently and safely.

Version Upgrade: The legs of GAIA 160AG are lengthened to provide more space for installation of various spraying equipment.

Flight Operation

Operation Environment

1. DO NOT use the aircraft in adverse weather conditions, such as heavy rain, high winds, fog, snow, lightning, tornadoes, or hurricanes.
2. Only fly in open areas. Tall buildings and steel structures may affect the search for satellite signals.
3. Maintain line of sight of the aircraft at all times, and avoid flying near obstacles, crowds, animals, trees, and bodies of water.
4. Avoid flying in areas with high levels of electromagnetism, including mobile phone base stations and radio transmission towers.
5. DO NOT operate the aircraft indoors.

Pre-Flight Checklist

1. Ensure that all parts are mounted correctly and firmly.
2. Ensure that the ESCs and receiver are connected correctly and firmly.
3. Ensure that the spraying hoses are without any blockage.
4. Test if the nozzles work normally.

Compass Calibration

Ensure the compass is calibrated before every flight. Failure to calibrate may lead to poor flight performance or a crash.

1. DO NOT attempt to calibrate your compass where there is a chance of strong magnetic interference. This includes areas where there are massive metal objects, parking structures, steel reinforcements underground, or under bridges.
2. DO NOT carry ferromagnetic materials with you during calibration, such as keys or mobile phones.
3. The compass should always be calibrated when moving from indoor spaces to outdoor spaces.
4. After successful calibration, the compass may become abnormal when you place the aircraft on the ground. This may be because of underground magnetic interference. Move the aircraft to another location and try again.

Calibration Procedures

Choose an open space to carry out the following procedures.

1. Hold and rotate the aircraft horizontally 360 degrees, as shown below:

Note: During the rotation, try to keep the drone as stable as possible.



2. Hold the aircraft vertically with nose pointing downward, and rotate it 360 degrees around the center axis, as shown below:



Flow Calibration

When spraying for the first time, be sure to perform flow calibration, otherwise it will seriously affect the operation. Always use the measuring cup in the package for water injection to ensure accuracy. The entire calibration process takes approximately 6 - 14 minutes, please be patient.

1. Preparation before calibration: Exclude pipe air (if it is excluded, flow calibration can be performed directly)

(1) Add approximately 2 L of water to the work box.


(2) Turn on the remote control and connect the aircraft to the power source.

(3) Open the four pressure relief valves, short press the remote control spray button to turn on the spray until the air in the pipe is exhausted*, then close the pressure relief valve and stop spraying.

* If the air cannot be removed for a long time, completely unscrew the pressure relief valve cover to remove it, and drain the air before replacing the cover.

2. Flow calibration

(1) level gauge calibration

Add approximately 1 L of water to the pesticide tank. Go to the App's job interface, click $\dots >$  and click the "Calibrate" button on the right side of the flow.

In the pop-up menu, select "Nozzle Model" (recommended to use the nozzles listed in the menu, otherwise the calibration may be biased), then click "Start Calibration", the aircraft will automatically spray until the App prompt to enter the liquid pump L calibration.

(2) liquid pump L calibration



Accurately measure 1 - 5 L of water using a measuring cup and add it to the pesticide tank.

Enter the amount of water in the pesticide tank on the App. It is important to ensure that the actual amount of water is the same as the input value, otherwise the calibration will be biased. Click "Start Calibration" and the aircraft will automatically spray to the App to enter the liquid pump R calibration.



(3) liquid pump R calibration

Same as the liquid pump L calibration procedure. App prompt Pump R calibration is complete, wait for a while until the App prompts "Flow Calibration Complete" and the entire calibration process is complete.

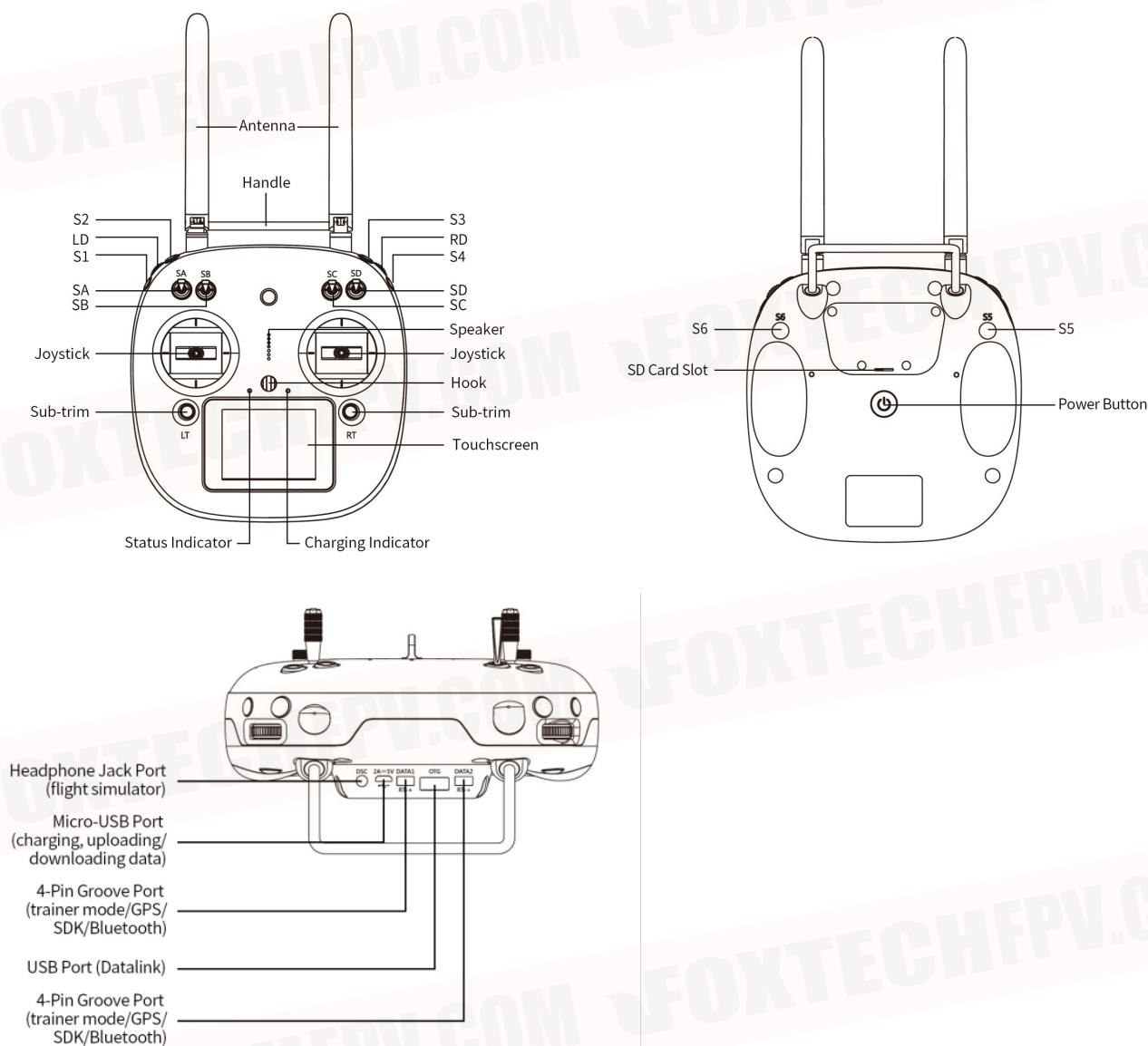
3. Perform the steps to remove the duct air again and then start the normal spray operation.

During the calibration process, click  >  to cancel the calibration. The flow accuracy is the data before this calibration.

Need to recalibrate

1. Replace the nozzles of different models. Note: After replacing the nozzle, you need to select the corresponding nozzle in the App option. Enter the operation interface, click  >  to select the nozzle model.
2. Replace the liquid with different consistency.
3. After the first task is completed, the error between the actual working area and the theoretical working area is more than 15%.

Remote Controller



2. Button/Switch Types

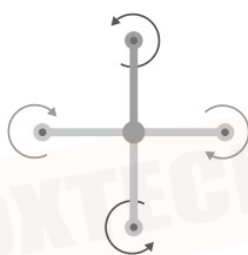
Name	Type
SA	3 Positions; Alternate; Short Lever
SB	3 Positions; Alternate; Long Lever
SC	3 Positions; Alternate; Long Lever
SD	3 Positions; Alternate; Short Lever
LD	Self-centering Dial
RD	Self-centering Dial

Name	Type
S1	Self-return Button
S2	Self-locking Button
S3	Self-locking Button
S4	Self-return Button
S5	Self-return Button
S6	Self-return Button

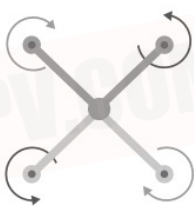
Installation

- 1.Ensure all parts are in good condition.
- 2.Mount the parts to your airframe and connect them properly.
- 3.Launch the Boying Mobile Ground Station and configure the parameters.
- 4.Ensure the motor, remote controller channels and Failsafe settings are correct.
- 5.Ensure the devices connected to the flight controller are working normally and correctly set in Boying Mobile Ground Station.

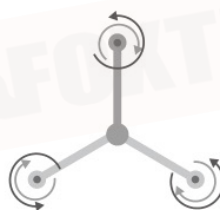
Remember to select the corresponding airframe type in Boying Mobile Ground Station after assembling the airframe and connecting the cables.



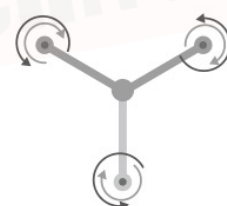
I4



X4



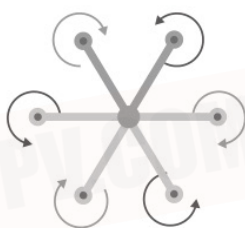
IY6



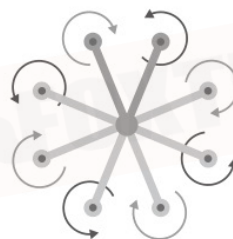
Y6



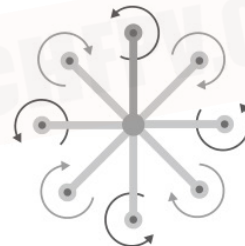
I6



V6



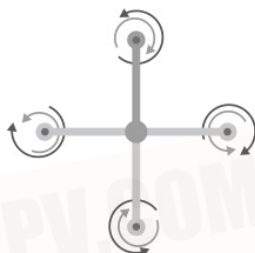
V8



I8



X8










IX8



- The arrow directions in the above diagram indicate the rotation direction of the motor/ propeller. Dark colored arm (s) indicate the direction of the aircraft's nose.
- For coaxial propellers, dark colored propellers are at the top and gray colored propellers are at the bottom. Otherwise, all propellers are at the top.

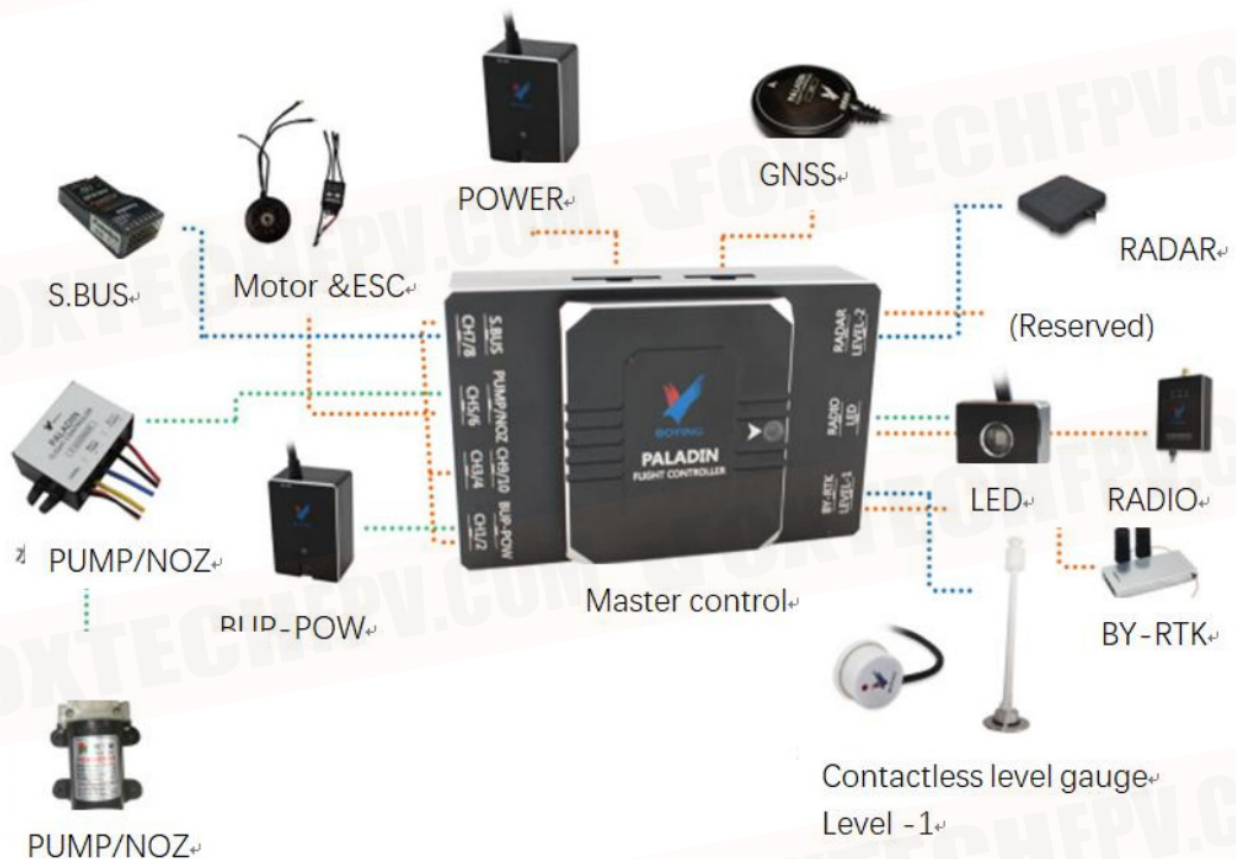
PALADIN Flight Controller Set

System Supporting List

	Master control
	High-precision and high-sensitivity GPS with positioning and orientation module using external compass
	Power conversion and monitoring module, allowing 6S~12S
	Flight indicator
	Ultrasonic sensor, which is used for imitate-terrain flight and fixing height at low attitude
	Level sensor, which is suitable for agriculture and plant protection unmanned aerial vehicle users
	Flowmeter for precision spraying

Flight Controller System Connection Diagram

This is the schematic of flight controller and peripheral equipment during installation you must pay attention to the direction of interface and install the interface firmly to avoid virtual connection. Diagram 2.2 is the schematic.



Power System Description

Power supply range of Version 2 flight controller power module: DC 24V(6S)~50V(12S);

Power supply range of RTK base station: DC 24V (6S)~50V(12S)

Power supply range of RTK board: DC 12V (3S)~50V(12S)

Power supply range of water pump module: Input DC 24V (6S), Output DC 12V

Interface Definition

The panel layout of Paladin interface is as the picture shows.



Interface definition picture on the front panel

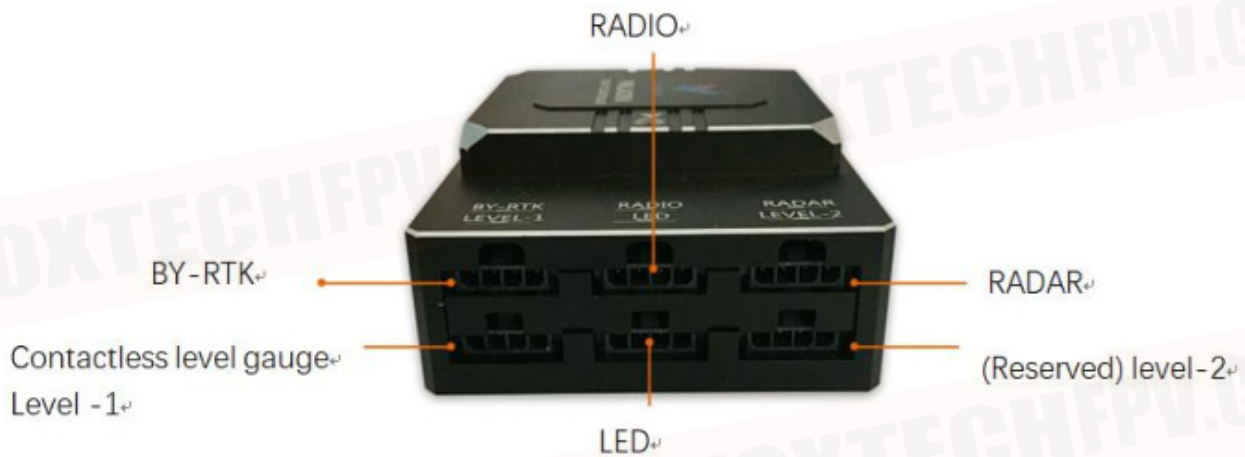


Chart 2.1 interface board description

Name	Use Instructions	Remarks
BY-RTK	Difference airborne terminal.	
LEVEL1	Contactless level gauge.	It should be pasted at the bottom of medicine box with free nail glue.
LEVEL2	Reserved	
RADAR	Radar	There should be nothing blocked in the range of 15 below the radar, and it needs to be far away from the satellite navigation module.
RADIO	Data transmission radio	It needs to be far away from the satellite navigation module.
LED	External indicator.	If the external indicator is accessed, indicators on motherboard of the flight controller won't work.
POWER	Power interface.	Input: 6S~12S, Output: DC 5V

Interface definition picture on the back panel.



Interface name	Use instructions	Remarks
S.BUS	Receiver interface.	
CH1~CH8	Output Port of motor signal.	CH1~CH8 correspond to NO.1~8 motor. The signal line splits into two, the shorter part links motors with odd numbers and the longer part links motors with even numbers.
PUMP/NOZ	Pump/Centrifugal nozzle signal port.	The longer wire links the pump and the shorter links the centrifugal nozzle.
BUP-POW	Backup power	

Status Indicator Description

Here is Paladin's status indicator,



Number	Status of RGB	Malfunction status	Instructions
1	Light is not on.		Line fault or light fault
2	Lights of all colors are always on, and it cannot connect with the ground station.	It's crashed.	
3	The red light and the white light flash alternately.	The flight controller is initializing.	
4	The red light, the yellow light, the blue light and the green light flash alternately. (in low brightness)	The equipment is not calibrated.	Remote control, compass and accelerometer.
5	The red light, the blue light and the green light flash alternately.	The equipment is being calibrated or tested.	Motor test or ESC test
6	Only the yellow light flashes once.	Remote control failure.	
7	Only the yellow light flashes twice.	Low power.	
8	Only the fuchsia light flashes once.	Magnetic compass failure.	
9	Only the fuchsia light flashes twice.	Accelerometer failure.	
10	The fuchsia light flashes quickly.	Other failure before unlocking.	The gyro is not working properly.
11	The red light is always on.	The log storage device failure.	
12	The red light and the yellow light flash alternately.	GPS failure.	
13	Only the blue light flashes once.	Cannot find GPS and being locked.	If the blue light is on, it means that there is no problem with the equipment.
14	The blue light is always on.	Cannot find GPS and being unlocked.	
15	Only the green light flashes once.	Can find GPS and being locked.	If the green light is on, it means that there is no problem with the equipment.
16	The green light is always on.	Can find GPS, and being unlocked.	
17	The green light flashes quickly.	GPS is working with high precision.	



- Paladin has three kinds of working status: one is the normal status, one is the calibration status and the other is the protect status. Among them, the calibration status and the protect status mean that the equipment is not working properly, you must pay attention to it!

Ground Station Setting

Installation

Operating environment: WIN2000, WINXP, WIN Vista, WIN7, WIN8, WIN10

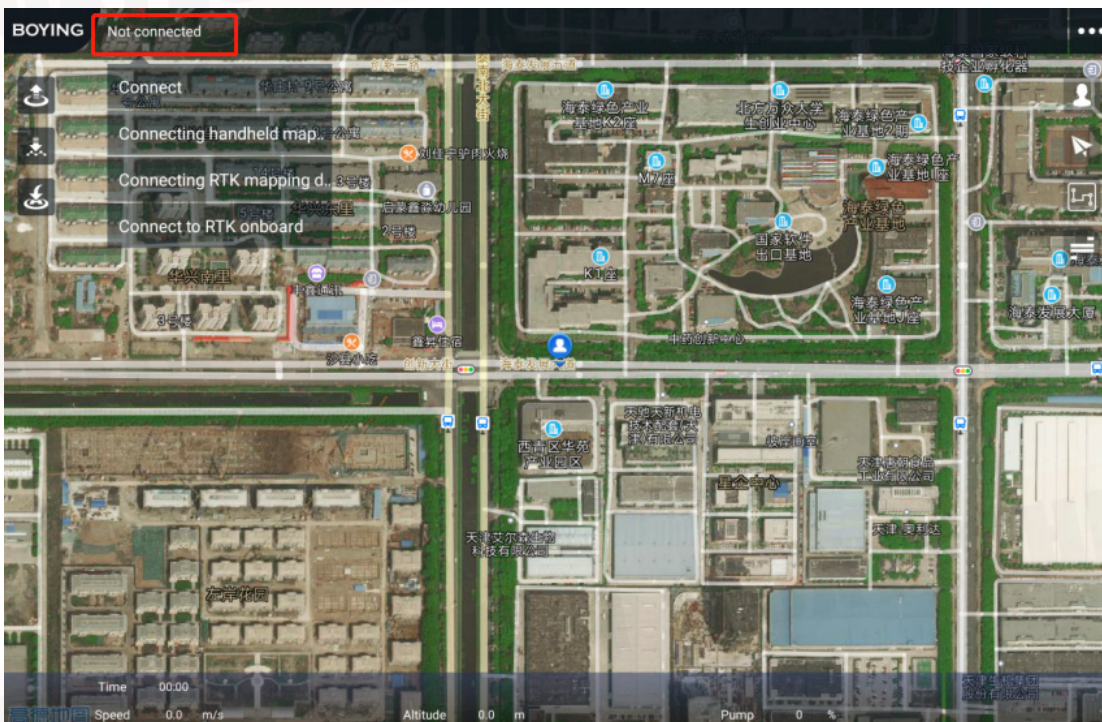
First, if you want to install it in Win10 system, it needs digital certificate authentication; the specific operation is as follows:

- 1) Click "settings" "update and safety"
- 2) Click "recover" -> "advanced startup" -> "restart immediately"
- 3) After restart, click "troubleshooting" -> "advanced options" -> "startup settings" -> "restart" follow the prompts to enter 7 to forbid drivers to force signatures Then, install the ground station software:
 - 1) Click "ByAero.exe"
 - 2) Choose the installation path
 - 3) Follow the prompts
 - 4) Finish

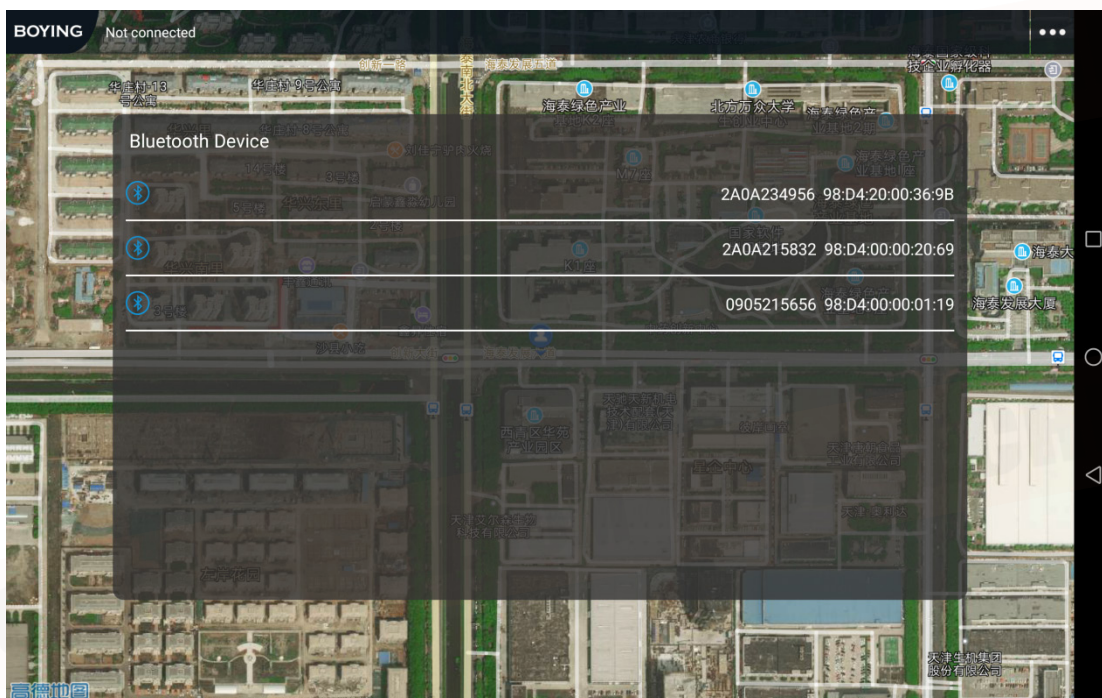
Finally, if you need to connect the flight control to the ground station using USB cable, please make sure that you have chosen the right driver, as shown below:

Equipment Connection

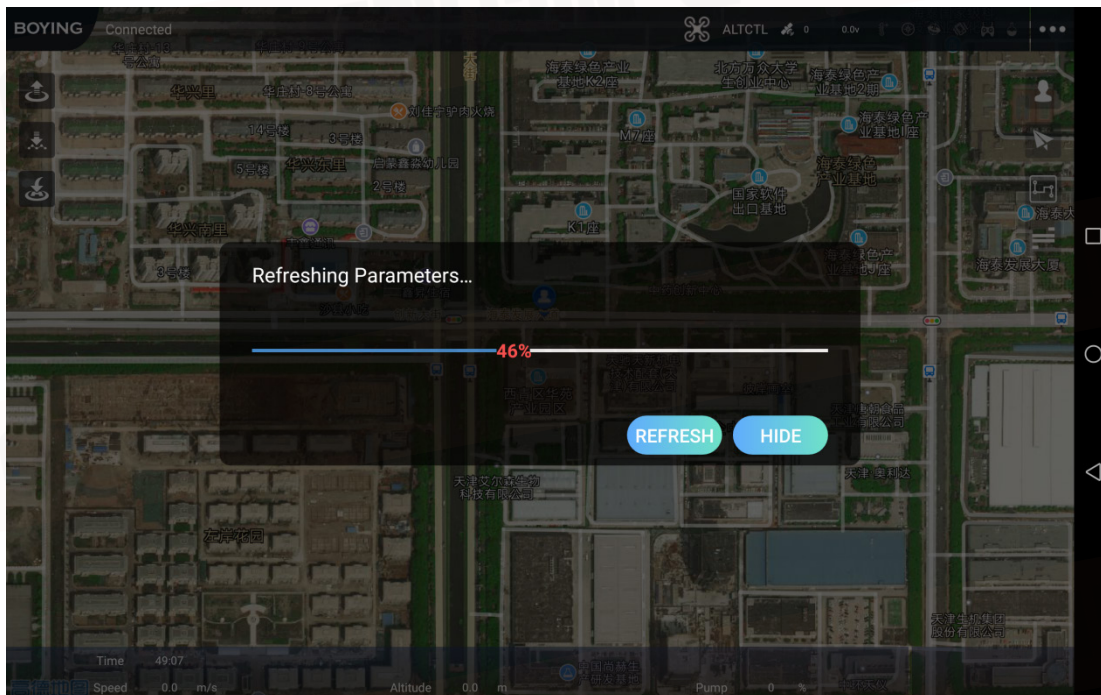
1. Click "Not connected" will pop up the following dialog box, select "Connect" to connect the drone, "Connect handheld mapping device" to connect the handheld mapping device, "Connect RTK mapping device" to connect RTK mapping device, "Connect RTK onboard" to connect RTK air unit.



2. Select the corresponding address based on the paired Bluetooth device.

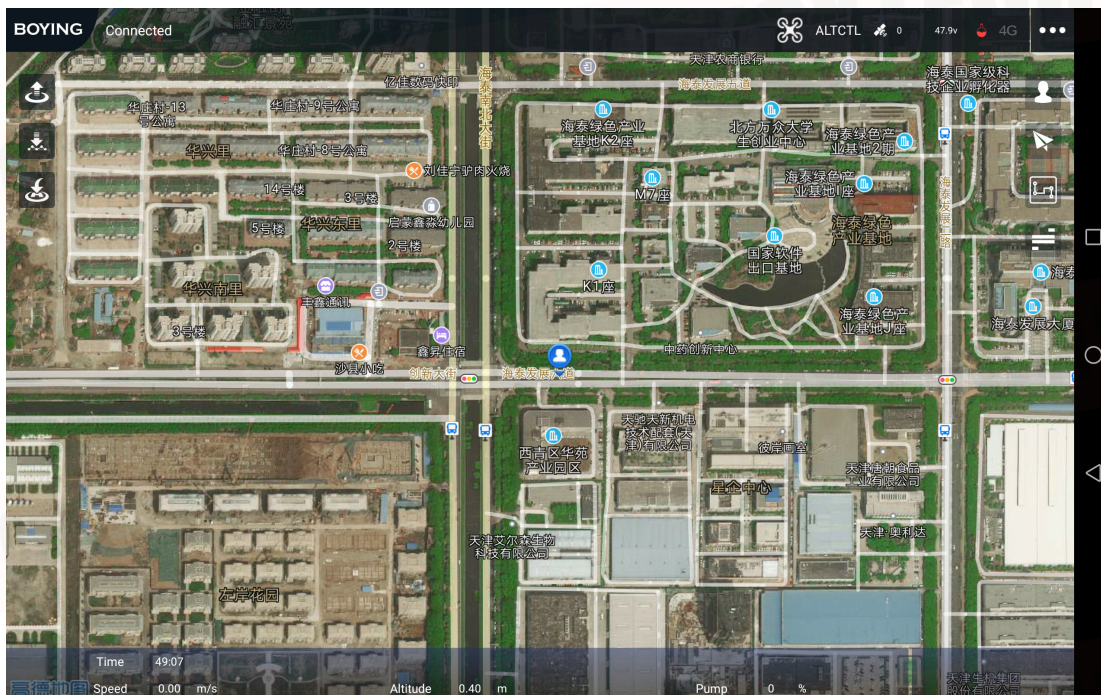


3. Waiting for the drone to be connected (voice prompt).

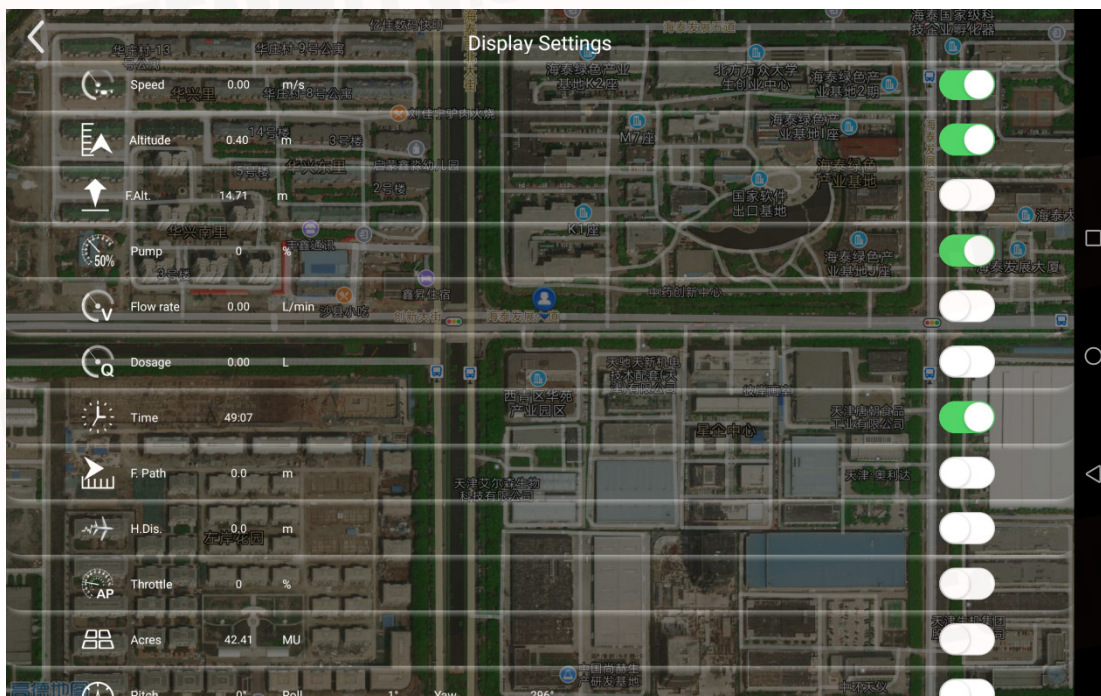


Function Introduction

1. Main interface function.

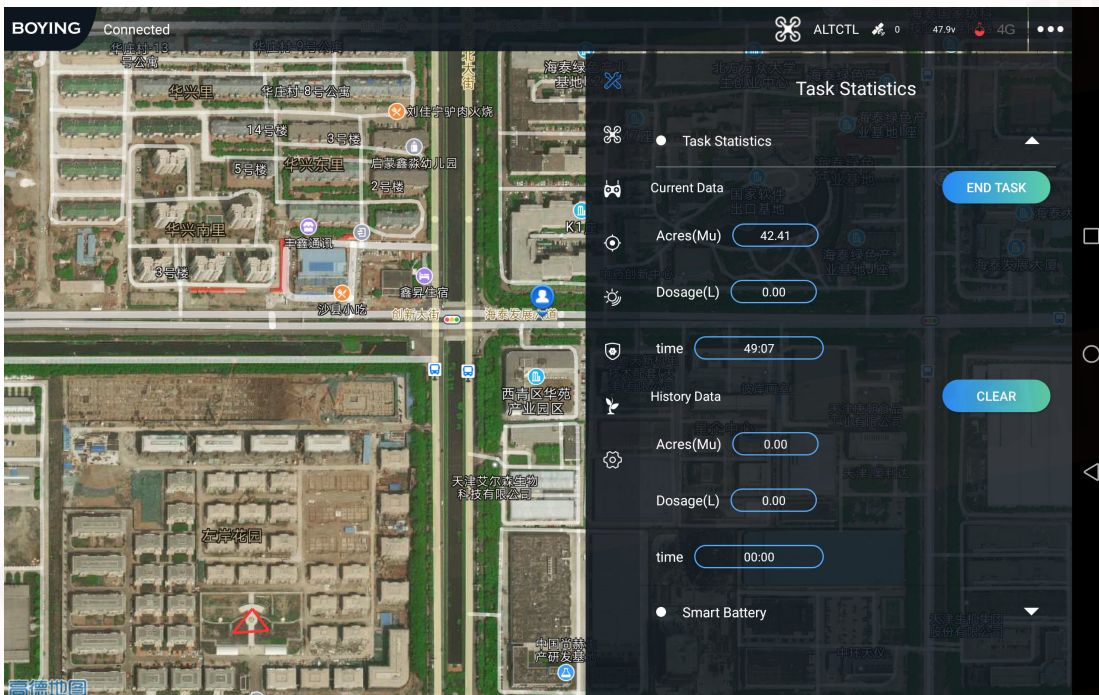


2. Click "Display Settings", the user can select the parameter item you need (up to 6 items).



Click "Setting", then will pop up the dialog box.

Task Statistics: the cumulative number of working acres(Mu) ,Dosage (L) and time.



Frame Type Setting Select the drone type (it has been set at the factory, please do not change it

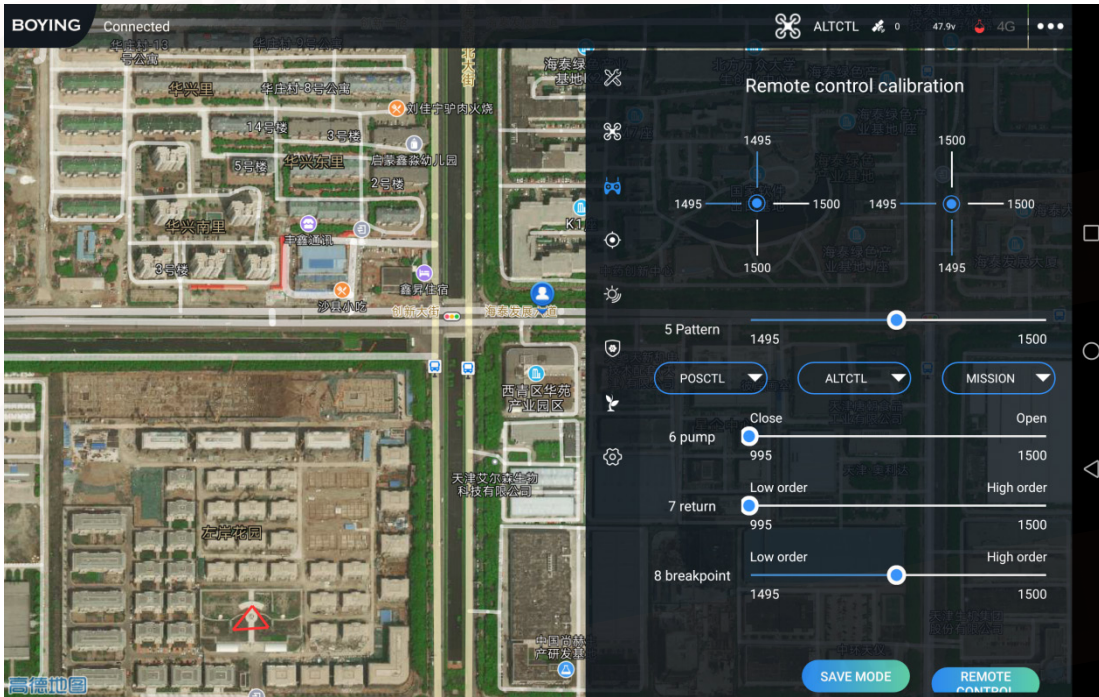
Motor test: Input duration (recommended 3s-5s), throttle (recommended 10%-15%), then according to the diagram, check whether the propellers of the multi-rotor motors are normal (please test away from the crowd to prevent accidents).



Remote Control Calibration

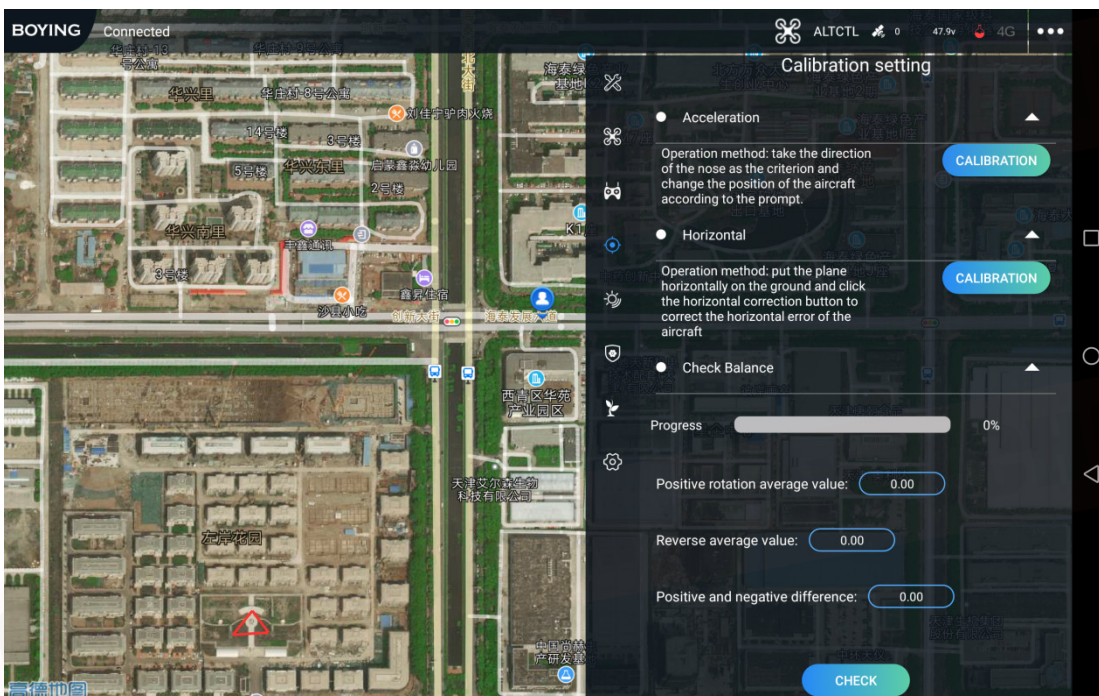
Check if the remote control joystick is in the position shown below, check the status of each channel in turn (do not check multiple channels at the same time). If the position of the remote control joystick develop offsets, please click the “remote control” button, then successively dial the channels of the remote control in the maximum to the minimum range.

Please click” SAVE MODE” after modifying the fifth channel mode.

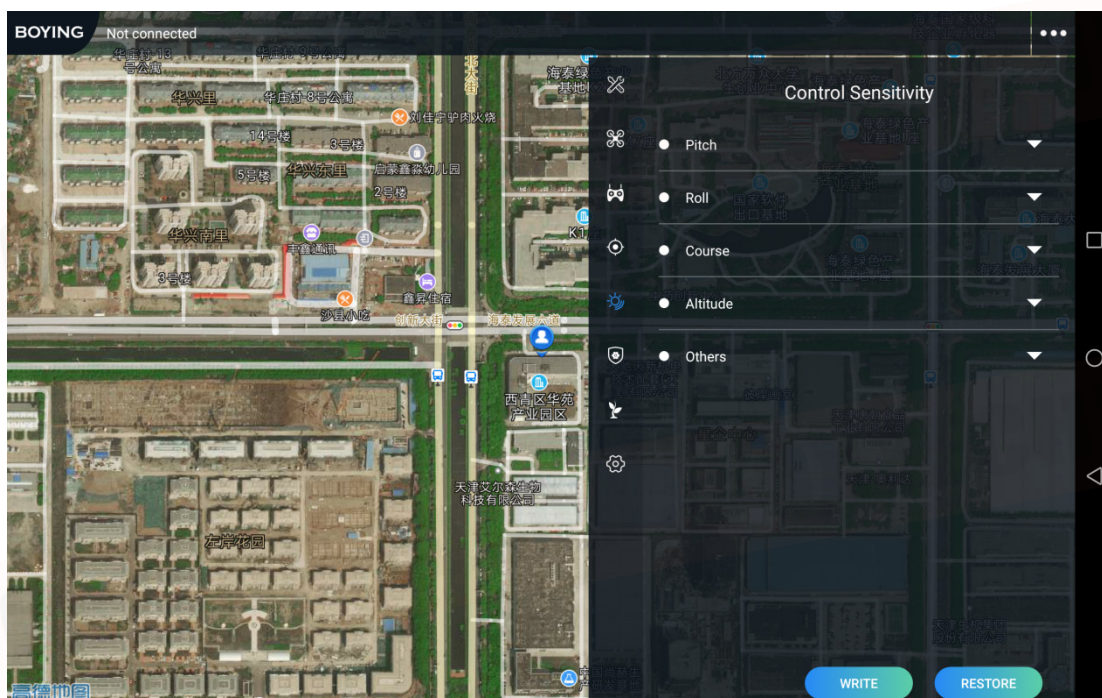


Calibration Setting

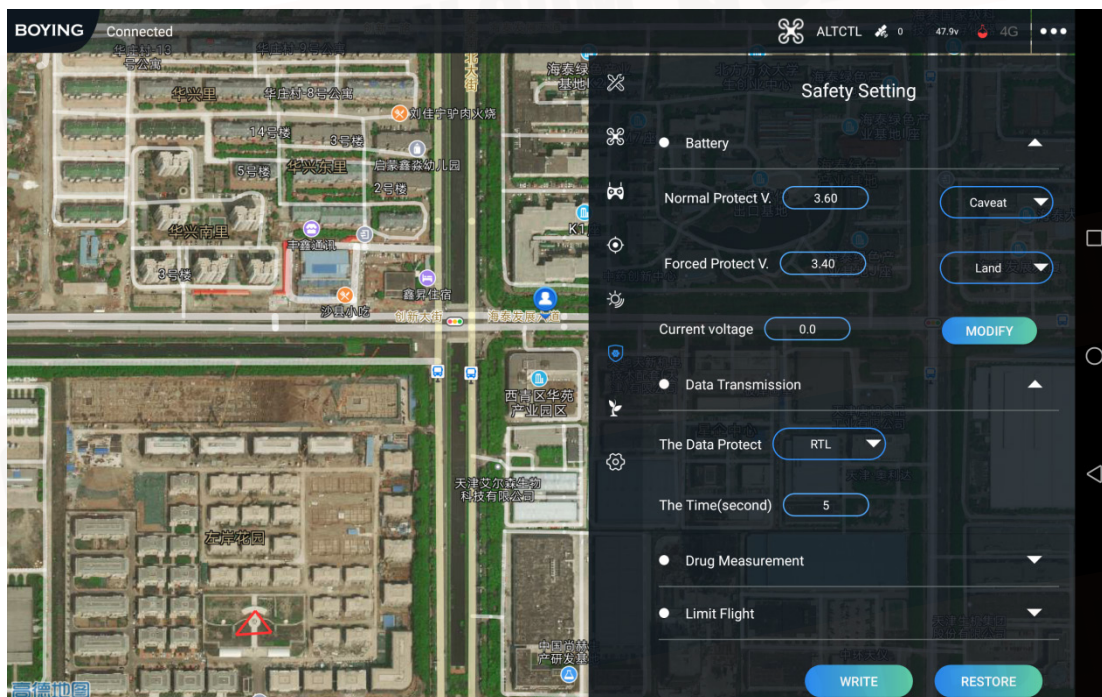
Calibrate accelerometer, horizontal calibration, dynamic balance correction.



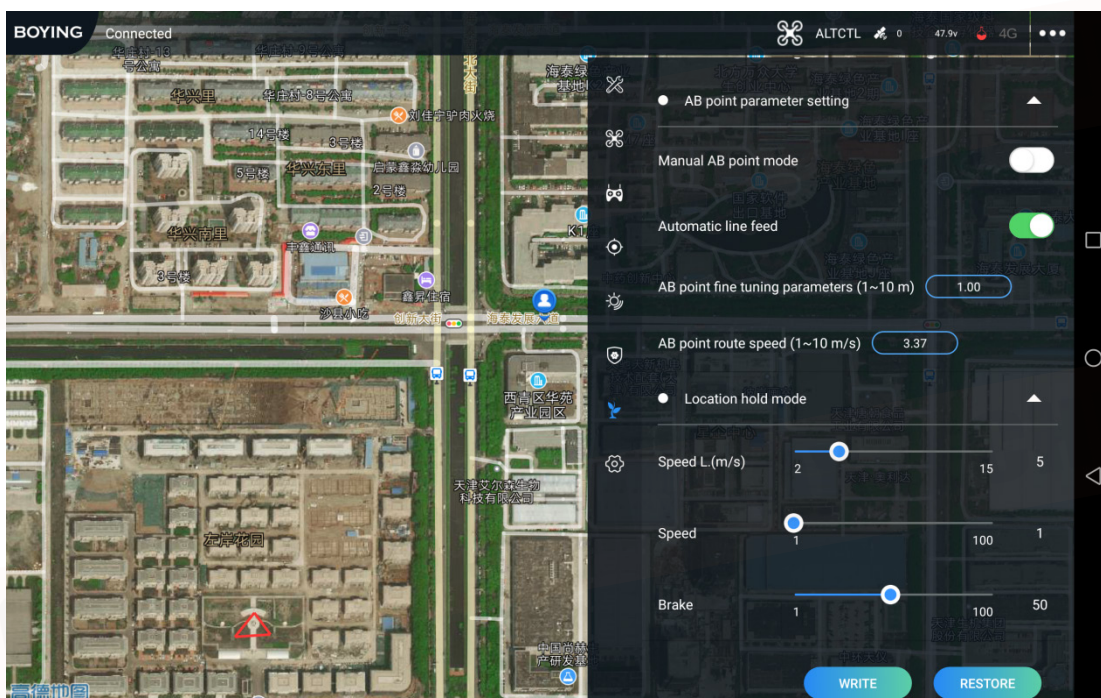
3. Control Sensitivity Setting



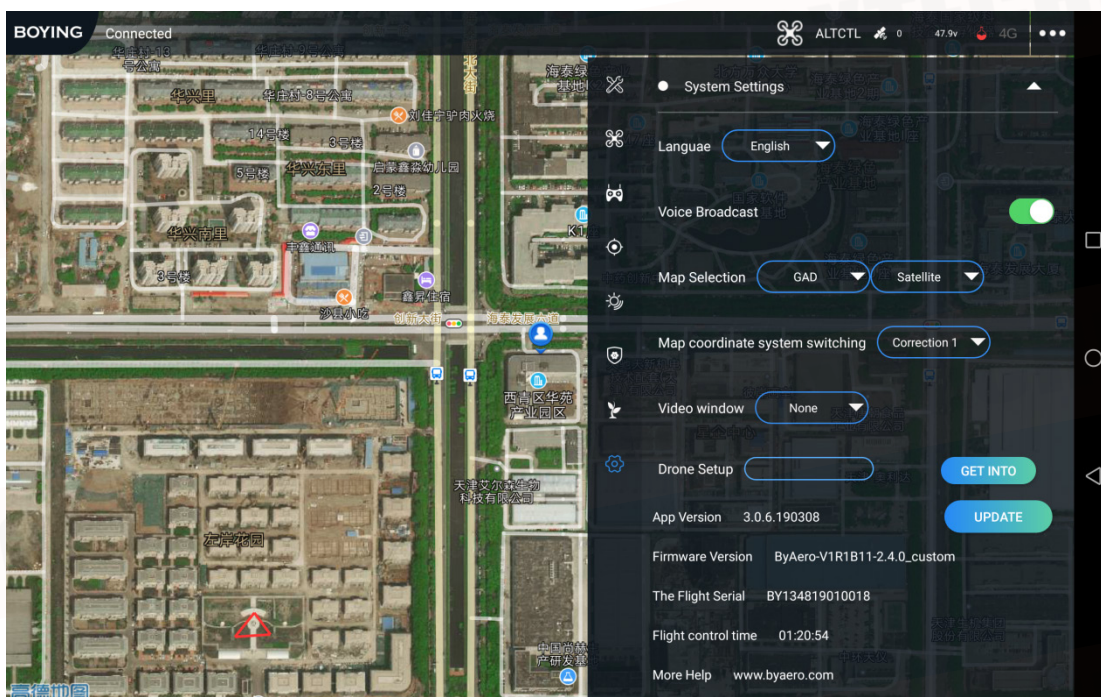
4. Safety Setting



5. Agriculture Plant Protection Setting

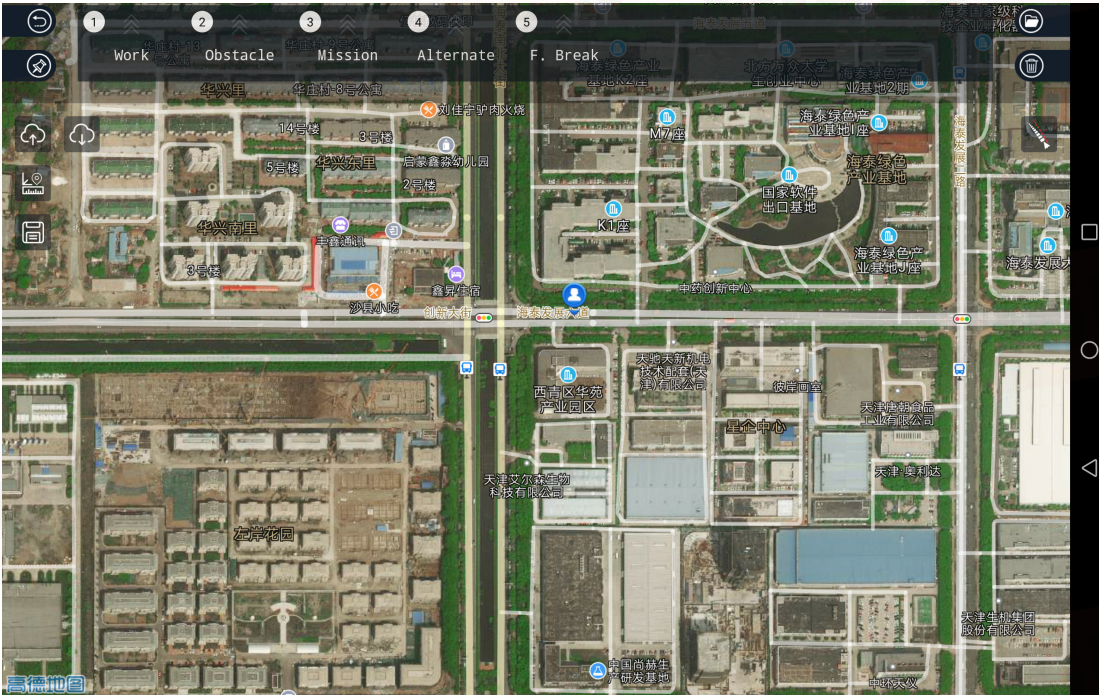




6. System Setting(including system version etc.)

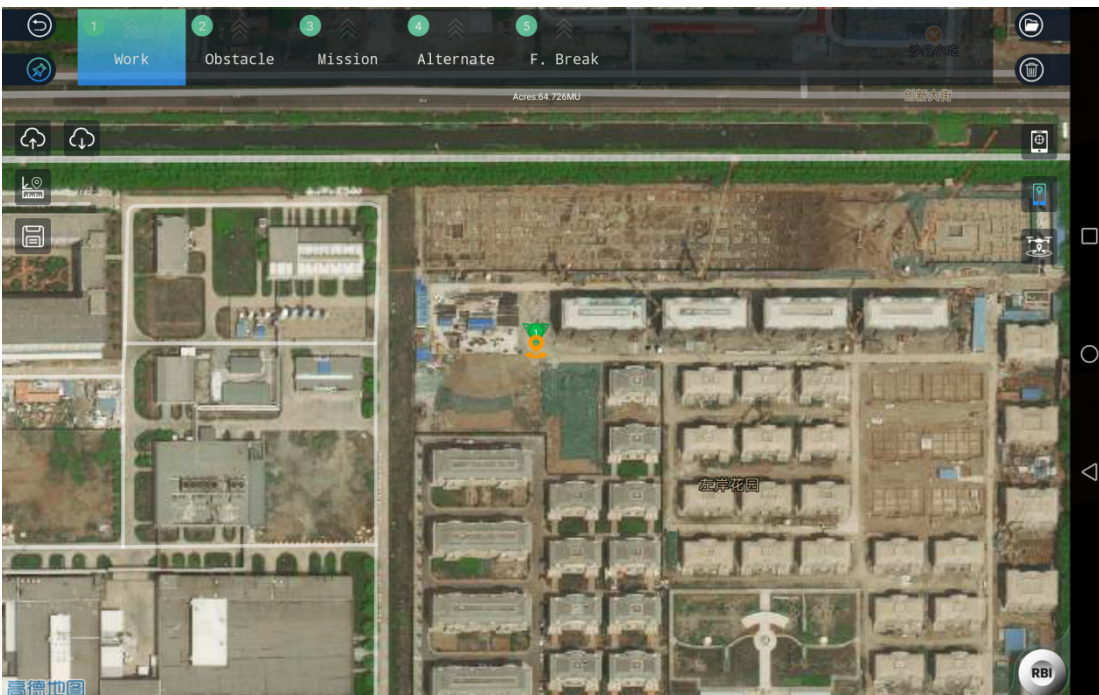




Route Planning

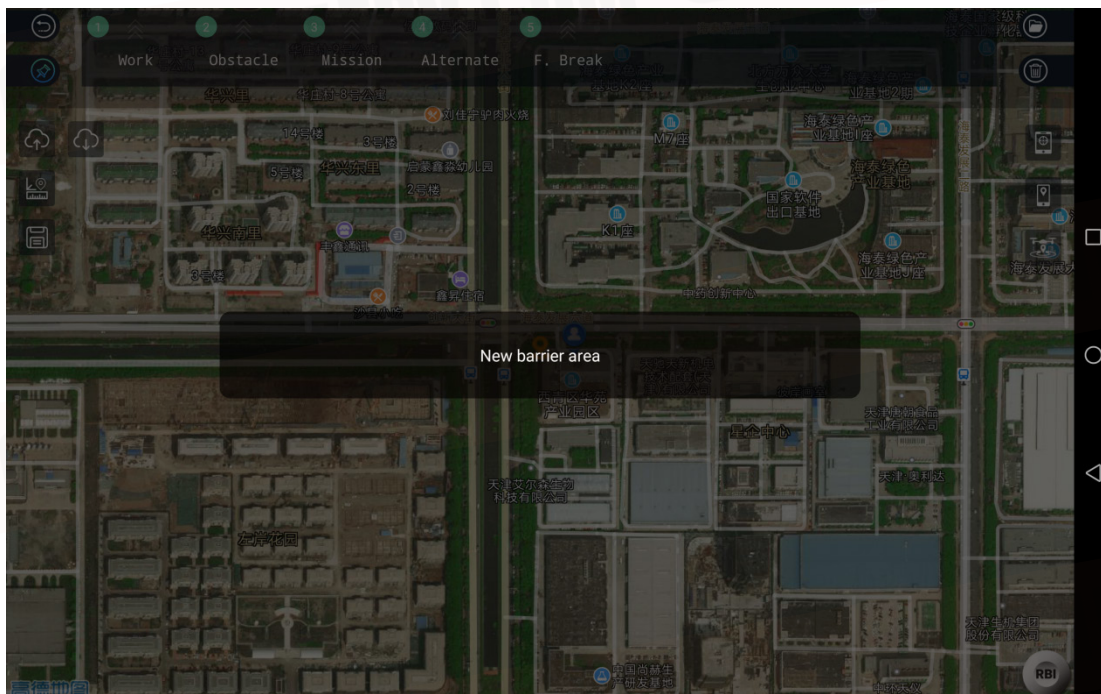
1. Click  enter the route planning interface.




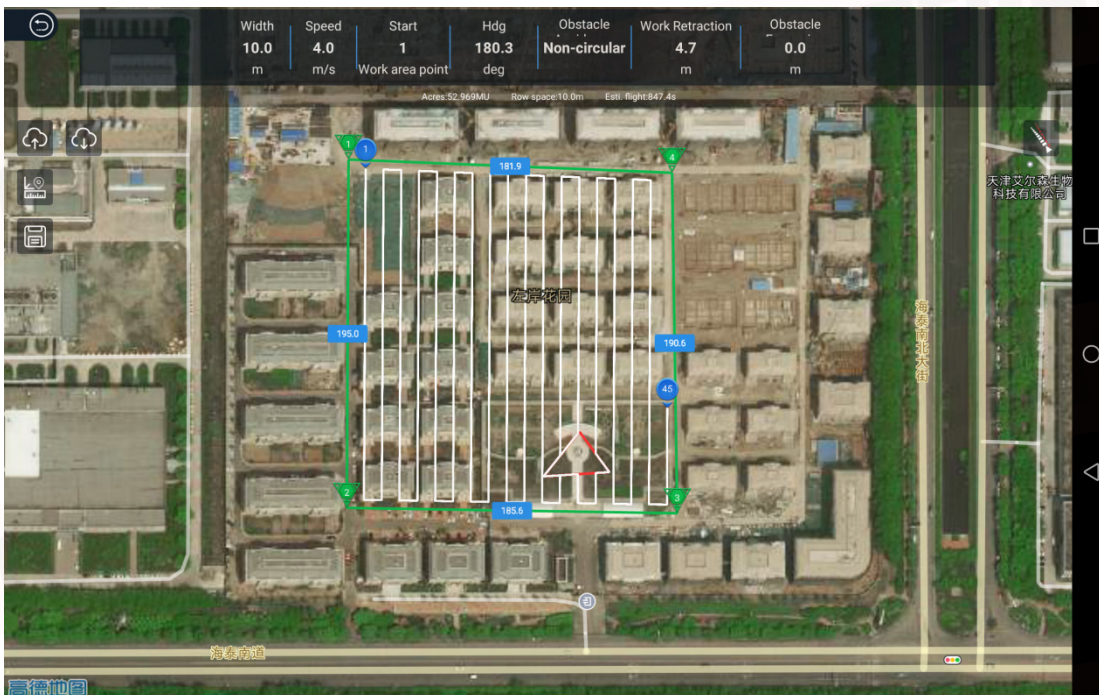
2. Click  Enter the mark mode, then select 1. work (working area), select the mark mode on the right side, from top to bottom there are 3 modes: the mobile phone GPS positioning mark, mobile map manual mark, aircraft GPS mark. Click the , start to mark. Use green lines and green markers as the edge of the work area in the map. (at least three points form an area).



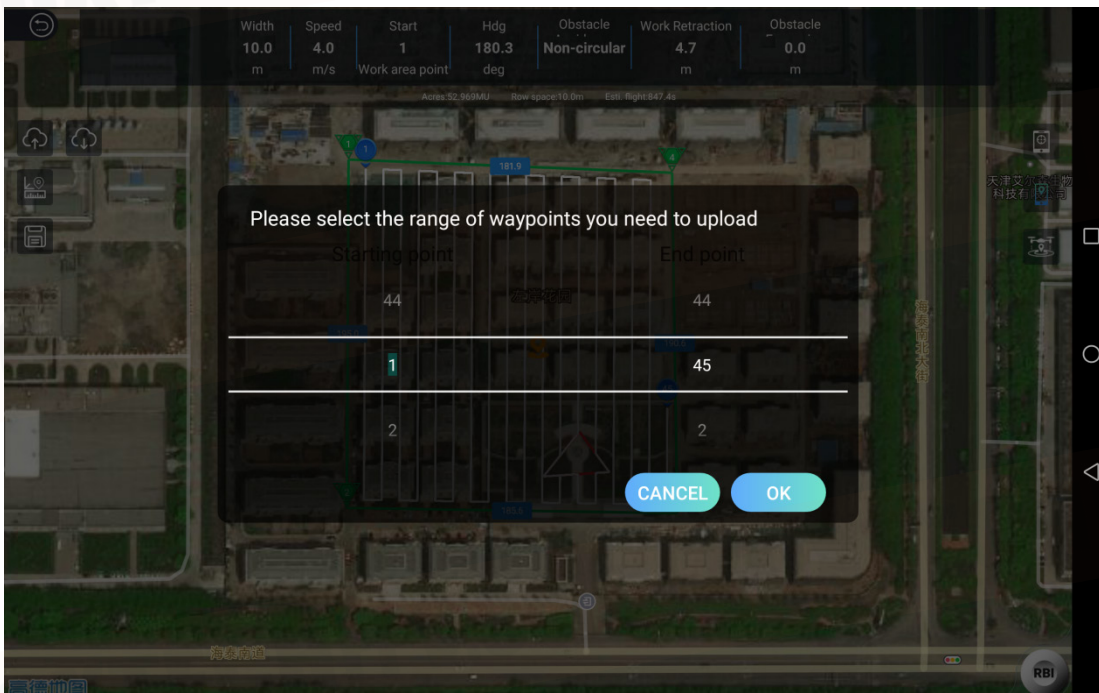
3. Mark the obstacle area in the work zone. Click  enter the marker mode, then select 2 Obstacle obstacle area select to create new obstacle area (multiple obstacle areas can be created), select the mark mode on the right side, from top to bottom there are 3 modes: the mobile phone GPS positioning mark, mobile map manual mark, aircraft GPS mark. Click the  start to mark, the red line and blue icons in the map represent the obstacle area (at least three points form an area).




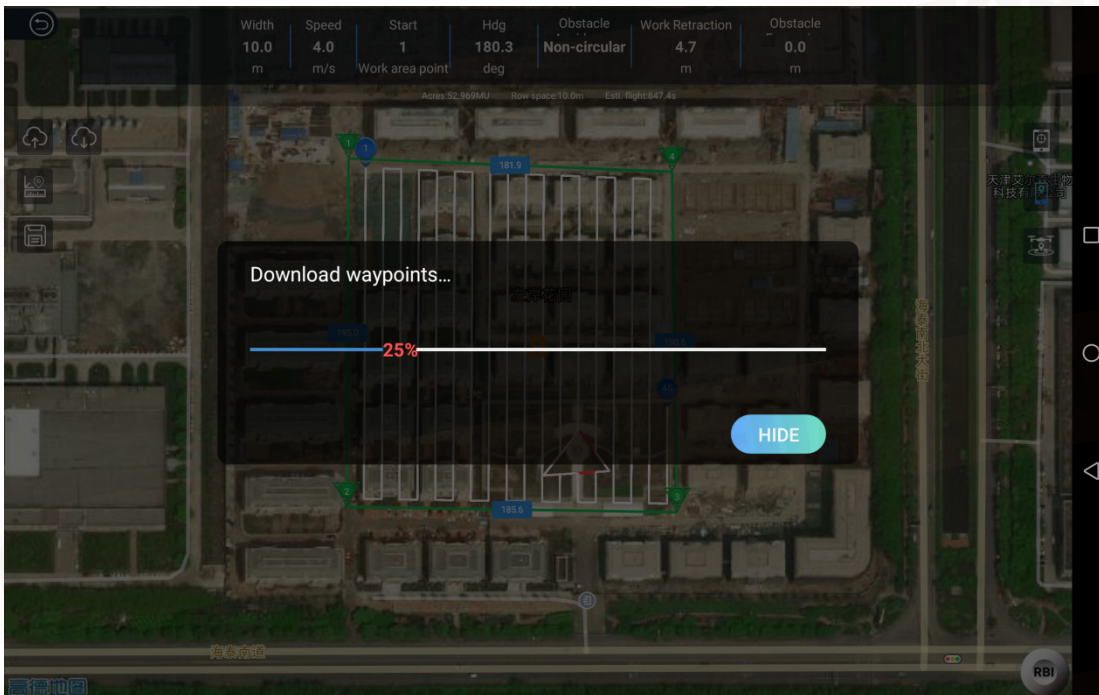
4. Click the  on the left to generate the route. The top parameters can be edited separately. From left to right: the route interval, flight speed, start position of the route, route angle, obstacle avoidance scheme, overall retraction of the work area (m), Expansion of obstacle area (m).







5. After the route planning is completed, click  on the left side, upload the route to the aircraft.



6. After the upload is completed, you need to click  to download the route and ensure that the route is transmitted to the aircraft accurately.



Ready to Take Off

1. Click  to exit the route editing interface.
2. Click , the aircraft takes off automatically, the height is 2m.
3. Click , the aircraft enters the autonomous operation mode and will fly following the route that has already been uploaded.
4. After the flight is completed, the aircraft will return to home automatically and hover or click  to control the aircraft to return according to the actual situation.

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