THEA-130 / 160

Sprayer Drone

User Manual

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FOXTECH

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Flight Operation

Environmental Requirements

-In an open environment, there is no occlusion, so as not to affect the search for satellite signals.
-The wind is less than 5 (≤8m/s).
-There is no strong magnetic field around, such as high-voltage lines, magnetite, etc., so as not to affect the normal operation of the magnetic compass.

Pre-flight Check

-Make sure that the drone battery, remote control battery, and ground station (Android phone) are fully charged.
-Make sure the drone battery is fixed.
-Ensure that the components are tightly fastened and that all screws are not loose.
-Make sure all connections are correct.
-Make sure that the propellers are not damaged, securely mounted, in the right direction, and that it works correctly. All arms and propellers are fully deployed and the arm sleeve is locked.
-Make sure the spray system is free of impurities and can work properly.

Compass Clibration

Compass calibration must be performed before first use, otherwise the system may not work properly, which may affect flight safety.

- Do not calibrate in areas with strong magnetic or large blocks of metal, such as high voltage lines, magnetic mines, parking lots, and buildings near steels.
- Do not carry magnetic substances with your body during calibration, such as mobile phones
- If the compass is calibrated indoors, remember to recalibrate when using it outdoors to prevent the magnetic field difference between the two areas and cause abnormal flight data.
- The position of the Earth's magnetic field is different. Please recalibrate the compass when replacing a remote area.

Calibration Steps:
The remote control E switch continuously dials 7-8 times or clicks the magnetic calibration command in the ground station software. The LED indicator turns green and enters the horizontal calibration phase, as shown below:

Rotate the drone horizontally until the LED turns blue and enter the vertical calibration phase, as shown below:

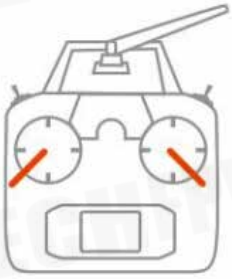
Then the drone head vertically upwards and rotates. When the LED indicator turns off, then it flashes, and the calibration is successful. When the LED indicator turns red, the calibration fails and needs to be recalibrated.
After the calibration is completed, you need to unplug the power to restart the aircraft.

Recalibration is required in the following case:
- The compass data is abnormal: the LED status indicator of the drone indicates that the yellow-green light flashes alternately.
- The flight field is far from the site where the last calibration of compass was made.
- The mechanical mechanism or the body circuit of the drone has changed.
- Drifting during flight is more serious, or can not fly in a straight line

Work in Manual Stabilization Mode

Unlock, Start the Motor

Before performing the unlocking operation, keep away from the drone to avoid danger and injury. The motor can be started by performing the following operations on the remote control.



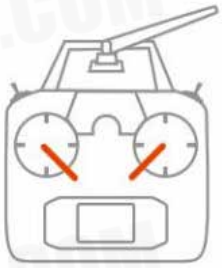
Unlock

After unlocking, push the throttle stick above the middle position and the drone can take off.

Push the throttle slowly.

If the throttle is not pushed to more than 10% after unlocking, the motor will automatically stop and lock after 3 seconds.
Immediately after the motor starts, release the rocker and take off as soon as possible.
If does not calibrate the range the remote control, the motor cannot be started by performing an unlock operation.
If the fine adjustment of the joystick is not 0, the motor may not start when the unlocking operation is performed!

Lock, Stop the Motor
The locking operation must be performed after the drone has landed. The motor can be stopped by performing the following operations on the remote control.



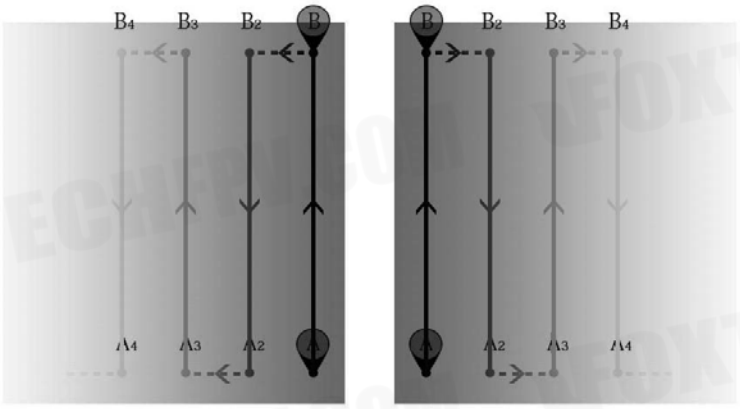
Lock

Work in Manual Plus (AB point) Mode

When working in Manual mode and Manual Plus mode, you can use the ground station to view the track and enter the viewing page of the ground station software.

Mode introduction
Manual Plus mode, also known as AB mode. After the user defines points A and B, the AB route is automatically copied for flight. In the AB mode, it supports Terrain Following flight (with radar), supports the adjustment of the length of the AB route during flight, and supports manual adjustment of altitude (the middle position of the throttle defaults to a fixed altitude flight) and the direction of the nose.

Records AB Process in AB Mode
Takes off in the manual stabilization mode,if you do not want to use the AB point information of the previous trip, you can continuously dial the G dial 7-8 times to clear the AB record to ensure that there is no AB point inside the drone.
Operate the drone to the first starting point. In the manual stabilization mode, the G dial switch is switched from standby to point A. At this point, the coordinates of point A are recorded. After the recording of point A is successful, the LED light will flash with a purple light.
Manually open the water pump and control the drone to fly to the B point. In the manual stabilization mode, the G dial switch switches from point A to point B and records the coordinates of point B. After the point B is successfully recorded, there will be 2 purple lights flashing.
After the AB point recording is completed, the E dial switch is set to the AB mode, and then the roll channel is switched to the far left or far right. At this time, the AB point mode starts to be executed, The aircraft will continue to fly to the left/right ridge (the G dial switch is at position B, it is recommended to return to the standby position).
Exit AB mode: E dial switches to manual stabilization mode/attitude mode to exit AB mode (the SB dial switch is at position B, it is recommended to return to the standby position).
After exiting the AB mode, if you want to clear the AB point record, you need to continuously dial the G dial 7-8 times or more. At this time, the 2 flashing purple lights of the AB point will be extinguished, indicating that the clearing is successful.

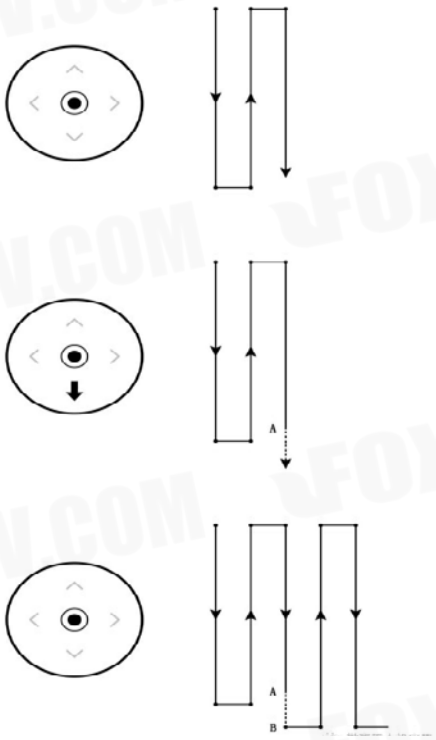


Real-time Adjustment in AB Flight Mode

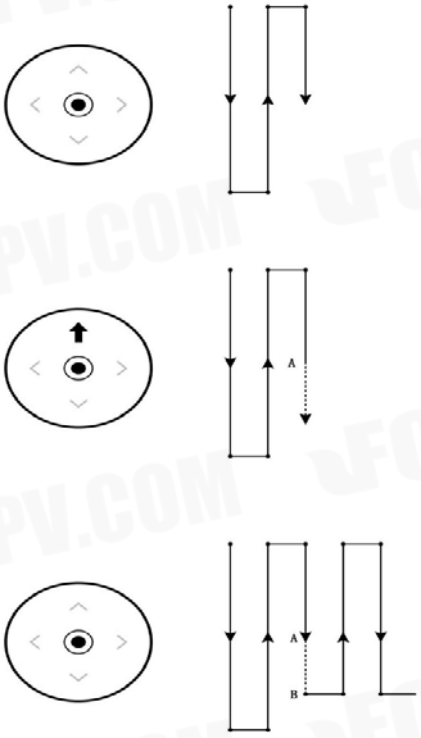
At present, the function correction is made for the extension or shortening of the route in the AB mode. The flight control firmware is 180915 and above, and the extension and shortening of the route in AB point mode realized by the following method ,please pay attention.

Regulated ridge length

Extension of AB point: When the plane flies to the edge, push the pitch switch (push or pull, to the far end is push, to the near end is pull), the drone will slowly advance at 2m/s, When reaching the extended position, the pitch switch is back to center, the drone stops, and then the corresponding route is copied, and the AB point is extended.



Shorten the route of the AB point: When the drone flies to a position close to the shortened position, push the pitch switch (push or pull, to the far end is pull, to the near end is push), and the drone will slowly advance at 2m/s. When the shortened position is reached, the pitching switch is back to center and the drone stops, and then the corresponding route is copied, and the AB point route is shortened.



- Adjust the altitude

During the flight, when the throttle stick is in the middle position, it will fly in a fixed-height status(with a radar,can realize terrain following flight), when the throttle is pushed up, the height rises and the throttle is pulled down, the height drops.

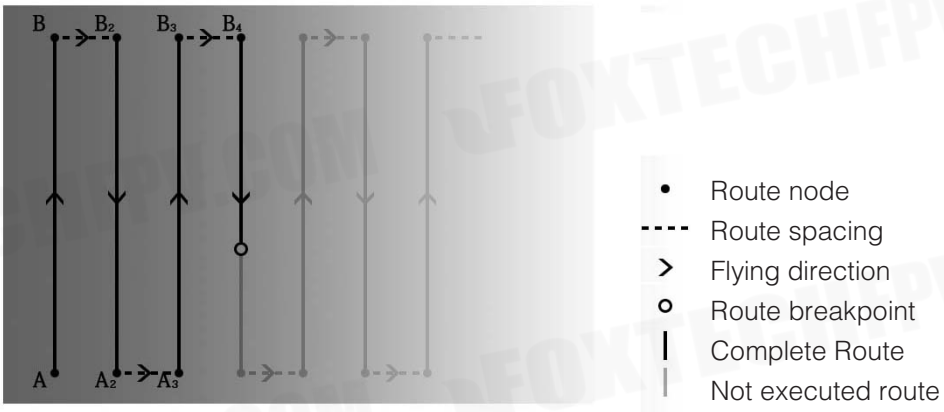
- Adjust the direction of the nose

During the flight, when the yaw joystick is in the middle position, the nose is locked, the yaw joystick is pushed to the left, the drone turns to left, when the yaw joystick is pushed to right, the drone turns to right.

Continue to fly at breakpoints in AB Point Mode

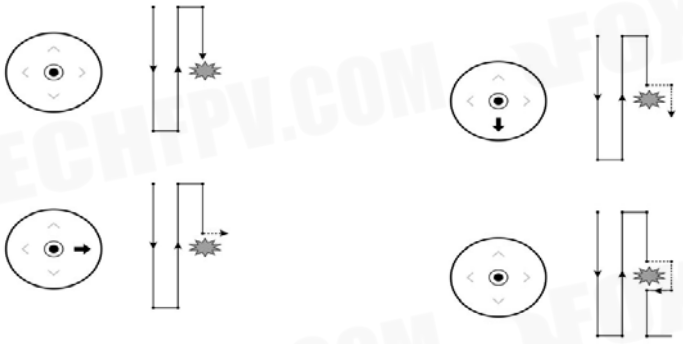
When exiting from AB point mode, the drone saves the current spray breakpoint, AB point definition, and task direction. If you want to use the original AB point record and continue to perform the AB point mode, you can follow the following steps:

- In the manual stabilization mode, the remote controller E dial switch is set to the AB mode, and the drone is hovering at a certain position.
- The pitch channel is fully pushed forward, and the drone enters the breakpoint-flying mode, flying to the place where the drone exited the AB mode last time. Then continue to perform in AB point mode.



Avoids obstacles and continue to fly in AB Mode.

At present, the manual intervention for obstacle avoidance is added for AB mode. The flight control firmware is 180915 and above. Please pay attention:



Manual intervention for obstacle avoidance at AB point mode When the drone is performing AB point task, after encountering obstacles in front, first dail the roll joystick, the drone will stop, then will move to the direction to which the roll joystick is dial, then could start operating the pitch joystick after moving to an secure position, then all the joysticks are back to center, the drone will automatically turn to AB point mode, then perform the subsequent task.

Repair and Maintenance

Replace the Propeller

- Insert the propeller into the motor column (note the direction of the propeller).
- Turn the propeller, align the mounting holes, and tighten the four M3x6 screws.

Replace the Motor

- Place the motor on the lower cover of the motor base and align it with the mounting hole (note the direction of the motor)
- Secure the motor and motor base lower cover with four M4X16 screws.
- Pass the motor wire through the hole in the lower cover of the motor base and connect it to the ESC. Secure the motor cover and lower cover with four M3X10 screws.

Replace the ESC

- After the wire and signal wire at one end of the ESC pass through the arm, the wire is connected to the distribution board, the signal line is connected to the flight controller, and the wire at the other end is connected to the motor.
- In the motor check setting, check if the motor is turning correctly and the speed is the same as other motors.
- The ESC is placed in the motor base, and the motor upper cover and lower cover are fixed with four M3X10 screws.

Replace Nozzles

- Insert the nozzle into the nozzle fixed rod (Note: the connection part of nozzle and hose need to be inserted into the fixing rod gap)
- Place the nozzle clamp into the nozzle and fix it with the M3 locknut and M3X14 screw.
- Prepare auxiliary tools such as pliers and pipe clamps, connect the hose from the pump to the nozzle.
  * Pass the hose through the pipe clamp and then onto the nozzle joint.
  * Use an auxiliary tool such as pliers to clamp the upper part of the pipe clamp to open it, move it to the connection part of hose and joint, and then loosen it to clamp the connection part between the hose and the joint.

Replace the Pump

- Place the pump on the pump mounting plate (note: the arrow on the pump is facing up), align the mounting holes, and secure with four M4X6 screws and four 4-flat washers.
- Prepare auxiliary tools and pipe clamps such as pliers, and connect the nozzle and the hose exported from the flowmeter to the water pump.
  * Pass the hose through the pipe clamp and connect it to the pump coupling.
  * Use an auxiliary tool such as pliers to clamp the upper part of the pipe clamp to open it, move it to the connection part of hose and joint, and then loosen it to clamp the connection part between the hose and the joint.
- Align the projections on the pump wire with the grooves on the pump connection and insert the pump motor.

Cleaning After Use

The spray system needs to be cleaned after each use:

Step1: Remove the filter from the nozzle and wash off the attachment.

Step2: Wash the aircraft pesticide tank with soapy water.

Step3: Clean the aircraft pesticide tank with clean water.

Step4: Install the filter in the nozzle and then clean with water, and the degree of atomization of the nozzle is used to judge whether it is cleaned.

System Introduction

System Characteristic

Main features:

· With the comprehensive flight status monitoring alarm function (including the state of power supply voltage, state of inertial navigation, GPS, link-state, etc.) and perfect emergency protection mechanisms (including return, hover, autonomous landing, etc.), and Paladin system can realize the control law of restructuring in some failure cases of sensors or attitude algorithm, thus the maximum guarantee the safe operation of the user's system;

· Provide highly integrated ground station software BY- GCS, which has the functions of flight data monitoring, dashboard status display, abnormal status alarm, flying remote control, electronic map, route planning, etc;

· The attitude algorithm of Paladin system adopts KALMAN filtering technology, which has high measurement accuracy, and reduces the probability of attitude divergence, thus ensuring the reliability and safety of the system work;

· Combined with the remote control device, the Paladin system can be controlled by the remote control mode to control the operation, thus ensuring that multi-rotor UAV can step in and ensure flight safety during take-off and landing.

· It provides a strong route planning capability and flexible task control function, and users can use ground station software to make a variety of flight tasks conveniently service;

· The Paladin system integrates high precision inertial and satellite navigation sensors, and the sensor data is covered by the pretreatment and the whole temperature range compensation and data fusion can obtain flight attitude, position coordinate and working status in real time, and complete the high-precision attitude and route control of the multi-rotor UAV platform;

· The Paladin system integrates dual degree CPU and sensor, which can automatically detect and switch independently to ensure flight safety.

Navigation task:

· Offer up to 170 user routes, or 340 navigable points.

· Automatically generate return routes Protection configuration:

· Low voltage protection of battery;

· Exceed the maximum flying range protection (isolation regional security protection);

· Remote control protection;

· Radio interrupt protection;

· GPS fault protection;

Protection measures to switch to high maintenance mode;

· Flight overrun protection: when the aircraft pitch and roll attitude angle more than 60 °, the plane automatically lock blade.

Remote control equipment:

· Compatible the commonly used remote control;

· Manually mode or autonomous control mode can be switched through the remote controller;

· Failsafe (protection when it’s out of control) status of the remote control can be monitored;

Airborne data record:

· Flight data is stored on dedicated storage devices for flight control;

Ground station software

· Strong ability of route planning;
· A powerful digital map;
· A clear, intuitive flight instrument;
· Convenient operation and anti-error operation of key instructions;
· Integrated sensor calibration, protection configuration and other functions;
· The display, alarm and recording of telemetry data;

Communication interface

· Physical interface: USB, digital radio;

Introduction to Flight Mode

Flight Control Mode	The Control Mode	Features	Remark
High maintenance mode.	Remote control.	In the return of the remote rod, the aircraft will maintain its own posture, the position of the throttle can be fixed, but the precise fixed point suspension cannot be realized, and manual correction is required.	
Position maintenance mode.	Remote control.	When the satellite signal is good: Hovering can be done with high precision and the limit can be achieved speed, but the RC remote control aircraft still control, speed can pass over ground station settings.	
Return mode .	Remote control.	Depends on the satellite, flew home from the current point and hovered over.	
Fully autonomous flight mode (point mode formula).	Fully autonomous can be divided into 5 kinds of flight modes: 1.autonomous takeoff 2.autonomous landing 3.waypoint flight 4. return 5. hover	According to the ground station set a good mission route, autonomous flight, due to independent mode the type depends on the satellite, so the satellite should be located before unlocking and taking off.	1. The route up to 170 article, that way to do more 340. 2. The throttle can still control height, throttle setting middle will maintain the current height.
AB point mode.	Semi-autonomous flight	According to the set point A, B, to achieve semi-autonomous flight, this mode depends on the satellite, so before the unlock and take off the satellite to locate.	1. By the roll channel to provide wrap instructions 2. By the pitch channel to provide fine-tuning instructions. 3. The throttle can still control the height and when it is set middle, it will maintain the current height.

Installation and Connection

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
	Data transmission radio on 2.4Ghz loaded on aerial vehicle, which is applicable for ground station users
	Data transmission radio on 2.4Ghz on the ground, which is applicable for ground station users
	Ultrasonic sensor, which is used for imitate-terrain flight and fixing height at low attitude
	Data transmission checkpoint based on Bluetooth, which is applicable for ground station on mobile phone users
	Water pump governor, which is suitable for agriculture and plant protection unmanned aerial vehicle users
	Level sensor, which is suitable for agriculture and plant protection unmanned aerial vehicle users

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 evice 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!

Remote Control Equipment

Receiver

Paladin System could communicate with the receiver (like Futaba) which supports S.BUS through S.BUS protocol. If S.BUS function doesn't supported by the remote control, an optional PPM encoder is required. The definition of each channel is shown in Table 3.1. The frequency should be adjusted before the use of receiver. For detailed operation, please refer to the corresponding remote control manual.

Table 3.1 Definition of RCreceiver channel(take Japanese hand as example)

Receiver channel number	Definition	Remarks
1	Rollover	
2	Tilt	
3	Accelerator	
4	Course	
5	Flight mode.	For channel 5, except the flight mode, when rapid repeated dial more than 6 times, flight control will enter the magnetic compass calibration state. So do not quickly and repeatedly dial channel 5 when not necessary.
6	Task load switch.	Two switches—Triggered in high level.
7	RTL Return and land.	Return—Triggered in high level.
8	Add breakpoint.	Two switches—Triggered by dial back and forth once in auto/AB point mode.

- The RC remote control's channel definition should be configured according to Table 3.1.

Remote Control Configuration

FUTABA remote controller is recommended for flight control operations (The remote requires at least 8 channels to achieve basic flight control functions). Specific remote control settings include the following steps (take FUTABA 14SG, receiver R7008SB for example):

1. Double-click the LNK button to enter LINKAGRE MENU;
2. Enter the MODE SEL directory;
3. Choose NEW. Long press RTN to create a new control model(Fixed wing or quadrotor);
4. Click RTN twice to confirm;
5. If the remote accelerator is in the middle, please turn the ON of THR POS to OFF in the WARNING menu;
6. Enter the REVERSE menu, turn Channel 3 and Channel 6 NORM to REV;

7. Enter the FUNCTION menu, set AIL, ELE, THR, ROU to J1, J3, J2, J4 (Japanese Hand). Set AIL, ELE, THR, ROU to J1, J2, J3, J4 (American Hand).Please map Channel 5 to 9 to the appropriate switch or knob. The recommended settings are as follows: Channel 5 mapping is SE, Channel 6 mapping is SG, Channel 7 mapping is SC, Channel 8 mapping is SD, and Channel 9 mapping is SB. So far the basic settings of the remote control are completed.

- After configuring, please connect Paladin for verification. In manual (fixed high / fixed point) state, the remote can control the motor. (without propeller).

Unlocking and Locking for Flight Control

The aircraft can take off only after unlocking (take Japanese Hand as example).
Unlockable mode: Altitude Hold / GNSS Assist / Position Hold Mode
Lockable mode: Altitude Hold / GNSS Assist / Position Hold Mode

Waysto Unlock:
· Unlock requirements:
1) Altitude Hold Mode: available after self-test passed;
2) GNSS Assist/Position Hold Mode: available after positioned by satellite and indicator flashes green light;
·Unlock action: Maximum tilting degree with lowest accelerator degree, push the course-control stick to the far right and the rolling-control stick to the far left. Indicator light changes from blinking to steady means unlock successful, as shown in figure 3.3a

Waysto Lock:
· To lock immediately, maximum tilting degree while with lowest accelerator degree, push the course-control stick to the far left and the rolling-control stick to the far right.
· If the light starts flashing, the lock is successful.

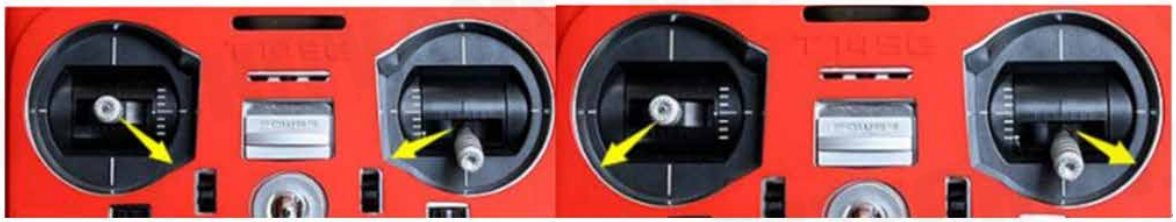


Figure 3.3a: unlocked

Figure 3.3b: locked

ESC Calibration (Electronic Speed Controller)

The purpose of ESC calibration is to match the PWM value output by the flight control with the range of PWM values that the ESC can receive.
The Paladin system provides two ESC calibration methods(take HOBBYWING ESC for example):

·General steps of ESC calibration(ESC signal line disconnected to flight control):
a. Connect a single ESC signal line to the receiver Channel 3(Accelerator Channel);
b. Power on the remote control, push the accelerator to the highest position, power on the ESC, hear "Di - Di" twice, pull the accelerator to the lowest position, hear "Di - Di - Di" three times, then push the accelerator, motor rotates, calibration completed;.
c. Repeat the above steps for other ESC calibration;

· Flight control ESC calibration steps(ESC signal lines and receivers have access to flight control):
d. Power on the remote control, push the accelerator to the highest position;
e. Power on the flight control, indicator lights flashing red and blue, flight control enter the ESC calibration mode, turn off the power of flight control, the remote control maintains the highest position;
f. Re-power the flight control, turn on power system, when hear the ESC "beep - beep" sound, pull the accelerator to the lowest position immediately, at this point will hear "Di - Di - Di" three times, then push the accelerator again, motor rotates, calibration completed.

- ESC calibration must be propeller-free, the audible tones of ESC calibration may be different by different manufacturers, please refer to the manual of ESC .

Remote Control Protection

Protect Content

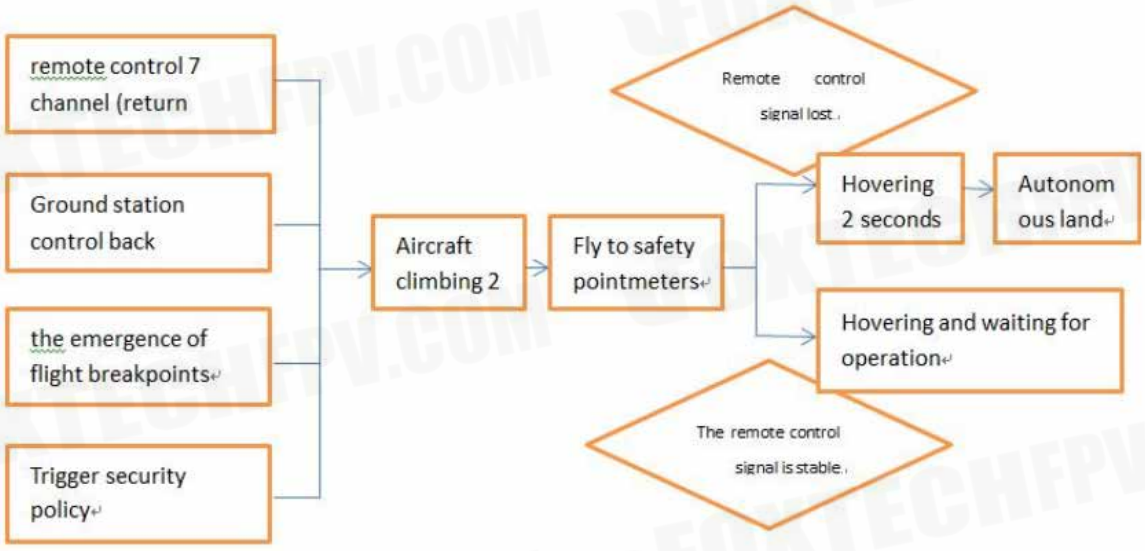
Paladin has perfect protection mechanism, the specific content and measures of protection are hown in table 4.1

TABLE 4.1 Paladincontent and Measures of Protection

Protect Content	Protect Measures	Description
Low battery voltage.	1. Return 2. Landing 3. Continue to perform the task.	-Protective measures: valid or invalid. -Protection mode optional.
Remote control signal lost.	1. Return 2. Landing	-Protective measures: valid or invalid. -Protection mode optional.
Data link is interrupted.	Return	Protective measures: valid or invalid.
GPS is abnormal.	1. Set High 2. Landing	When GPS is abnormal, it will be switched to fixed high mode. If high modulus fails to switch, it will carry out landing.
No medicine.	1. Return	-Protective measures: valid or invalid. -Autonomous mode trigger protection.
Regional restrictions.	1. Not Open 2. Hovering	Exceeded maximum radius: hover Above maximum height: height cannot climb, but can drop.
Angle protection.	1. The maximum angle of flight 35 °. 2.Out of control protection angle of 60 °.	When the plane is in normal flight, the angle will not exceed 35°;when the pitch and roll angle more than 60 ° at the same time, fly machine will turn off the motor output, lock the paddle.

Return Logic

The trigger conditions of aircraft into the return status are: remote control channel 7 (return mode) to high, the ground station control, the emergence of flight breakpoints, the phenomenon of runaway protection, etc. The return process is: the aircraft climbed 2 meters in the current location (to ensure return safety, climbing value can be set by the ground station), then fly to safety point (return back to the point if no automatic mode has been taken off or return to nearest ascending point if there is a near standby point) and hovering waiting for the operation, if the remote control signal is lost during the return process, the aircraft will hover for 2 seconds to perform autonomous landing. The returning logic execution diagram is:



Remote Control Security

Remote control is the most direct means of control the aircraft, from a security point of view, the current remote control for UAV plant protection operations are still irreplaceable. In order to ensure the safety of UAV flight, taking into account the actual needs of large areas of independent spraying, PALADIN designed a more complete remote control security strategy. The out-of-control protection action can be set by the ground station software. It should be pointed out that the out-of-control protection setting of the remote controller is only for the "fully autonomous mode"; the manual mode (constant height / positioning mode) and the AB point mode are both open by default and cannot be closed, the remote control out of control logic diagram (for details, please refer to "5.4.3 Security Settings"):

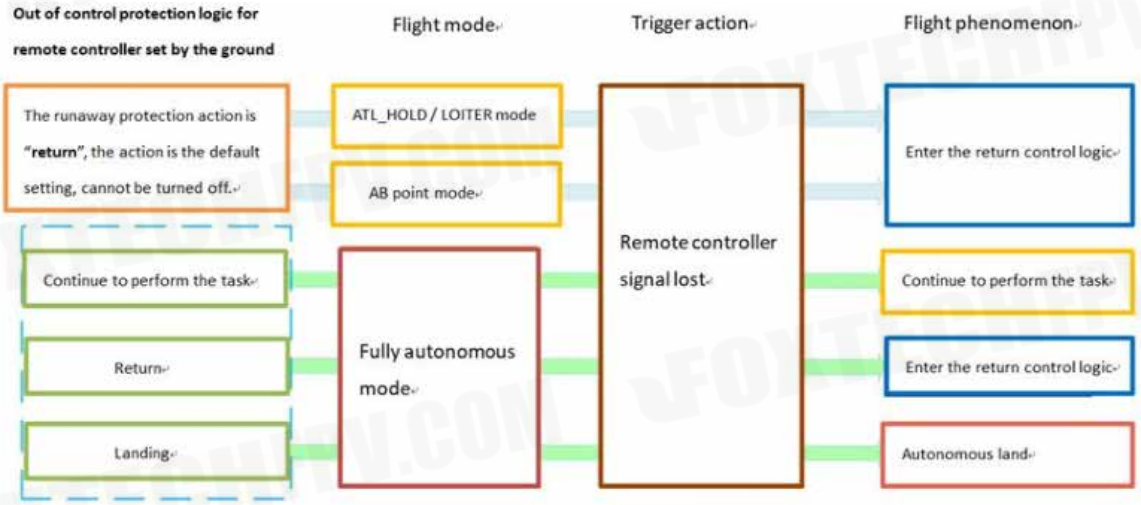


FIG.4.3 Out of control protection logic for remote controller

Data Link Loss of Control

Data link for aircraft and ground station connectivity, in order to improve ease of use, PALADIN the ground station is set to asynchronous equipment required that the actual flight plane can observe the state of the aircraft through the ground station, you can also disconnect the data link , only to observe the status of aircraft and lights to determine the aircraft work. In order to prevent the instability of the digital link from affecting the actual operation, the data link failsafe protection is set to be valid only in the fully autonomous mode and the remote controller signal loss. The manual mode (fixed height, positioning) and the AB point mode cannot be triggered, Autonomous mode remote control signal cannot be triggered normally, please refer to the details according to "5.4.3 Security Settings."

Voltage Detection and Protection

PALADIN offers a voltage protection function based on a modifiable voltage value, that the user can correct the voltage value of the flight control via the ground station (if the difference between the actual value and the measured value can be used to correct the measured value), flight control detection monolithic voltage and implement protection. The voltage fail-safe protection action can be set to "Off", "Return" or "Landing". For details, please refer to "5.4.3 Security Settings".

Area Limited Protection

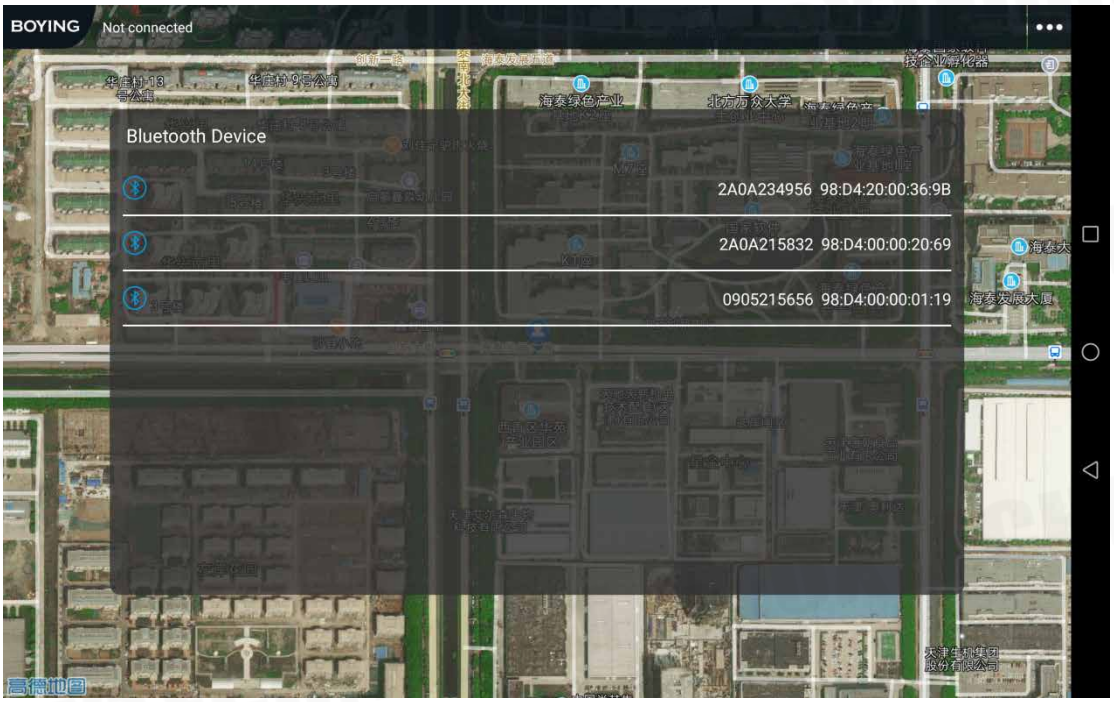
For details, refer to "5.4.3 Security Settings".

Ground Station Setting

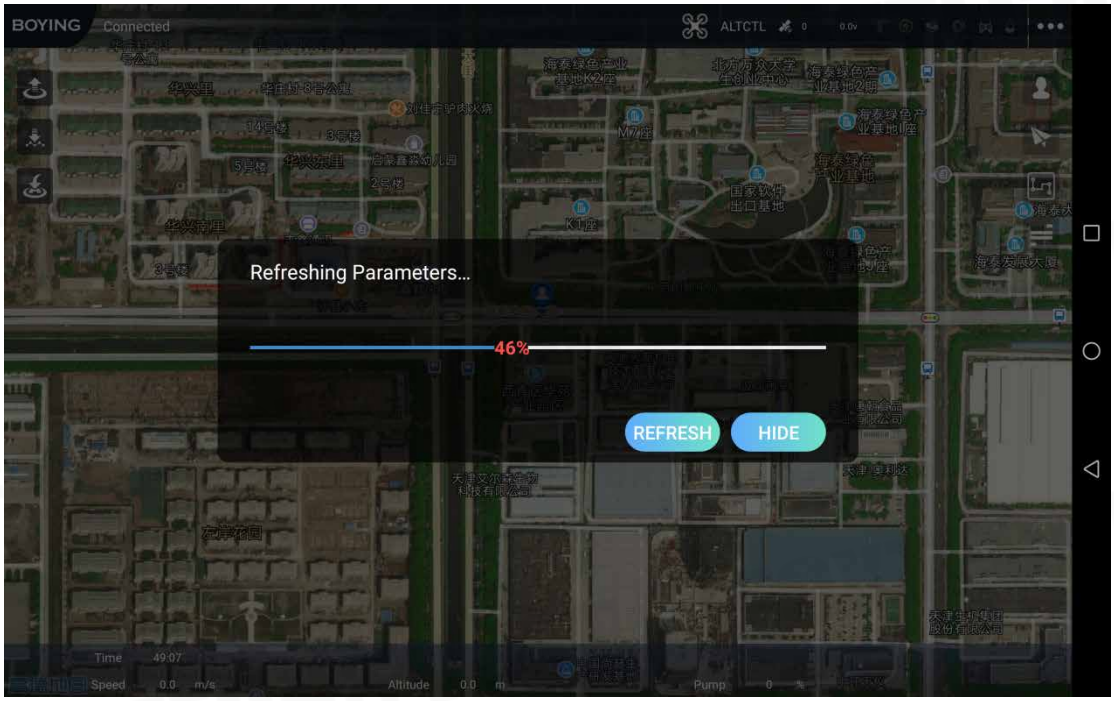
Equipment Connection

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.

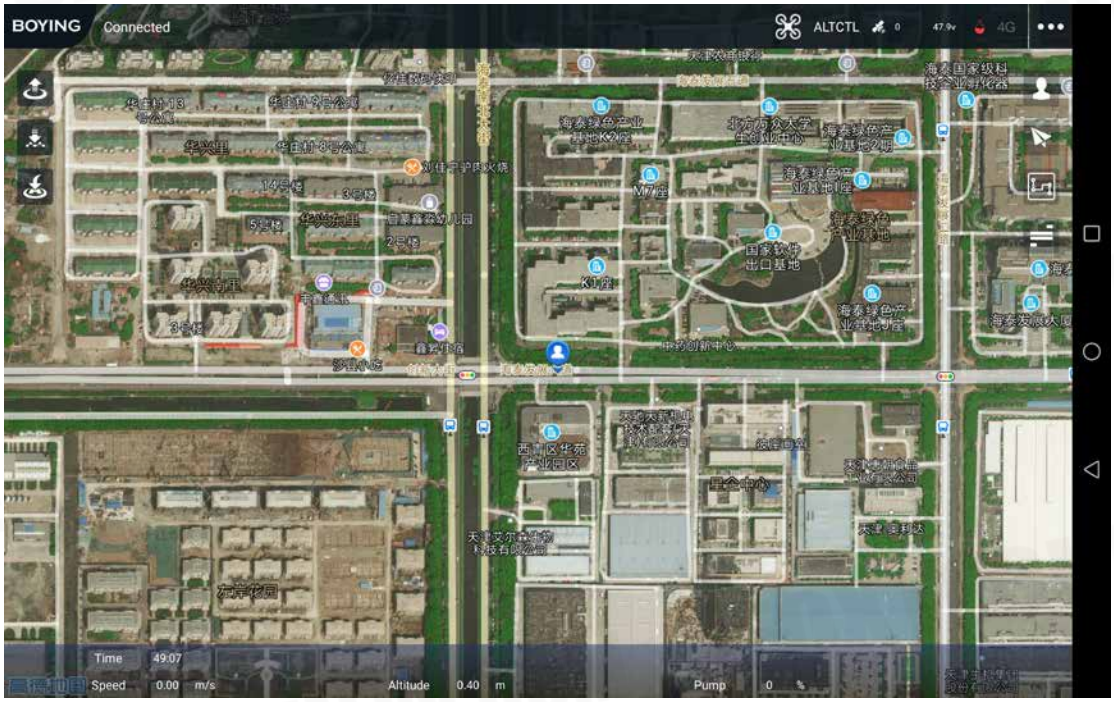


3.Waiting for the drone to be connected (voice prompt).

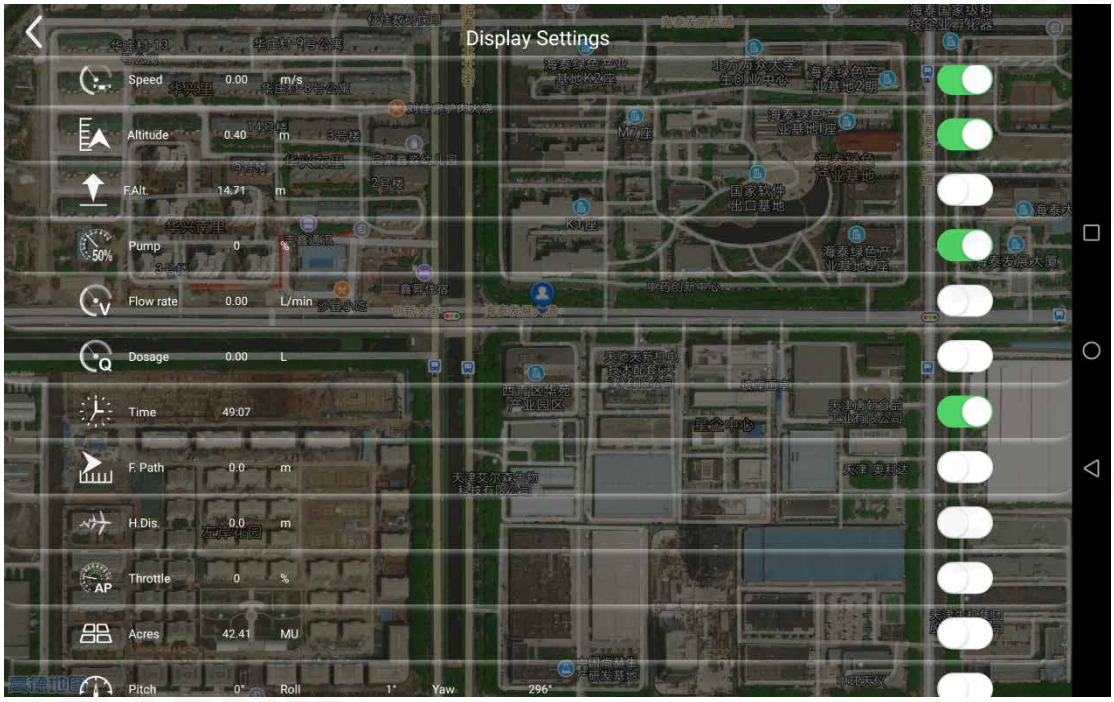


Function Introduction

1.Main interface function.



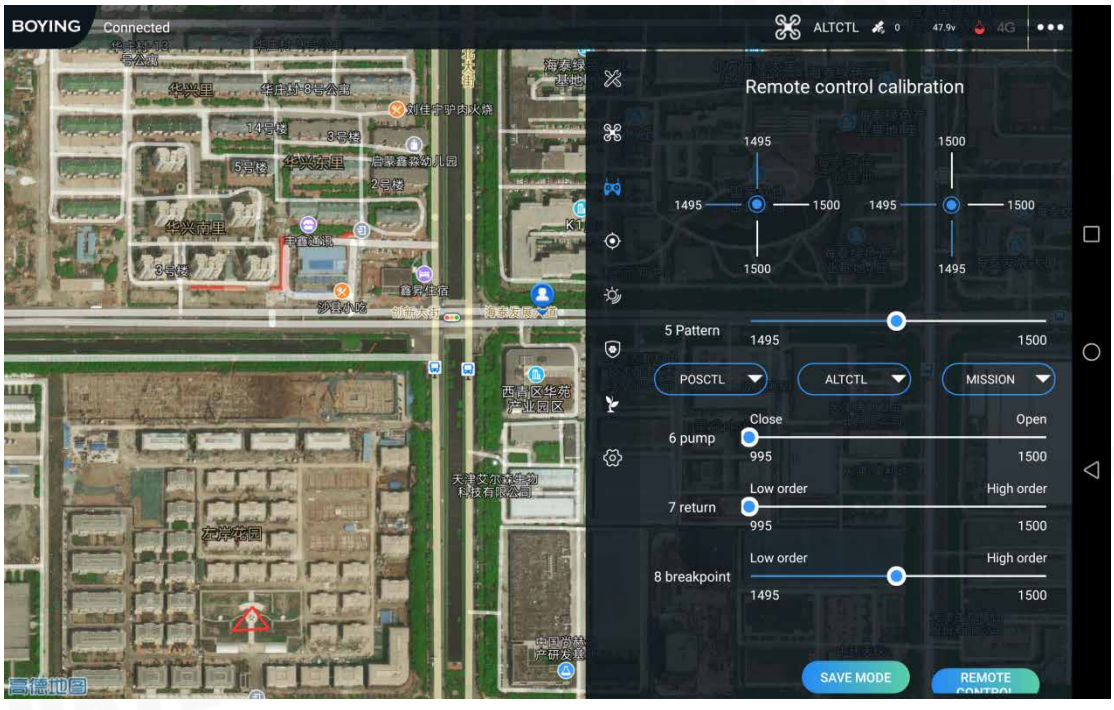
2.Click “Display Seetings”, the user can select the parameter item you need (up to 6 items).



Click ”Setting”, then will pop up the dialog box.
Task Statistics: the cumulative number of working acres(Mu) ,Dosage (L) and time.

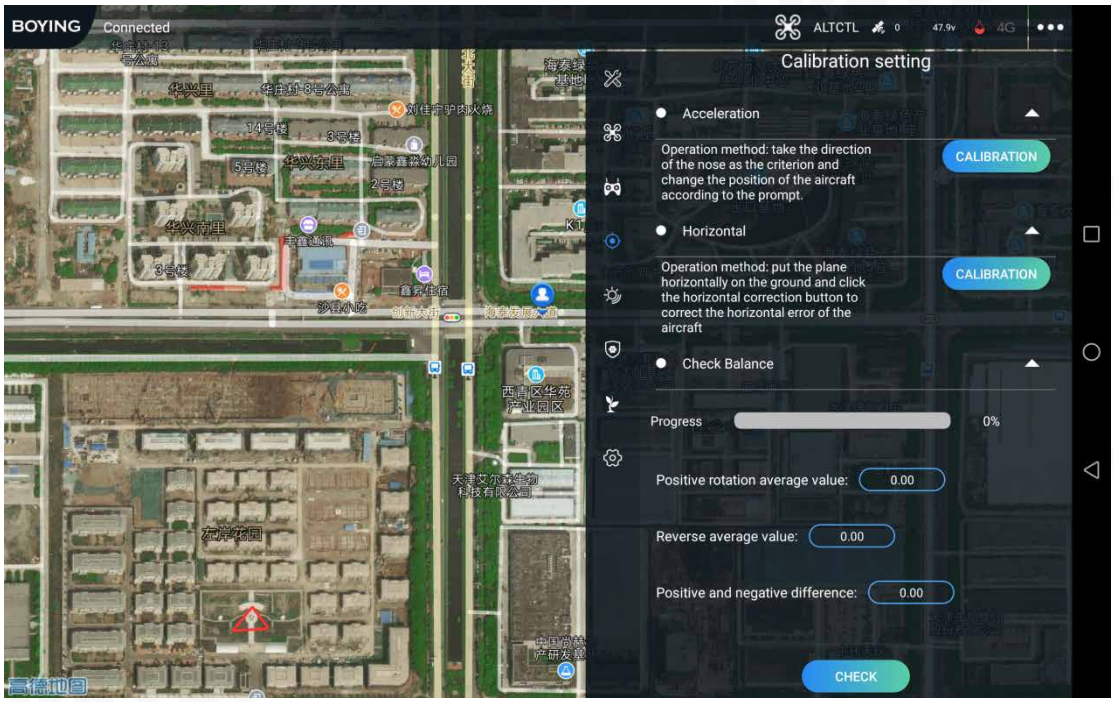
Frame Type Setting Select the drone type (it has been set at the factory, please do not change it
Motor test: Input duration (recommended 3s-5s), throttle (recommended 10%-15%), then according to the diagram, check whether the propellers of the multi-rotor motors are normal (please test away from the 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.

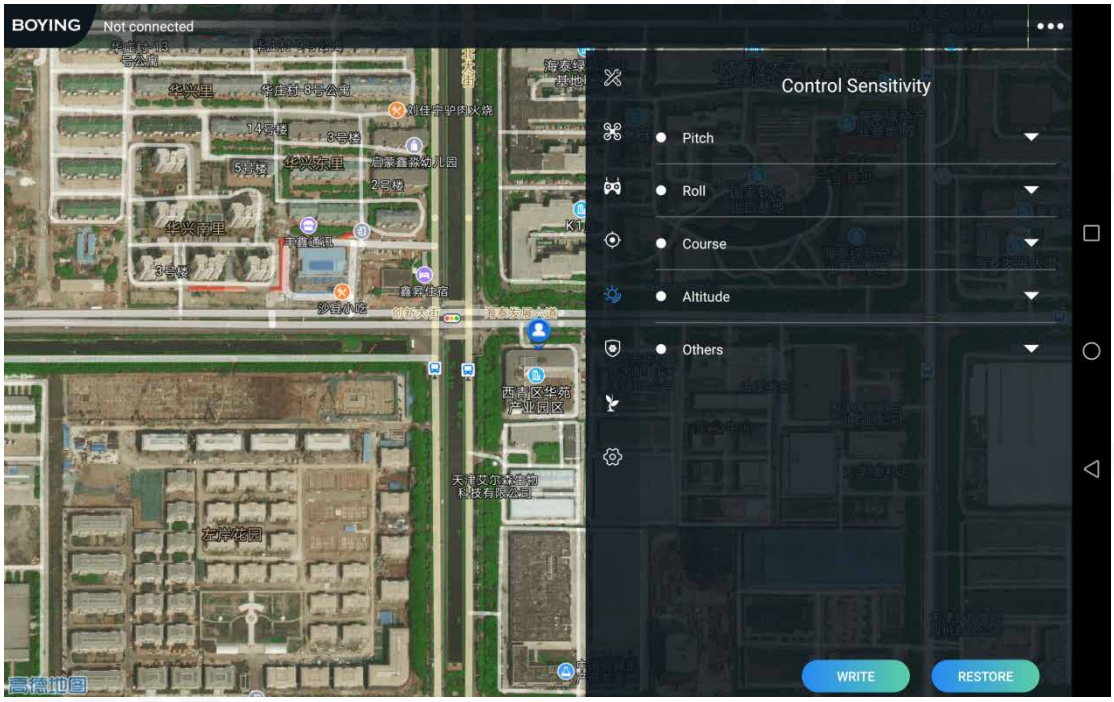


Calibration Setting

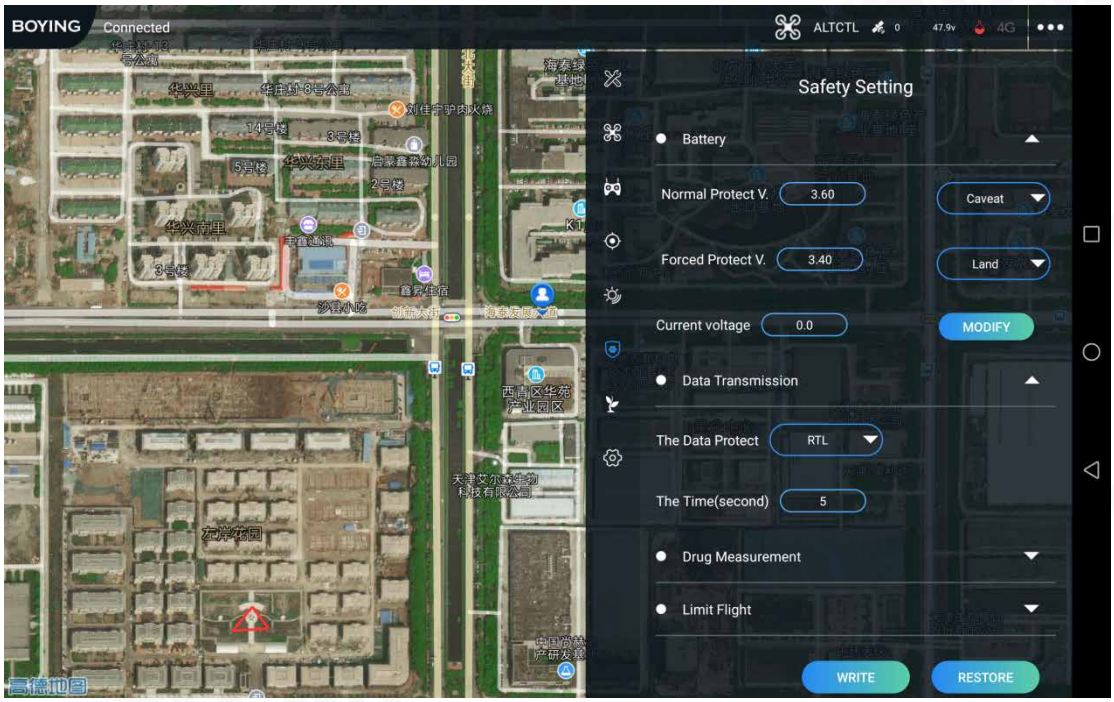
Calibrate accelerometer, horizontal calibration, dynamic balance correction.



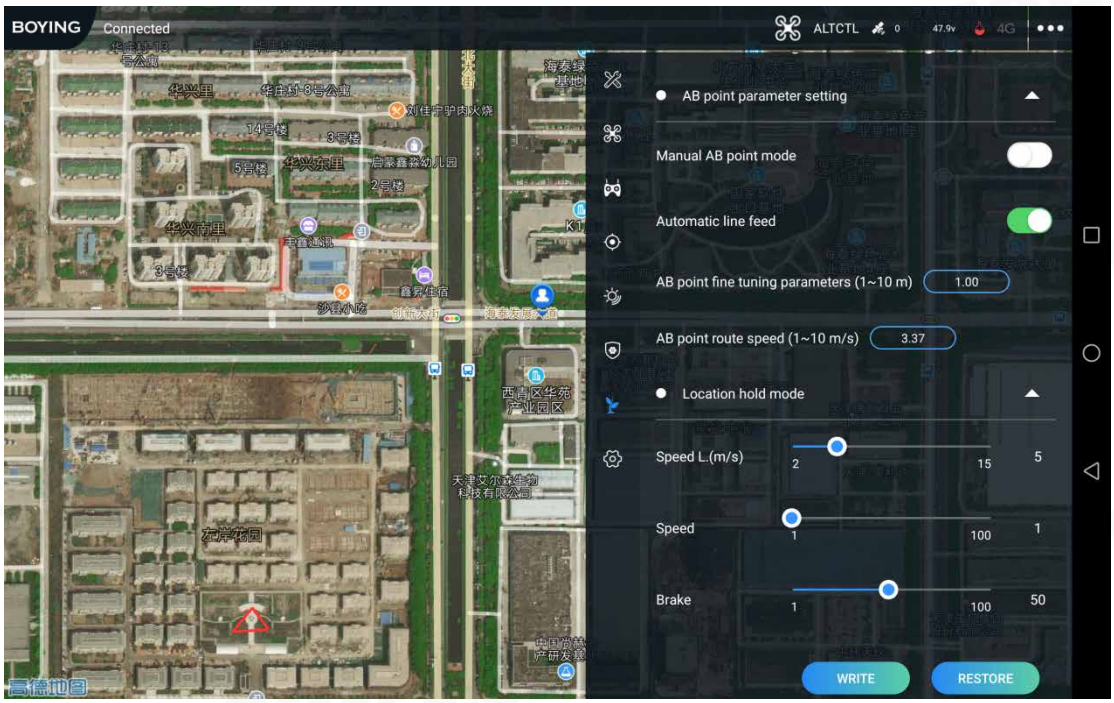
3.Control Sensitivity Setting



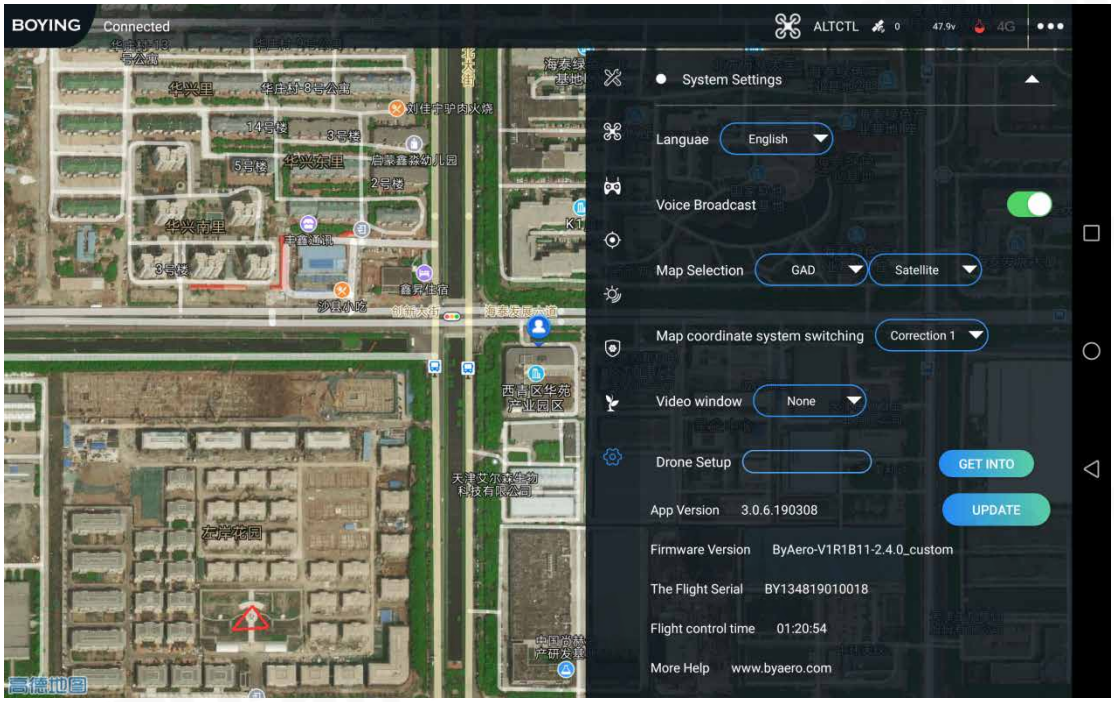
4.Safety Setting



5.Agriculture Plant Protection Setting

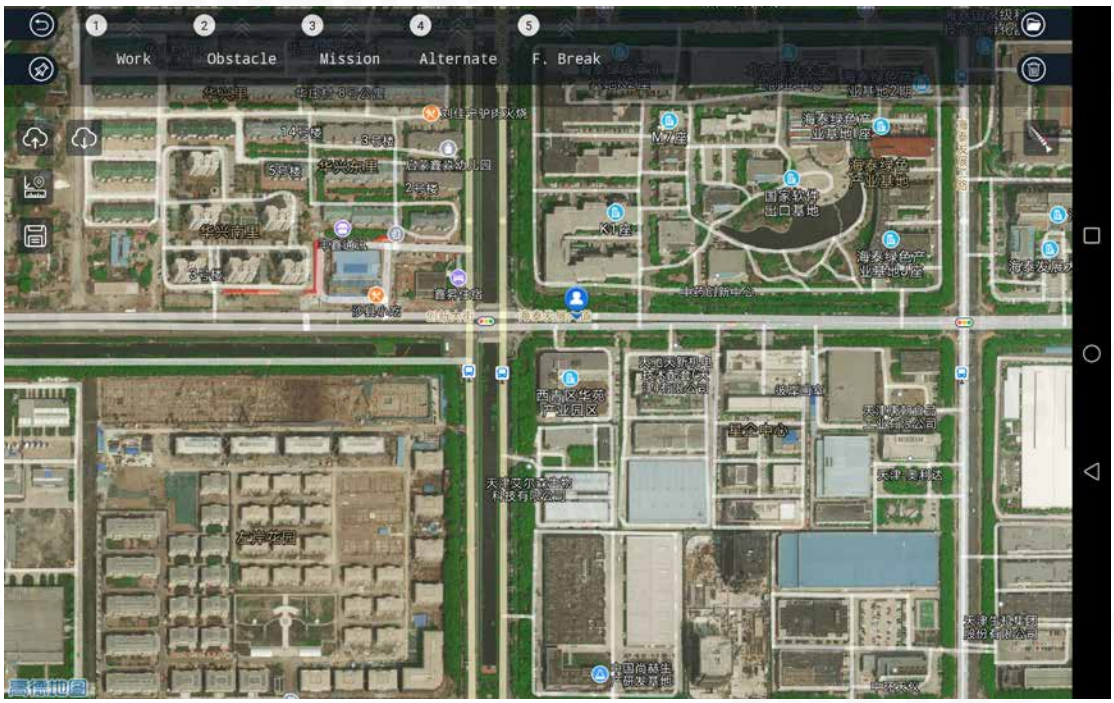


6.System Setting(including system version etc.)

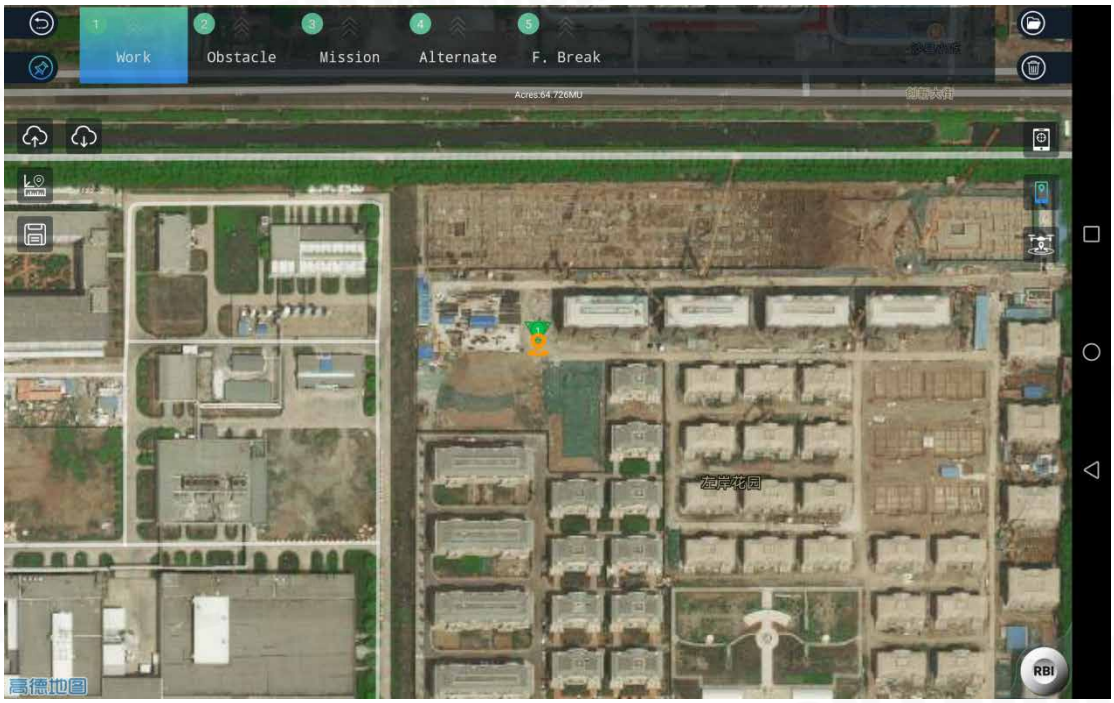


Route Planning

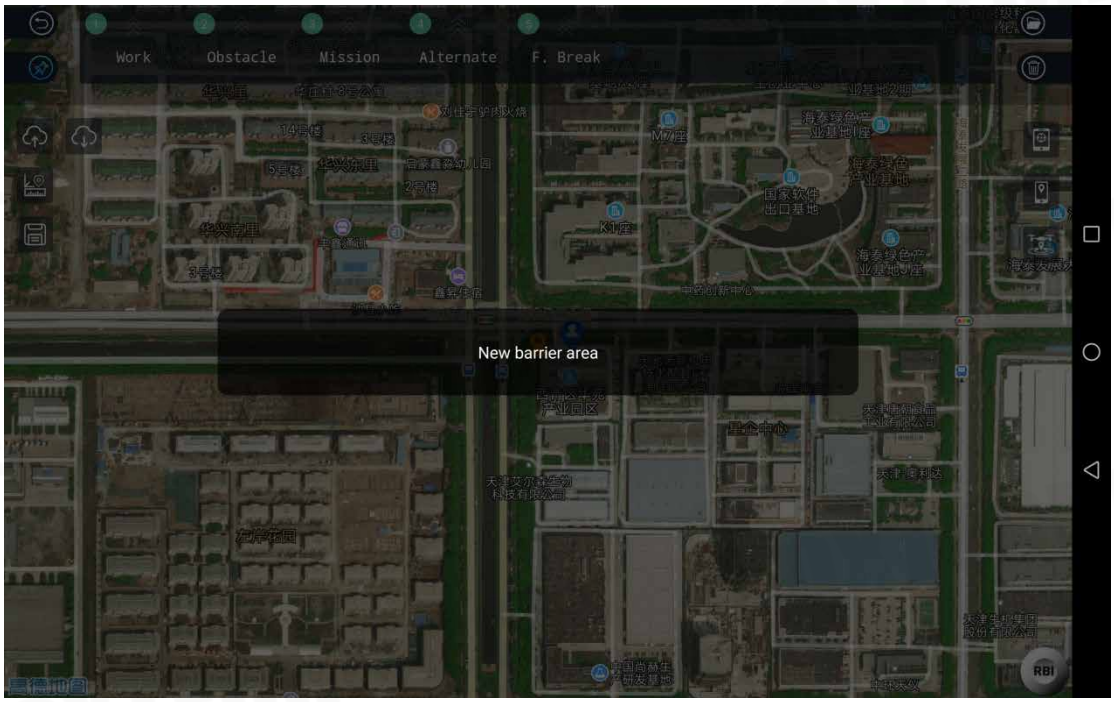
1.Click  enter the route planning interface.

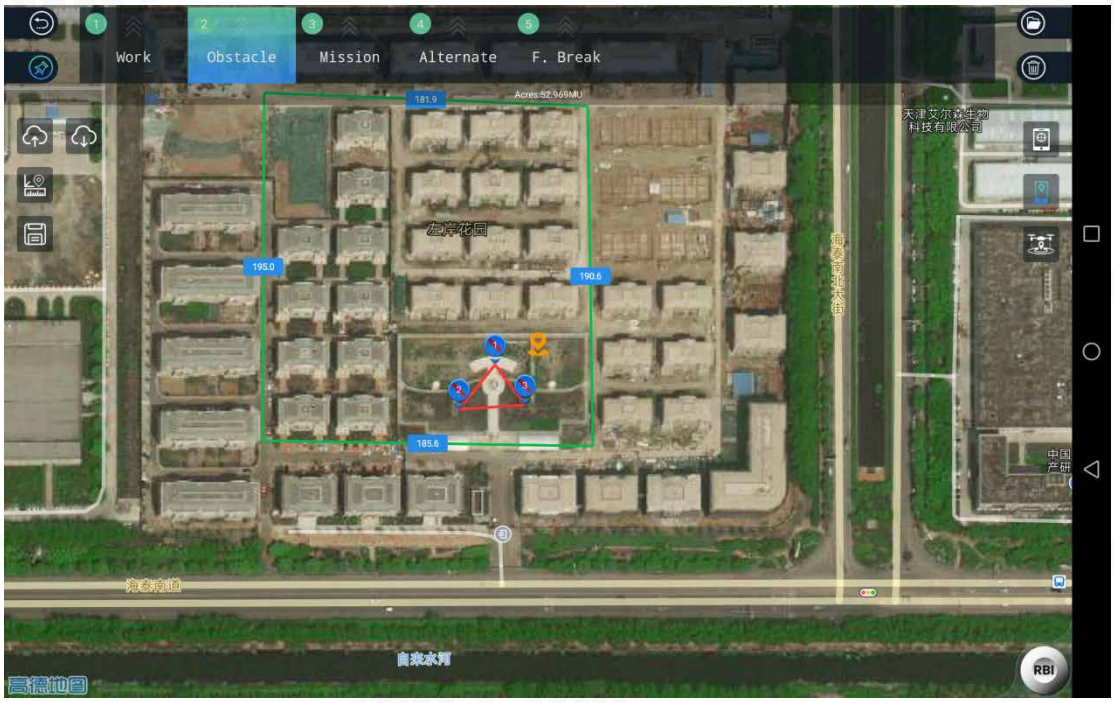


2.Click  Enter the mark mode, then select 1. work (working area), select the mark mode on the right side, from top to bottom there are 3 modes: the mobile phone GPS positioning mark, mobile map manual mark, aircraft GPS mark. Click the  , start to mark. Use green lines and green markers as the edge of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



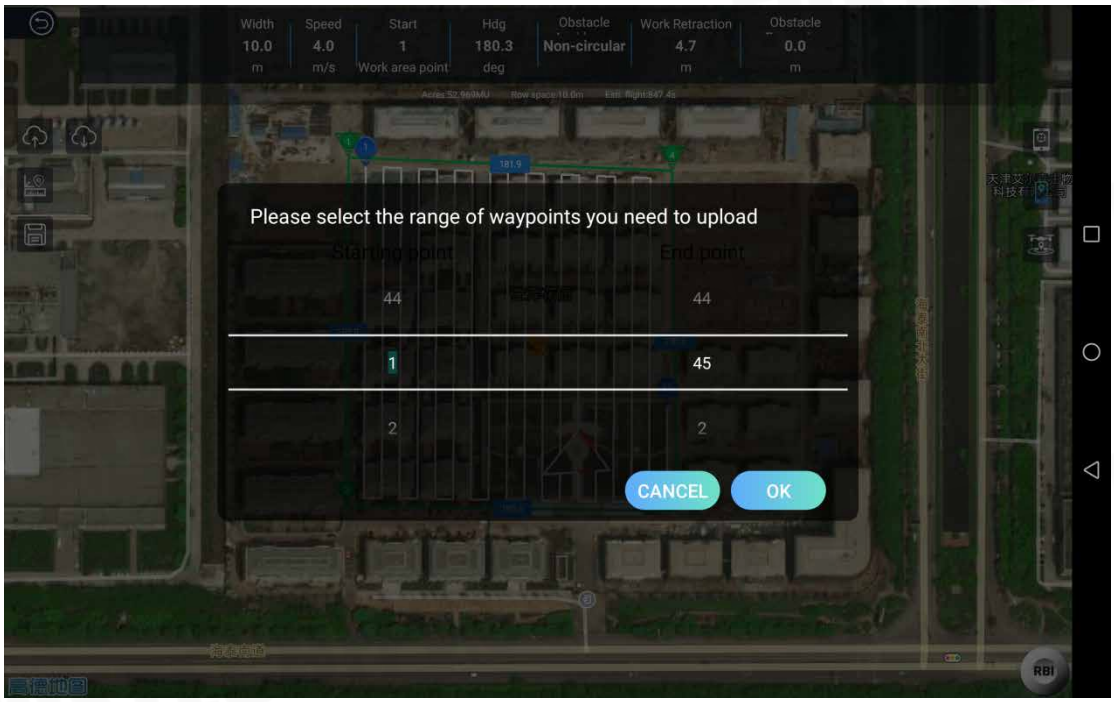
3.Mark the obstacle area in the work zone. Click  enter the marker mode, then select 2 Obstacle obstacle area select to create new obstacle area (multiple obstacle areas can be created), select the mark mode on the right side, from top to bottom there are 3 modes: the mobile phone GPS positioning mark, 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).



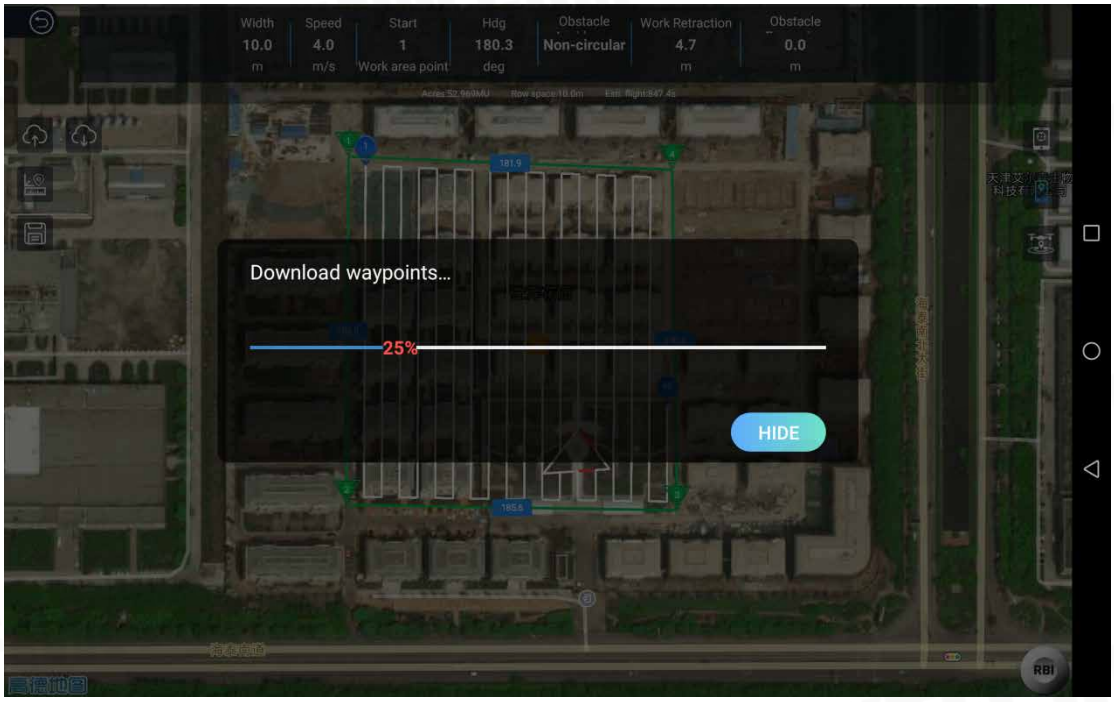


4.Click the  on the left to generate the route the top parameters can be edited separately. From left to right: the route interval, flight speed, start position of the route, route angle, obstacle avoidance scheme, overall retraction of the work area (m), Expansion of obstacle area (m).

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

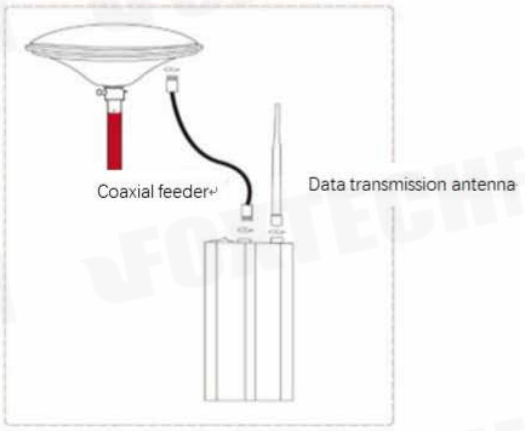
1.Click  to exit the route editing interface.

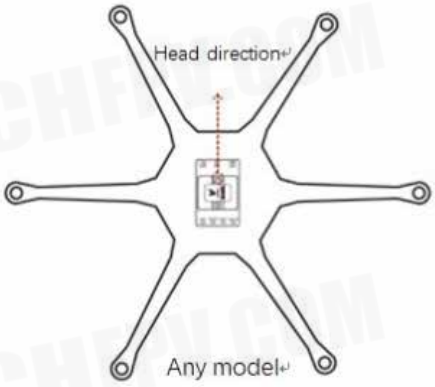
2.Click  , the aircraft takes off automatically, the height is 2m.

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.

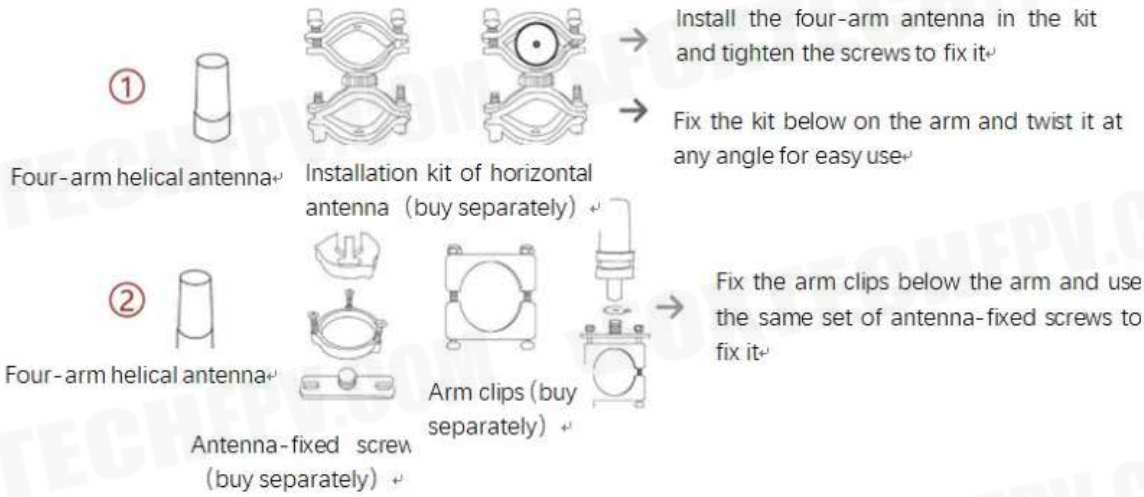
RTK Use Instructions

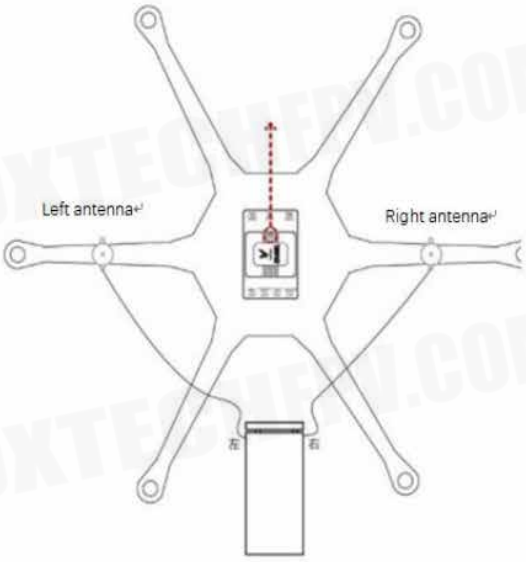


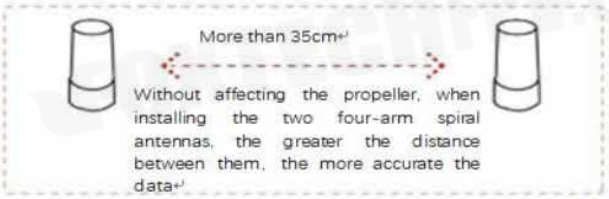


Determine the head direction by the arrow on the flight control

Installation method of four-arm helical antenna







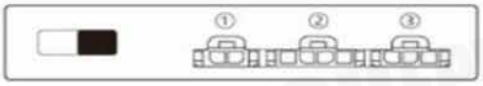
Without affecting the propeller, when installing the two four-arm spiral antennas, the greater the distance between them, the more accurate the data.

In connection with the head direction, there are the left antenna and the right antenna, the left antenna corresponds to the left interface and the right antenna corresponds to the right. When connecting, antennas should not be overlapping, do not install cross in order to make sure the right direction.

RTK Airborne terminal

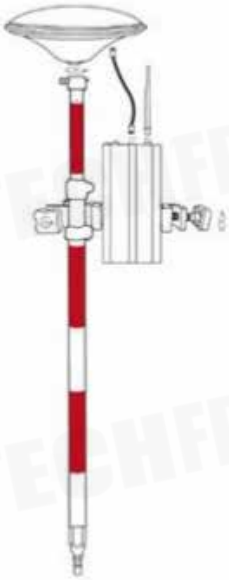
It must be put in the cabin after connecting (pay attention to waterproof), connect other devices according to sockets.

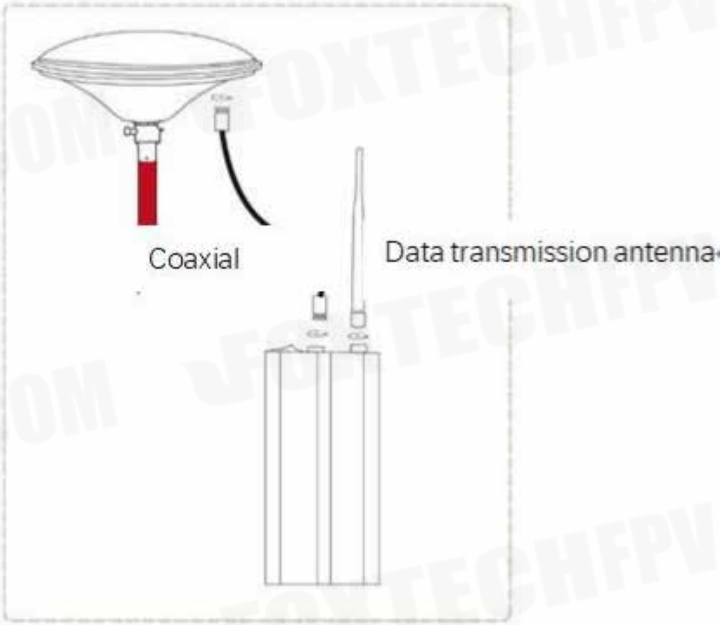
Other devices interface below the airborne terminal



① Power
② RTK flight control
③ RTK data transmission

RTK handheld terminal





Software terminal connection method

RTK work flow

Turn on your mobile phone Bluetooth then match the devices with the default password 1234.

1. First work

Connect your mobile phone and the base station and save the position of the base station.

·Purpose of saving the position of the base station: In order to fix the position of the base station when working in the same area the next time. It can ensure accuracy of navigation if the base station is in the same position(less than 5m) in the same region using the same route. If the situation doesn't match, the accuracy of navigation will be reduced, but it won't affect the work. So you should select whether it needs to fix the position of the base station, if not, you don't need to save the position.

Specific methods of operation:

Switch the "route planning" interface on your mobile phone, and click "connect RTK base station"

·When prompted "connection XXX success", it means that Bluetooth connection is successful.

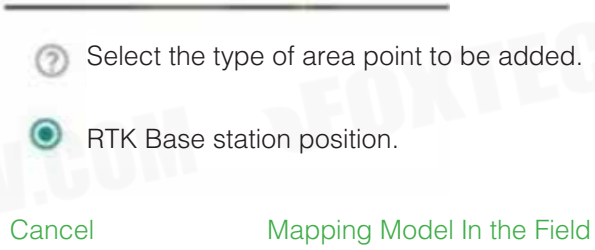
When prompted "connection XXX failed", it means that Bluetooth connection is failed.

·When prompted "receive RTK base station data successfully", it means that the data we received is right.

·If it's prompted "receiving data" for a long time, it means that Bluetooth connection is successful, but it hasn't received effective data, please wait.

If RTK base station data is right, the position of RTK base station will be displayed on map at real time (blue point).

If you click the  , as shown below will appear:



Click "mapping model in the field", then click  , the position of RTK base station will be displayed on map  . at the same time, the ground station will save the position as file (in Boying-GCS/RTK/ , the suffix name is .rtkbase). You can mark many points on map, every point you mark will be saved as file separately. After marking points of position of the base station, click "disconnect RTK base station" in the upper right corner.

Concise Operation Process

1) check power cable and cable between peripherals and flight control;
2) launch ground station, and launch BY-GCS ground station;
3) switch on RC remote control equipment;
4) switch on the aircraft system and connect to the ground station;
5) calibrate the remote control, if it has been calibrated, skip;
6) calibrate the electronic governor(Do not install propellers.), if it has been calibrated, skip;
7) start the function of motor test on the ground station, and make sure the whirling and the serial number of motors match;
8) calibrate the accelerometer, if it has been calibrated, skip;
9) calibrate the magnetic compass, if it has been calibrated, skip;
10) set flight model;
11) set protection of being out of control;
12) check if there is any warning from the ground station, analyze the reasons and solve it;
13) check if key data is normal such as attitude data, course data and GPS data, and move the aircraft to observe whether change of data is normal;
14) check installation of external GPS and compass;
15) check installation direction of the flight control and damping;
16) check whirling direction of motors and propellers and check if they are installed firmly;
17) toggle switches of flight models and observe whether the displayed area in flight model on the ground station switches normally;
18) set route tasks and upload, then download them and make sure the route has been planned right; If you have any question, don't force it to fly, please contact the technician.

- Only when the position has been decided by GPS can you unlock it in the fixed-point model.

Precautions

Due to safety concerns, here is what you should pay attention to before using:

Environmental factor precautions:

1) Try to be familiar with the flight environment and be far away from the obstacle and the crowd when flying
2) Don't fly when in low spirits.
3) Don't fly after drinking wine or taking psychotropic drugs to avoid causing accidents because of human factors.
4) Don't fly in thunderstorm or windy weather to avoid the damage of equipment and the danger of flying.
5) If you need to use it in glare, please use sunglasses.
6) Be far away from high-temperature heat source to avoid damage to the electronics.
7) Beginner should be taught by experienced pilots before using.
8) You should prepare necessary tools before using, such as wrenches, screwdrivers, spare propellers, telescopes, walkie-talkies, sunglasses, first aid kit and so on.
9) Don't overload, or it will cause damage to the aircraft structure and fly dangers.
10) Be far away from propellers rotating at high speed,
11) Check every device before flying, if the key devices don't work normally, and don't force it to fly, or it will cause accidents.

Equipment factors precautions:

1) We suggest that you had better debug the aircraft when propellers are not installed, check if the remote control and motors work normally, and then install propellers if everything is ok.
2) Keep the accelerator the lowest before flying.
3) Check if there is any interference on the same frequency among devices.
4) The 2.4G antenna has weak ability of avoidance, please keep a good visibility between antenna on the aircraft and on the ground station while flying. Put the ground station at a height and keep the antenna up when using, and keep the antenna on the aircraft down as possible so that it can increase the distance of transmission.
5) Check if every device works normally.
6) Make sure the life time of your battery matches your needs, such as the battery in your remote control and your aircraft.
7) Check if whirling direction of propellers is right.
8) Follow the instructions strictly.

Failure Analysis

1) Cannot unlock
a. The accelerator is not set the lowest.
b. The tilt angle of the aircraft is too large.
c. The signal line of the receiver doesn't connect well, or it has connected to the wrong interface.
d. Observe the warning from the ground station and check if sensors and the remote control have been calibrated.

2) When do you need to calibrate the magnetic compass
a. If you have moved or disassemble the flight control or GPS,
or it's far away from the region where you calibrated last time,
or the magnetic field has changed a lot.
b. You can check if the data from the magnetic compass is right, for example, if the aircraft turns around, the course will change 360 degrees, and observe if the course data from the ground station is with the actual match.

3) Rotating speed of motors doesn't match when you increase the throttle.
a. If the throttle is too low, rotating speed of motors doesn't match, but it matches after you increase the throttle, it's a normal phenomenon. If motors still don't match after you increase the throttle, you need to calibrate the ESC again.

4) rotate after taking off or flip
a. Check if propellers are installed correctly.
b. Check if the whirling direction of motors is right.
c. Check if the dynamic equilibrium of the aircraft is well. You can reference the "troubleshooting center" on our official website to get more failure analysis, or you can contact us for technical support, we will answer timely.

After-sales Service

Warranty regulation

·If the malfunction is caused by products quality, BOYING will offer limited quality assurance in the circuit part.

·Since the date of purchase, six months is the shelf life based on the proof of purchase.

·If it's within the warranty period and within the warranty, BOYING will offer free replacement or maintenance service.

Not covered by the warranty

·Not follow instructions provided by BOYING when installing or operating.

· Performance problems caused by man-made improper operation or chemical agents.

·Performance problems caused by the unofficial part.

· Electronic equipment performance problems caused by water.

·Performance problems caused by private modification.

·Performance problems caused by electronic interference.

·Performance problems caused by using poor quality power or using nonstandard input voltage.

· Damage caused by human factors (such as handling, operating error, collision and so on).

·Damage caused by irresistible factors outside world (such as earthquake, typhoon, thunderstorm, fire and so on).

Installation of Ground Station and Drivers

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:

Install data transmission driver:
The first method: If your computer is in a networked state, access the data transmission radio, drivers will be loaded automatically.
The second method: If your computer hasn’t link to the network, unzip “BOYING data transmission drivers” to the root directory of C, then access the data transmission devices on the ground station, it will prompt that it could not find drivers.
Specific steps of loading drivers are as shown below:
a. Right-click “my computer”->”management”->”devices management”->”port”

b. Choose the driver with yellow exclamation point, right-click “update drivers”->”browse the computer…” choose the folder where to unzip the driver, click “next”. If installation fails, repeat it twice or more.

This content is subject to change.

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