

## Section1. The importance of ground test

★Details determine success or failure!

In the real flight, we always found such problems: some pilot did not close the parachute cabin door before the flight, and the door was open by the vibration of the motor; some pilot did not remove the cover of the camera before launch, so all the photos were black; etc. Some problems are related to the autopilot (but many people do not operate following the user manual), and many of them have nothing to do with the autopilot (some pilots are careless in the ground test; some do not want to “waste time”).

Because of the safety of the flight, we have talked a lot about the details of test and checking. This part is so important that we repeat one more time here.

★Limited to the article length, we only talk about the normal situations. But we recommend you to do:

1. Do a “opening box” test to the autopilot.

Mainly to check the power supply relationship and the servo control situation.

2. At least do a “No payload” test.

That is, do not carry the expensive devices such as camera on board, do not use big plane, only use normal parts and electronic airframe, setup the autopilot, RC Rx and data radio, fly in the sight range to test the manual control and the path flight, to ensure the autopilot can work normally.

3. In the first some time, do check everything carefully.

4. Do check carefully when the autopilot system is moved from one airframe to the other.

5. To those used often, reduce the steps if Ok. But to important steps such as checking the sensor data, must do them carefully everytime.

6. Use the default parameters if possible. Do not modify them too much. Do the settings on the ground if possible. DO NOT change the unfamiliar settings during the flight.

7. Check out the use manual and the tech files before the operation. Beginners should ask for help from the skillful pilot in the beginning.

## Section2: “Opening box” test

If you are the first time to use this autopilot system, please setup the system only after reading the related tech files carefully. Here is a simple method to test the autopilot when out of box. It is used to make the customer to know about the basic knowledge of the hardware, especially for the power supply, the servo, and the GCS.

1. Get the devices ready.

Open the box, and take out the autopilot and the related cables. You have to get other device, such as laptop, RC Tx and RC Rx, and 3 normal servos (act as AIL/ELE/RUD), ready. Suppose you had install the GCS and the USB-RS232 driver.

Connect them according to related tech files. And put the GPS close to the window. DO NOT connect the batteries at the beginning. In order to avoid some big mistakes. Connect the batteries later after get familer with the whole system.

2. Ground part

1) USB-RS232 converter

Install the USB-RS232 converter driver, and set the right COM port then your can

go to the GCS and open the data connection. Even you do not connect the dataradio to the laptop this time, you can press down the F2, or click "File->Open data connection" menu in the GCS. The "failed to Open COM port" will not come out.

#### 2) Power supply of the ground dataradio

The laptop is connected with the dataradio through the USB-RS232 dataradio and the standard ground dataradio cable. If the 12V dataradio battery is not connected, even the USB-RS232 converter is already connected with the dataradio, the indicator of the dataradio will not be light up.

To make it more safety, you can do 2 tests to get it clear:

First, leave the laptop un-connected, that is, do not plugin the USB-RS232 converter to the laptop, but to connected the dataradio battery to the standard dataradio cable, and the dataradio can get powered from the battery and the indicator is light up normally.

Next, leave the battery un-connected, and connect the dataradio to the laptop through the USB-RS232 converter and the standard dataradio cable, and find out that the indicator of the dataradio can not light up this time.

It is proven completely that the ground dataradio will not get powered from the laptop. Connect the battery using the standard dataradio cable, the laptop will not be burnt.

#### 3. On board part.

To make it simple, do not connect the ESC and the motor, and leave camera and some servos unused. It is enough to check out the situation of AIL/ELE/RUD only.

##### 1) The power supply of the autopilot

First, leave the servo battery un-connected. Use the autopilot battery only, connect it to the 12V power input interface of the autopilot, and then the autopilot indicator will light up.

##### 2) The power supply of the on-board dataradio.

The on board dataradio shares the same battery with the autopilot. There is no pin for the Vcc of the dataradio in the autopilot interface board, but for its Tx, Gnd and Rx. Because the power interface and the data interface of the on-board dataradio are separated. In the standard data cable, there will come out a two pin cable to get powered from the 12V autopilot battery.

Ensure the indicator of the autopilot is lighted up.

If the power cable of the on-board dataradio is not connected right, its indicator will not light up, even the data cable is connected to the autopilot already, the indicator will not light up without power supply.

Ensure the power cable of the on-board dataradio is connected right, and the indicator lights up. Open the data connection in the GCS, and the telemetry data can be downloaded and shown in the GCS, refreshing in a certain frequency.

Check the working states of the GCS.

Roll the autopilot to a different attitude, and the AI meter will change to related states.

##### 3) The power supply of the RC Rx

First step: Connect the AIL/ELE/RUD servo to the RC Rx. But Keep communication

of the working mode change channel and the autopilot.

In this time, if the RC Rx is not powered by the battery directly, and its power cable does not connect to the 5V power output of the autopilot, then, it can not get powered actually. No matter how you move the Sticks of the RC Tx, the 3 servos will not response. And on the same time, No matter how you change the position of the 3 way switch of the working mode change channel, the GCS will not show any information like “the working mode is changed” .

The next step, Ensure the autopilot indicator lights up, then connect the power cable of the RC Rx to the 5V output of the autopilot (if there is a indicator in the RC Rx, then the indicator will light up), and move the sticks of the RC Tx, you will find out that the 3 servos will response to the sticks movements. You can change the working mode and see the related change in the GCS data. But the servo data related to the 3 servos will not changed because the related servo input interfaces are unused.

#### 4)The power supply of the servos

Ensure the autopilot indicator lights up, and the RC Rx is powered on (If there is a indicator, then it should light up).

Disconnect the connection between the RC Rx and the servos. Connect the AIL/ELE/RUD output of the RC Rx to the Related input of the autopilot, but keep the related output of the autopilot to the servo un-connected.

In this time, move the sticks of the RC Tx, and the GCS servo data will change according to the pace of the sticks.

Then connect the servos to the related output of the autopilot. Note that if you do not connect the servo battery to the related input of the autopilot, no matter how you move the sticks of the RC Tx, the servos will have no response without powering.

#### 5)The The mixing of the servos.

Cancel all the servo mixing settings in the RC Tx, and set it to the fixed wing mode.

In the “Flight parameter setting” dialog in the GCS, set the airplane layout to “normal layout” . “Send” out the msg to the autopilot, and then the you can change the AIL data in the GCS via the AIL stick separately, the same to the ELE channel and RUD channel. The same to servos.

Similarly, set to “flying wing” layout, and “Send” it out, then move the AIL stick separately, the AIL and ELE servo data in the GCS will be changed in the same time. The same to servos.

#### 4.Simple test of the waypoints

Set a simple path, upload it to the autopilot, then select the path on the GE map, and down the path from the autopilot.

### Section3:The working procedure in the normal conditions

#### 1.Simple outline

Step1:Setup the devices.

Step2:Open the Power supply of the Ground Station. Open the GCS and press down F2 to

open the COM port.

Step3:Open the RC Tx, and power the on-board devices. The telemetry data will be received and shown in the GCS in 3 seconds.

Step4:Check out the sensor data.DO NOT forget to do the vibration damping test.

Step5:Checkout the batteries data.Ensure there are enough power to support the normal working states of the deveces.The autopilot battery volt is about 11-13 volt normally.

Step6:Check out the RC Tx and RC Rx.

To the RC Tx,,cancle all the mixing settings,and do the servo reverse,capture the servo key positions.Check the parachute servo.Check the switch of the working mode changing.Check the related data in the GCS.eg:”parachute open”,”manual mode chang to auto mode”,etc.

To RC Rx,check if the F/S can work:Shut down the RC Tx,and the “fliht mode” in the GCS should be changed to “Auto mode”.

Step7:Reverse the servo,capture the key positions,

Step8:Take off the airplane manually,and capture the neutral positions of AIL/ELE/RUD.

Step9:Set a test path.Test the system in sight range.Adjust the PID parameters.

Step10:Fornal flight.Capture images following the preset path.

Step11:Recycle with parachute,and get the photo POS data.

## 2.Details

### 1)Setup:

Install the airframe after setup the devices.Connect the wings to the body.Fold the parachute and put it to the right cabin.Note to test if the connection between the parachute and the airframe is firm enough.

### 2)Ground test (working with the GCS)

See if the communication of the dataradio is OK.Check the COM port connection.And check the hardware situation of the dataradio.

The GCS data should be refreshed continually after opening the data connection.

Change the working modes of the RC tx,and check if the ralated data in the GCS can be changed.

Close the RC Rx in the GCS,and check If the flight mode will change to auto mode in the GCS data.

### ①Check sensor data.

#### I. Accelerometer

The “Down acc” should be around 1g.The “back/right acc” should be around 0.

The static angle get from the acc data,should match the real attitude.

Vibration test:Move the THR stick to different positions(eg;top,a point between top and middle,middle,a point between middle and bottom,bottom).And keep it there for a while(eg,20seconds).If the related data in the GCS is zero all the time,and we consider the vibration damping is OK.But if it change once duiring this time,then must redo the damping.

#### II.Airspeed and baro altitude

The baro altitude should be close to zero.and the airspeed should be in the range of 0-30km/h.

Airspeed meter:Blow to the pitot tube,but note to keep some distance between the mouse and the pitot tube.The value should be little than 100 km/h.

#### III.GCS and gyro.

When the QTY of the located GPS satellites are more than 5,we consider that the GPS location is finished.The GPS time should match the local time after that.

The autopilot will start to calculate the formal attitude using IMU data and GPS data.If difference between the formal attitude and the static angle is little that 5deg(0-4deg),then can take off the airplane,if not ,zero the gyro.

To zero the gyro,get into the setting mode of the GCS,and do the initialization operation.Quit after that.

Move the airframe (shut down the THR first) and roll it,check if the AI meter data will match the real attitude.

#### IV.Battery volt.

Set the low battery volt to the autopilot battery and the servo battery.

Input the max volt values.

②Servo reverse settings.

③Capture the servo key positions

Max THR, Min THR, and THR hold.

Key positions of gimbal servos.

Parachute open/close.

More options,that is flap piston.keep them level.

④Test flight

Capture the neutral position of the AIL/ELE/RUD.

Roll the airframe via the sticks,check if the AI meter data matchs the real situation.

⑤Auto take off.

⑥Recycle by parachute

Get out the POS data before cut down the power supply.

#### Section4:problem solving

##### **1. The motor of the gasoline engine stop running.**

###### **1)The sign of failure**

**The RPM meter value is always zero,and the related value in the flight data is zero eith.In the same time,the real flight altitude is reducing fast.Please note that the RPM data is no meaning to the electronic airframe.**

###### **2)Reason**

One is mistake in operation,the other is motor failure.

###### **3) Solving method**

If the flight altitude is high enough and the flight control is Ok,and the distance to the launch point is small,then there should be some possibility to glide back to the launch point.We recommend you to change the target point to #1 (the default home point),to make the airplane glide back to the launch point.Then use the RC Tx to land it.

If the distance is too far,or because of other reason that the airplane can not glide back to the launch point,then ,change target waypoint to #1 first,and glide back heading the launch point as close as possible.Open the parachute to land it when the altitude is too low.

## 2. Altitude reduce too fast

### 1) The sign of failure

The real altitude data (including the meter data and the number value) reduce fast.

### 2)Reason

Reason 1 is servo failure,reason 2 is sensor failure,reason 3 is the downdraft.

### 3)Solving method:

If it is caused by the servo failure obviously,then open the parachute to land ASAP.

If it is caused by the sensor failure(can be checked out in the GCS data),the open parachute.

If there is enough altitude,you can watch for a while.but if the situation can not turn well,then open parachute ASAP.Ensure to stop the motor (the aircraft can glide for a while after the motor stop running when working in the auto mode) before there is still enough altitude.And open the parachute soon.

## 3.Low battery

### 1)Sign of failure

The TTS, or the related Volt data in the flight data bar shown in red color.

### 2)Solving method:

Change the target waypoint to #1 at once when the low battery situation is found out. In normal situations, there will be 20-30 minutes left during the time point to sign low battery to that of no any battery. If the airplane can not fly back to the launch point, then open the parachute ASAP.

## 4.GPS satellite lost

### 1)Failure sign

TTS, or the related GCS data shown in red color, and the number reduced from bigger than 5, to smaller than 5.

### 2)Failure reason

Reason1:signal interference,reason2: Mechanical failure(eg the antenna is loosen).

### 3)Solving method

Keep the altitude hold state if possible.To leave the area that with possible signal interference first.Check if the GPS location recovered again.If the situation can not turn well in a while,then open the parachute to land.

## 5.Airspeed too high.

### 1) Sign of failure

The attitude data changed too much in the GCS,the real airspeed value is out of normal range(close to zero or too big).

2)Failure reason: Changes in the weather.

3)Solving method:Try to change the flight altitude,to make the airplane to fly in a place that with lower airflow (eg:fly in much higher place).

## Section5:Safety problems

## 1. Cable loosen

### 1) Risk

Common phenomenon: Power cable loosen, signal cable loosen, gnd cable loosen, GPS antenna loosen. Will cause crashes.

### 2) Warning

All the cables should be connected firmly.

Eg: Some cables are taken apart before sending out according to request of the post office. They should be fastened again using some tools, eg: screwdriver.

Eg: If the autopilot is placed in a wet place, the pins will be possible to get rusty. So you need to check the working volts before the flight.

## 2. GPS antenna loosen or short-circuit.

### 1) Risk

The attitude accuracy will be reduced after the GPS location is lost. And, the autopilot can not do the navigation with accurate position data.

### 2) Warning

It is not enough to fasten the GPS antenna by hands only. Better to use some tools to help.

The vibration of the gasoline engine may cause the loosen situation of the GPS antenna, and lead to the GPS location failure. Need to check the GPS location situation carefully before launch. Ensure the GPS location keeps good states, no matter how you roll or rock the aircraft, the GPS satellites are working well.

## 3. Gyro failure

### 1) Risk

Gyro failure will cause a wrong attitude calculation, and lead to a crash.

### 2) Warning

The gyro is a sensitive part, it may be damaged when there is a big collision in the landing. Check if the formal attitude (get from multi-sensor data fusion) matches that of the static angle (get from Accelerometer).

It is not a must to zero the gyro in normal conditions. But for some reason (temperature change, no use for a long time, latitude change too much, etc), the zero point of the gyro may get too big drifts to cause a bad attitude calculation.

When the QTY of the located GPS satellite is equal to or bigger than 5, the formal attitude data will be calculated and show in the AI meter in the GCS. Keep the airplane still, and compare the static angle and the formal attitude, if the difference is bigger than 5 deg, than zero the gyro. If the difference is smaller than 4 deg (0, 1, 2, 3, 4), than it is safe to launch.

If the gyro data is still not right after zeroing it for many times, then there should be some hardware problem in the gyro. Contact the factory for a repair.

PS: When the airplane is doing big movements, then the static angle will not be effective.

## 4. Vibration damping does not take effect

### 1) Risk

The reason that Vibration damping does not take effect: The damping device is damaged, or the vibration damping of the motor is not good.

The Accelerometer data is not accurate enough if the vibration damping is not good, and the autopilot can not get the right attitude data to control the airplane.

2) Warning

Check the vibration situations after a big collision.

Try to use the standard vibration damping mount from the factory.

### 5. Baro sensor damaged

1) Risk

A crash may be caused if the baro meter can not work well when on the ground.

2) Warning

Gyro, baro meter, such sensors are sensitive hardware, they may be damaged in big collision during the time of launch and landing. So we need to check their situation in every flight.

When the airplane is on the ground, the altitude value should be around 0 meter, and jump in the range of -3~+3. The temperature should match the real value in the cabin and lower than 50 deg.

### 6. Wrong servo reverse settings

1) Risk

The stabilization function will not take effect in the auto mode in this situation. May cause a crash.

2) Warning

DO NOT set the servo reverse in the RC Tx.

Ensure the manual servo data in the GCS is matched with that of the stick movements.

Check the GCS data and the servo surface later.

In this time, to the flying wings, the two differential servo surfaces will move up or move down in the same time, if not, replace the related cables from the servo to the autopilot. Or reverse the "mixing" item in the servo reverse dialog.

After replacing the connection or reversing the mixing, then, move up the ELE stick, the two differential servo surfaces should move down in the same time. Move down the ELE stick, the differential surfaces should move up in the same time.

Move the AIL stick to the left, the left differential surface will move up, and the right one will move down in the same time. Move the AIL stick to the right, the left differential surface will move down, and the right one will move up.

To the V tail, should check if the stick movements are matched to those of the servo surface. Move the ELE stick, and the two differential servo surfaces should move up or move down in the same time, if not, there are also two methods to solve this problem. One is to replace the connections of the two channels between the servo and the autopilot. The second one is to reverse the "mixing" channel in the servo reverse dialog.

If the reverse setting is right, then, move up the ELE stick, and the two differential surfaces should move down in the same time. Move down the ELE stick, and the two differential surfaces should move up in the same time. Move the RUD stick to the left, and the two differential surfaces should move to the left in the same time. Move the RUD stick to the right, and the two differential surfaces should move to the right in the same time.

## 7. Wrong key servo positions

### 1) Risk

If the key servo positions (AIL neutral position, ELE neutral position, RUD neutral position, Max THR, Min THR, THR position to stop the motor running, Open parachute, close parachute, etc) are wrong, then the motor maybe burnt, the battery maybe short-circuit, and leading to a big crash.

### 2) Warning

You can capture the neutral positions anytime if the RC Rx is open. But for safety reason, we DO NOT recommend you to capture the key positions (except those of the AIL/ELE/RUD neutral positions) in the sky. Better to do most of them on the ground before the flight. Note to capture them in the manual mode.

To the neutral positions of AIL/ELE/RUD, ensure the manual servo data in the GCS is in the middle position when releasing the related sticks.

To the Max THR and Min THR, will come out a msg box if the operation is OK. The autopilot will limit the THR to in the range from Min THR to Max THR during the flight.

THR hold (to stop the motor running) is important too. When the parachute is open, the autopilot will send out the stopping signal to the motor in the same time, so that the aircraft can be landed nearby.

But we recommend you to stop the motor before opening the parachute in normal conditions.

Ensure the parachute servo will not be stuck when opening the parachute. If the parachute servo is stuck, then the servo battery maybe short-circuited, and all the other servos can not work.

## 8. Batteries too low or in short-circuit

### 1) Risk

The plane maybe crashed, no matter witch battery is in short-circuit (or the battery volt is much lower than the normal range).

### 2) Warning

The batteries are important components. Must ensure they can work well before the flight.

## 9. The path not confirmed before the flight

### 1) Risk

The airplane may get lost if the path is not confirmed.

### 2) Warning

The preset path maybe lost in the uploading procedure.

Check out the QTY of the preset waypoints before the formal flight.

## 10. Other Mechanical failure of the airplane itself

### 1) Risk

All kinds of airplane failures, such as servo struck, rod broken, servo surface broken, motor stopping running, etc, may cause crashes.

### 2) Warning

Check every servo surface, screw, rod before the flight. Especially check if the servos are struck.

## 11.RC Tx signal out of range,or F/S setting wrong

### 1) Risk

When the autopilot still working in the manual mode, and the working mode can not be changed to auto mode when signal lost, then a crash maybe occur.

### 2)Warning

To check the control range of the RC devices, and the F/S settings before the flight.

## 12.Use wrong flight control parameters

Try to use the default values if you are not so familiar with them.

The screenshot shows a software window titled "Flight Control Parameters" with a blue header and a close button in the top right corner. The window contains various configuration fields and sections:

- RUD 4HZ:** P/128 (128), I/128 (5), D/32 (208)
- AIL:** P/128 (95), I/128 (5), D/128 (8)
- Pitch To ELE:** P/128 (95), I/128 (3), D/128 (8)
- ALT to Pitch:** P/128 (128), I/128 (2), D/32 (16)
- Mixing mode:**  Traditional,  Flying,  V taile
- Max Pitch Up:** 20
- Max Pitch Down:** 15
- Max Roll:** 45
- Takeoff Speed:** 60
- Waypoint Turn Range:** 100
- Circle Radius:** 200
- Parachute Open ALT:** 38
- Servo Transmission Ratio:** 12
- ALT-EN:** 1
- Max Offset Correction:** 25
- Offset-P/64:** 21
- Offset-D/64:** 32
- Takeoff Angle:** 1
- Original Angel:** 17
- Telemetry Frequency:** 1
- Photo Interval:** 50
- Max Gimbal Angle:** 0
- ALT Compensation:** -50
- Extended Parameter 2:** 128
- Refresh ROMboot (Debug):** 0
- Correction For Turn:** 10
- ALT to NAV:** 20
- THR Control Mode:**  Control Slowly (For Gasoline),  THR Hold,  PI Control (For Electronic)
- Gimbal Control Mode:**  Downwards Gimbal Max Angle,  Lock Gimbal
- AP orientation:**  Normal,  Wing
- Slope Style:**  Slope,  Not Slope
- Turing Mode:**  AILE Turing,  RUD Turing

At the bottom of the window, there are two buttons: "Get" and "Send".