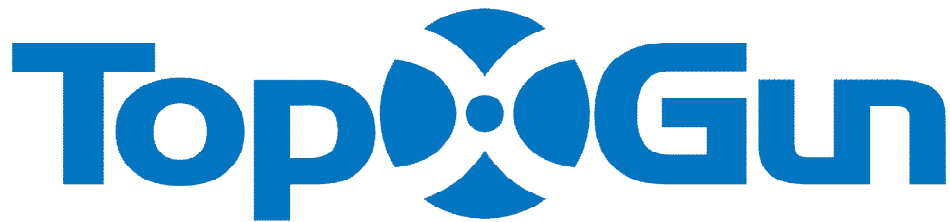# M2 Multirotor Flight Controller

User Manual V1.1

Using Firmware V2.0 & Assistant Software V2.0

Revision date 2018.04

Shanghai TopXGun Robotics Co., Ltd.
www.TopXGun.com

What you need to know before using?

Please strictly follow the requirements of this manual to install and use this product. The TopXGun robotics official website (www.TopXGun.com) has a special page about M2. You can login to the web for the latest product information, technical support and user manuals. It is recommended that you should download and use the latest version of the user manual. If this manual is updated, no further notice.

You can also obtain product usage information or technical support through the official customer service phone, WeChat client, and Weibo client. We are dedicated to serve you. Due to different production batches, the appearance or function parameters are slightly different. However, these do not affect the normal use of the product.

Before using this product, please install the corresponding assistant software to your computer or mobile device. This manual needs to be used together with the corresponding assistant software. For more information, please refer to the instruction text on the assistant software. If there is inconsistency with the user manual, the assistant software shall prevail.

Disclaimer

Please read the instructions carefully before using this product. Once you start using this product, you are deemed to have accepted and accepted all the contents of this statement. This product is suitable for people 18 years of age or older.

This product is a flight control system for multi-rotor aircraft. In the case of normal power supply and correct connection, it can provide users with an excellent flying experience. When using this flight control system to debug parameters and perform firmware upgrades, we strongly recommend that you remove the propeller and ensure that the power supply is normal and that the corresponding functional module wiring is correct. When using it, be sure to keep away from people, dangerous goods, and fragile items.In case of direct or indirect personal injury and property damage caused by the following reasons during use, TopXGun will not be liable for compensation:

1. The user did not assemble and use according to the requirements of this manual;
2. The user manipulates the aircraft in the event of poor physical or mental conditions such as drinking, drug use, fatigue, etc.;
3. The user actively or intentionally manipulates the aircraft to create damage;
4. The user has used the non-overheaded accessories to personally modify the product and caused the aircraft to fail to work properly;
5. Injury caused by user error or subjective misjudgment;
6. The damage caused by the aircraft's natural wear, circuit aging, etc.

7. The user is still able to control the damage caused by the aircraft, while he knows that the aircraft is in an abnormal state of operation;

8. The user still controls the flight of the aircraft under severe weather conditions such as typhoon, hail and fog;

9. Users fly in magnetic interference areas, radio interference areas and government no-fly zones;

10. The user is driving the aircraft in a situation where the visibility is poor and the line of sight is blocked;

11. Users use this product to control the aircraft to obtain any data, image data, etc. caused by infringement;

12. Other losses that do not fall within the scope of the extension responsibility.

Intellectual property

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Certification

This product has passed FCC, CE, RoHS certification.

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Top✕Gun

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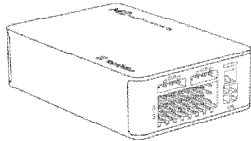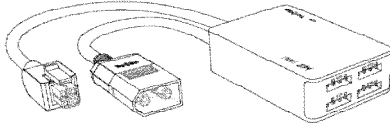
1 Introduction

1.1 Product Introduction

TopXGun M2 standard multi-rotor flight controller uses dual IMU and dual GPS/compass modules for high reliability. It is mainly applied to patrolling application scenarios such as aerial photography, power line inspection, security, police use, and traffic.

Product Features:

l   Standard dual redundancy IMU, dual GPS or compass module

l   Automotive gyro, high precision, high reliability, -40~125 full temperature calibration, strong anti-vibration performance

l   Automotive accelerometer, high precision, high reliability

l   GPS/compass module and LIU module, IP65 protection class

l   Industrial grade reliability, surge protection, anti-static level: 8000V

l   Independent control of flight controller core components to ensure flight safety

l   Black box function

l   3~14S power supply, a wider range of use

l   Double API open, serial port, CAN, building private function module

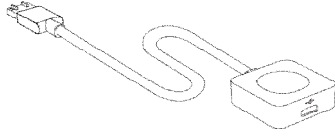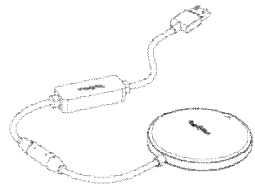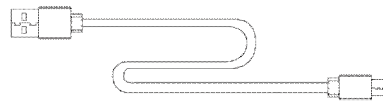l   Supporting remote landing function

l   New Assistant Software

1.2 List of Items in the Box

M2 Multi-rotor flight controller

Name	Amount	Schematic diagram
FCU Modules	1	
PMU Modules	1	

LIU Modules	1	
GPS/Compass module	2	
GPS/Compass module	2	
USB cable	1	
Micro USB conversing to 4PIN flat plug line	1	
Steering line	8	
3M double-sided adhesive	6	
Certification	1	
Quick guide	1	

1.3 Symbol Description

Universal symbols

Symbol	Significance	Instructions
⚠	Notes	Text starting with this sign indicates potential risks. Ignoring these texts can result in equipment damage, data loss, or other unpredictable consequences.

	Instructions	The text starting with this sign is the additional information of the text, which emphasizes and supplements the text.

LED symbol

Symbol	Instructions
⬤ N	Indicating that the lamp of ⬤ flashes "N" times.
{⬤ ⬤} N	Indicating that the lamp of" ⬤ ⬤ "flashes "N" times.
⬤ ∞	Indicating that the lamp of ⬤ continues to flash.
▬▬ N	Indicating that the lamp of ⬤ stays on for "N" seconds.

2 Installation and Commissioning

2.1 Hardware installation

Step 1. Determine the multi-rotor type and head orientation and install the motor and blades as shown in Figure 2-1.
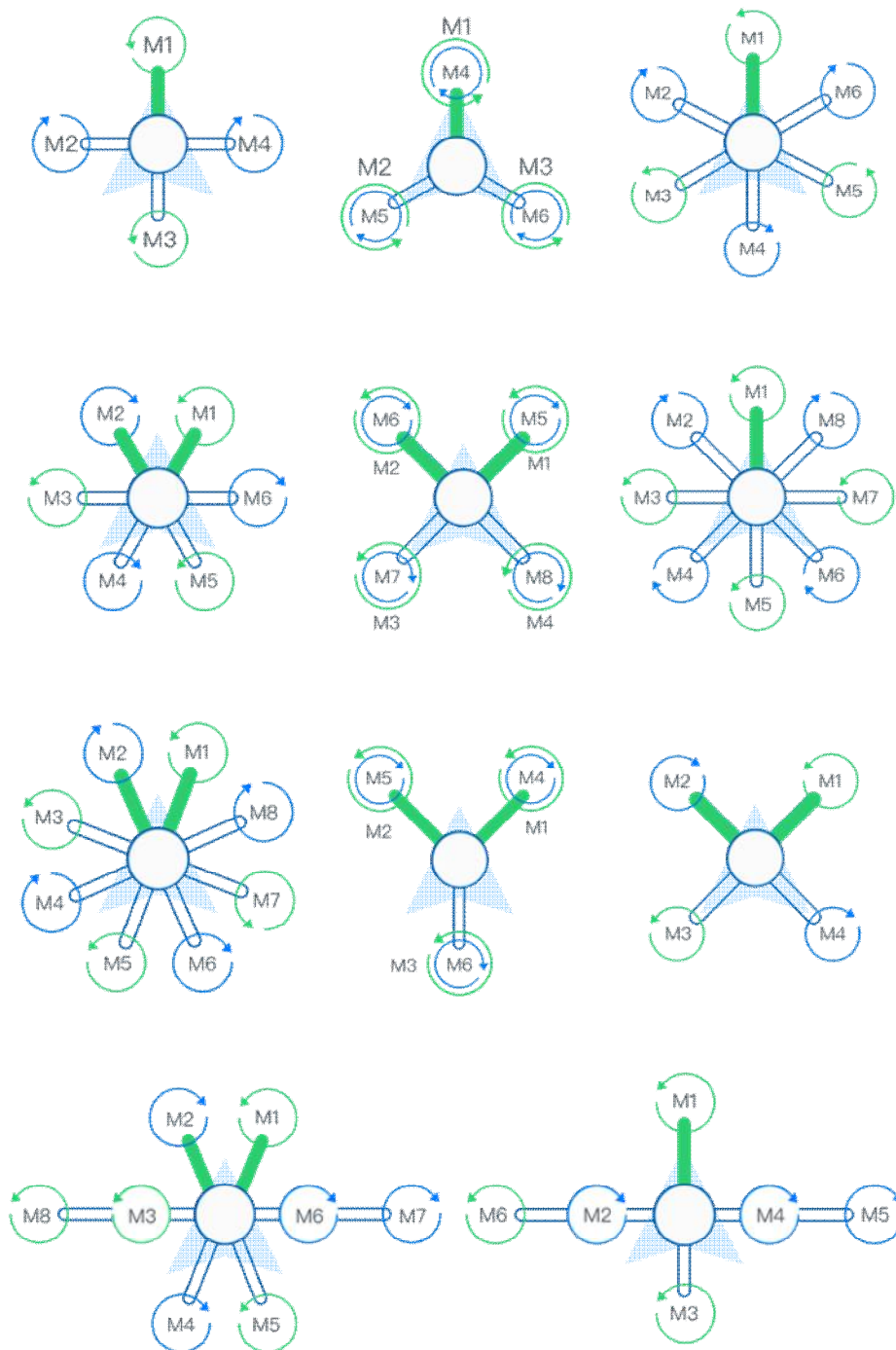
Figure 2-1 Determining the type of multi-rotor

Step 2: According to Figure 2-2, install the main controller and connect the line according to the requirements of "Installation Connection Instructions".
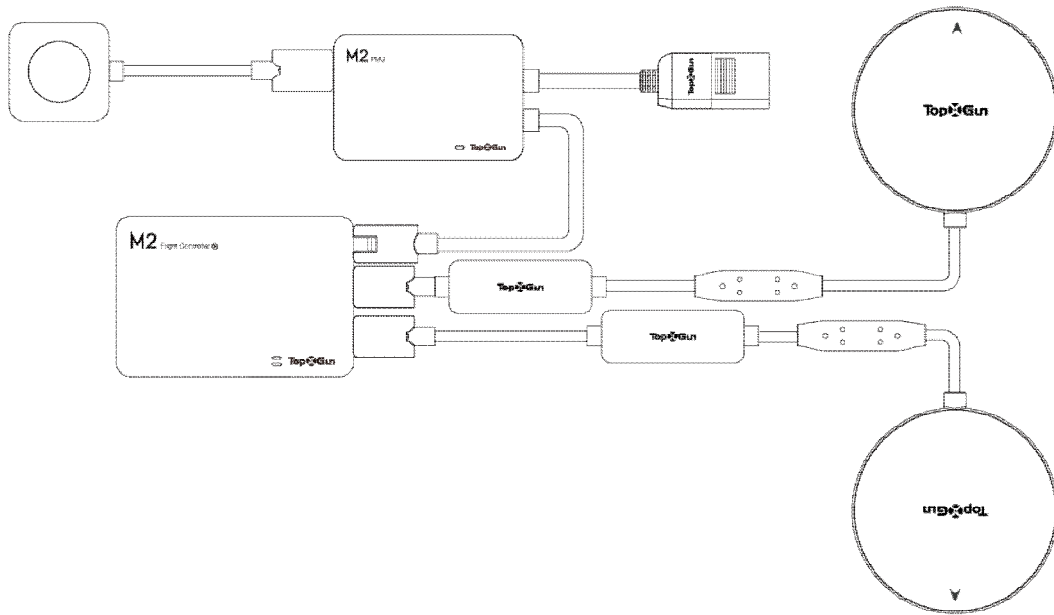
Figure 2-2 Connection diagram of the main control circuit

Installation connection instructions

l   FCU (master controller) installation

Installation location requirements

When installed, the M2 mark is printed with the side facing up, and the direction of the arrow on the housing remains the same as that of the aircraft head. In order to achieve the best flying effect, the main controller should be installed at the center of gravity of the center plate of the aircraft.

Port connection description

The FCU ports are shown in Figure 2-3 and Table 2-1.

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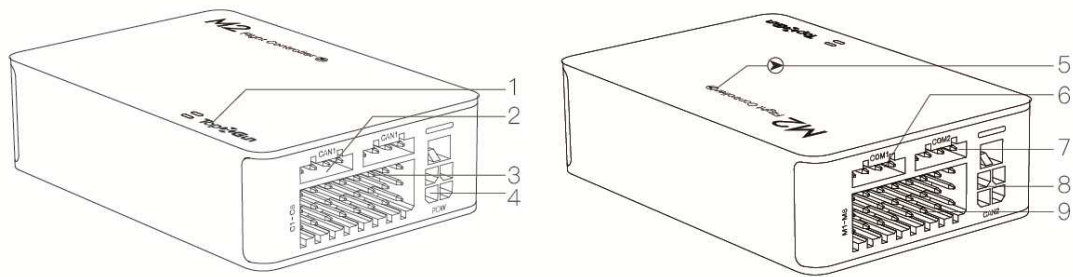
Figure 2-3 FCU Port

Table 2-1 FCU port connection description

No.	Instructions		
1	Front of FCU: This side is facing up when installed		
2	CAN1 interface: connect the main GMU and subordinate GMU		
3	C1~C8: PWM receiver interface C1: SBus and PPM Receiver Interfaces		
4	POW interface: CAN1 and power sharing interface		
5	FCU mounting arrow: pointing in the direction of the head during installation		
6	COM1 interface: digital interface		
7	COM2 interface: Open SDK API port		
8	CAN2 interface: as an API port for extending other peripherals		
9	M1~M8 Electrical adjustment interface (If the ESC with BEC output is used, the middle BEC power output line must be cut off)	Connecting GND	
		Connecting+5V	
		Connecting signal output	

l PMU module installation

Do not install it on any other electronic device to ensure ventilation and heat dissipation. Ensure that the four CAN expansion ports on the PMU are installed to facilitate the insertion and removal of the connectors.

> 💡 The four CAN expansion ports on the PMU have the same definition.

| GPS/Compass module installation

During installation, the TopXGun mark is printed with its side facing up. The arrow of the round casing is aligned with the direction of the FCU arrow. It is aligned with the direction of the aircraft head and is horizontally mounted on the GPS/Compass module bracket.

It is recommended to use the GPS/Compass module holder that comes with the package. If using another stand, make sure it is not magnetic.

⚠️	1, M2 flight controller set includes two GPS / compass module. When installing, connect two GPS/Compass modules to the two CAN1 ports of the FCU. 2. This module has a built-in magnetic compass. For magnetically sensitive devices, be careful to keep away from motors, ESCs, power batteries, and power cords during installation and use.

| LIU module installation

Install the LIU module in an easy-to-observe position, such as the rear of the aircraft, without obstructing the USB port. And use the attached 3M glue to connect it to any CAN expansion port on the PMU.

2.2 Assistant software installation and debugging

Preparation before installation and commissioning

The M2 flight controller supports PC tuning.

If you use a PC for tuning, you need to meet the following conditions:

| The PC system is Windows XP/7/8/10
| PC is connected to the Internet
| Download and install the latest driver and assistant software

Installation and commissioning steps

The following uses the PC-side assistant software as an example to explain the parameter setting procedure before test flight. For detailed setting methods, refer to the description of the assistant software embedded.

⚠️	For safety reasons, if the aircraft is equipped with a propeller, remove the propeller before commissioning.

| Step 1: Give the flight controller power.
| Step 2: Use the product's own USB cable to connect the flight controller and PC.

The PC will automatically detect the flight controller and connect it.

| Step 3: Select the model setting corresponding to the aircraft, as shown in Figure 2-4.
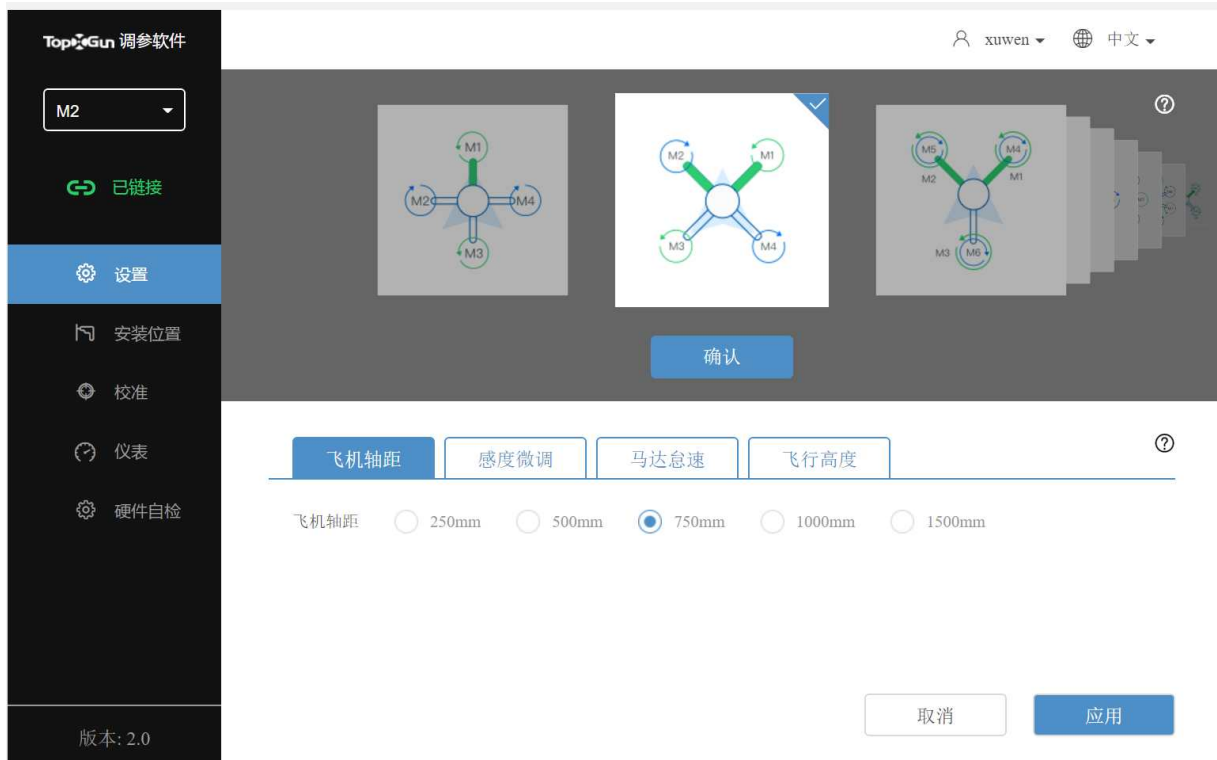
Figure 2-4 Model selection

	1) The green rotor indicates that it rotates counterclockwise when viewed from above. 2) The blue rotor indicates that it rotates clockwise when looking from above. 3) For upper and lower coaxial rotors, green indicates the upper rotor and blue indicates the lower rotor. 4) The bottom blue arrow indicates the direction of the aircraft nose.

Step 4. Set the remote controller input method and calibrate it, as shown in Figure 2-5 and Figure 2-6.

1. Select the receiver type.

2. Create a new fixed-wing or multi-rotor model on the remote controller and set 5 channels as a 3-stage switch. The 6-channel is a 3-stage switch, the 7-channel is a 2-stage or 3-stage switch, and the 8-channel is a 2-stage or 3-stage switch.

3. Click "start calibration" and turn the remote controller 1-4 channel joystick and

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5-8 channel switch to the maximum limit position and minimum limit position of each channel several times, then click "Complete Calibration".

⚠️	Unlocking is only possible if the remote controller is properly calibrated. Please check whether the forward and reverse directions of each channel are correct: l The aileron goes right, rolling the slider to the right l The rudder goes right, yaw slider goes right l The elevator goes down and the pitch slider goes right l Throttle lever goes up, throttle slider goes right If the directions are not consistent, click "REV" to set the reverse direction.

4. Switch 5~8 channel switches. Check whether the stop position corresponds to the control mode one by one and whether the return flight map is normal.

💡	If the receiver is not an SBus receiver, the remote controller must be set to runaway protection. When the setting is successful, if the remote controller is turned off, 1~4 channels maintain the neutral point position. 5 channels jump to the red "runaway" area, no need to set other channels. Please refer to the remote controller manual for specific operation.

Figure 2-5 Remote Control Settings

Figure 2-6 Remote Controller Calibration

Step 5. Set the sensitivity, as shown in Figure 2-7.

⚠️	It is forbidden to adjust the sensitivity during the flight. It is recommended to adjust the unlocked state.

1. Select the closest wheelbase to the rack. The M2 flight controller uses the default sensitivity to get a better flight status.
2. According to the assistant software's instructions, combine the aircraft's own state to fine-tune the sensitivity.

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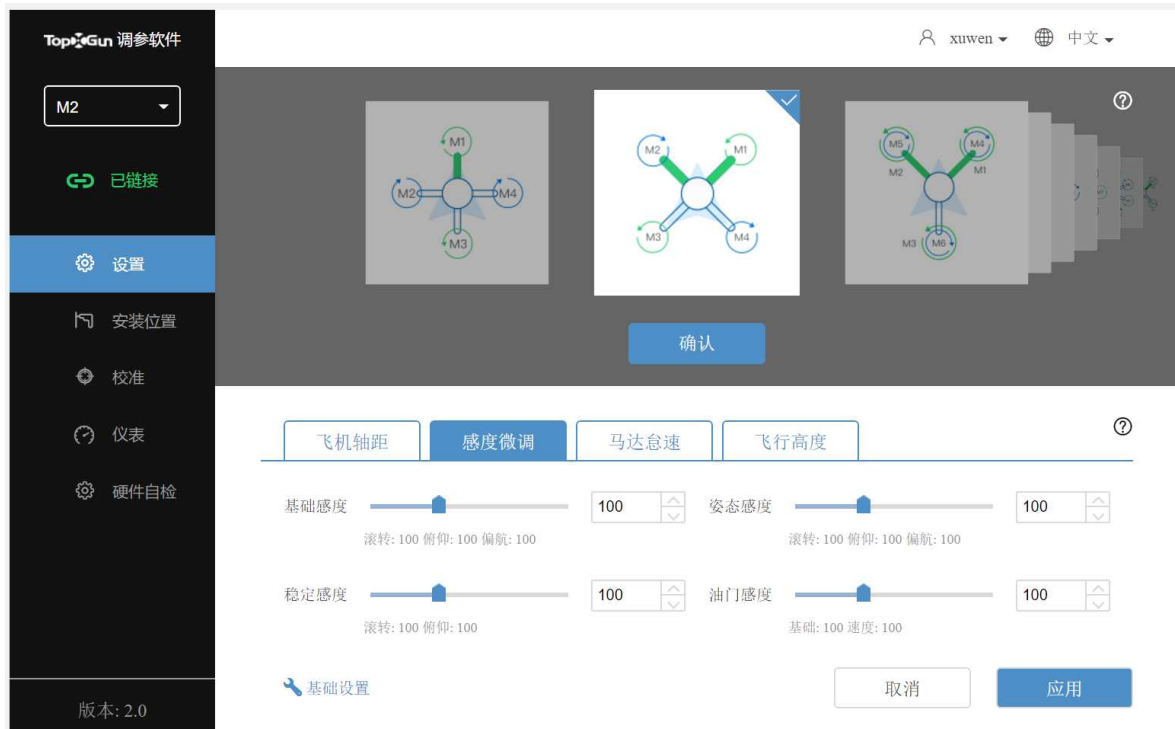
Figure 2-7 Operational sensitivity adjustment

Step 6: Set voltage protection, as shown in Figure 2-8.

1. Use a multimeter to measure the actual voltage value.

2. If the actual voltage value does not match the main measurement value, enter the actual voltage value in the box and click the "Calibration" button to calibrate.

3. Set voltage protection.

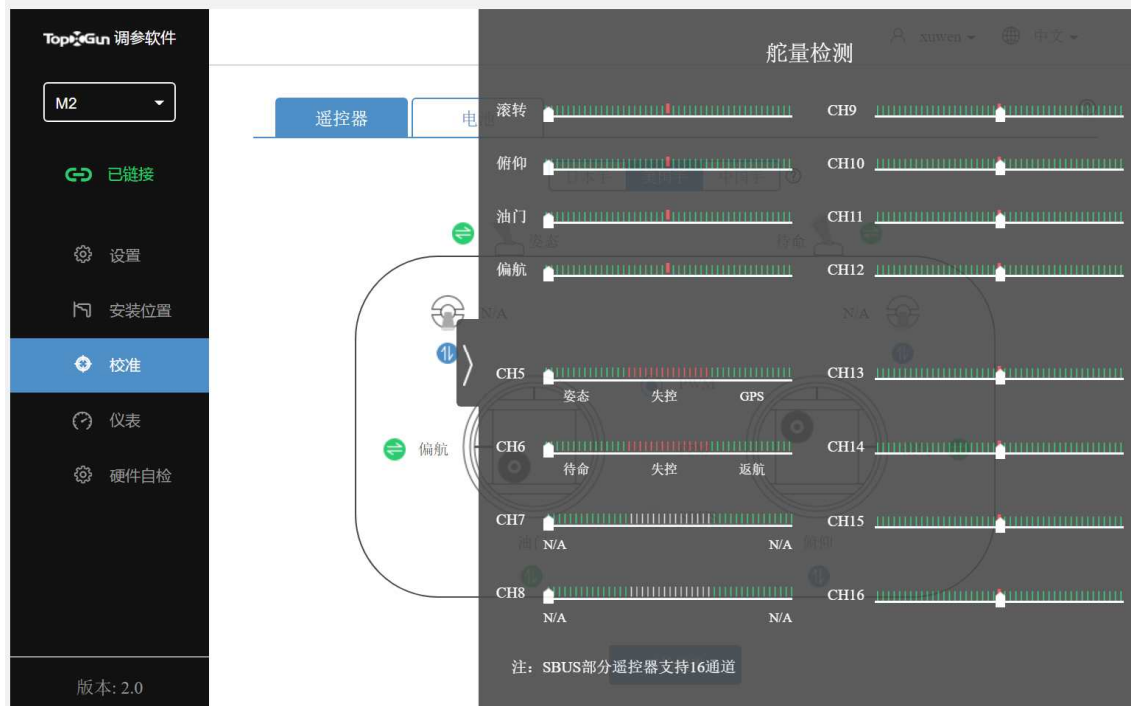If you do not need the flight controller to perform the low voltage protection action, you can turn it off. At this time, the flight controller will only flash the alarm when the voltage is low. The yellow light flashes for one level of protection, and the red light flashes for two levels of protection.

If you start the low-voltage protection action, you can further set the "first-class protection" to "landing" or "return." If the setting is "return flight", automatic return trip is performed when the primary protection is triggered. If the setting is "landing," an in-place landing is performed when the primary protection triggers. When the secondary protection triggers, the in-place landing will be performed automatically

	When the remote controller is out of control after the low-pressure protection is turned on: if "primary protection" is set to be "return to base", the aircraft will automatically return; if it is set to be "landing", it will perform to land in place.

Whether it automatically return to base or land in place, you could terminate low-pressure protection at any time by toggling 5-channel mode switch back and forth. (For the security reasons, it is strongly recommended that the appropriate low voltage value is set to ensure the enough batteries for the return of the aircraft. If the voltage is too low and the aircraft is short of power, it will cause the serious consequences such as a crash.

Fig.2-8 voltage protection setting

Step 7.   Set up the motor, as shown in the fig.2-9
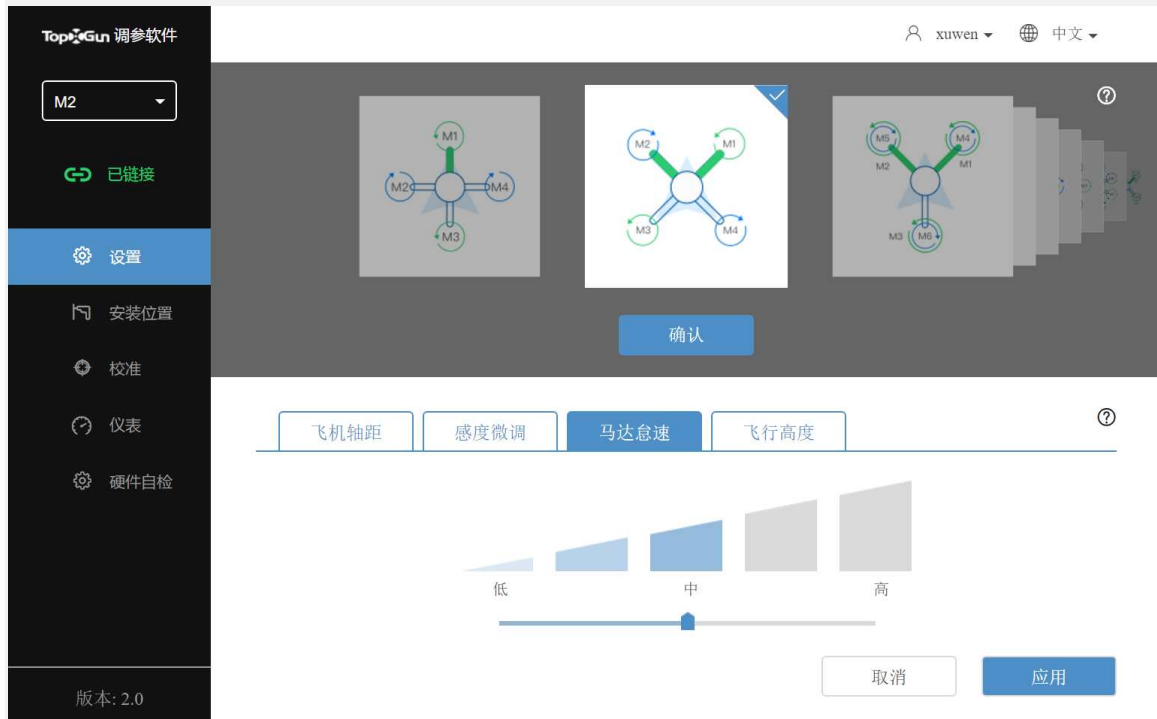
Fig.2-9 Motor related setting

Step 8   hardware self-test setting, as shown in the fig.2-10.
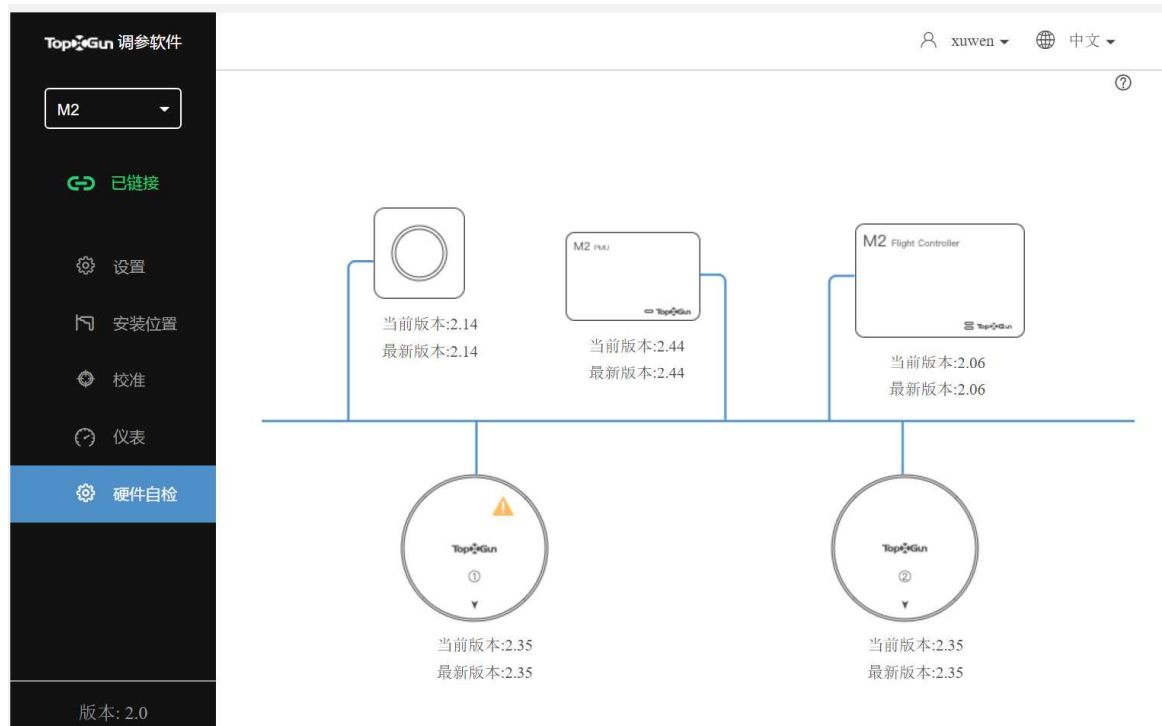
Fig2-10 hardware self-test setting

2.3   Unlock and lock

There is only one way to unlock M2 flight controller. Whether you are Japanese or an American , you must perform to unlock it as shown in the fig.2-11 and lock it as shown in the fig.2-12.

The throttle of the aircraft stays at its lowest level for at least 3 seconds after landing and the aircraft performs to lock automatically.

After M2 flight controller calibration adjustment is finished, the motor will rotate in proper sequence when it is unlocked.

When the No.1 motor starts running, you just push the accelerator and all the motors will start running at the same time.
The electric speed controller idle of DJI series is higher, when using the

recommended idling speed to unlock, there will be phenomenon of no idling speed for motor, which can be solved when it is adjusted from motor idle interface to high idle interface.
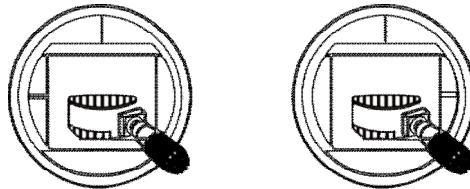
fig. 2-11 Unlock
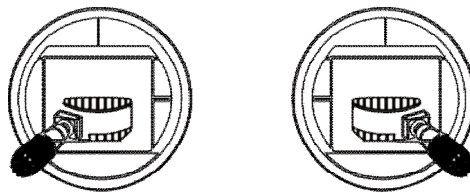
fig.2-12 Lock

2.4 Electric speed controller and compass calibration

The electric speed controller and compass could be calibrated by switching combination of 5-channel switches on the remote controller.

Electric speed controller calibration

⚠️ The aircraft propeller should be removed before calibration.

The operating steps for Electric speed controller are as follows:

Step 1. Push throttle to the highest level At this time, status indicator indicates current status GPS/Compass module and flight mode.

Step 2. Switch 5-channel switches back and forth at lowest level and highest level about 6 to 10 times until red light on status indicator is on.

Step 3. Keep the throttle position in place, disconnect general supply and then power on again.

⚠	If the power and flight controller are powered separately, you need to cut off the power first before applying the power to the electric speed controller calibration again, then disconnect the flight control power and finally connect the power after powering the flight controller on .

Step 4. After the power is turned on about 0.5 second, you will hear "beap-beap" from motor two times and then pull the throttle to the lowest level in 2 seconds. At this time, the state indicator red lights and blue lights are flickering alternately and then get into normal indication.

Operation chart is shown in the fig.2-13.
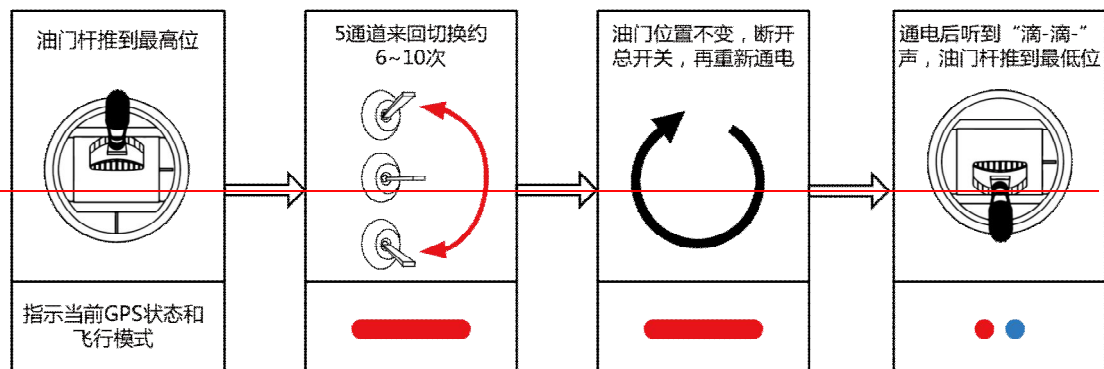
Fig.2-13 Electric speed controller calibration   2-13

After ESC is calibrated successfully, the motor will rotate in sequence when it is unlocked, otherwise recalibration is required. Because DJI series ESC idle speed is higher, when you apply the recommended idle speed to unlock the motor, there will be phenomenon without idling speed

Compass calibration

Operating steps of compass calibration as following :

Step 1. Push throttle to the lowest level

Step 2. Switch 5-channel button back and forth between the lowest level and highest level about 6-10 times until the red light and blue light of the state indicator are in long brightness.

Step 3. Forward the head of the flight and lay it on the horizontal position, then slowly rotate clockwise at least one full turn until the green light of the state indicators is on long brightness.

Step 4. Head down the flight and make the fuselage to be vertical, then slowly rotate clockwise at least one full turn until the white light of the state indicators is on long brightness.

The Operation chart is shown in the fig.2-14
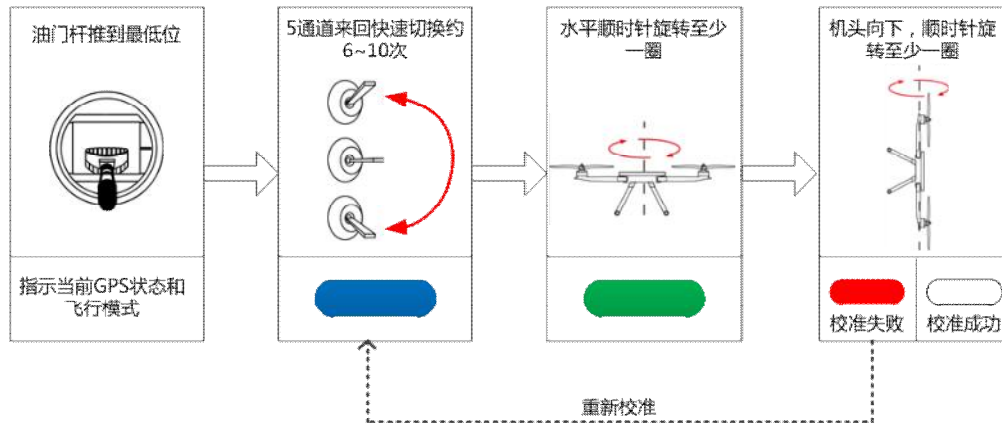
Fig.2-14 compass calibration

2.5 Horizontal Calibration

The operation steps of horizontal calibration is as follows:

Step 1. Lay the flight on the horizontal ground in order to ensure the fuselage level and viberation-free.

Step 2. Perform the outer eight characters lock on the remote controller and hold for more than 10 seconds until the status indicator starts flashing alternately with the blue green light

Step 3. Release the remote control lever . After about 10 seconds , the status indicator changes to a blue light single flicker , and after about 15 seconds , the status indicator light becomes normal .

The operation chart is shown in Figure 2-15

飞行器水平放置	执行外八字加锁动作，保持10s以上	松杆
指示当前GPS状态和飞行模式	🔵 🟢	🔵 ⟶ 正常闪灯
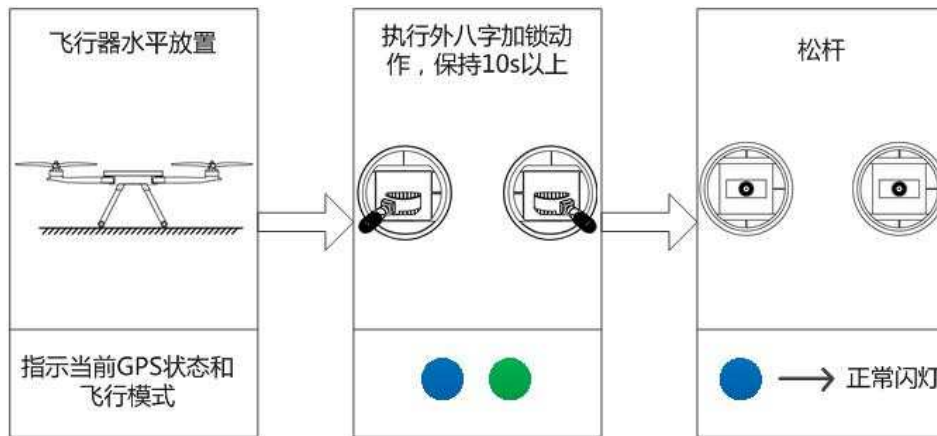
fig.2-15 horizontal calibration

If the aircraft is still severely side-slipping after taking off with gesture mode in the course of a subsequent flight, it is recommended to be reperformed horizontal calibration.

3 Flight test instructions

3.1 Flight modes and corresponding responses

M2 has a variety of use modes , aircraft performance will be different in different use modes. The measurement of lever in different modes corresponds to the movement of the aircraft as shown in table 3-1

Table 3-1 m2 Flight Controller Mode description

| Control mode	lever operation	Aircraft response
gesture mode	Roll / pitch	The roll / pitch angle of inclination is proportional to the input size of the lever
	yaw	Yaw speed corresponds to yaw lever input size
	throttle	The average output of the motor corresponds to the current throttle value, and throttle input occupies the maximum power.
GPS mode	Roll /pitch	Roll / pitch tilt angle corresponds to the lever input size, but the corresponding directional flight velocity is limited to be below the maximum horizontal velocity (12 m / s)
	yaw	Yaw speed corresponds to yaw lever input size
	Throttle	Keep Throttle corresponding height , and the amplitude of the throttle corresponds to the rising / descending speed .

3.2 Indicator light instructions

3.2.1 lIU lights indicator

1) In the table, r stands for red, g for green, b for blue, Y for yellow , P for purple, C for ching, W   for white;

2   The three primary colors of light are RGB, and the other colors are all synthesized from the three primary colors. At the same luminance, RG synthesize Y, RB synthesize P, GB synthesize C, RGB synthesize w;

3   The number in the color definition bar table represents the duration of the color status;

4   The column of times indicates how long will the status lasts, and ∞ indicates continuous flicker.

Definition	Color						Circulate frequency time/sec.	Circulate Number of times	Meaning	Explanation
Flight instruction	R2	0.1	0.1	0.1	1.7			0.5	∞	Manual mode GPS satellite<7	
	R1	0.1	1.9					0.5	∞	Manual mode GPS satellite>=7and low precision	
	G1	0.1	1.9					0.5	∞	Manual mode GPS satellite>=7 and high precision	
	R2Y1	0.1	0.1	0.1	0.2	0.1	1.4			Gesture mode GPS satellite<7	
	R1Y1	0.1	0.2	0.1	1.6			0.5	∞	Gesture mode GPS satellite>=7 and low precision	
	G1Y1	0.1	0.2	0.1	1.6			0.5	∞	Gesture mode GPS satellite>=7 high precision	
	R1P1	0.1	0.2	0.1	1.6			0.5	∞	GPS mode GPS satellite>=7 and low precision	
	G1P1	0.1	0.2	0.1	1.6			0.5	∞	GPS mode GPS satellite>=7 and high precision	
	G1G2	0.1	0.2	0.1	1.6			0.5	∞	Self-driving mode	
	R5	0.1	0.3					2.5	5	Self-driving mode reach the waypoint	
	G1R1	0.1	0.2	0.1	1.6			0.5	1	the nose heading locked	
	G1B2	0.1	0.2	0.1	1.6			0.5	∞	Returning point locked	
	B10	0.1	0.1					5	10	Take-off point have recorded	
Module indication	R1B1	0.1	0.1					5	10	System initialization completed	alternately
Alarm indication	Y1B1	0.1	0.1	0.1	0.2			2	∞	Remote controller is out of control	
	Y1G1	0.1	0.1	0.1	0.2			1	∞	Data of compass is unusual	
	Y1	0.1	0.3					2.5	∞	Alarm for the first stage low voltage	
	R1	0.1	0.3					2.5	∞	Alarm for the second stage low voltage	
Magnetic compass calibration indication	B0							Always on	∞	Start Compass Horizontal Calibration	Always on
	G0							Always on	∞	Start compass vertical calibration	Always on
	W0	White lig						Always on	4s	Compass calibrated successfully	

		ht						
	R1				Always on	4s	Compass calibration failure	

3.2.2 FCU   Indicator light instruction

There are four lamp positions on the module, which are at the same side of the pmu interface and the different side of the PMU, and on top of the outer side of the FCU ,and the top of the inside of the FCU.

1　PMU side: power indicator light, white, light is on when it is electrified ;

2　PMU different side: USB connection indicator light, light Is on when USB is connected

3　outside of the top of FCU: main IMU indicator light, seven colors; when enabled, the green light is always on, when backuped ,the blue light is always on, when it is abnormal, the red light is always on;

4　Inside of the top of FCU: subsidiary IMU indicator light, seven colors; when enabled, the green light is always on, when backuped ,the blue light is always on, when it is abnormal, the red light is always on;

3.2.3 GMU indicator light instruction

GMU There is a light position at the front arrow.

1　GMU   Before starting to search satellite: the blue light is always on;

2　GMU After starting to search satellite successfully: green breath lamp flashes;

3　GMU Magnetic compass data is abnormal after startup: the blue light flash by 2Hz ;

4　GMU After GMU start-up, GPS communication is abnormal: red light flashes by 2Hz; Alarm priority of magnetic compass is higher than GPS.

3.2.4 PMU Indicator light instruction

PMU Total 2 indicators are reserved on PMU, one is the power indicator light, when it is electrified, it will be always on, and the other one is a seven color lamp, it is used for indicating status.

1　PMU has input voltage detection function, if the input voltage is abnormal (not within the scope of design, exceed the upper and lower limits 10%), the yellow light will flash and alarm;

2   The output voltage should be monitored by PMU. If the output voltage (i.e. CAN bus voltage, standard 9v) exceeds the designing standard 3%, the red light will flash and alarm.

3   The green light is always on when the PMU voltages are working normally.

3.3 Initial flight test

Before the initial flight test, The following steps are recommended for pre-flight inspection and flight to ensure flight safety.

Pre-flight inspection

Please check the following in order to avoid flying accidents.

l   Head direction

l   GPS/ compass module GPS orientation

l   Main controller installation direction

l   whether the individual rotor steering match or not

l   whether all parts of the electrical connection secure or not

l   whether the type of aircraft is selected correctly or not

Self-test when it is electrified

For power-on checking steps as follows, please refer to "indicator light instructions" about the meaning of LED status indicator light.

Step 1. Turn on the remote controller and then connect to the main power supply.

⚠	After the main controller is switched on avoid shaking the aircraft as much as possible before the flash of { 🔴 🔵 } 10 combination light is completed Otherwise, it could cause a bad flight gesture.
	If the power and flight controller are separately supplied power, you need to disconnect the power first, and then disconnect the flight controller ; if you use the unified power supply, the flight controller will be powered up first, and then the power will be switched on until the flight controller is started-up.

Step 1. Observe the LED status indicator light, try to wait until the GPS/ compass module GPS search satellite normally and the position can be located, then continue the next step.

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Step 1. Switch the 5-channel flight mode button back and forth and observe whether LED lamp of the flight mode indication is consistent with the position of the mode switch.

Low altitude test flight

Step 1. Keep the aircraft at least 5 meters away from the operator and wait for the flight control system to search the satellite normally (the red flash light turns to the green flash light).

Step 2. Push the remote controller lever to the lower right corner under the gesture mode, the motor is unlocked, and starts up in turn from motor 1; If the throttle lever exceeds 20% during the course of start-up in turn, all motors will start-up immediately.

Step 3. After the motor is fully started, slightly push the throttle lever to be held at about 30% with slightly rolling and pitching rod, observing whether the acceleration trend of the motor is the same as the lever, if so, rolling and pitching rod return to the middle, then continue to push the throttle until the aircraft is off the ground.

Step 4. Feel the handling of each control channel below 2 meters height, if the response is normal, you can continue to tap the maximum potential of flight controller.

⚠️	After flight, you must check that if the temperature of the forward motor and the reverse motor are the same. If the temperature is not consistent, the aircraft may have the phenomenon of load imbalance, the propeller plane needs to be calibrated to ensure that the propeller plane is consistent.

4 Functional description

4.1 Out of control return

If you use an SBus receiver, you do not need to set out of control protection separately; if you use a PWM or PPM receiver, you need to set 5-channel as an out-of-control protection area (check that if it is set as the out-of-control protection area by turning off the remote control). See "step 4" in "the installation Test steps".

After the remote control signal is lost, the LED indicator changes to { 🟡🔵 } (∞) first, After hovering for 5 seconds, the aircraft will return to over the take-off point and land,locked. If the remote control signal recovers during this process, the aircraft will continue to perform automatically return; to interrupt the return action, the remote control 5-channel must be switched at least one time.

The aircraft will exit automatical return and automatically switch to the current flight mode corresponding to the remote control 5-channel.

4.2 Low voltage protection

You can set a low-voltage protection trigger threshold in the adjusting parameter software. The trigger threshold is the battery voltage value with load, so the battery measuring voltage after landing is generally higher than the trigger voltage you set when low-voltage protection is triggered during flight .

he low voltage protection has two levels. After the first stage low-voltage protection is triggered, the LED alarm is ⬤ (∞). The aircraft will automatically return or land in place according to the settings in the adjusting parameter software. (To set protection measures for primary low-voltage protection, please see "step 6" in the "installation and testing step"). After the two stage low-voltage protection is triggered, the LED alarm is 🔴 (∞). The aircraft will automatically land in place.

	l When the low-voltage protection function is implemented, it can only be switched to gesture mode or return mode. l After the automatic landing function of low-voltage protection is implemented, you can exit the protection action by switching to gesture mode.

4.3 Automatic return altitude statement

	l It is automatically returned to the home point when the altitude is above 100M and decreases uniformly until reach to the altitude of 100m above the home point, and then landing at a vertical uniform speed. l It is automatically returned when the altitude is below 100m, flight to the home point with translation uniform velocity, and then landing at a vertical uniform speed.