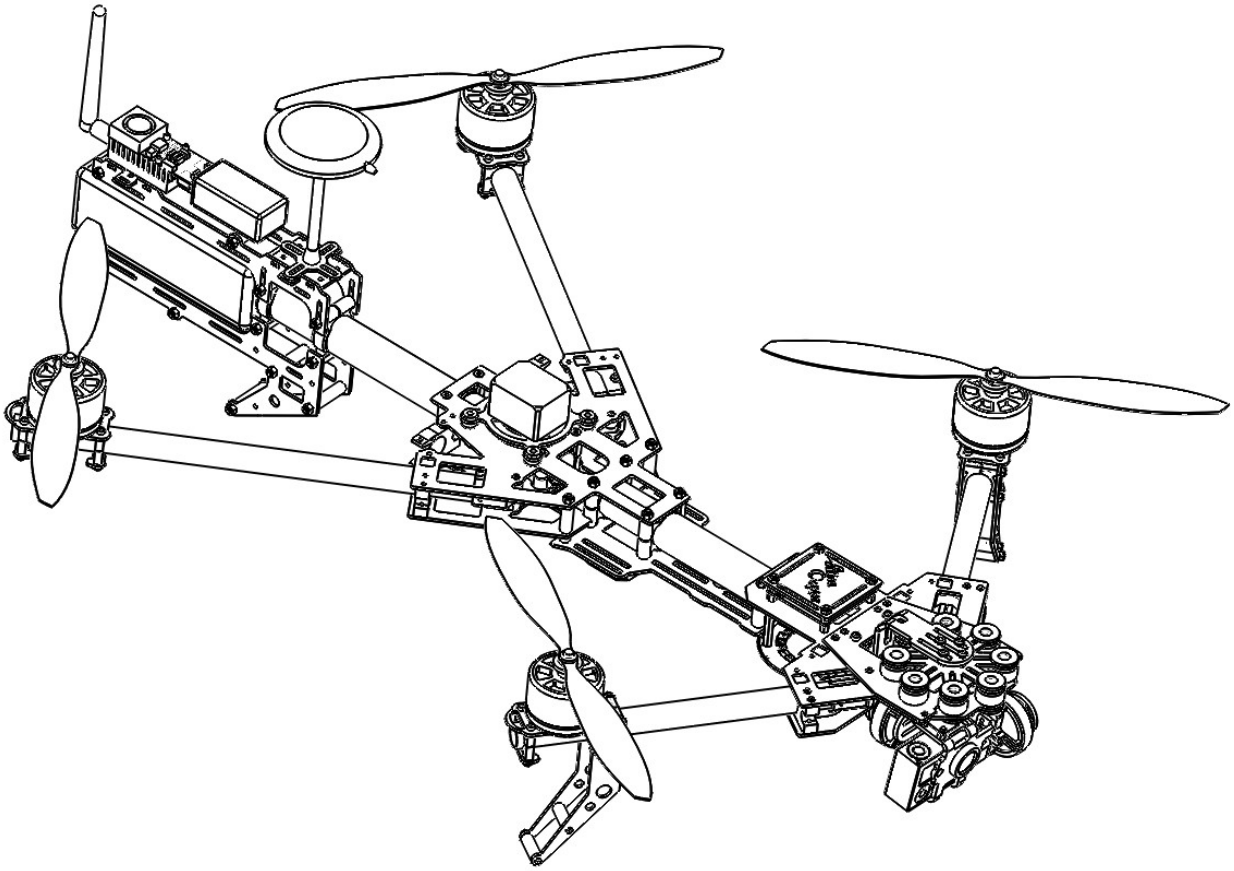
Alien Quad's Flyman
User Manual



Special Lightweight Multi-rotor Helicopters
Special Brushless gimbal Customized for Gopro Hero 2 or Hero3
Recommended Camera: Gopro Hero3,Gopro Hero2

V1.00
2013.0823 Revision

Disclaimer

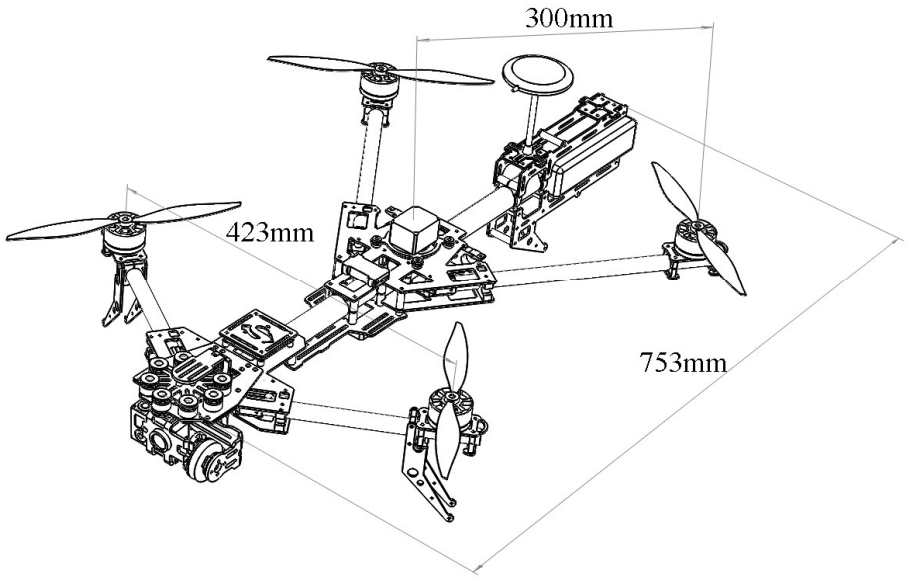
Thank you for purchasing this aliencopter studio product, please regularly visit the Flyman Multi-rotor web page at www.aliencopter.com, which is updated regularly more detail. Product information,technical updates and manual corrections will be available on the website.Due to unforeseen changes or product upgrades,the information contained in the manual is subject to change without notice.

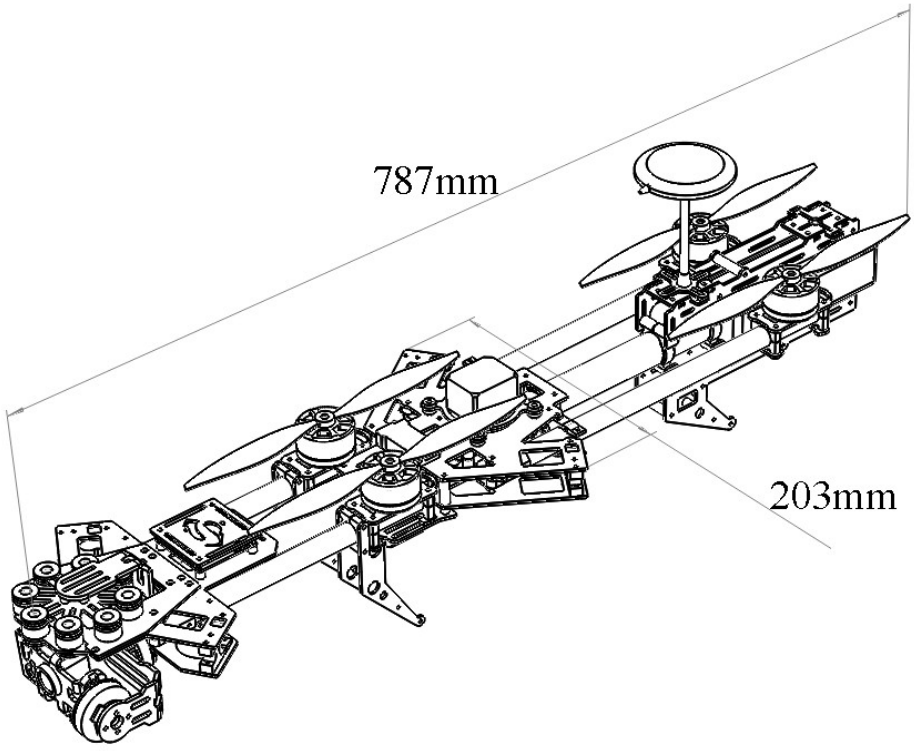
Read this disclaimer carefully before using this product. By using this product, you hereby agree to this disclaimer and signify that you have read them fully. Please strictly follow the manual to assemble and use the product. The manufacturer and seller assume no liability for any resulting damage or injury arising from the operation or use of this product.

Profile

The ALIENCOPTER FLYMAN is a multi-rotor designed for aerial photograph which Pure carbon fiber structure, Clever designs make assembly and configuration become especially easy and fast; protrate foldable frame and collapsible GPS Mount are conveniently portable for optimal user experiences.

The brushless gimbal had 245 drgree super vision which to create omnidirectional aerial view and high quality photograph. Combined with professional multi-rotor autopilot system, The ALIENCOPTER FLYMAN will achieve hovering, cruising and other steady flight elements, which can be applied for aerial photography and other aero-modeling activities.





Contents

Product Usage Cautions

The ALIENCOPTER FLYMAN is not a toy and should beoperated with extreme care, as improper operation can cause serious personal injury and damage to property. When flying, the fast rotating propellers may cause serious damage(s) and injuries. Therefore, please fly with a high safety in mind at all time.

The ALIENCOPTER FLYMAN should not be flown over or around people, power lines or other aircraft. It is important to always check The ALIENCOPTER FLYMAN and its components prior to operation. Always maintain a safe distance fromThe ALIENCOPTER FLYMAN when in use. Never attempt to touch it when the propellers are moving. As with any multi-rotor helicopter, The ALIENCOPTER FLYMAN is a complax and technical machine. Novice pilots should invest sufficient time on a flight simulator and seek training from an experienced pilot prior to operation. A flight simulator is nosubstitute for training with an experienced pilot, particularly when it comes to learning how to safely operate The ALIENCOPTER FLYMAN. Novice pilots should never fly without the supervision of an experienced pilot.

Always remove the props when you are making a change to the configuration of The ALIENCOPTER FLYMAN. Always test The ALIENCOPTER FLYMAN with the props removed to make sure that the motors are spinning in the correct direction and that the motor assignment is correct with respect to your flight control board. If you have either of these wrong. The ALIENCOPTER FLYMAN will be uncontrolled and dangerous.

Aliencopter studio disclaims all warranties, whether express or implied, including but not limited to the implied warran-ties or merchantability and fitness for a particular purpose. Airtechno does not assume any liability, whether direct, indirect, special, incidental, punitive, contingent or consequential damages to persons or property caused by The ALIENCOPTER FLYMAN. In no event shall Airtechno be liable for personal injury up to and including

death.

It’s your responsibilty to perform a full system check of The ALIENCOPTER FLYMAN prior to flight. As Aliencopter Studio can not control every operations of the users, like assembly, final assembly, refit or inappropriate operation, the follow consquences or damages caused by above actions have nothing to do with Aliencopter Studio. It’s your responsibilty to learn how to safely operate The ALIENCOPTER FLYMAN and to adhere to all applicable rules and regulations. Fly at your own risk

Assembly Cautions

(1) Mount the GPS Module with a bracket, to avoid interference with the power board of main frame.

(2) For IMU mounting, make sure the arrow direction marking on the IMU is pointing to the aircraft nose.

(3) The receiver is strongly recommended to be attached under the bottom board of center frame, and the Head of antenna is downward without any obstacle. Otherwise the aircraft may be out of control, since the wireless signal may be lost.

(4) Mount the arms correctly.
   a) front Arm installed in front frame
   b) back Arm installed in back frame

(5) For removing screws in the bottom board, please proceed with cautious, avoiding damages. Do not remove any other screws fixed with glue.

(6) Notice matching the indications is very important, please pay attention to them.

Flight Cautions

(1) With YS-X4 or Other autopilot system, make sure the output signal of F1~F2 and M1~M6 are all normal, to avoid serious damages and injuries.

(2) Keep flying the multi-rotor a distance from people, building, high-voltage lines, tall trees, water, etc.

(3) Make sure to use 4S LiPo battery for power supply.

(4) Do not get close to or touch the working motors and propellers, which will cause serious injury.

(5) Do not over load the multi-rotor.

(6) Make sure the propellers and the motors are installed correctly and firmly before flying.

(7) Make sure all parts of product are in good condition before each flight. Do not fly with wore or broken parts.

(8) Strongly recommend you to use Aliencopter Studio parts as much as possible.

Technical Foreword

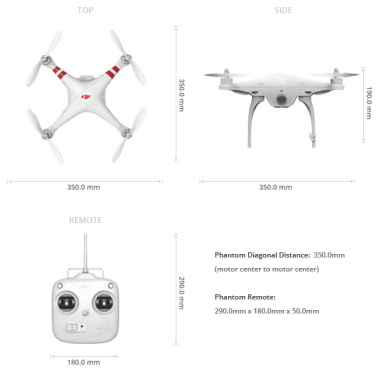
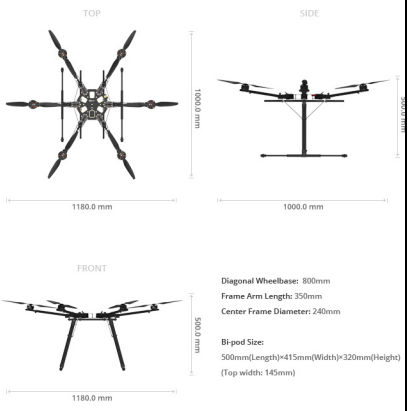
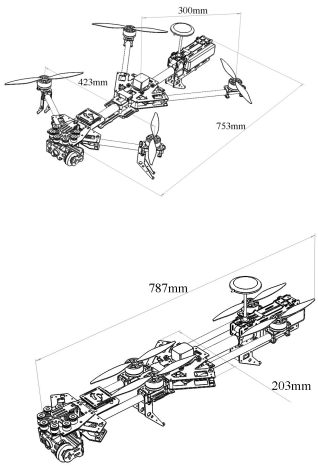
Below are a few tips from the designers to aid in assembly, flght and maintenance of the ALIENCOPTER FLYMAN.

ALIENCOPTER FLYMAN is designed to be a lightweight lift multi-totor helicopter. As such, it is very important totake your time and assemblr with care.

Here are a few important tips in assembling the ALIENCOPTER FLYMAN:

1) Locknuts are needed in installing motor mounts. Make sure to install the screws tightly into the plate and through locknuts, in case the locknuts would loosen when meet vibration. A lot of press nuts are needed to be installed into the main frame plates, this kind of nuts will not loosen in normal conditions, but you shouldalways install the screws tightly.
2) Be careful working with carbon fiber booms and frame. Carbon fiber has sharp edges which can cur your fingers and/or chafe delicate electronic wires.Any time a wire has to make a bend around the carbon fiber booms or frame, we recommand using some kind of protective sleeve(e.g. shrink tubing,nylon braid,etc.). Carboin fiber is also conductive, so it is very important to make sure that a flight components are appropri-ately insulated.
3) Always remove the props when you are making a change to the configuration of the ALIENCOPTER FLYMAN. We always recommend first testing the ALIENCOPTER FLYMAN with the props removed to make sure that all the motors are spinning in the correct direction, or ALIENCOPTER FLYMAN will become uncontrolled and dangerous. Mismatch any two wires out of the three wires of the motor, the spinning direction will be changed. You may look up how to make the motors spin in the right direction in the instruction book of your flight control board.
4) For different flight control system, there are different requirements in assembly and debugging. Always assemble and debug the control system and the machine in accordance with your selected flight control system.

Compare Products

<table>
<tr><th>Key Features</th><th>DJI phantom</th><th>DJI S800</th><th>Aliencopter Flyman</th></tr>
<tr><td>Duration</td><td>10～15min</td><td>10~16min</td><td>10～18min</td></tr>
<tr><td>Battery capacity</td><td>2200mah</td><td>10000mah~15000mah</td><td>5200mah~10000mah</td></tr>
<tr><td>Dimensions Weight</td><td> 
</td><td> 
</td><td> 
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<tr><td>BASIC PARAMETERS</td><td><table>
<tr><td>Operating Temperature</td><td>-10°C ~ 50°C</td></tr>
<tr><td>Take-off Weight</td><td><1000G</td></tr>
<tr><td>Hovering Accuracy (GPS Mode)</td><td>Vertical: ± 0.8m
Horizontal:±2.5m</td></tr>
<tr><td>Max Tilt Angle</td><td>45°</td></tr>
<tr><td>Max Ascent / Descent Speed</td><td>±6m/s</td></tr>
<tr><td>Max Flight Velocity</td><td>10m/s</td></tr>
<tr><td>Diagonal distance (motor center to motor center)</td><td>350mm</td></tr>
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<tr><td>Take-off Weight</td><td>5KG~7KG</td></tr>
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<tr><td>Max Ascent / Descent Speed</td><td>±6m/s</td></tr>
<tr><td>Max Flight Velocity</td><td>10m/s</td></tr>
<tr><td>Diagonal distance (motor center to motor center)</td><td>800mm</td></tr>
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<tr><td>Operating Temperature</td><td>-10°C to +60°C
(You have to keep the IMU warm if you want to use it under low temperature, could be -10°C or lower)</td></tr>
<tr><td>Take-off Weight</td><td>2.5KG~3.5KG</td></tr>
<tr><td>Hovering Accuracy (GPS Mode)</td><td>Vertical: ± 0.5m
Horizontal:±2m</td></tr>
<tr><td>Max Tilt Angle</td><td>35°</td></tr>
<tr><td>Max Ascent / Descent Speed</td><td>±6m/s</td></tr>
<tr><td>Max Flight Velocity</td><td>10m/s</td></tr>
<tr><td>Diagonal distance (motor center to motor center)</td><td>600mm</td></tr>
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Control Channels：6 Channels;
Communication Distance 300m；</td><td>Working Frequency:2.4GHz ISM；
Control Channels：8 Channels;
Communication Distance 1000m；</td><td>Working Frequency:2.4GHz ISM；
Control Channels：8 Channels;
Communication Distance 1000m；(maybe more)</td></tr>
<tr><td>Gimbal</td><td>No</td><td>Three Axis ZENMUSE GIMBAL Z15</td><td>Two Axis Brushless gimbal</td></tr>
<tr><td>AP stability
Aerial Photography</td><td>No</td><td>Very stabilizing</td><td>Good stabilizing</td></tr>
</table>

Shooting vision	Very small vision - Under Propeller and landing Gear	Nice vision - Under Propeller	Super vision - Never see Propeller and landing Gear
FPV	To but not for	To but not for	To be for
Air attitude	No Clearly	No Clearly	Very Clearly
Portable	Small and All in one	disassembly	Fold
Airline	To but not for	Good but not for turning	Good and for turning
Diy Space	No	No	A lot of Space
Black Box	No	No	Have it (last 1 min flight Data)
Adjustable parameters	Need PC and link Flight Controller	Need PC and link Flight Controller	Wifi and Mobile only

In The Box

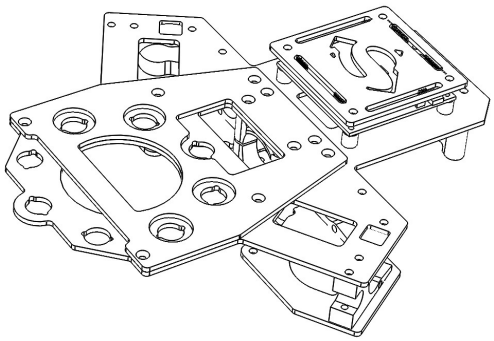
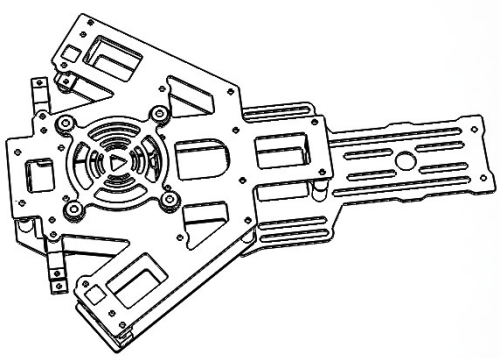
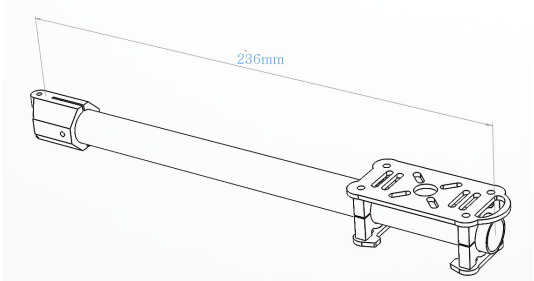
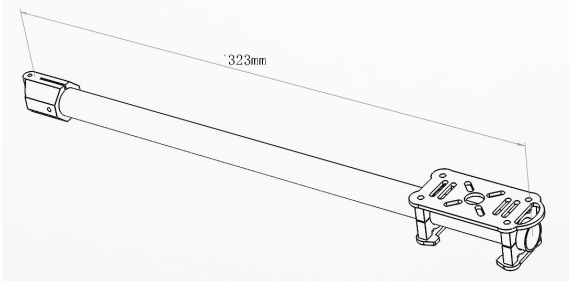
The Kit parts

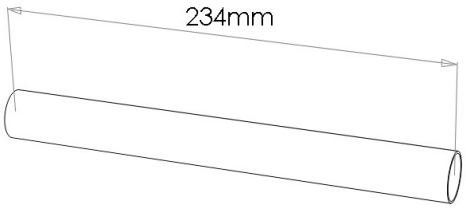
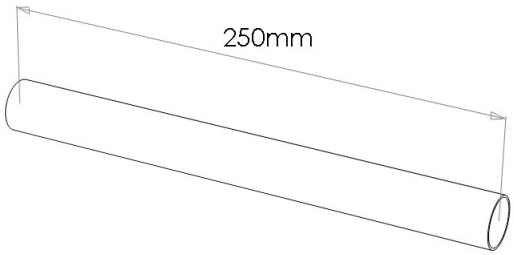
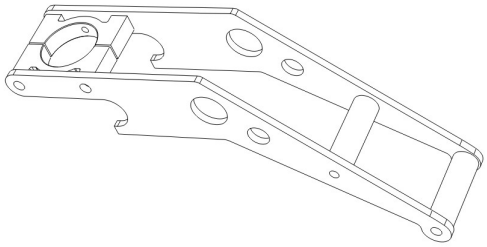
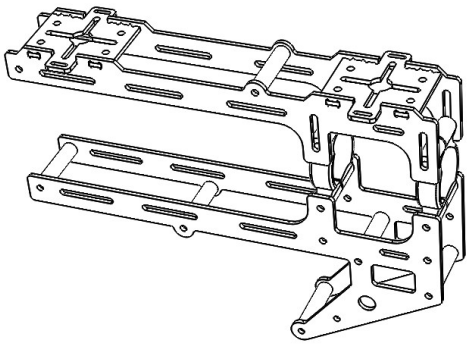
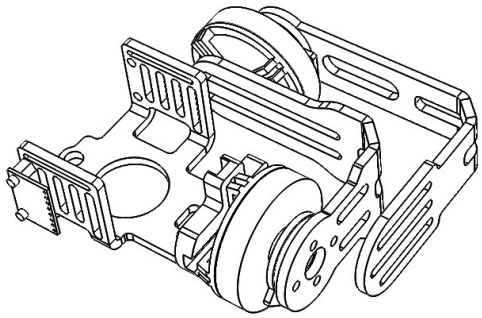
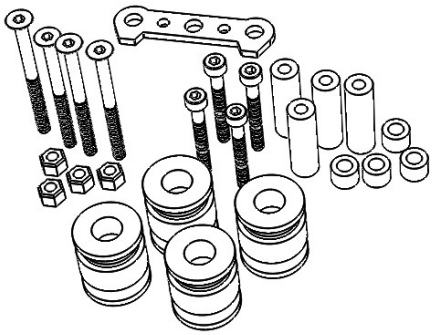
Number	Type	SN	Name	PCS
1	main frame	FA410001	IMU Mount Board	1
2		FA410002	16mm Motor Mount Board	4
3		FA410003	Simple Landing Gear	4
4		FA410004	M3*16mm Motor Mount Carbon Pad	4
5		FA410005	Front Upper Carbon Frame	1
6		FA410006	Front Bottom Carbon Frame	2
7		FA410007	Front Bottom Mount Carbon Plate	1
8		FA410008	Back Upper Carbon Frame	1
9		FA410009	Back Bottom Carbon Pad	1
10		FA410010	25mm Motor Mount Carbon Pad	1
11		FA410011	16*236mm Front Carbon Tube	2
12		FA410012	16*323mm Back Carbon Tube	2
13		FA410013	25*234mm Link Main Fream Carbon Tube	1
14		FA410014	Battery Package Carbon Frame	1
15		FA410015	25*250mm Battery Balance Carbon Tube	1
16		FA410016	Front Upper intensive Carbon Frame	1
17		FA410017	Gimbal damping Upper Carbon Frame	1
18		FA410018	electrical installations Mount Carbon Pad	1
19		FA410019	Back Bottom Carbon frame	2

20		FA410020	Gimbal Control Panel Upper shell	1
21	Brushless gimbal&accessories	FA410021	Brushless Gimbal Roll Arm	1
22		FA410022	Camera Mount Plate	1
23		FA410023	Gimble Cantilever Arm	1
24		FA410024	Camera Gravity Cross Plate	1
25		FA410025	4215 Motor for Brushless Gimbal	2
26		FA410026	Gimbal Control Panel & IMU Sensor	1
27		FA410026 1	DCDC Power Supply Module	1
28	Screw & parts Kit	FA410027	16mm Tube Clip	4
29		FA410028	16mm C Type Tube Clip	8
30		FA410029	6mm Silicone Damper	4
31		FA410030	16mm CNC Tube Clip	10
32		FA410031	M3 Embedded Nut	8
33		FA410032	25mm Plastic Tube Clip	9
34		FA410033	10mm Silicone Damper	8
35		FA410034	Power Supply Hub	1
36		FA410035	M4*7*30MM Nylong Hex Bolt	12
37		FA410036	8mm M2.5 Countersun Head Screw	6
38		FA410037	6mm M2.5 Countersun Head Screw	20
39		FA410038	14mm M2.5 Countersun Head Screw	8
40		FA410039	30mm M2.5 Countersun Head Screw	28
41		FA410040	M2.5 Hexagon screws	24
42		FA410041	6mm M3 Nylong Screw	8
43		FA410042	Gimbal Roll and pitch Data Cables	2
44		FA410043	10mm M3 Plasstic Screw	8
45		FA410044	40mm M3 Cup Screw	28
46		FA410045	M3 Hexagon Self Locking Nut	30
47		FA410046	5mm Nylong Plastic Bolt	4
48		FA410047	10mm Nylong Plastic Bolt	8
49		FA410048	25mm Nylong Plastic Bolt	4
50		FA410049	M3 Plastic Nut	6
51		FA410050	30mm M3 Screw	4
52		FA410051	Black Plastic Cable Tie	Several

53		FA410052	M3 Inner Hexagon Spanner	1
54		FA410053	IMU Foam Double Sided Adhesive Tape	1
55		FA410054	Sticker	1
56		FA410055	Landing Gear Sponge Tube	1
57		FA410056	T Type Slope Indicator	1
58		FA410057	Self Adhansive Tape	1
59		FA410058	Gopro3 Data Cable	1
60		FA410059	Video Transmitter JST Cable	1
61		FA410060	Signal Sheilding Cable	1
62		FA410061	20mm M2.5 Countersun Head Screw	4
63		FA410062	M2.5 shims	4
64		FA410063	M4*7*6mm Nylong Plastic Bolt	10
65		FA410063 1	M4*7*22mm Nylong Plastic Bolt	10
ARF Parts List				

main Component Parts

Front Frame×1	Back Frame×1
	
Front Frame 16*236mm Arm×2	Back Frame 16*323mm Arm×2
	
Link Main Frame 25mm Pipe×1	LiPo Battery Balance 25mm Pipe×1

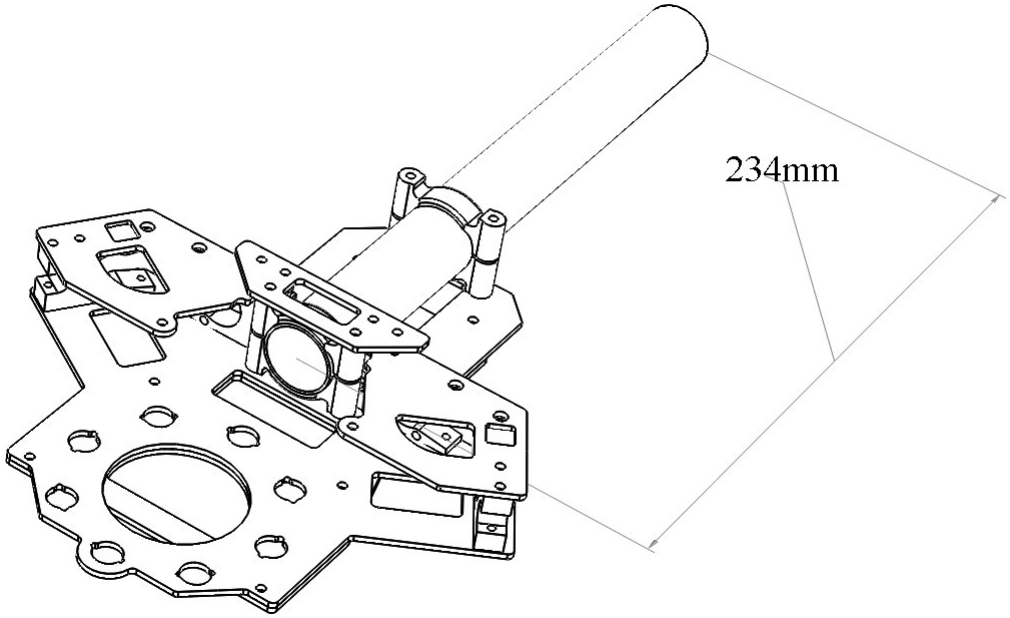
	
Simple Front Landing Gear×2	LiPo Battery Packge Frame×1
	
Gopro Hero Brushless gimbal×1	Screw & parts Kit
	

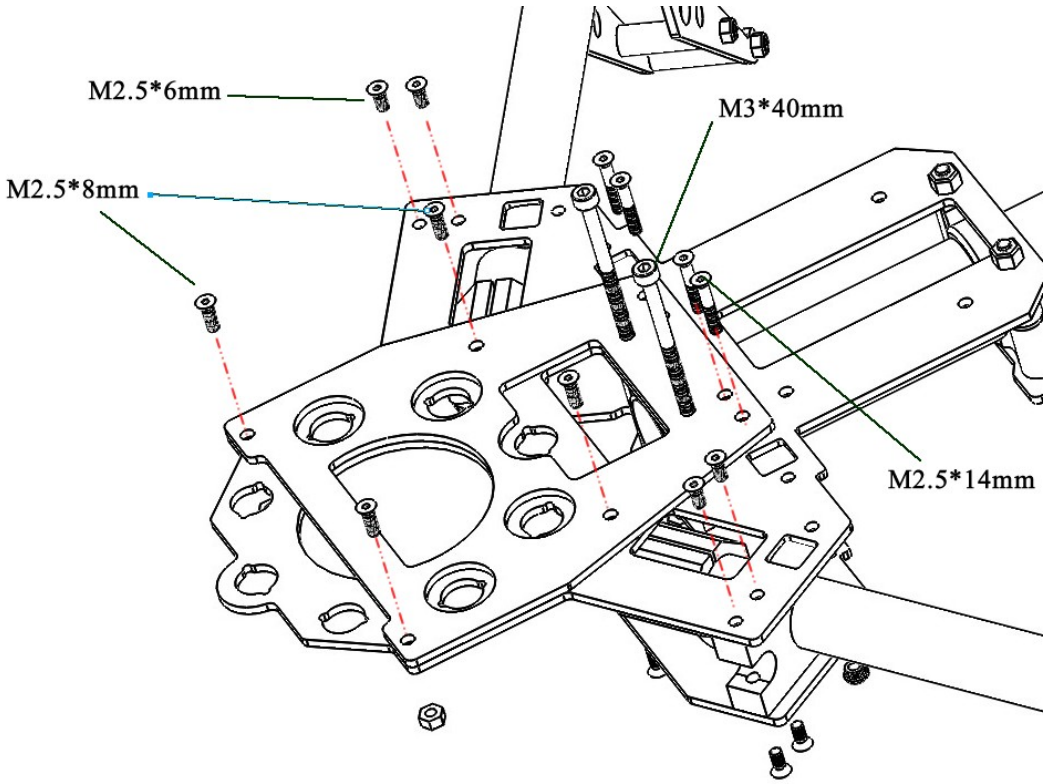
Tools Needs

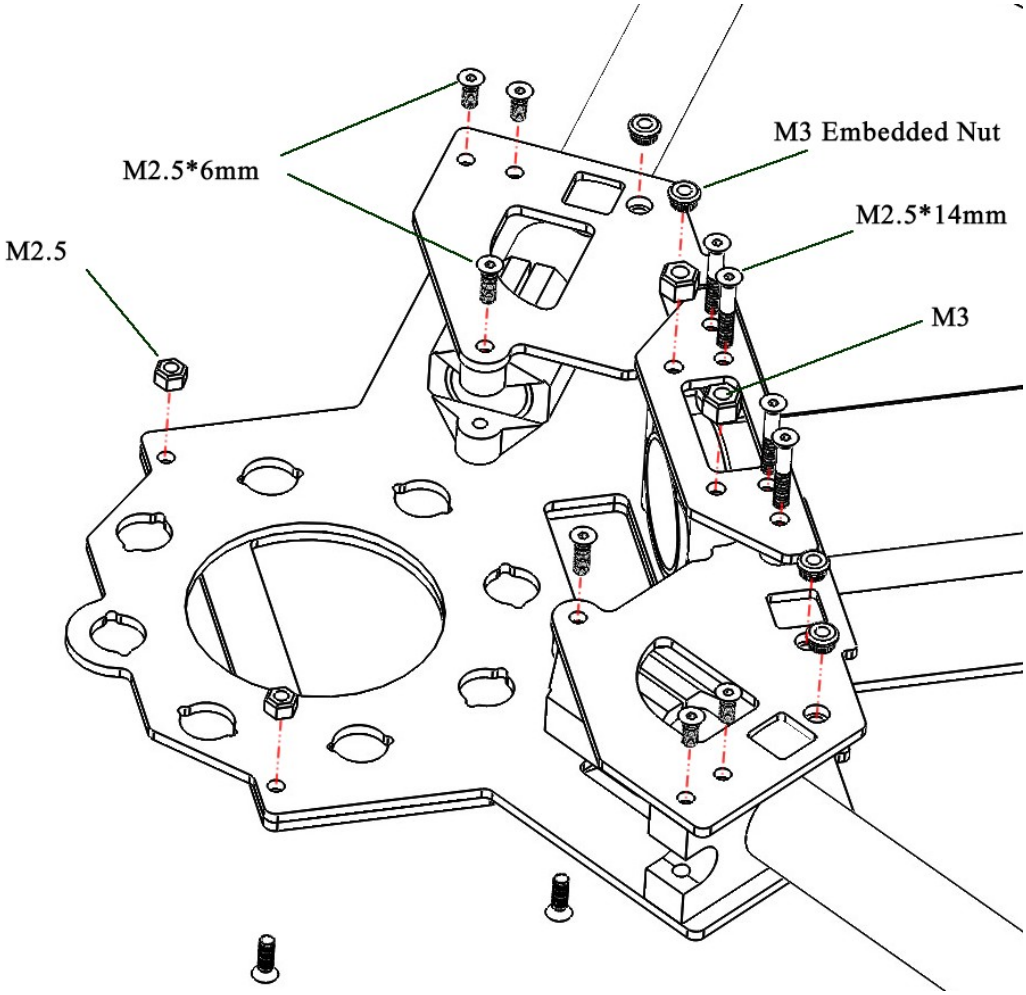
No.	Tools name	Usage
1	2.00mm Hex Wrench and 2.5mm Hex Wrench	For mounting screws
2	Thread Locker	For fastening screws
3	Nylon Cable Tie	
4	Scissors	
5	Diagonal Cutting Pliers	
6	Foam Double Sided Adhesive Tape	For mounting IMU and so on

Main Frame Setup

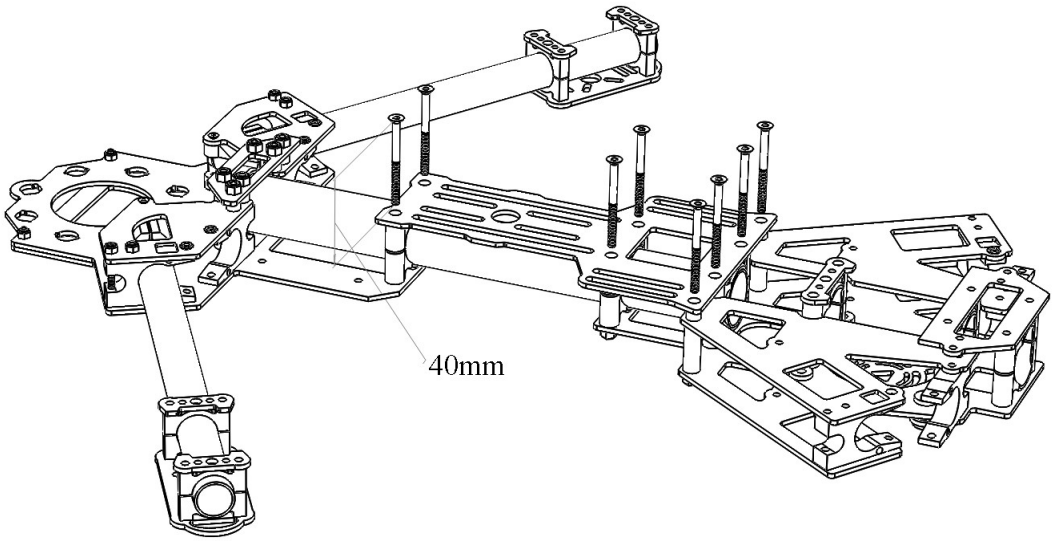
The First step: Front Frame Setup

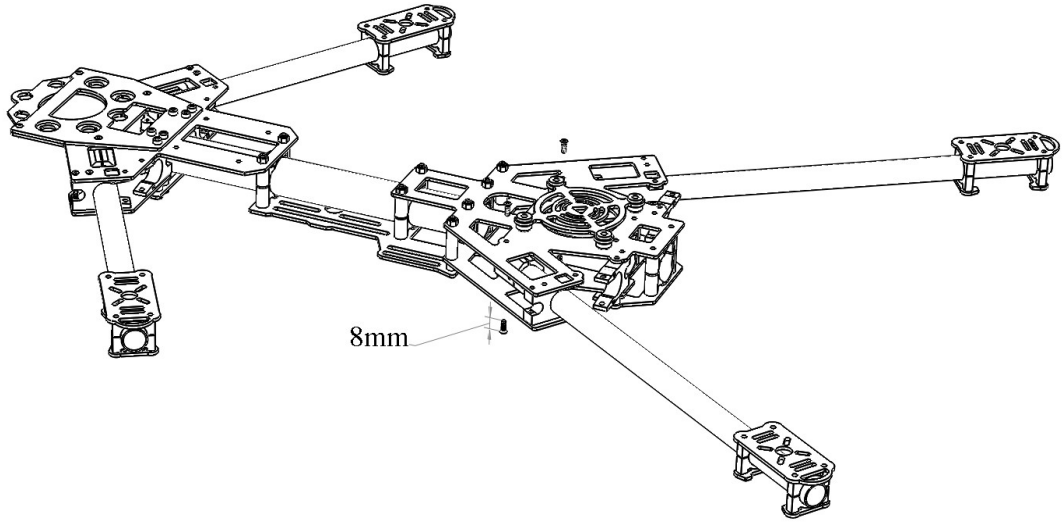




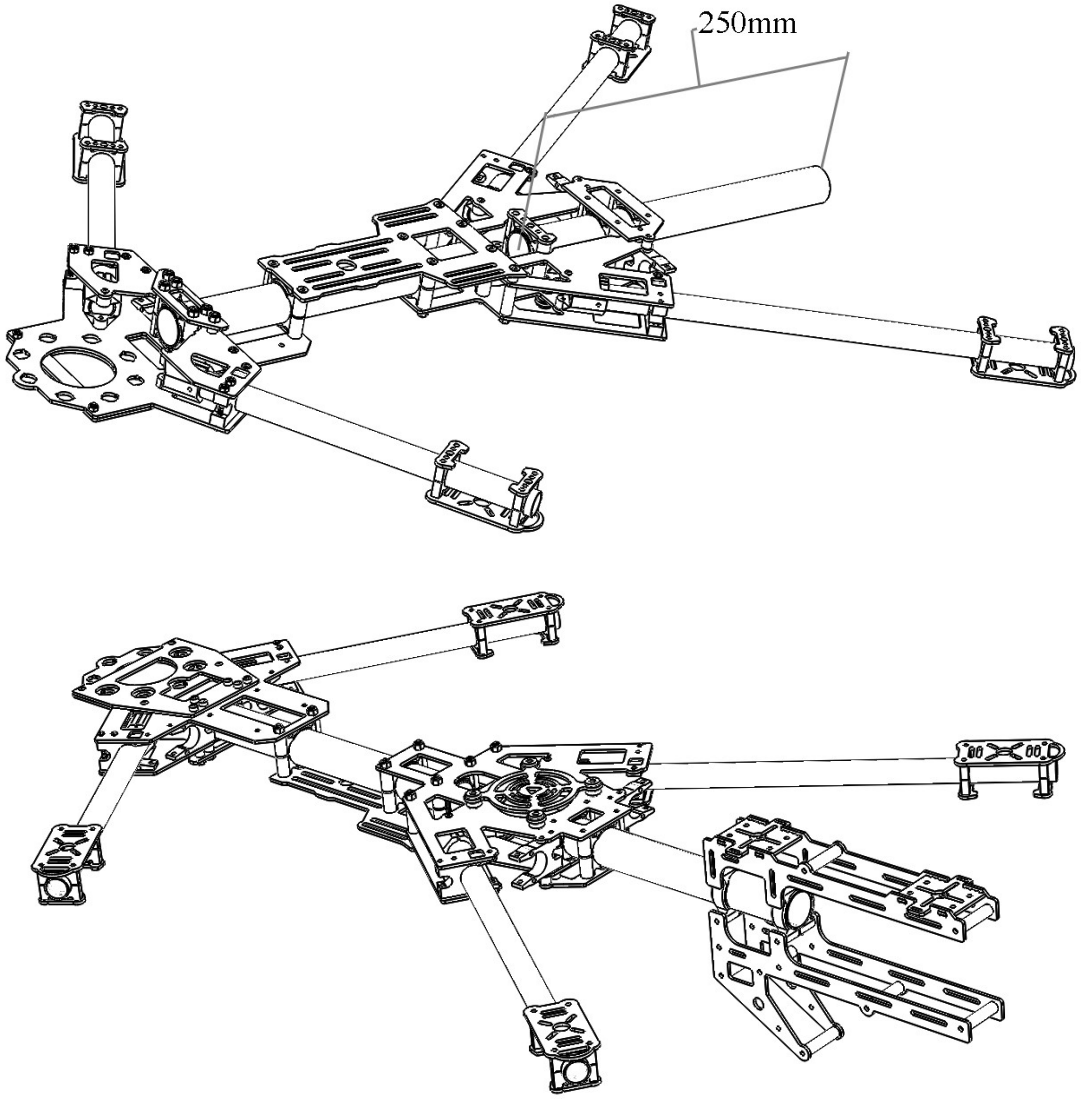


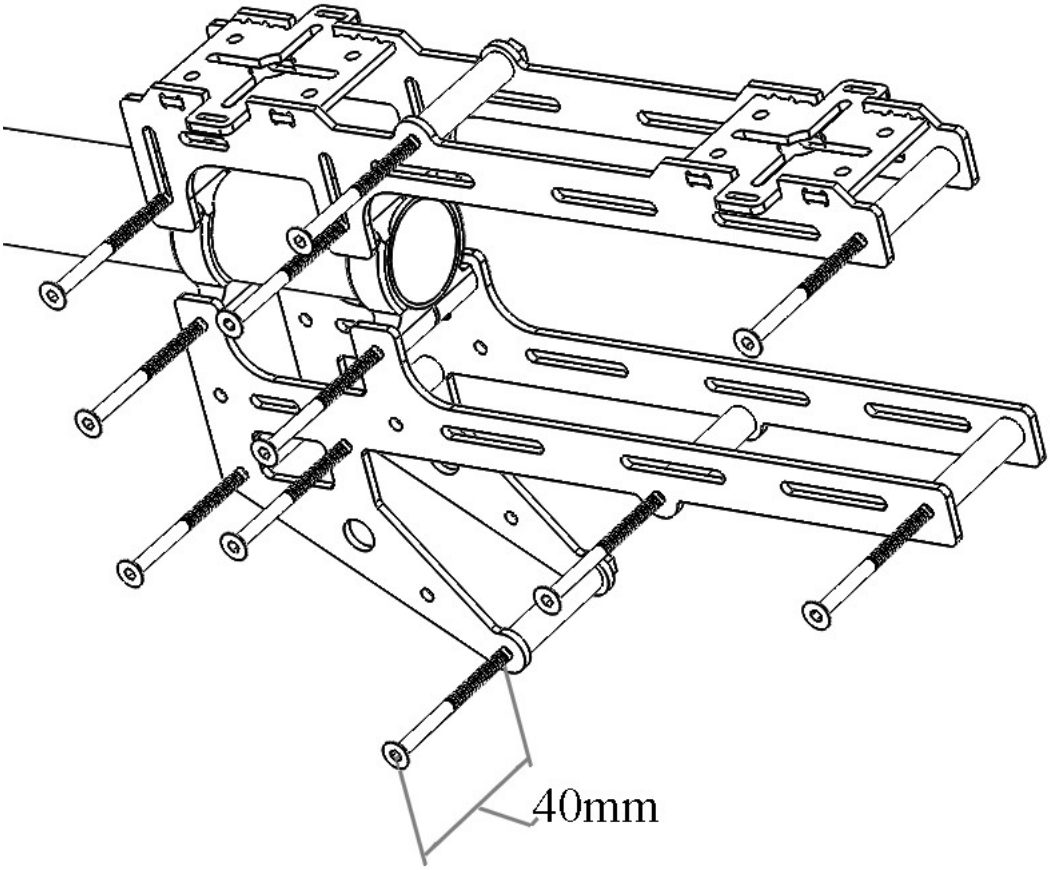
The Second Step:Back Frame setup



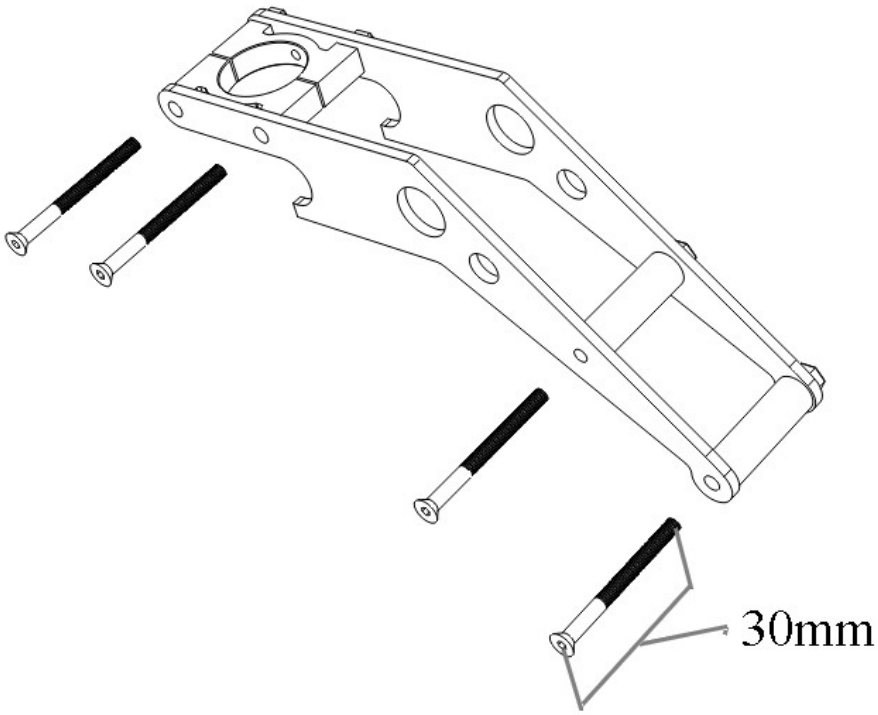


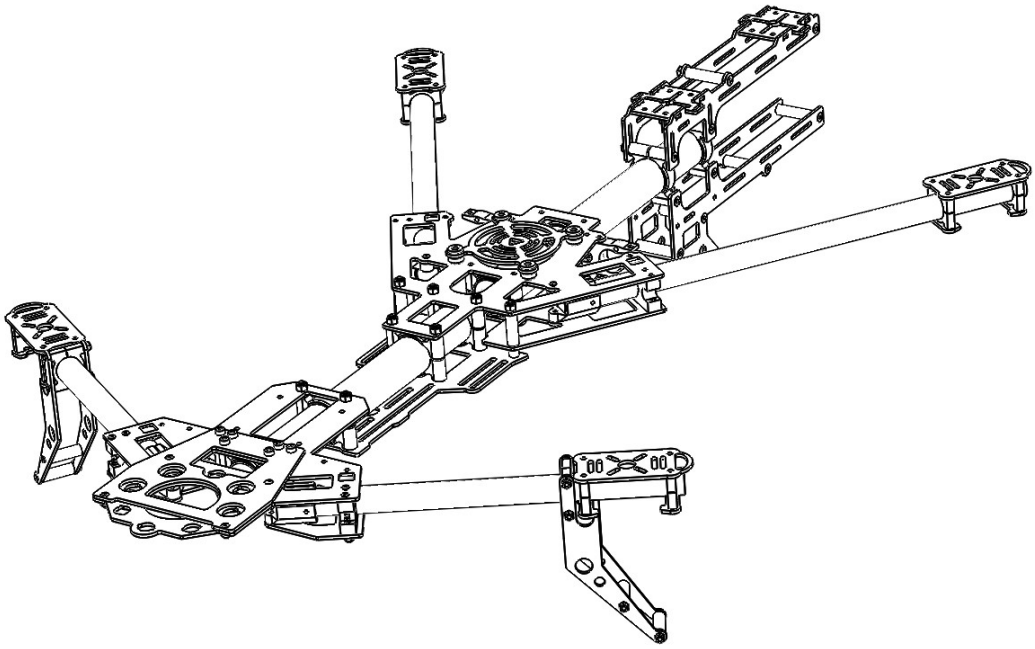
The Third Step: Bartty Package Frame setup



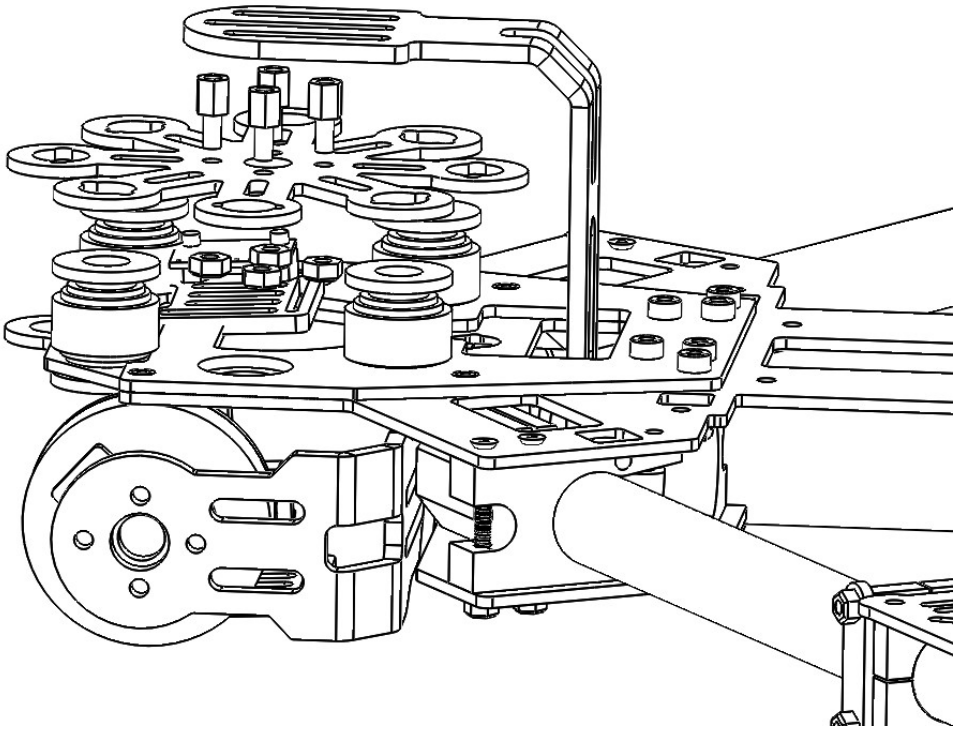


The Fourth Step: Mount Simple Landing Gear



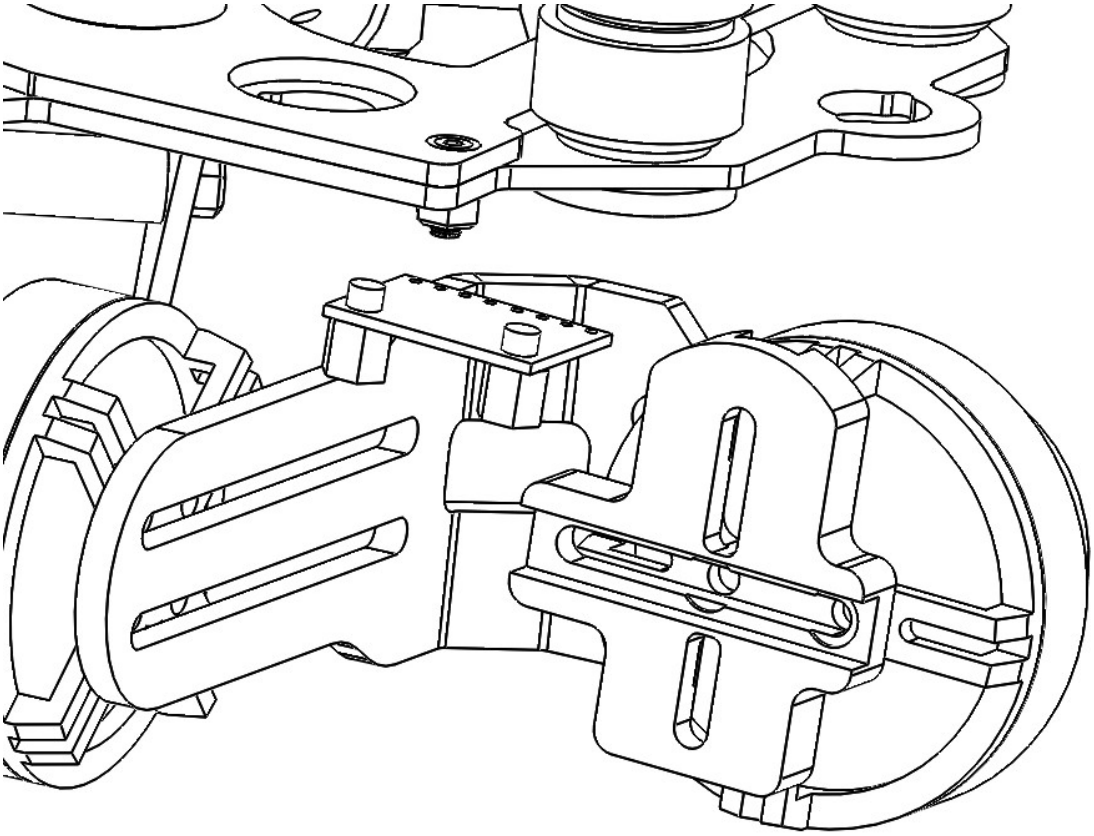


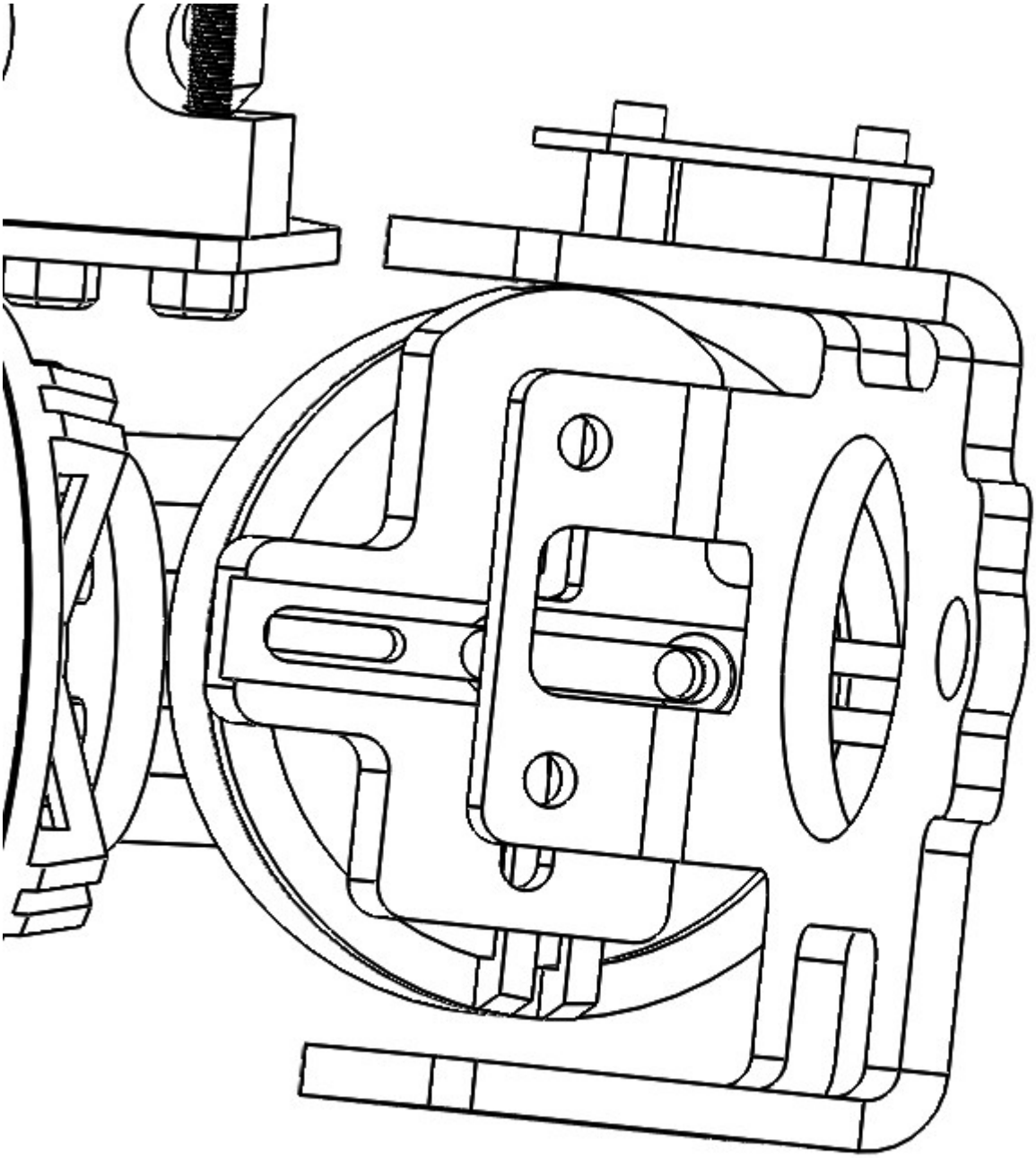
The Final Step:Mount Brushless gimbal



1. First, install the Gorpro Hero camera on the brushless gimbal. Gopro Hero 3 needs to be installed in the default installation position. If it is Gorpro Hero 2 camera that you choose, you can install it by adjusting the screws on the swashplate of the pitching motor, as you can see from the image below, until the camera reaches a balanced position. Based on our experience, the screws are usually installed on the upper and rear

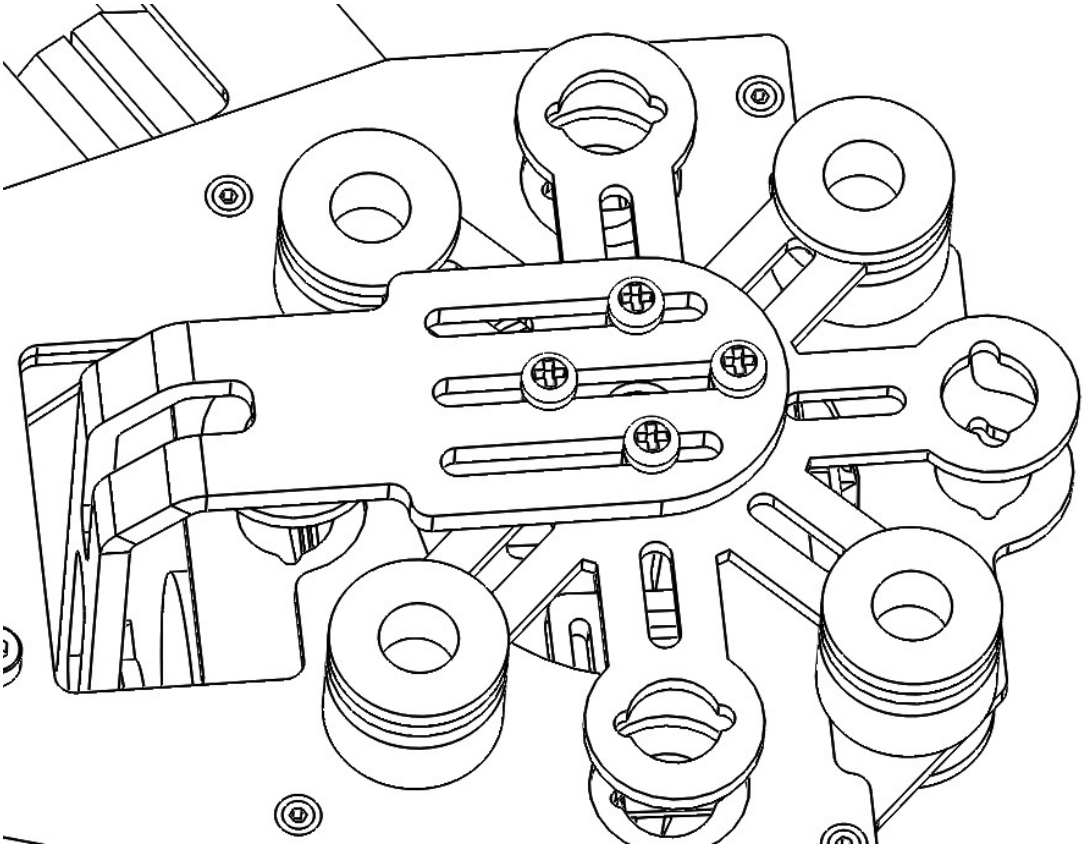
position to the center of the swashplate.





Please click here to view the Gimbal Installation Video Guide.

2. When you install Gopro gimble，please make sure that the gravity center of the gimbal suspension arm, which is curving at the top, is right on the center of the vibration absorption carbon-fiber plate. Please note that there might be slight differences between the positions of Gopro 2 and Gopro 3 at top, as shown in the image below.

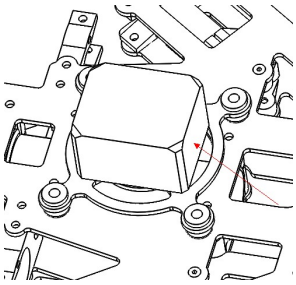


Attach Electric Equipment to main Frame

The ALIENCOPTER FLYMAN pack includes only the gimbal and the main frame. Therefore, please consult your electric equipment providers for specific requirements before assembling under the following instructions. The suggestive assembling instructions provided in this document only apply under the most common circumstances. Aliencopter Studio shall bear no responsibility for any electric products that are not provided by us.

Install the IMU Mount

There are two types of IMU installation, the installation of integrated IMU and independent IMU, which share the same installation solutions. This document will elaborate only on independent IMU installation.

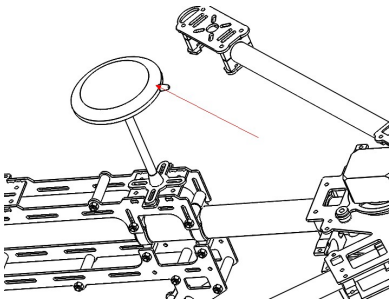


The IMU mounting plate needs to be fixed on 4 anti-vibration rubber balls, the size of which fits most of the flight controls or IMU. During installation, attention needs to be paid to the direction in which IMU should be installed. In the image on the right, the triangular arrow icon points to the direction where the aircraft is heading and IMU needs to be installed in the center of the IMU mounting plate, as this is also the center of the main frame. The image below displays the correct IMU installation. The red arrow points to the front of IMU, and also the same direction the triangle arrow on IMU mounting plate pointing to

The instructions above only apply to IMU installation under most circumstances. If there are any conflicts between this document and the installation guide provided by the flight control manufacturers, please proceed the installation according to your manufacturers' version.

Install the GPS & Video Transmitter Mount

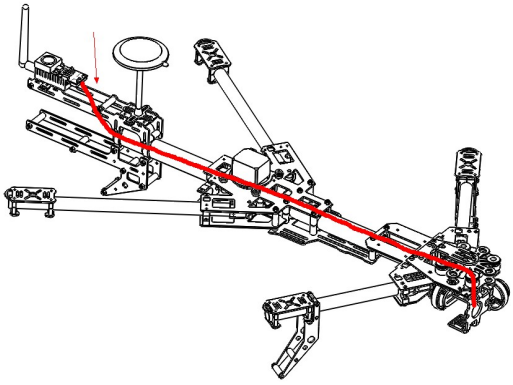
There are two carbon-fiber mounting plates need to be installed on the battery installation frame, which are used to hold GPS or the video transmitter. We suggest users to install GPS on the front mounting plate, while the video transmitter on mounting plate in the back. Because in most cases, GPS needs to be installed as near to the center of the main frame as possible. Similar to IMU installation, when installing GPS, the direction of GPS also needs to be taken into consideration. As you can see from the image below, the red arrow points to the front of GPS.



The instructions above only apply to general IMU installations. If there are any conflicts between this document and the installation guide provided by the flight control manufacturers, please proceed the installation according to your manufacturers' version.

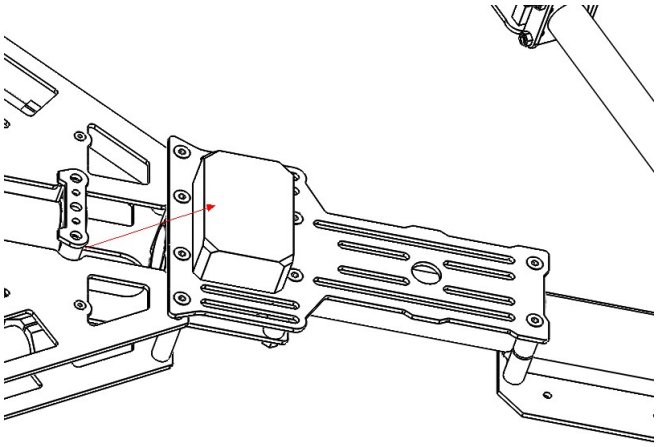
The image on the right shows how the video transmitter should be installed on the rear carbon-fiber mounting plate. The video transmitter needs to be installed with the wire facing the back, as in this way under most circumstances, it can help prevent the video transmitter from being blocked by the main frame, thus expanding the effective transmission range.

The image on the right shows the installation position and direction of the video transmitter. Please use 3M double-sided tapes in the Screw & Parts kit to hold the video camera and carbon-fiber mounting plate together, and at the same time, use plastic zip ties to make them firmly fastened. Considering the comparatively long distance between the video transmitter and Gopro camera, please use 2-core shielded signal cable in the Screw & Parts kit and install the cable through the 25mm carbon-fiber tube to the front of Gopro camera. Meanwhile, if possible, please adopt independent power supply. When you use a 3s 850mah LiPo battery as the power supply for the video transmitter, the battery can be installed next to the video transmitter, as the red arrow in the image below shows. The red line in the following image highlights the route where the 2-core shielded signal cable needs to be installed. You may put the cable into a harder cooper wire or a slim tube to help it pass through the carbon-fiber tube.



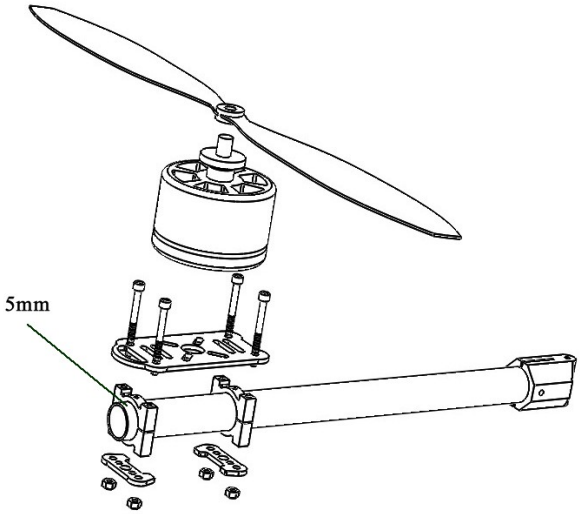
Install the Flight control and so on

If you decide to use the integrated flight control, please install it on the IMU mount. For installation instructions, please refer to the “Install the IMU Mount” section. As for independent flight control, it usually comes with a main control device and there’s a mounting plate below the main frame for users to install more optional equipment, for example, the main control device, OSD, LED control, DCDC power supply module, etc.. as the following image indicates. This document only uses images to demonstrate the main control device installation. For other devices, you may install according to your own needs.



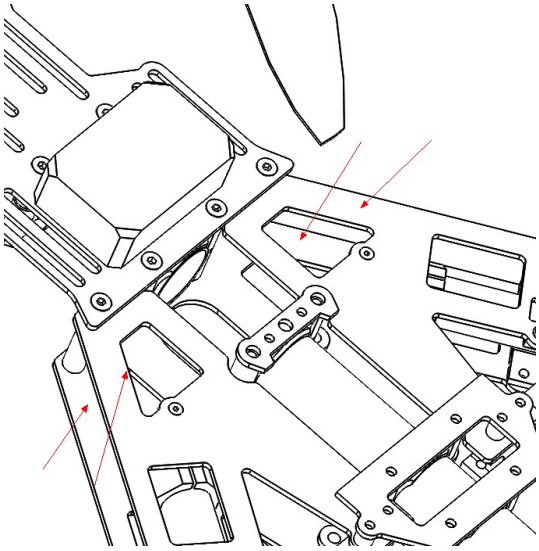
Install the Motor

During motor installation, please make sure to keep the motor flat and the wire outlets facing outside. As the following image shows, there’s a bezel outside the motor set to protect the outlets。



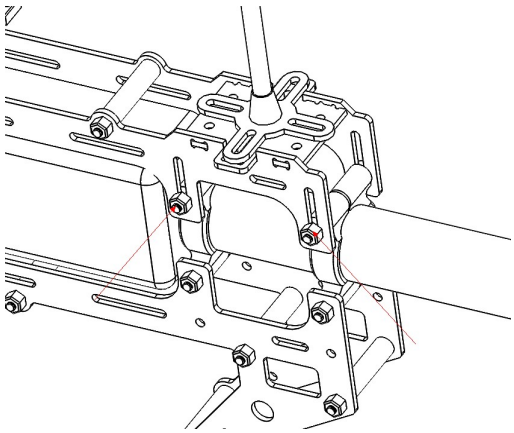
Install the BEC

The BEC installation needs wires connecting to the 4 motors set on both the front and back arms. The signal wires should be linked to the main control device or IMU mount. The red arrows in the image on the right show the ideal BEC installation position. Motors on the front arms are connected to BEC through 25mm carbon-fiber tube, while wires of the back arms motors can directly connect to BEC below the back frame.



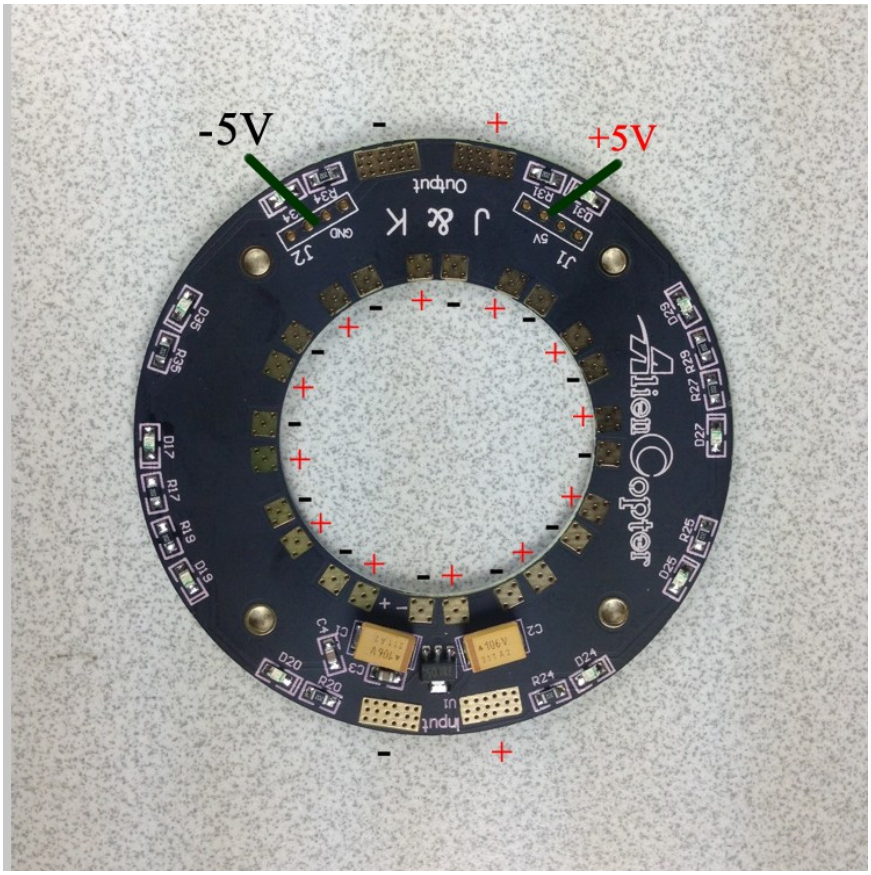
Install The Lipo Bartty

The main purpose of installing the LiPo battery is to adjust the center of gravity of the whole frame and try to keep the frame's center and its center of gravity overlapped on the back frame. Therefore, LiPo battery installation should be the last step of the whole frame assembly, which can only be done with all the wires and equipment installed and Gopro Hero camera tuned. As shown in the image on the right, the red arrows indicate the screws that need to be loosed, which help tuning the back-and-forth position of battery after installation. The image below shows the innermost of the 25mm carbon-fiber tube, and the outermost end located two rows of retaining plates。The battery we used for testing and tuning is 4S 5800mah LiPo battery. Once the battery reaches the balancing point, you can adjust the height of the upper retaining plate, as the following image shows.

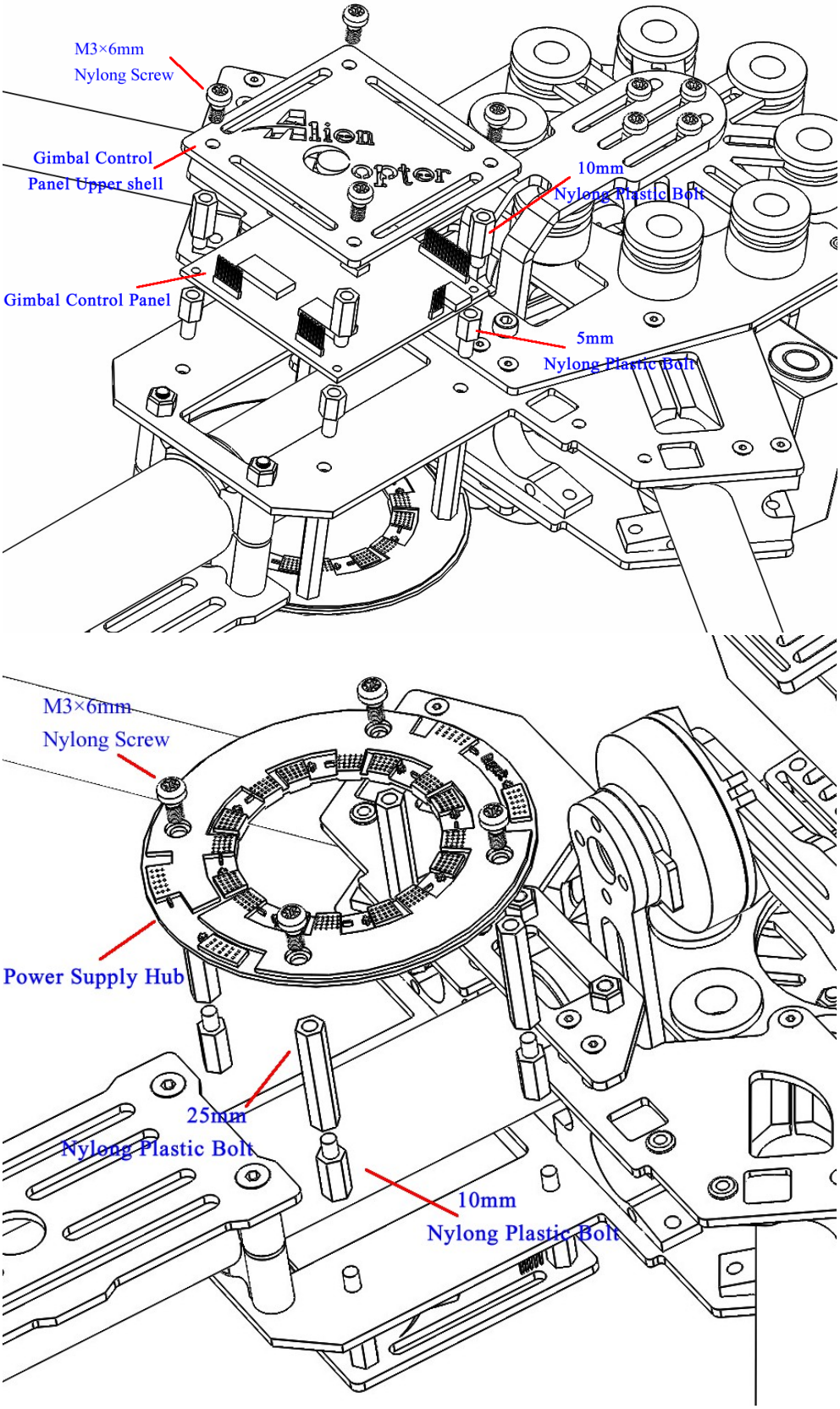


Install Gimbal Control & Power Supply Hub

How to use it as the following image shows.

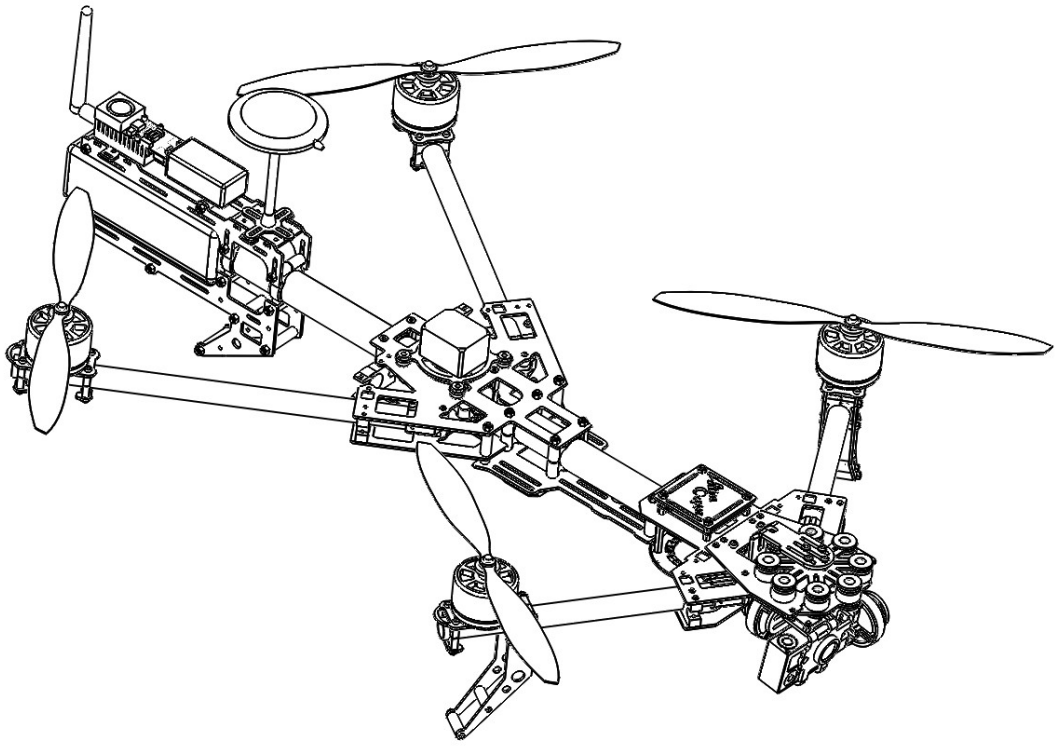


How to install it inside to the Flyman frame as the following image shows.



Full Installed Flyman Frame

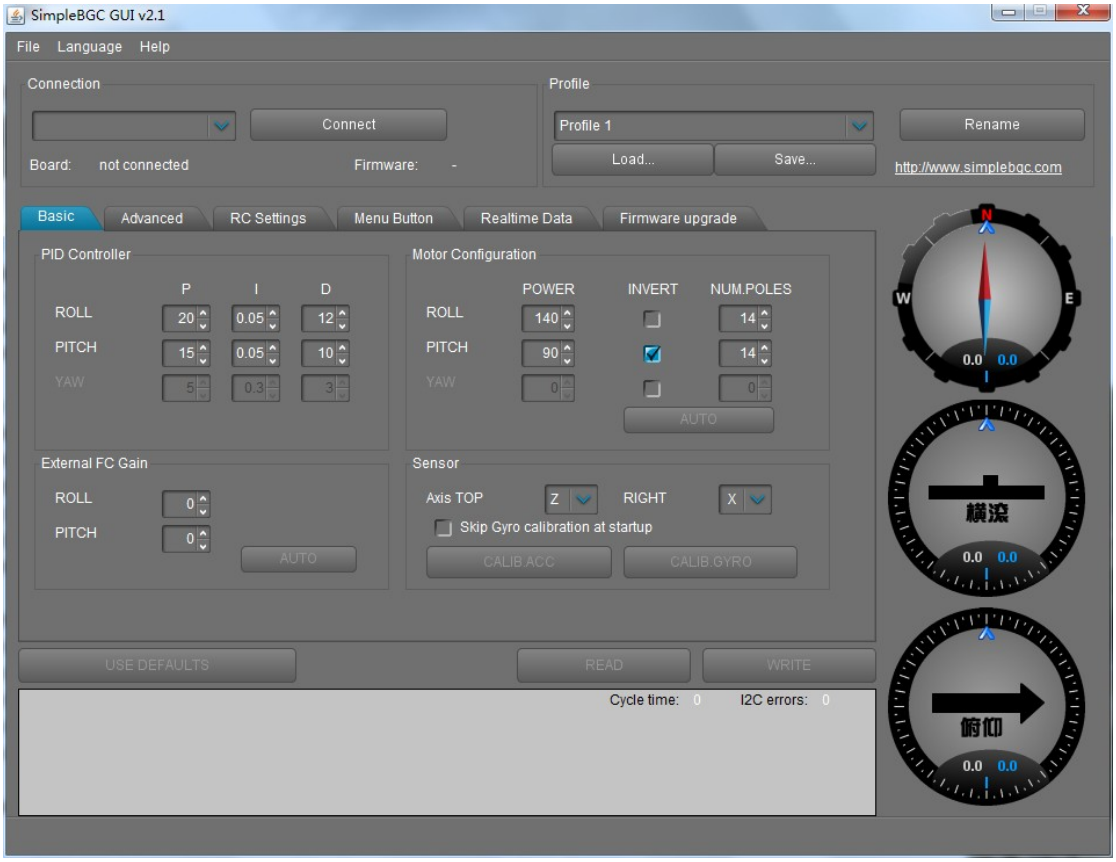
Below is the image of a Flyman Frame with most of the electric equipment installed, for your reference.

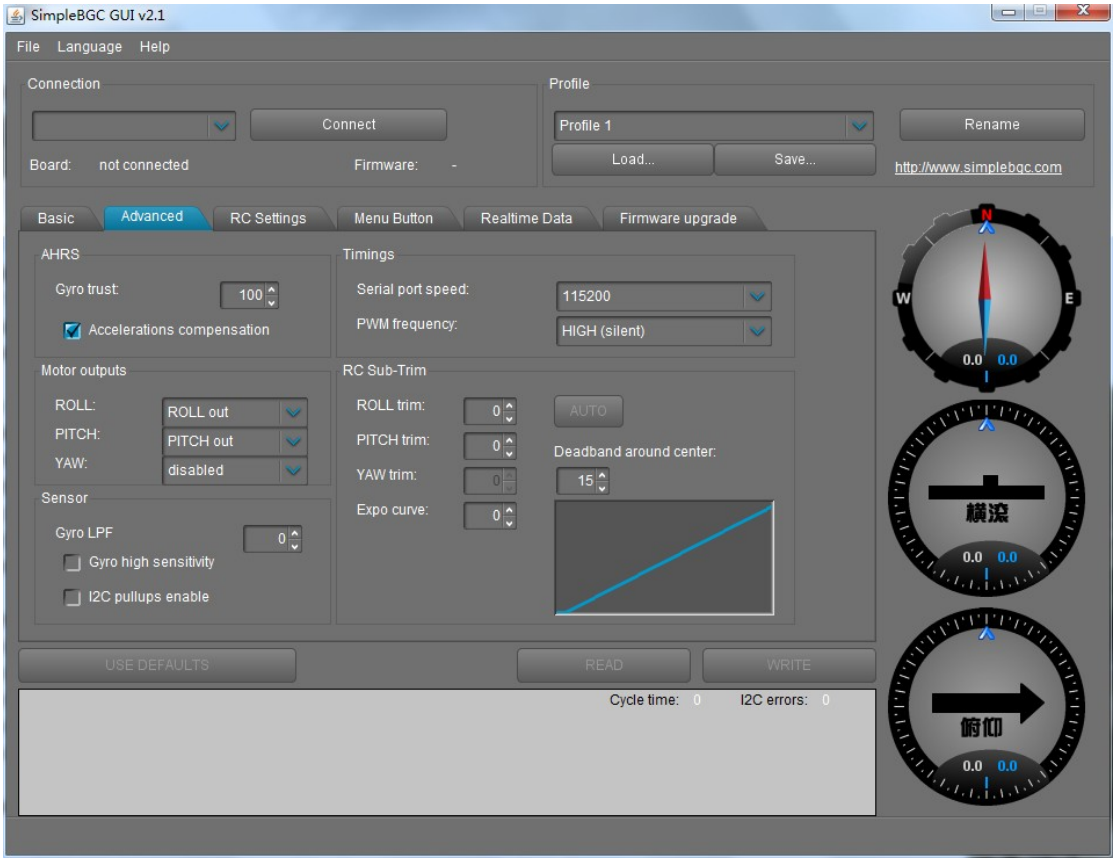


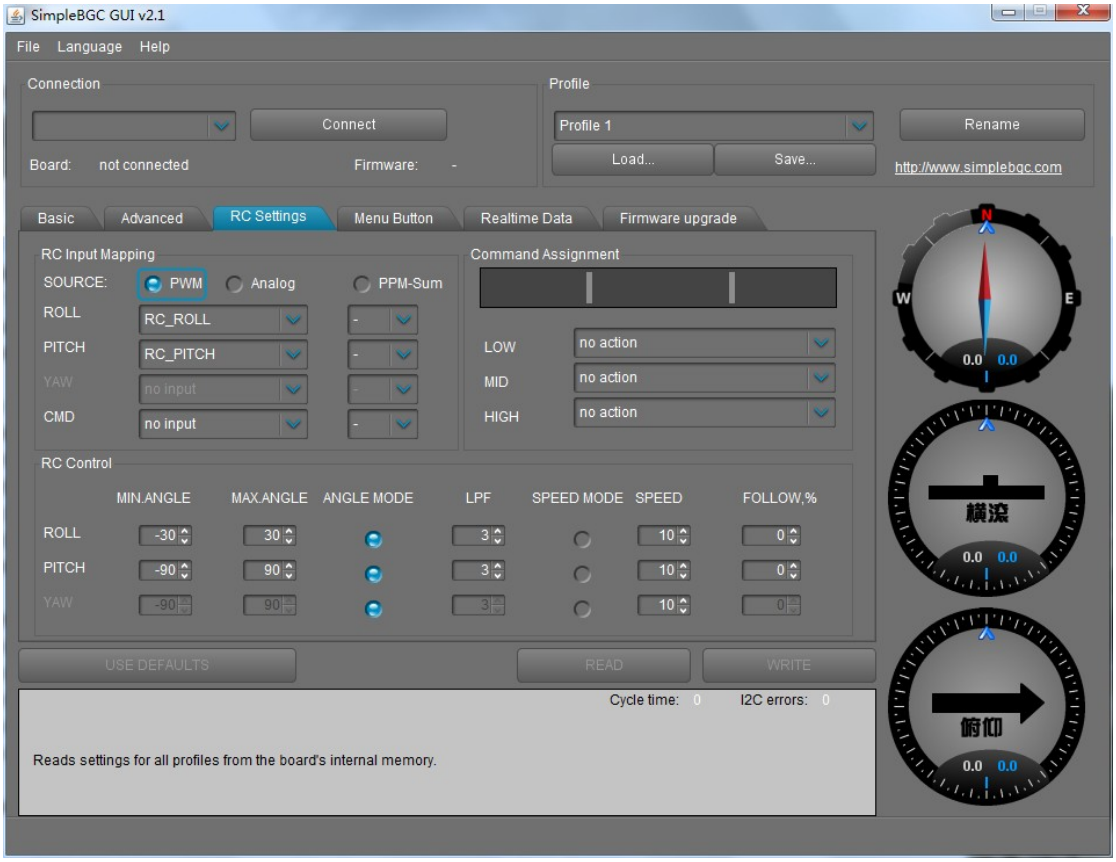
Ready For The First Flight

Brushless gimbal Testing

1. 1.To make sure that the gimbal control board cable, sensor board cable and power cable are working properly. If so, cut off the power cable first, then connect USB cable to the control board to see if the gimbal is properly connected to your PC, and if the control board drive has been installed. If you have not yet installed the control board drive on you PC, please click here to visit AlienCopter's official website to download and install the drive. Please note that there are two versions for the control board drive, working on x86 and x64 operating system respectively. You may install the version that is compatible with the operating system you are using.
2. Open the gimbal configuration interface, select "COM" port in the dropdown list under "Connect" tab, and then click on "connect". In normal conditions, your PC will successfully connect to the gimbal control board via COM port and read the default parameters. Before leaving the factory, the optimal parameters for the control have been set. For Gopro Hero3 camera, you don't have to reconfigure the parameters. You just need to select "Load" in the dropdown list under "Profile" tab, which is on the interface's upper-right corner, find the default setting files and then reload the default parameters. If you are using Gopro Hero2, please configure the parameters according to your need. The image below is for your reference. For more details, please click here to view the videos.

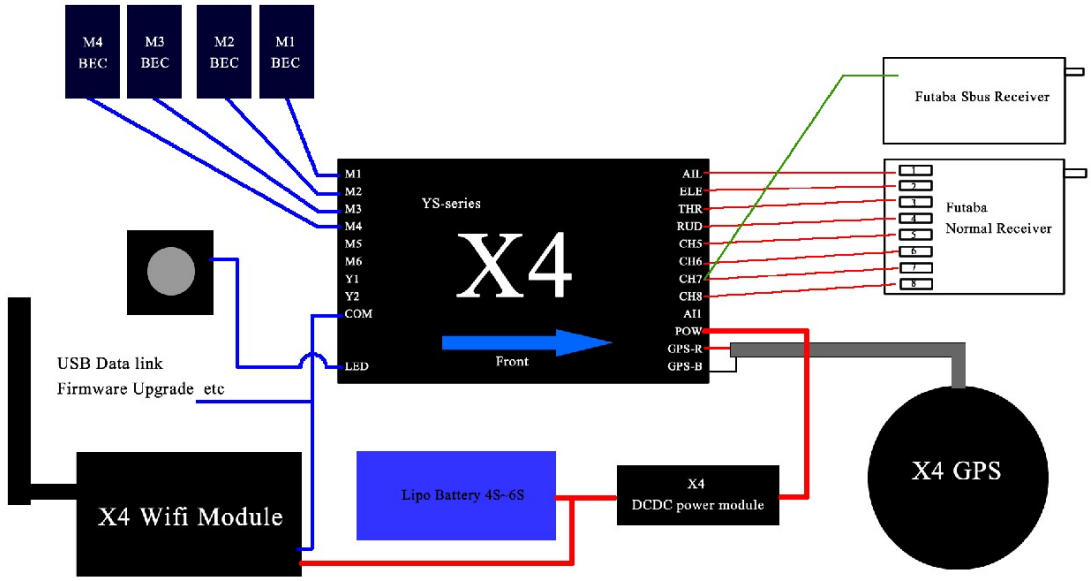






YS-X4 Flight Control Testing

If you are going to test YS-X4 for the first time, please firstly check if the flight control has been installed, as shown in the image below.



Connect to WiFi hotspot SSID: ZERO-TECH, Default Password: 82890430. Once the WiFi connection is established, please complete the necessary settings and checks according to YS-X4 user manual. The link of its official website is http://www.zerouav.com/en/Product/chanpinxilieyi/222.html. You can also download the user manual and configure software on AlienCopter's website. For the first-time installation, please refer to the

“Installation Guide” on the last slide page of the YS-X4 ground station’s “Set” sheet, as shown in the image below.

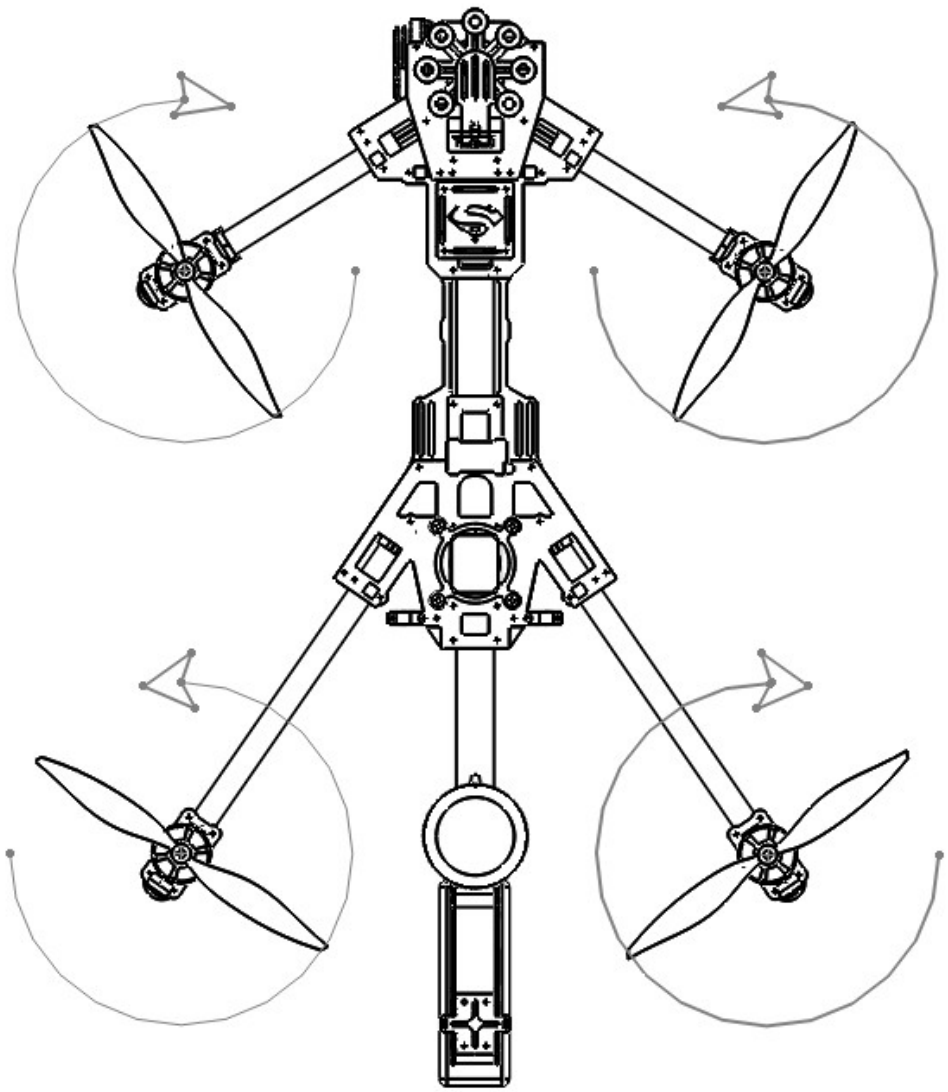
Please keep testing until the flight control parameters appearing on the ground station get normal, as the image below shows.

If you are using our recommended types for the motor and propeller, which are 4108, kv600, apc1238 (for propeller), please configure the sensor parameter on the ground station's "Param" sheet once the initialization completes. Please pay attention to the parameters in the image below.

Please It is very important to note that in the first vertical row in the image above, the Roll Sensitivity should be set to 45, Pitch Sensitivity to 80 and Sway Compensation to 80(as the image shows). As for the Magnetic Declination parameter, you need to set the number based on the magnetic declination of your location. Take Shenzhen, China for instance, the Magnetic Declination parameter should be set to 2.0. Cell Number indicates the number of battery cells. 4s battery is the type we recommend. You may leave other parameter settings as default. In the second vertical row, you need to set "Aircraft Type" to "Quad-Rotor X" and leave other parameter settings as default.

Pre-flight Checks and Tuning

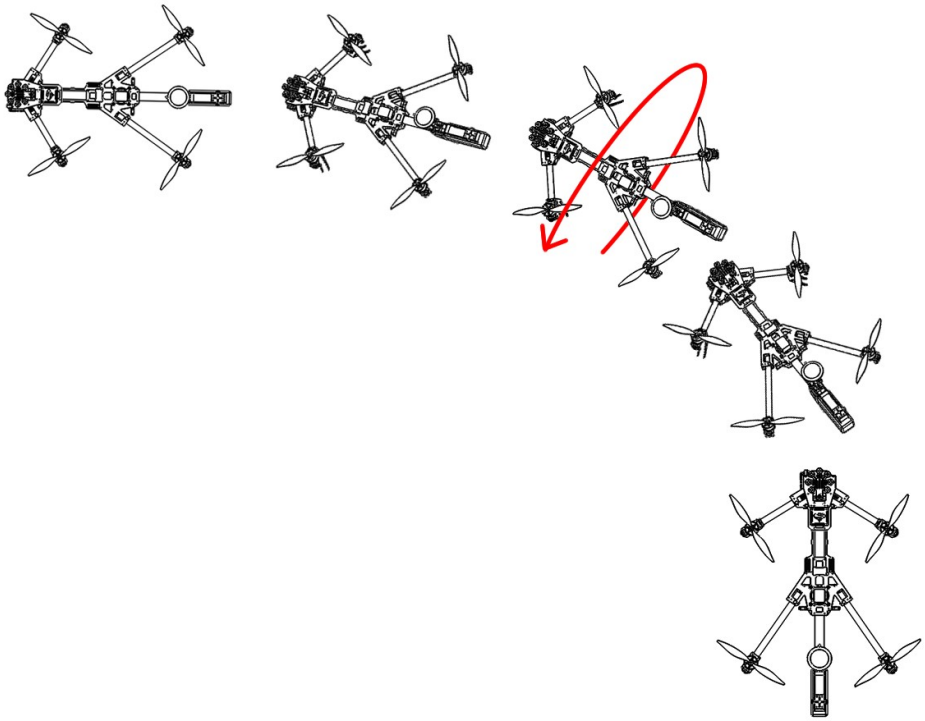
1. First, check the 4 motors to see if they rotate in the correct direction; if the motor plugs of the flight control are properly plugged (Motor 1-Motor 4); and if the propellers are correctly installed. Arrows in the image below show the correct direction in which the motors should rotate.



2. Second, make sure that the brushless gimbal remains flat during the its first power-up after the installation of Gopro 2 or Gopro3。

Important Notes for Flight

1. Because of the extraordinary design of the aircraft's main frame, it has some unique features in flight. The aircraft is quite good at high-speed flight and steep turns. Its center of gravity is not on the center of the central plate。Therefore, when it flies steep turns in high speed, it needs to make a certain angle. In most cases, when you flip the direction switch on the remote control, you need to add a certain amount of aileron rudder, in order to achieve the flight performance similar to the fixed-wing aircrafts. For this reason, the video recorded by this aircraft is very sharp and vivid, unlike those taken by the standard multi-rotor aircrafts, which is more rigid.



Appendix