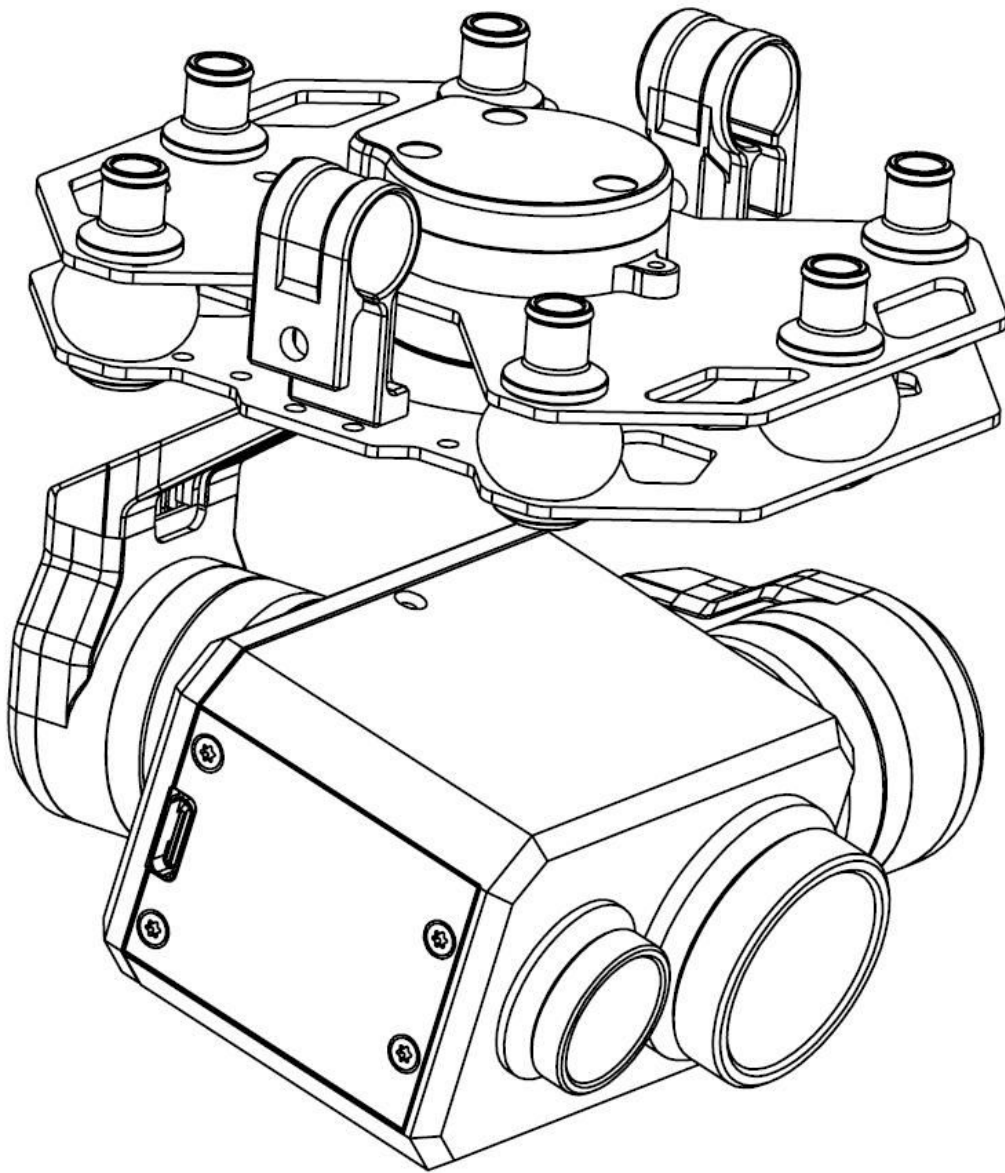


TAROT TL3T21

Thermal Imaging Dual-sensor Gimbal User Manual



2023.03.10 Revision V1.2

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Warning and Disclaimer

Congratulations on purchasing your new TAROT product. The information in this document affects your safety and your legal rights and responsibilities. Read this entire document carefully to ensure proper configuration before use. Failure to read and follow instructions and warnings in this document may result in serious to yourself or others, or damage to your TAROT product or damage to other objects in the vicinity. This document and all other collateral documents are subject to change at the sole discretion of TAROT. For update product information, visit <http://www.tarotrc.com> and click on the product page for this product.

The TL3T21 has been calibrated before leaving the factory. No physical or mechanical modification or adjustment of the gimbal is required or recommended. Do not add any other component or device to the camera. The TL3T21 is a delicate instrument. Please do not disassemble or assemble the TL3T21 yourself, otherwise it will cause the gimbal and camera to work abnormally.

To ensure the safety of flight control system after powering up, we recommend you remove all the propellers and use non-power-supply for the gimbal. Keep the entire components far from children and flammable & combustible materials!

Because TAROT cannot control the specific use, installation, modification, and improper use of users, TAROT will not be liable for the corresponding loss and compensation caused by following conditions :

- 1.Damage caused by failure to read this user manual carefully.
- 2.Damage caused by failure to operate in accordance with the relevant laws and regulations.
- 3.Damage caused by the operator continuing to operate the product in a poor physical or mental condition.
- 4.Damage caused by improper use or subjective intent.
- 5.Damage caused by the use of products or accessories not manufactured by our company.
- 6.Any damages relating to moral damage caused by the occurrence of an accident.
- 7.Damage caused by products out of warranty or improper maintenance resulting in poor operation of the product.
- 8.Damage caused by operation in bad weather such as heavy rain, snow, wind or hail.
- 9.Damage caused by flying in areas unsuitable for manoeuvring such as difficult observation areas,magnetic interference areas, radio interference areas, no-fly zones,etc.
- 10.Damage to the pod caused by homemade wire or incorrect soldering wire sequences.

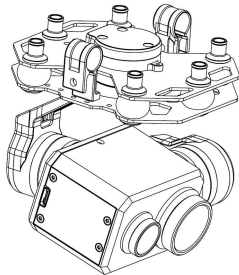
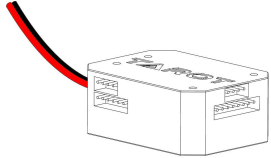
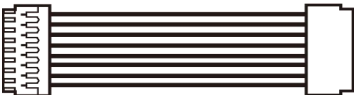
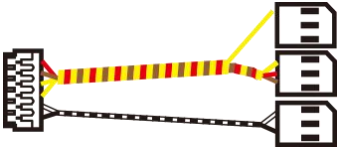


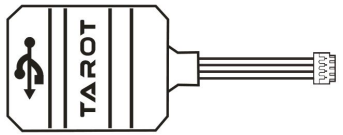
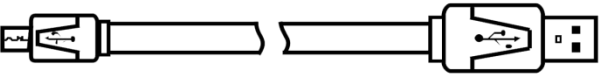
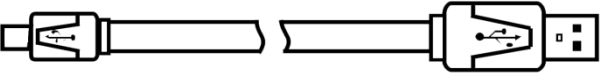
I . Product Introduction

Tarot TL3T21 Gimbal is a professional three-axis dual-sensor Gimbal built by our company for the needs of many industries such as power inspection, fire fighting, etc. It has a built-in independent IMU for precise control of the Gimbal attitude, integrated Gimbal special servo drive module, supports pointing and following and FPV first view two working modes, equipped with professional-grade 640 thermal imaging and 720P visible light camera, can be widely used in fire fighting, forest security, public security monitoring, search and rescue, environmental protection law enforcement and other industries.

Product Features:

- 1.The gimbal supports wide voltage 3-6S input.
- 2.Mechanical three-axis stabilized image, $\pm 0.01^\circ$ stabilized image accuracy.
- 3.Aluminum alloy structure design, light and strong, good heat dissipation performance.
- 4.Highly optimized servo motor vector control algorithm.
- 5.Fast AV signal video output mode.
- 6.RAN direction controllable angle(PAN): $\pm 125^\circ$.
- 7.TILT direction controllable angle(TILT): -120° to $+80^\circ$.
- 8.PWM receiver support, control gimbal Tilt/Point, two-way video switching.
- 9.Movement thermal imaging output resolution 640*512, visible light output 1280*720.
- 10.Movement debugging software(computer side) multi-mode optional.
- 11.Weight 287g

II . Product List

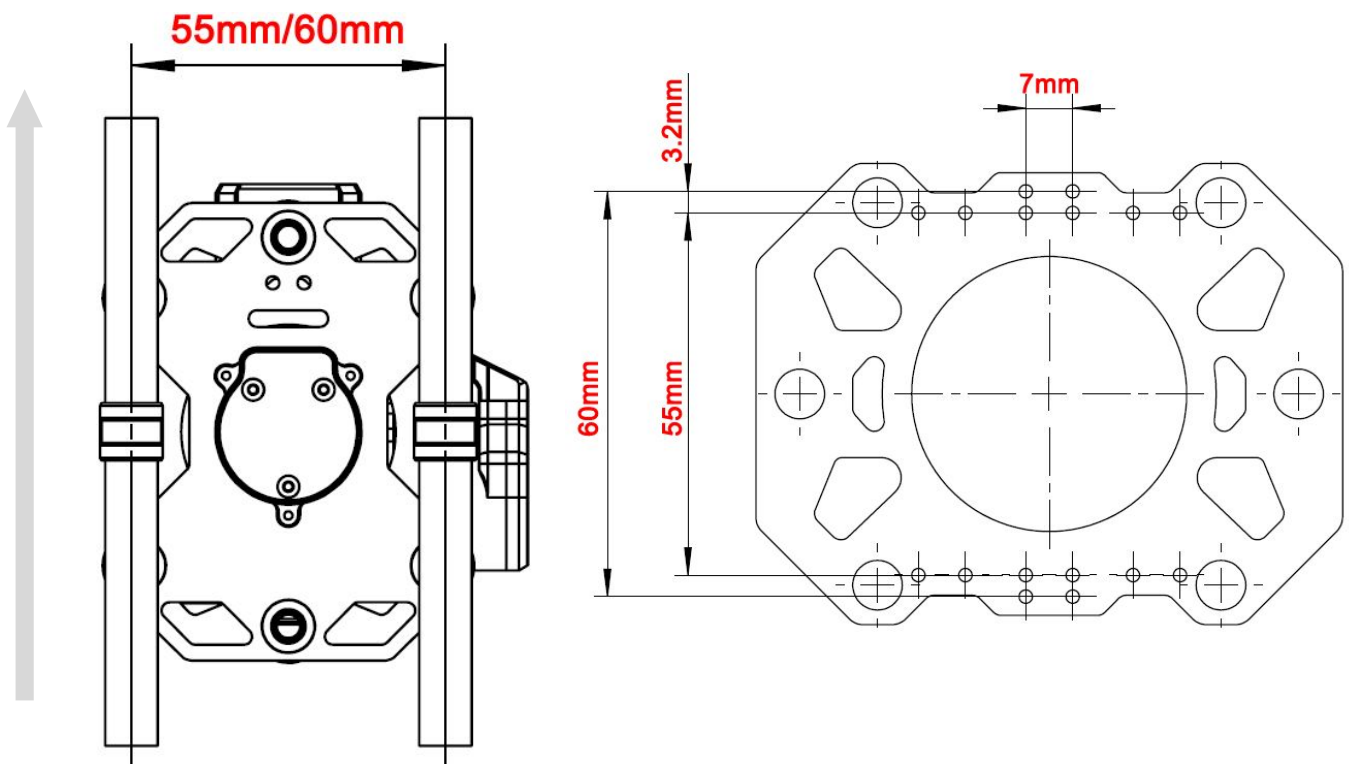
Gimbal × 1	
Gimbal Main Control Module (Power Supply) × 1	
Gimbal main control and Gimbal body connection cable/8P × 1	
AV output and receiver connection cable/6P × 1	
Gimbal main control and Gimbal body connection cable/4P × 1	
Video two-way signal switching PWM connection cable/2P × 1	
Gimbal Debug Module × 1	
Gimbal Tuning Module Connection Cable/Micro-USB × 1 (Not included, self-provided)	
Thermal imaging movement debugging cable / Type-C × 1 (Not included, self-provided)	

III. Mounting & Configuration

3.1 Mounted installation of gimbal

Customizable installation according to the hole size shown below, supports 2 types of mountings :

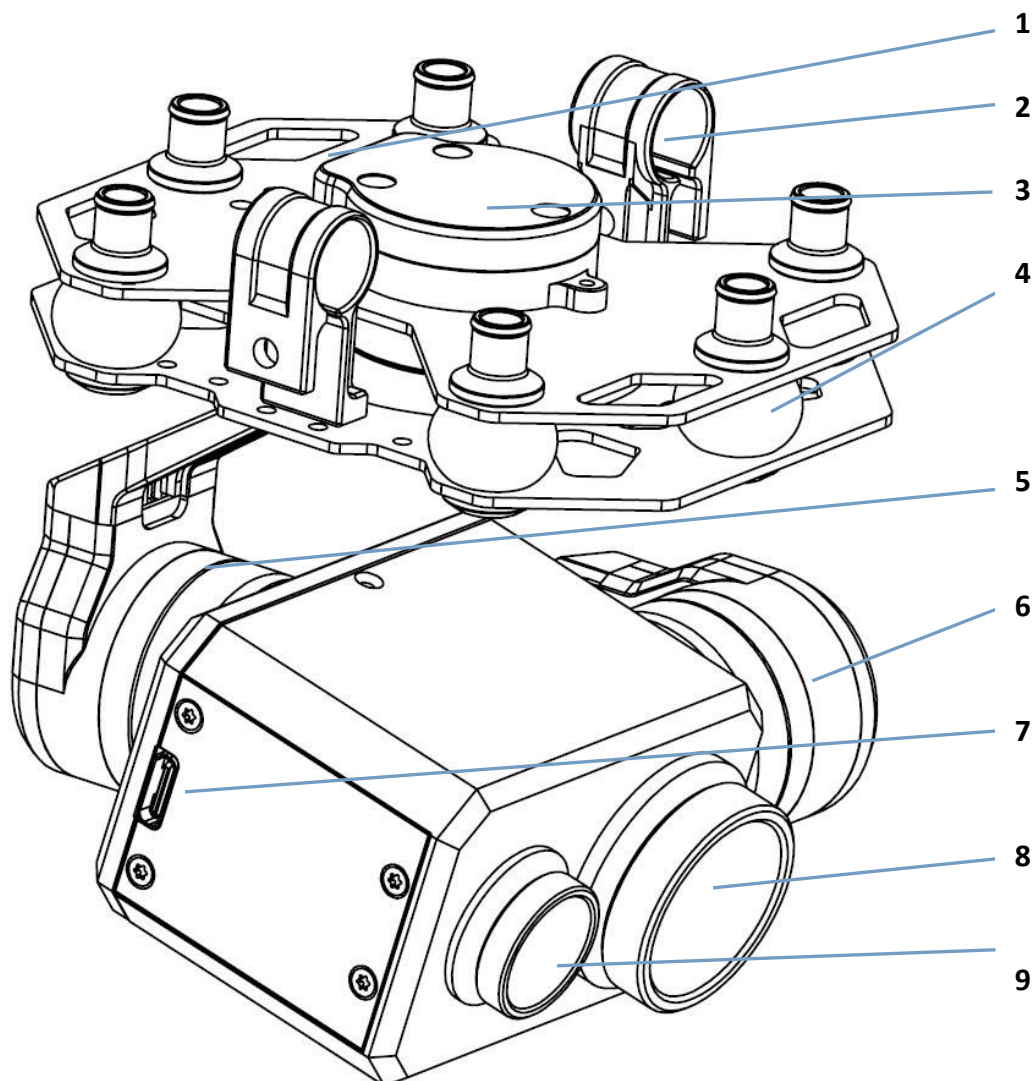
- 1: Prepare Gimbal to mount carbon fiber tube ($\Phi 10$), the mounting distance supports 55mm/60mm, you can hang Gimbal directly on the carbon fiber tube quickly;
- 2: Or add 4*M2 mounting holes to the vehicle, remove the Gimbal 2 suspension hooks and customize them with aluminum posts.



Cautions :

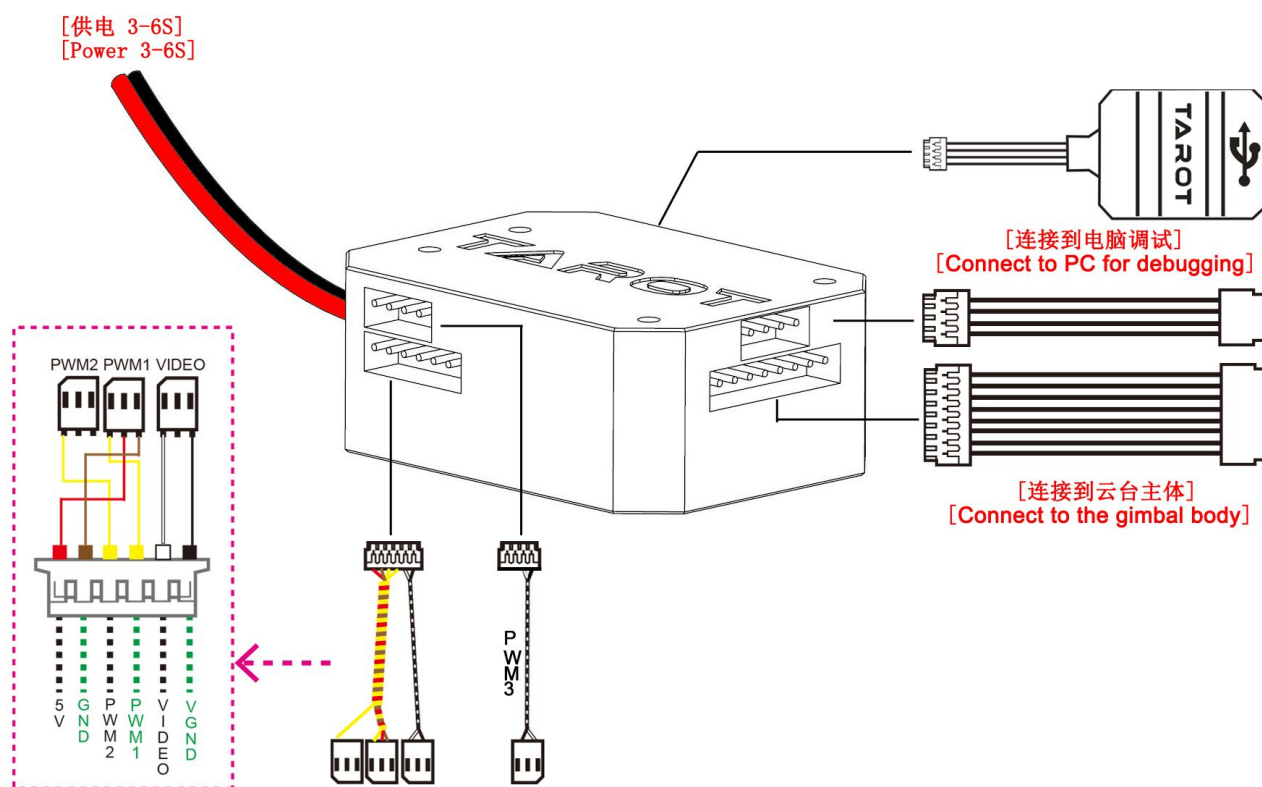
1. Please make sure there is enough space on the aircraft to ensure that the Gimbal camera does not touch the ground when going down vertically;
2. Please ensure that the Gimbal camera is installed in a horizontal position, firm and without looseness, to avoid abnormal vibration affecting the Gimbal image stabilization effect;
3. Make sure there are no foreign objects around the Gimbal camera body to ensure that it does not touch other objects while working.

3.2 Introduction of Gimbal Components



1	Connection Controller	4	Gimbal Shock absorbing ball	7	Movement commissioning interface
2	Gimbal Suspension Hook	5	Gimbal Roll axis	8	Thermal Imaging Movement
3	Gimbal Point axis	6	Gimbal Tilt axis	9	Visible light movements

3.3 Gimbal Controller Wiring Diagram and Instructions



Power supply	<p>Power supply: 11V-26V (3-6S lithium battery)</p> <p>Too low or too high a voltage can cause damage to the Gimbal , If using the same battery to power both the Gimbal camera and the aircraft, please ensure that the battery voltage meets the specifications of both the Gimbal camera and the aircraft</p>
PWM3/ PWM2/ PWM1/ Video	<p>Gimbal controlled by PWM signal</p> <ol style="list-style-type: none"> 1.Connect the Gimbal controller PWM1 and PWM2 channel lines to the corresponding required channel interface of the PWM common receiver, then set the [receiver type] to "common receiver" in the Gimbal tuning software, [channel mapping] under the Tilt / mode / pointing to the three functions mapped to "channel one" "channel two" can be (the above settings have been set by default in the Gimbal factory); 2.Plug the independent PWM3 channel cable into the corresponding required channel interface of the receiver to control the thermal imaging/visible light screen output switching via the corresponding channel button of the remote control; 3.Video cable can be directly connected to AV analog monitor or AV analog picture transfer to display the screen. <p>Note : If your receiver already has a 5V supply, disconnect the 5V power from the PWM1 channel line (red wire).</p>

DATA

Gimbal debugging module] can be connected to a PC for debugging Gimbal parameters.

IV. Introduction of ZYX-Assistant Gimbal Tuning Software

4.1 Installation of Tuning Software

①Please go to the official website to download Tarot TL3T21 Tuning Software. Website: <http://www.tarotrc.com/>

②Run the driver installation software under the "USB Driver" folder. Follow the prompts to complete the driver installation.

32-bit system running : "CP210xVCPInstaller_x86.exe"

64-bit system running : "CP210xVCPInstaller_x64.exe"

③Connect to the computer via the Micro-USB cable to complete the final installation of the device driver.

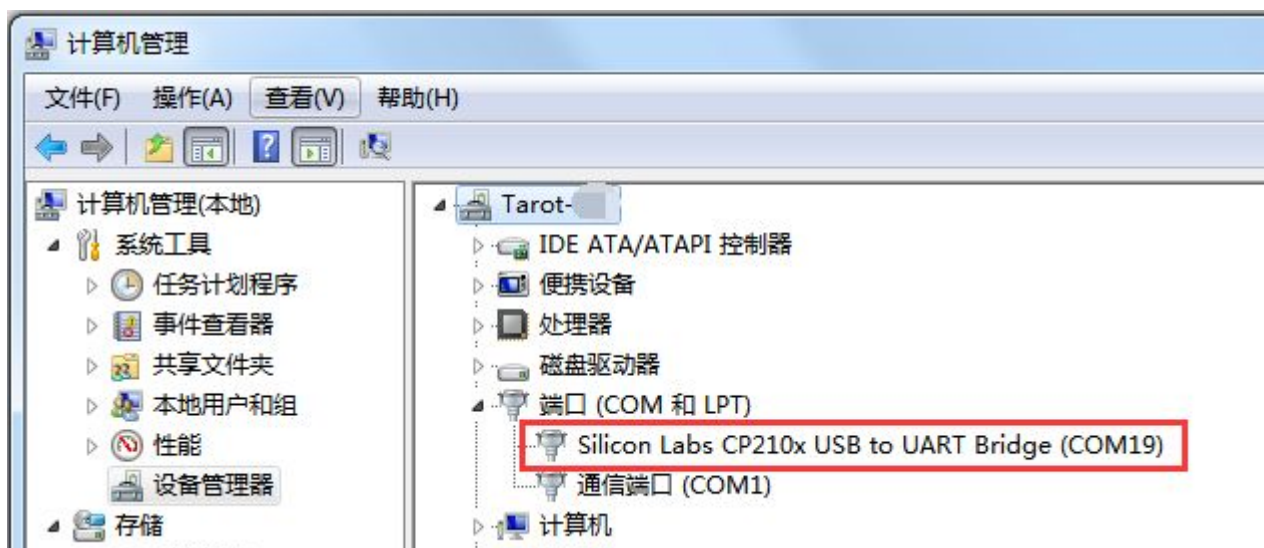
④Run the software "ZYX-Assistant.exe" for parameter setting and other operations.

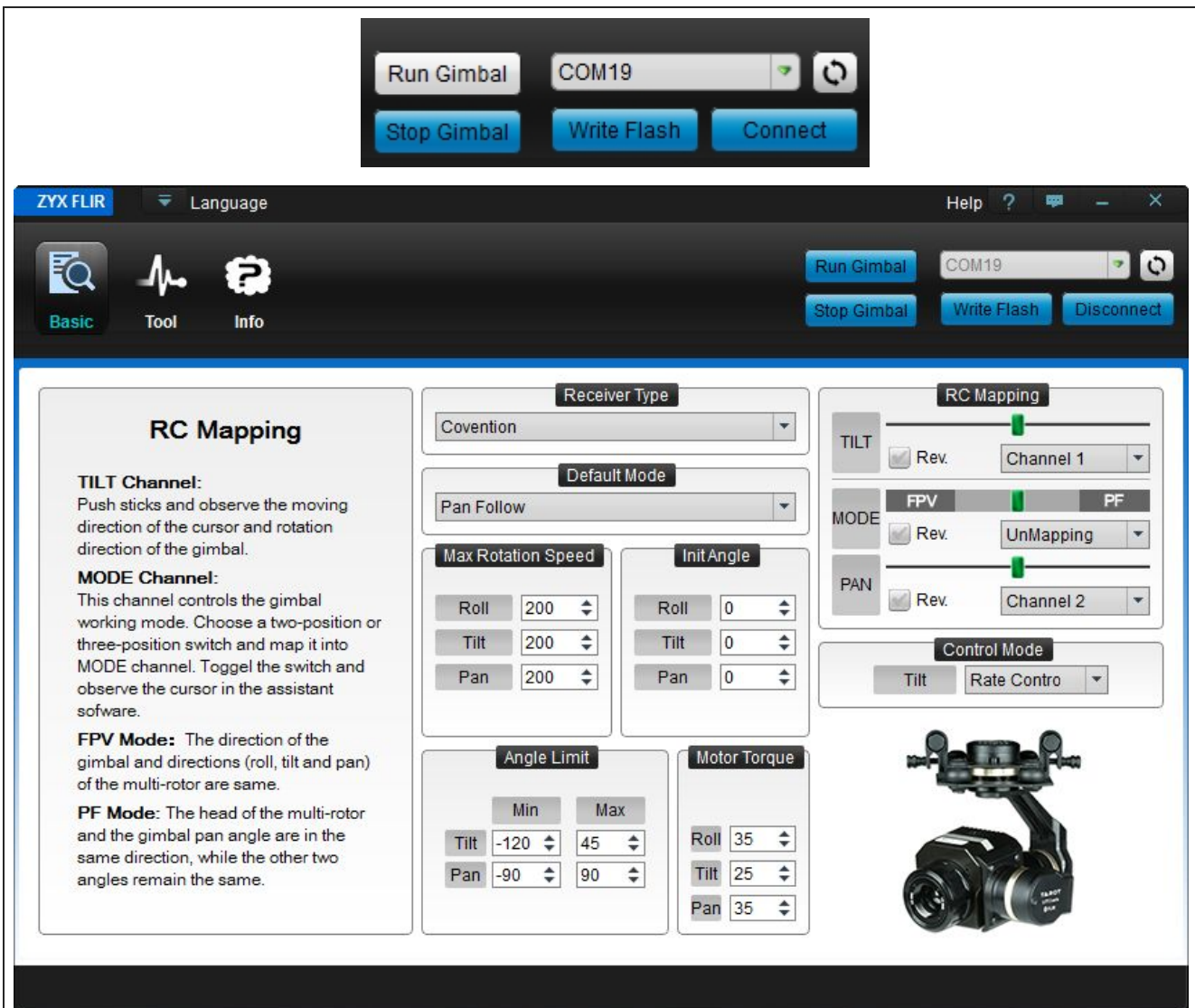
4.2 Connection of the Tuning Software

TL3T21 three-axis thermal imaging Gimbal, in flight can stabilize the angle of Roll, Tilt, Point in three directions, and output stable thermal imaging images.

By using ZYX-Assistant software, you can change the settings of the Gimbal control channels and set the corresponding Gimbal functions.

First, connect your Gimbal to the [DATA/FC] port of the Gimbal Master Module via the [Gimbal Tuning Module] and [Micro-USB cable] to your computer, then check the real port number of the Gimbal by "right-clicking" on [My Computer] - [Manage] - [Device Manager] - [Ports (COM and LPT)]. **(If you are not sure of the real port number, please re-plug the corresponding USB cable, the port number will be refreshed in real time)**, Run the software "ZYX-Assistant.exe", click the Refresh button in the upper right corner and select the correct port number, click "Connect".





When the Gimbal connection is successful, the software will actively stop the Gimbal from spinning to protect your device.

Once you have set the relevant parameters, you can make your Gimbal work properly by clicking the "Run Gimbal" button. At this point, you can push and pull the rocker, toggle the switch to see if the Gimbal settings meet your requirements.

After you have set the Gimbal parameters, **click the "Write Flash" button** to ensure that the parameters are cured in the Gimbal. When the Gimbal is next powered up, it will run with the saved parameters.

4.3 Basic Setup of Tuning Software

1. **Receiver not connected:** Gimbal mode is run by "default mode";

2. **Receiver is connected:** Gimbal mode is controlled by the receiver's "Mode" channel setting.

FPV mode: FPV mode, Gimbal is aligned with the three-axis orientation of the vehicle.

Pan fllow mode : Pan Follow mode, Gimbal Pan in line with the nose Pan.

The maximum rotation speed that Gimbal can achieve.

When you find that the Gimbal rotation speed is low when the remote control rocker is pushed and pulled to the maximum value, you can increase the value to increase the rotation speed.

Or, if the Gimbal is rotating too fast when the joystick movement is small, you can reduce the value to slow down the rotation speed.

Roll max.speed input range:

0~200 (Degree/sec)

Tilt max.speed input range:

0~200 (Degree/sec)

Pan max.speed input range:

0~200 (Degree/sec)

Note : After modifying the value, please hit the [Enter] key to upload the parameters and click "Write Flash".

Gimbal's angular range of rotation in Tilt and Pan directions.

When the Gimbal is rotated to the angle limit setting by the remote control, the Gimbal will not continue to rotate until the rocker is pushed and pulled in reverse to bring the Gimbal back within the angle limit.

Tilt Angular limit input range: $-120^{\circ} \sim 80^{\circ}$

Pan Angular limit input range: $-125^{\circ} \sim +125^{\circ}$

Note: After modifying the value, please hit the [Enter] key to upload the parameters and click "Write Flash"

Receiver connection method

General receivers: Connect to PWM1 and PWM2 channels respectively with connecting wires;

The initial angle in each direction after the Gimbal is powered up. For example, if you want the camera to remain at -45 degrees in the Tilt direction after the Gimbal is powered up, you need to enter -45 in the corresponding item.

Roll angle range: $-50^{\circ} \sim 50^{\circ}$

Tilt angle range: $-120^{\circ} \sim 80^{\circ}$

Pan angle range: $-125^{\circ} \sim 125^{\circ}$

Note : After modifying the value, please hit the [Enter] key to upload the parameters and click "Write Flash"

This parameter affects the response speed of the Gimbal, too small a parameter will lead to poor stability of the Gimbal, too large a parameter will lead to self-excited oscillations of the Gimbal.

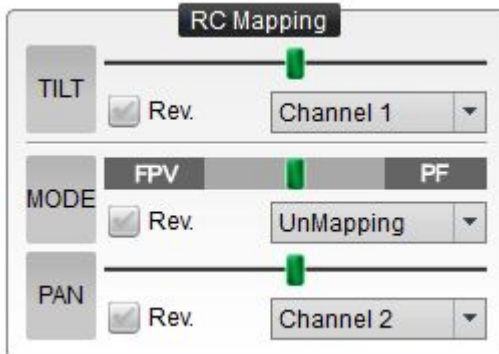
Adjustment method: If the Gimbal has a vibration phenomenon, please slightly reduce the parameter until the vibration disappears.

Input Range: 0~200

Note : After modifying the value, please hit the [Enter] key to upload the parameters and click "Write Flash".

Note: This parameter has been adjusted to a more appropriate value when Gimbal is shipped, please do not modify this parameter if there is no abnormal situation in Gimbal.

4.4 Channel Setting and Mapping for Tuning Software



Tilt Channel :

Push the rocker and observe the direction of movement of the slider and the direction of rotation of the Gimbal.

Mode Channel :

This channel controls the Gimbal mode, selecting the channel with the two- or three-position switch and mapping it to the "mode" channel.

When the toggle switch is moved to the corresponding position, the slider will be located in the corresponding mode area.

Pan Channel :

Push the rocker and observe the direction of movement of the slider and the direction of rotation of the Gimbal.

Remote control of Gimbal rotation (only Tilt direction is supported).

Push the rocker and observe the direction of movement of the slider and the direction of rotation of the Gimbal.

Rate Control : The remote control rocker position corresponds to the Gimbal's speed.

Angle Control : The remote control rocker position corresponds to the angle of the Gimbal.

① Gimbal Mode Settings

Select a two- or three-digit switch as the mode switch control (default off) :

Take a three-position switch as an example:

Position 1: FPV mode

Gimbal Roll, Tilt, Point three angles follow the aircraft attitude change and change; and when the remote control Point rocker back to the center, Gimbal each Point will also automatically back to the center;

Position 2: No operation;

Position 3: Follow mode, Point follow mode

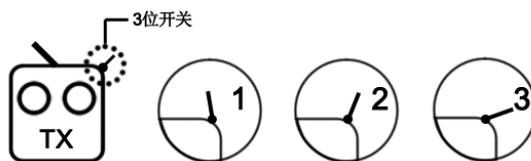
Gimbal Roll, Tilt two angles remain unchanged, Point follows the head pointing change;

The settings of position 1 and position 3 can be switched.

Note :

When the mode channel is not connected, the Gimbal will work in the default mode; if the mode channel is accidentally disconnected during use, the Gimbal will maintain the operating mode before disconnection;

When the Gimbal is powered on, the Gimbal will work in default mode if no receiver is connected.



② Gimbal Tilt Settings

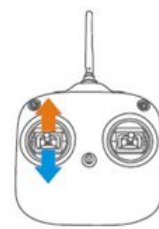
Select a rotary push button switch or rocker for Tilt axis control (default channel one) :

Take the rocker as an example :

Rocker up, Gimbal turns up corresponding to Tilt axis;

No operation in the center;

With the joystick down, the Gimbal turns down corresponding to the Tilt axis.



③ Gimbal Point Settings

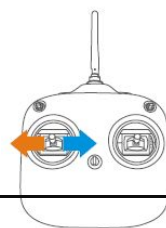
Select a rotary button switch or rocker for Point axis control (default channel two) :

Take the rocker as an example:

Rocker to the left, Gimbal corresponds to Point axis to turn left;

No operation in the center;

Rocker to the right, Gimbal corresponds to Point axis to the right.



③ Video Output Switching Settings

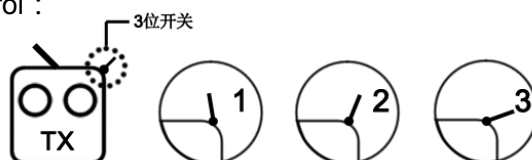
Select a two- or three-position switch for Point axis control :

Take a three-position switch as an example:

Position 1: Thermal imaging video output;

Position 2: No operation;

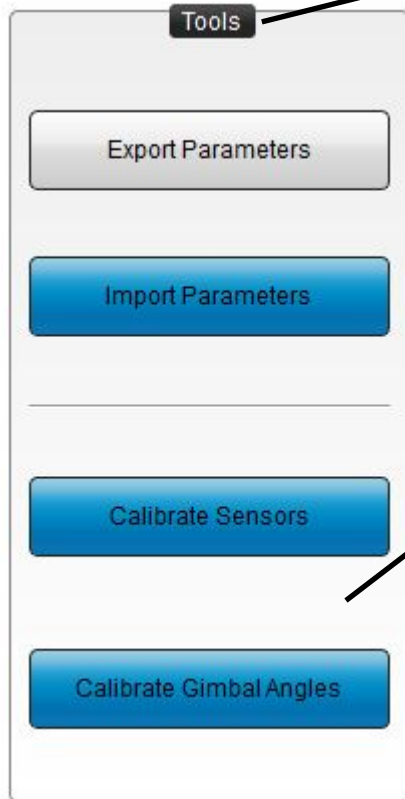
Position 3: Visible video output



Cautions:

- 1.The Gimbal function can be changed to control forward and reverse by setting the channel forward and reverse rudder in the Futaba remote control;
- 2.The effective travel of each channel control can be changed by setting the channel travel in the Futaba remote control;

4.5 Tool



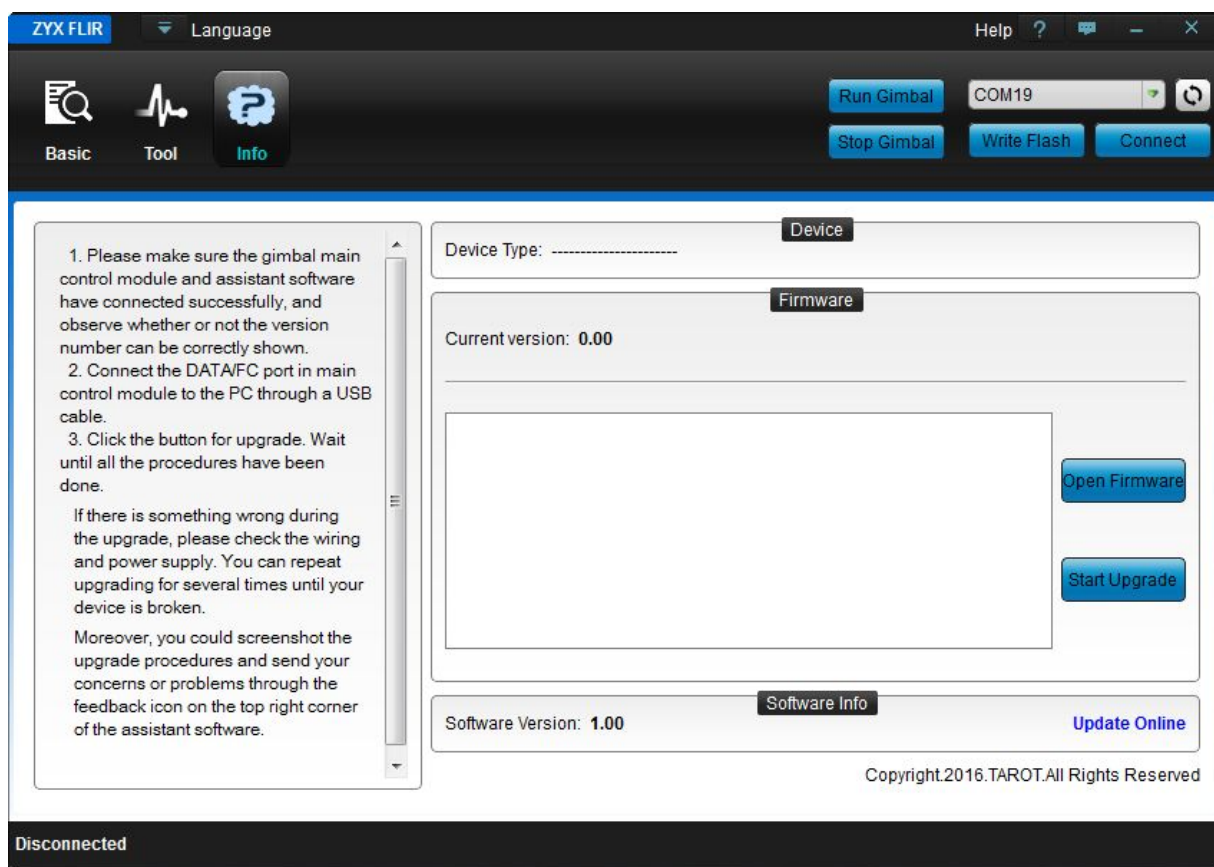
Calibrate the sensor when the Gimbal angle is not horizontal or when you find that the output of the gyroscope is far from the zero value when the Gimbal is at rest.

Calibration method: Place the Gimbal horizontally at rest (the level directly affects the calibration effect), then click the "Calibrate Sensor" button, when the bottom left corner of the software shows "Sensor calibration successful", calibration is complete.

Note: Gimbal has been factory-tested rack calibration, no need to operate calibration in case of no problem

Please keep the three axes of the Gimbal perpendicular to each other when calibrating the angle of the Gimbal, incorrect placement will affect the stable angle of the Gimbal after operation.

4.6 Firmware Upgrade



Upgrade Steps :

1. Please download the latest version of Firmware Upgrade package from the official website (<http://www.tarotrc.com>).
2. Ensure that the Gimbal master module is successfully connected to the software.
3. Click the button "Open Firmware" to import the latest downloaded firmware file, click the button "Start Upgrade", the progress bar will reach 100% to be successful.

If you get an error during the upgrade process that you cannot upgrade, please check if the wiring is correct, the power supply is normal, and the driver installation is successful. As long as your device is not damaged, it is possible to repeat the upgrade several times.

V . Frequently Asked Questions

Question	Analysis	Solutions
Angle not horizontal	1.Excessive sensor error; 2.The remote control does not return to zero;	1.Calibration Sensors; 2.Remote control back to zero;
Gimbal Vibration	1.Locking not fixed tight; 2.Excessive motor torque;	1.Tighten each fixing screw of Gimbal; 2.Slightly reduce the motor torque value;
Poor screen stability	1.Excessive vibration of the aircraft; 2.Loose vibration damping ball; 3.Motor torque is too small;	1.Reduction of aircraft vibration; 2.Check and correct shock ball position; 3.Slightly increase the motor torque value;
Fast flashing red light	1.Gimbal main control and Gimbal body connection cable is loose; 2.Gimbal blocked rotation protection over 10 times;	1、 Check the connection cable and fix it tightly; 2、 Check for resistance to Gimbal rotation, then reapply power;

VI. Product Specifications

	Projects	Parameters
Function Indicators	Video Output	AV output PAL system(Does not support internal recording)
	Support Control Type (Gimbal)	PWM
Gimbal Technical Indicators	Input power	3S-6S Lipo (11V-26V)
	Operating current	30mA (@25V) 50mA (@12V)
	Blocking current	350mA (@25V) 700mA (@12V)
	Working environment temperature	-20℃~+50℃
	Weight	278g
	Maximum external dimensions (length, width and height)	96mm*80mm*99mm
	Maximum speed	Tilt : ±200°/S
		Roll : ±200°/S
		Point : ±200°/S
	Controlled rotation range	Tilt : -120°~ +80° Point : -125°~ +125°
	Attitude control accuracy	±0.02°
	Assembled camera model	640 Thermal imaging cameras
Thermal Imaging Cameras Technology Indicators	Resolution	640*512
	Focus	13mm F1.2
	Focus type	Athermalization
	FOV	33°×26°
	IFOV	0.95 mrad
	Pixel Pitc	12μm
	Frame Rate	50Hz
	Response Spectra	8 ~ 14μm
	NETD	≤50mK@25℃ , F#1.0 (≤40mK optional)
	TEC	No
	Brightness&Contrast Adjustment	Manual/Auto0/Auto1
	Polarity	Blackhot/whitehot
	Palette	Support
	Reticle	Display/disappear/move
	Image Processing	Shutterless I、NUC、Digital filtering/noise reduction、DDE
	Image flip	Right-left/Up-down/Diagonal
	Camera Tuning interface	Type-c
	Camera Tuning software	PC (Win10 and above, drive-free)

Visible light Cameras Technology Indicators	Program Devices	1/3" CMOS
	Effective Pixels	1280(H)*720(V)
	Minimum Illumination	0.05Lux/F1.2
	Horizontal clarity	1000TVL
	White Balance	Automatic
	Auto Gain	Automatic
	Backlight compensation	Automatic

VII. Port Description

Gimbal Master Control Port	
PWR	Power port
DATA/FC	Gimbal Main Control Parameter Upgrade and Flight Control Data Entry Port
PWM/PWM2/AV	Gimbal control PWM receiver output (with 5V), thermal imaging/visible light AV output
PWM3	Thermal imaging/visible video signal source switching
Thermal imaging camera port	
Type-c	Thermal imaging commissioning interface (PC side)

VIII. LED Indicator

Gimbal Main Control Indicator Status	
Red and blue lights flash twice	Power-on self-test status
Red and blue lights are always on	Power-on self-test failure
Blue light goes off	Flight control not connected
Blue light is always on	Flight control is connected
Blue light blinking	The flight control is connected properly and the flight control data is available
Red light flashing	1. Line failure 2. Gimbal blocked rotation protection over 10 times
Motor Drive and Sensor Module Indicator Status	
Blue light flashes once	Power-on self-test status
Blue light is always on	Power-on self-test failure

