

Guidance for DJI XP3.1 Control Parameters Tuning

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This document is for the purpose to give you some tips about tuning control parameters of DJI XP 3.1 Autopilot. Please read the DJI XP3.1 Standard Manual for configuration software installation and operations. Please pay attention to all the notices/ warning.

Gain-Parameter

Gain parameters adjust the strength of the autopilot system's attitude control in a certain direction (pitch, roll, yaw and vertical). When a gain value is too low, the helicopter position will drift back and forth in that direction. When a gain value is too high, the helicopter attitude will oscillate rapidly in that direction.

This is a method to properly adjust the gain parameters. Apply this method to each of pitch, roll, yaw and vertical, one at a time. First, increase gain until the helicopter oscillates in the given direction during flight. Next, decrease the gain in small increments until the helicopter stops oscillating during flight. Finally, decrease the gain once more by 10%. This gain setting is theoretically at the best possible value; high enough to steady the helicopter, but not high enough to over-control and cause shaking.

P-Parameter

Usually parameter P doesn't need adjustment, the default value is often sufficient. Adjustment of P will cause difference when starting to move from hovering. The larger the P, the sooner the helicopter will start moving from hovering, while there's no obvious angle change, and the effect will only last for a short period of time.

I-Parameter

The I parameter corresponds to consistent and accurate speed, or steady hovering, when the helicopter receives external disturbance. When the pilot gives a command through stick position, the helicopter might not be able to achieve the desired speed due to head wind. The larger the I value, the faster the helicopter will compensate and adjust for wind, while smaller I values may cause more time for the helicopter to reach the commanded speed.

Similarly, when the helicopter is hovering and wind blows the helicopter away from the hover point, the helicopter will gain a certain acceleration proportional to the I value to return to the hover point. The larger the I value, the sooner the helicopter will make this adjustment.

When the I value is too low, the helicopter will drift within a certain range, similar to what happens when a gain parameter is too low.

V-Parameter

The V parameter adjusts the tendency of motion during pilot commands. Higher V values cause the helicopter attitude to adjust more aggressively to obey command input. For instance, when a stick position command is given, a high V value causes the helicopter to have a relatively sharper angle in response. This allows the helicopter to reach the desired speed sooner, but sometimes the helicopter will become unstable and difficult to control. A low V value causes the helicopter to respond slower to stick position commands, even with very extreme stick positions.

One can say that the V parameter adjusts the tendency of motions, and the change of control feeling after the adjustments will be similar to the difference between using hard or soft rotor head. But V is not the sole influence on the time of respond, please note.

The V parameter adjusts the tendency of motions, and gain adjusts the feedback strength of such tendency. V is adjusted according to user preference, but gain has a theoretical best possible value.

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Q-Parameter

Parameter Q is special; it gives feedbacks to angle velocities. For helicopters with a softer rotor-head, if shaking occurs in Roll direction during high-speed flight, increasing the Q will counteract such shakings. However for helicopters with a harder rotor-head, such setting of Q will cause less smooth movements, and even jittering. And a too large Q for a hard rotor-head will cause abnormal shaking in roll direction, even during hovering.

Be cautious when you adjust the parameter Q. Theoretically, helicopters with a hard rotor-head does not necessarily need adjustment of Q, and you can simply use 0. If you're not sure whether the rotor-head is so soft that it requires the assistance of a parameter Q, to ensure the stability in Roll direction under high speed, please then use the following steps to adjust.

Firstly, make sure that parameters Gain, P, V and I are set to an ideal value under low-speed or hovering status, and the helicopter flies smoothly and stably.

Then try high-speed flying (under Auto or WayPoint mode), if the helicopter is stable in Roll direction, then adjustment of Q is not needed; and if there's shaking in Roll direction, increase the Q and see if the shaking is eliminated.

If after repeated increase of Q, and the Roll direction remains unstable, or that the Q is already very large (more than 300-500), and there has been abnormal shaking even under low-speed or hovering status. Then the problem may not be caused by Q. You need to adjust the Q to 0, and re-adjust the parameter Gain, P, I and V under low-speed (since these parameters are not set to the ideal value), until the helicopter flies stably.

If after increasing the Q, and the shaking in Roll direction has been eliminated, please slightly decrease the Q, so that the helicopter will also maintain smooth and stable flying under low-speed.

Again, if you have a hard rotor-head, the Q is not needed. And most helicopter platforms does not require a Q.

Tested control parameter setting for some of the helicopters

	T-Rex 600	GSR260Z	Kyosho 260	Maxi Joker II	
Roll Gain	140	250	260	200	
Pitch Gain	180	300	280	200	
Yaw Gain	500	400	450	300	
Vertical Gain	45	65	65	65	
Roll	P	0.15	0.15	0.15	
	V	0.6	0.8	0.6	
	Q	1	1	250	1
	I	0.5	0.6	0.8	0.6
Pitch	P	0.15	0.15	0.15	0.15
	V	0.8	0.6	0.6	0.8
	Q	1	1	300	1
	I	0.5	0.9	0.85	0.6
Testing Condition					
Weight	~5kg	~10kg	~8kg	~5kg	
Rotor RPM	1280	1280	1280	1280	
Main Blade Length(Single)	610mm	810mm	810mm	810mm	

Notice: 1.As you may see, only the Kyosho 260 which has softer rotor head has the parameter Roll Q 250 and Pitch Q 300.

2. From our experience, every helicopter can be configured to a very stable state. Customers need to make sure that the helicopter itself flies perfectly and smoothly before equip with the DJI product. If the payload or gravity of the helicopter has been changed, you might need to adjust the control parameters.