

XAIRCRAFT X600-D

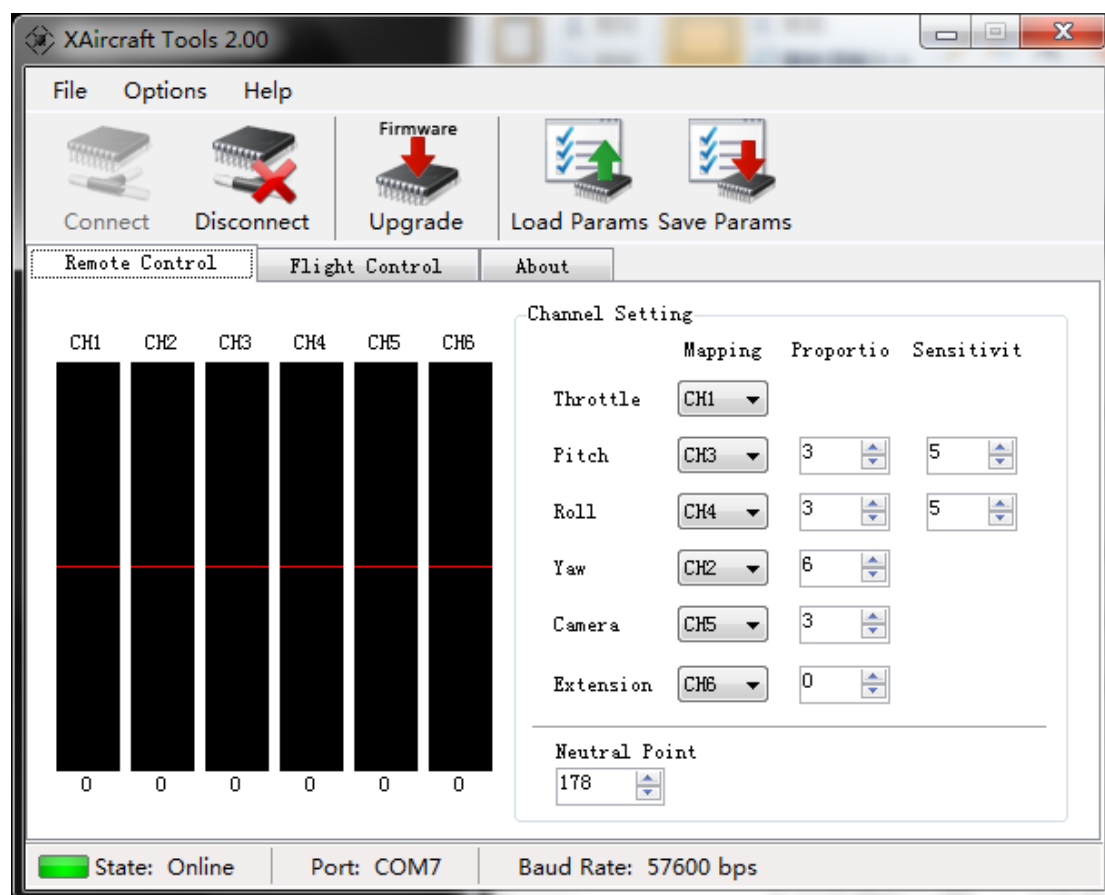
How to set parameters for X600D

V0.2

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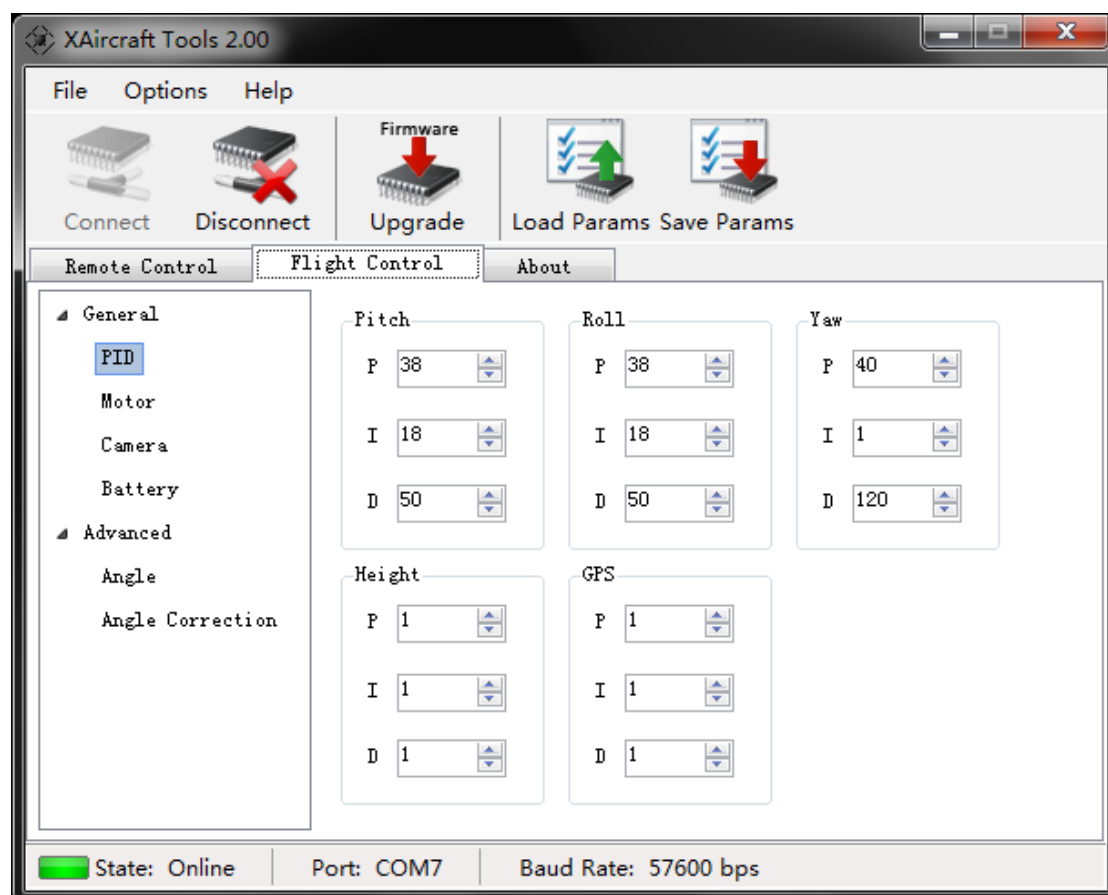
A. Remote Control Settings



Proportion: It ranges from 1 to 255, it's a gain factor for RC signals. For example, when the value of 'pitch' stick gets to 5, you set the proportion value as '3', FC will translate it into 15 ($5 \times 3 = 15$). If you set the value as '1', there's no gain for sticks.

Sensitivity: ranges from 1 to 255. The higher the value, the faster the response for the FC to sense the moving of sticks.

B. PID Tuning



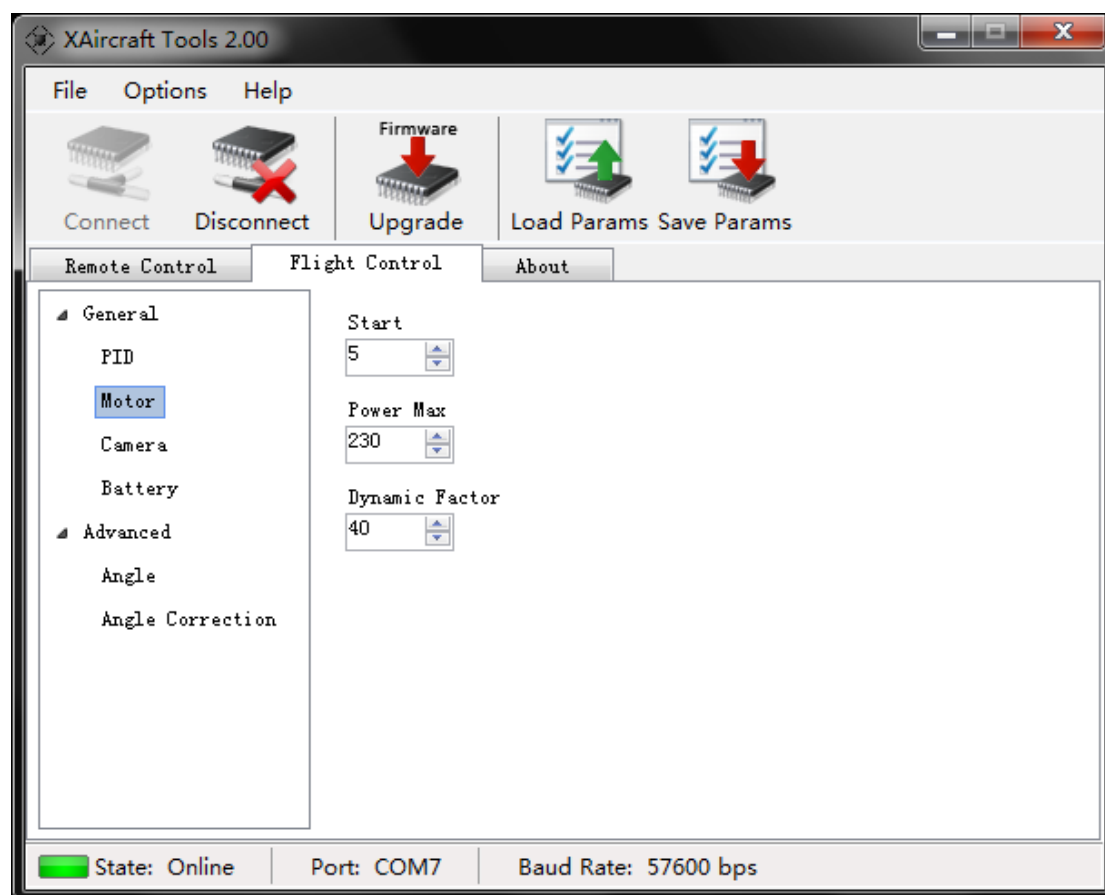
It needs basic engineering control theoretical knowledge; we strongly suggest you set these values near the defaults.

FC use PID control theory to balance the machine automatically.

You can set the PID parameters for pitch, roll, and yaw. The height and GPS settings are invalid before you install GPS.

Before you setting the parameters, please refer to the appendix document <How to Set PID Parameters>.

C. Motor Settings



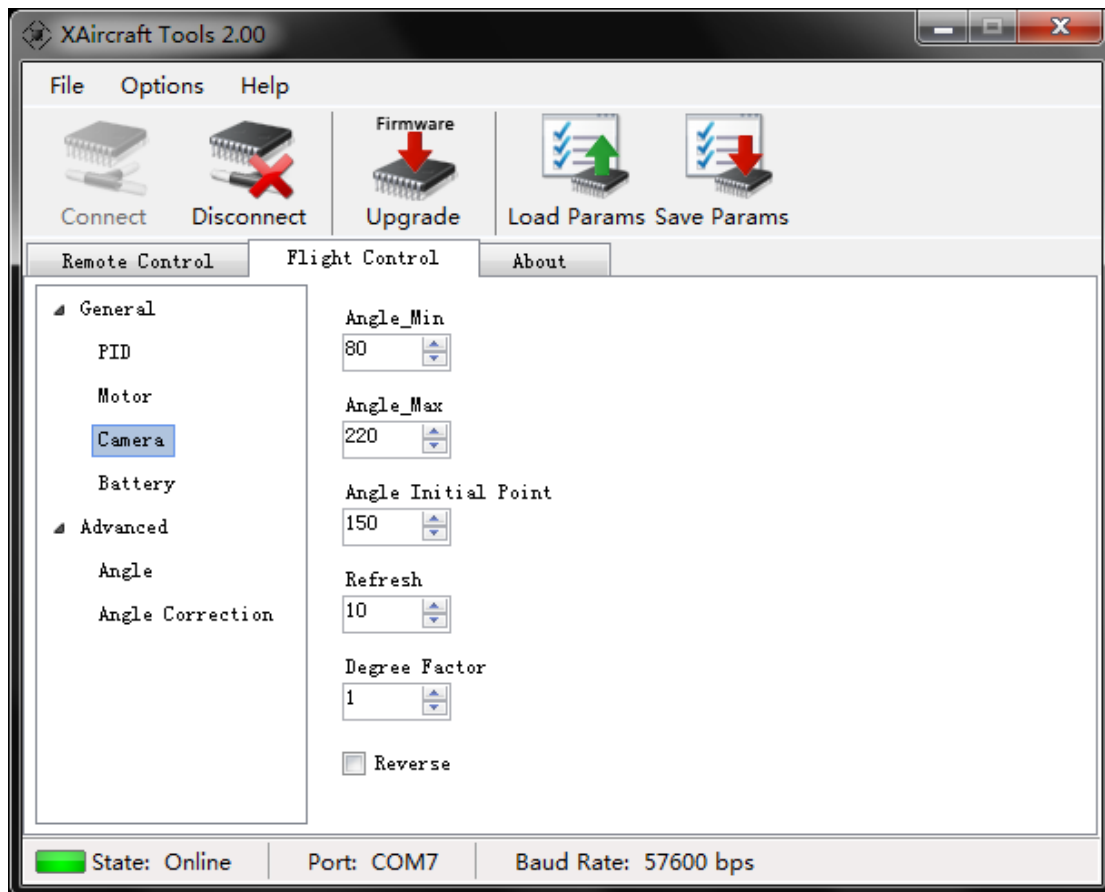
The value of throttle was ranged from 0 to 255 by FC.

Start: when throttle from RC reached this value, the motors start.

Power Max: the max value for throttle can reach.

Dynamic Factor: to gain the control signals output by PID. The higher the value the more powerful the machine reacts.

D. Camera Settings



X600D reserved one channel output, which can drive steering engine, which supports adding DIY camera mount (it also needs DIY landing gear).

The settings are used to configure how the FC controls the servo (control the pitch of camera mount indirectly).

Angle_Min: the minimum value FC can output for servo. The smaller the value, the bigger angle the X600D can overlook.

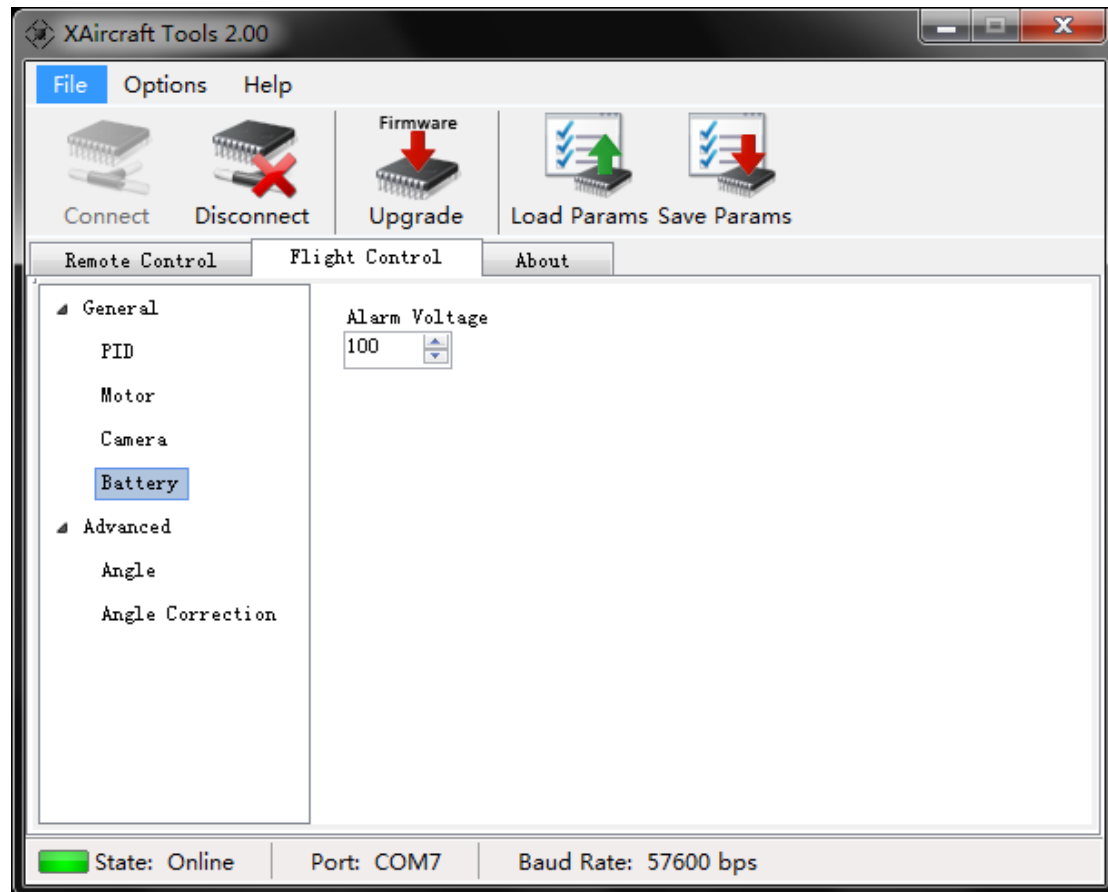
Angle Initial Point: the initial value FC outputs for servo, you should change this value to set your camera initial visual angles vertically.

Refresh: the output cycle for servo. For digital servo, the value can be set to greater than 1ms. But for other servo, the value should be set to beyond 10ms according to the servo features.

Degree Factor: as the machine moves in pitch direction, the factor for balancing the camera mount. Suggested you set 1, but different servos response differently, you need tuning.

Reverse: If the servo you have is inverse, please check the box.

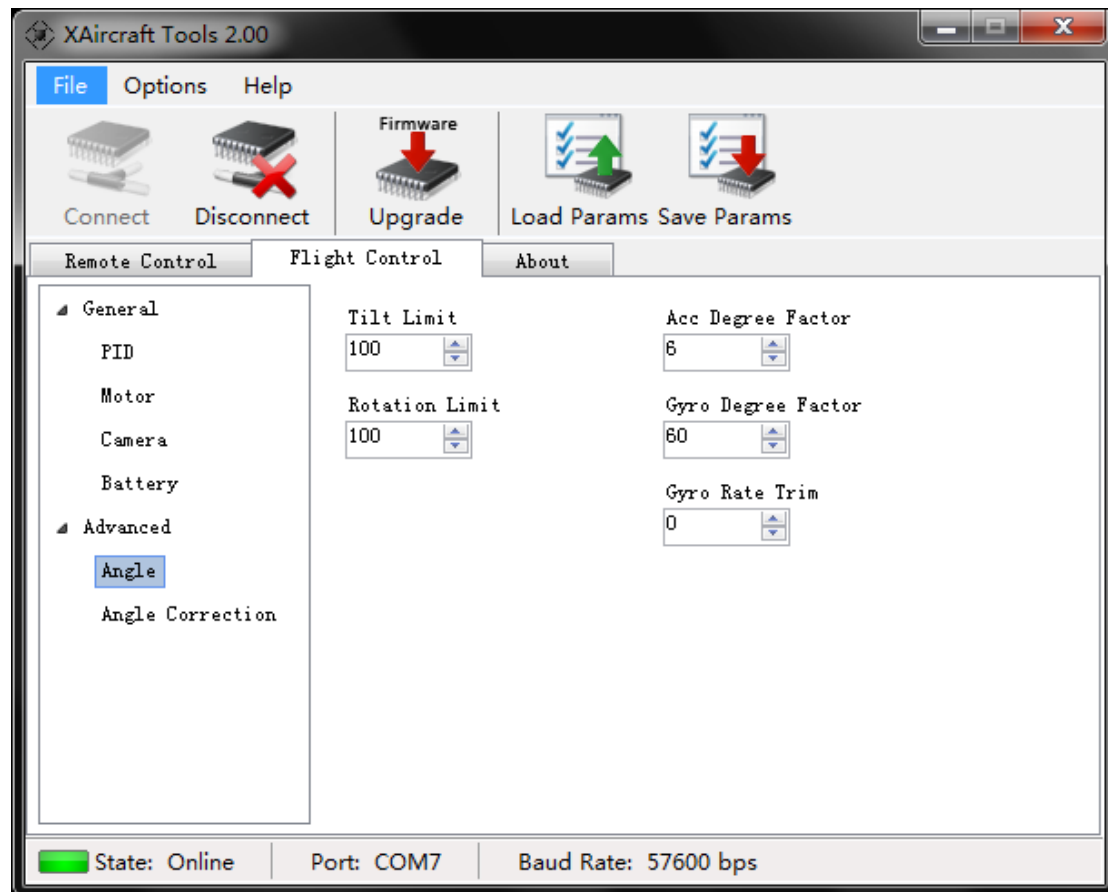
E. Battery Settings



Setting the minimum value for low-voltage alarm, 1 = 0.1V.

The advanced setting needs more professional electronic and engineering control knowledge. We DO NOT advice you modify the default values.

F. Angle Settings



Tilt Limit: the maximum tilt for the pitch and roll.

Rotation Limit: Because of Gyro' s drift, when without yaw controlling from RC, the X600D will spin slightly. The FC attempts to limit the wrong value from gyro to avoid over-integral, when over-integral occurred, the RC cannot correct the spin.

Acc Degree Factor , Gyro Degree Factor, Gyro Rate Trim : These are used to correct the individual variances of acceleration sensor and gyros.

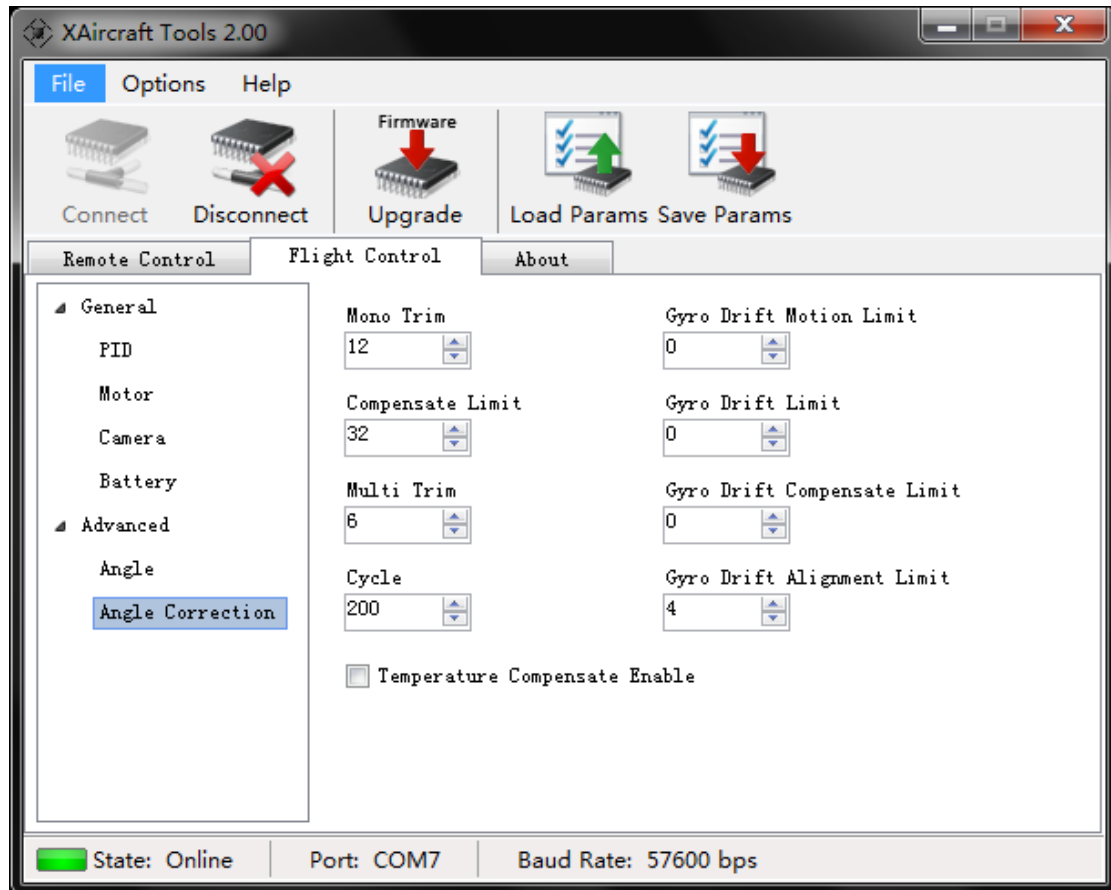
Acc Degree Factor : The factor is used for calculating the angle of inclination on the basis of 3-axis acceleration sensor value.

Gyro Degree Factor : The factor used in calculating the angle of Inclination based on gyros.

Gyro Rate Trim : Different gyros have different response rate, these factor helps trim

the rate, which make different gyros have same response rate to FC algorithm.

G. Angle Correction Settings



Mono Trim: FC algorithm attenuates the d-value between the acceleration sensor and gyros in one control-cycle. When the value is proper, the machine balances itself well. One control cycle is 2ms.

Compensate Limit : The limit for FC algorithm to make compensation for the d-value.

Multi Trim: FC algorithm make integral operation for the acceleration sensor and gyro, arranging one attenuation every n-cycle (set by next item 'Cycle'), to avoid over-integral.

Cycle: set the times of control cycle for a multi trim

Gyro Drift Motion Limit : invalid for X600D.

Gyro Drift Limit : invalid for X600D.

Gyro Drift Compensate Limit : invalid for X600D.

Gyro Drift Alignment Limit : FC corrects the drift of gyro by acceleration sensor, the value you can understand as the maximum degree can be corrected every time. It is

usually small. For example, FC detected 10 drift, but this value is set to 4, then the FC only let the gyro value minus 4 not 10.

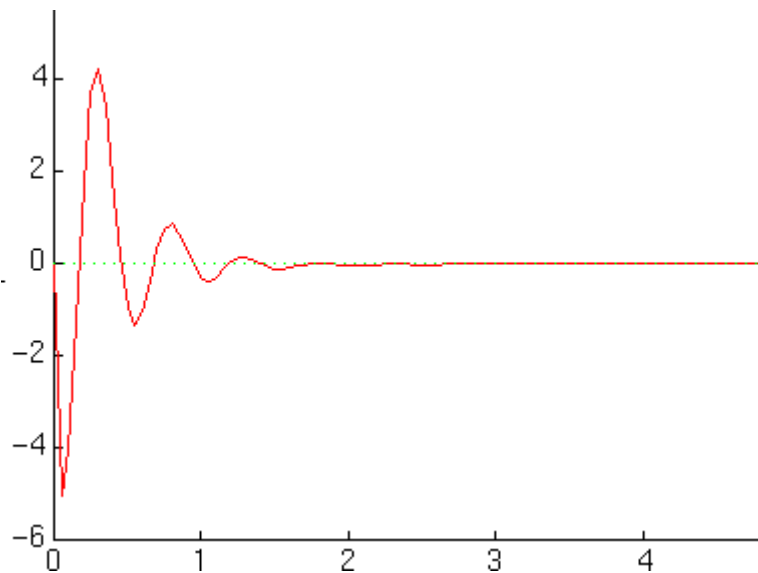
Temperature Compensate Enable : Check the box on if you permit the temperature Compensate .

H. Appendix <How To Set PID Parameters>

This document is not for professional, but trying to use little words to explain the PID method. Setting PID parameters is a technical task in automatic control, we suggest you to turn the values near the defaults.

The X600D uses PID method to balance itself.

PID is a kind of control method in automatic control area, which represents proportion, integral and differential. The procedure of control is as follows.



X-Axis represents time, Y-Axis represents error. The target for PID is to reduce the error value to zero. For X600D, the zero value represents the balanced status or special flight attitude (controlled by RC), that is, when the value of error is not zero, the X600D detects tilts. We call these two states as stable states.

Additionally, XAircraft consider several assumptions:

- 1) We assume the machine flights stable, so if the FC detects any tilt from one side, and the tilt is not originated from RC controls, then the FC considers the tilt as error, and output control signal to motors to makes the machine return to stable status.
- 2) As the machine tilts in some direction, combined with all the situations in the past, if the tilt is only vibration or twitter, the FC considers the flight status as stable.
- 3) As the machine tilts in some direction, we consider it as a trend, and will intensify, such as a gust of wind comes toward the machine.

Notice, the 2 and the 3 are reconcilable.

At present we haven' t built math model on X600D. You need tuning the parameters through your sense directly. It is suggested that you set the parameters by handing the machine on the ground. It needs a lot of patience and skills, maybe many times to get the ideal values. Make sure be careful during testing how the parameters work.

Before modifying the parameters, we suggest you remember the default values and feel the reactions while you tilt the machine by handing the X650 on ground.

There are three visualized functions of PID.

Proportional Band

When the X600D tilts toward one side, the resistance will be weak if the value of P is too small; the resistance will be severe if the value of P is too big. So the proportional directly makes influence on how fast the X600D returns to stable status.

Integral

On account of the second assumption above, the integral action tries to eliminate the vibrations depending on how X600D flies in a past period. If you set 'I' too lower, the FC will mostly rely on current error and can' t control the 'over-sensitive' , which cause thrashing. If you set 'I' too higher, the ability of response error will be weaken a lot, which cause bluntness.

Differential

On account of the third assumption above, this factor determines the degree of depending on tilt trend. If you set 'D' too lower, the FC will rarely rely on the current trend, and seems to be not sensitive enough. If you set 'D' too higher, it may causes 'over-sensitive' .

Compared with 'P, the 'D' emphasis in the sensitivity rather than power for correcting errors.

So it is advised that you set as the order 'P-D-I' in turn and fine tune all the parameters nearing defaults. If you are very interested in the procedure of setting, please have a try as below, and watch the different reaction.

- Tuning the 'P' value, in proper range, the machine can flap to stable status, but can' t fly off-ground.
- Tuning the 'D' value, the machine can fly off-ground when the values for

'P' and 'D' are proper in theoretically, but not stable, a little over-sensitive.

- Tuning the 'I' value, in the proper value, the machine can fly more stable.
- Fine tuning the three parameters, make the machine satisfy operation requirement.

For more about PID, you could visit <http://www.expertune.com/tutor.html>, or google about it.