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XXXXX VTOLXX XXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXX at
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XXXXX XXXXXXXX XXXXX ,XXXX XXXXXXXX XXXXXXXXXXXX
XXXXXXX 3XXXXX .

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- XXXXXXXX
- XXXXX ESC X PWM XXXXXXXXXXXX (XX “ XXXX ”)
- XXXX ESCXXXXXXXXXXXX

XXXXXXXXXXXX sag. XXXXXXXXXXXXXXX

- ** MOT BAT VOLT MAX ** XXXXXXXXXXXX ,XXXX LiPosX 4.2v x XXX ,
XXXXXXXXXXXX ,XXXX
- **MOT BAT VOLT MIN (XX (XX)). ** XXXXXXXXXXXX ,XXXX LiPosX 3.3v x XXX ,
XXXXXXXXXXXX ,XXXX
- XX = 0 (default). The default is to use sag compensated voltage for the above and during tuning computations. It can be set to 1 to use raw voltage instead of sag compensated voltage, which may improve tuning results for light vehicles.

Next setup the thrust expo. If you are setting up a professional aircraft then you should invest in a thrust stand so you can accurately measure the true thrust for your motor/ESC/propeller combination as you vary the throttle. Then you will adjust the expo value along with the endpoints (given by motors setup below) so that the thrust between the endpoints is as linear as possible. Do not trust manufacturer data for the thrust curve as they are frequently inaccurate. See **motor-thrust-scaling** for details on thrust scaling.

If you are setting up a hobby grade vehicle then you can use the graph below to estimate the correct **MOT_THST_EXPO** value for your aircraft.

- **MOT_THST_EXPO**: 0.55 for 5 inch props, 0.65 for 10 inch props, 0.75 for 20 inch props (or larger). This parameter should be derived by thrust stand measurements for best results (don't trust manufacturer data).

[../../images/tuning-process-instructions-1.hires.png](#)



Do not set an expo above 0.75 unless you have thrust stand data for your own motor, ESC and propeller combination showing that a higher value is needed. The graph is an approximation for hobby grade hardware, and guessing at a high expo can make the vehicle harder to tune rather than easier.

Motors setup

The motor parameters define the PWM output range sent to the ESCs. This is critical to ensure that the entire range of throttle values used in flight is within the linear range of your propulsion system.

Parameters used to define the output range sent to the ESC.

- **MOT_PWM_MAX**: Check ESC manual for fixed range or 2000us
- **MOT_PWM_MIN**: Check ESC manual for fixed range or 1000us
- **MOT_SPIN_ARM**: use the **motor test feature** to determine a value which will reliably start the motors spinning at a low rpm as an indication of the armed state.
- **MOT_SPIN_MAX**: 0.95
- **MOT_SPIN_MIN**: use the **motor test feature** and motor test data, if available, to set the lower range of linear thrust. The default value is usually adequate for hobby uses.
- **MOT_THST_HOVER**: 0.25 or below the expected actual hover thrust percentage (lower is safe)

PID Controller Initial Setup

The settings below are meant to get your PID controller acceleration and filter settings into the right approximate range for your vehicle. These parameters are critical to the tuning process. The PID controller default values for axis P/D/I values are usually safe for first test hovers of most vehicles.

- ****INS_ACCEL_FILTER****: 10Hz
- ****INS_GYRO_FILTER****: 80Hz for 5 inch props, 40Hz for 10 inch props, 20Hz for 20 inch props (or larger)
- **ATC_ACC_P_MAX**: 1100 for 10 inch props, 500 for 20 inch props, 200 for 30 inch props
- **ATC_ACC_R_MAX**: 1100 for 10 inch props, 500 for 20 inch props, 200 for 30 inch props
- **ATC_ACC_Y_MAX**: 200 for 10 inch props, 100 for 20 inch props, 90 for 30 inch props
- ****ATC_RAT_PIT_FLTD****: ****INS_GYRO_FILTER**** / 2
- ****ATC_RAT_PIT_FLTT****: ****INS_GYRO_FILTER**** / 2
- ****ATC_RAT_RLL_FLTD****: ****INS_GYRO_FILTER**** / 2
- ****ATC_RAT_RLL_FLTT****: ****INS_GYRO_FILTER**** / 2
- ****ATC_RAT_YAW_FLTE****: 2
- ****ATC_RAT_YAW_FLTT****: ****INS_GYRO_FILTER**** / 2

[../images/tuning-process-instructions-2.hires.png](#) [../images/tuning-process-instructions-3.hires.png](#)
[../images/tuning-process-instructions-4.hires.png](#)

Mission Planner Helper

A tab under SETUP/Mandatory Hardware/Initial Parameter Setup is provided in Mission Planner to setup the above parameters easily.

[../../../../images/mp-initial-copter-param-setup.png](#)



ArduPilot Copter Setting the Aircraft Up for Tuning [\[link\]](#) · CC BY-SA 3.0

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