

maxon motor control		
maxon motor ag Brünigstrasse 220 CH – 6072 Sachseln <a href="http://www.maxonmotor.com">www.maxonmotor.com</a>	<b>MAXPOS</b> <b>Control Parameter Tuning</b>	Version: 2016-04-11 ROMA

## MAXPOS Tuning Procedure

The tuning of MAXPOS control parameters consists of two steps:

1. Current Control Tuning
2. Position Control Tuning

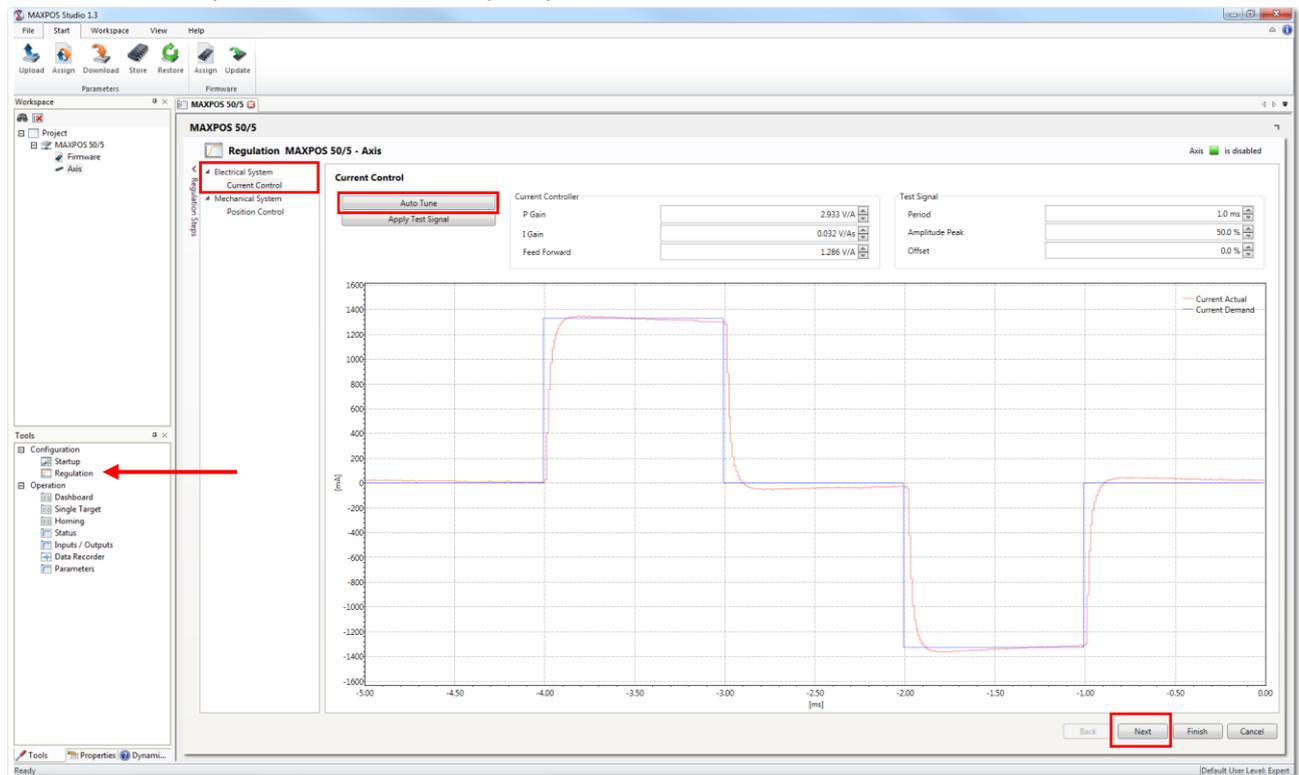
Each type of controller offers an “autotuning” feature or can be tuned manually in addition too.

- Autotuning -> Button “Auto Tune”:  
An automatic tuning is processed based on a configured (default) test signal.
- Manual tuning -> Button “Apply Test Signal”:  
A configurable test signal for the corresponding control will be applied. It is possible to change the control parameters online and observe the resulting system’s step response by the data recorder.

## MAXPOS Current Control Tuning

- Press “Configuration -> Regulation” and the “Current Control” Tuning window will show up.

The “Auto Tune” feature will find a good compromise for the parameters values of the current regulator for most applications. There is still the possibility to optimize the control parameters for special demands by applying a test signal and checking the influence of an online modification of the current control parameters. Typically the parameter “P-Gain” and “I-Gain” will be modified to do so. Such a modification can result in a more or less steep rise of the current step response or some remarkable overshoot.



- Press “Next” to go on with “Position Control Tuning” after the current control tuning is finished.

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## MAXPOS Position Regulation Parameter

Any manual tuning of the MAXPOS **Position Regulator** is mainly focused on the following parameters:

- Bandwidth (Object 0x30A1 Subindex 0x01)
- Damping (Object 0x30A1 Subindex 0x02)
- Reset Time (Object 0x30A1 subindex 0x03)

These parameters are related to the PID feedback controller of the MAXPOS. The internal PID function is linked to these parameter value as follows:

- $P = f(\text{Bandwidth}^2)$
- $I = f(\text{Reset Time})$
- $D = f(\text{Bandwidth}, \text{Damping})$

If you want to make the control's step response more stiff, the following control parameters and manual modification should be focused:

- Increase the "Bandwidth"
- Decrease the "Reset time"

If the system gets unstable by a too strong modification of these two parameters, the parameter "Damping" can be increased too. Anyway "Damping" is more for a final fine tuning and will be set to 100% for most applications.

Additional hints:

The parameters "Inertia" and "Friction" hold the information about the "mechanics" and load of the concrete system and are handled similar to a feedforward term of control. These parameters are evaluated during "Auto Tune" and typically do not have to be modified if autotuning was processed properly. It is assumed that the inertia and friction is constant for the full range of movement. Otherwise these parameters have to be based on a compromise of averaged data.

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## Manual Tuning hints: Position Regulator

A manual tuning of the “Position Regulator” is possible by applying a test signal and modifying the parameters online (similar to the Current Control manual tuning). The test signal corresponds to a movement in between two target positions. This movement is configured by the two target positions and the velocity, acceleration, and deceleration data of the movement.

Important:

- If there are mechanical limits, the two configured absolute(!) target positions must be chosen within a possible mechanical range of movement (plus some overshoot).
- Make sure that the actual position value and the concrete absolute target positions of the test signal configuration matches the drive’s movement range (e.g. in case of a linear unit).
- It is possible to configure the actual position as “Home” by pressing the “Home” button. The actual position value is set to “0” then. The configured absolute target positions are related to this updated actual position value then.
- The initial movement of the test signal is always heading to the configured target “Position 1” first of all if the actual position is not already there.

By pressing the button “Apply Test Signal” the movement will be started according to the configured position and motion data.

All the control parameters can be modified online during the test signal and the movement of the motor is active. Typically just the parameters “Bandwidth”, “Damping”, and “Reset Time” will be modified by such manual tuning tests.

The resulting step response by any parameter modification can be observed immediately by the data recorder. The “Actual Position” and the “Demand Position” are recorded in the left data recorder. The “Position Error” can be observed in the data recorder on the right. The maximum of the “Position Error” represents the overshoot at the target position and will depend strongly on the “Bandwidth” and “Damping” control parameters.

For most applications the manual tuning will be focused to minimize this “Position Error” (= overshoot in the target position) but some applications requiring a very dynamic reaction and steep acceleration might even accept some remarkable overshoot. The optimum parameter setting is always a compromise depending on the concrete application requirements.

Screenshot of MAXPOS Studio's Manual tuning of the position regulator:

- Configuration -> Regulation Tuning -> Apply Test signal

