

# TB045 (Rev1) - Autotune Parameters and What They Mean to You

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(See TB044 for more information on Kv1 and Kg)

## Overview

Autotune automatically sets the following parameters: Kg, Kv1, Ka, Max rate, Accel/Decel time, and Dead Start. This document will describe what these parameters are and what they mean.

## Kg

Kg is called the Gravity Constant. It indicates an imbalance in an axis. A high Kg value means that the motor is working harder to move the axis in one direction than the other. Typical Kg values range from -5 to +5 for X and Y-axis and -10 to +10 for Z-axis.

### Causes of high Kg

1. A bed mill with an incorrect weight on the counter balance.
2. A loose gib. (See TB037)
3. A failing support bearing.

In version 6.0 a drag plot will show you the drag in both directions, the "gap" or difference between the two lines in the plot is the Kg value.

## Kv1

Kv1 describes the amount of current it takes to slow jog the axis. By knowing the amount of current it takes to slow jog the axis, we can know the amount of friction or mechanical resistance that axis has. Common values for Kv1 on a knee mill are 10 - 20 on the X, 12 - 22 on the Y (higher because it carries the weight of the X) and 3 - 10 on the Z.

## Software

1. Version 6.0: You can see a plot of Kv1 over an entire axis by doing a drag run ("Drag" in the PID screen) and then plotting it.
2. 5.27 and earlier: Slow Jog the machine and observe the PID OUT parameter in the PID screen and take a visual average of the numbers you see being displayed. You may get different results depending on the direction you are jogging. (See Kg)

**Note:** Remember that a Kv1 of 10 on a machine equipped with a 15-amp drive is not the same as a machine with a 12-amp drive. To figure out how much current is required to slow jog the machine, take Kv1 and divide by 128 and then multiply the result by the amp rating of the servo amplifier. Example:  $Kv1 = 35$ , Servo amp is a 3T or 15 amp drive (see Table 1 for turn to amp conversions) therefore  $35/128 = .2734$  multiplied by 15 = 4.1 amps! Way too much power to slow-jog an axis.

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Table 1: Relation of current sensor turns to drive amps	2T	25 amp
	3T	15 amp
	4T	12 amp
	5T	9 amp
	6T	6 amp

## **Ka**

Ka describes the current necessary to accelerate the axis to its maximum velocity at the acceleration rate set by autotune.

### **Example**

If Ka is 54, Max rate is 330, and accel time is .245 seconds, it takes  $54/128$  times 15 amps = 6.3 amps of continuous current for .245 seconds to accelerate that axis to 330 inches per minute.

## **Accel**

Accel is the time for the axis to reach maximum velocity. It is set by autotune to be as fast as possible. Sometimes a customer may desire a slower rate. For example an accel rate of .1 second is very fast and the machine will appear to be "jerky". You can change the accel rate to a slower setting but Ka must be manually changed at the same time. If autotune produced a .1 second accel time and a Ka of 60 and you want to increase the accel time to .2 seconds you would manually double the accel value and divide the Ka value by 2. The new values would be an accel of .2 and a Ka of 30. This will produce a noticeable difference.

## **Max Rate**

Max Rate is 80% of the maximum physical speed on the axis. It is set at 80% to compensate for environmental changes. For example, without this, on a hot day when the lube is "loose" autotune might find a value of 400 IPM. In a few months it may be very cold in the machine shop and the lube will be like molasses. Now the control will try to run at 400IPM and, unable to, will most likely give a position error message.

## **Deadstart**

Deadstart has to do with direction reversal of an axis. Autotune does a good job of setting the Deadstart. The deadstart usually never has to be changed on a Milling machine. Sometimes very light wood routing tables with very low resistance and low inertia can benefit with a Deadstart change along with other "hand tuning." Call in if you have this case.

## **AC Brushless Systems:**

When performing an Autotune on an AC Brushless machine for the first time you should set the Autotune Move Distance parameters 95 through 98 for a short distance then increase until the Max Velocity levels off.. Start with 0.5 inches, and then increase the parameter number until the Max Velocity does not increase significantly. Autotune will overshoot this distance by 2 times, so if the distance is set to 1 inch expect the movement to go out to 3 inches. Care should be used in setting the starting point for autotune so not to crash the machine.

If the machine has low friction and high mass, the drive may stop due to overcurrent. If this happens the max velocity and the jog rates may be set to zero by the autotune. Reset these numbers to the previous values and move back to the starting position. Decrease the travel distance parameter and try again.

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**Document History**

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