# PID Configuration and Tuning Guide

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**Introduction:**

The purpose of this guide is to explain the process and where to find the appropriate registers to adjust the PID settings. Please remember that you will always want to create good initial voltages (cut height, pierce height, probe offset-Z). Once feedback is present, the scale factor must be derived to scale the actual voltage to where it should be. This should be done in Manual THC Mode using multimeters or a scope.

The

**Register Definitions:**

PIDdval: *Derivitave Value – Result of time and distance – returns readable data*

PIDimax: *Integral Max – Maximum "wind-up" of the integral gain.*

PIDival: *Integral Value – Result of time and distance – returns readable data*

PIDkd: *Derivative Value*

PIDki: *Integral Value*

PIDkp: *Proportional Value*

THCActualScaled: *Voltage – After it has been scaled, multiplies volts coming in*

THCActualScaledFactor: *Used to get voltage in range that falls in line with the plasma unit*

You can locate these values within Mach4 by clicking on '*Diagnostic*' > '*Regfile – Newfangled Solutions*', then click on the plus sign beside '*iRegs0*' then '*nf*' and finally, '*thc*' (as depicted in **Fig-1.0**).

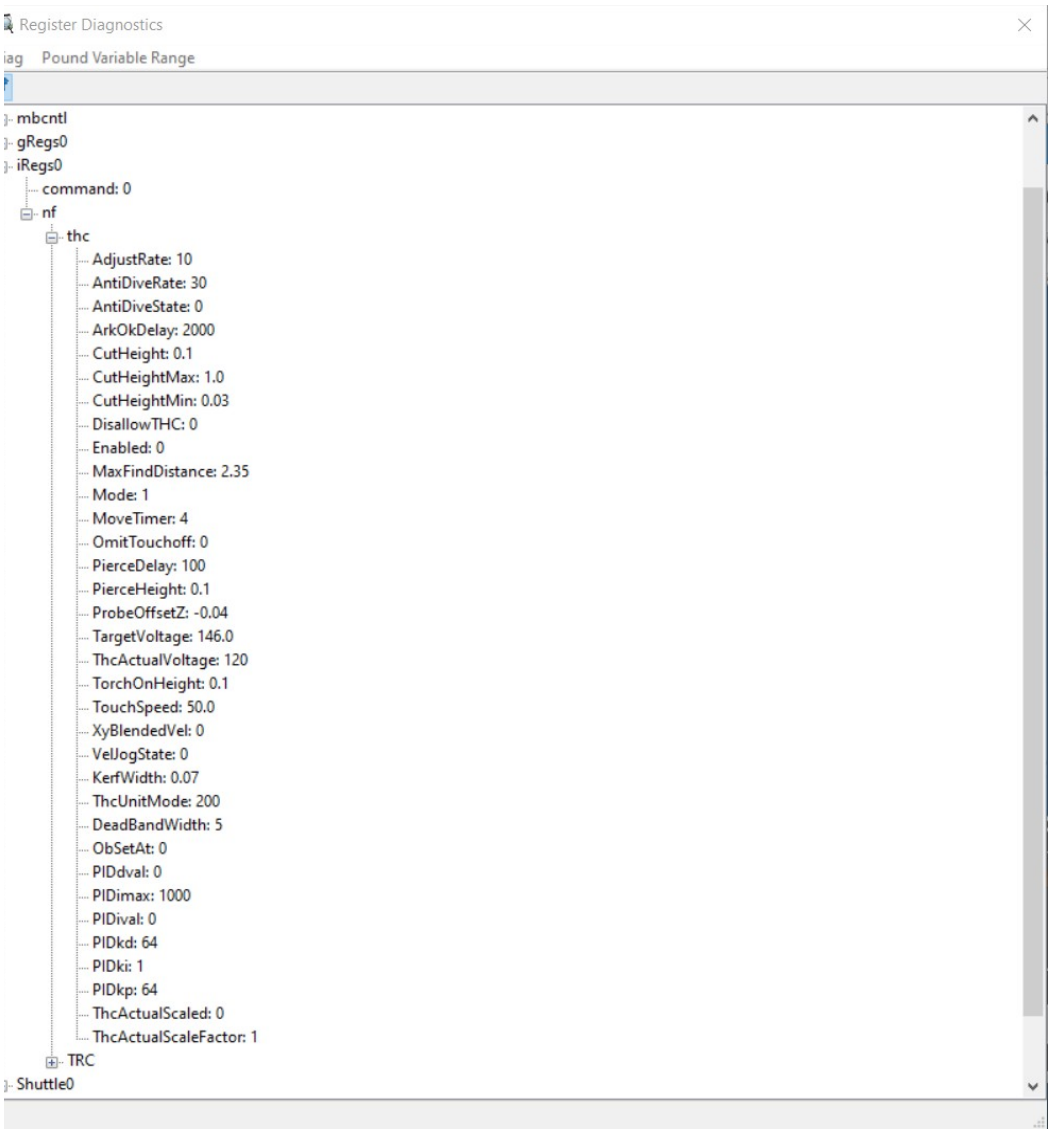


***Fig-1.0***

**<u>Tuning the PID configuration:</u>**

Tuning the PID is defined as adjusting the gain term in each of the three branches of the controller; Proportional, integral, and derivative (PID). The gain (proportional) is essentially how fast your tool moves to your desired (or target) location and is defined as a multiplier in which how to calculate the speed.

Each branch of the controller has its own purpose. The proportional branch calculates present error in order to reach its target value, the integral branch keeps a record of these calculations, and the derivative branch predicts future errors that occur... so that the proportional gain may function accordingly without overshooting or undershooting its target (desired) value.

An error can be interpreted as the present position of your tool in relation to the desired position. So if your tool is at X01 and your desired value is X50, your error is 49 (or 50 minus 1). You will want the error to decrease over time to get to where you want and eventually reach an error of 0. Your gain is how fast your tool reaches 0.

An important term to remember, Deadband, is a tolerance factor for Target voltage. If the Actual voltage does not rise above or drop below the dead band tolerance + Target Voltage, there will not be any THC movement. Example: if the dead band is set to 5v, the tolerance is +- 5 actual volts above or below the target. You can see the DeadBandWidth in Fig-1.0.

**Words of Wisdom:**

You start with a default set of values in Mach4 (**Fig-1.0**), and you can tune them by replacing the values with your own. Please remember that when tuning your PID configurations, that you are entering the values for your specific machine for optimal operation and output. Every machine is different and this needs to be considered before operating in a live environment. Testing, fine-tuning, and experimentation with your machine's unique measurements and specifications is imperative.