

DSPMC PID Configuration

Before setting PID the user must ensure that motors and encoders are functioning properly.

Step 1: Identify if using Analog or Step/Direction Drives.

If using Digital Drives with Step/Direction input signals please follow this guide.

https://www.vitalsystem.com/portal/motion/hicon/hicon_integra/Integra_PID_Guide.pdf

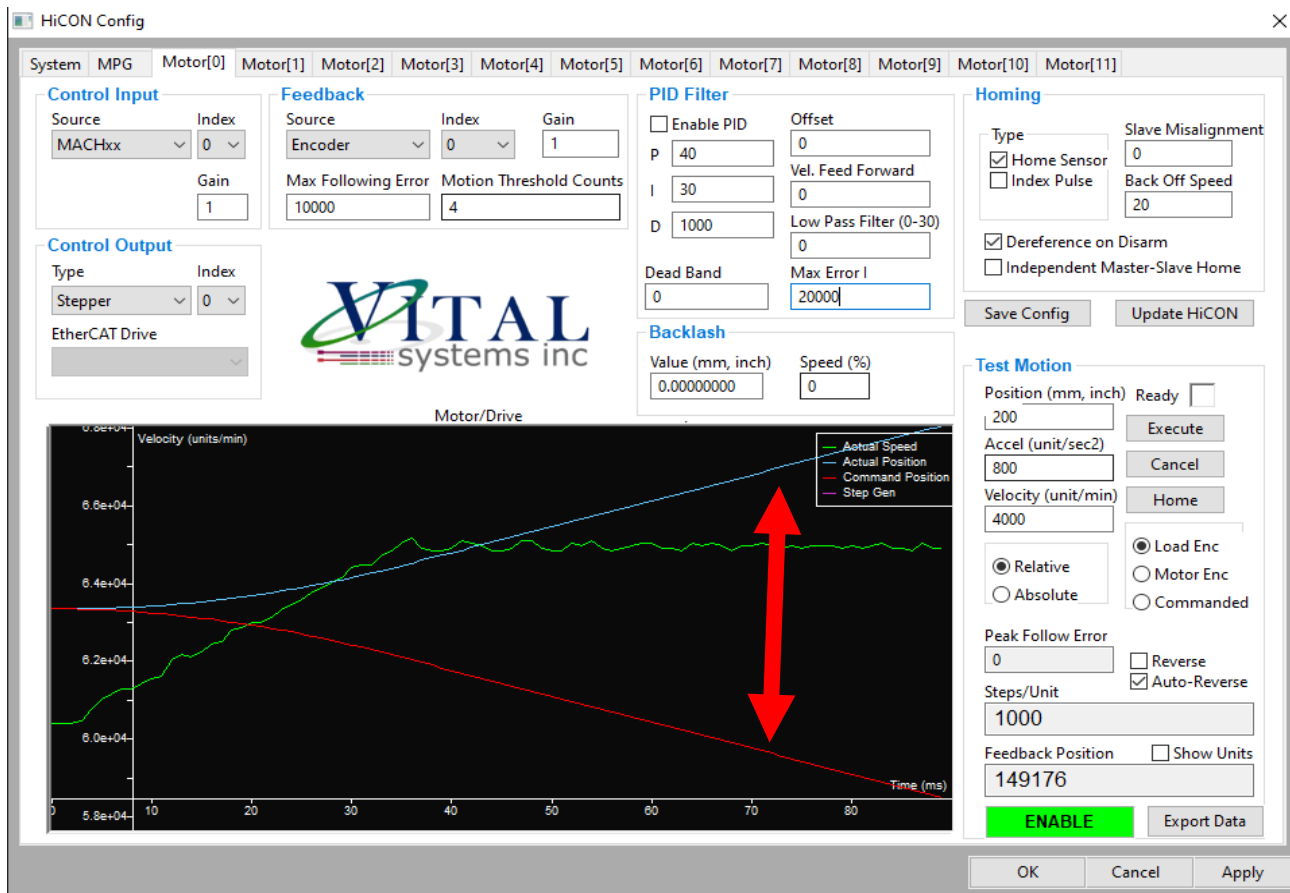
Follow next steps for Analog PID configuration.

Step 2: Test motion:

Set Feedback Gain value to 1. Execute a test motion of a known distance.

When running the test motion be sure to inspect the graph. If the 'actual position' and 'command position' or blue and red lines respectively are diverging, then the user must change the polarity of the encoder. As seen in the illustration below the blue and red lines are moving away from each other. To change the polarity, navigate to the 'System' tab. Under the 'Encoder Polarity' select the encoder number and change its polarity. Click 'Apply' to save the changes.

Execute another test motion to verify that the lines are no longer diverging.



System **M G** Motor[0] Motor[1] Motor[2] Motor[3] Motor[4] Motor[5] Motor[6] Motor[7] Motor[8] Motor[9] Motor[10] Motor[11]

Communication

Serial Number

Max Buffer Level
(1 - 5000 millisecc)

Polling Frequency
(2 - 250Hz)*

Spindle

Spindle Type

Feedback Source

Spindle Index

Feedback Index

Analog Spindle Scale
(10 - 200%)

RPM Counts/Rev

RPM Sampling(ms)

Misc

Enable Debug Window
** Requires program restart*

Sensor Debounce (ms)

Enable Reverse XY Toolpath

Warning: Enabling this feature will write the X and Y motion coordinates to a file so you can



EtherCAT

Project Name: EtherCAT Mode Disabled!
Mod Time: -

Encoder Polarity

[0]	<input type="text" value="Positive"/>
[1]	<input type="text" value="Positive"/>
[2]	<input type="text" value="Positive"/>
[3]	<input type="text" value="Positive"/>
[4]	<input type="text" value="Positive"/>
[5]	<input type="text" value="Positive"/>
[6]	<input type="text" value="Positive"/>
[7]	<input type="text" value="Positive"/>
[8]	<input type="text" value="Positive"/>
[9]	<input type="text" value="Positive"/>
[10]	<input type="text" value="Positive"/>

Encoder Debounce

[0]	<input type="text" value="100ns (1.79MI)"/>
[1]	<input type="text" value="100ns (1.79MI)"/>
[2]	<input type="text" value="100ns (1.79MI)"/>
[3]	<input type="text" value="100ns (1.79MI)"/>
[4]	<input type="text" value="100ns (1.79MI)"/>
[5]	<input type="text" value="100ns (1.79MI)"/>
[6]	<input type="text" value="100ns (1.79MI)"/>
[7]	<input type="text" value="100ns (1.79MI)"/>
[8]	<input type="text" value="100ns (1.79MI)"/>
[9]	<input type="text" value="100ns (1.79MI)"/>
[10]	<input type="text" value="100ns (1.79MI)"/>

Analog Outputs

Analog Channel Volts

Analog Inputs

Ch:0	<input type="text" value="0"/>	Ch:4	<input type="text" value="0"/>
Ch:1	<input type="text" value="0"/>	Ch:5	<input type="text" value="0"/>
Ch:2	<input type="text" value="0"/>	Ch:6	<input type="text" value="0"/>
Ch:3	<input type="text" value="0"/>	Ch:7	<input type="text" value="0"/>

Step 3: Configuring PID

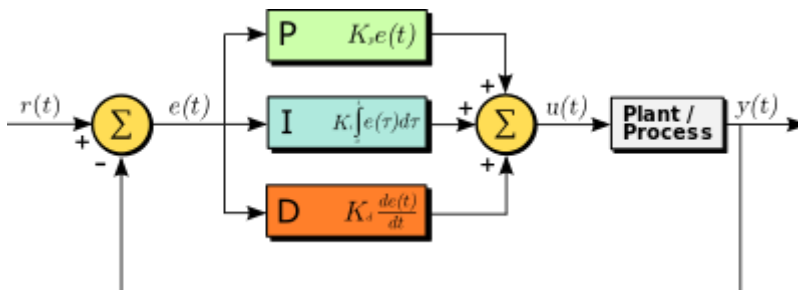
If all the above steps have been completed successfully the user can now move onto configuring the PID filter.

In order to use the PID mode more effectively you must complete all the above steps correctly as this sets the foundation for the PID. If any of these steps are not completed successfully then the PID will not have the desired effect on the encoder.

To achieve the most accurate results all PID parameters need to be configured appropriately.

The PID filter calculates the difference between the commanded position and the actual position, which constitutes the error.

The diagram below illustrates how the PID functions are implemented into the system:



P - Proportional Gain

The 'P' value is multiplied with the instantaneous error to create motor power proportional to the error. Thus higher values increase the output volts for DAC.

I - Integral Gain

The 'I' value works the same as the 'P' value with the exception that it adds the error for each instantaneous step along the move to correct the position. When setting a value for 'I' the user must also set a 'Max Error I' value. The 'Max Error I' puts an upper limit on the accumulated error in order to avoid uncontrolled oscillation. To begin with the user may set MaxError I to 100.

D - Derivative Gain

The D parameter is multiplied to the difference of the following-error between the current and previous cycle.

Velocity Feed Forward

The value bypasses the PID filter and directly increases the output command. This parameter only takes effect when the motor is moving at higher velocities. Velocity feed forward has little to no effect on lower velocities.

Offset

Applying an offset will simply command the motor to counteract the motor creeping in an open loop condition. The offset can also help compensate for the effects of gravity in a vertical axis configuration

Low Pass Filter (0-30)

Determines how gradually the PID filter takes effect. In doing so it reduces noise to allow the for smoother motor movement. The PID loop runs at 1Khz, thus a low pass value of 2 is an ideal initial starting point. Not all systems will require a low pass filter.

Max Error I

The 'Max Error I' puts an upper limit on the accumulated error in order to avoid uncontrolled oscillation. To begin with the user may set MaxError I to 100.

Dead Band

Allows the user to set the limit for the system to fluctuate within before the PID takes effect. The system will be allowed to deviate within the parameter of the 'Dead band' before any correction takes place by the PID.

Step 4: Tuning PID Steps

1. Set 'P' to 10, 'Max Follow Error' at 10000, and 'Low Pass Filter' to 2. Set all other parameters to zero.
2. Execute a test motion with high acceleration and velocity over a short distance such as 1 inch or 20-30mm.
3. If no motion is observed, start increasing "P" until the user motion can be observed physically and on the motion graph. Check the Response graph for details on the motion.
4. If the actual position moves in the opposite direction of commanded, reverse the "Encoder Polarity" in the system tab.
5. Once a satisfactory motion graph is achieved (i.e. actual position follows commanded), the motion can be further tuned:
 - a. Initially set 'I' to 5 and 'MaxError I' to 100. Start gradually increasing the 'I' value to close the gap between the commanded and actual positions. If required, increase 'Max Error I', however, large values of this parameter will result in excessive oscillations
 - b. Start increasing 'Velocity Feed Forward' to reduce the error during while motor is in motion. (a value of 20 seems to work well)
 - c. If oscillations (jittering moves) are observed with the motion, increase the 'D' term to balance out the oscillations (start at a tenth of the 'P' Parameter and gradually increase as necessary).
6. Ideally, the actual position (blue line) should be as close to commanded position (red line) as possible. Execute test motions for short and long distances with 'Auto-reverse' checked. Repeat the test motion as necessary, while tweaking the PID parameter values. If the drive does not have enough power then the user may not achieve perfect tuning. Be sure that the driver is configured to deliver maximum current required for the user application.
7. The screenshot below is an example of an ideal graph utilizing the PID configuration:

System MPG Motor[0] Motor[1] Motor[2] Motor[3] Motor[4] Motor[5] Motor[6] Motor[7] Motor[8] Motor[9] Motor[10] Motor[11]

Control Input

Source: MACHxx Index: 0

Gain: 1

Feedback

Source: Encoder Index: 0 Gain: 1

Max Following Error: 10000 Motion Threshold Counts: 4

PID Filter

Enable PID Offset: 0

P: 40 Vel. Feed Forward: 0

I: 30 Low Pass Filter (0-30): 0

D: 1000 Max Error I: 20000

Dead Band: 0

Homing

Type: Home Sensor Index Pulse

Slave Misalignment: 0 Back Off Speed: 20

Dereference on Disarm Independent Master-Slave Home

Control Output

Type: Stepper Index: 0

EtherCAT Drive: [Dropdown]



Backlash

Value (mm, inch): 0.00000000 Speed (%): 0

Save Config Update HiCON

Test Motion

Position (mm, inch): 200 Ready

Accel (unit/sec2): 800

Velocity (unit/min): 4000

Load Enc Motor Enc Commanded

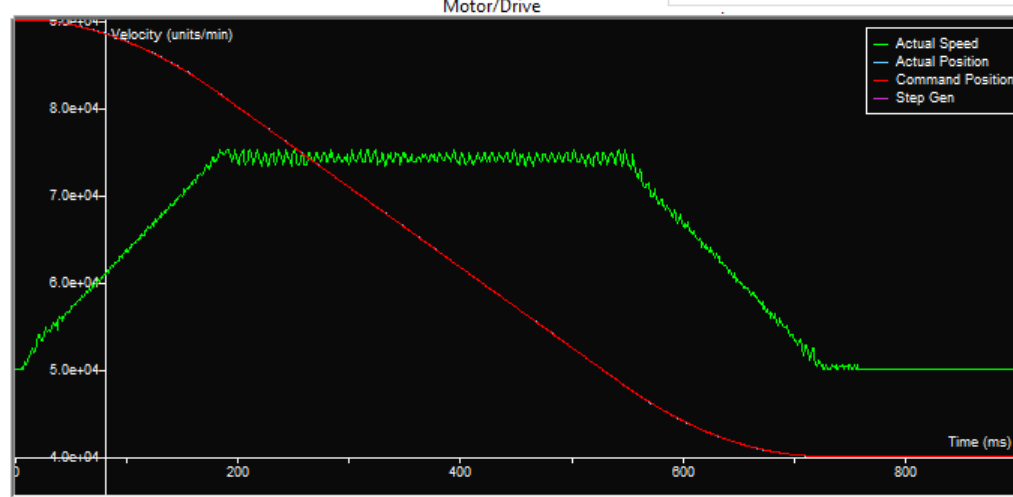
Relative Absolute

Peak Follow Error: 0 Reverse Auto-Reverse

Steps/Unit: 1000

Feedback Position: 149176 Show Units

ENABLE Export Data



OK Cancel Apply