HiCON Mach3
Software Integration

Ethernet Motion Controller
Data Acquisition System
Logic Controller

User Guide

Document Revision 1.0
(Updated March 19, 2013)

For more information please visit the product web page:
www.vitalsystem.com/hicon

Contents

License Agreement

Before using the HiCON and accompanying software tools, please take a moment to go thru this License agreement. Any use of this hardware and software indicate your acceptance to this agreement.

It is the nature of all machine tools that they are dangerous devices. In order to be permitted to use HiCON on any machine you must agree to the following license:

I agree that no-one other than the owner of this machine, will, under any circumstances be responsible, for the operation, safety, and use of this machine. I agree there is no situation under which I would consider Vital Systems, or any of its distributors to be responsible for any losses, damages, or other misfortunes suffered through the use of the HiCON board and its software. I understand that the HiCON board is very complex, and though the engineers make every effort to achieve a bug free environment, that I will hold no-one other than myself responsible for mistakes, errors, material loss, personal damages, secondary damages, faults or errors of any kind, caused by any circumstance, any bugs, or any undesired response by the board and its software while running my machine or device.

I fully accept all responsibility for the operation of this machine while under the control of HiCON, and for its operation by others who may use the machine. It is my responsibility to warn any others who may operate any device under the control of HiCON board of the limitations so imposed.

I fully accept the above statements, and I will comply at all times with standard operating procedures and safety requirements pertinent to my area or country, and will endeavor to ensure the safety of all operators, as well as anyone near or in the area of my machine.

WARNING: Machines in motion can be extremely dangerous! It is the responsibility of the user to design effective error handling and safety protection as part of the system. VITAL Systems shall not be liable or responsible for any incidental or consequential damages. By using the HICON motion controller, you agree to the license agreement.

Mach3 Software Integration

The Mach3 Software is an off-the-shelf Milling and Lathe machine control software. User can download the trial version of the software from www.machsupport.com.

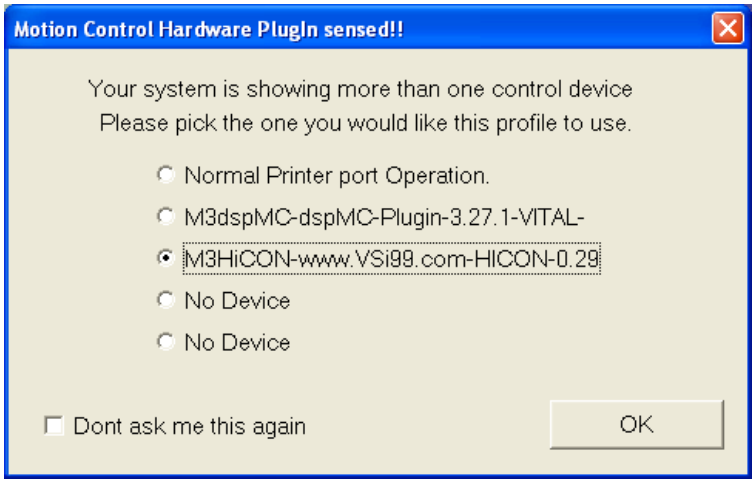
The HiCON Integra or HiCON OEM can be integrated with Mach3 to form a high performance machining center. The HiCON Software Tools provide the necessary drivers and configuration files to interface with Mach3 software. If you have installed the software tools as explained in the software installations section of the HiCON User Guide, then you already have all the necessary drivers.

This document assumes that user is familiar with the usage of Mach3 software. This chapter describes the mapping of Mach3 internal software signals to the HiCON connector.

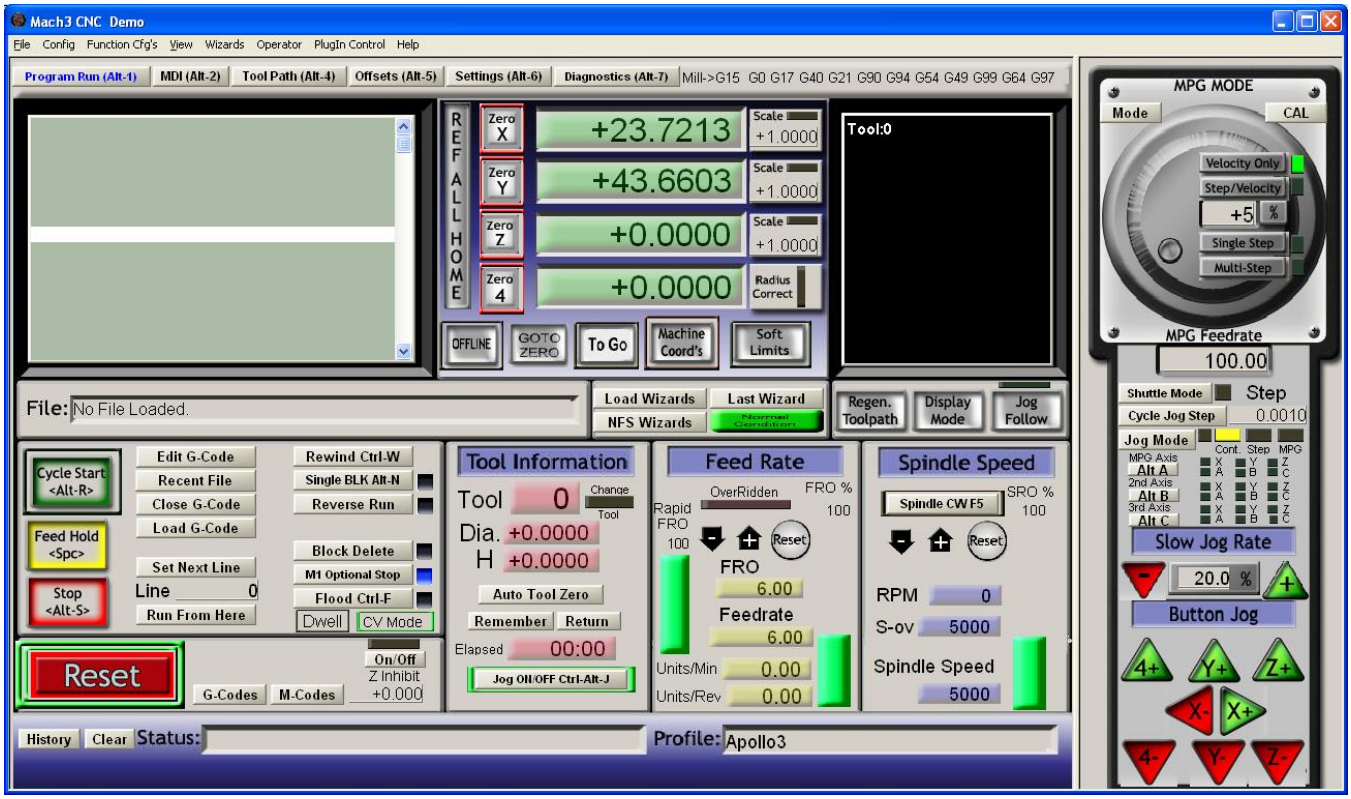
The general Mach3 software operation remains mostly the same when using HiCON plugin.

Starting Mach3 with HiCON

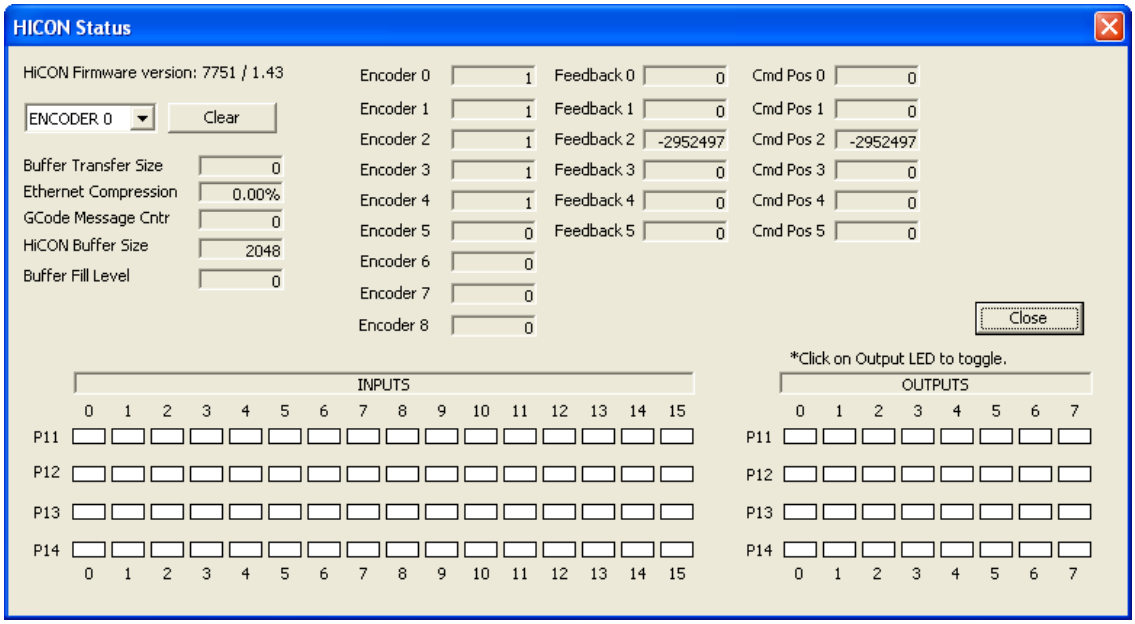
To launch Mach3 with HiCON plugin, double-click on the Mach3 Mill or Lathe software icon on the desktop as you would normally run using parallel port. It shows the following dialog box with the option to select M3HiCON plugin. Make sure this plugin is selected and click 'OK'.



Make sure the HiCON is powered up and connected to the Ethernet network. The Mach3 software shows up as follows with a message 'HiCON Online' in the Status bar.



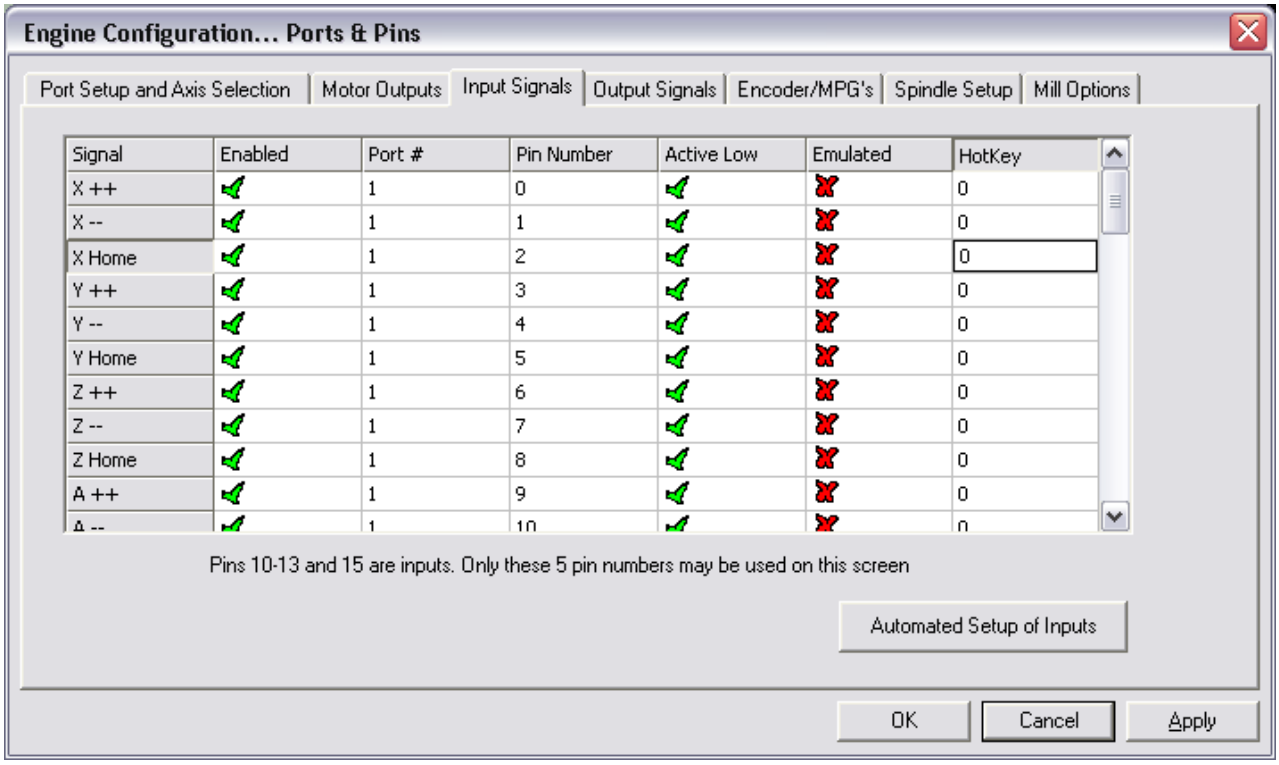
Click on the Menu item ‘PlugIn Control’, and then click on the item ‘HiCON Status” which displays the following screen indicating that the HiCON board is connected with current states of counters and I/O status.



Outputs can be toggled by clicking on the output LEDs. If an output is defined in Ports and Pins, it will be controlled by Mach3 and clicking on its LED will have no effect. This window may be left open while running Mach3.

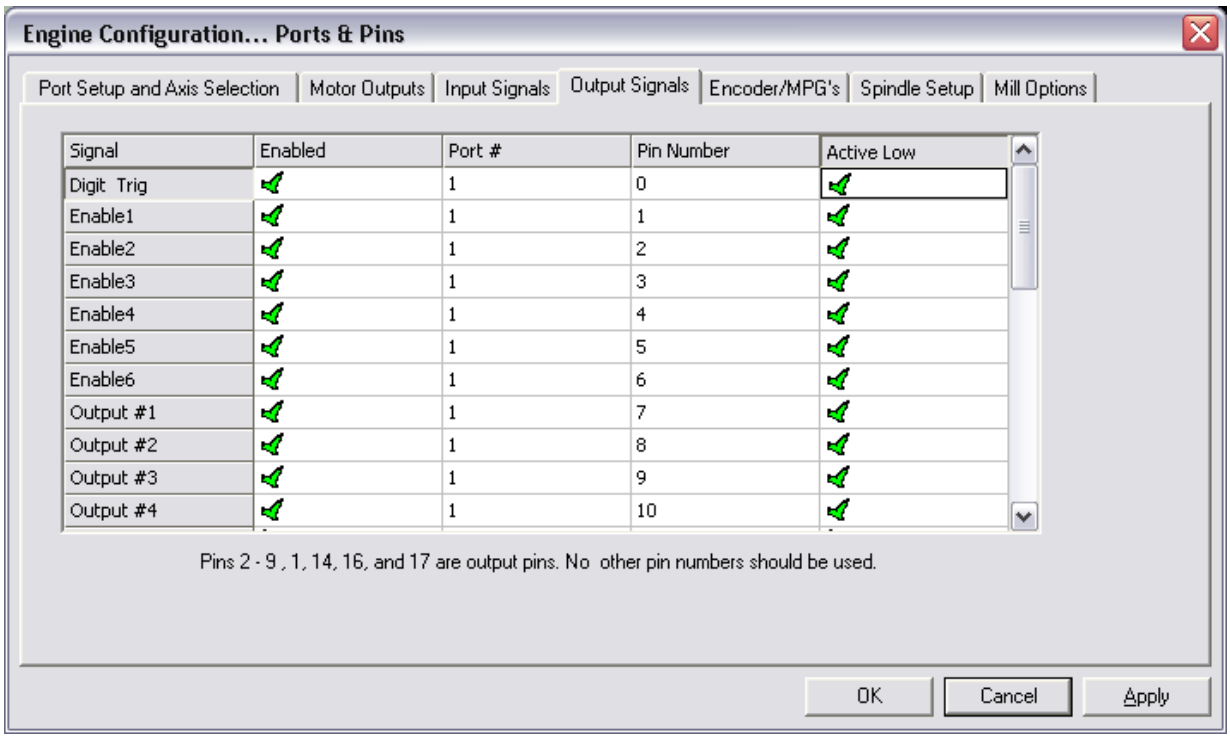
Mach3 Configuration

If using any of the Mach3 input signals, make sure the pins are 'Enabled' and set 'Active Low' as shown in the example figure below.



Ignore the line printed on the above window about pins 10-13 and 15 !@#$. This does not apply to HiCON based system.

As with the input configuration, if using any of the Mach3 output signals, make sure the pins are 'Enabled' and set 'Active Low' as shown in the example figure below.



Ignore the line printed on the above window about pins 2-9,1,14… !@#$. This does not apply to HiCON based system.

Mapping Mach3 Input Signals to HiCON OEM Digital Inputs

The following table shows the mapping from Mach3 input pin numbers to the actual digital input pin numbers available on the HiCON board.

Mach3 *Input* ports and pins		**HiCON J8 pin assignments**	**HiCON Basic**	**MACH3 LED**
Port #	**Pin Number**	**J8 Pin number**	**GetPin Index**	**OEMLED**
11	0	10	11, 0	1300
11	1	11	11, 1	1301
11	2	12	11, 2	1302
11	3	13	11, 3	1303
11	4	14	11, 4	1304
11	5	15	11, 5	1305
11	6	16	11, 6	1306
11	7	17	11, 7	1307
11	8	18	11, 8	1308
11	9	19	11, 9	1309
11	10	20	11, 10	1310
11	11	21	11, 11	1311
11	12	22	11, 12	1312
11	13	23	11, 13	1313
11	14	24	11, 14	1314
11	15	25	11, 15	1315

Mach3 *Input* ports and pins		**HiCON J12 pin assignments**	**HiCON Basic**	**MACH3 LED**
Port #	**Pin Number**	**J12 Pin number**	**GetPin Index**	**OEMLED**
14	0	Lands on J6, J7	14, 0	1348
14	1	Lands on J6, J7	14, 1	1349
14	2	Lands on J6, J7	14, 2	1350
14	3	Lands on J6, J7	14, 3	1351
14	4	Lands on J6, J7	14, 4	1352
14	5	Lands on J6, J7	14, 5	1353
14	6	Lands on J6, J7	14, 6	1354
14	7	17	14, 7	1355
14	8	18	14, 8	1356
14	9	19	14, 9	1357
14	10	20	14, 10	1358
14	11	21	14, 11	1359
14	12	22	14, 12	1360
14	13	23	14, 13	1361
14	14	24	14, 14	1362
14	15	25	14, 15	1363

Mach3 *Input* ports and pins		HiCON J9 and J11 pin assignments	Breakout 7535 pin assignments	HiCON Basic	MACH3 LED
Port #	**Pin Number**	**J9 Pin number**		**GetPin Index**	**OEMLED**
12	0	10	0	12, 0	1316
12	1	11	1	12, 1	1317
12	2	12	2	12, 2	1318
12	3	13	3	12, 3	1319
12	4	14	4	12, 4	1320
12	5	15	5	12, 5	1321
12	6	16	6	12, 6	1322
12	7	17	7	12, 7	1323
12	8	18	8	12, 8	1324
12	9	19	9	12, 9	1325
12	10	20	10	12, 10	1326
12	11	21	11	12, 11	1327
12	12	22	12	12, 12	1328
12	13	23	13	12, 13	1329
12	14	24	14	12, 14	1330
12	15	25	15	12, 15	1331

Mach3 *Input* ports and pins		HiCON J11 pin assignments	Breakout 7535 pin assignments	HiCON Basic	MACH3 LED
Port #	**Pin Number**	**J11 Pin number**		**GetPin Index**	**OEMLED**
13	0	10	0	13, 0	1332
13	1	11	1	13, 1	1333
13	2	12	2	13, 2	1334
13	3	13	3	13, 3	1335
13	4	14	4	13, 4	1336
13	5	15	5	13, 5	1337
13	6	16	6	13, 6	1338
13	7	17	7	13, 7	1339
13	8	18	8	13, 8	1340
13	9	19	9	13, 9	1341
13	10	20	10	13, 10	1342
13	11	21	11	13, 11	1343
13	12	22	12	13, 12	1344
13	13	23	13	13, 13	1345
13	14	24	14	13, 14	1346
13	15	25	15	13, 15	1347

Mapping Mach3 output pins to HiCON OEM Digital Outputs

The following table shows the mapping from Mach3 output pin numbers to the actual digital output pin numbers available on the HiCON board.

Mach3 *Output* ports and pins		**HiCON J8 pin assignments**	**HiCON Basic**
Port #	**Pin Number**	**J8 Pin number**	**SetPin Index**
11	0	2	11, 0
11	1	3	11, 1
11	2	4	11, 2
11	3	5	11, 3
11	4	6	11, 4
11	5	7	11, 5
11	6	8	11, 6
11	7	9	11, 7

Mach3 *Output* ports and pins		**HiCON J9 pin assignments**	**Breakout board 7535 pin assignments**	**HiCON Basic**
Port #	**Pin Number**	**J9 Pin number**		**SetPin Index**
12	0	2	0	12, 0
12	1	3	1	12, 1
12	2	4	2	12, 2
12	3	5	3	12, 3
12	4	6	4	12, 4
12	5	7	5	12, 5
12	6	8	6	12, 6
12	7	9	7	12, 7

Mach3 *Output* ports and pins		**HiCON J11 pin assignments**	**Breakout board 7535 pin assignments**	**HiCON Basic**
Port #	**Pin Number**	**J11 Pin number**		**SetPin Index**
13	0	2	0	13, 0
13	1	3	1	13, 1
13	2	4	2	13, 2
13	3	5	3	13, 3
13	4	6	4	13, 4
13	5	7	5	13, 5
13	6	8	6	13, 6
13	7	9	7	13, 7

Mach3 *Output* ports and pins		**HiCON J12 pin assignments**	**dspMacro**
Port #	**Pin Number**	**J12 Pin number**	**SetPin Index**
14	0	2	14, 0
14	1	3	14, 1
14	2	4	14, 2
14	3	5	14, 3
14	4	6	14, 4
14	5	7	14, 5
14	6	8	14, 6
14	7	9	14, 7

Mapping Mach3 Input Signals to HiCON Integra Digital Inputs

The following table shows the mapping from Mach3 input pin numbers to the actual digital input pin numbers available on the HiCON Integra.

Mach3 *Input* ports and pins		**HiCON Integra (J13, J14) pin assignments**	**HiCON Macro**	**MACH3 LED**
Port #	**Pin Number**	**(J13, J14) Pin number**	**GetPin Index**	**OEMLED**
11	0	INP0	11, 0	1300
11	1	INP1	11, 1	1301
11	2	INP2	11, 2	1302
11	3	INP3	11, 3	1303
11	4	INP4	11, 4	1304
11	5	INP5	11, 5	1305
11	6	INP6	11, 6	1306
11	7	INP7	11, 7	1307
11	8	INP8	11, 8	1308
11	9	INP9	11, 9	1309
11	10	INP10	11, 10	1310
11	11	INP11	11, 11	1311
11	12	INP12	11, 12	1312
11	13	INP13	11, 13	1313
11	14	INP14	11, 14	1314
11	15	INP15	11, 15	1315

Mach3 *Input* ports and pins		**HiCON Integra J10 pin assignments**	**HiCON Macro**	**MACH3 LED**
Port #	**Pin Number**	**J10 Pin number**	**GetPin Index**	**OEMLED**
14	0	8	14, 0	1348
14	1	15	14, 1	1349
14	2	7	14, 2	1350
14	3	14	14, 3	1351
14	4	6	14, 4	1352
14	5	13	14, 5	1353

Mach3 *Input* ports and pins		**HiCON Integra J7 pin assignments**	**HiCON Macro**	**MACH3 LED**
Port #	**Pin Number**	**J7 Pin number**	**GetPin Index**	**OEMLED**
12	0	10	12, 0	1316
12	1	11	12, 1	1317
12	2	12	12, 2	1318
12	3	13	12, 3	1319

12	4	14	12, 4	1320
12	5	15	12, 5	1321
12	6	16	12, 6	1322
12	7	17	12, 7	1323
12	8	18	12, 8	1324
12	9	19	12, 9	1325
12	10	20	12, 10	1326
12	11	21	12, 11	1327
12	12	22	12, 12	1328
12	13	23	12, 13	1329
12	14	24	12, 14	1330
12	15	25	12, 15	1331

Mach3 *Input* ports and pins		**HiCON Integra J8 pin assignments**	**dspMacro**	**MACH3 LED**
Port #	**Pin Number**	**J8 Pin number**	**GetPin Index**	**OEMLED**
13	0	10	13, 0	1332
13	1	11	13, 1	1333
13	2	12	13, 2	1334
13	3	13	13, 3	1335
13	4	14	13, 4	1336
13	5	15	13, 5	1337
13	6	16	13, 6	1338
13	7	17	13, 7	1339
13	8	18	13, 8	1340
13	9	19	13, 9	1341
13	10	20	13, 10	1342
13	11	21	13, 11	1343
13	12	22	13, 12	1344
13	13	23	13, 13	1345
13	14	24	13, 14	1346
13	15	25	13, 15	1347

Mapping Mach3 output pins to HiCON Integra Digital Outputs

The following table shows the mapping from Mach3 output pin numbers to the actual digital output pin numbers available on the HiCON board.

Mach3 *Output* ports and pins		**HiCON Integra J15 pin assignments**	**HiCON Macro**
Port #	**Pin Number**	**J15 Pin number**	**SetPin Index**
11	0	OUT0	11, 0
11	1	OUT1	11, 1
11	2	OUT2	11, 2
11	3	OUT3	11, 3
11	4	OUT4	11, 4
11	5	OUT5	11, 5
11	6	OUT6	11, 6
11	7	OUT7	11, 7

Mach3 *Output* ports and pins		**HiCON Integra J7 pin assignments**	**HiCON Macro**
Port #	**Pin Number**	**J7 Pin number**	**SetPin Index**
12	0	2	12, 0
12	1	3	12, 1
12	2	4	12, 2
12	3	5	12, 3
12	4	6	12, 4
12	5	7	12, 5
12	6	8	12, 6
12	7	9	12, 7

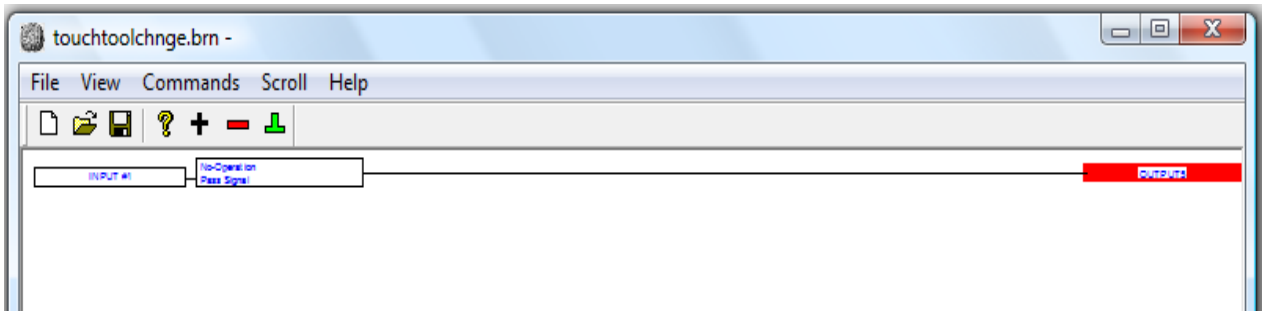
Mach3 *Output* ports and pins		**HiCON Integra J8 pin assignments**	**HiCON Macro**
Port #	**Pin Number**	**J8 Pin number**	**SetPin Index**
13	0	2	13, 0
13	1	3	13, 1
13	2	4	13, 2
13	3	5	13, 3
13	4	6	13, 4
13	5	7	13, 5
13	6	8	13, 6
13	7	9	13, 7

Mach3 *Output* ports and pins		HiCON Integra J12 pin assignments	HiCON Macro
Port #	**Pin Number**	**J12 Pin number**	**SetPin Index**
14	3	RL1	14, 3
14	4	RL2	14, 4
14	5	RL3	14, 5
14	6	RL4	14, 6
14	7	RL5	14, 7

Getting beyond the basic input/output with Mach3.

When you are done with limit switches and other basic I/O you will probably want to have several switches on you control panel next to the e-stop such as feed hold, stop, g-Code rewind and other things. To get this added functionality you will need to learn how to write brains in Mach3. Brains are used to get access to all of the extra I/O and to work tool changers and just about anything you can think of.

Here is a pretty basic brain to map input 1 to output 5.

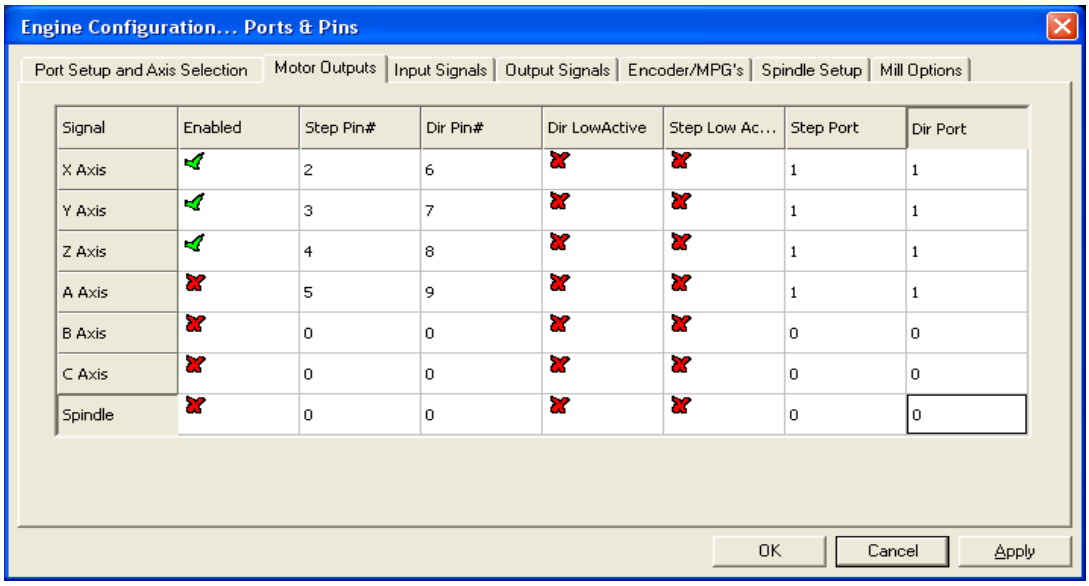


You would setup what wire goes to input 1 and output 5 under the ports and pins tab of Mach3. After a few tries you will get the hang of it.

For more information: go to www.machsupport.com and then to the video section and look for Brains.

Motor outputs.

On the Motor Ouputs tab, enable the axis that you will be using. **Spindle setting in this window is not used by the HiCON plugin.**



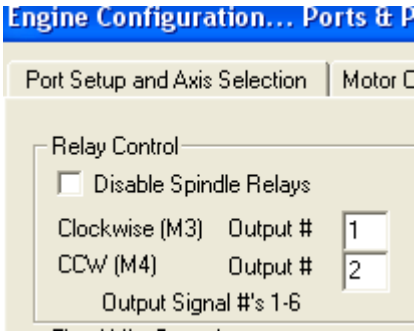
Spindle Setup.

When using a VFD or other motor controlling device that uses 0-10v or ±10v control, the following steps are needed. The spindle setup is done via the Plugin config screen.

Make sure Spindle Relays are enabled in the Port and Pins Spindle window.

Go to the Config tab and then spindle pulleys. Current pulley 1. For this example, set min speed to 0 and max speed to 100. This will give a 0v output to the spindle at S0 (min speed) and a 10v at S100 (max speed).

This setting is great for testing. Without the VFD/Drive hooked up, you can test your output with a digital volt meter to make sure you are getting 0-10volts for 0 to max speed.



When it all works then put in min 0 and max gets set to the max speed of your machine, eg, 5000. This will allow you to program S in the G-code in actual rpm, ie 0 … 5000.

On the Plugin Config System tab, you can configure the spindle to use ±10V or 0-10V by selecting the Spindle Type.

Setting an Axis as a Spindle

You may set any axis (0 – 5) as the spindle axis by specifying from the Spindle Type field and selecting "GCode Axis". The Axis number is specified in the Spindle Index field on the System tab. Once the spindle axis has been set, you may then issue any GCode command (e.g. G0C10) for spindle position control, as well as Spindle speed commands (e.g. S500M3) to control the spindle speed and direction

using the closed loop axis PID control. The Steps Per, Max Speed, and Acceleration of the spindle is read from the selected axis motor-tuning configuration.

NOTE: The spindle's motor-tuning settings are always ignored.

Axis Homing and Direction

In the Config menu, select Homing/Limits. You will see the following window.

To change the axis direction, click on the Reversed column for the axis you want to change the direction. A green check mark indicates the direction is now reversed.

NOTE: When reversing the axis direction. Make sure that the corresponding Encoder Polarity is changed in the System Tab if using Encoder Feedback.

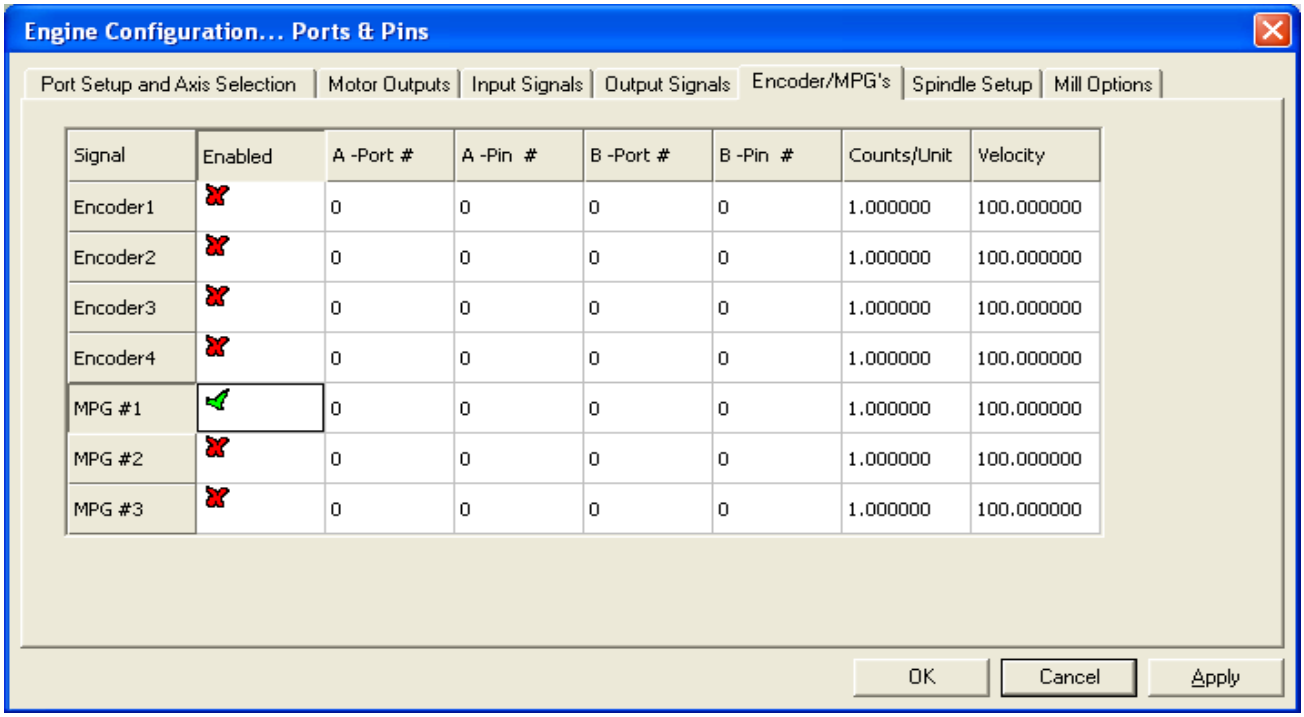
Homing Offset lets you define the home position co-ordinates. When homing sequence is complete, the axis machine position is set to this value. Home Neg, changes the default homing direction.

HiCON offers a number of different homing types for each axis. Please review section Control Parameters to select the correct homing sequence.

If you are using Index-Pulse-Only Homing without a home sensor, you must assign an unused digital input in Mach3 as home sensor. Mach3 software requires a home sensor definition regardless of homing method.

Manual Pulse Generation - MPG

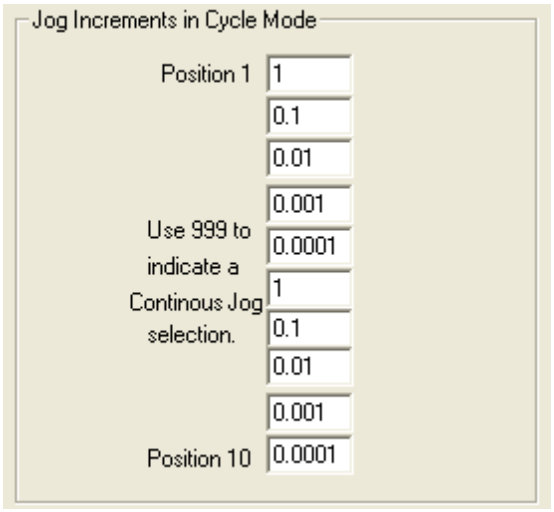
HiCON allows using a quadrature encoder as a MPG source. The encoder is connected to the dedicated encoder inputs on J5, J6 and J10 connectors, as well as to the K4 connector (Channel 3) on the breakout board 7775. Users can configure MPG parameters as explained in Manual Pulse Generation (MPG).



Signal	Enabled	A -Port #	A -Pin #	B -Port #	B -Pin #	Counts/Unit	Velocity
Encoder1	✗	0	0	0	0	1.000000	100.000000
Encoder2	✗	0	0	0	0	1.000000	100.000000
Encoder3	✗	0	0	0	0	1.000000	100.000000
Encoder4	✗	0	0	0	0	1.000000	100.000000
MPG #1	✓	0	0	0	0	1.000000	100.000000
MPG #2	✗	0	0	0	0	1.000000	100.000000
MPG #3	✗	0	0	0	0	1.000000	100.000000

To turn on MPG feature, make sure MPG #1 is checked green as shown above in the Ports and Pins window. Enter the Encoder resolution in the Counts/Unit field. The rest of the fields in this window are not used.

You set the encoder multiplier in the General Config setting as shown below. You can use your own multiplier values in this window as well as use the standard .1, .01, .001, etc values.



When MPG mode is selected, and a G-Code file is run, the HiCON Plugin will switch to jog mode automatically in order to run the file. Once the file is complete or stopped, the mode will revert back to MPG.

OEMDROs and LEDs

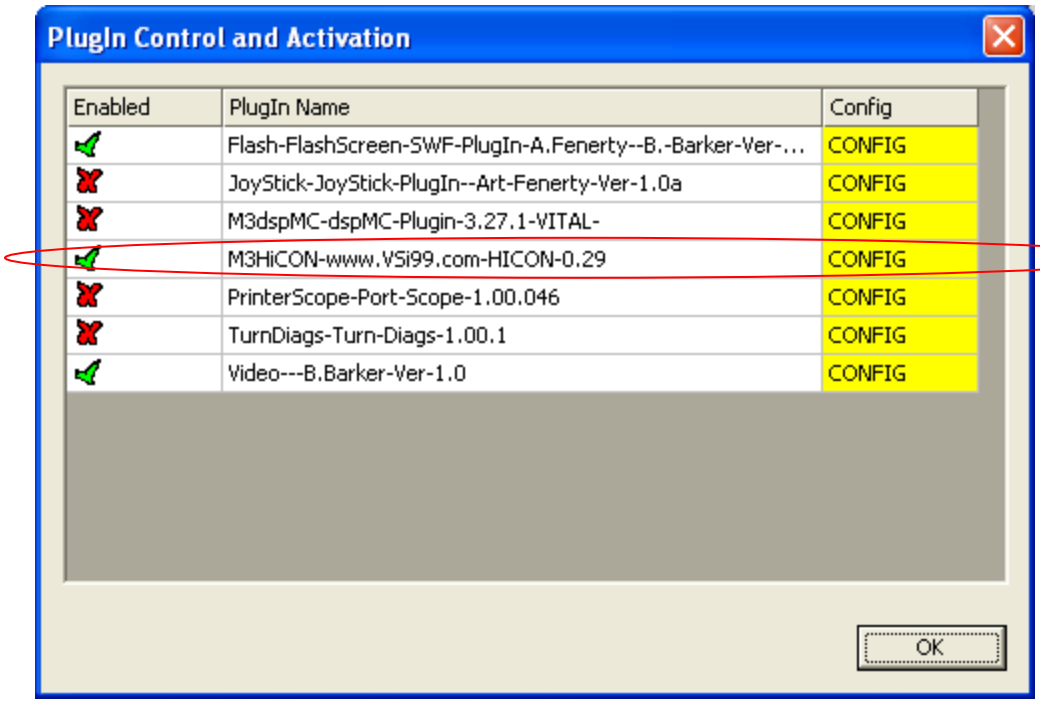
The following table lists the OEM DROs and LEDs used by the HiCON plugin.

OEMDRO Index	Description
1320 - 1321	Analog Inputs (Channels 0 – 1). Value should be between (0 – 3.3V)
1330 - 1338	Encoder Counter (Channels 0 – 8).
1340	Threading RPM. This RPM is calculated based on the parameters defined in the Threading section of HiCON Plugin Configuration, and is used by the Threading Logic.
2000 – 2009	HiCON Basic DRO Inputs. (See HiCON Basic documentation)
2050 – 2059	HiCON Basic DRO Outputs. (See HiCON Basic documentation)

OEMLED Index	Description
1300 – 1363	Input 0 – 63
2035	Launch HiCON Macro from Mach3
2000 – 2031	HiCON Basic LED Inputs. (See HiCON Basic documentation)
2050 – 2081	HiCON Basic LED Outputs. (See HiCON Basic documentation)

HiCON Plugin Configuration

HiCON plugin configuration screens can be launched from Mach3 by navigating to Config -> Config Plugins and selecting M3HiCON-www.VSi99.com-HiCON-xxx- option.



Once the HiCON plugin configuration is launched you can see seven tabs, these are:

1. System Tab
2. Axis X(0)
3. Axis Y(1)
4. Axis Z(2)
5. Axis A(3)
6. Axis B(4)
7. Axis C(5)

Each Axis tab represents an axis to be controlled through HiCON. By default, System tab will be selected, as shown in HiCON Configuration window.

HiCON Plugin Configuration System Tab

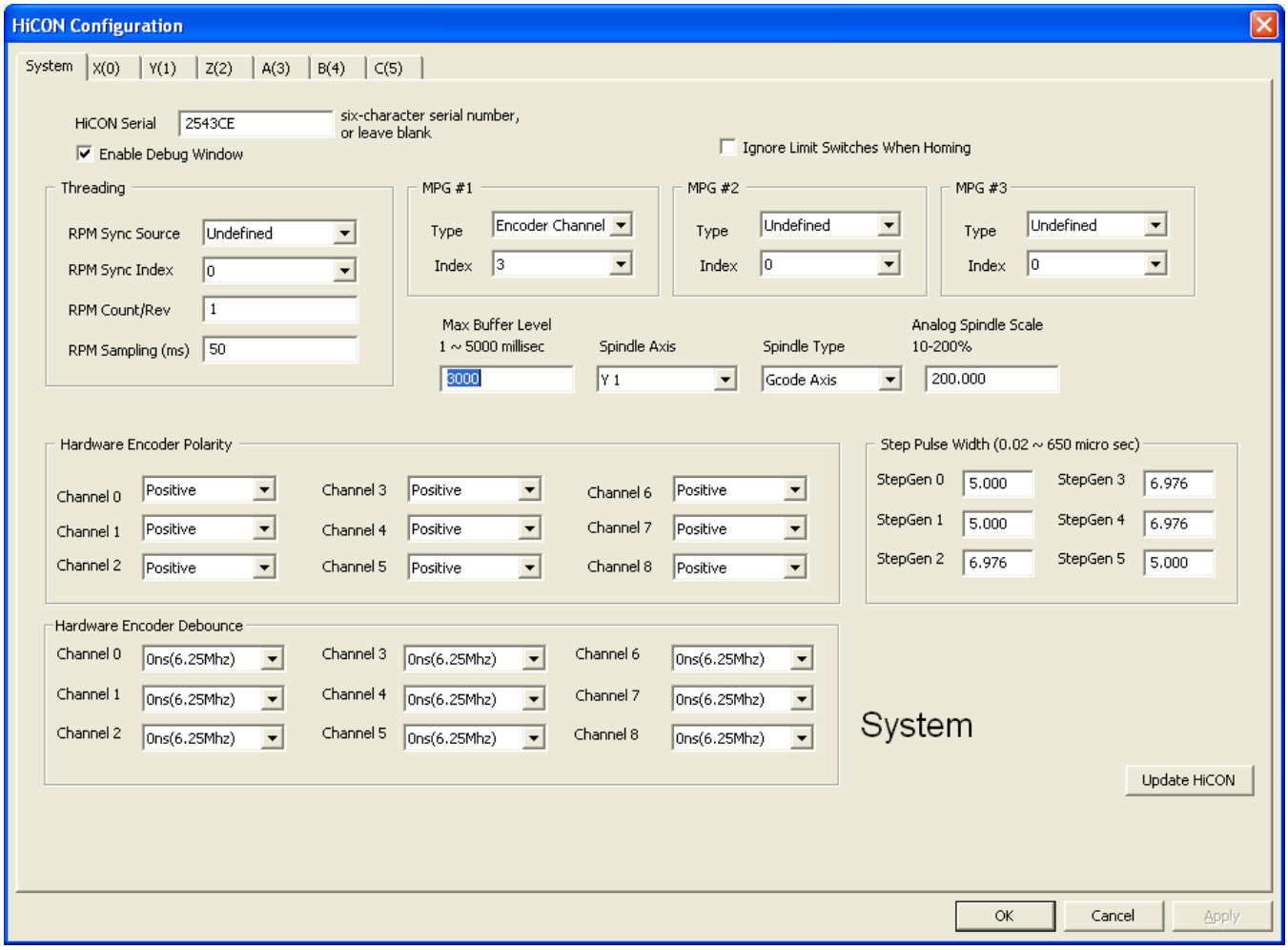


Figure: HiCON Configuration window

In the system tab, you can set a number of configurations. Clicking on “Update HiCON” will transmit these settings to the HiCON controller. Clicking OK will also transmit the data, and also save this data in selected mach3 profile (e.g. mach3mill, mach3turn etc)

In the following sub sections users can find detailed information about various configuration options that are provided under the system tab.

HiCON Serial Number

To connect to a specific HiCON device on the network, you must enter the 6-character serial number in the “HiCON Serial” field. If left blank or ‘0’, the plugin will connect to the first device it can find.

Spindle Type and Axis

Spindle Type
The Spindle Type configuration sets the spindle to either Analog Voltage or to a GCode Axis. Valid values are:

Undefined: The plugin ignores the spindle commands.
GCodeAxis: Sets the spindle as an axis.
Analog Voltage 0-10V: unidirectional only.
Analog Voltage ±10V*:* clockwise and counter-clockwise spindle direction.

Spindle Axis
The Spindle Axis field sets the axis number when using "GCode Axis" as the Spindle Type (*Valid values are from 0 – 5*).

Analog Spindle Scale
Multiplier to scale the voltage output for the spindle motor. Applicable with **Analog Voltage** type only.

Max Buffer Level

This parameter defines how much command position buffering will be done inside the HiCON controller. The size of the buffer can range from 1 – 5000 millisec. These points are consumed by the HiCON at 1 KHz. To get faster response time on feedrate changes, you may select a lower value, but the side effect is that if the PC software slows down and cannot sustain the motion data rate to the HiCON, then the motion could be jerky.

Enable Debug Window

By checking this option users can enable debug window for debugging purpose. This option should be turned on only if directed by a factory personal. The debug window will appear next time you start Mach3.

Ignore Limit Switches when Homing

HiCON allows Limit switches to be used as Home Sensors. This parameter should be checked to use Limit switches as Home sensor.

Threading

Following sub sections describes parameters to configure threading in HiCON.

Threading RPM Synch Source
This parameter defines the encoder type for Spindle speed calculation and starting the threading cycle. The Index pulse from the encoder is used to launch the Z-Axis at the right time in order to position the tool correctly for Threading in every cycle. The RPM calculation is used to override the feedrate of the Z-Axis during the threading cycle.

The possible values for **RPM Sync Source** parameter are: "***HardEncoder***" and "**Undefined**".

Undefined: When this option is selected, HiCON will not enable threading and value of **RPM Synch Index** will be ignored.

When ***HardEncoder*** is selected, the spindle feedback encoder must be connected to one of the encoder inputs on HiCON Integra J6, J8 (Expansion B), J10, or J11 connectors. The encoder's differential A and B signals are used to calculate the RPM of the spindle, and Index pulse is used to trigger the threading cycle.

Threading RPM Synch Index
This parameter defines the encoder index for Spindle speed feedback. Below is the range for this index:
HardEncoder: index range is 0 – 7.

Threading RPM Count/Rev
This parameter defines the encoder resolution in terms of count per revolution for Spindle speed feedback. For ***HardEncoder*** type encoder, the encoder resolution must is multiplied by 4.

Threading RPM Sampling (ms)
This parameter defines the timing window in milliseconds to add the encoder counts for RPM calculation. For slow pulse train (eg only few ticks per rev), this value should be high enough to accumulate enough counts to calculate RPM consistently. If the window time is too long, the system reaction time (regulation of Z-Axis feedrate) to changing RPM will be slow. A higher count/rev encoder will allow this window time to be very small, which will allow the system to react fast (regulate Z-Axis feedrate) if RPM changes. The range of this field is from 1 thru 10000 milliseconds.

Manual Pulse Generation (MPG)

MPG Source Type
This section defines MPG (Manual Pulse Generation) Quadrature encoder source. Both Differential and Single Ended Encoder types are supported. One differential encoder can be hooked up to J11 while single-ended encoders can be wired to J6, J8 (encoder usage), or J10. These encoders are defined as ***Hard Encoder***. An **Undefined Encoder** option causes HiCON to ignore MPG Source values.

MPG Source Index
If Hard Encoder is selected in MPG Source Type, MPG Index denotes the hardware encoder channel.

Hardware Encoder Polarity

The ***Hardware Encoder Polarity*** field is used to reverse the direction of the encoder counters. If A/B signals are connected in reverse such that it does not match the PID control direction, the system will not be able to arm. To fix this issue, the hardware A and B signals can be reversed using this parameter.

Note that this encoder polarity setting only swaps the A and B signals to change the counter direction. The Index pulse signal polarity is not affected by this setting.

Encoder Debounce

The ***Encoder debounce*** field is used to remove noise from the hardware encoder signals. Setting of 100ns is normally sufficient, but if encoder count is still changing by noise, you can try higher debounce value. The higher the value in debounce, the maximum frequency of encoder signal will be reduced. This setting only applies to hardware encoders 0 – 7.

Step Pulse Width

The step pulse width is the amount of time the step signal is held high (measured in microseconds). The values shown on StepGen 0 – 5 are read-only; – the plugin calculates the values and overwrites any values entered by the user. The step pulse width value is computed through this formula:

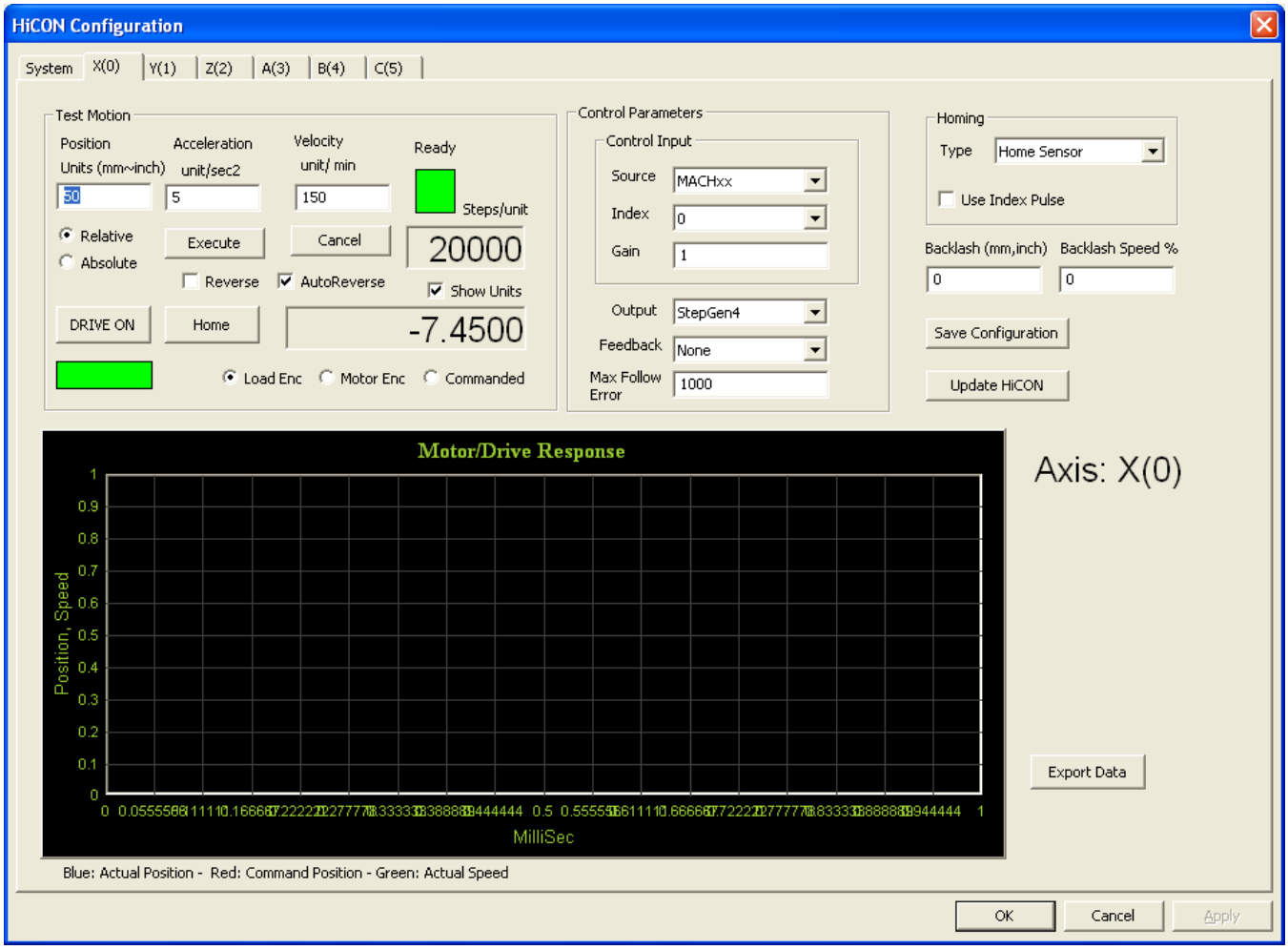
SPW = 1 / (CountsPerUnit * Velocity) * 1,000,000 / 2

The “CountsPerUnit” and “Velocity” variables are retrieved from Mach3 Motor Tuning settings.

Update HiCON Button (Under System Tab)

This button downloads the entire system configuration parameters to the HiCON. If you make any changes to Controls parameters, you must download the new settings by clicking on this button before ARMing the HiCON or executing a test motion. To save data to your computer hard-drive, click OK. All configuration data from all pages is saved in the selected mach3 profile.

HiCON Plugin Configuration Axis Tab



The Axis tabs provide configuration settings that are directly related to each axis. These tabs also provide motion testing features. The Controls parameters must be transmitted to HiCON manually by pressing 'Update HiCON button before the Drive is armed. Clicking on OK or the 'Save Configuration' buttons saves the entire configuration to the selected Mach3 profile.

Test Motion

Test Motion options can be used by users to configure Control parameters.

The Ready LED shows if the HiCON is ready to accept motion command. If Ready LED is GREEN, it implies HiCON is ready to accept new motion command. While executing a motion profile, the Ready LED turns to RED and HiCON cannot accept a new motion command until the current motion sequence is complete or cancelled.

Once the test motion is complete, you can see how closely the axis followed the commanded motion profile on the "Motor/Drive Response" graph. By selecting "AutoReverse" check box, you can make the

axis reverse the direction automatically in next Execute command and thus avoid the axis to keep on going in one direction during testing.

Position – Test motion final position or displacement in terms of Position Units, e.g. 1.5, 10.093, mm or inches etc.

Acceleration – Test motion acceleration value in terms of Units per second squared, e.g. inches/second^2, mm/sec^2 etc.

Velocity – Test motion velocity value in terms of Units per minute, e.g. inches/minute, mm/minute etc.

Relative* and *Absolute – These check boxes indicate whether the value in the Position field is either the distance to travel (relative) or the final position (absolute).

Execute Button – Transmits the Execute-Motion command to the HiCON. User can press 'Cancel' button to cancel the motion execution anytime during the machine operation. Make sure you have downloaded the axis controls setting by clicking "Update HiCON" before clicking on Execute.

The Ready LED shows if the current motion command is completed and HiCON is ready for new motion command. New motion command can be launched by Execute button when the Ready LED is Green. If the LED goes to Red after click on Execute, but you do not observe any motion, the velocity or acceleration may be too low.

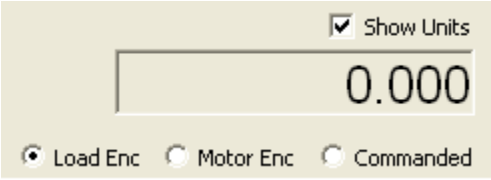
PID Arm Button – By clicking this button, the Plugin download's PID Filter parameters and arm or disarm the PID. If PID is armed, the LED below this button will turn to GREEN**,** otherwise it will be RED**.**

Home Button – Executes the Homing sequence based on selected Homing settings. Review section 6.12.3 Control Parameters to configure Mach3 Homing options for each axis before executing Homing.

***Reverse* -** Checking this option will multiply parameter in the position box with -1 and thus direction of motion will be reversed.

***Auto Reverse* -** Checking auto reverse option will toggle "reverse" option between two consecutive motion commands, thus the user do not have to manually reverse the direction of motion every time.

Axis Position Display (DRO) – Shows the position of the axis based on different settings as described below:



Show units - When this option is selected, the data shown will be converted and shown in units (mm, inches etc), otherwise data will be displayed in raw encoder counts.

Commanded position - Display shows the value of the internal variable for the commanded position for the selected axis.

Load Encoder - Display shows the axis position derived from backlash count and selected feedback encoder.

Motor Encoder - Display shows the current value of the axis position derived only from the encoder feedback.

Note that the actual position may slightly deviate from the Commanded position when PID is enabled.

Control Parameters

Control Input Source - Control Input Source defines the input type (or set-point) for a particular axis. This should be set to **MACHxx**. If the axis is not used, it must be disabled by selecting **undefined**.

Control Input Index - Defines the index of the PID input source. Normally this is equal to the axis number. For slave axis, it should be set to the number of the master axis.

Control Input Gain – The control input (Commanded) is multiplied by this number before applying to PID filter.

Control Output Source - Control Output Type defines the output for the PID filter for a particular axis. The possible values are:

Stepper: Use one of the stepper channels for the Step and Direction signals (range of StepGen0 – 5) used in stepper drives.

Undefined: This setting is used to disable the axis and to ignore the control output index. If the axis is not used, the Control Output Source must be set to **undefined**.

Feedback Source - Feedback Source defines the feedback type for the selected axis. The possible values are:

Encoder: Use one of the encoder channels (Encoder 0 – 7) as the feedback.

Max Follow Error – Maximum deviation allowed between command and actual, above that, the PID controller shuts down and need to be re-enabled manually. If 0, PID will never shutdown which can be extremely dangerous in a run-away motor condition. So always use a positive value in this field. This field can be back calculated from the maximum velocity of the axis, e.g. 600 000 count/sec max velocity divide by 1000 gives 600 counts per millisecond. So to achieve 600K count/sec speed, the max following error should be 600 or more. The actual value may be lot more than that based on the mechanical characteristics of the axis.

Homing Type - Defines homing sequence for each axis. Two types of homing sequence are supported:

1. **Home Sensor** (homing with or without Index Pulse)
2. **IndexPulseOnly** (Use only the Index pulse to Home)

For ***Home Sensor*** method, the axis moves in configured direction until home sensor is seen. It then moves in the opposite direction at 20% of initial speed until the sensor is not seen. At this point the home position is defined. If ***Use Index Pulse*** option is set, the axis then continues to move until Index pulse clears the position counter and indicate the home position.

For ***IndexPulseOnly***, the axis moves in the configured direction to locate the index pulse to home the axis. As soon as the index pulse is detected, it clears the position counter to indicate the home position and stops the axis.

Backlash – This field let you enter backlash amount in terms of units (inches or mm etc). HiCON uses this value to calculate virtual load position (mill table).

Backlash Speed % – This field let you enter backlash speed percent, 1% to 500%. It defines how fast you want to apply the backlash. The percentage is applied to the Motor acceleration, eg, if the configured acceleration for the axis is 10 inch/sec^{2,} and Backlash Speed is 400%, the Backlash motion will be performed at 40 inches/sec^2.

Slave Axis Configuration

To set an axis as a slave axis, set the Control-Input index equal to the master axis, e.g., if A axis is slave and Y is the master axis, set the control-input index for A equal to 1. Make sure mach3 configuration is done properly for slave axis. Do not run any test motion command on slave axis tab. Always do test-motions on the master axis. The slave axis always uses the PID values of the master axis automatically.