

This document covers the following three topics:

- 1) Download and Install Mach 3.
- 2) Install the JAMEN Driver.
- 3) Set Mach 3 parameters to communicate with the mill.

**WARNING: This document does not cover personal safety issues. The user of this product must be familiar with machine shop procedures, machinery and safety practices. If you are not familiar with these matters, seek professional instruction.**

**NOTE: Do not modify any switches or setting in the control cabinet of the unit.**

**NOTE: Prior to first testing the machine, manually raise the head so the spindle is at least 4-5 inches above the table; furthermore, center the table below the spindle. The manual table cranks can be turned when the unit is not powered on.**

**NOTE: The parameters herein do not adjust all table limits as this will depend on how the user programs their CNC software.**

**NOTE: Care must always be taken when operating the machine. Pressing the red Reset button on the main menu or on the mill operator panel will stop the machine. Always watch the machine carefully and be prepared to press the Red Reset or emergency stop button.**

**The parameters and settings herein are a starting point for future modification and customization by the user. It is the user's responsibility to know and understand how to use Mach 3 to control the mill. Until the user gains familiarity with the system, make changes cautiously, always observe proper shop safety protocol and be prepared to press the Reset or Stop buttons.**

General Considerations:

It is assumed the user of this product is familiar with computers as well as general knowledge of typical software installation procedures. This document does not show every possible screen the user will see during installation. Only the most significant screen-shots are shown. The user is expected to know how to follow on-screen installation instructions.

The computer on which Mach 3 will be run must have adequate processing power to run the software. Very important details about this are found on the ArtSoft website.

The user is highly advised to first watch general Mach 3 instructional videos:

<http://www.youtube.com/watch?v=R3futACR6dM>

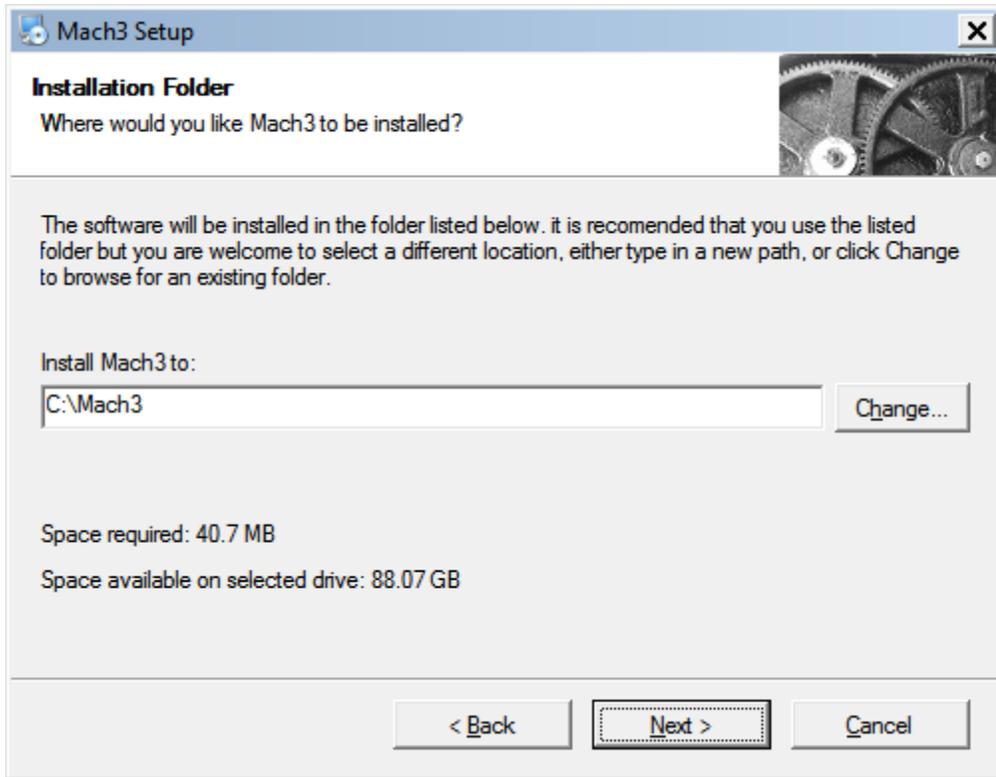
YouTube Title: MACH 3 CNC Router Training Tutorial after install setup

**PART I: Download and Install Mach 3.**

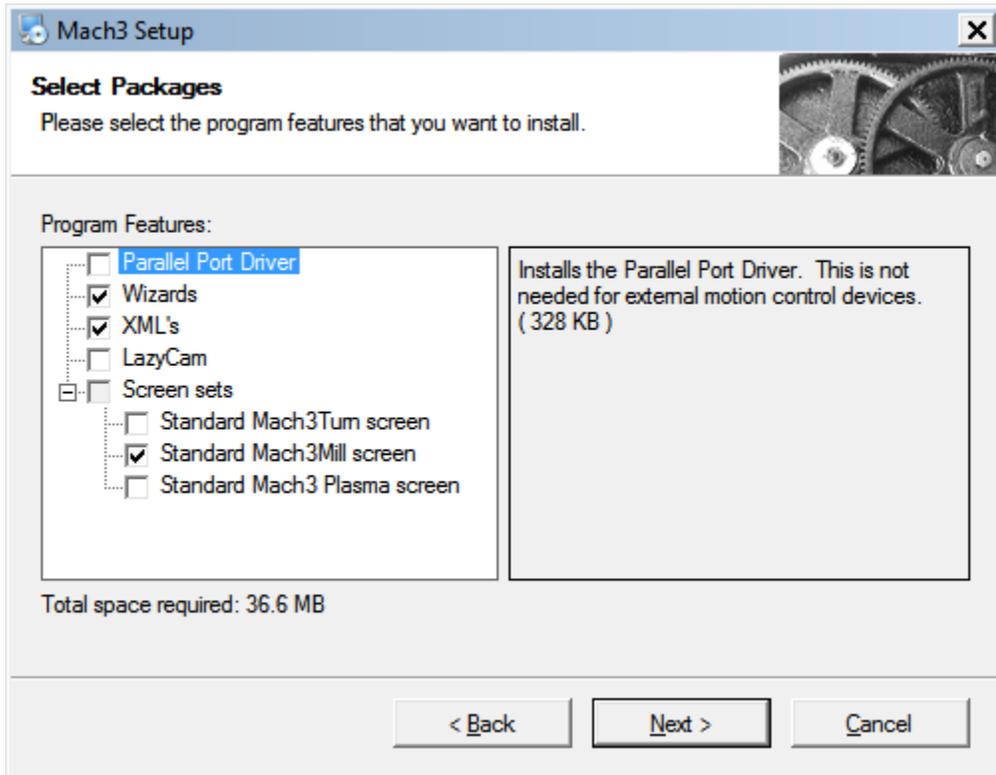
Download Mach 3 from the Artsoft website. The version that comes on the CD is a demo version. The demo product will operate your mill but, for full support from ArtSoft, the latest and licensed version is recommended.

<http://www.machsupport.com/software/downloads-updates/>

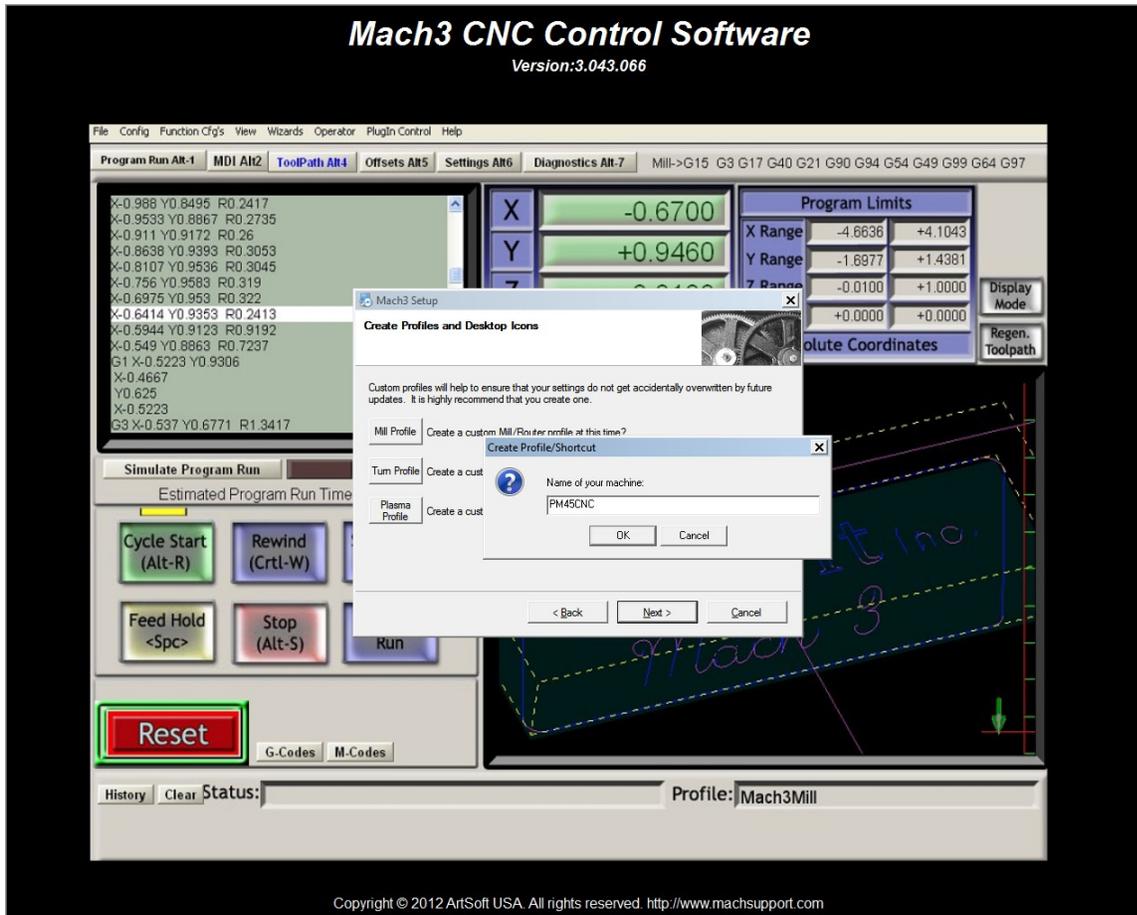
After obtaining the Mach 3 software (either from the supplied CD or from ArtSoft) install Mach3 in the default location or, a location of your choice.



Only select the basic Wizards, XML profiles and Mach3 Milling screens. Other options can be added at your choosing but, are not needed for the PM45CNC mill.



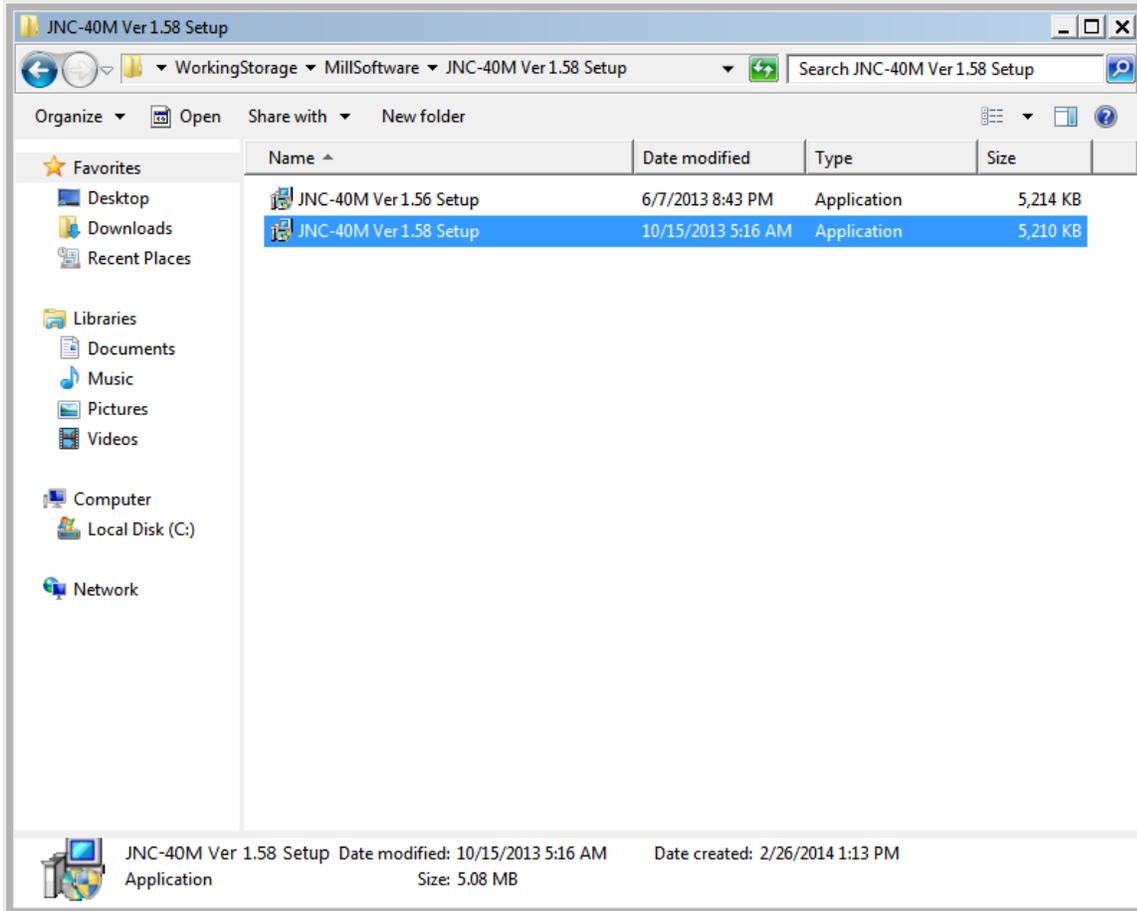
During installation, only a Mill Profile is needed for this machine. Create other profiles if you need them. A profile named PM45CNC (or other appropriate name) is necessary. This will be the profile you select when using your mill.



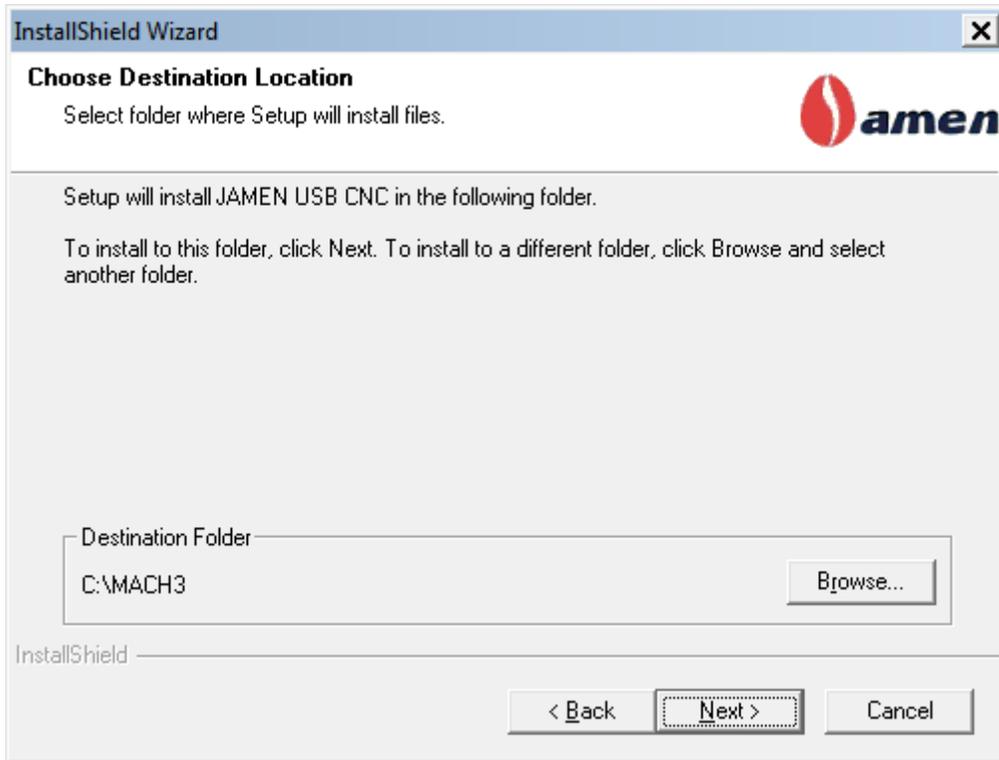
**PART 2: Install the JAMEN Driver.**

Once Mach 3 is installed, make sure the mill is turned off and USB not plugged in.

Select and install V1.58 of Jamen driver located on the CD that came with the Mill.



When prompted, install the USB driver files in the C:\Mach3 directory or, in the directory you chose when installing Mach 3.



When the installation is complete, turn the mill on and connect the supplied USB cord between the Mill and a USB port on your computer. The mill is powered on by first rotating the round dial on the left side of the control box and by pushing the green power button on the mill control head.

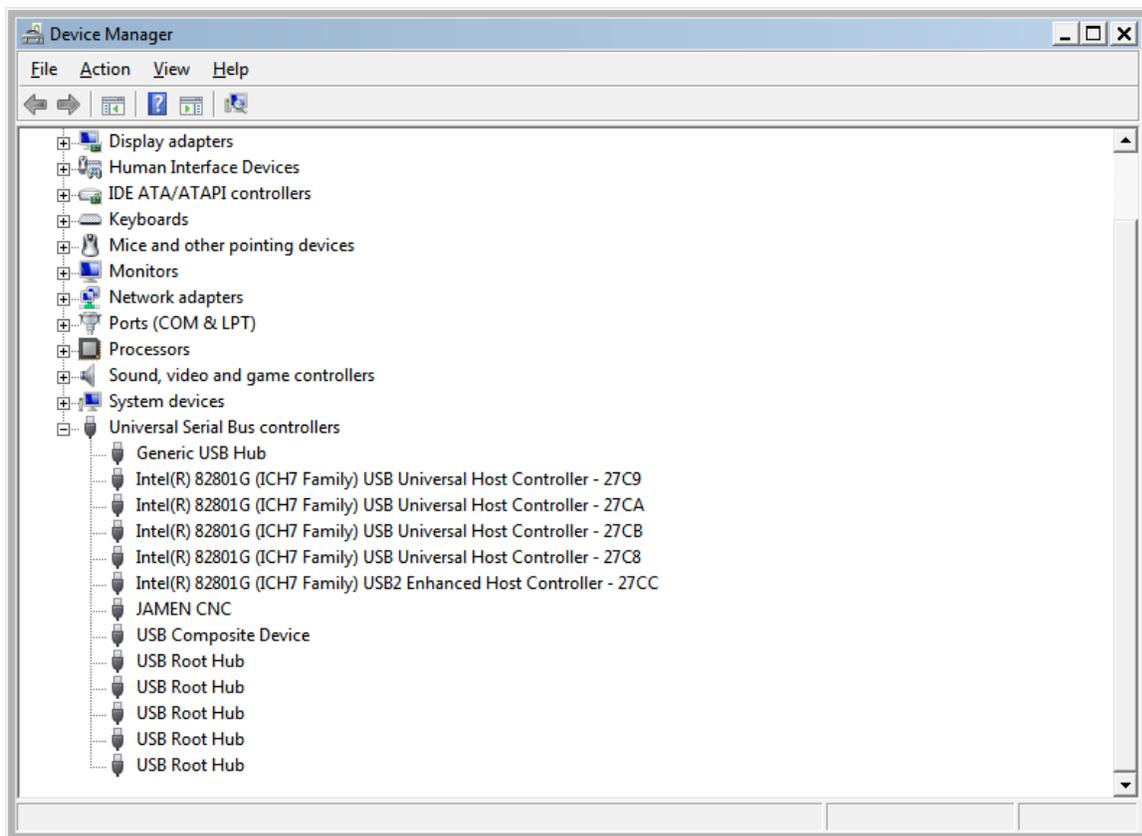
**NOTE: Some systems might auto-detect the JAMEN hardware while some systems may not. If your computer auto-detects the JAMEN hardware skip to screen “SELECT DRIVER SOFTWARE” below.**

Open the device manager for your computer and expand the entries in the Universal Serial Bus Controller section. In some cases, you may see a yellow Triangle and exclamation point next to the JAMEN entry. This will depend if you have previously attempted to install the driver or, if your computer auto-detected the new hardware. If you previously attempted to install the driver, right-click the JAMEN entry and uninstall it first followed by unplugging the USB cable and plugging it back in.

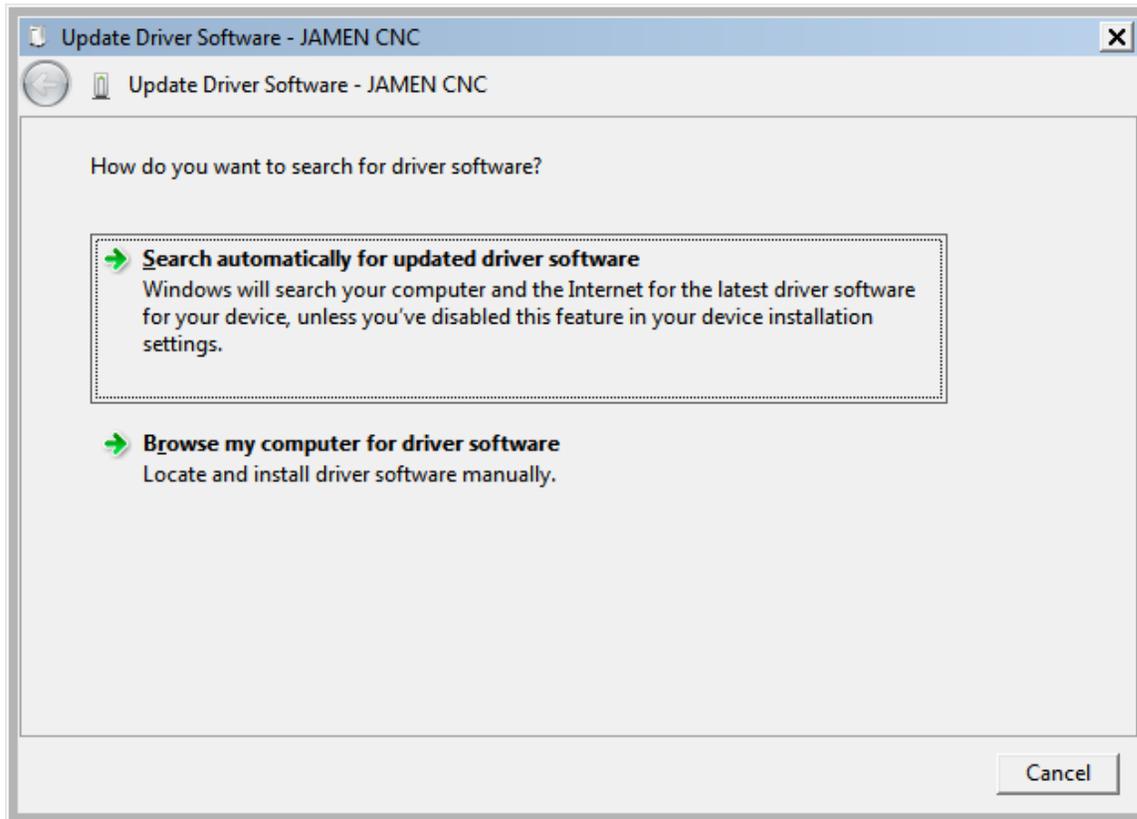
Right-click the JAMEN entry and select “Install/Update Driver”.

NOTE: Depending on operating system, the JAMEN device might show-up in some location other than Universal Serial Bus controller.

Example Device Manager for Win 7.

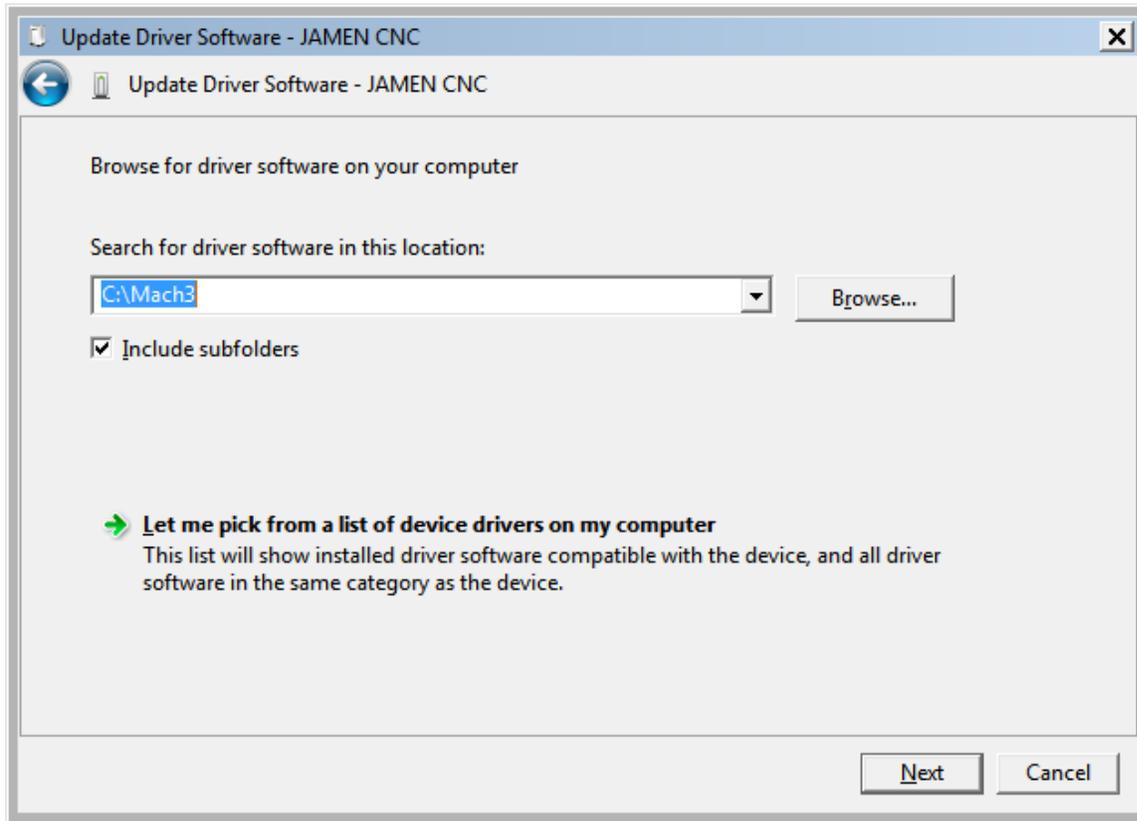


Upon seeing this screen, press "Browse my computer for driver software".



## **SELECT DRIVER SOFTWARE:**

Use the Browse button and select the base installation directory of your Mach 3 software.



Upon pressing “Next”, the JAMEN driver will be installed and you are ready to run and configure Mach 3.

**Part 3: Set Mach 3 parameters to communicate with the mill.**

This section covers basic configuration of Mach 3 to establish communication between your computer and the mill.

**WARNING:** This document does not cover personal safety issues. The user of this product must be familiar with machine shop procedures, machinery and safety practices. If you are not familiar with these matters, it is highly advised you seek professional instruction.

**NOTE:** Do not modify any switches or setting in the control cabinet of the unit.

**NOTE:** Prior to using the machine, manually raise the head so the spindle is at least 4-5 inches above the table; furthermore, center the table below the spindle. The manual table cranks can be turned when the unit is not powered on.

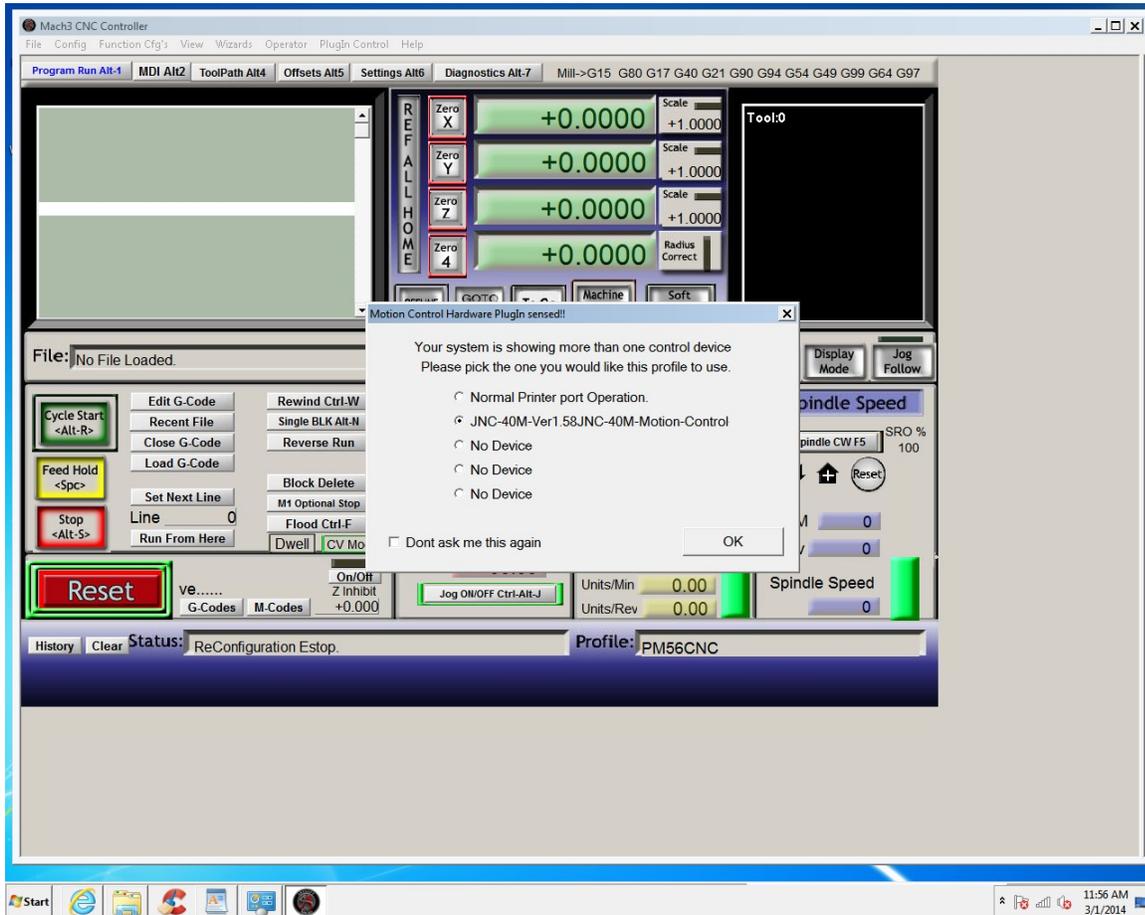
**NOTE:** This document does not describe how to use Mach 3 CNC software or CAM software.

**NOTE:** The parameters herein do not adjust all table limits as this will depend on how the user programs their CNC software.

**NOTE:** Care must always be taken when operating the machine. Pressing the red Reset button on the main menu or on the mill operator panel will stop the machine. Always watch the machine carefully and be prepared to press the Red Reset or emergency stop button.

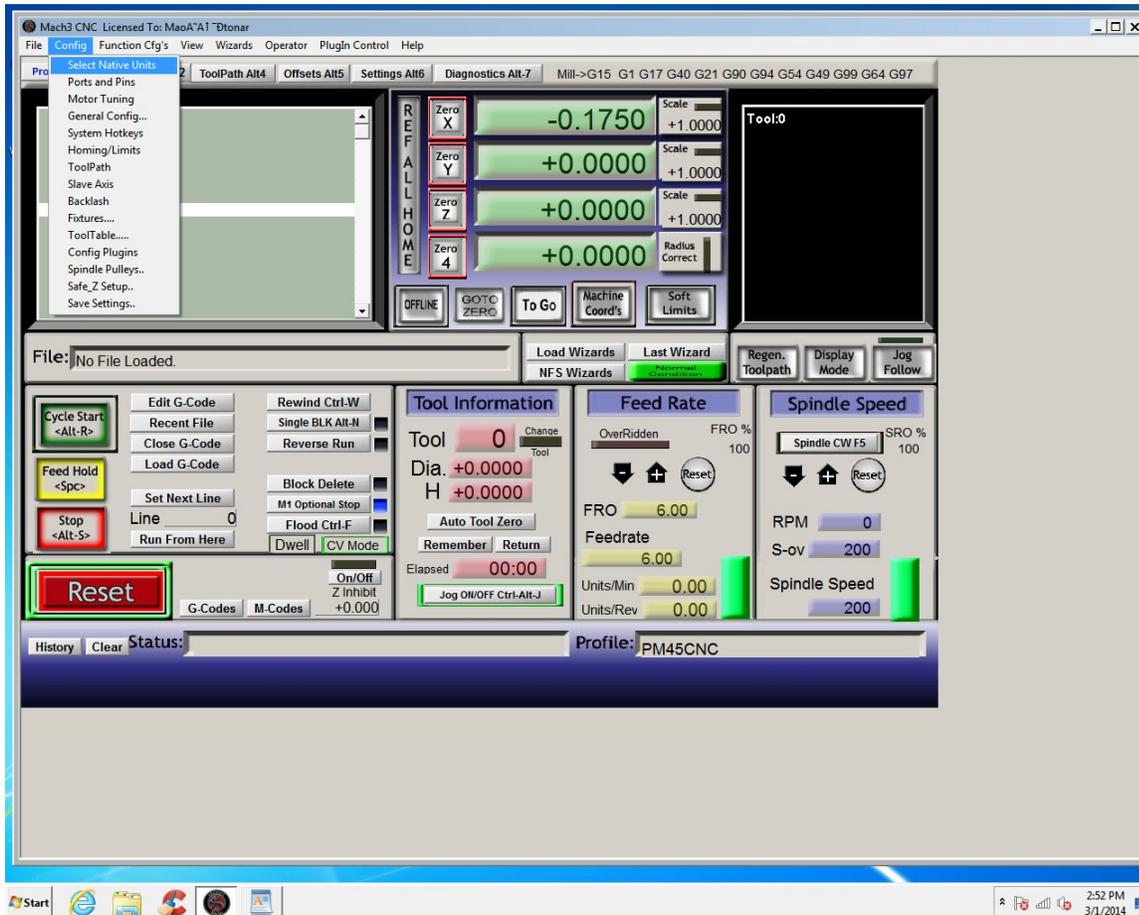
The parameters and settings herein are a starting point for future modification and customization by the user. It is the user's responsibility to know and understand how to use Mach 3 to control the mill. Until the user gains familiarity with the system, make changes cautiously, always observe proper shop safety protocol and be prepared to press the Reset or Stop buttons.

Locate and select the desktop Icon that corresponds to the Mill profile you created when installing Mach 3 and start the program. When Mach 3 starts, it will auto detect the controller. You must select the JNC motion control device.



Follow the menu directions to set the native measurement system.

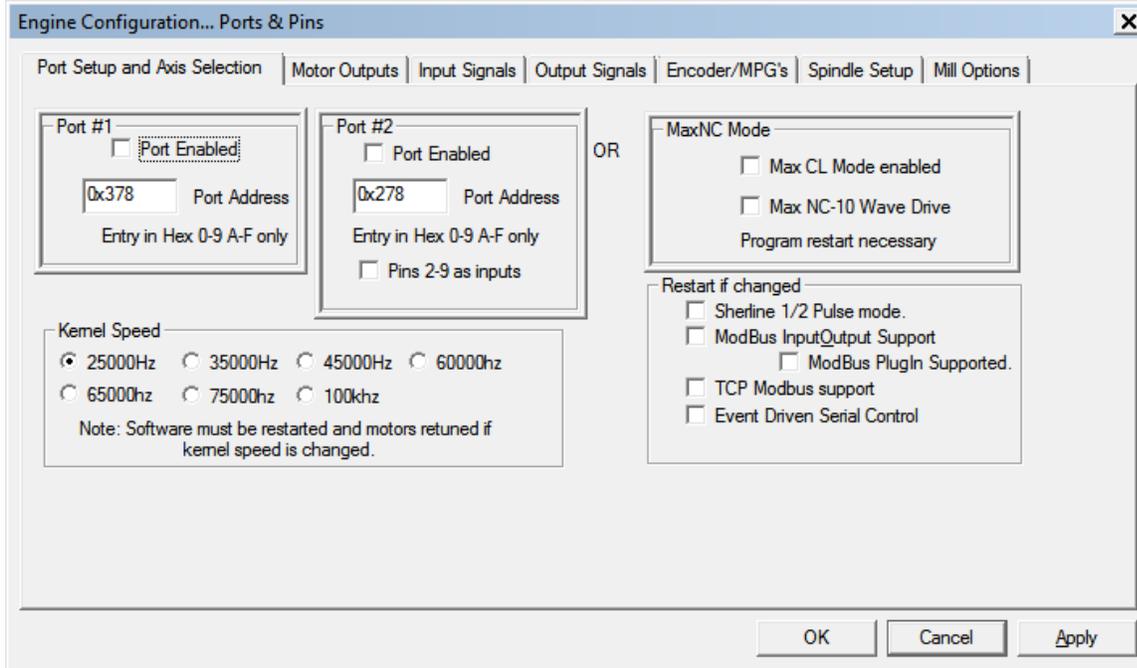
Select: Config-> Select Native Units. The US measurement system is chosen in this example.



**NOTE: In all following screens, be certain to press the Apply button to make the setting permanent.**

From the main menu of Mach 3, select:

Select: Config-> Select Ports and Pins and verify these settings.



From the main menu, set the general parameters as follows:

Select: Config-> General Config

**General Logic Configuration**

**G20,G21 Control**  
 Lock DR0's to setup units

**Tool Change**  
 Ignore Tool Change  
 Stop Spindle, Wait for Cycle Start  
 AutoTool Changer

**Angular Properties**  
Unchecked for Linear  
 A-Axis is Angular  
 B-Axis is Angular  
 C-Axis is Angular

**Pgm End or M30 or Rewind**  
 Turn off all outputs  
 E-Stop the system  
 Perform G92.1  
 Remove Tool Offset  
 Radius Comp Off  
 Turn Off Spindle

**M01 Control**  
 Stop on M1 Command

**Serial Output**  
ComPort #  BaudRate   
 8-Bit 1 Stop  7 Bit 2-Stop

**Program Safety**  
 Program Safety Lockout  
This disables program translation while the External Activation #1 input is activated.

**Editor**  
GCode Editor

**Shuttle Wheel Setting**  
Shuttle Accel.  Seconds

**Inputs Signal Debouncing/Noise rejection**  
Debounce Interval  x 40us  
Index Debounce

**Startup Models**  
 Use Init String on ALL "Resets"  
Initialization String   
Motion Mode  
 Constant Velocity  Exact Stop  
Distance Mode  Absolute  Inc  Absolute  Inc  
IJ Mode  
Active Plane of Movement  
 X-Y  Y-Z  X-Z

**Jog Increments in Cycle Mode**

Position 1	<input type="text" value="1"/>
	<input type="text" value="0.1"/>
	<input type="text" value="0.01"/>
	<input type="text" value="0.001"/>
Use 999 to indicate a	<input type="text" value="0.0001"/>
Continuous Jog	<input type="text" value="1"/>
selection.	<input type="text" value="0.1"/>
	<input type="text" value="0.01"/>
	<input type="text" value="0.001"/>
Position 10	<input type="text" value="0.0001"/>

**General Configuration**  
 Z is 2.5D on Output #6  
 Home Sw. Safety  
LookAhead  Lines  
 Ignore M calls while loading  
 M9: Execute after Block  
 UDP Pendant Control  
 Run Macro Pump  
 ChargePump On in EStop  
 Persistent Jog Mode.  
 FeedOverride Persist  
 No System Menu in Mach3  
 Use Key Clicks  
 Home Slave with Master Axis  
 Include TLO in Z from G31  
 Lock Rapid FRO to Feed FRO  
Rotational  
 Rot 360 rollover  
 Ang Short Rot on G0  
 Rotational Soft Limits

**Screen Control**  
 Hi-Res Screens  
 Boxed DR0's and Graphics  
 Auto Screen Enlarge  
 Flash Errors and comments.

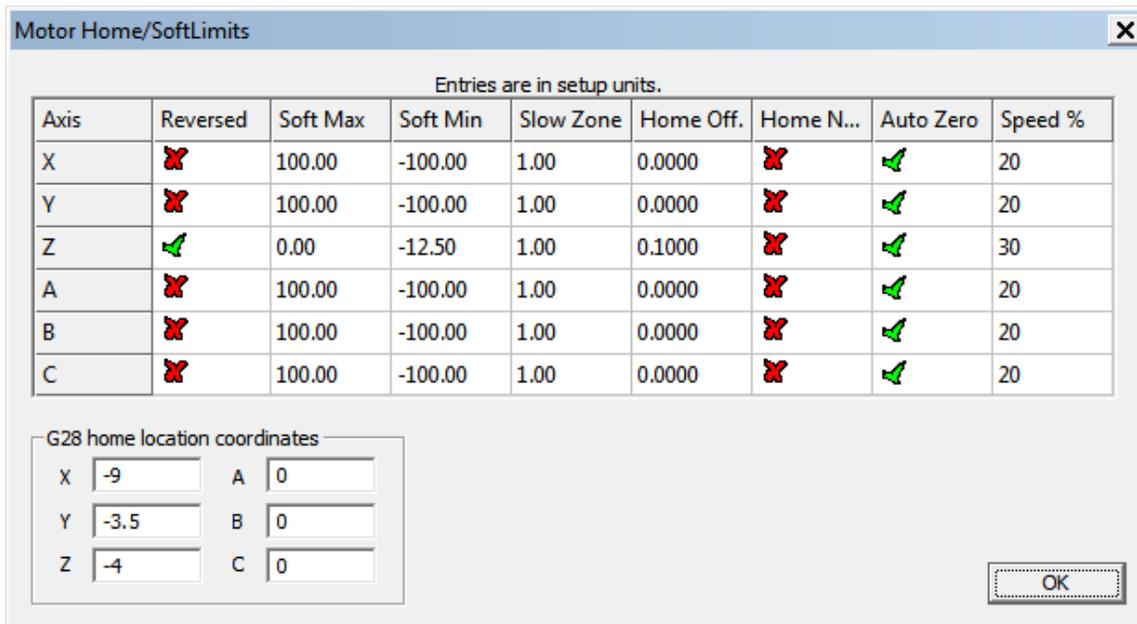
**Disable Gouge/Concavity Checks**  
 G04 Dwell in ms  
 Use WatchDogs  
 Debug This Run  
 Enhanced Pulsing  
 Allow Wave Files  
 Allow Speech  
 Set Charge Pump to 5KHz - Laser Stndby  
 Use OUTPUT20 as Dwell Trigger  
 No FRO on Queue  
 Turn Manual Spindle Incr.  
 Spindle OV increment

**CV Control**  
 Plasma Mode  
 CV Dist Tolerance  Units..  
 G100 Adaptive NurbsCV  
 Stop CV on angles >  Degrees

**Axis DR0 Properties**  
 Tool Selections Persistent.  
 Optional Offset Save  
 Persistent Offsets  
 Persistent DR0s  
 Copy G54 from G59.253 on startup

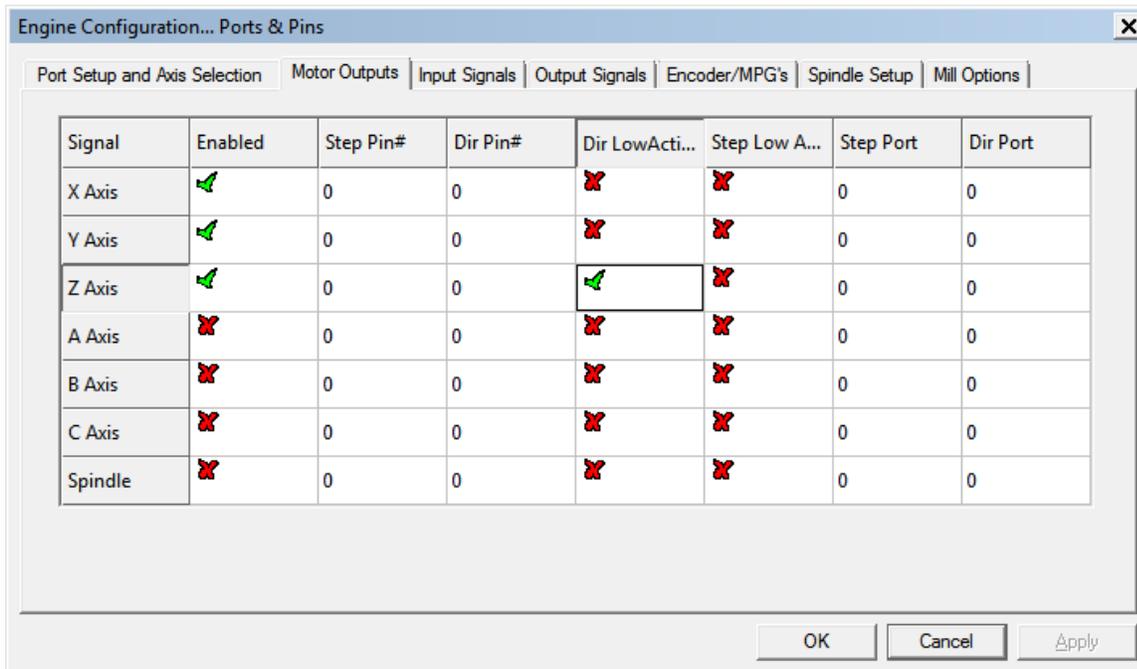
Set the soft limits as follows:

Select: Config-> Homing/Limits



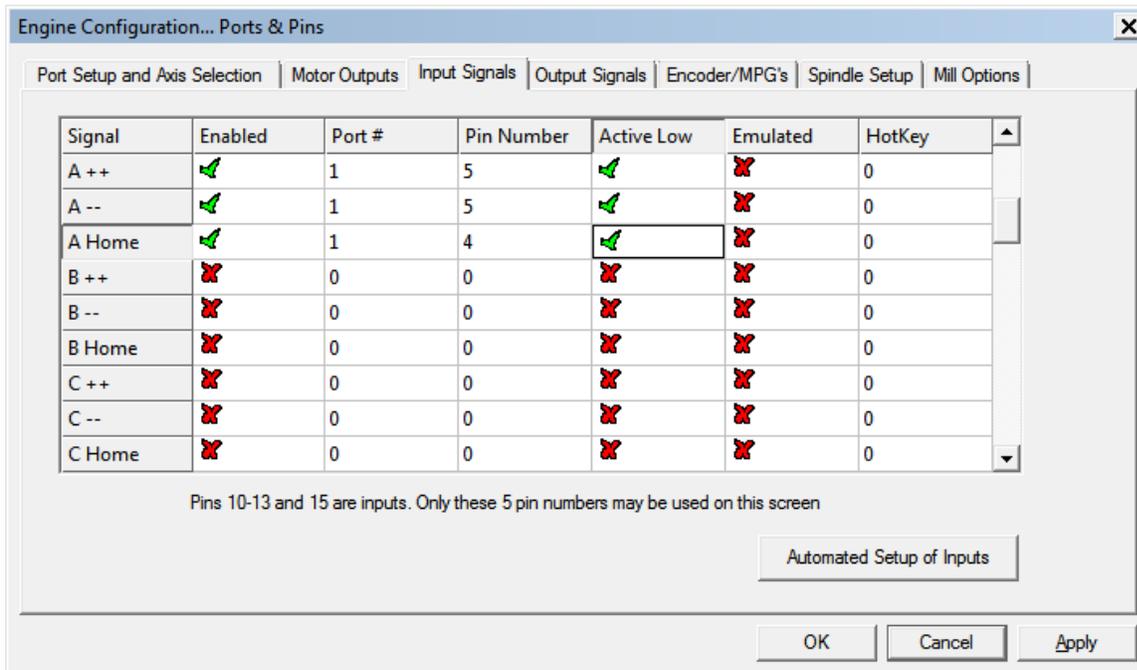
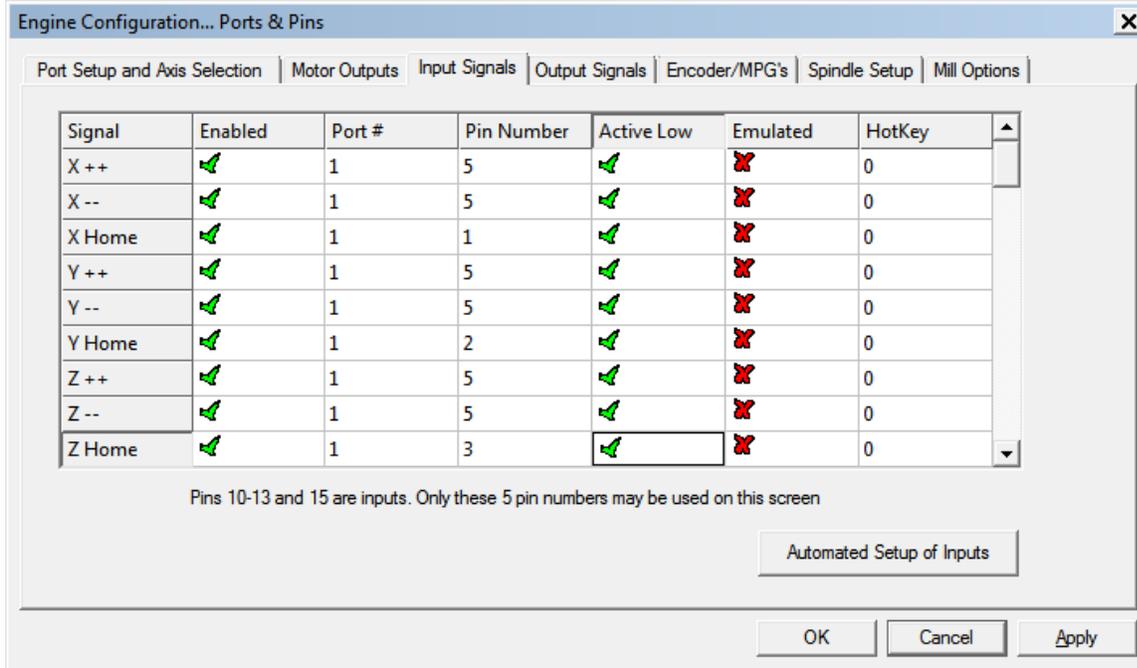
Set the Motor Output as follows:

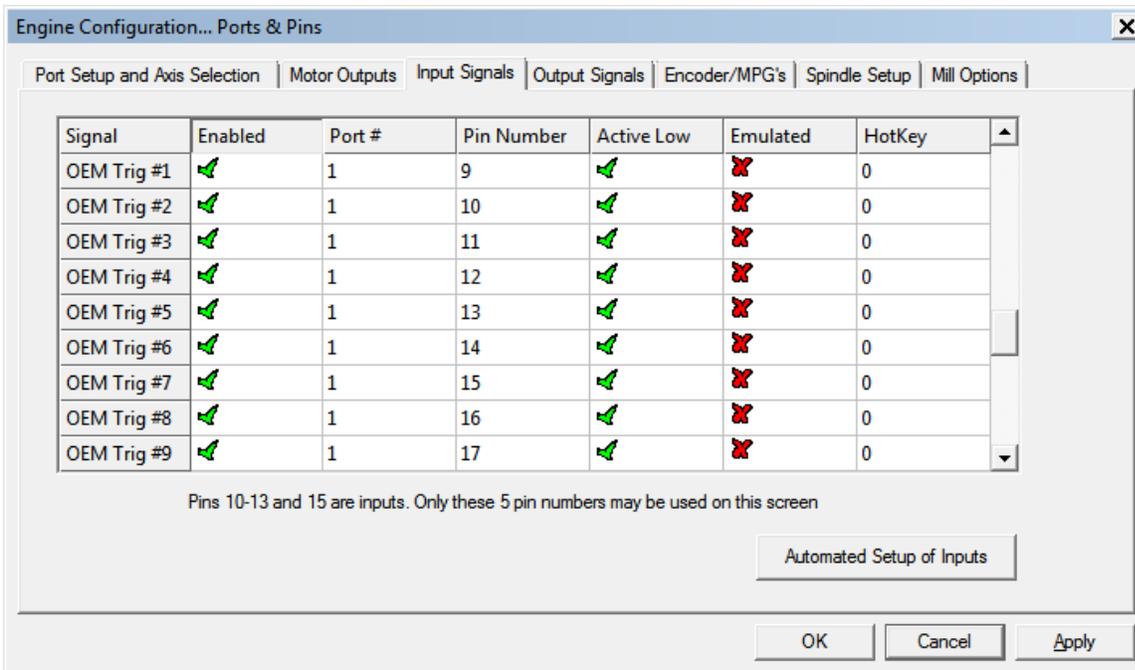
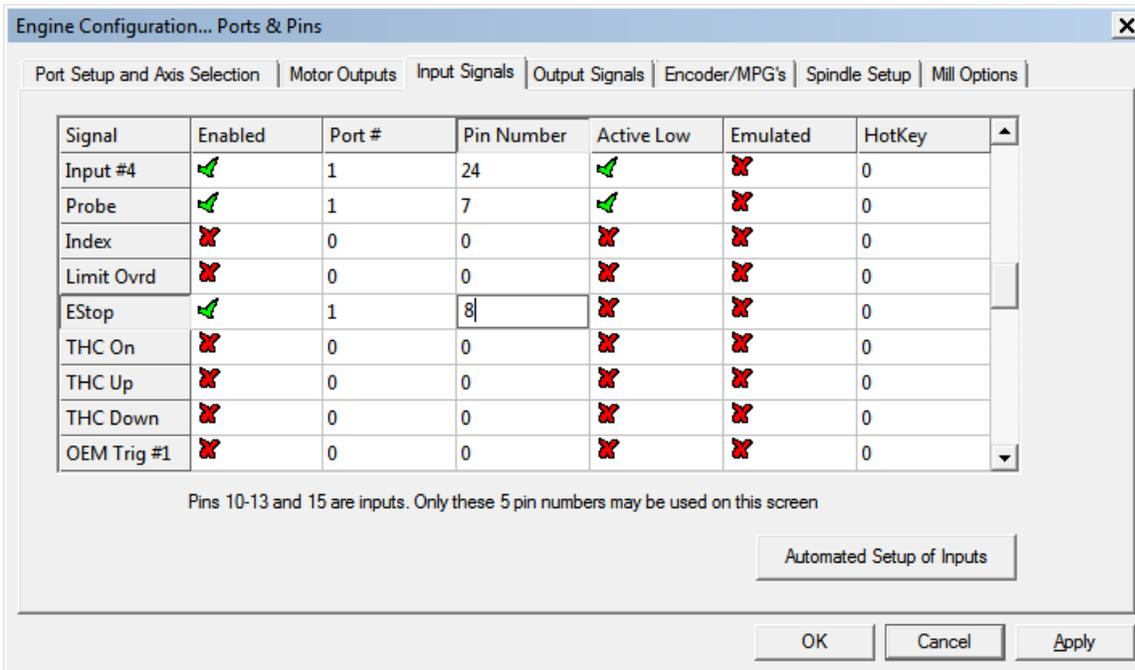
Select: Config->Ports and Pins>Motor Outputs

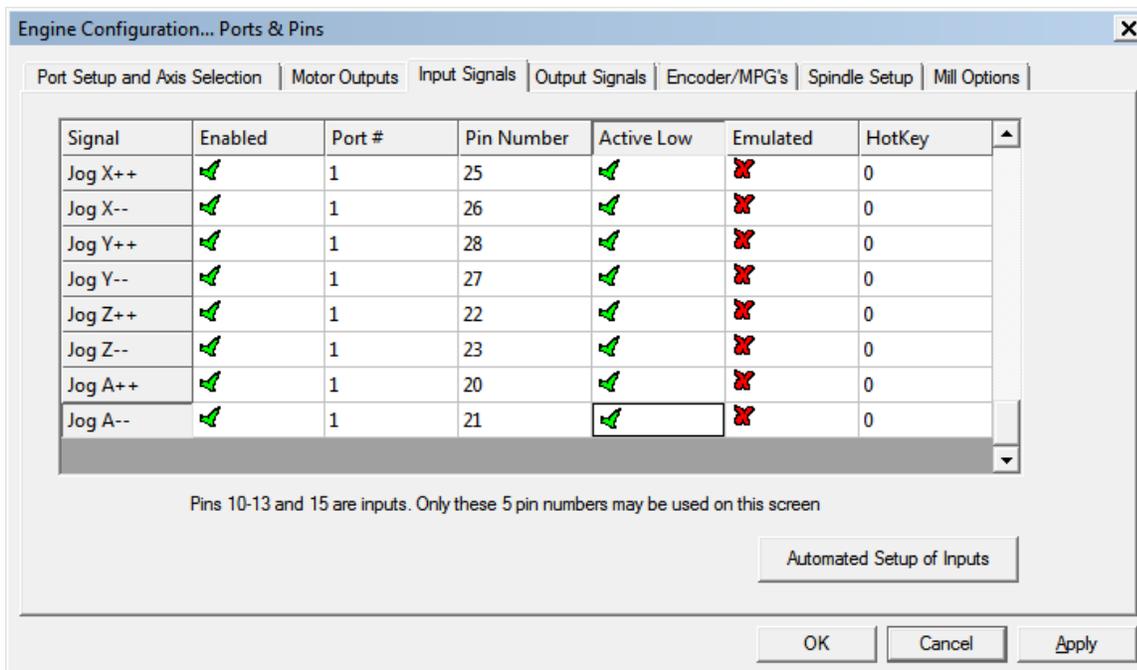
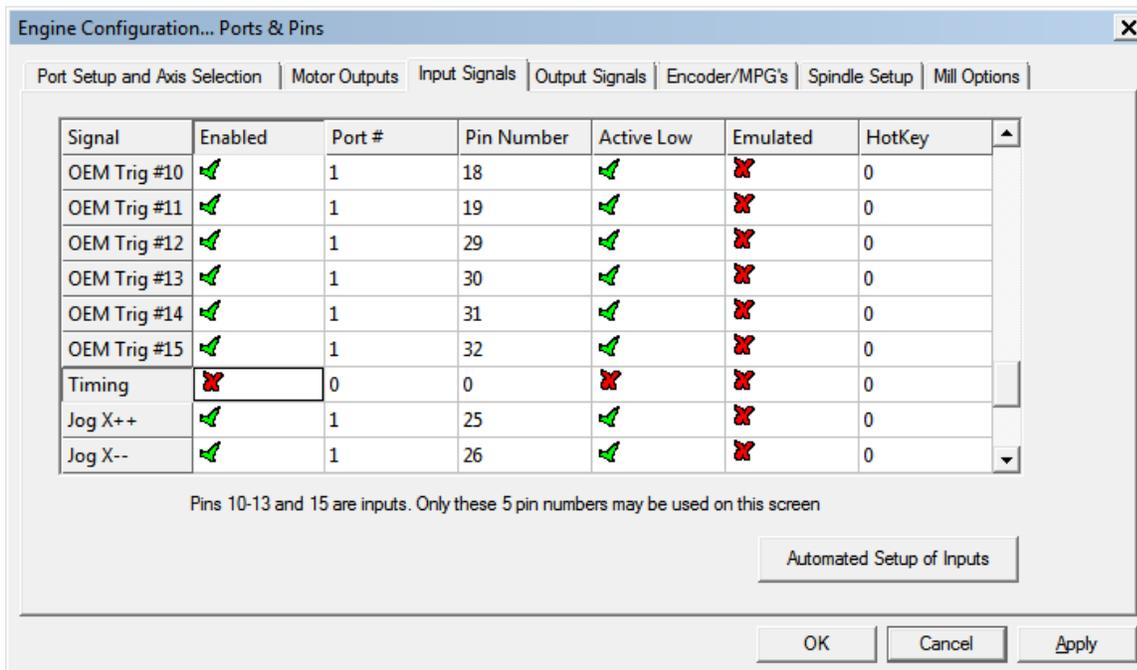


Set the motor input signals as follows. Carefully observe all numbers and settings. **Note: There are several screenshots spanning multiple pages on this set of configuration parameters. All other parameters other than the ones show are not significant.**

Select: Config->Ports and Pins-> Input Signals

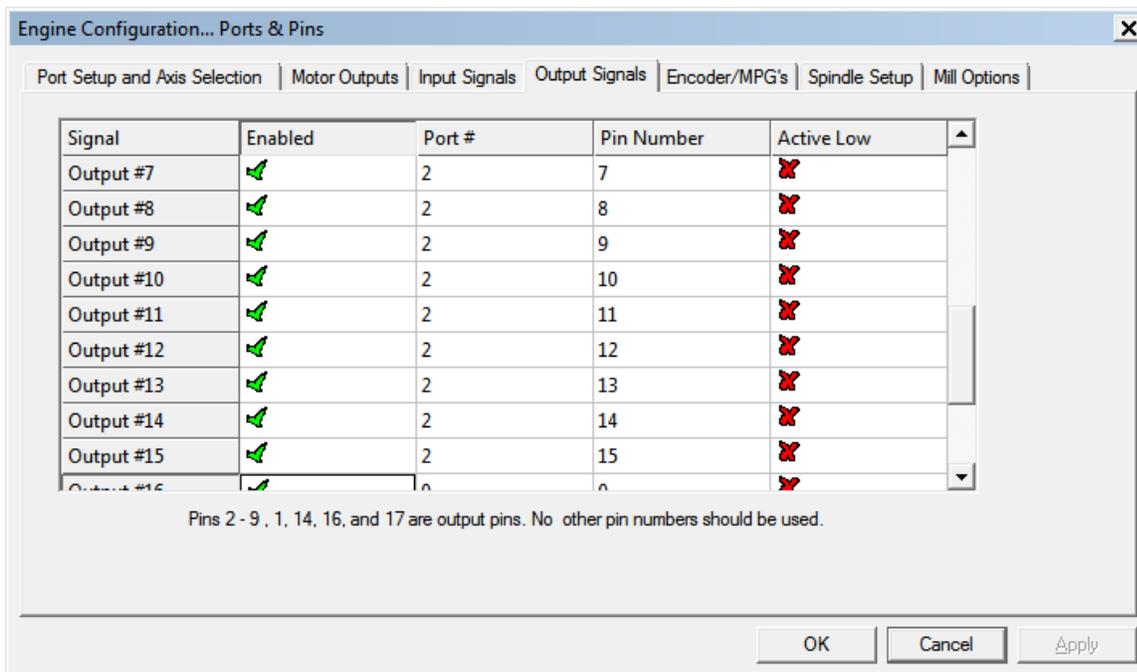
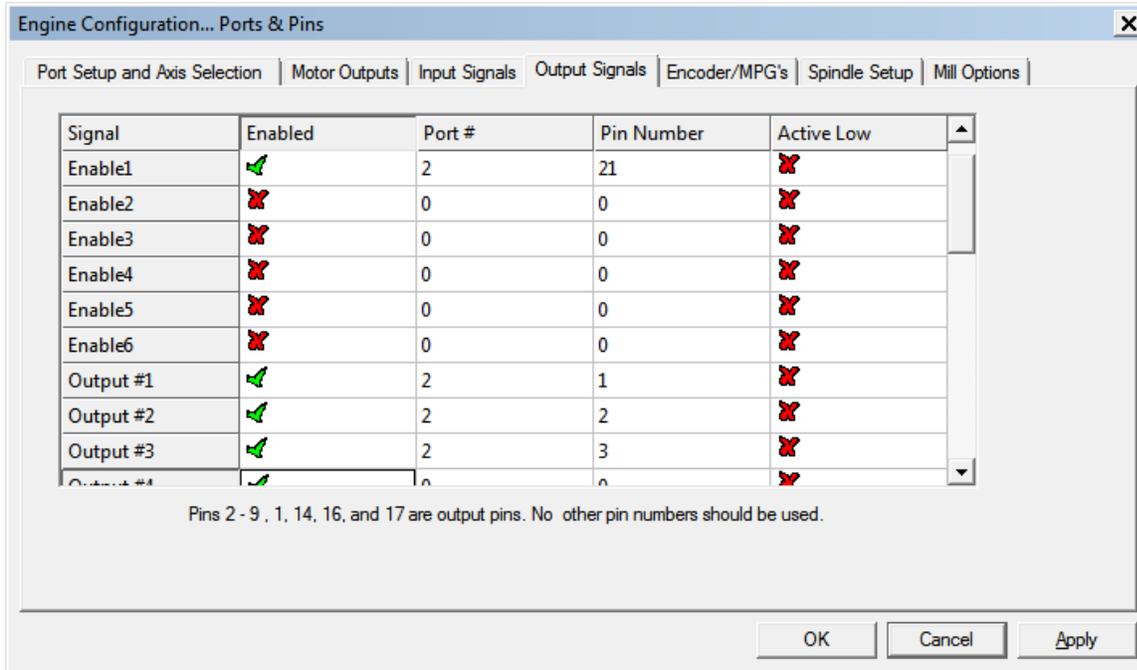


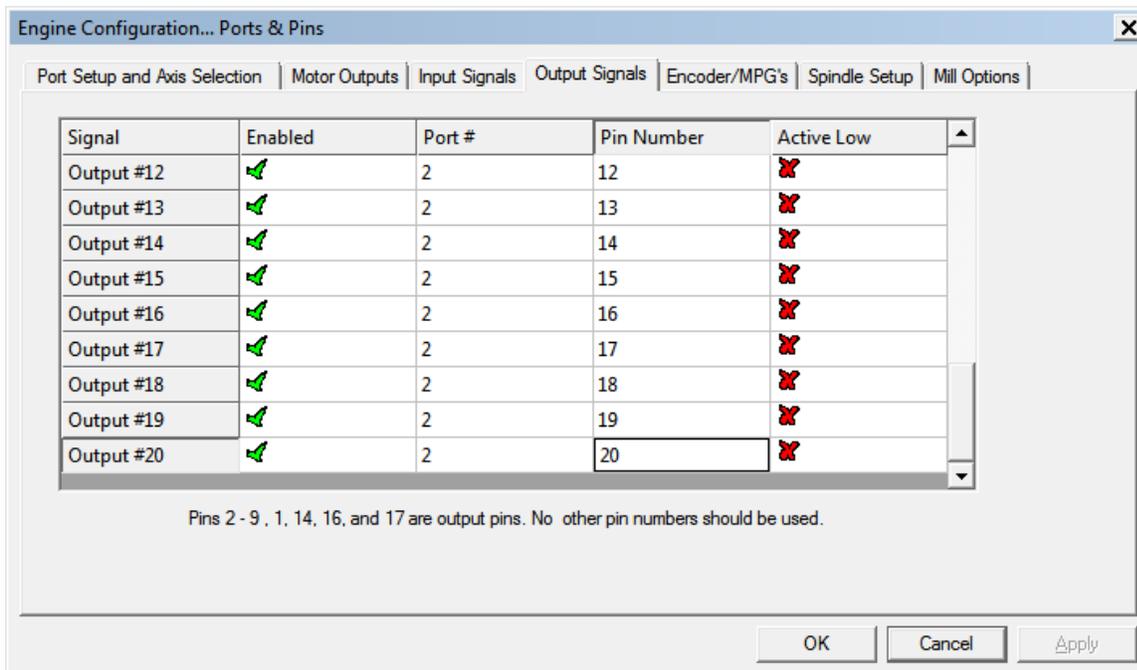




Set the Output Signals exactly as shown. **Note: There are several screenshots spanning multiple pages on this set of configuration parameters. All other parameters other than the ones show are not significant.**

Select: Config->Ports and Pins-> Output Signals





Set the Spindle Setup parameters.

Select: Config->Ports and Pins-> Spindle Setup

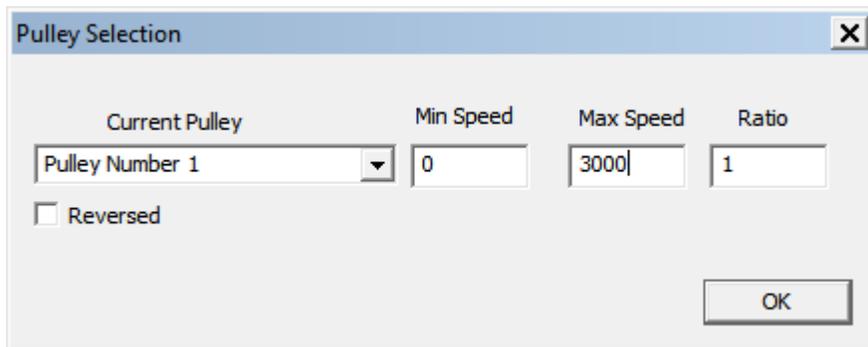
The screenshot shows the 'Spindle Setup' tab of the 'Engine Configuration... Ports & Pins' dialog box. The dialog has several sections for configuring spindle parameters:

- Relay Control:** Includes a checkbox for 'Disable Spindle Relays'. Below it, 'Clockwise (M3) Output #' is set to 1 and 'CCW (M4) Output #' is set to 2. A label 'Output Signal #'s 1-6' is present.
- Flood Mist Control:** Includes a checkbox for 'Disable Flood/Mist relays'. Below it, 'Mist M7 Output #' is set to 4 and 'Flood M8 Output #' is set to 3. A 'Delay' field is set to 0. A label 'Output Signal #'s 1-6' is present.
- ModBus Spindle - Use Step/Dir as well:** Includes a checkbox for 'Enabled' (unchecked), a 'Reg' field set to 64 (range 64-127), and a 'Max ADC Count' field set to 16380.
- Motor Control:** Includes checkboxes for 'Use Spindle Motor Output' (checked), 'PWM Control' (checked), and 'Step/Dir Motor' (unchecked). Below are 'PWMBase Freq.' set to 5 and 'Minimum PWM' set to 0%.
- General Parameters:** Includes four delay settings: 'CW Delay Spin UP' (1 Seconds), 'CCW Delay Spin UP' (1 Seconds), 'CW Delay Spind DOWN' (1 Seconds), and 'CCW Delay Spin DOWN' (1 Seconds). A checkbox for 'Immediate Relay off before delay' is unchecked.
- Special Functions:** Includes checkboxes for 'Use Spindle Feedback in Sync Modes' (unchecked), 'Closed Loop Spindle Control' (unchecked), and 'Spindle Speed Averaging' (checked). Below are PID parameters: P (0.25), I (1), and D (0.3).
- Special Options, Usually Off:** Includes checkboxes for 'HotWire Heat for Jog' (unchecked), 'Laser Mode. freq I' (unchecked), 'Torch Volts Control' (unchecked), and 'Torch Auto Off' (unchecked).

At the bottom of the dialog are three buttons: 'OK', 'Cancel', and 'Apply'.

Set the Spindle Pulley parameters.

Select: Config->Spindle Pulleys



The image shows a software dialog box titled "Pulley Selection" with a close button (X) in the top right corner. The dialog contains four input fields: "Current Pulley" (a dropdown menu showing "Pulley Number 1"), "Min Speed" (a text box with "0"), "Max Speed" (a text box with "3000"), and "Ratio" (a text box with "1"). Below these fields is a checkbox labeled "Reversed" which is currently unchecked. An "OK" button is located at the bottom right of the dialog.

Current Pulley	Min Speed	Max Speed	Ratio
Pulley Number 1	0	3000	1

Reversed

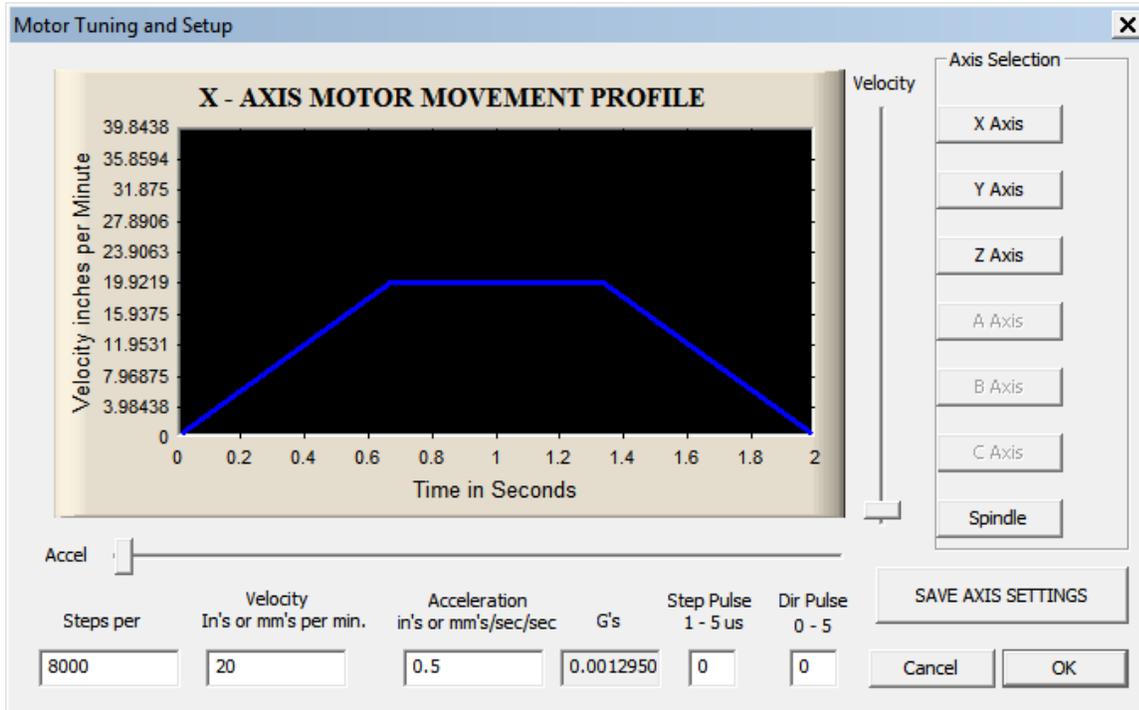
OK

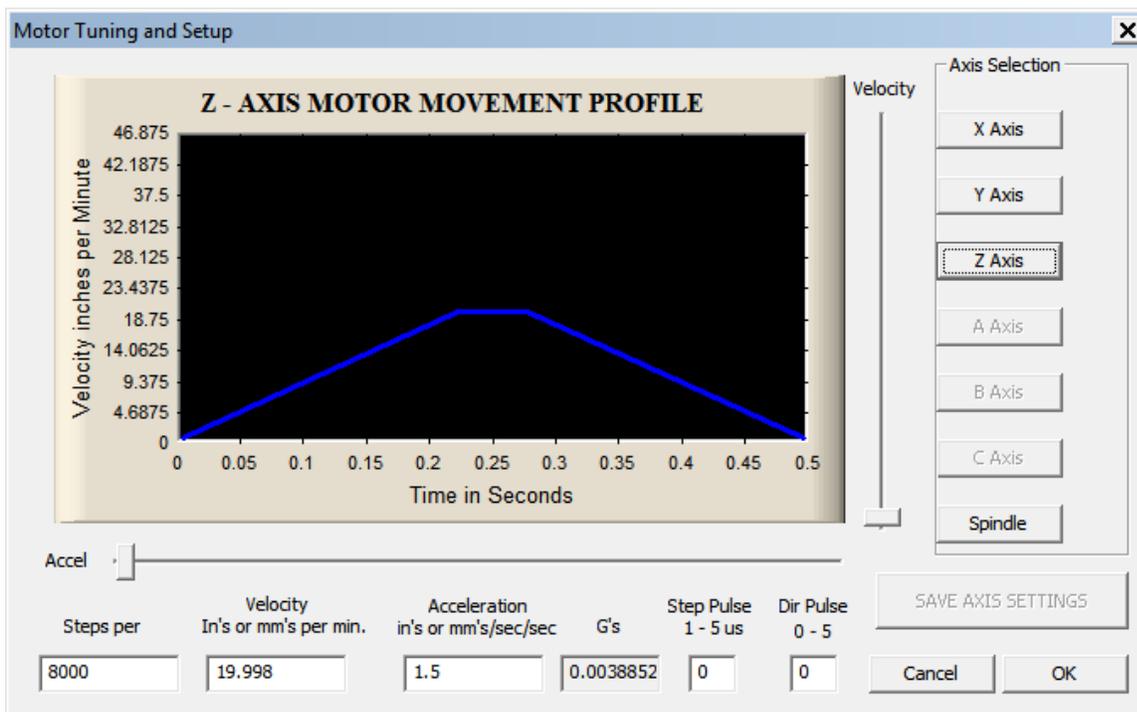
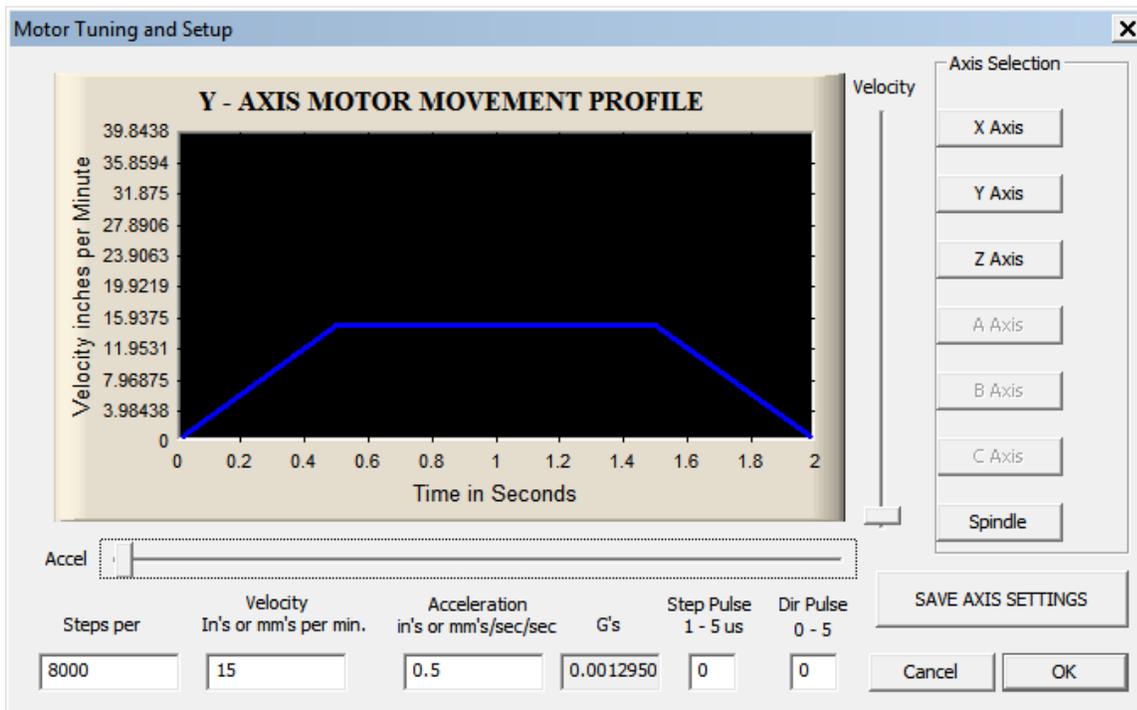
Set the Motor Tuning parameters for X, Y, Z and Spindle.

NOTE: The speed and acceleration parameters are set to fairly low values and can be increased once the operator has become familiar with the system.

**NOTE: Each time a parameter setting is changed on the MotorTuning screens, the "SAVE AXIS SETTINGS" button must be pressed.**

Select: Config->Motor Tuning (Four screens follow, do this for X, Y, Z and Spindle).





Motor Tuning and Setup

### SPINDLE MOTOR MOVEMENT PROFILE

Velocity

Axis Selection

- X Axis
- Y Axis
- Z Axis
- A Axis
- B Axis
- C Axis
- Spindle**

Accel

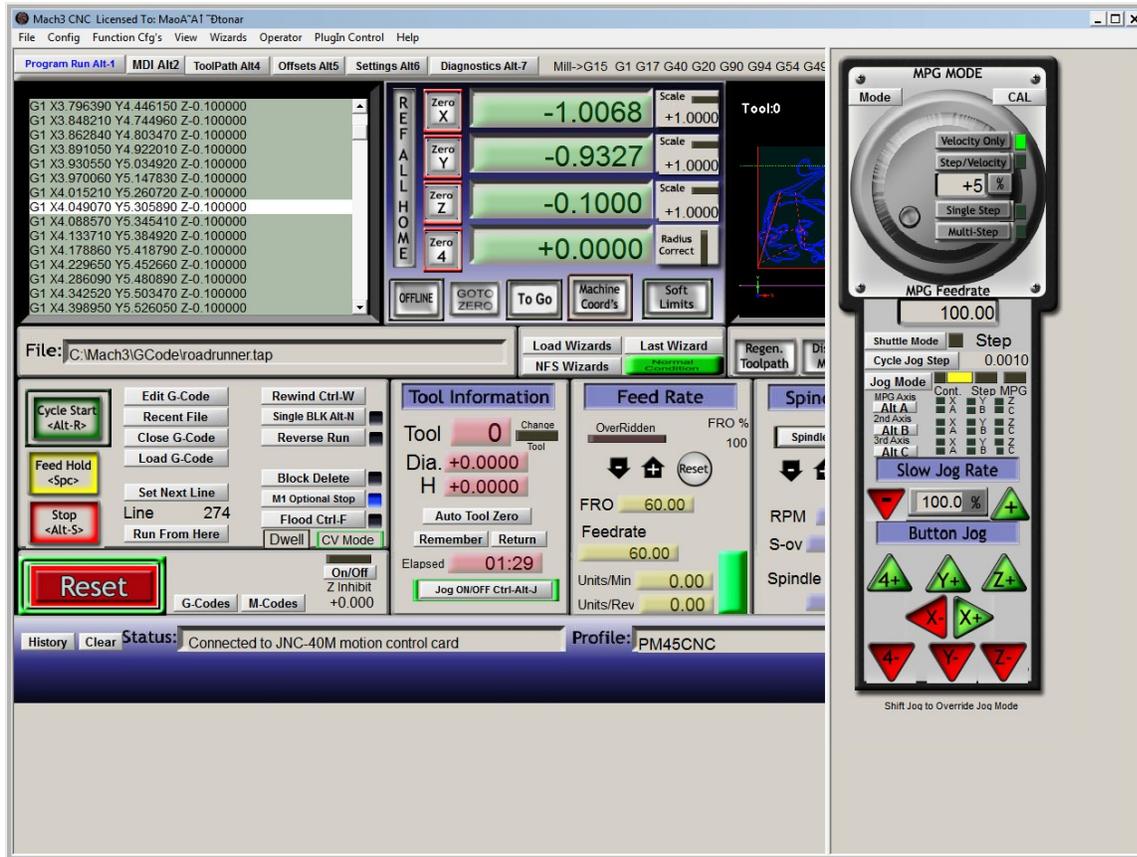
Steps per	Velocity In's or mm's per min.	Acceleration in's or mm's/sec/sec	G's	Step Pulse 1 - 5 us	Dir Pulse 0 - 5
1	120	4	0.0103607	0	0

SAVE AXIS SETTINGS

Cancel OK

It is advisable to exit the Mach 3 program and upon closing the application, save any profile information if prompted.

Upon restarting Mach 3, press the TAB key and the jog panel will appear on the right side of the screen. The Reset button must be pressed so it is not flashing. At this time, the X, Y and Z jog buttons can be pressed to operate the mill. In addition, the spindle panel on the main screen can be used to operate the spindle.



This concludes basic installation of Mach 3, the JAMEN driver and, configuration of basic communication parameters. **The parameters and settings herein are a starting point for future modification and customization by the user. It is the user's responsibility to know and understand how to use Mach 3 to control the mill. Until the user gains familiarity with the system, make changes cautiously, always observe proper shop safety protocol and be prepared to press the Reset or Stop buttons.**

Further information about this product can be found at <http://www.cmf-llc.com/pm-qmt-machines/>

## ADDENDUM: Setting Home to the South-East Corner

Many prefer to have the home location of the table set to the South-East corner of the mill. This can be accomplished by relocating the limit switch stops and updating the Home and Soft Stop parameters. Because each user may set the limit switch stops in slightly different locations, the exact values of the Mach 3 settings will need fine tuning to you machine.

**WARNING: When making these changes, the Mach 3 “Reset” button must be activated (flashing) to disable the mill from moving while the switches are manually checked.**

**WARNING: In order to follow these instructions, you MUST have previously followed the basic software setup and Mach 3 configuration procedures.**

The following procedure involves determining which switches activate the Limit signals and which activates the Home signals. The stop tabs are then rearranged and positioned to engage the switches to achieve the desired stopping location.

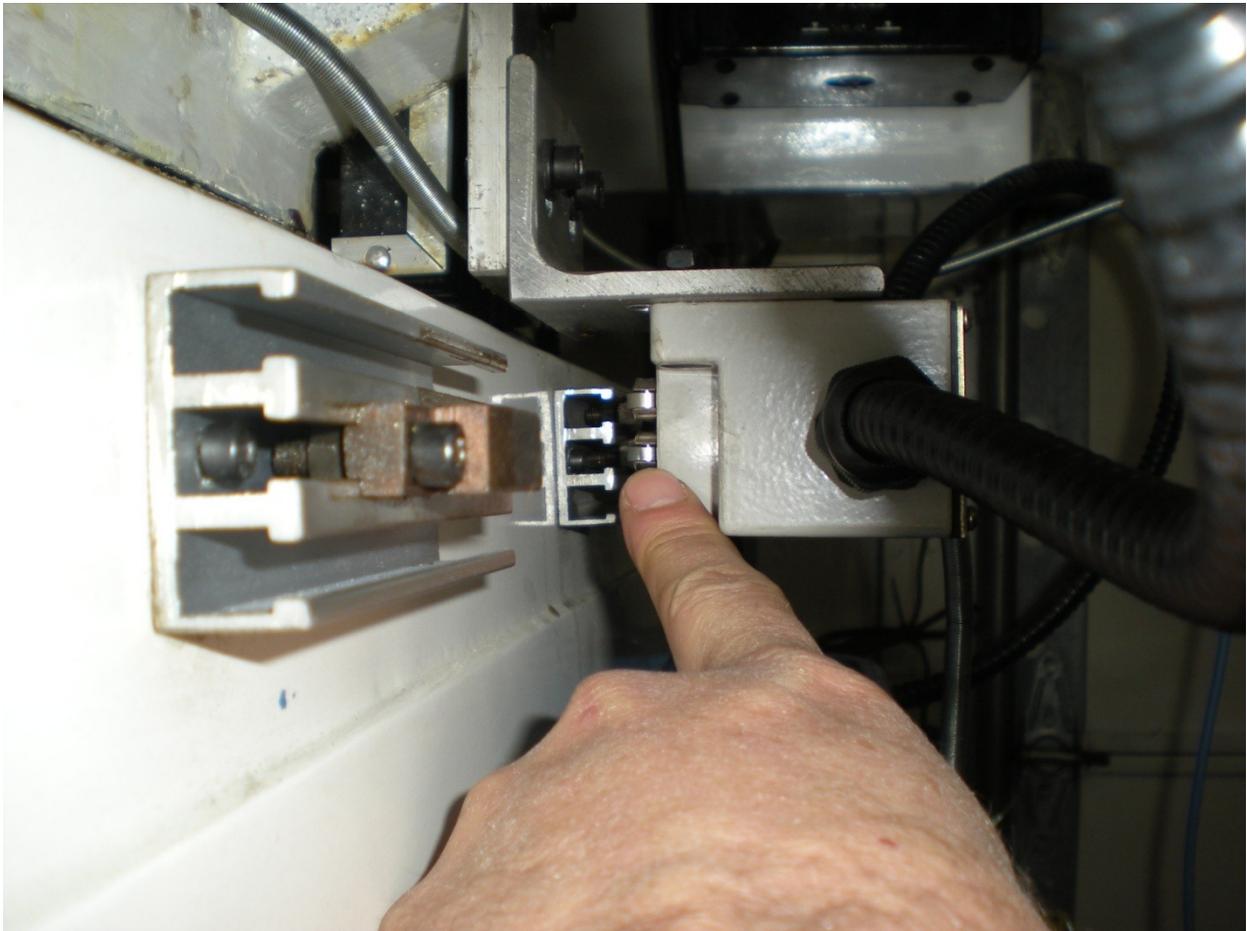
When this procedure is followed, the mill’s home location will show like this:



Adjusting the Y Limit

**WARNING: Exercise caution and ensure the Mach 3 Reset switch is flashing and the mill is in the disabled mode.**

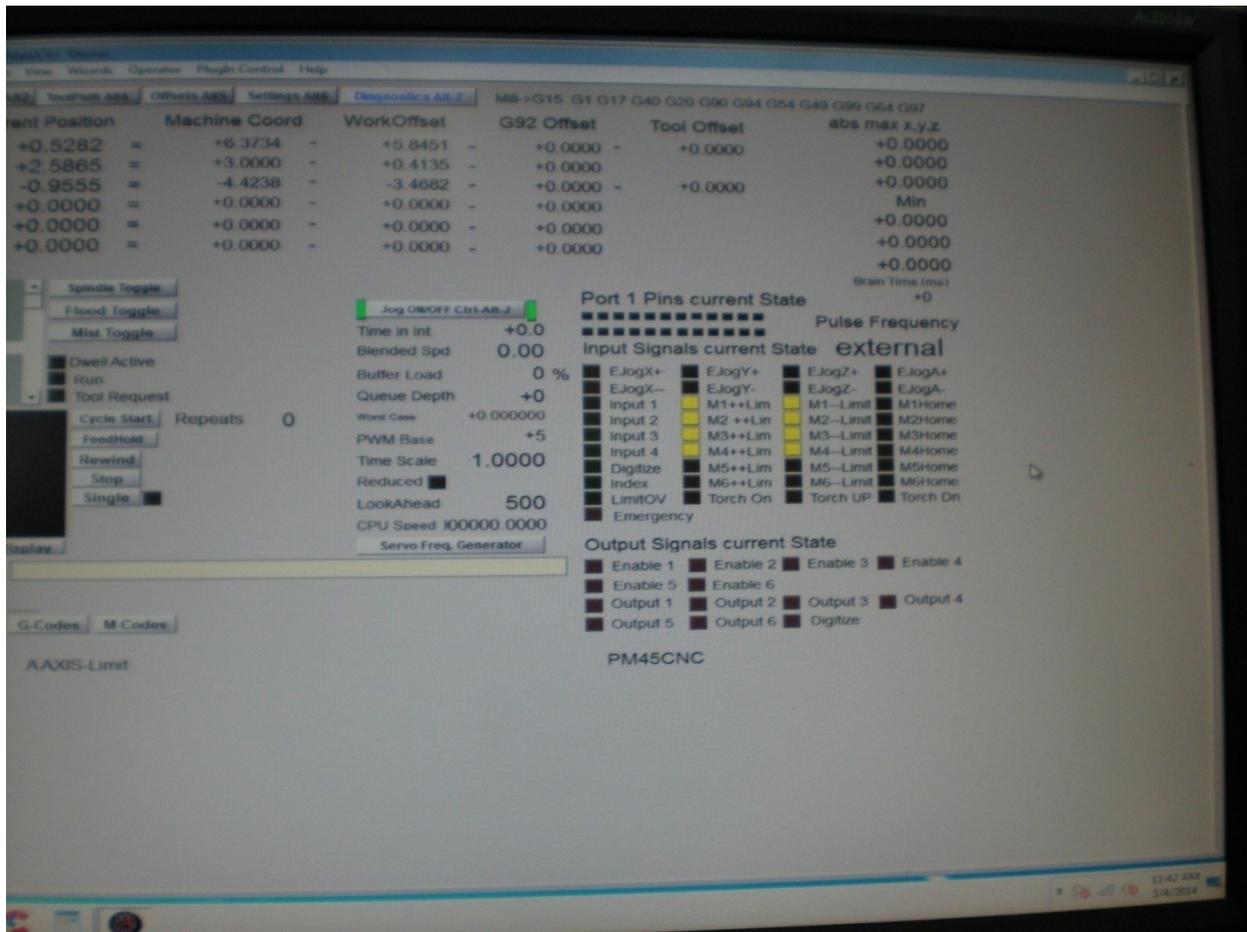
First locate the Y-direction limit switch on right side of the mill table. Notice the two roller switches one on top of the other.



Set the Mach 3 program to the “Diagnostics” screen.

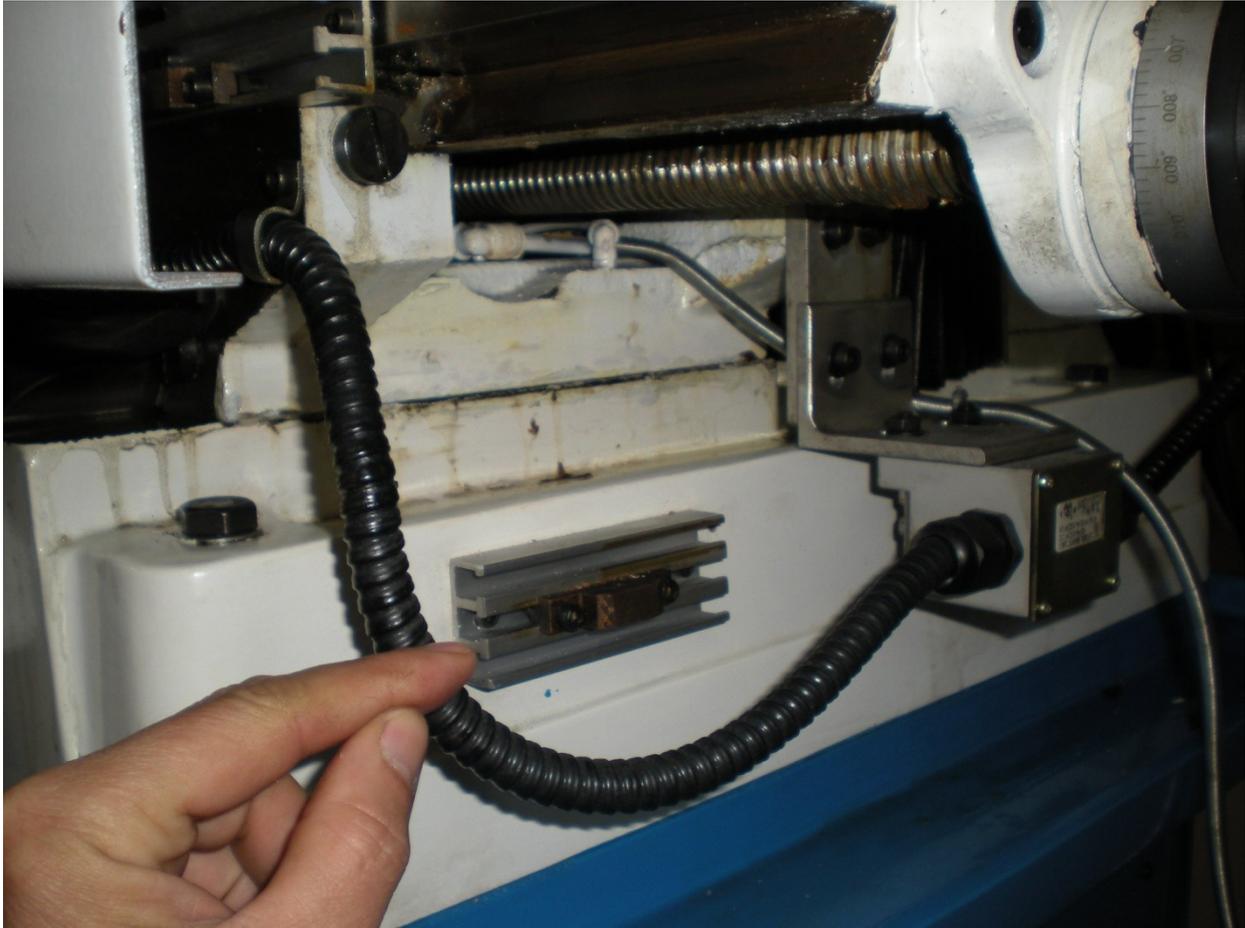
Note that which switch (Top or Bottom) that lights the limit indicators is arbitrary as, it is the positioning of the metal activator tabs which defines the behavior of the system. In your system, depending on how wired at the factory, your machine may be opposite from this example. The instructions herein provide the generalized steps to perform this adjustment.

Manually press each switch until the Motor Limit Light indicators show as active. Note which switch (top or bottom) produces this screen. See the picture below.



In order to home the mill to the South-West corner one of the front Y limit tabs must be relocated to the rear set of tabs (covered in the next set of steps).

The picture below is the front Y axis limit stop tab. It must be adjusted in the proper track to engage the switch (top or bottom) identified as being the Limit switch. In this case, the correct tab is located in the center track. Exact positioning (left or right in the track) of the tab must be customized to your individual mill and where you want the Y limit to occur.



In the rear set of Y axis tabs, the tab which engages the Home switch (in this case, the top switch) must be positioned in the track which activates Home switch. In this case the top slot aligns with the top (Home) switch and the tab must be positioned about 3/8" forward of the Limit tab below it. As the table moves toward the column, the top tab will engage the Home switch first.

It is important to keep the Limit tab so it will always engage the limit switch. This is a safeguard to stop the table in the event the Mach 3 parameters are not set properly. At either end of the Y axis, engaging the limit switch will stop the table.



## Adjusting the X Limit

The procedure for adjusting the X limit and Home switches is the same as adjusting the Y axis; however the switch is located in the center of the X axis table direction. Keep in mind, that from the factory, the orientation of the top and bottom switches may not be the same as this example. The procedure involves determining which switch activates the Limit signals and which activates the Home signal. The stop tabs are then positioned to engage the switches to achieve the desired stopping location.

For homing the mill as outlined in this procedure, the left-side X axis requires two tab stops and the right side requires one tab.

The following image shows the X axis limit switch and the stop tab on the right-hand (X-axis) side of the table.



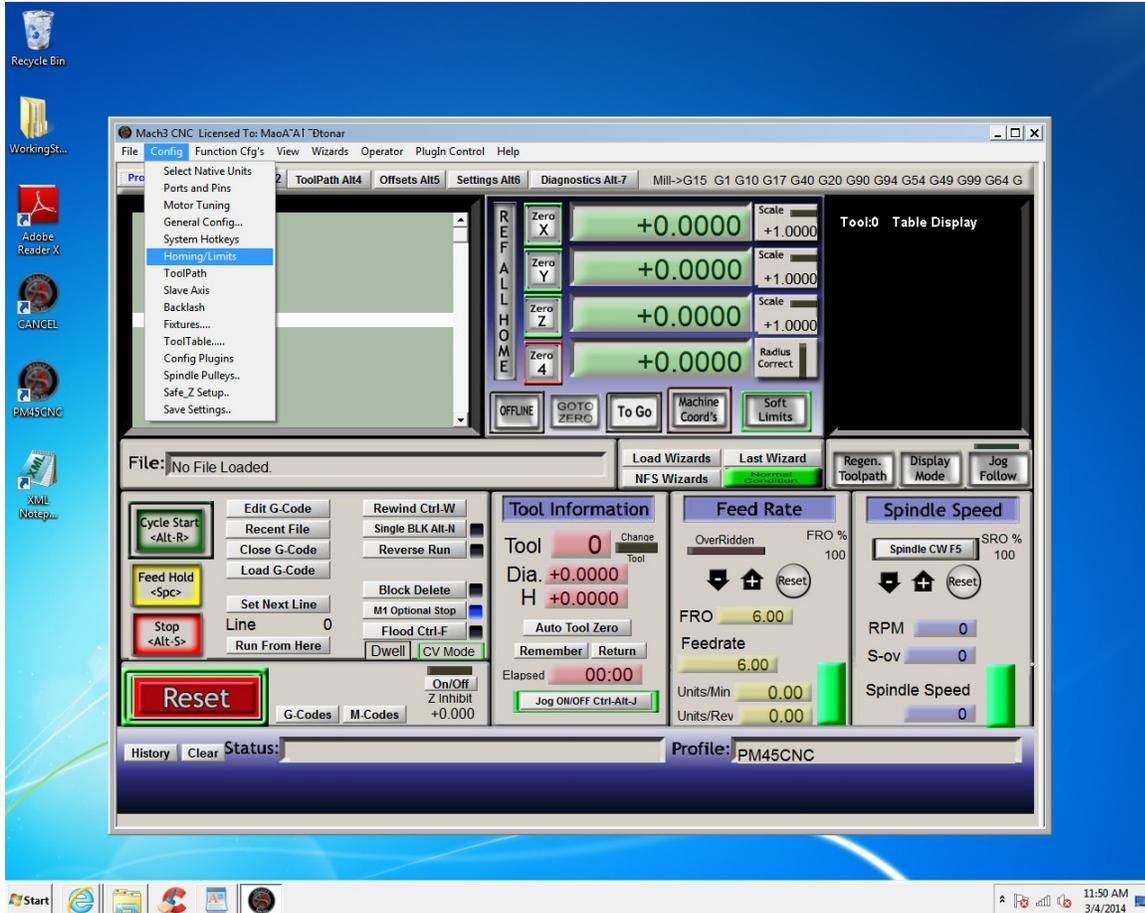
The following image shows the left side stop tabs. Notice that the tab corresponding to the Home switch is approximately 3/8" forward of the limit switch. The orientation on your particular machine depends on which switch you determined was the Home switch and which was the limit switch. In this case, bottom tab corresponds to the bottom (Home) switch. To determine which switch controls the Home or Limit signals, read the procedure for setting the Y axis but instead, toggle and test the X switches.



Setting the Mach 3 parameters.

With Mach 3 communication established,

Select: Config->Hommg/Limits



Set the table parameters as shown. In this example, the table size is limited to 17.25 x 7.75 inches. You may adjust these parameters to your liking within practical limits of the actual table size and desired range of motion. Finally, the physical position of the limit stop tabs will define where the table actually homes. You may adjust this to your liking. Note that the “soft” values should be adjusted to stop the table before the limit switches are ever engaged. Engaging a limit switch will cause the Mach 3 reset to become active and this requires an override operation to clear the Reset.

Motor Home/SoftLimits ✕

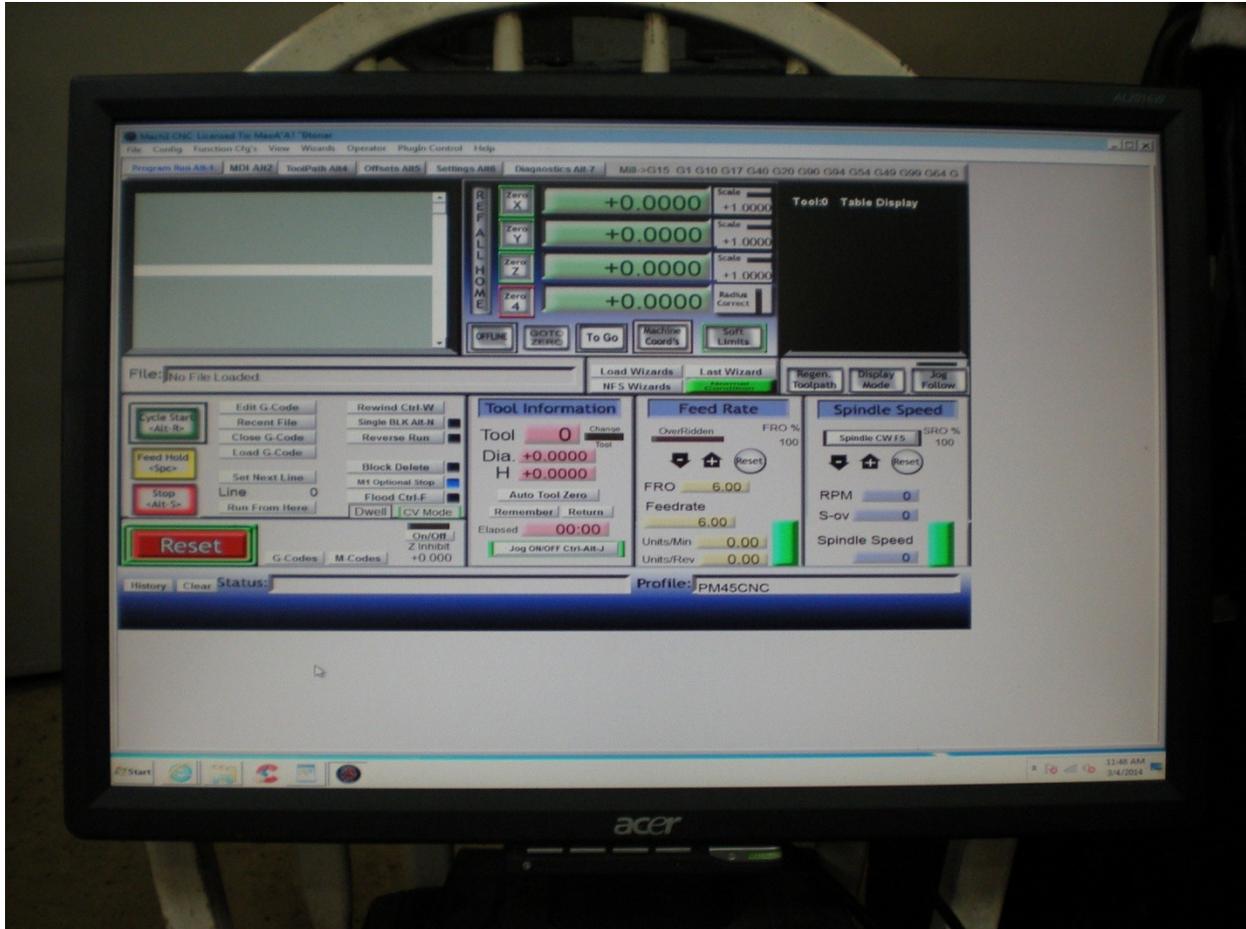
Entries are in setup units.

Axis	Reversed	Soft Max	Soft Min	Slow Zone	Home Off.	Home N...	Auto Zero	Speed %
X	✖	17.25	0.00	1.00	0.0125	✔	✔	75
Y	✖	7.75	0.00	1.00	0.0125	✔	✔	75
Z	✔	0.00	-12.50	1.00	0.0125	✖	✔	75
A	✖	100.00	-100.00	1.00	0.0000	✖	✔	20
B	✖	100.00	-100.00	1.00	0.0000	✖	✔	20
C	✖	100.00	-100.00	1.00	0.0000	✖	✔	20

G28 home location coordinates

X	<input type="text" value="0"/>	A	<input type="text" value="0"/>
Y	<input type="text" value="0"/>	B	<input type="text" value="0"/>
Z	<input type="text" value="0"/>	C	<input type="text" value="0"/>

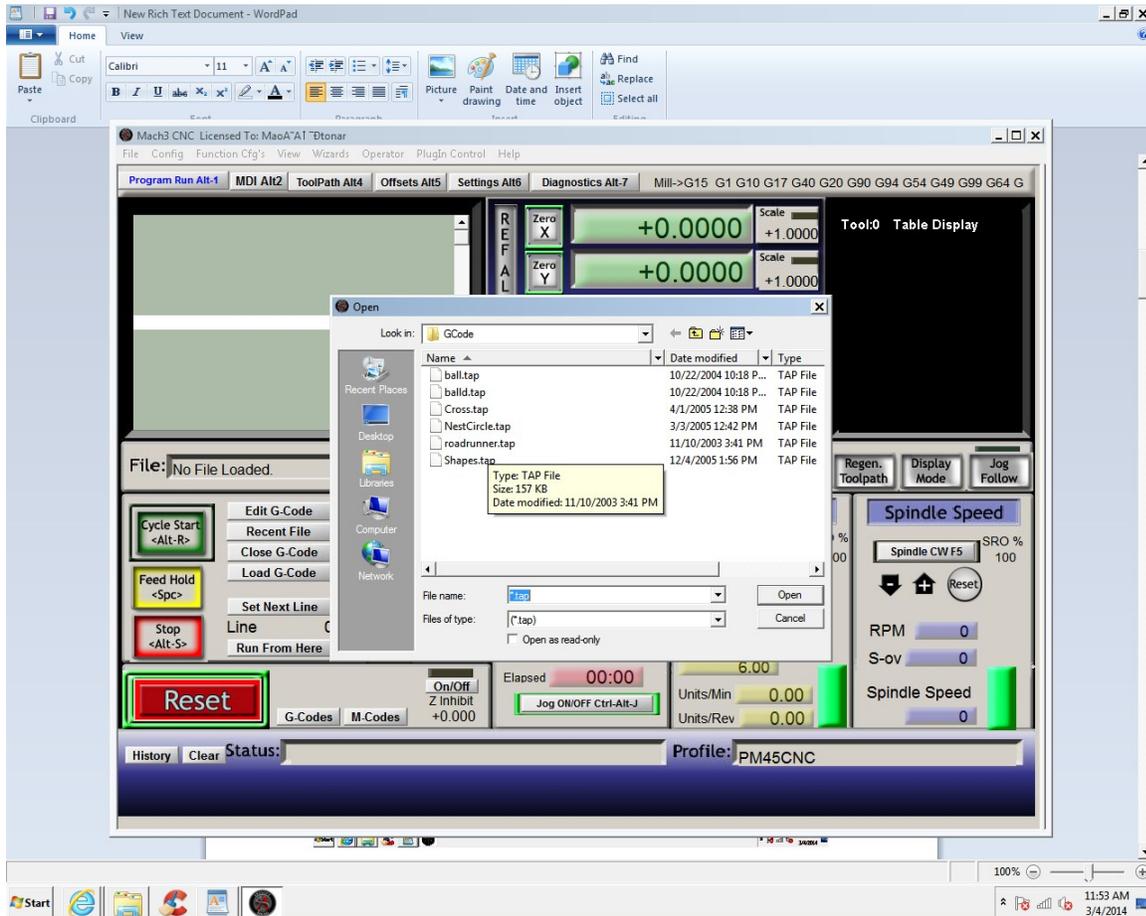
To verify proper setting of the table parameters, press the Reset button to stop any Reset conditions and press the REF ALL HOME button. The table will move to its new home location.



Load the roadrunner g code which comes as a sample with Mach 3.

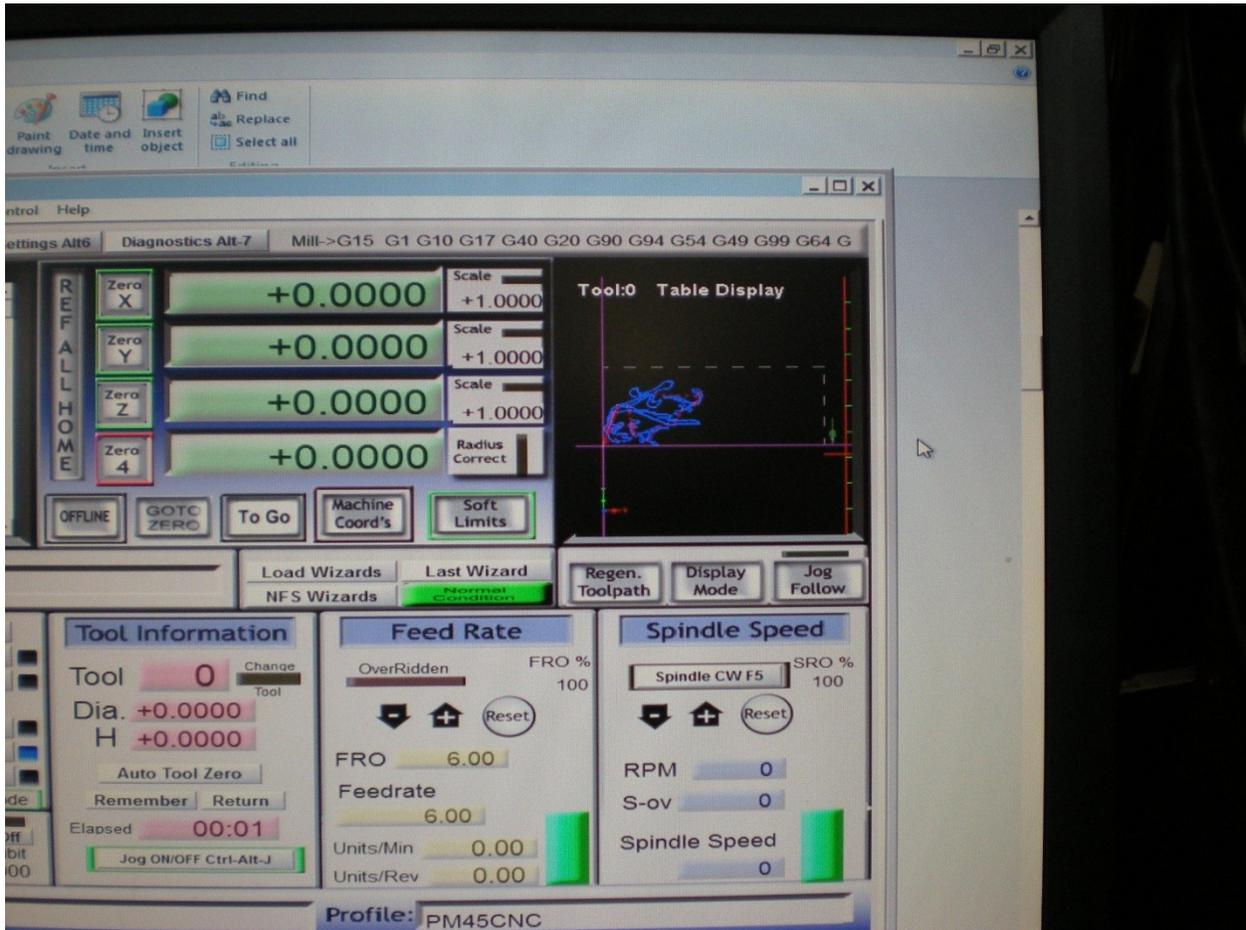
From Mach 3, Select: File->Load G-Code to see the following screen.

The roadrunner g-code is located under C:\Mach3\Gcode (note: this depends on where you installed Mach 3).



Once the program is loaded, press Display Mode to show “Table Display”. You will see the outline of the table and the G-code image at the new home location.

**Note:** With the mill head lowered to about 10” off the table, it is OK to run the roadrunner g-code.  
**WARNING:** Do not attempt to actually cut the pattern as, the code sample does not set spindle speeds appropriately for cutting any material.



This concludes the setup process of changing the factory default home table location.