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SOURCE - Axis Setup

Axis Setup

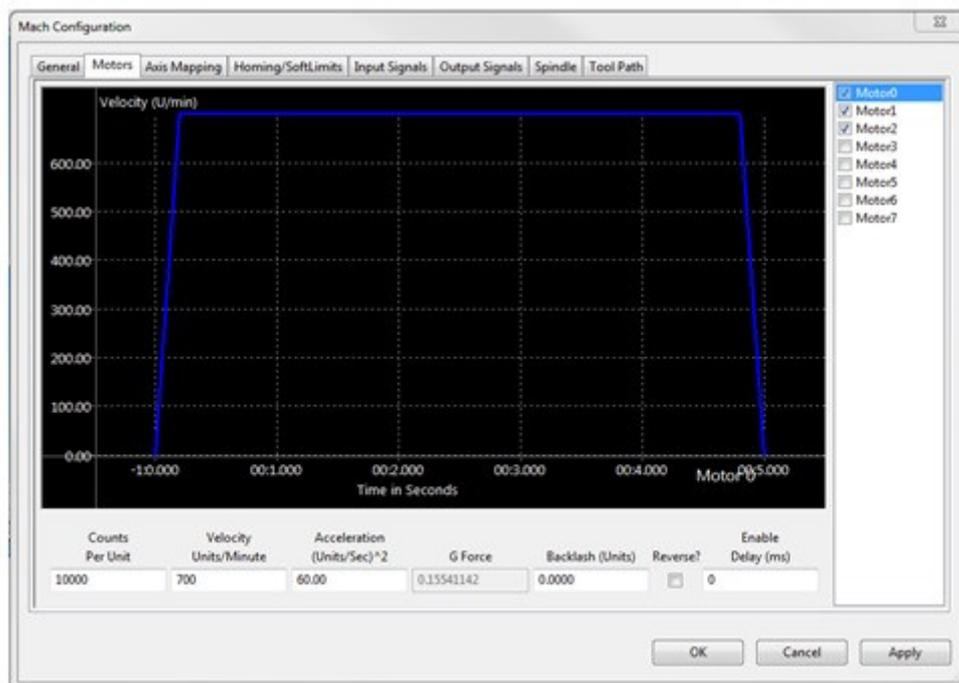
Enabling Axes

Note: This may already be setup depending on your system.

1. On the menu bar, click **Configure->Control**. Then select the **Motors** tab (pictured below).

If menu options are grayed out (not active/selectable), click the button to disable the system, then try again.

1. Enable all the motors that are to be controlled by setting the respective boxes in the right pane to checks. In the example below, motors 0, 1, and 2 are enabled.



Motor Setup

3. Press [**Apply**] to save any changes.
4. Next, select the **Axis Mapping** tab as pictured below. Associate the enabled motors to the applicable axis. In the below example, Motor0 is the X master, Motor1 is the Y master, and Motor2 is the Z master.

Mach Configuration							
General	Motors	Axis Mapping	Homing/SoftLimits	Input Signals	Output Signals	Spindle	Tool Path
	Enabled	Master	Slave 1	Slave 2	Slave 3	Slave 4	Slave 5
X (0)	✔	Motor0					
Y (1)	✔	Motor1					
Z (2)	✔	Motor2					
A (3)	✘						
B (4)	✘						

Axis Mapping

5. Press [**Apply**] and [**OK**] to save and close.

The system is now set up for motion, however,....

WARNING

The machine can be crashed very easily. No limits have been set up and the units have not been configured yet.

Axis Calibration

For the machine to move the correct distance, the axes need to be calibrated. To get the units perfect, they must be calculated automatically from the machine specifications. However, you can get them extremely close if you manually calibrate especially if you measure at greater distances of travel.

Go to **Configure-> Plugins -> Machine Calibration.**

If menu options are grayed out (not active/selectable), click the button to disable the system (Service Tab), then try again.

Select the type of configuration you would like to perform from the window:

1. Manual; Calculate the steps per by comparing distance traveled vs. distance commanded. See the next section for instructions.
2. Automatic; Calibrate motors using specifications of your motor type. Continue for instructions.
3. Screw Mapping; Calibrate motors using points on the ball screw.

Automatic Calibration

1. Select the type of configuration you would like to perform

1. Manual; Calculate the steps per by comparing distance traveled vs. distance commanded. See the next section for instructions.
2. Automatic; Calibrate motors using specifications of your motor type. Continue for instructions.
3. Screw Mapping; Calibrate motors using the wizard to map the ball screw.

2. Select the drive type of the axis being configured.
3. Select the max motor RPM.
4. Verify the correct drive ratio.

	Drive Type
	CTB
	Delta
	Yaskawa

Default Drive Ratio Value

MachMotion Plugin Calibration Calculator

5. Choose the machine configuration for the axis from the following three options.

- **Ball Screw**

- Enter the ball screw pitch

- Enter the ball screw pulley # teeth and motor pulley # teeth

Note: If the system has a pulley ratio and a gear box use this equation to get the total gear ratio: [Gear Box Ratio] x [Pulley Ratio] = [Total Gear Ratio] Ex: [10:1 Gear Box] x [30 Motor Pulley Teeth/15 Ball Screw Pulley Teeth] = [10] x [30/15] = [20 Total Gear Ratio](20 Motor Pulley Teeth, 1 Ball Screw Pulley Teeth)

- **Rack and Pinion - Pinion Diameter**

- Enter pinion diameter

- Enter the gearing ratio between the shaft and the motor

- **Rack and Pinion - Rack Pitch**

- Enter number of teeth on pinion

- Enter the rack pitch

- Enter the gearing ratio between the shaft and the motor

6. Select the axis to calibrate.

7. Press the [Calculate] button.

8. Choose [Accept] or [Ignore] to save or discard the changes.

9. Repeat starting at step 2 for each additional axis.

10. Press [OK] and restart the software to save the calibration settings.

Manual Calibration

Machine Manual Calibration

Calibration

Select Axis to Calibrate Current Steps Per

Axis Position

Axis Calibration

Configuring Using:

Jog Distance Commanded Distance

Distance to move axis units

Feedrate units/min

User Input

How far did the axis move? units

Axis will be set to steps per unit

Manual Calibration

1. Select **Manual Calibration** from the Machine Calibration Selector menu.
2. Select the axis to calibrate.
3. Select either Jog Distance or Commanded Distance.
4. Enable the system and either press [**Move**] or [**Record Jog**].
 - For Jog Distance mode, manually jog the axis a distance that can be accurately measured.
5. Measure how far the axis moved.
6. Enter in the distance the axis moved and press [**Submit**].
7. Choose [**Accept**] or [**Ignore**] to save or discard the changes.
8. Repeat this procedure until the axis is within the required accuracy.

If you want to adjust your velocity, select **Configure** on the top menu bar, then **Control**. Select the **Motors** tab as shown below.

<Insert Image>

Motor Setup

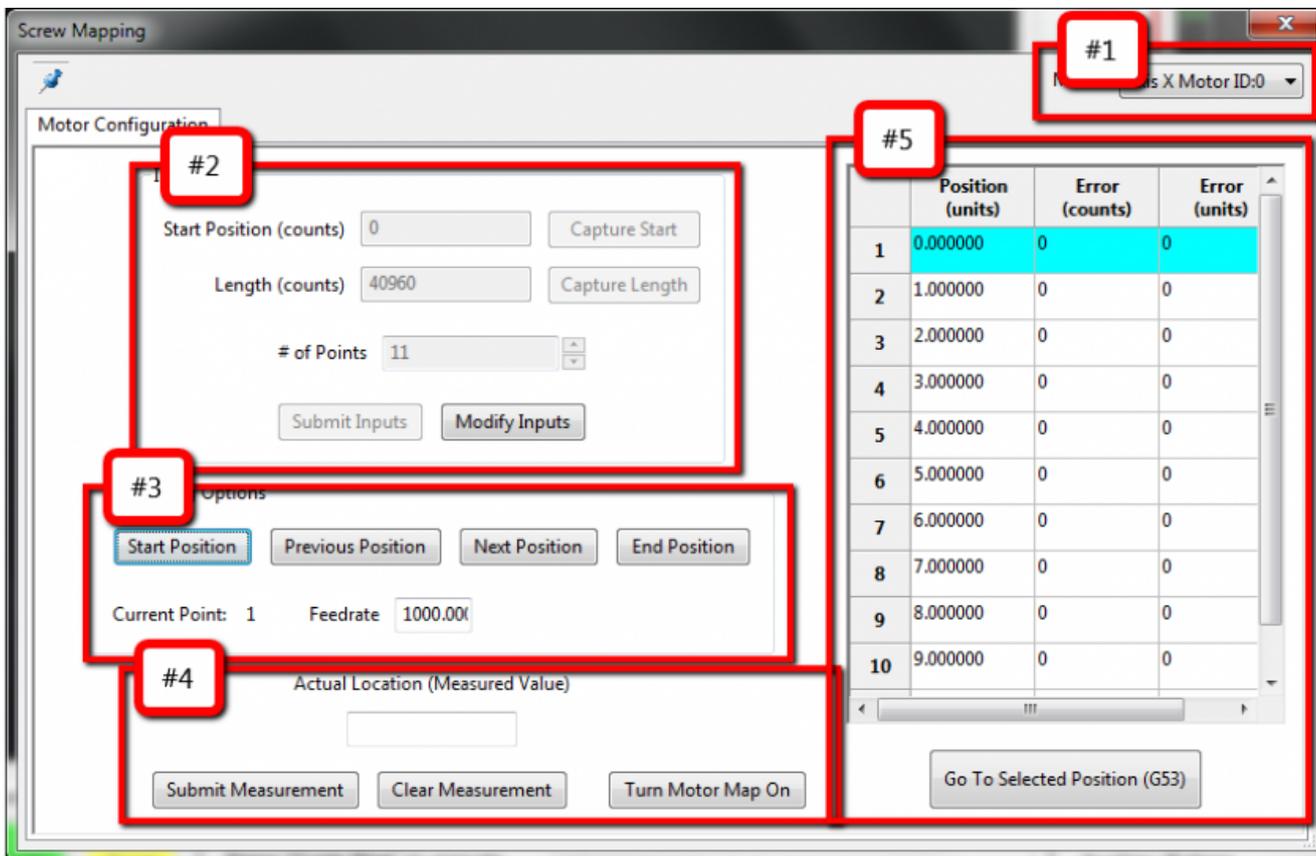
In the right pane, select the motor you want to set up. The selected motor's parameters will be loaded and the velocity or acceleration settings can be adjusted.

Press [**Apply**] before clicking on another motor or closing out the **Control Configuration** window.

WARNING

No limits have been set up. DEATH, INJURY or serious PROPERTY DAMAGE can occur if the system is not operated carefully.

Screw Mapping Calibration



Screw Mapping

#1 Motor

- o Select the motor to be calibrated
- o For gantry systems each motor of an axis can be individually mapped

#2 Positions

- o Set the mapping positions
- o If you want to modify the number of points or the start/end positions you have to redo the mapping

#3 Move

- o Use the [Start] and [End Position] buttons to send motor to end of travel
- o Use [Next Position] and [Previous Position] buttons to increment through points
- o "Feedrate" will be used to define the speed in units/min during each reposition move

#4 Enter Data

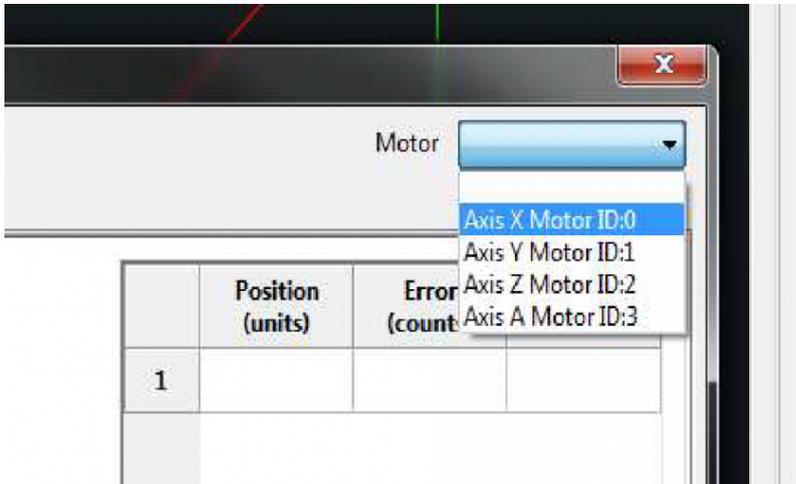
- o This field is where you will enter the true position from your measurement device
- o It is critical that the measurement device is zeroed at the start location

#5 View Data

- o From here you can see the mapped error in motor counts or system units
- o You can use the [Go To Selected Position (G53)] button to send the motor to any of the points at any time. This is useful after mapping for verification purposes

Set up Points

Select the axis to be calibrated



Jog axis to most negative side of travel

Note: If machine 0 (home) is on the positive side of travel then jog to far limit switch **away** from machine 0 (home)

Press [**Modify Inputs**] to configure mapping locations

Press [**Capture Start**] to record starting position

This is a good time to zero your measurement device (Laser or glass scale)

Jog axis to most positive side of travel

Note: This will be at the far other side of travel as the position set in the last step

Press [**Capture Length**] to record end position

Enter the number of points to map along the length of the screw

Note: If you are mapping each inch along a 10" screw you would enter 11 points. (one for 0" position)

Press [Submit Inputs] to save data points

Enter all error corrections

At this point you're going to move the axis to each of the locations and enter the measured position being reported by your measurement device (laser or glass scale) You will need to zero your measurement device at the start position before taking any measurements.

It is suggested that you start from the most negative side at the point you pressed [Capture Start] and zeroed your measurement device. (Note: The error for your first point should be 0.)

1. Press [Start Position]
2. Press [Next Position]
3. Type in the measured value to "Actual Location"
 - a.
4. Click [Submit Measurement]
 - a. Verify the "Error (units)" is less than half of the distance between "Position (Units)" (less than .5" in example)
 - i.
 - ii.
5. Repeat back to Step 2 [Next Position] until at last point

Backlash Calculation

MachMotion controls have backlash compensation. Use the MDI line to enter G-Code to move the axes. To calculate the machine's backlash, follow the steps below.

1. Move an axis in one direction farther than the maximum possible backlash.
2. Mount a dial indicator and zero it.
3. Move the axis again in the same direction for a specific distance (it doesn't matter how far).
4. Move the axis backwards the same distance.
5. Note how far the dial indicator was off from zero to see the axis's backlash value.
6. Backlash is configured in the Mach4 software located in Configure->Control->Motors Tab
7. Select the desired motor tab and enter the value (see explanation below). Select [OK] to save settings.

Backlash - This field sets the backlash amount in inches or millimeters, depending on the setup units.



Backlash

WARNING

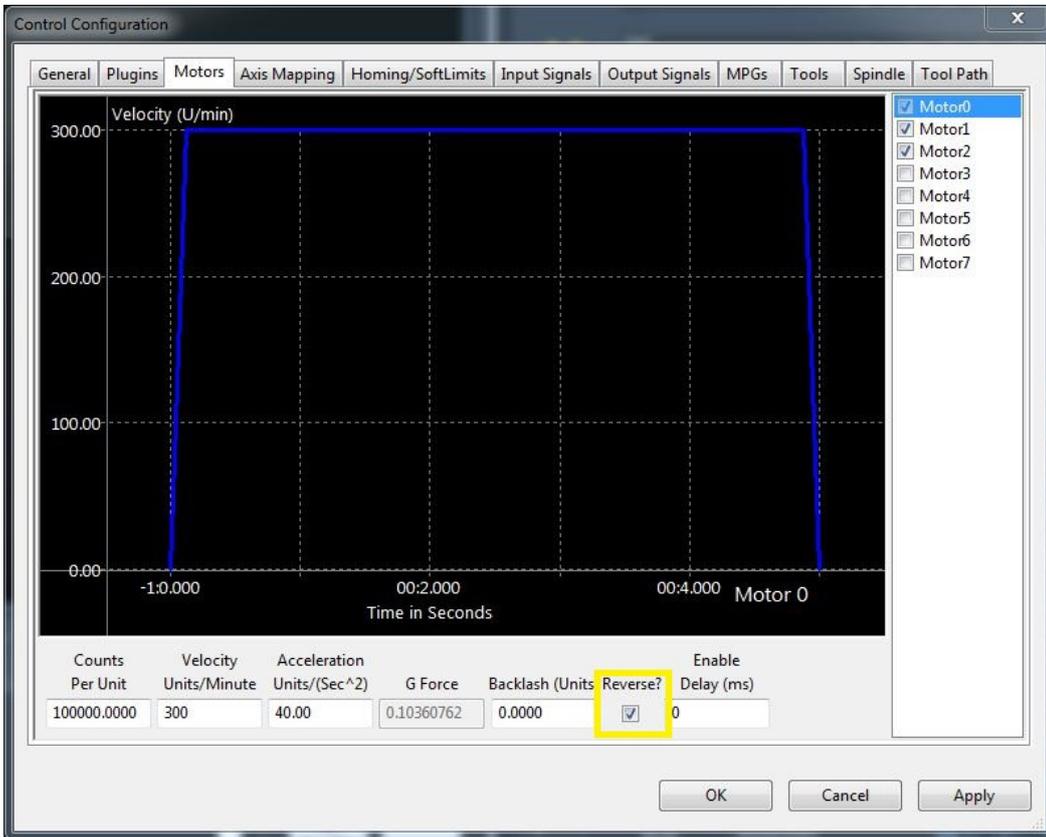
For best performance, backlash should be less than .0015 inches.

Reversing Direction

If a motor moves the wrong direction, it can be reversed in the software.

1. Navigate to the menu bar and click **Configure->Control** and select the **Motors**

The following window will come up:



Reverse Motor

2. Check the **Reverse?** box if the motor direction needs to be reversed.
3. After making all the changes, press **[OK]**.

The motor will now move the opposite direction than it did before.

Slaving a Motor

To configure a motor as a slave, follow the steps outlined below.

1. Click **Configure->Control** on the main menu bar and select the **Axis Mapping**
2. Select the motor from the dropdown menu for the axis that the motor will be slaved to. Each enabled axis must have one master and up to 5 slave motors. For example, the configuration below is used to slave Motor3 to Motor0 on the X axis.

insertimage Figure 18 Motor3 slaved to Motor0

3. Press [**OK**] to save changes.

SOURCE - MachMotion Logo



SOURCE - Spindle Setup

Spindle Setup

Wiring a Spindle

VFD from MachMotion

The process for setting up a VFD from MachMotion is extremely simple.

VFD Other Than from MachMotion

Any VFD can be wired into the Spindle Control RJ45 jack by cutting the end off of a CAT5 cable and wiring the loose ends to the VFD according the following pin out.

Function	Analog 0-10VDC	CW Relay	CW Relay	Drive Enable	GND	N/C	CCW Relay	CCW Relay
RJ45 Pins	1	2	3	4	5	6	7	8
Colors (T-568B)	White & Orange	Orange	White & Green	Blue	White & Blue	Green	White & Brown	Brown

No VFD

Figure 21 No VFD Spindle Wiring

Spindle Configuration

Spindle Range Setup

For the control to know how to scale the analog voltage output, the maximum RPM for the spindle motor must be defined. If the machine has different ranges, the software can have multiple maximum speeds. The software uses a different range for each different speed configuration.

For example, one range could be set as 75 to 300 RPM for a low speed. A medium speed range could go from 300 to 1200 RPM and high speed range could run from 1200 to 2400 RPM. The control will output 10V when the MaxRPM is called for any speed range.

To define the range(s), go to **Configure->Control**. Select the **Spindle** tab as shown below.

Pulley Speed Setup

Enter in the maximum and minimum speeds for each range. The accel and decel time should also be defined for each range (seconds to max rpm). Press [**OK**] to save changes.

Note: Only set up multiple ranges if the machine has different gears/pulleys.

Note: If the spindle is turning the wrong direction check the reversed box in the applicable range.

The ranges can be changed from the control by using M40-M45. The macros can be used to just change ranges or they can be used to automatically change gears on the machine. To shift the machine range 0, run M40. M41 is range 1, M42 is range 2, and so on.

Turning on the Spindle

To control the spindle use the following M-Codes with an S word for spindle RPM in the MDI line (Ex. M3 S2000).

M-Code	Function
M3	Clockwise
M4	Counterclockwise
M5	Stop

Table 5 Spindle M-Codes

If the spindle is not running correctly at this point some settings may need to change inside the VFD. In this situation, reference the VFD manufacturer manual.

Note: See the Mitsubishi VFD Installation Guide for setup information if it was purchased from MachMotion.

SOURCE - Limits and Homing _ Configuring Signals

Configuring Signals

To set up and wire 24V limit/home switches, follow the steps outlined below.

1. On the menu bar at the top of the screen select **Configure->Control**. Select the **Input Signals**
2. Scroll down through the list until you find the different motor sections (Home, -- , and ++). The example image below shows the inputs scrolled down to the motor home section. Further down is ++ and --.

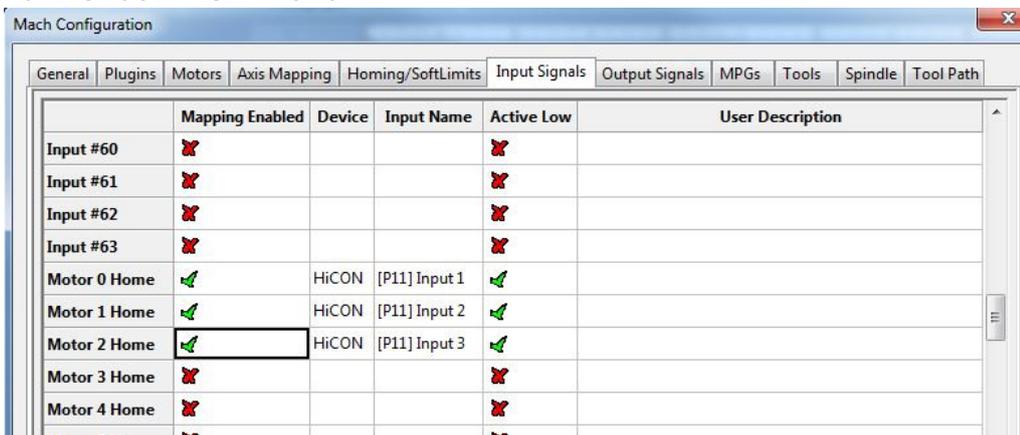


Figure 24 Input Signals

3. Enable the limit and home switches by clicking the red [X] (in the **Mapping Enabled** column) by the signal to make it a green check.
 - Note: Each motor has three signals, the max travel (motor ++), the min travel (motor --), and the home (motor home). All three must be enabled and set to the correct device and input name for everything to work correctly using the wiring description above.
4. Set the device and input name to the desired input.
5. Set up the active low checkbox to a green check for a normally closed switch.
 - Note: Under the active low column the active state can be changed by clicking on the [X] or check mark. If the limit switches are normally open the red X should be used. However, this is not recommended as it is not as safe.
6. When the limit and home switches for each motor are completely configured, press [**Apply**] and then [**OK**].

In the example above, motor 0, 1, and 2 home switches are enabled. All of them are wired normally closed. The device and input name for motor 0 is **HiCON [P11] Input1 (X1)**. Since the switches

for each motor are wired in series, the motor ++ and motor -- signals lower down in the list would also have the same corresponding device and input names. Manually trigger each limit switch and make sure they disable Mach before continuing.

SOURCE - Limits and Homing

_ Soft Limits Setup

Soft Limits Setup

With machine homed correctly and soft limits set, the machine will not hit a physical limit switch. If at any time a command is made for the machine to move outside of the soft limits (while they are enabled), an error will appear in the status line and motion will stop. To set up the soft limits, follow the procedure outlined below.

1. Home the machine.
2. Select **[Viewing Part]** so that the DRO's are orange. The button label will change to **[Viewing Machine]**.

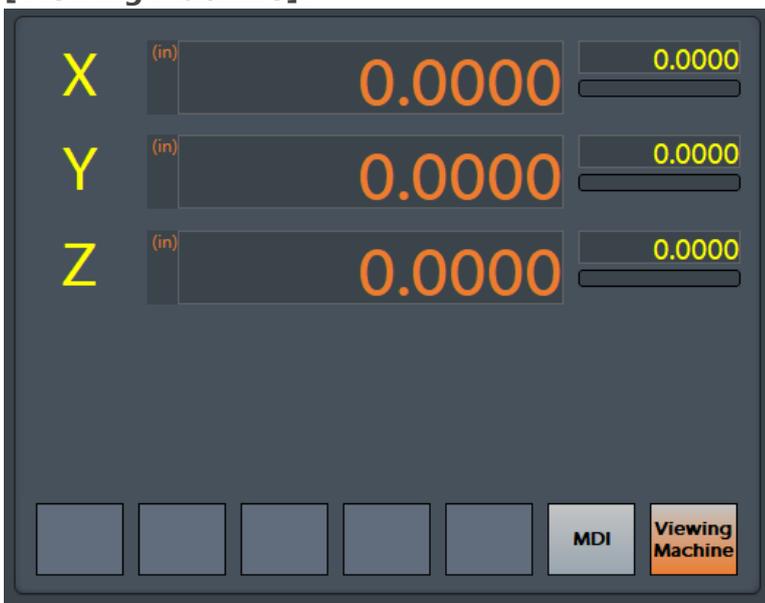
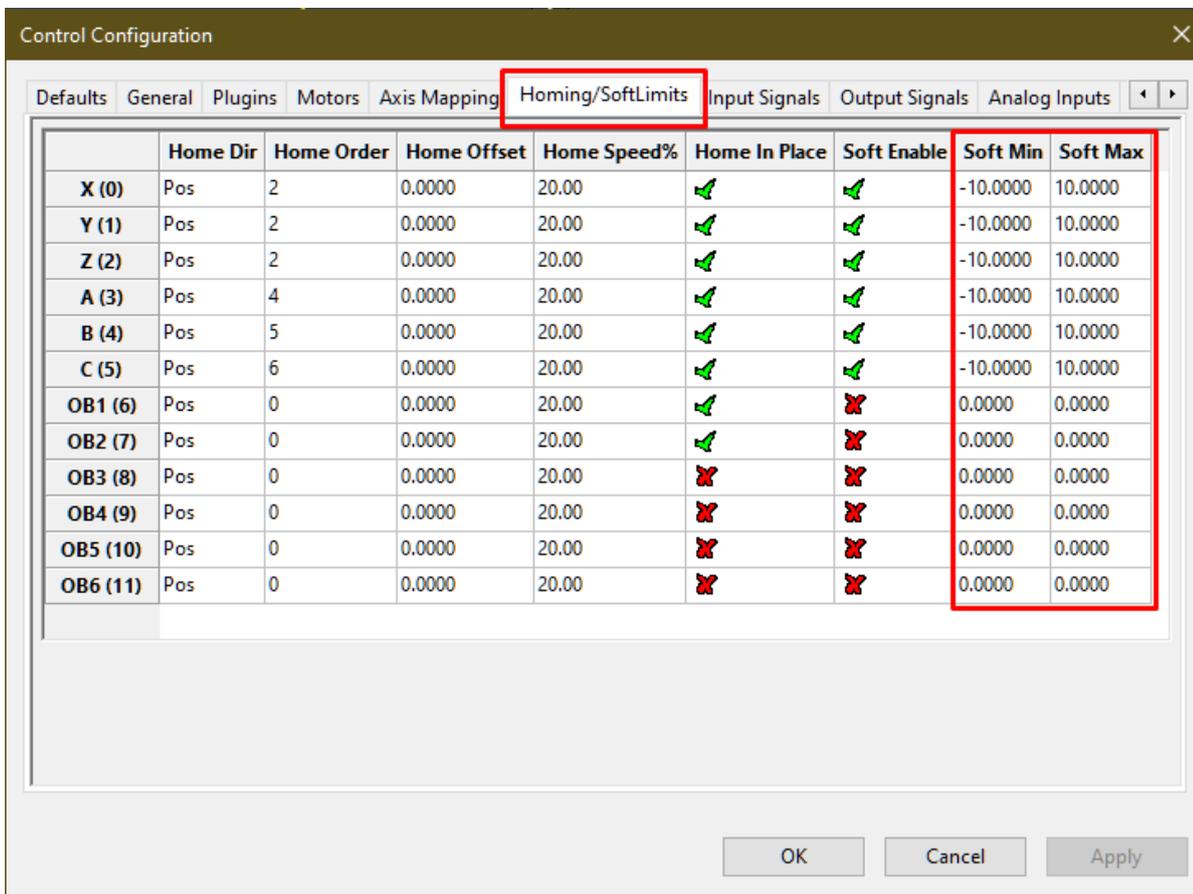


Figure: Machine Coordinates

3. Jog the machine to the maximum distance from the homing switches.
 - *Note: Make sure to stay inside the physical limit switches. If the machine is jogged outside of the limit switches, it completely defeats the purpose of soft limits.*
4. Record the machine coordinates at the end of the travel.
5. On the service tab, disable both the machine and soft limits.
6. Open the menu bar and click **Configure->Control** and select the **Homing/SoftLimits** tab as shown below.



7. Enable soft limits on each desired axis and enter in the recorded values.
 - *Note: If the value is positive, place it into the Soft Max limit and set the Soft Min limit to zero. Otherwise, with a negative value, set the Soft Max to zero and the Soft Min to the recorded value.*
8. Press [OK] to save changes. Test the soft limits by jogging the axes to maximum amounts in all directions.

Note: When loading a G-code file, the tool path display will show the soft limits as dashed lines. If any part of the tool path renders outside the soft limits, check your file.

SOURCE - Warranty Information

Warranty Information

MachMotion warranty policy is subject to change. Updated information is available at our website:

<https://machmotion.com/warranty>

The MachMotion Team

<http://www.machmotion.com>

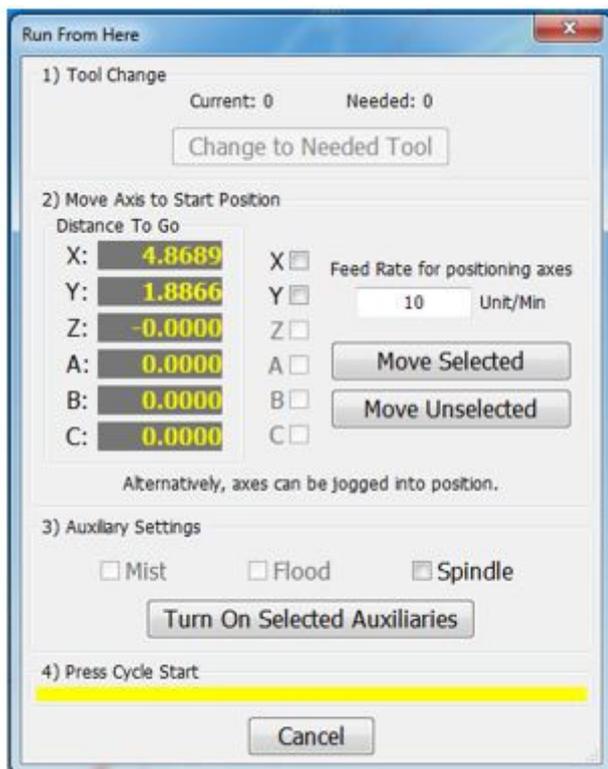
14518 County Road 7240, Newburg, MO 65550

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SOURCE - Run From Here

Run From Here\File Resume:

1. Use the Up/Down arrows in the gcode file window to select the line to start from
2. Press the **[Run From Here]** or **[File Resume]** button
3. Select the **[Change to Needed Tool]** button if applicable (See Image Below)
4. Enter desired value in the Feed Rate field (See Image Below)
5. Select axis to move and press **[Move Selected]** button (See Image Below) to move the axis into position
6. Select desired Auxiliary Settings and press **[Turn On Selected Auxiliaries]** button
7. Press **[Cycle Start]** to begin the file at selected starting line File Resume - If selected this will start the program at the selected gcode line and resumes the file



SOURCE - Emergency Stop Warning

WARNING!!

Estop Connctions should not have any voltage connected to this circuit. If voltage is applied it will damage components and void warranty.