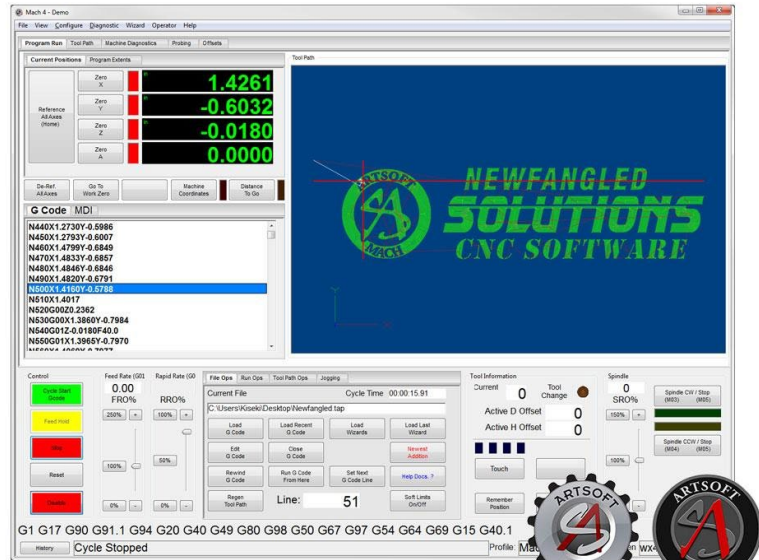# SOFTWARE

Mach4

Mach4

Graphical interface to control machine

Interpret G code

Mill, lathe, router, plasma cutter, laser cutter.

Calculate trajectory of tool

Communicate moves to motion control.

Motion control

Ethernet Smoothstepper

Converts commands from Mach4
into stepper motor pulses.

3

Set up PC

Mach4 requires a PC running Windows 10 or 11. Use common windows setup, no extra software is needed, or desired, this PC should only be used as a machine control.

Install Mach4 from memory stick, Or download file from downloads tab at https://machsuspport.com

Also requires a plugin from Warp9 tech on the memory stick or Download from https://warp9td.com

Documents

Mach4 provides many manuals when installed

`C:\Mach4Hobby\Docs`

The ESS has many pages of on-line documentation

`https:\\Warp9td.com`

This document is a simplified guide to the installation.

If questions arise see the above sources.

Mach4 Profile

A PC can be setup to run several different machines.

Each machine has a separate configuration appropriate to that machine.

The configuration is saved in a folder `C:\Mach4Hobby\Profiles`

When installing Mach4 you will be asked for a profile. Create a meaningful name.

In the sample screens here we used `MyLathe` as profile name.

DO NOT use one of the system profile names, it will be overwritten if you upgrade the software.

Optional profile

We have provided a profile suitable for the LMS 5100

We called it MyLathe.

A copy is on the memory stick.

Copy the file from the stick and put it in the profile folder.

`C:\Mach4Hobby\Profiles`

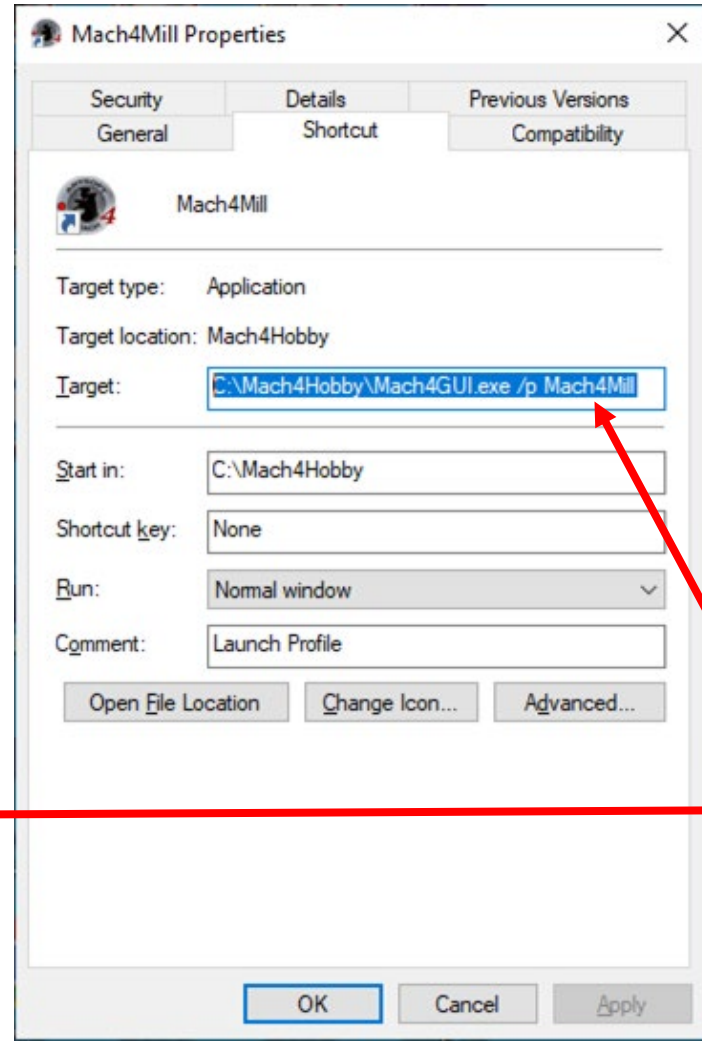All of the following configuration steps are completed in this profile.

Profile (2)

The Mach4 install will create some desktop icons.

Right click on the icon for Mill.

Select Properties

The Target line will have the start command for Mach4, followed by the profile name. Edit this to the name you have given your profile.
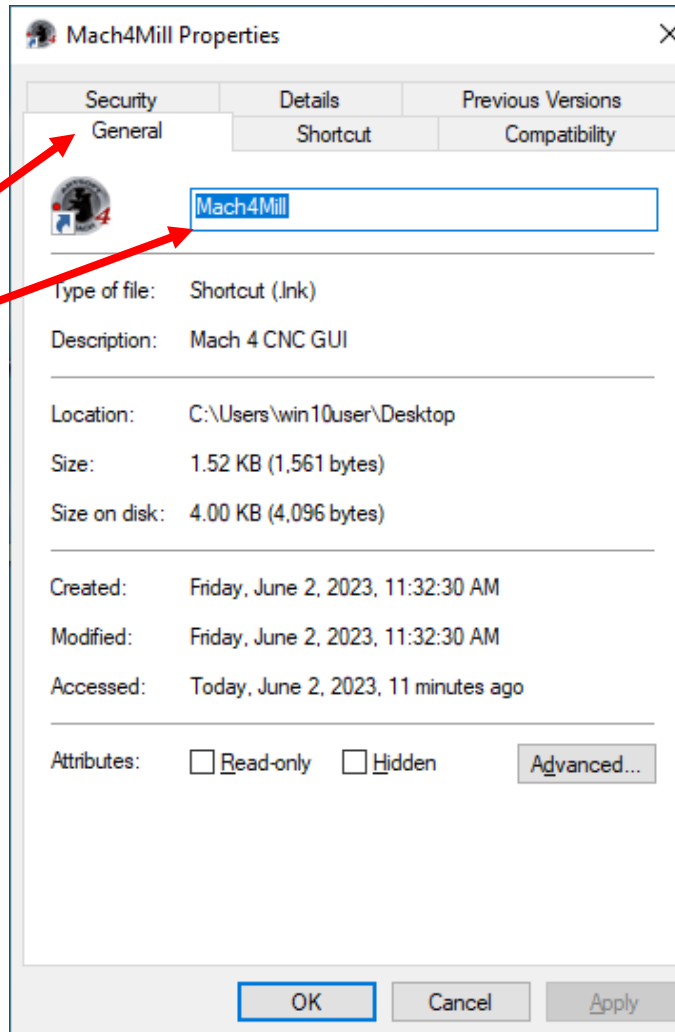
You can now start Mach4 with a double click

Mach4Mill Properties ✕

Security	Details	Previous Versions
General	Shortcut	Compatibility

Mach4Mill

Target type: Application

Target location: Mach4Hobby

Target: C:\Mach4Hobby\Mach4GUI.exe /p Mach4Mill

Start in: C:\Mach4Hobby

Shortcut key: None

Run: Normal window

Comment: Launch Profile

[Open File Location] [Change Icon...] [Advanced...]

[OK] [Cancel] [Apply]

Profile (3)

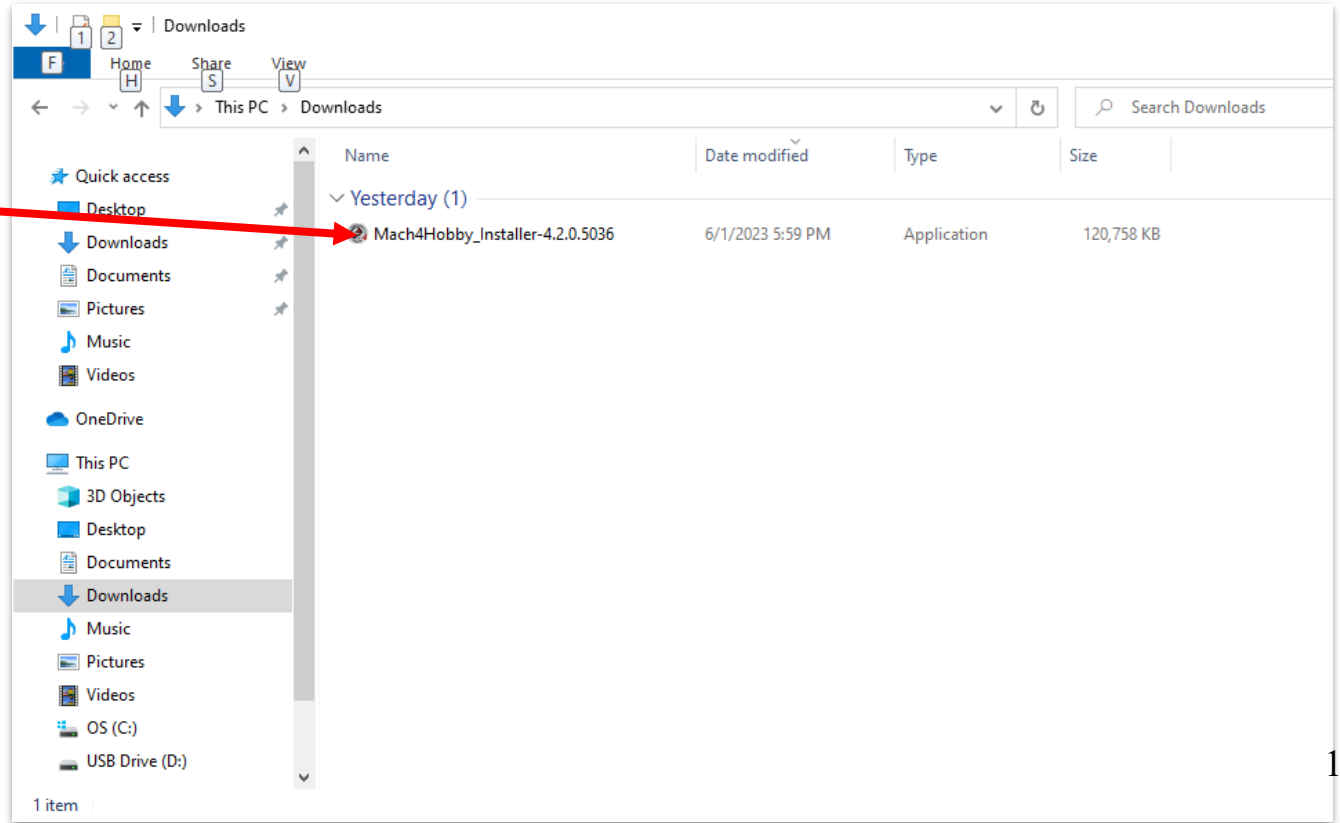Change to the General tab

Replace the name with your profile name.

Needs new image

Mach4 Install

Find the install file.

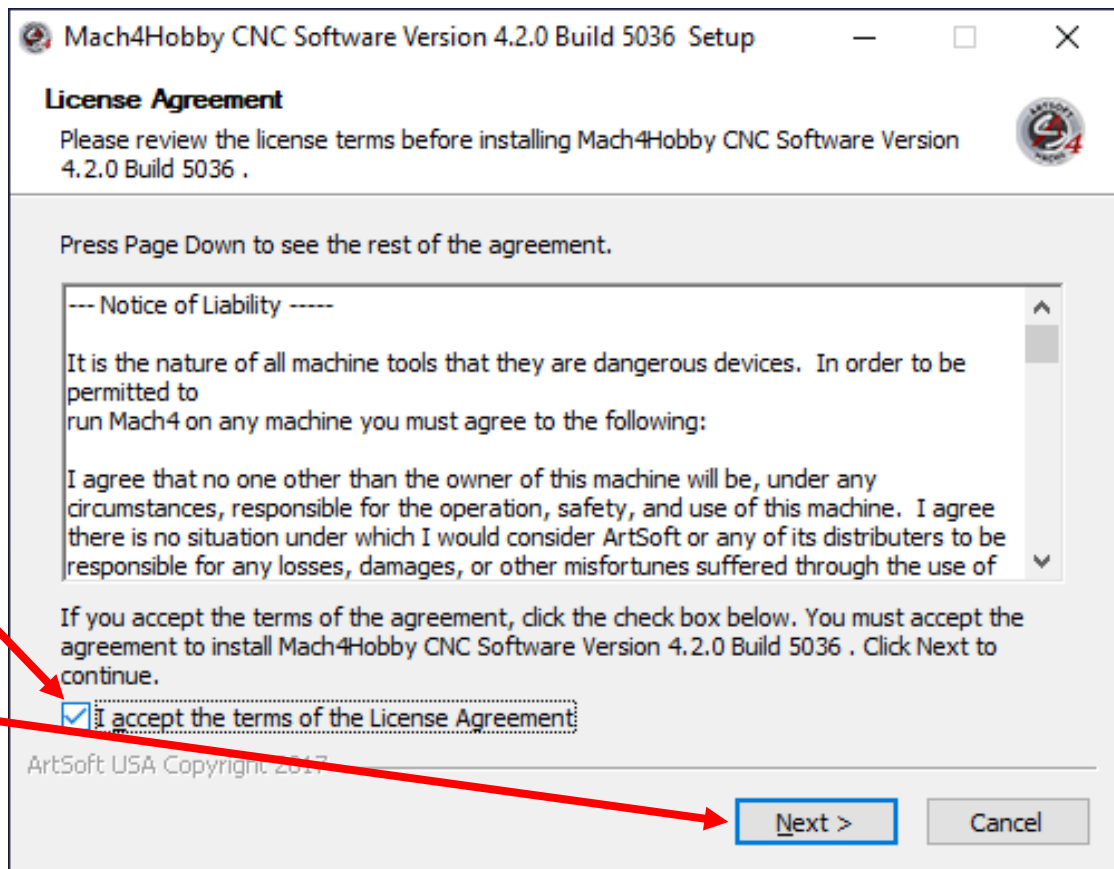Double click it.
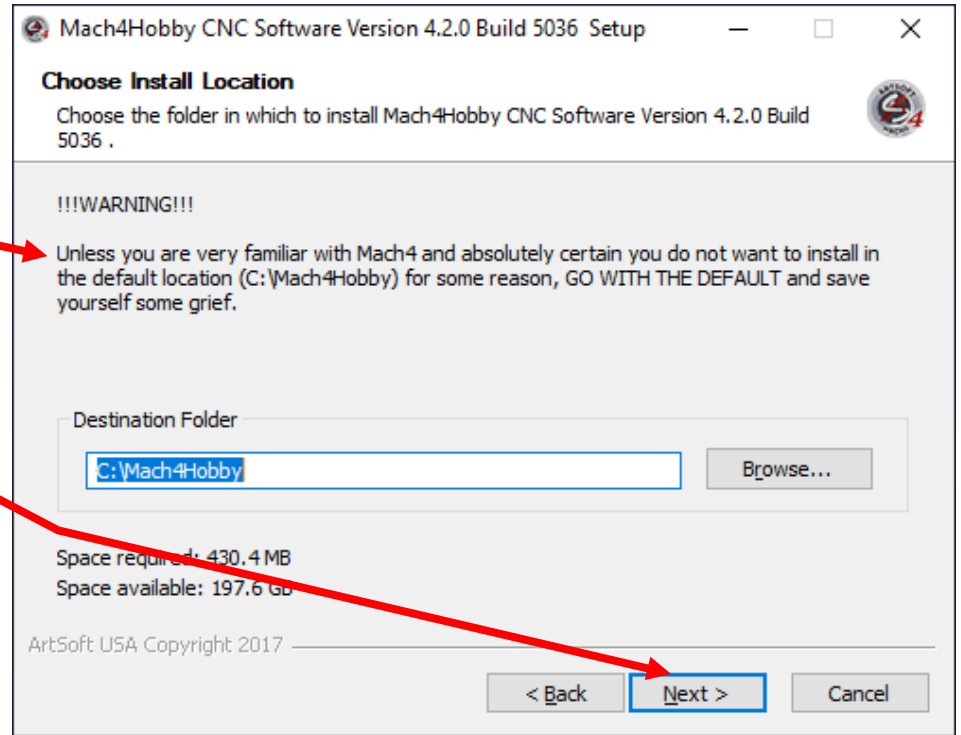
Mach4 Install

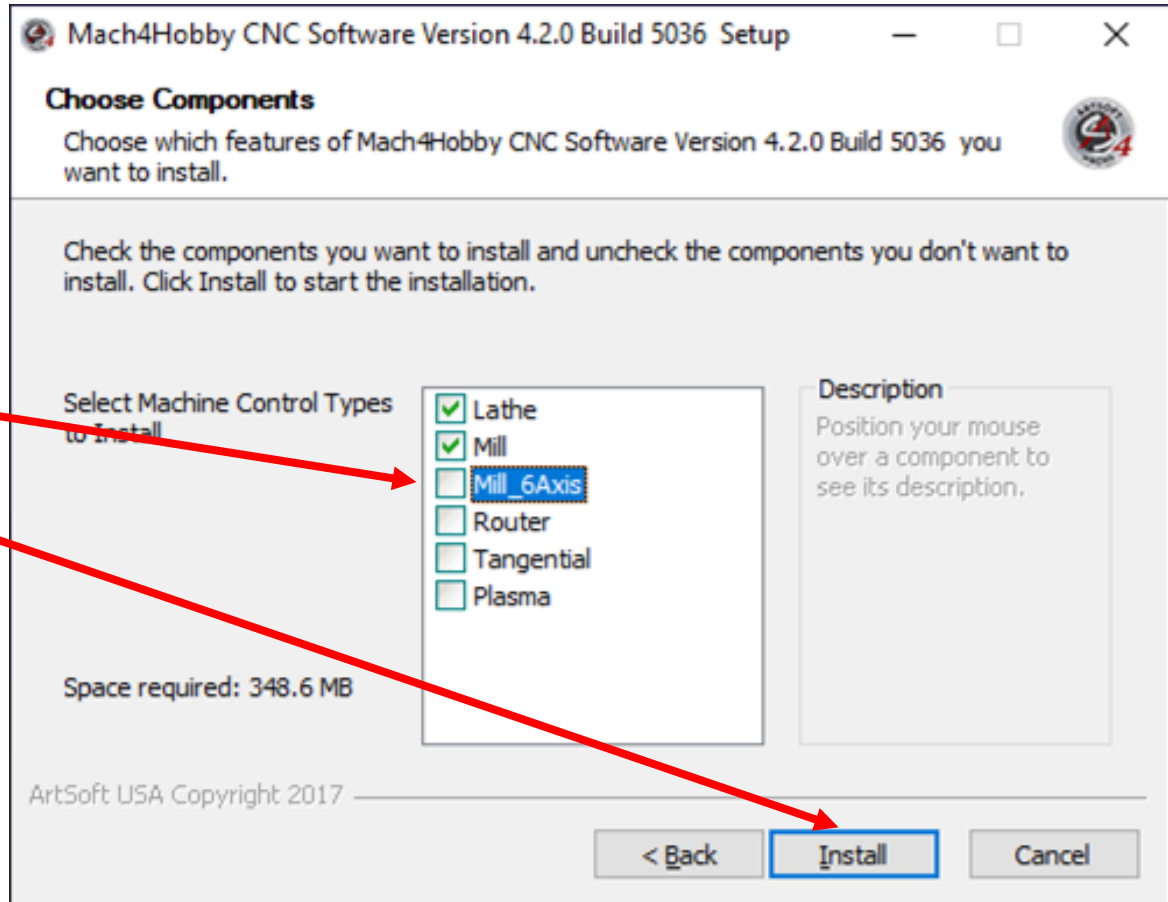Check to accept license terms

Click Next

Mach4Hobby CNC Software Version 4.2.0 Build 5036 Setup

License Agreement

Please review the license terms before installing Mach4Hobby CNC Software Version 4.2.0 Build 5036 .

Press Page Down to see the rest of the agreement.

--- Notice of Liability -----

It is the nature of all machine tools that they are dangerous devices. In order to be permitted to
run Mach4 on any machine you must agree to the following:

I agree that no one other than the owner of this machine will be, under any circumstances, responsible for the operation, safety, and use of this machine. I agree there is no situation under which I would consider ArtSoft or any of its distributers to be responsible for any losses, damages, or other misfortunes suffered through the use of

If you accept the terms of the agreement, click the check box below. You must accept the agreement to install Mach4Hobby CNC Software Version 4.2.0 Build 5036 . Click Next to continue.

☑ I accept the terms of the License Agreement

ArtSoft USA Copyright 2017

Next >   Cancel

Mach4 Install

Observe the warning message!

Click Next

Mach4Hobby CNC Software Version 4.2.0 Build 5036 Setup

Choose Install Location

Choose the folder in which to install Mach4Hobby CNC Software Version 4.2.0 Build 5036 .

!!!WARNING!!!

Unless you are very familiar with Mach4 and absolutely certain you do not want to install in the default location (C:\Mach4Hobby) for some reason, GO WITH THE DEFAULT and save yourself some grief.

Destination Folder

C:\Mach4Hobby   Browse...

Space required: 430.4 MB
Space available: 197.6 GB

ArtSoft USA Copyright 2017

< Back   Next >   Cancel

Mach4 Install

UnCheck type of machines you are not using.

Click Install

Mach4Hobby CNC Software Version 4.2.0 Build 5036 Setup

Choose Components
Choose which features of Mach4Hobby CNC Software Version 4.2.0 Build 5036 you want to install.

Check the components you want to install and uncheck the components you don't want to install. Click Install to start the installation.

Select Machine Control Types to Install

- ☑ Lathe
- ☑ Mill
- ☐ Mill_6Axis
- ☐ Router
- ☐ Tangential
- ☐ Plasma

Description
Position your mouse over a component to see its description.

Space required: 348.6 MB

ArtSoft USA Copyright 2017

< Back   Install   Cancel

13

Mach4 Install

Wait for progress bar

Mach4 Install

Click Finish

Mach4 Install

Mach4 will start and show the profile select screen.

Select Your profile then Copy

Click OK

Screen Set

Mach4 has a built in screen editor

You may use it to modify any part of a screen

You may add or remove buttons.

You may change colors or type fonts.

You may add controls.

Screens can be fully customized, but start with one of the pre-built screens

You may switch screens at any time during operation.

17

Mach4 Install

Copy profile will ask for screen choice.

Select wxLathe set for Lathe

Click "Open"

18
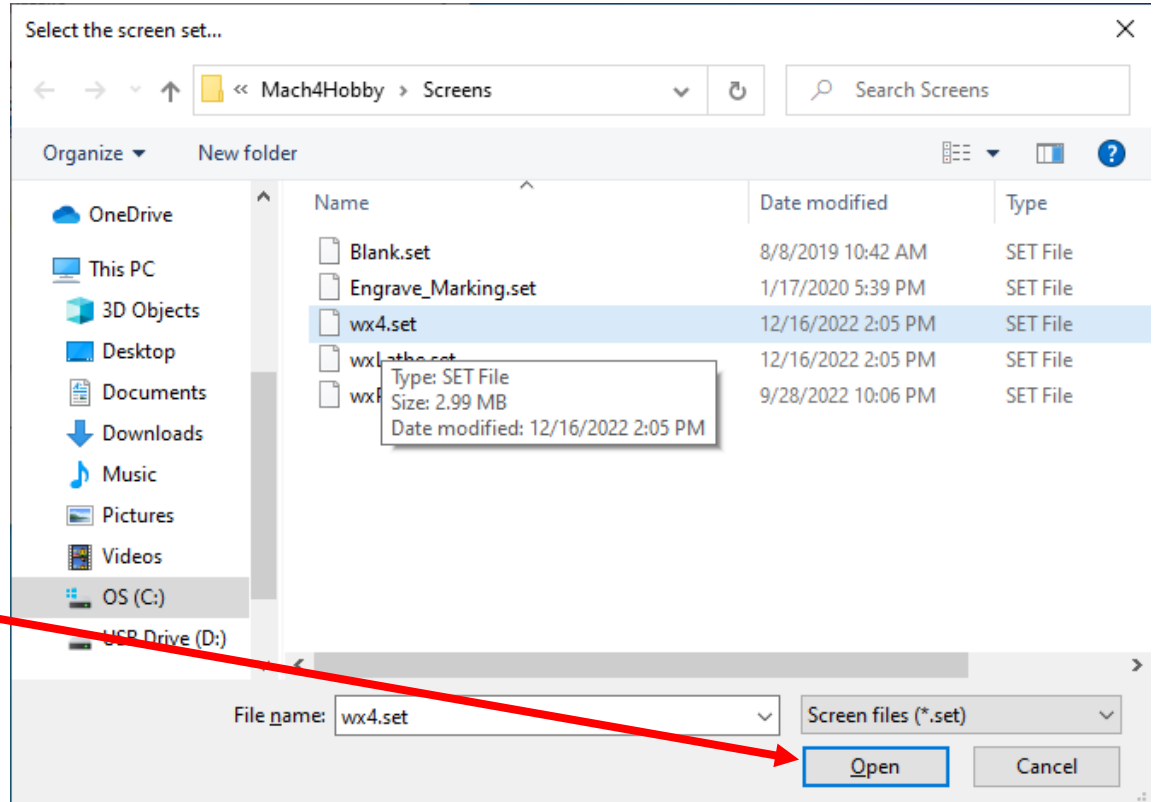
Mach4 Install

As Mach4 Starts it will try to use some internal network functions.

Windows will show this block warning.

This will only happen on the first time start up.

Allow access
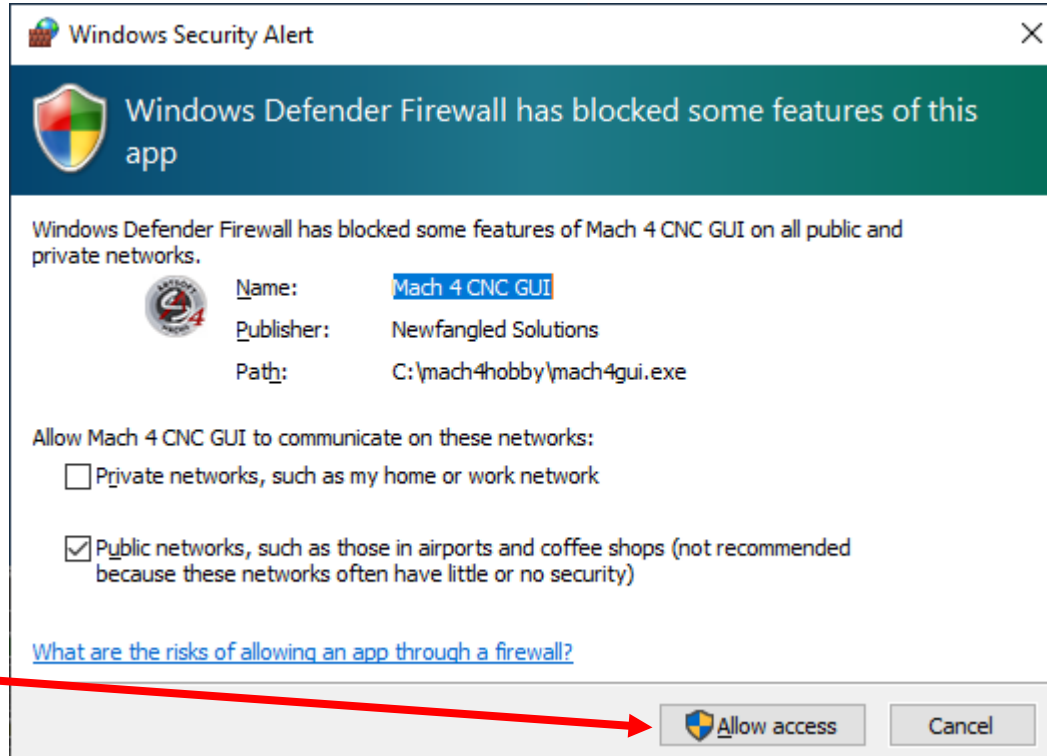
Mach4 Install

SUCCESS! Mach4 is installed.

Before we can run we need to install a plugin for motion control.

Stop Mach4 with the X
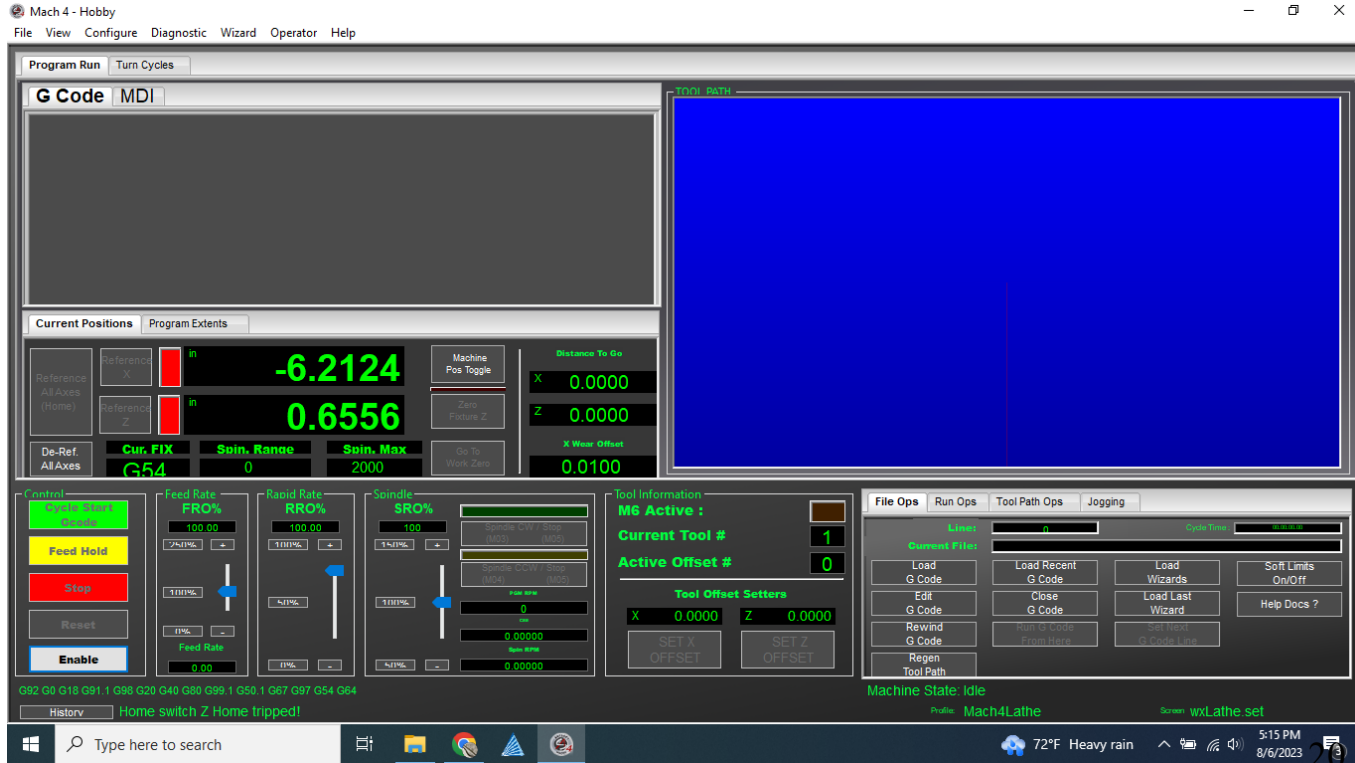
Mach4 Install

Mach4 will build a screen icon for each machine type you selected.

Convert one of them to be your profile.

Right click on the icon and select Properties
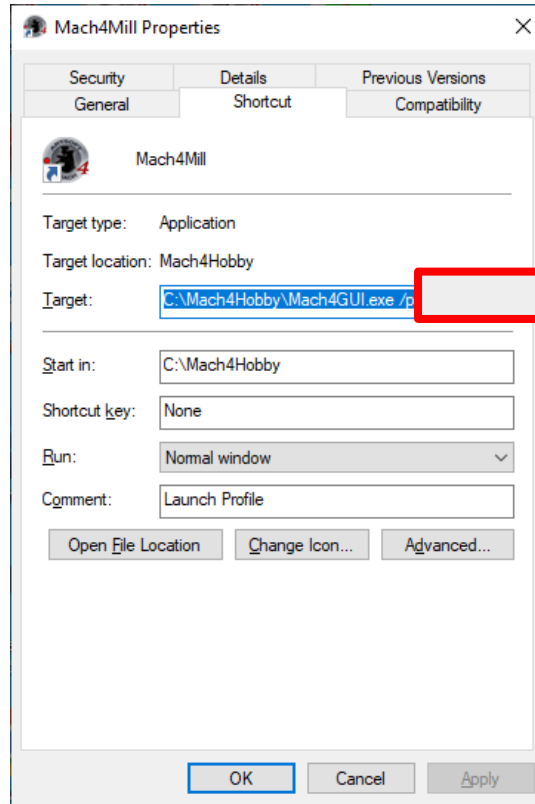
Change the profile name to the profile you created.

Mach4 Install

Change to the
General tab

Change the name to
your profile name

Click OK

The desktop icon will
now start Mach4 with
your custom profile.
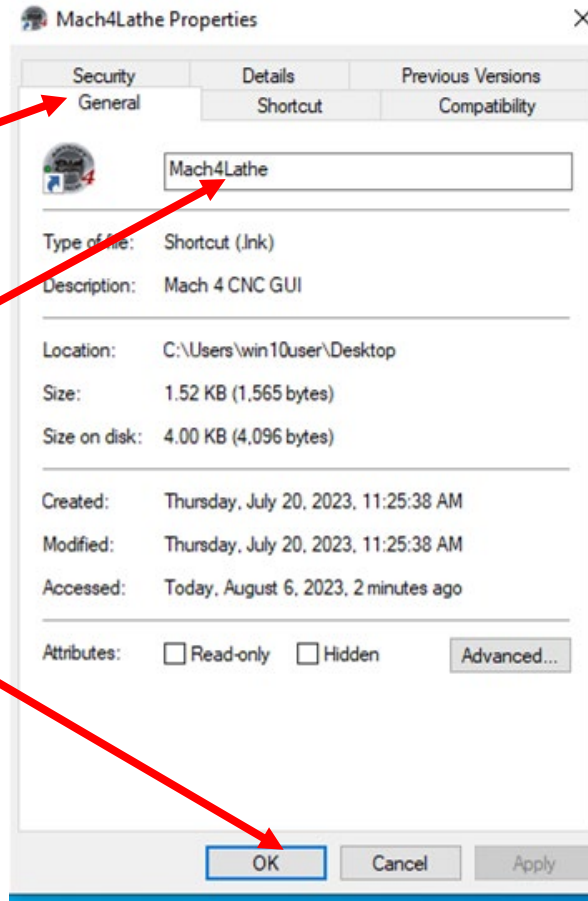
ESS- Ethernet Smooth Stepper

The motion control- ESS- requires a software driver, called a plugin.

It is supplied on the memory stick with this system.

To check for a newer version look at https://warp9td.com/

Download the .zip file **ESS_Mach4_v298.zip**

298 indicates the version number.

Open the .zip file and copy the two files

ESS plugin install

Using File Explorer navigate to c:\Mach4Hobby\Plugins

Paste the two files into this folder

Warp9Mach4.sig

Warp9Mach4.m4pw
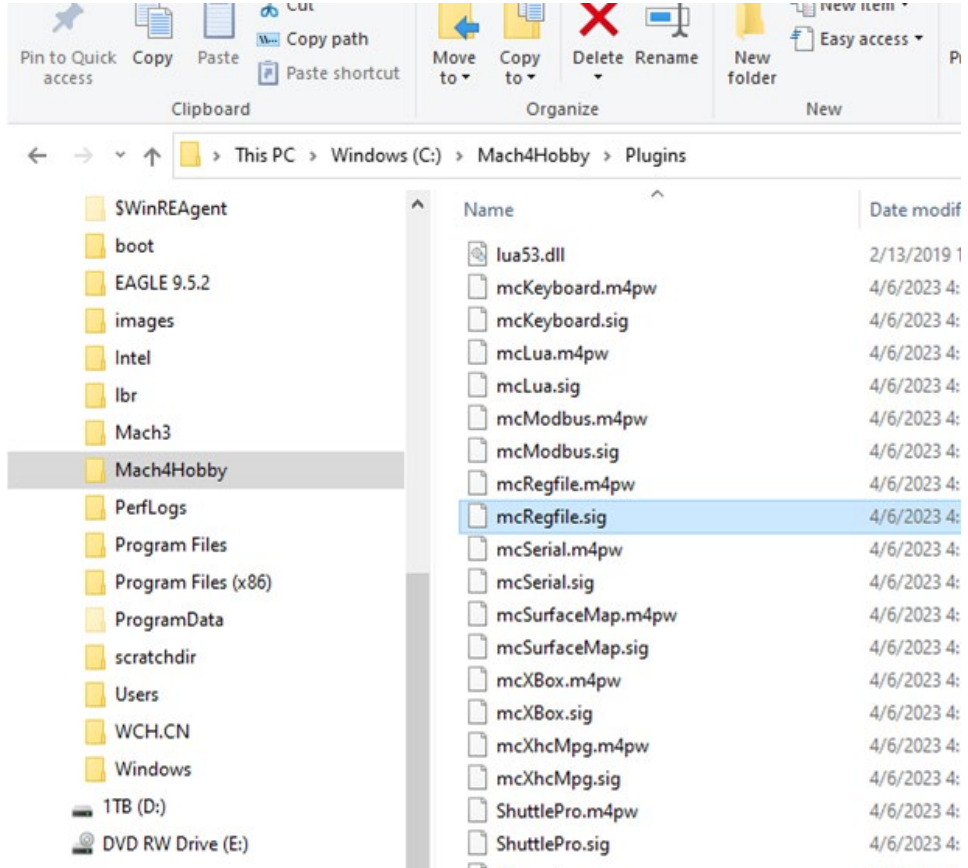
Mach4 Install

Double click your profile Mach4 icon

When Mach4 starts select the *configure* menu bar item

Select Control
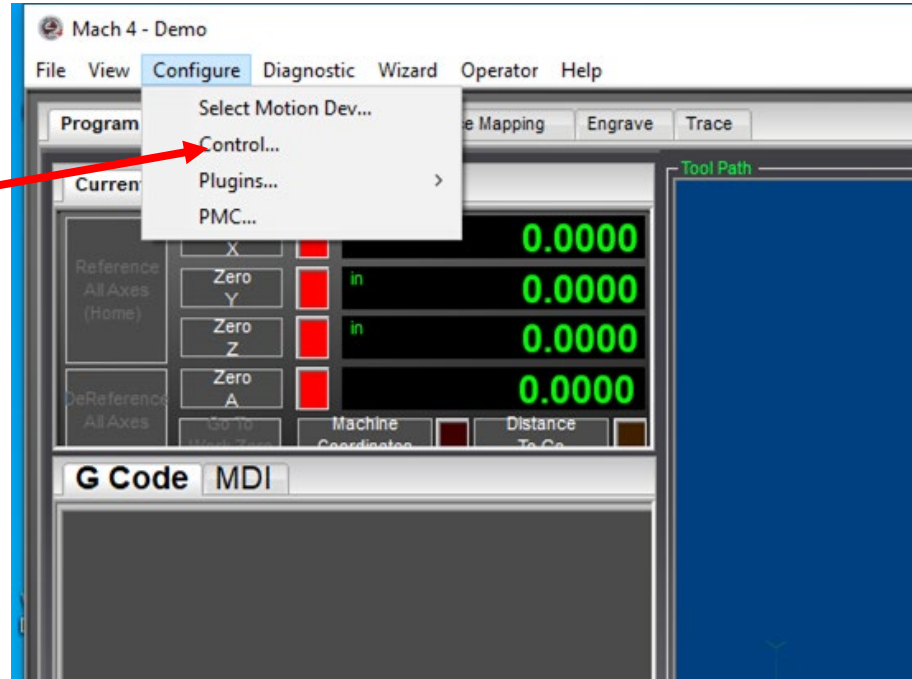
Mach4 Install

Select the ESS plugin

Click OK

Shutdown Mach4

Restart Mach4 to start the ESS plugin.

Control Configuration MyMill:0

Defaults | General | Plugins | Motors | Aux. Positions | Axis Mapping | Hom

	Enabled	Description	Version
1	✔	Core - Newfangled Solutions	4.2.0.5036
2	✔	Keyboard Inputs - Newfangled Solutions	4.2.0.5036
3	✔	LUA - Newfangled Solutions	4.2.0.5036
4	✘	Modbus - Newfangled Solutions	4.2.0.5036
5	✔	Regfile - Newfangled Solutions	4.2.0.5036
6	✘	Serial - Newfangled Solutions	4.2.0.5036
7	✘	Surface Map - Newfangled Solutions	4.2.0.5036
8	✘	XBox Controller - DazTheGas and Newfangled	2.1.3
9	✘	XhcMpg - Newfangled Solutions	4.2.0.5036
10	✔	ShuttlePro - Newfangled Solutions	4.2.0.5036
11	✔	Simulator - Newfangled Solutions	4.2.0.5036
12	✘	WarpRunner v 002 - Warp9 Tech Design, Inc.	0.002
13	✔	ESS v284 - Warp9 Tech Design, Inc.	1.0.1.284

Mach4 Install

When Mach4 starts select Configure

Select motion device

Choose ESS

Click OK

Shutdown Mach4

Select Motion Device

Select the motion control device.
WARNING!
Changing the motion control device will destroy any existing axis to motor mapping and motor tuning.

☐ Simulation Device
☑ Ethernet SmoothStepper

OK   Cancel   Apply

ESS setup

Browse to https://warp9td.com

Follow the directions to download the SCU application. There is also a great amount of background on setting up the ESS

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ESS setup

Select the SCU

Current Software Page

Which piece of software are you looking for:

- SCU (System Configuration Utility) for ESS (Ethernet SmoothStepper)
- Mach4 Plugin for ESS (Ethernet SmoothStepper)
- Mach3 Plugin for ESS (Ethernet SmoothStepper)
- Configurator for ESS (Ethernet SmoothStepper)
- Windows Driver for USS (USB SmoothStepper)
- Mach4 Plugin for USS (USB SmoothStepper)
- Mach3 Plugin for USS (USB SmoothStepper)
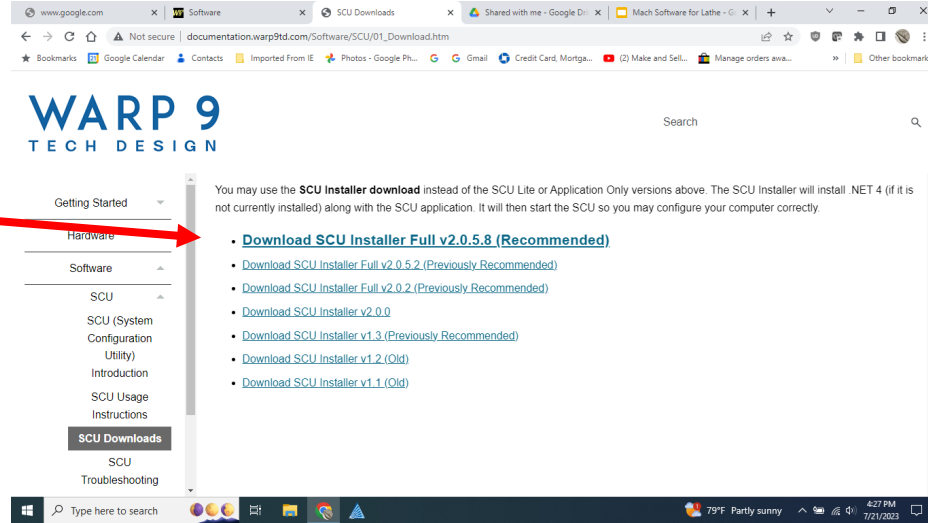
ESS setup

Select the SCU

Browse to https://warp9td.com

Follow the directions to download the SCU application. There is also a great amount of background on setting up the ESS

ESS setup

Find the downloaded file and
double-click on it to run,

SCU setup

Start the SCU

Select Language

Select NEXT
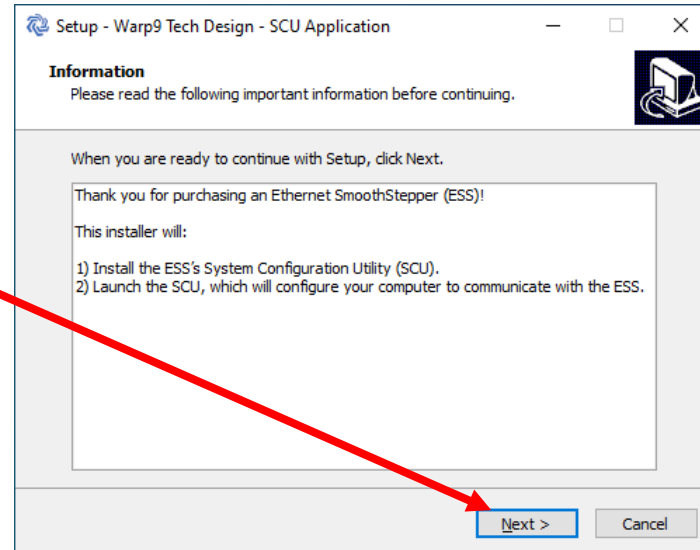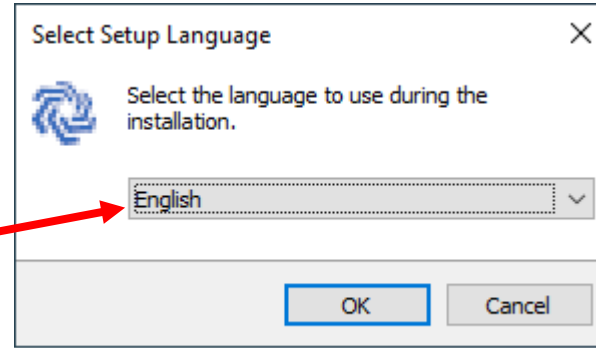
ESS setup

Use the suggested folder

Select Next to install
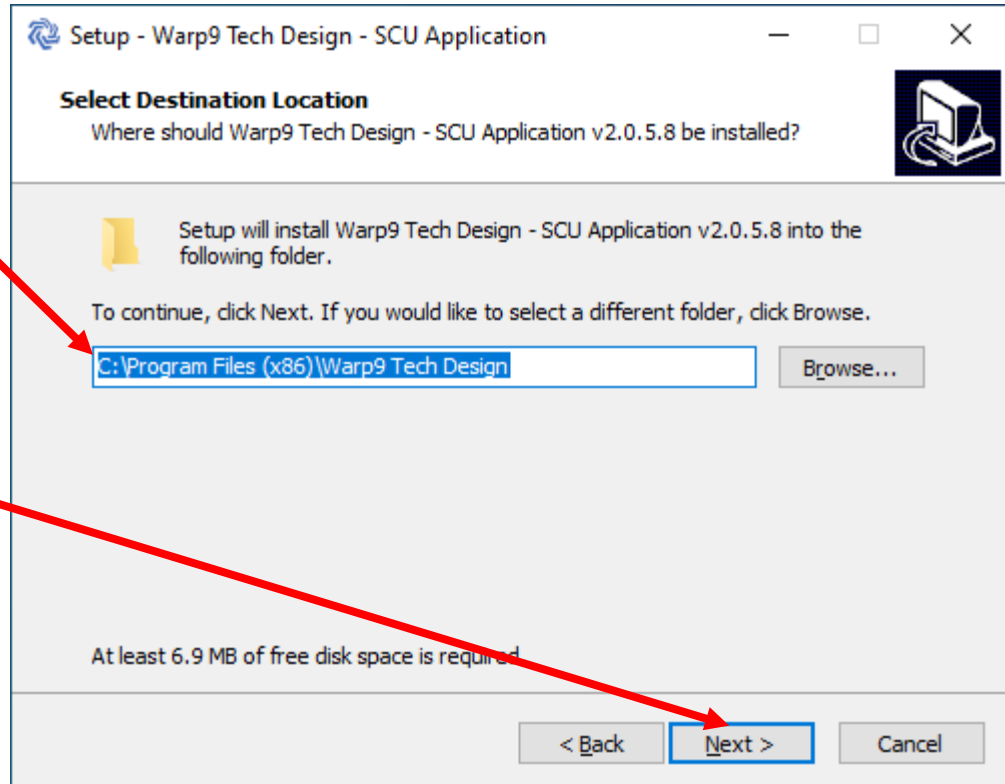
ESS Setup

Note the instructions.

Select Next

Setup - Warp9 Tech Design - SCU Application

Information
Please read the following important information before continuing.

When you are ready to continue with Setup, click Next.

When the SCU starts, it will guide you through:

1) Installing Mach (if you have not done so already).
2) Installing the ESS's plugin for Mach (if you have not done so already).
3) Configuring your computer with "Easy Mode".
4) Detecting your ESS.
5) Run "Windows Performance Tuning", so Windows will can run its best with Mach.

Next >

ESS Setup

Select Finish
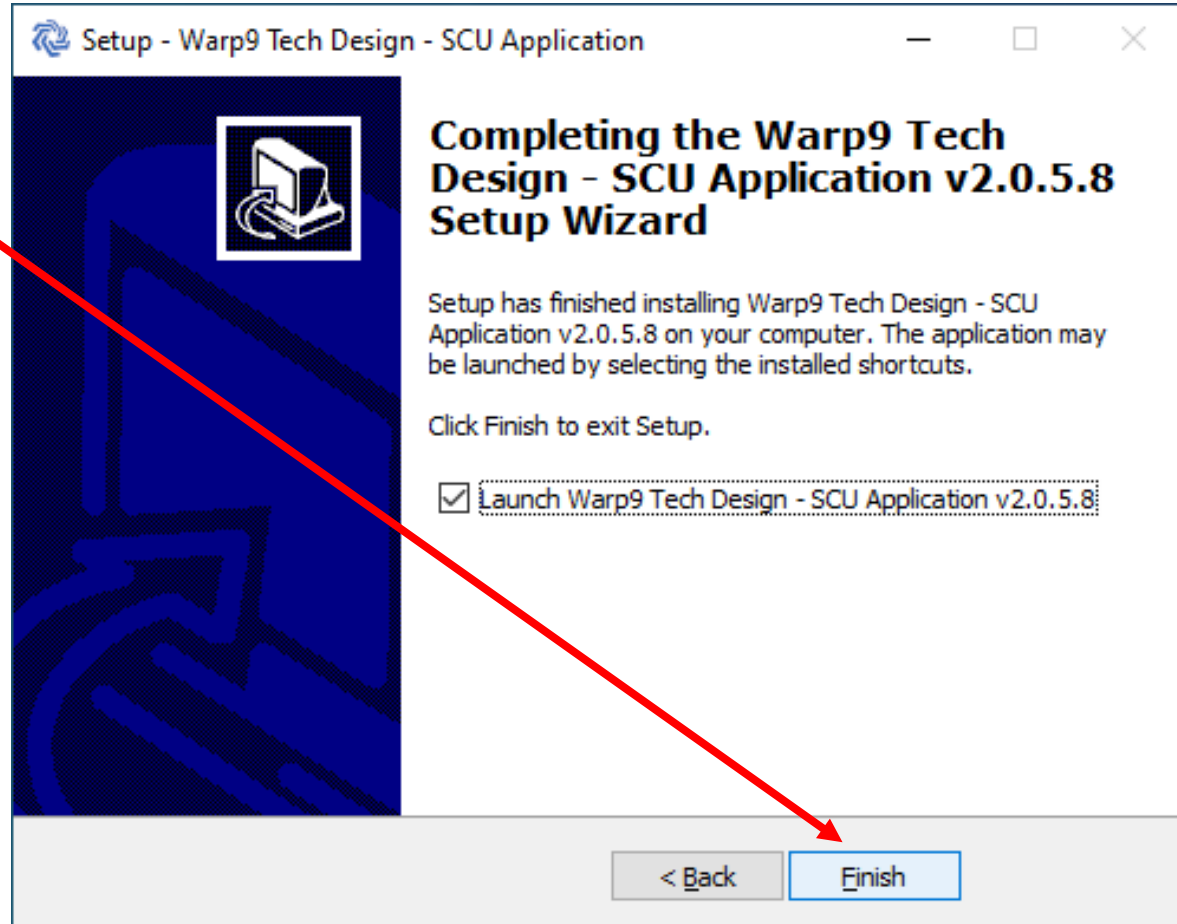
ESS Setup
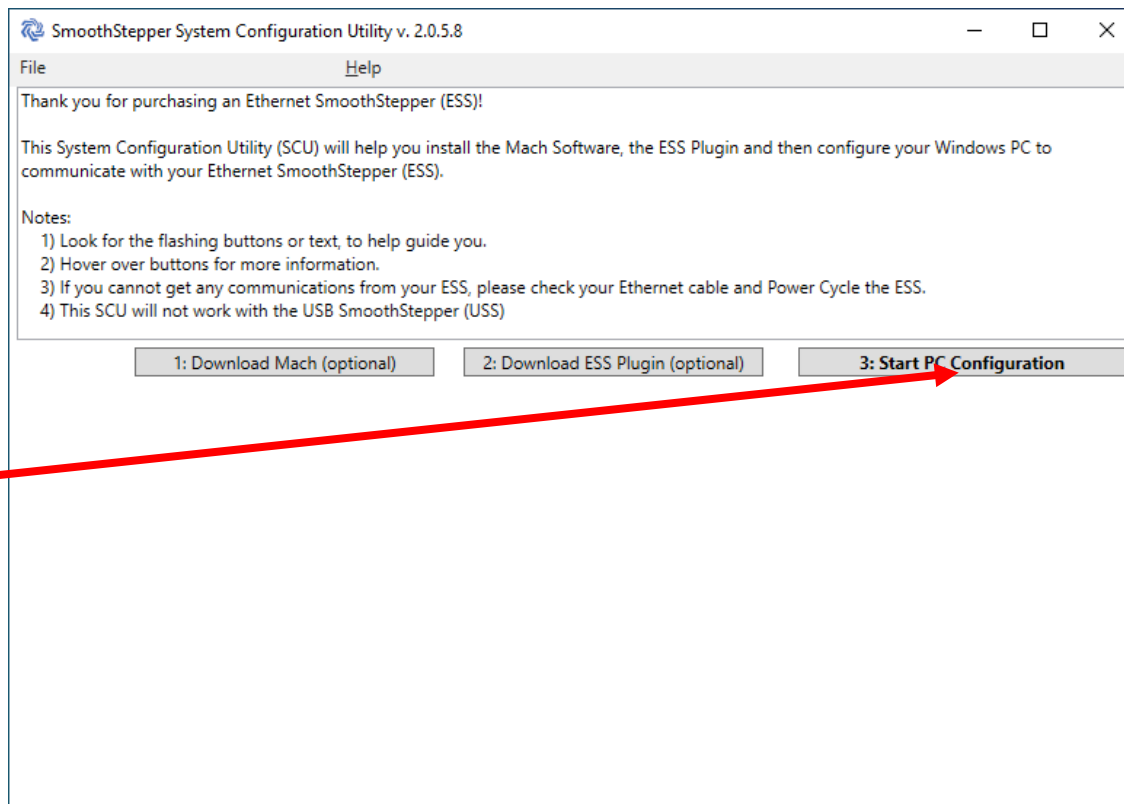
Use option 3

ESS Setup

Select Easy Mode

ESS Setup

Click on this adapter
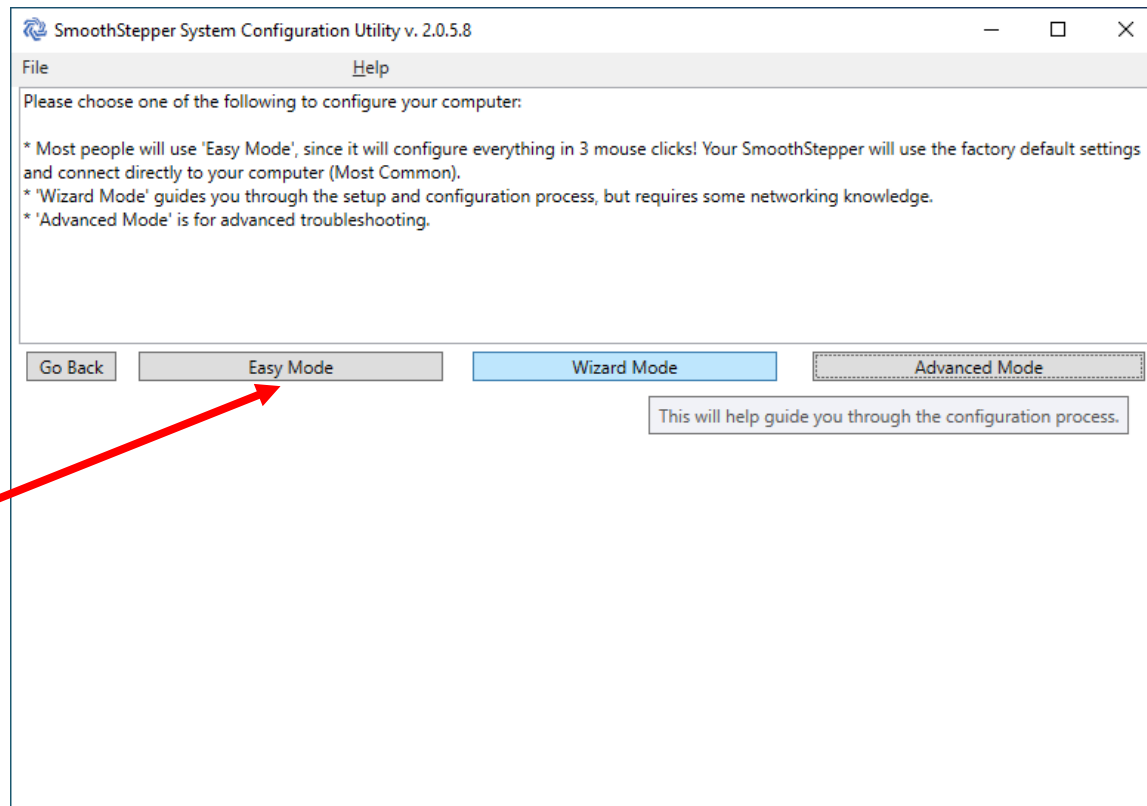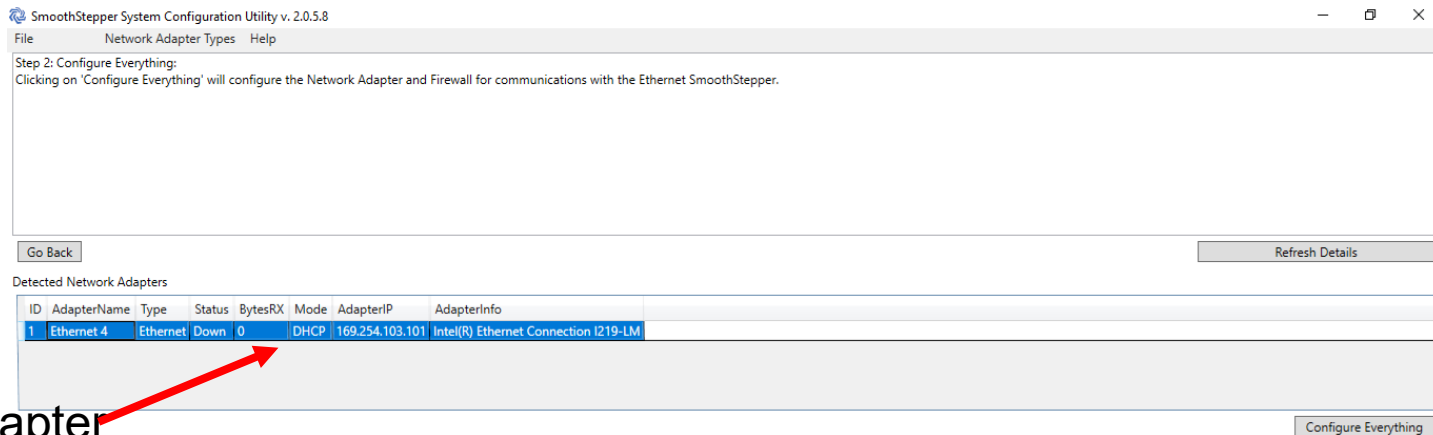
ESS Setup

Make sure that your ethernet cable is connected to the controller "PC" port and that the controller is turned on.

Then, select the "Files" drop down box.
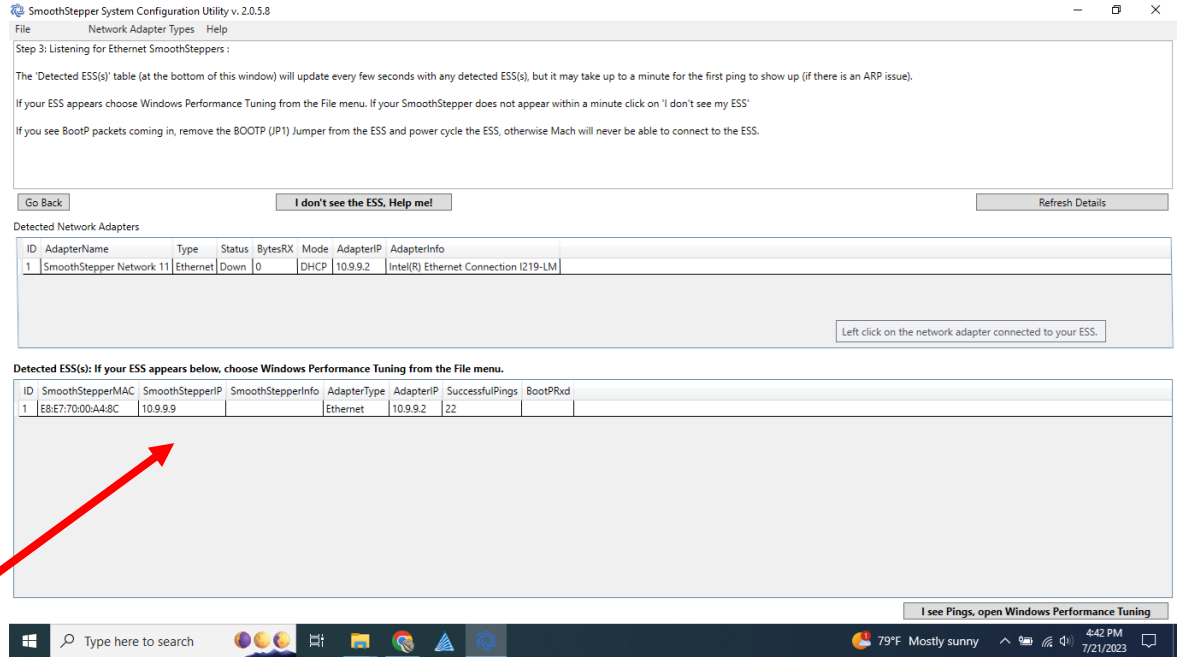
ESS Setup

Select "Windows
Performance Tuning"
from the drop down box.
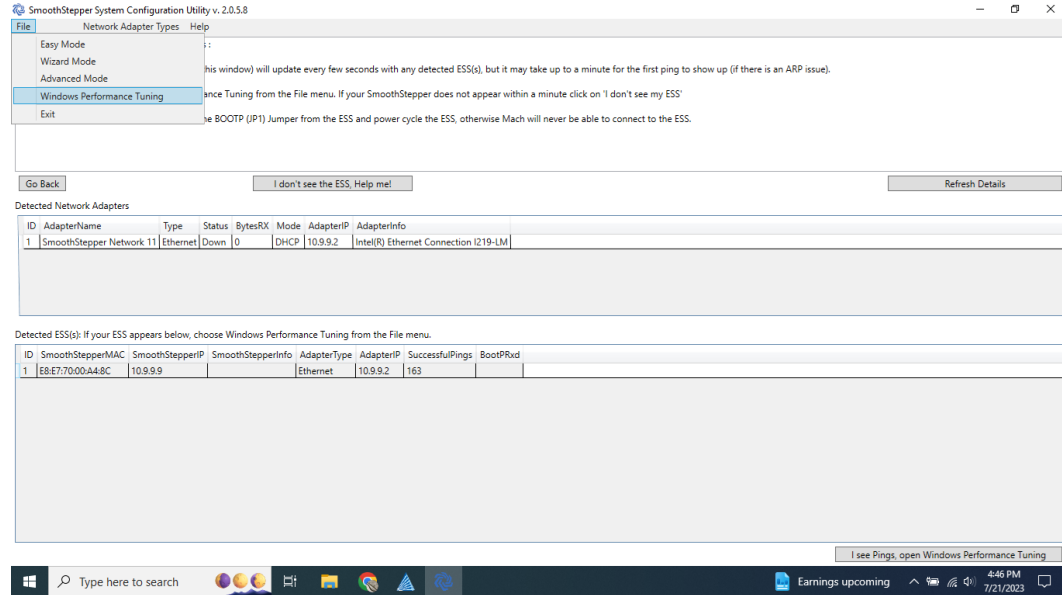
ESS Setup

Follow the instructions as shown.
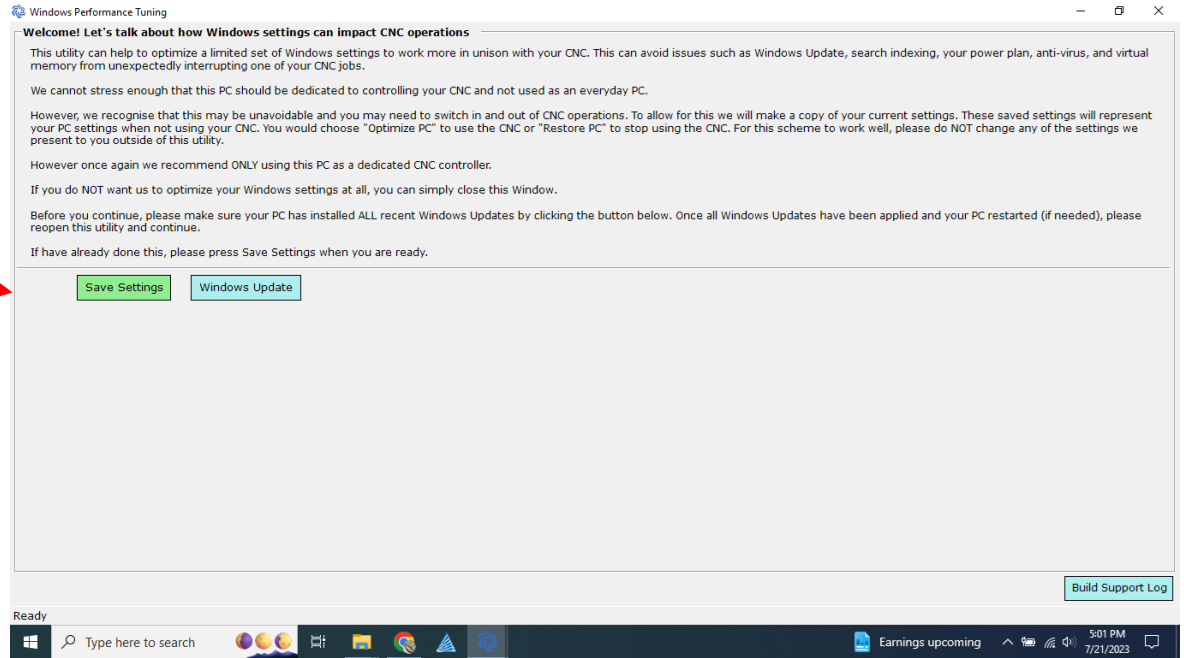
ESS Setup

Select "apply all recommended actions".

This will require you you restart your PC.
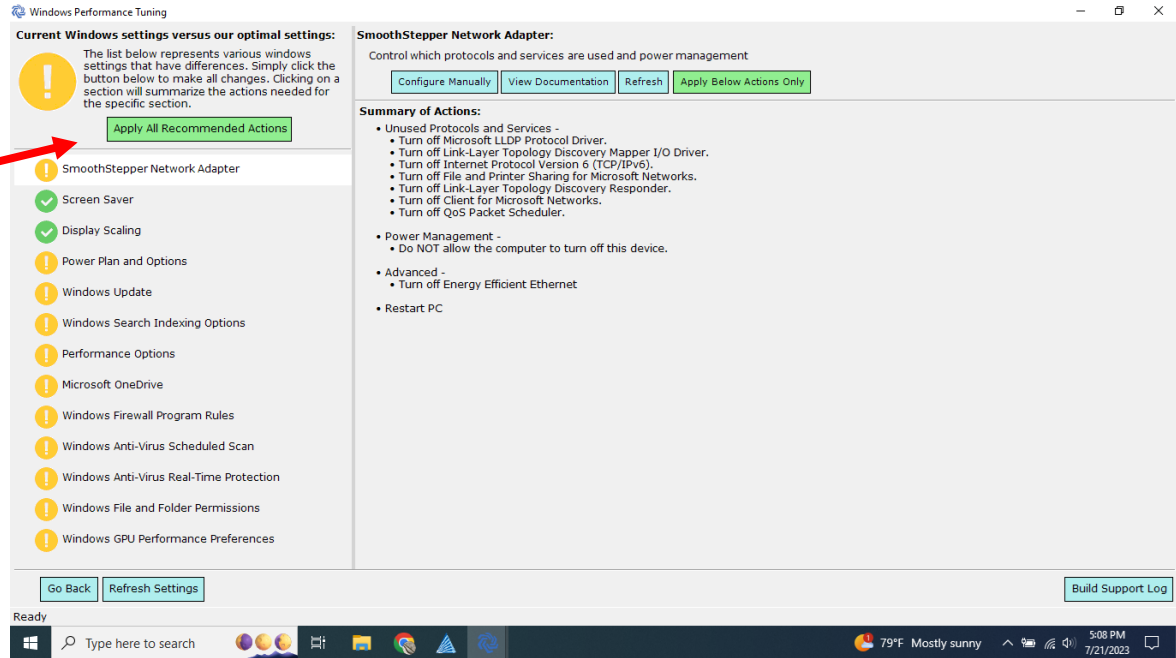
ESS Setup

After Your PC re-starts, run the Smooth Stepper Utility from your desktop, and you should see this screen.

Select "Close Window and SCU"

ESS setup is now complete.
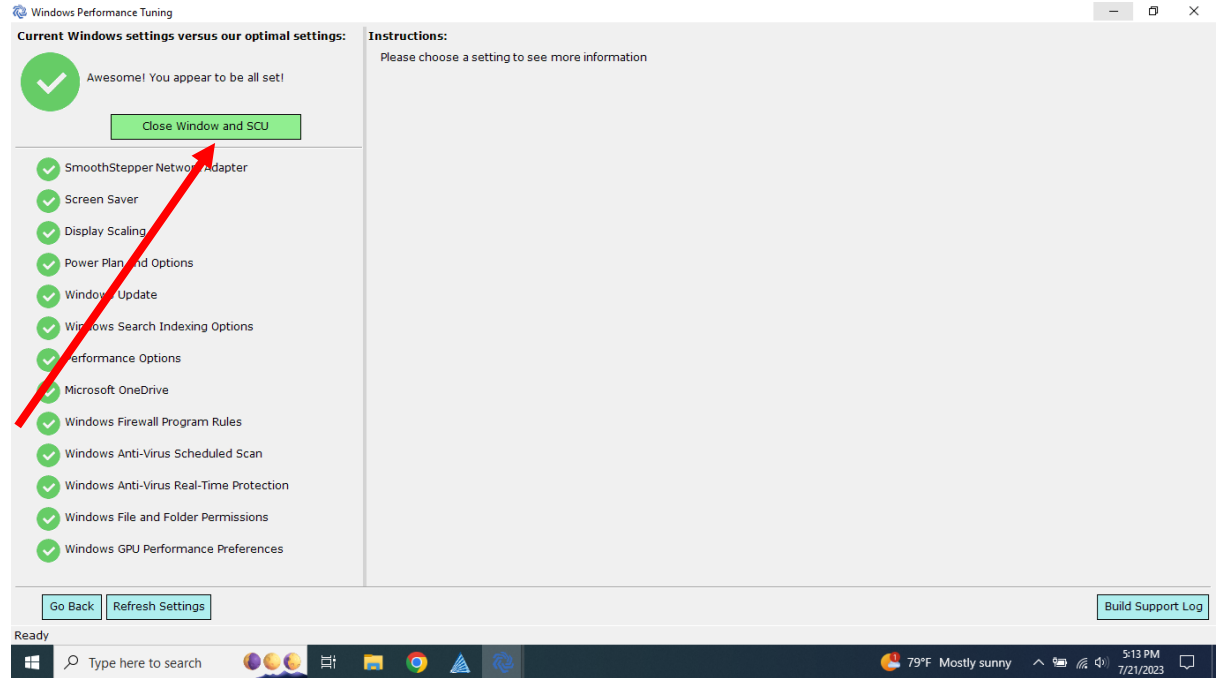
ESS Setup is now complete

Machine Configuration

The ESS has 3 ports of 17 pins.

Most pins can be assigned as input or output.

The system has several control signals which are connected to an ESS pin

We must associate each signal with the correct pin.

All this data is stored in the Machine.ini file within your Profile.

There is a Machine.ini file on the memory stick supplied with this system.

You may simply copy it from the stick to replace the current file in your Profile.

Active Low

All signals in this system are digital, binary.

That means they may be a HIGH (typically +5V) or LOW (typically ground)

The system needs to know when the signal is TRUE, or ACTIVE

Active High means the signal is TRUE when it is HIGH

Active Low means the signal is TRUE when it is LOW.

There is no right or wrong, here, you just must use whichever choice the system designer chose.

Machine Configuration

If you want to fully understand the wiring of your machine use the following screens to configure the ESS pins.

The general process is to assign alias names to the pins in the ESS config and assign the alias names to the correct functions in Mach4.

The following screens refer to the tabs of the ESS Config screens.

Machine Configuration

From the main Mach4 screen menu bar

Select Configure->Plugins->ESS

Info screen will open

Work across the tabs

Ethernet SmoothStepper (ESS) Configuration v285, Mach4 build 4.2.0.5036 - Instance 0

| Info | General | Motors | Spindle | Laser | Laser... | Analog | Pins Config | Input Signals | Output Signals | Homing | Probing | Backlash |

Click here for: Getting Started: Setting up the SmoothStepper and Mach4   Please read the Safety Page   Warp9TD.com FAQ   Warp9T

This plugin recommends using Mach4 4612 or newer
☑ Show a waring at startup if Mach4 is older than that

PLEASE READ! This will help you to set up your ESS (Ethernet SmoothStepper) motion controller plugin.

If you DO have the motion controller board connected, you can freely switch back and forth between this config and Mach's config, and the ch
If you do NOT have the motion controller board connected, do not change settings in Mach's Signals Tabs. Only work in this config window.

General Setup Steps:
    1) Configure the 'General' tab and then the 'Motors' tab.
    2) Configure the 'Pins Config' tab:
            * STRONGLY RECOMMENDED: Use Aliases! It will make it much easier to remember which pins do what.
            * Read the Setup Guide for details on Noise Filtering
                    - If the value is 0, noise filtering will be disabled and the pin's data will not be delayed.
                    - If you are getting erroneous Limit Switch Hits, add some noise filtering to the limit switches and fix your limit switch wiri
    3) Assign pins to your 'Input Signals' tab and to your 'Output Signals' tab.
    4) Configure the 'Homing' tab.
    5) Finally, close this configuration window, and go into the Mach config to finish your system setup.

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OK   Cancel

ESS Config Tab General

On the General tab leave all the settings as is.

ESS Config Tab Motors

We are using Step/Dir motors on all positions.
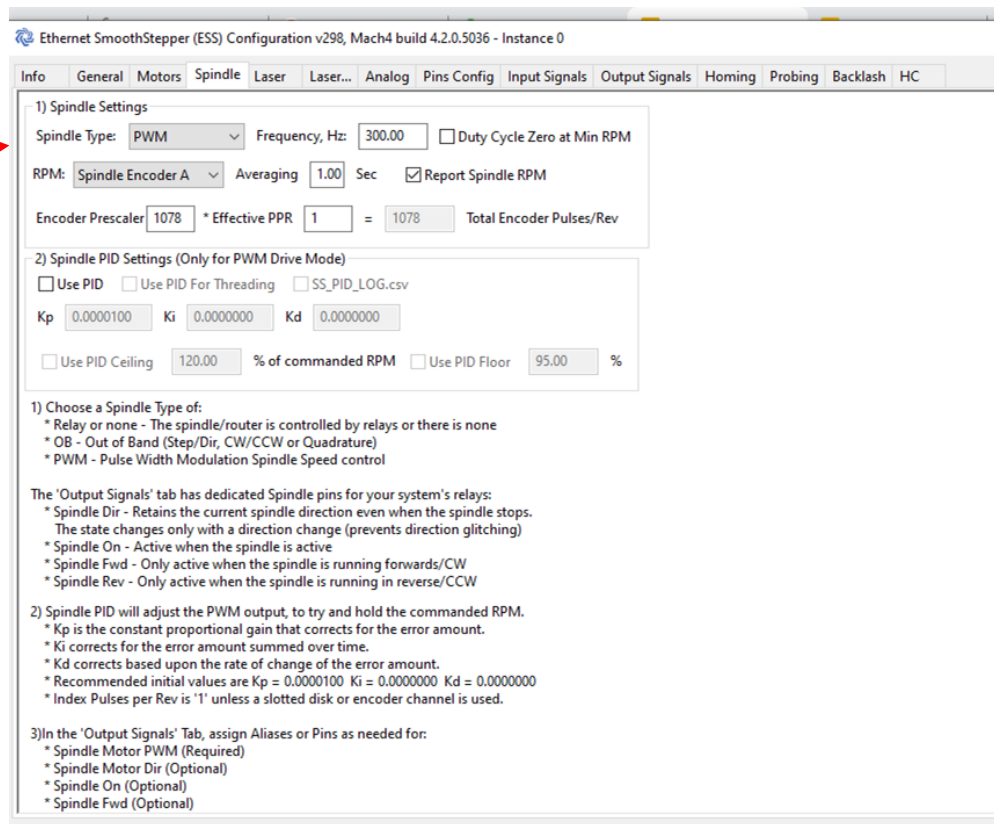
ESS Config Tab Spindle

We use a PWM signal to control spindle RPM.

Do not use PID terms.

ESS Config Tab Pins Config

Scroll down on the Pins tab to see the Port 2 assignments.

Enter alias names for these pins.

1) Set the pins Active High (Red Arrow Up) or Active Low (Green Arrow Down).
2) Give the Pins you are using an Alias: {P#-#} DESCRIPTION (This is the {Port#-Pin#} for the pin and a descrption of it) .
     This makes it MUCH EASIER to identify which pins do what in the Input and Output signal tabs.
3) Assign Noise Filtering, in us, for each input pin, if needed (see the 'Info' tab for more details).
4) A Feed Hold or Stop (Stop, EStop, Disabled or Limit) event can set theOutput state to 'Force ON', Force OFF', or 'No Change'.
     'No Change' means that the output is controlled by Mach4. With 'Force ON' and 'Force OFF' the ESS will force that desired state.
5) Pins are always enabled, only Signals can be enabled or disabled. Connect pins as needed on the Input and Output signal tabs.

	DIR	Active High/Low	Alias or Name	Noise Filtering	Stop State	Feed Hold State
Port1-Pin1	Out	↑	Motor4 step {P1-1}	-----	No Change	No Change
Port1-Pin2	Out	↑	Motor 0 step {P1-2}	-----	No Change	No Change
Port1-Pin3	Out	↓	Motor 0 Dir {P1-3}	-----	No Change	No Change
Port1-Pin4	Out	↑	Motor 1 Step {P1-4}	-----	No Change	No Change
Port1-Pin5	Out	↑	Motor 1 Dir {P1-5}	-----	No Change	No Change
Port1-Pin6	Out	↑	Motor 2 Step {P1-6}	-----	No Change	No Change
Port1-Pin7	Out	↑	Motor 2 Dir {P1-7}	-----	No Change	No Change
Port1-Pin8	Out	↑	Motor 3 Step {P1-8}	-----	No Change	No Change
Port1-Pin9	Out	↑	Motor 3 Dir {P1-9}	-----	No Change	No Change
Port1-Pin10	In	↓	Estop {P1-10}	0.00	-----	-----
Port1-Pin11	In	↓	Motor 0++{P1-11}	0.00	-----	-----
Port1-Pin12	In	↓	Motor 1++{P1-12}	0.00	-----	-----
Port1-Pin13	In	↓	Motor2++{P1-13}	0.00	-----	-----
Port1-Pin14	Out	↑	Spindle PWM {P1-14}	-----	No Change	No Change
Port1-Pin15	In	↓	Probe {P1-15}	0.00	-----	-----
Port1-Pin16	Out	↑	Spindle REV {P1-16}	-----	No Change	No Change
Port1-Pin17	Out	↑	Motor 4 Dir {P1-17}	-----	No Change	No Change

ESS Config Tab Pins Config

Continue entering alias names as per the screen to the right.

Ethernet SmoothStepper (ESS) Configuration v298, Mach4 build 4.2.0.5036 - Instance 0

Info   General   Motors   Spindle   Laser   Laser...   Analog   Pins Config   Input Signals   Output Signals   Homing   Probing   Backlash   HC

1) Set the pins Active High (Red Arrow Up) or Active Low (Green Arrow Down).
2) Give the Pins you are using an Alias: {P#-#} DESCRIPTION (This is the {Port#-Pin#} for the pin and a descrption of it) .
    This makes it MUCH EASIER to identify which pins do what in the Input and Output signal tabs.
3) Assign Noise Filtering, in us, for each input pin, if needed (see the 'Info' tab for more details).
4) A Feed Hold or Stop (Stop, EStop, Disabled or Limit) event can set theOutput state to 'Force ON', Force OFF', or 'No Change'.
    'No Change' means that the output is controlled by Mach4. With 'Force ON' and 'Force OFF' the ESS will force that desired state.
5) Pins are always enabled, only Signals can be enabled or disabled. Connect pins as needed on the Input and Output signal tabs.

Port 2 Pins 2-9 Direction   Port 3 Pins 2-9 Direction
◉ Inputs   ○ Outputs   ◉ Inputs   ○ Outputs

	DIR	Active High/Low	Alias or Name	Noise Filtering	Stop State	Feed Hold State
Port1-Pin15	In	⬇	Probe {P1-15}	0.00	-----	-----
Port1-Pin16	Out	⬆	Spindle REV {P1-16}	-----	No Change	No Change
Port1-Pin17	Out	⬆	Motor 4 Dir {P1-17}	-----	No Change	No Change
Port2-Pin1	Out	⬆	{P2-1}	-----	No Change	No Change
Port2-Pin2	In	⬆	{P2-2} Spindle Encoder A	0.00	-----	-----
Port2-Pin3	In	⬆	{P2-3} Spindle Encoder B	0.00	-----	-----
Port2-Pin4	In	⬆	{P2-4} Spindle Encoder Index	0.00	-----	-----
Port2-Pin5	In	⬆	{P2-5}	0.00	-----	-----
Port2-Pin6	In	⬆	{P2-6}	0.00	-----	-----
Port2-Pin7	In	⬆	{P2-7}	0.00	-----	-----
Port2-Pin8	In	⬆	{P2-8}	0.00	-----	-----
Port2-Pin9	In	⬆	{P2-9}	0.00	-----	-----
Port2-Pin10	In	⬆	{P2-10}	0.00	-----	-----
Port2-Pin11	In	⬆	{P2-11}	0.00	-----	-----
Port2-Pin12	In	⬆	{P2-12}	0.00	-----	-----
Port2-Pin13	In	⬆	{P2-13}	0.00	-----	-----
Port2-Pin14	Out	⬆	{P2-14}	-----	No Change	No Change

OK   Cancel

ESS Config Tab Pins Config

This system does not include a coolant pump.

Charge Pump is a safety feature, commonly known as a "watchdog timer". If Mach4 should crash the control logic will shutdown all motion.

ESS Config Tab Pins Config

This shows the remainder of the Pins Config Tab

ESS Config Tab Input Signals

Limit switches and the E-stop button, etc

Ethernet SmoothStepper (ESS) Configuration v298, Mach4 build 4.2.0.5036 - Instance 0

Info | General | Motors | Spindle | Laser | Laser... | Analog | Pins Config | Input Signals | Output Signals | Homing | Probing | Backlash | HC

1) When you enable an input signal here, it will automatically be enabled and mapped into Mach.
2) An Input Pin (or Alias) may be assigned to multiple Input Signals.

	Enable	Mach Mapping	Mapped Pin
E-Stop	✓	ESS	Estop {P1-10}
Motor 0 Home	✓	ESS	Motor 0++{P1-11}
Motor 1 Home	✗	ESS	Motor 1++{P1-12}
Motor 2 Home	✓	ESS	Motor2++{P1-13}
Motor 3 Home	✗		
Motor 4 Home	✗		
Motor 5 Home	✗		
Motor 0 ++ Limit	✓	ESS	Motor 0++{P1-11}
Motor 1 ++ Limit	✗		
Motor 2 ++ Limit	✓	ESS	Motor2++{P1-13}
Motor 3 ++ Limit	✗		
Motor 4 ++ Limit	✗		
Motor 5 ++ Limit	✗		
Motor 0 -- Limit	✗	ESS	Motor 0++{P1-11}
Motor 1 -- Limit	✗		
Motor 2 -- Limit	✗		
Motor 3 -- Limit	✗		
Motor 4 -- Limit	✗		
Motor 5 -- Limit	✗		
Motor 0 Index	✗	ESS-only	
Motor 1 Index	✗	ESS-only	

OK | Cancel

56

ESS Config Tab Input Signals

Spindle and encoder input signals

Ethernet SmoothStepper (ESS) Configuration v298, Mach4 build 4.2.0.5036 - Instance 0

Info | General | Motors | Spindle | Laser | Laser... | Analog | Pins Config | Input Signals | Output Signals | Homing | Probing | Backlash | HC

1) When you enable an input signal here, it will automatically be enabled and mapped into Mach.
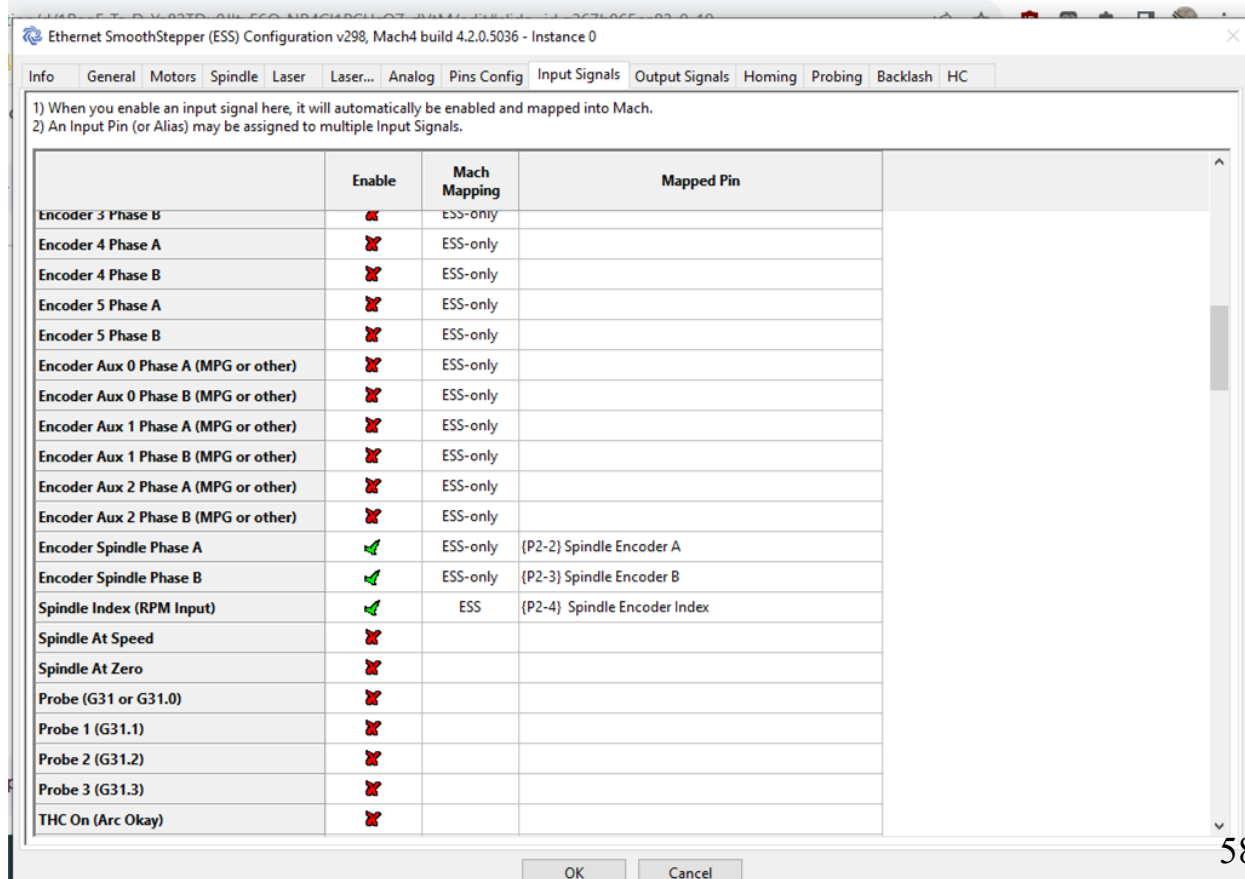2) An Input Pin (or Alias) may be assigned to multiple Input Signals.

	Enable	Mach Mapping	Mapped Pin
Encoder 3 Phase B	✗	ESS-only	
Encoder 4 Phase A	✗	ESS-only	
Encoder 4 Phase B	✗	ESS-only	
Encoder 5 Phase A	✗	ESS-only	
Encoder 5 Phase B	✗	ESS-only	
Encoder Aux 0 Phase A (MPG or other)	✗	ESS-only	
Encoder Aux 0 Phase B (MPG or other)	✗	ESS-only	
Encoder Aux 1 Phase A (MPG or other)	✗	ESS-only	
Encoder Aux 1 Phase B (MPG or other)	✗	ESS-only	
Encoder Aux 2 Phase A (MPG or other)	✗	ESS-only	
Encoder Aux 2 Phase B (MPG or other)	✗	ESS-only	
Encoder Spindle Phase A	✓	ESS-only	{P2-2} Spindle Encoder A
Encoder Spindle Phase B	✓	ESS-only	{P2-3} Spindle Encoder B
Spindle Index (RPM Input)	✓	ESS	{P2-4} Spindle Encoder Index
Spindle At Speed	✗		
Spindle At Zero	✗		
Probe (G31 or G31.0)	✗		
Probe 1 (G31.1)	✗		
Probe 2 (G31.2)	✗		
Probe 3 (G31.3)	✗		
THC On (Arc Okay)	✗		

OK | Cancel

ESS Config Tab Input Signals

There are no additional changes to be made on the "Input Signals" tab

Ethernet SmoothStepper (ESS) Configuration v298, Mach4 build 4.2.0.5036 - Instance 0

| Info | General | Motors | Spindle | Laser | Laser... | Analog | Pins Config | **Input Signals** | Output Signals | Homing | Probing | Backlash | HC |

1) When you enable an input signal here, it will automatically be enabled and mapped into Mach.
2) An Input Pin (or Alias) may be assigned to multiple Input Signals.

	Enable	Mach Mapping	Mapped Pin
Encoder 3 Phase B	✗	ESS-only	
Encoder 4 Phase A	✗	ESS-only	
Encoder 4 Phase B	✗	ESS-only	
Encoder 5 Phase A	✗	ESS-only	
Encoder 5 Phase B	✗	ESS-only	
Encoder Aux 0 Phase A (MPG or other)	✗	ESS-only	
Encoder Aux 0 Phase B (MPG or other)	✗	ESS-only	
Encoder Aux 1 Phase A (MPG or other)	✗	ESS-only	
Encoder Aux 1 Phase B (MPG or other)	✗	ESS-only	
Encoder Aux 2 Phase A (MPG or other)	✗	ESS-only	
Encoder Aux 2 Phase B (MPG or other)	✗	ESS-only	
Encoder Spindle Phase A	✓	ESS-only	{P2-2} Spindle Encoder A
Encoder Spindle Phase B	✓	ESS-only	{P2-3} Spindle Encoder B
Spindle Index (RPM Input)	✓	ESS	{P2-4} Spindle Encoder Index
Spindle At Speed	✗		
Spindle At Zero	✗		
Probe (G31 or G31.0)	✗		
Probe 1 (G31.1)	✗		
Probe 2 (G31.2)	✗		
Probe 3 (G31.3)	✗		
THC On (Arc Okay)	✗		

OK   Cancel

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ESS Config Tab Output Signals

These outputs drive the motors.

For a lathe Motor 3 through 4 are not needed and will not be used, but it's OK to have these defined.

Ethernet SmoothStepper (ESS) Configuration v298, Mach4 build 4.2.0.5036 - Instance 0

Info | General | Motors | Spindle | Laser | Laser... | Analog | Pins Config | Input Signals | Output Signals | Homing | Probing | Backlash | HC

1) An Output Pin (or Alias) may only be assigned to a single Output Signal.
2) An Output Signal may have up to 3 Output Pins (or Aliases) assigned to it:
   * When enabled in this window, only 'Mapped Pin1' will be enabled and mapped into Mach.
   * 'Mapped Pin2' and 'Mapped Pin3' will still receive the same Output Signal as 'Mapped Pin1', but will not be referenced in Mach.

	Enable	Mach Mapping	Pin1 Mapping	Pin2 Mapping	Pin3 Mapping
Motor 0 Step	✔	ESS-only	Motor 0 step {P1-2}		
Motor 0 Dir	✔	ESS-only	Motor 0 Dir {P1-3}		
Motor 1 Step	✔	ESS-only	Motor 1 Step {P1-4}		
Motor 1 Dir	✔	ESS-only	Motor 1 Dir {P1-5}		
Motor 2 Step	✔	ESS-only	Motor 2 Step {P1-6}		
Motor 2 Dir	✔	ESS-only	Motor 2 Dir {P1-7}		
Motor 3 Step	✔	ESS-only	Motor 3 Step {P1-8}		
Motor 3 Dir	✔	ESS-only	Motor 3 Dir {P1-9}		
Motor 4 Step	✖	ESS-only			
Motor 4 Dir	✖	ESS-only			
Motor 5 Step	✖	ESS-only			
Motor 5 Dir	✖	ESS-only			
Motor 0 Enable	✖	ESS			
Motor 1 Enable	✖	ESS			
Motor 2 Enable	✖	ESS			
Motor 3 Enable	✖	ESS			
Motor 4 Enable	✖	ESS			
Motor 5 Enable	✖	ESS			
ESS, XY Feed Rate PWM	✖	ESS-only			

OK | Cancel

ESS Config Tab Output Signals

Spindle and charge pump outputs.

Ethernet SmoothStepper (ESS) Configuration v298, Mach4 build 4.2.0.5036 - Instance 0

Info | General | Motors | Spindle | Laser | Laser... | Analog | Pins Config | Input Signals | Output Signals | Homing | Probing | Backlash | HC

1) An Output Pin (or Alias) may only be assigned to a single Output Signal.
2) An Output Signal may have up to 3 Output Pins (or Aliases) assigned to it:
   * When enabled in this window, only 'Mapped Pin1' will be enabled and mapped into Mach.
   * 'Mapped Pin2' and 'Mapped Pin3' will still receive the same Output Signal as 'Mapped Pin1', but will not be referenced in Mach.

	Enable	Mach Mapping	Pin1 Mapping	Pin2 Mapping	Pin3 Mapping
ESS, XY Feed Rate PWM	✗	ESS-only			
Laser PWM/XY Vel PWM/AOut1	✗	ESS-only			
Spindle Motor PWM Or AOut 0	✓	ESS-only	Spindle PWM {P1-14}		
Spindle Motor Dir	✓	ESS-only	Spindle REV {P1-16}		
Spindle On	✗	ESS			
Spindle Fwd	✗	ESS			
Spindle Rev	✗	ESS			
Alarm	✗	ESS			
Charge Pump	✓	ESS-only	Charge Pump {P2-17}		
Coolant, Flood (M08, M09)	✓	ESS	Coolant On {P2-16}		
Coolant, Mist (M07, M09)	✗	ESS			
Current Hi/Low	✗	ESS			
Cut Recovery	✗	ESS			
Digitize Trigger	✗	ESS			
Dist To Go	✗	ESS			
Dwell	✗	ESS			
Feed Hold	✗	ESS			
Feed Hold Disabled	✗	ESS			
F.H. Not Allowed (4720+)	✗	ESS			
Feed Rate Override	✗	ESS			

OK | Cancel

ESS Config Tab Output Signals

There are no additional changes to the "Output Signals" tab

Ethernet SmoothStepper (ESS) Configuration v298, Mach4 build 4.2.0.5036 - Instance 0

Info | General | Motors | Spindle | Laser | Laser... | Analog | Pins Config | Input Signals | Output Signals | Homing | Probing | Backlash | HC

1) An Output Pin (or Alias) may only be assigned to a single Output Signal.
2) An Output Signal may have up to 3 Output Pins (or Aliases) assigned to it:
   * When enabled in this window, only 'Mapped Pin1' will be enabled and mapped into Mach.
   * 'Mapped Pin2' and 'Mapped Pin3' will still receive the same Output Signal as 'Mapped Pin1', but will not be referenced in Mach.

	Enable	Mach Mapping	Pin1 Mapping	Pin2 Mapping	Pin3 Mapping
Feed Hold	✗	ESS			
Feed Hold Disabled	✗	ESS			
F.H. Not Allowed (4720+)	✗	ESS			
Feed Rate Override	✗	ESS			
Feed Rate Override Disabled	✗	ESS			
FRO Not Allowed (4720+)	✗	ESS			
GCode Complete (4802+)	✗	ESS			
GCode Running	✗	ESS			
ESS, Is Moving	✗	ESS-only			
Jog Cont	✗	ESS			
Jog Enabled	✗	ESS			
Jog Inc	✗	ESS			
Jog MPG	✗	ESS			
Limit Override	✗	ESS			
Machine Coord	✗	ESS			
Machine Enabled	✗	ESS			
Machine Idle	✗	ESS			
Machine Probing	✗	ESS			
Parts Finished	✗	ESS			
Rapid Rate Override	✗	ESS			

OK | Cancel

ESS Config Tab Homing

The motors in this system do not have an index signal.

Home operations approach the switch at higher speed, then back off slowly to make accurate location.

Ethernet SmoothStepper (ESS) Configuration v298, Mach4 build 4.2.0.5036 - Instance 0

Info | General | Motors | Spindle | Laser | Laser... | Analog | Pins Config | Input Signals | Output Signals | Homing | Probing | Backlash | HC

1) Homing is enabled for a Motor 'N', when the 'Input Signals' tab has:
   * 'Motor N Home' Enabled with a green check.
   * 'Motor N Home' has an assigned 'Mapped Pin'.

2) If you have encoders with an index pulse, you may enable homing to a motor's index pin by:
   * Place a green check in 'Home to Motor's Index Pin'.
   * Make sure that the index signal is enabled for that Motor.

	Home Pin (Automatically Populated from 'Input Signals' tab)	Approach Velocity (Units/Min)	Backoff Velocity (Units/Min)	Home To Motor's Index Pin	Rotational Axis Motor Index Pin (Automatically Populated from 'Input Signals' tab)	After Backoff Move (Units)
Motor 0	Motor 0++{P1-11}	20.0	20.0	✗		0.0000
Motor 1	Motor 1++{P1-12}	20.0	20.0	✗		0.0000
Motor 2	Motor2++{P1-13}	20.0	20.0	✗		0.0000
Motor 3		1.0	1.0	✗		0.0000
Motor 4		1.0	1.0	✗		0.0000
Motor 5		1.0	1.0	✗		0.0000

OK | Cancel

This number sets the velocity of the home move.
20 is a reasonable value for the LMS5100

ESS Config Tab Backlash

We use ballscrews with near zero backlash.

Mach4 can compensate for backlash when it exists.

Leave these values unchanged.

W9 Ethernet SmoothStepper (ESS) Configuration - v260

Info | General | Motors | Spindle | Laser | Pins Config | Input Signals | Output Signals | Homing | Probing | **Backlash** | HC

1) Backlash Compensation Options

☐ Use Backlash Compensation   ☐ Show Backlash Comp Messages in Log

	Enabled	Backlash Amount (Read Only)	Mach Velocity (Units/Min)	Mach Acceleration (Units/Sec^2)	Use Custom Values?	Custom Velocity (Units/Min)	Custom Acceleration (Units/Sec^2)
Motor 0	✔	0.0000	501.0000	20.0000	✘	10.0000	1.0000
Motor 1	✔	0.0000	502.0000	20.0700	✘	10.0000	1.0000
Motor 2	✔	0.0000	125.0000	5.0200	✘	10.0000	1.0000
Motor 3	✔	0.0000	500.0000	20.0000	✘	10.0000	1.0000
Motor 4	✔	0.0000	15.0000	10.0000	✘	10.0000	1.0000
Motor 5	✔	0.0000	15.0000	10.0000	✘	10.0000	1.0000

1) When 'Use Backlash Compensation' is enabled, the SmoothStepper will perform Backlash Compensation (B.C.).
Fixing backlash through software is never as effective are removing backlash with better hardware.

* The first column, 'Enabled', should be CHCKED if it is a normal motion axis, or if you want that motor's movements to affect B.C.

Associating ESS and Mach4 connections.

We have now assigned a name to each signal connected to the ESS

Now we need to use these names to configure Mach4.

In the ESS we simply refer to motors 0-6.

Mach4 needs to associate a motor with an axis.

Select Configure->Control from Mach4 main screen.

Configure Mach4 signals- Motors

Each motor must be configured for step per unit and speed.

The motors maximum velocity is set here.

Test these values carefully to be sure you are not pushing the machine too fast.
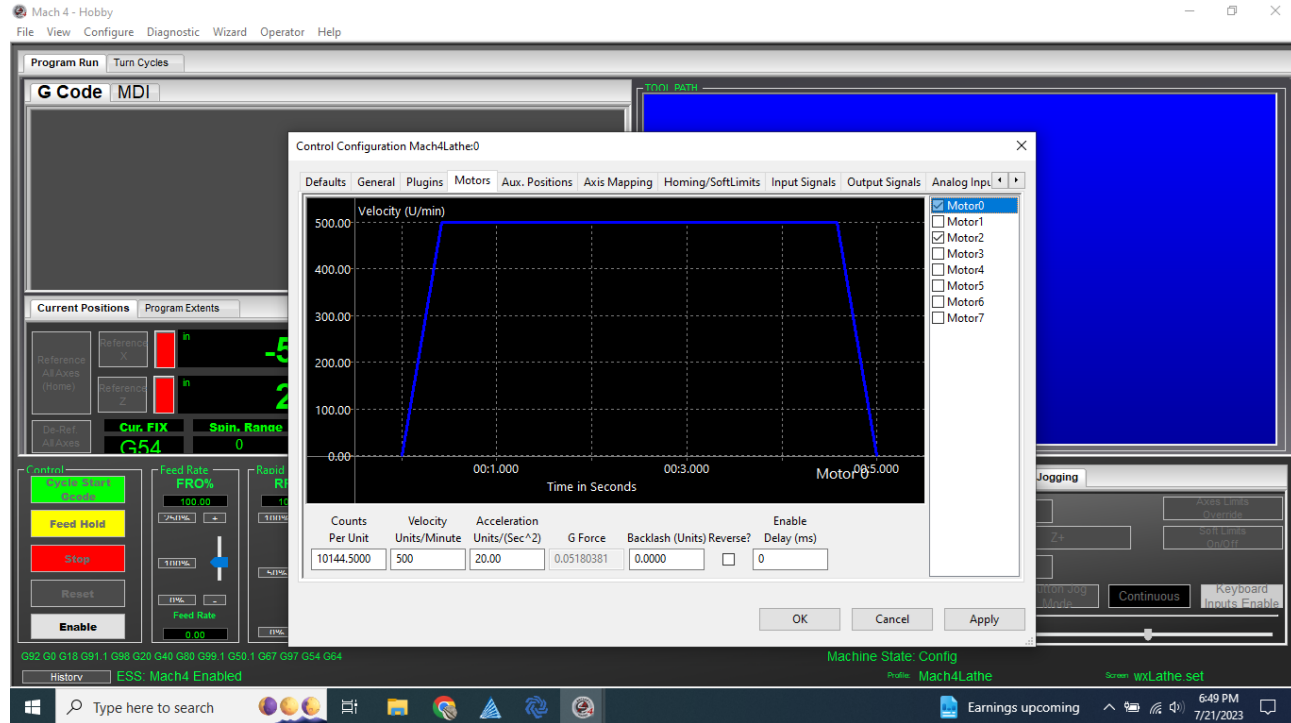
Configure Mach4 signals- Motors

On the prototype machine we found these values

Axis	Step		Vel	Accel
X	10144.5	200	10	
Z	8130	200	15	

You should make accurate measurement by commanding a set distance and measuring the actual move.

Configure Mach Aux Positions

Enable each motor and associate the Axis with motor.
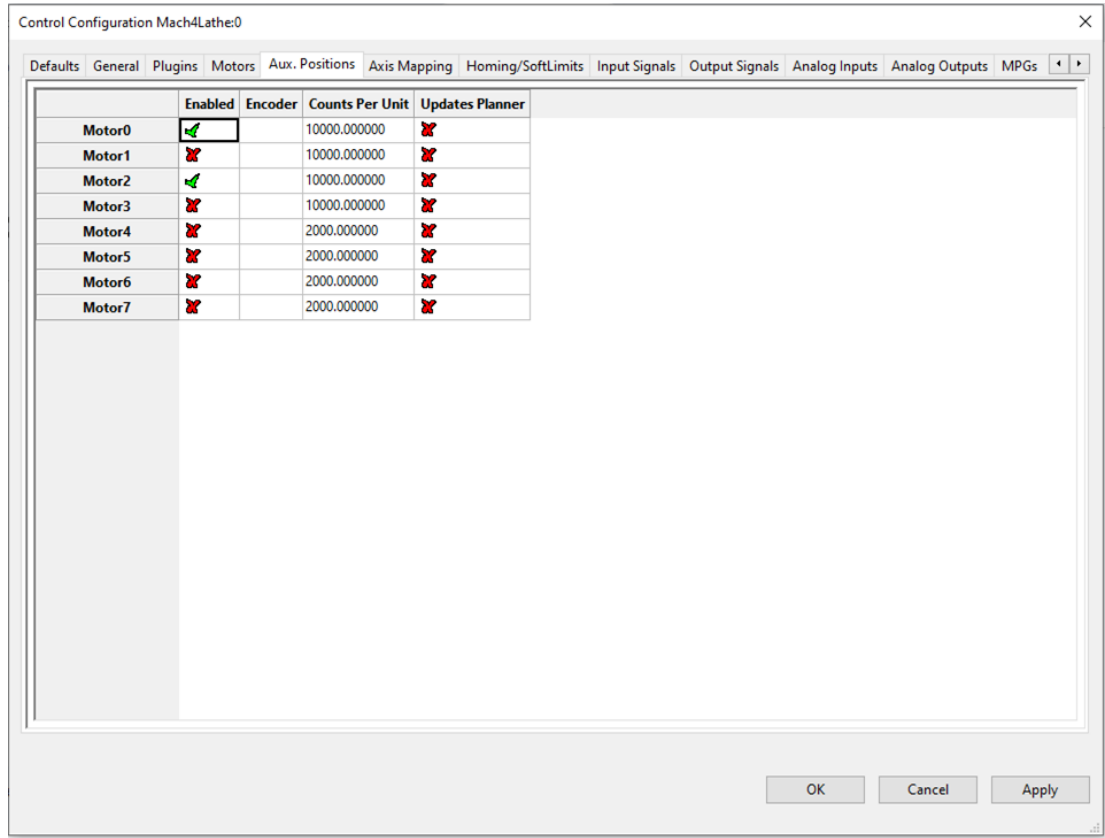
Configure Mach Axis Mapping

Enable each motor and associate the Axis with motor.

Note Mach4 supports slave motors when one motor is not powerful enough for an axis (large routers)
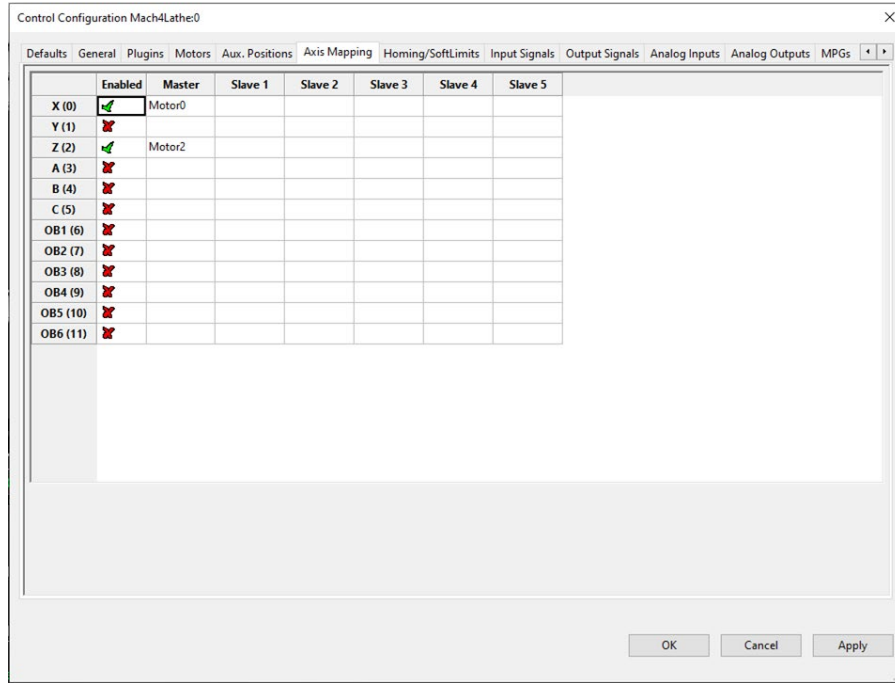
Configure Mach Input Signals

Associate input pins with motors home position.

Configure Mach Input Signals

Scroll down to Motor Home area of the sheet and make these changes.

Control Configuration Mach4Lathe:0							×

Defaults | General | Plugins | Motors | Aux. Positions | Axis Mapping | Homing/SoftLimits | **Input Signals** | Output Signals | Analog Inputs | Analog Outputs | MPGs

	Mapping Enabled	Device	Input Name	Active Low	Log Enabled	User Description
Input #63	✗			✗	✓	
Motor 0 Home	✓	ESS	Motor 0++{P1-11}	✗	✓	
Motor 1 Home	✗	ESS	Motor 1++{P1-12}	✗	✓	
Motor 2 Home	✓	ESS	Motor2++{P1-13}	✗	✓	
Motor 3 Home	✗			✗	✓	
Motor 4 Home	✗			✗	✓	
Motor 5 Home	✗			✗	✓	
Motor 6 Home	✗			✗	✓	
Motor 7 Home	✗			✗	✓	
Motor 8 Home	✗			✗	✓	
Motor 9 Home	✗			✗	✓	
Motor 10 Home	✗			✗	✓	
Motor 11 Home	✗			✗	✓	
Motor 12 Home	✗			✗	✓	
Motor 13 Home	✗			✗	✓	
Motor 14 Home	✗			✗	✓	
Motor 15 Home	✗			✗	✓	
Motor 16 Home	✗			✗	✓	
Motor 17 Home	✗			✗	✓	
Motor 18 Home	✗			✗	✓	
Motor 19 Home	✗			✗	✓	

OK | Cancel | Apply

Configure Mach Input Signals

Scroll down to Motor++ area of the sheet and make these changes.

Control Configuration Mach4Lathe:0

Defaults | General | Plugins | Motors | Aux. Positions | Axis Mapping | Homing/SoftLimits | Input Signals | Output Signals | Analog Inputs | Analog Outputs | MPGs

	Mapping Enabled	Device	Input Name	Active Low	Log Enabled	User Description
Motor 31 Home	✗			✗	✓	
Motor 0 ++	✗	ESS	Motor 0++{P1-11}	✓	✓	
Motor 1 ++	✓			✗	✓	
Motor 2 ++	✗	ESS	Motor2++{P1-13}	✓	✓	
Motor 3 ++	✗			✗	✓	
Motor 4 ++	✗			✗	✓	
Motor 5 ++	✗			✗	✓	
Motor 6 ++	✗			✗	✓	
Motor 7 ++	✗			✗	✓	
Motor 8 ++	✗			✗	✓	
Motor 9 ++	✗			✗	✓	
Motor 10 ++	✗			✗	✓	
Motor 11 ++	✗			✗	✓	
Motor 12 ++	✗			✗	✓	
Motor 13 ++	✗			✗	✓	
Motor 14 ++	✗			✗	✓	
Motor 15 ++	✗			✗	✓	
Motor 16 ++	✗			✗	✓	
Motor 17 ++	✗			✗	✓	
Motor 18 ++	✗			✗	✓	
Motor 19 ++	✗			✗	✓	

OK | Cancel | Apply

Configure Mach Input Signals

Scroll down to Motor– area of the sheet and make these changes.

Control Configuration Mach4Lathe:0

Defaults | General | Plugins | Motors | Aux. Positions | Axis Mapping | Homing/SoftLimits | Input Signals | Output Signals | Analog Inputs | Analog Outputs | MPGs

	Mapping Enabled	Device	Input Name	Active Low	Log Enabled	User Description
Motor 30 ++	✖			✖	✔	
Motor 31 ++	✖			✖	✔	
Motor 0 --	✖	ESS	Motor 0++{P1-11}	✖	✔	
Motor 1 --	✔			✖	✔	
Motor 2 --	✔			✖	✔	
Motor 3 --	✖			✖	✔	
Motor 4 --	✖			✖	✔	
Motor 5 --	✖			✖	✔	
Motor 6 --	✖			✖	✔	
Motor 7 --	✖			✖	✔	
Motor 8 --	✖			✖	✔	
Motor 9 --	✖			✖	✔	
Motor 10 --	✖			✖	✔	
Motor 11 --	✖			✖	✔	
Motor 12 --	✖			✖	✔	
Motor 13 --	✖			✖	✔	
Motor 14 --	✖			✖	✔	
Motor 15 --	✖			✖	✔	
Motor 16 --	✖			✖	✔	
Motor 17 --	✖			✖	✔	
Motor 18 --	✖			✖	✔	

OK   Cancel   Apply

Configure Mach Input Signals

Scroll down to Index (Encoder) area of the sheet and make these changes.

	Mapping Enabled	Device	Input Name	Active Low	Log Enabled	User Description
Motor 30 --	✗			✗	✔	
Motor 31 --	✗			✗	✔	
Digitize	✗			✗	✔	
Index	✔	ESS	{P2-4} Spindle Encoder Index	✗	✔	
Limit Override	✗			✗	✔	
E-Stop	✔	ESS	Estop {P1-10}	✗	✔	
THC On	✔			✗	✔	
THC Up	✗			✗	✔	
THC Down	✗			✗	✔	
Timing	✗			✗	✔	
Jog X+	✗			✗	✔	
Jog X-	✗			✗	✔	
Jog Y+	✗			✗	✔	
Jog Y-	✗			✗	✔	
Jog Z+	✗			✗	✔	
Jog Z-	✗			✗	✔	
Jog A+	✗			✗	✔	
Jog A-	✗			✗	✔	
Jog B+	✗			✗	✔	
Jog B-	✗			✗	✔	
Jog C+	✗			✗	✔	

Configure Mach Input Signals

There are no more changes to be made to "Input Signals"

Note that there are 127 inputs available within Mach4 software.
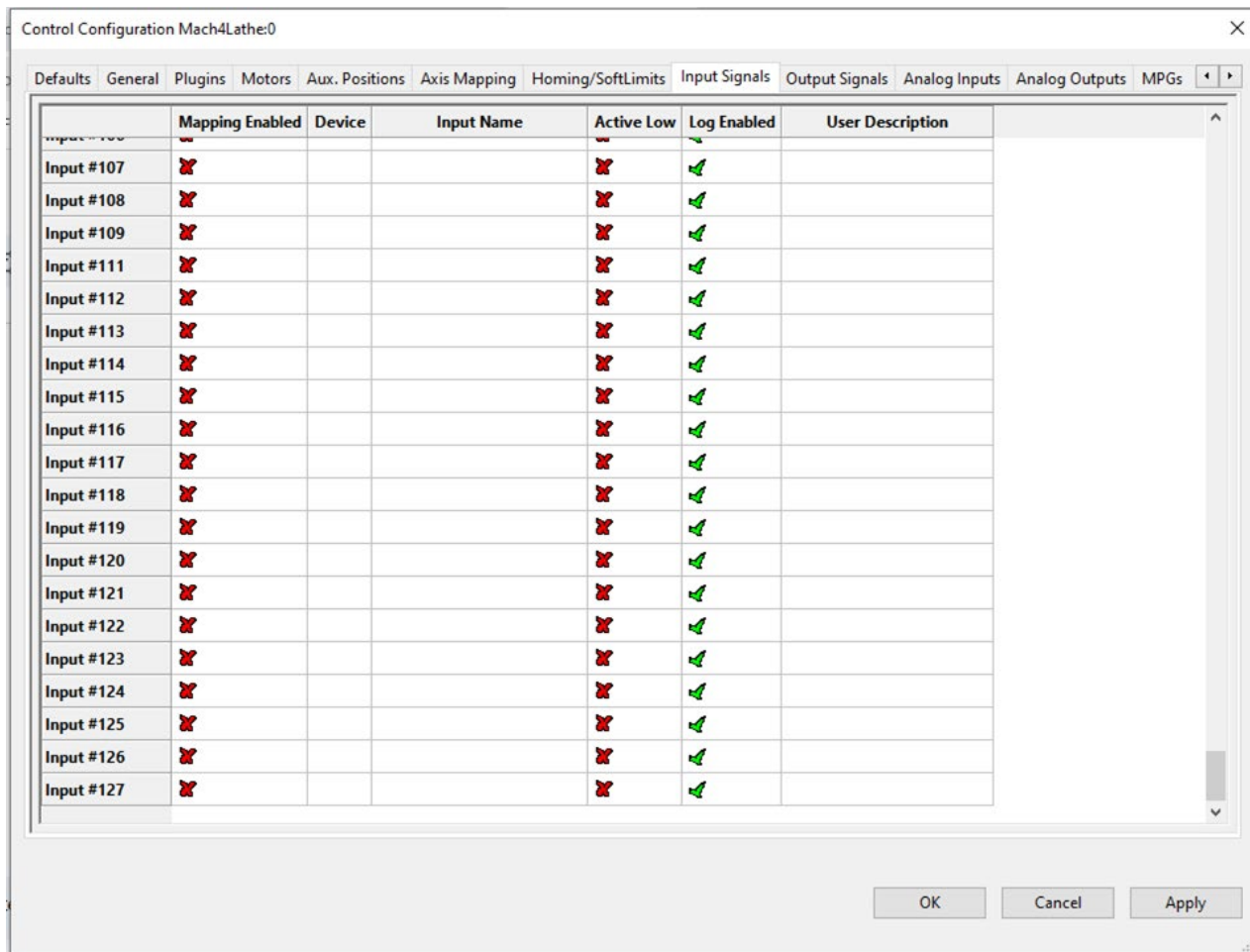
Configure Mach Output Signals

There are no changes to the "Output Signals" tab
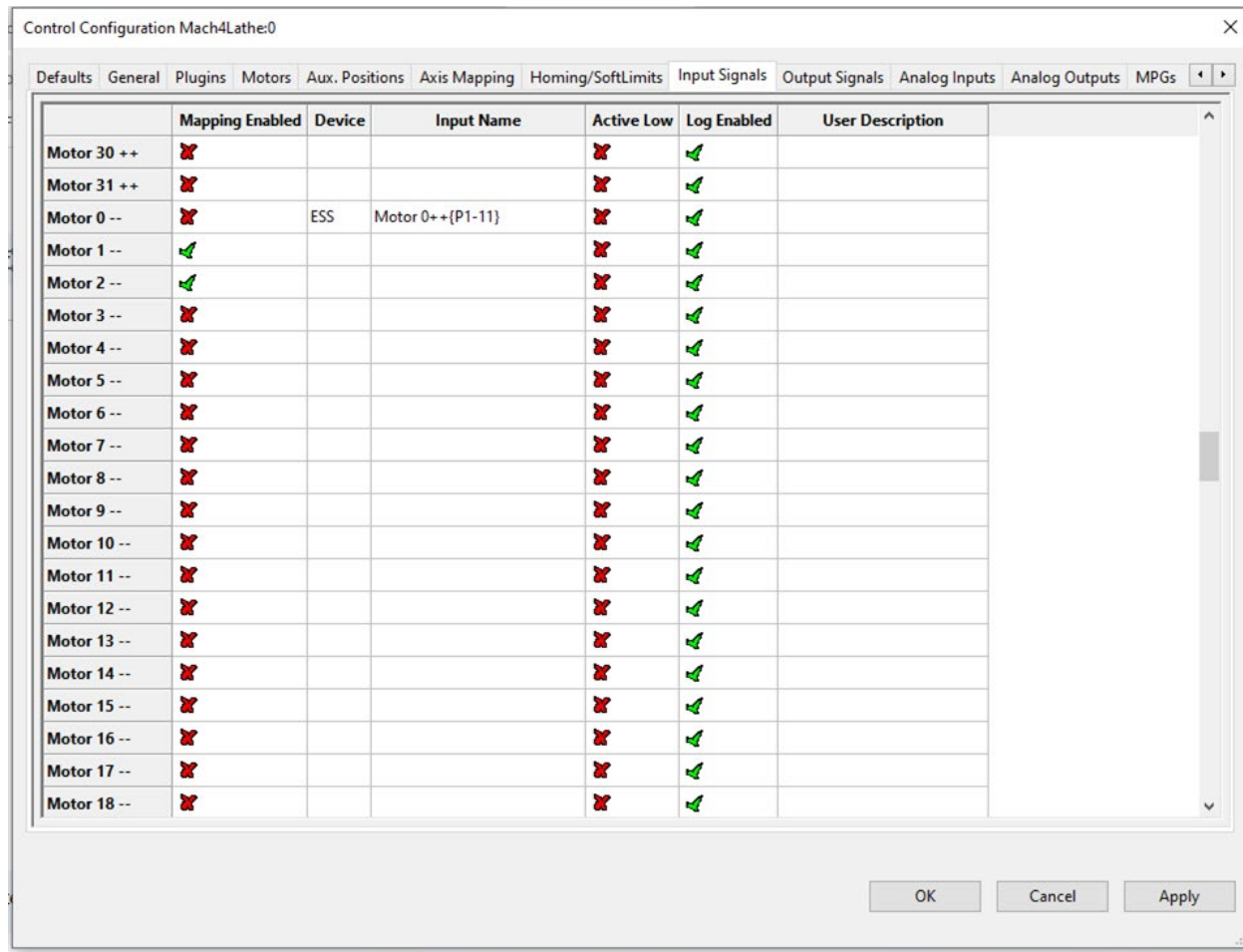

Control Configuration Mach4Lathe:0

Defaults | General | Plugins | Motors | Aux. Positions | Axis Mapping | Homing/SoftLimits | Input Signals | Output Signals | Analog Inputs | Analog Outputs | MPGs

	Mapping Enabled	Device	Output Name	Active Low	Log Enabled	User Description
X ++	✖			✖	✔	
X --	✖			✖	✔	
X Home	✖			✖	✔	
Y ++	✖			✖	✔	
Y --	✖			✖	✔	
Y Home	✖			✖	✔	
Z ++	✖			✖	✔	
Z --	✖			✖	✔	
Z Home	✖			✖	✔	
A ++	✖			✖	✔	
A --	✖			✖	✔	
A Home	✖			✖	✔	
B ++	✖			✖	✔	
B --	✖			✖	✔	
B Home	✖			✖	✔	
C ++	✖			✖	✔	
C --	✖			✖	✔	
C Home	✖			✖	✔	
Enable #0	✔			✖	✔	
Enable #1	✔			✖	✔	
Enable #2	✔			✖	✔	

OK | Cancel | Apply
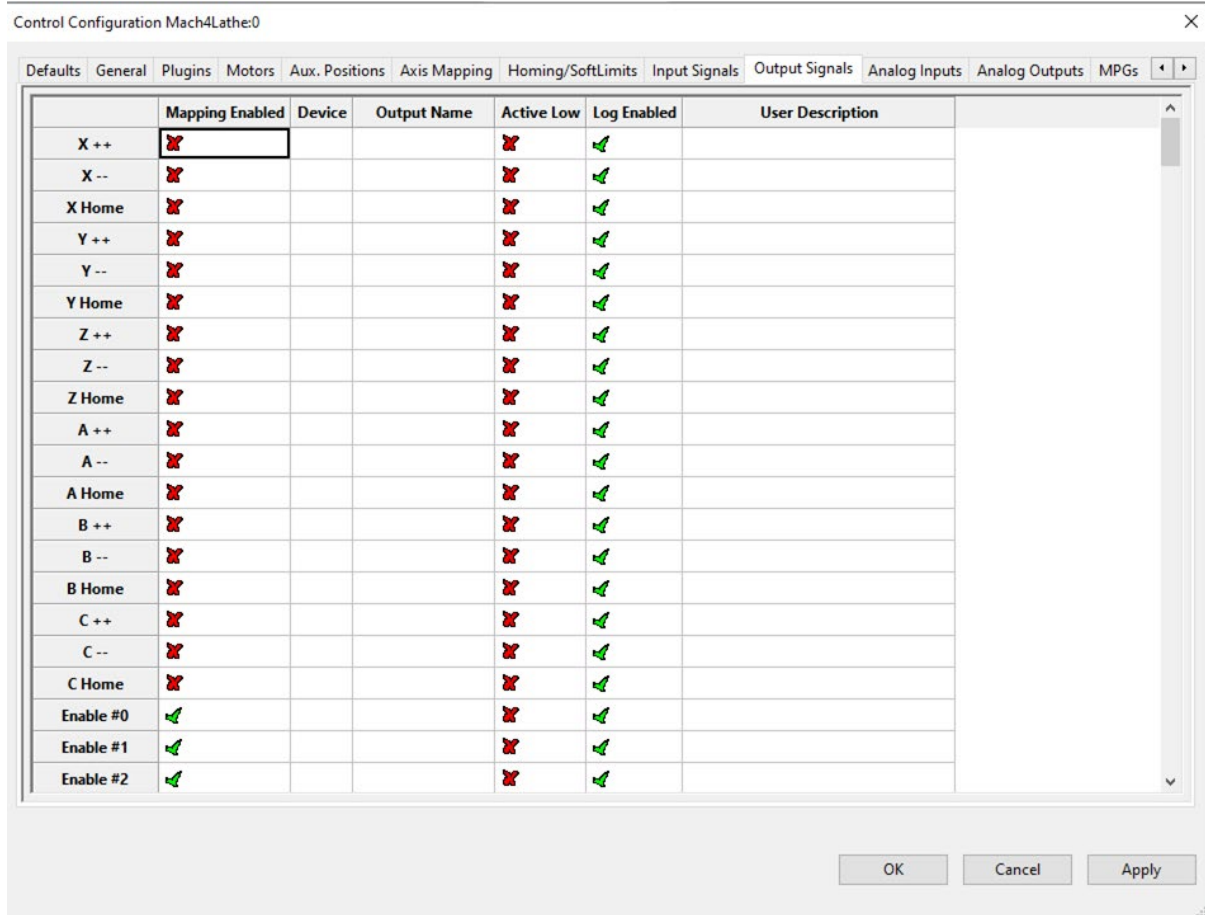
Configure Mach Tools

These values are appropriate for a lathe.

Configure Mach Spindle

Set a Min and Max speed for the lathe.

This value must be set to 0

These two values must be set as shown

The lathe has no belt ranges.

Set MAX spindle RPM

ontrol Configuration Mach4Lathe:0

Aux. Positions | Axis Mapping | Homing/SoftLimits | Input Signals | Output Signals | Analog Inputs | Analog Outputs | MPGs | Tools | Spindle | Tool Path

	MinRPM	MaxRPM	Accel Time	Decel Time	FeedBack Ratio	Reversed
0	0.00	3500.00	2.00	2.00	1.00000	✗
1	0.00	500.00	2.00	2.00	1.00000	✗
2	0.00	0.00	0.00	0.00	1.00000	✗
3	0.00	0.00	0.00	0.00	1.00000	✗
4	0.00	0.00	0.00	0.00	1.00000	✗
5	0.00	0.00	0.00	0.00	1.00000	✗
6	0.00	0.00	0.00	0.00	1.00000	✗
7	0.00	0.00	0.00	0.00	1.00000	✗
8	0.00	0.00	0.00	0.00	1.00000	✗
9	0.00	0.00	0.00	0.00	1.00000	✗
10	0.00	0.00	0.00	0.00	1.00000	✗
11	0.00	0.00	0.00	0.00	1.00000	✗
12	0.00	0.00	0.00	0.00	1.00000	✗
13	0.00	0.00	0.00	0.00	1.00000	✗
14	0.00	0.00	0.00	0.00	1.00000	✗
15	0.00	0.00	0.00	0.00	1.00000	✗
16	0.00	0.00	0.00	0.00	1.00000	✗
17	0.00	0.00	0.00	0.00	1.00000	✗
18	0.00	0.00	0.00	0.00	1.00000	✗

Max Spindle Motor RPM: 3600.00   ☐ Wait on spindle to stabilize to 90 percent.

Spindle Override Delay: 25 (ms)

Step/Dir Spindle Axis: None ▾ (Axis must be enabled and mapped.)   ☐ Enable Step/Dir Spindle rigid tapping.

OK   Cancel   Apply

Generating a Mach4 license key

Mach4 is licensed software.

A license is needed for each machine.

The license is keyed to the PC it is running on.

Each system in this project was provided with a registration code that is needed to activate a license.

Generating a Mach4 license key
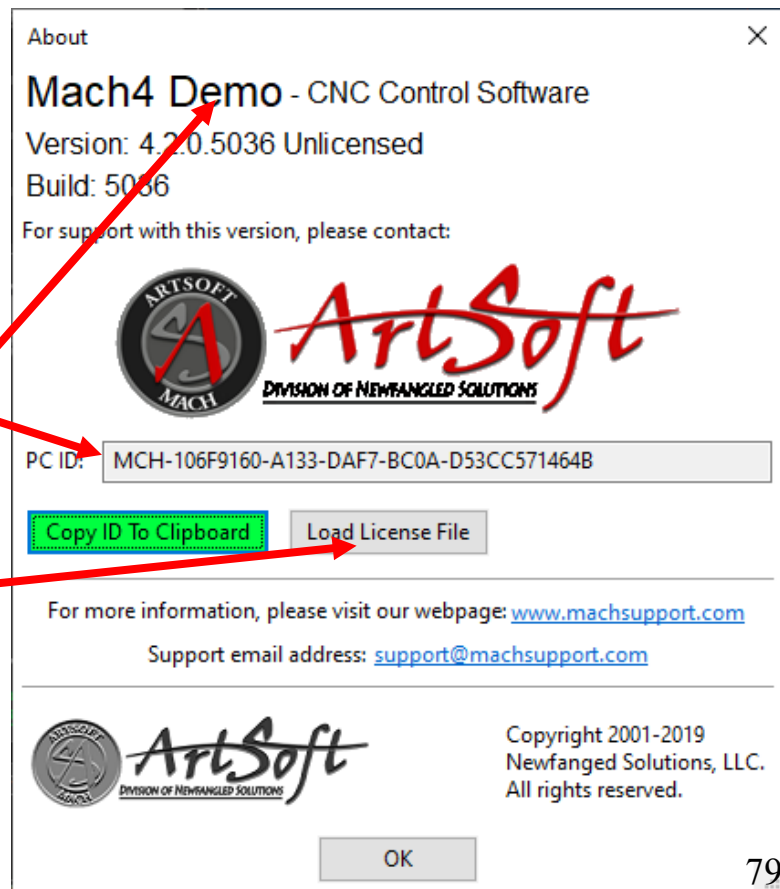
Click Help->About on the Mach4 menu bar

Copy this PC ID to clipboard.

On the Machsupport.com site paste the ID when asked.

A key file will be E-mailed to you.

Load it here.

DEMO will be changed after license is installed.

About   ×

Mach4 Demo - CNC Control Software
Version: 4.2.0.5036 Unlicensed
Build: 5036
For support with this version, please contact:

PC ID: MCH-106F9160-A133-DAF7-BC0A-D53CC571464B

Copy ID To Clipboard   Load License File

For more information, please visit our webpage: www.machsupport.com
Support email address: support@machsupport.com

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Newfanged Solutions, LLC.
All rights reserved.

OK

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Mach4 license

After the license key is successfully loaded Mach4 will change references to DEMO to your user ID.

There are some restrictions built into Mach4 DEMO that will be removed after the license is installed.

Certain changes to the PC, replacing hard drive or net card, will change the PC_ID

This will require getting a new key from Machsupport.com

Backup

Mach4 stores all configuration values and some current operation data in a file `C:\Mach4Hobby\Profiles\MyLathe\Machine.ini`.

This file is saved during shutdown.

A copy is also stored in the folder `\Backups` in the Profile folder.

A revolving list of 20 backups are saved with a 2 digit number appended.

If you ever have a problem and want to go back to a previous version simply move the file from `\Backups` to replace the current `\Machine.ini`, removing the 2 digit number.
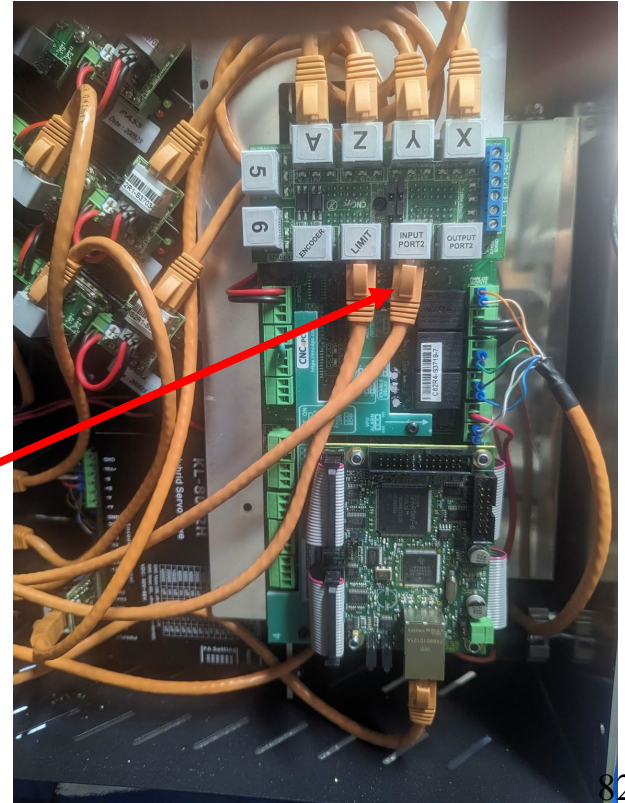
Calibrating Spindle Speed

The spindle speed is controlled by a PWM signal generated by Mach4.

A circuit on the C82 control board converts this pulse stream to a varying DC voltage between 0 and +10 volts.

Set the machine ro run at its mid-speed, #### RPM

You can use the MDI command S### M3 to set the speed.

Adjust this pot to set the speed.
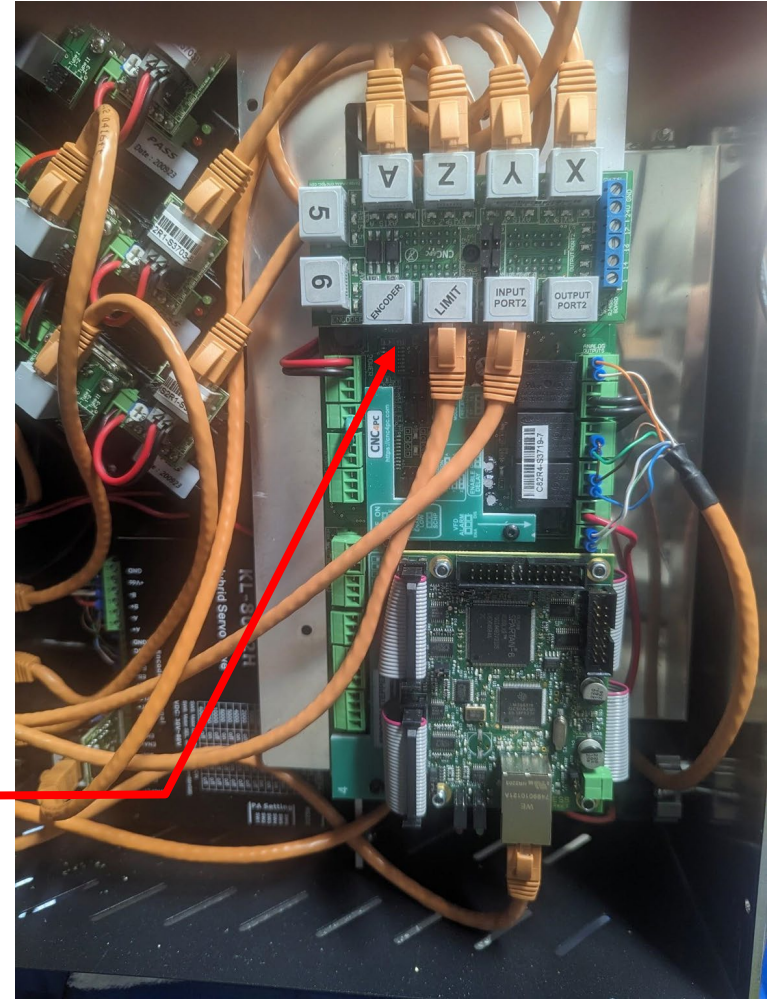
Spindle Direction control

The C82 board has outputs for Forward and Reverse run of the spindle motor.

There are two common schemes for managing these signals, one commonly used in the US, another in Europe.

The C82 board has two jumpers to set this.

If set to INT the motor will only run in one direction.

For this control the jumpers should be set to the US position.

Congratulations

You should now be ready to make parts with your new Lathe.

Good Luck!