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Installing and Configuring the Ethernet SmoothStepper V3.0

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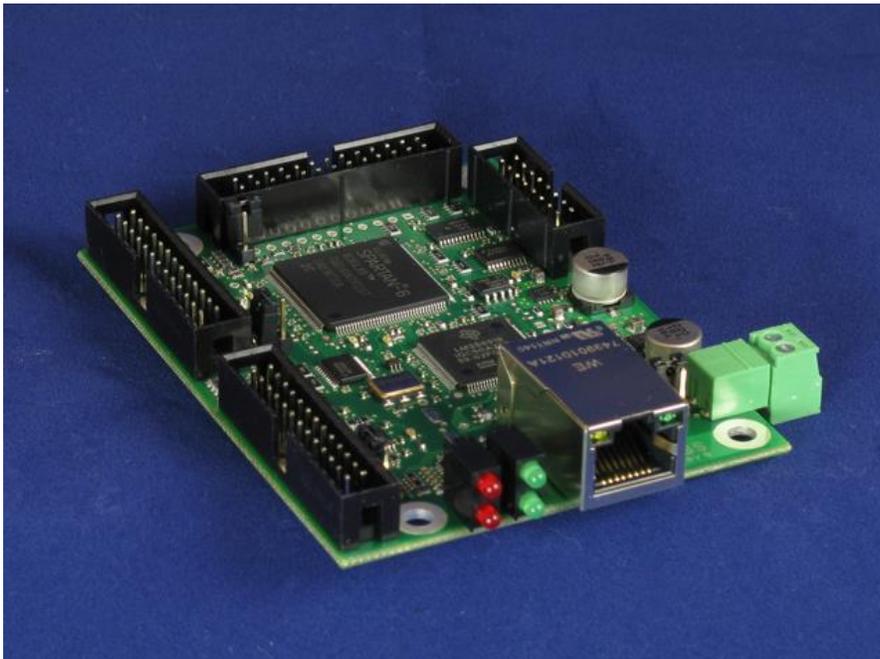
A quick guide to installing and updating the Ethernet SmoothStepper

This guide in a continuation of our famous USB SmoothStepper guide; It is intended to aide those folks who are wanting to know a bit more about configuring the Ethernet SmoothStepper for best performance and keep it update with the latest and plug-ins. Please do not try and run Mach until your installation or upgrade is complete.

This guide is not complete and is not intended to replace the SmoothStepper or Mach user's manuals. Please download both of them as they contain valuable information.

What you need to get started doing a fresh installation (SEE NOTE BELOW)

- Download the latest Mach 3 lock-down version here:
    - http://machsupport.com/downloads.php
- **Recommended version of Mach 3:**
    - http://www.soigeneris.com/Document/Mach/Mach3Version3.043.062.zip
- Download the latest Ethernet SmoothStepper driver:
    - http://warp9td.com/downloads.htm
- **Recommended version of Ethernet SmoothStepper driver:**
    - http://www.soigeneris.com/Document/Warp9/Ethernet_SmoothStepper.zip

NOTE: We recommend the versions marked '**Recommended**' above. In general we recommend using the latest Mach3 lockdown, not the development version, in this case it is important you use Mach3 Version 3.043.058 or higher and the latest Ethernet SmoothStepper plug-in. We recommend using Mach 3 Version 3.043.062.

Since the new Ethernet SmoothStepper (ESS) uses the standard Ethernet interface no driver needs to be installed. You do need to install the ESS plug-in for Mach3; this is NOT the same plug-in as the USB version. There is also a Configurator program that is a small utility that allows you to change the IP address of the ESS if you wish to. **Unless you need to change the default IP address programmed into the ESS then you don't need to mess with the configurator. It is best to not use the Configuator or change the 'Boot P' jumper on the ESS board.**

Another difference between the USB and Ethernet versions of the SmoothStepper is that the Ethernet version requires a 5V power supply. I have been using this power supply: 5V power supply , for a few years now in our 'SmoothStepper in a Can' products. We also have a new version out now for the Ethernet SmoothStepper, you can find it here.

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Let's get started

BIG NOTICE: It should go without saying that you do not want to plug the ESS into your home's networking router (but I'll say it anyhow). You should have a direct connection from your PC's Ethernet port to the ESS. On a modern Ethernet adapter a crossover cable is not needed a regular 'patch cable' can be used. If you have an older PC/network adapter you may need to use a 'crossover' type Ethernet cable.

There are five basic steps to setting up the ESS:

1) **Configuring the PC's network adapter**
2) **Allow Mach3 through the PC's firewall**
3) **Install the ESS plug-in for Mach3**
4) **Tell Mach you want to use the ESS for the motion device**
5) **Tell Mach the IP address of the ESS**

1 - Configure the PC's network adapter

The first step is to get to the right location in Windows to change your network adapter settings. The easiest is to click on the Windows 'Start' button and type 'network and sharing' and then click on the 'Network and Sharing Center' selection. Next, select 'Change adapter settings' as shown in Figure 1.
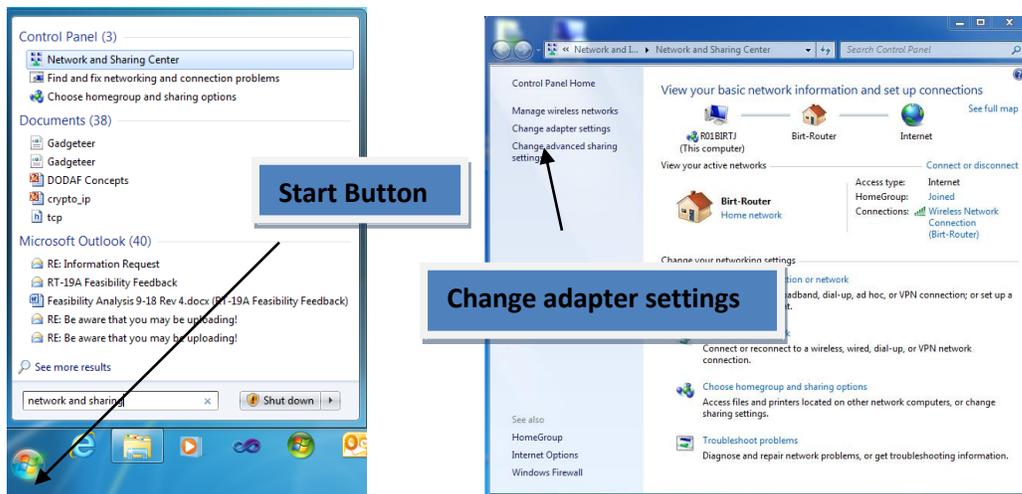
Figure 1

For Windows 8 you can get to the network settings from the Desktop by right clicking on the Networking icon in the lower right corner of the screen and selecting 'Open

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Network and Sharing Center'. This will open up a window that shows you all of the networking adapters installed on your PC. See Figure 2 below. In this case we have one wired network adapter ('Local Area Connection') and one wireless adapter. Right click on the wired network adapter and select 'Properties' from the list.
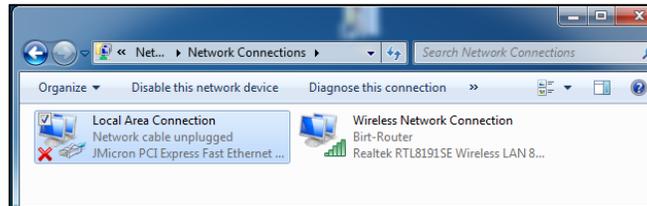
Figure 2

The 'Local Area Connection Properties' page will pop up, select 'Internet Protocol Version 4 (TCP/IPv4)' and then click on the 'Properties' button. This will bring up the properties window shown to the right in Figure 3. This is where you set the IP address of this network adapter. Click on the 'Use the following IP address' radio button, the IP address of the network adapter should be set to 10.9.9.1 and the subnet mask should be set to 255.255.255.0. The settings shown below will work well with the default settings that come programmed into the ESS. Click 'OK' to save the settings.

Note for advanced users: If you change the IP address of your ESS you PC's IP address must be on the same subnet. Unless you are an advanced user who is well versed with networking please do not use the 'Configurator' program and/or move the 'Boot P' jumper.
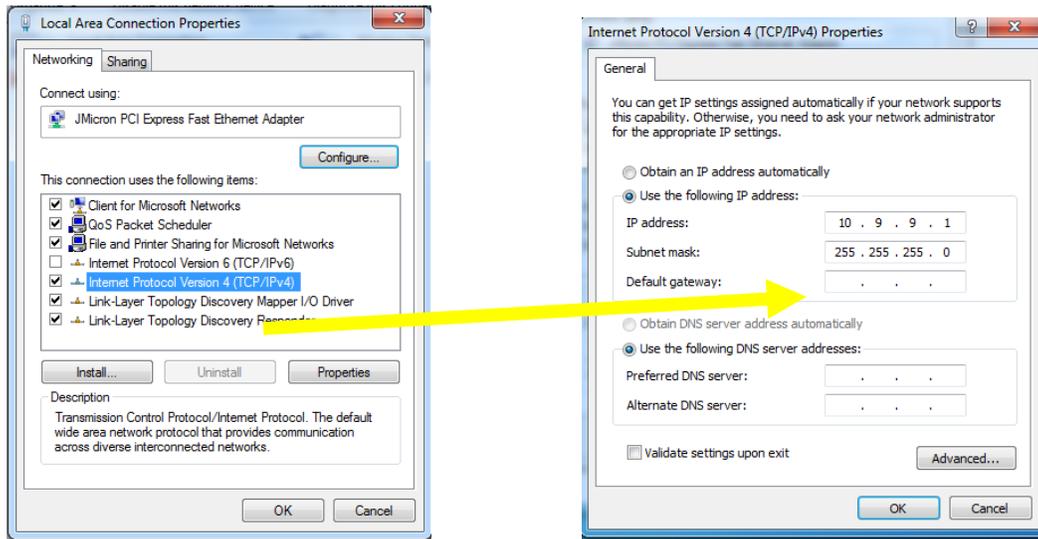
Figure 3

2 - Firewall settings

The next step is to set the Windows Firewall to allow Mach 3 program through. The easiest way to get to the firewall is to go to Start->Control Panel and then search for 'firewall' as shown in Figure 4.

Figure 4
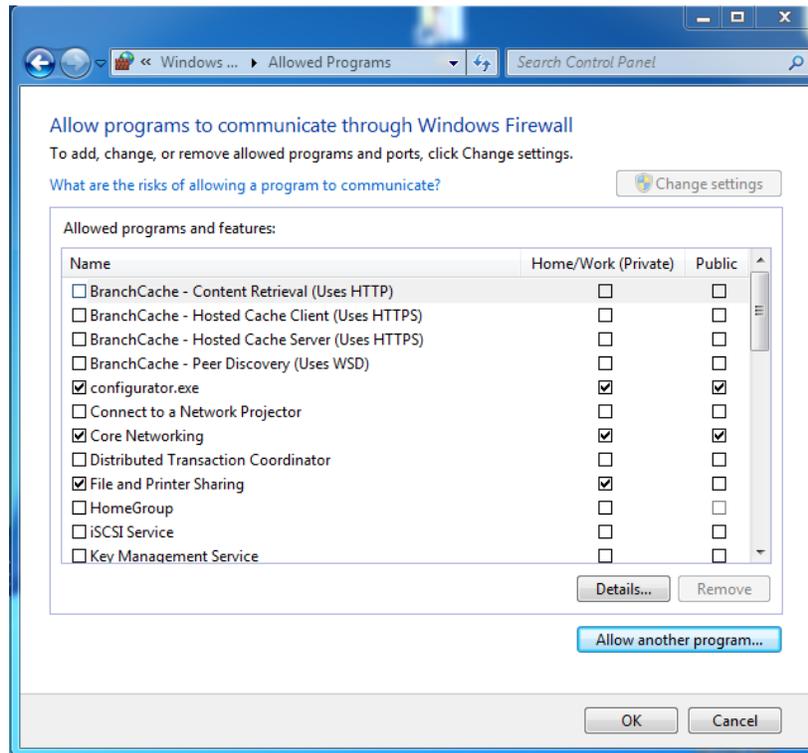
Figure 5

Now click on 'Allow a program through Windows Firewall' and the Firewall Utility will open up. See Figure 5. Click on 'Change Settings' and then 'Allow another program'. Navigate through the list of programs and choose Mach 3. These firewall instructions are for Windows Firewall, if you use a different firewall program the steps will be similar. Since there are so many different types of firewall programs it is impossible to provide step-by-step instructions for all of them.

Some anti-virus programs, like Windows Defender, may stop an unfamiliar program from having Ethernet access. If you have let Mach3 through Windows Firewall then Defender will know it is OK. If you are using a PC that was set up by your companies IT department please note that they can implement group policies can prevent you from making changes to the PCs settings. If this is the case you will need to talk to your IT department about making the needing changes.

Note - As a quick test you can open up a command window and type ' ping 10.9.9.9 **' and you should get responses back from the ESS board. This is a very low level test of the Ethernet connection. Windows may take up to 20 minutes to refresh the ARP tables after you change your IP settings. If Mach 3 is not able to find the ESS you can force the ARP cache to be cleared by opening a command window and typing '** *netsh interface ip delete arpcache* **'**

3 - Installing the SmoothStepper Plug-in

To install the Ethernet SmoothStepper plug-in for Mach 3 double click on the ESS plug in icon and it will automatically be installed in the Mach plug-in folder. A pop up window will then appear to confirm the plug-in was installed. Do not install more than one ESS plug-in. If you want to update the plug-in you must delete the old plug-in first. See the section on updating toward the end of this guide.
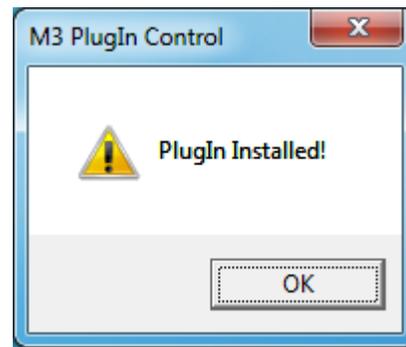
4 - Set Mach to use the ESS as the motion device

To use the Ethernet SmoothStepper with Mach 3 you need tell Mach to use it as the motion control device. Since Mach saves all your settings in 'Profiles' you need to create or modify a profile. If you are retrofitting an existing machine you can use Mach Loader to clone your existing profile. If you don't have an existing profile you can use Mach loader to create a new one.

Start Mach up with your new profile and then click on the 'Function Cfg's' menu and select 'Reset Dev Sel…'. Now shut down Mach and restart using your new profile. When Mach starts it will ask you to choose a motion control device, select the Ethernet SmoothStepper.

5 - Set the IP address of the ESS in Mach3

After selecting the Ethernet SmoothStepper as the motion device you'll see a small pop up window telling you that the plug-in was not able to communicate with the ESS. This is because you need to tell the plug-in what the IP address of your ESS is. To do this press the 'OK' button and type in 10.9.9.9 and then click 'OK'.

The only other thing to watch out for is that the ESS plug-in is likely to complain about some of the settings not being set properly, just press the button to have the plug-in set all the new ESS profile settings to their default state.

Configuring power options

On Windows 7 and up you can configure the power options in the Control Panel, Windows 7 screen shots are shown below. Open the Control Panel and type "Power Options" in the search bar as shown in Figure 6. Then select Change power savings settings.
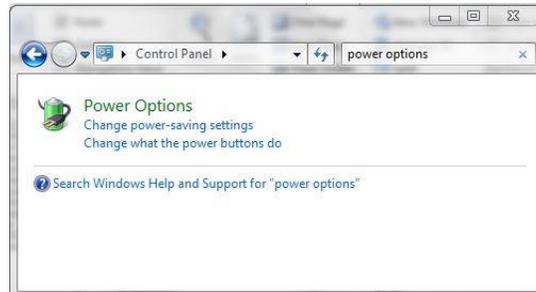
Figure 6

You will see the screen shown in Figure 7. Click 'Show additional plans' and select the High Performance plan (if available), if you only see a 'Balanced' plan use that. then click on Change plan settings.
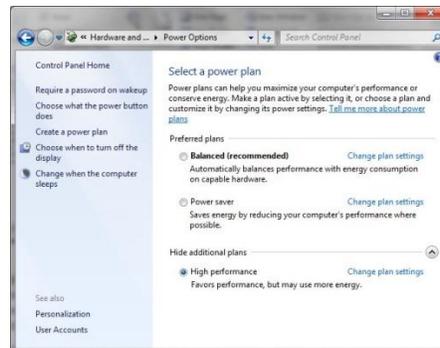
Figure 7

Go through the advanced options and make sure things are set as follows, then click 'Apply'.
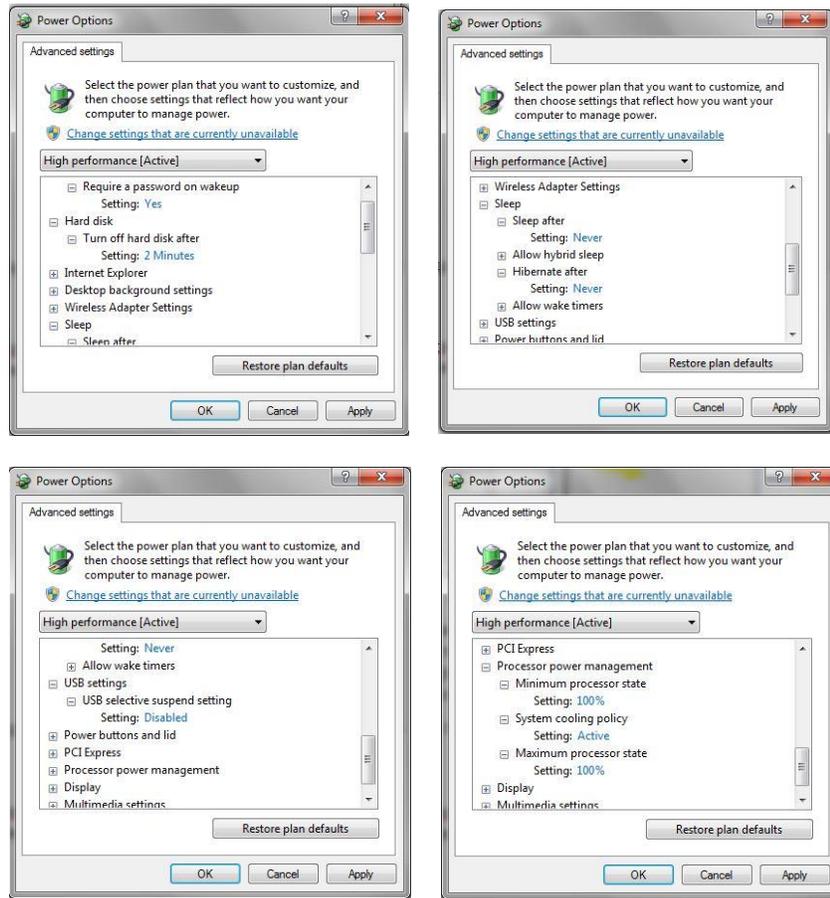
Figure 8

Configuration Tips

The SmoothStepper or any other motion control device that works with Mach DOES NOT interpret or manipulate the G-code, Mach ALWAYS does that. Mach's planner interprets the G-Code and breaks every movement down into the itty-bitty movements that needs to take place between each clock cycle; by clock cycle I am referring to the 'kernel' rate on the parallel port drive and the 'Controller Frequency' and 'Max Step Frequency' in the SmoothStepper configuration. In the SmoothStepper you can think of the 'Max Step Frequency' as sort of a kernel frequency that you can assign per axis. Just like with the parallel port driver, the steps/unit and max velocity determine the frequency needed.

In either case let's say you are starting from 0,0,0 and have a 'G0 X0.1234'; Mach will break that distance down into the small bits that need to be moved to each clock cycle (accounting for acceleration, deceleration and velocity, steps/unit). If your using the LPT driver then this clock is the kernel frequency, for the SmoothStepper is a combination of the 'Controller Frequency' and 'Max Step Frequency', as mentioned above. In some case breaking down a movement into all of these little steps leads to very minute rounding errors in the axis DRO. Since Mach runs a sort of cumulative axis DRO this is not an actual error as if it could not break a move down into an even number for display purposes the next move will be calculated properly, so any single step will be taken up on the next move. A crude analogy would be typing '1/3' into a calculator. You'll get 0.33333333...which we would just say is '0.3333'.

If the SmoothStepper has its 'Max Step Frequency' set too high for an axis it will limit the output resolution for that axis. You can get an idea of what this frequency should be set to by knowing your steps/unit and max velocity.

Steps/Unit * Units/Min = Steps/Min
Steps/Min / 60 = Steps/Second (or Max Step Frequency)

This Steps/Second is the needed step frequency for that Axis, you should set the SmoothStepper's 'Max Step Frequency' to the lowest value that is equal to or greater than your Steps/Second. Once you get all your axis' 'Max Step Frequency' set, adjust the 'Controller Frequency' to the lowest value that proved Smooth movement, the note on the SmoothStepper configuration page says higher settings will limit resolution.

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SmoothStepper Spindle Set Up

Go to Config->Ports&Pins->Motor Outputs tab

- Enable the spindle
- Assign port and pin values to match your system

Go to Config->Ports&Pins->Spindle setup tab

- Check the box that says 'Use Spindle Motor Output'
- If your spindle uses an Output to trigger a relay this needs to set up.
- The other settings do not apply to the SmoothStepper

Go to Config->Motor Tuning->Spindle Axis (press Save when done)

For a PWM spindle:

- Set "Steps Per" to 1000 (can adjust later for acceleration)
- Set "Velocity" to 60 (Effects some Mach calculations, no effect on SS)
- Set "Accel" to 1 (The accel is calculated as "Steps Per" * "Accel", so just adjust "Steps Per" to get the accel results that work well)

For Step & Direction:

- Set "Steps Per" to the maximum step frequency. This is the frequency that will produce the maximum speed of the spindle motor.
- Set "Velocity" to 60. This is a magic number that allows you to enter the max step frequency for "Steps Per".
- Set "Accel" to whatever value gives you the acceleration you want.

Go to Config -> Spindle Pulleys

- Select a pulley
- Choose min and max RPM, and a ratio so that spindle feedback calculates the correct RPM for display

SmoothStepper Config (Under PlugIn Control)

For PWM:

- Check the box for PWM
- Select a base frequency for PWM (in Hz)

For Step & Direction:

- Check the box for Step & Direction
- Select a step pulse width. Make sure the frequency that was selected in Motor Tuning is not too fast for this pulse width. Otherwise the signal will never transition. For example, for a max step frequency of 25 kHz, the maximum pulse width is 40 microseconds. At 25 kHz, the waveform would be 100% duty cycle if the pulse width is 40 us.

Homing and Limits

Here is a screen shot of the new Homing Dialog.

Axis	Approach Speed (units/min)	Backoff Speed (units/min)	Index Port	Index Pin	Index Active Low	Final Position (units)	Slave Misalignment (units)	Max Master/Slave Separation (units)
X	10	1	2	10	☐	0.1	0	0
Y	10	1	2	11	☐	0.1	0.014	1
Z	5	1	2	13	☐	0.1	0	0
A	0	0	2	12	☐	0		
B	0	0	0	0	☐	0		
C	0	0	0	0	☐	0		

OK   Cancel

☑ Enable This Config

Approach and Backoff speeds are in units/min (i.e. inches/minute or mm/minute). Absolute values are better than using a percentage, which is the way it is done with the Parallel Port. If you want to use a percentage, using a value of 0 for either of these options will make it revert to using Mach's reference speed percentage. For Slaved axes it is not necessary to enter an approach speed or Backoff speed since it will use the master's.

The Index Port and Pin are used if you have encoders with index pulses. This is by far the most accurate way to home. If these values are set to non-SmoothStepper Ports and/or pins, the plugin will ignore them and use the switches when backing off. Index Active Low changes the polarity of the signal.

Final Position is the position it should move to relative to Machine Zero. The plugin commands a G1 G53 move to this position. In the same move, it also adjusts the slave's destination by the Slave Misalignment amount. At the end of the move, the master and slave should be square and slaved again.

Max Master/Slave Separation is the maximum distance it will allow the master and slave to separated by. On the approach to the switch, this is not be enforced as precisely as I'd like. The separation is monitored in the plugin rather than the device. I actually haven't added this code yet, but I will soon. When it backs off of the switches, it backs off as a slaved pair. On the final gcode move, the max separation is strictly enforced.