

Ethernet SmoothStepper Troubleshooting Guide

The Ethernet SmoothStepper (ESS) operates in one of two modes:

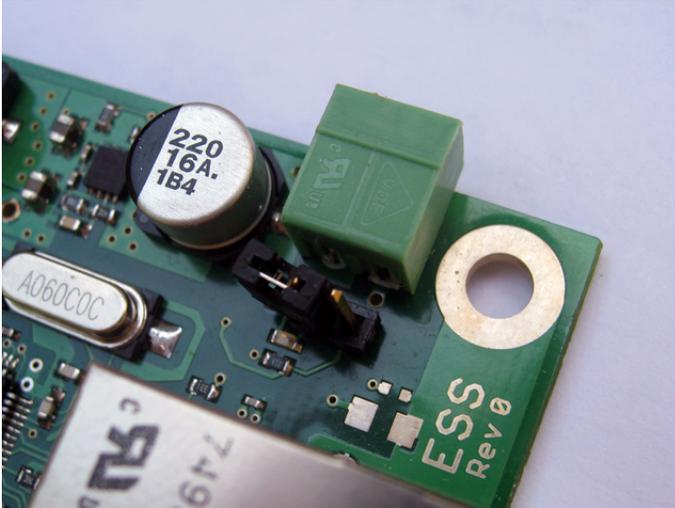
1. Wakeup mode (used with the Mach3 plugin)
2. BOOTP mode (used with the Configurator program)

In the Wakeup mode, the board does not transmit any Ethernet data until it is woken up by the Mach plugin. BOOTP mode is the opposite. In that mode the board will output a BOOTP Request about once per second. The Configurator is listening for this data and will reply to the board with an IP address that the board may use. Since the PC is not likely to be the server on the network that assigns IP addresses (DHCP server), there is a chance that the assigned address could conflict with another computer on the network. Since the BOOTP mode is only used for configuration of a SmoothStepper device, this is not much of a concern. If you are in doubt and concerned, directly connect an Ethernet cable from the computer to the SmoothStepper board and make sure that no other Ethernet connections are being made to the computer. Since the board requires a static IP address in order to run, you will be responsible for choosing that address. It is very unlikely that the default value of 10.9.9.9 that was programmed by Warp9 is in use in your system. You may reprogram the device to use any address of your choosing.

BOOTP (Boot Protocol) is the predecessor to DHCP (Dynamic Host Configuration Protocol). The two protocols use the same port numbers (67 and 68) and are differentiated by the contents of the packet. BOOTP is simpler, but it is inefficient. When an IP address is assigned to a device, there is no mechanism to reclaim the address in the future if the IP address is no longer used. DHCP adds this functionality by leasing the addresses for a specified amount of time. The device must renew the address periodically if it wishes to continue operating at that IP address. If the device fails to renew the address, the address goes back to the available pool of addresses.

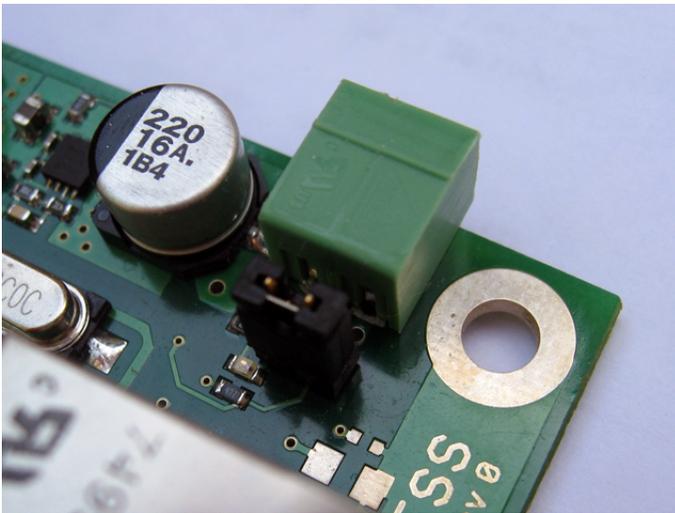
The Configurator is a good tool for debugging your installation. Since the board broadcasts a BOOTP Request message about once per second, you will be able to see this Ethernet traffic if you install an Ethernet packet sniffer on your computer. There is an awesome free program named “Wireshark” that you can download and install that will allow you to observe all of the Ethernet traffic on your computer. It uses an underlying program named WinPcap that captures packets of data at a very low level.

When the board is powered up, the microcontroller on the board runs a bootloader that is locked in its flash memory. Whether the bootloader starts in BOOTP or Wakeup mode is determined by a jumper that is located near the 5V screw terminals of the board. Please refer to the following two pictures that show the jumper in the on and off positions.



Wakeup Mode

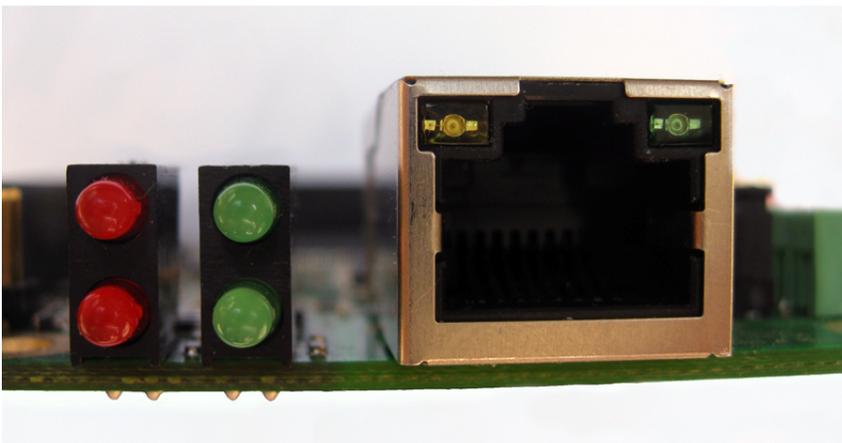
The Ethernet SmoothStepper is shipped with the jumper attached to one of the two posts for convenient storage. In this configuration it will enter the Wakeup mode when it is powered.



BOOTP Mode

In this picture the jumper is shorting out the two pins. When power is applied the device will be operating in BOOTP mode.

You will be able to observe which mode it is in by looking at the right-angle LEDs to the left of the Ethernet jack. The upper one of the two green LEDs will blink a code that will tell you which mode it is in.



Blink Code of Upper Green LED	Mode	Meaning
Two short blinks followed by a longer pause	Wakeup Mode	The static IP address that was programmed by the Configurator and stored in the flash memory of the device is valid. The board will be listening for a wakeup message at that IP address.
Long On followed by long Off	BOOTP Mode	The jumper is attached and it is in BOOTP mode.
Long On followed by two short blinks	BOOTP Mode	The jumper is not attached, but the memory where the static IP address is located does not have a valid signature. Without a valid IP address it needs to revert to the BOOTP mode.

Once the board is powered-up and enters a mode, it will remain in that mode until the board is reset by software or power is removed and reapplied.

The Ethernet jack has two LEDs. The yellow/amber one indicates that the low-level Ethernet link to the computer has been established. If the yellow/amber LED is not lit, then that is a major problem. The other LED is green and it blinks when there is Ethernet traffic that is intended for the board, or the board is transmitting. You should see this green LED blink once per second (it might blink more often if there is other Ethernet traffic present in addition to the BOOTP Requests).

The IP address that you enter when you run the plugin is stored in the XML file. I apologize for the unpolished interface for setting the IP address. I will be making that more clear in the future. Since you are starting with an XML file that does not have the IP address of board written to it, the plugin will tell you that it can't find the board and will give you three options. If you click on the "Yes" button it will retry, but it will be unsuccessful and it will return you to the same point. If you click "Cancel", it will not do any good but allow you to exit to Mach. Clicking "No" will allow you to type in an IP address. This address will be used by the plugin to address the board. When you gracefully exit Mach, the IP address that you specified will be written to the XML file. The next time you run Mach with that XML file, it should connect OK.

Make sure that the PC is configured to use a static IP address in the IPV4 settings of the network settings for the Ethernet port of the PC. The mask should be set to 255.255.255.0, otherwise it will not work. The address that you type in when Mach runs needs to be in the same subnet as the computer. In other words, the first 3 groups of numbers of the IP address for the PC and the ESS board must match. For example, the PC could be assigned 10.9.9.1, and the ESS board could be assigned 10.9.9.9 (anything that starts with 10.9.9., but not the same address as the PC or the address of another device on the network).

If you are unable to get the plugin to talk to the board when it is in Wakeup mode, I would recommend running the Configurator (<http://warp9td.com/files/Configurator.exe>). The Configurator is a simple program that is used to program a static IP address into the board. Since there is practically no chance of a firewall blocking a BOOTP Request, you should be able to successfully run the Configurator. The Configurator will allow you to program a "Nickname" into the board, though that feature is not being used yet. When it is used, the nickname will be splashed on the screen so that you know which board you are connecting to. For example you could program the name "Lathe" or "Mill" or whatever you want. If you have more than one board you can program each one with its name and then you will see what you are connecting to when you run Mach. The other option that the Configurator has is the "Server Address". This will allow you to program the MAC address of your PC into the board so that it will only communicate with a specific Ethernet port on your PC. The MAC address (Media Access Control) is a unique address that is programmed into every Ethernet device. This further ensures that you will not be able to inadvertently operate the wrong machine if you happen to have multiple boards on the same network. If you program a MAC address of FF:FF:FF:FF:FF:FF, the board will respond to any Ethernet port.

If you are unable to get a response when trying to run the Configurator, you should install the freeware Ethernet packet sniffing program named Wireshark. Here is the link:

<http://www.wireshark.org/>

When WinPcap installs (the packet capture program that Wireshark uses), you will have the option of allowing it to run each time you start Windows. If you choose no, then you will need to manually start it before running Wireshark. If you are using Windows 7, you will need to open up a command prompt as Administrator. To do that, go to the Windows Start button, and type "cmd" in the search box. It will find the cmd.exe program and list it (alternatively, look in the Accessories Folder and you should find cmd.exe there as well). Right-click on cmd.exe and choose the option "Run as administrator". If you don't, the command window will only have user privilege. Once you have a command window open, type the following:

```
sc start npf
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This will start the WinPcap packet capture software. If you want to change it so that it always starts automatically when starting Windows, I believe the following command will work:

```
sc config npf start=auto
```

With the packet capture software running, you can start Wireshark. Choose the pulldown menu "Capture" and then choose "Interfaces". This will list all of the ports on your computer that you can capture data on. If you don't know which one is the right one, you can try each one until you find it. Click on "Start" to start capturing data.

In Wireshark you should see something that looks like this (probably not the same exact columns since I have added a few to mine):

No.	Time	Delta Time	Source	Destination	Protocol	SRC	Dest	Size	Info2
1	0.000000	0.000000	0.0.0.0	255.255.255.255	BOOTP	68	67	342	Boot Request from 00:50:c2:ea:b0:00 (warp9Tec_00:00)
2	1.019904	1.019904	0.0.0.0	255.255.255.255	BOOTP	68	67	342	Boot Request from 00:50:c2:ea:b0:00 (warp9Tec_00:00)
3	2.039813	1.019909	0.0.0.0	255.255.255.255	BOOTP	68	67	342	Boot Request from 00:50:c2:ea:b0:00 (warp9Tec_00:00)
4	3.059720	1.019907	0.0.0.0	255.255.255.255	BOOTP	68	67	342	Boot Request from 00:50:c2:ea:b0:00 (warp9Tec_00:00)
5	4.079625	1.019905	0.0.0.0	255.255.255.255	BOOTP	68	67	342	Boot Request from 00:50:c2:ea:b0:00 (warp9Tec_00:00)
6	5.099536	1.019911	0.0.0.0	255.255.255.255	BOOTP	68	67	342	Boot Request from 00:50:c2:ea:b0:00 (warp9Tec_00:00)
7	6.119442	1.019906	0.0.0.0	255.255.255.255	BOOTP	68	67	342	Boot Request from 00:50:c2:ea:b0:00 (warp9Tec_00:00)
8	7.139351	1.019909	0.0.0.0	255.255.255.255	BOOTP	68	67	342	Boot Request from 00:50:c2:ea:b0:00 (warp9Tec_00:00)
9	8.159256	1.019905	0.0.0.0	255.255.255.255	BOOTP	68	67	342	Boot Request from 00:50:c2:ea:b0:00 (warp9Tec_00:00)
10	9.179167	1.019911	0.0.0.0	255.255.255.255	BOOTP	68	67	342	Boot Request from 00:50:c2:ea:b0:00 (warp9Tec_00:00)
11	10.199071	1.019904	0.0.0.0	255.255.255.255	BOOTP	68	67	342	Boot Request from 00:50:c2:ea:b0:00 (warp9Tec_00:00)
12	11.218982	1.019911	0.0.0.0	255.255.255.255	BOOTP	68	67	342	Boot Request from 00:50:c2:ea:b0:00 (warp9Tec_00:00)
13	12.238890	1.019908	0.0.0.0	255.255.255.255	BOOTP	68	67	342	Boot Request from 00:50:c2:ea:b0:00 (warp9Tec_00:00)

If you don't see this, then something is wrong. A firewall shouldn't block this traffic, but just in case, you can try turning off your firewall to see if anything is captured. If it still doesn't work you can try to get it to work on another computer, just to make sure there isn't anything wrong with your computer. When you run the Configurator program, Wireshark should see this BOOTP request and the Configurator's response to it (BOOT Reply). Then you will see some UDP messages.

Besides helping diagnose problems with your Ethernet SmoothStepper installation, Wireshark is a pretty useful piece of software when trying to connect to a wireless router. Wireshark shows you what your computer is doing and whether or not there is any response from the wireless router. If a computer cannot obtain an IP address, it will eventually fall back to a "Link-local" address. This is an address in the range of 169.254.1.0 to 169.254.254.255. The computer is allowed to randomly pick an address in this range which will allow it to send normal Ethernet packets such as TCP. Without an IP address, the computer is unable to send anything but broadcast packets (if a device is supposed to respond to the packets, it needs to be a specific address, not a broadcast address, thus the reason for the 169.254.x.x addresses).

Once you have successfully used the Configurator, you can use Wireshark to observe the Ethernet traffic in the Wakeup mode. When you start capturing you won't see anything until you press "Yes" to try again. You should see an ARP Request (Address Resolution Protocol) since the PC doesn't know which MAC address matches up with the IP address it is trying to talk to. The board should respond, telling the PC what its MAC address is. Once it gets past that it, then it can blast away.

I wouldn't expect a problem with the PC's ARP Table, but you could open up a CMD prompt window and type in the following to clear the ARP table:

arp -d

You can try a different Ethernet cable, though if the yellow/amber link LED on the Ethernet jack lights up when you plug the cable into the jack, then it probably isn't the cable. It doesn't matter if the cable is straight-through or crossover. The microcontroller will automatically swap the wires so that it is right.