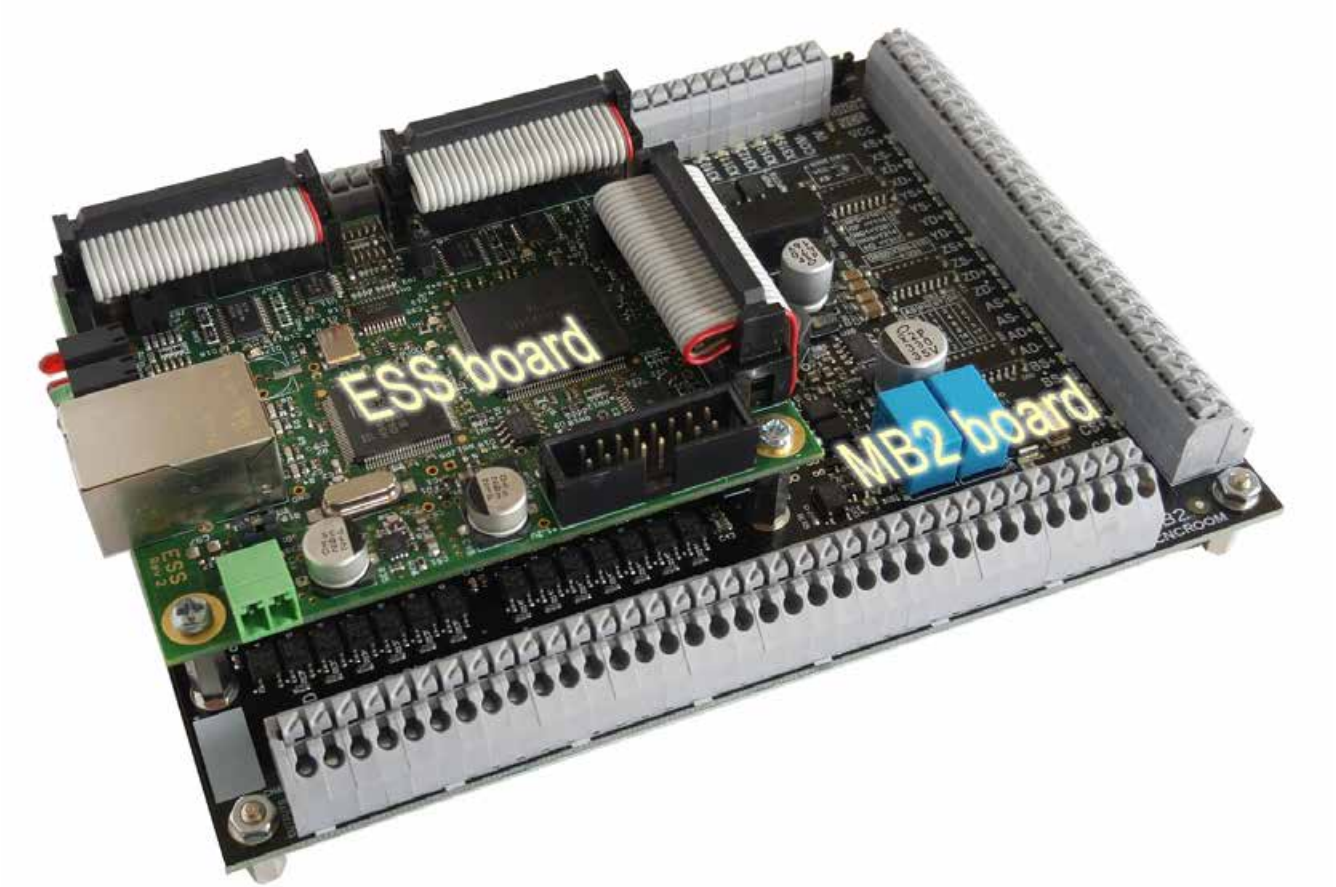
MachBob2 (MB2)

Owner's manual



Doc E1.6Rev5 (8/17/2017)
for PCB ver 1.3, 1.5 and 2.0

Introduction

It is perhaps well understood that in an industrial environment, personal computers, motion control boards and logic signals can face a large amount of interference from things such as power cables, motors, welding machines, magnetic contactors etc.

We can help to minimize the effects of this interference by having any susceptible electronics enclosed in a metal control cabinet and using the correct safety and best practice techniques, which include, but are not limited to the installation of noise reduction such as an isolated transformer and noise filters.

While these things will help us achieve a better result, using a control board designed for industrial applications can be more important.

MachBob2 (MB2) is designed for industrial application and specifically to work with the Ethernet Smooth Stepper (ESS) which is an excellent motion control board designed to be used with Mach3 and Mach4

Specification and Features

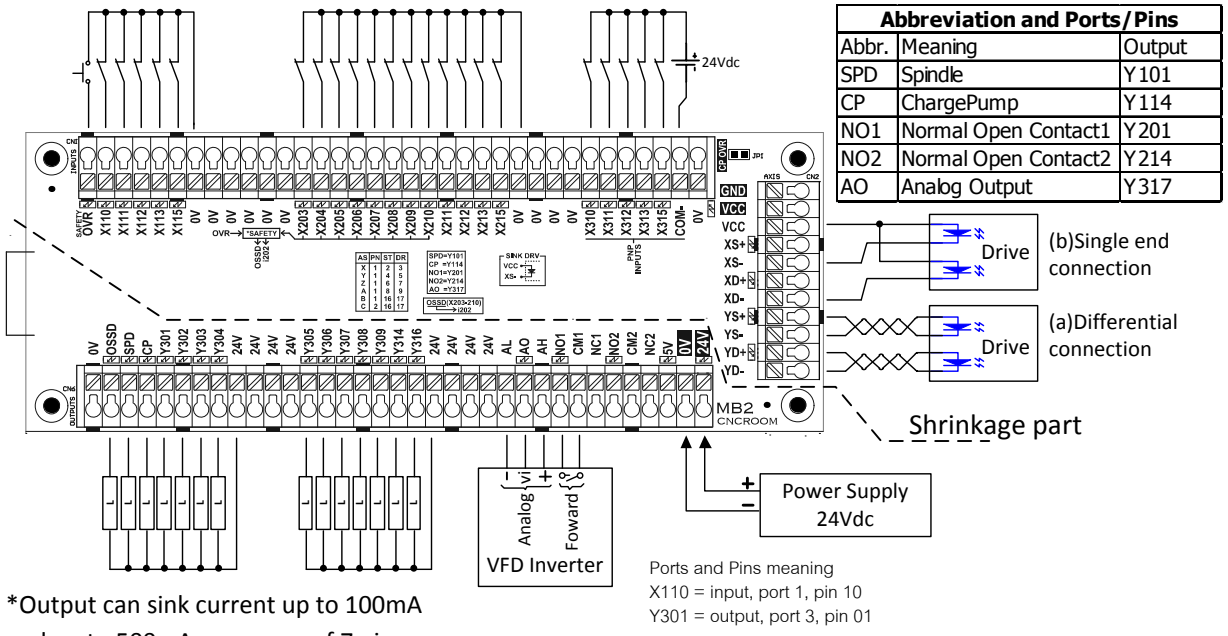
- By using an Ethernet connection, the ESS is far more noise resistant than when using a USB or parallel Port connection and therefore helps to protect the logic signal when the controller and drives are located a large distance from the computer.
- Runs on Mach3 / Mach4 with Windows XP, Win7, Win8 both 32 and 64 bit, on both desktop and notebook computers.
- New! Utilizes All 3 ports of the ESS.
- New! The Motion Command Signal can be selected between Pulse/Sign, CW/CCW, and Quadrature. Frequency can be selected from 32 kHz to 4 MHz
- New! Differential line driver for motion signals, allows for longer wiring with more resistance to interference when compared to TTL open end.
- New! A single 24Vdc Power Supply is needed. There is a 5Vdc isolated and non-isolated dc2dc converter on board, thus saving installation space and wiring.
- New! OSSD (Output Signal Switching Device) outputs and safety circuit are implemented when a peripheral device such as a servo motor drive or a spindle VFD (Variable Frequency Drive) trigger an alarm condition, which causes the Safety Circuit to disengage the OSSD output. This method is used on large CNC machines to cut power from the drives.
- New! LED status for all inputs and outputs including motion control signals. Makes it much easier to diagnose and trouble shoot.
- Isolated power and ground between the PC, ESS and I/O, which eliminates crossover noise and ground loop problems.
- New! Polarity and over voltage protection (in conjunction with a fuse) for the 24Vdc power supply.

- An “AnaSpeed” circuit has been implemented. This circuit is totally isolated from the MB2 and forms a part of the VFD inverter, acting as a digital VR (variable resistor). High voltage noise from the inverter cannot cause interfere through this connection.
- A charge-pump signal is provided. This helps the user to form a safety interlock condition between controller and devices.
- 22 isolated input terminals, consisting of 17 terminals of NPN and 5 terminals of PNP type.
- 14 NPN isolated output terminals capable of sinking current up to 100mA for each channel and up to 500mA per group.
- New! MB2v1.5 and 2.0 - 2 onboard relays with both NO/NC contacts and “Off Delay Time”, which can be used for such application as “Z Drop Protection.” (*MB2v1.3 does not have this feature*)
- New! MB2v2.0 -The K2 Relay can now be controlled by a charge pump signal. Please notice blue arrow on page19, ***Figure 19,*** *the underneath layout of the MB2*. Showing the appropriate solder bridge for modification.
- Spring terminals for quicker connecting and disconnecting of cables. They are resistant to vibration, so no more screws which have rattled loose and no more forgetting to tighten.

Precaution

- Remember to static discharge before touching any part of ESS/MB2. Ground your body by wearing a grounding strap or frequent touching an earthed metal chassis to release electrostatics.
- Make sure that there is no high voltage leak from your soldering iron when soldering the solder-bridge – the safest way is to unplug your soldering iron from the mains power when it has reached a high enough temperature to melt the solder. High voltage leakage from a cheap soldering iron can potentially damage the integrated circuit (IC) on the MB2 board.
- The MB2 board is **Fragile**, do not drop, as it could badly damage the electronics.
- In certain circumstances, it could be possible for the MB2 board to build up excessive heat if many of the inputs and outputs are active at same time over an extended period. It is therefore advisable to install a good quality cooling fan to ventilate the cabinet.

Quick Reference



Abbreviation and Ports/Pins		
Abbr.	Meaning	Output
SPD	Spindle	Y101
CP	ChargePump	Y114
NO1	Normal Open Contact1	Y201
NO2	Normal Open Contact2	Y214
AO	Analog Output	Y317

Figure 1, MB2 Overview Connection

Port1 (output)			
Pin	I/O	Term Name	I/O Type
1	O	SPD(Spindle)	Sink output
2	O	XS (X Step)	Line driver
3	O	XD (X Dir)	Line driver
4	O	YS (Y Step)	Line driver
5	O	YD (Y Dir)	Line driver
6	O	ZS (Z Step)	Line driver
7	O	ZD (Z Dir)	Line driver
8	O	AS (A Step)	Line driver
9	O	AD (A Dir)	Line driver
10	I	X110	NPN input
11	I	X111	NPN input
12	I	X112	NPN input
13	I	X113	NPN input
14	O	CP(ChargePump)	Sink output
15	I	X115	NPN input
16	O	BS (B Step)	Line driver
17	O	BD (B Dir)	Line driver

Port2 (Pins 2-9 as input)			
Pin	I/O	Term Name	I/O Type
1	O	NO1 Relay1	Contact
2	I	OSSD	Sink Output
3	I	X203	NPN input
4	I	X204	NPN input
5	I	X205	NPN input
6	I	X206	NPN input
7	I	X207	NPN input
8	I	X208	NPN input
9	I	X209	NPN input
10	I	X210	NPN input
11	I	X211	NPN input
12	I	X212	NPN input
13	I	X213	NPN input
14	O	NO2 Relay2	Contact
15	I	X215	NPN input
16	O	CS (C Step)	Line driver
17	O	CD (C Dir)	Line driver

Port3 (Pins 2-9 as output)			
Pin	I/O	Term Name	I/O Type
1	O	Y301	Sink output
2	O	Y302	Sink output
3	O	Y303	Sink output
4	O	Y304	Sink output
5	O	Y305	Sink output
6	O	Y306	Sink output
7	O	Y307	Sink output
8	O	Y308	Sink output
9	O	Y309	Sink output
10	I	X310	PNP input
11	I	X311	PNP input
12	I	X312	PNP input
13	I	X313	PNP input
14	O	Y314	Sink output
15	I	X315	PNP input
16	O	Y316	Sink output
17	O	AO	Analog output

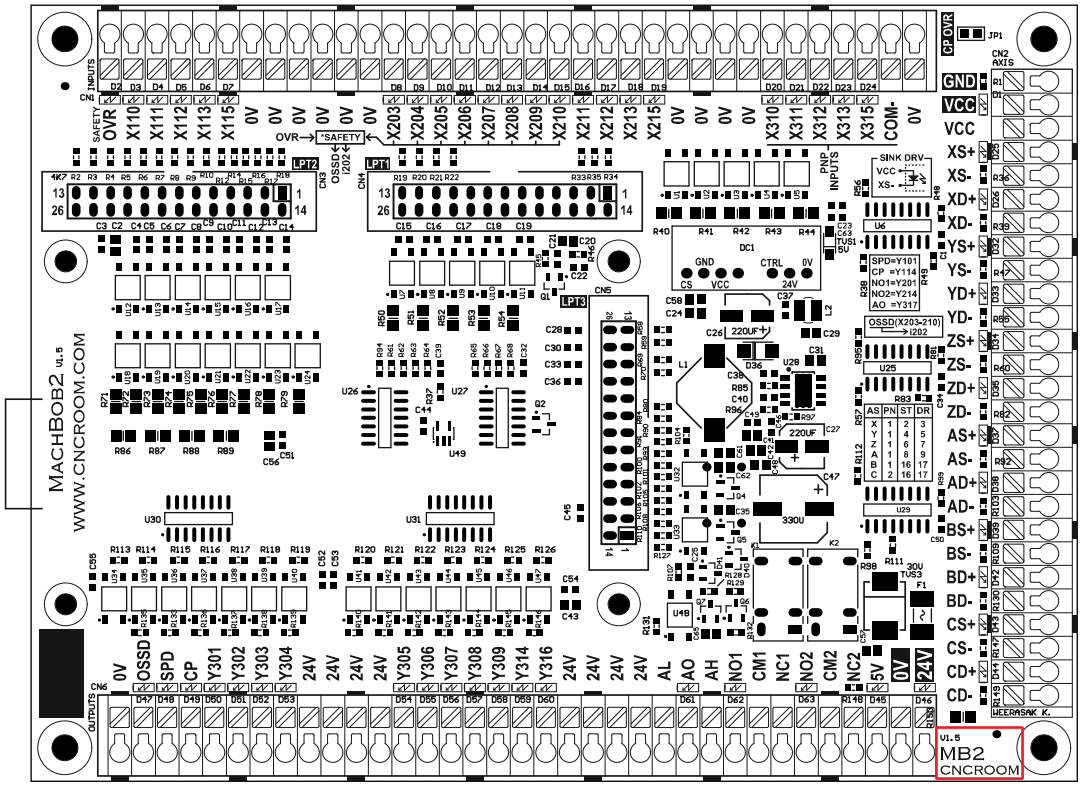
Table 1, Ports and Pins Reference Tables

Quick Reference is a summary for the experienced user.

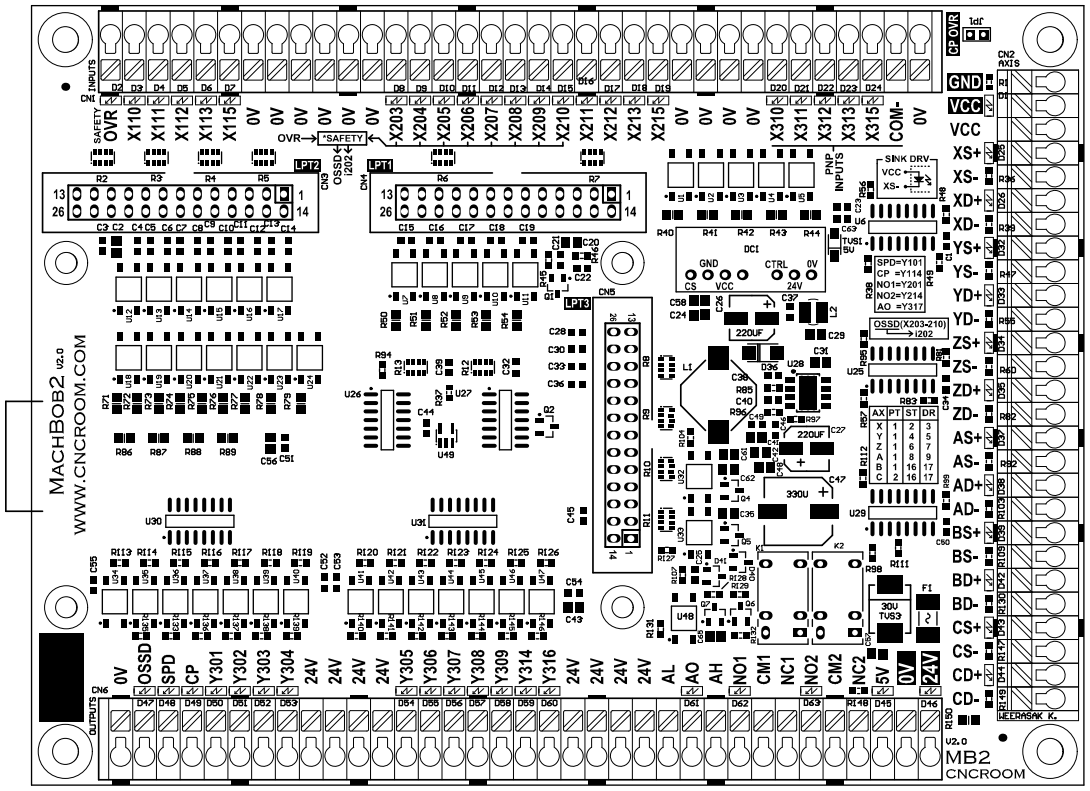
Figure 1 is a shrinkage view of MB2 board. It shows the connection of inputs & outputs, power supply, analog output for the VFD and axis signals, including differential and single end connections. If possible, it is suggested that you should first try the differential connection option as shown in **Figure** 1 **(a)**, as it is more noise resistant than the single end connection of **Figure** 1 **(b)**

Table 1 is a summary of Ports and Pins and their corresponding reference numbers. All pin numbers preceded by an "X" are inputs and if preceded by a "Y" are outputs. Using X110 as an example. The "X" means it is an input. The first digit "1" is the port number, the last 2 digits "10" is the pin number.

MB2 Layout

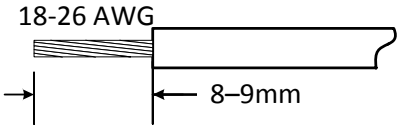


MB2v1.5



MB2v2.0

Figure 2, MB2 version 1.5 VS version 2.0 Board Layout



Input (CN1) – Input terminals, consisting of 18 channels of NPN type and 5 channels of PNP type
Axis (CN2) – Axis signal terminals, consisting of 6 axes, which are; X, Y, Z, A, B, C
Output (CN6) – Output terminals, consisting of 14 NPN sink outputs, Analog signal, 2 Relay's NO/NC and an inlet for the 24Vdc power supply
LPT1-3 (CN3-5) – Connectors for the ESS
JP1 – Charge Pump override
RJ-45 – Communication connector, part of the ESS board

ESS and MB2 piggyback

The ESS receives its 5Vdc power from the MB2 when all three jumpers are closed, which is the default setting. This eliminates the need for an external 5Vdc supply, See **Figure 3** below. Any excess in the ribbon cables, has been adjusted to inboard side of the cable clamp, see **Figure** 4, this enables you to clearly see the LED status and terminal labels.

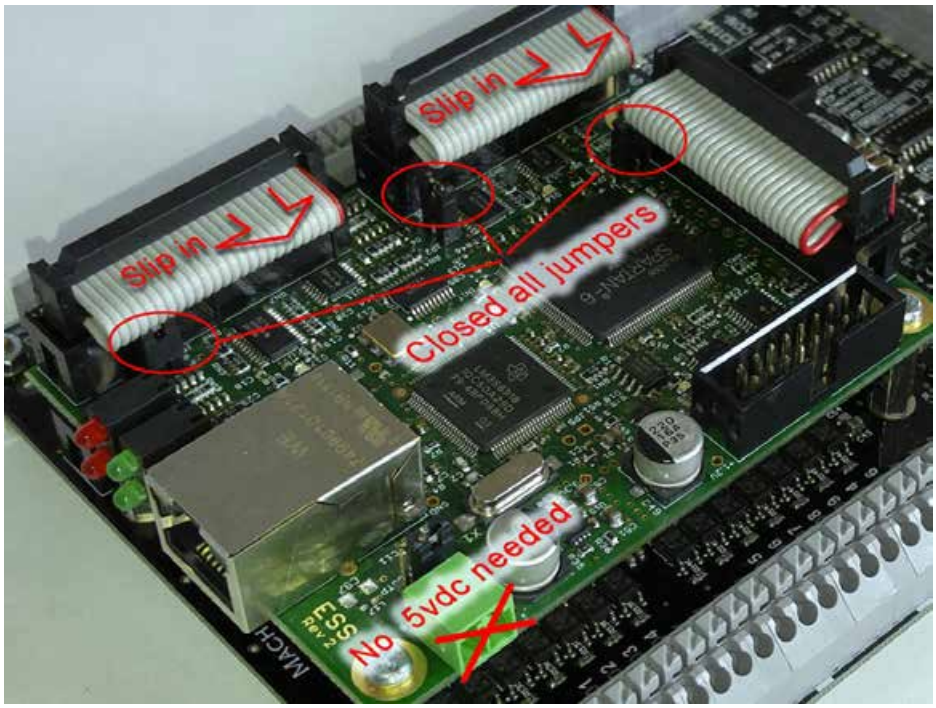


Figure 3, Jumpers are closed, No external 5Vdc

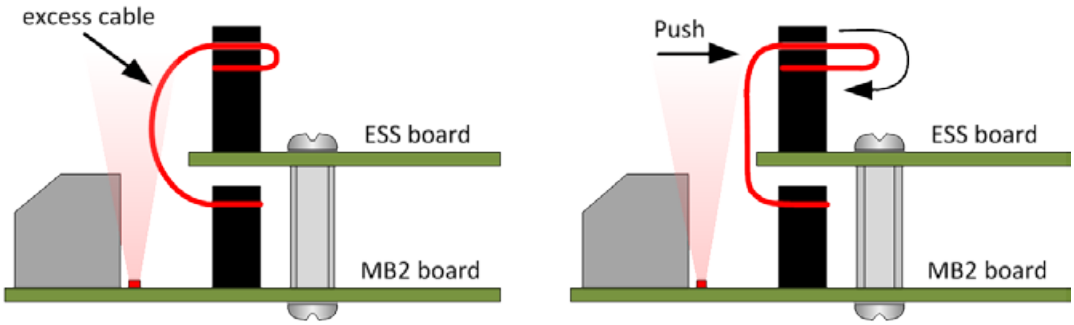


Figure 4, Excess cable has been adjusted to give clear sight of the LEDs and terminal labels

MB2 Connection Diagram

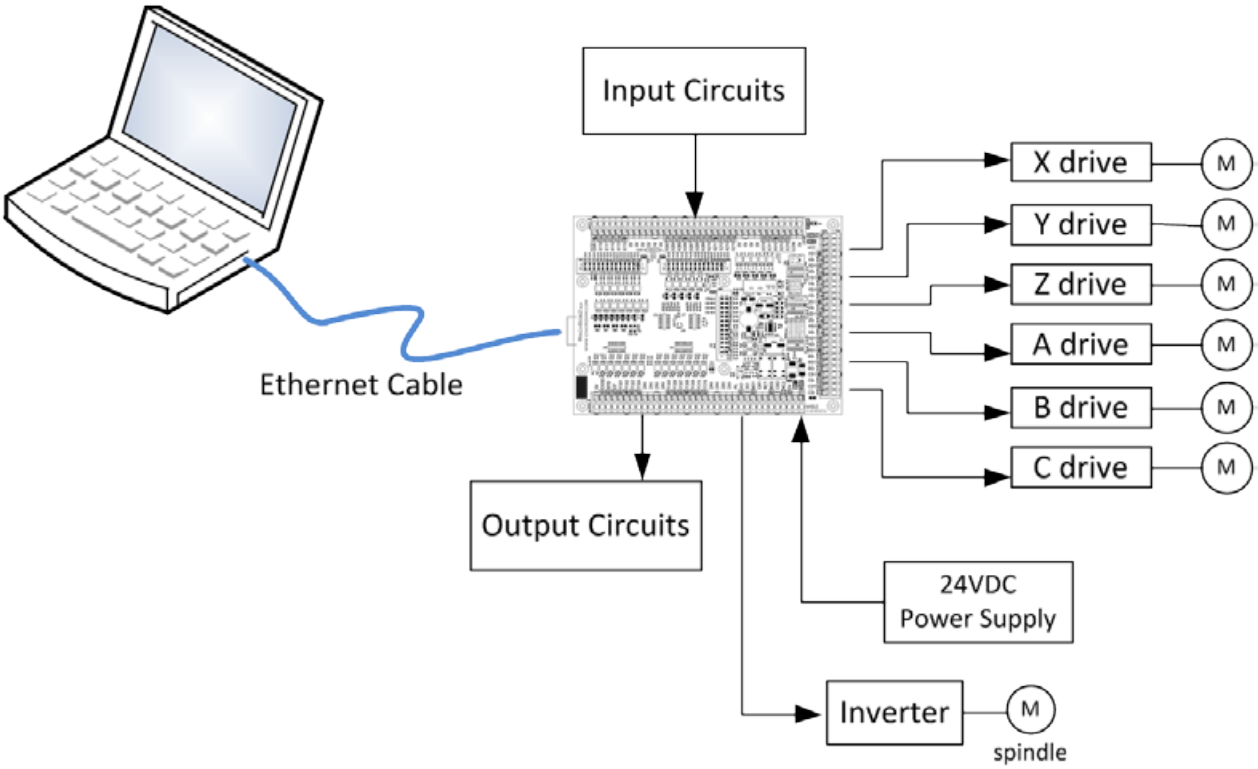


Figure 5, Connection Diagram

Hardware

Connecting the SmoothStepper to Your PC

The following section has been copied with permission from the Warp9 website at;

http://www.warp9td.com/index.php/documentation/doc-ess#Connecting

The best way to connect your ESS to your PC is to use the Direct Connect method: hook the Ethernet cable directly from your ESS to the network adapter in your PC. This will make trouble shooting easier since there are no switches or routers between the ESS and your PC. (A switch should be fine since it only operates in the lower 3 layers of the TCP/IP stack, but why add extra equipment if you don't need it. A router should be fine if you only have your ESS and PC connected to it, but this will require more work to configure and setup. As a result we highly recommend the direct connection, which is what the SCU [System Configuration Utility] expects.)

If you don't have an Ethernet Adapter on your PC, we recommend using a PCI or PCI Express Ethernet Adapter -OR- a USB 2.0 or USB 3.0 Ethernet Adapter. Quite a few people use these alternatives successfully, including myself.

We STRONGLY discourage using a wireless connection to communicate with your ESS. There can be much more latency or delay involved with wireless communications, along with a much higher risk of dropped packets. The ESS needs a fast, stable, and consistent link to your PC.

Many people use a second Ethernet connection or their wireless connection on the PC so they may easily connect to the internet, which is fine.

While you are running Mach and your CNC system, we recommend that you refrain from browsing the internet, gaming or streaming music or videos. This can cause your computer to take too much time away from Mach which could cause lost communications with your ESS (which can ruin your project).

We also recommend that you disable power saving options (monitor sleep and power off timers, hard drive sleep timers, and computer sleep timers); these have been known to cause lost communications with your ESS.

We also recommend that you set Windows Update to notify you that there are updates available instead of automatically installing them on its own.

We also know of cases where antivirus and anti-malware software have caused problems. We recommend that you disable them while you are running Mach, IF your PC is not connected to the internet.

Note that you do not need to assign a static IP address to your computer if you program the ESS to use an address that is in the same subnet as your computer. The subnet is the same if the first 3 groups of numbers in the IP addresses are the same. Quite often Internet routers will assign

addresses in the 192.168.0.x or 192.168.1.x ranges. If you wish to use a DHCP server for your computer, you can do that but the ESS still needs to use a static IP address in the same subnet. A direct connection to the ESS is the preferred way to go because there is no question as to whether there is enough bandwidth available to run your machine reliably.

We STRONGLY RECOMMEND THAT YOU DO NOT hook your ESS up to the same Ethernet adapter that you connect to the Internet with. There is no telling how much CPU and Ethernet bandwidth is being used up by other applications or other devices on the network. It is therefore officially discouraged. You are on your own if you wish to mix the Internet with your CNC data. However, if you wish to change the IP address of the ESS, you may do so with the Configurator Utility.

If the remainder of this section confuses you, don't worry. The SCU in the next section will do all of the work for you in just a few mouse clicks! The remainder of this section is just to document what the ESS uses and needs, you may skip to the SCU section.

The ESS comes configured from the factory with a default static IP address of 10.9.9.9 With your ESS at 10.9.9.9, you will need to assign your network adapter to use 10.9.9.2 or another valid and unused address in the subnet. We recommend that you keep the 10.9.9.9 IP address assigned to your ESS, since all of our documentation and videos will use that value. In fact MOST the user keep this value assigned to their ESS. However, if there is a need to change it, you may do so with the Configurator Utility.

Axis Connection X, Y, Z, A, B, C

AXIS CN2 terminal supplies motion command for drives.

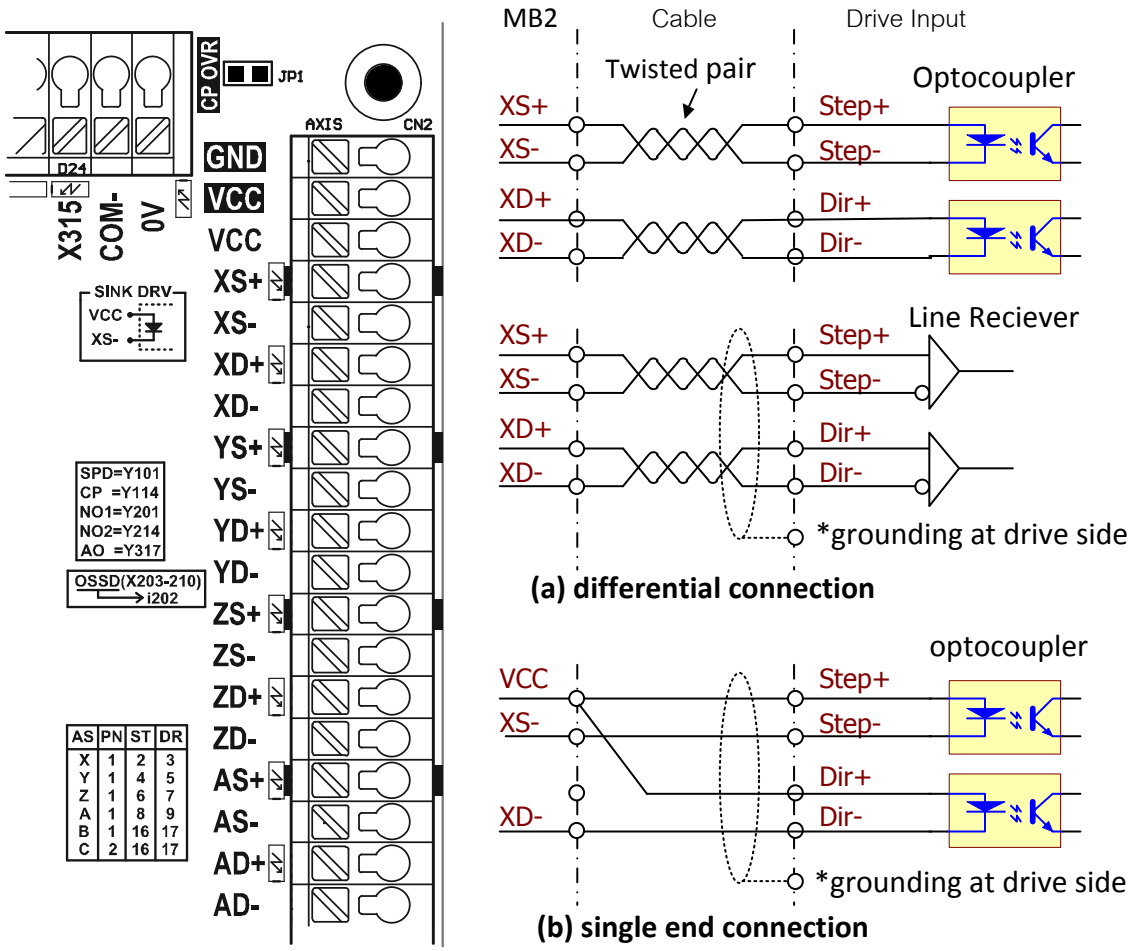


Figure 6, Axis command terminal and various connection modes

There are two modes to make connection to CN2.

Figure 6 **(a)** Differential mode has the best noise immunity. It is recommended to use differential mode if possible.

Figure 6 **(b)** Single end mode is used if the drive is not compatible with differential mode. There are two points of VCC to share with all axes.

Inputs

By default, all MB2 inputs are 24V tolerance for industrial sensors and switches. However, sometimes we need to interface with 5V devices, such as MPG and low voltage sensors. On the topic "5V inputs for low voltage devices" shows the way to hack the MB2 board and a simple interface circuit.

Switches

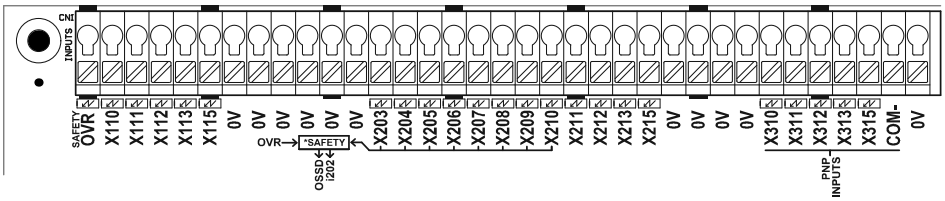


Figure 7, Input terminals

Figure 7 shows 22 input terminals. There are 17 points of NPN type which are X110-X115, X203-X215 and 5 points of PNP type which are X310-X315.

There are solder-bridges underneath of MB2 board for the user to bridge the input status of inputs X203 – X210 to safety circuit (see page 18). Use the "OVR" input as the override signal for the OSSD safety circuit.

The Safety Circuit forms an "AND" logic for all involved signals. This eliminates the need to build a separate safety circuit, hopefully saving the user time and money.

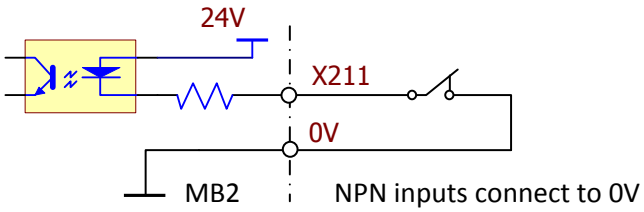


Figure 8, Connection of the NPN inputs, it references to 0V

Figure 8, shows the conventional way to connect a switch to an NPN input, X211 with 0V

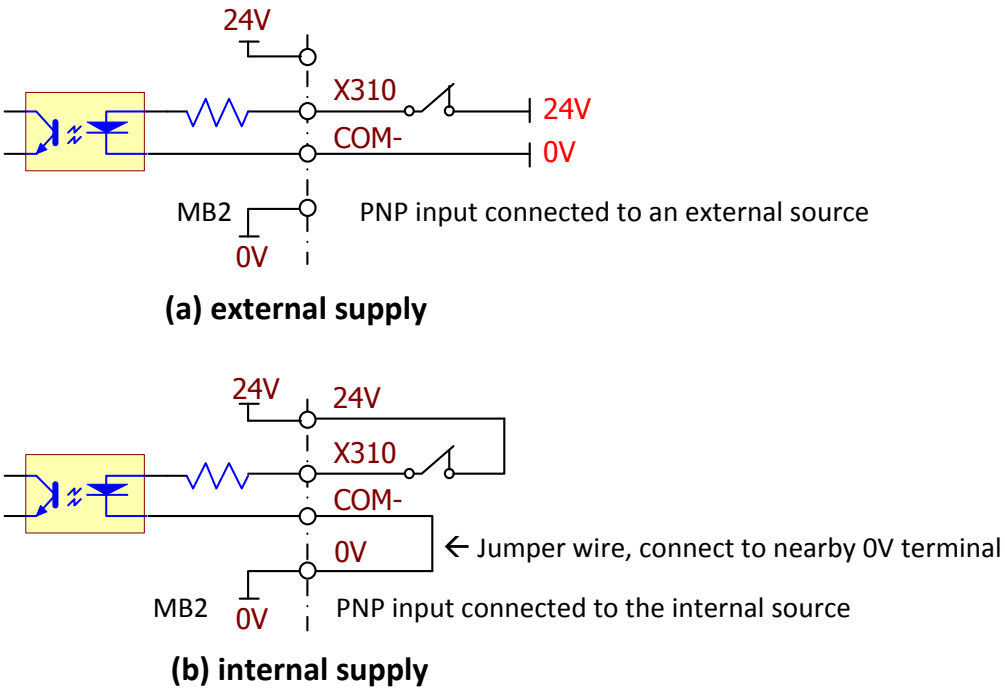


Figure 9, Connection of PNP inputs, it references to 24V

Figure 9, **(a)** shows a PNP input connected to an external power source. This connection is totally isolated from any part of the MB2 circuit. This external circuit, for instance, could be the fault output of a VFD drive or servo drive.

Figure 9, **(b)** shows a PNP input connected to the internal power source.

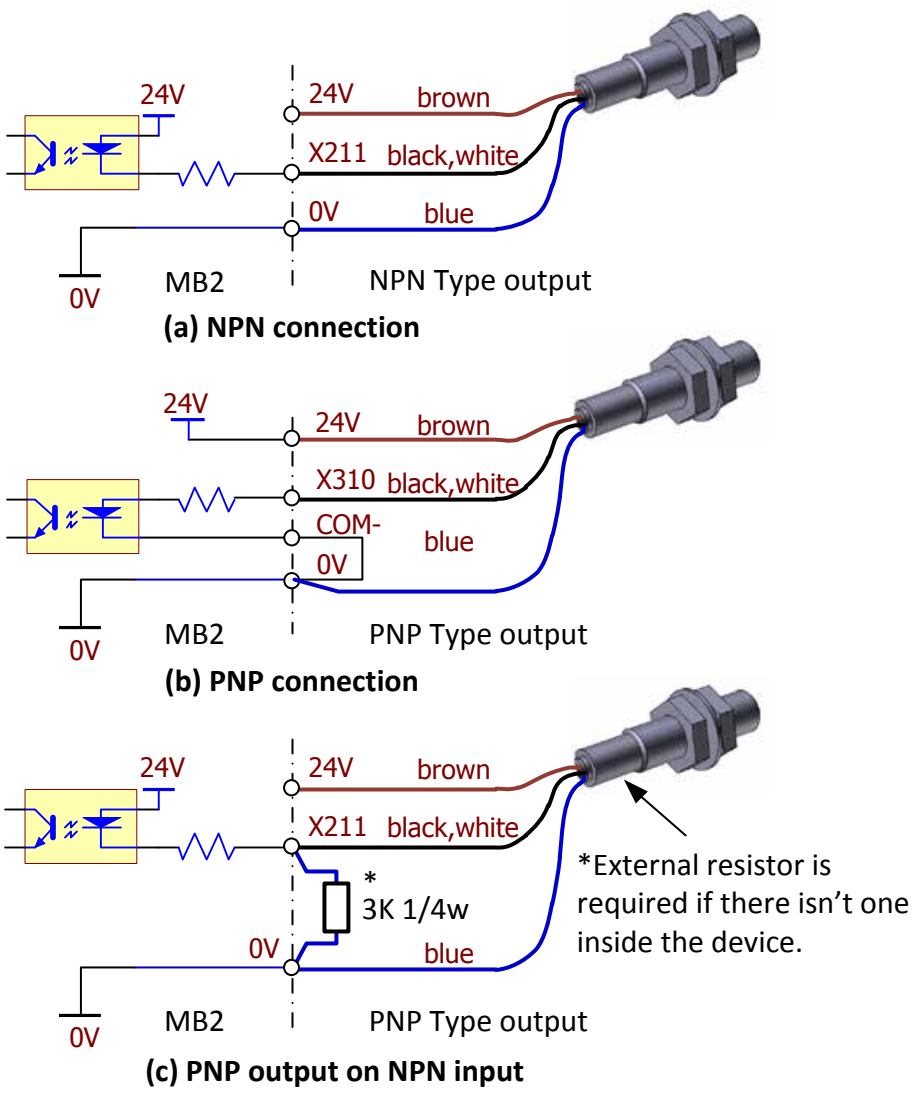


Figure 10, Sensor connections

Figure 10, **(a)** shows the connection of NPN type sensors. This connection is applicable for input terminals X110 - X115 and X203 - X215 only.

Figure 10, **(b)** shows the connection of PNP type of sensors. This connection is applicable for input terminals X310 - X315 only.

Figure 10, **(c)** this connection gives an alternative for PNP sensors to connect to NPN inputs. However, the logic is **inverse**, so you must also change the logic in the corresponding setting within Mach to also be inverse.

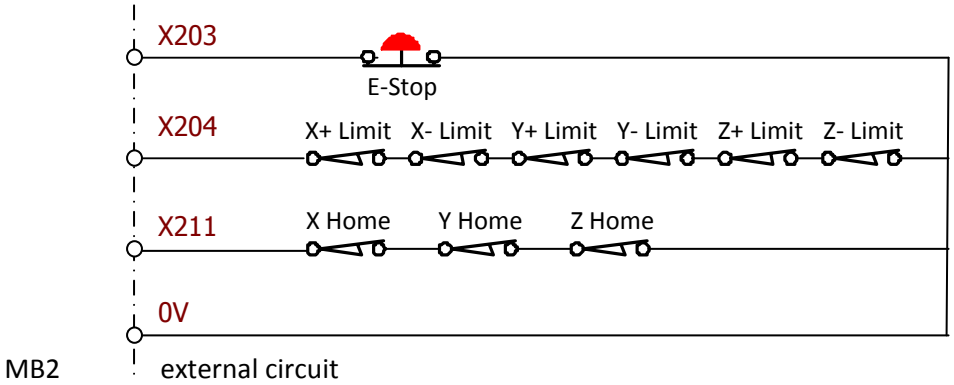


Figure 11, is an example of E-STOP, LIMIT and HOME switch connections

Figure 11 shows the conventional way to connect the Estop, Limit and Home switches. This will form an "AND" circuit. Notice that all use NC contacts (normally closed).

Outputs

Transistor Sink Output

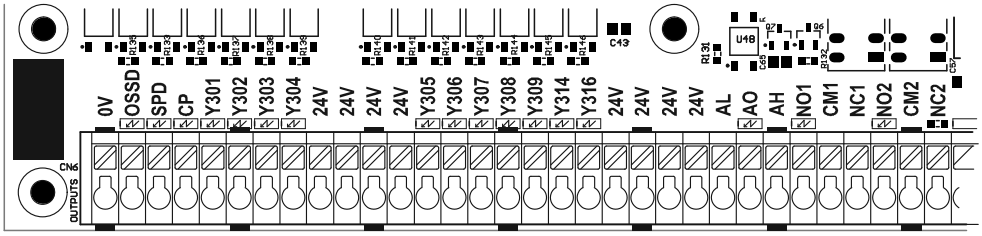


Figure 12, Output terminals

Figure 12 shows 14 output terminals, each output can sink current up to a maximum of 100mA with a total maximum of 500 mA per group of 7 outputs, as shown in **Figure** 1 **on page 4**.

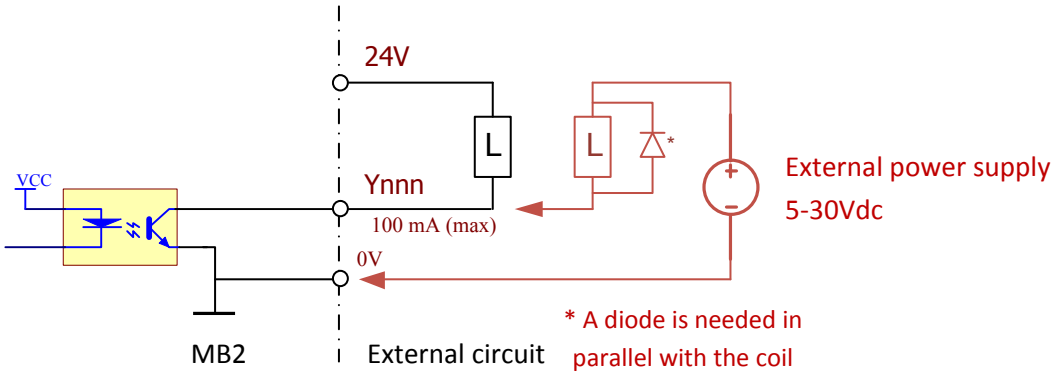


Figure 13, connecting various loads to a "Y" output

Relays

The MB2 comes with two on-board relays, K1 and K2. Both provide NO or NC contacts. MB2 v1.5 or later, also provides an "OFF Delay" feature. To activate this feature the user needs to follow the instructions as set out on on page 17, note *7 under the heading of ***Modifications***.

These two relays are signal relays and should never be used as power relays. They are intended to convey signals such as forward and reverse to a VFD (Variable Frequency Drive) to control motor rotation of a spindle or similar. They can be used for other purposes as well, and the user needs to map them in Mach accordingly. However, please take care, as the contacts of these relays can carry a maximum current of only 0.5 Amps at 120VAC, or 1 Amp at 24Vdc. The user must use an external relay if the load requirements of the device will exceed the aforementioned current rating.

Charge Pump

Charge pump is pulse frequency signal from Mach3/Mach4 indicating that Mach is present and ready to run. MB2 has special circuit to capture this pulse frequency and output to CP (Charge Pump) terminal. Normally an external relay would be connected to this CP terminal for cutting the power source from any attached loads. However, in board MB2v2.0 the user can choose to select K2 as an output for the CP signal. To choose this option, Please see **Figure 19,** the underneath layout of the MB2. There is a blue arrow pointing to the appropriate solder bridge, *8.

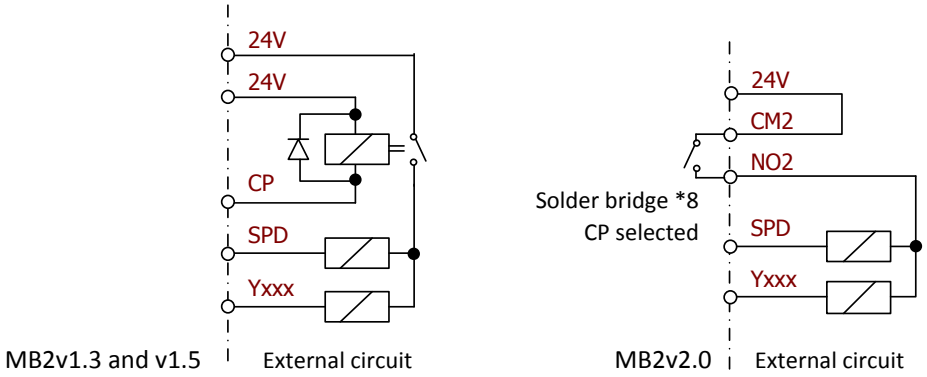


Figure 14, Charge pump interlock with other relays

Analog

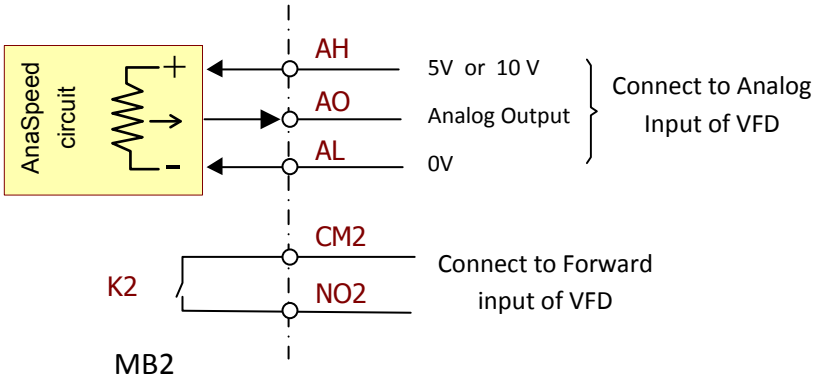


Figure 15, VFD connection

The “AnaSpeed” circuit converts PWM signal into an analog signal. The maximum voltage level is dependent upon the external power supply. For example, if the circuit is connected to a 0-10V analog input of the VFD, it will demand 10Vdc from the VFD as well.

The “AnaSpeed” has a tolerance margin of about ± 0.2V. It is able to generate a voltage up to 9.8V only (10V-0.2V) when supplied with external power of 10V. Compensation of this margin can be done in the VFD’s parameters.

Normally, a VFD needs a forward command to rotate the motor. Thus, any NO contact of K1 or K2 can be used for this purpose.

OSSD Output and Safety Circuit

The MB2 has an OSSD (Output Signal Switching Device) output for the user to form a simple safety circuit in their system. When the system is error free, the MB2 energizes the OSSD output and it will de-energize the OSSD output if an error has occurred.

Most drives will give an OK signal or “Servo Ready” or similar, by energizing its appropriate output and connected external devices will receive this status. The MB2 collects all OK signals from various devices through terminal inputs X203 - X210 and then sends out an OK signal to the next device.

However, if there is an error feeding in, MB2 will send out a “Not OK” signal by de-energizing the OSSD output and the external safety circuit will cut power and stop the hazard.

Using a magnetic contactor as an external device is a simple way to disconnect the power supply from the drives or the VFD. The “OVR“(Override) input is provided for temporarily energizing the magnetic contactor, which lets the machine operator recover from the error.

To activate this function, the user needs to select one or more inputs from X203 to X210. Then by creating a solder bridge across the appropriate corresponding solder pads, i203 to i210, which are shown in **Figure 18 on page 18**, the chosen inputs will become part of the safety circuit.

Figure 16 shows the safety circuit block and relevant I/O including, inputs, solder-bridge, and override input and outputs.

Warning. The MB2 utilises only a simple safety circuit. There is no guarantee it will protect against a serious external failure. It is therefore advised that the user **MUST ALWAYS** check the functionality of any external circuit that is connected to the MB2.

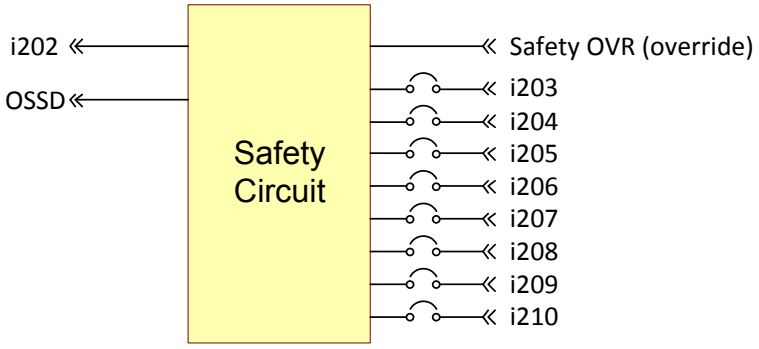


Figure 16, On board safety circuit

Power Supply

The MB2 needs only a single 24Vdc power supply to operate the board. **Figure** 17, shows the input terminals for 0V and 24V.

There is a non-isolated step-down switching regulator that converts 24V (18-24Vdc) down to 5V to power most parts of the circuit, including the inputs and outputs.

However, there is also a special isolated DC2DC convertor that generates 5Vdc, this is used purely to power the ESS board.

On board there is also a small fuse for protection against over voltage and polarity reversal.

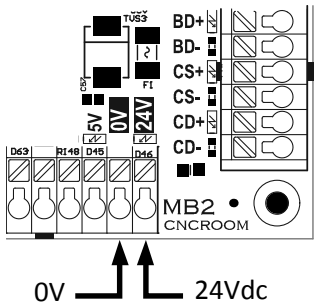


Figure 17, Power supply connection

Modification

Solder Bridges

The MB2 has a number of places where the user can conduct modifications. Instead of using pin jumpers, solder bridges have been implemented to save cost and space. The user needs to solder or de-solder these bridges to achieve their purpose.

(*Note: the below sub heading numbers, *1 to *8 relate to the printed numbers on the under-side of the MB2 board.)*

*1. Safety Circuit Inputs; X203 - X210 primarily function the same as the other normal inputs. However, there is the option to use these inputs as part of the safety circuit by soldering a bridge across one or more pairs of the solder pads, which are shown in the image below. The i203 bridge is already soldered by default.

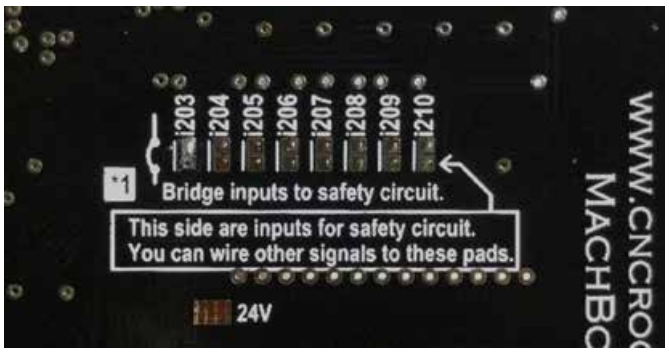


Figure 18 Bridges for safety inputs

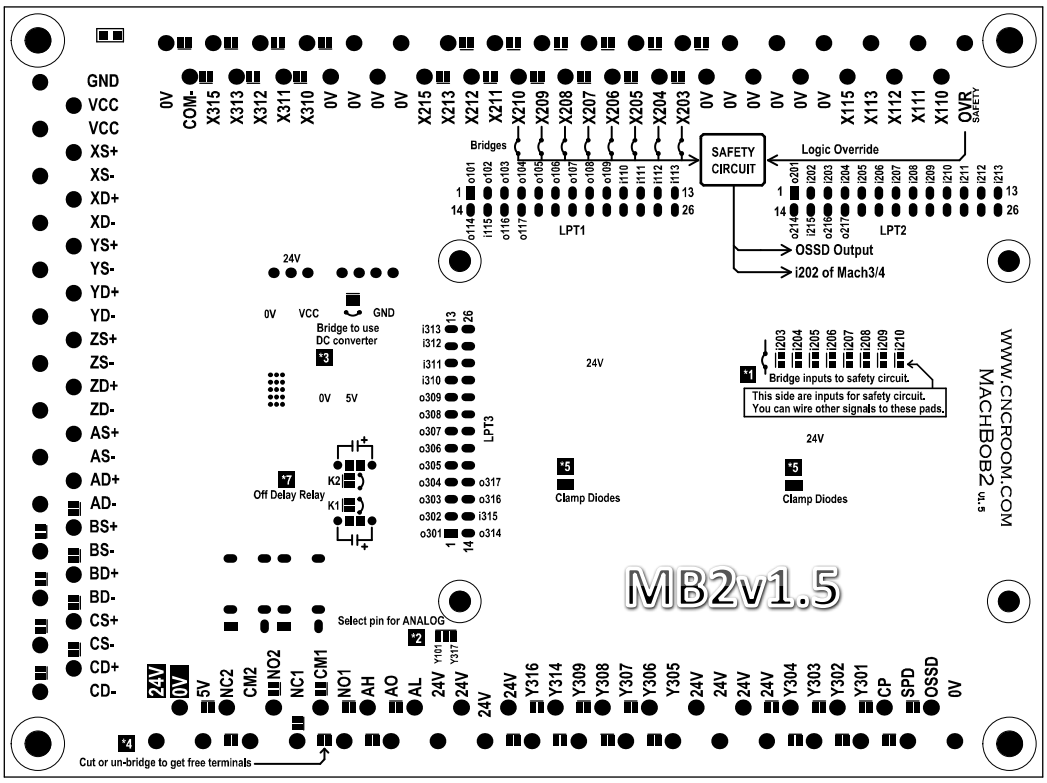
*2. Analog pin select, The Pin for PWM (Pulse Width Modulation) Analog, lets the user chose between SPD (Y101) and Y317. The default setting is Y317. See the Abbreviation Table **on page 4**.

*3. DC Converter – There is an option to not use the default onboard 5V isolated DC2DC converter. Because this on-board converter can only supply a limited current, in some cases it may be necessary to use an external 5V power supply. The existing bridge has to be de-soldered, then the user can connect an external 5V power supply to the VCC channel at the Axis CN2 terminal.

*4. Free Terminals – In some circumstances, the user may need a few extra terminals for their work. This can be achieved by cutting or de-soldering one or more of the bridges at the respective terminals. These free terminals are only meant for use with low voltage, nothing over 24V.

*7. Off Relay (MB2v1.5) – This feature can be used where an “OFF DELAY” is required, such as in “Z-Drop” protection, which allows a mechanical brake to engage before the motor loses its holding torque. This can happen after the control signal or the main power is cut from its drive. Solder the bridge at K1 to enable an off delay of 220 ms, or at K2 for 440 ms. The delay time can be extended by adding more capacitors to the provided pads underneath the board.

*8 K2 Relay pin select– Normally, K2 is associated with output Y214. However, on the board MB2v2.0 you can select K2 as an output relay of CP (charge pump) signal. (see Figure 19, the underneath layout of the MB2)



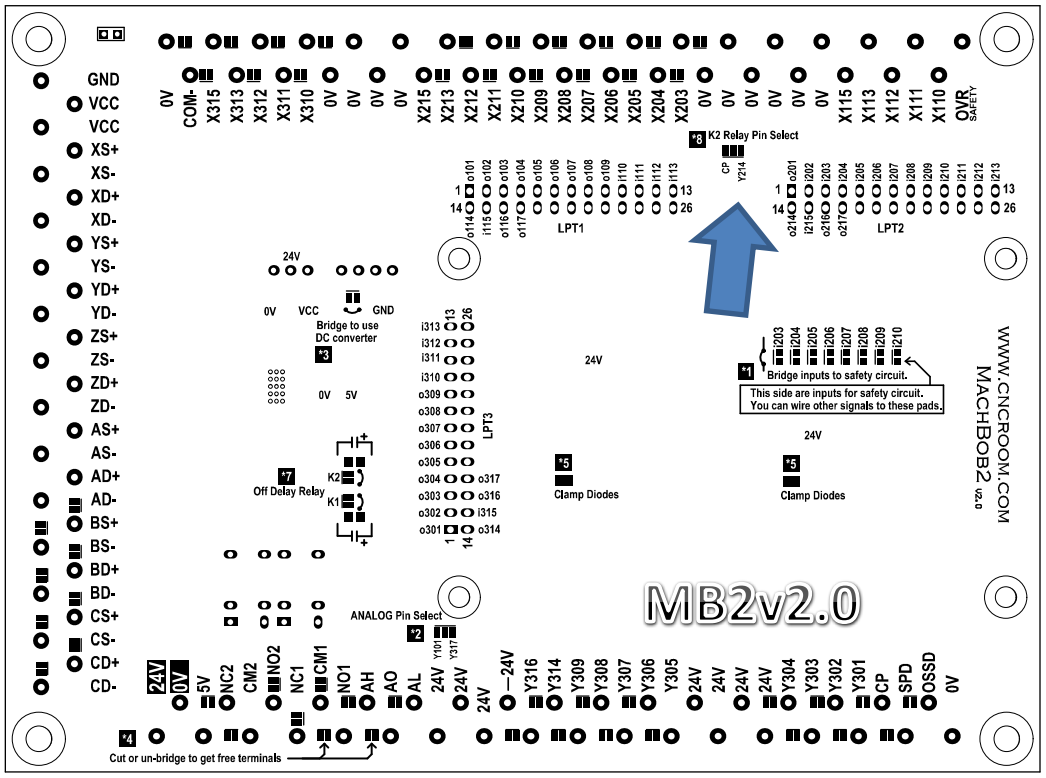


Figure 19, the underneath layout of the MB2

5V inputs for low voltage devices

In some circumstances, there are 5V devices need to be connected to the board MB2. Figure 20, Replace 3k with 470 ohm resistor for PNP inputs.shows each 3k resistors need to be replaced by a

470 ohm resistor. Figure 21, Interface circuit for NPN inputs. shows an interface schematic for NPN inputs.

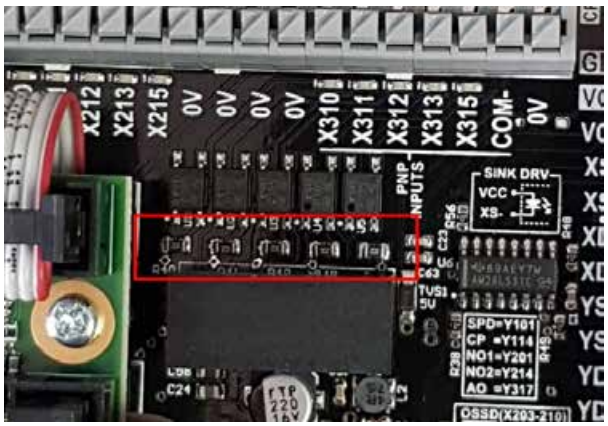


Figure 20, Replace 3k with 470 ohm resistor for PNP inputs.

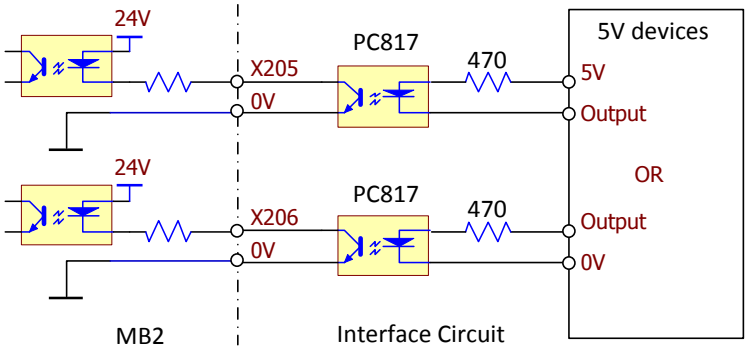


Figure 21, Interface circuit for NPN inputs.

Software

The user can obtain up to date software, plugins and tutorials from the following links.

http://warp9td.com/index.php/sw

http://www.youtube.com/channel/UCpg3EROtW8xA_KzrFHgn4ZQ

The user also can obtain the MB2 pre configuration file from the product link below.

http://www.cncroom.com/index.php?main_page=product_info&cPath=7&products_id=209

Mach3 Configuration

The user can obtain the pre configuration XML file and copy it to their system. However, there are some values that need to be set to suit individual applications.

After downloading and extracting the pre configuration profile. You will find MB2.xml that needs to be copied and pasted into C:\Mach3 which is shown in picture below. Run Mach3 Loader and choose MB2 profile.

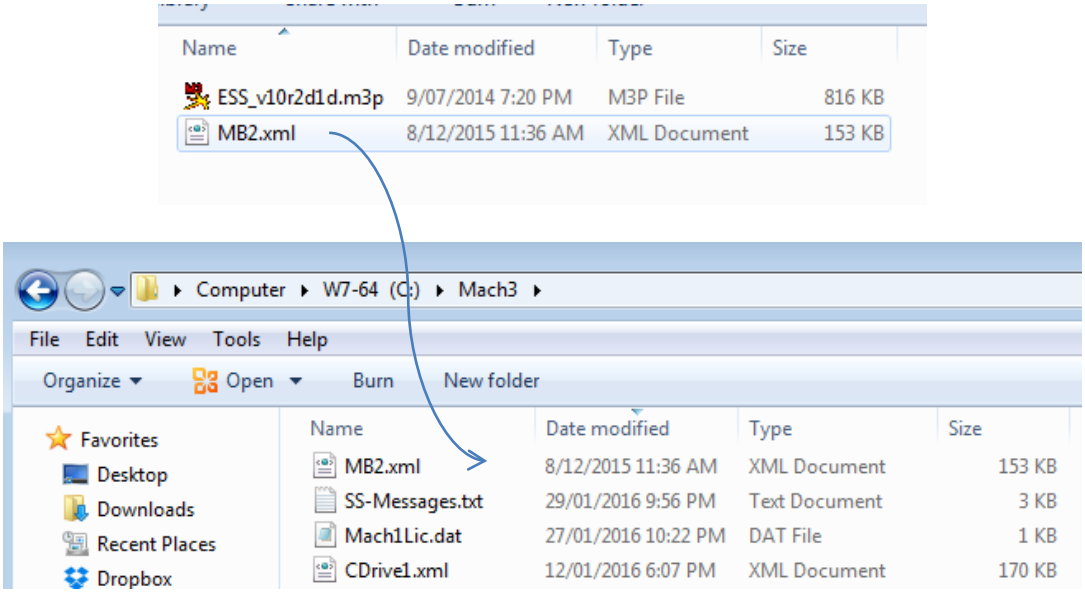


Figure 22, Copy and Paste the MB2 pre-configuration file

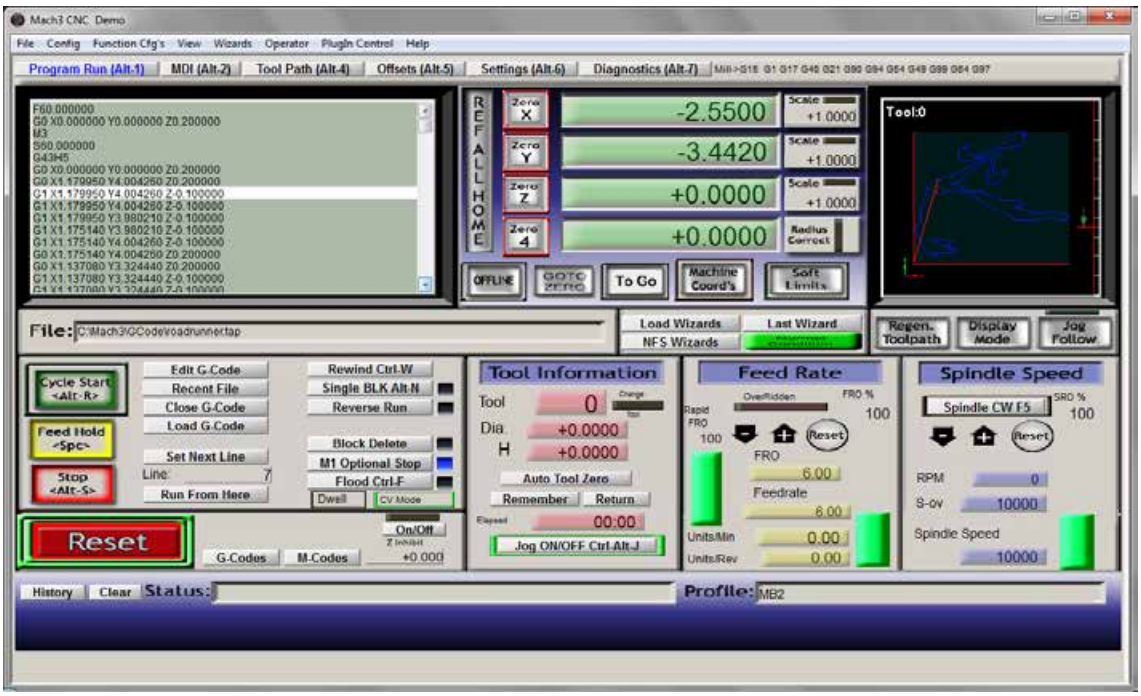


Figure 23, Mach3's first screen

Menu Config > Ports and Pins

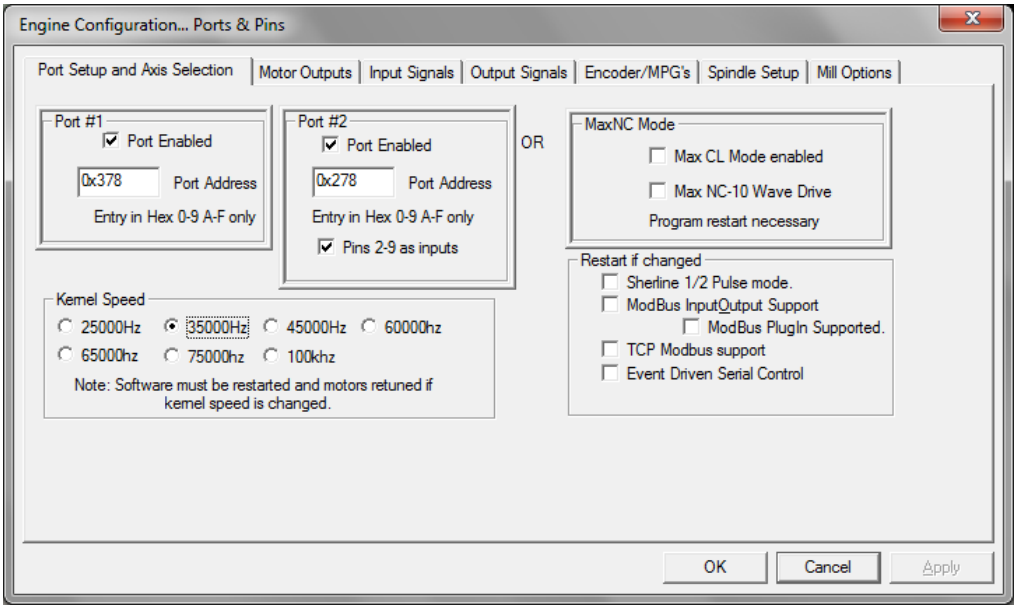
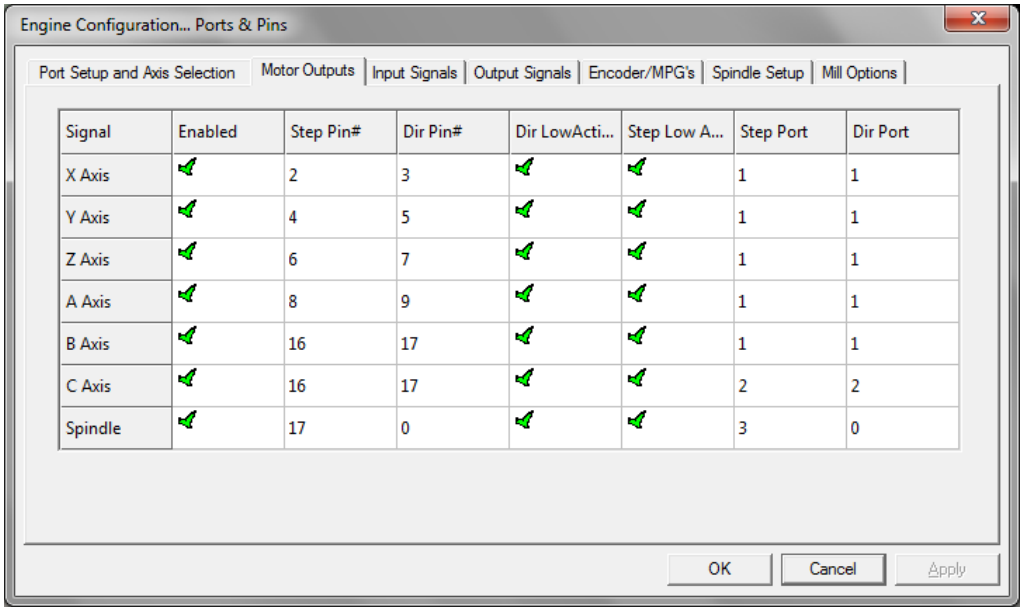


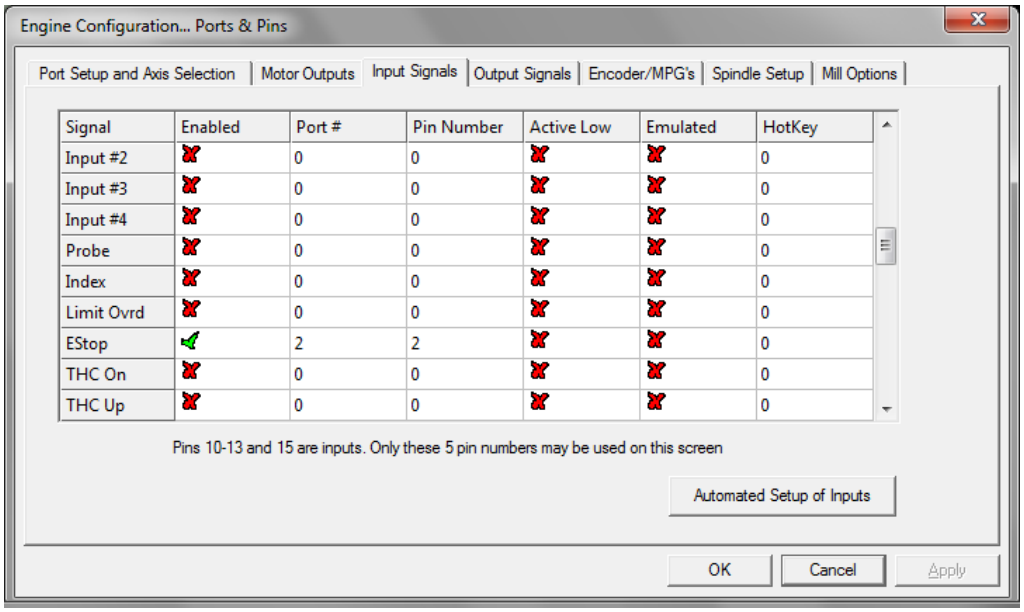
Figure 24, Mach3 Ports and Pins dialog



Signal	Enabled	Step Pin#	Dir Pin#	Dir LowActi...	Step Low A...	Step Port	Dir Port
X Axis	✓	2	3	✓	✓	1	1
Y Axis	✓	4	5	✓	✓	1	1
Z Axis	✓	6	7	✓	✓	1	1
A Axis	✓	8	9	✓	✓	1	1
B Axis	✓	16	17	✓	✓	1	1
C Axis	✓	16	17	✓	✓	2	2
Spindle	✓	17	0	✓	✓	3	0

Figure 25, Motor output tab

Specify values as shown in the picture.



Signal	Enabled	Port #	Pin Number	Active Low	Emulated	HotKey
Input #2	✗	0	0	✗	✗	0
Input #3	✗	0	0	✗	✗	0
Input #4	✗	0	0	✗	✗	0
Probe	✗	0	0	✗	✗	0
Index	✗	0	0	✗	✗	0
Limit Ovrd	✗	0	0	✗	✗	0
EStop	✓	2	2	✗	✗	0
THC On	✗	0	0	✗	✗	0
THC Up	✗	0	0	✗	✗	0

Figure 26, Mach3 Input tab

The user needs to set suitable values by themselves

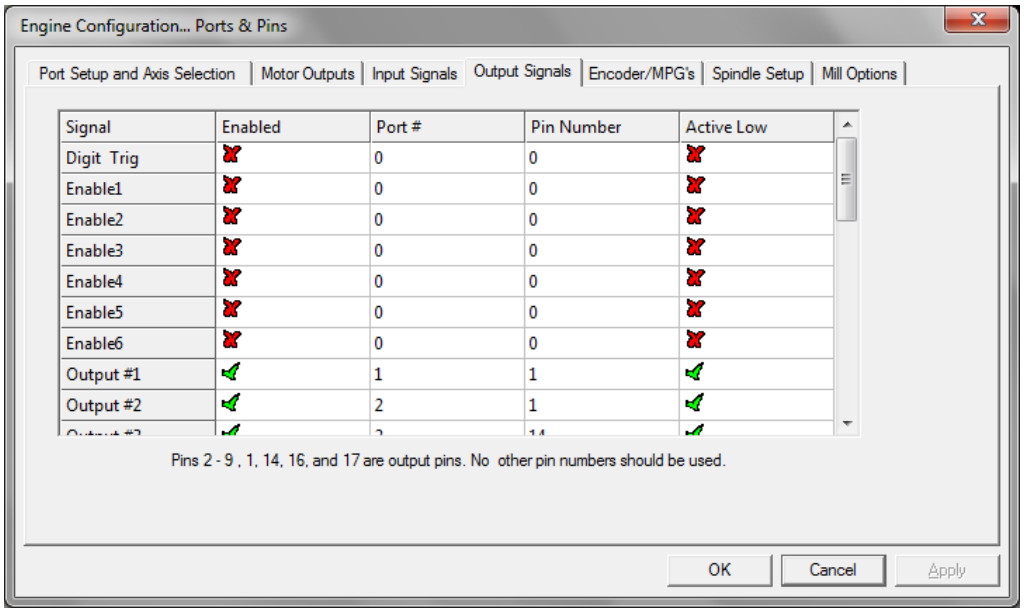


Figure 27, Mach3 Output tab (1/4)

The user needs to set suitable values by themselves

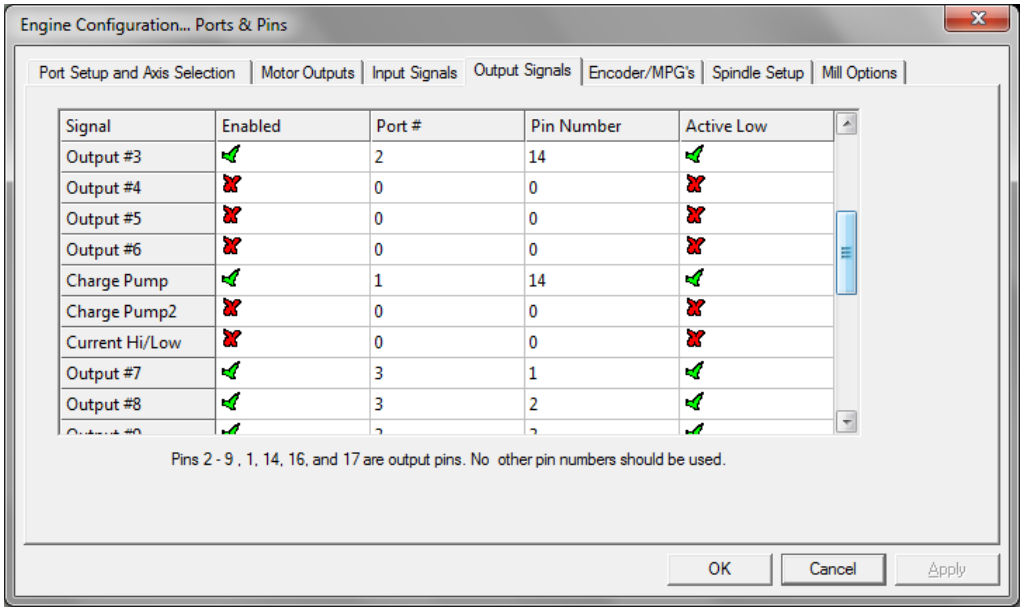


Figure 28, Mach3 Output tab (2/4)

Specify the Charge Pump value as shown in the picture.

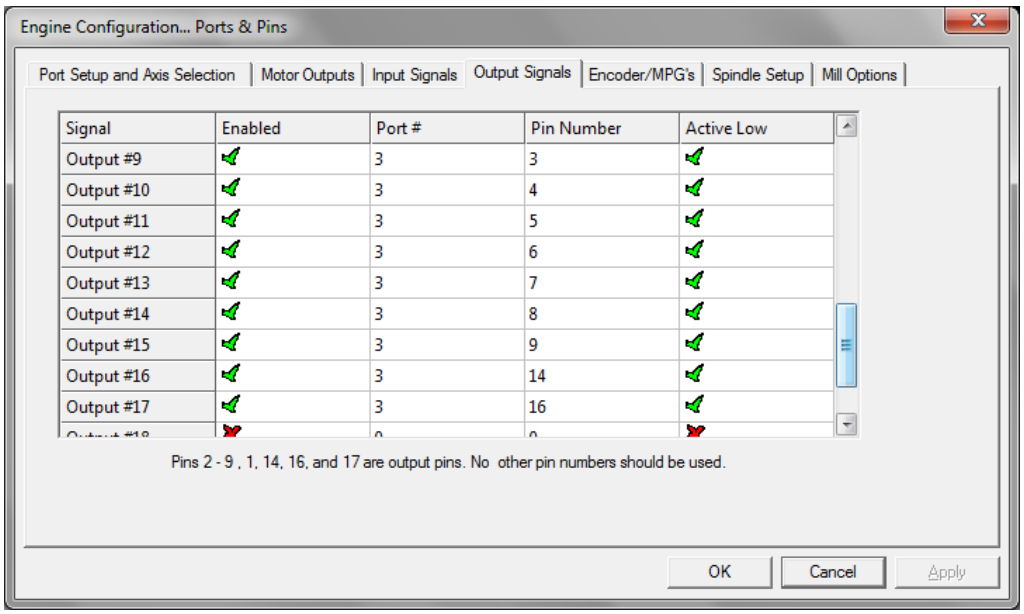


Figure 29, Mach3 Output tab (3/4)

Specify values as shown in the picture.

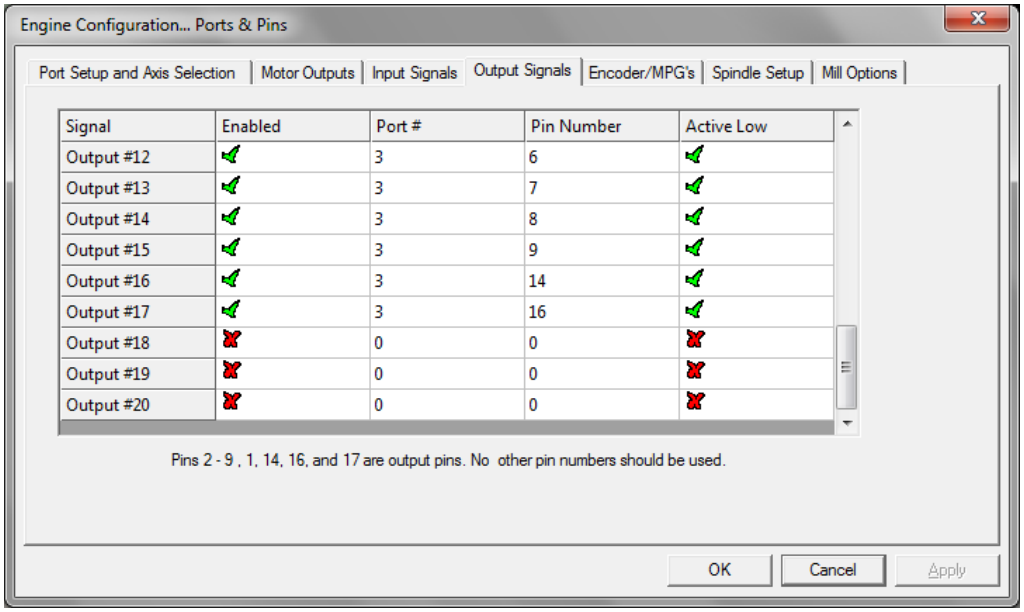


Figure 30, Mach3 Output tab (4/4)

Specify values as shown in the picture.

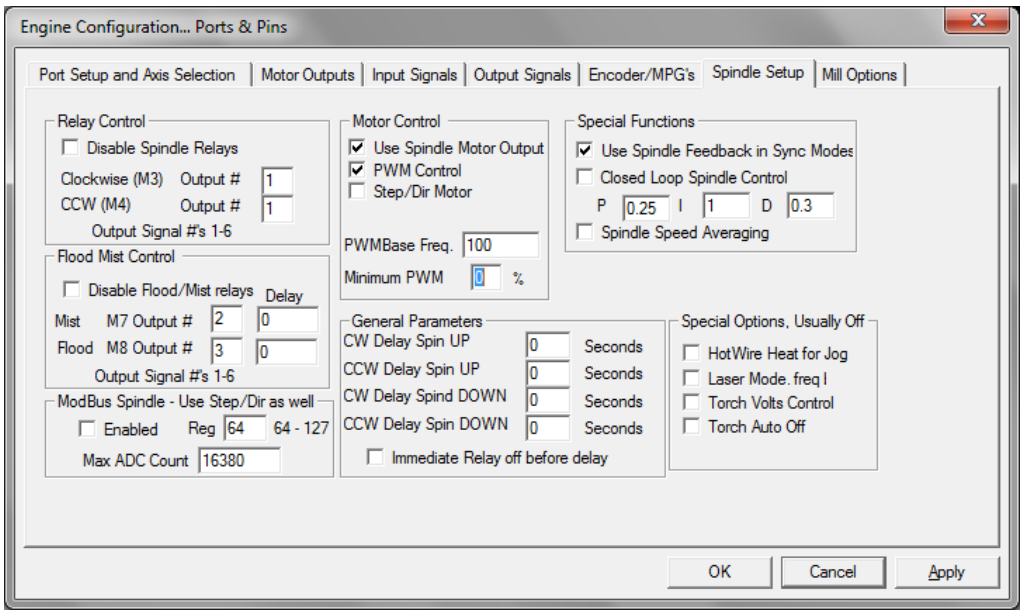


Figure 31, Mach3 Spindle tab

Menu Config > Motor Tuning

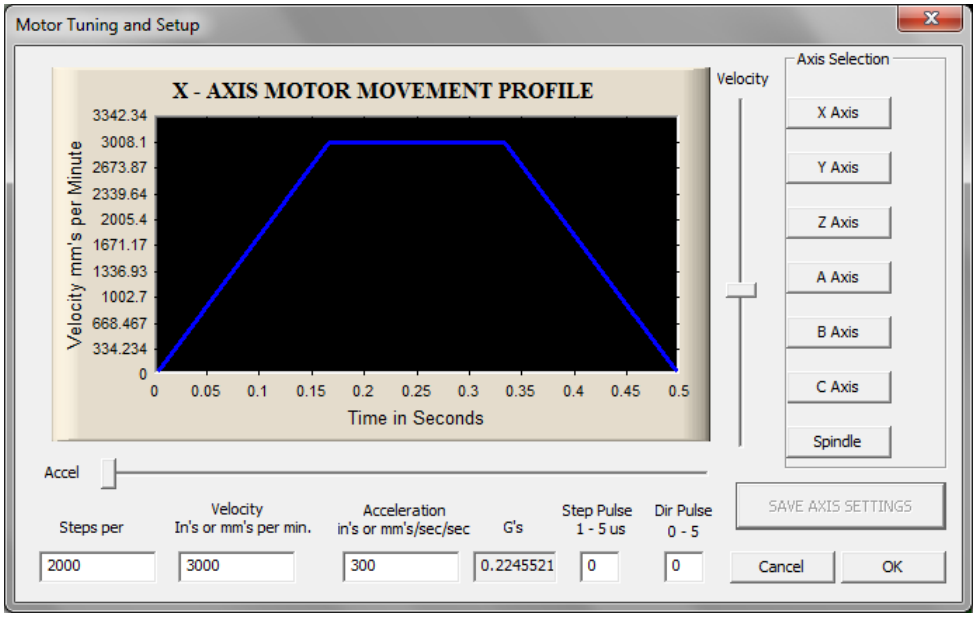


Figure 32 Mach3 Motor tuning dialog

Motor Tuning and Setup, The user needs to set suitable values by themselves

Menu PlugIn Control > ESS-v10r2d1d Config

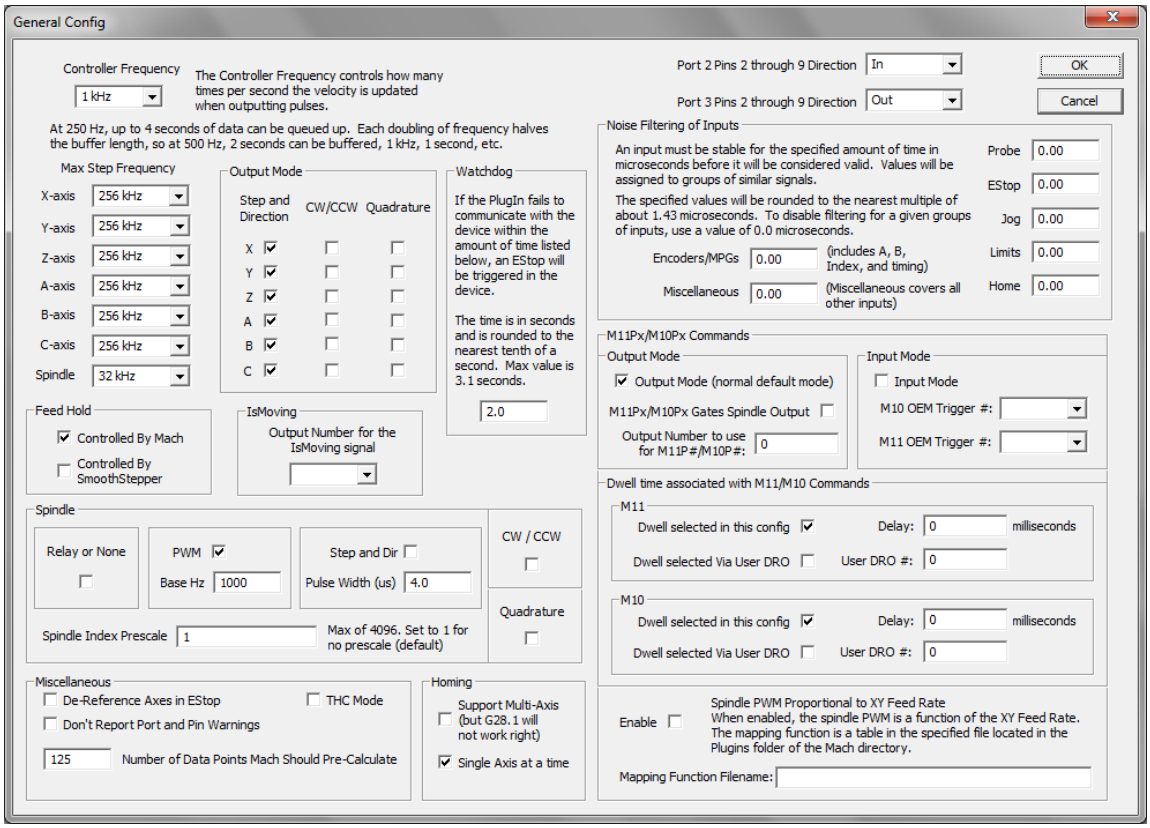


Figure 33, ESS General Configuration

Mach4 Configuration

The user can obtain the pre configuration profile from the CNCRoom product page. However, there are some values that need to be set to suit the user's individual system.

After downloading and extracting the pre configuration profile. You will find a folder named MB2, copy and paste this folder into C:\Mach4Hobby\Profiles as shown in picture below. Run the "Mach4 loader", then choose the MB2 profile.

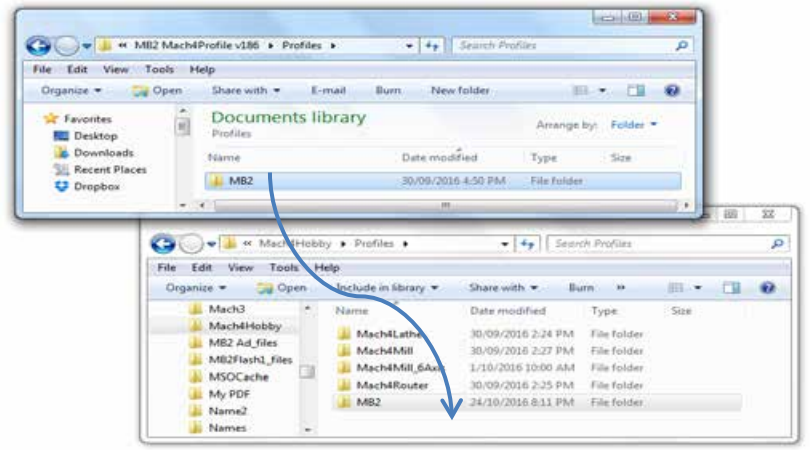


Figure 34, Copy n Paste, or drag n drop the Mach4 pre- configuration file

Setup instructions

The following section has been copied with permission from the Warp9 website at;

http://warp9td.com/index.php/gettingstarted/setting-up-the-smoothstepper-and-mach4#MachFourInitialESS_NEW_PLUGIN

1. **Run the SCU**: Confirm that you have used the SCU to prepare your PC for the ESS.
2. **Install Mach4**: We recommend that you use Mach4 release version 3233 or newer

    - Note for systems using MM as their jogging increment units: If you set increment to metric, jogging works okay in Mach4 4.2.0.3272. In Mach4 versions 4.2.0.3286 through 3365), after the first jog, it will move 25.4 times farther than expected (it switches to inches instead of staying in mm). Release 3368 fixes this issue on their FTP site.
    - Recommended: Here is the official current release of Mach4. (We don't test against every new release, but they are usually stable.)
    - Optional for advanced testers: Here is a link to the Mach4 FTP download page, where they have newer development releases. (We don't test against every development release, so they may have hew features and fixes or they may introduce new bugs and break functionality.)

3. **Install ESS Plugin:** Use the latest ESS Mach4 Plugin, build 202 - NEW.

    - For a new install: Place the plugin's '.m4pw' and '.sig' files into your plugins folder, which is typically: 'C:\Mach4Hobby\Plugins\'
    - For an upgrade from a previous plugin version: This plugin should be fully compatible with profiles made in version 184 or newer. First, make a backup copy of your entire Mach4 folder. Then replace the plugin's '.m4pw' and '.sig' files in your plugins folder, which is typically: 'C:\Mach4Hobby\Plugins\' The upgrade is complete.
    - Here is where the Beta Releases are posted, if you want to try a newer test release.
    - The previously recommended stable release was ESS Mach4 Plugin build 193.

4. Make sure that your ESS is powered and connected to your PC via Ethernet cable.
5. Start Mach4.
6. For the "Session Profile" window, if you have already created a profile, skip to step 8. Otherwise, if you have not yet created a profile, click on "Create Profile".

Configure Menu

Figure 35 shows the step sequence where we are going to make setting.

Before we can see sub menu [2] and [3], we need enable them in next dialog which shown in **Figure** 36

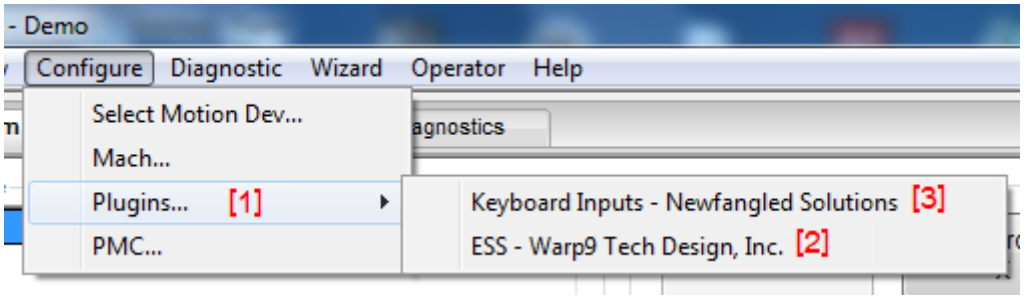


Figure 35, Configure menu and step sequence

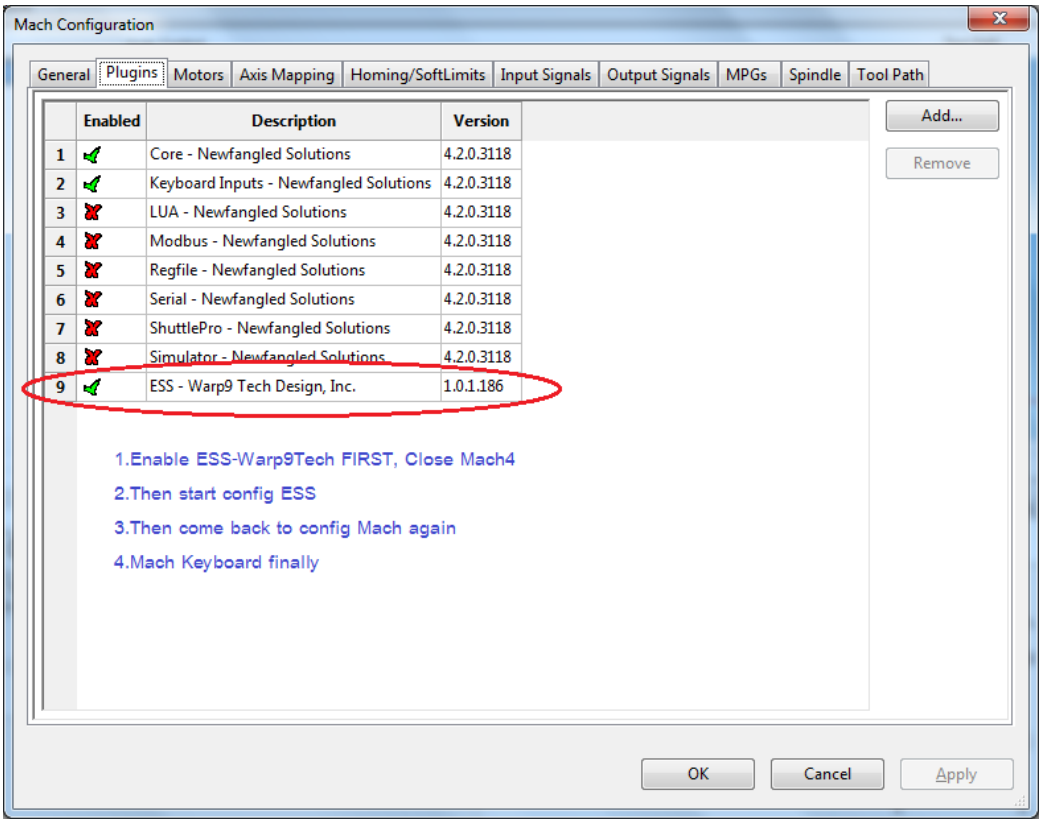


Figure 36, Plugins Enable

ESS configuration

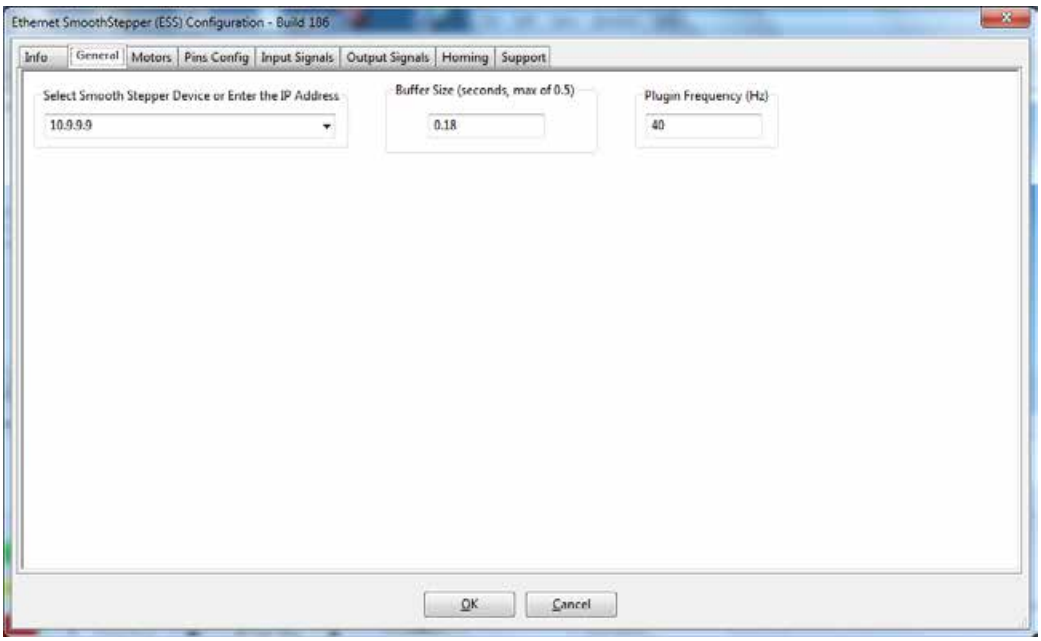


Figure 37, ESS IP address and buffer size

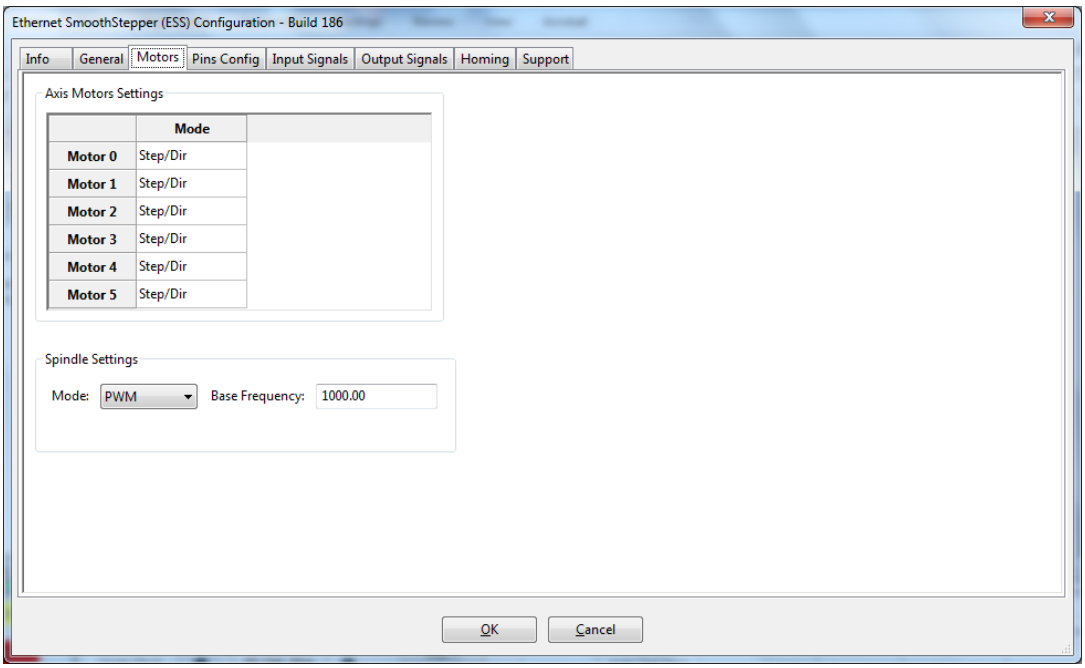


Figure 38, Motor command mode

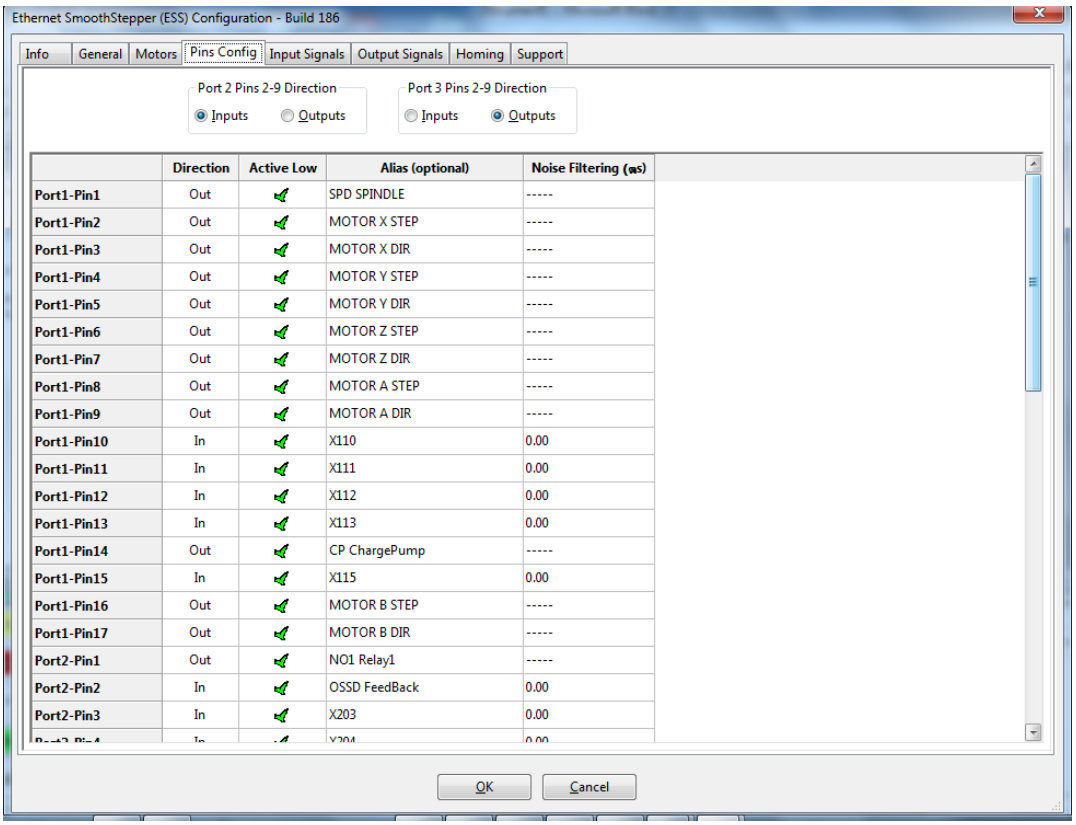


Figure 39, Pin Alias Names

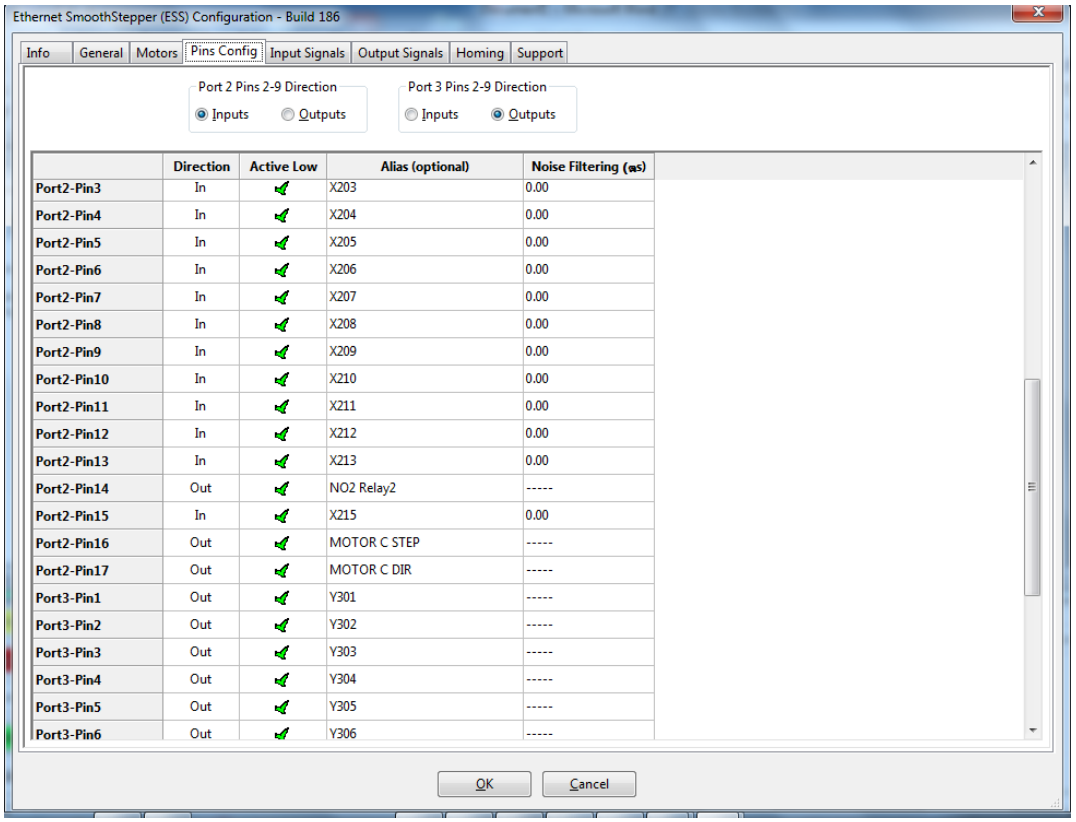


Figure 40, Pin Alias Names (continue 1)

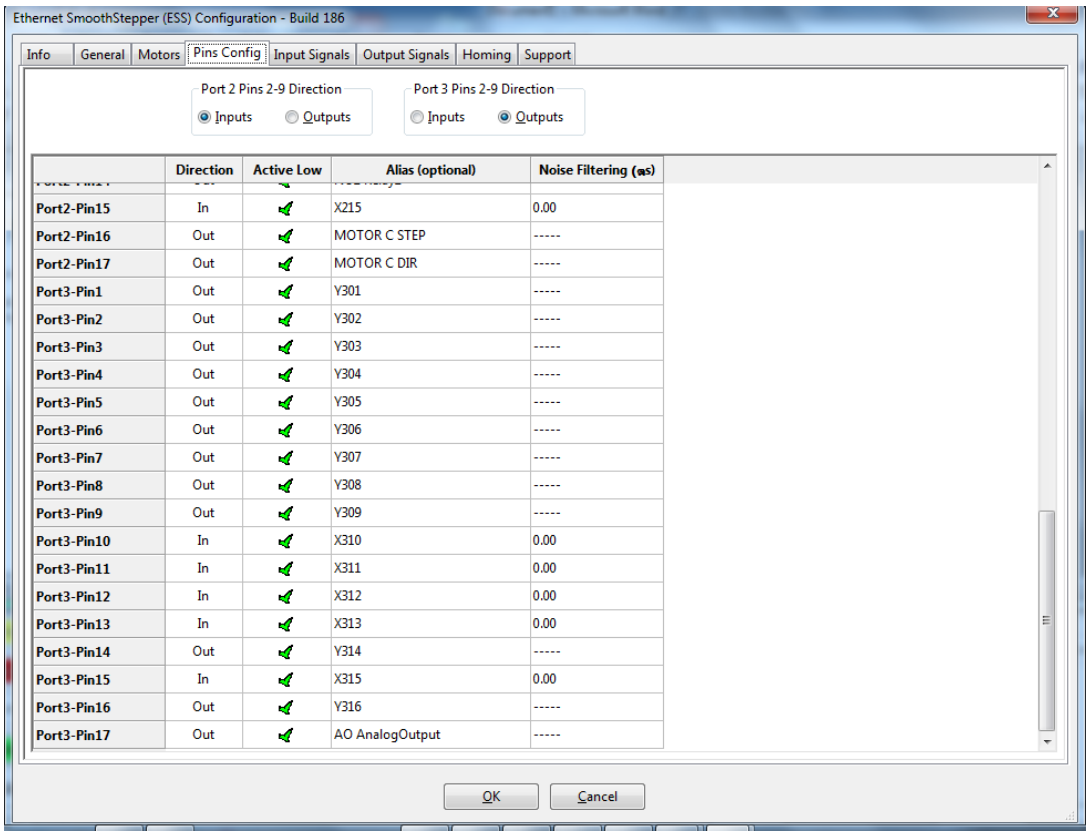


Figure 41, Pin Alias Names (continue 2)

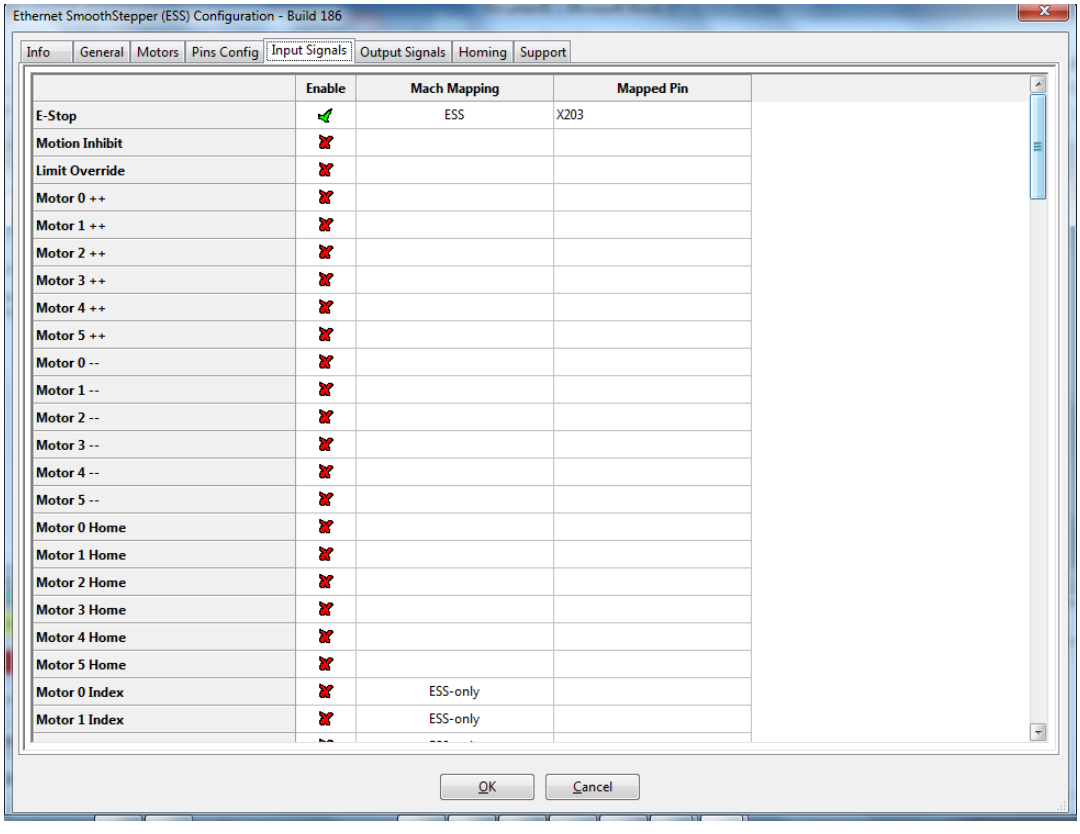


Figure 42, Input Signals Mapping

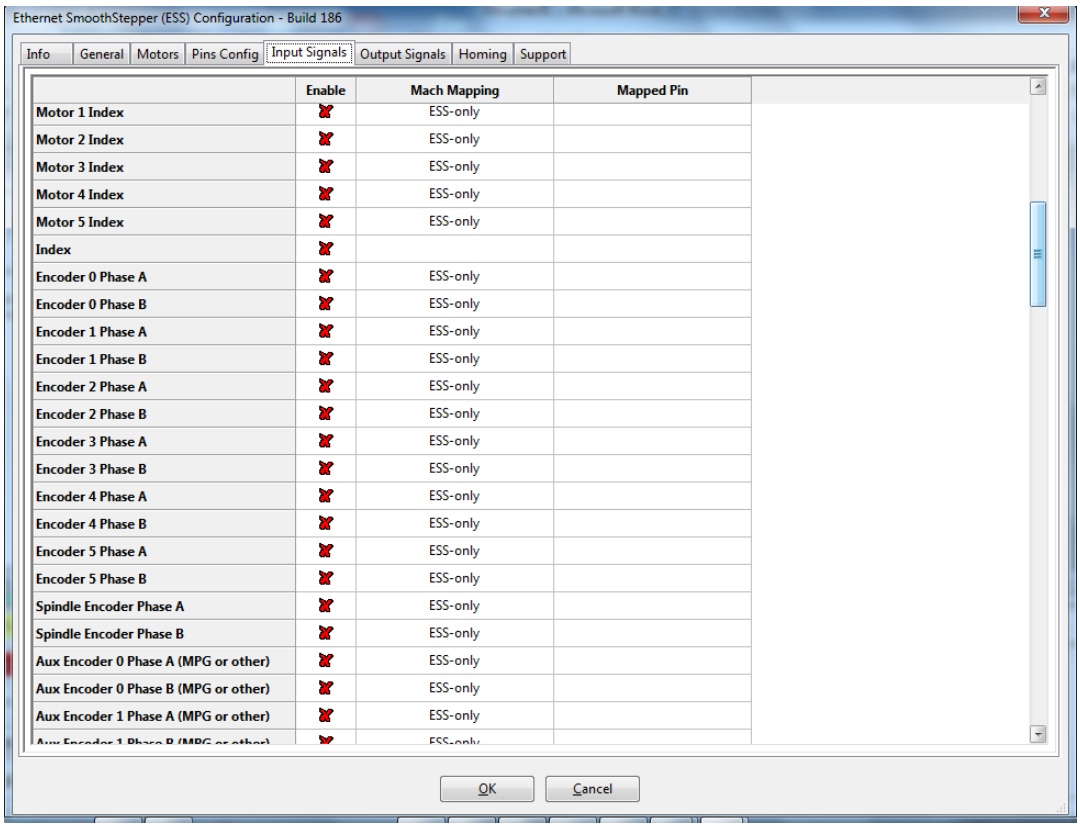


Figure 43, Input Signals Mapping (continue 1)

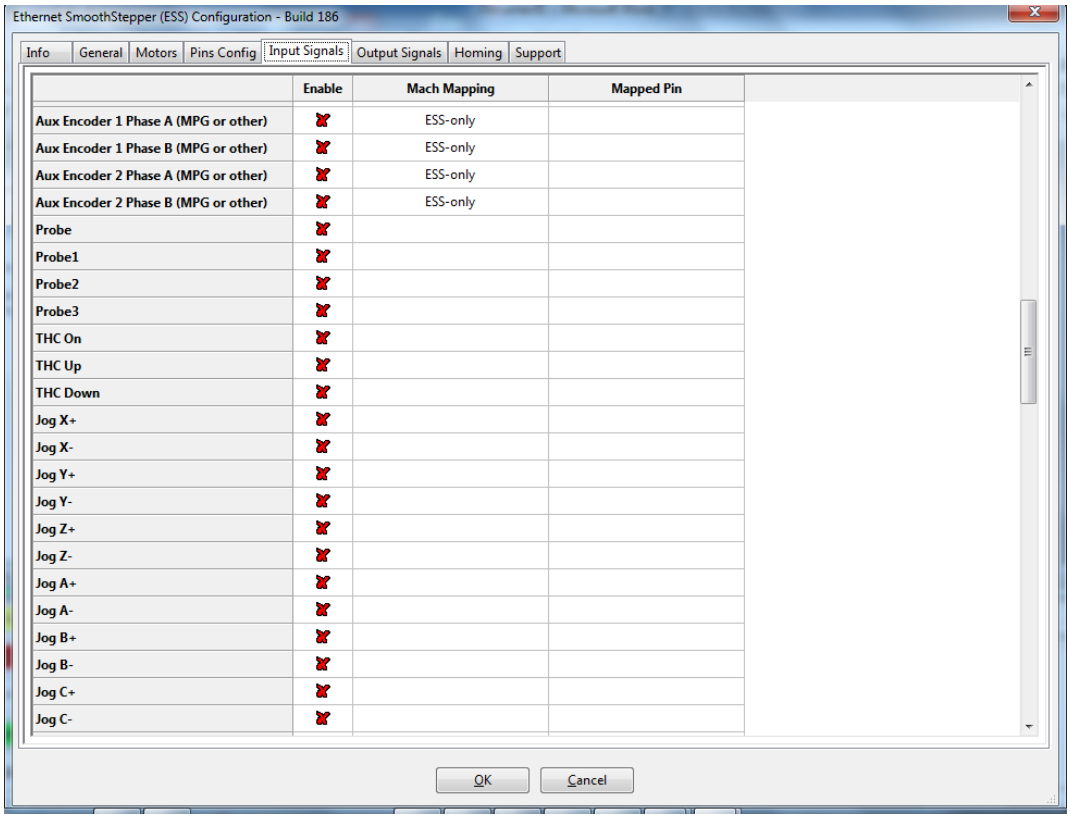


Figure 44, Input Signals Mapping (continue 2)

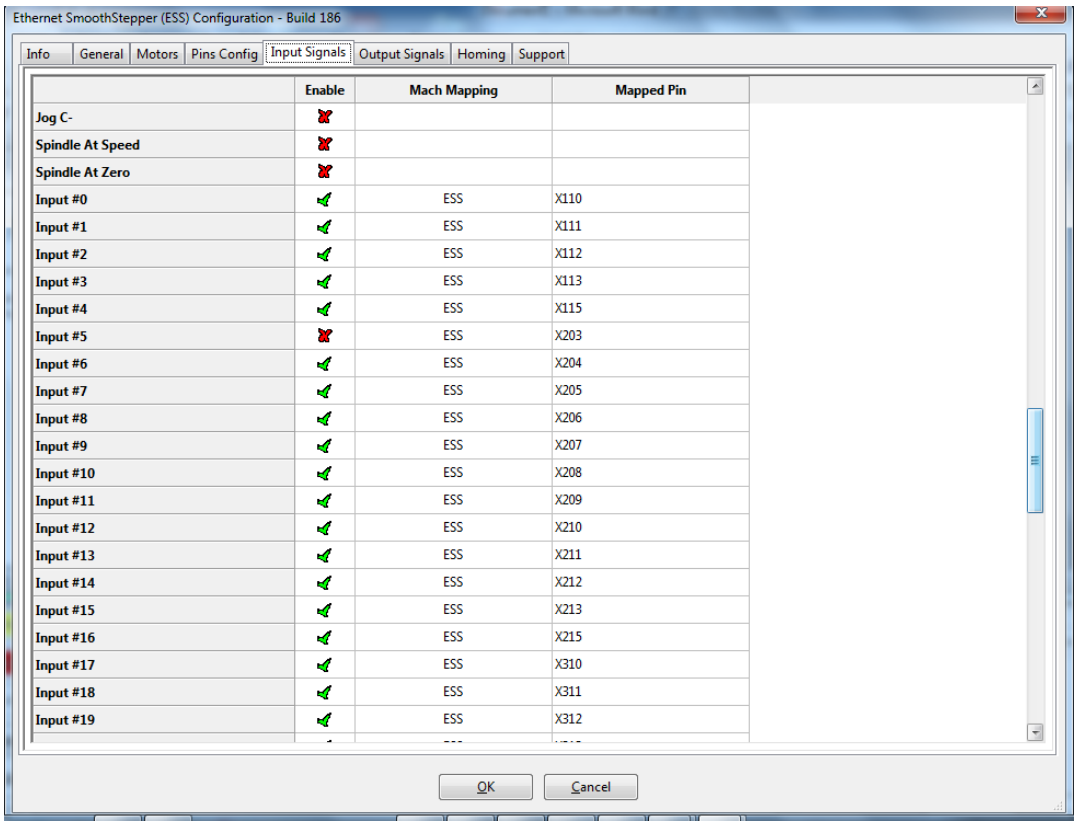


Figure 45, Input Signals Mapping (continue 3)

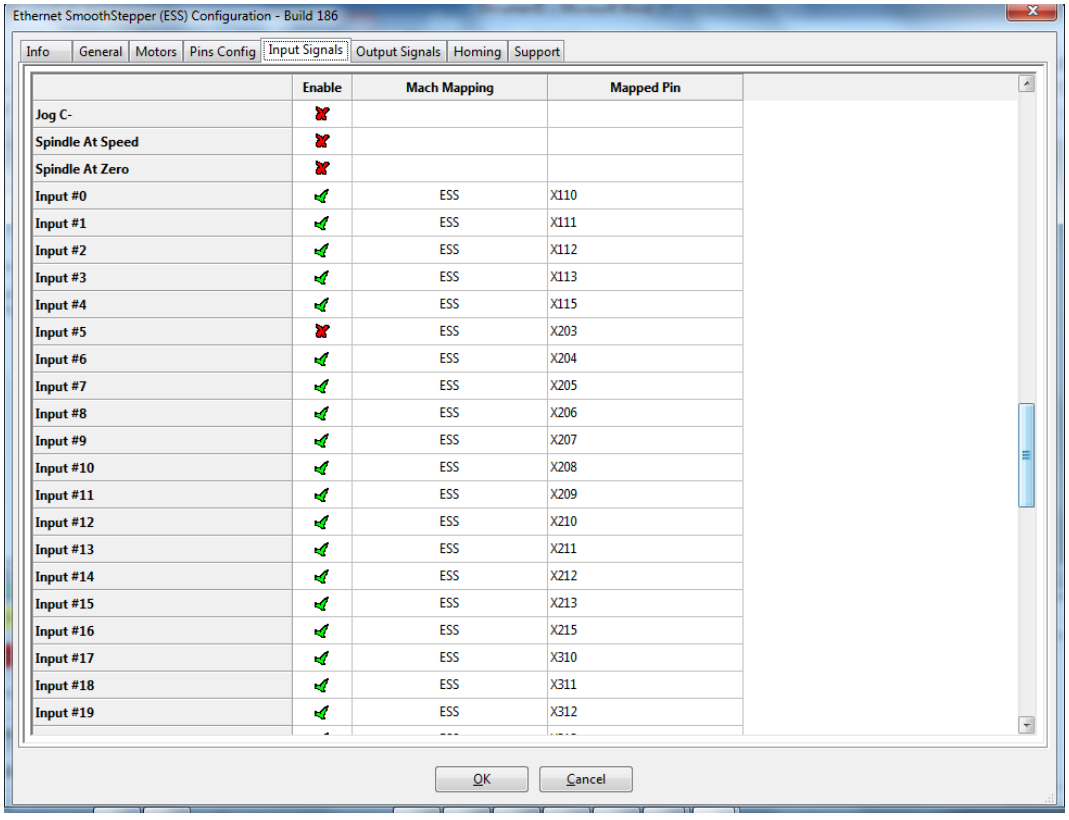


Figure 46, Input Signals Mapping (continue 4)

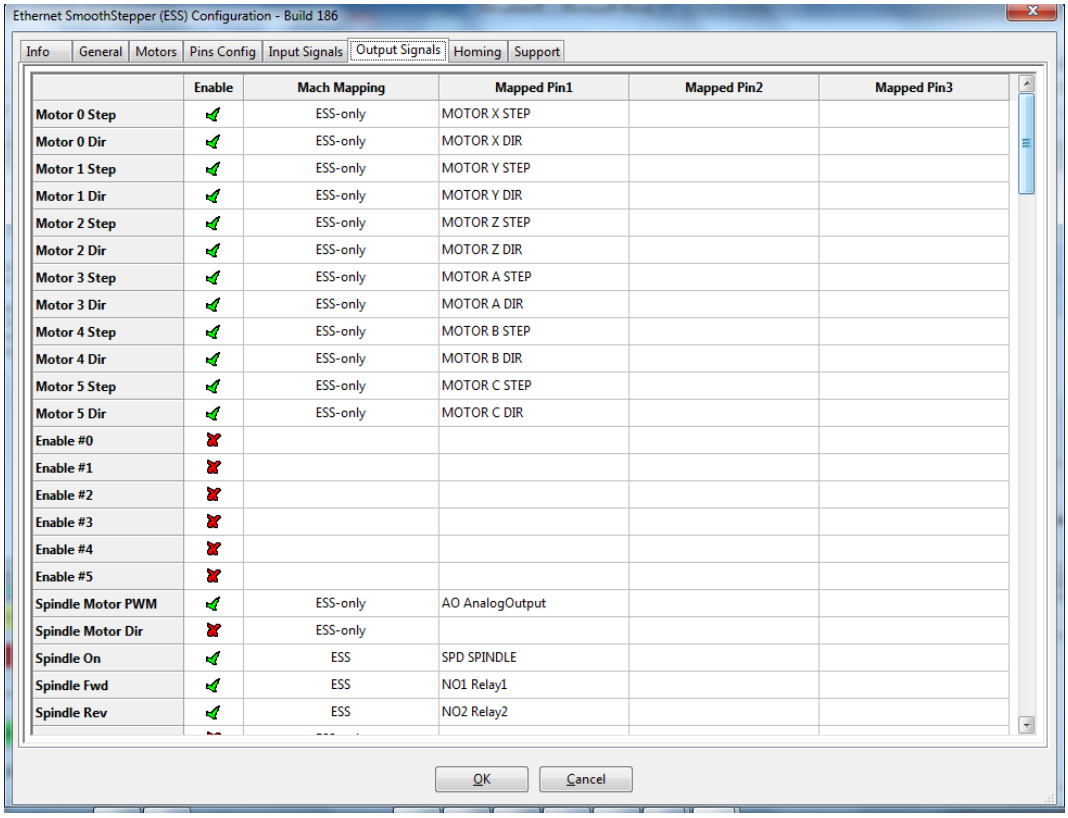


Figure 47, Output Signals Mapping

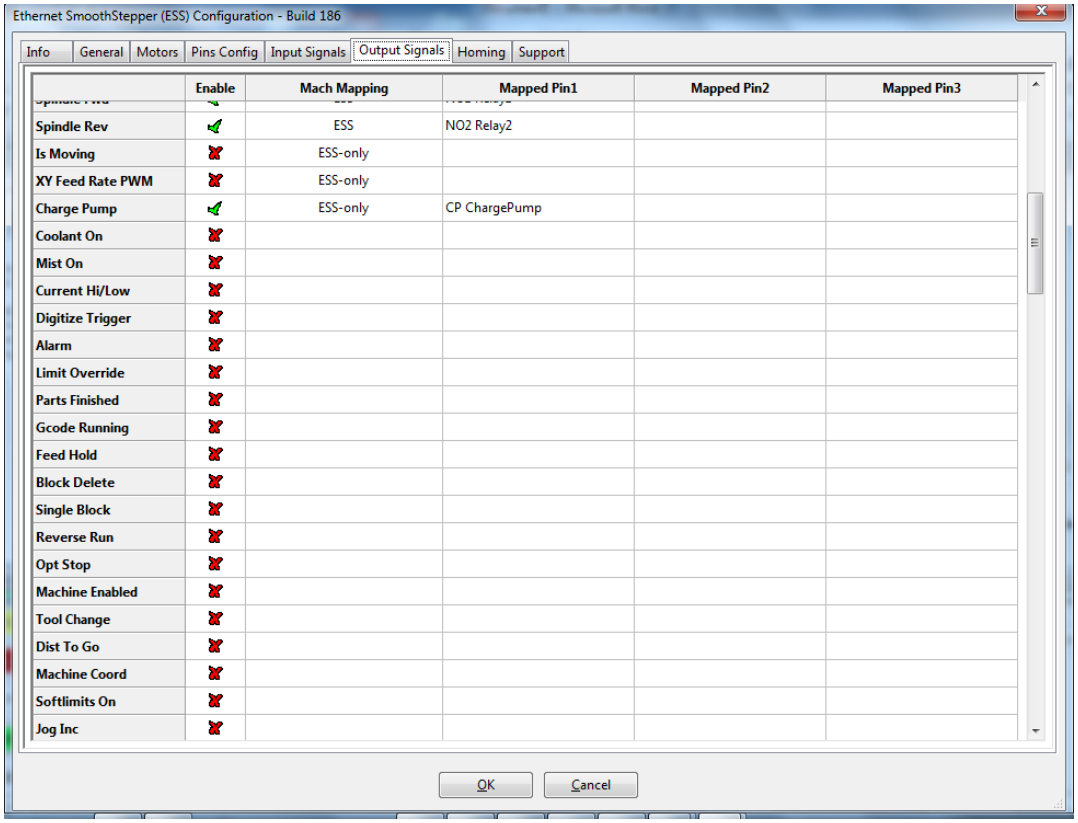


Figure 48, Output Signals Mapping (continue 1)

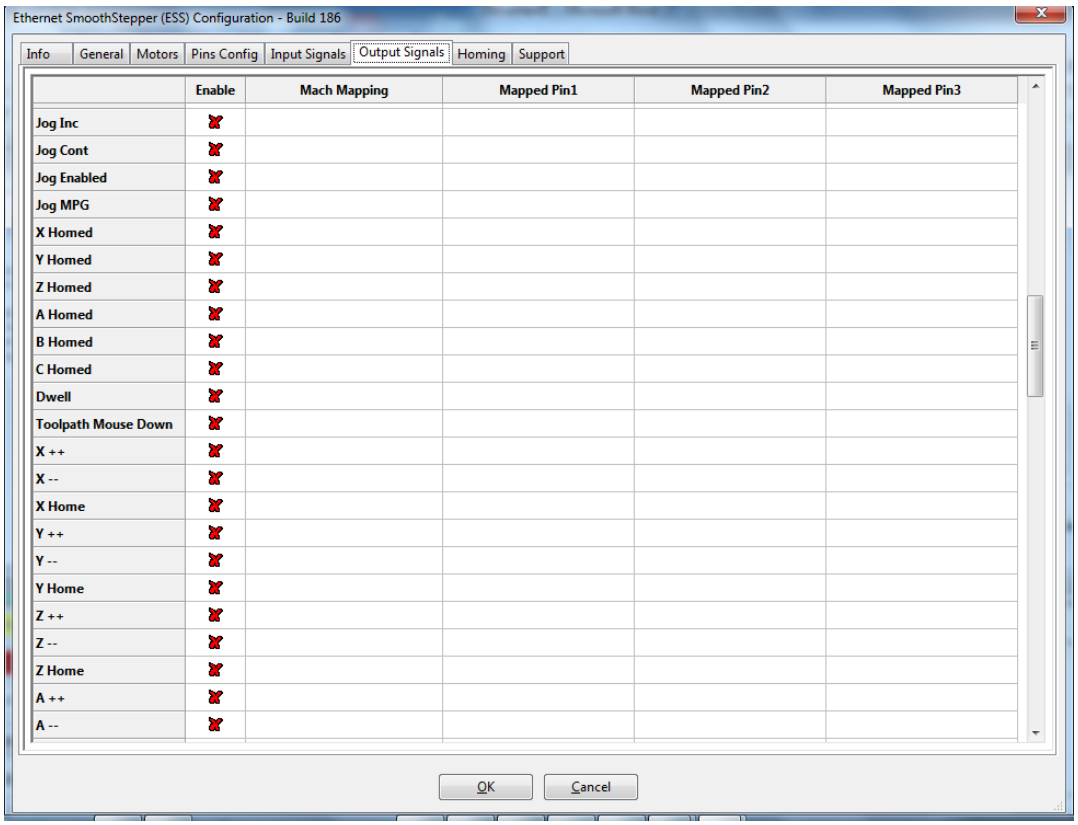


Figure 49, Output Signals Mapping (continue 2)

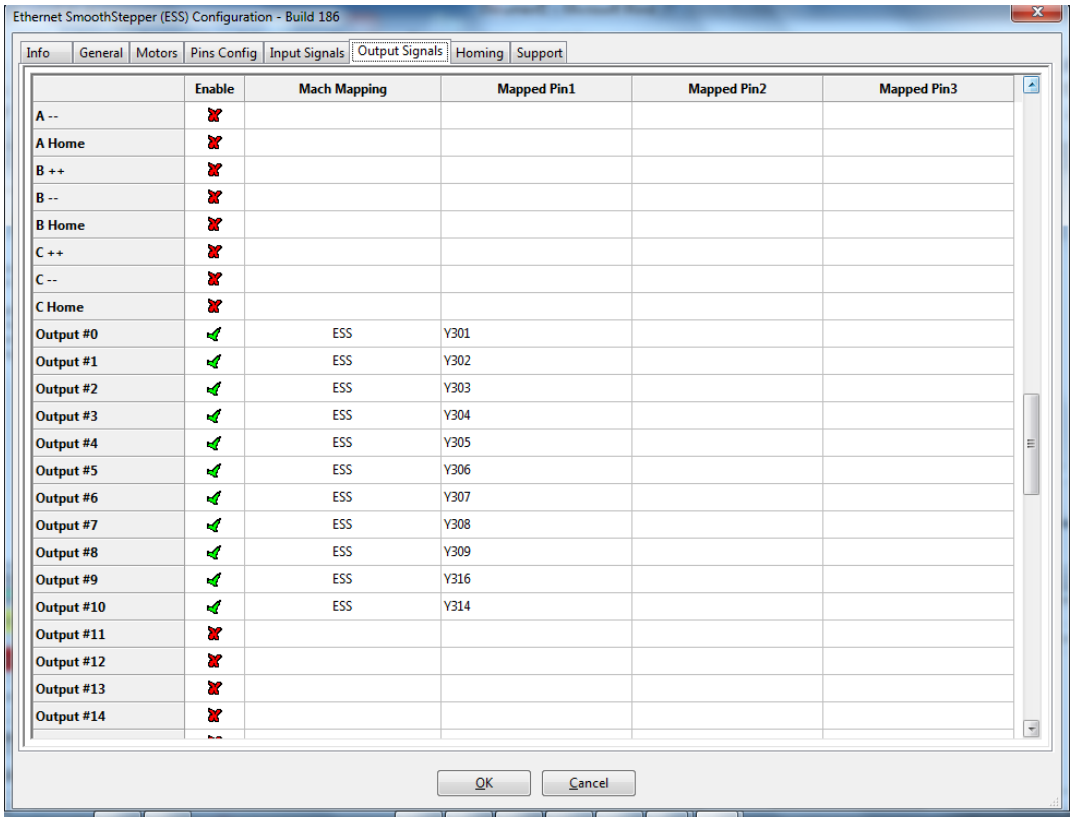


Figure 50 Output Signals Mapping (continue 3)

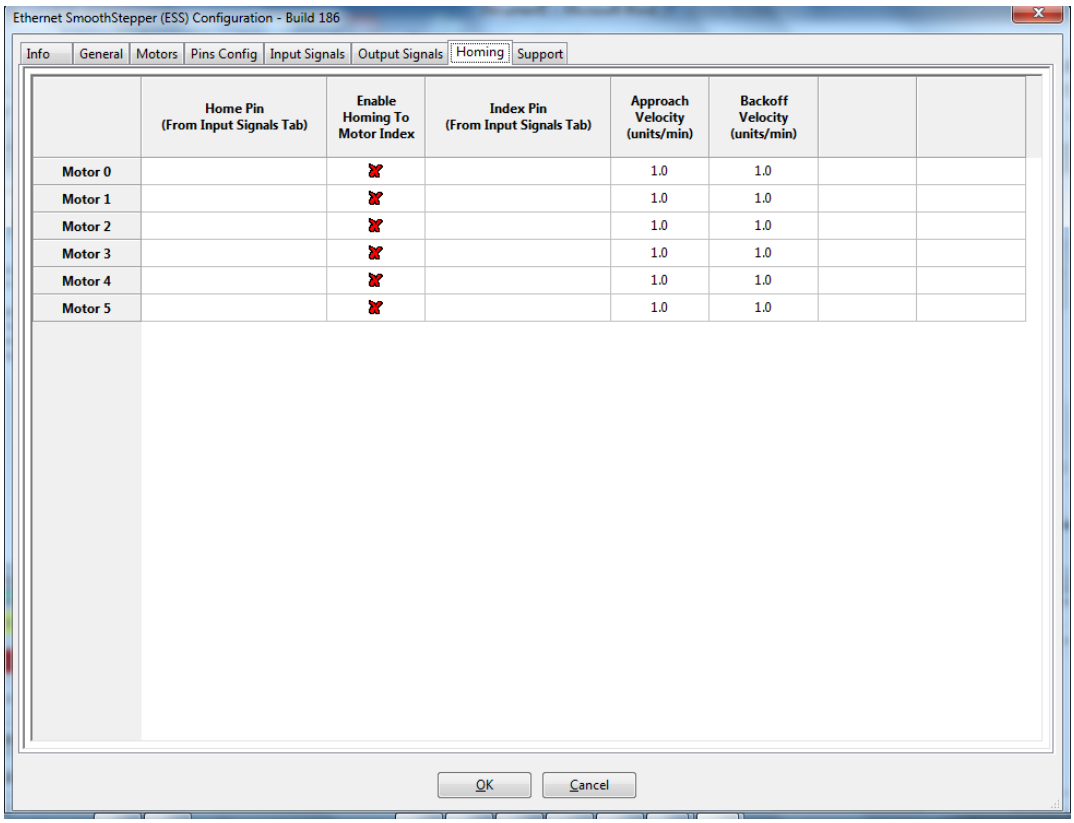


Figure 51, Homing, depends on the user's choice

Mach configuration

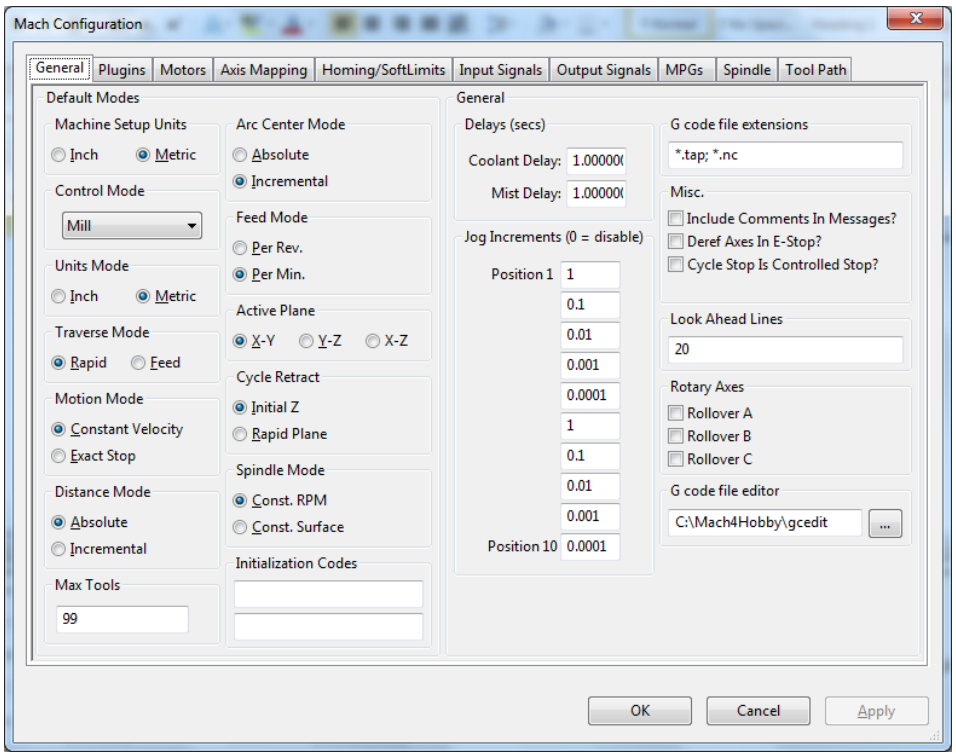


Figure 52, Mach4 General Configuration

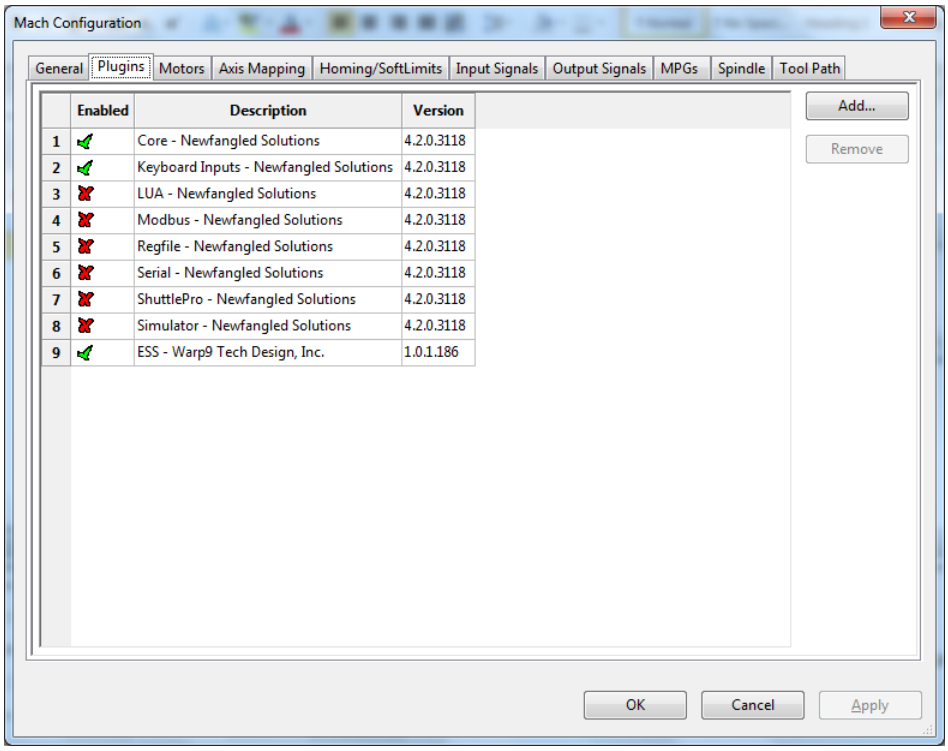


Figure 53, Mach4 Plugins enabled

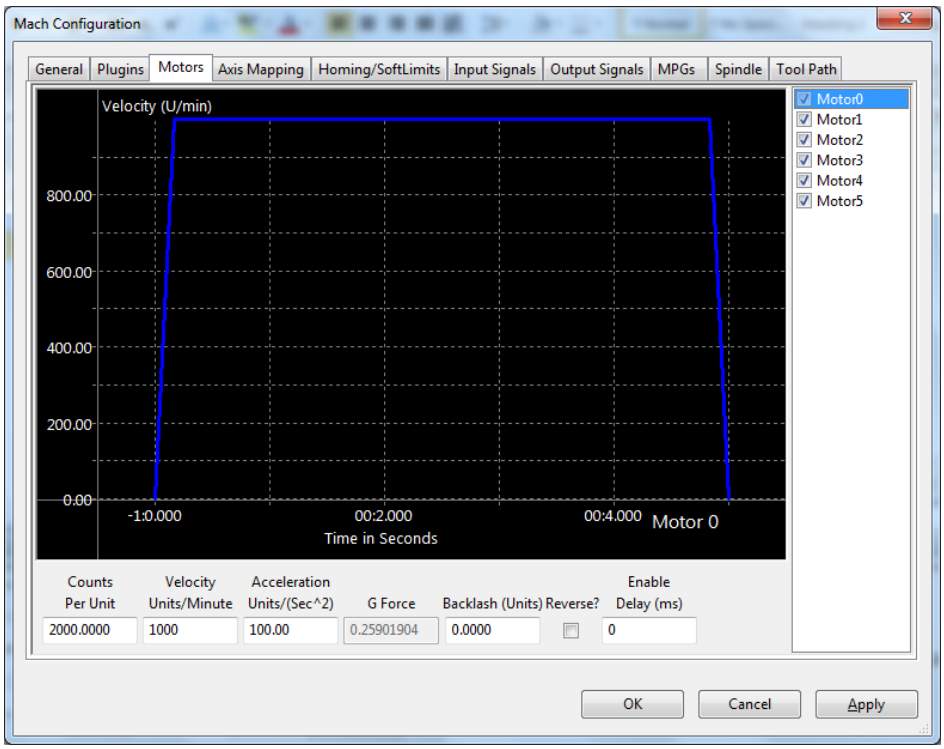


Figure 54, Mach4 Motors profiles

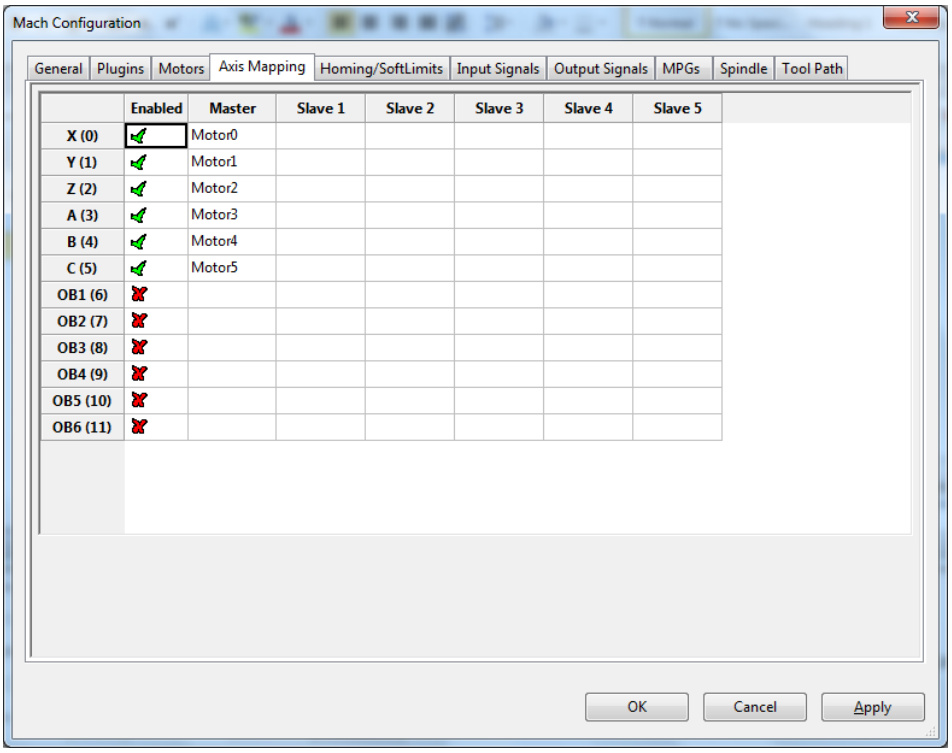
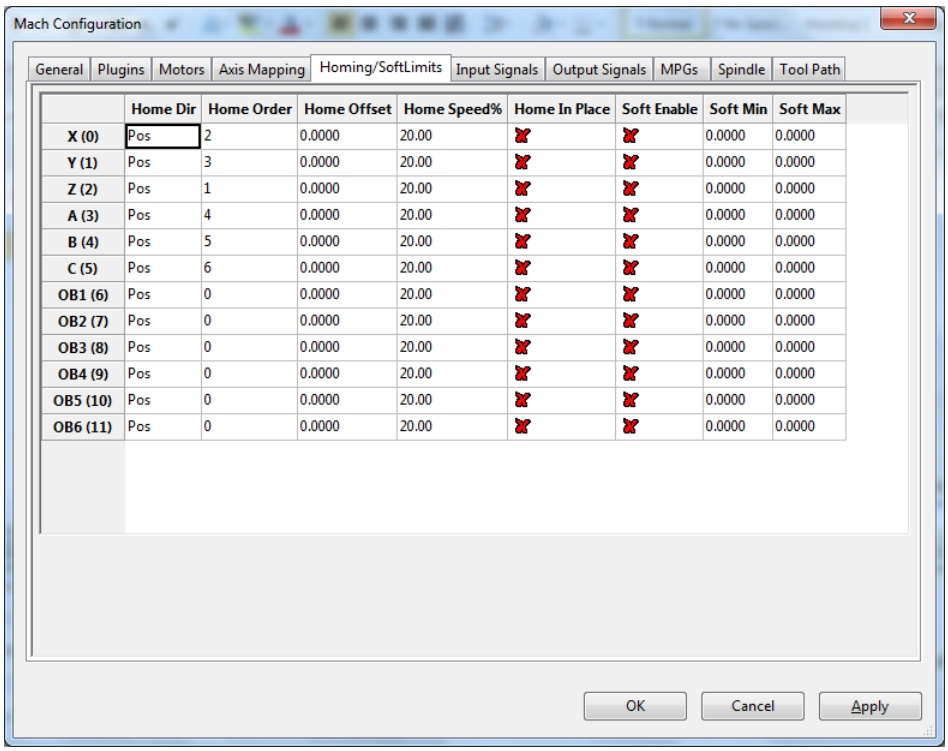
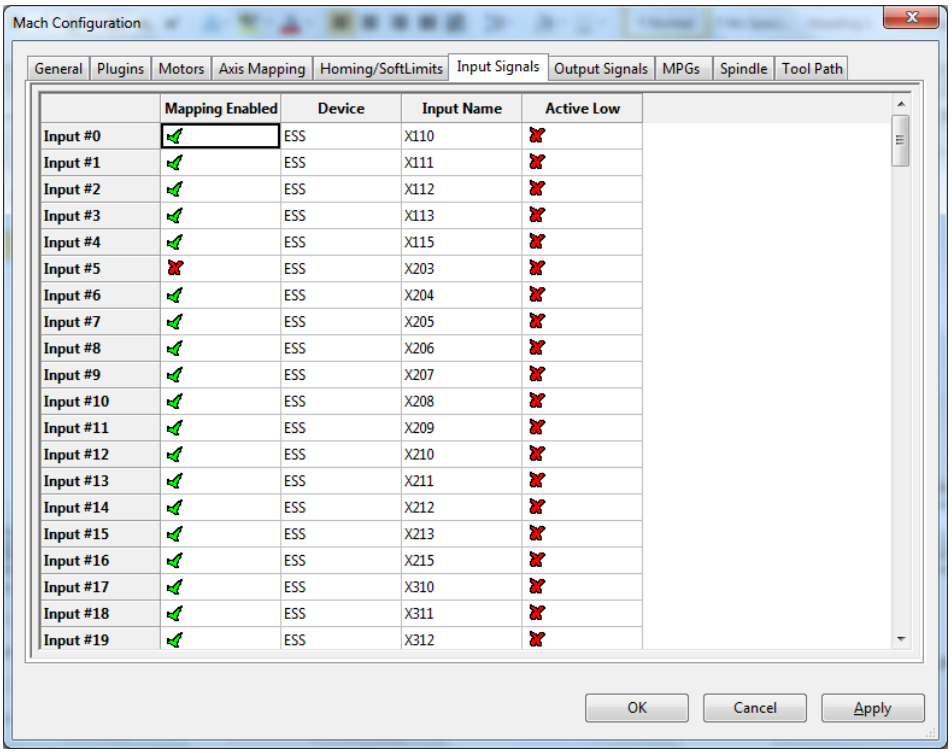


Figure 55, Mach4 Axis Mapping



	Home Dir	Home Order	Home Offset	Home Speed%	Home In Place	Soft Enable	Soft Min	Soft Max
X (0)	Pos	2	0.0000	20.00	✗	✗	0.0000	0.0000
Y (1)	Pos	3	0.0000	20.00	✗	✗	0.0000	0.0000
Z (2)	Pos	1	0.0000	20.00	✗	✗	0.0000	0.0000
A (3)	Pos	4	0.0000	20.00	✗	✗	0.0000	0.0000
B (4)	Pos	5	0.0000	20.00	✗	✗	0.0000	0.0000
C (5)	Pos	6	0.0000	20.00	✗	✗	0.0000	0.0000
OB1 (6)	Pos	0	0.0000	20.00	✗	✗	0.0000	0.0000
OB2 (7)	Pos	0	0.0000	20.00	✗	✗	0.0000	0.0000
OB3 (8)	Pos	0	0.0000	20.00	✗	✗	0.0000	0.0000
OB4 (9)	Pos	0	0.0000	20.00	✗	✗	0.0000	0.0000
OB5 (10)	Pos	0	0.0000	20.00	✗	✗	0.0000	0.0000
OB6 (11)	Pos	0	0.0000	20.00	✗	✗	0.0000	0.0000

Figure 56, Mach4 Homing and Soft Limits



	Mapping Enabled	Device	Input Name	Active Low
Input #0	✓	ESS	X110	✗
Input #1	✓	ESS	X111	✗
Input #2	✓	ESS	X112	✗
Input #3	✓	ESS	X113	✗
Input #4	✓	ESS	X115	✗
Input #5	✗	ESS	X203	✗
Input #6	✓	ESS	X204	✗
Input #7	✓	ESS	X205	✗
Input #8	✓	ESS	X206	✗
Input #9	✓	ESS	X207	✗
Input #10	✓	ESS	X208	✗
Input #11	✓	ESS	X209	✗
Input #12	✓	ESS	X210	✗
Input #13	✓	ESS	X211	✗
Input #14	✓	ESS	X212	✗
Input #15	✓	ESS	X213	✗
Input #16	✓	ESS	X215	✗
Input #17	✓	ESS	X310	✗
Input #18	✓	ESS	X311	✗
Input #19	✓	ESS	X312	✗

Figure 57, Mach4 Input Signals

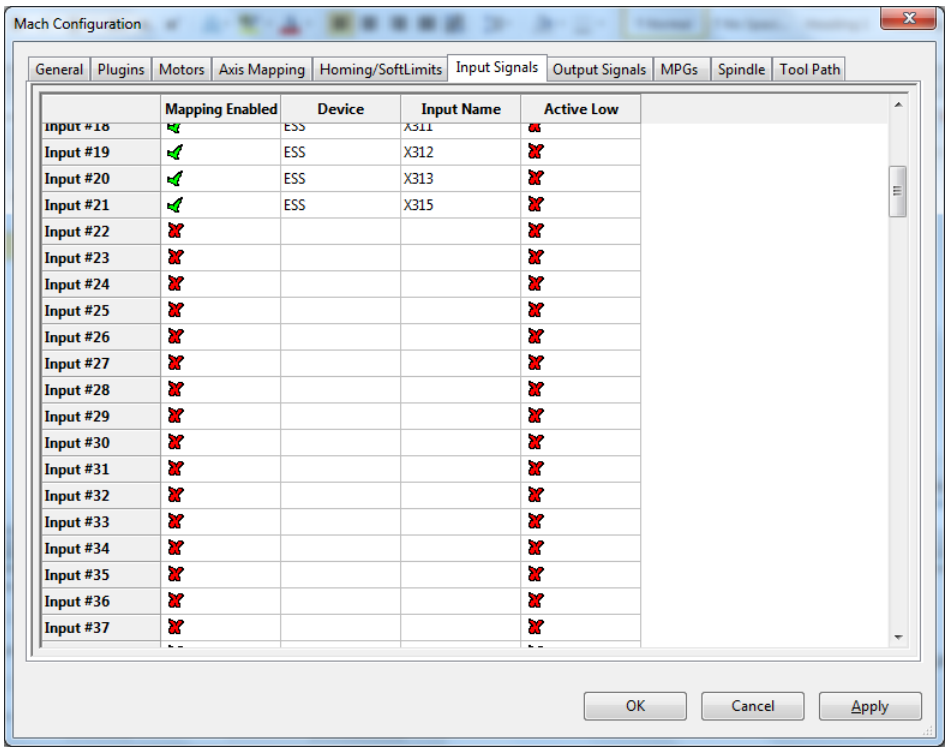


Figure 58, Mach4 Input Signals (continue 1)

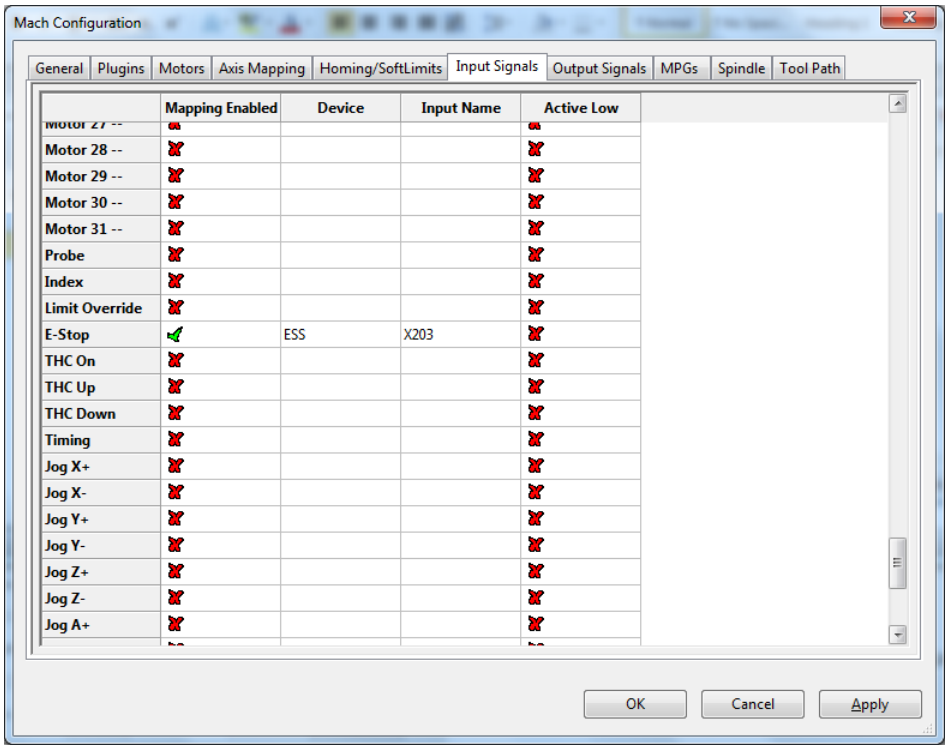


Figure 59, Mach4 Input Signals (continue 2)

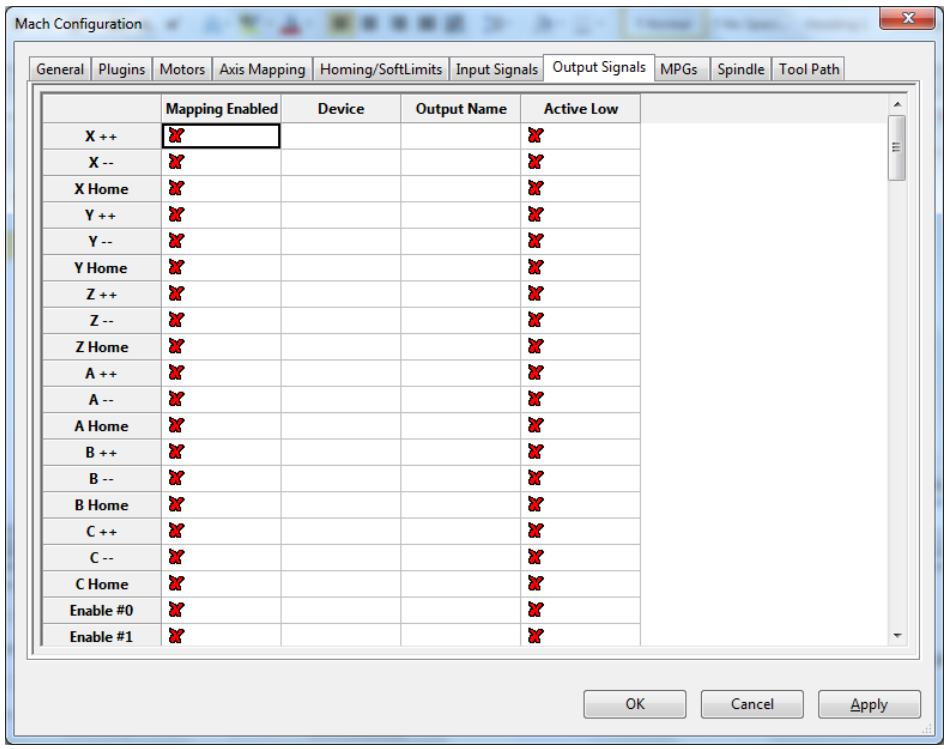


Figure 60, Mach4 Input Signals (continue 3)

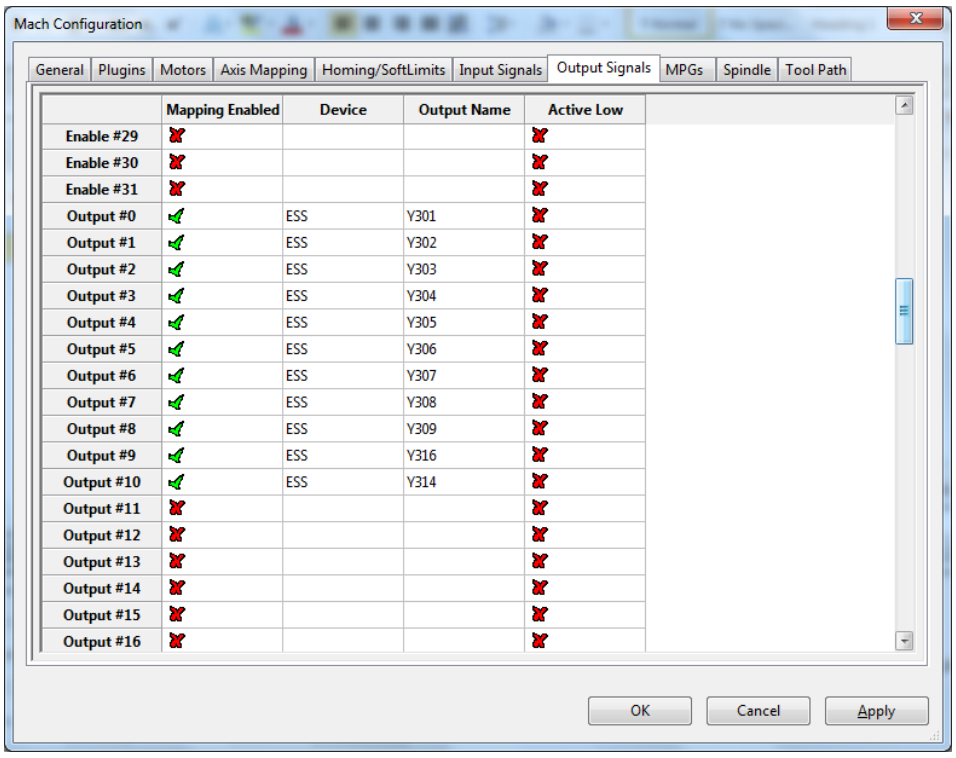


Figure 61, Mach4 Output Signals

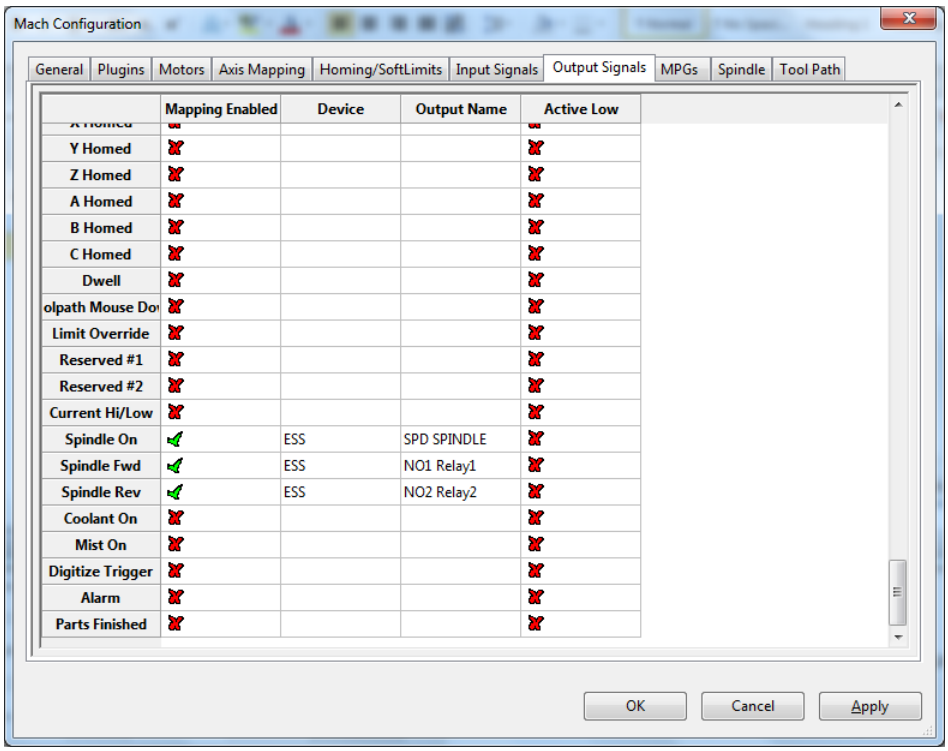


Figure 62, Mach4 Output Signals (continue 1)

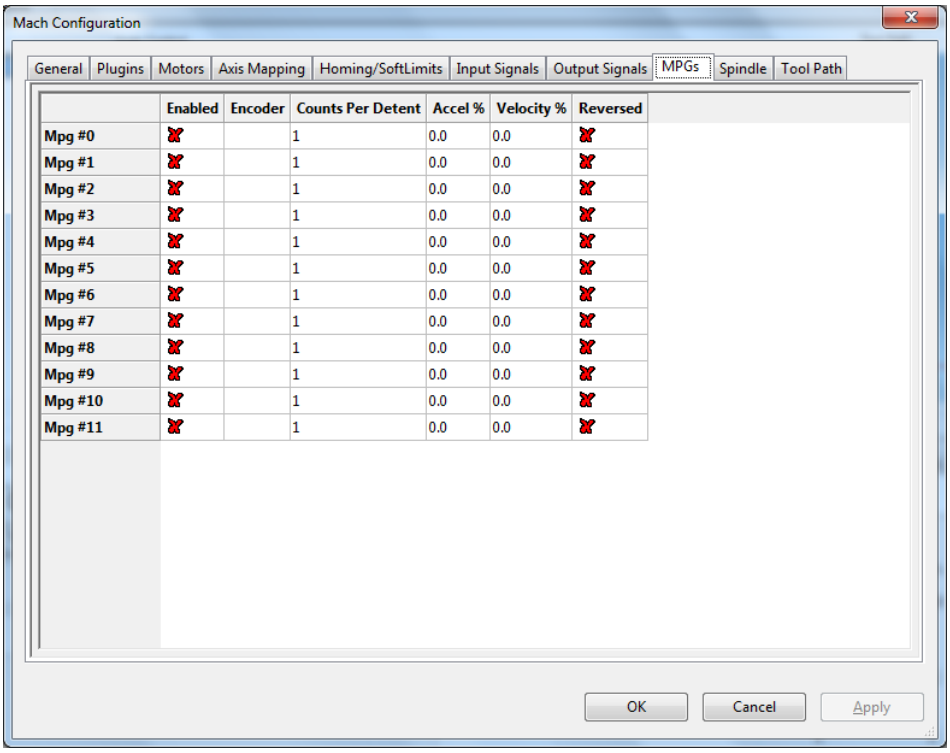


Figure 63, Mach4 MPGs

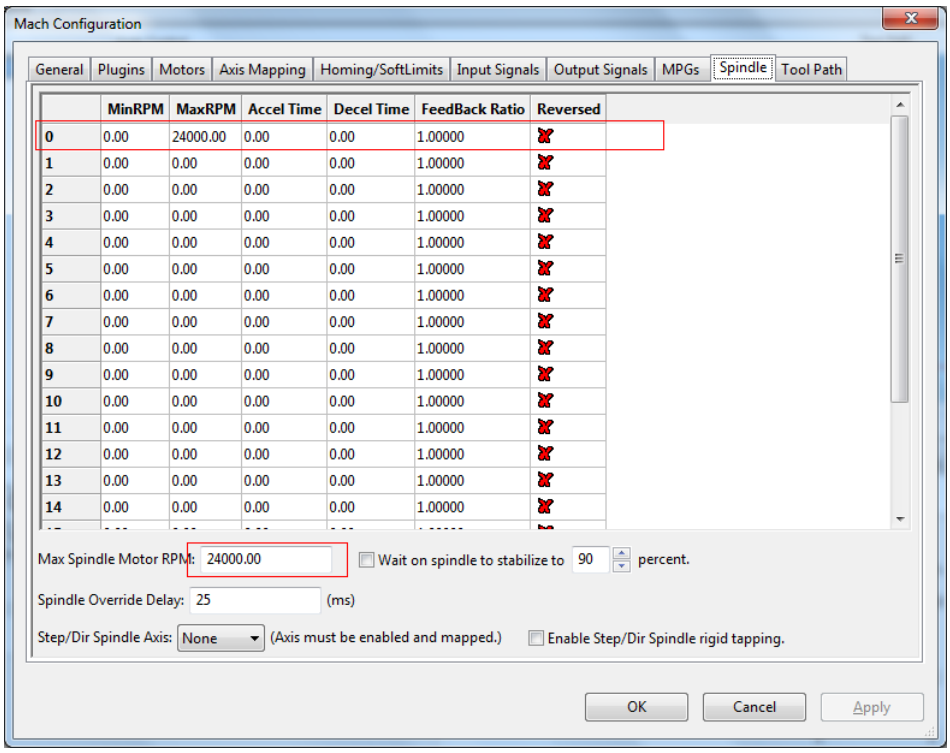


Figure 64, Mach4 Spindle

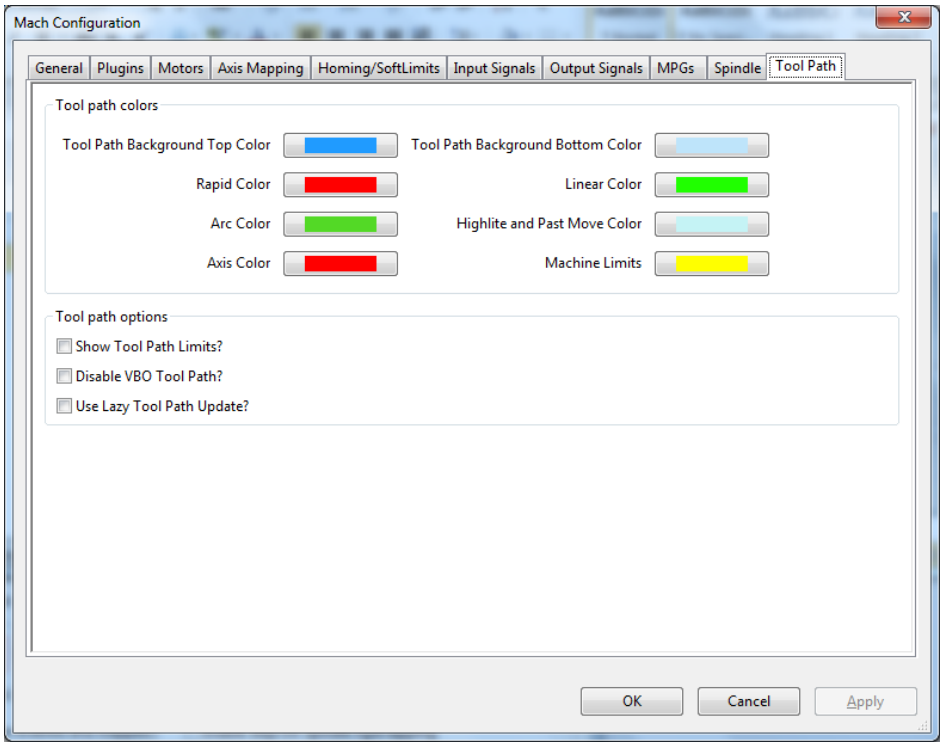


Figure 65, Mach4 Tool Path Colors

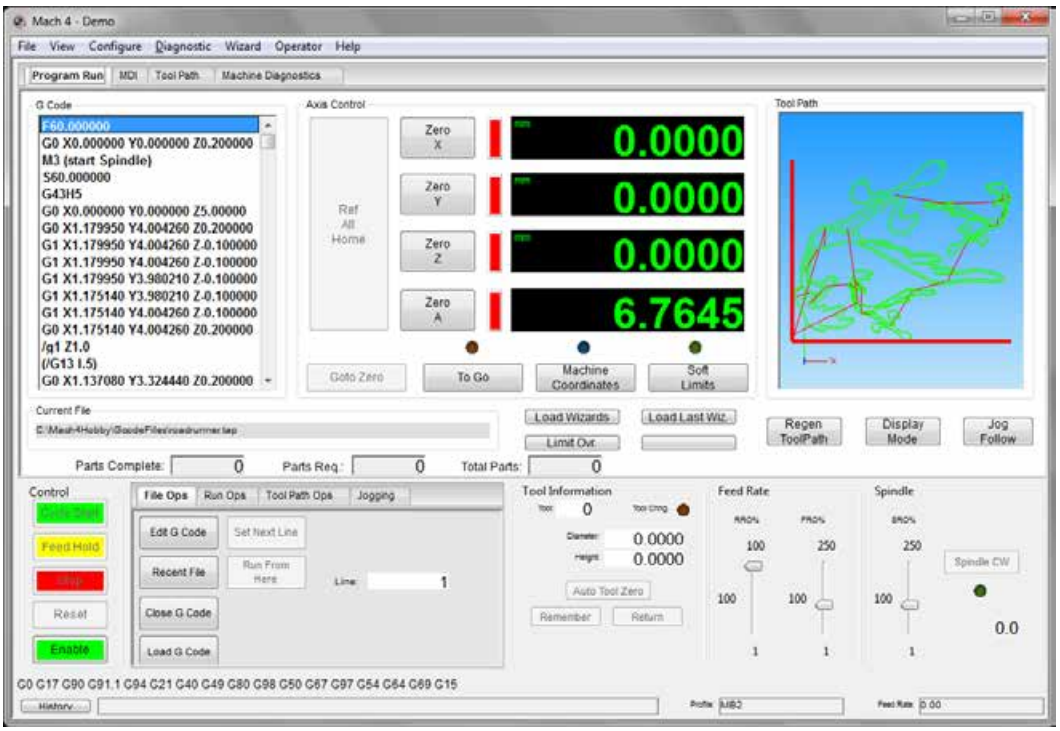


Figure 66, Mach4's first screen

Mach Keyboard

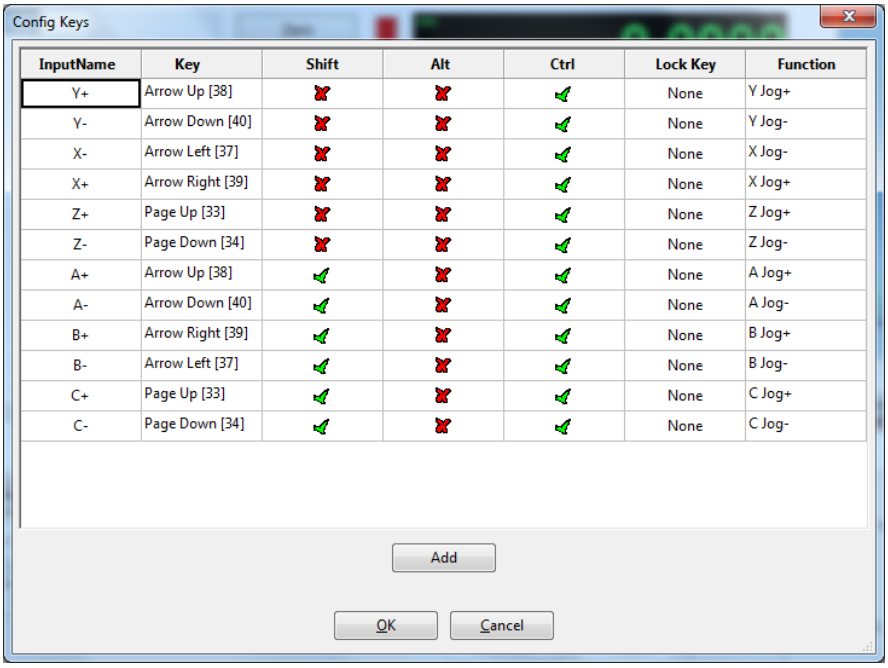
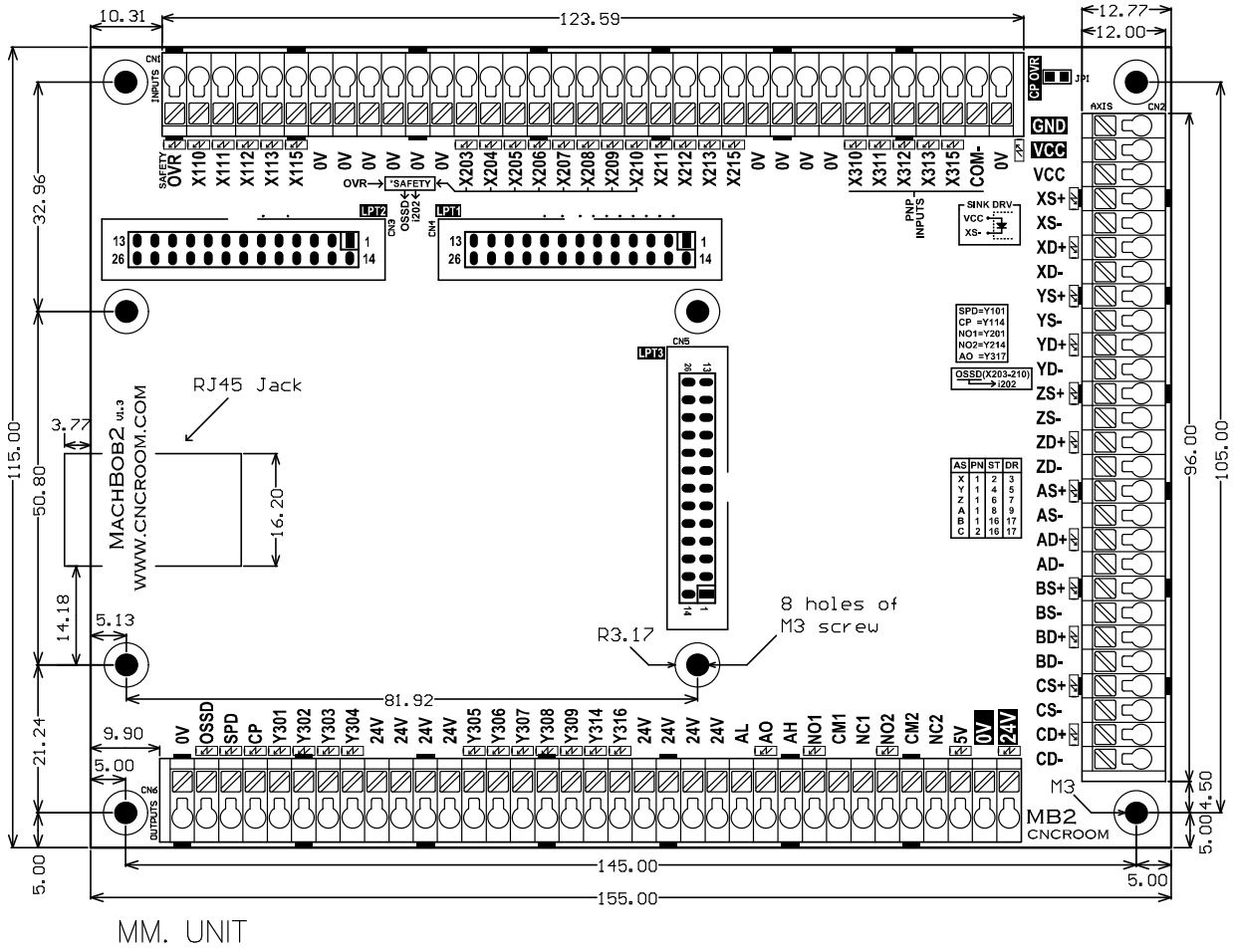


Figure 67, Mach4 Keyboard Mapping

Appendix I MB2 Specifications

Dimensions	115 x 155 mm (height x width)
Supply voltage	24V (12-28Vdc), 500mA (MB2v1.3)
	24V (18-28Vdc), 500mA (MB2v1.5,v2.0)
Supply voltage ripple	≤ 5%
Outputs	NPN, Sink 5-24Vdc
Output current	100mA Max (total 7 outputs ≤ 500mA)
Relay contact	0.5A 120Vac, 1A 24Vdc
Analog output range	(0V + 200mV) ~ (Vin – 200mV)
Inputs	NPN, PNP, 5-24Vdc
Ambient operating temperature	0-40°C

Appendix II MB2 Board Dimensions



Appendix III Safety circuit options

The circuits shown below are only examples and adhere to no particular country's safety standard. Please always seek professional advice from a qualified electrician or electrical engineer in your country of residence before implementing any circuit that is presented in this manual. CNCRoom cannot be held responsible for any adverse outcome, which came about as a result of copying anything from this manual.

Safety Circuit 1

Safety circuit 1 is simple but effective. It has fewer components and less wiring and relies mainly on good and consistent function of the computer and electronic components to disengage the drive's power through a "servo on" signal or similar.

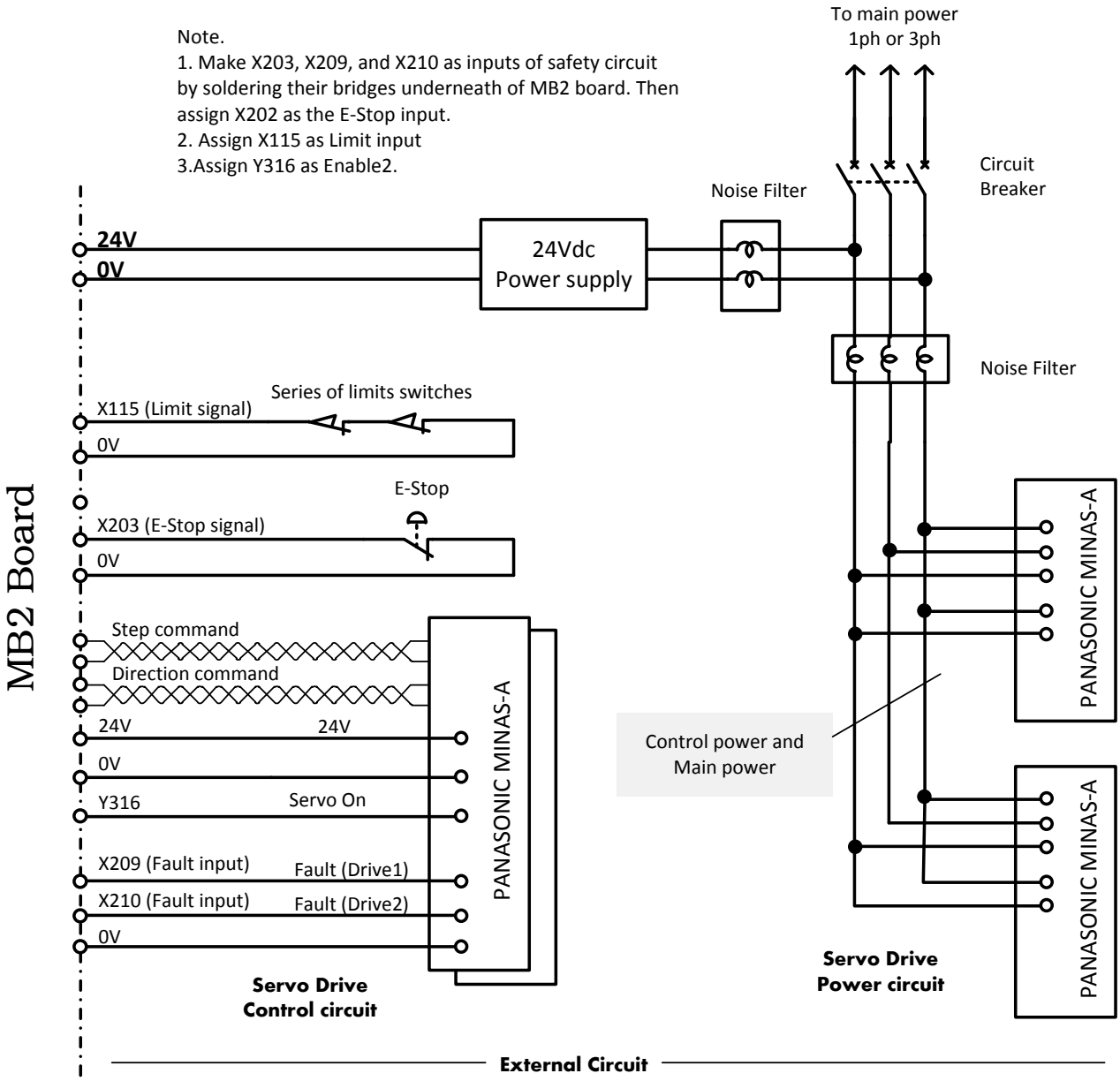


Figure 68, Safety Circuit 1

Safety Circuit 2

Safety circuit 2 is more for the user who prefers not to rely on electronics for safety and would prefer the option of disengaging power from the drives or hazardous devices by the use of unintelligent components, such as limit switches, the Estop button or a magnetic contactor.

In a situation where a motor runs out of control, being caused either by electromagnetic interference or even human error, a well-designed system should be able to halt the machine by the use of limit switches alone or by hitting the Estop button.

However, in normal circumstance, the MB2 with an external circuit and connection to a computer should work well together. In some drive connections you may need to implement the use of timer relays to handle an “Under Voltage” error.

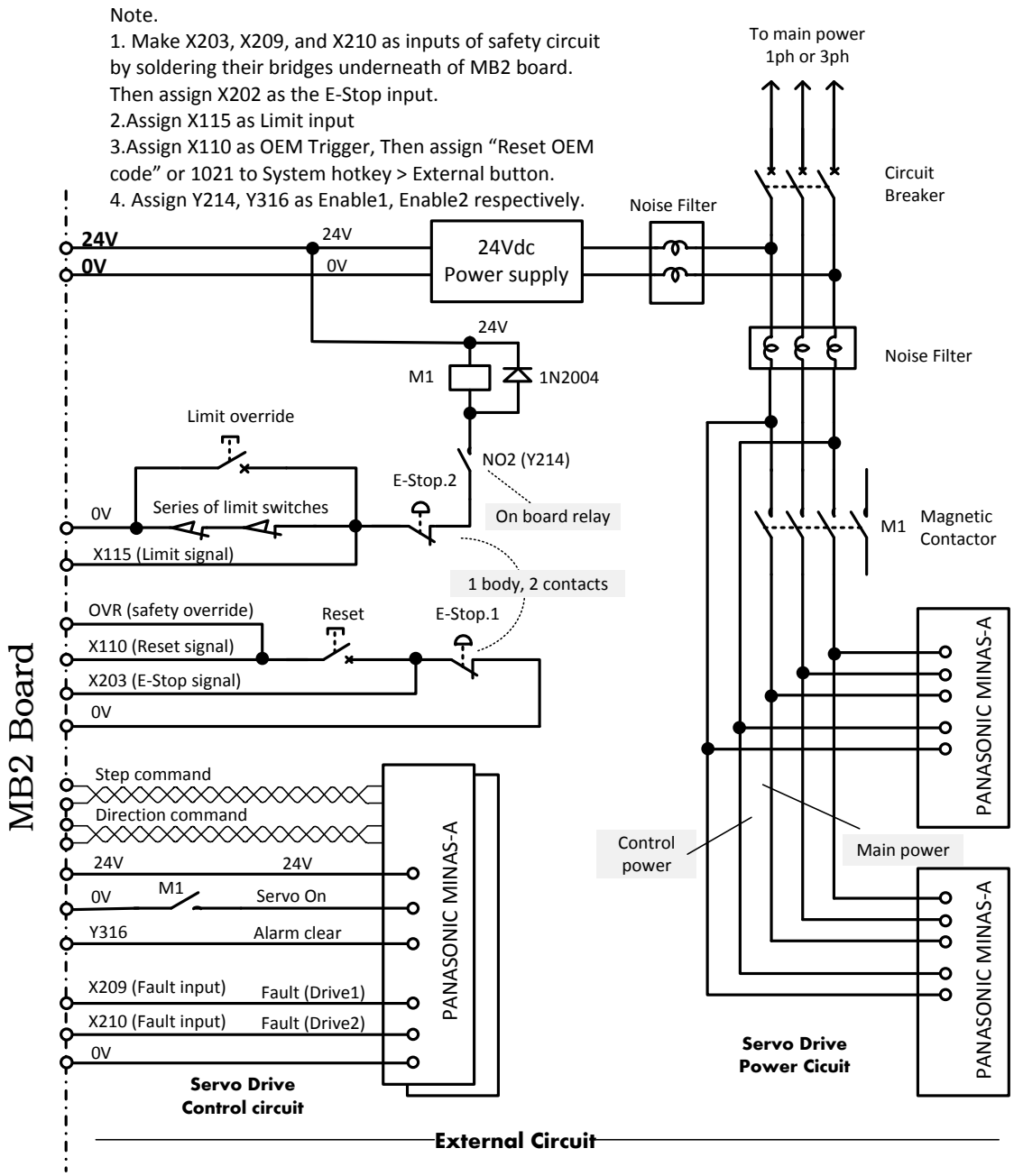


Figure 69, Safety Circuit 2

Safety Circuit 3

Since the MB2 board supports an “Off-Delay” function for relay K1 and K2, it allows the user to create a timing sequence for devices that need to power up or power down independently at different times.

In this circuit an AC line monitor for recognising a “Power-Out” or “Black-Out” condition has also been introduced. This circuit will halt the machine in an orderly fashion before it loses power completely. A UPS is needed to power AC drives for few seconds after the power has failed. For DC drives a lower cost, slow charging capacitor is all that is necessary.

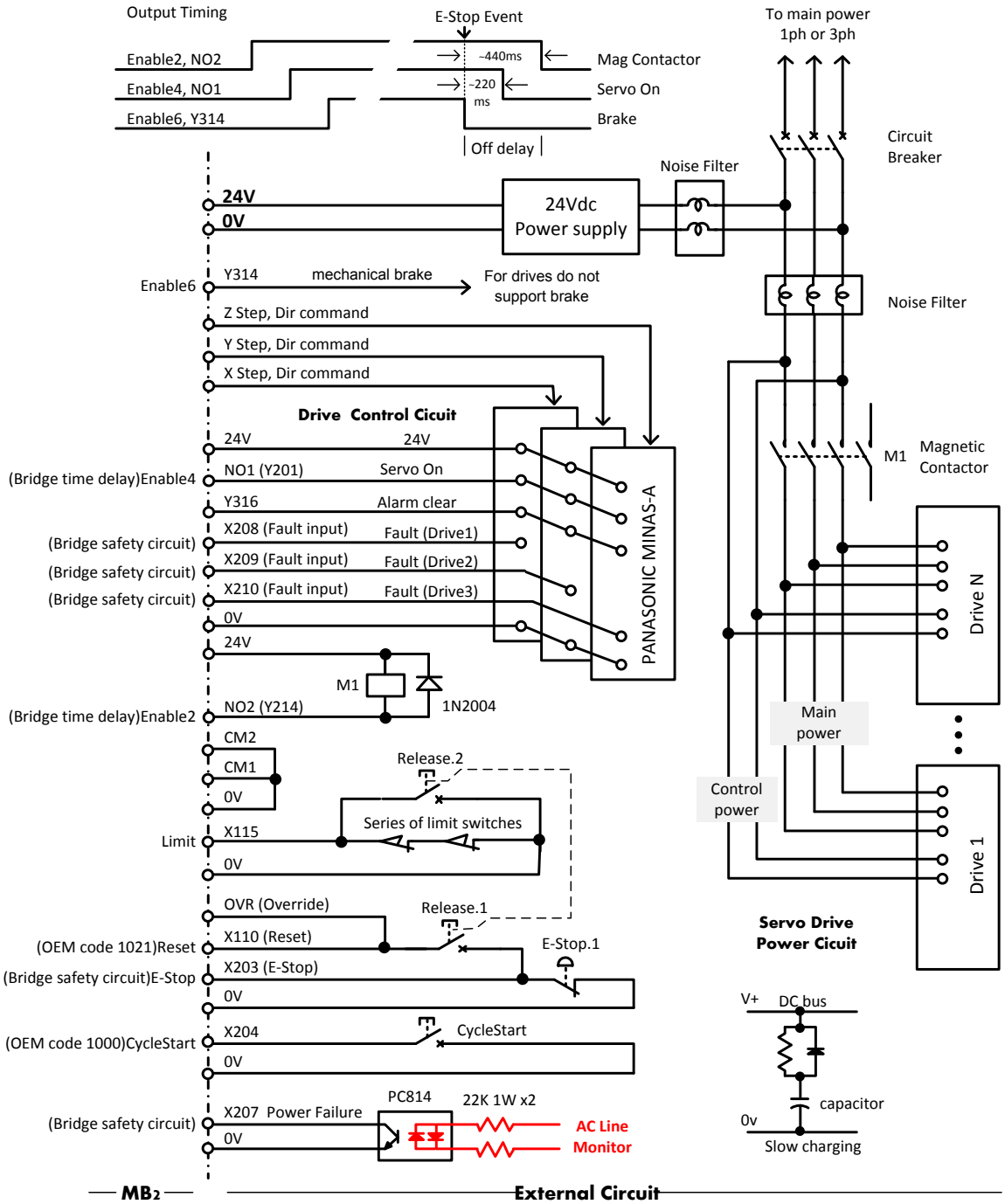


Figure 70, Safety Circuit 3

Appendix IV Figure and Table references

Figures

Figure Number Page Number

Table