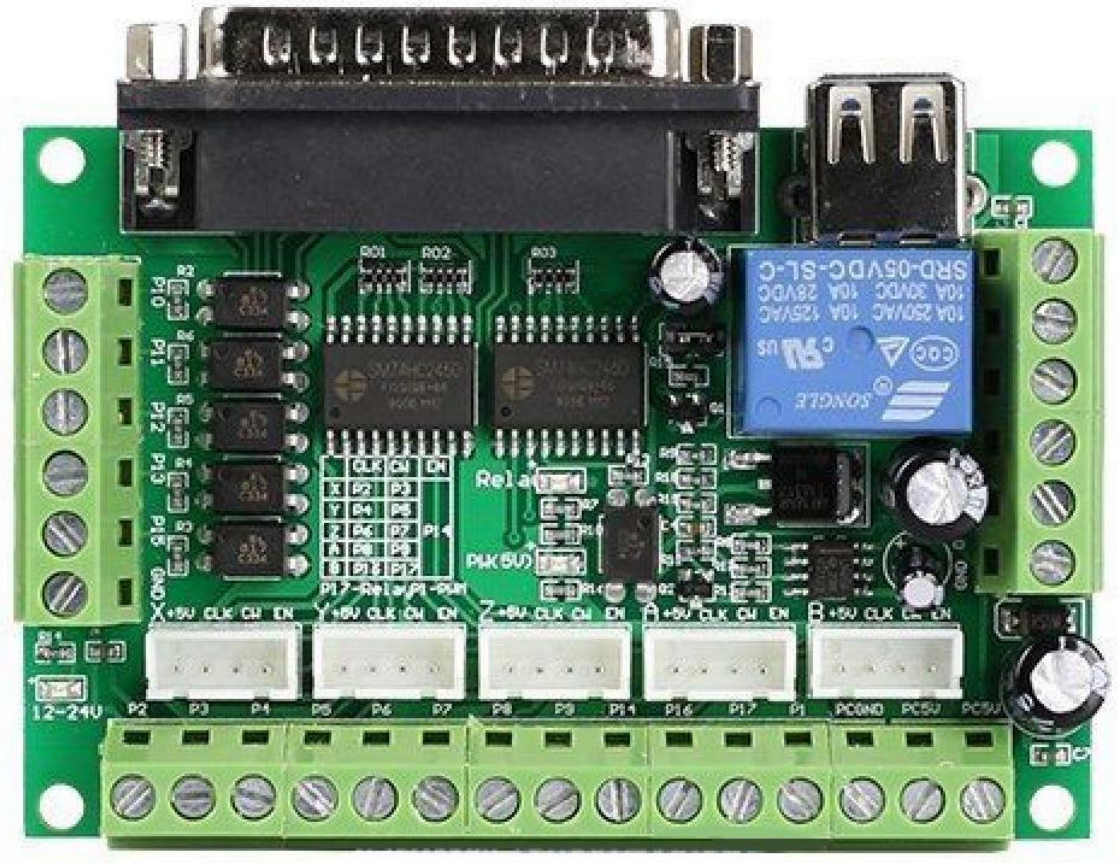
VIKING

5 Axis CNC Breakout Board Wiring & Set Up Guide



www.vikingmachinery.co.nz

Version 1.2 – November 2017

0.0 Safety Statement

All machinery, especially CNC machinery, has inherent dangers and risks. It is the responsibility of the system designer to ensure that any systems built using any Viking Machinery Ltd. products are safe for use. Any technical information is provided as a reference only, and does not constitute a recommendation as to the fitness of use in any particular application.

Viking Machinery Ltd. strongly urges customers to seek expert advice when dealing with potentially dangerous electrical voltages and sources of mechanical energy. Information contained in this document does not constitute a substitute for expert advice.

1.0 Product Overview

- Controller interface: DB25 (Parallel Port) – Male socket & USB A – Female socket (power only)
- Board supply voltage: 12-24V DC (Must be connected for full board function)
- Number of inputs: 5 (Preconfigured with pullup resistors)
- Dedicated spindle speed control options: Relay, 0-10V DC Analog, 5V DC PWM
- Number of outputs: 12
- Board dimensions: 90mm x 70mm x 20mm approximate
- Mounting hole spacing: 83mm x 53mm – M3 screws & 6mm stand offs required for gear plate mounting. 3d printable DIN rail mounts and board bumpers available from; https://www.thingiverse.com/VikingNZ/designs
- Compatible with Mach3, Linux CNC and Smooth Stepper Products

2.0 Scope of Document

This document is designed to give an overview of the wiring options for the 5 axis breakout board product. It is assumed that your PC based software is installed as per it's instructions, and any additional motion control devices are also installed and configured.

Software setting examples are given for Mach 3 only, but other CNC software will also work with the board.

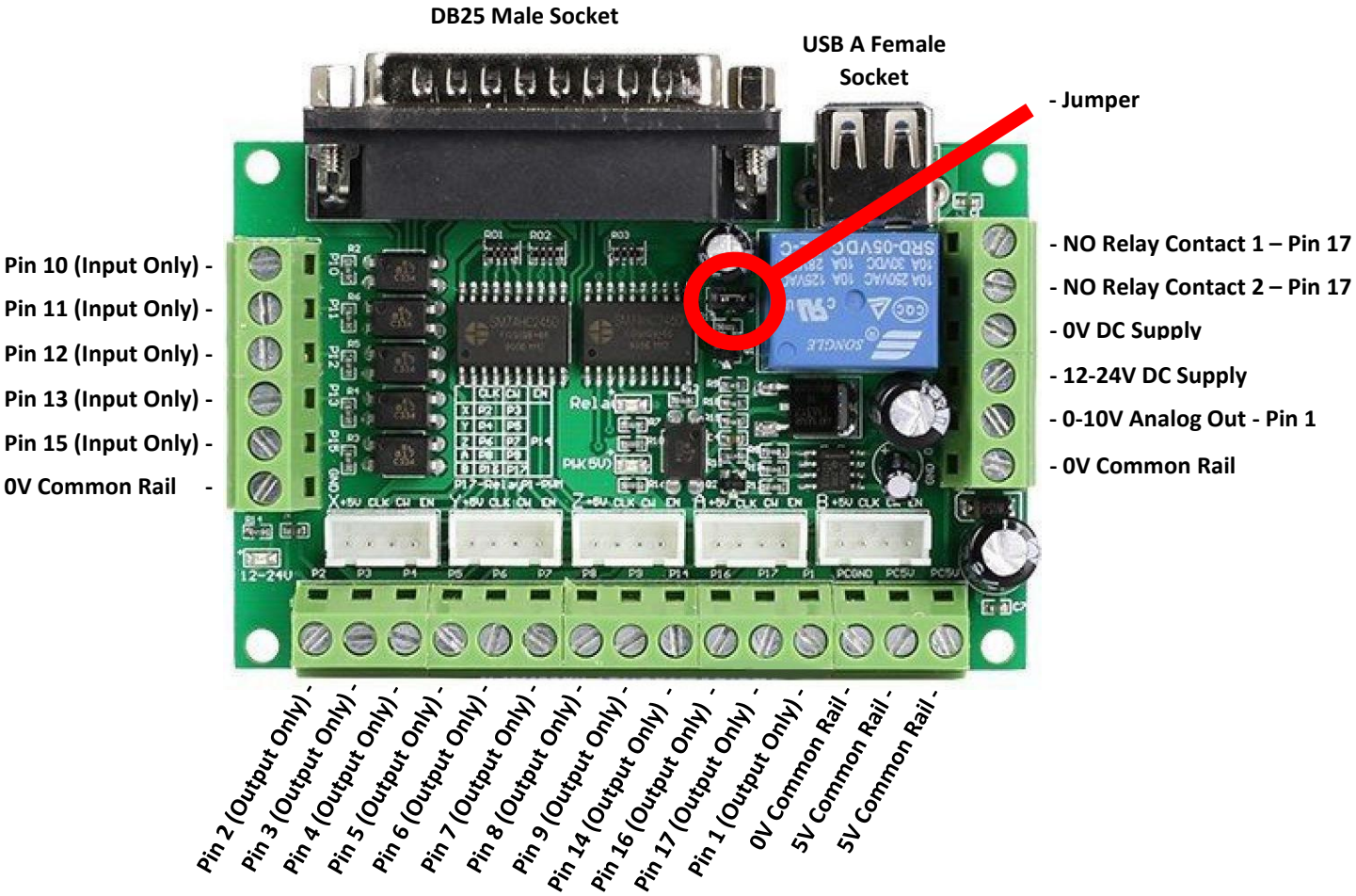
3.0 Pin Map & Conenctions

The pin numbers below correspond with the pin numbers within the Mach3 ports and pins settings. Common pin assignment will be adressed in a later section.

The DB25 cable needs to be of the straight through type – avoid the corssover style, or USB to DB25 converters as these will not work. The USB connection is used to power the logic side of the board.

It is essential that the 12-24V DC supply is connected, or else the inputs and 0-10V output will not function.

If the breakout board is used with a Smoothstepper motion control board, we recommend connecting it to port 2. There is a known fault with both the USS & ESS that prevents proper spindle speed control via port 1 pin 1. Port 2 pin 1 is fully functional however.



4.0 Input Wiring

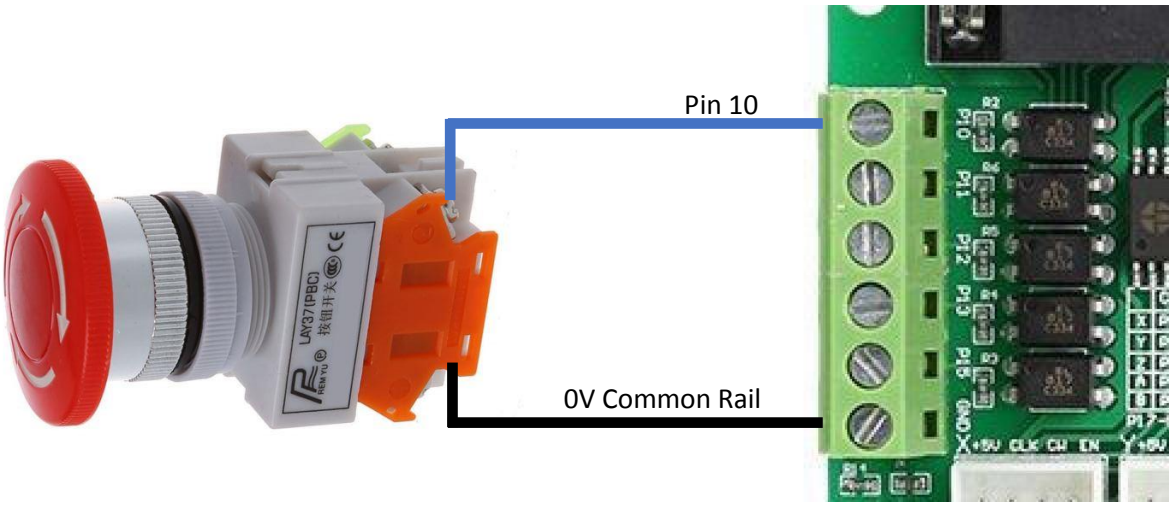
4.1 E-Stop Wiring

The emergency stop is an essential safety component in the CNC control system. We strongly recommend that this is the first component connected in any project. Spare contact sets on the E-Stop button can be used to cut power to motor drives or other sub systems as required.

We recommend connecting the E-Stop in its normally closed setting. If the wiring to the button is ever accidentally severed the system will the read this as an E-Stop event.

Software settings to reflect the choice of NO or NC switch wiring will be addressed in section 6.4

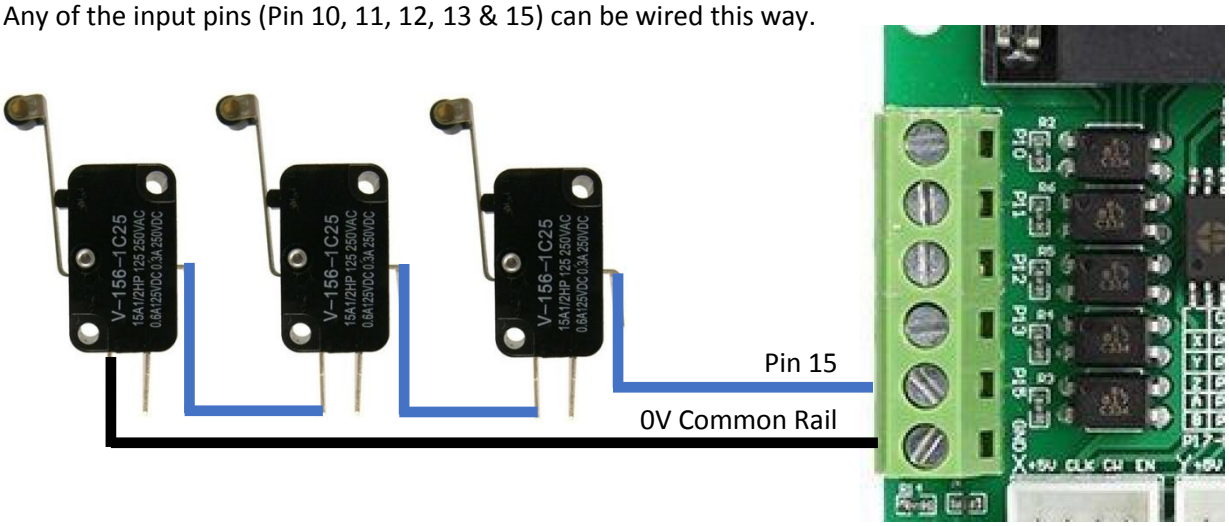
Any of the input pins (Pin 10, 11, 12, 13 & 15) can be wired this way, but we recommend using pin 10 for consistency.



4.2 Mechanical Limit Wiring (Series)

Series wired limit switches are a great way to protect your machine without using too many of your limited input pins. Using the normally closed contacts on your limit switches you can connect any number of mechanical switches in series. We recommend using high quality switches such as the Omron V-156-1C25.

Any of the input pins (Pin 10, 11, 12, 13 & 15) can be wired this way.



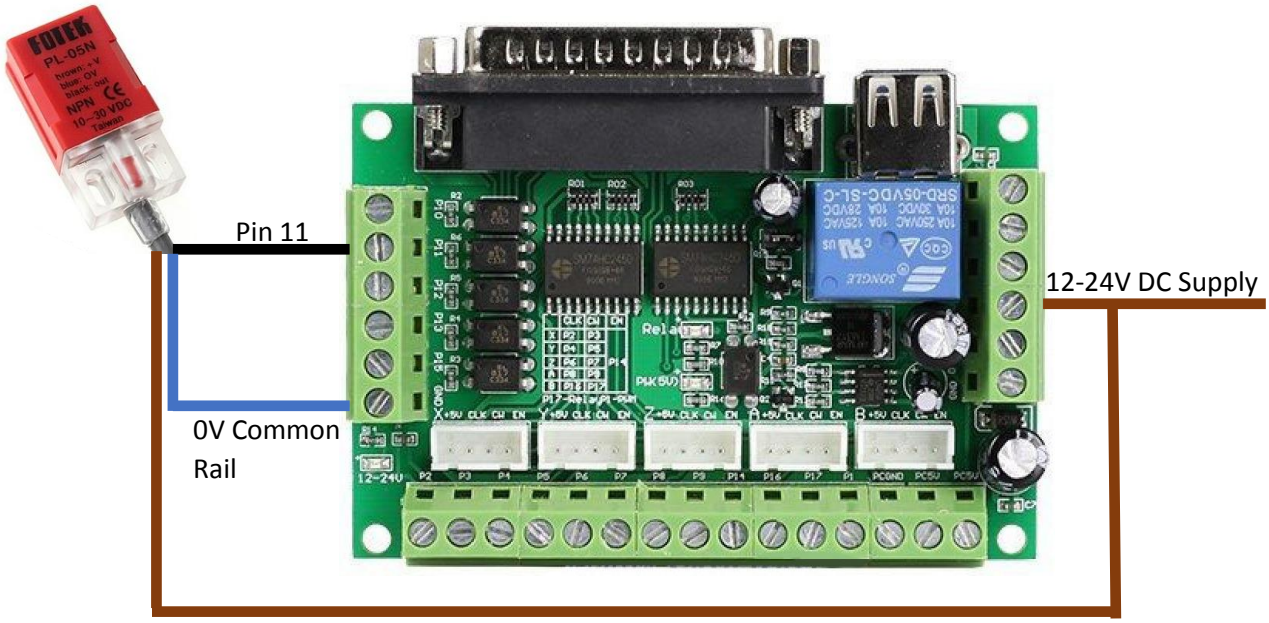
4.3 Proximity Home Switch Wiring

Proximity sensors are a robust and accurate way to home your machine. We use Fotek PL-05N NPN proximity sensors wherever possible due to their ease of use and longevity. A sample circuit drawing is provided below using this particular sensor complete with colour coded wiring.

It is possible to use other makes and models of proximity sensor. You will need to refer to the manufacturers specifications for wire colouring.

To avoid damaging your breakout board it is essential to power your proximity sensors from the same power supply as the board.

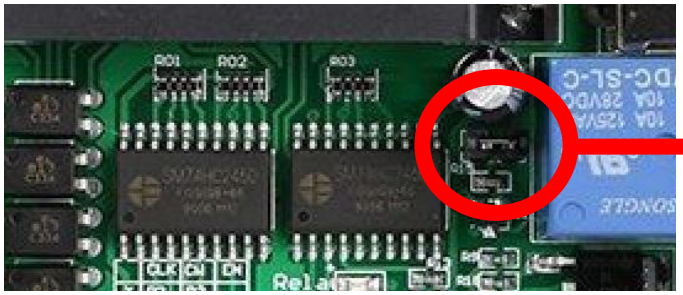
Any of the input pins (Pin 10, 11, 12, 13 & 15) can be wired this way.



5.0 Output Wiring

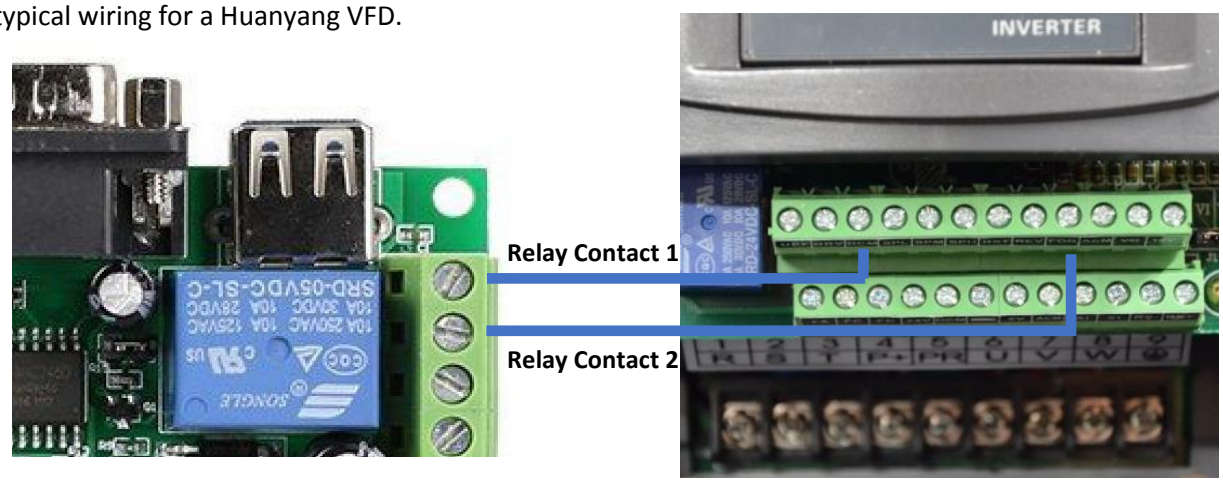
5.1 Spindle Relay Wiring

The onboard relay is controlled by pin 17 when the jumper is connected (Remove the jumper for full B axis function – discussed further in section 5.3). The jumper can be found next to the relay on the board.

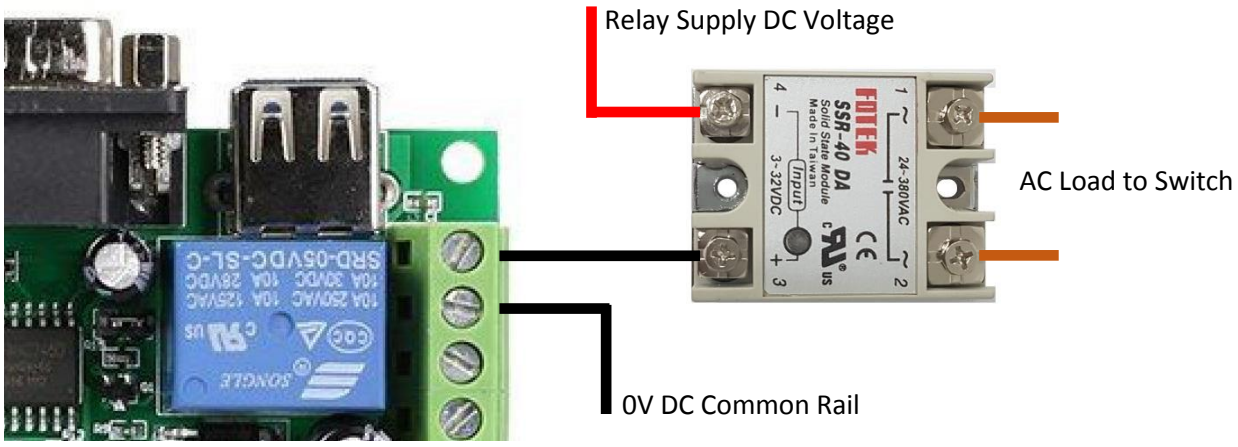


The onboard relay is wired in the Normally Open configuration. It can either be used to switch a signal on a VFD or else drive a contactor or SSR to switch a load directly. Under no circumstances should the onboard relay be used to switch a mains load directly.

Making a logic level switch on the VFD can be accomplished in the manner shown below. For specific wiring details you will need to refer to your specific VFD's user manual. The example below shows the typical wiring for a Huanyang VFD.



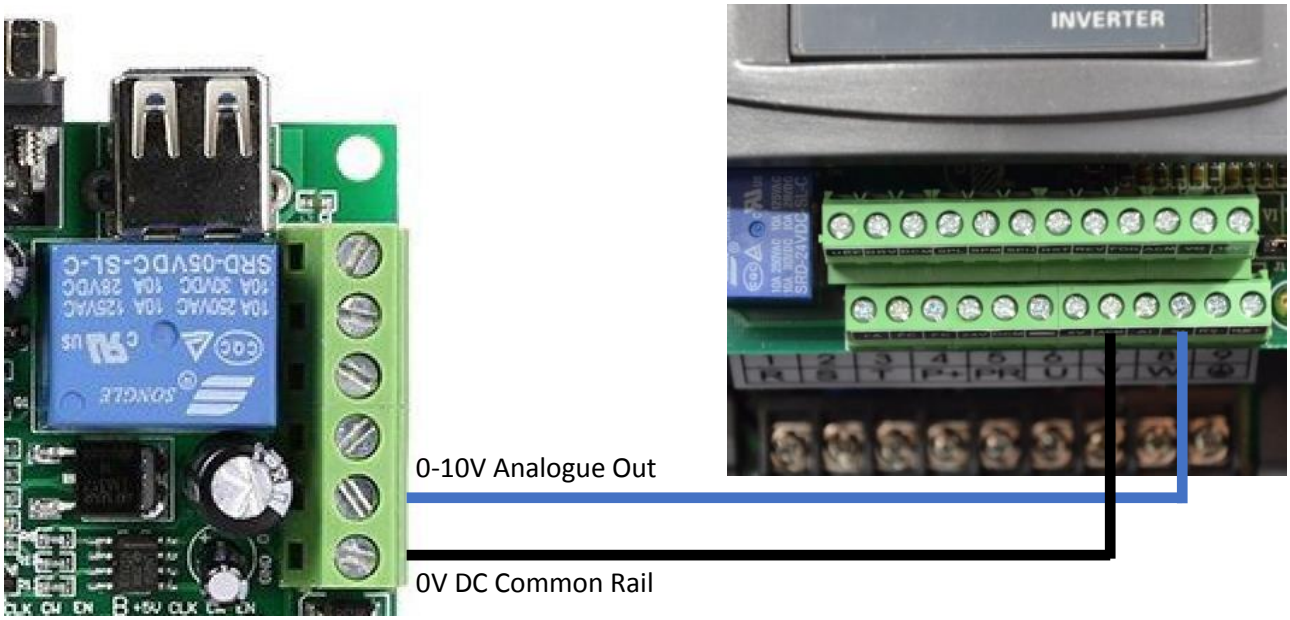
Switching AC loads or similar can be achieved by switching a relay, solid state relay or contactor through the onboard relay. This successfully isolates the AC load from the onboard control electronics. Be sure to follow all local requirements regarding work on mains voltages.



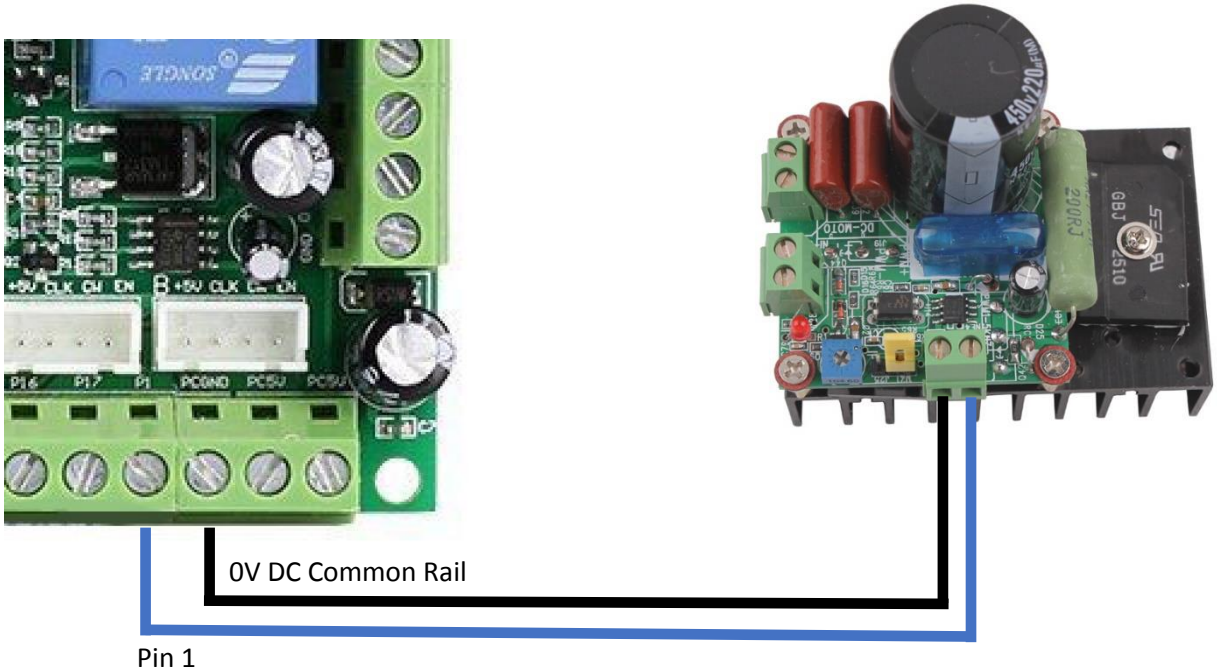
5.2 Spindle Speed Control Wiring

The breakout board supports two options for supplying spindle speed information to your spindle drive. The board will either supply a 0-10V DC analogue signal, or else a 5V PWM (pulse width modulation) signal.

The diagram below shows the typical wiring for a Huanyang VFD using the 0-10V analogue method. For specific wiring details you will need to refer to your specific drives user manual. It is essential that the 0V rail from the motor control drive and the breakout board are wired in common.



PWM control of your motor driver is accomplished in much the same way. The example below shows PWM control of a common DC motor driver module. Again, for specific wiring details you will need to refer to your specific drives user manual. It is essential that the 0V rail from the motor control drive and the breakout board are wired in common.



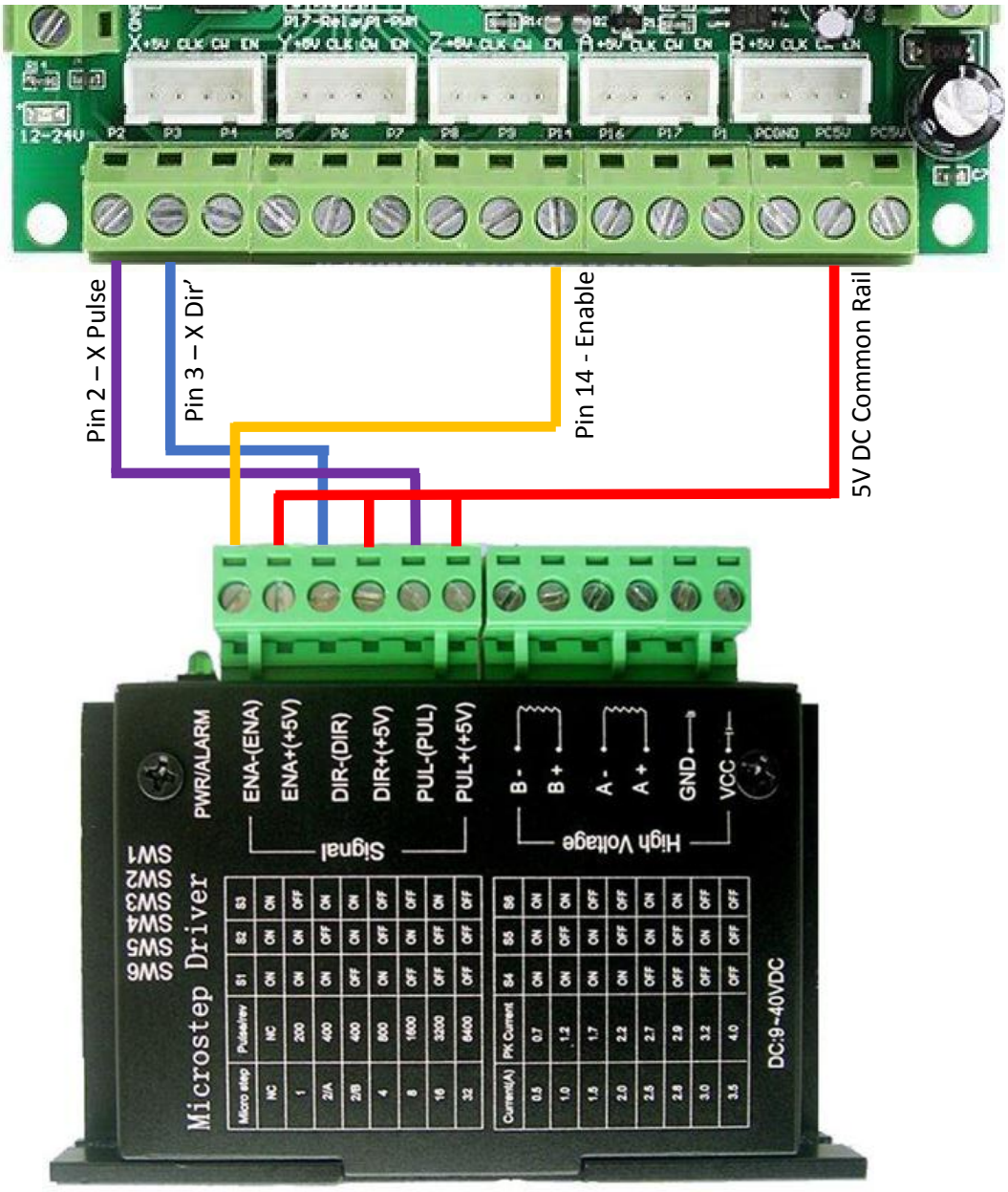
5.3 Stepper Motor Drive Wiring

Stepper motor drives can be driven from pins 2,3,4,5,6,7,8,9,16,17, and enabled with pin 14. Generally your stepper motor driver will be wired as shown below (example shown for X axis only), although you will need to refer to the specific instructions to confirm the explicit requirements of your drives.

Pin 14 (Enable) is optional, and can be used in common between all your motor drives. If you do not wish to use the enable function, you can leave both the 5V and Pin 14 disconnected for a permanently enabled driver.

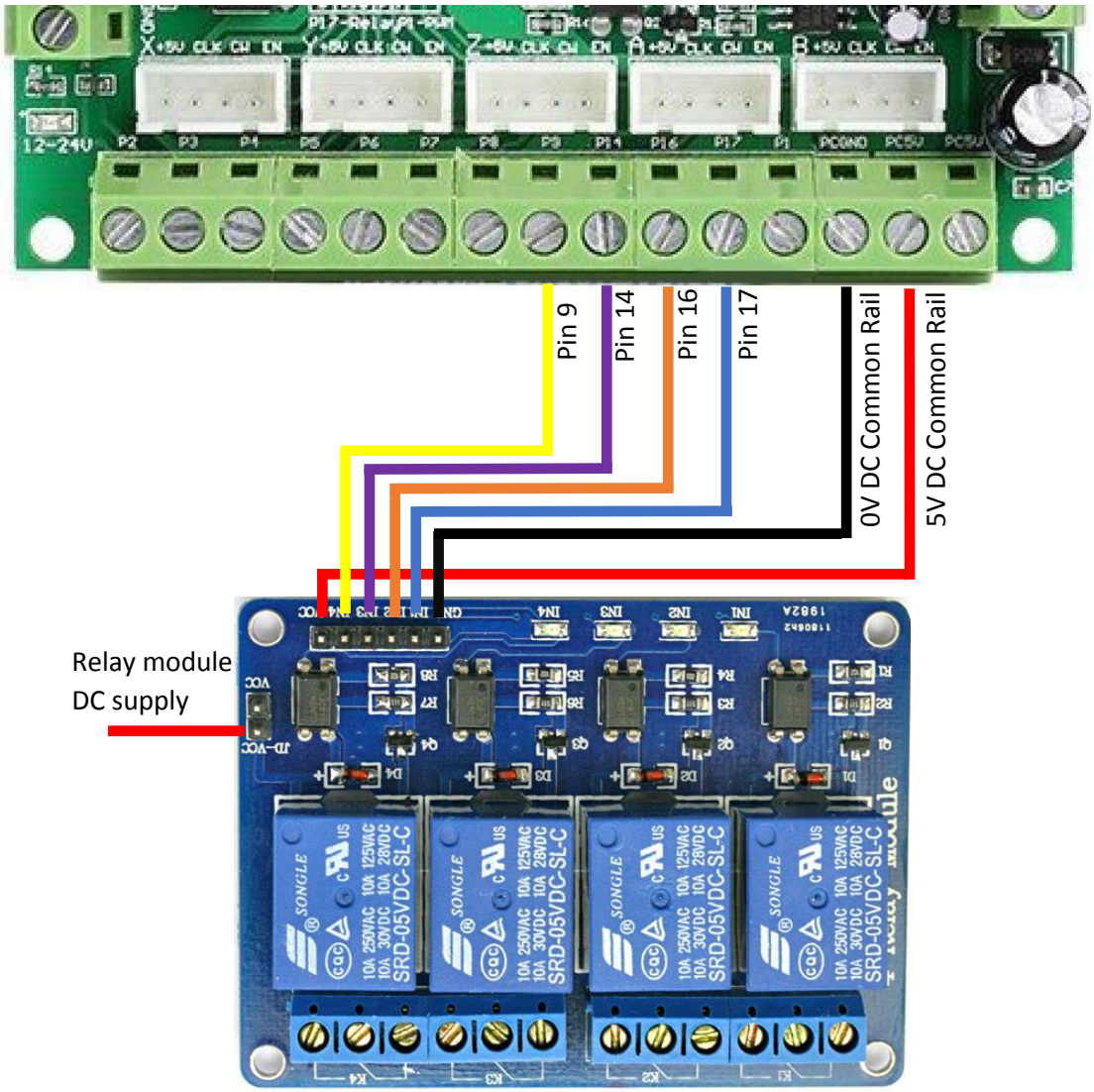
We recommend wiring the following pins to the corresponding stepper axis;

X Axis Step – Pin2, X Axis Direction – Pin 3
Y Axis Step – Pin 4, Y Axis Direction – Pin 5
Z Axis Step – Pin 6, Z Axis Direction – Pin 7
A Axis Step – Pin 8, A Axis Direction – Pin 9
B Axis Step – Pin 16, B Axis Direction – Pin 17 (When the jumper is removed)



5.4 Additional Relay Output Wiring

It is possible to use any unused output pins (Pins 2,3,4,5,6,7,8,9,14,16 & 17) to switch a separate relay module. The diagram below shows the typicl wiring of a common 4 channel relay module using pins 9,14,16&17. It is essential that the relay module is powered from it's own source to prevent browning out the break out board. Often this will mean removing a jumper on the board to separate the logic and power sources (usually marked JD-VCC & VCC), and connecting a separate DC power supply of the correct voltage to the JD-VCC pin. Again you will need to ensure that all 0V DC rails are connected in common.



6.0 Software Settings

6.1 Software Installation

Download and install Mach3 as per the manufacturer's instructions. Software can be downloaded using the following link:

http://www.machsupport.com/wp-content/uploads/2013/04/Mach3Version3.043.066.exe

Viking machinery is a registered agent for Mach licenses – please contact us via our website to purchase these.

Please refer to the Mach 3 user manual for information on which versions of Windows are compatible with the software and your parallel port. In general, we recommend using Windows XP or Windows 7 32 bit for parallel port operation. 64 bit Windows will not support parallel port operation for Mach 3.

The user manual for Mach3 can be found using the following link. Please read it carefully before proceeding.

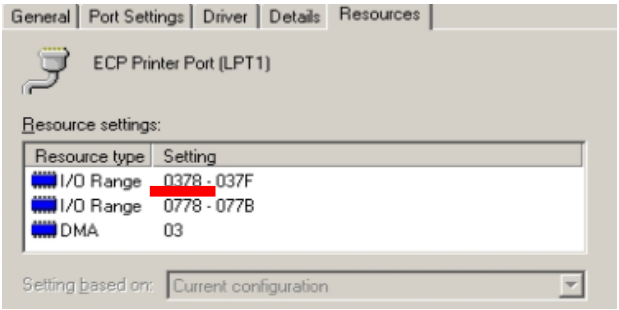
http://www.machsupport.com/wp-content/uploads/2013/02/Mach3Mill_Install_Config.pdf

6.2 Port Set Up

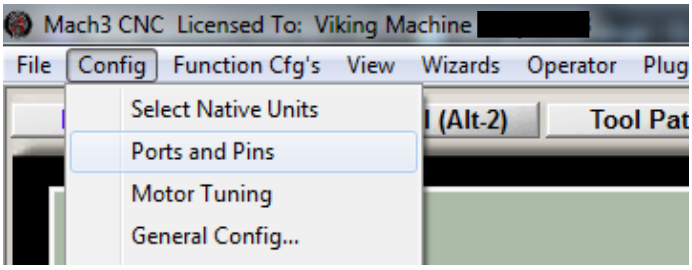
Mach3 needs to know where to find your breakout board. For this explanation we will assume that you are using the parallel port on your PC and not an external motion control board.

You will need configure your LPT port to ECP mode. You can find your LPT port under "Device Manager" in Windows.

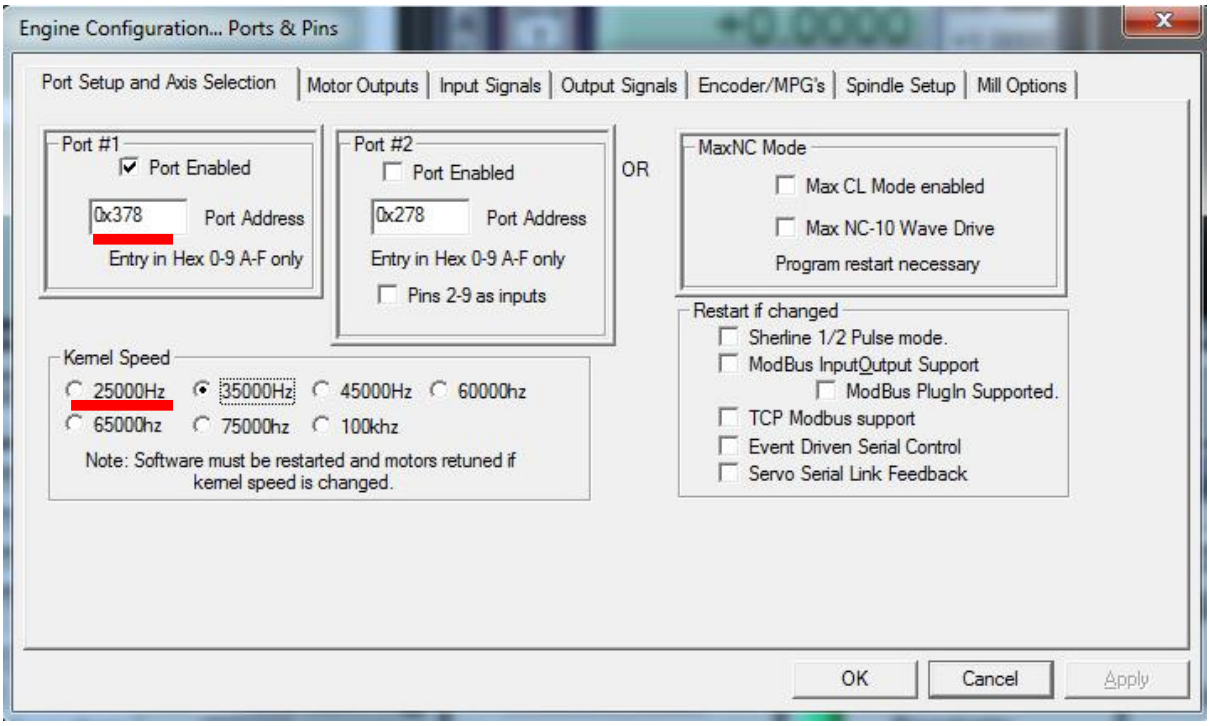
Once you have the ECP port open in Windows, you should see this screen. You now need to write down the number you have in the position that is underlined. This will be the basis of your port address in Mach 3 later.



You now need to open the Mach3 ports and pins configuration panel. Access this via Config -> Ports and Pins from the Mach3 menu bar.

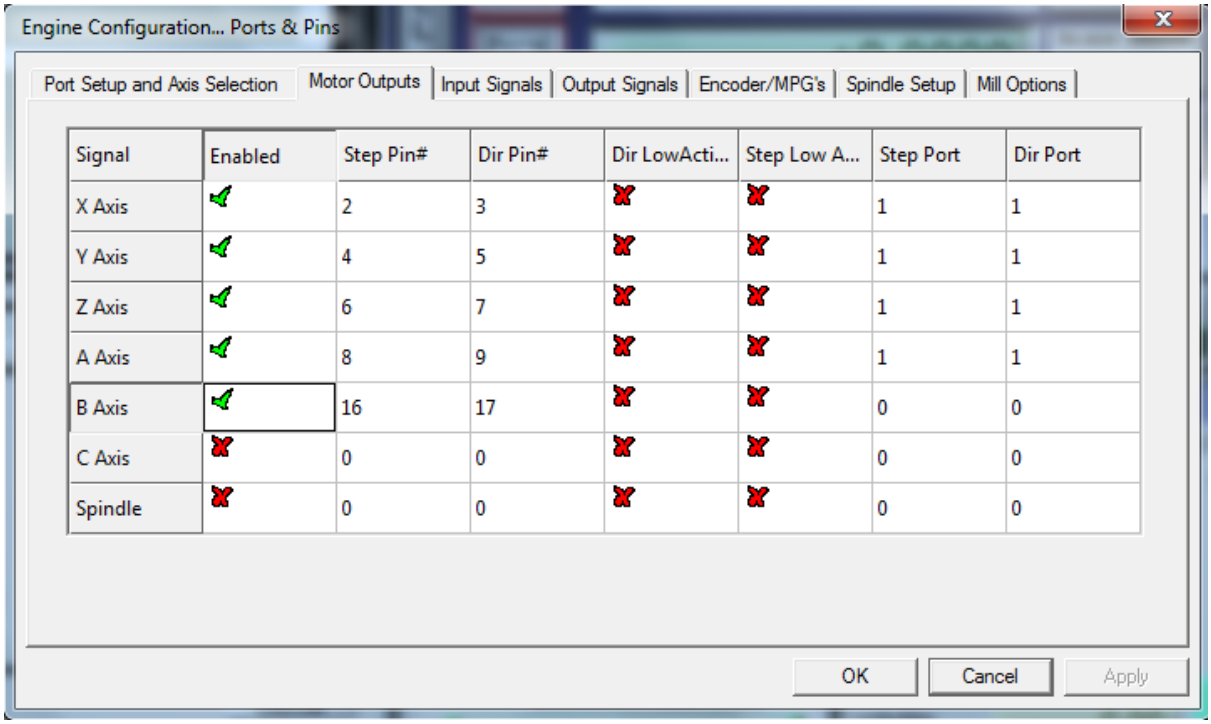


You will see the screen below. You need to enter the port number from before into the port 1 text box. Mach3 will now do some wizardry and add an “x” after the first digit. This is normal and correct. On this screen you will also need to check the 25000Hz radio box (this is a safe starting point for your first set up) and the “Port Enabled” tick box. Click the “Apply” button in the bottom right corner to save your changes.



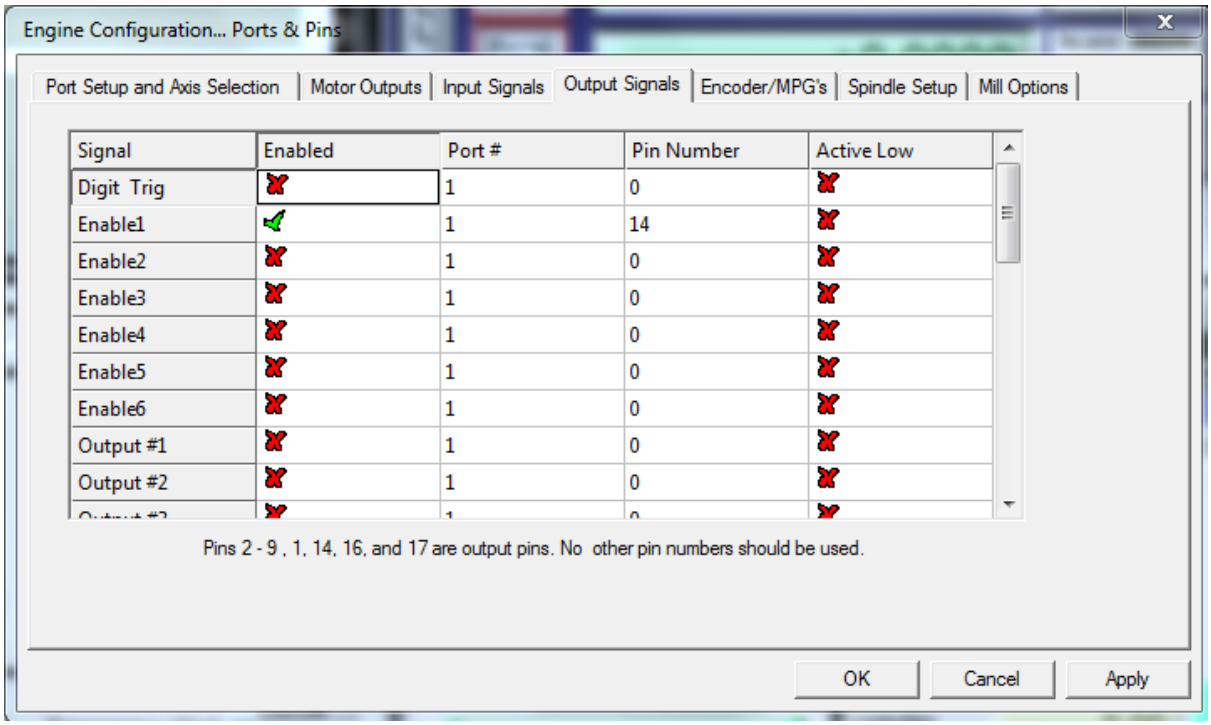
6.3 Motor Output Set Up

We will now set up the motor outputs. Select the “Motor Output tab at the top of the window to bring up the window below. You will need to click and get a green tick in the “Enabled” column for each axis you plan to use. You can see the appropriate pins for each axis in the box below. Make sure that both the “Step Port” and “Dir Port” are set to 1.



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	✗	✗	0	0
C Axis	✗	0	0	✗	✗	0	0
Spindle	✗	0	0	✗	✗	0	0

If you later find that your motor is turning the wrong way, you will need to tick the “Dir LowActi…” box and make it a green tick. If you are choosing to use the “Enable” function, set it up on the “Output Signals” tab as shown below.

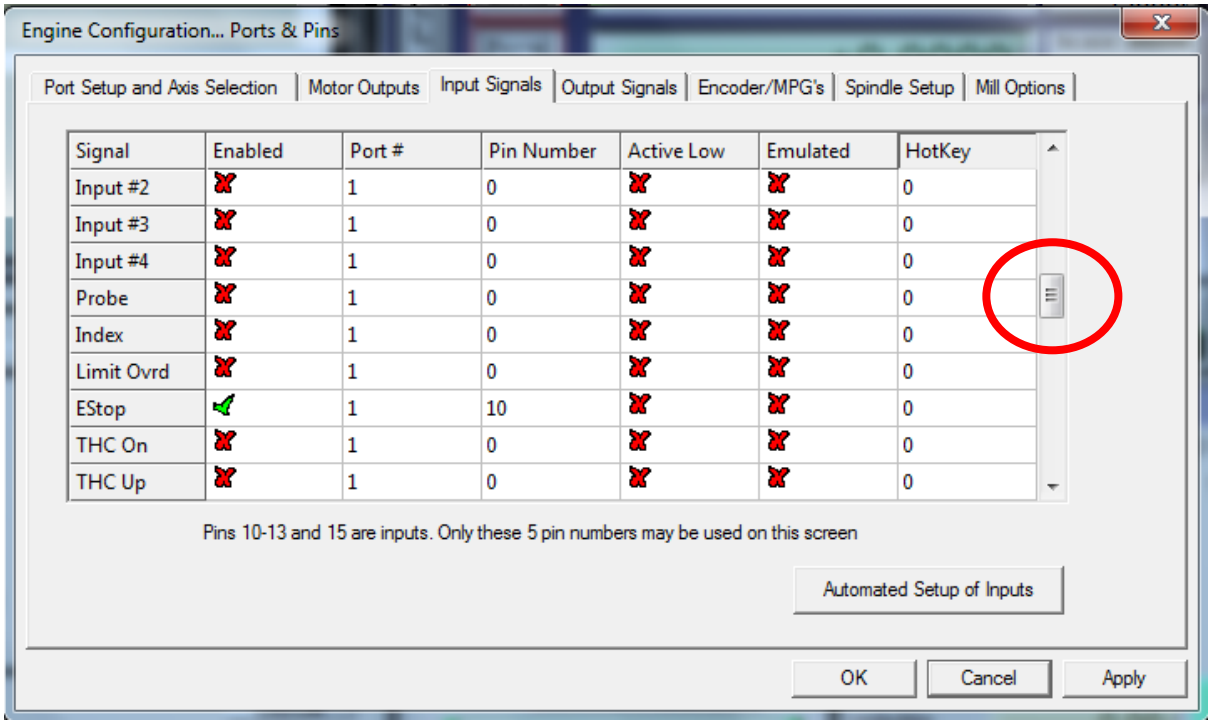


Signal	Enabled	Port #	Pin Number	Active Low
Digit Trig	✗	1	0	✗
Enable1	✓	1	14	✗
Enable2	✗	1	0	✗
Enable3	✗	1	0	✗
Enable4	✗	1	0	✗
Enable5	✗	1	0	✗
Enable6	✗	1	0	✗
Output #1	✗	1	0	✗
Output #2	✗	1	0	✗

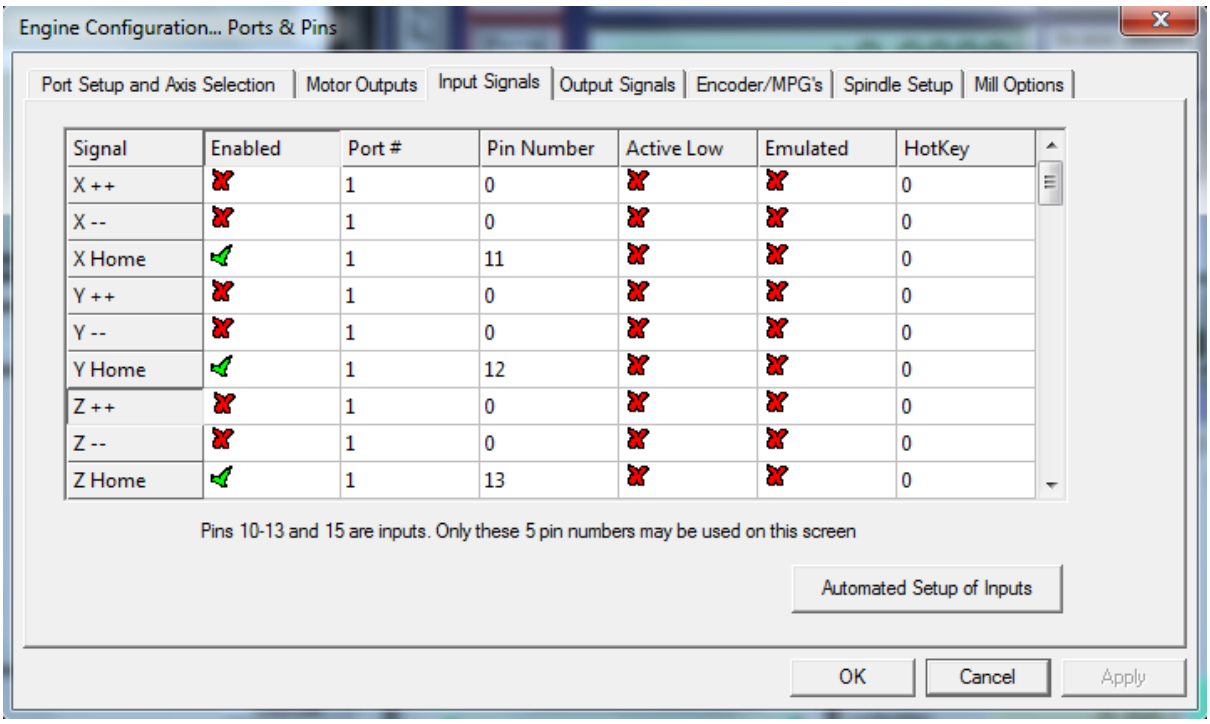
Click the “Apply” button in the bottom right corner to save your changes.

6.4 Input Set Up

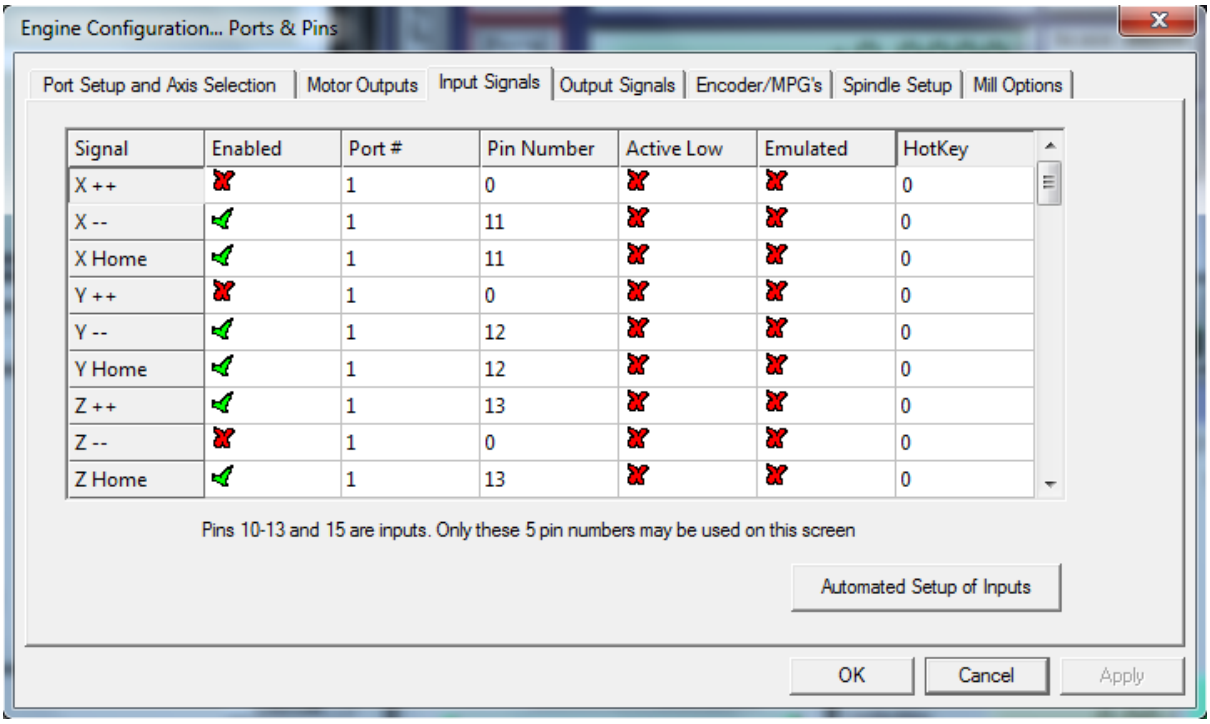
The first input to set up is the E-Stop. You will need to scroll about half way down the list to find the "Estop" option. It needs to be configured as you see below. If your E-Stop is wired differently to the diagram in section 4.1 you may need to tick the "Active Low" box to a green tick. If you have wired the E-Stop to a different input pin you will need to change the pin number to suit.



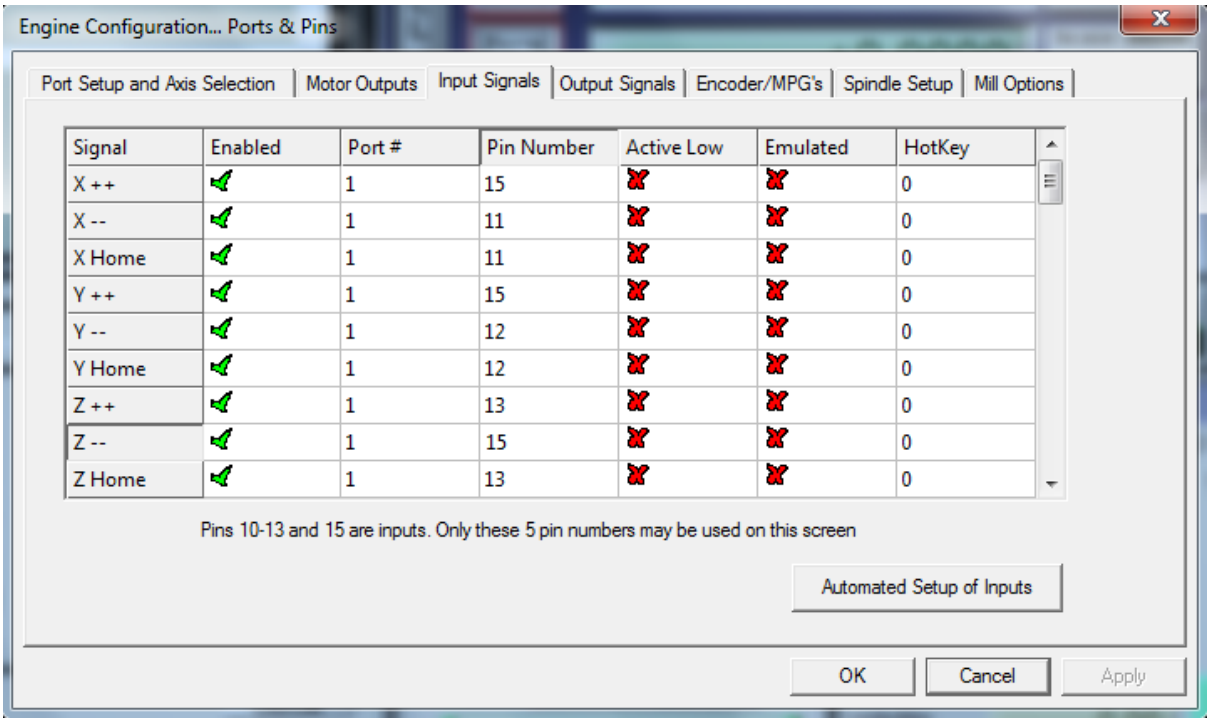
Next we want to set the home inputs. For a 3 axis system we want to use pins 11,12 & 13 as shown below. Again, the "Active Low" box may need ticking depending on your actual wiring.



Next you will want to set your limits at the end of the travels that have the home switches fitted. The example below is for a typical 3 axis milling machine. Your switch locations may be in a different position that this example, but the principle is the same. When Mach3 'homes' it will ignore the limit input set. When it is running normally however it will act as a normal limit switch.

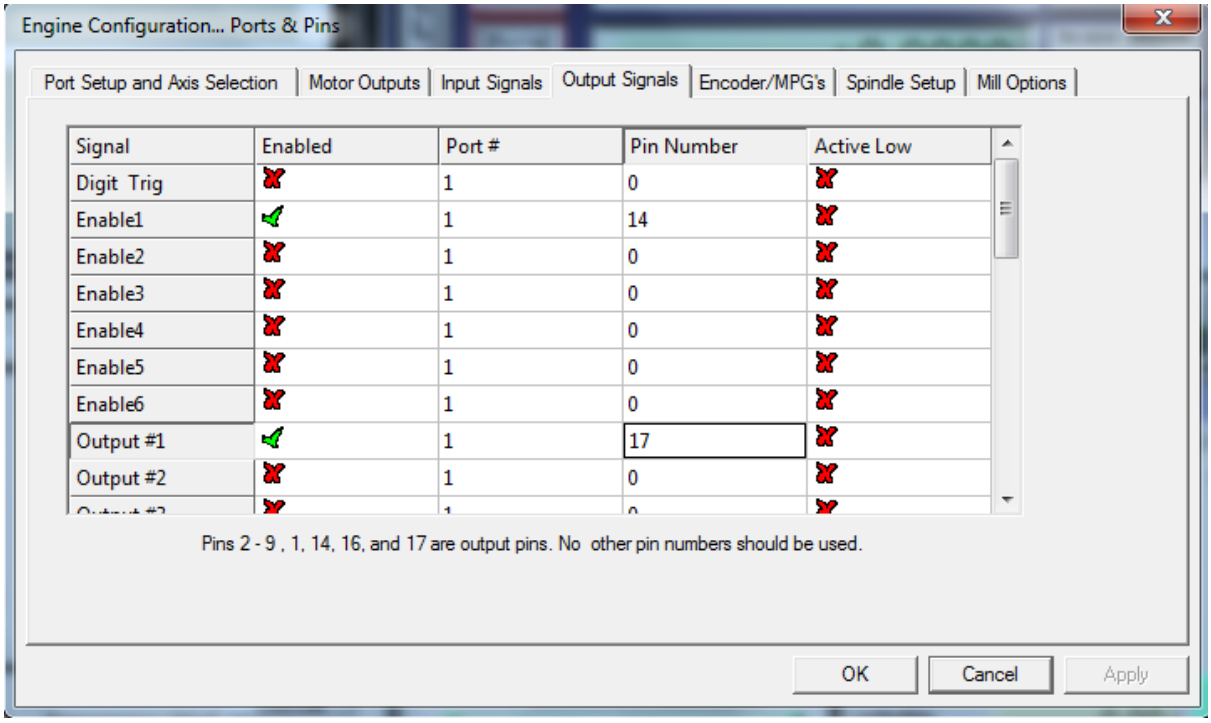


Finally, we will set up the limit switches at the opposite ends of each axis. Assuming that the limits are wired in series as shown inspection 4.2, then the settings below can be entered.

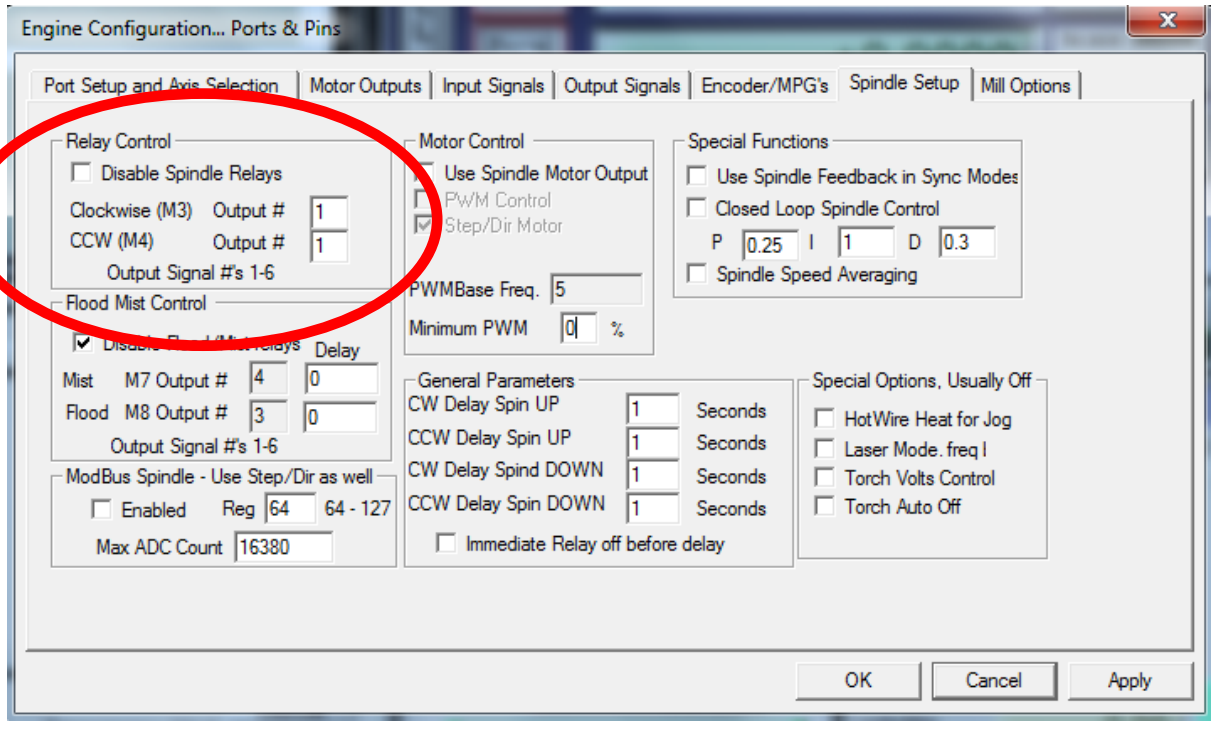


6.5 On Board Relay Set Up

Assuming the jumper is in place (See section 5.1), then the relay can be activated via pin 17. For a spindle on relay, we recommend setting “Output 1” up as shown below in the Output Signals panel. Click “Apply” to save the settings.

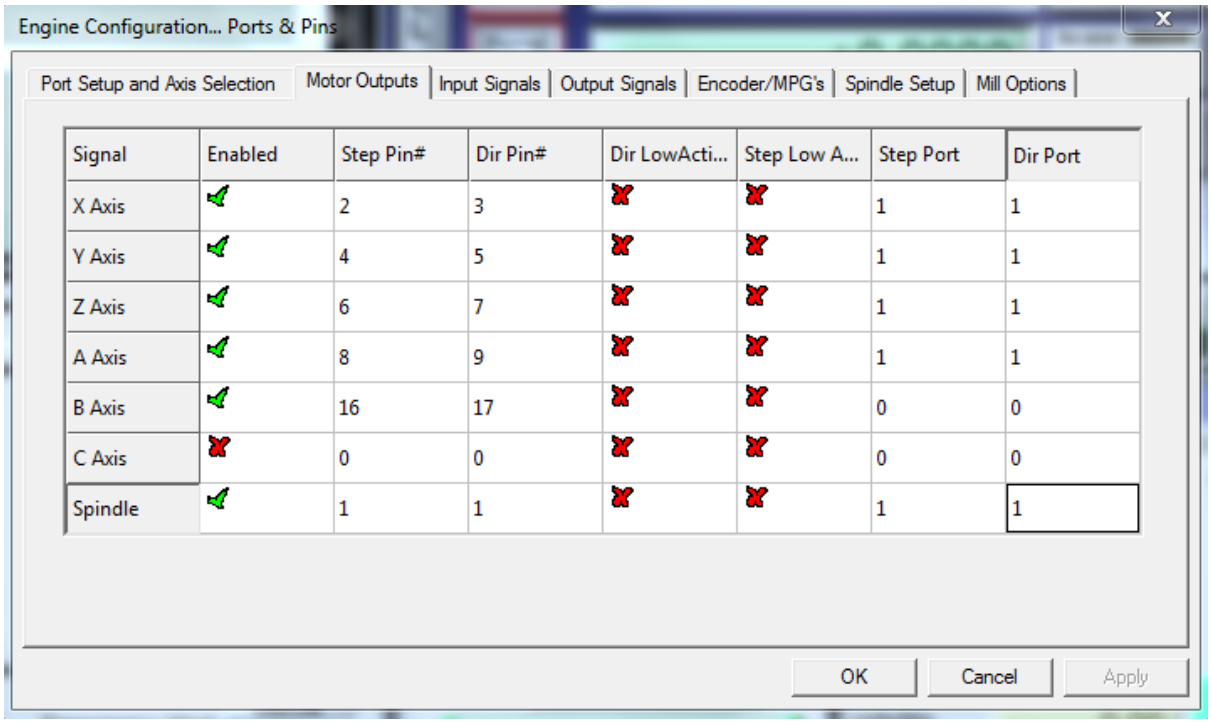


Now open the “Spindle Setup” tab and make sure that the “Disable Spindle Relays” box is UNCHECKED. You need to set the Clockwise (M3) Output number to #1(or whichever number output you set just before). Mach3 will only allow you to use outputs 1-6 for spindle relay control.

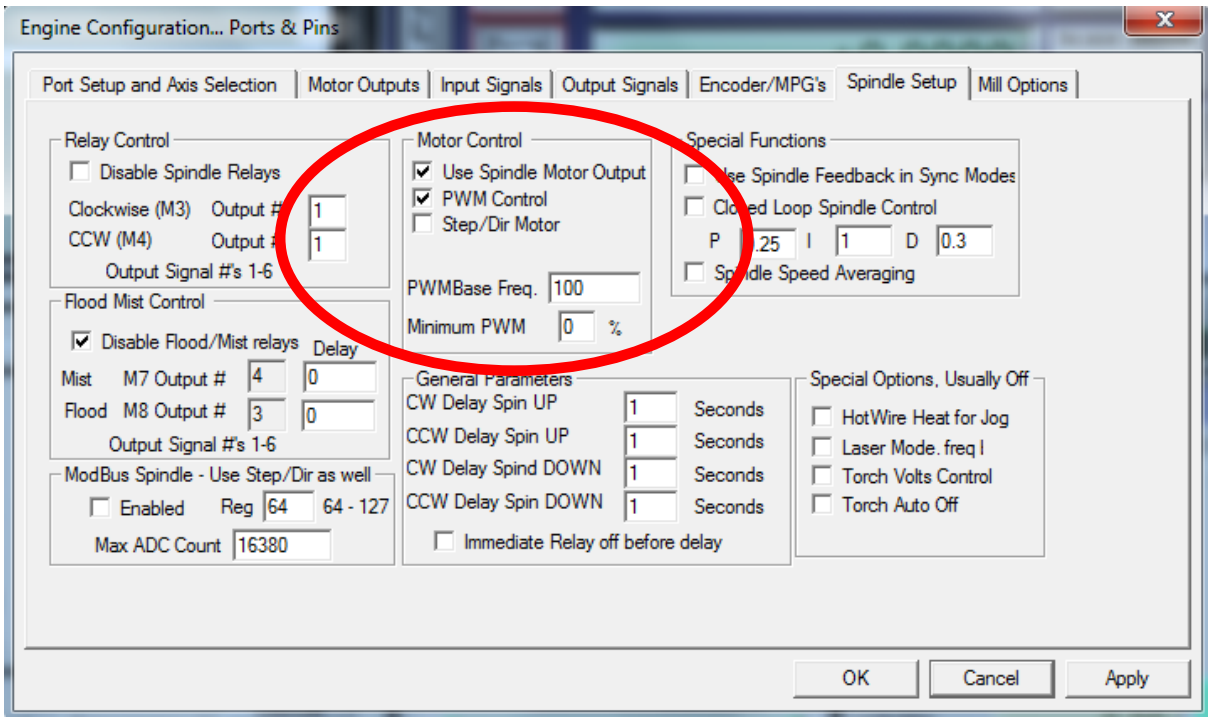


6.6 Spindle Speed Control – 0-10V Analogue

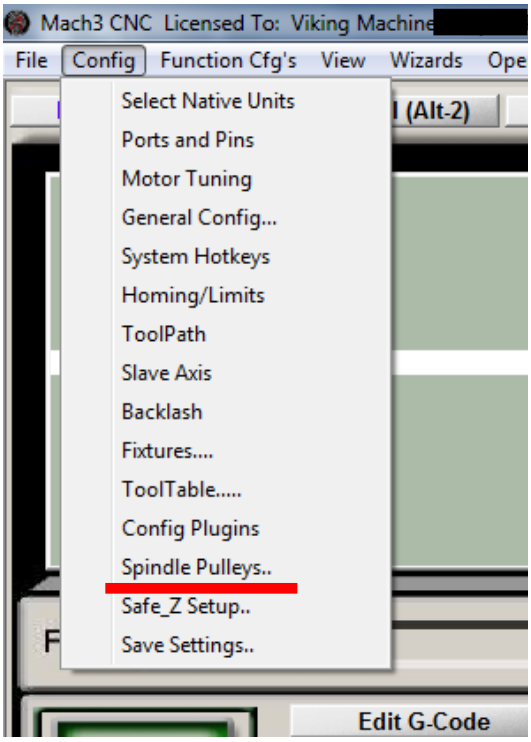
In the Motor Outputs tab, you need to enable the spindle, set the Step Pin#, Dir Pin#, Step Port & Dir Port all to 1. Click on Apply again to save!



Next return to the Spindle Setup tab and enter the details below. If your VFD needs a higher than 0V minimum setting then adjust the minimum PWM setting up by 10% per volt required. For most VFD's however 0% will be perfect.

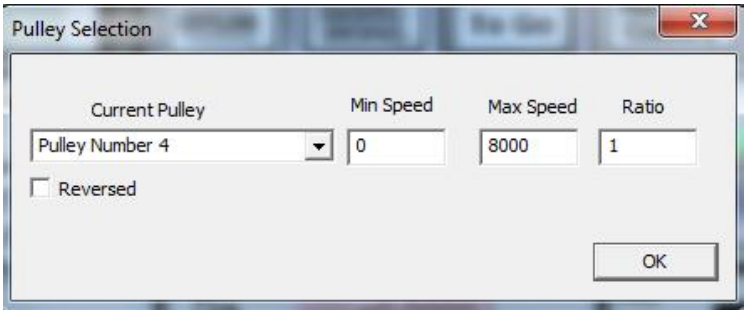


You will now need to configure your spindle pulleys to match the hardware on your machine. Find this via Config -> Spindle Pulleys.. as shown to the right.



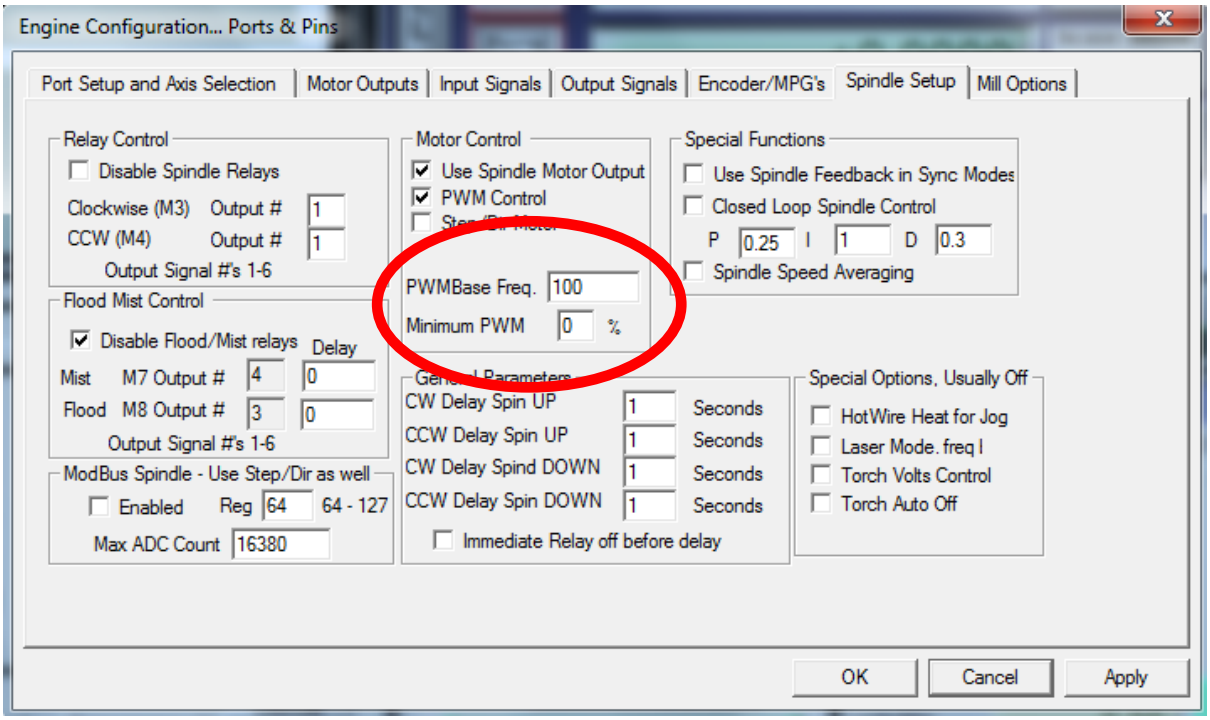
Leave the box set as Pulley Number 4 (Mach 3 doesn't like it if you change) and then set the minimum and maximum speeds to match those that your VFD supports. This number is the RPM (Revolutions per minute) that you are limited to. For example, the common Huanyang shown in section 5.2 would use 4000 as its minimum and 24000 as its maximum, as it must be running at least 4,000RPM, but no more than 24,000RPM (with its standard spindle).

Click OK to save your settings.



6.7 Spindle Speed Control – 5V PWM

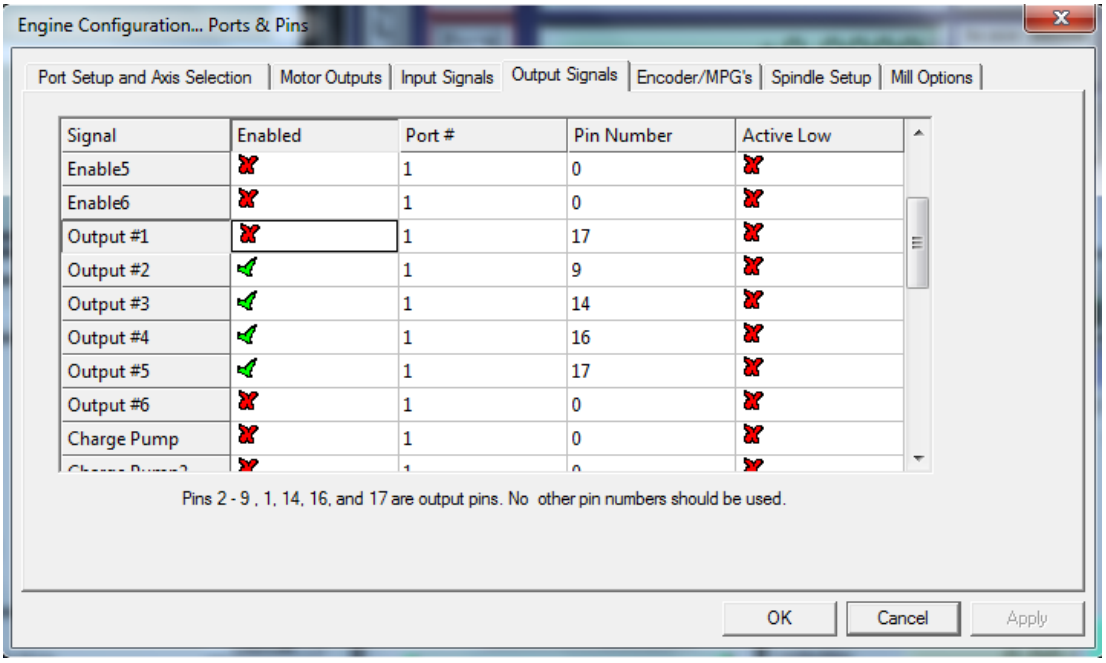
This is set up exactly the same as in section 6.6, EXCEPT the “PWMBase Freq” will need to be set to the carrier frequency of your spindle drive. The DC motor driver shown in section 5.2 would use a carrier frequency of about 3,000Hz. You will need to refer to your hardware manufacturers specification sheet to find this value.



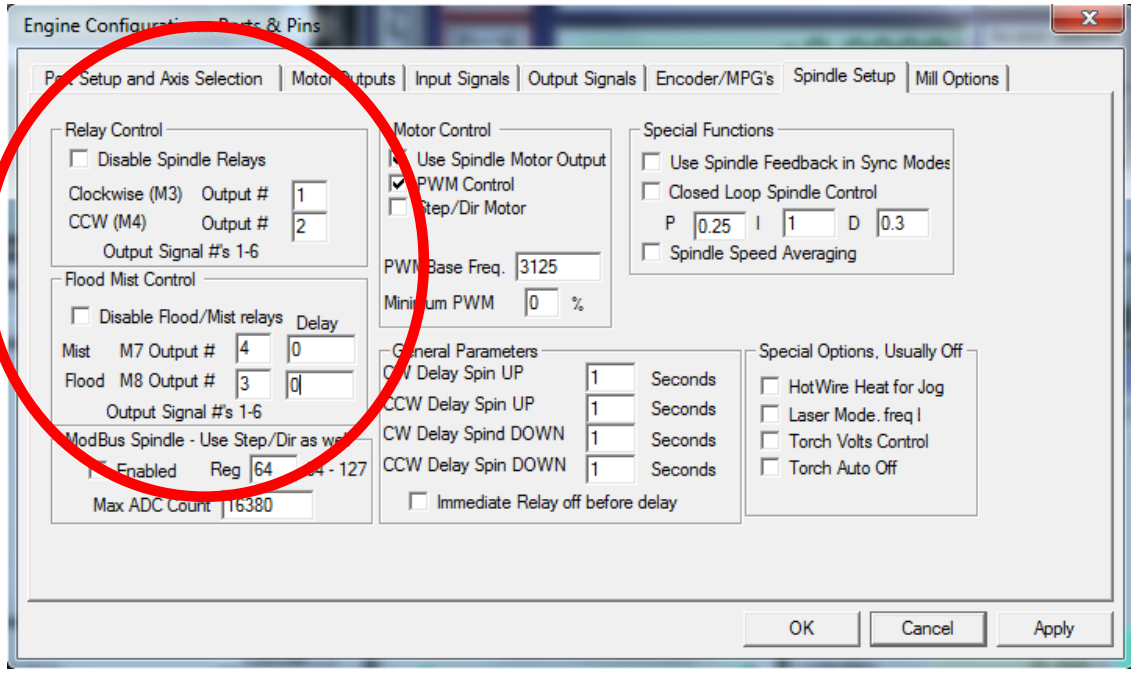
6.8 External Relay Module Control

The example settings below assume that you have wired the relay module as per the diagram in section 5.4. Other output pin options will work as well, you will just need to update the pin settings in Mach3 to suit. Be aware that in this example pin 14 (the enable Pin) is used to drive a relay rather than in the usual manner.

Changing the active low setting will invert the relays function (it will change it from normally on / normally off).



Typically, you will want to drive these relays from the Spindle Setup page. Make sure the “Disable Relay” options are unticked, and then enter the output number from the last screen in the box next to the appropriate function. To make the output operate from a G code program, you need to call the M code that is in brackets next to the description. Outputs can also be called from custom M codes (refer to Mach 3 manual for details).



7.0 Reference Links

Viking Machinery - Home Page

www.vikingmachinery.co.nz

Viking Machinery - TradeMe Store

https://www.trademe.co.nz/Members/Listings.aspx?member=4906214

Viking Machinery - Email

vikingmachinerynz@gmail.com

Viking Machinery - Social Media

https://www.instagram.com/james_viking_machinery/

https://www.thingiverse.com/VikingNZ/about

https://www.youtube.com/channel/UCgnl_7dUO9MeNOyI_jWO5QQ?view_as=subscriber

https://grabcad.com/james.hussey-3

Mach3 Useful Links

http://www.machsupport.com/wp-content/uploads/2013/04/Mach3Version3.043.066.exe

http://www.machsupport.com/wp-content/uploads/2013/02/Mach3Mill_Install_Config.pdf