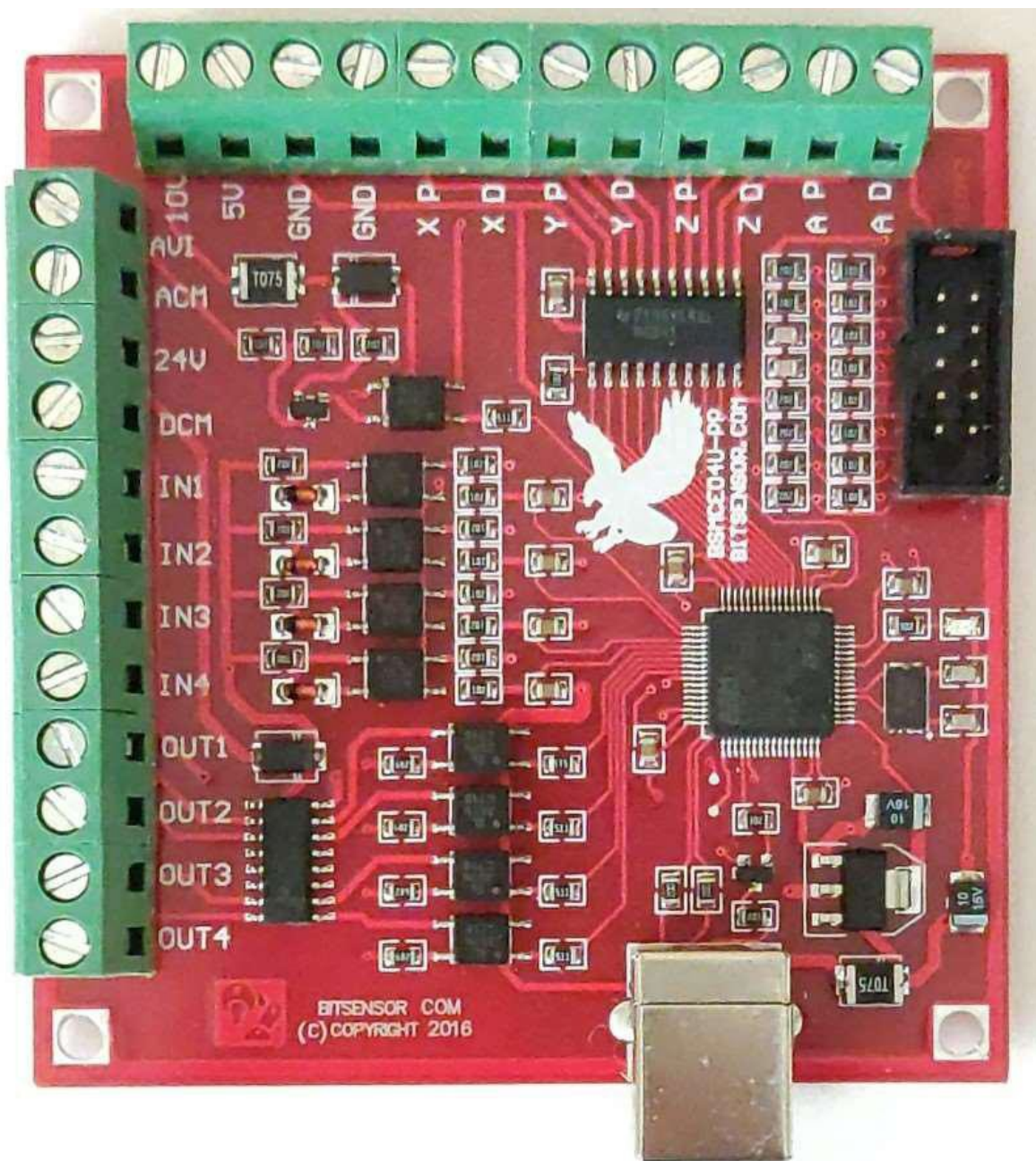# Mach3 USB Motion Card (BSMCEO4U-PP)
Installation Manual

Installation requires the operator to have the relevant knowledge of how it is used! If used improperly, damage to the equipment or personal injury may result. Please follow the instructions and warnings when using this product. If you are not sure, consult a professional for help. First time users, that are not familiar with the product, and the software features of Mach3 should get professional training.

 When testing or using this product, make sure the machine's power switch is at hand, and that you can quickly turn off the power. We strongly recommend that users install the emergency stop button and make sure the button is functioning properly. Please strictly follow the instructions and warnings using this product. Any direct / indirect personal injury, our company does not assume any responsibility.

Note: This document is the culmination of researching any document that could found concerning the BSBCEO4U CNC Controller board. Some of the documents were in English and the others in Chinese. With the aid of Google translate and my skills as an Electronics Engineer, I endeavored to translate and Americanize the document text for relatively easy understanding. Pictures that appeared to be useful were borrowed from wherever I found them.

Any errors found in this document are most likely my doing. And I would appreciate notification of any errors you find, and contributions you offer.

Thanks,

Bill Vancura

cnc@vancura.biz

July 20, 2024

Contents

Features:

Support for 4-axis linkage, you can connect four stepper motor drives or servo drives;

Maximum step-pulse frequency is 100KHz, which is suitable for both servo and stepping motors. Use the lowest clock that works for your system setup.

General-purpose opto-couplers isolation inputs: for connecting limit switches, E-STOP switch, auto tool zero, home switch, and etc.

Support for connecting an electronic hand-wheel;

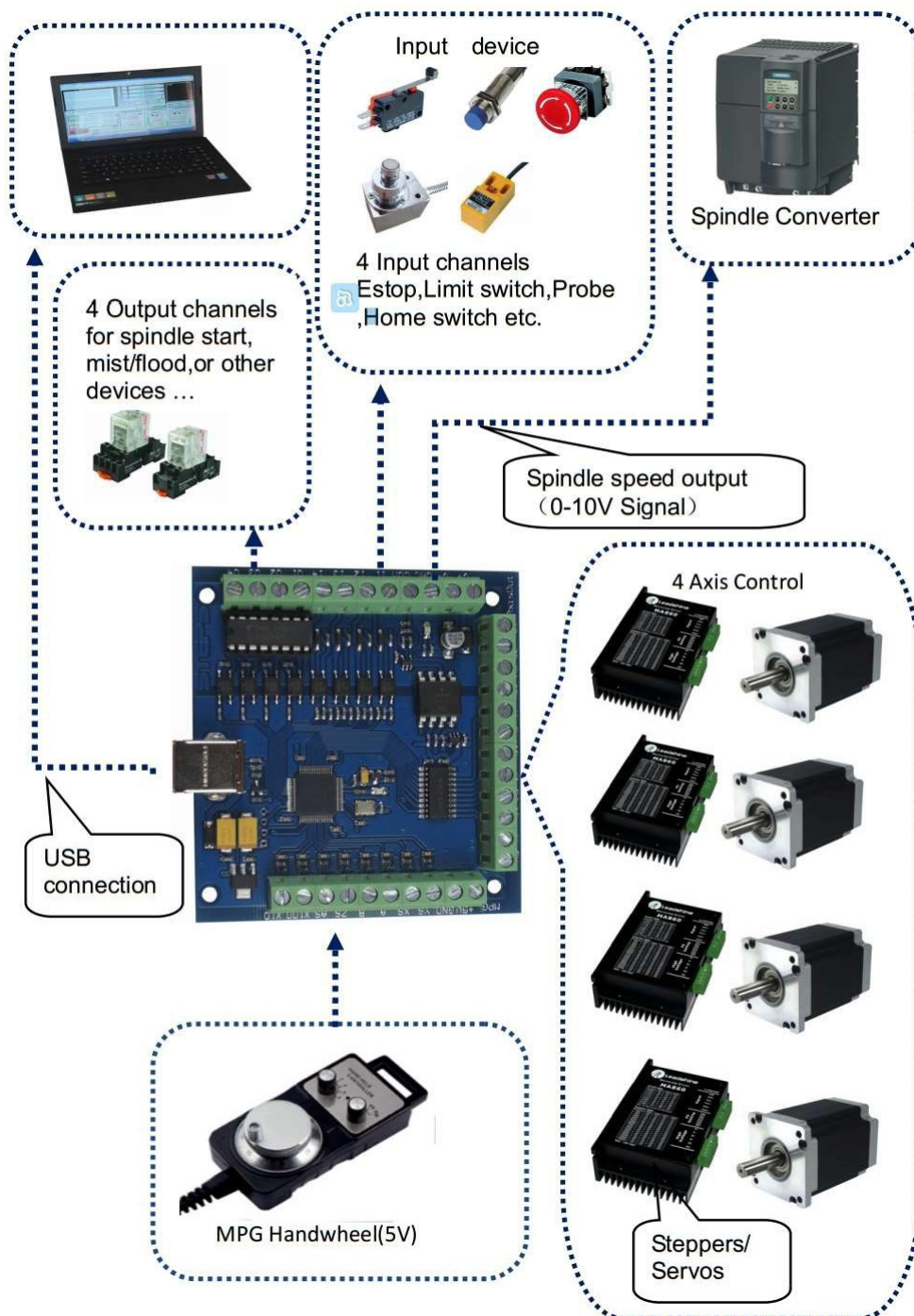Has 0-10V (PWM) signal output, Mach3 software can be used to control the spindle motor speed.

General-purpose isolated relay drive output interface can drive four relays for controlling spindle start, forward and reverse rotation, pumps, or other devices.

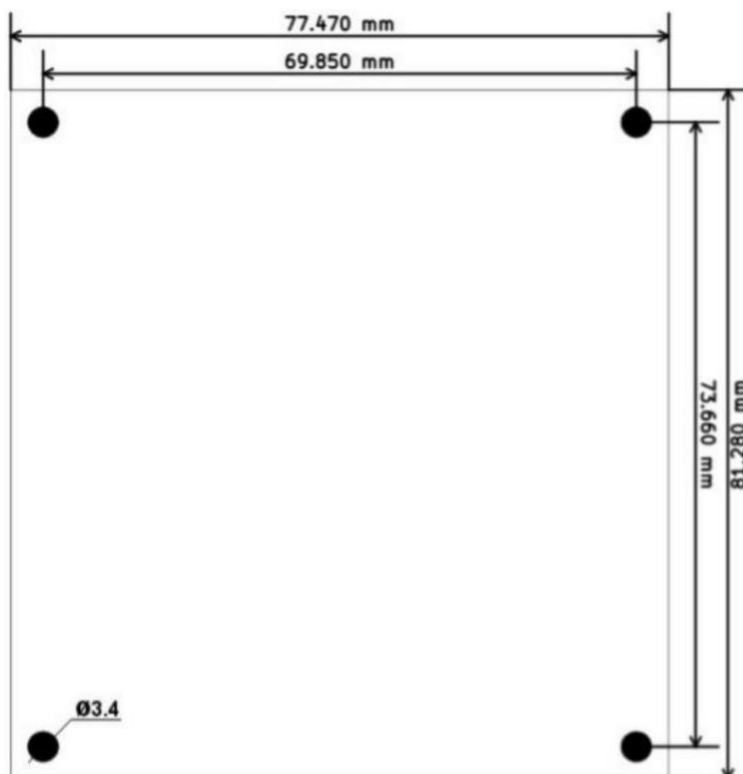On-board status LED, indicate connection status and operation.

Note: The BSMCEO4U-PP board has three optical isolated circuits: Only the 5V circuit is needed for driving the motors. Do not cross connect the different grounds.

1) The 5V circuit is supplied through the USB connector and it powers the Microprocessor and the outputs to the motor drivers. The motor pulse and direction outputs must reference only either the 5V or GND terminal on the same terminal block.

2) Spindle speed circuit uses only; ACM, AVI and 10V.

3) Control inputs (IN1-IN4) and outputs (OUT1-OUT4) Use only the 24V and DCM (ground). All switches, buttons, and relays must reference only the DCM ground terminal and be 24 volt compliant. All of the inputs are biased with 24V, and a simple switch closure is all that is needed. The outputs are open collector and pull to DCM (low) when active, and can drive low power loads from 3 Volts to 24V.

Basic connection diagram (an Overview):

Input device

Spindle Converter

4 Input channels
Estop,Limit switch,Probe
,Home switch etc.

4 Output channels
for spindle start,
mist/flood,or other
devices …

Spindle speed output
（0-10V Signal）

4 Axis Control

USB
connection

MPG Handwheel(5V)

Steppers/
Servos

Mechanical dimensions diagram:

1. Prepare:

Installation the Mach3:

Open the CD, find mach3 software. Run the installation file :

Follow the prompts to install, until the last step.

For the last step, do not to select "LoadMach3 Driver". This controller uses USB not the parallel port.

Software license application:

Note: If you already have a full license for Mach3, Use that license. The supplied license on the CD is a DEMO license and is good for 500 Lines of G-Code only.

Get the demo license from "mach3 software folder"

Copy your registered license file "Mach1Lic.dat" to C:\Mach3 replacing the original free trial file, then reset the Compute （you must reset the computer, please don't open the software without first resetting the computer!）

Installation the software of the USB motion card:

This USB motion card does not require installation of a USB driver,Windows2000/XP/Windows7, will detect it automatically.

Connecting the USB cable to the PC and the motion card:

The first installation of motion control card, may take about 10s, when the green led lights on motion control card, indicating that the connection is successful, try the following tips when you install on your computer:
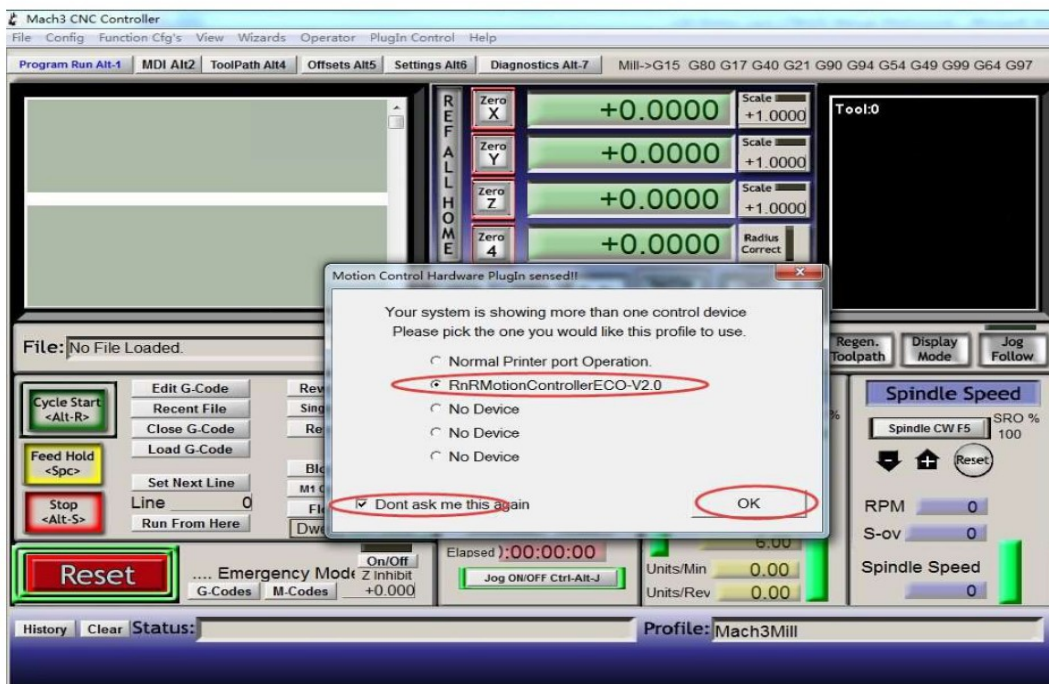
Installing the motion card plug-in.

Unzip the **USB Driver RnRMotion.dll**, and copy or drag RnRMotion.dll into your Mach3\PlugIns folder.
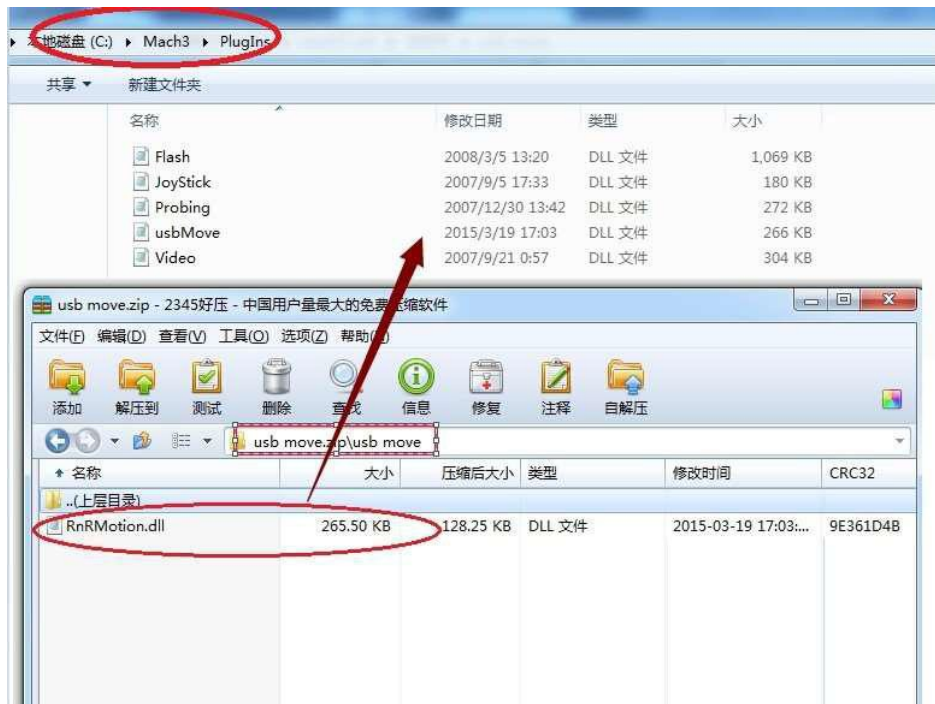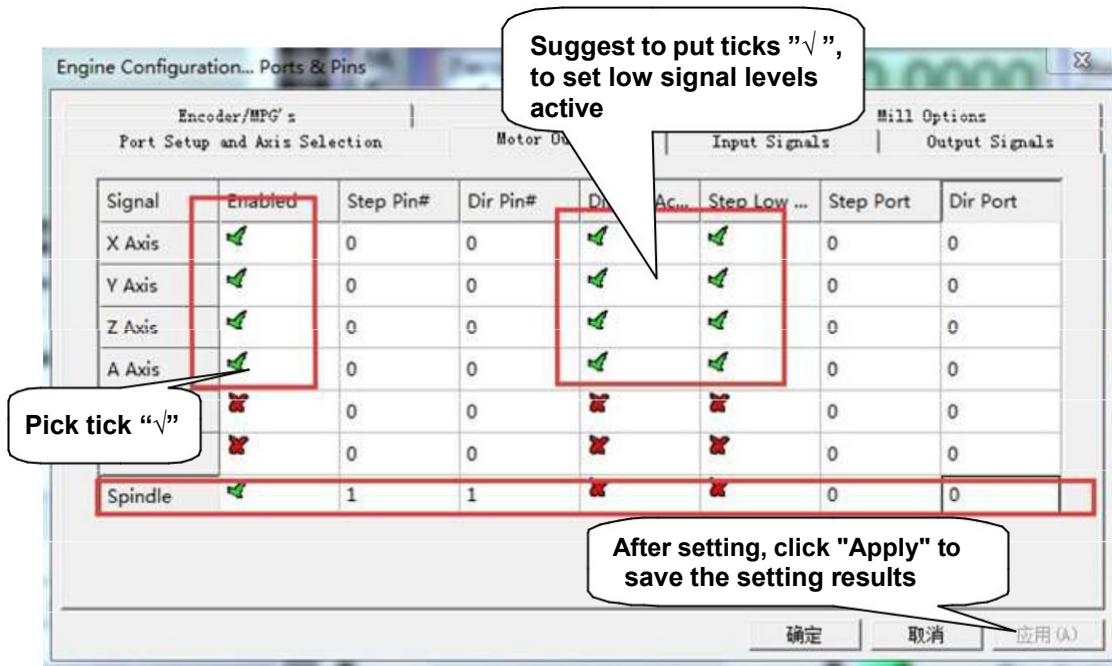

Run Mach3 for setup.

Start the Mach3 software, a dialogue of "Motion Control Hardware PlugIn sensed!" is shown. Please select the "RnRMotionControllerECO-V2.0". You can also check" Don't ask me this again".

2. Config for mach3:

For Mach3 X, Y, Z & A Axis configuration, use the settings as shown below: Config => Ports and Pins):

A **check** enables, an **X** disables the Port, Direction selection, and Step mode. These allow the steppers to move in the appropriate direction.

Enable only the individual axis as needed and select the step and direction modes to be compatible with your driver requirements.

Pulse output:

 Connection of (step/servo) motor driver:

The RNR universal motion control card can control 4 motors, named

> X axis,
>
> Y axis,
>
> Z axis,
>
> A axis motors.

There are two motor control signals for each axis:

> The terminals labeled P represents the **PULSE** output for the X, Y, Z, & A axis. The terminals labeled D represents the **DIRECTION** output for the X, Y, Z, & A axis.
>
> Use only the terminal labeled **GND** for the for the Pulse and Direction ground reference.
>
> If the drivers require an external +5 Volts for the optical isolators, the **BSMCEO4U-PP 5V** terminal may be used. Do not use this voltage for anything other than supplying the optical isolators. This voltage comes directly from your PC through the USB connector and overloading it will cause system failure. A separate 5 volt supply would be a much better choice.

Signal connection of motor driver

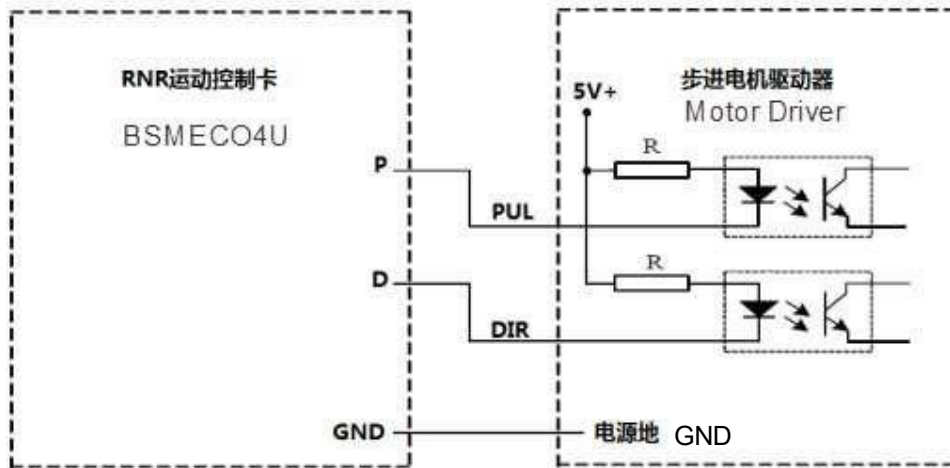There are usually two types of interfaces: **Active HIGH and Active LOW**.

Active HIGH method
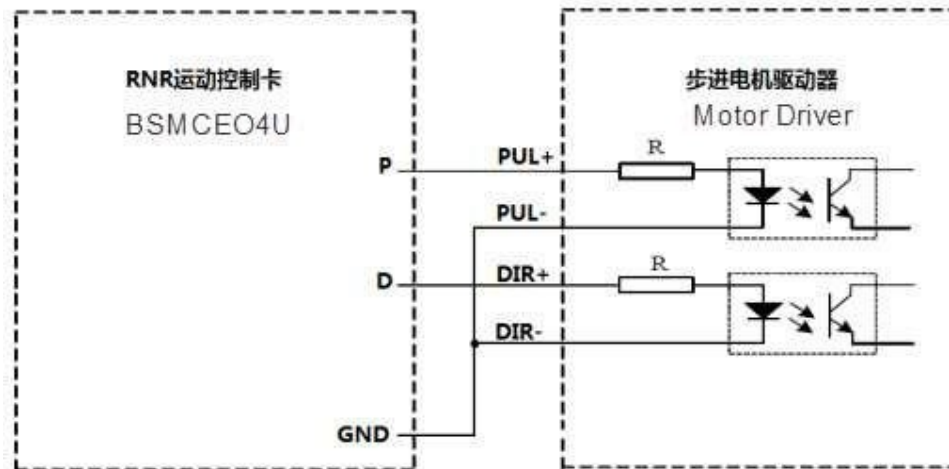
Active HIGH configuration

   The **BSMCEO4U-PP** activates the optical isolators by pulling PULSE and DIRECTION inputs high (5V).

Active LOW method

Active LOW configuration

BSMCEO4U-PP activates the optical isolators by pulling PULSE and DIRECTION inputs LOW (0V).

Note: it is possible to use the **BSMCEO4U-PP 5V** terminal to supply the Optical isolators with 5 volts externally, but it is not recommended.
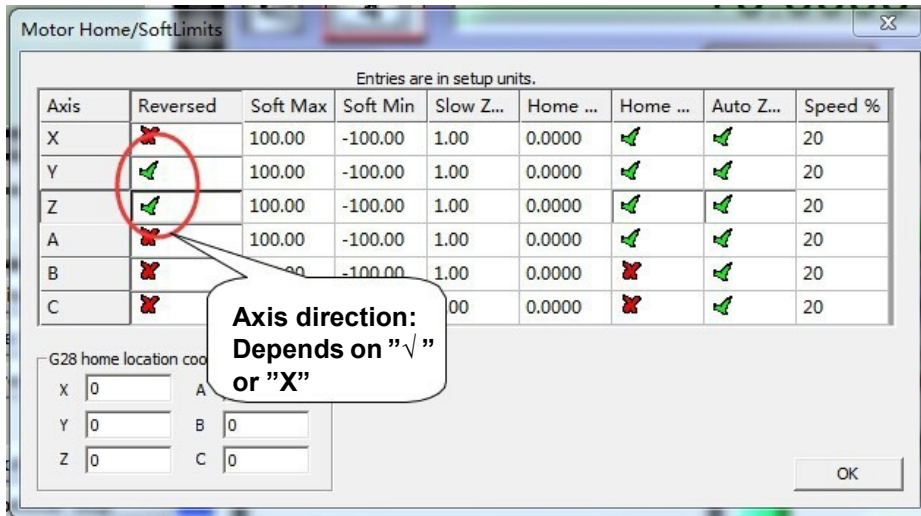
2.1 Motor Tuning

Motor tuning setup as shown below: (Config => Motor Tuning)

2.3 The Mach3 Menu => Config => Homing/ Limits dialog：

Axis direction, depends on the "Reversed"

2.4 Setup the input signal：

There are 4 general-purpose input channels. The channels number is from I1 to I4.

Example of input signal settings: I1 (input 1) is connected to emergency stop switch, I2 (input 2) is connected to the 4 axis limit switches, I3 (input 3) is connected to the 4 axis home switches, I4 (input 4) is connected to auto tool zero, set as shown.
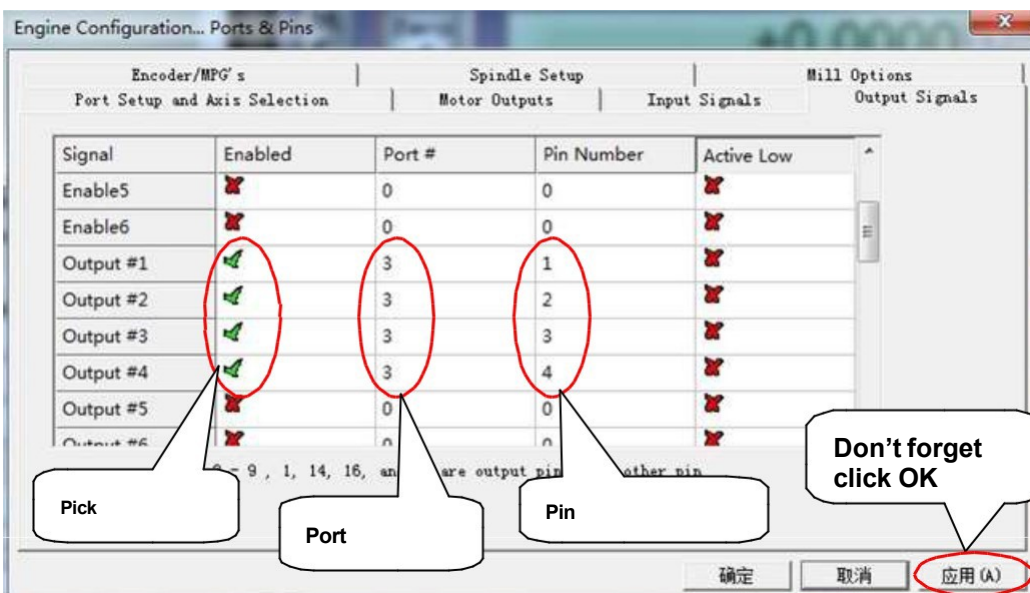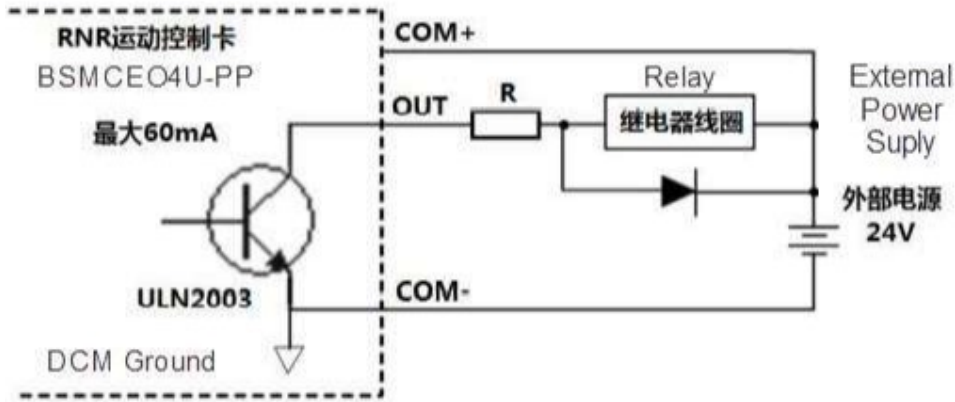
below: Note: All Digital inputs are on port 3.
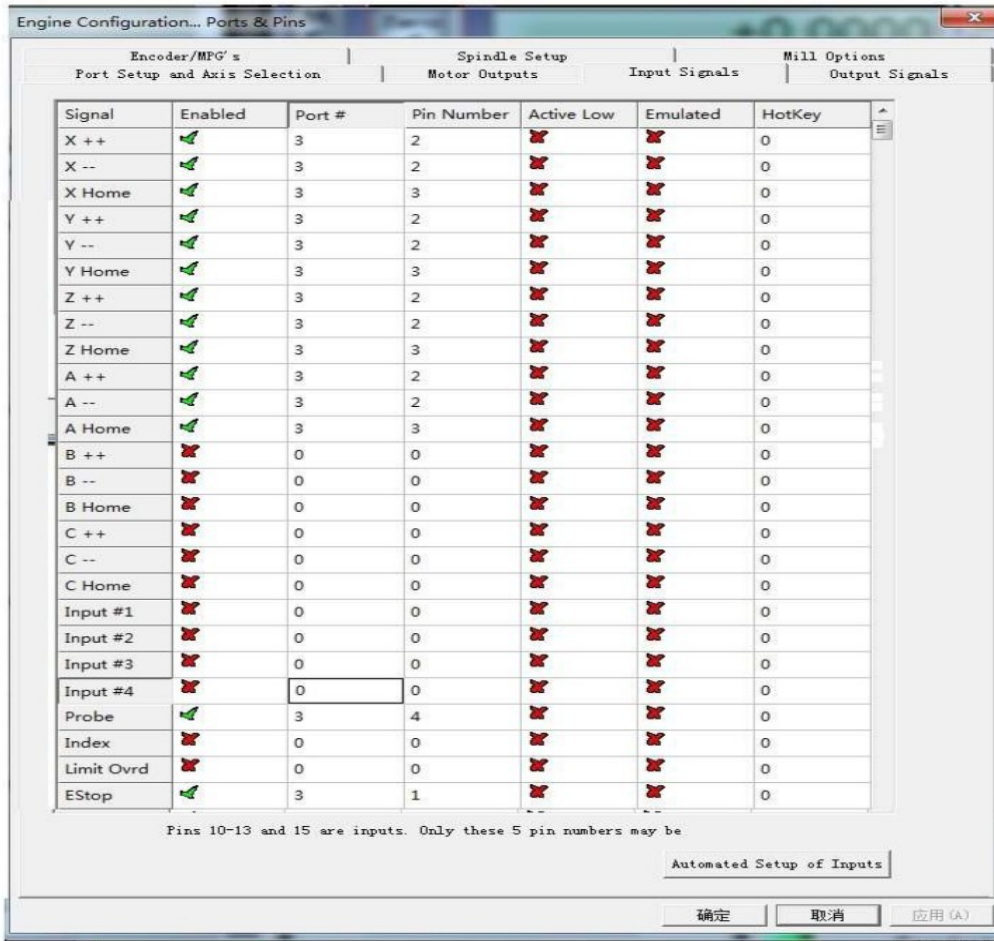
2.5 Setup the Output signals:

There are 4 general-purpose (open-drain) output channels, the channels number from O1 to O4, Mach3 setup as shown below: Note: All Digital outputs are on port 3.

Loads are limited to 60ma each

Note: Only **OUT** and **COM-** are used to activate most types of VFD spindle motor drives.

This lousy picture shows 24 volts being supplied from two different places (COM+ and 24V battery). Choose one or the other, not both. If you use an external supply (battery or equivalent), you can use any voltage from 5V to 24V so long as the relay or load is voltage compatible.

.

2.6 Slave axis setting:

Some mechanical devices use a gantry structure, which requires dual motors to drive it. The A-axis of the motion control card can be set as a slave axis, so that it can operate in sync with the designated master Axis to move the gantry.

The method of setting the A axis as a slave axis:

1) Select the menu in Mach3 [Settings (Config)],

2) Select [Slave Axis],

3) In the [Slave Axis] Select (Slave Axis Selection)] page to set the slave axis. As shown below:

4) Example below shows the A axis slaved to the X axis.
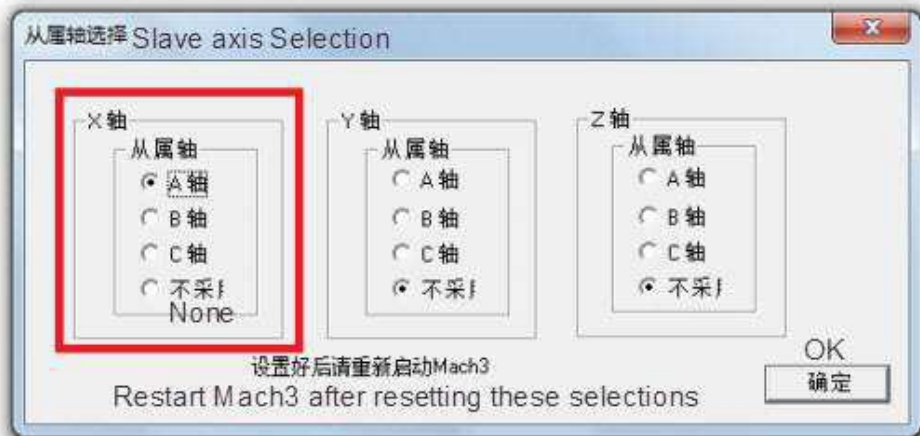
M3 code (Start Clockwise) turns output 1 ON, M4 code (Counter clockwise) turns output 2 ON, and M5 code (Spindle Stop) turns OFF both output 1 and output2.

M7 code controls output 3 to ON, M8 code control output port 4 to ON, M9 turns both output 1 and output2 OFF.

2.7 Spindle speed control (0-10V or PWM) Setup:

There is 0-10v signal output on the control card (AVI), Can be used to control the spindle speed of a connected Inverter. The circuit is optically isolated; and all three terminals must be connected for proper operation.

The terminal **ACM** is **0V** for the speed output, terminal **10V** is the supply for the speed circuit, and **AVI** terminal is a **PWM** output to control speed. This output is not very linear. Use caution if speed settings are critical.
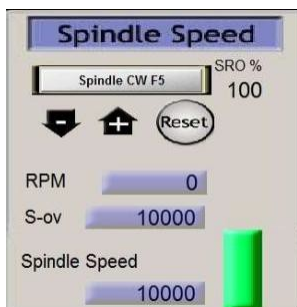
The maximum spindle speed is defined in the pulley setup:

(For example, 24000 RPM). As shown below: The Mach3 Menu => Config => Spindle pulleys:

Completion of the setting, there are two ways to control the output value of 0 ~ 10V.
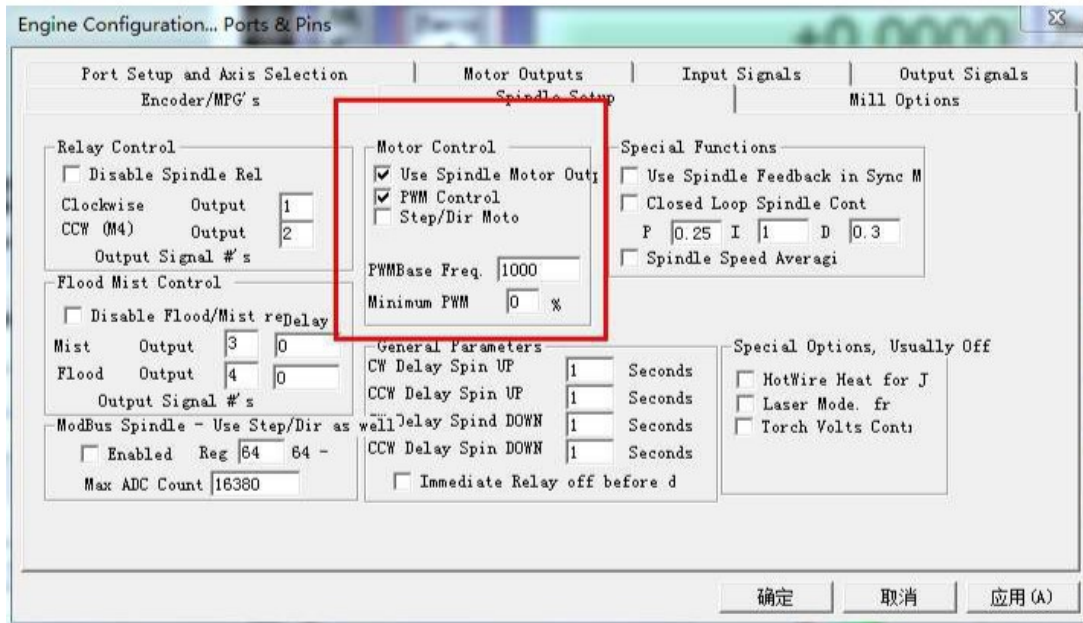
Using the S command. Such as S20000 (the speed to 20000RPM)
Using the Mach3 interface control (input Spindle Speed, and adjust Percentage SRO's). Figure: 2.6
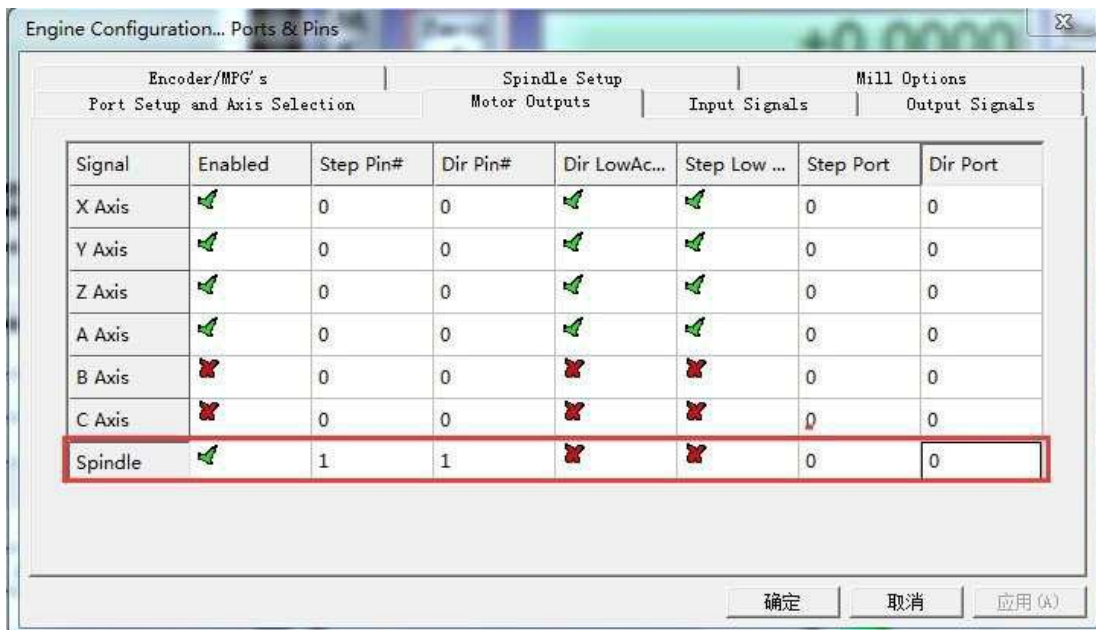

Setup Spindle PWM parameters: as shown in the red box below.

Enable spindle output as shown below:

2.8 Mach3 MPG Setup:

Note: The electronic hand-wheel is supplied 5V voltage. The output must not exceed 5V or damage to the board may result. Refer to the following wiring diagram:
The RNR universal motion control card provides a handwheel interface to connect the handwheel provided by the user. It is the 10 pin connector.
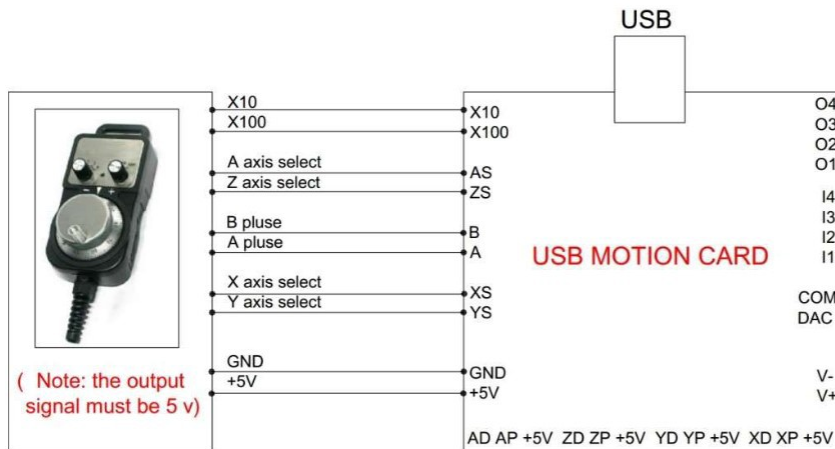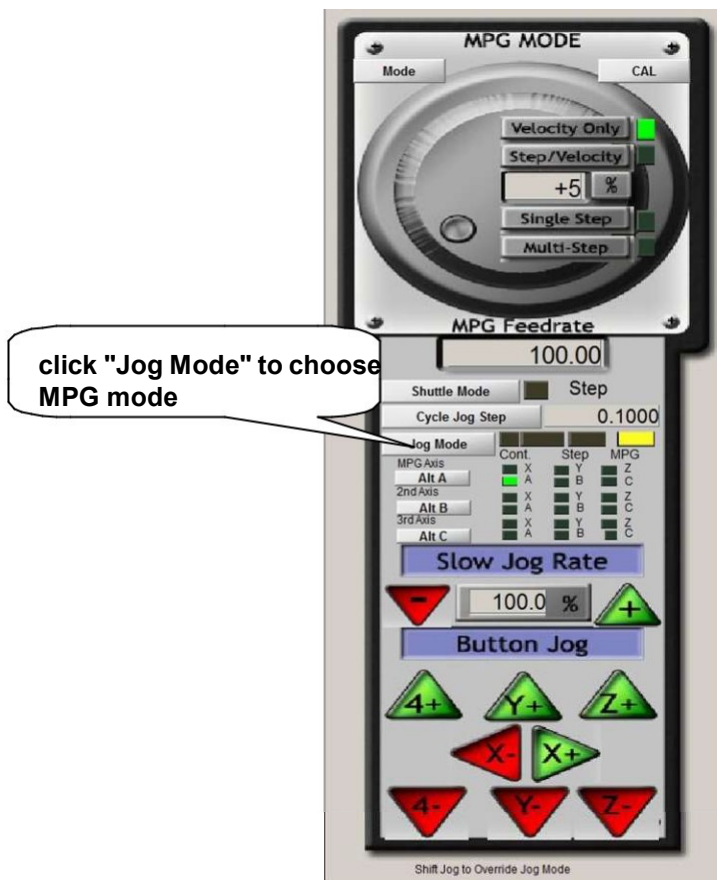

2.8 Mach3 MPG Setup:

The Mach3 Menu => Config =>Ports and Pins=>Encoder/MPG 'S
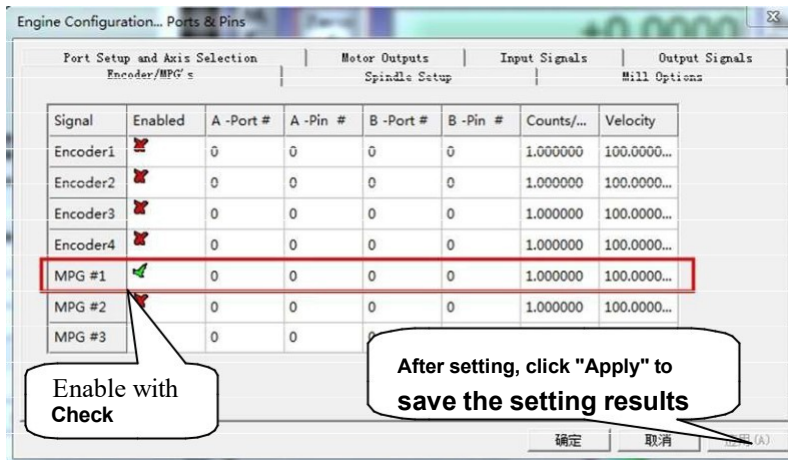
Mach3 USB Motion Card BSMCEO4U V2.7

Press the "Tab" key on your keyboard, to bring up the "MPG MODE"
in mach3:

click "Jog Mode" to choose
MPG mode

Click the "Jog mode" and select MPGmode, You can use the electronic
hand-wheel to control the stepper motors manually.

The inputs are all rated for a maximum of 5Volts. 3.3 Volts is preferred.
The interface is as follows   Port/Pin#

Mach3 USB Motion Card BSMCEO4U V2.7

1) 5 Volt source to run hand-wheel
2) Ground
3) X select (Pull low)   IN5
4) Y select (Pull low)   IN6
5) Encoder A (Zero phase)   IN7
6) Encoder B (90 degree phase)   IN8
7) Z Select (Pull low)   IN9
8) A select (Pull low)   IN10
9) Multiply Speed by 100   IN11
10) Multiply Speed by 10   IN11

These pins can be used as general purpose inputs if a hand-wheel is not installed.

Note**: The input terminals IN5 through IN12 corresponding to the hand-wheel interface cannot be used for limit switches, homing, tool settings, or other critical functions**. They can only be used as a general switch input terminals (usually used as a connection to control panel). Consider X axis input as an example. An additional input can be connected to the X axis select input IN5. The following schematic diagram shows the correct method:
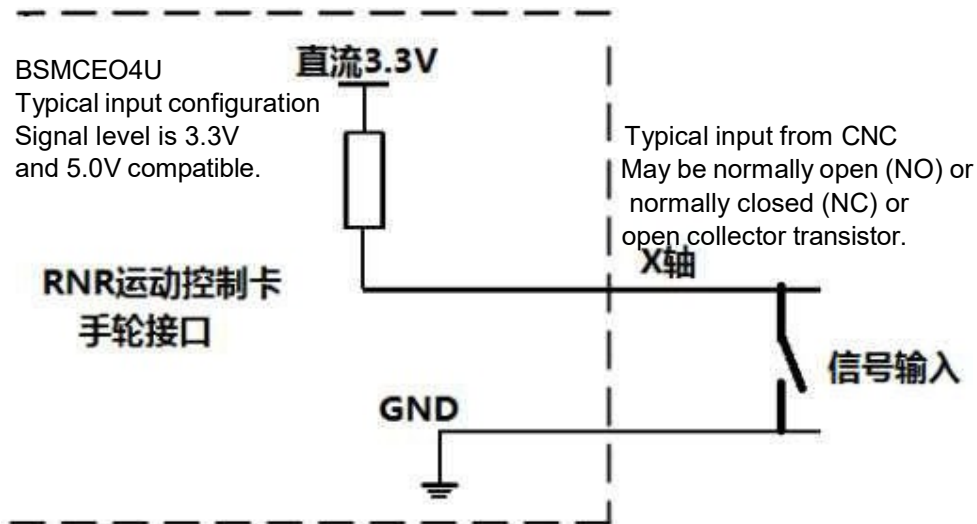
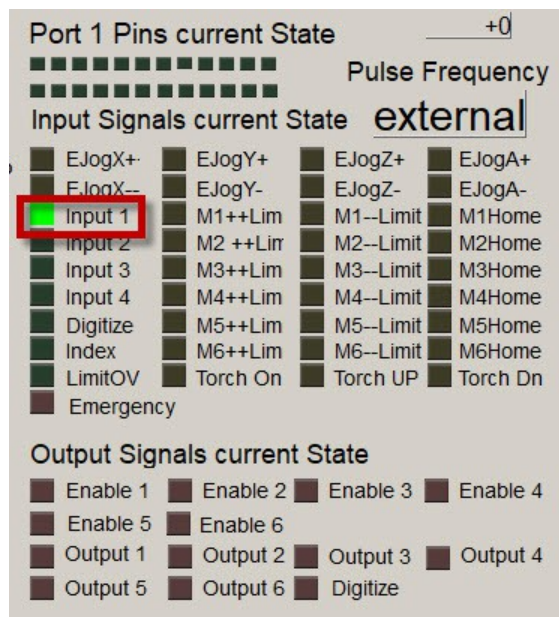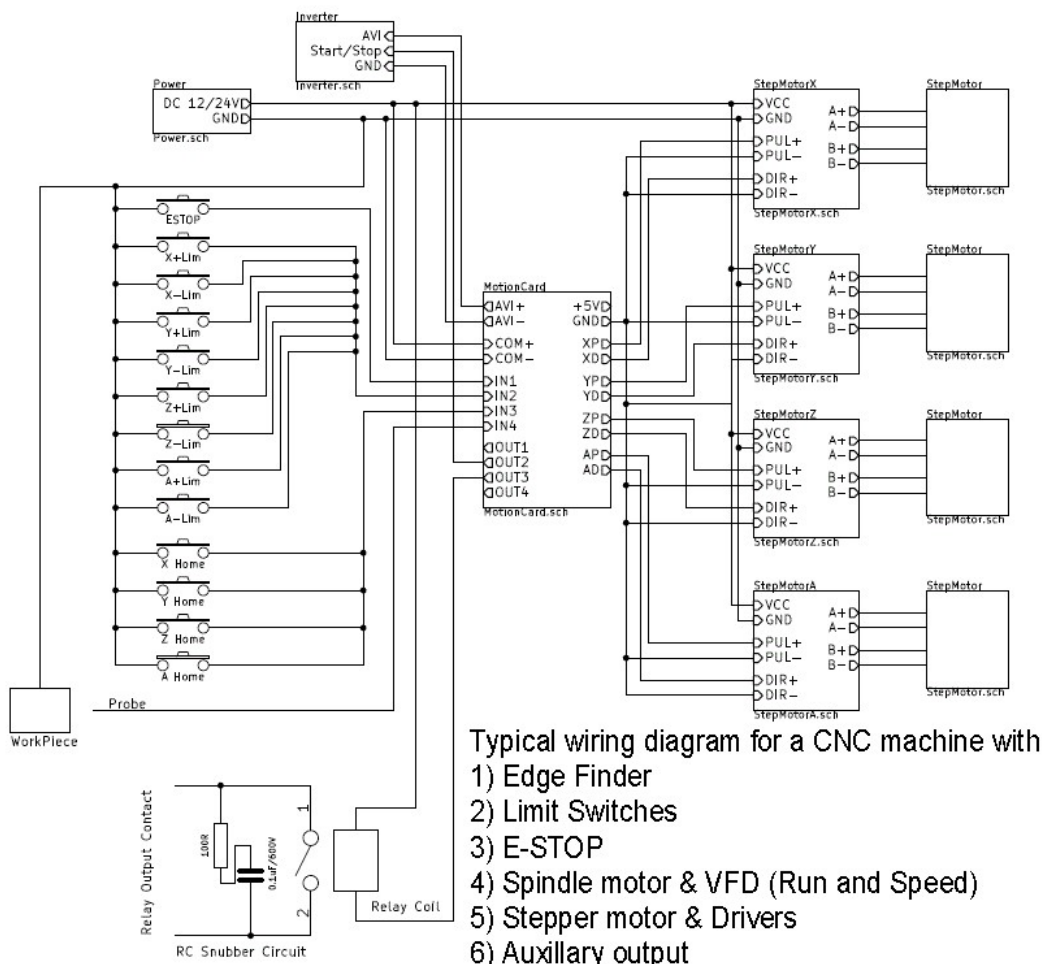**Example Mach3 settings for Input on Hand-Wheel pins:**
Handwheel X select input is on Port3 pin 5 and in the example, and is associated to input #1.

On the Diagnostic Screen, the indicator marked Input #1 will illuminate whenever the switch on Port3-IN5 is closed.

3.0 Classic Wiring Configuration for BSMCEO4U

Typical wiring diagram for a CNC machine with
1) Edge Finder
2) Limit Switches
3) E-STOP
4) Spindle motor & VFD (Run and Speed)
5) Stepper motor & Drivers
6) Auxillary output

4.0 Specifications Electrical

USB input	<150ma	5V nominal
5V output	50ma	
PUL & **DIR** drive output	+/-6ma	
Voltage **24V** for control circuit	500ma	12V – 24V
Output for loads **OUT1-OUT4**:	250ma continuous	5V - 24Vdc
Input **IN1-IN4** contact closure	4 - 8ma	12V - 24Vdc
Input **IN5-IN12** MPG	5ma @ 0V	3.3V
Spindle Speed **10V** input	10ma	10V - 15V
Spindle Speed **AVI** output	10ma	0V - 10V (PWM 0-100%)
Selectable Pulse Frequencies	10KHz, 25KHz, 50KHz, & 100KHz	
Control Ports input	Port 3	Pins 1-4 High priority
Control Ports input	Port 3	Pins 5-12 Low priority
Control Ports Output	Port 3	Pins 1-4
Axis Ports	4 Axis X, Y, Z, & A	
USB driver	RnRMotion.dll	RnRMotionControllerECO-V2.0