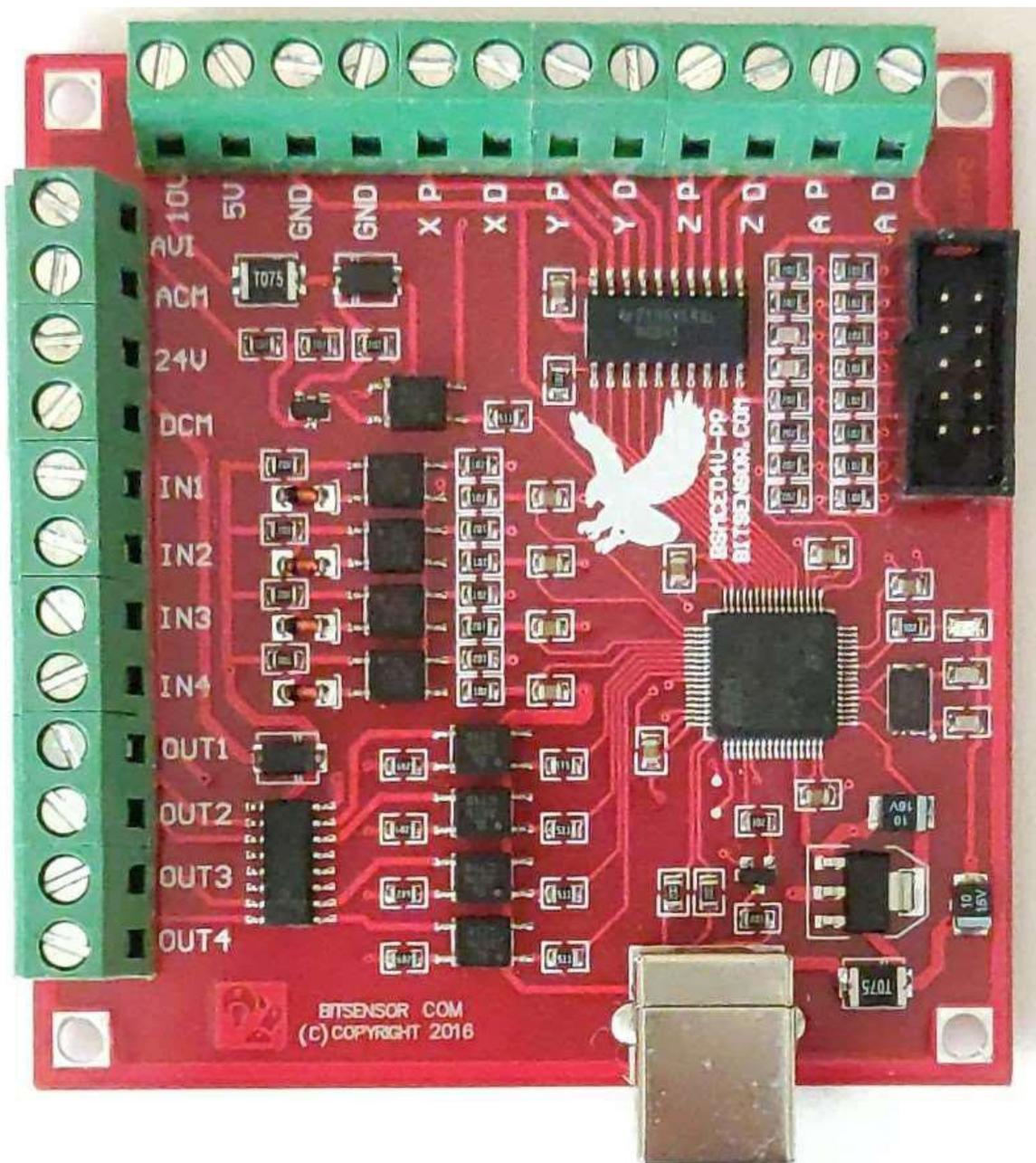


Mach3 USB Motion Card (BSMCEO4U-PP) Installation Manual





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,

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January 20, 2025

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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.

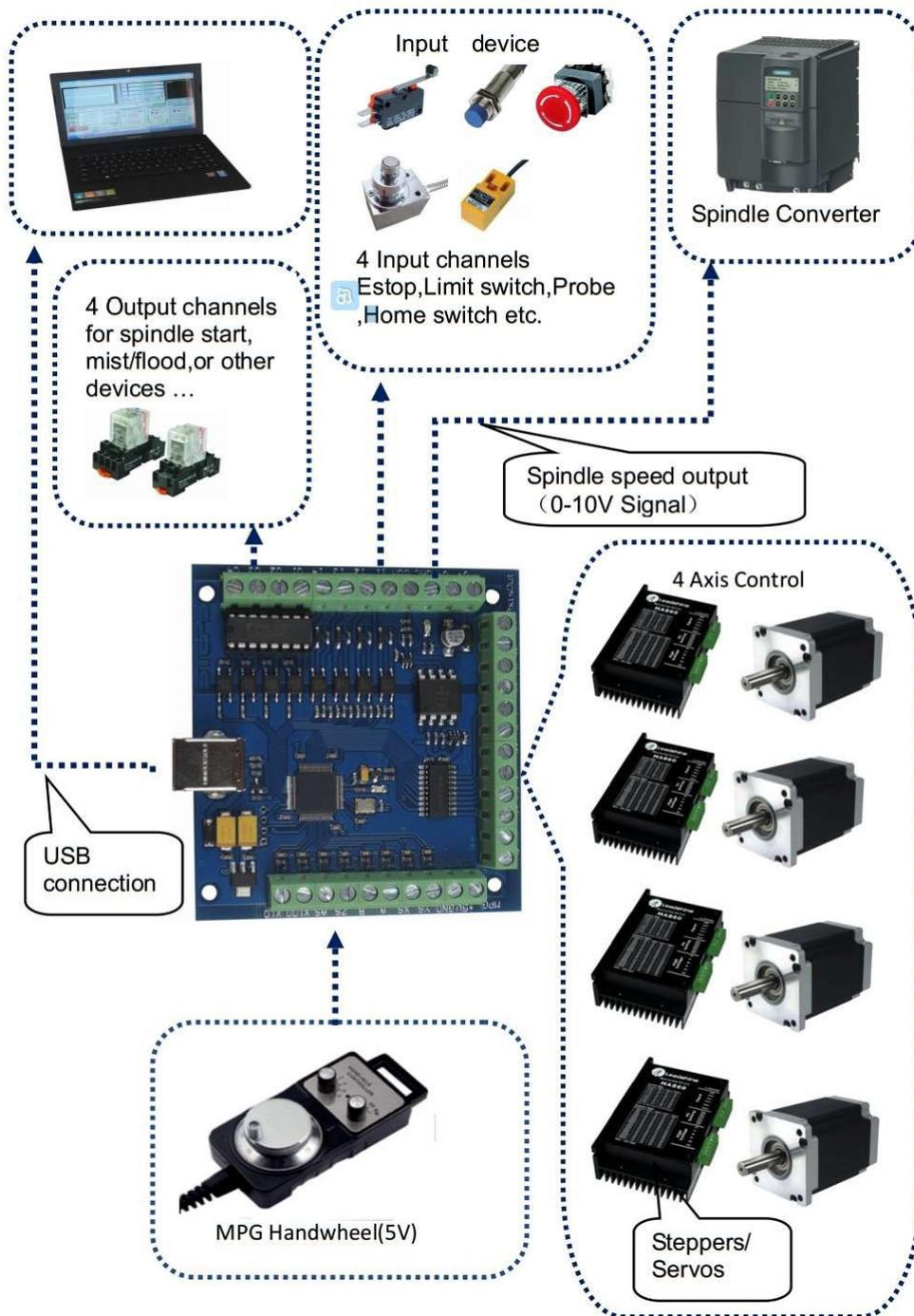
General-purpose isolated relay drive output interface can drive four relays for controlling spindle start, forward and reverse rotation, pumps, or other devices.

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

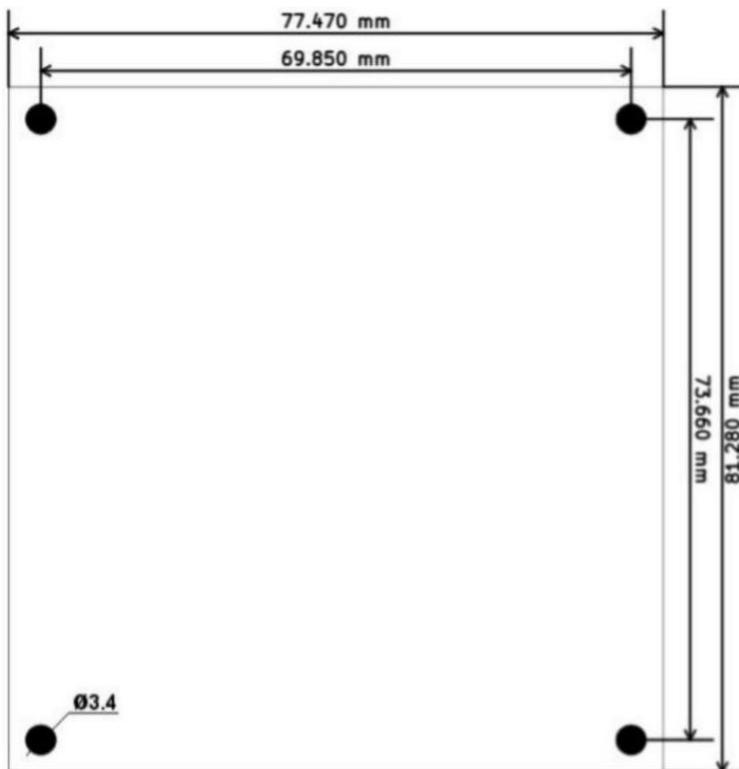
Note: The BSMCEO4U-PP board has three optical isolated circuits. Do not cross connect the different grounds to minimize noise interference. The circuits are:

- 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 to the 5V or GND terminal on the same terminal block.
- 2) Spindle speed circuit uses only; ACM (VFD ground), AVI (Spindle Speed), and 10V from the VFD drive.
- 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 (200ma) from 3 Volts to 24V.

Basic connection diagram (an Overview):



Mechanical dimensions diagram:



1. Prepare:

Installation the Mach3:

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

名称	修改日期	类型	大小
Mach3VersionR3.041	2014/1/10 13:23	应用程序	25,733 KB

Follow the prompts to install, until the last step.

For the last step (Setup Finished", do not to select "Load Mach3 Driver". This controller uses only USB not the parallel port. See image below.



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.

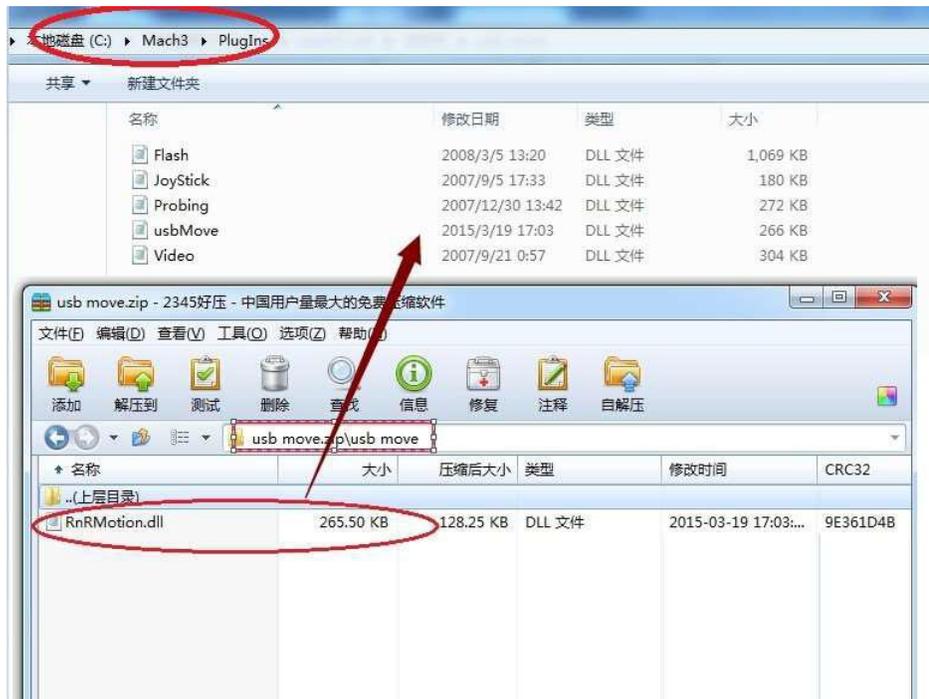
Connecting the USB cable to the PC and the motion card:

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:



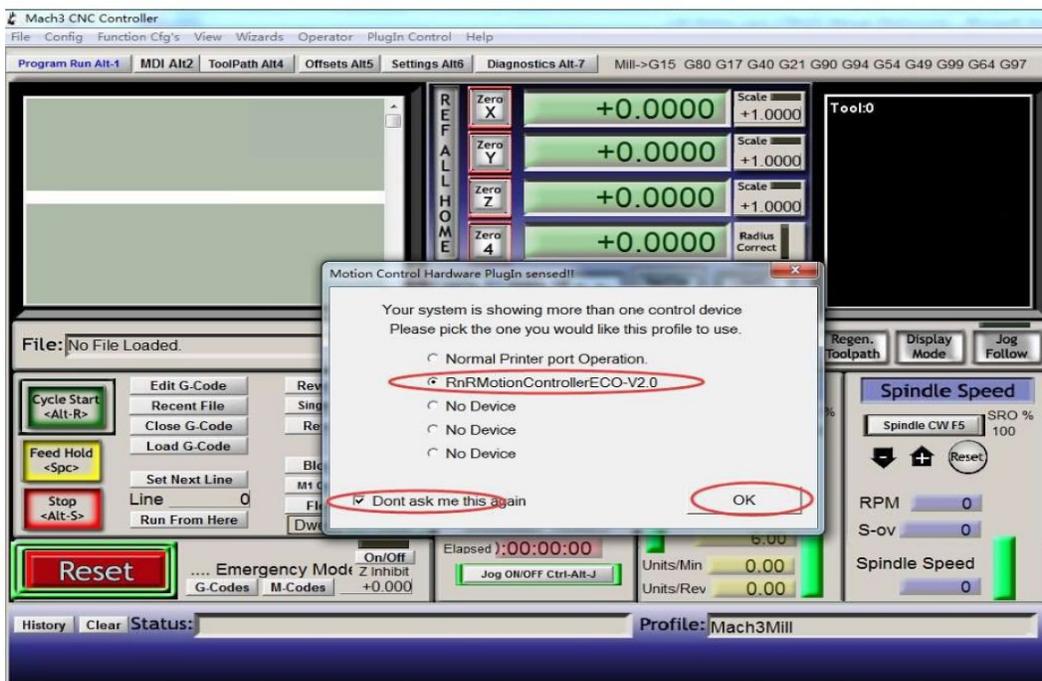
Installing the motion card plug-in.

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



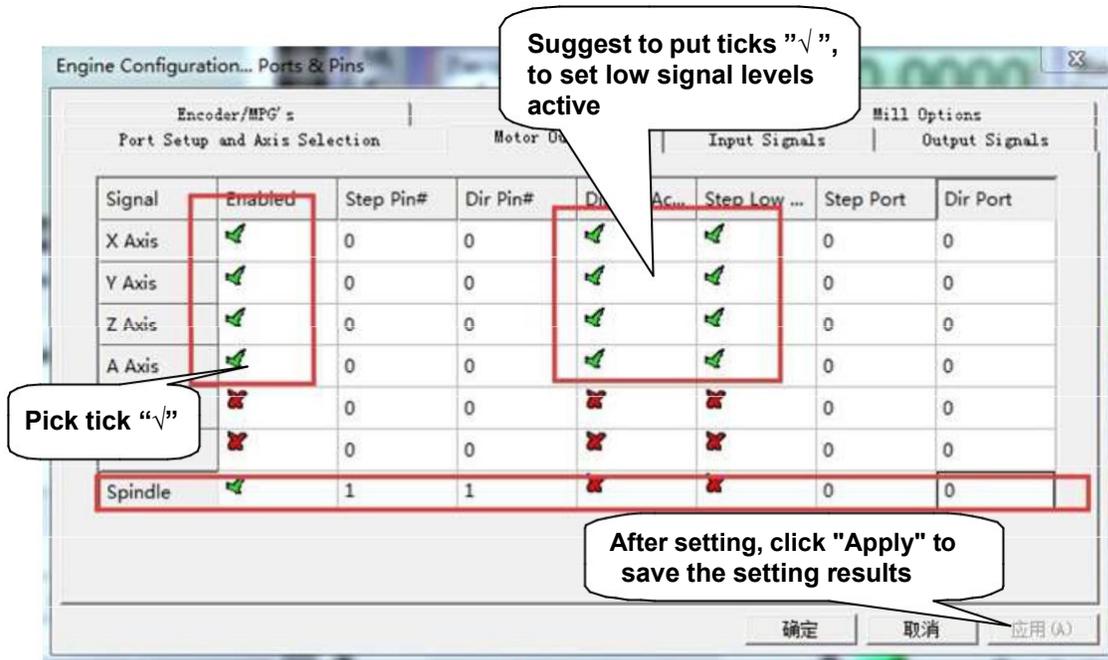
Run Mach3 for setup.

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 **checkmark** enables, and an **X** disables the Axis. **Checkmarks** also determine **stepper direction** and **step-pulse phasing**. They allow the stepper motors to move in the appropriate direction as desired. Proper step pulse phasing will improve stepping reliability and minimize lost steps under load and stepper reversing. Proper phasing will prevent the pulse from occurring at the same time as a direction reversal. In general, while the system is idle, the step signal should be in the OFF state. This varies depending on how the stepper drivers are wired. The stepper pulse idle voltage should be zero/low when the stepper drivers are wired in the **active high** configuration. The opposite is true for steppers wired in the **active low** configuration.

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

Note: The Axis step and direction Pins and Ports are hard coded and value 0 is correct. These numbers can be changed, but the changes won't have any effect.

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, and
- 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.

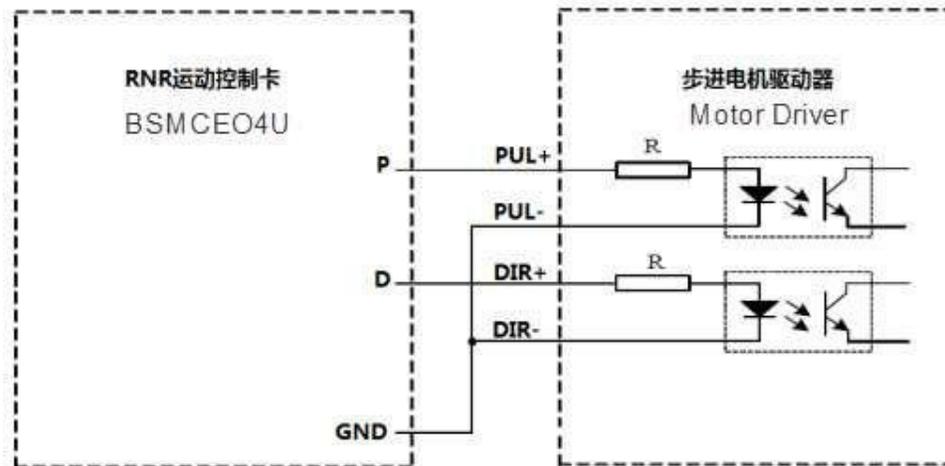
Use only the terminal labeled **GND** for the for the Pulse and Direction ground reference.

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**.

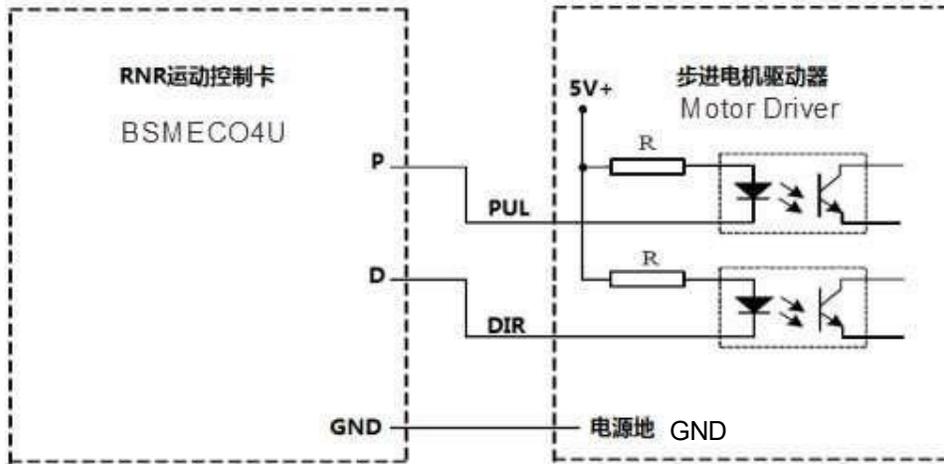
Active HIGH method



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: (Configuration => Motor Tuning)

Note: You must save the settings for each axis before moving on to the next axis.

1) Select Axis to tune.

2 Mach3 steps per unit:
Mach3 steps per unit = Mach3 steps per rev x Motor revs per

- 2) Steps Per mm or inch: A calculation of how your hardware is configured.
- 3) Velocity: maximum velocity the system can handle without losing steps.
- 4) Acceleration: Maximum acceleration you system can handle without losing

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



The HOME location can be set to any corner of the CNC as determined by the checkmarks for each axis. The **X** chooses the default direction and the **Checkmark** chooses the opposite.

Reversed is for the soft limits, **Home Neg** selects positive or negative direction to HOME, and **AUTO Zero** allows the system to reset the DROs after getting to the HOME position.

Once a system is homed, you can default set the DROs for the HOME position to be something other than 0, 0, 0. Modify the values in the boxes below the **G28 Home Location** title as desired.

Example: If Y is set to 600, then after a HOME, the Y DRO will read 600.

2.4 Setup the input signal :

There are 4 general-purpose input channels. The channels number is from IN1 to IN4.

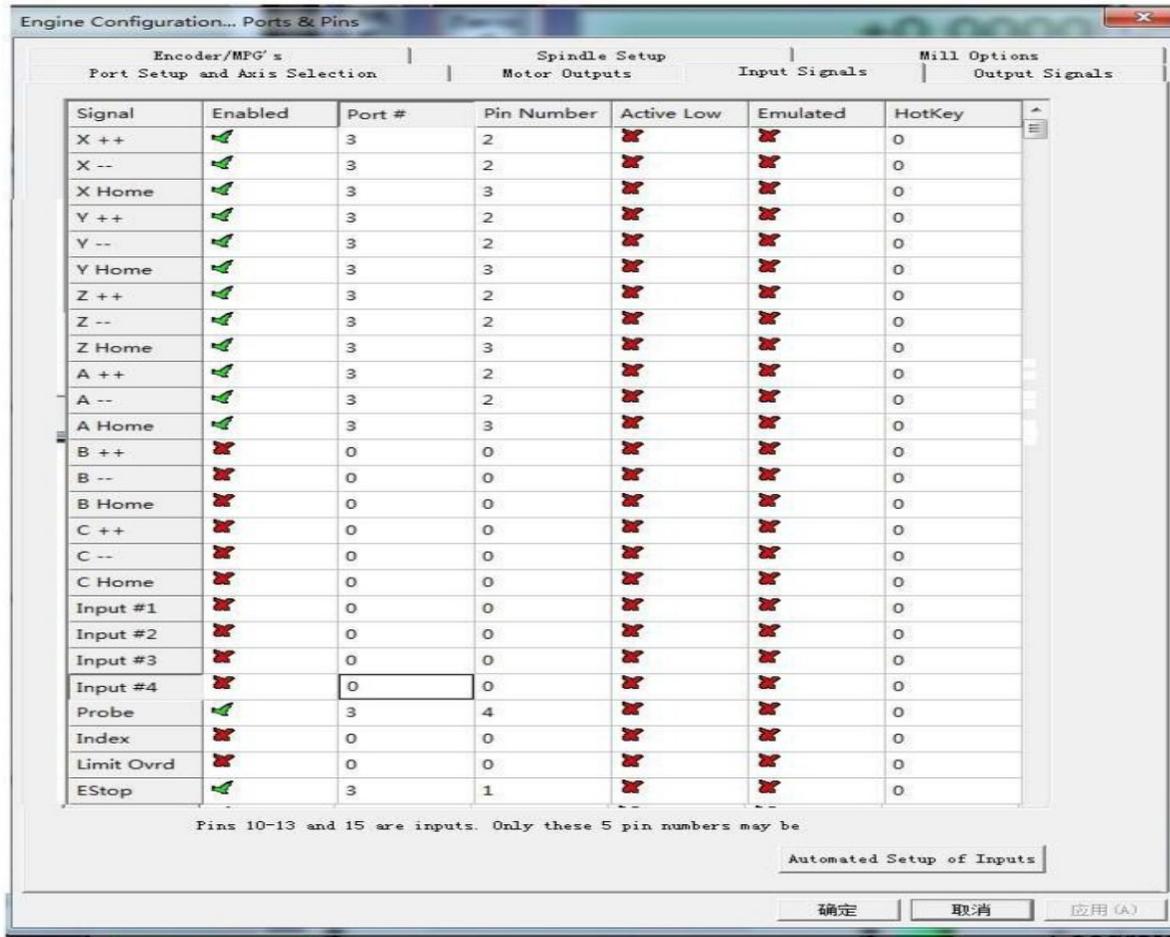
Example of input signal settings: IN1 (input 1) is connected to emergency stop switch, IN2 (input 2) is connected to the 4 axis limit switches, IN3 (input 3) is connected to the 4 axis home switches, IN4 (input 4) is connected to auto tool zero, set as shown.

Note: The BSM board uses only PORT 3. The inputs IN1 to IN4 are numbered PORT-3 Pins 1 to 4. The Outputs OUT1 to OUT4 are similarly numbered PORT 3 Pins 1 to 4. The Ports for the hand-wheel are PORT-3 PINS 5 through 12.

The Stepper Driver outputs are hard coded and no matter what port and pin values you choose, it will make no difference, The Default numbers are best left at PORT-0 and PIN-0.

Note: it is recommended that you install at least 5 limit switches to protect your system from damage or injury The Z minus limit switch is generally not needed.

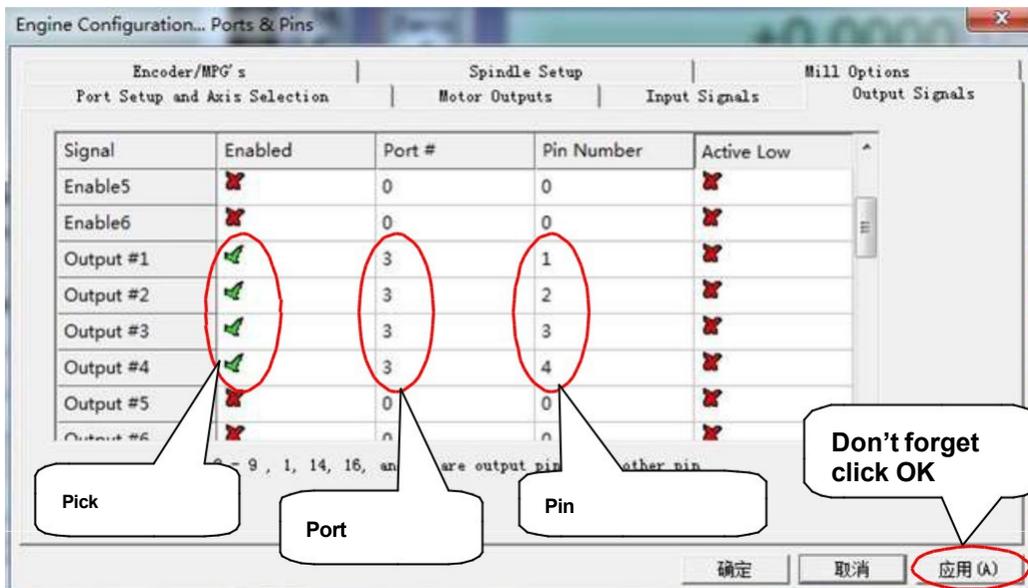
The Limit switches can also be used as HOME switches. Just use the same port and pin number for the home and limit switches.

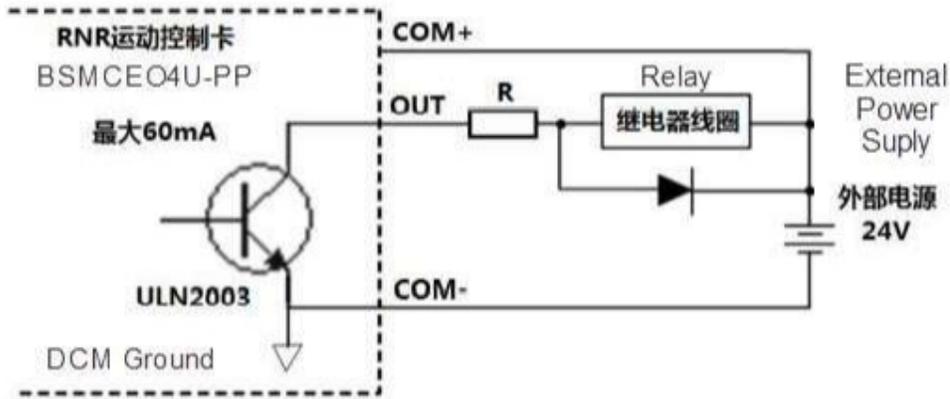


All Digital inputs are on port 3.

2.5 Setup the Output signals:

There are 4 general-purpose (open-drain) output terminals, the terminals number from OUT1 to OUT4, Mach3 setup as shown below: Note: All Digital outputs are on port 3.





Loads are limited to 60ma each

This picture shows 24VDC supplying both the BSM board and a 24V relay. If you use an external supply (battery or equivalent) to power only the relay, you can use any relay voltage from 5V to 24V so long as the relay or load is less than 250ma and voltage compatible. In many cases, the external device will have its own internal supply. A VFD spindle controller usually has its own internal supply.

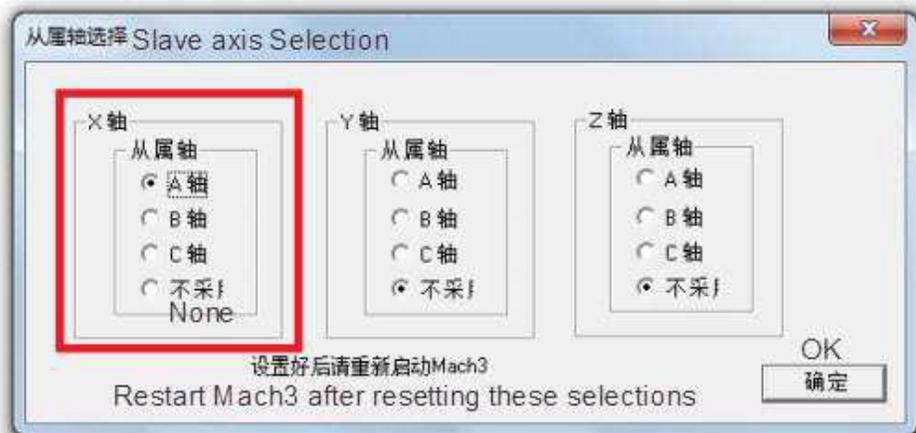
Note: Only **OUT** and **COM-** are used to activate most types of VFD spindle motor drives.

2.6 Slave axis setting:

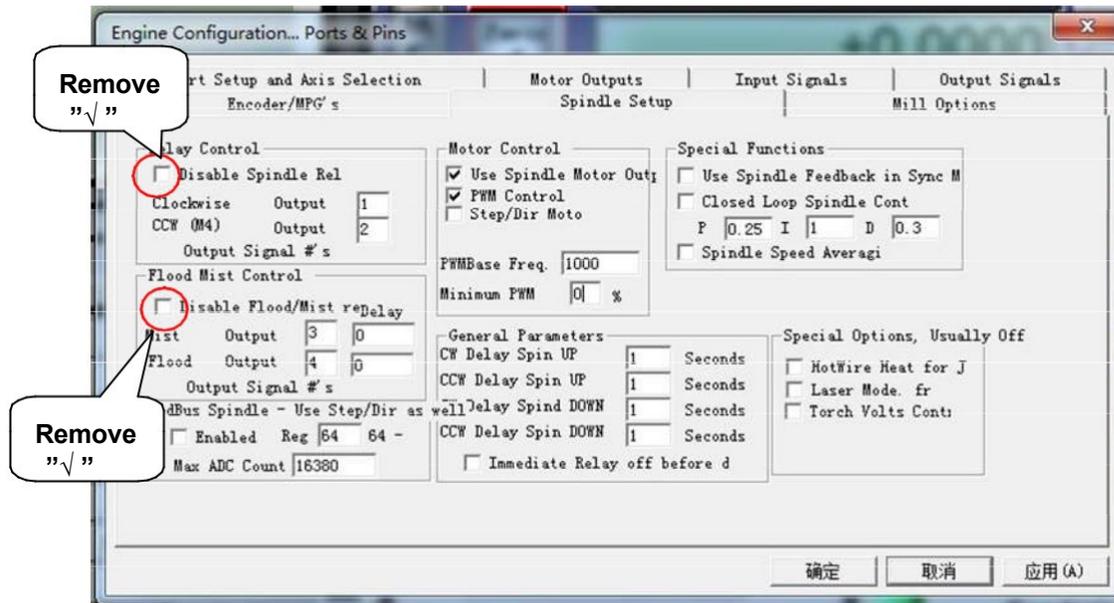
Some mechanical devices use a gantry structure, which requires dual motors to drive it. The A-axis of the motion control card can be set as a slave axis, so that it can operate in sync with the designated master Axis to move the gantry.

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

- 1) Select the menu in Mach3 [Settings\Configure],
- 2) Select menu item [Slave Axis],
- 3) In the page [Slave Axis Selection] select the axis for the slave to follow and check the A axis. As shown below. Note: Only the A axis is available as a slave on the BSM board. Then save and exit.
- 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 output #2.



M7 code controls output 3 to ON, M8 code control output #4 to ON, M9 turns both output #1 and output #2 OFF. Shown is the default settings, the numbers can be changed as needed.

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

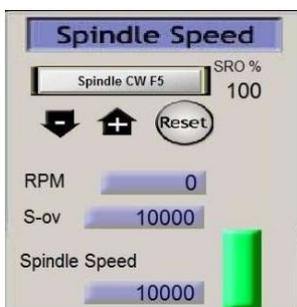
There is 0-10v signal output on the control card (AVI). It can be used to control the spindle speed of a connected Inverter. The circuit is optically isolated; and all three terminals must be connected for proper operation.

The terminal **ACM** is **0V** or ground for the speed output, terminal **10V** is the supply for the speed circuit (supplied by the VFD), 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:

There are two ways to control the speed control voltage output value from 0 ~ 10V.

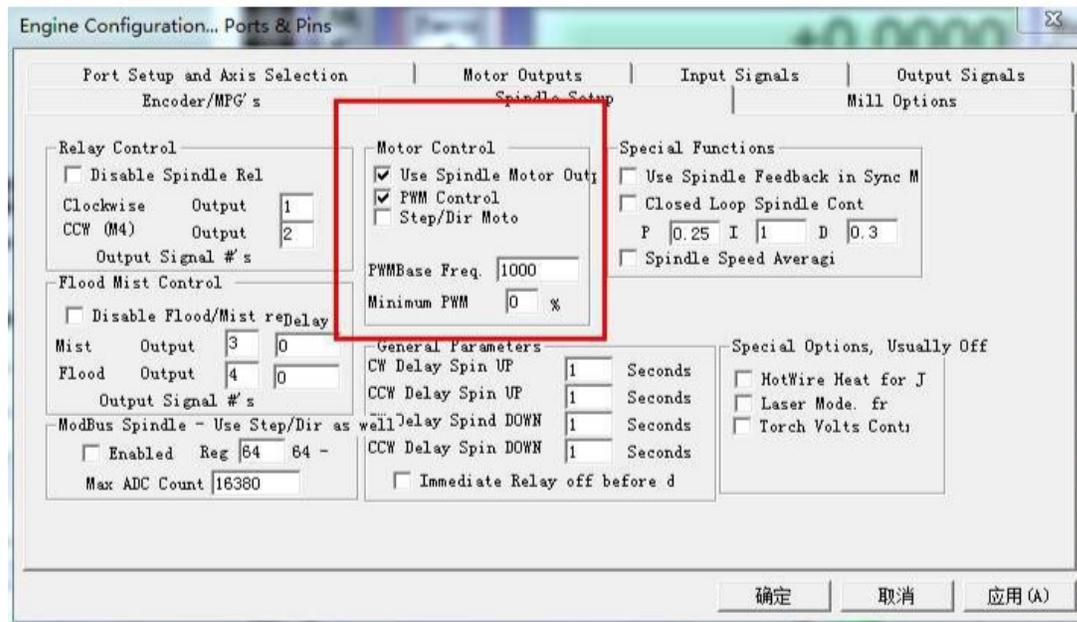


- 1) The S command in G-code. Such as **"S20000 M03"** will set a voltage equivalent to the speed of 20000 RPM and M03 starts the spindle CW.
- 2) The Mach3 front panel **"Spindle Speed"** window can start and stop the spindle, and set the speed by adjusting from zero to 250%, by moving the Green slider up and down.

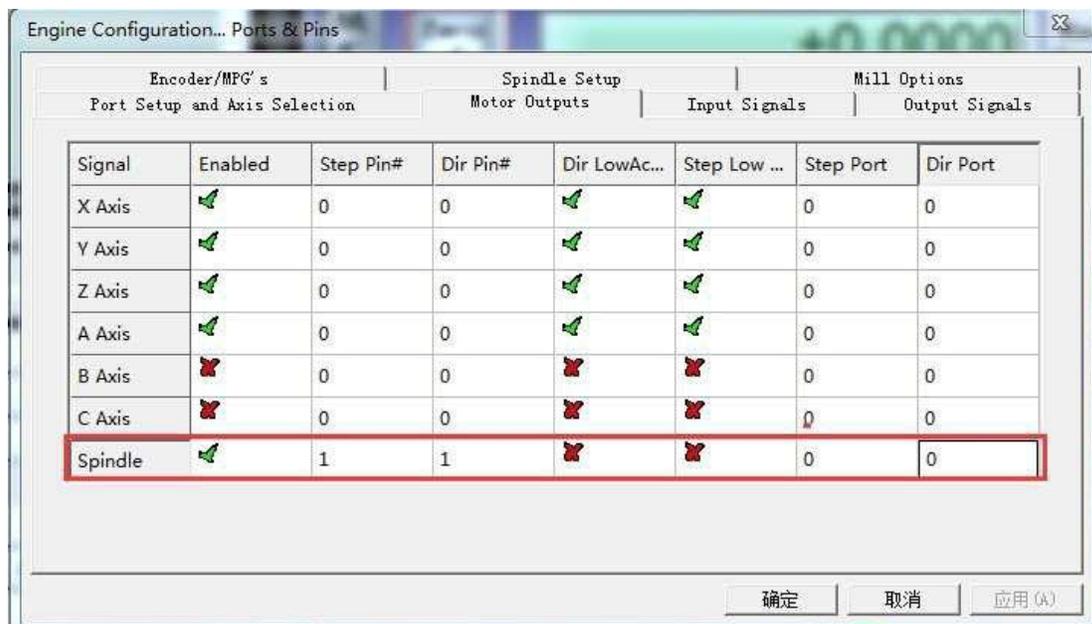
Figure: 2.6

Mach3 USB Motion Card BSMCEO4U V2.8

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



Enable spindle output as shown below



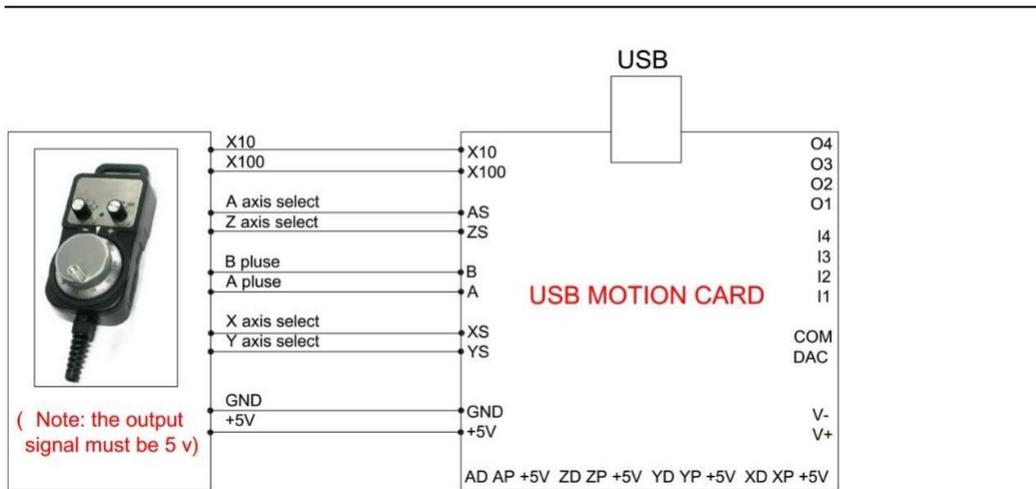
Spindle is activated by setting Spindle to Pin 1 Direction 1

The Stepper Driver outputs are hard coded and no matter what port and pin values you use, they will make no difference, The Default values are best left at PORT0 and PIN0.

2.8 Mach3 MPG Setup:

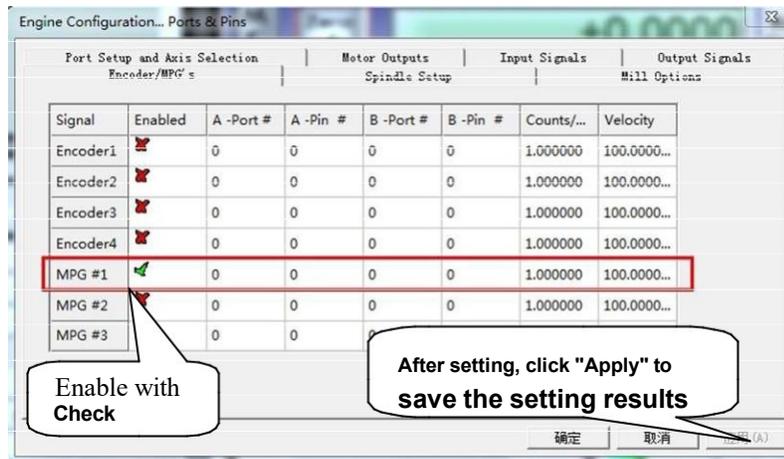
Note: The electronic hand-wheel is supplied with 5V voltage. The inputs must not exceed 5V or damage to the board may result. Refer to the following wiring diagram:

The RNR universal motion control card provides a hand-wheel interface to connect the hand-wheel provided by the user. It is the 10 pin connector.



2.8 Mach3 MPG Setup:

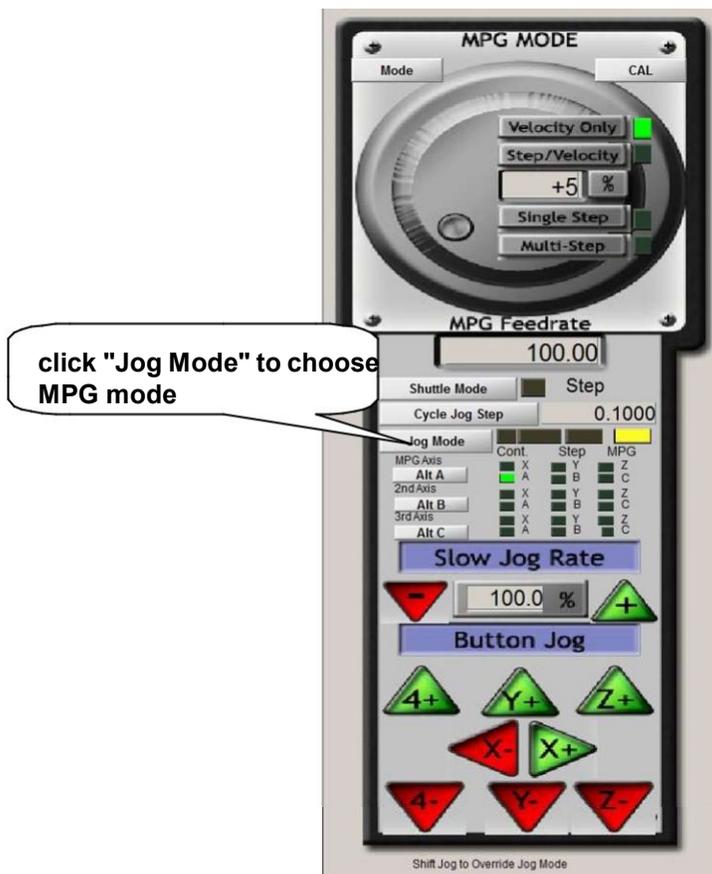
The Mach3 Menu => Config =>Ports and Pins=>Encoder/MPG 'S



Activate the MPG in order to use. Again, Port and Pins do not need to be set.

Mach3 USB Motion Card BSMCEO4U V2.8

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



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

If an MPG device is not used, Motion and Jogging can be controlled easily with the arrow keys.

- 1) Set jog Mode to continuous
- 2) Set Cycle Jog Step to about 0.1mm (whatever works for you)
- 3) Set the Slow Jog Rate to something near 20%
- 4) Jog at full 100% speed by using SHIFT arrow keys
- 5) Jog at Slow Jog Rate by using arrow keys
- 6) Step at Jog step distance by Using CTRL arrow keys

Mach3 USB Motion Card BSMCEO4U V2.8

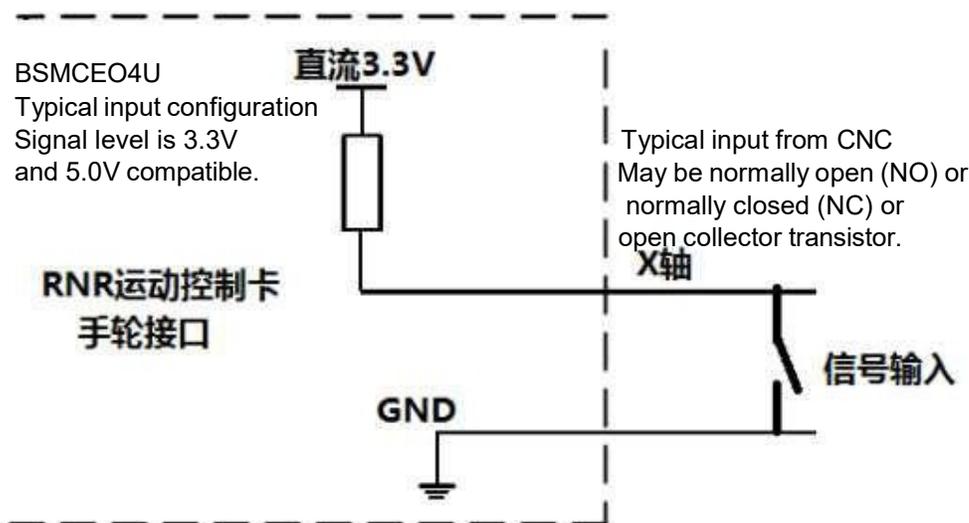


The auxiliary inputs are all rated for a maximum of 5Volts. 3.3 Volts is preferred. The interface is as follows.

- Pin#
- 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 (Pull low) IN11
 - 10) Multiply Speed by 10 (Pull low) IN12

These pins can be used as general purpose inputs if a hand-wheel is not installed. The left column of pins are odd numbers and The right column is even numbers, with pin #1 in the upper left corner

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:



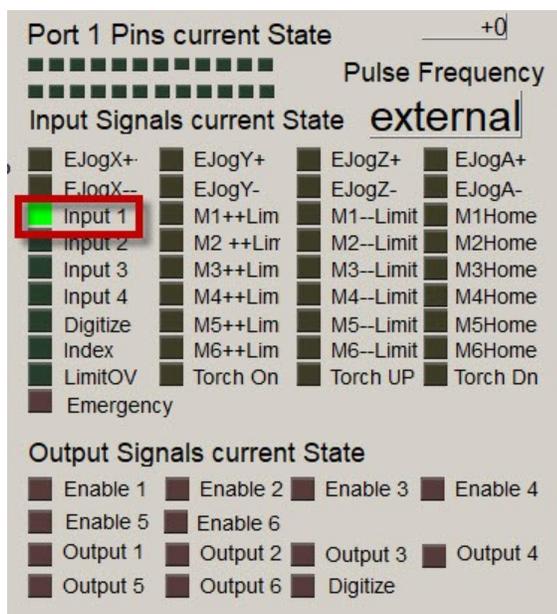
Mach3 USB Motion Card BSMCEO4U V2.8

Example Mach3 settings for Input on Hand-Wheel pins:

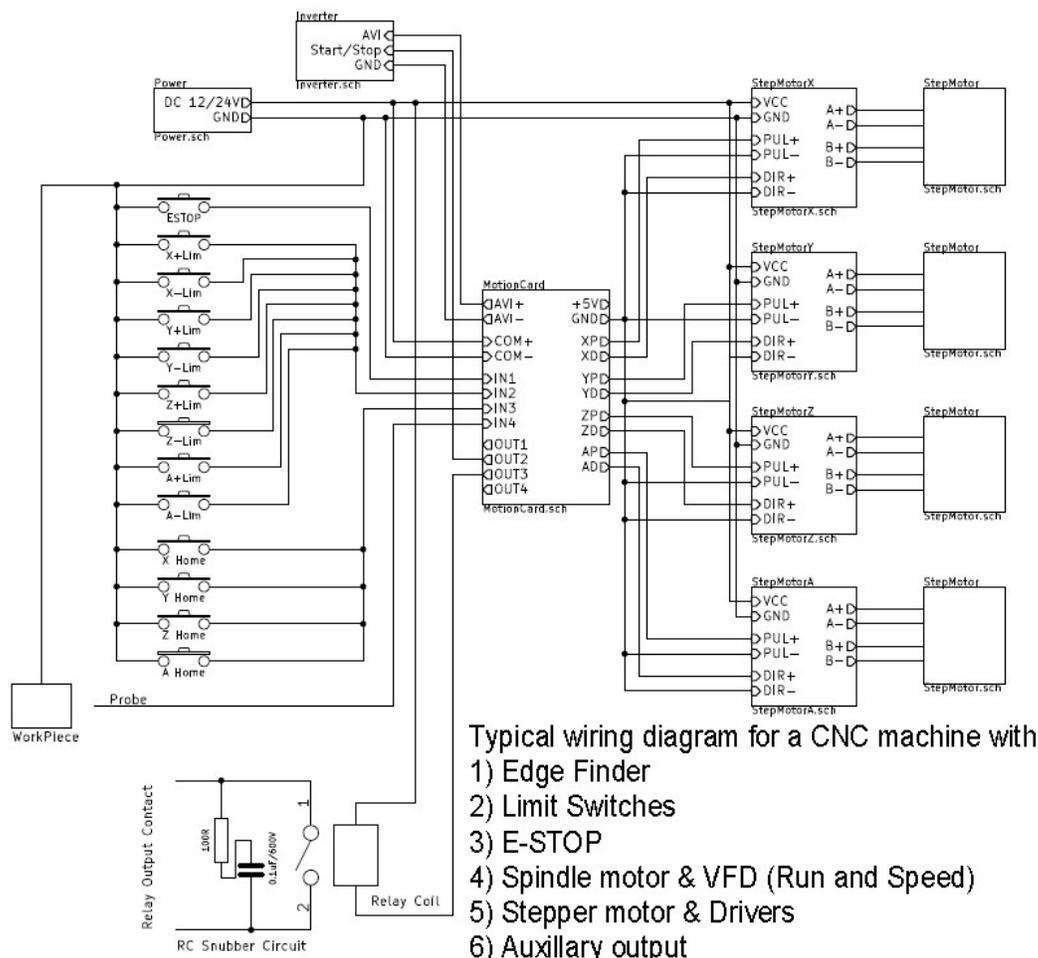
Handwheel X select input is on Port3 pin 5 and in the example, and is associated to input #1.



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



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 Step 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 (four) Axis X, Y, Z, & A	
USB driver	RnRMotion.dll	RnRMotionControllerECO-V2.0