



Mach3 USB/Ethernet Motion Board (EDG381) Installation Manual

MODEL: LF77-EDG381-USBETH3

Doc Ver: 1.0.8



Features:

- ✧ Ethernet (using TCP/IP) or USB Full-speed connection.
- ✧ 100M Ethernet interface, built-in network transformer isolation, support long-distance wired connection. With the wireless router, the wireless connection between the PC (laptop) and the motion control board can be realized.
- ✧ Up to 6 axes, 500kHz pulsing engine, which is suitable for the servo or stepping motor.
- ✧ 2 real-time Manual Pulse Generation (MPG) input ports for 2 MPG at the same time. When the MACH3 MPG is set in the multi-step mode, it has the same real-time performance as the CNC machining center, smoothly. The control board has no delay and the mechanical system performance is fully utilized.
- ✧ 18 general-purpose input, with particular indicators, the input signal states can clearly shows.
- ✧ 8 general-purpose output, It can be configured as: spindle clockwise / CCW / Mist / Flood / VB script programming control.
- ✧ PWM signal spindle control or Step/Dir signal spindle control.
- ✧ 2 analog input ports for adjusting the machining speed / jog speed / spindle speed.
- ✧ Status indicator LED can be useful to show the USB/Ethernet connection, and working status by flashing.
- ✧ 6 high-speed optocouplers (Dual Channel) with 10MHz, 28 general



optocouplers for isolating all of the input/output signals, this high-cost design can be provided high performance and stable system.

- ✧ Fully supporting all Mach3 versions, including the Mach3 R3.043.066 version. Supporting Windows series, including Windows XP-Windows10(32bit/64bit).
- ✧ No need to install any USB drivers, it can be used after plugging in the computer.
- ✧ Easy firmware update.



Contents

[Revisions List](#)

[Basic connection diagram \(Overview\)](#)

[Mechanical dimensions diagram](#)

1 [Prepare](#)

1.1 [Mach3 download and install](#)

1.2 [Download and install the Mach3 plugin](#)

1.3 [Status indicator \(LED\) of motion control board, External power supply, Grounding](#)

2 [Motion control board and PC connection](#)

2.1 [USB](#)

2.2 [Ethernet](#)

2.2.1 [Ethernet cable directly connected](#)

2.2.2 [Router](#)

2.2.3 [WLAN](#)

3 [Firmware upgrade, Restore factory firmware, Restore factory settings](#)

4 [Electrical characteristics and wiring table](#)

5 [Wiring and configuration with stepper \(or servo\) drives](#)

5.1 [6-axis outputs interface schematic](#)

5.2 [Stepper/Servo Driver Wiring Diagram](#)

5.3 [Motor parameter configuration](#)

5.4 [Pulse Spindle Configuration](#)



6 [Digital input](#)

6.1 [NPN input interface characteristics, wiring and configuration](#)

6.2 [PNP input interface characteristics, wiring and configuration](#)

6.3 [NPN MPG \(Manual Pulse Generation\) wiring](#)

6.4 [PNP MPG \(Manual Pulse Generation\) wiring](#)

6.5 [Wiring of MPG switch](#)

6.6 [Configuration of the MPG](#)

6.7 [Probe \(Auto Tool Zero\) wiring and configuration](#)

6.8 [Wiring and configuration of spindle speed measurement signal input](#)

7 [Digital output](#)

7.1 [Interface characteristics of general digital output](#)

7.2 [Wiring diagram](#)

7.3 [Configuration](#)

8 [Spindle speed control analog output](#)

8.1 [Interface Characteristics of PWM Output](#)

8.2 [Spindle Inverter Wiring](#)

8.3 [Configuration](#)

9 [External Adjustment Knob](#)

9.1 [Interface characteristics of analog input](#)

9.2 [Wiring diagram](#)

9.3 [Configuration](#)

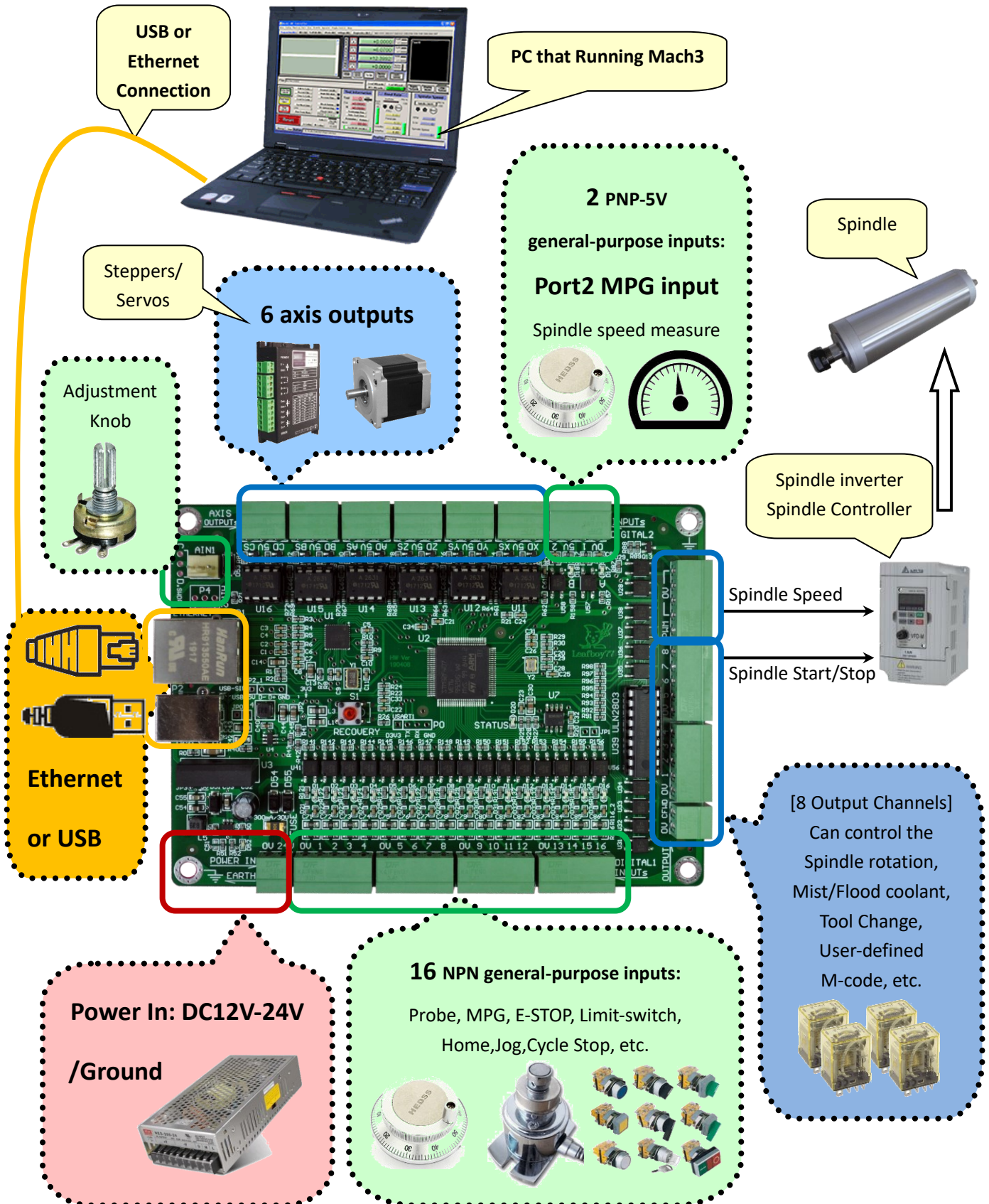


Revisions List

Date/Version	Info
2019-6-25 Ver1.0	Init
2019-7-12 Ver1.0.1	Add Basic connection diagram (an Overview), Adjustment Knob connection diagram Correct the trigger current of digital input port 2 to 2mA
2019-8-8 Ver1.02	Publish the English version of the document
2019-9-7 Ver1.03	Amendment to page 41/42: "6.6 Configuration of the MPG"
2019-9-26 Ver1.0.4	Add: Mach3 configuration spindle speed measurement
2019-9-29 Ver1.0.5	Add: Product Model
2019-10-12 Ver1.0.6	Added warning description: "CFWD" terminal cannot be used when the output controls both inductive loads (such as relays, solenoid valves) and other devices (such as inverter control).
2019-10-21 Ver1.0.7	Power Input: DC12V-24V
2021-4-27 Ver1.0.8	Added: MPG Enable Button wiring and description

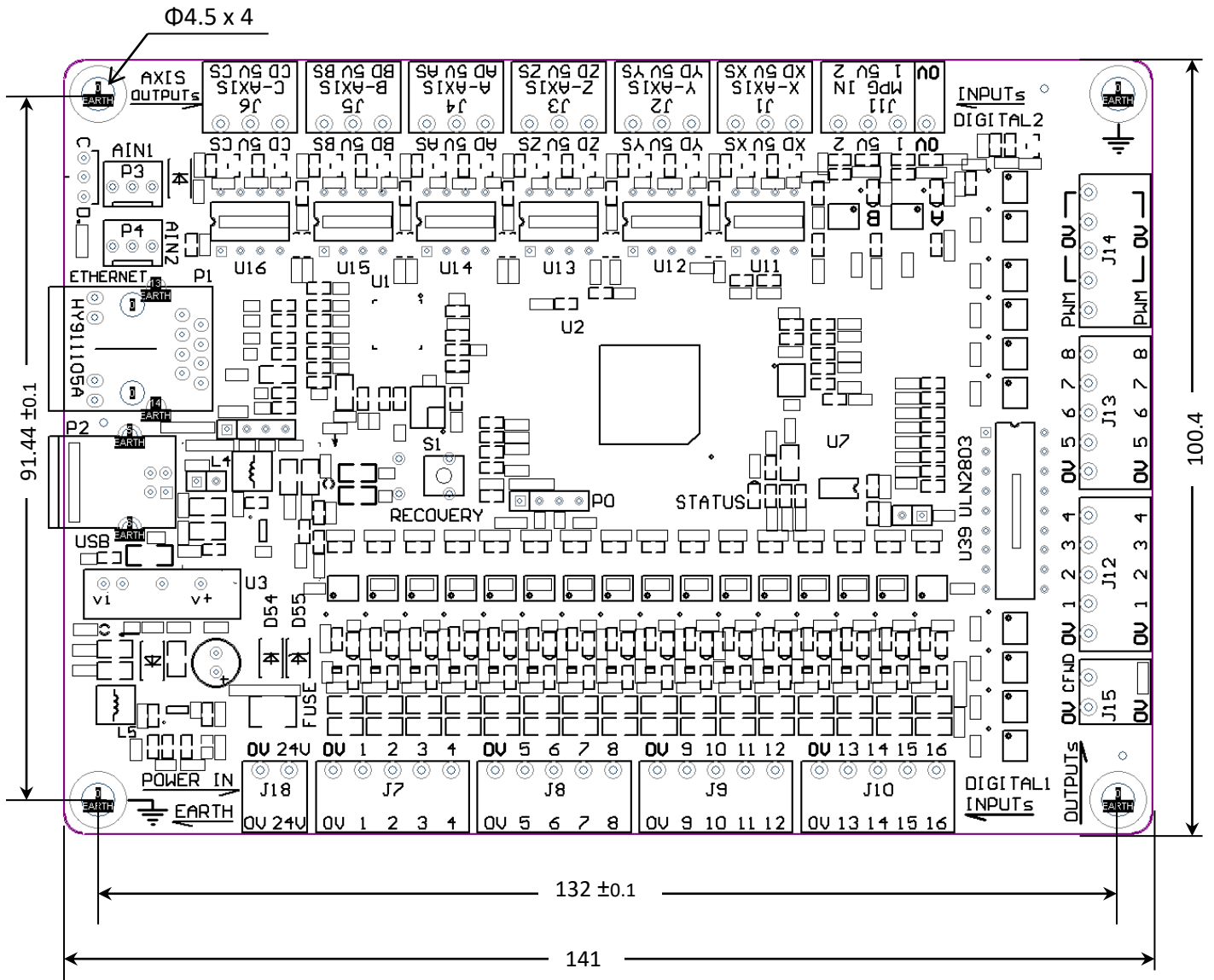


Basic connection diagram (Overview)





Mechanical dimensions diagram





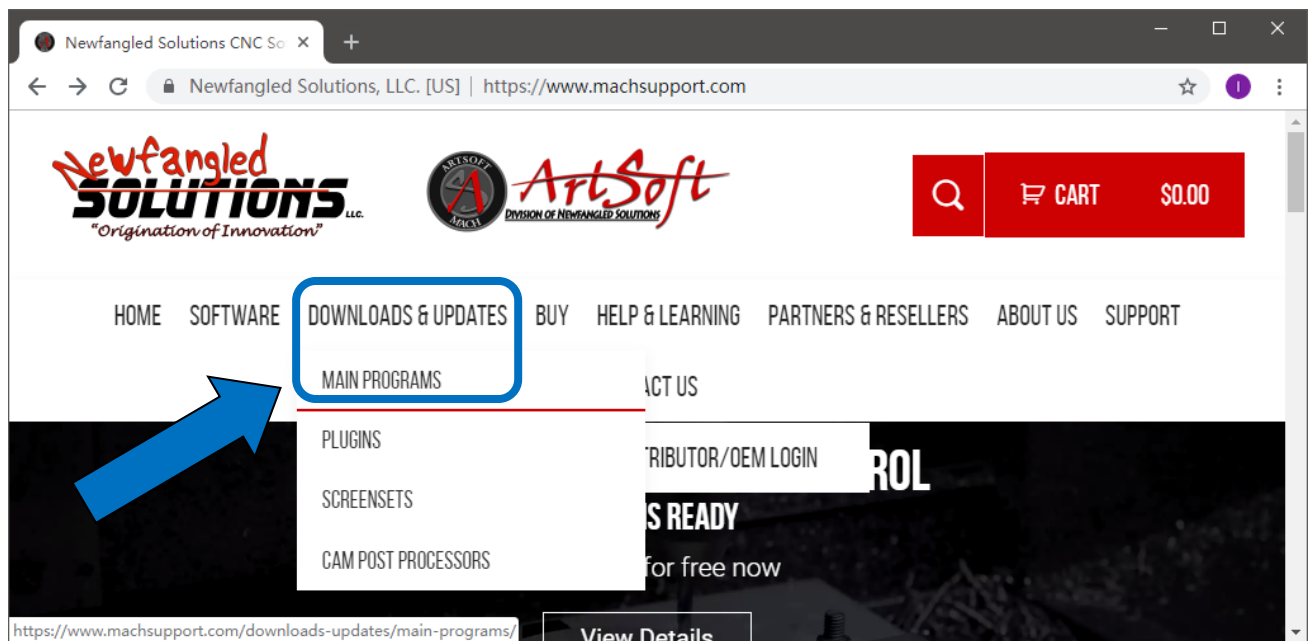
1. Prepare

1.1 Mach3 download and install

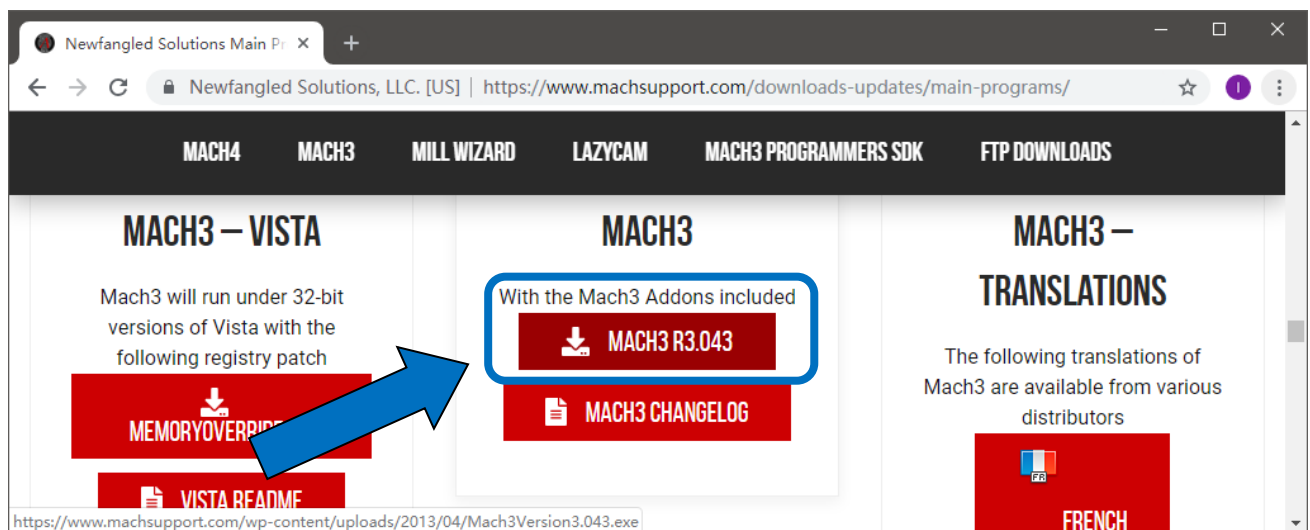


The latest version of Mach3 official website download URL: <https://www.machsupport.com/>

After entering the official website, click DOWNLOADS & UPDATES => MAIN PROGRAMS as shown in the blue circle below



After entering the download page, find MACH3 and download it, as shown in the blue circle below.





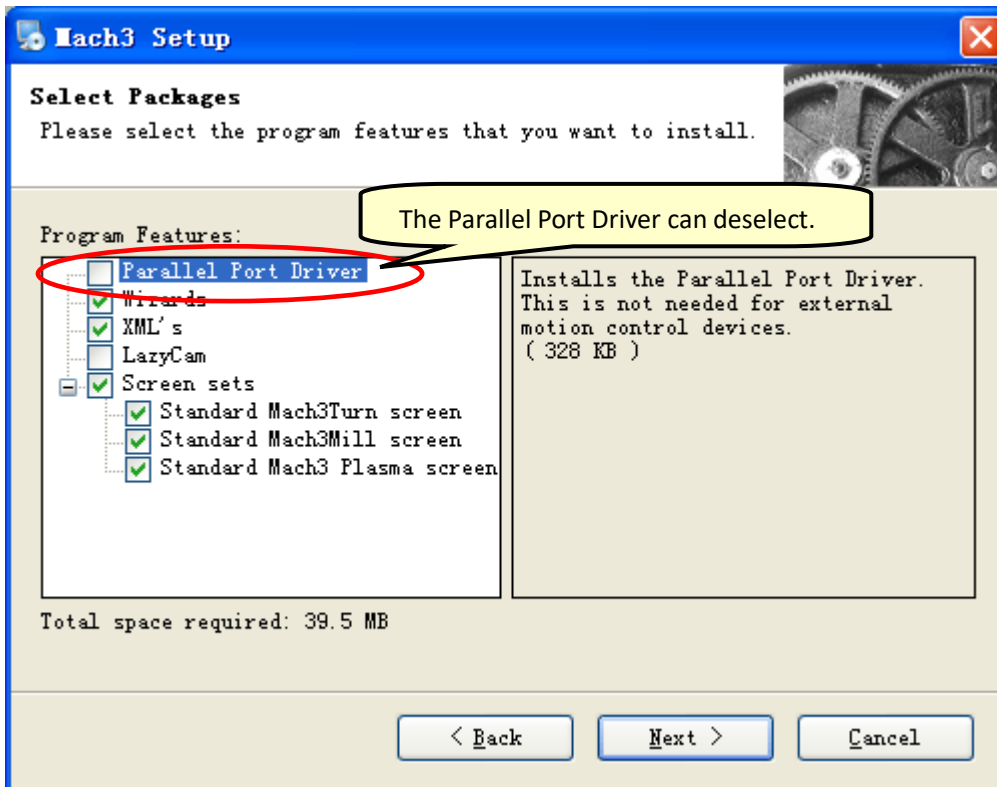
Mach3Version
n3.043.exe

After the download is complete, install Mach3



Note:

The Parallel Port Driver does not require.





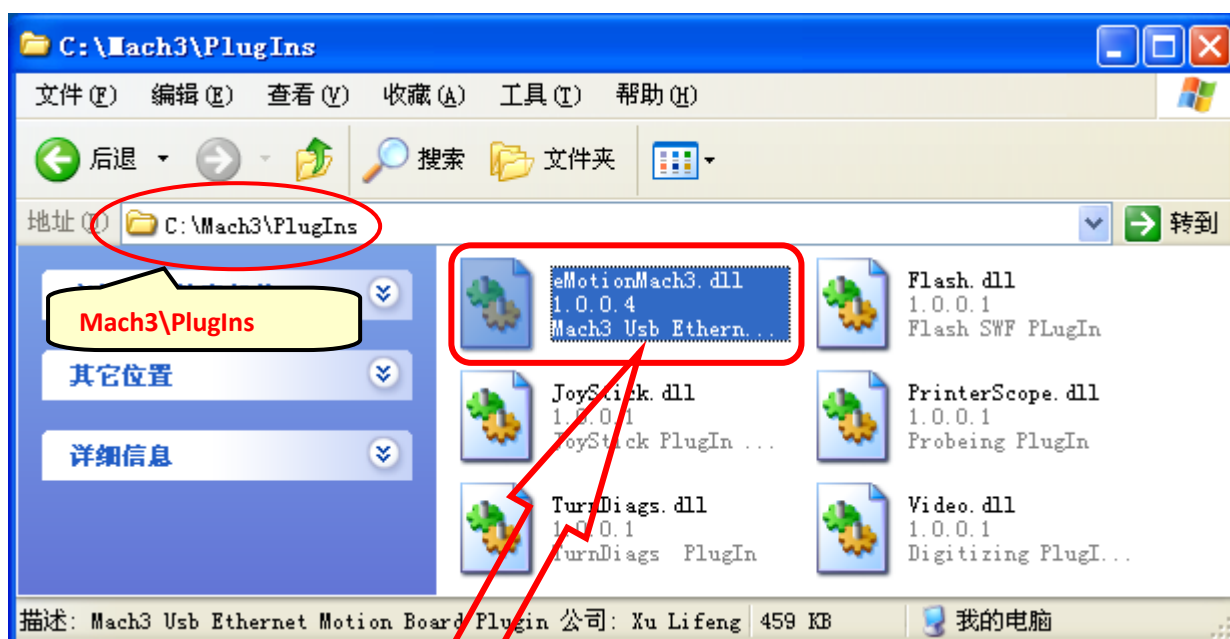
1.2 Download and install the Mach3 plugin



In order to enable MACH3 to recognize and drive this motion control board, you need to install a mach3 plugin.

Copy or drag **eMotionMach3.dll** (Unzip the eMotionMach3.zip) into **Mach3\PlugIns** folder.

For example, if your Mach3 software is installed in C:\Mach3, place eMotionMach3.dll into **C:\Mach3\PlugIns**



Mach3 Plugin eMotionMach3.zip

Please go to the following URL to download the latest version.

<http://leafboy77.com/>

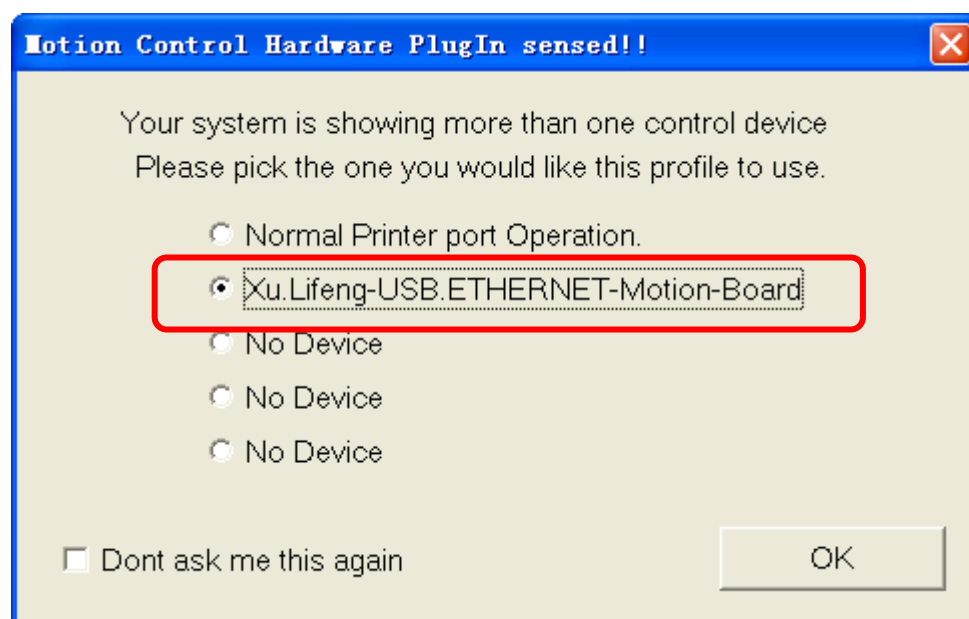


Mach3Mill After completing the Mach3 plugin installation, start the Mach3 software.

A dialogue of "Motion Control Hardware PlugIn sensed!!" is shown.

Please choose the option "USB.Ethernet-Motion-board".

You can also check "Don't ask me this again".

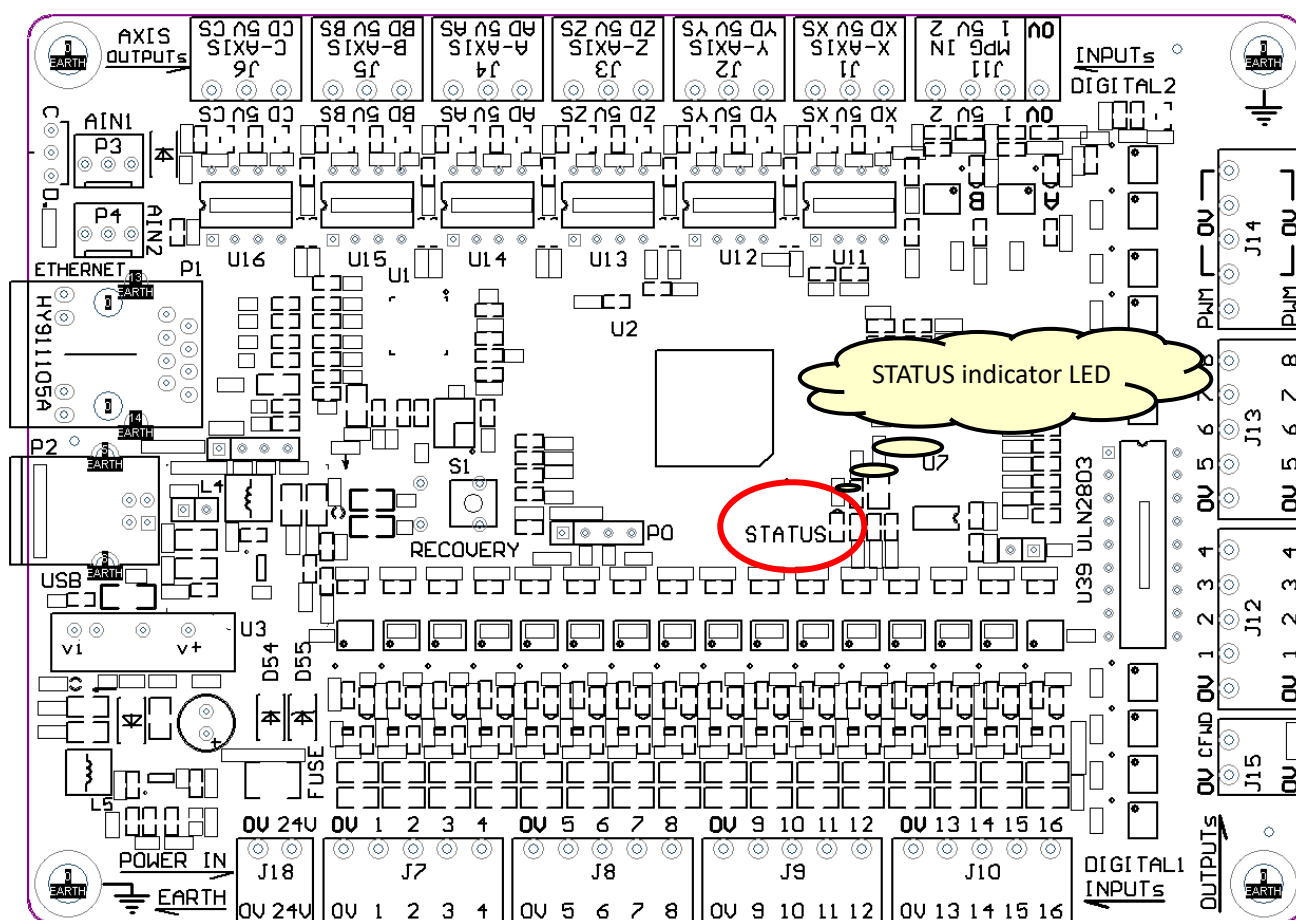




1.3 Status indicator(LED) of motion control board, External power supply, Grounding

1.3.1 The motion board has a status indicator LED that indicates the current status by different blinking modes.

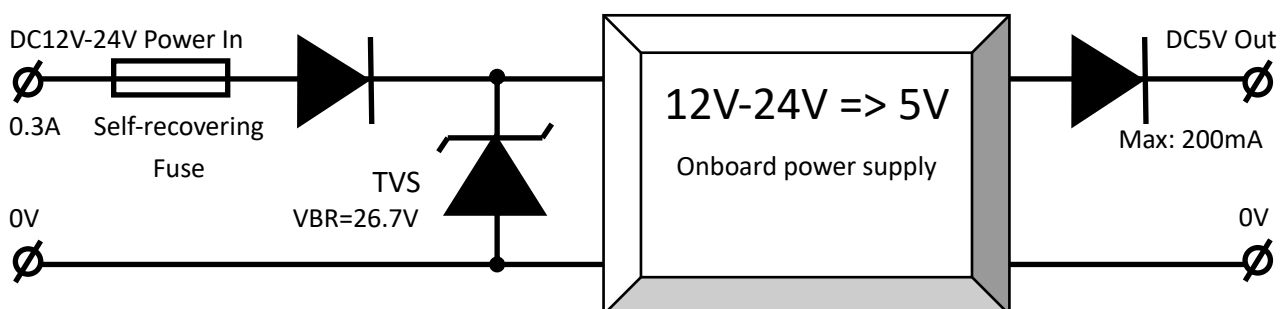
LED flashing mode	Status
Always bright	Standby(POWER ON)
Slow flashing	Connection (has already established a connection with MACH3 via USB or Ethernet)
Fast flashing	6-axis operation (eg running G code, jog, but not pulse spindle)
Slow flashing, gradually flashing quickly, turn off after 5 seconds	After pressing the RECOVERY button for 5 seconds, the IP parameters are restored to the factory settings.



1.3.2 External power supply, ground



1.3.2.1 Schematic





1.3.2.2 Wiring

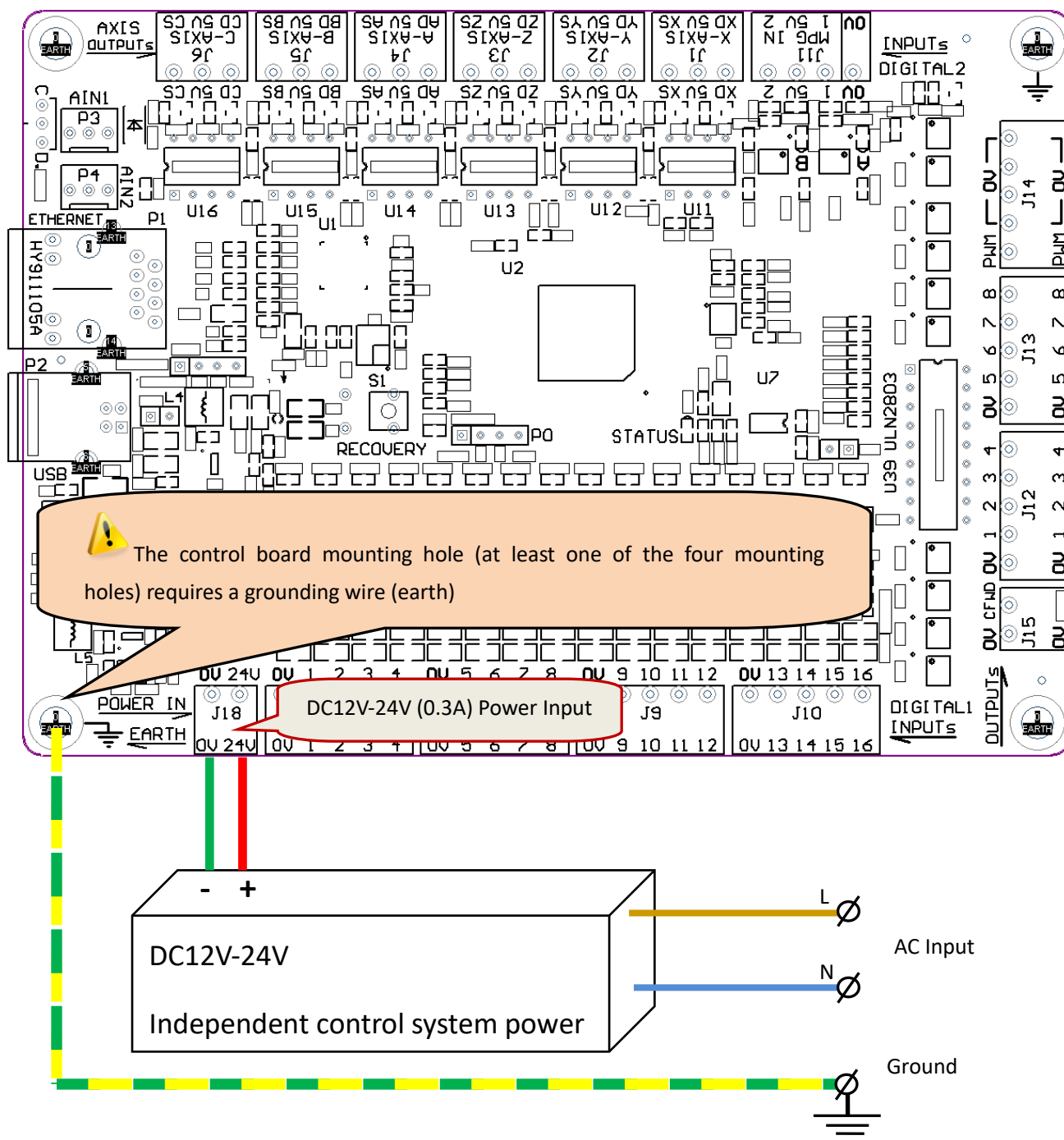
Motion control board, requiring DC12V-24V (0.3A) power supply



Warning: The control panel input voltage (peak) cannot exceed 26V.

The board requires an **independent power supply** (control system power supply) that can be shared with sensors, handwheels, and the like.

Because the motor has a back EMF, the control board **cannot share a power supply with the motor** to ensure safety and reliability.





2. Motion control board and PC connection



Note:

First: complete the [Mach3 plugin installation](#), start Mach3 and [select the external motion control board](#)



2.1 USB

Magnet ring installed in the USB cable at both ends

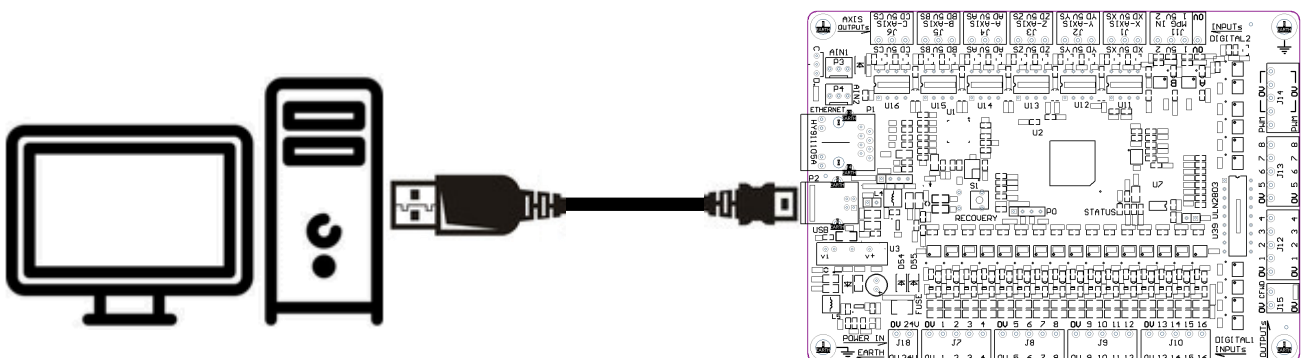


Attention:

Please use the USB cable supplied with this product.

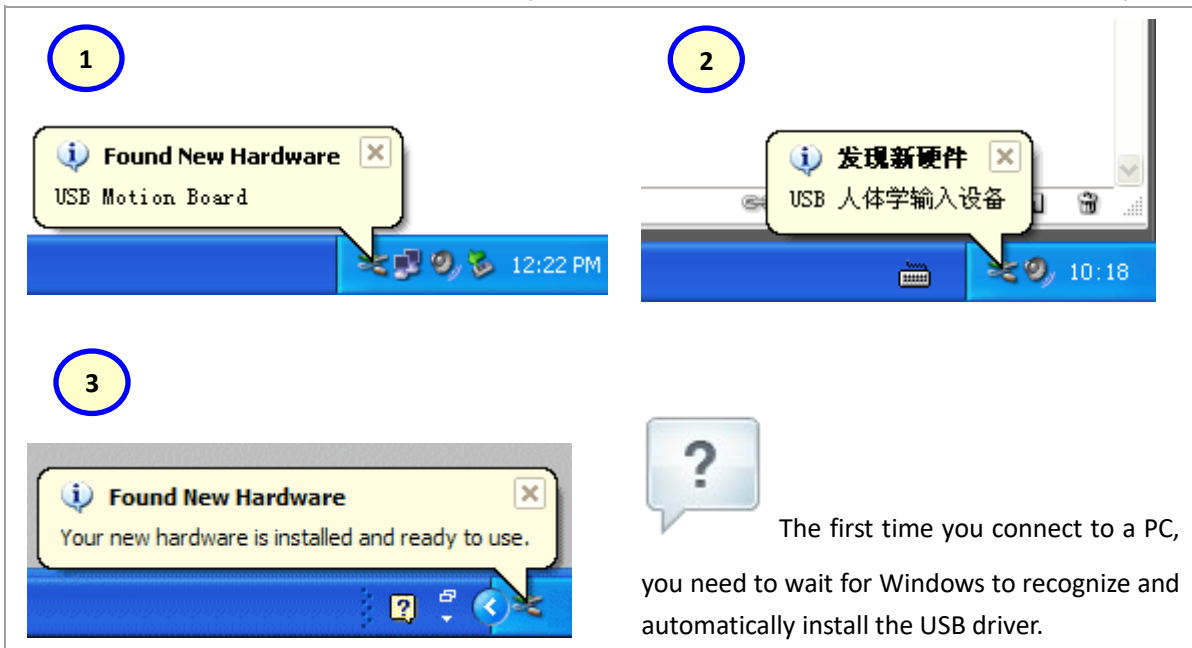
If you choose the USB cable yourself, please make sure to use a quality cable.

The motion control board is connected to the PC using a USB cable and is [powered on \(DC12V-24V\)](#)



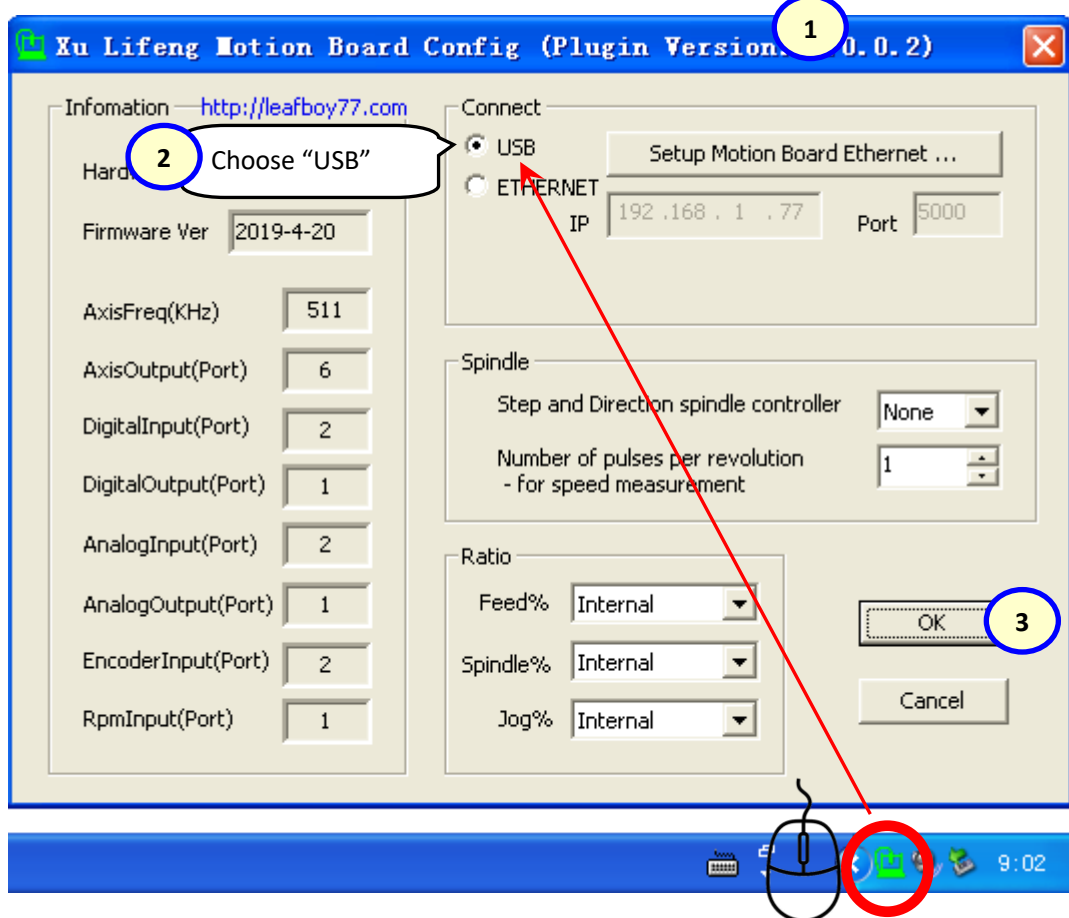


This motion board does not need install any USB driver, Windows XP - Windows 10 can directly identify



Start Mach3 and [select external motion control board](#).

Right click on the CNC icon, pop up the settings dialog, select "USB" and press OK to save the settings.



When the Mach3 is successfully connected to the motion control board (USB or Ethernet), the STATUS-LED indicator flashes slowly.

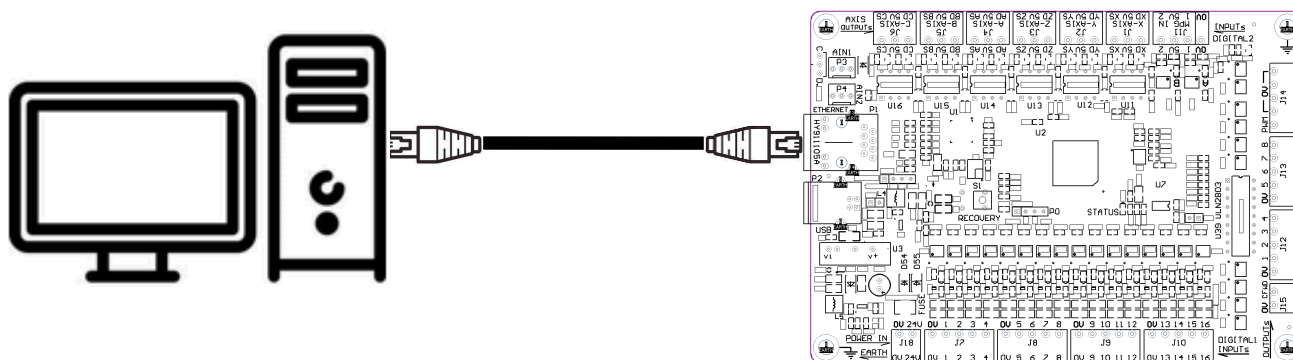


2.2 Ethernet

There are 3 connection methods between the motion control board and the PC through the Ethernet interface.



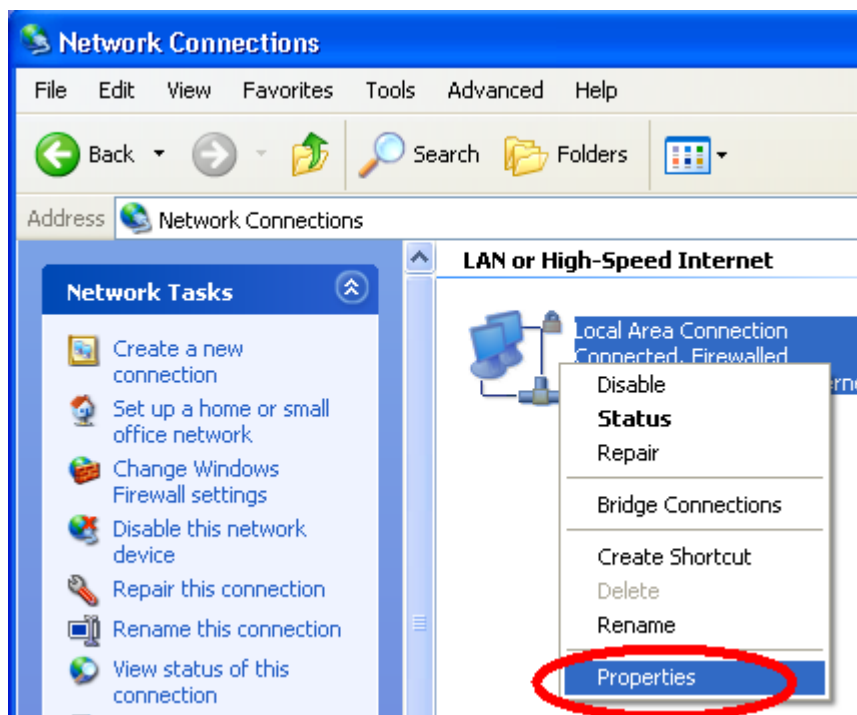
2.2.1 Ethernet cable directly connected



The PC does not have an IP address (because no router automatically assigns an IP address to the PC). You need to manually set the IP address parameter of the PC, which is on the same subnet as the IP address of the motion control board.

Step 1: Network parameter settings for the PC.

Since no router assigns an IP address to the PC (because it is a direct connection), it needs to be set manually.

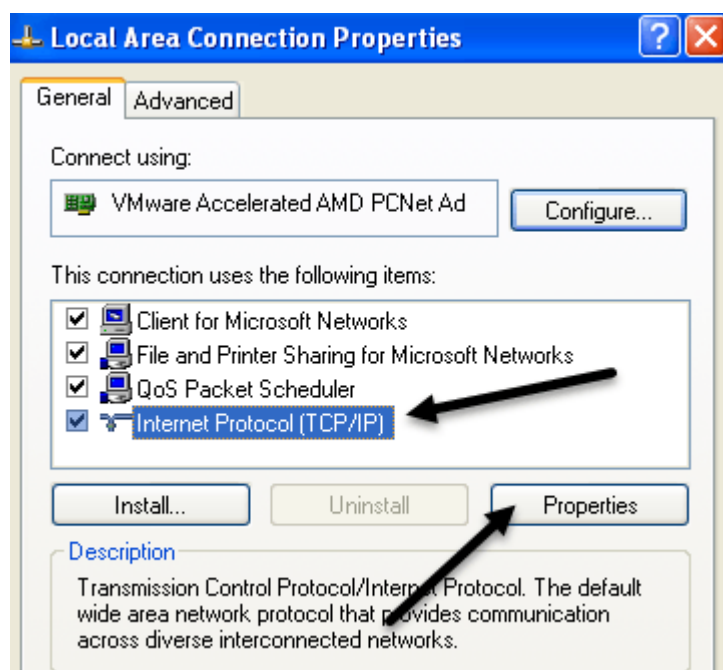


For example Windows XP:

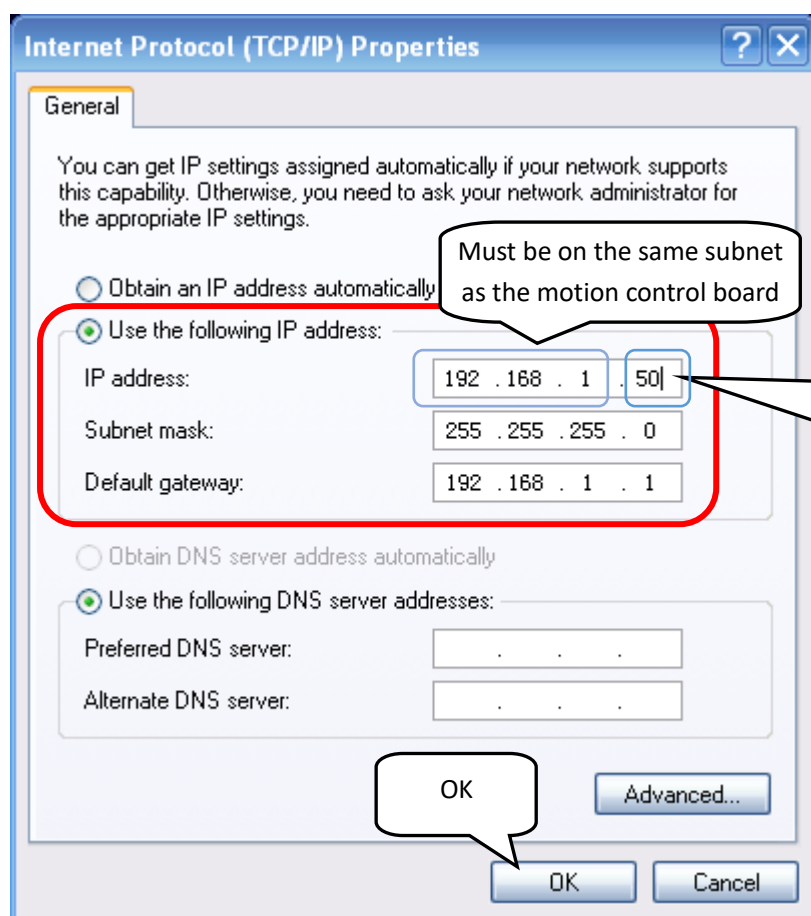
Control Panel =>

Network Connection =>

Local Area Connection (Right click)
=> Properties



Double click "Internet Protocol (TCP/IP)"



Choose "Use the following IP address:", then type the computer's IP address, subnet mask, and default gateway address. Press "OK"



Step 2: Motion Control Board [Restore factory settings](#) (power up => press the RECOVERY button for 5 seconds until the STATUS-LED goes out => lift button).

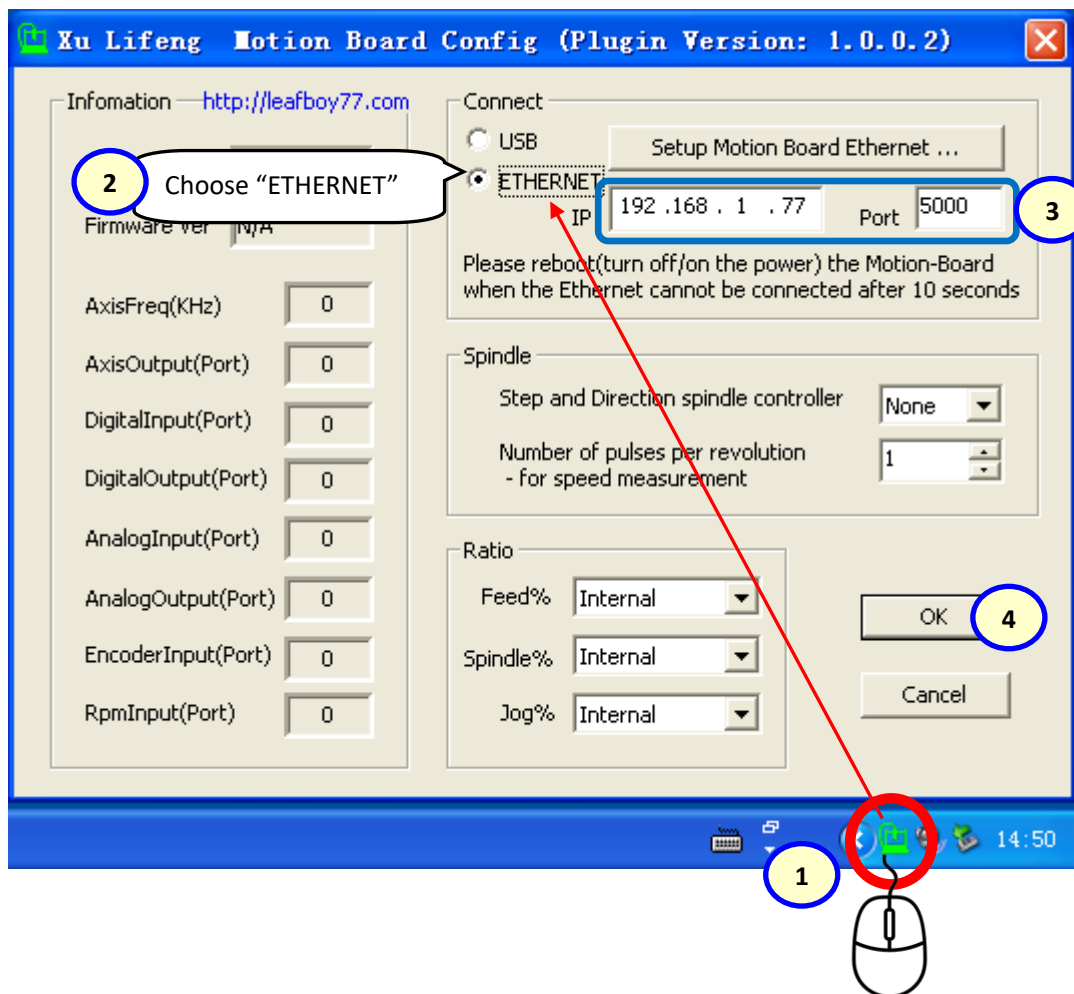


Note:

You can also configure the IP address parameters of the control board after [USB](#) connection.

Step 3: Start Mach3 and [select the external motion control board](#). Right click on the CNC machine icon and pop up the settings dialog box to confirm the selection of "ETHERNET".

Type the motion control board IP to be connected: 192.168.1.77, Port: 5000, press OK to save the settings.



When the Mach3 is successfully connected to the motion control board (USB or Ethernet),
The STATUS-LED flashes slowly.



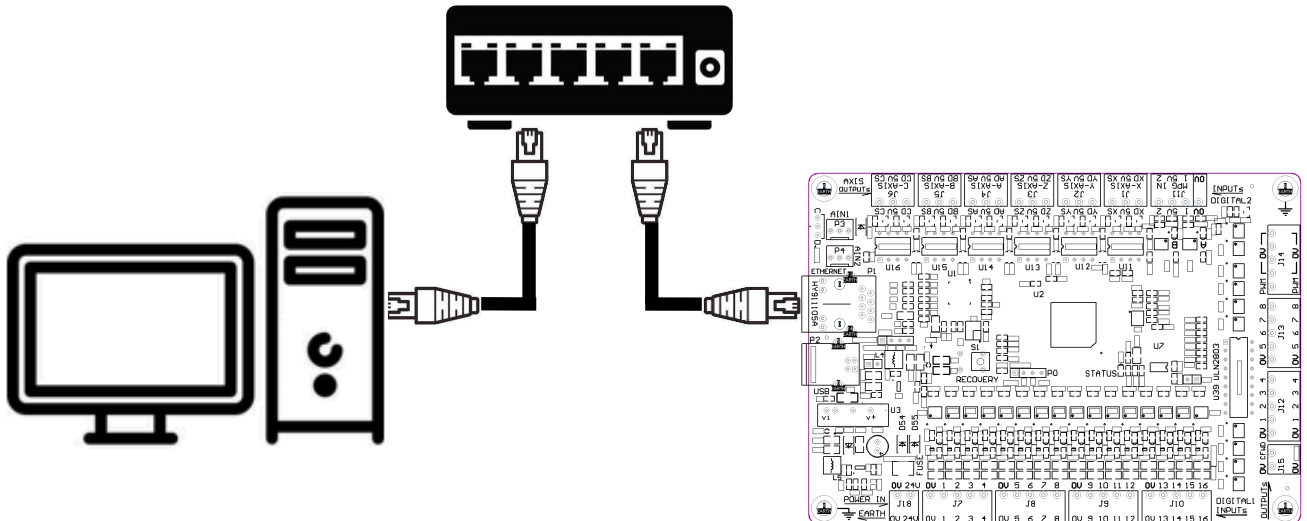
Connect the Ethernet cable before turning on the power to the motion control board.

If Ethernet cannot be connected for more than 10 seconds,

Please restart the control board (power off => re-open)

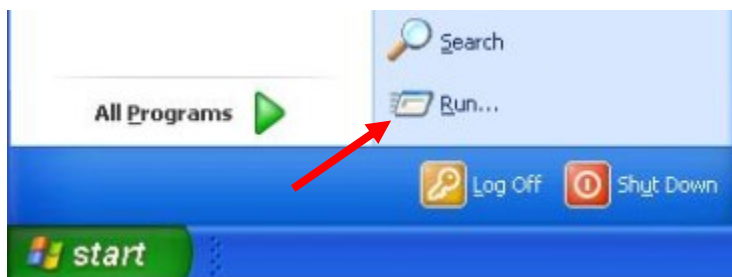


2.2.2 Router

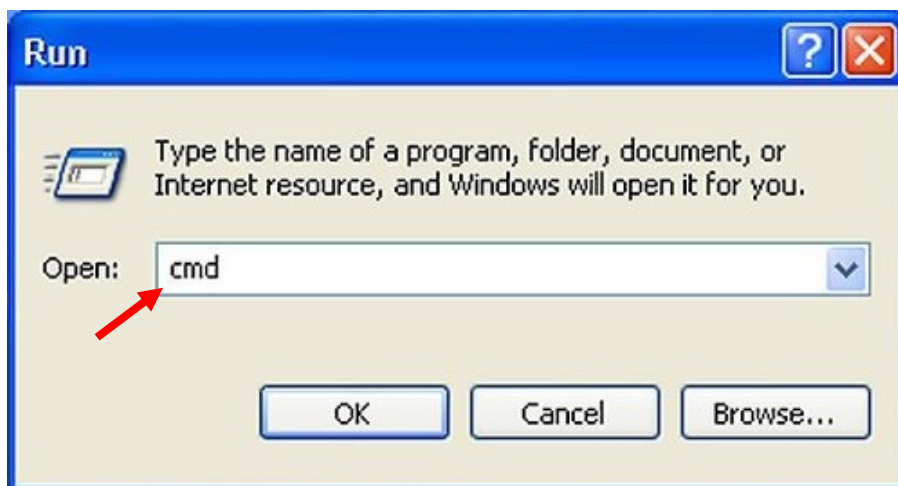


You need to set the IP address of the control board, which is on the same subnet as the IP address of the PC.

Step 1: View the IP address of the PC (automatically assigned by the router)



"Start" => "Run"



Type "cmd", Press "OK" button



Enter the command "ipconfig" to see the IP address of the computer.

```
C:\WINDOWS\system32\cmd.exe
Microsoft Windows XP [版本 5.1.2600]
(C) 版权所有 1985-2001 Microsoft Corp.

C:\Documents and Settings\leaf>ipconfig

Windows IP Configuration

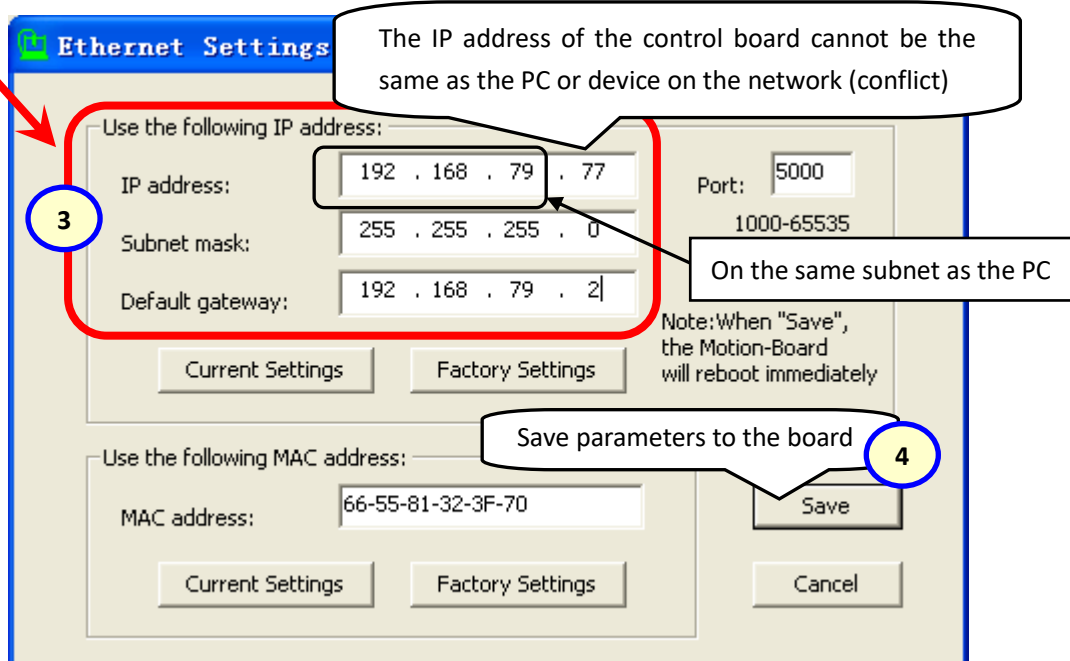
Ethernet adapter 本地连接:

    Connection-specific DNS Suffix  . : localdomain
    IP Address. . . . .               : 192.168.79.133
    Subnet Mask . . . . .             : 255.255.255.0
    Default Gateway . . . . .         : 192.168.79.2

C:\Documents and Settings\leaf>
```

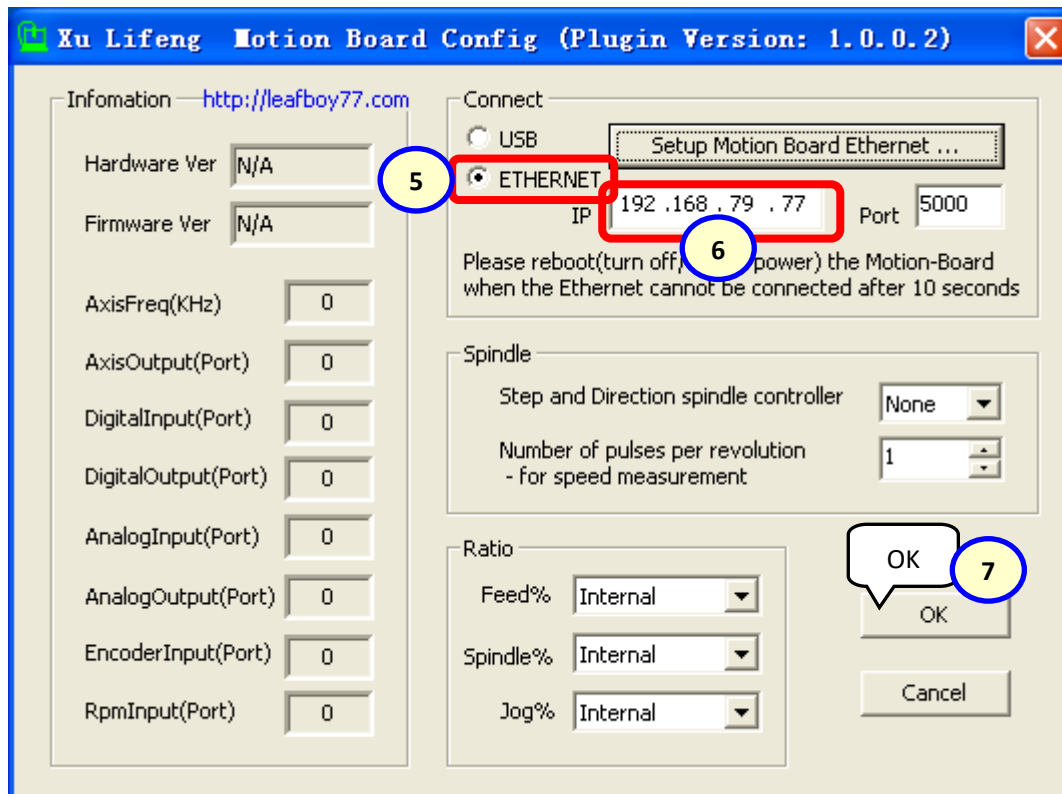
Step 2: Configure the IP address parameters of the motion control board.

After the PC needs to be connected to the board, the IP address parameters of the motion control board can be modified. You must use [USB](#) (recommended, easy to operate) connection, IP parameters can also be configured after the [Ethernet cable is directly connected](#). After the connection is successful (the STATUS-LED indicator flashes slowly), then modify the IP address of the motion control board, on the same subnet as the router.





Next select the "ETHERNET" connection option and type the Motion Board IP address.

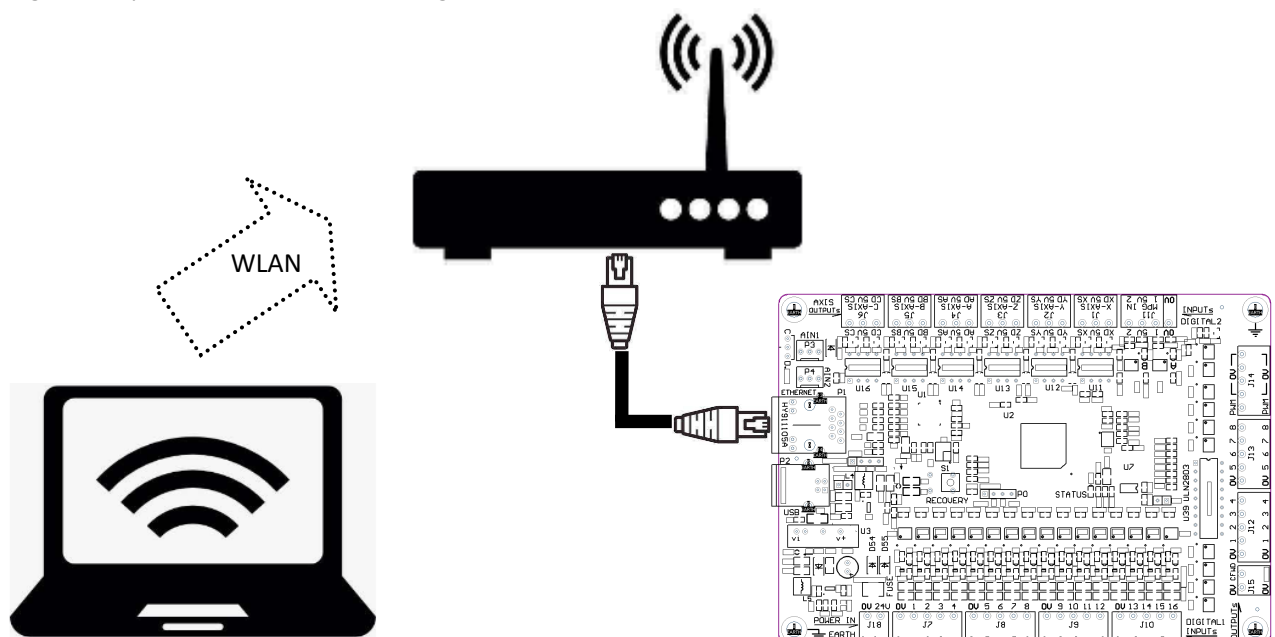


When the Mach3 is successfully connected to the motion control board (USB or Ethernet), the STATUS-LED indicator flashes slowly.



2.2.3 WLAN

Use a wireless router to connect wirelessly to a PC (such as a laptop) via WLAN. The motion control board IP configuration process is the same as using a wired [router](#).

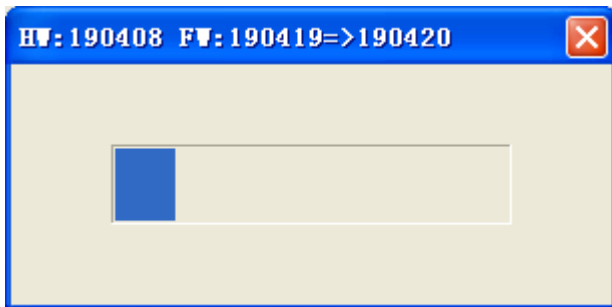




3. Firmware upgrade, Restore factory firmware, Restore factory settings



The chip firmware of this motion control board supports upgrades, and users can continuously get the latest feature support. The firmware is stored in the Mach3 plugin (the latest version of the Mach3 plugin, please download it from <http://leafboy77.com/>). When Mach3 is launched and connected to the motion control board, the firmware version is checked and automatically upgraded.



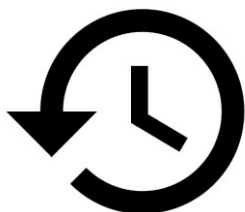
Normally, the upgrade can be completed successfully. If the upgrade fails in a special situation and the board fails to start, the motion board provides the function of **restoring the factory firmware**. The steps are as follows:

- Confirm that the control board is powered off (turn off 12V or 24V power)
- Press and hold the RECOVERY button
- Motion control board is powered on (12V or 24V power is turned on)
- Release the RECOVERY button
- The STATUS LED is always on (standby status), indicating that the recovery operation is complete (It takes about a few seconds)



Note:

Restore the factory firmware operation, and the Ethernet parameters will be restored to the factory settings.



If only Ethernet parameters need to be **restored to factory settings**, the steps are as follows:

- The control board is powered and the STATUS-LED is on.
- Press and hold the RECOVERY button for more than 5 seconds, STATUS-LED flashes slowly => fast flashing => off
- Release the RECOVERY button, the STATUS-LED is always on (standby), and the IP parameters are restored to factory settings.



Ethernet parameters (factory settings):

IP address: **192.168.1.77**

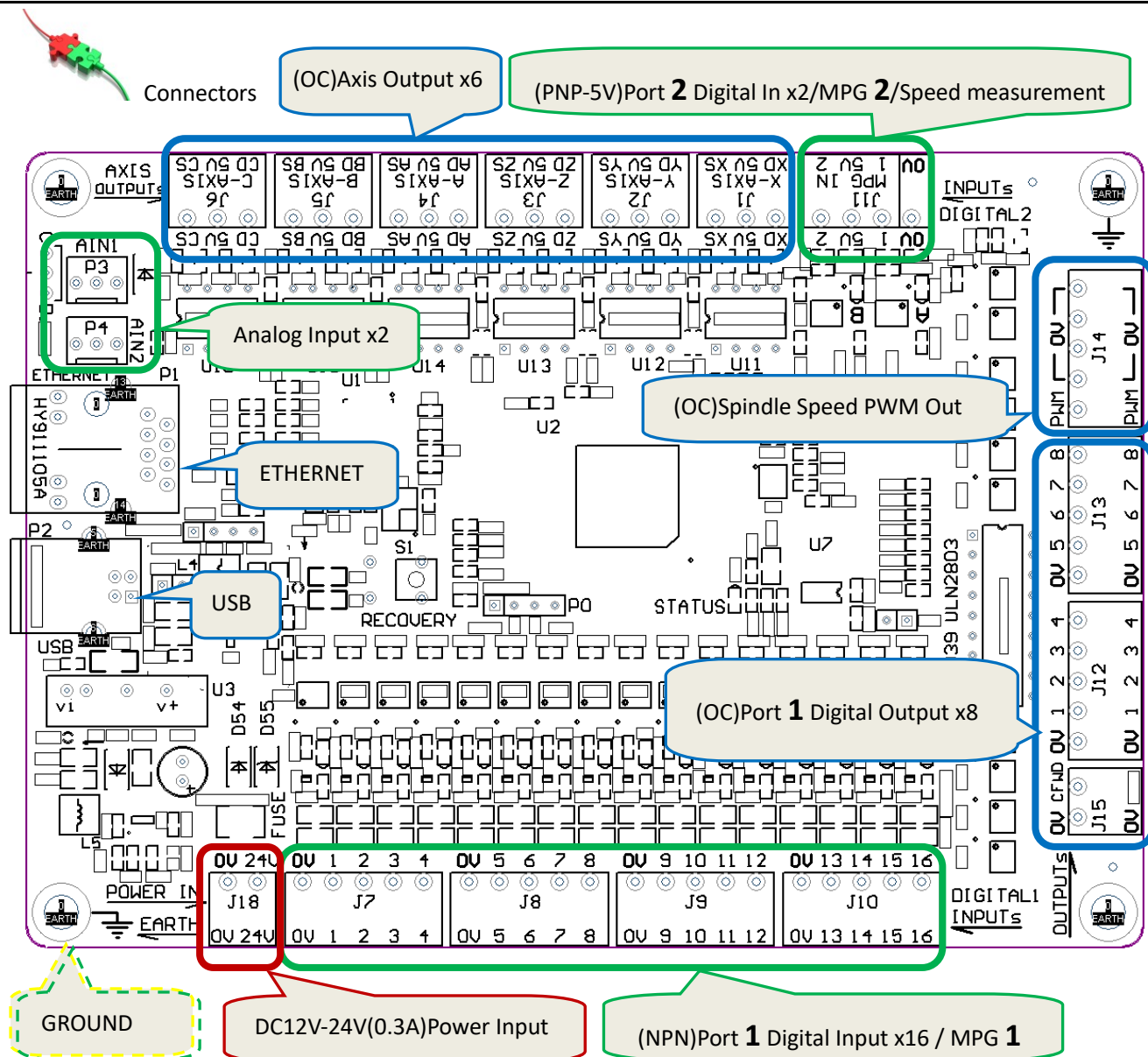
Subnet mask: **255.255.255.0**

Default gateway: **192.168.1.1**

Port: **5000**



4. Electrical characteristics and wiring table



4.1 Power Input

Connector	FUNCTIONS	ELECTRICAL	Description
0V	power input negative	0V	Common ground: (axis/digital input/digital output/PWM)
24V	power input positive	DC12V-24V / 0.3A	Independent power supply required, separate from motor

4.2 Power Output

The Motion board has a 5V output power supply for the interface of the 6 stepper drives and the PNP-5V MPG 2.

Connector	FUNCTIONS	ELECTRICAL	Description
5V	power output positive	DC5V / 200mA	All 5V Connectors, a total output of 200mA



4.3 (NPN) Port 1 Digital Input x16 / MPG 1

Connector	FUNCTIONS	ELECTRICAL	Description
1	Digital Input Pin 1	NPN Optocoupler isolation x16 Interface voltage = power input (12V-24V) Min trigger current: 3mA Max operating current (12V): 5mA Max operating current (24V): 9mA	Port 1 Digital Input MPG 1 Input
2	Digital Input Pin 2		
3	Digital Input Pin 3		
4	Digital Input Pin 4		
5	Digital Input Pin 5		
6	Digital Input Pin 6		
7	Digital Input Pin 7		
8	Digital Input Pin 8		
9	Digital Input Pin 9		
10	Digital Input Pin 10		
11	Digital Input Pin 11		
12	Digital Input Pin 12		
13	Digital Input Pin 13		
14	Digital Input Pin 14		
15	Digital Input Pin 15 MPG 1 Input A		
16	Digital Input Pin 16 MPG 1 Input B		

4.4 (PNP-5V) Port 2 Digital Input x2 / MPG 2 / Speed measurement

Connector	FUNCTIONS	ELECTRICAL	Description
1	Digital Input Pin 1 MPG 2 Input A Speed measurement	PNP Optocoupler isolation x2 Interface voltage: 5V Min trigger current: 2mA Max operating current: 7mA	Port 2 Digital Input MPG 2 Input
2	Digital Input Pin 2 MPG 2 Input B		

4.5 Analog Input x2

Analog input for external potentiometer control speed, electrical characteristics are **non-isolated**

Connector	FUNCTIONS	ELECTRICAL	Description
AIN1	Analog Input Port 1	Non-isolated x2 Input voltage: 0V-3.3V Input current: <0.1mA	For external speed control: Spindle speed / jog speed / Feed
AIN2	Analog Input Port 2		



4.6 Axis Output x6

Connector	FUNCTIONS	ELECTRICAL	Description
XD (Xdir)	Xaxis Direction signal	High speed optocoupler isolation x12 Max: 24V / 13mA OC=Open collector output	Used to connect: Stepper drive server Driver
XS (Xstep)	Xaxis Step signal		
YD (Ydir)	Yaxis Direction signal		
YS (Ystep)	Yaxis Step signal		
ZD (Zdir)	Zaxis Direction signal		
ZS (Zstep)	Zaxis Step signal		
AD (Adir)	Aaxis Direction signal		
AS (Astep)	Aaxis Step signal		
BD (Bdir)	Baxis Direction signal		
BS (Bstep)	Baxis Step signal		
CD (Cdir)	Caxis Direction signal		
CS (Cstep)	Caxis Step signal		

4.7 (OC) Port 1 Digital Output x8

Connector	FUNCTIONS	ELECTRICAL	Description
1	Digital Output Pin 1	Optocoupler isolation x8 Max: 24V / 500mA OC=Open collector output	Digital output pin for driving inductive loads (eg relay / solenoid valve) In order to prevent the back EMF from breaking through the driver chip (ULN2803), the CFWD terminal must be connected to the (loaded) power supply positive terminal. Or need an external independent freewheeling diode
2	Digital Output Pin 2		
3	Digital Output Pin 3		
4	Digital Output Pin 4		
5	Digital Output Pin 5		
6	Digital Output Pin 6		
7	Digital Output Pin 7		
8	Digital Output Pin 8		
CFWD	Common freewheeling diode	Connected (loaded) power supply positive	The CFWD terminal must be connected when driving an inductive load (or need an external freewheeling diode)

4.8 (OC) Spindle Speed control signal (PWM) output

Connector	FUNCTIONS	ELECTRICAL	Description
PWM	Spindle Speed signal output (PWM = Pulse-Width Modulation)	Optocoupler isolation x1 Max: 24V / 50mA OC=Open collector output	Spindle pulse width speed regulation, can also be used for inverter 0-10V speed regulation

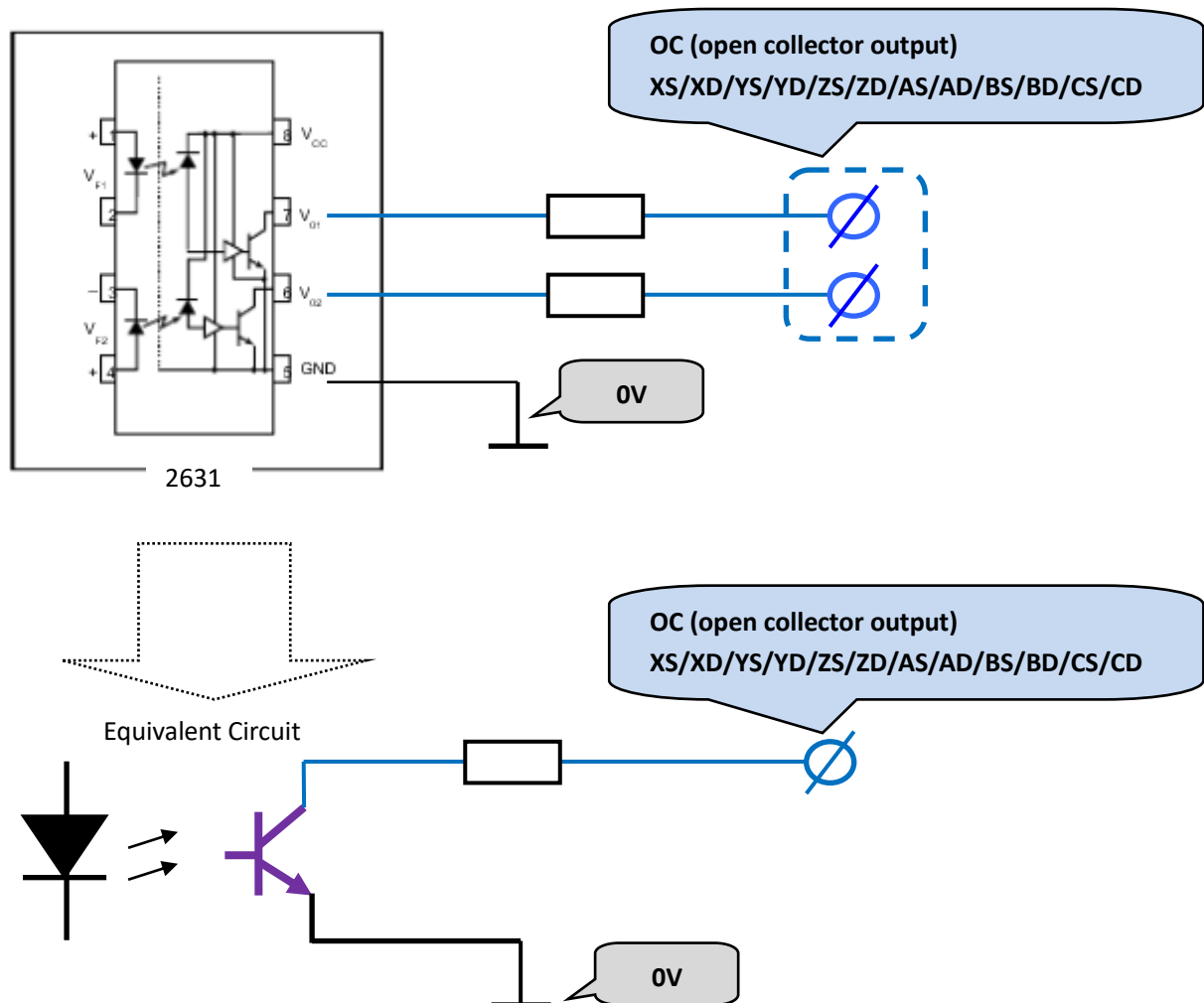


5. Wiring and configuration with stepper (or servo) drives



5.1 6-axis outputs interface schematic

6 axis output of the control board (12 channels): open collector output, high speed optocoupler isolation



5.2 Stepper/Servo Driver Wiring Diagram

The interface of the stepper/servo drive uses the following two power supply methods:

- Internal power supply 5V (suitable for stepper drive)
- External power supply 5V-24V (suitable for servo drive)

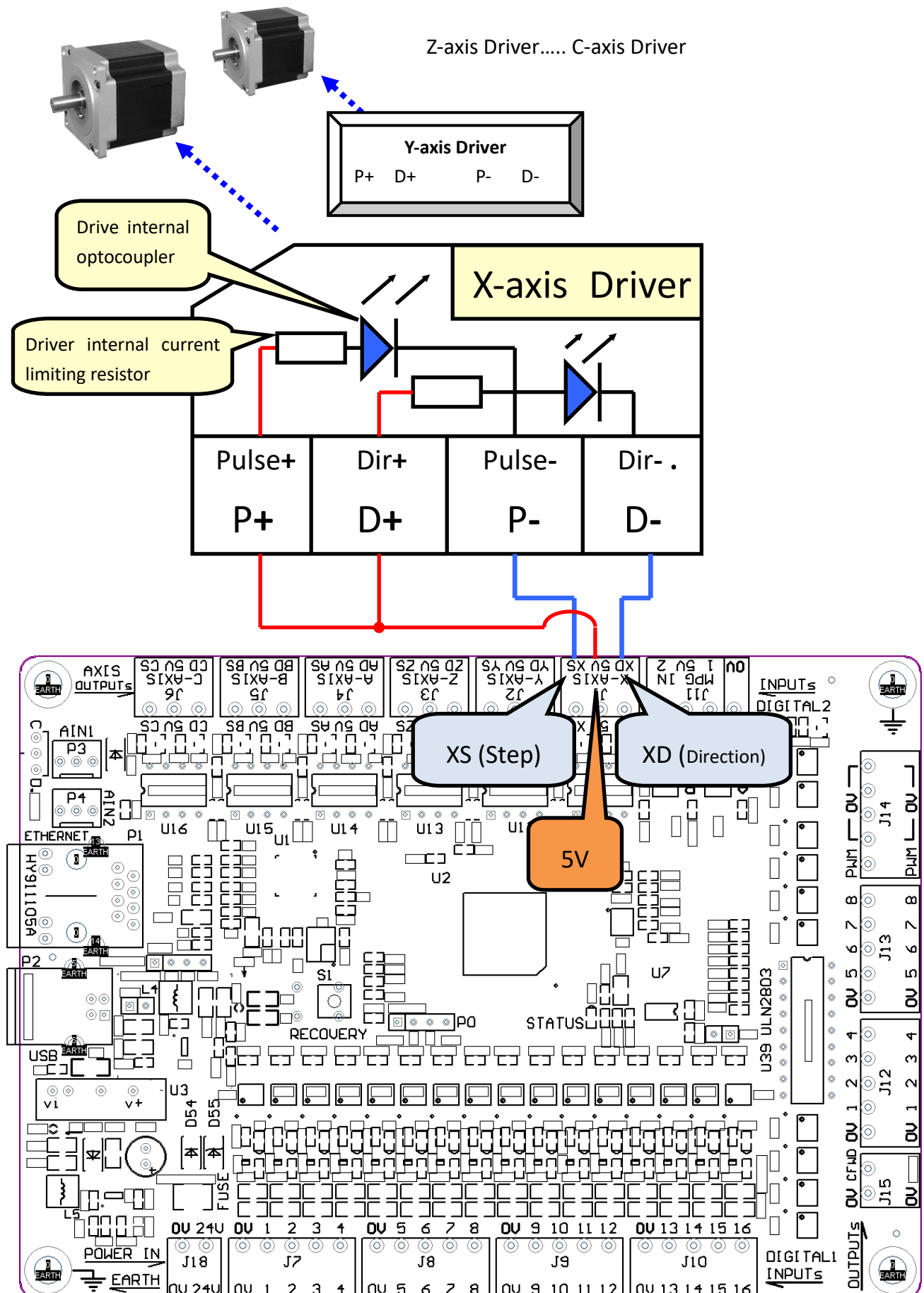


Note:

External power supply 12V-24V, this power supply can also supply power to the control board at the same time (share one control system power supply)

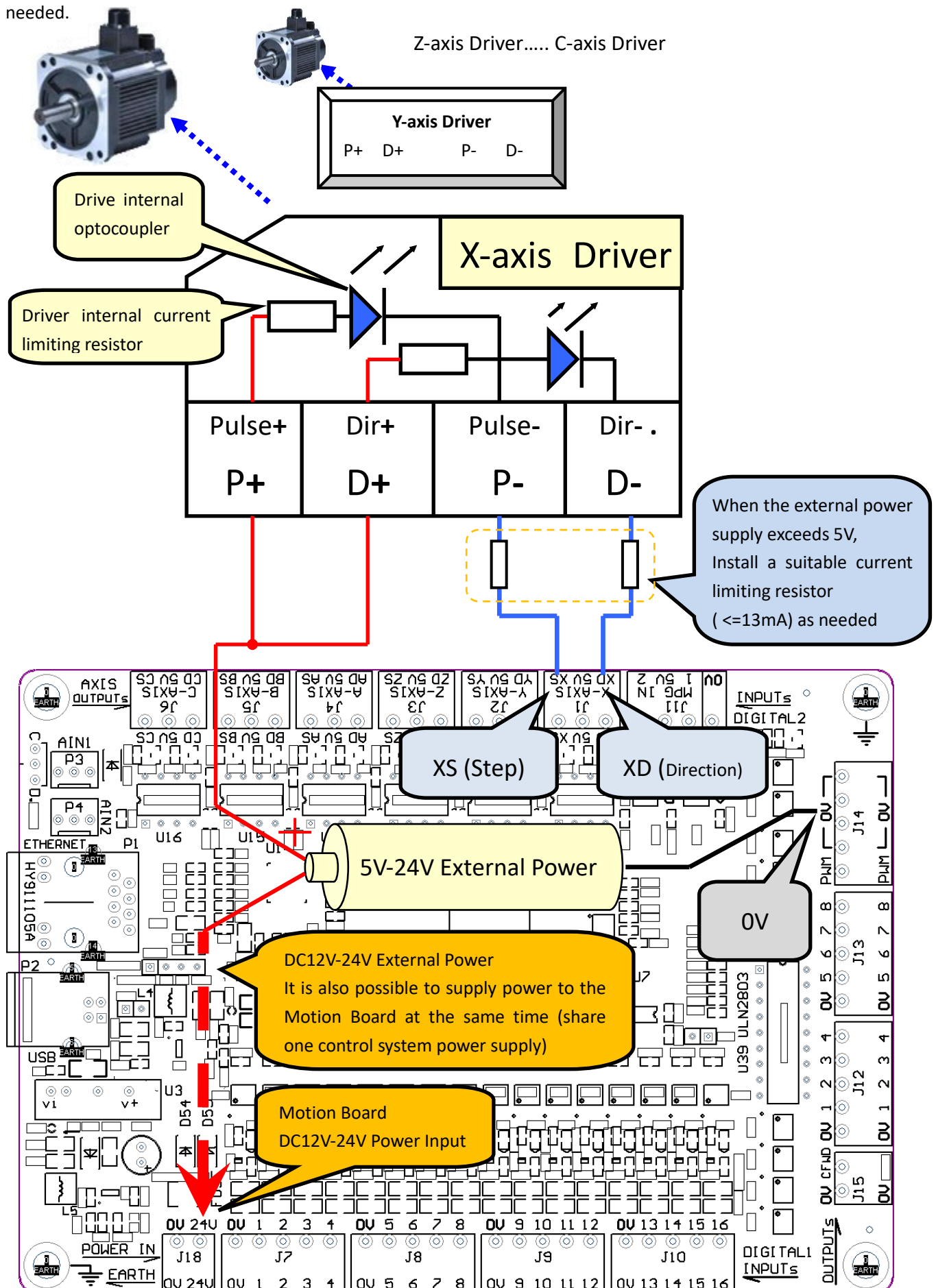


5.2.1 Use the 5V power supply inside the motion control board, suitable for stepper drivers, please install suitable current limiting resistors as needed.





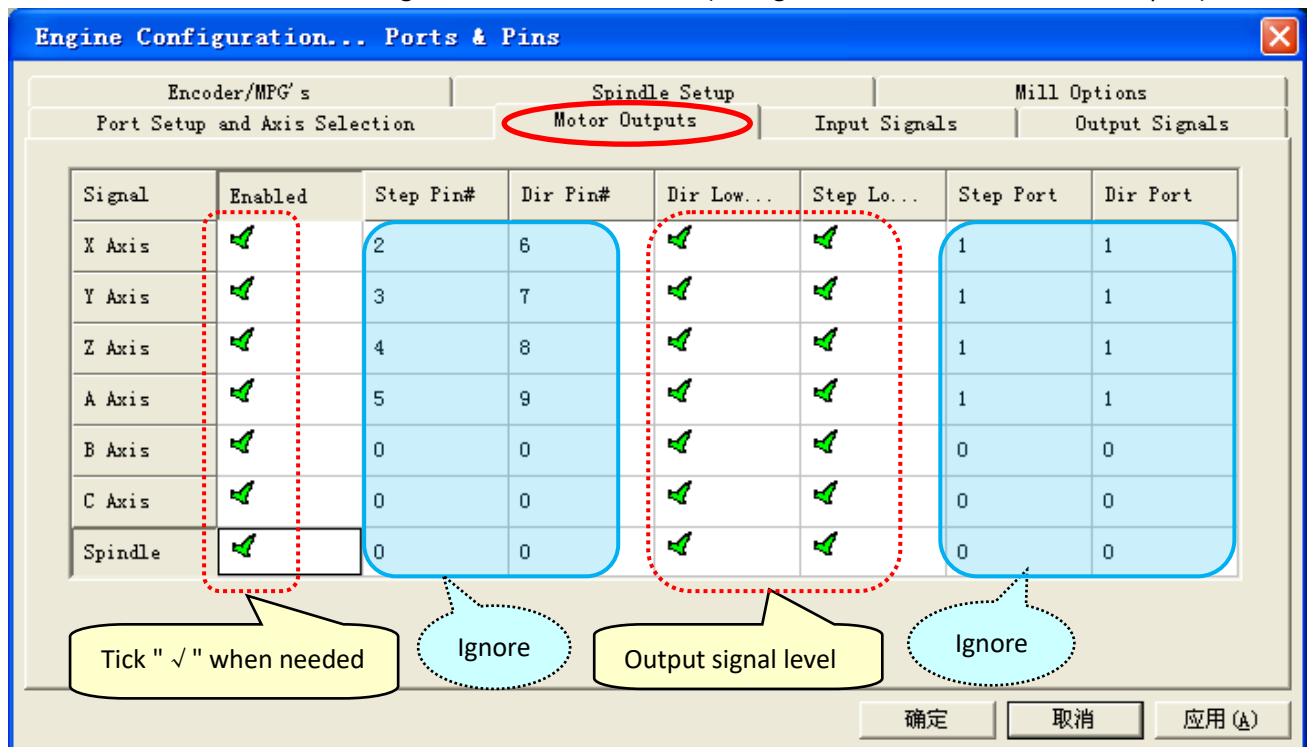
5.2.2 Use 5V-24V external power supply, suitable for servo drive, please install suitable current limiting resistor as needed.



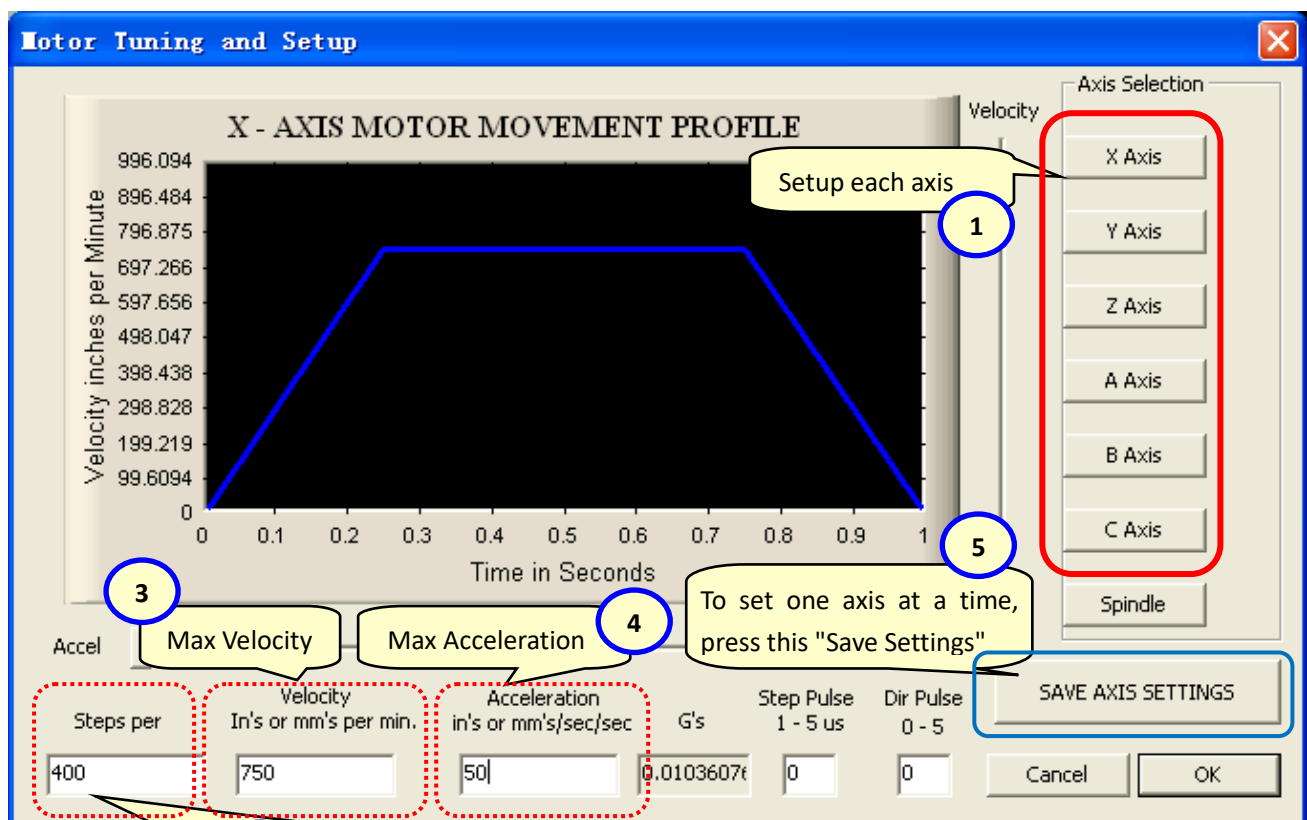


5.3 Motor parameter configuration

5.3.1 Mach3's X,Y,Z,A,B,C axis configuration, as shown below: (Config => Ports and Pins => Motor Outputs)



5.3.2 Mach3 tuning setup as shown below: (Config => Motor Tuning)



Steps per:

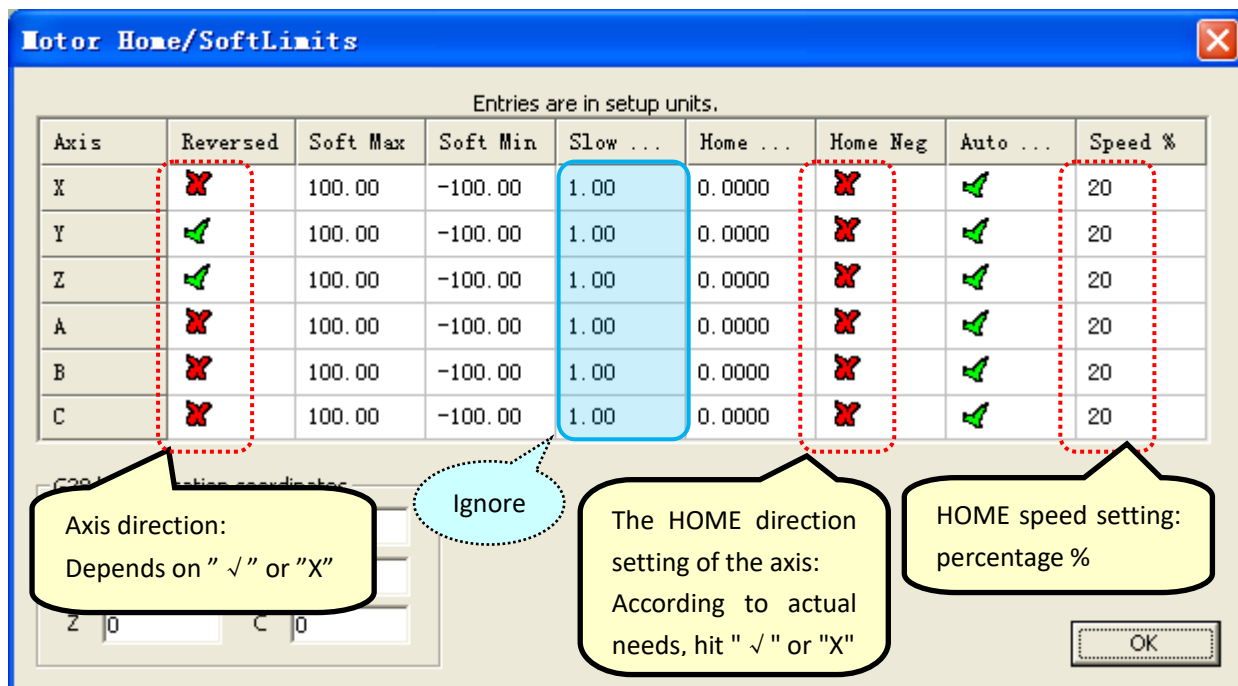
Mach3 steps per unit = Mach3 steps per rev x Motor revs per unit

Please refer to: **Mach3Mill_Install_Config.pdf**



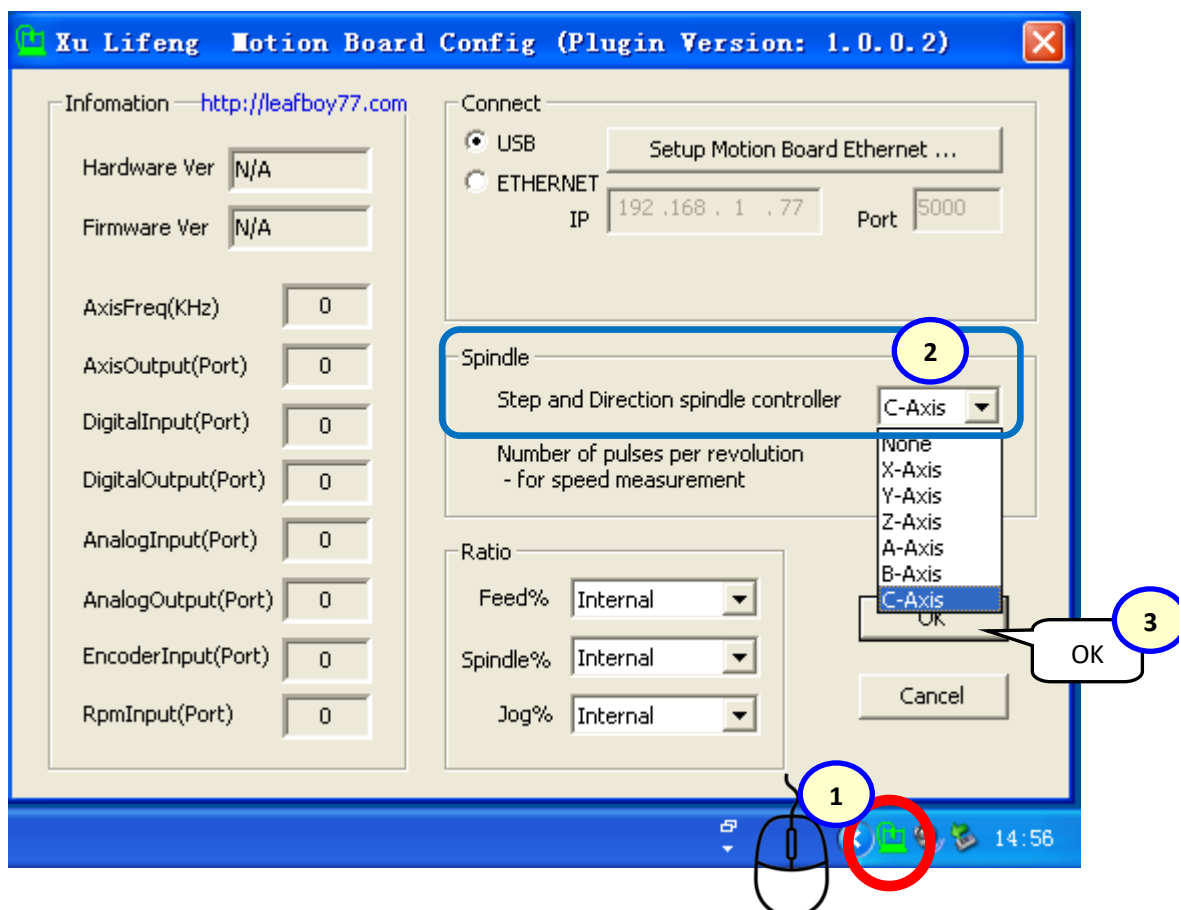
5.3.3 Mach3's **axis running direction** is recommended as shown below:

Mach3 Main menu => Config => Homing/Limits



5.4 Pulse Spindle Configuration

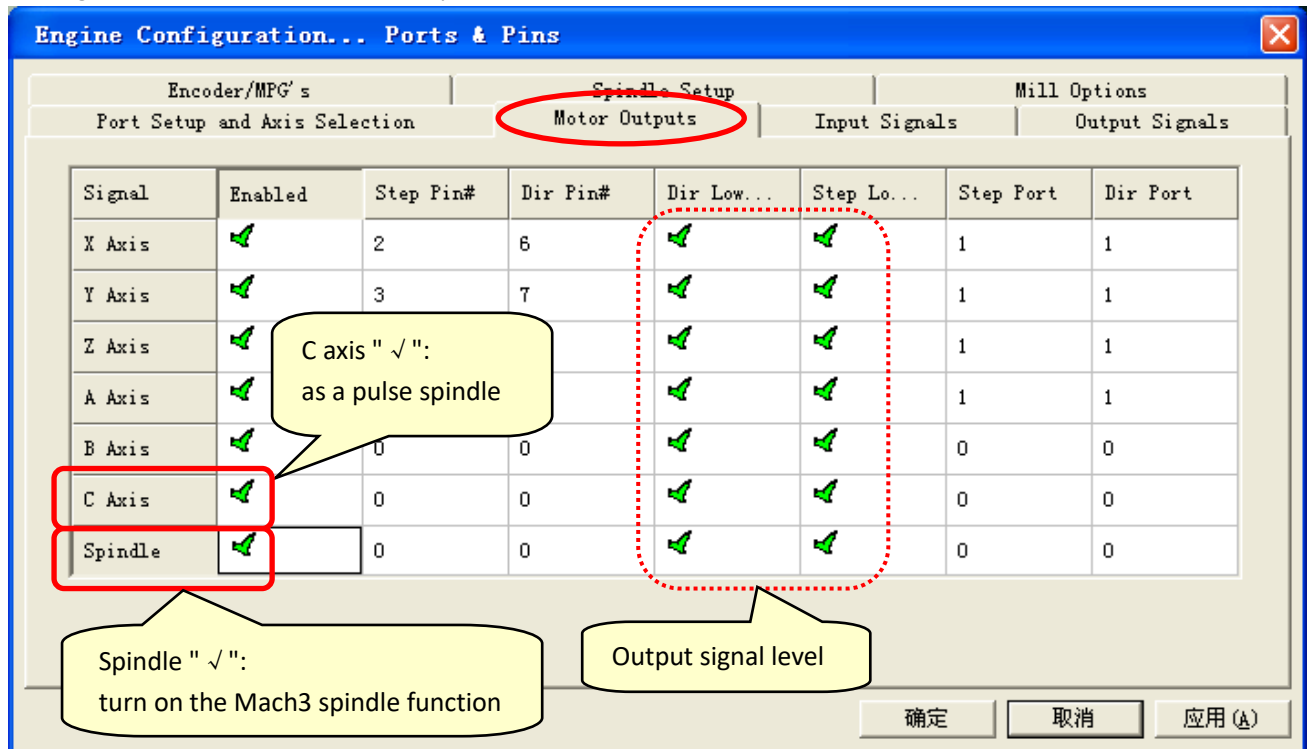
You can set any one axis of the motion control board as the pulse spindle output, and specify the C axis as an example: Right click on the CNC icon, pop up the settings dialog, select "C-Axis", press OK to save the settings.(Turn off the pulse spindle function Select "None")





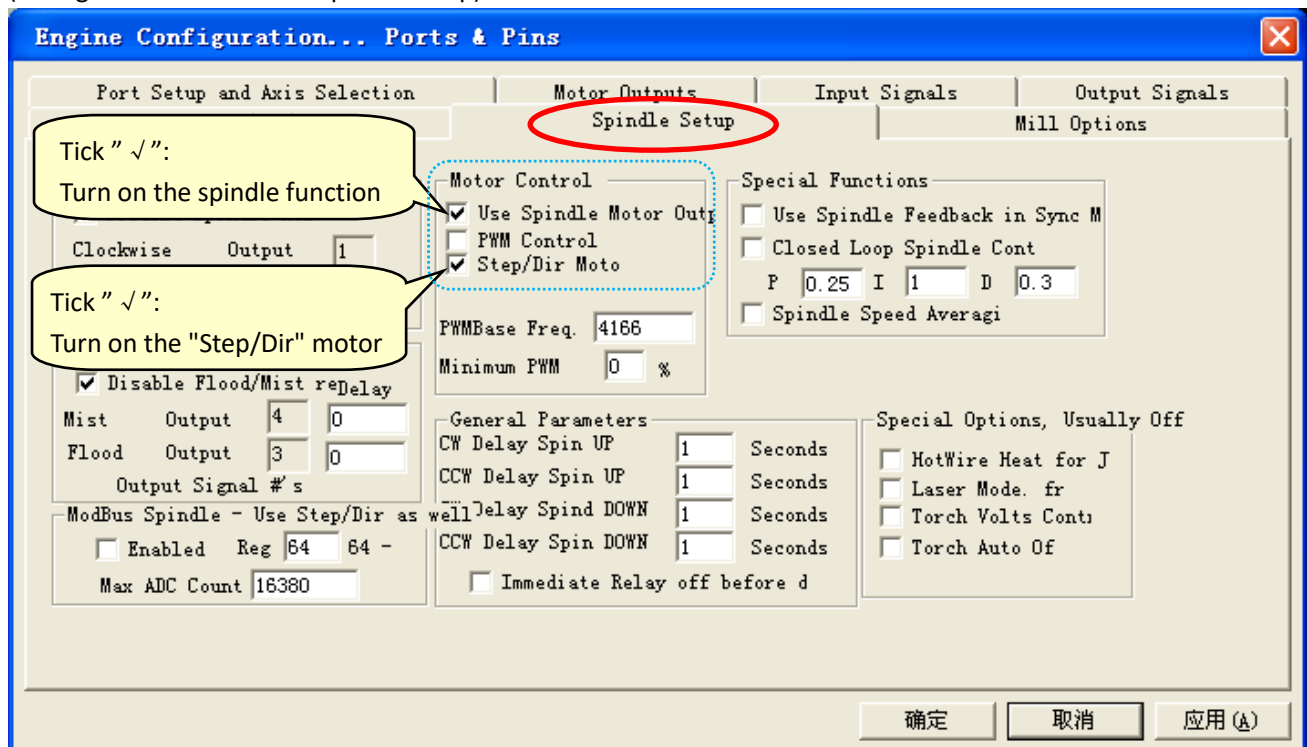
Confirm that the C axis is turned on (as a pulse spindle), and confirm that the spindle function (Spindle) is turned on, as shown in the figure below:

(Config => Ports and Pins=>Motor Outputs)



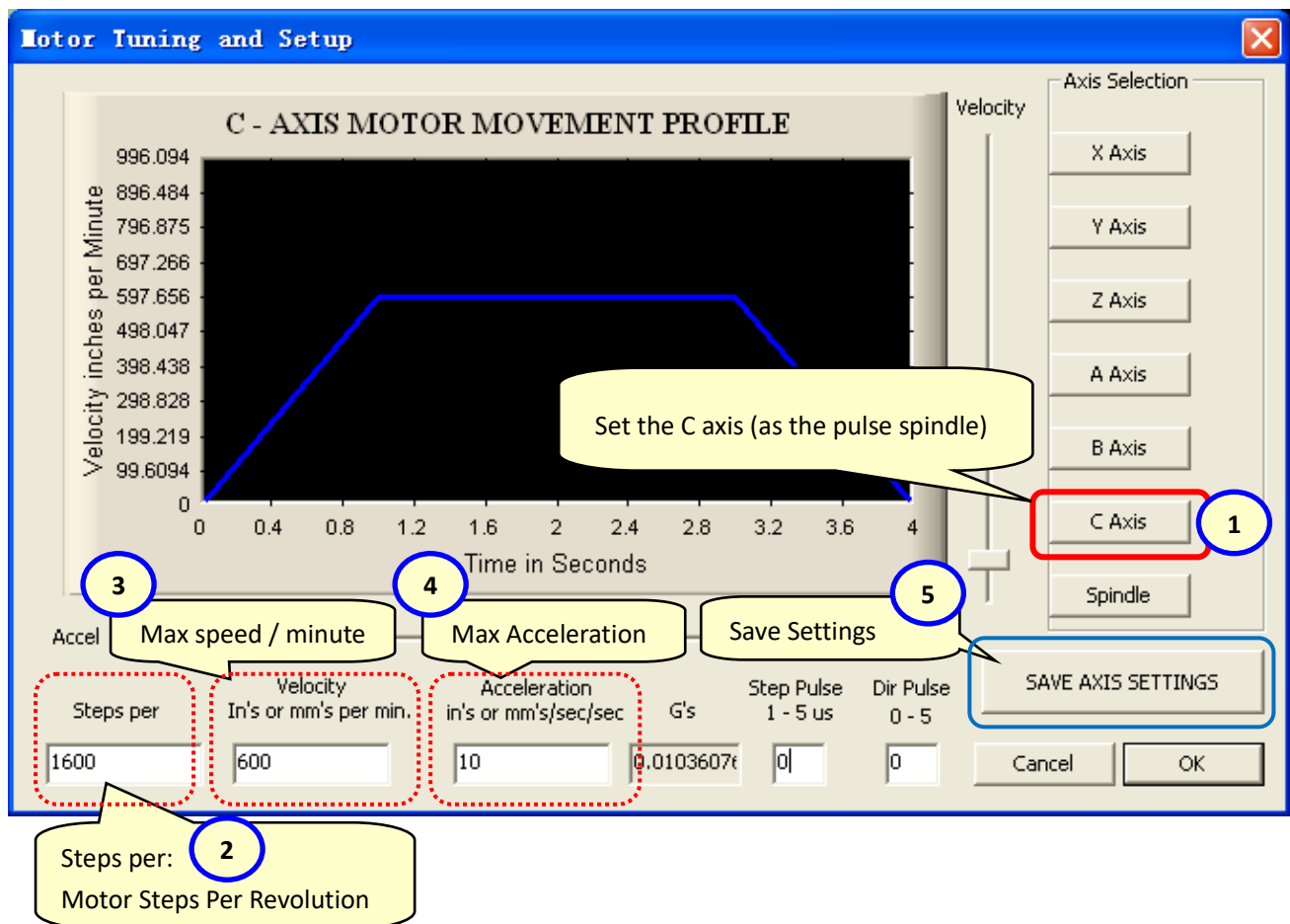
The spindle is set to: pulse / direction motor

(Config => Ports and Pins=>Spindle Setup)



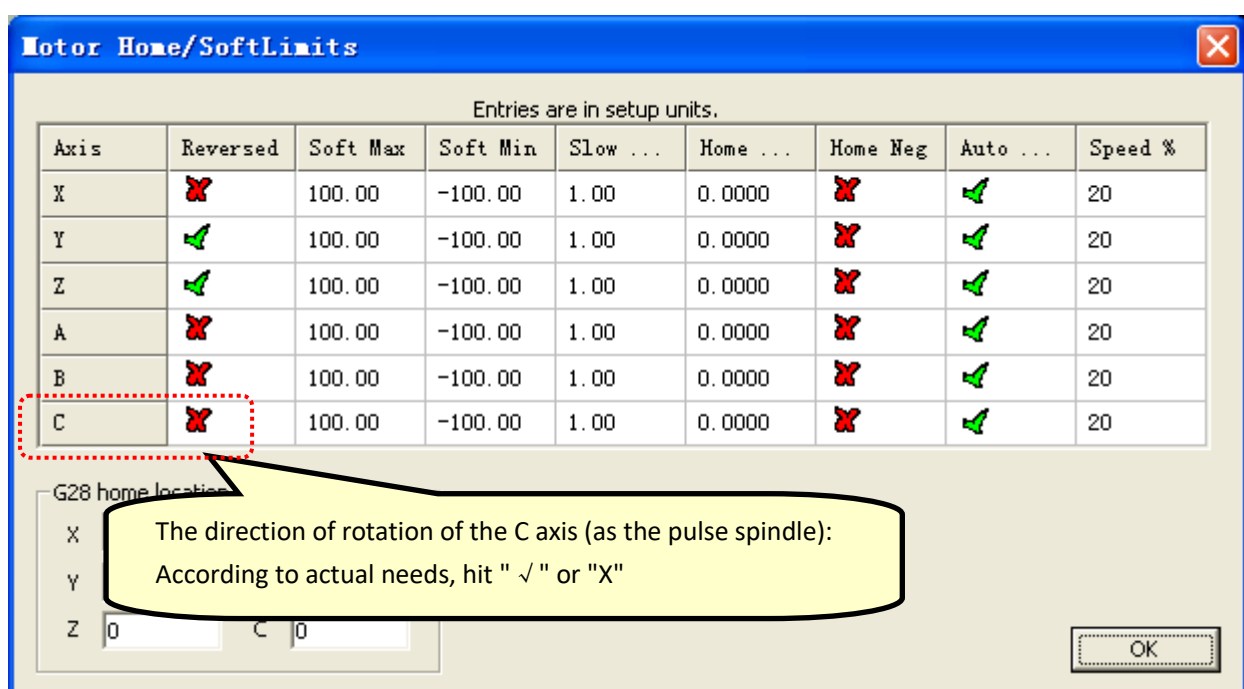


Motor operating parameter setting of C axis (as pulse spindle), as shown below: (Config => Motor Tuning)



The direction of rotation of the pulse spindle is recommended as shown in the following figure:

Mach3 main menu => Config => Homing/Limits





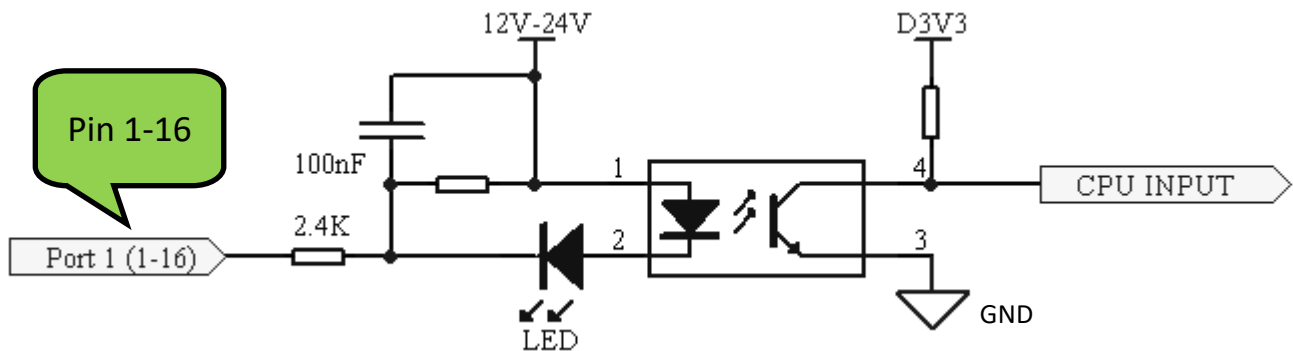
6. Digital input

6.1 NPN input interface characteristics, wiring and configuration



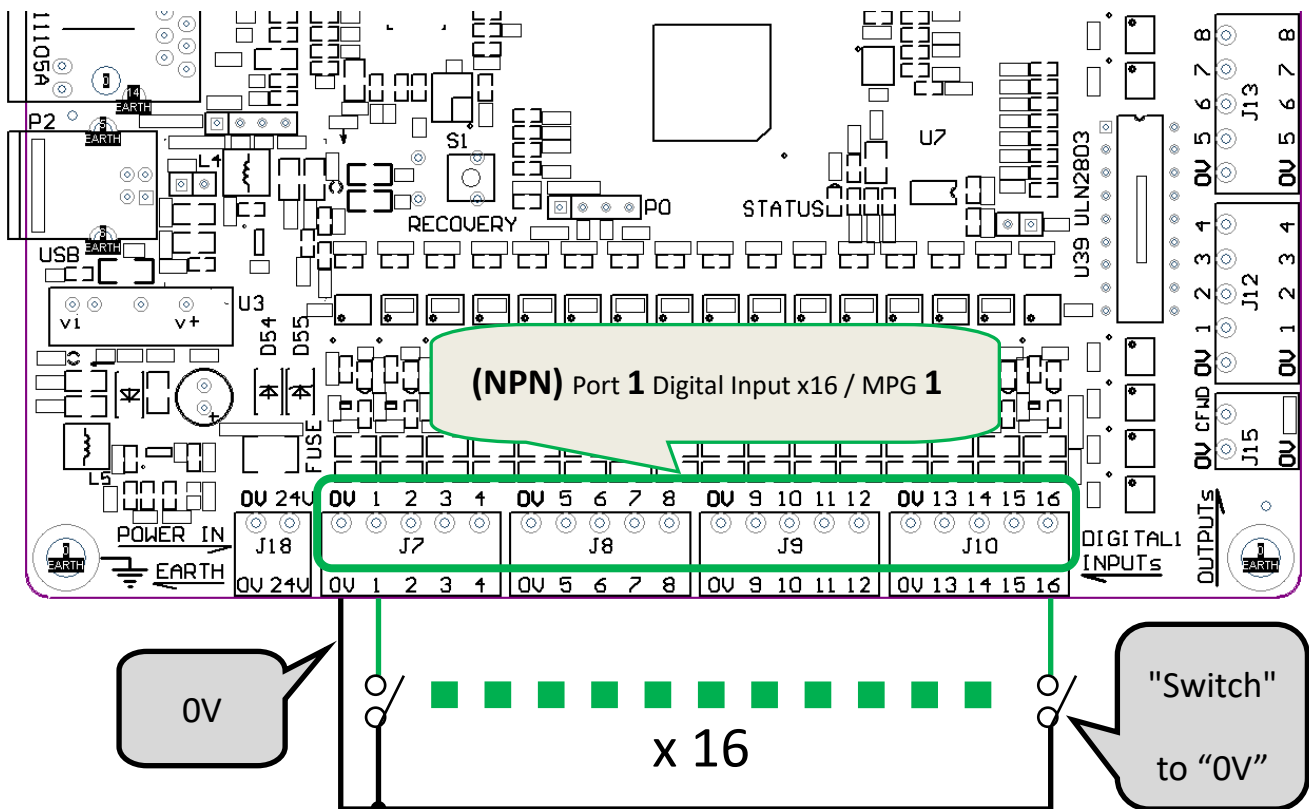
6.1.1 Interface schematic

Port **1** Digital Input: **NPN** Input x16, optocoupler isolation



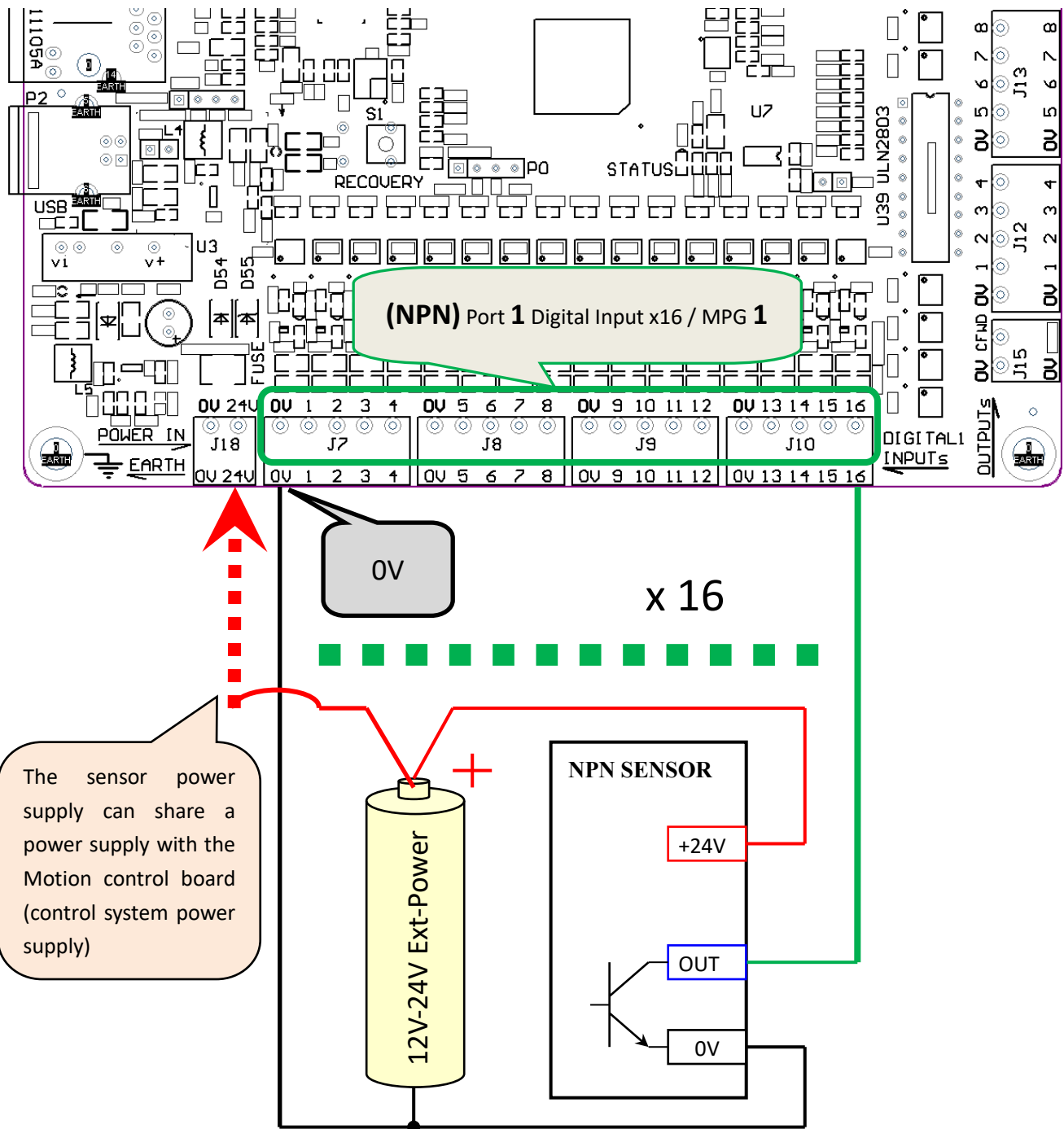
6.1.2 Wiring

6.1.2.1 Button, mechanical switch wiring





6.1.2.2 NPN sensor wiring



6.1.3 Mach3 input signal configuration (Config => Ports and Pins=>Input Signals)

Encoder/MPG's		Spindle Setup		Mill Options	
Setup and Axis Selection		Motor Outputs		Input Signals	
Enabled	Port #	Pin Number	Active Low	Emulated	HotKey
☒	1	10	☒	☒	0

Tick "✓" to enable

Port
1

According to the actual wiring, Type **1-16**

NPN sensor is set to "✓"
(0V = active low)

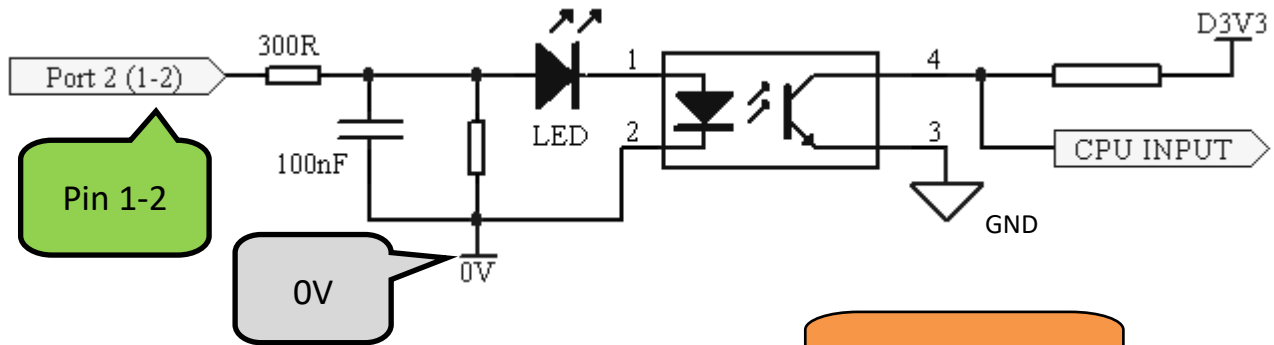


6.2 PNP input interface characteristics, wiring and configuration



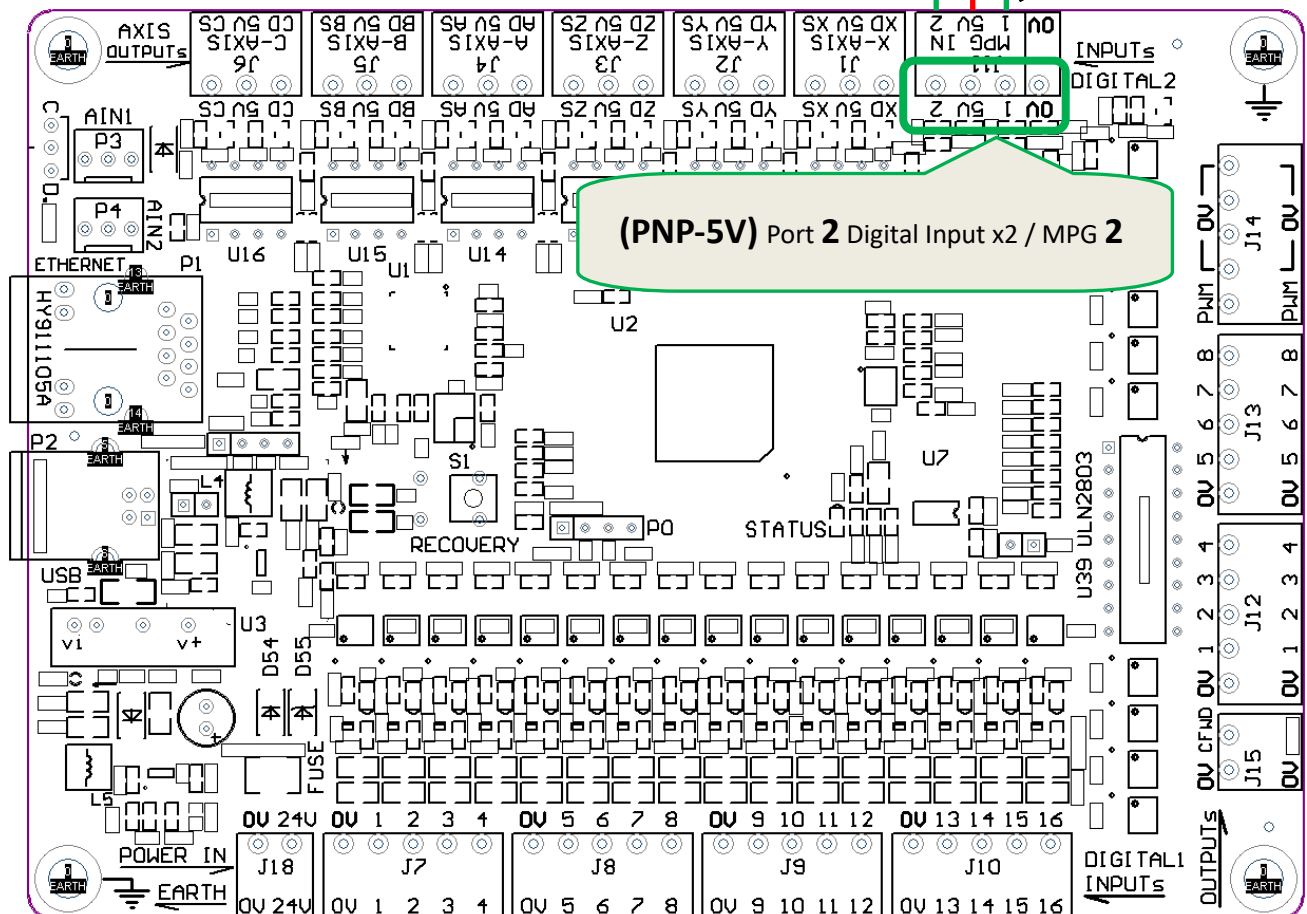
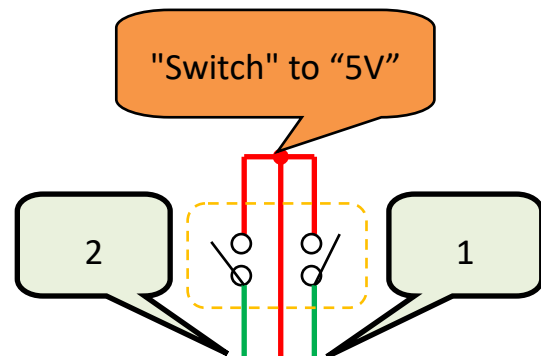
6.2.1 Interface schematic

Port **2** Digital Input: **PNP-5V** Input x2, optocoupler isolation



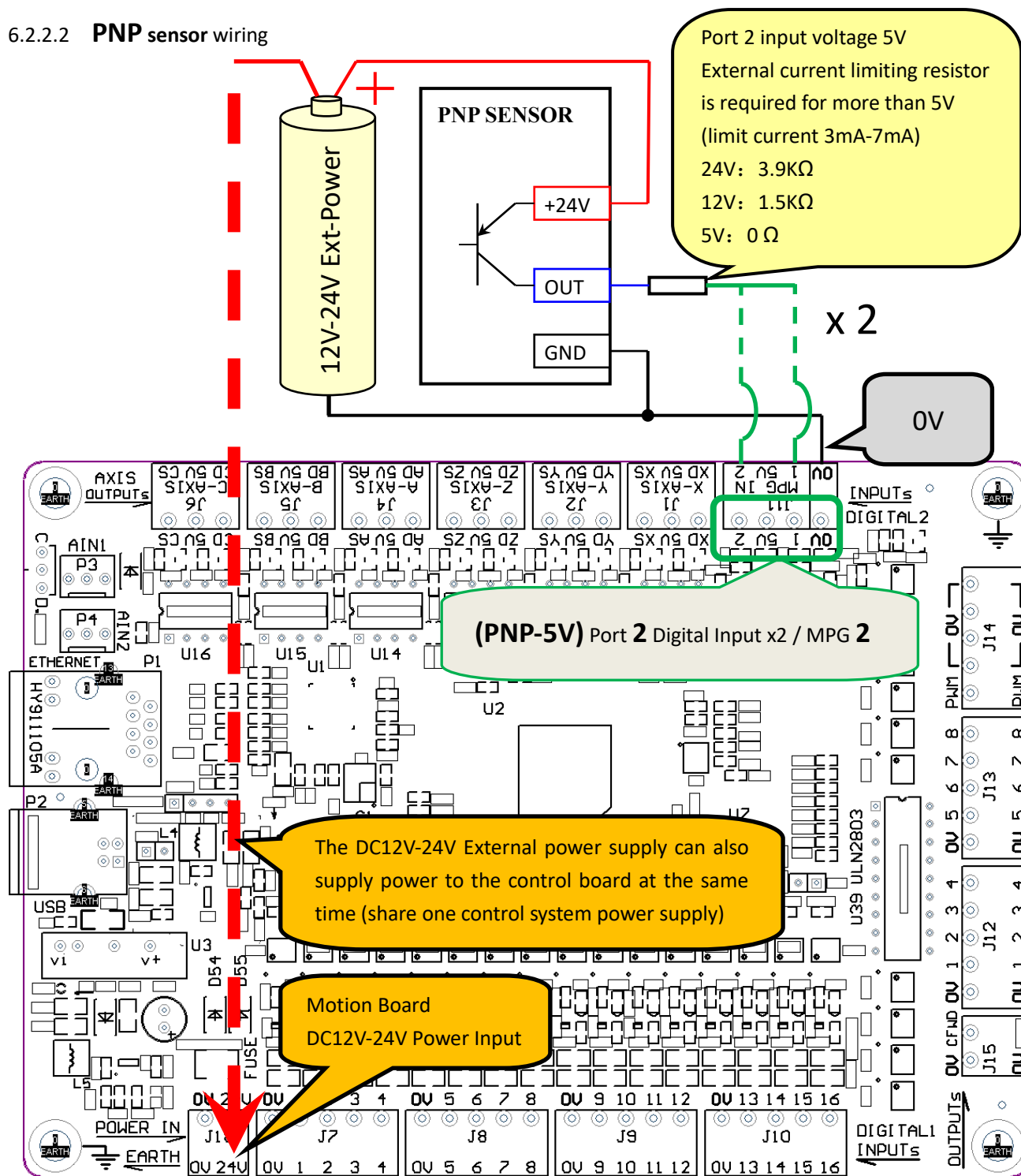
6.2.2 Wiring

6.2.2.1 Button, mechanical switch wiring





6.2.2.2 PNP sensor wiring



6.2.3 Mach3 input signal configuration (Config => Ports and Pins => Input Signals)

Encoder/MPG's		Spindle Setup		Mill Options	
Setup and Axis Selection		Motor Outputs		Input Signals	
Enabled	Port #	Pin Number	Active Low	Emulated	HotKey
☒	2	1	☒	☒	0

Tick "✓"
to enable

Port
2

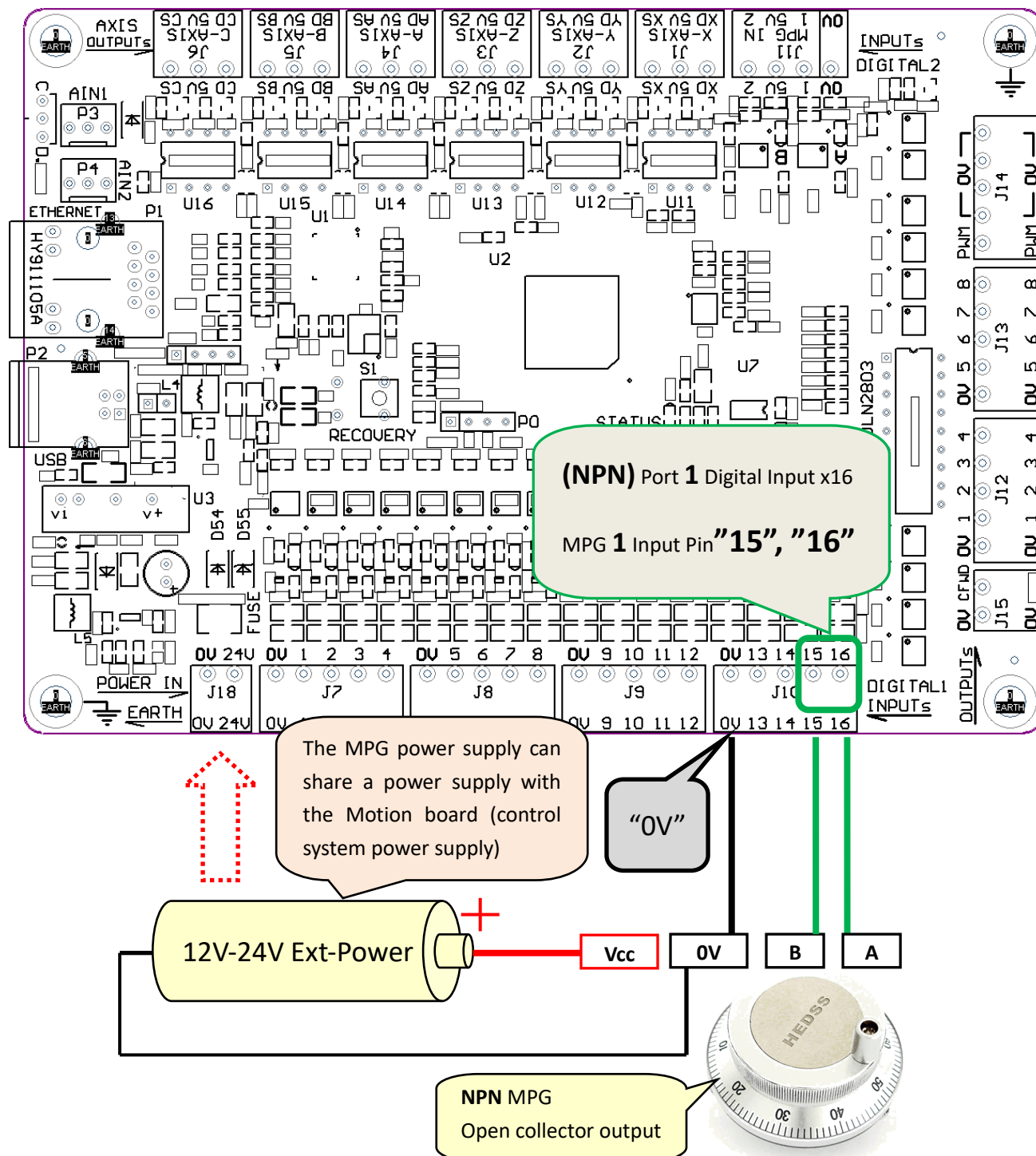
According to the actual
wiring, Type 1-2

NPN sensor is set to "X"
(Active high)



6.3 NPN MPG(Manual Pulse Generation) wiring

Output type of NPN MPG: **Open collector output (OC)**



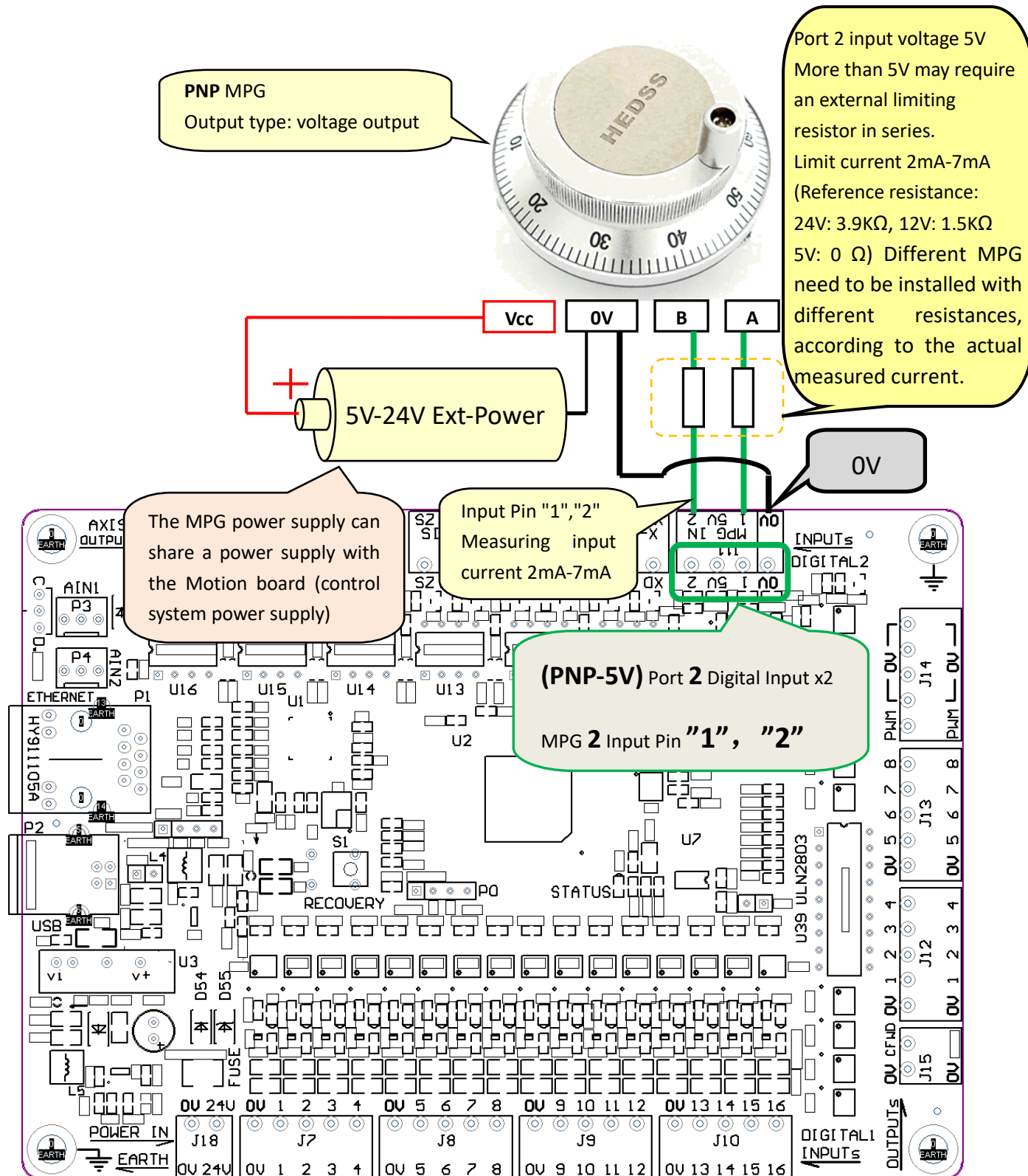
Usually the MPG rotates clockwise, the coordinates increase; counterclockwise rotation, the coordinates decrease.

If the direction of rotation of the electronic handwheel is opposite to the direction of the MACH3 coordinate, exchange the wiring of the electronic handwheels "A" and "B".



6.4 PNP MPG(Manual Pulse Generation) wiring

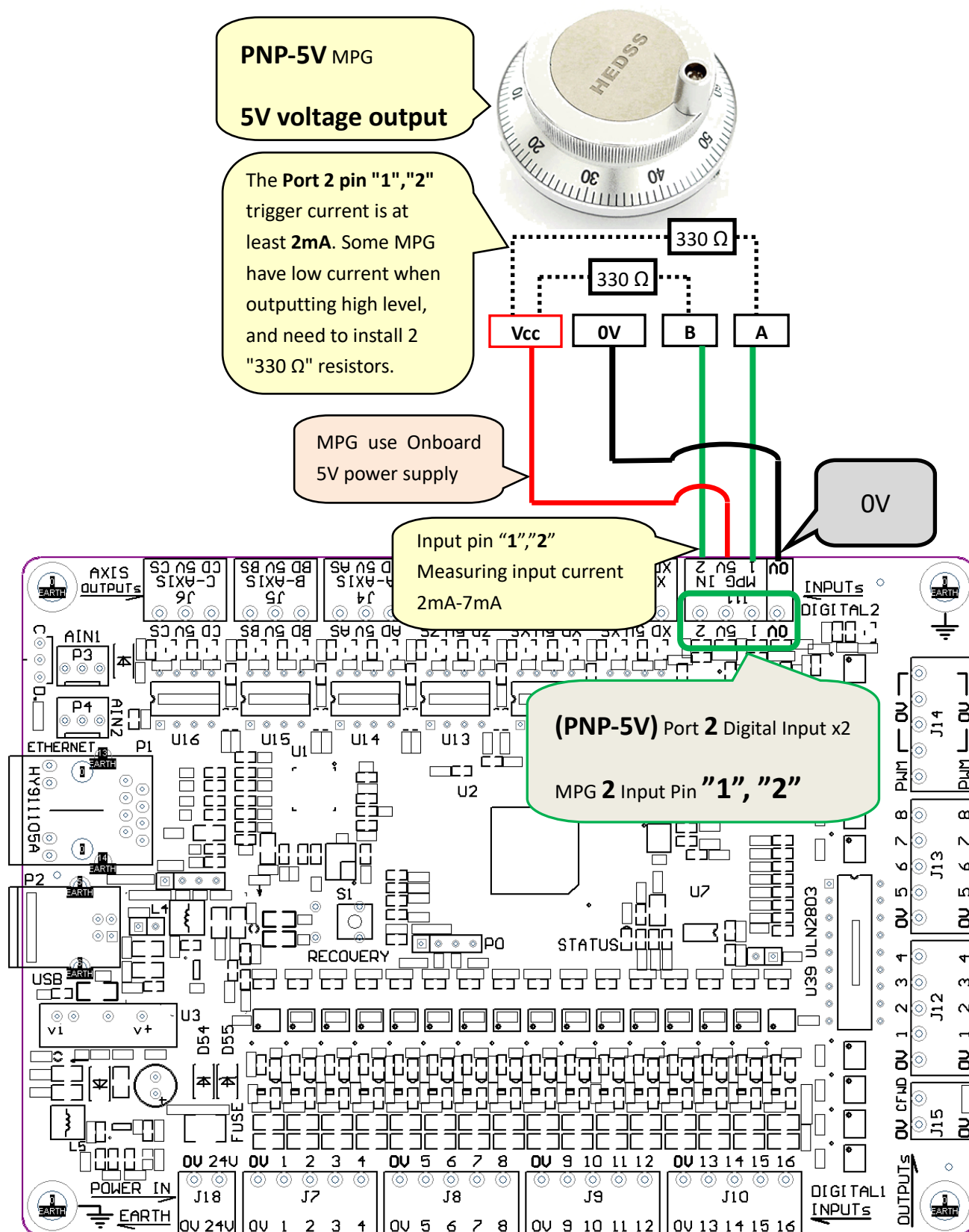
6.4.1 PNP MPG, output type: **voltage output** (if more than 5V, series current limiting resistor may be required)





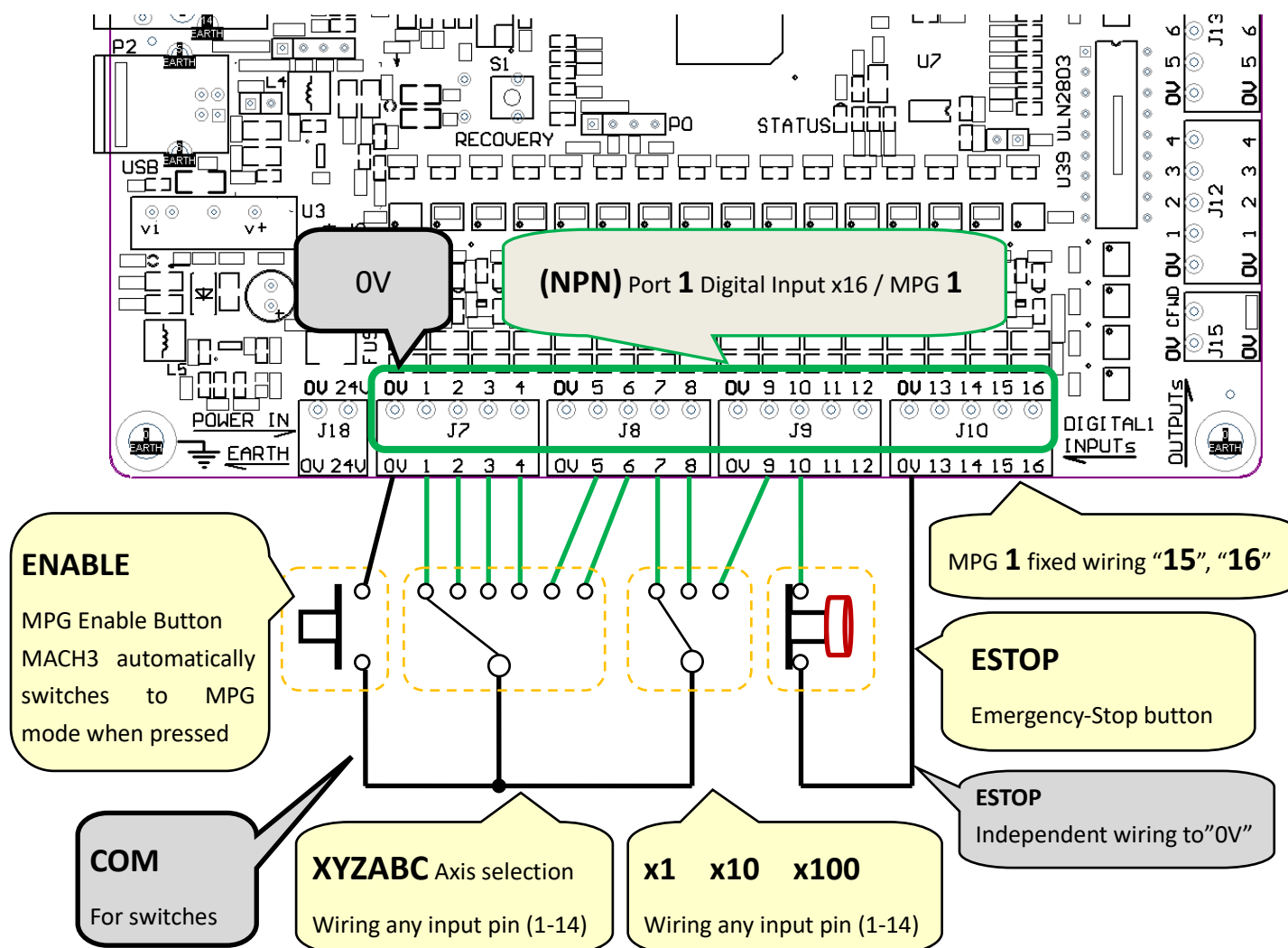
6.4.2 PNP-5V MPG, Output type: 5V voltage output.

When the MPG operates at **5V** and the current consumption does not exceed **50mA**, it can be powered by the onboard 5V power supply of the Motion control board.





6.5 Wiring of MPG switch



"Switch" and "Emergency Stop button" are connected to any input pin and then configured in Mach3.



When the "Enable Button" is pressed, the Jog Mode of Mach3 automatically switches to MPG mode, and automatically switches back to the original mode when the button is released.



The "Enable Button" automatically switches the JOG mode. The control board plug-in v1.3.1.2 (or later) version is required. See ["Download and install the Mach3 plugin"](#) to download the latest version.



If the "Enable Button" is not needed, please short-circuit it (the common terminal "COM" of the switches is directly connected to the "0V" terminal of the control board).



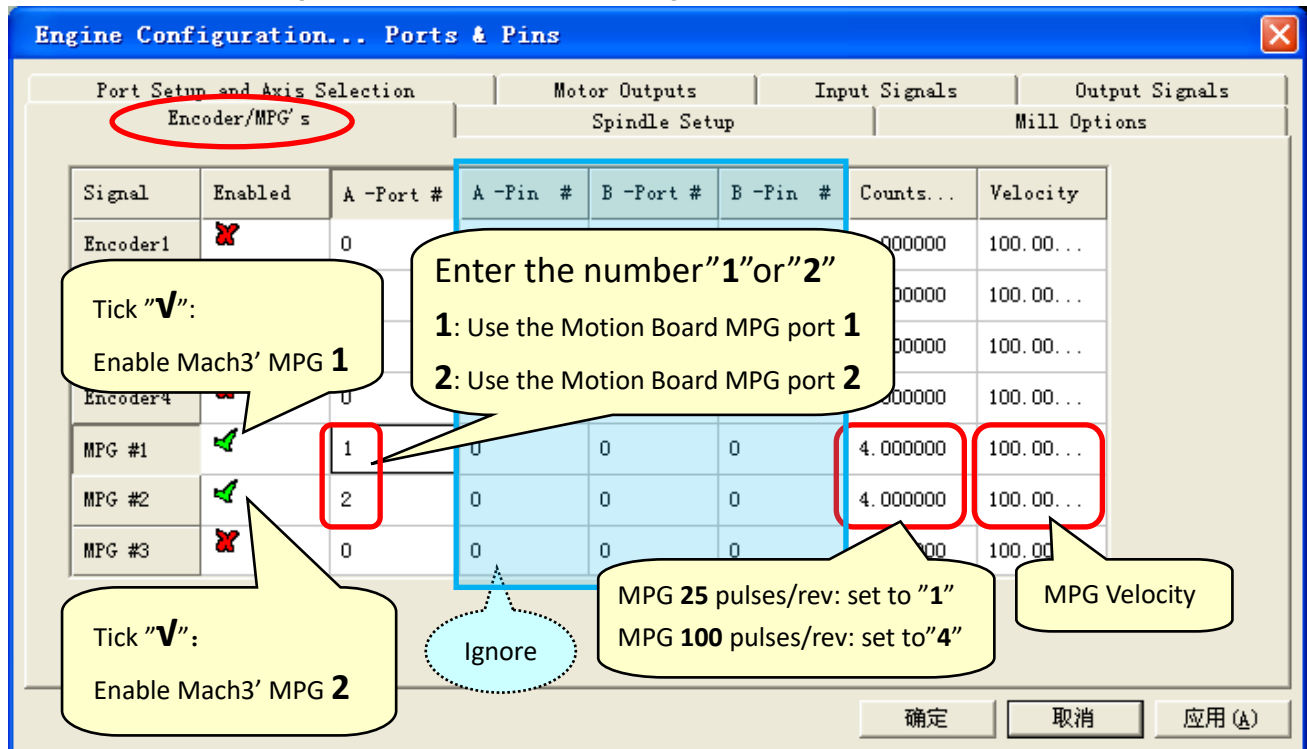
Attention:

"Emergency-Stop button" It is recommended to use the "normally closed" contact. If a fault occurs in the disconnection of the wiring, an emergency stop will be triggered.

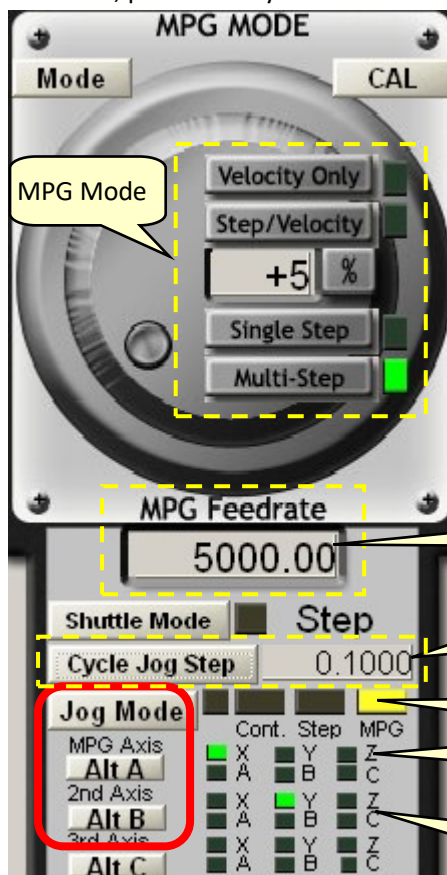


6.6 Configuration of the MPG

6.6.1 Mach3 MPG configuration, as shown below: (Config => Ports and Pins => Encoder/MPG's)

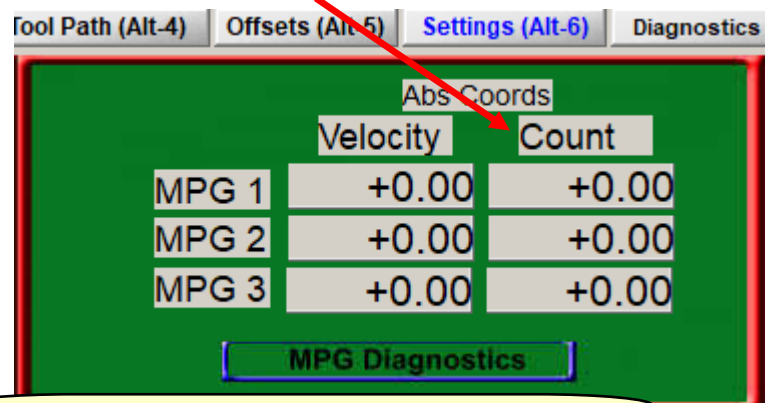


In Mach3, press the keyboard "TAB" and set it as shown below.



Multi-Step mode, MPG signal is processed in real time by motion control board

Mach3's MPG Count does not change at this time.



MPG Velocity: mouse click, type number, press **Enter**

Jog Step: setup by click "Cycle Jog Step" button, or key in

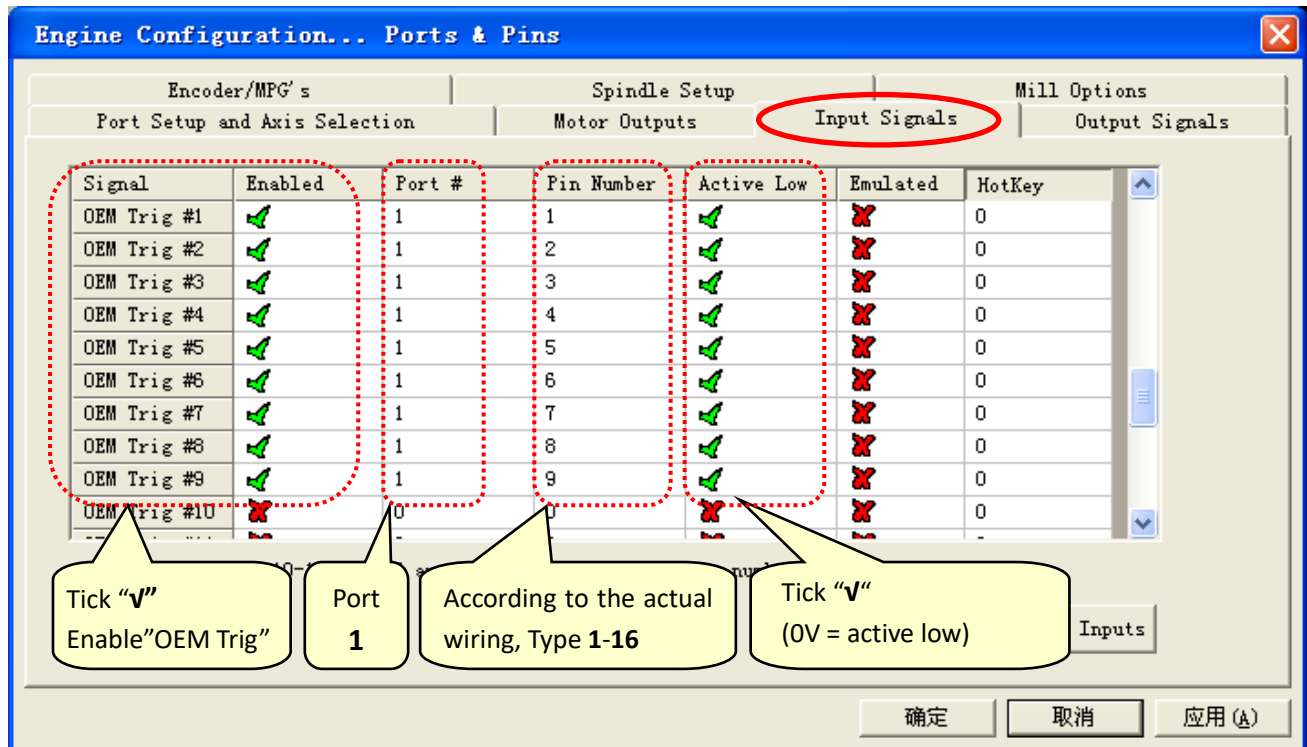
Click "Jog Mode" button, set the jog to "MPG" mode

Click "Alt-A" button, select the axis(XYZABC) controlled by MPG **1**

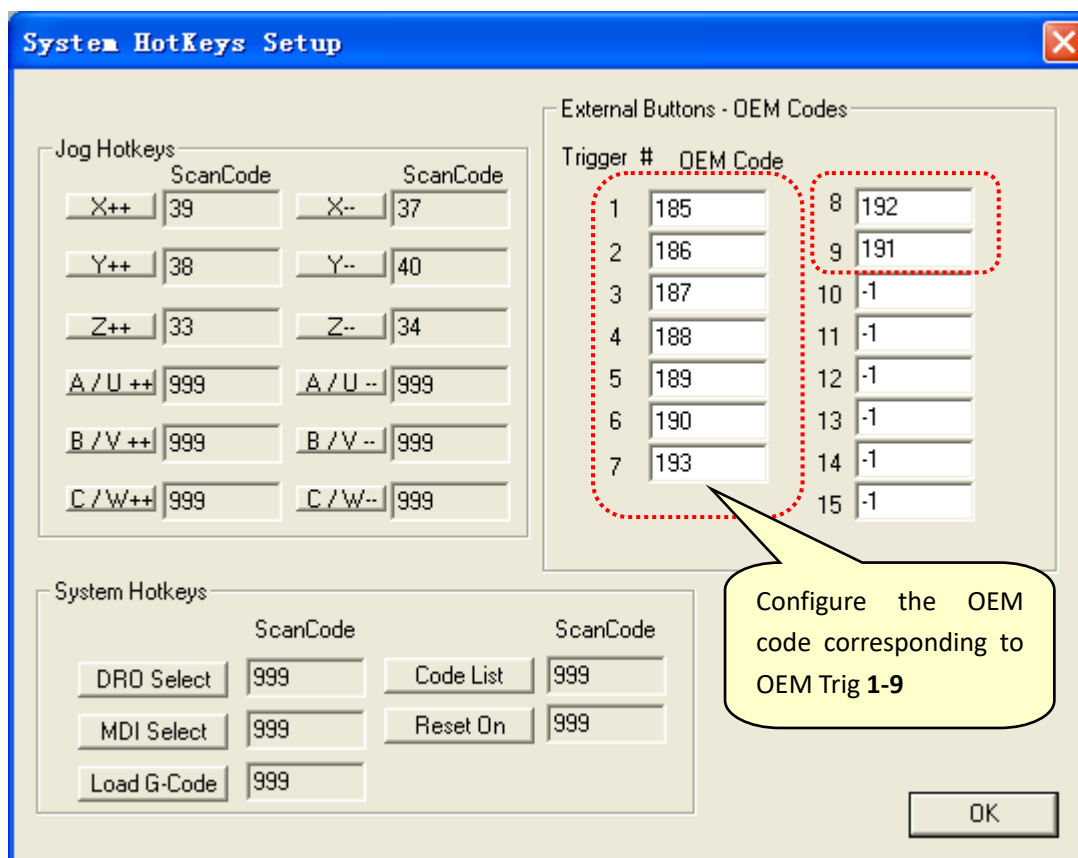
Click "Alt-B" button, select the axis(XYZABC) controlled by MPG **2**



6.6.2 Mach3 electronic MPG switch configuration, as shown below: (Config => Ports and Pins=>Input Signals)



Configure the functions performed by "OEM Trig" as shown below: (Config => System Hotkeys)





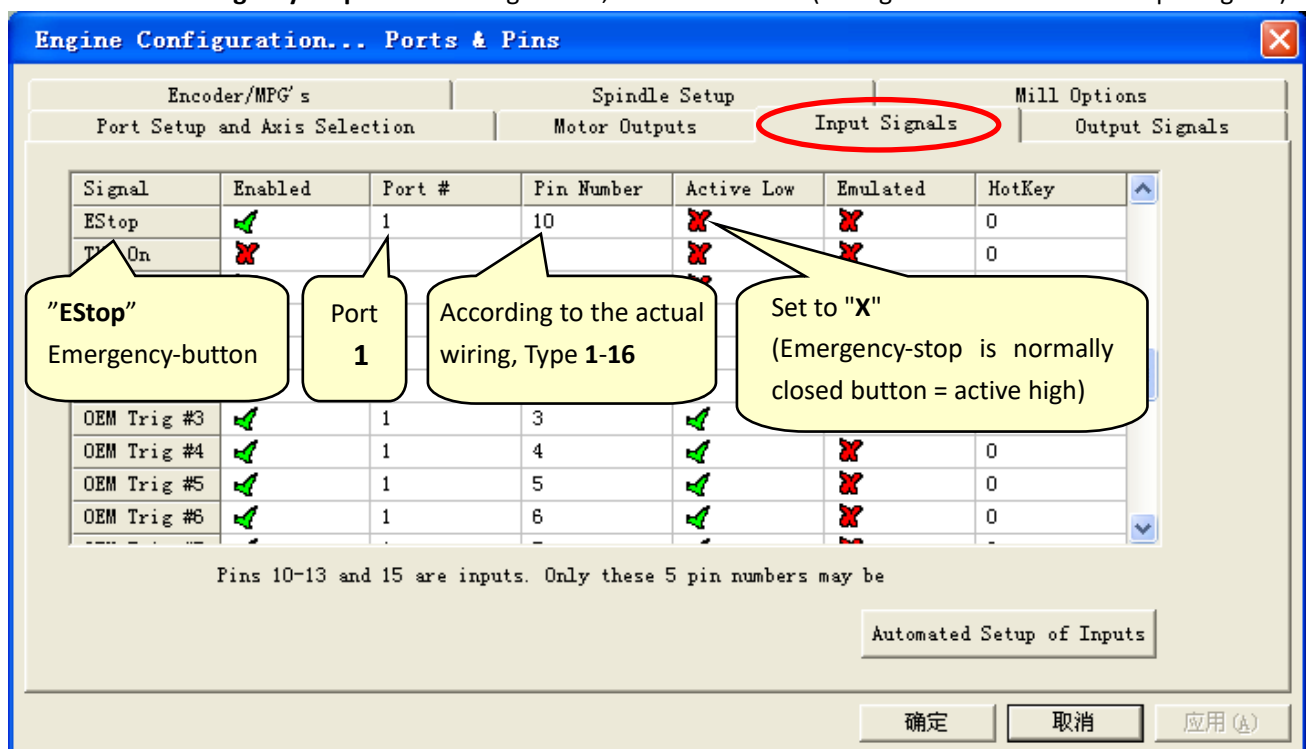
Mach3 axis selection for MPG / Jog step select OEM Buttons code table

Function	OEMCode
Select X for MPG 1	185
Select Y for MPG 1	186
Select Z for MPG 1	187
Select A for MPG 1	188
Select B for MPG 1	189
Select C for MPG 1	190
Select Jog Increment 1	191
Select Jog Increment 2	192
Select Jog Increment 3	193



Complete OEM Buttons code table, please search online

6.6.3 Mach3's **emergency-stop button** configuration, as shown below: (Config => Ports and Pins => Input Signals)

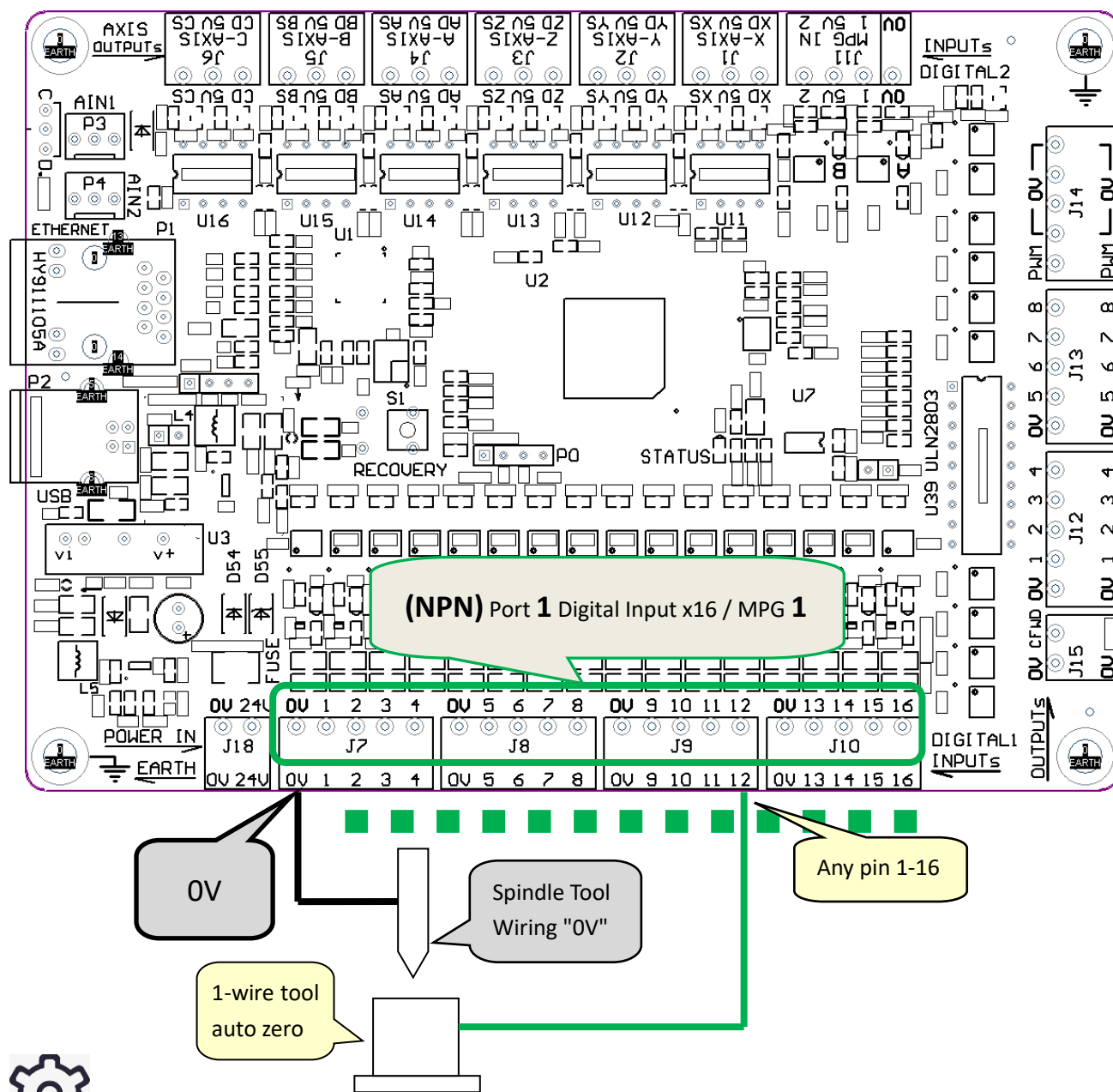


Attention:

"Emergency-stop button" It is recommended to use the "normally closed" contact. If a fault occurs in the disconnection of the wiring, an emergency stop will be triggered.



6.7 Probe (Auto Tool Zero) wiring and configuration

6.7.1 Wiring: Use digital input port **1**, any pin(1-16), as the Probe input signal

6.7.2 Mach3 Probe input signal configuration, as shown below: (Config => Ports and Pins=>Input Signals)

Encoder/MPG's			Spindle Setup		Mill Options	
Port Setup and Axis Selection			Motor Outputs	Input Signals	Output Signals	
Signal	Enabled	Port #	Pin Number	Active Low	Emulated	HotKey
Probe	☒	1	12	☒	☒	0
Index	☒	1	0	☒	☒	0

Tick "✓"
Enable Probe Input

Port
1

According to the actual
wiring, Type 1-16

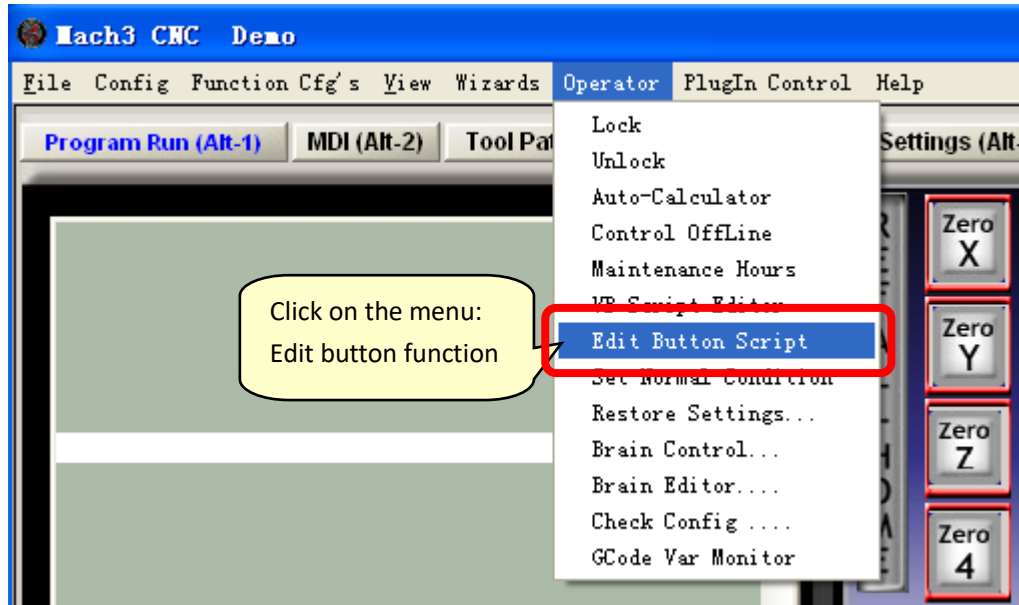
Tick "✓"
(0V = active low)



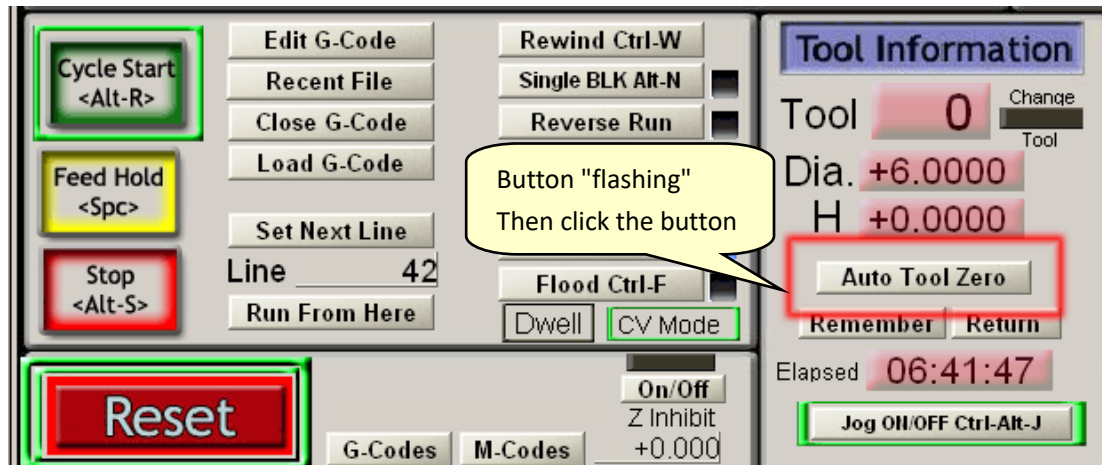
6.7.3 Mach3's "auto tool zero" button, loading VB code

Mach3 can customize the function of some existing buttons on the screen, such as the "Auto Tool Zero" button, set the VB script.

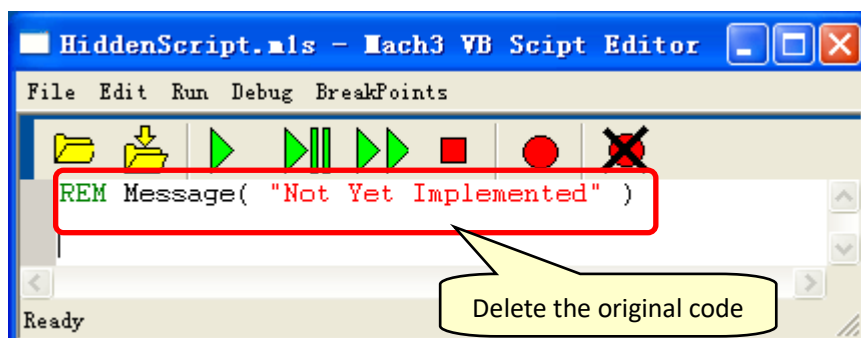
6.7.3.1 Mach3 menu (Operator => Edit Button Script)



6.7.3.2 Click the "Auto Tool Zero" button in the flashing



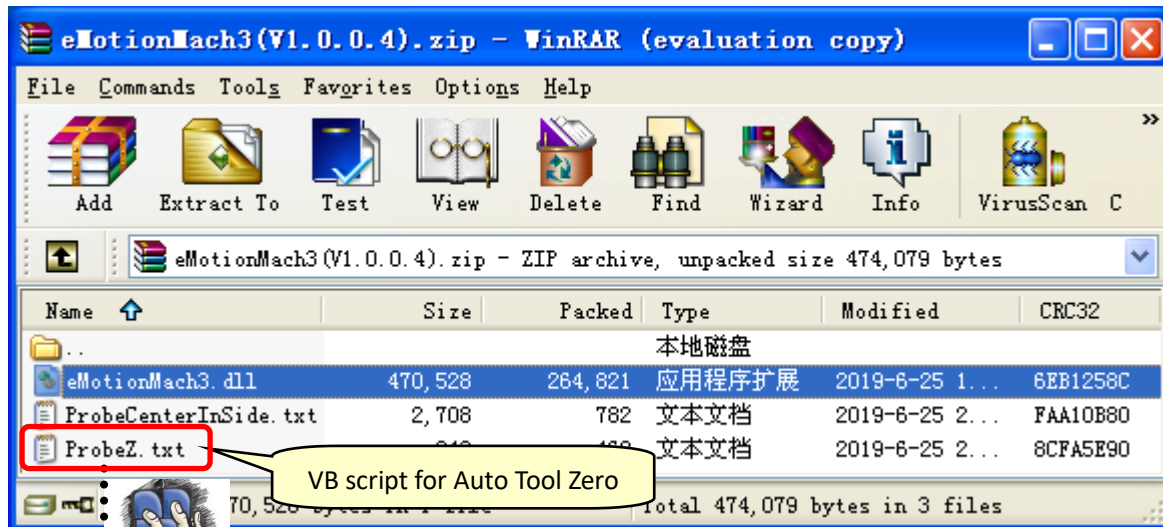
6.7.3.3 Pop up the VB editor and delete the code



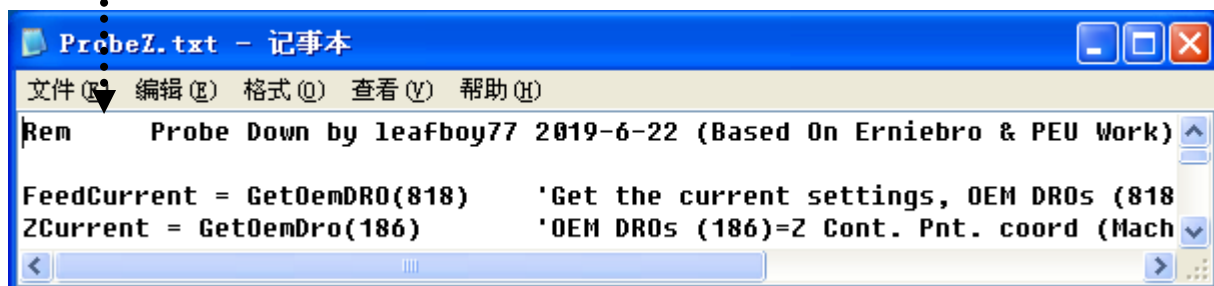


6.7.3.4 Enter the VB script in the VB editor

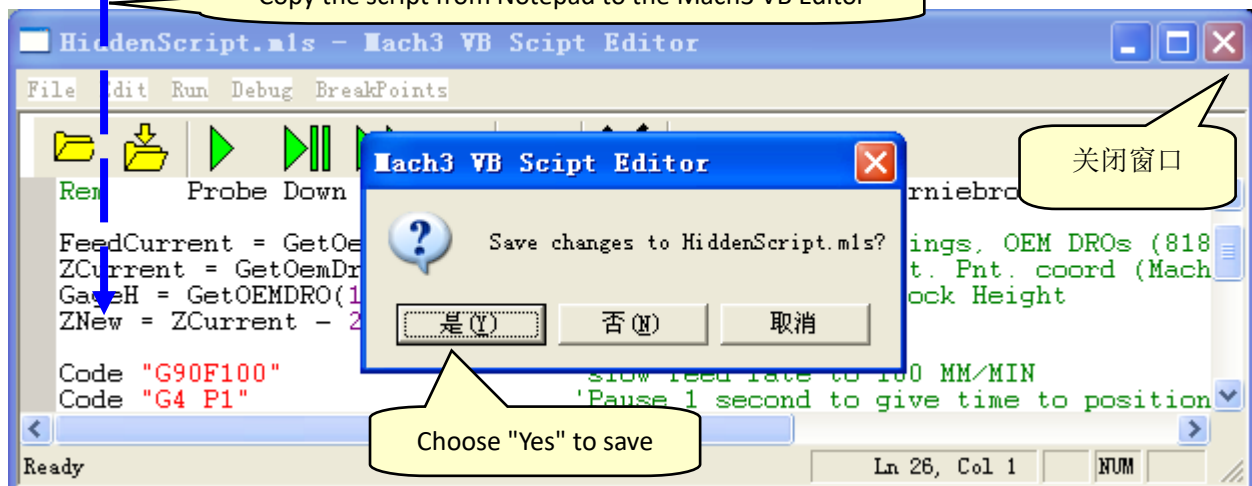
The VB "Auto Tool Zero" demonstration script "ProbeZ.txt" is provided in **eMotionMach3.zip** attached to the motion board. Please open it with Notepad.



Open "ProbeZ.txt" with Notepad: drag in with the mouse



Copy the script from Notepad to the Mach3 VB Editor



6.7.3.5. Test: Click the **"Auto Tool Zero"** button **Auto Tool Zero** to test the tool zero action.



The VB "Auto Tool Zero" demonstration script "ProbeZ.txt", can be changed according to actual needs.



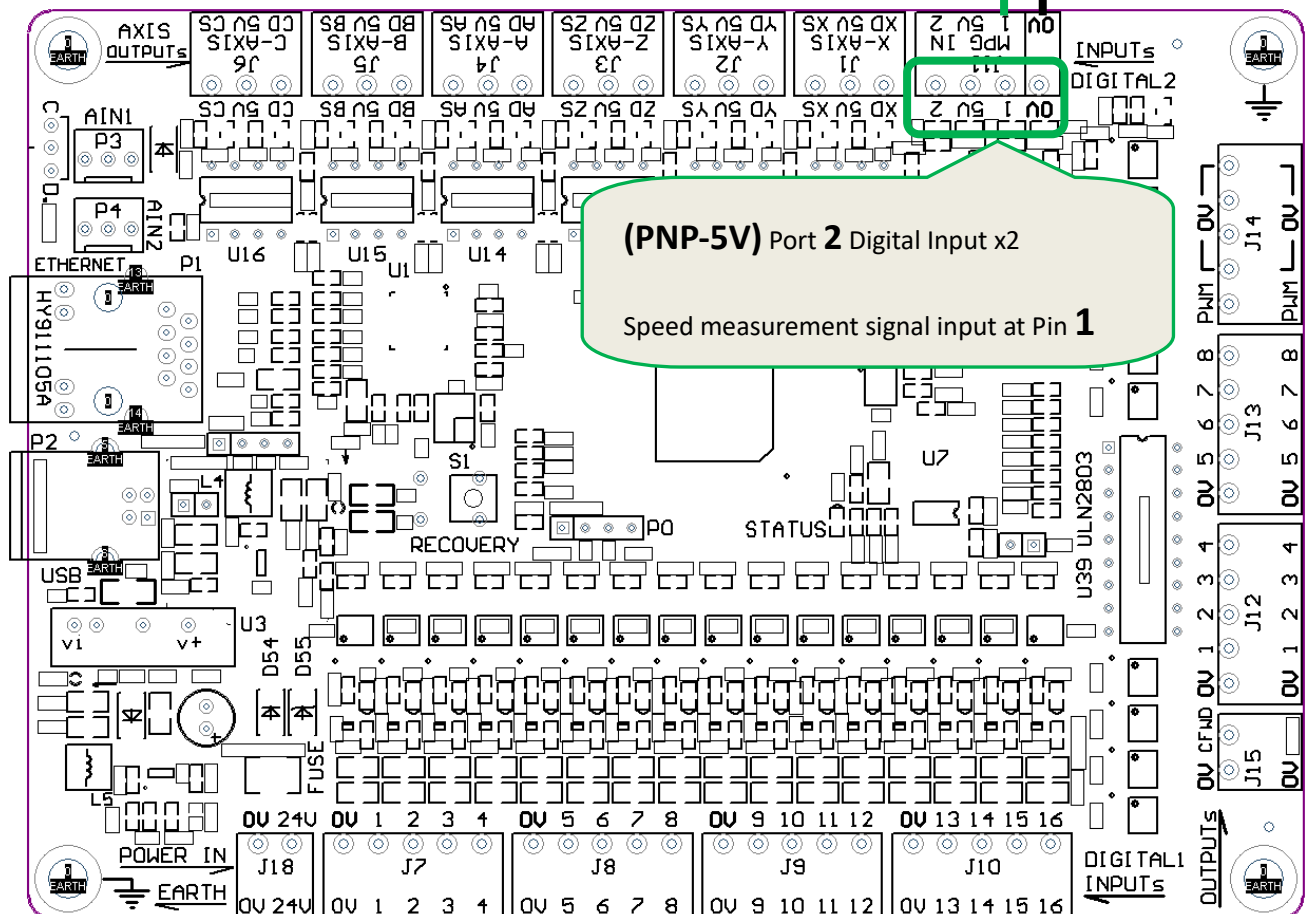
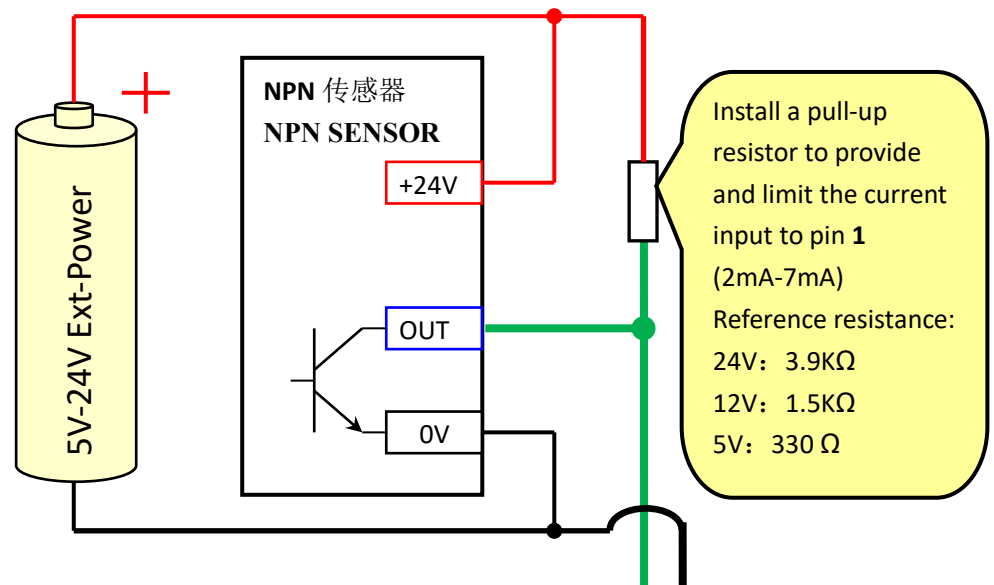
6.8 Wiring and configuration of spindle speed measurement signal input



6.8.1 Wiring: Speed measurement signal input fixed wiring at Pin **1** of digital input port **2**.

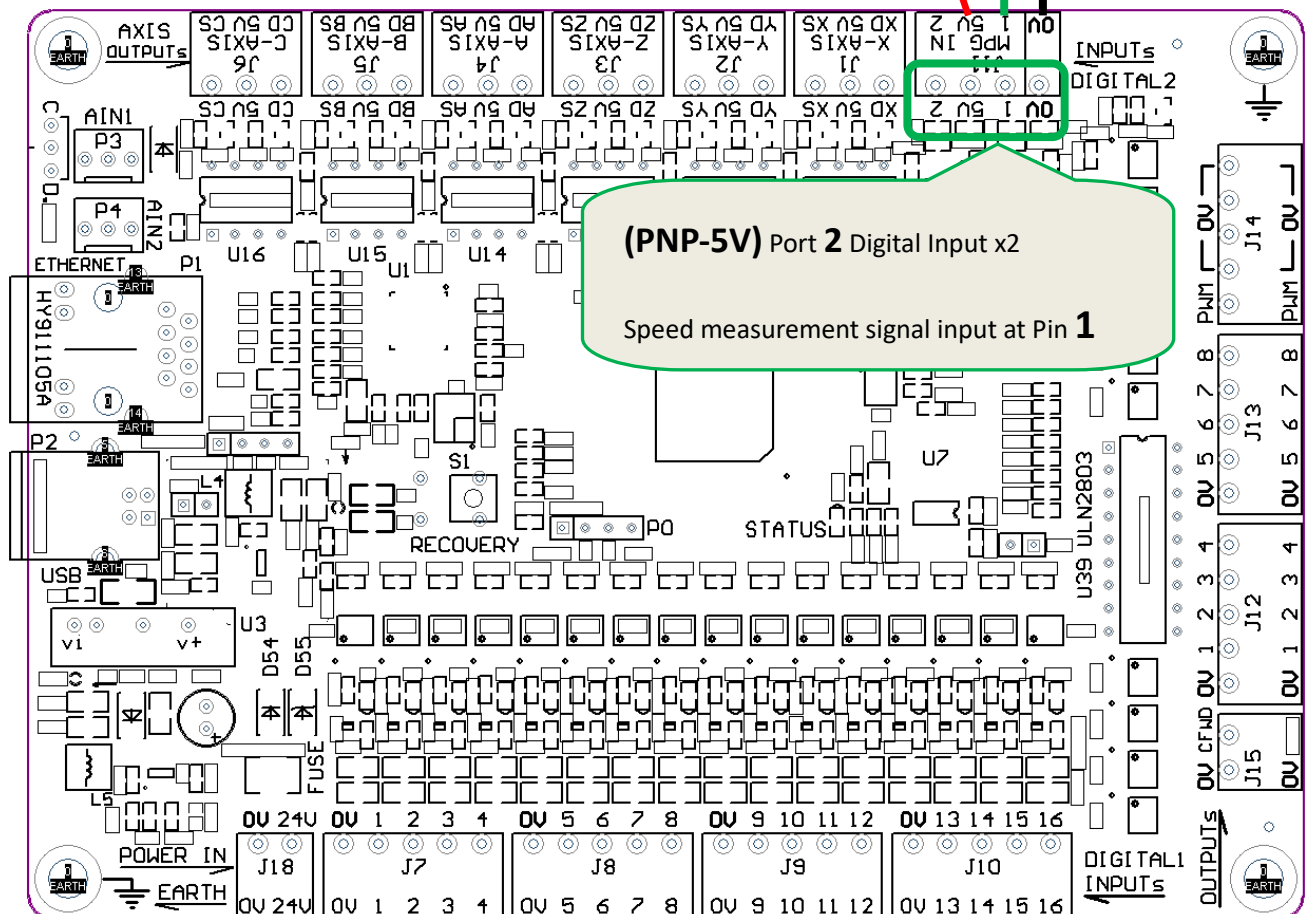
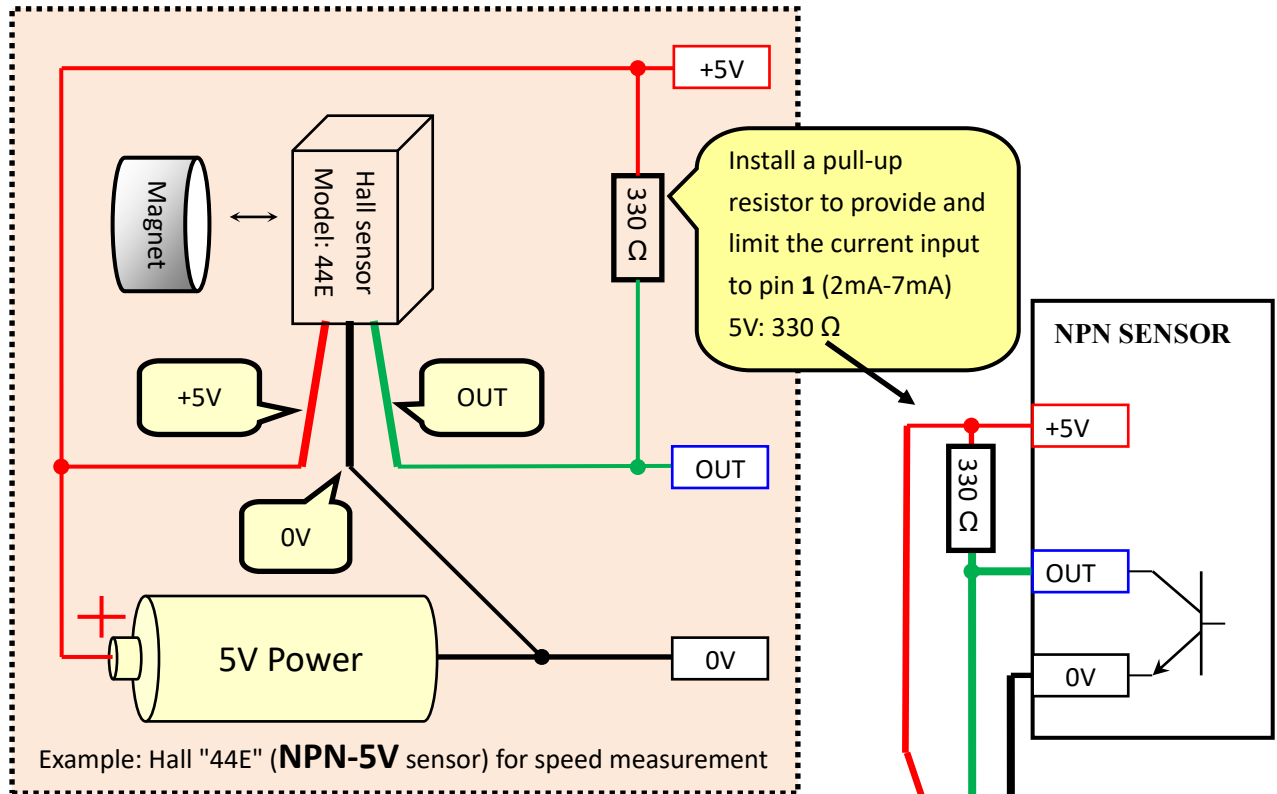
6.8.1.1 **PNP-5V** The speed signal is directly wired to the Pin **1** of digital input port **2**.

6.8.1.2 External power supply, wiring of **NPN** sensor speed signal:





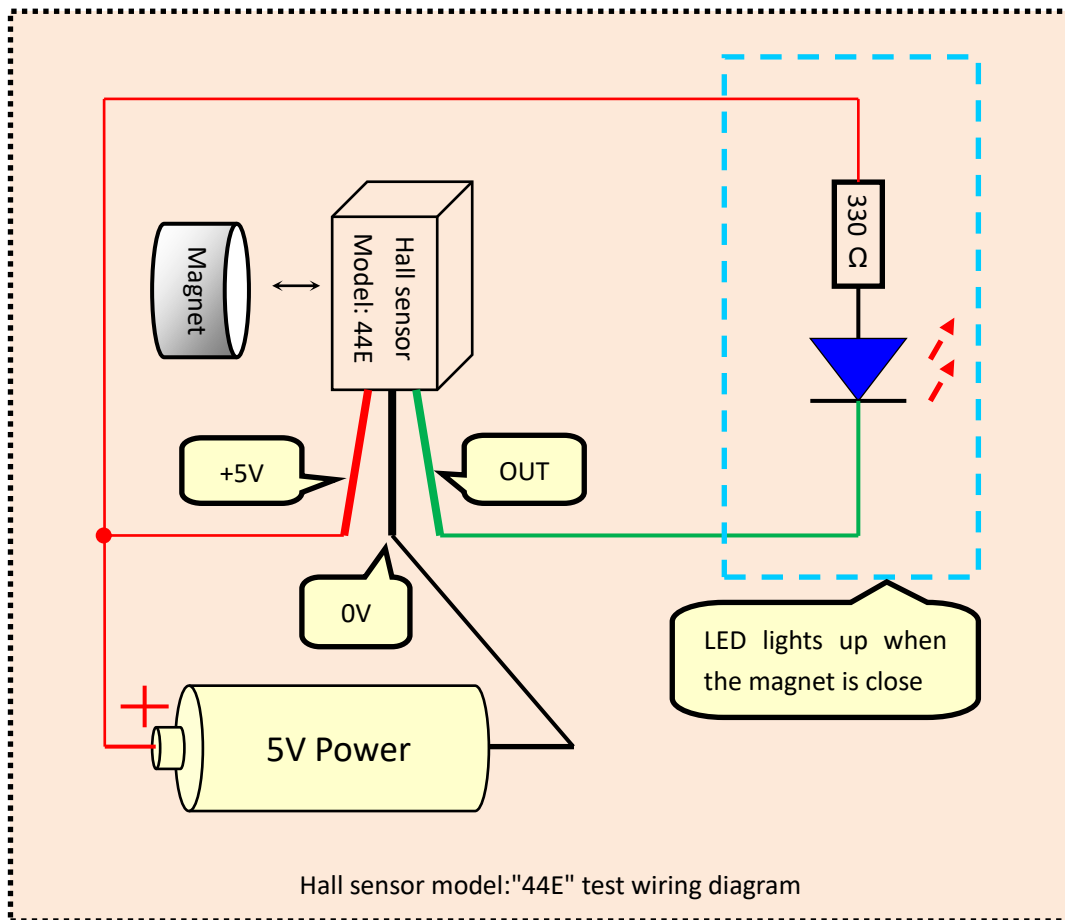
6.8.1.3 On-board 5V power supply, wiring of **NPN-5V** sensor speed signal:





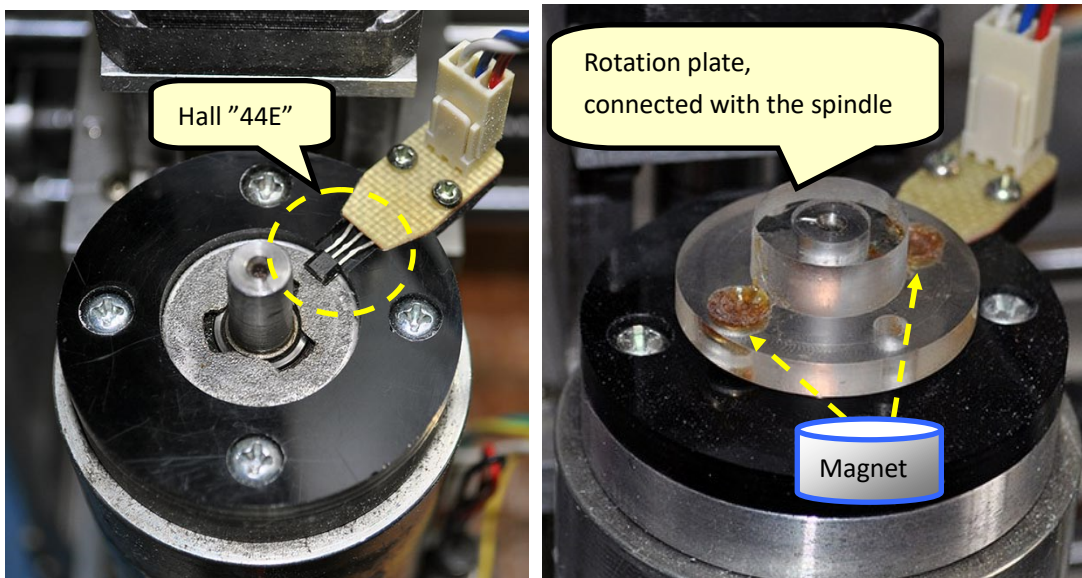
6.8.1.4 Example: Hall sensor "44E" (**NPN-5V** sensor) for speed measurement

Hall sensor "44E": 5V supply, open collector (OC) output, ie NPN-5V.



Hall sensor / Rotation plate installation diagram

Note: The magnet has a SN pole and should be adjusted during installation.





6.8.2 Mach3 measurement speed configuration

Start Mach3 and [select the external motion board](#), right click on the CNC icon, type the "Number of Pulses" in the settings dialog box, press OK to save the settings.

The screenshot shows the 'Motion Board Config (Plugin Version: 1.0.0.2)' dialog box. The 'ETHERNET' tab is selected, showing IP '192.168.1.77' and Port '5000'. The 'Spindle' section has 'Number of pulses per revolution - for speed measurement' set to '1'. A callout bubble points to this field with the text: 'One revolution per spindle, Sensor pulse number: Range: 1-65535'. Another callout bubble points to the 'OK' button. A third callout bubble points to the 'RPM' field in the Mach3 Spindle Speed display, which shows '6480'. A yellow callout bubble points to the 'RPM' field with the text: 'RPM: The measured speed will be displayed in Mach3'.

Mach3 measures the speed signal configuration as shown below: (Config => Ports and Pins=>Input Signals)

The screenshot shows the 'Engine Configuration... Ports & Pins' dialog box. The 'Input Signals' tab is selected. The table below shows the configuration for various signals:

Signal	Enabled	Port #	Pin Number	Active Low	Emulated	HotKey
Input #1	☒	1	0	☒	☒	0
Input #2	☒	1	0	☒	☒	0
Input #3	☒	1	0	☒	☒	0
Input #4	☒	1	0	☒	☒	0
Probe	☒	1	0	☒	☒	0
Index	☒	1	0	☒	☒	0
Limit Ovrd	☒	1	0	☒	☒	0
ESstop	☒	1	10	☒	☒	0
THC O	☒	0	0	☒	☒	0
THC U	☒	0	0	☒	☒	0

A callout bubble points to the 'Index' row with the text: 'Index: Tick "V" Enable Measures speed'. Another callout bubble points to the 'Active Low' column with the text: 'Ignore'. The 'Automated Setup of Inputs' button is visible at the bottom.



7. Digital output

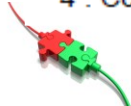
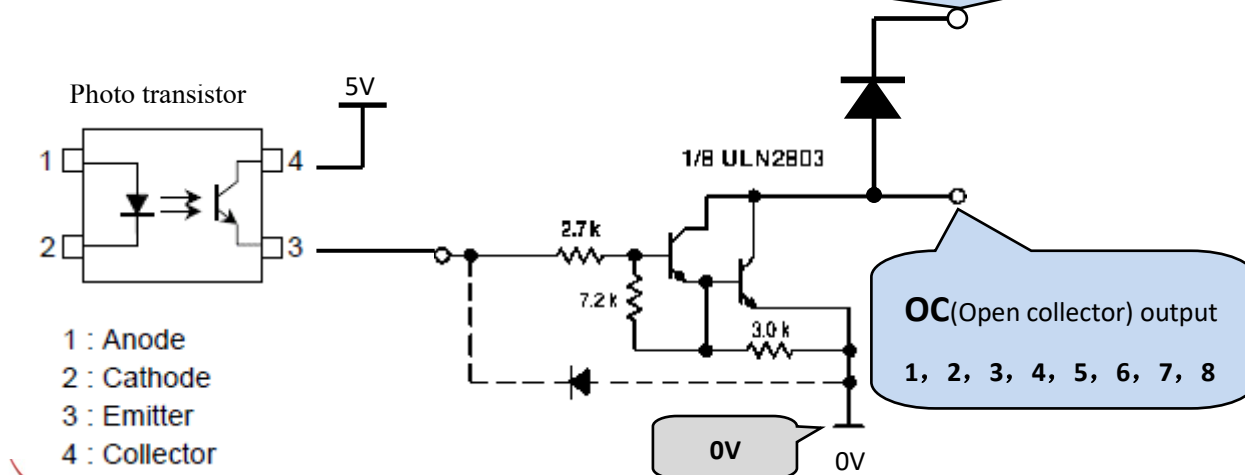


7.1 Interface characteristics of general digital output

Port **1** Digital Output: **OC**(Open collector) output x8, optocoupler isolation.

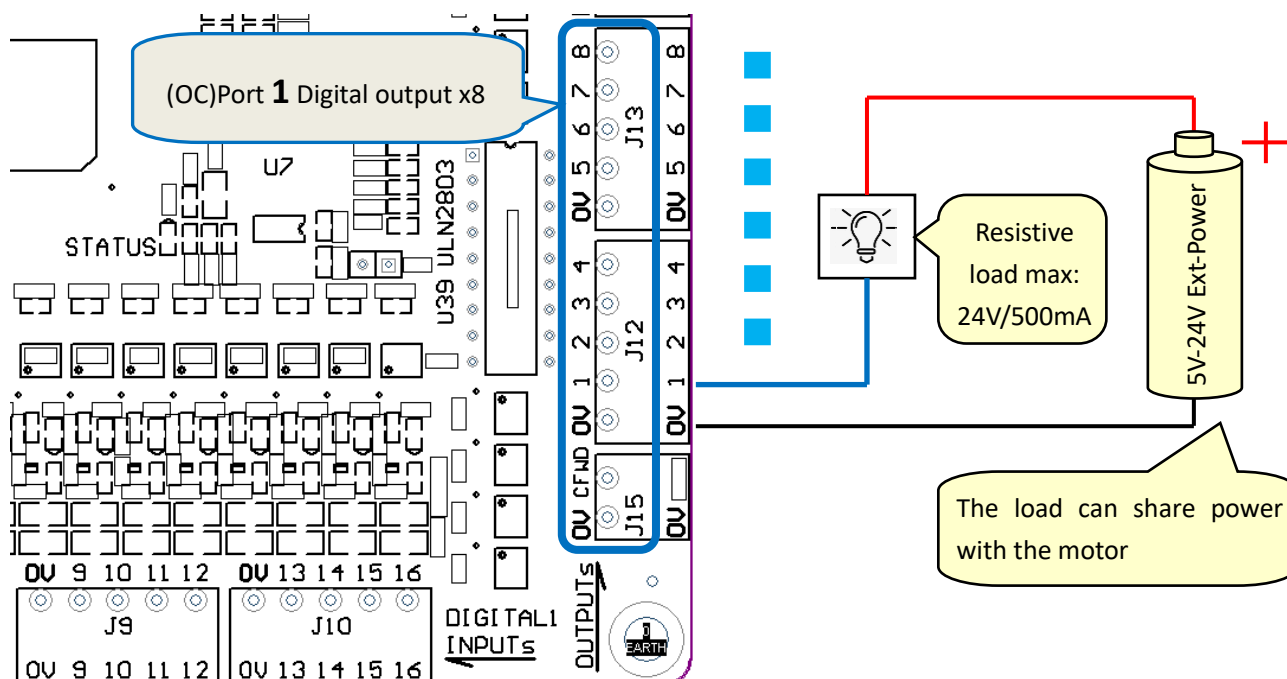
CFWD: Freewheeling diode common

When driving an inductive load, wire the positive terminal of the (load) power supply



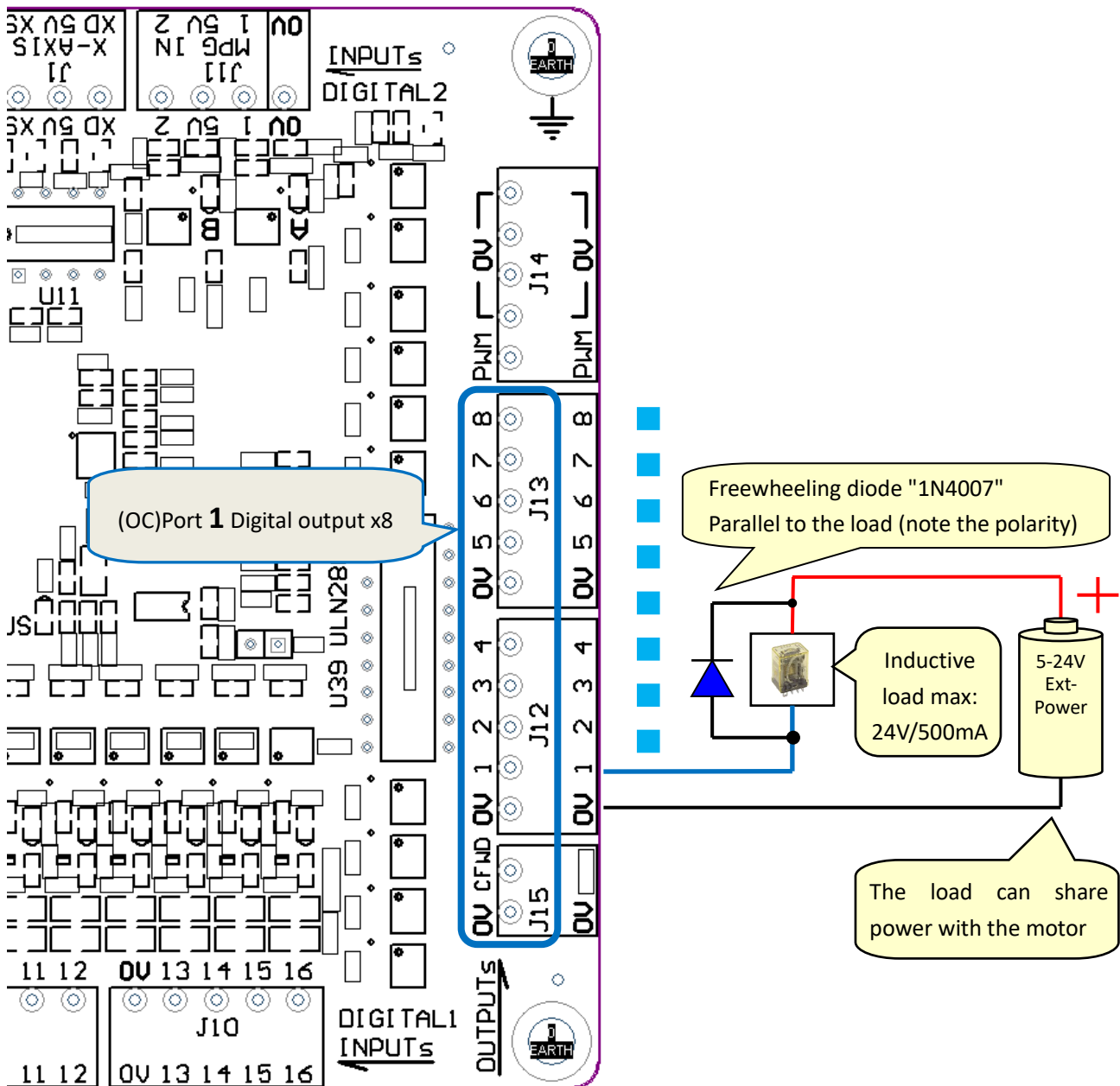
7.2 Wiring diagram

7.2.1 Driving **resistive load**





7.2.2 Driving **inductive loads** (such as relays, solenoid valves): installing **an external freewheeling diode**



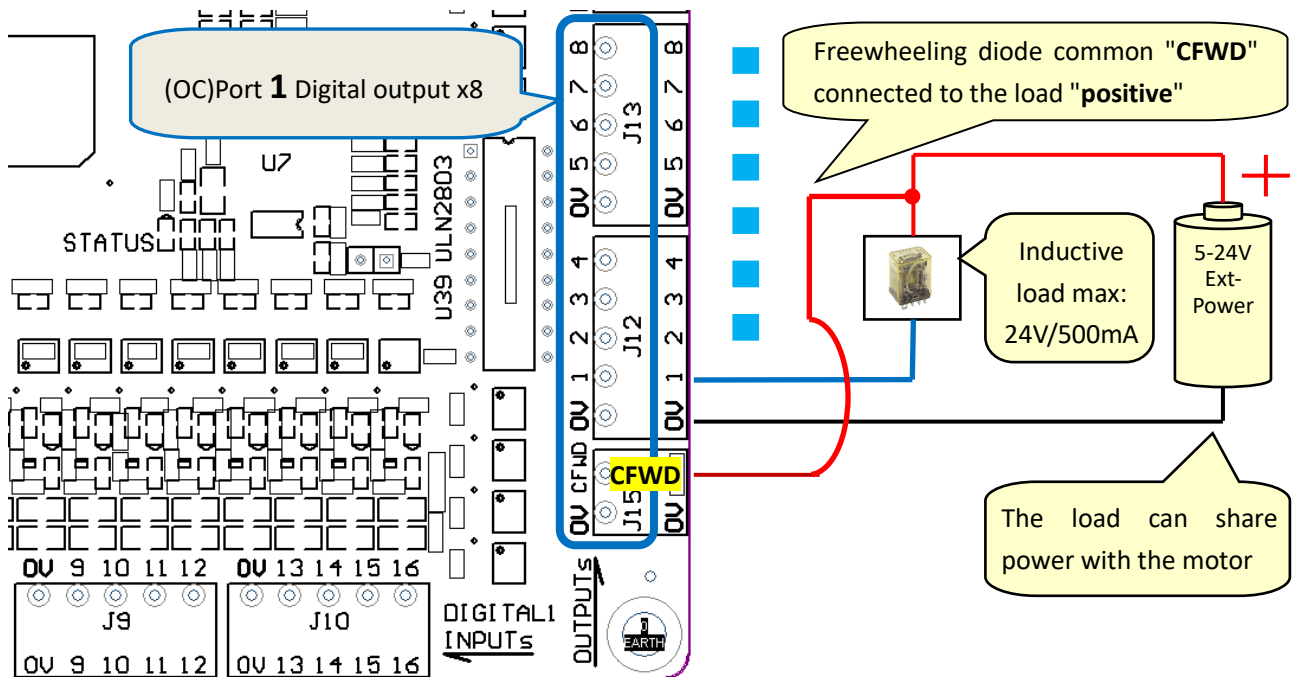


7.2.3 Driving **inductive loads** (such as relays, solenoid valves): use the internal freewheeling diode common terminal "**CFWD**" on the motion board



With the "CFWD" terminal, all loads can only be connected to the same external power supply.

With the "CFWD" terminal, the "inverter" cannot be connected because there is an additional separate power supply inside the "inverter" interface.



Note: There are 2 or more external power supplies for the loads. You cannot use "CFWD". An external freewheeling diode must be installed.

See: [7.2.2 Driving inductive loads: installing an external freewheeling diode](#)

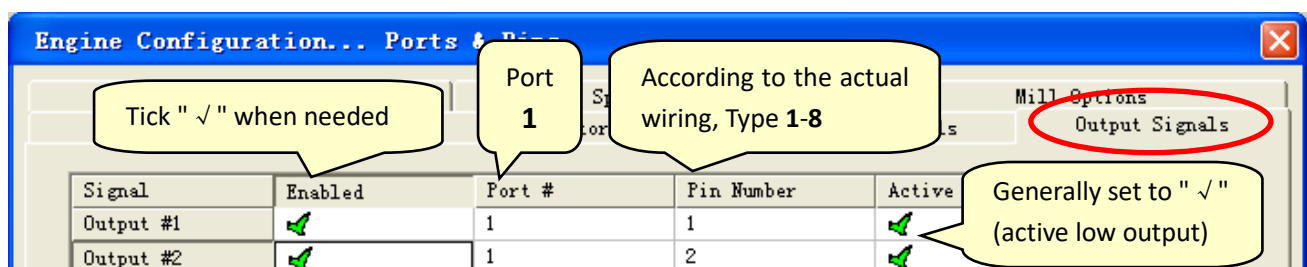
For example, the two output terminals of the Motion-board are connected to the inverter and the relay,

In this case, an external freewheeling diode must be installed for the relay (or inductive load).

Reasons for explanation: There is one independent power supply inside the inverter interface, and the relay also has one external power supply. There are two power supplies in total.

When the power is turned off, or when the power is suddenly turned off, the voltage drop speeds of the two power supplies are different, which may cause the inverter to trigger the operation by mistake, which may cause danger! (For example, changing a Tool). Install an external freewheeling diode (you cannot use "CFWD") to avoid malfunction caused by the interaction of the two power supplies.

7.3 Mach3 output signal configuration, as shown below: (Config => Ports and Pins => Output Signals)



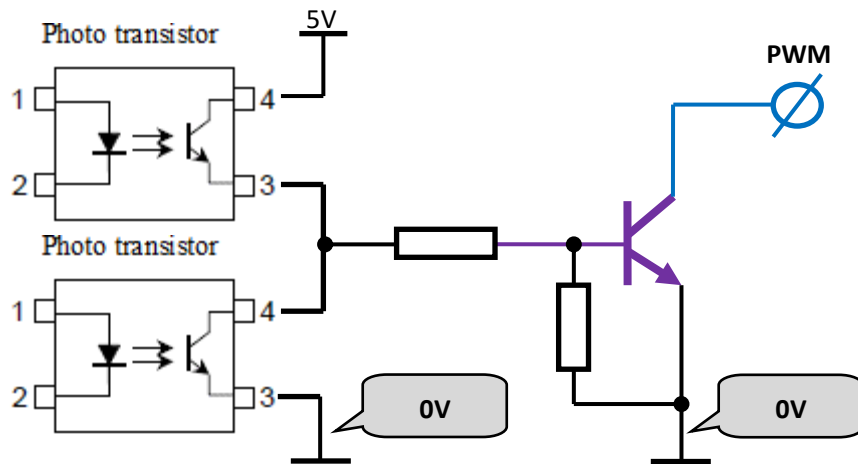


8. Spindle speed control analog output

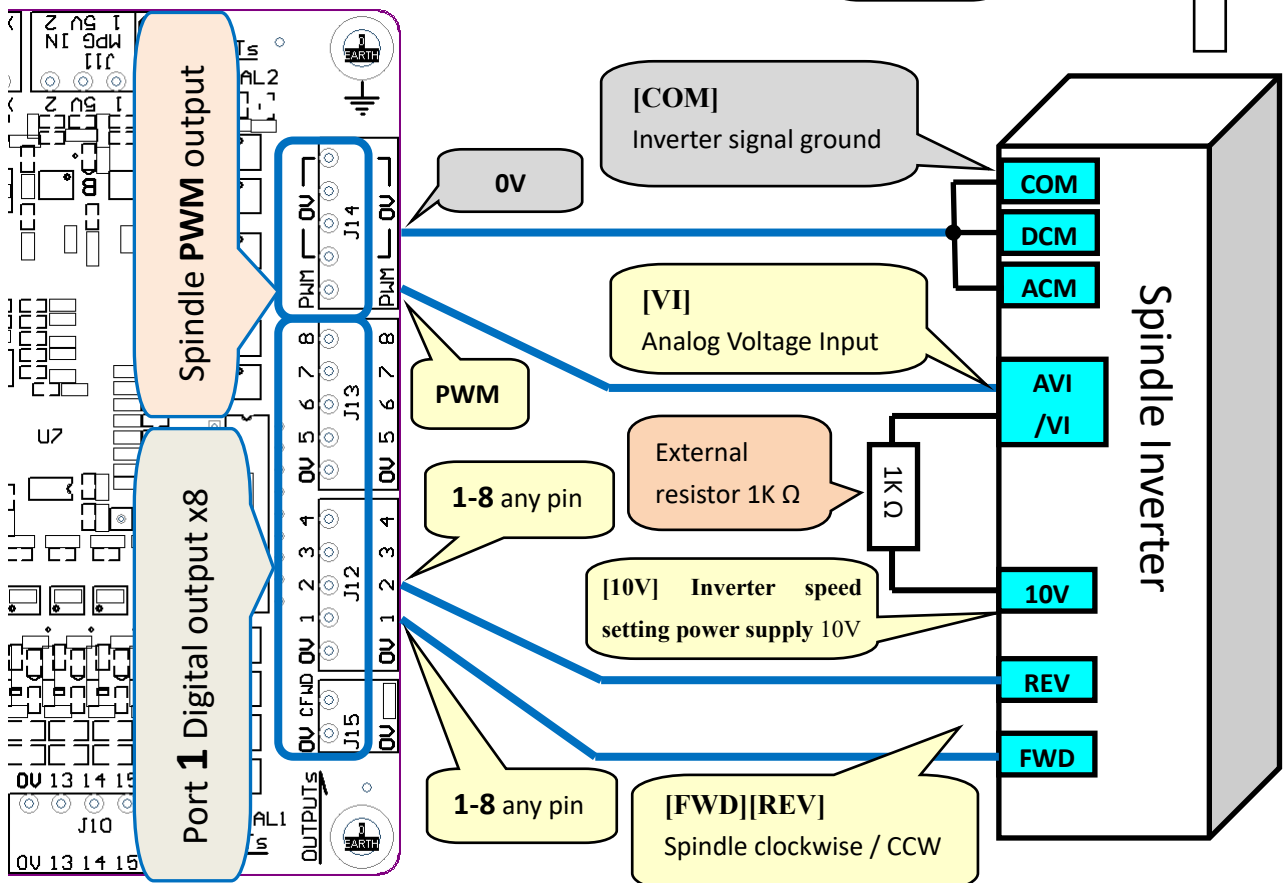


8.1 Interface Characteristics of PWM Output

PWM Analog (Pulse Width Modulation) output: **OC**(Open collector) output x1, optocoupler isolation.



8.2 Spindle Inverter Wiring

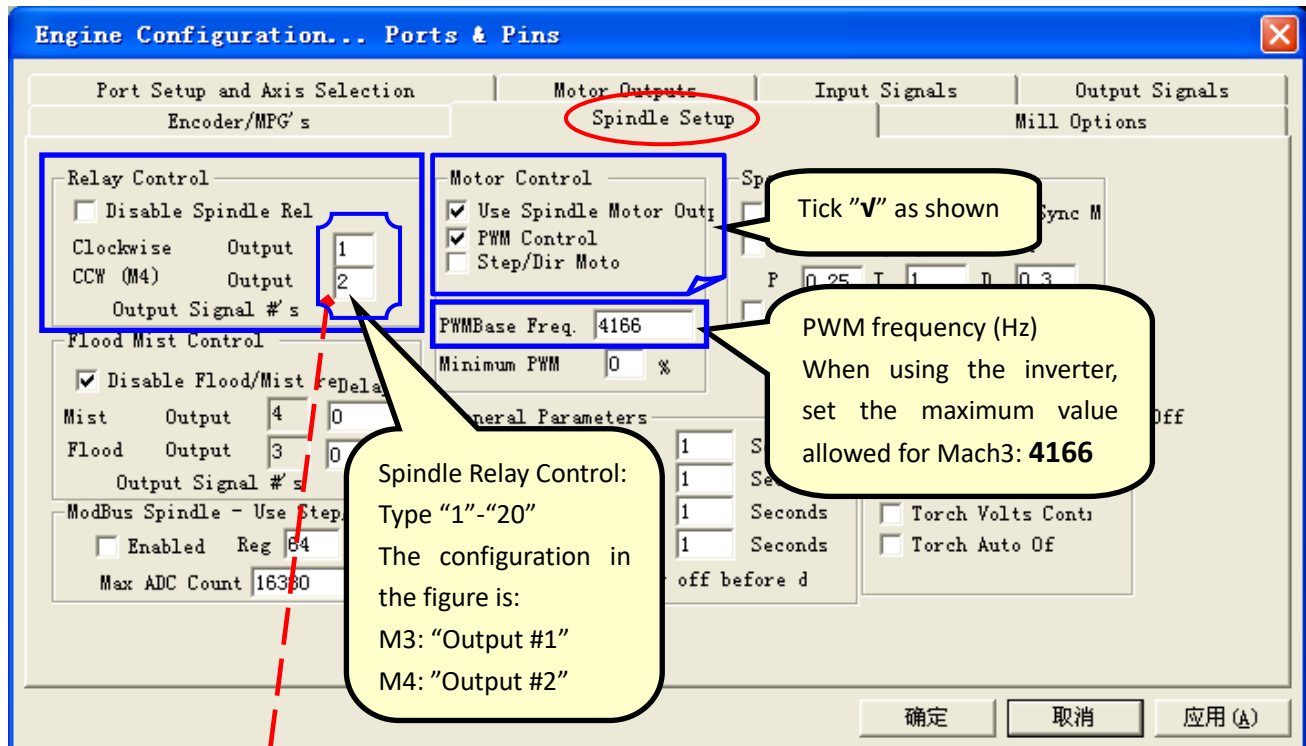




8.3 Configuration

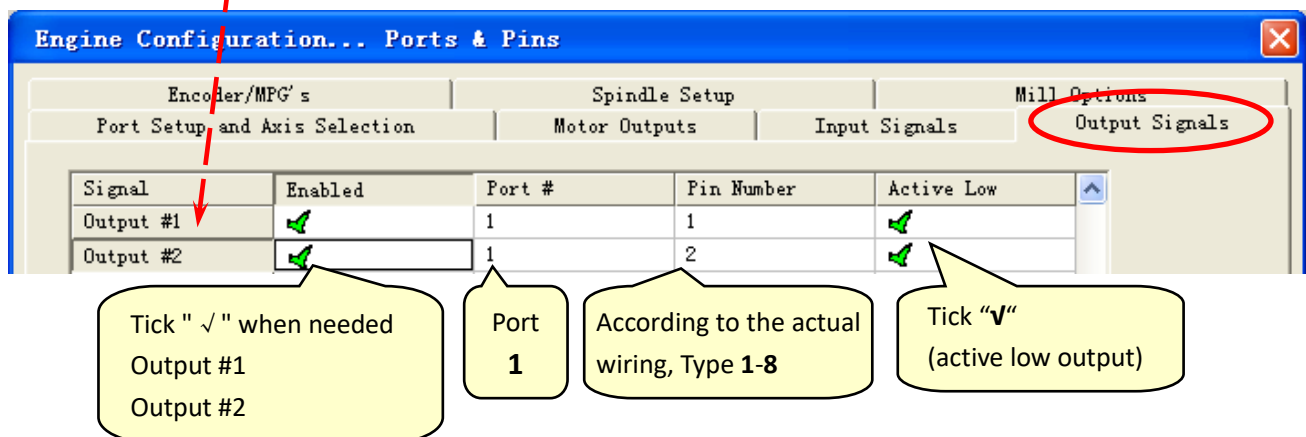
8.3.1 Mach3's Spindle configuration, as shown below: (Config => Ports and Pins=> Spindle Setup)

Tick "Use Spindle Motor Output" and "PWM Control", type the required frequency in "PWMBase Freq.", the unit is Hz.



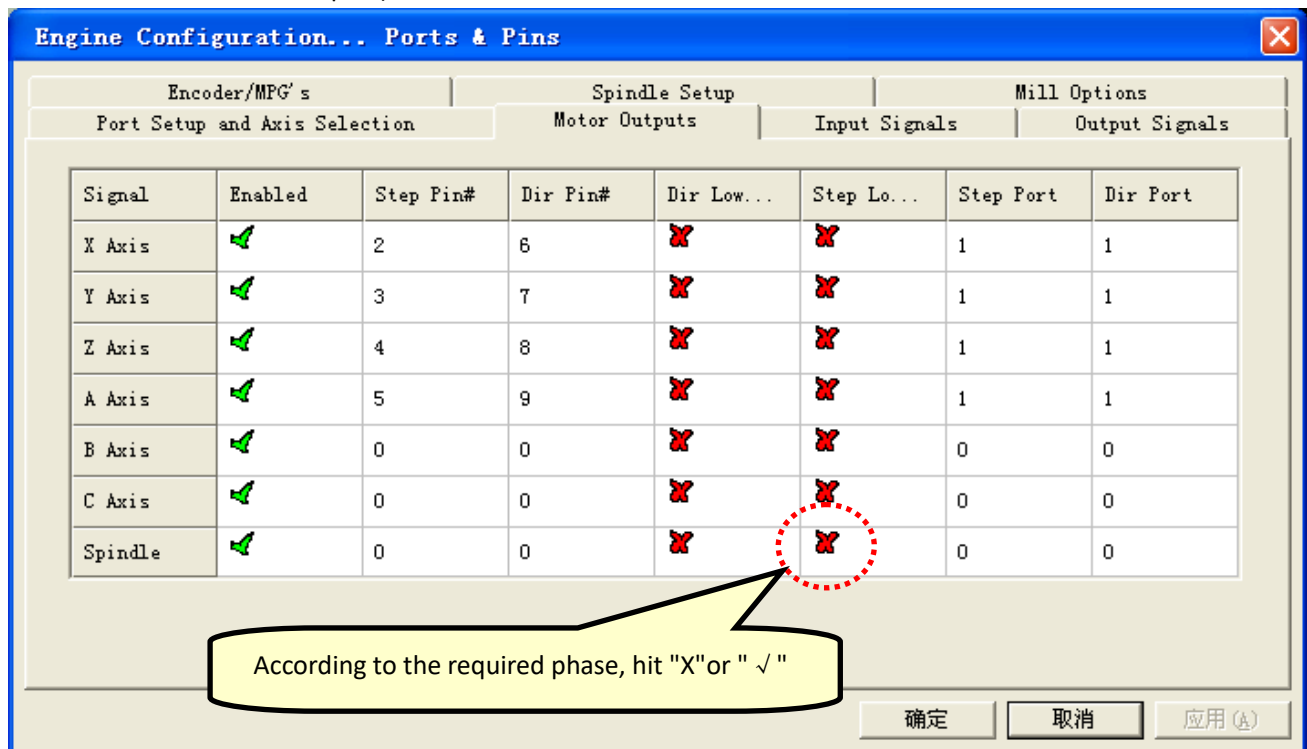
Output signal configuration "Output Signals",
Set the corresponding "Output #1—Output #20"

8.3.2 Spindle relay configuration, as shown below: (Config => Ports and Pins=>Output Signals)

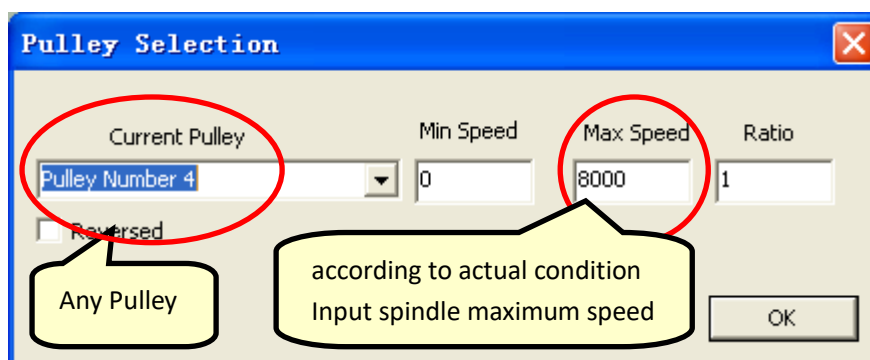




8.3.3 The **phase configuration of the spindle speed control signal PWM** is shown in the figure below: (Config => Ports and Pins => Motor Outputs)



8.3.4 Mach3 menu "Config => Spindle Pulleys..", "Pulley Selection"



8.3.5 For other configurations of the spindle, please refer to "**Mach3Mill_Install_Config.pdf**"

8.3.6 Spindle test

In Diagnostics (Alt-7) or MDI(Alt-2):

- Keyboard input "M3".
- Keyboard input "S10000", spindle starts to rotate. (When testing, it is recommended to use half of the maximum speed to avoid the phase setting error and the spindle does not rotate. After the spindle is running, adjust the speed. Adjust the [spindle phase setting](#) when the spindle speed is opposite to the set speed)
- Keyboard input "M5", the spindle will stop rotating.



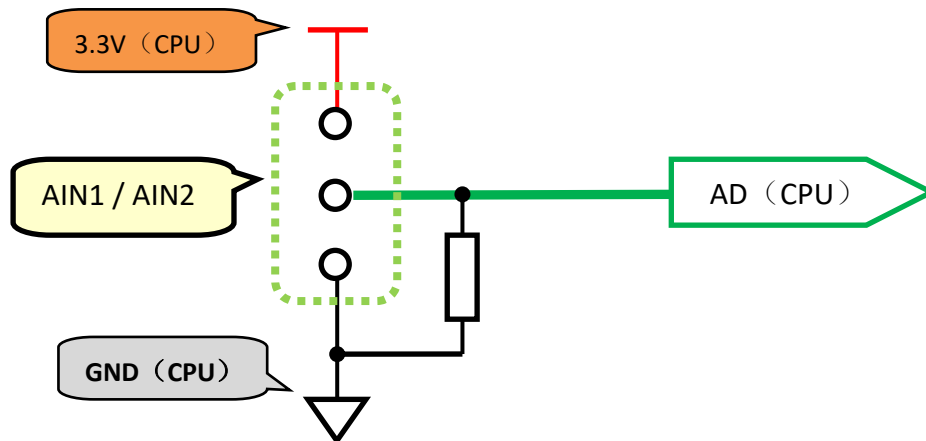


9. External Adjustment Knob



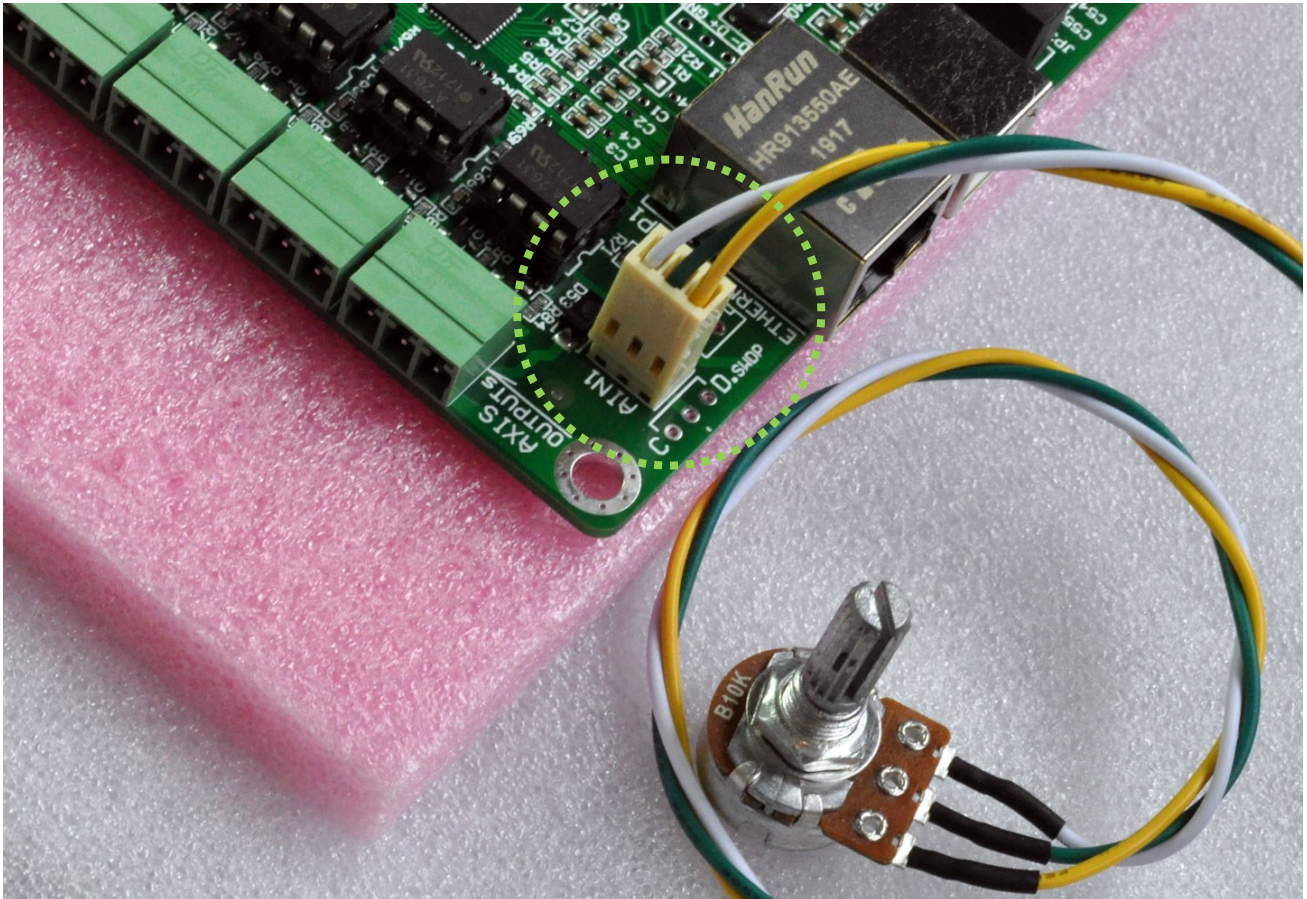
9.1 Interface characteristics of analog input

AIN1、AIN2 analog input port: 0 - 3.3V, **non-isolated**



9.2 Wiring diagram

Connecting the adjustment-knob with the AIN1 of Motion board

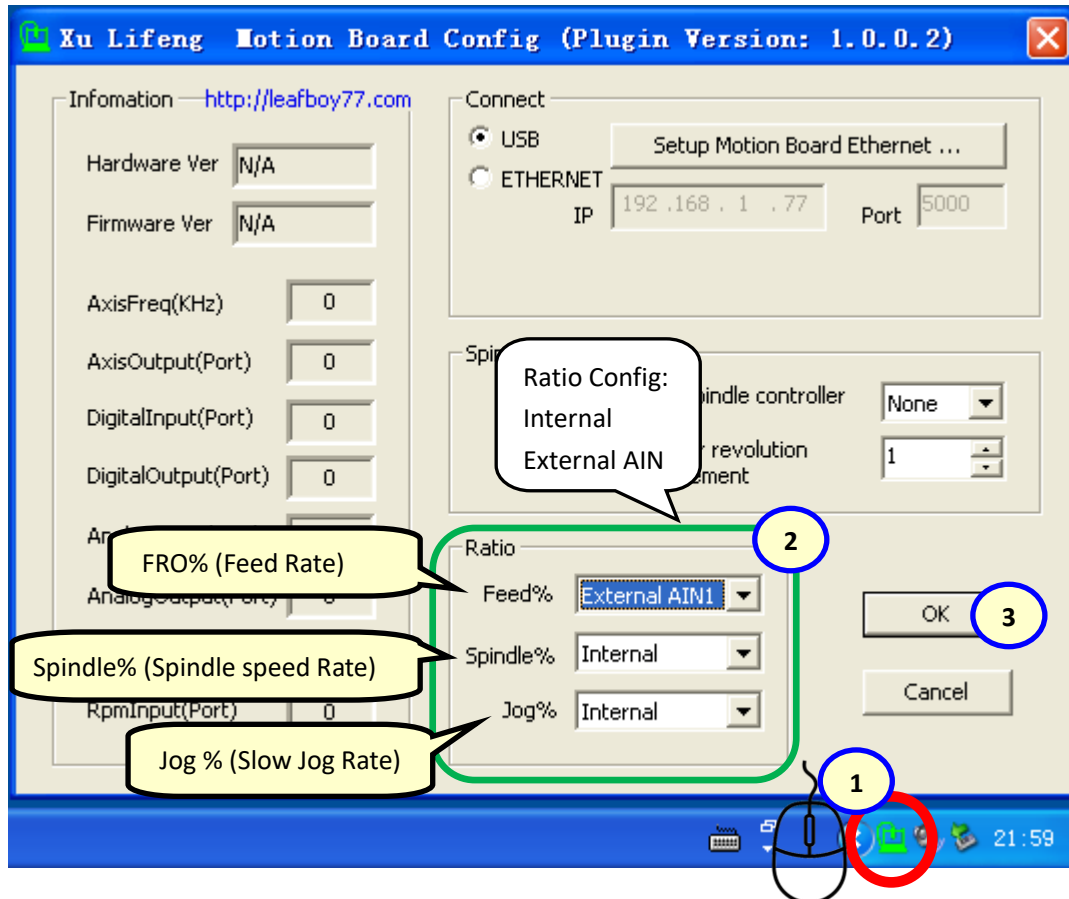




9.3 Configuration

Start Mach3 and select the external motion board. Right click on the CNC machine icon, setting dialog will be shown. You can select one of the functions which is able to controlled by the external knob.

Please select "External AIN1" in your particular setting.



Then, click "OK" to exit.

Now, you can try to turn the knob to adjust your selected function.

