



## **MACH3 USB Card for Beginner**

**NVUM\_SK**

**Manual**

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## Chapter 1. Introduction

### 1.1 Product Introduction

Novusun CNC has engaged in the Numerical control industry for 7 years, specialized in the research, development and production of various CNC controller systems with high quality and high reliability. We produce the Brushless DC motor, Stepper motor driver, and also 1 to 6 axes CNC motion controllers.

NVUM\_SKv1.1 is the 4axis motion controller we spend 4 years to design.

NVUM\_SKv1.1 support Mach3 software . through USB to communicate with computer.

NVUM\_SKv1.1 motion controller adopts the ARM design framework. The ARM design includes communication,codeanalytic,underlying algorithm and pulse generation. Rational design, reliablecontrol, convenient operation.

This manual introduces operation, connection and usage schedule of our professional motion controller for engraving machine. Through a lot of the drawing the users can learn quickly how to use this motion controller.

### 1.2 Products specification

- ◆ Support USB;
- ◆ 8 ports photoelectric isolated input interface for ordinary digital data;
- ◆ 3 ports photoelectric isolated output interface for ordinary digital data;
- ◆ 1 port 0-10V spindle speed analog output interface(can change to PWM output);

- can support 4 axis stepper systems,100KHz pulse output for every axis;
- ARM motion control chip;

### 1.3 Products Appearance and size

NVUM\_SKv1.1 motion controller is with simple structure, there are 4pcs setting holes at the bottom. We can fix 4pcs 4mm diameter holes at the cabinet, and install the controller into the cabinet. The controller appearance as the Figure 1-1 and Figure 1-2 show:

The products overall size is 69mm\*52.5mm;

The bottom install size is 61.7mm\*45mm。

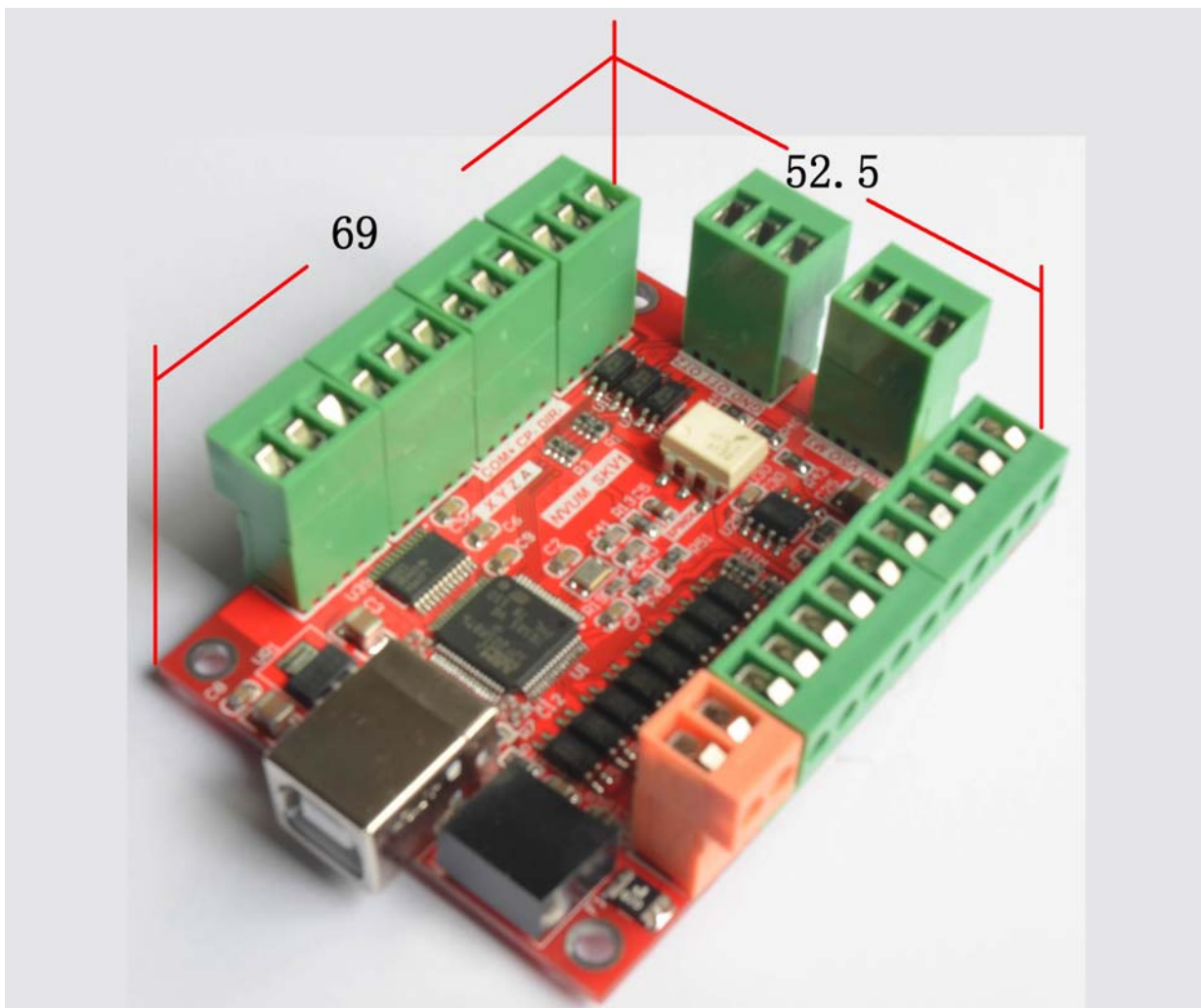


Figure1-1. NVUM\_SKV1.1 front appearance and size

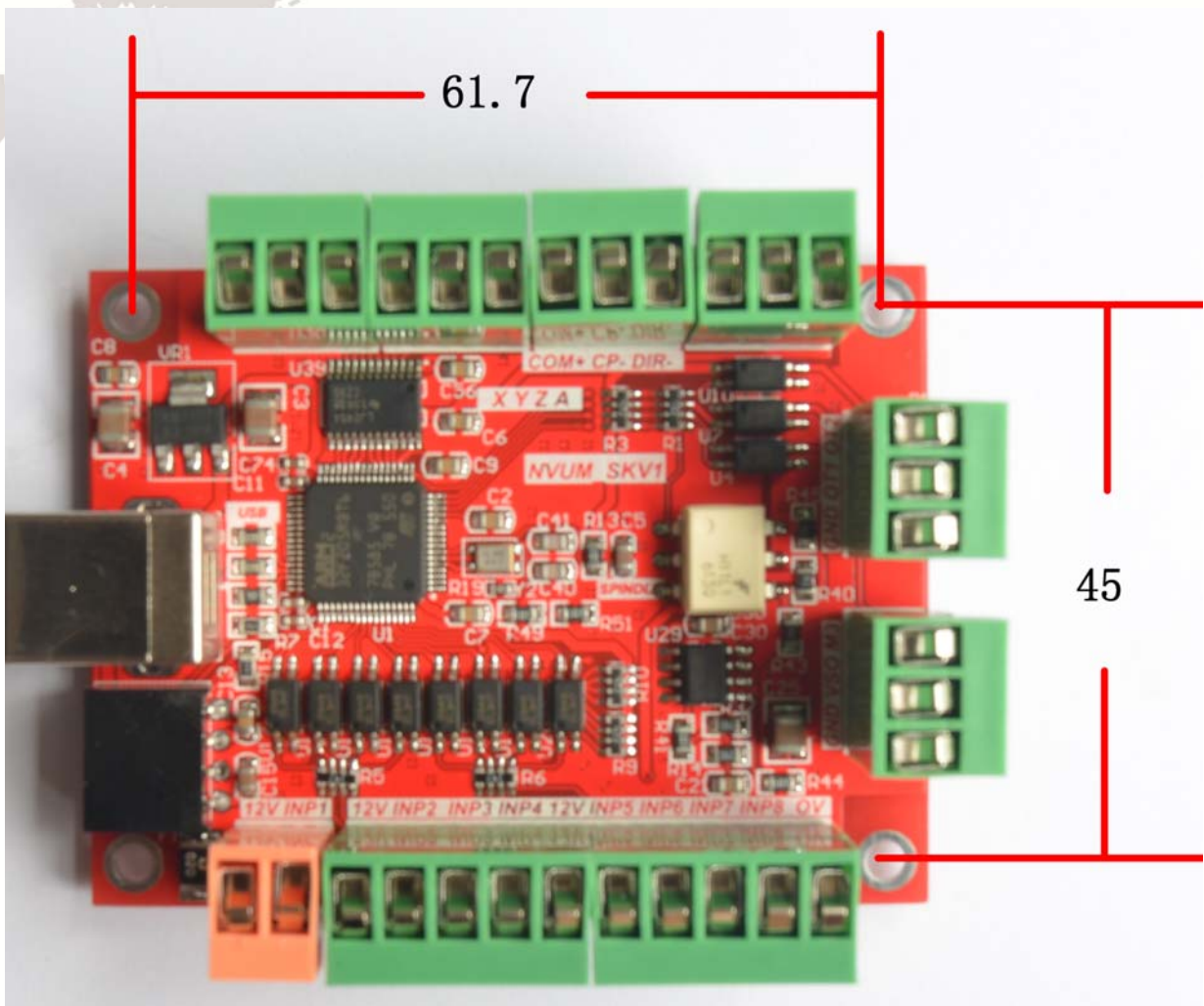


Figure1-2. The installation dimensions

## 1.4 substantial explanation

When operate the NVUM\_SK, where will be a lot of English abbreviation, now we list all of them for your kindly references:

FRO: Feeding adjust: During the operating process, the F value already set, and need to adjust the current feeding speed, then we can adjust FRO value to realize it.

SRO: Spindle speed adjust: During the operating process, the S value already set, and need to adjust the current spindle speed, then we can adjust SRO value to realize it :

Current Speed  $S\# = \text{setting } S * SRO$ .

SRJ: speed adjust manually

During the operating process,as the manual speed already set,and we need to adjust the current speed,and impossible to fix the value during it is working,then we can revise the SRJ value to realize it.

Current manual speed  $FS\# = \text{Setting manual speed} * SRJ$ .

F:Feedingspeed,the unit is mm/min.For example  $F=200$ ,means every minute feeding 2000mm.

S: Spindle Speed. Unit is rad/min.For example  $S=20000$ ,means 20000 revolution/Minute.

X axis Coordinate

Y axis Coordinate

Z axis Coordinate

A axis Coordinate

## 1.5 Noting and Waring



Free from exposure to the electronics without waterproof function. Please environment as dry as possible. This is the icon.



Wiring warning, the IO input terminal of this equipment support the equipment with source switch (such as Inductive proximity switch.) When using such kind of switch, attention please: avoid the +terminal and -terminal of power supply to connect with GND. This equipment's analogy quantity output terminal of spindle control also have a certain load capacity. Please avoid this terminal connect with GND. In case that the interior components and parts be broken down.



Operation warning, Please do the security measures well when connecting with the machine tools. The ESTOP, limit and other things must be perfected. When comes across the emergency, please press the ESTOP key at once or cut off the power directly, thus avoiding the equipment damage and casualty.



High voltage danger, the primary device is 18-32VDC power supply. Voltage equipment. Pls pay attention to the electricity, safety when conducting the operation

## Chapter 2 | Connection

### 2.1 Device Power supply Solution

The power supply solution in the field of the Industrial automation is always very complicated, there is a lot of the GND, now we describe the structure of the power supply as below:

The power supply structure as the Figure 2-1, main power supply input and stepper control output module are common GND, Limited and Estop input module and Spindle speed adjust M3/M8/M10 module are common GND, between main power supply and output module there are photoelectric isolation. The inputs of limited switch and Estop and so on are Common anode, inside of the device, there is +12VDC as common+, no need to connect external power supply. Based on the reference of output GND interface, output a 0-10V adjustable voltage to adjust the the spindle speed, M3/M8/M10 digital output interface is open-GND. If connect an external relay, need to output GND to refer to, and give the relay an external power supply.

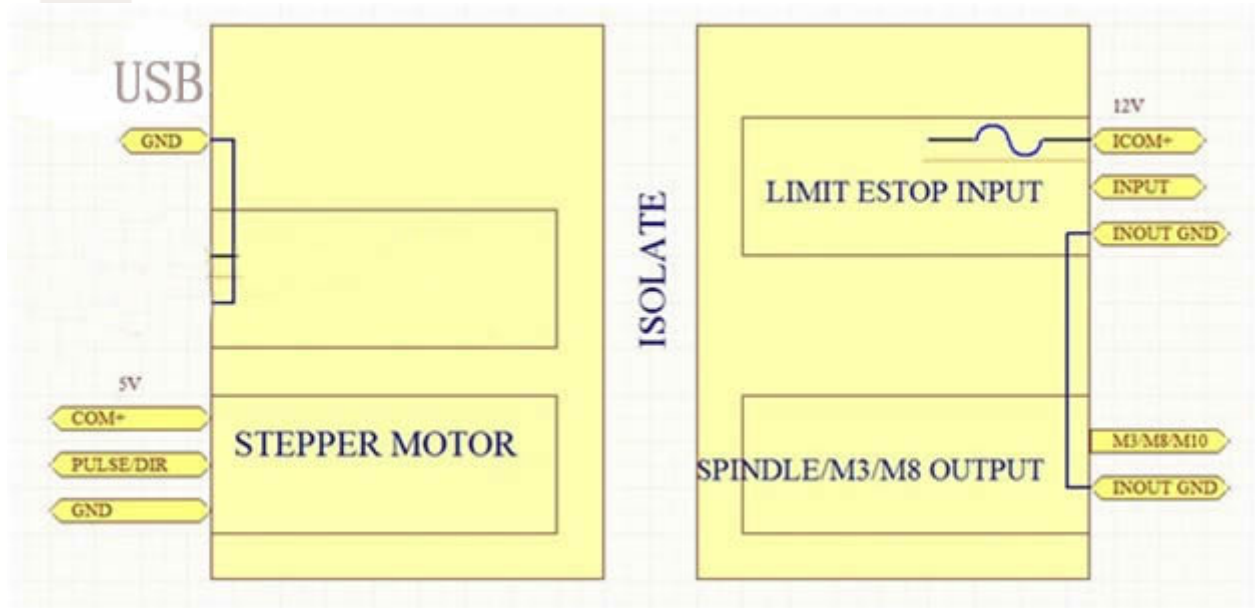


Figure2-1. Power supply structure of NVUM\_SK



**2.2 Product connection define and method**

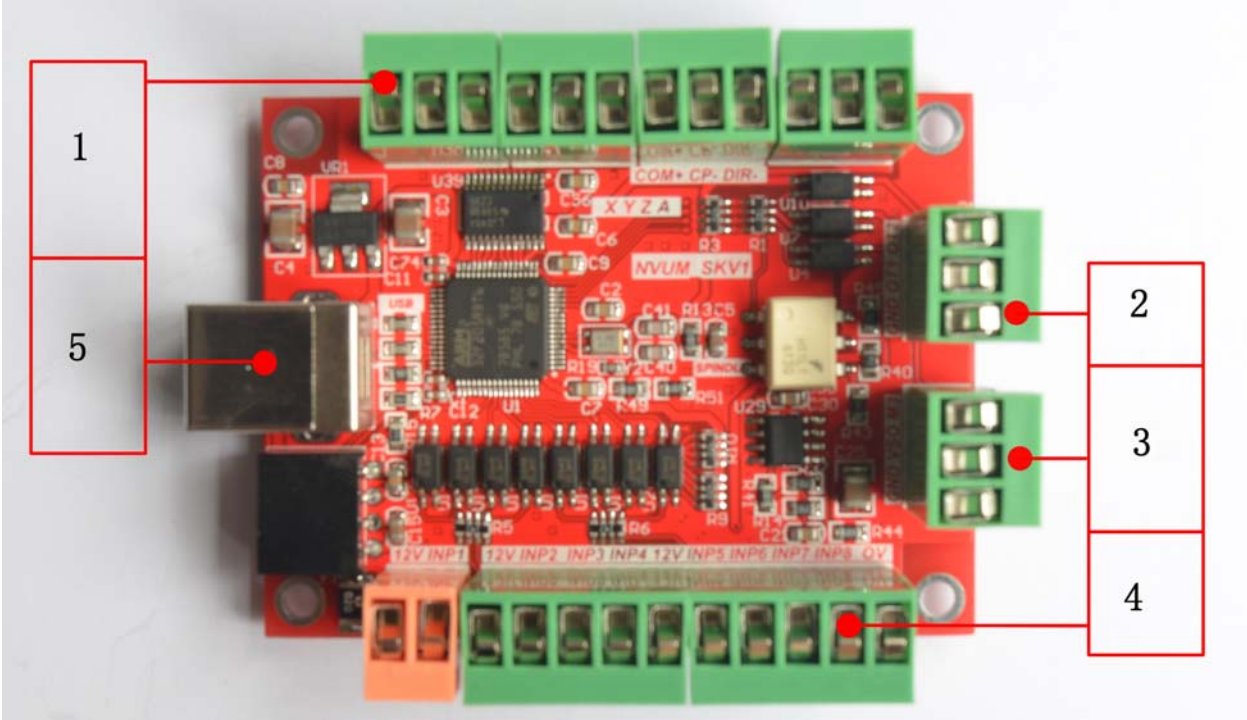


Figure2-2. Product wiring section and interface summary

As the Figure 2-2 shown, the connection of the controller includes USB connection interface, Stepper/Servo control output interface, spindle control output interface, Estop and limited switch and tool setting input interface and so on. Now we descript them in details as below.

**2.2.1 Stepper motor control interface**

As Figure 2-2 shown, No.1 terminal block is 4 axis stepper driver control output interface, from left to right, there are X,Y,Z,A,4 axis output, it's common positive, the cable connection for each axis is COM+/CP-/DIR-, COM is common+, CP is Pulse-, DIR is direction-. Connection shown as Figure 2-3. COM+ connect with the SP+ and DIR+.

Pin mark	Axis	Definition
COM+	Common+	common anode +5V
CPX-	X axis	Pulse output- for X axis

<b>DIX-</b>	X axis	Direction output- for X axis
<b>CPY-</b>	Y axis	Pulse output- for Y axis
<b>DIY-</b>	Y axis	Direction output- for Y axis
<b>CPZ-</b>	Z axis	Pulse output- for Z axis
<b>DIZ-</b>	Z axis	Direction output- for Z axis
<b>CPA-</b>	A axis	Pulse output- for A axis
<b>DIA-</b>	A axis	Direction output- for A axis

Table 2-1. Stepper driver control interface define

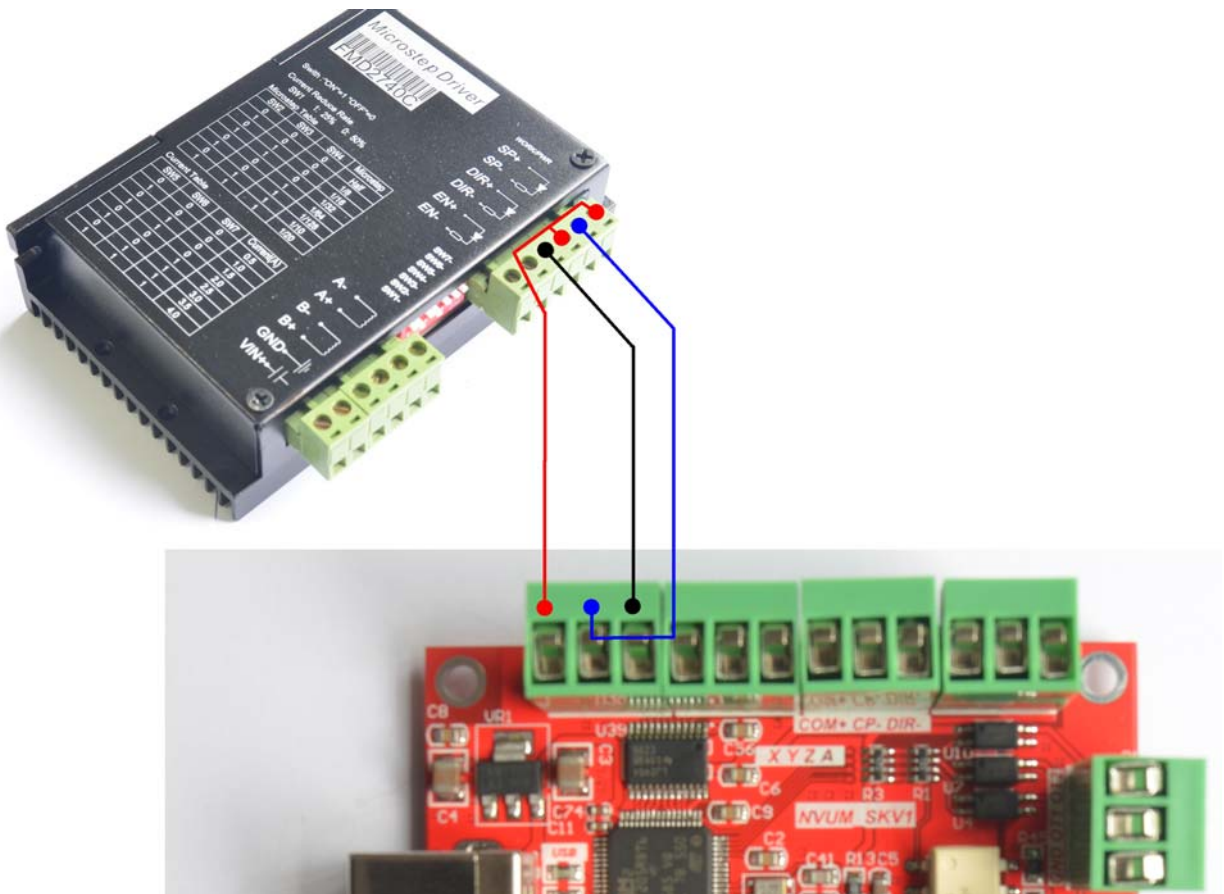


Figure 2-3. Stepper driver connection

### 2.2.2 Common IO output interface

See as Figure 2-2, The port marked 2 is Common IO output interface. Include GND\OUT1\OUT2 from down to up, open drain output, internal structure as Figure 2-4:

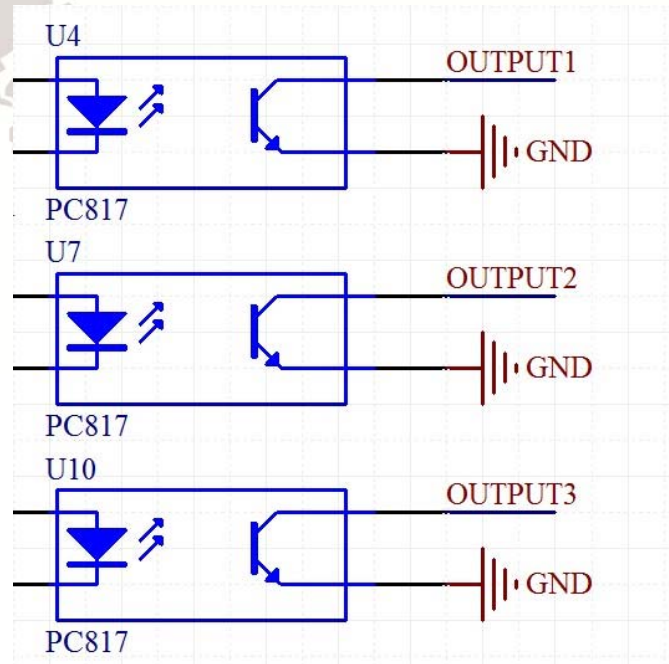


Figure2-4. OUT1-OUT3 internal structure

Now just make a switch between OUTX(X=1-3) and GND, to control the relay output, the connection as the Figure 2-5. External power supply need to accord with the relay specification, the internal optocoupler GND open circuit only can absorb less than 50mA current, if relay absorb the current over 50mA, pls add current amplifier. In the Figure connect with OUT1, the others similar.

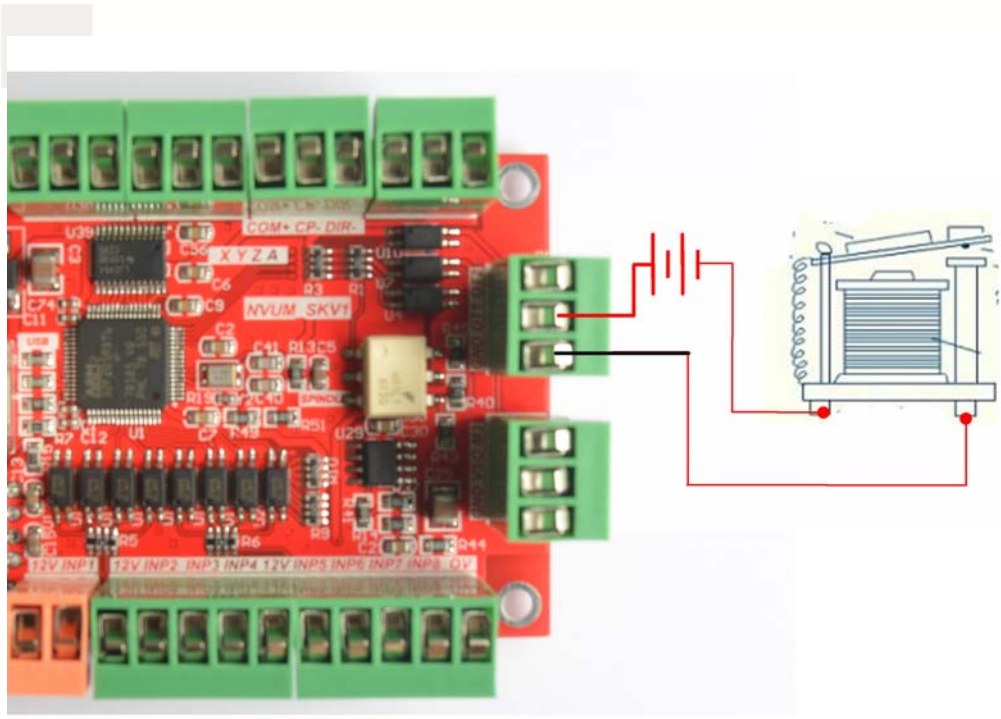


Figure2-5. OUTX connect with external relay method

### 2.2.3 Spindle control output

We define the interface from left are: INDS(spindle speed feedback input), VSO(0-10V adjustable speed output), M3(Spindle run switch), GND1(Output GND).

Take Nowforeuer inverter as the example. Spindle control output and the inverter connection shown as Figure 2-6.If ACM and DCM are closed, only need to connect one port.

If need the Mach 3 to show the real in time spindle speed,just fix one hall device, every revolution send one pulse between INDS and GND1,pulse voltage is 5V-10V.

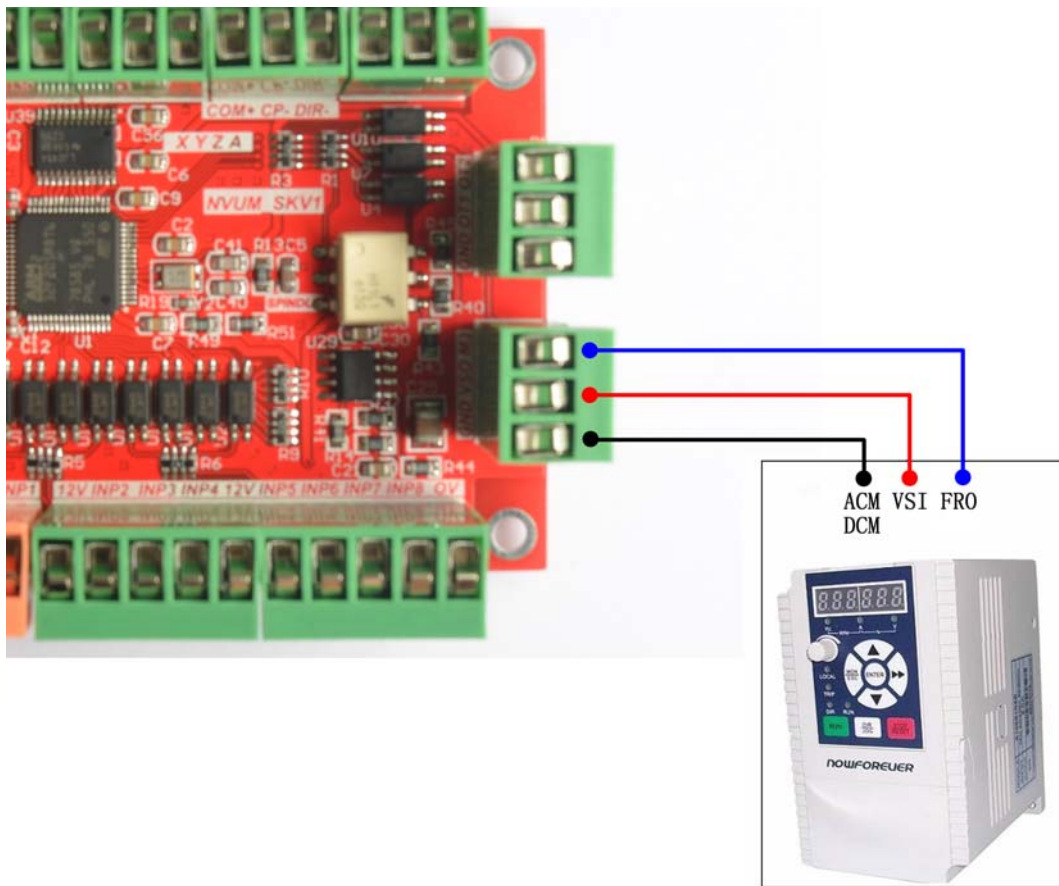


Figure2-6. spindle control output and inverter connection

VSO real output voltage= $10V \times \text{spindle setting speed} / \text{max spindle speed}$ . For example, if max spindle speed is 24000,current spindle speed is  $S=18000$ ,so the VSO output voltage= $10 \times 18000 / 24000 = 7.5V$ .

Max. spindle speed setting ports as shown as Figure 2-7,open it from Pulley from Menu

config. The current spindle speed can be set by S directive or Mach 3 spindle setting speed module.

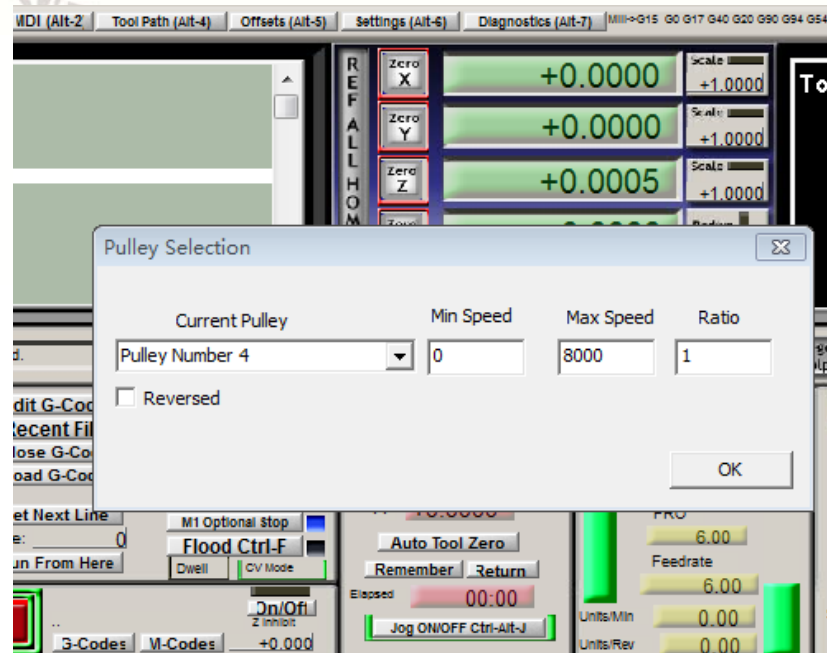


Figure2-7. Max spindle speed setting position

### 2.2.4 Estop limited Tool setting input interface

.As the Figure 2-2 shown, Marked No. 5 position is the Estop limited ect. they are the optical isolated Input interface, from the left, there are 12V, INP1, INP2, 12V, INP3, INP4, INP5, INP6, 12V, INP7, INP8, INP9, INP10, GND. Internal structure Figure of Input interface see as

Figure 2-8.

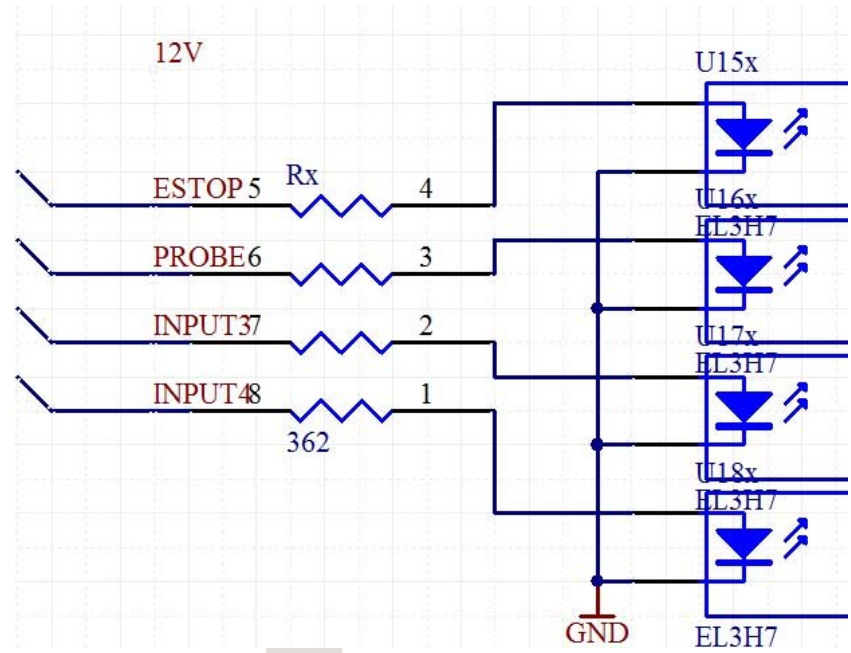


Figure2-8. Internal structure drawing of Input interface

2 lines Proximity Switch/ordinary fretting switch/ESTOP/probe drawing see as Figure 2-9

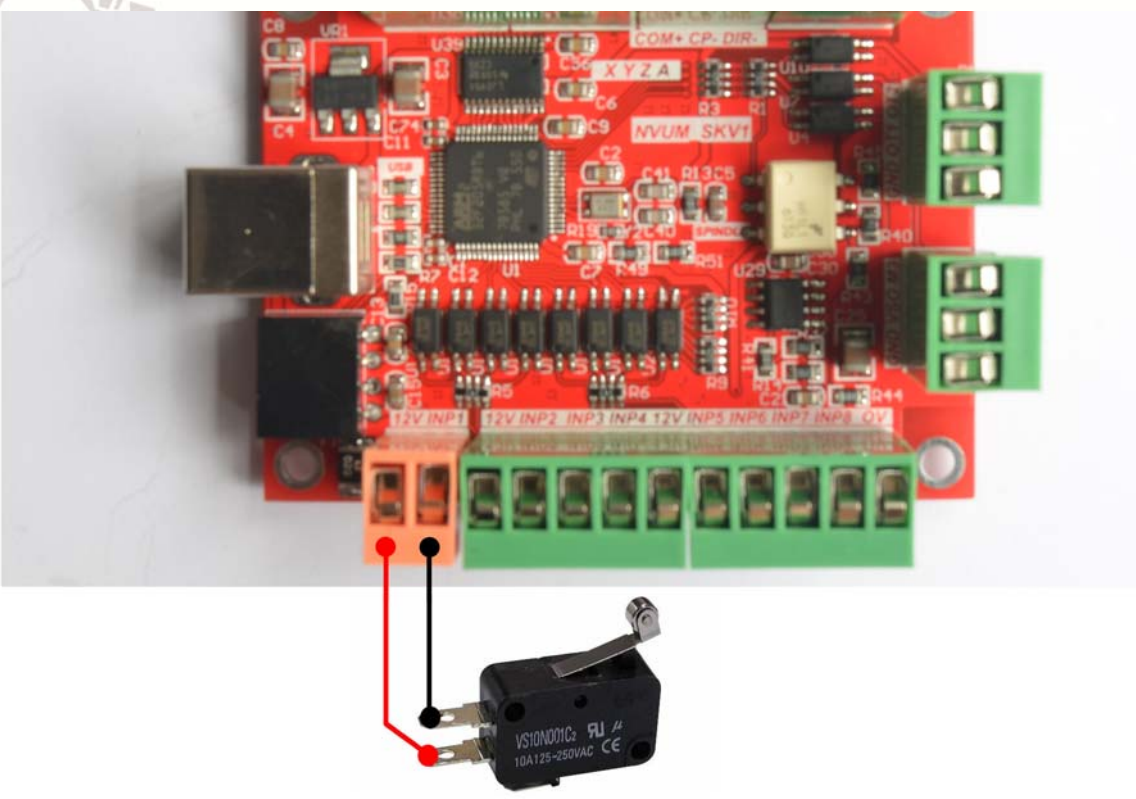


Figure2-9. 2 lines Proximity Switch/ordinary fretting switch/ESTOP/probe drawing

3 lines Proximity Switch connection Figure 2-10,brown cable for Proximity switch connect with 12V,Black cable connect channel,blue cable connect with GND1.

Only support PNP 3lines proximity switch.

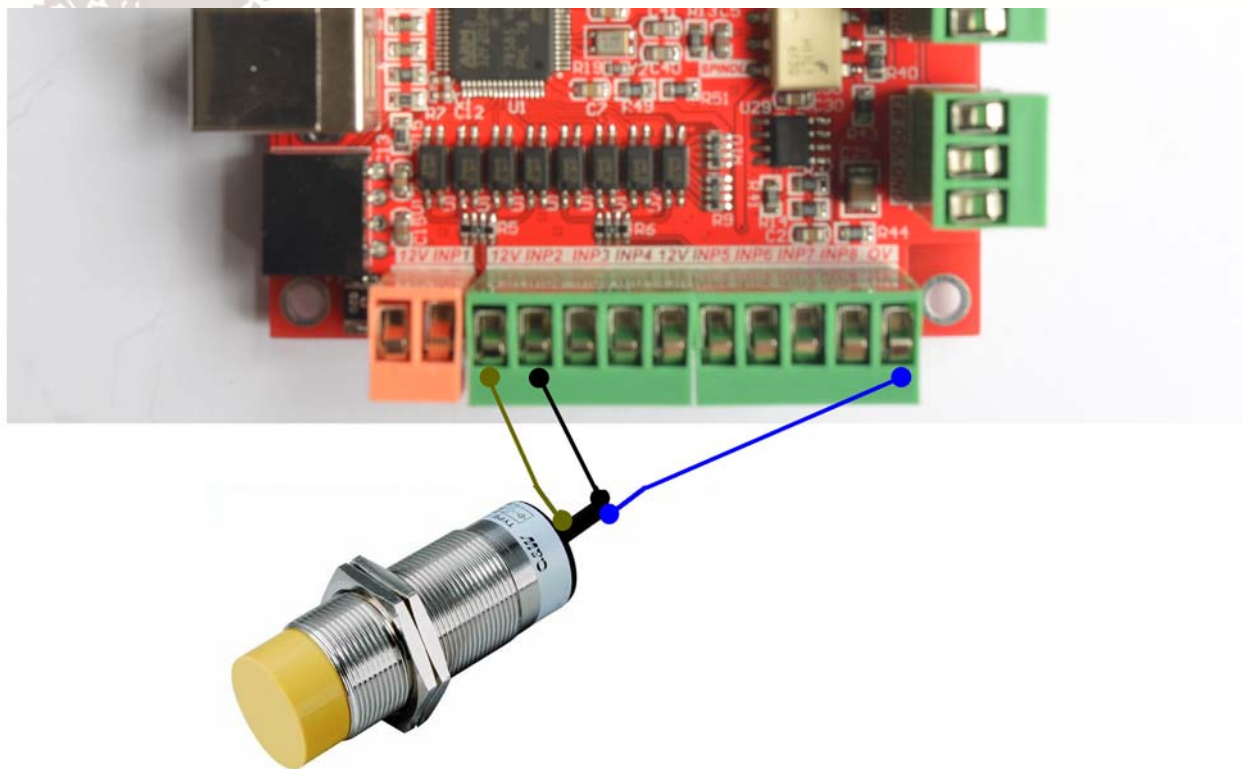


Figure2-10. PNP 3 lines Proximity Switch connection drawing

### 2.2.5 USB Port

As the Figure 2-2 show, The marked No. 5 port is USB communication port, NVUM\_SK communicate with mach 3 through it.



## Chapter 3.

# Software Installation

### 3.1 MACH3 Install

When you purchase our product, we will supply a CD-ROM, which contains the MACH3 installation, registration, and USB plug-ins. See as Figure 3-1

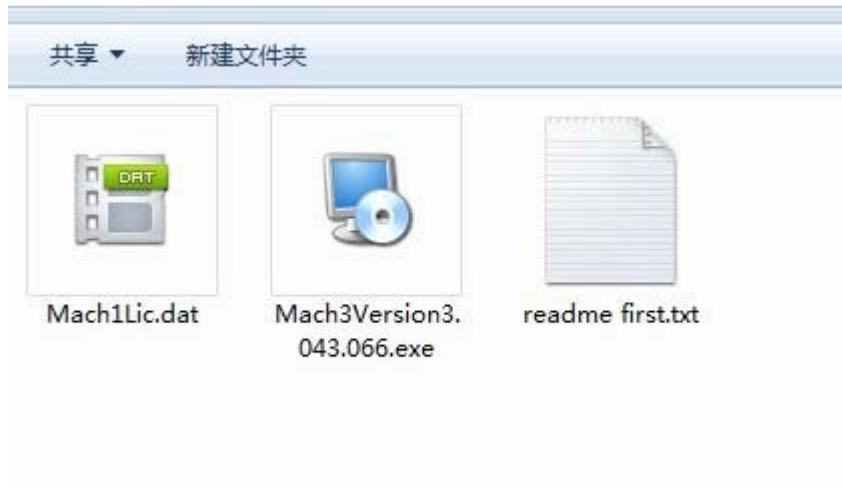


Figure3-1. MACH3 soft installation

First run the installation Mach3Version3.043.066 page. See as Figure 3-2.



Mach3Version3.043.066  
Setup Application

.Into the first



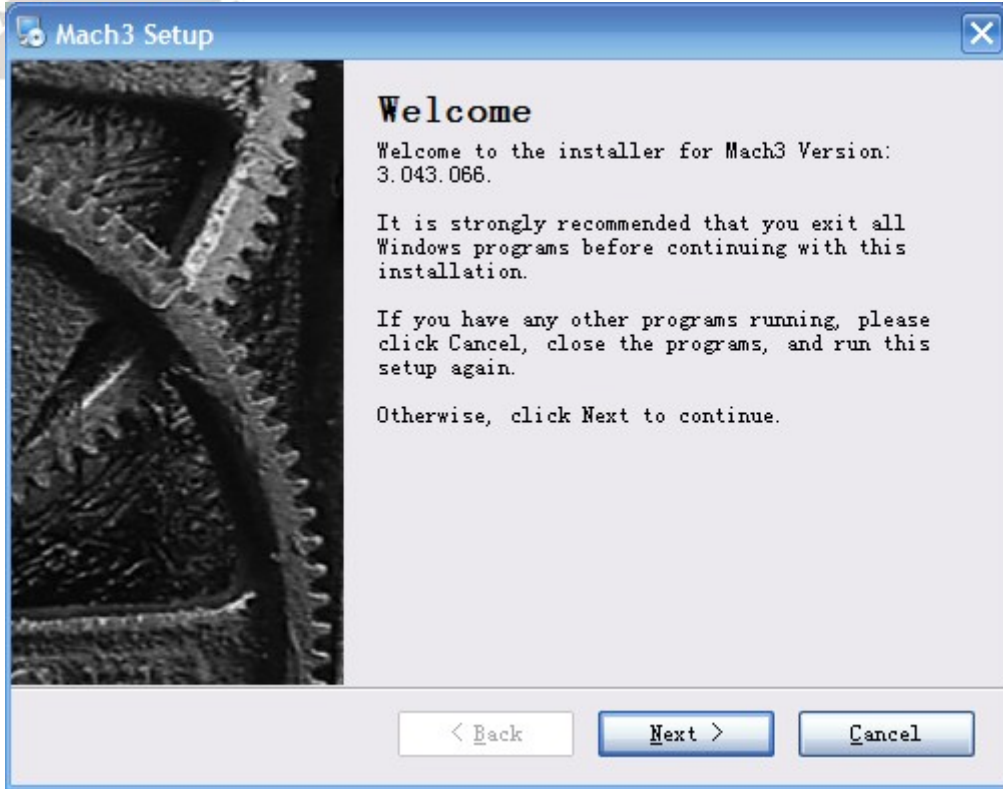


Figure3-2. MACH3 installation process 1

Click Next and then enter the page shown in Figure 3-3

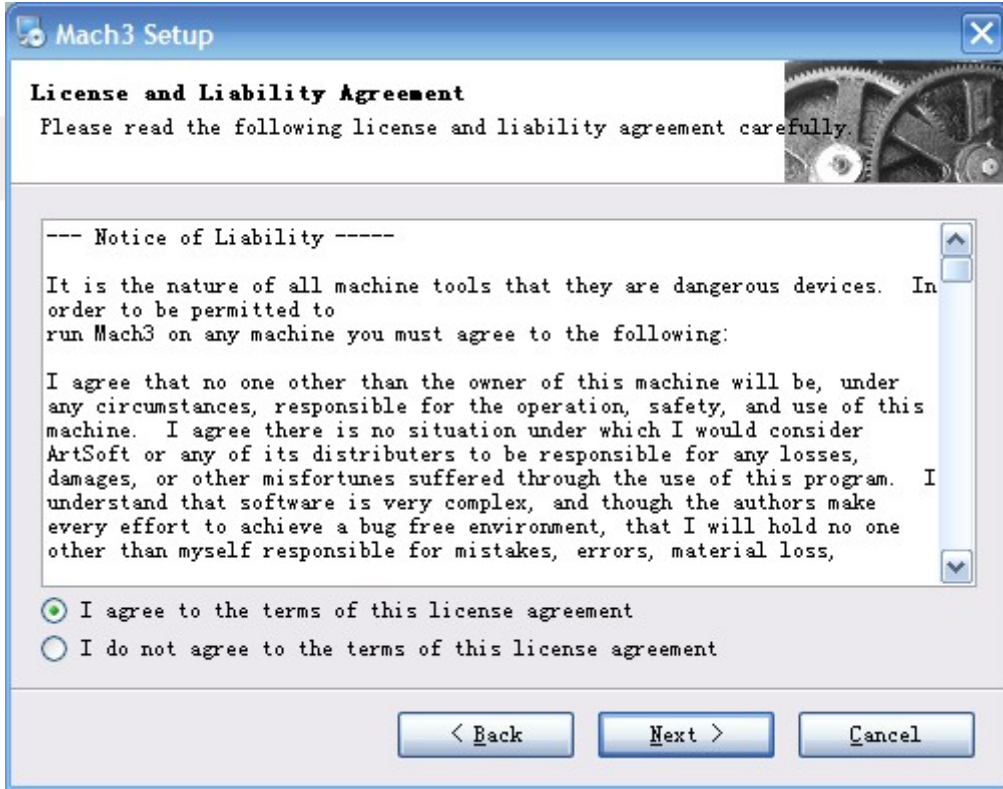


Figure3-3. installation process 2

Select I agree and click Next, See as Figure 3-4.



Figure3-4. MACH3 installation process 3

Select the installation path, click Next (it can be installed on any disk, and recommended to install the C drive or the D drive) See as Figure 3-5

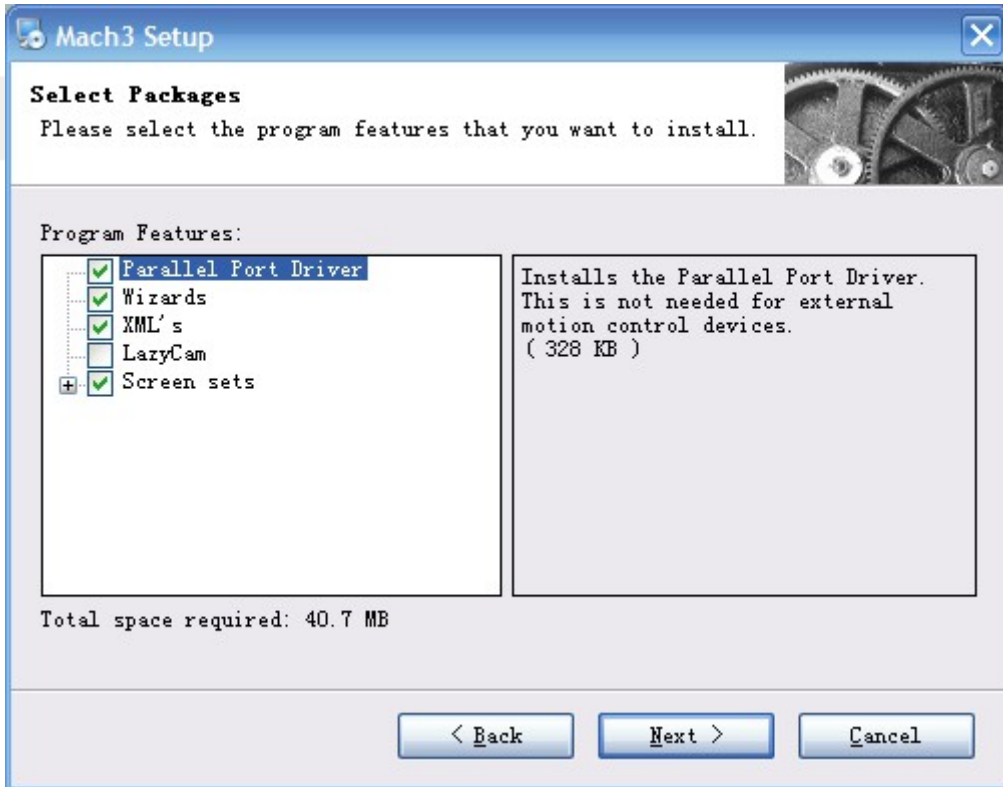


Figure3-5. MACH3 installation process 4

Click Next until completion. Then restart the computer.

## 3.2 NVUM\_SK Plug-in installation



Copy the file NVUM\_SK.dll NVUM\_SP.dll to X:\Mach3\PlugIns, X is the disk where the soft is installed.

## Chapter 4. | Setting of software

### 4.1 Open software

Double-click the mach3mill



Enter mach3 software. Pop-up the plug-in dialog box. See as Figure 4-1.

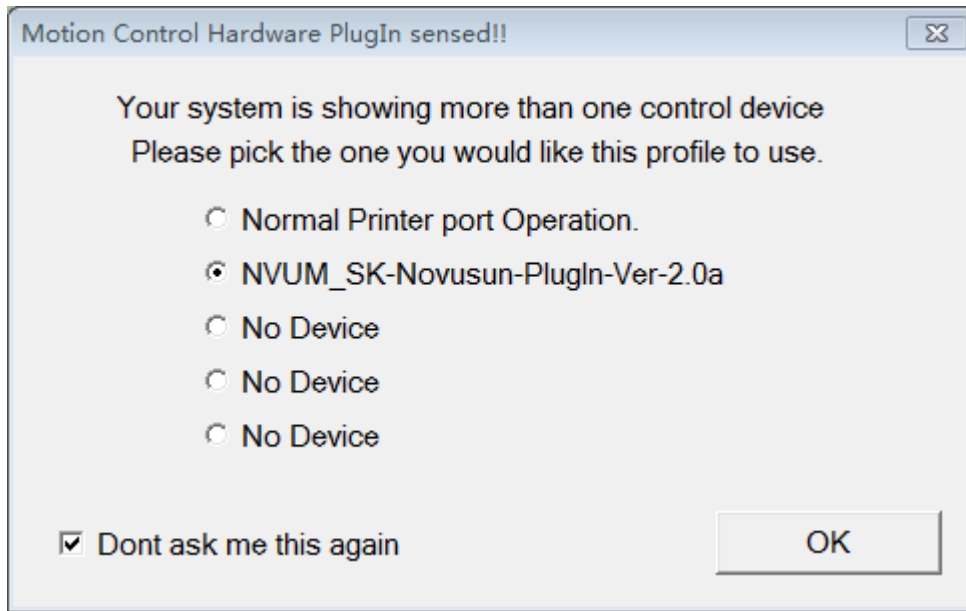


Figure4-1. Plugin selection dialog

Choose our plugin NVUM\_SK\_Novusun-PlugIn---Ver-2.0a. Then press OK. If you do not want to the dialog box appear again next time, you can select Don't ask me this again. If connect successfully, Status bar will show "NVUM\_SK device is connected to your computer". See as Figure4-2.

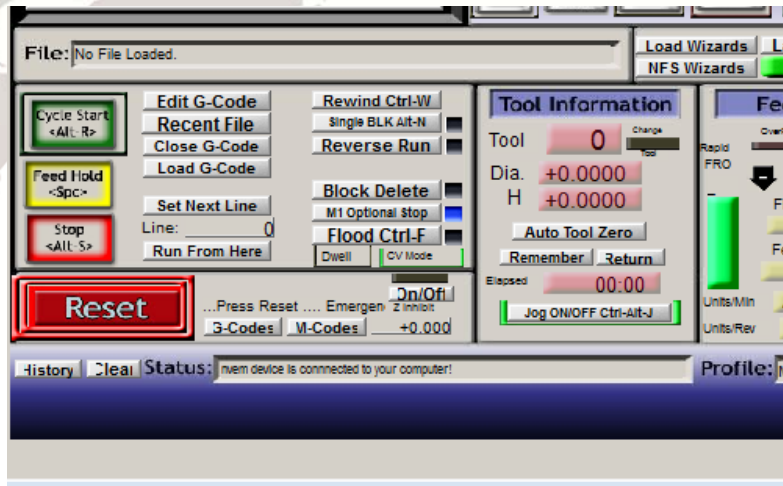


Figure4-2. connect successfully

## 4.2 Software Common settings

### 4.2.1 Check NVUM\_SK plugin

Click config plugins to input PluginConfig,you can seeNVUM\_SK. See as Figure4-4.

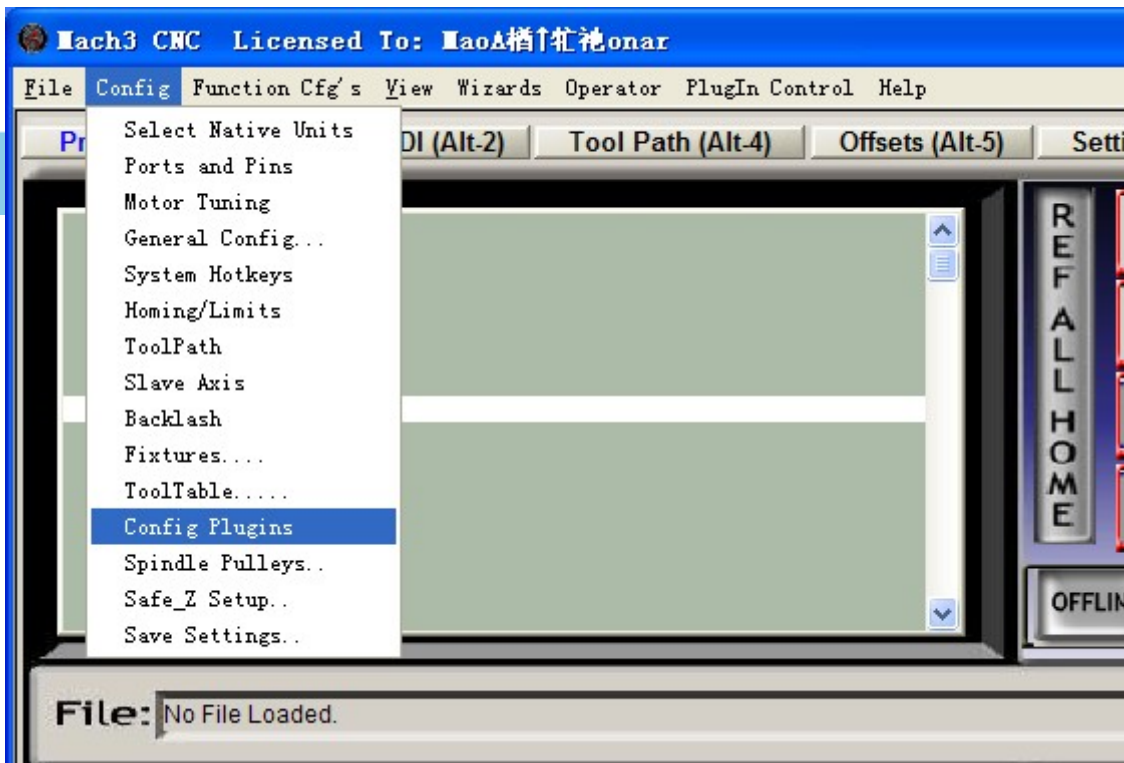


Figure4-3. Input Config plugins

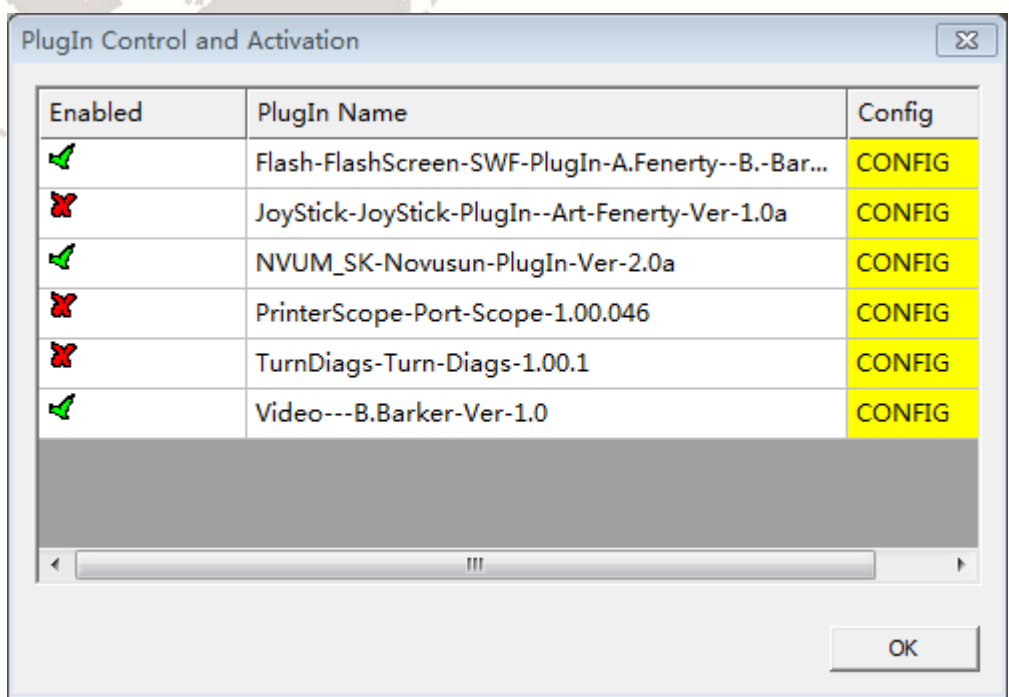


Figure4-4. MVUM\_SK Plugin

4.2.2 Motor operating parameters setting



Figure4-5. Motor operating parameter setting menu entry

See as Figure 4-5.From submenu “motor tuning” of the menu “config” into the motor parameter settings dialog. See as Figure 4-6

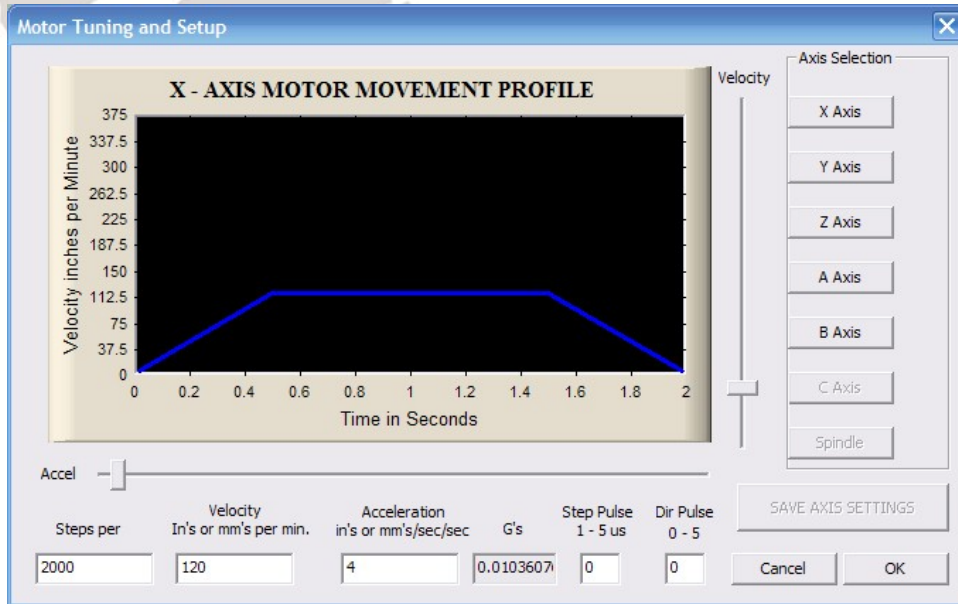


Figure4-6. Motor operating parameter settings dialog

The parameters are defined as follows:

Steps per: Pulse equivalent ,it is number of pulses required with axial movement 1mm, This can be calculated by lead screw pitch and motor drive segment. Such as pitch 2.5mm,2-phase motor 8 segments, Calculation method is  $8*200/2.5=640$ 。

Velocity: The speed is the axial velocity, Units is mm/s, Recommended settings 1500.

Acceleration: Units is mm/s<sup>2</sup>, Recommended settings 200.

Step Pulse: Step Pulse Cannot be set, it's 2.5us in default.

Dir Pulse: . Dir Pulse Cannot be set, it's 2.5us in default.

**Attention: The parameters for each axis is not necessarily the same, To select the axis, and then set parameters. You should click “SAVE AXIS SETTINGS” After setting.**

### 4.2.3 Port Settings



Figure4-7. Port setting entry

See as Figure 4-7, Click the sub-menu “ports and pins” of menu “Config” into Port Settings dialog box.

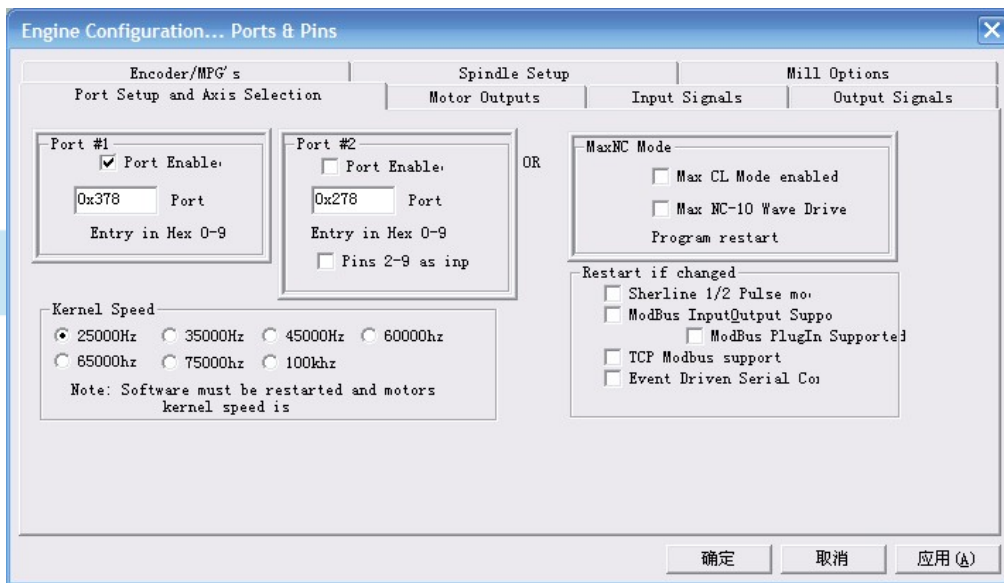


Figure4-8. Pin&Port Dialog

The sub-pages you need to set include “Motor Outputs”, “Input Signals”, “Output Signals” and “Spindle Setup”.First Click to enter “Motor Outputs”. This page is to select the stepper motor control pin. Because our usbmach3 interface board stepper motor signals are fixed, So here only need to Select, no need to select the specific pin. See as Figure4-9

To make the Z axis to the same direction, Z axis’s “Dir low” should be set to”√”.Other



axes's should be set as system need.

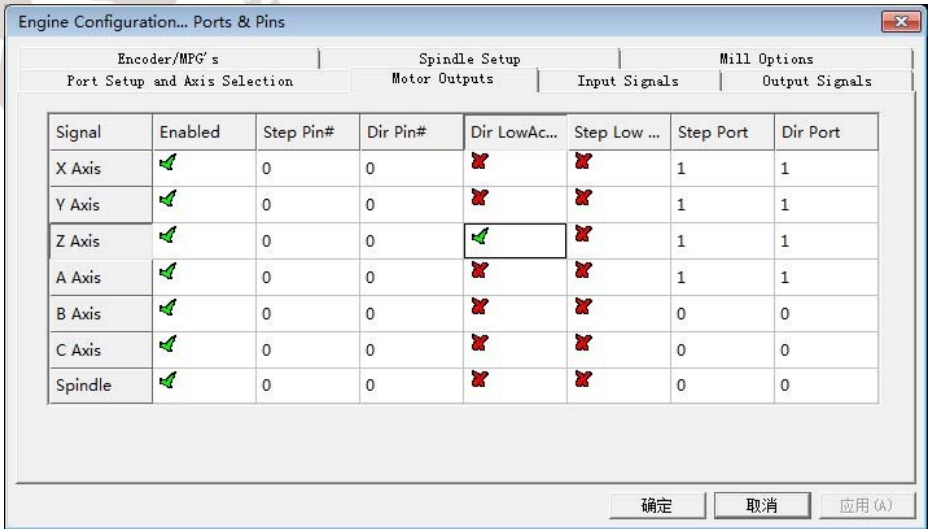


Figure4-9. Stepper motor port settings dialog

Click "Input Signals" Into the input signal settings page. See as Figure4-10

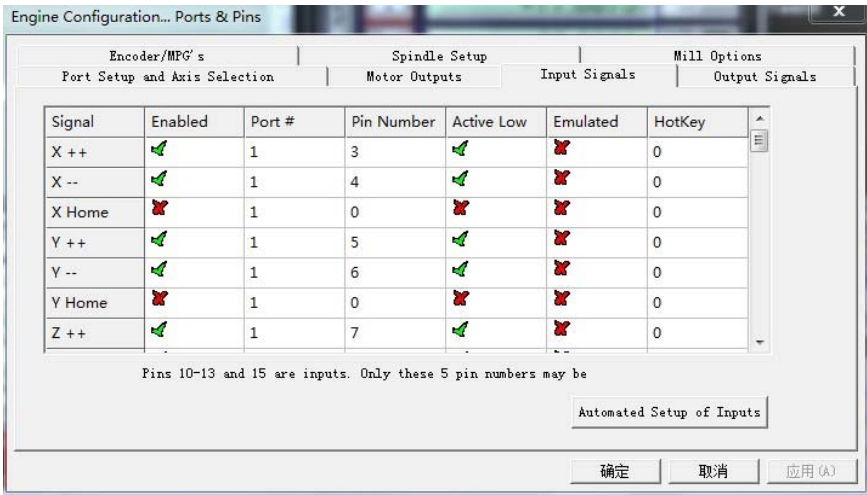


Figure4-10. limited Input Settings dialog

Here you can configure according to your actual needs the corresponding function. Optional Function include XYZABC6axis's Upper and lower limit、XYZABC6axis's HOME point.

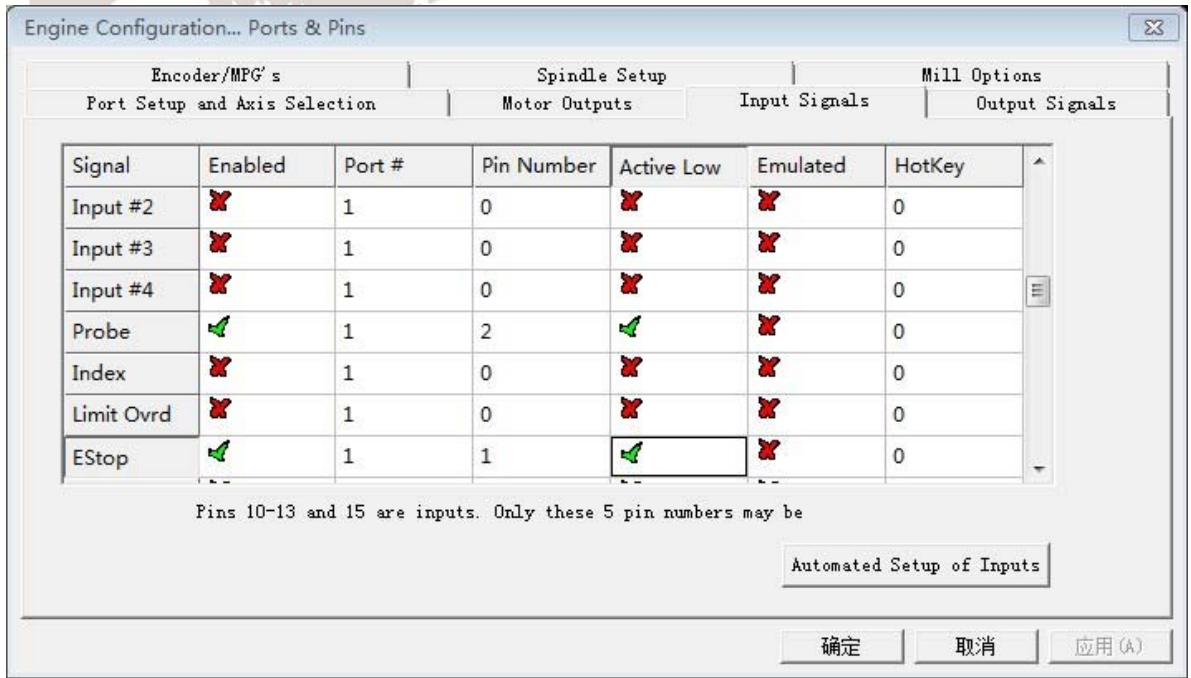


Figure4-11. Estop Probe and index Setting dialog

PROBE、ESTOP Setting see as Figure 4-11, and probe’s pin number is 2, estop’s pin number is 1.

Click “Spindle Setup” switch to the spindle settings page. See as Figure4-12.

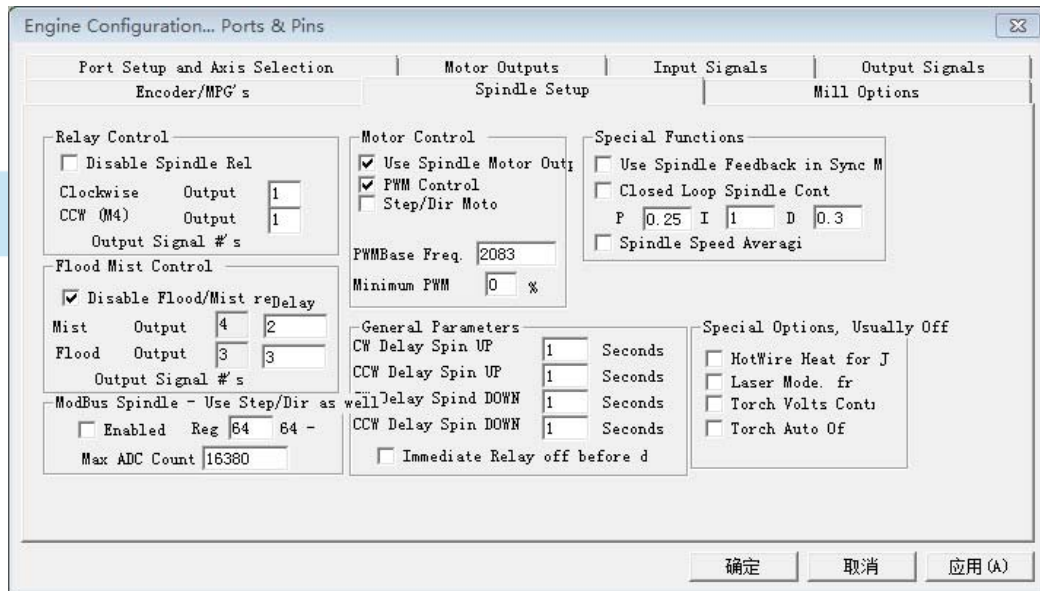


Figure4-12. Spindle Settings dialog

Here we can configure the spindle rotates CW、Reverse CCW、Mist、Flood pin, See as Figure4-13, They have been configured as 1、2、3、4. Corresponding to output#1~output#4 in Figure4-14.output#1~output#6 in Output Signal Setup dialog can be Configured into these 4 signals. Here we only configure CW \MIST\FLOOD. They are M3\M7 and M8 in G-code file. CW is controlled by OUT1 and MIST is controlled by OUT2 and Flood is controlled by OUT3.

Here we note correspondence between 2 page. Please select “use spindle motor output” if required PWM speed spindle. And select “ PWM Control”. Our PWM pin fixedly arranged on a special pin, it’s no need to be set.

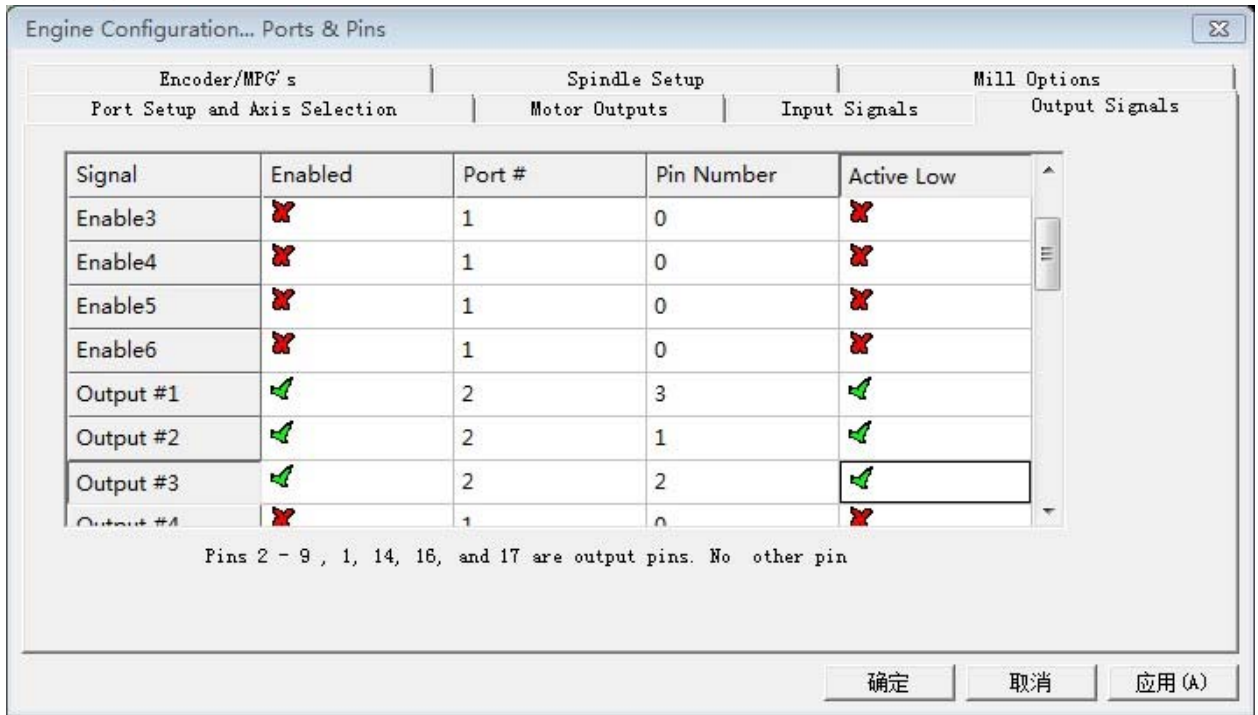


Figure4-13. Spindle setting corresponds to the output configuration

# Chapter 5. Using of software

## 5.1 Set Machine Coordinate system

Firstly Open the software,as the drawing 5-1 shows,at this time,the software can operate the machine movements,but before the setting machine coordinate system,there is no connection between the software and machine.So first step is to set the machine coordinate system.

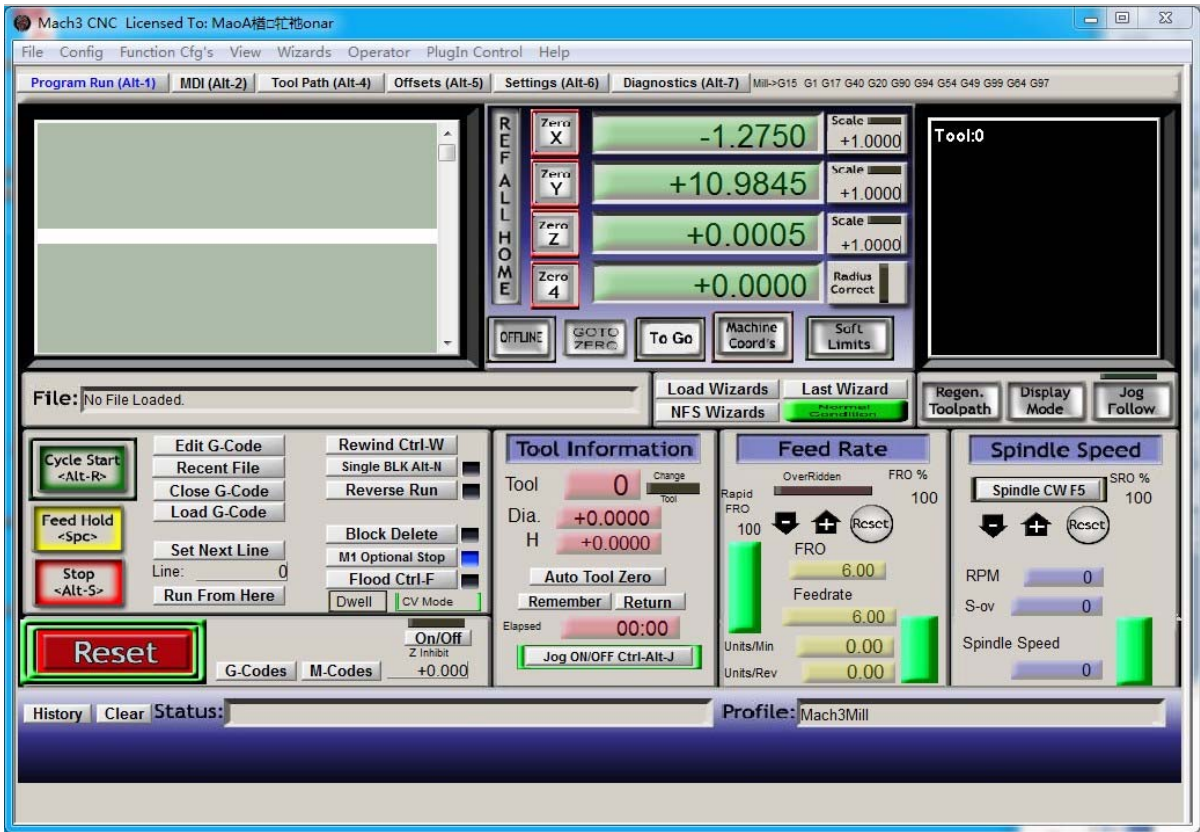


Figure5-1. Main Screen of mach3

### 1、Set the machine original position switch

As our request,some machine set the original point at the coordinate positive direction,some machines set the original point at the coordinate negative direction.Mach 3 can search out the machine original point direction by the software setting.As the pic 5-2 shows,open Homing on the config menu.Then as pic 5-3 shows.On this page,Home Neg is for searching for the machine

original point direction, × means searching original point at negative direction; √ means searching original points at the positive direction. As the picture 5-3 shows, X axis's original position is at the negative direction, Y and Z's original points are at the positive direction.

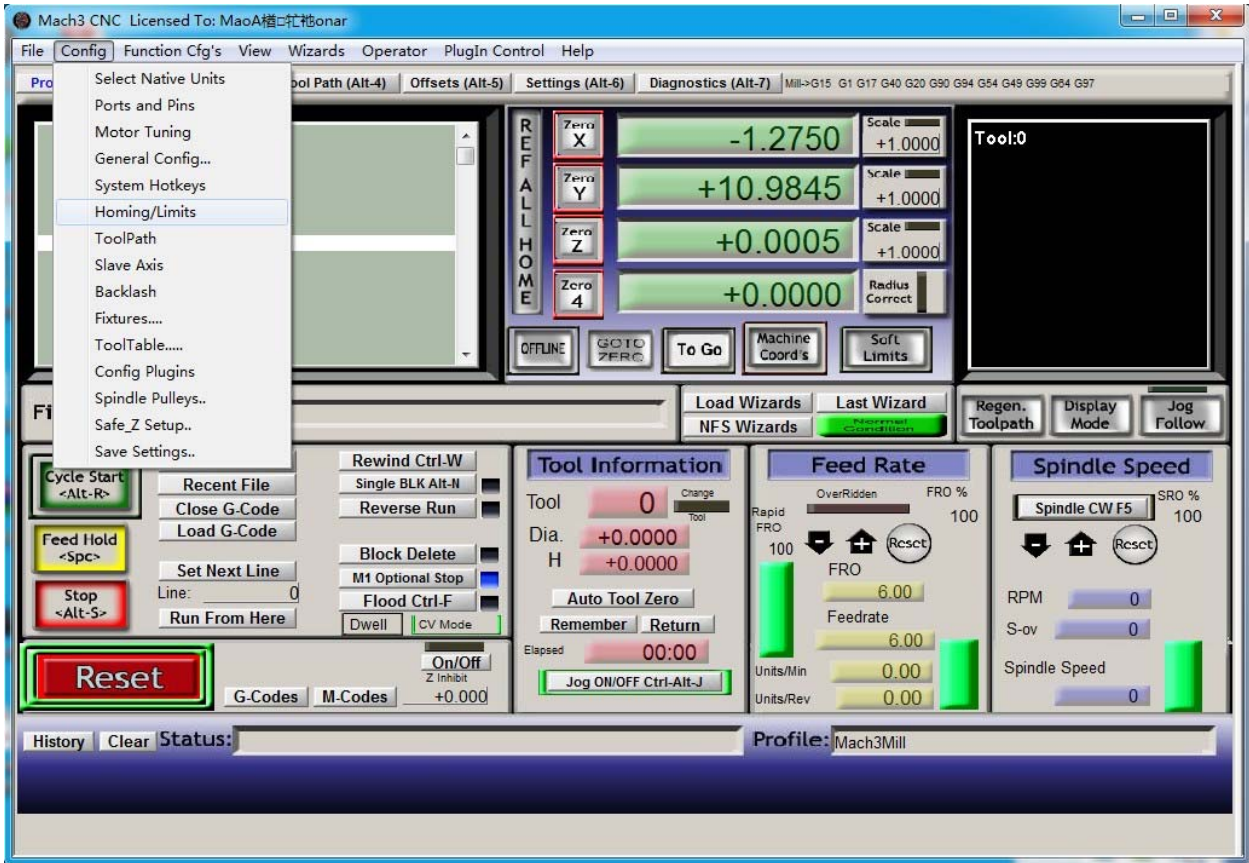


Figure5-2. Click homing of Config



Figure5-3. Motor Home and Softlimits dialog

2、Set soft limits

As Figure 5-3 shows, this page also can set machine soft limit points, Soft Max is positive direction soft limited points, soft Min is negative direction soft limited points. The soft limited points values is according the references to the machine coordinate system, so as this example shows, Y and Z axis's max value is 0, all the effective coordinate data is less than 0. As the Figure shows, according to our current request, we set our XYZ axis soft limited points area as [0,270] [-390,0] [-100,0].

### 3、 Searching for machine original points

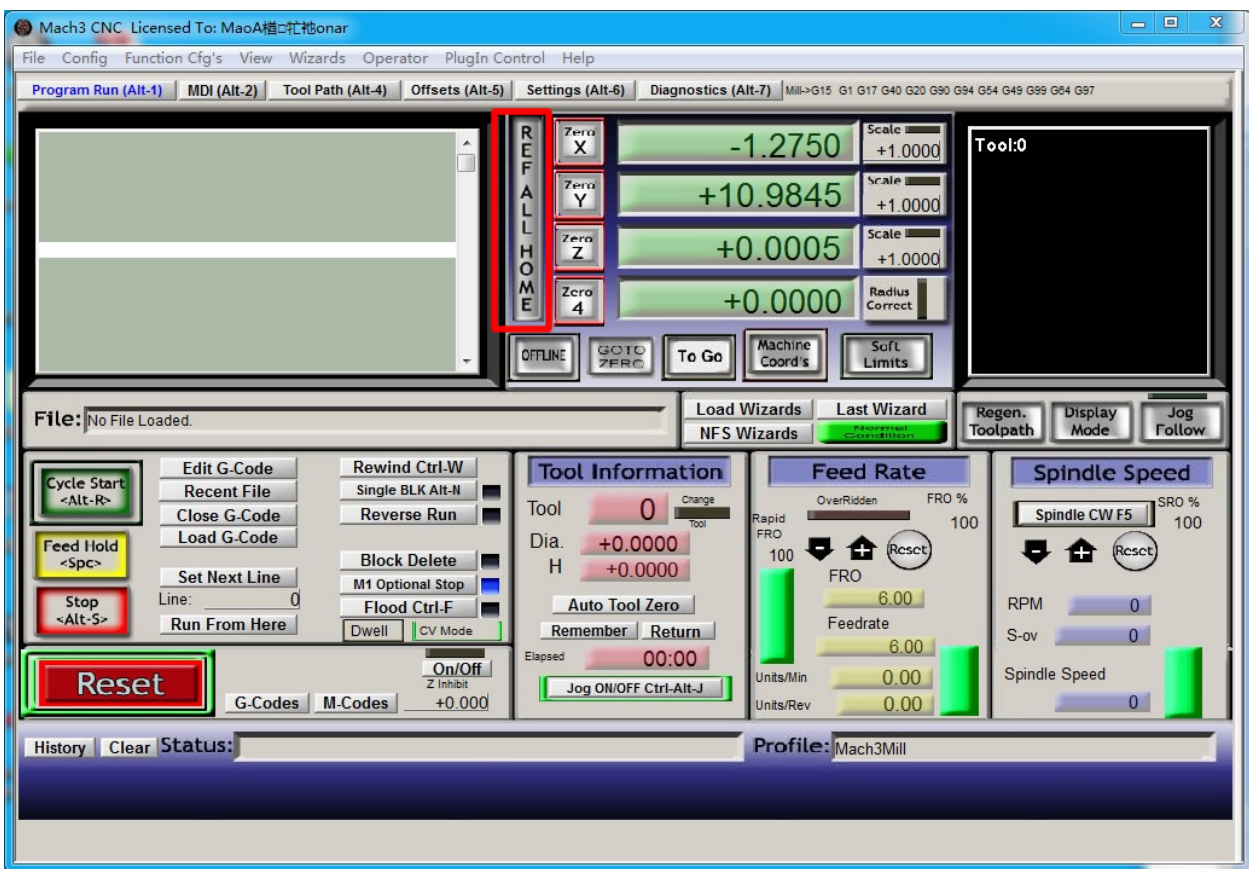


Figure 5-4. Click REF ALL HOME to HOME all axis

As Figure 5-4 shows, press REF ALL HOME at main display page, then XYZ A4 start to search for the original points, if you need more axis's operation, edit macro command, or press Alt+7 into Diagnostics display page, you can search original point for every axis. Diagnostics

## 5.2 Set workpiece coordinate system

Because every working material is hold in different position on the machine, we need to set

one or more workpiece coordinate system.

- 1、 Move to current working piece 0 point

Firstly hold down the material,use keyboard or pendant to move tool tip at the 0 point,so this 0 point is the working piece 0 point,it related with the working G code file,so the user must be very familiar to his own working G code.As our example shows,the 0 point is on the center of the working piece surface,so we just move the tool tip to this position.

- 2、 clear Coordinate

As 5-5 shows,press Zero button on each axis, then clear to 0 for each axis.After operation,the result shows as Figure 5-6.

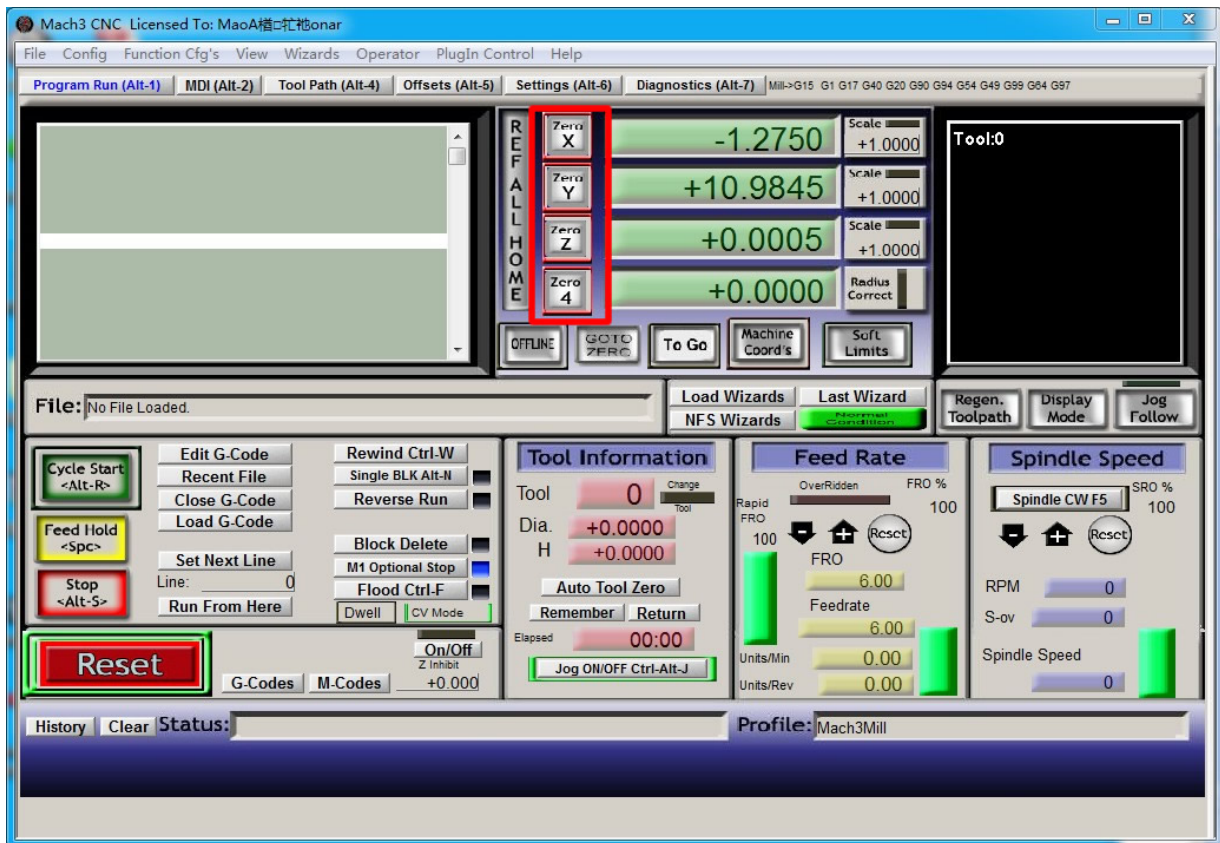


Figure5-5. Press Zero on each axis,all clear to 0

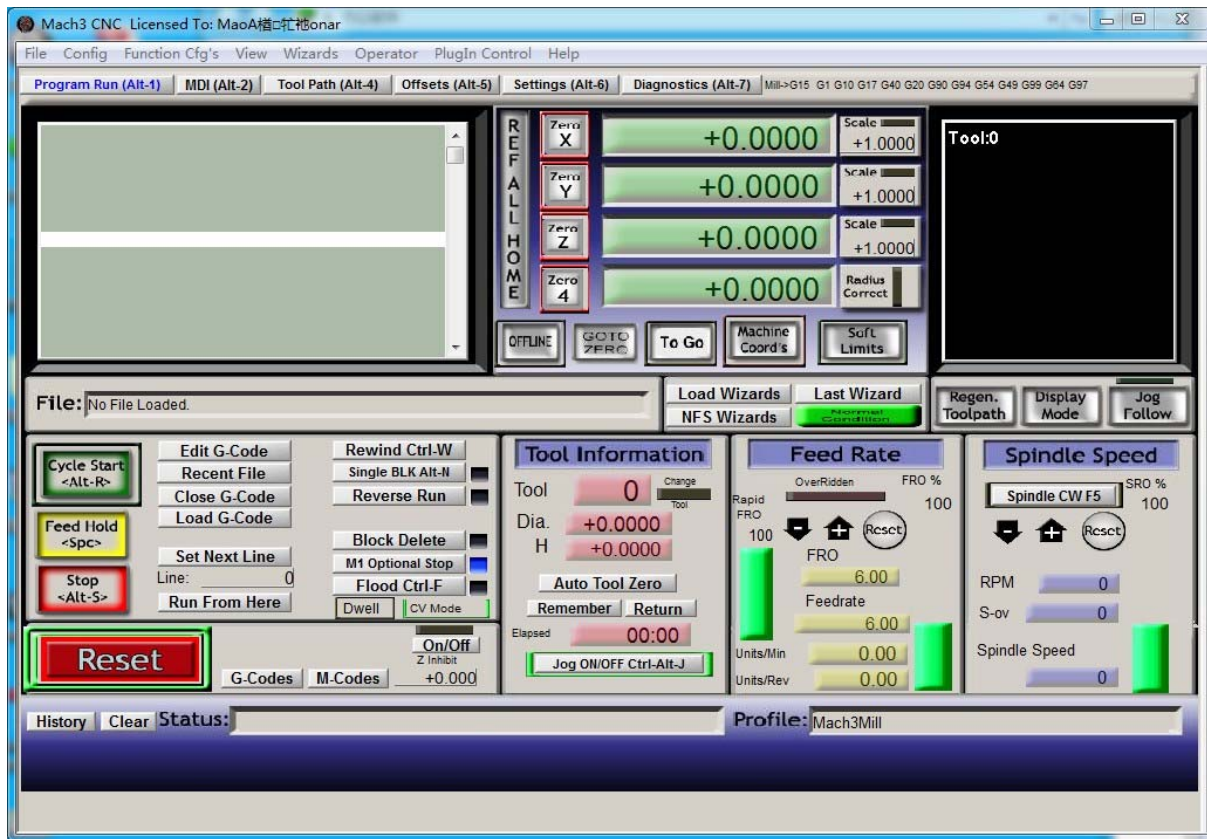


Figure5-6. Main Screen after ZERO all axis

### 5.3 Open G code file and run

As Figure 5-7 shows,press “load G code” button at the main page or open “Load G code” at main menu “File”,open your G code.It displayed as Figure 5-8 showing,then press button “cycle start” then machine start to work.



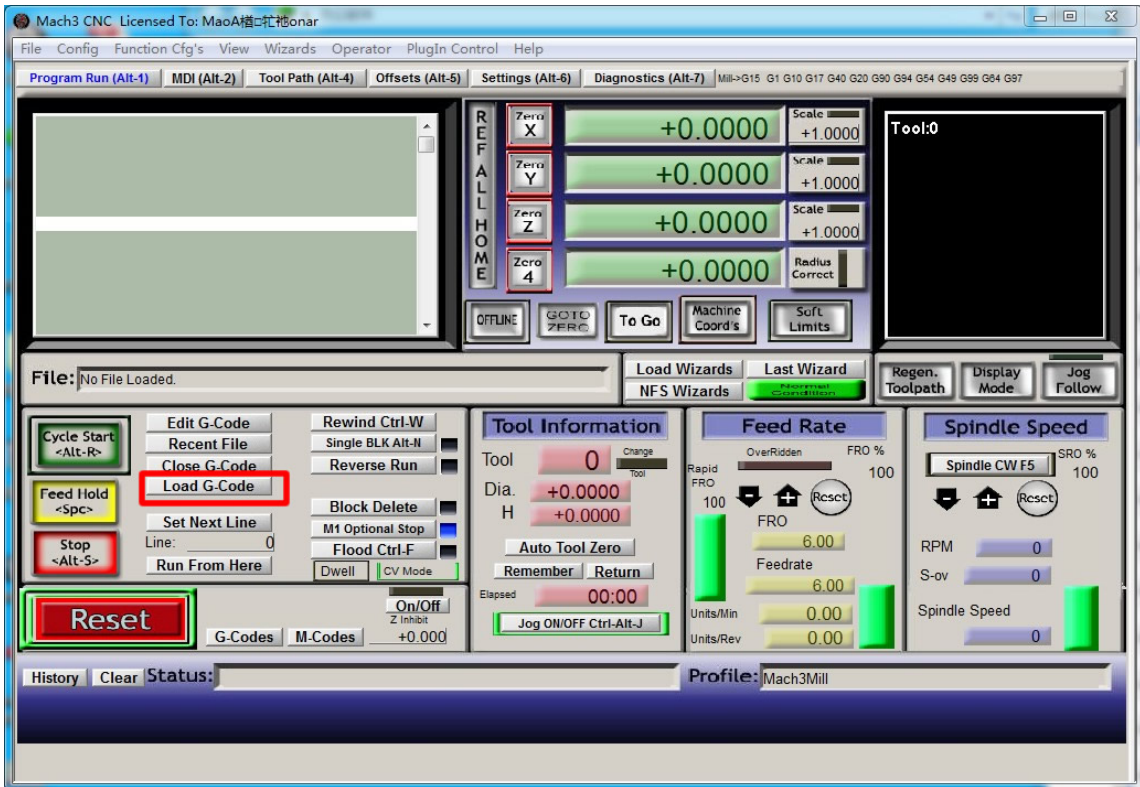


Figure5-7. Press Load G-Code and open your G code

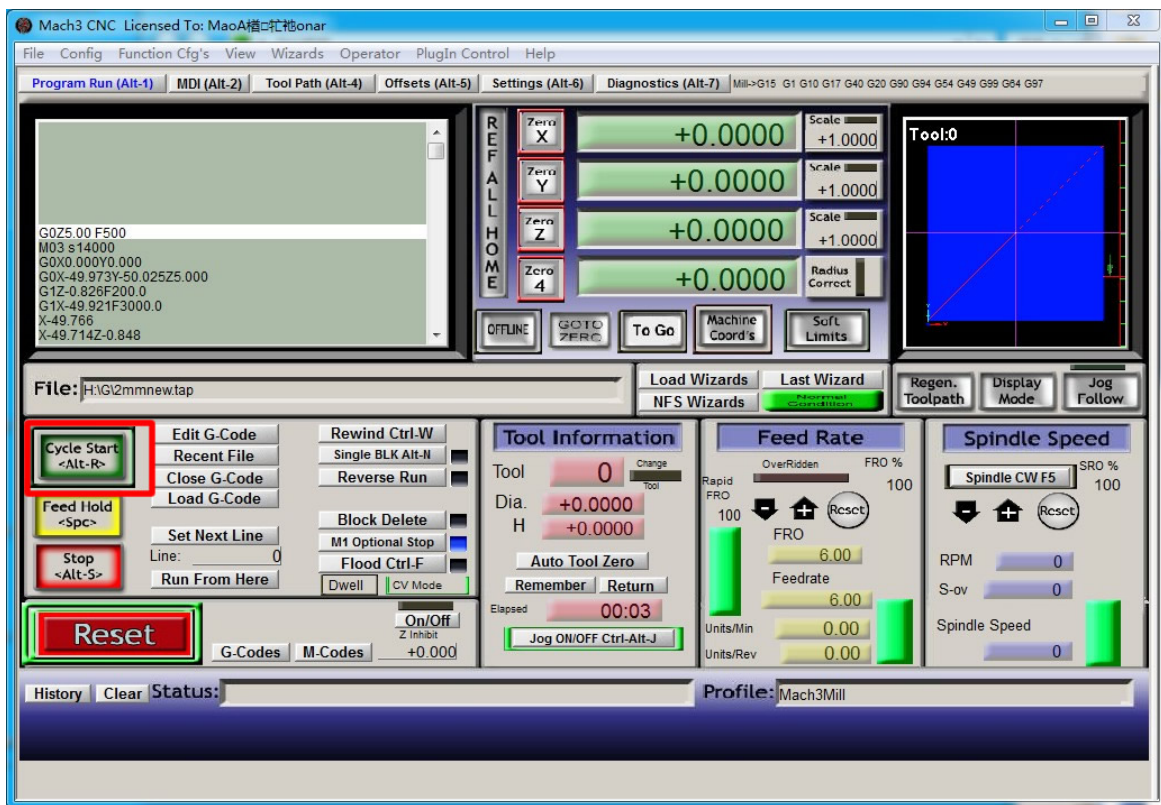


Figure5-8. After opening G code,press “Cycle Start” and start to work



**Chapter 6 | Question & Answer**

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**6.1 Q&A for Hardware**

**6.2 Q&A for Software**

## ➤➤ Chapter 7. Contract us

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- ⊠ Website: [WWW.NVCNC.COM](http://WWW.NVCNC.COM)
- ⊠ Support Email: [Support@nvcnc.com](mailto:Support@nvcnc.com)