CNCDIY

CNCDIY CNC Routing Machine System
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CNC 6040

ROUTER / ENGRAVER / DRILLING / MILLING MACHINE

User's Manual

Latest update: 9 September 2009

Copyright

Declaration

- Although, the routing machine system is produced by CNCDIY Routing Machine System, it cannot be called a real commercial product. The user must require having relative knowledge about mechatronics. All matters concerning the machinery, electronics, computer equipment, are likely due to improper use or a virus, software compatibility reasons, result in failure, this failure may cause a certain degree of risk and economic losses. CNCDIY Routing Machine System does not bear the direct and indirect losses corresponding responsibilities.

- Any routing machine you purchased from CNCDIY Routing Machine System is only paid for the price of the machine and relative device itself only, does not included any software and software training costs. You can follow this "User's Manual" learning how to operate or through the network under the guidance from our staff. Each routing machine system is operation normally after a standard test produce to identify the three-axis can be controlled and able to run imported tool path properly. This recognition of our work is completed. All the software training is not in our capacity. CNCDIY Routing Machine System is a vast CNC-DIY enthusiast platform, we are very happy in our own knowledge, ability and time to give novices within reach of as much as possible help, but please do not use these to help and look at the FAQ to make is that we have obligations.

- Software copyright: This machine does not come with any software, operational use, and covered in this guide are all related software from the Internet, the original author enjoys copyright to the author's official Web site at your own download a trial version or purchase licensed software, because not authorized the use of for all damage caused by the software and legal issues from the users themselves.

Reminder

- The machine uses a parallel interface and control computer connected through the parallel port control software MACH3 controlled carving machine to run the various axes in accordance with instructions, make sure you prepare for the routing machine control computer has a parallel port, and the required work in EPP parallel port mode, any other mode may result in engraving machine cannot operate normally, the EPP mode is set to be carried out in the computer motherboard BIOS, all manufacturers to set methods vary, please refer to the instructions to set up your computer. Part of the desktop computer does not have built-in parallel port, users can be purchased parallel port PCI expansion card slot to use. But any commercially available USB-parallel port adapter does not allow normal operation of the machine

- Controlling the computer should be dedicated and, if possible do not install other applications software; do not recommend the use of laptop computers to control the engraving machine, part of the notebook computer's battery-saving chip may interfere with the pulse signal, some parallel port voltage is low, may lead to pulse signal is lost the use of engraving machine could not be properly controlled.

Warning

- The machine system is to rely on related software control, the need for the right software settings in order to function properly, in the absence of fully recognized under the temerity to set the correct test machine loaded knife can be dangerous or permanent damage to machinery. During the software installation and settings, do not open the control box power supply, in order to avoid malfunction causing damage.

- Do not at any time the power electronic control box connected to the case, pulling the plug inserted above the line terminal; spindle power each time you open the speed control knob must be transferred before the low-end office and then start-up; both spindle switch or driver switches repetition interval of the switch at least once every 30 seconds or more; not pay attention to the above questions is likely to cause some damage control circuits.

- As the use of the AC110V or AC220V voltage, power state, do not open the electronic control cover, do not touch the spindle motor terminals, operation of the spindle motor driven high-speed rotary cutting tool, do not touch, and a closer look at sculpture, the working must be worn goggles or protective masks! The operator must wear a protective mask and a goggle.

Warranty

All electrical products manufactured or marketed by CNCDIY Routing Machine System has a warranty period of 6 months from the day they are shipped out of our warehouses. The electrical products are included CNC driver and DC spindle driver only and the VFD driver is not included

The mentioned warranty covers repair material and labor costs, at CNCDIY Routing Machine System facilities, incurred in the repair of the products.

Within the warranty period, CNCDIY Routing Machine System will repair or replace the products verified as being defective. The purchaser must send the damaged or broken part back to Hong Kong office of CNCDIY Routing Machine System after providing photos to show the damage part and proving the causes of the problem to our staff.

It is entirely up to CNCDIY Routing Machine System to determine whether a repair is to be considered under warranty.

Contents

Chapter 1   Introduction

Thank you for your selection of our product. We have provided CNCDIY routing machine system, also very honored that you have the time to read, prepared by the Walter, "Quick Start Guide" in the hope of its initial contact with routing machine will be able to help! This is not a company. We are formed from some CNC lovers in different Places and hope provide some low price and high quality DIY CNC machines for you!

We hope to provide some low price and high quality DIY CNC machines for you! All of our machine set are included a CNC Machine body with 3 Stepping Motors, a CNC controller, a 24V Switching Power Supply and a Driller. Each machine set is installed completely and pass testing before shipping, users can use the machine immediately when received.

Chapter 2   Safety and Protection

Before you open the packages and check the machine parts, please care about the following items

2-1   Gloves

Your hands are easy hunt by the sharp edges of the parts and the packages. The Gloves can reduce the risk for your hands!

2-2   Handling Posture

Some of parts are heavy, when you move or put up them, please be careful and take care you body with good Handling Posture

"LIFTING - PUSHING - PULLING – LOWERING"
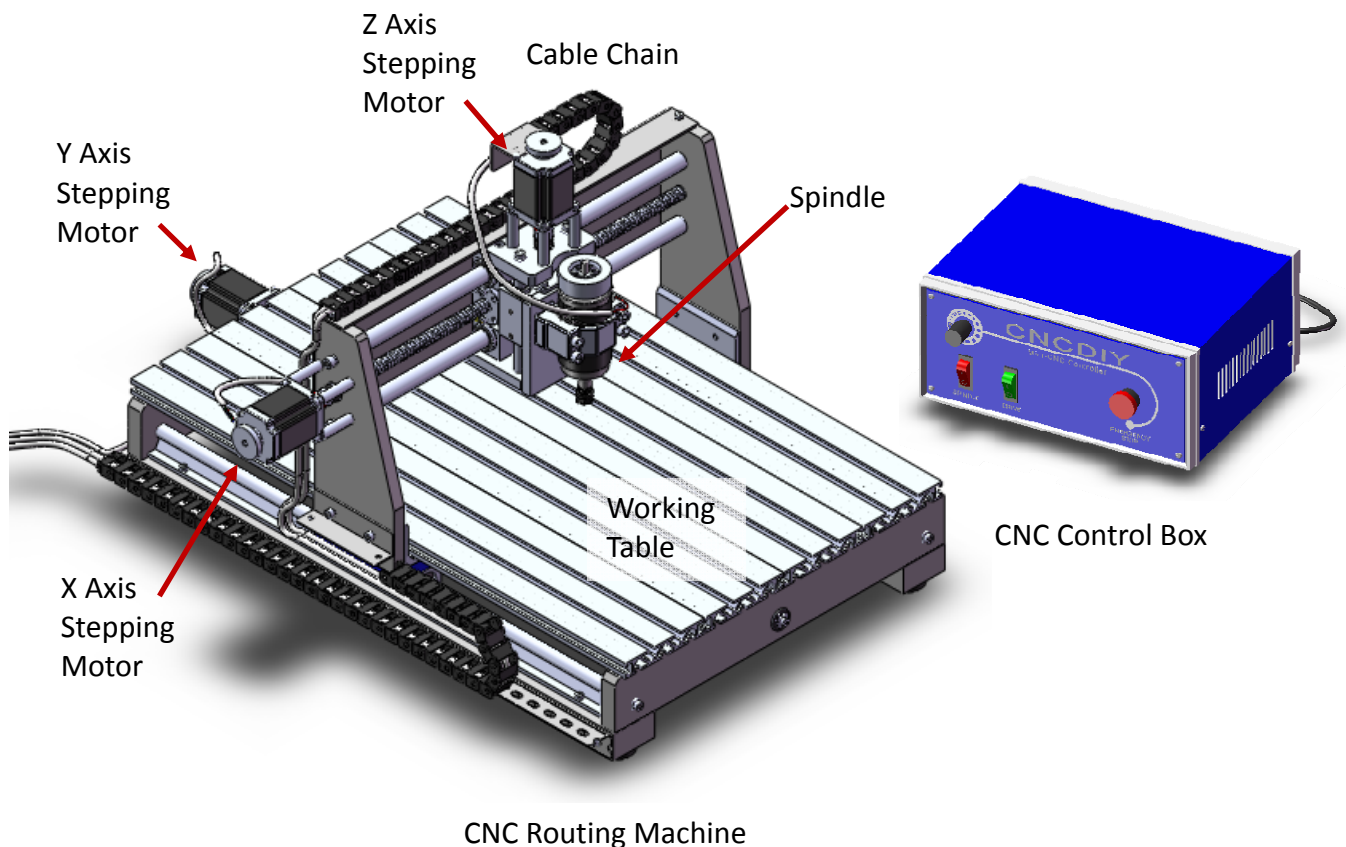
Chapter 3   Hardware Installation

3-1   Installation Precaution

The CNC Routing Machine system contains numerous delicate electronic circuits and components which can become damaged. Prior to installation, carefully read the user's manual and follow these procedures:

- When connecting hardware components to the connectors of the Control system, make sure they are connected tightly and securely.

- Before using the product, please verify that all cables and power connectors of your hardware components are connected

- Before unplugging the power, make sure the power supply voltage has been set according to the local voltage standard.

- Do not place the machine system on an uneven surface.

- Do not place the machine system in a high-temperature environment.

- Turning on the control system power during the installation process can lead to damage to system components as well as physical harm to the user.

- If you are uncertain about any installation steps or have a problem related to the use of the product, please consult a certified computer technician.

- The main material of the routing machine is used aluminum alloy, cannot be used due to any inadvertently fall or collision to damage the machine. Please placed the routing machine system in a firm, stable, level of desktop, thin desktop will result in a greater resonance in the noise during the machine running.

- Electric control box is installed well with a switching power supply, a stepper drive controller and a spindle power driver. Please place it in the level of ventilation. Electric control box cannot have electromagnetic interference within around 10 meters. Please also care about wrestling and fear flows effect!

- Remember to tidy up the wiring harness, messy take place. It is likely to impede the normal movement of the routing machine. Please consider the stroke area for the moving gantry and any sliding part with sufficient margin of the wiring harness.

3-2   Understanding of Your Machine System

For the future use and maintenance, user should understand your routing machine system first. The major parts are shown in below figure and include a set of routing machine, a CNC control box, spindle with bracket, and an attachment box. The attachment box is included 4 sets of platen, 5 of basic tooling, a pair of brushes for spindle replacing, a pair of spindle handles and a Hex wrench and some screws. (Note: The screws are attached to a few random, different parts may require different lengths and types of screws, is depending on the actual needs of their own, separately purchased locally)

Z Axis Stepping Motor

Cable Chain

Y Axis Stepping Motor

Spindle

X Axis Stepping Motor

Working Table

CNC Control Box

CNC Routing Machine

3-3   Machine Specification

CNC6040 Router / Engraver System

1. Effective Travel:	400mm(X) * 580mm(Y) * 60mm(Z)
2. Machine Outside Dimensions:	850mm * 640mm * 470mm
3. Maximum Workpiece Dimensions:	750mm*480mm*90mm
4. Working Table Dimensions:	750mm*480mm*20mm
5. Sliding Units:	
i) X Axis	Dia. 16mm Guide
ii) Y Axis	Dia. 20mm Guide
iii) Z Axis	Dia. 13mm Guide
6. Driving Units:	New Ball Bearing (BB) 1605
7. Coupling	Plum Coupling / Simple Coupling
8. Stepping Motor Type:	57 Two-Phase 1.45A~2A (New)
9. Main Materials of Machine	Aluminum Alloy 6061
10. Actual carving precision:	0.08mm (carving different hardness materials vary)
11. Repeat positioning accuracy:	0.06mm
12. Engraving speed:	0 ~ 2000mm/min
13. Machine weight:	53KG (excluding packaging)
14. Acceptable Processing materials	PVC, PCB, Plastic, Woods, Brass and Aluminum

Driving Units

The diffient type of driving units are using on X, Y and Z axis for the smooth driving unit! The basic information is shown below:

| Model	Ball Bearing Screw		
Axis Name	X	Y	Z
Diameter(mm)	16	16	16
Pitch(mm)	5	5	5

3-4   Spindle (D57 and C57) Specifications

The spindle is a used of ELECTROCRAFT E240 motor installed an ER11 chuck and a Plastic Cooling Fan. The original is a DC servo motor, it is a waste and the encoder has been damaged. This is a good choice and environmentally friendly for using the small CNC.

The ER 11 chuck is using with tooling diameter of 3.175mm. It can reduce the radial runout and increasing the routing Precision to 0.03mm. The ER 11 chuck is included two handles for locking the cutting tools.
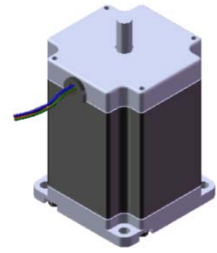
Specification			
Seq.	Description	Details	Unit
A. Motor			
1	Voltage Range	24 – 110	V
2	Rated Power	200	W
3	Peak Torque	1.7	Nm
4	Stall Torque	0.22	Nm
5	Peak Current	24.5	Amps
6	Stall Current	3.1	Amps
7	Radial Load	4.5	kg
8.	Axial Load	2.3	kg
9.	Voltage Constant	7.8	V/kRPM
10.	Diameter	57	mm
11.	Axial Diameter	8	mm
12	Axial length	42	mm
13	Weight	1.1	kg
B. ER Chuck			
1.	Hold Diameter	3.175	mm
2.	Precision	0.03	mm

Speed Vs Voltage		
Seq.	Voltage (V)	Speed(rpm)
1	24	2400
2	36	3500
3	48	4700
4	60	6000
5	70	7000
6	80	8000
7	90	9000
8	100	10000
9	110	11000

Spindle Speed vs Input Voltage
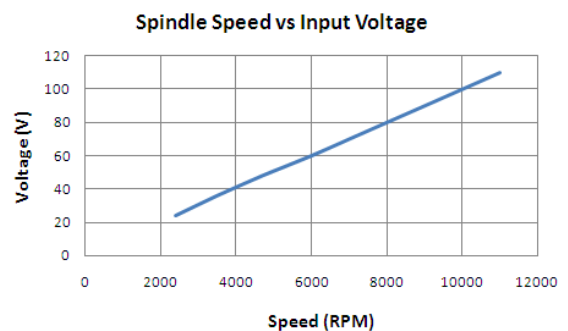
3-5   Stepping Motor Specifications

The stepping motors are selecting the new Chinese stepping motors or used Japanses and USA stepping motors.

Specification			
Machine Model	**CNC3040**	**CNC3020**	**Unit**
Stepping Motor Model	**57BYGH218**	**Not fixed**	
Step Angle	1.8	1.8	(deg)
Motor Length	51	N/A	(mm)
Rate Voltage	2.6	2.6	(V)
Rate Current	2	2	(A)
Phase Resistance	1.3	N/A	(Ω)
Phase Inductance	4	N/A	(mH)
Holding Torque	9	N/A	(kg.cm)
Lead Wire	4	N/A	(NO.)
Rotor Inertia	275	N/A	(g.cm^2)
Detent Torque	0.36	N/A	(kg.cm)
Motor Weight	0.65	N/A	(kg)

3-6   Components Check

A check listed is shown in Figure 3.6 below. Please check them with your received components and pull a tick or an across for record.

Figure 3.6 Components Check List

Items	Qty	Parts Number	Received or not?	Remarks
A .Stepping Motor Part				
1. 57 Type Stepping Motor	3	S01		
2. Plum Coupling	3	S02		
3. Stepping Motor Support	12	S03		
4. Knob	3	S04		
5.Chain Support (For Z axis only)	1	S05		
6. Crank Bolt M5 60mm	12	SB01		
7. Bolt M5 6.5mm	1	SB02		
8. Bolt M3 4mm	2	SB03		
E. Spindle Part				
1.D57 Spindle	1	S01		
2.D57 Spindle Bracket	1	S02		
3.ER11 Chuck	1	S03		
4.ER 11 Head	1	S04		
5.Crack Bolt M8 60mm	4	SB01		
6. Top Handle	1	SH01		
7.Bottom Handle	1	SH02		
Items	Qty	Parts Number	Received or not?	Remarks
F. Accessories Parts				
1. Control Box CB001	1	N/A		
2. A39773XB001	1	N/A		Installed in CB001
3. Cutting Tools CTS001	1	N/A		
4. Parallel Port	1	N/A		

3-7   Tools and Materials Requirement

In this chapter, there are discuss the major tools for the assembly work!
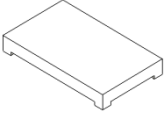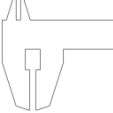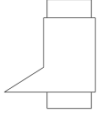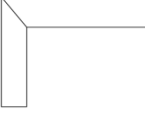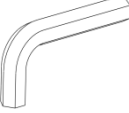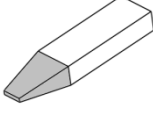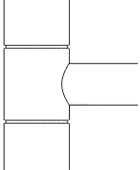
Figure 3.7 Tools list

A. Mechanical Part		
Tools Name	**Description**	**Picture**
Processing Platform	The Processing platform is an important for assembly. A Processing platform can make sure the machine table is level. 1. The best is metal Processing platform. 2. Any level plate or platform can also be used such as metal plate /table or wood plate /table.	
Frame Level	The frame level use to measure the working table, Horizontal and vertical parts	
Dial Test Indicator	Measures displacement at an angle of a lever or plunger perpendicular to the axis of the indicator. A regular dial indicator measures linear displacement along that axis.	
Calliper	Measure the distance between two symmetrically opposing sides.	
Height Gauge	Measure vertical distances. The pointer is sharpened to allow it to act as a scriber and assist in marking out work pieces.	
Square ruler	To measure the right angle when you assembling the Gantry Frame Part and the Base Part.	
Hexagon keys	The **Metric** Hexagon keys are the main assembly tooling! The long arm type of the Hexagon keys is most useful and save your energy! The sizes are from 1.5 to 10.	
Screwdriver	The flat and crosshead types of screwdrivers are needed. The electric screwdriver is highly recommended!	

Spanner	The nuts and crank bolts installation	
Hammer (Plastic)	The small adjustment and part assemble!	

B. Electrical Parts		
Tools Name	**Description**	**Picture**
Soldering iron	To melt the solder for wire connection. The best power range is between 30W~ 60W.	
Soldering Tin	To melt to join wire cable	

Power Cable 300/300V	1. 4 wires Cable
	    Model RVV4*1
	    Length: 5.9m (19.4ft)
	2 wires Cable
	    Model RVV2*1
	    Length: 3.1m (10.2ft)	

Heat-Shrinkable plastic	To protect the wire's join The recommended sizes are 3mm and 5mm	
Spiral Wrappings	To protect the cable The recommended inside diameter are 5mm and 8mm	

3-8   Machine Installation

There are shown the assemble step for your following! The following table are shown the tips when you doing the assembling work!

Tools Name	ICON
Processing Platform	
Frame Level	
Dial Test Indicator	
Calliper	
Height Gauge	
Square ruler	
Hexagon keys	
Screwdriver	
Spanner	
Hammer	

1   Stepping Motor Part

S03 S03

S04

S02 S03 S03

S01

SB01
Crank Bolt M5 60mm
(4 Qty)

Component Clearance

The flat side of the shaft is connecting with the bolt of knob for locking!

S02

S04

2 S01 1

Z Axis Part

SB03
Bolt M3 4mm
(2 Qty)

S05
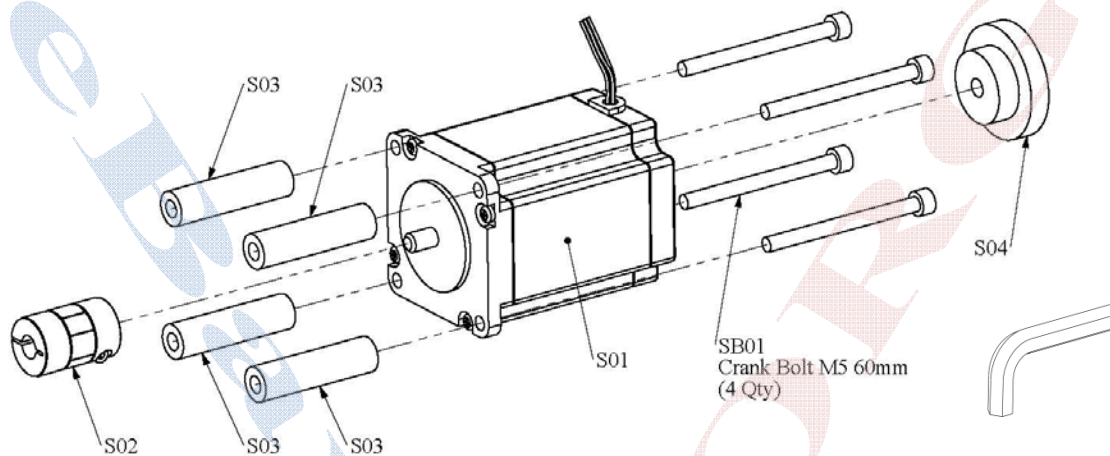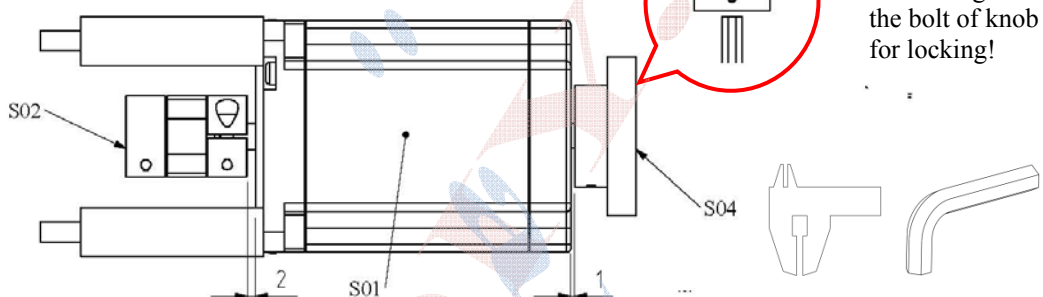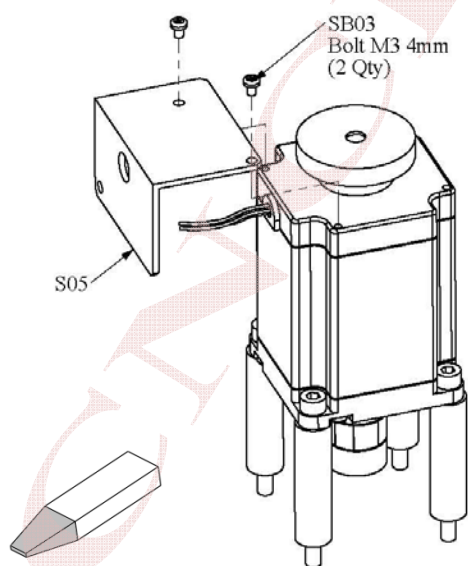
Completed!

The wires are through the hold!
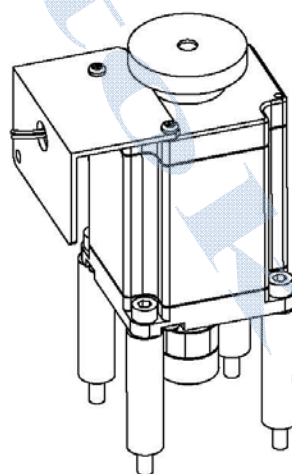
2   **Gantry Part**
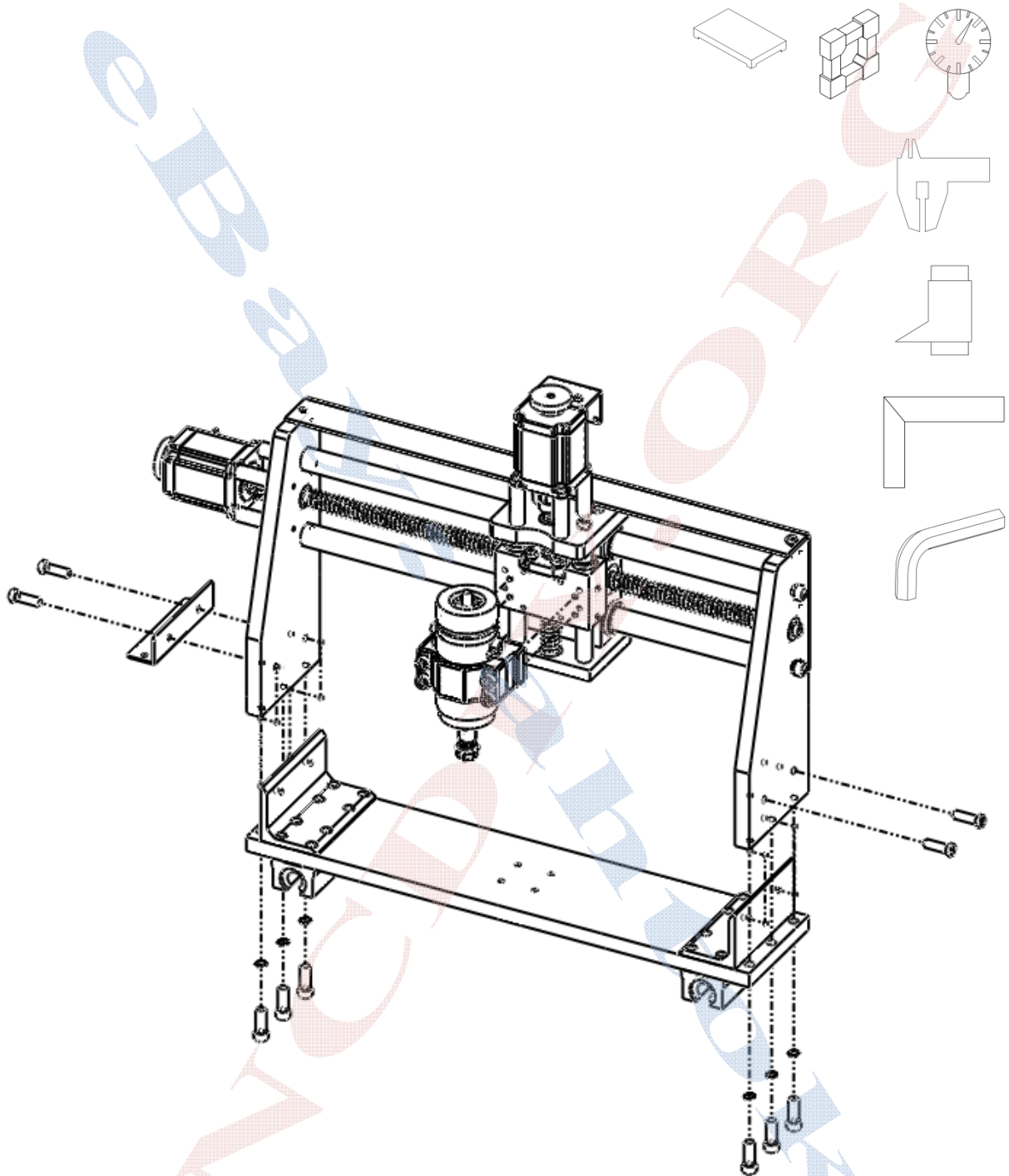
3   Cable Chain installation

GB02
Crank Bolt
M5 10mm

SB02
Bolt
M5 6.5mm

10 x 15 Cable Chain
(36Qty)

15 x 20 Cable Chain
(42Qty)

BB01
Bolt
M5 6.5mm

BN01
Nut M5
(with fillet)

GN02
Nut M5
(with fillet)

GB07
Bolt M5 6.5mm
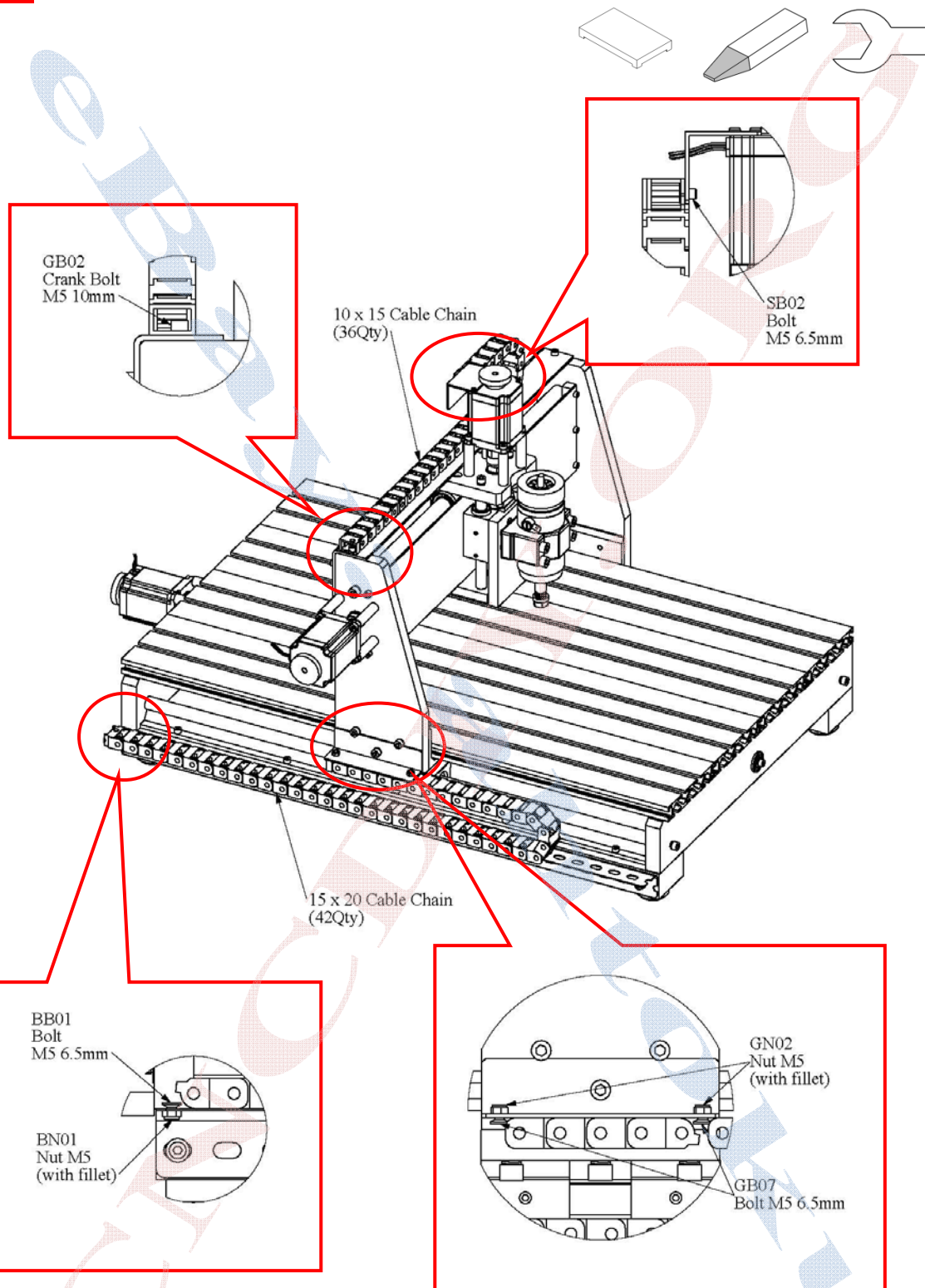
4   **Machine Assemble Completed**
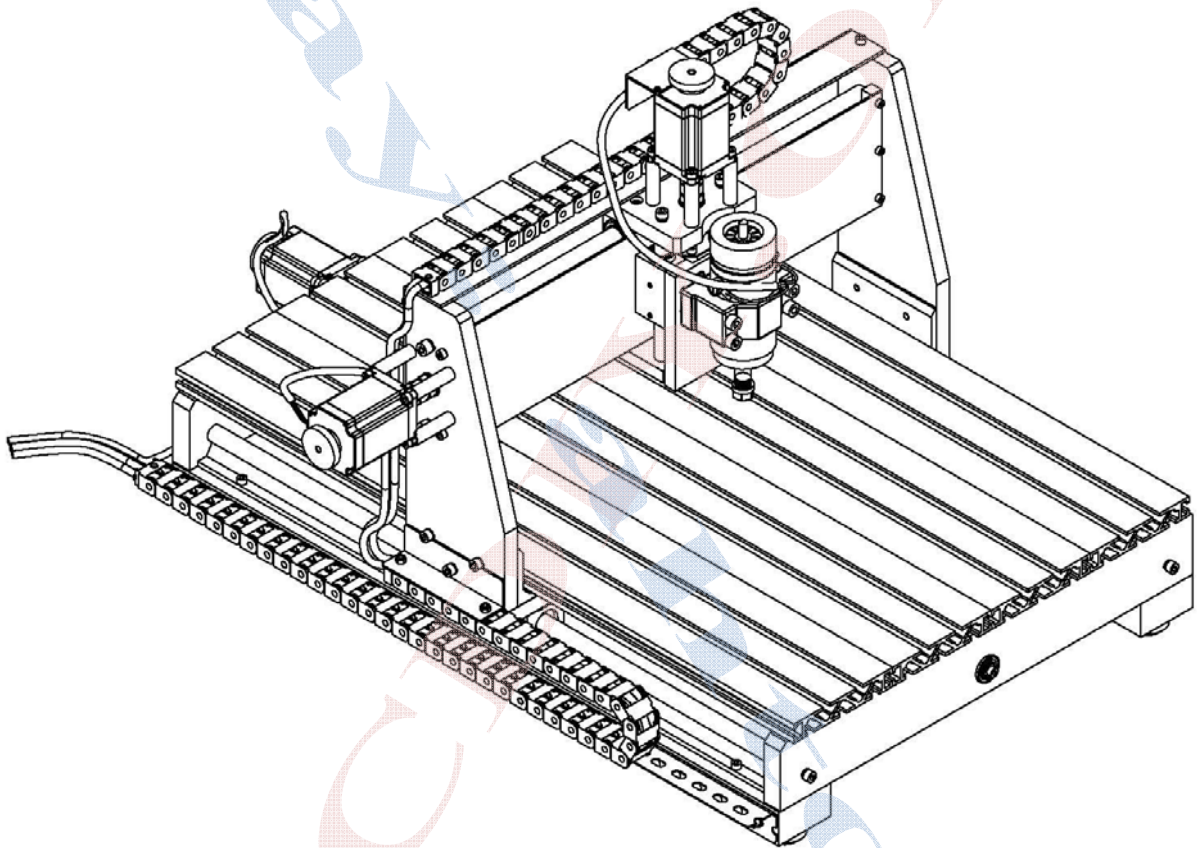
3-9   Electrical Connection

The machine and the CNC control box are separated. Therefore, you need to connect each cable. Please connect them be carefully.

3-9-1   Spindle's Cable Connection

3-9-1-1   Pins Connecting Head of Spindle's Cable Connection

The spindle is requested two main wires, which are Cathode (+) and Anode (-) of the motor. Therefore, you can connect them easily. The pin 1 of the 2 pins connecting head is connected to Cathode (+) of the spindle, the pin 2 of it is connected to Anode (-) of the spindle!
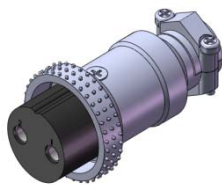
Pin Number	Spindle poles
1	Cathode (+)
2	Anode (-)
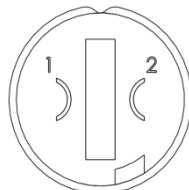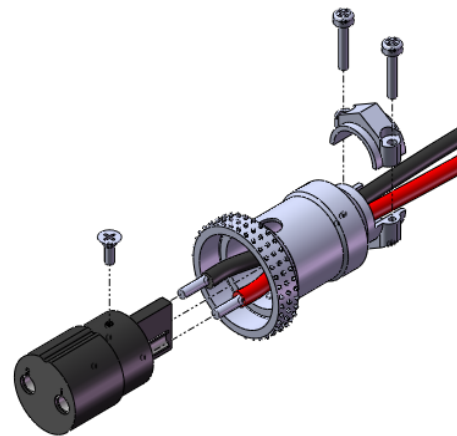
Outlook   Welding Pins   Exploded view

3-9-1-2   Spindle Connecting

The spindle has two connector for connecting the cathode (+) and the anode (-)! There are using different colour to represent the poles of it. The red cover is Cathode (+), the black cover is Anode (-)!

Anode (-)   Cathode (+)

Cable

2 Pins Head   Spindle
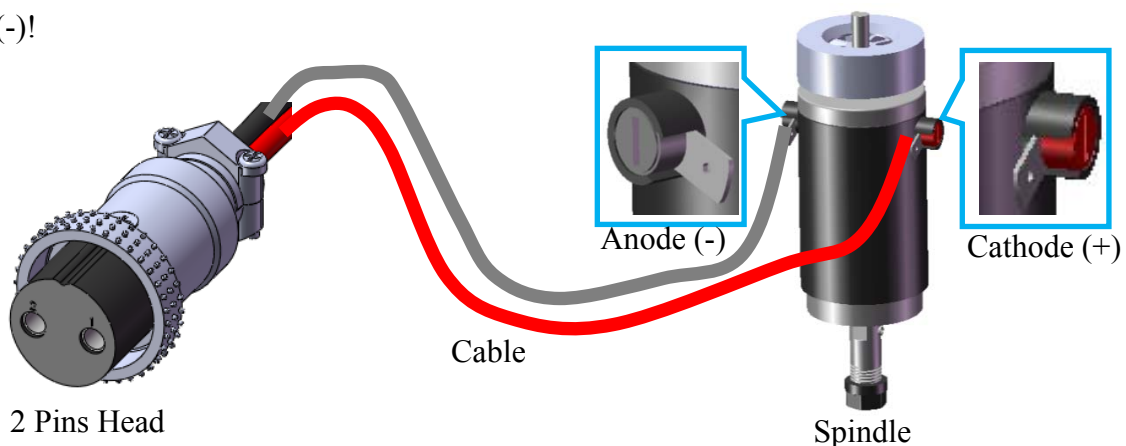
Connection diagram of spindle

3-9-2   Stepping motor's cable connection

Each stepping motor is requested four wires. They are representing A+, A-, B+ and B-. The A+ and A- is the same coil, the B+ and B- is another coil. (Please refer to the related CNC control box user's manual) Therefore, please do not connect them wrong.

3-9-2-1   Methodology of finding the poles of stepping motor

Basically, the stepping motor is included four wires of two coils. **The colour of each cable is not a good reference for identifying the poles of the stepping motor!**
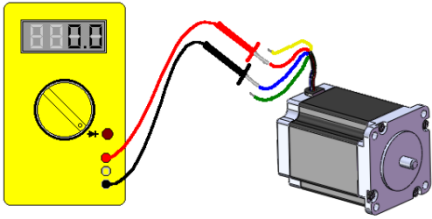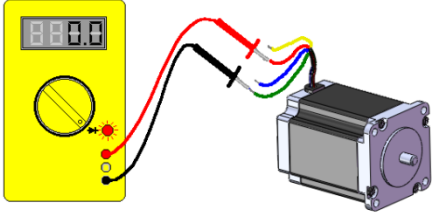
Step 1   Understanding the basic structure of the stepping motor

The stepping motors are 2 coils (phases) with 4 wires or 6 wires. The 4 wires type is included 2 wires in each coil. The 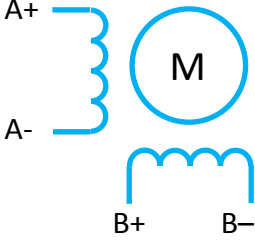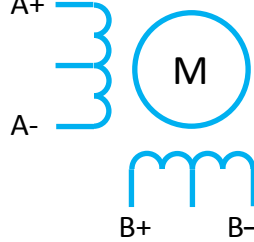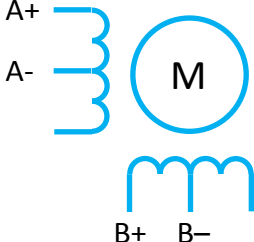6 wires type is similar to 4wires and with an additional wire at the middle of the coil ends! It called common wire! There are three connection methods for your reference!

a) 4 wires connection	b) 6 wires connection (Large torque)	c) 6 wires connection (High speed)

Step 2   Identify the each coil by test the poles or wires of the each stepping motor
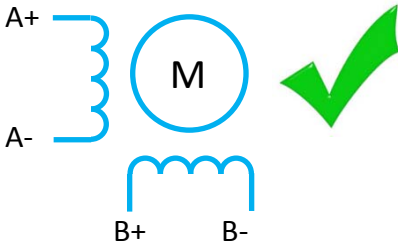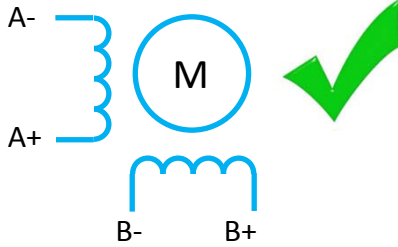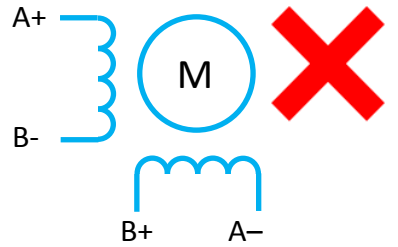
The multimeter or DMM can help you for this action! Select the Diode Symbol ▶▌ or testing conductively function!

Find and fix a wire with the red testing pin, use the black testing pin to test the other 3 wires to find out the conducted wire!	
	a) The wires are not the ends at the same coil!
If the multimeter shown that the testing wires are conducting, they are the ends at the same coil. Please record the colour and test the other two for confirming! Separating them into two group of wire for identifying the coil and coil ends!	
	b) Find the ends of the same coil!

Step 3   Assuming the poles for step 2

After find out the group of wires, you can assume that one group is A coil and the other group is B coil!

The A+ pole and the A- pole can be exchanged. The B+ pole and the B- pole can also be exchanged! **But, the any wire of A coil cannot be exchanged with any wire of B coil, it will burn the control system!**

A+ A- M ✔ B+ B-	A- A+ M ✔ B- B+	A+ B- M ✘ B+ A−
c) correct connection	c) exchange the coil ends at the same coil (phase)	c) exchange the coil ends with different coils (phases)

3-9-2-2   Header of cable (Connect with the control box)

You must following the "Methodology of finding the poles of stepping motor" for this part! Because the Pin number of the 4 pins head is represented the poles connection of the CNC controller, if the connection of poles was wrong, the controller would be burnt!

Pin Number	Stepping Motor poles
1	A+
2	A-
3	B+
4	B-
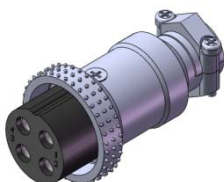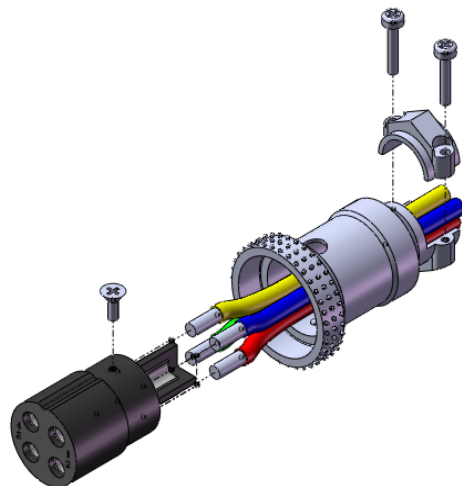
Outlook   Welding Pins   Exploded view

3-9-3 Understanding the direction of the axis

There are two types of axes direction setting. The major different are exchanged the X axis and Y axis. Before you connect the control box with the stepping motors, please understand and confirm the following setting.

3-9-3-1 Type A Setting

The Maximum stroke of the **X axis** is **400mm** and **Y axis** is 58**0mm**.
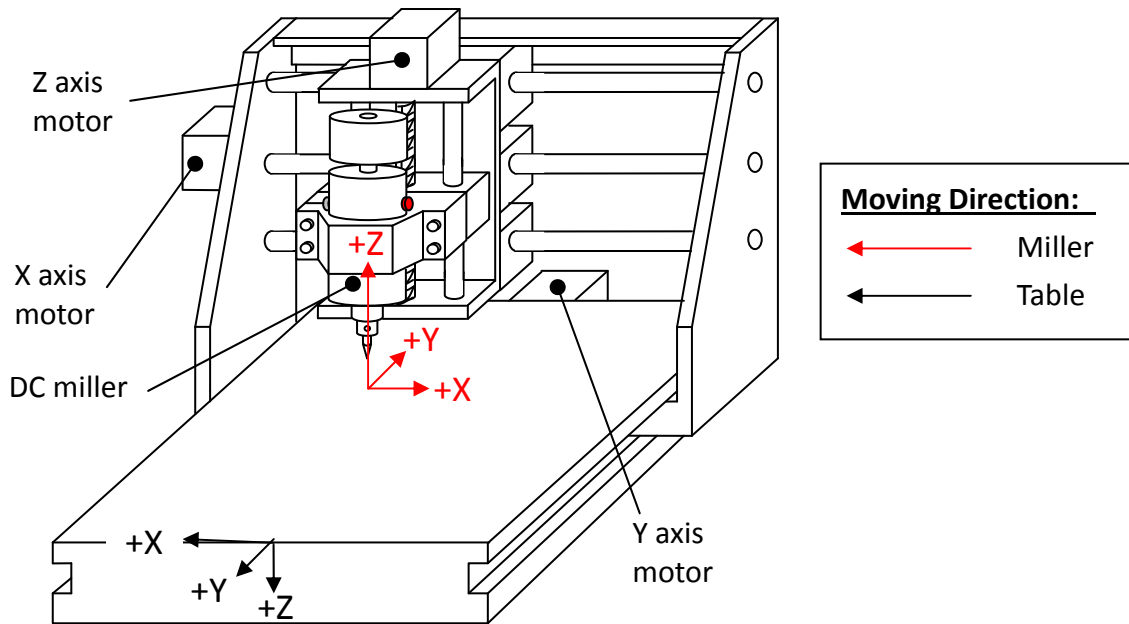
3-9-3-2 Type B Setting

The Maximum stroke of the **X axis** is **580mm** and **Y axis** is **400mm**.
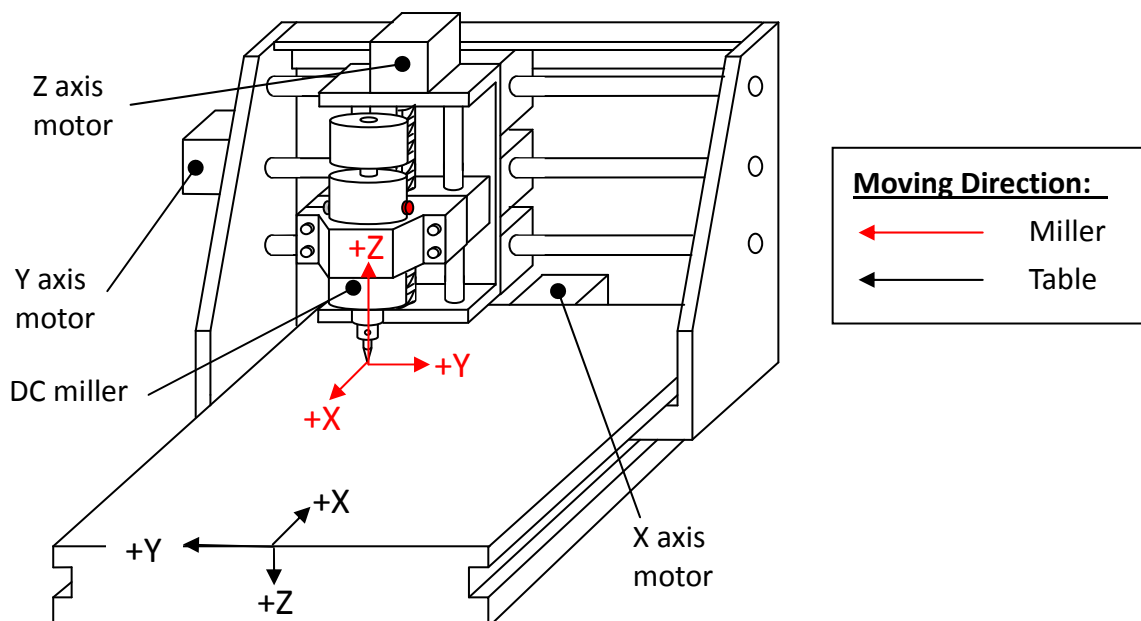
3-9-4 Final Connection

At the back of the control box, there are also requested to connect the electrical power supply cable and the computer parallel port cable.

3-9-4-1 CNC Control Box (Please refer to the related CNC control box user's manual)

Plugging the four cable connectors of the machine into the CNC control box with corresponding marking in the back of the box! Please look carefully to identify the X, Y and Z axes and the spindle motor. The spindle connector is a 2 pins plug. **User does not plug the parallel cable in the box at this moment.** Do not plug and connect any unknown connector or socket.

Connect the connector heads to correct socket!
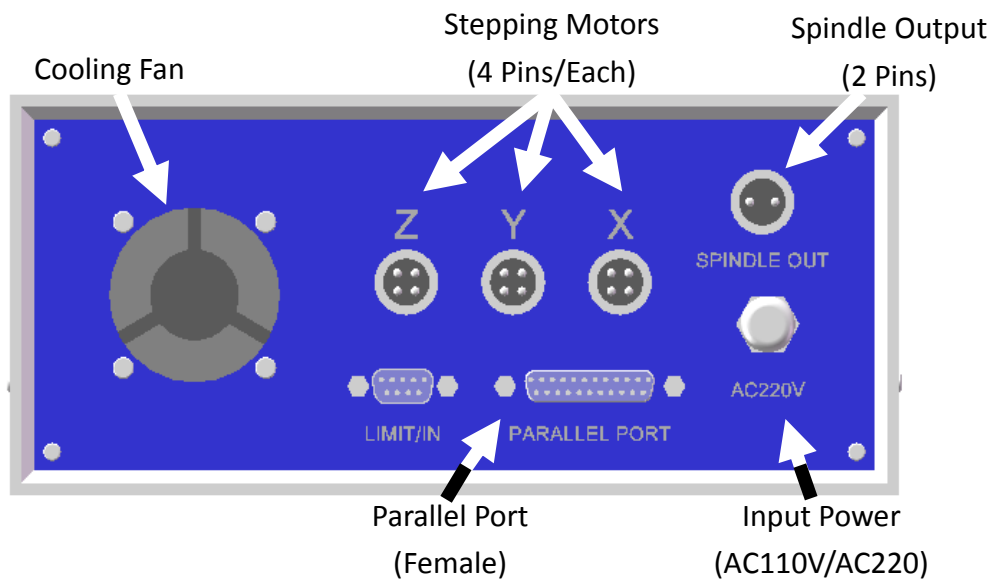
3-9-4-2 Electrical Power Supply Cable

The cable connects between the socket and the CNC control box.
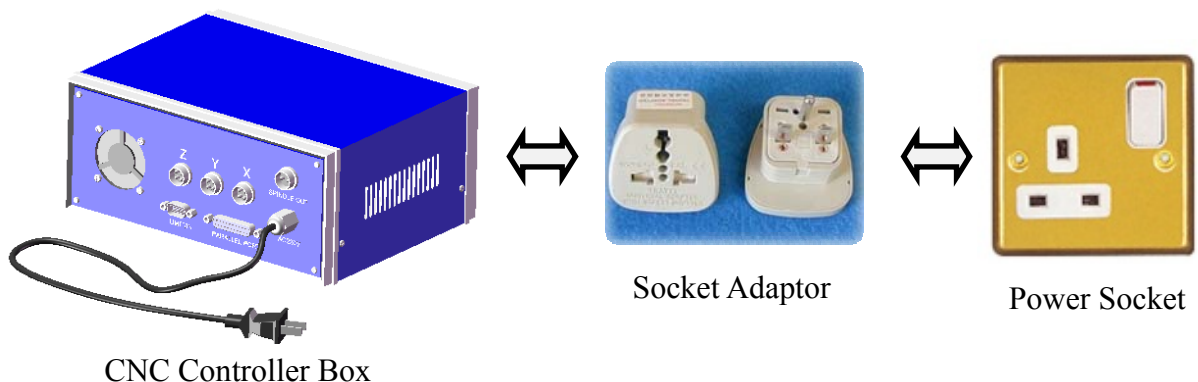
3-10 Basic Testing with CNC Control Box

Step 1 Interconnection Check

This is a preliminary test to confirm the interconnection between the CNC control box and the engraving machine. Therefore, all axes of the machine and the spindle (D57/C57) can be controlled by the CNC control box properly.

Step 2 Switching off all of the driver power

First of all, please switch off both of the spindle power and the driver power switches (switch on the "○" is off, "|" is opened), the spindle speed control knob transferred to "Safe Place" position. The Emergency Stop button must be released. (Please refer to the related CNC control box user's manual)

Step 3 Turning the knobs of each axis during power off

Now, user turns the knob of X-axis by hand twist to feel the axis whether locked by the particular stepping motor or freedom to turn!

If it is Locked = Problem

If the axis was locked before switching on the driver power, please find the cause of this problem. (i.e. Check the steeping motor moving part) If the problem cannot be solved, please contact us asap!

If it is freedom to turning = Normal

Please check another axis with the same method!

Step 4 Turning the knobs of each axis during power on

User switches on the driver power and turns the knob of X-axis by hand twist to feel the axis whether locked by the particular stepping motor or freedom to turn again!

If it is Locked = Normal

If the axis was locked before switching on the driver power, this is a normal. Please check another axis with the same method!

If it is freedom to turning = Problem

If the axis was unlocked after switching on the driver power, please find the cause of this problem. (i.e. Check the connection, Check the steeping motor moving part) If the problem cannot be solved, please contact us asap!

Step 5   Spindle Test

Then, we switch off the drive power and set the spindle speed control knob to "Safe Place" position. (Please refer to the related CNC control box user's manual)

After that, you can turn on the spindle power switch and justifying the spindle speed control knob clockwise slowly. When the knob arrive the first small circle of the marker, the spindle motor should start normal rotation. You can continue to adjust the knob clockwise slowly that the spindle motor speed will be higher and higher.

Note:

To observe the rotational direction of spindle, the correct rotation is turning clockwise, and if you found to be anti-clockwise rotation, close the spindle power, exchange the connection of the poles of the spindle motor. (Please refer to Chapter 3-9-1-2)

Attention:

Spindle Power State,

1. The 2 side terminals of the spindle is applying at or up to 90V DC voltage during the spindle operation, do not touch and contact the high-speed rotary tool for safety reason. The operator must wear a protective mask and a goggle. Child cannot use, touch and operate this machine system.

2. Before switching on the spindle power (when you start the spindle), please make sure that the "Spindle speed control knob" pointer in the "Safe Place" position. After that, you may open the spindle power switch, and then adjust the speed slowly.

3. User can turn off the spindle switch directly after uses, and remember to turn the speed knob back to a "Safe Place' smoothly. If you do not pay attention when you open the spindle the power and the spindle speed control knob in a high-speed digital, it may be a result of the high starting current to damage, breakdown or burning whole system.

Chapter 4   Installation of Mach 3 Software

The Mach 3 is one of most common CNC control interface for Microsoft Windows's users. The setting of the Mach 3 is very easy for your CNC control! It will help you to set up the basic settings and show the useful function in Mach 3 for you.

4-1   Connect to the CNC Control Box

Switch off the CNC control box and the computer, after that, user can plug the parallel cable to connect to the computer and the CNC control box. You able to switch on your computer now!

| Your PC | Parallel Port Cable | CNC Machine |

4-2   Basic Setting of Mach 3 software

There are discussed the basic setting of the Print port configuration parameters:

Step 1   Open MACH3 Software

Select "*MACH3Mill*", and then press "*OK*"!
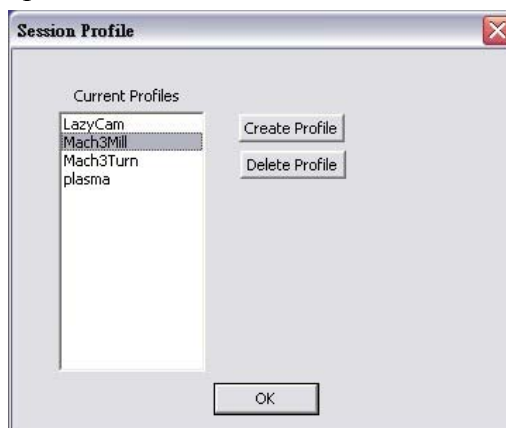
Mach 3 opens interface as below.
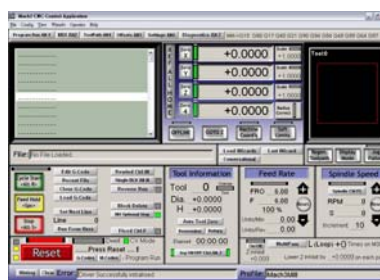
Step 2   Select the "Ports and Pins" menu

Open the "*Ports & Pins*" menu under the "*config*" menu.

Step 3   Setting the frequency of the parallel port

Select "*Port Setup and Axis Selection*" and set the basic frequency to "*35000Hz*".
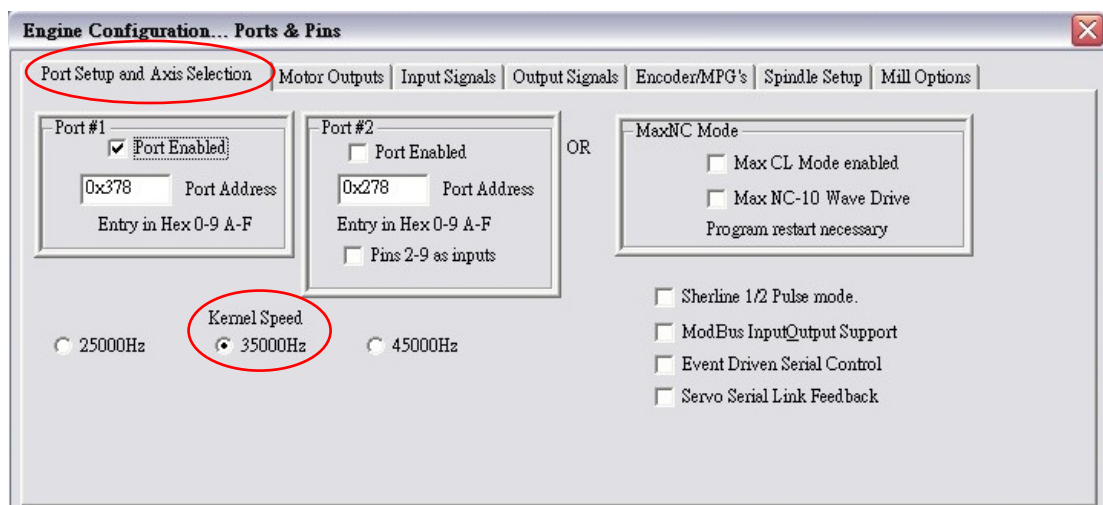
Note: most of cases are Port1, 0x378. For special models, please see "Device Manager" in the relevant attributes!
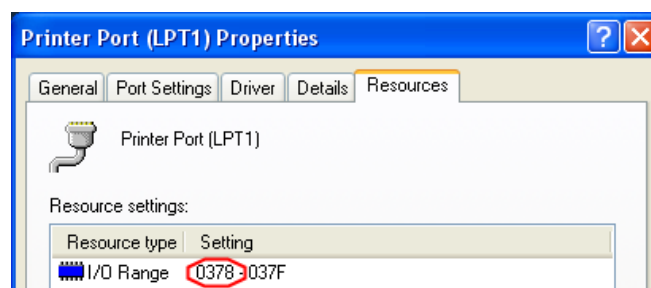
If the computer does not have the parallel port, please obtain either following items:

1. Optional PCMCIA laptop cards to LPT

2. Optional desktop PCI or ISA cards to LPT

USB to LPT port converter does not use for engraving machine control.

Step 4   Select Units

Open the "Select Native Units" menu under the "config" menu.

Select the suitable units for you system and press "OK" to confirm!

Step 5   Motor Output Setting

According to the definition of the board parallel port, please indicate in accordance with the plans to amend the definition of the software settings.

Remind: If you find the axis direction was reversed, please change the setting in the particular box under the "Dir LowActive". Please refer to the chapter 4.4.3 (Understanding of direction of the axis)

Signal	Enabled	Step Pin#	Dir Pin#	Dir LowActive	Step Low Ac...	Step Port	Dir Port
X Axis	✓	2	3	✗	✗	1	1
Y Axis	✓	4	5	✓	✗	1	1
Z Axis	✓	6	7	✓	✗	1	1
A Axis	✗	0	0	✗	✗	0	0
B Axis	✗	0	0	✗	✗	0	0
C Axis	✗	0	0	✗	✗	0	0
Spindle	✗	0	0	✗	✗	0	0

Step 6 – Input Signals Setting

Select the "*Intput Signals*" columns and change the "*Pin Number*".

Signal	Enabled	Port #	Pin Number	Active Low	Emulated	HotKey
X ++	✓	1	11	✓	✗	0
X --	✓	1	11	✓	✗	0
X Home	✗	0	0	✗	✗	0
Y ++	✓	1	12	✓	✗	0
Y --	✓	1	12	✓	✗	0
Y Home	✗	0	0	✗	✗	0
Z ++	✓	1	13	✓	✗	0
Z --	✓	1	13	✓	✗	0
Z Home	✗	0	0	✗	✗	0
A ++	✗	0	0	✗	✗	0
A --	✗	0	0	✗	✗	0
A Home	✗	0	0	✗	✗	0
B ++	✗	0	0	✗	✗	0
B --	✗	0	0	✗	✗	0
B Home	✗	0	0	✗	✗	0
C ++	✗	0	0	✗	✗	0
C --	✗	0	0	✗	✗	0
C Home	✗	0	0	✗	✗	0
Input #1	✗	0	0	✗	✗	0
Input #2	✗	0	0	✗	✗	0
Input #3	✗	0	0	✗	✗	0
Input #4	✗	0	0	✗	✗	0
Probe	✗	0	0	✗	✗	0
Index	✗	0	0	✗	✗	0
Limit Ovrd	✗	0	0	✗	✗	0
EStop	✓	1	10	✓	✗	0
THC On	✗	0	0	✗	✗	0
THC Up	✗	0	0	✗	✗	0
THC Down	✗	0	0	✗	✗	0
OEM Trig #1	✗	0	0	✗	✗	0
OEM Trig #2	✗	0	0	✗	✗	0
OEM Trig #3	✗	0	0	✗	✗	0
OEM Trig #4	✗	0	0	✗	✗	0
OEM Trig #5	✗	0	0	✗	✗	0
OEM Trig #6	✗	0	0	✗	✗	0
OEM Trig #7	✗	0	0	✗	✗	0
OEM Trig #8	✗	0	0	✗	✗	0
OEM Trig #9	✗	0	0	✗	✗	0
OEM Trig #10	✗	0	0	✗	✗	0
OEM Trig #11	✗	0	0	✗	✗	0
OEM Trig #12	✗	0	0	✗	✗	0
OEM Trig #13	✗	0	0	✗	✗	0
OEM Trig #14	✗	0	0	✗	✗	0
OEM Trig #15	✗	0	0	✗	✗	0
Timing	✗	0	0	✗	✗	0
Jog X++	✗	0	0	✗	✗	0
Jog X--	✗	0	0	✗	✗	0
Jog Y++	✗	0	0	✗	✗	0
Jog Y--	✗	0	0	✗	✗	0
Jog Z++	✗	0	0	✗	✗	0
Jog Z--	✗	0	0	✗	✗	0
Jog A++	✗	0	0	✗	✗	0
Jog A--	✗	0	0	✗	✗	0

Engine Configuration... Ports & Pins

Port Setup and Axis Selection | Motor Outputs | Input Signals | Output Signals | Encoder/MPG's | Spindle Setup | Mill Options

Pins 10-13 and 15 are inputs. Only these 5 pin numbers may be used on this screen

OK   Cancel   Apply

Step 7   Output Signals Setting

Select the "*Output Signals*" columns and change the parameter as below:

Signal	Enabled	Port #	Pin Number	Active Low
Digit Trig	✗	0	0	✗
Enable1	✗	0	0	✗
Enable2	✗	0	0	✗
Enable3	✗	0	0	✗
Enable4	✔	1	17	✗
Enable5	✔	1	16	✗
Enable6	✗	0	0	✗
Output #1	✔	0	0	✗
Output #2	✗	0	0	✗
Output #3	✗	0	0	✗
Output #4	✗	0	0	✗
Output #5	✗	0	0	✗
Output #6	✗	0	0	✗
Charge Pump	✗	0	0	✗
Charge Pump2	✗	0	0	✗
Current Hi/Low	✗	0	0	✗
Output #7	✗	0	0	✗
Output #8	✗	0	0	✗
Output #9	✗	0	0	✗
Output #10	✗	0	0	✗
Output #11	✗	0	0	✗
Output #12	✗	0	0	✗
Output #13	✗	0	0	✗
Output #14	✗	0	0	✗
Output #15	✗	0	0	✗
Output #16	✗	0	0	✗
Output #17	✗	0	0	✗
Output #18	✗	0	0	✗
Output #19	✗	0	0	✗
Output #20	✗	0	0	✗

Engine Configuration... Ports & Pins

Port Setup and Axis Selection | Motor Outputs | Input Signals | Output Signals | Encoder/MPG's | Spindle Setup | Mill Options

Pins 2 - 9 , 1, 14, 16, and 17 are output pins. No other pin numbers should be used.

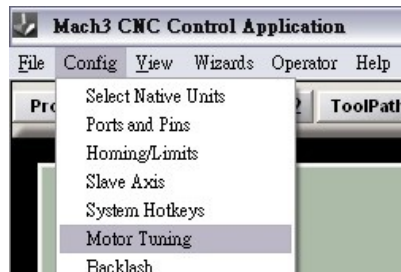OK   Cancel   Apply

Step 8   Finish the setting

Select "OK" to confirm

4-3   Stepping motor setting in Mach 3 with different coupling type

The procedure of motor setting is discussed in follow:

Step 1   Open the Motor setting dialog

Select the "*Motor Tuning*" under the "*Config*" menu.

Step 2   Understanding the relationship between the parameters and the coupling type

The life of coupling is affect by the stepping motor speed and the type of processing materials. The basic comparison table is listed below:

No.	Description	Flexible coupling	Simple coupling	Plum coupling
1.	#Velocity(mm's per min)	Below 1500	About 2000	About 2500
2.	Materials	Aluminum Alloy	Aluminum Alloy	Aluminum Alloy
3.	Suggested processing materials	PCB, wood and plastic etc.	PMMA and soft metal.	PMMA and soft metal.

# This velocity is the same as the "Velocity" parameter in Mach 3

Therefore, before you set up the parameter of the velocity in Mach 3 for each stepping motor, please consider the coupling type and processing materials first.

If the velocity setting is too high such as the velocity is 2000 mm's per min with installed the Flexible coupling, the machine will be produced two situations:

1. The coupling may be broken.
2. The movement of the axis does not smooth and presents sharking.

Step 3   Parameters of stepping motor
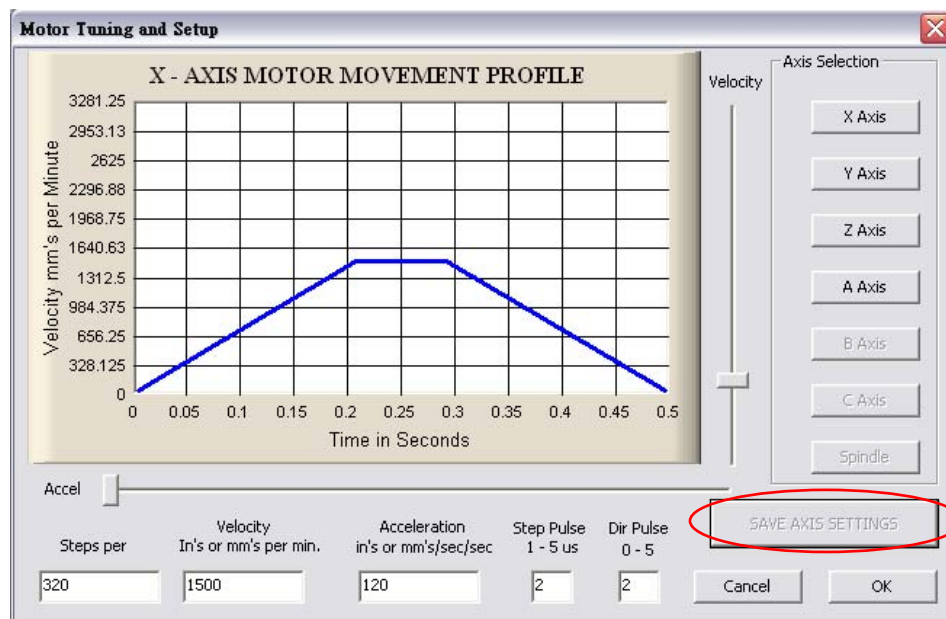
The suggested settings for different unit are shown in the table below:

A. For **millimeter** unit use

	Steps per	Velocity	Acceleration	Step Pulse	Dir Pulse
X	320	1500 - 2000	300	10	5
Y	320	1500 - 2000	300	10	5
Z	320	#750 - 1000	150	10	5

B. For **inch** unit use

	Steps per	Velocity	Acceleration	Step Pulse	Dir Pulse
X	8128	59 – 78.7	12	10	5
Y	8128	59 – 78.7	12	10	5
Z	8128	#29.5 – 39.4	6	10	5

After completed the setting for each axis, please press the "*SAVE AXIS SETTINGS*" button to save and confirm your setting.

(#)The velocity of Z axis is depended on the cutting speed and processing materials to define, the speed cannot fast, which will break the cutting tools!
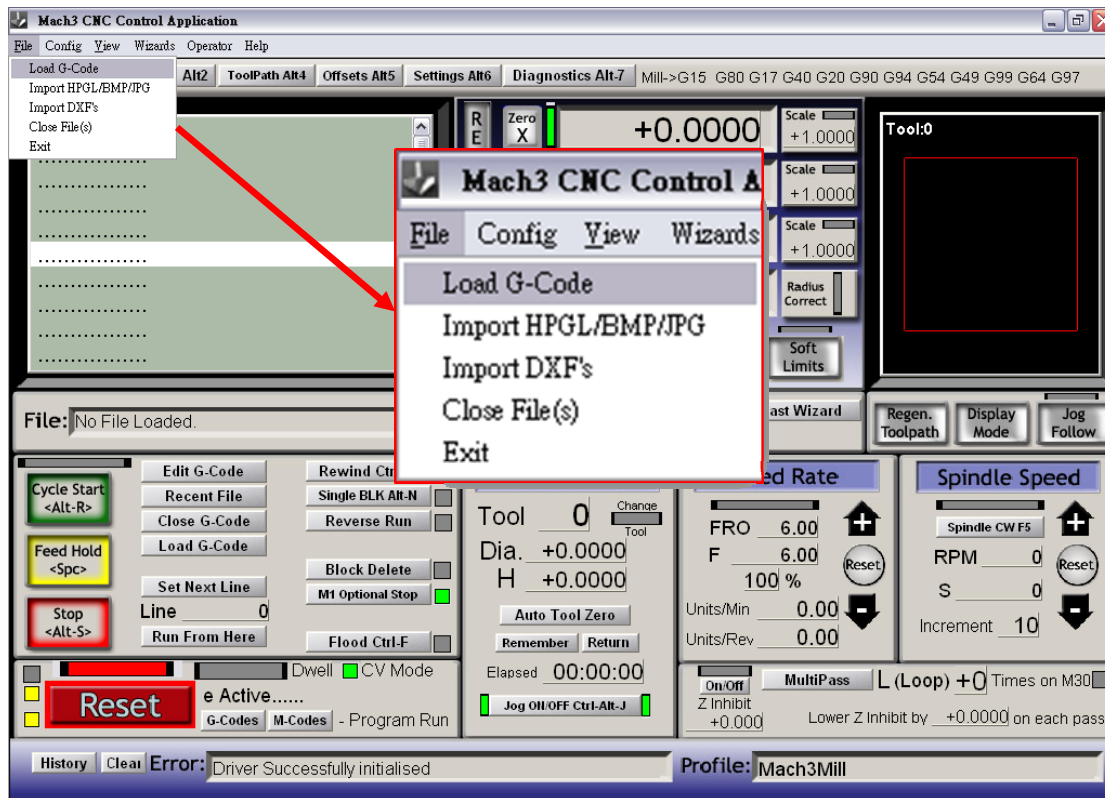
Step 4   Save and Exit the setting

Select "*OK*" to save all setting and exit.

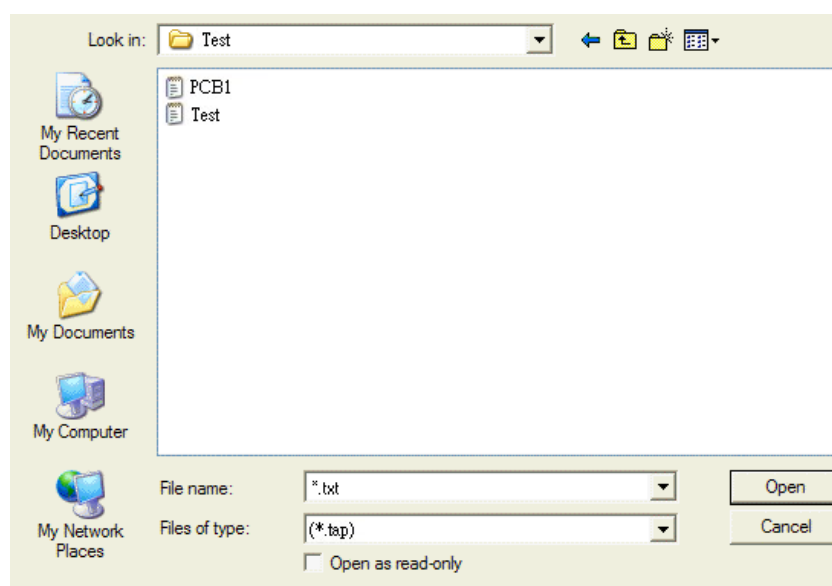## 4-4   Load a G code file

After completed all setting, you can open and run a G-code file into Mach 3.

Step 1   Open a G code file

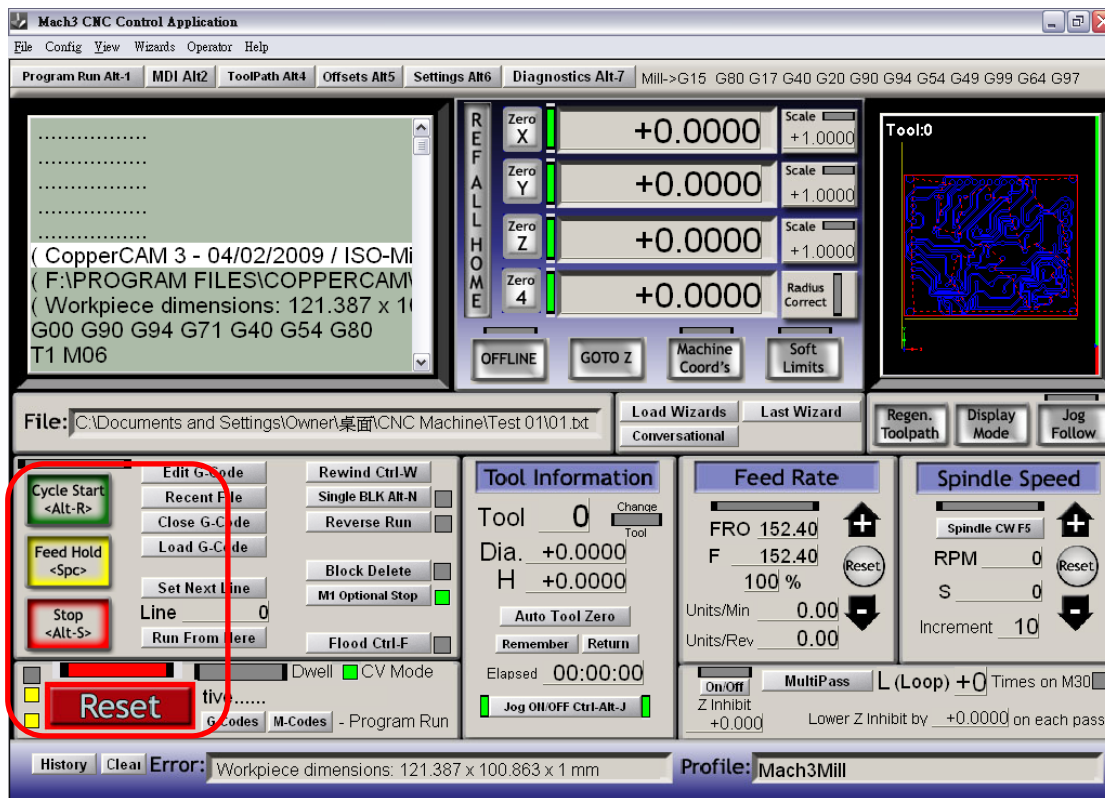Select "*Load G Code*" under the "*File*" menu.

Step 2   Select your file.

### Step 3   Start running the G code

You can see the red flashing "*RESET*" button, and click it to stop the flashing, after that please select the "*Cycle Start*" button or press <Alt> and <R> keys on your key board to run the G code.

 If you want to stop running, select "*Stop*" button or press <Alt> and <S> keys on your keyboard.

4-5   Testing with CNC machine

Press "*TAB*" functional key on your keyboard, the Mach 3 will show a manual control panel on the right side of your screen, you can test each axis setting of direction by pressing the particular buttons.
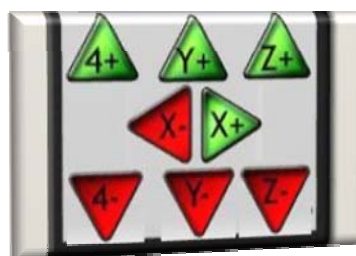
Chapter 5   Installation of EMC2 Software

The EMC2 is a famous CNC control interface for Linux's users. It will guide you to complete setting the parameters for you machine and show the useful function in EMC2 for you.

5-1   Connect to the CNC Control Box

Switch off the CNC control box and the computer, after that, user can plug the parallel cable to connect to the computer and the CNC control box. You able to switch on your computer now!

Your PC   Parallel Port Cable   CNC Machine
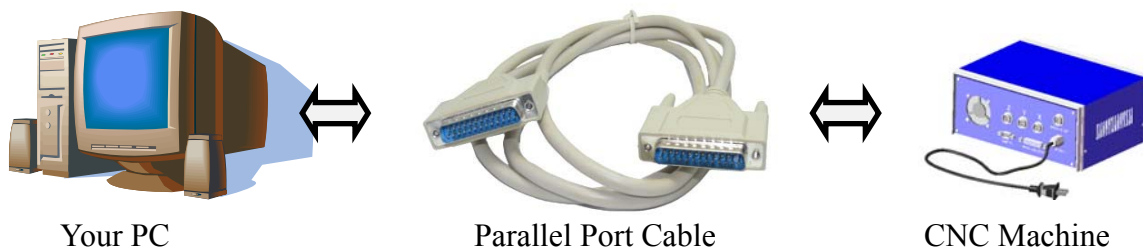
5-2   Basic Setting of EMC2 software

There are discussed the basic setting of the Basic machine information for you system.

Step 1   Check Your Hardware

Go to the *"Applications"* toolbar, select *"Accessories"* and then *"Terminal"*.

It will run the **Latency Test**, which will put you into the good old *nix command line interface.

If the computer does not have the parallel port, please obtain either following items:

1. Optional PCMCIA laptop cards to LPT
2. Optional desktop PCI or ISA cards to LPT

USB to LPT port converter does not use for engraving machine control.

EMC2 / HAL Latency Test

Let this test run for a few minutes, then note the maximum Jitter. You will use it while configuring emc2.

While the test is running, you should "abuse" the computer. Move windows around on the screen. Surf the web. Copy some large files around on the disk. Play some music. Run an OpenGL program such as glxgears. The idea is to put the PC through its paces while the latency test checks to see what the worst case numbers are.

	Max Interval (ns)	Max Jitter (ns)	Last interval (ns)
Servo thread (1.0ms):	1004233	**8370**	996727
Base thread (25.0µs):	33555	**9403**	24242

## Step 2   Set up the CNC Configuration

Select the *"Applications"* menu (equivalent of the Windows Start Button) and choose the *"CNC"* submenu and the EMC2 *"Stepconf"* Wizard. It will go to the *"Stepper Mill Configuration"*.

EMC2 Stepper Mill Configuration

EMC2 Stepper Mill Configuration

This program creates configuration files (.ini and .hal) for "step and direction" milling machines and lathes connected to the PC parallel port.

Check the *"Forward"* button for next.

Cancel   Back   Forward

Step 3   Create a new CNC Configuration

Select the checkbox of the *"Create a new Configuration"* and Check the *"Forward"* button for next.
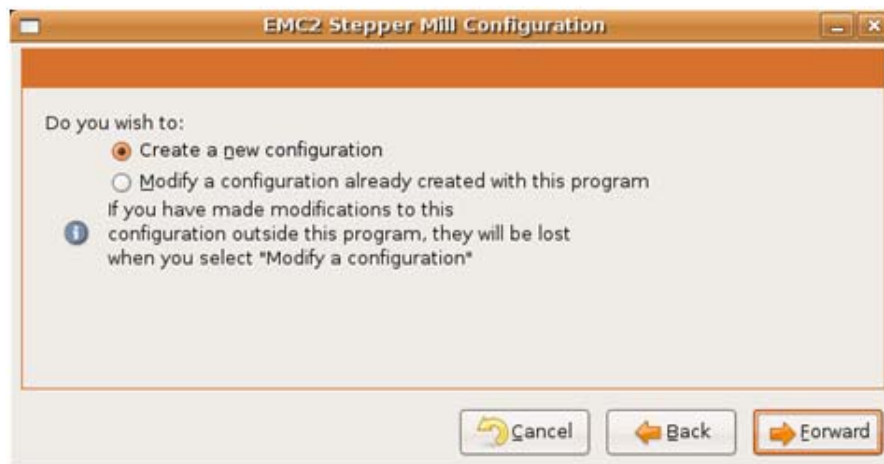
Step 4   Entering the Basic Machine Information

Please follow the below setting!

Step 5   Setting up the Parallel Port

Please follow the below setting for you parallel port! You can find the related information in the *"Parallel port interface definition"* of the CNC Controller Specification:

The **invert signal checkbox** next to every signal is an importance functions.

Input signal

As for inputs, inversion will switch from a true signal being high (+5V) to low (0V) and a false signal from being low (0V) to high (+5V). According to the "Parallel port interface definition" of the CNC controller (refer to 6.1 CNC Controller Specification), the E-Stop is needed the "Active Low input" signal, so, the invert signal checkbox of the Pin 10 (ESTOP Out) must be checked.

Output signal

On the output side inverting the signal will convert from a high (+5V) signal when active to a low (0V signal).   For example, if you find the axis direction was reversed, please change the selection of the particular **invert signal checkbox**. It can be help you to select the correct direction by software. Please refer to the chapter 3.5.4 (Understanding of direction of the axis).

5-3   Stepping motor setting in EMC2 different coupling type

The life of coupling is affect by the stepping motor speed and the type of processing materials. We are provided two type of coupling for each user. The first type is flexible coupling and the other type is simple coupling. The basic comparison table is listed below:

No.	Description	Flexible coupling	Simple coupling	Plum Coupling
1.	#Velocity(mm's per sec)	Below 25	About 33.33	About 41.7
2.	Materials	Aluminum Alloy	Aluminum Alloy	Aluminum Alloy
3.	Suggested processing materials	PCB, wood and plastic etc.	PMMA and soft metal.	PMMA and soft metal.

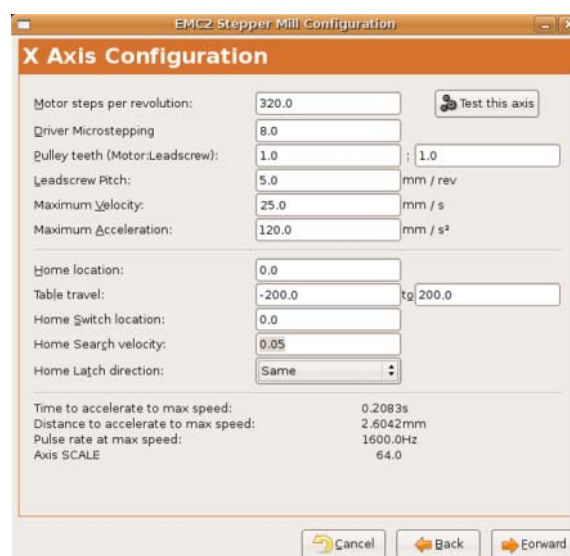# This velocity is the same as the "Velocity" parameter in EMC2

Therefore, before you set up the parameter of the velocity in EMC2 for each stepping motor, please consider the coupling type and processing materials first.

If the velocity setting is too high such as for example, the velocity is 41.7 mm's per sec with installed the Flexible coupling, the machine will be produced two situations

1. The coupling may be broken.
2. The movement of the axis does not smooth and presents sharking.

Step 1   Parameters of stepping motor

Step 1   Parameters of stepping motor (continue)

The suggested settings for different unit are shown in the table below:

A. For **millimeter** unit use

Seg.	Description	X	Y	Z	Unit
1	Motor steps per revolution	200.0	200.0	200.0	
2	Driver Microstepping	8.0	8.0	8.0	
3	Pulley teeth (Motor):	1.0	1.0	1.0	
	Pulley teeth (Leasdscrew):	1.0	1.0	1.0	
4	Leadscrew Pitch:	5.0	5.0	5.0	mm/rev
5	Maximum Velocity:	18.0	18.0	#5.25	mm/s
6	Maximum Acceleration:	120.0	120.0	#60.0	mm/s^2
7	Home location	0.0	0.0	0.0	
8	Table travel (minimum):	-200.0	-300	0	
	Table travel (maximum):	200	300	90	
9	Home Switch location:	0.0	0.0	0.0	
10	Home Search velocity:	0.05	0.05	0.05	
11	Home Latch direction:	Same	Same	Same	

B. For **inch** unit use

Seg.	Description	X	Y	Z	Unit
1	Motor steps per revolution	200	200	200	
2	Driver Microstepping	8.0	8.0	8.0	
3	Pulley teeth (Motor):	1	1	1	
	Pulley teeth (Leasdscrew):	1	1	1	
4	Leadscrew Pitch:	5	5	5	rev/in
5	Maximum Velocity:	0.7	0.7	#0.2	in/s
6	Maximum Acceleration:	4.7	4.7	#2.4	in/s^2
7	Home location	0.0	0.0	0.0	
8	Table travel (minimum):	-7.87	-11.8	0	
	Table travel (maximum):	7.87	11.8	3.5	
9	Home Switch location:	0.0	0.0	0.0	
10	Home Search velocity:	0.05	0.05	0.05	
11	Home Latch direction:	Same	Same	Same	

After completed the setting for each axis, please press the "*Forward*" button to save and confirm your setting.
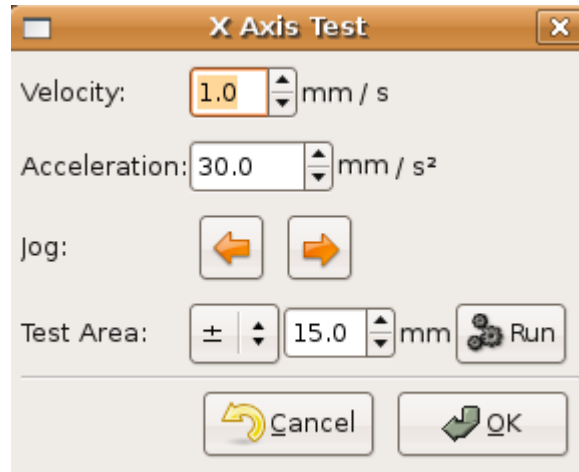
(#)The velocity of Z axis is depended on the cutting speed and processing materials to define, the speed cannot fast, which will break the cutting tools!

Step 2   Axis Test

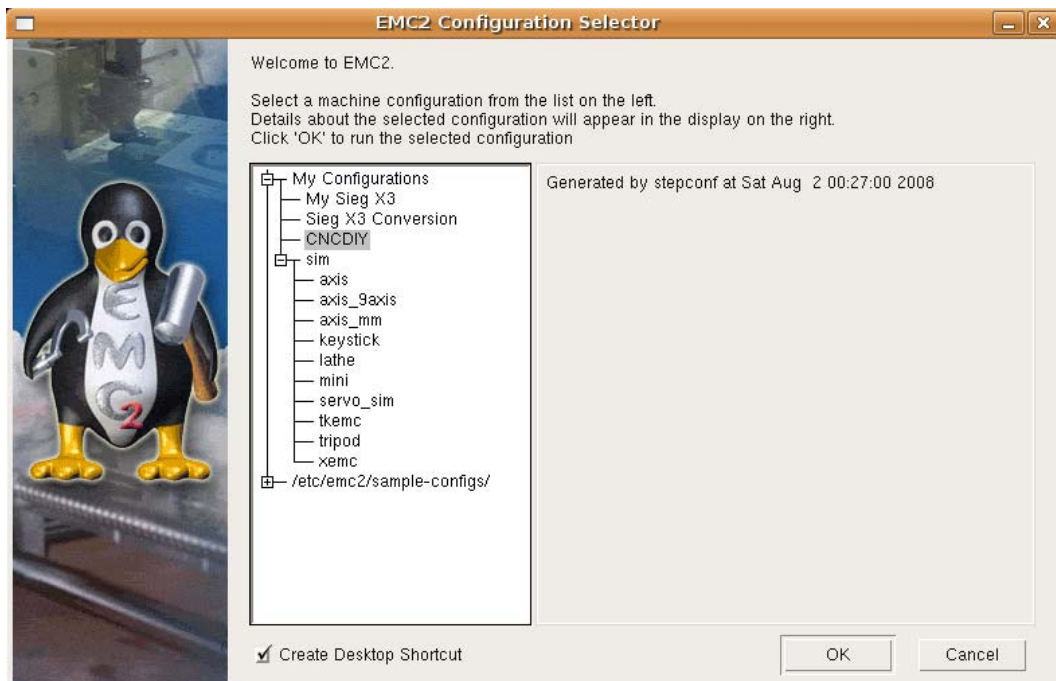Please the "*Test this axis*" button at the top right hand comer.
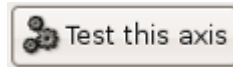
You can enter any value for each item to test the response of each axis

You can check the "*Run*" button to start the testing.

Step 3   Select your new configuration

Select the suitable configuration for your system.

Check the "OK" to start the EMC2! For more operation details of EMC2, please go to the original website: http://www.linuxcnc.org/

Chapter 6   Test Your System

In this Chapter, we use a g code file of a word "CNC" to discuss for you!

Step 1   Fixing the carving material

1. Looking for a 5X15 cm rectangle around the aluminum allow material.

2. The material fixed to the table with the platen as shown below. Attention to tighten the screws, but be careful not to T-slot table to pull the edge of distortion.
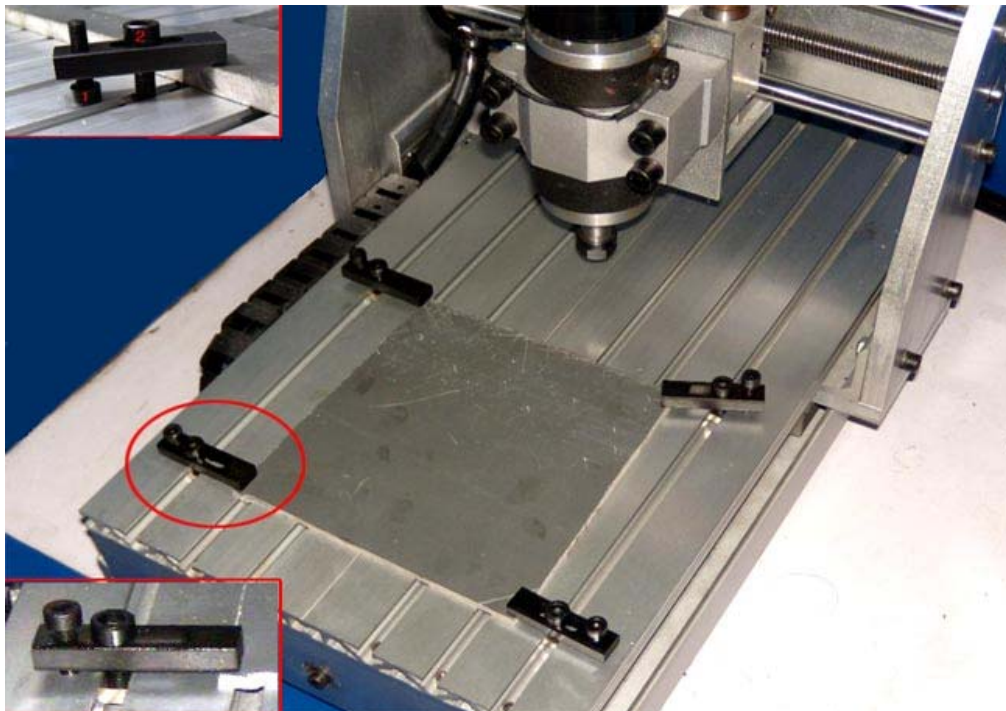
Step 2   Tool path running test

Import the "G Code" tool path file in the Mach 3 or EMC2.

Step 3   Find the original location

Turning on the drive power switch of the CNC control box and using the software manual control function to move all axes to the start point as the below image.
The red area is the "Safety Boundary"(excluding the space occupied by the platen). The black point "+"is the original location of the tool path. Place the center point of the spindle (without loading a tooling) at the original location on the material.

User must rise up the Z axis part to avoid the spindle crashing the screws and the plate during running. And then, set "Zero" for all axes in your software.

Step 4   Start running without tooling

User can start running the G code file now. **If the running path is not correct, please push the E-Stop button and switch off the power of the CNC control box immediately. Please check again the setting in your software carefully.**

During the running operation without loading cutting tool, please observe the tool path whether will be crashing the screws and platens carefully. If the cutting tool crashed the screws or platen, the tooling maybe broken or the routing machine system may also be damaged in serious.
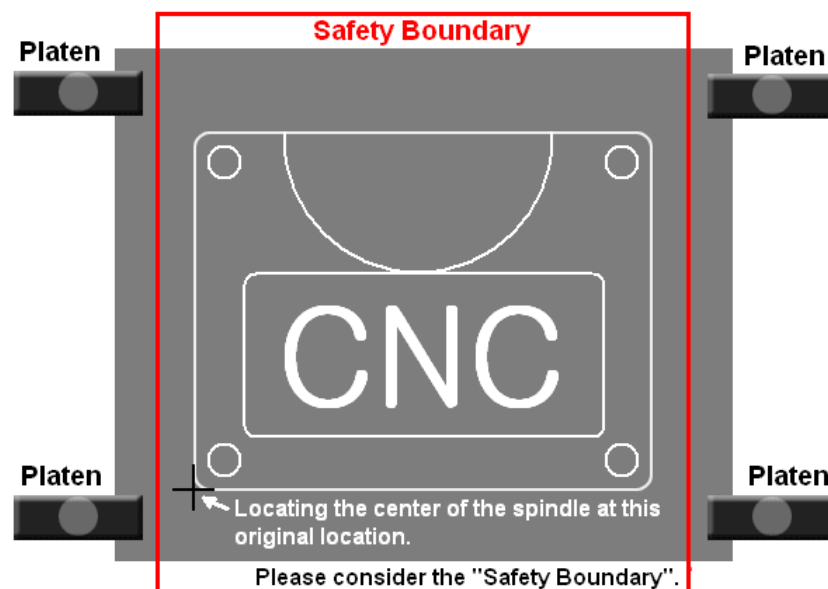
Step 5   Start running with tooling

Install a miller tool in the spindle and the chuck should have a distance between the chunk and the surface of the workpiece at least one cm or more. After that, locking the cutting tool with the spindle handles.

Tooling Locating Procedures:

1. Turn on the CNC driver and turn off the spindle. Then, set the spindle back to the original location with using manual control of the software: Adjusting the tip of the tool location at the top of the original location with about 1mm of the distance between the tip of the tooling and the workpiece (X and Y position must be arrived at the original location, the Z position should have at least 1mm distance between the tooling tip and the original position). Be carefully the distance between the tip of the tooling and the workpiece to avoid breaking the tooling due to insufficient space.

2. Turn off both CNC driver and spindle. Place a thin paper on the original position. You can use the knob on the top of the Z axis stepping motor to adjust the distance between the tooling tip and the workpiece slowly. When the tip of the cutting tool is approaching on the paper, move the paper to feel that whether the paper can torn by the cutting tool. The tooling tip must not touch and contact the surface of the workpiece. Therefore, the accuracy can be reduced to about 0.05mm.

3. When all axes arrived at the original location, set "Zero" for all axes in your software interface. Turn on the CNC driver switch and make sure all stepping motor are locking the axes.

4. Make sure that the "Spindle speed control knob" pointer in the "Safe Place" position. (Please refer to the related CNC control box user's manual). Then, switch on the spindle power and adjust "Spindle speed control knob" to obtain sufficient rotating speed of the spindle. At the first time, you can turn to the maximum spindle speed to test the spindle.

5. Please wear a protection mask and a goggle for safety reason. You can start to run the G code now!
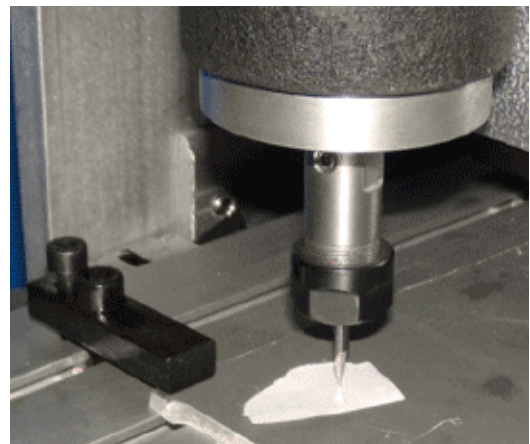
Attention

Note: If any accident happening during the processing (such as a sudden out of step wrong, the spindle suddenly stop, etc.), press the e- stop button on the CNC control box immediately, or use the mouse to click "emergency stop" button or function to stop the machine system.

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We hope that you can share your experiences with using our machines! Otherwise, If you have any problem with using our product, please feel free to leave a message on this forum.