

# he ZY series of double side PCB prototype machine



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## *Notes:*

1. In order to avoid damaged in transportation, the principal axis motor is fixed on the prop stand, please tore down the principal axis fixture before switch on until it can be free move.

2. Take out the tools and cutters attached with the machine.

3. Please turn off the main power when after work, in order to prevent damage cause in machine is over hot.

4. For prevent the accident. Do not open the machine door when the principal axis motor is working.

5. Please read the manual carefully before operation.

Prepared by customers

1. 1 set Computer: The software requests the WIN2000/ NT/ XP, CPU: 586-500 MHz up, RAM: 256 M up, with connect and CD-ROM.

2. 1 set Vacuum: The power is above 500 W

3. 1 piece fine sand paper

4. 1 double-stick tape: The bigger the best

5. 1 electric outlet

# Chapter 1            Brief introduction

## *The ZY serials of double side PCB prototype machine*

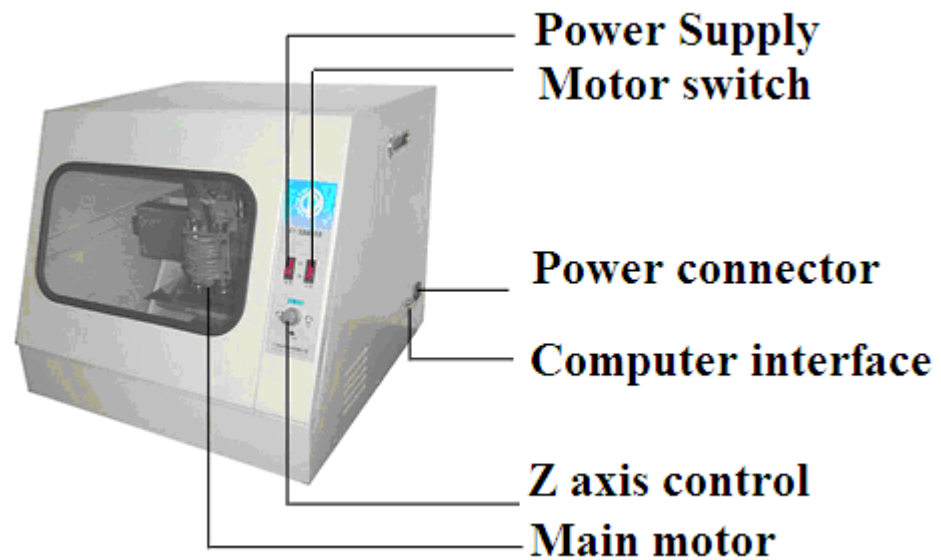
The ZY serials of double side PCB prototype machine include ZY2518-B、ZY2518-C、ZY3222、ZY3222-C double side machines and ZY3220 profession machine which produce single \double side PCB automatically, quickly and precisely with PCB document created by software PROTEL. Compare with PCB prototype machine of importing, has a highly cost-effective. The PCB document is finished by customers with computer, then transmit it to machine through RS-232 communication connects (Portable computer use 232 Converse wire through USB plug ).The PCB prototype machine is capable to finish milling, drill a hole and milling side processes. Software promoting to higher grade with infinite, plain copper-plated equipments etc, Make product kit in variety, Boards can be produced at low cost and high-efficiency. this machine has extensive function, which is the experiment equipments of university and college, military college, occupation technique school, teaching use, also is the important implements of Science woks organizations to engage in the electronics, industry automation, software, the design of integrated circuit.

## *Functions*

The ZY serials of double side PCB prototype machine is a high and new technology product that combine together with machine electricity, software and hardware. With the control of computer, the milling process is employed to produce a shallow channel around the pattern on a plain copper-plated pc board. By leaving the pattern, these units are capable of drilling boards with multiple ground surfaces .Because the machine drills the holes and the Routing dimensions of the pc board after the pattern has been produced, boards for laboratory experiments and small quantities of Boards can be produced quickly and at low cost.

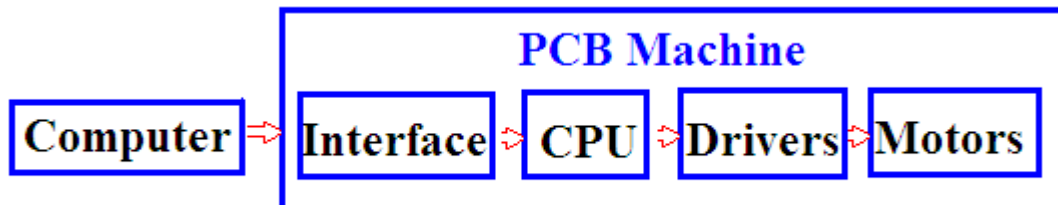
The PCB prototype machine is a professional machine for producing PCB system that is capable to finish engraving, drill a hole and milling processes.

## *The shape of machine*

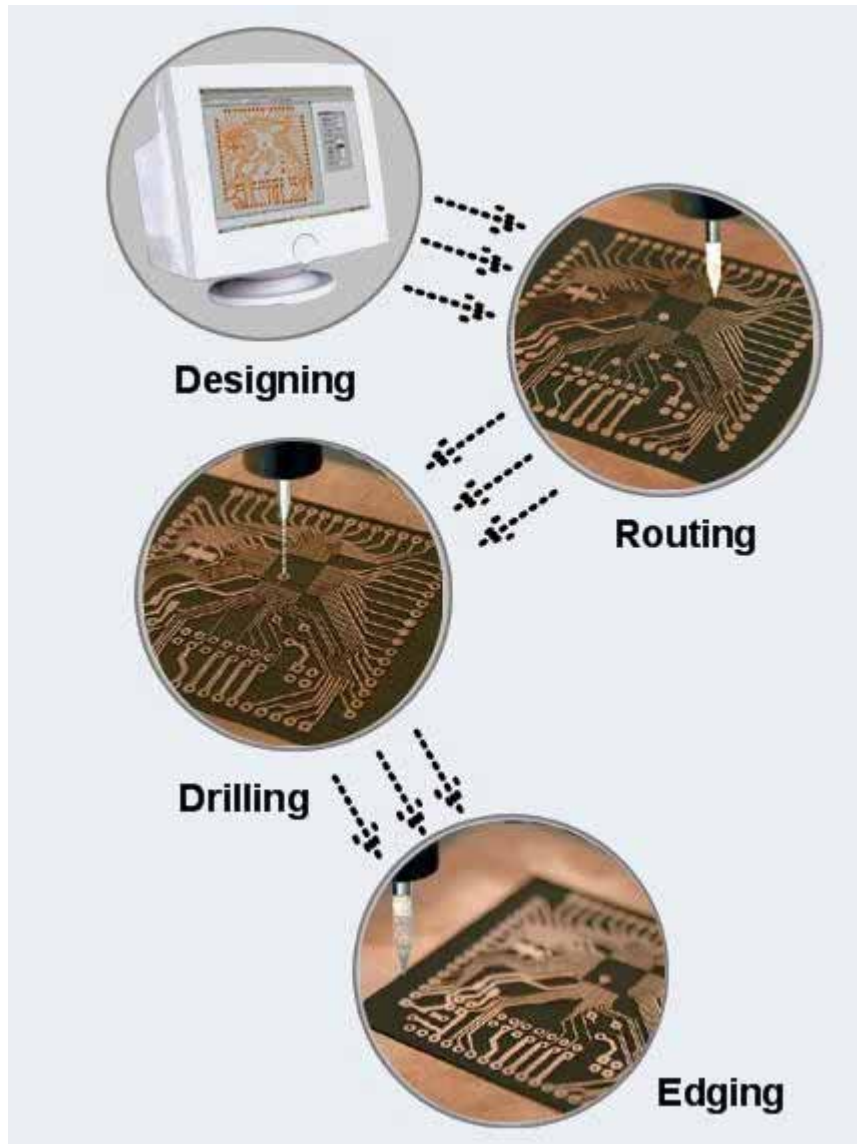


## *Construction*

The PCB prototype machine is made of software system and hardware system. As follows :



The processes and principles of single side PCB prototype machine



## ***Processes***

First, fix the plain copper-plated pc board on work set, turn on power, adjust the primitive position, and click “milling” (see details of Product manual)

The best route of cutter is calculated automatically by computer according to the PCB document and can be resolved into orders which are transmitted to machine through communication connects

With the calculator of main CPU , the accurate stepping level pulse signals can be output to control three stepping level motors revolve. The synchronous gear arouses the main axis and work set moving, the cutter moves opposite to PC boards, transmit signal of finish to computer when it is finished.

The principal axis motor revolves with high speed, the cutter mills the plain copper-plated surface Routing dimensions of the pc board to remove out superfluous copper, then the machine are capable to finish drill a hole and milling side processes automatically and the PCB product has been produced.

## ***Main principles***

### **1. Concerning blank PCB**

Blank PCB is to which covered a layer of conduct copper on insulator. Remove superfluous copper on blank PCB with milling process to produce a PCB. It is similar in traditional produce process which is manmade. The different between them is our product use numerical control principle to do it automatically.

### **2. Concerning the path of the milling**

When produce a PCB product, the first thing is to know which parts need to leave over or remove out, and what path dose the cutter routing. In this system, the best route of cutter is calculated automatically by computer according to the PCB document. This process is called the path of the milling.

### **3. Concerning the orders transmission**

The best route of cutter is calculated automatically by computer according to the PCB document and can be resolved into orders which are transmitted to machine through communication connects. While orders are received, for example click "milling " button, the path orders will be transmitted to PCB machine item by item through communication connects. The completely signal will be reported to computer as PCB machine obey an order. The signal of stop will be transmitted to computer as all tasks are finished and the machine stop working.

With the calculator of main CPU , the accurate stepping level pulse signals can be output to control three stepping level motors revolve,

transmit the signal of finish to computer.

#### 4. Concerning the control of combined movement

In this machine, three mutual independent slideways which movement straightly are installed at Mutual verticality. The Y shaft pulley block movement front and back to power the work set . The Y shaft pulley block movement front and back to power the work set . The X shaft pulley block movement left and right to power the Z shaft pulley block and the principal axis motor which is installed on the Z shaft. The Z shaft movement up and down to power the motor. Three shafts are controlled by C P U , making the principal axis to power the cutter which revolving with high speed movement as three-dimensional space, then produce the PCB product which is required by customers

For example, while the Z shaft is motionless and the point of cutter is below to the surface of PCB, the Y shaft is motionless, the X shaft moves, at the meantime, main cutter will mill a straight line in X direction, and width is as the top of knife; While the X shaft is motionless and the Y shaft moves,, main cutter will mill a straight line in Y direction; While the X shaft and Y shaft is move at the same time , main cutter will mill a line in angle45 direction. Control the velocity of X & Y ,the line in different angle will be milled on surface, control the distance , with varies combine, different shape will be milled on surface.

while the Z shaft is motionless and the point of cutter is high to the surface of PCB, the cutter is moved to the point which is required by X&Y movement.

while the X &Y shaft are motionless, the Z shaft moves down touch the surface of PBC, the principal axis motor makes bit to drill holes on this point.

#### 5. Concerning the slightly adjustment

There are push buttons: “up””down””slight adjustment””test”on the surface of machine.

1.2 the feature of The ZY serials of double side PCB prototype machine

- It is support PCB document format directly which are output by various EDA software such as Protel 99 SE, do not need any format transfer
- High automatism, the series of process: milling, drill a hole, mow the side complete automatically;

- The language of operation software is Chinese, interface is friendly, and the operation is very simple;
- No chemical treatment, environment-friendly.
- Compare with the same product of international market, we offer a highly cost-effective way to make boards. The price is 1/5 times cheaper than them.

### **1. 3**



					
	Double side	Double side	Double side	Double side	Professional
<b>Model</b>	ZY2518-B	ZY1815A	ZY3222A	ZY3030	ZY3220
<b>Capability</b>	single/double	Single/double	Single/double	Single/double	Single/double
<b>Wording area(cm)</b>	25 × 18	18 × 15	32 × 22	30 × 30	32 × 20
<b>Mini trace(mil)</b>	10	6	6	6	6
<b>Mini gap(mil)</b>	12	10	10	10	10
<b>Drive</b>	stepper motor	stepper motor	stepper motor	stepper motor	stepper motor
<b>Speed(m/min)</b>	2.4	2.4	2.4	2.4	2.4
<b>Interface</b>	RS-232	RS-232	RS-232	RS-232	RS-232
<b>Baud rate(bps)</b>	28800	28800	28800	28800	28800
<b>Main Motor speed(r/min)</b>	30000	30000	30000	30000	30000
<b>Main Motor power(W)</b>	50	50	50	95	95
<b>Main motor</b>	Blushless	Blushless	Blushless	Blushless	Frequency control
<b>Drill diameter(mm)</b>	0.55 ~ 3.175	0.5 ~ 3.175	0.55 ~ 3.175	0.5 ~ 3.175	0.5 ~ 3.175
<b>Drill depth (mm)</b>	0.2 ~ 3	0.2 ~ 3	0.2 ~ 3	0.2 ~ 3	0.2 ~ 3
<b>Drill speed/(mm/min)</b>	100	100	100	100	100
<b>Operation mode</b>	Semi-auto	Semi-auto	Semi-auto	Semi-auto	Semi-auto
<b>Power</b>	AC220V	AC220V	AC220V	AC220V	AC220V
<b>Computer</b>	Win2000/NT/XP	Win2000/NT/XP	Win2000/NT/XP	Win2000/NT/XP	Win2000/NT/XP
<b>RAM(MB)</b>	256	256	256	256	256
<b>Size(L*W*H) cm</b>	50 × 50 × 46	42 × 42 × 53	70 × 70 × 50	70 × 70 × 50	---
<b>Weight(Kg)</b>	68	42	76	80	120
<b>Drilling bid (included)</b>	10	10	10	10	10
	Electroplating tank included				

## **Chapter 2      how to install software and hardware**

Hardware and software need to be installed for the ZY serials of double side PCB prototype machine. hardware install means to connect the machine with the data line( DB9 line) of the PC machine and the power line ; Software install means the operation software which Is opposite with operate system software need to be installed.

### ***2.1 hardware install***

Put the machine on the work set with the same high to computer work set, and then connect the COM of machine with one of the side COM line attached. Connect the COM (COM1 or COM 2) of PC with Another side, and then connect the power line, install process completely.

### ***2.2 software install***

#### ***PC basic:***

- CPU586DX-500M up , 256M up
- COM1/COM2 one more
- WIN2000/NT/XP
- CD-ROM driver
- software Protel 99 SE or Protel DXP are installed

Insert the disk of machine software into CD- ROM, open it,

Click (zhong yue electric), showing as follows:



Click “next”, until finished.

*Note: support Windows2000/WindowsNT/WindowsXP*

## **Chapter 3    how to use**

### ***3.1 Ready to milling***

Please read the manual carefully before operation.

#### ***1. connect***

Put the machine on the work set with the same high to computer work set, take out the data line ( DB9 cable )and then connect the COM1 of machine with COM which is on the right of box.

#### ***2. suppose parameters***

Suppose parameter for cutter in the DK with the request of design .choice parameters that it is a little less than the safety distance which is designed by PROTELPCB document (for example :choice

cutter in 0.38mm ,choice parameter in 0.36mm) After open the document, check the machine if the PCB line glue cause of the cutter parameters has a mistake chosen , until the choice is correct .

### *3. Install cutter*

Suppose parameter for cutter with the request of design, choice cutter from the box.

Caution: the cutter is shape; it wound fingers easily if operation is not correct.

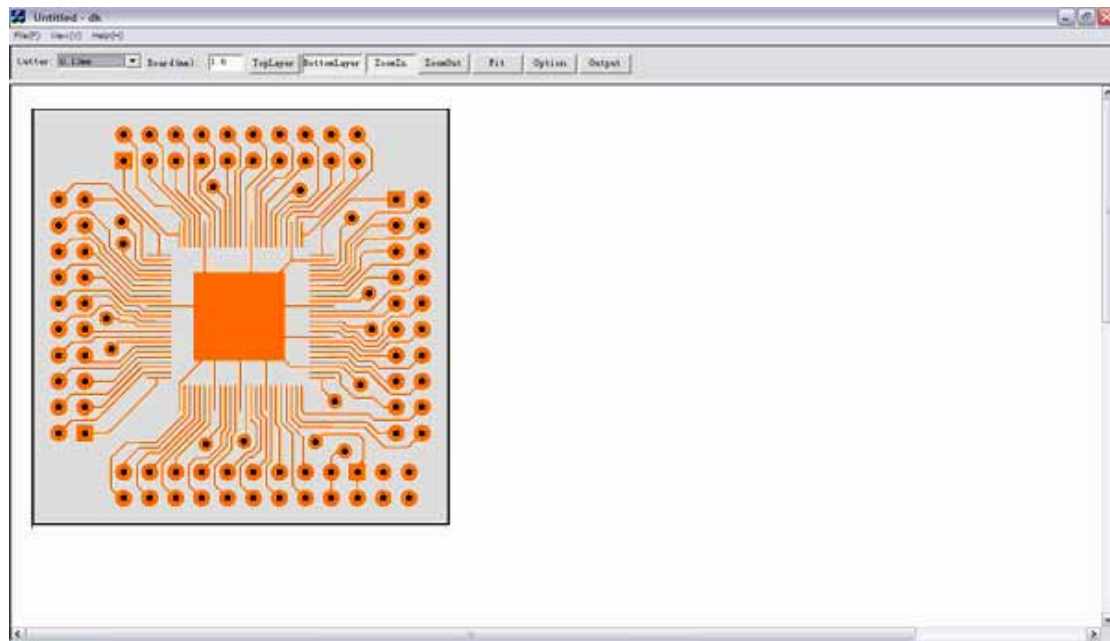
### *4、 Fix the PC board*

Confirm the software and hardware have been installed, the plain copper-plated pc board which to be milled paste the double-stick tapes with no air bubbles, then paste the longer side of copper-plated pc board to the work set of the PCB prototype machine, and compress tightly with two thumbs.

Caution: do not push and pull the principal axis motor and bottom work set when power on.

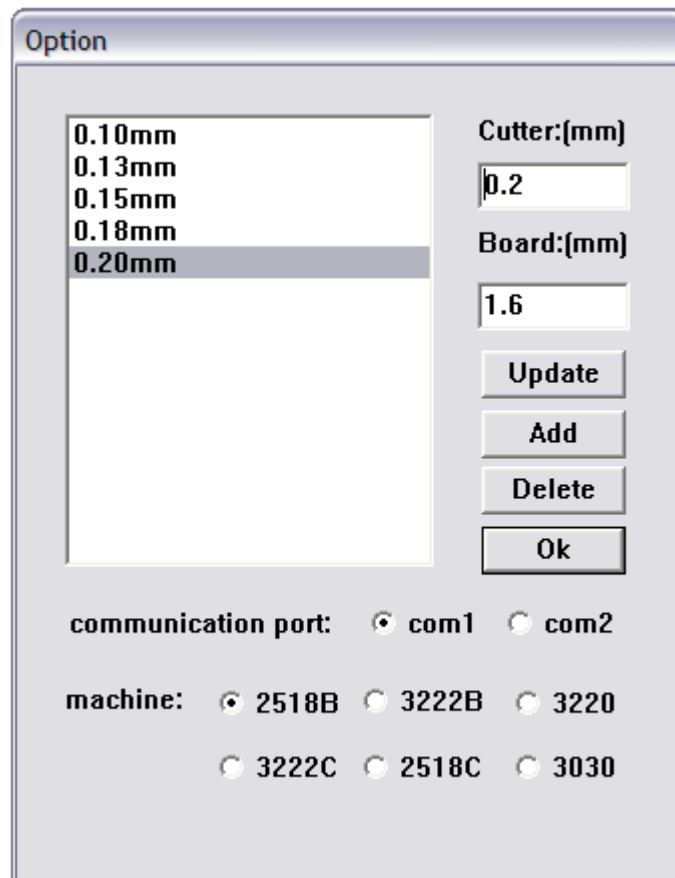
### *3.2 Key functions introduction*

For example, when produce a double-side PCB, input the PCB picture to the windows of operate software, showing as follows:



Click “Options” button in the tool bar, choose the machine’s type

and computer's COM. showing as follows:



Set up the thickness of board and specification of cutter ,click the “output ” button in tool bar, showing as follows :



Describe the function mold as follows

### 1 、 Velocity

The machine provide 5steps velocity of milling and drill holes , we suggest choice medium velocity for drill holes .according to the minimum crack and radius of path ,choice the suitable velocity, the wide the fast .(the medium velocity is set up by machine, please adjust it as your requiring )

### 2 、 first layer \top surface

Click “first surface” or “top surface” to provide the accurate surfaces.

### **3 、 X left /X right**

Adjust the left and right deviation at static form in power on, if input “2” (mm unit is set up),then click “X left”, the principal axis will move from original position to left in 2mm ; if click “X right”, it move from original position to right in 2mm ;

### **4、 Y forward /Y back**

Adjust the forward and back deviation at static form in power on, if input “2” (mm unit is set up),then click “Y forward”, the principal axis will move from original position to forward in 2mm ; if click “Y back”, it move from original position to back in 2mm ;

### **5、 Z up /Z down**

**Adjust the up and down deviation at static form in power on, if input “2” (mm unit is set up),then click “Z up”, the principal axis will move from original position to up in 2mm ; if click “Z down”, it move from original position to down in 2mm ;**

### **6、 Drill technology holes**

**Drill technology holes so as to provide accurate positions. Press “drill technology holes” to drill 2 holes each on the upper left and upper right.**

### **7、 Drill holes**

**There is a list beside the button “Drill holes”, it shows varies specification of radius for holes, choice one of them (brace a bit), click “Drill holes”, the machine will finish drilling automatically (see details in drill holes operation steps )**

### **8、 Mill**

**Click “Mill”, the machine will finish milling automatically (see details in milling operation steps)**

### **9、 Side Cutting**

**According to the shape designed, cut down the side when finished milling, as cutting do harm to cutter , we suggest: use blunt cutter. (See details of Cutting)**

## **10、 Neglect radius of holes**

Click “Neglect radius of holes”, the machine will drill all holes at one time; will not drill holes as designed.

### **3.3 drill holes operation steps**

**1. Stick a plain copper-plated pc board, and set up X/Y deviation, define the original positions**

**2. Press “test”button, estimate if the range of milling is in the plain copper-plated pc board. If over the effective area, please change the bigger plain copper-plated pc board or adjust X/Y deviation again**

**3. Brace a bit, adjust the vehicle height of bit by computer, until it is about 2mm away from pc board.**

**4. Use slightly adjusts by hand. There is a knob of digital electric potential equipment on the surface of PC board, the knob has the function both adjusts the vehicle height of bit fixture and test the milling.**

**5. Revolve the knob to left, the Z shaft moves up, revolve the knob to right , the Z shaft moves down , press “test ”,the machine mills, means milling the PC board according to the length and width.**

**6. Adjust the height of bit until the bit is close to a plain copper-plated pc board, revolve the knob must slowly, till the bit touch the board.( the principal axis motor should be turned on ,other -wise the bit will break )**

**7. Starting drill holes, choice the radius of holes by computer ,click “drill holes ”, the machine will finish drilling automatically.**

**8. If the bit does not need to change, please choice another specification of radius, click “drill holes”, and the machine will finish drilling automatically.**

**9. If the bit needs to change, we suggest that turn off the principal axis motor ,keep the power on , so that the parameters does not be supposed again ,Brace a bit, repeat 6、 7、 8steps ,finish drilling .**

### **3.4 copper-plated operation steps**

**Copper-plated is a complex process in the double-side PCB producing process**

**Pour the electroplate liquids into trough; the vehicle height of**



liquid which is away from Insulate board is about 3mm.

Polish the PCB which the holes has been drilled with sand papers, so as to spread the glue evenly

Open the bottle top, dip in glue, spread it to the position which has been drilled

Aim the pipe of a vacuum at the position which has been drilled, and move slowly, so that the glue permeates the holes from surface to the holes wall evenly. One side of copper-plated PC board spread completely; wait a minute to make it dry. Repeat the processes to another side ,and clean both side of board with gauze

Take out the copper-fixture from electroplate trough, put the PC board which will be plated into the fixture and tighten up screws

Put the PC board which has been fixed into the electroplate trough, soaked with electroplate Liquids.

Grip copper board which is near to PC board with clip marked “+”, and grip the middle of copper fixture with clip marked “-.”

Turn on the power, check the electric current data, adjust it to 15A~20A, after electroplate for 8~10min, turn off the electroplate trough power.

Take out the copper-plated PC board, aim it at the strong lights, all the holes wall must Deeply bright and reflecting the lights. If few holes reflecting the lights badly, it means plated not good, please plated it again for 2~4 min; if only one or two holes plated not good, it perhaps glue permeates the holes no evenly , spread glue to the hole , wait a minute to make it dry, then electroplate it .

**Caution:** electroplate liquids is a kind of acidity aqua\_ CuSO<sub>4</sub> with causticity, so after electroplating, the PC board need to be washed with the alkaline liquid. If electroplate trough do not use for long time ,need to take out the fixtures from the electroplate liquids and wash it with alkaline liquid ,keep it dry .please do not keep it into electroplate liquids to prevent causticity by CuSO<sub>4</sub> aqua.

### 3.5 milling operation steps

Paste the top layer of PC board which has been electroplated on double-stick tape (according to the dispersion of holes, the fist floor or top layer can be judged directly), paste the sides of copper-plated pc board to the work set of the PCB prototype machine.

**Install fit cutter (according to the minimum crack and radius of path, choice the suitable cutter), and choice correspondence specification of cutter with computer**

**Turn on the main power and the principal axis motor, click “the first surface”button; keep it on state of operating.**

**Click “input”button, set up X/Y deviation.**

**Choice fit velocity, the principal axis motor and the first layer work set move correspondence distance at X/Y directions**

**Adjust the height of cutter, the point of cutter close to PC board, and aim it at the right position hole, if it is not, the X/Y deviations will be input again and define the original positions. Repeat these operations, until aim the point of cutter at the right hole.**

**Press “test”button, the cutter mill the PC board according to the keepout layer. Before the cutter touch the copper-plated PC board, please check up if the path of cutter moving across 2 position holes and inspect the position of first layer.**

**Revolve the knob slowly, test again, until all the surface of copper-plated PC board broken by milling ;click “milling ”,start mill the first layer .**

**After finished the mill of first layer, take out PC board, tear off the double-stick tape which is on the top surface, and paste the first layer with double-stick tape, one side which has position hole to the work set. Repeat 4`8 steps; finish the milling of top layer.**

**Caution: during the milling process, do not adjust the velocity, do not close the “output” and software windows, otherwise the milling operate is failure or the machine stop working.**

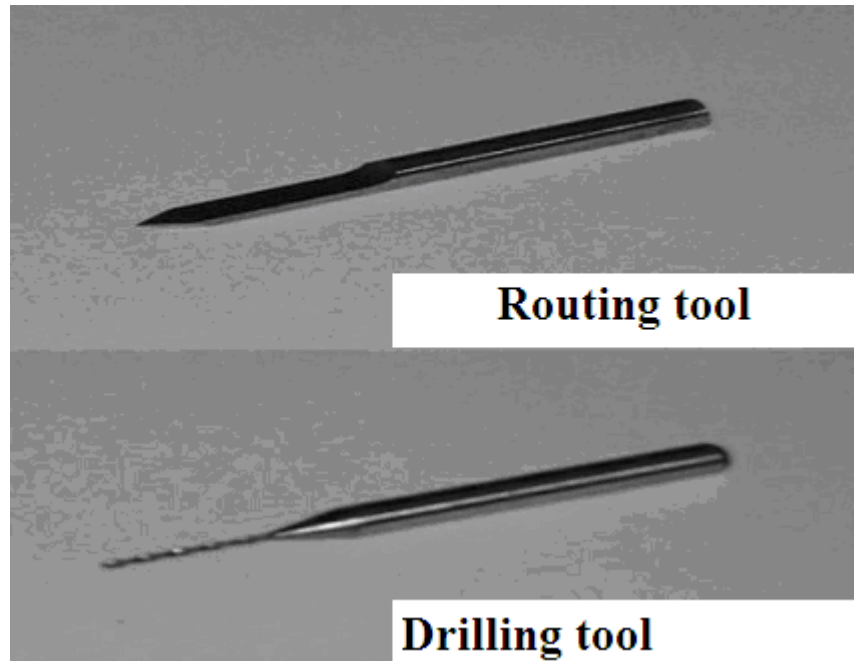
### **3.6 Side Cutting**

**After finished double-side milling, the machine cut out the frame of keepout layer, (do not change the X/Y deviations at this time .as cutting do harm to knives, we suggest: use blunt cutter), press “Side Cutting” button , the machine will finish side cutting automatically, “drill holes ”\”producing ”\”cut side” all completely .**

### **3.7 surface disposal**

**Take out PC board, clean it, Polish two sides with sand papers, keep the circuits smooth, spray oil on both side in order to prevent PC board were oxidized.**

## ***cutters***



### Techniques and attentions

As a good habit of operations, before turn on main power confirm the principal axis motor is turned off. Turn off main power, turn off the principal axis motor at the same time

Tighten up screws when install cutters and brace bits.

If over cutting or shallow cutting, please adjust the height of the principal axis at any time.

During the work time, turn on the main power, and turn on it immediately ,the machine will make mistakes, please do not do it .

If Press function buttons have no respond, please check up if the connections of COM are correctly

Open documents showing: "non-PCB documents"

Answer: This machine permits the PROTEL PCB 2.8 ASIC documents format, if this can not output by drawing software, please input the document you designed in PROTEL99, transform it and output it.

7、 Open documents showing: "no KEEPOUT LAYER"

Answer: the machine take a keepout layer as a frame, the PCB

documents must be draw a frame line; the width of the line is equal to the diameter of cutter (3.15mm)

8、 Why does the machine mill non-clean?

Answer: the reason is choice the point of cutter more bigly with the software “cutter chosen”; choice small one will solve this problem

Question: Which kind of formats does the machine identify?

Answer: All the software which is permit by PROTEL can produce PC board with opening documents through PROTEL PCB 2.8 ASIC documents format.

Question: How long does the machine running?

Answer: The continue working time is less than 6 hours; after half hour cooling it can working continue .

Question: Is there silk-printing technology fit in with the machine?

Answer: No, there is not

Question: How to promote the wieldable of the PC board?

Answer: After finished the producing, spread rosin oil.

Question: What is the size of the board can be produced?

Answer: The thickness of the board is no demand for the machine (the thickness of drilling holes is less than 3mm)

Question: How about the guarantee and spare parts supplied?

Answer: We can offer 2 inner turret wrenches and one set cutters (10 cutters, 10 bits),and the machine is guaranteed for one year.