MITS Design Pro

CAM-Auto

for AutoLab

Precautions

1. Intended Use

   The intended use of the PCB Prototyping Machine is to process PCB by milling, drilling and routing. **Any other uses are strongly prohibited**.

2. While Processing

   Keep away from the machine especially the spindle head while processing. Spindle head is constantly moving. Be sure to keep away and not to get your caught in the machine. Make sure to wear eye protective gear/goggle while processing.

3. Power Voltage

   The allowable voltage for Auto Lab **90V-240V**.If the voltage of your region is out of range, be sure to use voltage regulator.

4. Working Area

   The working area of Auto Lab is **229mm x 300mm**. Be sure to process within the working area of Auto Lab.

5. Dry Run and Milling Speed

   Below is the optimal speed for Auto Lab.

Dry Run	..	20~30mm/sec
Milling Speed	..	12~18mm/sec
Routing Speed	..	1~2mm/sec

   If the processing speed is too fast during processing or manual operation, step-out could occur to the machine.

6. Milling/Drill/Routing Tool Settings

   The machine will process with the settings in **CAM Pref.** >>**Milling, Drill, Routing**. If the parameter in the setting is missing or unintended value, there is a possibility of tools breaking or processing error occurring. Be sure to check the parameter in the settings.

7. Vacuum Cleaner

   While processing, if the dust from the PCB piles up, not only the processing quality is affected by it, there also is a chance of spindle motor malfunction. Be sure to use Vacuum Cleaner while processing.

8. CAD with Dongle Key

   Make sure to remove Dongle key when you are using the prototyping machine. Connection error may occur and prototyping machine may be unable to use.

9. Tools and RPM

   For processing, set the RPM to 30-40. The unit in the software is x1000RPM. To drill 0.3~0.4mm size holes, set the Lower2 3~4mm/sec.

   IMPORTANT

   To drill 0.3~0.4mm size holes, go to **CAM Pref.** >> **Board Maker** and set the **Lower2** 3-4mm/sec. After setting the Lower2 speed slower, make sure to set **Drill Wait** and **Before Cutting** longer than the default setting. If not, there is a possibility of spindle head moving too early before the drilling is completely penetrated.

10. Transportation

    Since Auto Lab is a precision machine, use the container box which was used for shipping. For long distant transportation using carrier, make sure to select carrier with great handle care with the transportation.
    Do not apply any force to the shaft, lead screw, spindle head while transportation. It could result to have the accuracy to drop.

11. Spindle Motor Cleaning

    Note that spindle motor and collet are ultra-precision component. In order to keep the machine performance well, daily checkup and cleaning is necessary. Spindle motor may result to malfunction when dust or debris are caught between tool and collet, decreasing the holding power of the tools. Make sure to check and clean the spindle motor before using.

12. Warranty

    The term of warranty for PCB Prototyping Machine is 1 year with the intended use. Note that spindle motor and consumable supplies are not included in the warranty. Also note that even within the warranty period, below circumstances will be considered as charged repair. Improper use, inappropriate assembly, damage/breakage by carelessness, natural disaster, abrasion, modification, use of non-genuine components/parts, use in undesignated voltage. Please operate with great care when you are using the machine without any training.

CONTENTS

Introduction

This manual is a tutorial guide to prototype PCB with Design Pro **CAM-Auto.**
For further explanation, "mdemo.mit" file is used, which is automatically saved on to your computer when the software is installed.

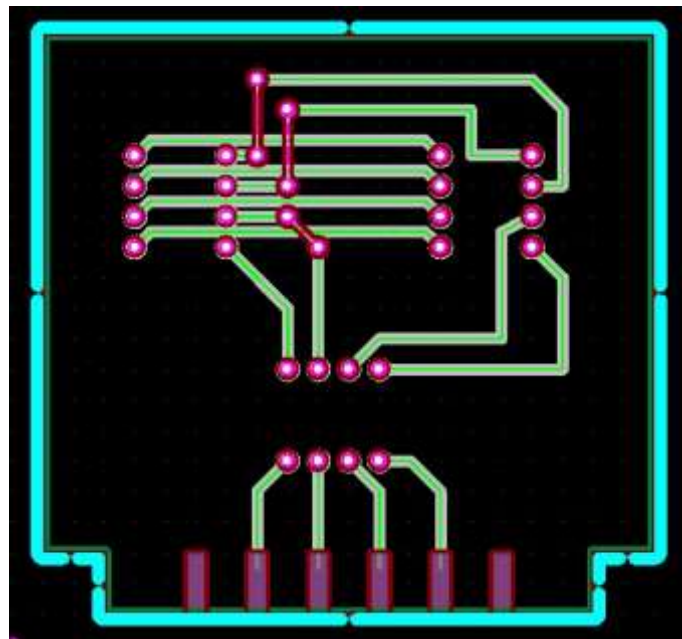Below are the board and the tools used in this tutorial guide.

Board
- Double-Sided Copper Cladded
- Thickness: 1.6mm
- Copper Thickness: 35μm

Tools
- 90°Milling Bit   36mm
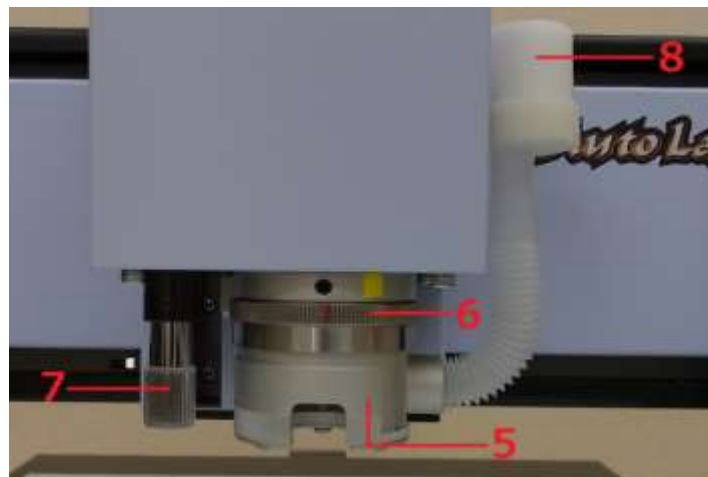- Drill Bit 0.8mm   38mm
- Router Bit 1.0mm   38mm

<File Used> mdemo.mit

Prototyping Machine Part Name

1 – Power Switch

2 – Spindle Head

3 – Working Table

4 – Tool Post

5 – Pressure Foot

6 – Depth Adjustment

7 – USB Camera

8 – Vacuum Hose Connector

9 – AC IN (Power Plug)

10 – AC OUT (Vacuum Outlet)

11 – Fuse Holder

12 – USB Port

13 – RS-232C Port

Installation of Software

See "**Setup Guide**" in Software CD-ROM for your reference.
(PDF_manual >> Setup_Guide >> **Auto Lab Setup Guide**)
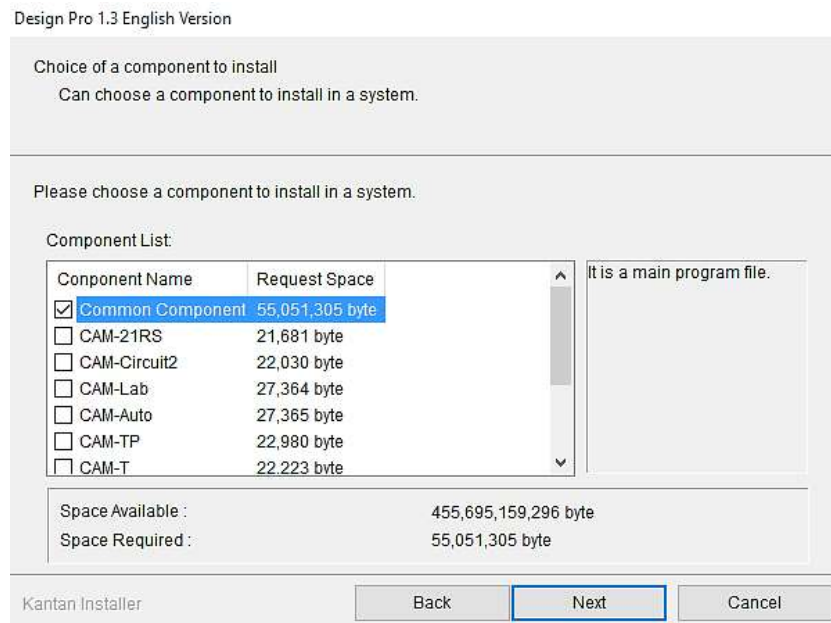
*Select **Common Components**, otherwise Converter and EASYCAD will not be installed.

*Also, select "**CAM-Auto**" and "**Design View**".

Setup Operation Check

1. Connect the power cable to the AC In (Power Plug).

2. Attach and hold the vacuum hose by fixing the plastic vacuum holder on the backside of the machine with the screw.

3. Attach vacuum hose into the connector.
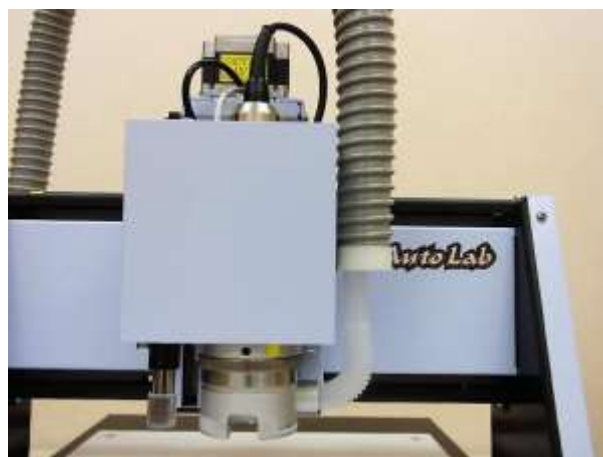
4. Connect the USB cable to the USB port.

5. Connect the Vacuum Cleaner to the Prototyping Machine with power cable. Be sure to turn the Vacuum Cleaner power "On" at all time.

6. Turn the power switch "On". The spindle head will move to the back left corner (in order of; Z, Y, and X-axis).

 >
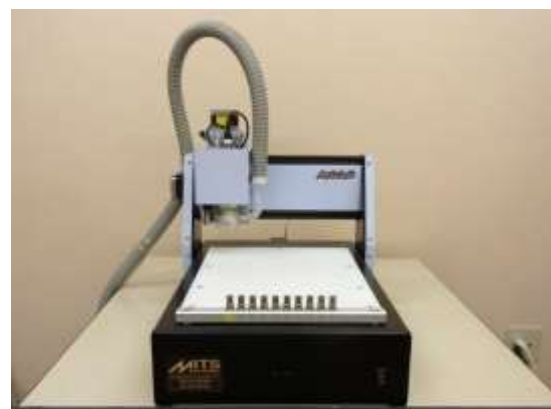
Warning: Contact your local distributor or MITS Electronics if the machine does not move to the back left corner.

Communication Port Settings

After you finished connecting your PC and PCB prototyping machine, set up the correct communication between them for the correct operation.

1. Turn on your personal computer.
2. Turn on your PCB prototyping machine.
3. Check the name label on the front panel of gantry, then set up the communication settings as following instruction.

<A. The color of name label: **Silver**>

[When RS232C Cable is used]
①. Open "**Device Manager**" on your computer.
②. Double-click "**Port (COM and LPT)**", and then double-click the communication port device of prototyping machine. Set the port number as either of COM1, COM2, COM3, or COM4.

[When USB Cable is used]
There is no need to change any communication settings.

<B. The color of name label: **Gold**>

[When RS232C Cable is used]

①. Open "**Device Manager"** on your computer.

②. Double-click "**Port (COM and LPT)"**, and then double-click the communication port device of prototyping machine. Set the port number as either of COM1, COM2, COM3, or COM4.

[When USB Cable (VCP: Virtual COM Port communication) is used]

①. Open "**Device Manager**", and double-click "**Ports (COM & LPT)**".
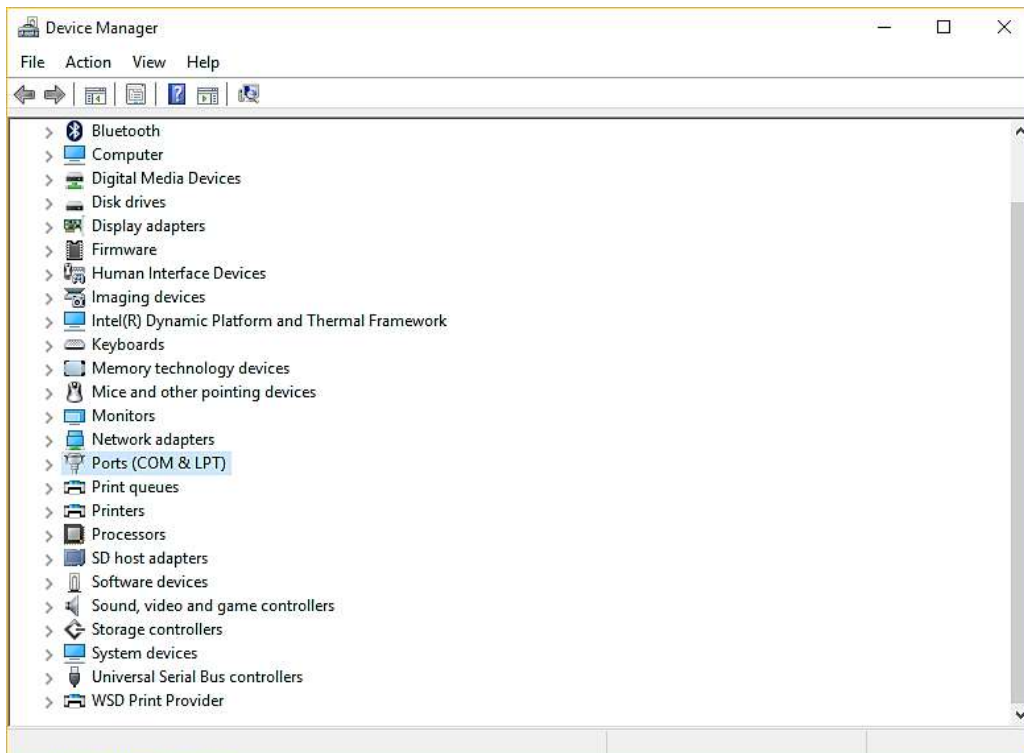
②. Double-Click "**USB Serial Port (COM***X***)**" (*X* = Number). <u>Skip section 3 to 5 if the COM port No. is set as either of COM1, COM2, COM3, or COM4.</u>
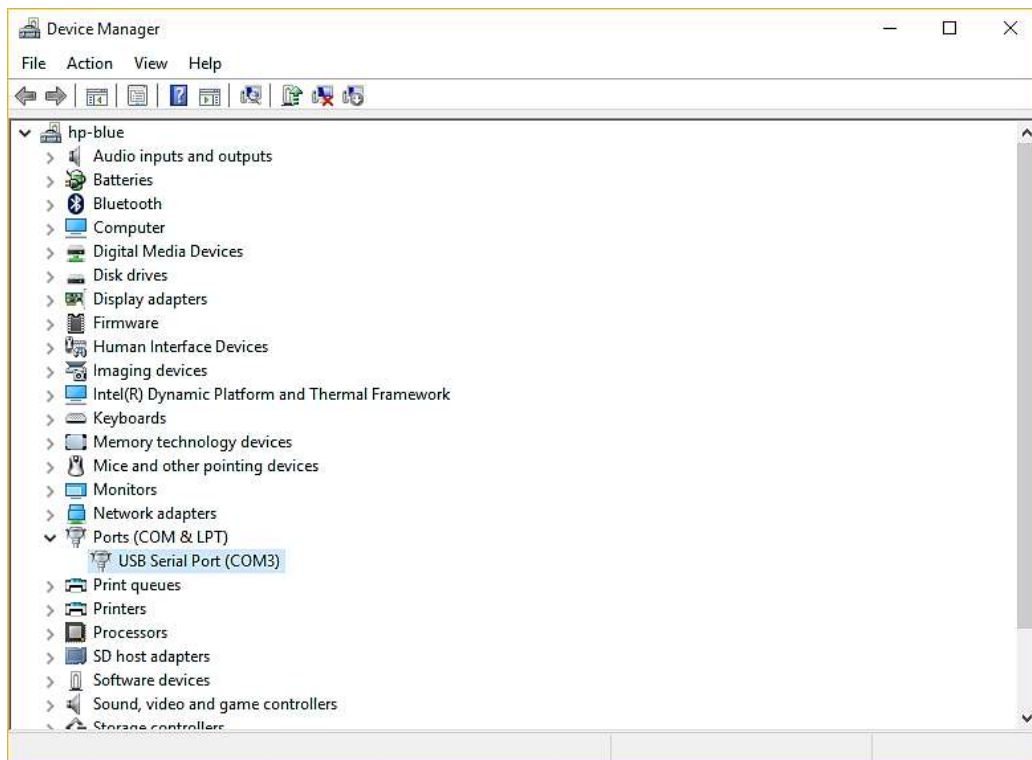
③Click "**Port Settings**".
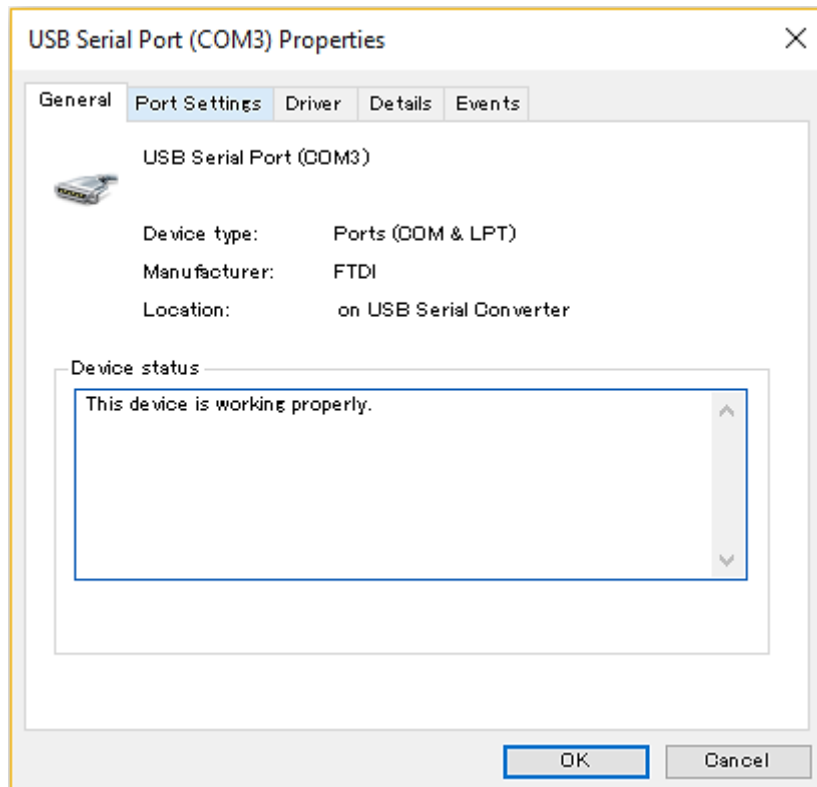
④. Click "**Advanced…**".
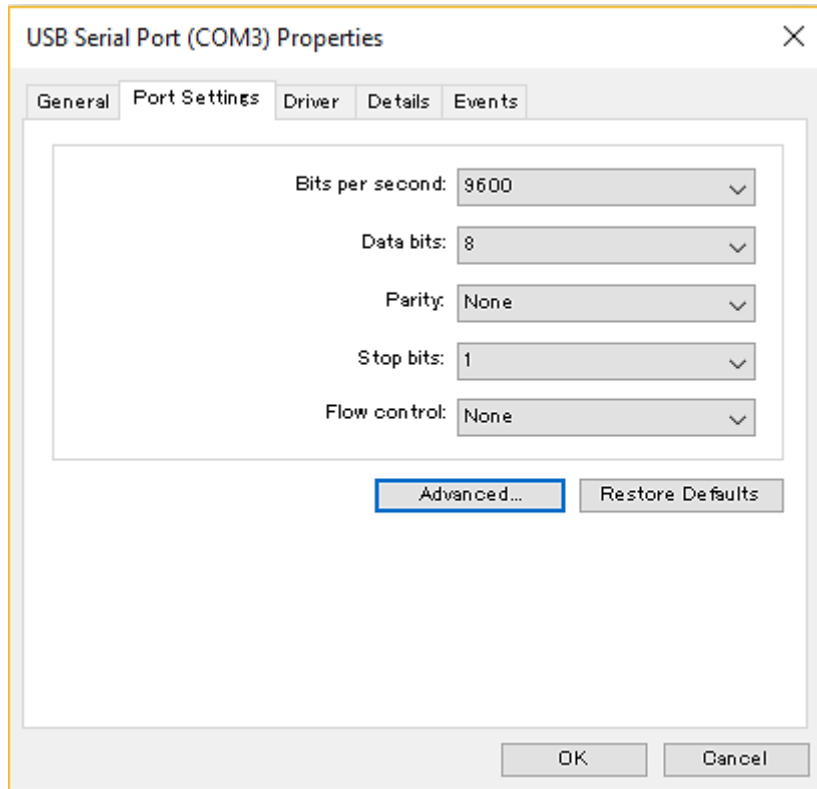
⑤Click pull-down menu of "**COM Port Number**", then <u>select either of COM1, COM2, COM3, of COM4</u>. There is no problem if you select a COM number marked as "(in use)".
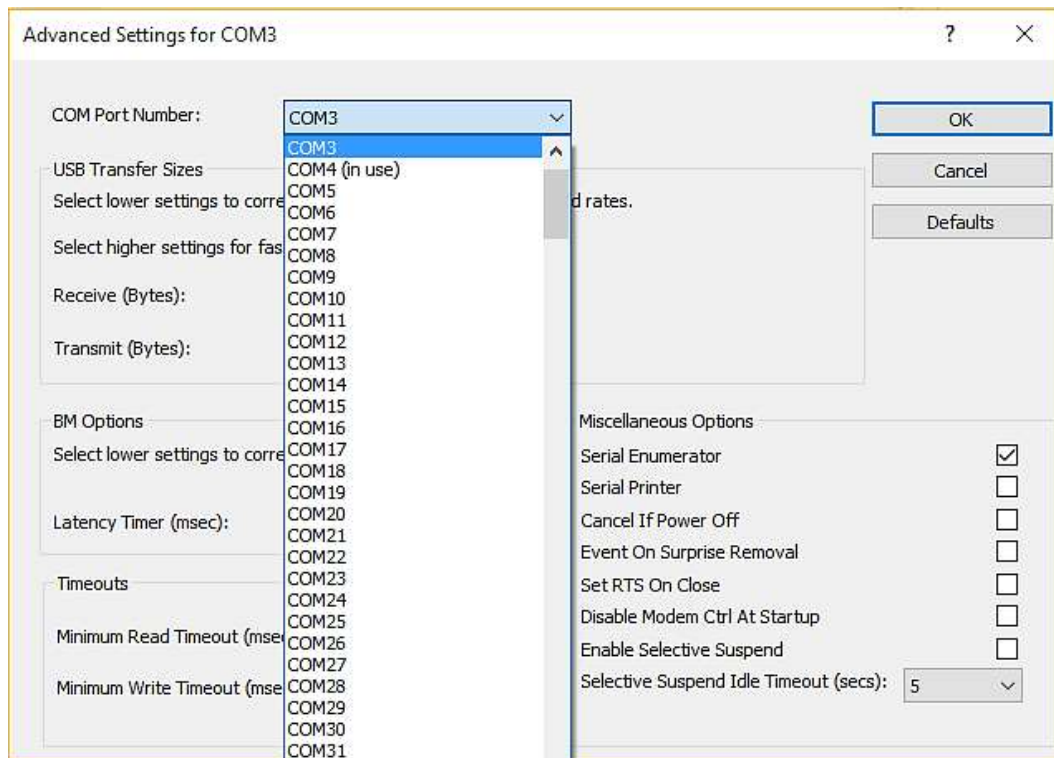
Click "**OK**" to finish the settings.

4. Open MITS Design Pro.

Start >> **Program** >> **Mits Design Pro** >> **Design Pro**

Note: USB Drivers

USB driver for MITS PCB prototyping machines is already applied when you installed Design Pro, and the driver will be automatically detected for the first time you turn on your prototyping machine if PCB prototyping machine and your PC are connected with USB cable.

Attention:

The communication fails sometimes if you start up your PC after turning on PCB prototyping machine. In this case, retry the communication after you restart the PCB prototyping machine.

>> Does the machine still have a problem?
See Trouble Shooting [Trouble Shooting (USB, RS232C Serial Connection) - p.59]

Starting Up CAM-Auto

CAM-Auto is one of the applications which operate on MITS Design Pro, and this application controls Auto Lab.

This application is used when you prototype PCBs based on the data made by using **Converter** or **EASY CAD**.

Click "**Application**" on the right of the window. Select "**CAM-Auto**".
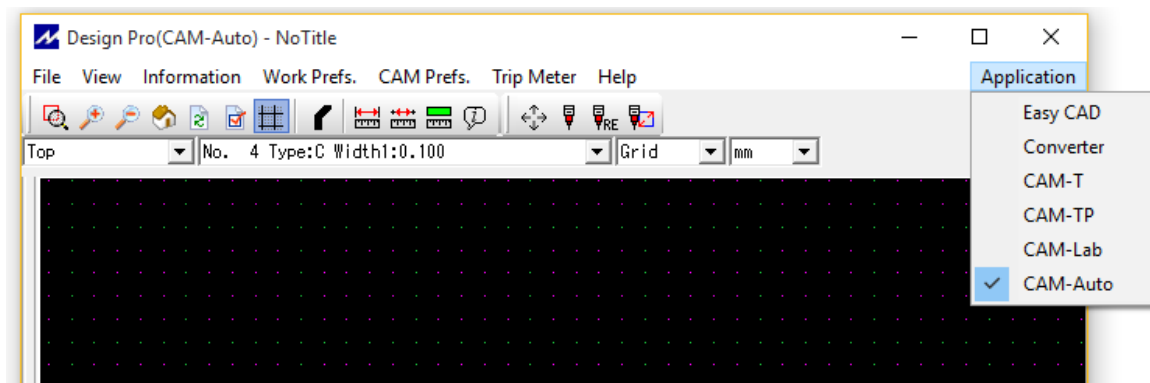
Click "**CAM Prefs.**" >> "**Board Maker Settings**".
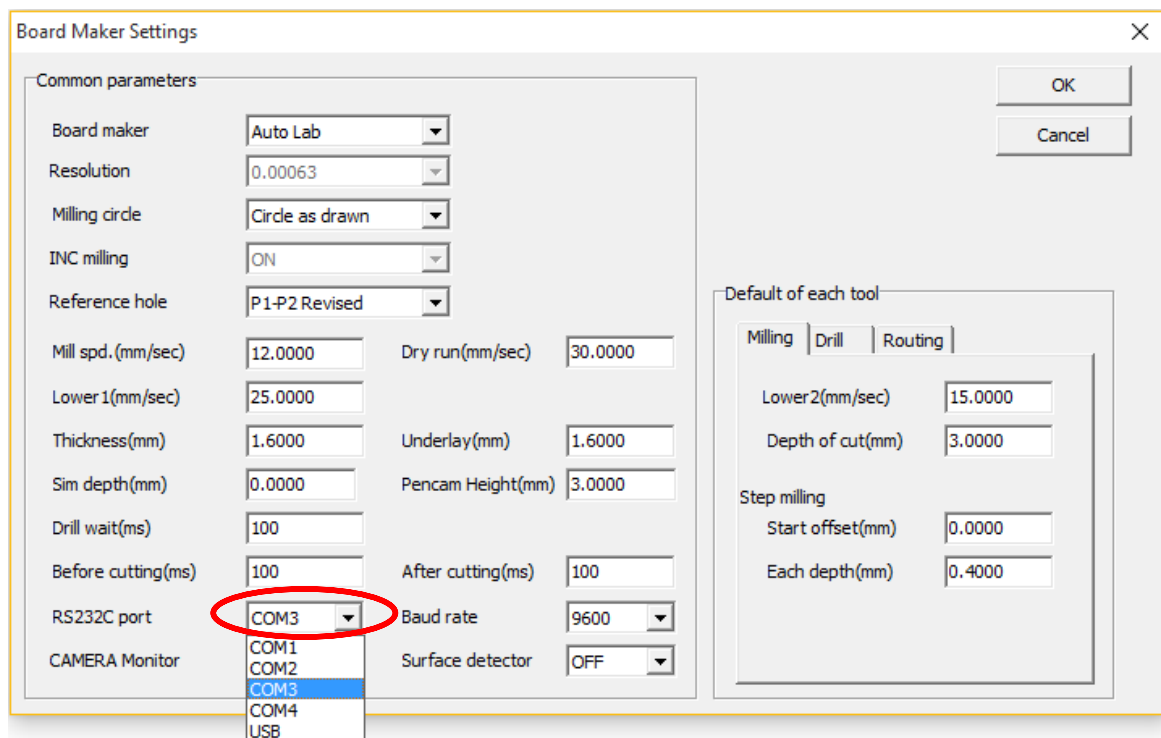
Click pull-down menu on the right of "**RS232C port**". Select correct Communication Port number as you set in the section, **Communication Port Settings** (Page 10 – 14).

(If the name label of your prototyping machine is Silver, and the connection is USB cable, select "USB" here)

Click "**OK**" and restart the software Design Pro, otherwise the settings are not applied.

CAM-Auto Screen Basic Operation

CAM-Auto Screen
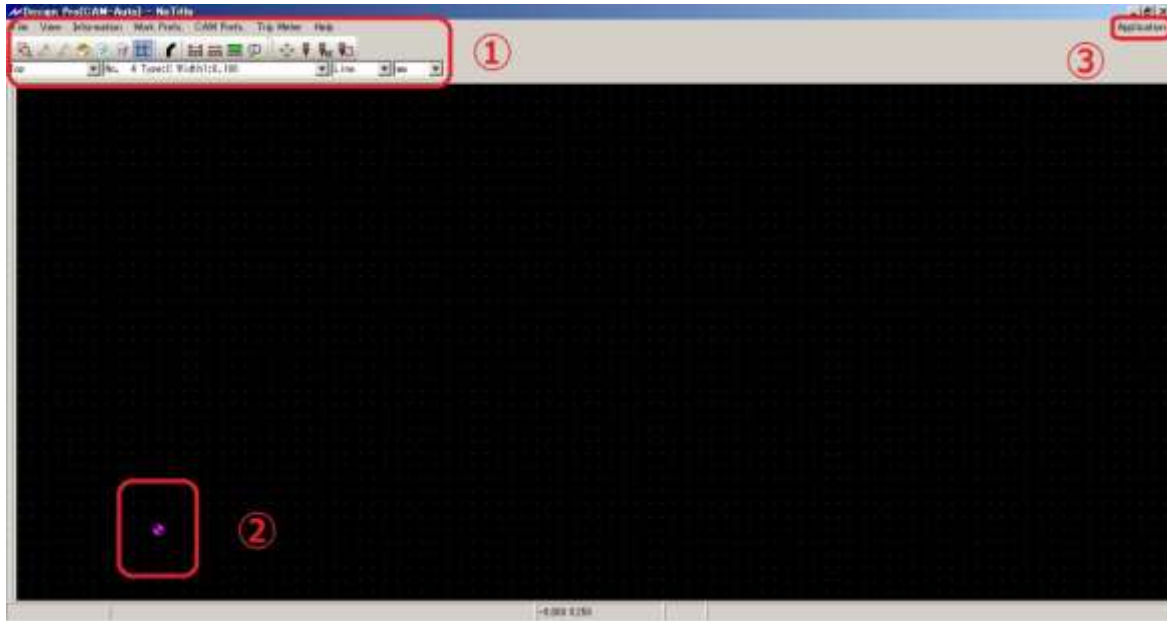
① - Command Icons
② - CAD Origin
③ - Application

Basic Operation

Mouse

Scroll: Move Up/Down

Shift + Scroll: Move Right/Left

Ctrl + Scroll: Zoom In/Out

Keyboard

Esc: Pause Milling

Backspace: Undo

Shift + Backspace: Redo

Delete: Delete Selected Element

1. Procedures

The below is the procedures to produce prototype PCB.

Preparation
- Open "mdemo.mit" file
- Setup underlay and PCB

:

Setup Tools

:

Set Milling Sequence

:

Adjustment
- Set P1P2
- Adjust Milling Width
- Drill Fiducial Holes
- Camera Offset

:

Process Top Layer
- Drill (Top)
- Mill (Top)

:

Adjustment before Bottom Layer

:

Process Bottom Layer
- Mill (Btm)
- Route (Btm)

2. Preparation

First you will begin with the below steps.

1 - Open mdemo.mit file (**1**~**2**)

2 - Set underlay and PCB on working table (**3**~**4**)

mdemo.mit file (below)
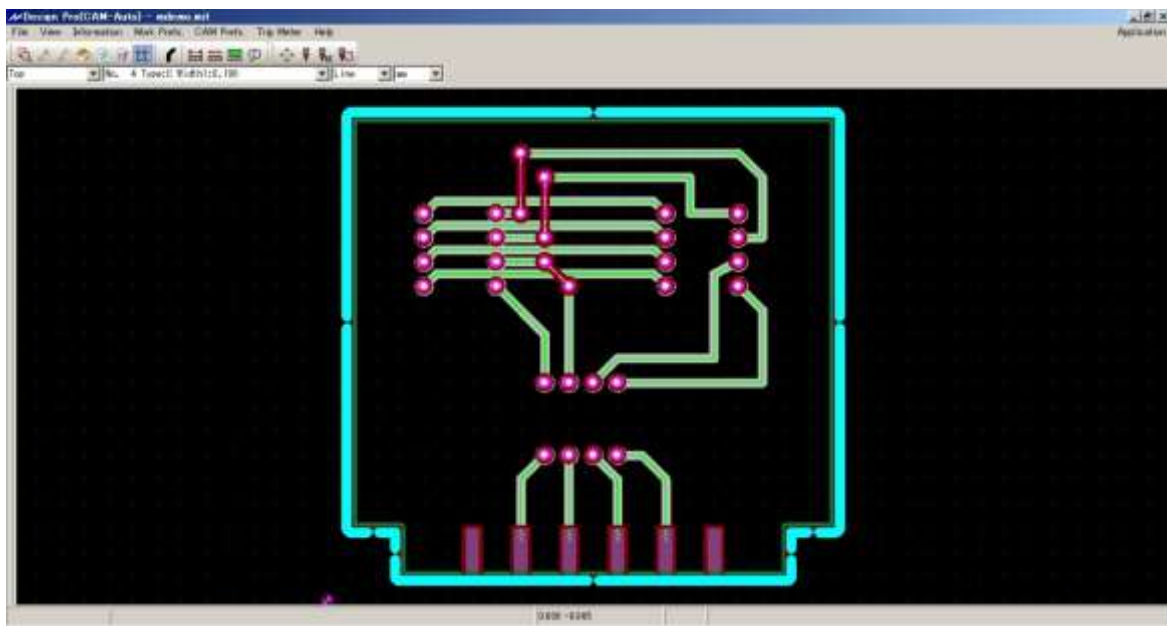
After setup (below)
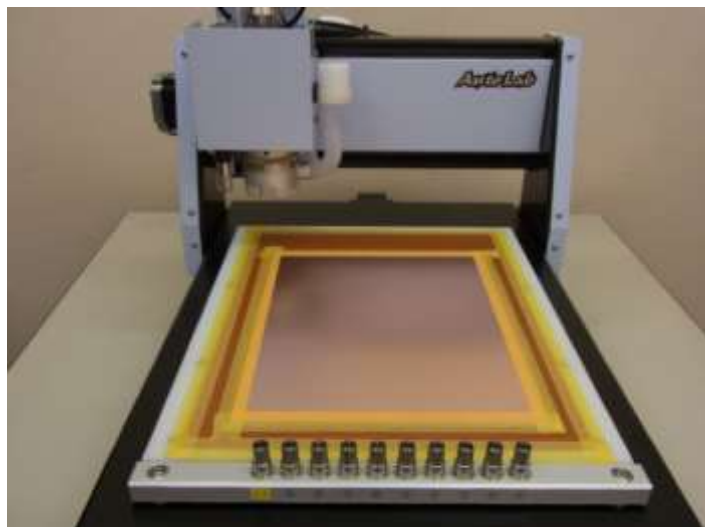
1. Click on Application and select **CAM-Auto**
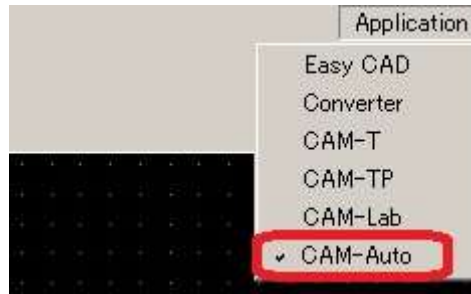
2. Open **mdemo.mit** file. The files are saved as below for each OS.

   Windows 10:
   Local Disk (C:) >> Users >> Public >> Documents >> Mits Software >> MT Path >> Data >> mdemo.mit

   Windows 7:
   Local Disk (C:) >> Users >> Public >> Documents >> Mits Software >> MT Path >> Data >> mdemo.mit

   Windows Vista:
   Public >> Documents >> Mits Software >> MT Path >> Data >> mdemo.mit

   Windows XP:
   Local Disc (C:) >> Documents and Settings >> All Users >> Shared Document >> Mits Software >> MT Path >> Data >> mdemo.mit
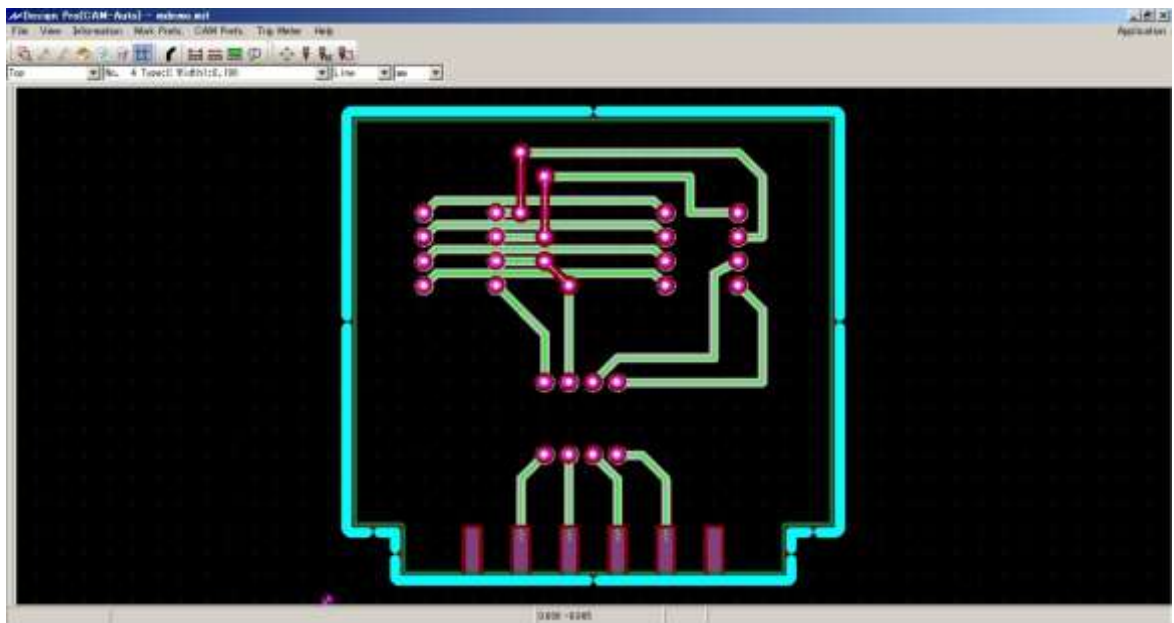
3. Next you will set underlay and PCB on to the working table.
   Clear the working table and place the underlay.
   Use the masking tape to hold the underlay.
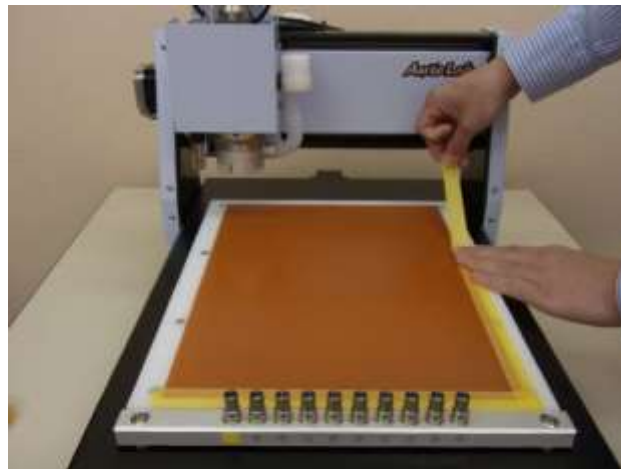
4. Clear the underlay and place the PCB.
   Use the masking tape to hold the PCB.
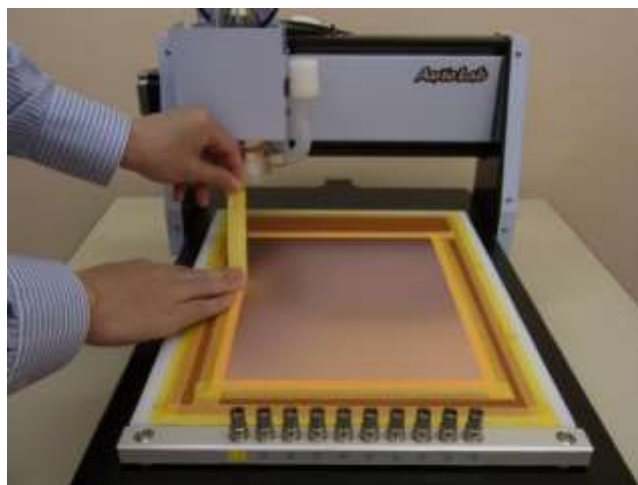
You've completed the underlay and PCB setup. Now you will proceed to Setup Tools.
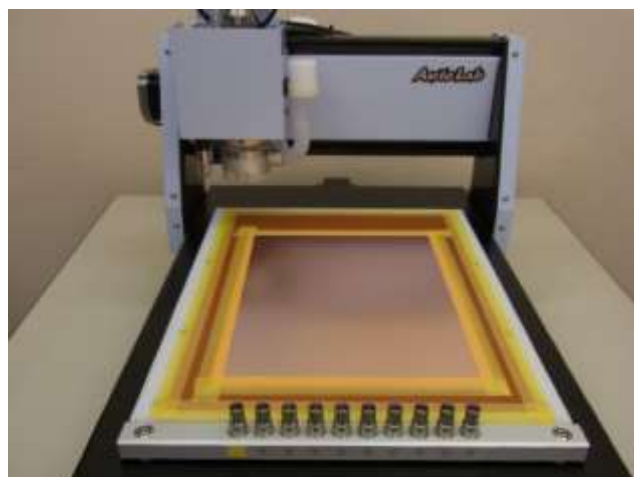
3. Setup Tools

Now you will prepare the tools. Below are the items you will use in this chapter.

-Simplified Ring Setter

-Tool Rings

-Ring Setter Tube 18mm, 20mm

-Tools

You will set the tool rings on to the tools and set them on the tool post.
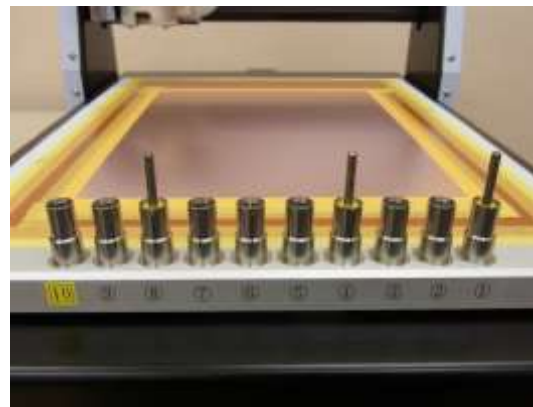
1. Go to **Information** >> **Tool List**

2. Tool List window will appear. Scroll down to check **Tool Size** and **Post No.** for each **Layer Name** and prepare appropriate tools for it.

Layer Name : Mill Top

Tool No.	Tool Size	Time Estimated	Type	Notes	Post No.
11	0.300 mm	0:3:00	Outline		1
11	0.300 mm	0:1:00	Manual Draw		1
	Total	0:3:00			

The tools used for each layer is shown like below.

Mill Top: Milling Bit 90°

Mill Bottom: Milling Bit 90°

Routing: Router Bit 1.0mm

Drill: Drill Bit 0.8mm

Next, you will attach the ring on to the tools.

3.   Insert the ring inside the ring setter.

4.   Insert the ring setter tube inside the ring setter. Make sure to use the **18m** tube (shorter tube).

5.   Insert the tool (**Milling Bit 90°**) to the ring setter. Insert from the blade first and hammer it all the way in.

6.   Remove the tube from the ring setter. Ring has been set to the Milling Bit 90°.

7. Repeat the above steps for **Drill Bit 0.8mm** and **Router Bit 1.0mm**. Make sure to use the **18mm** tube.

8. Insert the tools to the corresponding Post No. on the Tool List window. Insert the tools into the post with blade down and make sure to insert it all the way.

Milling Bit 90°: Post 1
Drill Bit 0.8mm: Post 4
Router Bit 1.0mm: Post 8
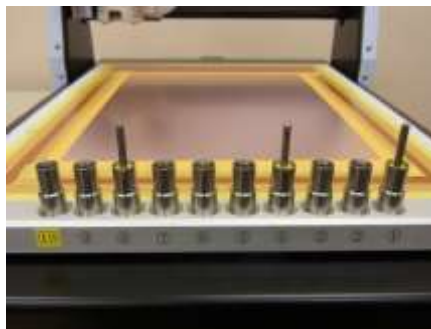
You've now completed tool setup.

4. Set Milling Sequences

Now you will set Milling Sequence. The sequence will be as shown below.

- Drill (Top)
- Mill (Top)
- Mill (Btm)
- Routing (Btm)
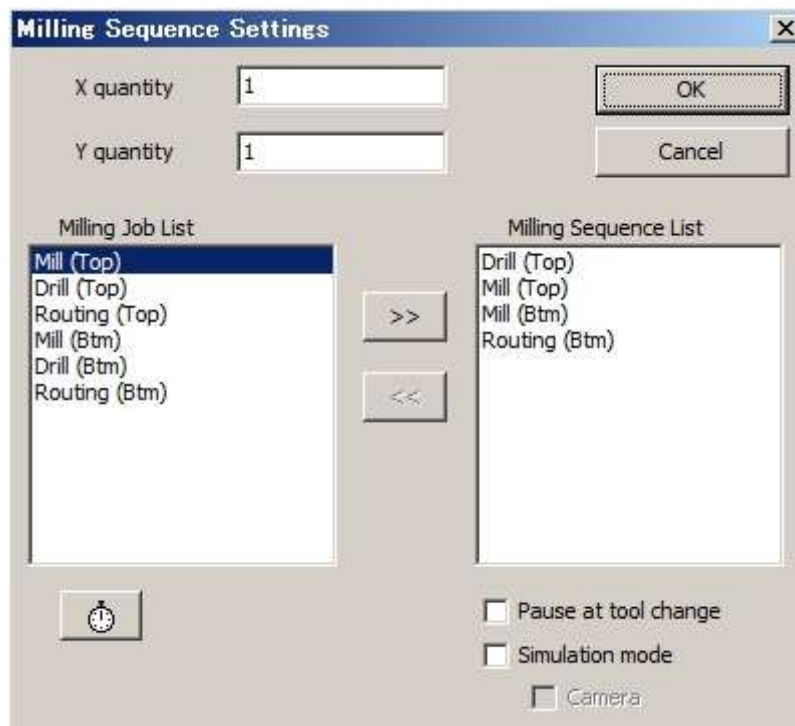
1. Click on Start Job Icon

2. Window shown below will appear. Click **Yes(Y)**.
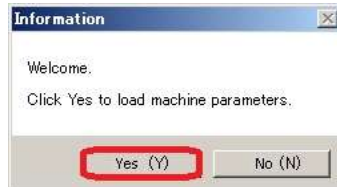
3. Milling Sequence Settings window will appear.

   Check and see **X quantity** and **Y quantity** is set to **1**.
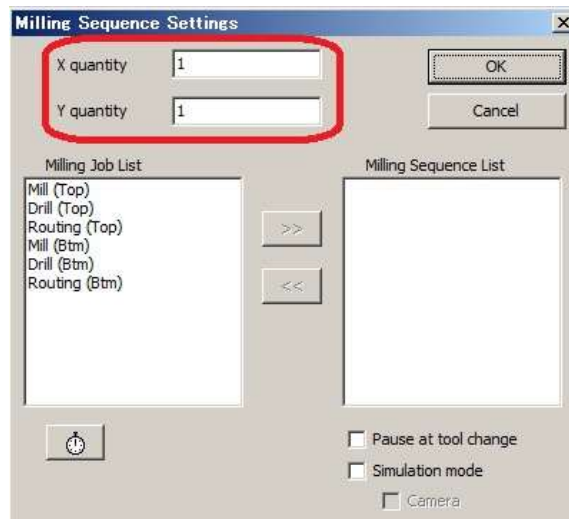
4. Next you will move the jobs from Milling Job List to Milling Sequence List.

   Double click on **Drill (Top)** in Milling Job List. The job will move to the Milling Sequence List.

>>
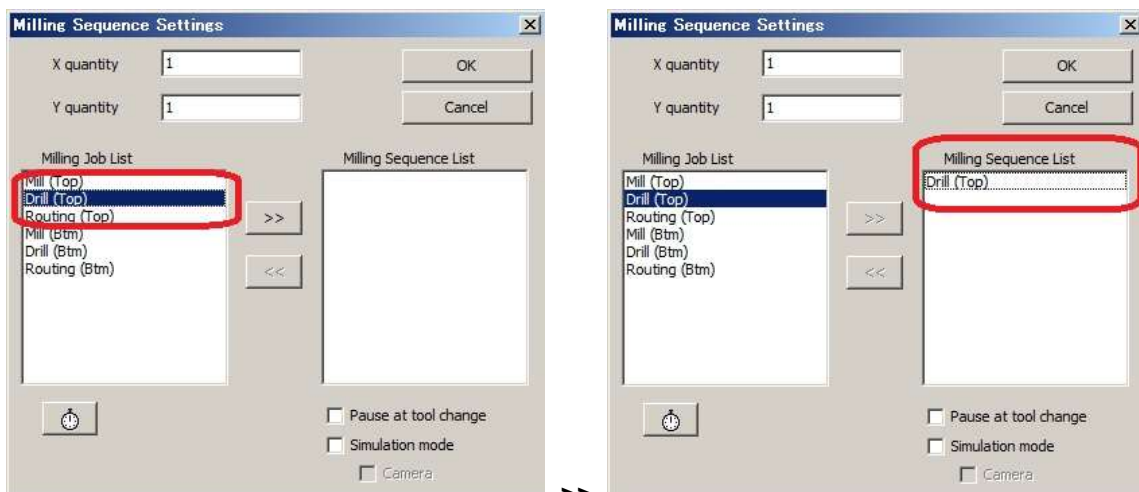
5. Repeat the above and move the below jobs to the Milling Sequence List.
    - Mill (Top)
    - Mill (Btm)
    - Routing (Btm)
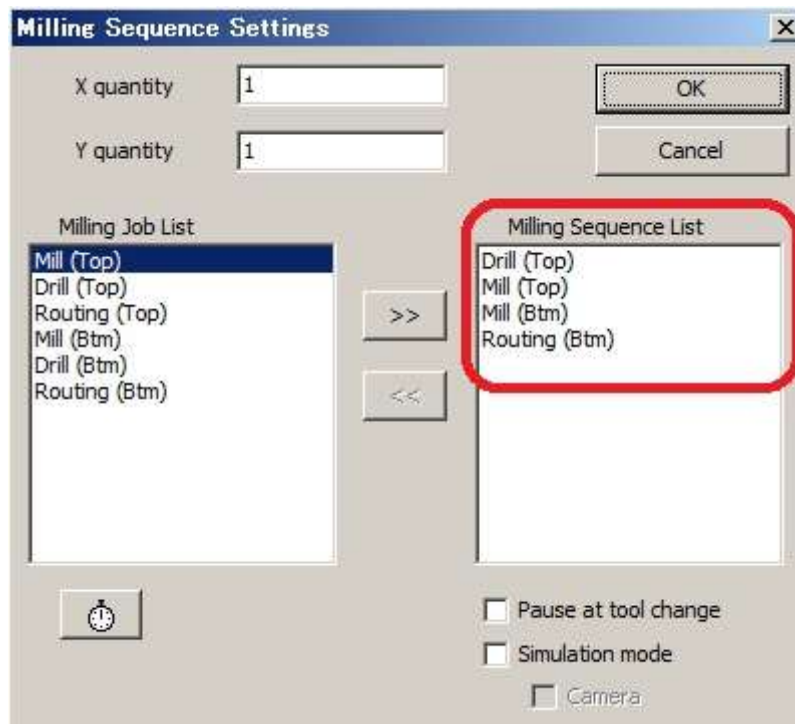
6. Click **OK** and the machine will move.

Now Milling Sequence setting is completed. After you finish setting Milling Sequence, "Board Top/Bottom Change window" will appear.
>> Read through next chapter to continue.

5. Adjustment

In this chapter, you will do the below steps.

1 - Set P1 P2 (**2**~**5**)
2 - Set Camera Offset (**6**~**14**)
3 - Set Milling Width (**15**~**17**)
4 - Drill Fiducial Holes (**18**~**25**)

P1 P2: P1 P2 are the points used to determine the actual working area during the prototyping. As shown in the picture below, P1 is the intersected point which is 2mm to the left and down from the working area P2 is 2mm right and up from the working area. You will set P1 and P2 is automatically calculated and derived.
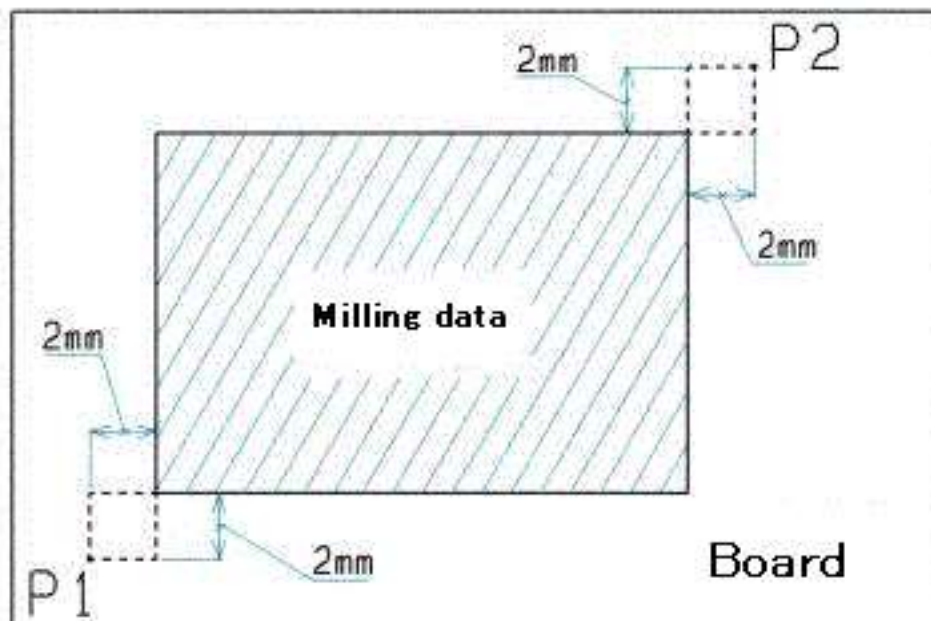
1. Board Top/Bottom Change window will appear.
   Click **Adjust** and Manual Operation Window will appear.
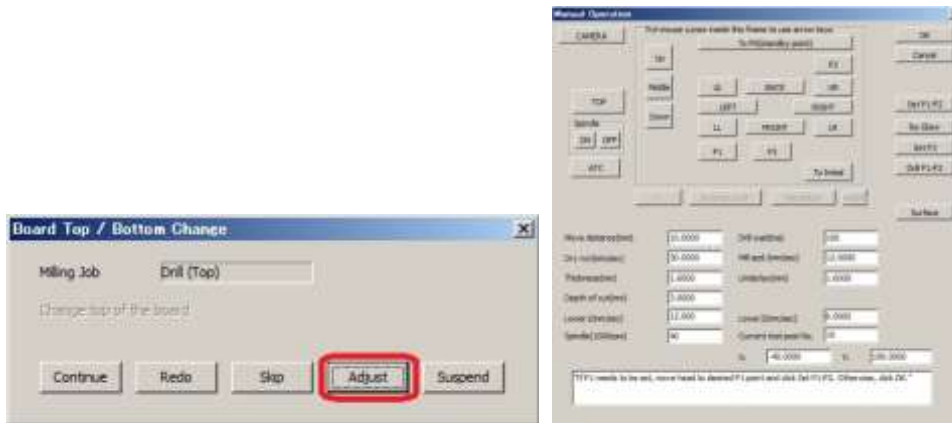
   Now you will **set P1 and P2**.

2. Move the machine to the front left corner by using the Movement Icon (**FRONT**, **BACK**, **LEFT**, **RIGHT**) and entering distance to move per click in **Move Distance**.
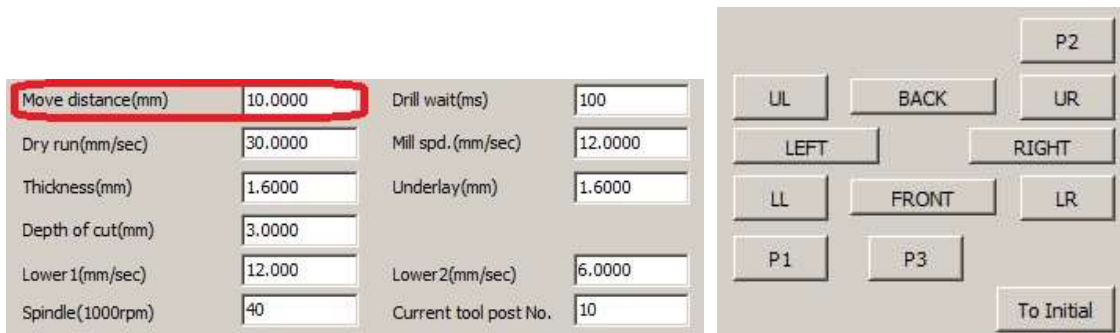
3. After moving the head to the left corner, click **Set P1-P2**.
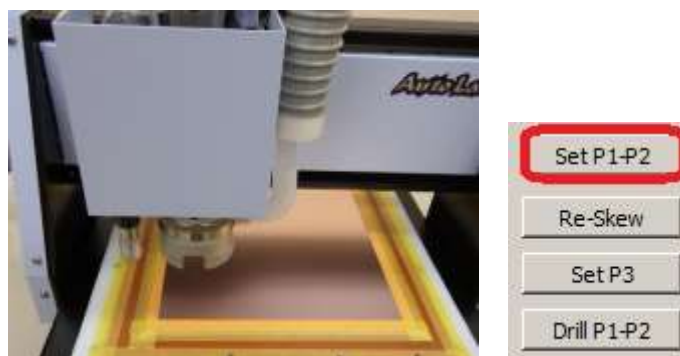
4. Confirm P2 window will appear. Click **No(N)**.

5. Click **P1** and **P2** button to check if the spindle head stays inside the PCB.
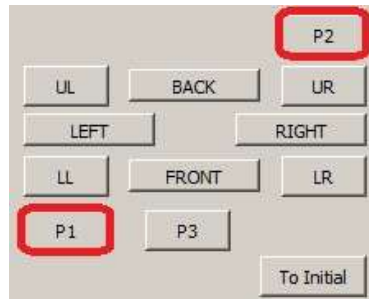
WARNING:Do not set P1 all the way at the left corner. Camera will not be able to use to read the fiducial hole when the board is flipped over.
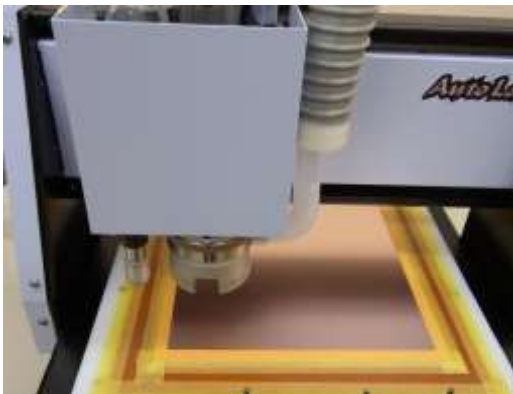
P1   P2
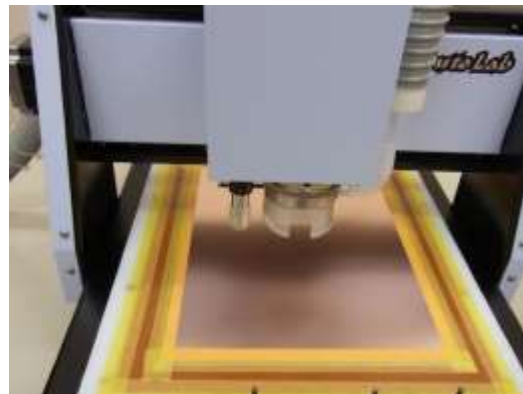
P1 P2 setting is completed. Now you will set **Camera Offset**.

6. First, click **P1** button.
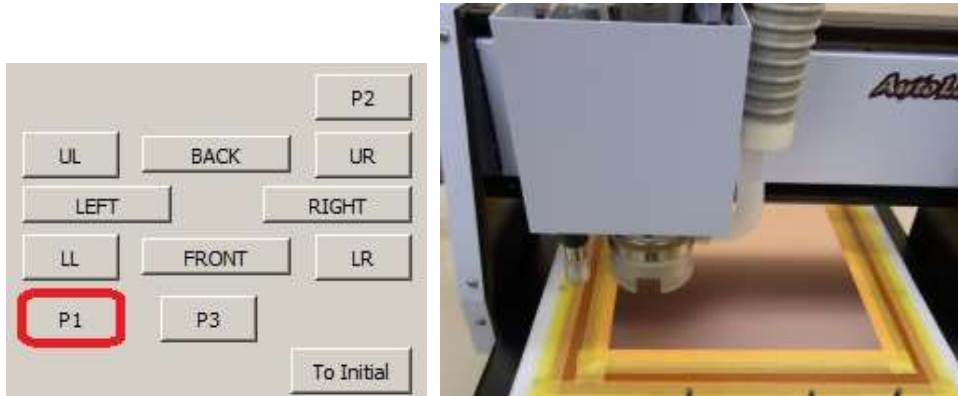
7. Now you will change tools.
   Click **ATC** button.
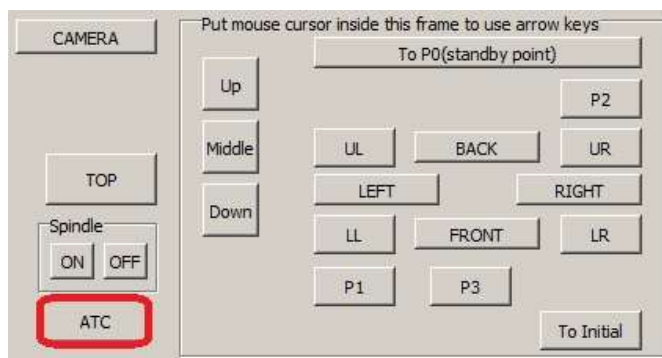
Auto Tool Change window will appear. Enter **1** in **Pick up** (At this time, Put back to is masked and displayed as 10). Make sure to check tool post 10 on the machine is empty and click **OK**.

The Machine will change the tool automatically. It will put the current tool to Put back to post and pick up from Pick up post.

 > >

Tool Change is completed.

Use the depth adjustment screw to make the tip of the tool same height level as the pressure foot. The tool will move **down** when the depth adjustment is rotated **clock-wise** and **up** when rotated **counter clock-wise**.

Down/Deep   Up/Shallow
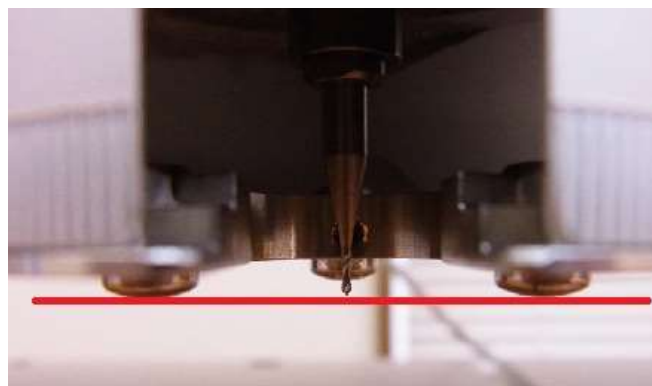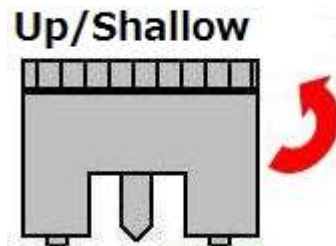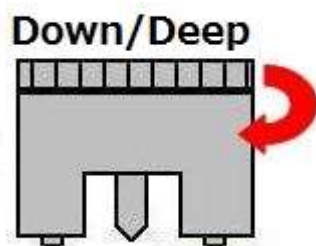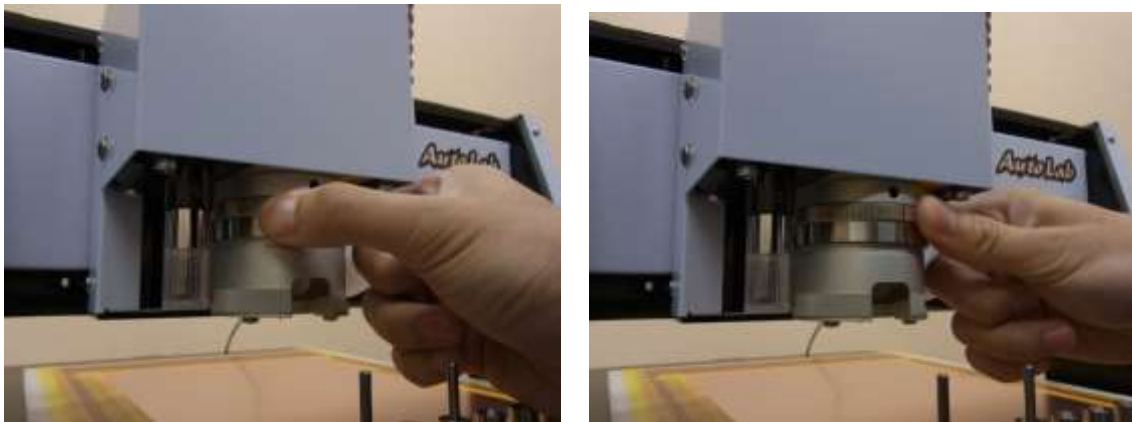
IMPORTANT: The tool will move up/down 3μm with 1 click on depth adjustment screw. 1 revolution will be 0.5mm.

8. Click **ON** to turn the spindle on and click **DOWN** to move the spindle head down.
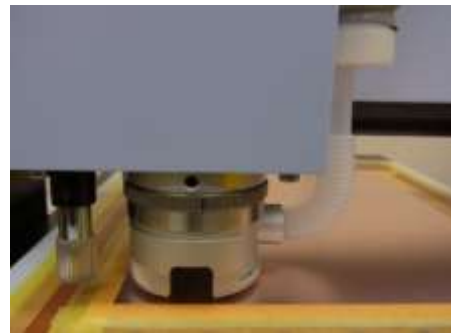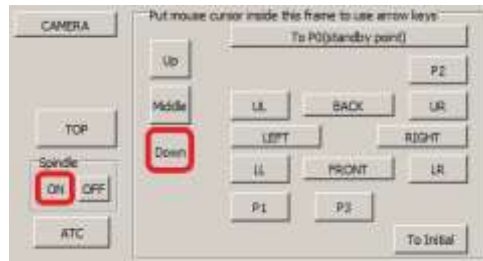
9. Click **UP** to move the spindle head back up and **OFF** to turn the spindle off.
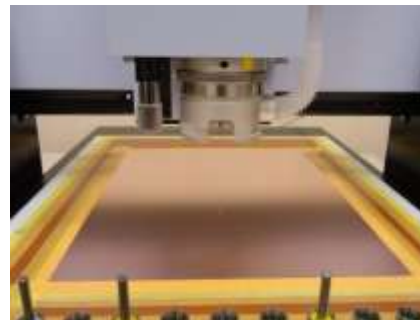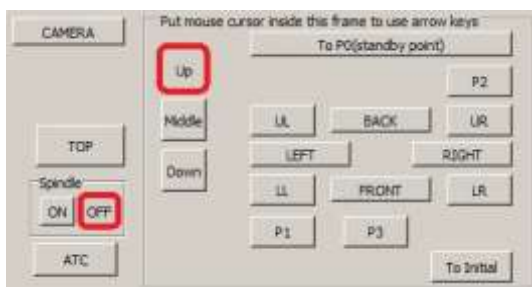
10. Now you will check if the surface of the board has been milled. Repeat **8~10** until the board is milled.

11. When the surface of the board is milled, clicked **CAMERA**. The head will move to camera position.

 >>
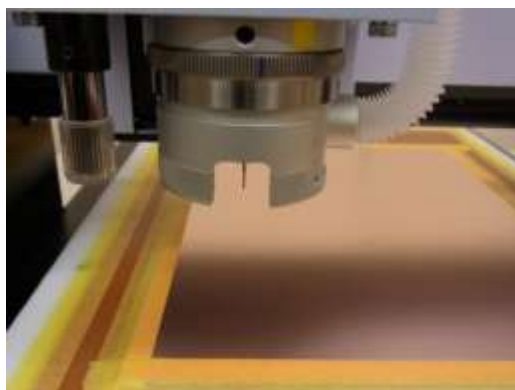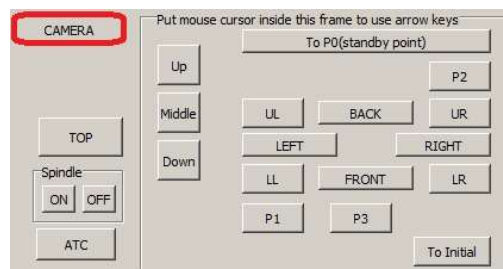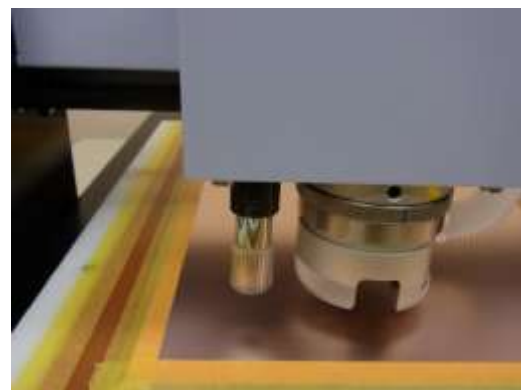
12. Launch **Design View.**

If the Design View does not display image from the USB camera, click **Source** and select appropriate camera.
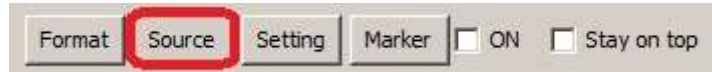
13. Use the switch on the camera USB cable to adjust the light.

 >>
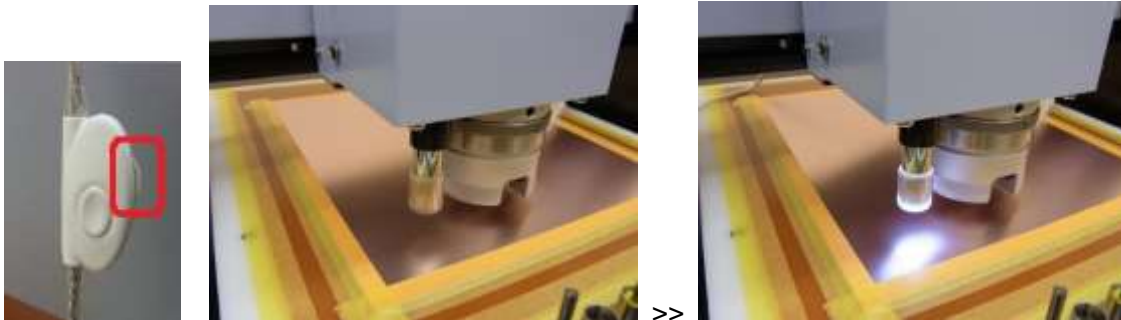
14. Next you will set the camera.

Click **Marker** button and click on the **checkbox** for **ON** and **Stay on top**.

Marker will be displayed on the window and Marker setting will be shown below. Click on the **Black colored box** and set the color of the marker. Click and select a color which is easy for you to see, and click OK.
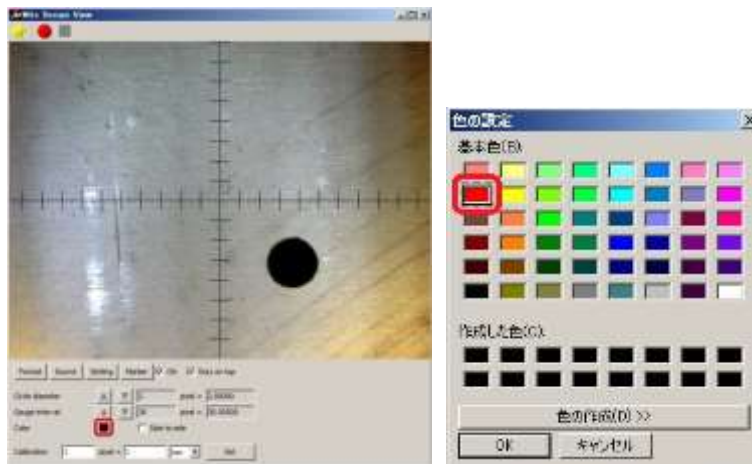
Circle diameter and **Gauge interval** will be used to align the center to P1.

 >>
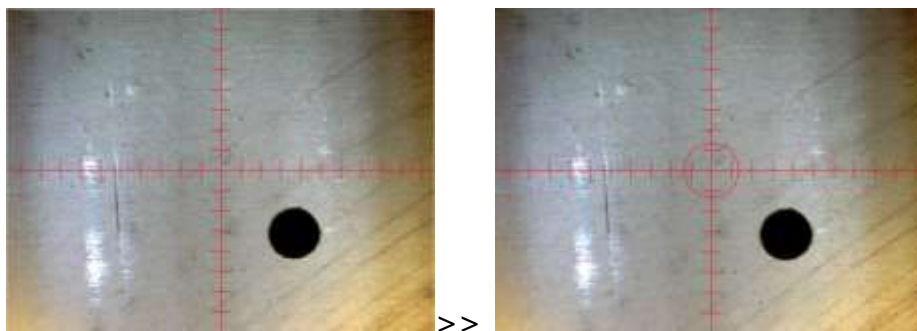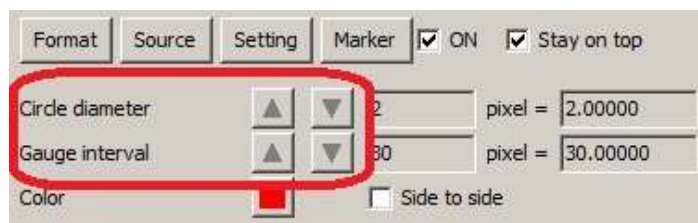
Click on **Format** and select **640 x 480 x 24b** and click OK.

For calibration, set as **90 pixel = 1 mm** and click Set.
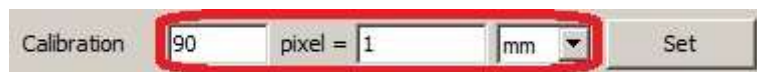
Design View will stay on top of other application. Move the Design Pro Manual Operation window as below.
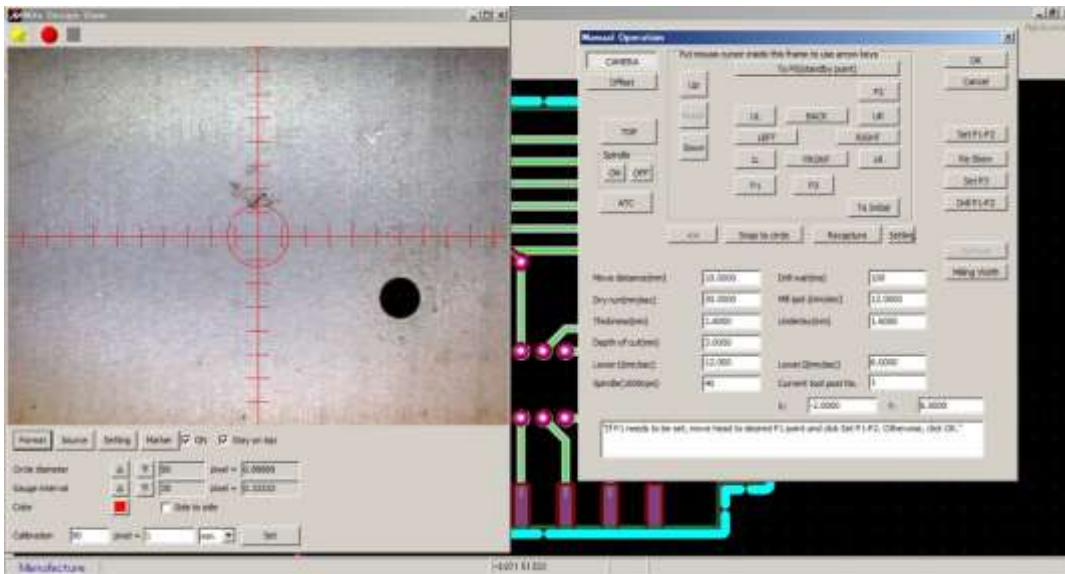
Camera setting is now completed.

15. Click **Offset**
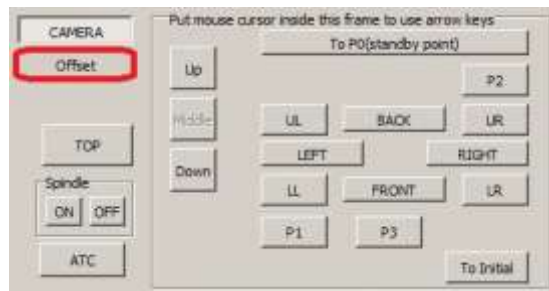
16. Camera Offset Window will appear. Check if the milled circle is on Design View screen. Click **Snap to circle**.
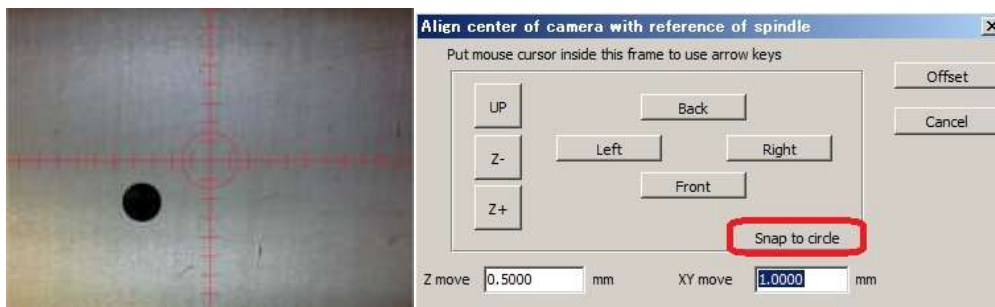
The machine will automatically move and align to the center of the circle. Click **OK**.

>>
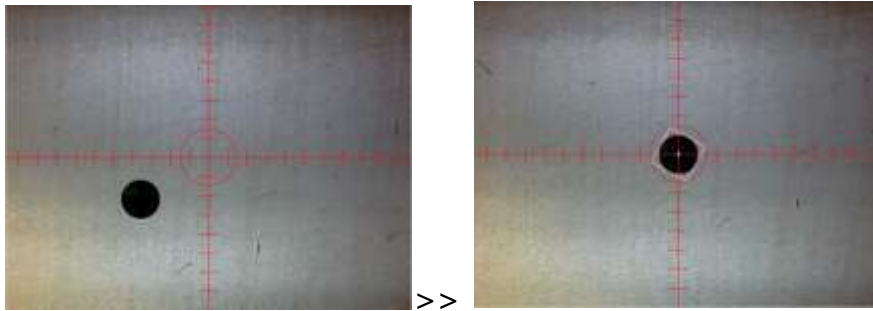
*If the milled circle is not on the Design View screen, enter distance to move per click in XY move and use movement icons.

17. Check if the center of the camera is aligned to the milled circle and click **Offset**.
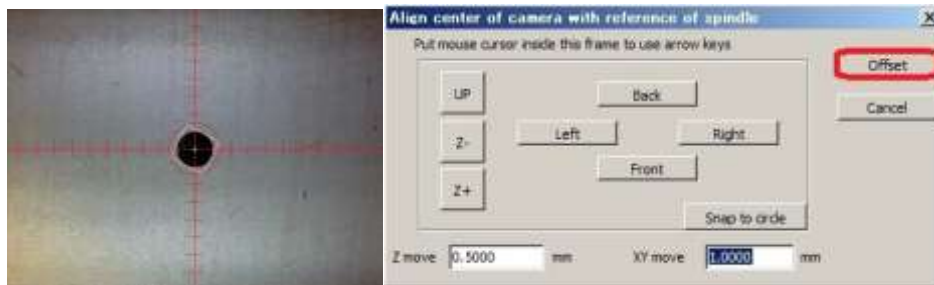
If the center of the camera is not aligned to the milled circle, enter distance to move in XY move and use Circle diameter on Design View on Design View to align.

18. Click **CAMERA** button and end camera mode.
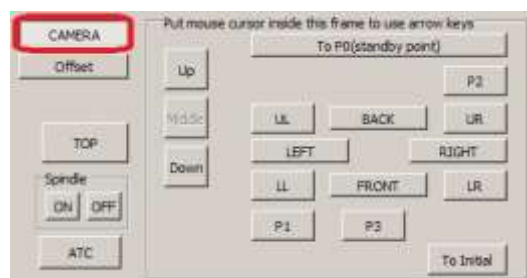
Camera offset is now completed. Now you will **set milling width**.

19. Click **P2**.

20. Move the spindle head **5mm to the right** by entering the Move Distance 5 and clicking **RIGHT** button once.

Click **CAMERA** button and click **Milling Width**.
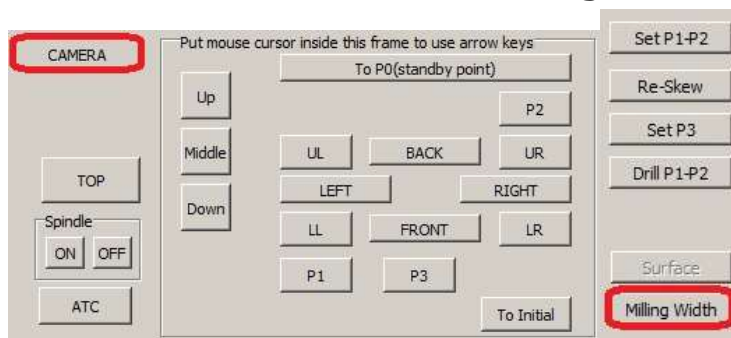
21. Check Milling Width window will appear. Click **Go**.
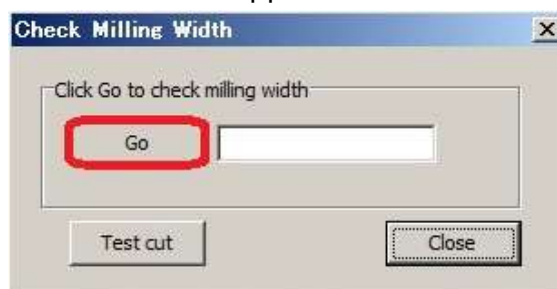
22. The machine will automatically mill and measure the milling width. The result will be shown soon after that. Use the depth adjustment screw to set it to

<u>0.3mm</u>. Rotate the depth adjustment screw clock wise to widen the milling width and counter clockwise to thin it.
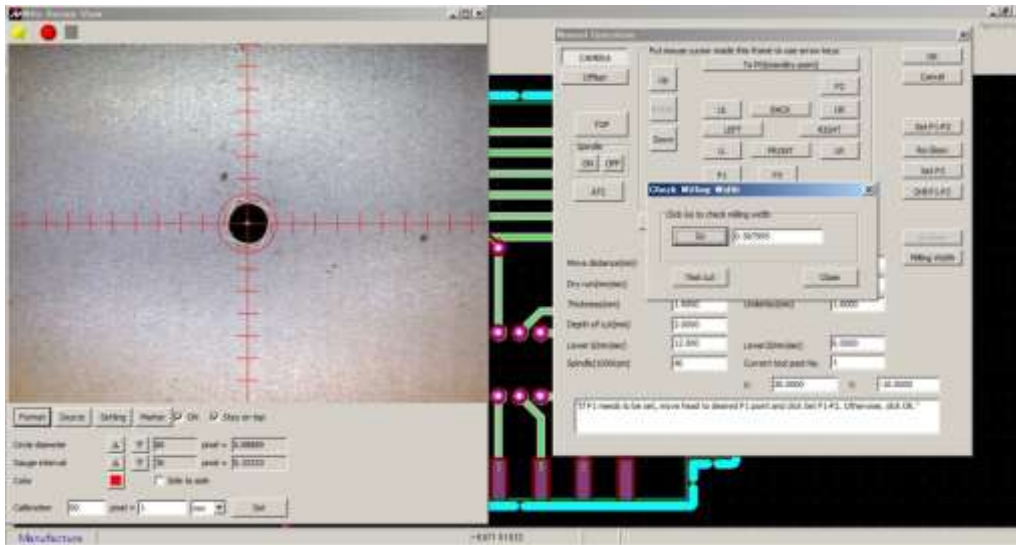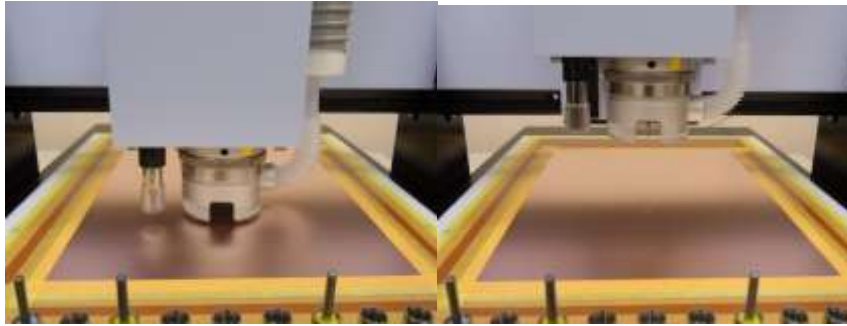
23. After depth adjustment screw is set, click **Go** again. The machine will automatically move 1mm back and mill.
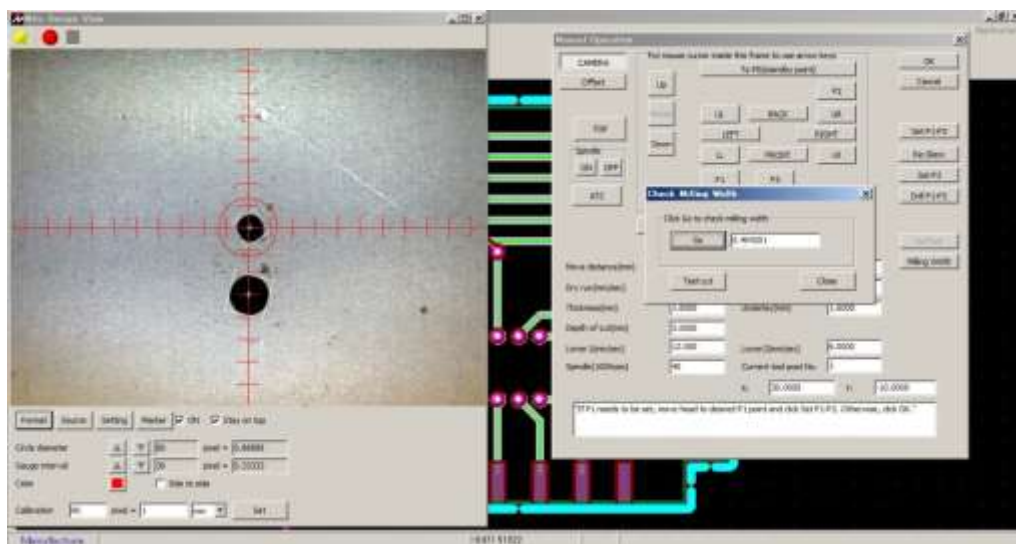
24. Repeat **23~25** until the result becomes 0.3mm. After it becomes 0.3mm, click **Close**.
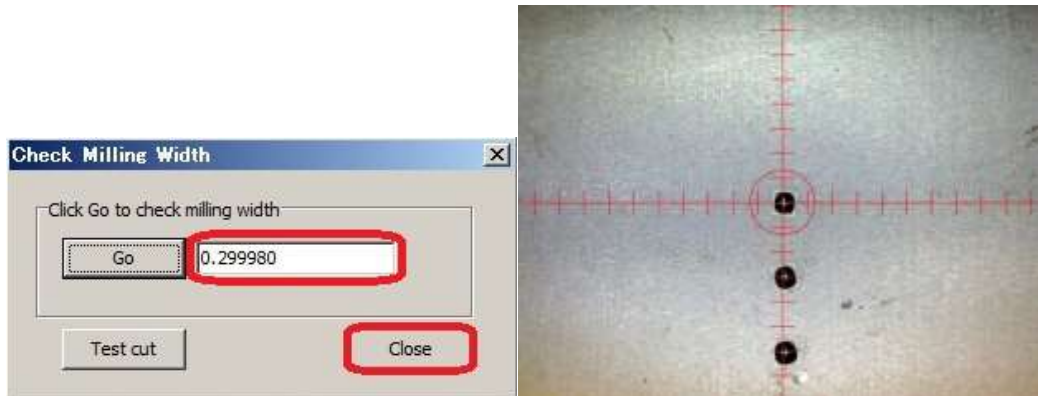
25. Click **CAMERA** and end camera mode.
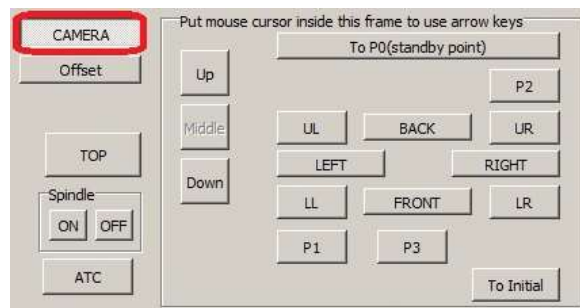
Milling width setting is now completed. Next you will **drill fiducial hole**.

26. Change the tool to 0.8mm drill. Click **ATC** and enter **4** under the **Pick up** and click OK.
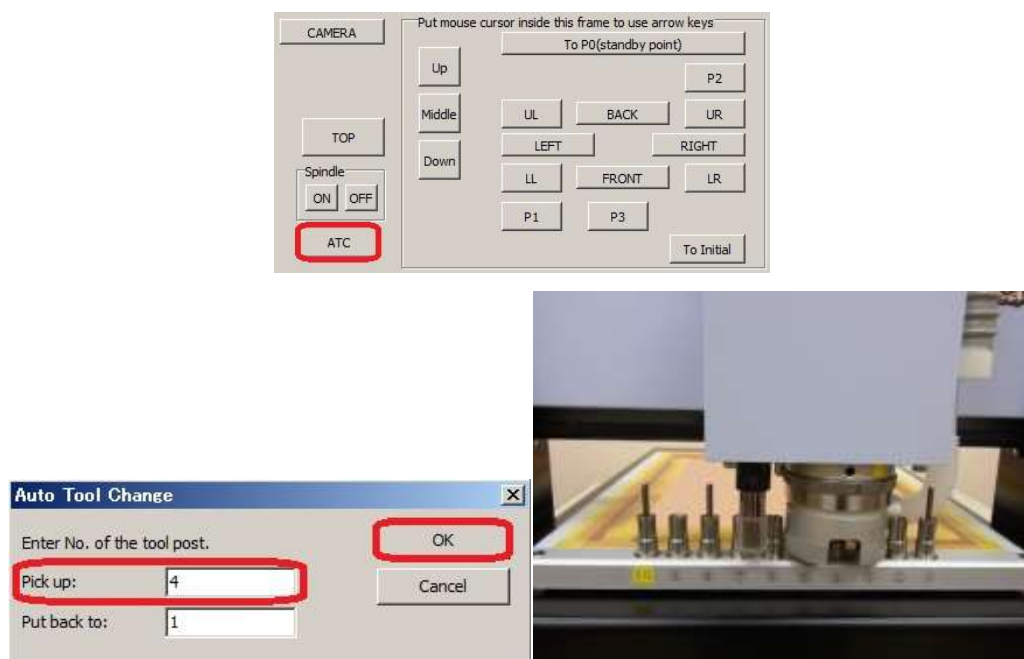
27. Click **Drill P1-P2**. Confirmation of drilling holes window will appear. Click **Yes(Y)**. The machine will automatically move to P1P2 and drill holes.
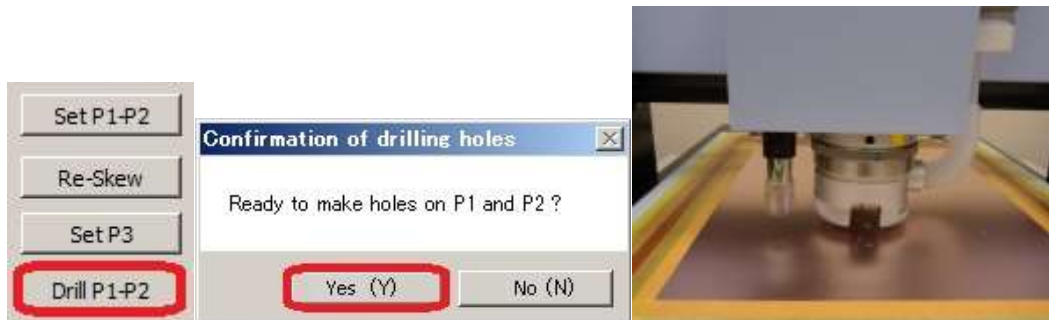
28. Click **CAMERA** button to double-check the offset. If the P1 and the center of the Design view is not aligned, repeat **16~18**.
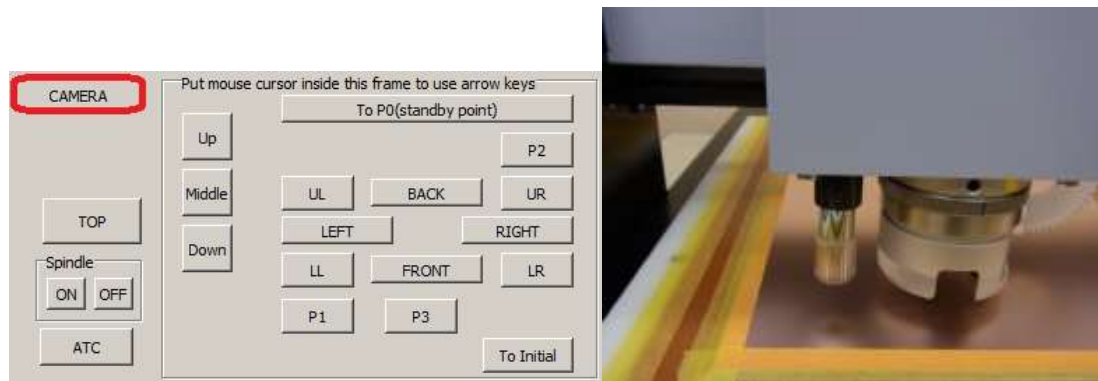
29. Click **OK** on the Manual Operation window.
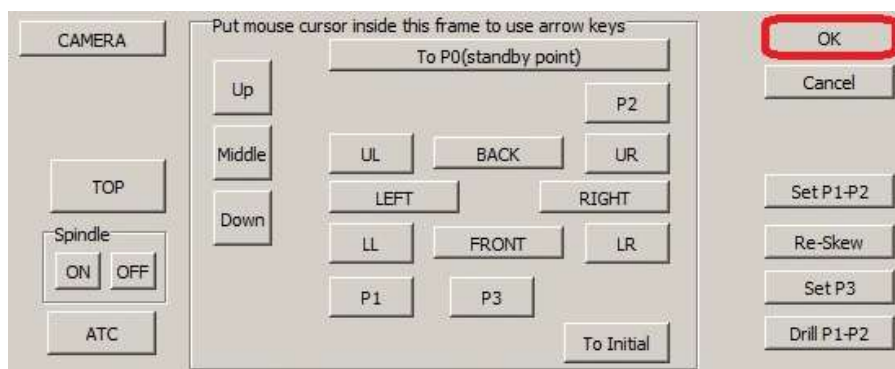
Adjustment is now completed. You will now move on to Process Top Layer.
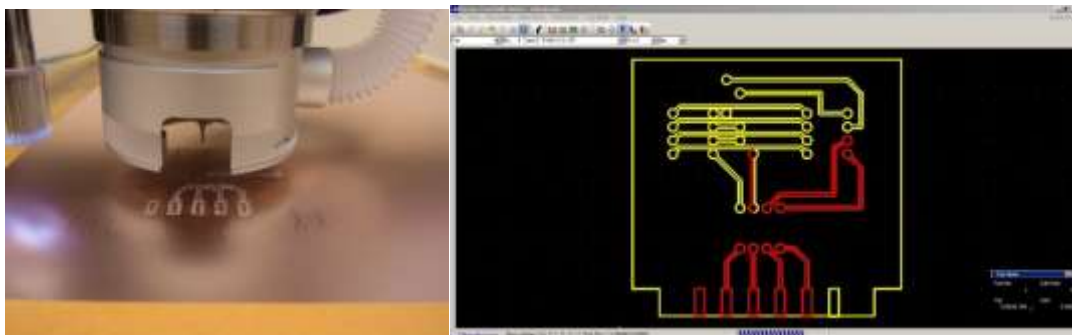
6. Process Top Layer

Next you will process Top layer of the PCB.

1 – Drill (Top) (**1~3**)

2 – Mill (Top) (**4~5**)

Drill Top (Below)
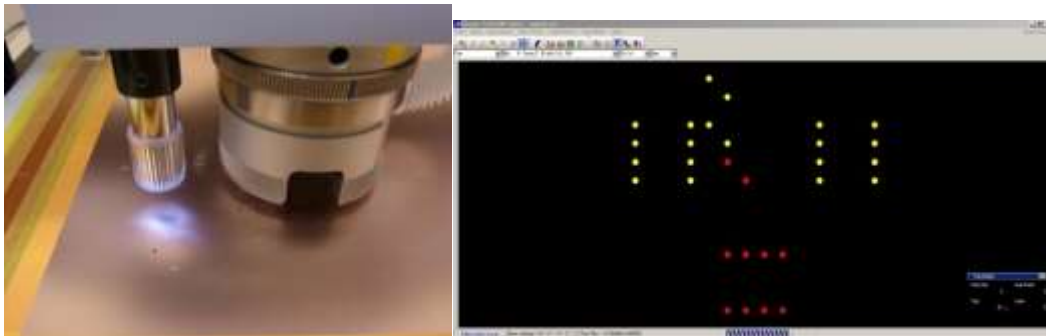
Mill Top (Below)

Top Layer Completed (Below)
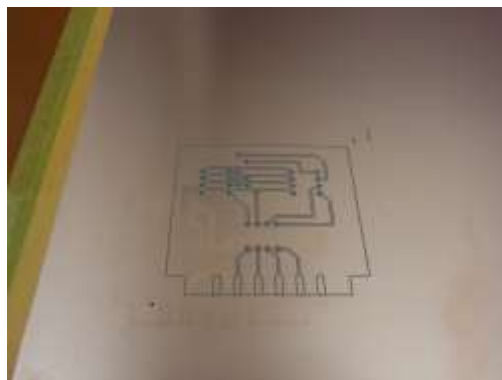
1. Check to see if the Milling Job is set as **Drill (Top)** and click **Continue**.

2. Drilling will begin. Data which will be drilled will show in yellow and data drilled will show in red.
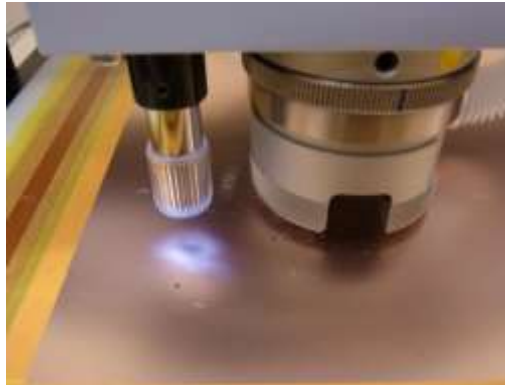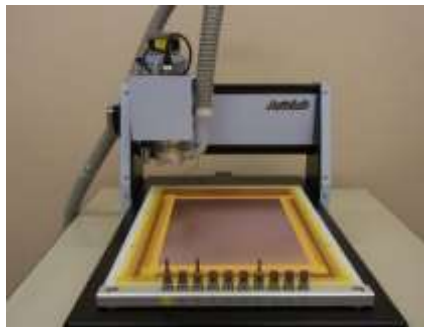

3. After drilling is finished, the machine will automatically change its tool to milling bit (tool post #1).

4. Milling will begin. Data which will be milled will show in yellow and data milled will show in red.
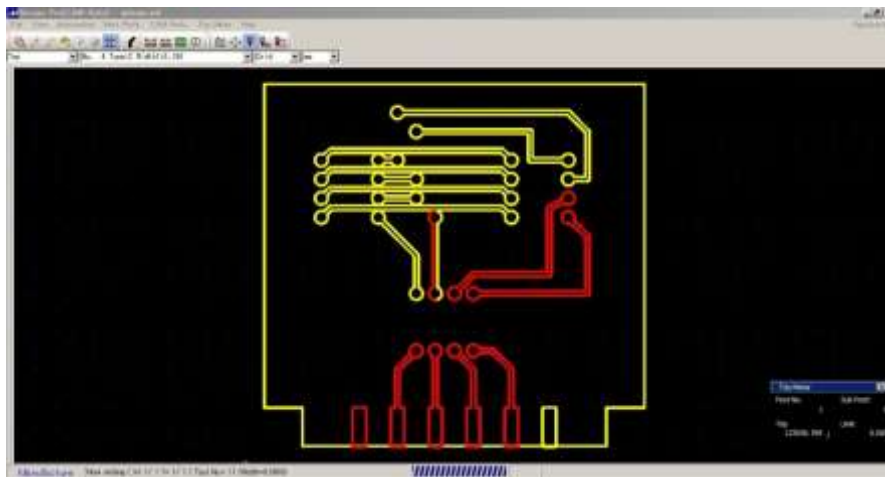
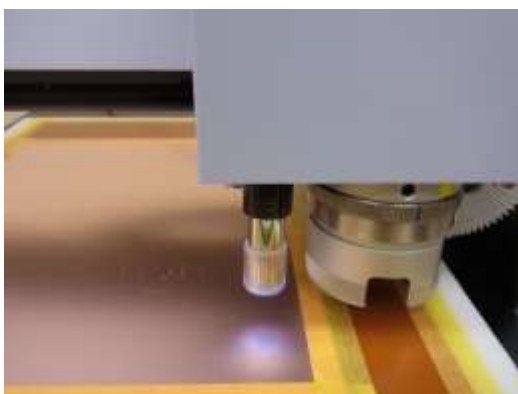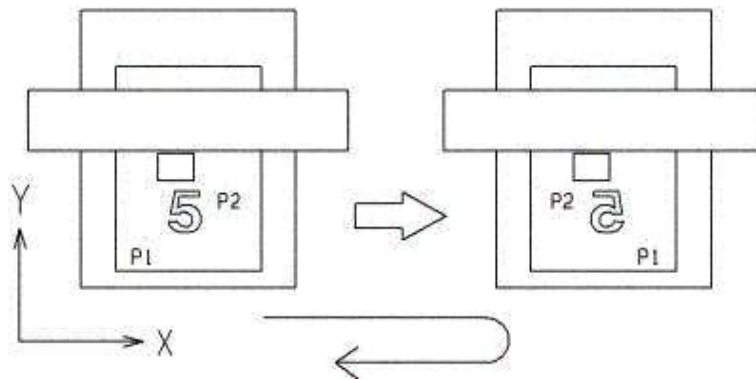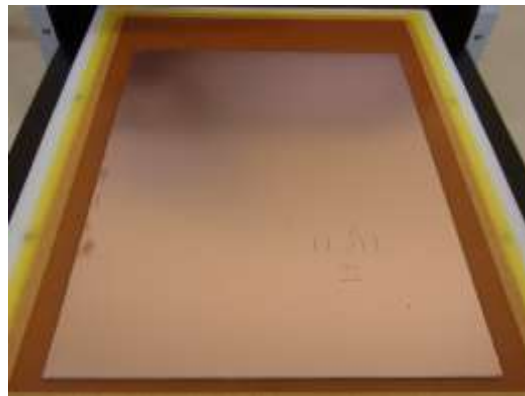5. After milling, the spindle head will move backwards.

Top layer prototype is now completed. Next you will flip the board over and align the fiducial points (P1 P2 points).
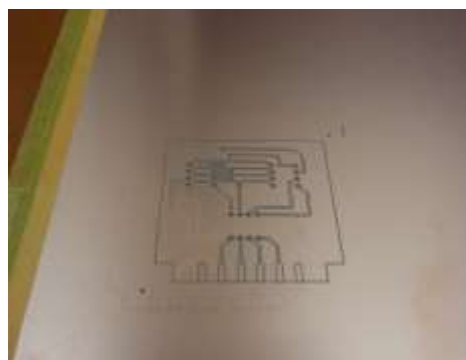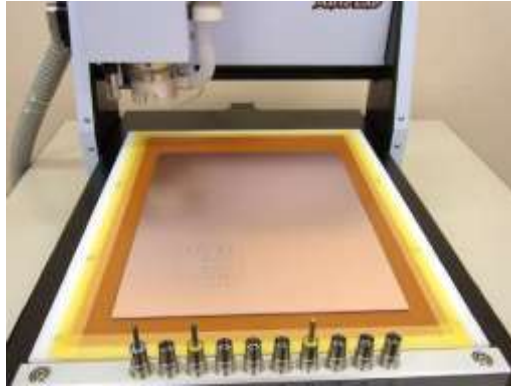
7. Adjust/Align Bottom Layer

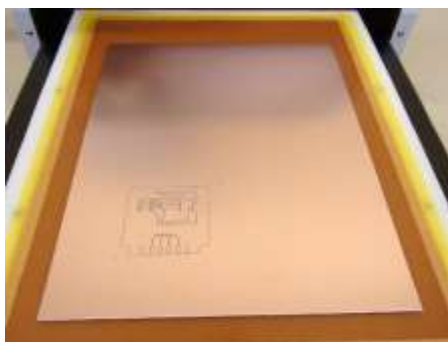Next you will flip the board over and adjust/align to the fiducial points (P1 P2 points)

1 – Flip the board over (**1**~**3**)
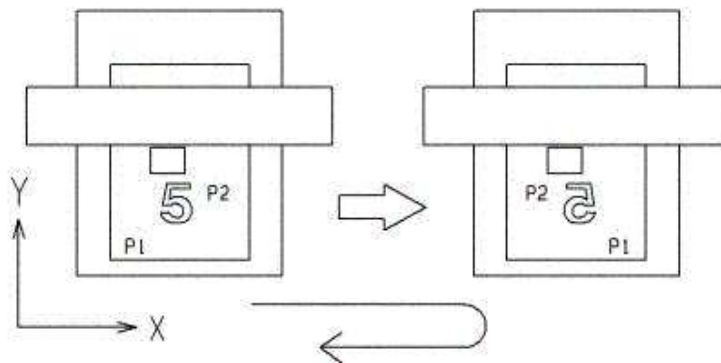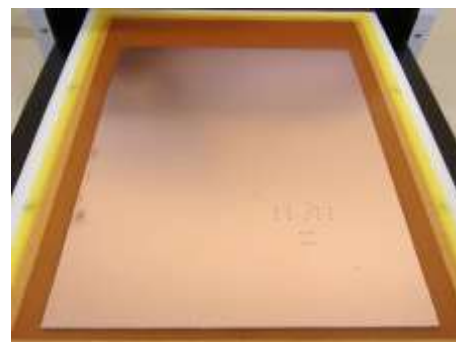2 – P1 P2 Adjust/Align (Bottom) (**4**~**11**)

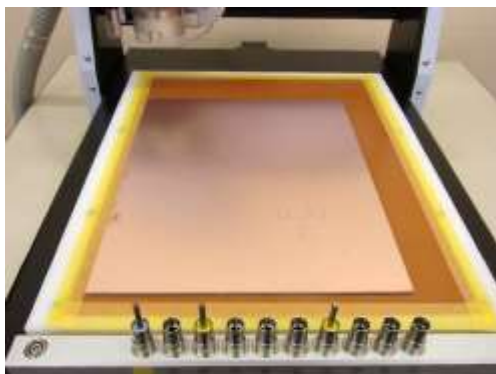Remove the tape on the PCB. Do not throw them away, they will be reused.

1. Flip the board over. Bring the left side of the board to the right side when it is flipped over.
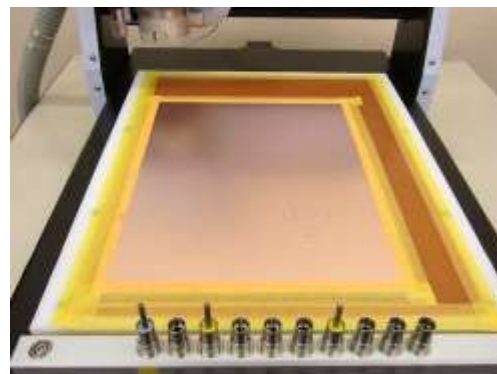

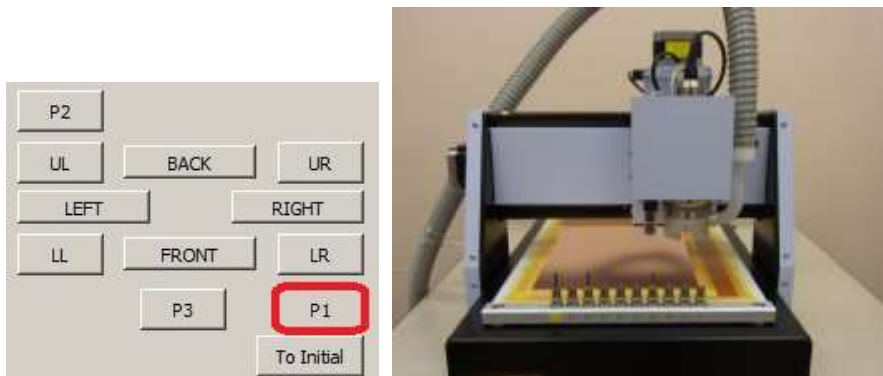2. Move the PCB to the left side and reused the tape to hold it down.
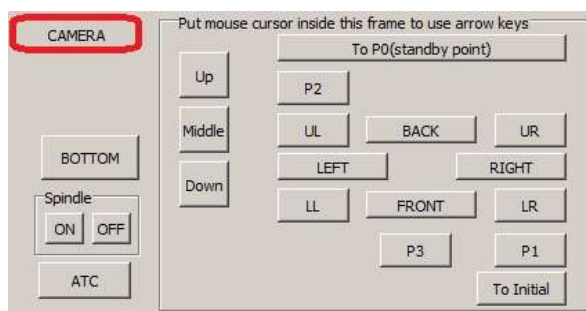

Next you will adjust/align P1 P2.

3. On Design Pro, Board Top / Bottom Change window is shown. Click **Adjust**.
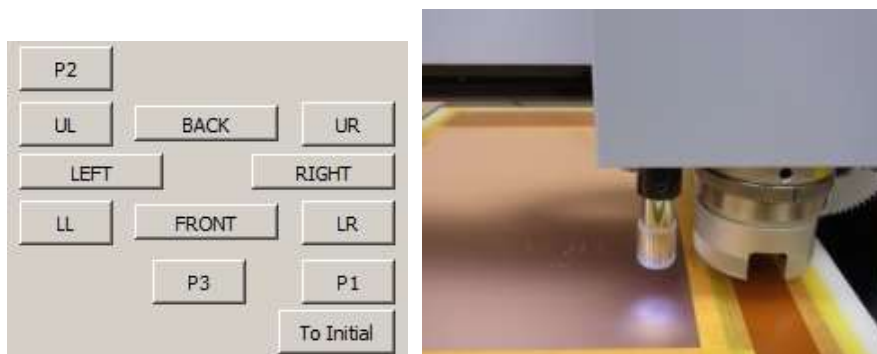

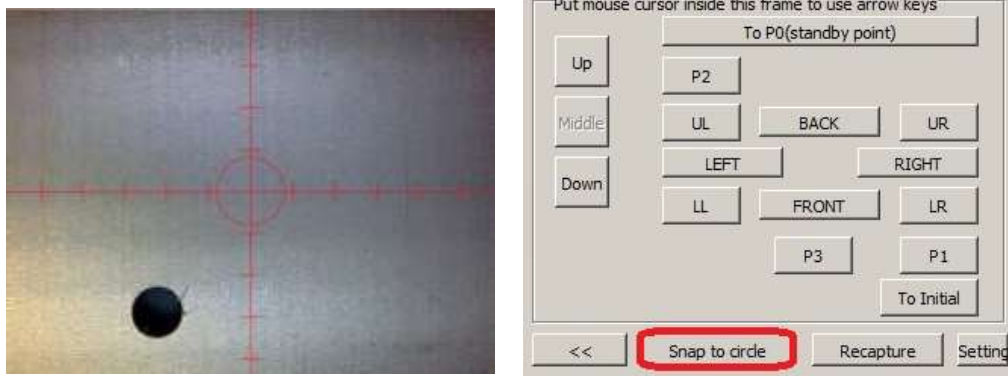4. Manual Operation window will show up. Click on P1.

5. Open Design View and click **CAMERA** button in Manual Operation window.

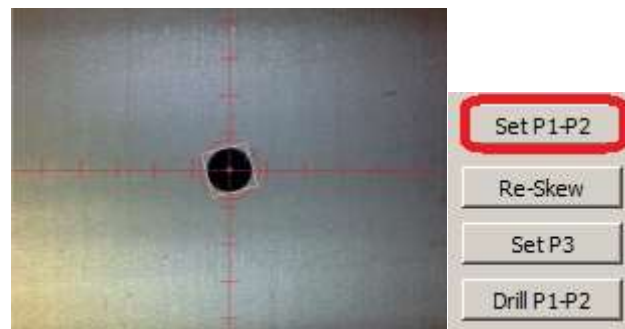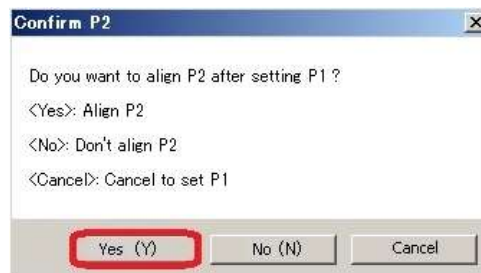6. Use the movement button (FRONT, BACK, RIGHT, LEFT) to find the P1 hole on the Design View screen.

7. After confirming the P1 hole in the Design View window, click **Snap to circle**.

8. The machine will automatically move and align to the center of the circle. Click **OK**. Check if the center of the P1 and camera is aligned and click **Set P1-P2**.

9. Confirm P2 window will appear. Click **Yes(Y)**.

10. The machine will move to P2. Repeat **7~9** to use Snap to circle and align center of the P2 to the camera and click **Set P1-P2**.
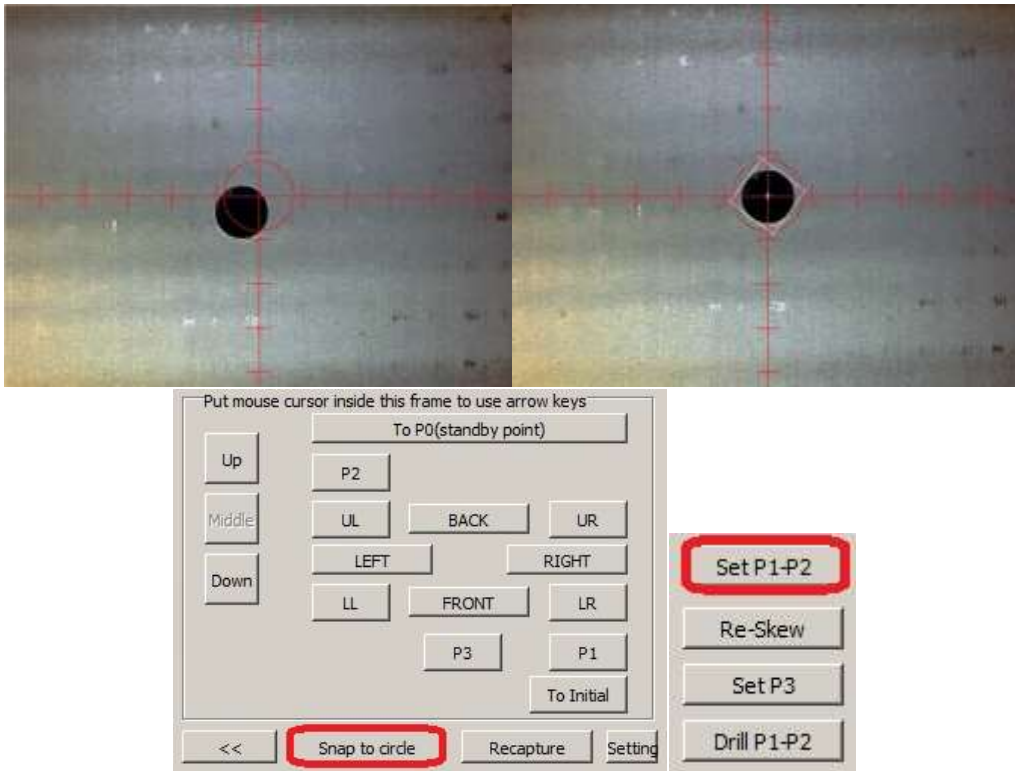
11. Click **OK** on the Manual Operation window.
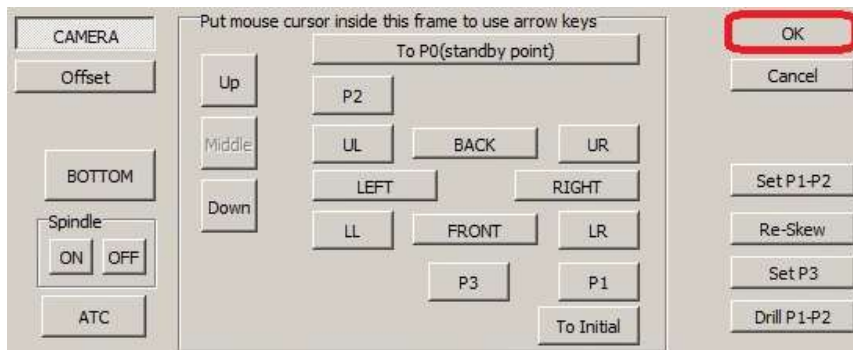
Bottom layer adjust/align is completed.

8. Process Bottom Layer

Lastly, it is the prototyping of the bottom layer.

1 – Drill (Btm) (**1**~**3**)
2 – Routing (Btm) (**4**~**6**)

Milling Bottom (Below)
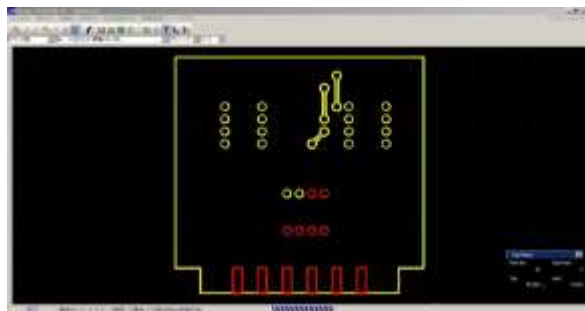
Routing Bottom (Below)
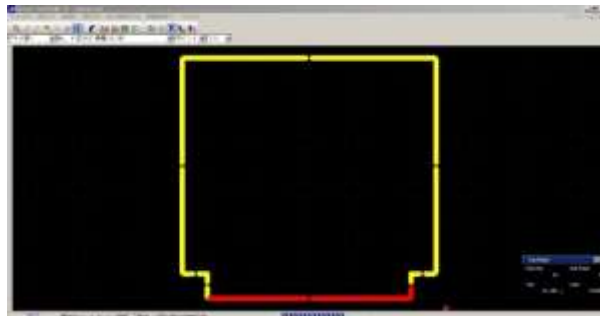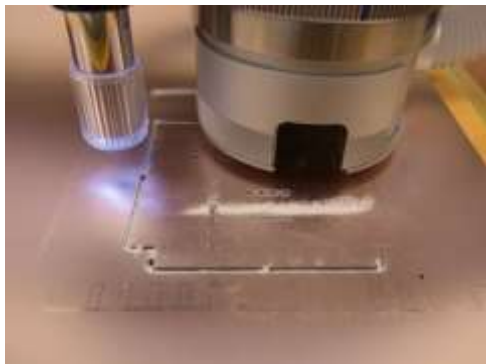
Bottom Layer Completed (Below)
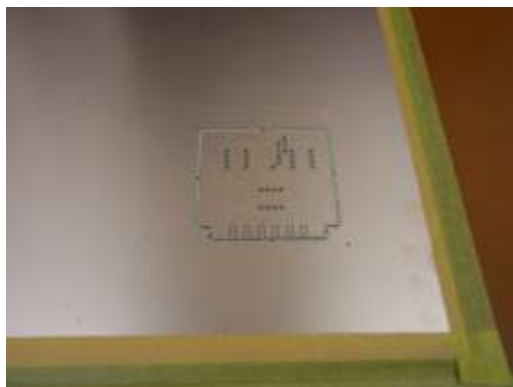
1. Check to see if the Milling Job is set as Mill (Btm) and click **Continue**.

2. Milling will being. Data which will be milled will show in yellow and data milled will show in red.
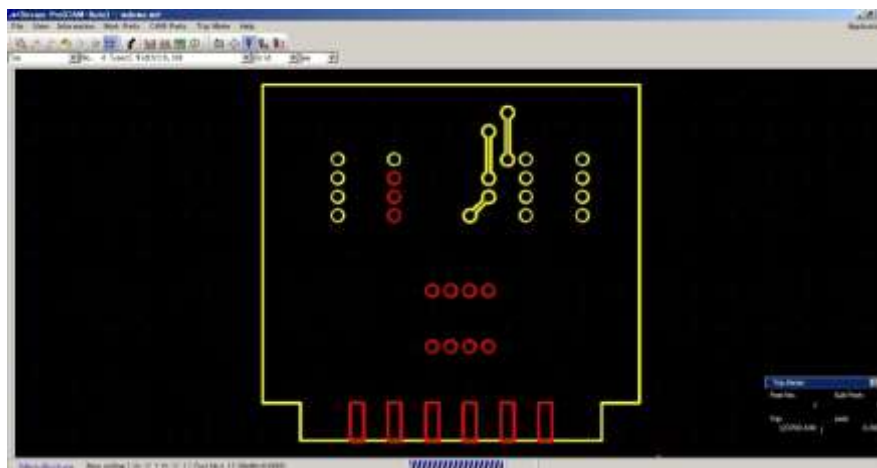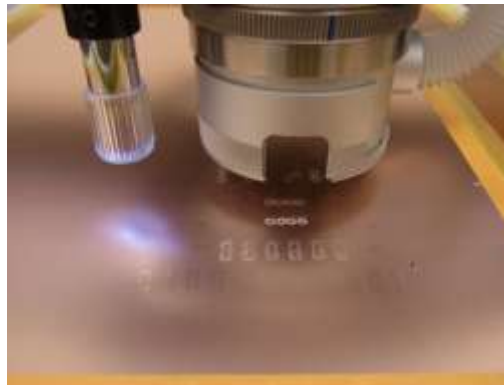
3. After drilling is finished, the machine will automatically change its tool to router bit (tool post #8).

4. Routing will being. Data which will be routed will show in yellow and data milled will show in red.
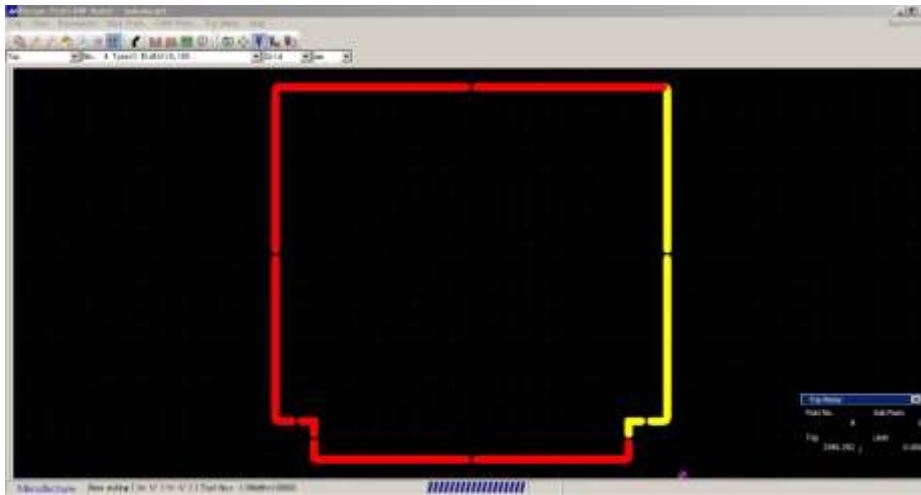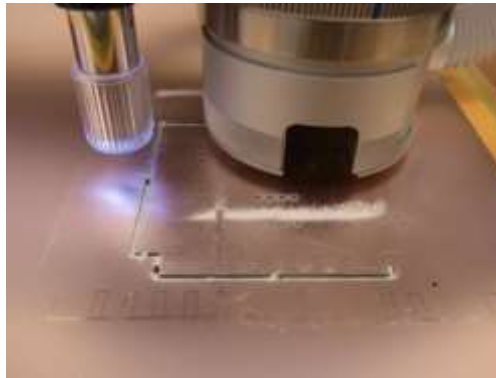
5. Closing Confirmation window will appear. Click **Close**.
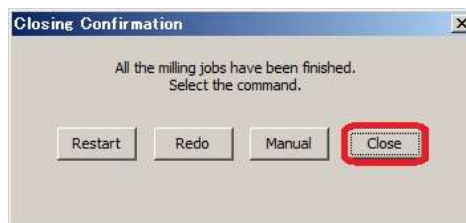
6. The machine will automatically change its tool to dummy tool (tool post #10).

Prototyping is completed.

Top Layer
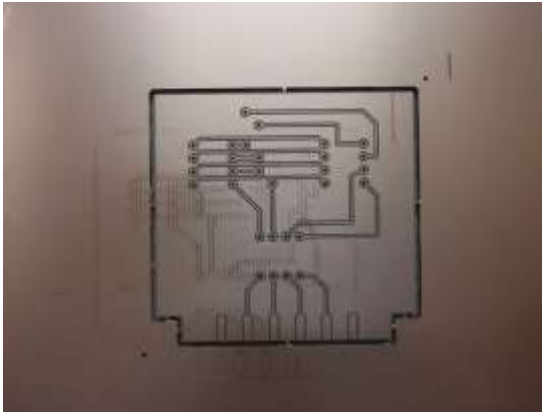
Bottom Layer
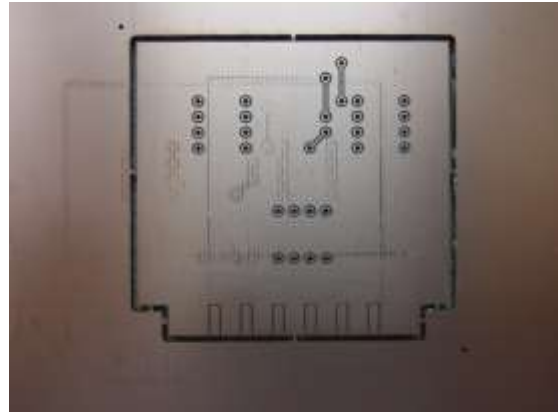
9. After Completed

Remove the masking tape from the PCB and use the brush to scrub the PCB.

Use the cutter knife or nipper to separate the finished PCB from the blank PCB.

Turn the power switch off.

All operation is finished now.

Trouble Shooting (USB,RS232C Serial Connection)

1. Prototyping Machine does not activate after clicking Start Job icon

   Enter **SHIFT** + **ESC** on the keyboard. Check the below points:

   - Prototyping Machine Switch is On
   - RS-232C Serial Cable/USB Cable is not connected

     * For RS-232C Serial Cable, use Straight connection cable.
       Do not use reverse/cross connection.

   - If you are using USB, go to WINDOWS Device Manager in Control Panel. Check MITS USB driver is properly installed.

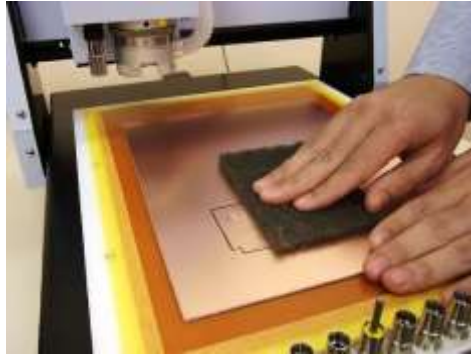   * If the Prototyping Machine does not activate with properly installed MITS USB driver, go to **CAM Prefs. >> Board Maker** in Design Pro. Set the RS232C port to USB. Click OK on the Board Maker Setting window and close Design Pro. The setting changed will be applied after the software is closed.

2. Port Open Error message appears after clicking Start Job icon

   - Go to **CAM Prefs. >> Board Maker** and select the port/cable you are using on **RS232C port**.
   - After selecting to the port, close Design Pro. The changes will be applied after the software is closed.
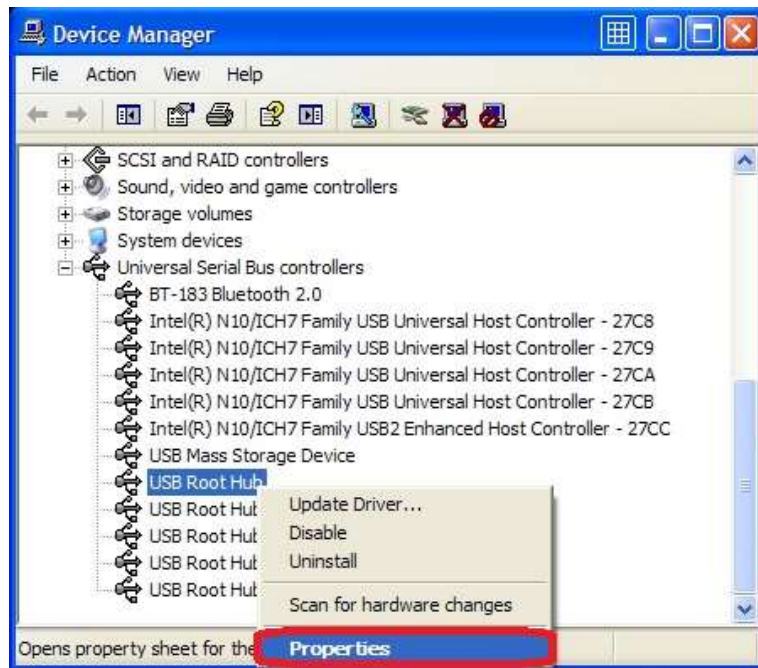
   Prototyping Machine does not activate after clicking Start Job icon.

   If the connection does not suspend after entering SHIFT + ESC on the keyboard;

   - Turn the Power Switch Off and enter **SHIFT** + **ESC** again.
   - Go to Control Panel >> Device Manager. Change the setting for USB Root Hub. (See next page)

<USB Root Hub Setting>

Go to Device Manager. Right click on **USB Root Hub** and select **Properties**.

Select Power Management tab and remove the check mark in the box for **Allow the computer to turn off this device to save power**.

Repeat the above for all of the USB Root Hub in Device Manager.
After setting has been changed, restart your computer.

If the connection trouble with USB cable does not resolve with the above, please use the USB Serial converter cable. We kindly ask you to source locally.

Trouble Shooting (Prototyping Machine)

- Working Area

    When the machine moves out of the working area during processing or manual operation, the error message will appear.

    Hardware Limit Error: Recovery (Manual Operation)
    Click **Initial**. The spindle head will move to initial position and recover from hard limit error.

    Hardware Limit Error: Recovery (While Processing)
    Click **Suspend**.

    If ⌛ is shown and stays, enter **SHIFT** + **ESC** on the keyboard.

    After doing so, turn the power switch off and back on.

- Step-Out (Losing step)

    When step-out occurs, the software coordinates and the actual coordinates will be misaligned. Click **Initial** button in Manual Operation window to move the spindle head to initial position to realign the origin coordinates.

- Lubricate Lead Screw

    Lubricate the lead screw using the oil when abnormal sounds occur from the X, Y, Z-axis while processing. After coated with the oil, move the spindle head with manual operation to coat evenly.
    (Suggested Product: STP OIL TREATMENT)