

MITS Design Pro

CAM-Lab

for ElevenLab

• Precautions

◆ 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.**

◆ 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.

◆ Power Voltage

The allowable voltage for Eleven Lab **85V~264V**. If the voltage of your region is out of range, be sure to use voltage regulator.

◆ Working Area

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

◆ 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.

◆ 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.

◆ 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.

◆ 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.

◆ Tools and RPM

For processing, set the RPM to 30~40. The unit in the software is x 1000RPM.
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.

◆ Transportation

Since the Auto Lab 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.

◆ 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.

◆ 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.

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• Introduction

This manual is a tutorial guide to prototype PCB with Design Pro **CAM-Lab**. 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.

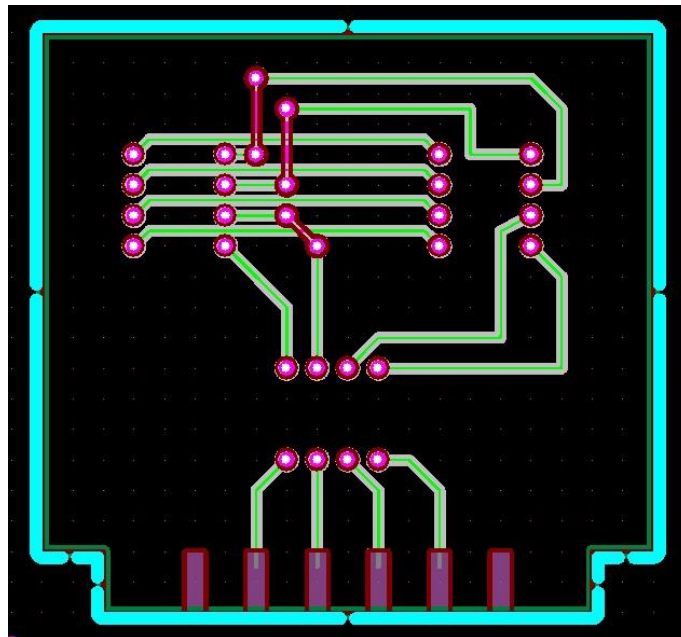
Board

- Double-Sided Copper Cladded
- Thickness: 1.6mm
- Copper Thickness: 35 μ m

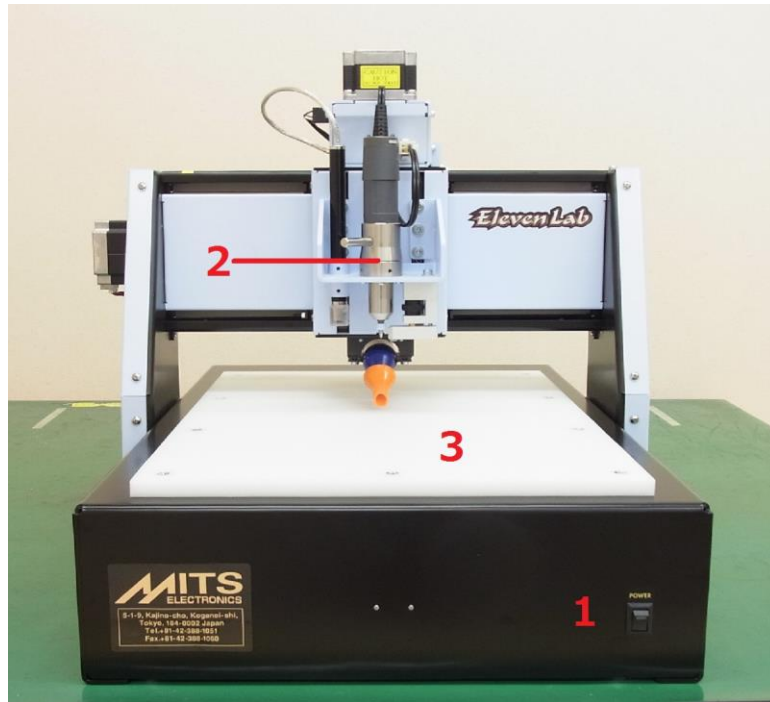
Tools

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

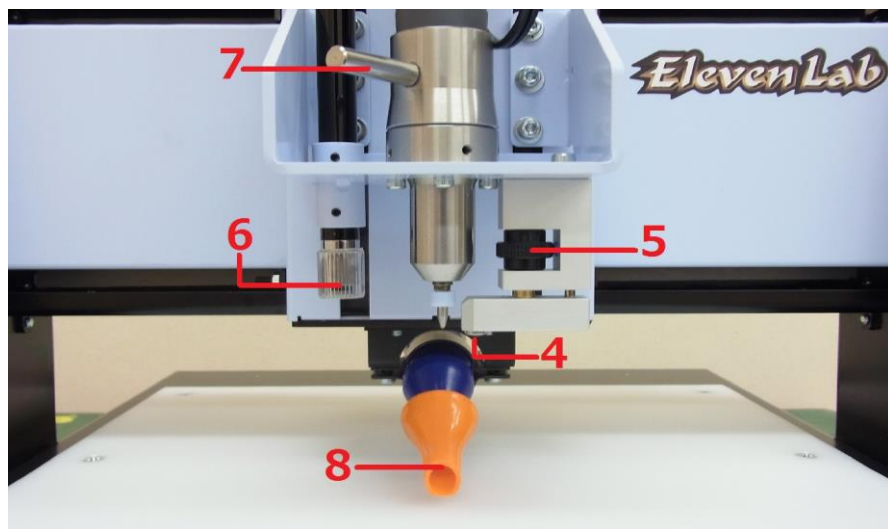
<File Used> mdemo.mit



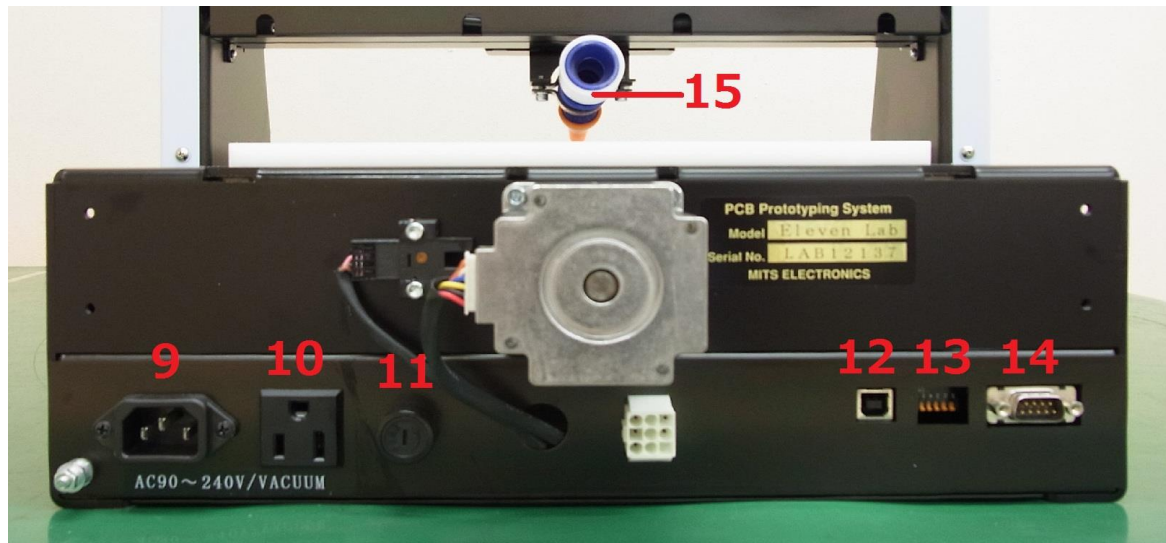
• Prototyping Machine Part Name



- 1 – Power Switch
- 2 – Spindle Head
- 3 – Working Table



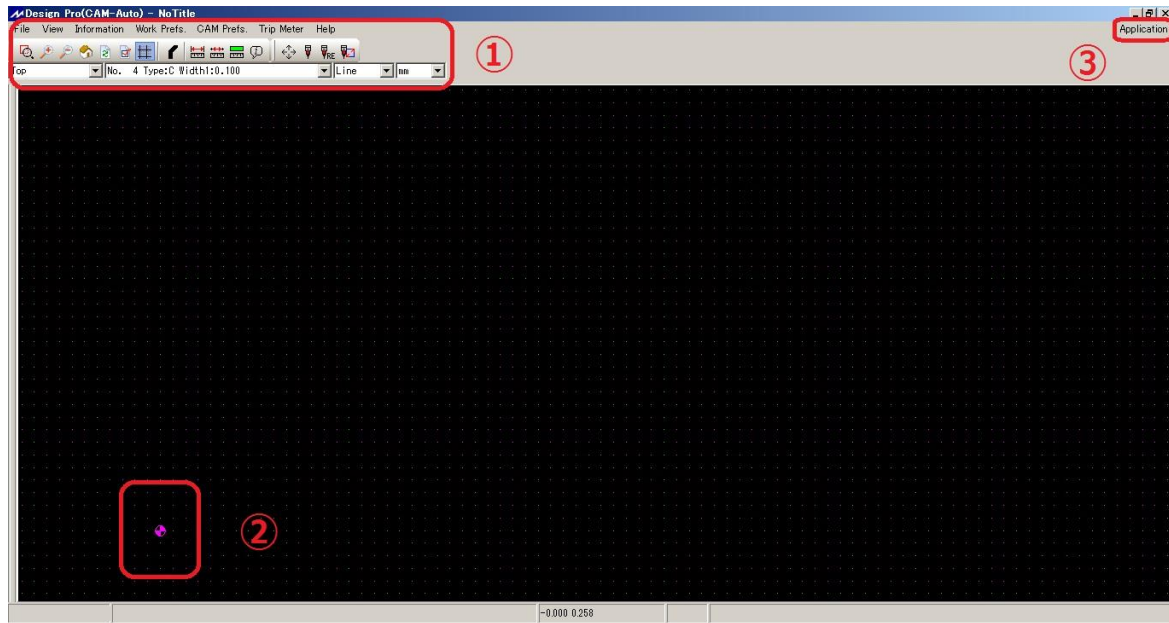
- 4 – Pressure Foot
- 5 – Depth Adjustment Screw
- 6 – USB Camera
- 7 – Tool Change Lever
- 8 – Vacuum Nozzle



- 9** – AC IN (Power Plug)
- 10** – AC OUT (Vacuum Outlet)
- 11** – Fuse Holder
- 12** – USB Port
- 13** – Dip Switch
- 14** – RS-232C Port
- 15** – Vacuum Hose Connector

• CAM-Lab Screen Basic Operation

CAM-Lab 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

• Setup Operation Check

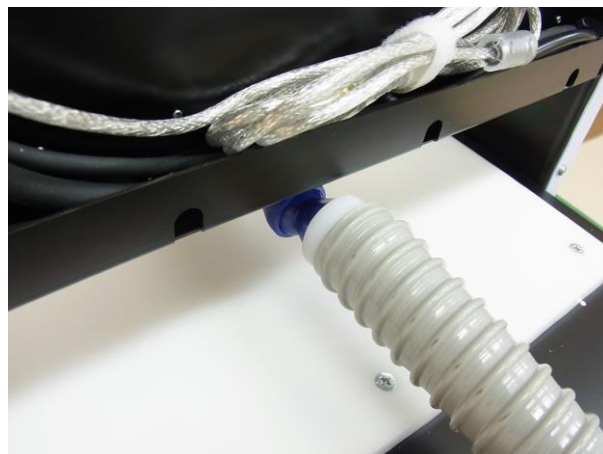
1. Connect the power cable to the AC In (Power Plug).



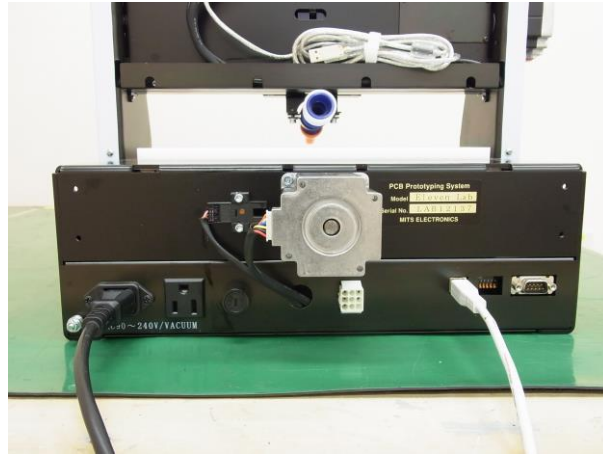
2. Attach and hold the vacuum hose by fixing the plastic vacuum holder on the backside of the machine with the screw.



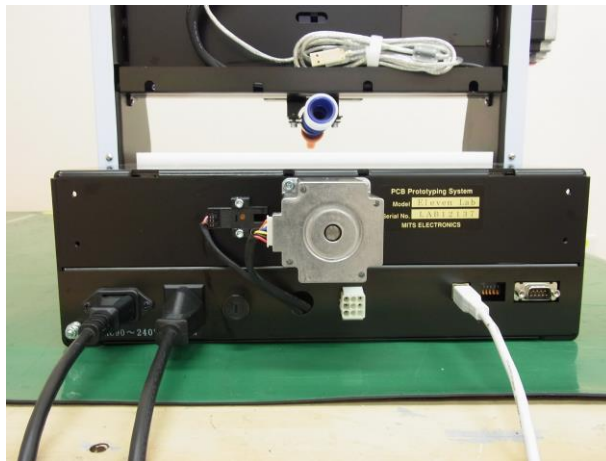
3. Attach vacuum hose into the connector.



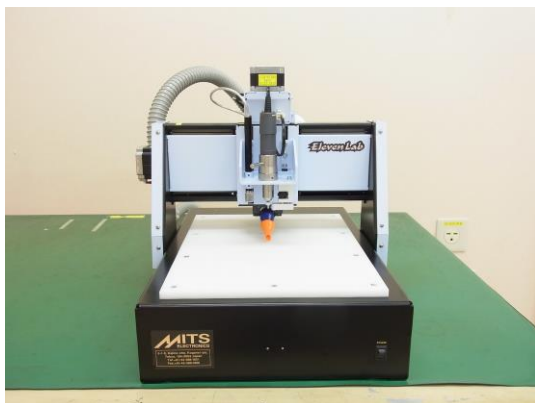
4. Connect the USB cable to the USB port.



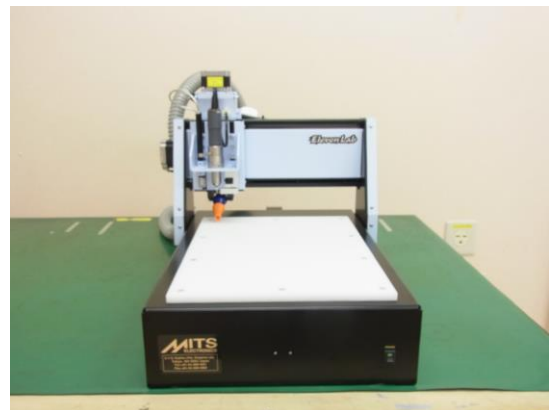
5. Connect the Vacuum Cleaner to the Prototyping Machine with power cable. Be sure to turn the Vacuum Cleaner power "On" at all time.



6. Turn the power switch "On". The spindle head will move to the back left corner.



→



Warning: Please contact us if the machine does not move to the back left corner.

I . Procedures

The below is the procedures to produce prototype PCB.

Preparation

- Open “mdemo.mit” file
- Setup underlay and PCB



Set Milling Sequence



Adjust

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



Process Top Layer

- Drill (Top)
- Mill (Top)



Adjust Bottom



Process Bottom Layer

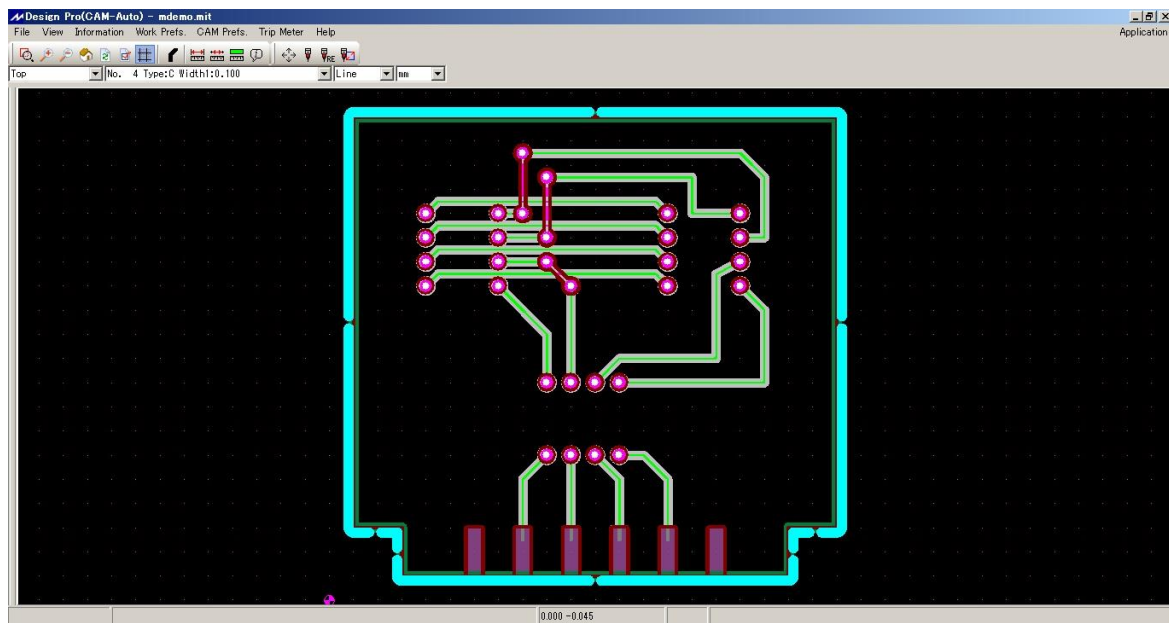
- Mill (Btm)
- Route (Btm)

II. Preparation

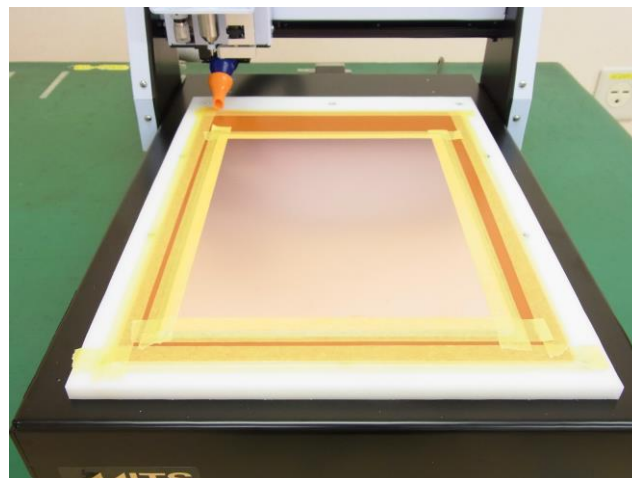
First you will begin with the below steps.

- 1 — Open mdemo.mit file (1~2)
- 2 — Set underlay and PCB on working table (3~4)

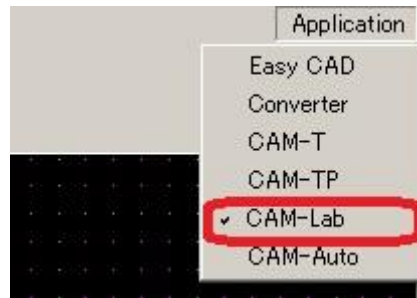
mdemo.mit file (below)



After setup (below)



1. Click on Application and select **CAM-Lab**



2. Go to **File → Open** and select mdemo.mit file. The files are saved as below for each OS.

Windows 7 :

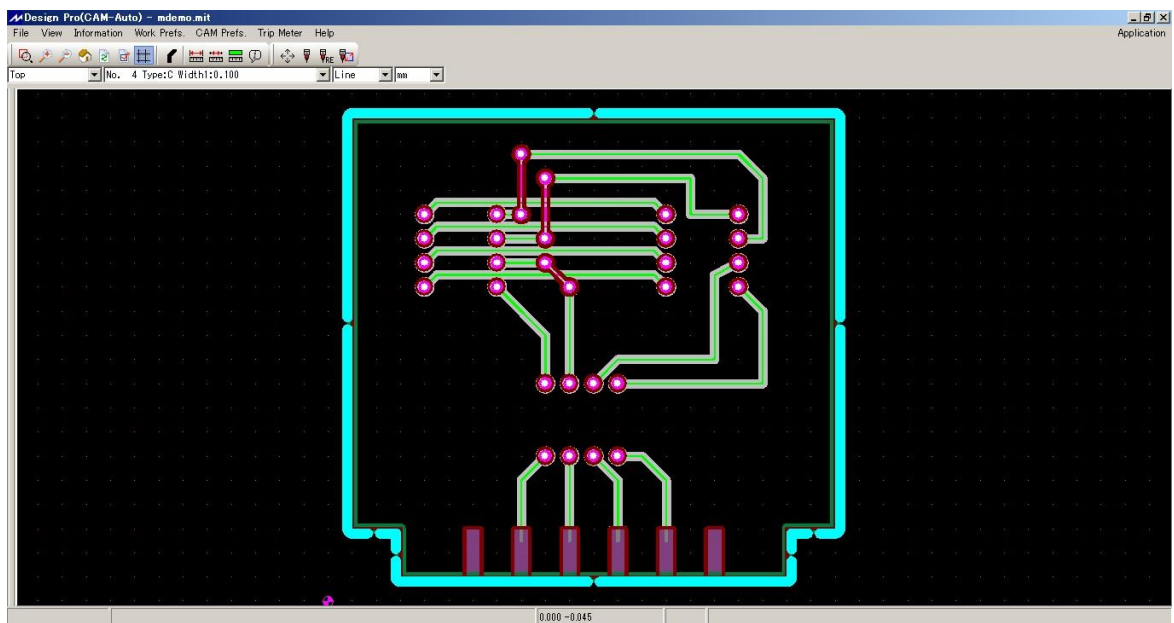
Document → Public Document → Mits Software → MT Path → Data → mdemo.mit

Windows Vista :

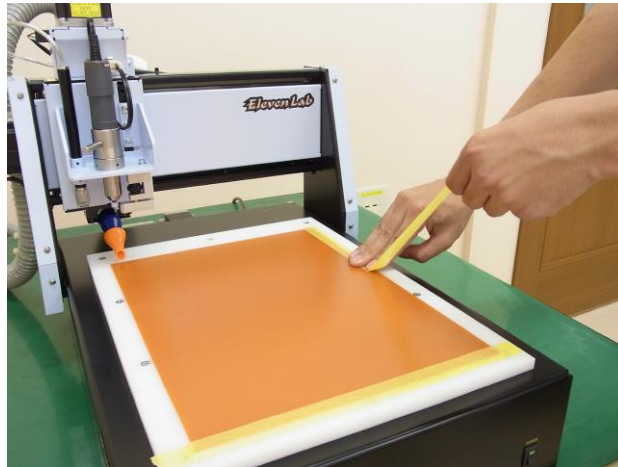
Public → Documents → Mits Software → MT Path → Data → mdemo.mit

Windows XP :

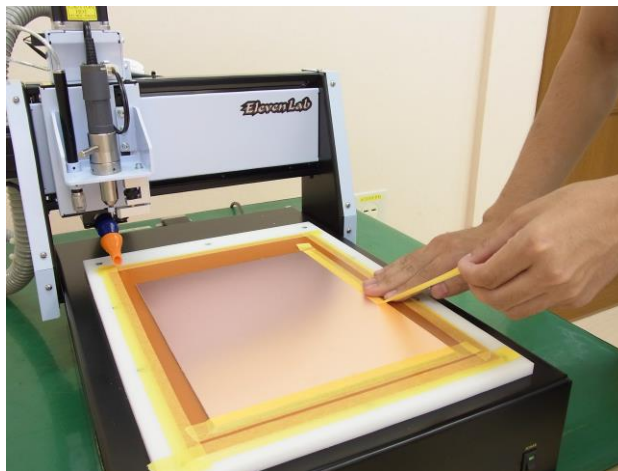
Local Disc (C:) → Documents and Settings → All Users → Shared Document → Mits Software → MT Path → Data → mdemo.mit



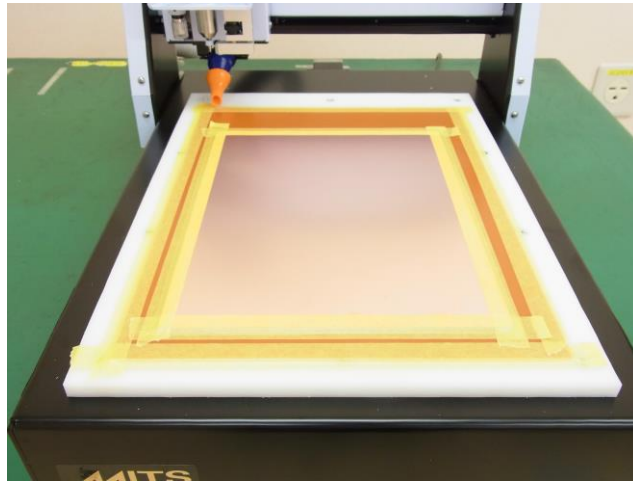
- 3.** Next you will set underlay and PCB on to the working table.
Clear the working table and place the underlay.
Use the masking tape to hold the underlay.



- 4.** Clear the underlay and place the PCB.
Use the masking tape to hold the PCB.



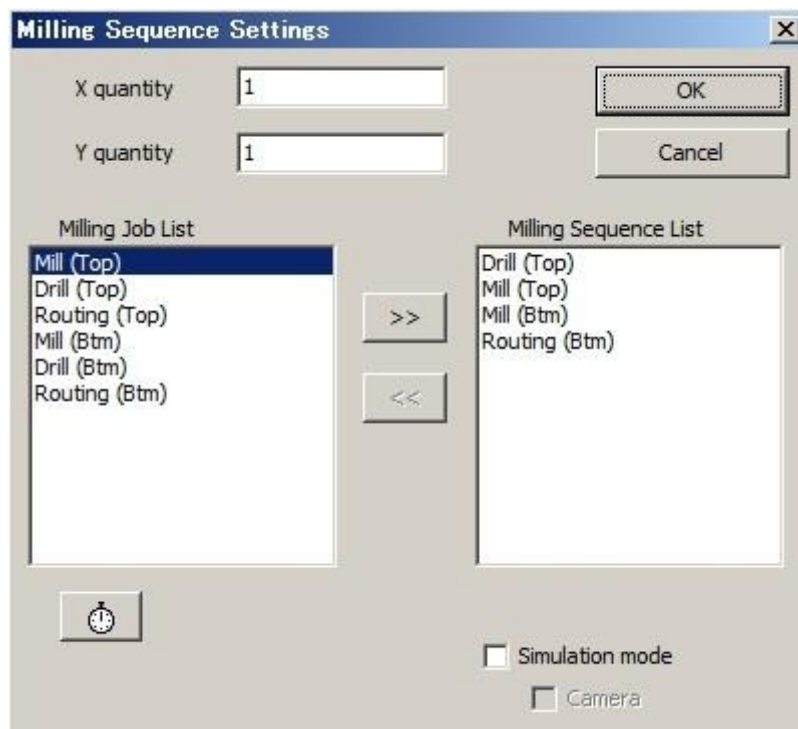
You've completed the underlay and PCB setup. Now you will proceed to Set Milling Sequences.



III. Set Milling Sequences

Now you will set Milling Sequence. The sequence is as below.

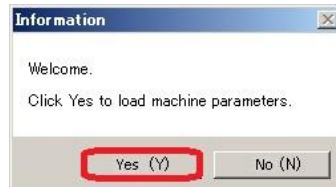
- Drill (Top)
- Mill (Top)
- Mill (Btm)
- Routing (Btm)



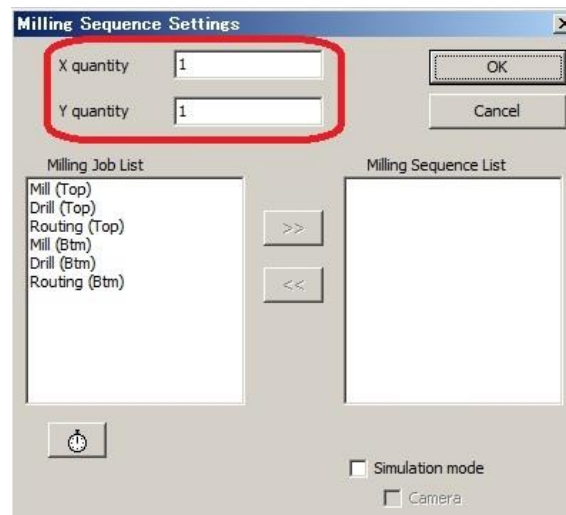
1. Click on **Start Job Icon** 



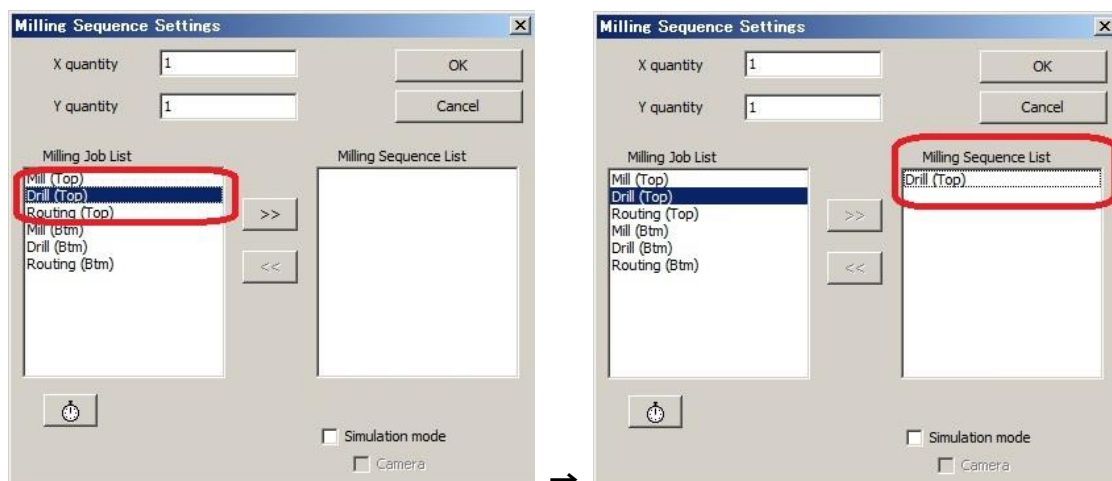
2. Window shown below will appear. Click **Yes (Y)**.



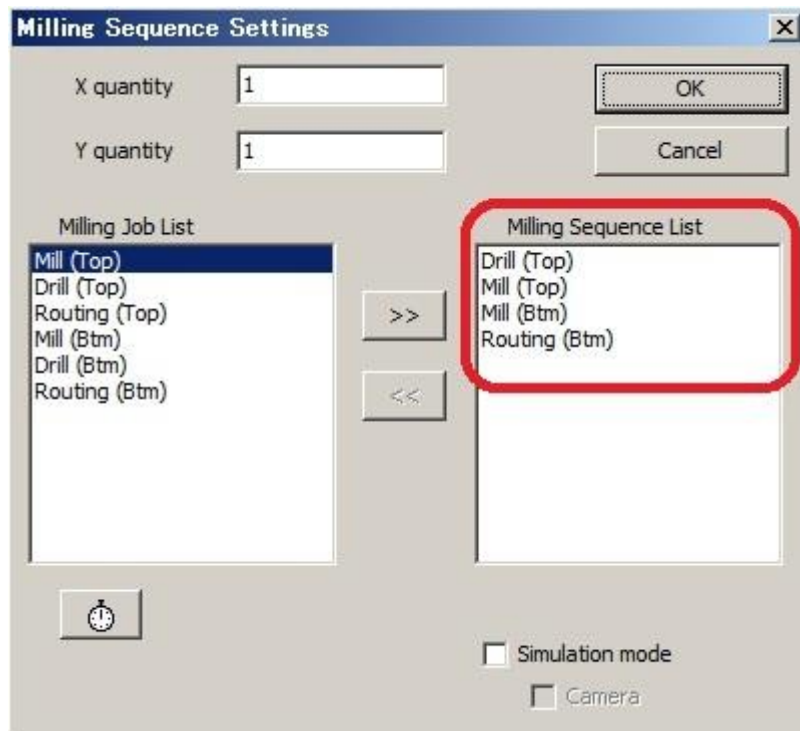
3. Milling Sequence Settings window will appear.
Check and see **X quantity** and **Y quantity** is set to 1.



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.

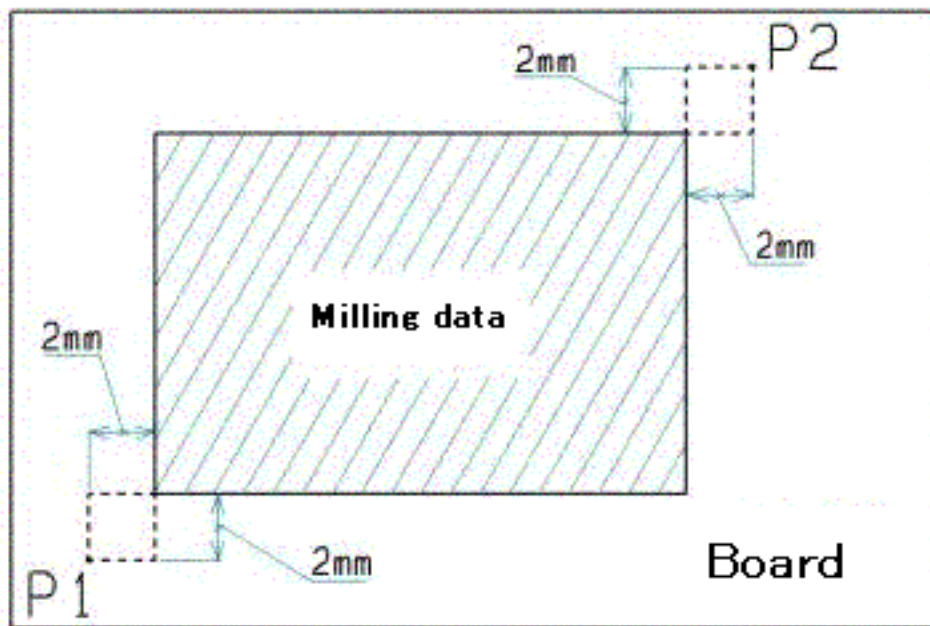
Now Milling Sequence setting is completed.

IV. Adjust

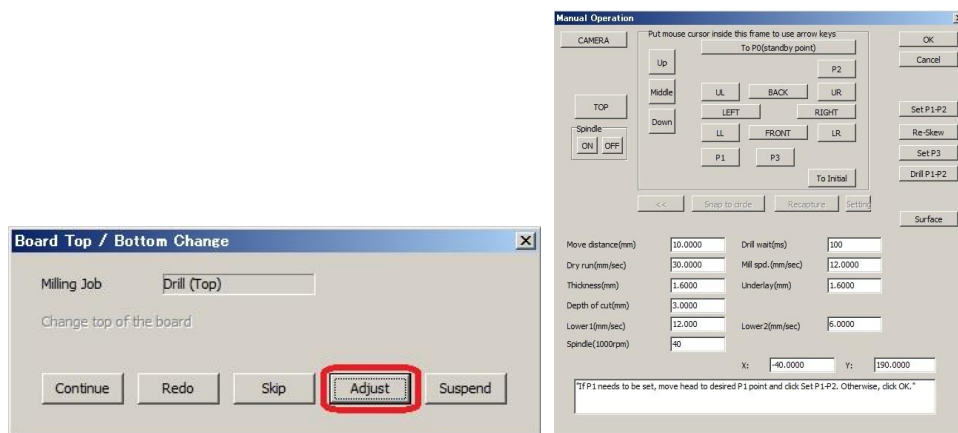
In Adjust you will do the below steps.

- 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.

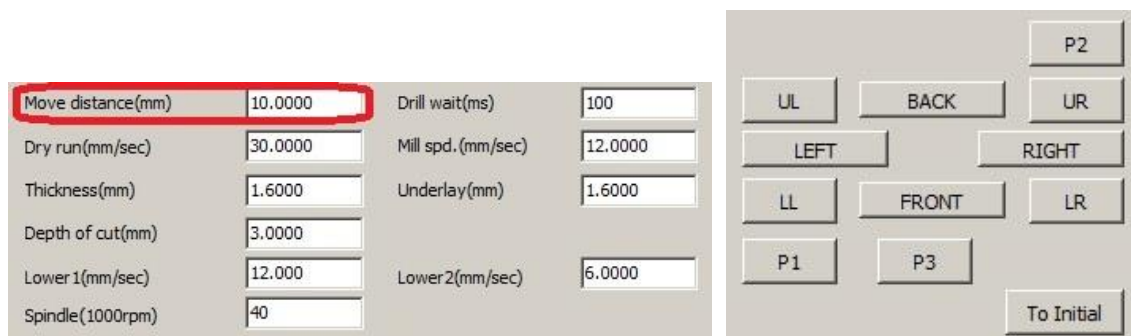


1. Board Top/Bottom Change window will appear
Click **Adjust** and Manual Operation Window will appear

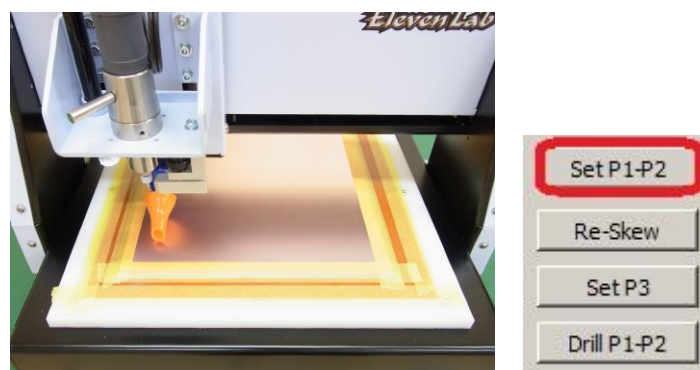


Now you will **set P1 and P2**.

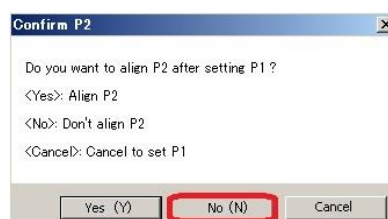
2. Move the machine to the front left corner by using the Movement Icon (**FRONT**, **BACK**, **LEFT**, **RIGHT**) and entering distance to move per click in **Move Distance**.



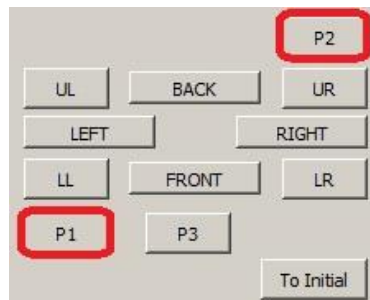
3. After moving the head to the left corner, click **Set P1-P2**.



4. Confirm P2 window will appear. Click **No (N)**.

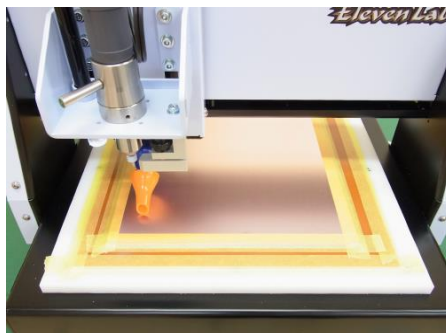


5. Click **P1** and **P2** button to check if the spindle head stays inside the PCB.

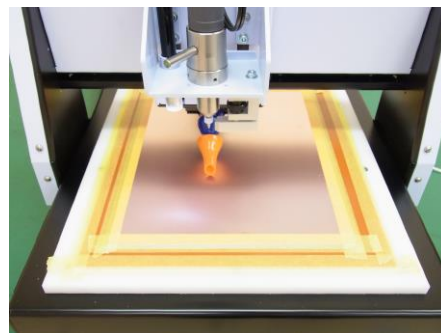


WARNING : Do not set P1 all the way at the left corner. Camera will not be able to use to read the fiducial hole when the board is flipped over.

P1

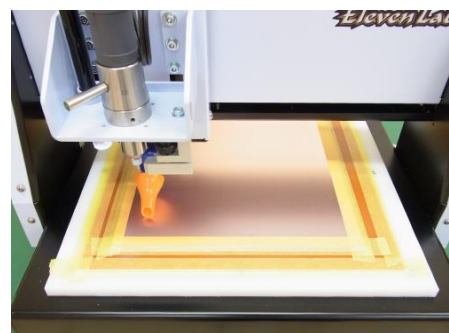
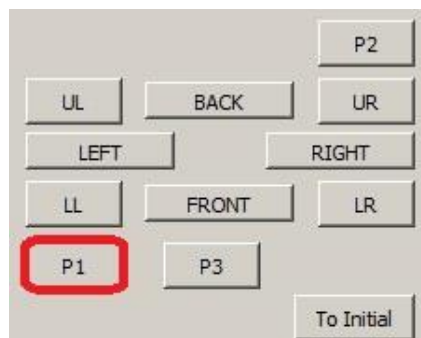


P2



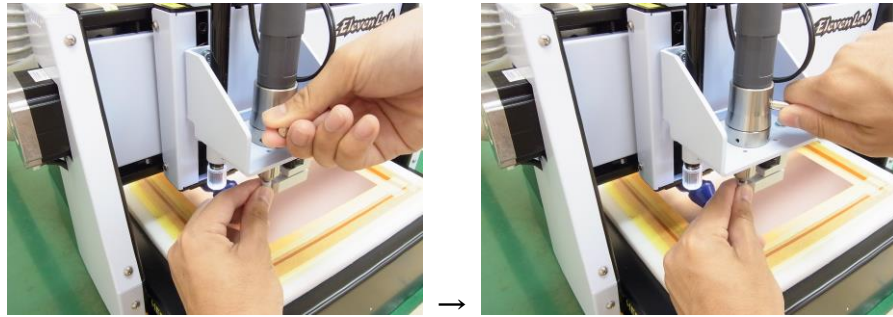
P1 P2 setting is completed. Now you will set **Camera Offset**.

6. First, click **P1** button.

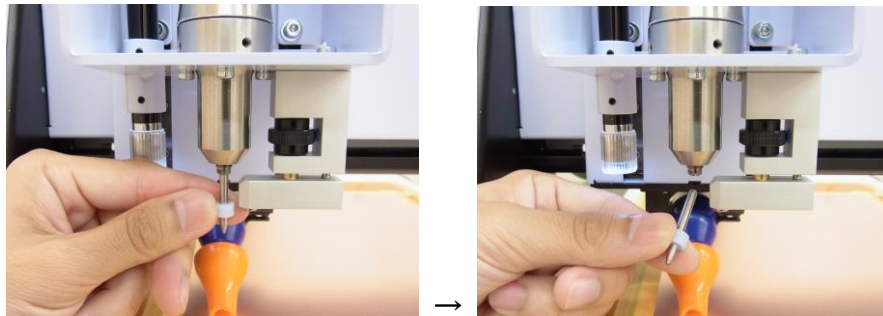


7. Now you will change tools.

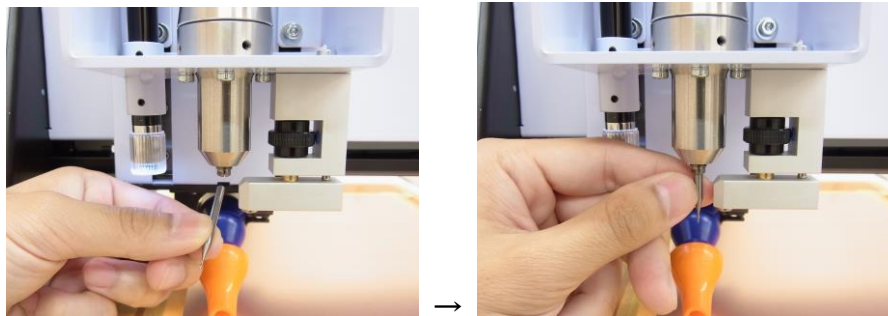
Turn the Tool Change Lever to the right and open the collet chuck.



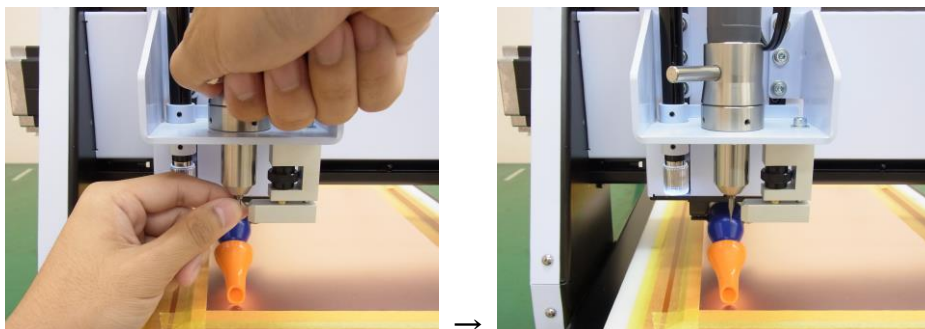
Remove the dummy tool.



Insert the Milling Bit inside the collet chuck.



Make sure to insert the Milling Bit all the way inside and turn the Tool Change Lever to the left to close the collet chuck.

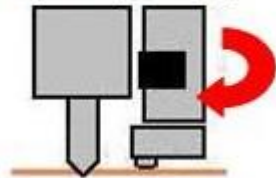


Tool Change is completed.

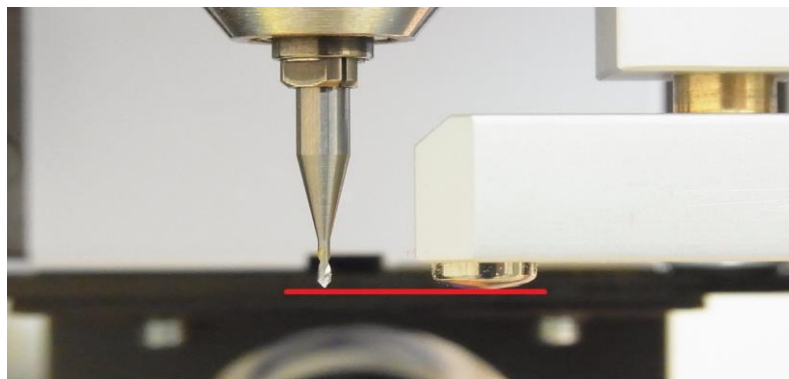
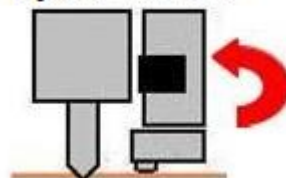
8. Use the depth adjustment to make the tip of the tool same height level as the pressure foot. The tool will move **down** when the depth adjustment is rotated **clock-wise** and **up** when rotated **counter clock-wise**.



Down/Deep

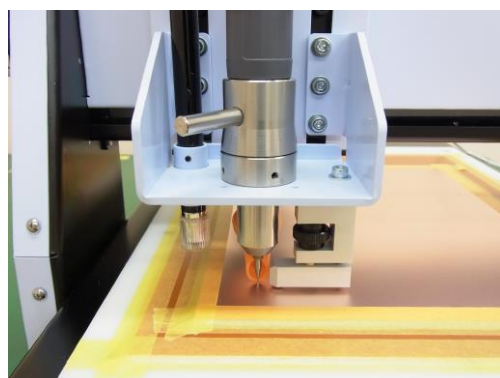
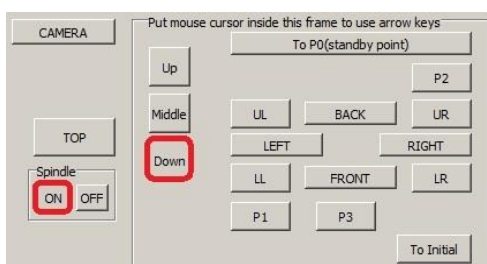


Up/Shallow

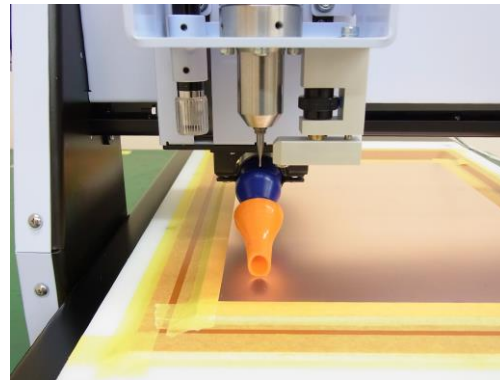
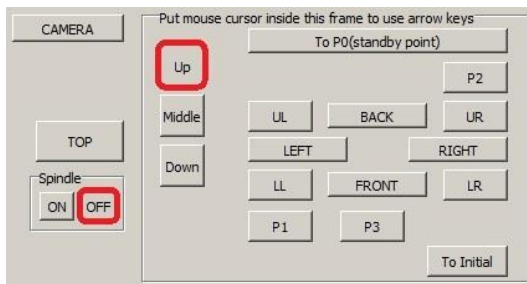


IMPORTANT : The tool will move $3\mu\text{m}$ with 1 click on depth adjustment. 1 revolution will move 0.5mm.

9. Click **ON** to turn the spindle on and click **DOWN** to move the spindle head down.

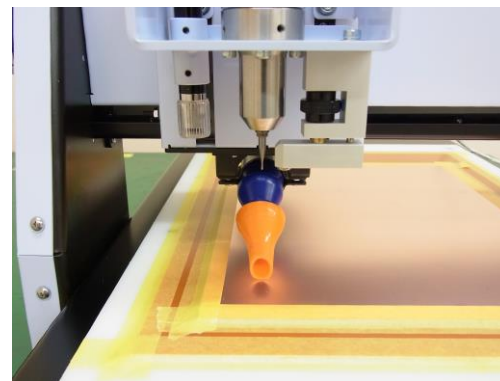
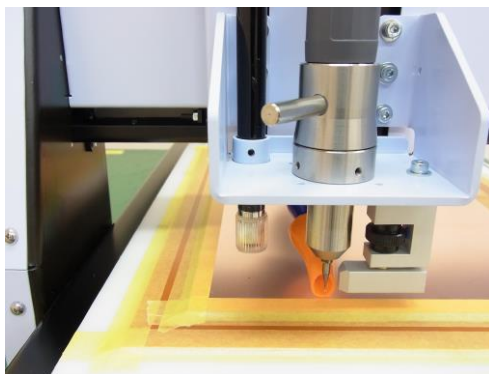
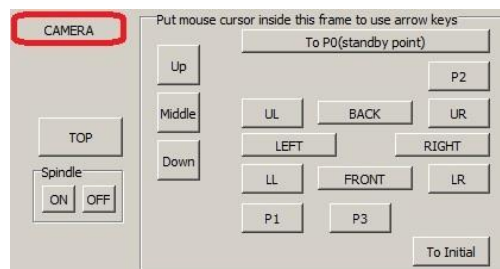


1 0. Click **UP** to move the spindle head back up and **OFF** to turn the spindle off.



1 1. Now you will check if the surface of the board has been milled. Repeat **8~10** until the board is milled.

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



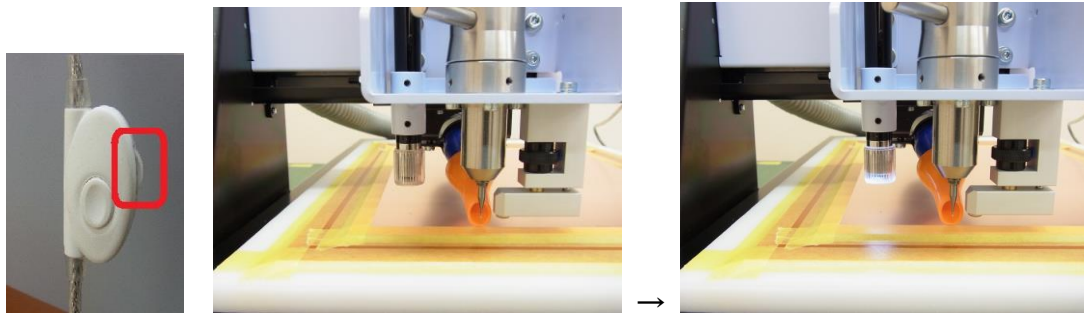
1 3. Launch **Design View**.



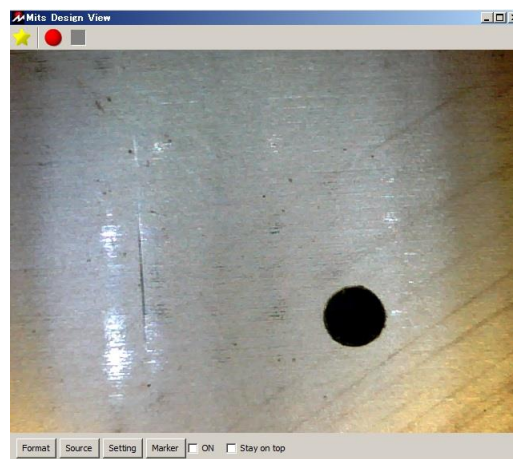
If the Design View does not display image from the USB camera, click **Source** and select appropriate camera.



1 4. Use the switch on the camera USB cable to adjust the light.



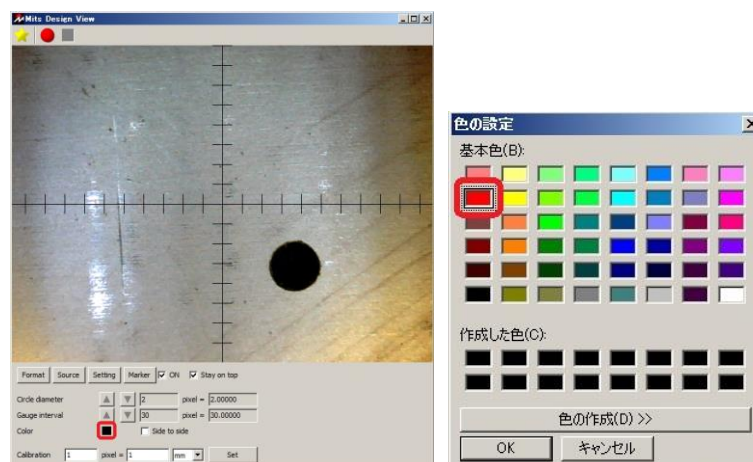
1 5. Next you will set the camera.



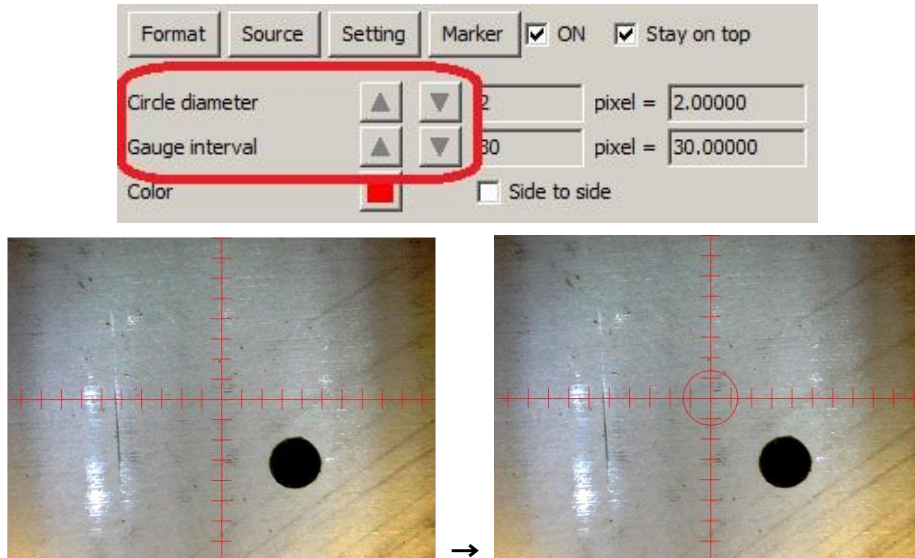
Click **Marker** button and click on the **checkbox** for **ON** and **Stay on top**.



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 **Red** and click OK.



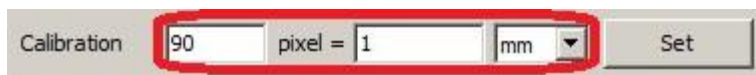
Circle diameter and **Gauge interval** will be used to align the center to P1.



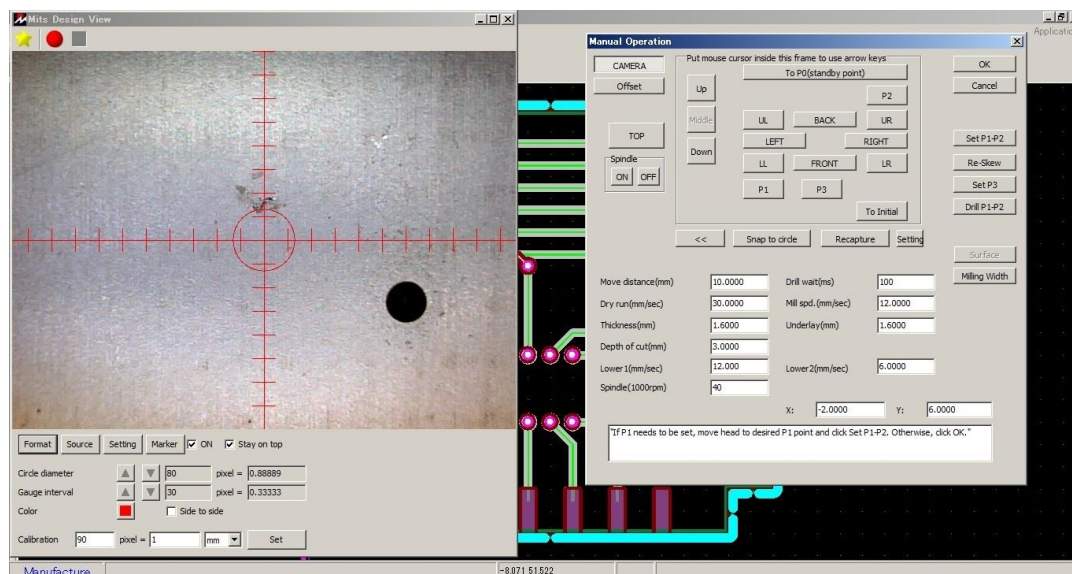
Click on **Format** and select **640 x 480 x 16b** and click OK.



For calibration, set as **90 pixel = 1 mm** and click Set.

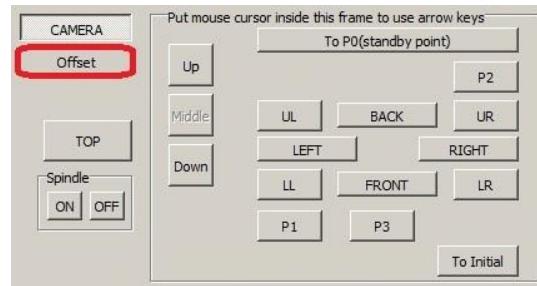


Design View will stay on top of other application. Move the Design Pro Manual Operation window as below.

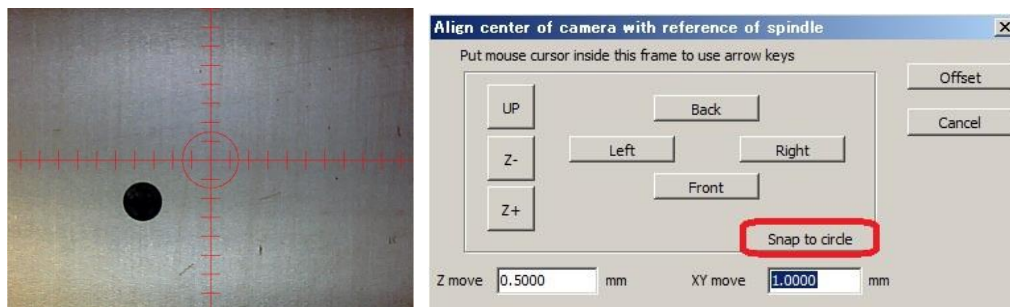


Camera setting is now completed.

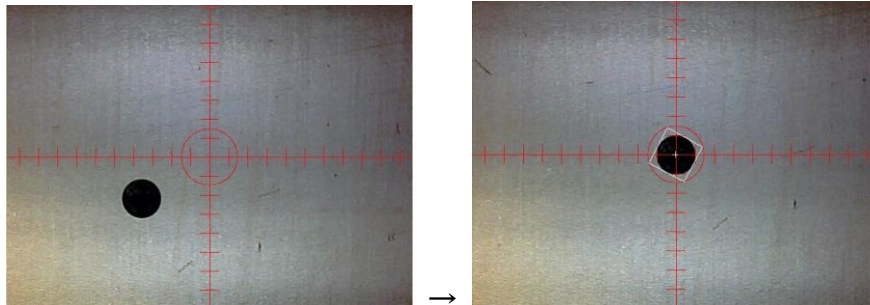
1 6. Click Offset



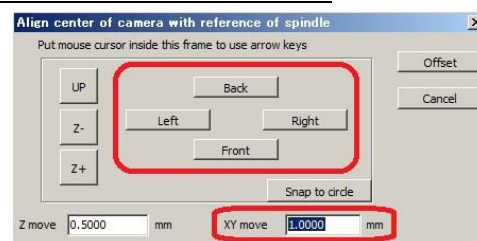
1 7. Camera Offset Window will appear. Check if the milled circle is on Design View screen. Click **Snap to circle.**



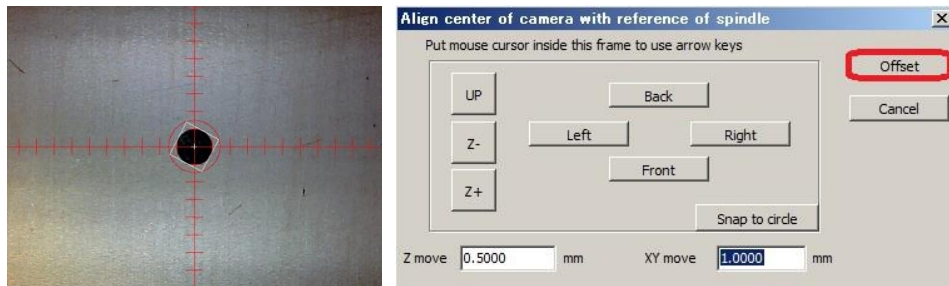
The machine will automatically move and align to the center of the circle. Click **OK**.



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

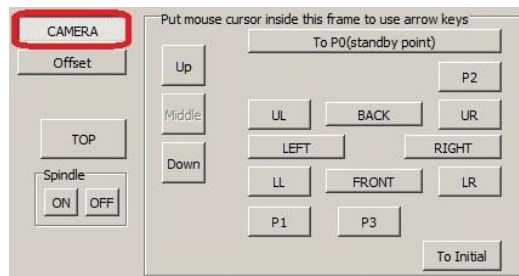


- 1 8.** Check if the center of the camera is aligned to the milled circle and click **Offset**.



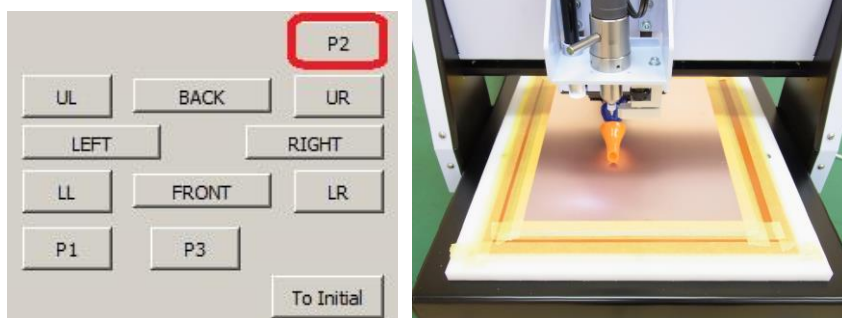
If the center of the camera is not aligned to the milled circle, enter distance to move in XY move and use Circle diameter on Design Viewon Design View to align.

- 1 9.** Click **CAMERA** button and end camera mode.

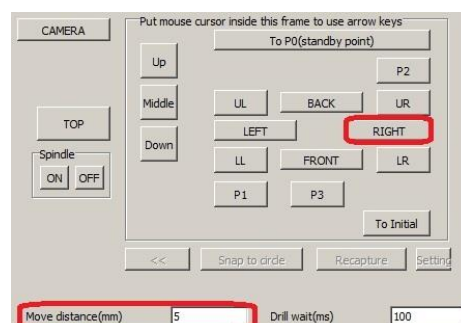


Camera offset is not completed. Now you will **set milling width**.

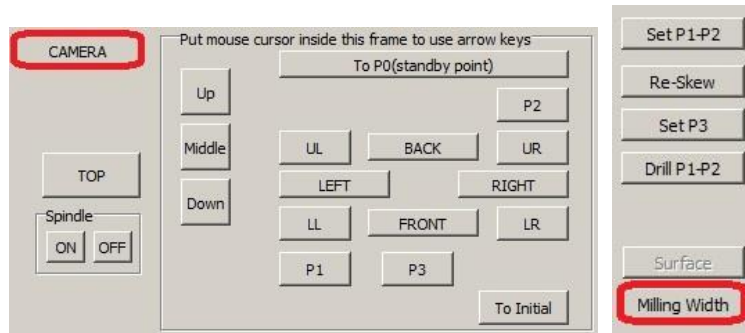
- 2 0.** Click **P2**.



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



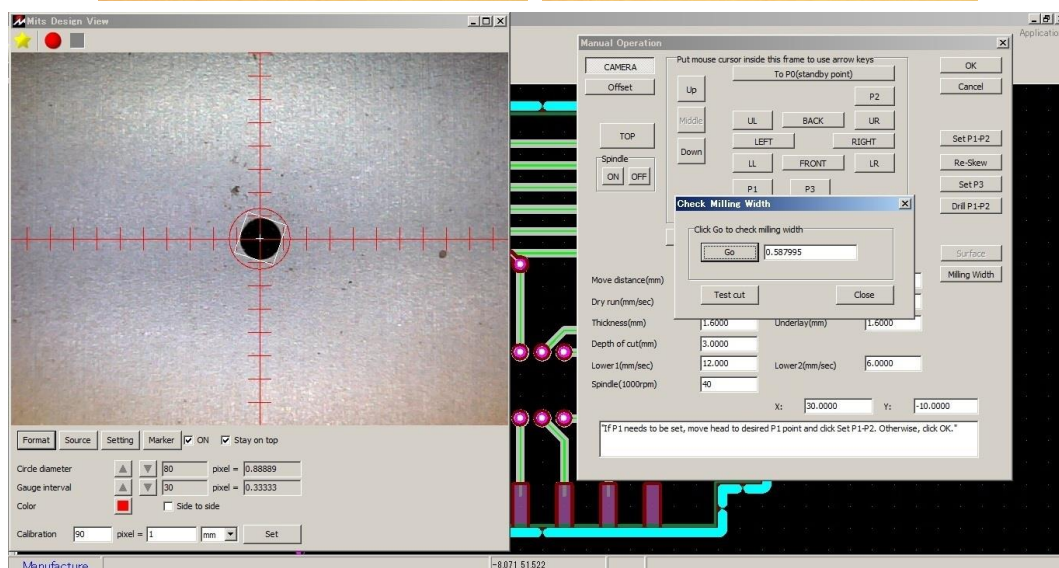
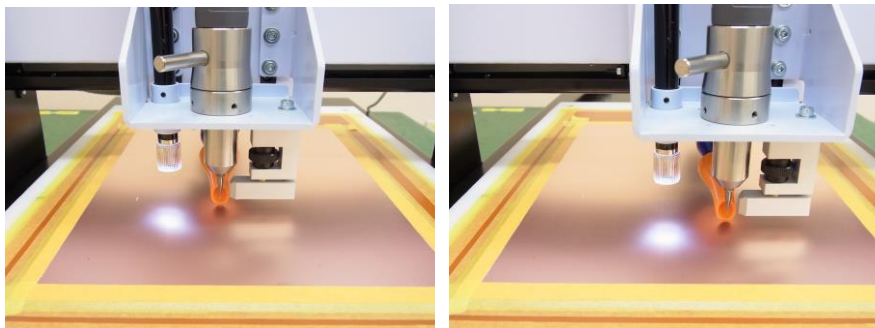
2 2. Click **CAMERA** button and click **Milling Width**.



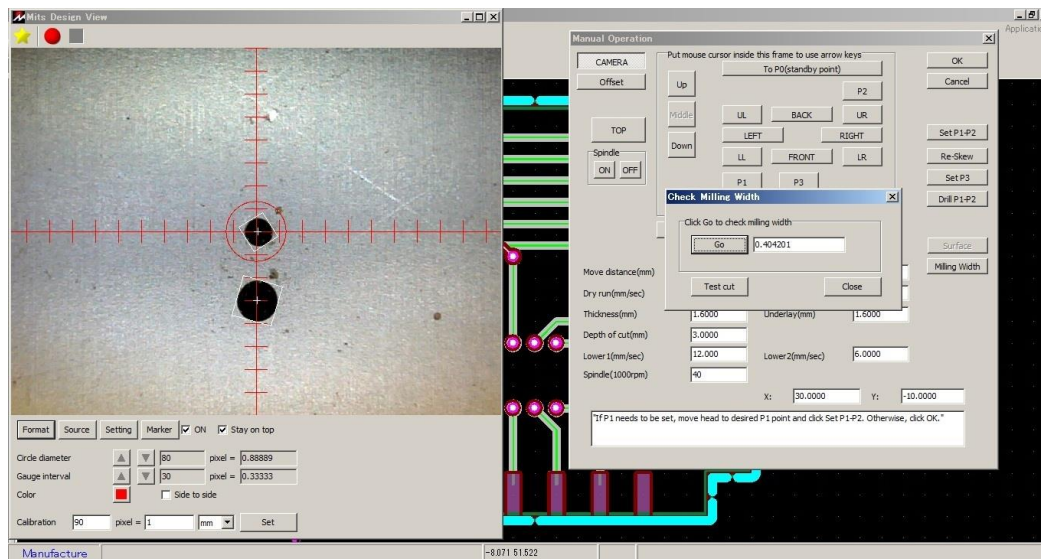
2 3. Check Milling Width window will appear. Click **Go**.



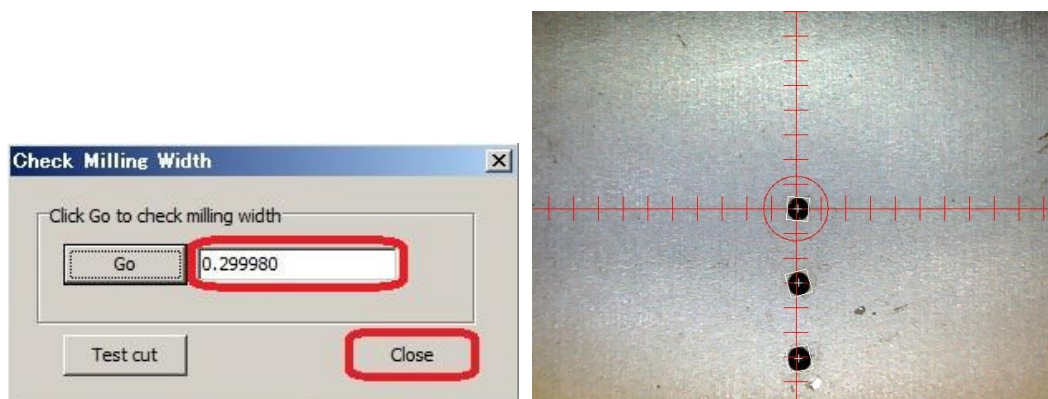
2 4. The machine will automatically mill and measure the milling width. The result will be shown. Use the depth adjustment screw to set it to 0.3mm. Rotate the depth adjustment screw clock wise to widen the milling width and counter clockwise to thin it.



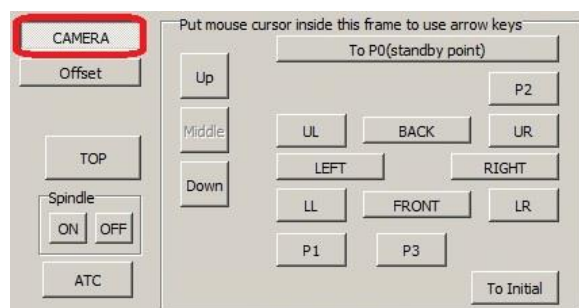
- 2 5.** After depth adjustment screw is set, click **Go** again. The machine will automatically move 1mm back and mill.



- 2 6.** Repeat **23~25** until the result becomes 0.3mm. After it becomes 0.3mm, click **Close**.

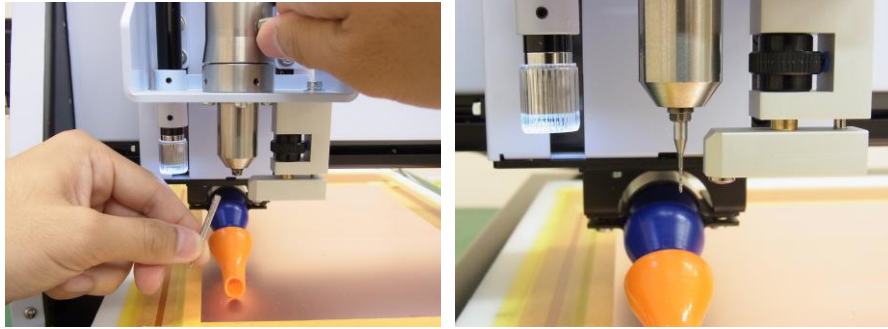


- 2 7.** Click **CAMERA** and end camera mode.

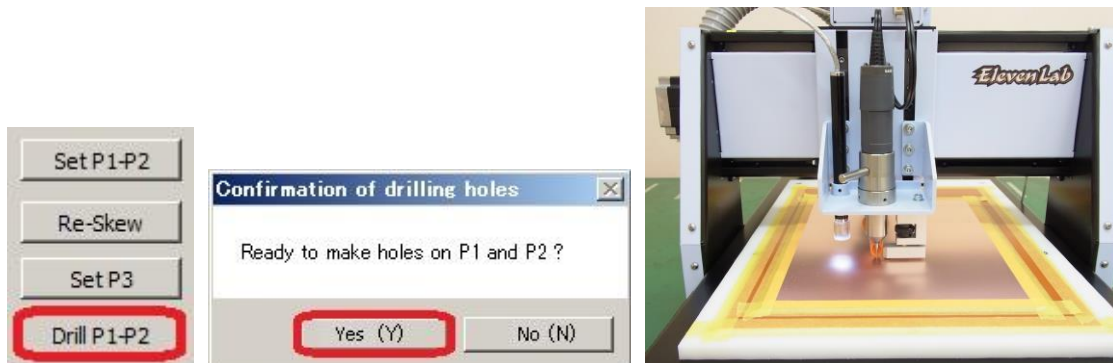


Milling width setting is now completed. Next you will **drill fiducial hole**.

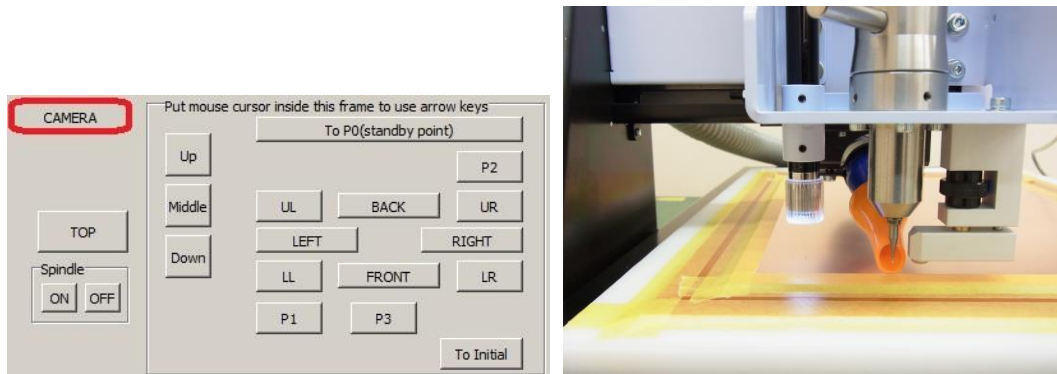
28. Turn the Tool Change Lever and change the tool to 0.8mm drill.



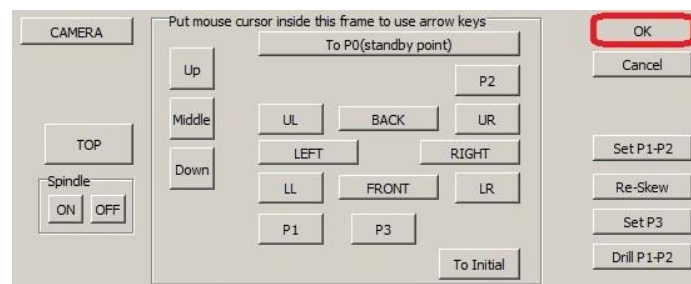
29. Click **Drill P1-P2**. Confirmation of drilling holes window will appear. Click **Yes (Y)**. The machine will automatically move to P1P2 and drill holes.



30. Click **CAMERA** button to double-check the offset. If the P1 and the center of the Design view is not aligned, repeat **16~18**.



31. Click **OK** on the Manual Operation window.



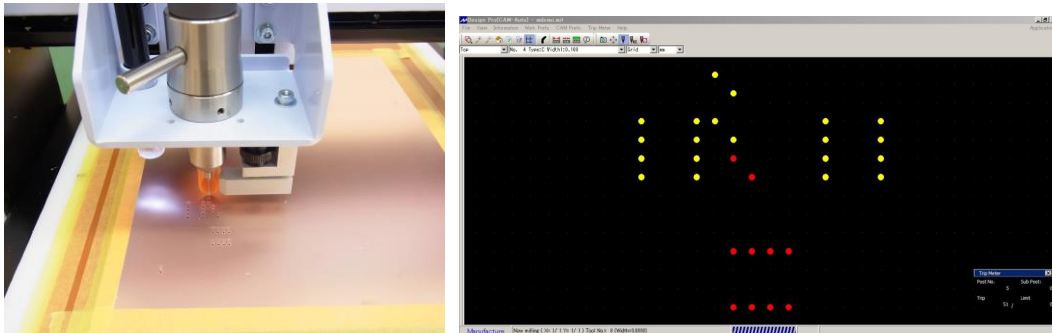
Adjust is now completed. You will now move on to Process Top Layer.

VI. Process Top Layer

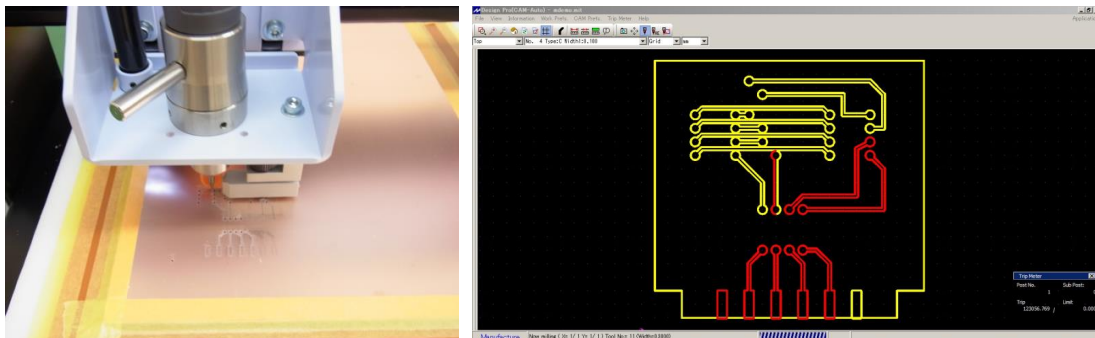
Next you will process Top layer of the PCB.

- 1 – Drill (Top) (1~3)
- 2 – Mill (Top) (4~5)

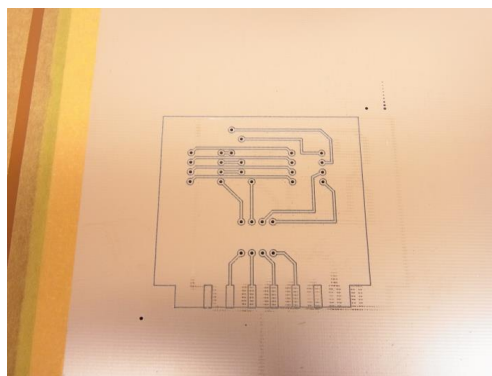
Drill Top (Below)



Mill Top (Below)



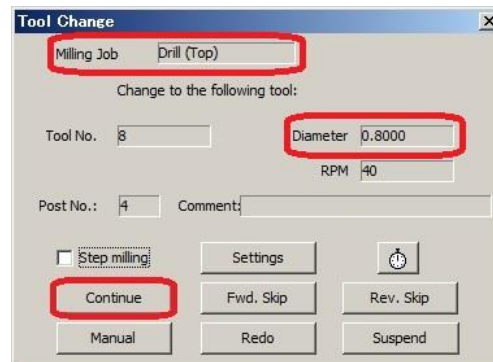
Top Layer Completed (Below)



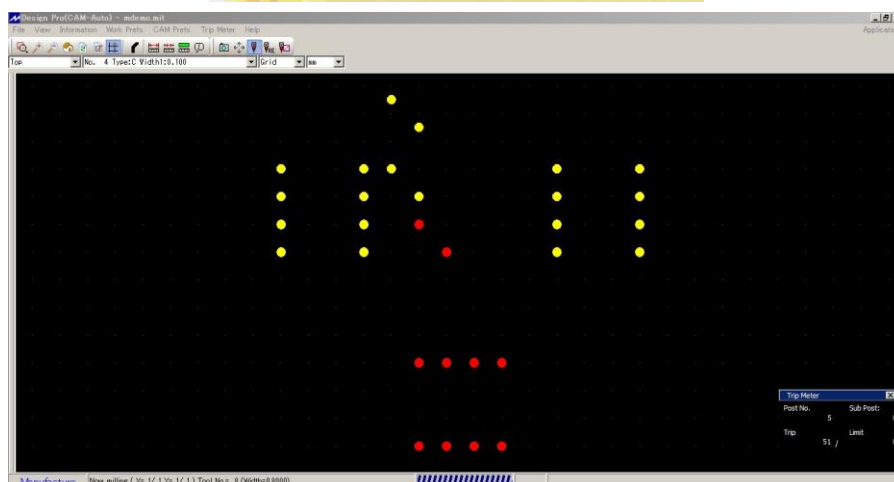
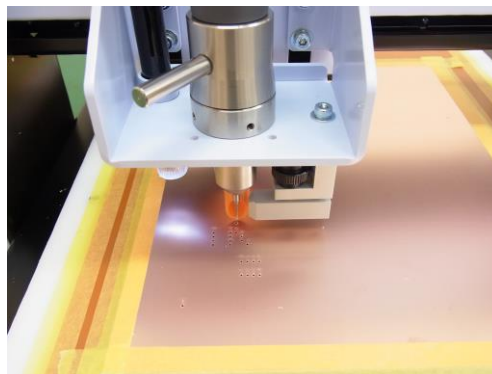
1. Check to see if the Milling Job is set as **Drill (Top)** and click **Continue**.



2. Tool Change Window will appear. Check to see if the Milling Job is **Drill (Top)** and the diameter is **0.8000**. Click **Continue**.



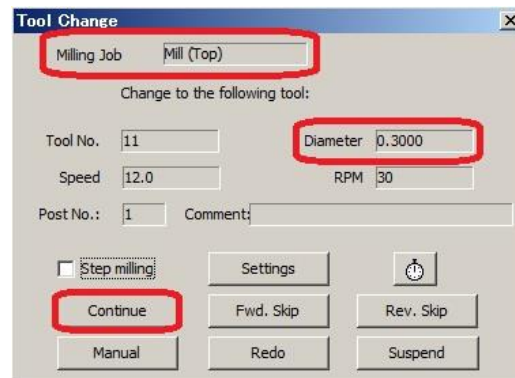
3. Drilling will begin. Data which will be drilled will show in yellow and data drilled will show in red.



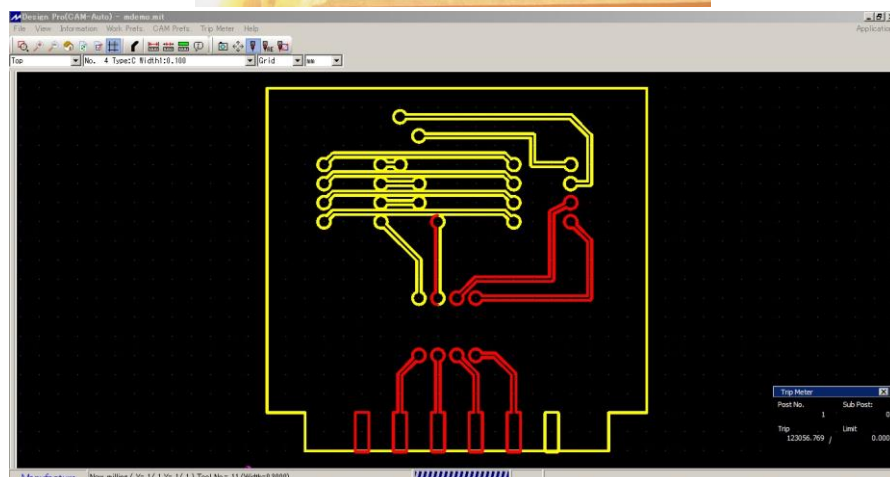
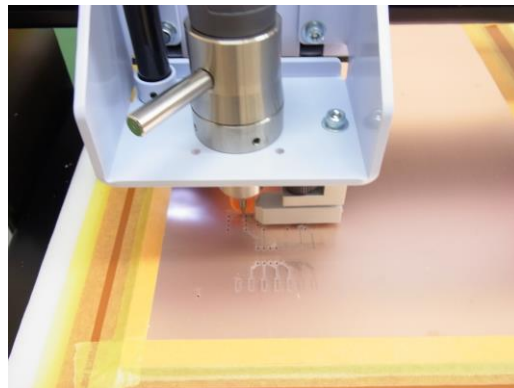
- 4.** After drilling is finished, Board Top/Bottom Change window will appear. Check to see if the Milling Job is set as **Mill (Top)** and click **Continue**.



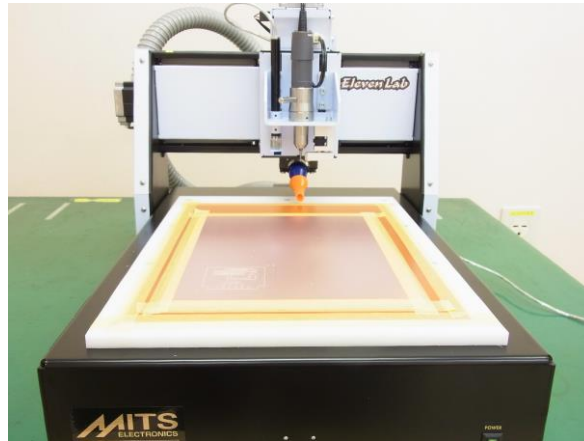
- 5.** Tool Change Window will appear. Change the tool to **90° Milling Bit**. Check to see if the Milling Job is **Mill (Top)** and the diameter is **0.3000**. Click **Continue**.



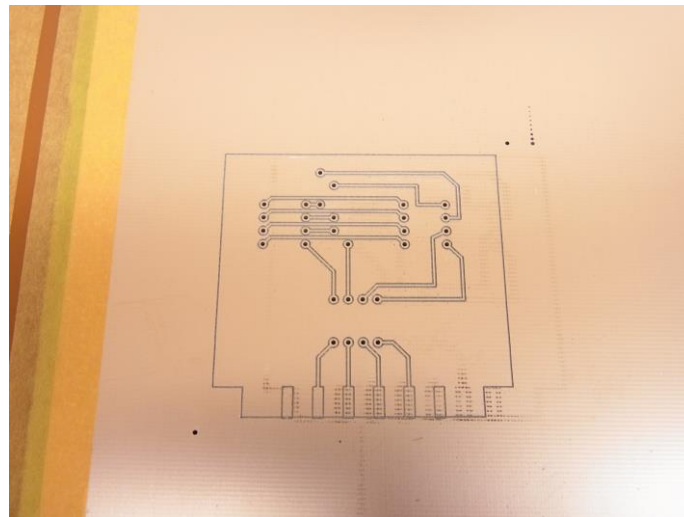
- 6.** Milling will begin. Data which will be milled will show in yellow and data milled will show in red.



7. After milling, the spindle head will move backwards.



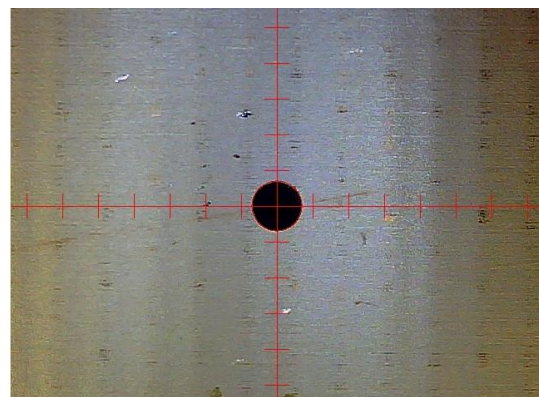
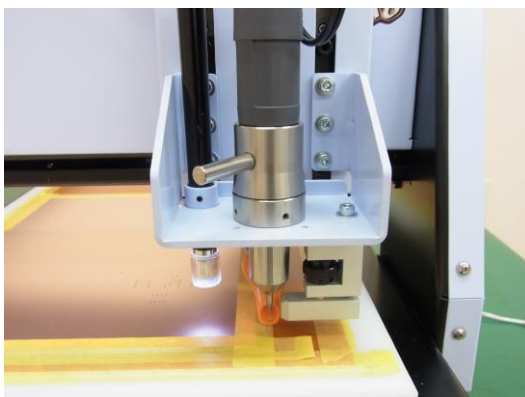
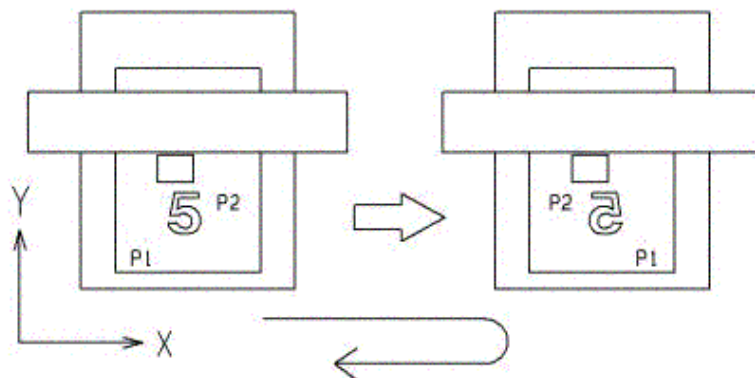
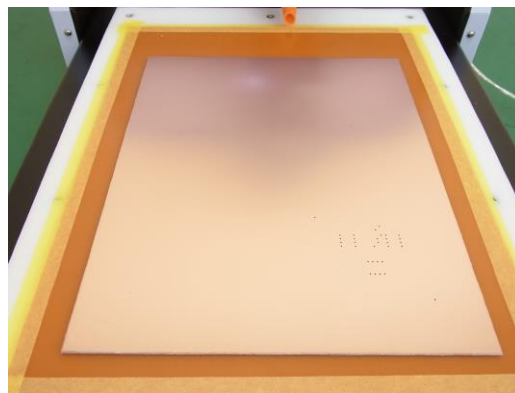
Top layer prototype is now completed. Next you will flip the board over and align the fiducial points (P1 P2 points).



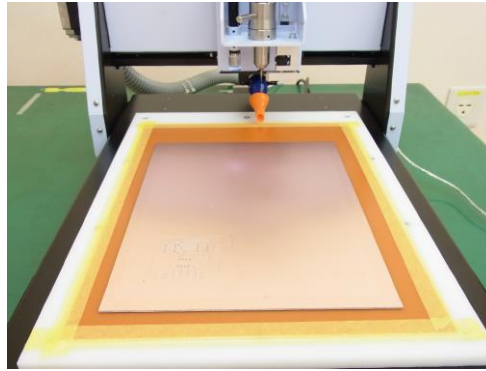
VII. Adjust/Align Bottom Layer

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

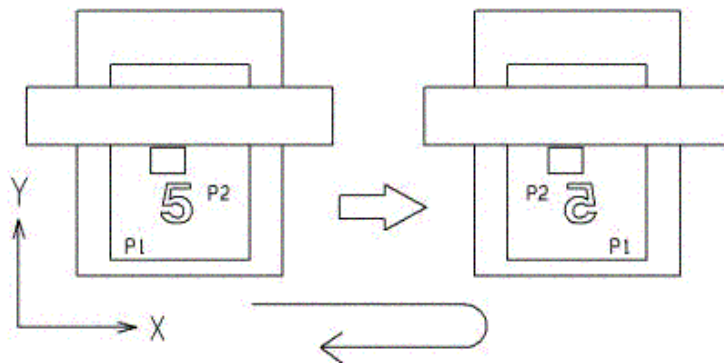
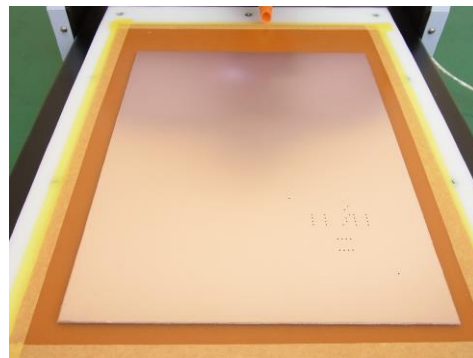
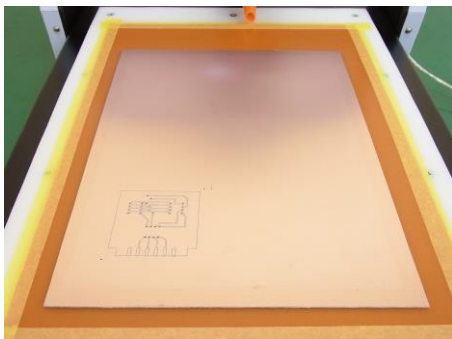
- 1 – Flip the board over (1~3)
- 2 – P1 P2 Adjust/Align (Bottom) (4~11)



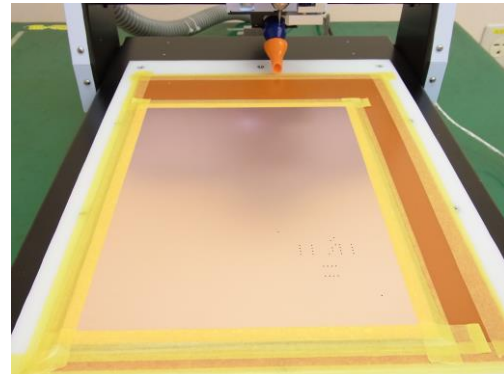
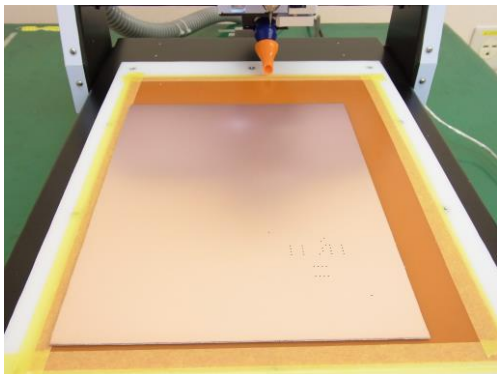
1. Remove the tape on the PCB. Do not throw it away, it will be reused.



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



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

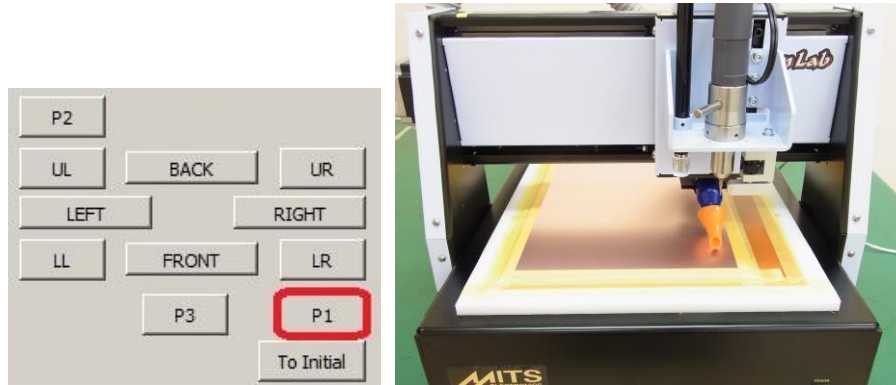



Next you will adjust/align P1 P2.

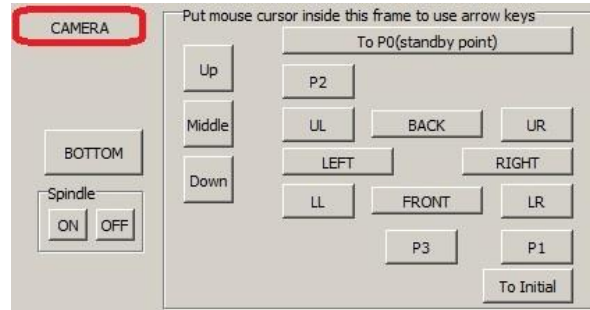
4. On Design Pro, Board Top / Bottom Change window is shown. Click **Adjust**.



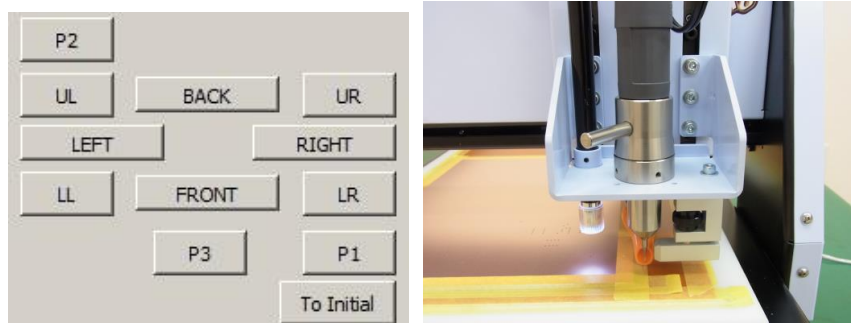
5. Manual Operation window will show up. Click on P1.



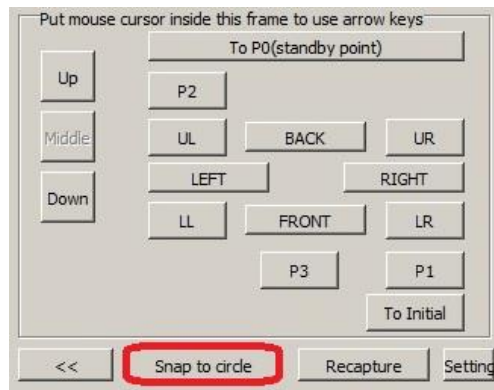
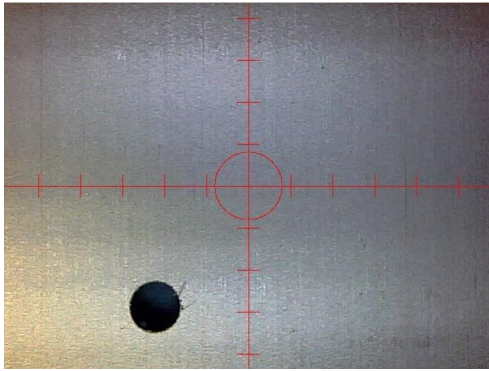
6. Open Design View  and click **CAMERA** button in Manual Operation window.



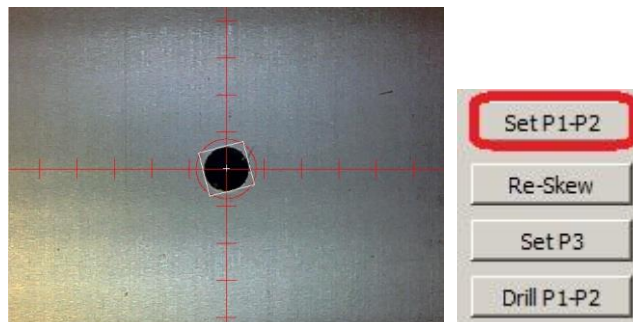
7. Use the movement button (FRONT, BACK, RIGHT, LEFT) to find the P1 hole on the Design View screen.



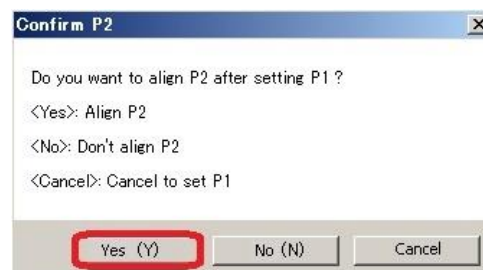
8. After confirming the P1 hole in the Design View window, click **Snap to circle**.



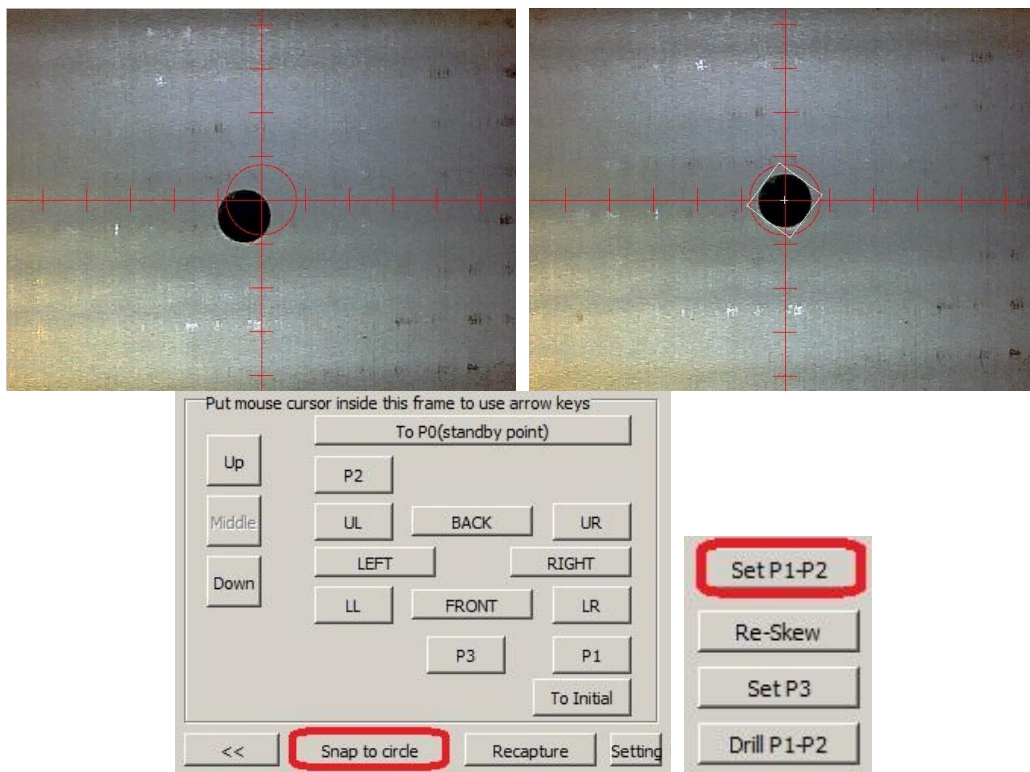
9. The machine will automatically move and align to the center of the circle. Click **OK**. Check if the center of the P1 and camera is aligned and click **Set P1-P2**.



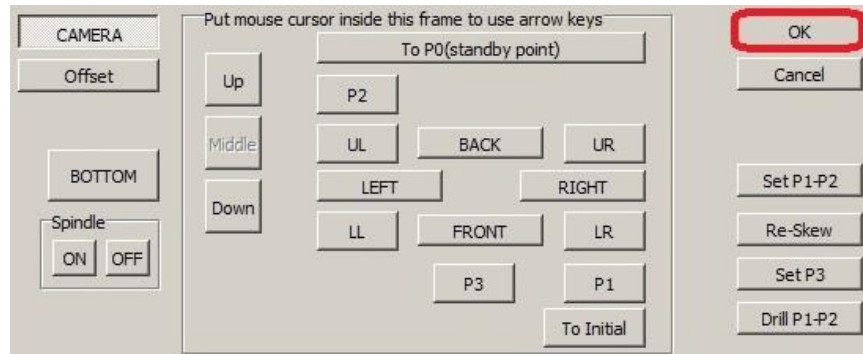
10. Confirm P2 window will appear. Click **Yes (Y)**.



- 1 1.** 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**.



- 1 2.** Click **OK** on the Manual Operation window.



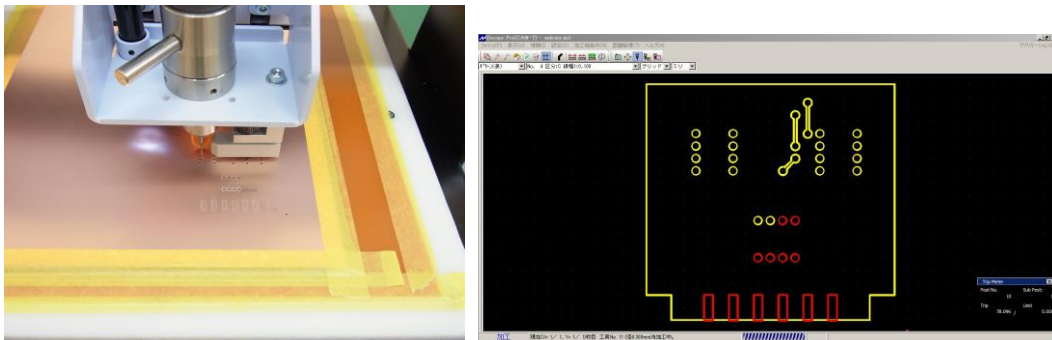
Bottom layer adjust/align is completed.

VIII. Process Bottom Layer

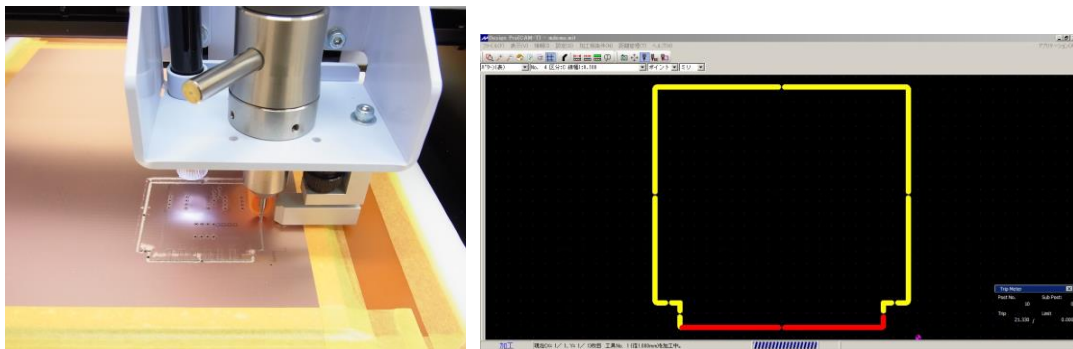
Lastly, it is the prototyping of the bottom layer.

- 1 – Mill (Btm) (1~3)
- 2 – Routing (Btm) (4~6)

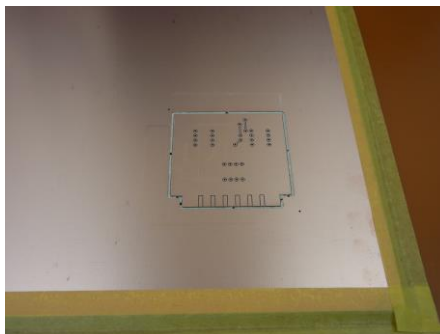
Milling Bottom (Below)



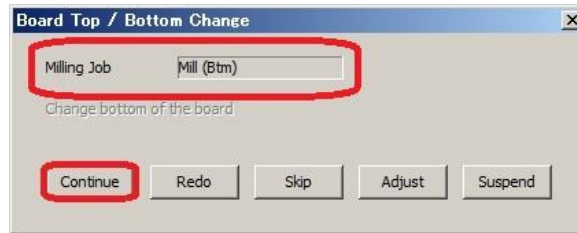
Routing Bottom (Below)



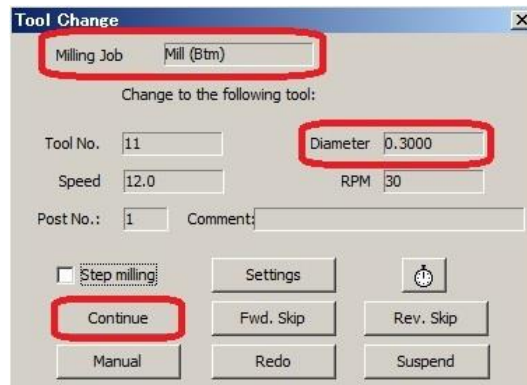
Bottom Layer Completed (Below)



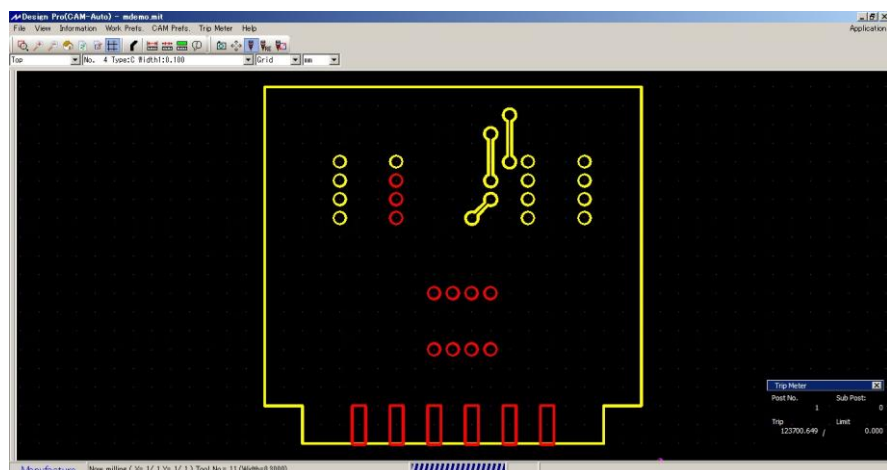
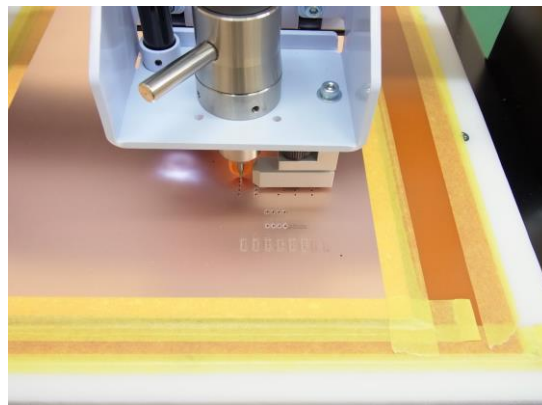
1. Check to see if the Milling Job is set as **Mill (Btm)** and click **Continue**.



2. Tool Change Window will appear. Check to see if the Milling Job is **Drill (Top)** and the diameter is **0.8000**. Click **Continue**.



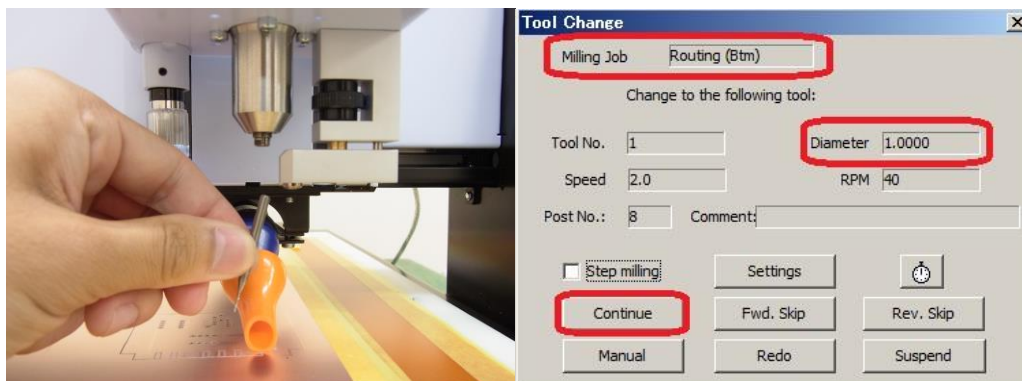
3. Milling will begin. Data which will be milled will show in yellow and data milled will show in red.



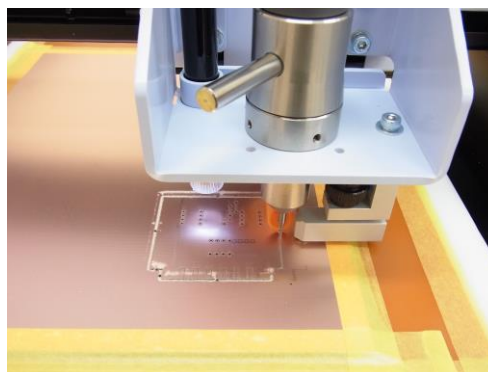
4. After drilling is finished, Board Top/Bottom Change window will appear. Check to see if the Milling Job is set as **Routing (Btm)** and click **Continue**.

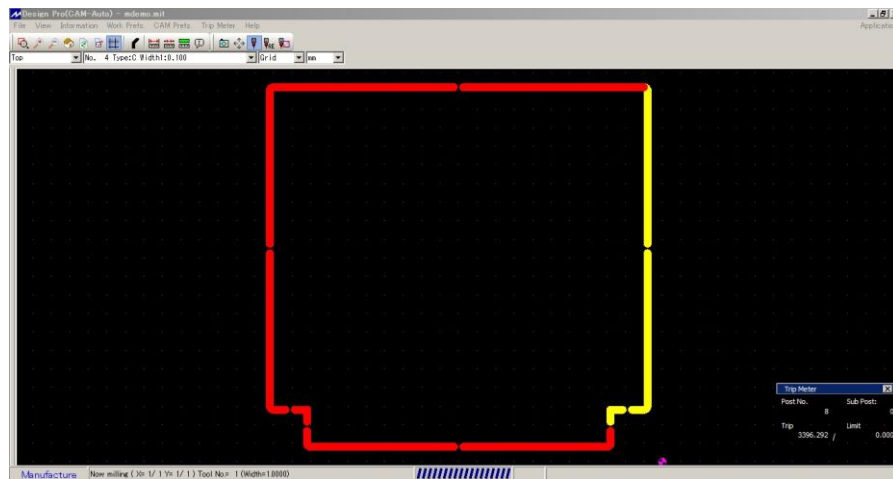


5. Tool Change Window will appear. Change the tool to **Router Bit 1.0mm**. Check to see if the Milling Job is **Routing (Btm)** and the diameter is **1.0000**. Click **Continue**.

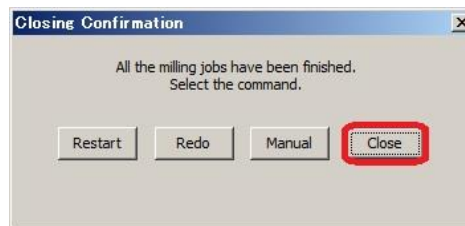


6. Routing will begin. Data which will be routed will show in yellow and data milled will show in red.



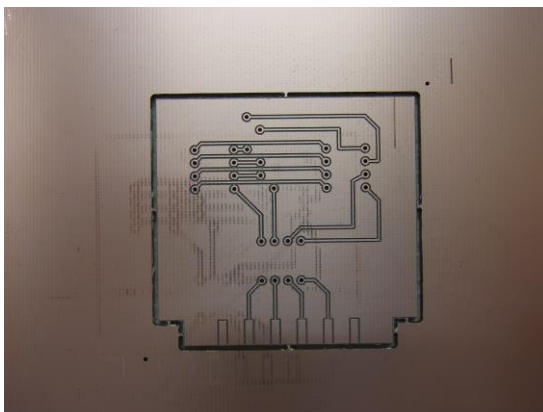


7. Closing Confirmation window will appear. Click **Close**.

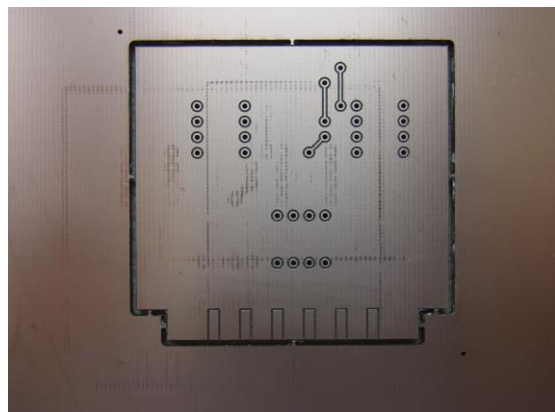


Prototyping is completed.

Top Layer



Bottom Layer



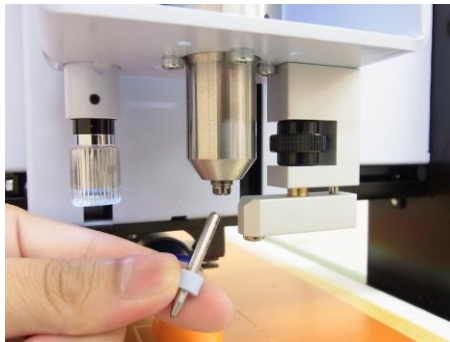
IX. After Completed

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.

Change from Router Bit to Dummy Tool.




WARNING: Make sure to change back to Dummy Tool. The spindle motor needs to hold on to a tool at all time to maintain the retentive power.

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

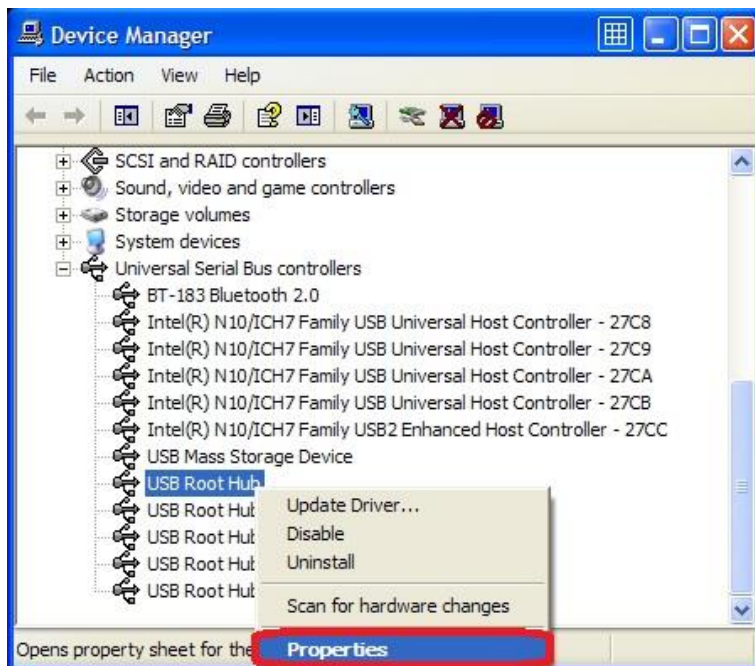
- Go to **CAM Prefs. → Board Maker** and select the port/cable you are using on **RS232C port**.
- After selecting to the port, close Design Pro. The changes will be applied after the software is closed.

3. 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

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)