PCB Prototyping Machine

Seven Mini / Eleven T

User's Guide

MITS Electronics

Revision

Date	Page	Description
091210	Long board	Added
091210	(whole)	Improve problem of requiring Acrobat Japanese font pack
100507	Adjust	Home/Home2 buttons are renamed to SetP1P2/ Re-Skew
100720	Setup	64 bit USB driver is released

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Long Board

- **Divide Data**
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Notes of Caution

⚠ DO NOT get close to the board maker during milling.

Be especially care ful around the area of the head.
Be sure not to get your face injured or your hand caught in the mechanism.
Also, please wear protective goggles or similar protective equipment while the
board maker is operating.

⚠ Attach the dummy tool not in use

While the board maker is not used, attach the dummy tool bit to the chuck of the
spindle motor.
It is useful to expand the lifetime of the chuck of the spindle moter.

HELP Recovery from the hard limit error

If the head passes outside the maximum milling range, the message "Hard limit
detected" will appear on the screen.
In such an event, you need to recover the board maker's home point.
Click "To Initial" on the Manual Operation screen.
Another way is to shut down the board maker and Flashwin and then restart
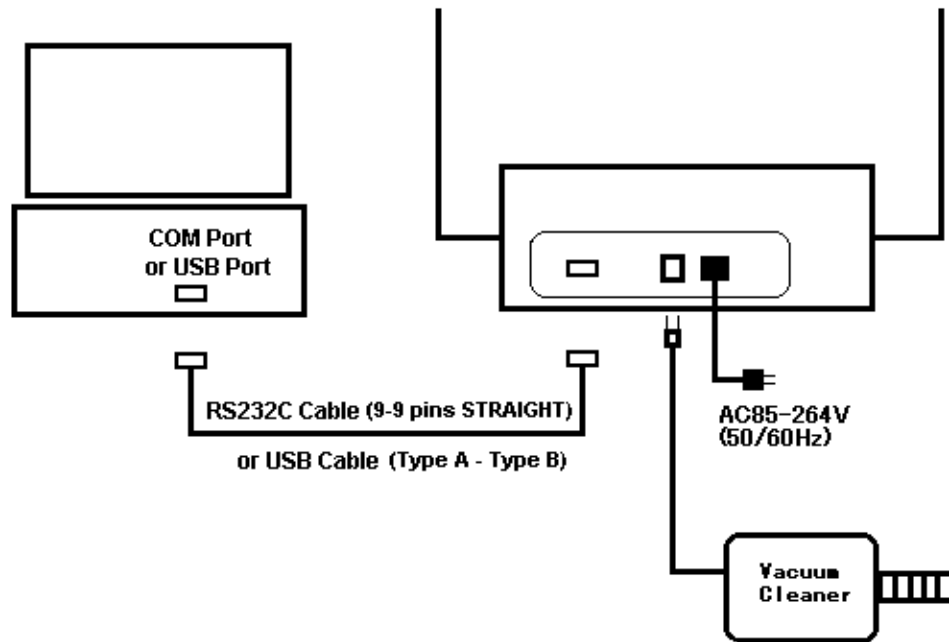both of them.

HELP SHIFT+ESC key to cancel waiting

If you click the icon to start the communication to the board maker which is still
turned off, the mouse pointer changed to the timer icon and keep waiting for the
reply from the board maker.
In this event, press SHIFT+ESC key to cancel waiting for the reply. Ctrl+Alt+Del
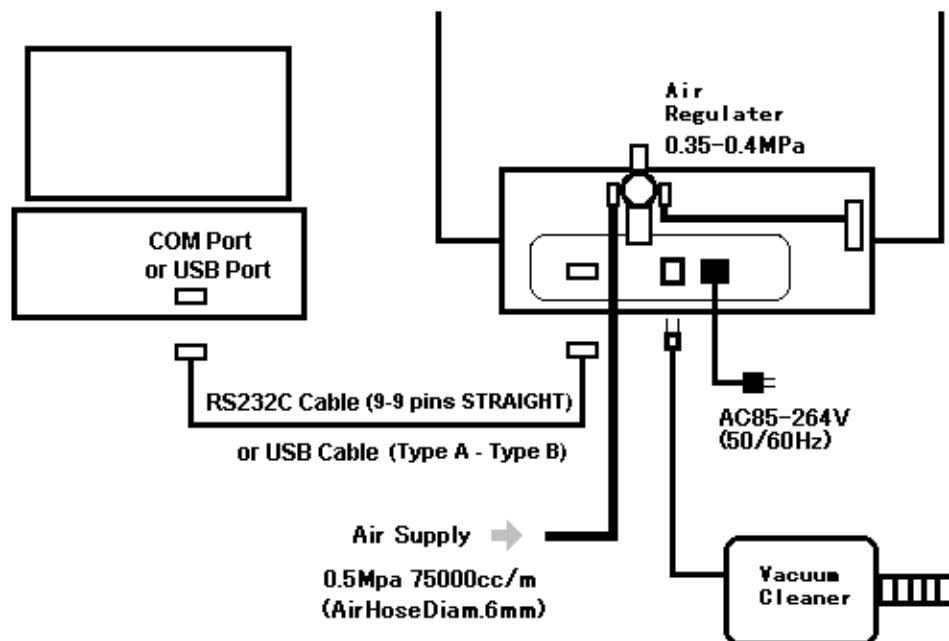is not necessary.

Connect Boardmaker to Your PC and Other Equipments

Seven Mini

ElevenT

COM Port
or USB Port

RS232C Cable (9-9 pins STRAIGHT)
or USB Cable (Type A - Type B)

AC85-264V
(50/60Hz)

Vacuum
Cleaner

ElevenTHP

COM Port
or USB Port

Air
Regulater
0.35-0.4MPa

RS232C Cable (9-9 pins STRAIGHT)
or USB Cable (Type A - Type B)

AC85-264V
(50/60Hz)

Air Supply

0.5Mpa 75000cc/m
(AirHoseDiam.6mm)

Vacuum
Cleaner

Install Software

MITS Design Pro is a software for PCB design, converting data from other CAD system and controls the machine.

PC Specfications:

OS: Windows XP/Vista/7 (NOT supported WinXP 64bit)
RS232C or USB port is required.

Install Procedures:

Open CD-ROM and then start Designpro_en_setup.exe to install the software.

Choose the appropriate items in the list during the set-up procedure:

Conponent Name	Request Space	
☑ Common Component	17,326,843 byte	
☐ CAM-21RS	21,303 byte	
☐ CAM-Circuit2	21,651 byte	
☐ CAM-Lab	26,984 byte	
☐ CAM-Auto	26,985 byte	
☐ CAM-T	21,639 byte	
☐ CAM-TP	22,508 byte	
☐ CAM-Z	21,579 byte	
☐ DFM-300	22,077 byte	

*Common component must be installed together with the applications.
It includes Converter and EASYCAD.

Choose one of the following applications related to your board maker:
*CAM-21RS controls FP-7A / FP-21A < including HP option>.
*CAM-Circuit2 controls Seven mini / Eleven-T < including HP option>.
*CAM-Lab controls Eleven Lab.
*CAM-Auto controls Auto Lab.
*CAM-T controls FP-21T < including HP option>.
*CAM-TP controls FP-21T Precision.
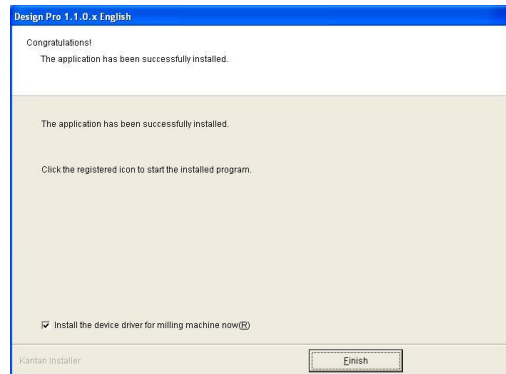*CAM-Z controls Eleven Auto / FPZ-31AT / FPZ-73AT.

Please check also Design View if the Fidicial Positioning Camera is equipped.

Install USB driver

If your board maker has a USB port, it is possible to communicate with your PC via USB.

Check "Install USB driver for milling machine now" at the final screen of Design pro setup.
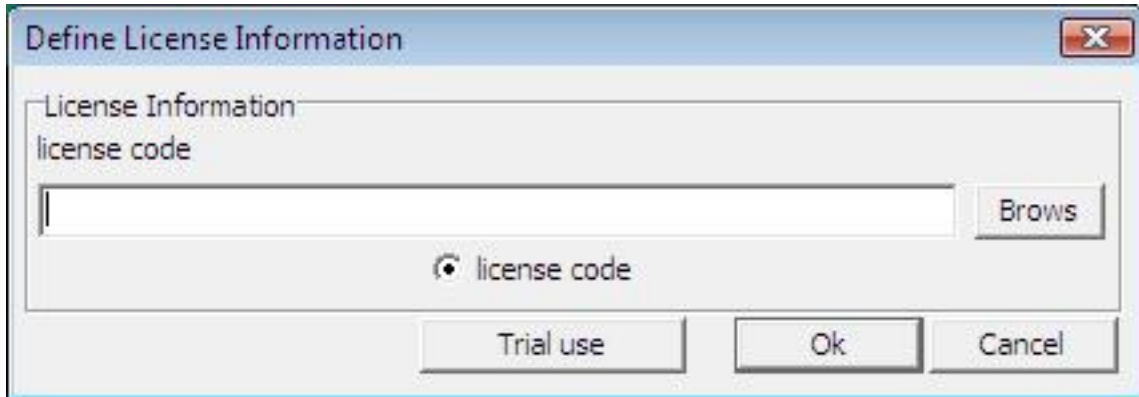
Device driver installation will begin..
Follow the screen messages and installation will be completed.

Registration

Registration is necessary to continue to use MITS Design Pro and board
maker. The following screen is displayed when MITS Design Pro is started.
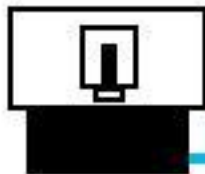

Please enter the license code and then click OK to finish the registration.

Otherwise, click "Trial use" to evaluate the software for 1 month.

MITS Electronics submit 2 type of license code:
- Activates optional EASYCAD
- No optional EASYCAD (Converter+CAM ONLY)

License Policy:
One boardmaker includes one license of
Mits Design Pro software.
With this one license, you can install it
to a PC for the control of the machine,
and to another PC for making milling data
for the machine.
When you install to 2nd PC, enter same license code of
1st PC.

If you need more license, please purchase one license
on one PC.

Start Up the System

The Sequence of Starting Up the Equipments

1. Turn on the computer (Windows).
2. Start up the software.
3. Turn on the Boardmaker.

When turning on the boardmaker, the milling head automatically makes the homing action:
It confirms the limit of each axis Z -> Y -> X and then stop at the initial position (home position).

Do NOT turn on the boardmaker until the computer has been completely started up. Otherwise, communication may fail.

Be sure the air supply if it is necessary for your boardmaker.

At the first time of turning on the boardmaker via USB, the "Found New Hardware Wizard" will appear.
Please refer to USB settings for installing USB driver.

Change Application to CAM

Choose Application menu at the upper right corner of the screen:

    EasyCAD : Used for designing PC boards. (Option)
    Converter : Converts Gerber and DXF data.
    CAM xxx : You will find one CAM application in the list.

Please check the correct CAM application which matches the model of the boardmaker is installed.
If not, it is necessary to re-install the software.

CAM	Model
CAM-21RS	FP-7A, FP-21A
CAM-Circuit2	Seven Mini, Eleven T
CAM-Lab	Eleven Lab
CAM-T	FP-21T
CAM-TP	FP-21T Precision
CAM-Z	Eleven Auto, FPZ-31AT, FPZ-73AT
CAM-Auto	Auto Lab

Please click CAM in the list and it will be changed to the CAM application.

Before working with the boardmaker, it is necessary to prepare the milling data using
EasyCAD or Converter.
Please refer to the EasyCAD/Converter manual for the detail operations.

Port Settings

Choose CAM Prefs. menu -> Board Maker on CAM screen.

RS232C Cable between Boardmaker and PC

- Set RS232C port to the available COM port such as "COM1".

USB Cable between Boardmaker and PC

- Set RS232C port to "USB".
- It is not necessary to set Baudrate.

Restart the software when the port settings are changed.
This setting is available from the next start.

Trouble Shooting - RS232C

1. No response (mouse pointer keeps hourglass)
   Press Shift+ESC to cancel the communication at once.
   And then check the following items:
   - ❍ Power is not turned on yet.
   - ❍ RS232C cable is not connected.
   - ❍ RS232C cable is wrong (Straight/Reverse)
     Refer also to "Connect Boardmaker" in User's guide.

2. Message "Port Open Error" "Port No. Error"
   - ❍ Port No. is wrong.
     Choose CAM Prefs. -> boardmaker.
     And re-confirm that RS-232C field is correct port No.(COMx)
   - ❍ Re-start the software when RS-232C field is changed.
     The settings will be available from the next start.

Trouble Shooting - USB

1. Message "Port Open Error"
   - ❍ Power is not turned on yet.
   - ❍ USB driver is not installed yet.
   - ❍ USB cable is not connected.

   In this case, there is no MITS USB driver in device manager screen.

2. There is MITS USB driver in device maneger screen.
   However, no response when Start Job icon is clicked.
   - ❍ Press Shift+ESC to cancel the communication at once.
     And then try again.
   - ❍ If no response without message, choose CAM Prefs -> boardmaker.
     And re-confirm that RS-232C field is set to USB.
     And re-start the software.

3. No response when Start Job icon is clicked.
   And Shift+ESC key cannot cancel the communication.
   - ❍ Turn off the boardmaker and then try Shift+ESC key to cancel.
   - ❍ If this situation frequently happens, change the properties of
     USB root hub in device manager screen (See another page)

   If everything mentioned above cannot solve the problem,
   or the communication is unstable,
   we have no choice but we recommend to use RS-232C communication.

   If your PC has no RS-232c port, try USB-Serial conversion cable
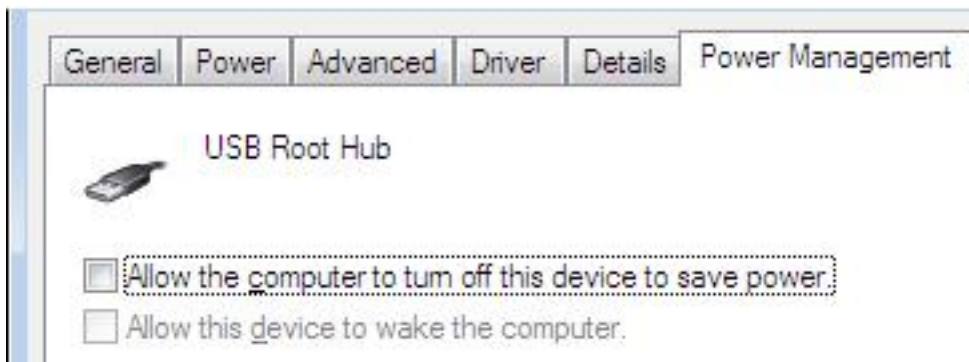   which is sold in PC shop.

Setting of USB Root Hub

Open the device manager screen in control panel on Windows.

Right click on USB Root Hub and click Properties.
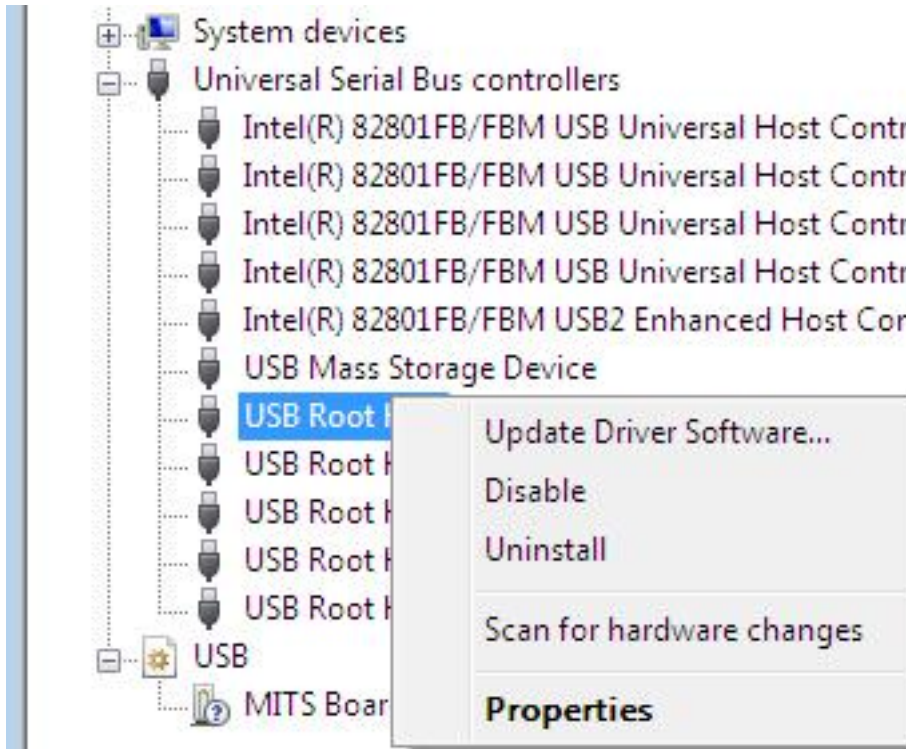
Click Power Management tab,
Check off the Allow the computer to turn off...

There are several USB Root Hub in screen.
Do the same settings on all the USB Root Hub.
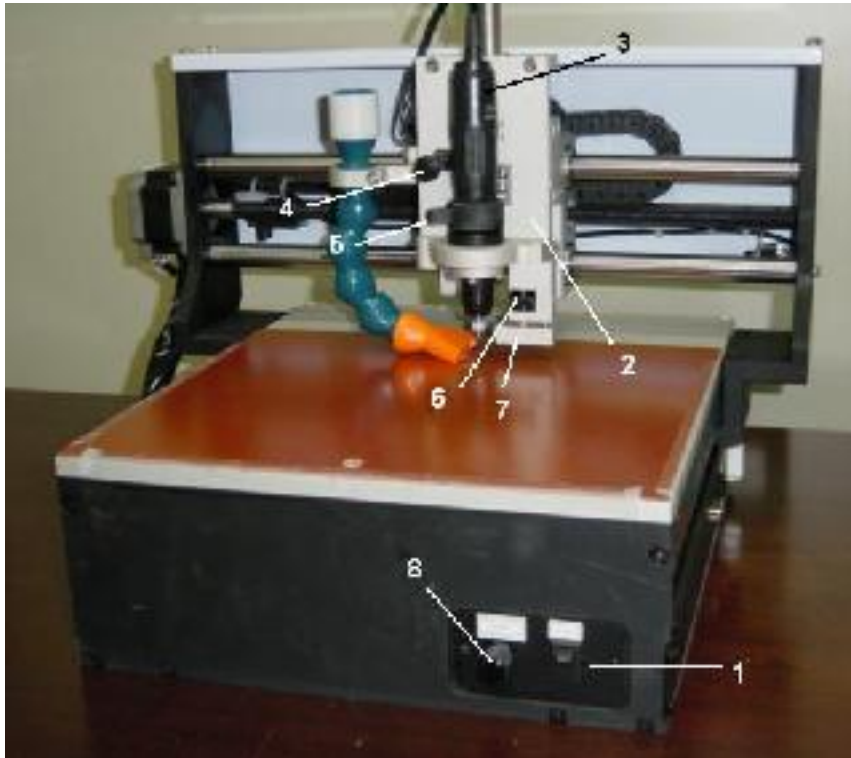
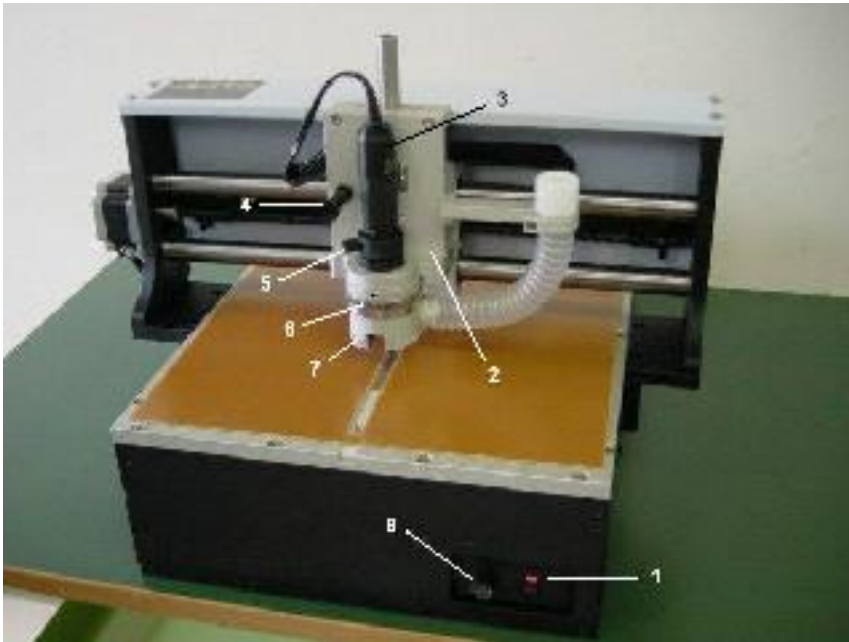Restart your computer when the settings are finished.

# Basic Information

Name of Parts of Seven Mini (Front)

1. Power Switch
2. Head
3. Spindle Motor
4. Head Holding Knob
5. Tool Change Knob
6. Depth Adjustment Screw
7. Pressure Foot
8. Head Lowering Speed Adjustment Volume

Name of Parts of Eleven T (Front)

1. Power Switch
2. Head
3. Spindle Motor
4. Head Holding Knob
5. Tool Change Knob
6. Depth Adjustment Screw
7. Pressure Foot
8. Head Lowering Speed Adjustment Volume
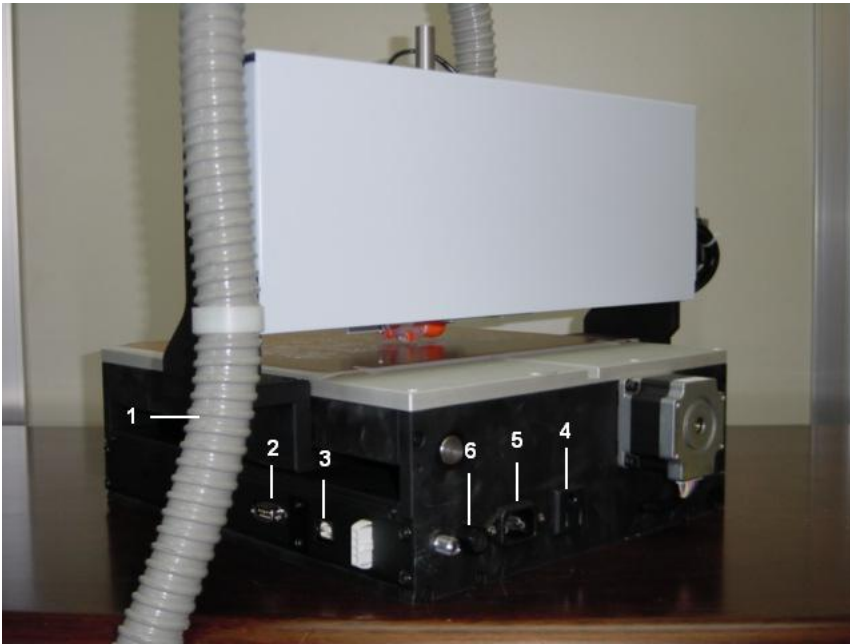
Seven Mini

Eleven T

REAR VIEW

1. Vacuum Hose
2. RS232C Port
3. USB Port
4. Outlet for Vacuum Cleaner
5. Power Plug
6. Fuse (2A)

Tools

| Tool	Size	Application
Milling bit	90 degree 60 degree (The tip is pointed-end)	**For standard FR-4 material such as 1.6mm (0.063") thickness.** • For milling outlines and rubout • 36mm (1.42") overall length
Endmill	1.0mm (0.40") and more..	**For standard FR-4 material such as 1.6mm (0.063") thickness.** • For removing copper with large width. • 36mm (1.42") overall length
RF Milling	0.2mm (0.008") 0.3mm (0.012") 0.5mm (0.020") and more..	**For Teflon(PTFE) and/or thin material** • For milling outlines and rubout. • 38.1mm (1.5") overall length. • Recommended to use with the machine equipped with non-contact pressure foot.
Drill	various	• For drilling holes. • 38.1mm (1.5") overall length.
Router (Forming cutter)	0.8mm (0.31") 1.0mm (0.39") 2.0mm (0.78") and more..	• For routing inner and outer board contours. • 38.1mm (1.5") overall length.

Change Tool
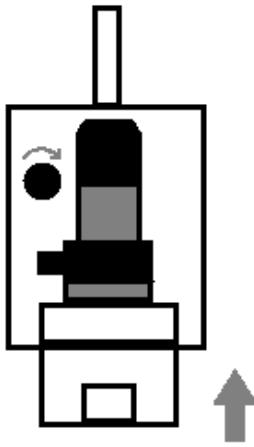
Raise the head to the hold position.

Pull and turn the holding knob slightly to match the slit.

It goes into the slit and the head will be hold at that postion.
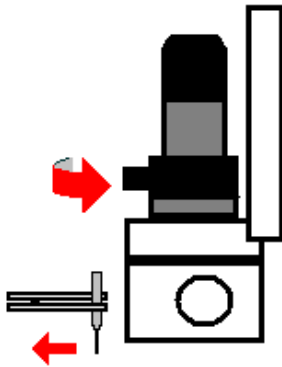
To release the tool bit,

Turn the tool change knob of the spindle motor to the right side.

The tool bit will be released.

Use the tweezer to hold the tool bit not to drop it in Eleven T.

In Seven mini, hold the tool bit by hand.

To install the tool bit,

Insert the bit into the collet chuck.

Please make sure that the bit is inserted to the inside bottom of the chuck.

Turn the tool change knob to the left side.

The bit will be secured.

And then release the holding knob of the head assembly.

Hold down the head slowly to the original position.

When the head is released, please support the head by your hand not to fall it. Otherwise, the tool bit may be broken when the head falls down.

While the board maker is not used, attach the dummy tool bit to the chuck of the spindle motor. It is useful to expand the lifetime of the chuck of the spindle moter.

The head holding knob should be locked at the position which the slits don't match each other except the tool change. Otherwise, it may prevent from the smooth up and down motion of the head.

Contact & Non-Contact Method

When making boards with fine patterns, we usually adopt the incremental
milling method in which the material board is held down and the tool tip
is made to stick out accurately from the very point where the board is
being held down. For holding down the material boards,
there are two methods called the contact method and the non-contact method.
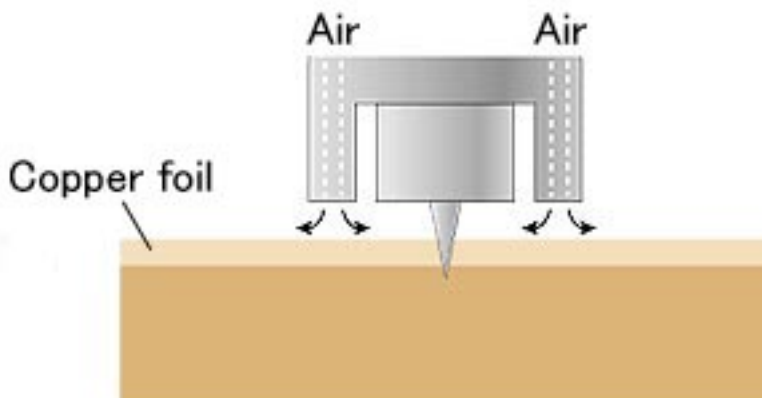
Contact Method
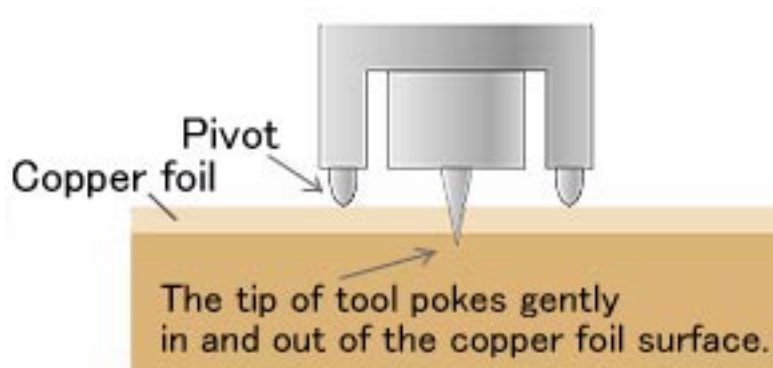
This system leaves the thin trace of pivot touch on the surface of copper foil.
(But this pivot does not leave any scratch.)

You don't have an air compressor using contact method.

Non-Contact Method (HP option)

As the jet of air pushes down the board without touching, this system leaves
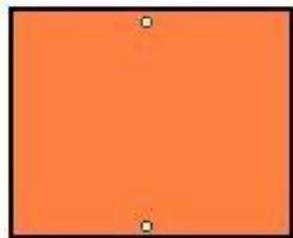no trace on the copper foil.
Therefore, this system is suitable for the processing of thin or soft materials.
However, additionally you have to have an air compressor.

Alignment for Making the Double-Sided Board

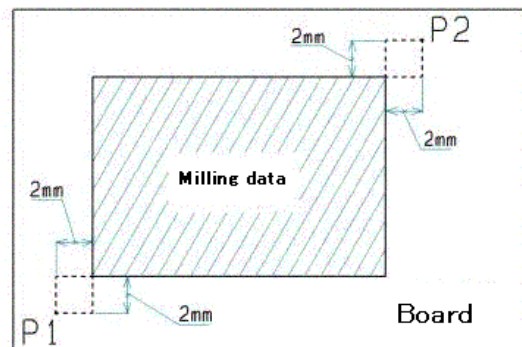There are two approach of alignment for making the double-sided board.

Registration Pin (reference pin, alignment pin)

Make two holes for pins on the machine table and PC board.
The board is turned over by the help of these pins.

Fiducial positioning camera

Make two holes on PC board.
These holes are called P1 and P2
which are on the corner of the milling data.

When the board is turned over without pins,
the board is placed angled.
See the P1 and P2 holes with camera
and the software caliculate the angle of the board.
(This operation is not automated.)
Mostly, the registration pins are not necessary when using
camera.

Please note, However, that the right side of the working area is out of range that the camera can see due to the mounting position of the camera.
So milling large board needs the registration pin although you have the camera system.

Registration Pin and Underlay

The Concept of the Registration Pin on Table

The couple of pins should be located vertically (along Y axis) on the center
of the table. The front pin is called "P3". Another pin on the back side has
no name especially.

Considering the working area size of the machine and the board material size
which you often use, there is a recommended distance between two pins.
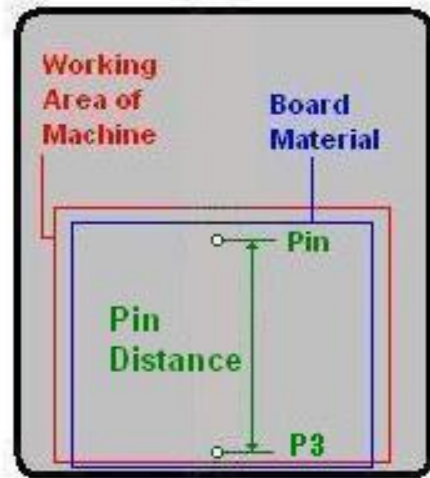
In LAB series such as *Eleven Lab and Auto Lab*, the whole table is the plastic plate and the recommended pin distance is as follows:

Board Material Size	Recommended Pin Distance
200x250mm (8"x10")	240mm (9.5")
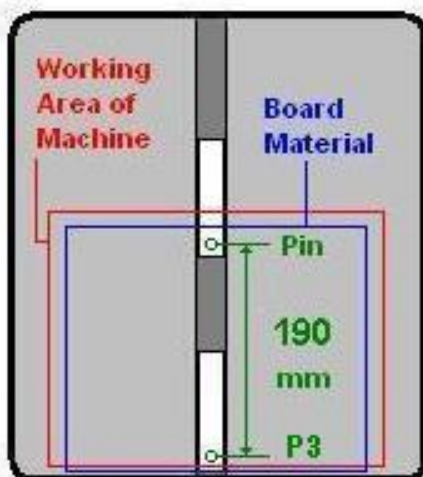
In some of MITS machines, there is a couple of the plastic plate to be put into the aisle of the table.:
*Seven Mini, Eleven T, FP-21T, FP-21T Precision, Eleven Auto, FPZ-31AT*

Board Material Size	Recommended Pin Distance
250x200mm (10"x8")	190mm (7.5")

The values introduced in this section are one of the recommendations and there may be the other suitable distance of the pins depending on the situations.

Set P3 for Seven Mini and ElevenT

Click Manual Operation icon so that the head comes to the front location and the manual operation screen appears.
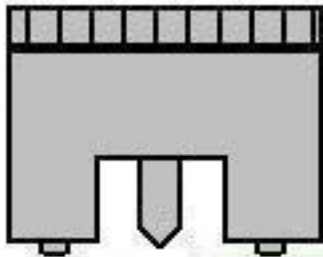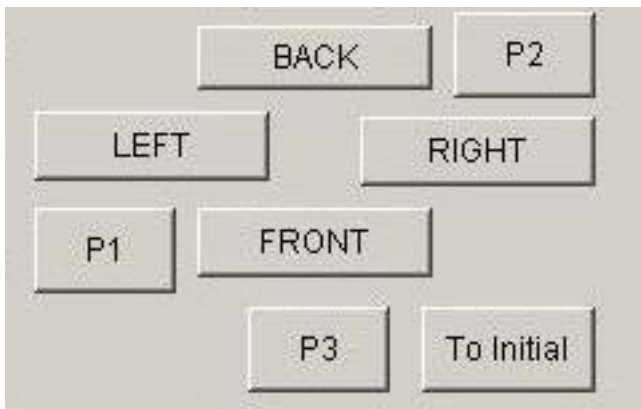
Shallower 浅

Change the tool to 38.1mm (1.5") length bit. Turn the depth adjustment screw shallwer so that the bit touches just the surface of the board.

This depth setting is helpful when the hole of registration pin is made later.

Move the head to the desired P3 location using the manual operation screen.

You may press down the head by hand. It is easy to see the location when the head is down.

Click **Set P3** temporarily to register the P3 location to the software.
Attempt to move the head backwards with the recommended pin distance.
If you don't encounter any limit error, it is good.
It means the couple of pins are inside the working area.

If P3 location is necessary to re-adjust, move the head to the desired location and then click **Set P3** again.

If you encounter the hard limit error (L), click **To Initial** on the manual operation screen. It will retreive the current location of the head. Otherwise, the software will lost the position.

If you don't see **Set P3** button in manual operation screen. Close screen and choose **CAM Prefs.**-> **Boardmaker** screen. Set **Reference** to P1-P2 Revised. And then, try again.
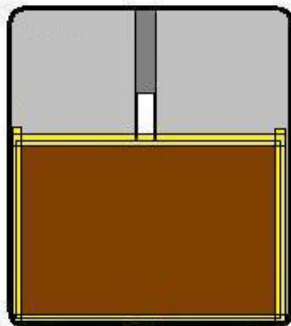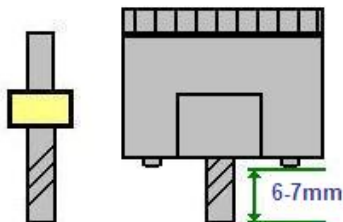
Make Hole for Registration Pin
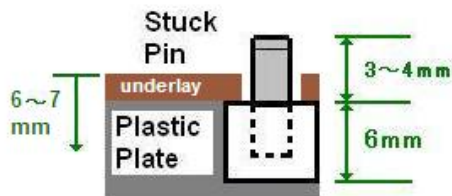
The dimension is :

- The thickness of the plate is 6 mm.
- The length of the registration pin is 8 mm.
- 3 - 4 mm of the pin is sticked out of the plate.

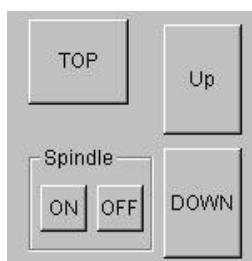However, this dimension is not so necessary to be precise.

Secure underlay on the table with tape.

Change the tool to the special drill bit
for making a hole for the pin.

When the depth screw is adjusted good,
the special drill bit is 6 - 7mm out of
the pressure foot.

Set Lower2 to 3mm/sec.

Move the head to the P3 point, click spindle ON and then click Down to lower the head,
so that the head will make the hole for the registration pin.

Click Up to raise the head, move 190 mm backwards and drill the hole too.

After work, set Lower2 to the previous value.

Backup P3 Info

After making hole for the registration pin,
it is recommended to make backup of P3 coodinate.

Close Manual Operation Screen.

Choose CAM Prefs. -> Save P3.
Enter the file name and then click save
And P3 coodinates are stored to the file.

If the coodinate is lost accidentally,
you can retreive P3 coodinates by load P3 in CAM Prefs. menu.

Working with Standard FR-4

Change Pressure Foot Non-Contact -> Contact

The contact-pressure foot is suitable for milling the standard FR-4 material.
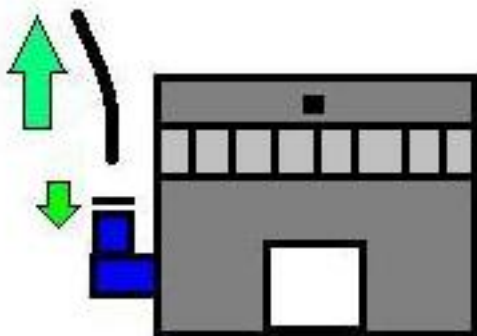You don't have an air compressor using the contact method.

If you have two type of pressure foots: contact and non-contact.
The following procedures are changing the pressure foot to contact.

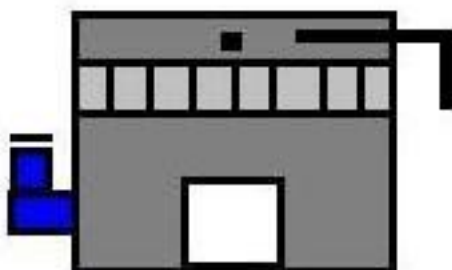⚠️ Please remove the tool bit before changing the pressure foot.
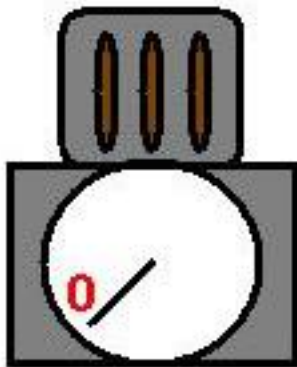
Close the valve of air regulater on the back of the machine.

Pull out air hose from the non-contact pressure foot.

Push down the tip of the hose joint and then pull out the hose.

Also, remove the vacuum hose on the right side of the pressure foot.

Loosen the screw of pressure foot.:
(1) on front side
(2) on right side

Raise the head a little and then remove the non-contact pressure foot.

And then attach the contact pressure foot and tighten the screw.

Prepare Tools for working with standard FR-4

Prepare the following tool bits for working with FR-4 material.

1. Milling (Pointed-end):

Pointed 90 degree is most frequently used for standard milling.

90 degree milling bit is suitable for milling width 0.2mm-0.4mm

60 degree milling bit is suitable for milling width 0.1mm-0.2mm

Endmill is suitable for rubout (removing copper).

2. Drill and Router (Forming cutter):

Check the diameters used in your pcb data and prepare them.
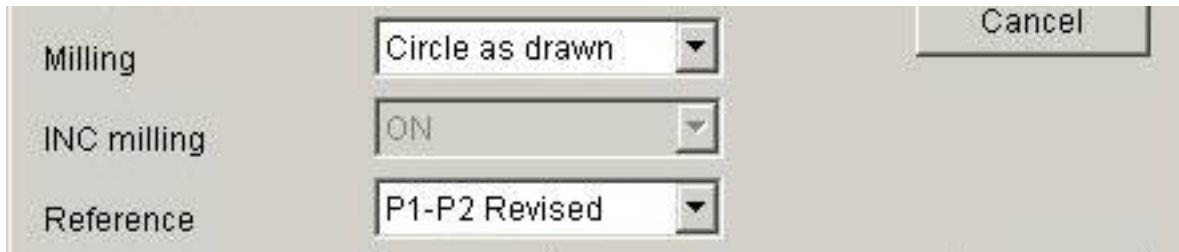
Choose Information -> Tool List.
It will help you to check the diameters used in pcb data.

Set Adjust Method

Open the Board Maker screen from CAM Prefs menu.
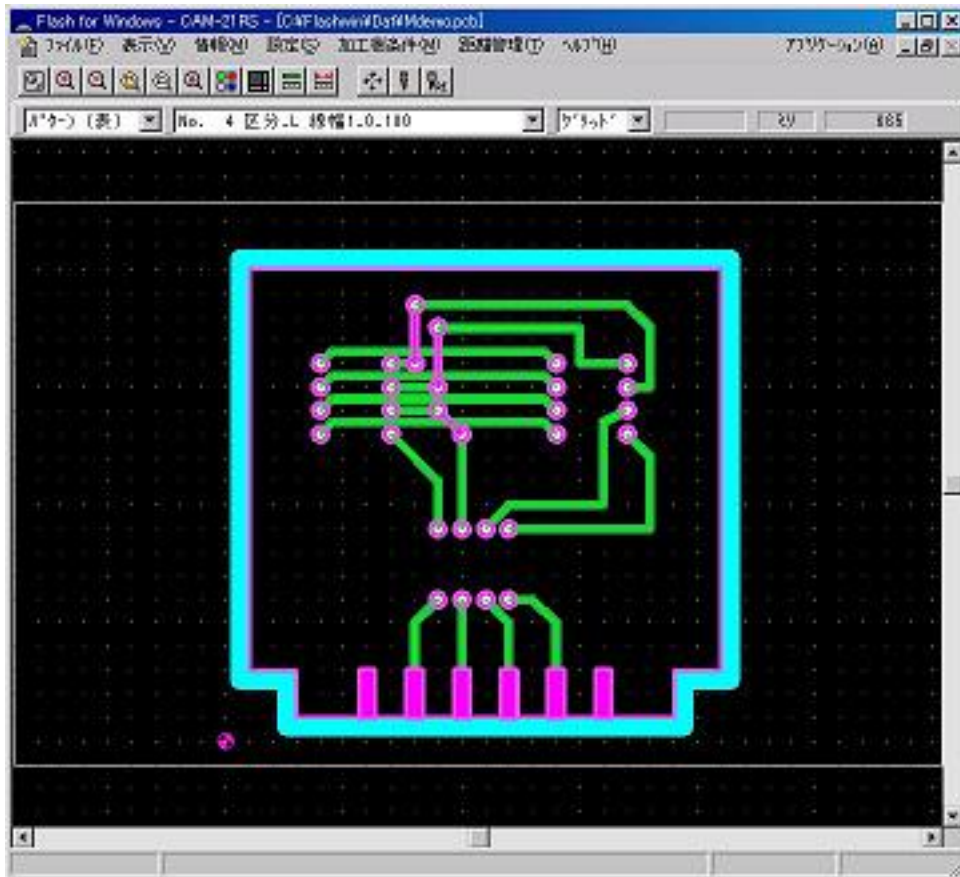

Set Reference to P1-P2 Revised.

 P1-P2 Revised is one of the adjust (alignment) methods and the further operations will be explained later.

Display Milling Data

Choose Open from the File menu and select the file name from the list.
Then click Open to display the data on screen.

For this example, open Mdemo.

Before the milling operation with the boardmaker, it is necessary to prepare the milling data using EasyCAD or Converter.
Please refer another manual for how to use EasyCAD and Converter.

Start Job

 Click the Start Job icon.

For this example, select:

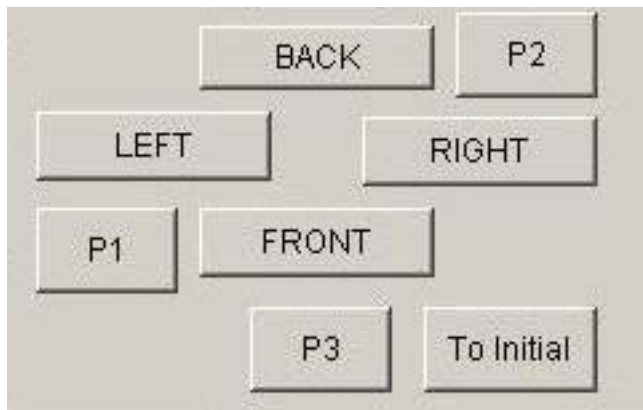1. Drill (Top)
2. Milling outlines (Top)

Click OK.

Click Adjust to Call Up the Manual Operation Screen

When OK is clicked in the Milling Sequence Settings screen, the Board Top/Bottom Change screen appears.


Click Adjust to call up the Manual Operation screen.

You can move the head to left, right, front and back using move buttons in the manual operation screen.

Size of Board Material

It is necessary to prepare the board material which has enough size to mill.
It is easier to understand what is enough size to put the board material temporarily
on the table and move the head of the machine from P1 to P2.
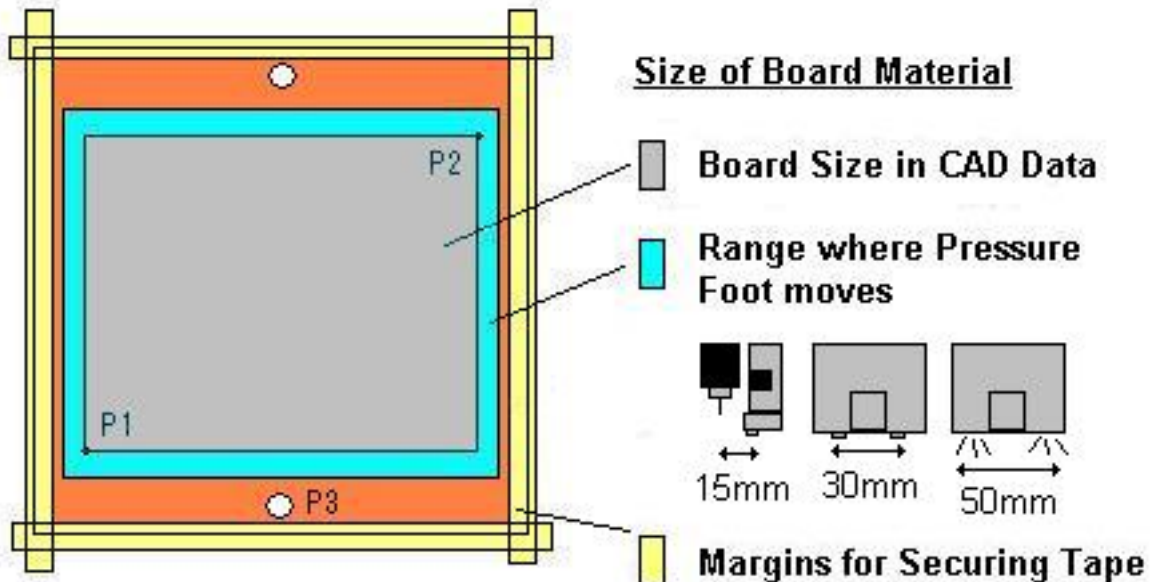
- Range where Pressure Foot Moves:
  Though it depends on the model of Pressure Foot,
  it requires the 15 - 50mm margin for pressure foot.

- Margin for Securing Tape:
  It requires approx. 5mm margin for securing tape.

- Space for Stuck Pins:
  It requires 3 mm holes for stuck pin to the underlay and the board material.
 The stuck pins should stand outside the range where the pressure foot moves.

Put board on table and secure it with tape.

Set P1 Point and then Confirm P2 Location

Adjust

First, we need to set the milling reference point (P1).

- Click on the move buttons (FRONT, BACK, etc.) to move the head to any location on the board.
- Click on the Set P1-P2 button, and that location will become P1.
- At this time, a < Align P2? > message will appear, but just click No.
- When P1 has been set, please check the location of P2:
  Click the P2 button and the head will move to P2.
  Please confirm that the milling area fits within the board.
 If you want to change P1, move the head again to the desired location and click Set P1-P2.
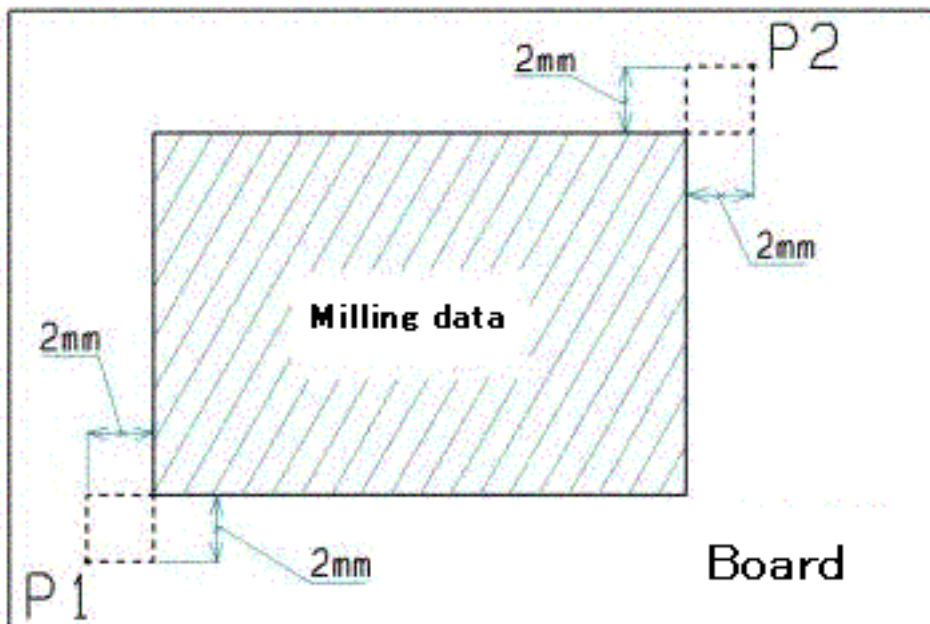
It is very important to check the location of P2.
If the head goes outside of the board during milling, it may cause accident such as breaking the bit, hurt the surface of the table and so on.

Adjust Depth of Cut

Make a test cut to check the width of the channel cut by the milling cutter.

Change the tool to milling bit.
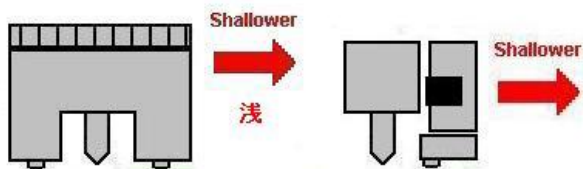
First, turn the adjustment screw enough shallower so that the milling bit doesn't touch the surface of the board.

From now, we will make a trial cut.
So move the head to the outside of P1-P2 milling area to prevent from hurting the surface inside the P1-P2 area. (use the FRONT, BACK, LEFT, RIGHT move buttons as needed)

Turn ON the spindle motor.
Click DOWN to lower the head.
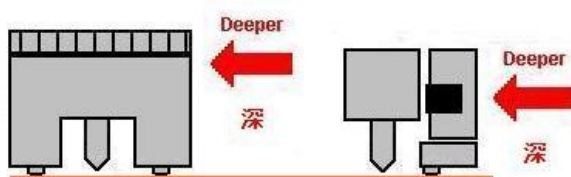
Turn the depth adjustment screw deeper so that the bit gets into the board surface.

In this position, press one of the move buttons once and a trial cut will be made.
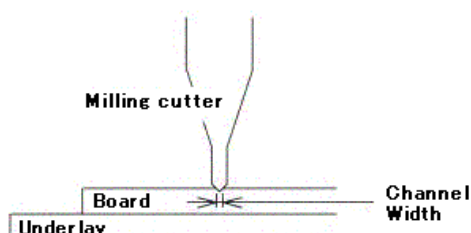
Click UP to raise the head.

Turn OFF the spindle motor.

Move the head aside so that you can check the result of cut.

Check the width of the channel that was cut.

Adjust the milling cutter depth and make trial cut several times
so that the width of this channel is the same as the diameter of the tool
specified in EASYCAD or the Converter program for milling outlines.

Make Hole for Registration Pin on Board

When processing double-sided board, the hole for registration pin
is necessary on board.
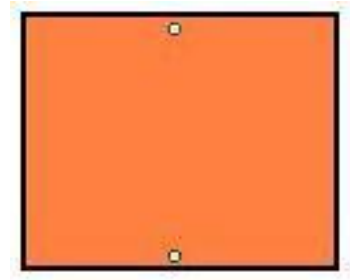
Change the tool to 3mm drill.
When the depth screw is adjusted good with the milling bit which is
2mm shorter than the drill bit, the 3mm drill bit is 2mm out of
the pressure foot.
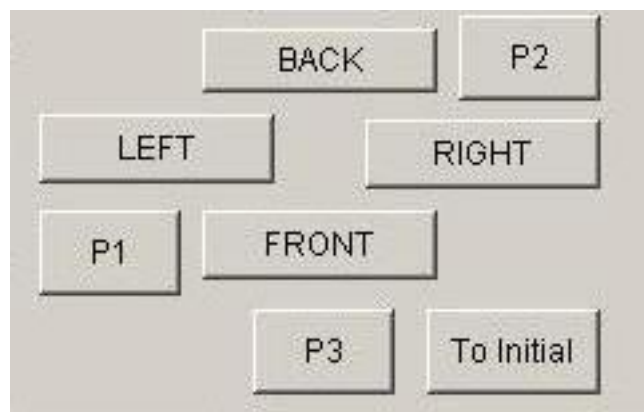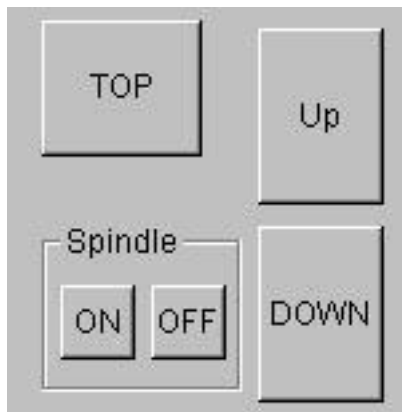
Click P3 to move the head on p3 point.

Move the head to the P3 point, click spindle ON and then click Down to lower the head,
so that the head will make the hole for the registration pin.

Click Up to raise the head, move 190 mm backwards and drill the hole too.

Insert the registration pin into the hole.
Otherwise, you may insert registration pin when milling top side was
finished and you need the alignment for bottom side.

Drill P1 and P2 Location

After setting the reference point, we need to make the reference holes for P1 and P2.

Reference holes are used for the alignment using optional camera system.
Also, making these holes are useful for understanding how large the milling area is.

- Attach the drill.
  For example, 0.8mm drill.
- Click on Drill P1-P2 and the head will move the P2 point.
  And then a message "Ready to drill P1 and P2?" will appear.
- Click Yes on the message screen and the head will start to drill holes on P2 and P1.
- After the reference points has been drilled, click OK on the manual operation screen.
  And the manual operation screen will close and go back to the Board Top/Bottom Change screen.

Drill (Top)
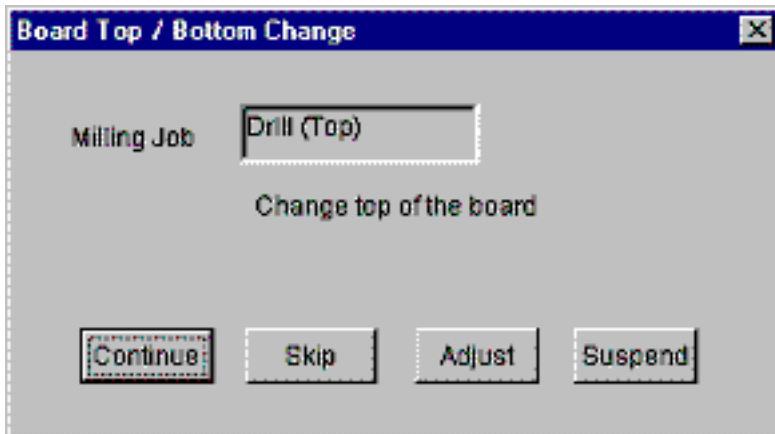
Board Top / Bottom Change

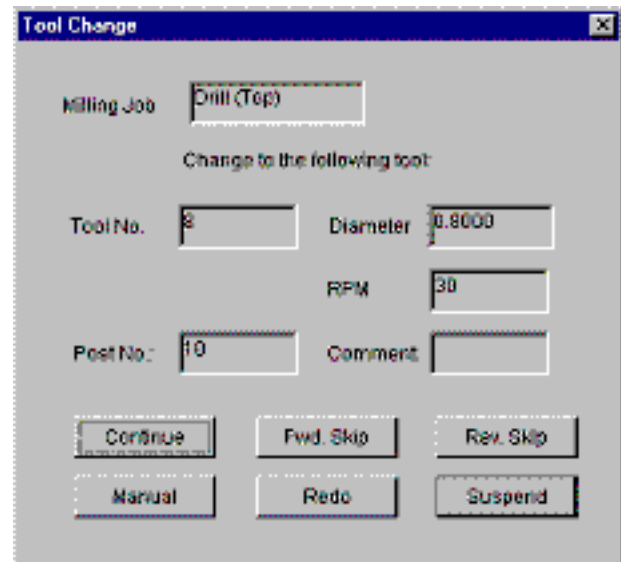Milling Job   Drill (Top)

Change top of the board

Continue   Skip   Adjust   Suspend

Click Continue to proceed the next Tool Change screen.

- This screen will appear when your board maker need the tool change manually.
- The layer to be milled and the tool number and tool diameter in the milling data are displayed here.
  Change the tool to the one displayed in this screen.
- Click Continue to start drilling.

Tool Change

Milling Job   Drill (Top)

Change to the following tool:

Tool No.   8   Diameter   0.8000

                       RPM   30

Post No.:   10   Comment

Continue   Fwd. Skip   Rev. Skip

Manual   Redo   Suspend

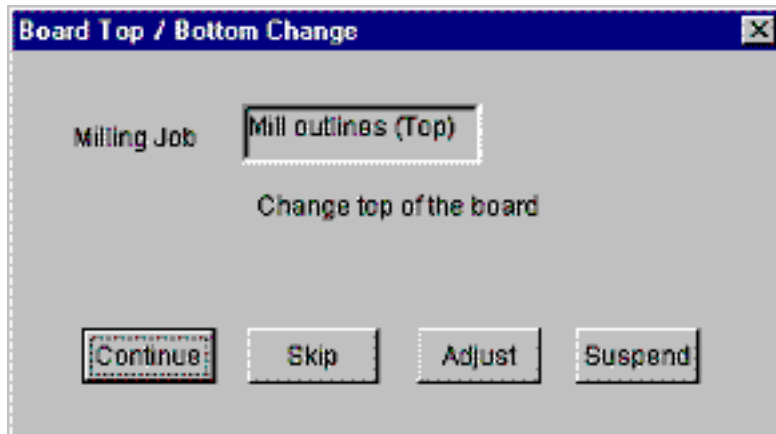⚠ DO NOT touch the spindle motor or allow your face to get near it during milling.

📝 To interrupt the milling operation, press ESC key. After finishing the milling data which has been already sent, the operation will stop.

⚠ If emergency stop is needed, turn off the power switch.

Milling Outlines (Top)

When the drilling process is finished, the Board Top/Bottom Change screen will appear again to tell that you will enter the milling process.
Click Continue to proceed the next Tool Change screen.

- The layer to be milled and the tool number and tool diameter in the milling data are displayed here.
  Change the tool to the one displayed in this screen.
- Click Continue to start milling.
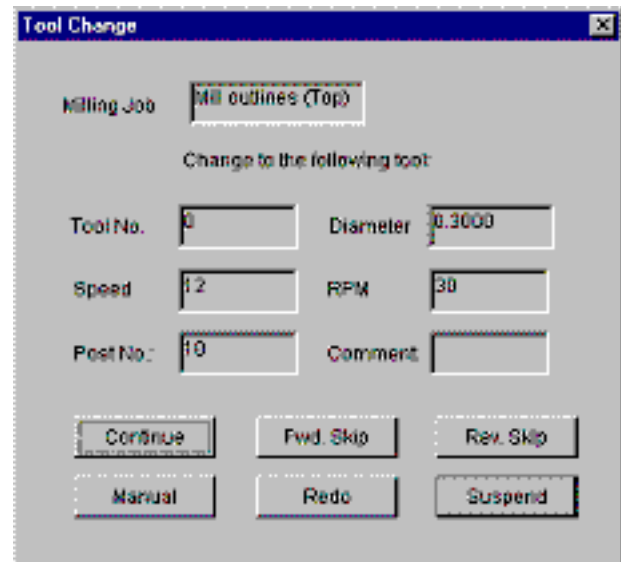
ESC Key to Interrupt

To interrupt the milling operation, press ESC key.

After finishing to process all the milling data which has been already sent,
(which was shown by red color in the screen)
the operation will stop.

If emergency stop is needed, turn off the power switch.
Using Eleven Auto, press emergency switch.

Redo

In the event that a drill or milling cutter breaks during milling or you find there is still apart of the board that has not been milled, the software offers you 3 methods to mill just the part of the board that still needs it.:
Redo, Mill selectively and Resume

Redo

When Redo is clicked, the Redo screen appears and asks you to enter which board in the sequence you want to redo milling from. The number to the right of the entry field indicates the total number of boards in the sequence.
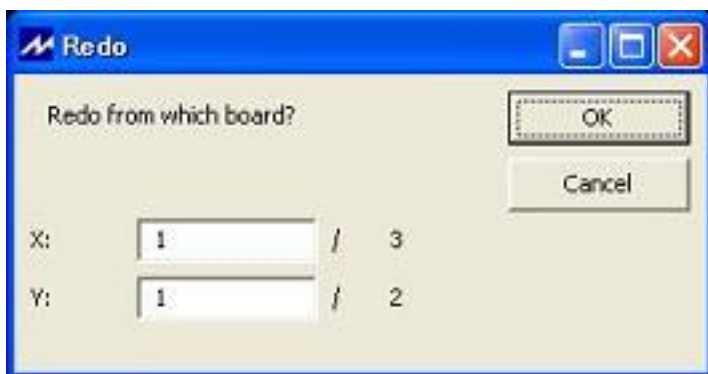
When the message appears, click on the element from which milling is to be redone (started again). The data that will be milled is displayed in the red and yellow.

If step milling is checked, software ask which step you want to start from.

Redo from 0 or 1 means redo from 1st step.

When the element to be redone is confirmed, the Tool Change screen will appear.
Click Continue to start milling.
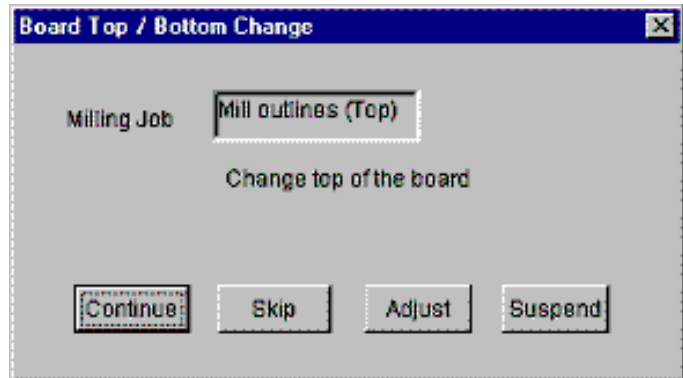
Mill Selectively

Click Mill selectively icon.

The most of operations are very similar to the usual one.

The difference is that it needs an operation to select area to be milled.

This operation is done after Continue is clicked in the Board Top/Bottom Change screen.

Board Top / Bottom Change

Milling Job   Mill outlines (Top)

Change top of the board

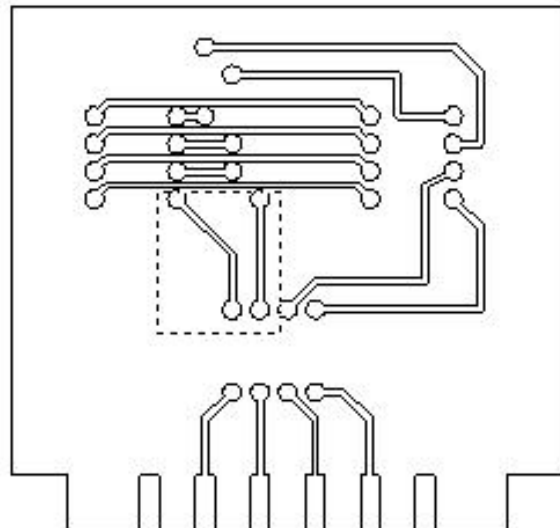[Continue]   [Skip]   [Adjust]   [Suspend]

Click on an element or drag rectangle so that element(s) change its color. It is "selected".

After selection, right-click -> Confirm to go to the next step.

Confirm
Grouping Masks
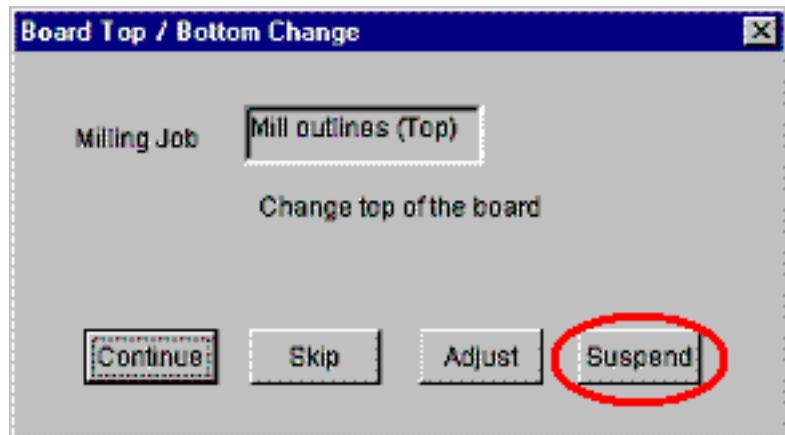Add series segments
Command cancel

The rest of operations is same as the usual one. The software will mill only the selected area.

Resume

When suspend button is clicked to terminate job.....

Board Top / Bottom Change

Milling Job: Mill outlines (Top)

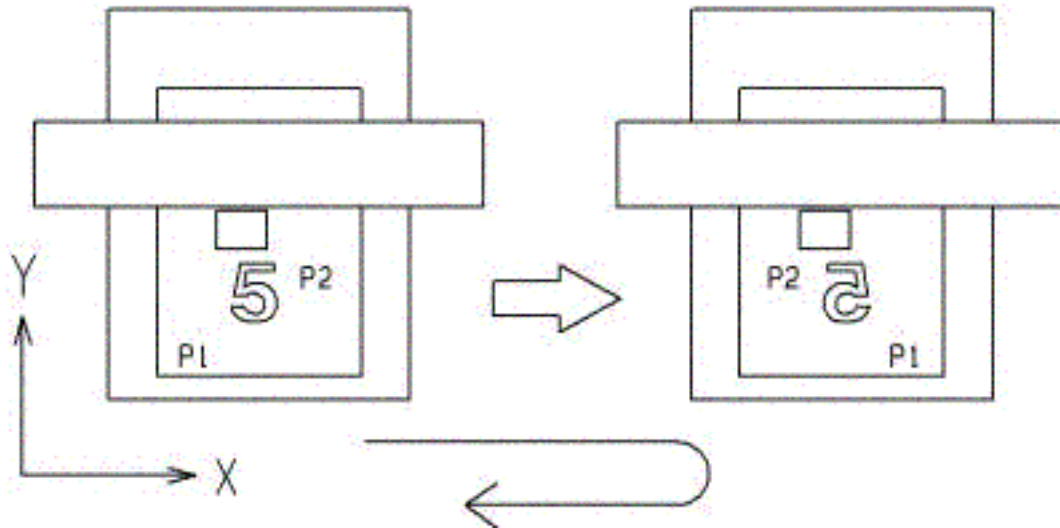Change top of the board

[Continue] [Skip] [Adjust] (Suspend)

You can resume job by Resume icon.

Resume information is available until you leave CAM application or another file is opened

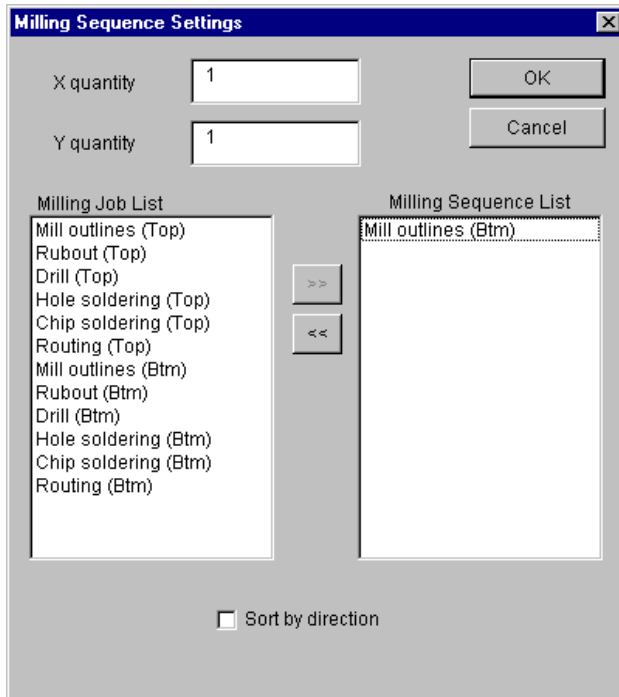# Turn Over Board

Turn over the board as illustrated below.

From TOP view, P1 is located on the front-left.
From BOTTOM view, P1 is located on the front-right.

Start Job (Bottom Side)

Click Start Job icon.

Milling Sequence Settings

X quantity	1
Y quantity	1

OK

Cancel

Milling Job List

Mill outlines (Top)
Rubout (Top)
Drill (Top)
Hole soldering (Top)
Chip soldering (Top)
Routing (Top)
Mill outlines (Btm)
Rubout (Btm)
Drill (Btm)
Hole soldering (Btm)
Chip soldering (Btm)
Routing (Btm)

>>

<<

Milling Sequence List

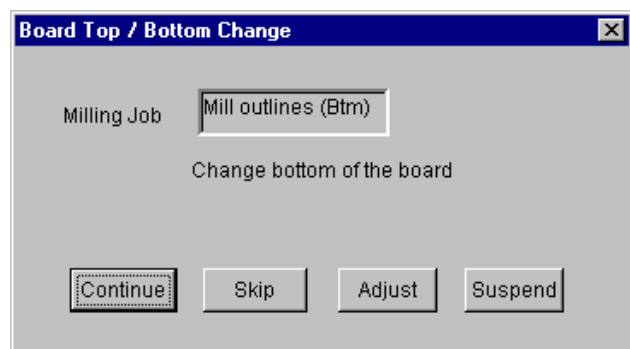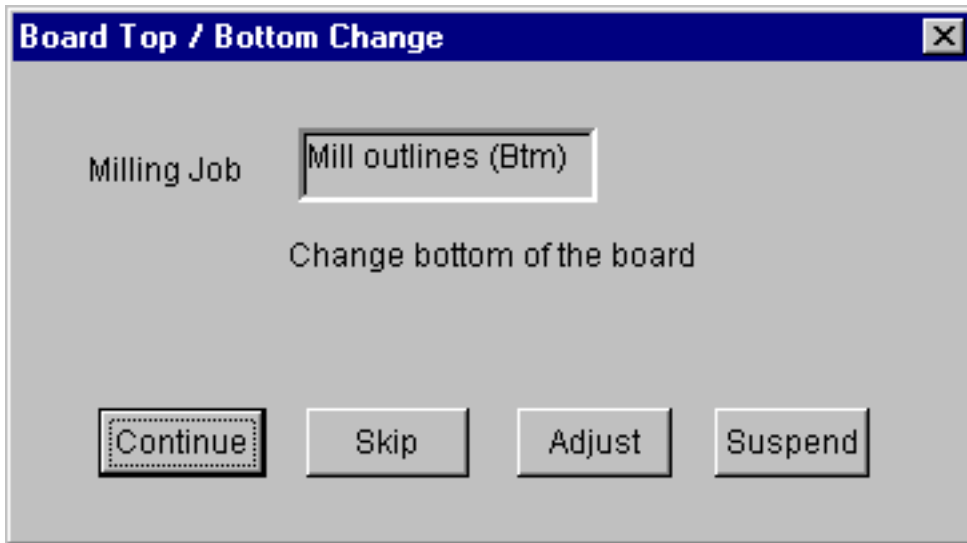Mill outlines (Btm)

☐ Sort by direction

For this example, select:

1. Milling outlines (Btm)

Click OK.

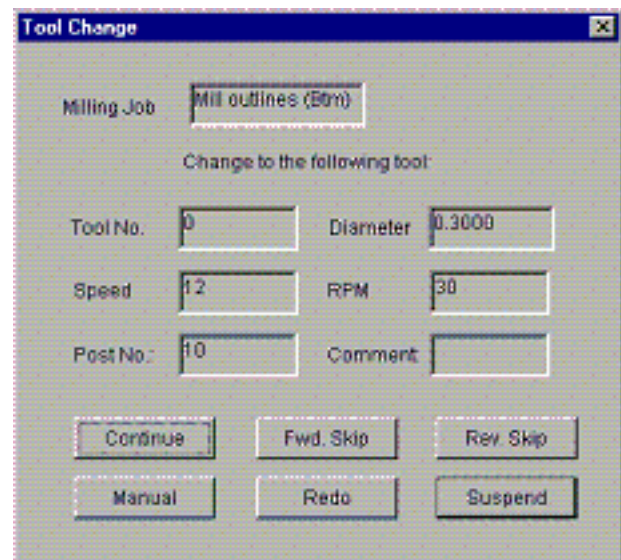When OK is clicked in the Milling Sequence Settings screen, the Board Top/Bottom Change screen appears.

Board Top / Bottom Change

Milling Job | Mill outlines (Btm)

Change bottom of the board

Continue | Skip | Adjust | Suspend

Milling Outlines (Bottom)

Board Top / Bottom Change

Milling Job   Mill outlines (Btm)

Change bottom of the board

[Continue]   [Skip]   [Adjust]   [Suspend]

The following operations are same as milling top side.
Click Continue to proceed the next Tool Change screen.

- This screen will appear when your board maker need the tool change manually.
- The layer to be milled and the tool number and tool diameter in the milling data are displayed here.
  Change the tool to the one displayed in this screen.
- Click Continue to start milling.

Tool Change

Milling Job   Mill outlines (Btm)

Change to the following tool:

Tool No.   0   Diameter   0.3000

Speed   12   RPM   30

Post No.   10   Comment

[Continue]   [Fwd. Skip]   [Rev. Skip]
[Manual]   [Redo]   [Suspend]

Start Job (Routing)

 Click Start Job icon.

And then select Routing (Btm) in the Milling Sequence Settings screen.

Click OK.

When Board Top / Bottom Change screen appears,

click OK.

When the Tool Change screen appears, attach the router bit (forming cutter).

Before starting the milling operation, Be absolutely sure to check the milling speed.

If this speed is too high, it could cause the tool to break.

Click **Continue** to start the routing job after confirming the settings.

The Sequence of the routing:

When the drawings have the inside routing
data, it is good to separate the tool No.
for inside and outside.

And also, tool No. for Inside should be
smaller than one for outside
because contour routing will process
smaller tool No. first.
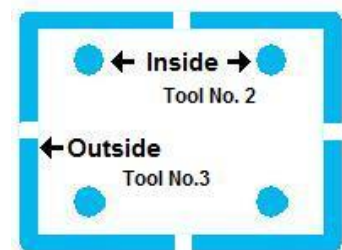
Please refer Converter and EasyCAD manual for how to generate routing data.

Ensure Depth of Cut (Routing)

If you want to ensure the depth of cut of routing bit,
the following procedure is helpful to make sure the depth.

Setting the Routing (Forming Cutter) Depth

Follow the procudure below to adjust the depth of the routing bit:

- Click Manual to call up the Manual Operation screen.
- Use the Move buttons to move the head to the location shown in the illustration.
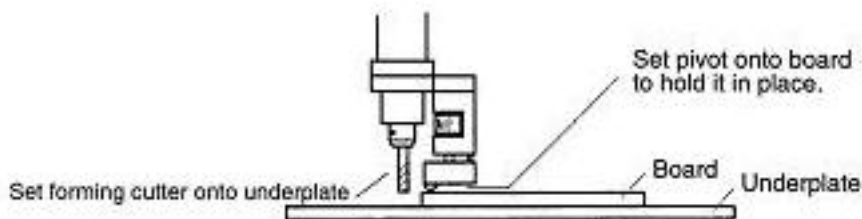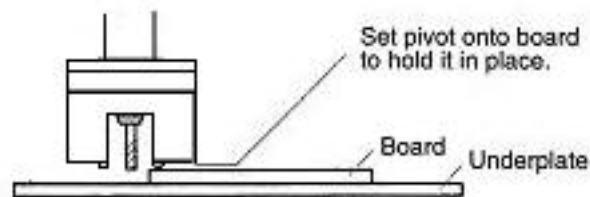
- First, turn the adjustment screw enough shallower.
- Turn ON the spindle motor and click the Down button.
- Turn the depth adjustment screw little by little so that the depth of the routing bit gradually increases.
- When the bit reaches a depth where the tip of the bit will just slightly scratch the surface of the underplate, click the Up button and turn the spindle motor OFF.
- From that point, turn the adjustment screw shallower by 15-20 notches.

Once this adjustment is complete, a two-sided board can be milled at a depth
so that just enough of the copper plating will remain.

Working with Tefron(PTFE) and/or Thin material

Change Pressure Foot Contact -> Non-Contact

If you have two type of pressure foot: contact and non-contact.
The following procedures are changing the pressure foot to Non-contact.

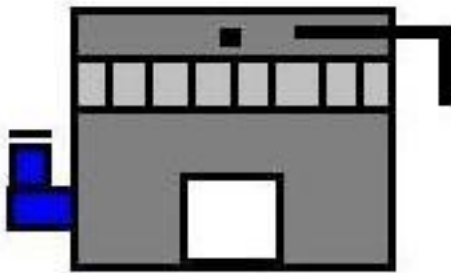⚠️ Please remove the tool bit before changing the pressure foot.

Remove the vacuum hose on the right side of the pressure foot.

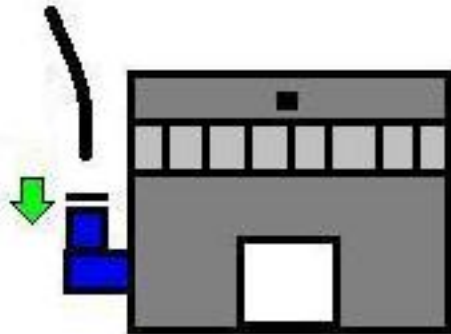Loosen the screw of the contact pressure foot.:
(1) on front side
(2) on right side

Raise the head a little and then remove the contact pressure foot.
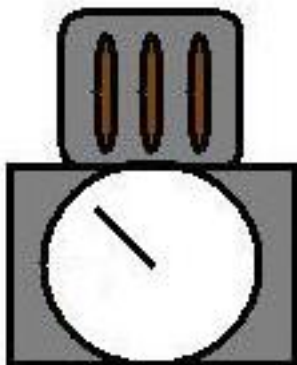

Attach the non-contact pressure foot and tighten the screw.

Also, attach the vacuum hose to the right side of the foot.

Insert the air hose to the joint.

Open the valve of air regulater on the back of the machine.

The value is **0.4 - 0.45 MPa**.

Prepaing Tools for working with Thin material
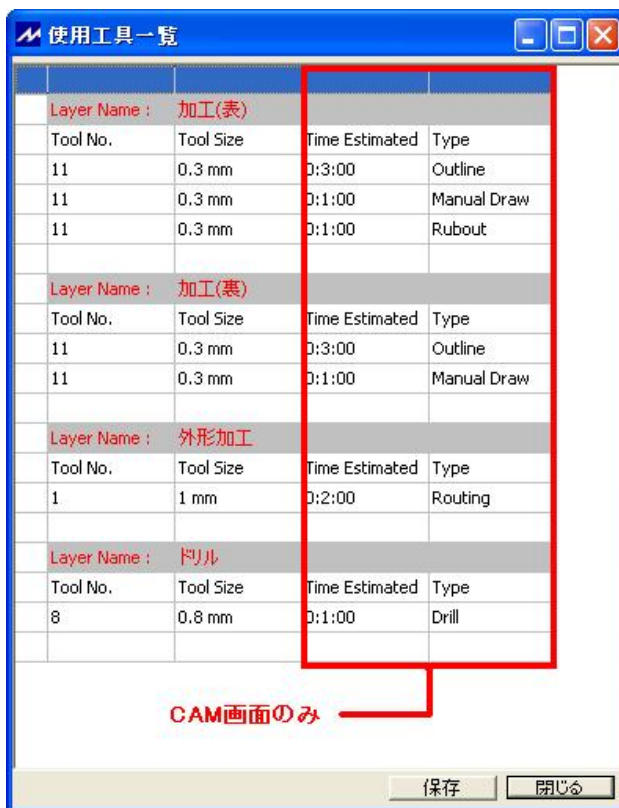
Prepare the following tool bits.

1. RF Milling (stub-end):

2. Drill and Router (Forming cutter):

Check the diameters used in your pcb data and prepare them.

Choose Information -> Tool List.
It will help you to check the diameters used in pcb data.

How to Secure Thin Material

There is some difficulty to secure thin substrate on the machine table.
Even though 4 sides of substrate are secured with tape,
the center of substrate could not be secured and float.

Adhesive Spray

One of the ideas to secure thin substrate on table
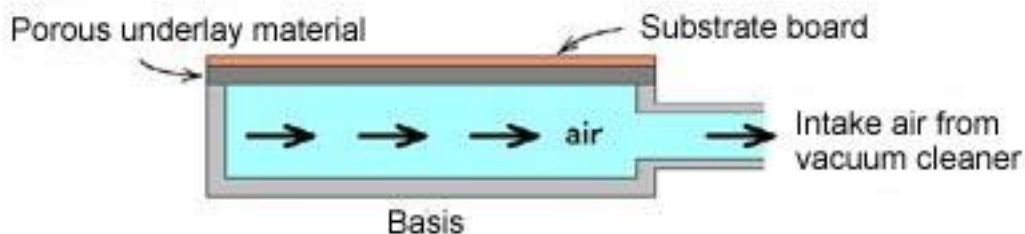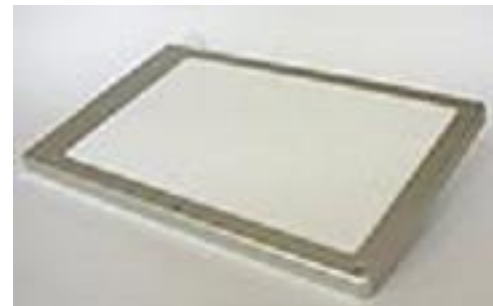is to blow the adhesive splay on the bottom of substrate.

Put the material on the underlay of the table.
Wipe the surface of the material to make the surface smooth.

Vacuum Table

It is suitable to use vacuum table option
for securing the thin substrate.

It holds the substrate firmly on the machine table
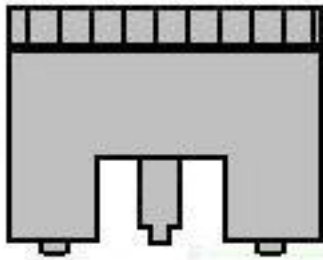using the vacuum pressure.

Adjust Depth of Cut (RF Milling)
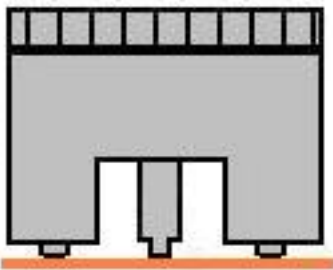
The shape of RF milling bit is stub-end.
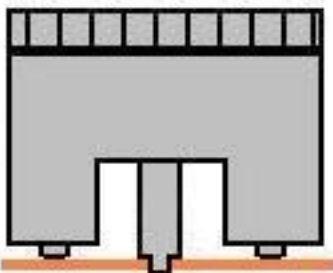This paper introduces how to get the depth of cut using RF milling bit.

Shallower

First, turn the adjustment screw enough shallow for bit
not to touch the surface of the board.

Deeper

Lower the head and then turn the adjustment screw deeper
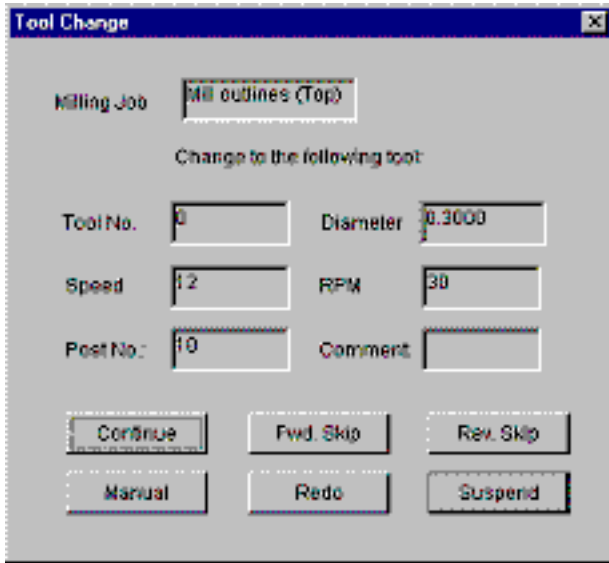until the bit touch the surface slightly.

1 click ≒ 3 um

From the very suface point, turn the adjustment screw deeper,
considering 1 click of screw is approximatly 3 um deep.

It is very difficult to set the depth to mill ONLY copper foil
without touching the substrate under copper foil.
Set the depth under the copper foil to 20um at least.
And set deeper if the milling result is still shallow.

Milling Parameters for Thin Material

Tool Change

Milling Job: Mill outlines (Top)

Change to the following tool:

Tool No. 0   Diameter 0.3000

Speed 12   RPM 30

Post No.: 10   Comment

Continue   Fwd. Skip   Rev. Skip

Manual   Redo   Suspend

Click Manual before clicking Continue in Tool Change screen,
set the milling parameters for RF milling bit in Manual Operation screen.

|			
Dry run(mm/sec)	20.0	Mill spd.(mm/sec)	4.0
Thickness(mm)	0.2000	Underlay(mm)	1.6000
Mill depth(mm)	1.5000		
Lowering1(mm/sec)	12.0	Lowering2(mm/sec)	2.0
Spindle(1000rpm)	30		

Refer the following chart:

RF Milling (mm)	Spindle (x1000rpm)	Milling spd. (FR4) (mm/sec)	Milling spd. (Teflon) (mm/sec)	Lower2 (mm/ sec)
0.2	30	4-6	3-5	1-2
0.3	30	8-10	6-8	1-2
0.5	30	10-12	8-10	2-6

Adjust Depth of Cut (Drill&Router on Thin Material)

The length of drill and router bit is same as RF milling bit.
So it needs to make the depth of cut deeper in order to penetrate material.

First, Remember the position of the depth adjustment screw
where the depth of cut of RF milling is good.
It is the reference point.
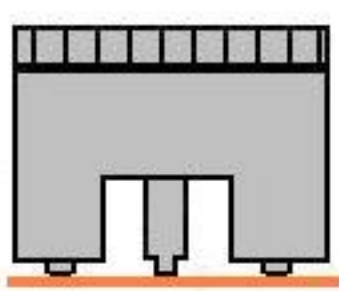
Deeper

Turn the adjustment screw deeper from
this point with Board Thickness +0.5mm.

It helps to know that turning
the adjustment screw one round
deeper direction become the depth
of cut 0.5mm deeper.

And 1 click of screw is approximately 3um deeper.

Long Board

Divide Long Board Data

How to divide the longer board than the working area:

For the preparation before dividing the long board data,
use Make holes command and place 2 holes for alignment on data.
The pair of holes must be placed horizontally.

1. Click Make Holes button.

2. Choose hole diameter from list box.
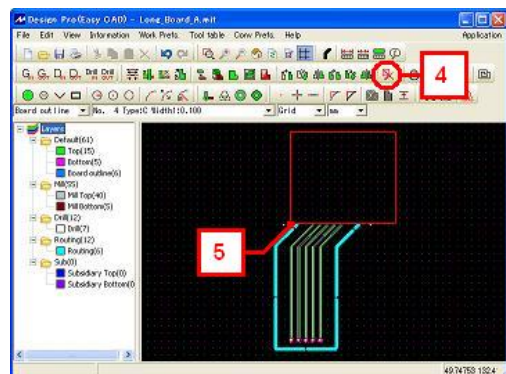
3. Place 2 holes horizontally.

File -> Save
Save this data as the original one.
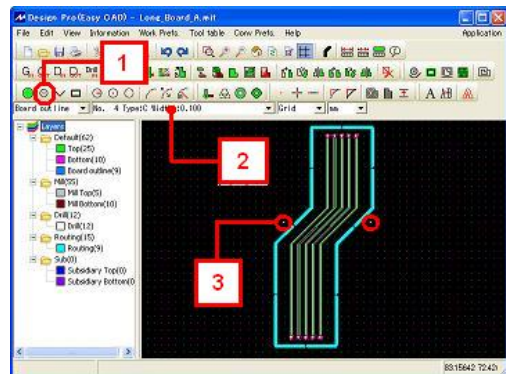
4. Click Delete Inside/Outside Region button.

5. Use mouse to make region surround the upper part beyond the alignment holes and delete it.

   Be careful not to delete the alignment holes.

File -> Save As
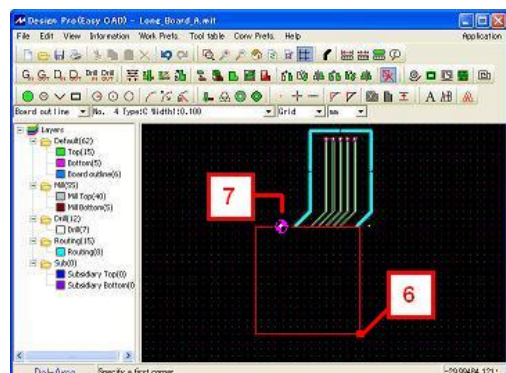Save this data as different name.

6. Open the original data again.

   Delete the lower part of the data with the same operation.

7. Work Prefs -> Home.
   Place CAD Home point upon the left alignment hole

   Changing the location of CAD Home point is necessary for the alignment of the upper part to the lower part.
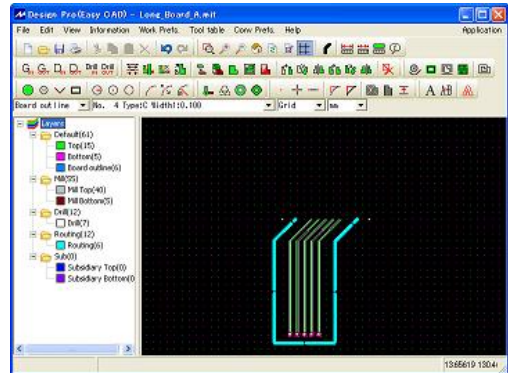
File -> Save As
Save this data as another different name.
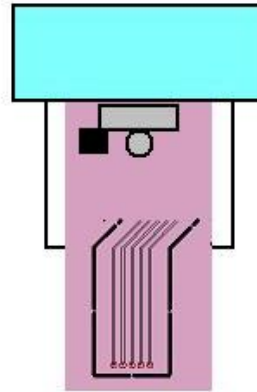
Milling Lower Part of board

Open the lower part of board data.

Go to CAM screen and milling this data as usual operation.

After finishing the job, slide the pc board to the front and secure it.
Take care that the alignment holes are inside the work area of the machine.

Align Upper Part of board

In order to align the upper part to the lower part, it needs to change the alignment method to CAD HOME.

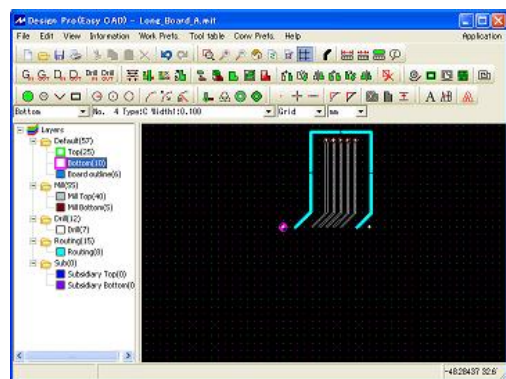CAM Prefs. -> Board maker screen in CAM, change Reference hole to CAD Home.

Open the upper part of board data.

Be sure that the location of CAD Home point is upon the left alignment hole.

Start Design View to see the camera display.

Click Start Job icon.

In Manual screen which you always set P1 and P2, (Click Adjust button in Top/Bottom Change screen) you will notice Set P1-P2 button at the right side of manual screen disppear and CAD HOME button appear.

Push Camera button at the upper left corner of the manual screen. It goes into Camera mode.
Move camera to the location of the left alignment hole, and then click CAD HOME.

When software ask you Align Angle ?, click Yes.

Click CAD HOME button on the same location again to register the left hole as the first point of angle.

Move camera to the location of the right alignment hole, now click CAD HOME button again. (third time)

Software caliculate angle of the board.
Close the manual screen and you can mill
the board as usual operation.

When you turn over the board for milling
bottom,
the alignment can be made using CAD
HOME button.