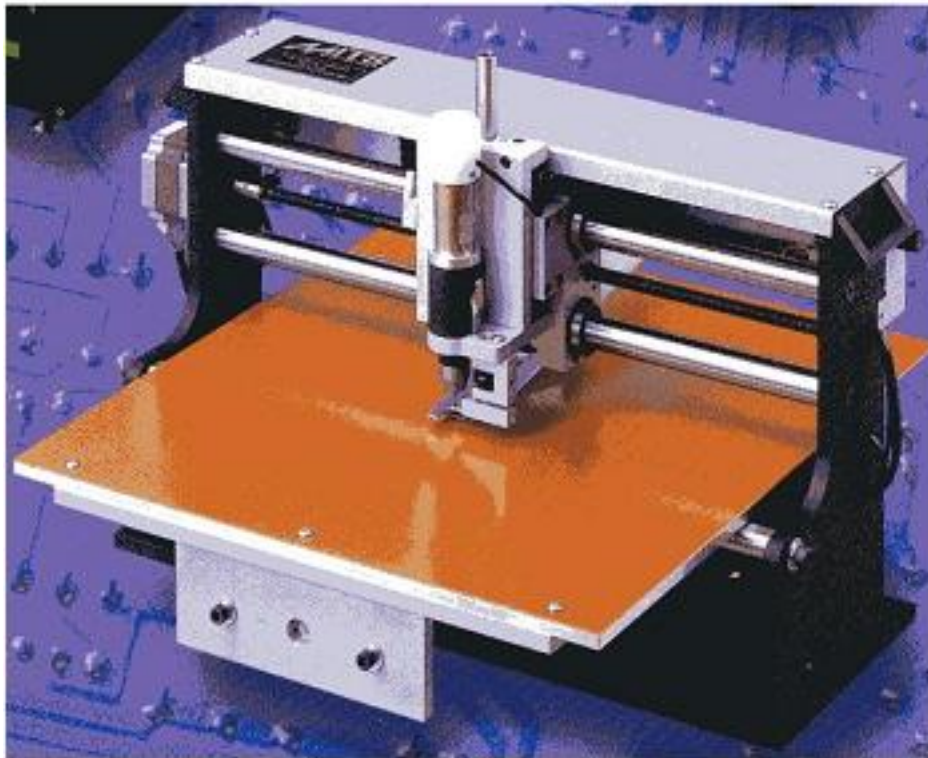


PCB Prototyping Machine

FP-7A / FP-21A



User's Guide
MIT S Electronics

Revision

091210 Bug Fixed: require Acrobat Japanese font pack

CONTENTS:

- [Notes of Caution](#)
- [Connect Boardmaker to PC](#)
- [Install Software\(mdp\)](#)
- [Registration\(mdp\)](#)
- [Start Up the System](#)
- [Change Application](#)
- [Trouble Shooting-RS232C](#)
- [Name of Parts of 7A](#)
- [Tools](#)
- [Preparing Tools for FR-4](#)
- [Set Adjust Method](#)
- [Display Milling Data](#)
- [Start Job \(Top\)](#)
- [Adjust](#)
- [Size of Board Material](#)
- [Set P1 point](#)
- [Adjust Depth of Cut](#)
- [Drill P1/P2](#)
- [Drill \(Top\)](#)
- [Milling \(Top\)](#)
- [Redo](#)
- [Mill Selectively](#)
- [Resume](#)
- [Turn Over Board](#)
- [Start Job \(Btm\)](#)
- [Align P1&P2](#)
- [Milling \(Btm\)](#)
- [Start Job \(Routing\)](#)
- [Home & Home2](#)
- [Home2 Example](#)

Notes of Caution



DO NOT get close to the board maker during milling.

Be especially careful 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 motor.



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.



SHIFT+ESC key to cancel waiting

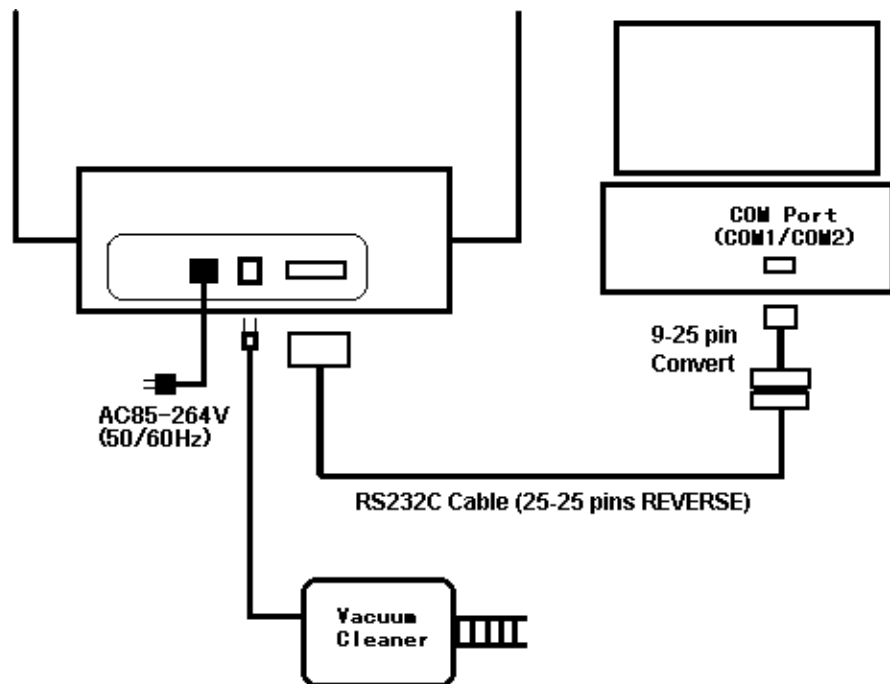
If you click the icon to start the communication to the board maker which is still turned off, the mouse pointer changed to the timer icon and keep waiting for the reply from the board maker.

In this event, press SHIFT+ESC key to cancel waiting for the reply. Ctrl+Alt+Del is not necessary.

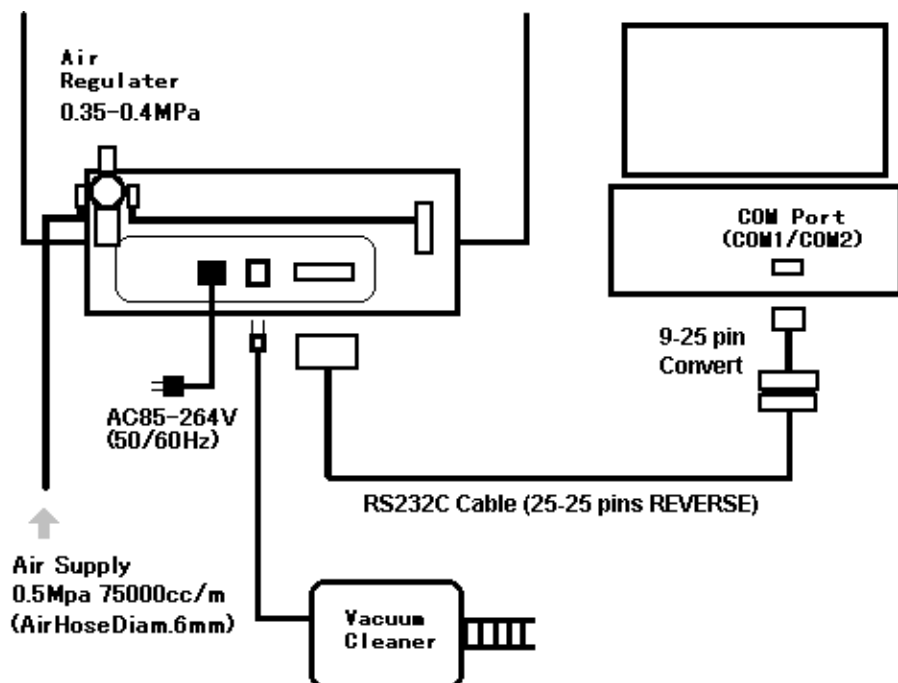
Connect Boardmaker to Your PC and Other Equipments

FP-7A

FP-21A



FP-21HP



Install Software

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

PC Specifications:

OS: Windows 2000(SP4 and newer edition)/XP Home(SP2)/XP Pro(SP2)/Vista
NOT supported in 64bit operating system.
RS232C or USB port is required.

Install Procedures:

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

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

Component Name	Request Space
<input checked="" type="checkbox"/> Common Component	9,986,645 byte
<input type="checkbox"/> CAM-21RS	22,974 byte
<input type="checkbox"/> CAM-Circuit2	23,000 byte
<input type="checkbox"/> CAM-T	22,992 byte
<input type="checkbox"/> CAM-TP	23,508 byte
<input type="checkbox"/> CAM-Z	22,929 byte
<input type="checkbox"/> DFM-300	23,429 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>.

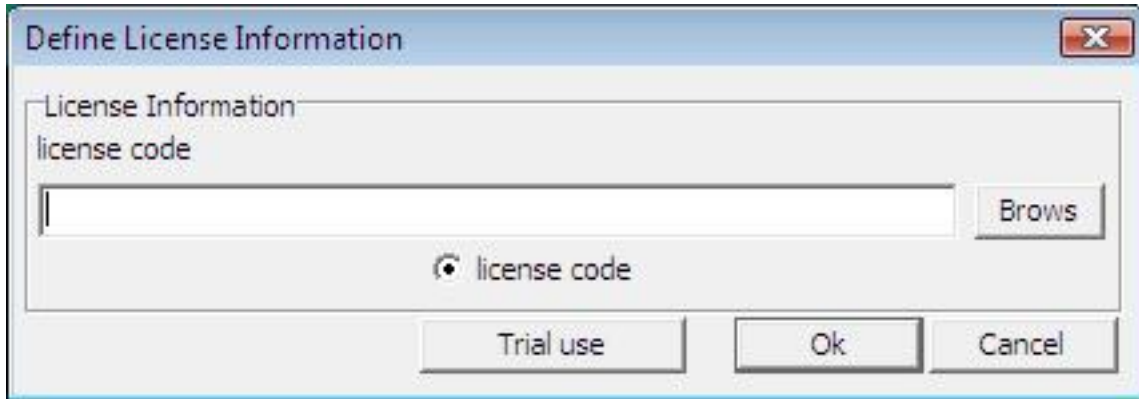
*CAM-TP controls FP-21T Precision.

*CAM-T controls FP-21T < including HP option>.

*CAM-Z controls Eleven Auto / FPZ-31AT / FPZ-73AT.

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)



1st License



2nd License



3rd License



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 Flash for Windows.
3. Turn on the Boardmaker.

At this time, the head automatically confirms the limits of the X, Y, and Z axis.

It then move to the initial point (home point) of the machine and stops.

This point is located at the far left, when facing the board maker.



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



Be sure the air supply if your board maker needs it.



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 operate the FP-7A / FP-21A, choose the application "CAM-21RS" in the Application menu at the upper right corner of the screen:

EasyCAD : Used for designing PC boards.

Converter : Converts Gerber, DXF.

CAM-21RS : Mills the board.



Before the milling operation with the boardmaker, it is necessary to prepare the milling data using EasyCAD or Converter.

Please refer to manual in CD-ROM for the detail operation.

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"

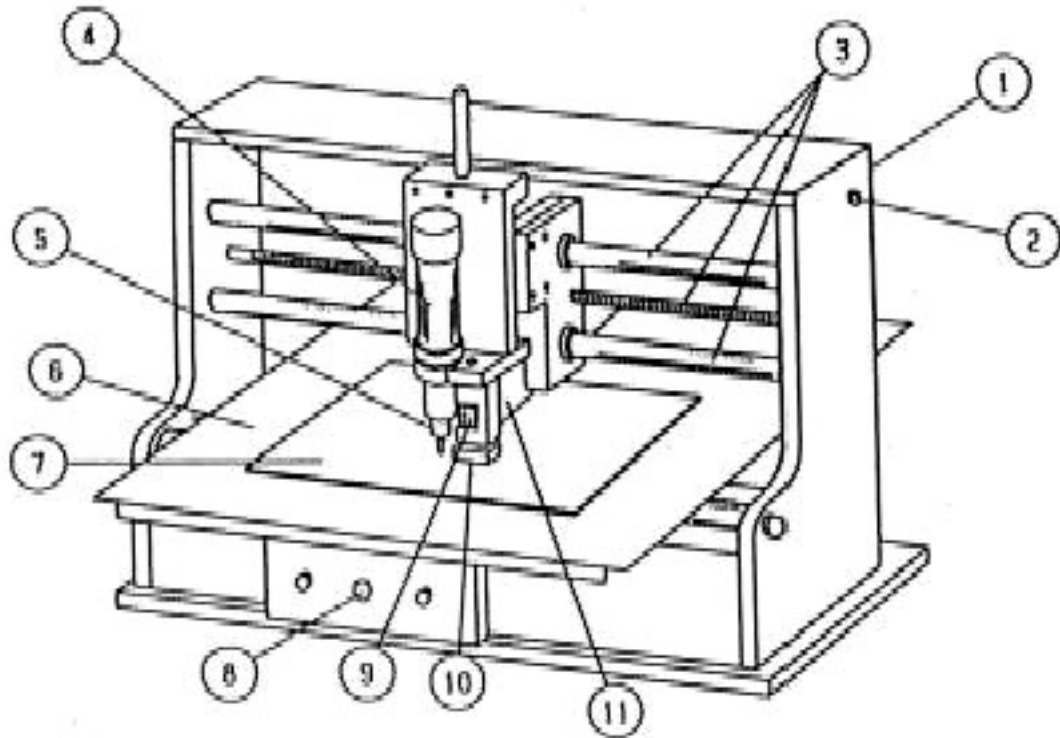
- Port No. is wrong.

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.

Name of Parts of FP-7A



1. Power Switch
2. Head Lowering Speed Adjustment Volume
3. X Axis Unit
4. Spindle Motor
5. Bit Holder
6. Underplate
7. PC Board
8. Y Axis Unit
9. Depth Adjustment Screw
10. Pressure Foot
11. Vacuum Duct

Tools

Types of Tool Bits



Milling cutter

Drill

Forming cutter

1. **Milling Cutter:**

It is used for engraving the copper surface.

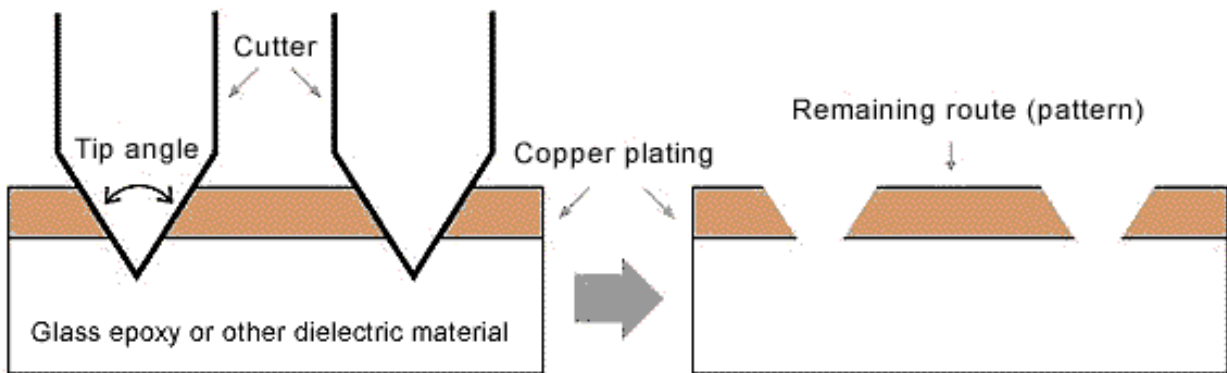
2. **Drill:**

It is for making holes.

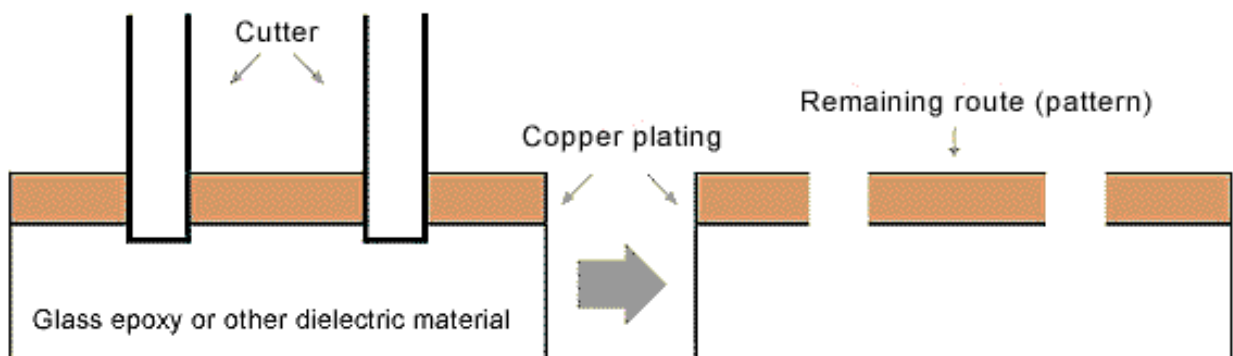
3. **Router (Forming Cutter):**

It is used for routing the outer shape of the board.

When milling with a Milling Cutter



When milling with a High-frequency (RF) Milling Cutter



Advantages Good high-frequency characteristics
Channel width does not change with milling depth

Disadvantage Thin cutters break easily

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.

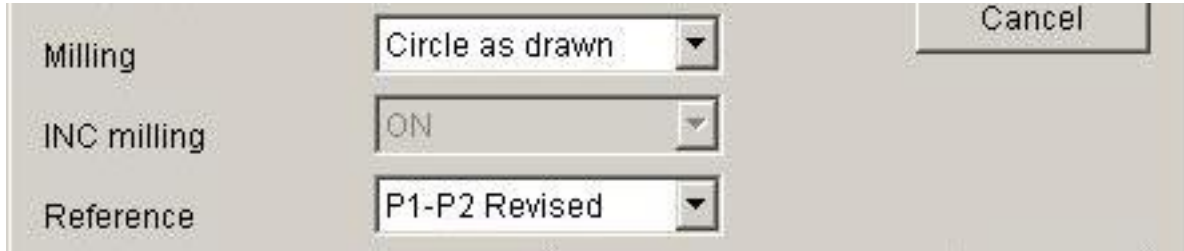
Choose Information -> Tool List.

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.

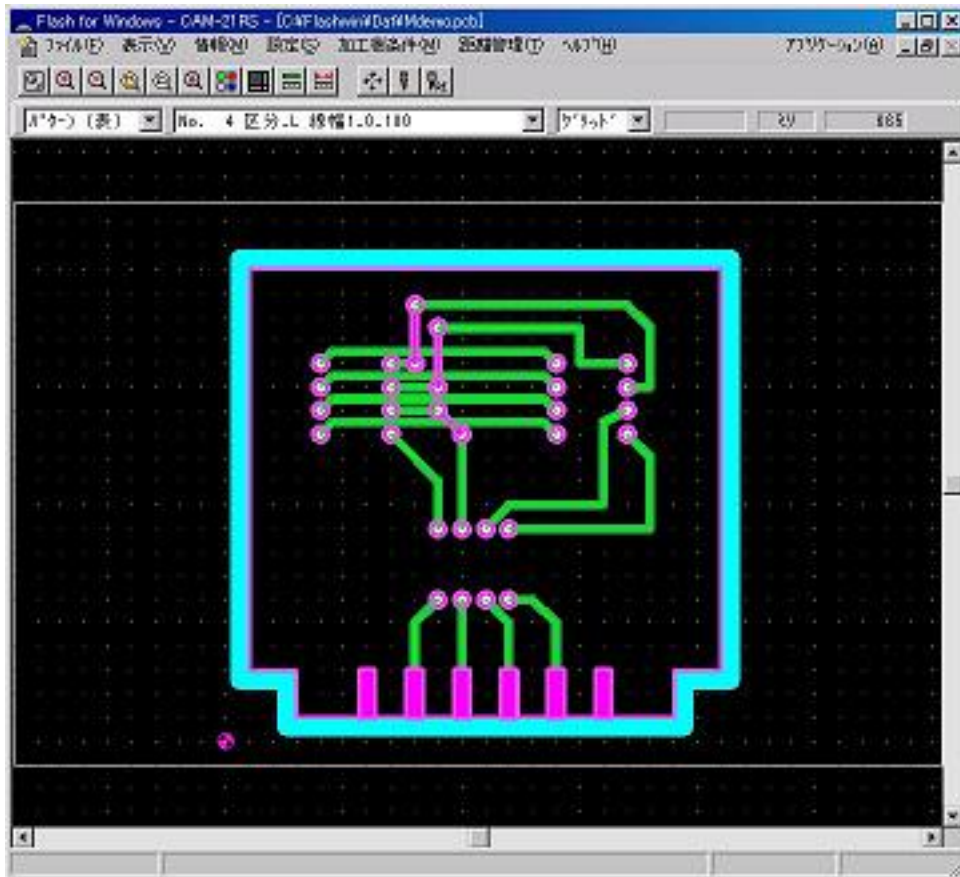


P1-P2 Revised is one of the adjust (alignment) methods and the further operations will be explained later.

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.

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

- Drill (Top)
- Mill outlines (Top)

>>

<<

Sort by direction

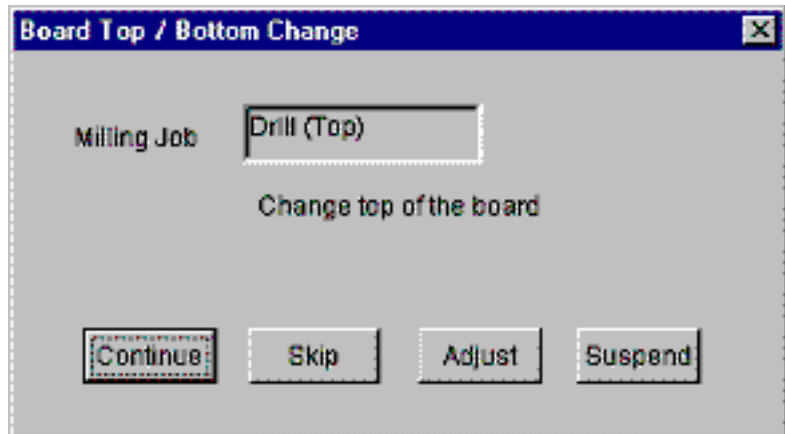
For this example, select:

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

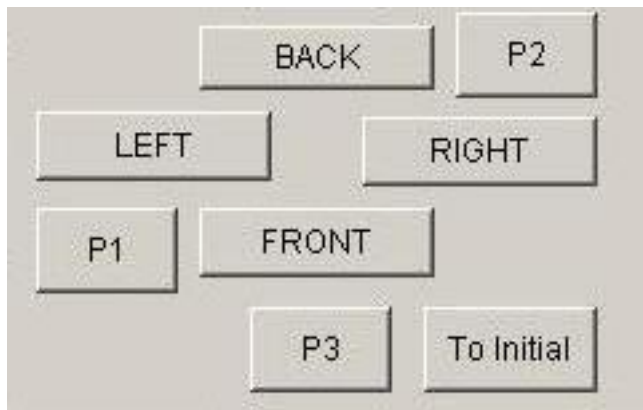
Click OK.

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.



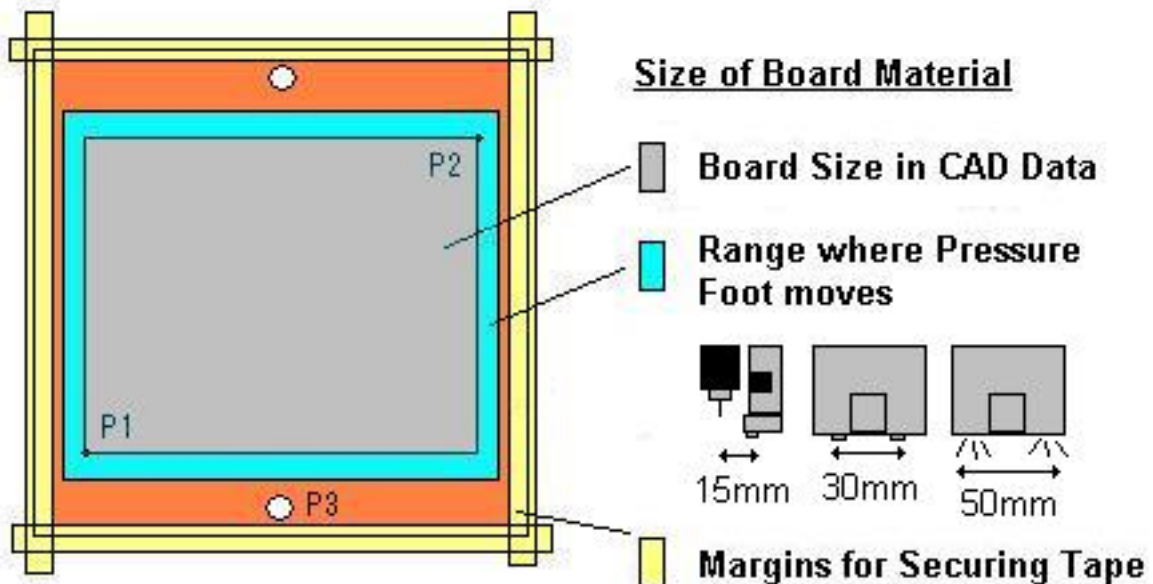
Click Adjust to call up the Manual Operation screen.



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.

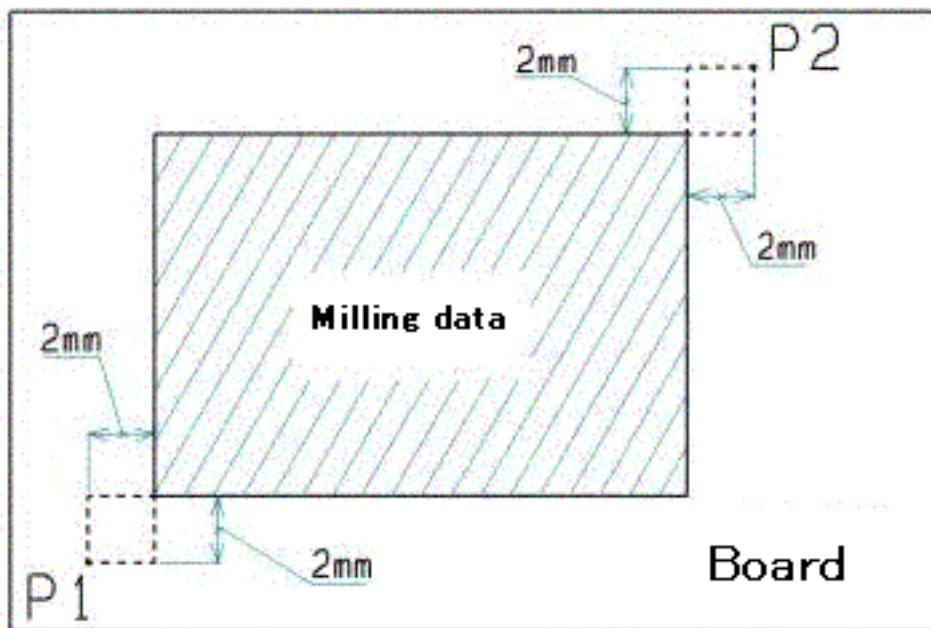
Put board on table and secure it with tape.

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 HOME button, and that point 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 HOME.



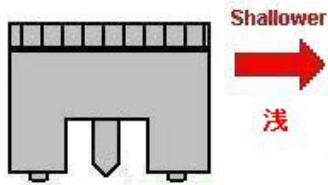
It is very important to check the location of P2.

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.

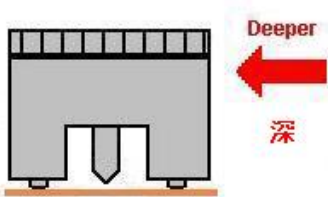
Change the tool to milling bit.



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

Move the head to the outside of P1-P2 milling area.
(using 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 tip of bit touch the surface of board.

In this position, press one of the move buttons once and a trial cut will be made.

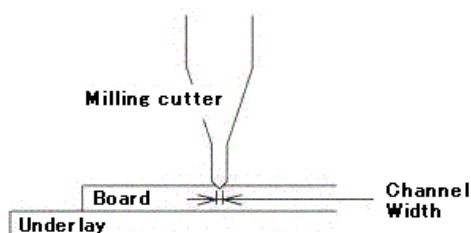
Click UP to raise the head.

Turn OFF the spindle motor.

Move the head to the position where 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.



Drill P1 and P2 point

After setting the reference point, we need to drill 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 the milling area.

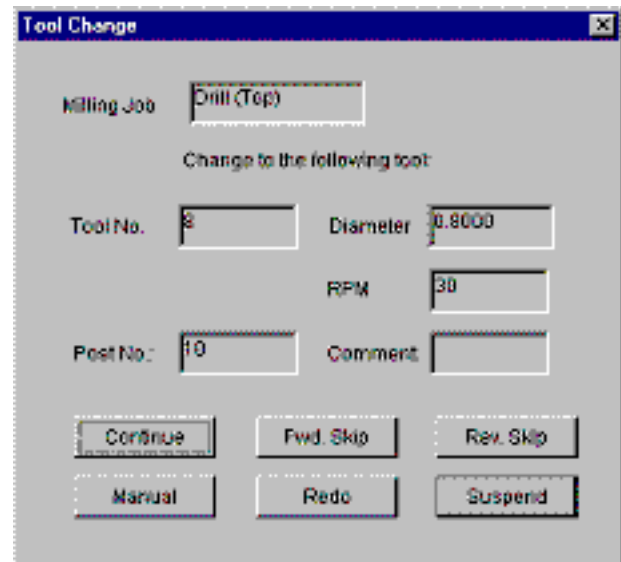
- Attach the drill to be used for drilling the holes.
For example, 0.8mm drill.
- Click on Hole Make and the head will move the P2 point.
And then a message "Ready to make holes on P1 and P2?" will appear.
- Click Yes on the message screen and the head will start to drill holes on P2 and P1.
- After 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)



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.



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

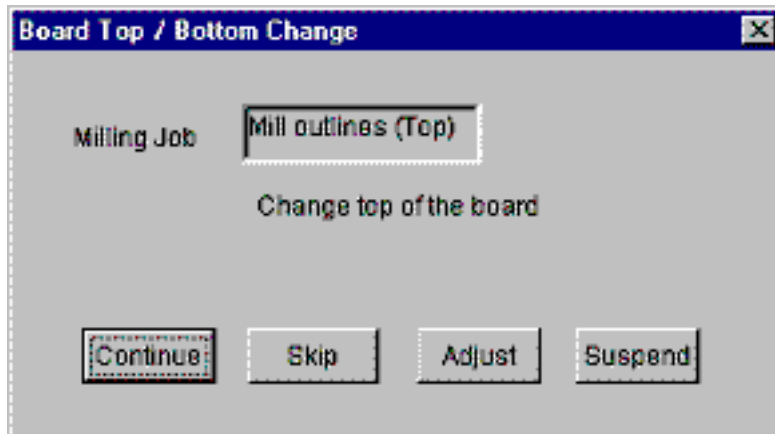


To interrupt the milling operation, press ESC key. After finishing the milling data which has been already sent, the operation will stop.



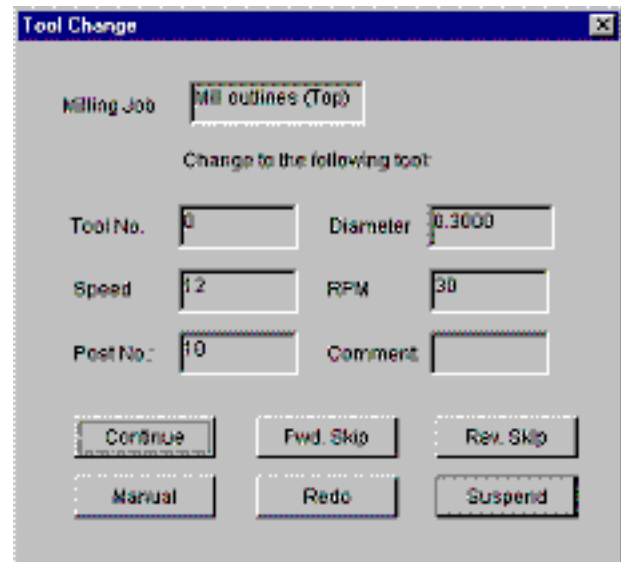
If emergency stop is needed, turn off the power switch.

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.



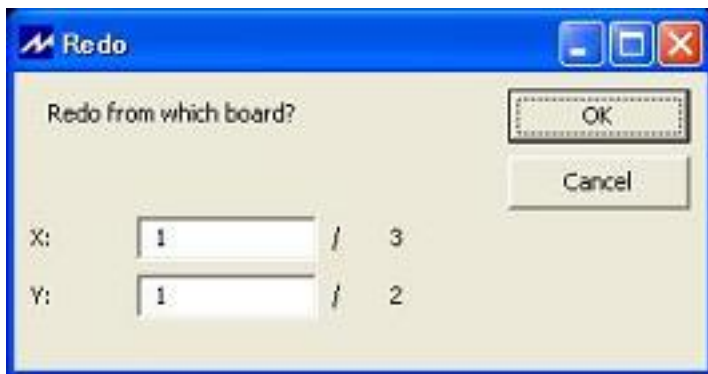
Redo

In the event that a drill or milling cutter breaks during milling or you find there is still part 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.

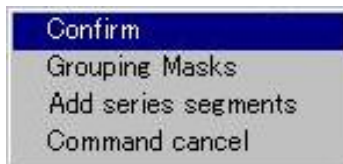
The difference is that it needs an operation to select area to be milled.

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

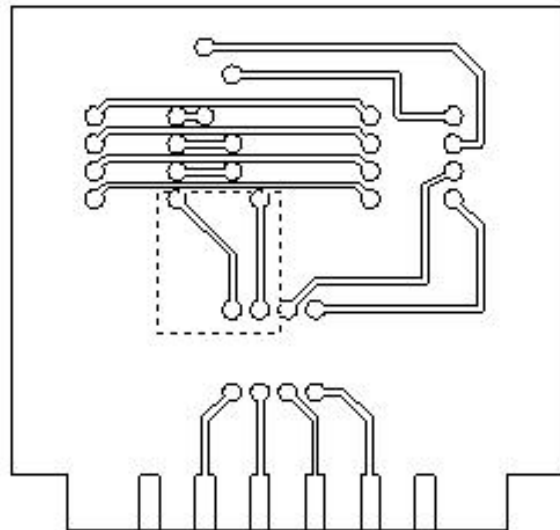


Click on an element or drag rectangle so that element(s) change its color. It is "selected".

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

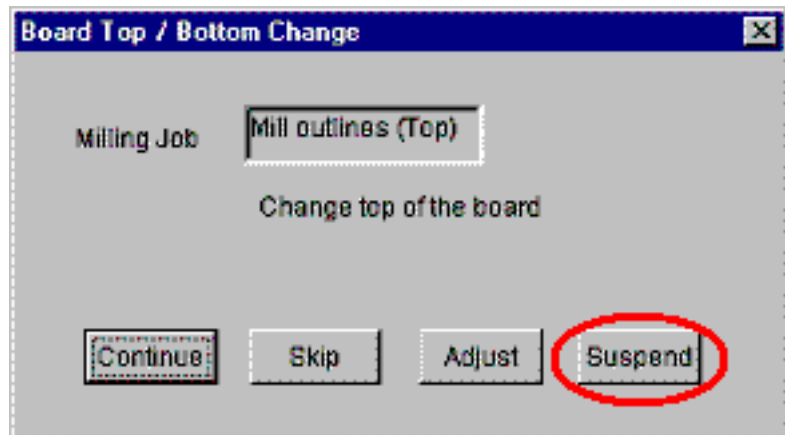


The rest of operations is same as the usual one. The software will mill only the selected area.



Resume

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



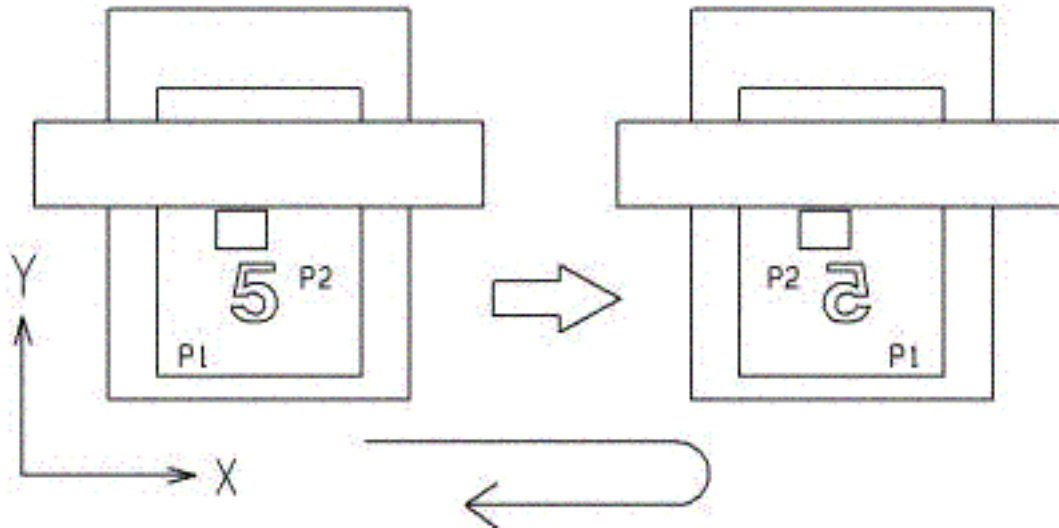
You can resume job by Resume icon.



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

Turn Over Board

Turn over the board as illustrated below.

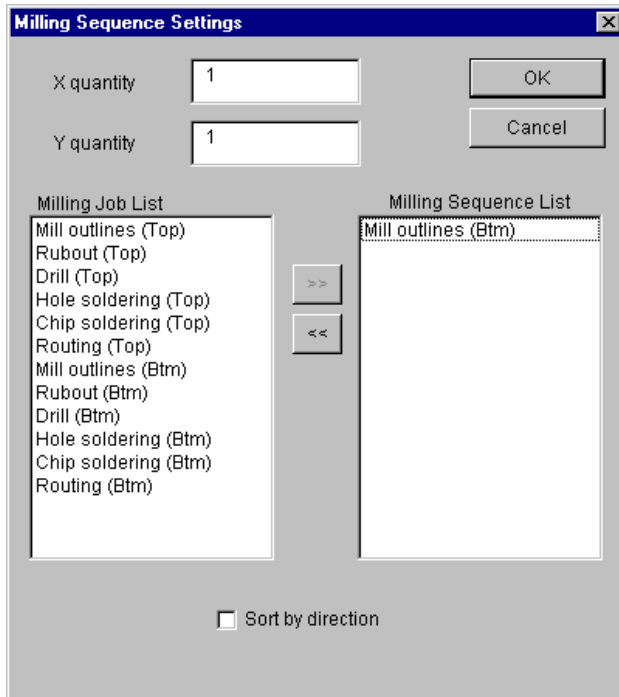


From TOP view, P1 is located on the front-left.
From BOTTOM view, P1 is located on the front-right.

Start Job (Bottom Side)



Click Start Job icon.

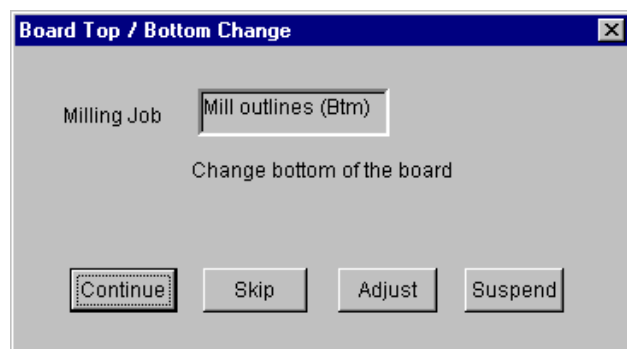


For this example, select:

1. Milling outlines (Btm)

Click OK.

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



Align P1 and P2

Adjust

Click the Adjust button in the Board Top/Bottom Change screen to call up the Manual Operation screen.

- When the "Move the head to P1 and click Home" message appears, click on the appropriate move buttons (FRONT, BACK, etc.) to move the head to P1.
- When the drill is at the location where it can go straight into the hole, click on Home, and the system will recognize the point as P1.
- Then use tape to secure the board in place.
- When the "Align P2?" message appears, you must set P2.
- Click on OK, and the board maker will recognize that the board has been turned over in parallel with the X axis, and the head will move to P2.
- Now change the movement distance for each time a Move button is clicked to either 1 mm or 0.1 mm, and move the drill to the exact location of P2.
- Once the drill is aligned with P2, click Home so that the software recognizes where P2 is located. The software then calculates any deviation in board alignment and compensates as needed.
- Click OK to close the Manual Operation screen.

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.

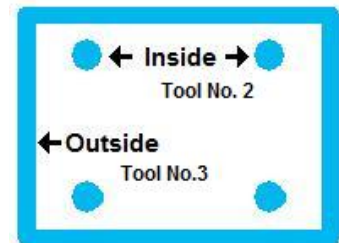
And then select Routing (Btm) in the Milling Sequence Settings screen.
Click OK.

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.

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

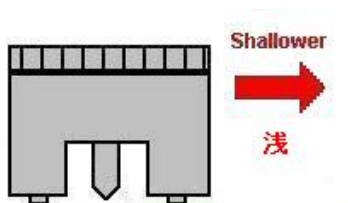
And also, tool No. for Inside should be smaller than one for outside because contour routing will process smaller tool No. first.



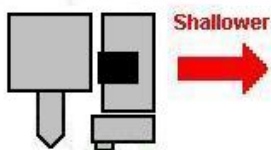
Please refer Converter and EasyCAD manual for how to generate routing data.

When routing inside data, the depth of cut is same as drill.

When routing outside data, adjust the depth of the tool so that milling is made slightly shallower. Shallower milling will ensure that the board does not pop away and that it doesn't leave the scur on underlay.



Turn the adjustment screw shallower one round and more 15-20 notches so that depth of cut become 0.5 mm + approx. 60um shallower.



Turn the adjustment screw shallower one round and more 5-6 notches so that depth of cut become 0.5 mm + approx. 60um shallower.

Difference of HOME and HOME2 button in the Manual Operation screen

HOME button

HOME button is used for setting of P1 location in P1P2 method or setting of P3 location in P3P4 method.

In the P1P2 method, the software automatically corrects the angle, and this angle correction information that had been set is held in memory by CAM.

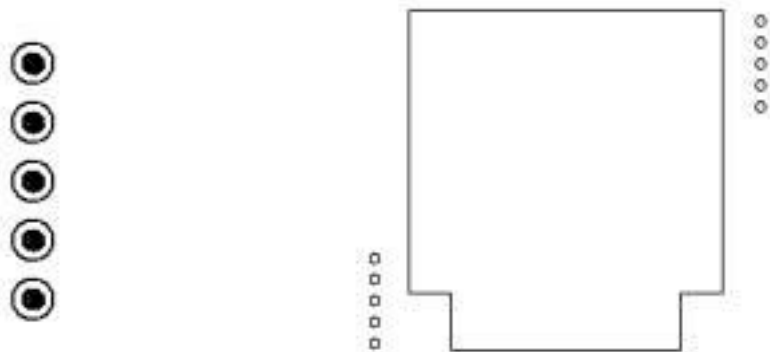
Also, this angle correction information is cleared from memory when a new P1 location is set (HOME is pressed again).

HOME2 button

HOME2 is clicked when a fine adjustment for P1P2 is needed while angle correction information is still being held in memory.

Example of Precise Adjustment using HOME2 Button

Create some pads in advance which can be used for adjusting the board.



Board adjustment pads Locations of "Board adjustment pads" on the board

Use EASYCAD to create pad data for use when adjusting the position of the board, and save them a part. (Save them as a part after generating the outlines.)

When the data for the board to be milled is all complete, place one group of adjustment pads near P1 and the other near P2.

When milling the bottom of the board after milling the top, first mill only the "Board adjustment pads".

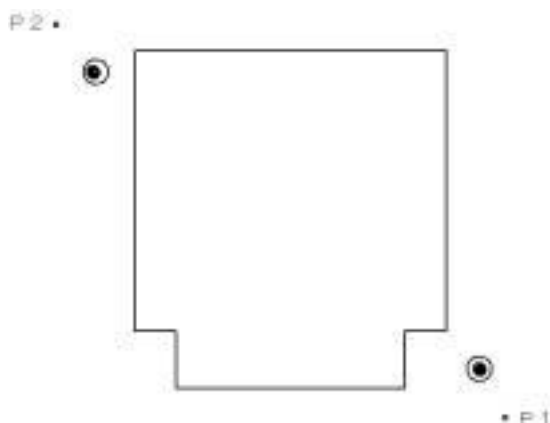
After checking the milled results of the adjustment pads, check to see if any angle correction is required.

If angle correction is not necessary, continue milling the rest of the board.

If angle correction is needed, interrupt (suspend) milling first.

And then start from the beginning to adjust P1/P2 location again.

Milling Example 1: Leave P1 as is, and move P2 0.1mm to the left.



Message: < Move to P1, click HOME >

--> Click HOME2.

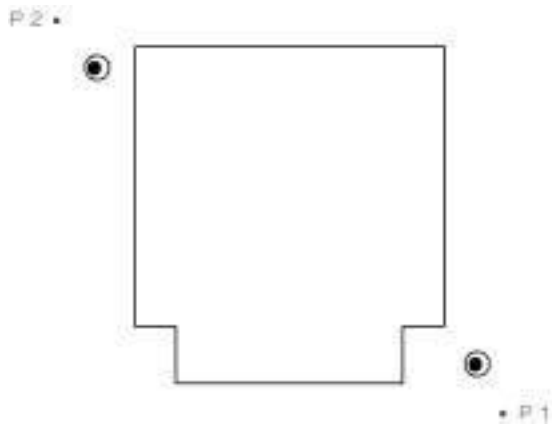
Message: < Align P2? >

--> Click YES.

Message: < Move to P2, click HOME >

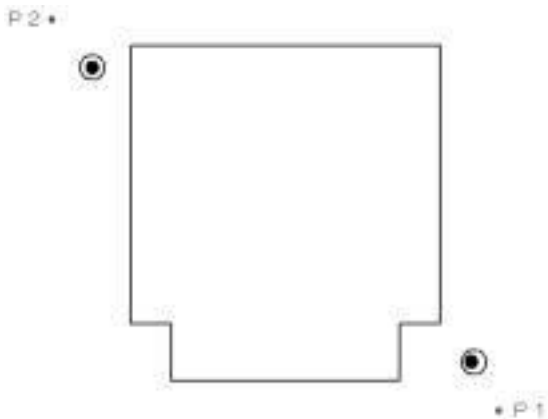
--> Click HOME.

Milling Example 2: Move both P1 and P2 0.1mm to the left.



Message: < Move to P1, click HOME >
--> Move 0.1mm to the left.
--> Click HOME2.
Message: < Align P2? >
--> Click NO.

Milling Example 3: Move P1 0.1mm to the left and leave P2 as is.



Message: < Move to P1, click HOME >
--> Move 0.1mm to the left.
--> Click HOME2.
Message: < Align P2? >
--> Click YES.
Message: < Move to P2, click HOME >
--> Move 0.1mm to the right.
--> Click HOME.



When P1 is moved, P2 is also moved.
Therefore, P2 must be adjusted back to its original location.