1 Double Sided process

Design the board in KiCad/Eagle/etc as usual. Export gerber files for top and bottom copper layers, edge cuts, and a drill file.

1.1 Turn on the Protomat machine and put vacuum power switch in auto (top) position.

1.2 Open CircuitPro and create a new "Double Sided No THP" project

1.3 Import Layers into Circuit Pro and assign to template layers

By way of File - Import, load the three .gbr gerber files and the .drl drill file generated by the PCB Layout editor.

Assign them to the correct default layers:

Aperture File	Layer/Template
B.Cu	Bottom layer
F.Cu	Top Layer
Edge.Cuts	Board Outline
Drill	Drill unplated

1.4 Place Fiducial holes (not necessary)

in CAM view, the view offset (anchor point) can be set through the Edit menu.

Fiducial holes may aid the alignment process in pcb routers with a camera system, ours does not have this, and the alignment works by assuming the 2.95mm holes at top and bottom are in the correct place after flipping the board later.

These holes can be placed by clicking the cross-hair icon and entering a position.

1.5 Save project

I just save as cbf file with the same name as the pcb project, in the same folder (default).

1.6 Generate Tool-paths

Click the corresponding tool path generation button.

Select the options:

- Insulation: basic, pads double.
- Contour Routing: Corner gap.
- tick all tool paths to be generated (all of them).

Press the start button, and review any warnings. 2.5D milling warnings should not affect us - the machine does not support this, and it is not used in our files either.

Warnings may include features that are too close together.

1.7 Go to machining view, and process all steps.

Select "Process all" from the drop down and press the green button. A series of setup steps follows before the machine actually starts moving.

1.7.1 Insert Material and fix with tape

place the copper clad board in the machine so that the holes snap into the holding pins, and affix the corners with paper tape so it cannot fall off.

1.7.2 Define Material type

The material shipped with the machine is FR4, 35um copper, of 1mm or less strength.

The material we have bought is thicker, d=1.6mm, but otherwise the same.

1.7.3 Placement: Drag the board outline to the desired position, in a clean area

The "Mouse Cursor" button allows us to click the work area representation and make the machine head move there. This is useful for estimating the offsets in relation to previously used areas of the board.

1.7.4 Follow drilling/routing instructions for tool changes, and adjust milling width.

As soon as OK is clicked in a tool change dialog, the machine starts moving, so make sure

everything is tight and safe before doing so.

At the first universal cutter stage (marking drill holes?), the option to calibrate the cutting width is given. This is important as there are small variations to the material thickness.

A small line can be cut with the current settings in a clean area (type an offset) and this can be inspected with the microscope. Cuts should be 0.2mm thick. If it is too thin or too thick, the height of the toolhead can be adjusted by turning the adjustment screw knob. I found adjusting it by 10-20 measures between each calibration line was quite a good step size.

2 Bare boards preparation (Drill alignment holes)

We ordered this Copper Clad Double Sided FR4 Fibre Glass Board 203 X 305mm.

It is 1.6mm thick with 35um copper coating on both sides. It is a bit smaller than the supplied boards (short edge is maybe 20mm shorter). It has no pre-drilled holes for alignment.

2.1 Remove alignment pins and place material

Move head to safe parking position.

Remove old material.

Use flat head tweezers to carefully remove the alignment pins from the red strips (do not move the red plastic strips however). Place pins in the tray next to the red strips for safekeeping.

Place one sheet of white backing material, on top of this place the new copper clad sheet.

Secure these with tape approximately matching the positions of the desired alignment holes but this is not crucial. It should be parallel to the machine edges though.

2.2 Insert 3mm spiral drill tool

Move machine to 0 position first.

Insert the tool, and tell the software (CircuitPro) that the tool has been changed. There is a tool-change button in the menu bar, click that and select the 3mm drill.

2.3 Adjust depth limiter so drill can go through material (just barely touch backing material)

Make sure the depth limiter is set up so the drill can go only just through the material. This is

the same adjustment that would be used for calibrating the milling width so we need to make sure to re-do that after!

Might have to judge this by eye or drill a test hole first as the machine head cannot be moved into material without switching on the spindle, when a tool is mounted.

2.4 Position head for drilling holes

Move head to home position - this will be close to position of first hole.

Ensure Z position is 0.1 or 0 (head up) so the tool does not hit the surface when moving around.

The holes are to be 295mm apart and should be centered, 5mm from the short sides of the materials.

Enter a number of millimeters to move next to the arrow keys.

Use the arrow keys to position for the first hole at the bottom edge of the material.

Then move 295 mm towards the top edge to confirm positioning of second hole is still within material (should also be 5mm from edge).

2.5 Drill holes

Make sure the right tool (3mm spiral drill) is selected in the software and placed in the tool head).

Turn on spindle (might have to turn on/off extractor fan and wait a bit, or reconnect, to enable the button?).

Wait a few seconds for it to warm up, then press the head-down button. It will drill a hole and come up a bit BUT NOT ENOUGH TO MOVE!

Turn off spindle.

Move Z axis up by 1.1mm or until highest point. Z position should read 0.0 or 0.1.

Move 295mm towards second hole by entering the number 295 and pressing the direction key once. This ensures no sideways moves are made and the distance is exactly 295mm!

Turn on the spindle, move head down, move head up (Z = 0), turn off spindle.

It can now be returned to parking position and the board is finished.

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