

PCB etching

Helena Pliszka, Blaise Thompson

March 30, 2020

Contents

1	design considerations	2
2	standard operating procedure	3

Part of the training materials prepared by the [Chemistry Shops](#) at UW–Madison.
This document was prepared using [L^AT_EX](#).
Source code and all associated files can be found at git.chem/shop/training/pcb-etching.
If you find any mistakes or feel that any information is missing, please [open an issue](#).

1 design considerations

We have the ability to make printed circuit boards (PCBs) in house. The end product is not typically appropriate for long term use, but the very short turn-around time makes in-house printing an invaluable prototyping tool.

We can print circuit boards up to 150 x 230 mm (6 x 9"). Printing cost depends on the size of the board:

- quarter (up to 75 x 115 mm) \$20
- half (up to 115 x 150 mm) \$30
- full (up to 150 x 230 mm) \$40

These flat prices include the cost of materials and staff labor.

Typically, boards can be printed in one day or less.

Use a PCB layout program like KiCAD to plan your board—ask a staff member for help if you are unfamiliar with these programs. We use photolithography to create our boards. Our boards are limited to two layers, and do not have vias. With these limitations in mind, the following guidelines are recommended when designing your prototype:

- use 35 mil (or larger) traces for power and common
- use 15 mil (or larger) traces for signal
- for typical components, use pads with 50 mil outer diameter and 39 mil hole diameter
- many components cannot be soldered from the top of the PCB—for these, ensure that connecting traces approach from the bottom
- avoid right angles in your traces, use two 45 degree bends instead
- mark 0.125" diameter circles at board corners for #4 standoff mounting screws

Once you are finished laying out your board, email it to Blaise (bthompson@chem.wisc.edu) for printing.

You will receive your board without any holes. Use the a drill press to make holes for all of your components. Ask a staff member for help if you are unfamiliar with this process. Drill all your holes and dry-fit your components before doing any soldering.

Typical components require a #65 drill bit. For 4-40 standoff mounting screws, use the large drill press and a 1/8" bit. When in doubt, use a pair of calipers to measure the component legs and use the next largest drill in the following table:

drill bit	diameter	typical usage
70	28 mil	integrated circuits, sockets
65	35 mil	discrete resistors, capacitors, diodes etc
60	40 mil	wire, large components
1/8	0.125"	#4 machine screw through holes

Enjoy your prototype! We hope that it works exactly as expected.

2 standard operating procedure

Personal protective equipment:

- lab coat
- goggles
- gloves

Setup:

- Turn on heating for copper etchant bath, since takes a while to warm up Align transparencies on well lit fume hood window and tape together with scrap board in between to mimic board thickness
- Turn off light sooner to let your eyes adjust (once don't have to leave room anymore) Pour about $\frac{1}{2}$ inch of 9:1 developer into bin

Board Exposure (room must be dark for all steps)

- Look through previously cut pieces for size match – if need be trim with heavy duty paper cutter
- Peel off protective sticker (will take off some photoresist too unfortunately)
- Place in between transparencies and lay in UW exposure box (carefully open/close box, lid is very heavy)
- Leave to expose for 6 minutes on dial

Developing

- Turn room light on
- Remove board from transparency enclosure and set in developing solution
- With your thumbs holding the board in place, slosh the solution over the board (if the board slides, it will be scratched)
- Flip board to ensure even washing
- Watch blue photoresist wash off

Quenching

- Rinse board gently with DI water (comes from hose)

Etching:

- Loosen one screw on etchant bath holder
- Tighten the circuit between the two plastic channels, resting it on the lower metal stops
- Tighten screw, ensuring circuit will not fall out of place
- With $\text{Na}_2\text{S}_2\text{O}_8$ bath around 40C, lower circuit into solution and switch on “stirrer” that will bubble air through the bath
- Check every 15 minutes, for roughly an hour till copper color goes from gold → salmon

pink → yellow (make sure not to overexpose)

Finalization

- dry circuit
- cut to size
- deliver to customer