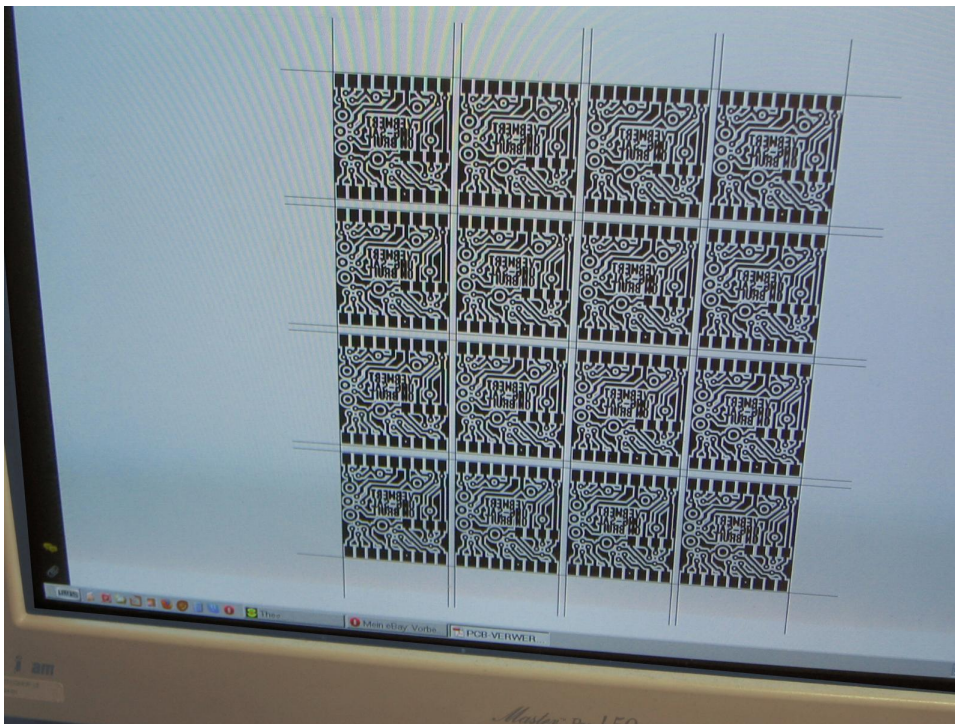
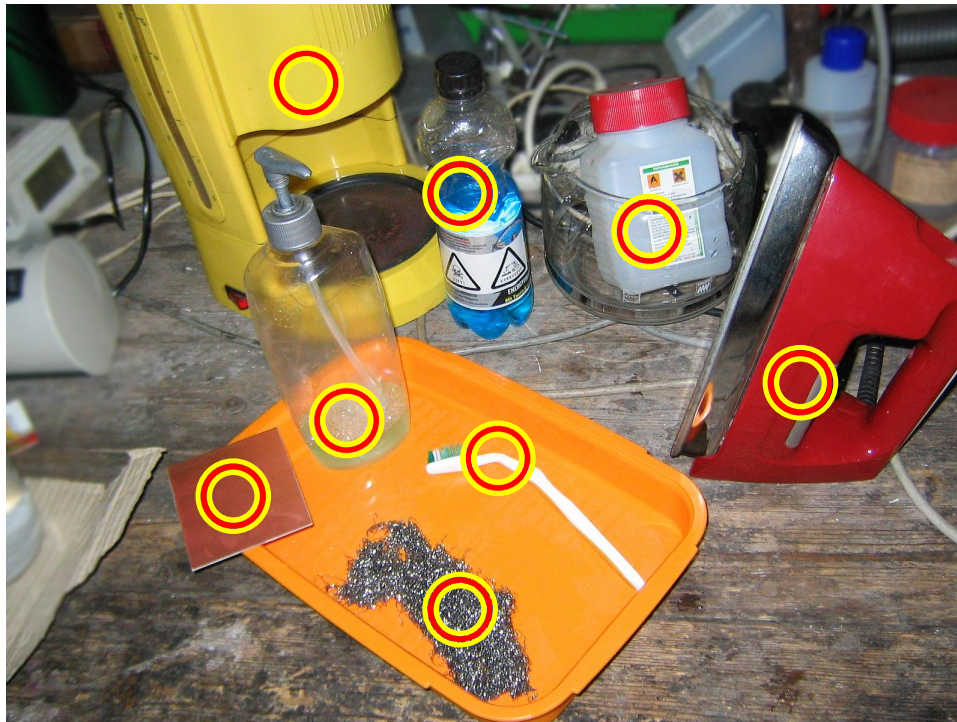


A Walkthrough of PCB Production with the Toner Method



Artwork Design:

I usually use a maximum resolution of 0,3mm (~ 12 mil, milli-inch) - MIRRORING is important when printing..



Collection of Materials:

Sodium persulphate, $\text{Na}_2\text{S}_2\text{O}_8$
 $\text{Na}_2\text{S}_2\text{O}_8$ solution, 260g/l, etchant
 Hot Iron
 Heat-bent toothbrush
 Stainless steel wool
 Copper clad board
 Detergent/Dishwash, 1:10 diluted
 Coffee machine



Preparing the raw Board: (Scrubbing)

Cut the PCB piece with a strong box cutter, beaking it sharply over the edge of a table. Then file away excess copperfoil at the sides of the board that everthing is really flat.

Coarse stainless stell wool is best for scrubbing the board clean and smoothing the sides and edges - use with some dish wash.

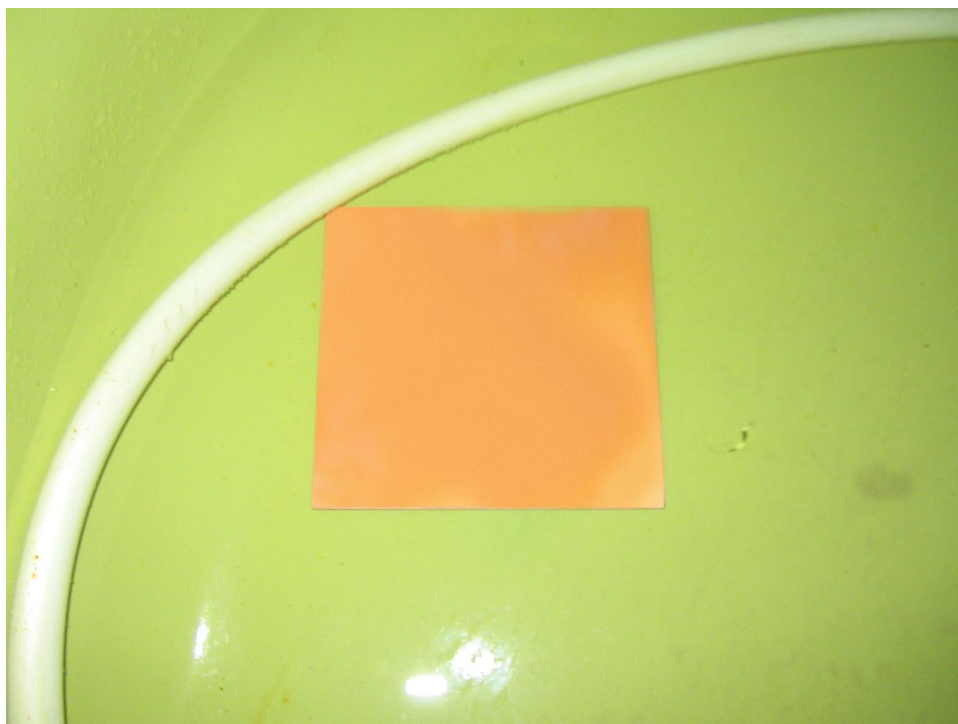
Rinse with clean water & dont touch the surface afterwards.



Preparing the raw Board: (Clean Etching)

Warm up the Sodium persulphate etchant solution to 50°C.

Put the PCB in for less than 1 minutes that you can see it getting pale matte.



Preparing the raw Board: (Watering)

Without touching the surface **QUICKLY** throw the board into clean water to rinse.

If it is too long outside the etchant, you get a discoloration.

I try to avoid that. If it happens, just repeat etching for some seconds to clean again and water **QUICKLY**.



Selecting suitable Paper:

Now it's about the paper. Choose paper from a high quality print magazine. The desired material should be matte, smooth and **coated**.

The paper is "coated", when it is covered by a mineralic layer (kaolinite or calcium carbonate).

You can easily identify it by burning a piece of the material recognizing a brittle, greyish white residue - unlike newspaper or photocopy paper, which just burns away.



Laser-Printing Artwork:

Use a laser printer and print your (mirrored) design onto this coated paper.

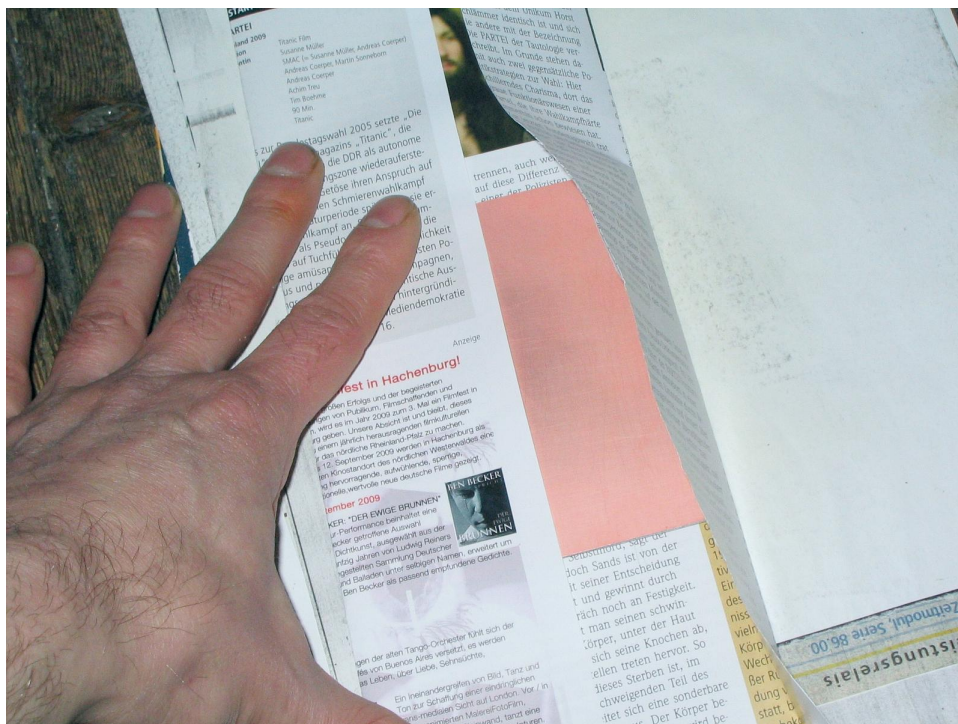
Usually I used settings like 600dpi (300 should also work) and **maximum toner density** (darkness).

Try to avoid color printed places on the paper - these will be more difficult to clean later..

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Folding the Paper:

Align the board on the design. Here trackmarks at the corners are very helpful. Then just fold the page sharply around the board in a **u-form**.

(Double sided boards are done by first folding the paper once in a v-form and then aligning the board in this "pocket". Keep it in this position until you touch it with the hot iron - a moment after the first touch the sticky toner keeps the PCB in position, then heat both sides for ca. 90 seconds.)



Ironing the Artwork: (Heating)

Set the hot iron to **maximum** (linen cloth).

After the first run over with the iron the laser toner will melt and stick the paper to the board -> no danger of unintended shifting from this moment on.

The thorough connection of PCB with the toner is crucial and may need some **practice**.

I usually apply "the weight of my arm" pressure when ironing the artwork for about two minutes, especially running the tip of the iron along the sides of the board.

Harder pressure insures better connection, but you also may squeeze the toner and tracks may get wider. This application of force is what needs **practice** and can be varied according to your track resolution.



Removing Paper Carrier: (Soaking)

Put the board with the attached paper into a container with (warm) water and some dish wash. This will quickly soak the paper.

Usually after a minute it is easy to pull off the outer layer of the paper.



Removing Paper Carrier: (Rubbing)

The rest of the paper is quite easy to rub off with your thumb.

If needed spray on some extra (diluted) dish wash for better soaking or rinse with some clean water when it gets too slippery.

If all paper is rubbed off, wipe dry the PCB and have another visual inspection: You will notice that there is a light haze over the tracks and the copper - this are the remains of the papers mineralic coating.

Spray the Board again and thoroughly brush the coated copper areas with the aforementioned bent toothbrush.

The coating will come off as a milky liquid.

This all needs a **little practice** but is easier to accomplish than it sounds..

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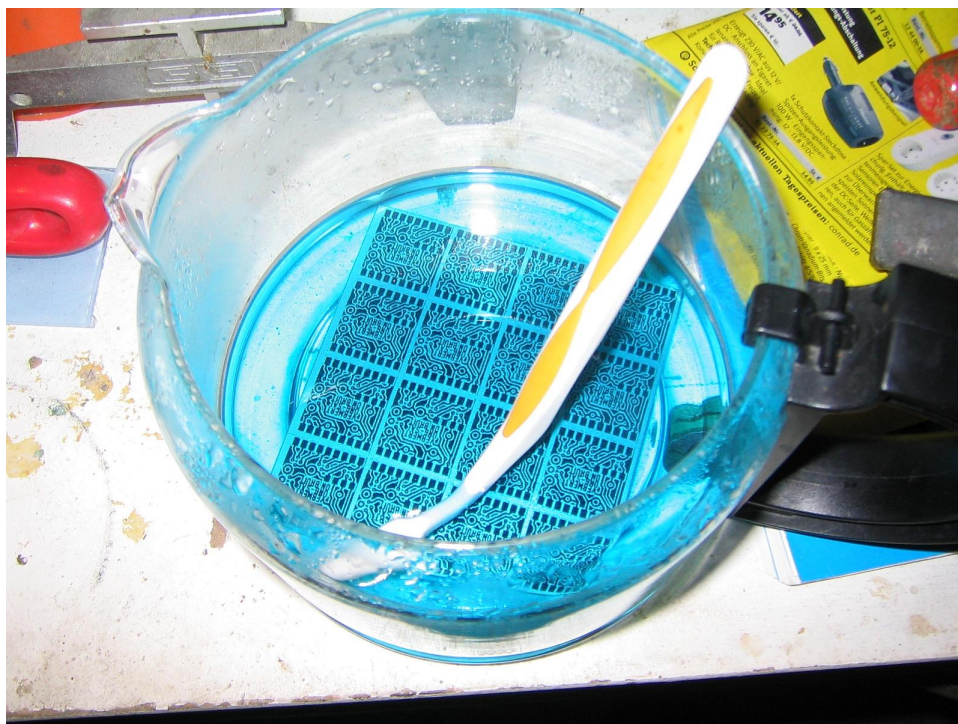


Examining Artwork: (Eye Balling)

Visually (magnifying glass may help) examine the board for smeared toner and unwanted connections (too much pressure and/or too hot), broken or missing tracks (uneven pressure or uneven first cleaning/etching).

Some touch-ups with an etch-resistant pen (sharpie/edding etc) are possible or cutting connections with a needle or sharp blade tip.

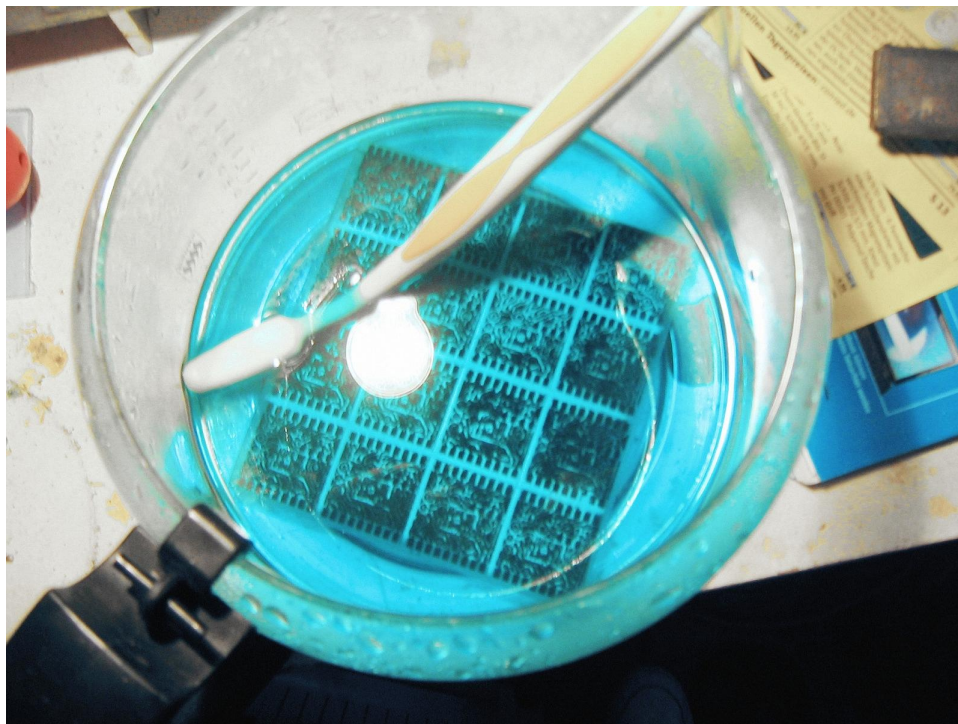
If unhappy with the outcome, just repeat from the beginning, which should take you (after some practice) just 15 minutes more..



Etching Artwork: (Pattern Etching)

Put the clean PCB into 50°C warm etchant.

To increase etching rate I rub over the surface with a bent toothbrush - you will see different structures have different etching rates.

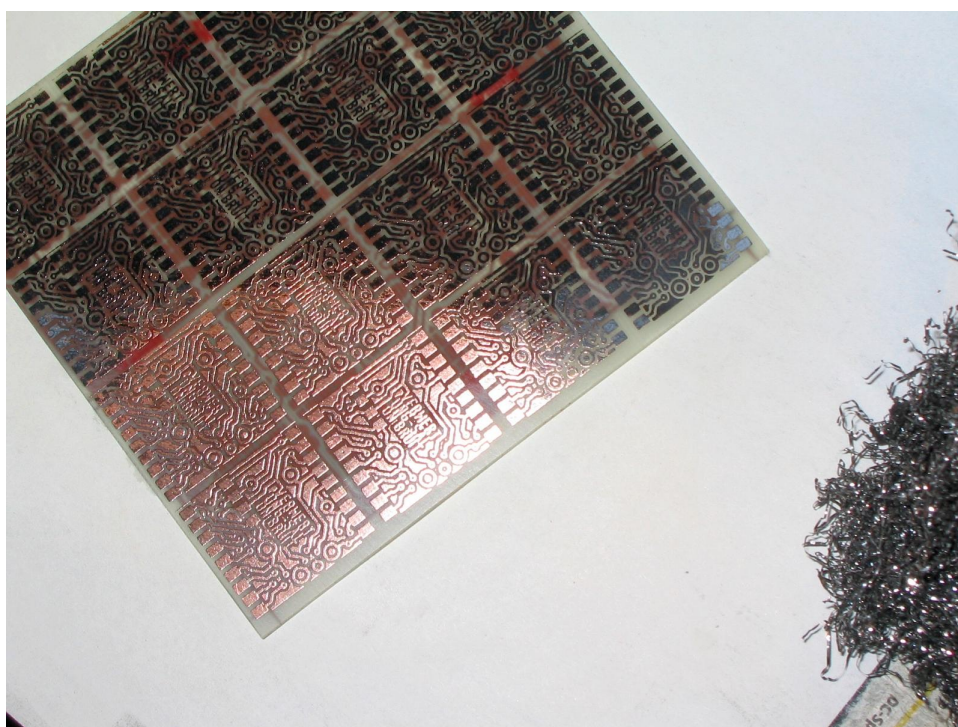


Etching Artwork:

After 2 to 10 minutes you should be able to see the copper etching through (dark clouds in the pattern).

Speed up etching in parts of the PCB where it is needed using the brush..

Then it usually takes only some extra time that all the board is finished.



Removing Toner:

Wash off the etchant, spray on some dish wash, rub off the toner with stainless steel wool.

Dry the board.

The board should be shiny and just beautiful!



Cutting PCBoard:

I use a cutter knife and ruler cutting first on the front then around the side - that it is easier to align the ruler on the back. Another cut ("scratch") there and a hard bend over the edge of a table.

This breaking may need some arm power on bigger boards and of cause some **practice..**



Spraying PCBoard:

Finally I use to cover the board with a 10% solution of colophony (tree) resin in isopropanol (or denatured alcohol).

This helps against oxidation of the copper surface and enhances solderability later as colophonium resin (rosin) is a good soldering flux.

THAT WAS MY SECRET RECIPE.
TRY AND ENJOY IT!

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