Making the PCB: Here's how to do it

DISCLAIMER

USE THIS INFORMATION ON YOUR OWN RISK! THE MENTIONED CHEMICALS ARE VERY STRONG, AND POTENTIALLY DANGEROUS IF NOT HANDLED WITH EXTREME CAUTION!!!

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GENERAL

First of all, I try to keep my layouts to the standard sizes that you gan get the Pre-sensitized PCB in. These are 10x16CM and 21x30CM - and easily-cut fractions of these.

When you're layouting your board, make it a habit to do this from the COMPONENT side - as if you are looking down on the PCB from the side where the components are mounted. This will result in a mirror'ed trackside layout when printed - and we need that, as you'll see later.

THE LIGHTBOX

As it is very important that you get VERY close contact between your laserprinted layout and the photosensitive emulsion on the PCB, you put the layout on the pcb with the printed side facing the photoresist.

Remember, that your PCB's are NEVER completely straight or flat when you get them.

To get close contact, you have to use a piece of glass to put the pcb and layout on, and some kind of a weight to hold them together. Then you expose the PCB thru' the glass.

The glass you use should be UV-transparent, because most Pre-sensitized PCB's are mainly UV-sensitive.

What I did, was taking apart an old photo-copying machine, using only the glass plate and the hinged

lid: The glass in photocopiers is UV-transparent for effiency, and the hinged lid has some rubber foam on the underside to even out height differences - ensuring better contact between layout and PCB.

PRINTING

The material I use to print out to, is standard "tracing paper" as used by architects. This allows (relatively) easy printing on just about any standard laserprinter - and on some inkjets also.

EXPOSURE

For the light source there's some different options. The best is to use UV tubes designed for the purpose. But I have also had good results with a standard 500W halogene light, like the ones you use on construction sites etc. The only problem with this is the chance that the pcb gets so hot from exposure, that the photoresist softens and adheres to the laserprinter toner, rendering the PCB layout a single-use-one.

For the exposure time you'll have to experiment to a start. Do a little PCB, and keep accurate track of distance and exposure time - changing the exposure time. I remember something like 90 seconds at 50CM distance, but these times can change a lot.

The PCB's are often claimed to comply with +/-50% exposure range, so dont worry too much about exact timing.

Once you've found a good exposure time, write down the settings - and stick to your selected PCB type. There's quite a lot of difference between the various brands of Pre-sensitized PCB's.

DEVELOPMENT

You can use dedicated PCB developer, or - much cheaper - simply a 0.6% NaOH solution. I use a mixture of 35mL 28% NaOH (bought as solution) and 600mL water. Works fine. Developer should not be warmer than room temperature.

Be sure to get the PCB out once it is fully developed, but not before that! Even the thinnest remaining layer of photoresist will effectively ruin the etching.

Once developed, check the PCB for errors and scratches (you should now be able to see the traces), and repair tracks with a permanent-ink marker or a razor blade if required.

Take care when handling the developer, it's quite capable of making nice little holes in your clothes if you drop some.

ETCHING: THE SAFE WAY

Use a solution of fine-etch chrystal (buy where you get the PCB's). This solution has to be more than 50 degrees celcius to be active. It is heated with an aquarium-like immersed thermostatic heater. Also you need to move the solution around a bit to get it working. You can either do this manually - by tilting the container continously - or by putting in bubbles from an aquarium air pump.

If you decide to save the solution for future use, it should be stored in a container with a ventilation hole. It develops gasses when stored - gasses that will be of extremely high pressure in a closed container. So watch out.

ETCHING: THE DIRTY WAY

This is an easier, cheaper and quicker - but more dirty - way of etching PCB's.

WARNING:

THIS PROCESS DEVELOPS POISONOUS GASSES, SO IT SHOULD ONLY BE USED OUTDOOR!!! Take extreme care if trying this - use protection eyewear, gloves and a lot of thought!

Slowly mix 2 dL 30%HCL acid with 1dL 40%H2O2(Hydrogen Peroxide) AND 1dL water.

Take care when mixing, it will tend to become hot - even boiling if you're not carefull.

This mixture is a very efficient coctail, so think twice when handling it.

Now you take a container with about L of cold water and keep it at hand - this is to slow down the etching process if it goes too fast: The etching process is exothermic, meaning that it generates heat, and also more efficient with temperature. So you're in danger of having a "thermal runaway". If the process goes too fast or the lot gets too hot, you pour in some of the cold water to slow it down.

If the solution gets too hot, there's a chance it'll boil off the photoresist - damaging the pcb.

Keep clear of the fumes that are produced, they're heavily etching and REALLY BAD FOR YOUR

LUNGS! (a chemist told me that the fumes might be explosive also...Oxygen and Chlor..) This is also why you should ONLY use this method if it is possible to do outdoor.

This solution will etch a pcb in 30 to 300 seconds, much faster than other processes. And the chemicals are - though very dangerous in concentrated form - not toxic to the environment if you flush it afterwards (in limited doses, that is - the removed copper is a little toxic).

CLEANING AND RESIN COATING

After etching and good cleaning of the board (use a lot of water), the residual photoresist should be removed. It can either be taken off with finegrain sanding paper, a thinner like acetone (watch out!), or - as the simplest way - you just expose the complete etched PCB again, and give it another development turn.

Rinse good, and set it to dry.

Once dry, coat the copper side with a resin - that will protect the copper and make it much easier to solder. I use the SK 10 FLUX areosol from "Kontact Chemie". (RS. PN# 143-7627)

DRILLING

Drilling the PCB is easiest with a small bench drill, like the Proxxon or the Drehmel. Drilling on free-hand is close to impossible.

Normal (HSS) drills can be used, if you dont plan to make a lot of PCB's. But the expensive "Carbide" types will last way longer, and give better results - but will also break very easily if uou dont take care.

The most common drill sizes are 0.8mm (resistors, small components..) and 1.2mm (large caps, tube sockets ..) Also you'll need a 3.5mm drill for the PCB mounting holes. Get your self more than one of the smaller size drills, as they're sure to break easily when used - until you get the hang of it..

A dust mask is a very good idea when drilling PCB's, as the glass dust off the fibreglass is unhealthy.

Also check out KEV's DIY-page on how to do PCB's

Kev's HowtoPCB

An alternative method - ironing a laserprint directly onto the copper-clad PCB's- is described here:

http://members.tripod.com/~AMN92/PC_Board_Fabrication.htm