RoeTest – Computer Tube Tester / Tube Measuring System

(c) - Helmut Weigl www.roehrentest.de

Manufacturing of Printed Circuit Boards - Helmut Weigl

The following statements express my own opinion. I exclude any liability !

Preliminary notes:

Meanwhile I let the PCBs for the RoeTest manufacture industrially as double sided PBCs, in addition to the required size, can hardly be self manufactured.

For other projects I make the PCBs by myself.

I think that the dread of making the PCB by yourself is unfounded. Making PCBs requires some work but is easy and relatively cheap. When using the right method no expensive devices are needed. There are a lot of instructions on the Internet how to make PCBs. In my opinion only a few are feasible.

1. Exposition film:

I print with a laser printer on transparent sheet and put two sheets over each other (stick and glue them together at the side).

Possible sources of errors:

- Wrong scale (sizes of PCBs are shown in the assembly plans).
- Side inverted (print PCB templates 1:1, colored side must be pressed to the PCB so that the text print is readable when looking on the bottom side of the PCB).
- Black locations are not light proof

→ Possible solution: If you do not have a suited laser printer you can get fabricated perfect films for only a few euros. I found for example the following address on the internet:

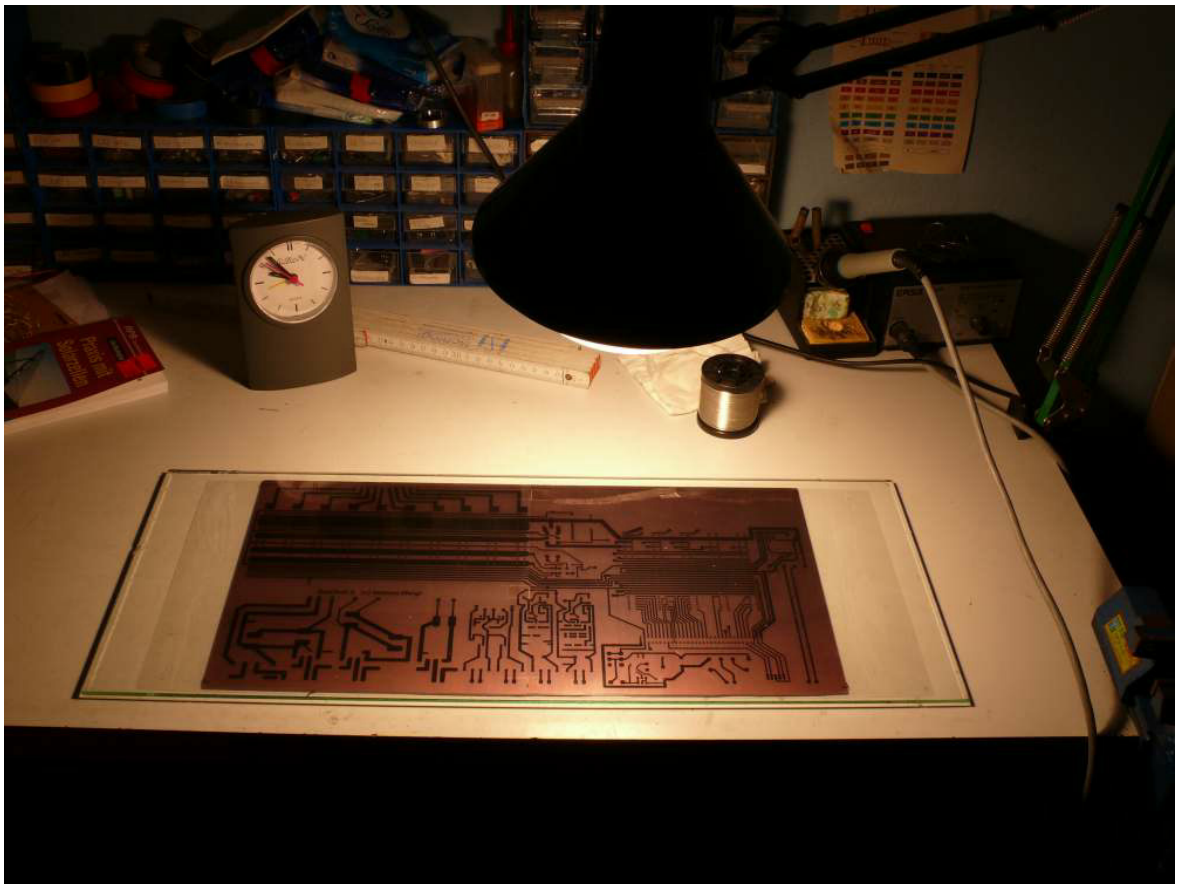
www.cadgrafik-bauriedl.de/leiterplattenfilme.htm

(no guarantee).

2. Board material:

I prefer quality board material from Bungard. Advantage: constant quality. High tolerance for exposure– and developing time. Absolutely required: epoxy material (rigidity). In my opinion pertinax is inappropriate for high quality devices.

3. Exposure:
The PCBs for the RoeTest2 were exposed using a simple Osram-Nitraphot-Lamp:



Important: **If the exposure template is light proof you can even expose a little longer**. This is important as the lamp lights punctual and must be moved several times for the large main board. Before exposing the large main board a test should be done with a rest of the material (exposure time at given distance). For the large main board I needed about 20 minutes to get all positions exposed nearly the same (you need a little bit luck for this method).

Possible error sources: exposed too short, template not light proof

The comfort solution:
In the meantime I built an exposure device by myself. There are plenty of building instructions for an exposure device built from face tanners and scanners on the Internet. These are too small for my purposes. I built a somewhat larger device using two face tanners (8 UV tubes) and a suitable wooden box (including a timer). For the glass panel normal window glass can be used. With my new exposure device I can make PCBs up to 41 x 25 cm and expose them within 2 minutes.

The results of exposure here are constantly perfect.

4. Developing:
For developing, watering, etching and again watering I built my own 'etching track'. This consists of plastic bins from household goods available at every hardware store.

To be able to move the board back and forth in the developing- and etching bath I built a flat bin with handle (use a hair dryer for warm forming). This way I can move the boards and pull them out – without touching the developing/etching solution. (Using tweezers would damage the photo resist and lead to often slip off the board).

Etching process - Developer, Etching bath and water bath

Please prepare the developer according to the directions of use with warm water. Important: The powder of the developer must dissolve completely. Obey the relationship of powder and water (normally 1 measure spoon per liter water).

Developing is completely uncritical. Immerse the board and move slightly. If the exposure was right the exposed areas will dissolve themselves (please do not rub on the board!). If quality board material and light dense foil is used, the board may be left a little bit longer in the developing bath without generating flaws.

5. Etching:

The most etching materials suggested on the Internet have some disadvantages:

Iron-III-Chloride: Yellow mess, needs heating
Fine-Etch-Sulfate (or similar): Clean, but expensive and needs heating

Due to the heating required you need an etching machine for those etching agents. Only a few hobby electronic technicians will have an etching machine needed for the desired size of the board!

My solution – the salt acid method:

SAFETY ADVICE:

This method, when applied carefully, is not riskier than the other methods (all etching agents are more or less toxic):
It is essential to protect eyes and hands. Etching should only be done outdoor (do not inhale acidly vapors). Secure from children and animals. Dispose of used etching solution properly.

You need:
- Salt acid 30% (drugstore)
- Hydrogen peroxide 30% (drugstore)
- Water
- Etching basin

First put one part of water, then one part of salt acid and then a strong shot of hydrogen peroxide into the etching basin (obey the correct sequence!). Insert the board and now and then move slightly. If etching is too slow, add some hydrogen peroxide (please do not overdo; with too much hydrogen peroxide very strong vapors will occur).

This method is completely automatic and clean. Just without etching machine or heating. The etching solution can be used again several times (just add some hydrogen peroxide).

After etching the board sufficiently rinse it with water.

6. Sawing the board:

This can be done easily using a coping saw with metal sawing blades. The edges can be abraded with raw metal-sandpaper. Just put the sandpaper on the table and draw the board across it. A belt sander is also well suitable to get the edges to the right dimensions.

7. Removing the remaining photo resist:

Use a cloth soaked with ethyl alcohol, acetone or nitro thinner.

8. Solder lacquer:
Apply lightly from spray can and let it dry for at least one day.

9. Drilling:
For that you absolutely need a mini drilling machine (for example Proxxon) and a drill rig. Most of the drill holes have a diameter of 0.8mm. Some components require slightly larger holes. You should always use sharp drilling bits and have some in spare. Most instruction manuals suggest a high rotation speed for drilling. I for myself think that lower rotation speeds (ca. 5000 rps) are suited better as the drilling bits will less deteriorate at that speeds. Drilling all the many holes will last a bit.

10. Soldering:

A soldering station with fine soldering tips should be an obligation for every hobby electronic technician.

One DIY constructor informed me about an interesting board manufacturer:

www.platinenbelichter.de

According to their price list this manufacturer is really favorable. Please note the restrictions of this manufacturer (e.G. maximum board size, no connect through).

(Note: Of course I cannot guarantee for the quality of this manufacturer).