

# 7:PCBs

Interactive Installations F07

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C:Art:Media  
Valand

# Let's Etch PCBs!

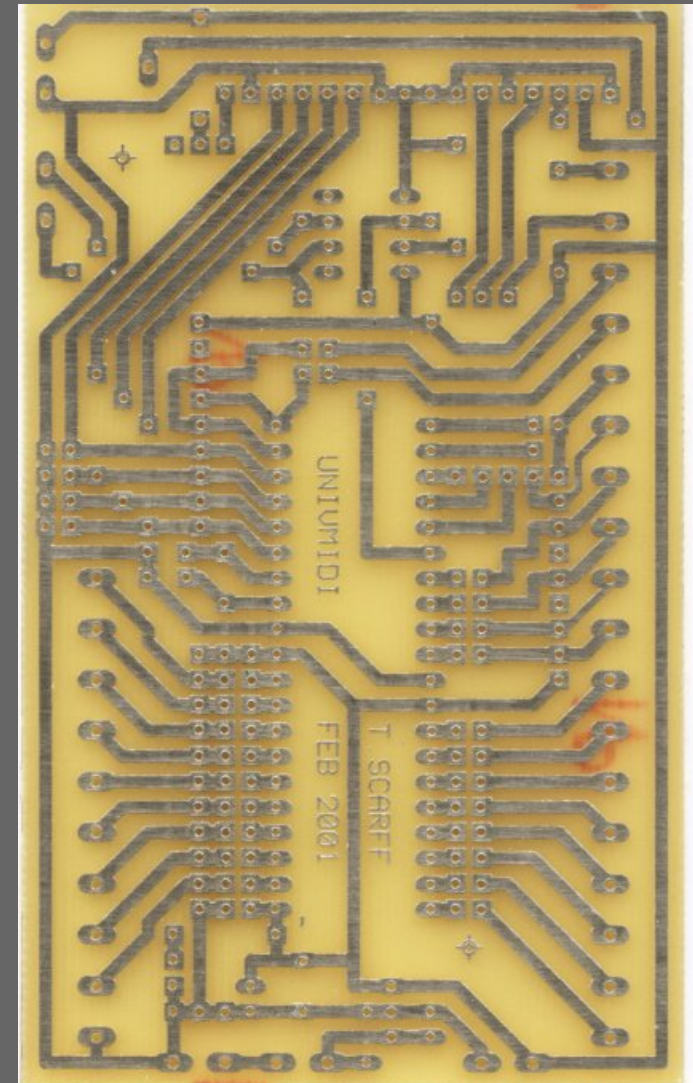


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# What is a PCB?

- **printed circuit board (PCB):** a thin board to which electronic components are fixed by solder (dictionary.com)



# Why PCBs?

- Why bother making a printed circuit board?
  - if you are planning on replicating a circuit design for a more permanent project, then save yourself the trouble of having to build everything from scratch
  - Etching pcbs can be as much of an artistic tool or method as screen printing, you just using different materials.
  - You can achieve a different aesthetic ... that can also be a functional electronic circuit.

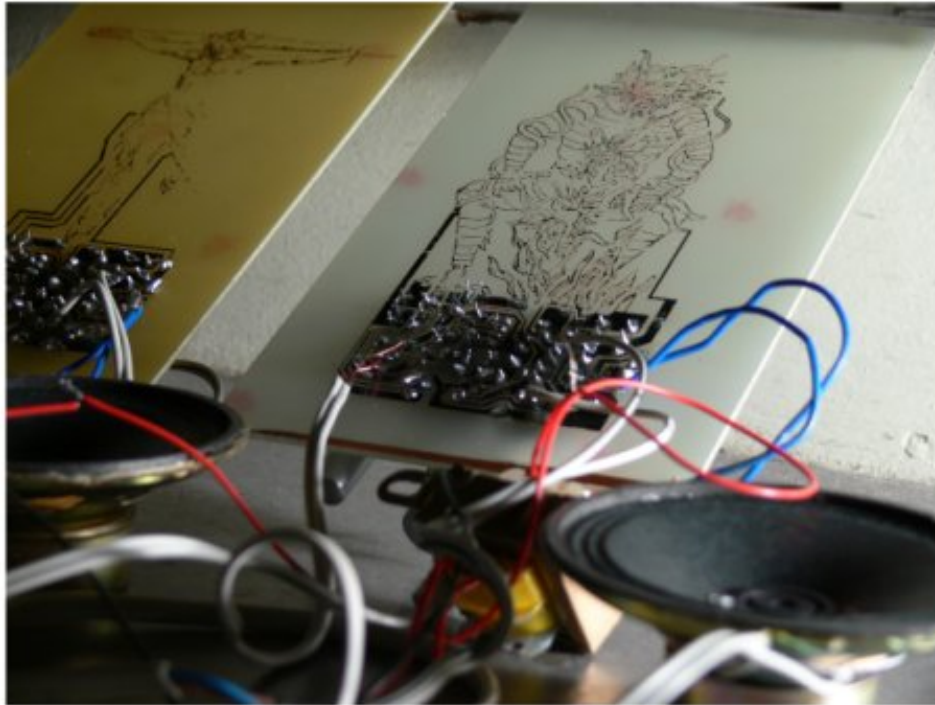
# DIY Methods

- Cheap diy PCB making methods:
  - UV exposure using photoresist
    - negative / positive exposure
    - use developing solution to produce the image
    - etch the copper from the board leaving the design
  - Laser Toner Thermal Print
    - transfer laser printer toner to a bare pcb using heat
    - etch the copper from the board leaving the design
- We will present the UV exposure method.

# Steps

- Steps
  - Gather Your Materials
  - Make Your Design
  - Expose
  - Develop
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  - Done

# Artistic Example



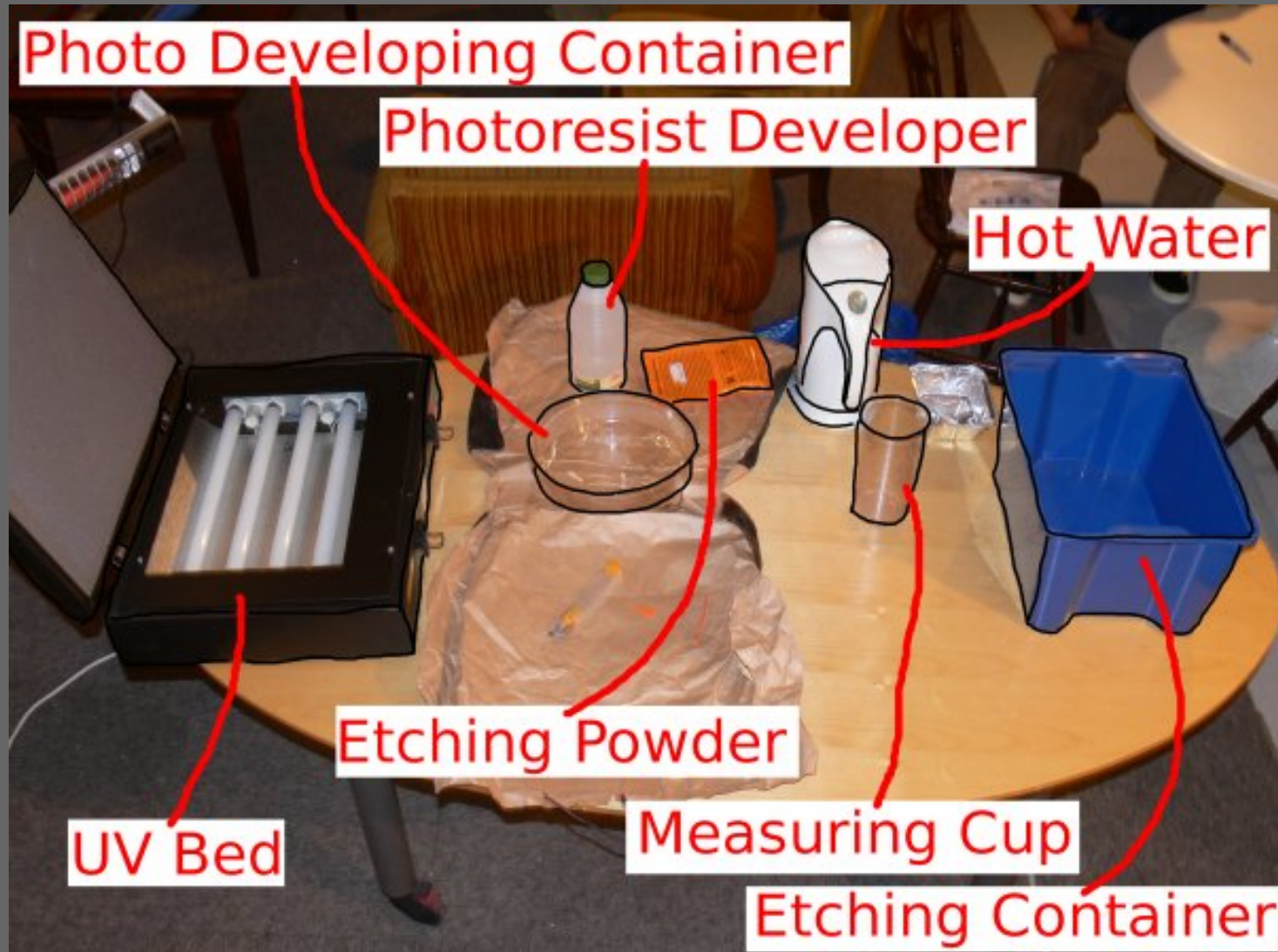
Feedback installation

**Feedback**  
Artistic Residence at STEIM  
October 2007



- Oscar Ramos built an audio feedback system using inexpensive computer amplifiers and custom circuit boards depicting Jesus and the Devil.
- In this case, the pcb is both a practical and aesthetic medium.

# 1. Gather Your Materials



# Safety Notes

- Before we began, we read up on the theory, methods, and materials involved with making pcbs.
- Since we are dealing with non-household chemicals make sure you understand their safe useage and disposal by checking their material saftey data sheets (msds).
  - etchant: sodium persulfate msds
    - DANGER! STRONG OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE.
    - HARMFUL IF SWALLOWED OR INHALED.
    - MAY CAUSE BURNS TO SKIN AND EYES. CAUSES RESPIRATORY TRACT IRRITATION.
    - MAY CAUSE ALLERGIC SKIN OR RESPIRATORY REACTION.

# Materials List

- a plastic transparency sheet
- printed circuit board w/ photoresist -->
- powder developer for positive photoresist
- etching powder, sodium persulfate
- uv bed, borrowed from work
- a photo developing container, in our case a glass bowl
- an etching container, in our case a plastic tub
- measuring cup
- hot/boiling water
- rubber gloves



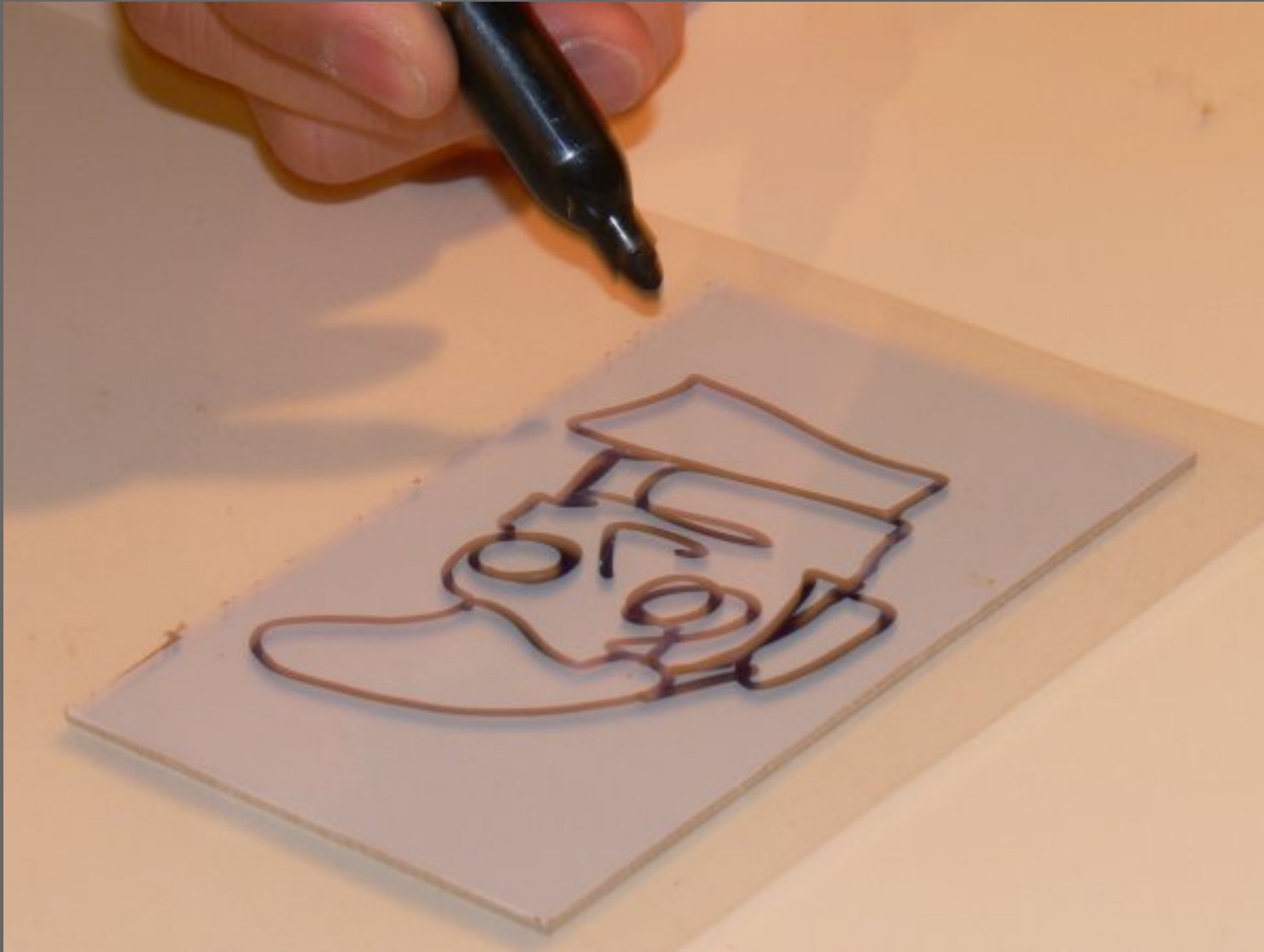
# Materials Notes

- We bought the photo and etching chemicals at ELFA and used a blank pcb lying around
- We managed to find a uv bed
- For messing with the chemicals, we used glass and plastic containers and rubber gloves to avoid contact with the skin
- We went ahead and prepared the photo developing solution by mixing the chemical powder with water and placing it in a plastic bottle

# Materials Notes, contd.

- The pcb blank we used is of the single-sided variety with one side being coated with the photoresist chemicals.
- There are 2 types of popular etching chemicals: ferric chloride and sodium persulfate. The former is cheap, dirty, and brown while the latter is pricier, cleaner, and clear.
- We were lucky enough to borrow a uv bed from work to expose the pcb. These things are generally expensive for some reason, even though they are just boxes with fluorescent uv lamps inside. You can make your own inexpensive exposure box using uv bulbs.

## 2. Make Your Design



# Drawing Methods

- There are 3 ways to make the design/artwork for your pcb:
  - draw the design by hand on the transparency with a black marker
  - use photoshop or another digital drawing program to create the design
  - use a computer assisted design (cad) program to create the design, such as EagleCad

# Design Notes



- The final result you want is the design in solid black on a clear transparency sheet.
- You want the lines to be as solid as possible, otherwise light might bleed through and the exposure will not be uniform on the pcb.
- UV exposure will give you good lines (circuit traces) down to about 0.2mm.

# 3. Expose

- Now remove the plastic film covering photoresist on the pcb and place it over the design on the transparency in the uv bed.



# Zap It!



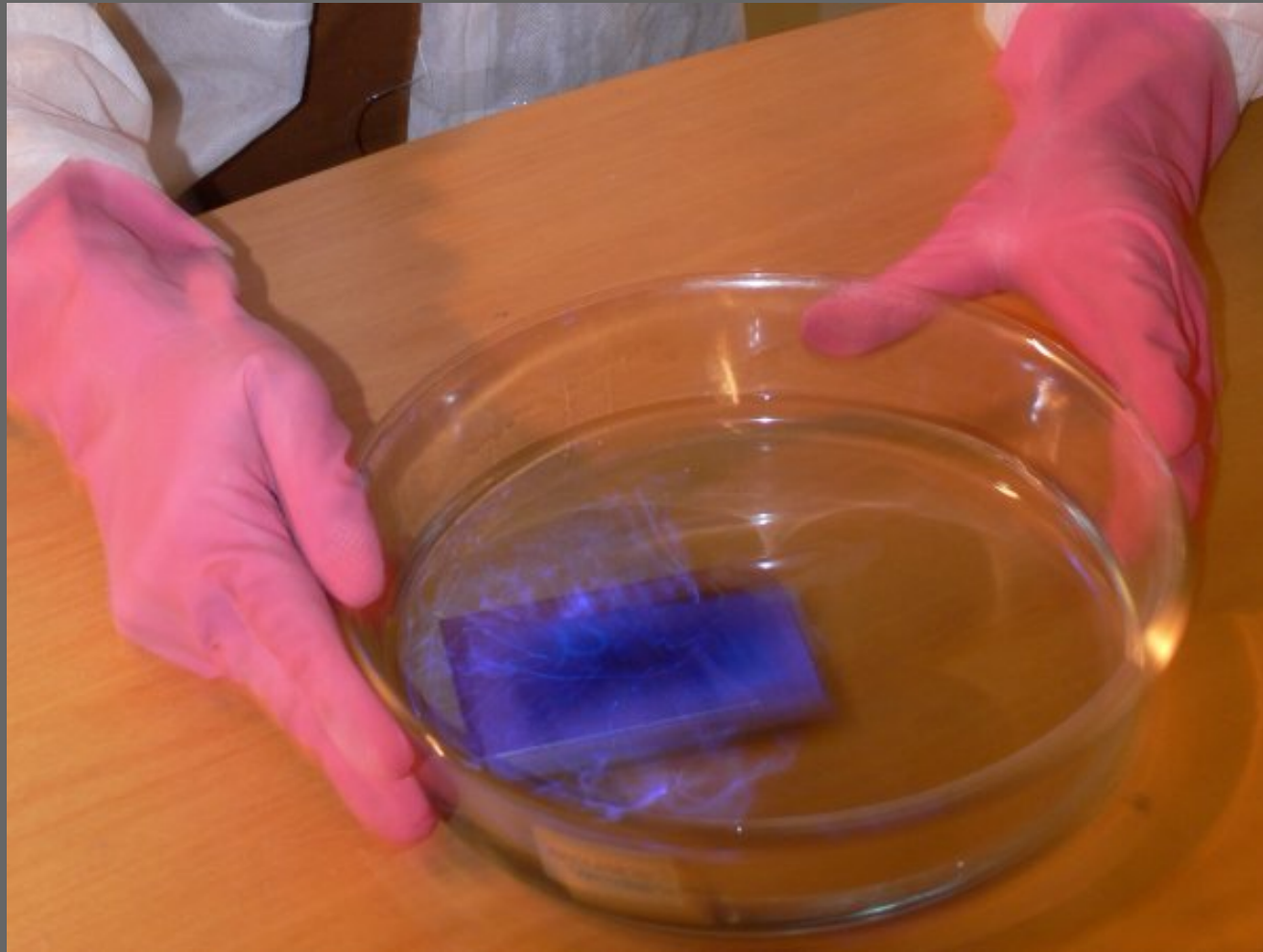
- Let it expose for a certain amount of time depending on the strength of your ul light source.
- You want more exposure time as opposed to too little.
- We set the uv beds timer to 96 seconds for our setup.

# Wait ...

- Now that we had some free time, let's dance!



# 4. Develop



# Develop!



- When the exposure is done, place the pcb in the developing solution (which you should have prepared earlier)
- Slosh it around in the container gently until the design appears as the photoresist is removed.
- Your end result should be a pcb with the design on top of a visible copper layer.

# Clean

- Clean the remaining photodeveloper from the pcb with water.



# 5. Etch



- Prepare the etchant powder for mixing with water.
- Make sure you wear those gloves, as the MSDS for sodium persulfate lists it as a strong oxidizer that may cause burns.

# Add Etchant

- Add the etchant powder with hot/boiling water.
- The powder should dissolve quickly yielding a light blue solution.
- Add the pcb to the solution.

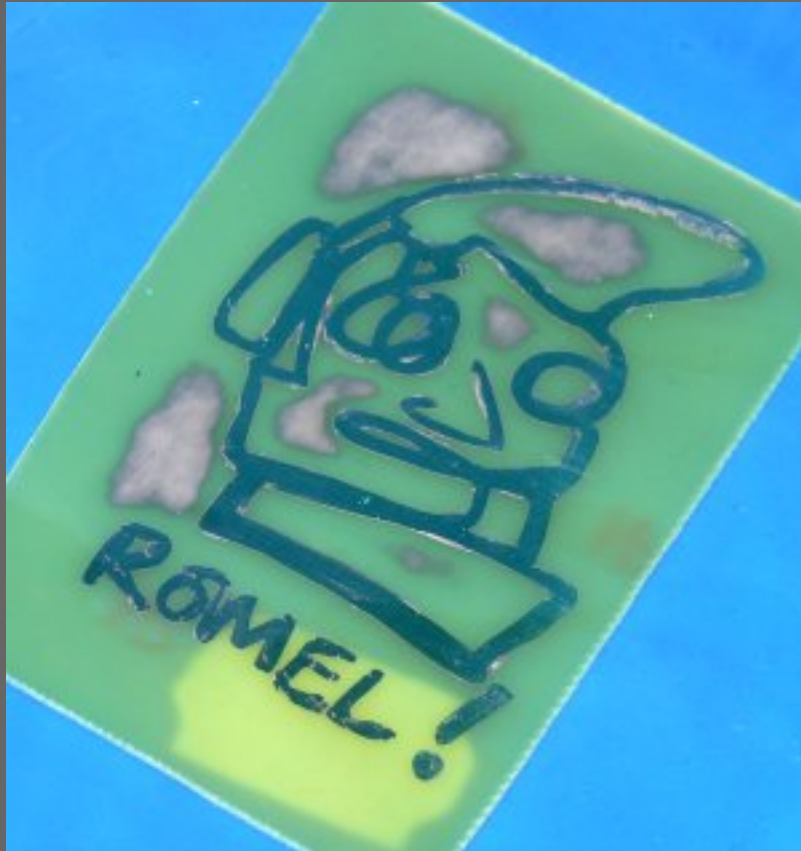


# Etching ...

- Gently slosh the pcb in the etchant solution which essentially dissolves the exposed copper from the board and leaves the copper under the design.
- ELFA notes that our powder yeilds best results at 50°C and only takes about 5 mins to fully etch a board.



# Goodbye Copper



- As you watch, the copper will disappear, leaving your design.
- Make sure you do not etch for too long, as the copper under the edges of the design will begin to dissolve.
- As you can see in this picture, most of the copper is gone, but the process needs another minute of two.

# 6. Done

- If all went well, you should end up with clean design in copper on a bare board.
- Our first try failed as our initial drawing was not dark enough on the transparency, so the design did not expose properly.
- It may take several tries before you come up with the right method depending on the materials you have available.



# Fin

