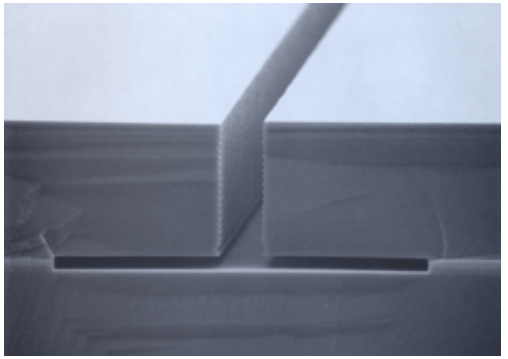
Continuing..

PRINTED WIRING BOARD TECHNOLOGIES

Etching

- Removal of ‘unwanted’ or non-circuit copper from board
- Etch resists
  - organic and metallic resists
    - photoresist
    - tin, gold, nickel, silver and alloys of these
- Circuit gets defined
- Corrosive chemicals
  - Ferric chloride, Cupric chloride, ammonium persulfate, chromic acid+ sulfuric acid...

Etching



- Time and temperature dependant
- Process control required
- ‘Undercut’ issues in etching
- Recycling of spent etchants
- Regeneration of etch solutions is required frequently
- Conveyorized operations in industry
- Pollutant and personnel safety

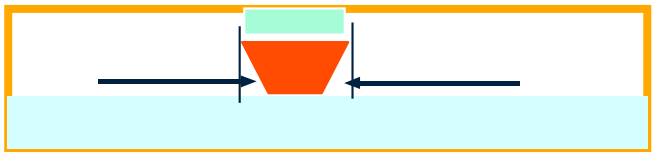
Aspect ratio - laminate thickness/hole dia

Smaller holes are difficult to plate because the field is narrow and solution is not easily replenished

Keep the aspect ratio as small as possible … 2-4

Etch Factor

Etch profile



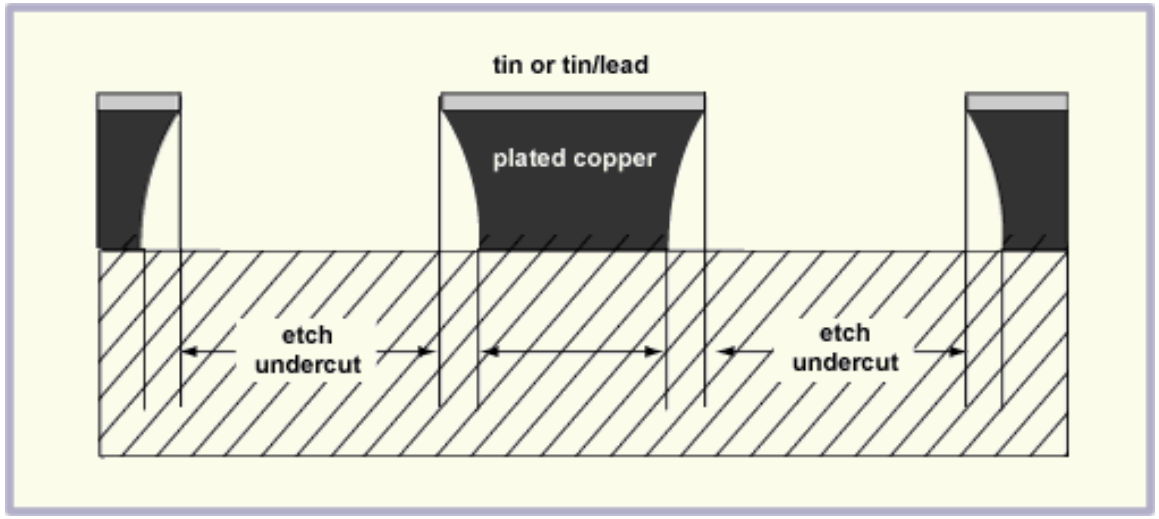
No etchant give perfect straight cuts…..
etching always result in undercuts…..

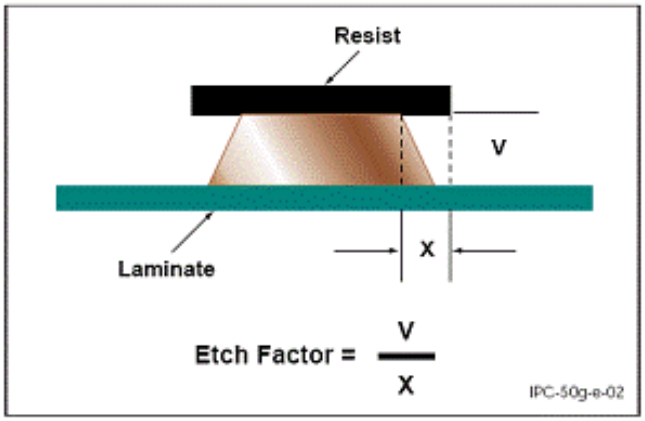
Provide etching allowance 5-8% on track width

Aspect Ratio and Etch Factor are two very important process issues NOT to be ignored

Etch Factor

The ratio of the depth of etch to the amount of lateral etch, i.e., the ratio of conductor thickness to the amount of undercut.





Wet etching where the material is dissolved when immersed in a chemical solution

Dry etching where the material is sputtered or dissolved using reactive ions or a vapour phase etchant

Figure: IPC T-50


©CEDT
Etching/ Photoresist Strip

Chemistry involved in PCB etching process

2 Fe(3+) + Cu(0) –> 2 Fe(2+) + Cu(2+)

Ferric Chloride reacts with the Cu on the PCB to give Ferrous ions and Cupric ions

Cu(2+) + Cu(0) –> 2 Cu(+)

Both reactions are just exchanges of electrons between ions.

The problem with ferric chloride is that the ferric ion Fe(3+) is not easily regenerated from the ferrous ion Fe(2+). Reaction between ferrous and the oxygen in air is slow:

4 Fe(2+) + O_2 + 4 H(+) –> 4 Fe(3+) + 2 H_2O (slow)

However, reaction between cuprous ion Cu(+) and oxygen is virtually instantaneous:

4 Cu(+) + O_2 + 4 H(+) –> 4 Cu(2+) + 2 H_2O (fast)

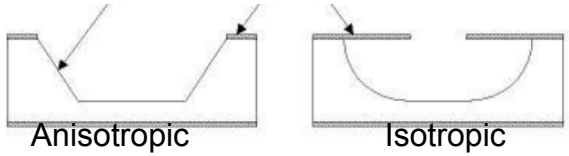
$CuCl_2$ - 45°C

- Etch Rate Vs Temperature
- Etch Rate Vs Cuprous Ion concentration (Cu+)

Etching Defects

ETCHING- A brief summary

1. Etching is removing ‘unwanted’ metal or material from a substrate
2. Different etchants for different metals/materials
    - ❑ Gold
    - ❑ Copper (eg. PCB)- $CuCl_2$; $FeCl_3$; Alkaline Ammonia
    - ❑ Steel
    - ❑ Glass?
    - ❑ Silicon?
3. Different etching rates for different etchants towards different metals
4. Mechanical etching?
5. Chemical etching or Wet etching
    - ❑ Electrochemical etching
6. Dry etching
    - ❑ Plasma etch/ RIE (OR) ICP (RF & magnetic field; more isotropic)
7. Undercut is to be minimized during etching
    - ❑ Minimal in dry etching compared to wet etching
    - ❑ Etch factor to be high/small undercut
8. Vertical etching and Horizontal etching
9. Isotropic and Anisotropic etching



10. Undercut shapes vary with conditions and protective resist
11. Can additive technology help in solving problems with wet etching?

Resist Strip & Quality Assurance

- Stripper
  - Aqueous: hydroxide based solution
  - Anti-tarnish treatment for Copper
- Quality Assurance
  - Visual examination on every step
  - Thickness measurements
  - Microscopic examination for residues
  - Test coupons for every batch of boards made
  - Feedback to manufacturing process

PRINTING- SCREEN PRINTING FOR PCBs

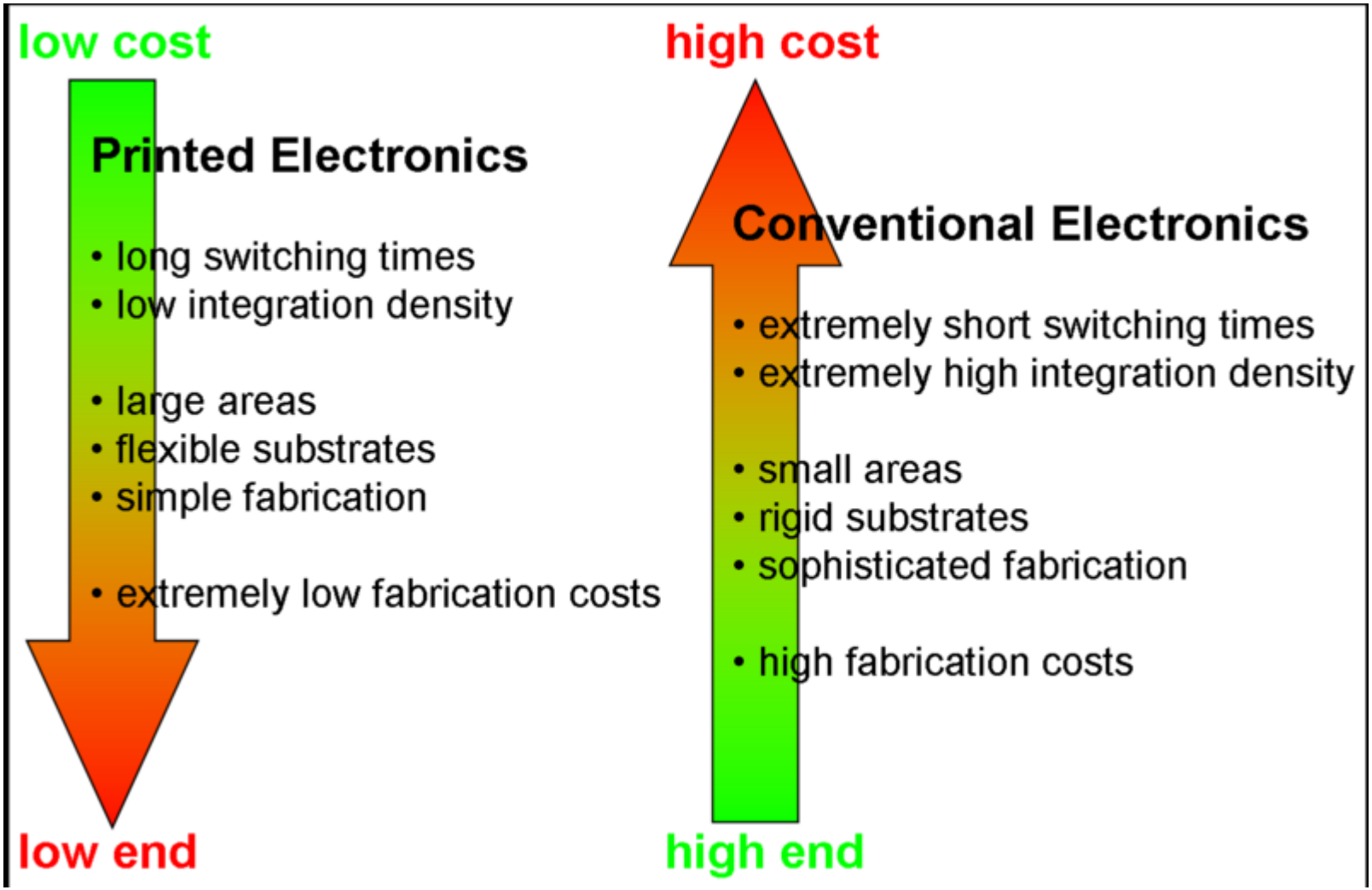


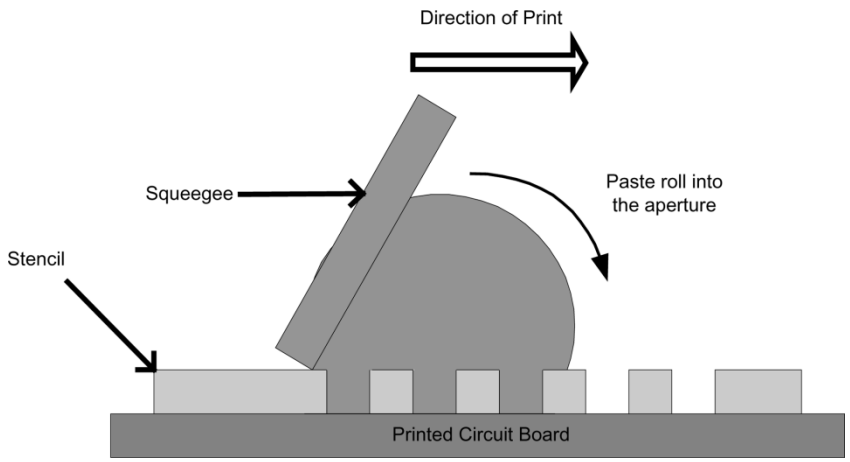
Illustration: Wikimedia

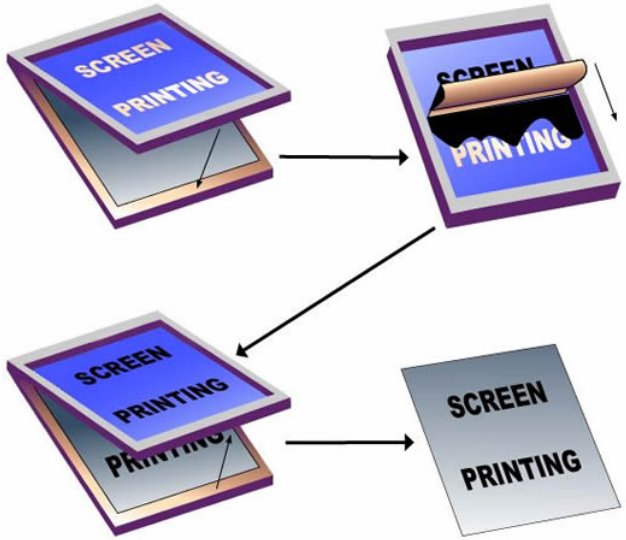
❑ **Screen printing** is a printing technique that uses a woven mesh to support an ink-blocking stencil.

❑ The attached stencil forms open areas of mesh that transfer ink or other printable materials which can be pressed through the mesh as a sharp-edged image onto a substrate.

❑ A roller or squeegee is moved across the screen stencil, forcing or pumping ink past the threads of the woven mesh in the open areas.

❑ Screen printing is also a stencil method of print making in which a design is imposed on a screen of silk or other fine mesh, with blank areas coated with an impermeable substance, and ink is forced through the mesh onto the printing surface. It is also known as silkscreen, serigraphy, and serigraph.



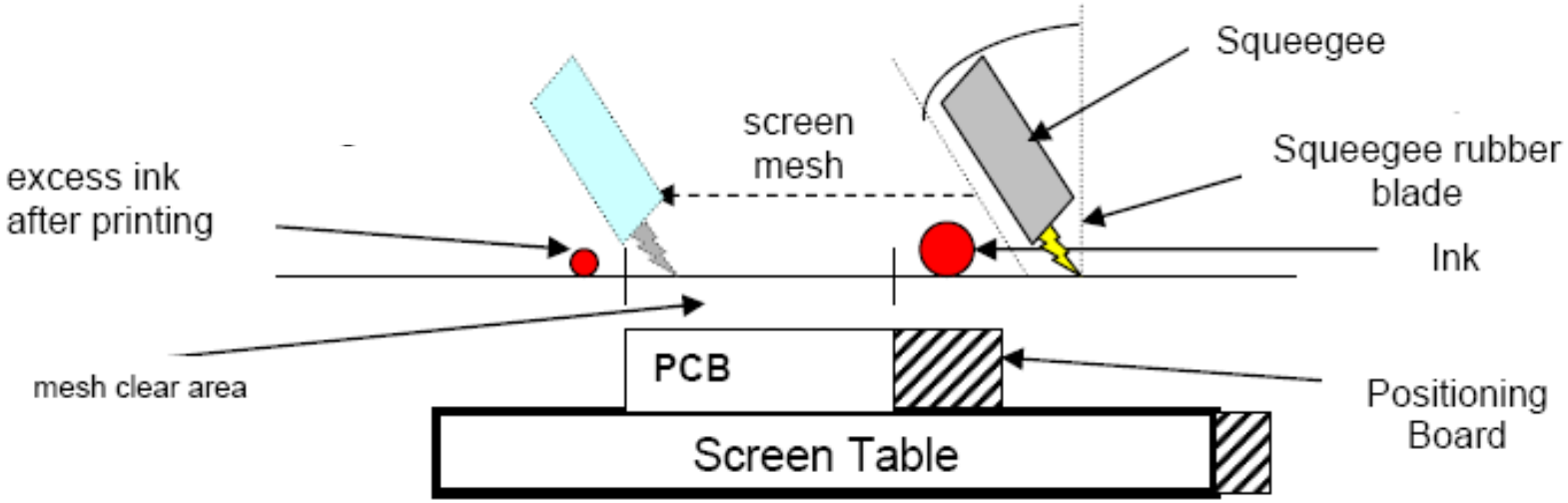


Single-sided Board: Screen Print and Etch Technique

1. Select Laminate and Clean/ Surface Preparation
2. Screen Print Resist ink followed by bake in oven
3. Etch Copper in non-circuit areas
4. Strip Resist ink from the copper areas
5. Drill holes for component mounting
6. Protect Copper with Sn
7. Post-process like solder mask print and legend printing

DEFECTS- SCREEN PRINTING FOR PCBs

- ❑ Board Surface Preparation
- ❑ Quality of ink; Flow properties
- ❑ Right mesh size of screen/stencil
- ❑ Quality of squeegee blades
- ❑ Angle of print strokes (45°)
- ❑ Right volume and spread over surface
- ❑ Minimum wastage
- ❑ Cleaning of mesh and blade regularly (to avoid drying)
- ❑ Clean and dust-free environment




CEDT
Semi-automatic screen printing
for PWB applications

DEFECTS- SCREEN PRINTING FOR PCBs

Saw-toothed

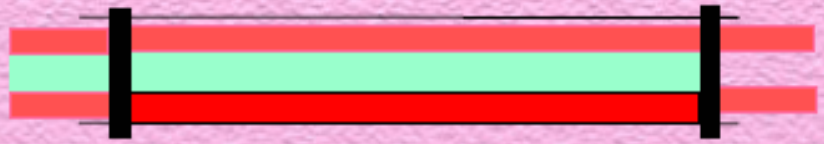
Well-defined

Irregular

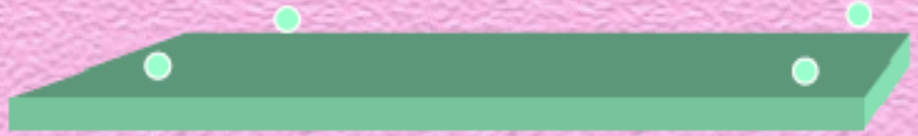
MECHANICAL DRILLING OF HOLES FOR PWBs

Why holes ?

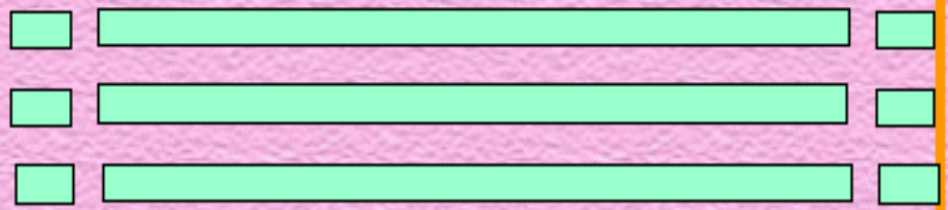
Registration during PWB manufacture



Mounting Holes for assembled PCBs



Stacking holes during drilling

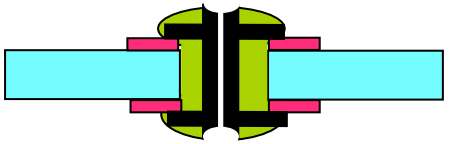


Plated through holes to electrically connect different layers

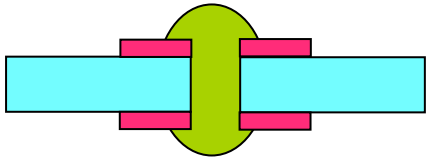
Double Sided Plated Through Hole Printed Wiring Board

Interlayer connection..

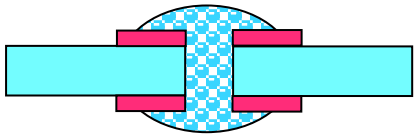
Riveting Technology



Filling with solder



Filling with conducting polymer paste



Metal deposition on the hole wall- 1964 – Shipley