Etching

Definition: a selective removal of material from the surface of a PCB by means of the chemical action of an etchant (or etching agent). Etching usually removes the copper areas which are not desired on the finished PCB.

There are two basic ways to remove unwanted copper from copper clad substrates to form electronic circuits:

1. **mechanical etching**: involves the use of a machine tool and a special cutter to remove a narrow strip of copper from the boundary of each pad and trace - this electrically isolates the circuit element from the rest of the foil
2. **chemical etching**: relies on the action of a corrosive liquid to dissolve away unwanted copper in order to define the desired circuit

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Chemical Etching

Process Details

Etching is usually done by total immersion of the board in the chemical and agitating by bubbling air through the bath. The copper which is to remain on the PCB is protected from the etchant by an etch resist.

Etching time has to be carefully controlled to ensure only unwanted copper is removed

- Over etching can cause undercutting of the resist which can result in serious damage to the edges of tracks and pads
- Rinse in deionized (or distilled) water and examine the etched pattern for shorts or incompletely etched areas
- If you find small isolated shorts, etch for another 30 seconds and re-examine - if shorts persist, remove them with a razor. Continue until etched circuit is totally free of shorts and other defects
- After etching the PCB, rinse thoroughly with water

Etching Defects

Some defects due to etching are:

- **Non-etched Copper:** copper areas which have not been removed completely by etching are acceptable if they are not causing short circuits.

- **Pits:** small void areas from which the copper has been erroneously etched away are acceptable if they are very small - they can result from bad protection of copper by the resist.
- **Undercut:** during etching the sidewalls tend to etch sideways to produce an undercut action - the degree to which this occurs is known as the *etch factor* - defined as the ratio of depth to side attack. Immersion etching techniques generally lead to a low etch factor.

Several different types of etching chemicals are used industrially including ammonium Persulphate, chromic/sulphuric acid and ferric chloride.

Etchant	Advantages	Disadvantages
Ferrous Trichloride (Fe_3Cl)	cheap, easy to obtain	makes stains which are hard to remove, not very fast
Sodium (or Ammonium) Persulphate: $Na_2S_2O_8$ & ($NH_4S_2O_8$) - ammonium Persulphate	clean, transparent solution (turns dark blue when used up)	not as cheap as Fe_3Cl, needs heating to 35^oC