

BE1M13VES

Manufacturing of Electrical Components

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CTU in Prague

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Overview

1 Base Material Manufacturing

2 PCB Manufacturing

3 Multilayer PCB Manufacturing

TOPIC

1 Base Material Manufacturing

2 PCB Manufacturing

3 Multilayer PCB Manufacturing

Printed Circuit Board

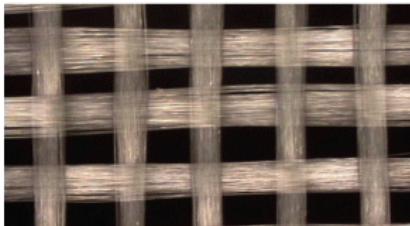
Circuit interconnections created as traces of conductor on dielectric substrate.

Conductor: Cu Film. Thickness is measured in ounces (oz). $1 \text{ oz} \approx 35 \mu\text{m}$, most common thickness are 0.5 oz, 1 oz and 2 oz.

Dielectric: Glass Fabric + Resin. There are several substrates depending on glass to resin volume ratio in the market. Typical parameters are:

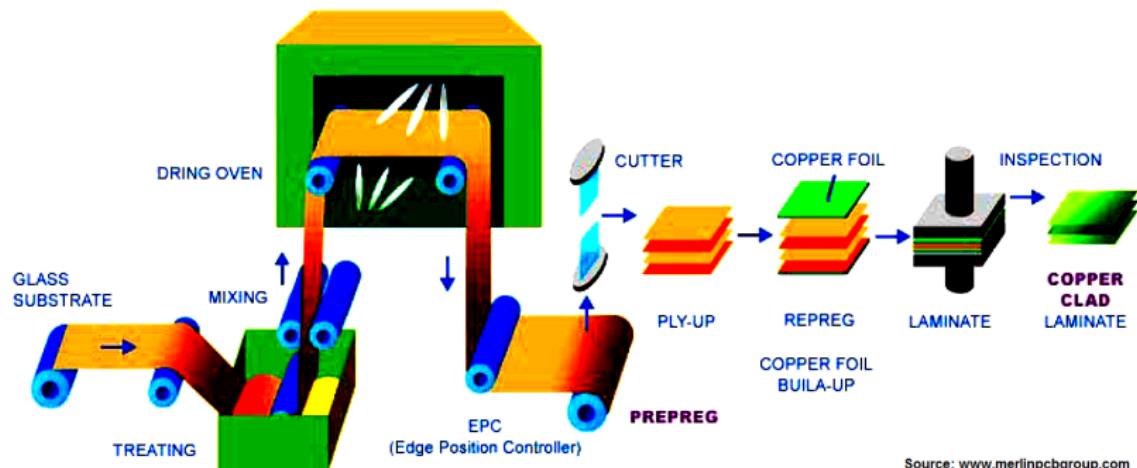
- $\epsilon_r \approx 3.8 - 5$,
- $E_{max} \approx 50 \text{ kV/m}$,

Dielectric Glass-Resin Composite - Laminate



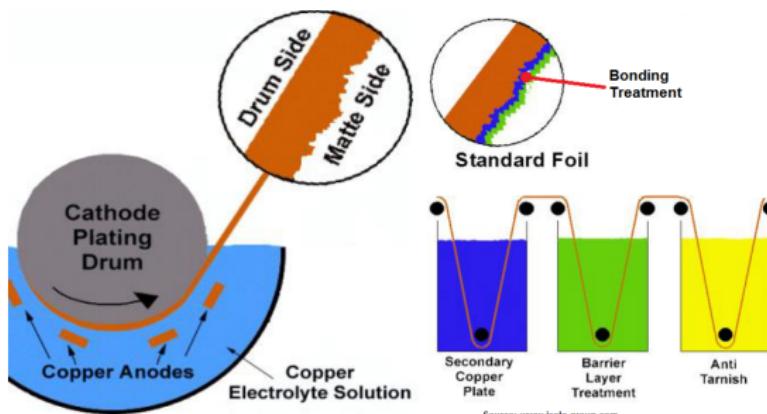
- Properties are affected by resin (FR2 phenolic+paper, FR4 epoxy+glass) material and warp and fill of the glass,
- common thickness of the layers are from 0.04 mm up to 2 mm.
- FR4 are core materials of laminate with cured resin.
- Pre-preg - stands for "pre-impregnated", resin is cured to an intermediate stage.

Lamination process



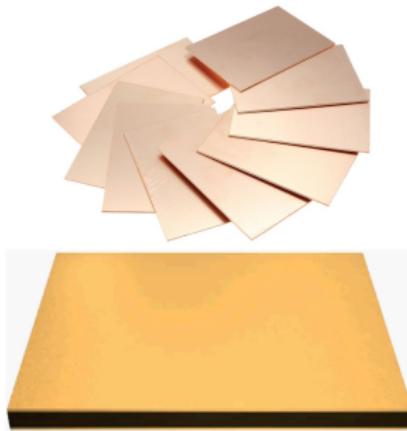
Source: www.merlinpcbgrou.com

Copper Foil Manufacturing



- Copper is electroplated onto a rotating drum.
- Treatments are applied to: micro-roughen surface for adhesion, plate barrier layer, coat with anti-tarnish

FR4 Core Material



Lay up

- Sandwich, FR4 core is between two (can be also one sided) Cu layers,
- layers are bonded and resin is cured at specific pressure (from 1.9 MPa to 2.8 MPa) and temperature (about 190 °C),

- this base is used as a core for multilayer PCBs or for one or two sided PCBs.

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1 Base Material Manufacturing

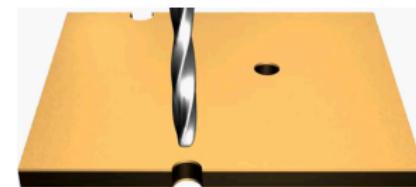
2 PCB Manufacturing

3 Multilayer PCB Manufacturing

Drilling the holes to the core

This is done only if:

- it is one or two sided pcb or
- there are some vias only in the inner layers.



The connection between sides is ensured after through hole plating.

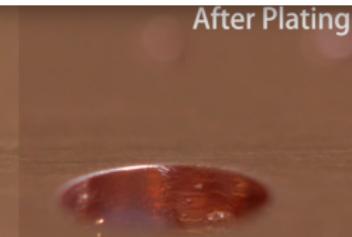
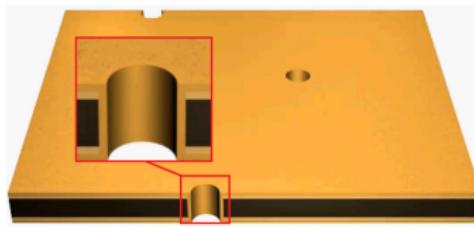
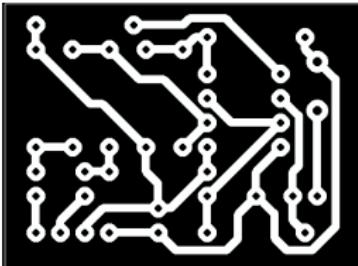


Photo-resist deposition

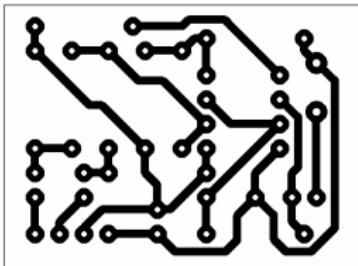
- resist is applied by heat and pressure to the metal surfaces of the core,
- it is rolled out in most of the cases,
- it can be also sprayed in case of piece production (amateurs),
- the film is sensitive to UV light,
- yellow light is used in most image processing areas to prevent inadvertent exposure of the resist.



Basic Types of resists



Pattern for negative resist



Pattern for positive resist

There are two possible reaction of the resist:

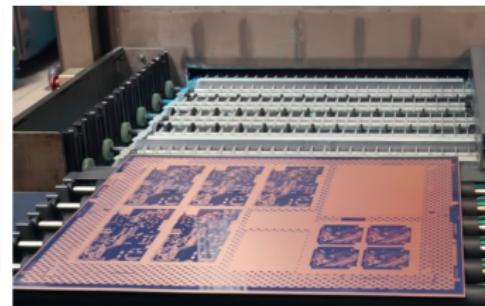
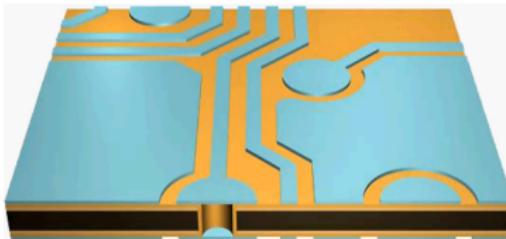
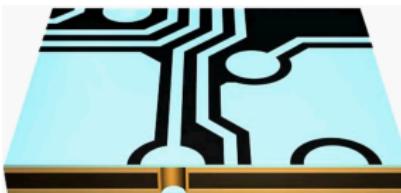
- 1 illuminated parts are polymerized (hardened) or
- 2 they are chemical changed and then soluble in developer.

First type is called negative resist, because the negative pattern (mask) is needed. Second one is positive resist. The negative resist is more common in mass production.

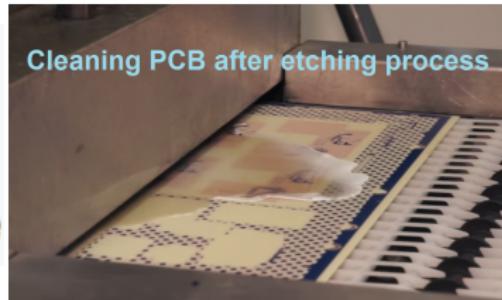
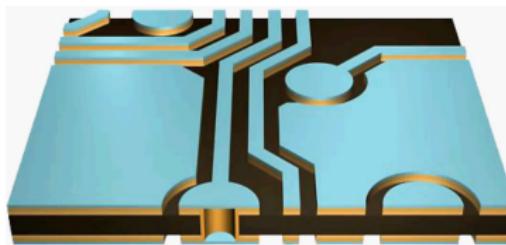
Exposition and developing

⇐ The exposition is made by UV light,

↓ after that the unwanted resist is washed (developed) and only the pattern stays on the board.



Etching



- If there are plated holes, then they must be covered by the resist.
- The unwanted copper is solute in an acid.
- Etching liquid are mainly copper chloride solution, ferric chloride liquid, alkaline etching, acid/hydrogen peroxide (hydrogen peroxide) etching.

Core PCB



- The core is cleaned from the resist and the pattern is checked via automated optical inspection.
- If there are only two track layers then the process continues with solder mask deposition.
- In case of multilayer PCB the process continues with lamination of other layers.

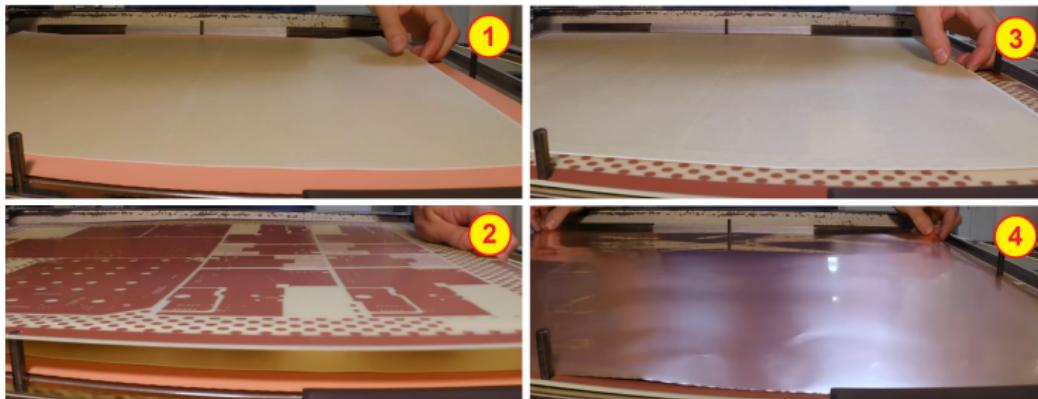
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Adding other Layers



Hand-made sandwich:

- 1 Placing bottom Cu and prepreg layer,
- 2 placing core layer,
- 3 placing top prepreg layer,
- 4 placing top Cu layer.

Bonding the Layers by Heat and Pressure



- Use the similar lamination process as in case of core laminate. The resin is cured at about 190°C .

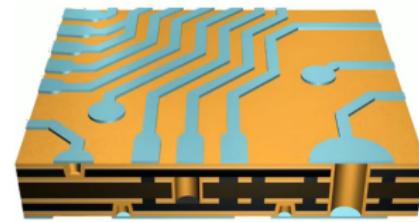
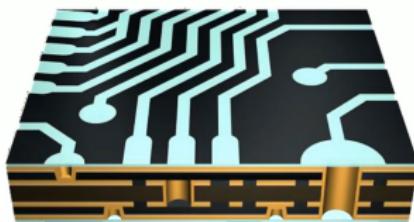
Drilling



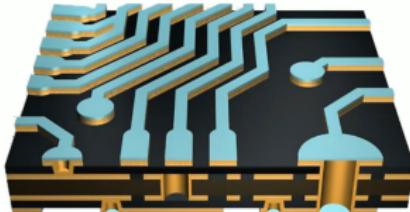
- Several PCBs are drilled together at a drill station.
- Similarly to core manufacturing, the next process is through hole plating.

Pattern Processing

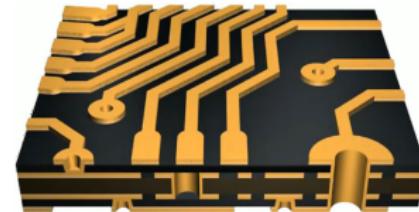
...is the same as in case of the core pattern processing:



Resist deposition and
UV illumination



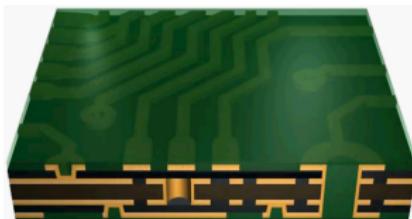
Etching



Resist cleaning

Solder-mask Processing

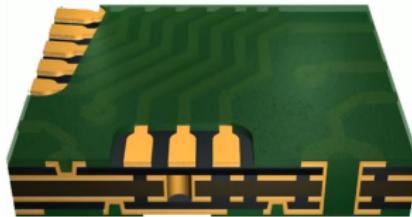
...is the same as in case of the core pattern processing:



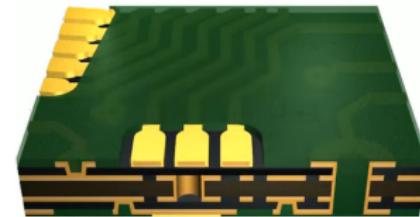
Mask deposition



Exposition



Developing



Metal plating

Metal Plating



Resources

- 1 <http://www.isola-group.com/wp-content/uploads/>
- 2 <https://www.youtube.com/watch?v=z4f-D1EKKD4>
- 3 <https://www.youtube.com/watch?v=T7S40GYEsbY>
- 4 <https://www.youtube.com/watch?v=hpR4e1n0HKo&t=204s>