PCB Fabrication Process

1. Cut laminate
2. Inner layer circuits
3. Lamination
4. Drilling
5. Plating copper
6. Outer layer circuits
7. Pattern plating
8. Etching
9. Solder mask
10. Legend
11. Surface finish
12. Profile
13. Testing
14. Final quality control

Cut laminate

- Steps: Cut laminate -> edging -> fillet

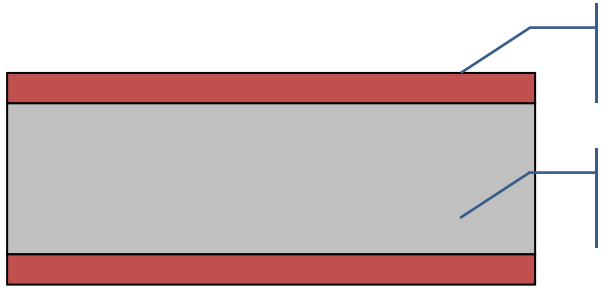
- Cut laminate:

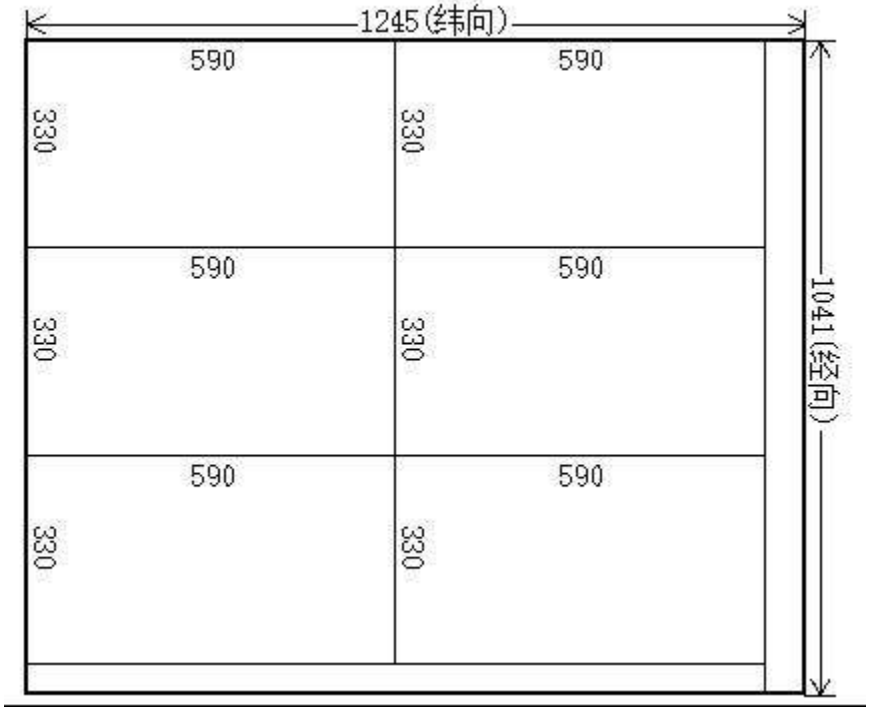
According to the design requirements, cut the laminate to the PNL(panelization) board's required size.

- Laminate materials:

Copper-clad laminate is laminated from copper foil and an insulating layer. According to different PCB specs requirements, the laminate copper thickness can be H/Hoz, 1/1oz, 2/2oz, etc.

- In case of burrs on the PCB edges that affect quality, we trim the edges and fillet the corners.





Inner Layer Circuits

- Steps: Pretreatment -> paste film -> exposure -> development -> AOI (automatic optical inspection)

- Purpose:

  - Generating the internal circuit layers by the image transfer method.

Inner Layer Circuits

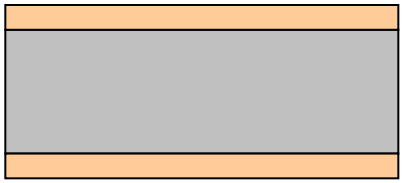
- Pretreatment

- Purpose: Removing contaminants and increasing the roughness of the copper surface to facilitate the subsequent dry film process.

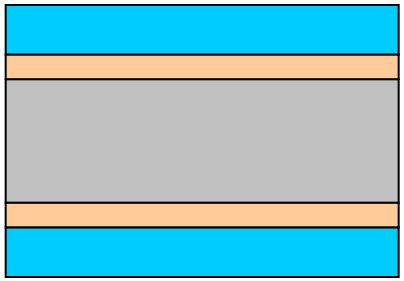
Inner Layer Circuits

- Paste dry film

- Purpose: Paste the photoresist dry film on the treated copper surface of the laminate by thermoforming.



before



after

Inner Layer Circuits

- Exposure

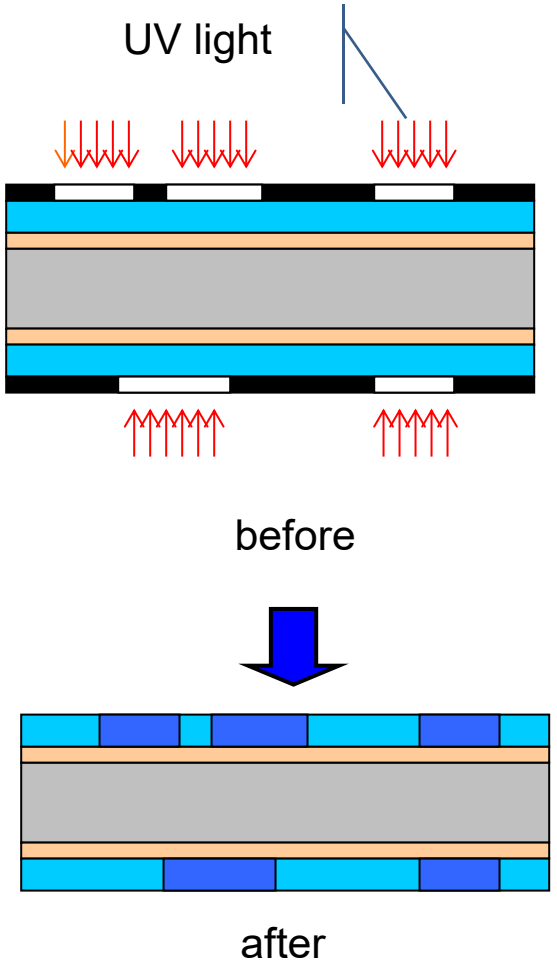
- Purpose:

➢ Transfer the circuit graphic on the original film to the photosensitive plate film by the light source

- **Materials:** Photosensitive plate film

➢ The photosensitive plate film used for the inner circuit layers is a negative film, that is, the white transparent part undergoes a photopolymerization reaction, and the black part does not react because it is opaque.

➢ The photosensitive plate used in the outer circuit layers, on the opposite, is a positive film.



Inner Layer Circuits

- **Development**

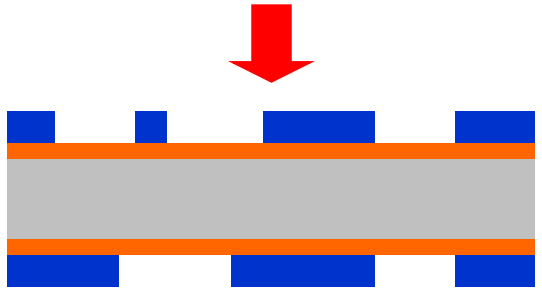
- **Purpose:**

➢ The purpose is to wash away the dry film areas that have no chemical reaction using an alkali solution.

before

- **Material:** Na_2CO_3

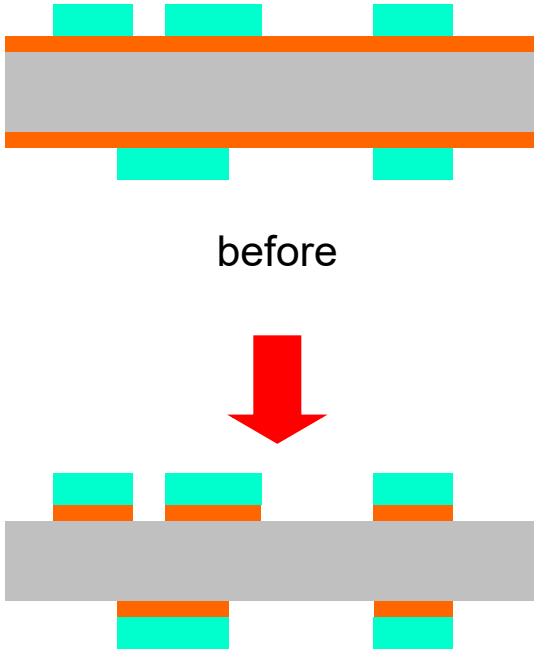
➢ Na_2CO_3 washes away the dry film that has no polymerization reaction. In contrast, the dry film that has undergone polymerization remains on the board's surface as a resist protective layer during etching.



after

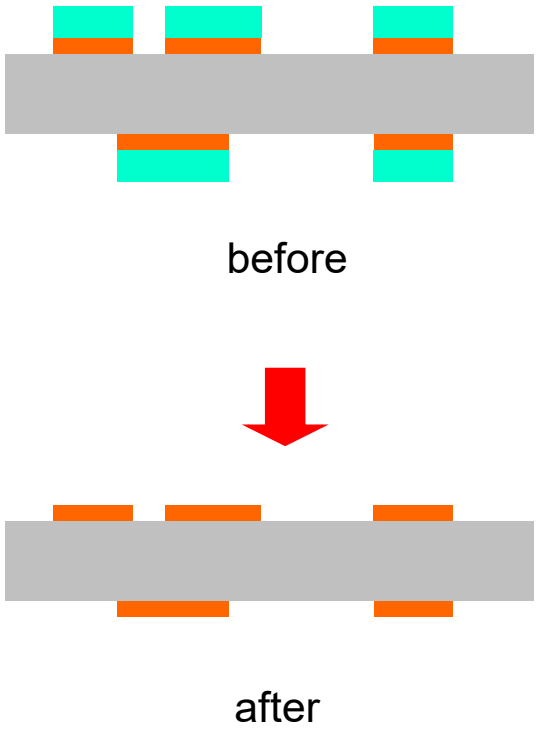
Inner Layer Circuits

- Etching
- Purpose:
  - After development, etching away the exposed copper using a chemical solution to form the inner circuit pattern.
- Material: Etching solution



Inner Layer Circuits

- Film removal
- Purpose:
  - Peeling off the resist layer that protects the copper during etching using a strong alkali to expose the circuit pattern.
- Material: NaOH



Inner Layer Circuits

- AOI

- Purpose:

➢ Detecting common defects encountered in production based on optical principles.

Lamination

- Steps: Brown -> rivet -> stack layers -> laminate -> post-process

- Purpose:

➢ Laminating the copper foil, PP (prepreg) sheets, and the oxidized inner circuit layers into a multi-layer board.

Lamination

- Brown

- Purposes:

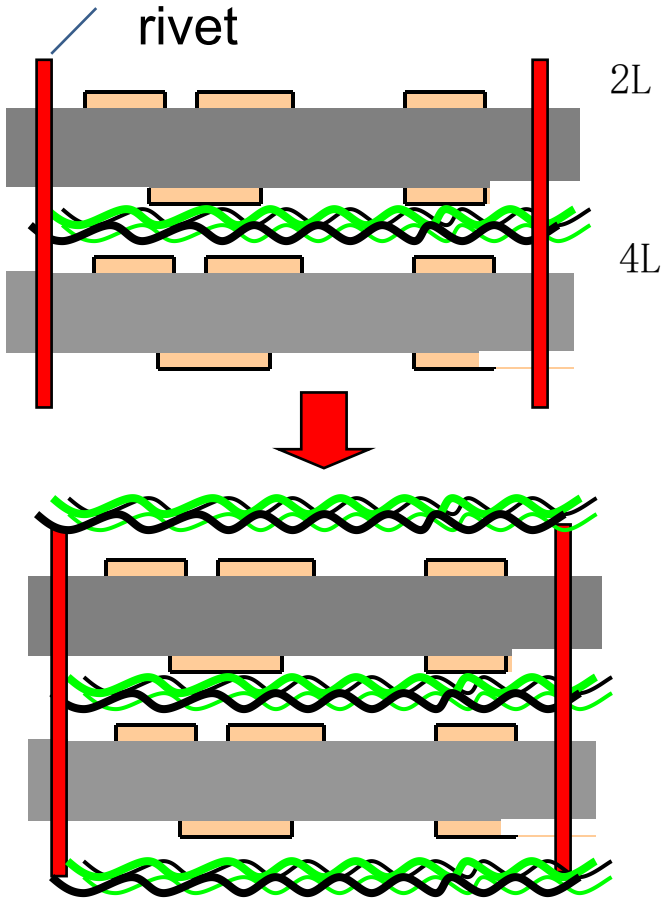
➢Roughening the copper surface to increase the contact area with the resin.

➢Increasing the wettability of the copper surface to the flowing resin.

➢Passivating the copper surface to avoid adverse reactions.

Lamination

- Rivet/pre-stack (Not for four-layer PCB)



- Purpose:

➢ The purpose is to use rivets to nail multiple inner layers together to avoid interlayer slippage during subsequent processing.

- **Material:** Rivet, PP

➢ PP(prepreg) is composed of resin and glass fiber cloth. According to the type of glass cloth, PP can be divided into 1060, 1080, 2116, and 7628.

Lamination

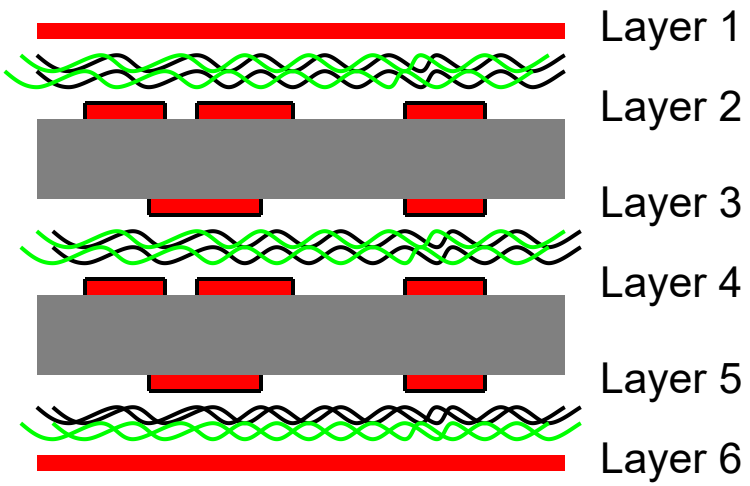
- Stack layers

- Purpose:

➢ Stacking the pre-stacked layers into a multi-layer board for lamination.

- Material: copper foil

➢ It is electroplated copper. The copper thickness can be 1/3OZ (code T), 1/2OZ(code H), 1OZ(code 1).



Lamination

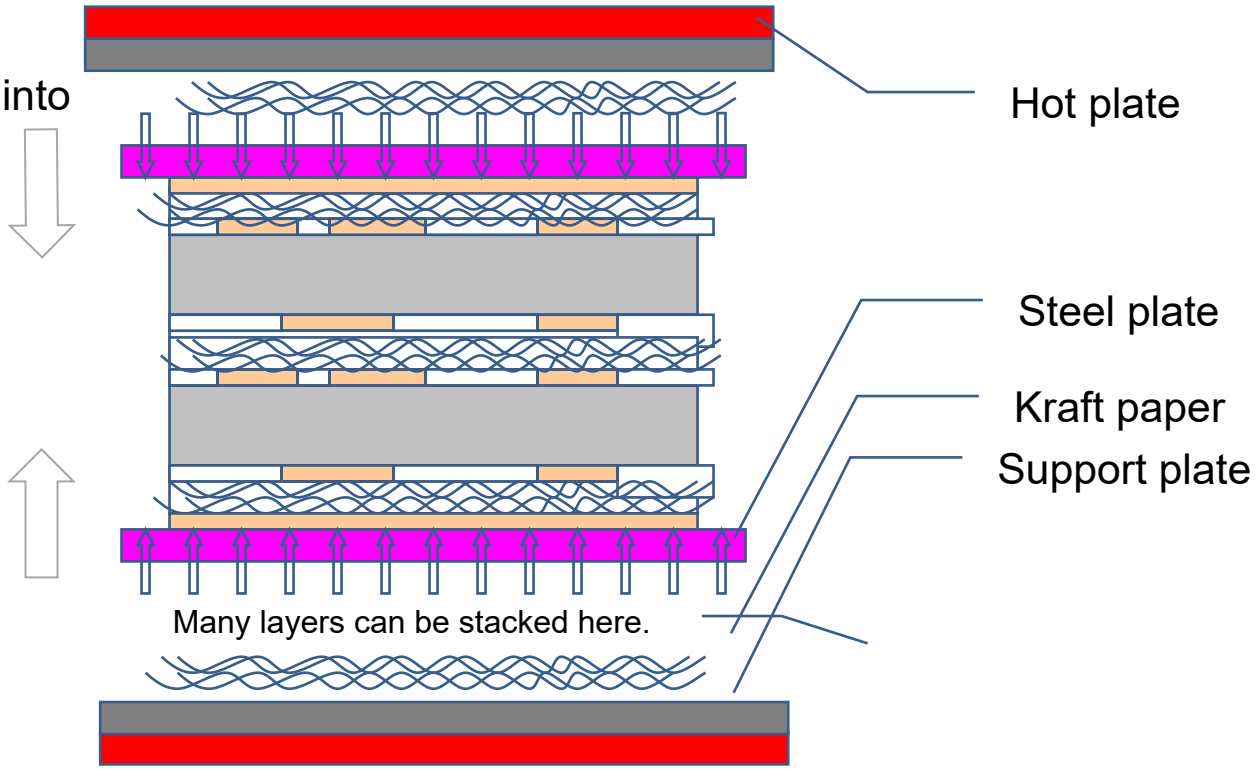
- Lamination

- Purpose:

➢ Turning many stacked layers into a multilayer PCB by the thermoforming method.

- Materials:

Kraft paper, steel plate



Lamination

- Post-processing: drilling positioning holes, profile the PNL (panelization)

- Purposes:

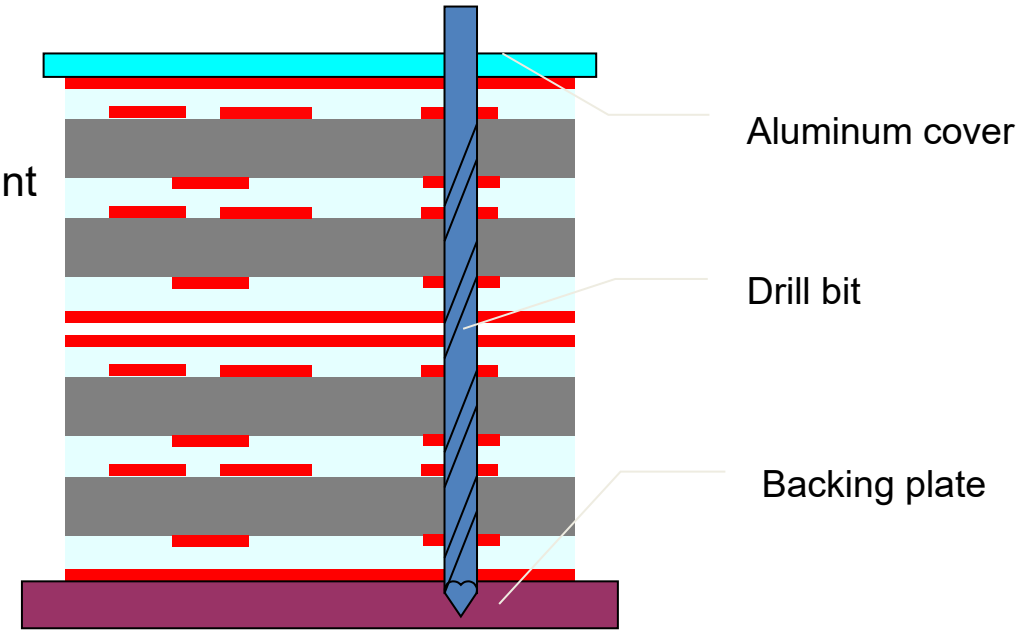
➢ Forming the shape of the PCB panelization preliminarily to meet product quality control requirements for subsequent processes.

➢ Creating positioning holes for subsequent processes.

Drilling

- Drilling

- Purpose:
  - Drill conductive vias to connect different PCB layers.

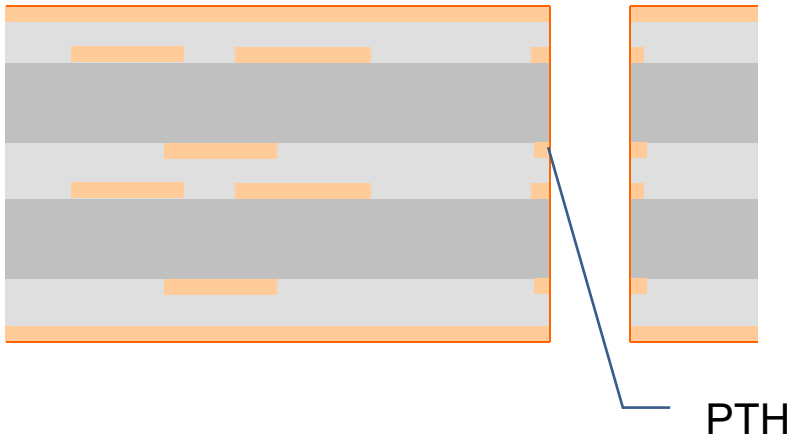


Electroless Plating Copper

- Chemical copper plating

- Purpose:

➢ The purpose is to metalize the non-conductive resin and fiberglass in the PTH (plated-through hole) walls. This facilitates the copper electroplating process, which makes metal hole walls sufficiently conductive and suitable for soldering.

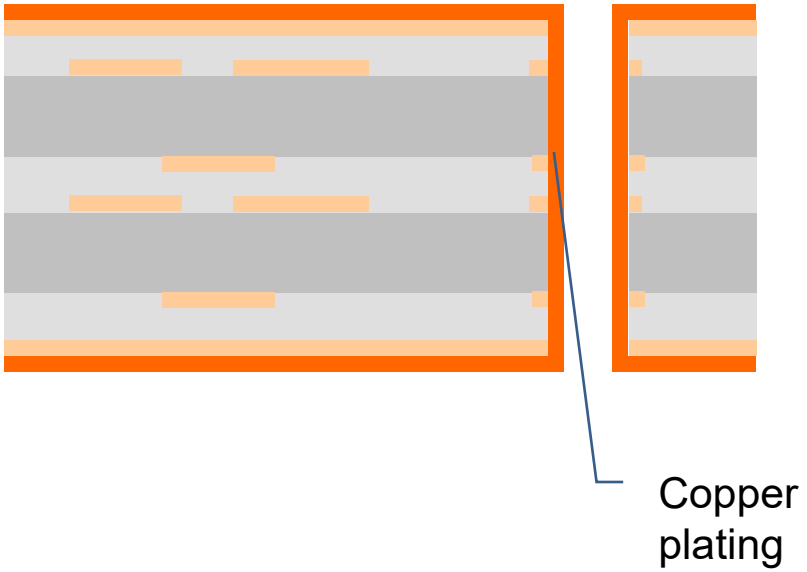


Plating Copper

- Plating copper

- Purpose:

➢ Plate a copper layer with a thickness of 5-10um (micrometers) to protect the 0.5um to 1um-thick chemical copper from damage in subsequent processes.



Outer Layer Circuits

- Steps: Pre-treatment -> paste dry film -> exposure -> development
- Purpose:

➢ After the electroless copper plating and panel copper plating processes, the inner and outer layers are interconnected by generating the outer layer circuits to achieve electrical performance.

Outer Layer Circuits

- Pre-treatment

- Purpose:

➢ Removing contaminants from the copper surface and increasing the surface roughness to facilitate the subsequent dry film process.

Outer Layer Circuits

- Paste dry film

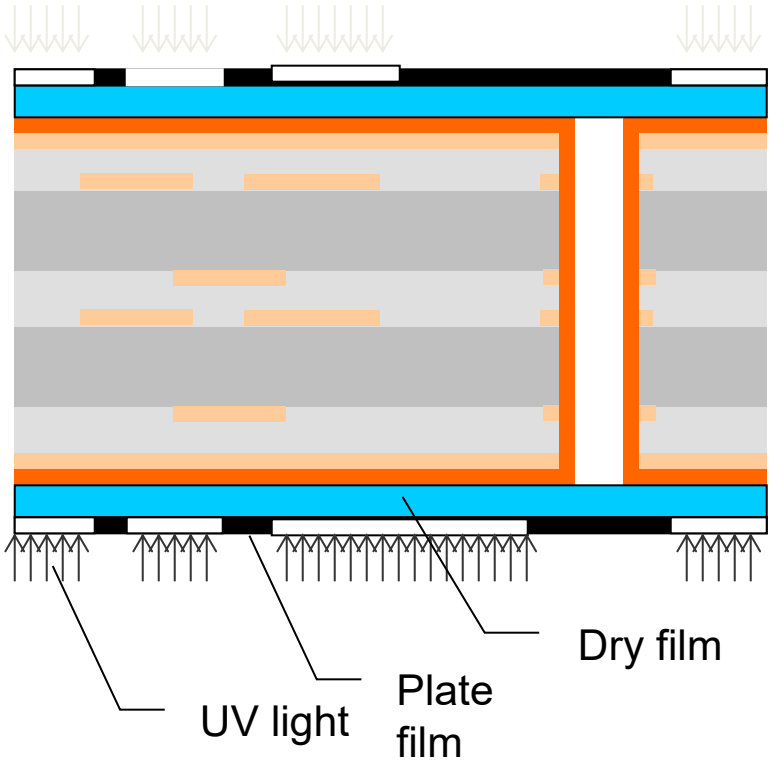
- Purpose:

➢ The purpose is to securely paste the dry film to the copper surface by thermoforming.

♣Dry film is a water-soluble dry film. It can react with a strong alkali to form organic acid salts, which can dissolve in water.

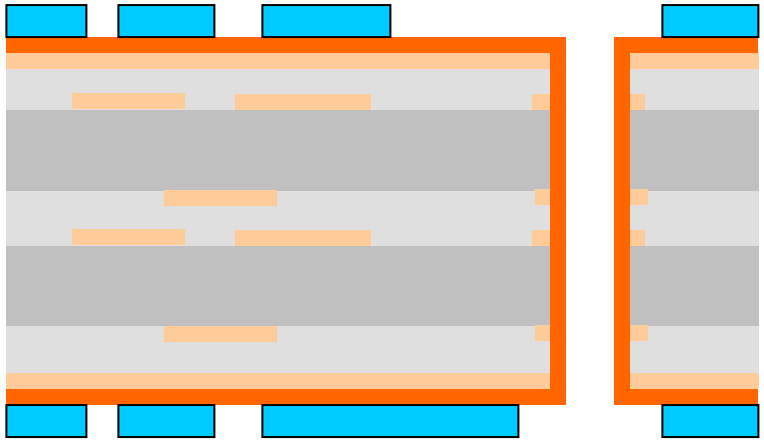
Outer Layer Circuits

- Exposure
- Purpose:
  - Exposing the desired circuits with the dry film by circuit graphic transfer.



Outer Layer Circuits

- Development
- Purpose:
  - The purpose is to rinse away the circuit areas with no polymerization reaction using a developer solution.



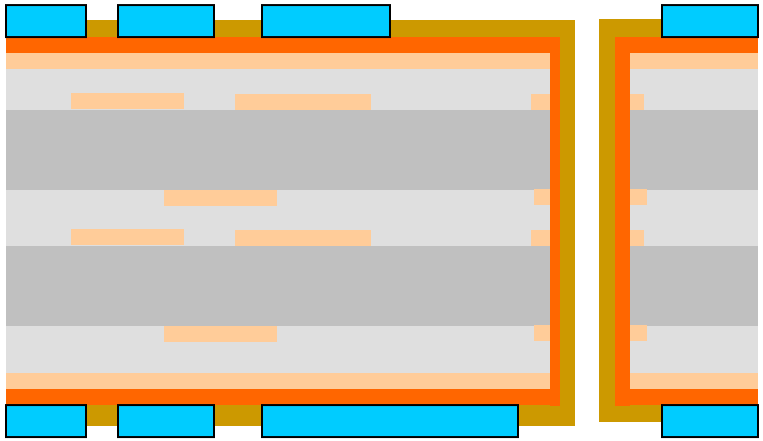
Pattern Plating

- **Procedures:** Secondary copper plating -> tin plating
- **Purpose:**

➢ Plating the copper to the thickness required by the client.

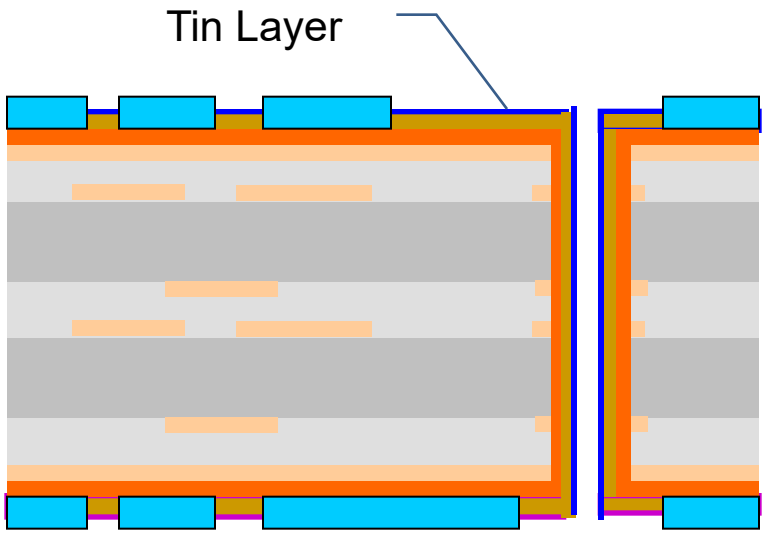
Pattern Plating

- Secondary copper plating
- Purpose:
  - Plating the copper to the required thickness.



Pattern Plating

- Tin plating
- Purpose:
  - The purpose is to plate a layer of tin onto the copper surface after the secondary copper plating, serving as an etching resist.



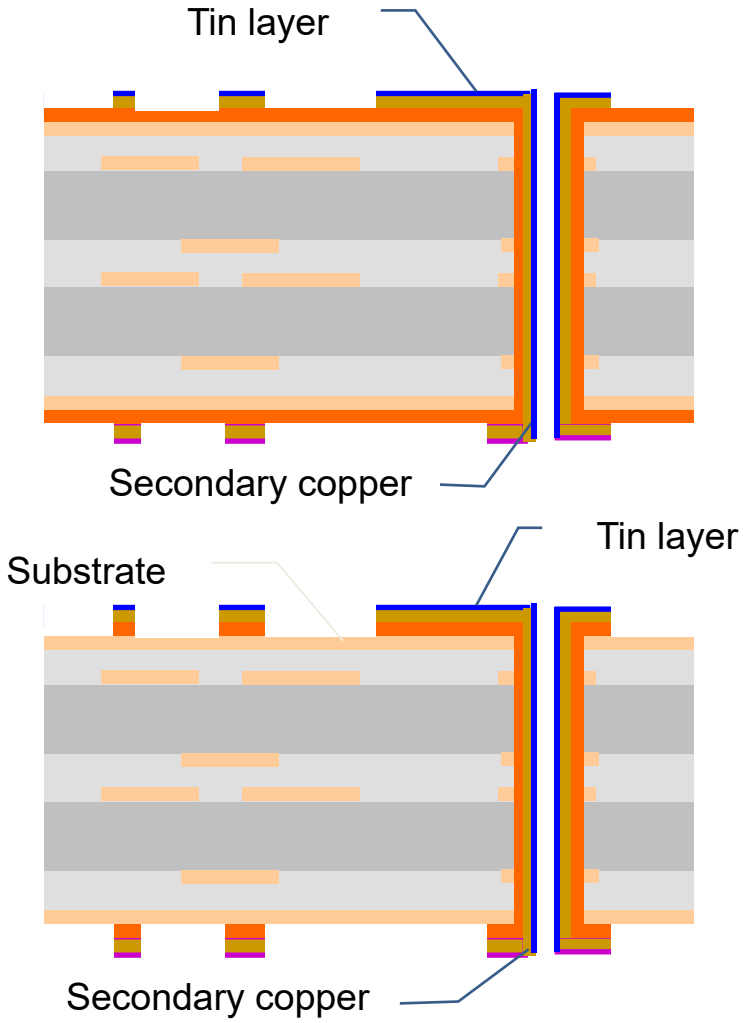
Etching

- **Dry film removal**
- **Purpose:**

➢ Removing the dry film using a chemical solution.

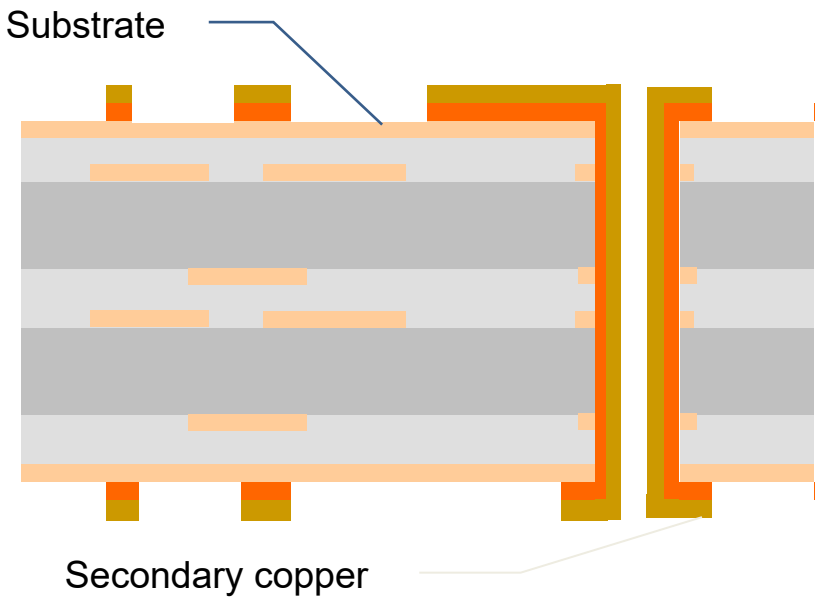
- **Etching**
- **Purpose:**

➢ Etching away the non-circuit areas of copper.



Etching

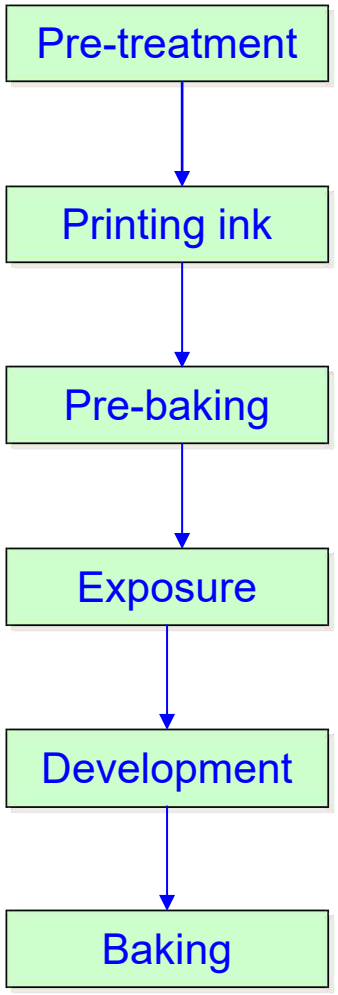
- **Tin layer Removal**
- **Purpose:**
  - Removing the protective tin coating on top of the conductor.

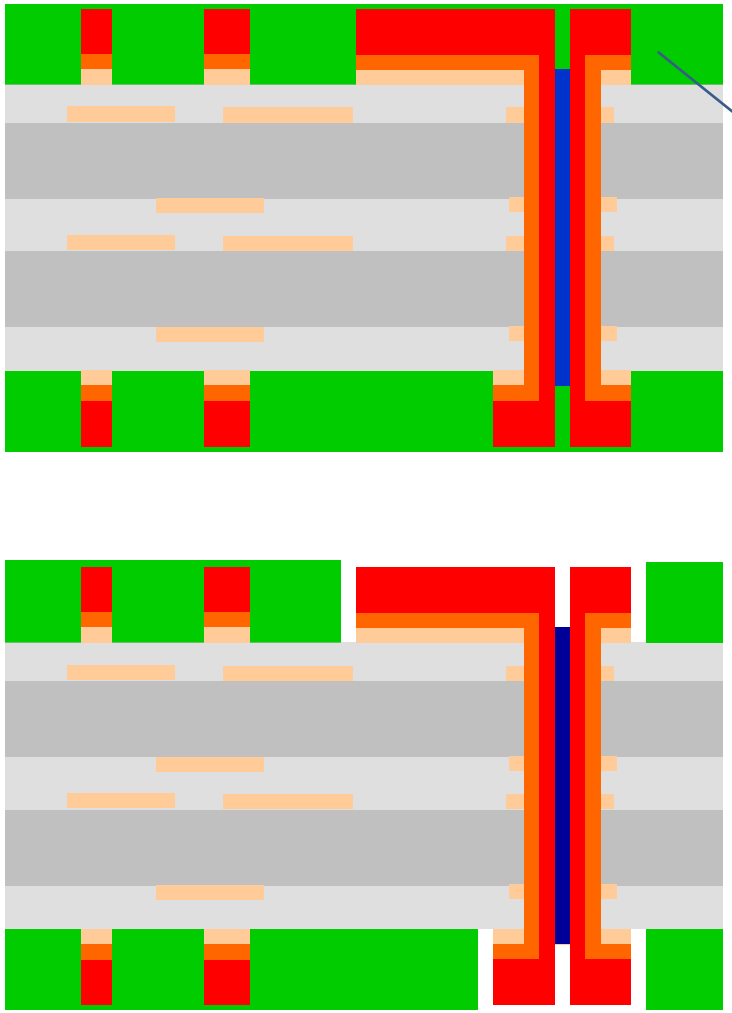


Solder Mask Process

- Solder Mask
- Purposes:
  - Preventing short circuits during wave soldering and saving the usage of solder.
  - Protecting the PCB from moisture, electrolytes, and external mechanical forces.
  - Insulation: As PCBs are getting smaller, the line space is narrow, which requires solder mask ink with a higher insulation.

Solder Mask Process



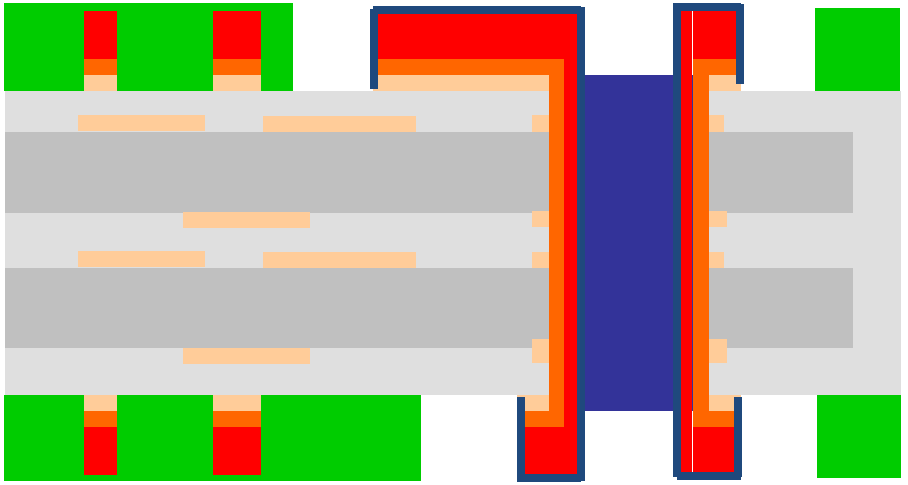


Legend Process

- Legend/Silk Screen
  - ♣Purpose: To facilitate repair and identification.
  - ♣Principle: Silkscreen printing and baking
  - ♣Material: Solder mask ink

Surface Finish

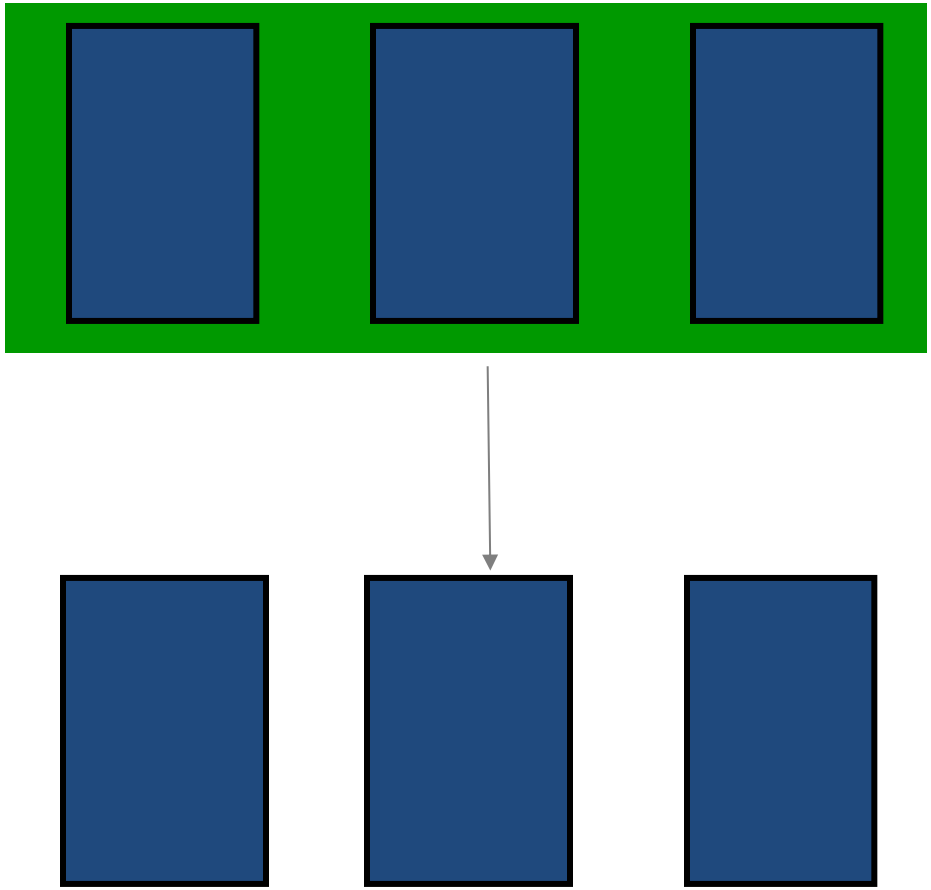
- ENIG (electroless nickel immersion gold)
- HASL (hot air solder leveling, including HASL and lead-free HASL)
- After testing, the surface finish of immersion tin or OSP is applied to small PCBs.



Profile Process

- Profile: Routing/profiling, V-cut
- Purpose:

➢ Cutting the PCB to the required dimension/size.



Testing

- **Verify**
  - **Purpose:** Not all PCBs are fabricated in good, and the purpose of testing is to identify and separate the not-good boards to avoid economic losses in the downstream processes.
  - **Methods:** Test fixture, flying probe

Final Quality Control

- **FQC**

- Purpose: Final quality assurance during the manufacturing process.

- Items to inspect:
  - Dimension inspection items
    1. Outline dimension
    2. Hole to edge
    3. PCB thickness
    4. Holes diameter
    5. Line width/space
    6. Annular ring

Final Quality Control

7. Bow and twist
8. Plating thicknesses

- Surface inspection items

1. Void
2. Hole plug
3. Copper exposure
4. Foreign particle
5. Extra/missing hole
6. Gold finger defect
7. Legend (markings)

Final Quality Control

- Reliability
  1. Solderability
  2. Peel strength
  3. Micro section
  4. S/M adhesion
  5. Gold adhesion
  6. Thermal shock
  7. Impedance
  8. Ionic contamination