PCB Fabrication Processes

Brief Introduction
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PCB Fabrication Processes

Brief Introduction
PCB Processes Flow Chart

- M/L’s I/L manufacture
- Lamination
- Drilling
- Copper Plating
- Outer Layer
- Solder Mask
- Silk Screen
- HASL
- G/F Plating
- HASL
- ENIG
- Final Finish according to customer requirement
- OSP or Immersion Silver should be applied after FQC
- G/F Plating
- Routing
- E-Test & FQC
- OQC
- Packing
- Shipping
- OQC
# Inner Layer Processing

<table>
<thead>
<tr>
<th>I/L Flow</th>
<th>1-1 Cutting</th>
<th>1-2 Beveling</th>
<th>1-3 Pre-treatment</th>
<th>1-4 Roller Coating</th>
<th>1-5 Exposure</th>
<th>1-6 DES Line</th>
<th>1-7 I/L holes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1 Cutting</td>
<td><img src="image1" alt="Base materials before cutting" /></td>
<td><img src="image2" alt="Base materials after cutting" /></td>
<td><img src="image3" alt="Stack panels and send to next process" /></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-2 Beveling</td>
<td><img src="image4" alt="Before beveling" /></td>
<td><img src="image5" alt="After beveling" /></td>
<td><img src="image6" alt="Double sided: send to drilling" /></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>1-3 Pre-treatment</td>
<td><img src="image7" alt="Brush foreign materials away from board surface" /></td>
<td><img src="image8" alt="After pre-treatment brushing" /></td>
<td><img src="image9" alt="Multi-Layer: send to inner layer pre-treatment" /></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>1-4 Roller Coating</td>
<td><img src="image10" alt="Before roller coating" /></td>
<td><img src="image11" alt="Roller coating" /></td>
<td><img src="image12" alt="After roller coating" /></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Inner Layer Processing (continued)

1-5 Exposure
Exposure $\rightarrow$ Board surface after exposure

1-6 DES Line
Before developing $\rightarrow$ After developing $\rightarrow$ After etching $\rightarrow$ After stripping away the film

1-7 I/L holes
Before hole formation $\rightarrow$ After hole formation
Mass Lamination Process

ML Flow:

- 2-1: Brown Oxide
- 2-2: Pre-lay up
- 2-3: Pinning
- 2-4: Lay up
- 2-5: Lamination
- 2-6: Unload boards
- 2-7: Drill tooling holes
- 2-8: Routing
- 2-9: Beveling

**2-1 Brown Oxide**

**2-2 Pre-lay up**

Inner layer surface before brown oxidation

Inner layer surface after brown oxidation

Cut prepreg before pre-layup

Multilayer board procedure:

**Step 1**

**Step 2**

**Step 3**

Above 8L boards should punch holes before pre-lay up procedure.

**PrePreg Cutting**

P/P roll is cut into pieces to prepare for pre-lay up

**PrePreg Hole Punching**

punch the holes used for lamination
Mass Lamination (continued)

2-3 Stack-up Pinning

4L boards above 8L boards

Hot copper rods melt spots to preserve layer alignment.

2-4 Lay up

bottom copper foil placed on the press plate

Lay up

upper copper foil placed

Cover the press plate

Pinning

Boards shown after pinning

2-5 Lamination

Copper foil cutting

Hot press

Cool press
Mass Lamination (continued)

2-6 Unload boards

2-7 Drill target holes

2-8 Routing

2-9 Beveling

Step 1

Step 2

Step 3

Step 4

X-ray target hole drilling

Board surface after X-ray drilling

Before routing

After routing

Before beveling

After beveling
Drilling Process

**Drilling Flow**

3-1 Entry and Backing
3-2 Alignment Pins
3-3 Drilling
3-4 Pin removal

3-1 Backing & Entry board cutting

Before cut ➞ After cutting ➞ Stack for next procedure.

Back-up boards ➞ Entry boards

Stack panels ➞ Add pins

Add entry board ➞ Tape Edges ➞ Drill

Pins shown ➞ After pin removal
Copper Plating

CP Flow:

4-1 Deburr

4-2 Desmear

4-3 PTH

4-4 Copper Plating

Deburr pre-treatment:

Use the brushing & high pressure water rinse to clean away the fibers on the board surface and in the holes.

Deburr pre-treatment:

non-woven rollers

High pressure water rinse

Water column spray pressure 15kg/cm²

1. Swelling

Dip boards into high temperature alkali bath liquids (which contains organic solvent) to swell the resin smears.

1. Swelling

resin smear on hole wall

2. Desmear

Cleaning away the resin smears attached on the hole wall to expose a clean copper surface.

2. Desmear

hole wall after desmear
Copper Plating (continued)

4-3 PTH

PTH:
Plated Through Holes
provide conductive connections between layers, and mechanical support for components

PTH process:
→ Desmear
→ Hole conditioning
→ Micro-etch
→ Activation
→ Acceleration
→ Electroless copper

4-4 Plating

PTH plating must establish minimum hole wall thickness, and increase surface copper thickness to meet specification or customer requirement.

“” indicates Electroless copper plating on base copper and hole wall
“” indicates the plated copper layer
**Outer Layer Processing**

**O/L Flow**

1. **5-1 Pre-treatment**
2. **5-2 Etch Resist**
3. **5-3 Exposure**
4. **5-4 DES Line**

**Pumice Line:**
Clean foreign material from board surface and roughen board surface to increase adhesion to dry film.

**Board surface before pre-treat**

**Board surface after pre-treat**

**Dry film:**
Consists of PE film, photopolymer film resist and PET film.

**Laminator:**
Heat and sentering press to apply the dry film on the board surface.
Outer Layers (continued)

Exposure:
Blue material is light-sensitive, so UV energy will cause a chemical reaction to “cure” the areas that are exposed by the image.
Solder Mask Process

**S/M Flow**: 6-1-1 Pre-treatment → 6-1-2 Printing → 6-1-3 Pre-curing → 6-1-4 Developing → 6-1-5 Post-Curing

### 6-1-1 Pre-treatment
**Pumice Line:**
Clean foreign material and roughen the board surface to increase solder mask adhesion

### 6-1-2 Printing
**Printing:**
Apply photoimagible mask on board surface to protect circuitry, prevent copper surface oxidation and act as solder resist

### 6-1-3 Pre-curing
**Pre-curing:**
Partially remove solvent so surface is not tacky

### Before pre-treat ↔ After pre-treat

### Before mask ↔ After mask
**Solder Mask Process**

6-1-4
Develop

**Developing:**
Remove the solder mask which wasn’t exposed to UV curing

6-1-5
Post curing

**Post Cure:**
Final cure to increase surface hardness and resist soldering

Before developing  ⇒  After developing

(board appears same as in previous step)
Silk Screen Process

S/S Flow:
6-2-1 Screen printing → 6-2-2 Post curing

Legend:
Text and/or numbers printed on the final board surface using non-conductive ink. Commonly used to identify components (and orientation or polarity), and identifying board part number and revision level.

Legend baking oven:
The ink used for silk screen printing contains hardening ingredients that are activated thermally, so it is cured at high temperature. This is called “Polymerization” or a “crosslinkage reaction”

S/S Flow:
6-2-1 Screen printing
6-2-2 Post curing
# Gold Finger Plating

<table>
<thead>
<tr>
<th>G/F Flow</th>
<th>7-1-1</th>
<th>7-1-2</th>
<th>7-1-3</th>
<th>7-1-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue Tape</td>
<td>Expose</td>
<td>Gold plating</td>
<td>Tape removal</td>
<td></td>
</tr>
</tbody>
</table>

**7-1-1 Blue Tape**
- Cover entire board with semi-transparent film to mask from plating
- Before: Apply Blue tape
- After: After Covering

**7-1-2 Opening**
- Expose the gold finger area.
- Before: Remove for Plating
- After: Exposed Fingers

**7-1-3 Gold Plate**
- Gold plating line:
  - Pre-treat → Ni plating → Au activation → Gold Plate → Rinse → Bake
- Before: After pre-treat
- After Ni-plating
- After gold plating

**7-1-4 Tape removal**
- Remove the blue tape covering from the board
- Board surface after gold finger plating
## Hot Air Solder Level (HASL)

<table>
<thead>
<tr>
<th>HASL Flow</th>
<th>7-2-1 Tape Mask</th>
<th>7-2-2 Tape Press</th>
<th>7-2-3 Pre-Treat</th>
<th>7-2-4 HASL</th>
<th>7-2-5 Post Treat</th>
<th>7-2-6 Tape Remove</th>
<th>7-2-7 Hole Count</th>
</tr>
</thead>
</table>

### 7-2-1 Tape Mask
- Mask areas that should not be coated with HASL

### 7-2-2 Tape Press
- Increase temperature and pressure to make the tape adhere to the gold surface.

### 7-2-3 Pre-Treat
- **HASL pre-treat:**
  1. Clean copper surface
  2. Flux coating

### 7-2-4 HASL
- Hot Air knives blow excess solder from board surface

### 7-2-5 Post Treat
- Apply tape manually

### 7-2-6 Tape Remove
- Press tape to board surface

### 7-2-7 Hole Count
- micro-etch spray
- Flux coating & dip
HASL process (continued)

7-2-5 Post Treat
Post treatment cleaning line brushes debris from the board surface

7-2-6 Tape Removal
Solder board surface after removing tape

7-2-7 Hole Count
Hole Counter:
Uses light to perform automatic checking for correct hole count, will detect missed drilling and plugged holes
# Routing Process

**F/M Flow:**

<table>
<thead>
<tr>
<th>Flow</th>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7-3-1</td>
<td>Routing</td>
<td>Route away the outer frame and board edge of the panels, and route slots if needed.</td>
</tr>
<tr>
<td>7-3-2</td>
<td>V-Cut</td>
<td>V-Groove: cutter creates grooves for easier de-panelization after assembly.</td>
</tr>
<tr>
<td>7-3-3</td>
<td>Beveling</td>
<td>Bevel: To aid gold finger insertion into socket, board edge is bevelled to 30~45 degree angle.</td>
</tr>
<tr>
<td>7-3-4</td>
<td>Water Rinse</td>
<td>High pressure water rinse and brushes remove dust. Boards are then stacked.</td>
</tr>
</tbody>
</table>

Before Routing After Routing
Electrical Test & FQC

ET Flow:

8-1 Electrical Test → 8-2 Repair

8-1 Electrical Test:
Test Fixture is developed using customer data, and will make sure finished board matches design. Test program will identify opens and shorts.

Board loaded into fixture → Fixture engaged

8-2 Repair:
Boards that didn’t pass test are evaluated by the repair operator to determine whether the fault is “real” or “false”, to avoid waste and cost caused by wrong judgment.

Repair work
Final Finish (OSP and ImAg)

FPQ Flow: 8-3 → 8-4

OSP:
Liquid bath of organic chemicals to protect copper from oxidation to preserve solderability

Flow:
Acid degrease → Micro-etch → Acid water rinse → Major bath → Blowing → Pure water rinse → Blowing

Immersion Silver:
Apply a layer of organic silver on the copper surface to prevent oxidation and preserve solderability

Immersion Silver Flow:
Acid degrease → Micro-etch → Pre-dip → Immersion Silver Bath → Hot water rinse → Blowing