



**FINELINE**

The Global PCB Experts

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A guide to PCB surface finishes

## Why do we need a Surface Finish?

Surface finish is necessary for 2 key reasons:

- To prevent oxidation of exposed copper surfaces which would lead to poor solderability/reliability
- To provide a reliable, solderable surface which acts as the connection between the PCB and the components

## Hot Air Solder Level (HASL) Leaded

- Still most widely used finish
- Eutectic 63% tin/37% lead
- Molten solder applied to exposed copper and excess blown off with air “knives”
- 12 months’ shelf life

### Issues

- Poor surface planarity and variation not suited for surface mount and/or HDI
- Extremely aggressive thermal excursion and stresses on PCB
- Not ROHS compliant

## Hot Air Solder Level (HASL) Lead Free

- Also widely used finish
- Variety of alloys – Sn/Ag/Cu (SAC- most common), Sn/Cu/Co, Sn/Cu/Ni/Ge
- Same equipment/process but different solder pot
- Better thickness control and variation than leaded HASL
- ROHS compliant
- 12 months' shelf life

### Issues

- Surface planarity and variation still not suited for surface mount and/or HDI
- Due to higher temperatures, even more aggressive thermal excursion and stresses on PCB

## Immersion Silver

- Metallic finish
- Very flat and planar surface
- Ideal for surface mount, BGA etc
- Al wire bondable
- 6 – 12 months' shelf life

## Issues

- Sensitive to handling
- Tarnishing

## Organic Solderability Preservative - OSP

- Protects copper until assembly
- Very thin coating
- Suitable for both dip tank and conveyorised processing
- Good planarity for surface mount and HDI
- Low cost

### Issues

- 6 months' or less shelf life
- Very sensitive to handling issues – poor solderability
- Usually requires aggressive flux/cleaning
- Issues with multiple assembly process steps

## Electroless Nickel Immersion Gold – ENIG

- Nickel immersion barrier layer
- Gold “flash” protecting nickel from oxidation
- Very flat and planar surface
- Ideal for fine pitch surface mount, BGA etc
- Excellent contact resistance and lifecycle e.g. keypads
- 12 months’ shelf life

### Issues

- Not gold wire bondable
- Many processing steps
- “Skip plating” issue/galvanic effect

## Immersion tin

- Strong copper/tin intermetallic
- Lubricating properties assist with pressfit
- Fine grain, non-porous and excellent chemical resistance

## Issues

- 6 months' shelf life
- Unpleasant chemistry with carcinogenic substance – Thiourea
- Handling issues
- Potential for tin whisker growth over time – short circuits



## Electrolytic Nickel Gold (Hard or soft bondable)

- Can be applied in varying thicknesses
- Gold can be deposited in varying degrees of hardness depending on application
- 12 months' shelf life
- Good planarity
- Al wire bondable
- Au wire bondable (soft only)

### Issues

- Undercut of copper under nickel creates overhang and potential for flaking/shorts
- Expensive
- Not good for high frequency due to skin effect

- Forms excellent joint with SAC solders (lead free)
- Palladium barrier layer eliminates nickel corrosion issues (black pad)
- Al wire bondable
- Au wire bondable
- 12 months shelf life

### Issues

- Palladium does not form strong bond with leaded solders
- Many processing steps
- Expensive

## Immersion Silver Immersion Gold – ISIG

- Nickel free – excellent for high speed applications
- Excellent planarity so ideal for fine pitch SMT, BGA etc
- Very high conductivity
- Ductile so ideal for flex
- Al wire bondable
- Au wire bondable

### Issues

- Very expensive
- Few suppliers have capability, most are sub contracted
- 6 months' shelf life

# Surface finish comparison summary

Type	Planarity	Solderability	Al Wire bondable	Au Wire bondable	Relative cost adder
HASL	POOR	GOOD	NO	NO	1.0
LFHASL	FAIR	GOOD	NO	NO	1.0
OSP	GOOD	GOOD	NO	NO	1.0
IMMAg	GOOD	GOOD	YES	NO	1.1
IMMSn	GOOD	GOOD	NO	NO	1.1
ENIG	GOOD	GOOD	YES	NO	1.1
ENEPIG	GOOD	GOOD	YES	NO	2.5
ElecAu	GOOD	POOR	YES	YES	3.5
ISIG	GOOD	GOOD	YES	YES	6



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