

Design-Rules and important information around the topic Solder mask

FINELINE

FINELINE
EXCELLENCE IN PCB

Albert Schweitzer
Fine Line Gesellschaft für
Leiterplattentechnik mbH
Itterpark 4, D-40724 Hilden

16.09.2015 Vers. 1.0

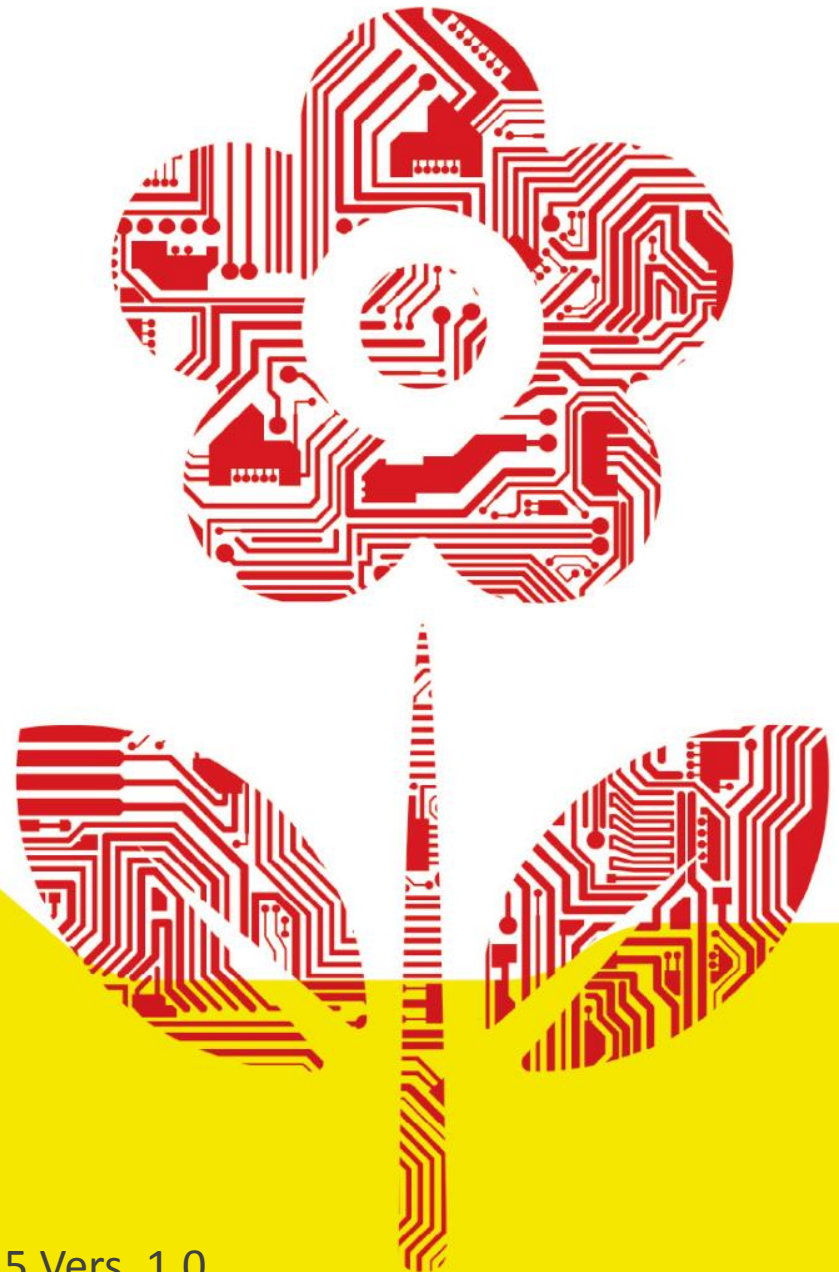


Table of Content

Content

- 1 General
- 2 IPC Standard
- 3 Application process
- 4 Thickness of Solder mask
- 5 Min. Solder mask web
- 6 Definition SMD / NSMD Pads
- 7 Why NSMD Pads?
- 8 Parameter NSMD Pads
- 9 Others

1



General

General

Solder mask is a protective layer for printed circuit boards with the following essential functions:

- ▶ Prevent of short circuits (solder bridges) during soldering process
- ▶ Reduction of solder past consumption during Solder process
- ▶ Additional insulation of the components from PCB
- ▶ Protection of the PCB against mechanical and chemical attack (corrosion)
- ▶ Increasing the breakdown voltage
- ▶ Prevent growth of metal whiskers

2 ▶ IPC Standard

IPC-SM-840

In IPC standard “IPC-SM-840”, the following requirements are defined:

- ▶ Visual requirements
- ▶ Adhesiveness
- ▶ Soldering resistance
- ▶ Cleaning and flux resistance
- ▶ Layer thickness
- ▶ Curing

IPC-SM-840

The test methods and conditions in IPC-SM-840C are based on end use and environmental reliability requirements for two classes of user:

Class 2 is equivalent to Class T;

Class 3 is the equivalent of Class H.

T – Telecommunication (includes computers, telecommunication equipment, sophisticated business machines, instruments, and certain non-critical military applications.) Solder mask on boards in this class is suitable for high performance commercial and industrial products in which extended performance life is required, but for which interrupted service is not life-threatening.

IPC-SM-840

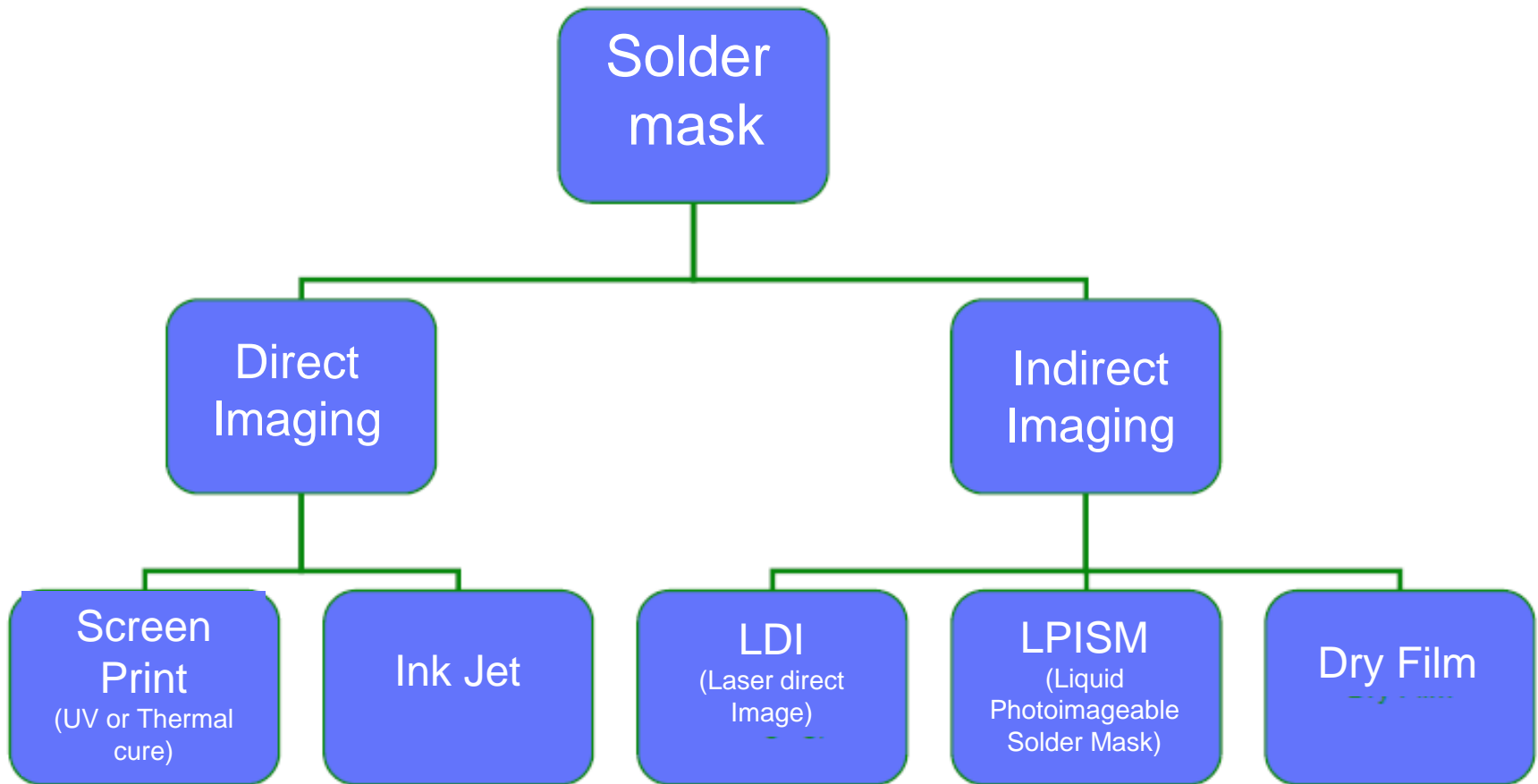
H – High Reliability/Military (includes that equipment where continued performance is critical, equipment down-time cannot be tolerated and/or the equipment is a life support item). Solder mask on boards of this class is suitable for applications where high levels of assurance are required and uninterrupted service is essential.

3



Application process

Solder mask Types



LPISM Application Method

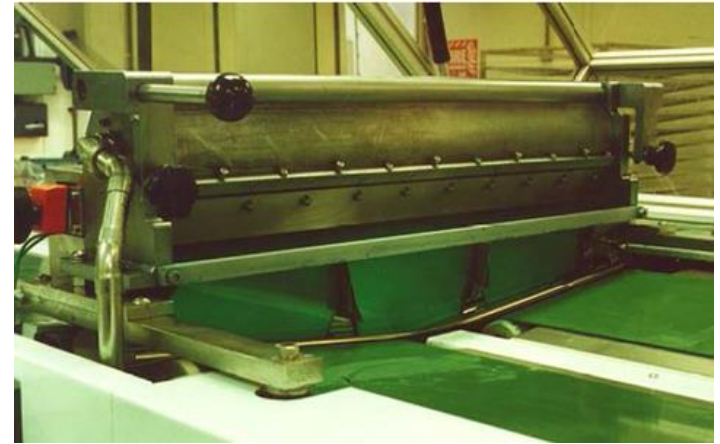
We will concentrate on the Liquid Photoimageable Solder Mask (LPISM) Method. There are currently four main categories of LPISM available:

- ▶ Screen print
- ▶ Curtain coat
- ▶ Electrostatic spray
- ▶ Air spray

Air spray



Double sided screen print



Curtain coat



Electrostatic spray



Air spray

Curtain coat

The curtain coating principle is used in various industries. It can apply liquid material at very high speeds with low material loss. Curtain coating has become more widely used in the circuits industry as PCBs have become more complex, with higher track densities and narrower track widths. A vertical falling curtain of coating material is produced by pumping the feedstock through a slit on the underside of a reservoir. The substrate to be coated is moved briskly through the resulting liquid curtain, collecting a thin and even deposit on the way. It is then passed on to separate machinery for baking.

Curtain coat



4

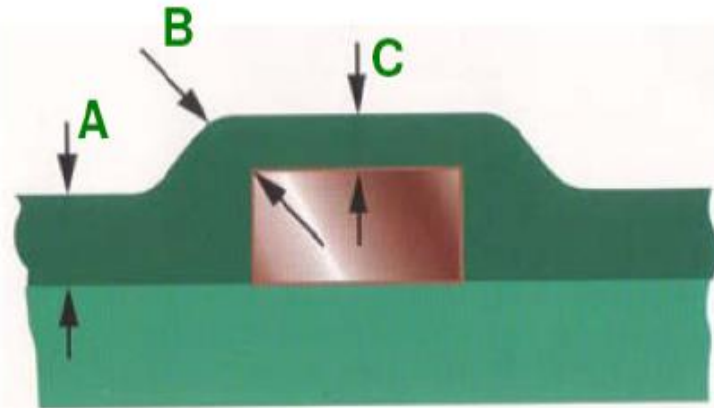


Thickness of Solder Mask

Thickness of Solder Mask



Thickness of Solder Mask



A = Thickness above laminate
 B = Thickness above line edge
 C = Thickness above copper

Dicke der Lötstopmmaske / Solder mask thickness				
Copper Thickness	A	B	B	C
		min.	max.	
35µm	≤50µm	5µm	15µm	10 - 25µm
50µm	≤60µm	5µm	15µm	10 - 25µm
75µm	≤75µm	5µm	15µm	10 - 25µm
105µm	≤100µm	5µm	20µm	10 - 30µm
140µm	≤150µm	5µm	20µm	10 - 35µm

Values for
 Screen Print
 process

Thickness of Solder Mask

IPC-SM-840C don't describe the thickness of the Solder Mask. It merely requires that the solder mask having a dielectric strength of 500VDC / 0,025mm.

The thickness of the solder mask can only predicted accurately in limits and depends on used process. It differs also from manufacturer to manufacturer and used chemistry.

In case a customer ask for a specific thickness, it must be stated in order documents.

5

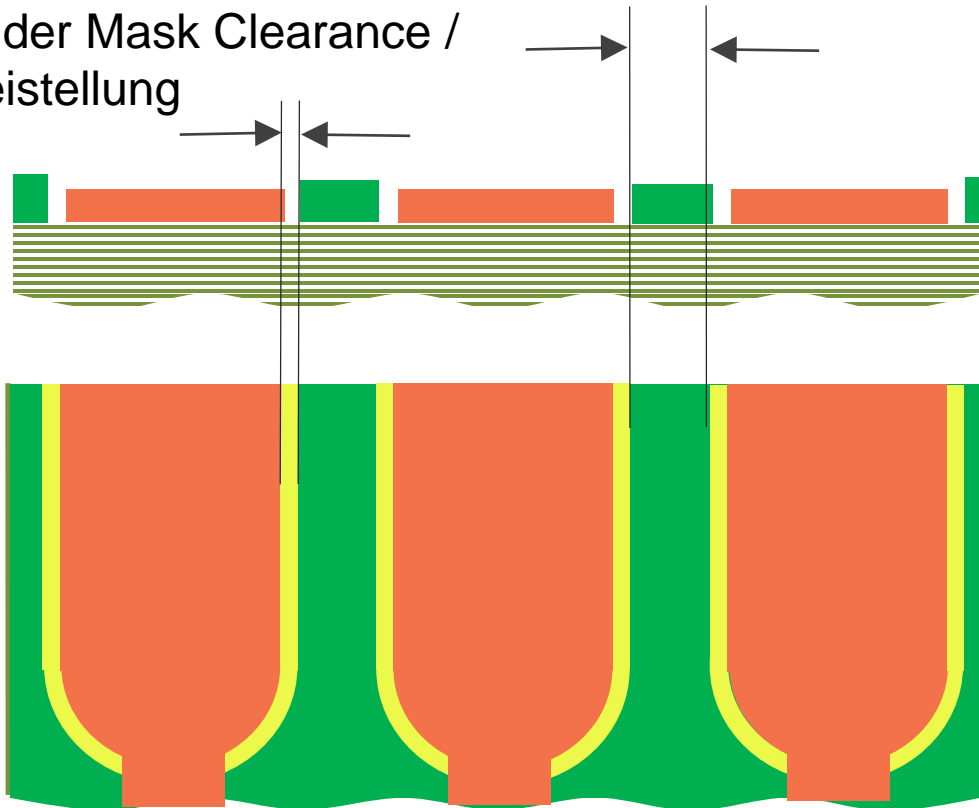


Min. Solder Mask dam

Solder Mask dam

Min. Solder Mask Dam /
Min. Lötstoppmaskensteg

Solder Mask Clearance /
Freistellung

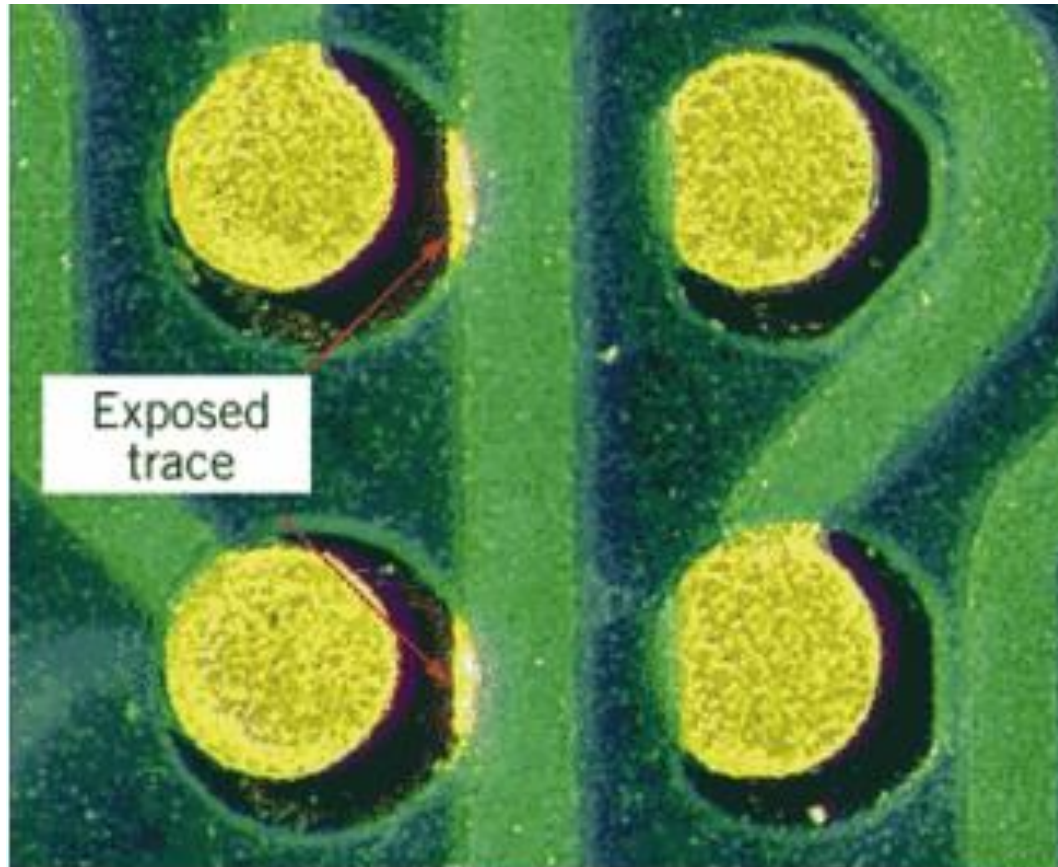


Min.
Solder Mask
Dam /
Min.
Lötstopp-
maskensteg
= > 150µm

Solder Mask
Clearance /
Freistellung
= > 75µm

Solder mask dam is different for non-green SM

Misregistration



6

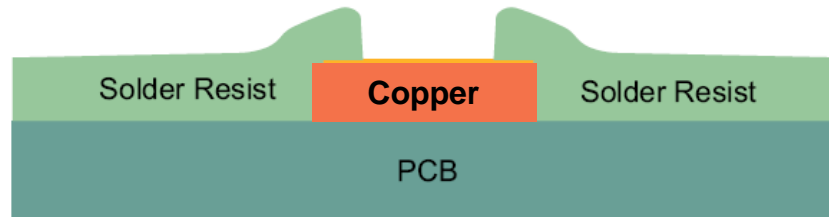


Solder mask defined (SMD) and non solder mask defined (NSMD) Pads

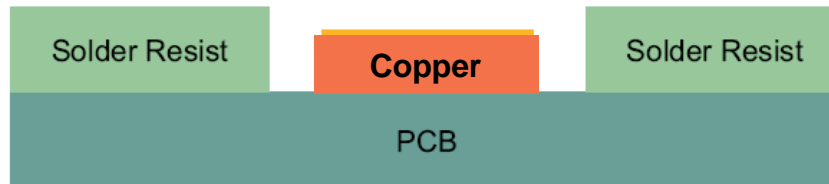
Definition Solder Mask defined (SMD) and non Solder Mask defined (NSMD) Pads

The difference between:

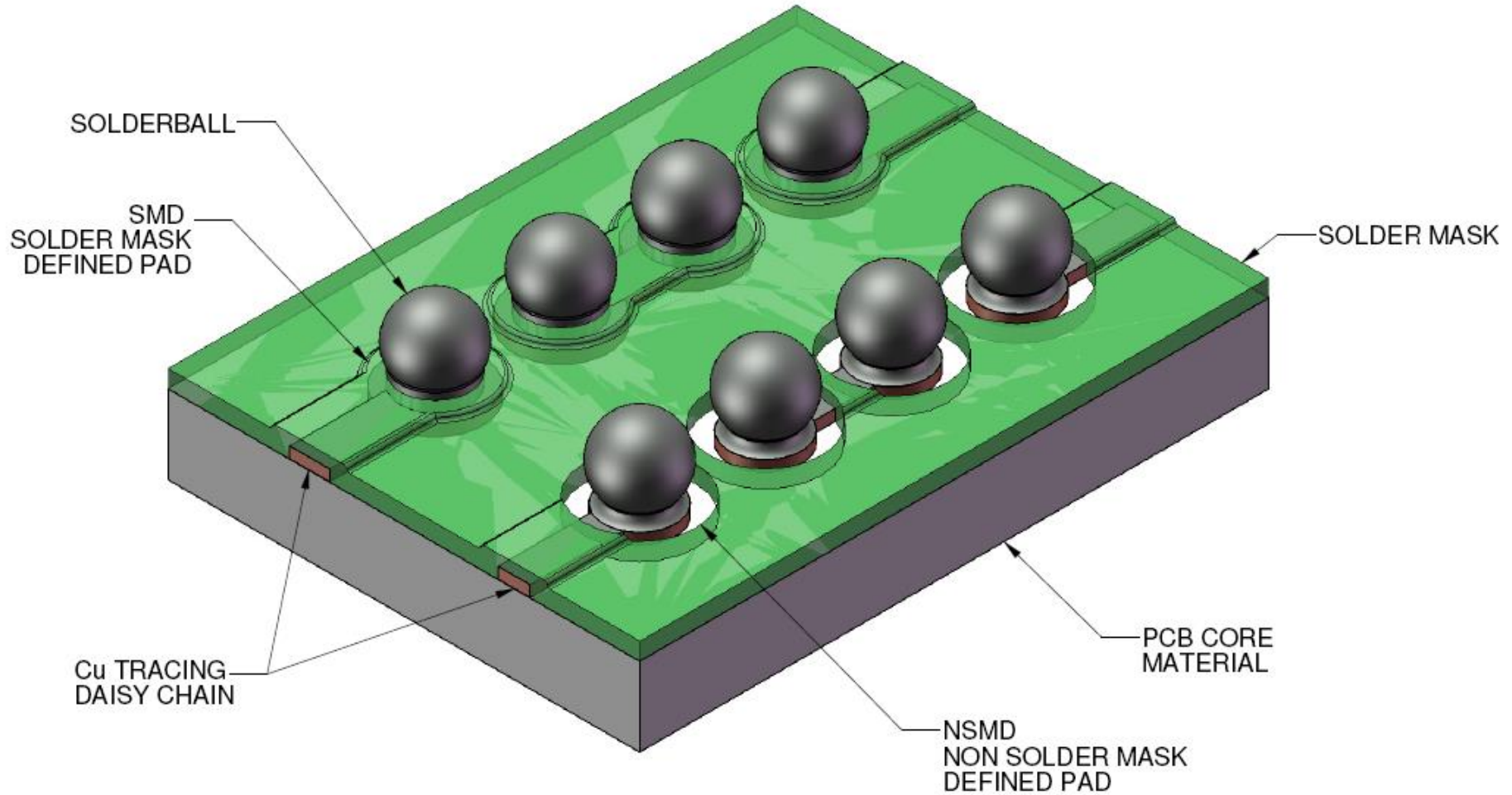
Solder Mask Defined, SMD Pads:



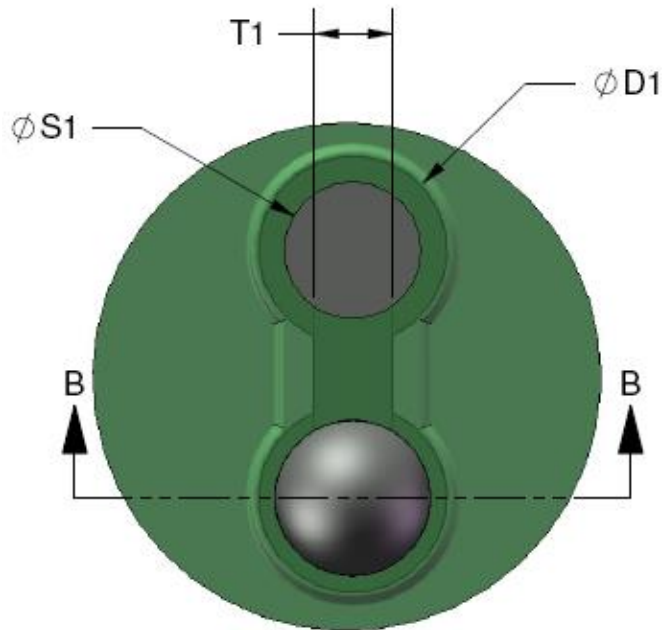
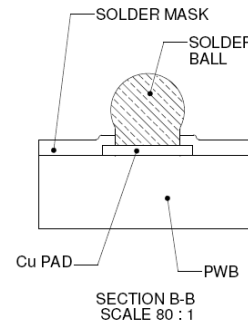
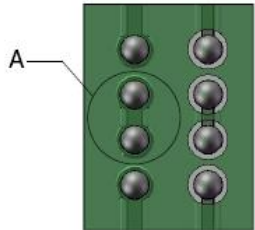
Non Solder Mask Defined, NSMD Pads:



Difference between SMD and NSMD Pads



Typically dimensions of SMD Pad

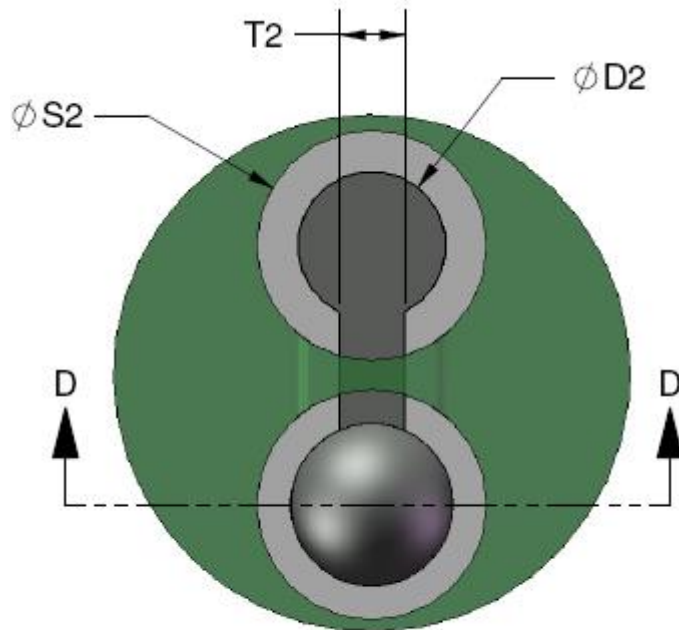
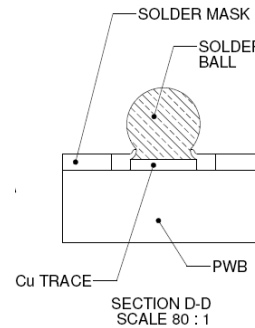
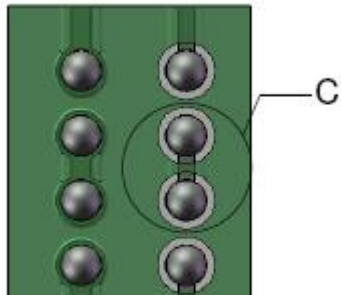


DETAIL A
SCALE 80 : 1

Dimensionierung SMD Pad / Dimension Table SMD Pad

			S1		D1		T1	
Pitch	Ball Durchmesser		Ø Lötbares Pad		Ø Pad Kupfer		Leiterbahnbreite	
1.5mm	0.76mm	30mil	0.61mm	24mil	0.8mm	32mil	0.25mm	10mil
1.27mm	0.76mm	30mil	0.61mm	24mil	0.8mm	32mil	0.25mm	10mil
1.00mm	0.634mm	25mil	0.51mm	20mil	0.63mm	25mil	0.2mm	8mil
1.00mm	0.5mm	19,7mil	0.4mm	16mil	0.56mm	22mil	0.2mm	imil
0.8mm	0.5mm	19,7mil	0.4mm	16mil	0.56mm	22mil	0.15mm	5mil
0.8mm	0.45mm	17.7mil	0.36mm	14mil	0.50mm	20mil	0.15mm	6mil
0.8mm	0.4mm	15.7mil	0.32mm	13mil	0.40mm	16mil	0.15mm	6mil
0.75mm	0.35mm	13.8mil	0.28mm	11mil	0.40mm	16mil	0.12mm	5mil
0.65mm	0.35mm	13.8mil	0.28mm	11mil	0.40mm	16mil	0.12mm	5mil
0.50mm	0.3mm	11.8mil	0.24mm	10mil	0.36mm	14mil	0.12mm	5mil
0.40mm	0.25mm	9.8mil	0.20mm	8mil	0.30mm	12mil	0.12mm	5mil
0.30mm	0.2mm	7.9mil	0.15mm	8mil	0.23mm	9mil	0.10mm	4mil

Typically dimensions of NSMD Pad



DETAIL C
SCALE 80 : 1

Dimensionierung SMD Pad / Dimension Table SMD Pad

Pitch	Ball Durchmesser		S1		D1		T1	
	Ø Lötbares Pad	Ø Pad Kupfer	Leiterbahnbreite					
1.5mm	0.76mm	30mil	0.76mm	30mil	0.63mm	25mil	0.20mm	8mil
1.27mm	0.76mm	30mil	0.76mm	30mil	0.63mil	25mil	0.20mm	8mil
1.00mm	0.634mm	25mil	0.63mm	25mil	0.50mm	20mil	0.15mm	6mil
1.00mm	0.5mm	19,7mil	0.58mm	23mil	0.45mm	18mil	0.15mm	6mil
0.8mm	0.5mm	19,7mil	0.58mm	23mil	0.45mm	18mil	0.12mm	5mil
0.8mm	0.45mm	17.7mil	0.53mm	21mil	0.40mm	16mil	0.12mm	5mil
0.8mm	0.4mm	15.7mil	0.50mm	20mil	0.35mm	14mil	0.12mm	5mil
0.75mm	0.35mm	13.8mil	0.45mm	18mil	0.30mm	12mil	0.10mm	4mil
0.65mm	0.35mm	13.8mil	0.45mm	18mil	0.30mm	12mil	0.10mm	4mil
0.50mm	0.3mm	11.8mil	0.40mm	16mil	0.25mm	10mil	0.10mm	4mil
0.40mm	0.25mm	9.8mil	0.30mm	12mil	0.20mm	8mil	0.10mm	4mil
0.30mm	0.2mm	7.9mil	0.25mm	10mil	0.15mm	6mil	0.07mm	3mil

7



Why NSMD Pads?

Difference between SMD and NSMD Pads

Important!

Today all Semiconductor manufacturers are recommending NSMD pads.

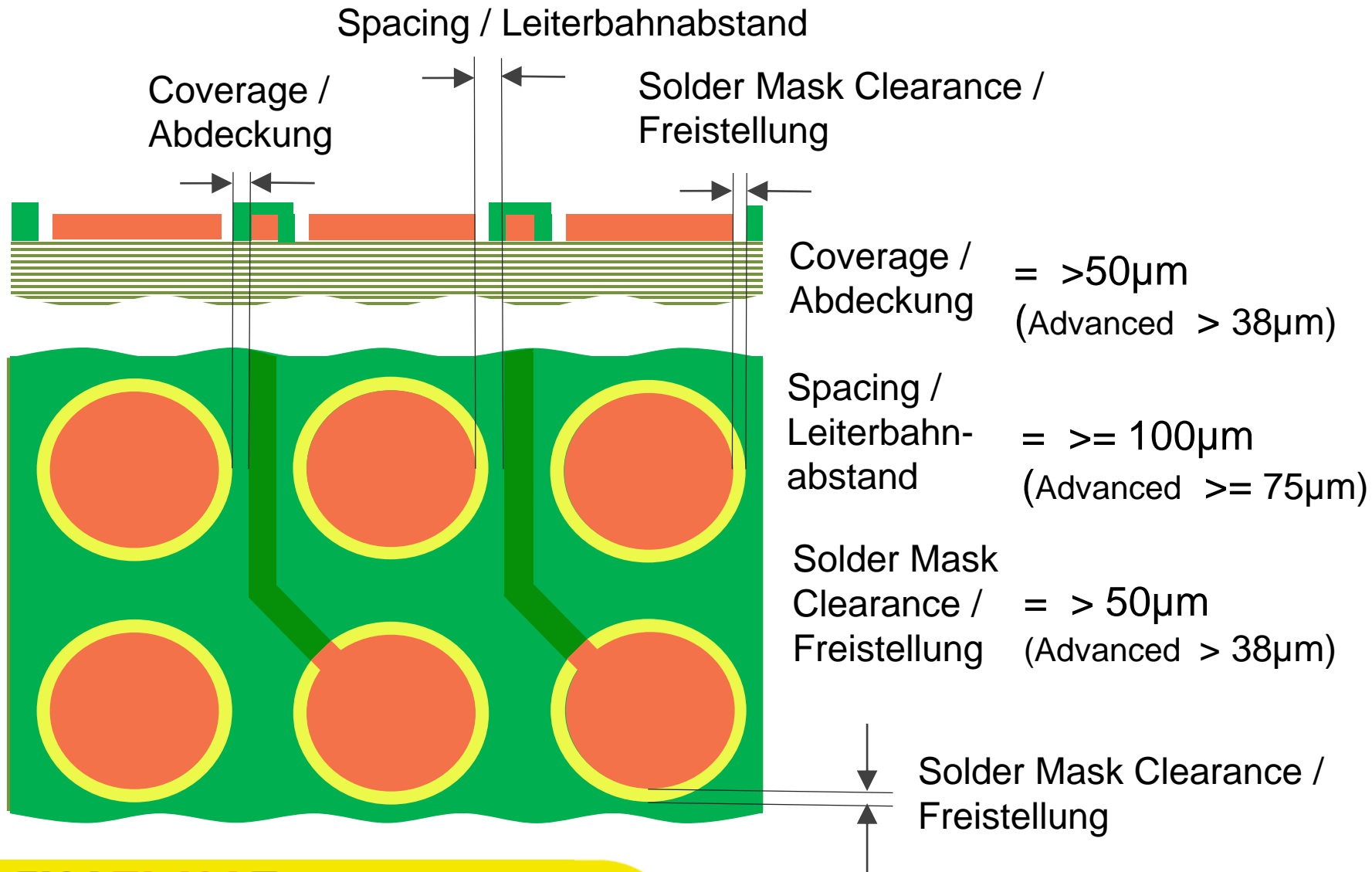
The reason for that:

NSMD pads offer more space for routing (e.g., additional conductor paths between the pads) and lead to a higher reliability of the solder joint.



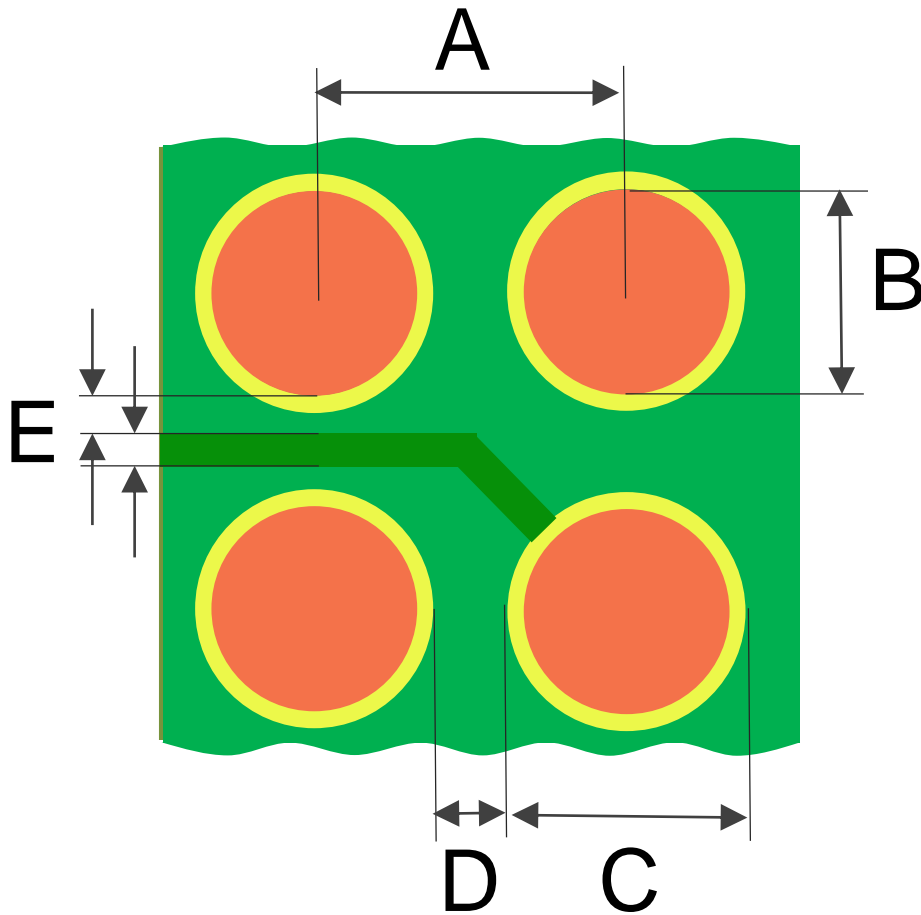
Parameter NSMD Pads

Non solder mask defined (NSMD) BGA pads



Ti Design Rekommandation for 0.5 pitch BGA

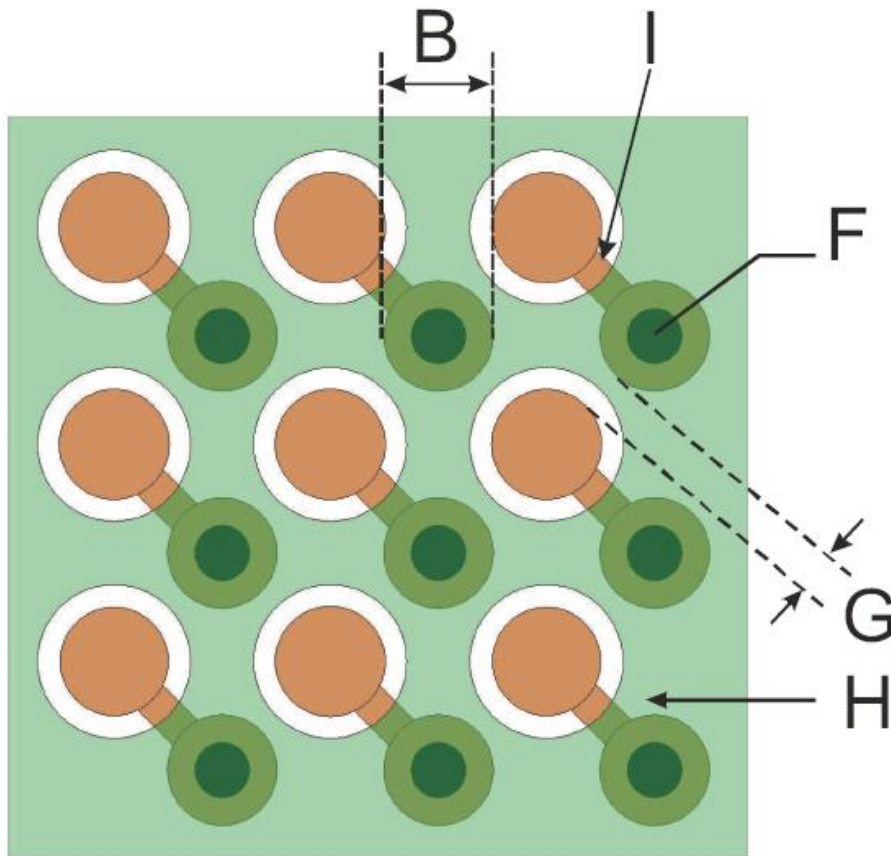
Pad Type: NSMD



Pad Pitch	A = 500 μ m
Pad Size	B = 250 μ m
Mask Opening	C = 50 μ m around Pad
Mask Web	D = 150 μ m
Trace Width	E = 82 μ m
Pad to Trace Clearance	E = 82 μ m

Ti Design Recommendation for 0.5 pitch BGA

Pad Type: NSMD



Pad Size

B = 250 μ m

Via pad size

B = 254 μ m

Via Drill size

F = 127 μ m

Pad to Via clearance

G = 72 μ m

Pad to Via Trace

H = 82 μ m

Length of Connecting

I = 35 μ m

9



Others

Why green Solder Mask?

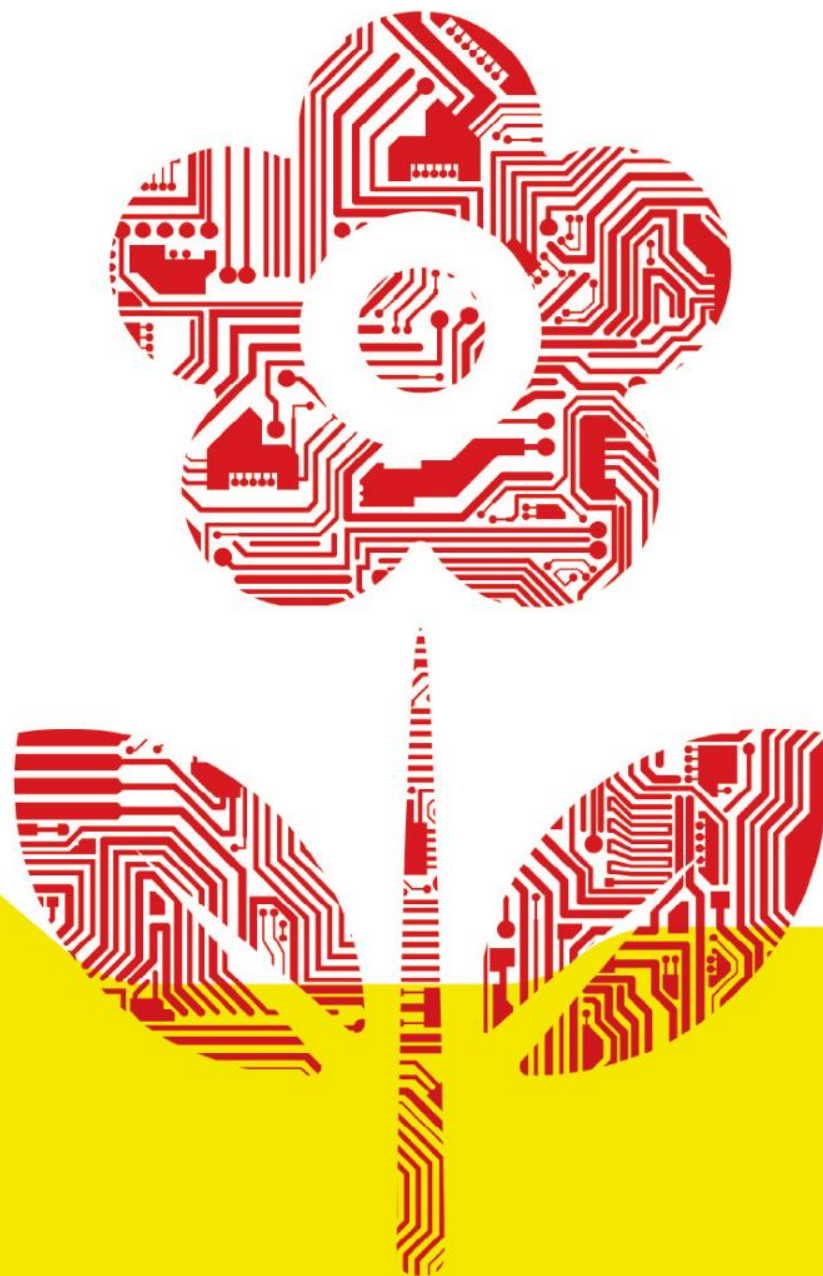
Why is the green color for solder mask an industry standard?

The right placement of components in SMD Lines are often controlled by IR or visible-red light and monochromatic cameras. The contrast is in case of non-red color paints is the highest one and cameras typically operate as a quasi- "B / W" camera.

There are also brown and blue colored SM, but it is more difficult to cure this colors with UV light

THANK'S FOR LISTENING

Danke für's Zuhören



FINELINE
EXCELLENCE IN PCB