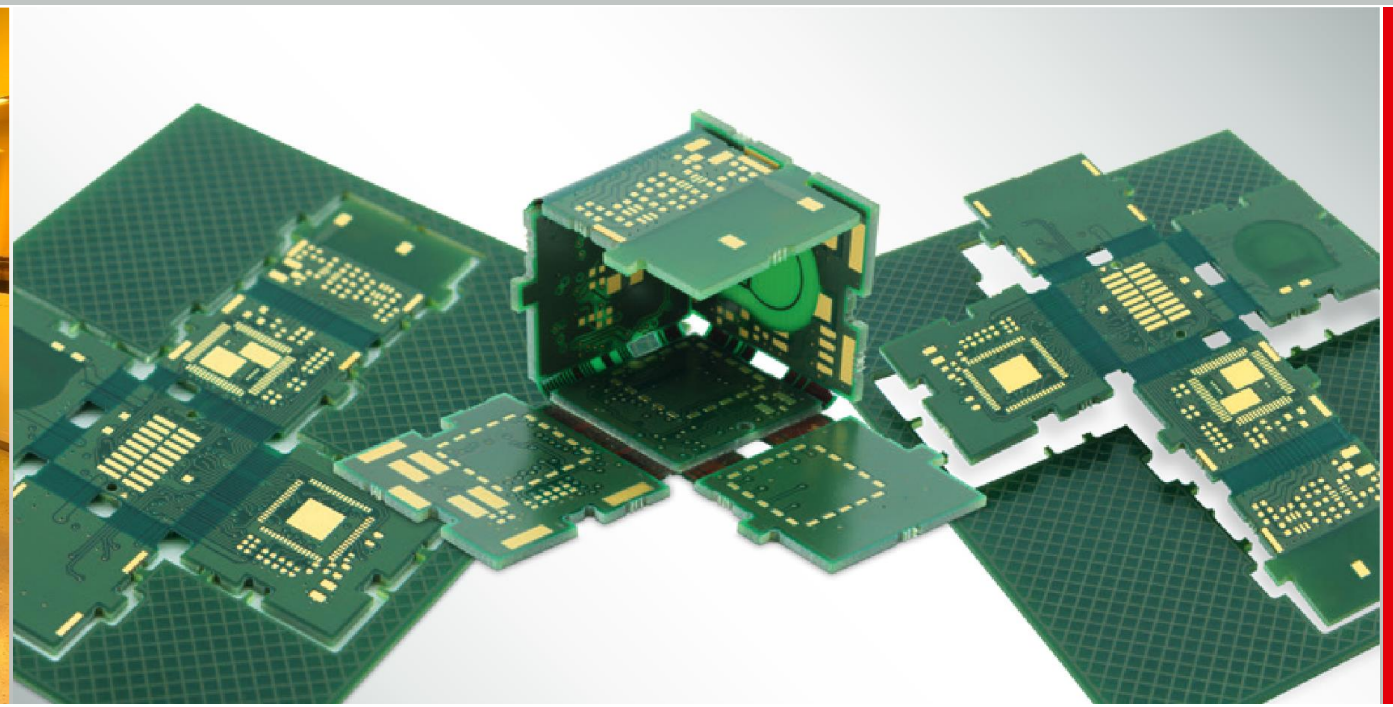
WÜRTH ELEKTRONIK

ADDITIVE SERIES PROCESS FOR FLEXIBLE SOLDER RESIST - OUR NEW STANDARD



Webinar

09.11.2021

Markus Kennert

Jürgen Wolf

AGENDA

1. Flexible solder resist in the conventional process
2. Flexible solder resist in additive technology
   - Process flow and procedures
   - Technology comparison
   - Presentation of the equipment and flexible inkjet solder resist
3. Summary

AGENDA

1 **Flexible solder resist in the conventional process**

2 Flexible solder resist in additive technology

- Process flow and procedures
- Technology comparison
- Presentation of the equipment and flexible inkjet solder resist

3 Summary

FLEXIBLE SOLDER RESIST

What does „flexible solder resist“ mean?

Common industry terms:

- **Flexible lacquer, flexible solder mask or flexible solder resist**

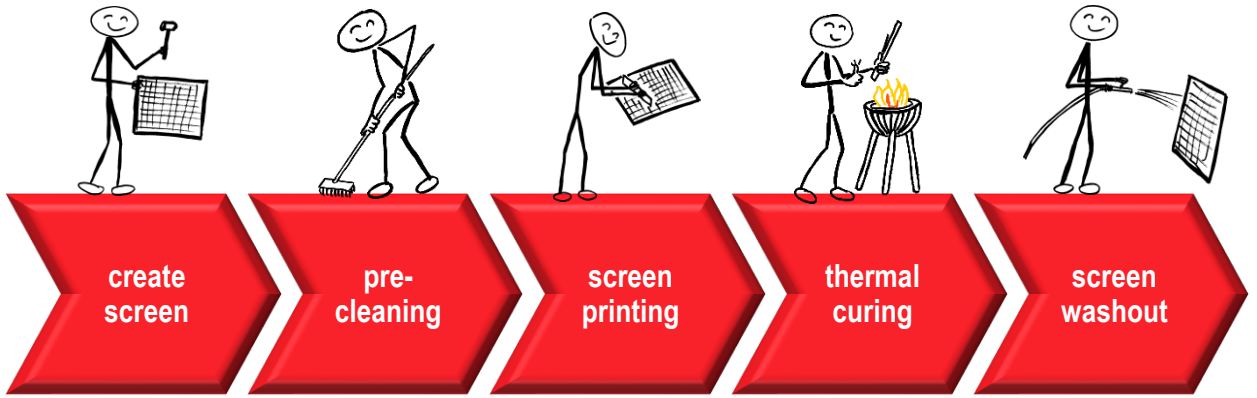
Flexible solder resist serves different purposes on a printed circuit board for electronic circuits:

- **Protection of copper structures in bendable areas of**
  - flex-rigid with external flex
  - semiflex (thinned FR4 for simple flex-to-install applications without polyimide)
- **Flex-to-Install – multiple bending capability**
- **Small bending radii**
- **Defined transition rigid to flexible solder resist**
- **Replacement of expensive polyimide coverlay, which is partially applied**

FLEXIBLE SOLDER RESIST

The "conventional" process flow

Screen printing of flexible resists:



AGENDA

1 Flexible solder resist in the conventional process

2 **Flexible solder resist in additive technology**

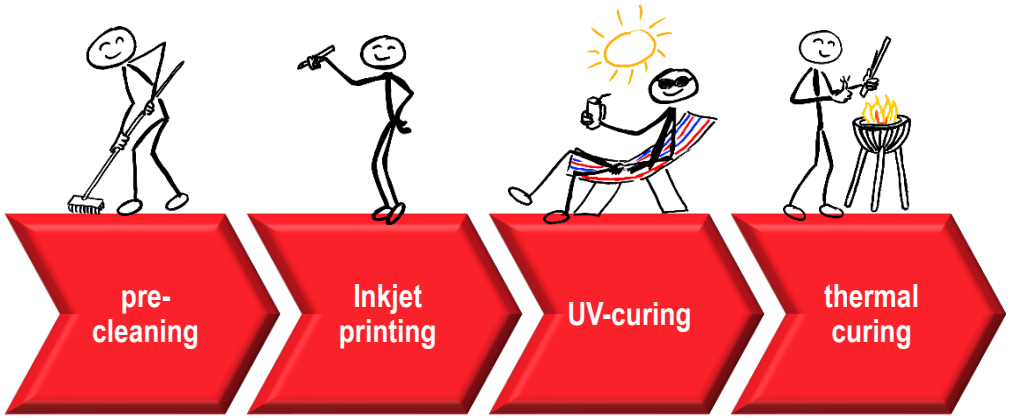
- **Process flow and procedures**
- **Technology comparison**
- **Presentation of the equipment and flexible inkjet solder resist**

3 Summary

FLEXIBLE SOLDER RESIST IN ADDITIVE TECHNOLOGY

Process flow

Flexible solder resist in additive technology:

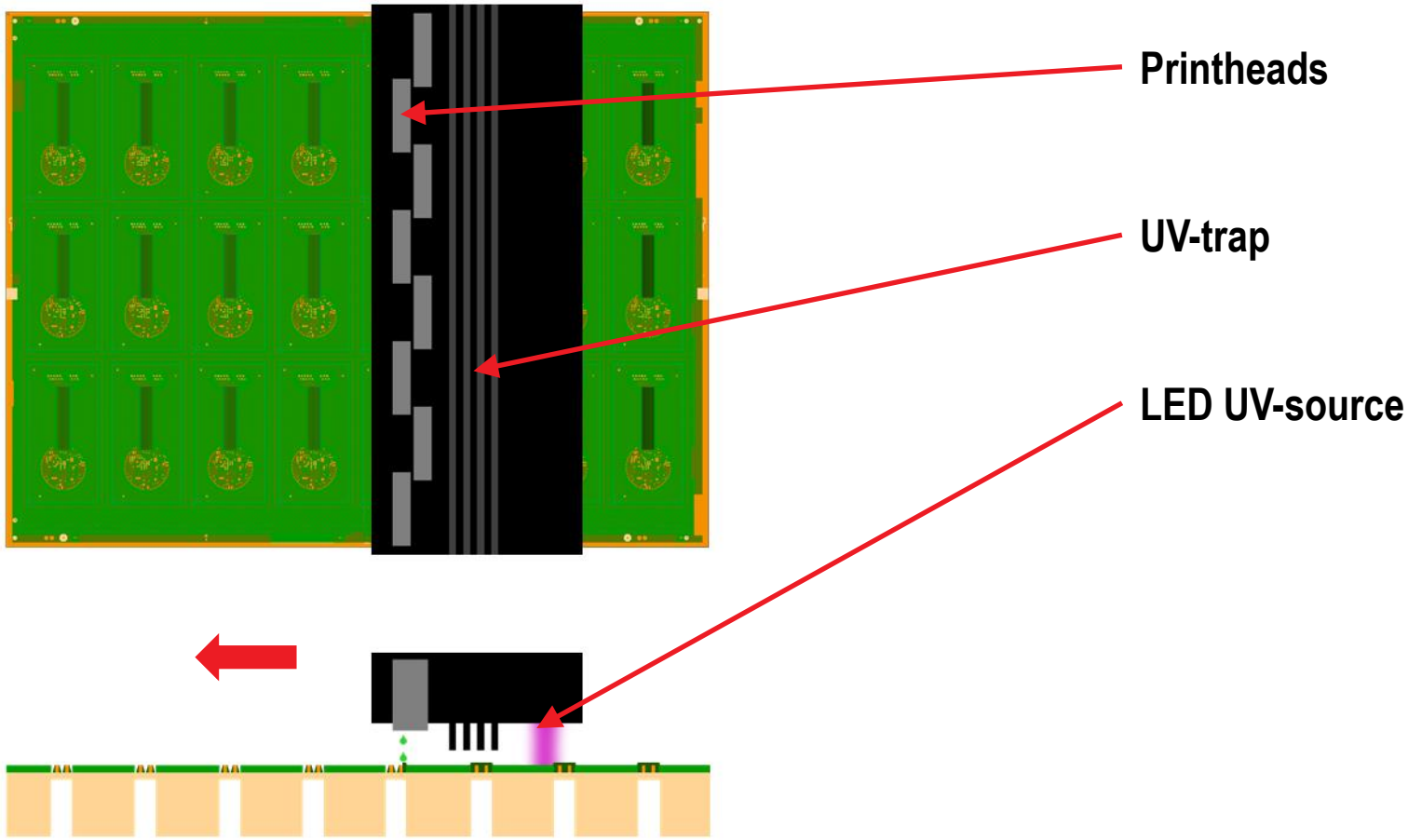


FLEXIBLE SOLDER RESIST IN ADDITIVE TECHNOLOGY

How to print? Schematic Illustration

Basic procedure:

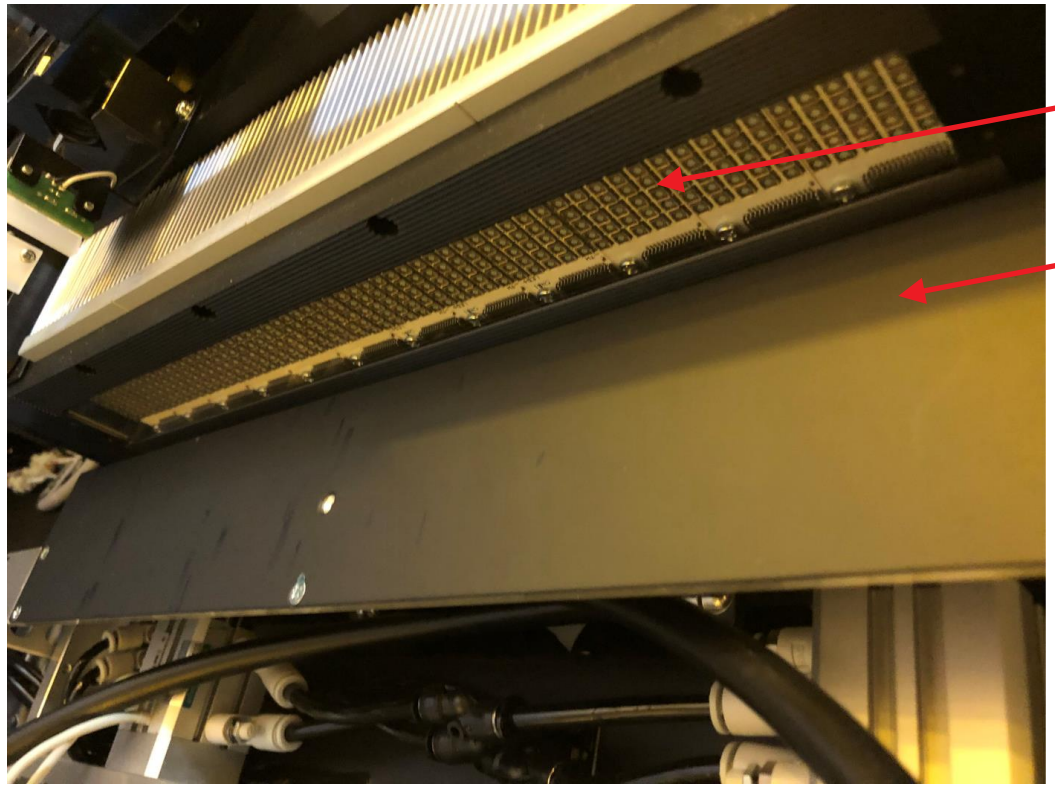
- **1st printing step: Covering of the edges**
- **2nd printing step: Filling of the flex area**



FLEXIBLE SOLDER RESIST IN ADDITIVE TECHNOLOGY

How to print?

3D-printing with multiple printheads in parallel



FLEXIBLE SOLDER RESIST IN ADDITIVE TECHNOLOGY

How to print? Real time process

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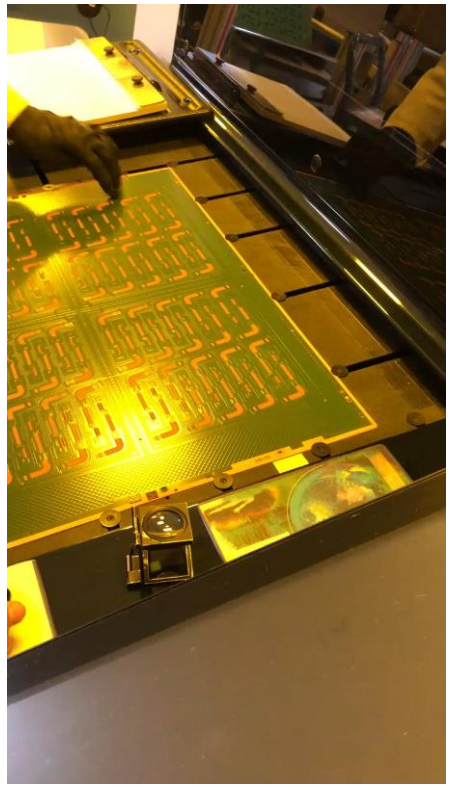
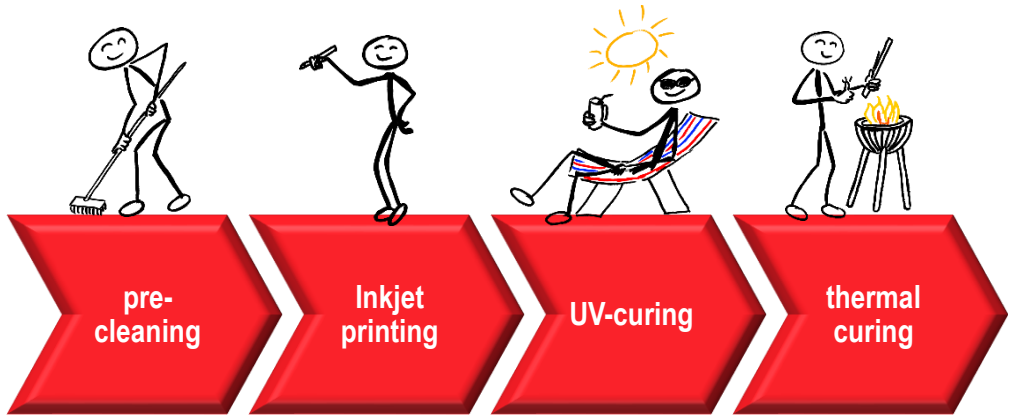
Printing of flexible solder resist using additive technology in production



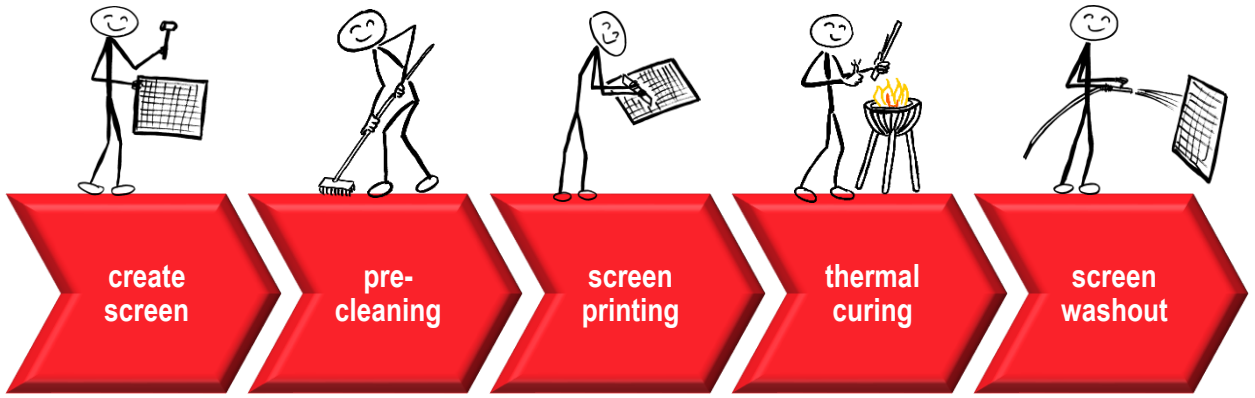
FLEXIBLE SOLDER RESIST

Comparison of process flows

Flexible solder resist in additive technology:



For comparison, once again, the application by screen printing:



FLEXIBLE SOLDER RESIST IN ADDITIVE TECHNOLOGY

Implementation in the Niedernhall flex-rigid plant

Presentation of the equipment and flexible inkjet solder resist

MicroCraft CPQ7861

MicroCraft MPJ101-FG20

UV & thermal curable inkjet solder resist

FLEXIBLE SOLDER RESIST IN ADDITIVE TECHNOLOGY

Presentation of the machine and the inkjet printable resist

Presentation of the equipment and flexible inkjet solder resist

Welcome,

Takayuki Hidehira
Executive Vice President – MicroCraft

and

Hans Fritz
General Manager – SAT Electronic GmbH

FLEXIBLE SOLDER RESIST IN ADDITIVE TECHNOLOGY

Presentation of the machine and the inkjet printable resist

Presentation of the machine

MicroCraft CPQ7861

- **Extremely fast printheads:**
  discharge frequency of up to 45 kHz and 1024 nozzles per head
- **4 parallel printheads for high throughput**
- **Automatic high-pressure “Air Purge System”, prevents clogging of the nozzles**
- **Selectable resolutions up to 2160 dpi**
- **Serialization and Barcode is possible**
- **Table with edge clamps and vacuum suction**
- **Loader and Unloader available (CPA)**

FLEXIBLE SOLDER RESIST IN ADDITIVE TECHNOLOGY

Presentation of the machine and the inkjet printable resist

Presentation flexible solder resist

MicroCraft MPJ101-FG20

- **Designed for the use in CraftPix series printers**
- **Designed to work with printers with piezo-electric printheads**
- **Specially developed for direct-to PCB**
- **Requires chemical or physical pretreatment**
- **Applications include:**
  - Flexible PCBs (Polyimid)
  - Flex-rigid PCBs
  - Metal or plastic substrates
- **Certified UL 94 V-0**

FLEXIBLE SOLDER RESIST IN ADDITIVE TECHNOLOGY

Presentation of the machine and the inkjet printable resist

Presentation flexible solder resist

MicroCraft MPJ101-FG20 – Extract from the TDS

Item	Test method	Test standard	Test Result
Pencil Hardness	On Copper	IPC-SM-840C 3.5.1 IPC TM650 2.4.27.2 (ASTM D3363)	3H Pass (Above 3H)
(Lead-free) Solder Heat Resistance	Solder float test ; Rosin Flux	IPC-SM-840C 3.7.2 (288°C / 10 sec, 1cycle)	Passed
Adhesion	Cross Cut 10x10 & Tape peeling test On Cu foil/FR-4	IPC-SM-840C 3.5.2 IPC TM 650 2.4.16 (ASTM D3359) (J-STD-003)	Passed
Solvent Resistance	PGM-Ac and IPA, 20°C / 30min	IPC-SM-840C 3.6.1	Passed
Electroless Ni/Au	Ni: 3 - 5µm, Au: 0.03µm	Internal Test Method	Passed

FLEXIBLE SOLDER RESIST IN ADDITIVE TECHNOLOGY

Presentation of the machine and the inkjet printable resist

Presentation flexible solder resist

MicroCraft MPJ101-FG20 – Extract from the TDS

Item	IPC-SM-840E Test Method		Standard	Result
Dielectric Strength	3.8.1	Determined in accordance with TM2.5.6.1 of IPC-TM-650.	No change of ink in DC 500V (25µm)	Passed
Insulation Resistance	3.8.2	Minimum resistance before and after soldering.	More than 5×10^8 ohm More than 5×10^8 ohm	Passed
Moisture & Insulation Resistance	3.9.1	25-65°C 85%RH cycling for 7days Bias voltage 50 V D.C.	More than 5×10^8 ohm More than 5×10^8 ohm	Passed
Electrochemical Migration	3.9.2	Class H/FT:85±2°C 90±3%RH 168hrs. Bias voltage 10 V D.C.±5%.	More than 2×10^6 ohm No change of appearance	Passed
Thermal Shock	3.9.3	-65°C 15min to +125°C 15min, Transition should not exceed 2 minutes. 1000 cycles.	No blistering, crazing, and delamination	Passed
Flammability	3.6.3	UL-94	V-0	Passed
BendingTest		30µm on Polyimide Film 180° Folding (500g Weight)	Above 3Cycle No Crack, Delamination	Passed
RoHS	2005/618/EC(IEC62321 Edition 1.0:2008)			On going
Halogen-free	JPCA-ES01-2003			On going

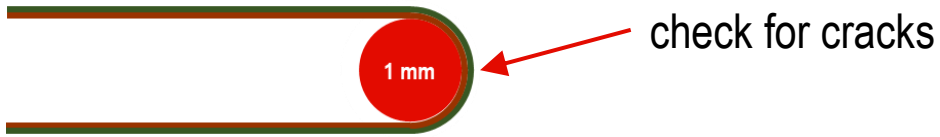
FLEXIBLE SOLDER RESIST IN ADDITIVE TECHNOLOGY

Presentation of the machine and the inkjet printable resist

Presentation flexible solder resist

MicroCraft MPJ101-FG20

- **Excellent continuous temperature resistance at 125°C:**
  - after 500h still 25 cycles 180° bending around 1mm mandrel
  - previous screen printing resist already cracks after 250h



FLEXIBLE SOLDER RESIST IN ADDITIVE TECHNOLOGY

Quick poll

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Poll

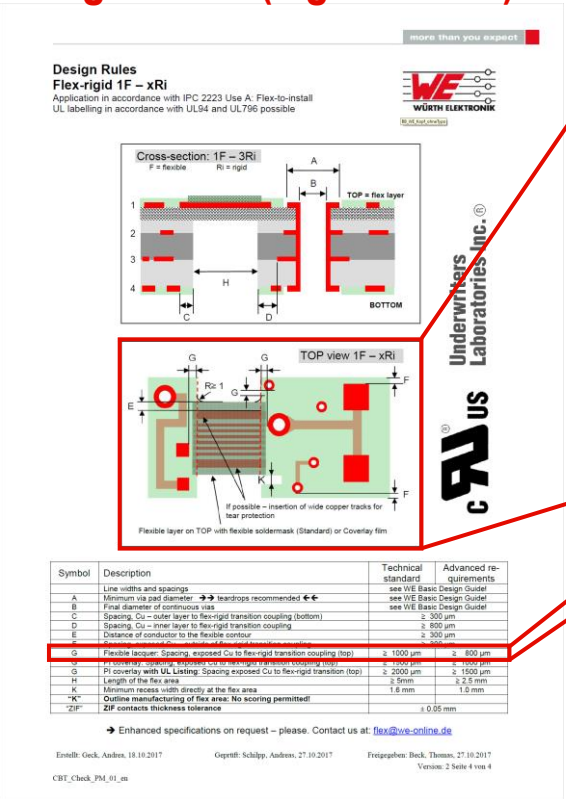
At present, we have a distance from the copper to the flex-rigid transition of 1000µm in the standard for build-ups with flexible solder resist.

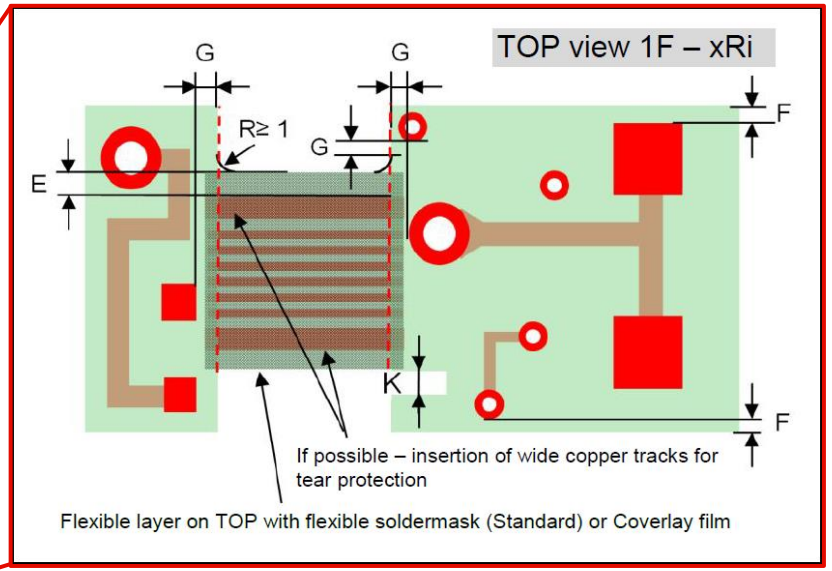
Which value would you like to see for a new process to support miniaturisation?

FLEXIBLE SOLDER RESIST

Comparison of the technologies – Details

Design Rules (e.g. 1F – xRi)





Now

		Technical standard	Advanced requirements
G	Flexible lacquer: Spacing, exposed Cu to flex-rigid transition coupling (top)	≥ 1000 µm	≥ 800 µm

-50%

New

		Technical standard	Advanced requirements
G1	Flexible lacquer: Spacing, exposed Cu to flex-rigid transition coupling (top)	≥ 800 µm	≥ 400 µm

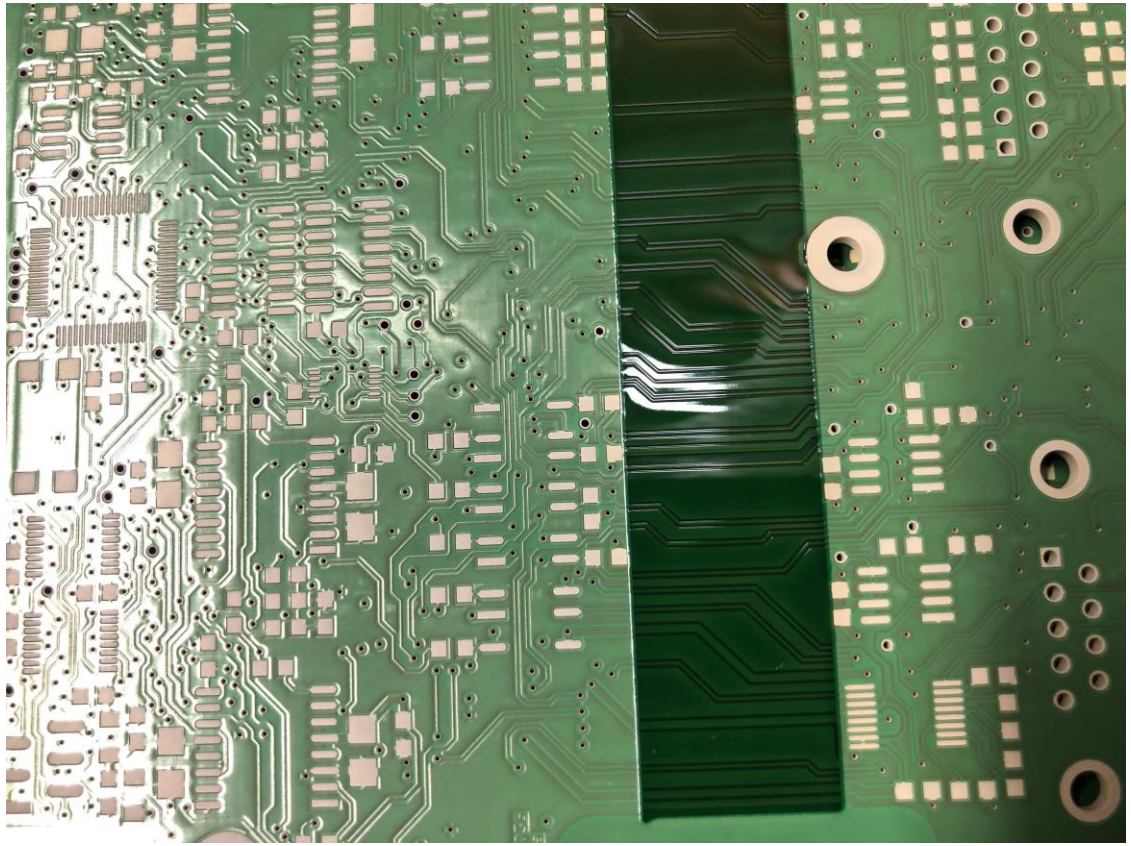
FLEXIBLE SOLDER RESIST IN ADDITIVE TECHNOLOGY

The detailed view

Higher Accuracy

- **Reduction of the distances**
  - flex resist to copper and thus
  - less overlapping flex resist to rigid resist

  possible
- **Better usage of the rigid area, especially with narrow layouts**
- **Further reduction possible in future**



FLEXIBLE SOLDER RESIST IN ADDITIVE TECHNOLOGY

The detailed view

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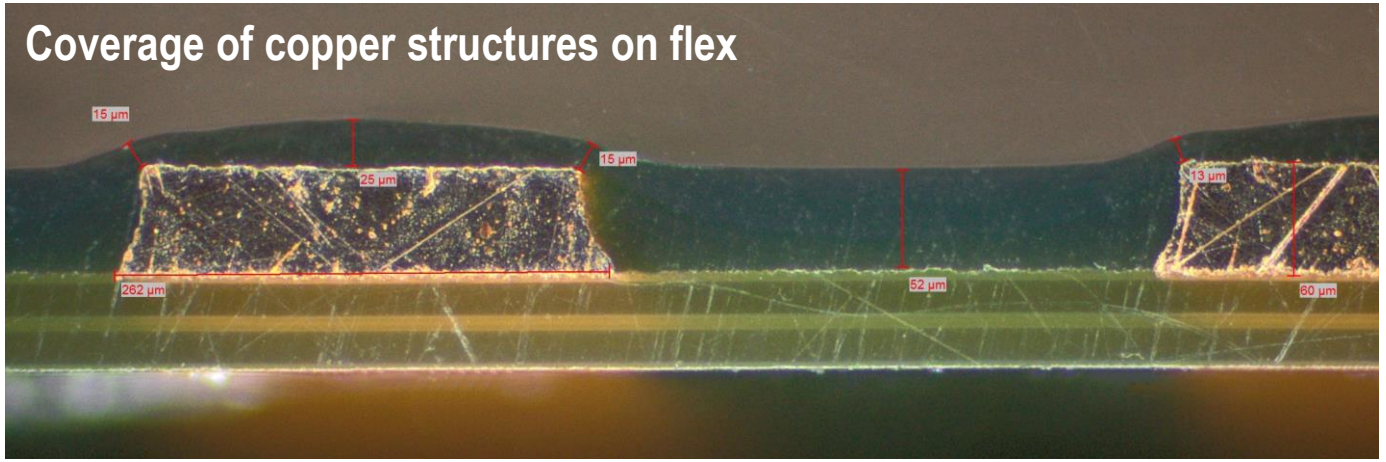
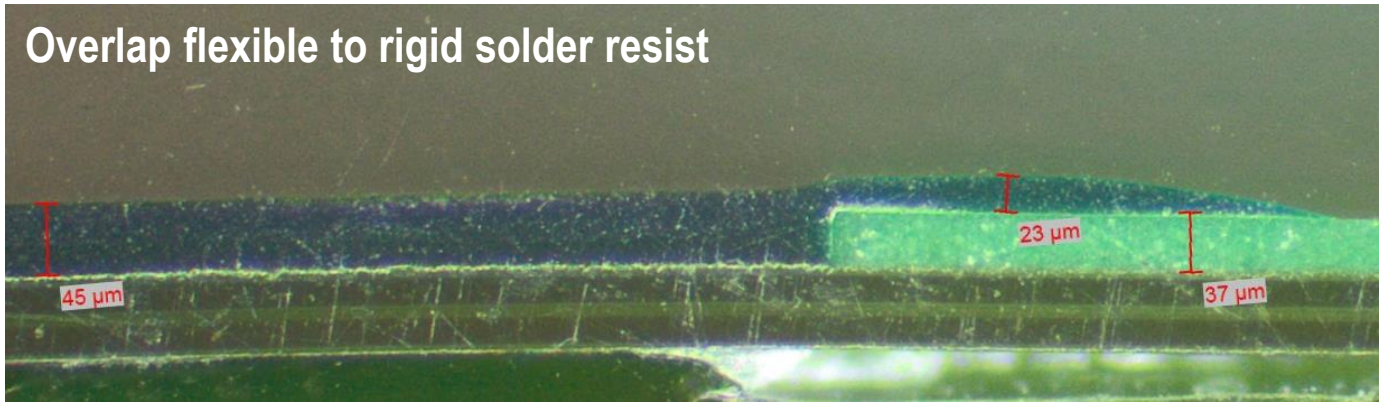
Microsections





FLEXIBLE SOLDER RESIST

Process comparison

	conventional	digital additive
Number of process steps	↘	↗
Equipment costs	↗	↓
Resist costs	↗	↘
Screen preparation costs	↘	↑
Screen washout costs	↘	↑
Resist waste	↘	↗
Energy consumption	↘	↗

Equipment and resist costs lead to a cost-neutral process

Digital additive process is more sustainable

FLEXIBLE SOLDER RESIST IN ADDITIVE TECHNOLOGY

Quick poll

Poll

What further developments would you like to see from WE on the subject of flexible solder resists?

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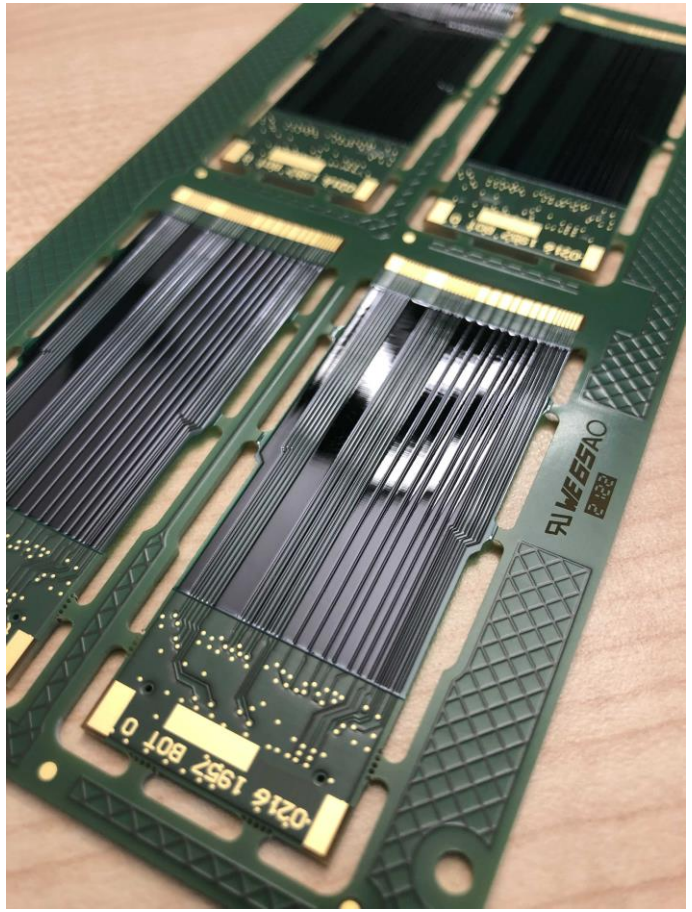
3 Summary

FLEXIBLE SOLDER RESIST IN ADDITIVE TECHNOLOGY

Summary of key points

Flexible solder resist applied via Inkjet

- represents a digital and additive technology
- meets all common flexible solder resist specifications
- offers minimal thickness variation
- can be combined with legend printing
- promotes greater design freedom by reducing spacing requirements by half compared to conventional screen-printing resists
- provides higher reliability with higher bending cycles



Flexible solder resist in additive technology

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What kind of application do you have?

How can WE support you?

Talk to our “FLEXperts”

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