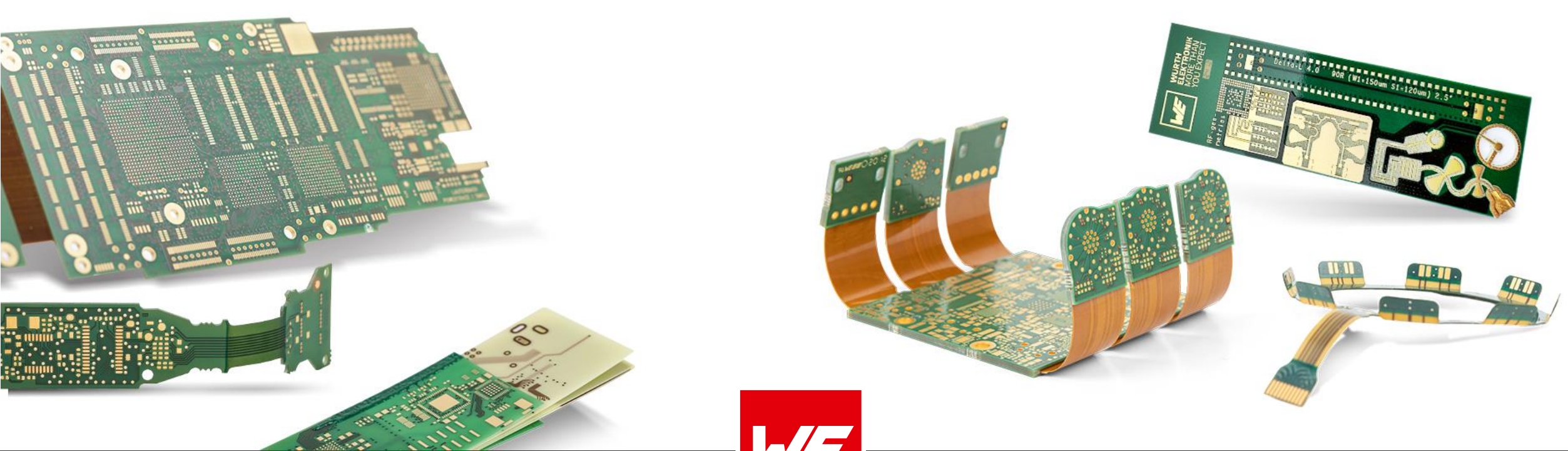




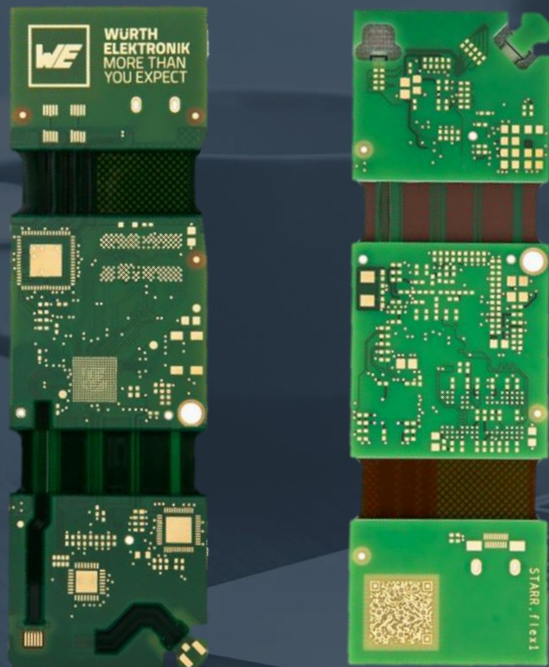
EXPERIENCE THE FLEXIBILITY! PHYSICAL PCB SAMPLE WE.FLEXTWO!

Klaus Schill-Mulack

WÜRTH ELEKTRONIK MORE THAN YOU EXPECT



WÜRTH
ELEKTRONIK
MORE THAN
YOU EXPECT



WEBINAR

Experience the flexibility!

WE physical PCB sample WE.flexone

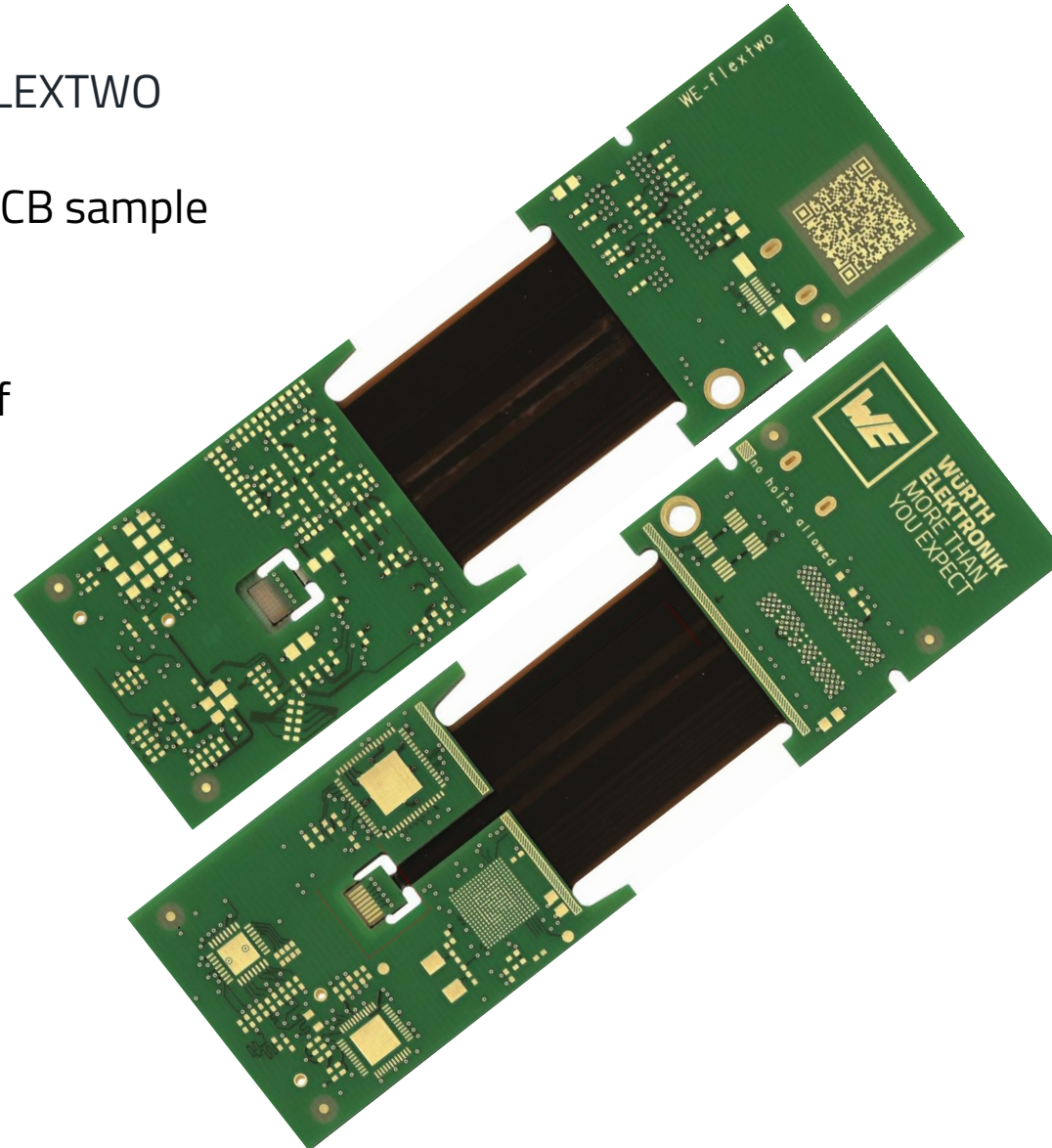
- Presentation physical PCB sample WE.flexone
- Stackup
- Flexible soldermask versus coverlay
- Signal integrity
- ZIF-contact and Lift-Off
- Combination with HDI
- QR-Code



AGENDA

Physical PCB sample WE.FLEXTWO

1. Presentation physical PCB sample
2. Stack-Up
3. Signal integrity
4. ZIF-contakt und Lift-Off
5. Design Rules

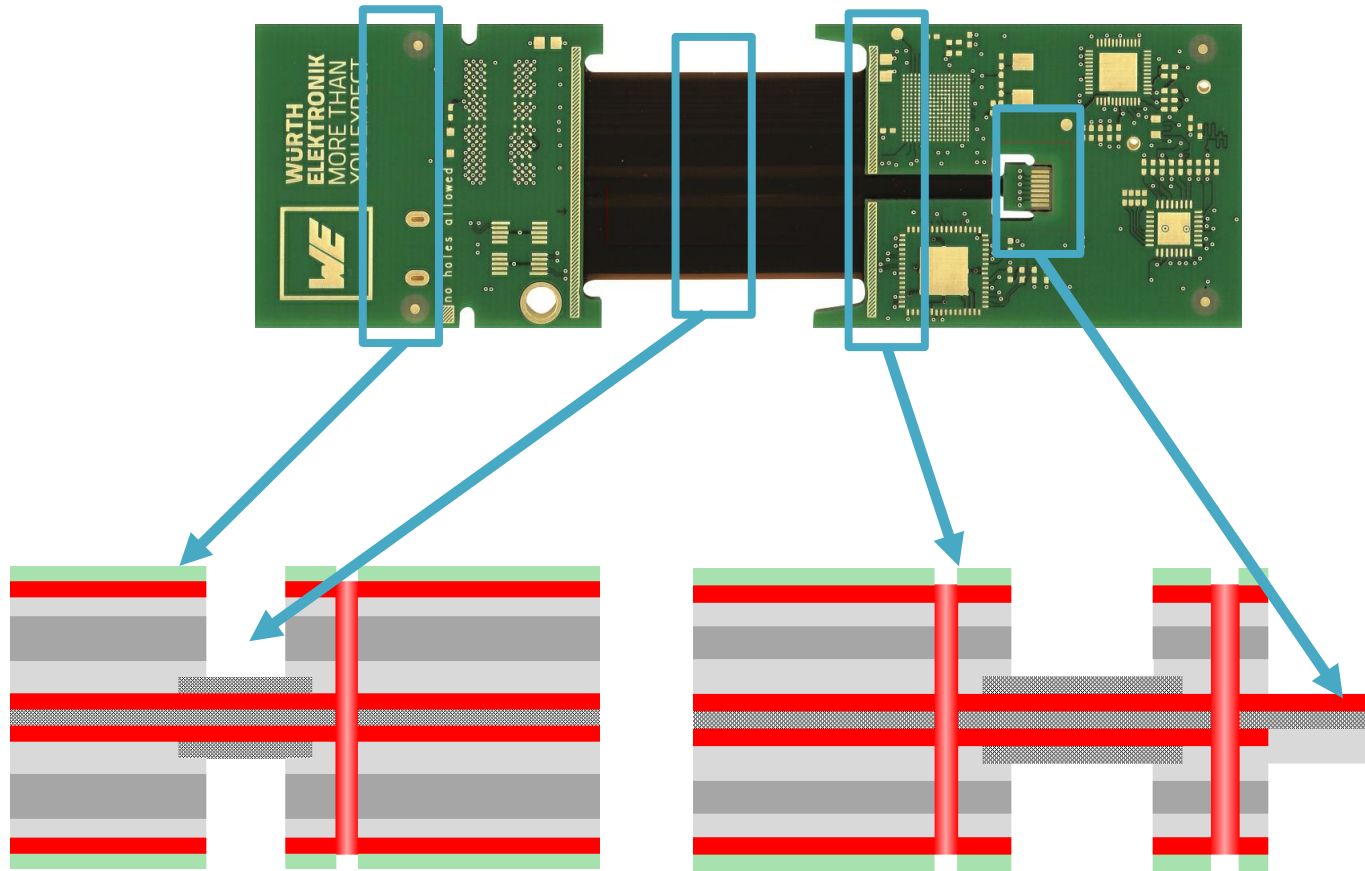


Klaus Schill-Mulack
Technical Project Management



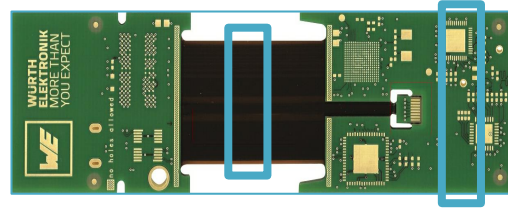
WE.FLEXTWO

Physical PCB sample WE.FLEXTWO

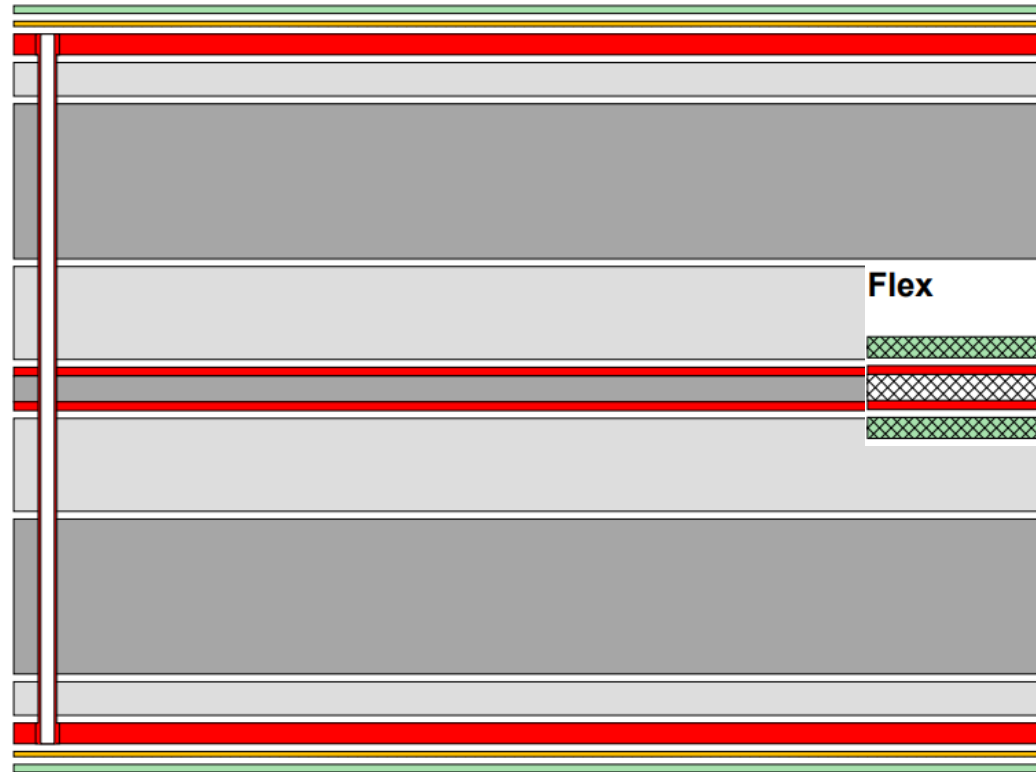


WE.FLEXTWO

Stack-Up

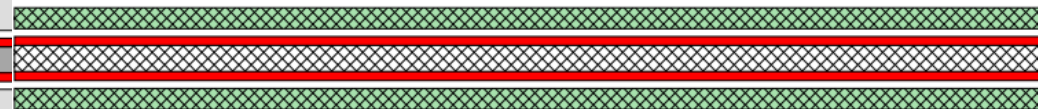


Rigid



Rigid Material
IPC-4101/127/128/102/42

Flex

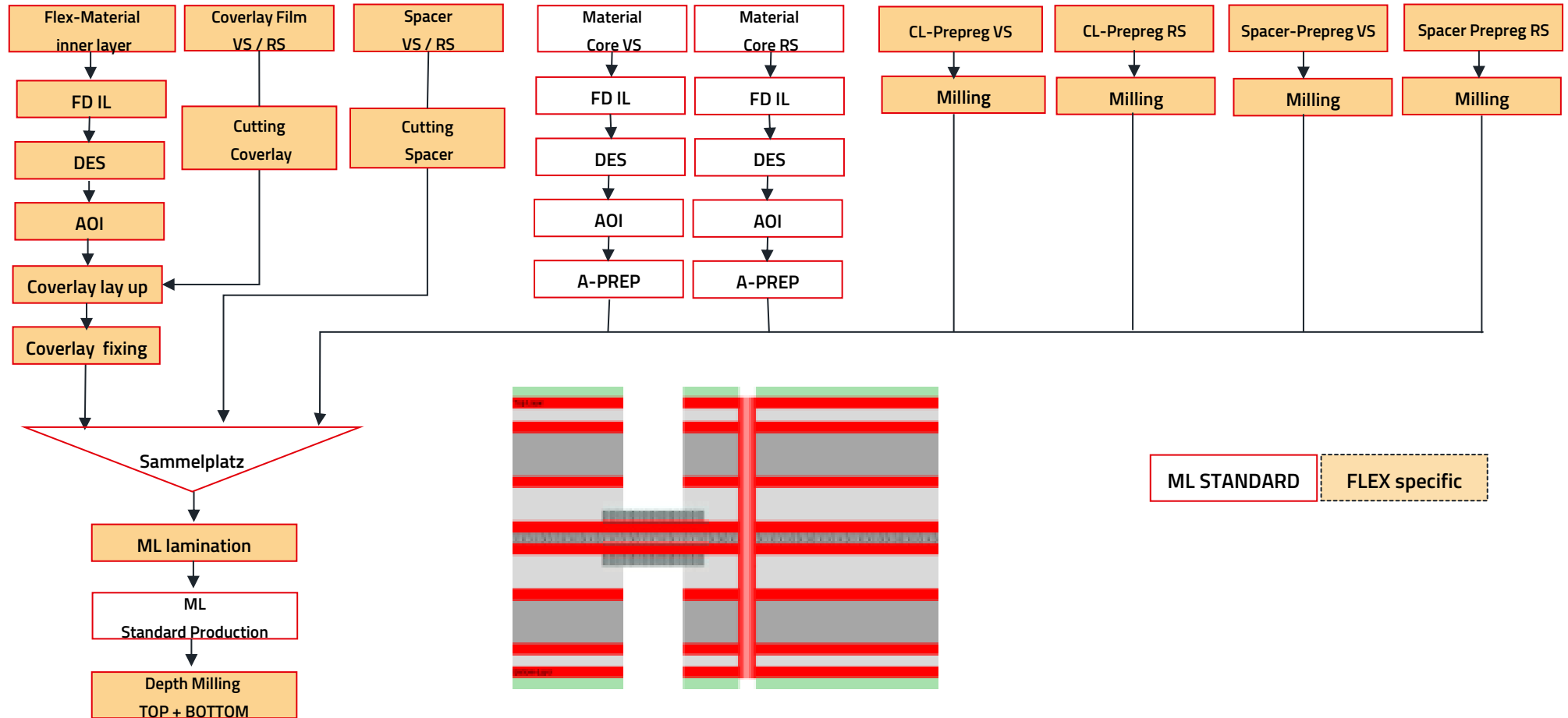


Flex Material
IPC-4202/11
IPC-4203/1 ; JPCA-DG04

WE.FLEXTWO

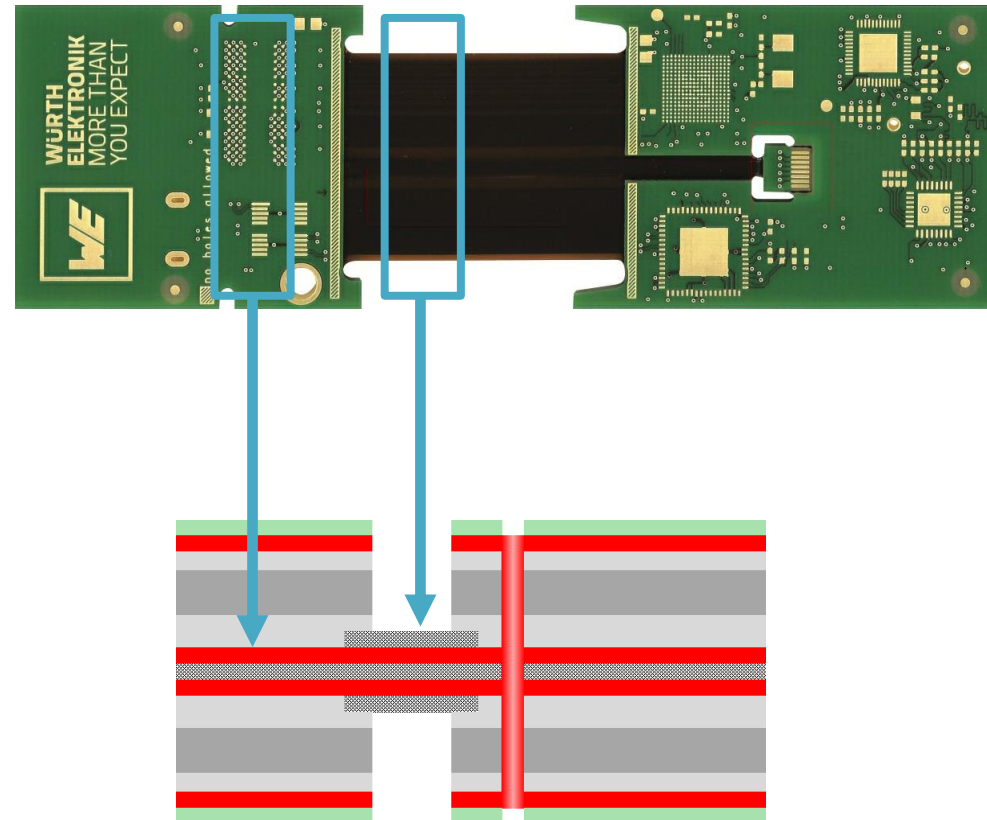
Production RIGID.flex xRi-2F-xRi

■ Example 3Ri-2F-3Ri



WE.FLEXTWO

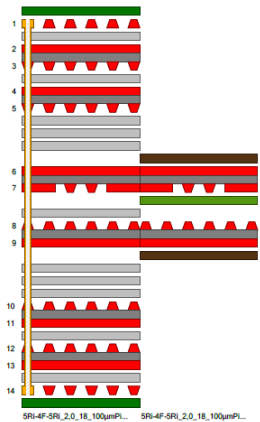
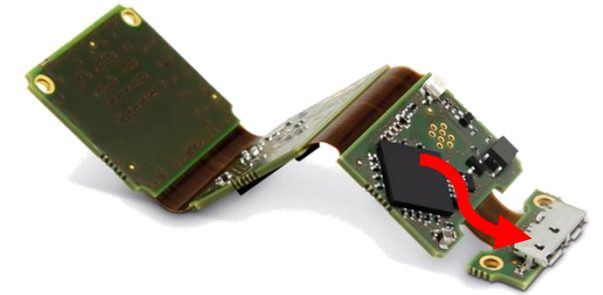
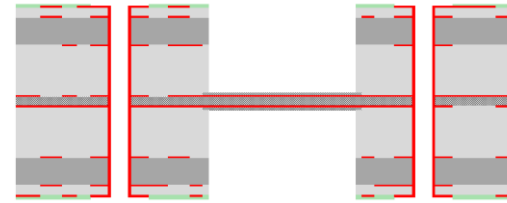
Signal integrity



WE.FLEXTWO

Signal integrity

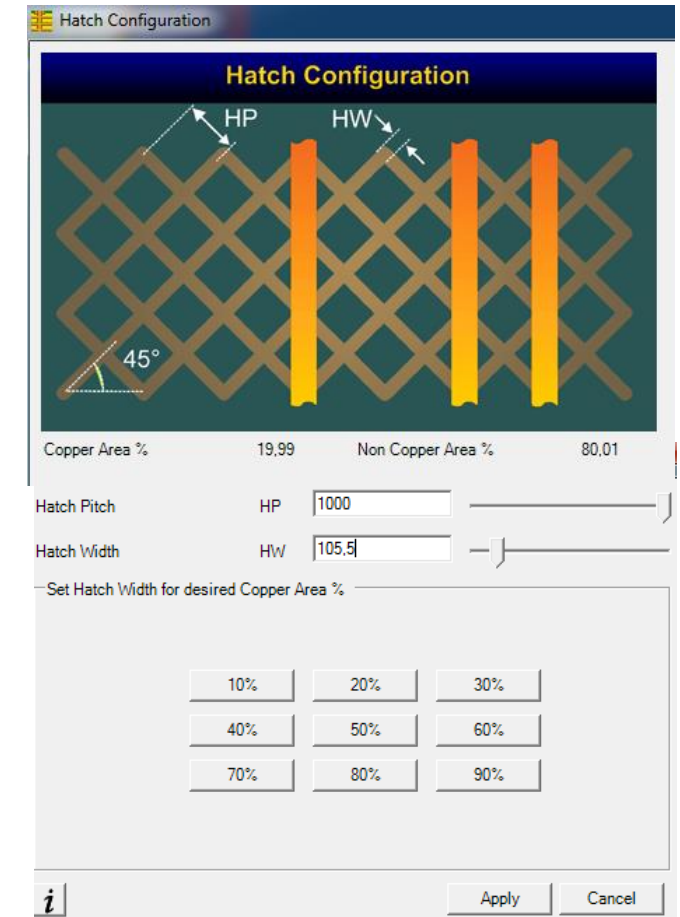
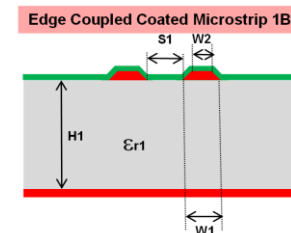
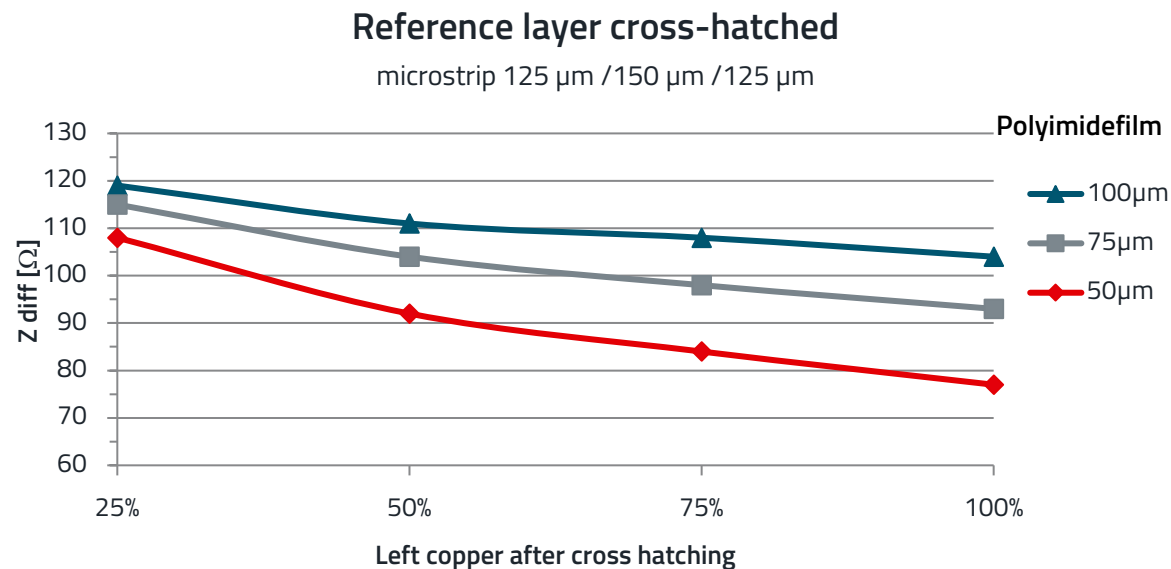
- Impedance-defined signals
- USB connector on a separate rigid area
- Elimination of connectors, saving of footprint areas
- Calculation and documentation of Impedance values

A screenshot of a software interface showing impedance calculation results. The interface displays a table with columns for Layer, Thickness, Material, and Impedance. The table lists various layers and their corresponding impedance values. The interface also includes a graph showing the impedance profile across the layers.

WE. FLEXTWO

Signal integrity

- Hatch: copper openings through rasterized reference layers
 - Improve flexibility
 - Improve the drying of the flexmaterial
 - Increases impedance values → thinner polyimide possible

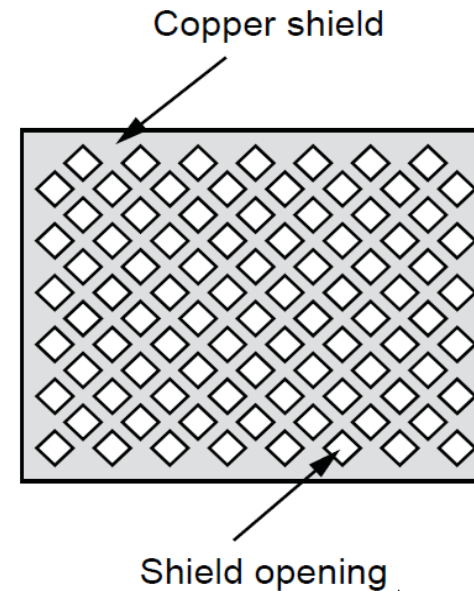
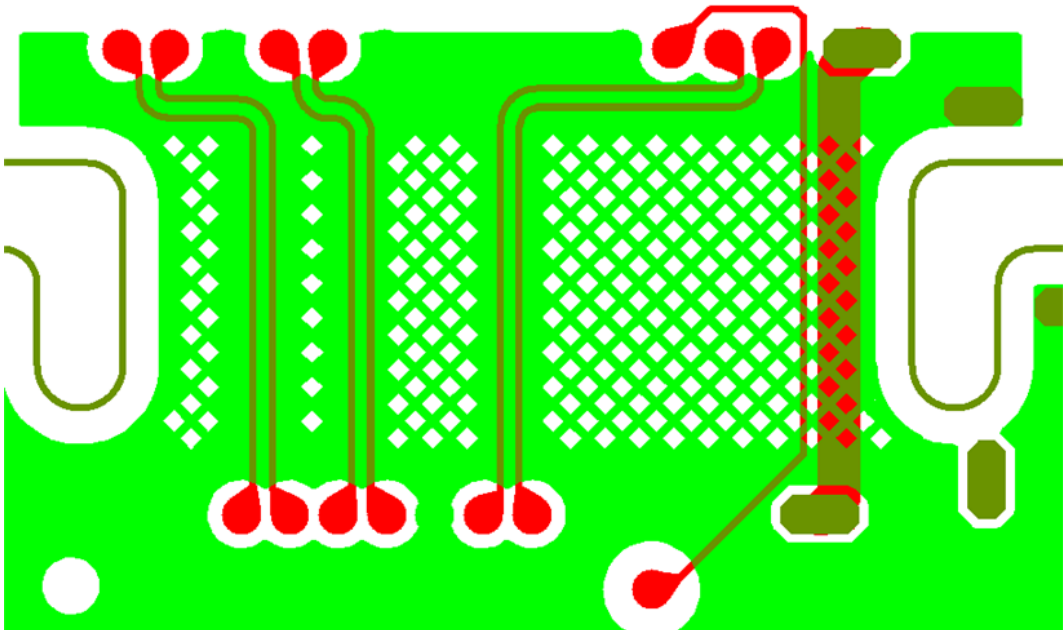


WE.FLEXTWO

Signal Integrity

Compromise for an undisturbed return path

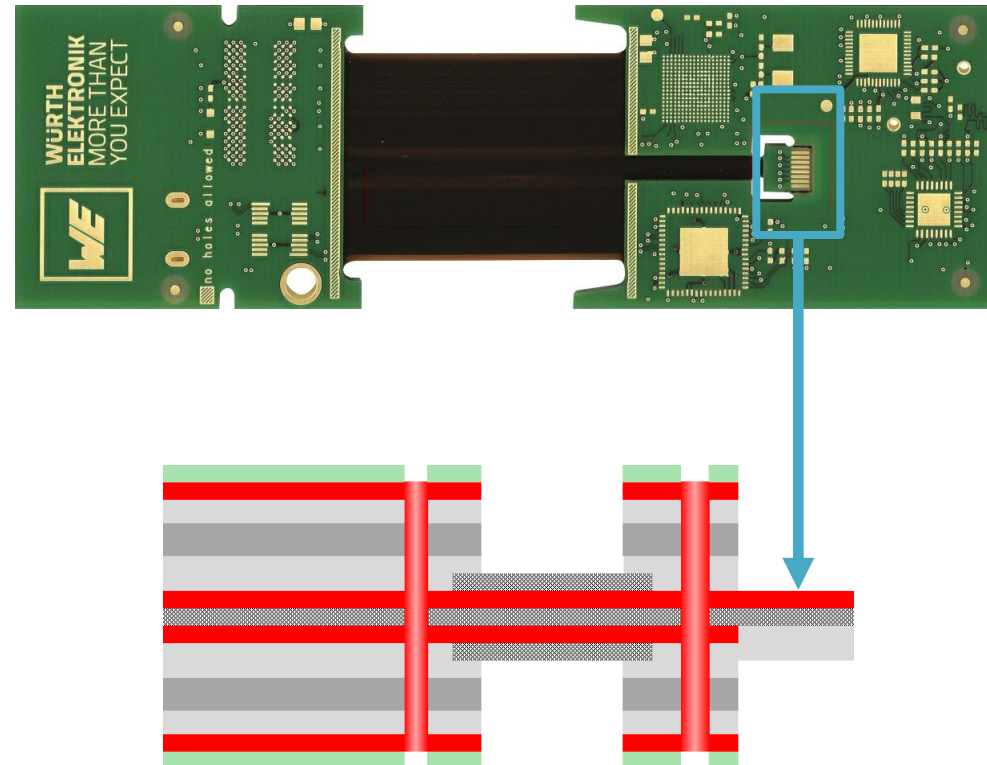
- Differential conductor pair in the flex area
 - 100% copper under the pair of conductors
 - Remaining areas grids for driving and flexibility



IPC-2223

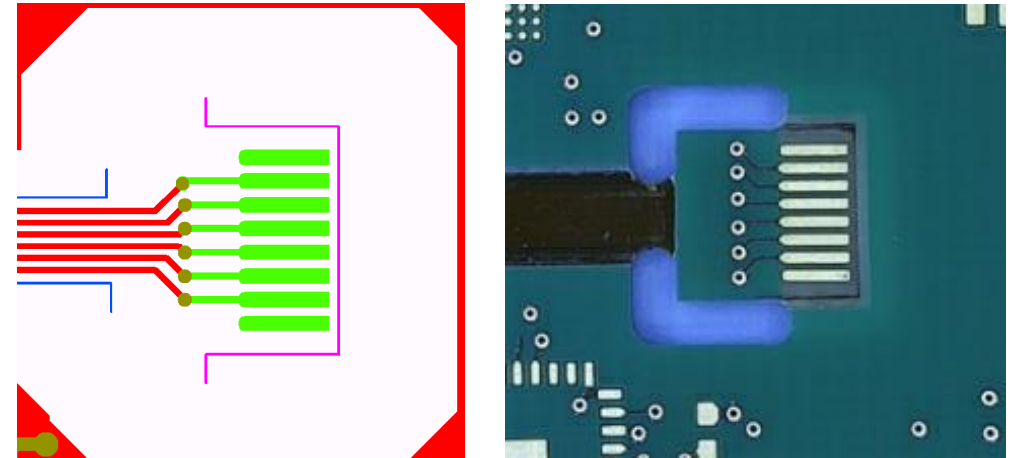
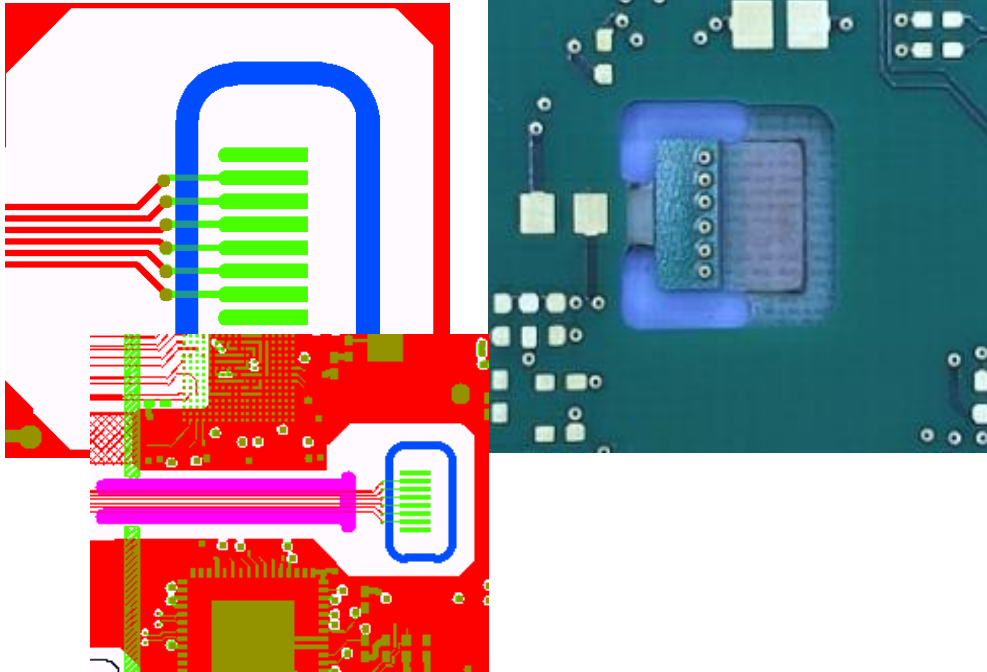
WE.FLEXTWO

ZIF-Contact + Lift-off



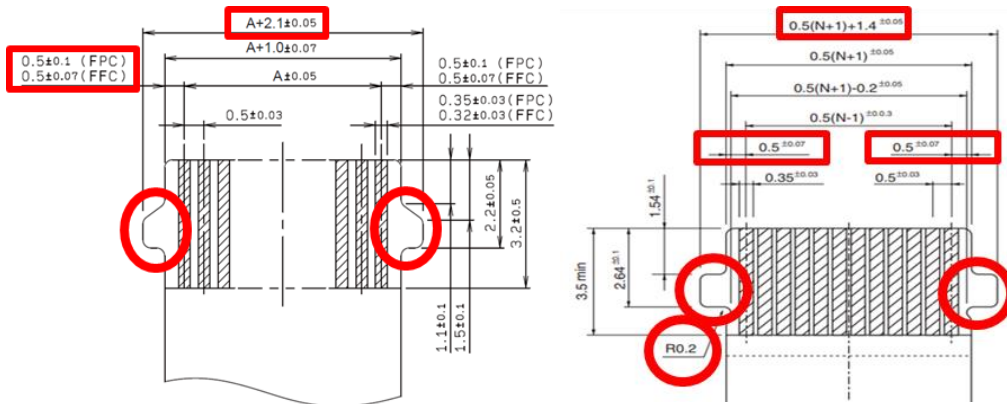
WE.FLEXTWO

ZIF-Contact + Lift-off



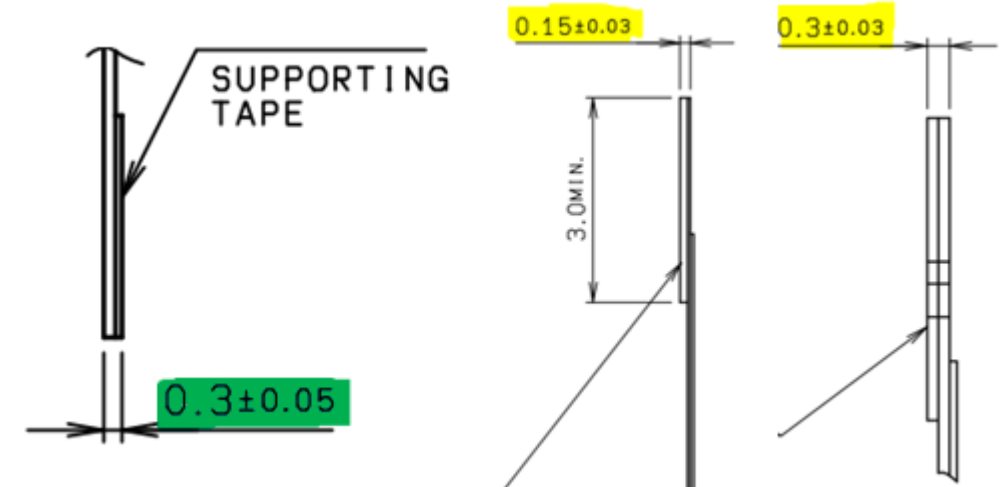
WE.FLEXTWO

ZIF-Contact Contour and Thickness



Contour tolerance

- Tight contour tolerances
- Tight tolerances finger contacts to contour
- Small radii at the interlocks
- Contour processing generally by laser cutting



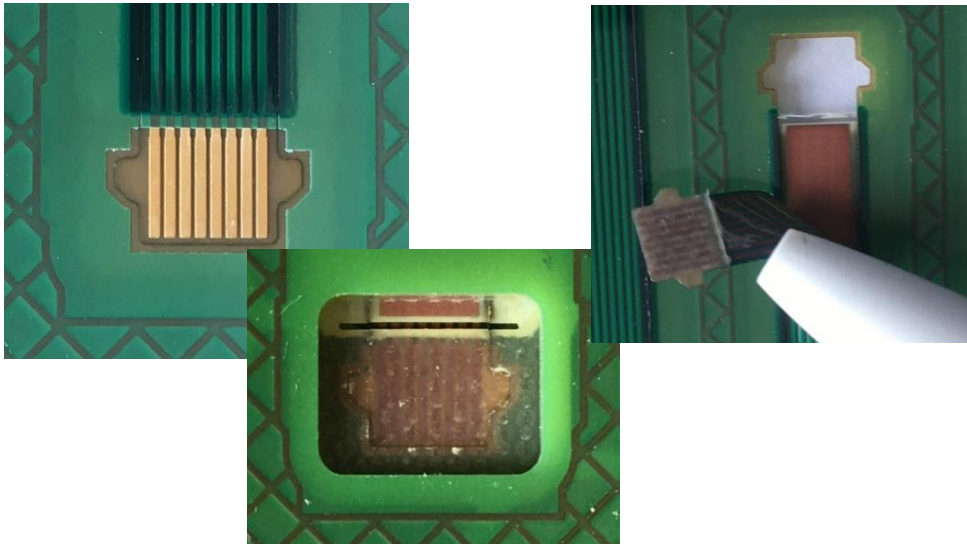
Thickness tolerance

- Standard tolerance +/- 0.05 mm
- Advanced tolerance +/- 0.03 mm
- Smaller tolerances in PCB production not possible

WE.FLEXTWO

ZIF-Contacts und Construction

Standard: FR4-Stiffener



- Standard version
- Automated depth milling process
- Thickness tolerance +/- 0.05 mm

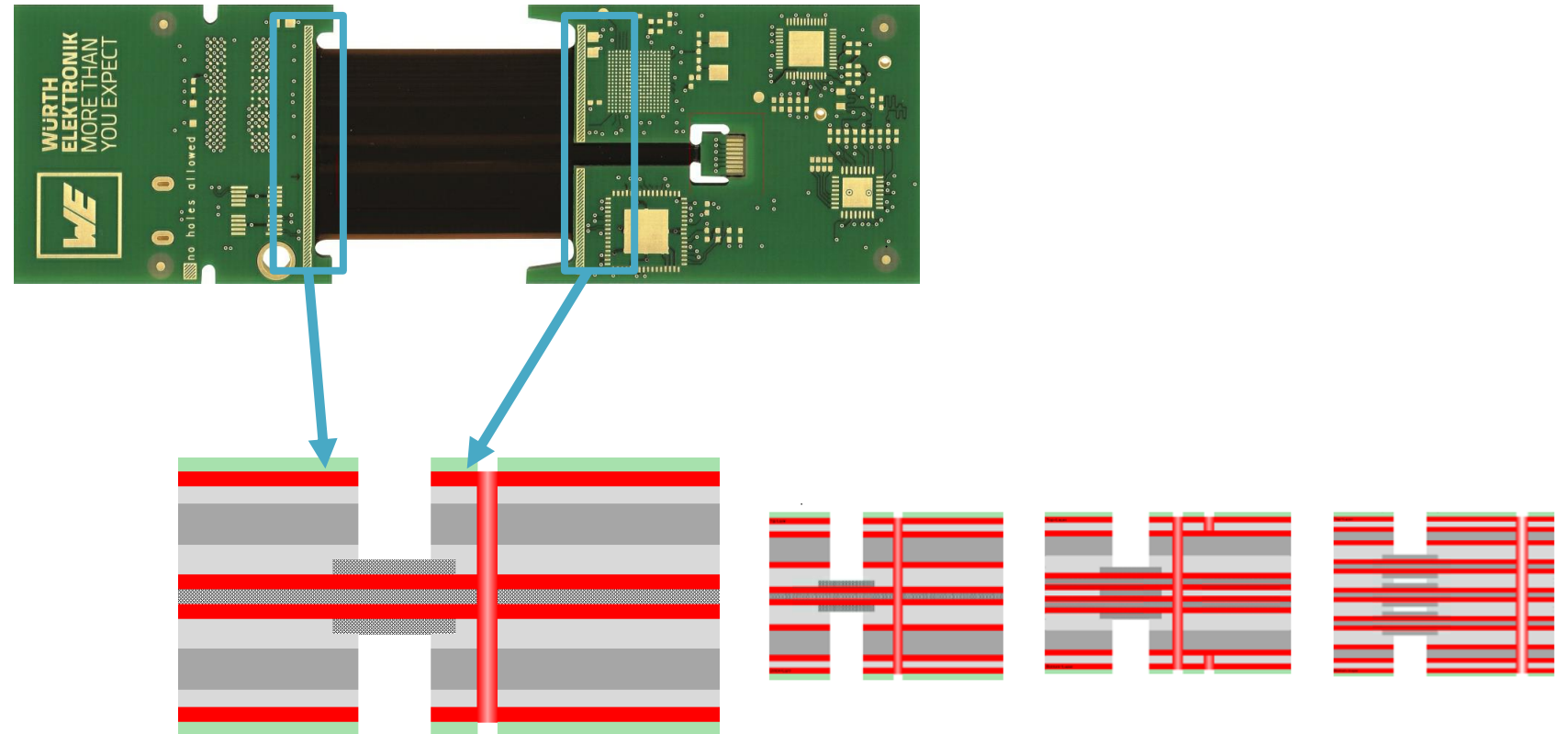
Option: Polyimide-Stiffener



- Additional production steps + increase costs
- Polyimide stiffeners need to be inserted manually
- Thickness tolerance +/- 0.03 mm

WE.FLEXTWO

Design Rules



WE.FLEXTWO

Design Rules – IPC-Specification

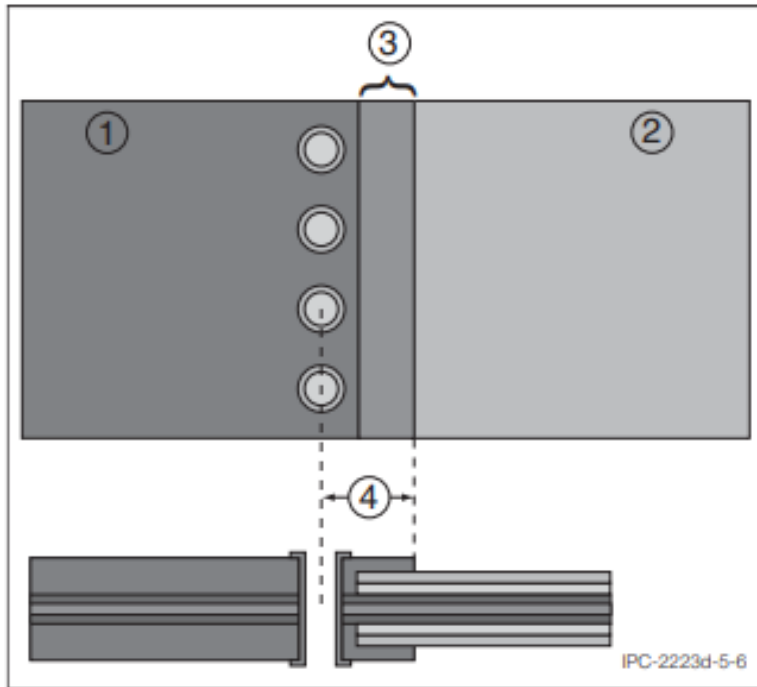


Figure 5-6 Spacing of PTH from Rigid to Flex Interface

Note 1: Rigid region.

Note 2: Flexible region.

Note 3: Rigid to flex interface region.

Note 4: Minimum recommended spacing of 3.18 mm [0.125 in] plus one-half PTH pad diameter from the PTH center to the edge of the rigid material.



IPC-2223E

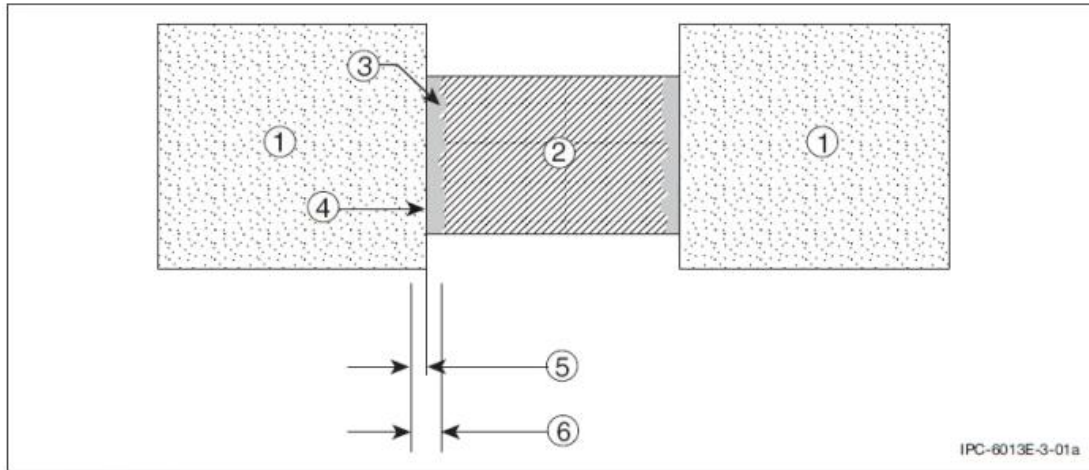
Sectional Design Standard for Flexible/Rigid-Flexible Printed Boards

- IPC-2223
 - Distance PTH to Flex 3.18 mm + $\frac{1}{2}$ diameter drill tool size
 - Coverlay overlap in rigid part 1.27-2.54 mm

The images are Copyright 2024 by IPC International, Inc. and are used with permission of IPC International, Inc.

WE.FLEXTWO

Design Rules – IPC-Specification



- Transition Zone / IPC-6013
 - ±1.5 mm
 - A non-laminated gap due to material misalignment, prepreg cutback
 - Adhesive squeeze out
 - Abweichende Dickenwerte/Isolation
 - Recommendation overlay coverlay min. 0.635 mm

IPC-6013E

2021 - September

Qualification and Performance Specification for
Flexible/Rigid-Flexible Printed Boards

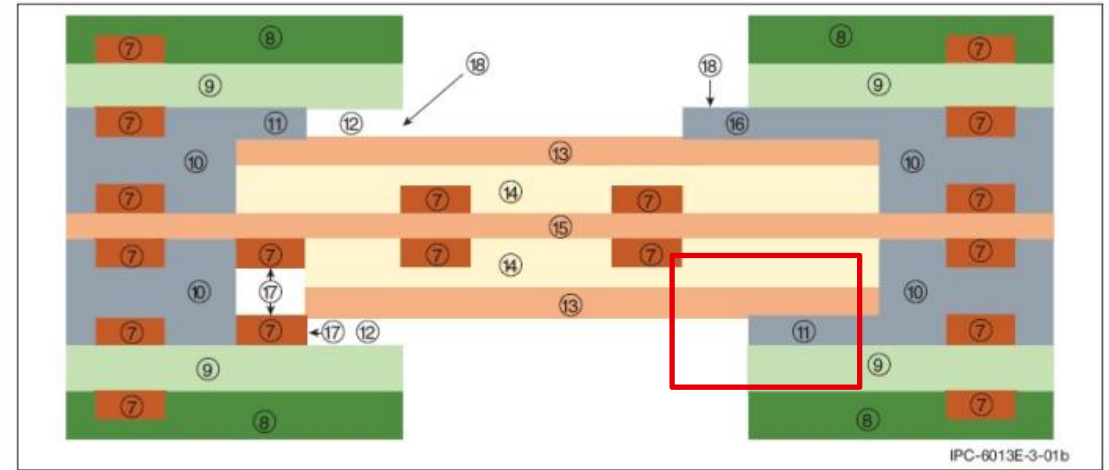


Figure 3-1B Transition Zone

Note 1. Rigid Printed Board

Note 2. Flex Circuit

Note 3. Adhesive or Prepreg Flow

Note 4. Potential Halving of Rigid Printed Board along Edge is permitted in Transition Zone

Note 5. 1.5 mm [0.059 in]

Note 6. Limit of Inspection Range (3.0 mm [0.118 in]), centered on the Transition Zone.

Note 7. Conductor.

Note 8. Solder Mask.

Note 9. Rigid Cap.

Note 10. Prepreg.

Note 11. Overlap.

Note 12. Gap.

Note 13. Polyimide Cover.

Note 14. Cover Adhesive.

Note 15. Polyimide Core.

Note 16. Overlap with Squeeze-Out.

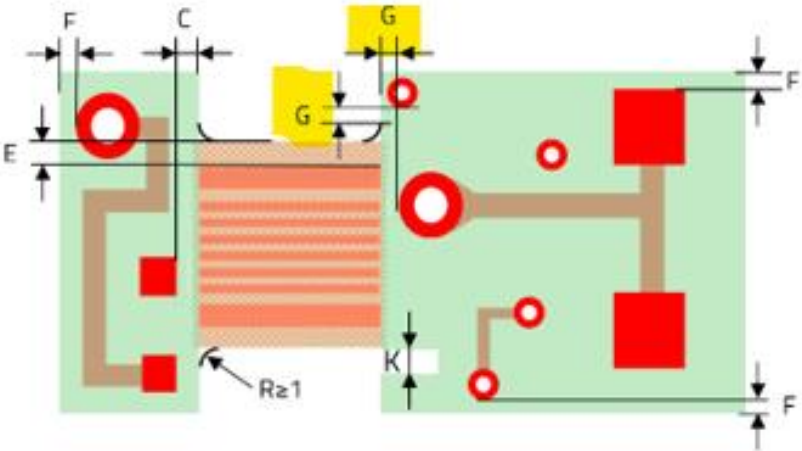
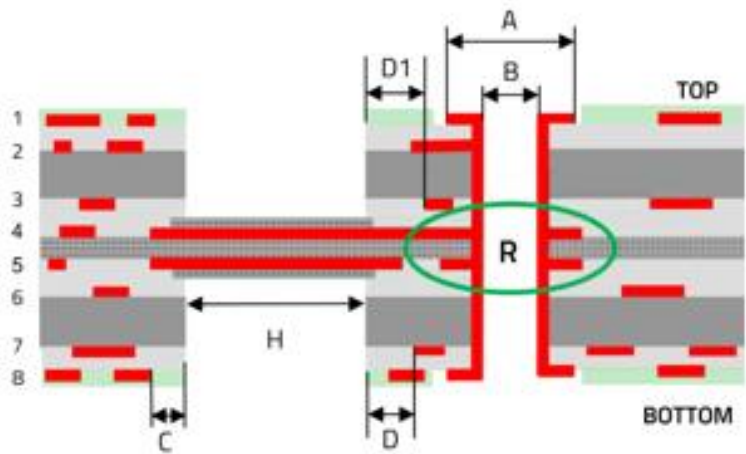
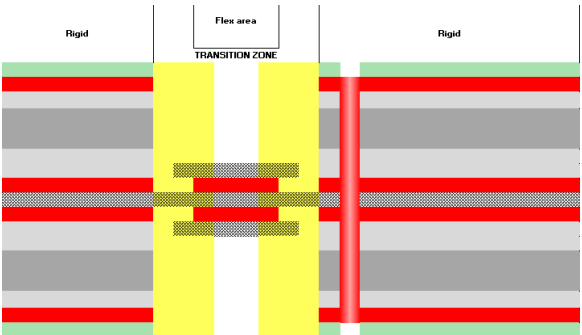
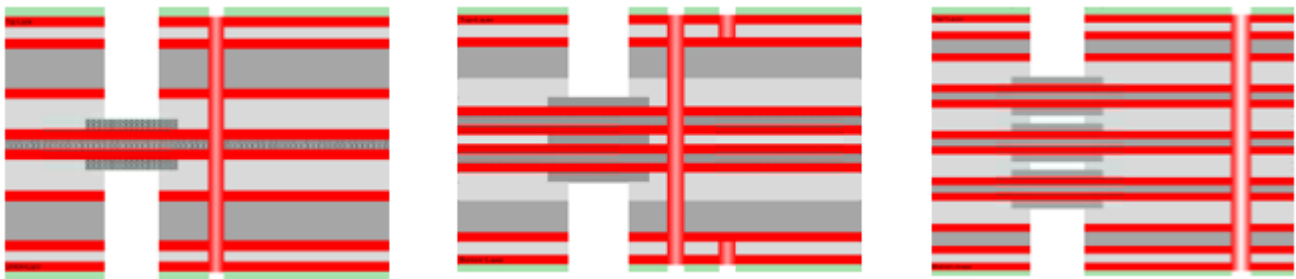
Note 17. Nonconforming Exposed Conductor Due to Lack of Dielectric Insulation.

Note 18. Acceptable Conditions of Gap/Squeeze-out within Inspection Range described in Note 6.

The images are Copyright 2024 by IPC International, Inc. and are used with permission of IPC International, Inc.

WE.FLEXTWO

Design Rules



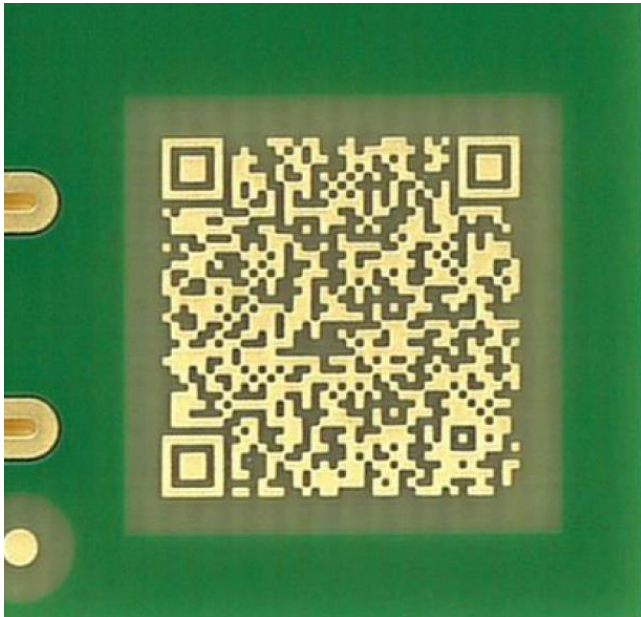
<https://www.we-online.com/designrulesrigidflexinside>

https://www.we-online.com/designguideflex_en

Symbol	Description	Technical Standard	Advanced requirements
G	Flexible area 2F: Distance of via pad to flex-rigid transition	≥1500 μm	≥1000 μm
G	Flexible area >2F: Distance of via pad to flex-rigid transition	≥2000 μm	≥1500 μm
G	For your information: Recommendation in IPC-2223D 5.2.2.3:	3.18 mm+ ½ pad diameter	

WE.FLEXTWO

QR-Code & traceability



ORDER HERE:
RIGID.flex
physical sample
WE.flextwo

Code types and content				
Codes types	DMC	QR	Barcode	Text
Standard		ISO / IEC 18004	ISO / IEC 15420	
Picture				„WE“
Recommended minimum size	6 x 6 mm (square) 4 x 12 mm (rectangular)	8 x 8 mm		1 mm font size

Content can be numeric or alphanumeric characters.

Dynamic content:

- Numbering of production panel
- Numbering of delivery panel in production panel (nest number)
- Numbering single PCB in production panel (nest number)
- Serial number for delivery panel
- Serial number for single PCB

The codes are printed on the printed circuit board by inkjet printing in white colour.



A close-up, high-angle photograph of a green printed circuit board (PCB) with intricate white and silver circuit traces and numerous circular solder pads. The image is slightly blurred, creating a sense of depth.

THANK YOU FOR YOUR ATTENTION!