more than you expect
WE
WÜRTH ELEKTRONIK
RIGID.flex 2F-xRi
An attractive rigid-flex variant

AGENDA

1 RIGID.**flex technology**

2 RIGID.**flex 2F-xRi**

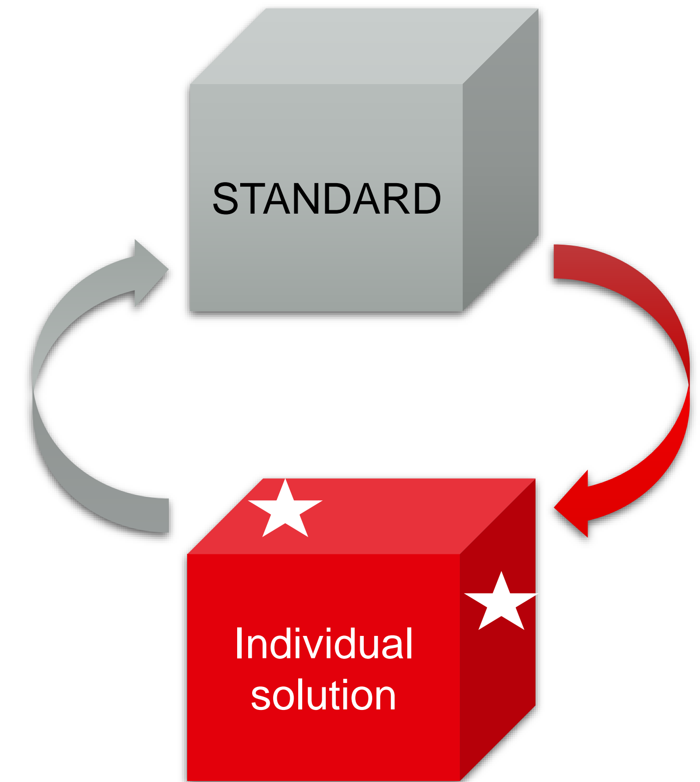
- a **Standard stacks + manufacturing process**
- b **Signalintegrity**
- c **HDI-combinations**
- d **Mechanical options**

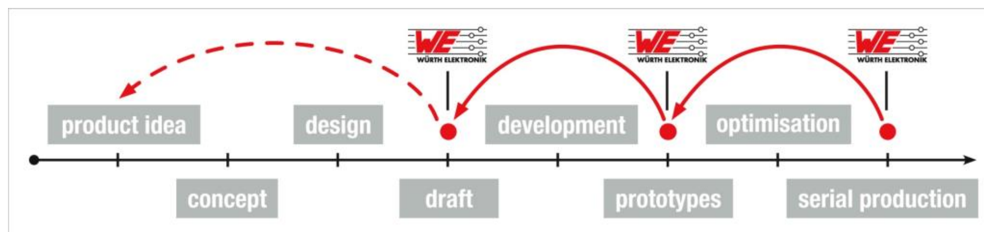
3 **Capability WE**

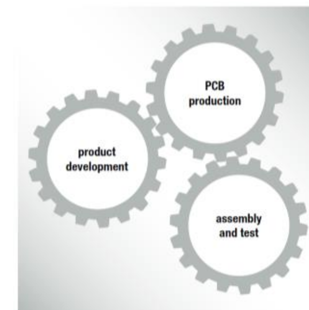
Werner Öchslen
technical
project management

RIGID.flex TECHNOLOGY

- **Rigid-flex offers a variety of constructions and material combinations**
- **Use our generated STANDARDS**
  - Design Guides
  - Designrules
  - Layerstacks PDF or Digital
  - Tips und tricks of our webinars
- **An ideal cooperation enables quality, reliability and saves costs**

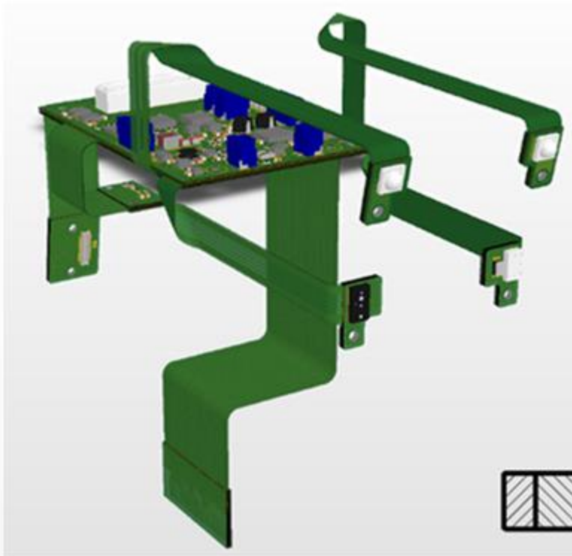


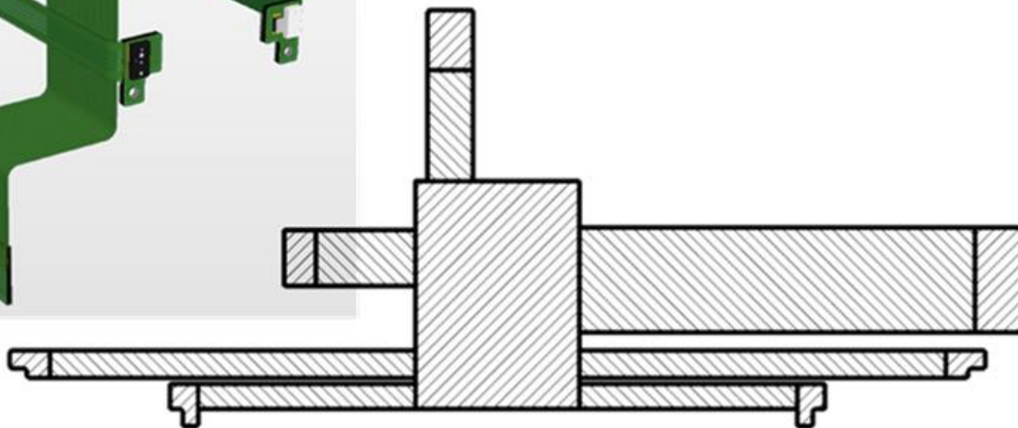


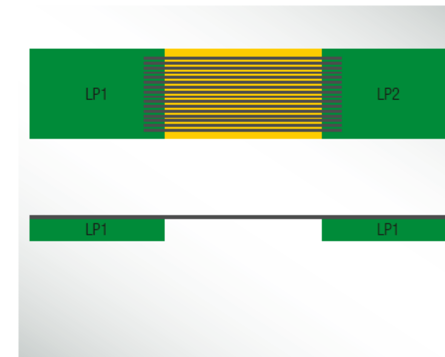


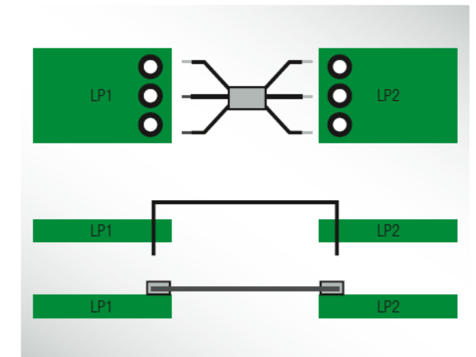
RIGID.flex TECHNOLOGY
Systemview

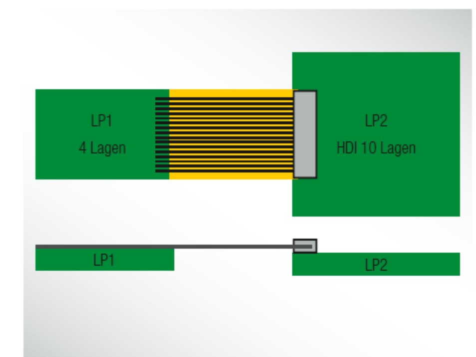
Rigid-flex is mechatronic = mechanics + electronics











RIGID.flex TECHNOLOGY

Standardstacks

Standard 1F-xRi Stackup

Material description		Flex area Structure	Viatypes: Standard	Viatypes: Modifications	Standard values	1F-7Ri	1F-5Ri	1F-3Ri	1F-1Ri	1F-0Ri no plating	Modifications
soldermask											flexible soldermask / coverlay (FR0210)
copper incl. plating	Top-Layer				45µm	L1	L1	L1	L1	L1	
Polyimide					50µm						
LowFlow Prepreg					50µm						
copper					18µm	L2	L2	L2			35µm
core 1											≥ 250µm
copper					18µm	L3	L3	L3			35µm
prepreg					2 x 1080						≥ 2 x 1080
copper					18µm	L4					35µm
core 2											≥ 100µm
copper					18µm	L5					35µm
prepreg					2 x 1080						≥ 2 x 1080
copper					18µm	L6	L4				35µm
core 3											≥ 250µm (= thickness core 1)
copper					18µm	L7	L5				35µm
prepreg					2 x 106						
copper incl. plating	Bottom-Layer				45µm	L8	L6	L4	L2		
soldermask											

Standard 2F-xRi Stackup

Material description		Flex area Structure	Viatypes: Standard	Viatypes: Modifications	Standard values	2F-6Ri	2F-4Ri	2F-2Ri	2F-1Ri	Modifications
soldermask										flexible soldermask / coverlay (FR0210)
copper incl. plating	Top-Layer				45µm	L1	L1	L1	L1	
Polyimide					50µm					
copper	Top-Layer				18µm	L2	L2	L2	L2	
LowFlow Prepreg					90µm					2x 106
core 1										≥ 250µm
copper					18µm	L3	L3	L3		35µm
prepreg					2 x 1080					≥ 2 x 1080
copper					18µm	L4				35µm
core 2										≥ 100µm
copper					18µm	L5				35µm
prepreg					2 x 1080					≥ 2 x 1080
copper					18µm	L6	L4			35µm
core 3										≥ 250µm (= thickness core 1)
copper					18µm	L7	L5			35µm
prepreg					1 x 1080					
copper incl. plating	Bottom-Layer				45µm	L8	L6	L4	L2	
soldermask										

Standard xRi-2F-xRi Stackup

Material description		Flex area Structure	Viatypes: Standard	Viatypes: Modification	Standard values	3Ri-2F-3Ri	2Ri-2F-2Ri	1Ri-2F-1Ri	Modification allowed
Soldermask									
copper incl. plating	Top-Layer				45µm	L1	L1	L1	
prepreg					1 x 1080				≥1 x 1080
					18µm	L2	L2		35µm
Core 1									≥100µm
					18µm	L3			35µm
prepreg					3 x 1080				
Coverlay									
					18µm	L4	L3	L2	35µm
Polyimide					50µm				75µm/100µm
					18µm	L5	L4	L3	35µm
Coverlay					3 x 1080				
prepreg									
					18µm	L6			35µm
Core 2									≥100µm
					18µm	L7	L5		35µm
prepreg					1 x 1080				≥1 x 1080
copper incl. plating	Bottom-Layer				45µm	L8	L6	L4	
Soldermask									

Standard xRi-4F-xRi Stackup

Material description		Flex area Structure	Viatypes: Standard	Viatypes: Modification	Standard values	3Ri-4F-3Ri	2Ri-4F-2Ri	1Ri-4F-1Ri	Modification allowed
Soldermask									
copper incl. plating	Top-Layer				45µm	L1	L1	L1	
prepreg					1 x 1080				≥1 x 1080
					18µm	L2	L2		35µm
Core 1									≥100µm
					18µm	L3			35µm
prepreg					3 x 1080				
Coverlay									
					18µm	L4	L3	L2	35µm
Polyimide					50µm				75µm/100µm
					18µm	L5	L4	L3	35µm
Bondply / PP					111 / 1080				121 / 2116
					18µm	L6	L5	L4	35µm
Polyimide					50µm				75µm/100µm
					18µm	L7	L6	L5	35µm
Coverlay					3 x 1080				
prepreg									
					18µm	L8			35µm
Core 2									≥100µm
					18µm	L9	L7		35µm
prepreg					1 x 1080				≥1 x 1080
copper incl. plating	Bottom-Layer				45µm	L10	L8	L6	
Soldermask									

POLL

- **Is the rigid-flex technology already in use in your company?**

Answer options (multiple answers possible):

- NO
- NO, but there is potential
- YES, with flex layers inside
- YES, with flex layers outside
- YES, in SEMI.flex or BEND.flex technology

AGENDA

1 RIGID.flex Technology

2 RIGID.flex 2F-xRi

- a Standard stacks + manufacturing process
- b Signalintegrity
- c HDI-combinations
- d Mechanical options

3 Capability WE

RIGID.flex 2F-xRi

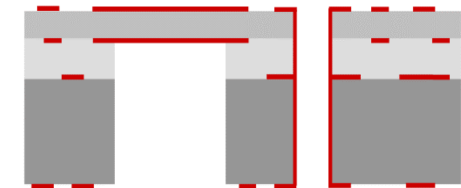
Standardstacks

- **Basematerial Standard**
  - Rigid: FR4 Tg ≥ 150°C, halogenfree, filled
  - Flex: Polyimid Tg > 200°C, 50µm, adhesiveless
  - Coverlay partiell on Layer 2, flexible soldermask partiell on TOP flexarea
  - Innerlayercopper 18µm (Base thickness)

Material description	Layer	Standard values	2F-6Ri	2F-4Ri	2F-2Ri	2F-1Ri	Modifications
soldermask							flexible soldermask / coverlay (FR0210)
copper incl. plating	Top-Layer	45µm	L1	L1	L1	L1	
Polyimide		50µm					
copper	Top-Layer	18µm	L2	L2	L2	L2	
LowFlow Prepreg		90µm					2x 106
core 1							≥ 250µm
copper		18µm	L3	L3	L3		35µm
prepreg		2 x 1080					≥ 2 x 1080
copper		18µm	L4				35µm
core 2							≥ 100µm
copper		18µm	L5				35µm
prepreg		2 x 1080					≥ 2 x 1080
copper		18µm	L6	L4			35µm
core 3							≥ 250µm (= thickness core 1)
copper		18µm	L7	L5			35µm
prepreg		1 x 1080					
copper incl. plating	Bottom-Layer	45µm	L8	L6	L4	L2	
soldermask							

Column headers also printed: Flex area structure; Viatypes: Standard, Modifications. Side marker: ≡

GENERAL:
materials for different stackup types
min. and max. pcb thickness acc. technical guideline
no changes allowed!



2F-xRi (flex-rigid)
- 2F-1Ri_0,85_18
- 2F-1Ri_1,0_18
- 2F-1Ri_1,5_18
- 2F-2Ri_0,85_18
- 2F-2Ri_1,0_18
- 2F-2Ri_1,5_18
- 2F-4Ri_1,0_18
- 2F-4Ri_1,5_18
- 2F-6Ri_1,6_18

Digital stacks

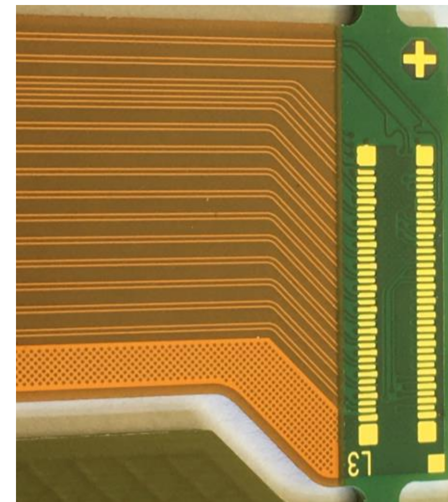
RIGID.flex 2F-xRi

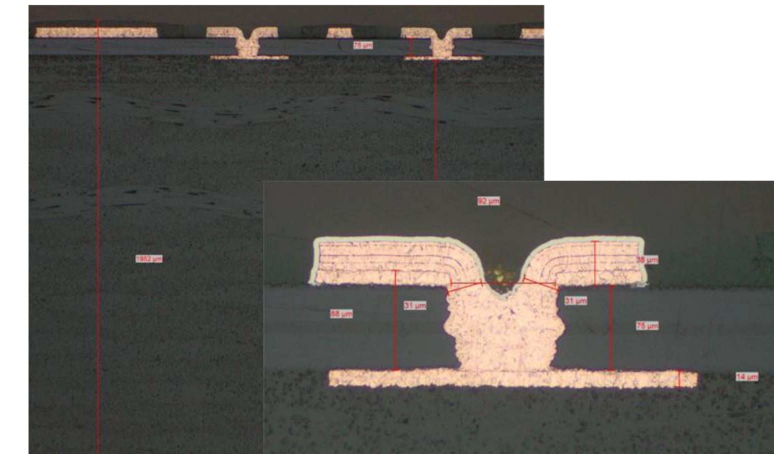
Standardstacks

- **Standard modifications**
  - Polyimidthickness 75µm / 100µm
  - 35µm innerlayercopper
  - HDI 1-x-1 (Microvias also in flexarea)
  - Coverlay on TOP-layer partiell in flexarea

Material description	Flex area structure / Viatypes (Standard, Modifications)	Standard values	2F-6Ri	2F-4Ri	2F-2Ri	2F-1Ri	Modifications
soldermask							flexible soldermask / coverlay (FR0210)
copper incl. plating	Top-Layer	45µm	L1	L1	L1	L1	
Polyimide		50µm					
copper	Top-Layer	18µm	L2	L2	L2	L2	
LowFlow Prepreg		90µm					2x 106
core 1							≥ 250µm
copper		18µm	L3	L3	L3		35µm
prepreg		2 x 1080					≥ 2 x 1080
copper		18µm	L4				35µm
core 2							≥ 100µm
copper		18µm	L5				35µm
prepreg		2 x 1080					≥ 2 x 1080
copper		18µm	L6	L4			35µm
core 3							≥ 250µm (= thickness core 1)
copper		18µm	L7	L5			35µm
prepreg		1 x 1080					
copper incl. plating	Bottom-Layer	45µm	L8	L6	L4	L2	
soldermask							

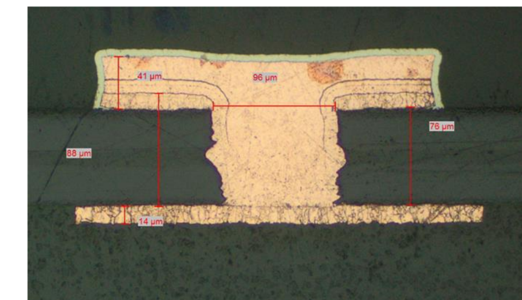
GENERAL:
materials for different stackup types
min. and max. pcb thickness acc. technical guideline
no changes allowed!





stack 2F-0Ri

- 75µm Polyimid
- „only“ Microvias
- Impedance defined
- Coverlay TOP



RIGID.flex 2F-xRi

Manufacturing Process

Flex-Material Innenlage → FD IL → DES → AOI → Coverlay Verlegen → Coverlay Fixieren

Material Coverlay Film RS → Schneiden Coverlay → Coverlay Verlegen

Material 1. IL-Kern → FD IL → DES → Sticheln → AOI → A-PREP

Material IL-Kern(e) → FD IL → DES → AOI → A-PREP

Material Low Flow Prepreg → Verstiften 5-er Pack → Fräsen

Sammelplatz → ML Verlegen → ML Verpressen → ML Fertigung Standard → Tiefenfräsen RS → ML Fertigung Standard

ML STANDARD

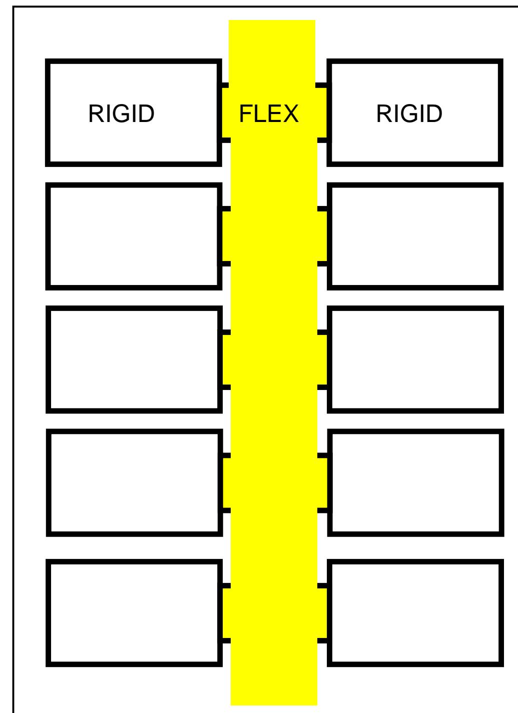
FLEX spezifisch

RIGID.flex 2F-xRi
Manufacturing Process

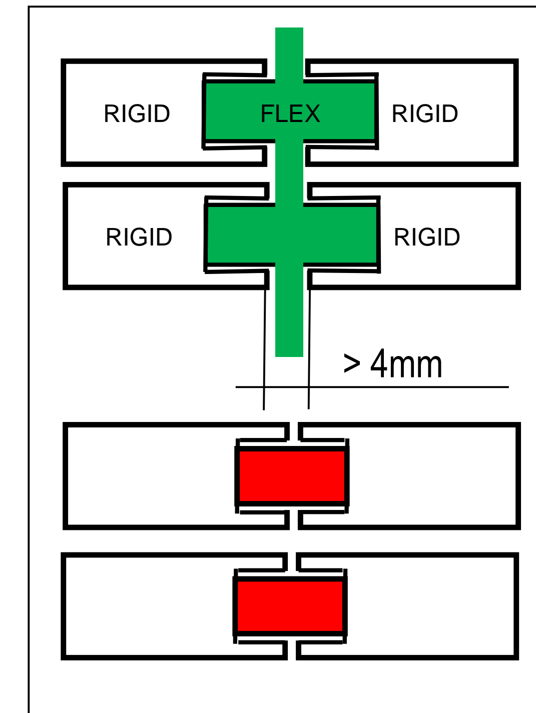
Array formation with coverlay

- **depending on the mechanical design**
- **influences the effort in PCB production:**
  - Optimization significantly reduces the effort
  - Optimization increases the registration accuracy = quality

- **with sufficient flex length:**



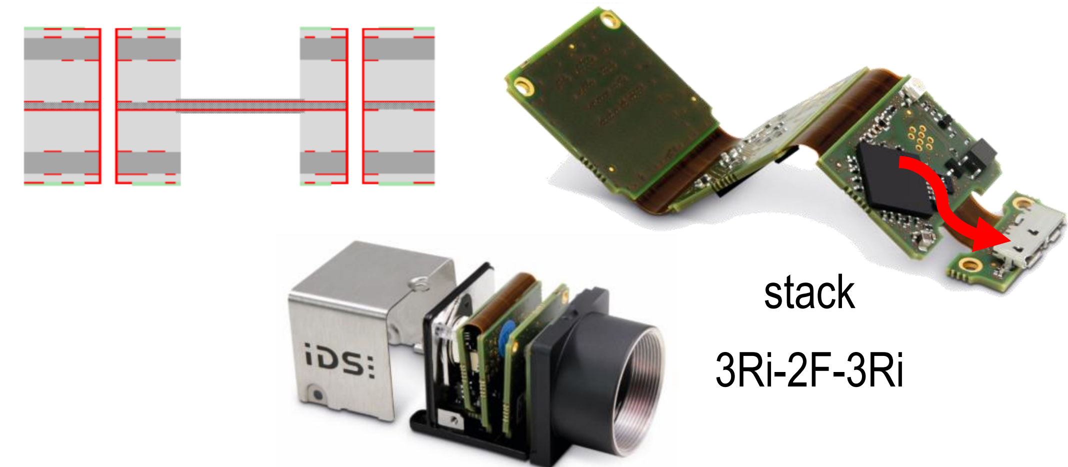
- **for short flex areas:**



RIGID.flex 2F-xRi

Signalintegrity

- **Impedance-defined traces**
- **USB connector on a separate rigid area**
- **Prevention of connectors, saving footprint areas**



- **Advanatges of 2F-xRi technology**
  - 1:1 transmission of the signals
  - No jumps in impedance due to vias
  - Contacting reference layer via microvias possible
  - Signal routing optionally also possible on L2

customer	
pcb name	
WE-number	
engineer	
date	

WÜRTH ELEKTRONIK

Rigidflex 2F-2Ri + HDI 1-2-1

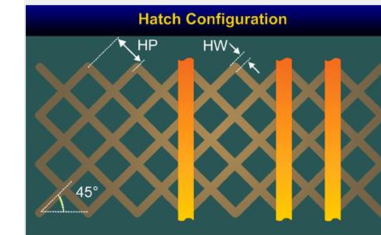
PCB Thickness : 0,99 mm +/- 10% Flex Thickness: 0,21 mm +/-0,05mm

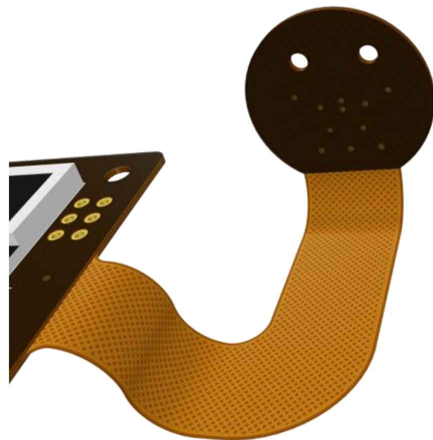
Rigid area Structure	Flex area Thickness	Rigid area Thickness	Material description	Structure	Layer usage	Er	Impedance Z[Ohm] / Line / Space
Flex Soldermask	30						
Soldermask		15				3,5	
L1	45	45	* Incl. Plating	Top-Layer	SIG		L1: 90OHM DIFF: 135µm line / 200µm iso / 135µmline (REF L2)
	75	75	Polyimid adhesiveless			3,4	
L2	17	17			REF		
	40	90	Coverlay				
			FR4 HTG 150°				
		610	FR4 HTG 150°				
L3		17					
		65	FR4 HTG 150°				
L4		45	* Incl. Plating	Bottom-Layer			
Soldermask		15					

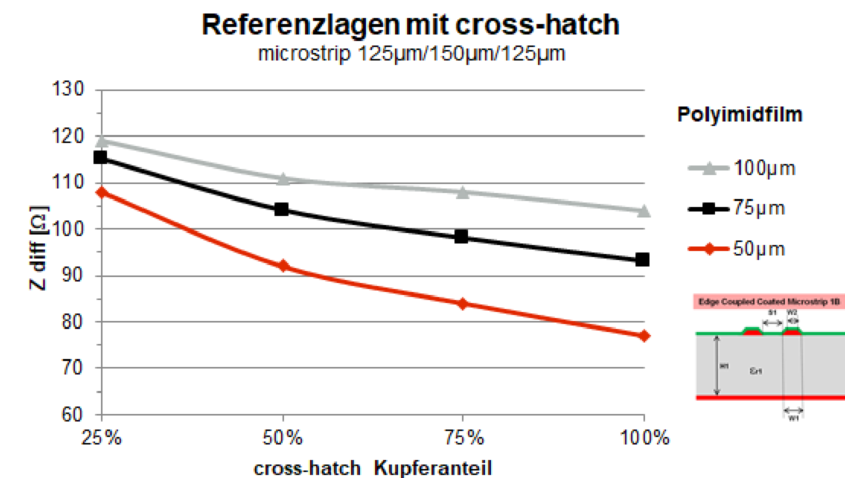
RIGID.flex 2F-xRi

Signalintegrity

- **Hatch: copper openings through rasterized reference layers**
  - Improve flexibility
  - Improve the drying of the flexmaterial
  - Increases the impedance → thinner polyimide possible
  - Become critical from frequencies of 5-6 GHz





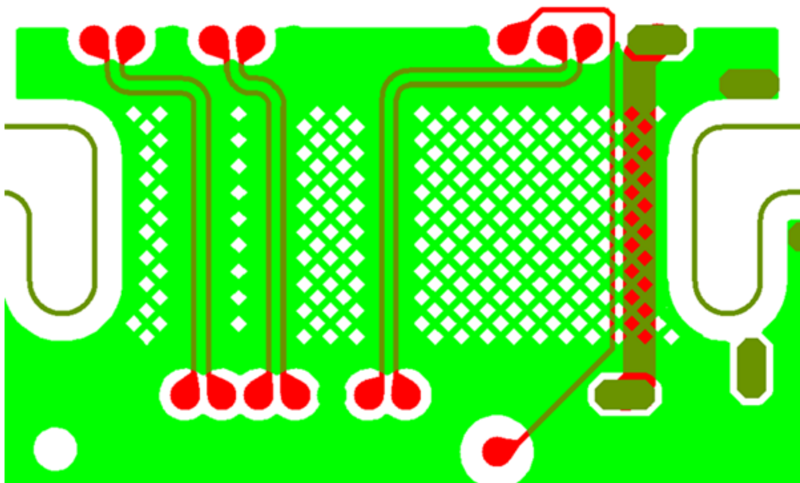


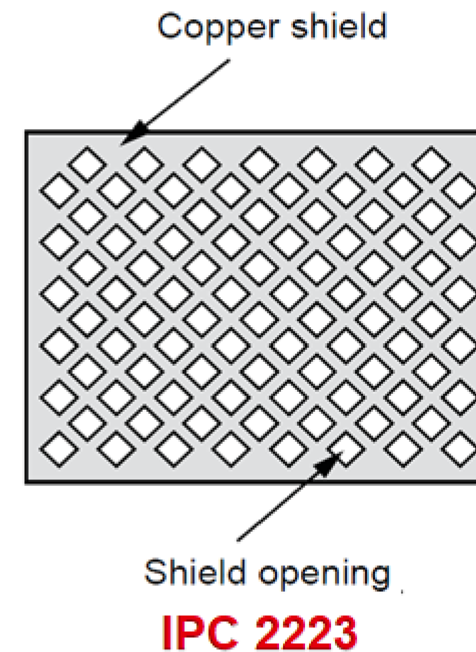
RIGID.flex 2F-xRi

Signalintegrity

Compromise for an undisturbed return path

- **Differential pair in the flex area**
  - 100% copper under the conductor pair
  - The remaining areas are rasterized for drying and flexibility





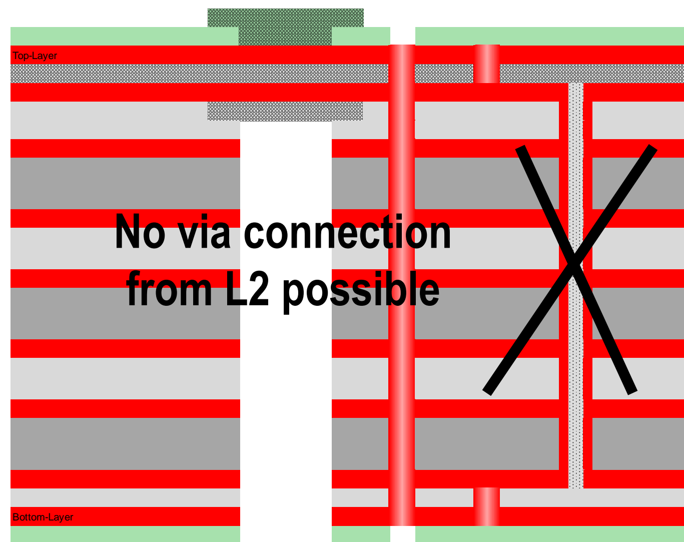
RIGID.flex 2F-xRi

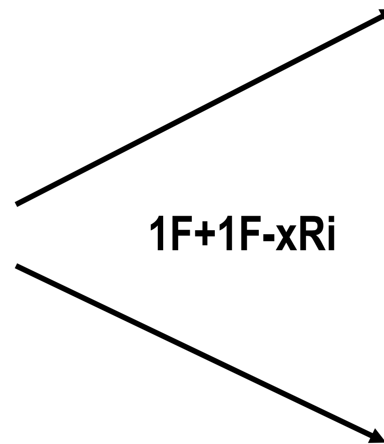
Signalintegrity

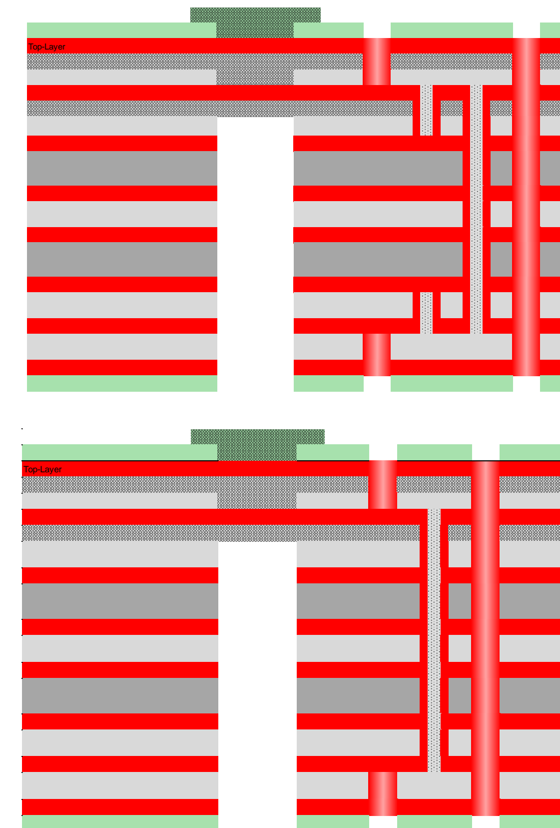
- **Calculation and documentation of the impedances**

RIGID.flex 2F-xRi

HDI-combinations



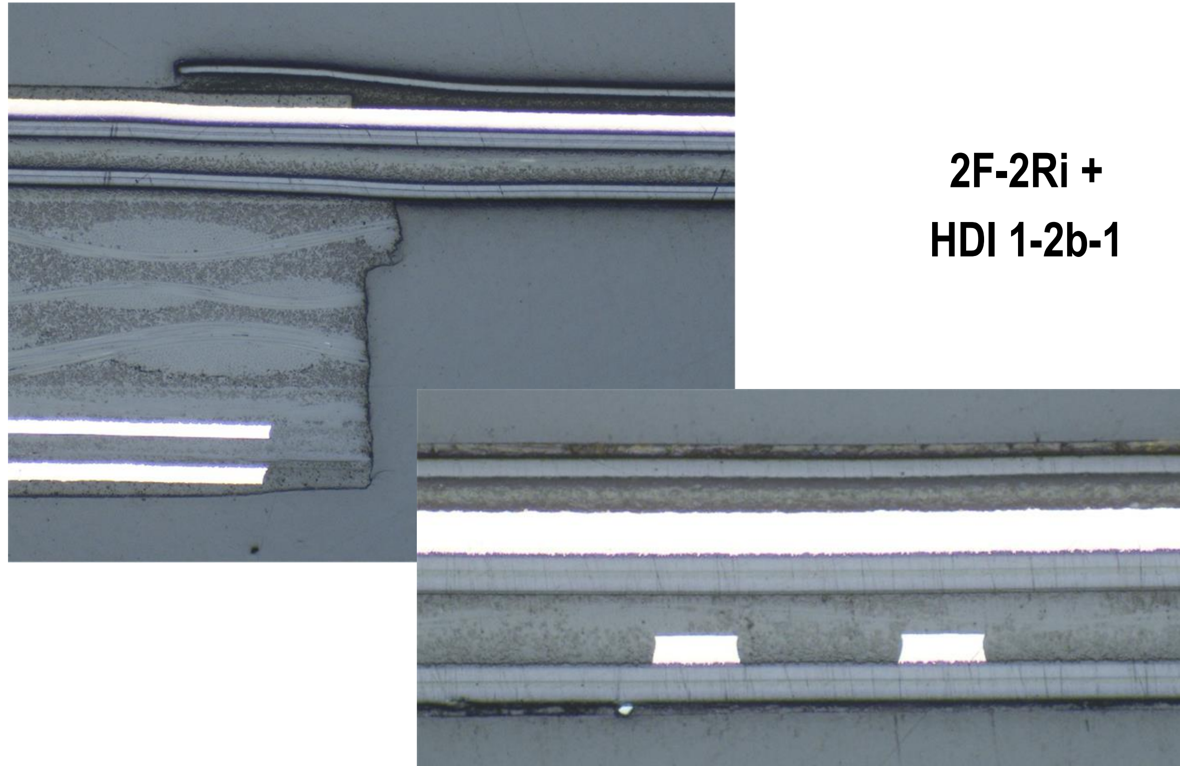




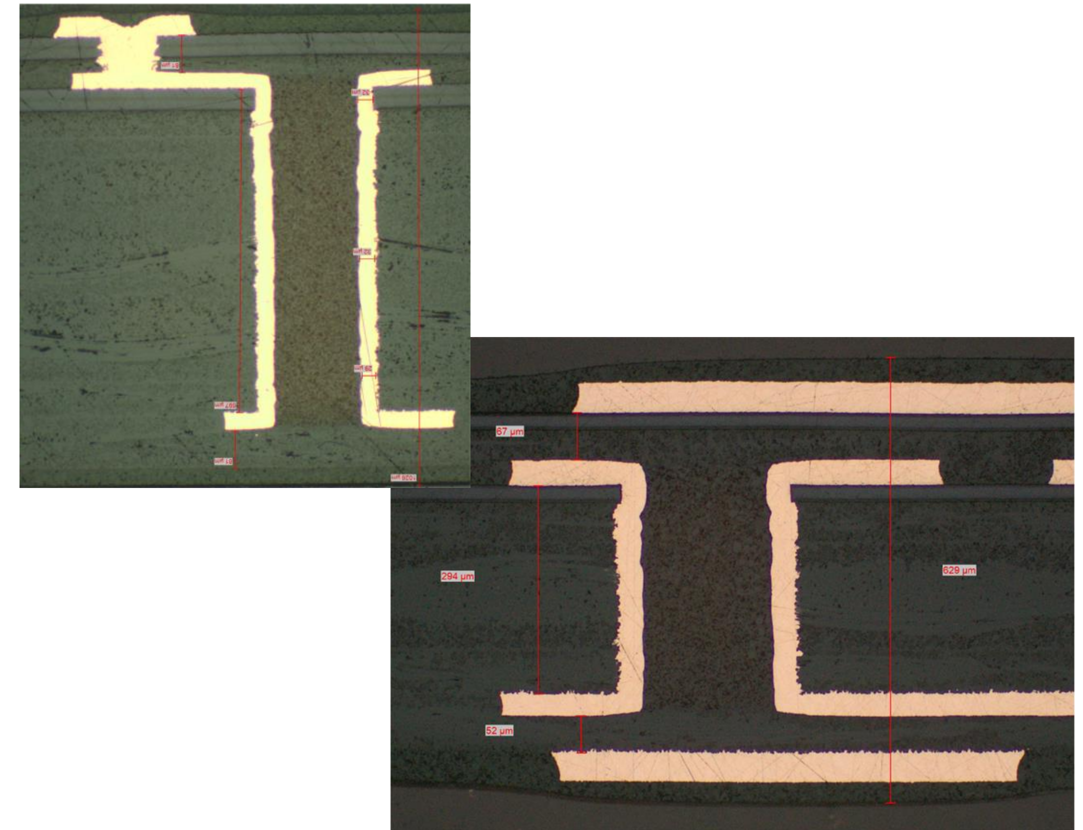
2F-6Ri +
HDI 2-4(6b)-2

2F-6Ri +
HDI 1-6b-1

RIGID.flex 2F-xRi
HDI-Kombinationen



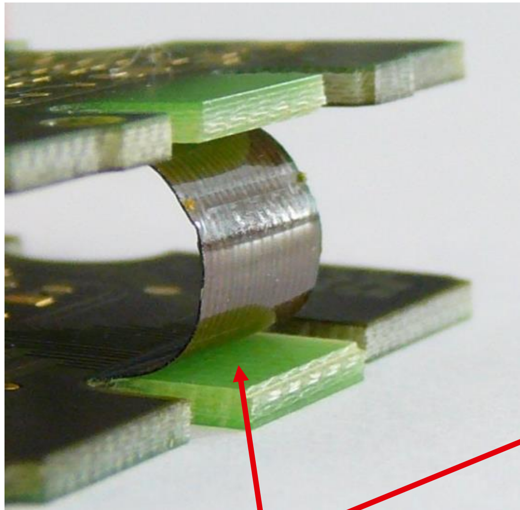
2F-2Ri +
HDI 1-2b-1



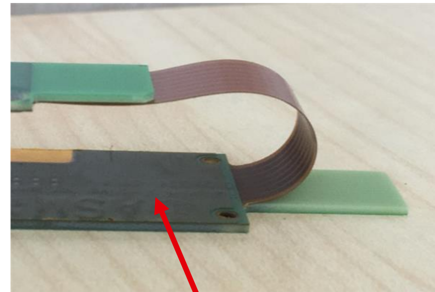
- **Based on HDI design rules - cannot be combined 1:1**

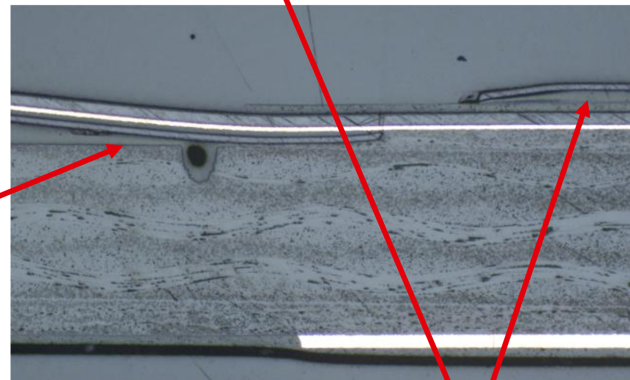
RIGID.flex 2F-xRi

Mechanical Options



FLEX LiftOff





Extra insulation through coverlay on the rigid area

Rigidflex 2F(1F)-1Ri + Microvias

PCB Thickness : 0,95 mm +/- 10% Flex Thickness: 0,12 mm +/-0,05mm

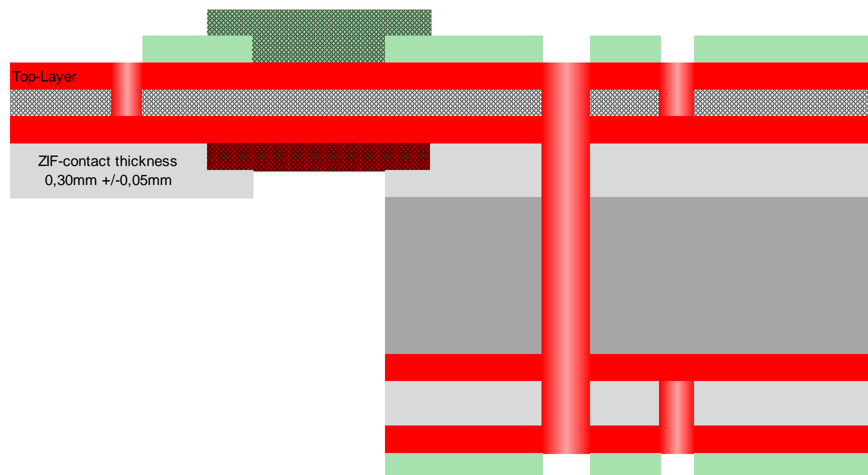
Rigid area Structure	Flex area Thickness	Rigid area Thickness	Material description			LiftOff Area	Flex area Structure	LiftOff Area		Viatypes
Coverlay										
Soldermask		15								
L1		40	* Incl. Plating	Top-Layer						
	50	50	Polyimide							
L2	16	16								
Coverlay	50	95	2x 106 LowFlow							
		610	FR4 TG 150							
		65	1x 1080							
L3		40	* Incl. Plating							
Soldermask		15								

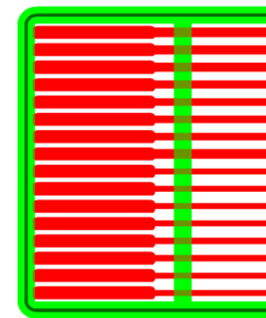
Dynamic bending

- Flex on L2 with RA copper
- Covered with Coverlay
- No galvanic copper application on L2
- LiftOff for rolling movement
- >1 Mio bending cycles

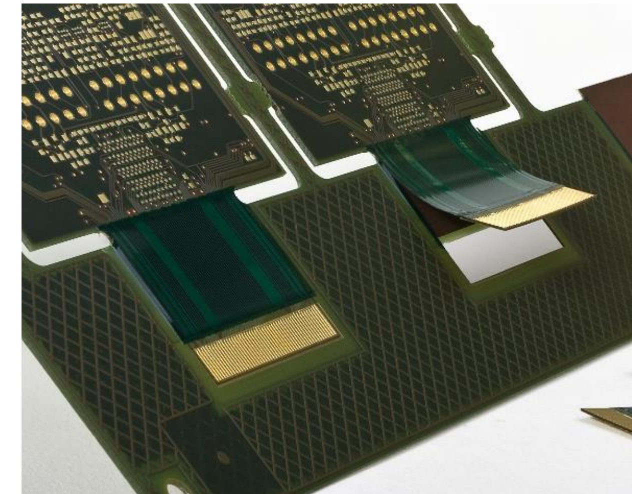
RIGID.flex 2F-xRi
Mechanical Options

- **ZIF-connector**
  - Contacting GND via microvias
  - Manufacturing “easier” compared to an xRi-2F-xRi solution
  - Note the thickness tolerance of +/- 0.05mm
  - ZIF contour generally cut by laser





are for microvias
(not in spring contact area)



Snap-in hooks as a pull-out protection

POLL

- **What applications for the use of 2F-xRi technology do you see in your company?**

Answer options (multiple answers possible):

- Optimization of running products with regard to performance
- Optimization of running products with regard to costs
- Planned use in current projects
- Possibly for future projects (nothing planned at the moment)
- No need for this technology

RIGID.flex 2F-xRi
Summary Advantages

- **Performance**
  - Standards are generated
  - Impedance tracks can be routed over the flex area without PTHs
  - Microvias as a switch to GND contact or signal routing to L2
  - HDI combinations possible
  - Mechanical options such as LiftOff; ZIF contacts can be easily manufactured
  - Suitable for dynamic bending stress
- **Costs**
  - Lower cost compared to xRi-2F-xRi

WÜRTH ELEKTRONIK

WE CAPABILITY RIGID.flex

Variants	• 1-2 Flexlayers outside, 1-10 Flexlayers inside, SEMI.flex, BEND.flex
Materials	• FR4 (Tg135) / Tg150 HF filled, TG170 HF filled, Tg240, Flexmaterial adhesiveless
Stacks	• Standards, NON-Standards, HDI-RIGID-FLEX combinations
Options	• Impedancecalcualtions, Coverlay on outerlayer, LiftOff areas, ZIF-contacts
Quantities / Lead-times	• Express services, samples, series, large series

VIELEN DANK FÜR IHRE AUFMERKSAMKEIT!

Welche

Applikation

haben Sie?

Wie können wir

Sie unterstützen?

Kontakt:
flex@we-online.de