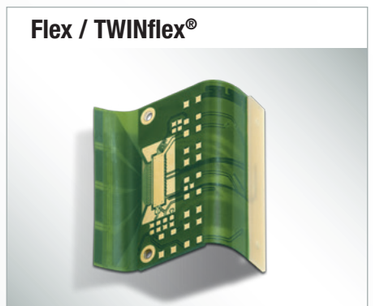
Flex-Rigid, Semiflex & Flex Design Guide

WÜRTH ELEKTRONIK

Technology variants

Flex / TWINflex®



2F (Flex)

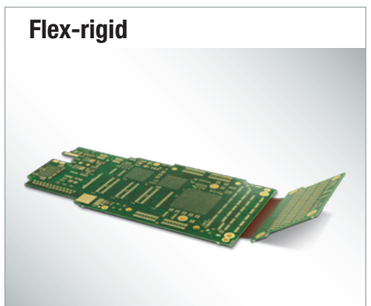
2F-Ri (TWINflex)

4F with microvias 1-2/2-3/3-4

In comparison:
1F-Ri (TWINflex)

1F-0Ri (flex-rigid)

Flex-rigid



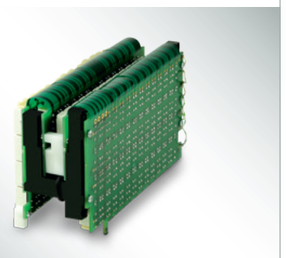
1F-3Ri

2F-2Ri

3Ri-2F-3Ri

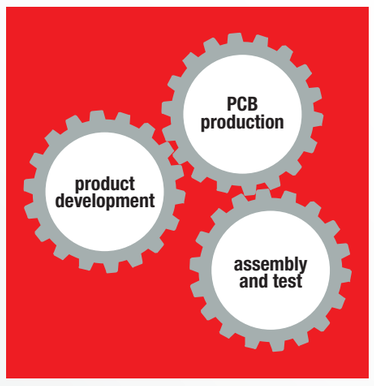
3Ri-8F-3Ri

FR4 Semiflex



1Ri-3Ri

2Ri-4Ri



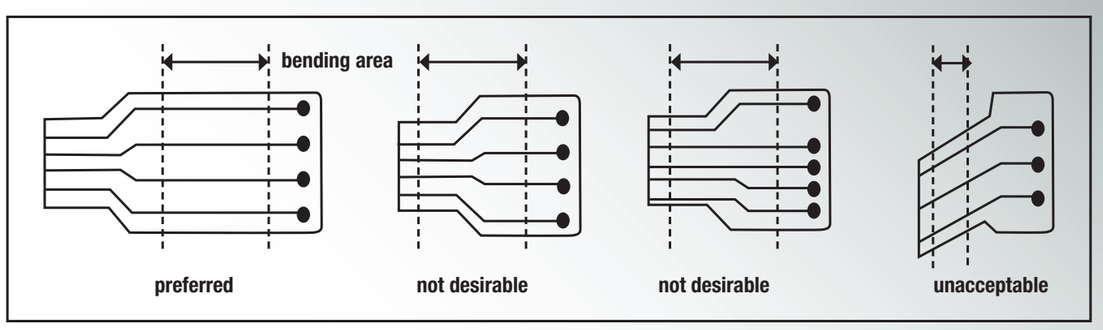
Indicators for preferential use of individual variants:

Variant	Indicators for	Comments
Flex xF	Very small, dense circuits	Microvias and contour possible with laser
	Very limited installation space	Flexible foil 50 µm thick
	Use in vacuum	Practically no gas emission
	Use at high temperatures	PI and LCP can be used up to more than 200°C (without solder mask)
	High frequency applications	Good thickness tolerance, copper treatment flat
	Vias in flexible area	But NOT permitted in bending area!
TWINflex xF-Ri	Cooling problem	Metal reinforcement (heatsink)
FR4 Semiflex	Flex-to-install with large bending radii	Affordable solution
	Large board with angled connector	Only bendability is necessary
	Flex material not permitted	Only rigid base materials
Flex-rigid 1F-xRi	Large portion of flex surface	Laser-cut panel very stable
	1:1 wiring across flexible area	More affordable than xRi-2F-xRi
	Small bending radii	Thin flexible area, highly flexible soldermask
	Short drying times	Flex layer on outside
Flex-rigid 2F-xRi	High-frequency component-to-connector connection across flexible area with reference layer	No vias necessary for transfers WARNING: complex (see table below)
Flex-rigid xRi-1F-xRi	Highly-dynamic prolonged bending	Copper in neutral phase ideal
	High-level reliability requirements	-
Flex-rigid xRi-2F-xRi	Reference layer in flex area due to signal integrity	Polyimide with 75 or 100 µm for impedance control
	High-level reliability requirements	Rugged technology, mechanical stability

Indicators against the use of individual variants:

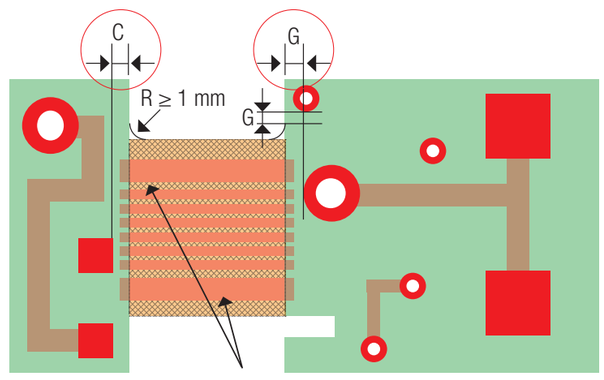
Variant	Indicators against	Comments
Flex xF	Wired components or connectors	Low mechanical stability
TWINflex xF-Ri	Many individual reinforcements	Better to use flex-rigid 1F-xRi
FR4 Semiflex	S-shaped bending in one surface	Do not subject glass mat to tension
	Multi-section casing	Assembly tolerances have effect on Semiflex area
Flex-rigid 1F-xRi	-	-
Flex-rigid 2F-xRi	Large circuit boards	Design tends to bow and twist
	Large quantities	limited area, tends to be expensive
Flex-rigid xRi-2F-xRi	-	-

Layout / routing in the bending area:



(Source IPC-2223)

- No PTH in the bending area with flex circuit boards
- With flex-rigid vias only in the rigid area, not in the flex area
- If possible provide wide conductors outside near the flex contour for stability purpose
- On flexible cores use offset design for tracks (Avoid „I-Beam“ effect)
- Always provide hatched copper reference layers with copper openings to improve flexibility and accelerate drying
- Use teardrops
- Apply round routing and big outline radii



If possible – insertion of wide copper tracks for tear protection

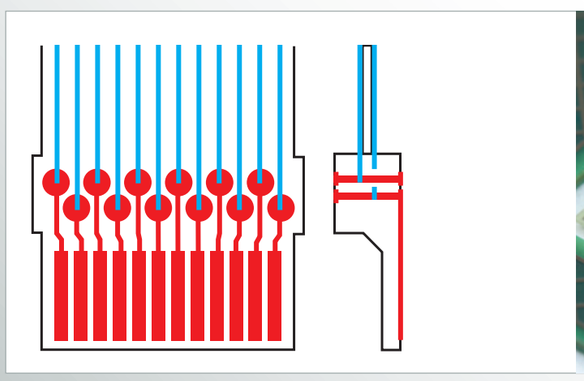
! Regard distances of drill holes and SMD pads to flex-rigid transition, see Würth Elektronik design rules (items C + G).

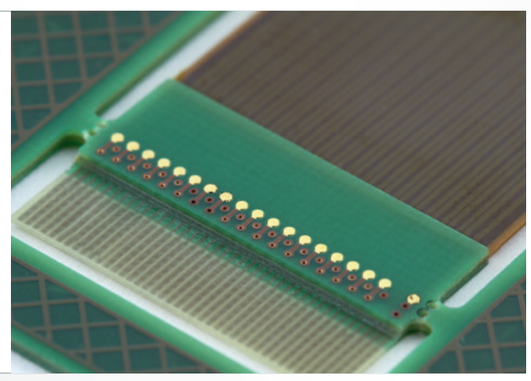
Number of flex layers	1	2	4	6	8	10	12
Flex/TWINflex							
Flex-rigid flex outside							
Flex-rigid flex inside							flex cores not glued
FR4 Semiflex							

! For IPC-2223 „Use B“ (continous flexing) and Use D (UL recognition), be sure to consult with our specialists!

Bending radius [mm]	1	2	3	4	5	6	IPC-2223: Use A Flex-to-install Thickness x 10
Flex area 1-layer							
Flex area 2-layers							
Flex area 4-layers							
FR4 Semiflex							

ZIF contacts on outer layer by using vias





! Please respect the Basic Design Guide of Würth Elektronik for design rules regarding structures, via sizes and soldermask.