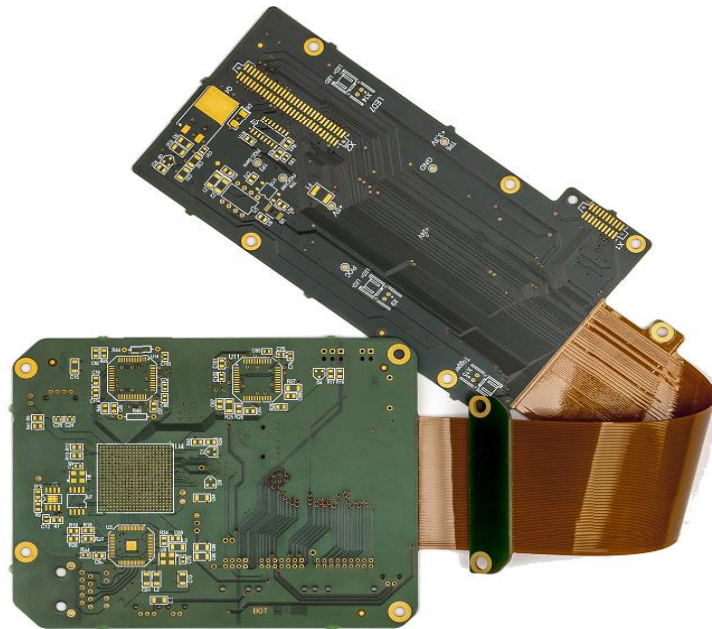


# RigidFlex Inner

## Design rules and production limits



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## Introduction

### Basic information

#### What is RigidFlex Inner PCB?

RigidFlex board with 1-2 flexible copper layers placed in the middle of symmetrical stackup. Flexible layers are covered always by coverlay.

### Notation code

Flex are described using short code which describe number of copper layers. Code also shows position of flexible core inside symmetrical stackup.

- **xRi-yF-zRi**

- X ... Number of copper layers above flex core (on rigid area of PCB)

- Y ... Number of copper layers on flex core

- Z ... Number of copper layers below flex core (on rigid area of PCB)

- Example of our flexi PCB configurations:

1Ri-2F-1Ri ... Total of four copper layers with 2 flex on the inner layers

3Ri-1F-3Ri ... Total of seven copper layers with 1 flex on the inner layers

### Stackup examples

Code	Stackup	Description
1Ri-1F-1Ri		Four layer RigidFlex with one layers on flex and two on rigid. Flexible core is covered by flexible coverlay.
2Ri-2F-2Ri		Six layer RigidFlex with two layers on flex and four on rigid. Flexible core is covered by flexible coverlay.

## Materials

### Basic materials

Brand	Type	PI [µm]	Cu [µm]	Cu type	Adhesive [µm]	TG [°C]	Diel. [kV]	Datasheet
Pyrалux AP	AP8525R	50	18/18	RA	Adhesiveless	220	13	<a href="#">Datasheet</a>
	AP9121R	50	35/35	RA	Adhesiveless	220	13	<a href="#">Datasheet</a>
Brand	Type	PI [µm]	Cu [µm]	Cu type	Adhesive [µm]	TG [°C]	Diel. [kV]	Datasheet
ThinFlex W	W-2005RD	50	18/18	RA	Adhesiveless	350	11	<a href="#">Datasheet</a>
	W-2010RD	50	35/35	RA	Adhesiveless	350	11	<a href="#">Datasheet</a>
	A-4005RD	100	18/18	RA	Adhesiveless	250	27,6	<a href="#">Datasheet</a>

\*RA Rolled copper; \*ED Elektrodeposited copper

### Coverlay

Brand	Type	PI [µm]	Adhesive [µm]	TG [°C]	Diel. Stren. [kV]	Datasheet
Pyrалux LF	LF0110	25	25	220	5	<a href="#">Datasheet</a>
	LF0210	25	50	220	5	<a href="#">Datasheet</a>
	LF0220	50	50	220	5	<a href="#">Datasheet</a>

### Flexible solder mask

Brand	Type	Datasheet
Peters	SD 2463 HF	<a href="#">Datasheet</a>

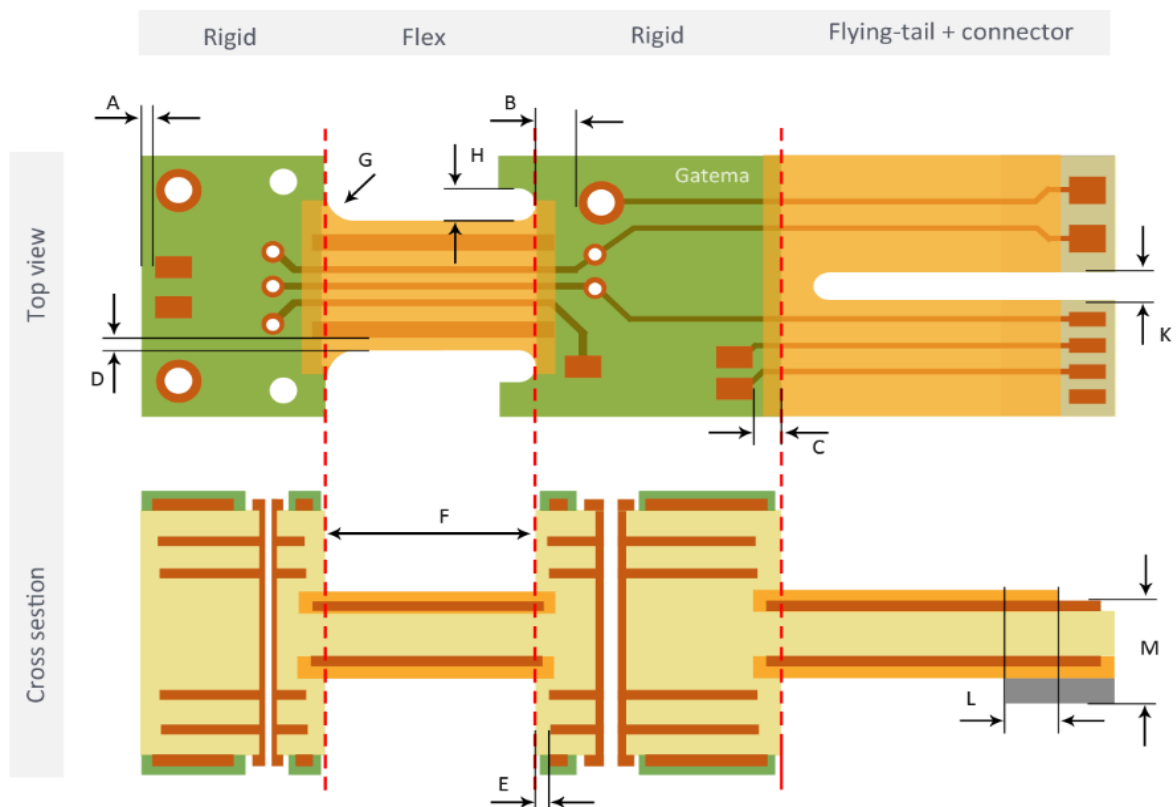
### Stiffener basic material

Material	Brand	Thickness [µm]	TG [°C]	Datasheet
Laminate	Isola FR4	-	150	<a href="#">Datasheet</a>
Polyimide	Pyrалux AP	-	220	<a href="#">Datasheet</a>
Polyimide	ThinFlex W	-	350	<a href="#">Datasheet</a>

## Design rules: basic rules for xRi-yF-zRi

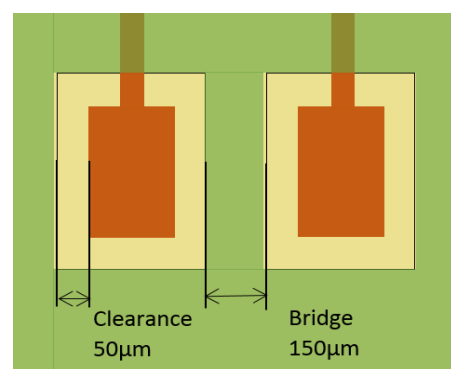
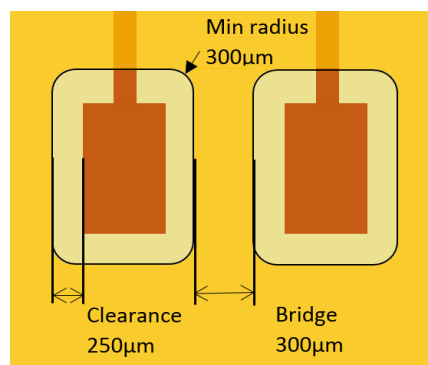
### Basic rules

Legend	Description	Standard	Advanced
A	Exposed Cu to board outline	$\geq 0,3 \text{ mm}$	
B	Spacing via pad to transition zone Recommendation in IPC-2223D 5.2.2.3	$\geq 2,0 \text{ mm}$ $3,18 \text{ mm} + \frac{1}{2} \text{ pad diameter}$	
C	Exposed Cu to transition zone	$\geq 0,8 \text{ mm}$	
D	Spacing of conductor to flexible contour	$\geq 0,3 \text{ mm}$	
E	Spacing inner layer to transition zone	$\geq 0,5 \text{ mm}$	
F	Length of flexible area	$\geq 5 \text{ mm}$	
G	Min diameter (bigger better for prevent material tearing)	$R \geq 1,5 \text{ mm}$	
H	Outline manufacturing between flex and rigid area	$\geq 1,6 \text{ mm}$	
K	Outline manufacturing	$\geq 1,6 \text{ mm}$	$\geq 1,0 \text{ mm}$
L	Overlap of coverlay (soldermask) with stiffener as prevention from flex material crack	$\geq 0,9 \text{ mm}$	
M	Polyimide (PI) stiffener thickness tolerance	$\pm 5 \%$	
-	Maximal PCB dimension	263 x 385 mm	
- - - -	Transition zone		



## Design rules: production limits

Coverlay vs solder mask pad clearance		
Dimension	Polyimid coverlay	Flexible solder mask
Min. bridge	300 µm	150 µm
Min. clearance	250 µm	50 µm
Min radius in pad clearance	300 µm (routed with tool D 0,6 mm)	-
Color	amber	gloss green
Bend radius	unlimited	radius 1,5 mm; 90°
Application	dynamic, semi-dynamic, stable	semi-dynamic, stable



Spacing between PCB in production panel		
Type	Single pieces	Panelised in panel
xRi-yF-zRi	>= 12 mm	>= 12 mm

Other limitations	
Type	Value
Maximal dimension	263 x 385 mm
Min track/isolation	100 µm

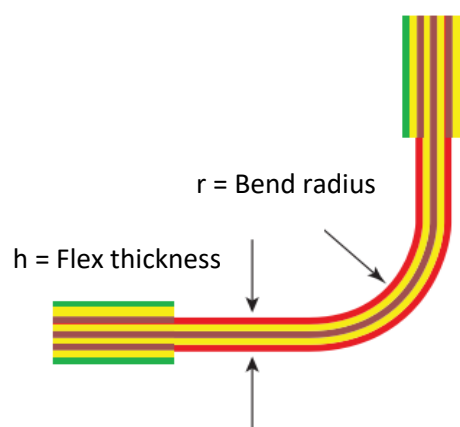
## Design rules: General recommendations

### Flexi PCB types according to number of bending cycles

#### 1) How to choose proper material?

Choosing proper material depends on final type of application. First type of PCB must be identified than is possible to recommend suitable materials. Type of application depends on number of bending cycles and minimal bending radius

2) Indicate type	Number of bending	Min. bending radius
Dynamic	Frequent	100-150 x flex layer thickness
Semi-Dynamic	Max. 20x	> 20 x flex layer thickness
Stable	Bend to install	> 10 x flex layer thickness



#### 3) Choose flexible core

Application type	Dynamic	Semi-Dynamic	Stable
Copper type	<b>RA copper</b>	<b>RA or ED copper</b>	<b>RA or ED copper</b>
Material	Pyralux AP Thinflex W/A	Pyralux AP Thinflex W/A	Pyralux AP Thinflex W/A

#### 4) Choose soldermask or coverlay

Application type	Dynamic	Semi-Dynamic	Stable
Covering type	<b>Coverlay</b>	<b>Coverlay or flexi SM</b>	<b>Coverlay or flexi SM</b>
Material	Pyralux LF	Pyralux LF Elp. SD 2463 FLEX-HF	Pyralux LF Elp. SD 2463 FLEX-HF

### IPC-2223 Sectional Design Standard for Flexible/Rigid-Flexible Printed Boards

We recommend following the design recommendations listed in IPC-2223 Sectional Design Standard for Flexible/Rigid-Flexible Printed Boards when designing a Flex or RigidFlex PCB.

IPC standard is available in online store:

[shop.ipc.org](http://shop.ipc.org)

## Stackup: Stiffeners + flying tails

### Stiffener possibilities

Type and description	Stackup example
<b>Polyimide (PI)</b>	

Polyimide based stiffener by applied NoFlow prepregs under the high temperature and pressure.

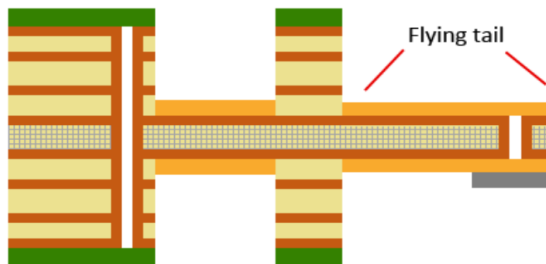
+ More accurate final thickness  $\pm 5\%$

		PI STIFFENER BOT (D)	
Material text	Cu usage	Material	Thick [ $\mu\text{m}$ ]
ENIG		Surface	5
Copper (RA)	L 1	Copper	35
PYRALUX AP		Flex laminate	50
Copper (RA)	L2 (67%)	Copper	35
No-flow49N 1x106□		NoFlow prepreg 2	44
No-flow49N 1x106□		NoFlow prepreg 2	56
No-flow49N 1x106□		NoFlow prepreg 2	56
Pyralux AG-185018RY		Stiffener PI	50
Stackup thickness		Thick [ $\mu\text{m}$ ]	
Estimated		331	
Required		300	

### Flying tail

#### What is flying tail?

Flying tail is flexible area on RigidFlex PCB, which is not ended by rigid area and contains exposed pads or vias. Very often is this area with exposed pads (connector fingers in many cases) supported by stiffener. Exposed pads can be placed on both sides of flexible core top and bottom.



		FLYING-TAIL (C)	
Material text	Cu usage	Material	Thick [ $\mu\text{m}$ ]
Pyralux 0110		Coverlay	25
		Adhesive	25
Copper (RA)	L3 (67%)	Copper	35
PYRALUX AP		Flex laminate	50
Copper (RA)	L4 (67%)	Copper	35
Stackup thickness		Thick [ $\mu\text{m}$ ]	
Estimated		160	
Required		-	

## Stackup: Default stackups

Standard stackup			
Layer count	Thickness	xRi-1F-zRi	xRi-2F-zRi
3	1,00 mm	<u>1Ri-1F-1Ri</u>	-
3	1,50 mm	<u>1Ri-1F-1Ri</u>	-
4	1,00 mm	-	<u>1Ri-2F-1Ri</u>
5	1,60 mm	<u>2Ri-1F-2Ri</u>	-

Minimum thickness >= 1,2 mm



## Stackup: 1Ri-1F-1Ri

### Standard stackup

Layer count	Thickness	Code
3	1,2 mm	1Ri-1F-1Ri

### Stackup preview

Type: Inner RigidFlex 1Ri-1F-1Ri							
6 layer stackup; Tg 150°		RIGID (A)			FLEX (B)		RIGID (A)
Material text	Cu usage	Material	Thick [µm]	Pit drill	Material	Thick [µm]	
Green		Solder mask	20				
Copper (ED)	L1	Copper	18+25 Plt	A			
IS 400 ML		Rigid laminate	300				
Copper (ED)	L2 (0%)						
No-flow49N 1x106		NoFlow prepreg 2	56				
No-flow49N 1x106		NoFlow prepreg 2	56				
Pyrallux 0110		NoFlow prepreg 1	44		Coverlay	25	
No-flow49N 1x106					Adhesive	25	
Copper (RA)	L3 (67%)	Copper	35				
PYRALUX AP		Flex laminate	50				
Copper (RA)	L4 (67%)						
No-flow49N 1x106		NoFlow prepreg 2	44				
No-flow49N 1x106		NoFlow prepreg 2	56				
No-flow49N 1x106		NoFlow prepreg 2	56				
Copper (ED)	L5 (0%)						
IS 400 ML		Rigid laminate	300				
Copper (ED)	L6	Copper	18+25 Plt				
Green		Solder mask	20				
Stackup thickness			Thick [µm]			Thick [µm]	
Estimated			1174			160	
Required			1155			-	
Plated drill		Start-stop layer					
Through holes		A = L1 - L6					

## Stackup: 1Ri-1F-1Ri

### Standard stackup

Layer count	Thickness	Code
3	1,50 mm	1Ri-1F-1Ri

### Stackup preview

Type: Inner RigidFlex 1Ri-1F-1Ri							
6 layer stackup; Tg 150°		SECTION RIGID (A)			SECTION FLEX (B)		SECTION RIGID (C)
Material text	Cu usage	Material	Thick [µm]	Plt drill	Material	Thick [µm]	
Green		Solder mask	20				
Standard	L1	Copper	18+25 PIt	A			
IS 400 ML		Rigid laminate	507				
Standard	L2 (0%)						
No-flow49N 1x1080		NoFlow prepreg 2	46				
Pyralux 0110					Coverlay	25	
No-flow49N 1x1080		NoFlow prepreg 1	43		Adhesive	25	
Standard (ED)	L3 (40%)	Copper	35				
ThinFlex W		Flex laminate	50				
Standard (ED)	L4 (0%)						
No-flow49N 1x1080		NoFlow prepreg 2	29				
No-flow49N 1x1080		NoFlow prepreg 2	46				
Standard	L5 (0%)						
IS 400 ML		Rigid laminate	507				
Standard	L6	Copper	18+25 PIt				
Green		Solder mask	20				
Stackup thickness			Thick [µm]			Thick [µm]	
Estimated			1440			214	
Required			1400			-	
Plated drill							
Description		A = through L1-L6					

## Stackup: 1Ri-2F-1Ri

### Standard stackup

Layer count	Thickness	Code
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5	1,20 mm	1Ri-2F-1Ri
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### Stackup preview

Type: Inner RigidFlex 1Ri-2F-1Ri							
6 layer stackup: Tg 150°							
Material text	Cu usage	RIGID (A)			FLEX (B)		RIGID (A)
		Material	Thick [µm]	Pit drill	Material	Thick [µm]	
Green		Solder mask	20				
Copper (ED)	L1	Copper	18+25 Pit	A			
IS 400 ML		Rigid laminate	300				
Copper (ED)	L2 (0%)						
No-flow49N 1x106		NoFlow prepreg 2	56				
No-flow49N 1x106		NoFlow prepreg 2	56				
Pyralux 0210		NoFlow prepreg 1	30		Coverlay	25	
No-flow49N 1x106					Adhesive	50	
Copper (RA)	L3 (40%)	Copper	18+25 Pit				
PYRALUX AP		Flex laminate	50				
Copper (RA)	L4 (40%)	Copper	18+25 Pit				
No-flow49N 1x106		NoFlow prepreg 1	30		Adhesive	50	
Pyralux 0210					Coverlay	25	
No-flow49N 1x106		NoFlow prepreg 2	56				
No-flow49N 1x106		NoFlow prepreg 2	56				
Copper (ED)	L5 (0%)						
IS 400 ML		Rigid laminate	300				
Copper (ED)	L6	Copper	18+25 Pit				
Green		Solder mask	20				
Stackup thickness			Thick [µm]			Thick [µm]	
Estimated			1162			246	
Required			1142			-	
Plated drill		Start-stop layer					
Through holes		A = L1 - L6					
Buried vias		B = L3 - L4					

## Stackup: 2Ri-1F-2Ri

### Standard stackup

Layer count	Thickness	Code
5	1,60 mm	2Ri-1F-2Ri

### Stackup preview

Type: Inner RigidFlex							
6 layer stackup; Tg 150°		SECTION RIGID (A)			SECTION FLEX (B)		SECTION RIGID (C)
Material text	Cu usage	Material	Thick [µm]	Plt drill	Material	Thick [µm]	
Green		Solder mask	20				
Standard	L1	Copper	18+25 Plt	A			
IS 400 ML		Rigid laminate	507				
Standard	L2 (0%)	Copper	18				
No-flow49N 1x106		NoFlow prepreg 2	64				
No-flow49N 1x106		NoFlow prepreg 2	64				
Pyrалux 0110					Coverlay	25	
No-flow49N 1x106		NoFlow prepreg 1	43		Adhesive	25	
Standard (ED)	L3 (40%)	Copper	35				
ThinFlex W		Flex laminate	50				
Standard (ED)	L4 (0%)						
No-flow49N 1x106		NoFlow prepreg 2	64				
No-flow49N 1x106		NoFlow prepreg 2	64				
No-flow49N 1x106		NoFlow prepreg 2	64				
Standard	L5 (0%)	Copper	18				
IS 400 ML		Rigid laminate	507				
Standard	L6	Copper	18+25 Plt				
Green		Solder mask	20				
Stackup thickness			Thick [µm]			Thick [µm]	
Estimated			1639			214	
Required			1619			-	
Plated drill							
Description		A = through L1-L6					