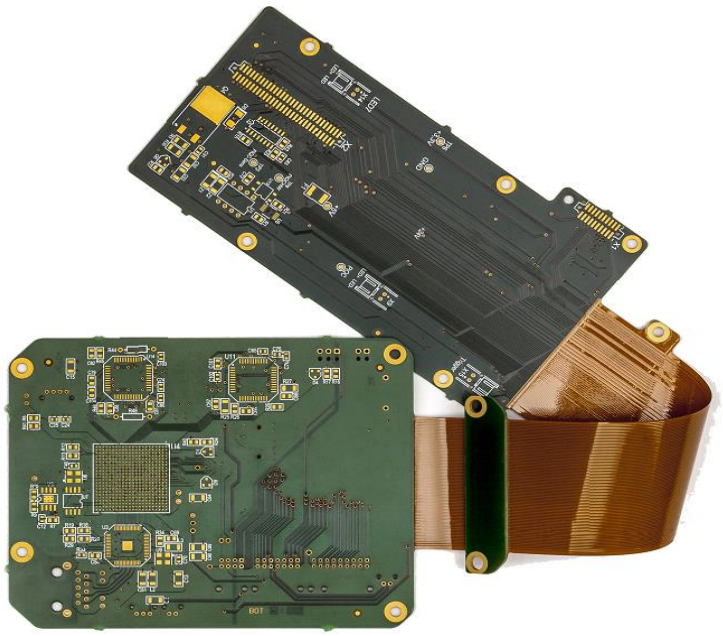
RigidFlex Inner

Design rules and production limits



Content

Introduction

Basic information

What is RigidFlex Inner PCB?

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

Notation code

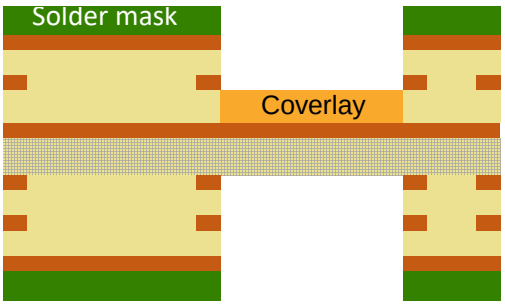
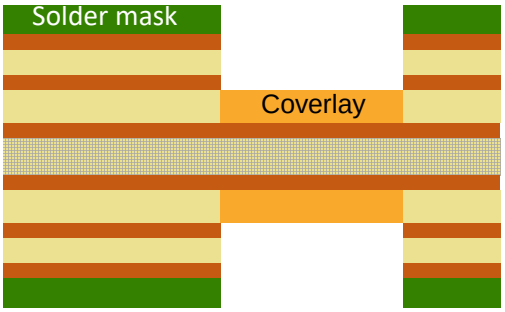
Flex are described using short code which describe number of copper layers. Code also shows position of flexible core inside symetrical stackup.

- **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
Pyralux AP	AP8525R	50	18/18	RA	Adhesiveless	220	13	Datasheet
	AP9121R	50	35/35	RA	Adhesiveless	220	13	Datasheet

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	Datasheet
	W-2010RD	50	35/35	RA	Adhesiveless	350	11	Datasheet
	A-4005RD	100	18/18	RA	Adhesiveless	250	27,6	Datasheet

*RA Rolled copper; *ED Elektrodeposited copper

Coverlay

Brand	Type	PI [µm]	Adhesive [µm]	TG [°C]	Diel. Stren. [kV]	Datasheet
Pyralux LF	LF0110	25	25	220	5	Datasheet
	LF0210	25	50	220	5	Datasheet
	LF0220	50	50	220	5	Datasheet

Flexible solder mask

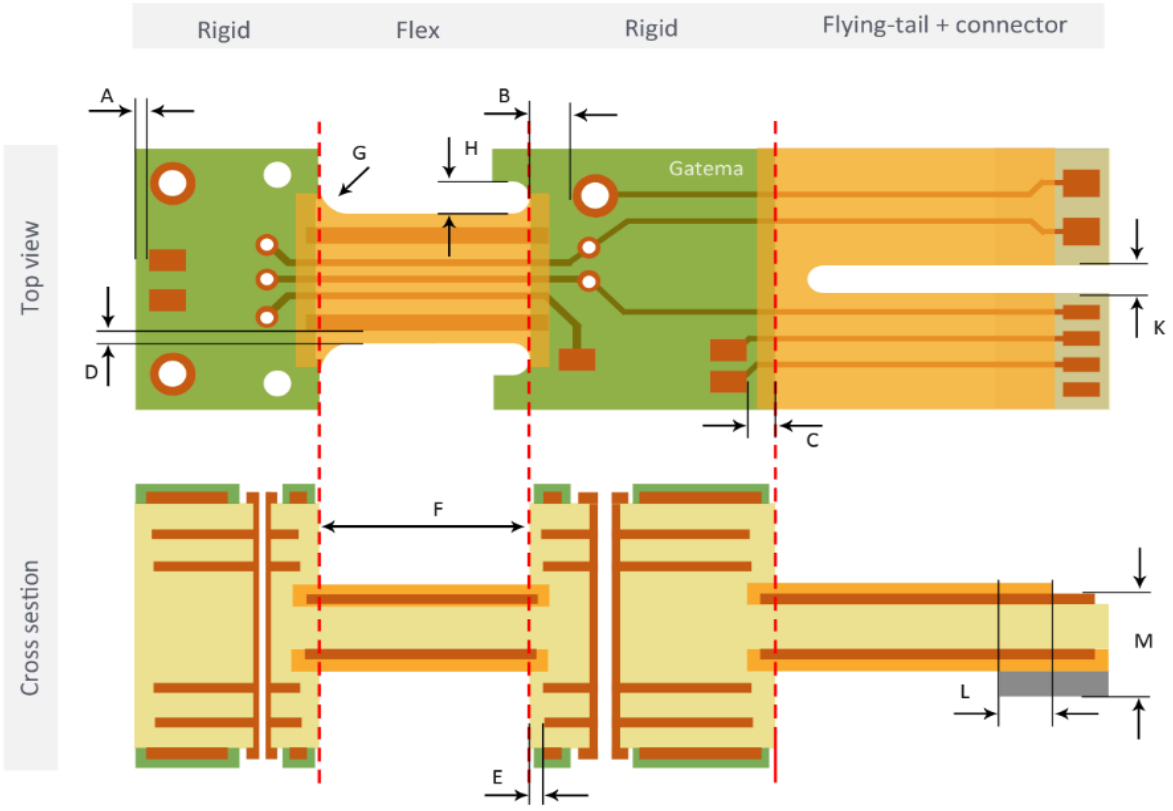
Brand	Type	Datasheet
Peters	SD 2463 HF	Datasheet

Stiffener basic material

Material	Brand	Thickness [µm]	TG [°C]	Datasheet
Laminate	Isola FR4	-	150	Datasheet
Polyimide	Pyralux AP	-	220	Datasheet
Polyimide	ThinFlex W	-	350	Datasheet

Design rules: basic rules for xRi-yF-zRi

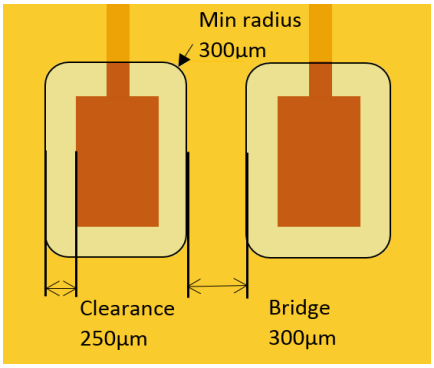
Basic rules			
Legend	**Description**	**Stadard**	**Advanced**
A	Exposed Cu to board outline	>= 0,3 mm	
B	Spacing via pad to transition zone	>= 2,0 mm	
	Recommendation in IPC-2223D 5.2.2.3	3,18 mm+ ½ pad diameter	
C	Exposed Cu to transition zone	>= 0,8 mm	
D	Spacing of conductor to flexible contour	>= 0,3 mm	
E	Spacing inner layer to transition zone	>= 0,5 mm	
F	Length of flexible area	>= 5 mm	
G	Min diameter (bigger better for prevent material tearing)	R >= 1,5 mm	
H	Outline manufacturing between flex and rigid area	>= 1,6 mm	
K	Outline manufacturing	>= 1,6 mm	>= 1,0 mm
L	Overlap of coverlay (soldermask) with stiffener as prevention from flex material crack	>= 0,9 mm	
M	Polyimide (PI) stiffener thickness tolerance	± 5 %	
-	Maximal PCB dimension	263 x 385 mm	
- - - -	Transition zone		

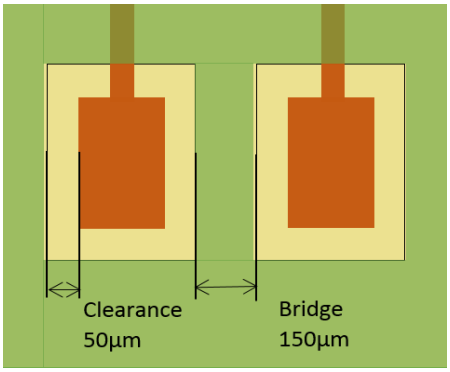


Design rules: production limits

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 radious	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

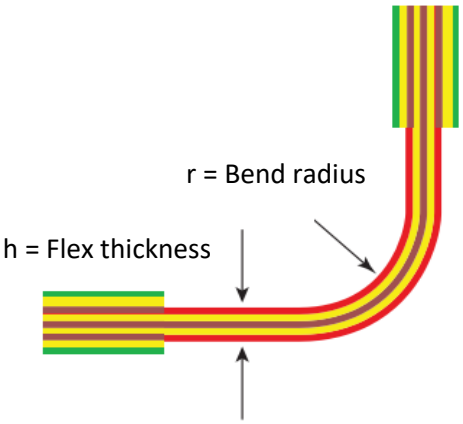
Design rules: General recommendations

Flexi PCB types according to number of bending cycles

1) How to choose proper material?

Choosing proper material depands on final type of application. First type of PCB must be identified than is possible to recommend suitable materials. Type of application depands 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	**RA copper**	**RA or ED copper**	**RA or ED copper**
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	**Coverlay**	**Coverlay or flexi SM**	**Coverlay or flexi SM**
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

Stackup: Stiffeners + flying tails

Stiffener possibilities

Type and description	Stackup example

Polyimide (PI)

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

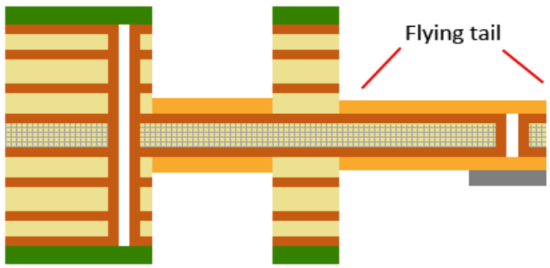
+ More accurate final thickness ±5 %

		PI STIFFENER BOT (D)	
Material text	Cu usage	Material	Thick [µm]
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 AG185018RY		Stiffener PI	50
Stackup thickness			Thick [µm]
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 plased on both sides of flexible core top and bottom.



		FLYING-TAIL (C)	
Material text	Cu usage	Material	Thick [µm]
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 [µm]
Estimated			160
Required			-

Stackup: Default stackups

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

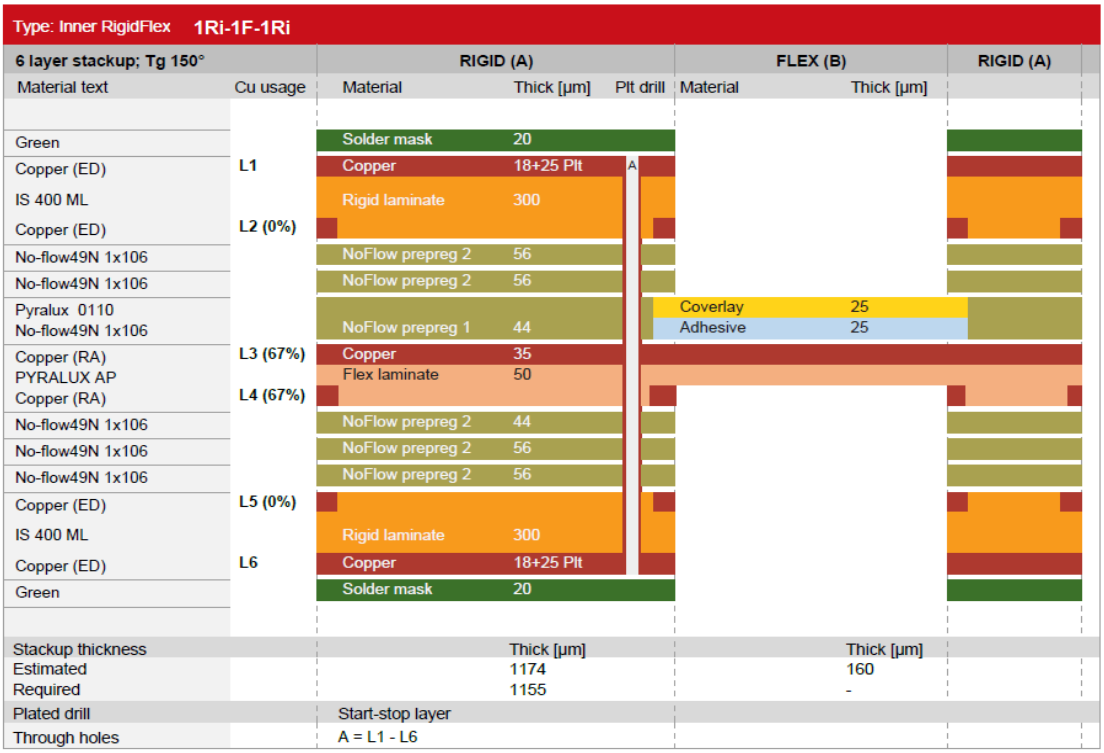
Minimum thickness >= 1,2 mm

Stackup: 1Ri-1F-1Ri

Standard stackup

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

Stackup preview

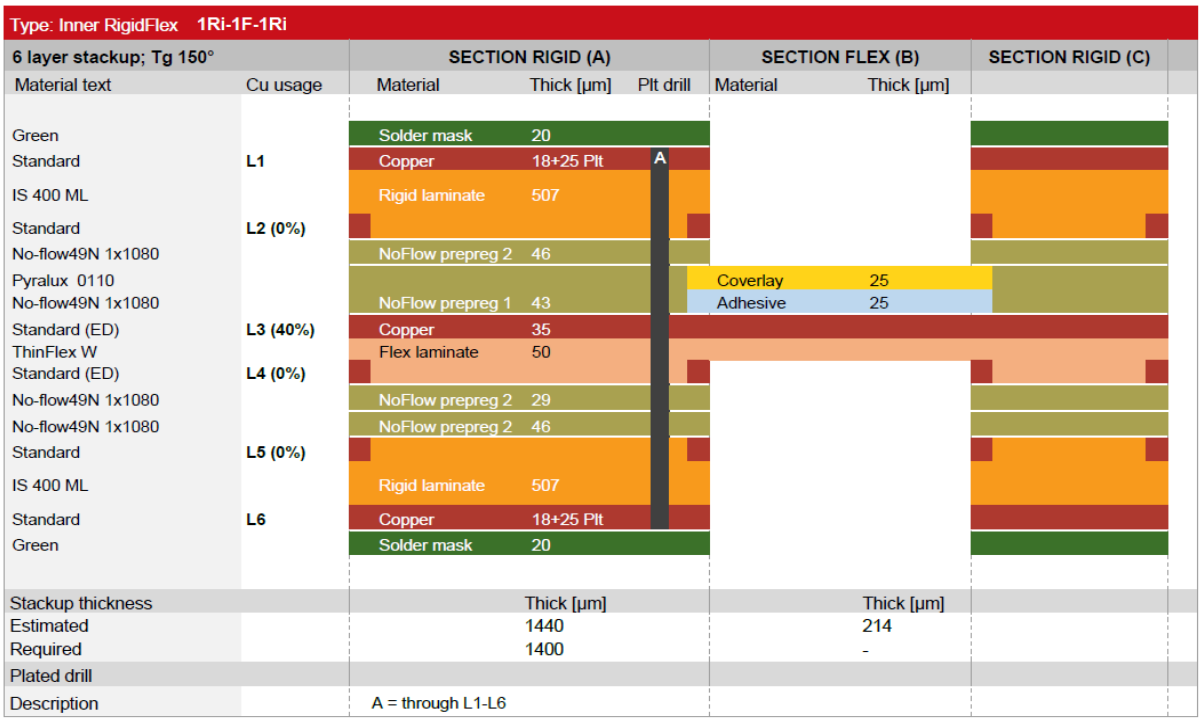


Stackup: 1Ri-1F-1Ri

Standard stackup

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

Stackup preview

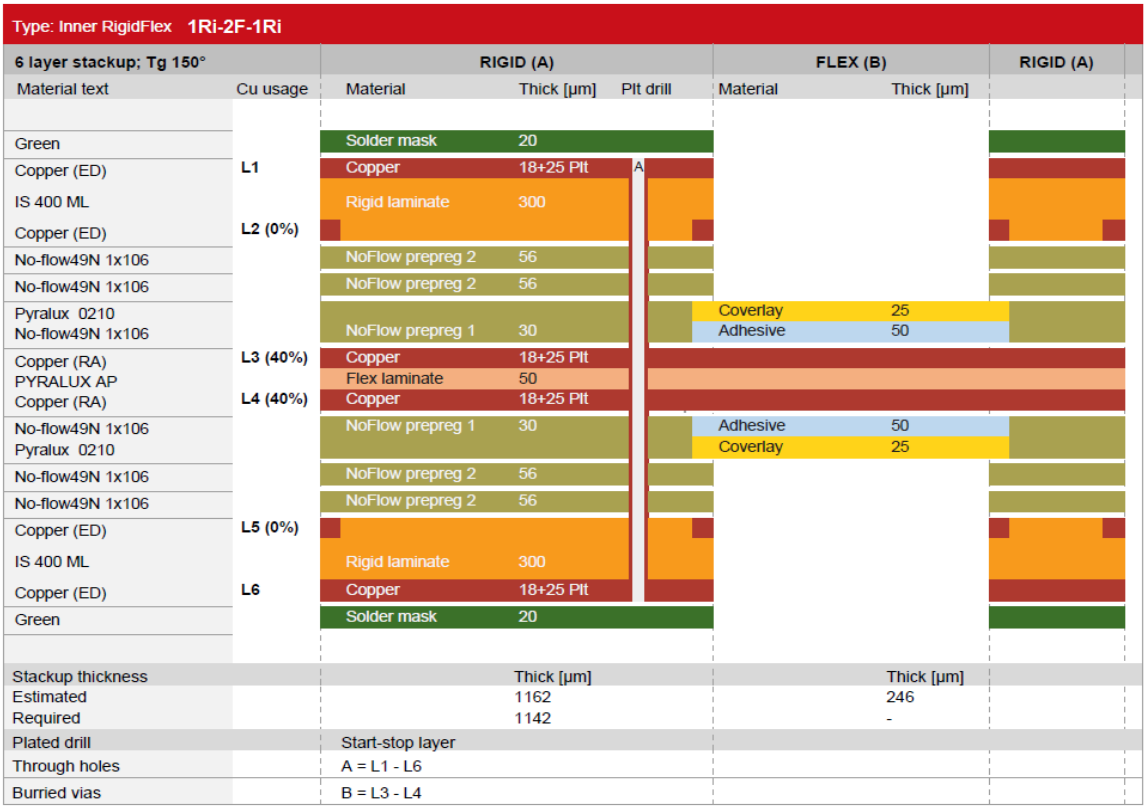


Stackup: 1Ri-2F-1Ri

Standard stackup

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

Stackup preview



Stackup: 2Ri-1F-2Ri

Standard stackup

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

Stackup preview