

# Pure flex PCB

## Design rules and production limits



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## Introduction

### Basic information

#### What is pure flex PCB?


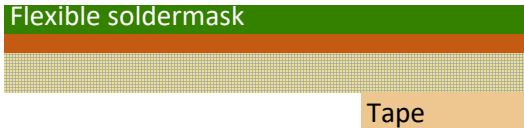
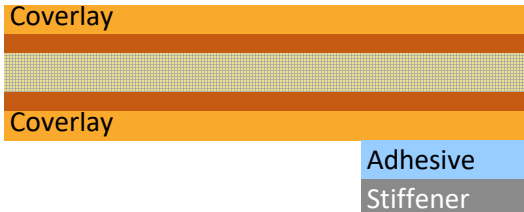
Flexible circuit boards with 1 - 2 copper layers, produced from polyimid material (Pyralux, Thinflex).  
Optional flexible solder mask; coverlay; stiffener or double sided tape.

### Notation code

Flex are described using short code which describe number of copper layers. Optionally presence of stiffener/double sided tape

- **xF + stiffener/tape**  
X ... Number of copper layers on flex core
- Example of our flexi PCB configurations:  
1F ... Single sided flexible PCB  
2F ... Double sided flexible PCB

### Stackup examples

Code	Stackup	Description
1F		Single sided flex with flexible soldermask or coverlay or its combination
1F + tape		Single sided flex with doublesided adhesive tape which customer will remove cover sheet from and stick PCB where is needed
2F + stiffener		Double side flex with FR4 stiffener. There is several option of stiffener materials like laminate, ALU, polyimide.

## Materials

### Basic materials

Brand	Type	PI [µm]	Cu [µm]	Cu type	Adhesive [µm]	TG [°C]	Diel. [kV]	Datasheet
Pyr lux 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
Pyr lux 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>

### Adhesive for stiffeners

Brand	Type	Thickness [µm]	TG [°C]	Datasheet
3M	467MP	50	204	<a href="#">Datasheet</a>
	468MP	130	204	<a href="#">Datasheet</a>
	9077	50	260	<a href="#">Datasheet</a>
Pyr lux LF	LF0100	25	220	<a href="#">Datasheet</a>
	LF0200	50	220	<a href="#">Datasheet</a>

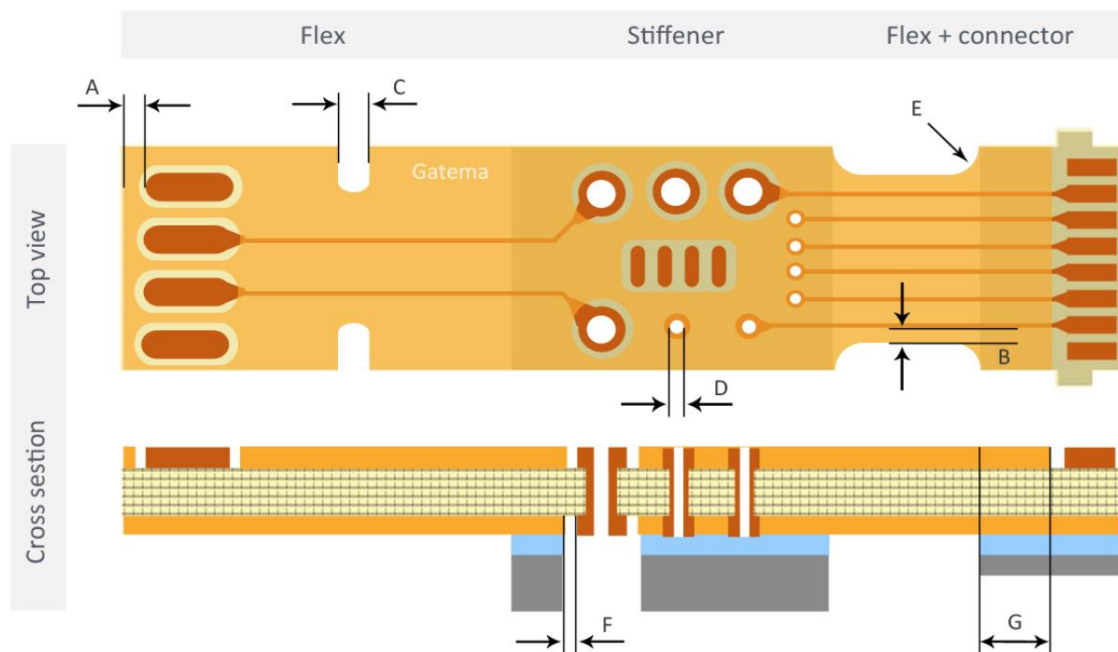
### Stiffener basic material

Material	Brand	Thickness [µm]	TG [°C]	Datasheet
Laminate	Isola FR4	100-1500	150	<a href="#">Datasheet</a>
Polyimide	Pyr lux LF	50 -100	220	<a href="#">Datasheet</a>
Aluminium	Polytherm	1000-2000	-	<a href="#">Datasheet</a>

## Design rules: 1F and 2F

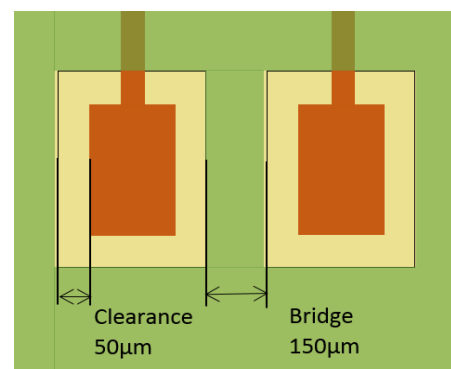
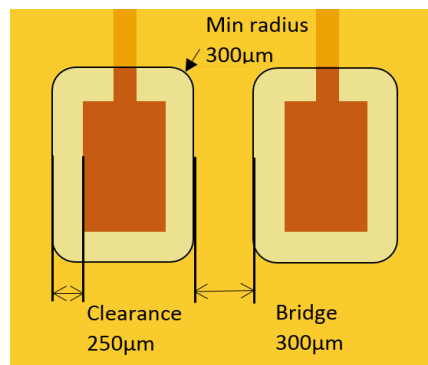
### Basic rules

Legend	Description	Standard	Advanced
A	Exposed Cu to board contour	$\geq 0,3$ mm	
B	Spacing of conductor to board contour	$\geq 0,3$ mm	
C	Countering of flex area	$\geq 1,6$ mm	$\geq 1,0$ mm
D	Minimum via hole diameter	0,150 mm	
E	Min diameter (bigger better for prevent material tearing)	$R \geq 1,5$ mm	
F	Clearance of plated hole pad in stiffener	$\geq 0,25$	
G	Overlap of coverlay (soldermask) with stiffener as prevention from base material crack	$\geq 0,9$ mm	
-	Maximal PCB dimension	275 x 428 mm	



## Design rules: Production limits

Coverlay vs solder mask pad clearance		
Dimension	Polyimid coverlay	Flexible solder mask
Min. bridge	300 $\mu\text{m}$	150 $\mu\text{m}$
Min. clearance	250 $\mu\text{m}$	50 $\mu\text{m}$
Min radius in pad clearance	300 $\mu\text{m}$ (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
xF without coverlay/stiffener	$\geq 10$ mm	$\geq 10$ mm
xF with coverlay/stiffener	$\geq 6,5$ mm	$\geq 2,5$ mm

Other limitations	
Type	Value
Maximal dimension	275 x 428 mm
Min track/isolation	100 $\mu\text{m}$

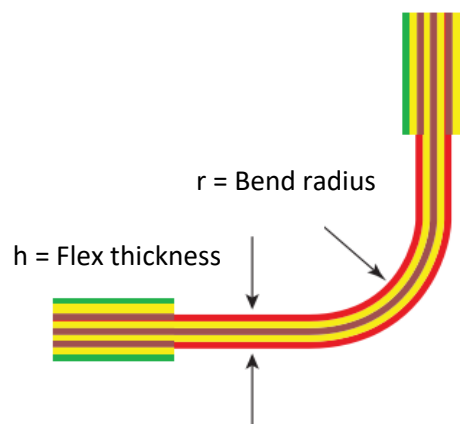
## Design rules: General recommendations

### 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

## Stiffener possibilities

Type and description	Stackup example
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### FR4 + doublesided tape

The most common type. Stiffener is applied on flexible PCB by double sided tape only under the pressure.

- + Cheapest variant
- + Good adhesion

		STIFFENER BOT (B)	
Material text	Cu layer	Material	Thick [µm]
GreenSD2463HF	L1	Flexible mask	20
Copper (RA)		Copper	18+25 Plt
Pyralux AG185018RY	L2	Flex laminate	50
Copper (RA)		Copper	18+25 Plt
GreenSD2463HF		Flexible mask	20
3M 7952MP		Adhesive tape	50
FR4-IS400 0,15mm		Stiffener	150
Stackup thickness			Thick [µm]
Estimated			336
Required			300

### FR4 + adhesive sheet

Stiffener which is applied on flexible PCB by acrylic adhesive under pressure and high temperature

- + Very good adhesion
- + Good thermal resistance

		STIFFENER BOT (B)	
Material text	Cu layer	Material	Thick [µm]
GreenSD2463HF	L1	Flexible mask	20
Copper (RA)		Copper	18+25 Plt
Pyralux AG185018RY	L2	Flex laminate	50
Copper (RA)		Copper	18+25 Plt
GreenSD2463HF		Flexible mask	20
Pyralux LF 0200		Adhesive sheet	50
FR4-IS400 0,15mm		Stiffener	150
Stackup thickness			Thick [µm]
Estimated			336
Required			300

### Polyimide (PI)

Coverlay based stiffener applied by acrylic adhesive under the high temperature and pressure. Possible to combine more coverlays together to achieve required thickness.

- + Very good thermal resistance

		PI STIFFENER BOT (B)	
Material text	Cu layer	Material	Thick [µm]
Copper (RA)	L1	Copper	35+25 Plt
ThinFlex W-2010RD		Flex laminate	50
Copper (RA)	L2	Copper	35+25 Plt
		Adhesive	25
Pyralux LF0110		Coverlay	25
Pyralux LF0220		PI stiffener	100
Pyralux LF0220			100
Stackup thickness			Thick [µm]
Estimated			370
Required			340

### Z-axis routed stiffener

Standard stiffener which thickness is adjusted by z-axis depth routing. Less accurate on final thickness ±15 % (other stiffeners ±10 %)

- + Allow more stiffener thickness from same side of flex PCB

		Z-AXIS ROUT STIFFENER BOT (C)	
Material text	Cu layer	Material	Thick [µm]
Pyralux LF0110	L1	Coverlay	25
		Adhesive	25
Copper (RA)	L1	Copper	35
ThinFlex W-2010RD		Flex laminate	50
3M 7952MP		Adhesive tape	50
FR4-IS400 0,9mm		Stiffener	175
Stackup thickness			Thick [µm]
Estimated			300
Required			300

## Stackup: Double sided tapes

### Stiffener possibilities

Type and description	Stackup example
<b>Tape on flex</b>	

Double sided tape allow to apply flex PCB on variety of materias. Final product is then applied only by pressure in room temperature after removing release foil from tape.

		DOUBLESIDED TAPE BOT (B)	
Material text	Cu layer	Material	Thick [µm]
		Coverlay	25
		Adhesive	25
Copper (RA)	L1	Copper	18+25 Pit
ThinFlex W-2005RD		Flex laminate	50
Copper (RA)	L2	Copper	18+25 Pit
3M 7952MP		Adhesive tape	50
Stackup thickness		Thick [µm]	
Estimated		226	
Required		-	

### Tape on stiffener

Double sided tape is placed not directly on flex material but on stiffener if customer need.

		TAPE ON STIFFENER BOT (C)	
Material text	Cu layer	Material	Thick [µm]
Copper (RA)	L1	Copper	18+25 Pit
Pyralux AP8525R		Flex laminate	50
Copper (RA)	L2	Copper	18+25 Pit
3M 7952MP		Adhesive	50
FR4-IS400 0,2mm		Stiffener	200
3M 7952MP		Adhesive tape	50
Stackup thickness		Thick [µm]	
Estimated		416	
Required		-	



## Stackup: Default stackups

Standard stackup		
Type	1F	2F
	<u>1F + stiffener</u>	<u>2F + stiffener</u>

## Stackup: 1F + stiffener

### Standard stackup

Layer count	Thickness	Code
1	0,125 mm	1F + stiffener

### Stackup preview

Type: Single sided flex (1F); Id:		Date:	
<b>1 layer stackup; Tg 150°</b>		<b>FLEX (A)</b>	
Material text	Cu layer	Material	Thick [µm]
Pyralux LF0110	<b>L1</b>	Coverlay	25
		Adhesive	25
Copper (RA)		Copper	35
ThinFlex W-2010RD		Flex laminate	50
Stackup thickness		Thick [µm]	
Estimated		125	
Required		50	

		<b>STIFFENER BOT (B)</b>	
Material text	Cu layer	Material	Thick [µm]
Pyralux LF0110	<b>L1</b>	Coverlay	25
		Adhesive	25
Copper (RA)		Copper	35
ThinFlex W-2010RD		Flex laminate	50
3M 7952MP		Adhesive	50
FR4-IS400 0,9mm		Stiffener	900
Stackup thickness		Thick [µm]	
Estimated		1055	
Required		1000	

## Stackup: 2F + stiffener

### Standard stackup

Layer count	Thickness	Code
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2	0,156 mm	2F + stiffener
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### Stackup preview

Type: Double sided flex (2F); Id:		Date:		
<b>2 layer stackup; Tg 150°</b>		<b>FLEX (A)</b>		
Material text	Cu layer	Material	Thick [µm]	Plt drill
GreenSD2463HF		Flexible mask	20	
Copper (RA)	<b>L1</b>	Copper	18+25 Plt	A
Pyralux AP8525R		Flex laminate	50	
Copper (RA)	<b>L2</b>	Copper	18+25 Plt	
GreenSD2463HF		Flexible mask	20	
Stackup thickness		Thick [µm]		
Estimated		156		
Required		50		
Plated drill		Start-stop layer		
Through holes		A = L1 - L2		

		<b>STIFFENER BOT (B)</b>	
Material text	Cu layer	Material	Thick [µm]
GreenSD2463HF		Flexible mask	20
Copper (RA)	<b>L1</b>	Copper	18+25 Plt
Pyralux AP8525R		Flex laminate	50
Copper (RA)	<b>L2</b>	Copper	18+25 Plt
GreenSD2463HF		Flexible mask	20
3M 7952MP		Adhesive	50
FR4-IS400 0,15mm		Stiffener	150
Stackup thickness		Thick [µm]	
Estimated		336	
Required		300	