



ENGINEERED TECHNOLOGIES

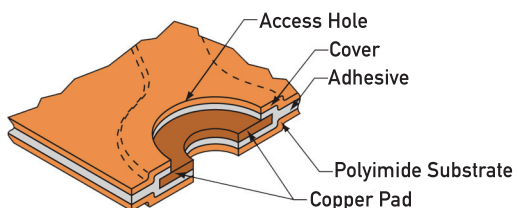
▶ YOUR LEADING PROVIDER OF HIGH QUALITY FLEX & RIGID-FLEX CIRCUITS

▶ SUPERIOR PACKAGING OPTIONS

Flex circuits can be shaped to fit where no other design can. They are a hybrid of ordinary printed circuit boards and round wire, exhibiting benefits of each. In essence, flex circuits give you unlimited freedom of packaging geometry while retaining the precision density and repeatability of printed circuits.

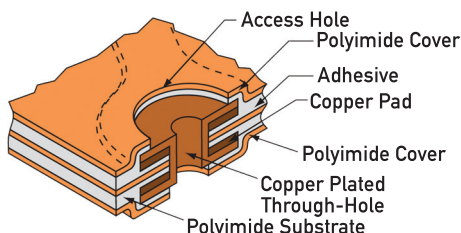
Epec has over 52 years of experience in building Printed Circuit Boards. Let our expertise in engineering and manufacturing assist you in meeting your Flexible Circuit Board needs.

▶ TYPES OF FLEX CIRCUITS



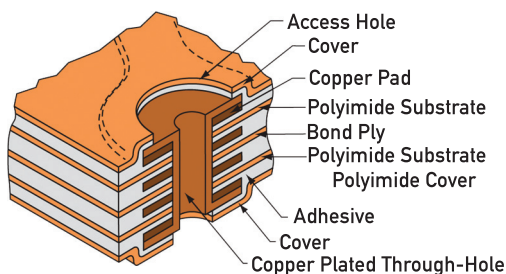
Single-Layer

- IPC 6013 - Type 1
- One conductive layer either bonded between two insulating layers or uncovered on one side.
- Stiffeners, pins, connectors, components, are optional.



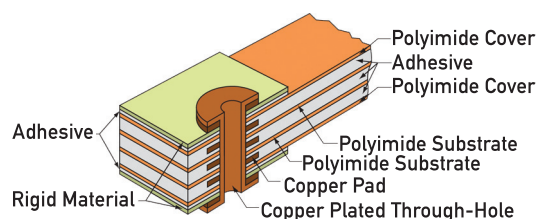
Double-Sided

- IPC 6013, - Type 2
- Two conductive layers with an insulating layer between; outer layers may have covers or exposed pads.
- Plated through-holes provide connection between layers.
- Stiffeners, pins, connectors, components are optional.



Multi-Layer

- IPC 6013 - Type 3
- Three or more flexible conductive layers with flexible insulating layers between each one; outer layers may have covers or exposed pads.
- Plated through-holes provide connection between layers.
- Controlled impedance possible.



Rigid-Flex

- IPC 6013 - Type 4
- Two or more conductive layers with either flexible or rigid insulation material as insulators between each one; outer layers may have covers or exposed pads.
- Rigid-flex has conductors on the rigid layers, which differentiates it from multi-layer circuits with stiffeners. Plated through-holes extend through both rigid and flexible layers (with the exception of blind and buried vias). Rigid-flex costs more than a standard circuit with stiffeners.

▶ STANDARD MANUFACTURING CAPABILITIES

Circuit Constructions:

- Single-Sided
- Double-Sided
- Multi-Layer
- Rigid-Flex



Circuit Sizes:

- Single-Sided:
up to 22" by 28"
(558.8mm by 711.2mm)
- Double-Sided:
up to 16" by 22"
(406.4mm by 558.8mm)

Multi-Layer:

12" by 24" (304.8mm by 609.6mm)

Drill Position:

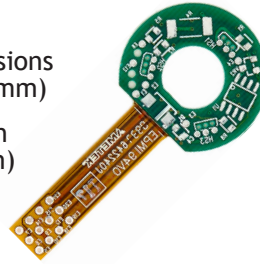
Tolerance of +/- .003" (.076mm)

Line Width and Spacing:

.005" (.125mm) Minimum Line
.005" (.125mm) Minimum Spacing

Circuit/Blanking Considerations:

- Soft Tooling:
Outline dimensions
+/- .05" (.127mm)
Radius of inside corners
minimum of .032" (.081mm)
Edge insulation
.010" min (.254mm)
- Hard Tooling
Outline dimensions
+/- .001" (.0254mm)
Edge insulation
.006" min (.152mm)
- Laser Cut
Outline dimensions
+/- .003" (.25mm)
Edge insulation
.004" (.102mm)



Hole Size:

- Non-Plated
(Standard Processing)
- Thru Holes:
.005" (.125mm) min. drilled
hole size.
Tolerance +/- .0015" (.038mm)
- Plated Thru Hole:
.005" (.125mm) min. drilled
hole size.
Tolerance +/- .003" (.076mm)

Added Value Capabilities

- Surface Mount Components
up to 0204
- RoHS Compliant Assembly
- Precision Stenciling
- Heat Sinks
- Electrical Testing
- Thru Hole Assembly

▶ STANDARD MATERIALS

Base Materials:

- Polyimide:
.5 mil to 5 mils
(.012mm - .127mm)
- Polyester:
2 mil to 15 mils
(.050mm - .127mm)
- Adhesiveless Materials:
Copper thickness
.5 oz. to 2 oz.
- Flame Retardant:
Laminates and Coverlay



Base Copper:

.5 oz. - .0007" (.018mm)
thick copper
1 oz. - .0014" (.036mm)
thick copper
2 oz. - .0028" (.071mm)
thick copper
3 oz. - .0042" (.107mm)
thick copper
4 oz. - .0056" (.142mm)
thick copper

Solder Mask:

- Polyimide Coverlay:
.5 mil to 5 mils
(.012mm - .127mm)
- Polyester Coverlay:
1.5 mil to 3 mils
(.076mm - .228mm)
- Photo-imageable
Covercoat:
Liquid for Surface Mount
and dense applications

Surface Finish:

- Hot Air Solder Level (HASL)
- Tin Plating
(RoHS Compliant)
Electroless and Electrolytic
- Silver (RoHS Compliant)
Immersion
- ENIG (Electroless Nickel
Immersion Gold) (RoHS
Compliant)
- Organic Coating
OSP (RoHS Compliant)

Added Value Capabilities

- FR4-drilled,
routed and scored
- Aluminum
- Polyimide
- Polyester

Certifications:

- ISO 9001: 2000 Certified
- QS 9000 Compliant
- RoHS Compliant
- IPC MEMBER:
Product is manufactured
in accordance with the
requirements of IPC-6013
- UL certified



▶ ADDITIONAL TECHNICAL INFORMATION

TYPICAL PROPERTIES OF DIELECTRIC MATERIAL FOR FLEXIBLE PRINTED CIRCUITRY

PROPERTY (TYPICAL)	UNITS	POLYIMIDE	POLYIMIDE (Adhesiveless)	POLYESTER
REPRESENTATIVE TRADE NAME		KAPTON	KAPTON	MYLAR
PHYSICAL				
Thickness Range	mil	0.5 to 5	1-6	2-5
Tensile Strength (@25° C)	psi	25,000	50,000	20,000 to 35,000
Break Elongation	%	70	50	60 to 165
Tensile Modulus (@25° C)	100,000 psi	4.3	.7	5
Tear Initiation Strength	lb/in	1000	700-1200	1000 to 1500
Tear Propagation Strength	g/mil	8	20	12 to 25
CHEMICAL				
Resistance to:				
Strong Acids		Good	Good	Good
Strong Alkalis		Poor	Good	Poor
Grease and Oil		Good	Good	Good
Organic Solvents		Good	Good	Good
Water		Good	Good	Good
Sunlight		Good	Good	Fair
Fungus		Non-nutrient	Non-nutrient	Non-nutrient
Water Absorption (ASTM D570)	% (24 hours)	2.9	.8	<0.8
THERMAL				
Service Temperature (min/max)	degree C	-125/+200	-125/+200	-60/+105
Coefficient of Thermal Expansion (@22° C)	PPM/degree C	20	20	27
Change in Linear Dimensions (100° C, 30 min)	%	<0.3	0.04-0.02	<0.5
ELECTRICAL				
DIELECTRIC CONSTANT (ASTM D150) 1MHz		3.4	3.4	3
DISSIPATION FACTOR (ASTM D150) 1MHz		0.01	.003	0.018
DIELECTRIC STRENGTH (ASTM D149) @ 1 mil thickness	V/mil	6000	6000	3400
Volume Resistivity (ASTM D257)	ohm-cm	1.0E+16	1.0E+16	1.0E+16

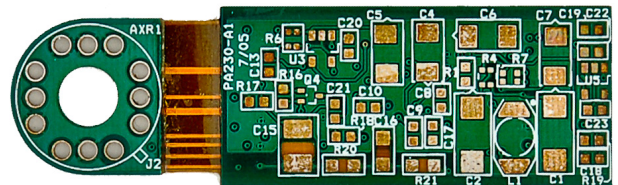
▶ STIFFENERS

Stiffeners are typically used to reinforce selective areas of flexible circuitry for component support, durability and mounting. They can also be used for strain relief and heat dissipation. Bonding materials include pressure sensitive adhesive (PSA), Temperature sensitive adhesive (TSA), and glass reinforced low flow prepreg.

Stiffener Materials:

- Unclad Epoxy / Polyimide
- Aluminum / Stainless Steel Kapton

Stiffener thickness is determined by your actual needs. Typical stiffeners thickness' range from .005" to .125".



▶ IMPEDANCE

Impedance is the single most important transmission line property used to determine the performance of a high-speed circuit. Impedance can be controlled with several different configurations including Characteristic, Differential, and Coplanar models.

▶ ADDITIONAL TECHNICAL INFORMATION

IPC Information

The following list contains the IPC specifications that you can reference in regards to specific materials, design, performance and assembly questions.

Performance

- IPC-6011
Generic Performance Specifications for Printed Circuits
- IPC-6012
Qualification and Performance for Rigid Circuit Boards
- IPC-6013
Qualification and Performance for Flexible Circuits

Design

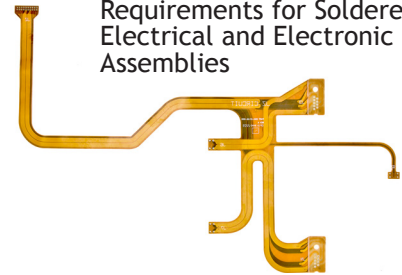
- IPC-FC-2221
Generic Standard on Printed Circuit board Design
- IPC-FC-2222
Rigid Circuit Boards
- IPC-FC-2223
Flexible Circuits

Materials

- IPC-4202
Flexible Base Dielectrics
- IPC-4203
Adhesive Coated Dielectric Films
- IPC-4204
Flexible Metal-Clad Dielectrics

Circuits and Assembly (Quality Guidelines)

- IPC-A-600
Acceptability of Printed Boards
- IPC-A-610
Acceptability of Printed Board Assemblies
- IPC/EIA J-STD001
Requirements for Soldered Electrical and Electronic Assemblies



▶ DOCUMENTATION REQUIREMENTS

1. The FPCB shall be fabricated to IPC-6013, class (your requirement here) standards.
2. The FPCB shall be constructed to meet a minimum flammability rating of V-0 (if required).
3. The FPCB shall be RoHS compliant (if required).
4. The rigid material shall be GFN per IPC-4101-24 (if using epoxy materials).
5. The flexible copper clad materials shall be IPC 4204/11 (flexible adhesiveless copper clad dielectric material).
6. The covercoat material shall be per IPC 4203/1.
7. The maximum board thickness shall not exceed (your requirement here) and applies after all lamination and plating processes. This is measured over finished plated surfaces.
8. The thickness of acrylic adhesive through the rigid portion of the panel shall not exceed 10% of the overall construction.
9. The flexible section thickness shall be (your requirement here, do not add this note if this thickness is not critical).
10. Minimum copper wall thickness of plated through holes to be (your requirement here) { .001" average is recommended } with a minimum annular ring of (your requirement here) (.002" is recommended)
11. Apply green LPI soldermask (if required) over bare copper on both sides, in the rigid sections only, of the board. All exposed metal will be (your surface finish requirement here).
12. Silkscreen both sides of the board (if required) using white or yellow (most common) non-conductive epoxy here.
13. Your electrical test requirements.
14. A drill chart is required. This chart depicts your finished hole sizes, associated hole size tolerance and indicates if the hole is to be plated thru or non-plated. A finished hole size of +/- .003" is typical.
15. A dimensional drawing is required. All critical dimensions must be noted and the rigid to flex interfaces (this is where the rigid material stops and the flexible material begin) must be defined. Typical outline tolerances are +/- .010".
16. A board construction and layer order is also required. This should show which layers are rigid materials and which layers are flexible material including copper weights.

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