Your Doorway to Innovation

San Francisco Circuits, Inc.

Bridging Concepts with Reality
Introduction to Flex Circuits
What is Flex Circuits?

- From Wikipedia - a technology for assembling electronic circuits by mounting electronic devices on flexible high-performance plastic substrates, such as Polyimide.

  a) electronic circuits - a closed path formed by the interconnection of electronic components through which an electric current can flow.
  b) Polyimide - (sometimes abbreviated PI) is a polymer of imide monomers.
  c) Monomers - is a small molecule that may become chemically bonded to other monomers to form a polymer.

- Flex Circuits - a printed circuit pattern using a layer of copper foil over a polymer base (Polyimide). Polymer material (Coverlay) is also used as the insulator for the exposed circuit pattern.

  a) Coverlay - Kapton film coated on one side with a proprietary B-staged modified acrylic adhesive.
  b) Kapton - a polyimide film developed by DuPont.
What is Flex Circuits used for?

Replacing conventional wiring, cut assembly costs, packaging solutions, high temperatures, space and weight.

Defense, Aerospace, Medical, High-Reliability Industrial, Communications, Commercial, Automotive, etc.
• **FRclad - (Acrylic adhesive)** DuPont Kapton® polyimide film with copper foil on one or both sides. UL approved with a Part Temperature: 182–199°C (360–390°F).

• **LFclad - (Acrylic adhesive)** DuPont Kapton® polyimide film with copper foil on one or both sides. **Not** UL approved with a Part Temperature: 182–199°C (360–390°F).

• **APclad - (Adhesiveless)** Pyralux® AP double-sided, copper-clad laminate is an all-polyimide composite of polyimide film bonded to copper foil. UL 94V-0, UL 796, 180°C (356°F) max. operating temperature.
• **FRcoverlay - (Acrylic adhesive)** Pyralux® FR™ coverlay is a composite of DuPont Kapton® polyimide film, coated on one side with a proprietary, flame retardant B-staged acrylic adhesive. Coverlay can be used to encapsulate etched details in flexible and rigid-flex multi-layer constructions (eight conductive layers or less) for environmental protection and electrical insulation. UL approved with a Part Temperature: 182–199°C (360–390°F).

• **LFcoverlay - (Acrylic adhesive)** Pyralux® coverlay composites are constructed of DuPont Kapton® polyimide film, coated on one side with a proprietary B-staged modified acrylic adhesive. Coverlay is used to encapsulate etched details in flexible and rigid-flex multilayer constructions for environmental and electrical insulation. **Not** UL approved with a Part Temperature: 182–199°C (360–390°F).
• **FRadhesive - (Acrylic adhesive)** Pyralux® FR sheet adhesive is a proprietary, flame-retardant, B-staged modified acrylic adhesive.


• **FRbonply – DuPont Kapton® polyimide film, coated on both sides with a proprietary, flame-retardant, B-staged acrylic adhesive. UL approved with a Part Temperature: 182–199°C (360–390°F).**

• **LFbonply - DuPont Kapton® polyimide film coated on both sides with a proprietary B-staged modified acrylic adhesive. Not UL approved with a Part Temperature: 182–199°C (360–390°F).**
Rigid to Flex Material Comparison

1. Based Materials: FR4, Nelco, Getek, Polyimide, etc.
2. Soldermask: Polymer, Green, Blue, Red, Black.
3. Pre-Preg: Woven glass with resin

2. Coverlay: FRcoverlay, LFcoverlay.
3. Bonply: FRbonply, LFbonply
Folding & Bending

- One of the inherent characteristics of Flexible Circuitry is its ability to be folded and bend for certain applications.
- Care must be taken during the design stage to ensure proper material selection and conductor placement. The formability of flexible circuit is dependent to a certain degree on the thickness and the ductility of the copper as well as insulating material used.
- The suggested mandrel size for single and double sided flexible circuits is 12X the total Ply thickness, reduced to the nearest 1/8 inch (0.125)
- Bend radii should always be kept as large as possible to prevent damage to the circuitry.
- The minimum suggested bend radius for Single and Double sided flexible circuits should be 6-10 times the circuit thickness.
- For Multi-layer Flex and Rigid-Flex the minimum suggested bend radius is to 10-15 times the overall thickness in the areas to be bend or formed.
Q: We design many PCBs, but we have never attempted a Flex Circuit. Are there many
differences and can we get help with the design?
A: Flex Circuits can be designed in much the same way as PCBs, but there are some
critical differences to which the designer must have an appreciation.
Q: I have heard that Flex Circuits are much more expensive than PCBs?
A: The raw materials used to make Flex Circuits are - per square foot - more expensive than the
same materials used to make PCBs.
Q: I just need a small prototype run to get started. What are you minimum lot charges and tooling
and test charges?
A: These charges can vary significantly depending upon product complexity and size.
Q: How long will it take to make my Flex Circuits? Can I get them as quickly as PCBs?
A: As with minimum lot charges this can also vary depending on complexity and part size.
Q: Can I solder components to a Flex Circuits?
A: Electronic components (through hole and SMT) can be soldered to Flex Circuits in much the
same way as PCBs