

Using Flexible Circuits as an Electronic Interconnection...Do's and Don'ts

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Summary: Flexible Circuits are proven, reliable interconnect solutions for many of today's electronic packages. This article gives some general guidelines in terms of "dos" and "don'ts" that will help the engineer or designer make better decisions when using flexible circuitry as an electronic interconnect.

Flexible Printed Circuits have become standard fare in many of today's electronic products. The continuing demand for smaller, lighter, and more functional fits well with what flexible circuits provide. Wikipedia has a nice definition of when a flexible printed circuit (FPC) might be used as follows:

- Tightly assembled electronic packages, where electrical connections are required in 3 axes, such as cameras_(static application).
- Electrical connections where the assembly is required to flex during its normal use, such as folding cell phones (dynamic application).
- Electrical connections between sub-assemblies to replace wire harnesses, which are heavier and bulkier, such as in cars, rockets and satellites.
- Electrical connections where board thickness or space constraints are driving factors.

There are some basic rules to follow if you are thinking about using flexible circuitry as the interconnect medium in an application. The list below was prepared as a general guideline for a designer or engineer considering adoption of FPC.

Do...

Do some basic research on the technology, terms, and processes used to produce FPC.

You don't need to become an expert, but there are many terms used in the industry that are unique to the technology. Most suppliers have a downloadable design guide that can serve as a reference document and a good starting point. The IPC also has a good glossary (see *"Terms and Definitions for Interconnecting and Packaging Electronic Circuits" IPC-T-50 Rev. H*). Words like soldermask, coverlay and coverfilm might be used differently or interchangeably among various suppliers so having some basic technical knowledge will help avoid confusion. Good communication and understanding will result in a good design.

Work with an experienced supplier.

Find a company that has been in the industry for several years. Have they been successful and grown their business? Is there a management team in place that has considerable industry experience? How experienced is their engineering and manufacturing team?

Then investigate what type of product niche they supply. If you are designing a rigid-flex circuit, does the supplier have considerable background with this technology? What about fine line? If you require component assembly, do they have a broadly developed assembly capability?

Follow design input from the supplier (Incorporate design features from flexible circuit design guideline).

There are features to be incorporated into a flexible circuit for enhanced reliability and manufacturability. Sharp turns in conductors create stress points vs. blending and making a radiused turn. Broken traces at solder joints are one of the most common flex problems and this issue can be mitigated during the design phase. Filleting the intersection point between a trace and a pad tends to distribute stresses that might occur when the circuit is bent. Many suppliers offer this "flexizing" of the design as a service provided when the circuitry is prepared prior to panelization.

Develop a technical contact at your supplier.

Communication with a contact that can explain the processes, materials, design guidelines and cost implications will make the project more likely to succeed and improve the experience. It may also help the designer develop as an internal expert within their company. At the same time, personal relationships get both parties invested in the success of a program.

Talk to other customers that have had a relationship with your prospective vendor.

A little due diligence on the front end is always a good idea. Ask for customer references. Talking to a few previous customers can quickly confirm a positive (or negative) relationship has occurred. Even in this age of internet and electronic communication, word of mouth is still a pretty important step in getting new customers.

Don't...

Don't assume rigid PCB's and flexible PCB's should follow the same design rules.

Most of the CAD software available for printed circuit designs was developed for rigid PCB's. As such, rounded corners, filleted pad intersections, and tear stops are not a consideration. Incorporating these features into a flexible circuit can be a critical step in assuring reliability.

Don't consider the product a commodity that can be purchased anywhere.

Flexible printed circuits are custom engineered parts. They are unique in features and in the way they perform across a wide variety of applications. Getting a quotation from multiple suppliers is probably a good first step but going with the lowest price isn't always the best idea. Did I mention due diligence?

Don't wait until the project timeline is so compressed your only option is a premium price for quick turn parts.

Consider the flexible circuit early in the design cycle. This will allow time to take advantage of the supplier's expertise and incorporate reliability and/or cost saving ideas. If the timeframe is so compressed a quick-turn order is required, the overarching concern is time. In this situation there is too little consideration for preparing a project for the long term.

Don't believe buying parts overseas is always less expensive...even if the price is lower.

Total cost of ownership includes technical support, good communication, getting a project launched on-time, and avoiding "do-overs". There are several capable and reliable suppliers producing flexible circuits in the United States. Some of these are highly automated and compete with the highest volume and lowest cost producers in the world. Cell phones, cameras and automobiles are examples. Other suppliers focus on low to medium volume with high mix. These companies are located in the United States and they work during the same hours as the engineering community in North America!

Don't assume flexible means indestructible.

Flexible circuits have been designed to operate in dynamic flex applications with flex life requirements exceeding millions of cycles. Material types, thicknesses, and construction layout are critical to achieve this performance. But mechanical strains through abrasion, twisting, or an inappropriate bend radius can cause premature failure. It gets back to early involvement with the supplier's application engineering team, sharing information about the particulars of the application, and designing a circuit with long term reliability considerations.

There are no startling revelations here, but the above list should provide a good start when adopting flexible circuits as an electronic interconnect technology.

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Dave Becker Bio-

Dave Becker is the V.P. of Sales and Marketing at All Flex Flexible Circuits. Dave has been in the flex circuit industry for the past 32 years with a variety of positions in Quality Engineering, Product Management, and Sales Management. Dave has authored several technical articles on flexible circuitry design, manufacturing, and new product introduction processes. All Flex Flexible Circuits specializes in low to medium volume flexible circuits and flex circuit assembly. Their featured products include Flexible Heater Circuits and Maxi-Flex.