Registering High-End Rigid-Flex Multilayers for Lamination
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Selecting a Flexible Circuit Supplier

by Dave Becker
ALL FLEX FLEXIBLE CIRCUITS AND HEATERS

The selection of a flexible circuit supplier is a multidimensional decision. An Internet search produces a long list of suppliers capable of building a wide range of products. If you can believe what you read on the Internet, there are very few suppliers unable to support any technology (single-sided to 30+ layer rigid-flex) and volume (prototype to serial production). And if you believe everything you read on the Internet, call me directly, as my uncle in Nigeria has some money that he needs help transferring to a U.S. bank account.

Since all flex circuits are custom designed and manufactured, a more thorough review of a supplier’s capabilities and specialties is critical for the specifics of an individual design. Everyone is not good at everything. Significant characteristics that help distinguish from among the myriad of flex circuit suppliers include the following.

Volume Capabilities
Most suppliers claim a wide range of volume capabilities, but what does “high volume” mean in this manufacturing world? Flex circuit suppliers build product using either a panel process or a continuous reel process. Reel-to-reel processing is used extensively to manufacture high volumes of cell phone, camera, and automotive applications. Most of these suppliers are located in Asia, but Multek Flexible Circuits remains a U.S.-based, high-volume supplier capable of competing with the cost pressures of these markets. Extensive reel-to-reel processing provides parts with little direct labor cost and the ability to produce in quantities exceeding millions of parts. Other flex circuit suppliers provide high-volume parts by acting as brokers (i.e., working with an overseas fabricator and
acting as the middleman in the supply chain. As independent agents, these companies often take responsibility for product logistics, transit, quality, and provide domestic applications engineering support.

Panel processing is generally a lower-volume option; however, it does mimic the processing used by high-volume rigid PCB suppliers. Unit volume capacity is highly dependent on circuit size so capacity expressed in quantity of units can be misleading. A more meaningful measure is number of panels processed per day/week/month. Circuit board panel fabrication generally follows a sequential flow through multiple pieces of process equipment. Complex part numbers may require 40+ process steps as panel processes include chemical cleaning, imaging, developing, copper plating, etching, automated optical inspection, platen pressing, plasma cleaning and surface treatment finish, to mention a few. Actual capacity within a given factory is mostly driven by the number of panels possible through a piece of bottleneck equipment, so many shops manage their factory flow with a “theory of constraints” manufacturing philosophy.

**Vertical Integration**

Building a flexible circuit is usually not the extent of a customer’s requirements. Design and assembly services may also be required, and these are often provided by the flex circuit supplier. Under the umbrella of “design” is a wide range of services. Many flex circuit suppliers are able to provide a
completed design (CAD files and drawing) if they are provided with a schematic or netlist and the mechanical outline. Reverse engineering a circuit from a sample part or photograph is also possible. One big advantage of having a design created by the fabrication shop is that DFM is an obvious upfront consideration. The opportunity to minimize and eliminate costs can be carefully considered when the design is embryonic. Fabrication yield is always a significant cost driver, so many suppliers “flexize” the artwork patterns to incorporate manufacturability and reliability features such as optimized line widths, enlarged copper via pads, filleted intersections between traces and pads, and rounded traces through curved circuit features. At a minimum, getting early input from a fabrication shop is highly recommended.

Many circuit shops have further integrated vertically by providing assembly services. Most flex circuit applications require some added value ranging from wire assembly and through-hole connector soldering to multiple components attached with automated SMT equipment. Most flex circuit suppliers offer some level of value-added assembly as their customer base continues to express a desire for a shorter supply chain. As products move into higher volumes and/or require more sophisticated assembly, contract manufacturers with these specialized capabilities look increasingly tempting.

HDI

With the constant pressure for miniaturization of electronic products, conductor traces and plated through-holes have become extremely small, with tight manufacturing tolerances. Conductor widths are often reduced to .003" or smaller, and .001" microvias formed with lasers are becoming more common. Specialized high-resolution imaging equipment and microvia formation capability are needed to produce these features. Equally important is process control over the multiple pieces of equipment (developing, etching, resist stripping, and plating) also used to build fine-featured circuits at a high yield.

Suppliers that build these products will generally require additional engineering support and more sophisticated equipment. In the U.S., these companies often support development projects for products that are eventually sourced overseas as volumes ramp. Another example of parts produced with this technology is hearing aid circuits, where pricing based on square inches of area is meaningless.

Quick-Turn Capability

Standard lead times for flex circuits vary considerably among fabricators, with a typical standard delivery offer of a few weeks. This can vary substantially depending on product complexity and may also be paced by the availability of components when assembly is included. Other flex makers specialize in producing parts with highly compressed cycle times and are able to deliver products with lead times of a few days. A portion of this market demand is supported by companies specifically focusing on quick-turn as a manufacturing niche. It is also true that most “standard delivery” suppliers reserve some portion of their capacity for expedited deliveries of low volumes at a premium price. Willingness to support a quick-turn request is often determined by the availability of factory capacity at a given time.

Certifications and Systems

Quality system certifications and registrations are requirements for some applications. The most common of these are:
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ITAR

International Traffic in Arms Regulations is a set of U.S. government regulations controlling defense-related products. ITAR requires defense-related information to be controlled by U.S. citizens. Customers and suppliers can face fines if they provide non-U.S. citizens with access to information protected under an ITAR contract. A flex circuit supplier's registration with the U.S. Defense Trade Controls Compliance Division is required.

ISO 9001

The ISO 9000 family of standards is intended to ensure a certified quality management system is in place, and it is designed to help organizations ensure they meet the needs of customers and regulatory requirements related to their product. ISO 9000 deals with the fundamentals of quality management systems and details certification requirements. Third-party certification bodies provide independent confirmation companies are meeting ISO 9001 requirements.

AS 9100

AS9100 is another standardized quality management system, and in this case, specifically designed for the requirements of the aerospace industry. Aerospace manufacturers and suppliers worldwide require compliance and/or registration to AS9100 as a condition of doing business.

Mil-P-50884, MIL-PRF-31032, and IPC-6013

These quality assurance requirement documents are frequently specified by the government for military applications. The two military specifications require building coupons of generic product samples that are submitted to an independent lab for test and product qualification. This certifies that a supplier is eligible to bid on programs requiring these specifications. In addition, end-product quality requirements are defined with frequencies specified for some in-process tests. In an attempt to combine military and commercial program requirements, government and industry representatives have written and widely adopted IPC-6013. Many applications now specify the IPC document as a quality standard, with IPC Class 3 products defining quality requirements intended for high-reliability applications.

Summary

The products and capabilities offered by flex circuit suppliers vary considerably. Fortunately for the U.S. electronics industry, there is a good selection of domestic suppliers available...no need to schedule work in an Asian time zone or learn Mandarin. These criteria should help determine some of the questions to be asked when considering sourcing a new part number. The Internet can help as an initial filter, but you should then spend some time talking to applications engineers with a couple of potential suppliers. It does take a little due diligence, but matching the proper source with a new application will save headaches in the future.

Dave Becker is vice president of sales and marketing at All Flex Flexible Circuits and Heaters.

Key Surface Properties of Complex Oxide Films

Better batteries, catalysts, electronic information storage and processing devices are among the benefits of a discovery made by Oak Ridge National Laboratory scientists.

The findings, published in Nanoscale, showed that key surface properties of complex oxide films are unaffected by reduced levels of oxygen during fabrication—with implications for the design of functional complex oxides used in a variety of consumer products, said Zheng Gai, a member of DOE’s Center for Nanoscale Materials Sciences at ORNL.

“With these materials being a promising alternative to silicon or graphene in electronic devices, the ever-decreasing size of such components makes their surface properties increasingly important to understand and control,” Gai said.