



## ELECTRONIC MFG. SERVICES (EMS)

# At PFC Flex Is King

By Steve Kelly, President, PFC Flexible Circuits Ltd, Scarborough, ON, Canada

Flexible printed circuits represent one of the fastest-growing segments of today's electronics manufacturing industry. Today's sophisticated packaging requirements require complex electrical and mechanical interfaces. Flexible Printed Circuits provide a preferred electrical connection while simplifying the ever-increasing mechanical challenges. Miniaturization is continuing to demand increased performance of each component. Few products other than Flexible Printed Circuits can provide mechanical and electrical interfaces in a cost-effective solution within small packages. The application and configurations using Flexible Printed Circuits are limited only by the designer's innovation. But for flex circuits to perform the way their designers intend, means a total design and manufacturing package — from the ground up — a package that includes not only the flex substrate and its circuits, but virtually every minuscule component that is attached to it.

Flexible printed Circuit assembly is much different than assembling a printed circuit board. PFC has developed unique processes over the last 13 years that make the assembly process predictable. Starting with circuit design, materials, panel layout, temperatures, component placement requirements and oven flow — all are critical factors in creating an assembly that works the first time.

### Cost of Ownership

When analyzing the commercial aspects of having a flex designed, a flex built, and a flex assembled — and using two to three different subcontractors — there are many hidden costs to consider. Handling issues, logistic management, component mark-ups, lead time considerations, shipping costs and miscommunication all must be factored into deciding how to get a flex delivered in a cost-effective manner.

Technically, material considerations, temperature variances, assembly techniques, component tolerances, test parameters and overall ownership of the design and product can create havoc for any company looking for an electronic interconnect device. PFC provides an overall lower cost of ownership and ultimately "Flexcertainty" by providing all services under one roof.

### Design to Deliver

There is always the potential for improvement in the process of product development and eventually the time to market. As a manufacturer of flexible circuits, PFC actively advocates that customers and prospects utilize the company's expertise in the early stages of development to assist in cre-

ating a buildable, producible, and repeatable solution. The upfront assistance saves the customer both time and money in the long run. We call this concept "design to deliver".

Understanding the application is key to a solid design. Interconnect parameters, mechanical considerations, product environments, signal speeds, and shielding are key to design and cost parameters. Early involvement and documenting of multiple options along with their advantages and weakness is critical to prevent wasted time and costly choices which are often not the best practice or best fit for the fabrication or the end application.

Costing can be started at the concept stage and can also be a measure of progress along the production path. The more information and the better the quality of the information, the more reliable are the cost estimates — all resulting in fewer surprises and critical supplier assumptions.

### Documentation requirements.

Complete documentation packages are required to insure manufacturability, testing parameters, assembly instructions,

and technical requirements. This requires a tight communication link between PFC and its customers. Document packages should include:

- Assembly drawings. ● Mechanical drawings. ● Drill files.
- Gerber files. ● Specifications and quality requirements.
- Bill of materials.

**Tooling.** The quantity, delivery, and estimated annual usage all impact the fabrication methodology and tooling approach. Pricing targets prevent a fine Cadillac from being designed for a short-run market that really wants a Smart car. If within this package one or more items are missing, the opportunity for error arises; a clean package will again result in fewer surprises.

### Flex Production

PFC's flexible printed circuit manufacturing capabilities include single-sided, double-sided, multilayer flex, and rigid flex to 18 layers. Specialty designs include fine line capabilities (2mil and below lines and spaces); impedance controlled flex; high-speed circuits; sculptured circuits and flex heaters. Additional specialties include unique alloy capabilities and silver epoxy shielding. While PFC does not emphasize box-build capabilities, some 70 percent of its customers are provided a fully assembled solution.

### PFC Assembly Capabilities

The company provides flexible printed circuits with elec-



Surface mount line.

tronic assembly — surface mount, through-hole and sub-assemblies. Capabilities include installing connectors, resistors, and capacitors — accommodating packages that are 01005, 0201, CCGA, COB, MCM, MEM, BGA and  $\mu$ BGA, Chip Scale Package (CSP), fine and ultra fine pitch high pin count connectors (12mil pitch), flip chips, SOIC, TSSOPBGA, and leadless packages.

Recently PFC completed a major in-house expansion of its second SMT assembly line, adding a DEK semi-automatic printer with vision, a Panasonic high-speed pick-and-place system, a Folungwin lead-free-capable 8-zone reflow oven, a Cluso optical vision inspection/verification system, and an Ascentech ionic contamination test system. The new assembly line will support smaller package sizes such as 0201s, and is capable of placing 1005 size packages when available.

Operations are rated IPC A-610 Class 3, and products are RoHS-compliant, except for exempt categories that include military & aerospace and medical devices.

### Additional capabilities

Full turnkey production is offered, which includes circuit design, signal characteristics and analysis (impedance, loss, crosstalk), drawings, Gerbers and appropriate documentation. Services available include component identification and testing, production test set design and builds, tooling fixtures, quick turn prototypes and assembly, supply chain management of supplied or authorized components, including sheet metal, PCBs and plastics. Naturally, the company provides top-of-the-line production manufacturing and assembly, along with product logistics, procurement and warehousing — all part of the turnkey solution.

### Test capabilities

PFC incorporates state-of-the-art test capabilities, providing flying probe, universal grid, dedicated test systems, and 100 percent netlist-driven test processes. Netlist formats are IPC D356, ODB++, CAD generated, PC 9252 Class 1,2,& 3 testing, and in-house test program generation and fixture manufacturing. Hipot testing measures dielectric breakdown, dielectric withstanding, insulation resistance, and impedance testing. Full in-house functional test capabilities include connectorized, digital & analog product. In addition, PFC offers in-house test program generation and fixture manufacturing, as well as full X-ray and AOI inspection. Other testing includes full in-house reliability and failure analysis, bare and assembled product testing, plating and surface finish analysis, mechanical testing for shear, pull, flexure and tensile strength.

And finally, PFC has access to a scanning electron microscope which is available for more exhaustive failure analysis. This is performed by an independent company that is housed in PFC's facilities, and run by a top expert in failure analysis.

### Two Adjoining Buildings

Founded in 1997, PFC today occupies 45,000 sq. ft. (4180 sq. meters) in two adjoining buildings and has a total workforce of more than 90 employees. The company's extensive engineering experience permits working hand-in-hand with customers to engineer a cost-effective design correctly the first time. Included in this process is design for manufacturability, functionality, and repeatability. PFC's engineering staff is expert at providing complex solutions, using special materials, and cutting-edge processes.

The company's location in Scarborough is conveniently located among Toronto metro's many other electronics and manufacturing houses, just 27 km from the city's International Airport. The location has numerous benefits, including an excel-

lent skilled labor pool which doesn't have to be drawn upon very often. The reason: the company's employee turnover is very small — about 1 percent in the last 10 years.

The company works continuously at being a world class designer and provider of flexible and rigid flex printed circuits and assemblies. This success is based on providing quality product, on-time deliveries, and impeccable service. To do this requires total involvement by all employees, our most important asset. We are as committed to our employees as they are to PFC. That one percent turnover rate speaks volumes for employee loyalty and management's loyalty to employees in return. An additional factor is the company's profit-sharing program, which helps to drive such common goals as quality. PFC is ISO 9001 certified and 13485 registered.



*Hand soldering components on a rigid flex.*

### Vertical Markets

Products that incorporate PFC flex circuits are designed for use in medical, telecom, military and aerospace, industrial controls and instrument manufacture. Typical high-reliability medical products include hearing aids, cardiac pacemakers, defibrillators, and ultrasound probe heads. Typical telecom products are optical transceivers, high-speed cables, base stations, smart cards and RFIDs. The military and aerospace category includes satellites, instrumentation panels, plasma displays, radar systems, jet engine controls, night vision systems, smart weapons, laser gyroscopes, torpedoes, electronic shielding, radio communications, and surveillance systems. Industrial controls encompass laser measuring, inductor coil pickups, copy machines and heater coils, while instruments comprise NMR analyzers, X-ray equipment, particle counters and infrared analyzers.

### ITAR Capable

PFC is entitled to possess or transfer controlled goods through the Defense Production Act and the Controlled Goods Regulations of Canada. The Controlled Goods program is part of an agreement between the US and Canadian governments. In order to be granted admission into the Controlled Goods Program, PFC must adhere to certain rules and regulations agreed upon by the US and Canada.

The ITAR regulations — 126.5, written by the US government — specifically outline the agreements between Canada and the US for imports and exports of ITAR projects. The Controlled Goods Program allows US companies working on ITAR programs to exchange/export data (drawings, prints, specifications) with Canadian registered companies without a license (Technical Assistance Agreement). If a customer uses multiple subcontractors and the resulting flex assembly does not work, who is to blame? How does the client recover? Was it the design? The manufacturing of the circuit? or the assembly that created a failure? How long will it take to discover the issue? And to recover?

With PFC's extensive and full service capabilities, a customer will never be stuck in the position of finger-pointing between multiple subcontractors.

The bottom line is that at PFC the entire operation is geared to helping the customer's bottom line, providing whatever part of the production process that is required. The final and most important ingredient in this mix is peace of mind for the customer, no matter how difficult or complex the project — Flexcertainty.

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