

IPC Conference in June Flex, Chipscale Packaging and RFID

The IPC will be holding a conference on flex circuitry, chipscale packaging and RFID technology in Minneapolis, Minnesota on June 21st-23rd!

The first day has four half-day workshops on flex circuitry and advanced packaging taught by such flex gurus as Ken Gilleo, Joe Fjelstad, and Vern Solberg. June 22nd and 23rd is the conference itself with papers and exhibits.

You can get the schedule of workshops, papers, hotel info and other conference details on the IPC web page: www.ipc.org/calendar/2005/FlexCSP_RFID605/FlexCSPRFID_Conf0605.htm. 

Throughout *The Flex Circuit News* there are links to the web pages of those companies or individuals mentioned in the articles, as well as links to advertisers web pages. Look for the pointing finger. 

Road trip!!!

Looking For Flex On The Frozen Tundra

I have visited most of the flex circuit manufacturers in California and New Hampshire, but have never seen any flex vendors in Minnesota. So I planned a four day trip to see six flex manufacturers in Minnesota and one in Ohio: Printed Circuits Inc., Minco, Multek, All Flex, Innovex, Century Circuits and Sovereign Circuits.

**Tom
Woznicki**

Being somewhat of a contrarian, when did I plan the trip? In winter, of course! But flying into Minneapolis I saw nothing but brown fields. Where's the snow? Turns out Minnesota was having one of the warmest winters on record — some places had received less than two feet of snow the entire season. Not trusting such luck to last I rented a four-wheel-drive SUV and headed for my only appointment that afternoon at Printed Circuits, Inc.

Printed Circuits, Inc. (PCI) is a unique company. They build rigid-flex circuits almost exclusively, with layer counts typically between six and twenty but sometimes as high as thirty. They have the capacity to support production volumes — up to one hundred thousand units per year on some programs. About forty-five percent of their sales come from the medical industry and another forty percent comes from the military. While most of the business is production volume stuff, they occasionally tackle special projects that no one else wants to build. They have an expertise in making bookbinder rigid-flex circuits — those most-complicated flex circuits where the flex layers are different lengths, enabling the circuit to fold with no binding or buckling. In fact, Denny Cantwell, a flex veteran if there ever was one, showed me a circuit he was working on with a double-bookbinder construction — a circuit with bookbinder folds in opposite directions!

Bob Burns, the PCI sales and marketing guy, couldn't have been nicer as showed me around the facility and introduced me to the staff. I got the feeling that I was in the Jaguar motorcar factory as he described how they create teams to work on the various flex circuit programs.

JPL is looking for a flex circuit engineer!

[Go to page 8 for details!!!](#) 

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1200 West 96th Street
Minneapolis, MN 55431-2699
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Bob Burns of PCI

PCI has no lasers in-house, but can mechanically drill four and six mil holes. They are also in the process of installing a laser direct imaging system. As Bob explained it to me, laser direct imaging greatly reduces the problem of panel shrinkage and aligning artwork to the panel. The laser system picks up fiducials on the panel and creates the new circuit pattern in the resist very accurately in relation to the etched features on the layers below. It will increase fine line etching capability, increase yields and reduce costs when making circuits with high layer counts.

The first day now finished, I headed for the hotel. Next morning I peaked out the window and, sure enough, there was several inches of snow on the ground. Fortunately the snow removal folks had

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Flex Circuit Design Company is a consulting company that specializes in designing flexible printed circuits for OEMs and flex circuit manufacturers.

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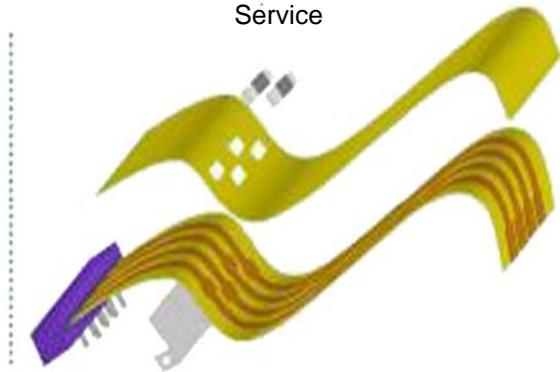
already taken care of any white stuff on the street — if I could negotiate my way out of the parking lot I was home free. I set the heated seats of the SUV to “Arizona summer” and headed north on 35W through the snow to see Minco.

As I reached the north side of the city I crossed a bridge over a river and the sign said “Mississippi River.” No way — the Mississippi? Sure enough, the headwaters of the great river are way up in Minnesota. I guess it’s been too many years since fifth-grade geography.

Before the trip the only thing I knew about Minco was that in addition to building flex circuits they had a special capability for building heater flex circuits. I was really surprised at how big a company they are! Minco’s marketing manager Merle Tingelstad explained to me that there are

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three divisions of Minco: temperature sensors and instrumentation, flex circuits, and heater circuits. Each division had sales of about \$30 million in sales in 2004!

The flex circuit division builds mostly hi-rel multi-layer and rigid-flex circuits, with about twenty-five percent of their sales coming from military and aerospace. Their in-house capabilities include circuit design, bondable gold and immersion silver plating, SMT assembly and three lasers. Minco has a proto shop where they can build small

volumes in two weeks or less, but they reserve it for programs that will lead to production volume.



Mark Finstad, Dave Hans and MerleTingelstad of Minco.

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With three different divisions, Minco can provide complete temperature sensing/controlling assemblies including instrumentation, flex circuits, sensors and/or heaters. In fact, there is a Minco temperature sensing assembly in every french fryer in every McDonald's restaurant. The three divisions provide redundancy in key processes — for example, if the etching line goes down in the flex division they can use the etcher in the heater division.

Even though Minco is a good-sized company they are still privately owned. They will be investing about \$6 million in capital equipment this year, including a horizontal plating line which will allow them to plate extra-long flex circuits. They also intend to add a laser direct imaging system very soon.

After the tour by Merle, Dave Hans and Mark Finstad, I ventured back into the snow flurries to drive south to see Multek (aka Sheldahl) and All Flex in the small town of Northfield. Fortunately, none of the snow was sticking to the roads and driving was no problem and even quite pleasant. Driving past farm and field I approached the town, came around a bend in the road and came face to face with this huge building — was it the Multek factory?



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No — it was the Malt-O-Meal factory! Who knew my Cocoa Dyno-Bites came from Northfield?

Multek is a high-volume manufacturer of printed circuit boards. A wholly-owned subsidiary of Flextronics, Multek scooped up Sheldahl in a stock-for-stock merger back in August of last year. The flex circuit manufacturing has taken on the Multek name, but the flex materials and other specialty materials will still be branded as Sheldahl.

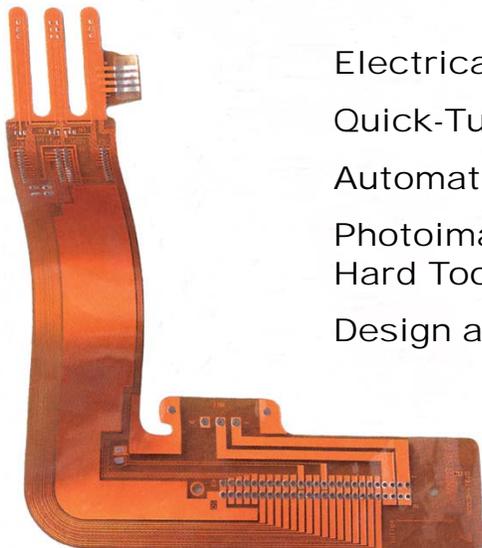


The flexible circuit division has turned the corner from it's woes of a few years ago. Automotive flex circuits now only account for around fifty percent of their finished flex circuits, down from eighty percent in previous years.

In addition to standard copper-on-polyimide flex circuits, Multek produces a wide variety of flex circuits, including fine-line semi-additive, copper-on-polyester and conductive-ink-on-polyester circuits. Their in-house process capabilities



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www.sheldahl.com/Product/TechMaterials.htm



include laser microvias, immersion silver plating and bondable gold plating. Multek also has large manufacturing facilities in Mexico and

about the “Northfield Bank Raid” at the historical society website: www.northfieldhistory.org/JJ/.



With newfound respect for the Northfield citizenry I very carefully drove to the southern part of town to see All Flex. All Flex is a quick-turn prototype/low-volume flex manufacturer. They have been in business fourteen years and they are the only proto shop in the USA I know that builds copper-on-polyester flex circuits. Polyester circuits account for about five percent of their business.

The Philippines and they're building a large plant in China that is scheduled for completion in January 2006.

The flex circuit plant itself was very clean, with row after row of reel-to-reel process equipment within clean-area walls and windows. The materials plant was particularly impressive, with huge vacuum chambers that produce metalized films for both flex circuitry and aerospace. I did not realize how many different materials they produced for applications outside the flex circuit world, especially the vacuum-deposited aluminum on various films.

At Multek I also learned that Northfield is known for being the place where the Jesse James gang was defeated as they tried to rob the town bank in 1876. In the Multek lobby there were several pictures depicting the events of that day. The townsfolk, realizing that the bank was being robbed, grabbed their guns and opened fire on the James gang. They foiled the robbery, killing two of the eight gang members and wounding several others. Sadly, two of the townspeople died — a teller who refused to open the safe was shot by Frank James and another person was killed by a stray bullet.

Jesse and Frank James escaped to the Dakotas and eventually made their way back to Missouri. A week later the posse found the four remaining outlaws. One was killed in a shoot-out with the posse and the other three were captured.

The town has a festival every year called “The Defeat of Jesse James Days” to celebrate the bravery of the townspeople. You can find out more

The shop itself is very similar to the quick-turn proto shops here in California — small and flexible

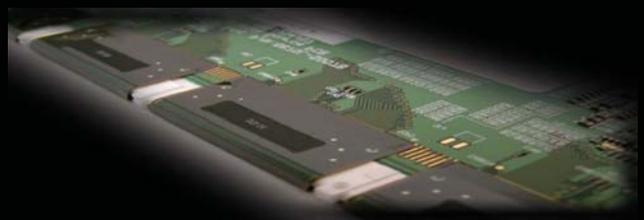
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with lots of skilled operators. They build flex circuits up to six copper layers, but no rigid-flex.

Done for the day, I said good-bye to the All Flex gang and headed back north towards Minneapolis

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for the long drive to Litchfield, where I planned to see the Innovex folks first thing in the morning. Poking along in early rush hour traffic I noticed something on a nearby hill. It was a ski jump — a great big one, just like in the Winter Olympics! That's something you don't see every day.



Paul Gerlach of Innovex. Where's the snow?

Like Multek, Innovex is a high-volume flex circuit manufacturer. Unlike Multek, Innovex builds millions of flex circuits a month for the disk drive industry. Paul Gerlach, design engineer for Innovex, met me at the Litchfield facility along with Ramon Salguero, the senior process engineer. Wow — are they busy there! There are two Innovex buildings in Litchfield, and one whole

building was being completely remodeled to make room for new processes and equipment.

Why all the changes? Innovex is sending more of their manufacturing processes to their facility in Thailand and closing the factory in Maple Plain, Minnesota. They are also getting out of the FSA attachment business, but will still build flex circuits for disk drive heads. Finally, Innovex has also recently purchased the assets of Gould's adhesiveless laminate business.

When finished, the renovated Litchfield building will manufacture prototypes. The other Innovex building in Litchfield has high-volume, roll-to-roll



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wet processing to support their flex factory in Thailand. It is impressive, with row after row of roll-to-roll etching and plating lines inside clean areas. I kept thinking how unusual it was to have all this world-class flex manufacturing way out on the rolling plain of Minnesota surrounded by farmland! Innovex can reliably etch forty micron lines and fifty microns spaces in high volume. They have in-house bondable gold and immersion silver plating and are evaluating immersion silver plating for flip-chip assembly.



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Paul and I said good-bye to Ramon and drove towards the Maple Plain facility, which is on the way back

to Minneapolis. About halfway there, Paul turned off the highway into the tiny town of Darwin, drove down a side street and stopped. There it was — the world's biggest ball of twine, housed in it's very own little gazebo! Francis A. Johnson created the 12 foot wide, 17,400 pound ball of twine between 1950 and 1989. After his death the town moved it to the gazebo across from the park where there is a "twine ball days" festival the second week of August every year. Not bad for a town of about 300 people!

Jordan Ortquist, another Innovex design engineer, joined us for lunch at this little hole-in-the-wall restaurant called McGarry's that had some of the best burgers I've ever eaten — good ol' Midwestern cornfed beef! It was snowing again as I said good-bye to Paul and Jordan in Maple Plain. It's a shame that they're closing this plant down because it's a beautiful building that



Bob Newberry of Century Circuits.

looks out onto rolling farmland. When they sell the building the corporate headquarters and engineering group will move to a smaller office somewhere close by.

One more stop before flying to Pittsburgh — Century Circuits in St. Paul. Century Circuits has been in business for twenty-nine years. They specialize in manufacturing production volumes of high layer count flexible circuits that

Century Circuits
 155 Eaton Street
 Saint Paul, MN 55107
 Phone: 651-222-5833
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 www.centurycircuits.com



are all polyimide rather than rigid-flex. They regularly build twelve to seventeen layer flex circuits and can go up to twenty layers! Their other specialty is impedance control, with etching equipment that can control line width on inner layers within a tenth of a mil along with HP and Polar impedance testers. Century Circuits also has a proto shop that can build circuits quickly to support programs in their early stages.

Bob Newberry, the sales and marketing guy, was nice enough to stay late on Friday afternoon to meet with me and show me around the shop. We then retreated to a local sports bar for a beer (mmmm...beer) as we

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along the freeway towards the airport. Then suddenly the snow stopped, the clouds parted and the sky was blue and filled with puffy white clouds! Whoa! It seemed strange to me, but I sure was thankful — before that I was convinced my flight would be cancelled and I'd be spending the night in the airport. The wind kept howling, but at least I was able to see where I was going as I dropped off the SUV and jumped on the shuttle to the airport.

After spending the weekend with some old friends in Steubenville, Ohio, I headed north to see the last vendor on my trip — Sovereign Circuits. In the early morning hours I wound my way along the Ohio River, past steel mills and coal-fired power plants and barges floating gracefully along the river. Then north through the countryside to Youngstown, Ohio.

Sovereign Circuits is a little different from the other companies I had visited on this trip — only about twenty percent of their

swapped stories about the flex biz, kids, sports and other stuff. Sadly, time was short — Bob had to get to Northfield to see his son play hockey and I had to get to the airport.

I guess the weather gods decided I needed a taste of real Minnesota weather before I left, because as I followed Bob towards the airport the snow really started to come down — I could only see about twenty feet in front of me as we crawled

business is flex and rigid-flex, the rest being rigid pcbs. As VP of operations Mike Frank explained to me, their specialty is building production volumes of circuits for military, hi-rel and hostile environment applications.

The rigid-flex boards they build typically have high layer counts with up to twenty-six layers in the rigid areas. While the circuitry is very complex, the shape of the rigid-flex circuits they make is

usually simple — two rectangular multilayer sections connected by two or four flex layers.

Sovereign has a special capability in plating small drilled holes with very high aspect ratios. Mike said they can plate an 8 mil drilled hole in a 100

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mil thick board with 1.8 mils of copper that will survive military temperature cycle testing!

They also build circuits with heavy copper — one rigid pcb they built recently had ten layers with six oz. copper.

Mike then gave me a tour of the plant — it is large, spacious and hospital clean. They have electrolytic soft and hard gold plating and immersion silver plating in-house. Next year they plan to add a laser direct imaging system.

My mission now complete, I made a side trip through Poland, Ohio hoping to find some good Polish food, but sadly there was not a Polish deli to be seen. Apparently the name of Poland was bestowed on the town in honor of a young Polish Revolutionary War hero who won the hearts of the community, not because lots of Polish people lived there. His Polish name was so long and complicated they decided the best way to honor him was to name the town for the country from which he came. I can relate. I'd be reluctant to name a town Woznicki — too many ways to misspell or mispronounce it. Oh well, I guess I'd just have to settle for some good Italian food when I got back to Steubenville. I drove the rest of the way back on the country roads, spent one more night with our old friends and caught the first flight in the morning back to Silicon Valley, where it was a balmy seventy degrees.

What a fun trip — I gotta get out of the CAD cave more often. It's good to see laser direct imaging either in place or about to be installed in so many locations. It was also good to see immersion silver plating is becoming accepted as a way to meet lead-free requirements for flex. I hope that immersion silver proves to be acceptable for flip



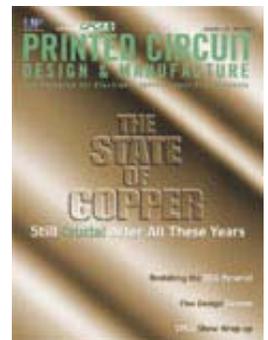
chip assembly. It will really improve the circuit design if there is no longer a need for organic coating in the flip chip area — just plate all the exposed copper with the immersion silver!

Big, big thanks to all the folks who were gracious enough to meet with me and share all the good stuff about their companies. There were a couple of flex companies in Minnesota I didn't get a chance to see — I hope to follow up with them by phone and e-mail and write about them in the next issue.

More cool stuff...

Flexdude in Printed Circuit Design and Manufacture

Shameless plug — if you missed it, check out my article “More Flex Design Tips” that was published in Printed Circuit Design and Manufacture magazine last month.



Big thanks to George P at NG and Victor Llanes, the bikini expert, at Tyco Santa Clara for their pictures and illustrations — they were a big help in trying to explain some of the unique aspects of flex.

If you don't subscribe to PCD&M, you can read it on the web. The link to the May issue is:

<http://pcdandm.com/cms/content/view/1802/128/>

