Flex Circuit news

April 1999

IBM Flex Facility Bought By International Flex Technologies

Led by Don Friedman, former senior vice president of IBM, a group of investors has purchased the flex circuit plant at Endicott, NY. The new company, International Flex Technologies, Inc., produces fine-line flex circuits for IC substrates and advanced interconnection applications as well as complete TBGA packages. IFT produces flex circuits additively on adhesiveless material in a roll-to-roll format.

Mr. Friedman will be President and CEO. Joining him as VP of Sales and Marketing is Mark Derwin, another IBM veteran. Tim Meehan, long-time consultant in the adhesiveless flex industry, will be VP of New Business Development. Derek Schultz will be sales manager for the Western United States, and Stephen Payne will be sales manager for Europe. Sales in all other parts of the world will be handled by manufacturers reps.

The entire manufacturing group came over from IBM and production hasn't skipped a beat. Manufacturing is led by General Manager Al Buyck, VP of Engineering Ralph Parsons and VP of Operations Bob Lageman.

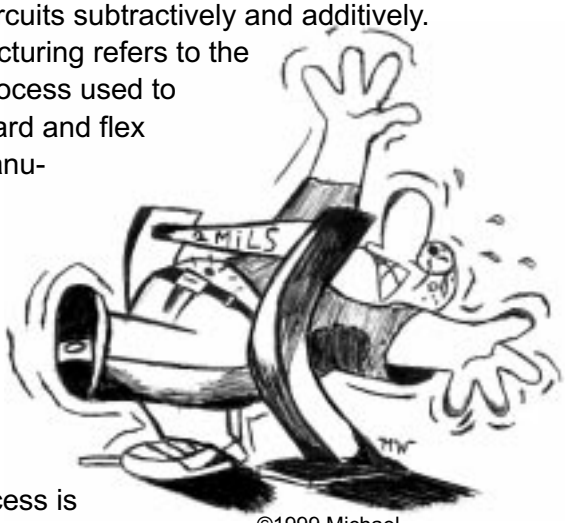
You can reach International Flex Technologies at 607-755-3920.

Fine-Line Flex Circuits
How Low Can You Go?

Making fine lines and spaces is like dancing the limbo, how low you go depends on how much effort you put into it. This article will review which flex circuit makers can produce fine-line flex circuits in a wide web or panel format.

Tom Woznicki

First, we need to divide the discussion between making circuits subtractively and additively. Subtractive manufacturing refers to the standard etching process used to make most rigid board and flex circuits. Additive manufacturing starts with film sputtered with a seed layer of copper. Photoresist is applied and the traces are plated up to the desired thickness. This process is sometimes call semi-additive.



Subtractive Processing

Nitto Denko and Mektec (a.k.a. Nippon Mektron) can make 2.0 mil lines and spaces on 0.5 ounce copper. Both Nitto and Mektec prefer to produce their fine-line flex circuits at factories in Japan that have the process controls necessary for these fine geometries, and both companies do charge a premium for these fine-line circuits. Mektec also has produced lines and spaces below 2.0 mils using 0.33 ounce copper. Nitto has produced lines and spaces down to 1.5 mils in the lab, but they aren't ready to build these circuits in high volume production.

Innovex in Minnesota produces high volume fine-line flex circuits as well. They specialize in circuits for the disk drive industry, chip-scale packaging and the medical industry. Innovex only uses adhesiveless materials and can etch 1.5 mil lines and 2.0 mil spaces on 0.5 ounce copper. They can make finer features by using adhesiveless materials with thinner copper.

There are links throughout *Flex Circuit News* 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.

What do you mean, you want 3 mil lines and spaces?

When designing or buying fine-line flex circuits, it's important to be clear about what will be an acceptable line width, because normal workmanship standards may not apply. In IPC spec FC-250A, acceptable line width for class 2 circuits is defined as having no sections more than one inch in length where the trace is reduced by 40% or more, and having no local reductions such as nicks and pinholes where the conductor is reduced more than 70% and is no greater than 3 times the conductor width. By that standard a 3 mil trace could be etched down to 1.8 mils with ratbites that reduce the conductor to 0.9 mils—not a pretty picture.

I recently designed a flex with 3 mil lines and spaces. The vendor and my customer agreed that the circuits would be acceptable if the line widths were between 3.25 mils and 2.25 mils. The vendor increased the line width in the artwork by 0.25 to compensate for etching and was able to meet the agreed-upon line width.

AdFlex Solutions classifies programs as green, yellow or red. On 0.5 ounce copper, anything above 2.5 mil lines and 3.5 mil spaces is green (no problem), 3.0 mil spaces is yellow (slightly reduced yields) and below 2.5 mils is red, meaning they can build it, but there will be a premium for reduced yields and there must be a clear definition from the customer as to what is an acceptable circuit (see box above). On AdFlex's web page they say they can make flex circuits with a pitch lower than 125 microns (5 mils).

Sheldahl can etch down to 3.0 mil lines and spaces, but they prefer to use their fine-line facility in Longmont, Colorado where they make circuits additively.

Up to this point, all the vendors we've discused are high volume flex manufacturers. What about getting prototypes or small volumes made?

When choosing a proto shop to build fine-line flex circuits, it's important to know what kind of etch chemistry they are using. Usually a vendor will use either an alkaline etchant (ammonia) or cupric chloride. Alkaline will etch more quickly and is not as good for fine-line circuits as cupric chloride. I found this out the hard way when good proto shops were stubbing their toes on flex circuits with lots of 3 mil lines and spaces, only to find out that because of their alkaline etching they were having yield problems. That doesn't mean that proto shops that use alkaline etching can't build fine-line circuits—if the circuit has only a few fine lines and spaces in one area and the vendor has good process controls. But if the circuit has lots of fine lines and spaces it's better to use cupric chloride.

The following companies are flex proto shops who I know have cupric chloride etching: Brothers International, Circuit Solutions, Q Flex and Tyco-Flex.

If you are devoted to your favorite proto vendor and they don't have cupric chloride etching there is another option—have your vendor outsource the etching. For example, I just found out about a company in Southern California named Pacific Image whose sole business is cupric chloride etching for other circuit shops. Companies supply the material and their plotted artwork to Pacific Image and they apply the resist, do the etching and stripping and return the etched circuits to the customer for finishing. I checked them out with a few

folks in the flex business down there and everyone said they do fine work.

Additive Manufacturing

Up to this point we have only talked about etched circuits. Now let's consider making circuits additively.

One of the biggest benefits of building circuits this way is that the walls of the traces are almost vertical—there are none of the trapezoid shaped traces caused by etchant undercutting.

Another unique feature of additive circuits is their grain structure. Unlike the vertical grain structure found in most electrodeposited copper, these traces have an "amorphous" grain structure—the grains go in all directions. This amorphous grain structure has tested very well in dynamic applications.

According to Mark Derwin at International Flex Technologies, their studies show that fine-line additive circuits are more reliable in dynamic applications than fine-line etched circuits because they are free from etching defects that are stress concentrators.

Sheldahl has a facility in Longmont, Colorado that is dedicated to building additive circuits using roll-to-roll

See "Fine-line," page 4

New Materials

Good new! Representatives at Rogers Corporation and DuPont have told me they now offer laminates with 0.33 ounce rolled-annealed copper. Unfortunately, neither company's web page has been updated yet, so you'll have to call them directly to get the information and part numbers. (see below).

Companies for fine-line flex

AdFlex Solutions
2001 Chandler Boulevard
Chandler, AZ 85224
Phone: 602-963-4584
Fax: 602-786-8457
www.adflex.com

Allied Signal
Substrate and Interconnects
Costa Mesa, CA
714-708-2500
714-545-7616

Brothers International
2964 Corvin Drive
Santa Clara, California 95051
Phone: 408-749-8811
Fax: 408-749-8509

Circuit Solutions
620 S. Raymond Ave. Suite 10
Pasadena, CA 91105
Phone: 626-358-8414
Fax: 626-358-6178
www.circuitsolutions.com

DuPont Corporation
Flexible Circuit Materials
14 T. W. Alexander Drive
Research Triangle Park, NC 27709
Phone: 919-248-5619
Fax: 919-248-5341
www.dupont.com/fcm/

Innovex, Inc.
1 Litchfield Drive
Litchfield, MN 55355
Phone: 320-693-2891
Fax: 320-693-4444
www.innovexinc.com

International Flex Technologies, Inc.
1093 Clark Street
Endicott, NY 13760
Phone: 607-755-3920
Fax: 607-755-7934

Mektec (Nippon Mektron)
4211 Starboard Drive
Fremont, CA 94538
Phone: 510-413-2400
Fax: 510-440-1335
www.mektec.com

Nitto Denko America, Inc.
48500 Fremont Blvd.
Fremont, CA 94538
1-800-356-4880
Fax: 510-445-5480
www.nitto.com

Pacific Image Company
1875 S. Santa Cruz, Suite A
Anaheim, CA 92805
Phone: 714-978-6691
Fax: 714-978-6693

Q Flex
1220 South Lyon Street
Santa Ana, CA 92705
Phone: 714-835-2868
Fax: 714-835-4772

Rogers Corporation
Circuit Materials Division
100 N. Dobson Road.
Chandler, AZ 85224
Tel: 602 917-5270
FAX: 602 917-5256
www.rogers-corp.com/cmu/

Sheldahl
1150 Sheldahl Road
Northfield, Minnesota 55057
(507) 663-8000
FAX (507) 663-8545

Micro Products Operation
1285 South Fordham Street
Longmont, Colorado 80503
(303) 651-2880
FAX (303) 651-2265
www.sheldahl.com

Tyco-Flex
400 Mathew Street
Santa Clara, CA 95050
Phone: 408-727-9169
Fax: 408-654-5806

"Fine-line," from page 3

equipment. They can make lines and spaces as fine as 1.25 mils.

International Flex Technologies in Endicott, New York also builds additive flex circuits and can achieve line and spaces down to 1.3 mils and spaces down to 1.6 mils.

Allied Signal has a facility in Costa Mesa, California that builds additive flex circuits for the IC substrates. In production they can make 1.4 mil lines and spaces. They are building circuits in panels.

Both Nitto Denko and NOK have additive flex facilities, but they are currently dedicated to only building suspension flex circuits for the disk drive industry. These suspension circuits take the place of wires for connecting heads to the actuator flex. In the future they may plan to make other circuits additively.

Book Reviews

By Leora Lawton, Ph.D.

I recently reviewed three excellent books on flex—Joseph Fjelstad's *Flexible Circuit Technology,* Thomas Stearns' *Flexible Printed Circuitry*, and Clyde Coombs, Jr's *Printed Circuits Handbook, Fourth Edition*.

Joe Fjelstad's book is for someone who wants a quick overview without being overburdened with engineering detail. It begins with a lively introduction to flex, beginning with an enthusiastic wake-up to the benefits that flex circuitry can provide. The next several chapters discuss materials, design,

See "Book Reviews," page 5

"Book Reviews," from page 4

manufacturing and assembly. As with all three sources, the chapter on design is the lengthiest. There is a separate chapter on inspection and test, a chapter covering the standards (IPC and Mil-Spec) relevant to flex, and a list of additional references.

Tom Stearns' book is far more detailed. As with Fjelstad's book, there are chapters on materials, design, manufacture, and assembly. But whereas Fjelstad had one chapter on materials, Stearns has 3—dielectric, conductive and adhesiveless. There is a separate chapter on rigid-flex manufacturing and an extensive glossary of terms in the back of the book. This book would be perfect for someone with solid engineering expertise who wants a preview of flex in order to make specific evaluations or recommendations for business strategies, or for a preliminary text before delving into flex as a competency. [Another choice for this purpose is a volume by Fjelstad, *An Engineers Guide to Flexible Printed Technology,* which was not reviewed.]

Finally, Coombs' *Printed Circuits Handbook* chapters 39-42 are about flex circuits. The shortest of the texts reviewed here, it is also the least comprehensive, covering only materials, design, assembly and a short chapter on rigid-flex. Unfortunately, the chapter content was gleaned from a 1988 text by Steve Gurley and 1984 documents by Sheldahl, making the information somewhat dated. Nevertheless, the text does cover the essential basics. For someone who already has access to this handbook, these chapters are a quick, convenient introduction.

My recommendation is choose Stearns for engineering detail, Fjelstad for readable comprehensiveness, and Coombs for the convenience.

Fjelstad, Joseph. 1998. *Flexible Circuit Technology, Second Edition*. Sunnyvale, CA: Silicon Valley Publishers Group, 217pp.

Stearns, Thomas. 1996. *Flexible Printed Circuitry*. New York: McGraw-Hill, 291 pp.

Coombs, Clyde F. Jr. 1996. *Printed Circuits Handbook, Fourth Edition*, Chapters 39, 40, 41, 42. New York: McGraw-Hill, 77pp of 1,088 pp.

All of the books reviewed here are available through The SMTA Bookstore at www.smta.org or through SMT Plus at www.smtplus.com.

Dr. Leora Lawton is a senior consultant with High Tech Business Decisions, a marketing research firm that has recently done a study on the flex circuit industry. You can reach the smiling folks at High Tech Business Decisions at 925-631-0920 or though the web at www.hitechbiz.com.

Dilbert reprinted by permission of
United Features Syndicate

Each edition of the *Flex Circuit News* contains a vintage Dilbert comic strip. Under our agreement with United Features Syndicate, we cannot include Dilbert in our archieved editions. Please be sure to subscribe to *Flex Circuit News* at: www.flexdude.com

More on Protos

A clarification—in the last issue I described proto shop Brothers International as "I wouldn't send my most complicated designs for them to build because they have been in the flex business for a short period of time, but they are worth looking at for garden-variety flex circuits." Well I caught an earful from the folks at Brothers, and rightfully so— I could have phrased it better. What I was trying to convey is that they are not experts at flex yet, but they are building good circuits. As I wrote in the third paragraph of the story "this article will discuss some of the better proto shops in the country." If they didn't do good work, they wouldn't have been mentioned at all. Sorry guys.

Just as the January issue was going out I got an e-mail from Elcid Aranas who was chief engineer at World Circuits. He had started his own flex proto shop over a year ago down in Pasadena, California. I had worked with Elcid on several flex designs while he was at World and he is a very knowledgeable flexdude. You can reach Elcid at 626-358-8414 or through his web page at www.circuitsolutions.com

Another flexdude Chetan Shah at Flex Interconnect Technologies in San Jose sent me an e-mail that their web page is up. You can contact them at www.fit4flex.com

Flex Circuit News is a monthly newsletter published by Tom Woznicki and Flex Circuit Design Company in San Jose, California. It is dedicated to providing information about all aspects of and promoting the use of flexible printed circuits in interconnection and electronic packaging.

Flex Circuit News is a free publication that is delivered to subscribers by e-mail. To subscribe or unsubscribe, visit our web site at: www.flexdude.com.

To submit a story for *Flex Circuit News*, send an abstract along with the author's credentials to: Twoznicki@AOL.com, or to the mail address below. For information on advertising in *Flex Circuit News*, contact Tom Woznicki at: Twoznicki@AOL.com or call 1.408.629.8343.

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

Flex Circuit Design Company
6468 Applegate Drive
San Jose, California 95119

Got a question about flex circuits?
Send it to: Twoznicki@AOL.com

Subscribe to Flex Circuit News on the web at:
www.flexdude.com