Flex Circuit news

May 2001

IPC Flex Circuit Conference

June 12th & 13th
Fremont, California

The IPC's seventh annual conference on flex circuits will be held at the Marriott hotel in Fremont, California June 12th and 13th. For both OEMs and folks in the flex circuit industry, especially those in California, this is a perfect opportunity to learn about the latest stuff in the flex circuit world and rub elbows with such flex circuit legends as Joe Fjelstadt, Bill Jacobi, Russ Griffith & Tom Stearns!

In addition to the two-day conference there will be three all-day workshops offered on June 11th for an additional fee.

The conference schedule, registration form and other information are listed on pages 5, 6 and 7 of this newsletter.

Hope I'll see you there!

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.

Wire Bonding On Flex

Attaching Bare Die Directly To Flex Circuits

Tom Woznicki

While it may not be as sexy and leading-edge as flip-chip-on-flex, wire bonding is a tried and true method of attaching chips directly to flex circuits for both low volume and high volume applications. This article will discuss design rules for successful wire bond attachment to flex circuits.

Wire bonding to flex circuits is also known as chip-on-flex (COF), not to be confused with flip-chip-on-flex (FCOF). Though it's considered an advanced packaging technology, wire bonding on flex is a very mature technology that has been successfully done in extremely high volume for over a dozen years. Wire bonding will continue to be a popular method of electrically connecting chips to boards, ceramics and flex circuits for years to come and there are many contract manufacturers all over the world who can provide COF assembly whether your program is prototype, low volume or high volume. By contrast, there are only a handful of contract manufacturers who can provide flip-chip-on-flex assembly and you will only get their attention if you have a very high volume product.

As a designer I love designing flex circuits for wire bonding. The amount of real estate needed for COF is much smaller than the space required for surface mount (SMT) packages so there is more room to route traces. More important - the flexibility in the wire bonding process enables you to fix interconnection problems between the chip and the other components on the flex circuit. Let's suppose that your flex circuit has to connect to a rigid board, and the pin assignments on the rigid board prevent you from connecting traces directly to the connector, as illustrated in Figure 1 on the following page. If you're using a surface-mounted IC you would be forced to use a two-layer flex circuit or several zero-ohm resistors to jump the

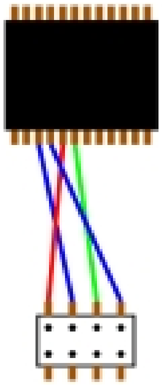

Figure 1

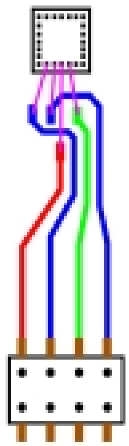

Figure 2

signals over one another. But if you are wire bonding the chip directly to the flex you can adjust the wire bond lengths and bond pad locations so the circuit can be routed in only one layer, as shown in Figure 2. In addition to fixing routing problems, this can be used to add enhancements to the circuit, such as adding ground lines on either side of sensitive signals.

For chip-on-flex there are two main types of wire bonding: gold ball bonding and aluminum wedge bonding. Gold ball bonding starts with a thin gold wire, then a hydrogen flame or spark is used to form a gold ball at the very end of the wire. This ball is pressed onto the bond pad of the chip. The bonder then feeds the wire up and over to the pad on the flex circuit where a wedge bond is created - the bonding tool smashes the wire into the bond pad while ultrasonic energy is applied, then the wire is broken off and the process is repeated. Aluminum wedge bonding uses aluminum wire and makes a wedge bond on both the chip and the circuit. A more detailed description of ball bonding and wedge bonding with illustrations is available on the web at http://www.eccb.org/pbps/tg/wirebond.htm.

Aluminum wedge bonding is the more common method for COF. While gold ball bonding is a faster process than aluminum wedge bonding, gold ball bonding requires the flex circuit to be heated. This heating softens the adhesive layers within the flex

Back issues of The Flex Circuit News are now available on our web page - www.flexdude.com!

circuit which causes the circuit to absorb the ultrasonic energy from the wire bonder. Aluminum wedge bonding is done at room temperature. Gold ball bonding also requires a much thicker gold layer on the flex circuit than aluminum wedge bonding. The thicker gold layer not only increases the cost of the circuit but also affects the soldering of any other components. Finally, aluminum wire costs less than gold wire.

Here is a short list of things to look at when designing a flex for COF.

Stiffeners

Stiffeners are very important in wire bonding to flex. The most common stiffener materials for COF are aluminum and stainless steel, but other materials such as ceramic are also used. These materials keep the bond pad area rigid, preventing ultrasonic energy from being absorbed by the flex circuit. Also, by cutting a hole in the flex circuit the die can be mounted directly on the metal stiffener for a great heat sink. Figure 3 below is a close-up of a flex designed for COF. You can see the hole in the flex where the chip will be placed directly on the aluminum stiffener.

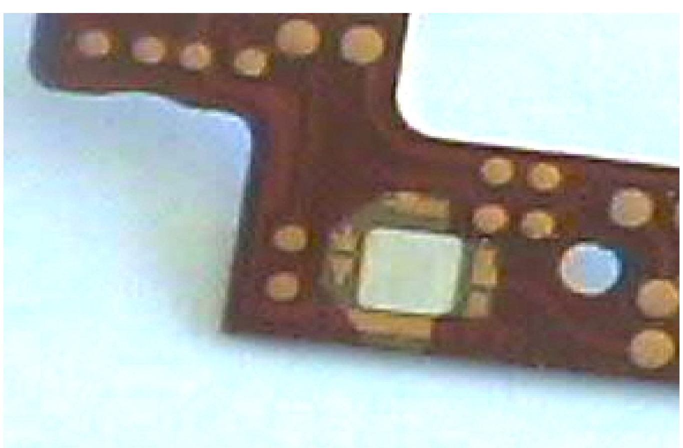

Figure 3

It is important to specify on the fabrication drawing that the stiffener should be laminated to the flex circuit with ***thermoset*** adhesive. Applying the stiffener with pressure-sensitive adhesive (PSA) will not work because PSA is soft and will absorb the ultrasonic energy.

Gold and Nickel Plating

Wire bonding requires extremely pure gold and nickel plating. On the fabrication drawing you must specify that you want ***bondable*** gold and nickel. There are two methods of applying gold to the circuit - electroplating and immersion. Electroplating requires that all surfaces that are to receive gold must be electrically connected together. If there is an isolated pad on the flex circuit a plating tie must be added that must be punched or drilled out after plating. Immersion gold requires no electricity - the circuit is simply dunked in the tank.

As mentioned earlier, gold ball bonding requires thicker gold - usually at least 50 microinches of gold over 150 microinches or more of nickel. This much gold can only be applied using the electroplating process.

Aluminum wedge bonding requires a very thin layer of gold over a thick layer of nickel - typically 5 to 10 microinches of gold over 150 microinches of nickel. For these thicknesses the flex manufacturer can use either electroplated gold or immersion gold over electroless nickel. Using immersion gold and electroless nickel can be a big advantage when there are lots of isolated pads - no plating ties necessary!

A word of caution - adding too much gold to solder makes the solder joint brittle and less reliable. If there are components that have to soldered to the flex circuit after wire bonding I would recommend using aluminum wedge bonding instead of gold ball bonding. The small amount of gold needed for aluminum wedge bonding will not affect the solder joints so the flex manufacturer can gold plate the entire circuit. If you need to use gold ball bonding and also solder components to the flex circuit the flex manufacturer will have to mask the circuit during gold plating and then mask the gold plating while you selectively apply the solder. This will add both cost and lead time.

Component Spacing

There needs to be a certain amount of room around the chip attachment area for the wire bonder to fly in and create the wire bonds. Surface mount components must be far enough away so their vertical height does not interfere with the wire bonding process. Also, the application of epoxy over the wire bonds, the glob top, requires about 40 mils of space beyond the wire bond area so epoxy doesn't cover any other components.

Check With Your Vendor

The design rules I just gave you will help you get started, but for the best results choose a wire bonding company early and let them help you fine tune the flex circuit for their equipment. This is especially important regarding plating requirements and component spacing. They may also want you to include assembly fiducials in the artwork.

A big thank you to Tim Patterson at Saturn Electronics for reviewing this article for me. Saturn, formally Smartflex Systems, is one of the best companies in the world for advanced packaging using flex circuits. Their web page is www.saturnee.com.

The Flex Circuit News is a bimonthly 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.

The Flex Circuit News is a free publication that is delivered to subscribers by e-mail.

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

Got a question?

Send e-mail to Twoznicki@AOL.com or call 408-629-8343 or toll-free

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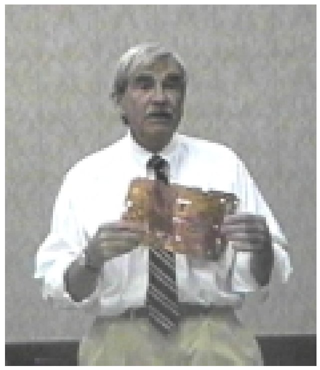
IPC Seventh Annual National Conference on Flexible Circuits

June 11th - All Day Workshops
8:30AM to 4:30PM

W-01:
FLEX CIRCUIT FUNDAMENTALS

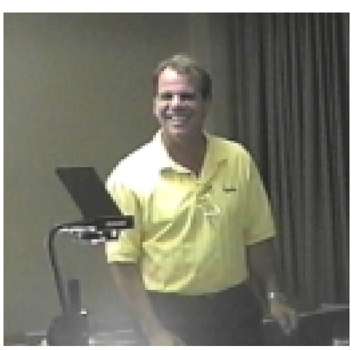
Bill Jacobi, William Jacobi and Associates and Thomas Stearns, Brander International Consultants



Because of its thinness, light weight, ability to fold, and variety of applications, flexible circuitry is quickly becoming the interconnection solution for many of today's electronic products. This workshop will focus on the manufacture, characteristics, and end uses of flexible circuitry. New material options, such as adhesiveless flex, and their effect on costs and processing will be covered along with critical design issues.

W-02:
PRINCIPLES OF FLEX CIRCUIT DESIGN

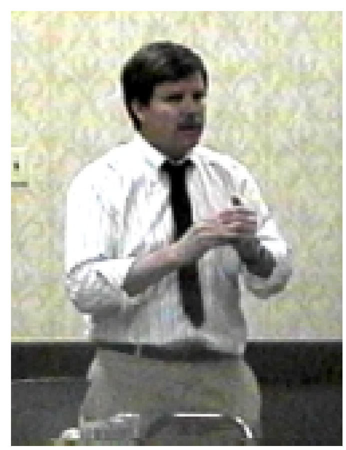
Russell Griffith
Tyco Printed Circuit Group



The enormous promise of flexible circuits cannot be realized without a thorough understanding of design principles. This course presents the electrical, mechanical and material properties of flex, and reviews the flex circuit manufacturing process. Designers will be taken through a checklist of considerations when utilizing flex circuits in their system packaging.

W-03:
FLEX AS AN ADVANCED PACKAGING MEDIUM

Joe Fjelstad
Pacific Consultants



Flex circuitry is a critical enabling technology. Unparalleled properties, including extreme thinness, high temperature stability, compliance and ultra-high density have made flex the premier chip carrier.

This workshop will cover the special characteristics of flex and contrast the differences compared to rigid PCBs. A special section on flex-based chip carriers will include Flip Chip-on-Flex, TAB, TBGA and micro-BGAs. Other major topics will include materials, designs, processing, handling, applications and SMT assembly.

IPC Seventh Annual National Conference on Flexible Circuits
Conference Schedule

Tuesday, June 12th

8:30 am **Registration and Continental Breakfast**

9:15 am **Introduction** *William Jacobi*
Conference Chair, Wm. Jacobi & Associates

9:30 am **KEYNOTE ADDRESS: SIX SIGMA, A STRATEGY OR A TOOL?**
J. Stan Erikson, Divisional President,
Du Pont High Performance Materials

10:00 am **Flex World Market Overview**
William Jacobi, Wm. Jacobi & Associates

10:30 am **BREAK AND EXHIBITS**

APPLICATIONS AND DESIGN

10:50 am **A Flex Circuit Application For a Wearable Consumer Display Product**
Ron Kane, Inviso

11:20 am **Flex Circuit Design Factors**
Scott Riley, International Flex Technologies

12:00 pm **LUNCH AND EXHIBITS**

PROCESS INNOVATIONS AND TESTING

1:15 pm **Panelization Standards and Automation**
Keith Hildahl and Dave Roesler, TRI-C Design

:50 pm **New Chemical Etching Process for Thermoplastic Polyimide Substrate**
Masanori Akita, Toray Engineering Company

2:20 pm **BREAK AND EXHIBITS**

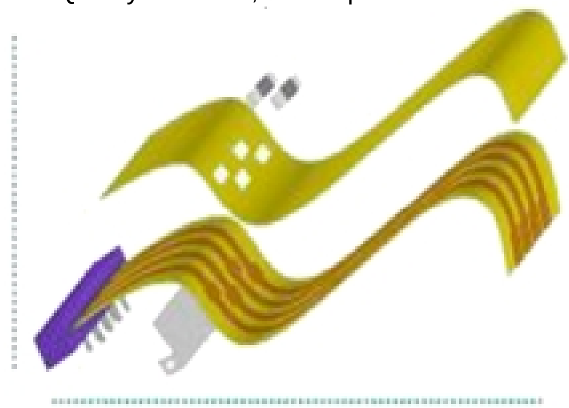
2:40 pm **Second Generation of High Density Flex Circuits is in Volume Production**
Dominique Numakura, Parlex

3:15 pm **Laser Processing Innovations for Improved Fabrication of High Density Flex**
Sri Venkat, Coherent

3:50 pm **Materials Testing and UL Qualification**
Bob Neves, Microtek Laboratories

4:25 pm **New Approach to Flex Circuit AOI**
Brian Tithecott, Focus Automation System

5:00 pm **IPC RECEPTION AND EXHIBITS**



Wednesday, June 13th

8:00 am **Continental Breakfast and Exhibits**

ADVANCED PACKAGING SOLUTIONS

8:45 am **Flex Circuit Characteristics Benefit Today's Packaging**
Dan Labzentis, International Flex Technologies

9:20 am **A Flexible Circuit Array-Area Interconnection for Biomedical Sensors, MEMS Systems and Chip Array Interconnection**
Scott Corbett, MicroSound Systems

10:00 am **BREAK AND EXHIBITS**

10:20 am **Neo-Manhattan Bump Interconnect Technology for Advanced Substrates and 3D IC Packaging** *Stephen Pierce, North Corporation*

10:55 am **Adapting Flex Circuits for High Performance and High Density BGA Packaging**
Vern Solberg, Tessera

11:30 am **An Update on Standardization Efforts**
Thomas Gardeski, DuPont

11:50 am **LUNCH AND EXHIBITS**

Conference Fees & Registration Stuff

Workshop fees: $350 for IPC members
$450 for nonmembers.

Conference fees: $475 for IPC members
$575 for nonmembers.

Super Package: Conference registration and one Workshop -$725 for IPC members
$825 for nonmembers.

All workshop registrants receive course materials, refreshments, and lunch. All conference registrants receive conference proceedings, continental breakfast and lunch on both days, admission to the tabletop exhibits and the June 12th reception.

Please register by June 6, 2001. For more information or if the registration deadline has passed, contact the IPC directly at 847/790-5361.

Cancellation Policy: Cancellations received before June 9, 2001 will be refunded in full. No refunds after the start of the program. Individuals failing to cancel will be billed for the registration fee. If events are cancelled, participants will receive a full refund. Substitutions are acceptable.

Location, Times & Hotel Information

All events will take place at the Fremont Marriott, 46100 Landing Parkway, Fremont, CA.

Rooms are available at the hotel for the special IPC meeting rate of $209 (single/double) per night.

For hotel reservations, call 510-413- 3700. Rooms and rate are subject to availability after May 25, 2001, so please make your reservations early.

Interested in exhibiting?

Many of the industry's top suppliers will be showcasing their products and services during the conference breaks, lunches and reception.

If you are interested in exhibiting, contact Alexandra Curtis at 847-790-5377 or by e-mail at: AlexandraCurtis@ipc.org.

IPC 7TH ANNUAL NATIONAL CONFERENCE & WORKSHOPS ON FLEXIBLE CIRCUITS–JUNE 11–13. 2001

PLEASE CHECK APPROPRIATE BOX: ❏ I am a member of IPC (MB) ❏ I am not a member (NM)

WORKSHOP REGISTRATION

_____ Workshops–$350 (MB) or $450 (NM)
I am registering for one workshop on June 11th only.
I am selecting Workshop *(circle one):* W-01 W-02 W-03.

CONFERENCE REGISTRATION

_____ Conference–$475 (MB) or $575 (NM)
I am registering for the Conference on June 12th–13th only.

SUPER PACKAGE SAVINGS REGISTRATION

_____ Conference and 1 Workshop–$725 (MB) or $825 (NM)
I am selecting Workshop *(circle one):* W-01 W-02 W-03.

METHOD OF PAYMENT: MY TOTAL COST is $____________

❏ Check enclosed and made payable to IPC
❏ Bill P.O. number:____________ (IPC Members Only) for $___________.
❏ Charge my credit card *(check one):* ❏ Amex ❏ Visa ❏ Diners Club ❏ Master Card

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Signature | Expiration Date

Billing Address | *PLEASE NOTE:* Your credit card will be debited for your registration fee. No receipt will be sent.

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