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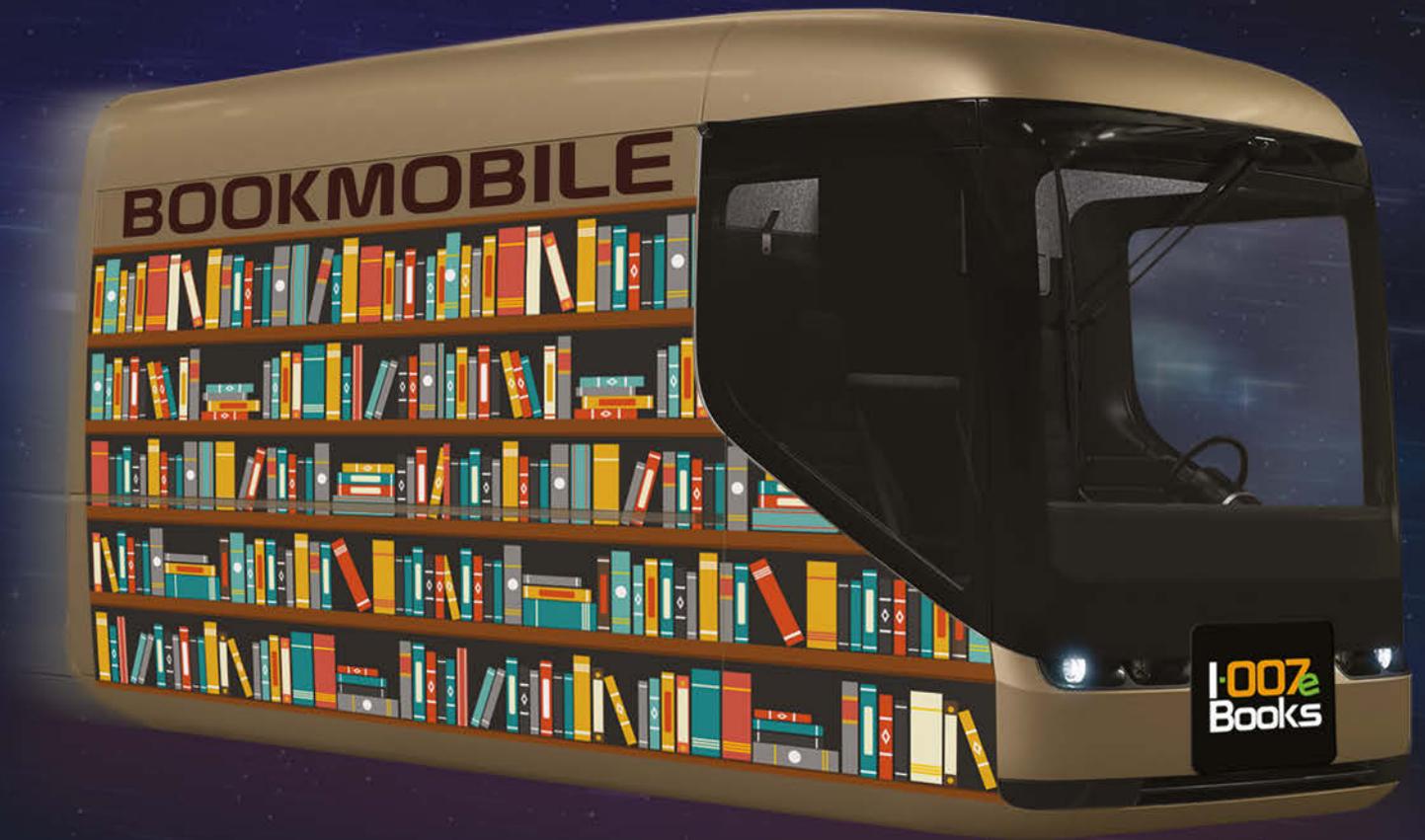
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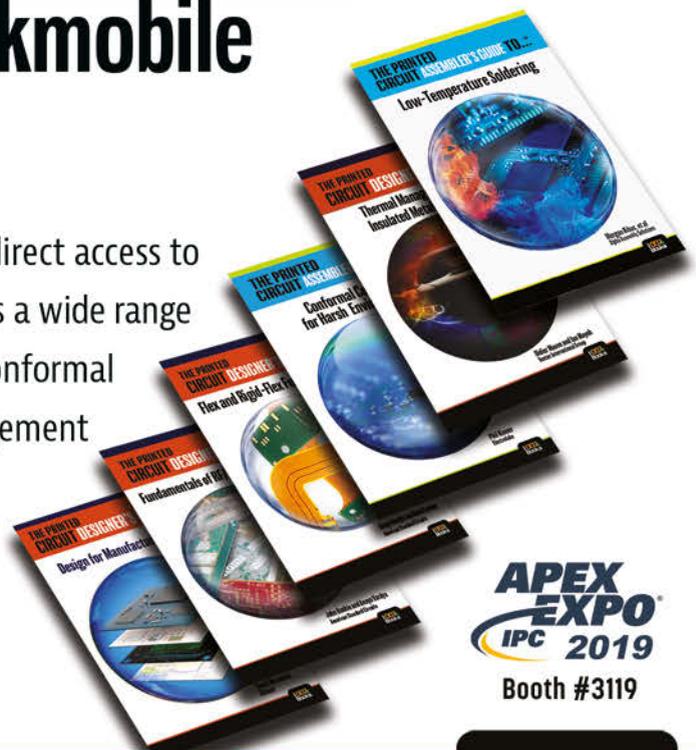
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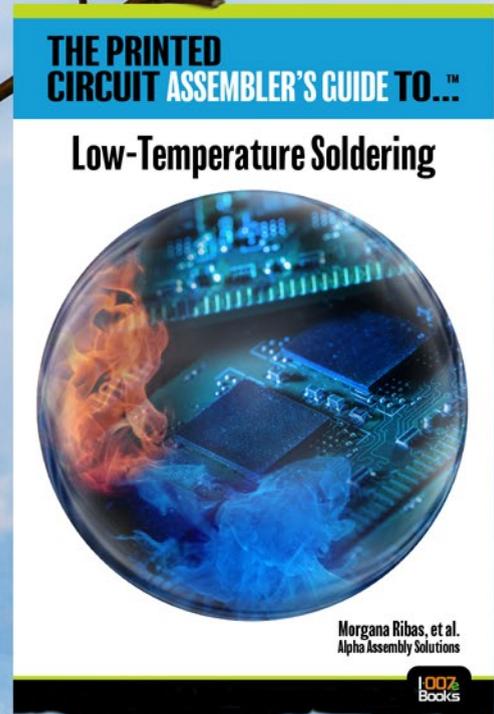
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IPC APEX EXPO 2019 PREVIEW

The electronics manufacturing industry continues to grow and change, and there's no better place to participate in the excitement than at IPC APEX EXPO 2019. In this issue, we preview the show including new events, exhibitions, technologies, awards, competitions, and standards work. We even step back with two members of the APEX EXPO board of directors responsible for starting the show. So, take your seat, whether as an attendee or as an industry representative, and let's get this show started.



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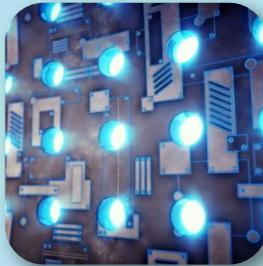
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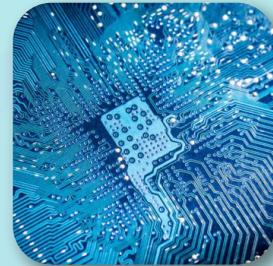
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Welcome to the **BIG** Show!

Nolan's Notes

by Nolan Johnson, I-CONNECT007

Ed Sullivan was a radio and television pioneer. Though he was a print journalist at first, he shifted his focus first to radio, and, later, television. *The Toast of the Town* (later named *The Ed Sullivan Show*) ran on CBS from 1948 to 1971. For 23 years, Sullivan's Sunday evening live program was where Americans turned to see something new, and also to see entertainment that was comforting. TV critic David Bianculli is credited for commenting, "Before MTV, Sullivan presented rock acts. Before Bravo, he presented jazz... Sullivan discovered, anointed, and popularized young comedians... Ed Sullivan was where the choice was."

Each week, Sullivan's show had something for everyone, bringing the whole family—and indeed the whole nation—together for an hour of entertainment. Regular performers (Topo Giggio!) maintained and grew their audiences by appearing on the show, and new acts (The Beatles, The Doors, The Rolling Stones) could launch a career with one appearance on Sullivan's stage. Yes, there were other variety shows, but Sullivan was the star-maker. Sullivan didn't start with intentions

of becoming an entertainment powerhouse, but how he put together his show certainly worked magic.

This month, we celebrate the impact and reach of the IPC APEX EXPO slated for January 26–31, 2019, in San Diego, California.

If there is an equivalent to the Ed Sullivan Show in our industry, it's IPC APEX EXPO. Have something truly new? It needs to be seen here at IPC APEX EXPO; long-standing products and evolutionary advances from industry stalwarts will grow their installed base here, too. There are other industry shows, but the must-go show for our industry is IPC APEX EXPO; appropriately, it seems that this is the event's 23rd year, matching Ed Sullivan's television run.

In an earlier life as a software engineer at an ECAD company, the product manager for my project once said, "The only deadline that will never, *ever* slide is the tradeshow. We have to be ready for the show no matter what." Which brings us to the cover image for this issue: the stool on the stage, behind the curtain. For those of us who've taken the stage or floor, we recognize the tension and the





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excitement that go with the moment of taking your place just before the curtain opens. In entertainment, once the curtain goes up, you're on—for better or for worse. Anyone who has had to demonstrate a product that isn't acting the way it's supposed to, will know that same feeling.

This issue, we like to think, shows the same balance that Ed Sullivan always brought to his program—something for everyone.

We kick it off by giving the stage to Dr. John Mitchell, IPC president and CEO. Dr. Mitchell warms us up with an introduction to this year's show themed "Technology's Future Comes Together."

We step further in with a back-pocket overview of the show including facts, schedules, events and locations, and the keynote presenter.

Next up is our first headliner. CFX and Hermes will be a key highlight at this year's show. We spoke to Michael Ford and Dave Bergman about the live demonstration planned for the IPC APEX EXPO floor, and we tell you how to access the live data from the demo so you can fully experience CFX and Hermes in action.

Picking up the pace, IPC's Kris Roberson, director of certification, sat down with Nolan Johnson to preview the world championships for the IPC Hand Soldering competition. This competition is a big event worldwide; bringing the championships to the U.S. is a new development. Check in with Kris's interview and learn why you should be involved.

Following up, Collette Buscemi, senior director of education programs for IPC, explains the educational outreach plans under the STEM umbrella, how students will engage with the industry at IPC APEX EXPO, and what the goals are for expanding the program. Get involved after the show; this is the future of our industry.

New products are a key at any show, and IPC APEX EXPO delivers on that expectation. In "Shopping at IPC APEX EXPO: Evolutionary or Revolutionary Products?" Andy Shaughnessy looks at the new technologies, products, and announcements you should expect to see



at IPC APEX EXPO. Plus, he steers you to the complete list of new products.

Membership in IPC is key and growing. Mark Friedman, IPC member success advocate, tells Barry Matties what's new in membership, how industry members can get involved, and why they should.

Automotive technologies are at the fore during the executive development sessions this year. Patty Goldman and IPC staff provide an overview of the itinerary for the session.

Contributing editor Dan Feinberg channels his inner Bob Newhart in a phone conversation with Jim Hickman. Hickman and Feinberg were original members of the board of directors who launched the EXPO 23 (24? 25? there was some debate) years ago.

Wrapping up our IPC APEX EXPO preview, Andy Shaughnessy showcases the Real Time with... coverage that I-Connect007 provides on the show floor. Stop by booth #3119 to catch our interviews, share news with the I-Connect007 team, or even cut your own interview.

Michael Ford's column, "Accelerating Tech—Insights from the Smarter Factory," explores the productivity paradox using examples from automotive, Industry 4.0, and CFX. This column is a great follow-on to the CFX/Hermes interview with Ford and Bergman as previously mentioned.

And, in his ongoing "Quest for Reliability" column, Eric Camden takes us backstage, so to speak, with his review of testing standards published and maintained by IPC.

Yes, a well-rounded lineup indeed! So whether your role at IPC APEX EXPO puts you in the lights or making buying decisions, we'll see you there. **SMT007**



Nolan Johnson is managing editor of *SMT007 Magazine*. Nolan brings 30 years of career experience focused almost entirely on electronics design and manufacturing. To contact Johnson, [click here](#).



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3x Lam Cycles Standard Lead Time	20 Days	20 Days	20 Days	-
3x Lam Cycles Expedited Lead Time	7 Days	10 Days	7 Days	-
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IPC APEX EXPO 2019: Where **Technology's Future** Comes Together

One World, One Industry

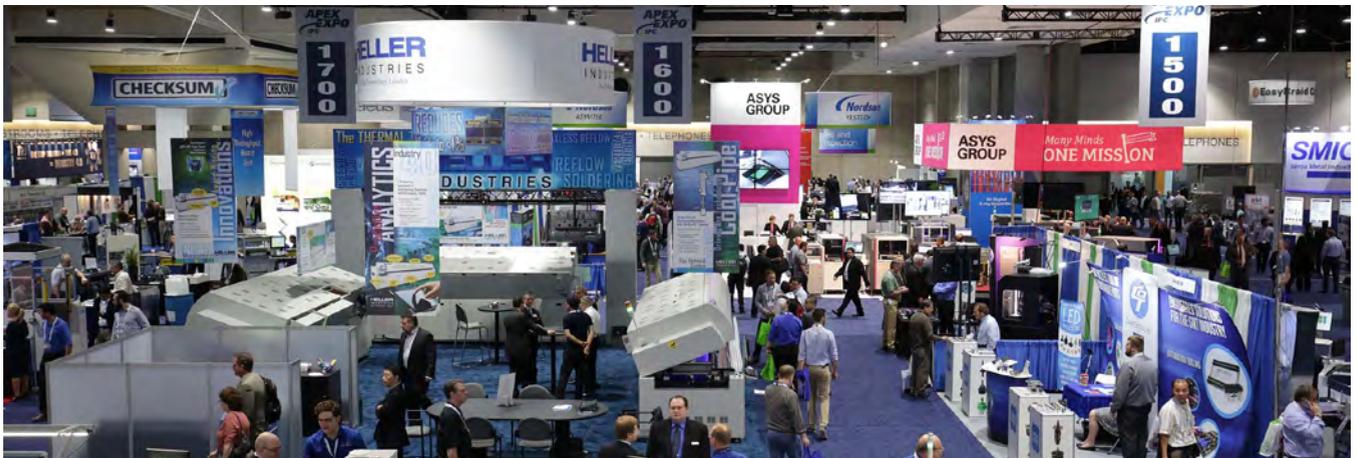
by John Mitchell, IPC—ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES

The electronics manufacturing industry continues to grow and change, and there's no better place to participate in the excitement than at IPC APEX EXPO 2019. We've built a strong community of enthusiastic individuals passionate about electronics manufacturing, and I'm eager to work with exhibitors, speakers, standards committee leaders, members, and attendees alike to ensure that "Technology's Future Comes Together" at the 2019 event.

While at the show, attendees will have the opportunity to experience and compare equipment from nearly 500 of the industry's top innovators and suppliers, discover new processes to gain greater efficiency, and find new suppliers while uncovering new solutions that will prepare them for tomorrow's opportunities.

Educational program offerings will help keep attendees and their companies productive in 2019. Here are my top eight reasons to take part in IPC's technical conference sessions and professional development courses:

- 1 All IPC APEX EXPO 2019 programming is designed to help address current and future industry challenges such as the expanding importance of automation and data exchange, the increasing miniaturization of assemblies, the need for low-temperature soldering to lower energy consumption, and the growing complexity of design.
- 2 The education is not theoretical—it's grounded in and driven by real-world applications that are happening right now.
- 3 All submitted abstracts are a snapshot of what the industry is interested in, and the education program committee is comprised of people working in the industry. Selected submissions are always based on how they will truly offer value to the attendee.
- 4 The content that participants experience during our technical conference is presented here first and is completely unique to IPC APEX EXPO.



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5. IPC APEX EXPO is a multidisciplinary event. This is an opportunity to learn while interacting with others who represent different functionalities within the supply chain. The conference also provides a greater, more well-rounded picture of the industry when compared to other events available.
6. Attendees will have the opportunity to connect with equipment and solution providers on the show floor to discuss how current or future technology may impact what they learned in the classroom.
7. Learn how updated IPC standards around reliability, assembly, and other concerns address changes in both traditional areas such as PCBs and emerging technologies like printed electronics.
8. 83% of IPC APEX EXPO attendees say the training and education delivered met or exceeded their learning objectives.

Further, part of the fun of attending IPC APEX EXPO is learning from individuals who are influential in the industry. IPC APEX EXPO 2019 will feature JB Straubel, chief technical officer (CTO) and co-founder of electric vehicle maker Tesla Inc. Straubel will present “Accelerating and Disrupting Innovation: The Tesla Story” on January 29. In his presentation, Straubel will draw on his extensive experience and share the history of Tesla, detailing that



An attendee participating in a buzz session.



Attendees connecting with exhibitors on the show floor.

innovation was not an add-on to its operations but woven into every element of the business. He will also answer the perennial question, “How can my organization re-engineer itself to create products and ideas that answer 21st-century needs?”

From the show floor to the classroom and all points in between, IPC APEX EXPO 2019 is the place to be to learn, network, conduct business, and create new relationships while building on established ones.

Every year, IPC APEX EXPO provides me with unique ways of learning things I didn’t realize that I needed to know. I look forward to seeing you and learning along with you in sunny San Diego in just a few short weeks!

A few noteworthy happenings:

• Show Floor Reception: January 29

You’re invited to the industry’s largest networking event—the IPC APEX EXPO show floor reception. This is your opportunity to network with industry colleagues, make new connections, and interact with nearly 500 exhibitors in a dynamic environment.

• New Products Corridor

View cutting-edge products and services in the New Products Corridor located in the Sails Pavilion (upper-level exhibit hall). Get a sneak preview of tomorrow’s equipment, materials, and services that are breaking new ground in our industry.

- **Connected Factory Exchange (CFX)**

IPC-CFX is an electronics manufacturing industry developed standard forming the foundation and backbone of Industry 4.0 applications. Participate in a live demonstration of IPC CFX on the show floor with a larger presence of supporting exhibitors for 2019.

- **IPC Hand Soldering World Championship and Rework Competition: January 29-30**

Competitors will be presented with a soldered assembly that will be partially populated with components. Contestants will be required to remove six specific components, remove the old solder, and clean the area of removed components. This will take place in the Sails Pavilion (upper-level exhibit hall).

- **Ice Cream Social on the Show Floor: January 30**

Satisfy your sweet tooth while networking with the innovators and suppliers of the electronics industry. Check the IPC APEX EXPO mobile app for the specific time, so you don't miss out on the fun!

- **Passport to Prizes: January 31**

Travel around the show floor collecting stickers from participating exhibitors and enter for



Attendees networking with industry professionals.

a chance to win an exciting prize including an Apple Watch, GoPro, VR Headset, Ring Doorbell, and Star Wars Hero Droid BB-8. Submit your completed card to the IPC Bookstore on or before Thursday, and attend the drawing giveaway at 12:30 p.m. SMT007

For more information on IPC APEX EXPO 2019, visit ipcapexexpo.org.



John Mitchell is president and CEO of IPC—Association Connecting Electronics Industries. To read past columns or contact Mitchell, [click here](#).

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IPC APEX EXPO 2019

Schedules, Stats, and Programs

Feature by Nolan Johnson
I-CONNECT007

IPC APEX EXPO 2019 will open its doors at the San Diego Convention Center in late January. IPC APEX EXPO is regarded as the largest event for electronics manufacturing in North America, attracting more than 9,000 professionals from 45 countries.

Attendees at all career stages can expect to access new research and best practices; learn about trending materials, applications, and processes such as Industry 4.0 and wearables; address real-world problems to help with job success; experience the largest electronics industry collection of top suppliers, live demonstrations, and extreme innovations; and make connections in educational sessions on the show floor and during networking events.

Read on to find schedules, stats, and programs in preparation for IPC APEX EXPO 2019.

Event Information

- Meetings: January 26–31
- Courses: January 26–31
- Conference: January 29–31
- Exhibition: January 29–31
- IPC CID/CID+: January 31–February 3



EXPO by the Numbers

- 8 Buzz sessions
- 16 Special events
 - Chairman's reception
 - Event awards luncheon
 - Hall-of-fame breakfast
 - IPC first-timers welcome
 - IPC annual meeting
 - Opening keynote
- 5 Management sessions
- 30 Professional development sessions
- 36 Technical conference sessions
- 105 New product announcements
- 117 Standards committee meetings
 - 23 Assembly and joining
 - 17 Base materials
 - 11 Cleaning and coating
 - 10 Electronic product data description
 - 4 Flexible and rigid-flex printed boards
 - 6 High-speed/high-frequency interconnections
- 4 Management
- 6 Packaged electronic components
- 4 Printed board design technology
- 13 Product assurance
- 6 Rigid printed boards
- 3 Testing
- 10 Other topics



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Activities

Innovation Awards

The IPC APEX EXPO 2019 Innovation Awards are a celebration of the innovators and forward thinkers who are changing the technological landscape of the electronics industry.

Buzz Sessions

Buzz sessions are free, educational, and informational and are meant to bring participants up to speed on the topic. They are usually moderated and may include one presenter or multiple depending on subject matter. Questions from participants are encouraged; for some sessions, questions can even be submitted ahead of time. Here is a list of the current [buzz sessions](#):

Export Control

- January 28, 10:30 a.m.–12:00 p.m.

E-textiles—The Fourth Industrial Revolution

- January 29, 1:30–3:30 p.m.
- Send your electronic textile integration questions in advance to etextiles@ipc.org

IPC-2581

- January 29, 3:30–5:00 p.m.

Perm Buzz Session

- January 30, 9:00–10:00 a.m.



Impacts of Warpage on SMT Processes

- January 30, 10:30 a.m.–12:00 p.m.

Shoring Up the U.S. Defense Electronics Industrial Base

- January 30, 1:30–3:30 p.m.

Findings from IPC's PCB Technology Trends

- January 30, 3:30–4:30 p.m.

iNemi Next-Generation Solder Materials

- January 31, 8:00 a.m.–2:00 p.m.

Management Programs

EMS Executive Management Meeting

- January 28, 7:30 a.m.–5:00 p.m.

Executive Forum on Advancing Automotive Electronics

- January 28, 7:30 a.m.–5:00 p.m.
- A must-attend event brought to you by the IPC Hall of Fame Council

Technical Information for Designers

Ray Prasad, Ray Prasad Consultancy Group

- Design and assembly process challenges for bottom-termination components such as QFN, DFN, and MLF in tin-lead and the lead-free world

Dale Lee, Plexus

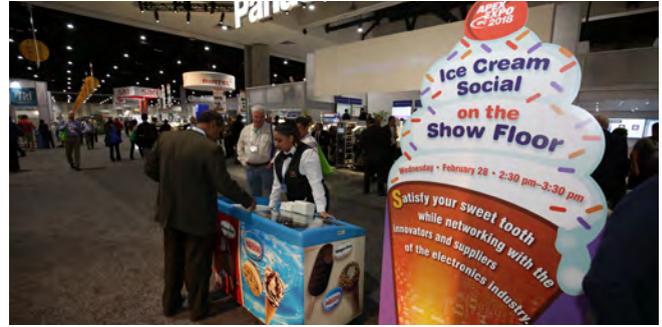
- Design for excellence: DFM, DFR, DFA, and more—Parts 1 and 2

Martin Goetz, Northrup Grumman Corporation

- Designing additive manufacturing/3D printing to PCB fabrication and assembly
- High-speed/high-frequency laminate materials used in design
- Electrical and thermomechanical design constraints affecting system and component performance

IPC Designer Certification (CID and CID+)

- Tutorials January 31–February 2
- Exams February 3



Professional Development Program Highlights

Topics include reliability, reflow soldering, troubleshooting PCB related defects, Lean practices, design for testing (DFT), thermal management, high reliability for lead-free solder joints, electrostatic discharge, design for manufacturing (DFM), contracting with the customer, PCB fabrication basics, and process and specification.

Show Floor Highlights

January 29

You're invited to the industry's largest networking event—the IPC APEX EXPO show floor reception. This is your opportunity to network with industry colleagues, make new connections, and interact with nearly 500 exhibitors in a dynamic environment.

January 29-30

The IPC World Championship Hand Soldering and Rework Competition will require steady hands, nerves of steel, and a will of iron—only at IPC APEX EXPO 2019.

January 29-31

Participate in the live show floor demonstration of the IPC CFX Industry 4.0 protocol. Look for CFX supporting booths to answer all your questions.

January 29-31

The New Products Corridor will be the place to find cutting-edge products and services. This showcase of innovation will be located in the Sails Pavilion (upper-level exhibit hall).

January 30

Satisfy your sweet tooth at the ice cream social while networking with the innovators and suppliers of the electronics industry. Check the IPC APEX EXPO app for the specific time. You don't want to miss out on the fun!

How to Connect

Available mid-December on Google Play and the Apple Store, the IPC APEX EXPO smartphone app allows you to plan for sessions and events at the expo, review the show floor exhibitors, stay informed on schedule updates, and receive event alerts as they happen. You can also use the schedule at a glance from the IPC APEX EXPO conference guide. **SMT007**

For more information, visit the
IPC APEX EXPO 2019 website: ipcapexexpo.org
email: registration@ipc.org

or call the attendee hotline:
Toll-free: 877-472-4724
Outside of the U.S. and Canada: +1 847-597-2861



OPENING KEYNOTE
JB STRAUBEL

Accelerating and Disrupting Innovation: The Tesla Story



by Nolan Johnson
I-CONNECT007

Each year, IPC APEX EXPO features the industry's most dynamic, innovative minds to deliver keynote presentations that are both educational and entertaining. IPC APEX EXPO 2019 will feature JB Straubel, chief technical officer (CTO) and co-founder of electric vehicle maker Tesla Inc. Straubel will present "Accelerating and Disrupting Innovation: The Tesla Story" on Tuesday, January 29, 2019 (8:30–9:30 a.m.).

In his presentation, Straubel will draw on his extensive experience and share the history of Tesla, detailing that innovation wasn't an add-on to its operations, but woven into every element of the business. He will also answer the perennial question, "How can my organization re-engineer itself to create products and ideas that answer 21st century needs?"

At Tesla, Straubel focuses on technical direction and engineering design including battery technology, power electronics, motors, software, firmware, and controls. He also launched many Tesla initiatives including the Tesla Energy business providing grid storage for commercial utilities and residential consumers, the worldwide Tesla Supercharger network of fast DC chargers, and the Tesla Gigafactory, which is leading the way toward increasing worldwide battery production and lowering the cost per kWh. He is also responsible for new technology evaluations, R&D efforts, and technical diligence reviews of key vendors. Breaking through barriers to innovate faster and better has been Straubel's strength.

Straubel's keynote session is free to all registered IPC APEX EXPO attendees. **SMT007**

Reprinted from the IPC APEX EXPO conference guide.

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IPC APEX EXPO 2019 Offers a Full Operating CFX Demo Line

Feature by the I-Connect007 Editorial Team

A year on from their first demonstration, IPC's Connected Factory Exchange (CFX) now nears the release of version 1.0 at this year's upcoming IPC APEX EXPO. The I-Connect007 team spoke with CFX specialists Michael Ford and Dave Bergman about how far the program has come from the first initial public demo all the way through now becoming a published standard, and what users can expect from the demonstrations planned for the 2019 show.

Barry Matties: Gentlemen, can you please tell people about the CFX program at IPC APEX EXPO 2019—what should they know?

Dave Bergman: I am the current staff liaison for the CFX committee for IPC. Michael serves as a working chairman. We have three chairmen, but Michael is a vital industry volunteer. He is the glue for all the pieces, answering tons

of questions, and giving presentations everywhere. He has a crucial role in this effort and works very hard on this, including staying up late to do interviews like this one. I am happy he is joining.

From IPC's perspective and what we have going, I think it's important to note that IPC-2591 CFX is marching forward continuously and getting nearer to publication. CFX is in a 30-day final draft for industry review cycle per our standardization rules. Then, it will be followed by a 30-day vote cycle where companies need to give a vote of approval—a thumbs up, thumbs down, or technical comments.

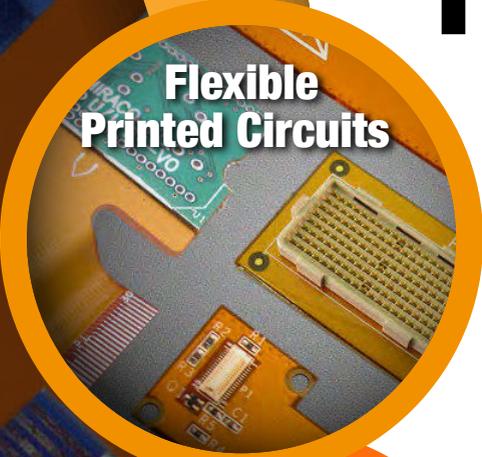
We're doing this circulation slightly differently: IPC-2591 explains everything about CFX and provides examples and explanations. The nuts and bolts of CFX, which are the messages that machines both publish and consume, are on the open-source software development site called GitHub. We pushed both the standard and the GitHub link out a week or so ago to have people starting to look at. I am happy to announce that we are getting closer to the release of version 1.0 of CFX.

At the same time that we're doing that, Michael and the committee decided we had to draw a line in the sand somewhere. We looked at this and said, "Does CFX have enough content that the industry can start implementing it and getting excited about it?" We drew the line in the sand and said, "Okay, this is enough for now. Let's stop here, get this approved and published, and then we'll turn our focus on

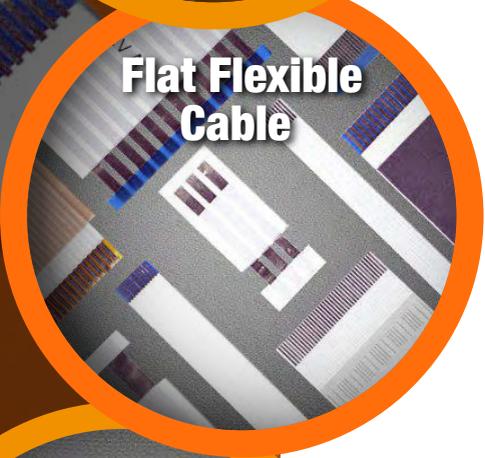


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additional messages.” At IPC APEX EXPO, we will start to discuss messaging for the 1.1 version of CFX, which will be part of the activity that takes place in San Diego this year.

In addition, we will highlight several things at IPC APEX EXPO 2019, including the collaboration between IPC and the HERMES Consortium. The HERMES standard should also be approved as an IPC standard IPC-9852 because that is undergoing a consensus vote very soon. The HERMES Consortium will also meet at IPC APEX EXPO 2019, so they will be talking about any potential upgrades for that standard format.

Then, the most exciting thing will be the show floor demonstration. We plan to have two manufacturing lines. We needed to go with two because there are more and more companies interested in showcasing their capability. We will have one manufacturing line, which is a combination of both the HERMES format, which will be IPC-9852, and CFX, which is IPC-2591. We’ll run messages in both of those standards and an assembly operation on the show floor.

We will have a second line, which will be all CFX. Some companies don’t do both formats. Some companies have said, “I can only have so many manufacturing pieces of equipment within the line.” So, the second line gives more companies the ability to participate outside of the combined HERMES/CFX line. I think people are going to get to see some very exciting activities. We’ve been building on this. We did the first CFX manufacturing line in Birmingham, England, in the U.K. in September. Then, we did one at the LEAP Expo with MMI in Shenzhen, China, in October. This will be the next step—adding in collaboration with HERMES—and then expanding from our virtual demonstrations when we have that at this year’s IPC APEX EXPO.



Michael Ford

Michael Ford: Yeah, it’s easy to forget that it was not even a year ago at IPC APEX EXPO 2018 when people saw CFX working for the first time. The people there could not believe that they could just go to a QR code with their mobile phone and look at data with value and meaning from so many different machine vendors all in one platform—no installation or configuration, it was just there. That was the point where started to chart the history of what’s happened over the last

year in terms of people getting really excited about it. Whenever we talk about CFX, you would think that people would be into all of the messaging, protocol, and technical stuff, which people do have an interest in. But for me, most of the questions surround, “How is CFX going to solve Industry 4.0 and how is going to bring me that value?” People are talking about the value that is brought for manufacturers as well as that for machine vendors.

For example, in the beginning, we had a number of machine vendors who were interested in taking part in that very first demo. What you will see coming up is that so many more machine vendors have come along. Even those who had kind of been holding out, hedging their bets, and waiting to see what the industry was going to do have heard from customers who had specific issues in manufacturing related to Industry 4.0, and suddenly related to making machine processes smarter than they used to be.

They’re being faced with the idea of having to develop something again, worrying it’s going to cost too much money, and it will all be bespoke for this customer. But now CFX is in their minds, and they’re thinking, “Well, with that CFX demo we saw, we could use the messages in that to achieve what we want to do.” They start to really understand the business process that this represents for the whole industry. It’s

not just one or two companies or certain of companies—absolutely everyone that is involved is going to benefit from this.

As we've been talking about CFX, the business processes have been put into place as well. That is what drives the achievement of that critical mass of adoption for the standard, which I believe is happening behind the scenes right now. A lot of companies have taken on board their own demonstrations. They've set it up in their own workshops and are starting to go out and explain it to customers proactively. We've had people come along recently and say, "The software development kit (SDK) that we have is completely free of charge from IPC and it is so easy for people to adopt CFX, but what about smaller pieces of equipment?" We had one company with soldering irons. How do you embed a whole infrastructure of an industrial internet of things (IIoT) standard within a soldering iron? They came up with a solution. It's a five-millimeter square chip, and they're running a Linux-based software development kit and producing CFX messages directly and natively from their soldering irons.

This is something I hope we are going to see at IPC APEX EXPO 2019—the fact that it's not just the big expensive machines now. The majority of the machines that actually exist in the factory are smaller, bespoke, niche, specialist, and even homemade for the functional testers. We're even talking about a method to integrate all of that within CFX as well. It means that the excitement is reaching areas that, from what we've seen in the past in terms of communication, it has never even gone to. It's never even been able to get kind of close to these areas.

But CFX, even now that we are imminently close to publication, has already started to reach these kinds of people. It's really exciting to see



Dave Bergman

it coming together because that marks the sustainability for CFX in the future. We've had an incredible year with so many people providing contributions and ideas, and getting together and talking. Even direct competitors are willing to talk to each other and help each other out in certain areas. It's been an amazing ride.

The milestone of getting this first revision, as Dave said, has everything in there that we need to establish this as a real, usable, and valuable industry

standard, and we will have further messages to come. On this publication date, we're going to find a lot of people who already have embedded CFX into their machines. We have around 40–50 different machine types that already have CFX. Many people are already developing and close to having full support for their machines. This was an amazing year from the first initial public demo all the way through now to a published standard, and not only that, but the actual implementation being supported as well.

Matties: When you look at a visitor at the show, how will they tour the CFX demonstration? Is it a booth-by-booth tour, or what's it going to look like?

Bergman: Barry, we're physically planning to build assemblies at the show, so we will have two manufacturing lines—one with CFX only, and one with both CFX and Hermes. The plan is to put a bare board on, have an assembled board come out at the other end, and show users a variety of flat panel displays and the related the data, or they can monitor that on their phones.

I can tell you that when the Birmingham event took place, you could monitor what was going on with one of the reflow ovens including what the temperature was in each zone of

the oven on your phone as it went through. The data was being pushed live, and you could see what was going on in manufacturing. In addition to physically seeing what's going on, we expect that they'll be able to view it on a web browser on their phone as well.

Ford: It's really important that people come to the demo. A normal demo is kind of like smoke and mirrors—the people have fantastic claims and wonderful messages. However, with the CFX demo like the one we did last year, you can actually see the data, as Dave said. It's human-readable data. You can go to your phone and see that it's there. Nobody is hiding anything or pretending that something is working; it's right in front of people. That's when they get the thought, “Well, there's my traceability. I didn't have to pay for anything. It's right there.” That is really amazing for them.

Matties: Visitors can come to the show, see the process, and experience the data. Whether they are an equipment supplier or a fabricator, they're going to want more information. What will be available to them to look at in the next step? Will you direct them to the website, or is there any collateral material that you'll have to hand out? What's the takeaway?

Bergman: The thing I would like them to take away is a complete appreciation that Industry

4.0 is many steps closer to reality and is within reach of more companies—even small—and medium-sized companies.

It has been very gratifying to see IPC CFX being born. A year ago before IPC APEX EXPO when we were talking about CFX at production, we said maybe we should do a demonstration line. The questions we got from people were, “What the heck is this CFX thing? Who is supporting it?” The equipment guys said, “I won't support it unless my customer asks,” and the customer said, “My equipment guys won't support it, so I'm not really interested.” That has changed significantly over the last year and many more companies are on board. We have a [CFX website](#) where people can see who supports it now or where they can commit to join the movement.

It's challenging to try and do manufacturing demonstrations when you're writing the standard that you're using for delivering the messages, which is kind of scary in itself, but it's important because so many more people have heard about it. People are now asking more questions to consider than ever before. That tells us they're excited about it, and now they're visualizing what this can now do stuff for them, so how soon can we get to the really cool stuff? When Michael mentioned the different formats with Linux where we have a group, we were ready to form some subgroups to target these areas or allow companies to work together and say, “Okay, how about you guys focus on this. Build an SDK so that more companies using Linux can start to implement CFX.”

LabVIEW came up at the meeting on Industry 4.0 just this week in Fremont, California. There were a number of people interested in LabVIEW, and Python also came up. There are these formats where companies have software programming capability or things that they've been working on. This is what they're comfortable working with, but they really want to communicate with CFX, so how can IPC help do that? I guess the way IPC can help, like we do with anything else, is to try and get people





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with common interests together and work on it. We certainly want as many companies as possible to be able to use the format because that's the way that everyone will benefit.

Matties: Is there anything that we haven't talked about that you feel like visitors should know?

Ford: One of the most important beneficiaries of CFX is manufacturers. In the committee so far, and we have a few actually, the most vocal people have been machine vendors and solution providers because we understand the pain that's been gone through. When I say to people, "Guys, this will last interface that you will ever have to develop." They know that they're supporting 30–40 bespoke interfaces for customers that can now be just replaced by one. They get it, but I think we need to talk to manufacturers as well because it's the chicken and the egg scenario in terms of, "Do manufacturers want to use it, and will equipment vendors support it?"

We're making headway with the machine vendors and manufacturers. A very large manufacturer in China has already come out and said they expect all of their equipment vendors to support CFX in the future. We need more people to do that. We need people to see the demonstration, ask questions, and come to us with their challenges: "Can CFX do this for me? Can CFX provide the data that I need here? Can I get the level of control?" Come along and see what those answers are. We can start to talk about the real benefits for manufacturing, and that pays for the whole thing. Manufacturers will get the benefit from the data, the machine vendors will see the demand from the customer, and everything starts to work. It's really important that we start to get the actual manufacturing customers involved in seeing this demo.

Bergman: There are a couple things I would like people to take away with from the show. We have a core group out of hundreds of people

on the CFX committee. In our current committee that we're managing from headquarters, there are over 250. Our IPC China team has a local committee also working on it at the same time, and there are around 100 people there. We have 350–400 individuals who are interested in working on IPC CFX. There were a lot of messages written, and some individuals carried the lion's share of the work to get it to the point where it could start to take on a life of its own.

The CFX messaging is done in an open-source software-development mode. We have proven that this can work. I'd like to see that catch fire. What I am trying to do is plant seeds that say, "Don't expect me to write all of this stuff for you. You want CFX to do cooler stuff, so you can help by writing a message." We had companies come in with a whole section of messages on sensors that we weren't expecting or it wasn't on our list. A guy came in and said, "This makes sense to me. I understand this. It doesn't look so hard. I'm going to write all these messages," and when he was done, everybody thought it was pretty darn good. We were able to add a new section with minimal modification.

What I am starting to hear—particularly from some people that I've known for many years that are now in different job functions—is, "Dave, what's going on with CFX? Can it do this, this, and this?" I say, "Well, I don't know that I'm smart enough to know all of the answers to those questions, but I can point to where the messages are, and you can tell. If it doesn't, it means the message hasn't been written yet, so why don't you look at that if this is important for you and draft a message. You won't break anything."

The development process is not going to allow something to come in without some vetting. We have experts in the committee that spend a lot of time debating whether things make sense. They edit them, and we get comments on them. They won't be pulled in until they've gone through a vetting process. I would like this to get to the point where we

spread the writing, and more people submit messages because then CFX could grow even faster.

Matties: Do you have a classroom or session talking about CFX for people to attend as an overview?

Bergman: We give a lot of presentations. I honestly don't think we will for IPC APEX EXPO this year. I'm not sure we'd be able to do that with all the demonstration lines and the committee meetings. Michael travels the world giving these presentations. I don't know how many presentations you've made, Michael, but I'm sure it's a lot at the various PCB conferences and different assembly shows. We get a lot of visibility; I just don't know that we'll do a tutorial. I can tell you from a messaging-writing standpoint that we recorded a great webinar that's available on the [CFX website](#). I've been pointing to people there who are interested in trying to look at this. Watch the video, and you'll find it's not as hard as you think.

Ford: At the show, there will be times where we'll start to produce actual PCBs, which I think is a good demonstration to do as an introductory presentation. We could probably do a very short presentation where we let people know the basics while at the line and see the actual boards being made. We could explain what's happening and give some background on CFX so they can understand the context of what's been shown. It would probably be five or six slides to get people to understand the technical side and the value. Then, each individual vendor could explain what they see as people walk down the line.

Bergman: I think it's important to highlight the fact that we're going to be demonstrating two standards. We have managed to pull together



two open industry standards, which will be two approved IPC standards. We've found a way to demonstrate how they can work together to benefit the industry. Both HERMES and CFX will be showcased. That could've just as easily been perceived as a competitive thing and had them go in different directions, but that's not the case. They're going to be working in lock-step with each of their strengths, and we'll be able to show that.

Michael, one of the things that came up at the conference and when we toured Nuremberg a little bit was the retrofit for pieces of equipment that may not be the newest. There's certainly of interest from some of the big EMS companies with a huge install base looking for opportunities: "How can I get this manufacturing line? I can't afford to replace everything? How can I get these things to play in the CFX world?" We saw some of that starting to happen at one of the booths in Nuremberg, and I'm hoping that will continue.

Ford: Yes, that's one of the key things. Look at Industry 4.0. Everybody is thinking, "Wow, do I have to buy all new equipment? Do I have to replace everything in my factory even though it works?" With CFX, we provide a solution

for that. I would expect current machines will be fitted with CFX. Even those under support should be very easy to extend the support back. But some old machines are 10–20 years old and had no idea there was going to be this kind of revolution. If we look beyond electronics to even robot and mechanical assembly, again, the interfaces are nowhere near as developed as the modern surface mount area. So, we have to have a strategy to expand CFX to those machines.

Now, when any factory becomes smart, people will try to look for solutions that they can apply off the shelf. To get a 100% solution, no matter what anybody may claim, it's not going to happen. You'll always end up with a load of machines that are kind of in blackout as far as visibility is concerned. The nice thing about CFX is that customers themselves can take that software development—the IT people who are the ones wanting to take responsibility for the factory but don't want to develop everything themselves. They can take CFX and apply it to the machines that they created within the factory. They can equip them with a CFX interface.

Now, there may be some very old machines where you might think, “How on earth do we

get information out of these?” It's going to be necessary to put in some sensors to interrupt some lines of communication within the machine to try and get out some status. We see that at least three or four hardware vendors are coming along and saying they can retrofit some kind of hardware interface onto these machines, which is not a real expensive thing. This is like a Raspberry Pi computer that costs \$30 or this system-on-a-chip that we see in soldering irons that costs \$14, and you have a CFX client on that. You connect through sensors into the machines. They may not be the cleverest machines in the world, but they are machines that work adequately and are part of this digital factory.

Let's not forget people who are at their manual workstations accepting products in and out—doing, recording, and noticing things, and acting. Their activities have to be recorded as well. CFX extends into user interfaces that may be present in the factory. There's something here for everybody to do. It means getting to 100% visibility without resorting to a customization that is going to be very, very difficult to sustain. It's all going to be based on this one standard and work together seamlessly. That's what CFX is all about.

Matties: You're giving an opportunity for DIY-ers all the way to buying new equipment that's ready to go.

Ford: Absolutely.

Nolan Johnson: Gentlemen, I just wanted to circle back to what you're doing at the demo at IPC APEX EXPO 2019. I heard you say that you will be able to monitor some of the parameters from the machinery in real time on the show floor with a smartphone. Did I hear that correctly?

Bergman: Correct.

Johnson: Is that something where that application can be downloadable by visitors at the





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show so they can actually watch that happening on their own phone?

Bergman: Yes, they can visit the website, which we used at last year's show and in Germany. We've used that quite a few times this year, but basically, they visit the website where it's running. If you want to see it, the website is live and being used as a test bed for equipment manufacturers that are working on their CFX interface. Visit connectedfactoryexchange.com. Companies have found it's a helpful tool. It's also been really helpful for the equipment guys who are playing around with trying to build some interfaces. We think IPC APEX EXPO 2018 was the first time that it was ever done—very exciting.

Ford: Yes, we use QR codes to make it easy for people to do it; they can simply visit the URL. There's no app to install or configuration—nothing at all. They go there and the data is there waiting for them. It's updated live. You can look at it right now. There are actually four people who are currently testing this CFX interface online right now as we speak.

You just reminded me of something. Throughout this whole year of trying out and developing CFX for the various shows and demonstrations that we've been doing, there has not been a single business trip taken by anybody—not the engineers. We have not had any problems with people arguing with each other, exchanging non-disclosure agreements (NDAs), or talking about how interfaces work. All of the normal pain associated with any two pieces of equipment talking to each other has been completely eliminated with CFX. What you see with CFX is how that happened. People can see the data from their machine, know that it adhered to the specification of the standard, and the job's done; that's all they needed to do. As long as what they produce matches what is in the standard, then they are confident that their machine can talk to anybody else's machine and any customer's systems. It's a revolution in the way that the interface has been developed.

Matties: Sounds like we can use this in our politics (laughs).

Ford: Save the environment, reduce business trips and lawyers, and all kinds of stuff. A bunch of things make a difference.

Matties: You keep it simple, and simplicity is elegant.

Ford: Absolutely.

Matties: This is going to be exciting. We look forward to the show, and while we're there, we'll be sure to cover this extensively with our editorial crew, get user feedback, and interview people on their takeaways with their experience with this demonstration.

Ford: That's very cool. Thanks.

Matties: Thank you guys very much.

Bergman: Thank you. SMT007



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Who's the Best of the Best in Hand Soldering?

Feature by Nolan Johnson
I-CONNECT07

IPC APEX EXPO 2019 will include the new IPC World Championship Hand Soldering and Rework Competition on the expo floor on January 29 and 30.

IPC's website describes the contest as follows: "Competitors will be presented with a soldered assembly that will be partially populated with components. Contestants will be required to remove six specific components, remove the old solder, and clean the area of removed components. The competitor's time to completion is paused while an IPC master instructor evaluates the removal results and scores the board according to IPC standards. Once the evaluation is completed, time to completion will resume, and the competitor will be required to place the remaining components including new parts in place of the removed components. The competitors will have a total of 75 minutes to complete the rework and soldering of the circuit board."

Twelve competitors from Britain, China, France, Germany, India, Indonesia, Japan,

South Korea, and Thailand will compete for the crown and the title of the first-ever IPC World Hand Soldering and Rework Champion.

The IPC hand soldering competition is a growing competitive program around the globe. Hand soldering has become even more skillful and challenging as parts technologies and dimensions have evolved. As a result, local competitions in Germany, the U.K., France, China (multiple), Vietnam, and Taiwan continue to thrive, speaking to the artistry and technique shown by master solder technicians.

Though the hand soldering contest was previously a part of the IPC APEX EXPO program, U.S. participation has been low in recent years. This year's strategy has two parts: bring the hand soldering world championships to IPC APEX EXPO and introduce high school students to this crucial professional discipline through on-site instruction.

Over the two days, five soldering stations will be set up for competitor use. Judges will be certified master trainers for IPC. The finished assembly will be judged based on the current IPC-A-610 standard. During the competition, judges will monitor competitors and

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parts, and assembly instructions with the board required to be functional at the end of the assembly process.

This year, competitors will receive a partially assembled board with instructions to remove some of the components and prepare the reworked area for reassembly. Judges will stop the clock after component removal, inspect the work, then restart the clock as the competitors reassemble and finish the

work instructions.

work instructions. This competition can be surprisingly vibrant. “In other countries, spectators will bring vuvuzelas [stadium horns] and attend in large numbers. It’s a big event!” shared Roberson. “Not only are the competitors timed and judged to Class 3 requirements, but they also have people hovering over them. Meanwhile, everything they’re doing is up on the big screen.”

In trying to answer the question as to why the interest in the U.S. competition is not as enthusiastic as elsewhere, Roberson suggests, “Part of it is that the factories don’t want to let their most talented staff off the line. They need these people working, making money.” He continues, “In other places and cultures,

evaluate habits, techniques, and rework processes based on the IPC J-STD-001 standard and the IPC-7711/7721 guideline document.

Competitors’ work will be judged first on quality. Points are deducted for flaws and problems with workmanship, work practices, and safety. In the case of a tie in points, the victor will be the competitor with the fastest overall time. Even with the difficulty of the board to be built, when more than one competitor delivers a perfect board, quality is not sufficient to win. There have been multiple instances in which the competition came down to build time. Kris Roberson, IPC director of certification programs, says, “These people are very excellent at their work! The criteria for judging the competition mirror the job performance criteria for our contestants. Even in the factory, the priority is quality first, but quality can’t take very long to achieve.”

Each year, the competition uses a different board design and parts lists and includes a variety of unexpected twists that reflect real-world situations. This year, the competitive twist is a rework requirement in addition to standard assembly. In the past, competitors have received a bare board,



the craftsmanship embodied in this set of skills is recognized and admired. Being proclaimed the world's best at something is really a significant achievement no matter what the skill is.”

“The people doing this work deserve respect. It's intricate work, especially as components keep getting smaller and smaller down to 01005s. We haven't put any of those components in the competition yet. We're down to 0402s, and we'll probably go smaller in the coming years as we make the competition a little more challenging every year.”

Roberson points out, “When a company can go to their customers and say ‘Look, we have the world's best soldering technician on our staff and they'll be building your product’, that can be a boost to the business. For example, a former winner of the U.S. competition has seen this title continue to help him in his career. Now he's an instructor for his employer.” Even in the U.S., the cache of this competition is still regarded with respect.

Product development can depend upon hand soldering skills as well. Roberson states, “In many cases, prototypes simply aren't ready for prime-time production, requiring the prototypes to be assembled by hand. The experiences of the soldering technicians are also problem-solving feedback for the production process.”

The industry also benefits from these competitions in some unexpected ways. Roberson mentions that a number of techniques submitted to IPC repair and rework committees have come from what contestants demonstrated during a competition.

Sponsors (American Hakko Products Inc. and Thales Dms France SAS) are providing the soldering stations and inspection equipment. The competition is also partnering with Blackfox Training Institute and others to coordinate and supply certified judges for the competition. Roberson points out that by sponsoring this competition, sponsor companies

gain a forum in which to show the industry how their product performs in real-world use, “As opposed to that same equipment running a robotic demo pattern as they often do on the show floor,” Roberson adds.

Roberson also notes that we face a shortage of new, younger talent entering into these technical professions, calling it “the graying of the industry or the gray tsunami.” He sees the competition and the STEM program as crucial to the industry: “We need these kids to get excited about manufacturing and soldering, and pick up the knowledge from the experts.”

As a result, the competition equipment on Thursday at the expo will be used as part of the STEM program, which is new this year. Local high schools will be invited to participate. Students can see some practical demonstrations, and then in teams of five, take over the soldering stations and get the chance to assemble some boards themselves. It's an opportunity for these students to get practical experience.

“The products we work on are, in some cases, life-saving products; they're not just sitting off in a corner. People live longer lives because of what we do,” Roberson concludes.

For more information, or to sponsor the competition, visit the [IPC Hand Soldering Competition webpage](#) or [contact Alicia Balonek](#), IPC senior director of tradeshow and events. **SMT007**





STEM: The Future of Our Industry

Feature Interview by Barry Matties I-CONNECT007

Facing a growing shortage of talented labor with which to fill the employment positions in America, IPC is working to help solve this problem. With over 4,400 members globally and chapters in almost every state, Colette Buscemi, senior director of IPC's education programs, is encouraging IPC members to better engage pre-college and post-secondary college students at the local level. Barry Matties spoke with Colette about the educational programs IPC has put in place to invest in future generations, including the STEM program at this year's IPC APEX EXPO, which has doubled in size from last year.

Barry Matties: You're the senior director of the education program for IPC. First, tell me a little bit about your position and what you do.

Colette Buscemi: I was hired in January of 2018 to oversee IPC's education programs targeting high school or pre-college students and post-secondary college students. We're also looking at K-8 but in a slightly different way. The goal is to attract more students into the electronics industry generally, everything from engineers to operators and technicians.

Matties: I know you have a STEM program at IPC APEX EXPO. We're proudly sponsoring

that. Tell me a little bit about what the program and what people can expect.

Buscemi: We're super excited about IPC APEX EXPO 2019. When I joined in January of 2018, within two weeks, I was at the show, and we had already set the foundation for what you're going to see in 2019. Our goal is to get in 100 students from the local San Diego region. We're going to provide them with a full day of activities beginning with a breakfast and a panel session of industry leaders who will be talking about careers in electronics. Then we'll spend about an hour to an hour and a half with the students on the floor showcasing all the exhibition has to offer. We'll also be giving the students an opportunity to have a hands-on experience with soldering. We're bringing in some of our trainers to support us, so the students will have a good experience and exposure to what the purpose of a PCB is, how it's designed, how they interact with it—everything from “that's hot, don't touch it,” to the basics and fundamentals.

The goal is to expose them to see, feel, touch, and experience what this industry is about, and there's no better way to do that than getting them on the floor or putting tools in their hands so they can see how the equipment works. We'll also be providing them with potential mentoring opportunities. We're building that program as well. They'll have a well-rounded day.



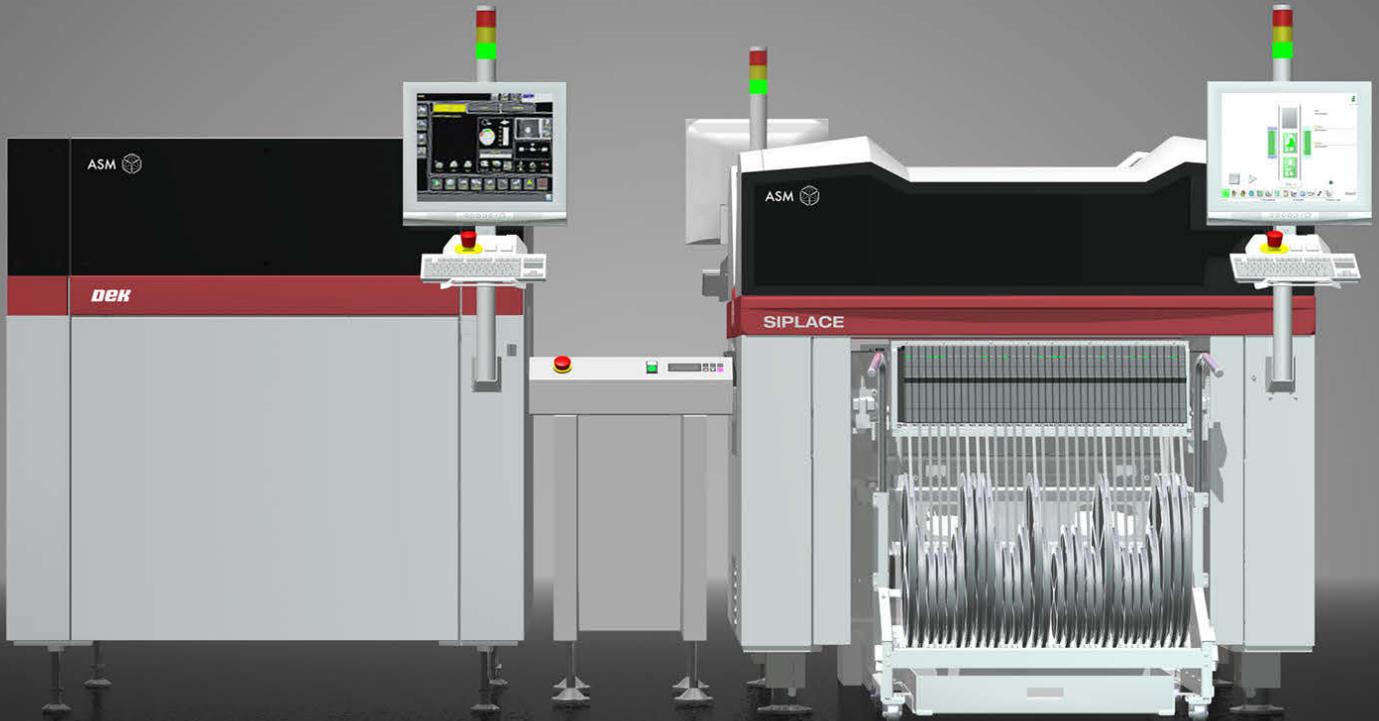
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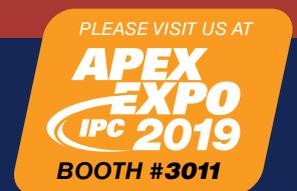
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Matties: When you say mentoring opportunities, can you talk more about that?

Buscemi: When we talk with college students, one of the most important things they ask us for beyond courses is connections to the industry. We will have thousands of people at this event. We're figuring out how we can start to build our mentoring program and use IPC APEX EXPO as the launching point. Whether it's an open Q&A where we have some of our industry members present and talk to the students, or we do one-on-one "speed dating," we're in the process of building that program and welcome participation from our IPC industry members. We believe that 2019 and 2020 will be even better.

Matties: Last year was the inaugural STEM event with high school students. What feedback did you receive from students?

Buscemi: We received great feedback. They were all very excited to be there. In fact, we gave a scholarship to one of the schools, awarding \$1,000 to Canyon Crest Academy and Preuss School to help fund STEM programs. We plan on repeating that this year. The students were really excited about the opportunity to get on the floor, and they were really impressed with what they saw. We took them through the booths of Panasonic and Nordson, and many of our members stepped up to the plate and took the time to have these students tour their booths. They loved it. The students enjoyed the opportunity to see this equipment and get a first-hand view of what was happening.

Matties: If you look at the climate today, we know how difficult it is to keep our supply of talent in the labor pool; I think it's the most vital resource we have.



Colette Buscemi

Buscemi: According to Deloitte and the Manufacturing Institute, it is estimated that in 2025, two million manufacturing jobs will go unfilled due to the skills gap. We need to fill those jobs and have a technically competent, skilled, knowledgeable workforce to do that. There are many things we need to do to attract the next generations of workers to our industry, and our efforts must start at an even younger level. That is why we are starting in high school because we

know that's the feeder point, but reaching further down into junior high school will probably be the next thing on our horizon. We are also reaching out to local community colleges and universities to provide technical training and scholarships for students interested in pursuing a career in manufacturing, and connecting students with IPC industry members locally.

Matties: In the educational system, we see that not every child goes to a university. Some go to vocational schools, but not every high school has that available. It seems like this is a great opportunity to take some of those kids that may otherwise not have exposure into this industry and introduce them into a career path.

Buscemi: Absolutely. We talk about the three Ps: perception, preparedness, and pathways. It's a misconception that college is the only game in town, and I think we're culturally moving away from that mindset. Not only is it not the only game in town, but there are many different pathways, and these students need to be exposed to that. For example, part of our strategy is to work closely with career technical education (CTE) programs at the high school level across the country. With over eight million students in CTE programs and a fair number of them studying electronics, it's a chance to shine a light on the possibilities

and raise awareness of the opportunities that exist in the electronics industry. What we need to understand is what gaps currently exist in high school electronics curricula. How can IPC as an industry trade association supplement and enhance the content teachers are using so that when students graduate, they can hit the ground running?

If they're able to take an additional course or series of courses, that might get them a certificate or certification sooner, making them more marketable. They will have the skills that the industry is looking for. Given IPC's interface with the electronics industry and the fact that we have 4,800 global member sites, we are uniquely positioned to lead the way. For example, David Hernandez, IPC's senior director of learning and professional development, is heading up an initiative called the Jobs Task Analysis (JTA)—a volunteer effort by IPC industry members to document the core knowledge, skills, and abilities required to succeed in key roles in our industry. The outcome of this project will be to shape IPC's future certification and education programs for years to come.

Matties: When they come to this program, it's a great introduction to the industry. It sounds like you're putting together a nurturing path to carry this forward beyond high school. How many of the 2018 participants are on that path?

Buscemi: We just concluded a market study with a third-party research firm to identify the gaps and needs in current electronics CTE programs at the high school level. From this analysis, our plan is to develop resources and content to supplement what the students are learning, which will also include badging, certificates, and certifications. We plan to begin piloting this new offering in Q3 of 2019 by making it available to high school students and districts who are interested in partnering with IPC to integrate those programs into CTE course pathways.

Matties: When they come, what sort of feedback do you get from them about this industry or what they've learned throughout day?

Buscemi: We received feedback from one of the CTE instructors whose digital electronics students spent the day with us last year. He said the class was "wowed with IPC" at IPC APEX EXPO 2018 because they saw first-hand how the manufacturing process works in the real world with state-of-the-art equipment in PCB design and fabrication. We will be seeking feedback after IPC APEX EXPO 2019 to help us understand how we can make that experience better.

Matties: Is there a next step already in place that they sign up for?

Buscemi: We have two demographics—the high school student population and post-secondary students attending technical or community colleges or four-year degree programs at universities. For our college or post-secondary students, we have some exciting announcements that we're going to be making at IPC APEX EXPO 2019 related to IPC student chapters. For our high school students, we're looking at curriculum integration and enhancement, as I mentioned previously. We believe we can have the most impact at the high school level through that curriculum. We are very interested in engaging these students and their instructors, but the first step is to understand what they don't know and what they need to know.

The follow-up from IPC APEX EXPO from a programmatic standpoint is going to be building on the market research that we receive at the end of this year, and then starting to think about the curriculum that we're going to develop to enhance and support that. It's an exciting time for us. Many of these initiatives are very new, so your point about surveying and getting feedback is going to be a critical part of what we take into IPC APEX EXPO 2019.

Matties: What's the cost for the student to take part in this program?

Buscemi: For the students at IPC APEX EXPO, it costs them nothing. This is all subsidized by generous donations from scholarships and membership contributions. It gives them an opportunity to be in the space with industry members. We offer them breakfast, programmatic activity, and a very generous donation of time from our training centers. They do that free of charge. It's truly a community of people coming together to make this happen.

Matties: It's a great way for the industry to invest in the future.

Buscemi: And give back.

Matties: Yes, and help the kids today who could make this into a career. If somebody was interested in taking part and becoming a sponsor or supporting this, what would they need to do?



Buscemi: They would need to contact IPC. They can contact me to discuss supporting our STEM and education initiatives or my colleague, Dave Hernandez, if they are interested in joining the JTA.

Matties: Is there anything that we haven't talked about that you feel we should include in this conversation?

Buscemi: We would love to start engaging with our industry members on the local level. By that, I mean IPC members are located in almost every state—and certainly globally. We're building our outreach model by identifying where there is a concentration of IPC members and academic institutions (community and technical colleges and universities). This ecosystem is dependent on one another. Universities depend on the industry, as do community colleges and high schools. The industry is drawing its next generation of workers in part from these institutions. We always start with

industry participation, whether that's through hosting facility tours of students, sponsoring internships, apprenticeships, etc.

I see our role as helping to connect and build this ecosystem—not only as a builder, but also a contributor. That's what I'd love to impress upon our IPC members—please get involved. If you're in a community where you know that there are high schools, community colleges, or universities that could use your support in any way, IPC is well positioned to be a strong intermediary.

Matties: If a company wanted to bring in a graduating student say from high school, what sort of support would they get in terms of training? Or is there something in place where that company can mentor through an IPC structure?

Buscemi: We're building that out right now. The apprenticeship model is a little further out. Once we complete our JTA effort, we'll look at what IPC's role is in supporting our industry members with apprenticeships. The same thing applies to internships. We'll be building out that earn-and-learn model in the first half of next year, which is why industry support is critical. We need our partners to come along, help us, and tell us what they need, and then we'll work with the schools, community colleges, and universities to build that bridge.

In addition to the programmatic activity, we are fundraising and seeking financial support from IPC members. We have a lot of mindshare and great ideas, but these things only happen with funds. That's the other opportunity that we're looking at—fundraising over the next several months.

Matties: Great. Thank you so much for your time, Colette. I greatly appreciate it.

Buscemi: Thank you. SMT007

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A close-up photograph of a green printed circuit board (PCB) being assembled. A pair of tweezers is holding a small, square, black integrated circuit (IC) component, preparing to place it on the board. Other components like a capacitor and various surface-mount devices are visible on the board.

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Effective Ways to Cut PCB Assembly Cost Without Sacrificing Quality

Shopping at IPC APEX EXPO: Evolutionary or Revolutionary Products?

Feature by Andy Shaughnessy
I-CONNECT007

Every year, managers and technologists descend upon IPC APEX EXPO, shopping list in hand, scouring the aisles in search of deals on capital equipment, software, alloys, chemistry, and whatever else they can find. Sure, many of the big pieces of equipment on display are already sold. On the flip side, there are plenty of deals to be made at IPC APEX EXPO because no company wants to pay to ship a machine twice.

As you're finalizing your shopping list, take a second to consider this: Are you in the market for products that are evolutionary or revolutionary? And what do those terms even mean for someone looking for new DFM software or a new pick-and-place machine?

Evolutionary vs. Revolutionary

The term "revolutionary" gets thrown around pretty often in the electronics world. But most new products—even the most expensive—fall into the evolutionary category; they feature logical updates and improvements over the last revision of that particular product. You could see these updates coming, and they make a good product a better product.

If you look back on a product's life cycle, you can track the new func-

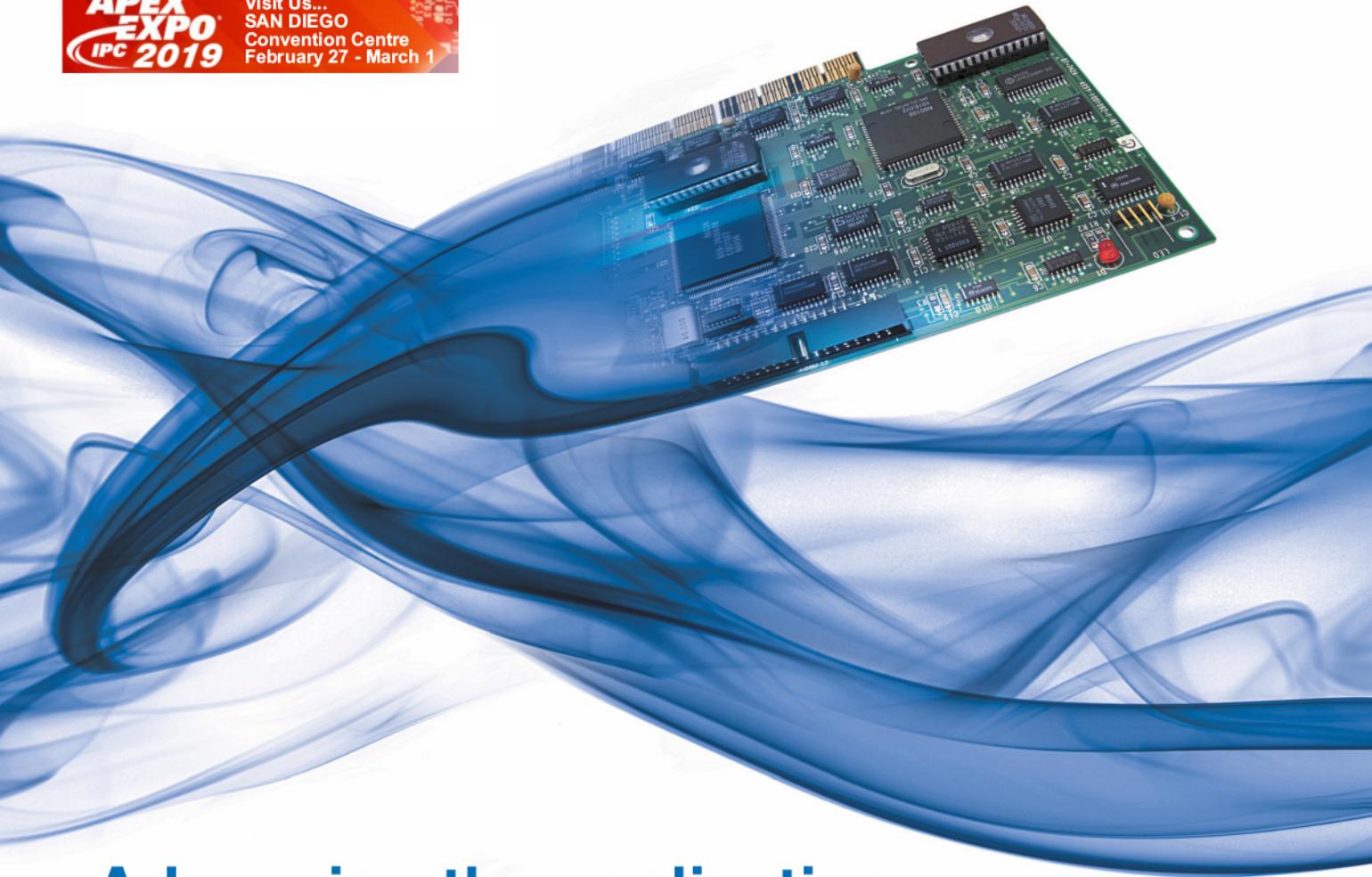
tionalties as they were incorporated each year or so, much like parents chart their children's growth by marking the kids' height on the wall on their birthday. Evolutionary change is slow and gradual, and fairly predictable. I imagine that most of the equipment and software in your facility contain evolutionary improvement and upgrades over the previous models.

But revolutionary change is disruptive to the status quo. Revolutionary change is unpredictable, an upset applecart that can't be set right until the full effects of the shift are quantified and understood. Sometimes the reverberations from revolutionary change make it almost impossible to measure its long-term effects for years.

You know your product is revolutionary if it forces other companies to change the way they operate. I liken revolutionary change to a quantum leap; it's not exactly an apples-to-apples comparison, but it's close.

The Model T was clearly revolutionary, putting the average Joe into an automobile and blacksmiths and wagon builders out of work almost overnight. EDA software and the SMT process were likewise revolutionary, changing the way PCBs were designed and assembled, and





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allowing employees to be more productive.

Then again, some products are “leaners” that are tough to categorize.

The Wright brothers’ first airplane was revolutionary, but there is some debate about whether the first jet plane was too since it’s really just an airplane with a more powerful engine. Similarly, the Tesla seems revolutionary to most of us, but electric vehicles (EVs) have been around since the 1800s, and one EV held the world land speed record until 1900. Is a new type of fastener or squeegee capable of being revolutionary? Undoubtedly, some companies will say so, especially if they increase their profit margin.

Products at IPC APEX EXPO

Keep all of this in mind as you roam the aisles at IPC APEX EXPO. You’ll probably see some

“leaners,” somewhere between evolutionary and revolutionary. IPC’s Connected Factory Initiative (CFX) comes to mind. The open-source CFX standardizes machine-to-machine communications, allowing one person to monitor all of the machines on a line through a smartphone. But is CFX a truly revolutionary? You be the judge. Try it out in San Diego next month and see.

To help you craft the ultimate trade show shopping list, IPC has created this [handy listing](#) of all 311 new products on display at IPC APEX EXPO. It’s not too late to thumb through these pages and start making a list of new products that could put your company light years ahead. Whether your company needs the latest cutting-edge tools or not, you can find what you need at IPC APEX EXPO 2019. **SMT007**

Enhancing the Piezoelectric Properties of Organic Polymers

by **A’ndrea Elyse Messer**

PENNSYLVANIA STATE UNIVERSITY

Researchers at Pennsylvania (Penn) State and North Carolina (NC) State University have developed a molecular approach that can improve the piezoelectric properties of organic polymers, making them suitable in flexible, wearable, and biocompatible devices.

They looked at ferroelectric poly(vinylidene fluoride-co-trifluoroethylene)-P(VDF-TrFE)-copolymers and found that tailoring the molecules to specific arrangements around chiral, or asymmetric, centers led to transitions between ordered and disordered structures and created a region within the material where ferroelectric and relaxor properties compete. Relaxors are disorganized materials, while normal ferroelectric materials are ordered. In ferroelectric polymers, an MPB-like effect is induced by the



Ferroelectric poly(vinylidene fluoride-co-trifluoroethylene) molecule. (Source: Penn State)

molecular chain conformations that are tailored by chemical compositions. The simulation work was done at NC State University.

The researchers used a wide variety of methods to investigate the polymer including nuclear magnetic resonance, X-ray powder diffraction, and Fourier-transformed infrared spectroscopy looking at the transition area and boundaries. Given the flexibility in molecular design and synthesis, this work opens up a new avenue for scalable high-performance piezoelectric polymers, according to the researchers. The research was reported in the journal *Nature*.

Qing Wang, professor of materials science and engineering; Yang Liu, a postdoctoral fellow in materials science and engineering; and Haibibu Aziguli and Wenhan Xu, graduate students in materials science and engineering, worked on this project from Penn State. Researchers at NC State University included Bing Zhang, a graduate student at the Center for High-Performance Simulations; Wenchang Lu, research associate professor of physics; and J. Bernhole, professor of physics. The Office of Naval Research and the National Science Foundation supported this work.

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MilAero007 Highlights



Rick Hartley is Bullish on PCB Design, 3D Printing ▶

At the recent PCB West in Silicon Valley, Consulting Technical Editor Tim Haag met with long-time design industry veteran Rick Hartley to discuss the changing landscape of circuit board design, the layout designers of the future, and how designers can benefit from 3D printing of circuit boards.

Substrates for Advanced PCB Technologies: What Will the Future Hold? ▶

The UK chapter of the global IMAPS community of electronics and microelectronic packaging engineers shared a wealth of knowledge and wisdom about PCB substrate technology trends, developments, and future requirements in a webinar on the first of November.

Standard of Excellence: Forging Partnerships Through Adversity and Problem Solving ▶

For the past few months, this column has discussed how to find and work with a great PCB vendor, and most importantly, how to form a strong, productive partnership. This month, Anaya Vardya will address how adversity can forge a great partnership between you and your PCB vendor that will last for life.

NASA Looking to Tiny Technology for Big Payoffs ▶

NASA is advancing technology that could use large amounts of nanoscale materials to launch lighter rockets and spacecraft than ever before. The super-lightweight aerospace composites (SAC) project seeks to scale up the manufacturing and use of high-strength carbon nanotube composite materials.

Increasing Productivity for Flex Fabricators ▶

Barry Matties and Nolan Johnson of I-Connect007 met with Shane Noel and industry veteran Mike Jennings of ESI to discuss the introduction of their CapStone laser tool, a product aimed at doubling their flex circuit fabricators' throughput. Mike also shares advice for fabricators who are looking to move into the ever-growing flex market.

Ventec at electronica 2018: No Compromises for High-frequency Materials ▶

Ventec's IMS material families, thermally conductive and standard laminates and prepregs for multilayer PCB's, Ventec has teamed up with EMI Thermal to provide a range of thermal interface materials (TIM) to the European market.

ERAPSCO Inks \$40M in Navy Sonobuoy Contracts ▶

Ultra Electronics Holdings plc (ULE) and Sparton Corporation announce the award of subcontracts valued at \$39.6 million to their ERAPSCO joint venture, for the manufacture of sonobuoys for the United States Navy.

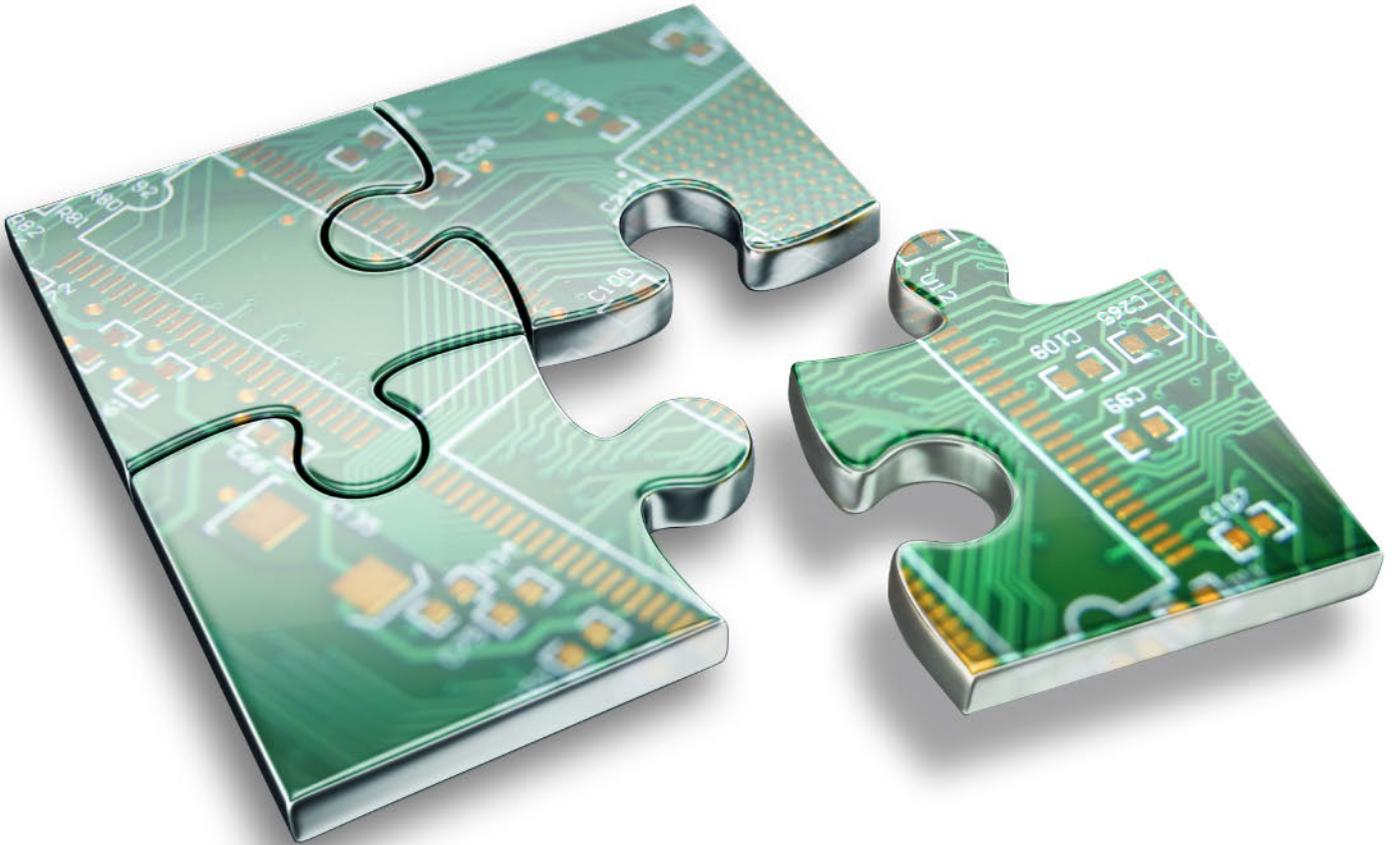
Nano Dimension Partners with Productivity Inc.; Expands Reseller Network ▶

Nano Dimension announced a new reseller agreement with Productivity Inc., significantly expanding the company's North American channel partner ecosystem.

Sparton Receives 2018 Asia Pacific Entrepreneurship Award ▶

Dung Tran, managing director of Spartonics Viet Nam Co. Ltd, has been presented with the 2018 Asia Pacific Entrepreneurship Award for exemplary leadership and innovation in the electrical and electronics industry.

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Mark Friedman on IPC Membership

Feature Interview by Barry Matties I-CONNECT007

I recently spoke with Mark Friedman, a member success advocate at IPC, about the current status of IPC's membership programs, the recent growth they've seen, and some hidden benefits of IPC membership that potential members might not be considering.

Barry Matties: Mark, you're a member success advocate at IPC, and your function surrounds membership. Tell me a little bit about what that title means.

Mark Friedman: I support IPC's membership, so if they have any issues or inquiries, I make

sure that they get the responses they deserve. We have several programs that members might not be aware of, and I guide them to the appropriate individual who can help them out with their inquiries.

Matties: How long has this position been at the IPC?

Friedman: It's been there for about three and a half years.

Matties: So, it's a newer position.

Friedman: That's correct. Management realized that a lot of our members weren't getting the attention and support that they needed from a personal standpoint, so they created this position to enhance the member experience.

Matties: Is this a global function?

Friedman: Yes, we support members globally.

Matties: Great. Can you tell us about your background?

Friedman: I'm an electrical engineer with more than 30 years of sales experience in the semiconductor industry.

Matties: How did you find your way to the IPC?

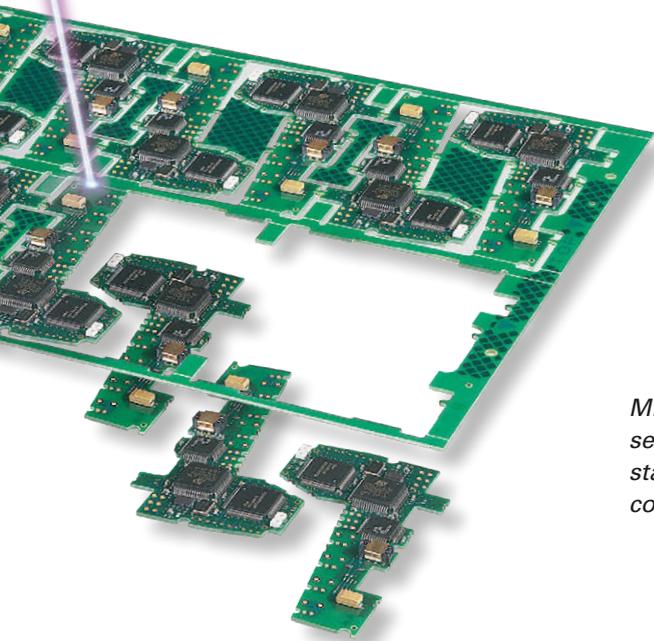
Friedman: I had a colleague who worked with me in the semiconductor industry and



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he mentioned that there was a position open, so I applied and was offered the position.

Matties: Nice. Congratulations.

Friedman: Thank you.

Matties: In your role, what kinds of issues do members have that you can help them with?

Friedman: The interesting thing is a lot of members aren't aware of all the services and programs that IPC offers. We expose them to different areas. For instance, they'll have questions about certification, so we support them from our certification quality initiative (CQI) program. They'll have questions on standards, so we support them with technical liaisons and experts who sit on committees and explain and interpret the standards from a practical standpoint.

Matties: How do you measure your success, and is there a metric of retention?

Friedman: Yes, renewal, retention, and new member acquisition are all metrics we track.

Matties: Let's talk about renewals. Since this position has been established, have you experienced an increase in renewals?

Friedman: By supporting our members, we build relationships with them, gain their trust, and they realize that there's someone internally to help them. They appreciate that and extend their membership.

Matties: Now, you mentioned oftentimes it's just an education process to help them understand all of the value that the association brings. Why do you think they don't know this up front?

Friedman: Members are singularly focused when they join IPC. The main thrust has been either standards or certification. We have other programs as well, such as market research,

validation services, global advocacy efforts, and transportation solutions. We also have various membership initiatives that they're not aware of.

Matties: You were talking about existing members, but certainly in your role, you're also looking at increasing membership.

Friedman: We have about 4,800 member locations globally and growing that span the globe from China to Brazil and all points in between.

Matties: When you say locations, are you talking about factories or people?

Friedman: Facilities. We have two options when it comes to membership: conventional membership, which is based on location, and revenue-driven membership (Enterprise membership), which you can picture as a corporate membership based on global revenue. While conventional membership is site specific, revenue membership will incorporate all global locations of the member company.

The advantages are that, from an administrative standpoint, you're dealing with a single invoice. Also, the duration of the membership is uniform throughout all locations. You don't have to worry about one site expiring in February and another expiring in August. Additionally, now that all global locations are members, you have a uniform approach to standards and procedures that are governed by IPC standards.

Matties: Everything's synchronized, and everybody has full access.

Friedman: That's correct.

Matties: That definitely makes it a lot easier for your member. With IPC APEX EXPO 2019 just around the corner, what efforts do you have for membership during the show?

Friedman: IPC APEX EXPO is the biggest motivator for nonmembers to join IPC. Attend-

ing one of the largest exhibitions of its kind in North America—coupled with all the activities such as technical sessions, professional development courses, standards committee meetings, and the number of exhibitors and attendees—generates so much energy that you want to be a part of it and become a participating member rather than a spectator on the sidelines.

In addition, we always have a booth with management ready and available to answer all questions. We also have various programs that we announce at IP APEX EXPO to enhance membership. Typically, if it's a first-time member, we offer an introductory rate for membership. Those are some of the various programs that we have.

Matties: You talked about 4,800 locations. What sort of growth have you experienced in the last three years?

Friedman: Growth has been phenomenal: 20% over where we were three years ago.

Matties: What do you expect for the coming year?

Friedman: With enterprise memberships being offered—which is only a year old now—the growth rate will be maintained.

Matties: What do you think is the most hidden value that an IPC member needs to know about?

Friedman: We're focusing a lot on education, especially with the labor shortage and retirement of experienced engineers. This will fill a niche to provide continuity for both us and corporations and from a relevancy standpoint, bringing added value to the IPC relationship.

Matties: I was talking to a couple of training facilities, and they mentioned there's an unexpected increase in the demand for training. Is



that part of the awareness that you're driving as well as market conditions?

Friedman: Plus, we're enhancing our online ability to train up-and-coming engineers. We're planning more courses online that will be instructor led. You can get real certification as a member of the team going through various projects, which is something that is not available today.

Matties: Do member companies request training, and if so, do you build curriculums specifically for that? For example, maybe a large OEM says, "We need this type of training."

Friedman: Licensed third-party training centers provide most of our training and certification, and we offer precertification-level training, online training, and some certification through IPC EDGE. If we do receive requests that seem to be an industry groundswell, then yes, we'll go ahead and develop training for that demand.

Currently, we're asking our members to volunteer to join the IPC JTAC (Job Task Analysis Committee) to help document the core knowledge, skills, and abilities required to succeed in key roles in our industry. The outcome of this project will shape IPC's future certification and education programs for years to come.

Matties: What if a singular large OEM says, “We’d like to train our workforce on this.” Would that be possible?

Friedman: That’s something we would take under consideration.

Matties: It seems like there’s a dynamic shift in the marketplace, and the needs for training are shifting as well. You mentioned earlier that there’s a shortage of entry-level workers. Do you see a groundswell there?

Friedman: Absolutely. In fact, we’ve hired industry experts to focus specifically on that issue. The other thing that companies have not taken advantage of in the past, which was your original question, is our global government relations group—especially today with tariff and trade issues. Members have an actual voice in Washington D.C. and other halls of government to channel their feedback and make it relevant so that the government pays attention to our industry as they’ve never done before.

Matties: It looks like you’re having some success there.

Friedman: That’s true. We’ve gotten some legislation passed that incorporates language from some of IPC’s positions that we’ve submitted to the government specifically in the areas of defense electronics and workforce education.

Matties: Is there anything we haven’t talked about that you feel we should share with the industry?

Friedman: If any issues require addressing and you feel strongly about it, we’re here to listen, and if it’s something that we see should be industry driven, then we’ll certainly take up the banner.

Matties: Thank you so much for your time today, Mark.

Friedman: Thank you. SMT007

Automotive Electronics: Past/Present/Future

In this video, IPC president and CEO John Mitchell discusses technological advancements in automotive electronics and IPC’s standards development activities that support the automotive industry.





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Executive Forum at IPC APEX EXPO 2019 Focuses on Advancing Automotive Electronics

Feature by Patty Goldman
I-CONNECT007

Summary: Senior-level executives from across the global electronics supply chain will gather to discuss opportunities and challenges facing the rapidly changing automotive electronics industry. With five expert speakers and a powerful keynote from GreenSource VP Alex Stepinski, registration will fill fast.

This year at the IPC APEX EXPO, the Hall of Fame Council has put together an executive forum on “Advancing Automotive Electronics.” This not-to-be-missed forum is designed for executives in the entire automotive electronics system supply chain. Reserve this date: January 28 at 7:30 a.m.

The program includes a special overview of the IPC’s growing role in automotive electronics by IPC President and CEO, Dr. John Mitchell, as well as important presentations by Tier-1 providers Robert Bosch in Germany and APTIV (formerly Delphi) in the U.S.

To quote a recent press release from IPC:

Senior-level executives from across the global electronics industry supply chain will gather to discuss challenges and opportunities of the burgeoning and rapidly changing automotive electronics industry during the IPC Executive Forum on Advancing Automotive Electronics at IPC APEX EXPO 2019. Presented by IPC’s Hall of Fame Council on January 28, the forum will focus on automotive electronics costs, reliability, and programs from concept to production.

With a global repertoire of speakers—including ones from the United States, Asia, and Europe—forum topics will include materials in automotive electronic packaging, PCB reliability testing for automotive electronics, developing dry-film photoresist to meet automotive fine-line circuit needs, cost models with suppliers and understanding costs of new technology, and developing and getting approval of new material for automotive electronics.

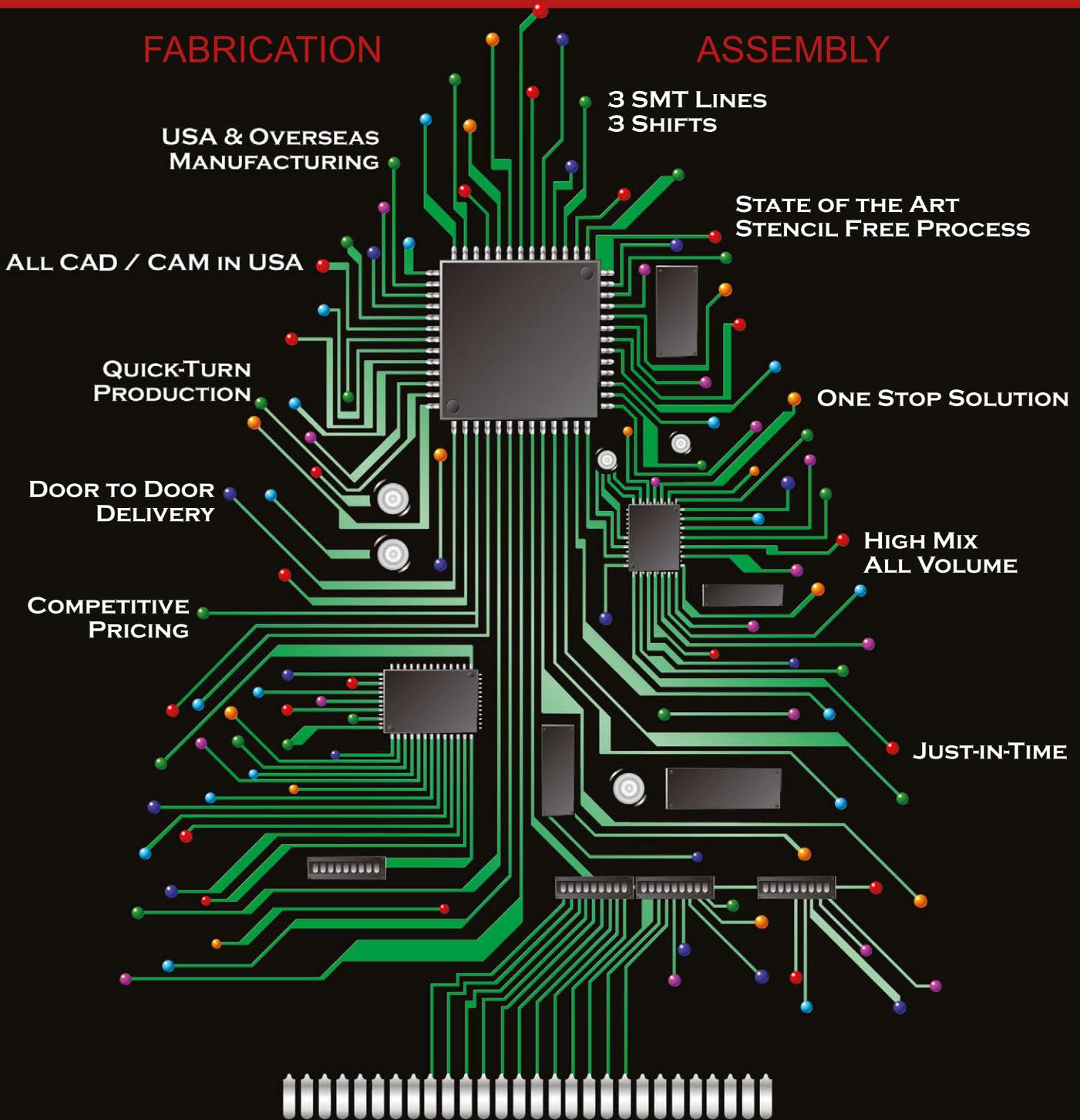
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The keynote speaker is Alex Stepinski, VP of GreenSource Fabrication, who will discuss recent innovations that enabled the construction of circuit production lines with the capability for single-piece flow, autonomous work cells, and extreme traceability capabilities that can yield higher quality levels and shorter cycle times than ever before while eliminating the traditional environmental footprint of a PCB manufacturer at the same time. Examples of these key innovations and how they relate to the future of the automotive industry supply chain will be presented.

Additional presentations will include:

- Alun Morgan, Ventec International Group ambassador, and Giorgio Favini, a founder of Elga Europe. Ventec and Elga are substrate and specialty chemical companies, respectively, both located in Europe and have developed materials specifically for automotive applications.

- The Senior Global VP of MacDermid Alpha Electronics Solutions, Joe D’Ambrisi, along with Director of Marketing Communications Don Cullen will present their global outlook for specialty chemicals and materials in automotive electronic packaging.

- Larry Wilson III, the leader of Nexteer Automotive’s Global Electronics Costing Team, will provide a cost history and forecast of automotive electronics by following the history of a particular motor vehicle.

- CTO of MicoteK Labs China, Bob Neves, will present “PCB Reliability Testing for Automotive Electronics—The China Story.” Neves is a member of the HoF Council and the IPC Board of Directors.

- Randy Hierbaum, VP of OptimalPlus, will present “Striving for Zero DPPM.” He is working with Tier-1 automotive supplier Continental in Guadalajara on this topic.

- Gene Weiner, IPC Executive Forum program chair, had this to say: “As the automotive industry increasingly incorporates electronics into its manufacturing, this provides a unique opportunity for IPC and our members to participate in this continually evolving field. This forum provides us with a chance to hear from subject-matter experts about the many ways for the involvement of our industry in automotive electronics.”

According to IPC’s VP of Solutions, Sanjay Huprikar, this forum at IPC APEX EXPO 2019 is a great follow-up to IPC’s June Automotive Electronics Forum held in Nuremberg, as well as the September launch of a new Reliability Council in Frankfurt. “It directly supports IPC’s efforts to engage heavily with the transportation vertical,” said Huprikar.



2018 IPC Automotive Electronics Reliability Forum attendees, L-R: David Bergman, Lars-Olof Wallin, and Sanjay Huprikar.

Early registration is highly recommended to ensure participation in this event as it could be limited to 100 delegates. Information and registration for the IPC Executive Forum on Advancing Automotive Electronics is available online at www.ipcapexexpo.org. Along with breakfast, lunch and the VIP networking dinner are included, although the dinner is for IPC members only. Judging from past events, the networking alone is worth the registration price. **SMT007**

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Supplier Highlights



Are You Connected to Reliability? ▶

The need for communication between every operator on the manufacturing floor can be a critical difference between a reliable piece of hardware and one that presents some level of unexpected performance. This column highlights a few things happening in the shop floor, such as touch-up soldering and third shift issue, not commonly communicated, which can cause performance issues.

Process, Design, and Material Factors for Voiding Control for Thermally Demanding Applications ▶

Solder voiding is a common phenomenon across all semiconductor packaging and electronic board assemblies. There are many factors that influence void frequency and size. This article focuses on several process, design and materials selection considerations which control or potentially reduce voiding to meet industry and end-market acceptance criteria.

Top 5 Things to Know When Moving from Hand Assembly to Robotic Assembly ▶

A lot of factors go into the decision to hand-build or outsource circuit boards. When the decision is to outsource, there are a few important things to consider. Some things that work fine when hand soldering may stand in the way of quality, repeatability, and reliability when machine assembling. Here are some of the most important considerations when changing from hand-build to outsourced.

Low-temperature Solder Paste Process Advantages ▶

This article examines the performance of two low melting point SnBi alloys used in solder paste when assembling BGA components with

SAC alloy spheres, and the advantages of a low-temperature process over the regular SAC assembly process. It will also evaluate solder paste capability regarding the process and the performance of a joint formed with a low melting point alloy solder paste and SAC305 spheres, including process advantages and material capabilities.

Alpha Assembly Solutions on Training, Education, and Low-temperature Soldering ▶

In this interview, Jason Fullerton of Alpha Assembly Solutions discusses the benefits and challenges of low-temperature soldering. He also highlights the biggest concerns he's currently seeing in the industry, including young engineers lacking hands-on manufacturing experience and training, voiding and head-in-pillow issues, and low-temperature soldering demands.

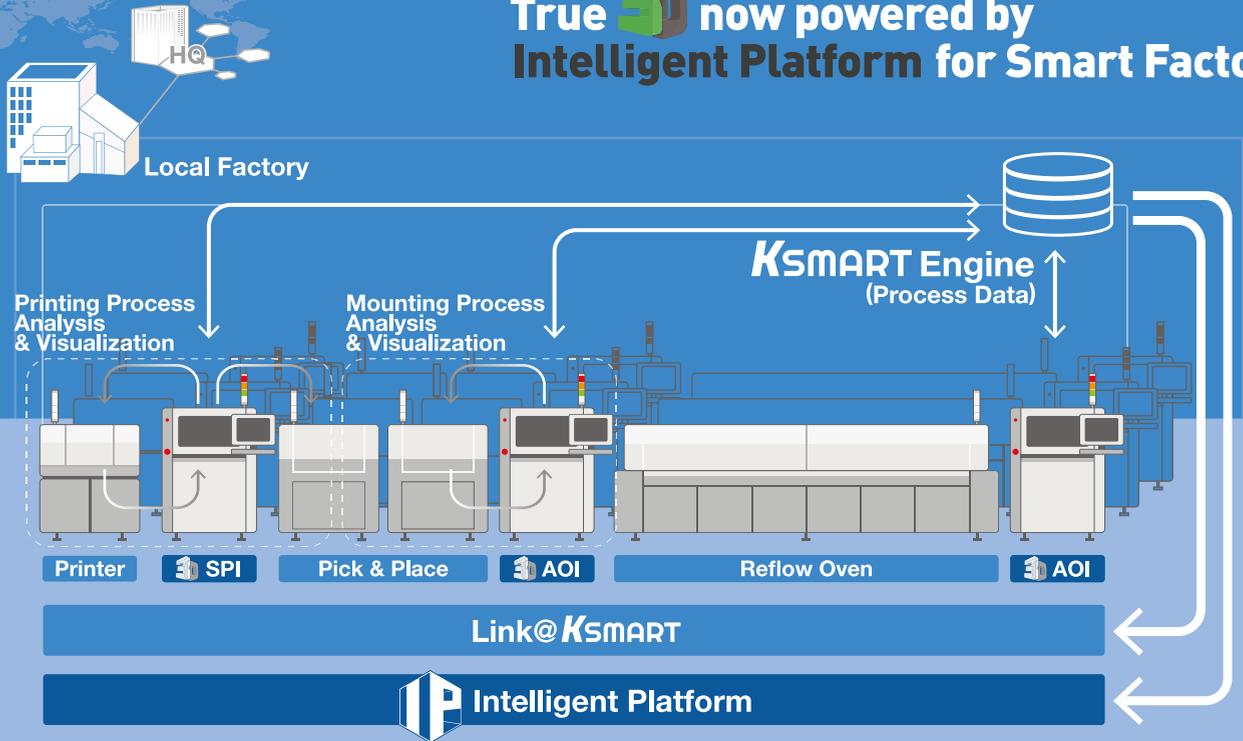
MacDermid Performance Solutions to Integrate Electronics Chemicals and Assembly Materials Businesses ▶

MacDermid Performance Solutions announced that effective January 1, 2019, it will combine its Alpha Assembly Solutions and MacDermid Enthone Electronics Solutions business units to form MacDermid Alpha Electronics Solutions, a \$1.2 billion electronics chemicals and materials business, headquartered in Waterbury, Connecticut, USA.

Aegis Software and CircuitByte Form Partnership in Europe ▶

Aegis Software announces that CircuitByte (formerly Router Solutions GmbH) has partnered with Aegis, integrating their advanced BOM Connector™ tool with Aegis' Factory-Logix digital MES platform.

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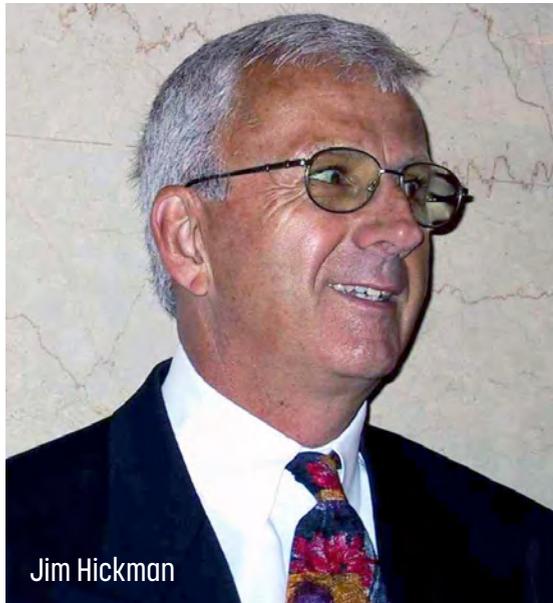
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APEX Pioneers Discuss the Original EXPO

by Dan Feinberg
I-CONNECT007

With IPC APEX EXPO 2019 right around the corner, I spoke with Dr. Jim Hickman who was one of the original pioneers for the event along with myself. We discuss the show's history and how it has changed over the years.

Dan Feinberg: Hey, Jim, I'm calling so we can talk about the past.

Jim Hickman: 25 years ago, I figure.

Feinberg: It was about 23–24 years ago.

Hickman: 24 years ago.

Feinberg: Yeah, in the spring. Oh my goodness.

Hickman: That's when we were young, right?

Feinberg: That's right. We were a lot younger anyway. We were in our 50s then, so think about it. Wow.

Hickman: I'm 76 now.

Feinberg: And I'll be 76 in a couple of months. First, let's start with a little bit of history. Back in the mid-'90s when you were with DuPont, and I was with Dynachem. We were competitors, but we worked well together on various IPC things. I got a call from Thom Dammrich who was IPC president at the time, and he asked me to put together a suppliers counsel. At that time, if you recall, IPC suppliers could not be full members—we were associate members.

So, we didn't have a whole lot of say on many things, but that was starting to change; hence why they asked us to set up the first Suppliers Counsel. I contacted a number of folks including you at DuPont, MacDermid, Excellon, Shipley, LeRonald and me with Dynachem/Morton.

Hickman: Was Gould on that board?

Feinberg: Yes, that could have been. I was trying to look it up, but I don't have the records. That was a long time ago and a different life for me.

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I'm trying to think who else might have been on it.

Hickman: I think there was a German equipment company.

Feinberg: I remember vaguely. Anyway, the point is that it was the first time that there was a committee put together of suppliers. The other thing is that IPC had asked, and we all agreed, was that the only people who could be on the committee were the presidents or CEOs of the companies, which I think there were about a dozen of us.

Today's suppliers counsel can include management—not just the presidents or CEOs. The reason for that had to do with making sure the people that were on the committee could make decisions for their company and not have to go back and forth to get approvals. That's the thing that enabled us to put together the EXPO quickly.

Hickman: Right. They could make decisions, plus they had the financials to do something if it was required.

Feinberg: Exactly. And if I recall correctly, we got together in a separate meeting and did a brainstorming session. I think we spent a whole day on it.

Hickman: Yes, I remember that.

Feinberg: I'm trying to think what else we talked about, but we did come up with some things that needed to be done. One of the big conversations was the expense of doing the major trade show. At that time, the largest trade show in the world was NEPCON in California.

Hickman: That was a big deal for us. We weren't getting any value out of it.

Feinberg: I know. You guys used to have a huge hospitality suite, and since we were competing with you, we had one too. I don't remember exactly what it cost us, but it was literally tens of thousands of dollars each night.

Hickman: Plus the number of people you had to have come to support it. Also, the other big expense was floor space. We were looking to find a way to reduce the floor space so that the cost would be more in line with what we would expect. I think we put some guidelines in place for how much floor space you could have. The equipment guys got so much while the non-equipment guys did not.

Feinberg: That's correct. One of the key things we decided we could do in our brainstorming session was put together an IPC trade show so that we didn't have to go to NEPCON in California. We limited the space so that we didn't have to compete with each other in taking thousands of square footage of floor space that wasn't really needed, especially for a supplier of chemistry. We also limited the entertainment. We decided that



we would not be able to have huge hospitality suites.

Hickman: Right, I think we discussed doing away with them altogether. In the end, we said we wanted to put limits on them. Obviously, you can't control them, but one thing we reached an agreement upon among the members was that we would greatly reduce the size of the hospitality suites, which was more in line with the show. We wanted an event to show off our wares to key customers at a reasonable cost because they were getting really out of hand at that point if you remember.

Feinberg: I do remember.

Hickman: It was unbelievable.

Feinberg: Believe me, I remember. I think that there was one show—one of the last ones before this—where we figured that the cost of the hospitality suites was approaching \$500 a minute. That was crazy.

Hickman: It was crazy.

Feinberg: Absolutely. So, that's how we started the EXPO. The first one was in Boston.

Hickman: Right, but there was another part that we wanted to do at the same time. We felt that we could have more in-depth technical seminars. We wanted to expand the technical side of it in line with the trade show. The NEPCON show was becoming a mishmash of a whole bunch of different stuff. We wanted to be able to take more control of the technical seminar side along with the IPC of course. Each one of the companies said that they would want to participate and bring more people to the technical side of it.

Feinberg: Yes, because NEPCON was basically just a trade show and a huge party.

Hickman: Exactly.

Feinberg: No one thought that IPC could be successful, but here we are 20+ years later, and NEPCON is still a big show in other parts of the world. However, we basically drove them out of the U.S.

Hickman: Didn't NEPCON start increasing the price per square foot, too?

Feinberg: That's what kicked it off. They kept raising the cost per square foot, made the location choices into an auction, and took away the carpeting in the aisles unless we were willing to pay more for them.

Hickman: The key element there for our success was the fact that although we may have been competitors in the industry, we reached a mutual understanding on how to do it effectively without helping or hurting anybody. It was really a combination.

Feinberg: Definitely.

Hickman: It was a great combination. I know the suppliers added a lot of impressive features back in those days.

Feinberg: Do you recall us having to go the IPC board and recommend this?

Hickman: Yes, I wasn't there, but you were.

Feinberg: I was there. The board was interested, but some said, "We're not a trade show company. We are a standards group and shouldn't be doing this. Why would we do it?" I remember talking with them and saying we think that we can bring in a couple hundred thousand dollars a year to help IPC. That immediately changed their mind.

Hickman: It worked out because we were very successful. I think that most of the companies followed the guidelines. Remember there were a few that did not and we had a little talk with them?

Feinberg: I do remember that.

Hickman: Regarding the size of the booths or hospitality, people stayed pretty much in line.

Feinberg: And then a couple of years later, the equipment suppliers came up with their own show, and that's where we got APEX. I think it was the combination of the EXPO and APEX that really made it the dominant show in the United States. Interestingly, though, the market share in the U.S. for manufacturing was so big then, so that was what made the trade show big here too.

Hickman: Yeah. That slowly disappeared, didn't it?

Feinberg: It did. I hope it comes back and that the next generation can start to bring some of this stuff back too. Is there anything else that you recall about that first show?

Hickman: Let me look at my notes. The only comment that I have, and I don't remember the numbers, was that when this first show was over, somebody—maybe it was you—from the committee went back to the IPC board with the profit—the money that we were giving back. I don't remember what that was, but there was a fair amount of cash that came back to IPC after the first show and the second show was even higher. I don't remember the dollar amount, but that's what I do remember.

Feinberg: That was me, and it was significant, but I don't remember the exact amount. Then, the decision was that Boston was probably not the best place to do it, so we went to the San

Jose area and then down to Anaheim. Anaheim wasn't very friendly to us because they wanted the big hospitality suites.

Hickman: I remember that. Didn't we go to Vegas one year? And it didn't turn out to be very good.

Feinberg: The first Vegas one didn't, then some of them did, but the costs in Vegas was starting to get too high. Now we're in San Diego, but the cost isn't exactly low either. But, you know, things are different now.

Hickman: Is that where the venue is now? San Diego?

Feinberg: That's right because you haven't involved now for a number of years—five or six years, right?

Hickman: Hey, I retired at the end of '98. Would you believe it's been 20 years?

Feinberg: My goodness, Jim.

Hickman: It's incredible. SMT007



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IPC Recognizes Volunteers at Awards Luncheons

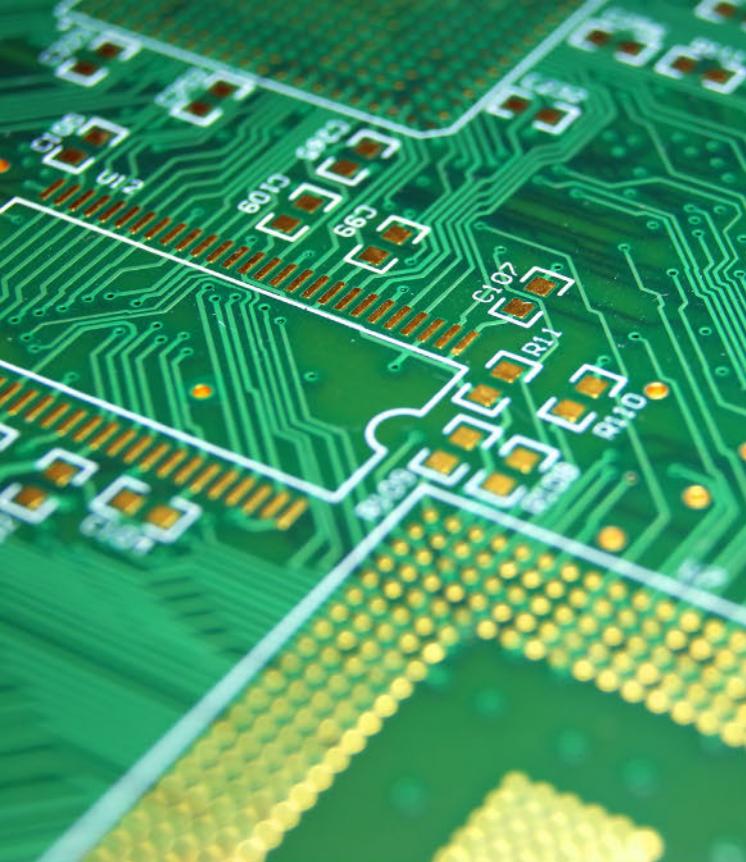
Feature by Patty Goldman
I-CONNECT007

Those not involved in the committee activities may wonder what the awards luncheons at IPC APEX EXPO are all about. If nothing else, IPC—Association Connecting Electronics Industries—is an organization of volunteers. Every document issued—whether specification, standard, guideline, or training program or webinar—is generated entirely by volunteers. The IPC staff facilitates the creation of those documents by organizing and scheduling meetings, keeping the documents moving through the actual creation and approval process, and disseminating the results to the electronics world.

Today, IPC has more than 100 standards committees (including subcommittees and task groups) working on over 300 active documents that cover every aspect of electronics manufacturing from design through assembly, including addressing specific needs of the various market segments such as automotive, military, and medical.

This translates into many volunteers discussing, writing, and editing a lot of documents (including revisions and updates) for our industry, which also represents a lot of time—endless hours—spent on these efforts. Whether it is company time or one’s personal time (which, believe me, much of it is), the individuals who put forth this effort are to be commended. And, I might add, those individuals





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should be especially appreciated by those who use the finished documents.

Each year, a number of these documents comes to fruition and is published—often after several years of work. The completion of a document is a momentous occasion for those who have been working on it (“We’re finally done!”). IPC has made a practice of recognizing committee leaders and volunteers for their work completing standards and specifications—and for other activities within the organization—at the committee luncheons during IPC’s spring and fall meetings. According to IPC, the two categories include ^[1]:

1. Committee Leadership Awards are presented to committee chairs upon the completion of a standard or specific program. Any chair is eligible. This award can be given more than once and can also be presented to an outgoing chairman who has made contributions over a period of time.

2. Distinguished Committee Service (DCS) Awards are presented to IPC committee members who have made an exceptional contribution to a specific standard or program. Any person who is actively involved on an IPC committee is eligible, except members of the board of directors. This award can be given more than once. Exceptional contributions include consistent participation through attendance or regular contributions, ballot submission, and having a significant impact on a document or project.

Corporate and Individual Awards

IPC has also created several special awards over the years. These awards are presented for extraordinary efforts and long-time commitments to both IPC and the electronics industry. There are six of these award categories: four go to outstanding individuals, and two recognize companies whose IPC involvement has been extensive. As described by IPC, the awards are ^[1]:

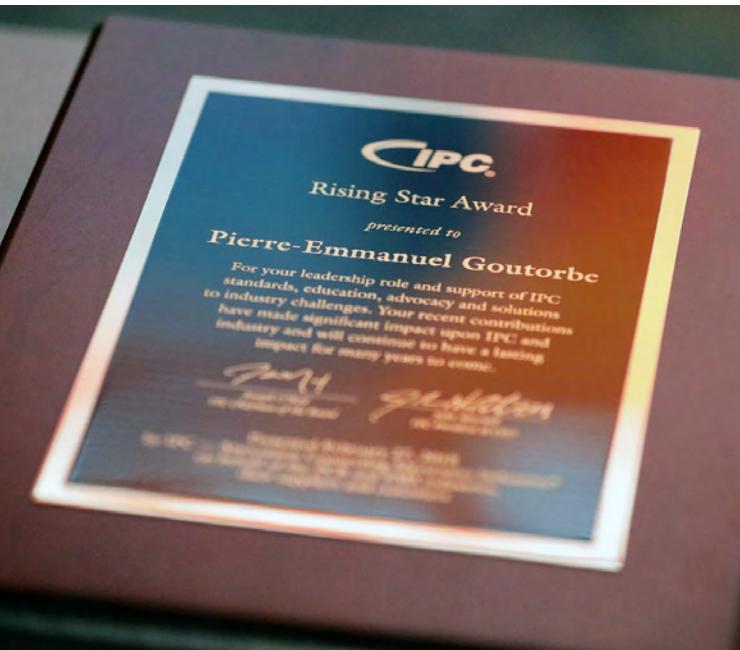
- **The IPC Raymond E. Pritchard Hall of Fame Award** is given to individuals in recognition of extraordinary contributions and distinguished service to IPC and in the advancement of the industry, including the creation of a spirit of mutual esteem, respect, and recognition among members consistent with the goals and mission of IPC. This is the highest level of recognition and achievement that IPC can give to an individual, and it is based on exceptional merit over a long-term basis—the operative imperative being “long-term.”

- **The Dieter Bergman IPC Fellowship Award** is given to individuals who have fostered a collaborative spirit, made significant contributions to standards development, and have consistently demonstrated a commitment to global standardization efforts and the electronics industry. Each recipient will be eligible to bestow the Dieter Bergman Memorial Scholarship upon the university or college of their choice.



- **The President’s Award** is given to IPC members who have exhibited ongoing leadership and have made significant contributions of their time and talent to the association and the electronics interconnect industry. Individuals can receive this award only once.

- **The IPC Rising Star Award** is given to IPC members who have taken leadership roles and provided support to standards, education, advocacy, and solutions to industry challenges. Their contributions have made a significant impact on IPC and industry within the past five years and will continue to have a lasting impact for many years to come.



- **The IPC Peter Sarmanian Corporate Recognition Award** honors and recognizes an IPC member corporation (or appropriate division) in the PCB industry (supplier, board manufacturer, or OEM) that has made contributions to the industry while demonstrating support of IPC through participation in technical and/or management programs. While it is individuals who volunteer their time and talent, corporate support can be critical to any individual (or group of individuals) continuing to participate. This award recognizes companies who have not been content to “let the other guy

do it,” but who have actively made our industry better. The award is named for former IPC Board Chairman Peter Sarmanian, former president of Printed Circuit Corporation. Companies may receive this award more than once.

- **The IPC Stan Plzak Corporate Recognition Award** honors and recognizes an IPC member corporation (or appropriate division) in the electronics assembly industry (supplier, EMS company, or OEM) that has made contributions to the industry while demonstrating support of IPC through participation in technical and/or management programs. While it is individuals who volunteer their time and talent, corporate support can be critical to any individual (or group of individuals) continuing to contribute. This award recognizes companies who have not been content to “let the other guy do it,” but who have actively made our industry better. The award is named for former IPC Board Chairman Stanley Plzak, former president of Pensar Corporation, and a founding member of the IPC Electronics Manufacturing Services Industry Management Council. Companies may receive this award more than once.

While none of the recipients has been named yet, we have learned that three individuals will receive the President’s Award, the Rising Star Award will be presented to four recipients, and three people will be honored with the Dieter Bergman IPC Fellowship Award. The other awards will have one recipient each. All of the awards will be announced at IPC APEX EXPO 2019 in San Diego, California, from January 26–31. We will also explore these awards further in our I-Connect007 post-show “Show & Tell” publication to be published in February. **SMT007**

Images courtesy of IPC Flickr album.

Reference

1. [IPC Corporate and Individual Awards.](#)

In the Studio: *Real Time with...IPC*

Article by Andy Shaughnessy

I-CONNECT007

It's almost time for IPC APEX EXPO 2019 at the San Diego Convention Center, and that means another *Real Time with...IPC* video program bringing you interviews with the electronics industry's top movers and shakers, engineers, and managers. It's hard to believe that *Real Time with...IPC* has been a staple of IPC APEX EXPO since 2007.

I still remember my first *Real Time with...IPC* at IPC APEX EXPO 2008 in Las Vegas quite well. I had just begun doing video interviews, and to say I was a little rough is an understatement. Publisher Barry Matties had given me some training beforehand, but I was still trying to find my groove.

My first interview went along pretty well; so far, so good. Then, the engineer I was interviewing stopped talking and I couldn't think of a good follow-up question to ask. I looked around, trying to find inspiration for another

question, and saw Barry raise one eyebrow at me and start smiling. We all started laughing. Finally, he said, "Don't look at me, focus on who you're interviewing."

That turned out to be good advice because an interviewer has to tune out everything except the person being interviewed, no matter where you are, and I'm usually surrounded by distractions at IPC APEX EXPO. Pick-and-place machines and vacuums always seem to be running. If we're doing a show wrap-up interview as the event is breaking down, a forklift driver will usually pull up next to us and drop a half dozen pallets. Once I tuned out the distractions, I could focus on the interview like a hunter's gun-proofed retriever.

Then and Now

Things have certainly changed since 2008. For one thing, I've gotten much better at doing





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on-camera interviews; of course, after those first attempts, there was really nowhere to go but up.

We've also added a whole range of guest editors—many of them are people just like you—who conduct fantastic interviews with individuals in their segment of the industry. No matter what topic the interviewee wants to discuss, we probably have a guest editor who is familiar with that topic. Some of our guest editors have been doing *Real Time with...IPC* interviews for a decade, and we couldn't do it without them.

The technology we use today is also light years ahead. In 2008, we used our big old-school camcorders that still ran on tape, and our video editing operations sometimes took well into the night. Now, we shoot interviews with digital recorders; editing is finished before the show closes each day, and most of that day's interviews are posted on the *Real Time with...* site on the same day.

Another thing that I've noticed is that people in this industry are much more open to doing on-camera interviews than they were 10 years

ago. It used to be tough finding someone to sit in front of the camera. Back then, a company might have had one person—perhaps in marketing communications—who was accustomed to doing video interviews. Now, forward-thinking companies consider video interviews to be another part of the marketing process, and they come to IPC APEX EXPO with a handful of camera-ready technologists.

Each year, we set up a studio at IPC APEX EXPO that allows us to conduct two video interviews at the same time. Jo Ann Sotelo is the conductor in the middle of this synchronized madness, rapping her baton on the dais, making sure that interviewers and interviewees are ready to go when the time comes. I still don't understand exactly how she makes all these interviews work out; I just do what she tells me to do!

So, stop by our *Real Time with...IPC* studio at IPC APEX EXPO 2019 and say hi. You just might meet some of the biggest names in the industry. And if you'd like to be a guest editor, all you have to do is ask. **SMT007**



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Resolving the Productivity Paradox

Accelerating Tech-Insights from the Smarter Factory
by Michael Ford, AEGIS SOFTWARE

You would have thought that by now, with a few years of Industry 4.0 under our belt, that our German friends would be reveling in the success of Industry 4.0. However, recent reports show that overall factory productivity has continued to decline in German companies, even though investments have been made in new automation technology. This is being called the “productivity paradox.” To a growing number of people and companies, this does not come as a surprise because investment in automation alone is still just an extension of Industry 3.0. There has been a failure to understand and execute what Industry 4.0 really is, which represents fundamental changes to factory operation before any of the clever automation and artificial intelligence (AI) tools can begin to work effectively.

In the electronics manufacturing world, we experience the worst-case scenario of effects that change has on production operations. We have accepted deep down that higher product mix leads to reduced productivity. It is easy to

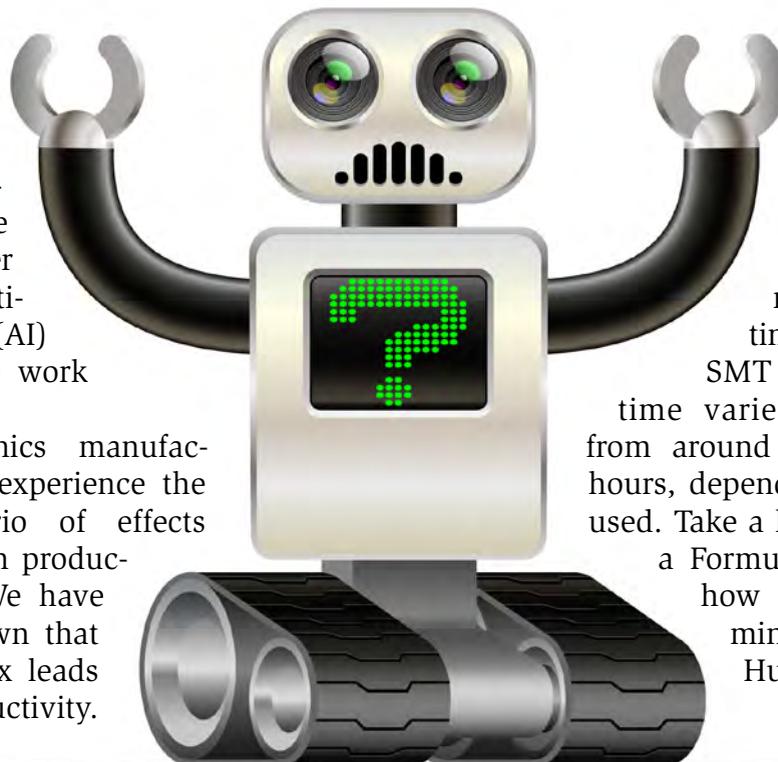
simply write this off as a cost of doing business where there is the need to provide flexibility without an increased stock holding of finished goods.

However, this is not the complete story. For example, SMT machine vendors have long been making their equipment suitable for flexible production with hardware- and software-based solutions where feeders can be placed anywhere on the machines. Further, SMT machine vendors have been developing techniques to provide rapid changeovers with common feeder setups for groups of similar products,

and even changeovers between disparate products with the simple swap out of removable feeder trolleys.

Even without these technology aids, the manual changeover time on a fully-loaded SMT placement machine time varies across companies from around five minutes to six hours, depending on the approach used. Take a look at the pit stop in a Formula One race to learn how to achieve the five minute SMT turnaround.

Huge losses to achieve flexibility are not a done deal.





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- Power electronics
- Failure Analysis
- Product assembly challenges
- Material selection and advancement test methods
- Adhesive and coating development

There are both technology and management options out there.

The productivity paradox continues to thrive. At an event in Scandinavia recently, I showed a slide of how high-volume productivity expectations of 80% or more are now replaced with 20–40% in today's higher mix environment. I was approached afterwards by someone saying that I had the numbers wrong, as they dreamed of being able to achieve 20%. The real number in many companies is far less than that today, which appears to support the German report. The mix of products in production continues to increase. Additionally, with a more volatile demand requirement, customers of manufacturing want the ability to change delivery quantities and times immediately whilst also not accepting the cost of holding additional buffer stock. Factories are paying the price of the effect of fluctuating customer demand directly into their automated production lines.

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To find the answer to this apparent conundrum, we start by looking at what is reported in terms of metrics within factories. Targets are the critical drivers for manufacturing performance. Around the factory, we see reports and charts explaining targets and achievement related to things such as on-time delivery, production rate, materials scrap, quality issues, etc. Pretty much everything in the factory is measured to some extent based on those statistics. Management wants to see that each process is under control and improvements are being steadily made. To focus on the productivity perspective, seeing what is posted in fac-

tories appears rather optimistic compared to what would be expected when thinking about the productivity paradox. Any schoolboy mathematician will quickly deduce that the metrics within the factory are based on a different dataset than the German report, which is where the problem lies.

The measurement of internal performance can be justifiably made in many different ways. Statistics can be made to show whatever specific perspective is needed. This style of reporting started when many enjoyed high-volume production. Dedicated production lines were making products as fast as possible. The emphasis was on getting more and more throughput from each square meter of line space. Performance was simply based on how many placements per hour could be achieved. Extreme effort went into the optimization of machine programs. However, to measure the machine performance accurately meant that machine downtime outside of machine responsibility should be ignored. If the line could potentially make 2,000 products per day, this was the rate against which performance was measured. It was extremely unlikely that the customer needed exactly 2,000 products per day.

Even in those days, demand fluctuated. When the finished goods warehouse started to fill to a bursting point, the line was taken down, unscheduled, and perhaps used this opportunity to perform maintenance. These times were excluded from the productivity calculation because it was an external, uncontrolled variable from the point of view of the machine engineers. This was the start of bad habits that developed and broadened over the course of time. More and more exclusions were made to reflect specific narrow scopes of responsibility as product mix increased. Productivity and capacity calculations became far more complex as techniques to manage higher mix came into play.

For example, the common setup of feeders on SMT placement machines was seen as a way to avoid the physical changing of locations of materials on the machines between different products. If two products running consecutively required the same materi-

als, then why not keep the same materials in place on the machine and eliminate the time to change them? Unfortunately, this created a new restriction for machine program optimization. The path travelled by the machine head to pick the most commonly used materials to the points of placements could no longer be optimized through the choice of where the materials should be set up on the machine. As a result, the program execution time was longer and less efficient.

Many overlooked this as the focus on machine program optimization had changed once the effects of higher mix came in; it became all about the changeover time. However, in many scenarios, as time went on, the losses in the programs exceeded those avoided in the changeover process. This lost productivity due to reduced program efficiency was almost never included in the productivity reports. Throughput performance was simply measured against the machine program time. Invisible losses like these started to become an increasingly common part of the regular high-mix production paradigm.

Production planning is another black hole example of lost productivity where fixed production configuration assignment rules for product allocation to line configurations by engineers have to be followed due to the sheer time and effort needed to prepare product data, thereby significantly restricting the optimization process. Generic legacy scheduling tools are useless in this environment. In reality, production is mainly scheduled utilizing Excel as a just-in-time (JIT) planning tool; no one has time to think about whether more optimized production allocation plans could be made.

The associated losses of opportunity continue to increase due to these kinds of problems, many of which are hidden and not reported due to the narrow focus of individual operations and lack of overall visibility. Productivity reports made from each perspective look good on the shop floor and everyone is making an excellent effort, but if you step back and look at the bigger picture, the overall result is going in the wrong direction, which is exactly what the German reports are highlighting. The real-

ization of this is a good thing because even if the numbers themselves are very poor, without this information, there is no opportunity to investigate and improve. In the meantime, it is fine to continue to measure the internal performance of each element within manufacturing with the current metrics and key performance indicators (KPIs); one should not replace the other.

However, what the German reports don't offer is a solution to this issue. From a high-level perspective, the situation is complex and bewildering with numerous variables and barriers, many of which are buried in the technical detail of operations. Discovery of hidden issues—as well as the consequences of actions taken—are very difficult to understand, never mind quantify. To start to gain a sense of it all, there are two main things to address.

Discovery of hidden issues— as well as the consequences of actions taken—are very difficult to understand, never mind quantify.

The first is to understand the real need of the business—both current and future. For example, in Germany, the most active sector of the industry is automotive. The pride of German automotive assembly lines has a final production assembly line running at a fixed takt rate like a heartbeat delivering cars reliably and on time every time. The line is also fully flexible and capable of making any of the millions of combinations of options and features that any customer could require. It all sounds good and appears to be a supreme achievement of automation, which includes human activity.

However, if you focus away from the final line operation, it is possible to see the damage that the assembly-line operation is causing. Looking downstream, we see that the factory

still has to make sure that the total demand for the family of cars that each line produces exactly meets the customer demand, so as not to create a buildup of finished goods stock. There is no scope for the line to make any model changeover. Sales and marketing will create campaigns and incentives in the market to drive a constant factory demand, but even so, making to customer order has to be mixed with some standard builds to keep the line running continuously, which are often sold at a discount.

One would imagine that if you ordered a new car in this situation—even with a bespoke set of features—it could be made quite rapidly, as it is clearly shown that just a couple of days lead time in the factory is all that is required. Instead, the reality of the situation is that the waiting time for a production slot can be many months. People tend to want to look elsewhere for their cars when faced with this ordering lead time. The reason for the long lead time is the planning that goes into the final assembly line.

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To ensure that it never stops, there is a buffer of orders upfront. This is needed JIT to give the forecast of demand for subassembly options and configurations to be supplied to the factory. The cost of flexibility is simply being passed upstream. Suppliers to automotive final assembly lines receive a somewhat variable production demand, often volatile, with which they have to comply. Delivery must occur within a specific window—no sooner, and certainly no later. Optimization of the subassembly factory operations represents the worst-case scenario in the industry. Safety-critical assemblies require in-depth quality, process, and engineering management. With a high mix and often small work-order quantities, changes are

continuously required in the factory flow with each configuration change needing to be qualified against the required standards. There is little compensation for this, as the pricing in automotive is very sensitive indeed.

A typical automotive subassembly provider needs to be aware of these constraints of doing business and create a production model that is optimized and developed in a way that all of the hidden losses are exposed and addressed as a part of the model. The same process applies to all types and sectors of electronics and assembly manufacturing in general. However, creating the optimum operation is not as simple as it used to be. Industry 4.0 was created to address these new operational paradigms, the software-based automation layer above the increasing number of automated processes that the older Industry 3.0 represents. The German reports are looking for Industry 4.0 results, but are based on Industry 3.0 activities. It is time to create some real tools for Industry 4.0, which is the second thing that needs to be addressed.

Industry 4.0 is the optimization of every aspect of the manufacturing process through the use of live data. The solution for each factory taking Industry 4.0 on board is going to be a little different depending on the business need, whether this is lines of machines talking to each other, managing Lean materials, adaptive planning, assignment of products to line configurations, or digital twin-based assembly process engineering. However, it is not practical to develop individual bespoke Industry 4.0 software that would drive these factory processes because the cost quickly becomes prohibitive and non-sustainable.

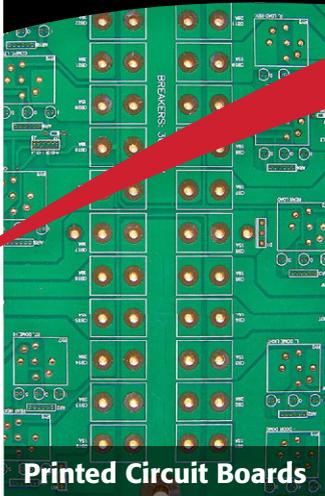
Standardization needs to happen at a level that promotes the use of standard digital platforms that deliver values based on the use of Industrial Internet of Things (IIoT) technology specifically for manufacturing. This technology is a distinct paradigm shift from legacy data collection. Through the inclusion of data flow between every operational process, a live, digital, and detailed holistic view of the shop floor, with a scope that is inclusive of every manufacturing and dependent event and has a deep



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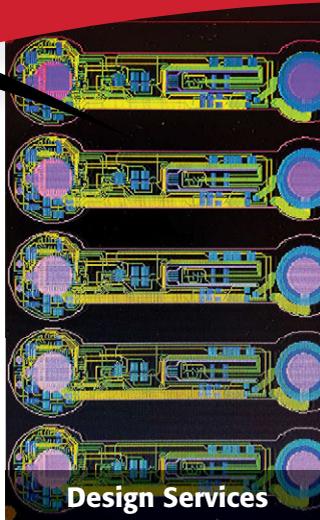
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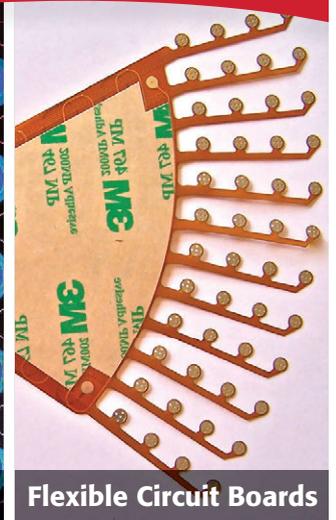
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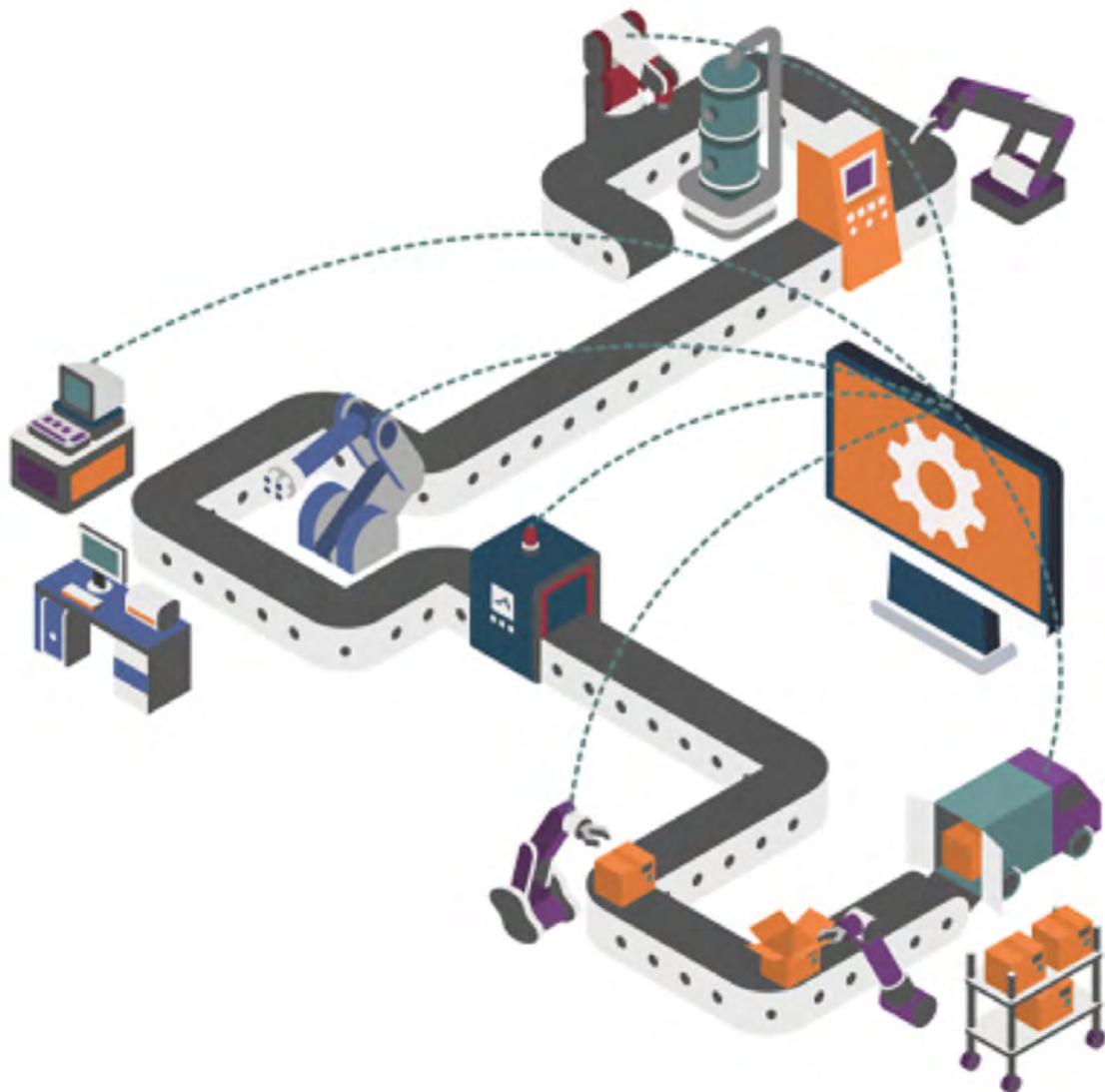
and well-defined level of detail is available at all times. Unacknowledged losses are no longer out of sight and can be included in any activity related to performance improvement, optimization, and operational decision-making all in line with the goals of Industry 4.0. Effects of decisions made and changes executed can be seen, measured, and continuously refined, and in this case, directly contribute to the overall productivity of the factory.

At IPC APEX EXPO 2018, we saw the world's first demonstration of the Connected Factory Exchange (CFX). Though machine communication is nothing new, the fact that key metrics and data from any type of machine from any vendor could be viewed on demand by visitors on their mobile phones without any installation or configuration of software was an eye-opener. The barriers of having differ-

ent communication methods—as well as different levels of data content from machines—had been eliminated.

One year later at IPC APEX EXPO 2019, we look forward to seeing the published CFX standard in action in terms of the scope and depth of communication now supported, gathering data for use in dashboards, AI decision-making, and factory optimization. Whatever the software tools of choice are for manufacturing, the ability to have visibility of the status and performance of every event that takes place on the factory floor provides the opportunity to see and understand exactly where time and opportunities are being lost.

Software tools at the factory level can then utilize this information to optimize the entire factory in real time. Machine vendors also have the opportunity to get significantly more



data about the environment in which their machines are working through seeing materials and planning information with which to further automatically optimize their machine operations. As a standard based on true industry consensus, CFX has been designed to provide information about all areas of opportunity, control, and management in the factory.

CFX is the definition of how data is exchanged and the exact language and meaning of that data. The adoption of CFX is now being made into software tools provided by machine vendors on the machine or line level, as well as by solution providers across the whole factory. The paradigm of manufacturing execution systems (MES) changes as a result. Legacy MES systems that simply gather data save it into a series of databases and then provide reports are not going to be up to the challenge of processing IIoT data in real time; thus, they will be limited when it comes to live optimization and decision-making support.

A new breed of digital MES systems specifically designed for the IIoT and CFX environment deliver the most value, spanning the whole gamut of factory operations and offering a single standard digital platform. For example, bespoke extensions to the platform to support specialized reporting and monitoring—as well as the inclusion of product-specific processes such as functional test—can easily be added by local IT developers by creating the required CFX interface and utilizing the free IPC CFX software development kit (SDK).

The technology shown by the many participating vendors at IPC APEX EXPO 2019 represents the key turning point to reverse the productivity paradox and enable new automation management techniques and digital best practices that address the long-standing hidden, ignored, or unavoidable causes of lost productivity. Full visibility and control of even the most complex of factory operations for engineers and managers are restored, providing the intelligence with which to identify and eliminate causes of losses. This provides an opportunity for increased flexibility whilst also increasing productivity, quality, on-time delivery, and a reduction of material-related costs.

Though the demonstration of CFX—together with the IPC Hermes Standard (which replaces SMEMA)—at IPC APEX EXPO 2019 is limited in scope due to the nature of an unconnected manufacturing line working live in a trade show environment, the fundamentals will be on display from machine vendors. The latest CFX-enabled MES software tools and experts will be on hand to demonstrate and explain how the use of CFX technology can bring an end to this productivity paradox. I look forward to meeting you there. **SMT007**



Michael Ford is the senior director of emerging industry strategy for Aegis Software. To read past columns or contact Ford, [click here](#).

Tempo Automation's Open House Raises the Curtain in San Francisco

Based in San Francisco, California, Tempo Automation specializes in rapid PCB assembly and on low-volume production for a wide range of board complexities. It recently held an open house at its brand-new facility in the South of Market (SoMa) district—which is normally restricted under customer non-disclosure agreements as well as International Traffic in Arms Regulations (ITAR) regulations—to customers, vendors, local designers, and government officials.

The new 42,000 square foot facility occupies two floors with a software-driven automated factory on the first floor, and software development, design for manufacturability, marketing, and sales teams on the second. I-Connect007 Managing Editor Nolan Johnson was there to attend the open house and witness Tempo's manufacturing lines.

[\(Read the full article here\)](#)

ein Electronics Industry News and Market Highlights



Nine Top-15 2018 Semiconductor Suppliers Forecast to Post Double-Digit Gains ▶

The expected top-15 worldwide semiconductor (IC and O-S-D—optoelectronic, sensor, and discrete) sales ranking for 2018 is shown in the figure. It includes seven suppliers headquartered in the U.S., three in Europe, two each in South Korea and Japan, and one in Taiwan.

Global Biometrics Technology Market to Reach \$59.31 Billion by 2025 ▶

The global biometrics technology market size is likely to reach \$59.31 billion by 2025, experiencing a CAGR of 19.5% during the forecast period.

NASA Looking to Tiny Technology for Big Payoffs ▶

NASA is advancing technology that could use large amounts of nanoscale materials to launch lighter rockets and spacecraft than ever before. The super-lightweight aerospace composites (SAC) project seeks to scale up the manufacturing and use of high-strength carbon nanotube composite materials.

Seven of Top 10 Smartphone Markets Down in Q3 2018 ▶

Worldwide smartphone shipments fell by 7% in Q3 2018, a fourth consecutive quarter of decline. This was also the worst third quarter performance since 2015.

Gold 'Micro Jewels' from 3D Printer Printing Pure Metal Microparts ▶

Thanks to a laser technique that ejects ultra-tiny droplets of metal, it is now possible to print 3D metal structures, not only simple 'piles' of droplets, but complex overhanging structures as well: like a helix of some microns in size, made of pure gold.

Is an 'Internet of Ears' the Next Big Thing for Smart Homes? ▶

Next generation of connected buildings environments using changes in vibrations, sound and electrical field to improve energy consumption, monitor occupants' movements.

Global Semiconductor Sales Up 14% YoY in September ▶

According to SIA, worldwide sales of semiconductors reached \$122.7 billion during the third quarter of 2018, an increase of 4.1% over the previous quarter and 13.8% more than the third quarter of 2017.

Fleets of Drones Could Aid Searches for Lost Hikers ▶

Finding lost hikers in forests can be a difficult and lengthy process, as helicopters and drones can't get a glimpse through the thick tree canopy. Recently, it's been proposed that autonomous drones, which can bob and weave through trees, could aid these searches. But the GPS signals used to guide the aircraft can be unreliable or nonexistent in forest environments.

IDC Reveals Worldwide CIO Agenda 2019 Predictions ▶

In the multiplied innovation economy, enterprises are racing to reinvent themselves as the pace of digital transformation (DX) becomes exponential.

Solution for Next Generation Nanochips Comes Out of Thin Air ▶

Researchers at RMIT University have engineered a new type of transistor, the building block for all electronics. Instead of sending electrical currents through silicon, these transistors send electrons through narrow air gaps, where they can travel unimpeded as if in space.

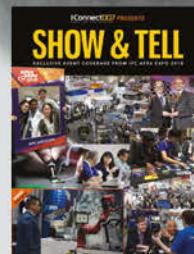
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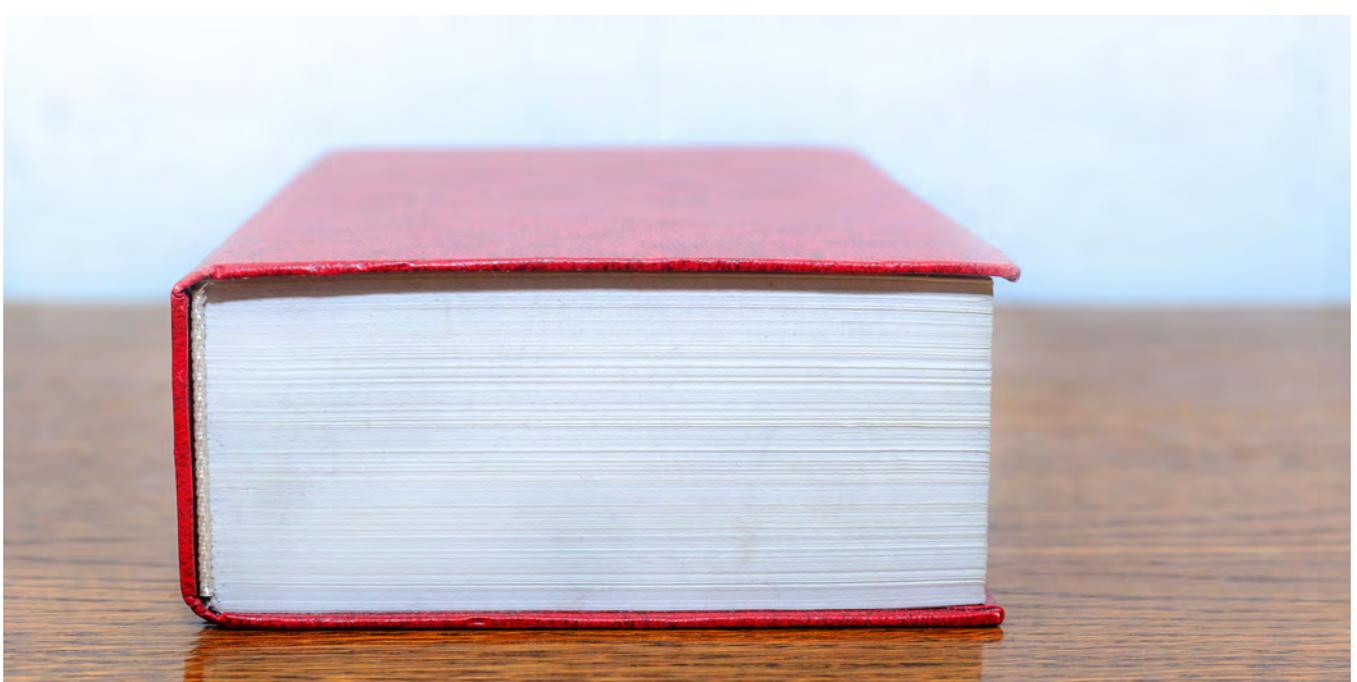
Feature Column by Eric Camden, FORESITE INC.

The biggest conference in the electronics industry will be upon us before you know it, and when you live in the Midwest, a trip to San Diego can't come soon enough. So, in advance of IPC APEX EXPO 2019, I wanted to put together a quick snapshot of a few test methods in IPC TM-650 that are the most important to use regarding quality and reliability.

Before I get into specific test methods and their importance, let's discuss IPC and TM-650 test methods in general. IPC was originally formed in 1957 as the Institute of Printed Circuits. A lot has changed since then, including what IPC's acronym stands for; now, IPC is known as Association Connecting Electronics Industries. While IPC's new name may not directly relate to the three letters they are known for, it more accurately describes the mission and industry in general. This was a

good move because the scope of the IPC has drastically changed since 1957, as has the electronics industry.

The IPC has done an excellent job keeping pace with new advancements in the industry with test methods and educational offerings. In my position at a testing lab, we test samples of all kinds to different approved IPC test methods that are all found within TM-650, which is a big book full of testing that covers pretty much every conceivable aspect of manufacturing electronics. TM-650 had its first release in April of 1973 with around 200 test methods; today, it includes 253 active test methods and 18 old test methods. Current test methods are on a five-year review cycle within the 7-11 task group that updates them as needed for various reasons. The old test methods are still applicable but are not part of a review cycle.





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Some of the current test derivatives of military specifications and others are original test methods designed by professionals from different corners of our industry based on specific materials or processes. The test methods are the backbone of the J-STD series, which are the assembly documents of choice that cover bare boards, assemblies, flux, paste, solder, etc. If you have any questions about how to assemble a product, you can find a section in one of those standards; within that, you will more than likely find a reference to a test method.

If you have any questions about how to assemble a product, you can find a section in one of those standards; within that, you will more than likely find a reference to a test method.

There are even standards that apply specifically to space and automotive industries among others with demands outside of most electronics. These standards are used in most assembly houses around the world to ensure quality and reliability. On any print, you should find a reference to what specifications to build to and the order of precedent as agreed upon between user and supplier (AABUS). IPC specs are also typically called out. That is a normal default that in lieu of direct specifications from the customer, an assembler should use IPC standards as assembly guidance documentation that will include tests from TM-650.

The test methods I want to discuss in this column are mostly related to cleanliness and different ways to determine if the process is clean enough for the intended end-use environment. Knowing the effect of residual ionic content is among the most important data points when looking at reliability. It is so critical because the ionic content is directly related to electrical

leakage and electrochemical migration-related issues in a normal field service environment. When you have the fire triangle—contamination, available atmospheric moisture, and bias differential—the risk of electrical leakage is greatly increased. There are no industry limits regarding allowable amounts of ionic content determined by ion chromatography because there isn't a single set of cleanliness limits that apply to all electronics. It is important for each assembler to determine if the ionic content present will be detrimental to the field performance of your specific product.

The single test used by the industry the longest to test cleanliness is TM-650 2.3.25: Resistivity of Solvent Extract. The problem with using this test for acceptance is that it was designed in the 1970s and was never intended to be used for this purpose. You can find a very detailed white paper—IPC WP-019—that describes the history of this test method and why it should no longer be used as it most commonly is today. In short, the product being built when this test was introduced did not use bottom-terminated surface-mounted parts using no-clean solder paste among dozens of other material differences.

When addressing cleanliness, the most accurate method to determine the ionic content is ion chromatography. The test method for that is TM-650 2.3.28: Ionic Analysis of Circuit Boards, Ion Chromatography Method. This method requires subjecting the sample to a mixture of isopropyl alcohol and deionized water at 80°C for one hour. This will bring surface contaminants that can become soluble into a solution that will be processed through the ion chromatography (IC) equipment. After an IC test is complete, you will have the exact type and amounts of each anion, cation, and a general weak organic acid total. Each of the materials that go into the assembly process will have a chemical signature that can be matched back to the IC results.

This information is crucial in determining the risk of electrical leakage. If you find elevated levels of ionics, you can look at the IC results and compare them to flux activators, plating chemistries, wash signatures, bare board fab,

handling, etc. When you know the process or material that is causing elevated ionic residues, you can then address that specific process and optimize it to a point where it leaves minimal active residues. The standard extraction method is usually done on a full board where you must calculate the total surface area of the sample to include a population factor of 10% if components are present. This means the results are an average of contamination if they were evenly spread across the entire sample—front and back.

While this information is good, it leaves a few questions unanswered. There is a growing understanding in the industry that to better determine the risk of electrical leakage or other contamination related issues, you need to look at much smaller areas of the sample. This allows you to look at specific processes like wave solder, hand solder, localized cleaning effectiveness, etc. This type of extraction can be done in several ways—both manual and automated. When the IC is processed on the effluent, the number is much more meaningful than an average cleanliness number. When elevated ionics are found after a localized extraction process, you can then go back and compare to data from the PC fabrication, component, or flux residues. From my perspective, IC analysis is generally the best tool to use for determining the possible impact processing residues will have on reliability.

The next test method I want to highlight is TM-650 2.6.3.7: Surface Insulation Resistance (SIR). This test is used for material and process qualification utilizing unpopulated test coupons with known spacing comb patterns in an elevated heat (40°C) and humidity (90%) chamber with constant voltage application. The test method was originally written to use the B-24 test boards, but in the past few years, more and more companies are using IPC B-52 test boards. This is a much better option because it incorporates components commonly used in today's manufacturing.

There is another SIR test option—TM-650 2.6.3.3—which is similar but uses test parameters of 85°C and 85% RH, which can alter the chemical composition of weak organ-

ic acids and give false results. The test runs for no less than 72 hours with most running it to 168 hours. Measurements are taken every 20 minutes to monitor any effect the elevated heat and humidity have when combined with the residues present on the sample. Much like the IC test, the idea is to determine if the residues present will facilitate electrical leakage and/or electrochemical migration. The acceptance criteria details for this test are found in the J-STD-004 standard—section 3.4.1.4.1.

While SIR is a good test to look at the assembly house's ability to process the chosen set of materials with their equipment, it does not necessarily translate to the actual product being built. For that test, I recommend temperature, humidity, and bias (THB) testing. This test is designed to accelerate electrical leakage or dendrite growth, particularly on device die surfaces that would never be tested with standard SIR testing. One standard set of parameters is 85°C and 85% RH for up to 1,000 hours, but that can vary.

THB testing is done on actual assemblies and not test coupons, which means there are no comb patterns to judge the results and you will use active components instead of dieless.

THB testing is done on actual assemblies and not test coupons, which means there are no comb patterns to judge the results and you will use active components instead of dieless.

There isn't a related IPC test method for this, but it is commonly done in many sectors of the industry. You will need to create a test fixture to apply normal operating power and cycles with a monitor of expected feedback for a measurement point. While there isn't an associated IPC test method, it is certainly a good idea for first article assemblies.

The main tests I would recommend for determining baseline cleanliness levels and what effect they will have on end-use reliability are IC, SIR, and THB tests. However, there are a handful of others that are worth the time and money. Cross-sectioning per IPC-TM-650 2.1.1 is a great way to get a better understanding of the solder joint quality as well as the PC fabrication process. Knowing there is a good intermetallic compound (IMC) will go a long way in determining if you will have possible issues with intermittent connectivity. A strong solder joint will also help with vibration issues in more severe operating environments.

If you are planning to use conformal coatings, it is a good idea to test how resistant to moisture it is using TM-650 2.6.3.4: Moisture

and Insulation Resistance. This test uses 20 cycles of various temperature and humidity levels to help drive as much moisture as possible into the coating and see how effective it is at preventing ingress onto the surface of the assembly.

I've mentioned six test methods, so that leaves just 247 more active test you could use to determine the reliability of your products. Did I mention I work for a test lab? Call me; let's talk. **SMT007**



Eric Camden is a lead investigator at Foresite Inc. To read past columns or contact Camden, [click here](#).

Carbon Fiber Can Store Energy in the Body of a Vehicle

A study led by Chalmers University of Technology in Sweden has shown that carbon fibers can work as battery electrodes and store energy directly. This opens up new opportunities for structural batteries where the carbon fiber becomes part of the energy system. The use of this type of multifunctional material can contribute to a significant weight reduction in aircraft and vehicles of the future.

Leif Asp, professor of material and computational mechanics at the university, headed up a multidisciplinary group of researchers who recently published a study on how the microstructure of carbon fibers affects their electrochemical properties. Studying the micro-

structure of different types of commercially available carbon fibers, the researchers discovered that carbon fibers with small and poorly oriented crystals have good electrochemical properties but a lower relative stiffness. If you compare this with carbon fibers that have large, highly oriented crystals, they have greater stiffness, but the electrochemical properties are too low for use in structural batteries.

The researchers are collaborating with both the automotive and aviation industries. Asp explains that for the aviation industry, it may be necessary to increase the thickness of carbon fiber composites to compensate for the reduced stiffness of structural batteries. In turn, this would also increase their energy storage capacity.

"The key is to optimize vehicles at the system level based on the weight, strength, stiffness, and electrochemical properties. That is something of a new way of thinking for the automotive sector, which is more used to optimizing individual components. Structural batteries may perhaps not become as efficient as traditional batteries, but since they have a structural load-bearing capability, very large gains can be made at the system level," Asp says.

(Source: Chalmers University of Technology)



Leif Asp

“Mark does an outstanding job detailing what needs to be included in the handoff from designer to fabricator. This book should be required reading for every designer.”



Douglas Brooks, Ph.D.
BS/MS EE

Most of the design data packages that a fabricator receives contain inaccurate or incomplete data.

Don't be a data violator!



I-007eBooks.com/data





Editor's Picks from SMT007.com

1 One World, One Industry: Back to School with IPC EDGE 2.0 ▶

IPC spent the summer gearing up for new education and certification platforms, and has announced that IPC EDGE 2.0 is ready for all certification users. John Mitchell talked with David Hernandez, senior director of learning and professional development, and Kris Roberson, director of certification programs, to talk about what's new in education and certification.



John Mitchell

2 A Brief History of Solder Stencil Manufacturing ▶

Greg Smith, manager of stencil technology at BlueRing Stencils, made his first SMT stencil in the 1980s. In this new column, SMT Stencils 101, Greg will discuss the fundamental concepts and principles in surface-mount technology (SMT) stencils, beginning with a bit of a history, and the latest developments and technologies in stencils.

3 Alpha Preforms Improve Thermal Management on BTCs ▶

Alpha Assembly Solutions has recently introduced ALPHA AccuFlux BTC-578 Solder Preforms, designed to enhance reliability and heat transfer through the reduction of voiding under bottom termination components (BTCs).

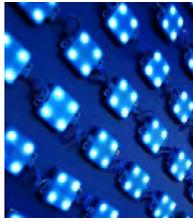
4 Low-temperature Solder Paste Process Advantages ▶

This article examines the performance of two low melting point SnBi alloys used in solder paste when assembling BGA components with SAC alloy spheres, and the advantages of a low-temperature process over the regular SAC assembly process. It will also evaluate solder paste capability regarding the process and the performance of a joint formed with a low melting point alloy solder paste and SAC305 spheres, including process advantages and material capabilities.



5 Process, Design and Material Factors for Voiding Control for Thermally Demanding Applications ▶

Solder voiding is a common phenomenon across all semiconductor packaging and electronic board assemblies. There are many factors that influence void frequency and size. This article focuses on several process, design and materials selection considerations which control or potentially reduce voiding to meet industry and end-market acceptance criteria.



6 Top 5 Ways to Mitigate PCB Component Availability Problems ▶

The electronics design world is by now aware that we're in a very serious period of components shortages. Allocation and shortages hit every few years, but this one seems to be the worst in recent memory. It could be a problem until 2020 and the supply chain and world of components manufactures will likely be a different animal coming out of it. Here are five things you can do to minimize the effects.

7 Pros and Cons of Dual Sourcing ▶

Now, more than ever, there's a need for responsive and flexible supply chains. For OEMs, one solution to mitigate the risk of supply chain disruption is to maintain relationships with more than one supplier through dual sourcing—the practice of purchasing a chosen raw material, product, or service from two (or sometimes multiple) sources. Here are its pros and cons.

8 Green Circuits' Joe O'Neil and Joe Garcia on the Best Kept Secret ▶

Joe O'Neil, CEO, and Joe Garcia, VP of sales and marketing, at Green Circuits discuss with I-Connect007



Managing Editor Nolan Johnson about recruiting new employees, new training and certification requirements, tariffs, and more.

9 Cirtronics Sponsors NH Social Venture Innovation Challenge ▶

Cirtronics, a socially responsible contract manufacturer located in Southern New Hampshire, will be a sponsor of the annual New Hampshire Social Venture Innovation Challenge (SVIC).



10 TT Electronics Opens Design Center in Shenzhen ▶

TT Electronics has announced the opening of a new design centre in Shenzhen, China. The site will provide world class design and R&D capabilities to support the company's anticipated growth plans, working in partnership with the global manufacturing centres of excellence to deliver smarter solutions together.



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Career Opportunities

Pssst!
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for Someone?



Place your notice in our Help Wanted section.

For just \$500, your 200 word, full-column—or, for \$250, your 100 word, half-column—ad will appear in the Help Wanted section of all three of our monthly magazines, reaching circuit board designers, fabricators, assemblers, OEMs and suppliers.

Potential candidates can click on your ad and submit a résumé directly to the email address you've provided. If you wish to continue beyond the first month, the price is the same per month. No contract required. We even include your logo in the ad, which is great branding!

To get your ad into the next issue, contact:

Barb Hockaday at barb@iconnect007.com or +1.916.608.0660 (-7 GMT)

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Career Opportunities



U.S. CIRCUIT

Sales Representatives (Specific Territories)

Escondido-based printed circuit fabricator U.S. Circuit is looking to hire sales representatives in the following territories:

- Florida
- Denver
- Washington
- Los Angeles

Experience:

- Candidates must have previous PCB sales experience.

Compensation:

- 7% commission

Contact Mike Fariba for
more information.

mfariba@uscircuit.com

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New England Territory PCB Sales Position

Prototron Circuits, a leading manufacturer of quick-turn PCBs for over 31 years, is seeking representation in our New England territory. Prototron Circuits is ITAR registered, ISO 9001:2015 and AS9100D certified, and MIL-PRF-31032 qualified with two facilities located in Redmond, Washington, and Tucson, Arizona.

Candidates should have:

- Experience selling PCBs or industry related products
- The ability to work from a home office and travel to and from customer facilities
- A proven track record prospecting and building sales in an existing territory

Prototron Circuits has maintained a 98% on-time rating every year and is well known for both outstanding quality and reliability. If you desire spending the day selling and not apologizing, this is the opportunity you've been looking for.

Direct position includes salary, incentive plan, full benefits package, and company covered expenses.

A rep agreement will be on a commission basis for a principal with a proven track record of reliability in an established territory.

To be considered for this opportunity,
please send your resume to Russ Adams at
russa@prototron.com.

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Career Opportunities



SMT Surface Mount Technician / SMT Operator

Huntingdon Valley, Pennsylvania

Manncorp, a leader in the electronics assembly industry, is looking for an additional SMT field technician to install and support our wide array of SMT equipment.

Duties and Responsibilities:

- Manage on-site installation of equipment and training of customers
- Must be capable of running SMT production lines on-site
- Post-installation service and support includes troubleshooting and diagnosing technical problems by phone, email, or additional on-site visits when necessary
- Assist with demonstrations of equipment to potential customers
- Build and maintain positive relationships with customers
- Produce service reports
- Cooperate with the technical team and share information across the organization
- Assist with the crating and uncrating of equipment

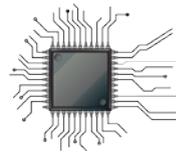
Requirements and Qualifications:

- Three to five years of experience with SMT equipment or an equivalent technical degree
- Proven strong mechanical and electrical troubleshooting skills
- Proficient in reading and verifying electrical, pneumatic, and mechanical schematics/drawings
- Organized, detail orientated, and capable of multitasking
- Have strong written and oral interpersonal skills with an ability to work under minimum supervision
- Ability to work with little supervision while traveling
- Frequent travel
- Ability to arrange and schedule service trips
- USA citizenship required

We Offer:

- Health and dental insurance
- Retirement fund matching

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Global

Multiple Positions Available

Want to work for a fast-growing company? MivaTek Global may be the place for your next career move. 2018 has brought significant growth, increasing sales and revenue. And, we are just getting started! To support the current customer base and fuel further expansion, we are looking for bright and talented people who are energized by hard work in a supportive and flexible environment.

Open Positions:

- Technical Service Technicians
- Regional Sales Representatives
- Regional Leader for Asia Sales and Support

Proven experience in either PCB or Microelectronics and willingness to travel required for all positions.

More About Us

MivaTek Global is a distributor of manufacturing equipment with an emphasis of Miva Technologies' Direct Imager, Mask Writer, Flatbed Photo-plotter imaging systems and Mach3 Labs X-Ray Drills. We currently have 45 installations in the Americas. Expansion into Asia during 2018 has led to machine installations in China, Singapore, Korea, and India.

To be part of our team, send your resume to n.hogan@kupertek.com for consideration of current and future opportunities.

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Career Opportunities



Sr. PCB Designer - Allegro

Freedom CAD is a premier PCB design service bureau with a talented team of 30+ dedicated designers providing complex layouts for our enviable list of high-tech customers. Tired of the commute? This is a work-from-home, full-time position with an opportunity for overtime at time and a half.

Key Qualifications

- EXPERT knowledge of Allegro 16.6/17.2
- Passionate about your PCB design career
- Skilled at HDI technology
- Extensive experience with high-speed digital, RF and flex and rigid-flex designs
- Experienced with signal integrity design constraints encompassing differential pairs, impedance control, high speed, EMI, and ESD
- Experience using SKILL script automation such as dalTools
- Excellent team player that can lead projects and mentor others
- Self-motivated, with ability to work from home with minimal supervision
- Strong communication, interpersonal, analytical, and problem solving skills
- Other design tool knowledge is considered a plus (Altium, PADS, Xpedition)

Primary Responsibilities

- Design project leader
- Lead highly complex layouts while ensuring quality, efficiency and manufacturability
- Handle multiple tasks and provide work leadership to other designers through the distribution, coordination, and management of the assigned work load
- Ability to create from engineering inputs: board mechanical profiles, board fabrication stack-ups, detailed board fabrication drawings and packages, assembly drawings, assembly notes, etc.

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MacDermid Enthone
ELECTRONICS SOLUTIONS

Product Group Field Manager Waterbury, CT

The Product Group Field Manager is responsible for creating and driving the regional product line strategic plan in coordination with the global product line managers, strategic account manager and regional business managers. The successful candidate must balance commercial obligations to assist the sales teams in closing new business, perpetuating technical expertise throughout the field and develop best practices for the region.

Education: Bachelor's degree; 5 years of related experience; or equivalent combination of both.

Responsibilities

- Thorough understanding of the PCB business; specifics in wet processing areas.
- Facilitate developing commercial and technical strategy for customers.
- Create and deliver customer facing presentations.
- Training.
- Create and execute a product rationalization program aligning with global product managers.
- Develop roll-out packages for new product introductions, including operating guides.
- Excellent written and oral communication skills.
- Expert in chemistry and chemical interaction within PCB manufacturing.
- Willingness to travel globally.

MacDermid Enthone is an E-Verify Company and provides reasonable accommodation for qualified individuals with disabilities and disabled veterans in job applicant procedures. "Equal Opportunity Employer: Minority/Female/Veteran/Disabled/Gender Identity/Sexual Orientation."

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Career Opportunities



MacDermid Enthone
ELECTRONICS SOLUTIONS

Global Application Specialist Waterbury, CT

Qualifications: Bachelor's in Chemistry, and seven years progressive experience in related field. Expertise preferably in ENIG and ENEPIG. Global travel required: up to 40%.

Responsibilities

- Chemical analysis and experiments of final finish chemistries; characterize new processes from research prior to beta site installations, establishing operating parameters, problem solving tools and analytical guidelines.
- Recommend product, process, and analytical method improvements; including changing composition of compounds.
- Develop final finish product line. Install products at beta sites; collect data.
- Lead technical teams during beta site installations of new products and problem-solving groups at customer locations.
- Train personnel.
- Set up tests of final finish chemistries and products for laboratory personnel to identify customer problems, analyze result to resolve customer issues, and communicate results to customers.
- Oversee laboratory analysis and processing of customer samples through our global technical centers; summarize data, make recommendations and write reports.
- Document technical bulletins.

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MacDermid Enthone
ELECTRONICS SOLUTIONS

Director of Final Finishes Waterbury, CT

Education: Advanced practical knowledge—formal education and experience in chemistry or related sciences. Knows all technology within the business area and has knowledge of end use processes and OEMs.

Responsibilities

- Collects and analyzes market information, understands the competitive landscape, identifies potential gaps in product portfolio and effectively communicates needs to the product development group.
- Oversees product development activities, and reviews projects as they reach PDP milestones.
- Responsible for customer presentations and participation in trade organizations and other industry activities.
- Constructs release package information for the introduction of new products and sets pricing guidance for the commercial teams.
- Responsible for customer presentations and participation in trade organizations and other industry activities. High-level customer interaction required.
- Has successfully demonstrated the ability to manage professionals and nonprofessionals in a technical and marketing environment.
- Develops and responsible for budgets and goals of the group.

MacDermid Enthone is an E-Verify Company and provides reasonable accommodation for qualified individuals with disabilities and disabled veterans in job applicant procedures. "Equal Opportunity Employer: Minority/Female/Veteran/Disabled/Gender Identity/Sexual Orientation."

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Career Opportunities



Careers with Gardien

The Gardien Group, a leading solutions provider in the PCB industry, is looking to fill multiple openings in their China, Japan, Taiwan and the United States service centres.

We are looking for electrical engineers, operations managers, [machine operators](#) and sales executives. Prior experience in the PCB industry is beneficial but not essential. Training will be provided along with excellent growth opportunities, benefits package and periodic bonuses.

Our global teams are from diverse cultures and work cohesively as a tight-knit unit. With performance and initiative, there are plenty opportunities for professional growth.

Interested candidates please contact us at careers@gardien.com with your resume and a cover letter. Kindly note that only shortlisted candidate will be contacted.

About Gardien Group

Gardien is the world's largest international provider of independent testing and QA solutions to the PCB industry with a global footprint across 24 service centres in 5 countries and we cater to a whole range of customers, from small, family-owned PCB shops to large international fabricators, and everything in-between. Gardien's quality solutions and process standards are trusted by leading high-tech manufacturers and important industries including aerospace, defense and medical technology.

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American Standard Circuits

Creative Innovations In Flex, Digital & Microwave Circuits

CAM Operator

American Standard Circuits is seeking a CAM Operator for its Phoenix, Ariz., office. Qualified applicants will need experience in using Valor/Genesis (GenFlex) CAD/CAM software with printed circuit board process knowledge to edit electronic data in support of customer and production needs.

Job Requirements:

- At least 5 years' experience in PCB manufacturing
- Process DRC / DFMs and distinguish valid design and manufacturing concerns.
- Modify customer supplied data files and interface with customers and engineers
- Responsible for releasing manufacturing tooling to the production floor
- Prepare NC tooling for machine drilling, routing, imaging, soldermask, silkscreen
- Netlist test, optical inspection
- Work with Production on needed changes
- Suggestions on continual improvements for engineering and processing.
- Be able to read write and communicate in English
- Must understand prints specifications
- Must be US Citizen or permanent resident (ITAR)
- High School Graduate or equivalent

Join our Team!

Founded in 1988, American Standard Circuits is a leading manufacturer of advanced circuit board solutions worldwide. Our ongoing commitment to leading-edge higher-level interconnect technology, cost-effective manufacturing and unparalleled customer service has put us at the forefront of advanced technology circuit board fabrication.

We manufacture quality rigid, metal-backed and flex printed circuit boards on various types of substrates for many applications.

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Career Opportunities

ELECTROLUBE

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We Are Recruiting!

A fantastic opportunity has arisen within Electrolube, a progressive global electro-chemicals manufacturer. This prestigious new role is for a sales development manager with a strong technical sales background (electro-chemicals industry desirable) and great commercial awareness. The key focus of this role is to increase profitable sales of the Electrolube brand within the Midwest area of the United States; this is to be achieved via a strategic program of major account development and progression of new accounts/projects. Monitoring of competitor activity and recognition of new opportunities are also integral to this challenging role. Full product training to be provided.

The successful candidate will benefit from a generous package and report directly to the U.S. general manager.

Applicants should apply with their CV to
melanie.latham@hkw.co.uk
(agencies welcome)

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Ucamco

Former Barco ETS

International Field Service Engineer located in ITALY

The successful candidate will:

- Install and service our plotters and direct imaging machines at customer sites Europe-wide
- Carry out maintenance in the field
- Frequent travel: 4 to 5 days a week, 3 to 4 weeks a month
- Assist product manager

We are looking for a team player who is:

- Strongly customer-oriented and experienced in on-site support
- Accustomed to travel, and willing to travel frequently
- Motivated, independent and enterprising
- Technically-minded with training/background in electromechanics/electronics
- Experienced with software (setup, configuration, and usage of Windows-based CAM front-end software and Linux-based RIP software)
- Fluent in Italian and English (German and/or French is a plus)
- An analytical thinker
- Capable of problem solving

The right candidate will be a valued member of a friendly, team-oriented, growing international company that is a leader in its field, dedicated to excellence in all it does. Dynamic and fun, the company offers a great working atmosphere, and this new position is forward-looking and open, with plenty of opportunities for enterprising individuals whose results could be rewarded with prospects for progression in technical development.

Apply to Anja Ingels after clicking below.

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Career Opportunities



Role: Vice President Gardien Taiwan TAOYUAN COUNTY, TAIWAN

Gardien Taiwan is a service provider of circuit board (PCB) quality solutions, including electrical testing, AOI optical inspection, engineering (CAM), fixture making, repair and rework. Gardien Taiwan operates service centers in Taoyuan and employs about 100 employees and is currently seeking a vice president to manage and oversee the entity.

Candidate Profile:

- Proficiency in Chinese and English (written and spoken)
- Excellent communication and organization skills
- Experience in change management
- PCB background appreciated, but not mandatory
- Management experience in internationally operating companies
- Savvy in standard office software (Word, Excel and Power Point)

If this sounds like you, please [click here](#) to send us an email with your attached CV.

About Gardien Group - Gardien is the world's largest international provider of independent testing and QA solutions to the PCB industry with a global footprint across 24 service centres in five countries and we cater to a whole range of customers, from small family owned PCB shops to large international fabricators. Gardien's quality solutions and process standards are trusted by leading high-tech manufacturers and important industries including aerospace, defense, and medical technology.

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ZENTECH

Zentech Manufacturing: Hiring Multiple Positions

Are you looking to excel in your career and grow professionally in a thriving business? Zentech, established in Baltimore, Maryland, in 1998, has proven to be one of the premier electronics contract manufacturers in the U.S.

Zentech is rapidly growing and seeking to add Manufacturing Engineers, Program Managers, and Sr. Test Technicians. Offering an excellent benefit package including health/dental insurance and an employer-matched 401k program, Zentech holds the ultimate set of certifications relating to the manufacture of mission-critical printed circuit card assemblies, including: ISO:9001, AS9100, DD2345, and ISO 13485.

Zentech is an IPC Trusted Source QML and ITAR registered. U.S. citizens only need apply.

Please email resume below.

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Career Opportunities



Sales Associate - Mexico

Manncorp, a leader in the electronics assembly industry for over 50 years, is looking for an additional sales associate to cover all of Mexico and to be part of a collaborative, tight-knit team. We offer on-the-job training and years of industry experience in order to set up our sales associate for success. This individual will be a key part of the sales cycle and be heavily involved with the customers and the sales manager.

Job responsibilities:

- Acquire new customers by reaching out to leads
- Ascertain customer's purchase needs
- Assist in resolving customer complaints and queries
- Meet deadlines and financial goal minimums
- Make recommendations to the customer
- Maintain documentation of customer communication, contact and account updates

Job requirements:

- Located in Mexico
- Knowledge of pick-and-place and electronics assembly in general
- 3+ years of sales experience
- Customer service skills
- Positive attitude
- Self-starter with ability to work with little supervision
- Phone, email, and chat communication skills
- Persuasion, negotiation, and closing skills

We offer:

- Competitive salary
- Generous commission structure

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A Siemens Business

PCB Manufacturing, Marketing Engineer

Use your knowledge of PCB assembly and process engineering to promote Mentor's Valor digital manufacturing solutions via industry articles, industry events, blogs, and relevant social networking sites. The Valor division is seeking a seasoned professional who has operated within the PCB manufacturing industry to be a leading voice in advocating our solutions through a variety of marketing platforms including digital, media, trade show, conferences, and forums.

The successful candidate is expected to have solid experience within the PCB assembly industry and the ability to represent the Valor solutions with authority and credibility. A solid background in PCB Process Engineering or Quality management to leverage in day-to-day activities is preferred. The candidate should be a good "storyteller" who can develop relatable content in an interesting and compelling manner, and who is comfortable in presenting in public as well as engaging in on-line forums; should have solid experience with professional social platforms such as LinkedIn.

Success will be measured quantitatively in terms of number of interactions, increase in digital engagements, measurement of sentiment, article placements, presentations delivered. Qualitatively, success will be measured by feedback from colleagues and relevant industry players.

This is an excellent opportunity for an industry professional who has a passion for marketing and public presentation.

Location flexible: Israel, UK or US

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Career Opportunities



BLACKFOX

Premier Training & Certification

IPC Master Instructor

This position is responsible for IPC and skill-based instruction and certification at the training center as well as training events as assigned by company's sales/operations VP. This position may be part-time, full-time, and/or an independent contractor, depending upon the demand and the individual's situation. Must have the ability to work with little or no supervision and make appropriate and professional decisions. Candidate must have the ability to collaborate with the client managers to continually enhance the training program. Position is responsible for validating the program value and its overall success. Candidate will be trained/certified and recognized by IPC as a Master Instructor. Position requires the input and management of the training records. Will require some travel to client's facilities and other training centers.

For more information, click below.

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For information, please contact:
BARB HOCKADAY
barb@iconnect007.com
+1 916.365.1727 (PACIFIC)

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Events Calendar

48th NEPCON JAPAN ▶

January 16–18, 2019
Tokyo, Japan

IPC APEX EXPO 2019 Conference and Exhibition ▶

January 26–31, 2019
San Diego, California, U.S.

DesignCon 2019 ▶

January 29–31, 2019
Santa Clara, California, U.S.

SMTA Pan Pacific Microelectronics Symposium ▶

February 11–14, 2019
Kauai, Hawaii, U.S.

EIPC 2019 Winter Conference ▶

February 14–15, 2019
Milan, Italy

China International PCB & Assembly Show (CPCA Show 2019) ▶

March 19–21, 2019
Shanghai, China

MicroTech 2019 ▶

April 4, 2019
Cambridge, U.K.

Medical Electronics Symposium 2019 ▶

May 21–22, 2019
Elyria, Ohio, U.S.

PCB Pavilion @ LCD EXPO Thailand ▶

June 27–29, 2019
Bangkok, Thailand

Additional Event Calendars



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SMT007
MAGAZINE

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Coming Soon to *SMT007 Magazine*:

JANUARY: **MANAGING THE SUPPLY CHAIN CRISIS**

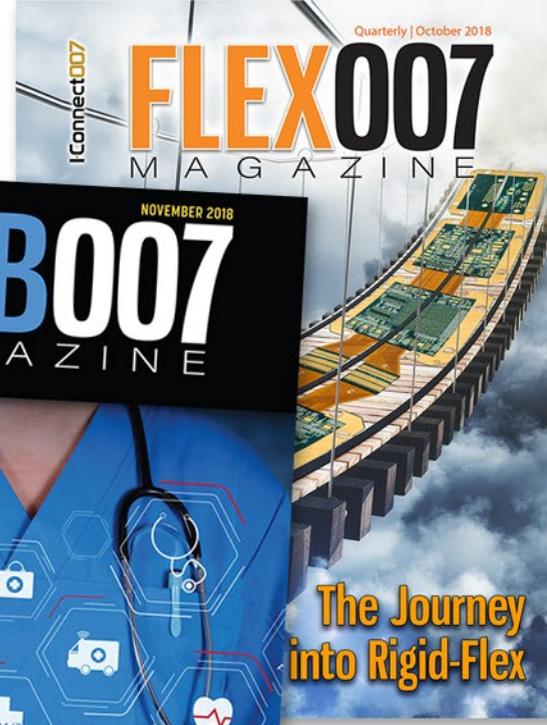
The parts supply chain is full of long lead times, price volatility, shortages, obsolescence, tariffs, and counterfeits. We help you cope.

FEBRUARY: **SELLING YOUR SERVICES**

A look at strategies to help you improve how you sell your electronics manufacturing and PCB assembly services.

I-Connect007

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