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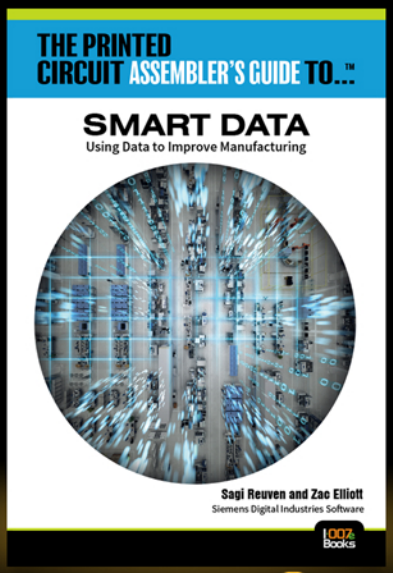

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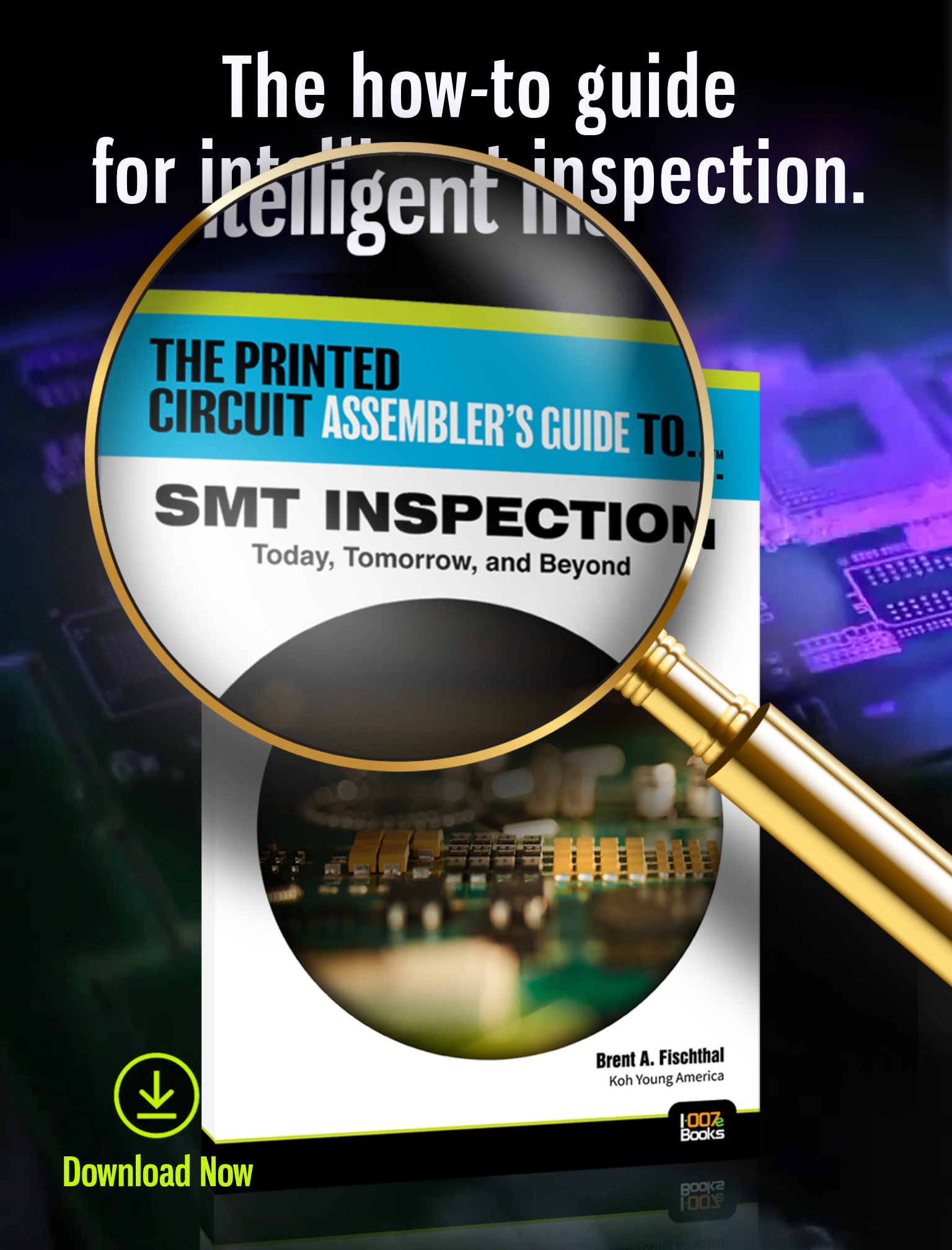

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SMT007 MAGAZINE

IPC Committees

In this important issue, we work to raise the awareness of 3,000 volunteers working IPC committees, and the value they bring to the industry. We bring you status reports from key committees, along with trends the committees are identifying, as well as a historical perspective of past achievements.

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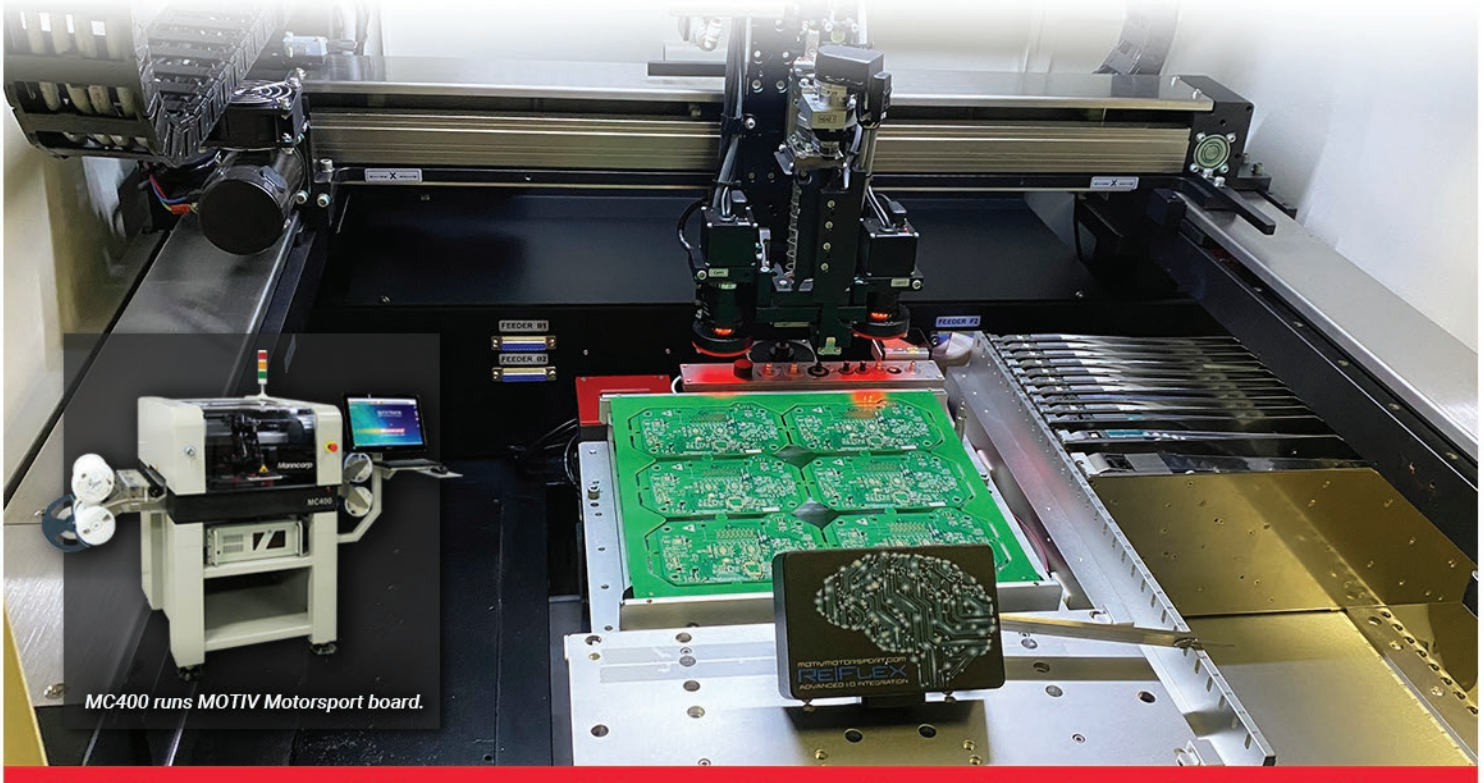
- Luke Cranford, Owner of Carolina Electronic Solutions



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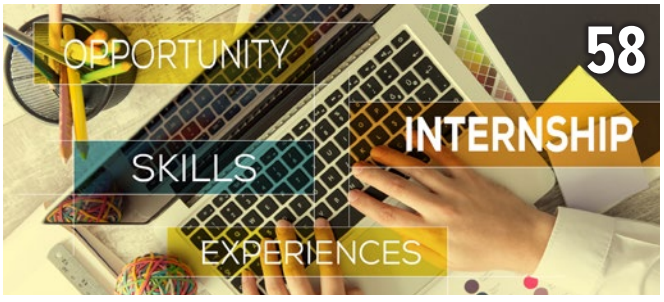

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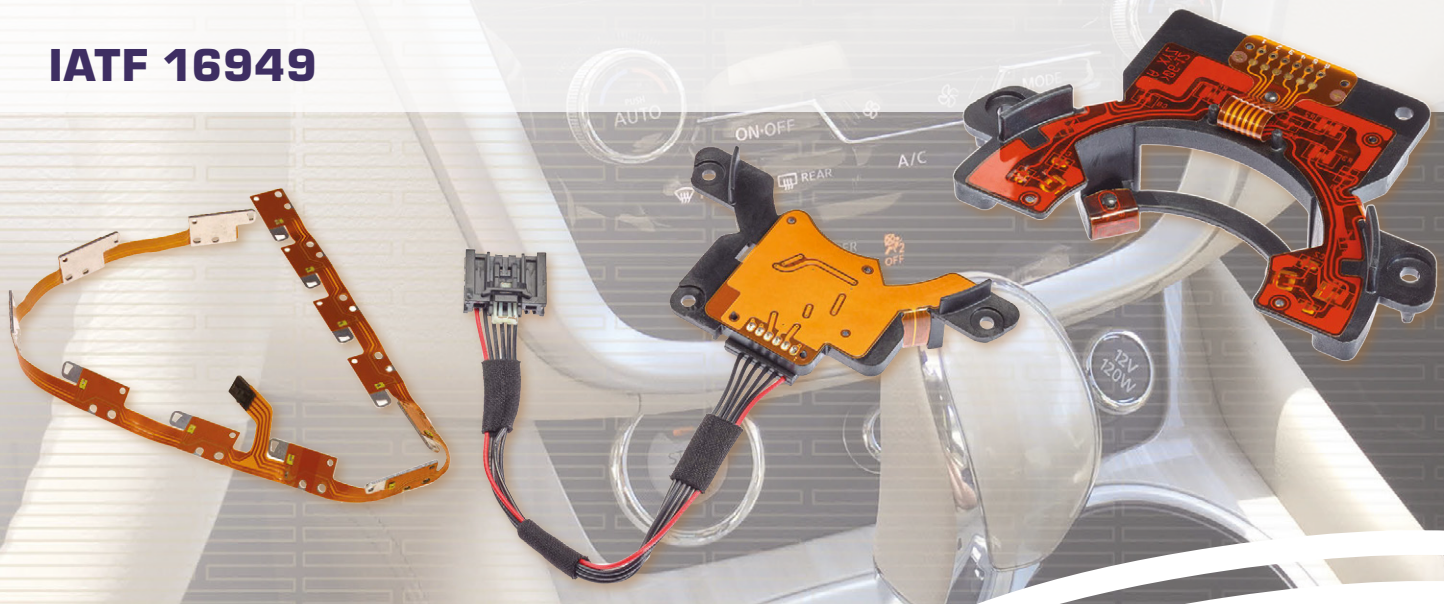

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Committees by Design

Nolan's Notes

by Nolan Johnson, I-CONNECT007

It's my opinion that not many of us technical types really took our high school civics courses all that seriously, or was that just me? No, something tells me I wasn't alone in that. Sure, I paid attention in class, and learned about how governments function—particularly government. But as a teenager, I simply did not realize how the fundamentals of civics would become critical to working in the technology field. With my attention on mastering 6502 assembly language and matrix algebra (when I wasn't rock climbing or racing bicycles), I simply saw civics class as checking off a box toward graduation and college.

I was so very wrong!

This month, we turn our attention to committee work within the electronics manufacturing industry. But what does that even mean in the context of an industry environment?

Merriam-Webster defines a committee as "a body of persons delegated to consider, investigate, take action on, or report on some matter." Merriam-Webster also adds that an advisory committee is "a group of fellow legislators chosen by a legislative body to give consideration to legislative matters."

The U.S. Senate's website says, "Committees are an essential part of the legislative process. Senate committees monitor ongoing governmental operations, identify issues suitable for legislative review, gather and evaluate information, and recommend courses of action to the Senate."

In all three definitions quoted, the scope of the definition is squarely on governmental committees; I'll come back to that. For now, I want to continue down the path of defining some terms. Now is a good time to clarify the difference between a committee and a commission:

> *The most clearly distinguishable feature is that a "committee" operates as a means of internal regulation of legislators by the legislature, while "commission" [sometimes called a "board"] serves as an external review process. Committees normally consist of legislators, while legislators do not serve on commissions in most states.*[1]

Of course, there's the "council" to consider as well. A council can be defined as a working body that consults about issues, deliberates on them, and makes decisions. Sometimes, if there is no separate executive group, the council may be the de facto governing body, as in a church, a

small community, or possibly even as a board of directors for an organization.

I turned to Quora and read through some thoughtful discussions by legal and governmental professionals. What I gathered is that:

- Members of a committee are "drawn" from among a larger body, entrusted with a larger job
- Commission members are more likely to be "appointed" from the outside
- A council is likely to be an elected body

Committee work (I'm including councils and commissions under this umbrella term) takes place at all levels, and in multiple organizations within our industry. That said, a central hub for [self] regulation and [self] legislation within our industry has been IPC. Over the years IPC has spearheaded the creation of standards, handbooks, training, and guidance. IPC has advocated for the industry worldwide and led in bringing the industry's competitors together for a larger purpose: making the world better through technology. To that end, IPC fields an army of 3,000 volunteers, staffing approximately 135 different committees, task groups and teams which are working from all parts of the globe.

In this important issue, we strive to raise the awareness of the work of these volunteers on IPC committees and the value they bring to the industry. We bring you status reports from key committees, along with trends the committees are identifying, and a historical perspective of past achievements.

To accomplish this goal, we talk with IPC about the purposes, roles, and organization of all 135 or so committee-type teams currently in process. We examine how committees come into being, and how they are organized into a larger strategic vision. We talk to IPC's technical directors whose job it is to guide the committee processes. We catch up with some of the newest committee leadership, and we also look back at IPC's earlier beginnings as a reminder of how far the industry has come.

It is also important to note that our current COVID pandemic has fundamentally reshaped how the committee process works. Whether intentional or not, this is a time of transition for how committees function within IPC. I'm referring, of course, to digital/virtual meetings in lieu of and in addition to in-person gatherings. It's my opinion that it's too soon to tell, but all indicators would suggest that IPC's methods have become more creative and flexible through this process. See what you think after you've read the articles and interviews.

Keeping technical, we also proudly bring you an interview with Miles Moreau, discussing the work currently ongoing at KIC; new materials work in thermal management at Aismalibar; the launch of a new Ron Lasky series on continuous improvement; and submissions from our regular columnists, Bob Wettermann and Sagi Reuven.

As I think about the role played by the various committees at IPC, it becomes increasingly clear how similar the authority, objectives, mission, and work methods run parallel to most any other consensus-based legislative body. Even without a desire to make a career out of politics, my civics class finds a practical application. If you are interested in learning more about joining a committee, click here.

We hope you find this issue as enlightening as we did. And, in the spirit of our emphasis on continuous improvement, we welcome you to share your stories. I would love to hear from you. **SMT007**

References

1. Committees and Commissions: What's the Difference, National Conference of State Legislatures.

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.

The Structure Behind IPC Committees

Feature Interview by Nolan Johnson
I-CONNECT007

Nolan Johnson speaks with Teresa Rowe, IPC senior director of assembly and standards technology, who breaks down the structure and major functions of an IPC committee and the collaborative effort that goes on behind the scenes to make it all work.

Nolan Johnson: Teresa, you are IPC's leading expert on committee organization and structure. How does IPC organize all of these 135 or so committees and groups?

Teresa Rowe: The committees are structured around general committees. We have a series of task groups that fall under a general committee with a subject behind it such as "printed board design," "assembly joining" or "product assurance." Those large areas are then broken down into smaller subcommittees and task groups where the work is done. For example, a task group may be on quality assurance on electronic assemblies, or acceptability of electronic assemblies. We have leaders from the industry for these general committees, and they are part of our Technical Activities Executive Committee (TAEC).

The TAEC is the management function related to the technical activities with IPC, and they are overseen by a much smaller group called the TAEC Global. The TAEC Global is comprised of seven people—two from the Americas, two from the European region, and two from the Asia Pacific region, along with the TAEC chair. These people meet with IPC quarterly, and they look at the health and the activities of the task groups, advise IPC on where we should put our standards focus, and help us understand what the industry is doing.

Johnson: It sounds like work on standards and work on steering. Some committees are oriented more toward outreach or advocacy, correct?

Rowe: Yes, as long as we think about it from the perspective that standards could be guidelines, they could be requirements for the product, or they could be test methods for the product.

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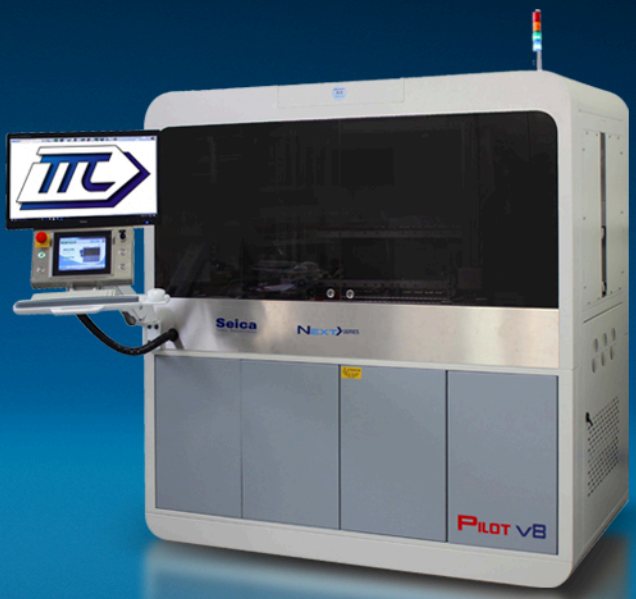

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Johnson: I see. It is groups delivering documents, delivering steering, or delivering advocacy.

Rowe: Correct.

Johnson: A high-profile deliverable would be the standards work. Do those deliverables come out of the subcommittees more often than a larger committee?

Rowe: Most of the standards work is done at the task group level. We look at where industry interest is, and we work with a group of people interested in that subject to develop a project identification notification (PIN). The PIN is reviewed by the TAEC Global and the TAEC to determine whether a project is viable.

Johnson: That means that a technical committee could have multiple standards in process and multiple subcommittees under their purview?

Rowe: A general committee would have multiple projects, and subcommittees may see a small, select number of projects that come together under a specific topic. Task groups typically stay focused on a single document.

Johnson: If I'm new to all this, and wanting to get involved with IPC committee work—maybe my employer is encouraging me to get involved—how do I get started?

Rowe: Excellent question. We embrace our volunteers. Staff liaisons will reach out. We see other task group members introducing themselves, making sure that they feel welcome. Many times, our new people don't say anything in the first meeting or two. They're just trying to study the room and understand the dynamics of the group, and the way they're working. Over a period of time, we see people say, "I get it, I get it. I'm going to start raising my hand. I'm participating."

Teresa Rowe

That's the exciting part. For those brand new to all of this, the easiest and the best way is to attend the meeting, listen and watch what happens, understand the dynamics, and then get involved by taking on an action item. We have many action items that come up during the discussion, anywhere from large technical conversations to "Can you help chase periods and commas in this document we're getting ready to publish?" The person responds, "Yes, I'd like to do that," they get involved, and then they start networking; it becomes a collective cohesive group at that point. It's exciting to see the journey someone takes from brand new to a really solid contributor to a document.

Johnson: Maybe I'm looking for topics I'm already interested in, a topic that I already have expertise in. How do I find that committee?

Rowe: IPC.org has information on all of our committees by topic and how to get started. It also lists the staff liaison and the charter for the project. Answers@ipc.org, listed on our website, is an email link where someone can say, "I'm interested in joining."

Johnson: That's how I can get started. Thanks to the pandemic, we're now a year into using different methods and meeting styles. Are you finding that working virtual/online makes the meetings more accessible for volunteers right now? Or is it less accessible?

Rowe: We have seen a lot of volunteers contributing during task group meetings over the past year that we don't typically see in person, or they would have participated in a face-to-face meeting once a year prior to the pandemic. The cadence for meeting also changed. Some task groups were excited to be meeting every other month—in some cases every other week—to keep their projects moving. They didn't want to lose the focus because we were all sitting at home in lockdown. They wanted to keep pushing forward. I heard from a few people who said, "I'm so excited to just be able to see people again."

Johnson: I know exactly what you're talking about.

Rowe: One interesting thing I heard was about IPC APEX EXPO when we're in San Diego. Before, we were all on Pacific Time. We had to get up early, start at 8 a.m. for a meeting and end at 5 p.m. But now, sitting at home, it might be 2 a.m., and you are sitting in front of your computer for this committee meeting, and thinking, "Well, I'm here." And that's what I keep saying: "But, you're here. Thank you so much for joining us no matter what time of the day it is in your time zone."

Johnson: Nicely put. I'm hearing that there are about 3,000 volunteers working on committees and standards. That is a lot of people!

Rowe: It is. We're excited to have the support!

Johnson: How is the morale amongst the volunteers and staff right now? You were just talking about how some task groups are working virtually to maintain their momentum, pushing hard, doing a lot of work. Does that seem to be the prevailing motivation or are there struggles as well?

Rowe: It is the prevailing activity. Most people are anxious to keep moving forward. Our industry hasn't stopped and technology hasn't stopped. We have professionals looking forward to new things in our standards. We actually have situations where people said, "I'm sitting here and don't have a lot to do in the evening. What action items can I do? Can I work on something? What can I do?" Turnaround time has been phenomenal. Now, obviously, when that person is back at work, we have to be sensitive to that, right? But for the most part, it has been very good.

We have professionals looking forward to new things in our standards.

We have seen very few groups say, "Hey, I want to take a break." They will slow down a little bit, and then they'll ramp right back up. We do have some committees that published in January. While we were working on typesetting the document and getting it published, they were kicking off their next revision.

Johnson: What are some of the key takeaways for you as far as how the IPC can use pandemic lessons to move forward in this sort of work?

Rowe: I'm going to take a step back here and explain that we have a platform called IPC Works. It is a network for our committee participants. They have an opportunity to look at any files we're working on. There is a place for them to message each other. They can reach out on chat. They can become a working family for an activity. As awful as the pandemic has

been, it has been an opportunity for the committees to turn something very negative into a positive through networking opportunities across the world. They're chatting like they're old friends—and that's what they have become. They are friends on the calls, they know each other's voices and recognize phone numbers on the Teams login. For the most part, the morale has been very good; again, turning a negative into a positive.

As awful as the pandemic has been, it has been an opportunity for the committees to turn something very negative into a positive through networking opportunities across the world.

Johnson: Can we expect some level of ongoing video connection in the future for committee and standards work?

Rowe: Absolutely. We've often said, we have two face-to-face events a year, IPC APEX EXPO and SummerCom, and they're roughly six months apart. We are finding that our committees are meeting at least once a month outside of those face-to-face activities or at some cadence in order to keep their progress moving forward. Very few of them are saying, "I may be at APEX EXPO. I'll see you at SummerCom. We'll just work on our action items until then."

Johnson: Teresa, all these teams need leaders, of course. How do you become a leader?

Rowe: Leadership roles are for IPC members. We look for people in a group who are interested in leading, who want to take that next step, be engaged in that effort, and who have the time to commit. Volunteers and committee members might say, "I'll take on an action item. I'll do something." But a leader is working with the staff liaison much more closely, especially as we move toward a publishing activity.

To become a leader, raise your hand and say, "I'm ready to take this next step. What do you have for me?" We're always looking for people who are excited about the topic, and who are willing to make the commitment to carry that through to the time a document publishes.

Johnson: So, the prerequisites are to have an interest and a passion, to want to see this move forward within the industry, and to basically reach out and be ready?

Rowe: Yes, it is activities and interest in the topic. When you get differing opinions with agendas in the room, a leader needs to really be able to focus, rein that conversation in, and still keep it moving forward.

Johnson: And if those are the prerequisites, then committee leadership is open to virtually anybody wherever they are in their career.

Rowe: It is. We do look for IPC members, and they have first dibs at it. We do have leaders who aren't IPC members, but we look at that very closely and encourage those people [and their companies] to consider membership.

Johnson: I've also noticed, in the past year or so, IPC members who are early in their career—still engaged in the Emerging Engineers program, for example—are also in leadership roles on committees.

Rowe: They are and it's great. We've embraced our Emerging Engineers program, and developing the leadership skills in our younger generation that is just entering standards development. When we see a position open up,

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we are encouraging our Emerging Engineers to step forward and take that on. We also see their mentors encouraging them. Some mentors even come to us and say, "I have a great emerging engineer. Here are the qualifications. Do you have any leadership roles?"

Johnson: Let's pivot and talk about advocacy. How is that different?

Rowe: The advocacy groups are discussing global government relations and environmental awareness where the other groups are discussing technical topics in electronics manufacturing.

Johnson: What sort of job function or background fits there? It's easy to think of standards work as being a place where you're getting people with a technical background and technical interests. But when you start talking about advocacy, is there a different skill set that you need there?

Rowe: It's still someone technical, someone interested in engaging with the industry on those topics, networking, and making recommendations.

Johnson: Having an interest, though, in a more outward-facing conversation for the industry.

Rowe: Yes. Outward conversation. Although, you can also look at it and say the standard is an outward-looking conversation as well with industry, right?

Johnson: That's a valid point, absolutely. Where do you see the highest visibility committees right now, on the whole? They're all important, but when you have that many committees, some of them are going to be in a place where they just have a spotlight on them for some reason. Who do you see?

Rowe: Interesting question. The hot topics include Factory of the Future, e-textiles, printed electronics, and CFX, the Connected Factory Exchange. If you're talking about the number of people who show up at a committee, those are traditionally the printed board and assembly activities. These are the task groups for IPC-A-600, IPC-6012, J-STD-001, IPC-A-610, and IPC-A-620. We see a lot of people come to committee meetings, not just to participate in standards development, but also to learn.

We see a lot of people come to committee meetings, not just to participate in standards development, but also to learn.

Johnson: As a participant in a committee, does a person have some level of competitive advantage due to the fact that they're involved in putting together the content for a standard or a protocol?

Rowe: We make certain our meetings are open and fair for everyone in attendance. Does a company participating in standards development have a competitive edge? That really is a decision a company has to make.

It would be unfair to say a company gains a competitive edge by participating in standards development, but it does give someone an opportunity to see how criteria are developed, to understand the opposing opinions, and to see the data that's presented around a requirement.

Johnson: That stands to reason, and while somebody who's participating in a committee for a new standard could be in a place where they

have a better understanding for their company, that knowledge is balanced by the fact that the committee meetings are open. Even if you're not participating as a committee member, you can still sit in and be exposed to the same information in real time, if you have a vested interest in that topic.

Rowe: Absolutely. Anyone can participate in a committee meeting, and many people who come to see what's happening will join the group and stay to contribute. Sometimes it takes years for a new requirement to make it into a standard because we need time to look at data, perhaps do testing, and build criteria.

Johnson: Right. It's a situation where it's not so much a competitive advantage as a collaborative advantage.

Rowe: Exactly.

Johnson: Thanks for this overview, Teresa. Very helpful!

Rowe: You're welcome! SMT007

Navigating Beneath the Arctic Ice

There is a lot of activity beneath the vast, lonely expanses of ice and snow in the Arctic. For scientists to understand the role this changing environment in the Arctic Ocean plays in global climate change, there is a need for mapping the ocean below the ice cover.

A team of MIT engineers and naval officers led by Henrik Schmidt, professor of mechanical and ocean engineering, is trying to understand environmental changes, their impact on acoustic transmission beneath the surface, and how these changes affect navigation and communication for vehicles traveling below the ice.

"Basically, what we want to understand is how does this new Arctic environment brought about by global climate change affect the use of underwater sound for communication, navigation, and sensing?" explains Schmidt.

To answer this question, Schmidt traveled to the Arctic with members of the Laboratory for Autonomous Marine Sensing Systems (LAMSS) including Daniel Goodwin and Bradli Howard, graduate students in the MIT-Woods Hole Oceanographic Institution Joint Program in oceanographic engineering.

Using an unpiloted, autonomous underwater vehicle (AUV) built by General Dynamics-Mission Systems (GD-MS), and a system of sensors rigged on buoys developed by the Woods Hole Oceanographic Institution, Schmidt and his team, joined by Dan McDonald and Josiah DeLange of GD-MS, set out to demonstrate a new integrated acoustic communication and navigation concept.

The framework, which was also supported and developed by LAMSS members Supun Randeni, EeShan Bhatt, Rui Chen, and Oscar Viquez, as well as LAMSS alumnus Toby Schneider of GobySoft LLC, would allow vehicles to travel through the water with GPS-level accuracy while employing oceanographic sensors for data collection.

"In order to prove that you can use this navigational concept in the Arctic, we have to first ensure we fully understand the environment that we're operating in," adds Goodwin.

(Source: MIT News Office)

(Credit: Daniel Goodwin LCDR, USN)

Held in Boston in 1994, the first IPC Printed Circuits Expo opened to rousing reviews. From left to right: Jerry Siegmund, Peter Sarmanian, Sam Altschuler, Dan Feinberg, and David Bergman.

IPC: Driving Our Industry for 64 Years

Feature Article by Dan Feinberg
I-CONNECT007

I have participated in many areas of IPC for several years, particularly the Government Relations Committee and the Suppliers Council.

Now, there are many IPC committees, and most of them are focused on standards. Many IPC members take part in the committees—after all, electronic design and manufacturing standards is one of the key reasons IPC was founded. The results of the committees' efforts represent a significant part of the value the IPC has contributed to the industry since it was founded in 1957.

PCB Suppliers Council

Back in the day, only PCB fabrication companies could be full members of IPC. After all, the Institute for Printed Circuits (its original name) was initially organized by PCB fabrication companies in the United States who, at that time, dominated the global industry. There was a need for common standards, especially as the industry had begun to move from single-sided print-and-etch boards to double-sided, and had started to move from side-to-side wired interconnects (accomplished by inserting an eyelet into every hole) to plated-through interconnects. In other words, moving to double-sided PTH with solder or gold overplating to simple multilayers, and from silk screening to photo-defined geometries. This required significant advancements in process and materials technology. Everyone was doing it differently and there were no commonly used standards for either the process or the result. Hence the founding of IPC. However, because fabricators founded IPC, only the fabricators could be full members. As the leading suppliers became involved—since they had to invent and improve the raw materials as well as many of the processes that were used to employ them—they were allowed to join as associate members. As things progressed through the 1960s, many suppliers felt like second-class citizens, which, in my humble opinion, they/we were.

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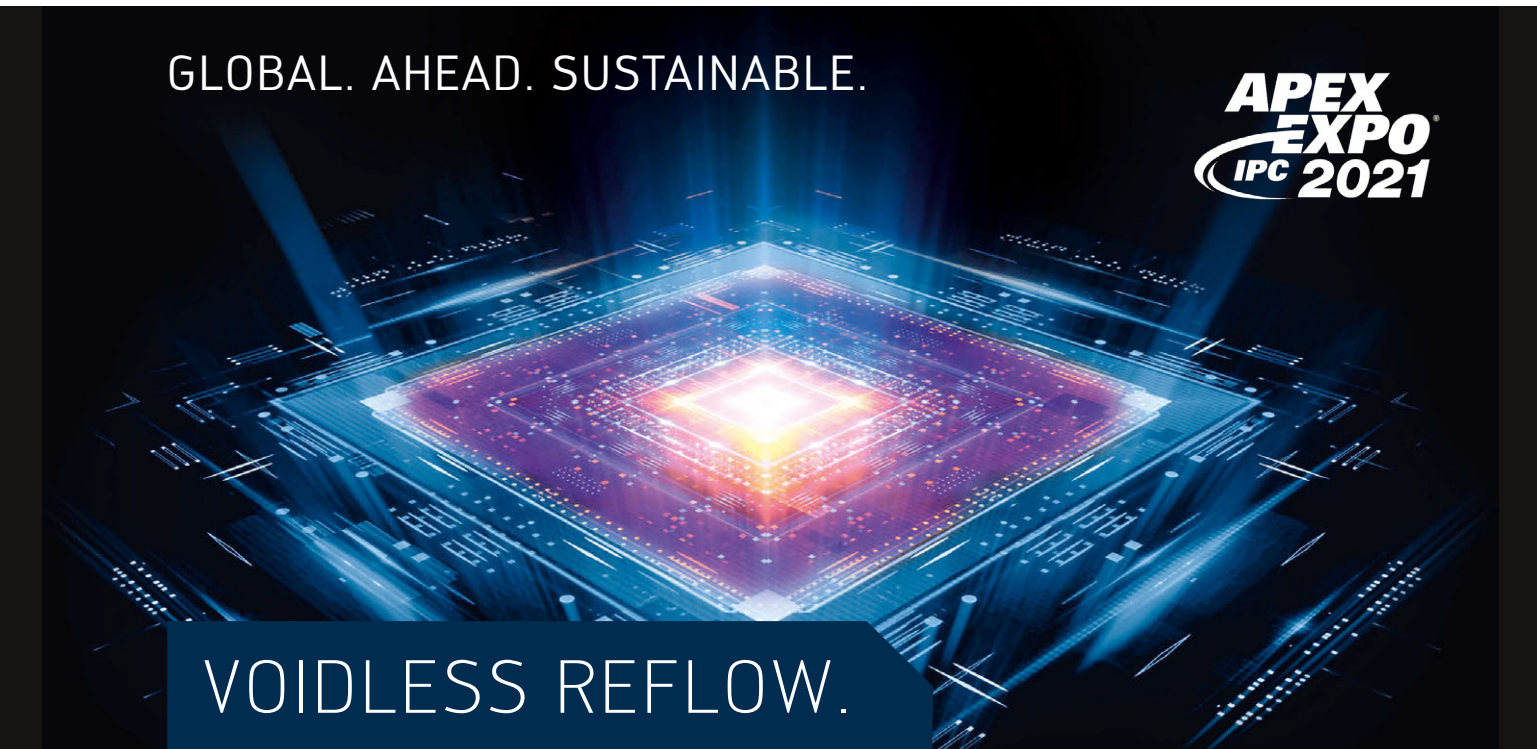

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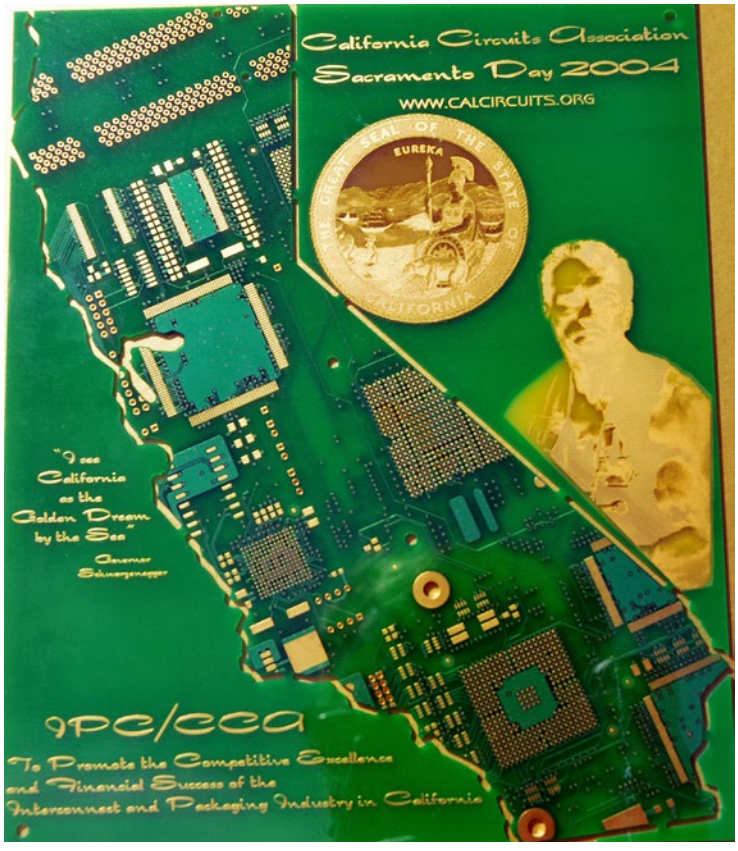

The IPC Government Relations Committee showed their appreciation to California Gov. Arnold Schwarzenegger by framing his image on a gold-plated circuit board.

At that time, I had evolved from being a process engineering manager at Trans/Circuits to president of Thiokol/Dynachem. By then, IPC had decided to allow suppliers to become full members and that a "suppliers council" should be formed. I was asked to help form and head that council; in 1993, we formed a committee under the council to define it and set goals. The suppliers strongly felt they needed to form a trade show that would be supported by the industry. I recall naming the goal, "Getting the Most Bang for Our Trade Show Buck." The suppliers had been spending a fortune at the commercial shows and the industry was not getting much of a bang. I was head of the new PCB Suppliers Council and Jerry Siegmund (MacDermid) chaired a subcommittee that was formed to set up the show. That original committee, which included the presidents or founders of companies such as Shipley, DuPont, MacDermid, Excellon, Chemcut, Dynachem, and others, decided to propose this idea of a trade show to the IPC. This was a new path for IPC and the discussion was...interesting, as IPC had primarily been a standards organization. The result, however, was the founding of IPC EXPO, the first totally PCB industry-run trade show. Over the years, EXPO grew: a second show was added to cover assembly and the result is the present IPC APEX/EXPO combo of trade show, technical presentations, and multiple committee meetings event.

Government Relations Committee

This second non-standards committee I was asked to join had already been formed the previous year. The following year, I became chair of this committee and, as I was already also involved with the California Circuits Association, we partnered to help lobby the state government. Over the next few years, representing the IPC, or in partnership with other technology associations, we sponsored and took part in several lobbying meetings with members of congress to build relationships with our government representatives and to push an agenda that was helpful to our industry. We found that many of them were attentive and able to help; some of them were (and still are) totally, let's just say, not helpful.

One of the more productive meetings we had was with California Gov. Arnold Schwarzenegger. In fact, he was so accommodating and encouraging that, as a thank you, we framed his image on a gold-plated circuit board. This was presented to him in 1994 at a special Sacramento Day event. I believe he is the only politician that has ever had his image included in a high technology circuit.

There are many volunteers doing so much great work on so many committees and not all of them are writing or updating standards. As important as it is to focus on standards, there is so much more being done that is "good for the industry." **SMT007**

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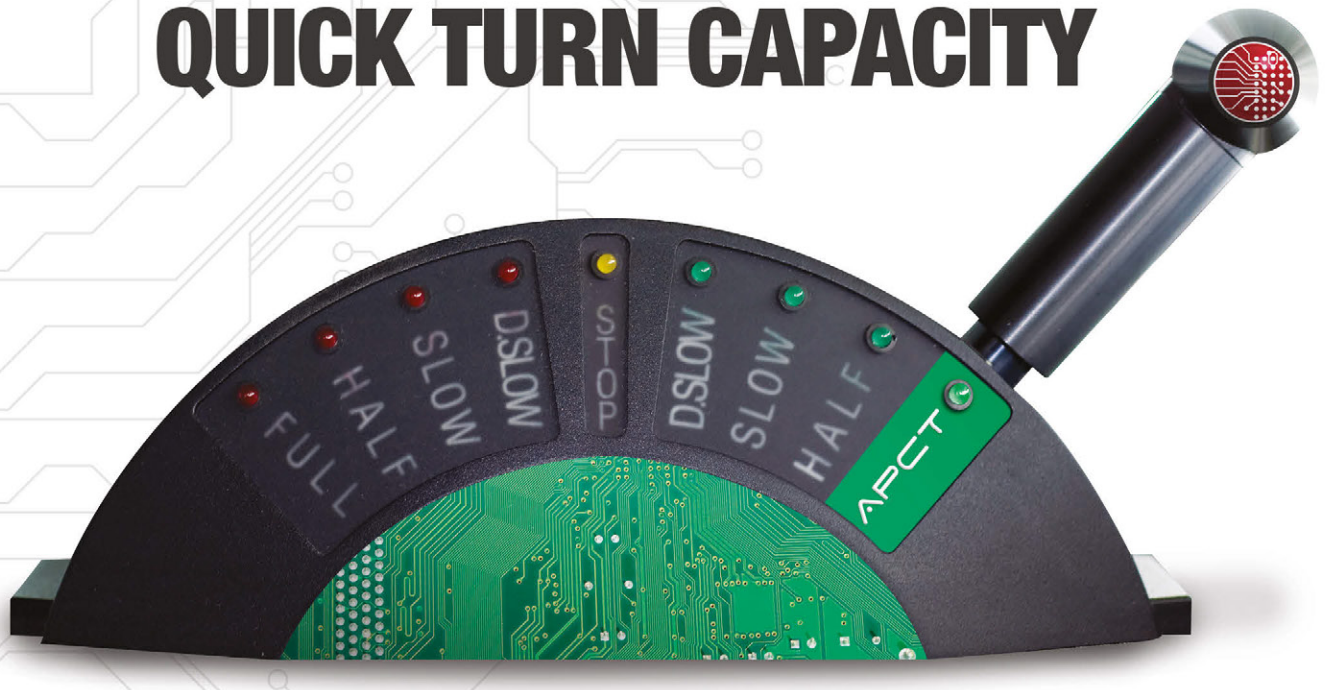

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An Inside Look at the IPC Committee Process

Feature Interview by the I-Connect007 Editorial Staff

As IPC committee meetings were in full effect at this year's IPC APEX EXPO, Nolan Johnson and Barry Matties have a discussion with many of IPC's directors and program managers—Teresa Rowe, Chris Jorgensen, Deb Obitz, John Perry, Andres Ojalill, and Patrick Crawford—to gain a better understanding of how committees work.

Barry Matties: Welcome, everyone. Thanks for gathering to talk about committees at IPC. There are, I think, 135-plus committees. And before we dive into any specifics, let's start with the overall goal or purpose of the committees.

Teresa Rowe: A committee is the lifeblood of standards development. The volunteers who make up that committee bring the energy and technical content to the standards as we know them.

Matties: That's one area where we were looking for some distinction. One is a project and the other is a requirement or a standard. But do the project teams or committees fit into a standard or requirement, or are they working on some specific problem-solving task?

Chris Jorgensen: The task group is the group of volunteers that's typically working on a standard project, but as you said, there could be some other special projects that they work on. You typically have a large number of volunteers on those task groups; it can range from 20 to hundreds. But it's difficult to try to write the content of a standard when you have dozens of people involved, so, maybe four years ago, we started the concept of A-Teams. These are smaller groups of subject matter experts from within the task group that can work on any number of things, from developing the draft document, collecting data for a standard, or other matters of importance to a particular area of technology.

This is not a group that's off developing the standard on their own and putting their stamp of approval on it. We still have a standardization process that needs to show openness, fairness, and consensus. These teams speed along the process of developing a standard, because rather than having dozens of people working on the content, the smaller

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group can focus on the content of the document with limited distractions. Once the group feels it has taken the document as far as they can, we submit it for comments by the full task group. When the larger group gets the draft document, they're able to provide input to help improve and further shape the standard itself.


Chris Jorgensen

As staff liaisons, we have seen great success with this process, and our task group members across the board have embraced it.

Deb Obitz: I had a team that called themselves the Rhinos and they dealt with a lot of cleanliness issues. They came up with white papers, but they were a smaller group that fed into the larger group, although not the similar subject matter experts. We actually cross over into other groups at times. I also have the 7-11, which is a test method, and those tests methods are within many of our committees; Chris, Doug, and John Perry create these test methods and then it comes back into the 7-11 once they've been validated or reaffirmed so that they can get released as actual test methods that all of the industry uses.

Nolan Johnson: An A-Team may not necessarily be a subset of the committee?

Obitz: Correct, the A-Team can be from a different group that has expertise in a specific area that impacts another task group. For example, the committees 5-22a (IPC-J-STD-001H) and 7-31b (IPC-A-610H) have sections dealing with conformal coating. We have a 5-33a Conformal Coating Task Group which can provide expertise for that particular section of their document.

Matties: When we look at these groupings, for example, e-textiles, there's nine. How does that number weigh in terms of importance or energy being put into a topic?

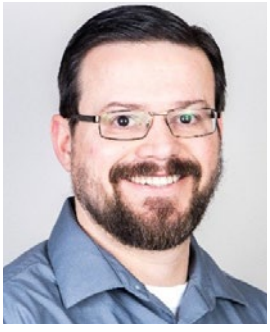
Jorgensen: If you're using the e-textiles as an example, the subcommittee and committee levels—those like D-70, D-71, D-72—are oversight groups, and they're not really the groups that are developing the standards, except for one—D-71. The activity happens at the task group level, and that's where you might see the groups use a designator, such as the "a," the "b," and the "a-eu." But looking at the number of active task groups that we have would give you a good idea of the importance of that area of technology, or at least the utilization of that area of technology. For instance, e-textiles is a new committee that formed within the last three or four years; even though that may seem like a long time, this committee is still a baby compared to our other groups. But if you were to look at John Perry's groups with printed board fab and design, or Teresa Rowe's groups with board assembly, you will see a much larger grouping. Now they may not all be coded in one group like D-70, but there are dozens of groups within those technology areas.

Matties: John, what are you covering?

John Perry: I cover standards for printed circuit board design and fabrication. And when I speak fabrication, I'm talking about acceptance of the fabricated board prior to its shipment to the assembler. As an example, IPC-6012 is our primary specification for accepting rigid printed boards after they've been fabricated. We have some addendum groups that create standards that are meant to be used with the base document, and these will typically list exception requirements to the requirements in the base document for a specific end use application. There is a new medical device addendum to IPC-6012E, for example. We published that earlier this year, and it's our first ever document focusing specifically on rigid printed boards intended for medical device applica-

tions, diagnostic equipment and things that are human implantable.

Matties: You have something that lines up for automotive as well?


John Perry

Perry: Yes. We published our first ever document dedicated to automotive electronics, IPC-6012DA, in early 2016. Many of our standards over the years have been developed by volunteers representing the military-aerospace community; if you compare them to other industry segments like medical or automotive, the military-aerospace companies have relatively lower production runs of printed board panels. As such you'll hear the question, "I'm building a production lot of five panels or 50 panels; how much testing do I have to do to verify the conformance of the production lot to the IPC-6012 specification?" With the military-aerospace community, they will usually say something like, "Test samples taken from a lot of the panels" or even, "Test every panel you build." In automotive and medical applications, fabricators would push back and say, "Wait a second. These are runs of a thousand production panels at a time because it's mass volume for our automotive customers. We can't possibly meet the testing frequencies used by the military-aerospace community." So, not only did the medical and automotive communities have different requirements, they needed different sampling frequencies for verifying the quality of the printed board production runs as well. Those two things led to developing these addendums.

Matties: I notice here in the list of work groups that there is a designator on IPC-A-610 indicating China. Is the only difference the language, or are there differences in standards?

Rowe: No, we have regional committees in Europe and in China, and these regional committees will review the comments and make their recommendations for disposition. That information is provided to the larger committee that meets at least twice a year, typically face-to-face or in a teleconference environment. In that larger 7-31bv committee meeting, the input from the 7-31B-EU (from Europe) and 7-31BV-CN group (from China), will be considered during discussion. Then, when the larger group is ready to vote on the disposition of the comment, the votes from those regional committees will carry forward. There's usually a spokesperson for each who says, "Yes, we vote in favor of the motion that the large committee is making," or, "No, we do not." By doing that, we can get input from those two regions by participants who might not be able to attend the large committee meeting because of time zones or travel concerns and issues.

Johnson: How does someone like me identify the committee and what it does?

Rowe: Our committees are organized into general committees by technology. If a committee ends with a zero in its number, that is a general committee that typically has a group of subcommittees and task groups under it. Each general committee has industry leaders overseeing the projects in that grouping from the volunteer perspective while IPC staff is overseeing the projects from the standards development perspective.

Matties: For example, 4-10 would be the top level or the zero and you would have a fabricator voice on that over the others. How do you attract people to that position? Is it volunteer or do you invite people? How does somebody get involved at the general committee level?

Rowe: General committee leaders are volunteers selected by IPC and often include discussion with the TAEC chair. The people selected

are highly involved in committee activities and are recognized as leaders in the industry. When someone is invited to become a leader of a general committee, they also become a voice on the Technical Activities Executive Committee (TAEC) which oversees all standards development. The TAEC and the TAEC Global (a small subset of seven representatives from the industry with a global presence) provide technical expertise and guidance on the standards development activities and programs.

Matties: How does a topic become a committee?

Rowe: We receive our ideas from industry. We also have interest groups that work together to discuss projects and provide input to our projects pipeline, and we will be introducing a place on our website where new project ideas can be proposed.

Andres Ojalill: In Europe, all committee chairs are members of the European Standards Steering Committee that Teresa mentioned. We have monthly meetings to discuss potential needs and caps; it could be anything from a recommendation for an existing committee to improve something or adding something to the document, to an area which is not covered anywhere else. At that point, we reach out to more companies in Europe to determine whether there is enough interest so we can group together and start the project. From there, we would develop a project initiation number request, or PIN, which goes to the TAEC for review and approval.

Matties: Who is on the steering committee and how do they become part of it? Because that sounds like the voice that's really driving the car forward, if you will, on these selections.

Ojalill: The leaders of task groups that were established in Europe came together and established that group. For example, the IPC-6012 medical addendum task group and automotive addendum task group we already discussed before. That's how it started in Europe, but it has a much longer history in United States. Could you cover that part, Teresa?

Andres Ojalill

Rowe: An IPC steering committee is a group of forward-thinking industry experts, typically from a specific region, who provide ideas for new projects and standards to IPC. We have several of these groups, but we also have industry experts come forward asking if they can talk to us about an idea they have. Many times, projects are born out of those discussions.

Jorgensen: Oh, this happens all the time. Where do the projects or the standards come from? It could be from a lunch discussion, or something that comes up through a committee while they're working on a document and realize that they need to have another supporting document to go with it. But the message to communicate here is that we have a process—it's set, understood, and standardized across all of our committees. We have a committee structure and committee hierarchies. We also have document designation structures so that when somebody comes to IPC with an idea, we can quickly move that idea from the discussion points with a couple of bullets to a published industry standard following our procedures.

A good example happened in the fall of 2019. We had a couple of people approach IPC and say, "We need a standard for digital twin. There's a lot of misunderstanding out in the industry about what digital twin is because the definitions for digital twin are typically solutions-based, but it's whatever a company decides that they want to call it. We need a standard." We formed a small group that had interest in developing the standard, we got the

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PIN approved and we had the document published in less than a year. That's an example of something where you can fast track a standard.

Many standards can't be fast tracked, though. Typically, we put these onto at least a three-year timeline because developing a standard is—even though we can speed it up—a slow-moving process because there's a lot of negotiation that happens along the way and we are relying on volunteer support. It all comes from industry. But we've proven time and again over the years that we can take an idea and make it into a standard through industry support.

Matties: One year is definitely a fast track. My understanding is the standard process is a multi-year process, depending on the standard, of course. What's the typical life cycle of a committee?

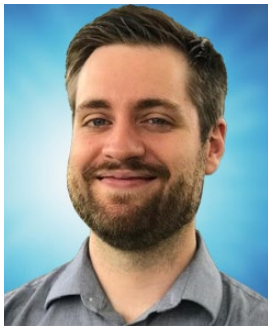
Rowe: It depends on the committee and the project, but many of the standards are on three-year review cycles. As a committee finishes a project, we are working toward publication and they are already working on deferred comments or criteria for new topics they want to include in the next revision.

Matties: I would think new topics sprout out of the ongoing committee work.

Rowe: Absolutely.

Matties: When volunteers sign up, they're really signing up for a multi-year volunteer commitment, generally speaking. Or do you have volunteers who cycle in and out throughout the process?

Patrick Crawford: Yes. I see a lot of main players there in leadership roles usually for a long time. But we see others. Just this morning I had a call from an individual from the U.S. Army; I had no idea they wanted to become involved in materials declaration and compliance reporting, but they showed up on the call. I don't expect them to stick around for the 10-year life cycle of the document, but I'm glad they're there for at least a couple of meetings to lend their support. No one is expected to sign up and hang out forever. Everyone is welcome to come in and lend their support.



Patrick Crawford

Matties: Now, when people come into a committee meeting as a guest or an observer for a meeting, what's the guideline there?

Crawford: They're open, and you can come in and observe for a couple of meetings. If you don't want to continue to contribute, that's okay. If you want to stick around for 10 years, we'd love it if you could hang out.

Matties: I heard it often during APEX EXPO about the number of emerging engineers getting involved in some of the committee work. Are you seeing that?

Rowe: We are encouraging the IPC Emerging Engineers to get involved in standards development. Their mentors attend some committee meetings with them to help them navigate through the process and break the ice by introducing them to as many people as they can during a meeting or activity. This gives them a strong foundation as they move forward in their careers and encourages them to share their knowledge as well.

Matties: What is a committee meeting week like? Just give us your take on what you hope to get out of a week-long session.

Rowe: Meetings are often several hours in length as groups do deep dives on content. For example, I had an 18-hour meeting this week with the task groups developing J-STD-001

and IPC-A-610. It was three consecutive days of six hours each day, and we resolved a lot of comments, developed content, and assigned action items where necessary. This was the first meeting after the kickoff for the new revisions of these documents. I believe everyone has a meeting of some sort this week so please speak up.

Jorgensen: This year is unhitched for anything that we've done in the past regarding IPC APEX EXPO meetings. If you're talking about what we would expect typically from a week of meetings when we're onsite at a convention center, it's a lot of running around between meeting rooms because we have multiple meetings happening at the same time—and that's not just with staff, that's also with the volunteers. When we knew that we were going virtual with the technical conference, as a staff we said, "Let's find a way to make the technical conference as open to our committee members as possible." In the past, we had heard that they would love to go to technical sessions, but they're locked up in committee meetings.

Then, we said, "Now if we're going to schedule these meetings in the weeks before and the weeks after IPC APEX EXPO, let's coordinate together as staff to be sure there's really no meeting conflicts. Let's try to make sure that committees or task groups that would have similar topics or similar attendees are not overlapping in the schedule." And we wound up with pretty much a full month, maybe even like five weeks of IPC APEX EXPO committee meetings. Rather than going back and forth between rooms, we are just going from virtual room to virtual room to virtual room throughout the day. But the feedback that we've gotten from committee members, at least those that I've spoken with, is that they're appreciative of the fact that we're able to make the technical conference available to them.

Matties: It seems that they would gain a lot of knowledge in those technical conferences that they would bring into the committee work. Having that offset is probably a benefit.

Jorgensen: Sure. Absolutely.

Matties: Do you see the level of participation higher with the virtual committee meetings over the in-person?

Rowe: I see a lot of the same people who would attend in person, but I'm seeing a lot of people who don't have the opportunity to attend in person as well. This virtual environment is an opportunity for anyone interested to take part, and people are embracing the idea of being able to join in the conversation and also learn from their peers.

Matties: If I am understanding correctly, Teresa, you were saying when a committee starts, you look at it from a design all the way through final product kind of process or assembled process. Is that the case in all committees?

Rowe: Committee members are certainly cognizant of the process as they're working through the criteria. A good example is a question that came up in the assembly committee with the response: "We need to take this back to the T-50 committee." So, someone broke out of the assembly meeting and went to one of John Perry's meetings to bring forward a new definition to add to the T-50 that they thought would impact both pieces of the process. Our committee members are not shy about taking action to find common ground, because ultimately, the standards are used throughout the processes in their company. They need to look at the big picture, and they're thinking like that all the time.

Matties: Training is one area that we keep hearing about—communication and operational training of the workforce. How does that play

into the committee work in terms of process training?

Rowe: Many of our standards committee members are also members of our training committees, and they bring their expertise and knowledge of the standard to the training committees for discussion.

Johnson: Recently we were talking with Todd Brassard from Calumet and he was pointing out a specific section of, I believe, AS9100 that includes what he says is a great section on how to write a business plan which is larger than the focus of the standard itself. And yet they used that section on how to build a business plan, how to understand your company's larger purpose, and how you fit into the community as well as how you fit in into the industry. From this document, they used that to put together their business plan, which is now driving Calumet to the degree that they are driven. I mean, they kind of turned the company in a completely different direction with a completely different culture based on what they pulled out of that particular document.

Rowe: Certainly, the business plan is looking at your overall process. We often hear our committee members talk about the need for the standard to work with the contractual requirements, because together they drive how the products are built through the process. As part of that, you need a trained staff that recognizes the requirements and understands how to apply them to get the quality product at the end.

Johnson: I'm not entirely sure that that's as well known in the industry as we would hope.

Rowe: I think it depends. Training is a piece of this, but so is knowledge of the standards in use and the processes. When we are asked questions about how to apply criteria from a standard to a product, we often recommend going back to the contract to see what it says. We can tell you what the standard says and help you understand it. We have training and handbooks available to help, but it really starts with, again, your business, your business plan, your contracts, your processes and your procedures, and how they all work together.

Matties: Right. If we look at conformal coating—I think it's the handbook task group—do you wind up publishing an actual handbook on that topic? I noticed we have several handbooks peppered throughout this list.


Deb Obitz

Obitz: These handbooks are created by various international industry members that are on this committee who provide input on what's good or not for conformal coating, which you mentioned. They've also created some white papers that help the industry on questions such as how to use conformal coating, how to select a conformal coating so that they select the proper one based on whether they're going to repair or rework, or the protective properties of those coatings.

Matties: That did catch my attention because you're not talking about necessarily a standard, but about methodology.

Obitz: Yes. You're not going to get requirements in those specific handbooks. You're going to get guidance on selection, removal, how to apply it, the different ways of application and things like that. It doesn't build in requirements like our standards do, like the 5-33a group is the conformal coating task group. That deals with the IPC 8-30, which is the requirement specification. The other one is the handbook 8-30, which is a guidance document that helps the users out there select coatings.

Matties: How do people access these handbooks? Is it membership only or is this something that they purchase? Tell us a little bit how the industry can take advantage of these.

Rowe: They're products just like our standards, and they're available in the same formats.

Matties: Regarding committees with the zero identifier, do they have a written mission statement, goal, or purpose?

Rowe: Yes. Each one has a charter and that's available on our website.

Matties: Okay, great. What committee has the most attention from the industry right now?

Crawford: Yes, that's a good question. I think it ebbs and flows. Right now, I think it might be one of John's documents because we don't have necessarily anything out right now for me.

Perry: I'll answer this for both design and fabrication at the same time, and this is for the arena we call ultra-fine features which includes ultra-high-density interconnect (HDI), additive and semi additive processing. Those are all buzzwords for one big bucket that refers to circuit boards with very fine, very small conductor width and spaces—"line and spacing" as you often hear—where you've got conductor widths and they're spaces that are below 50 microns in width and BGA packages below 75-micron pitch. Our design standards like IPC-2226A for HDI currently only go down to 50-micron spacing. They don't address ones below that. And the IPC-6010 performance specifications such as IPC-6012, IPC-6013 and IPC-6018, they presently don't deal with these very ultra-fine, ultra HDI features, either.

We've got some groups getting together now that are going to build proposals for updates to both the design standards and the board performance specifications to address these very small features. Some of these are so small that some of the traditional ways that you would test and evaluate them in production lot testing, such as inspection of microsection evaluations, can't really be done within large production runs. With these really small lines and spaces, we are looking toward more electrical-based, performance-based testing. We need new printed board design and performance standards, not only for design rules and how to accept those features in a fabricated printed board, but also how to properly test for them. The traditional way of testing is going to get more difficult the smaller these feature sizes get.

Crawford: If you're looking at just purely market drivers, a few of the standards I work with are the materials declaration standards. These are standards that allow companies to communicate within their supply chains and declare what chemicals may exist in their products that they sell to their customers or to consumers—are they in compliance or not? Those standards have been very high in demand for the last year because of new regulations in the EU. Not only is every technology area going to be critical to whoever's working on it, but also, especially from the regulatory landscape, some of these drivers come out of nowhere. Within a year I have had two separate standards groups working on the same issue. I just want to throw that in there. I think that there are a couple of concrete examples of, "This is really hot right now," with regulatory issues being one of them.

Matties: You just said something that's interesting: You had two committees working on a single topic. Were they working on it from different angles?

Crawford: Yes. We have the IPC-1752 materials declarations standard and then a separate standard, the IPC-1754 materials and substances declaration for aerospace, defense and other industries; the first one being more general, the second one being for industries that

require a different kind of substance reporting, but both address ECHA SCIP. It's a part of a new EU reporting obligation. Like the 1754, which is the aerospace one, the IPC-1752 had to revise their standard. And then the materials declaration 1752B or 1752 put out a whole new revision, but they're working on the same thing. There was a lot of crosstalk between the two committees, saying, "How are you handling this or that? How does this work in the greater framework?"

Someone earlier mentioned that they had committee members jumping out of meetings to go talk to other committees. This is an example of that, where they said, "We have to synchronize on this. This has to be the same," or not the same. "This has to be at least philosophically the same approach to how we tackle this issue that has a hard deadline. We can't just keep putting it off. We have to meet this regulatory deadline." Which they did. I'm proud to say they met it.

Matties: I guess when you have regulatory deadlines that really keeps the committee focused and moving on pace.

Crawford: Yes. It's kind of terrifying sometimes, but it's always exciting.

Matties: As we're talking, I'm gaining a greater appreciation for the hard work that you guys are doing. This is not easy work by any means. How many people do you have working in committees? What's the population right now?

Rowe: We have about 3,000 committee members worldwide.

Matties: Wow. That's amazing. I've heard recently that there is a lot more Asian participation in standards work. Are you seeing that as well?

Rowe: We are. We have a lot of committees that are working as regional groups out of the Asia Pacific region, and we have staff liaisons that reside and work out of our offices in China. We are in regular communication with them on how our groups are working, and then they're also working some projects that were initiated in the China region.

Teresa Rowe

Matties: What do you think is the most important thing the industry should know about the committees and the work that you're doing?

Jorgensen: It's open. Unlike IEC, our standards groups are open. We invite and encourage participation and debate. There's no cost to get involved. As you were talking to Teresa earlier about the number of committee members and their level and length of involvement, we have people that will come and go, people who stay on forever. But also, your involvement on the committee is entirely up to you. If you want to be an active participant and help to draft the document, you can do that. If you want to be somebody who is going to sit back, wait for the document to come out and then comment on it, we encourage that as well. But the thing is that all of our groups are open. We don't shut anybody out.

Crawford: Adding to that, if you're in industry and you are staring a problem in the face and you think, "I really feel like I'm not alone. I don't think I'm alone," and there doesn't exist an industry solution for it, standard or otherwise, talk to us. We are here for building standards. You can go to our website where we have a portal for you to submit an idea for a standard and we will work with you if we can find enough people to support it. That's something we can do. Let's not let problems stop us from getting better.

Rowe: Some of us on staff come from industry, and we understand those struggles. We're here to listen; nobody's comments or thoughts are just automatically shut down. Everyone has a voice, and everyone has an opportunity to speak at these committee meetings.

Matties: You've deepened my appreciation for the work that you're doing for sure. It's not easy and you definitely are helping the industry be better. Thank you for that.

Rowe: Thank you for the opportunity. SMT007

Teresa Rowe is IPC senior director of Assembly and Standards Technology.

Chris Jorgensen is IPC director of Technology Transfer.

Deb Obitz is IPC coordinator of Technical Programs.

John Perry is a IPC director of Printed Board Standards and Technology.

Andres Ojalill is IPC manager of Standards Development.

Patrick Crawford is IPC manager of Design Standards and Related Industry Programs.

Discovery Could Help Lengthen Lifespan of Electronic Devices

University of Sydney researchers have made a significant discovery in the field of materials science, for the first time providing a full picture of how fatigue in ferroelectric materials occurs.

Ferroelectric materials are used in many devices, including memories, capacitors, actuators and sensors. These devices are commonly used in both consumer and industrial instruments, such as computers, medical ultrasound equipment and underwater sonars.

Over time, ferroelectric materials are subjected to repeated mechanical and electrical loading, leading to a progressive decrease in their functionality, ultimately resulting in failure. This process is referred to as "ferroelectric fatigue."

It is a main cause of the failure of a range of electronic devices, with discarded electronics a leading contributor to e-waste. Globally, tens of millions of tonnes of failed electronic devices go to landfill every year.

Using advanced in-situ electron microscopy, the School of Aerospace, Mechanical and Mechatronic Engineering researchers were able to observe ferroelectric fatigue as it occurred. This technique uses an advanced microscope to "see," in real-time, down to the nanoscale and atomic levels.

The researchers hope this new observation, described in a paper published in Nature Communications, will help better inform the future design of ferroelectric nanodevices.

"Our discovery is a significant scientific breakthrough as it shows a clear picture of how the ferroelectric degradation process is present at the nanoscale," said co-author Professor Xiaozhou Liao, also from the University of Sydney Nano Institute.

Dr Qianwei Huang, the study's lead researcher, said: "Although it has long been known that ferroelectric fatigue can shorten the lifespan of electronic devices, how it occurs has previously not been well understood, due to a lack of suitable technology to observe it."

Co-author Dr Zibin Chen said: "With this, we hope to better inform the engineering of devices with longer lifespans."

"Our discovery has indicated that interfaces could actually speed up ferroelectric degradation. Therefore, better understanding of these processes is needed to achieve the best performance of devices," Dr Chen said. (Source: University of Sydney)

IPC Technical Staff Liaisons—Your 'Shepherds' in the IPC Standards Development Process

Feature Article by John Perry
IPC

If you have ever attended an IPC standards development meeting, whether it be in person or through a web meeting, then you've seen or heard us—that collection of IPC staff members within the IPC Technical Department that schedule the myriad face-to-face or online standards meetings taking place at annual IPC events or throughout the year. We're the ones you hear from when IPC circulates a new standard working draft, promotes it to Final Draft for Industry Review (FDIR) for broader industry input, or notifies you that the document is ready for balloting towards release. But we are more than just a team of individuals scheduling meetings, running around like rabbits attending to various concurrent meetings, taking notes, or announcing when it is time to submit comments to a standard draft or submit votes to one in ballot; we are very much "shepherds" of the IPC Standards Development process, ensuring that IPC standards are moving forward with technology and that the finished efforts represent the needs of suppliers, manufacturers, and end users.

Promoting that Volunteer Mentality

As IPC technical staff liaisons, one of the main responsibilities of our job is to inspire people to get involved and join an IPC subcommittee or task group developing or revising an IPC standard. As an accredited Standards Development Organization (SDO) under the American National Standards Institute (ANSI), our standards are developed strictly through an industry volunteer process; designers, material vendors, process engineers, quality assurance managers, contract assemblers and test houses (just to name a few—the overall list is much larger) all work together on a specific industry standard. Despite IPC being an industry trade association for over 60 years, however, there are still many in the industry who presume that IPC standards are written by staff members in closed groups and that a path to have their company or organization contrib-

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ute to how those standards are created and/or revised does not exist.

It's our job to remind people in our industry that they can have a voice within IPC standards, that their company can be represented in the effort and that they can influence the course of the standard and help ensure the finished document meets today's technology needs. IPC staff liaisons are not authors or writers of the standards; editors and publishers, yes, but it is the volunteer members that collectively write the content. People come and go within our industry over the years, and thus it is our task to promote the same message: IPC standards can only move forward with technology changes if there are industry volunteers willing to join our subcommittees and task groups and contribute their time, energy, input, comments, and votes.

Ensuring Balance and Industry Representation

IPC staff liaisons work to make sure these volunteer IPC subcommittees and task groups are well balanced and represent, as closely as possible, an equal mix of suppliers and users, as well as others representing design, testing, and perhaps also academia, government, and consultancies. You do not have to be an existing volunteer within one of our standards groups to visualize that if, for example, a subcommittee tasked with developing a qualification and performance specification for a specific material technology composed mostly or entirely of the material vendors will result in a standard that largely favors those suppliers, or that a performance specification for rigid printed boards developed by a committee dominated by the OEM end users will have very stringent requirements. IPC staff liaisons ensure that IPC's volunteer subcommittees and task groups have balanced representation among users and suppliers and that the published standard represents a compromise between suppliers and customers. The quality of the finished IPC standard depends greatly on the make-up of the subcommittee or task group that developed/revised it.

Maintain that Heading, Helmsman!

IPC staff liaisons are charged with supporting the leaders (e.g., chair, co-chairs and/or vice-chairs) in making sure the standard development effort stays on course throughout the entire project cycle from Working Draft to FDIR, Proposed Standard for Ballot (PSB) and final publication. It is no surprise to see volunteer contributors who wish to have their company's position reflected in the standard, and as such, often times, the staff liaison and the chairs must work to ensure that "scope creep" does not weave its way into the process and turn what was originally intended as a three- to four-year project into a five- to six-year behemoth that now struggles to achieve the group consensus required for publication. We as IPC staff liaisons may sometimes have to jump in, clarify the project scope, then "draw a line in the sand" and have some content put off to the side in order to prevent the document effort from turning into a "rolling donut" and not getting published. It may be necessary to set aside some of the goals for a future document Amendment or Revision in order to get the document published in a timely manner. IPC staff liaisons also ensure that Roberts Rules of Order are followed during meetings.

No Hanging Chads, Please

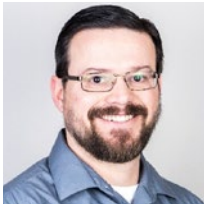
IPC staff liaisons oversee the voting on a standard during its PSB phase, including the creation of a Consensus Ballot Group (CBG) that is often composed of a subset of the main subcommittee or task group membership who have taken the responsibility to review and vote on the document. IPC staff liaisons work to obtain a minimum two-thirds response from the members of the CBG, and should negative ballots be submitted, IPC staff liaisons ensure they are accompanied by technical comments containing recommended changes that are in turn reviewed and dispositioned by the sub-

committee or task group. IPC staff liaisons are therefore entrusted to follow ANSI rules in providing a path for resolution of negative ballots, and in providing balloters with their rights should a compromise not be achieved, and the subcommittee or task group decides to move forward with the release of a document with a maintained negative vote.

IPC Wants You!

If you've determined that this article doubles as both a description of IPC staff liaison responsibilities and a thinly veiled attempt at soliciting your participation in an IPC standards development subcommittee or task group, then you've been paying attention! IPC staff liaisons simultaneously serve as recruitment officers, drill instructors, arbiters, and editors in the Standards Development Process; we are involved from inception to publication. As previously mentioned, the success of an IPC standard or revision depends on the volunteer contributions of the subcommittee or task group membership whose subject matter expertise is so critical to its viability in our industry.

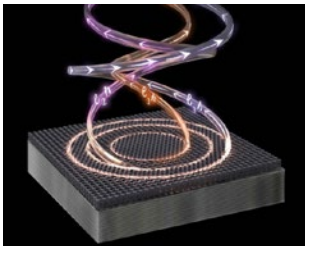
You can have a voice in shaping IPC standards, and your voice matters. We consider all volunteer input to be valuable, and if you are one of those folks who is hesitant to plunge head-first into the fray, we as IPC staff liaisons can help you get your foot in the door and to a place where you will ultimately feel comfortable participating in and contributing to an IPC standards development effort. That is one of the many reasons we are here. Want to dip your toe in the water? You can contact us through "IPC Standards Committee—Getting Started" or by emailing our staff at Answers@ipc.org. **SMT007**



John Perry is IPC director of Printed Board Standards and Technology.

Light Unbound: Data Limits Could Vanish With New Optical Antennas

Researchers at the University of California, Berkeley, have found a new way to harness properties of light waves that can radically increase the amount of data they carry. They demonstrated the emission of discrete twisting laser beams from antennas made up of concentric rings roughly equal to the diameter of a human hair, small enough to be placed on computer chips.



The new work throws wide open the amount of information that can be multiplexed, or simultaneously transmitted, by a coherent light source. A common example of multiplexing is the transmission of multiple telephone calls over a single wire, but there had been fundamental limits to the number of coherent twisted light waves that could be directly multiplexed.

"It's the first time that lasers producing twisted light have been directly multiplexed," said study principal investigator Boubacar Kanté, the Chenming Hu Associate Professor in UC Berkeley's Department of Electrical Engineering and Computer Sciences. "We've been experiencing an explosion of data in our world, and the communication channels we have now will soon be insufficient for what we need. The technology we are reporting overcomes current data capacity limits through a characteristic of light called the orbital angular momentum. It is a game-changer with applications in biological imaging, quantum cryptography, high-capacity communications and sensors."

Filmmakers take advantage of this when creating 3D movies, allowing viewers with specialized glasses to receive two sets of signals—one for each eye—to create a stereoscopic effect and the illusion of depth. (Source: UC-Berkely)

Why You Should Get Involved in IPC Standards Development

Feature Article by Chris Jorgensen
IPC

There are many reasons—from a personal, professional, or a business perspective—to get involved in IPC standards development activities. Based on your level of involvement, your experiences can touch on one, two, or all three of these areas.

From a business perspective, involvement in IPC standards is incredibly important. Usage of IPC's globally accepted standards creates a level playing field in the electronics supply chain. The playing field, however, is only as level as the participants who are involved in the development of a standard.

By actively participating on an IPC committee, subcommittee or task group, your company has a say in the content and requirements that go into an IPC standard. For instance, if a task group is moving forward with a change to a standard that could impact your business, you have the ability—working through the task group—to influence direction for that proposed change to ensure when the standard is published and out to market for use, your company will be able to continue to meet requirements of the standard.

Professionally, many of our task group members will tell you some of the best free education they can get is from participation on an IPC task group. By participating on these groups, you have a seat at the table with others from your industry with a direct interest in a topic that also specifically interests you. During the development of the standard, you will be an active participant along with other industry subject matter experts as you work together on an area of technology with idea exchange about the latest advancements within that area of technology.

Additionally, when the standard is published, you will bring to your company your direct knowledge of the whys and hows that went into the development of the standard, including reasoning for requirements. This will set you apart from those who did not participate and will need to best interpret the standard on their own.

On a personal level, you will greatly expand your business and personal networks. You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will meet and get to know people from across the globe who all share a common interest in building electronics better. Any IPC staff liaisons will attest to how satisfying it is to go from a first meeting of a standards group, where almost everyone is a stranger, to looking back on that meeting years later to see how strongly connected all those people are.

How to Get Involved

Because IPC has an established network of standards task groups and a set, consistent process for how all our groups work, getting involved in IPC standards activities is very easy.

If you know the group or standard that interests you, email answers@ipc.org and ask to be added to the effort. You can also view the IPC Status of Standardization to see the list of standards currently underway, many of which may be new projects you may not be aware of.

If you have an idea for a new standard, IPC also wants to hear from you. Because IPC has a set process for standards development, beginning a new group—even if you have no standards development experience—is very easy. Just like with the existing groups, email answers@ipc.org with your interest.

If you have an idea for a new standard, IPC wants to hear from you.

Initiating New Standards Activities

Here are a couple recent examples of how new standards activities were initiated within IPC.

At IPC APEX EXPO 2017, IPC hosted a meeting of e-textiles professionals with interest in forming a committee to develop industry standards. From that one meeting, the committee has grown to more than 200 people from around the world; it approved its first standard in late 2019, and has six more standards underway.

In the fall of 2019, IPC staff was approached with a need for a digital twin standard for the electronics manufacturing industry. From that one idea, IPC formed a task group that was able to develop and approve the first international standard for digital twin in less than one year.

These are just two of too many instances to mention, and IPC is looking for other new standards successes to add to the list. So, if you have an idea for a standard, IPC wants to hear from you. Using our network and yours, IPC can quickly set up a new task group and get to work.

Whether an existing or new project, once you have been added to one of our working groups, engaging in the process is very easy. We are often asked by new participants if they need any training to get involved. Although IPC provides resources and helpful guides for new committee participants, IPC standards development is a learn-as-you-go activity. It's been that way for decades. By attending a few meetings or commenting on draft documents when they are circulated, you will quickly become engaged in the process.

Don't forget, you have staff liaisons who are there to help guide you and the rest of the task group to ensure your goals are met.

If you don't have the time to devote to a task group, you can also get involved simply by submitting comments on standards—including published standards. If you have a comment on a standard, visit the IPC Status of Standardization web page, which includes an open comment form. All comments will be sent to the working group for deliberation.

Ways It Makes a Difference

Whether you join a subcommittee or task group to work on a widely used standard used by thousands of companies worldwide or which forms the basis for IPC certification and

training, or if you and a handful of other colleagues are coming together to fill an immediate need with a new standard, your efforts will make a difference.

IPC standards provide collective knowledge on best practices, lessons learned, and shared data to improve reliability of product, decrease manufacturing costs, improve time to market, and ensure the global supply chain is "speaking the same language." Summing it up, you and your company will demonstrate your support for our industry by building electronics better.

And when the standard your task group developed is out to market, your support will be recognized in the acknowledgements for the standard, which lists every person and their company who participated in the activity.

For any questions regarding IPC standards development, send an email to answers@ipc.org. The appropriate IPC standards committee staff liaison will make sure your issues/questions are addressed. **SMT007**

Chris Jorgensen is the IPC director of technology transfer.

How Do You Test a Helicopter Bound for Mars?

Caltech grad students helped JPL build a custom wind tunnel in a vacuum chamber for the Mars Ingenuity helicopter

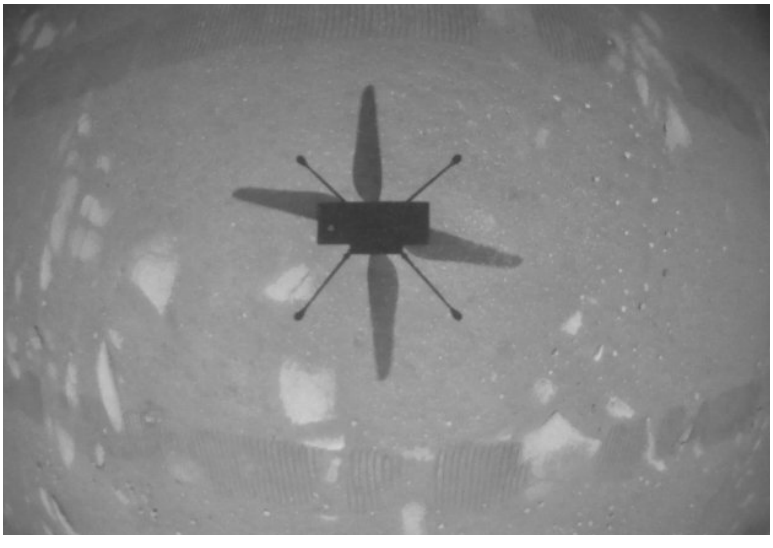
The Ingenuity helicopter may be the first vehicle ever to fly on Mars, but Mars was not the first place it has ever flown. Before packaging it up and blasting it to the Red Planet, engineers at JPL gave the helicopter a trial run in a special wind tunnel designed with help from researchers at Caltech.

To simulate flying on a planet where the atmosphere is 100 times thinner than Earth's, a custom wind tunnel was built inside of an 85-foot-tall, 25-foot-diameter vacuum chamber at JPL, which Caltech manages for NASA. Pressure in the chamber was pumped down to approximate the Martian atmosphere, while an array of 441 pairs of individually controllable fans blew on the helicopter to simulate forward flight in the enclosed space.

The fan array was designed and built by JPL engineers with input from Caltech's Chris Dougherty and Marcel Veismann, who are currently PhD students working with Mory Gharib, Hans W. Liepmann Professor of Aeronautics and Bioinspired Engineering and Booth-Kresa Leadership Chair of Caltech's Center for Autonomous Systems and Technologies (CAST). Dougherty and Veismann had previously overseen design and assemblage of a similar array of 1,296 pairs of fans for the Real Weather Wind Tunnel at CAST, which opened in 2017. Their design uses off-the-shelf computer cooling fans (albeit the most powerful ones currently available).

"This type of wind tunnel was particularly well suited for the intended applications, because the concept of using an array of small, cheap fans offers a space-efficient as well as cost-effective solution when compared to single-fan wind tunnels," Veismann says. "Furthermore, these types of fans are relatively robust and safe to operate, and the modularity allowed us to test how well the wall would perform prior to building the full-scale facility."

(Source: Caltech)



A Tribute to Dieter Bergman

Feature Article by David Bergman
IPC

BANNOCKBURN, Ill., USA, July 23, 2014—It is with great sadness that IPC announces the passing of Dieter Bergman, IPC staff member for more than 40 years. Decorated with countless awards over his lifetime, Bergman's name will forever be synonymous with IPC and he leaves a legacy of friendships, lasting memories, and what is affectionately treasured by IPC staff and close friends as "Dieter-isms"—such as a 45-minute answer to a 10-second question.

And with this announcement my father, IPC's prolific contributor, developer, learner, educator, and publisher for over 61 years, was gone.

Gone, but certainly not forgotten. The impact of Dieter's labors still forms the foundation of many pillars IPC provides as support to the industry. As Dieter's son, and an IPC staff member recruited by Dieter, I have been asked to reflect on his impact on IPC, and on the industry. I touched base with just a few of his innumerable industry friends to aid in this reflection. It may seem strange to you that I refer to him as Dieter, but I was comfortable this way—Dieter in public, Dad in private.

Dieter and Design

Design was continuously part of Dieter's core. He began his career in 1956 as a designer for Philco Ford in Philadelphia, Pennsylvania. He assumed the position of supervisor of the printed circuit design group in 1967 and joined the company's advanced technology group where he specialized in printed circuit computer-aided design.

In 1962, while at Philco Ford, he became the company's official representative to the IPC. Dieter tag-teamed with his friend and co-worker Gerald Ginsberg on the development of a prolific run of technical publications including a multilayer design standard and the massive binder known as the IPC-D-330 IPC Design Guide. For his standards contributions, Dieter received the IPC President's Award in 1968, the same year he assumed chairmanship of the IPC Design Committee.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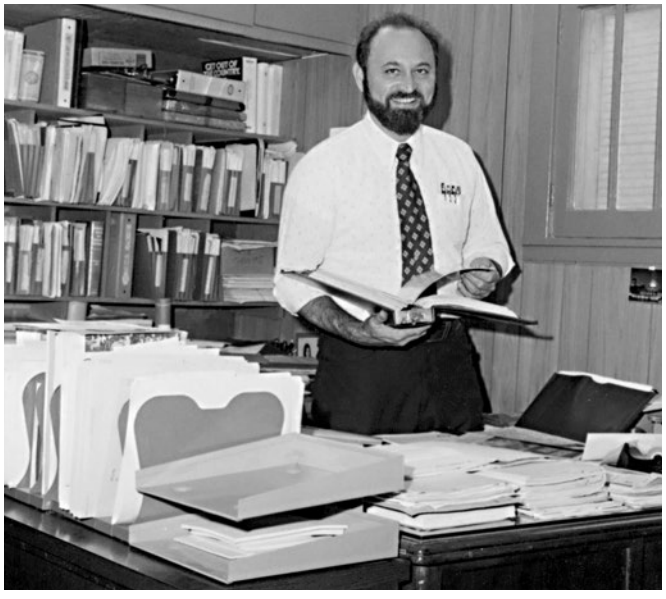

Dieter Bergman in the Technical Director office on Howard Street in Evanston, Illinois circa 1975.

Dieter joined the IPC staff in 1974. This wasn't the end of Dieter's efforts to create binders of content for industry, however. His name appeared on a few publications, including a handbook on gold usage, an electronics packaging manual, and an optoelectronics guide. His contributions to the industry as a whole earned him a place on the IPC Hall of Fame—IPC's highest honor—in 1985.

To raise the visibility of the importance of designers to the industry, Dieter led the effort to create the IPC Designers Council and the credentialing program, known as CID and CID+, to allow designers to demonstrate mastery of the body of knowledge required to be capable designers.

Dieter and Data Transfer

Passing complete information from design to production was a career-long obsession of Dieter's. Beginning with PCB data in IPC-D-350 in the 1970s, this effort evolved into the current IPC-2581. Dieter had hoped to see this standard globally adopted, and expressed disappointment that the incomplete Gerber format was still being used at significant levels.

Electronics assembly was not ignored; Dieter spent significant energy understanding XML and worked with industry to pull together the 2510, 2540, and 2570 series of data communication standards. I think Dieter would be quite proud of the traction we are seeing with IPC-CFX.

Dieter and Roadmaps

In 1993, Dieter pulled together over 200 industry experts to create IPC's first technology roadmap. From this effort, Dieter built bridges to other organizations such as SIA, iNEMI, TPCA, and others, to track industry technology trends and capture this information in our roadmap. Updated every two years, IPC Roadmaps help to drive consortium efforts as well as IPC standards efforts.

Dieter the Trainer

As mentioned earlier, I reached out to Dieter's colleagues and asked for their memories of his contributions. One industry friend, who had the "privilege" on three occasions to co-teach an IPC workshop with Dieter, said he would always remember Dieter's "tireless teaching" for those who were looking for the ultimate mentor, and that he marveled at how Dieter could wear so many hats within IPC.

Dieter would be happy to train a group of four or 400. It didn't matter what location, he

Dieter (center) discussing test methods with Joe Mulcahy of Methode using IPC's first portable computer, the Compaq luggable.

trained in so many places: Baltimore, Maryland; Denver, Colorado; Long Beach, California; Munich; Tokyo; Hong Kong; Shanghai; and Bangalore, India. It didn't matter about the topic either: PCB design, data transfer, roadmaps, microsections, SPC, and more. He could pull a panel session together to discuss a hot topic with minimal effort, or through connections and enthusiastic encouragement ("You can do it!" Thanks, Gene Weiner). Speakers and attendees invariably felt enhanced after these sessions.

Dieter posing with a class of design course students in Shanghai, China.

Dieter was driven to meet these efforts. Having forgotten that a visa was required to enter India, Dieter argued with immigration that he be allowed into the country because he had a class to teach. Immigration was unconvinced, but his friends at IPCA managed to get Dieter released from the holding room at the airport with an assist from the top government leader of the state.

Dieter the Workaholic

I am not sure how many of you have ever had a parent as your employee or had to give your father a performance review; I have. The nice part about workaholics is that they are extremely productive, and I very rarely had complaints. The only problem was that we had to ban IPC discussions at family and holiday gatherings, like Thanksgiving. Dieter and I would look at each other and not know what to talk about.

Another industry friend said about Dieter that he was the hardest working guy in the room, "but still had time to smell the flowers." He said that he was respected and listened to because of this work ethic. "He never asked more of someone than he was willing to do himself," was a common refrain I heard from his colleagues. He was determined (some would say stubborn) but always backed up his positions with logic and thoughtfulness. He was unencumbered by personal interest; doing "what's best for the industry" was the code he followed.

Dieter the Mentor

Others commented on Dieter's example as a mentor, even from their earliest involvement in the industry. He inspired those around him to give of themselves and devote their time to benefit the industry as a whole. In short, he inspired them to participate, and to effect change for the good of the industry. It was that inspiration from Dieter that led others to accomplish what they did.

Fellow IPC Hall of Famer and I-Connect007 technical editor, Patty Goldman, commented, "Dieter mentored countless people at IPC meetings, many of whom went on to leadership positions and more at IPC. Over the years, he has been nearly always mentioned by award recipients as a mentor."

Dieter the Friend

The world was a small place for Dieter, one industry colleague told me, and in his travels around the world with Dieter, he was shown the joyful parts of business travel that many people miss. He opened doors to companies and people that respected him for his efforts and dedication. He was friend to all who knew him and never let an argument stand in the way of friendship or fellowship.

Dieter had industry friends from everywhere on earth.

Dieter and Food

It needs to be said that Dieter could eat anything with zest. Even while singularly focused on business, he would also take the time to enjoy the variety of life. Those I spoke with recalled that Dieter's first rule of doing international business was to eat the food that the host presented to you and enjoy it—even if you had to pretend. "Enjoy!" he would say. "Your host brought out their finest foods and delicacies for you."

Always the avid fisherman, here's Dieter trying to win the Printed Circuit Industry Fishing Tournament with a few dorados.

Enjoying stories with Matt Aoki, Toshiba Chemical.

Some of my favorite pictures of Dieter are from his international meetings enjoying stories and laughing with his friends after a long day of meetings.

Dieter and Fishing

In a family album I have a picture of Dieter with me as a 7-month-old. Dieter is introducing me to a minnow bucket on a lake in upstate New York. Dieter would fish everywhere: blowfish and fluke in New Jersey, herring in Maine, marlin in Hawaii, cod in Copenhagen, walleye in Canada, dorado and wahoo in Mexico, sharks and barracuda in the Caribbean, grayling and Arctic char in the Arctic Circle. He was as happy catching a bluegill as he was catching a blue marlin. I was fortunate to be part of many of these trips for over 55 years.

Thanks to Bob Neves, Doug Sober, Patty Goldman, and Mike Carano for sharing your respective memories and quotes. We miss him. **SMT007**

David Bergman is IPC vice president of International Relations.

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Get Involved with IPC's EHS-Related Committees

Feature Article by Kelly Scanlon
IPC

Did you know that IPC members have several opportunities to learn about and get involved in policy debates about environment, health, and safety (EHS) issues?

As a member-driven organization, IPC's Government Relations (GR) team relies on the input of experts from member companies to ensure IPC's advocacy activities reflect the industry's priorities. For example, IPC's environmental policy priorities for 2021 were determined with input from our recently formed Environment and Health Strategic Management Team (ENV SMT), as well as from consultation with IPC's North American and European Government Relations committees. The experts who volunteer their time to participate in these committees recognize the importance of engaging with policymakers to educate them about the electronics industry and to advocate for policies that further the industry's competitive excellence and protect human health and the environment.

At the start of 2021, the ENV SMT was formed to shape the scope of IPC's environment and health advocacy efforts around the policy priorities, and craft position papers and stakeholder comments. The ENV SMT comprises just over a dozen electronics industry professionals with regulatory expertise in public health policies and technical expertise in areas such as environmental and occupational health, product stewardship, and quality assurance. ENV SMT members represent the entire electronics manufacturing supply chain, with representatives from OEMs, EMS providers, PCB manufacturers, and suppliers of chemicals and components.

IPC also convenes an EHS Committee, a larger forum of diverse professionals with EHS responsibilities. Members have regular opportunities to hear from IPC about the policies we're monitoring and engaging on and from peers about their own challenges or best practices on EHS-related issues.

Currently, IPC's environmental policy priorities include engagement on the:

- EU's RoHS (Restriction of Hazardous Substances) directive and REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) regulation

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- EU's Chemicals Strategy for Sustainability and Sustainable Products Initiative, which are both part of the EU's broader Circular Economy Action Plan
- U.S. TSCA (Toxic Substances Control Act) implementation

We're also prioritizing advocacy on several chemical substances that are essential to electronics manufacturing and the subject of emerging chemical and product policies:

- Lead (Pb)
- Flame retardants such as TBBPA and PIP (3:1)
- Per- and polyfluoroalkyl substances (PFAS) such as PTFE and other fluoropolymers

Here's an example of how our collective effort gets results. At the end of March, IPC submitted comments to the public docket on the U.S. Environmental Protection Agency's (EPA) proposed rule for "Fees for the Administration of the Toxic Substances Control Act." The expertise of IPC members and the information that they were able to share enabled IPC's GR team to advocate for a more equitable administration of fees to support TSCA. The existing fees rule was difficult to implement for companies importing articles containing TSCA high-priority substances and for companies manufacturing or importing small quantities of these substances. As a result of deliberations with member companies, IPC was able to partner with two other electronics industry associations to advocate for common-sense reforms to the rule. The proposed rule recognizes the implementation challenges faced by the electronics industry and includes solutions that will enable the EPA to achieve its goals without an unequitable burden on the electronics industry. Visit ipc.org/blog for the full story.

The EHS Committee and ENV SMT members also were helpful when we were evaluating the industry's role in providing feedback to the EPA on five final rules for risk management of specific persistent, bioaccumulative and toxic chemicals. Their expertise helped IPC to determine its level of engagement. Shortly after the industry's engagement, the EPA announced a new 60-day comment period. Now we are positioned to have a larger role in shaping the updated final rules to ensure realistic timelines for identifying safer chemistries and other practical risk management actions.

Meetings of the EHS Committee and ENV SMT offer members chances to engage with each other, exchange information, and learn about opportunities to get involved with broader advocacy activities. For example, the RoHS Industry Umbrella Project is a group of more than 50 associations and companies working together to track EU RoHS-related policy happenings and prepare exemption applications in accordance with existing protocols. IPC takes information learned from our work with the Umbrella Project and disseminates it to the EHS Committee and ENV SMT. Also, IPC encourages its members to engage directly with the various working groups of the Umbrella Project to support the exemption application process. In 2019 and 2020, IPC members participated in several working groups responsible for submitting more than two dozen applications.

There are more examples of our collective EHS work, but they all highlight the same truth: the electronics manufacturing industry, the environment, and human health all benefit from an active volunteer base of subject matter experts who dedicate their time to engaging on environmental policy issues. IPC appreciates the time taken by volunteers to get engaged with IPC's government relations activities.

For more information on joining either the EHS Committee or ENV SMT, please contact me at KellyScanlon@ipc.org. **SMT007**

Kelly Scanlon is IPC director of EHS policy and research.

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The Role of 3,000 Committee Members

Feature Article By Symon Franklin
CUSTOM INTERCONNECT LTD

Being a committee leader is both challenging and rewarding.

My career in electronics started with an HNC qualification in electronic engineering as part of an electronics apprenticeship at Marconi in Chelmsford, Essex in 1995.

My involvement with IPC began in 2012 when I became a Certified IPC Trainer to the IPC-A-610 Programme for my current employer, Custom Interconnect Ltd. (CIL), based in Andover, Hampshire, UK. My trainer was Debbie Wade at Advanced Rework Technology, who subsequently mentored me and gave me my first experience of attending committee meetings; later, she inspired me to take leadership roles and professional opportunities.


Symon Franklin

With CIL's support, I began to attend a variety of IPC Committee meetings in Europe and the U.S. I was thrilled to receive the IPC Rising Star Award in 2017. This is given to IPC members who have taken leadership roles and provided support to IPC standards, education, and advocacy, as well as solutions to industry challenges.

I am currently a co-chair of the 7-31B IPC-A-610 Task Group with Tiberiu Baranyi (Flex Ltd.) and Ekaterina Stees (Lockheed Martin). We work as a strong, dynamic team and can bounce ideas amongst ourselves as we take turns in leading meetings.

Because of the global pandemic, as well as personal and professional challenges, meetings are conducted remotely. One of the many skills we have learned is to confidently lead both face-to-face and online meetings of over 90 people. It is vital that we ensure participants can contribute fairly; providing guidance from an industry rather than a personal standpoint can be a careful balancing act. The leadership team also deals with different time zones and, as meetings are conducted in English, we encounter language nuances and diverse cultural experiences.

While others struggle just to keep pace, we stay ahead of the curve by constantly investing in the equipment, people and resources needed to be the best total PCB solutions provider in the industry.

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Because of the committee format, the global, business, and personal perspectives are very diverse. More than 20 countries are currently involved in developing and reviewing standards with contributors ranging from large multi-nationals and government agencies to small businesses. Members range from emerging engineers who are just starting out in their careers, to those nearing retirement with vast knowledge, experience, and expertise to pass on.

Members range from emerging engineers who are just starting out in their careers, to those nearing retirement with vast knowledge, experience, and expertise to pass on.

I believe the committee structure really shines as we are constantly striving to produce the best possible version of the standard and ensure consensus for best practices in each review cycle—currently every three years—for the industry. During the review cycle, users of the standard can submit comments on the document content which are then debated by the committee.

The committee has A-Teams and Working Groups that the leaders can delegate to; these groups have members with relevant expertise to review particular areas of the document or individual comments. This gives us a two-fold bonus of having knowledgeable participants provide feedback and frequently passing on information to someone who may not know as much in that area but is keen to develop the best possible document for the industry.

However, we have publication deadlines to meet so the leadership team ensures contributions and feedback are timely whilst giving each comment due consideration. This process can lead to personal time management issues where I am juggling my IPC committee contributions, leadership responsibilities, and my own role as a production engineer with CIL.

From a company point of view, my involvement with IPC has given Custom Interconnect Ltd. a global voice, and an insight into developments and innovations within the electronics industry, particularly in the BEV automotive sector. It also allows the company to be proactive with its customers when advising on the use of relevant IPC standards within their manufacturing documentation and requirements to ensure it is up to date and using best practices.

I have gained so much insight and knowledge from the fantastic sharing of ideas from different company structures and off-the-record knowledge. Examples are personal anecdotes, historical viewpoints from people who developed the original standards, and their motivation and reasons for the need for those original standards, to the introduction of new technologies and working practices. A real highlight is that moment when your line manager asks, "Do you know about ....," and I can say, "No, but I know a committee participant who does!"

I have made many new professional and personal contacts by meeting and corresponding with people whom I would not have encountered otherwise. I have also had the opportunity to travel to new countries. These connections inspire me to guide and mentor the next generation not only within my current employer but also within the committee structure, bringing it full circle to where I started my IPC journey. **SMT007**

Symon Franklin is a production engineer at Custom Interconnect Ltd.

IPC Committees as an Emerging Engineer

Feature Article by Jonathon Vermillion
BALL AEROSPACE

I started coming to committee meetings around 15 years ago. I was working at an aerospace company as an instructor and process control engineer. When I say aerospace, I mean space flight. At that time most of our contracts were with NASA and I participated in the monthly workmanship telecons. They would answer emailed questions and we had a few inputs to updated NASA standards. The big news was about a new document, an addendum to the J-STD-001. That sounded familiar. A colleague of mine that I worked with back in the '80s was heading up the effort. He was giving a presentation at a conference in Baltimore in the spring of 2001 and some Ball Aerospace instructors were attending. I had submitted my resume and they wanted to talk to me about that. My first interview was in the hotel pub before they got on the plane back to Colorado. I was basically hired based on that interview.

There were concerns about companies using the J-STD-001 Space Addendum. NASA wanted people from the different sites and their contractors to attend the committee meetings. My management had changed but I received permission and funding to start attending IPC APEX EXPO conference meetings. At first, I only attended one meeting and just held on, trying to get the hang of things. Eventually I started attending other meetings, participating, and submitting comments. My company was quite pleased as we had some issues with current criteria and the comments were discussed and resolved. We felt they supported manufacturability while still retaining reliability.

About four years ago, I was asked to co-chair the J-STD-001 task group for Revision H. My IPC liaison suggested that I read the IPC Chair Handbook, where I noticed under "Roles and Responsibilities" it listed "Drive for Consensus." This helped me clarify that decisions didn't


Jonathon Vermillion

need to be my way. Some comments are dispositioned and resolved easily, and some others take a little bit more time. Sometimes when we can't find consensus it's because we really haven't talked about the problem enough.

In my current position at my company, I have a lot of other roles and responsibilities, but it is my work on the IPC committees that I seem to enjoy the most.

The last time we met in person (IPC APEX EXPO 2020) was the first time I met my Emerging Engineer, who hadn't attended the professional development classes yet. We did talk a bit about the committee meetings. When I met with him the next day, I told him the "secret" to getting a comment passed in committee was that there wasn't a secret. To get a comment to pass, it just has to be the right comment. It helps if it is adequately explained and with data provided, if needed. We are extremely fortunate to have some of the industry leaders participating in our committees. We also try to make the documents easier to understand with simple wording, so it's easier to be translated and used globally.

In my current position at my company, I have a lot of other roles and responsibilities, but it is my work on the IPC committees that I seem to enjoy the most. Maybe the reason is I feel like I make a difference, even if it's just a small part. Sometimes it's an ad hoc working group closing an action item and sometimes it's FDIR (First Draft Industry Review). Everybody submitting comments and participating in committee meetings are actively making the document better for industry.

If any of this sounds intriguing to you, I encourage you to get involved with an IPC committee. You really can make a difference. SMT007

Jonathon Vermillion is a process control engineer for Ball Aerospace and a 2021 recipient of the IPC President's award.

Supplier Highlights

MacDermid Alpha Launches ALPHA CVP-390V High Reliability Solder Paste for Harsh Operating Conditions ▸

MacDermid Alpha Electronics Solutions, a global leader in specialty materials for electronics, announced the release of ALPHA CVP-390V high reliability solder paste, designed to maximize flexibility in manufacturing and provide excellent electrochemical reliability in harsh operating conditions.

Heraeus, Fraunhofer IISB Launch Joint Master's Program in the Field of Power Electronics ▸

Heraeus Electronics, a leading supplier of material solutions for packaging technology, and the Fraunhofer Institute for Integrated Systems and Device Technology (IISB) recently launched a joint program for master's theses on power electronics.

NovaCentrix's Stan Farnsworth Reconfirmed as OE-A Board Chair ▸

NovaCentrix, a leading provider of photonic curing tools, conductive inks and the new PulseForge® Soldering high-intensity pulsed-light solution, is pleased to announce that Stan Farnsworth, Chief Marketing Officer, has been reconfirmed as the Chair of the Board of Directors of the OE-A (Organic and Printed Electronics Association) for the term 2021 to 2025.

MIRTEC Appoints Experienced Sales Manager for Germany, Austria and Switzerland ▸

MIRTEC is pleased to announce the appointment of Rui Gésero to sales manager for Germany, Austria and Switzerland. With almost 10 years of sales experience in the electronics manufacturing industry in his territory, Gésero is an important addition to the MIRTEC Germany team.

Mek Launches MekCare, a Portfolio of AOI & SPI Support, Maintenance Services ▸

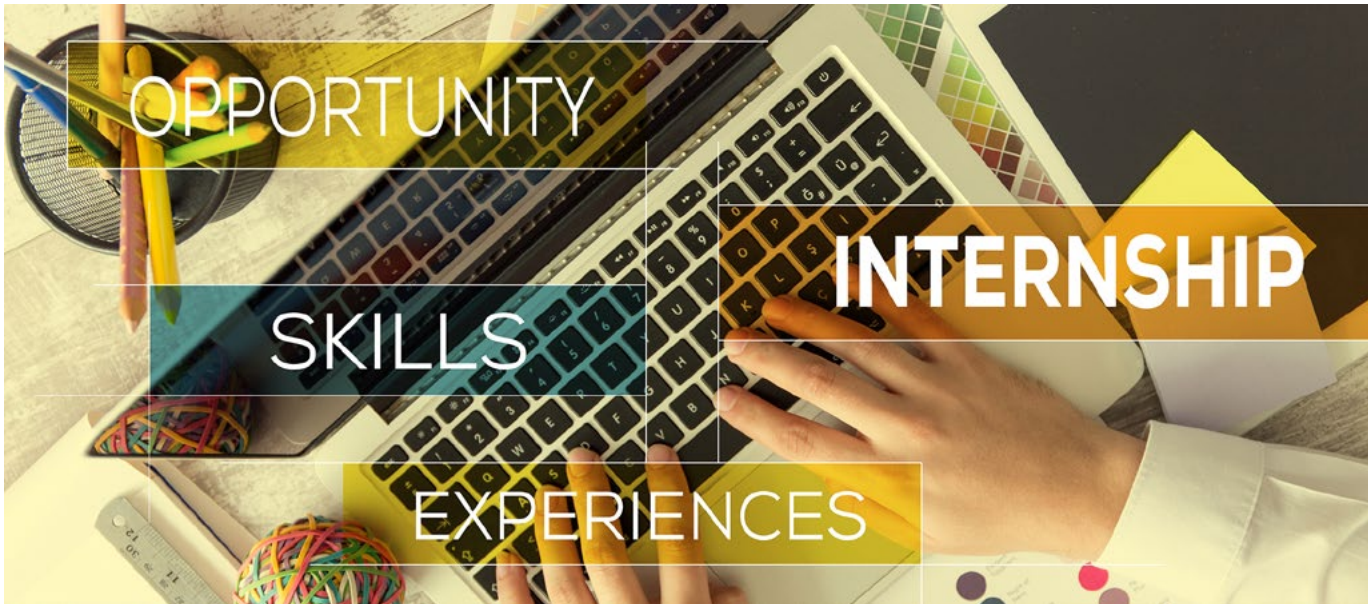
Mek (Marantz Electronics), a leading supplier of 3D Automated Optical Inspection (AOI) and Solder Paste Inspection (SPI) technologies, is launching MekCare, a range of flexible service plans designed to meet differing support requirements, all at a predetermined cost.

CyberOptics Receives $1.2 Million Order for 3D MX3000™ Systems ▸

CyberOptics Corporation, a leading global developer and manufacturer of high-precision sensing technology solutions, announced that it recently received an order valued at $1.2 million for its MX3000 memory module inspection systems, powered by Multi-Reflection Suppression™ sensors.

Aegis' Michael Ford Receives Dieter Bergman IPC Fellowship Award ▸

Aegis Software, a global provider of IIoT-based Manufacturing Execution Software (MES), announced that Michael Ford, Senior Director Emerging Industry Strategy, based in the UK, has been awarded the Dieter Bergman IPC Fellowship Award in recognition of significant contribution to IPC standards development, and commitment to global standardization efforts across the industry.



Creating Industry Awareness and Access Points for Students

Article by Charlene Gunter du Plessis
IPC

The mission of the IPC Education Foundation (IPCEF) is to create awareness of the careers the electronics manufacturing industry has to offer students in high school and college by providing them with opportunities to access people, courses, and knowledge.

Awareness and access are the key focus areas for 2021 and the programs, activities, and efforts driven by IPCEF will put students and teachers at the forefront. We have identified the following pillars under each focus area:

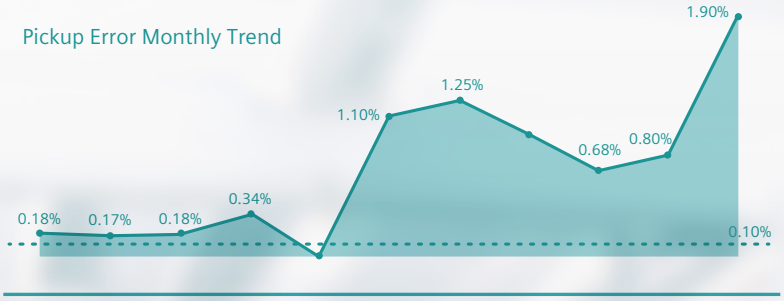
- **Awareness** will include virtual learning opportunities around industry-relevant topics for high school students, available this fall. These activities will be supported by downloadable learning activities with detailed descriptions for classroom implementation, a bill of materials list for hands-on exercises, and free industry-relevant videos. Pre-recorded career panel discussions on career exploration and information about the industry will also be provided.
- **Access** to the industry focuses on two main pillars: The IPC Student Chapter Program and IPC Mini Libraries, the new addition to the Foundation.

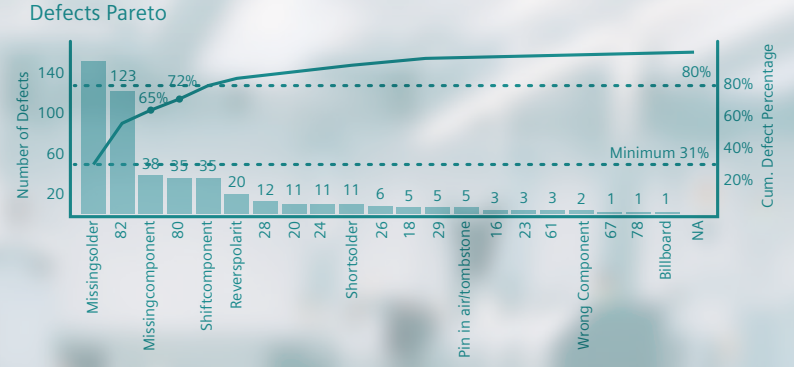
IPC Student Chapters

The IPC Education Foundation's Student Chapter Program focuses on providing scholarships, offering relevant industry content, and assisting with career readiness for its student members. IPCEF has 40 student chapters across 19 states in the United States, engaging more than 500 student members. Twenty-six chapters exist at four-year universities while 15 chapters exist at two-year community/technical colleges.

The main goal of the IPC Student Chapter program is to connect students with the industry through a variety of engagement initiatives that include facility tours, speaking opportunities, and information sessions. To learn more about how to get involved from an employer perspective, please complete the three-question survey.

SIEMENS





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Charlene Gunter du Plessis

To be eligible for membership, student members must be pursuing degrees in the following disciplines: electrical, electronics, mechanical, computer, technology, chemical, aerospace, and/or broad engineering. IPCEF has student members pursuing certificate programs, two-year degrees, four-year degrees, master's, and doctorates. To learn more, click here or contact me at aaronbirney@ipc.org.

The Foundation will continue to expand the reach of the program by growing the number of chapters in the United States with plans to expand internationally in 2021.

Scholarships and Awards

IPCEF awarded $25,000 in scholarships to IPC Student Members in 2020 and $23,000 in 2019. Last year, the scholarship recipients were members at the following IPC Student Chapters: Auburn University, Binghamton University, Colorado School of Mines, Gwinnett Technical College, Michigan Technological University, Oregon Institute of Technology, Purdue University, Triton College, University of California Irvine, University of California Los Angeles, University of Maryland, University of Maryland-Eastern Shore, University of New Orleans, University of Utah, and Valparaiso University. Each IPC Student Member receives $1,000 designed not only to reduce the financial burden, but also to encourage students to enhance their knowledge and skills of real-world industry-related experiences. To learn more about the scholarship winners, click here.

The Foundation aims to provide scholarships to 50 deserving student members in 2021, while expanding the scholarship program to include:

- Travel grants to attend IPC APEX EXPO in San Diego in 2022
- A leadership scholarship open to IPC Student Members currently serving in a leadership capacity at the IPC Student Chapter level

IPC Mini Libraries

This new program is designed to provide students with valuable industry-related knowledge through specific online IPC resources and content. The educational content will allow students to increase their current knowledge while better preparing to enter the workforce. Students will have access to a variety of videos on topics that include electronic assembly, soldering, ESD, and wire assembly, as well as introductory courses; all are accessible online. Students will receive a badge upon completion.

IPC's "full" library contains 78 industry-developed training videos for the electronics manufacturing and assembly industry. This is a complete library of operator-level training videos that provide the foundational knowledge required for ESD (electrostatic discharge) control, hand soldering, IPC-A-610 acceptance criteria, rework and repair, components, cable and wire assembly, and more. The cost of the full library is $2,500.

We responded to the request by high schools/technical community colleges for a focused set of videos by creating seven separate "mini" libraries for this purpose. Each

mini library contains six to 10 pre-selected videos on the designated topic, priced at $1,200. Topics include electronics assembly inspection, ESD fundamentals, hand soldering and rework—PTH and SMT, intro to electronics assembly (pre-employment training, intro to wire assembly), and others.

By equipping students with valuable industry-related knowledge through specific online IPC resources and content, IPCEF hopes to address some of the industry's needs:

- Lack of awareness of the careers and skills needed to participate in those careers
- Shortage of qualified technical candidates because not enough skilled younger workers are entering the electronics industry
- An aging workforce
- Lack of job preparedness, as many schools are not teaching the students the right curriculum related to industry and career readiness

This summer, we will be reaching out to high schools (preferably vocational high schools), technical community colleges, and universities to participate in various IPCEF programs. Our goal is to share relevant industry content with students that will not only create awareness but allow them to better understand the skills needed to pursue and access viable career opportunities. Contact Charlene Gunter du Plessis, senior director, IPCEF, at charlene-gunter@ipc.org. SMT007

Charlene Gunter du Plessis is the senior director of the IPC Education Foundation

Excerpt—*The Printed Circuit Assembler's Guide to... SMT Inspection: Today, Tomorrow, and Beyond*, Chapter 2

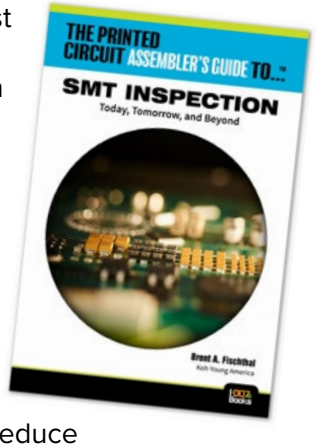
Chapter 2: Performance Anxiety

A limitation of many 3D optical inspection systems is the cycle time typically associated with processing millions of pixels to reconstruct a full 3D image using data captured from multiple channels. There should not be a compromise between 3D inspection and throughput. A successful inspection deployment should provide oversight for the process, not compromise, interrupt or slow that process.

The performance or speed of inspection equipment falls into two camps. One is the time taken to switch from one inspection program to another. The second is the speed of the individual inspection. The former should be as close to zero as possible and, at worst, not longer than the changeover time of the line. The latter should be at the cadence of a line itself or better. The inspection system should never be the bottleneck on the line or the process that dictates the speed at which boards are assembled.

Processes Optimized With Reliable Data

Some systems capture dozens of unique measurement data sets for each field of view. This produces a lot of data, and equipment makers need to manage the big data processing with parallel computing to satisfy even the most demanding applications.



Equipment suppliers can improve 3D AOI speed thanks to hardware and optical technology that generates reliable and repeatable data. These inspection results are then stored in a central database, which can be used in deploying the optimal inspection program for multiple operations and reduce programming and setting condition times.

Process optimization is desired by manufacturers and equipment suppliers, including manufacturers of inspection equipment. However, this optimization has been difficult to achieve with 2D systems, as most do not offer height information, and cannot accurately measure and quantify shape, coplanarity and solder amount. True 3D AOI systems measure every aspect of the component and solder joint in accordance with the IPC-A-610 standard, and then a significant set of reliable measurement data.

Click here to download this free book.

AI Wields Powerful Weapon in Counterfeit Components

Lean Digital Thread

by Sagi Reuven, SIEMENS DIGITAL INDUSTRIES SOFTWARE

The world is still very much in the middle of a pandemic that has been altering the global economy in multiple ways. For starters, millions of employees suddenly found themselves needing to have the technical resources to work from home, their children had to start attending elementary school via Zoom and, as a result, the demand for technology has seen a spike to unprecedented levels.

One would think that such demand for laptops, tablets, and other mobile devices would be a boon to the economy, but the truth is that this demand has plagued the global economy with another problem—a severe shortage of electrical components.

The shortage of electrical components did not become a problem in 2020 simply because of a global pandemic; electrical component shortages have been putting pressure on manufacturers for at least the last three years.

The shortage of electrical components in 2020 was perhaps most keenly felt due to tariffs that were placed on imported goods from China paired with the mandatory shutdowns at many factories in the United States.

This supply-demand imbalance creates a vacuum for counterfeiting enterprises which see the electronic component shortage as a wonderful opportunity to make some quick cash. Counterfeit components are filling supply chain gaps with sub-par, recycled, and otherwise counterfeit components as desperate manufacturers continue to frantically scour for electronic components without administering the appropriate supply chain vetting procedures.

The serious issues with the presence of counterfeit electrical parts in otherwise reputable devices hardly needs explanation. However, the harsh liabilities these companies take upon themselves by using counterfeit electrical components (whether knowingly or not) is worth explaining here.

The presence of counterfeit electrical components in any product exposes companies to sig-

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nificant liability because these products are much more likely to malfunction than products that are built entirely with genuine electrical components, due largely to the lower quality of the counterfeit electrical parts.

Your tablet malfunctioning can be frustrating enough. It is only when the presence of counterfeit electrical components poses real danger to consumers that it merits the attention this problem truly deserves. Certain products could cause physical harm to consumers if a counterfeit component failed. Equally disturbing, if a counterfeit electrical component caused a product to malfunction or short-circuit, one could be looking at the very real possibility of a fire and loss of life.

The presence of counterfeit parts in medical devices is perhaps the most troubling, and it is a very real possibility in the current market. If a medical device does not perform as it was designed due to a counterfeit or fake electrical component, it may not yield accurate test results, and that could directly harm patients.

The financial impact of counterfeit is no less disturbing, especially in the semiconductor market—an industry that loses as much as $250 billion annually because of counterfeit components.

Counterfeits show up in virtually any industry, and companies that work with electronic equipment need to have the technology in place to avoid fakes and detect counterfeit electronic components that found their way into the factory.

One company offering an incredibly adaptable solution to the widespread problem of counterfeit electrical components is Cybord.

Cybord's software solution, Cybord SMT, physically tests 100% of every product's components by analyzing each component's photo, which is already taken today by SMT pick and place equipment. The software verifies authenticity, solderability condition, external defects, and tampering concerns.

Cybord SMT achieves this by using advanced artificial intelligence algorithms and big data to make sure no counterfeit parts or hardware cyber components get integrated into larger product parts.

Companies find multiple value points in Cybord's software throughout the product's lifecycle. Early defect detection (pre-reflow) means that first pass yield rate is improved, and fewer internal failure costs are incurred. Products free of counterfeits fail less and minimize external failure costs. Cyber-tampering inspection helps in reduction of security threats in the field, and component analytics let companies optimize their recall criteria and perform surgical recalls and save significant expenses.

A combination of thoroughly vetting the resources in your supply chain along with the integration of Cybord SMT software is one of the most reliable strategies for protecting company investments and products from the damage that can be caused by counterfeit electrical components. Supply chain contamination risks should not be ignored and can now be minimized using software. Please contact me at sagi_reuven@mentor.com for more information. **SMT007**

Editor's note: This column originally appeared online at SMT007.com.

Sagi Reuven is a business development manager for the electronics industry at Siemens Digital Industries Software. Check out this additional content from Siemens Digital Industries Software:

- *The Printed Circuit Assembler's Guide to... Smart Data: Using Data to Improve Manufacturing* (a free eBook available for download)
- *The Printed Circuit Assembler's Guide to... Advanced Manufacturing in the Digital Age* (a free eBook available for download)
- Siemens' free, 12-part, on-demand webinar series "Implementing Digital Twin Best Practices From Design Through Manufacturing."
- RealTime With ... Siemens and Computrol: Achieving Operational Excellence in Electronics Manufacturing

Electronics Industry News and Market Highlights

Cisco Embraces Intel Innovation, Updates Server Portfolio ▶

Cisco has announced new server solutions supported by 3rd Gen Intel Xeon Scalable processors to bring new performance and security capabilities to customers' hybrid cloud infrastructure.

Global Semiconductor Materials Market Sets New High of $55.3 Billion ▶

The global semiconductor materials market grew 4.9% in 2020 to $55.3 billion in revenue, surpassing the previous market high of $52.9 billion set in 2018, SEMI, the global industry association representing the electronics manufacturing and design supply chain, reported in its Materials Market Data Subscription.

Robotic Assistance Devices to Integrate EAGL Gunshot Detection Technology ▶

Artificial Intelligence Technology Solutions, Inc. has announced that its wholly owned subsidiary, Robotic Assistance Devices, has entered into an agreement with EAGL Technology, Inc. to offer EAGL's Gunshot Detection System in all present and foreseeable future RAD devices.

North American Semiconductor Equipment Industry Posts February 2021 Billings ▶

North America-based manufacturers of semiconductor equipment posted $3.14 billion in billings worldwide in February 2021 (three-month average basis), logging a record high for the second consecutive month, according to the February Equipment Market Data Subscription (EMDS) Billings Report published by SEMI.

European Semiconductor Market Grew 6.8% in February YoY ▶

European semiconductor sales in February 2021 reached US$ 3.482 billion, an increase of 6.8% versus the same month one year ago, the European Semiconductor Industry Association (ESIA) reported on 5 April based on World Semiconductor Trade Statistics (WSTS) data.

A Breakthrough Enabling Practical Semiconductor Spintronics ▶

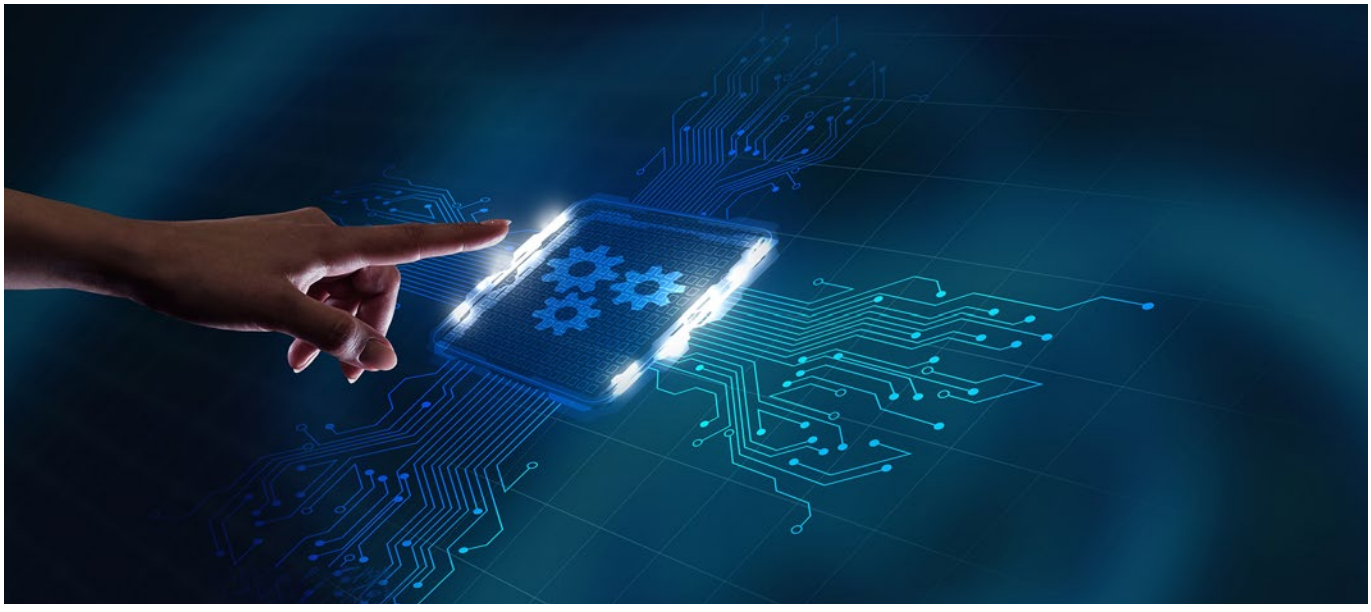
It may be possible in the future to use information technology where electron spin is used to process information in quantum computers. It has long been the goal of scientists to be able to use spin-based quantum information technology at room temperature.

Renesas Collaborates with Qualcomm Technologies ▶

Renesas Electronics Corporation, a supplier of advanced semiconductor solutions, has expanded its ongoing work with Qualcomm Technologies, Inc., to include 30W wireless charging capabilities for mid-range smartphones powered by the latest Qualcomm® Snapdragon™ 780G 5G Mobile Platform.

Sony and NTT DOCOMO Control Driverless "Entertainment Vehicle" in Guam from Japan ▶

Sony Corporation and NTT DOCOMO, INC. jointly announced that they have succeeded in remotely controlling Sony's Sociable Cart (SC-1) entertainment vehicle carrying passengers in Guam from a base in Tokyo, over 2,500km away, via a 5G network.



Process Control in Solder and Reflow

Interview by Nolan Johnson
I-CONNECT007

Nolan Johnson speaks with KIC's Miles Moreau to get his perspective on topics such as wave process inspection (WPI), wave solder, and vacuum reflow, and how they will fit into Industry 4.0 and smart factories.

Nolan Johnson: Miles, as general manager for EMEA, Americas, and Australia, you're watching what's going on in business around the globe. What are the general market trends?

Miles Moreau: The market trends I'm seeing—and it's been interesting the way some of this has progressed—is a change of what makes the most sense to effectively, from a global economy standpoint, produce and deliver product for the OEMs. People say, "We can do it over here in Asia—specifically in China—very effectively, and at a very low cost," but then you start to see these disruptions, and that mindset has changed.

That was just magnified by the pandemic, to where the market trends are localizing distribution points and manufacturing. Now you move from the OEM to EMS companies, and we will need to be more flexible and agile at meeting our customers' demands, not just in some manufacturing base, but anywhere that they want to move production; we must have systems in place to manage that. If I'm an EMS company, they may say, "I want you to build over here now, but you'd better build it exactly the same way you were building it in this spot." Especially when you compare OEM manufacturing vs. contract manufacturing (but it applies to both), they want to be able to deliver the same product regardless of where it's built, and they want to be able to shift something quickly and build it somewhere else.

I think that's why smart factory trends have accelerated; I've noticed in Europe and lately in the U.S., you're getting some manufacturing moving back to North America and they are looking at those capabilities, saying, "Yes, we're getting some manufacturing back here, but we want to keep it here," so we have to be just as agile about how we can manufacture. That's where these smart factory trends create the ROI; then I can say, "Here's the best way to manage that and compete against these lower cost manufacturing locations."

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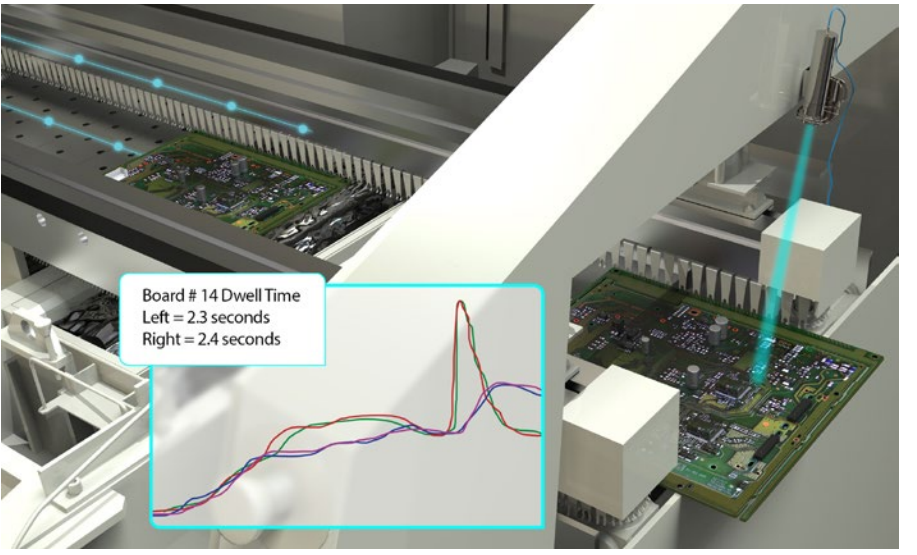

KIC WPI—wave process inspection. Click here to learn more.

Johnson: KIC has been working on some ongoing R&D throughout 2019-2020 that is just starting to roll out; tell me about it.

Moreau: We've had good solutions and a reputation for great reflow-related solutions around profile setup, optimization, and monitoring or inspection during production. That has been KIC's forte, and we do that across SMT assembly and semiconductor packaging. We've always had requests from our customers for other thermal processes, with wave being one in particular that's handled on the profiling side. We have some good solutions that help them set up and do a check on the machine, but it's always been a challenge during production.

Wave is a multifaceted process of fluxing, preheating, and then soldering, as opposed to the oven being continuous where it all happens during the same process and flow. How do you adapt? Because the machines can be configured a lot differently—some have convection, some have IR heat, different ways of applying the heat, top and bottom zones, sometimes only bottom, two waves vs. one wave, all sorts of different things—that makes it really challenging. There are some aspects around the mechanics of the wave that are part of what the manufacturer is trying to monitor or keep track of.

A big challenge for us was to come up with something that a fixture can do; run it through the process, get preheat topside temperatures, ramp rates, make sure you're activating the flux, and then capture some wave data as far as dwell time and parallelism with the fixture. But now what do you do during production? With a board going through a pot of liquid solder with a wave pumping and trying to have sensors and data collected so you can actually capture that data and do something in real time, this was our challenge.

The answer to that challenge was the WPI or Wave Process Inspection. It matches what our capability is on reflow with our RPI system, but it takes into account certain aspects of what the customer needs to measure when the board is going over the wave, which is dwell time. We have come up with a way, during production, to not only get the entire temperature profile of the product going through the preheat and the wave, but also a real-time dwell calculation for each and every production board. That's been a big challenge, and we've got it nailed down now.

Johnson: For those who may not be particularly familiar with the importance of dwell time and why it's a challenge, could you give us a quick primer?

Moreau: When it comes to the wave itself, the flux activation part is in the preheat coming up to that wave. Proper activation facilitates the soldering and cleans the surfaces. The dwell time is going to affect or impact the quality of the solder joint. It's how long the board is going through, and in, the wave. Most important is getting the metallized surfaces up to soldering temperature for proper wetting. Dwell is what facilitates this part of the process.

There's a lot of aspects to what happens through the wave. How long each section of the board is going through the wave—and getting that good solder joint—is directly correlated to the dwell time.

Johnson: Not to sound like an old timer, but back in the day this was generally a static process, the sort of thing that you would need time to set up. You would have to run through test boards, figure out what the appropriate settings were for all of the conditions through the three stages, do a thorough profile, inspect the test boards, and refine the process until that one particular board was dialed in. Then, you stuck with those settings, and you had to check the finished product regularly; it was a static process.

With the move to factory automation as a general trend, is the WPI doing real-time checking?

Moreau: Effectively that's what it's like, it's like running that fixture check through for every production board. The challenge on the wave is doing static vs. dynamic, or more real time. In a reflow oven you are managing based on the control of the zone and what external forces can impact the profile or how it changes. With the solder pot, it's extremely dynamic and somewhat unpredictable, even if you fine tune all of the mechanical settings and manage the height, how you're collecting off the dross, the pump, the temperature of the solder.

It's very dynamic so the more frequently you can do that check during production, then you're going to reduce the opportunities for defects. Now what you do is, why not take that to continuous? Let's do that for every single production board, so that if there is some change, we can put a tolerance around what's acceptable. Then if it goes beyond that, we can alarm and prevent other boards from going through when the setup is no longer good.

Johnson: That used to be a tactic, right? Especially in wave solder, you would create a tolerance window, and it would be pretty large, and you would have to make sure that you stayed within that window. Does this give you the opportunity to tighten the tolerance windows? And what is the benefit there to the customer or the OEM?

Moreau: Like you described before, you do all these tests, you run profile after profile, and then you come up with the tolerances, but that's just based on these static measurements. Now imagine I can run for two hours and get the data that took me two to three days to collect before. Then I make the necessary adjustments and can have continuous improvement on the fly, with real-time feedback from WPI. No more time-consuming manual processes; you're getting the real-time feedback so then you can tweak your tolerances as you go start to improve the process and really tighten it down. It not only gives you the value of, yes, I'm getting this data to make sure that my customers' product is being built correctly, but I have real-time feedback now where I can actually fine tune and improve this process.

Johnson: Does being able to fine tune and get more precise benefit the OEM?

Moreau: Yes, they have the assurance that the product being built is in a much better controlled process, so it's going to reduce the defects, the quality is going to improve, and then you have the traceability. They have the information that, "Here's what happened in the wave;" not saying at the beginning of the shift, "I checked the machine, and everything was okay," but, "As every one of my boards went through, I know what happened."

Johnson: Right, and there's a value there as well, isn't there?

Moreau: Yes, and that gives them full traceability.

Johnson: As customer tolerances get tighter, and speeds get higher, then managing all of the design constraints—crosstalk, RF issues, shielding, environmental resilience, wider temperature ranges and humidity issues—at some point this boils down to specifications that the soldering process needs to accomplish. How does the WPI receive its incoming setup data for a particular job?

Moreau: Most of that drives around the materials used, the assembly design, and the type of equipment you have. If the customers do have particular materials to run, the chemistries and components are going to drive what their selections are in relation to the product itself. And if they want to get better control and results, they need something to go on. Repeatability of the process will influence those types of things especially when you get to dwell time; that's going to impact how well that solder joint is completed going through the wave.

Johnson: There are people in the industry who are of the opinion that slowly, steadily, the wave soldering machines are on their way out. But this addition seems like it might breathe new life, new usefulness, to wave soldering. Is that how KIC sees it?

Moreau: I believe it was Mark Twain who said, "Rumors of my death have been greatly exaggerated." I think that's true for wave. It's been rumored year after year, "This will be completely replaced by surface mount or some other insertion method or something," and nothing has been provided that has reached that goal. We see that the machines have improvements on them now so they can have much tighter control. It's not as much a "voodoo art" of setting up the wave solder machine; it's a little more scientific, and the machines have more control parameters that they can accomplish.

We saw this as an opportunity; this is actually the path of wave solder, especially in the high-volume factories, that there is a need and it's not going to go away. They need this information to do the high-volume production. When you look at wave vs. selective, wave is a much more value-added process on the high volume, or there are a lot more parts on the board that need to be through-hole. We saw that this is the type of data they need on this process, so it seemed like a good fit and a good opportunity; not just a short-term solution but something that will continue.

Johnson: KIC has done a lot of work with Industry 4.0 and protocols like the CFX protocol, bringing process monitoring, process control, and inter-process communication into the whole flow. How much work is going on in the industry to include wave solder in Industry 4.0? Are you unique in doing this?

Moreau: With regard to the type of data we collect and the type of solution we have, as far as I know, this is the first solution that accomplishes that. We have had a solution, and even that has been unique on the preheat side. We could monitor the preheat profile of the wave process. We're taking WPI to the next level, and it's the only solution available where you get complete process information: "Here's the temperature profile of that board even going through the wave, and here's some key process indicators, dwell time, and parallelism on the wave itself in real time." It fits into that flow: "If I have this type of data on the wave machine, how can I relate that to my factory as a whole, and all the processes leading up to that?"

It's a unique solution that fits the market well and is something our customers are saying they need.

Johnson: This is something that could be retrofitted to existing wave soldering machinery?

Moreau: Correct. It's definitely retrofittable, though there are some limitations depending on the type of machine. With our reflow solu-

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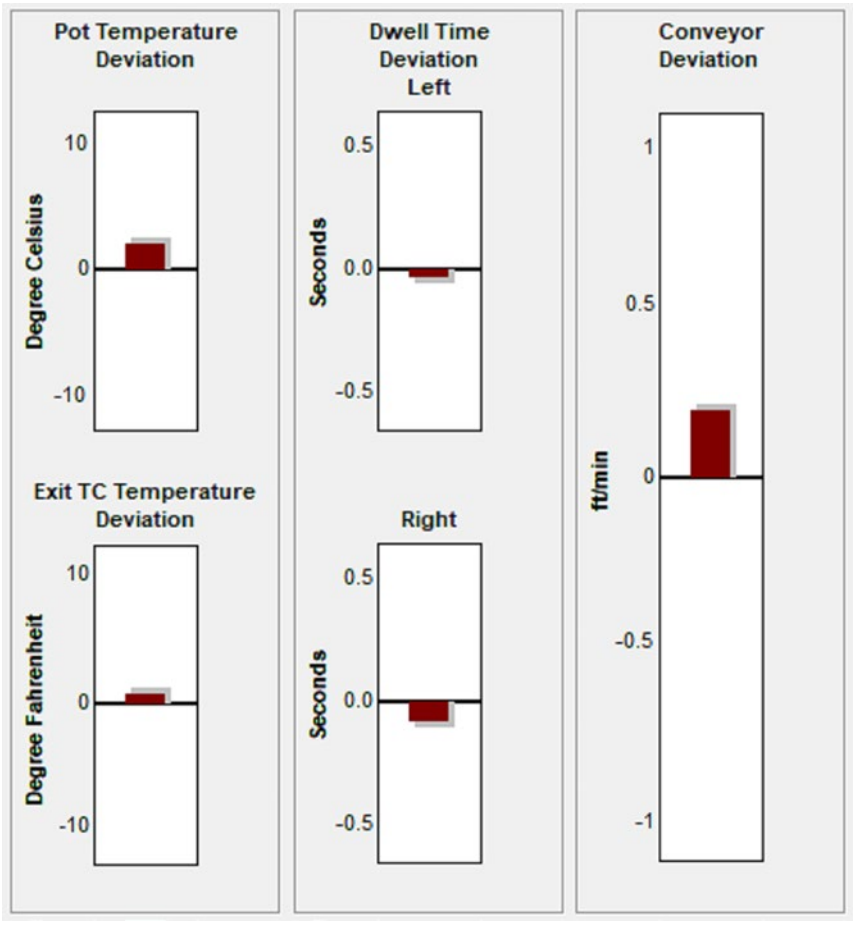


Wave process deviation tracking.

tions, reflow ovens are very similar—it doesn't matter about the make or model, you have very similar attributes as far as the physical oven and the mechanics. There is a lot of variety in the way the wave machine operates, so that made it a little more challenging. Our initial release is focused on certain configurations, so we have had that conversation with our early customers who have already implemented this.

Our process looks like this: "Okay, what's the setup of your machine? How is it configured? What type of heat source are you using? How is your wave configured?" Then, we see if we have a match for the WPI. As the product and our solutions mature, we'll make it more adaptable to all the configurations out there.

Johnson: There are multiple protocols out there—CFX is a leading one, of course—yet there are protocols now being used in PCB with roots in semiconductor. How multilingual do you have to be?

Moreau: It's funny, because at a certain point in the maturity of our solutions, we were adding more features to be able to track barcode or display certain things on the screen, how you alarm, or talk to the in-feeder to stop the board. Then it reached a level where we asked, "Now what do we do with that data and who do we need to connect it to?" It has become more interesting in this last decade, especially with the reflow and wave processes. We had progressed to having data as a simple format of text, CSV, or XML files that we could pass to any factory system; then it went to this factory level software that wanted it to—kind of like the semiconductor side—interact with the machines almost in real time, or at least during changeovers.

We started to integrate our KIC solutions with customers who had those requirements. But that became very customized when every customer had something a little different. Now with the IPC-CFX 2591 for PCB assembly and SECS/GEM on the semiconductor side, it provides some consistency. We've partnered with some of the major third-party MES software as well, such as Aegis, Mentor, Cogiscan, and iTAC. But that still leaves a large part of the market who have their own MES system that they've built. So, how do you do all these flavors, all these formats?

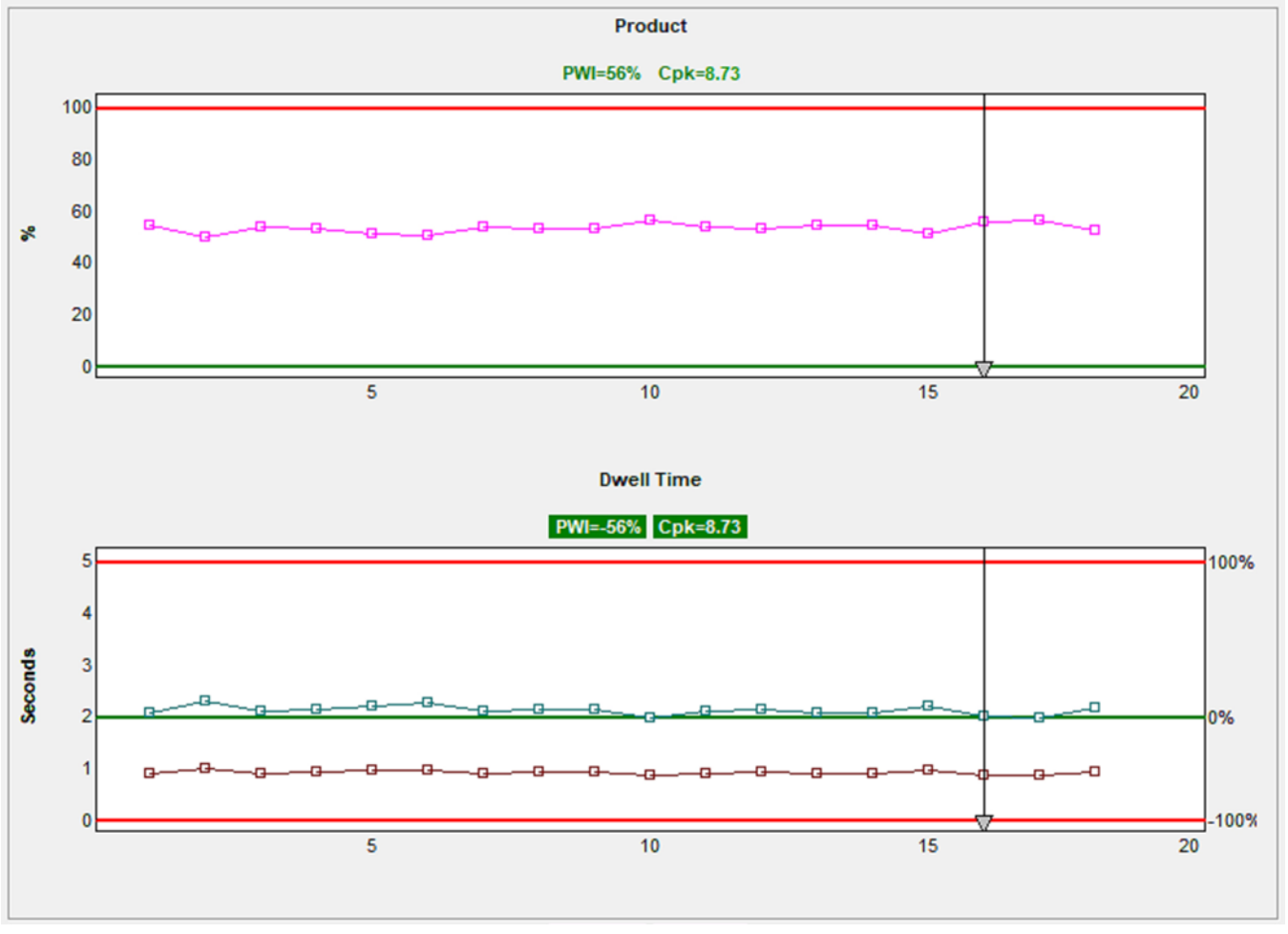
Those can be accomplished with industry standards because you aren't continually doing customized work. For example, with CFX, KIC has been involved with the CFX committee from the beginning and we were one of the first to get the IPC certification for CFX. They have a test bed that tests your system against

what the standard is and certifies the equipment as an IPC_CFX qualified product. The KIC RPI (Reflow Process Inspection) is the only automatic profiling system qualified at this point.

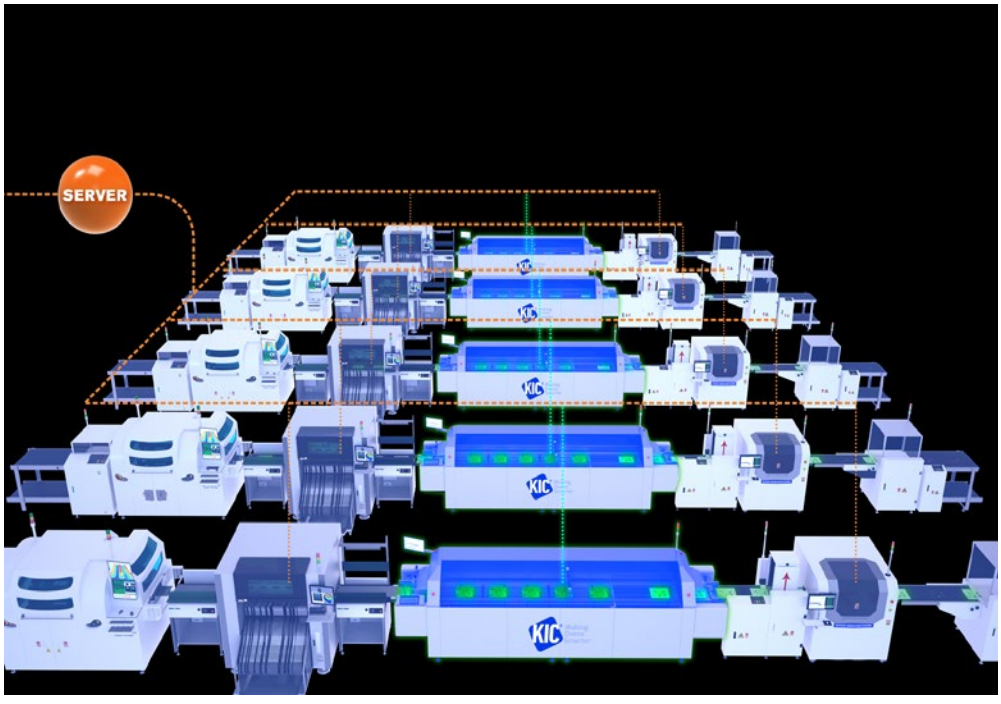
It makes it easy for the customer, who then can say, "Here is all this equipment that is CFX compliant, now I can make my CFX broker system and MES from that standard." I think our solutions around wave and reflow and being able to link to those types of factory systems, really play well into companies creating the smart factory. And coming up shortly we are releasing our own KIC API and SDK.

We have a software development kit for customers who don't want to necessarily have KIC customize everything for them; we can hand them the kit with an API and say, "Use this kit, it will show you how to connect to our system. You can pick and choose what data you want to go to your MES or factory system." It's a really good, robust way of handing off the data because the customer can pick and choose how they want to do it. It's those types of things—the standards, having an SDK—that allows our system to be a really flexible solution for the customer, not just with all the value that it brings as being a real-time system on the line, but now it's very flexible on how they want to bring it to that smart factory level.

Johnson: Is the implication that a customer can take baby steps as they work toward a final solution of an integrated digital factory? Maybe they're not ready for all the industry standard protocols because they have a homegrown system that they're working with or phasing out. By plugging into the SDK, are they still able to take what they already have and start to move that direction with KIC?



WPI with real-time production dwell time.



Inline reflow process inspection. Click here to learn more.

Moreau: Exactly. It gives the customer some flexibility. Rather than having to set up a structure, they can say, "We can grab some data off of here, we can grab some flat files, we can use their SDK and integrate their system directly with ours," even though ours isn't some standard.

Johnson: Interestingly enough, that very theme showed up in one of the keynotes for IPC APEX EXPO 2021. I don't know if you caught Travis Hessman's keynote presentation, but he was talking about how to migrate well into a digital factory environment; he talked about nibbling at the edges where you're solving a problem, not creating a new factory.

Moreau: Over the past couple of years, we've even promoted a smart factory starter kit. Why not start? As far as an inspection system, say for example the RPI reflow process inspection; it's a very low cost compared to AOI or SPI. You put in those embedded sensors, get that system working on your reflow process, and now use the tools it has to automate, inspect, and capture that data; it's your test bed for smart factory and at a low investment.

Now you've tested it and worked out how to accomplish it and who needs to be involved, then it's as you said—you start eating away at the other edges and combine them. We say, start with reflow because it's a pretty straightforward process. What's the key process thing on an oven? It's not necessarily the recipe, it's the temperature profile. If you have a system that's capturing the temperature profile of your production boards, now you can use that as the base and then extend that into your smart factory. You will have learned all your lessons and now you can start spreading it to other processes.

Johnson: KIC recently completed a first dual lane vacuum reflow RPI system with SMT, the German oven company, as your partner. Tell me about that?

Moreau: The vacuum reflow oven, it's a bit of a different animal. It has some challenges because smack in the middle of the reflow oven, you're stopping the product, putting it inside a chamber, and drawing down a vacuum to reduce voids. That's the key for those manufacturers and their end customer; it's driven by their end customer saying, "This is the maximum size void that you can have in our products when you build them. You need to be down at a very, very small level of voids." There are ways of mitigating that through the materials itself, through the solder and the solder paste, but another solution is vacuum ovens.

Our typical solution on reflow is an array of thermocouples down the tunnel mounted on the rails. Now you're putting a chamber and it's a stop/start process, so that creates some challenges. About a year and a half ago, we released an RPI for vacuum reflow ovens with Rehm, and now we have a couple of partners we've released that product with. We're able to capture the vacuum cycle time along with the reflow profile data; customers wanted to see that consistency and repeatability added to the typical profile data, and that ensures that their process is under control.

This past year, it's just a more challenging process because of that vacuum chamber. We've worked with SMT and come out with a solution on the dual lane, because as opposed to a typical RPI system on a dual lane oven and typical production where boards can go on either lane, with the vacuum chamber, the boards have to be aligned; it's about the timing and the way the boards move. When they go in the chamber, they have to go in at the same time, so there's a bit more logic and mechanical challenges around a vacuum reflow oven integrating the KIC RPI system, but a dual lane adds to that complexity. We were able to, with a common customer, come out with a dual lane RPI system for vacuum reflow with SMT. They are a good partner to work with.

Johnson: Great. What sort of ROI is the customer seeing?

Moreau: For the most part, the key customers using our system for the vacuum reflow process are automotive and medical. Those are high reliability products that they're building and there's a high level of traceability requirements that have to be met. To even get the contracts to build those products, they have to have a high level of traceability, they have to save the production data for a number of years.

Johnson: Ah, so it's not so much ROI as it is accountability.

Moreau: Yes, there is a certain value-add to have this real-time inspection, just like on a regular reflow process, but now you're trying to mitigate voiding, and because the customer requirement is you can have void sizes no larger than a certain amount on my products, how do you ensure that the temperature profile and the vacuum are done consistently? The value is added when it gives that data, which then can be handed off to their customer; it automates that.

It goes to continuous improvement in automation, rather than the customer saying, "Well, you're going to have to do more frequency of profiles; if you're going to do our product, then we want you to run a profile maybe twice a shift." Now they have to stop and run that profile through. Now that's your direct ROI saying, "I either have to run profiles pretty frequently and disrupt my production, or I can put this automated inspection system that gets me the traceability that my customer needs."

Johnson: The reason to implement traceability is so that, if something goes terribly wrong in the field, you can search back through the data to find the root cause.

Moreau: Correct, exactly.

Johnson: Miles, this has been most informative. Thanks for taking the time to talk!

Moreau: Excellent. Let's talk again soon. SMT007

Miles Moreau is general manager of KIC EMEA, Americas, Australia.

MilAero007 Highlights

NASA Begins Final Assembly of Spacecraft Destined for Asteroid Psyche ▸

Set to launch next year, the agency's Psyche spacecraft will explore a metal-rich asteroid in the main asteroid belt between Mars and Jupiter.

Her Voice: I'm Not Betty Crocker ▸

It takes both reason and intuition to outfit a manufacturing facility, a point I was able to demonstrate as we prepared and moved into our new building several years ago.

Defense Speak Interpreted: Industrial Base Evaluation ▸

So, what is an "industrial base" to the Defense Department? And wouldn't we expect a "battle plan" from Defense, not an "industrial strategy"? We want to review the Defense Industrial Strategy in the January 2021 report to Congress from the Acquisition and Sustainment section of the Department of Defense.

Averatek Announces A-SAP License Agreement with FTG ▸

Averatek Corporation has announced FTG as an A-SAP licensee. A-SAP is an advanced PCB manufacturing technology that enables feature sizes of 25 microns and below, effectively providing PCB designers with new opportunities in next-generation electronics.

Advanced Electronics Company Appoints Eng. Ziad Al-Musallam as CEO ▸

The Board of Directors of the Advanced Electronics Company (AEC), a Saudi Arabian Military Industries (SAMI) company, announced the appointment of Eng. Ziad bin Houmod Al-Musallam as CEO managing the company's business effective March 18, 2021, to succeed H.E. Mr. Abdulaziz bin Abdullah Al-Duailej.

Incap Produces Electronics for NASA's Lunar Mission Cameras ▸

Incap Corporation, headquartered in Helsinki, Finland, has produced PCBs for stereo cameras that will be used on the moon in connection with NASA's Artemis lunar program. The cameras have been developed by an Estonian company Crystalspace.

BAE Systems Australia Invests in Hypersonic Weapons Capabilities ▸

BAE Systems Australia announced that it will increase its investment in Australia to support the rapid development of a sovereign high-speed weapons capability.

Lockheed Martin Awarded $1 Billion Contract for Precision Fires All-Weather Rocket ▸

Lockheed Martin received a $1.12 billion contract from the U.S. Army for Lot 16 production of Guided Multiple Launch Rocket System (GMLRS) rockets and associated equipment.

Elbit Systems Deutschland to Supply XACT nv33 Night Vision Goggles to German Police ▸

Elbit Systems Deutschland was selected by the Procurement Office of the German Federal Ministry of the Interior, after a competitive tender procedure, to supply XACT nv33 Night Vision Goggles (NVGs) for the German Federal Police.

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Setting the Stage for Continuous Improvement

Maggie Benson's Journey

by Ronald C. Lasky, Ph.D., PE, INDIUM CORPORATION

Editor's Note: This is the first in a series of columns about Maggie Benson, a fictional character, to demonstrate continuous improvement and education in SMT assembly.

As she looked out of her office window at Acme Corporation's electronics assembly facility in Jaffrey, New Hampshire, Maggie Benson could just barely make out the first snowfall on Mount Monadnock. She was in a bit of a celebratory mood, as she had just been promoted to senior engineer—way ahead of her peers. She and her boyfriend, John, both attributed their success to being students at Ivy University in Hanover, NH. It wasn't just Ivy U; it was the teaching and mentoring of Professor Patty Coleman and, to some extent, Professor Coleman's mentor, "The Professor." As Maggie was contemplating these pleasant thoughts, she was startled by the phone ringing.

Maggie Benson

"Hello, this is Maggie Benson, how may I help you?"

"Hey, Magpie, it's your Gramps."

Maggie hated it when her grandad called her "Magpie," but she knew it was said with affection.

"Gramps, what's up?"

"Nothing much; it's just that Grandma and I want to give you and your loser boyfriend our company," Granddad replied.

"Gramps, it's not April Fool's Day!" Maggie chuckled.

She also knew her grandfather had great affection and respect for her boyfriend, John.

"We are serious, Sweetie. We want to retire, and we think you and John could really improve Benson Electronics," he said.

"But Gramps, we can't afford to buy you out," Maggie replied.

"Grandma and I want to give it to you. We love the people at the company and want them to have a bright future. In addition, we think you two can improve the company and bring it into the 21st century. Oh, and the $2 million in the company's bank account is yours, too."

Maggie was stunned. What a gift!

"Gramps, let me talk to John and see what he thinks."

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She called John and they both agreed they should take a half-day vacation to ponder this offer.

After a couple of hours of chatting, they agreed that they should take the offer. They believed they could do much to improve BE (Benson Electronics). However, they also both agreed that only one of them should take a leave of absence from Acme, in case things didn't work out.

They sketched out a continuous improvement plan, starting with the receipt of the order to the shipping of the assemblies. In trying to help Maggie's grandfather in the past, they already knew that the up time on the two lines was less than 15%, and first pass yield was in the low 90% range. That said, continuous improvement on the lines would likely involve more than five major projects. They both knew that the solder paste being used had poor transfer efficiency and poor response-to-pause. They also knew that there was no organized data collection of first pass yield fails; the boards just went to rework if they were defective. They had both chuckled a few months ago when they found out that no one at the company knew what a Pareto chart was. So, they were confident that they could make many improvements to the company's processes.

There were business processes, too. In some cases, it took a week to respond to an order with a quote. They were less confident to address some of these issues.

"Hey," John said. "Remember Frank Emory? He is getting his MBA at Ivy U and needs a business project to graduate. I'll see if I can recruit him to help us streamline the business processes."

They continued to discuss the challenges and worked out a high-level plan on several sheets of paper.

Finally, they both said in unison, "Let's do it!"

Maggie looked pensive for a moment, "We're forgetting something."

"What's that?" John replied.

"You proposed last night, and I accepted. We should tell our parents and grandparents," Maggie teased as she punched him in the shoulder.

"Yeah, right, let's start with your mom," John sheepishly replied.

Will Maggie and John's continuous improvement plans be able to bring BE into the 21st century?

How will their families accept the future wedding?

Stay tuned for the next episode. To read the prequel to this story, "The Adventures of Patty and the Professor," click here. SMT007

Ron C. Lasky is an instructional professor for the Thayer School of Engineering at Dartmouth College, and senior technologist at Indium Corporation.

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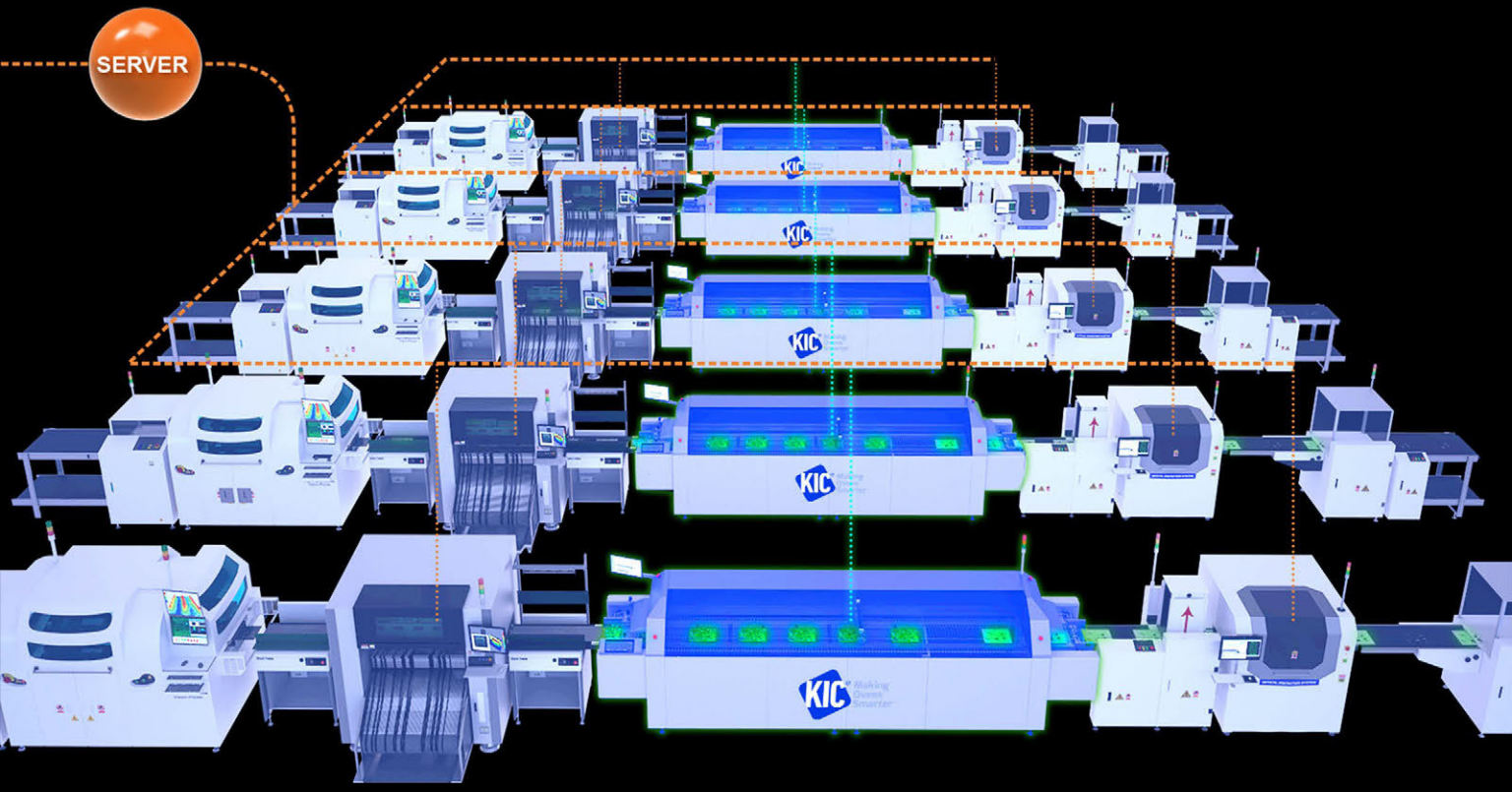

Reflow Process of the Future

Automation
Process Control
Traceability
Connectivity

TIM: Thermal Interface Material in Power Electronics

Article by Jeff Brandman
AISMALIBAR NORTH AMERICA

The omnipresent trend in power electronics for higher performance in smaller spaces requires a quick, effective, and cost-efficient heat transfer, within and out of, highly compact power modules. A well-designed, heat management concept from the beginning of a new design guarantees a longer lifetime of the electronic components and, by that, higher quality of the whole electronic power module.

In numerous electronic applications, especially in the field of power electronics, it is no longer sufficient to just transfer the heat generated by the electronic components to the ambient air via the printed circuit board. Instead, additional cooling of the components is required, which is achieved using an external, active, or passive cooled heat sink.

The metal housing of the application is quite often used to provide an additional cooling element for the power electronics. Therefore, protection against accidental shock because of dielectric breakdown is required as an additional safety precaution to guarantee personal protection.

TIM dielectric eliminates or minimizes air inclusions to enable efficient heat transfer from the heat source to the heat sink. An efficient solution for the thermal and insulation challenges in power electronics, both technically and commercially, can be found in an electri-

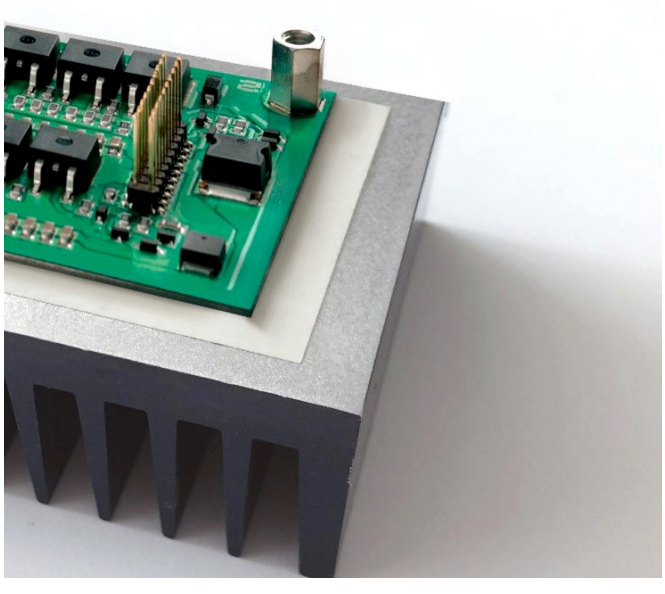

Figure 1: Thermal coupling of a heat source (power module using banks of power components) through a TIM to an external heat sink is an important element in the entire cooling chain that needs to be considered in power electronics. (Source: Aismalibar)

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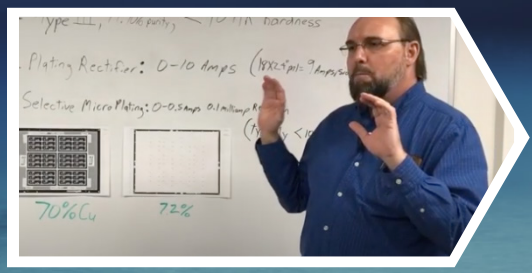

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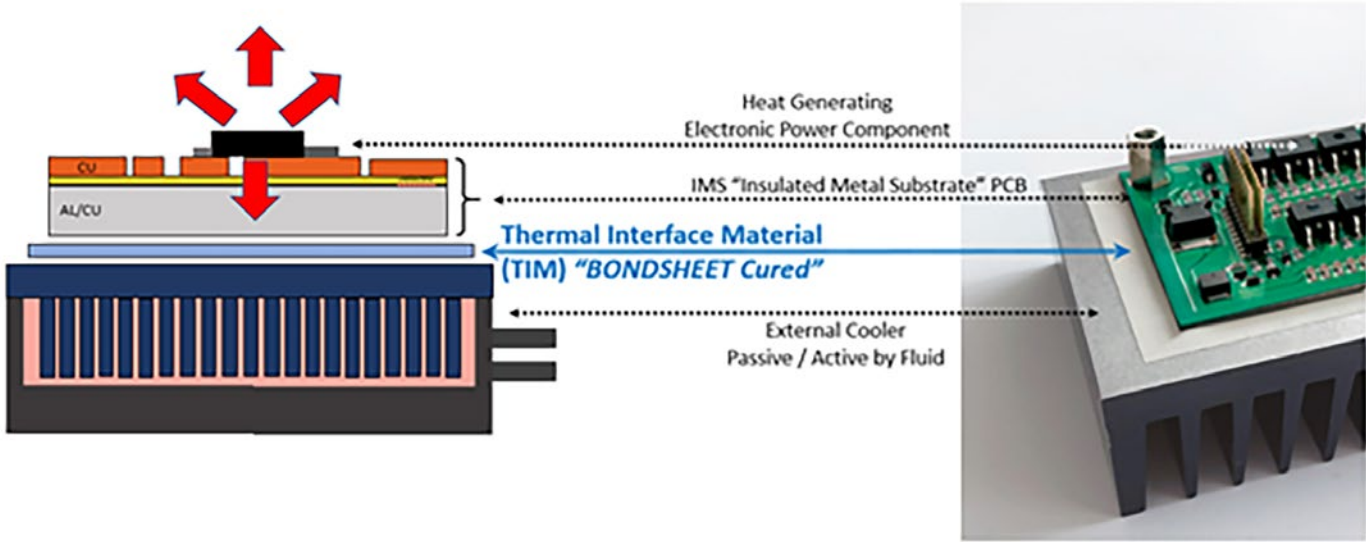

Figure 2: Schematic of a cooling system in power electronics, using the example of an IMS power board, coupled to an aluminum heat sink via TIM. (Source: Aismalibar)

cally insulating, heat-conducting dielectric layer such as the thermal conductive prepreg either in a typical B- or C-stage cured dielectric film.

The thermal conductive prepreg consists of a glass fiber base, enriched with mineral fillers. This thermal interface achieves a thermal conductivity of 2.2 W/mK with dielectric strengths greater than 4 kV (70 µm dielectric) or 6 kV (100 µm dielectric thickness). Utilizing a thin film thickness (70 or 100 µm), a low thermal resistance (Rth) of 0.315 or 0.45 Kcm²/W is achieved, which efficiently dissipates the heat generated by the power components to the attached cooling element for dissipation to the ambient air.

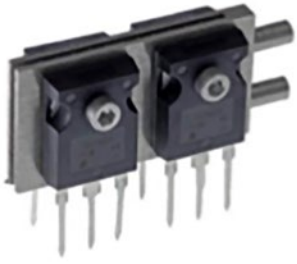

Figure 3: Application example of a liquid-cooled, highly compact MOSFET assembly for power electronics. (Source: IQ Evolution)

Application

The main usage for the thermally conductive/electrical isolating silicon-free TIM dielectric is in power electronics, where the best compromise of heat transfer combined with electrical isolation is essential.

This heat transfer is successfully utilized, for example, in electronic power modules controlling solar inverters, windmills, and industrial LED lighting. It is also used in industrial power electronics, in welding machines, and robot drives. Future projects are increasingly being identified in electric vehicles (EV) for power train and on-board-charger applications.

A key task of the film is to efficiently dissipate heat with maximum insulation dielectric strength in order to optimally connect power MOSFETs to the liquid-cooled micro-coolers from IQ-evolution.

Extensive tests have proven that for this parti-

Key Performances "BONDSHEET Cured" 2.2 W/mK			
Foil Thickness	70	100	µm
Thermal Resistance, Rth	0.315	0.45	Kcm²/W
Dielectric Strength (AC)	≥4	≥6	KV

cular application, the heat-conducting dielectric film achieves the best technical/commercial combination of heat dissipation and dielectric strength compared to alternative TIM techniques.

Dielectric Manufacturing/Contouring

The dielectric prepreg is manufactured as a glass fiber cloth, type 106 and 1078/1080, which is then enriched with mineral fillers in a proprietary process to achieve high thermal conductivity of the dielectric film. Apart from the pure filler material properties, particle size and distribution throughout the dielectric material are key factors in achieving a homogeneous thermal conductivity of the TIM film. The revolutionary prepreg film in B-stage is used by PCB shops worldwide for pressing thermally conductive multilayers in their PCB production.

In following the process steps, the B-stage prepreg is cured, where it achieves its specified high Tg values and thus obtaining maximum thermal conductivity and dielectric strength.

The bonding prepreg sheet in cured form is manufactured in sheets as large as 1245 mm x 945 mm, for use directly by customers who can machine the insulative thermal sheets to fit into their power module assembly. Customers can also purchase common PCB panel formats, such as 18x24 inches (460x610 mm).

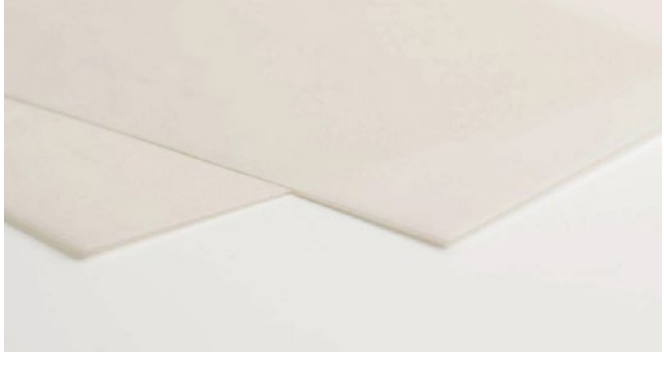

Figure 4: Bonding prepreg pre-cured, manufactured in formats: 1245x945 mm and 1245x1040 mm. (Source: https://www.aismalibar.com/de/product_group/bond-sheet-cured-de)

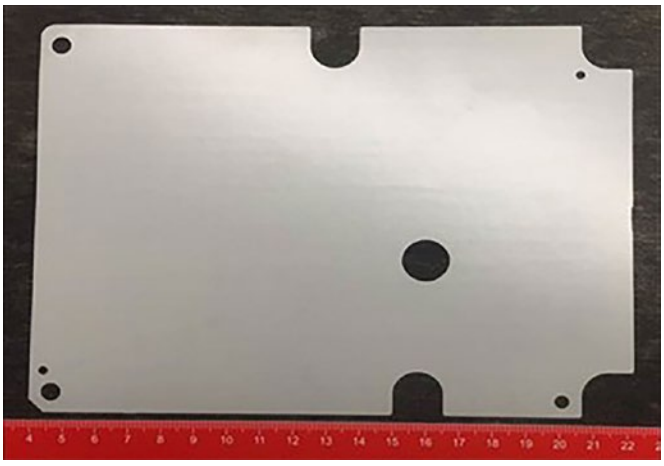

Figure 5: Example of bonding prepreg pre-cured and contoured. (Source: Aismalibar)

PCB manufacturers can request that the bonding prepreg cured film be supplied premachined to any rectangular or square format to be delivered in stacks of several hundred individual films for further manual or automated processing. For pre-production test samples, prototypes, and small quantity prerun tests, the bonding prepreg is offered premachined and specifically contoured, according to the customer's specification. This allows for a direct dielectric placement between the PCB and the heat sink in the customer's power module assembly. The usage of the bond film dielectric will achieve high thermal conductivity without requiring any oil, grease, paste, or silicone thermal material. This provides for easy mounting, as well as ease of disassembly.

For high-volume serial production, punching the bonding dielectric with a customized punching tool has proved to be the most cost-effective solution.

Future Outlook for TIM/Cooling—Concept Developments

Future research of the TIM dielectric technologies, where a combination of a cured thermal conductive dielectric layer, plus a PCB core, plus B-stage glue to a heat sink will allow the lamination of high count, multiple dielectric layer solutions for the customer's power module manufacturing, optimizing thermal

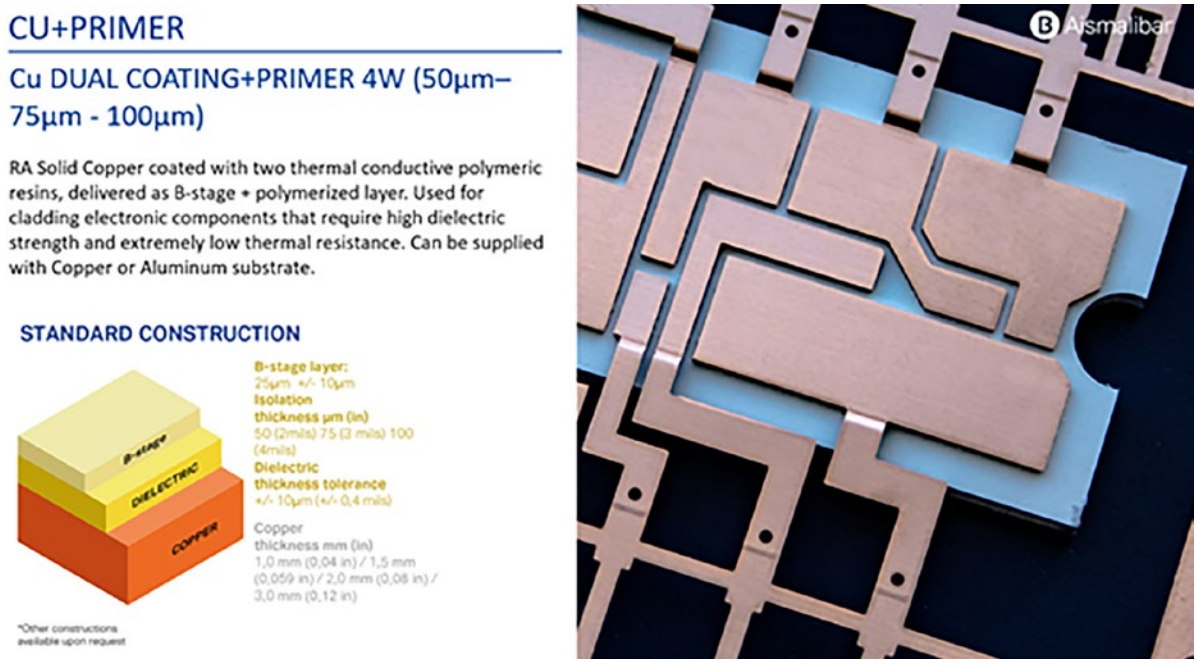

Figure 6: Copper substrate coated with two thermally conductive polymer resins, supplied as a B-stage over a polymerized C-stage layer. (Source: Aismalibar)

conductivity and dielectric strength of the cooling system.

In addition, there are now different prepreg dielectrics available that meet and exceed, the high requirements for thermal conductivity and especially for high dielectric strength. Optimizing the processability of manufacturing thermal PCBs is a key development target, especially for high-volume, serial productions such as the automotive sector.

One example is a dual thermal coating (DTC) process by which two glassless dielectric layers are applied directly to a metal carrier (copper or aluminum). With this new type of dielectric thermal technology, the heat-conducting/insulation dielectric layer is a direct part of a metal carrier utilizing very thin layers, decreasing thermal resistance.

The lower layer of the dielectric which is in direct contact with the metal base material is cured to a C-stage during the manufacturing process to obtain the desired electrical and thermal properties as specified in the datasheet. An additional layer of B-stage material is applied to the cured dielectric layer, which allows for further lamination processing by the user. This structure (metal carrier plus two-layer dielectric) is laminated under pressure and heat to form a homogeneous overall PCB. The result is a highly compact power module with optimized electrical and thermal properties, which does not require any mechanical components for pressing the different layers of the cooling system together. DTC offers an extended application lifetime throughout rough operational conditions, plus excellent longevity—meeting the strict requirements of the electronics industry.

Conclusion

The new thermal thin film B- and C-stage dielectric systems allow multilayer PCB designers to increase thermal conductance while providing higher voltage solutions with direct lamination to heat sinks or to a thermal metal base material. **SMT007**

Jeff Brandman is president of Aismalibar North America.

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Solder Excavation and Rework

Knocking Down the Bone Pile

by Bob Wettermann, BEST INC.

To properly perform rework—the removal and replacement of a component on a PCB—the remnant solder needs to be properly removed after the component has been desoldered and removed. This step is important for the following reasons:

1. The component, especially if it is a small outline package or an ultra-fine pitched component, needs to lie co-planar to the surface of the pad in order to get the replacement component properly aligned.
2. The remnant solder may already have a thick intermetallic layer which may cause the solder joint to prematurely fail.

There are several methods in use for the removal of the remnant solder including but not limited to vacuum extraction, solder braid (wick) and coupon use. Each method has its own advantages as well as drawbacks.

The solder braid approach is outlined in the IPC 7711 Methods for PCB Rework, section 4.1.3 (Figure 1)—surface solder removal-braid method:

- In this method, solder braid, which is a copper mesh, is placed onto the fluxed PCB pad. Some braids are pre-fluxed which increases the wicking action.
- The braid size chosen should be slightly smaller than the pad dimension. It is recommended that paste flux be used to make sure the flux is active during the solder removal process.
- Make sure the tip temperature corresponds to the reflow temperature of the solder alloy being removed. Move the soldering iron tip up and down perpendicular to the pad with the soldering braid in between the tip and pad.
- When solder wicks up into the braid, remove the braid from the pad advancing it such that a non-solder filled section of the braid can be used on the rest of the pad.
- Do not "swab the deck" on multi-leaded components or area array sites moving across the pads as the pads could be lifted or the mask damaged. This operation is

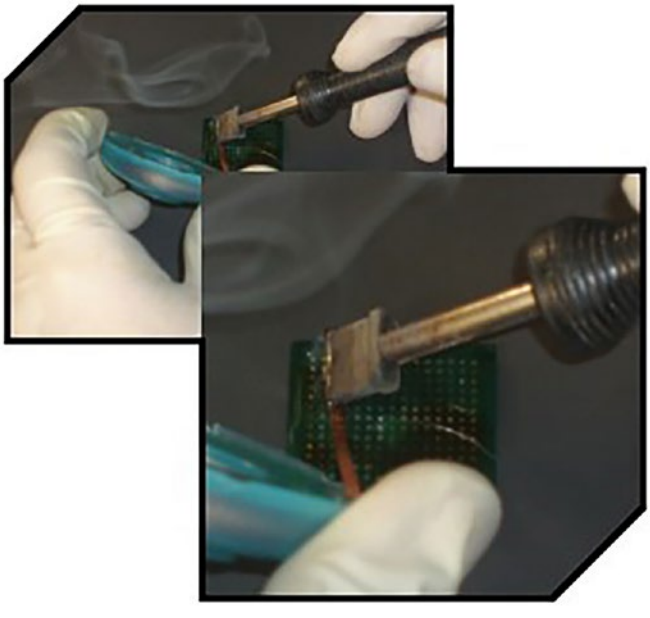

Figure 1: Solder wick being used to remove remnant solder prior to reballing BGA.

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operator dependent and requires skills practice in order to not damage the PCB.

- The solder wick method requires the least amount of equipment investment, but it does require intermediate soldering skills.

In addition to the solder wicking method, vacuum extraction is another means for removing the solder from a pad location. This vacuum can be created by a manual spring-loaded pump, a hand tool, as part of a BGA/leadless device rework system, or as a stand-alone programmable tool (Figure 2).

It is not recommended to use a manual pump as there is a lack of continuous suction at the tip as the solder joint is cycled through several heating and cooling cycles. In the case of the other powered vacuum desoldering tools, a hole in the tip center is used as a vacuum to remove solder which has gone into reflow. Matching the diameter of the tip to the width of the pad is recommended as larger-than-pad-sized tips may burn the PCB laminate. After applying flux to the location, place the heated tip onto the pad gently until you sense the solder is going into reflow. Do not exert pressure onto the pad as it may cause pad damage.

Integrated programmable soldering excavation tools usually have a sensor which keeps the distance of the PCB at a fixed height. Reservoirs which contain the excavated solder need to be cleaned out whether it is a manual hand piece or part of an automated system. The vacuum solder extraction method, regardless of the type of system used, is fast and requires less skill and experience compared to the solder braid approach.

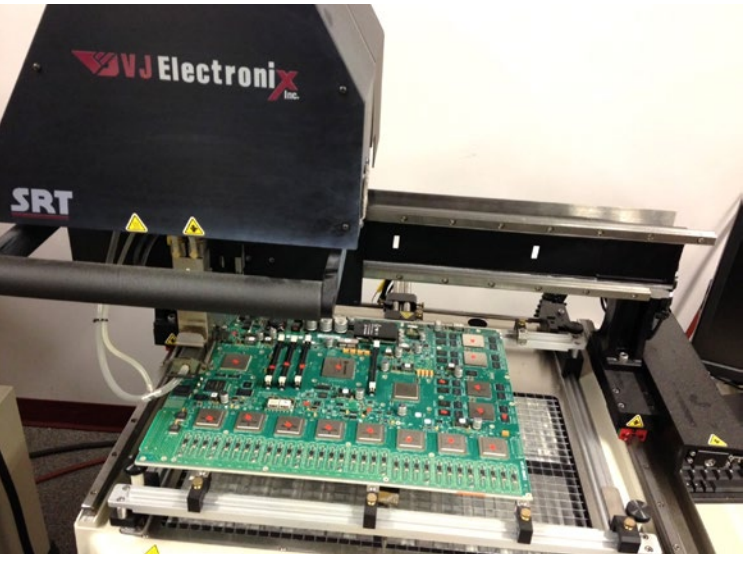


Figure 2: A programmable solder excavation tool.

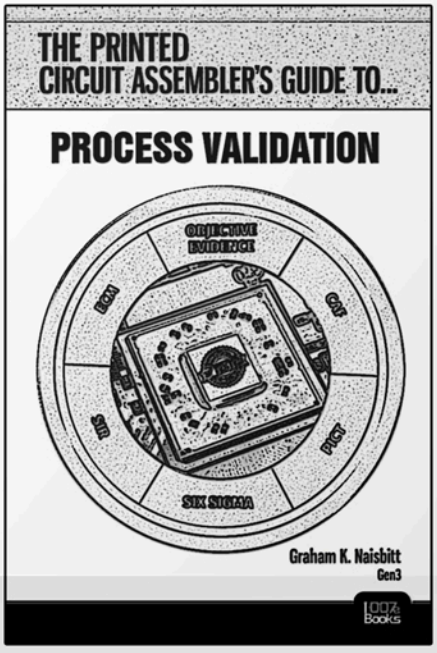
The technique which is used the least for solder removal in PCB rework is the copper coupon method. This method uses a flux-dipped copper coupon to remove all the solder at one time. The coupon is placed onto a BGA rework system nozzle and heated, then slowly lowered onto the surface of the PCB. As it gets in the vicinity of the BGA or CSP pads, solder is wicked onto the coupon. One of the advantages of this approach is the speed of excavation. This is offset by potential coplanarity problems for the PCB which may cause damage to the PCB laminate or cause it to not be as effective, the cost of the specially tooled single use coupon, and the need to be able to program or stop the coupon from going down onto the PCB.

Whether using the solder wick approach, a solder vacuum excavation tool, or a wicking coupon, solder removal from the pads prior to placement of the replacement device is important from both a reliability and quality of placement perspective. The use of the technique depends on the kind of tooling capabilities, the sophistication of the rework equipment, and the experience of the operators. Cycle times and potential risks in damaging the PCB laminate factor into choosing the appropriate method for PCB rework. **SMT007**

Bob Wettermann is the principal of BEST Inc., a contract rework and repair facility in Chicago. For more information, contact info@solder.net. To read past columns or contact Wettermann, click here.

E-BOK*

STEP 1



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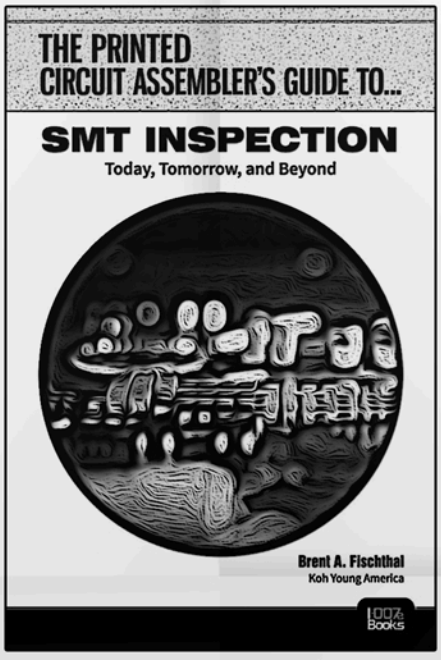

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STEP 3

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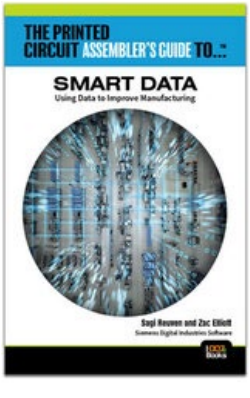
I-007eBooks

*Some assemblers required

1 Foundations of the Future: Introducing Students to a Career in Electronics ▸

At IPC APEX EXPO, the foundation held the Build Your Future Career Panel. While unable to host students in person this year, IPC hosted a virtual event that introduced hundreds of students and has the potential to reach thousands more thanks to the digital recording.

2 Excerpt: The Printed Circuit Assembler's Guide to... Smart Data ▸



Whatever data collection system is used, any effort to digitalize needs to engage and empower the production team at the factory. Their role is to attend to the manufacturing process but also to act as the front line of communications and control.

3 IPC Study: Europe's Economic Recovery, Long-Term Future Depend on Attention to Electronics Manufacturing Industry ▸

A new IPC study, "Digital Directions, Greener Connections," finds the electronics manufacturing industry has largely withstood the negative effects of the COVID pandemic and is poised to help drive Europe's economic recovery and resilience.

4 Zulki's PCB Nuggets: Five Key Benefits for Onshoring PCB Microelectronics Assembly ▸

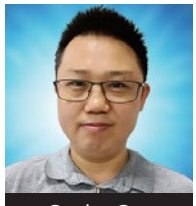

Zulki Khan

There are five key benefits to U.S. OEMs for onshoring PCB microelectronics assembly and manufacturing, but this discussion is prefaced by this fact: the future lies in PCB microelectronics assemblies compared to traditional SMT assemblies.

5 Plexus Announces Construction of Manufacturing Facility in Bangkok, Thailand ▸

Plexus, a global player in complex product design, manufacturing, supply chain and aftermarket services, announced that it broke ground on a new manufacturing facility in Bangkok, Thailand.

6 Global Connections: Staying in Spec ▸


Cooler Cao

To ensure that your custom cable assembly meets required specifications, the fabricator needs a well-equipped laboratory. The laboratory requires a variety of specialized test equipment to ensure that the cable harness assembly meets and exceeds expected results. Typical required laboratory equipment includes high voltage test units, environmental salt spray chambers, state of the art temperature cycling units, ultraviolet aging simulators, strain and stress relief measuring equipment, and bending and flexing test equipment. Columnist Cooler Cao explains.

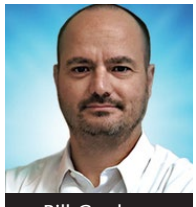
7 Absolute EMS Invests in High-End, Large Format Wave Solder System ▸

Absolute EMS, Inc., a provider of turnkey and consignment manufacturing services, has invested in a large format JAGUAR N450 high-end lead and lead-free wave soldering system.

8 Excerpt: The Printed Circuit Assembler's Guide to… SMT Inspection: Today, Tomorrow, and Beyond, Chapter 1 ▸

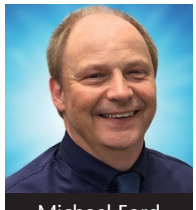
Today, optical inspection systems are the preferred solution for in-line quality control in the SMT industry. Systems such as solder paste inspection (SPI) or automated optical inspection (AOI) systems for pre- and post-reflow are almost standard in every production facility.

9 10 Ways to Identify Counterfeit ICs ▸


Bill Cardoso

While other visual inspection techniques provide important insight into component quality and authenticity, nothing exceeds X-ray inspection for fast, accurate, non-destructive evaluation.

10 IPC CFX Update v1.3 ▸


Michael Ford

There are some very interesting additions in this release, including messages for predictive maintenance and smart energy management. As CFX is an IPC standard, the industry is assured of open content, designed to evolve Industry 4.0 manufacturing for everyone.

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   b) Support manufacturability reviews with internal APL engineers (customers)
   c) Generate work travelers
   d) Communicate status to supervisors and internal customers
2. Support transition of software tools (Genesis 2000 to InCAM Pro)
   a) Edit design rules checks and generate automation scripts
   b) Develop new ideas to further the technical progress of our product
   c) Develop CAM area through continuous improvement initiatives
3. Interface and inform APL Engineers on PCB design for manufacturing guidelines
4. Operate bare board electrical tester
5. Backup operator for CNC drilling, routing, laser drilling (on-site training)

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The ideal candidate is a proactive self-starter with a strong customer service background. Friendly, approachable, and confident, you should have a good phone mannerism and be computer literate.

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Qualifications:

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- Identify customer requirements, priorities, and opportunities
- Build strong, trusting relationships with key decision-makers and influencers at target accounts
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- Visit customer facilities to observe manufacturing processes and exchange information
- Promote industry recognition of Indium Corporation, its products, and its services
- Be a key member of overall team, including worldwide sales organization, product management, operations, engineering, R&D, etc.
- Submit required paperwork in timely manner
- Work within established budget, while increasing market share
- Perform other duties and projects as assigned

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Experience

- Minimum of 5 years' working within printed circuit board manufacturing industry

Responsibilities

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- Improve process capability, yields and cost while maintaining safety and improving quality standards
- Work with customers in developing cost-effective production processes

Quality Engineer/Manager

Experience

- Minimum of 2 years' working within printed circuit board industry
- Possess working knowledge of the IPC requirements and submitting PPAP reports
- Should have knowledge of working with the A16949 certification

Responsibilities

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Summary of Functions

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Essential Duties and Responsibilities

- Import customer data into various CAM systems.
- Perform design rule checks and edit data to comply with manufacturing guidelines.
- Create array configurations, route, and test programs, penalization and output data for production use.
- Work with process engineers to evaluate and provide strategy for advanced processing as needed.
- Itemize and correspond to design issues with customers.
- Other duties as assigned.

Organizational Relationship

Reports to the engineering manager. Coordinates activities with all departments, especially manufacturing.

Qualifications

- A college degree or 5 years' experience is required. Good communication skills and the ability to work well with people is essential.
- Printed circuit board manufacturing knowledge.
- Experience using CAM tooling software, Orbotech GenFlex®.

Physical Demands

Ability to communicate verbally with management and coworkers is crucial. Regular use of the telephone and e-mail for communication is essential. Sitting for extended periods is common. Hearing and vision within normal ranges is helpful for normal conversations, to receive ordinary information and to prepare documents.

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SUMMIT INTERCONNECT

Our Summit Anaheim, CA, division currently has multiple open positions for planning engineers.

The planner is responsible for creating and verifying manufacturing documentation, including work instructions and shop floor travelers. Review lay-ups, details, and designs according to engineering and customer specifications through the use of computer and applications software. May specify required manufacturing machinery and test equipment based on manufacturing and/or customer requirements. Guides manufacturing process development for all products.

Responsibilities:

1. Accurately plan jobs and create shop floor travelers.
2. Create documentation packages.
3. Use company software for planning and issuing jobs.
4. Contact customers to resolve open issues.
5. Create TDR calculations.
6. Assist in the training of new planning engineers.
7. Review prints and purchase orders.
8. Create stackups and order materials per print/spec.
9. Plan jobs manufacturing process.
10. Institute new manufacturing processes and or changes.

Education/Experience:

1. High school diploma or equivalent
2. Minimum five (5) years' experience in the printed circuit board industry with three (3) years as a planning engineer.
3. Must be able to cooperate and communicate effectively with customers, management, and supervisory staff.
4. Must be proficient in rigid, flex, rigid/flex, and sequential lam designs.

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Career Opportunities

Now Hiring

Director of Process Engineering

A successful and growing printed circuit board manufacturer in Orange County, CA, has an opening for a director of process engineering.

Job Summary:

The director of process engineering leads all engineering activities to produce quality products and meet cost objectives. Responsible for the overall management, direction, and coordination of the engineering processes within the plant.

Duties and Responsibilities:

- Ensures that process engineering meets the business needs of the company as they relate to capabilities, processes, technologies, and capacity.
- Stays current with related manufacturing trends. Develops and enforces a culture of strong engineering discipline, including robust process definition, testing prior to production implementation, change management processes, clear manufacturing instructions, statistical process monitoring and control, proactive error proofing, etc.
- Provides guidance to process engineers in the development of process control plans and the application of advanced quality tools.
- Ensures metrics are in place to monitor performance against the goals and takes appropriate corrective actions as required. Ensures that structured problem-solving techniques are used and that adequate validation is performed for any issues being address or changes being made. Develops and validates new processes prior to incorporating them into the manufacturing operations.
- Strong communication skills to establish priorities, work schedules, allocate resources, complete required information to customers, support quality system, enforce company policies and procedures, and utilize resources to provide the greatest efficiency to meet production objectives.

Education and Experience:

- Master's degree in chemical engineering or engineering is preferred.
- 10+ years process engineering experience in an electronics manufacturing environment, including 5 years in the PCB or similar manufacturing environment.
- 7+ years of process engineering management experience, including 5 years of experience with direct responsibility for meeting production throughput and quality goals.

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Now Hiring

Process Engineering Manager

A successful and growing printed circuit board manufacturer in Orange County, CA, has an opening for a process engineering manager.

Job Summary:

The process engineering manager coordinates all engineering activities to produce quality products and meet cost objectives. Responsible for the overall management, direction, and coordination of the engineering team and leading this team to meet product requirements in support of the production plan.

Duties and Responsibilities:

- Ensures that process engineering meets the business needs of the company as they relate to capabilities, processes, technologies, and capacity.
- Stays current with related manufacturing trends. Develops and enforces a culture of strong engineering discipline, including robust process definition, testing prior to production implementation, change management processes, clear manufacturing instructions, statistical process monitoring and control, proactive error proofing, etc.
- Ensures metrics are in place to monitor performance against the goals and takes appropriate corrective actions as required. Ensures that structured problem-solving techniques are used and that adequate validation is performed for any issues being address or changes being made. Develops and validates new processes prior to incorporating into the manufacturing operations

Education and Experience:

- Bachelor's degree in chemical engineering or engineering is preferred.
- 7+ years process engineering experience in an electronics manufacturing environment, including 3 years in the PCB or similar manufacturing environment.
- 5+ years of process engineering management experience, including 3 years of experience with direct responsibility for meeting production throughput and quality goals.

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Career Opportunities

LENTHOR ENGINEERING
MAKING THINGS FLEXIBLE IN A RIGID WORLD®

Sales Account Manager

Sales Account Management at Lenthor Engineering is a direct sales position responsible for creating and growing a base of customers that purchase flexible and rigid flexible printed circuits. The account manager is in charge of finding customers, qualifying the customer to Lenthor Engineering and promoting Lenthor Engineering's capabilities to the customer. Leads are sometimes referred to the account manager from marketing resources including trade shows, advertising, industry referrals and website hits. Experience with military printed circuit boards (PCBs) is a definite plus.

Responsibilities

- Marketing research to identify target customers
- Identifying the person(s) responsible for purchasing flexible circuits
- Exploring the customer's needs that fit our capabilities in terms of:
  - Market and product
  - Circuit types used
  - Competitive influences
  - Philosophies and finance
  - Quoting and closing orders
  - Providing ongoing service to the customer
  - Develop long-term customer strategies to increase business

Qualifications

- 5-10 years of proven work experience
- Excellent technical skills

Salary negotiable and dependent on experience. Full range of benefits.

Lenthor Engineering, Inc. is a leader in flex and rigid-flex PWB design, fabrication and assembly with over 30 years of experience meeting and exceeding our customers' expectations.

Contact Oscar Akbar at: hr@lenthor.com

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LENTHOR ENGINEERING
MAKING THINGS FLEXIBLE IN A RIGID WORLD®

Senior Process Engineer

Job Description

Responsible for developing and optimizing Lenthor's manufacturing processes from start up to implementation, reducing cost, improving sustainability and continuous improvement.

Position Duties

- Senior process engineer's role is to monitor process performance through tracking and enhance through continuous improvement initiatives. Process engineer implements continuous improvement programs to drive up yields.
- Participate in the evaluation of processes, new equipment, facility improvements and procedures.
- Improve process capability, yields, costs and production volume while maintaining safety and improving quality standards.
- Work with customers in developing cost-effective production processes.
- Engage suppliers in quality improvements and process control issues as required.
- Generate process control plan for manufacturing processes, and identify opportunities for capability or process improvement.
- Participate in FMEA activities as required.
- Create detailed plans for IQ, OQ, PQ and maintain validated status as required.
- Participate in existing change control mechanisms such as ECOs and PCRs.
- Perform defect reduction analysis and activities.

Qualifications

- BS degree in engineering
- 5-10 years of proven work experience
- Excellent technical skills

Salary negotiable and dependent on experience. Full range of benefits.

Lenthor Engineering, Inc. is the leader in Flex and Rigid-Flex PWB design, fabrication and assembly with over 30 years of experience meeting and exceeding our customers' expectations.

Contact Oscar Akbar at: hr@lenthor.com

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Career Opportunities

Manncorp™

SMT Field Technician
Hatboro, PA

Manncorp, a leader in the electronics assembly industry, is looking for an additional SMT Field Technician to join our existing East Coast team and install and support our wide array of SMT equipment.

Duties and Responsibilities:
- Manage on-site equipment installation and customer training
- Provide post-installation service and support, including troubleshooting and diagnosing technical problems by phone, email, or on-site visit
- Assist with demonstrations of equipment to potential customers
- Build and maintain positive relationships with customers
- Participate in the ongoing development and improvement of both our machines and the customer experience we offer

Requirements and Qualifications:
- Prior experience with SMT equipment, or equivalent technical degree
- Proven strong mechanical and electrical troubleshooting skills
- Proficiency in reading and verifying electrical, pneumatic, and mechanical schematics/drawings
- Travel and overnight stays
- Ability to arrange and schedule service trips

We Offer:
- Competitive Pay
- Health and dental insurance
- Retirement fund matching
- Continuing training as the industry develops

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Manncorp™

SMT Operator
Hatboro, PA

Manncorp, a leader in the electronics assembly industry, is looking for a **surface-mount technology (SMT) operator** to join their growing team in Hatboro, PA!

The **SMT operator** will be part of a collaborative team and operate the latest Manncorp equipment in our brand-new demonstration center.

Duties and Responsibilities:
- Set up and operate automated SMT assembly equipment
- Prepare component kits for manufacturing
- Perform visual inspection of SMT assembly
- Participate in directing the expansion and further development of our SMT capabilities
- Some mechanical assembly of lighting fixtures
- Assist Manncorp sales with customer demos

Requirements and Qualifications:
- Prior experience with SMT equipment or equivalent technical degree preferred; will consider recent graduates or those new to the industry
- Windows computer knowledge required
- Strong mechanical and electrical troubleshooting skills
- Experience programming machinery or demonstrated willingness to learn
- Positive self-starter attitude with a good work ethic
- Ability to work with minimal supervision
- Ability to lift up to 50 lbs. repetitively

We Offer:
- Competitive pay
- Medical and dental insurance
- Retirement fund matching
- Continued training as the industry develops

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Career Opportunities

EAGLE electronics Inc.

MANUFACTURERS OF QUALITY PRINTED CIRCUIT BOARDS

Pre-CAM Engineer

Illinois-based PCB fabricator Eagle Electronics is seeking a pre-CAM engineer specific to the printed circuit board manufacturing industry. The pre-CAM Engineer will facilitate creation of the job shop travelers used in the manufacturing process. Candidate will have a minimum of two years of pre-CAM experience and have a minimum education level of an associate degree. This is a first-shift position at our Schaumburg, Illinois, facility. This is not a remote or offsite position.

If interested, please submit your resume to HR@eagle-elec.com indicating 'Pre-CAM Engineer' in the subject line.

apply now

Process Engineer

We are also seeking a process engineer with experience specific to the printed circuit board manufacturing industry. The process engineer will be assigned to specific processes within the manufacturing plant and be given ownership of those processes. The expectation is to make improvements, track and quantify process data, and add new capabilities where applicable. The right candidate will have a minimum of two years of process engineering experience, and a minimum education of bachelor's degree in an engineering field (chemical engineering preferred but not required). This is a first shift position at our Schaumburg, Illinois, facility. This is not a remote or offsite position.

If interested, please submit your resume to HR@eagle-elec.com indicating 'Process Engineer' in the subject line.

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BLACKFOX

Premier Training & Certification

IPC Instructor

Longmont, CO; Phoenix, AZ; U.S.-based remote

Independent contractor, possible full-time employment

Job Description

This position is responsible for delivering effective electronics manufacturing training, including IPC Certification, to students from the electronics manufacturing industry. IPC instructors primarily train and certify operators, inspectors, engineers, and other trainers to one of six IPC Certification Programs: IPC-A-600, IPC-A-610, IPC/WHMA-A-620, IPC J-STD-001, IPC 7711/7721, and IPC-6012.

IPC instructors will conduct training at one of our public training centers or will travel directly to the customer's facility. A candidate's close proximity to Longmont, CO, or Phoenix, AZ, is a plus. Several IPC Certification Courses can be taught remotely and require no travel.

Qualifications

Candidates must have a minimum of five years of electronics manufacturing experience. This experience can include printed circuit board fabrication, circuit board assembly, and/or wire and cable harness assembly. Soldering experience of through-hole and/or surface-mount components is highly preferred.

Candidate must have IPC training experience, either currently or in the past. A current and valid certified IPC trainer certificate holder is highly preferred.

Applicants must have the ability to work with little to no supervision and make appropriate and professional decisions.

Send resumes to Sharon Montana-Beard at sharonm@blackfox.com.

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Career Opportunities

eptac
TRAIN. WORK SMARTER. SUCCEED.

Become a Certified IPC Master Instructor

Opportunities are available in Canada, New England, California, and Chicago. If you love teaching people, choosing the classes and times you want to work, and basically being your own boss, this may be the career for you. EPTAC Corporation is the leading provider of electronics training and IPC certification and we are looking for instructors that have a passion for working with people to develop their skills and knowledge. If you have a background in electronics manufacturing and enthusiasm for education, drop us a line or send us your resume. We would love to chat with you. Ability to travel required. IPC-7711/7721 or IPC-A-620 CIT certification a big plus.

Qualifications and skills

- A love of teaching and enthusiasm to help others learn
- Background in electronics manufacturing
- Soldering and/or electronics/cable assembly experience
- IPC certification a plus, but will certify the right candidate

Benefits

- Ability to operate from home. No required in-office schedule
- Flexible schedule. Control your own schedule
- IRA retirement matching contributions after one year of service
- Training and certifications provided and maintained by EPTAC

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APCT
Passion | Commitment | Trust

APCT, Printed Circuit Board Solutions: Opportunities Await

APCT, a leading manufacturer of printed circuit boards, has experienced rapid growth over the past year and has multiple opportunities for highly skilled individuals looking to join a progressive and growing company. APCT is always eager to speak with professionals who understand the value of hard work, quality craftsmanship, and being part of a culture that not only serves the customer but one another.

APCT currently has opportunities in Santa Clara, CA; Orange County, CA; Anaheim, CA; Wallingford, CT; and Austin, TX. Positions available range from manufacturing to quality control, sales, and finance.

We invite you to read about APCT at APCT.com and encourage you to understand our core values of passion, commitment, and trust. If you can embrace these principles and what they entail, then you may be a great match to join our team! Peruse the opportunities by clicking the link below.

Thank you, and we look forward to hearing from you soon.

apply now

Career Opportunities

MivaTek Global

MivaTek Global: We Are Growing!

MivaTek Global is adding sales, technical support and application engineers.

Join a team that brings new imaging technologies to circuit fabrication and microelectronics. Applicants should have direct experience in direct imaging applications, complex machine repair and/or customer support for the printed circuit board or microelectronic markets.

Positions typically require regional and/or air travel. Full time and/or contractor positions are available.

Contact **HR@MivaTek.Global** for additional information.

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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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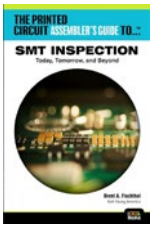
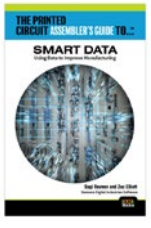


SMT Inspection: Today, Tomorrow, and Beyond

by Brent Fischthal, Koh Young America

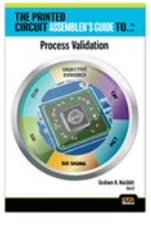
This book offers an accurate look at the aspects and challenges the electronics manufacturing industry faces with regards to SMT inspection and its surrounding technology. In-depth insight on new and exciting true 3D inspection technology is provided, with a look into the future of leveraging big data management and autonomous manufacturing for a smarter factory.



Smart Data: Using Data to Improve Manufacturing

by Sagi Reuven and Zac Elliott, Siemens Digital Industries Software

Manufacturers need to ensure their factory operations work properly, but analyzing data is simply not enough. Companies must take efficiency and waste-reduction efforts to the next phase using big data and advanced analytics to diagnose and correct process flaws.



Process Validation

by Graham K. Naisbitt, Chairman and CEO, Gen3

This book explores how establishing acceptable electrochemical reliability can be achieved by using both CAF and SIR testing. This is a must-read for those in the industry who are concerned about ECM and want to adopt a better and more rigorous approach to ensuring electrochemical reliability.

Advanced Manufacturing in the Digital Age

by Oren Manor, Director of Business Development, Valor Division for Mentor a Siemens Business

A must-read for anyone looking for a holistic, systematic approach to leverage new and emerging technologies. The benefits are clear: fewer machine failures, reduced scrap and downtime issues, and improved throughput and productivity.

Our library is open 24/7/365. Visit us at: I-007eBooks.com

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