

iConnect007

OCTOBER 2019

SMT007

M A G A Z I N E

Landscape of the Industry





OUR LIBRARY
IS ALWAYS
OPEN



Registered members of
my I-Connect007 have 24/7 access
to our ever-growing library
of eBooks, which now includes
a wide range of topics from
DFM to Complex PCBs.



Enrich your mind and expand your
knowledge! Download these popular
titles with just a click.

They're pretty awesome!

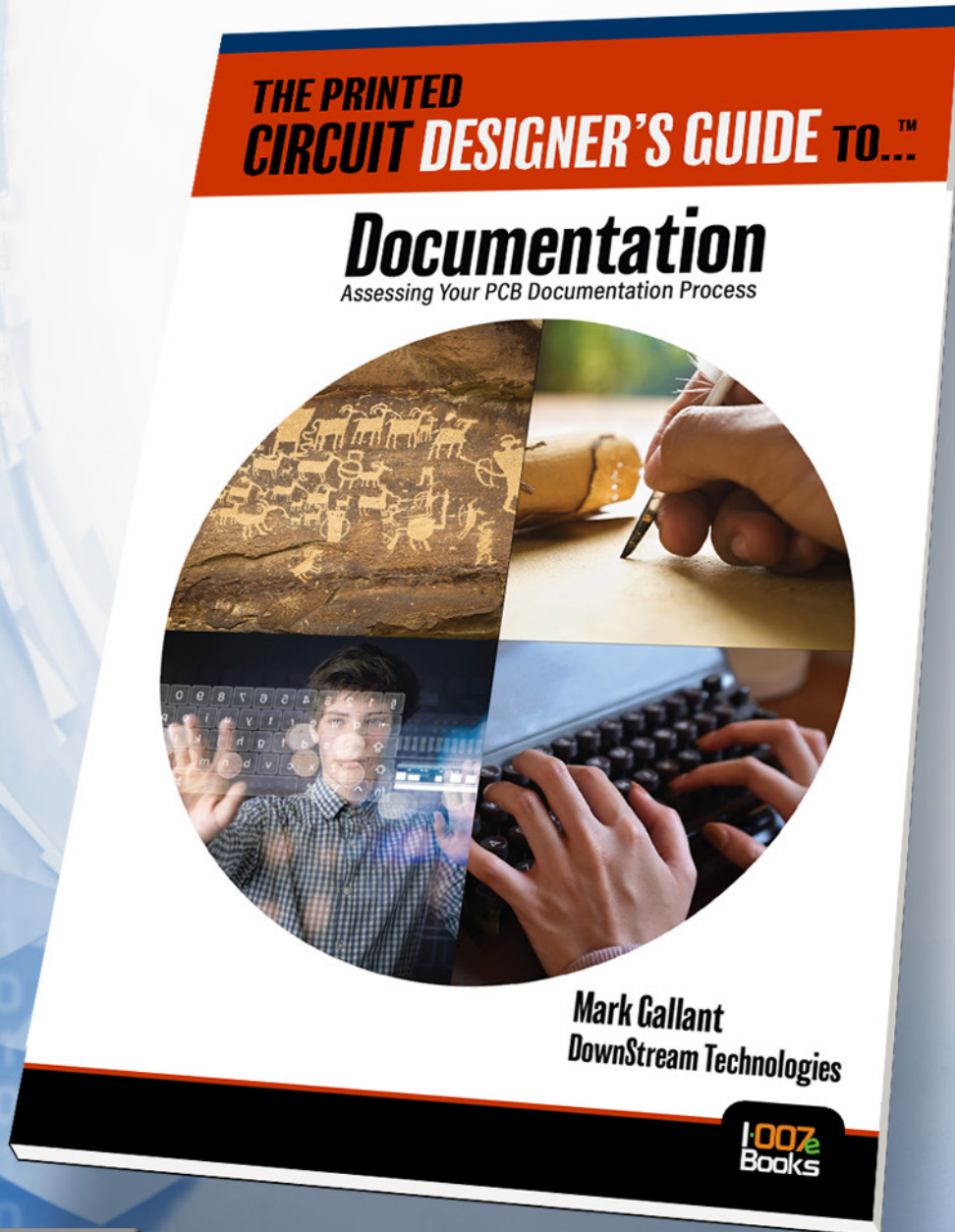


I-007eBooks.com



Your life just got better.

This book will teach you how to save time and money,
reduce frustration, and make your job easier!



I-007ebooks.com/doc



DOWNLOAD NOW

SMT007

M A G A Z I N E

The Landscape of the Industry

With so many new and emerging market drivers and influences—from technology to new product applications, environmental and government pressures, and human factors, such as staffing and expertise—the landscape of the industry is undergoing multiple changes. In this issue, we explore these shifts with a look at the trends causing these changes.



- 10** **Digi-Key on Adapting to the Changing Industry Landscape, Part 1**
Interview with Chris Beeson



- 24** **AI Cameras Help Park Rangers Stop Poachers**
Interview with Eric Dinerstein

- 42** **Merger and Acquisition Trends**
Interview with Joe O'Neil



- 52** **Global Political Turmoil Creating Uncertainties for the Industry**
by Chris Mitchell



7 REASONS TO “GO TURNKEY” ON YOUR NEW ASSEMBLY LINE

- 1 Lower Investment
- 2 Headache-Free Compatibility
- 3 Simple Financing
- 4 In-House Prototyping
- 5 Holistic Installation & Training
- 6 Easier Setups & Fast Changeovers
- 7 One Support Number to Call



Whether you choose a pre-configured Manncorp SMT assembly line or have our team build a line tailored to your production needs, turnkey assembly lines are the smart, stress-free choice for any business looking to start or expand in-house assembly. Starting at \$39,995.

Send your bill of materials to cellis@manncorp.com for a free assembly line consultation.



AP430 Stencil Printer



MC-389 Pick & Place



Reflow Oven

TEXT OR CALL

Chris (East) 215.869.8374
Ed (West) 215.808.6266

ManncorpTM
www.manncorp.com

Huntingdon Valley, PA | San Diego, CA

EMAIL

sales@manncorp.com



SMT007

M A G A Z I N E



SHORTS:

- 13 Researchers Report Possible Alternative to Silicon-based Solar Cells
- 16 Gallium Oxide Power Transistors With Record Values
- 22 Gary Tanel Provides an SMTA Update ▶
- 56 Researchers Develop Better Way to Harness Power of Solar Panels
- 84 EPTAC Continues Its Expansion ▶

DEPARTMENTS:

- 89 Career Opportunities
- 100 Events Calendar
- 101 Advertiser Index & Masthead



ARTICLE:

- 74 **Maximising Performance and Reliability of Automotive Electronics With Conformal Coatings**
by Phil Kinner

COLUMNS:

- 8 **The Changing Industry Landscape**
by Nolan Johnson

- 18 **Revisiting Globalization: Technology, Jobs, Trade**
by Dr. Jennie S. Hwang



- 36 **Dromology: Time-space Compression in Manufacturing**
by Michael Ford

- 60 **Today's Soldering Options**
by Ray Prasad



- 68 **Artificial Reliability Over Intelligence**
by Eric Camden

- 82 **Faster, Cheaper, Simpler**
by Chris Ellis

HIGHLIGHTS:

- 58 Supplier
- 66 Market
- 72 MilAero007
- 86 Top 10 from SMT007.com



CMs looking for a true turnkey PCB supplier need look no further.



Finding a reliable PCB supplier can be difficult for contract manufacturers with a variety of project needs. ASC has the technology, experience and engineering support needed to deliver on-time solutions for everything from quick-turn prototypes to the most demanding, complex applications.

Check out our capabilities



American Standard Circuits

Creative Innovations In Flex, Digital & Microwave Circuits

www.asc-i.com | (630) 639-5444

The Changing Industry Landscape

Nolan's Notes

by Nolan Johnson, I-CONNECT007

As I write this column, I'm in Chicago, wrapping up our coverage of SMTA International 2019 with other members of the I-Connect007 team; it was a productive, news-rich show. We'll be bringing you video and written interviews, articles, and—when the publication moratorium is lifted—some of the most impactful technical papers presented at the SMTAI technical conference sessions.

I couldn't help but be continuously reminded at SMTAI of the theme for this issue. Our theme is "Landscape of the Industry" with the implication that it's changing, which certainly fits the current state of our market. Factory automation continues to move forward. New developments are being introduced, which are based upon improved AI and data analysis (as opposed to simply capturing the data). And multiple tiers of equipment suppliers are introducing capital

equipment and add-ons to enable Industry 4.0 for (nearly) everyone.

SMTAI featured two keynote speakers: Adam Steltzner, a NASA Jet Propulsion Laboratory (JPL) engineer who led the Mars Science Laboratory's Entry, Descent, and Landing (EDL) Phase for the Curiosity rover and the chief engineer for the Mars 2020 Project; and Dr. Mike Hawes, Lockheed Martin Vice President for Human Space Exploration and Orion Program Manager. The energy at both keynotes was palpable. We're returning to extra-orbital space with human crews, and the demands of such missions drive innovation.

However, human factors in our industry are changing; as the "gray tsunami" of retirements begin to deplete the industry's hard-won wisdom in printed circuit fabrication and assembly, our work will need to be done in a different way. New technology and prod-



uct R&D is being driven by emerging applications (e.g., automotive, medical, and the return to space), and new applications are being enabled by leading-edge technologies. Together, these dynamics create an upward spiral and a wider view of how innovation can change our world.

This issue launches a multi-month, thoughtful look at our industry across all of our magazines. So, let's get started with Chris Beeson's perspective from Digi-Key. Our interview with Chris resulted in a two-part conversation: the first part on changes in the component supply chain, and the second on design tools and parts definitions. Catch Part 2 in the October issue of *Design007 Magazine*. Next, Dr. Jennie Hwang checks in with her column, "Revisiting Globalization: Technology, Jobs, Trade."

Our next feature is an interview with Eric Dinerstein from the non-profit organization RESOLVE. Eric leads a team developing wireless camera technologies for use in remote, extreme environments to monitor and identify illegal poachers of rare and endangered species. With sponsorship and support from companies like Intel, Inmarsat, Sigmatron International, Microsoft, Google, and others, Eric's team will change the landscape of our industry and protect our planet's wildlife.

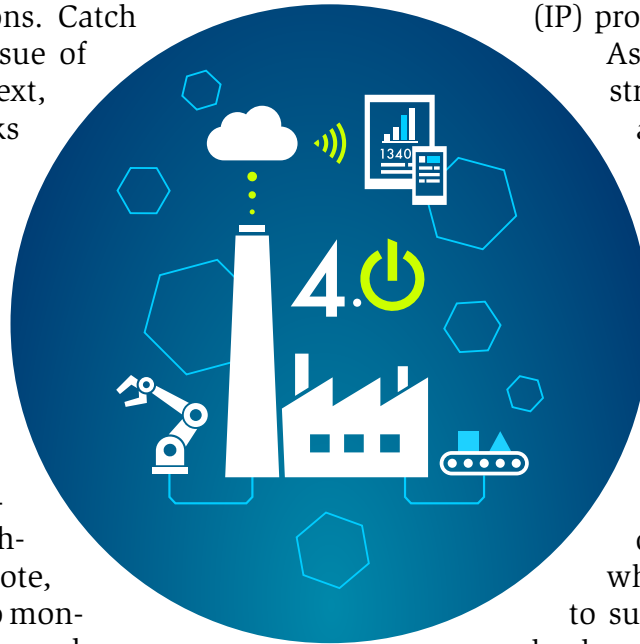
Michael Ford's column "Dromology: Time-space Compression in Manufacturing" moves the Industry 4.0 conversation beyond the interchange format itself and into its application. Michael also discusses this topic in more detail in my [video interview](#) with him from SMTAI 2019, which can be found at www.realtimewith.com. Further, changing landscapes can involve changes in ownership too; Dan Feinberg and Green Circuits' Joe O'Neil address merger and acquisition trends. Then, IPC's Chris Mitchell

addresses how global political turmoil is creating uncertainties for the industry.

Next, Ray Prasad discusses today's soldering options, and Eric Camden's column explores the interface between automation and human assessments in "Artificial Reliability Over Intelligence." Then, Electrolube's Phil Kinner explores conformal coating developments to meet new market requirements in "Maximising Performance and Reliability of Automotive Electronics With Conformal Coatings." Finally, Chris Ellis' column, "Faster, Cheaper, Simpler" explores shifts in production locations, ease of manufacturing, intellectual property (IP) protection, etc.

As always, I-Connect007 strives to bring you news and in-depth coverage that's good for the industry. Our goal is thoughtful, conversation-worthy journalism that you will want to share with your coworkers. In the coming months, we will bring you individual voices and their perspectives on the industry, and share what you will want to know to succeed in the future. We'll

also have in-depth coverage of IPC APEX EXPO 2020 and, along the way, we'll bring you highlights from SMTAI, production, the Additive Electronics Conference, designer user groups, such as AltiumLive and the IPC Designer's Council, and more. Feedback from you, our readers, helps propel the topics and stories we cover. We welcome your comments, suggestions, and even complaints; email us at editorial@iconnect007.com. **SMT007**



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

Digi-Key on Adapting to the Changing Industry Landscape, Part 1



Chris Beeson

Feature Interview by the I-Connect007 Editorial Team

The I-Connect007 editorial team recently spoke with Chris Beeson, executive vice president of global supplier and new business development at Digi-Key Electronics, about trends and the changing landscape of the industry. Beeson describes how Digi-Key is looking to continue growing its user community as a design service provider while providing greater services for the entire PCB.

Barry Matties: Chris, can you give us a little background of who you are and what you do?

Chris Beeson: Sure. I've been in the industry since '82, and I've been with Digi-Key since 2005. I'm the executive vice president of global supplier and new business development at Digi-Key Electronics. For my first 13 years, I had more of a sales role within Digi-Key, along with some other functions. But today, I'm focused on the supplier initiative and new business development.

We're working diligently to make sure that

we're aligned with where the industry's going and where Digi-Key needs to be positioned to support the industry. The company continues to prosper. When I joined in 2005, we were a \$500 million company. Last year, it was a little over three billion without acquisition. A lot of good things have happened.

Matties: To what do you attribute all of that growth?

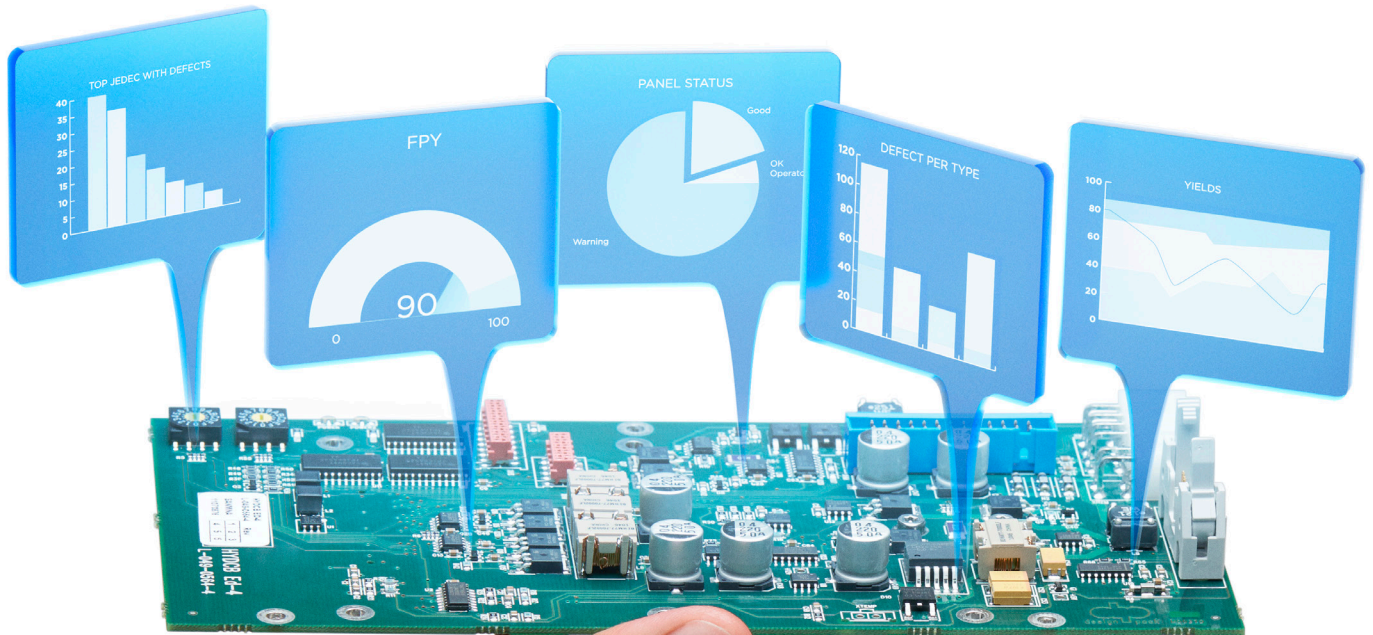
Beeson: Our dedicated staff is trying to focus in on business readiness, meaning what we need to do to be relevant and have the appropriate global positioning for our business to prosper. This mindset has aided us in the past and will continue to moving forward as to how we look at the opportunities. As a regional, U.S.-based company for many years, becoming more global was very important. Of course, our global focus on supporting innovation and the use of technology has aided our growth as well.

Nolan Johnson: What are some of the dynamics that you're seeing right now?

Put tomorrow's workflow in your control.

If you could boost your factory's productivity tomorrow, where would you start? Higher first-pass yield? End-to-end line integration? Automated job planning? Our comprehensive SMT solutions and expertise can help you get there. All so you can produce more boards with less work – from the first board to the final touch.

Visit booth A3 341 at Productronica to discuss how we can help put the future back in your control.



Beeson: We're more into the phrase "digital acceleration" than just becoming digital. Then, added product and services become part of the equation as well. We've been fortunate to add many key suppliers over time that historically might not engage broad-line distribution or even live on the same shelf as broad-line distribution. But with our focus on engineering and the orientation of design, we find that we can have strong synergies with a lot of different manufacturers that we are fortunate to represent.

Johnson: As Digi-Key is stepping into being a greater global supplier, are you seeing differences in trends and dynamics that are different based on region?

Beeson: Many people are using the words personalization and localization, and we're living that as well. Some basic fundamentals are more global in nature, such as design and innovation, but there are also contrasts related to the world of production, how that's done, and where that's done by region.

**Many people are using
the words personalization
and localization, and we're
living that as well.**

We're trying to make sure that we have greater empathy and understanding of where we see the contrast. Historically, we had a North American mindset related to user experience and how one wants to engage, but there's a contrast into how we provide solutions on a global basis. It's important for us to have that localization of content and methodology.

As a result, we have a light touch of resources around the world, which provides us guidance and feedback related preferred behavior. We're learning every day, and the landscape is

changing every day related to which is deemed an efficient business model.

Johnson: It sounds like there are a number of different facets to engaging your customers globally.

Beeson: The focus starts with the customer, and then we work our way backward. We're blessed to have a great deal of feedback from the customers, and a staff that understands this value. The monthly feedback that we receive online is critical for us. As a result, we take a great deal of time and energy to go through the feedback. We all like positive feedback, but what's most impactful for us is the opportunity for improvement or enhancing our services.

We take the voice of the customer very seriously and try to rationalize all feedback received. We ask our teams many questions concerning the feedback; for example, is it a one-off scenario, or is it something that's scalable and should be incorporated into our overall capabilities? That's an approach that has been embedded for a long time into our culture. Most of the decision to drop our catalog and move to a more digital orientation was based on the feedback we received from the user community.

Matties: Well, you really had no choice. The entire world moved to digital; it was either do it or be left behind.

Beeson: Right, but you can have successful blended models. Many of our business decisions have been related to feedback that we received from our user community.

Matties: I understand. Overall, this world continues to move digital more and more, which leads us to digital factories and smart manufacturing. How is that connected to what Digi-Key is doing?

Beeson: The consumption of technical content that we're seeing is sizable. In our corporate presentations we show a slide that relates to what happens in one hour at our organization. It depicts how many datasheet downloads

there are or how many articles are read versus customers calling Digi-Key and talking to someone live. We still provide that service and resources to support the user, but in all of our purchasing and methodologies, it's critical that we have the right content on our site. Sometimes, you monetize that, and other times, you don't, but it's archiving a lot of information so that we remain a resource to get the job done. Research is a big part of the technology, so a great amount of time and energy is put into making sure that we have the appropriate technical content for the users.

Matties: When you talk about users, are your primary customers circuit designers?

Beeson: Historically, yes, but it's evolving. We would be deemed an on-the-circuit-board type of organization with leading semiconductor, electromechanical, interconnect, and passive product portfolios, but that's evolving for us. The opportunity for us to get into some of the new or evolving verticals and industrial automation would be a good example where our user community is expanding. We all know

the focus surrounding IoT, 5G, AI, etc., but what we're seeing is nontraditional electronic experts need solutions, and a lot of times, that involves an electronics type of solution. We're seeing a lot of adoption of Digi-Key from what one would deem as the nontraditional user. Moving forward, that is the more traditional user, which has expanded in scope related to our user community.

Matties: Also, there's a generational shift going on in your user community as well. How is that changing the landscape?

Beeson: The other day, my wife asked, "What is this WeChat thing all about?" In China, we're trying to be proficient in WeChat, and use that type of platform to communicate to our users and add features like WeChat Pay. Now, commerce can be conducted outside of our website. It's about adopting methodologies that are aligned with the user and how they want to engage. That's a never-ending process for us. Over the last couple of years, we've expanded to about eight types of currency. Once again, we're trying to have a much more localized

Researchers Report Possible Alternative to Silicon-based Solar Cells

A possible alternative to silicon-based solar panels has been shown to convert solar energy into electricity more efficiently, reports KTH Royal Institute of Technology Professor Hans Ågren. He and researchers from Russia, South Korea, and China recently co-published a study of the material palladium diselenide (PdSe₂).

In the observations reported in the *American Physical Review*, Ågren and co-authors show that PdSe₂ can absorb a wider spectrum of solar energy compared to silicon-based materials, allowing a higher conversion rate of solar energy to electricity. Researchers at KTH and Siberian Federal University in Russia used high-precision calculations to examine, for the first time, the electronic and optical properties of both single- and multi-layer films made of the material.

Ågren says it is too soon to say how well PdSe₂ would perform in an actual solar cell application. He adds that research on two-dimensional materials has exploded in

recent years, particularly with regard to chalcogenides. "Our research on two-dimensional compounds between precious metals and such chalcogenides has resulted in us being able to optimize two-dimensional structures. This means that a wide wavelength range of the solar spectrum can be utilized if the material is used for capturing solar energy."

(Source: KTH Royal Institute of Technology)



methodology in which people can engage with us. Our goal is to be very in tune with what the possibilities are related to this objective. It definitely changes over time.

Matties: With the generational shift, I would think that you're seeing a new demand for different types of content as well. What are the flavor differences that you're finding?

Beeson: We're engaged in reviewing the ability to have more voice interaction on our website. We've talked about a "Digi-bot" for some time. We're developing these tools now. We're also utilizing more visual features, not just videos, but 360° images to enable visual product search. Those are a couple of examples of looking at our business evolving differently than what we did a few years ago and are enhancements to the foundation of our business and means of engaging us.

What's a version of research and development for Digi-Key, which is predominantly a distributor? It's making sure that you're aligned with the user community and well-positioned to support them.

Mobile is another prime example. How do we become more proficient in mobile? All of these things don't come with a guarantee, but it comes back to business readiness. What's a version of research and development for Digi-Key, which is predominantly a distributor? It's making sure that you're aligned with the user community and well-positioned to support them.

Johnson: Does that include providing user and customer feedback online to create more of a community?

Beeson: We're looking at that and will have some aspects of that incorporated into our organization. How does one do that? Right now, we have something called a tech forum, which is where we want the users to tell us what's on their mind. Sometimes, they're aiding others; other times, it's positive or critical feedback. But we want our users to have insight into the business to a much greater extent. We've had a maker site for about five years, and it's a great example for someone to engage us and provide feedback, and in many cases, aid others in their development as well.

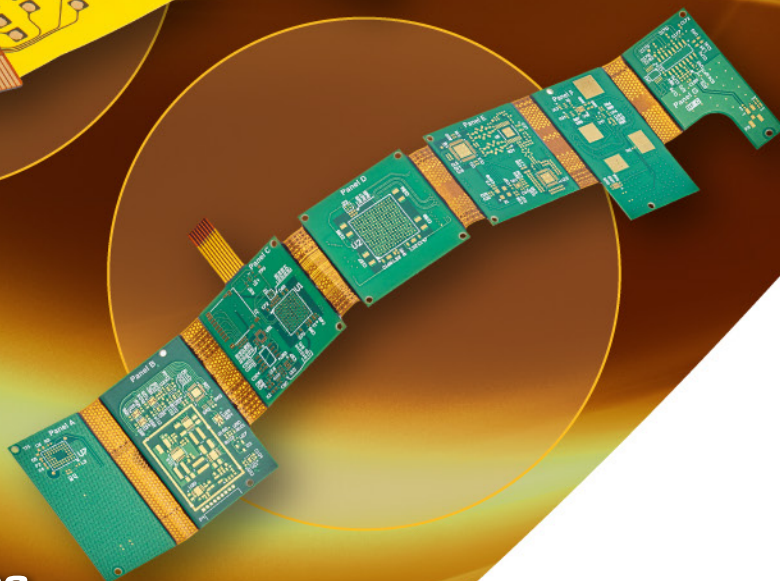
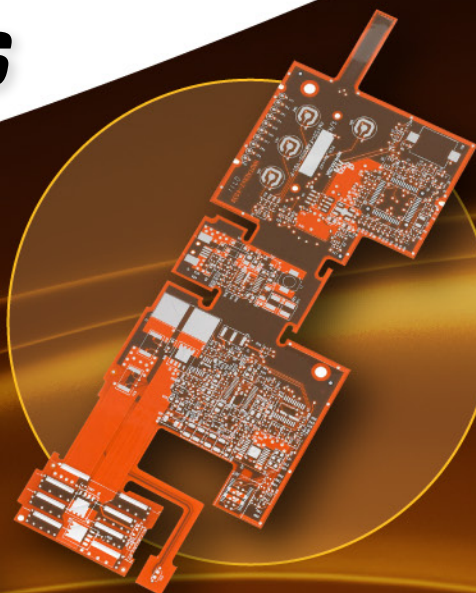
Johnson: There have been some emerging companies in the past few years, thanks to a ubiquitous internet, making a go of parts definitions and libraries online. Their approach may be to change the distribution of technical content or parts selection. How do you at Digi-Key see that changing your landscape?

Beeson: That's another example of enhancement. In some cases, if that's a direction we want to go in or those capabilities are now available, we need to participate. In our greater umbrella of what we would deem EDA tools, we need to make sure that we're aligned with and supportive. You'll see a number of those different capabilities evolving for us, and some already exist for us within our site. Again, I don't think any website related to a distributor is purely related to time, place, and utility for a part number—including ours. It's so much more than that in today's world. The more relevance you have, the stickier you'll be to the user community. We're trying to make sure that we're aligned with that.

Matties: You're primarily a distributor. Has there been any talk of becoming a component manufacturer?

Beeson: We whiteboard everything. What do we want to be? What's our true value proposition? We currently represent 800 suppliers. Should it be more? Who has the appropriate capabilities to provide a function? We go through that rationalization as to what is

PREMIER GLOBAL SUPPLIER OF FLEXIBLE CIRCUITS



- ***Flexible Circuits***
- ***Rigid Flex***
- ***Flexible Heaters***
- ***Flex/Rigid Flex Assemblies***
- ***Membrane Switches***
- ***Product Module to Complete Box Builds***

Flexible Circuit Technologies
9850 51st Ave. N.
Plymouth, MN 55442
sales@flexiblecircuit.com
+1-763-545-3333

FLEXIBLECIRCUIT
Technologies®

WE GO WHERE OTHERS WILL NOT
www.flexiblecircuit.com

our role and our value proposition. There's the ability for us to drive greater value-added services as well as a greater opportunity for us to have an orientation of partnership to others.

We do things today that were out of the norm a few years ago. Although it's not always easy to implement into your business model, an example is when customers come to us for connectors. These connectors need to have five or six various components coming together to become a connector assembly. Is that something we want to do, or can we partner with someone to have that function performed for us? At the same time, you incorporate options into your services so that the user experience is very solid.

We're doing those things today. We're taking that orientation and moving forward. How much more could we do? We're in the middle of a large expansion where we've touted our 2.2 million additional square feet, which is a sizable commitment to stocking things, but what more could this support? What more could we incorporate into this facility? Can we become more proficient? I use the phrase "value-added services" broadly, but could we be a de facto value-added supplier?

One thing we know is that in our user community, as well as in our supplier community, the word "solution" is becoming a common term. We want to drive solutions, but we think we're in a strong position to be an aggregator of all of these suppliers and incorporate the solution. It's difficult for a stand-alone semiconductor, IP&E, or industrial automation organization to provide the total solution. We're in this position where we are asked why couldn't we aggregate and truly be a one-stop shop for a solution-based equation? That changes things for us, but it's back to that business readiness conversation, because it plays into where the technology is going. For instance, I never thought we'd be into data plans or cloud services—things that are different than what a traditional distributor would have—but if you're going to play in IoT, you need a data plan solution. That's one more thing that we have to add to our arsenal to be of relevance. **SMT007**

Part 2 of this interview will appear in the October 2019 issue of *Design007 Magazine*.

Gallium Oxide Power Transistors With Record Values

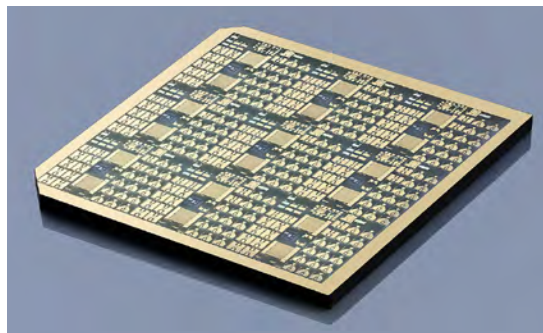
The Ferdinand-Braun-Institut (FBH) has now achieved a breakthrough with transistors based on gallium oxide (β -Ga₂O₃). The newly developed β -Ga₂O₃-MOSFETs (metal-oxide-semiconductor field-effect transistor) provide a high breakdown voltage of 1.8 kV and a record power figure of merit of 155 MW/cm², achieving performance figures close to the theoretical material limit of gallium oxide. At the same time, the breakdown field strengths achieved are significantly higher than those of established wide bandgap semiconductors such as silicon carbide or gallium nitride.

On a footprint as small as possible, these MOSFETs should offer low energy consumption and achieve ever-higher power

densities. This is where conventional devices reach their limits. Scientists all over the world are therefore investigating new materials and components that can meet these requirements.

To achieve these improvements, the FBH team tackled the layer structure and gate topology. The basis was provided by substrates from the Leibniz Institute for Crystal Growth with an optimized epitaxial layer structure. As

a result, the defect density could be reduced, and electrical properties improved. This leads to lower on-state resistances. The gate topology has been further optimized, allowing to reduce high field strengths at the gate edge, which leads to higher breakdown voltages. (Source: FBH)



Additive Electronics Conference: PCB Scale to IC Scale

October 24, 2019

DoubleTree by Hilton San Jose
San Jose, California, USA

Four Sessions That Will Change Your Business Forever

Session 1: The Need for Additive
Session 2: Materials & Technology
Session 3: Practical Applications
Session 4: Interactive Panel Discussion

Keynote Speaker



Rich Brooks
Senior Engineering Manager
Jabil Circuit, Inc.

Miniaturization – Driving the Advances in
PCB Technology and Assembly

www.smta.org/additive

Organized by:



In cooperation with:



Revisiting Globalization: Technology, Jobs, Trade

SMT Prospects & Perspectives

by Dr. Jennie S. Hwang, CEO, H-TECHNOLOGIES GROUP

In 2004, I wrote a column titled “Globalization: Technology, Jobs, Trade,” which was published in the July issue of *SMT Magazine*. Amid the protracted and roller-coaster trade uncertainty between the U.S. and China, and the renewed debate on globalization, I thought a revisit on the topic was befitting. What has changed over the last 15 years? Where do we stand today? Is globalization undergoing a retreat or reverse course?

Globalization was mind-boggling; the more I examined the subject, the more I revealed its complexity and intricacy. Many punchlines were thrown around by various media organizations. But one thing was clear; we were facing a new world characterized by change, uncertainty, flexibility, choice, and opportu-

nity. Today, we are facing yet another new world with no shortage of opinions, views, and positions. Nonetheless, some fundamental principles and primary underlying issues behind the technology, jobs, and trade remain the same.

For example, productivity and the competitiveness-driven environment continue to be relentless. For a given function, the productivity level continues to rise sharply, and the number of employees required to perform an equivalent function continues to decline. To produce more, with less manpower and lower cost, is every operation’s goal. The ever-increasing demand for innovation incessantly intensifies. The shortage of engineering talent and the inadequacy in the pipeline of engineering





LEAVING THE OTHERS IN OUR DUST BY INVESTING IN SPEED & TECHNOLOGY

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.

VIEW OUR CAPABILITIES



www.eagle-elec.com

talent in the U.S. continues. The job market and the shift of the job market in nature, geography, and number on the global scale are profoundly in flux. Then, the “eternal” trade issue with China has moved to the front and center of inside-the-beltway debates, government policies, and business strategies.

Today’s new world is not only entrenched with trade issues but also driven by shiny, new technological megatrends—namely artificial intelligence (AI), the internet of things (IoT), 5G, and the associated infrastructure and supply chain. The national unemployment rate reached 3.7%, the lowest since 1969, which is good news. Another major change in the global landscape during the last 15 years is that China became the largest exporter in 2013, replacing the United States.

Another major change in the global landscape during the last 15 years is that China became the largest exporter in 2013, replacing the United States.

The United States maintains its status as the largest consumer in the world. History tells us that the open market and free trade are prerequisites for global competitiveness. In this politically sensitive time, the challenge for the private sector and the U.S. Government’s policymaking is how to cultivate and formulate a virtuous cycle to feed the dynamic economy.

Our industry has been affected broadly as well as specifically by the globalization in technology, jobs, and trade. To my recollection, our industry was one of the frontiers (if not the first pioneer) heavily engaged in outsourcing and offshoring that commenced in the 1990s. As we move into ever-advanced manufacturing using IoT and AI and as the miniaturized dimensions drive all sectors of the industry,

where is the global competition going? And where does globalization stand?

The intertwined relationship between technology, jobs, and trade is a grand challenge to all of us. Diverse and opposing views about globalization and how it relates to technology, jobs, and trade are abundant as reflected through a plethora of data, manifold surveys, and growing debates. Whether globalization would undergo a retreat or reverse course, and how our industry is going to embrace changes, is important to future success. The critical thought-process goes to the diligent assessment of the core competencies and the sorting out of the priority in functions or products or services. The critical thinking also goes to what to embrace and how to leverage the new, almighty megatrends, such as how IoT is going to drive both product design and operation.

AI hardware, working hand-in-hand with software systems, plays a critical part in this increasingly recognized AI era. The future factory is driven by the nascent Industry 4.0, and its ultimate goal is to achieve the intelligence-teaming manufacturing operating in a truly integrated manner. In manufacturing, such as surface mount, agility, flexibility, reliability, efficiency, and desirable cost are the names of the game.

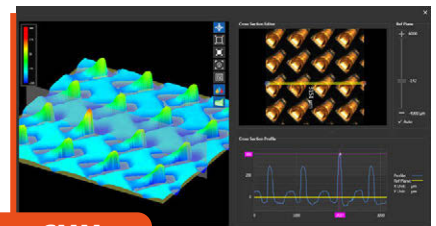
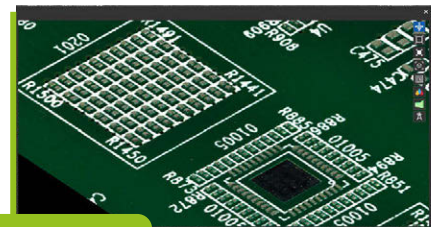
Many operations or organizations are embracing (or bracing for) President Trump’s next tweets. But we can control our destiny by controlling only what we can. We need to understand what Industry 4.0 is, what it requires, and what it takes to achieve it. I believe that is going to take the next several years to develop ^[1].

Moving forward, to enable AI and its building blocks—machine learning, deep learning, and neural networks—new chips (processor and memory), architectures, and system designs that deliver low power consumption, high performance, low latency, high bandwidth, and fast speed will be the ever-demanding targets. Only by fulfilling these criteria can inference processing in lieu of traditional program processing be achieved ^[2].

It’s equally demanding to assess and optimize for different types of AI workloads—a business

Thrives on a Challenge. Loves Variety.

The ultimate multi-process inspector for paramount speed, accuracy and ease of use.



SQ3000™ All-in-One Solution

Loaded with Powerful Tools that cover Inspection and Measurement for AOI, SPI and CMM.

Fast and highly accurate, repeatable and reproducible measurements for metrology applications in the manufacturing of a wide variety of products such as PCBs, semiconductors and consumer electronics.

The SQ3000™ offers unmatched accuracy with the revolutionary Multi-Reflection Suppression (MRS) technology by meticulously identifying and rejecting reflections caused by shiny components. Effective suppression of multiple reflections is critical for accurate measurement, making MRS an ideal technology solution for a wide range of applications including those with very high quality requirements.

CYBEROPTICS®

www.cyberoptics.com

Copyright © 2019. CyberOptics Corporation, Inc. All rights reserved.

case to justify building custom-designed chips (e.g., application-specific integrated circuit [ASIC]). The increased workload and almost unlimited processing power propelled by machine learning and AI will require the most advanced semiconductors, packaging approaches, and manufacturing prowess ever developed to reach the interconnect density that is and will be needed. Its timely materialization hinges on the successful effort of our industry.

Conclusion

Not being different from the past 15 years, in the long run, innovation and competitiveness are key to a constantly rejuvenating economy. Only a strong economy retains and creates jobs. In an uncertain time that inevitably “picks” winners and losers in the race of new technologies—and one that is filled with debate about trade policies and business strategies—an open mind to pragmatically assess the practical options is the way to go. In closing, this leads me to borrow the following quote from F. Scott Fitzgerald:

“The test of a first-rate intelligence is the ability to hold two opposing ideas in the mind at the same time, and still retain the ability to function,” effectively, swiftly, and timely. **SMT007**

References

1. Dr. Jennie S. Hwang, “[The Fourth Industrial Revolution \(Industry 4.0\): Intelligent Manufacturing](#),” *SMT Magazine*, July 2016.
2. Dr. Jennie S. Hwang, “[Artificial Intelligence: Super-exciting, Ultra-competitive](#),” *SMT007 Magazine*, September 2018.

Upcoming Presentation

I will present a lecture on “Electronics Reliability: Role of Intermetallics” at IPC APEX EXPO on February 3, 2020, in San Diego, California.



Dr. Jennie S. Hwang—an international businesswoman and speaker, and business and technology advisor—is a pioneer and long-standing contributor to electronics hardware manufacturing as well as to the environment-

friendly lead-free electronics implementation. Among her many awards and honors, she was inducted to the International Hall of Fame—Women in Technology, elected to the National Academy of Engineering, an R&D-Stars-to-Watch, and YWCA Achievement Award. Having held senior executive positions with Lockheed Martin Corp., Sherwin Williams Co., SCM Corp, and CEO of International Electronic Materials Corp., she is currently CEO of H-Technologies Group providing business, technology and manufacturing solutions. She is the Chairman of Assessment Board of DoD Army Research Laboratory, serving on Commerce Department’s Export Council, National Materials and Manufacturing Board, NIST Assessment Board, Army Science and Technology Board, various national panels/committees, international leadership positions, and the board of Fortune-500 NYSE companies and civic and university boards. She is the author of 500+ publications and several books, and a speaker and author on trade, business, education, and social issues. Her formal education includes four academic degrees as well as the Harvard Business School Executive Program and Columbia University Corporate Governance Program. For more information, please visit www.JennieHwang.com. To read past columns or contact Hwang, [click here](#).



Gary Tanel Provides an SMTA Update

At the recent SMTA International 2019 Conference and Exhibition in Rosemont, Illinois, SMTA Ambassador Gary Tanel gives Andy Shaughnessy an update on his work with Electronics Alliance and the Dallas chapter of SMTA. He also discusses the JoAnn Stromberg Student Leader Scholarship Award and the Charles Hutchins Educational Grant.

Click on the image to watch this interview.



SUNSTONE[®]
CIRCUITS

sunstone.com

how

LEAN



manufacturing
adds value

TO

PCB Production

Sunstone Circuits is committed to providing the resources you need in order to help you meet your important project deadlines.

More **RESOURCES** available on site.

DID YOU KNOW WE OFFER:

| | |
|------------------|--------------|
| Layout Services | RF/Microwave |
| Assembly Options | DFM |
| CAD Software | Stencils |
| SnapEDA Parts | |

Around the Clock

CUSTOMER
SUPPORT



Contact us at [1-800-228-8198](tel:1-800-228-8198) or email at
support@sunstone.com

AI Cameras Help Park Rangers Stop Poachers

The insides of the
TG AI camera.
(Source: Walden Kirsch/
Intel Corporation)

Feature Interview by Nolan Johnson I-CONNECT007

Eric Dinerstein, the director of biodiversity and wildlife solutions at the non-profit organization [RESOLVE](#), discusses the organization's TrailGuard AI camera—a low-cost, durable, easy-to-use, efficient, and low-power burglar alarm system for Africa's national parks—that alerts rangers at headquarters in near real-time of intruders and potential poachers coming into the park. With the help of leading companies, Eric explains how the project came to life, including implementing artificial intelligence (AI) and a satellite modem, making it the first of its kind.

Nolan Johnson: Your work involves a technology application that is intriguing and quite literally about the landscape! I'm interested in how emerging technologies like IoT and 5G will affect your work.

Eric Dinerstein: It's an exciting time for us right now because we just received the announcement that TrailGuard AI was selected as one of

10 finalists for Fast Company's "Innovation by Design Award" for 2019. Intel is very excited about it, as well as our other partners in this important endeavor.

What I'm about to say may seem like a contradiction to some of the things that are of greatest interest to your readers, such as IoT, which you mentioned. But first, I'll start by saying something that is ironic with the projected move toward 5G. When we take TrailGuard AI out into the field, meaning the wilderness where TrailGuard AI is supposed to work, we go in the other extreme direction; we use 2G, especially since TrailGuard AI is used in Africa. In the U.S., it's hard to find a 2G hotspot in a city to be able to test the transmission of our images. In the African bush, 2G is still the backbone system to contact rangers to alert them about intruders and poachers in the area or critically endangered wildlife moving around, such as an elephant moving to croplands where human-wildlife conflict will occur.

Thus, we use 2G because it's widely available across Africa. It's going to be a while before there is an upgrade to even 3G or 4G becoming

ELIMINATE SOLDER DROSS AND REDUCE YOUR SOLDER SPEND BY 50% !!!

Significantly reduce your solder bar spend by **over 50%** when you use **MS2®** along with the *revolutionary* and affordable **AKILA** dross recovery unit.



ISO 9001:2015



After just one hour in the AKILA unit, dross is converted to usable solder.



MS2®
Molten Solder
Surfactant

pkaymetal.com

+1 323-585-5058

PK
M·E·T·A·L

common in some places, particularly in remote areas. Another constraint is that there are a lot of places in Africa, in the U.S., and around the world where we can't even use a cellular network. Therefore, 95% of what we do uses a long-range radio link (LoRa) to transmit small images over long distances and have a near real-time burglar alarm system.

Johnson: That's a good point and a great teaser too (laughs). Let's step back and have you describe what you're doing with the technology, what the application is, and how and where you're using it.

Dinerstein: I'll focus on the problem and need for wildlife conservation, which is part of what I do in my field of work, and then I'll dive into the technology. For some background, we're going through the sixth-greatest extinction crisis in the history of our planet, and this is the only one that has been caused by humans; humans were not around when the five, big, previous ones hit. How it has manifested is we're losing 200 species a day, according to some experts. Most of the species are going extinct in rainforests, but the ones that receive the most attention, of course, are what we call "the charismatic megafauna," such as elephants, rhinos, lions, tigers, and mountain gorillas.

It's estimated that one elephant in Africa is poached every 15 minutes. At the current rate, there will be no forest elephants alive in the Congo Basin Forest in 10 years. Also, there are only 1,000 mountain gorillas left in a few parks; there are more lowland gorillas, but those are endangered too. As far as rhinos go, we have five species, but all rhinos face tremendous pressure.

We first tested TrailGuard at the edge of Serengeti National Park in Tanzania and its extension to the Maasai Mara in Kenya. Right now, you can go online and watch the migration of more than one million wildebeest—and sometimes up to two million—moving in a clockwise direction around this ecosystem, following the rains, and it's spectacular. But what most people don't know is that each



year, around 140,000 wildebeest are poached there for the industrial bushmeat trade. And that's only talking about wildebeest—not even giraffes, dik-diks, impalas, zebras, cape buffaloes, and other animals caught in snares, or, in the case of elephants and rhinos, poached with weapons.

Johnson: I knew it was a problem, but I had no idea about the numbers.

Dinerstein: Right. So, we've introduced this technology that has the capacity to stop poachers before they kill; it's the first of its kind. Other technologies work to track poaching events through DNA or isotope analysis, for example, or that can identify based on ivory from where elephants were poached. These technologies succeed in identifying areas that need to be more protected after the fact, but there was nothing out there to stop poachers



Humans detected by TrailGuard AI. These are not poachers but rangers posing as poachers during a field test of the technology in Kenya. Faces are hidden for confidentiality.



Anna Bethke from Intel holding the TrailGuard AI PCB, showing Movidius Myriad 2 chip in red circle.
(Source: Walden Kirsch/Intel Corporation)

before they arrive. Now, we have created a burglar alarm system for Africa's national parks that alerts rangers in near real-time of intruders coming into the park. Headquarters receives actionable evidence (i.e., transmitted images of humans) and can decide the level of response needed depending on if humans detected are heavily armed poachers versus herders trying to recover lost cattle.

We've had great success in the Serengeti with one of our prototype units that worked for 1.5 years and detected 50+ intruders, including 30 poachers arrested in 15 separate incidents. Even several years ago, we knew it worked, and we've gone through four iterations since then, like any piece of technology. But the greatest breakthrough came when we gained the attention of Intel and were able to incorporate their vision processing unit (VPU) system-on-a-chip known as the Intel Movidius Myriad 2, which allows for deep neural networks (DNNs) to be run on the chip so that we can do inference on the edge. This is a huge advancement because most wildlife camera traps, or trail cameras, have not changed much from a technological perspective. A trail camera I used in 1990 was one of the first ever built for commercial use. I tried it out to identify and photograph the elusive Javan rhino—the rarest mammal on earth—on the western tip of Java near the Krakatoa volcano.

Until today, no wildlife camera had incorporated AI. The value of having the inference on the edge is that 75–95% of the images recorded by camera traps have no value; they're triggered by the motions that pass infrared motion sensors, such as wind, branches, or a flying bird. Nevertheless, transmitting all of those empty or useless images cost you precious battery life. And the two critical features you have to do if you're going to put a sensor in the field is to greatly extend battery life and address connectivity.

We solved both of those problems by using AI to only send images of target species (i.e., humans) over our network. In the Serengeti, 95% of the images were of no interest, but we sent everything in our first try. By adding in the AI chip to permit inference on the edge, we're able to send a limited number of images that the rangers know are going to contain pictures of humans. This extends its battery life from about two months, which was what we had with our rechargeable lithium batteries, to now more than 1.5 years, which is a gamechanger.

Johnson: Regarding battery life, is that more a design issue than cell technology?

Dinerstein: Yes, because if you have hundreds of these units out, you don't want to have staff faced with the unnecessary time constraint of having to change batteries so frequently. That could possibly put them in harm's way or give away the locations of the hidden cameras. By using this chip, we've also been able to make our device low power. Almost all of the time that the TrailGuard AI unit is in the bush, it's in off mode. The system is only awakened for milliseconds when it's triggered by the motion sensor, which activates the whole system, and it wakes up in 100 milliseconds, which is extremely fast and critical. Next, it loads the AI module and does the inference on the edge. Then, it rates every image taken and sends the one that has the highest likelihood of being a human with a bounding box around the image. A text file with the probability that the subject in the image is a human based on a percent-



of those images to the cloud, the most expensive thing is the transmission of the images, so we save on that. But at the end of the day, if that's all we did, we'd have a smart camera that could run a bunch of different deep, neural network models, but it wouldn't be a burglar alarm. You'd still have to go to the site to remove the SD card, download the images, and then see that a poacher came through five days ago, for example; instead, you want to be out in near real-time and not just be aware of what already happened.

age accompanies each image sent to headquarters as well as a health check, including battery voltage.

Our mantra in designing and building this device to work in Africa might resonate with some of your designers; our five-part mantra, in order to scale, is it has to be cheap, durable, easy-to-use, efficient, and if it involves a battery, low-power. If it doesn't meet all five of those criteria, forget about it; it won't be used nor be scalable. We've had to check all of those boxes and engineer our technology to optimize on all of those fronts. The Myriad 2 chip helps us by being low-cost and low-power and has a very small form factor.

The other crucial piece about these cameras is that they're very small and easy to hide. Most wildlife cameras are bulky and conspicuous; some studies have shown that in the first year of operation for these types of cameras, 42% were either vandalized or stolen. That doesn't do you any good if you're spending a lot of money on these cameras and they have a short lifespan. Ours have yet to be found because they're so easy to hide. The camera and computer together are the size of your index finger. Also, the device is linked to a multipurpose communications unit that's three inches by one inch. It's so tiny in comparison to other cameras sold commercially.

Then, there has to be connectivity. We've solved the battery life issue by using inference on the edge and filtering there rather than in the cloud. And because we don't have to send all

As mentioned earlier, we've linked our TrailGuard AI camera to a communications unit that has Wi-Fi and a GSM and LoRa modem that looks for GSM first, which has a range of 35 kilometers. If there is a GSM range, it will send the image in under two minutes to headquarters. If there's no GSM, which is typical for a lot of parks around the world where the cell coverage stops at the edge of the park, we use a radio link. As long as the image is below 20 kilobytes, we can send it over the radio link with up to 30 kilometers line of sight, or about 10 kilometers not line of sight. Then, it goes over a LoRa modem to our "WildTech gateway," which allows many TrailGuard AI units to communicate with a single satellite modem. As Intel has helped us on the AI side in power consumption issues, Inmarsat, the leading satellite company, made a philanthropic contribution to help us solve connectivity issues.

Johnson: What does that look like, Eric?

Dinerstein: We use a state-of-the-art, military-grade satellite modem—the BGAN Explorer 540—that connects with our little gateway, which is two inches by one inch by one inch. That allows multiple TrailGuard devices to send images to a single satellite modem and amortize the cost of the satellite modem over many devices. Galaxy 1, through Inmarsat, has also offered us a reasonable transmission data rate that makes this affordable. After the initial capital cost of the satellite modems and the TrailGuard AI units in a park, we estimate

PCB FABRICATION & ASSEMBLY

CLASS 3 RIGID - FLEX METAL CORE

5 COMPETITIVE ADVANTAGES

1. Domestic / Overseas Mfg.

Imagineering, Inc. enjoys the reputation of being one of the most experienced & successful offshore PCB suppliers.

2. CAM USA

At our headquarters in Illinois we have a team fully trained CAD/CAM engineers who review and analyze Gerber files prior to fabrication.

3. Quick-Turn Production

Imagineering offers small volume production in 5 days or less and medium to large volume production in 2-3 weeks.

**15 SMT Lines
Domestic/
Overseas**

4. Shipping Logistics

With Imagineering there is no need to deal with multiple suppliers, language barriers, customs headaches, and shipping logistics. We do it all for you ..and deliver door-to-door

5. Significant Price Saving

Our global buying power combined with the capabilities of our overseas facilities translate into tremendous savings to our customers.

**Selective
Solder**

**State of the Art
Jet Printer**

**3D AOI Machine
(Automatic Optical
Inspection)**

**IPC-A-610
J-STD-001
Certified
Personel**

- AS9100D
- ISO 9001:2015
- ITAR REGISTERED
- SAM REGISTERED
- UL E333047
- WOMAN OWNED
SMALL BUSINESS



imagineering, inc. 847-806-0003

www.PCBnet.com

email: sales@PCBnet.com

that we can operate a burger alarm system for \$15–20 dollars per month, which is well within the range of any park in the world. We think it's a great solution, and we're trying to scale it. We just returned from a trip to China with Intel to visit the tinyGO factory—a subsidiary of WeiBu, an original design manufacturer (ODM) that specializes in building devices with their VPU's, including the Myriad™ 2 and X—and build the next 1,000 TrailGuard AI devices.

In many places, but particularly Africa, the parks are vast, and the wildlife is hard to protect with limited personnel. The Serengeti is the same size as the state of Maryland in the U.S., which is about 17,000 square kilometers, but there are only about 150 rangers on the force to protect it.

Imagine 150 guards trying to protect the wildlife of the state of Maryland; it's impossible. However, what if those 150 guards could act more like 1,500 guards? TrailGuard becomes a “force multiplier and an intelligence multiplier” by reorganizing the protected area system from rangers at guard posts to rangers who are involved in “event-triggered rapid response.” We are turning them into rapid-response teams based on TrailGuard alerts; they don't have to conduct random searches. The images come into a program, and there are several different groups. The late Paul Allen's company Vulcan has created a domain awareness system for park management that TrailGuard feeds right into and pops up as an alert; the rangers can see the image of the intruder on the screen.

Similarly, ESRI—the world's leading manufacturer of GIS software—also has a protected area management domain awareness system, and we integrate with both. We have an even

simpler system for parks that don't have the budget to afford those. Now, we have the capability that when there's an intruder, an alert is sent in under two minutes to the headquarters—either via GSM or LoRa—and somebody at the other end can see that there is an image and decide whether to send out a ranger team, which works well.



Three TrailGuard AI units. The left version shows how the unit is camouflaged using local detritus to make it even more cryptic when deployed in the field.

After talking with a lot of protected area managers, wildlife enforcement people, and military and ex-military we found out that no matter how big a park is, or what kind of vegetation or terrain it has, the basic problem is that there are essentially 10 major access routes into a park that poachers use; how they enter is not random. It could be influenced by guard posts, roads, villages, and most importantly, where the animals they're after concentrate. If you have that knowledge, then maybe you can create a program where it predicts the most logical entry points, and

you can put your TrailGuard devices at those “chokepoints.” Again, experts we talked to said that there should be no more than 10 major chokepoints per park, which experience about 80% of the poaching traffic. If you can interdict those poachers, that will have a tremendous effect on wildlife.

So, our hypothesis is if we can identify those 10 major access routes to any park and have 10 satellite modems put there—assuming that there's no GSM—and have our TrailGuard units in a star network around the satellite modems communicating with it, then we'll effectively and cheaply cover those access points and be able to provide that information for rangers to take action.

I went a little off-topic, but I am so excited about this that it is hard to contain myself

sometimes. We've been at this for four years, and before that, my inventor, Steve Gulick, had been at it for another four. Sometimes, it takes a while; you have to find the right group of collaborators to make something take off. Our growth and improvement have been exponential in the last year and a half.

Johnson: I can tell how passionate you are. Back to what you talked about earlier, from a system design perspective, that all sounds well-thought-out. How much of the hardware that you're using is custom?

Dinerstein: A lot more than I'd like to admit (laughs). One of my friends who is an angel investor in a company that was bought by Altium—who is also now one of our sponsors—told me what he learned while investing in the technology sector: “Don't invent hardware; invent software.” Essentially, grab off-the-shelf stuff and use that. Well, we wish we could. And for some of our components, we certainly have. We don't build our own GSM or LoRa modems, etc. But the technology, as I said earlier, was decades old. Put another way, the major consumer of standard wildlife camera traps are white-tailed deer hunters who use them to figure out where the large bucks are before they go hunting. Now, most hunters use trail cameras.

Overall, that was the market; there was no market signal to make devices that are more suitable for the needs of wildlife biologists or conservationists, so they end up using these camera traps that don't meet their needs. Again, they're expensive, bulky, and don't have any of the features that we have, such as AI and good connectivity. It's mostly weak GSM for those that have it, and they're expensive. So, the nearest wildlife camera trap that even has some of the functionality that we have is \$1,300, and we're looking at selling ours for around \$450. The next generation we're doing with Intel and tinyGO will be even cheaper

and more advanced with a chip that runs eight times faster and runs many more models. It's going to be disruptive, but we're not interested in competing. Let other companies continue to build their cameras for hunters; we're focused on the conservation side.

Back to your question, there was no incentive to build hardware that met the needs of these other groups in the conservation arena. We had to create our own camera with the help of some brilliant engineers at Intel who provided assistance on the hardware and software. I affectionately call Steve Gulick the Thomas Edison of conservation technology because he has one brilliant idea after another; he's a great innovator, but it takes a team to make something work. We've been fortunate to work with great engineers over the last 16 months at Intel that have adopted this project as part of their social platform. We've been able to telescope this and do things we could never have done on our own. Also, Sigmatron International in Union City, California, built our prototypes, worked with us closely and provided a lot of help.

Johnson: Undoubtedly, environmental extremes are a factor. Who tackles that challenge?

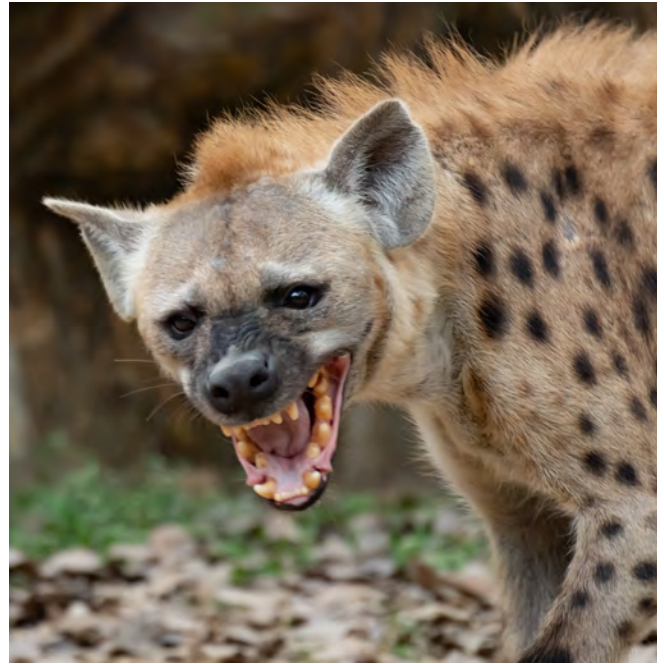
Dinerstein: Intel helped design the circuit boards and sourced components that work in extreme environments, and Sigmatron dealt with SMT and through-hole application. We've



also had to design our own encapsulation process because we have to make our device bulletproof so that it can withstand flooding, fire, precipitation, dust, and elephants coming up to the camera and putting their mucus from their trunks on the camera after sniffing it. A hyena carried off one of our units once too, so we had to make it “hyena-jaws-proof.” Overall, we’ve had to invent the hardware for the camera and communications unit, figure out how to put it together, and then write the software. All sorts of unique software had to be added. The parts that I’d say are off-the-shelf are the satellite modems, but getting access to them is not easy. And the gateway is assembled from off-the-shelf hardware, but then the software that binds that is unique.

Johnson: When we started this conversation, you made a couple of statements about what technology works for you and what doesn’t. I want to make sure that we have a chance to drill down into that because I think that’s a meaningful perspective. As you’re describing your application, it’s easy to jump to the conclusion that IoT and 5G will be helpful to you because you’re talking about the need for increased data rates and lower power consumption. But as a practicable transmission technology, it doesn’t work for you because you need long broadcast throws and strong, steady, and penetrating signals over long ranges—not high-frequency, short-range piconets. I’m paraphrasing, but I think I heard you imply that holding onto 2G technology is more appropriate for you moving forward.

Dinerstein: For cell connectivity, yes. For LoRa, Semtech—the company that has the patent on it—is advancing rapidly. We hope to take advantage of advances in LoRa technology. On the satellite modem side, it’s state of the art. The great thing about Inmarsat is that their satellite modems always work. With their geostationary satellites, as long as you have a window to the sky—even a light gap in a rain forest—and the azimuth and angle set correctly, you’ll have connectivity, which is vital for us. We’re now looking at a project to help



conserve mountain gorillas in several countries in Africa. You can imagine that the most difficult challenges you could possibly face would be in tropical mountain environments where you have steep slopes, deep hidden valleys, etc. How in the world are you going to get a signal out of a mountain gorilla in one of those valleys? We can do it with this new technology.

You have to invent or take advantage of the technology that applies to your use case. It would be great if there were 5G and more IoT adaptations that we can take advantage of, and there will be. We’re talking a lot with Microsoft, who is also one of our supporters and are helping us create DNN models to run on our device.

And while we had to invent the hardware, we think our platform could be useful for addressing a number of use cases without changing it very much. In addition to anti-poaching, we can address wildlife monitoring by having groups like Intel, Microsoft, and Google help us move models that detect gorillas, elephants, or chimpanzees, which we’re working on right now. That way, you could only send pictures of species of interest through the system to the person at the other end who wants that information, such as park officials or biologists.

It could help with wildlife monitoring because rather than trudging up a mountain-

PROTOTYPES IN **4** DAYS FROM TAIWAN



No Tariffs!

Best Quality and Price!

Technology:

Up to 50 Layers
Any Layer HDI
Sequential Lamination
Blind / Buried Vias
Laser Drilling / Routing
Heavy Copper

Materials:

Fr4
Metal Core
Isola
Rogers
Polyimide - Flex
Magtron



www.PCB4u.com sales@PCB4u.com

SAM & ITAR Registered UL E333047 ISO 9001 - 2015

side—like my colleague does who studies snow leopards—to check camera traps and pull out the SD cards, people could sit in a hut on their laptop to view images of wildlife passing by the cameras. In some places, saving wildlife is the critical objective, while the conservation objective is preventing “human-wildlife conflict.” There are about 16 species that this heavily applies to from polar bears entering villages in the Arctic to elephants entering croplands and lions raiding night corrals where livestock are kept. There are only 20,000 lions left in the wild, which is only six big populations. Everybody watches “The Lion King,” but most don’t realize how endangered lions are becoming. The big threat is retaliation killing, which is the same for snow leopards; that’s how most die. When these large cats kill livestock, the herders go after them. If you can prevent that, that’s vital.

Johnson: How do you accomplish that?

Dinerstein: What we’re doing for lions right now is testing LionShield, a new system created by another colleague of ours and inventor, Henrik Rasmussen of Savannah Tracking. LionShield works by first identifying “problem lions”; then, you put a radio collar on them with an RFID chip—although going forward, it

will be a LoRa chip—which communicates with the base station placed in front of a night corral. When the lion is within about one kilometer of the base station, it starts picking up its signal, which pings out frequently. When the lion is within 200 meters, it triggers flashing lights and an ear-piercing siren that scares the lion off; it also alerts the community to be vigilant because it’s very loud. The main problem is you have to capture the lion, tiger, leopard, or cheetah first. However, this can be extremely difficult in terms of the cost, permissions, logistics, and time and effort required.

What if you could replace having to capture the animals with computer vision? You could have a variation of TrailGuard AI called VillageGuard AI in front of livestock corrals. If you have enough of these out there, when it detects a predator, it could trigger the base station. That’s another way that we can use it. We’re also developing one called RiverGuard AI for the Amazon to protect indigenous communities; most of the traffic—and intruders—comes by boat because there are few roads. If you could monitor boat traffic, you could see who’s going in and out of these areas.

Indigenous reserves are also being invaded by poachers, gold miners, loggers, and oil and gas extraction explorers. Someone once said, “If you could only put a guard post at the con-



Standard camera trap (L) vs. the TrailGuard AI camera (R).

fluence of two rivers, you'd be able to monitor all of the traffic that goes up and down it." Well, what if you put a RiverGuard AI with our gateways linked by LoRa to a satellite modem, and then be able to have a satellite modem linked to a laptop in a village of indigenous groups where they can look at who is entering their reserve on the screen?

The key point is all of those applications use the same hardware platform. We're changing the DNN model we run on the Myriad chip to have this different use case, and it saves on manufacturing costs too. We're making the same hardware device, but the software varies.



Johnson: Where you're pushing boundaries is not where one would immediately think; you're pushing boundaries around extreme conditions. The technology that you're working on includes improving the sleep mode, battery life, AI-based image processing on the edge, and managing hardware so that it's much more rugged and durable, and much easier to hide. All of that technology is cutting-edge development for you and your team, but will also trickle back into consumer goods over the years.

Dinerstein: Definitely. Nobody wants cheap stuff that breaks easily or doesn't work. If it works in Africa, it can work anywhere.

Johnson: Given that, what does your development environment look like?

Dinerstein: It's quite philanthropic. For instance, for us to gain access to the Myriad 2 chip and program it, Intel has given us tremendous in-kind engineering support and critical access to their hardware and software libraries. Their contribution has been huge. And Sigmatron International, as the manufacturer, has helped us by absorbing some of the costs.

We're a very small non-governmental organization (NGO) with 20 people. I used to be a chief scientist at the World Wildlife Fund for 25 years, but I moved my operation to RESOLVE

to get away from the bureaucracy and be able to innovate again. I have to be chief strategist, fundraiser, and communicator, and part-time engineer. My Ph.D. is in both wildlife and conservation biology, but thanks to working with Steve Gulick and the engineers at Intel over the last five years, I've had a crash course in electrical engineering, manufacturing, and computer science.

Being a tiny NGO, we have to do everything, so it's a lot of work. The way that we've been able to do this is through creative partnerships and by picking the best groups out there. We wouldn't be where we are today without Intel, Inmarsat, Sigmatron International, Microsoft, and Google, who have helped us a lot. And we would be nowhere without the generous support from our donors, such as the Wildcat Foundation, the Stadler Family Foundation, OneEarth (formerly the Leonardo DiCaprio Foundation), Weeden Family Foundation, Operation Diana, Global Conservation, the Band Foundation, the Arcus Foundation, Marshall Field, Lori Price, Anne Pattee, and others.

Johnson: Eric, this has been great. Thank you for sharing your work with us.

Dinerstein: Absolutely. Thanks for including us in the conversation. SMT007

Dromology: Time-space Compression in Manufacturing

Smart Factory Insights
by Michael Ford, AEGIS SOFTWARE

Dromology is a new word for most of us, I expect; it certainly is for me (and Microsoft Word). Dromology resonates as an interesting way to describe changes in the manufacturing process due to technical and business innovation over the last few years, leading us towards Industry 4.0. It is easy to lose track of the many changes that are happening, as our experience of the compression of time and space has taken place over many years. Paradigm shifts that new technologies enable today should not be surprises if the trends and direction of business needs are understood. Best practices going forward should be based on achievable goals, edge towards expected future business needs, and be driven by the opportunities that technologies bring. Let's look at dromology in the assembly factory today.

dromology

< French dromologie < Ancient Greek δρόμος (drómos, "race, running, racetrack, course, path") + λόγος (lógos, "account, explanation, narrative"); term coined by the French philosopher Paul Virilio to discuss the importance of speed in warfare and communication. Equivalent to dromo- + -logy.

Noun (philosophy)
The science or logic of speed.

Digital Manufacturing Engineering

We started with what was once industrial engineering. For many, the earliest applications of computer system technology in manufacturing were related to electronic product design and the entry of data into manufacturing. Previously, data was created through reverse engineering, taking measurements and paper drawings to feed the need for automation. What took weeks, if not months, could now be done in days using computers.

Though the use of engineering systems helped, it was not enough to change the paradigm. Production configurations continued to be defined and decided by engineering and driven through the singular assignment of product to line configuration. Best practices today, enabled by digital manufacturing engineering tools, have broken through to support the business need for flexibility, allowing products to be made on any configuration whenever needed as determined by the capability to deliver closest-to-completion requirements.

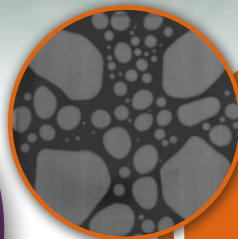
For data preparation, programming, and paperless documentation, the time needed using digital tools is compressed down to just a few minutes. Planners can utilize this capability and have a wider choice of planning options, increasing equipment utilization, overall productivity, and reducing the need for sub-assembly and finished goods storage and warehousing space. The use of standards, such as the IPC-2581 Digital Product Model Exchange (DPMX), together with the latest digital manufacturing engineering tools, revolutionizes design through manufacturing flow as well as the potential for planning in accordance with Industry 4.0.

DEFECTS ELIMINATED RELIABILITY DELIVERED

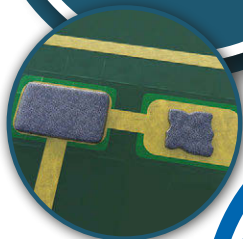
**AVOID:
DENDRITIC
GROWTH**



**AVOID:
VOIDING**



**AVOID:
INSUFFICIENT
SOLDER DEPOSITS**



**AVOID:
SOLDER BEADING**



**AVOID:
NON-WET
OPENS**



**AVOID:
HEAD-IN-PILLOW**



Visit us at Productronica: Hall A4, Booth 214

Learn more: www.indium.com/avoidthevoid/SMUS

Contact our engineers: askus@indium.com

From One Engineer To Another®

©2019 Indium Corporation



IIoT-based Digital MES

Manufacturing execution systems (MES) were once controlled with paper and a logbook. The paper travelled with the group of products being made, from process to process, to inform each stage of the operation what setup requirements had to be made. The resultant events were then written into a logbook.

With the introduction of computerization, nothing really changed other than the process became faster and more efficient. Information about work orders could be accessed on a computer. Barcodes could be used to eliminate manual records and provide flow control with data captured from machines to show what had been done. It was not a revolution, however, as legacy solutions were set up to follow the historical need rather than carve out the path for the future.

The required time-space compression has only now been achieved through the adoption of IIoT-based communication, now most strongly represented by the IPC-2591 Connected Factory Exchange (CFX) standard. The breakthrough is that any and all processes, automated or manual, are now connected to each other and to factory systems in real time with a specifically defined language content that makes them plug-and-play. With native CFX support, data exchange is a mere fraction of the difficulty and cost of any other connection method.

The digital MES is specifically designed to utilize CFX data to create the context of events and opportunities across the plethora of equipment and process types, building a true “big-data” digital model of the live manufacturing operation. Real-time dashboards, alarms, reports, tracking, flow control, process traceability, etc., are all elevated to the next level of accuracy and detail. But the true revolu-

tion comes in the way that software—which many now call artificial intelligence or (AI)—can start to make or offer real decisions for changes, supporting continuous micro-corrections as issues and opportunities arise, and more importantly, as customers change their delivery requirements. In this way, high-mix, small-lot production can be done without the traditional overhead of lost productivity due to inefficient changeover through the utilization of digital manufacturing engineering.

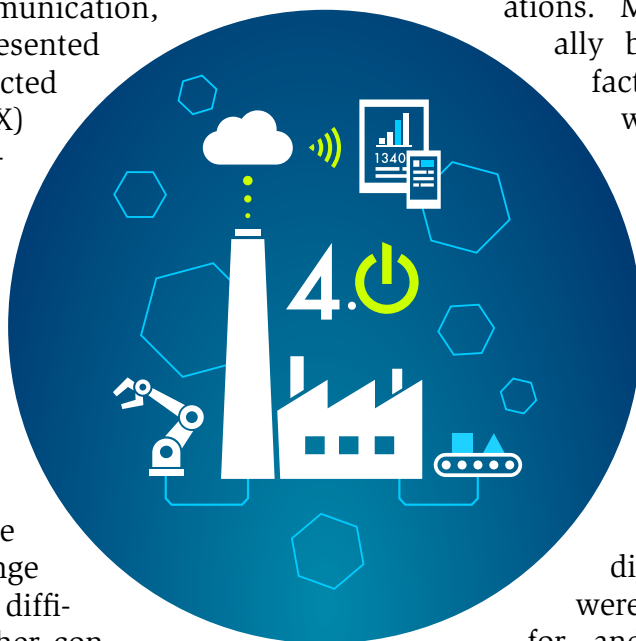
Lean Material Management (Supply Chain)

Being the most expensive aspect of manufacturing, materials have always been over-managed. Any mistake can cause huge quality issues, and shortages can cause serious on-time delivery-related problems. No other area of manufacturing has been allowed to waste money in the way that materials continue to do

for most assembly manufacturing operations. Materials have traditionally been supplied to manufacturing in the form of kits, which ensure all materials are present, such that the whole work order can run without the risk of material starvation.

The overhead of pushing kits out into manufacturing is essentially narrow-mindedness in the extreme. Even for high-volume manufacturing, it didn't work, as work orders were too big to make kits for, and daily kit requirements were never understood correctly due

to material spoilage and attrition. For small-quantity work orders, the oversupply of materials becomes the issue, as most materials are supplied on bulk carriers, the supply of which will far exceed the need to complete the work order in a kit in almost every case. Putting together the attrition and over-supply conditions, even computerizations within traditional MES could not keep track of significant



discrepancies between theoretical inventory levels and material locations versus physical reality. This resulted in unexpected internal material shortages, massive material scrap, and huge, bloated material inventories.

The revolution has come from the adoption of Lean technologies within the IIoT-based digital MES platform. Delivering materials “just in time,” as needed to production processes without any kit preparation—plus the exact material consumption derived from the CFX data—means that every individual component instance can be accounted for by the digital MES platform. Material logistics decisions are thereby optimized to reduce excess work and enable efficient use of automation. Material purchase decisions can be altered to remove the needlessly bloated stock, reducing the time for which materials need to be onsite and the space in which they need to be stored.

The elimination of kits also means that changes in product allocation and work orders, as demanded for the achievement of on-time delivery, can be supported through the JIT logistics operation, eliminating unmanaged shop-floor stock. This enables the flexibility of manufacturing that Industry 4.0 mandates, which is driven by digital manufacturing engineering and IIoT-based MES together. The whole factory, as a result, is more nimble and agile, and able to respond to needs for change far quicker without losses while using a lot less space.

Quality Management

As the most important aspect of successful manufacturing, quality management has transformed over the years, but somehow, is now going backwards. Factories used to test samples of incoming materials as well as outgoing products—each of which had a detrimental effect on the achievement of production and delivery targets, representing a very large and needless cost. After all, materials and products should be perfect.

Every dollar spent on quality checks could be interpreted as an admission of potential failure. Trends in quality management have followed this mantra for some time, pushing the respon-

sibility for material quality back to the supplier, such that incoming inspection can be reduced or abolished. In-line quality management has, to a great extent, replaced the dependency on finished goods sample testing. Quality management system (QMS) databases, with their collection of data from inspection and testing machines, have dramatically improved quality performance over time, and as a result, product reliability. Today, an effective, state-of-the-art QMS combines the ability to firewall quality issues in materials arriving from suppliers, detect and resolve in-process quality issues, and then digitally manage corrective actions to continuously improve the process via corrective and preventative action (CAPA).

**In-line quality management
has, to a great extent, replaced
the dependency on finished
goods sample testing.**

The revolutionary steps forward towards actually achieving zero defects, however, is facing an additional threat that might send quality management back decades: counterfeit materials. With the increase of ingress of counterfeit components not only of specialized parts but also everyday passive components—such as ceramic capacitors—the need for incoming inspection and testing of materials is returning, re-introducing associated costs and delays. However, modern counterfeits are delivered in such a way as to defeat inspection procedures and create maximum confusion in manufacturing to hide their origin.

Digital MES and Lean material management tools, combined with the quality management solution in a single package, are effective at being able to provide the exact traceability of materials. Patterns in test and inspection results throughout manufacturing can be associated precisely with the related incoming material carrier, providing clear and unambig-

uous accountability. With traceability established in manufacturing, the pressure is on material suppliers to extend such traceability upwards throughout the supply chain so that the origin of counterfeit ingress is discovered and eliminated. The revolutions described in each of the respective software solution areas combine to make this possible—a critical differentiator of a single-platform based manufacturing software solution.

Advanced quality programs, such as CAPA and failure reporting, analysis, and corrective action system (FRACAS), can also be expected to be incorporated into the modern real-time quality management solution, such that manufacturing quality control and accountability for issues can reach the level at which clear differentiation for the root-cause origin of potential defects can be accurately discovered. Quality is now a continuous process with no lead-time or loss-time required and has the potential to achieve zero defects from the advanced analysis of test and inspection data, eliminating the space needed for defect diagnosis and repair.

Manufacturing Feedback to Design

Our time-space journey within manufacturing ends at the beginning—the link between design and manufacturing. These entities were once very far apart from each other, in terms of time (in the order of months) and space (across many time zones). Following the business need for ever-shorter product cycles, faster new product introduction times, and on-shoring or re-shoring of manufacturing, design and manufacturing have had to become much closer. But things did not change for the designer who followed a set of design rules that determined how PCB designs should be laid out based on theoretical rules that often differed from product to product. From the design perspective, manufacturing has still been regarded as being in the “Wild West” phase until very recently.

Putting together all of the revolutions associated with digital manufacturing software as described, there is, for the first time, a very clear understanding of where responsibilities lie for production challenges and potential defects. Through the process of advanced

analysis, issues based on variation in manufacturing processes and material supply can be accounted for, leaving clear patterns associated with design features. For the first time, design for manufacturing (DFM) can work based on dynamic rules rooted in the reality of manufacturing and associated with a specific location, factory, line configuration, product type, and more. Dynamic design rules based on actual production performance enable designers to consistently create products that can be made cost-effectively with maximum quality.

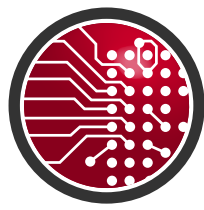
The IPC-2581 Digital Product Model Exchange (DPMX) is a prime candidate to become the bi-directional tool of choice, containing both design and manufacturing feedback data, enabling a direct assessment of design intent versus manufacturing result. Having introduced digital manufacturing engineering and an IIoT-based MES that includes Lean material management and advanced quality management on a single platform, we can consider the ultimate next step of qualified and contextualized design-related information to be used as part of the design process.

The Way Forward

Though this final part is yet to be realized commercially, all of the other manufacturing software technology mentioned is already available, representing a step-change opportunity in terms of the reduced cost of ownership and deployment issues as well as far greater potential benefits than ever experienced before. The final part is just a simple step away. Looking at the almost gradual change in manufacturing software technologies over the years that have helped—but, in some cases, hindered—manufacturing innovation, it is exciting today to see how the latest software solutions are key enablers and providers of the Industry 4.0 revolution. **SMT007**



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



APCT

Passion | Commitment | Trust

Risk

Transfer

Accept

Avoid

Mitigate

We've Got This Dialed In

APCT Global Specializes In Risk Mitigation

APCT Global Delivers

A Commitment To Integrity, Quality & Product Management

ADVANTAGES

- Ease-of-Use
- Seamless Recipe Transfer
- Inventory Management
- Risk Mitigation

STRATEGIC REGIONS

- Japan
- South Korea
- Vietnam
- Taiwan
- Northern China
- Southern China

DISTRIBUTION SITES

- Austin, TX
- Hong Kong
- Wallingford, CT
- Santa Clara, CA
- Orange County, CA

Contact APCT Global Today | 203.284.1215

APCT.com | Global Center

Printed Circuit Board Solutions

APCT.com

APCT Santa Clara HQ

408.727.6442

APCT Anaheim

714.921.0860

APCT Orange County

714.993.0270

APCT Wallingford

203.269.3311

APCT Global

203.284.1215



Merger and Acquisition Trends

Feature Interview by the I-Connect007 Editorial Team

In this interview with the I-Connect007 Editorial Team, Green Circuits' Joe O'Neil breaks down the current merger and acquisition (M&A) market in the electronics manufacturing space and the industry trends that affect it. Joe also gives his advice on best practices for the negotiating table from both the buyer's or seller's perspective.

Nolan Johnson: Dan, since you are particularly qualified to talk about M&A issues, I'm excited to have you lead this.

Dan Feinberg: It has been a while, but I was involved in a number of M&As as well as divestitures back in the '80s and '90s both as the acquiree and acquirer. It was an exciting time.

Johnson: What is your perspective on the global dynamics for M&A, especially since you have been involved in one or two transactions recently?

Joe O'Neil: It's probably not going to be set up as a good time for both the buying and selling side, but rather more one or the other. Rarely is it nicely aligned, but it does seem like a good time from the selling side. Multiples are up, and interest rates are non-existent, so it seems to be shaping up as a pretty good time to look at options. But it's more about whether it's the right time for a particular business, given the business cycle, especially with the election next year and a lot of other variables, which may indicate some longer-term uncertainty.

It has been a nice, long run, but how long will it continue? Uncertainties can play into people's assessment of whether it's a good time or not and impact the buying side. There are some things driving it in terms of new entrants in the market, new private equity firms, and new platform companies that are trying to do a roll-up strategy or something to take a bunch of Tier 4 organizations and end up in a Tier 2 space. There are a lot of moving parts.

Feinberg: I agree with you. Usually, it's either the best time to buy or the best time to sell.



The right solutions happen when
you care enough to ask the right questions.



At KYZEN, we have the **SCIENCE** and expertise to solve any cleaning problem, and the **CARE** to find the perfect solution for your individual cleaning process. When science and care converge, your cleaning process succeeds on every level.

Request expert cleaning advice and technical support at kyzencares.com!



KYZEN.COM

WORLDWIDE ENVIRONMENTALLY RESPONSIBLE CLEANING TECHNOLOGIES

And sometimes, it doesn't have anything to do with the global dynamics or economy; it has to do with what's going on in each company, such as, "It's a great time to sell my company because we just peaked out and we know that it's not going to do that again," or, "It's a great time for us to acquire a company because we want to diversify, invest, etc." Other times, it is the global dynamics, which are interesting right now. For example, I hear that some Chinese companies are looking to buy businesses outside of China. Do you see that?

O'Neil: I've heard talk in the same realm, and I don't know what's driving it other than maybe pricing. The tariffs and cost benefits are probably parts of it. There has been a consistent push from large OEMs that want some in-region capability and continuity, whether it's North America, Europe, etc. If they have engineering and development teams in Silicon Valley, and they're spending a billion dollars with a U.S. company, then they want them to make sure that they can have the service and support to take it through the R&D process into NPI and launch into low-cost regional production to capture and retain large opportunities. You need to be in a position to support engineering efforts, not just low-cost, high-volume production efforts, but I don't know that that's new.

Feinberg: One of the things that I've been told by some associates in that area recently is that they are looking to either build or buy outside of China, and it's not necessarily the tariffs; it's just the general trade environment. I have also heard speculation that the agreement on

trade between the United States and China is nearly final, but the Chinese don't want it to take effect for six years. Trump says, "No. The day we sign it, it takes effect," and that's what's holding it up. In other words, we're hearing that they're still trying to negotiate something. One of the thoughts is if the Chinese don't keep their word; would it matter? In six years, Trump will not be the president of the U.S. anyway.

O'Neil: Yes, six years is a long time.

Feinberg: So, why wouldn't China want to say, "We agree to pay you negative tariffs on everything, but it doesn't take place for six years." The global dynamics are interesting. There are trade disagreements, and a trade war, between the two countries with the largest economies in the world. If you take the two of them together, they would represent more than 50–60% or more of the global economy. One factor with any acquisition is the kind of technology you are getting; it is not just about sales but also future opportunities. Have you made some acquisitions with manufacturing?

O'Neil: Most of my experience has been domestic, not international, and in the \$5–100-million range, which isn't massive. But you touched on something earlier about if it's a good time for me to sell right now. I've heard about a bunch of places for sale, so if someone walks in with the Brinks truck, there's a discussion to be had. It's an interesting time in that the number of founders who started in the '80s and '90s are hitting retirement and either having trouble with a succession plan or asking how much longer they want to be doing this.

Right now, the economics are favorable from a buyer perspective, but from a seller perspective, multiples look like they are up. But something that doesn't support multiples being up is that there's a lot of availability right now. A lot of people are open to having those discussions, and it's a good thing for people to consider what it is that they're looking to do. It's never a great idea to sell just because your multiples are high. Is it the strategic thing to



do? Is it the right thing for you to do and for your management team, employees, and legacy? All of those things come into play.

Johnson: You mentioned that there might be some new sources of money coming into the market.

O'Neil: It feels like there are a number of new private equity players to the EMS industry that are coming in and looking to get involved and do some roll-ups and different things. There's a little more financial market attention since the original companies went public and assembly shops turned into electronic manufacturing services providers.

Johnson: Are investor groups rolling companies up and consolidating a bunch of smaller players?

O'Neil: Yes, and they may try to roll out some different models. There seems to be some demand aggregation for models out there and people who are simply performing intermediary-type plays, and that's gone a long way in the plastics injection molding type of market; some new models have come out of that. The PCB fabrication industry is becoming dangerously concentrated. The top four or five companies control around 90% domestically. Typically, that vacuum can create some opportunities.

On the assembly side, there's still a lot of fragmentation, and OEMs are still looking for their optimal solution. They don't all want the same thing, but most of them want at least in-region capability, and then they're just looking for the right match in terms of service and technology. The model plays a little bit too, so are you geared up to do high-mix, low-volume? Are you looking at a place where you're one of five customers on a deep production engagement?

Johnson: You said something about PCB fabrication that I want to talk about. You used the phrase "dangerously consolidated." PCB fabrication is an industry sector where we can identify quite a few smallish players as well as a

trend for ownership to be reaching retirement age and looking to move on to the next phase in their life. So, that's a great niche of the market in which to be consolidating, if that's what a financial investor wants to do. Yet, you also said that it's dangerously consolidated. Does that imply that there's room for new business model innovation there?

O'Neil: I think there is. I don't know what that new business model is, but I know that the fabrication industry has matured tremendously. There is less of a need for the designer or OEM to sit next to the CAM operator in the factory. There was a time when there were thousands of PCB fabricators, and every board was a step into the wild blue yonder, so there was a lot of face-to-face collaboration.

There are still ultra-complex projects, but the application engineers can get out there, and the equipment sets, capabilities, and tolerances have matured, which has led to a lot of the consolidation too. Now, your equipment is set to be a player in that rarified air. It's probably the continuous capital investment of millions of dollars annually. That definitely limits the ability of the sub-\$10-million revenue category players to continue to gain market share. It's a tough one, and there are still around 200 that fit in that category.

Feinberg: Our chairman of the board back in the day, Charlie Lock, converted Morton from just Morton Salt primarily to a bigger, more conglomerated company. He used to say exactly the same thing that Joe did. He often said, "Nothing is for sale, and everything is for sale." He and his successor, Jay Stewart, built the company up with enough cash that, as division presidents, we had goals every year to start an acquisition. We didn't need to secure an acquisition, but because the chairman of the board and the board of directors said we needed to expand, we wanted to make acquisitions.

So, there are other reasons why companies make acquisitions, and you must understand what they are if you're going to be acquiring or selling to a company. What is your

board targeting from a strategic standpoint? I also suggest that you try to meet with the other company's board to learn their goals and why you would want to buy them. What do they have to sell to you?

We were once in the middle of a significant acquisition where either we were going to acquire them, or they were going to acquire us, and the board of directors didn't seem to care what happened. Both companies were at a point where they were at a critical mass and needed to either get much bigger or sell. Those discussions went on for a while, but it was interesting to hear the reasonings behind this from the boards of directors; they seemed to have little to do with Company X getting our dry film or us getting their electroless copper.

One of my recommendations for anybody who is looking to acquire or be acquired is to try to have a meeting with the board of directors, not just with the senior executive who's leading the charge here because it will have to come out. Find out the directive and mission and whether you do or don't have what they want, but you may have additional benefits. If I was going to be involved in a major acquisition today, I would want to meet with the other company's board.

O'Neil: I agree. Identify the drivers and do as much reverse diligence as you possibly can to make sure that there's true alignment and it's not just checking all of the financial boxes.

Feinberg: You're looking for a partner in life. Think of it like getting married; you'd want to know if they liked you for your looks or your new car. Is there a long-term goal? If so, what is it? Joe, you have made some acquisitions, and we understand that you may not be able or want to talk about them. But have you considered selling? Are you in an acquisition or growth mode?



O'Neil: We're in growth mode, but we're definitely looking at acquisitions. We looked at—and went down the road with—a couple, but things don't always make it to the finish line. The group that's behind us has a full-time person who's doing nothing but reviewing opportunities. It's amazing how much is out there and how much is not truly differentiated. Whether you're thinking of selling or operating for the next 100 years, figure out what differentiates you and sets you apart, whether you're one of 200 sub-\$10-million PCB fabricators or one of 2,000 EMS companies that are in the sub-\$20-million range.

There are a lot of companies out there that position themselves as “high-mix, low-volume production, quick-turn, high-reliability, and medical and consumer”; they say, “We're everything under the sun for everybody.” But when you look under the hood, they aren't all things to all people because no company can be. So, figure out what makes you different in the market and why your customers work with you. If you ask them, they'll tell you. And if you have top-10 customers, and you talk to all of them, you're most likely going to find a common link. That common link is your secret sauce and will give you the answers. We get excited when a company is available or becoming available, they know why they want to exit, and they know what their secret sauce is; that's when things move quickly.

One X-ray, please.

100% inspection of hidden solder joints with
AXI within line cycle time.

Webinar · 22nd October 2019 · Tuesday
2 pm UTC · 4 pm MESZ · 10 am EDT · 9 am CDT



Feinberg: That company positioning sounds like any one of the 20 messages I receive on LinkedIn every morning, trying to sell me something.

O'Neil: Exactly (laughs).

Feinberg: But I agree. When you're going through an acquisition, the fun part is the negotiation. Once you've decided, "This would be a good acquisition for us," or, "We might be interested in selling," then the fun begins, and I seriously mean that. I found the acquisition process—even when it would take months and months sometimes—to be quite enjoyable. I made some good friends. I ended up with people who I had acquaintances with that I did business with later. It's an interesting process to go through and one that many never get the chance to do.

O'Neil: It is, and it can be daunting and complex. Some people oversimplify it and go alone, which is dangerous. Other people view it as complicated, and, therefore, avoid having conversations because they feel that they're out of their depth. It's something to explore, and it's worth having those conversations, but not on a daily basis. Often, you learn a little about your own business. Even if you don't get to the theoretical starting line of a process, you must explore it a few times before you're ready. Then, it makes all the difference in the world that you have advisors who you trust and who do it for a living. My experience has been from both the buying and selling side that those individuals are well worth the large amounts of money that they do make. That has always been money well-spent because it's a big inflection point from either side.

Feinberg: And don't forget that you're also negotiating the future of the employees, not just the company; I always considered that to be an important factor. For example, which part of the contract is going to guarantee that you will keep some or all of them, or that you will keep manufacturing? There's just so much to consider beyond the price. And when you're going

in to negotiate these things, it's so important that you have a team; part of the team's job is to do nothing but watch and listen. You'd be amazed when you come out of these meetings, and someone else from your team says, "When you said this, did you notice their reaction?" You don't always notice because you're the one talking and concentrating on something else, but those things are so important during negotiation.

Johnson: Do you have any words of advice for somebody who might be considering selling? Conversely, do you have any words of advice for somebody who might be considering growing by acquisition?

O'Neil: On the selling side, we touched on a lot of different points already. Make sure you do your diligence on what the underlying goals and objectives of the potential acquirers are. Now is a good time; everyone's going through their 2020 business planning process anyway and throwing systems into place that enable you to have intelligence into your customer base. Find out what markets they're in and what value you provide to each of them. That's just good business planning, whether it's preparing from a buying or selling side.

Part of the benefit of going through it a few times is you get to know what data is critical for M&A, and then you find out that that data is important for running your business anyway. Also, find advisors who can help shepherd you through the process. Different-sized organizations have various types of engagements, whether they're investment bankers or business brokers, an active board of directors, an advisory board, or a group of colleagues and friends. It can run anywhere along that gamut, but going it alone is dangerous and potentially costly.

From the buying side, make sure when that seller says, "Why are you interested in my business?" that you have a real reason. A lot of times, it's just, "We were told to put this money to work, so we're going through the list," but that's not a recipe for success. When you can have tens, hundreds, or thousands of employees thriving, I've seen it be successful when



**Get to Your “ah-ha!” Moment.
Become a Standard’s Expert with Our Experts.**



eptac

TRAIN. WORK SMARTER. SUCCEED.

ALL NEW PROGRAMS:
IPC-A-610, J-STD-001, IPC-A-620, and more...

EPTAC makes it easy. Complete the course, pass the exam, receive your certification.
Best of all, add credentials to your technical expertise with an industry recognized certification.

Call 1-800-64-EPTAC, email sales@eptac.com or visit eptac.com/cse to find a class near you!

“Having a clear shortlist of what you need to do that everyone understands from both sides of the table can create some early wins where the two teams truly join as one.”

everybody gets new opportunities and refreshed viewpoints; as they say, “The rising tide raises all ships.” It can be terrific strategically.

It’s exciting when you become a part of a bigger entity and have so much more to offer as well as more resources, tools, and opportunities for advancement. When it’s done just to deploy capital, it may have the same outcome, but you’re going to have to figure out how it plays out and reach a win-win situation, even though I know that’s an overused cliché. But if you don’t have a clear win-win situation at the time of the acquisition, you’re going to have a hard time with one moving forward.

Feinberg: I totally agree. The mission of the acquisition needs to be defined by the acquisition team as directed by the board. Is it to grow or diversify the business by entering other industries? The mission needs to be defined, and one of the first tasks should be to set up a mission statement for the acquisition.

Johnson: With your objectives clear and a mission statement in place, you’re not advising companies to stand pat in this current industry. If it’s in their sights to acquire or sell, they should be actively talking about that right now.

Feinberg: You should always have your eyes open and looking for opportunities. Leave it up to senior management to run the company, grow the business, and gain more customers; that’s the sales manager’s job. Strategic development and growth is the senior executive’s job, so let them do that. Set the mission when you’re looking at a potential acquisition, and you can’t finalize that mission until you come up with a target company. For example, if General Motors wanted to buy Boeing, they would probably be aiming to diversify, whereas if General Motors wanted to buy Ford, they would be expanding; those are different missions.

Johnson: My personal experience with M&A was the integration of systems and methods between two companies once they were brought together. Given that you’ve had some recent acquisition experience, is there anything you should pay attention to once you’ve signed the deal, money has changed hands, and you have combined employees trying to create a larger entity out of all of this?

O’Neil: Have an integration plan done beforehand; don’t wait for the deal to close, and then say, “Well, now we have to put them together.” Diligence and integration go hand in hand. Determine who your integration champions will be as well as the key points you want to highlight. Prepare 30-day, 60-day, and 90-day plans right away; together, assemble a plan for what you want to do in the first year, second year, etc., because it’s going to be more complicated than it appeared in the pre-close. Having a clear shortlist of what you need to do that everyone understands from both sides of the table can create some early wins where the two teams truly join as one.

Johnson: Those are great words of advice.

Feinberg: This is not an easy topic to discuss because it’s so variable. We’re talking about tactics for playing sports in general versus tactics for specifically playing football, pickleball, etc. M&A is such broad a topic; it’s a universe. I do not believe that anyone can be a true expert in all aspects of M&A.

Johnson: Joe, thank you for taking the time to talk with us.

O’Neil: It has been good to catch up with you both. **SMT007**

WHAT DO ALL OF THESE LEADING COMPANIES HAVE IN COMMON?



They all benefit by advertising with us—PCB007 China Magazine.
Should your name be on the leaders' list?



GET STARTED NOW!

I-Connect007
GOOD FOR THE INDUSTRY

pcb007china.com



Global Political Turmoil **Creating** **Uncertainties** for the Industry

Feature by Chris Mitchell

IPC—ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES

One of the most fundamental truths about human beings generally, and business specifically, is that we crave certainty. When we are optimistic about growth and the business environment, we are more likely to invest in people, equipment, and innovation. But when uncertainty rears its head, we become cautious and postpone our dreams.

From where I sit, representing the interests of electronics manufacturers and related companies around the world, I regret to say that the future of our industry—while bright overall—is fraught with uncertainties, from trade policy disputes to government leadership turnovers and economic and social megatrends. IPC is working with all governments and parties to overcome these uncertainties, but there is a lot to tackle.

The Future of Major Trade Policies in Doubt

Let's start with the future of international trade. The electronics industry is characterized

by a complex, integrated web of supply chain relationships that create jobs in all regions of the world. About 80% of IPC members are small- and medium-sized businesses with specialized niches and relatively thin profit margins.

But while electronic products and services are at the heart of almost all key industries—from defense and aerospace to automotive, information and communication technologies (ICT), manufacturing, retail, healthcare, and more—many policymakers don't seem to realize the importance of keeping those supply chains open.

The industry has changed dramatically over the last 50 years as governments steadily reduced tariffs and non-tariff barriers. Companies have invested in international supply chains to balance many factors, not only to take advantage of lower costs abroad but also to be closer to billions of consumers abroad. The growth of the global marketplace has delivered tremendous benefits to millions of workers and consumers. What will happen now with several governments and political parties resurrecting trade barriers?

Highly Certified Premier
Mil-Aero C5ISR
Electronics Contract Manufacturing
& Engineering Design Services

DESIGN
BUILD
TEST
TRUSTED



Protect your data and choose an electronics contract manufacturer that is IPC-1791 certified.



Zentech was one of the first electronics manufacturers to earn the IPC-1791 Trusted Assembler certification and to become NIST 800-171, DFARS 252.204-7012 and FAR 502.204.21 compliant.



Zentech is considered a subject matter expert in NIST 800-171 compliance.
Cybersecurity/John Vaughan
interview



NIST Compliance is just one of the many ways we take great care of our customers.
[Learn more at zentech.com](https://www.zentech.com)



Baltimore, MD Fredericksburg, VA

www.zentech.com • 443-348-4500 • sales@zentech.com

U.S.-Mexico-Canada Agreement Coming to a Head

In North America, the governments of the United States, Mexico, and Canada are laboring to secure a new U.S.-Mexico-Canada Agreement (USMCA) to replace the '90s-vintage NAFTA. IPC supports USMCA because it would reduce the risks of doing business in North America, creating a better environment for investment in people and facilities, and serving as a timely antidote to global uncertainty. Read the IPC study on the issue ^[1].

Mexico's government has approved the deal. Canada's government says it will move in tandem with the United States, but the outcome now depends on a federal election there on October 21. In the U.S. Congress, House Democrats are negotiating with the Trump Administration to reach a bipartisan compromise, but the window of opportunity before the next U.S. election may close soon with no resolution. The U.S. Trade Representative and congressional leaders are reporting progress in talks, but much work remains. IPC is working on getting a "yes" vote in Congress this fall, and we invite our U.S. members to join us in calling on your elected representatives to approve it without delay through the IPC Advocacy Team.

U.S.-China Dispute Creating a Drag

Across the Pacific Ocean, the United States and China are locked in a de facto trade war brought on by President Donald Trump's willingness to use pain-inducing tariffs to attempt to force China to accept long-desired concessions on intellectual property and market access. Tariffs of varying levels are now in place on most goods traded between the United States and China, and it's a challenge merely to keep track of the multiple lists of products that are affected and/or excluded.

As of this writing, intermittent U.S.-China talks are back on again; both sides clearly want a deal, but there is no clear path for reaching one. Senior leaders from both countries will meet again in October. From IPC's perspective, again, our members are located throughout the world—including the United States and China—and engaged in a variety of supply-chain relationships that cross multiple borders. Imposing tariffs on goods from a single country like China gives a false notion that these are Chinese goods. More accurately, goods coming from China are often made by U.S. companies and support American jobs.

IPC supports the right of all countries to address unfair trade practices, but the Trump administration's imposition of tariffs on China is self-defeating. The tariffs are effectively a tax on U.S. consumers and businesses, and they're creating significant uncertainties for businesses on all sides. There is also little evidence to suggest that the tariffs are bringing jobs back to the U.S. If anything, they are shifting investment and jobs to more stable developing countries, such as Mexico and Vietnam.

IPC maintains a network of offices and local representatives across the region, and we engage with policymakers in a variety of settings. We welcome member inquiries and suggestions about trade policy issues in these countries.

Europe Also Embroiled in Uncertainty

The theme of uncertainty is playing out in Europe as well. In the United Kingdom—which is home to dozens of IPC members employing nearly 200,000 people—the govern-



ment of Prime Minister Boris Johnson is trying to exit the European Union on October 31. If that occurs, World Trade Organization (WTO) tariffs between the U.K. and EU could snap back into effect, requiring goods to be repriced accordingly. Customs officials would need to re-establish rules and procedures at the various borders. Companies with operations in the U.K. and EU would need to comply with two sets of regulations instead of one.

The electronics industry could be disproportionately impacted. Without an orderly Brexit, the U.K.'s share of the EU's electronics market could drop as British companies find it harder to access European electronics workers and customers. Compounding the uncertainty, the British Parliament and Prime Minister Boris Johnson are locked in a prolonged political standoff, and another leadership change or snap election cannot be ruled out.

Moving eastward into Europe, in a bright spot for trade policy. The European Union and the four founding members of Mercosur—Argentina, Brazil, Paraguay, and Uruguay—reached an agreement in June on a new trade pact. If approved, it would cover a population of 780 million. The EU and Mercosur agreed on substantial market openings for industrial goods, government procurement, IT services, and agriculture.

However, spurred by the wildfires in the Amazon this summer, some EU policymakers and activist groups are raising concerns about the deal's environmental impacts. Simultaneously, a new EU President and slate of European Commissioners are just coming into office, and they have emphasized an agenda of environmental protection and trade policy enforcement. The ratification process for EU-Mercosur is beginning to look like a more complicated affair.

And remember the WTO? In theory, it is still the world's largest and most influential forum for trade policy and enforcement. However, the U.S. government—which has threatened to leave the WTO over national sovereignty concerns—has refused to consider nominees to fill four vacancies on the organization's appellate panel, which rules on disputes over WTO



rules. A U.S. lawyer who still serves on that panel has said he may resign by December, leaving it without a quorum to conduct business and throwing a dozen long-running cases into disarray.

Recession Fears and Technology Disruptions

So far, I've spilled more than 1,000 words on uncertainties created by international trade disputes and government leadership changes, but even higher-level uncertainties loom. There's no doubt that in recent weeks, you have seen the sudden wave of news and commentary about the possible risk of a recession in the next 12–24 months. Amid the various trade skirmishes and a batch of worrisome economic indicators, a survey released in August found that 74% of economists predict the next recession will hit by the end of 2021 ^[2].

Take the elevator up another level, and the world faces a confluence of megatrends that are already disrupting business and the economy, from the cloud and “big data” to the internet of things, wireless everything, automation, artificial intelligence (AI), cyber threats, 3D printing, and the shortage of technically skilled workers, just to name a few. Be on the

lookout for a new analysis of the global industry coming soon from Shawn DuBravac, IPC's new chief economist.

At a Crossroads

Business executives and entrepreneurs are used to taking risks amid uncertainty. But the current era is making us painfully aware of how much is up in the air and how much could be lost if our government policymakers exacerbate those doubts instead of easing them.

At IPC, promoting international cooperation and confidence in our industry's future has been in our DNA for more than 50 years. As the global leader in industry standards, training, market research, and public policy advocacy, we are always striving to bring people together to help them achieve greater success. And we will continue to do that, building on

decades of fruitful progress, and knowing that through good-faith collaboration and a focus on areas of mutual interest, we will continue to evolve and become stronger and more confident in the process. **SMT007**

References

1. IPC, "[Strengthening Interconnections: The U.S.-Mexico-Canada Agreement and the Electronics Industry](#)," May 2019.
2. National Association for Business Economics, "[Economic Policy Survey](#)," August 2019.



Chris Mitchell is IPC's VP of global government affairs and [I-Connect007](#) columnist. Contact Mitchell at ChrisMitchell@ipc.org.

Researchers Develop Better Way to Harness Power of Solar Panels

Researchers at the University of Waterloo have developed a way to better harness the volume of energy collected by solar panels. In a new study, the researchers developed an algorithm that increases the efficiency of the solar photovoltaic (PV) system and reduces the volume of power currently being wasted due to a lack of effective controls.

"We've developed an algorithm to further boost the power extracted from an existing solar panel," said Milad Farsi, a Ph.D. candidate in Waterloo's Department of

Applied Mathematics. "We do not change the hardware or require additional circuits in the solar PV system. What we developed is a better approach to controlling the hardware that already exists."

The new algorithm enables controllers to better deal with fluctuations around the maximum power point of a solar PV system, which have historically led to the wasting of potential energy collected by panels.

"Based on the simulations, for a small home-use solar array including 12 modules of 335W, up to 138.9 kWh/year can be saved," said Farsi, who undertook the study with his supervisor, Professor Jun Liu of Waterloo's Department of Applied Mathematics. "The savings may not seem significant for a small home-use solar system but could make a substantial difference in larger-scale ones, such as a solar farm or in an area that includes hundreds of thousands of local solar panels connected to the power grid."

The study was recently published in *IEEE Transactions on Control Systems Technology*.

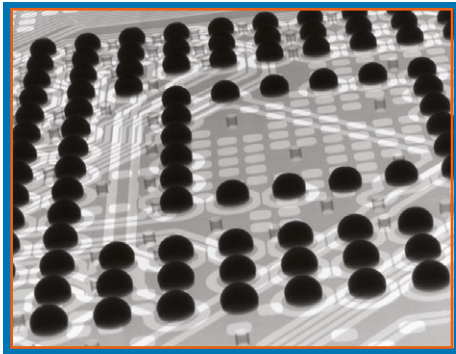
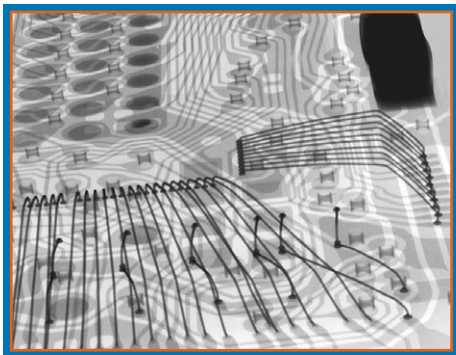
(Source: University of Waterloo)





Contact us and send us your sample!
info@creativeelectron.com

**Proudly
Designed and
Built in the USA**



The TruView™ Prime was designed to be easy to use. By utilizing the principles of “plug-and-play”, the TruView™ Prime can be installed and operated with minimal training. TruView™ Prime works as a semi-automated x-ray inspection system when powered by our TruView™ 10 Premium.



X-Ray Van
Schedule Your Visit Today!

Don't wait until the next trade show to check out the latest TruView x-ray inspection systems. Let the trade show come to you! Call us today to schedule a visit from our new X-Ray Van!

Creative Electron, Inc. 201 Trade St. San Marcos CA. 92078, USA
www.CreativeElectron.com • Phone: +1 (760) 752-1192



Supplier Highlights



The Role of Parylene Conformal Coatings in Next-gen Electronics ►

Designers and manufacturers of electronics are under pressure to make packages smaller, lighter, and more environmentally friendly while ensuring that their new technologies perform reliably in their operating environments.

Dispensing EMI Shielding Materials: An Alternative to Sputtering ►

Technological advancements toward 5G standards, wireless charging of mobile electronics, in-package antenna integration, and SiP adoption are driving the need to apply more effective EMI shielding and isolation to component packages and larger modules.

Conformal Coating Processes and Trends ►

The I-Connect007 editorial team spoke with one of Nordson ASYMTEK's conformal coating experts, Camille Sybert, to discuss where the coating industry is trending, and, with the rise of Industry 4.0 and automation, how it is much less about providing the right applicator and more about addressing the entire conformal coating process.

Koh Young Named Among Top 10 Smart Factory Solution Providers to Watch ►

Financial Times recently listed Koh Young as one of its 1,000 high-growth companies in Asia-Pacific.

Emerging Technologies Take Center Stage at IPC Electronics Materials Forum ►

The IPC Electronics Materials Forum is a new technical conference focused on developments in materials and processes associated with advanced electronics assembly and manufac-

turing for board fabrication and assembly and post-assembly protection.

Mycronic Inks Two Orders for MYPro Line Equipment ►

Mycronic has received two new orders worth approximately \$3 million on two different full-line solutions.

Electrolube Opens New Manufacturing Facility in China ►

Electrolube, the global electro-chemicals specialist, recently welcomed visitors to a grand opening of its new 8,800-square-metre manufacturing facility in Zhuji in the Zhejiang province of China.

Solder Mask Evolves into a Truly Additive Process ►

The 5G era is creating quite a bit of work for many PCB engineers as the materials required to keep up with the speed, frequency, and latency requirements need to be defined and qualified.

Aqueous Technologies Implements Trident's New Windows 10 Operating System ►

Aqueous Technologies has announced the implementation of Windows 10 Professional as the new operating system for all trident automatic cleaning/defluxing systems.

Altus Gets Innovative With Inovaxe ►

Altus will distribute Inovaxe's entire range of products which includes hardware and software to streamline material handling and accuracy issues in the electronic manufacturing operation, particularly where SMT devices are used.

YOUR PCB PORTAL TO THE WORLD



DELIVERING GLOBAL-SCALE PCB SOLUTIONS



15

Subsidiaries
Worldwide



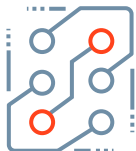
80

Leading PCB
Engineers



50

Countries
Supplied



40

Thousand Different
Items Annually

When you work with us, you have effortless access to a local partner who understands your short and long-term objectives, motives, environment, and concerns, while at the same time enjoying our global presence and the wide commercial advantages it brings.

**VIEW
CASE
STUDIES**



FINELINE
EXCELLENCE IN PCB

fineline-global.com

Today's Soldering Options

SMT Solver

by Ray Prasad, RAY PRASAD CONSULTANCY GROUP

There are various soldering methods, such as hand soldering, wave soldering, reflow soldering (e.g., vapor phase, convection reflow), and selective soldering. Some of these processes have been around for many years, while others were introduced more recently. All of these processes have unique characteristics, advantages, disadvantages, and applications. For example, no process can compete with the cost-effectiveness of wave soldering for through-hole board assemblies. Similarly, if the board contains only surface-mount components, the predominant soldering process choice is convection reflow.

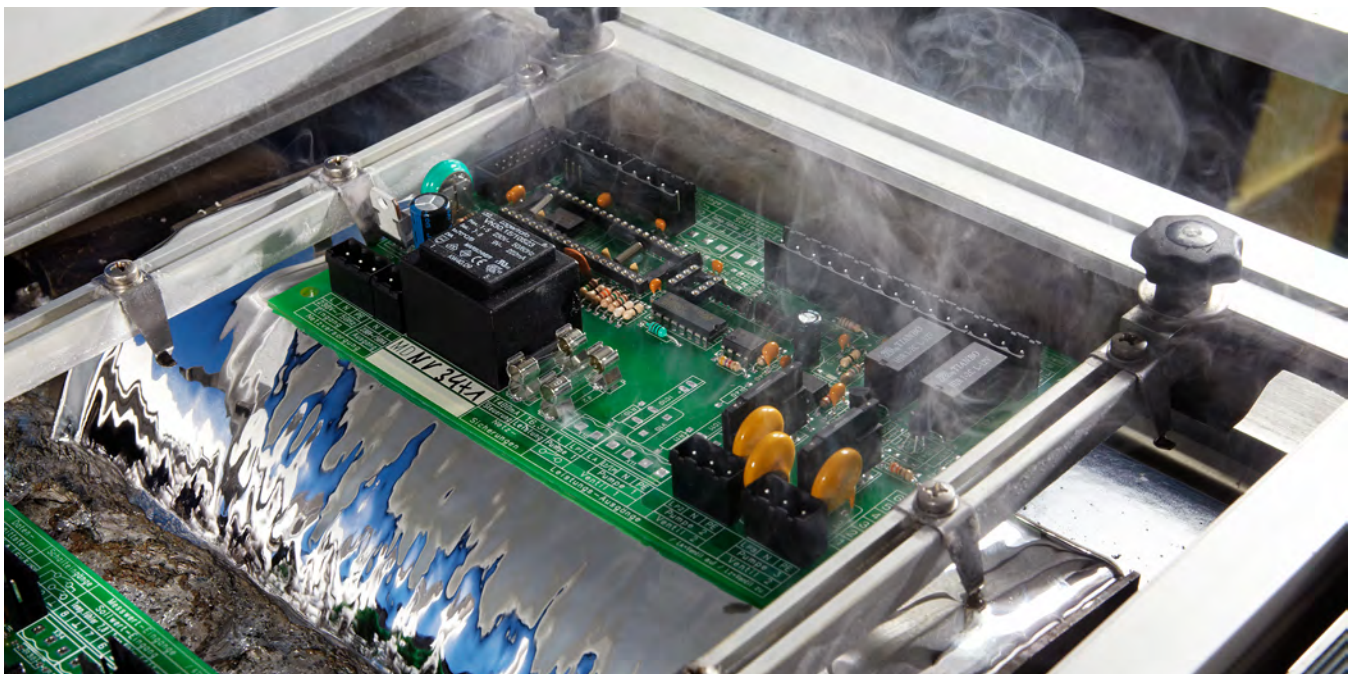
If you have to deal with mixed-assembly boards with both surface-mount and through-hole components—as is the case today for more than 95 % of electronic products—the selection

of a soldering process becomes more complex, especially if you use both tin-lead and lead-free components on the same board.

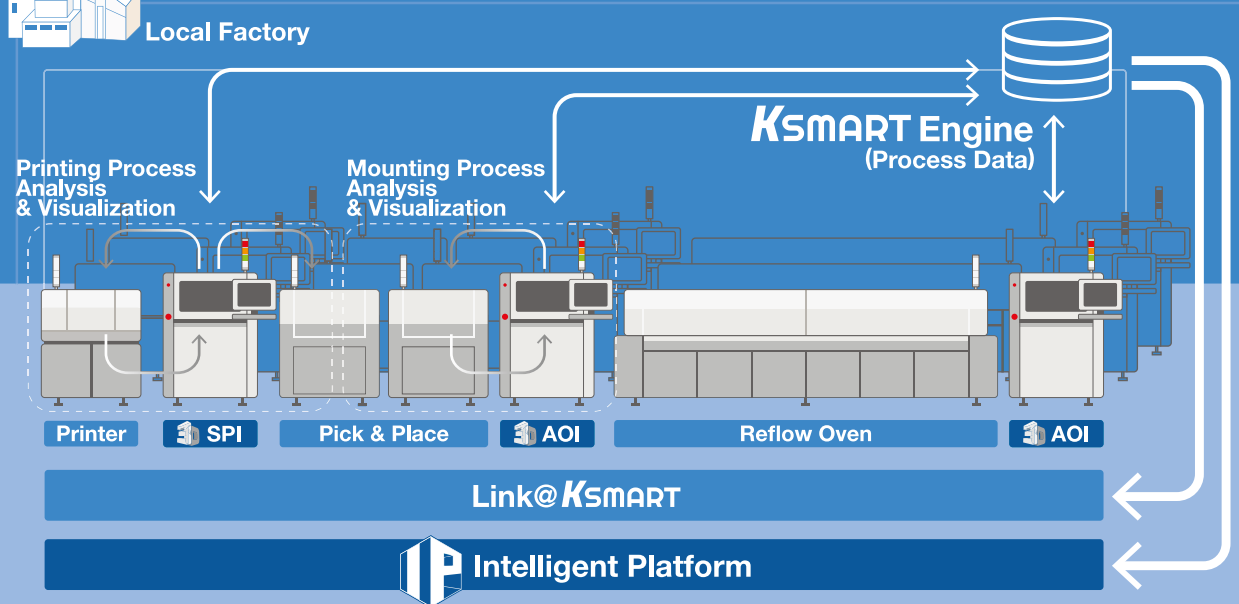
Soldering Options

Vapor phase soldering (VPS), also known as condensation soldering, has gone through changes in popularity. Once the process of choice in the early 1980s, its use has declined considerably for two reasons: problems with the VPS process itself and improvements in the convection reflow process. The problems with VPS are mostly in the areas of higher defects, such as wicking mostly in J-leaded parts and tombstoning in chip components.

However, the incidence of wicking in VPS has essentially gone away since J-leaded components are rare today. J-lead devices have



True 3D now powered by Intelligent Platform for Smart Factory



**World's No.1 Inspection Company,
now powered by Intelligent Platform
from Programming to Optimization**

World's Best Performance 3D SPI



ASPIRE3

- Ultra High Inspection Speed
- Complete Process Solutions
- Highest Accuracy

World's Fastest True 3D AOI

ZENITH UHS
Ultra High-Speed

- Ultra High Inspection Speed
- Perfect True 3D Inspection Performance
- 3D Data based SMT process Control System



Koh Young America, Inc.

6150 W. Chandler Blvd., Suite 39, Chandler, AZ 85226
Tel: +1-480-403-5000, E-mail: america@kohyoung.com

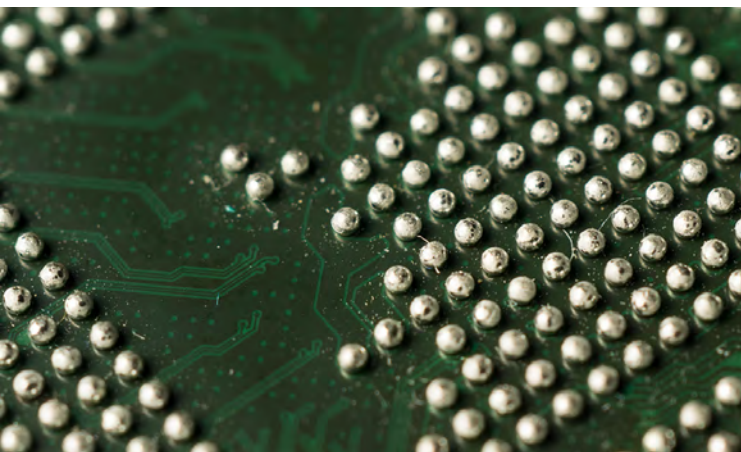
www.kohyoung.com

been mostly replaced by BTCs and gull-wing devices. Today's VPS has also improved since most of them have built-in preheating systems. Despite these improvements, you will be hard-pressed to find significant VPS users. The convection system provides efficient and uniform heating without the inherent problems of VPS and is the most common process for reflow soldering.

Soldering Options for Backward Compatibility

With the widespread use of lead-free soldering, companies must rethink their soldering options, especially when dealing with backward and forward compatibility. Backward compatibility is a situation in which the majority of components are tin-lead, but some are lead-free. Forward compatibility is a reverse—the majority of components are lead-free, but some are tin-lead. Forward compatibility is rarely an issue since it rarely comes up, but backward compatibility is a very common situation.

Backward compatibility is mostly a problem in military and space applications since this industry has not fully adopted lead-free, but they are stuck with lead-free components since component suppliers don't find it cost-effective to sell both tin-lead and lead-free components. All lead-free components can be soldered using tin-lead solder paste and a tin-lead reflow profile except lead-free BGAs. Some companies replace lead-free BGA balls with tin-lead balls at considerable expense and solder the reballed BGAs using a tin-lead process.



Meanwhile, others use a profile with a lower peak temperature than the lead-free profile but a higher peak temperature than the tin-lead profile—essentially, a profile that is a compromise between a tin-lead and lead-free profile.

In either situation, there is the problem of soldering components with differing heat-input requirements, and there are serious trade-offs. You cannot go to a higher temperature to reflow just a few lead-free BGAs, as the majority of tin-lead components will likely be damaged. And you cannot stay with the tin-lead profile because lead-free BGA balls will not fully melt, and the balls do not collapse, which is a key requirement for improved BGA solder joint reliability. I will cover this complicated subject in detail in future columns.

Selective Soldering Options for Mixed Assemblies

Mixed-assembly boards—those containing both surface-mount technology (SMT) and through-hole components—represent the majority of products in our industry. What do you do when you have a mixed assembly with SMT and through-hole components on the same board? Here are some commonly used selective soldering options to consider.

1. The use of non-metallic fixtures is a common method to solder through-hole components selectively on a mixed-assembly board. However, this method only works when the board is designed correctly. Otherwise, the fixture requires several iterations to come up with the final fixture that will expose the through-hole components and completely hide surface-mount components on the bottom side. This option can be very expensive, depending on the mix of products you must deal with, and requires considerable storage space for fixtures.
2. Another method generally referred to as solder fountains uses a metallic fixture that covers the solder pot. The solder comes out like a fountain at the designated locations under the through-hole leads. These fixtures can also be very



Since we first began in 1985, delivering the highest quality products possible has been our first priority. Our quality control systems are certified and we renew our commitment to quality each and every day.

Delivering quality products on time, combined with timely and accurate communication from our customer service team is how we create lasting relationships with our customers.

Take a look at our quality »

COMMERCIAL • MILITARY • MEDICAL • BAREBOARD

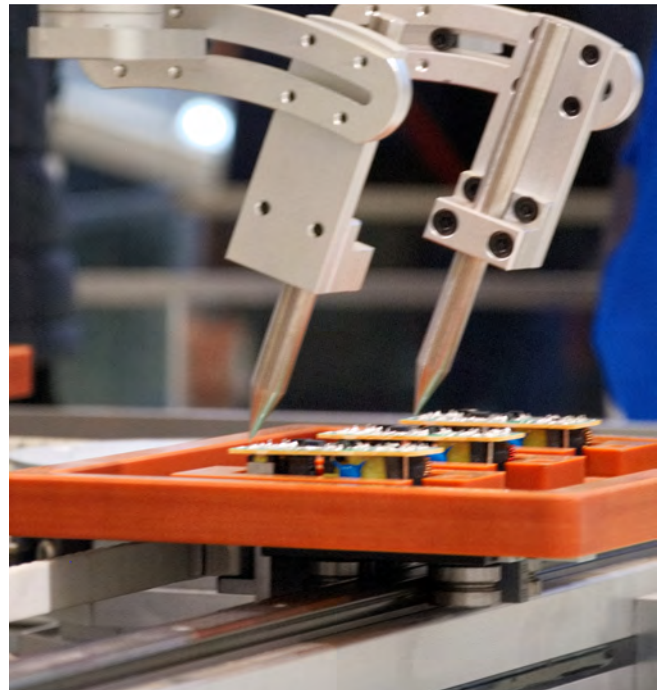


U.S. Circuit, Incorporated
2071 Wineridge Place
Escondido, CA 92029
+1 (760) 489-1413
www.uscircuit.com



expensive and take considerable time and effort to design and fabricate. Solder-defect levels can be high because solder fountains change a wave's flow dynamics. This is not a very common process.

3. Site-specific or “dancing wave,” in which a robotic carrier moves the solder fountain, is most common since the numbers of through-hole components on boards have been declining over the years. It is a perfect process if you have only a few components on the board. In this method, the board remains stationary, but the solder fountain travels to protruding leads. The solder fountain solders each lead or row of leads individually. These site-specific soldering machines have a built-in fluxer, preheater, and solder fountain, and tend to simulate the standard wave soldering process. Such machines are flexible and do not use fixtures and use entirely different soldering profiles, including much higher solder fountain temperatures than the standard wave soldering process (e.g., 290–300°C for selective soldering vs. 255–265°C for wave). You will need a separate machine or separate wave pots for tin-lead and lead-free.
4. There are various other selective soldering methods, such as hand soldering, focused light soldering, and diode laser soldering in unique applications for cost and technical reasons. For example, diode laser soldering is a newer technology, but not everyone feels comfortable being on the leading edge.
5. Solder pot for selective soldering or rework is used as well. However, the lead-free solder in solder pot also has been found to leach or erode away most of the copper from the plated through-holes if the duration of soldering or lead removal for rework tends to be long (i.e., almost 60 seconds, which is way longer than the approximate 5 seconds during wave soldering). Thus, one needs to be mindful about copper erosion when using solder pot, especially for rework (removal and replacement) of through-hole components.



Conclusion

What is the best method for soldering in general and selective soldering in particular? It depends on your application and capital budget. To select the right soldering option for your application, examine your product volume, mix, and complexity; then, weave through both technical and business issues to come up with the right soldering option for your products. You will need at least two different soldering options to handle both SMT and through-hole components in your mixed-assembly products. **SMT007**



Ray Prasad is the president of Ray Prasad Consultancy Group and author of the textbook *Surface Mount Technology: Principles and Practice*. Prasad is also an inductee to the IPC Hall of Fame—the highest honor

in the electronics industry—and has decades of experience in all areas of SMT, including his leadership roles implementing SMT at Boeing and Intel; helping OEM and EMS clients across the globe set up strong, internal, self-sustaining SMT infrastructure; and teaching on-site, in-depth SMT classes. He can be reached at smtsolver@ray-prasad.com and has an upcoming SMT class October 21-23, 2019. More details at www.rayprasad.com. To read past columns or contact Prasad, [click here](#).



INTERNATIONAL ELECTRONICS CIRCUIT EXHIBITION (SHENZHEN) 国际电子电路(深圳)展览会

Converging
Ideas
凝汇

Steering
Innovation
创新

Navigating
Industry
领航

2019.12.4-6



Shenzhen Convention &
Exhibition Center, China
Halls 1, 2, 4 & 9

中国深圳会展中心
1、2、4及9号展馆

www.hkpcashow.org

One of the World's Most Influential PCB & EA
Trade Shows for Sourcing and Information Exchange
Setting a New Benchmark for the Industry
with the Opening of Hall 9!

Close to
600
exhibitors

Almost
3,500
booths

67,500 sq.m.
exhibition space

- Visit the largest ever PCB & EA show spanning over Halls 1, 2, 4 & 9 of Shenzhen Convention & Exhibition Center, China.
- Check out more innovations from PCB equipment suppliers at the new Hall 9 to broaden your horizons and seize business opportunities.
- Connect with market leaders in the whole supply chain from all around the world to showcase the latest products and technologies in the industry.
- Industry experts are invited to spark great ideas at the International Technical Conference. Other onsite events including Welcome Dinner and Golf Tournament provide you with abundant networking opportunities.



Show Enquiry

Event Manager – Baobab Tree Event

Hong Kong & Overseas

Ms. Faye Lau

(852) 3520-3612

faye.lau@baobab-tree-event.com

China

Ms. Carman Feng

(86-20) 133-6057-8272

carmen.feng@baobab-tree-event.com

Please visit our official website www.hkpcashow.org or WeChat for more show information!!

Organizers



Supporting
Organization



Event Manager



Follow our WeChat!

ein Electronics Industry News and Market Highlights



Installed Base of Aftermarket Car Telematics Devices to Reach 150M in 2023 ►

According to a new research report from the IoT analyst firm Berg Insight, the number of active aftermarket car telematics units will grow at a compound annual growth rate (CAGR) of 20.6% from 58.7 million at the end of 2018 to 150.0 million at the end of 2023.

IDTechEx Forecasts \$6B Market for 3D-printed Medical Devices ►

IDTechEx reports that the market for 3D-printed medical devices and pharmaceuticals will be worth \$6.1 billion by the year 2029. IDTechEx finds this to be a rapidly growing market with compound annual growth rates of up to 18% in certain sub-segments.

Advanced Driver Assistance Systems Testing Equipment Market Report ►

The global sales of advanced driver assistance systems (ADAS) testing equipment accounted for the revenues worth ~\$67 million in 2018 and is projected to witness strong growth at a CAGR of ~12% over the foreseeable period.

Printed Electronics Market to Reach \$21B by 2026 ►

Global printed electronics market size was valued at \$6.86 billion in 2017 and is expected to reach \$21.44 billion by 2026 to exhibit a CAGR of 15.31% during the forecast period.

The Top Trends of 2019: The Year of 5G, Autonomy, and the Edge ►

If 2018 was a stellar year for tech IPOs, 2019 promises to be spectacular. Backed by valuations in the \$100-billion category, unicorn startups like Uber, Airbnb, Pinterest, and Lyft are gearing up to launch IPOs.

Annual Decline for Feed-in Tariff Should Be Set at 4% to Meet 2025 PV Goals ►

According to the latest “Solar Powering Taiwan: Special Report” by EnergyTrend, a division of TrendForce, Taiwan’s PV installations made it past the 1GW mark for the first time in 2018, attracting many investors to set up PV power plants in Taiwan.

AI Chip Market Worth \$91B by 2025 at 45.2% CAGR ►

According to the report, the global AI chip market was pegged at \$6.64 billion in 2018 and is projected to attain \$91.18 billion by 2025, registering a colossal CAGR of 45.2% during the forecast period.

3D-printed Wearable Market to Grow at a CAGR of 8% During 2019-2029 ►

The global 3D-printed wearables market, valued at approximately \$3 billion in 2018, will maintain its steady course, according to a new study by Future Market Insights (FMI).

Smart Home Integration to Drive Consumer Robot Shipments to \$39M a Year by 2024 ►

While challenges remain, this smart home integration leads global tech market advisory firm, ABI Research, to forecast nearly 79 million homes around the world will have a robot in the house by 2024.

Rising Demand for Effective Screening Diagnostics to Drive Molecular Diagnostics Market ►

Transparency Market Research (TMR) finds that the global Molecular Diagnostics Market is gaining traction on the back of rising geriatric population, which is prone to the several diseases and demands for advanced patient care.



Get Your PCBs Assembled within Budget and Time Schedule

PCBCart's Consigned & Turnkey Circuit Board Assembly services let you get fully assembled PCBs at lightning speed and low cost without compromising quality.

Our Advantages:

- Prototype, low-to-mid volume, production run
- SMT, THT, Mixed Assembly technologies
- Supported parts: BGA, QFN, 01005, 0201...
- Value-added options: Free DFM, AOI, AXI...



500\$ OFF
First Turnkey PCBA Order

Request **FREE** Quote NOW ►

www.pcbcart.com
sales@pcbcart.com

Artificial Reliability Over Intelligence

Quest for Reliability
by Eric Camden, FORESITE INC.

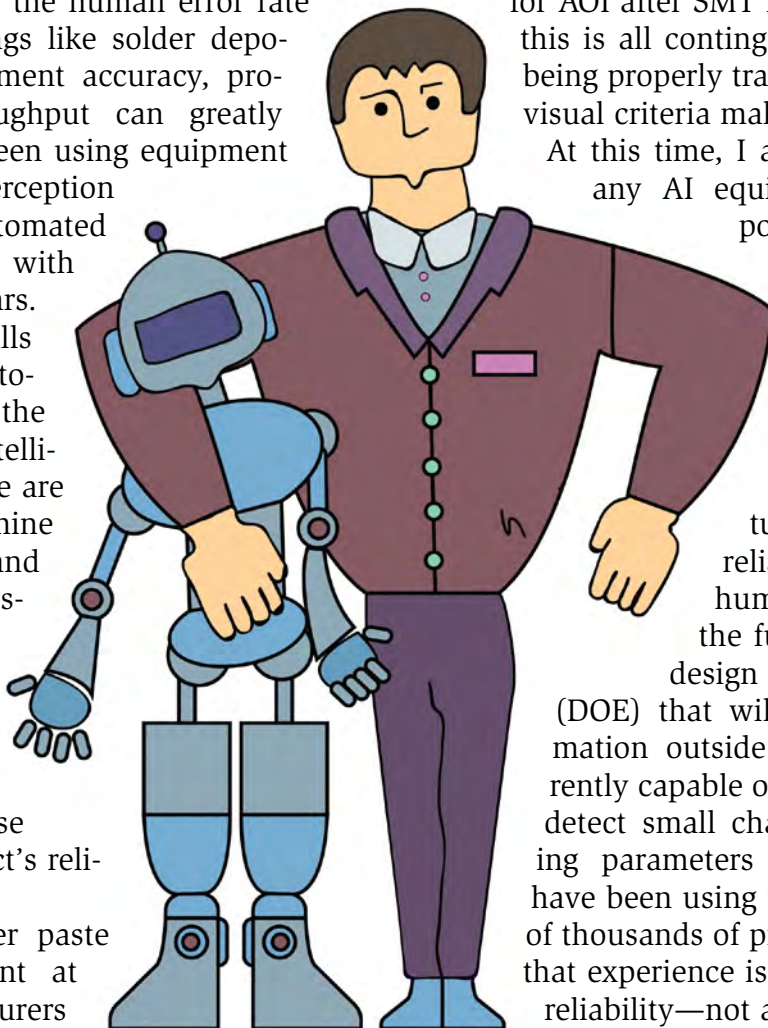
As the industry begins to shift from standard design tools to artificial intelligence (AI), reliability might be overlooked in an effort to build “smarter.” Over the last few years, the desire to manufacture anything and everything for less has included removing humans from as many positions as possible. There are a couple of viewpoints, and I can see positives in both.

When you remove the human error rate from inspecting things like solder deposition or part placement accuracy, productivity and throughput can greatly increase. We have been using equipment with machine perception (think AOI, or automated optical inspection) with great success for years. Where judgment calls are important, automation isn’t always the answer; actual intelligence and experience are required to determine if things like flux and other processing residues are present. Even more important is the decision of what to do with those residues to determine if they pose a risk to your product’s reliability.

I have seen solder paste inspection equipment at contract manufacturers

(CMs) that look at millions of pads each day that will catalog any locations that it can’t fully determine if the paste is sufficient or not; then, a human needs to accept or reject that PCBA based on visual inspection experience. Paste printing is a starting point for reliability that has not been completely taken over by AI yet, and that is a good thing. The same can be said for AOI after SMT reflow. Keep in mind this is all contingent on the operators being properly trained for the pass/fail visual criteria making that call.

At this time, I am not familiar with any AI equipment that is purposely built for reliability as a stand-alone; instead, there are several pieces that, when working in conjunction, can give you a clear picture of your products’ reliability. This requires humans to determine the full scope of a proper design of experiments (DOE) that will yield useful information outside of what AI is currently capable of doing. Humans can detect small changes in the operating parameters of equipment they have been using to produce hundreds of thousands of pieces of product, and that experience is what leads to better reliability—not an AI program that is





Now offering new IPC Certification Level: CSE in all six IPC Standards!



The IPC Certified Standards Expert (CSE) certification level was designed for high-level experts in an IPC standard that do not teach or train other people. We're proud to be one of the only centers in North America to offer them!



BLACKFOX

Premier Training & Certification

www.blackfox.com | Phone: (888) 837-9959 | sharonm@blackfox.com

looking for very specific outliers of an expected outcome.

Of course, AI can be used to the benefit of reliability with predictive modeling, but all of the statistics needed for the input of that modeling come from hands-on analysis. I was recently part of an iNEMI project that looked at the cleanliness of quad-flat no-leads (QFN) components after assembly with the idea that if you know how much ionic residue is present, you can predict the risk of that part failing in a normal field service environment. That was done with a consortium of companies around the world using ion chromatography, surface insulation resistance (SIR), cross-section, and scanning electron microscopy (SEM) imaging to create a very large dataset that was analyzed within an inch of its life to get a definitive answer on the inherent risk of using BTCs.

I won't spoil the ending, but the answer is like most cleanliness-related issues, it depends. (I think I now owe Doug Pauls a quarter.) It depends on what type of testing you do and what your sample matrix is comprised of as well as the end-use environment and expected life of that product in that atmosphere. In general, you need to perform ionic cleanliness evaluation using ion chromatography and elevated heat and humidity test under power at a minimum. Currently, there is no single machine or piece of software that can do both tests. The ability to recognize residues was done with several types of analysis and the experience of engineers and operators who did not rely on a single machine that lacked the tribal knowledge of that team.

When I think of AI today, I think of things like autonomous vehicles; if you do a quick online search, you will find several videos of people asleep at the wheel while going 60+ miles per hour on the highway. Does anyone think this is a good idea? Sure, we would all like to catch a quick nap on the way to work, but it seems like an abuse of a system designed to help with safety. I liken that to relying on only what one piece of equipment tells you about cleanliness because it's in a drawing specification that has been around much longer than it should have been.

In the videos with snoozing drivers, there isn't a horrific crash at the end, so a lot of people think, "Well, it worked for that person, so no harm, no foul." But to me, it's just a matter of time before it doesn't end well. This is how I relate it to reliability; we get comfortable when things are going well, and there isn't a massive rash of field failures. The assumption is that your process is on cruise control (no pun intended), and there can be a tendency to back off due diligence testing that was done to qualify the process in the first place. Without periodical testing in a manner, like what was done

This is how I relate it to reliability; we get comfortable when things are going well, and there isn't a massive rash of field failures.

for first article inspection, there could be creeping variability not being detected that could eventually steer you into the ditch (pun fully intended).

Eventually, I assume that AI will replace us all, and I, for one, welcome our robot overlords. But until then, we still need to put in the work to ensure that we are doing a hands-on inspection when a solder joint is in question or when the reflow oven doesn't seem to be running just right. When used in conjunction with actual experience and intelligence, AI can certainly help increase reliability, but we aren't there yet. Let's ensure that we are still relying on humans to do most of the critical thinking. **SMT007**



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

SHE SPEAKS FLUENT
STANDARDEASE.



**Introducing the IPC Certified Standards Expert—
the know-it-all your business needs.**

When it comes to ensuring consistent quality and reliability, IPC standards are the backbone of the electronics manufacturing industry. With Certified Standards Experts (CSEs) on your team, you'll have in-house subject matter experts on specific IPC standards who can navigate the ins-and-outs of those standards quickly and efficiently. They draw upon the same knowledge as Certified IPC Trainers (CITs) but are not required to train. Your CSEs will be the know-it-all go-tos for questions, issues, updates and best practices on standards specific to your organization.

**Change your standards operating procedure—learn more about the
CSE program at ipc.org/cse.**





MilAero007 Highlights



All Flex Gains NASA Heater Qualification ►

All Flex has recently been added to NASA's Goddard Space Flight Center's Qualified Parts List (QPL) for Thermofoil Heaters built in accordance with GSFC S311-P-079E specifications.

NASA Asks American Companies to Deliver Supplies for Artemis Moon Missions ►

In another major step toward landing American astronauts on the lunar surface by 2024, NASA is asking industry to respond to a Request for Proposals to deliver cargo, science experiments and supplies to the Gateway to support Artemis missions to the lunar surface.

BAE Systems to Enhance F-35 Electronic Warfare Capabilities ►

BAE Systems has received a Block 4 Modernization contract award from Lockheed Martin to enhance the offensive and defensive electronic warfare (EW) capabilities of the F-35 Lightning II fifth-generation fighter aircraft.

Automated Conformal Coating of CCAs Using Polyurethane ►

In the manufacturing of Class 3 circuit card assemblies, conformal coating can be critical to the lifespan of the circuit card. For circuit cards to withstand environmental factors in the field, they must be properly protected, which typically requires the use of conformal coating.

UTA and Lockheed Martin Team up on Unmanned Vehicle Project ►

A pair of University of Texas at Arlington researchers are teaming with Lockheed Martin Corp. to optimize how unmanned vehicles use sensors to gather information.

BAE Systems' RAD750 Single Board Computer Powers GPS III Satellite ►

The U.S. Air Force today launched its second GPS III satellite, the most powerful Global Positioning System (GPS) satellite ever built. BAE Systems' RAD750 Single Board Computer (SBC), part of Harris Corporation's navigation payload for GPS III prime contractor Lockheed Martin, will provide radiation-hardened, high-performance onboard processing capability for the satellite's mission.

DARPA Making Progress on Miniaturized Atomic Clocks for Future PNT Applications ►

DARPA's Atomic Clock with Enhanced Stability (ACES) program is exploring the development of next-generation, battery-powered CSACs with 1000x improvement in key performance parameters over existing options.

Autonomy Pivotal for a Future-ready Australian Army ►

Locally developed autonomous technologies will enhance the Australian Army's current armored personnel carriers in a demonstration project that could take soldiers off future battlefields.

Data Rate Increase on the International Space Station Supports Future Exploration ►

NASA recently doubled the rate at which data from the International Space Station returns to Earth, paving the way for similar future upgrades on Gateway, NASA's upcoming outpost in lunar orbit, and other exploration missions.



PROTOTRON.COM
(888)847-7686

Your Passport to Global PCB Sourcing

We are pleased to announce that with the same fine service, quality, delivery and attention to detail that our customers have grown to rely upon, we are now adding a complete global solution to meet all of your needs, both today and in the future.

Our Solutions:

- *FLEX & RIGID-FLEX*
- *HDI / MICROVIA*
- *COMPETITIVE VOLUME PRICING*
- *PRE-QUALIFIED OFFSHORE PARTNERS*
- *QUICK-TURN PROTOTYPES*
- *COMPLEX MULTILAYER*
- *MIL-SPEC PRODUCTION*
- *SPECIALTY MATERIALS*

MORE INFO
Global PCB Sourcing
PDF DOWNLOAD



FREE BOOK
DOWNLOAD
I-007eBooks.com

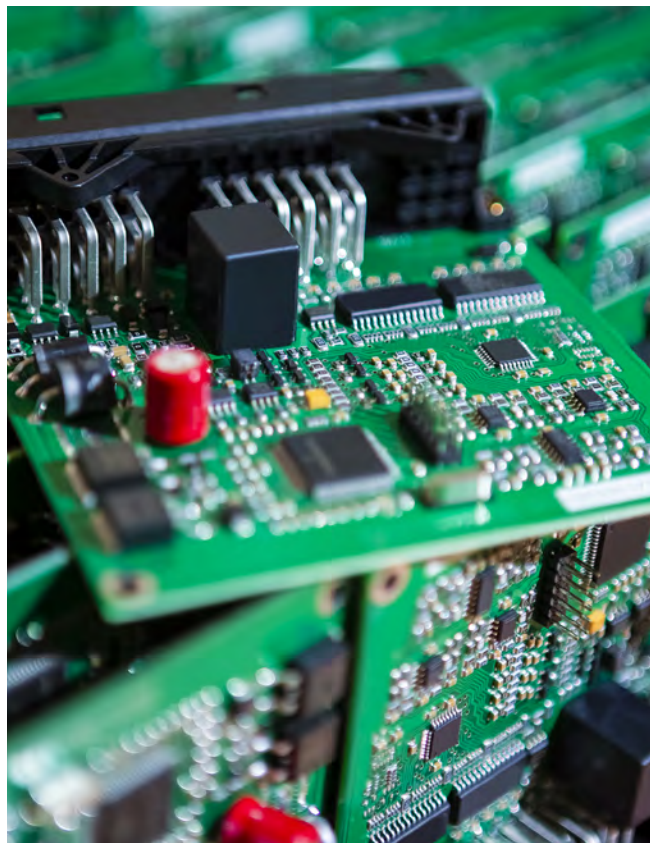


Prototron Circuits

A COMPLETE GLOBAL SOLUTION

REDMOND, WASHINGTON • TUCSON, ARIZONA • GLOBAL PARTNERSHIPS

Maximising Performance and Reliability of Automotive Electronics With Conformal Coatings



Article by Phil Kinner
ELECTROLUBE

While the value of the electronic systems in a modern vehicle typically exceeds 20% of the total vehicle cost, many estimate that this value will exceed 35% within the next five years. With the increased adoption of electronic vehicles and the development of the internet of things (IoT)—which has brought us driverless cars like those being tested by Google in California and BMW on the roads of Bavaria—the future of this industry is starkly different from that of the 1970s when electronic fuel injection systems were first introduced to mainstream production.

The proliferation of automotive electronics has been enabled by the development of powerful networked controllers and low-cost sensors. The development of low-cost, high-reliability electronic systems that have seen engine management, infotainment, and passenger comfort and safety applications becoming standard equipment in most modern automobiles have also contributed.

It is not uncommon for modern new vehicles to be supplied with five- and even seven-year warranties. This is challenging component suppliers to develop new designs that deliver long-term reliability at an acceptable cost. Automotive electronic systems are subject to temperature extremes, high humidity, and condensation and are increasingly exposed to corrosive gases. And with the growth of electric vehicles, where much higher voltages are the norm, increased dielectric protection is required to enable designs to be sufficiently dense to meet size and weight constraints.

The increased sophistication of these electronic systems often means they are more sensitive to contamination and adverse external environmental conditions. Moreover, as automotive electronic systems rely increasingly on their interconnection, failure in one assembly can compromise the operation of another. Unlike aerospace applications where two or three layers of redundancy may be built into these systems, automotive designs typically must work the first time, every time, throughout the life of the product.



First Time vs. Next Time

Deliver optimized designs the first time. By shifting manufacturing knowledge into the design process, concurrent DFM is now a reality, streamlining the design-to-manufacturing release process.

Shift left with Valor[®] NPI.

Mentor[®]

A Siemens Business

mentor.com/npi

Circuit Protection Using Conformal Coatings

Conformal coatings are thin, protective polymeric coatings that are often applied to electronic circuit boards or assemblies to provide the required environmental protection without excessive cost or weight penalties. For the automotive industry, conformal coating applications are either in-cabin (electronics systems located within the passenger compartment) or under-hood (electronics in close proximity to the engine). Such distinct categories make it convenient to discuss the main requirements of each; however, with increased sophistication and the move towards multi-function assemblies, these traditional environments continue to merge while the drive to higher power electronics in electric cars blurs the lines still further.

Electronic sensors and systems situated in the passenger cabin essentially occupy the same space as the vehicle occupants. In the winter, that can mean extreme cold and the tendency towards a condensing atmosphere, while in the summer, the tendency is towards a warm and humid atmosphere. Both condensation and high humidity challenge the reliability of electronics as they promote corrosion. In addition, electronics may be exposed to atmospheric pollutants, such as cleaning solutions, liquid splashes, etc.; any one of those factors may pose a potential reliability risk, especially in association with humidity and condensation (Figure 1).

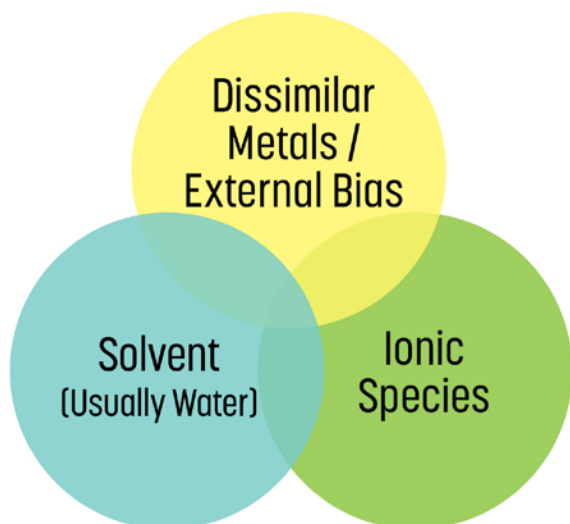


Figure 1: Potential reliability risks.

Corrosion is a complicated electrochemical process with a variety of potential mechanisms and causes, and any detailed description is beyond the scope of this article. However, in the vast majority of cases, there are three conditions that must be met for corrosion to take place:

1. Intrinsically, electrochemically dissimilar metals (e.g., gold/silver and nickel/tin) are present, or an anode and cathode are created by application of applied bias.
2. The presence of an ionic species (usually salts, halides, hydroxides, etc.).
3. Mono-layers of condensed water are present that dissolve the ionic species, resulting in an electrolyte solution.

To prevent the possibility of corrosion, it is necessary to remove one of the prerequisite conditions. The choice of metals is limited to those used in the solder and solder finish chemistries, which are dissimilar. And there will always be areas of potential difference due to the nature of an electronic assembly. Cleaning can help remove ionic species but cannot prevent the redeposition of ionic species from the operating environment.

Conformal coatings help prevent the formation of electrolytic solutions by acting as moisture barriers. The coating needs to be a good barrier against moisture and must have good adhesion to the substrate to prevent delamination. Once the coating is delaminated, moisture can eventually collect in this pocket and form an electrolytic solution with any pre-existing ionic contamination. This is why cleaning before conformal coating is recommended to provide a powerful synergistic elimination of two of the three prerequisite conditions for corrosion.

Given the relatively benign operating environments experienced by in-cabin electronics, acrylic conformal coatings have historically dominated this segment, offering good all-round properties, especially against high humidity and spills and splashes. Under-hood electronics, by dint of their location, face greater environmental challenges than in-cabin elec-

tronics. This environment is much less controlled with higher maximum operating temperatures and far more opportunities for contamination by fuels, oils, cleaning fluids, corrosive gases, metal particulates, and salt-water slush spray from treated road surfaces. Clearly, under-hood and other non-cabin electronic assemblies suffer much tougher environmental conditions and thus require the greater levels of protection provided by a new type of conformal coating.

Protective Coatings: The Next Generation

Coatings for electronic assemblies destined for under-hood and other non-cabin applications are required to be extremely resistant to wet conditions, have excellent chemical resistance, be highly flexible to survive thermal excursions and thermal shock, and be able to survive the much higher operating temperatures. To counter these challenges, Electrolube has developed a new range of highly durable, solvent-free, modified polyurethane conformal coatings, which can be applied more thickly than regular conformal coatings and which cure within 10 minutes at 80°C, re-using existing thermal curing ovens often used in solvent-based processes.

Moisture Resistance

Sharp-edge coverage—the ability of a coating to completely and reliably cover device leads, solder joints and other metal surfaces to prevent susceptibility to corrosion—is a long-standing, well-known issue that has recently been highlighted within the IPC5-22ARR J-STD-001/Conformal Coating Material and Application Industry Assessment. To demonstrate the

Coated PCB results – 3oz Cu tracks

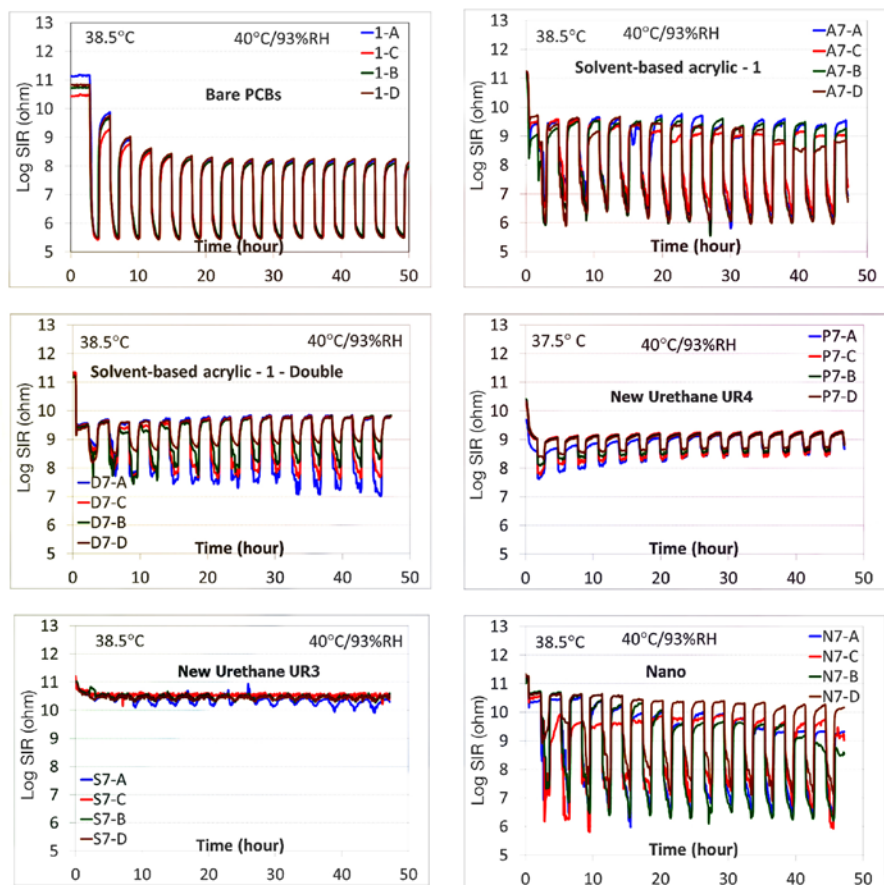


Figure 2: Comparison of condensation resistance of various coatings (data courtesy of NPL).

importance of edge coverage and protection from liquid water in the form of condensation, the U.K.'s National Physical Laboratory (NPL) is currently working on the development of a controlled condensation test.

NPL researchers have shown that at 40°C and 93% RH, a temperature differential of just 1.5°C can lead to the formation of moisture that is sufficient to reduce the surface insulation resistance (SIR) of a copper coupon from TΩ to 1MΩ (the limit of detection). Referring to Figure 2, the data from NPL clearly shows a significant drop in the SIR value of an uncoated assembly, limited protection by both the nano-coating and the single-coated acrylic, and improved protection from the double-coated acrylic. Both of the new urethane materials provide improved protection with UR3, in particular, showing outstanding protective capabilities against condensing water.

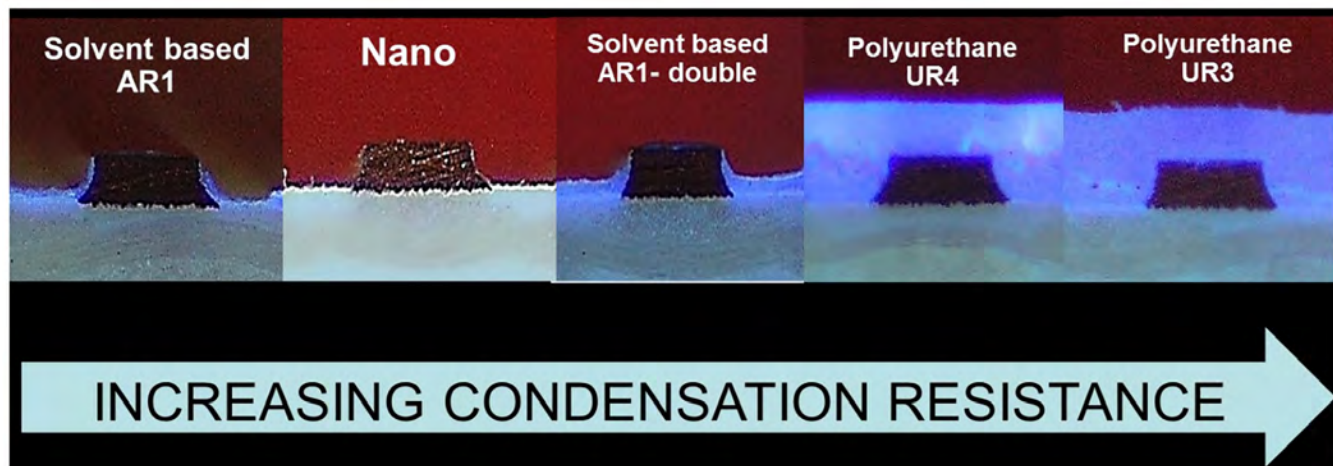


Figure 3: Cross-section of 3-oz. coated coupons, showing the importance of applied thickness and coverage in condensation resistance.

This can be explained in part by thickness and coverage—although the particular chemistry of the formulation also plays a significant role, as explained by the significant difference in performance between UR4 and UR3—even though the applied thicknesses (150 μm) are similar, as shown in the cross-section in Figure 3.

Thermal Shock Resistance

Automobile electronics are usually required to work between -40°C and 125°C with rapid transitions between the temperature extremes. The Electrolube SIR test coupon shown in Figure 4 was designed with a number of components laid out in a difficult configuration to bet-

ter simulate a production assembly. Coupons were selectively coated with polyurethanes UR3 and UR4 at a target thickness of 250 μm and subjected to 1000 air-to-air thermal shock cycles at the temperature extremes previously indicated with a rate of temperature change in excess of $40^{\circ}\text{C}/\text{min}$.

These coupons were visually inspected at 20X magnification for evidence of cracking, delamination, and solder joint or component damage. After 1,000 cycles, UR3 showed some signs of surface cracking and discoloration but did not expose any metal surfaces and did not propagate to the surface of the board, whereas UR4 showed almost no change in appearance.

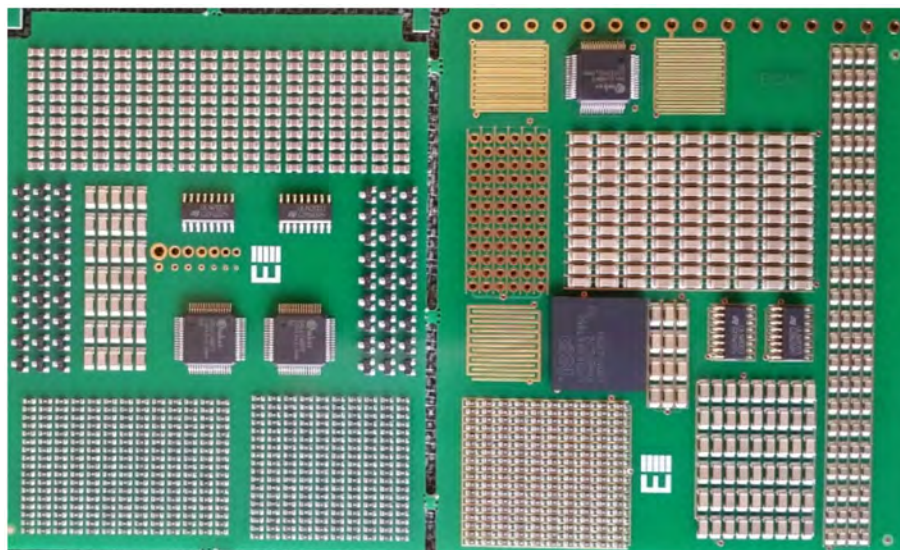


Figure 4: Electrolube test coupon for the assessment of conformal coating performance.

Salt-mist Resistance

To assess the protection provided under salt-mist conditions (simulating winter driving conditions), the test coupons shown in Figure 4 that were previously exposed to the 1,000 thermal shock cycles were subjected to a 196-hour salt-mist test (5% NaCl solution). The coupons were also continuously powered at 50 V for the duration of the test, and the insulation resistance was measured at periodic intervals throughout the test.

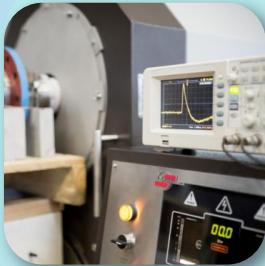


Candor

Circuit Boards

Innovative solutions for complex circuit board manufacturing

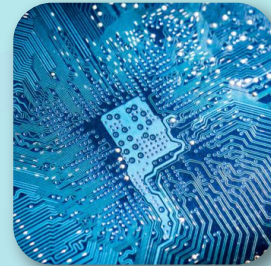
Click to see what we bring to each sector of the industry:



RF/Microwave
PCBs



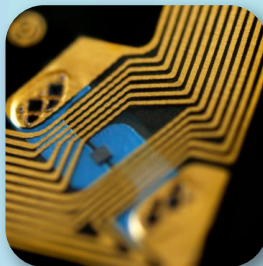
Power
Electronics



High-Speed
Data



Automotive
Electronics



Lamination



Startups

Our technology produces what our customers dream!

www.candorind.com | (416) 736-6306

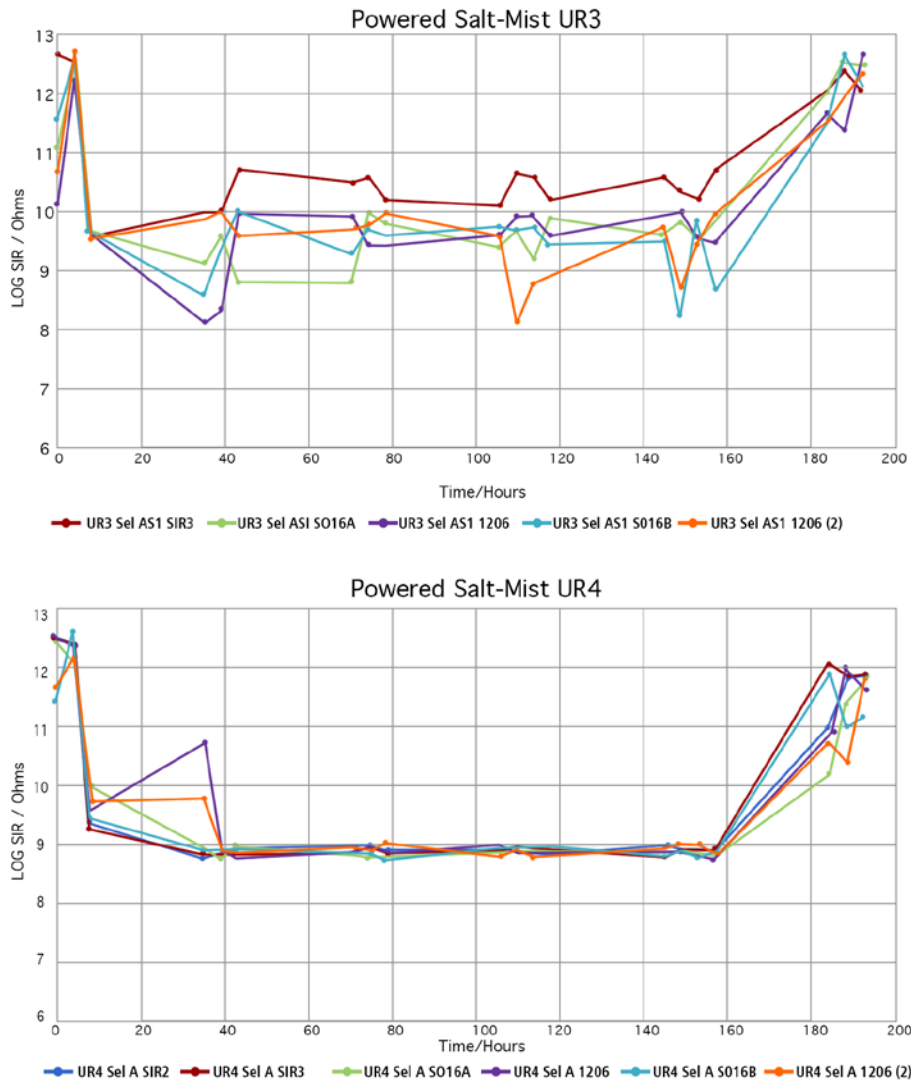


Figure 5: Insulation resistance of polyurethane materials under salt-mist conditions with a 50-V bias applied continuously.

As shown in Figure 5, both materials performed well, providing excellent protection against a salt-mist environment, although UR3 delivered a higher overall degree of insulation resistance, which is in line with the results from NPL's condensation test.

Summary

To meet the demands of the automotive industry for greater electronics reliability under increasingly adverse conditions, Electrolube has developed a range of solvent-free, higher-performance protective coatings that can be applied at greater thicknesses to overcome common application defects while improving sharp-edge coverage. These materi-

als have demonstrated significant performance improvements on model PCB test assemblies in terms of resistance to thermal shock, condensing, and salt-mist environments over that of traditional conformal coatings, ultra-thin coatings, or even UV curable materials. **SMT007**



Phil Kinner is the global business and technical director of conformal coatings at Electrolube and an I-Connect007 columnist. Kinner is also the author of *The Printed Circuit Assembler's Guide to... Conformal Coatings for Harsh Environments*. Visit I-007eBooks.com to download this and other free, educational titles.

You Need to Know This Stuff!



Enroll Today in the SMTA Assembly Essentials Package

Courses Cover 6 Key Processes:

- Stencil Printing
- Component Placement
- Reflow Soldering
- Wave Soldering
- Rework - **NEW**
- Cleaning - **NEW**



www.smta.org/training

Faster, Cheaper, Simpler

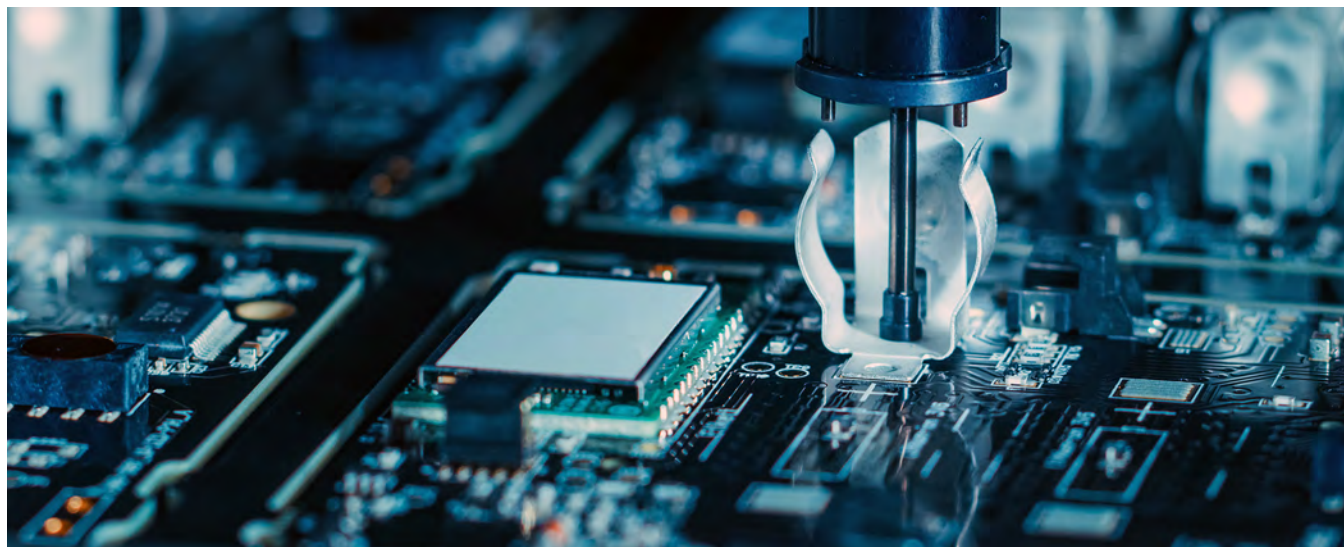
The Manifest
by Chris Ellis, MANNCORP INC.

Looking at the SMT industry right now, I see some very interesting things going on with shifts in production locations, ease of manufacturing, and intellectual property (IP) protection. OEMs are bringing production back to the U.S. in greater numbers—some even back to Mexico. A significant driver of this over the past year has been the tariffs. For the majority of OEMs I speak with, it's becoming clear how manufacturing in China is affecting their bottom line.

Most companies are genuinely surprised at how easy it is to bring manufacturing in-house—even financially. Some companies I've worked with have seen payback times of less than one year. With the rapid depreciation allowed through Section 179, payback can even be reduced to nine—or even six—months. Of course, after those months, manufacturers see a big increase in profits, and in most cases, a huge increase in quality. Better quality means fewer RMAs, less waste, and greater profit.

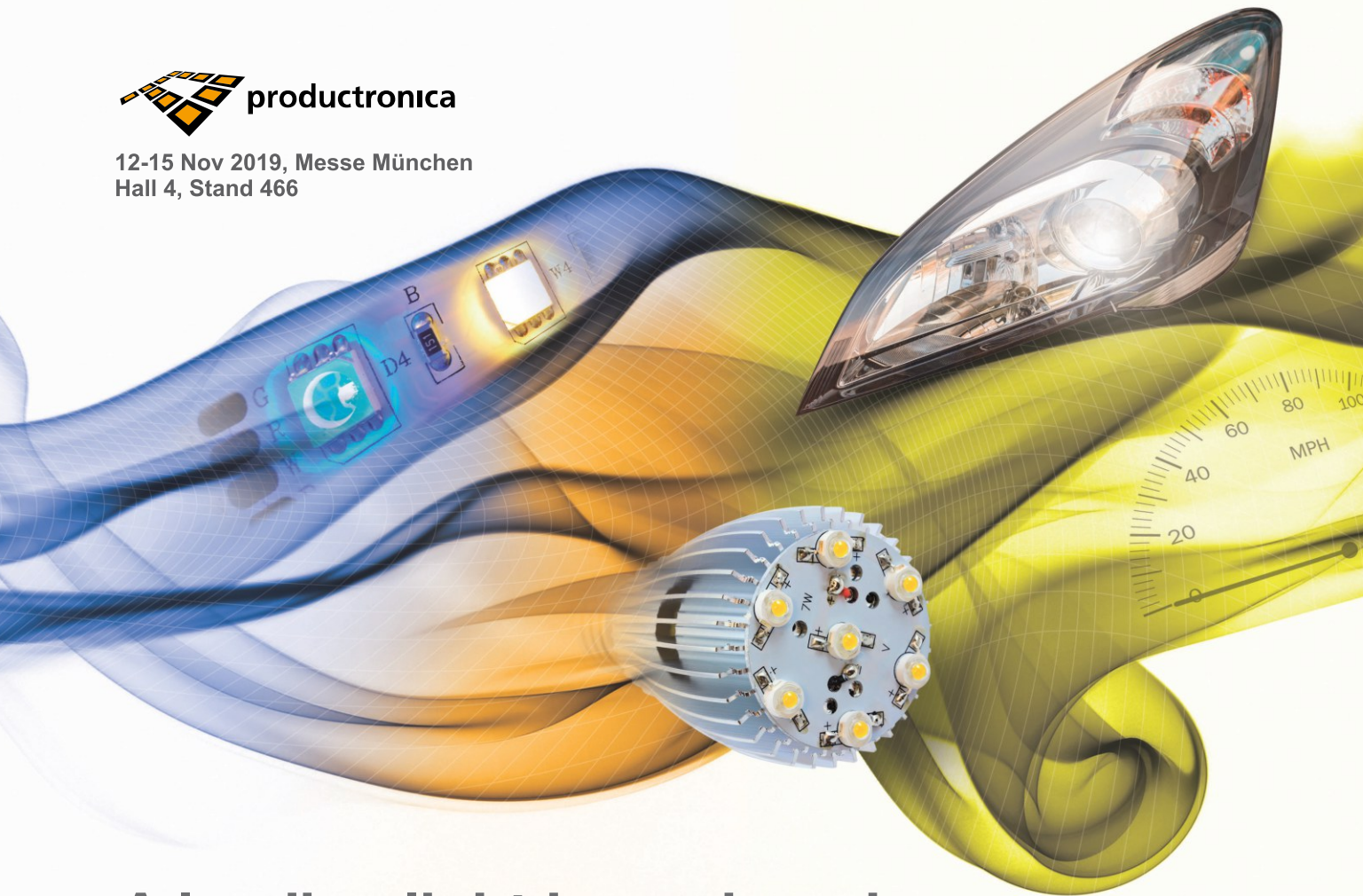
Most assembly equipment suppliers make the switch easy for manufacturers by looking at all production needs and considering board size, quantities per year (both now and forecasted), component types, etc. Then, they can formulate the equipment needed to handle both current and projected production. Some suppliers go further than that and diagnose your bill of materials (BOM) to determine which peripherals would be needed, from feeders to ancillary equipment, to make production integration as seamless as possible.

But it's not just sourcing equipment that has become easier. As the years have passed, the production process itself has become more reliable and less complicated. Items like predictive profiling on reflow ovens eliminate the tedious guesswork that used to go along with profiling a board through the reflow oven for the first time. Solder pastes are more forgiving than they used to be. Even the “dreaded lead-free” is almost a term of the past with it being a more simple process now.





12-15 Nov 2019, Messe München
Hall 4, Stand 466



A leading light in engineering improved LED performance

We don't just strive to exceed expectations, we innovate to make the best of industry, perform better.

The LED market is the perfect example of our capabilities in action. LEDs are considerably more efficient than traditional lighting forms, but they do still produce some heat, which without thermal management will have an adverse effect on both the efficiency and operational lifetime of the LED.

From bonding and non-bonding thermal interface materials, to thermally conductive resins and protective conformal coatings, our solutions offer the ultimate level of protection and heat dissipation for your LED application.

With an expansive product range and a strong emphasis on research and collaboration, we provide a complete electro-chemical solution to the world's leading LED manufacturers.

Isn't it time you discovered how Electrolube can serve you?



Scan the code to discover
our full spectrum of electro-
chemical solutions.

Tel: 800-474-1472

www.electrolube.org

ELECTROLUBE
THE SOLUTIONS PEOPLE

Electronic & General
Purpose Cleaning

Conformal
Coatings

Encapsulation
Resins

Thermal Management
Solutions

Contact
Lubricants

Maintenance
& Service Aids

I remember back in the day when pick-and-place machines used mechanical centering, and the smallest chips were 0805, if not larger. Now, the industry calls for smaller and smaller components, such as 01005 or 0201 chips, which are no larger than a flake of pepper and hard for an old guy like me to even see. But it's a cakewalk for most pick-and-place machines nowadays to inspect these and place them perfectly. The use of micro BGAs and ultra-fine pitch QFPs has become more popular, yet machine technology has evolved to the point that they can inspect down to the ball level and determine if one solder ball is missing or insufficiently sized, automatically avoiding potential failures down the line.

Software is also becoming more intuitive and user-friendly. A lot of the guesswork is now removed across the board, including automatic stencil printer setup, optimization of pick-and-place machines, and profile selection on reflow ovens. Further, Industry 4.0 is becoming more prevalent in all of these processes, and U.S. manufacturers are benefiting as they bring their production back home.

Another reason I see a lot of OEMs “onshoring” is intellectual property. Companies are seeing competitive products appearing on the market that are essentially carbon copies of their own products. Over 70% of the people I've talked with discuss moving their manufacturing back to the U.S., which is a very common problem. It is, of course, another issue that hurts the bottom line and decreases profits. A lot of the time, it forces companies to reduce sales margins of the end product.

Lastly, the turnaround time and expense of building prototypes often is a costly part of the design/build cycle, particularly with premium fees for setup on low-volume runs. Some high-volume OEMs have been investing in smaller in-house prototyping equipment to shorten the turnaround time for prototypes. These design teams go from two to (up to) six weeks when outsourcing prototypes down to a just few days when building them in-house.

Conclusion

In general, I see a very positive outlook for the U.S. right now in the manufacturing sector. A lot of OEMs realize that the cost of equipment is not as much as they think it will be. I commonly run across questions like, “I thought it would be a million-dollar acquisition to get started in this, but is that the case?” The short answer is no, not at all. Depending on the products and volumes, some companies start for as little as \$50,000—even less for low-volume production and up to approximately \$300,000 for mid-volume production with around 10,000 components placed per hour. Of course, if it is higher volumes than this, the costs can increase, but for the average electronics manufacturer in the U.S., the investment isn't very high at all, especially when compared to the return. **SMT007**



Chris Ellis is a sales manager/engineer for Manncorp Inc. To read past columns or contact Ellis, [click here](#).

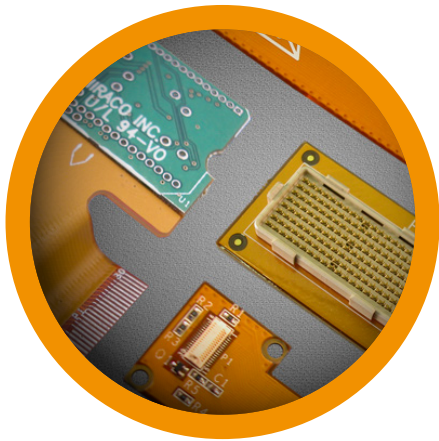


EPTAC Continues Its Expansion

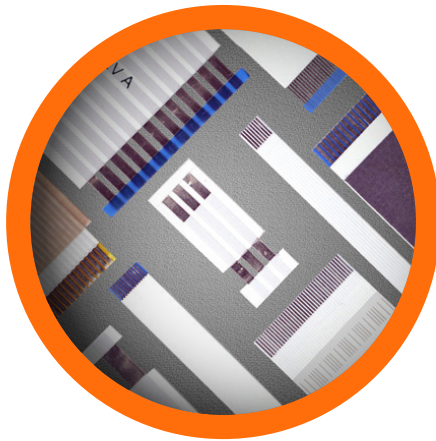
Andy Shaughnessy and Brenda Clunie, VP of operations for EPTAC, discuss the company's current growth plans and how its training facilities serve the needs of OEMs who are bringing in new, younger talent.

Click on the image to watch this interview.

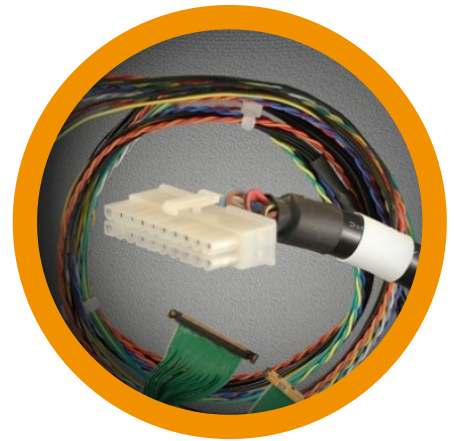
30+ YEARS EXPERIENCE. MORE THAN 30 PATENTS. JUST ONE GOAL.



**Flexible
Printed Circuits**



**Flat Flexible
Cable**



**Wire
Harnesses**

Providing a quality, cost-effective solution on time has been our goal since day one. We achieve this through unparalleled customer service and by designing, sourcing and finishing interconnection systems for our customers worldwide.

Miraco, Inc.
Manchester, NH
miracoinc.com
603-665-9449





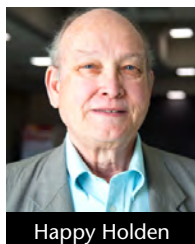
1 X-Rayted Files: Just Because You Can't See the Problem Doesn't Mean It's Not There! ▶

In this new column, Dr. Bill Cardoso will cover everything related to X-rays from cool historical facts to the latest in technological advancements, starting with the discovery of X-rays in 1895.



2 eSMART Factory Conference 2019, Day 1 ▶

The recent eSMART Factory Conference in June in Dearborn, Michigan, was the second annual conference on the smart factory. SMTA described it as "A technical conference with a focus on electronics manufacturing from software systems/processes to augmented reality and smart inspection." In this article, Happy Holden gives us the highlights of the conference.



3 The Mannifest: Custom Reflow Ovens and Curing ▶

It seems that a lot of companies in today's market are buying specialized ovens for curing. Did you know that most SMT reflow ovens can be modified by the manufacturer (and quite easily too) for curing applications? In most cases, these ovens will also still work for SMT reflow, eliminating the need to waste precious floor space on a second oven.



4 The Government Circuit: Recession Fears, Trade Wars—What Can We Do? ▶

Despite many strong economic indicators, recent news reports are filled with growing concerns about the risk of a U.S. and global recession in the next 12–24 months. Amid a prolonged trade war between the U.S. and China, and an "inversion" between long-term and short-term bond yields, a recent survey found that 74% of economists predict the next recession will hit by the end of 2021.

5 Operational Excellence: Becoming the Preferred Supplier, Phase 3—Re-engineer Your Quality System ▶

The final phase of becoming a preferred supplier is to apply a business process re-engineer approach to your quality system. Before you start with this phase, the company should have implemented Phase 1 and Phase 2, which are focused on changing its leadership mentality to embrace LEAN Six Sigma and the pillars of operational excellence.



Alfred Macha

6 Whizz Systems on Competing in Silicon Valley ▶

Whizz Systems is an EMS provider located in Silicon Valley that has managed to survive and thrive through many of the industry ups and downs of the past two decades. President Muhammad Irfan discusses the company's assembly and design services, as well as trends he sees from the industry in the Valley.



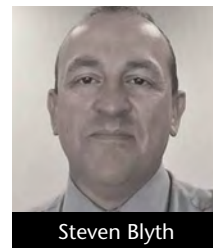
Muhammad Irfan

7 Libra Industries Continues to Support 'Alliance for Working Together' Competition ▶

Libra Industries has received the Best Sportsmanship Award at the 2019 Alliance for Working Together (AWT) Annual RoboBot Competition.

8 Smart Made Simple Appoints Steven Blyth Director of Business Development ▶

With over 20 years of executive experience in electronics, Steven Blyth is ready to transform Smart Made Simple (SMS) into the U.K.'s leading electronic manufacturing service provider (EMS) for concept-to-creation services, adding value along the production lifecycle for all customers.



Steven Blyth

9 Jet Dragster Champ Elaine Larsen to Keynote Women in Electronics Reception at IPC APEX EXPO 2020 ▶

Elaine Larsen, 2014 and 2015 IHRA Jet Dragster World Champion and driver of the Florida Institute of Technology Florida's Space Coast Jet Dragster, will speak at the IPC APEX EXPO Women in Electronics reception on February 4, 2020.



Elaine Larsen

10 IEEE's 5G Future ▶

Dan Feinberg speaks with Kathy Grise, IEEE Future Directions senior program director, at the AWE conference recently in San Jose, California, about the impending impact of 5G technology and related immersive technologies, including autonomous driving, XR, AR, and VR.



Kathy Grise

For the latest news and information, visit SMT007.com. Subscribe to our newsletters or premium content at [my I-Connect007](http://myI-Connect007).

Career Opportunities

Pssst!
Are You Looking
for Someone?



Place your notice in our Help Wanted section.

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

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

To get your ad into the next issue, contact:

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

I-Connect007
GOOD FOR THE INDUSTRY



Career Opportunities



WESTAK

NW Regional Quality Manager

Westak of Oregon is one of the premier manufacturers of military, aerospace and commercial printed circuit boards. We're an Equal Opportunity Employer, committed to hiring a diverse workforce in the beautiful state of Oregon, an economic force in technology. We offer a competitive salary, including comprehensive benefits and a relocation package for those who qualify.

As our NW Regional Quality Manager, you will be responsible for managing and leading the QA department to support the manufacture of quality product.

TASKS:

- Manage quality engineers and technicians
- Manage the Standard Inspection Procedure & Calibration Program
- Manage our internal/external CA/PA system
- Manage the RMA process
- Manage the ISO Quality System, including the Internal Audit System
- Manage the IPC, military, Bellcore and customer specs
- Measure quality performance
- Employee training, certification, and performance reviews
- Plan & coordinate audits to ensure controls are in place and maintained to continuously improve product yield
- Set QA compliance objectives
- Other duties as assigned

REQUIREMENTS:

- 5 years managerial experience in PCB operation
- Technical degree or equivalent experience
- In-depth understanding of IPC specifications, military specifications and Bellcore requirements
- SPC, SQC and DOE training/experience
- Able to analyze non-conformance of product
- Effective verbal and written skills
- Must be a U.S. person, as defined by ITAR regulations: a U.S. citizen, U.S. permanent resident, political asylee, or refugee
- Able to prioritize and meet deadlines

Send your resume to hr@westak.com.

[apply now](#)



ventec
INTERNATIONAL GROUP
騰輝電子

OEM Sales Manager Chicago/Home-Office-Based

Want to advance your career by joining a globally successful and growing world-class CCL manufacturer and help drive that success? We are seeking to hire an OEM sales manager to grow and manage key customer accounts with OEM's and Tier 1 manufacturers in the USA, focusing on Ventec's core market segments: mil/aero, automotive, and medical, offering a full range of high-reliability materials, including polyimide, IMS, and thermal management products.

Skills and abilities required for the role:

- Non-negotiable: Drive and tenacity!

Required:

- 7 to 10 years' experience in the PCB industry in engineering and/or manufacturing
- Detail-oriented approach to tasks
- Ability to manage tasks and set goals independently as well as part of a team
- Knowledge of MS office products

Full product training will be provided.

This is a fantastic opportunity to become part of a successful brand and leading team with excellent benefits.

Please forward your resume to
jpattie@ventec-usa.com and mention
"Technical Sales Engineer—Chicago"
in the subject line.

[apply now](#)

Career Opportunities



Advanced Connectivity Solutions

Senior Development Engineer

Rogers Corporation is seeking a senior development engineer accountable for the development of more complex products and processes, the establishment of sound technical bases for these developments, and effective interaction with technology, process, and platform innovation; operations; sales and marketing; and process engineering personnel to commercialize these developments.

Essential Functions:

- Design and conduct experiments and interpret the results
- Report on projects in both written and verbal formats at all levels of the organization
- Perform technical troubleshooting of new products and processes; act as new product/concept incubator for new technologies and platforms, identifying opportunities for improvement and incorporation design for manufacturing requirements resulting in a viable, scalable product
- Provide ongoing process and manufacturing support to newly launched products as applicable
- Provide support in terms of analytical equipment maintenance, methods development, material analysis, and documentation of new process or products
- Manage capital projects for the purchase and installation of new process or support equipment; train employees in new processes

Required Education and Experience:

Ph.D., Ch.E., M.E., or material science, or B.S. or higher in a technical discipline with accomplishment in product development and project management.

Rogers Corporation provides equal employment opportunities to minorities, females, veterans, and disabled individuals as well as other protected groups.

[apply now](#)



Field Service Engineer (Location Negotiable)

Are you passionate about delivering an exceptional user experience? Come work as a field service engineer at the industry's leading inspection company that offers great benefits with opportunities to advance while learning alongside accomplished business leaders.

The Company: Koh Young is the leading 3D inspection solutions provider in the electronics manufacturing industry. With its new offices in Atlanta and Guadalajara, it helps its customers optimize their printed circuit board assembly process.

The Position: Deliver technical services—including installation, support, and maintenance—to elevate the user experience. Location is flexible, but OH, IN, IL, MA, MI, FL, CA, or Toronto are desired.

The Reasons: An opportunity to apply leading-edge inspection technology to products you know and use every day. A great environment that supports its team and treats everyone like family.

Join the industry's leading provider of
true 3D inspection solutions

Interested? Submit your resume below.

[apply now](#)

Career Opportunities



Gardien Is Hiring!

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

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

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

Gardien is an equal opportunity employer. Employment decisions are made without any regard to race, color, religion, national or ethnic origin, gender, sexual orientation, age, disability, or other characteristics.

Interested candidates, please contact us with your resume and a cover letter. Kindly note that only shortlisted candidate will be contacted.

Apply at careers@gardien.com.

[apply now](#)



Key Account Managers/ Outside Sales

Itasca, IL • Hampstead, NH • Ontario, CA

NCAB Group is a global leader in the printed circuit board (PCB) industry, selling over 110 million PCBs yearly from 14 different countries. We are now looking for key account managers for our U.S. teams.

We are looking for sales professionals with at least five years of printed circuit board experience and/or semiconductor experience and knowledge. This is a sales position that requires your ability to convert those cold calls into high-value customer meetings.

What we are looking for:

- A "hunter" mentality
- The ability to create solid customer relationships
- A strong history of working closely with your inside sales teams
- An excellent ability presenting your product and doing the deep dive during your customer visit to identify your customers' pain points
- Knowledge of "SPIN" selling
- A college degree preferred but not required
- Someone who enjoys travel both domestically and globally

Who are we? At NCAB Group, it is the people that make us unique. We work according to our values; quality first, strong relationships and full responsibility, and encourage employee empowerment and initiatives.

[apply now](#)

Career Opportunities



Your Dreams, Our Challenge

TACONIC

TECHNICAL SALES ENGINEER RIGID/FLEX CIRCUITRY OR FLEX CIRCUITRY

AGC NELCO AMERICA, INC. is a global advanced materials company which develops and manufactures high-technology digital and RF/microwave printed circuit materials principally for the telecommunications and internet infrastructure and high-end computing markets.

ESSENTIAL RESPONSIBILITIES

- Training in the area of high-speed materials will be provided; the successful candidate will promote AGC high frequency materials.
- Visit companies that could employ flex circuitry or rigid/flex circuitry to promote AGC solutions/materials.
- Build an OEM customer base for AGC flexible materials; support design work around AGC materials.
- Visit fabricators building high-speed or high temperature rigid/flex circuitry.
- Participate in industry consortium, assist in publication of technical articles.
- Work from a home-based office; relocation not required.
- Domestic US travel required.

QUALIFICATION REQUIREMENTS

- BS degree in a relevant technical discipline.
- Industry expert in either rigid or flex circuitry design.
- Extensive experience in the high-speed cable and connector industry.
- Familiarity with the high-speed cable & connector industry and the customers that are converting designs to high speed flex circuitry.
- The candidate could come from the rigid/flex fabricator base and have familiarity with the manufacture and design of multilayer rigid/flex circuitry.

Please forward your resume to:
HR@AGC-Nelco.com

[apply now](#)



Assistant Department Manager, Operations, Carson City, NV

This is an entry-level professional management trainee position. Upon completion of a 1-2-year apprenticeship, this position will be elevated to facility/operations manager. Primary functions during training: shadow incumbent staff managers to learn and understand the operations and personnel of the operations department. This position will train and learn, develop, implement, and coordinate strategies related directly to the manufacture of Taiyo products. Additionally, this position will be learning all about the facility, environment, and health and safety functions. Eventually, this position will be responsible for the administration, security and maintenance of the facility and warehouse

Required Experience/Education:

- 4-year college degree in industrial engineering or another similar science discipline combined with work experience in ink or coatings manufacturing
- Ability to read, analyze, and interpret common scientific and technical journals, financial reports, and legal documents
- Ability to respond to inquiries or complaints from customers, regulatory agencies, or members of the business community
- Ability to develop and implement goals, objectives, and strategies
- Ability to effectively present information to top management, public groups, and/or boards of directors
- Ability to apply principles of logical or scientific thinking to a wide range of intellectual and practical problems
- Knowledge of governmental safety, environmental, transportation regulations/laws

Preferred Skills/Experience:

- Bilingual (Japanese/English)
- Toyota Production System (TPS)

Working Conditions:

- Occasional weekend or overtime work

See complete job listing for more information.

[apply now](#)

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

[apply now](#)



Technical Account Manager Chicago/Minneapolis

Insulectro, the largest national distributor of printed circuit board materials, is seeking a talented sales superstar for a Technical Account Manager role based out of either our Chicago or Minneapolis office. This role will focus on maintaining the existing customer base and developing new business within the assigned territory in both the printed circuit board and printed electronics industries. We are looking for the perfect fit of education, experience, and attitude that matches our company culture and enhances the service level to our customers.

Qualifications:

- A self-motivated business professional who is driven to succeed with a minimum of 3 years outside sales experience in the PCB or PE industry
- Proven sales/business development record
- Excellent communication and interpersonal skills
- OEM and electronic assembly experience is a plus

We offer:

- Competitive salary and commission plan with a comprehensive benefits package
- A fun, high-energy company with an entrepreneurial spirit
- A great group of people to work with!

[apply now](#)

Career Opportunities



Analyst Programmer, Hong Kong

We believe in caring about our people because they are our greatest asset. CML works with multi-cultural stakeholders daily to achieve more and bring them the best solutions. That's why we continuously invest in optimizing our culture and focus on providing our team with opportunities to develop their skills (e.g., through professional coaching to achieve their highest potential).

The analyst programmer will assist the IT and ERP manager in Hong Kong to support the company's BI systems, ERP systems, and other related IT-landscape applications.

In addition, this post will participate in system development projects and provide support including, but not limited to, user requirement collection and analysis, user training, system documentation, system support and maintenance, enhancement, and programming.

- Develop and enhance related IT systems and applications
- Prepare functional specifications
- Transfer the relevant business and interface processes into IT systems and other applications to get a maximum automation degree and prepare all required business reports
- Conduct function testing and prepare documentation
- Manage help desk/hotline service

CML is a leading provider of printed circuit boards. We develop tailor-made sourcing and manufacturing solutions for our customers worldwide with strong partnerships and reliable connections.

[apply now](#)



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



Development Chemist Carson City, NV

Develop new products and modify existing products as identified by the sales staff and company management. Conduct laboratory evaluations and tests of the industry's products and processes. Prepare detailed written reports regarding chemical characteristics. The development chemist will also have supervisory responsibility for R&D technicians.

Essential Duties:

- Prepare design of experiments (DOE) to aid in the development of new products related to the solar energy industry, printed electronics, inkjet technologies, specialty coatings and additives, and nanotechnologies and applications
- Compile feasibility studies for bringing new products and emerging technologies through manufacturing to the marketplace
- Provide product and manufacturing support
- Provide product quality control and support
- Must comply with all OSHA and company workplace safety requirements at all times
- Participate in multifunctional teams

Required Education/Experience:

- Minimum 4-year college degree in engineering or chemistry
- Preferred: 5-10 years of work experience in designing 3D and inkjet materials, radiation cured chemical technologies, and polymer science
- Knowledge of advanced materials and emerging technologies, including nanotechnologies

Working Conditions:

- Chemical laboratory environment
- Occasional weekend or overtime work
- Travel may be required

[apply now](#)



Multiple Positions Available

The Indium Corporation believes that materials science changes the world. As leaders in the electronics assembly industry we are seeking thought leaders that are well-qualified to join our dynamic global team.

Indium Corporation offers a diverse range of career opportunities, including:

- Maintenance and skilled trades
- Engineering
- Marketing and sales
- Finance and accounting
- Machine operators and production
- Research and development
- Operations

For full job description and other immediate openings in a number of departments:

www.indium.com/jobs

[apply now](#)

Career Opportunities



THERMAL SYSTEMS

Service Engineer Reflow Soldering Systems (m/f)

To strengthen our service team at Rehm Thermal Systems LLC. in Roswell, Georgia, we are seeking candidates to fill the position of Service Engineer—Reflow Soldering Systems.

Your area of responsibility:

- Installation of Rehm reflow soldering systems at the customers' site
- Maintenance and repair work as well as technical service for our customers in the USA and Mexico
- Execution of machine training

Your profile:

- Completed education studies as an engineer in the field of electrical engineering/mechatronics or comparable education (m/f)
- Basic and specialist knowledge in the field of electronics and electrical engineering/mechatronics
- High willingness to travel and have flexible employment
- Service-oriented and like to work independently

We offer:

- Performance-oriented, attractive compensation
- Comprehensive training
- A safe workplace in one successful group of companies
- Self-responsibility and leeway

Please send application documents online to Natalie Werner at n.werner@rehm-group.com.

[apply now](#)



SMT Field Technician Huntingdon Valley, 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:

- Health and dental insurance
- Retirement fund matching
- Continuing training as the industry develops

[apply now](#)

Career Opportunities



U.S. CIRCUIT

Sales Representatives (Specific Territories)

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

- Florida
- Denver
- Washington
- Los Angeles

Experience:

- Candidates must have previous PCB sales experience.

Compensation:

- 7% commission

Contact Mike Fariba for
more information.

mfariba@uscircuit.com

[apply now](#)

ELECTROLUBE
THE SOLUTIONS PEOPLE

We Are Recruiting!

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

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

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

[apply now](#)

Career Opportunities



ZENTECH

Zentech Manufacturing: Hiring Multiple Positions

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

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

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

Please email resume below.

[apply now](#)



BLACKFOX

Premier Training & Certification

IPC Master Instructor

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

For more information, click below.

[apply now](#)



Celebrating
20 YEARS OF
EXCELLENCE IN
ELECTRONICS

MEETINGS & COURSES: **February 1-6**

CONFERENCE & EXHIBITION: **February 4-6**

SAN DIEGO CONVENTION CENTER | CA

www.IPCAPEXEXPO.org

ELEVATE THE EXCELLENCE OF ELECTRONICS

STANDARDS

EDUCATION

SOLUTIONS

ADVOCACY

Join Us to Celebrate 20 Years of the IPC APEX EXPO!

The pursuit of excellence in electronics is year-round. But during IPC APEX EXPO 2020, the focus of the electronics industry will be on how collectively, we can elevate all aspects of our industry and the products we create.

Together, we'll celebrate the 20th Anniversary of IPC APEX EXPO, explore innovative ideas and share our experiences, all with an eye toward a future driven by success.

Plan now to elevate your excellence in San Diego at **IPC APEX EXPO 2020**.

Register by **December 19** to get your
20% advanced registration discount!



Events Calendar

52nd International Symposium on Microelectronics ▶

September 29–October 3, 2019
Boston, Massachusetts, USA

Korea Electronics Show ▶

October 8–11, 2019
Seoul, South Korea

DEFENSE Techconnect Innovation Summit & Expo ▶

October 8–10, 2019
National Harbor, Maryland, USA

New England Expo & Tech Forum ▶

October 8, 2019
Boxboro, Massachusetts, USA

electronicAsia ▶

October 13–16, 2019
Hong Kong

NEPCON West China 2019 ▶

October 15–17, 2019
Meishan, Sichuan, China

16th Annual International Wafer-Level Packaging Conference ▶

October 22–24, 2019
San Jose, California, USA

SMTA Additive Electronics Conference ▶

October 24, 2019
San Jose, California, USA

Additional Event Calendars



Coming Soon to *SMT007 Magazine*:

NOVEMBER: From My Point of View

Sometimes, the best view into an industry or a community is through individual voices. In this issue, we talk to members of our business community, gathering and sharing their voices and perspectives.

DECEMBER: What You Need to Learn

No matter your age or experience level, to move technology forward, we all need to be continuous learners. In this issue, we highlight the highest impact topics to further your expertise.

PUBLISHER: **BARRY MATTIES**
barry@iconnect007.com

SALES MANAGER: **BARB HOCKADAY**
(916) 608-0660; barb@iconnect007.com

MARKETING SERVICES: **TOBEY MARSICOVETERE**
(916) 266-9160; tobey@iconnect007.com

MANAGING EDITOR: **NOLAN JOHNSON**
(503) 597-8037; nolan@iconnect007.com

CONTRIBUTING EDITOR: **STEPHEN LAS MARIAS**
+63 906 479 5392; stephen@iconnect007.com

TECHNICAL EDITOR: **PETE STARKEY**
+44 (0) 1455 293333; pete@iconnect007.com

ASSOCIATE EDITOR: **KIERSTEN ROHDE**
kiersten@iconnect007.com

PRODUCTION MANAGER: **SHELLY STEIN**
shelly@iconnect007.com

MAGAZINE LAYOUT: **RON MEOGROSSI**

AD DESIGN: **SHELLY STEIN, MIKE RADOGNA,**
TOBEY MARSICOVETERE

INNOVATIVE TECHNOLOGY: **BRYSON MATTIES**

COVER: **SHELLY STEIN**

COVER IMAGE: **ADOBE STOCK © PHOTOLAS**

SMT007
M A G A Z I N E

SMT007 MAGAZINE®
is published by BR Publishing, Inc.,
942 Windemere Dr. NW, Salem, OR 97304

© 2019 BR Publishing, Inc. does not assume and hereby disclaims any liability to any person for loss or damage caused by errors or omissions in the material contained within this publication, regardless of whether such errors or omissions are caused accidentally, from negligence or any other cause.

October 2019, Volume 34, Number 10
SMT007 MAGAZINE is published monthly,
by BR Publishing, Inc.

ADVERTISER INDEX

| | |
|------------------------------------|--------|
| Accutrace..... | 33 |
| American Standard Circuits..... | 7 |
| APCT..... | 41 |
| Blackfox Training Institute..... | 69 |
| Candor Industries..... | 79 |
| Creative Electron..... | 57 |
| CyberOptics..... | 21 |
| Eagle Electronics..... | 19 |
| Electrolube..... | 83 |
| EPTAC..... | 49 |
| Fineline Global..... | 59 |
| Flexible Circuit Technologies..... | 15 |
| Goepel electronics..... | 47 |
| HKPCA..... | 65 |
| I-Connect007 eBooks..... | 2, 3 |
| Imagineering..... | 29 |
| Indium..... | 37 |
| IPC..... | 71, 99 |
| Koh Young..... | 61 |
| Kyzen..... | 43 |
| Manncorp..... | 5 |
| Mentor, a Siemens Business..... | 75 |
| Miraco Inc..... | 85 |
| Mycronic..... | 11 |
| P Kay Metal..... | 25 |
| PCB007 China Magazine..... | 51 |
| PCB Cart..... | 67 |
| Prototron Circuits..... | 73 |
| SMTA..... | 17, 81 |
| Sunstone Circuits..... | 23 |
| US Circuit..... | 63 |
| Zentech Manufacturing..... | 53 |

I-Connect007

GOOD FOR THE INDUSTRY



FREE SUBSCRIPTION



myiconnect007.com

EDITORIAL CONTACT

Nolan Johnson

nolan@iconnect007.com

+1 503 597-8037 GMT-7



mediakit.iconnect007.com

SALES CONTACT

Barb Hockaday

barb@iconnect007.com

+1 916 365-1727 GMT-7



www.iconnect007.com