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NOVEMBER 2019

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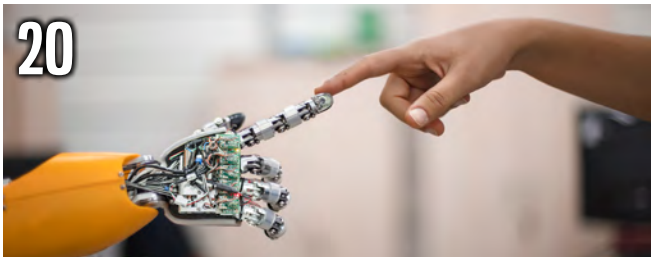
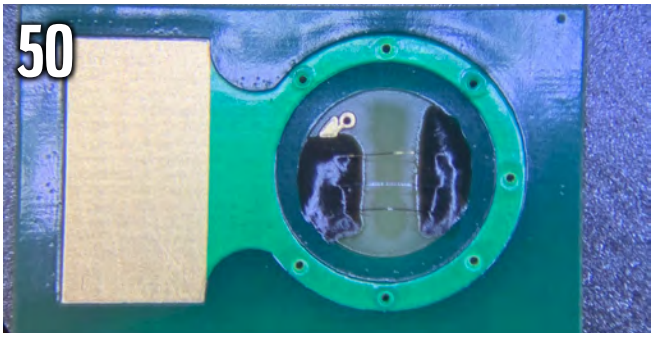
From My Point of View

This month, we embark on a tour of the industry, capturing different perspectives and bringing them to the fore. Sometimes, the best view of an industry or a community is through individual experiences. In this issue, we talk to members of our business community, gathering and sharing their voices and points of view.





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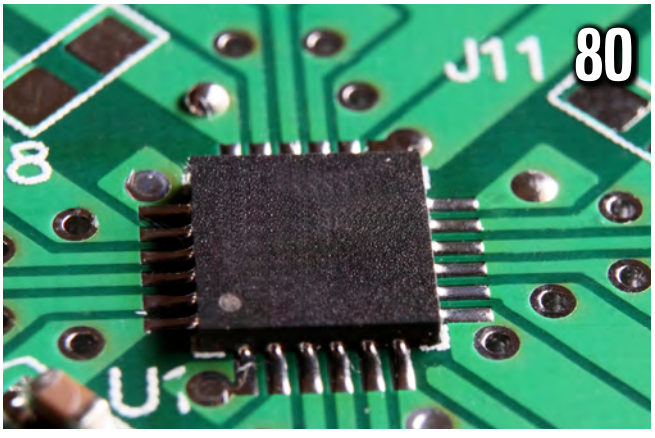

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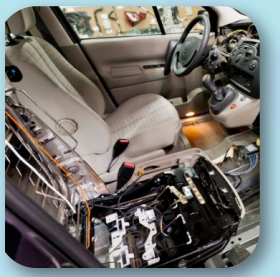

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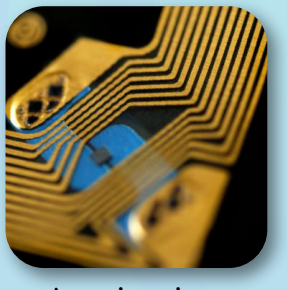

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A Tour of the Industry

Nolan's Notes

by Nolan Johnson, I-CONNECT007

As far back as the 1600s, and lasting through the mid 1800s, young, imperial English aristocrats would leave the island to travel "the world;" however, this often simply meant visiting continental Europe on an out-and-back trip, resembling a golf outing, before returning home to settle down to the business of running their family estate and/or the country. This practice was commonly called "the Grand Tour."

Richard Franks, a freelance writer, summarized the idea of the Grand Tour, with English spelling and all [1]: "…travellers would often head off for months—or even years—in search of Western civilisation, perfecting their language skills and even commissioning paintings in the process." He further points out, "Cultural integration was not yet fully-fledged and nothing like we experience today, so the only way to understand different ways of life was to experience them yourself. Hence why so many people set off for the Grand Tour—the ultimate trip across Europe!"

From what I can gather, travelers usually took a traditional route on the Grand Tour: Dover, England; France (Calais and Paris); Switzerland; and Italy (Turin, Florence, Rome, Pompeii, and Venice). On the back nine, so to speak, the route home often included Germany, Austria, Holland, and Flanders before sailing back

across the Channel to Dover again. But that's not really "seeing the world," is it? Certainly not by today's standards. And yet, I can't be too judgmental. Had I not been hired right out of college into the particular engineering job I landed, I might not have toured the world as a young man at all.

For example, I took my first airplane flight when I was 21 years old. I was tasked with delivering a magtape reel full of bug fixes to a major military customer (the internet was still mostly a university thing, and 8" floppy disks didn't have enough storage capacity, so magtape it was). It wasn't until after I returned to the office that my boss learned I'd never flown before.

After that late start, however, I've visited nearly every U.S. State, and the three "easiest" continents to reach from my home in North America. These trips have been incredibly valuable to me. I have grown professionally and personally through exposure to varied cultures and developed a wider, more encompassing perspective of the world and the people in it.

Such was the case with the Grand Tour. As a Wikipedia contributor puts it, "The primary value of the Grand Tour lay in its exposure to the cultural legacy of classical antiquity and the Renaissance and to the aristocratic and fashionably polite society of the European continent. In addition, it provided the only opportunity to view specific works of art, and possibly the only chance to hear certain music." At least these young men (and sometimes women) took the time to complement their classroom academics with a real-world, face-to-face experience to complete their education. Though the tour may have lacked much creativity in its route, it also served the purpose of standardizing the broad cut of their experiences, while leaving plenty of room for individual perspective.

This month, we embark on a similar journey for a related purpose: a tour of the industry, capturing different perspectives and bringing them to the fore. Sometimes, the best view of an industry or a community is through individual experiences. In this issue, we talk to members of our business community, gathering and sharing their voices and points of view.

Our first stop is a follow-up interview with Vexos' Stephanie Martin in "Supply Chain Update and the Impact of 5G," where she updates us on our global parts availability conversation from earlier in 2019. Next, we drop in on David Meyers to get a perspective on digital twin, "co-bots," PLM, and activities at Siemens. Then, Eric Camden gets "meta" with his perspective on perspectives in "Voices Carry."

Jumping continents for a moment, Pete Starkey, I-Connect007 technical editor, and André Bodegom from Adeon Technologies discuss current European market challenges, especially in automotive and automation. Alfred Macha's column follows, asking the question, "Are CMs Ready to Embrace Project Management?" Next, NexLogic Technologies' Zulki Khan sits for an interview with me, looking at what's current and upcoming regarding "The Digital Medical Revolution."

It's a special treat to bring you a very different perspective in this issue. Barry Matties introduces us to Dylan Nguyen, a teenage kite flyer, student, and inventor, in his interview, "The Future of the World Is Truly in the Hands of Our Youth." And even though Dylan Nguyen is a hard act to follow, Bob Wettermann holds his own, presenting the "Electronics Assembly Industry Outlook."

We conclude with a technical paper from Alfredo Garcia, Domingo Vazquez, Ricardo Macias, Rodrigo Ibarra, Joe Smetana, Mulugeta Abtew, and Iulia Muntele, titled "Practical Verification of Void Reduction Method for BTC Using Exposed Via-in-pad." We hope you enjoy this tour of the industry. **SMT007**

Reference

1. Richard Franks, "What Was the Grand Tour and Where Didi People Go?" The Culture Trip Ltd., December 4, 2017.

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.

Supply Chain Update and the Impact of 5G

Feature Interview by Nolan Johnson
I-CONNECT007

I caught up with Stephanie Martin, senior VP of global supply at Vexos, to talk about the current landscape of the industry from an EMS perspective. Stephanie describes an ongoing technology shift occurring with the industry's move to smaller case sizes and why it's in the customer's best interest to look at the design cycle and go as small as they can on components.

Nolan Johnson: Stephanie, you were so helpful earlier this year when we discussed parts shortages; you gave some great global insight. What has changed in the industry?

Stephanie Martin: This year has had significant changes. Last year through December of 2018, we were in the supercycle with shortages and extremely long lead times. MLCCs were out for 52 weeks, and several suppliers did not even accept orders. They were in that tight of supply, so everything was fully allocated, and we had that across a number of components. Lead times extended, and prices rose; it was a pretty bad situation. I've been in electronics for over 20 years, and it was the worst situation from a buying perspective I have ever seen.


Stephanie Martin

Starting in January of 2019, things started to ease up. We first caught wind of some easing up in Asia in late Q4 and early Q1 this year. The distributors in Asia told me their business was down 8% in Q4, and then an additional 10% in Q1 of this year. In their opinion, this was primarily driven by a reduction in the automotive industry in Chinese manufacturing and a reduction in the number of cellphones being built. As a result, that eased up a lot of material. By the end of Q1 of this year, we saw available supply in most commodities. Prices have been dropping and stabilizing. Lead times are down to what we would consider being near normal, which is somewhere in the 10–12-week range for most components as opposed to 30+ weeks last year.

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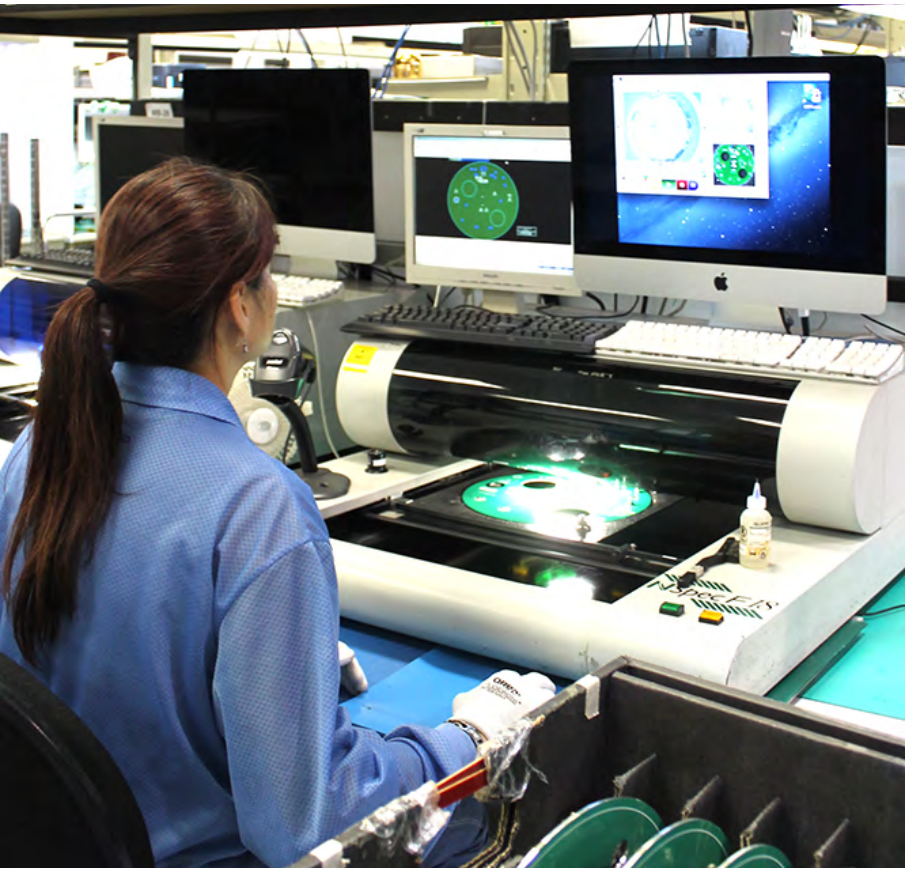

However, some spotty problems can still happen. We're still struggling with MOSFETs, which are still in the 30+ week range. I don't see any real change in that happening yet, but most of the other components—particularly the MLCCs and smaller sizes, such as 0201s and some 0402s—are down to reasonable lead times. The larger case sizes for the MLCCs are still constrained, of which the sizes 0603, 0805, and 1206 are the most common; those still have longer lead times with 25 weeks or more, and we do not expect to see them improve at all.

The other thing that is holding up the market is the launch of 5G technology. Huawei was leading the pack in that and was expected to release 5G technology toward the end of Q2, but that has not happened. It's not the cellphones themselves but the infrastructure, including repeaters, power stations, and devices. The big concern is those infrastructure devices use the same larger case sizes that are still somewhat constrained—0603s, 0805s, etc.

When 5G technology hits, we expect to see another wave of constraints. Right now, it's looking like it will be at the end of this year or the beginning of next year, but at this point, on the larger sizes, Murata has pulled out on MLCCs in most of those areas. They still have some, but no manufacturer is adding capacity in the larger case sizes. The capacity we have is all there is, and when 5G technology kicks in, it will put a strain on the market on those parts.

There's a major technology shift happening to smaller parts, which is very similar to what we saw in the early 2000s with the change from leaded to RoHS, which constrained the market. This is a technology shift, so the parts are not going to get bigger. They're going to continue to get smaller, and most customers have a very short period of time—maybe two to three years—before the availability is gone on those; then, they're into the gray market or constrained parts. Customers are going to have to redesign those parts, or they're going to experience extreme lead times and high prices, which is going to be pushed by 5G infrastructure.

Johnson: We seem to be on the same trajectory as at the start of 2019 except that the availability has adjusted, not so much by manufacturing capacity, but by changes in the demand.

Martin: Well, the manufacturers have brought on capacity in the smaller case size parts, like the MLCCs, which were fully constrained because the automotive industry, in general, is using more and more of those parts; between the handset and the automotive industry, they drive the demand for those parts. For example, a typical electric car may have as many as 30,000 MLCCs. The iPhone 10 has over 1,000 MLCCs. If demand and production drop in automotive—and China's a strong user of the electric car, to put it in perspective—the availability comes up. At the same time, manufacturers have been adding 10–15% capacity in the smaller parts—the 0201s and smaller. They

will ultimately take care of themselves. Where the problem will be with industrial, medical, and defense customers with the longer design cycles that use larger parts. There's no additional capacity coming on. Any type of device that comes in and uses more of those will put a strain on the market.

Johnson: That certainly is a change in the landscape and sends a cautionary message to those who are designing or maintaining designs for production to continue to pay attention to the parts they're using and potentially redesign to use parts earlier along in the bell curve.

Martin: Yes. That's what I tell our customers when we meet with them. You only have until the automotive industry backs out of the larger parts. In their design cycle, we're probably down to two to three years, and then the whole market will shift over. If they have not designed down to a smaller part size, they're going to have a problem; it's going to be constrained sourcing, limited or no availability, and higher prices. There's nothing on the horizon that says that these larger parts will ever come back, and it's mainly because they are the kind of parts that we would call "commodity" or "popcorn" parts. Over the years, they have become cheaper and cheaper, so the average selling price is extremely low, and manufacturers have low margins in these types of parts, so they are dropping the lines in favor of higher margin production. In the case of an MLCC, case size 1206, they can build as many as 300 0201-size parts at a higher average sling price per part than the cost of one 1206. The customers have squeezed the margins over time to the point that the manufacturers are not investing in the larger-size part capacity any longer; thus, from their perspective, they can get 300 + return in the same space of parts.

Johnson: That is not going to come back, is it?

Martin: No. The only ones that will stay are those that are high voltage because they can't get the capacitance yet; "yet" is the keyword. They can't get the capacitance yet in the high voltage part. Over-100-volt parts still have to be the larger sizes, but the smaller sizes—anything that's 50 volts or less—can get a higher capacitance in a smaller part, so they're going to shift and move the volume production there. There will always be some suppliers that produce a larger part, but there will be fewer suppliers, the lead times will go out, and the prices will go up because they become more of a specialty item then.

Johnson: How are things for Vexos? What's your perspective on the market from Vexos' business?

Martin: We're doing very well and growing the business. We've added a number of new customers on a regular basis, and our key focus is design services and information like I'm giving you. As a standard practice for our customers, we analyze the health of their BOMs. We tell them the life cycle of their parts. We tell them which MLCCs are going to be sourcing problems for them, both short-term and long-term, and those become differentiators for us. Our business is very strong. Most of the stress is off of the buyers, so they're in a planning mode. I wouldn't say it's a buyer's market yet, but it's very close to being one again.

Most of the stress is off of the buyers, so they're in a planning mode. I wouldn't say it's a buyer's market yet, but it's very close to being one again.

We believe the market is in more of a lull than a major shift. We're watching 5G technology because once that kicks in—which it will start in China first, and then Europe and the U.S.—you'll have telecom companies replacing infrastructure worldwide. Then, everybody, including me, will want new cellphones

so that we can get this new, whizzy technology. That's going to cause us another spike in the market when that happens.

Johnson: You touched on something that runs counter to history, as I recall, in the form of a 5G rollout in China first. Usually, that sort of stuff rolls out in Europe first.

Martin: Huawei was the Chinese company leading the pack and was almost ready to roll out, but I think the U.S. restrictions delayed that. The constraints the U.S. put in in terms of restrictions on data going to companies and individuals have limited the number of American companies that can work with Huawei, which is a concern. For instance, Qualcomm is a big component of Huawei. It has thrown a bit of a delay in Huawei, and I believe that's part of the reason it hasn't rolled out. The same is true with the Android system; they're having to look at developing their own system. Right now, the game plan from everything we hear from the suppliers is it rolls out in China first, and then Europe. The U.S. is hesitant as to which companies they're going to work with. I don't think they decided, but I believe the U.S. has restricted using any Huawei products, so even if they rolled out, we wouldn't get them here.

Johnson: That's great information. What do you expect to change over the next five years?

Martin: I expect us to see more parts go to the end of life at a faster pace. We're at the beginning of this rollout of moving to smaller case sizes, so I see a lot of sourcing issues going on with customers that are hesitant to redo their design. We're going to have some stumbling blocks and delays with those customers, particularly in medical where it takes almost 18 months to requalify. We'll also have some issues with customers not redesigning their product in a timely manner, which is going to create a gray market that may increase the likelihood of counterfeits. When there's a supply shortage, you see more counterfeit opportunities. Overall, this technology shift is going to continue to happen; it has already started, and it will ripple through all of the other commodities. Right now, you see it in the MLCCs and the resistors, in particular, but it will ultimately ripple through the entire technology base.

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Johnson: Usually, the next question we ask in these conversations is, "What keeps you up at night?" I think you probably just answered that (laughs).

Martin: I did (laughs). Because my team is global, every time there's a problem, we get involved as the escalation path from all the sites. Every day is a challenge for a new shortage, and it's holding up revenue and shipments. So, what can you do, and how can you do it? We're always trying to find solutions. I would tell you that every day brings a different issue, but they all come down to trying to meet the customers' demands and needs and find the parts in the market. At this point, most of the parts are not related to long lead times, but it's end-of-life issues. Still, when the parts are running 30 weeks for procurement, very few customers forecast well out—30+ weeks. If there's a three-week lead time for our manufacturing, then you're looking at 33–34 weeks total time from customer order to delivery. Very few customers have a good forecast out that far, at least in electronics; most of them are wanting products in less than 12 weeks, and the lead time on the components can be 30 weeks, so you're always scrambling trying to find parts for them.

Johnson: That would give me professional indigestion.

Martin: When you get a call from the general manager, telling you how desperately they need these parts, night after night, they ask for help. We're trying to find ways to solve the problem for them. I have one right now that is a special part, where the manufacturer put out an end of life notice for December. We went to place an order, and they said that they're out of the die. Even though their end of life is in December, they cannot make any more parts. That's today's problem.

Johnson: That's going to happen more and more with these older parts.

Martin: Right. We make multiple efforts. We look for any available inventory worldwide from franchise distributors. Concurrently, we work with a customer to get them to authorize or redesign in a new part, and then we look in the gray market worldwide for anything we can find and have those tested. That's how you go about this job.

Johnson: This is a cautionary tale, if you will, for teams that are designing or maintaining existing designs. This will be their life if they are slow to make the transition.

Martin: That's correct; it will be their life. It will impact their revenue stream because their chosen manufacturers won't be able to produce the part, or there will be a delay in getting the parts, and their unit costs will go up because the tighter the market gets, the higher the prices go. It's in the customer's best interest to look at the design cycle and go as small as they can with components.

Johnson: Stephanie, thank you for the time. It's always insightful and productive to talk to you.

Martin: Thank you. I enjoyed it. **SMT007**

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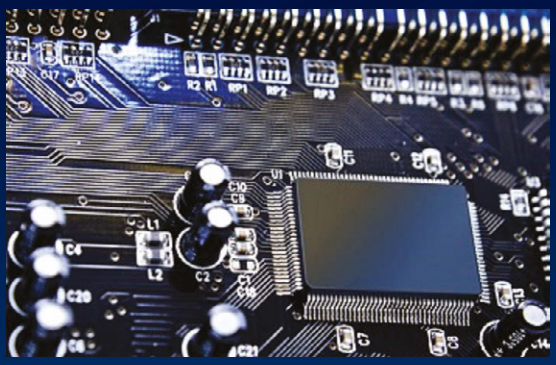

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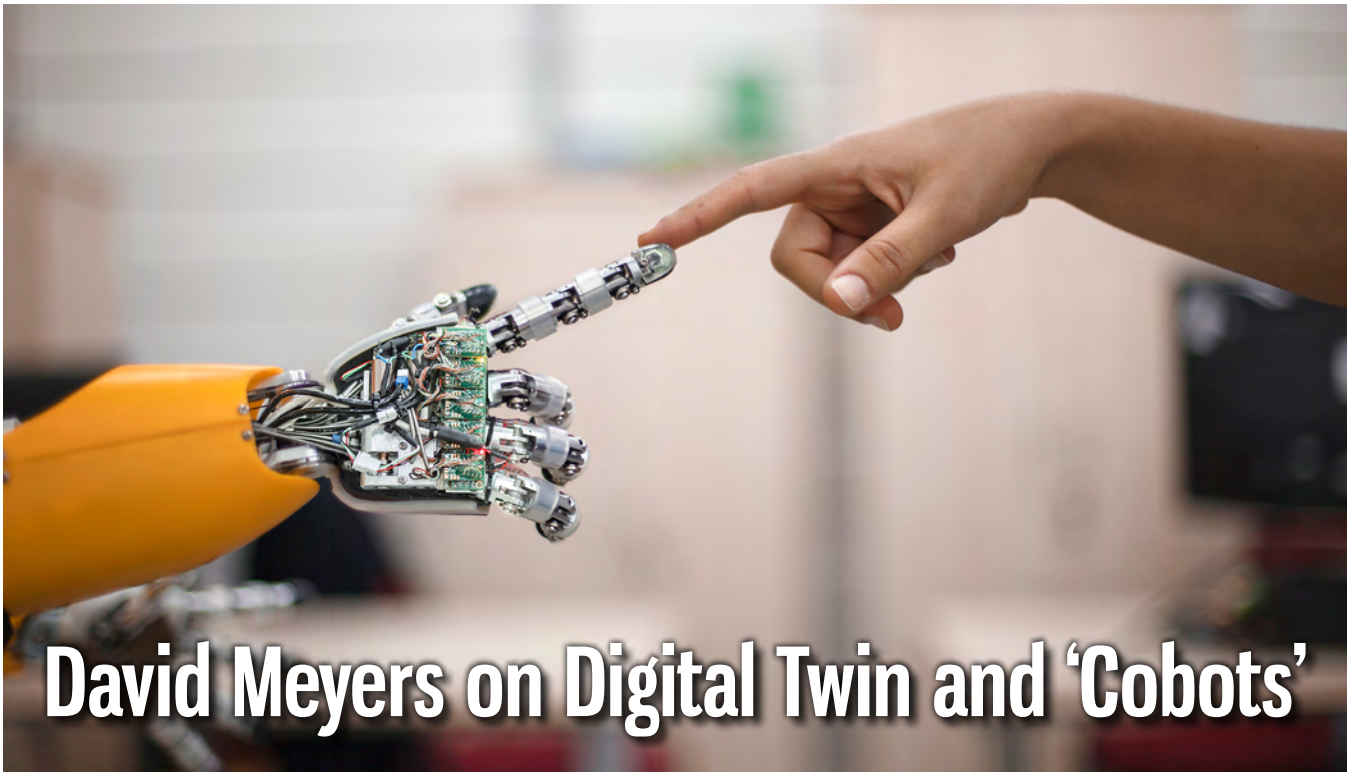

David Meyers on Digital Twin and 'Cobots'

Feature Interview by Nolan Johnson and Happy Holden
I-CONNECT007

With over 30+ years in the industry, David Meyers recently took on a new role at Siemens as a global solutions director in the Electronics Industry team of Siemens Digital Industries Software, working on improving communications between CMs and their OEM partners. In a conversation with Nolan Johnson and Happy Holden, David speaks on the digital twin and virtual environment software that should help establish that communication early in the process.

Nolan Johnson: David, can you start with a bit of background on yourself and your role in Siemens?

David Meyers: I've been in product development for about 35 years. I started at the end of 1981 while going to school. After working at the Department of Defense as a drafter, I learned CAD and worked at several companies, including Westinghouse, Motorola, Panasonic, and Dell. I spent the past 17 years with Dell, and then I had an opportunity to come on board with the industries group at Siemens because of my extensive background in product development and mechanical engineering. I led a team in the chief technology office at Dell for the last five years. I have a lot of familiarity with the OEM/ODM contract manufacturing model. At Siemens, I focus on the realization side, which is from engineering to manufacturing and developing the product from a hardware/software perspective.

Happy Holden: How do you see the industry landscape from your perspective?

Meyers: I've been around for a long time. I started my career doing drafting on the board, so pencils, paper, and lots of eraser shavings. We moved on over the years through using CAD systems, which have developed from wireframes to full-surface and solid models. Today, we have the capability to design products and have full simulation packages that demonstrate user environments and/or use case or safety reliability. You can do all of that, so that's a significant change. And I think that momentum is continuing.

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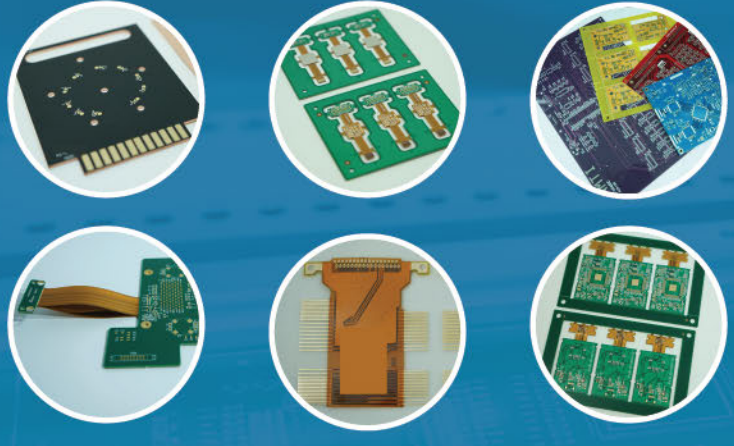

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Holden: Does your role take you to Asia and Europe?

David Meyers

Meyers: I had my first Europe trip this year. I went to Sweden and worked with the team there. I will spend a little time over the next years going through China, Taiwan, Japan, and Korea. One of my initiatives is to work on improving communications between CMs and their OEM partners. As you know, a good number of the CMs will contract manufacture for more than one company; most times, they do contract manufacturing for companies that compete against one another, so there's a big concern about communication and IP and data protection to protect that relationship. My goal is to start looking at where there are opportunities for the software that Siemens provides, as well as opportunities for us to help improve that communication and security.

Johnson: Where do you see the most activity in the manufacturing data and communications space?

Meyers: From my experience, Taiwan is probably the central hub for most of the ODM/CM environment. Many of them have factories in China, but they manage the business events and all that out of Taiwan. Typically, they are manufacturing, engineering, and doing product development. If there are product development engineers, they're in Taiwan, and they finish the details of the design, working directly with manufacturing engineering to determine precisely how they would, as a CM, develop the product.

Johnson: What sorts of features and functionalities seem to be on the forefront right now? What are the first things that companies are looking to improve?

Meyers: The tools that they have for product life cycle management, where they're managing all of the BOMs, components, and steps of the manufacturing process to develop a product. When you work for the CM, they have in-house parts that are theirs that they share between multiple OEMs. Their ability to manage those and not necessarily get that mixed up between clients when they're working for multiple OEMs and an OEM comes back and says, "I need to make a change to something that's a standard item for the CM." They need to be able to manage that in such a way that it doesn't affect the other OEM if the other OEM doesn't want to make that change. It turns into the same part with two numbers, one with a small change. That kind of stuff is problematic for them and adds complexity to their entire construct as far as what they have to manage from the manufacturing perspective when they may be building something similar for two companies.

Johnson: We often cover smart factory protocols, including how the capital equipment on the production floor passes data up and down the manufacturing line, along with the product itself. Industry 4.0 seems to be getting a lot of traction worldwide in the assembly business. It looks like the PCB fabrication part of the business, while following behind, is starting to get the message. From where you sit with the software, how do you integrate the CFX protocols to share data?

Meyers: Siemens has created hardware that converts multiple types of input languages into one database language. It then takes all digital information and converts it so that our software package can read it. When any of our software solutions connect to this hardware, almost any language is usable, and the data will convert into a format that the software can read—streamlining the communication between equipment on the shop floor and improving manufacturing processes, quality, and timing.

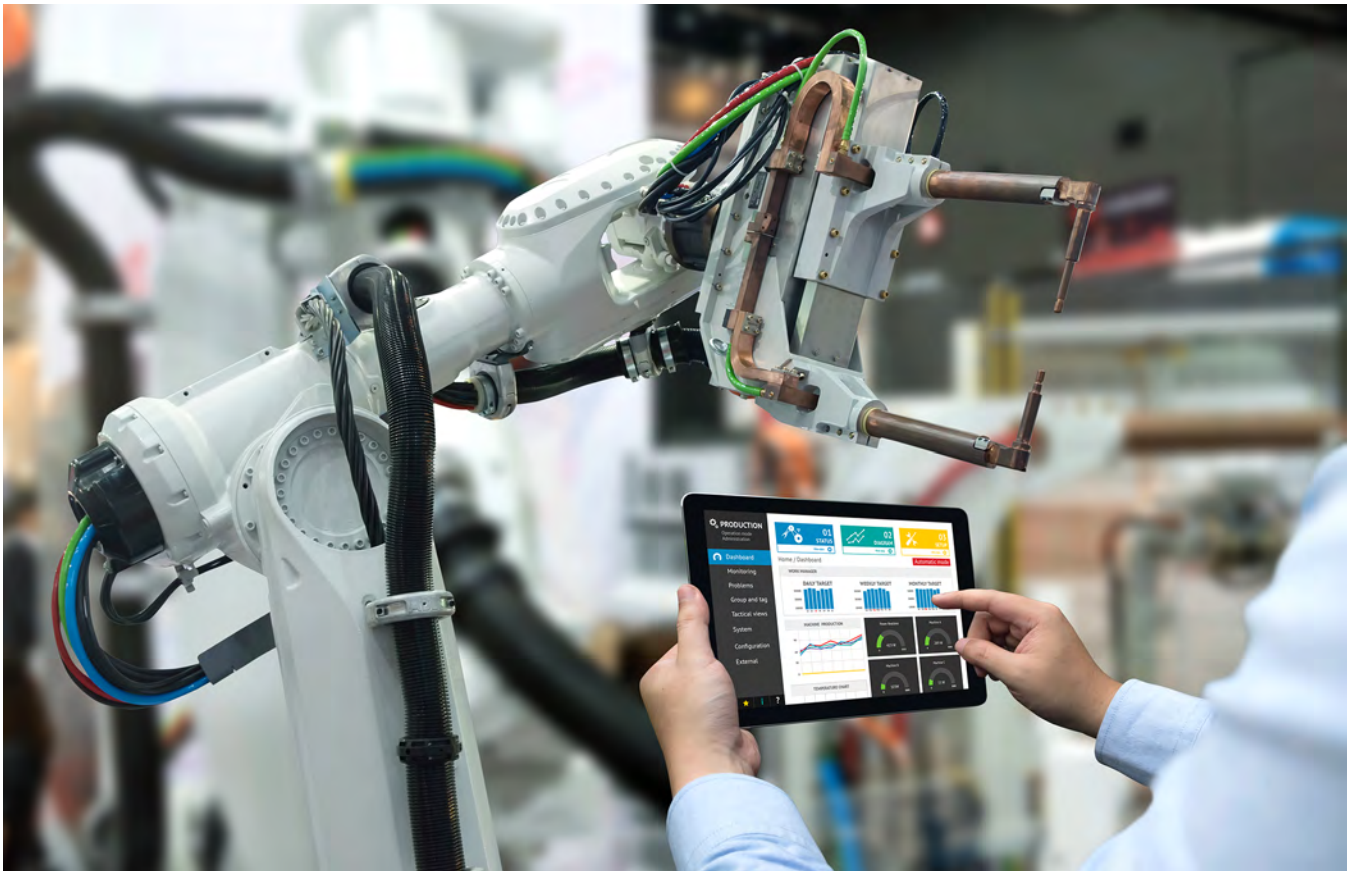
Johnson: Dave, are you referring to the external control boxes that Siemens and Mentor have to offer?

Meyers: Yes. My familiarity at this point is with the external box where you can run that one database language; they can feed information from the different manufacturing lines through those boxes. Those boxes then read back to the server database and allow you to input information that's pertinent to your manufacturing line. Most of my background is in the packaging side of this. While I'm familiar with exactly what it takes to get a board done, panelized, depanelized, and tested, the actual printed circuit design was not my area of focus.

Holden: Right now, many companies are at level one or two of the OSI hierarchy of applications within a smart factory, but it appears that Siemens is at level three or four. Do you focus mainly on levels three and four and the cloud? Those higher levels are the big promise of Industry 4.0, as well as digital twin.

Meyers: Digital twin is like a simulation model; it allows the mechanical and electrical people to design the product in a three-dimensional environment. We also have the ability with those tools to replicate the manufacturing environment. From a PCB perspective, if you're in a pick-and-place machine, you can simulate the machine; you can simulate the pick-and-place head as it passes over the board. You can look at what traditionally would have been a collision problem, like hitting a connector on the way to placing a resistor.

The digital twin allows you to virtually build your product and walk through all of the steps, not box build, but it includes box build. It also includes the manual labor and laying out a line in such a way that you can look at human interaction with the product as it goes down the line to look at efficiencies or inefficiencies



An engineer using tablet automation and a robot arm machine in a smart factory with a real-time monitoring system application.

Digital twin is the digital representation of product, in all disciplines.

in how you manage the material in the assembly sequence.

Holden: Especially the box builds, where now you start to involve robots and articulating devices, which gets into some of the hardcore Siemens products that have been available for many years. It sounds like you coming on board has helped to create a higher level of smart factory integration, or what I call "islands of automation," and pull them together for potentially much bigger paybacks.

Meyers: Absolutely. I spent most of my career on the upfront side; most of the work that I did was on the ideation and creation side. And because we followed our product into the factory and worked with them on launching, you find out that engineers can make many assumptions on what can be done on a factory floor "in a perfect world." But in the real factory, things can't always be done. Many engineers don't understand that, but when they find out, it's usually too late; their design is too well-baked for them to make the changes that the manufacturing organization would have recommended. Digital twin allows for that communication earlier and for engineers to go through that virtual environment and maybe even collaborate with the manufacturer on that virtual environment to talk about what changes could be made that would reduce the manufacturing time or improve cost or quality—anything that would help the bottom line.

Holden: I keep hearing questions like, "I hear all these great things about Industry 4.0 and smart factories, but how do I get started? How do I know what to prioritize? What's the first step on this long journey?"

Meyers: I've learned a lot in my time with Siemens about software and capabilities that I never knew existed. If I were an engineer, I'd say, "Wow. Why don't we do this?" It starts with a senior executive deciding that they're going to change their development model. Historically, a lot of this executes with a "turning the crank" ideology, and putting the onus on

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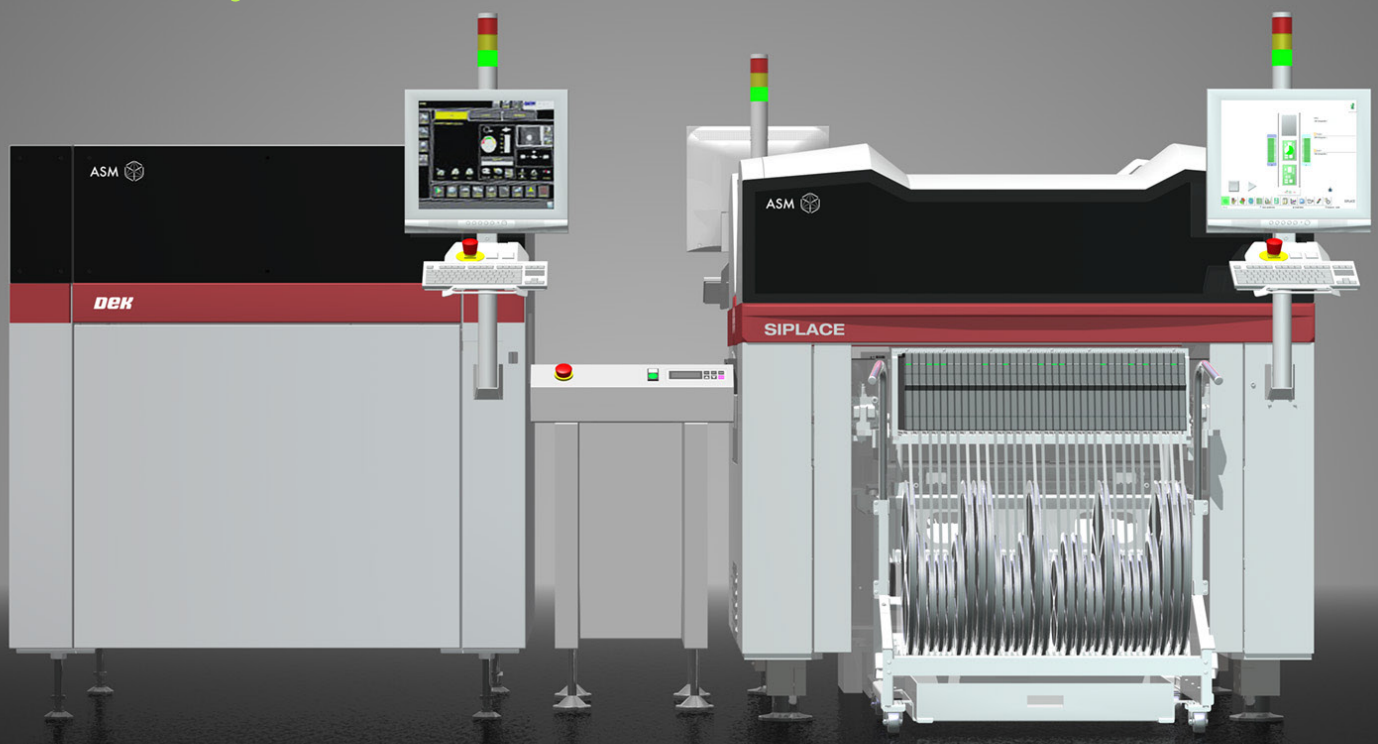

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the ODM partner to figure it out. We're going to give them what we want, tell them what we want on the backend, and let them figure out all of the issues and how to resolve them. We'll pressure them for time, and they'll be under the gun to get it done on time and budget. And they do, but in some cases, corners are cut that nobody pays attention to until the customer has it in their hands.

I think that you must have a company that looks at a program and says, "We're going to run this program differently. We're going to change the milestones of our development process so that we front-load the majority of what we need to do. And we're going to communicate more heavily in the front end so that we can develop a model that says, 'This is a new way of doing it, and we have proven that it works. Therefore, we can start to run that new model on a more regular cadence.'"

Some programs, again, are more about just turning the crank; that's the last version, and there's not enough of a change to warrant a process change. But there are new products where you have to look at it and say, "We want to do this a little differently to prepare for the future state where we're going to have a lot size of one; low-mix, high-volume; or high-mix, low-volume." You're going to have lots of versions but not much volume with any "one" version, and you're going to have to be nimble from a manufacturing perspective to achieve that.

Holden: With 35 years of experience, you're a member of the older guard like Nolan and me, who are used to hands-on learning. I teach a printed circuit course up at Michigan Tech, and the young engineers I teach often don't know how to hand solder. I believe that if you can't do it manually, why do you think you can do it with automation?

Meyers: I agree; I consider it the lost art of design intent, and a lot of the new kids don't understand. One day, I hope to write a book about it because it has frustrated me over the years to see that people create things in CAD and automatically think it is manufacturable without considering cost, quality, or time to market, but there's no such thing as perfection. So, how much imperfection can you accept before it doesn't do what it's supposed to do? Just because you can build it in the CAD world perfectly doesn't mean that the manufacturing world can build it exactly like that.

Holden: One of my favorite images is a CAD slide and a mechanical engineering slide of an Escher diagram; it says, "Guess what? The computer thinks this is perfectly manufacturable. You realize it's an optical illusion as an 'Escher,' but the computer doesn't." Again, just because you can do it by computer, doesn't mean that you can in real life.

Johnson: David, thanks so much for your time today. We look forward to having future conversations with you.

Meyers: My pleasure. SMT007

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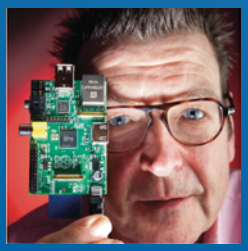

Pete Lomas, FREng
Co-Founder/Hardware Designer
Raspberry Pi

From Cardboard to Space - The Raspberry Pi Story

The keynote presentation will cover Pete's somewhat unusual early career in engineering through to how the Raspberry Pi was conceived and designed. He will also discuss the challenges involved in deploying two special Raspberry Pi computers to the International Space Station providing educational outreach that is literally "out of this world."

Technical Program

Session 1
KEYNOTE: From Cardboard to Space - The Raspberry Pi Story
Pete Lomas, FREng, Raspberry Pi

IPC Conformal Coating Material & Application State of the Industry Assessment Project
Jason Keeping, P.Eng., Celestica, Inc.

Session 2
Cleanliness Before Conformal Coating
Helmut Schweigart, Ph.D., Zestron

Implementation of a Low Melting Point Soldering Alloy in Electronics Assembly
David DeSomviele, Interflux Electronics

Automotive Grade Solder Paste - How to Engineer the Flux Chemistry to Achieve High SIR and Maximize the Print & Reflow Process Windows
Karthik Vijay, Indium Corporation

Session 3
Selective Solder Fine Pitch Components on High Thermal Mass Assembly
Gerjan Diepstraten, Vitronics Soltec BV

Laser Depaneling - The Future?
Allen Duck, Getech Automation

Yield Improvement at NPI Using X-Ray
Keith Bryant, Keith Bryant Consultancy

Session 4
Rework of Hybrid Land Grid-Array Sockets on Large High-Density Printed Circuit Boards
Prabjit Singh, Ph.D., IBM Corporation; Nandu Ranadive, Jabil Inc.

Using JTAG/Boundary-Scan in Manufacturing
Peter van den Eijnden, JTAG Technologies B.V.

Innovation in Jetting Technology for Advanced Manufacturing
Twan Aldenzee, Mycronic

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Voices Carry

Quest for Reliability

Feature Column by Eric Camden, FORESITE INC.

The title of my column this month is "Voices Carry," so not only is it a great chance to revisit the wonderfully written, top-10 hit song by 'Til Tuesday/Aimee Mann, but it is also a good opportunity to think back to the voices I have heard in the electronics industry, and the voices they heard, and even the ones they heard. I am referring to what I consider to be the voices of modern electronics and electronic assembly processes.

To me, this starts around 1943 with the advent of the PCB. Certainly, many other crucial inventions and advancements were made before that, which paved the way for the PCB to be necessary. But when I think about modern electronics, that includes the bare board as a basis for almost everything we do in this industry. The actual date, according to our friend Google, is 1936 when Paul Eisler developed the PCB while working on a radio set, but it was 1943 when the USA started to further develop and use this technology on a large scale for use in proximity fuses during WWII.

Paul Eisler, the father of the printed circuit board.

As with a lot of technology we have today, PCB and PCBA advancements were driven by war. It's a shame that the same type of technology can't be driven by tacos, but I digress. In 1958, a Texas Instruments employee by the name of Jack Kilby developed the hybrid integrated circuit, which really opened the flood gates of technology. Fun fact: Kilby also led the development of the handheld calculator, which would eventually be put on our wrists, making it very easy to spot the cool kids in a crowd.

Another engineer by the name of Robert Noyce was independently developing the monolithic IC at almost the same time. Noyce went on to found a couple of small companies called Fairchild Semiconductor and Intel. I think they are both still in business to this day. These three individuals should be mentioned when discussing the early history of our industry, as their voices still carry over to what we are doing today. They, along with many others not named in this column, represent the early days of the electronics industry. After that, this

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industry moved at lightspeed (in some cases, literally) compared to any other industry at the time.

The next generation began around the early 1960s when commercial products using more electronics than ever before began to soar in popularity: televisions, Hi-Fi stereos, and those sweet 900-pound TV/stereo combos that could never be moved once in place. Computers were being built at companies like Digital Equipment Corporation (DEC) and were becoming commonplace in larger companies and the military for tasks like payroll. Coupled with technological advances in automotive and aerospace electronics, the industry really began in earnest as we know it today.

When reflecting on the voices from that era, I think less about individuals and more about companies that made huge advancements, and the big companies thought less about the individuals as well. Most patents are owned by the companies, and some don't even reference any of the engineers that did the work. DEC was certainly a leader in computing, but they weren't the only ones.

When reflecting on the voices from that era, I think less about individuals and more about companies that made huge advancements, and the big companies thought less about the individuals as well.

IBM hit a homerun with the System/360 mainframe computer, and obviously, they are still one of the leaders in computing power with few rivals. There was a downturn in the 1990s after IBM failed to see the future of computing was on a desktop and not in a gigantic server room, but they managed to stay afloat and eventually release their own desktop units, which were very popular at the time. In the case of IBM, they have lasted by listening to a lot of their internal voices over the years. With multiple decades under one umbrella, there is a lot of history to look back on and learn from. This holds true for most companies that have been around for that long, but not everyone bothers to listen to their own voices, sometimes at their own peril.

Some industry giants are still around to learn from, but there are also a lot of individuals teaching as many as will learn. In my almost 20 years in the industry, I have had the good fortune of meeting and even working with quite a few who I believe have voices that will resonate for years to come. I attend industry events like SMTAI and IPC APEX EXPO, and these events are treasure troves for those looking for research papers on every aspect of our industry. From raw component processing to final packaging, if you have a question or interest in a specific topic, there is a great chance you can find a presentation covering it. And most are given by subject-matter experts from well-known companies, putting in the work to mainly benefit their own assembly process, but they are more than willing to share most of the details with the public at large.

When I started working at Contamination Studies Laboratories (CSL, but now Foresite), the first voice I heard is the one that I still hear almost every day—Terry Munson, company founder and president. In our lab, we are encouraged to not only do the work our customers request, but also to think about failure analysis outside of what would normally be considered for analysis. The equipment in our lab is certainly not all-encompassing when you look at all of the available equipment on the market, but we have a nice set of complementary pieces that allow us to get to the root cause of most failures.

Another big voice I hear around the office is Paco Solis, a lead investigator at Foresite. Paco is one of the smartest people I have ever met and has experience working in pretty much every part of the process with many years in

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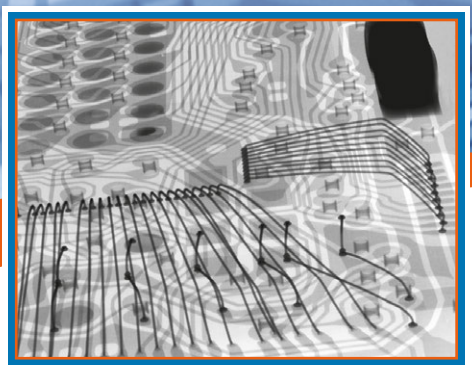

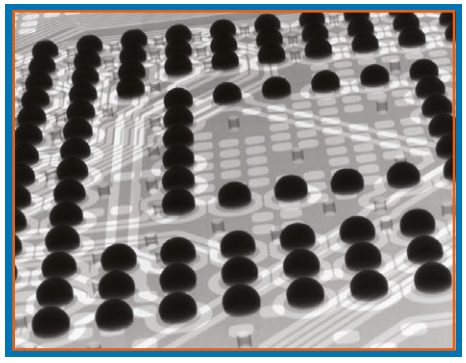

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wafer fabrication before coming on board over 15 years ago. Our current team is comprised of about 150 years of experience in different aspects, and that is a lot of exposure for me to learn from.

And when I think about voices outside of the walls of Foresite, I think of people like Doug Pauls at Rockwell Collins, a former CSL engineer, and how he helped me learn about topics like SIR testing and conformal coatings. Another former CSL voice I learned from when I first entered the industry is Joe Russeau, the founder and president of Precision Analytical Labs. He was the chemist who ran the ion chromatography lab in 2000 when I started, and he taught me a lot about how to run the equipment, as well as which ionics are found in most assembly processes. These are a few of the many voices I have learned from within CSL/Foresite.

And when I think about all of the presentations I have attended, the list of voices grows into the hundreds. Some that stick out are Dr. Polina Snugovsky at Celestica, Dale Lee at Plexus, Dr. Mike Bixenman at Kyzen, Dave Hillman at Rockwell Collins, and the list continues. The work and voices of the past like Kilby and Noyce echoed to the major corporations of the 1960s and their working engineer groups, and those still resonate today with the voices I have heard, starting in the 2000s.

I work with a lot of contemporaries with voices that will continue to be heard for many decades based on the work they are doing today. It is a great time to be in the electronics industry because we learn from those that came before us, and based on that, future generations will have the chance to listen to current voices for years and years. **SMT007**

Eric Camden is a lead investigator at Foresite Inc. To read past columns or contact Camden, click here.

Virgin Orbit Wants to Send Tiny Spacecraft to Mars in 2022

Virgin Orbit, the satellite-focused spinoff of space tourism company Virgin Galactic, announced plans to launch three missions to Mars. The company has inked a partnership with Polish satellite company SatRevolution and groups from Polish universities to send three small robotic spacecraft to Mars for science investigations. The missions would be launched by Virgin Orbit's flagship LauncherOne rocket and could start as early as 2022.

If it succeeds, Virgin Orbit will be the first commercial company to travel to the Red Planet. It will also mark an unexpected entrance into deep spaceflight for a company whose plans focus on air launches, which have always been considered unsuitable for traveling beyond low Earth orbit.

Virgin Orbit has yet to actually fly LauncherOne (it expects to do so later this year), but the plan is for a Boeing 747 called Cosmic Girl to carry the rocket to a high altitude and then release it. The rocket would fire its engines in midair and speed off into space. Air launches require less fuel and shielding than traditional rocket launches, and they can take place virtually anywhere since they're not restricted by a launch site or weather. But the airplanes struggle to take off with large rockets and large payloads.

Going into deep space with one of these air-launch systems "is a pretty new idea," says Glenn Lightsey, an aerospace engineer at Georgia Tech.

(Source: MIT Technology Review)

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André Bodegom on European Challenges, Automation, and Automotive

Feature Interview by Pete Starkey
I-CONNECT007

Pete Starkey speaks with André Bodegom, managing director for Adeon Technologies in the Netherlands, about changes he has seen over the years in major industry sectors, challenges in the European market, and other areas of growth.

Pete Starkey: It's good to speak with you again, André. Could you please give us a brief personal background to your present position?

André Bodegom: I studied as what we call "a fine-instrument maker" in Holland; in England, you would say "a toolmaker." I started as a process engineer in a PCB shop in 1986. I worked in ACB in Belgium in 1992, which was part of the transition to field engineer with Adeon from 1992–1996. I moved into the field of capital equipment sales in 1996 and became a major shareholder in Adeon in 2002 and 100% owner since January 2009.

Starkey: Looking at the European PCB manufacturing industry from your perspective, what's the most significant change you've seen in the past few years?

Bodegom: The industry is always on the move toward finer lines and spaces, different surface finishes, and new materials. And if you look at the way we see the market over the past few years, I think most European PCB companies have had a fairly good run behind them. Looking at these PCB companies, we believe that all sectors have been growing, although at a modest rate, perhaps with one or two exceptions like the automotive area. We've seen quite steady growth in aerospace and industrial, and even in telecom, datacom, and sensor and LED technology. The medical sector has seen some erratic movements, but it seems to be okay overall, and it's only a small part of the market.

We also believe that the larger European players have all expanded in capacity, judging by their investments in additional equipment.

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And I think that the investment went predominantly into direct imaging, optical inspection, and a lot more automation. At Adeon, we're not involved in wet chemistry, but we've seen many customers make large investments in plasma and vacuum filling of microvias.

One of the biggest changes we see is in the level of automation. Years ago, I told you that we foresaw a lot of automation coming up; that is now happening. But we also see higher demand from end-users who want to get more involved in the processes of the PCB manufacturers. They want to see how traceability is controlled so that they can make their judgment on the types of materials and processes and try to translate that into any of their potential future problems.

One of the biggest changes we see is in the level of automation. Years ago, I told you that we foresaw a lot of automation coming up; that is now happening.

We still see the increasing influence of the Asian market through more brokers and agencies. As a result of all that we have seen unfortunately over the last couple of years, some smaller companies could not stay up to speed with all of the investment in new technology and faster and more automated equipment; they've had to close their doors, which is a shame since the landscape in Europe is already fairly small. But we have also seen people who have found a good niche and are doing very well in the European market.

Starkey: What sort of challenges are your customers currently facing?

Bodegom: Human resources is one challenge. In recent years, we have seen a lot of experience leave the industry—more than we've seen enter the industry. Becoming a PCB specialist means that you have to get involved with manufacturing. There is no PCB school that I know of, and you can only really learn from seasoned engineers and by doing through hands-on experiences, but there's never enough time or money available anymore to do so. The manufacturing industry is small and involves disciplines in mechanical, electrical, and software engineering. And with companies already not having enough experienced engineers, it becomes increasingly difficult to train new ones.

Another challenge is the pressure from Asia, of course. People always like to talk about the price pressure from Asia, but I don't think that's the predominant pressure anymore. The Asian market operates at a lower cost, but through the volume it has achieved and its ability to invest on a much larger scale, it has gained a technology and capability advantage.

The big challenge in Europe is in finding and maintaining a niche market area if you're not a volume shop. I'm not saying that volume shops have it easy, but they can focus more on a certain market, and their customers depend on them more. The amount of investment required by PCB shops, in general, is relatively high due to the multitude of different systems and machines they require. Investing your money in the right sort of area is crucial; wrong investments won't be easily repaired or forgiven. You can really only spend it once, and, as I said earlier, we've seen some smaller companies who could simply not stay up to speed with the investments required.

Starkey: Looking to the future, how do you think the European PCB industry is going to change over the next few years?

Bodegom: That is a tough question to answer because changes don't usually happen very quickly in our industry. And it's not only a technical perspective; there are a lot of unknowns and uncertainties in the political and financial landscape too. Technically speaking, I think that we see more connections with the semi-

conductor world; we see signs of this already with PCB shops and semiconductor companies investigating how to jointly implement cheaper materials and have smarter utilization of the real estate of the materials.

Again, we also see higher levels of automation, but simply adding automation is not always the only answer; it has to be efficient and fit the purpose with the clear goal of making improvements and saving costs. It's not just about increasing the quality or structure or how the material is handled; you need to have a good payback on it.

Another trend we see is working smarter by implementing more intelligence at the front end to auto-analyze customer design data sets so that they can be translated faster, yet at the same time, maintaining the built-in intelligence that comes with that design data from the customer. That helps establish a faster and higher communication level with end-users in the build-up to the production stage, and it also increases the customer's confidence in the PCB manufacturer that they can respond quickly and efficiently to any sort of issue that might arise during the manufacturing; of course, that's key for end-users.

And we see PCB companies themselves developing into assembly. Of course, this can put their existing relationships with assembly shops or EMS companies under pressure. But the overall story we hear is that over time, it gives them a much stronger and more stable customer base not only in terms of price advantage and better product knowledge but the PCB is not just another component; it becomes a more advanced device that's complex to manufacture and understand by those not involved in manufacturing.

Finally, we see more momentum with inkjet solder mask after a long and winding development path. There's widespread interest from customers who understand that although it will still take some time, it's the only way forward that's visible on the solder mask roadmap today.

Starkey: Currently, what is your area of greatest concern?

Bodegom: The lack of understanding by the authorities with regard to what the industry can achieve with new developments in the near future, such as automotive. We do a lot of work in the German-speaking region, and automotive is the greatest part of that work. If you look at the emission regulations put in place by politicians who constantly give clear evidence that they're not in touch with this industry, it is worrying. Some of the milestones that have been set are going to be very difficult to achieve; it's already putting the industry under pressure. The industry understands it has to change, and it's doing it at a pace that's difficult to judge whether it should be faster, but there's definitely a willingness.

The industry understands it has to change, and it's doing it at a pace that's difficult to judge whether it should be faster, but there's definitely a willingness.

The main challenge we see is that the authorities are not wanting to understand or to be in any way sympathetic to the industry regarding the pace at which it can implement those changes. For example, BMW's CEO has recently confirmed that we won't be getting much more range out of battery-driven vehicles. We also have to think critically about the environmental impact of battery production and what will happen at end-of-life. We're also creating vehicles that weigh over 2,500 kilograms to transport one human being; we're going to have to take that seriously.

Starkey: André, many thanks for sharing your time today.

Bodegom: Thank you, Pete. SMT007

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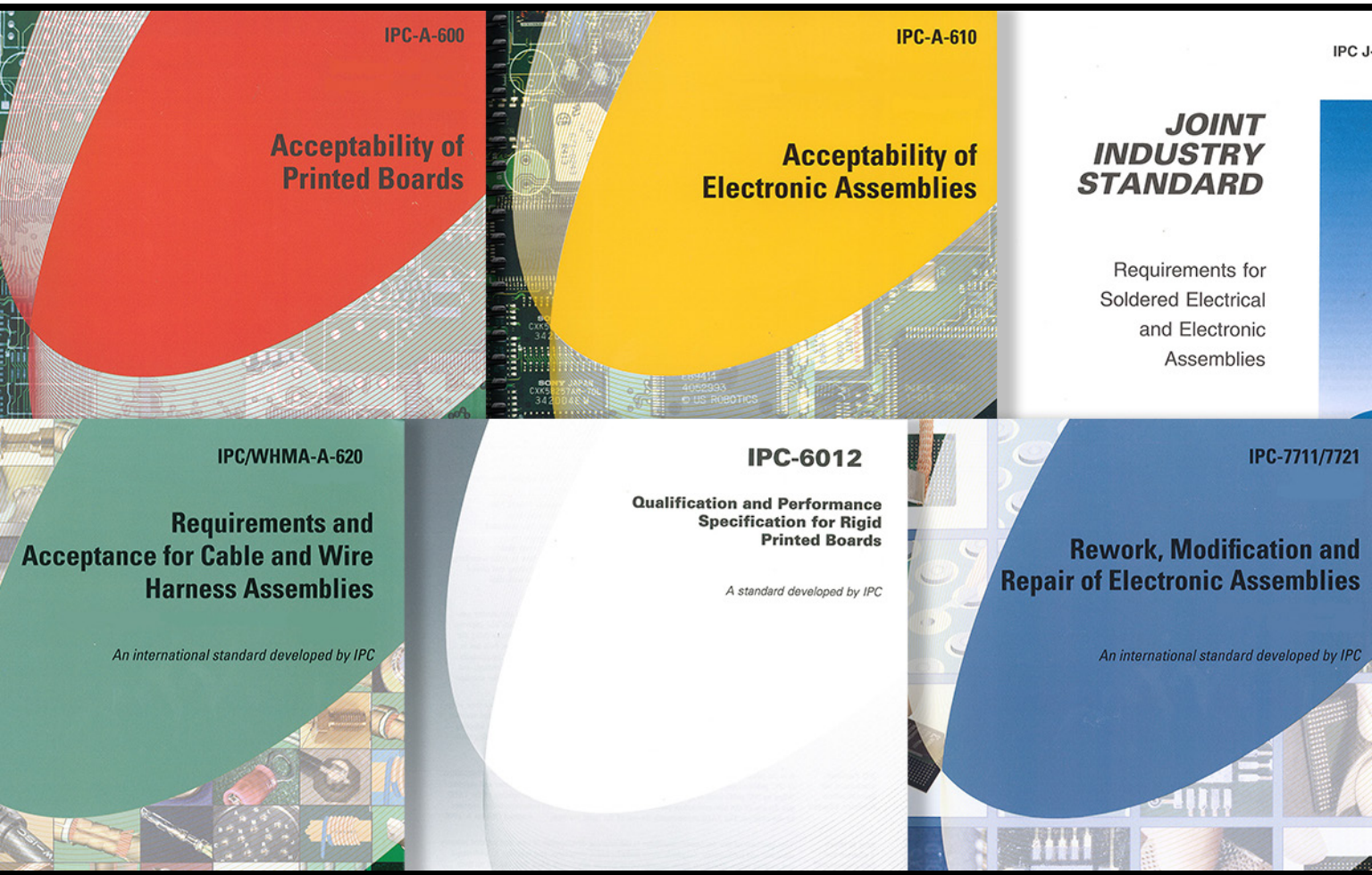

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Knocking Down the Bone Pile: Process Methods for Reworking High Lead Count SMT Parts ▶

There are numerous methods for getting the solder onto the right pads in the right volume during SMT rework of high pin count or very small footprint SMT devices.

Electrolube Reports Huge Success in India ▶

The specialist electro-chemicals manufacturer, Electrolube, has today announced the enormous success of its Indian manufacturing facility in Bangalore.

PVA Acquires Medical Device Company Specializing in 3D-printing Technology ▶

PVA has acquired additive manufacturing startup Create Orthotics & Prosthetics. Under terms of the agreement, PVA now owns all Create O&P software and intellectual property.

Indium's Graham Wilson to Present at Advanced Electronics Assembly Conference 2019 ▶

Indium Corporation expert Graham Wilson, applications engineer, will present at the Advanced Electronics Assembly Conference (AEAC) in two locations—first on November 19 in Budapest, Hungary, then on November 21 in Oradea, Romania.

MIRTEC Announces Technical Collaboration with Universal Instruments' Advanced Process Lab ▶

MIRTEC has installed one of its award-winning MV-6 OMNI 3D AOI systems at Universal Instruments' Advanced Process Lab (APL) in Conklin, New York.

RTW SMTAI 2019: Michael Ford on IPC-CFX and the Effects of Industry 4.0 ▶

Michael Ford, senior director of emerging industry strategy at Aegis Software, and Nolan Johnson discuss some of the long-term, global effects of Industry 4.0 and life beyond IPC-CFX.

RTW SMTAI 2019: Lenora Clark Discusses Company Changes and Her New Role ▶

Lenora Clark, director of autonomous driving and safety technology at MacDermid Alpha Electronics Solutions (and co-organizer for the upcoming SMTA Additive Electronics Conference), and Nolan Johnson discuss her new role, recent company reorganization, and the synergies customers are seeing.

Juan Arango on Koh Young's New U.S. Headquarters ▶

At the recent Koh Young America open house, managing director Juan Arango discussed his role in the company's transition from their Arizona facility to a new headquarters located outside of Atlanta, Georgia.

Blackfox Training Institute Officially Expands Training Centers in Mexico ▶

Blackfox Training Institute reports that it has officially expanded its electronics manufacturing training and certification services to a second location in Mexico with a new facility in Queretaro.

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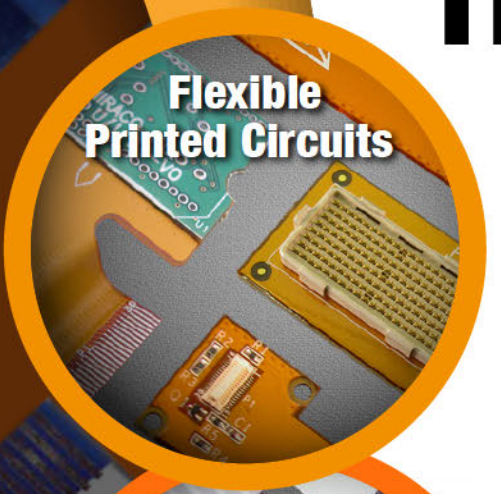

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Are CMs Ready to Embrace Project Management?

Operational Excellence

Feature Column by Alfred Macha, AMT PARTNERS

Project management is a fundamental function in many industries. Large-scale projects require a team of project managers, functional leaders, and subject-matter experts to deliver the project on schedule, within budget, and within the scope of the project requirements. In manufacturing, many projects are launched via the umbrella of Six Sigma, Kaizen, 5s, and other continuous improvement programs. However, many contract manufacturing organizations are hesitant to employ project managers or apply project management methodologies across the business due to the perception of high overhead costs and administrative burdens that project management could bring to the operations.

This column introduces a recommended approach to project management in a contract manufacturing environment. Project management does not have to be complex, nor costly; on the contrary, project management can help create a culture of operational efficiency, enhanced customer engagement, and employee self-accountability and enable data-driven decision-making.

Operational Challenges in Manufacturing

Project management can address operational challenges manufacturing companies face. Here are 14 operational challenges that were identified by a recent survey [1]:

1. Improving internal production processes
2. Strengthening customer relationships
3. Finding enough people with the right skills and talent
4. Increasing labor productivity
5. Increasing demand responsiveness
6. Maximizing capacity and asset utilization
7. Meeting customer demands for product customization
8. Achieving annual cost reductions
9. Improving product and service quality
10. Responding to customer requests for quotes and proposals
11. Improving labor flexibility
12. Enhancing supply chain collaboration
13. Optimizing supply chain performance
14. Faster and more frequent new product releases and launches

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These challenges resonate with every manufacturing organization. Project management provides the methodology to make improvements to successfully meet objectives presented by these challenges.

The Project Management Institute

Project management has matured over the last three decades into a well-recognized function embraced by many organizations. The Project Management Institute, a global nonprofit professional organization for project management, provides a wealth of information about project management. In addition, there are many books, associations, and consulting organizations that provide expert knowledge on project management.

Project Management Basics

Project management is the application of knowledge, skills, tools, and techniques to project activities to meet project requirements. And it is accomplished through the following five phases:

1. Initiating
2. Planning
3. Executing
4. Monitoring and controlling
5. Closing

Projects are typically monitored into these phases to provide better management control with appropriate links to the ongoing operations of the performing organization. Collectively, these phases are known as the project life cycle. Each project plan is then divided into six fundamental sections (additional sections can be added to these fundamentals, depending on the configuration of a project):

1. Scope
2. Schedule
3. Resources and budget
4. Quality
5. Customer satisfaction
6. Risks and mitigations

These all are so intertwined that a change in one will most often cause a change in at least one of the others. You will also need to do the following to establish a strong project management structure:

- Define a project management process that is appropriate for your organization
- Assign a project management leader that will train engineers, managers, and individual contributors in applying project management processes; give this role to any trained personnel in the organization and note that large projects do require a full-time project manager for successful completion of the project
- Define project management tools that the personnel assigned to be leaders can use to lead and manage the project successfully
- Incorporate project management as part of your quality management system (QMS)

Keep It Simple

Contract manufacturers (CMs) work in a fast-paced environment where simple processes are necessary for the effective execution of operations. At the core of practical project management is an ability to keep things simple and not get bogged down in lengthy and unwieldy processes; however, this does not mean cutting corners. Good project management practice is still necessary; it is about keeping it lean and mean. This, and getting the basics right, will help you deliver a successful project. Here are five guidelines to consider when implementing a practical project management structure for your organization.

1. Gather Requirements

Prepare a template that helps you define project requirements to effectively define the scope of a project. This template is referred to as the "project charter," which will be the approved document that the assigned project manager will use to plan, execute, and deliver the project to stakeholders.

2. Communicate

Does everyone in your team understand the project well enough to give an elevator speech?

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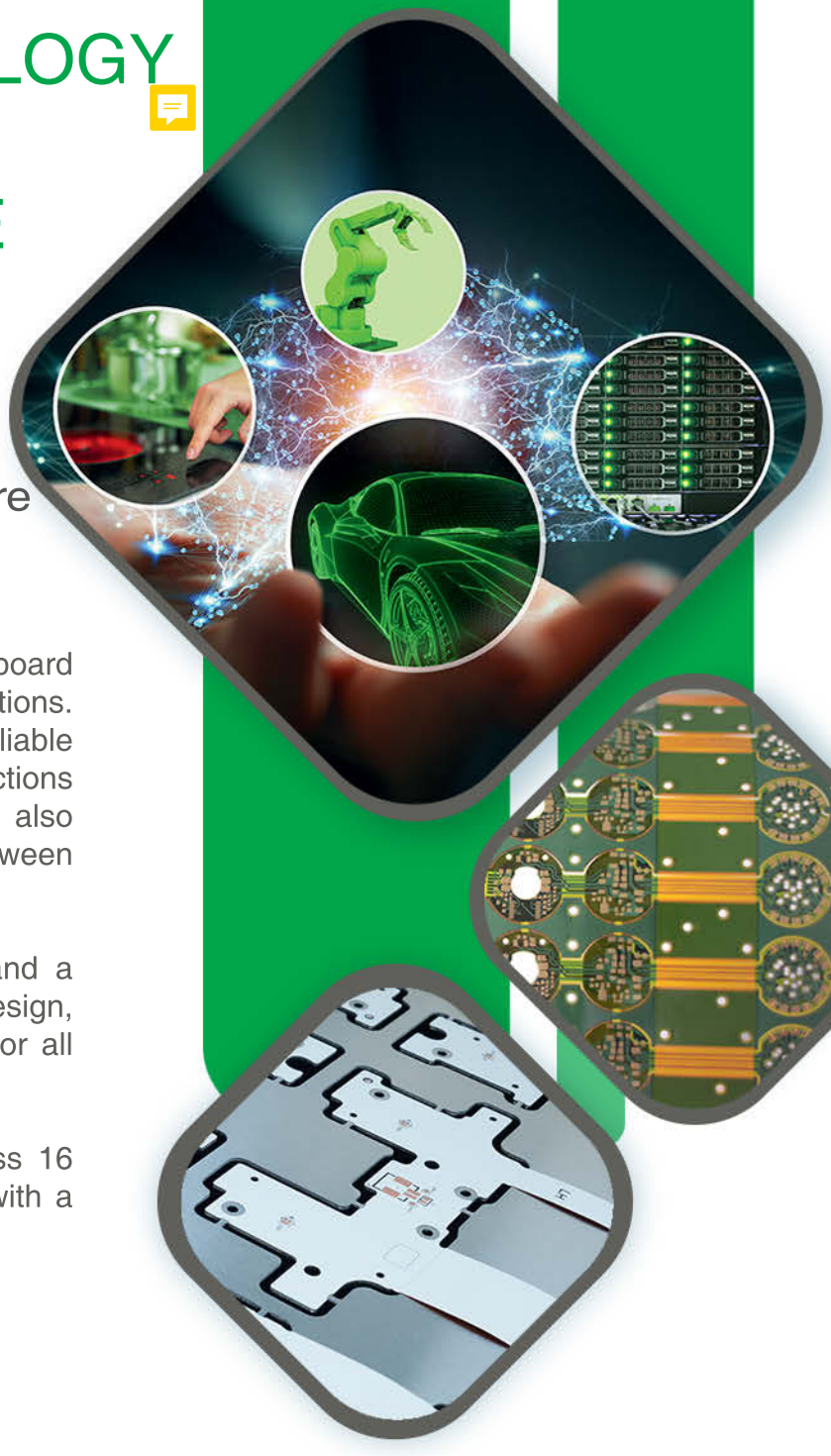

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If the answer is no, create a one-page executive summary of the project that contains all of the essential information. The content of your executive summary might look something like this:

- Project name: Give it a name that brings it to life
- Start and finish date: Everyone needs a target
- Project leader: The right person for the job
- Objective: Make it clear and concise
- Business potential: Agreement at every level
- Ideas summary: An outline of what it is
- Major issues: What are the stumbling blocks?
- Timeline: Hit the milestones
- Resources and materials: Everyone likes to know up front
- Budget: What do you need, and who signs it off?
- Evaluation: Measurement of the project and outcome
- Ideas for improvement: Set you up for your next project

Circulate this summary to all of your stakeholders before you start the project.

3. Monitor and Control

Now that the project is underway, you must deliver the plan. Communicate progress and manage resources. Here is where you earn your money:

- Stick to the plan, examine it regularly, and then adjust
- Provide regular updates, and don't let the project slip
- Hold everyone accountable
- Get work done no matter what happens
- Trust but verify
- Keep the end-users involved
- Deliver
- You've created something new; now people must use it

4. Ensure Gains Are Sustainable

To ensure that gains are sustainable, do the following:

- Gain cross-functional support
- Have an executive sponsor eliminate roadblocks to the implementation of the project
- Train, train, and train on new changes introduced by the project
- Involve QMS personnel to ensure procedures are properly updated, and records are kept in the quality system structure of the organization

5. Prevent Bureaucracy

Watch out for these commonplace project management pitfalls that can drag down a project and give a perception of bureaucracy. Do not do the following:

- Create a 50-page plan that you'll never carry out; a good plan, violently executed now, is better than a perfect plan next week
- File project assets incorrectly, and, as a consequence, waste time looking for them
- Allow people to involve themselves in areas where they have little or no knowledge; their involvement wastes time and money, so avoid this at all costs
- Create bottlenecks that slow your project down; instead, remove them

Important Tips

Here are some final tips you need to bear in mind before, during, and after project delivery:

- Create the right environment so that people will take ownership of their part of the project
- Baseline your project plan so you can see progress over time
- Evaluate project progress by continually asking, "How are we doing?"
- Add some slack to your project plan because some things will take longer than you think

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- Check with the customer after delivery to make sure everything works
- Look for improvement opportunities
- Check that the delivery of the expected benefits is on track
- Document lessons learned from your projects
- Kill failing projects quickly
- Recognize small wins
- Celebrate when the project is completed on time and within budget

Embrace the Journey

Once you initiate project management to address problems in the organization, make sure to continuously educate employees on the benefits of project management. The successful completion of a project is a win for the business, but the successful project management journey is a culture change that will take your business to new levels of growth and improved profitability. **SMT007**

Reference

1. "The Future of Manufacturing: 2020 and Beyond," IndustryWeek.

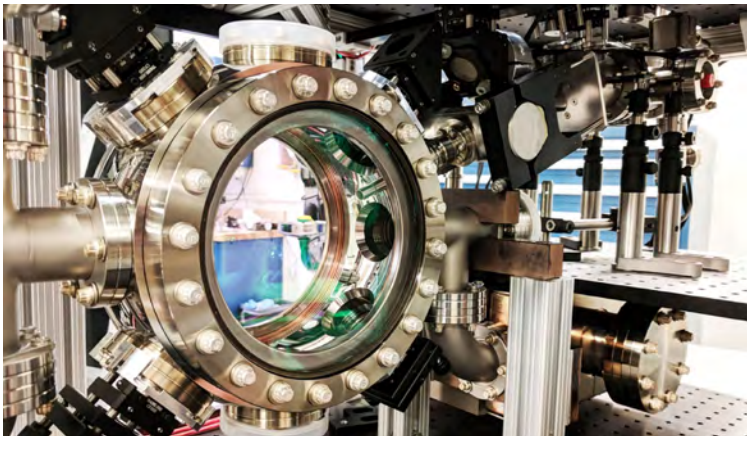
Alfred Macha is the president of AMT Partners. He can be reached at Alfred@amt-partners.com. To read past columns or contact Macha, click here.

Frozen Atoms Could Help Us Learn More From Gravitational Waves

It has been four years since the first detection of gravitational waves—those strange wobbles in spacetime caused when two massive objects in space collide. Finding that signal vindicated Einstein's century-old theory of general relativity, which says accelerating objects produce curvatures in spacetime that propagate into waves. Since then, scientists have observed these signals dozens of times, rippling out from many different parts of the universe and caused by very different types of cosmic collisions.

Here's how MAGIS-100 should work: atoms are cooled to a fraction above absolute zero (to keep them stable) and then dropped down a vacuum chamber housed within the shaft. A laser is pulsed down this chamber between atoms in free fall, and the time it takes for light to travel from one to the other is measured. Because light in a vacuum travels at a constant speed, this time should be precisely predictable. Any delay would presumably be caused by sensitive external signals–gravitational waves or potentially something else.

This is not altogether different from how conventional interferometers work. At its core, MAGIS-100 is sort of a shrunken-down version of the LIGO interferometers that made the first gravitational-wave detections in 2015. The difference is that LIGO uses mirrors stationed hundreds of kilometers apart instead of atoms. These mirrors are susceptible to disturbances caused by perturbations in the ground, which makes it more difficult to discern actual signals from false "noise." In theory, a free-falling atom won't be affected in this way.



Stanford University physicist Jason Hogan, one of the leads for the project, likens the technology behind MAGIS-100 to a hybrid of an interferometer and an atomic clock. "These atoms basically act like extremely good stopwatches that keep time on the propagation of light and look for fluctuations caused by other signals," he says.

The hope is that a future, bigger version of MAGIS-100 will be able to pick up gravitational-wave events that fall outside the scope of the big projects such as LIGO or Virgo, which is based in Italy. (Source: MIT Technology Review)

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The Digital Medical Revolution


Zulki Khan

Feature Interview by Nolan Johnson
I-CONNECT007

Zulki Khan, founder and CEO of NexLogic Technologies Inc., offers his unique perspective on manufacturing trends as a PCB turn-key solutions provider based in Silicon Valley. He discusses additional requirements that are now necessary to compete in different industry sectors, most notably medical, which he says is set for a "digital revolution."

Nolan Johnson: Today, we're talking about the industry from your point of view. Zulki, can you start by introducing yourself?

Zulki Khan: I have been in the industry for over 25 years. I started with a company out of Chicago that gave me the basic industry knowledge I needed, and then I started NexLogic in 1995. We offer full PCB services, including one-stop, turn-key solutions, to global hardware companies, including Apple, Phillips, Sony, Google, Facebook, and Uber.

We offer PCB design and layout, fabrication, assembly, and testing. People can come to us with a schematic of their hardware design. We do the layout by using CAD software packages like Allegro or PADS from Mentor, a Siemens Business, and Altium. Next, we perform the layout design and send the data for fabrication for the bare boards. We then assemble these boards with components and test, debug, and analyze to make sure they are working the way they were designed.

I have a degree in electrical engineering as well as a master's in business administration. We have done projects for the "who's who" from every different market segment. Although the essence of manufacturing stays the same, different industry sectors have additional requirements. The medical and aerospace sectors have their own standards that have to be followed to ensure that the products are successful; for example, in medical, there are requirements to address patient risk in case of a product recall.

One thing that becomes extremely critical in those two segments is the traceability of components. How much paperwork do you have to keep in the archive, and for how long? With lot, batch, and date code traceability requirements, there are certain things you have to keep for as long as seven years in some cases. That way, if something happens in the field, customers can go back and see who made the device, what the lot codes are, which country

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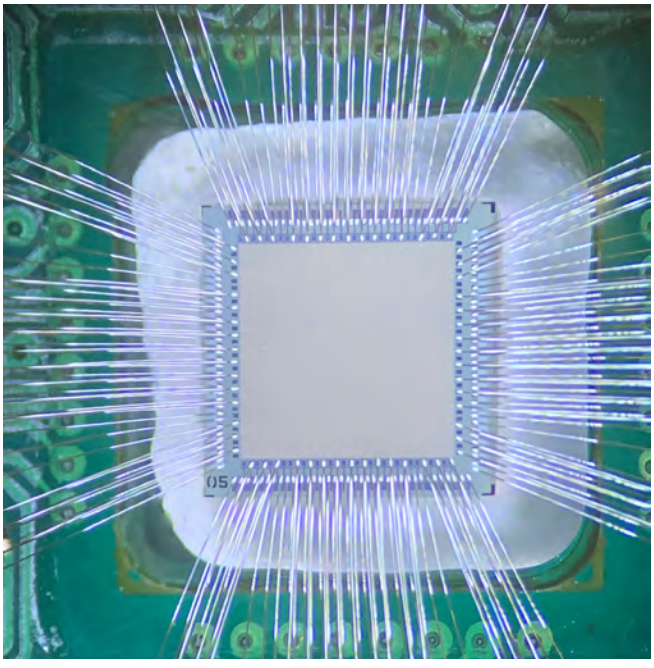

Figure 1: Stacked wire bonding is more complex than regular wire bonding and requires extra precision.

it was made in, and so on. This might become necessary to better evaluate product recalls.

Johnson: What is changing with manufacturing and the medical sector?

Khan: First, I'll address how manufacturing is changing, and then I will loop back to the medical sector. Traditionally, there are components with standard packaging, like the ICs that you buy from companies like Intel, AMD, or Nvidia. This surface-mount technology and through-hole technology have been around for a long time. They are stable and time-proven technologies because all of the nuances are known. What is coming to fruition is the fact that everything is shrinking from the size of the board to the size of the components; everything is becoming portable, handheld, and wearable.

The real estate on the PCB itself, as well as for the components, is becoming a prized commodity. The packages that were glass, ceramic, or aluminum are changing and going away. They are removing the packages and putting the dies directly onto the PCB or substrate. This gives you an enormous amount of real-estate savings, as well as gives you precise connectivity, but it comes at a price. For things like stacked wire bonding (Figure 1), die attach, flip chip, and so on, these are the upcoming technologies of the future that are used typically for handheld devices.

If you look at handheld and wearable devices, like watches, there are wire bonding and die attach packages in it. Regardless of what manufacturing sector we are going to be talking about, fine microelectronics packaging is now required. You put the die directly onto the substrate or PCB and do the wire bonding. Sometimes, you have to encapsulate the dies using glob top (Figure 2). I've talked about some of those in my previous columns. Manufacturing is also moving toward IoT, wearable devices, and Bluetooth-enabled technology in medical as well as in consumer, aerospace, commercial, and pretty much every sector.

Second, technology is changing at the fastest pace ever in recent history and becoming more powerful. In today's everyday devices—such as smartphones—the sensors, cameras, MEMs, etc., are becoming so good that they're surpassing conventional handheld cameras from a few years ago. In the healthcare sector, I see an upcoming "digital medical revo-

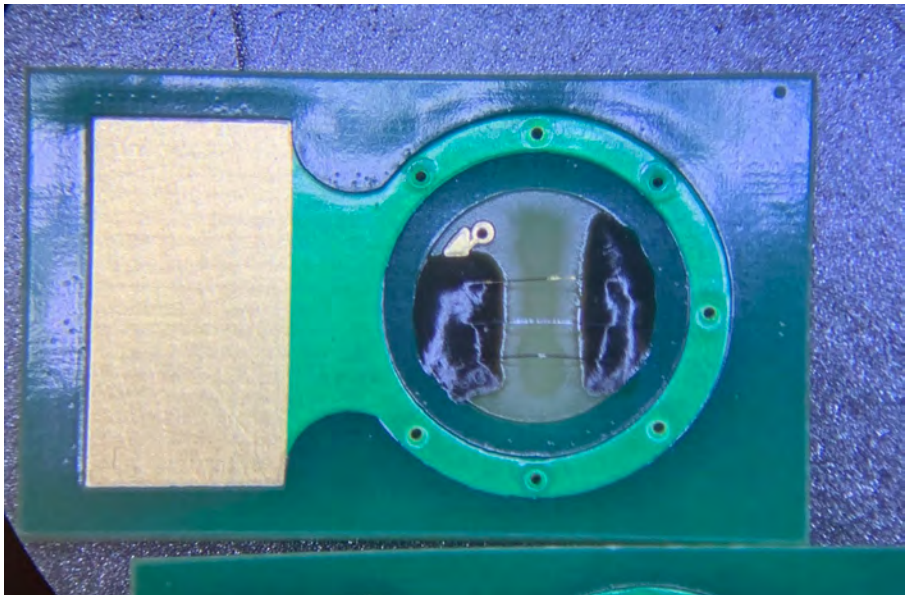

Figure 2: Glob top epoxy is used to encapsulate and protect bare dies.

lution." Traditionally, you have to go to a hospital and wait to access diagnostic machines and procedures. Now, with so many medical device changes coming into play, it is changing the whole landscape of treatment, analysis, and monitoring of patients.

If you look at ingestible smart pills and devices, for example, they have tiny sensors or cameras that go through your body and take pictures of the different organs. And if you're looking at the small intestine, for instance, there are several steps the doctor takes with a regular endoscopy to reach certain areas. But with ingestible smart devices, you quickly and efficiently get to those gastrointestinal areas with advanced sensors and cameras. Those sensors and cameras send vivid pictures to a patch or a device worn on the patient's body that records and displays that data in real time. Your doctors and medical service providers can look at how things are done and detect tumors, abnormalities, and anomalies inside of your different organs.

Johnson: What do you see as the risks to this technology?

Khan: Since the technology of these ingestible smart devices is new, the associated risks are also not well-known at this point. What happens if the pill gets stuck in some small portion of your intestine and won't come out? Would the patient feel pain or have to do a surgical procedure? Especially since these devices are going inside of your body, then you have to make sure that materials used, such as metals or plastics, and the shape and form are not harmful to people. This is something the industry will figure out as soon as this technology becomes more standard.

Johnson: Is this taking off, in your opinion?

Khan: It has started, but I see it taking off more in the next three to five years. I imagine it will have a hockey stick growth. By hockey stick growth, I mean that a lot of these time-consuming procedures that patients need at a big hospital now, where they have to wait for machine availability, can be performed more cost-effectively in the near future at outpatient clinics.

We are working with a local company that is developing a device that is comparable to magnetic resonance imaging (MRI), where you have to lie down in a hospital to get a good image of your body organs. This is expensive and time-consuming. This company is making a product that is about the size of a brick.

If you look at ingestible smart pills and devices, for example, they have tiny sensors or cameras that go through your body and take pictures of the different organs.

With this product, it will be a simple and small procedure where the patient can sit or lie down. A healthcare professional can then move the device over different parts of the body to perform the same functions as the large, million-dollar machines. They have a price point of $50,000–70,000. It's at the beginning stages of this disruptive technology, but if they are successful, then these are the types of changes I expect to see with the digital medical revolution. There are some similar products already in the marketplace, as well as some beta and alpha testing underway, so I feel that the medical sector is going to explode in the next few years.

Johnson: Based on what you do in your part of the market, you're likely to be working with some of these companies creating these innovations. How does this technology you're describing change "a day in the life" of a contract manufacturer or an EMS company compared to what they've been doing already?

Khan: These types of smart devices use PCB microelectronics technology, which means wire bonding, die attach, flip chip, chip on board (CoB), and associated technologies. These new and innovated medical electronics devices are changing traditional manufacturing.

With SMT machines, you have ambient room temperatures, so there's no need for a special environment. But when you talk about all of these new and very small devices, you need a Class 100 or 1,000 cleanroom (Figure 3), and you must maintain certain air pressure in those areas. You have to ensure the particles per million are often accounted for to maintain the integrity of the cleanroom. Then, you need sets of tools, devices, and machines; a different infrastructure inside of the cleanroom; and extremely knowledgeable personnel in the microelectronics arena, including operators, process engineers, and supervisors.

Typically, people who are in microelectronics stay there. People who are in traditional manufacturing stay there. In some cases, there is a match. So, some of the components are microelectronic-based, and others are traditional SMT-based. The marriage happens when you do the SMT manufacturing on the regular floor, bring those products into the cleanroom, and finish it off by doing the wire bonding and die attach. Some products are a cross between the traditional and microelectronic, and some are not; it depends on what the customers are trying to achieve.

Johnson: It sounds to me like the technology for EMS and assembly looks more and more like it was in the semiconductor industry 20 years ago.

Khan: Absolutely. It is a merging from regular PCB into semiconductor because we are talking about wafers, dies, and dicing.

Johnson: For EMS companies and contract manufacturers to move forward into this new technology, they need to revisit the practices and facilities used by semiconductor companies over the years as an example of their future.

Khan: If you want to keep your technology and service offerings for future products, then you have to incorporate that into your own floor or find an alliance because sooner or later, it is going to happen; it's only a matter of time. You have to ensure that you're able to offer these services unless you want to be a traditional manufacturer and work with the products that would not require these final manufacturing microelectronic techniques.

Figure 3: A Class 100 or 1,000 cleanroom is necessary for effective PCB microelectronics assembly.

Johnson: What is it about these changes that keeps you up at night?

Khan: Retaining customers, especially the top large ones with decent margins,

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is something that's always in the back of my mind. It requires a decent amount of resources to put together a good cleanroom and equipment. If you don't have the bandwidth to assemble those packages in your service offerings, then it could mean losing business. Your customers might go somewhere else.

Johnson: Let's consider some of the Tier 1 OEMs, as you mentioned earlier. As we break away from the more traditional manufacturing approaches and techniques—like a direct connection with the chips, etc.—do you see different companies choosing different paths? Of course, there's a risk of taking a company's customer base as they move into new technologies and fragmenting their customers into different specialties? Is that a concern for EMS suppliers as we look at new technologies?

Khan: There is some risk, and the Tier 1 EMS companies pretty much have the technology in their NPI or prototype divisions. But there is a risk factor as well. How many people see the changes in the technology that are happening? How many are willing to take the CapEx and put it into use by being able to put all of these types of infrastructures in place? And if you are not going to address that, then it will be a risk for you, and customers might go to some other places that are able to offer these PCB microelectronics.

Johnson: You raise a valid point there, Zulki. Thank you for your time.

Khan: Thank you. **SMT007**

Heard Mentality: AI Voice Startup Helps Hear Customer Pain Points

Eleven years ago, Carnegie Mellon University alumni Anthony Gadient, Edward Lin, and Rob Rutenbar were hunkered down in a garage, chowing pizza over late nights of coding. Eighteen months later, voice startup Voci emerged as a spinout from CMU.

Voci, like that of many early AI researchers, became a reality as a startup because of breakthroughs in deep neural networks paired with advances in GPU computing. "Our academic roots are based on this idea that you can do better by taking advantage of application-specific hardware, such as NVIDIA GPUs," said Gadient, Voci's chief strategy officer and co-founder.

Voci's V-Blaze automated speech recognition offers real-time speech-to-text and audio analytics to analyze conversations between customers and call center representatives. The data can be used by customers to understand the sentiment and emotion of speakers. Companies can use Voci to track what customers are saying about competitive products and different features offered elsewhere.

Voci is also addressing a problem that plagues automated customer service systems: caller verification. Many of these systems ask callers a handful of verification questions and then ask those same questions again if live support is required or if the call gets transferred. Instead, Voci has developed an API for "voiceprints" that can identify people by voice, bypassing the maze of verification questions.

"Biometrics for voice is a problem worth solving, if only for our collective sanity. It enables machine verification of callers in the background instead of those maddening repeated questions you can face when handed off from operator to operator in a call center," said Gadient. Voci uses a multitude of neural networks and techniques to offer its natural language processing services. The service is offered either on-premises or in the cloud and taps into NVIDIA V100 Tensor Core GPUs for inference.

Developers at Voci trained their networks on more than 20,000 hours of audio from customers seeking results for their businesses. "It took approximately one month to train the neural nets on a network of machines running a combination of NVIDIA P100 and V100 GPUs," said Gadient.

(Source: NVIDIA)

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MilAero007 Highlights

Arlon EMD and U.S. Air Force Academy Establish CRADA ▸

Arlon EMD—a privately held, veteran-owned, specialty laminate manufacturer—has entered into an agreement with the United States Air Force Academy to collaborate efforts in researching and developing technology platforms for electronic materials, resin systems, and copper-clad laminate products.

Amphenol Invotec to Exhibit at Space Tech Expo Europe ▸

Amphenol Invotec will be showcasing its PCBs alongside the extended range of interconnect solutions available from Amphenol for the space sector at Europe's largest B2B space event—the Space Tech Expo in Bremen, Germany, November 19–21, 2019.

Defense Speak Interpreted: Other Transaction Authority ▸

DIU grants contracts under a joint OTA and a parallel process called commercial solutions opening. Most of the five DIU focus areas depend on electronics: artificial intelligence (AI), autonomy, cyber, human systems, and space. At the end of 2018, DIU had funded 104 contracts with a total value of $354 million and brought in 87 non-traditional DoD vendors, including 43 contracting with DoD for the first time.

From the Hill: The Past 15 Years—Changes to MIL-PRF-31032 Certification, Part 2 ▸

Part 1 of this column series introduced background information and data from changes in military certification to MIL-PRF-31032 from 2003 to 2018. In this installment, Mike Hill provides an overview of the possible related factors to what could have caused the reduction in certified companies, including a decline in the total military market, cost of certification, and the number of military boards now built to industry standards, to name a few.

NASA Supports 'Wild' Ideas to Bring About New Space Tech ▸

NASA has a wild side. In fact, the agency has a program named NIAC that is dedicated to nurturing visionary ideas that could transform future NASA missions with the creation of breakthroughs—radically better or entirely new aerospace concepts.

BAE Systems' Advanced Typhoon Delivered to the Royal Air Force ▸

BAE Systems handed over the jet as work continues on delivering the capabilities required to ensure Typhoon remains the operationally effective backbone of the U.K.'s combat air power.

How to Dismantle a Nuclear Bomb ▸

How do weapons inspectors verify that a nuclear bomb has been dismantled? An unsettling answer is that they don't, for the most part. When countries sign arms reduction pacts, they do not typically grant inspectors complete access to their nuclear technologies, for fear of giving away military secrets.

Fast-track to the Moon: NASA Opens Call for Artemis Lunar Landers ▸

NASA is seeking proposals for human lunar landing systems designed and developed by American companies for the Artemis program, which includes sending the first woman and next man to the surface of the Moon by 2024.

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The Future of the World Is Truly in the Hands of Our Youth

Interview by Barry Matties
I-CONNECT007

The investments we make in our youth now will pay off for generations to come. We have to support and help wherever we can. At I-Connect007, we are proud to once again sponsor the STEM Outreach Program at the upcoming IPC APEX EXPO 2020. This year, IPC plans to double the number of participating students to 200. It should be a great event.

Another way we support our youth at I-Connect007 is by sharing the stories of young people who are doing amazing things. The following interview tells the story of 14-year-old Dylan Nguyen. Dylan is an avid kite flier in the master class and is often a featured flier at kite festivals along with his younger brother, Cardin, who is age 12.

Dylan started kite flying about four years ago. Now, he and his family can be found participating in and volunteering at kite events. Dylan also believes in giving back to the community. For example, he learned to sew beautiful, handcrafted delta kites so that he could give them away to kids at the 2019 Washington State International Kite Festival. During the same festival, he also co-organized an event to set a new world record with stack kites.

Dylan is also a great student, musician, and creative thinker. Recently, he shared with me the details of his school science fair project, "Kite: Powering the Future," which solved a problem that he faced. Dylan is a leader with a bright future, and the world is lucky to have him and other kids like him.

Barry Matties: Dylan, tell us about your recent STEM project.

Dylan Nguyen: At the 2018 Washington State International Kite Festival, I streamed music all day while flying. The issue was that I often found my phone running low on battery and had to go on long walks to the sound tent to

Thursday, February 6, 8:30 am–3:00 pm. **Activities include hands-on, project-based learning, including soldering, PCB assembly and design.**

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Dylan Nguyen with his airborne wind-generation invention.

recharge it. Then, I remembered a scene from the movie "Big Hero Six," where a little turbine flies in the air. I thought, "That's aerial energy!" Later, I read an article about a large part of Africa and India that does not have electricity but does have a lot of wind. I thought, "What if I build an airborne wind energy system tethered to a kite to convert wind energy into electrical energy?"

Instead of making a big generator, I went for something that was small, using easily obtained materials within my budget. It satisfied my need, and everything fits into a backpack. Its features—including being low-cost, compact, and low-maintenance—make it effective in developing countries and remote and offshore areas. My school project, though, wasn't meant to be a breakthrough in science or research of an important topic; it started out as something I tinkered with, combining my interest in kites with a practical solution. Then, it evolved into a plausible application that might benefit someone else's life in the future. It also connected me with a lot of people in the kite community.

Matties: What's the power source?

Dylan Nguyen: There is a turbine with a propeller mounted on to the line of a 27-square-foot airform kite that I built. An electrical wire running along the flying line connects the turbine to a motorcycle battery on the ground through a charge controller, which regulates the flow of power to protect the battery health. I can connect it to my phone, and if I use an inverter, I can put it into lights and appliances. Each component, including the kite, can be upgraded independently without having to replace the entire system, which can be accomplished by following simple instructions.

Matties: Why didn't you go with a solar option?

Dylan Nguyen: Torn sail? Patch it up. Broken propeller or parts? Make new ones. With such simplicity, repair costs are quite small. If you have a broken solar panel, that's kind of a done deal; you can't replace it without having to buy another one. It can be costly to replace many of them.

Matties: You did this with the idea of portable power, so are you thinking of any ways to improve it?

Dylan Nguyen: I plan to replace the PVC frame with a carbon fiber rod and 3D-printed picavet as well as parts to retain strength and weather durability while decreasing weight drastically. Holes can be made on the picavet to attach other equipment should the need arise. I've also been thinking about using a motor to reel the kite in and out autonomously to solve the relaunching issue, and a wind speed sensor to detect when to do it effectively.

Matties: A solar panel would plug directly into a device. You don't need to charge the battery. Is yours something where I could take the elec-

tricity, and through a regulator, put it right into my device and not need to worry about the battery so that it's on-demand power rather than stored power?

Dylan Nguyen: Solar panels need a battery to store electricity. For my system, I use a charge controller that has USB ports, which I can plug things in directly.

Matties: And then I don't have to worry about carrying a battery.

Dylan Nguyen: I like to carry it around because it also provides a reserve and keeps the power consistent.

Matties: If I'm a kite flyer or somebody who's hiking and I want this as a backup option, I don't necessarily have to carry the battery then. Is that what you're saying?

Dylan Nguyen: Sure, although solar power would not be available at night. And I've also talked to people about different kinds of batteries that I could use, which is one of the things that I want to develop into my design. This is a prototype right now, and I'm considering different paths to take it, such as hiking and other outdoor recreation. I'd make the whole system, scale it down, and focus it only on powering small lights and a phone, which would either eliminate the battery or make it a small battery like a portable charger. Or I could scale it up and make more of them, so they would be able to power large appliances, such as refrigerators, which would take a lot of power; that would also mean increasing the number of turbines I have, the kite size, and the battery size to hold more power.

Matties: The kite is an interesting approach. If you're going to the extent of a refrigerator, why wouldn't you just put it on a pole and create a generator that you don't have to worry about flying?

Dylan Nguyen: The thing about a pole is that with ground wind, you're not getting the best kind of wind you could possibly have. By using a kite, it's easier to harvest more consistent wind in the higher altitude, and it leaves little carbon footprint too.

Matties: Not a lot of other 14-year-old students are thinking about this sort of thing. You're a kite flyer, so is that part of the reason that you integrated kites into your strategy?

Dylan Nguyen: Yes, it was.

Expert kite maker (and manufacturing technician with Intel), Rod Thrall, took Dylan under his wing to teach him how to construct the lifting foil kite for his project.

The system is designed to fit into a backpack.

Matties: What was the process like for developing this STEM project?

Dylan Nguyen: First, I talked to a lot of my teachers and asked for resources. Kites aren't really an area most people at my school would be familiar with, so I took it to the kite community too. I observed and inquired about various kites that I was interested in; then, I combined them into something that would work the best for me. I've also had to adjust and re-engineer things along the way.

Initially, I planned to build the turbine onto the frame of a Cody or Conyne once used to carry war equipment. However, the Prism Flip spinner sparked the idea of attaching the turbine to the flying line, making the use of a sparless kite even more plausible. The first test flight did not turn out well as the system swung wild like a pendulum. Alden Miller, a kite mentor of mine, suggested I use a picavet. I made it out of pinewood to hoist the turbine and adjusted it so that it keeps the propeller stay pointed to the wind, which eliminates the need for a tailfin.

Matties: How big is the turbine, and how much does it weigh?

Dylan Nguyen: It weighs about one pound, which is still a lot for a kite to lift. The two-blade propeller is 15 inches. The motor is about 1.5 x 2 inches, so it's not a huge motor. It's not like an RC plane motor, which is something that I've been looking at.

Matties: Like a brushless motor?

Dylan Nguyen: Yes, because those seem to spin faster and produce a lot of energy. It's connected to a short spar to keep it away from the line. The turbine is inserted on to the frame that connects to the picavet mount. The picavet is then suspended from the flying line. The transfer of electricity to the ground-based battery is via an electrical wire.

Matties: What sort of voltage are you moving down to?

Dylan Nguyen: The motor is 12 volts at the moment. If I want to use something like a transformer, like a step down or step up, I'd go for 14 volts; that way, it would go into the 12-volt battery for more output. The whole system fits into a backpack and is easily carried.

Matties: And the kite you use is a very durable foil, so it has no rigid parts.

Dylan Nguyen: Correct. That makes it easier to set up and maintain because there are no extra parts nor anything to break other than the sail. The kite fits into a small compression bag. Storage and the size of the system have never been issues; instead, I've sacrificed a bit of the power output for the sake of portability, which is why I'm looking into a transformer or some other efficient way to produce energy.

Matties: Do you see this growing this product into a business for yourself?

Dylan Nguyen: I could see it growing into a business, and it's something that I want to expand

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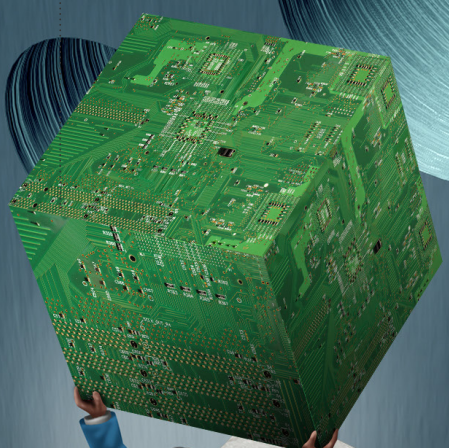

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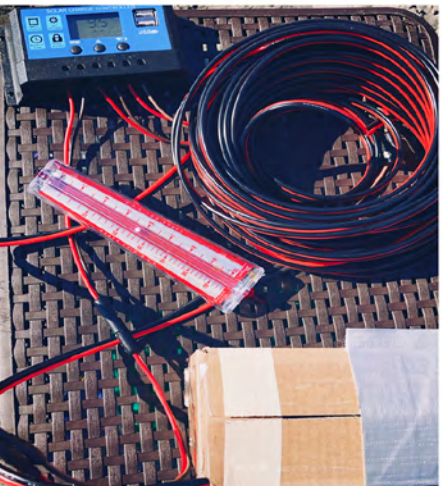
into a functioning product—one that works efficiently and reliably.

Matties: What market do you see this serving? I know you talked about developing countries.

Dylan Nguyen: I could see it being a humanitarian product. I've seen a website where donors would buy the product, and it would be sent to developing countries or airdropped into disaster-stricken areas. I could also see it being used in the outdoor recreation market. A scaled-up system could be used on a ship, using a foil kite flying in endless figure eights, or you could equip a truck with a large battery on its bed, drive into disaster-stricken areas, and launch the tethered kite. The electrical energy it produces can be plugged into an existing power grid. I don't see it competing with other utility-grade power generators used on wind farms, but it adds more ideas to the mix.



Detail images of the project.

Matties: You mentioned enough to power a refrigerator, for example, which takes quite a bit of power.

Dylan Nguyen: Right. That's one of my goals. For now, it can power something like a fan, especially in hot areas where that's important, and it can power lights continuously, which is also very useful. With a bigger system, battery, and kite, it can satisfy the need of a household or a small community.

Matties: Provided there is wind. What do people do when there is no wind?

Dylan Nguyen: That's something that I was looking at too, although the reserved electricity in the battery can cover that issue.

Matties: That's the market killer because if you don't have wind, you don't have power, which makes a stronger case for solar.

Dylan Nguyen: It does make a stronger case for solar, which is why I was thinking about combining the two to make a more reliable, balanced system. I want something that could roll with the punches if there was no wind, or it was nighttime, and there was no sun, and still generate power.

Matties: If there is wind at night, that's a good alternative to solar.

Dylan Nguyen: There are pros and cons to both, which is why I hope to find a way to combine the two.

Matties: It would be nice if your kite was a solar panel, so whether it was in the sky or on the ground, it would generate power.

Dylan Nguyen: Exactly, or make the kite from some sort of an energy-conducting material.

Matties: What advice would you give a young person who wants to work on a STEM project?

Dylan Nguyen: Don't be afraid of failure. Reach out and talk to experts. By working with other people, you can achieve a lot more than doing it solo. I could have borrowed a kite to test my system, but I chose to build it instead with the help of Rod Thrall, a master show kite builder. I sewed it at his workshop, tinkered with parts and materials, and learned a lot along the way. The making of this project expanded my knowledge of what my kite friends do; then, I can apply it to enrich my academic life and bring kite awareness to the public.

Matties: What do you think was the best advice you received for this project?

Dylan Nguyen: When I talked to Mark Reed from Prism Kites, he said, "Remember that your project is in its early stages. It isn't going to work on the first try, and problems are going to come up and need to be tweaked, but keeping at it will make it better." Good enough isn't enough; there are always going to be ways to improve my project.

Matties: You're talking about making this into product and business, which takes leadership. What do you think makes a good leader?

Dylan Nguyen: A good leader isn't just someone who bosses people around and tries to take control of everything. I accepted the fact that I'm new to all of this. I'm inexperienced, so being a leader is like being like a follower in that you have to rely on other people; it's not a one-man band. A leader has to know how to take insight from other people and ask for help because you can't do it on your own.

Matties: One of the things about being a leader is that means people believe in you, right? Because if they don't believe in you, they're not going to follow you. A leader means that people believe in your vision. You have to attract people to what you're doing as well as inspire them. How are you going to inspire people?

Dylan Nguyen: First, I have to believe in myself and that I can do it. Even if I fail, I can always try again. It's important to convey my passion to other people and not to give up. If people see me falter and not recover, they might lose faith in me.

Matties: That's when people will recognize that you're human; we all make mistakes.

Dylan Nguyen: But being able to get up from that with strength, dignity, and grace is when people really see who you are.

Matties: Who do you most admire?

Dylan Nguyen: My mom. She's the best mom I could ask for and has supported me along the way; I look up to her. My mom is strong, independent, and always happy; people gravitate toward her.

Dylan's project placed first in energy at the 2019 Intel Northwest Science Expo as well as a Ricoh Sustainable Development Award.

Matties: How long have you been flying kites?

Dylan Nguyen: My entire life, and going on my fifth year as a demonstration and competitive sport kiter.

Matties: What was the appeal when you started flying kites?

Dylan Nguyen: My brother and I grew up flying family kites and watching kites dancing to music at kite festivals. One day in 2015, we decided to give it a try by flying our first dual-line demo. It took off for us since. I like doing acrobatic tricks, choreographed routines, flying in teams, and hanging out with kiters of all ages. Being kids in an adult world is frustrating sometimes, but we're blessed to be surrounded with good friends who make it all fun.

Matties: You're flying some high-end, difficult kites—not just weekend kites. You're flying quad-line kites, sometimes in team situations, as well as solos, demonstrations, and with your family. What's the greatest joy you get out of kite flying?

Dylan Nguyen: It's the places I go and the people I meet. Flying with people and talking to them is something I can't do with a lot of other sports. I get to make lasting friendships with people who continue to have a positive impact on my life.

Matties: What advice would you give to a young kite flyer?

Dylan Nguyen: Whatever you do—whether it's single-line, quad-line, dual-line, etc.—get out there, have fun, and talk to people. It looks a little scary at first, but people are willing to share tips and tricks, or simply enjoy your company for hours.

Matties: What's one of your greatest experiences or memories from kite flying?

Dylan Nguyen: It was a zero-wind day with only a few kites airborne at a kite festival. I flew all morning with a standard quad-line—the only one I had back then. Al Washington walked up to me, complimented me for my effort, and gifted me his one-of-a-kind pin he won 25 years prior. It's nice to know that sometimes things get tough, but there are people who see us through. My greatest joy isn't those on the demo field but the stories we share at the end of the day. It's all about having fun and spending time together.

Matties: Who inspires you in kite flying?

Dylan Nguyen: Many people I've met and learned from inspire me, especially the few who see me for who I am, including Rich Comras, Terry Wiggill, Wayne Griffith, Brett Morris, Spence Watson, and recently, you.

Matties: It's an amazing community of people, and kites will carry you into amazing places in the world. I've been lucky to travel the world and fly kites in many of the places I visit.

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Dylan has a great assistant in his brother Cardin.

Wherever you see somebody flying a kite, you see a friend. Your 12-year-old brother is here as well. Cardin, how long have you been flying kites?

Cardin Nguyen: About four years in sport kites, and all my life, if you count diamond kites.

Matties: What do you like most about flying kites?

Cardin Nguyen: When I'm out at the beach, I'm able to interact with people and do something fun.

Matties: Who inspires you?

Cardin Nguyen: Alden Miller, Lam Hoac, Brett Morris, James Christman and you; you've all have given me tips to improve my flying.

Matties: Today, I noticed that sometimes the kite picks you up. When you're flying a really powerful kite, how does that feel?

Cardin Nguyen: Usually, it puts a strain on my forearms. If I'm flying a laser kite, I always move my torso to help move my hands, and if I'm flying something like a vented standard, then I won't use my torso to move the kite; instead, I'll just use my hands. And if I'm doing tricks, I push my hands into my chest to do tricks because if I have my hands straight out, I wouldn't be able to do anything.

Matties: Well, you're not a very big guy yet, but you're strong because you're flying some incredibly powerful kites.

Cardin Nguyen: When I'm flying powerful kites in a strong wind, I've learned from people to dig my feet into the sand or lean back enough; otherwise, I'll hit the ground. If I have trouble, people always give me tips, saying, "Do this, and it will be easier or lighter."

Matties: Right, so you also perform for crowds of people. How does that make you feel?

Cardin Nguyen: Fun, but sometimes, I get stressed out because I don't know what peo-

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ple will think if I mess up or accidentally land a kite on them.

Matties: Aside from that, when it's roped off, and you're performing to music, how do you feel?

Cardin Nguyen: I think of myself in an empty spot, keep my eye on the kite, and try to do whatever I can to follow the music. It's really fun, and it makes me happy to know how to do it.

Matties: And then at the end, when you land, and people cheer and clap, that has to make you feel pretty special.

Cardin Nguyen: It does.

Matties: Dylan, what about you?

Dylan Nguyen: I really enjoy that part of kite flying. Last summer, after I performed to "When You Say Nothing At All," a woman walked up to us and cried. Watching me fly to the emotional song reminded her so much of her husband, who was incarcerated, that she called him right after, and they talked for the longest time. I used to fly to get away from a dark period of being bullied. Now, when I fly, I think about the positive impact I have on people. It's great.

Matties: You touch people's lives in ways that you don't even understand or know sometimes. It's incredible how people react to kites and kite flying, especially with you two, because your passion is noticeable and people feel your energy. As I've watched you two fly, I see people react amazingly to what you're doing. You're helping make the world be a better place. What advice would you both give to a young kite flyer?

Cardin Nguyen: First, try to learn basic techniques; don't just attempt difficult tricks. You will learn new things from people. And once you get better and better, you can make up new moves, and you'll be happy about yourself.

Dylan Nguyen: Don't run if you can't walk. Everybody starts somewhere.

Matties: Thank you for sharing your story.

Dylan Nguyen: Thank you.

Cardin Nguyen: Thanks, Barry.

Dylan's project won first place in electrical engineering, a Naval Science Award from the U.S. Navy and Marine Corps, and the Lemelson Early Inventor Prize at the district science fair. At the 2019 Intel Northwest Science Expo, Dylan's project placed first in energy and earned another Naval Science Award as well as a Ricoh Sustainable Development Award. Even though it did not win the best of fair, to be entered in the next round of judging out of 330 projects was a great honor. Dylan was also among the top 10% of middle school scientists nationwide to compete in Broadcom MASTERS 2019 (Math, Applied Science, Technology, and Engineering for Rising Stars). **SMT007**

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Electronics Assembly Industry Outlook

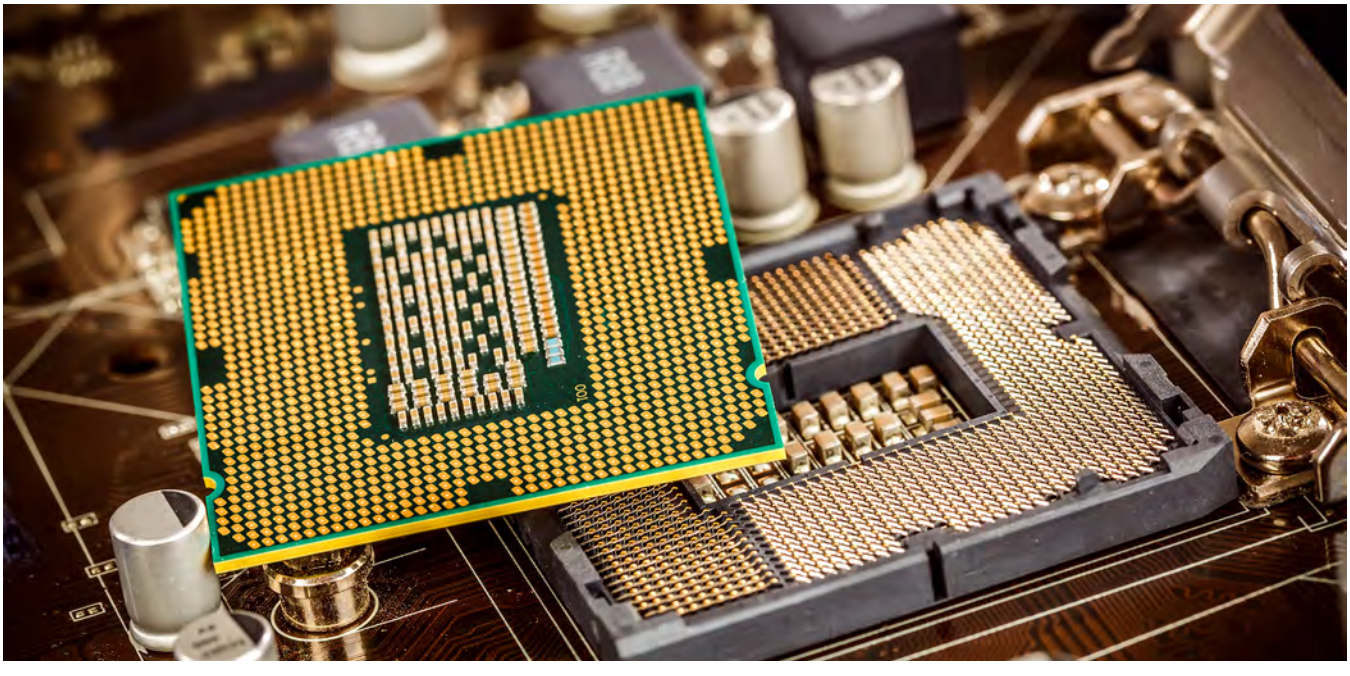
Knocking Down the Bone Pile

Feature Column by Bob Wettermann, BEST INC.

The next two to three years on the horizon should bring some challenges and opportunities for the electronics assembly industry. My perspective on the electronics supply chain is very broad in nature. Our firm is involved in PCB rework/repair, including the supply of niche PCB rework, repair, and assembly products, as well as the training of soldering technicians, engineers, and wire/cable harness users and suppliers.

In terms of markets, due to the very diverse nature of our business, we are involved in the military, aerospace, semiconductor, industrial, communications, EMS, IoT, computer, trade school, training center, education, research, and medical fields. The nature of our varied businesses and thousands of customers over 20+ years puts us in the mix from design through prototyping, manufacturing, and product support. Geographically, our products go directly into the market around the world, our rework and repair services are a harbinger of the EMS build market, and our training services are hyperfocused in the Midwest of the United States. Therefore, we see much of the activity in the global electronics supply chain.

There are numerous PCB rework/repair challenges being faced by North American customers. One trend has to do with increasing package sizes, which are being driven by the market desires. In the past five years alone, the state-of-the-art semiconductor package has gone from approximately 10 to 30 billion transistors on a single package. These larger package devices—such as LGAs, BGAs, and CCGAs with greater than 50 x 50 mm overall package size—challenge rework equipment and processing capabilities.



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Even more thermally massive boards—featuring high layer count and or heavy weighted ground planes, which require rework while meeting the original inspection criteria post-rework—are challenging in terms of hole fill and keeping neighboring areas from thermal damage. Neighboring devices are getting closer and closer together in their board layout, creating challenges in PCB rework—especially when it comes to RF circuits, handheld devices, and IoT products. The continued upward trend of these technologies will become more numerous and pronounced.

There are several changes we are considering in planning for our business in the coming years where these rework challenges will exist. Like almost all highly skilled labor forces in America, much of the workforce is approaching retirement age, and we need to make sure that we continue bringing the skill level of our employees up (e.g., 55 is the average age of a welder and age 57 is the average for tool and die makers). This same problem exists in the PCB process assembly arena where skilled process engineers are in this same age bracket. How will they be trained? How will the industry attract and train rising talent?

We are now in our 122nd month of economic expansion, and what comes up must come down. The landing will likely occur sometime in the next few years. Will it be a crash landing or a soft landing? How will we retain the employees who we are "bringing up" in the ranks during an economic softening? Some of the newer, high-growth technologies will continue to require attention in terms of the development of rework processes for flex circuits, embedded layer actives/passives, and the proliferation of micro-component packages. Many times the industry "figures out" a process before the rework and repair standards can catch up.

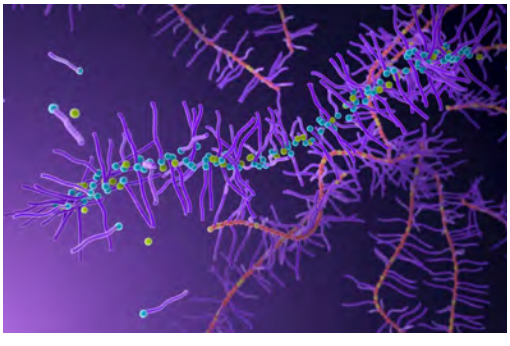
Lastly, with continued pressure on having enough highly trained personnel, an opportunity exists to reduce costs with respect to some hand soldering skills, AI or VR training, EOS/ESD and acceptability criteria. This is an opportunity to get the labor force skills up at a reasonable cost. **SMT007**

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

New Synthesis Method Yields Degradable Polymers

MIT chemists have devised a way to synthesize polymers that can break down more readily in the body and in the environment. A chemical reaction called ring-opening metathesis polymerization (ROMP) is handy for building novel polymers for various uses such as nanofabrication, high-performance resins, and delivering drugs or imaging agents. The resulting polymers, however, do not naturally break down in natural environments, such as inside the body.

The MIT research team makes those polymers more degradable by adding a novel type of building block or monomer to the backbone of the polymer/structure forming chemical bonds that can be broken down by weak acids, bases, and ions, such as fluoride. Jeremiah Johnson, the senior author of the study, says, "The nice part is that it works using the standard ROMP workflow; you just need to sprinkle in the new monomer, making it very convenient."



Potential uses include not only medical applications but also the synthesis of industrial polymers that would break down more rapidly after use, the researchers say. In tests in mice, the researchers found that during the first week or two, the degradable polymers showed the same distribution through the body as the original polymers, but they began to break down soon after that.

(Source: MIT News Office)

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Electronics Industry News and Market Highlights

IDTechEx: The Future of Wearables Is Medical (Part 1) ▶

Electronic devices on the body are perfectly placed for sensors to collect data relevant to healthcare, with communication options allowing them to be the gateway to digital health data.

Spending on AI Systems in the Middle East and Africa to Top $374M in 2020 ▶

Spending on artificial intelligence (AI) systems in the Middle East and Africa (MEA) is expected to maintain its strong growth trajectory as businesses continue to invest in projects that utilize the capabilities of AI software and platforms.

Radar Market Size Worth $38B by 2025 ▶

The global radar market size is expected to be valued at $38.01 billion by 2025, registering a CAGR of 3.8% over the forecast period, according to Grand View Research Inc.

Global Memory Semiconductor Market to Reach $52B by 2024 ▶

The global memory semiconductor market for the consumer electronics industry is projected to grow at a CAGR of 0.63% to reach $52.057 billion by 2024, up from $49.999 billion in 2019.

Europe Consumer Confidence Unshaken by Economic, Political Uncertainties ▶

The Conference Board Global Consumer Confidence Index for the European region was unchanged at 89 in the third quarter of 2019 (a reading of 100 or above is considered positive) and even increased by one point (from 87 to 88) for the broader European region.

Global Biometrics Technologies Market Report 2019-2027 ▶

The global biometrics technologies market accounted for $14.6 billion in 2018 and is expected to grow at a CAGR of 16.2% over the forecast period of 2019–2027, to account for $55.42 billion by 2027.

Top 10 Trends in Information and Communication Technology Industry for 2020 ▶

TrendForce provides predictions of the information and communication technology industry for 2020, focusing on 10 key themes.

Emergence of Miniaturized EO/IR Systems to Boost Global Military Laser Designator Market Growth ▶

The global military laser designator market is expected to post a CAGR of close to 5% during the period 2019–2023, according to the latest market research report by Technavio.

Pulsed RF Power Semiconductor Device Markets to Top $300M by 2024 ▶

Markets for pulsed RF power devices up to 4 GHz will show continued moderate and steady growth over the next five years and exceed $300 million by 2024, despite current economic and political turmoil.

U.S. Medical Technology Market Projected to Exceed $200B by 2023 ▶

Medical device manufacturing remains a strong market, driven by technological developments, an aging population, and increases in chronic and lifestyle diseases—trends that expand healthcare spending.

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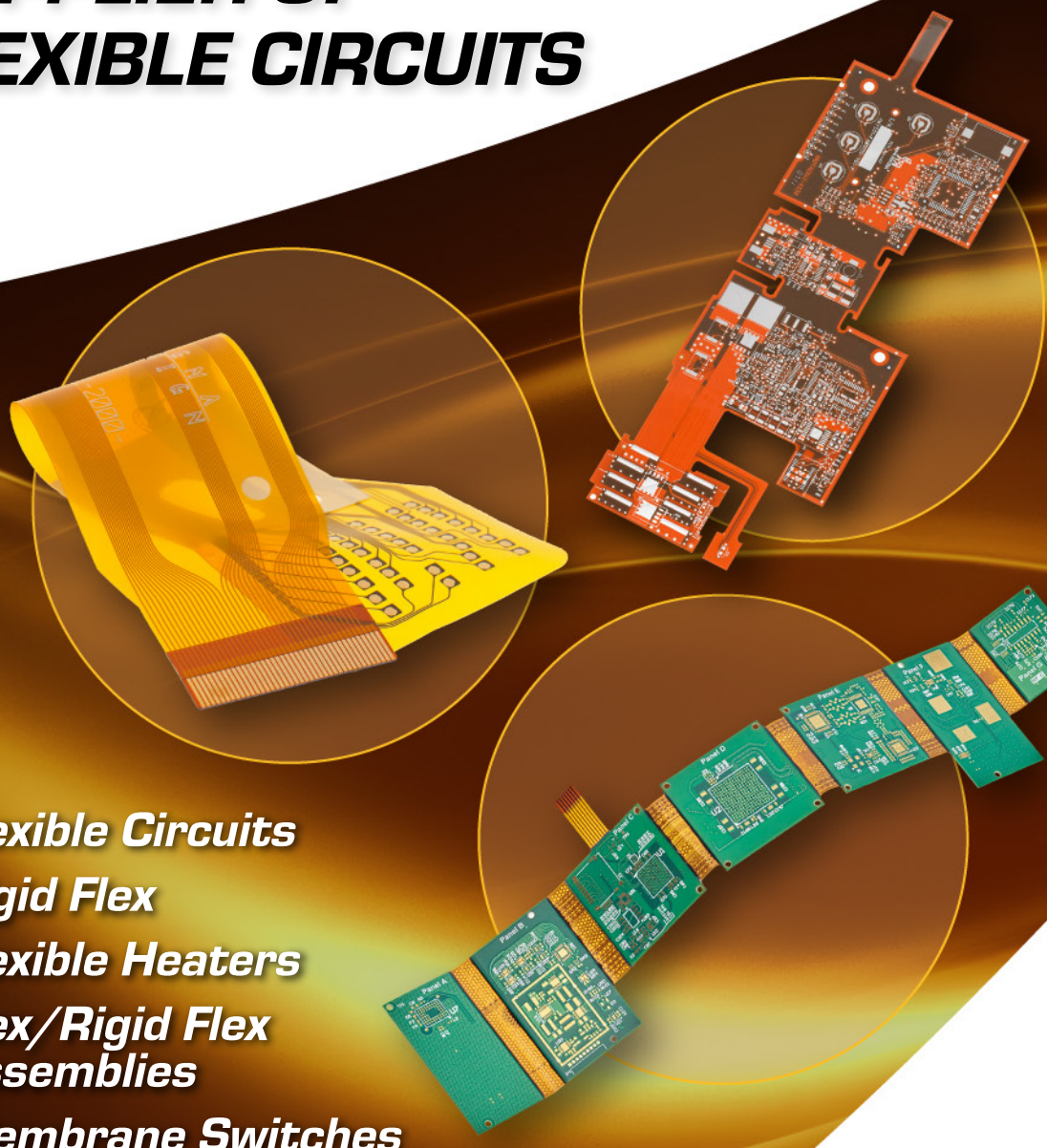

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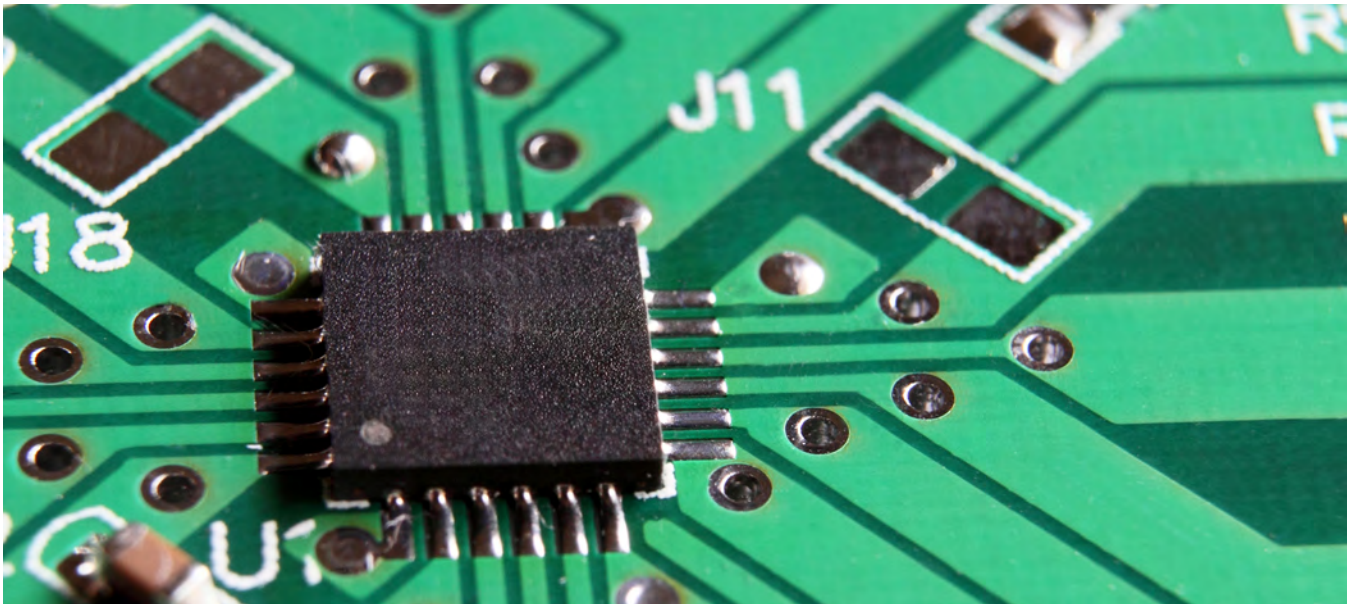

Practical Verification of Void Reduction Method for BTC Using Exposed Via-in-pad

Article by Alfredo Garcia, Domingo Vazquez, Ricardo Macias, Rodrigo Ibarra, Joe Smetana, Mulugeta Abtew, and Iulia Muntele
SANMINA AND NOKIA

Abstract

Void reduction strategies used with different levels of success throughout the industry include managing reflow profile parameters, solder paste deposit volume and solder paste type, stencil aperture cut to different geometries, thermal pad geometries with and without solder mask webs, vacuum-assisted reflow, sweep stimulation of PCB substrate, use of solder preforms, tinning of the components pads before placement and reflow, I/O aperture design to overprint at the toe of the pad, and exposed via-in-pad [1–8]. The translation of these methods and their combinations for void control on the thermal pad of bottom-terminated components (BTCs) has been met with different levels of success in volume production.

The method explored in this article regards the use of exposed via-in-pad. A dedicated test vehicle was designed for two types of QFN components. The main variables accounted for were the component size, number of exposed vias in the thermal pad, via pitch, via size, and solder paste coverage. The responses sought in this experiment include a thermal pad void level and solder wicking down the via barrel with resulting solder protrusion on the opposite side of the PCB.

The results indicated that solder will wick down the exposed via-in-pad regardless of the via diameter and solder paste coverage. Despite this finding, there were no defects recorded like component tilting, skewing, opens, or solder bridging. Specific configurations attained voiding levels in the thermal pad below 25%; however, other configurations did show a void level for the thermal pad up to 50%. A discussion will be presented regarding the effect of the board thickness and the geometry of the via array on the thermal pad solder coverage and voiding level.

Introduction

It has been hypothesized that a small enough (≤10-mil drill size before plating) diameter for an exposed via/plated through-hole (PTH)

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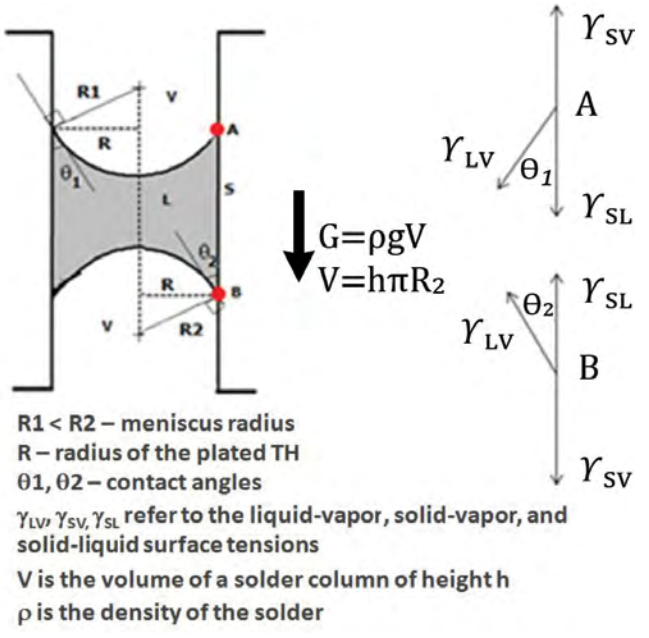


Figure 1: Equilibrium of forces acting on a finite volume of solder inside an exposed via.

would prevent molten solder from wicking down the vias while allowing volatiles developed during solder reflow to escape and minimize the size of the voids at the thermal pad of the BTC. The follow-up questions were if the void size would vary when solder is printed intentionally over such exposed via in pad, and how it would compare with the case when the solder paste is deposited between the exposed vias.

Starting from the hypothesis, Figure 1 shows a brief review of the force equilibrium of a finite volume of solder emerging in an exposed via-in-pad; the height of the solder column turns out to be a function of the contact angle and the size of the finished via. Figure 1 assumes the case of a wettable surface inside the PTH.

At equilibrium, the height (h) of the solder column is described by Equation 1:

$$h = \frac{2\gamma_{LV}}{\rho g R}(\cos\theta_2 - \cos\theta_1)$$

From a soldering application viewpoint, Equation 1 has no practical application; when solder reaches the TH exposed via, solder will wick down the via according to the wetting ability, amount of the solder available, and heating/cooling conditions. However, it is interesting to use Equation 1 and question what conditions would allow the height of the solder column to be minimized or made zero:

- If the solder does not wet the via (via not plated)
- If $\theta_1 = \theta_2$ (absence of gravity)
- If $\theta_1 = \theta_2 = 90°$ (cannot be a natural solution)

Since these three conditions cannot be satisfied for exposed plated through vias, and due to the relationship between the supposed height of the solder column and the radius R of the exposed plated via, it seems unlikely that it is possible to prevent solder from wicking down a wettable plated via for any via size, regardless of how small its practical finished size diameter may be. Back-of-the-envelope calculations aside, a practical verification is required to fully verify the hypothesis. For this purpose, a test vehicle was designed and parameters calculated as described in the following section.

Experimental Findings

Test Vehicle

The experimental approach was to design a test board having various PTH via diameters and via arrays, design the stencils such that solder paste is either printed over vias or between vias, fabricate the boards with different thicknesses, and after assembly, tally the vias with solder, void percentage, and the solder protruding from vias.

If the hypothesis is proven, then voiding in the thermal pad is minimized, heat transfer is optimized, and the components will present uniform solder joints stand-off height. Otherwise, the factors leading to solder wicking down the exposed vias could be the following:

- Volume and location of the printed solder
- Solderability of the finished via
- Solder wetting ability
- Presence of barriers (solder mask webs)
- Temperature values and temperature gradients

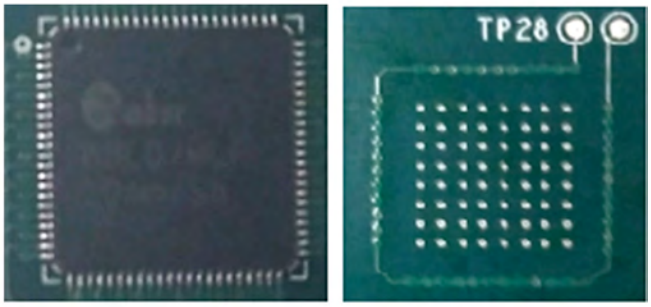


Figure 2: A-MLF88-10 mm-0.4mm -Sn, top and bottom side view on the board.

- Solder availability (surface tension forces equilibrium conditions between TH via, board surface, and component surface)

Board outline:

- 224 mm x 170 mm size, four layers, ImAg finish
- PTH vias in the thermal pad are fully connected with all layers
- Three different boards thicknesses: 93 mils (2.36 mm), 110 mils (2.8 mm), and 130 mils (3.3 mm)
- One type 0.4-mm pitch QFN component and one type 0.5-mm pitch QFN component
- 2 x 2, 5 x 5, and 8 x 8 matrix of PTH exposed via in the thermal pad
- Two solder mask designs (with and without solder mask doughnut around vias)

Via diameters are chosen such that $\phi 1 < \phi 2 < \phi 3$ are the drill's outer diameters (OD):

$\phi 1$ = 0.2 mm (~0.00787")
$\phi 2$ = 0.23 mm ~0.00905"
$\phi 3$ = 0.25 mm (~0.0098")

Although two component types populated the board, only the 10 mm x 10 mm, 0.4-mm pitch QFN component is discussed here. Figure 2 shows a component (A-MLF88-10 mm-0.4 mm-Sn) with 88 leads, 177.1 mil x 177.1-mil die size, 8.3 x 8.3 mm thermal pad size.

The finalized test board concept is described in Figure 3.

Locations with solder mask doughnut around vias are highlighted in Figure 3 and appear at all reference designators in lines 3, 4, 7, and 8 highlighted in red. The test board has symmetry, and each set of characteristics is repeated four times on every board.

Stencil Designs

Two stencils were calculated to provide a minimum of 50% solder paste coverage. The stencils used were NiCut with a thickness of 4 mils. Solder paste coverage was calculated according to IPC-7093 by considering the solderable surface area not to include open, filled, or solder mask encroached vias. The calculated and measured solder paste coverage values for the two stencils are given in Table 1. Stencil A was used to print solder paste dots (between vias), and Stencil B was used to dispense solder paste segments (over vias); an example is shown in Figure 4.

Some calculated and measured solder paste coverage values for Stencil B show values above 100% for 8 x 8 via arrays; this is the case where the solderable surface area has a smaller value (due to the presence of more exposed vias with solder mask doughnut) than the total printed area.

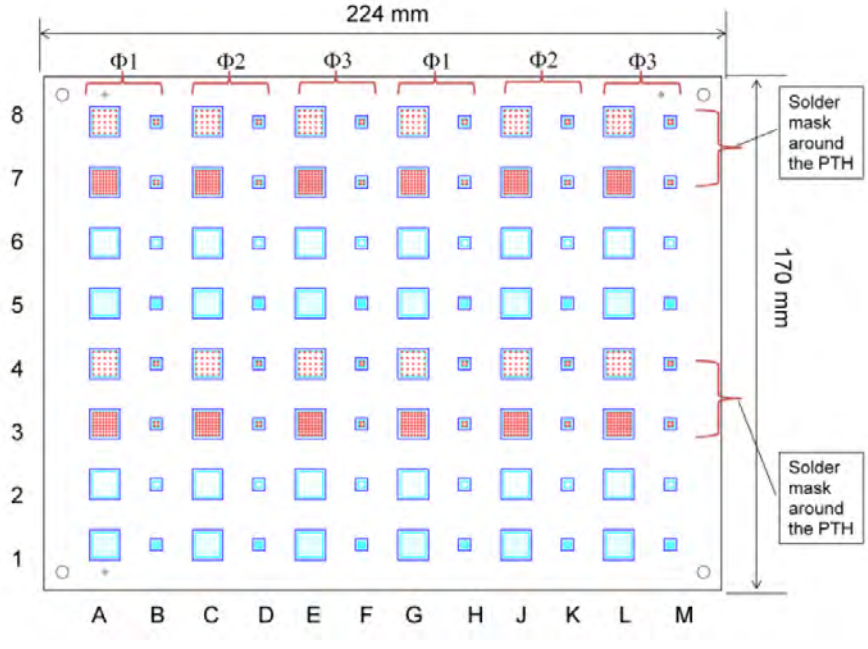


Figure 3: Test board.

Reference Desesignators	Solder mask (Yes-1, No-0)	Solder mask area/via area (mil2)	Number of vias	Stencil A aperture radius (mils)	Stencil A: number of apertures	Stencil B aperture length (mils)	Stencil B: number of apertures	Stencil A: solder paste coverage %		Stencil B: solder paste coverage %	
								calculated	measured (SPI)	calculated	measured (SPI)
A8,A4,G8,G4	1	531	25	34	16	53	25	61	61-63	76	76-79
C8,C4,J8,J4	1	573	25	32	16	53	25	54	55-57	76	77-80
E8,E4,L8,L4	1	616	25	34	16	53	25	62	62-65	77	76-84
A7,A3,G7,G3	1	531	64	17	49	70	16	58	59-64	108	107-113
C7,C3,J7,J3	1	573	64	16	49	70	16	56	57-61	113	113-117
E7,E3,L7,L3	1	616	64	15	49	70	16	55	56-61	117	119-123
A6,A2,G6,G2	0	49	25	35	16	53	25	60	58-63	67	68-70
C6,C2,J6,J2	0	64	24	35	16	53	25	60	59-63	67	68-70
E6,E2,L6,L2	0	75	25	35	16	53	25	60	59-63	67	68-70
A5,A1,G5,G1	0	49	64	20	49	70	16	58	59-64	76	75-79
C5,C1,J5,J1	0	64	64	20	49	70	16	58	59-65	77	75-80
E5,E1,L5,L1	0	75	64	20	49	70	16	59	59-67	77	77-80

Table 1: Solder paste coverage.

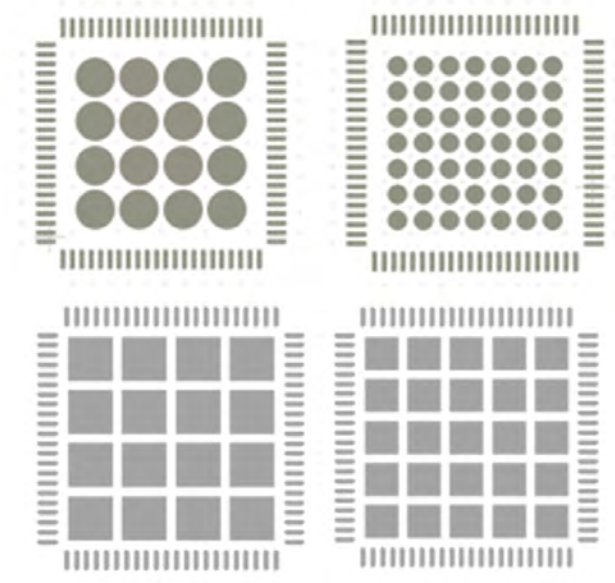


Figure 4: Dot and segmented apertures example.

Factors	Levels	Values	Response
Board thickness	3	93	- Number of PTH with solder wicked in. - Number of solder protrusions. - Void%
		110	
		130	
Stencil apertures	2	Segmented	
		Dots	

Table 2: DOE.

Board number	Board thickness (mils)	Stencil number	Aperture type
1	93	B	segmented
2	93	B	segmented
3	93	B	segmented
4	110	B	segmented
5	110	B	segmented
6	110	B	segmented
7	130	B	segmented
8	130	B	segmented
9	130	B	segmented
10	93	A	dots
11	93	A	dots
12	93	A	dots
13	110	A	dots
14	110	A	dots
15	110	A	dots
16	130	A	dots
17	130	A	dots
18	130	A	dots

Table 3: List of assembled boards.

Experiment Design and Assembly Parameters

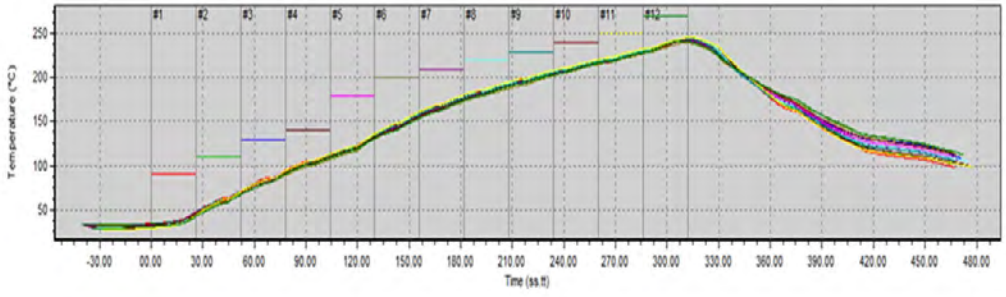
Eighteen boards—nine for each stencil type and three for each board thickness—were assembled in a lead-free process using SAC305 solder paste and reflow profiles according to each board thickness. Table 2 describes the experiment factors. Table 3 lists the assembled board's characteristics.

Reflow Profiles

A summary of the reflow profiles parameter ranges measured at 12 different locations for each board thickness is shown in Table 4. The reflow oven parameters (i.e., zone temperature, conveyor speed) were adjusted such that the reflow parameters for QFN components were highly comparable regardless of the board thickness (Figures 5–7). In this case, profiling for different thickness boards was not challenging since the boards are populated on one side only.

Board thickness (mils)	Rise time (s) (130÷217°C)	Risetime (s) (50C÷T_{peak})	TAL(°C)	T_{peak} (°C)	Negative slope (°C/s)
93	126÷135	274÷284	69÷86	240÷246	-1.6÷-2.1
110	123÷127	285÷293	73÷87	239÷247	-1.8÷-2.7
130	124÷128	277÷288	74÷85	240÷247	-1.4÷-2.3

Table 4: Reflow parameters.

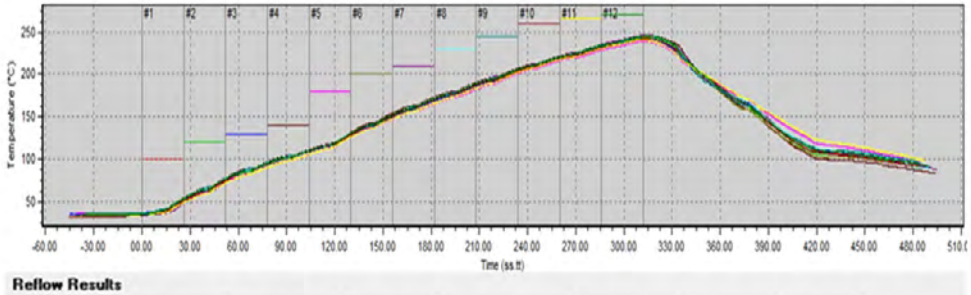


Reflow Results

Probe	Rise Time (130.0 - 217.0°C) (ss.tt)	Rise Time 50.0°C to Peak (ss.tt)	Mean Slope to Peak (°C/sec)	Time Above Liquidus (217.0°C) (ss.tt)	Peak Temperature (°C)	Delta T (°C)	Negative Slope (°C/sec)
#1 (°C)	130.90	284.40	0.69	79.30	244.6		-1.89
#2 (°C)	130.10	281.90	0.69	78.60	244.3		-1.93
#3 (°C)	132.60	280.60	0.70	74.40	243.3		-1.95
#4 (°C)	129.70	281.00	0.71	81.60	243.9		-1.98
#5 (°C)	133.40	281.50	0.69	74.30	243.0		-1.78
#6 (°C)	135.00	277.60	0.69	69.00	239.8	6.3	-1.74
#7 (°C)	131.00	280.60	0.70	76.90	243.3		-1.92
#8 (°C)	128.20	282.00	0.71	81.60	245.3		-2.20
#9 (°C)	130.10	282.70	0.69	78.00	245.0		-2.07
#10 (°C)	135.00	279.70	0.69	72.10	242.0		-1.63
#11 (°C)	126.60	282.00	0.72	86.90	246.1		-2.12
#12 (°C)	130.90	274.40	0.71	75.20	241.9		-1.59

Probe Key: #1 L8, #2 K8, #3 C4, #4 L1, #5 G6, #6 B7, #7 K5, #8 J2, #9 J7, #10 E5, #11 M1, #12 A3

Figure 5: Reflow profile of a 93-mil board.

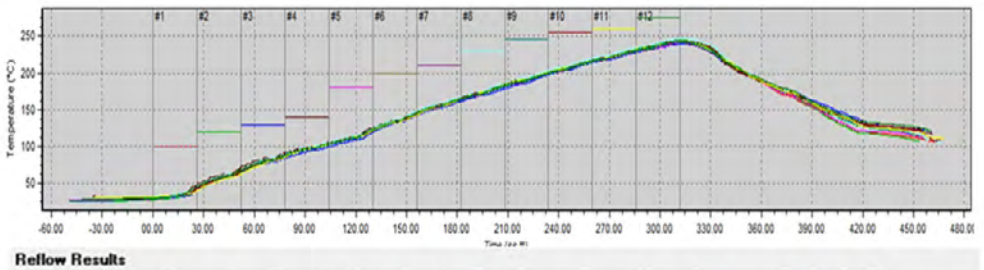


Reflow Results

Probe	Rise Time (130.0 - 217.0°C) (ss.tt)	Rise Time 50.0°C to Peak (ss.tt)	Mean Slope to Peak (°C/sec)	Time Above Liquidus (217.0°C) (ss.tt)	Peak Temperature (°C)	Delta T (°C)	Negative Slope (°C/sec)
#1 (°C)	126.30	286.40	0.67	81.00	242.9		-1.91
#2 (°C)	126.40	290.10	0.68	81.20	242.8		-2.06
#3 (°C)	126.80	290.30	0.67	78.40	242.8		-1.89
#4 (°C)	123.30	293.10	0.69	87.70	245.8		-2.69
#5 (°C)	127.10	286.00	0.66	73.90	239.3	7.4	-1.87
#6 (°C)	125.60	292.40	0.68	83.20	244.3		-2.65
#7 (°C)	122.10	288.00	0.70	86.60	246.7		-2.37
#8 (°C)	124.70	291.30	0.69	84.60	245.3		-2.31
#9 (°C)	125.30	292.00	0.68	82.60	245.5		-2.83
#10 (°C)	126.50	289.50	0.67	81.60	242.3		-1.88
#11 (°C)	125.00	284.90	0.68	76.80	240.8		-1.80
#12 (°C)	123.80	291.40	0.69	85.40	245.7		-2.24

Probe Key: #1 J1, #2 A4, #3 G2, #4 B8, #5 A6, #6 L3, #7 B1, #8 F5, #9 F7, #10 L5, #11 C7, #12 J8

Figure 6: Reflow profile of a 110-mil board.



Reflow Results

Probe	Rise Time (130.0 - 217.0°C) (ss.tt)	Rise Time 50.0°C to Peak (ss.tt)	Mean Slope to Peak (°C/sec)	Time Above Liquidus (217.0°C) (ss.tt)	Peak Temperature (°C)	Delta T (°C)	Negative Slope (°C/sec)	Probe Key
#1 (°C)	124.40	281.70	0.70	79.30	243.3		-2.07	#1 M3
#2 (°C)	124.30	280.10	0.69	80.50	242.5		-1.75	#2 M8
#3 (°C)	125.00	278.40	0.69	70.30	239.6	7.0	-1.87	#3 B5
#4 (°C)	128.70	287.50	0.68	73.50	242.6		-2.07	#4 G4
#5 (°C)	125.80	280.90	0.68	74.70	241.1		-1.69	#5 L6
#6 (°C)	124.50	280.70	0.68	74.40	242.2		-1.78	#6 J5
#7 (°C)	127.70	280.00	0.68	72.00	240.9		-1.41	#7 G7
[illegible]	120.00	282.50	0.70	84.70	246.6		-2.27	#8 F1
#9 (°C)	124.20	277.90	0.68	74.50	241.7		-1.53	#9 C8
#10 (°C)	122.00	281.70	0.69	78.10	244.5		-2.19	#10 C2
#11 (°C)	121.60	278.10	0.70	79.10	244.5		-1.65	#11 A1
#12 (°C)	123.50	282.50	0.69	77.60	243.9		-1.91	#12 E3

Figure 7: Reflow profile of a 130-mil board.

SPI Data

Solder paste inspection (SPI) data was acquired for each component. For the thermal pad, the apertures were numbered, and each solder paste deposit was measured against the calculated target value based on the apertures' sizes.

For the components leads, the apertures were reduced by 10%. The I/O were not overprinted so that upon melting and coalescence, the solder paste deposits would not lift the component and inadvertently interfere with the experiment hypothesis. The solder paste volume distribution for the I/O is shown in Figure 8. The mean of each distribution is slightly less than the target value of 1060 mil^3 of solder paste.

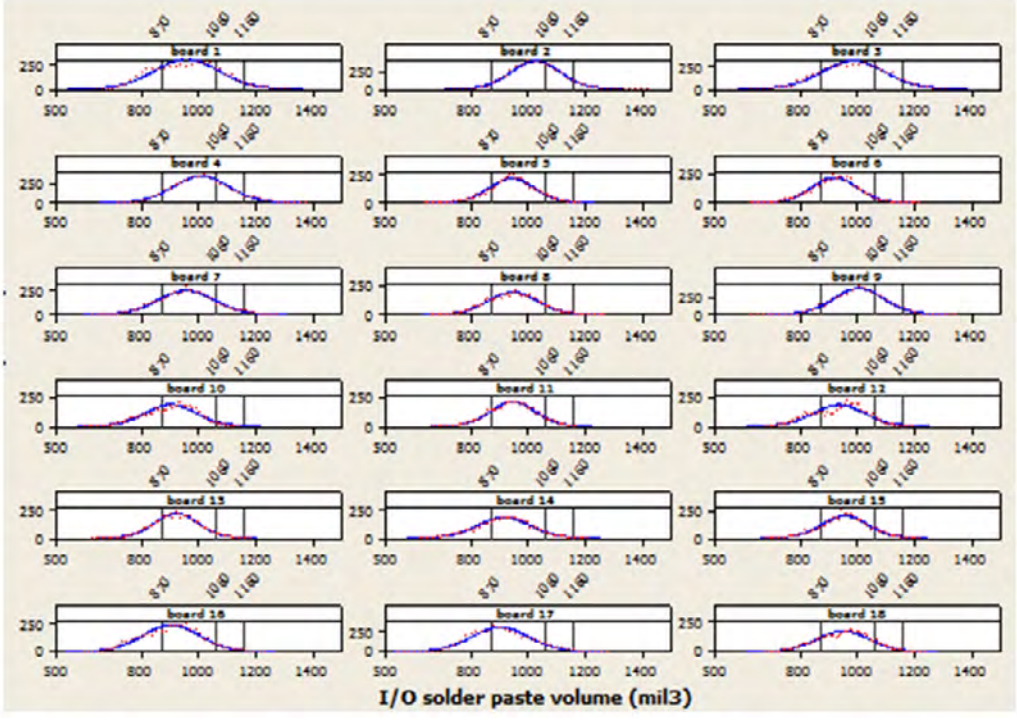


Figure 8: I/O solder paste volume by board.

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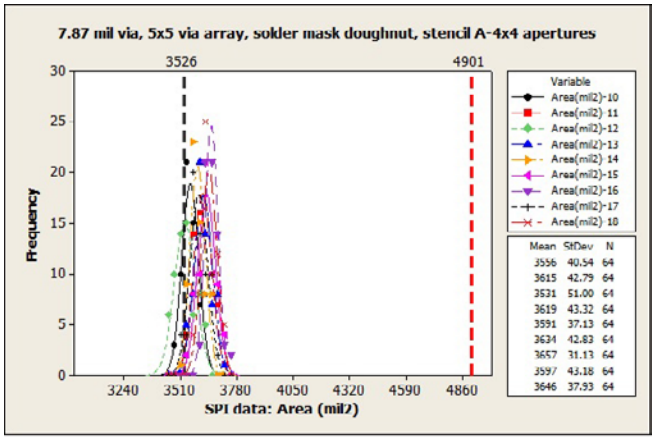
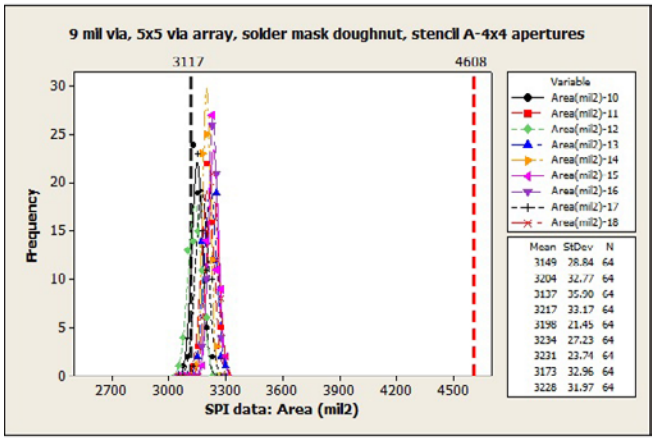




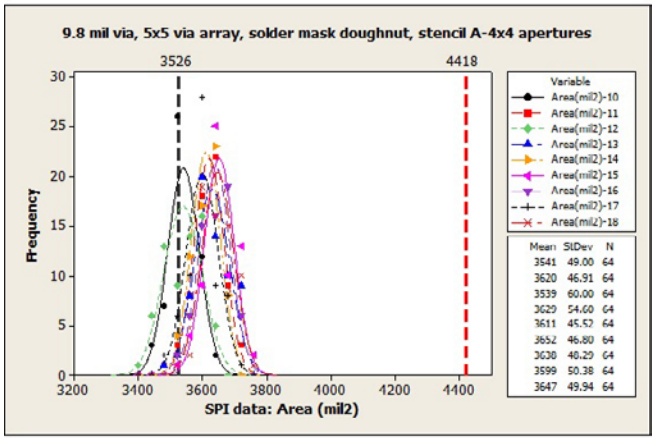
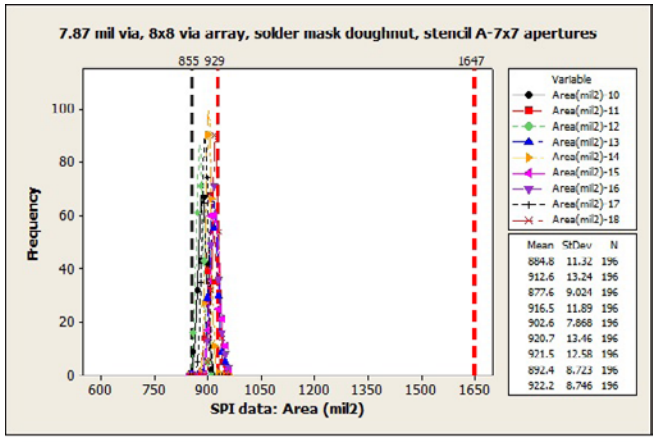
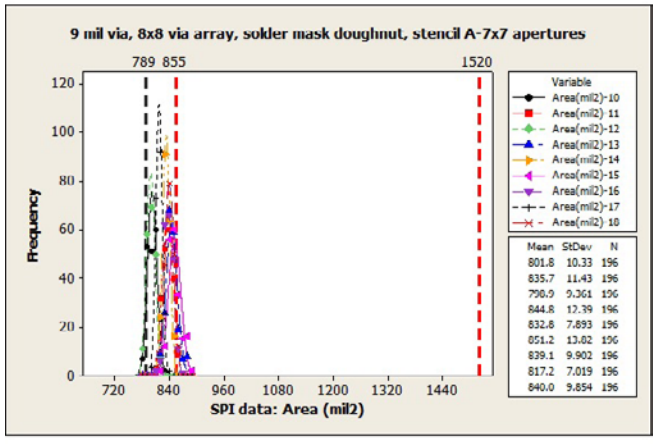


Figure 9: Thermal pad solder paste area distribution/single dot paste deposit; 5 x 5 via array with solder mask doughnut.





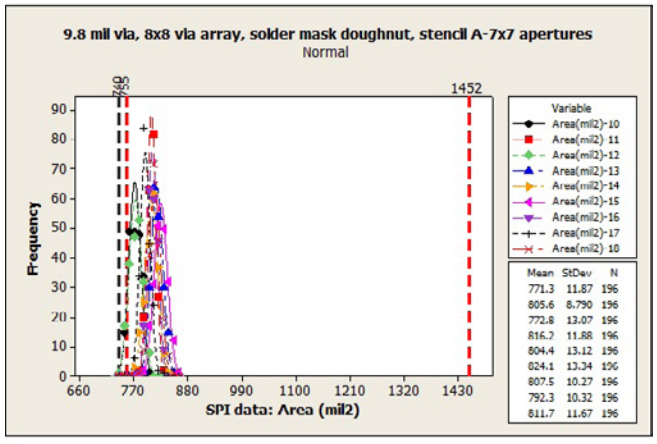


Figure 10: Thermal pad solder paste area distribution/single dot paste deposit; 8 x 8 via array with solder mask doughnut.

The solder paste deposits on the thermal pad are of interest to evaluate the area distributions by the aperture for Stencil A only to check if any solder deposit intersects the via land.

The distributions in Figure 9 indicate slight overprinting (median is above the target value indicated by the black dotted line); however, the solder paste area is well below the value, which would indicate contact of the solder paste with any of the via placed in the thermal pad.

The distributions in Figure 10 indicate slight overprinting (median is above the target value indicated by the black dotted line); however, the solder paste area is well below the value, which would indicate contact of the solder

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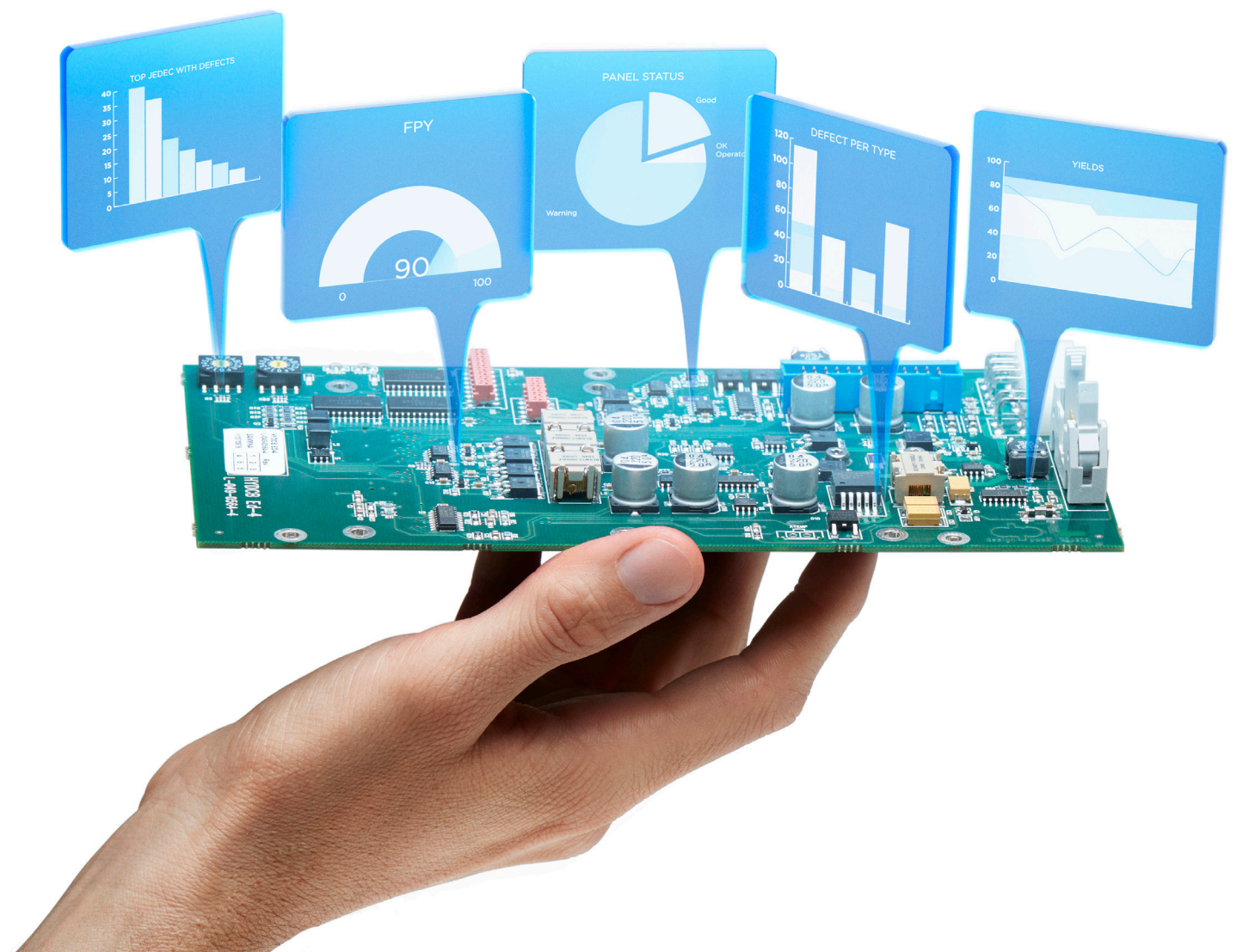

paste with any of the vias placed in the thermal pad. The red dotted line adjacent to the reference line was introduced to indicate that the solder area overlaps with the solder mask doughnut around the via but does not overlap with the via landing (red dotted reference line at the far right side of the graph).

Figures 11 and 12 show the solder paste area distributions for reference designators that do not have the solder mask doughnut around each via in the thermal pad. These paste deposits also appear to not intersect the via similar to the distributions in Figures 9 and 10. Any solder paste that would wick in the via after component placement and reflow would not be the direct result of the solder printed too close to the via or the via landing when Stencil A is used.

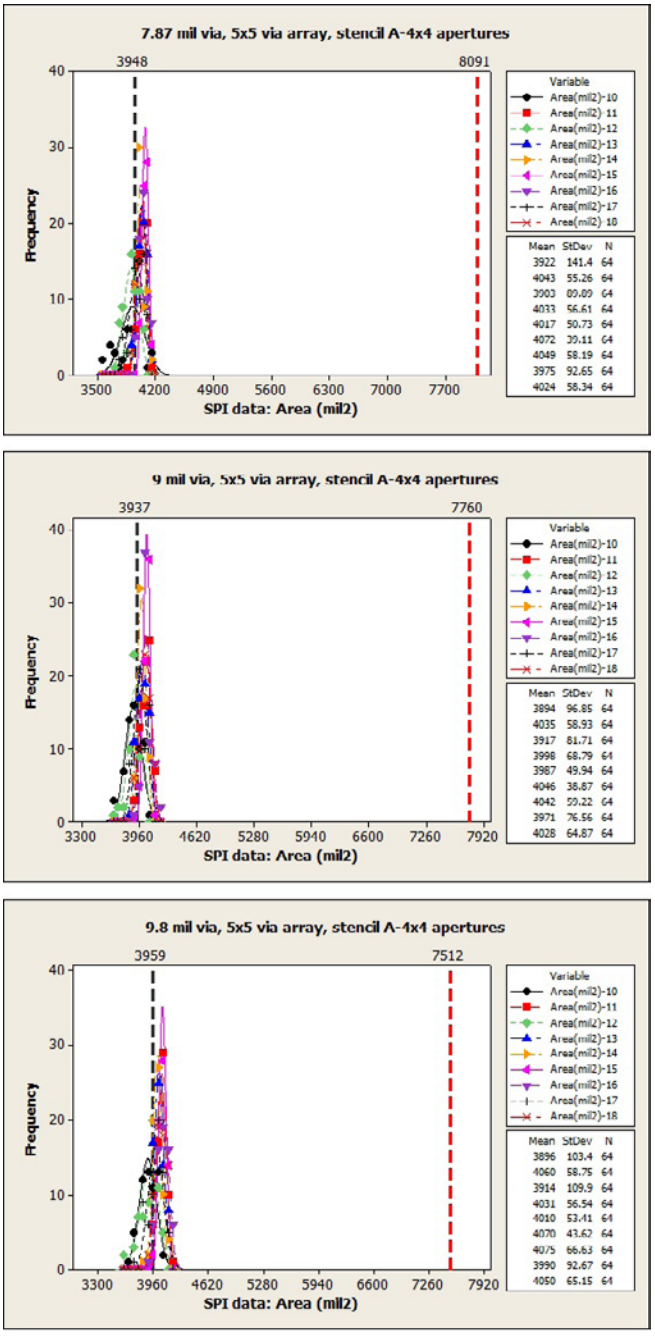

Figure 11: Thermal pad solder paste area distribution/single dot paste deposit; 5 x 5 via array.

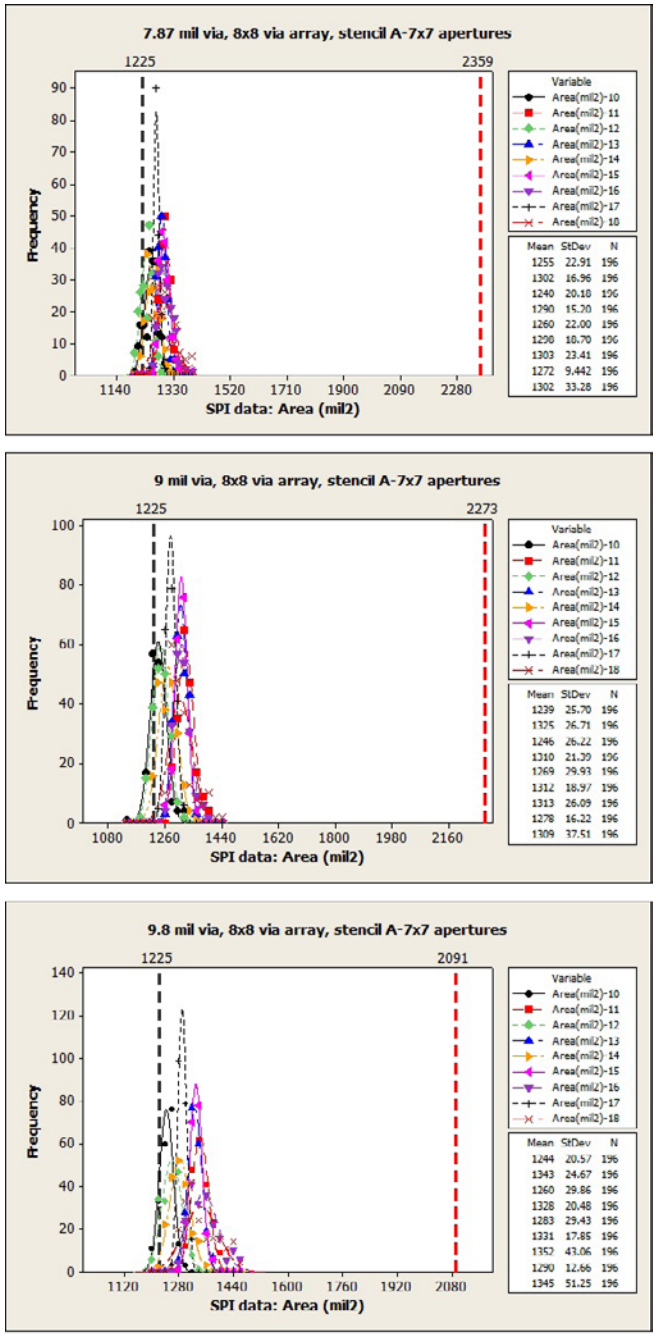

Figure 12: Thermal pad solder paste area distribution/single dot paste deposit; 8x8 via array.

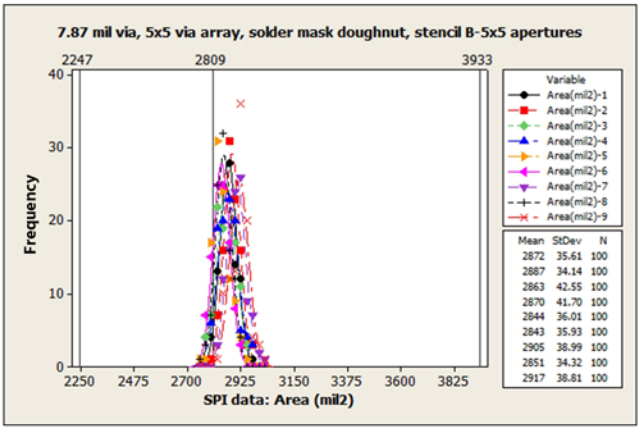

Figure 13: Thermal pad solder paste area–Stencil B.

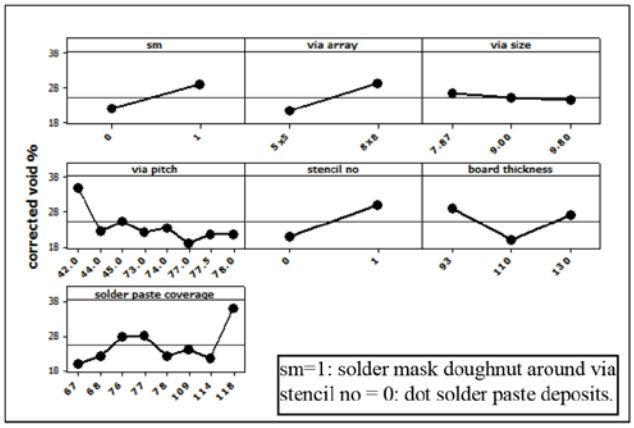

Figure 14: Main effects of solder mask (sm), via array, via size, via pitch, stencil type (dot=0, segmented=1), board thickness, and solder paste coverage on the corrected void% means.

The solder paste distributions for the segmented stencil, Stencil B, were verified, and the values meet the targets. Only one graph, Figure 13, was included here because, in the case of Stencil B, the solder paste was intentionally printed over the vias. Details of the solder paste coverage are included for each reference designator in Table 1.

AXI Data

Automated X-ray inspection (AXI) was done for each board, images were saved for each component, and an automated void% value was provided. Because the via diameter and the total solderable area are variable, the reported void% was adjusted to reflect each case. Raw void% data did not consider the actual solderable area of the thermal pad, and it removed the plugged via area from under the void. The formula used to correct the raw void% numbers is Equation 2:

$$\text{Void\%}_{\text{corrected}} = \frac{A_{\text{thermal pad}} \times \frac{\text{Void\%}}{100} - N_{\text{empty vias}} \times A_{\text{via}}}{A_{\text{thermal pad}} - N_{\text{vias}} \times A_{\text{via}}}$$

- $A_{\text{thermal pad}}$ is the total area of the thermal pad, which is 8.3 mm x 8.3 mm, in this case
- A_{via} is the area of via opening, or the solder mask around the via opening, as applies
- Void% is the as-reported value
- $\text{Void\%}_{\text{corrected}}$ is the void value after the total solderable area is considered
- $N_{\text{empty vias}}$ is the number of vias with no solder plugs intersecting a void

Upon correction, some as reported void% values changed to either increase or decrease the void%, depending on the solderable area; number of vias in the thermal pad; and the number of vias plugged with solder due to printing and reflow. An analysis of the main effects interactions shows the average void% dependencies, as described in Figure 14.

In terms of significance, all the factors considered for the main effects interactions are calculated to be significant, including some of the second-order interactions. As expected, the average void% decreases with increased via pitch, for a lower number of vias, and with increasing via size.

It is less intuitive to see that the average void size increased when solder mask doughnut is present around vias. For this reason, a tally by board and void% range was compiled in Table 5, which shows that PCA#13, 14, and 15 have the optimized outcomes in terms of voiding: all void on these 110-mil boards assembled with dot solder paste deposits is below 50%. For each of these three boards, only two reference designators show values between 25% and 40% void.

These reference designators do not have solder mask doughnut around vias. Figures 15, 16, and 17 show these reference designators, and the other three identical locations on each board.

PCA#		Void%<25%		50%>Void%>25%		Void%>50%	
		sm=1	sm=0	sm=1	sm=0	sm=1	sm=0
Segmented solder paste deposits (stencil no=1)	1	3	13	10	11	11	0
	2	4	12	10	12	10	0
	3	4	15	13	9	7	0
	4	6	16	12	8	6	0
	5	8	22	13	2	3	0
	6	6	21	16	3	2	0
	7	5	10	16	14	3	0
	8	9	12	14	12	1	0
	9	5	16	16	8	3	0
Dot solder paste deposits (stencil no=0)	10	13	14	11	10	0	0
	11	9	17	15	7	0	0
	12	14	16	10	8	0	0
	13	24	22	0	2	0	0
	14	24	22	0	2	0	0
	15	24	22	0	2	0	0
	16	14	15	10	9	0	0
	17	13	16	11	8	0	0
	18	14	13	10	11	0	0

Table 5: Tally of corrected void% range by board (sm=1: solder mask doughnut around via).

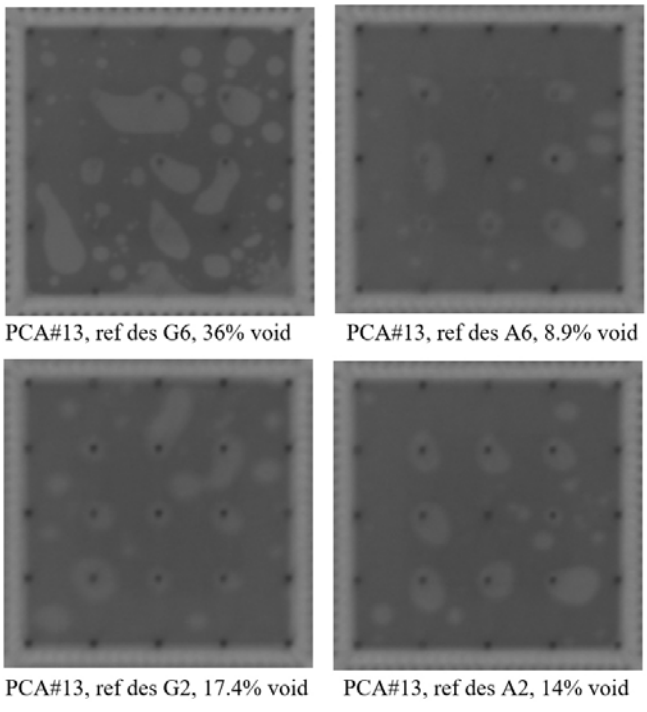

Figure 15: PCA#13 corrected void percentage for reference designator G6 (via diameter f1 = 0.2 mm ϕ 0.0098″).

Other inferences based on Table 5 data are as follows:

- No solder mask doughnut around the vias allows for void < 50% for all cases
- For void% range of 25% ÷ 50%, and for void% < 25%, the most favorable case is solder mask doughnut around via and a board thickness of 110 mils with solder paste dots

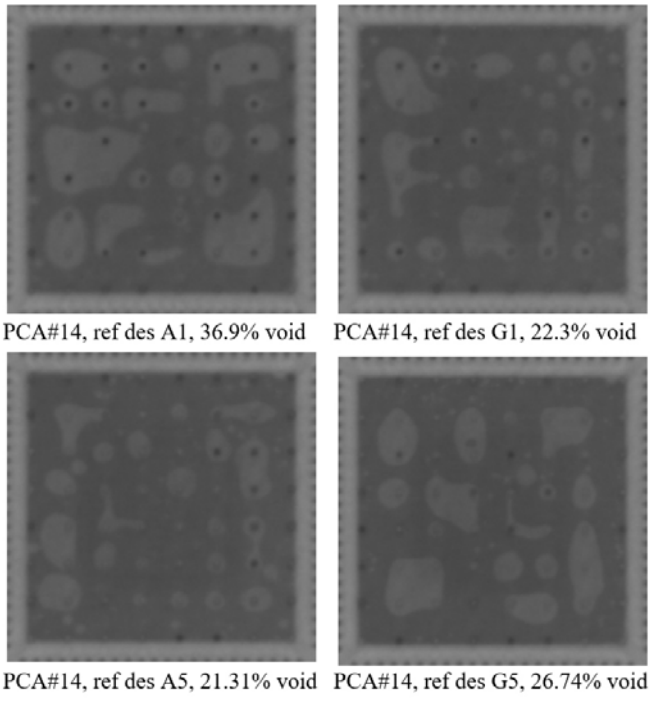

Figure 16: PCA#14 corrected void percentage for reference designator A1 (via diameter f1 = 0.2 mm ϕ 0.00787″).

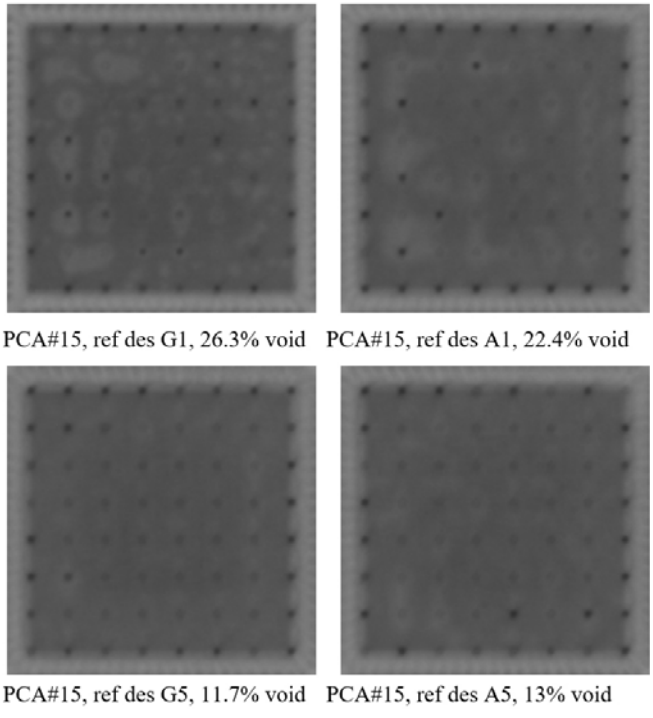

Figure 17: PCA#15 corrected void percentage for reference designator G1 (via diameter f1 = 0.2 mm ϕ 0.00787″).

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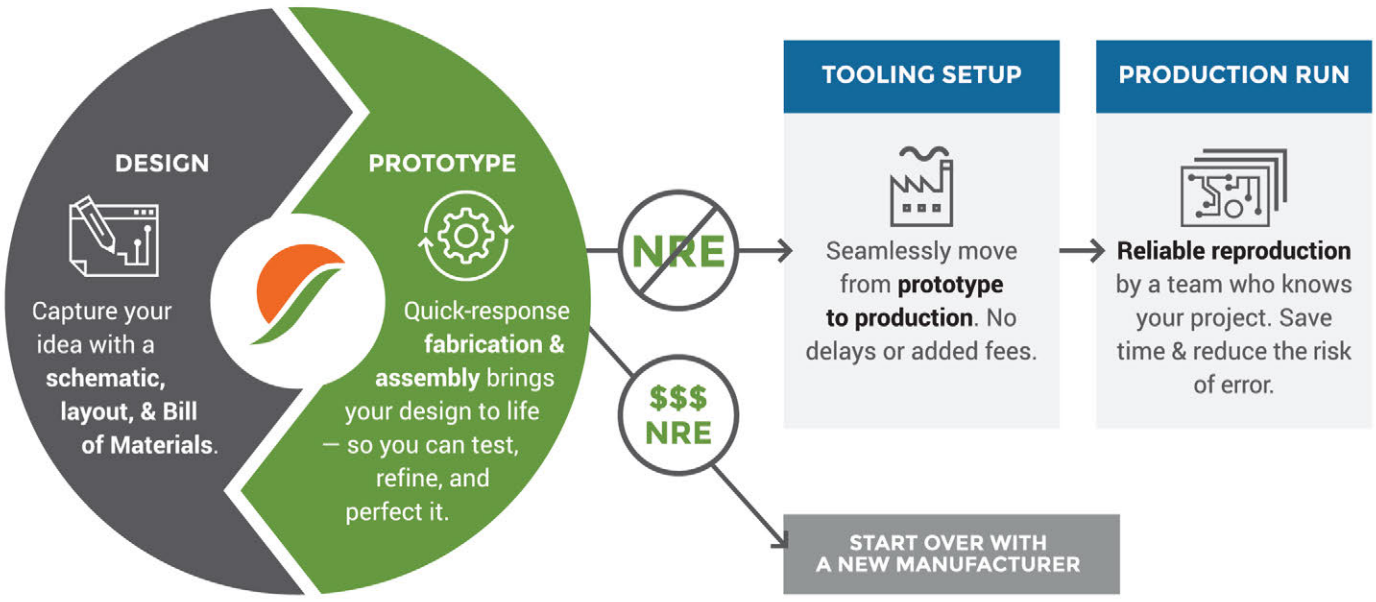

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- For void% < 25%, when solder dot paste stencil is used, the presence or absence of solder mask doughnut is indifferent; the same number of components show <25% voiding. Also, there are no cases of void% >50%; the largest void size is 44% for the nine boards assembled with the dot solder paste deposit stencil
- For void% < 25%, when segmented solder paste stencil is used, the absence of solder mask doughnut yields at least twice as many components with <25% voiding

Post assembly, it was observed that solder paste wicked in the vias, and some protruded on the back side of the board. An SPI program was developed to measure the solder paste protrusions height. The results of the post assembly SPI inspection, shown in Figure 18, were analyzed based on the main interactions, similar to the void% main interactions analysis.

In terms of significance, all the factors considered for the main effects interactions are calculated to be significant (except for solder mask), including some of the second-order interactions. The average protrusion height decreases with decreased via size. Void% and protrusion height responses change in the same direction with the number of vias, via pitch, board thickness, and solder paste coverage. They differ for solder mask, via size, and stencil type. However, when plotted against each other, there is no correlation found between the void% and the height of the solder protrusions.

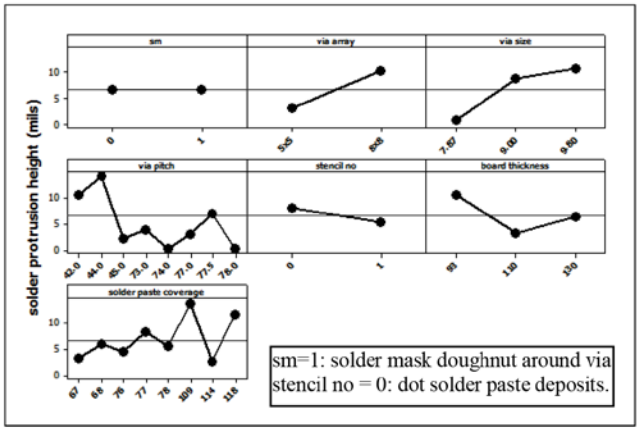


Figure 18: Main effects of solder mask (sm), via array, via size, via pitch, stencil type (dot=0, segmented=1), board thickness, and solder paste coverage on the solder paste protrusion height.

Additional X-ray inspection was done for one board only (PCA#6, 110 mils, assembled with the segmented aperture stencil). Selected images are included in Figures 19–24 to illustrate the presence of solder protrusions for different size vias and the wicking of solder inside the vias.

There are a significant number of cases with no visible solder trapped in vias, like most of

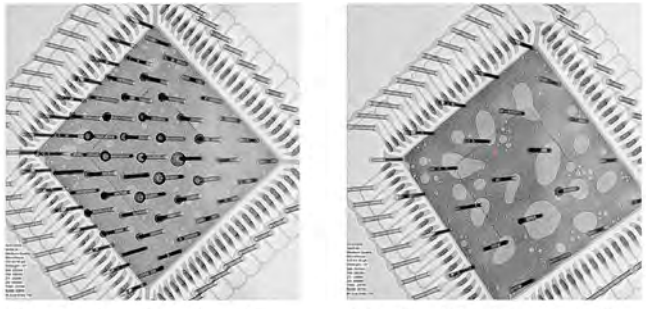


Figure 19: Segmented stencil, via diameter ϕ1 = 0.2 mm.

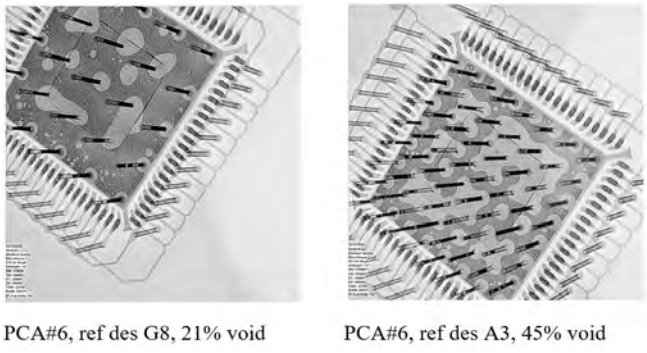


Figure 20: Segmented stencil, via diameter ϕ1 = 0.2 mm, solder mask doughnut around via.

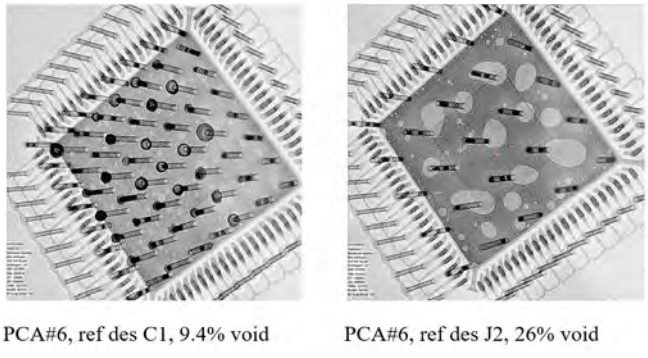
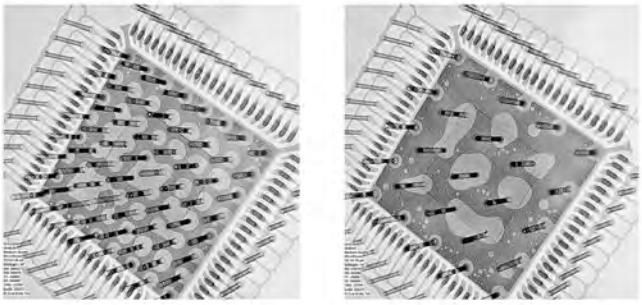
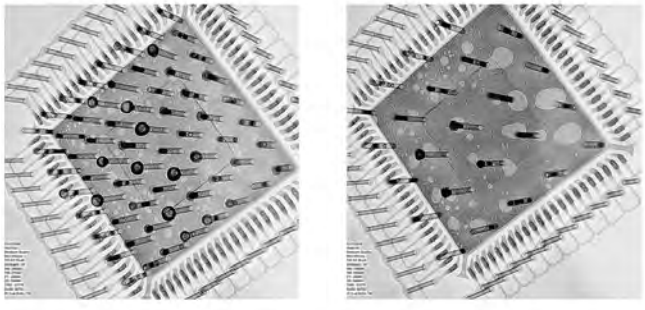


Figure 21: Segmented stencil, via diameter ϕ2 = 0.23 mm.



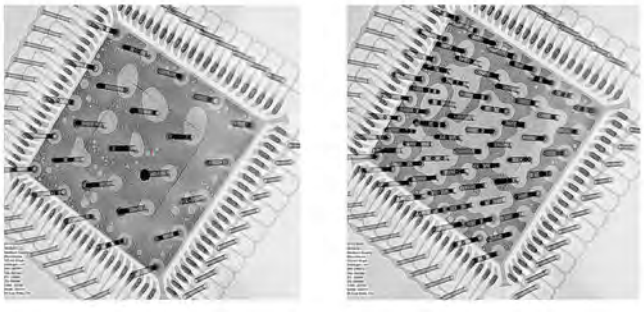
PCA#6, ref des C3, 23.8% void PCA#6, ref des C4, 30.4% void

Figure 22: Segmented stencil, via diameter ϕ2 = 0.23 mm, solder mask doughnut around via.



PCA#6, ref des E1, 11.4% void PCA#6, ref des L2, 20.7% void

Figure 23: Segmented stencil, via diameter ϕ3 = 0.25 mm.



PCA#6, ref des E4, 16.9% void PCA#6, ref des E7, 50.4% void

Figure 24: Segmented stencil, via diameter ϕ3 = 0.25 mm, solder mask doughnut around via.

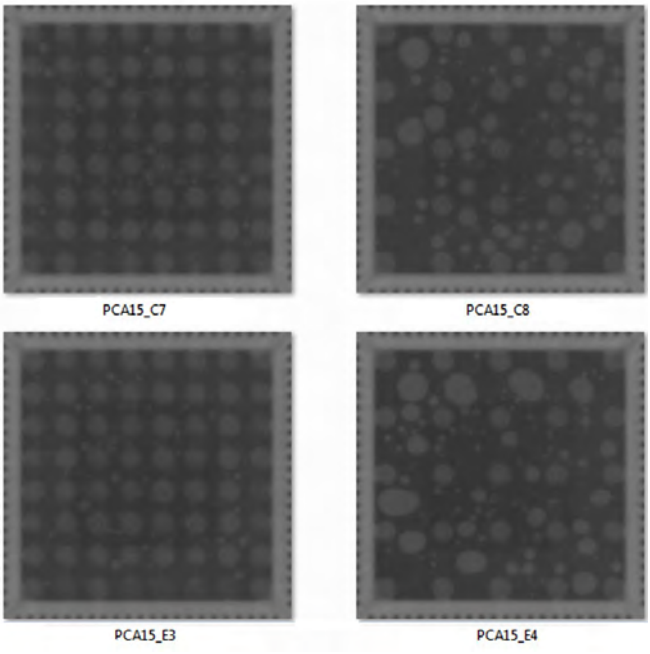


Figure 25: Dot stencil, solder mask doughnut around via, via diameter ϕ2 = 0.23 mm (above) and ϕ3 = 0.25 mm (below); no apparent solder trapped in vias.

the reference designators 3, 4, 7, and 8 (locations with solder mask doughnut) on the boards assembled with dot apertures stencil. An example is shown in Figure 25. Alcatel/Alcatel-Lucent/Nokia have been using the solder mask doughnuts extensively in volume for more than 15 years, and protrusion problems have essentially been non-existent (many millions of PCBA).

A cross-section verification of the PHT via diameter for the smallest via and the highest thickness board was done, and the data is included in Figure 26 and Table 6.

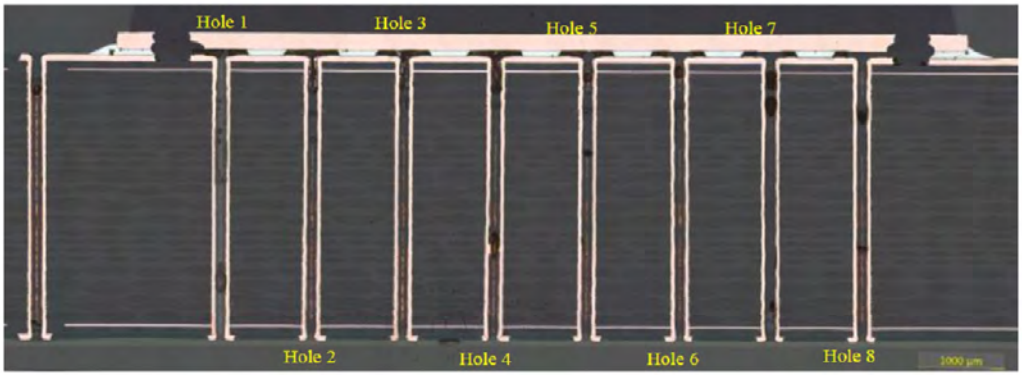


Figure 26: Cross-section at reference designator A7 (ϕ1 = 0.2 mm ~0.00787"), PCA#18 (130-mil thickness).

Via Diameter (mils)							
Via#	Measurement			Nominal	Tolerance	Expected value	Average
	1	2	3				
D1	8.28	7.93	8.31	8.0	±3.0	7.87	8.17
D2	8.21	8.06	8.46				8.24
D3	8.79	7.98	8.37				8.38
D4	8.60	8.38	8.49				8.49
D5	8.79	8.27	8.56				8.54
D6	8.47	8.22	8.40				8.37
D7	8.89	8.56	8.68				8.71
D8	8.68	8.32	8.54				8.51

Table 6: PCA#18, A7 via diameter measured at three locations along the via.

Conclusions

A test board was designed to test an isolated set of conditions for void reduction on the thermal pad of QFN. The hypothesis that a small enough via diameter would prevent molten solder from wicking in the via while allowing volatiles to escape and facilitate void reduction was limited to three finished TH via diameters: 0.00787", 0.0090" and 0.0098". Only a narrow set of parameters displayed a reduced void% and limited the wicking of solder inside the via.

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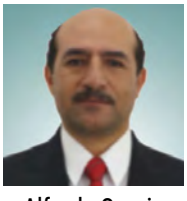
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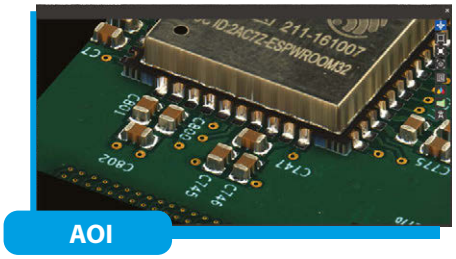

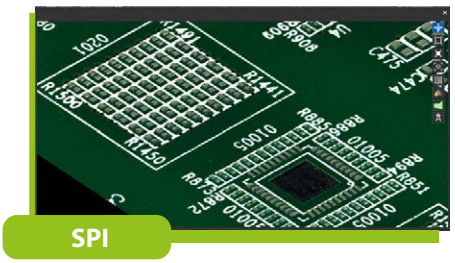

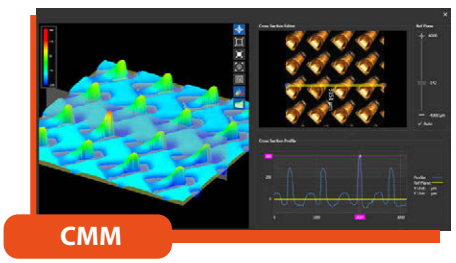

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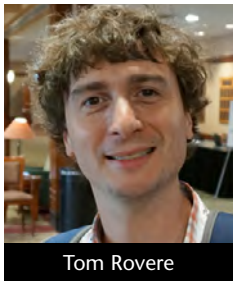
In Zulki's last column, he cited important aspects of glob top epoxies, calling attention to the fact there are different epoxy manufacturers. In this column, he continues to emphasize six other important factors of glob top epoxies.

3 Smart Factory Insights: Recognizing the Need for Change ▸

We are reminded many times in manufacturing that "you cannot fix what you cannot see" and "you cannot improve what you cannot measure." These annoying aphorisms are all very well as a motivational quip for gaining better visibility of the operation. However, the reality is that there is a lot going on that no-one is seeing.

4 IPC Panel on Bottom-terminated Components ▸


Tom Rovere

Andy Shaughnessy sat down with Tom Rovere, a materials and process engineer at Lockheed Martin in Owego, New York. They explored a panel discussion on bottom-terminated components (BTCs) that Tom participated in as well as the challenges and issues related to BTCs and the important role that designers play in that process.

5 X-Rayted Files: The Risk of Installing Counterfeit Parts ▶


Bill Cardoso

In high-tech manufacturing, the use of sub-standard components can be catastrophic. There is no greater need for quality control than in PCBs, as they are only as good as the components installed on them; therein lies the problem. Some components shipped to manufacturers are counterfeit!

6 SMTA 2019 International Awards ▶

The SMTA International conference honored industry members with awards for their contributions to the industry.

7 Catching up With Niche Electronics ▶

Niche Electronics President Frank Bowman speaks with Dan Beaulieu about his company, their services, how they help their customers, and their plans for the future.

8 Real Time with... SMTAI 2019 Videos Now Live ▶

If you couldn't make it to SMTAI 2019, be sure to catch I-Connect007's video interviews with the movers and shakers of the electronics industry. We've updated our video presentation for a better experience for our users, so check it out!

9 Combating ESD: The Silent Assassin in Electronics Manufacturing ▶


Neil Sharp

ESD is a constant but invisible force within electronics manufacturing that can have a powerfully detrimental impact on production yield, product and product reliability, and company profitability. And as the circuitry within electronic devices continues to get faster, smaller, and more sophisticated, their sensitivity to the effects of ESD is only likely to increase.

10 RTW SMTAI 2019: Technical Sessions Overview and 2020 Preview ▶


Karlie Severinson

Karlie Severinson, SMTA events and administrative manager, gives Nolan Johnson an overview of the SMTAI 2019 technical sessions and plans for next year's event.

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Quality Engineer

Scope of Responsibilities

Under the supervision of the director of quality, the quality engineer is responsible for various documentation and reports that support customers and internal systems. This individual will be key in supporting our current quality systems (AS9100, ITAF16949, and ISO9001) and our MIL certifications. This person will also be expected to use tools like PPAPs, FMEA, control plans, and MSA. This individual will ensure that all internal quality systems are effective via auditing processes and procedures. Reporting results to management is a critical part of this job. Following through to resolve any deficiencies or opportunities is required.

Attributes Desired

- Manage time (and have organizational skills) that will assist in taking on high-profile tasks and completing them in a timely manner
- Work independently with minimal supervision
- Advanced computer skills
- Effective oral and written communication skills

Qualifications

- Internal auditing experience with an emphasis on ISO9001, AS9100, and IATF 16949
- Certified internal auditing is desired
- A bachelor's degree in a related field is desired; an associate degree with a minimum of five years of manufacturing experience will be considered
- U.S. citizenship or proper documentation to work legally within the U.S.

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INDIUM CORPORATION®

Technical Support Engineer III

The technical support engineer III is responsible for providing leading-edge, high-level technical support to Indium Corporation's customers, potential customers, and sales staff. Due to their senior position and experience, their role also includes conceiving and devising projects, assisting with staff career development, marketing guidance, and more. The technical support engineer III has learned, mastered, and demonstrated unique and specific skills and information throughout their career. They are responsible for at least one sales territory and for leading other engineers. They train and evaluate colleagues on unique and general information. Continuing education/training is critical.

Requirements

- Technical undergraduate degree (B.S. in engineering, chemistry, physics, metallurgy, or materials science)
- 15 years of direct technical experience in applied materials science, electronics assembly techniques, and/or electronics assembly technical service
- Demonstrated technical competency
- Strong interpersonal, communication, and presentation skills
- Ability to work, with ease, with executive-level counterparts
- Strong alignment with the corporate and departmental missions
- Ability to work cooperatively and effectively in a cross-functional team environment
- Ability to travel with limited notice
- Proficient in Word, Excel, and PowerPoint
- Experience with JMP or Minitab preferred
- Special consideration is given to candidates with language skills in Spanish and/or Chinese

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Career Opportunities

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A KLA Company

West Software Application Engineer

This position reports directly to the Orbotech West software support manager and works with customers to support Orbotech's pre-production software products. Acts as a focal point for technical issues, manages product implementation projects, provides customer training, and supports the sales process. Advanced knowledge of Frontline PCB products, including InCam, InPlan, InStack, InSight, Genesis, and Genflex. Ability to travel and manage time to maximize results. Requires both written and oral technical communication skills. Skilled in the use of scripting languages, including C-Shell, Perl, or Python. Knowledge of relational databases and HTML/XML highly desirable. Knowledge of PCB manufacturing processes. Familiar with the processes used in front-end engineering departments at PCB fabrication sites. Requires use of project management skills to organize and complete projects that involve the implementation of sophisticated software tools used in printed circuit fabrication facilities.

An expected average of 35%+ travel. College degree or equivalent technical education, in addition to a minimum of five-plus years of related experience. Experience supporting sales and sales activities is a plus. U.S. citizen with the ability to work and travel within the U.S., Canada, and internationally.

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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.

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Career Opportunities

FREEDOM CAD SERVICES

Sr. PCB Designer–Mentor Xpedition

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

Key Qualifications

- EXPERT knowledge of Xpedition VX 2.x
- Passionate about your PCB design career
- Skilled at HDI technology
- Extensive experience with high-speed digital, RF, and flex and rigid-flex designs
- Experienced with signal integrity design constraints encompassing differential pairs, impedance control, high speed, EMI, and ESD
- Excellent team player who can lead projects and mentor others
- Self-motivated with the ability to work from home with minimal supervision
- Strong communication, interpersonal, analytical, and problem-solving skills
- Other design tool knowledge is considered a plus (Altium, Allegro, PADS)

Primary Responsibilities

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

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ROGERS CORPORATION

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.

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Career Opportunities

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 is 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.

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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.

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Career Opportunities

TAIYO AMERICA

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.

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Qualifications and skills

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

Benefits

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

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Career Opportunities

INSULECTRO

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!

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CML

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.

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Career Opportunities

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.

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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

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Career Opportunities

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:

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- 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:

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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

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U.S. CIRCUIT

Sales Representatives (Specific Territories)

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

- Florida
- Denver
- Washington
- Los Angeles

Experience:

- Candidates must have previous PCB sales experience.

Compensation:

- 7% commission

Contact Mike Fariba for more information.

mfariba@uscircuit.com

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

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

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

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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.

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BLACKFOX
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IPC Master Instructor

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

For more information, click below.

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CONFERENCE & EXHIBITION: **February 4-6**
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www.IPCAPEXEXPO.org

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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!

ipcapexexpo2020.ipc.org | #ipcapexexpo

Events Calendar

IPC Electronics Materials Forum ▶
November 5–7, 2019
Minneapolis, Minnesota, USA

IEEE Rebooting Computing Week ▶
November 6–8, 2019
San Mateo, California, USA

productronica 2019 ▶
November 12–15, 2019
Munich, Germany

Space Coast Expo & Tech Forum ▶
November 20, 2019
Melbourne, FL

2019 International Electronics Circuit Exhibition (Shenzhen) ▶
December 4–6, 2019
Shenzhen, China

Electronics Packaging Technology Conference 2019 ▶
December 4–6, 2019
Singapore

IPC APEX EXPO 2020 ▶
February 1–6, 2020
San Diego, California, USA

Electronica China ▶
March 18–20, 2020
Shanghai, China

Additional Event Calendars

Coming Soon to *SMT007 Magazine:*

DECEMBER 2019: **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.

JANUARY 2020: **IPC APEX EXPO Preview**
Join us in the January issue as we share what to expect and what to look for in San Diego at IPC APEX EXPO 2020.

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