

THE **pcb** **design** MAGAZINE

July 2017

an IConnect007 publication

New Challenges Facing
Mil/Aero Segment **p.12**

The International Paris
Air Show with ASC's
Anaya Varda **p.20**

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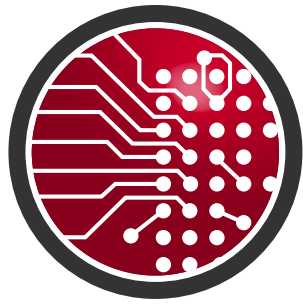
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Military/Aerospace

For some PCB companies, mil/aero work is their bread and butter, and one of the last markets that can't (legally) move overseas. Defense is a safe segment to bet on. But as we found while putting together this issue, mil/aero is not for those managers with an aversion to paperwork or cybersecurity regulations, or anyone who needs to get paid quickly.



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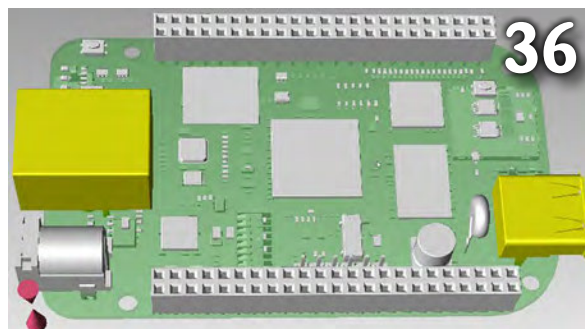
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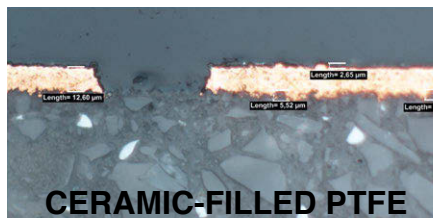
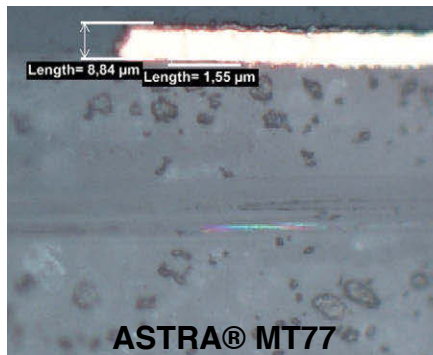
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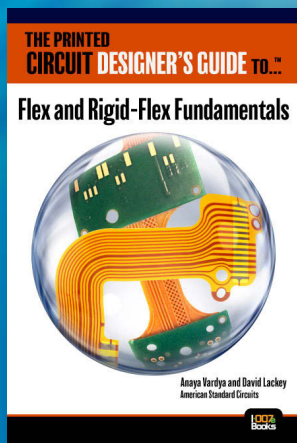
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Mil/Aero Work not for Everyone

by Andy Shaughnessy

I-CONNECT007

For some PCB companies, mil/aero work is the Holy Grail. Whether a downturn or a growing economy, defense is a safe segment to bet on.

The DoD is constantly exploring technological ideas that would have seemed crazy even 10 years ago, such as wearables. (We regularly publish [news items](#) about wearables.) Sensors built into a soldier's uniform and boots could potentially track blood pressure, heart rate, hydration, injuries, and ground speed. Solar cells sewn into a uniform's fabric could charge a soldier's growing list of electronic equipment.

Some of these innovations will make their way into the commercial world. So-called "precision-guided" rifles that are [commercially available](#) today utilize fire direction control technology designed for jet fighters and tanks; users can track a target through an LCD heads-up

display that provides distance and wind speed information, basically eliminating any chance of human error.

About a decade ago, some analysts worried that the military's move from the old "steamboat" technology of the not-too-distant past toward "smart" munitions and unmanned aerial vehicles might lead to a drop in demand for PCBs, but the opposite seems to be true. The technology level of today's smart weapons means that the PCBs of today and tomorrow are more high-tech—and more costly than ever.

No doubt about it: Despite an occasional dip in spending, the Department of Defense is one flush customer. Even sequestration, which put a scare into the Department of Defense and its contractors in 2013 by requiring defense cuts for 10 years, didn't have too much effect on most contractors' bottom line. Sequestration dictated



Vice President Mike Pence speaks at NASA's Johnson Space Center in Houston following the introduction of NASA's 2017 astronaut candidate class on June 7, 2017.

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that defense spending decrease from a high of \$670 million in 2012, with cuts of 6.4% in 2013 and 5.5% in 2014. But in 2015, spending began rising at 2.1%, the projected rate of inflation, reaching \$714 billion in 2023.

President Trump campaigned on beefing up the defense budget. He wants to raise DoD spending by \$54 billion for FY2018, which would require 60 votes in the Senate to lift the sequester. But Trump may have trouble getting eight Democrats to vote with him, assuming he can get all 52 GOP members of the upper chamber to vote “aye.”

So, all of this is subject to the winds of politics. Still, many U.S. PCB design bureaus, fabricators and EMS providers are considering moving into mil/aero work. It's one market that's never going to move overseas (at least not legally), so why not give it a shot?

Well, as our guest contributors point out in this month's issue, mil/aero work is not for company owners who are not fastidious record-keepers. The number of mil/aero regulations and certifications just keeps growing: ITAR, AS9100, DFARS, just to name a few. As Trilogy Circuits CEO Charlie Capers says in his

interview, “Remember, the government loves paperwork.”

Our first feature is based on an interview with a variety of experts who have worked in mil/aero for years: Freedom CAD's COO Scott Miller; Lenthor Engineering VP of Sales/Engineering John Rolle and VP of Marketing Dave Moody; and Zentech's CEO and President Matt Turpin and VP John Vaughan. They discuss the mil/aero challenges they see for PCB design bureaus, fabricators, and assembly providers, especially in the area of cybersecurity.

American Standard Circuits CEO Anaya Vardya attended the International Paris Air Show recently, and he speaks with Dan Beaulieu about some of the highlights of the world's largest air show. Charlie Capers of Trilogy Circuits discusses some of the benefits, as well as regulatory hurdles, facing companies entering the mil/aero market. Next, Stephen V. Chavez, CID+, of UTC Aerospace Systems, explains the myriad of cybersecurity hoops that companies like his have to deal with. And Craig Armenti of Mentor Graphics focuses on ways to use vibration and acceleration analysis tools to improve reliability.

You'll also find columns from our regular contributors Barry Olney of iCD, Alistair Little of Electrolube, and consultant Tim Haag.

We bring you amazing coverage of the recent IPC event IMPACT Washington, D.C., written by Patty Goldman, editor of our sister magazine [The PCB Magazine](#). Patty somehow interviewed a variety of people at the weeklong Capitol Hill event, from our industry and in government. One great takeaway: The EPA under President Trump no longer considers every board shop owner a polluting Snidely Whiplash, bent on destroying the planet. Now, the EPA asks, “How can we help you?” Isn't that how government is supposed to function?

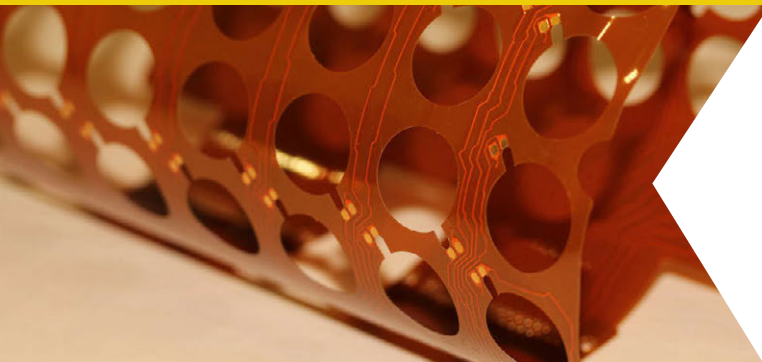
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Andy Shaughnessy is managing editor of *The PCB Design Magazine*. He has been covering PCB design for 18 years. He can be reached by clicking [here](#).

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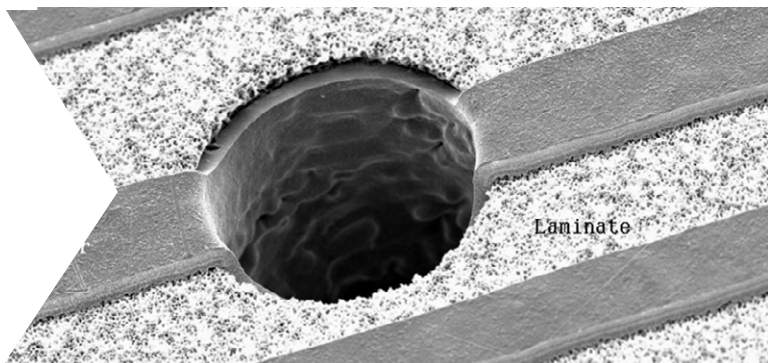
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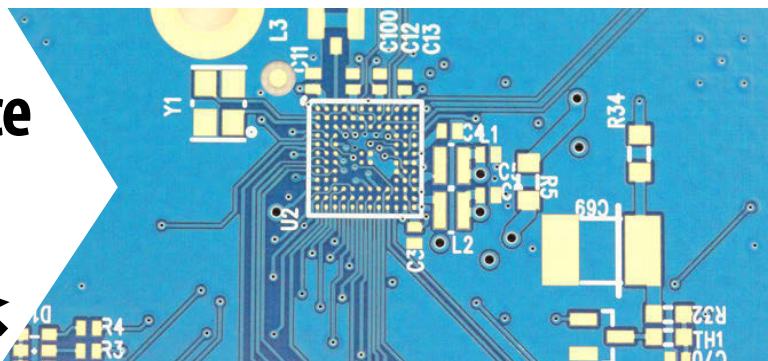
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New Challenges Facing Mil/Aero Segment

by Stephen Las Marias
I-CONNECT007

For the July issues of our monthly publications at I-Connect007, we spoke with a sampling of professionals whose experience centers on the military and aerospace world, including experts from design, PCB manufacturing, and assembly. Joining us for a frank discussion were Freedom CAD's COO Scott Miller; Lenthor Engineering VP of Sales/Engineering John Rolle and VP of Marketing Dave Moody; and Zentech's CEO and President Matt Turpin and VP John Vaughan.

Our discussion centered on the challenges associated with military work, including the new regulatory requirements for cybersecurity, dealing with leaded vs. lead-free components, and mil/aero's similarities (and differences) with the commercial world.

The discussion started on the PCB design perspective, whether the biggest challenges are more technical or more centered on the regulatory side.

"I can tell you from our perspective, this year and going forward, the rules of engagement have really begun to change because of cybersecurity, and that's having a huge impact on the engineering services community—how to comply with cybersecurity requirements that are now being mandated to us as external suppliers," explained Freedom CAD's Miller. "It's something we're spending a lot of time on. We've got work to do. We are ITAR-compliant, but cybersecurity compliance is a far deeper level of compliance than ITAR information management. That's huge. We're engaging with a consultant to help us understand how we can fulfill those requirements. And I think that's going to be a game changer for a lot of the smaller companies that currently participate in the mil/aerospace marketplace, because there are some serious costs associated with cybersecurity management."

"It's a year-end objective. They want to have a supply base compliant, or at least have identified where the holes are, the weaknesses are, as far as we can tell, but there's a huge impact."

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Assuming we overcome and address that, the other thing that has been kind of a mystery, and I'm sure everybody along the path sees this, is the defense budget, the DoD or Homeland Security, or whatever—any kind of government program—the defense budgets and understanding how the administrative change is going to slow down. Obviously, it looks like there's going to be more spending in that area, but it's not clear. Getting accurate forecast information or project information is difficult to do. We do our best to try to communicate with the customer and the subcontractor, etc., but they can only tell you so much because they only know so much," he added.

Miller said that as the device types continue to get smaller and pin pitches get tighter, meeting traditional Class 3 requirements becomes increasingly difficult.

"You can't meet Class 3 in certain applications, so you're consistently asking for a deviation or a waiver," Miller continued. "Just because of the physics involved, you just can't physically meet Class 3 in some cases. And if it's a rigid requirement, then you have to work with the customer's engineers to fit the components that will allow you to meet that. From the standpoint of technology and architecture, we do things that are just as challenging in mil/aerospace, with fine lines and impedance matching, etc., that drive the consumer commercial world as well. From a technology standpoint, I don't think there's that big a gap in terms of what we're seeing as design requirements. It's been interesting to see how the government and the IRAD^[1] product development drives a lot of new technology as the government subcontractors try to figure out how to do things to differentiate their capabilities, and that kind of flows into the consumer world eventually, and vice versa; the commercial consumer world is developing technologies that are now being adopted readily in the mil/aerospace."

Lenthor's Dave Moody explained the challenges from a PCB fabricator's viewpoint. "There are a couple, though John might have some different perspectives from an engineering standpoint," said Moody. "The requirements in the mil/aero defense industry are mirroring what is available everywhere else. The perception



Scott Miller, Freedom CAD.

that there are cost advantages or margin advantages for fabricators to work in the military industry are going away and have been disappearing for quite some time. There's a demand from a business standpoint on their end to buy more smartly—and better. So, the days where everybody thought, 'I'm going to participate in this military business because I can make more money at it' are kind of gone. There is a protection, to some degree, for the domestic fabricators because of ITAR content, so that remains as a competitive advantage on the business side for companies, domestically, who are trying to do business in this industry. But it is from the other aspects, such as design requirements, delivery requirements, etc."

Rolle added, "It's certainly challenging from a business perspective, because the expectation is to be competitive and then to continue to reduce that pricing. At the macro level, more dollars are being spent all the time. I'll build off what you were talking about earlier. Will it play down even to the fab level, where even if you're successfully participating in a contract with really good schedule performance and very low defects, the expectation is that costs will reduce if you want to entertain the next bid on the contract? I think in some cases those contracts are summarily rejected if you came back to the same price. So, I think that's the challenge. I don't know that it is different from other large programs in other industries. However, I just want to add on to what Dave was saying, that our experience has been a difficult one."

According to Rolle, also challenging from the engineering and tooling perspective are drawings with existing requirements.

"You're trying to comply with the drawing and you'll have situations, like you were mentioning. You have to get a waiver, to do something differently, or something's very cost-prohibitive due to an impact to yields. Getting changes through is always one of the supreme challenges. Even in cases where you provide a good service and your customer agrees to what you're requesting, often there's no funding in the program to pay for your engineering change. We've come across that recently where we all agree with this, it makes a lot of sense, and it's going to help you reduce costs, but nobody's going to pay you any money to fix that. Or cases where it does go through, but the length of time it takes to go through automatically puts the entire program on schedule jeopardy and puts immense pressure on the entire supply chain to perform to levels that maybe are unreasonable or difficult to come out looking good, when really you were just trying to do the right thing and build to print or reduce costs," he said. "Those are some challenges as well. I've seen many cases where jobs go on hold for three months, and then of course everyone needs it tomorrow. And I certainly understand that, no matter who that customer is. Everyone is making a product, and we're all feeding upwards towards some goal, and you can't recover that lost time. I'd say to Dave's point, there are certainly business challenges with that. I think change management, where it changes, and their impact on the overall schedule is also a challenge that's worth noting."

From an EMS standpoint, Zentech's Matt Turpin also mentioned the need to comply with the new cybersecurity rules. "The NIST 800-171^[2] guidelines are complex. It's night and day. ITAR is really nothing compared to the cyber rules. Complying with ITAR would be maybe a three, and to comply with the NIST 800-171 is more like an 83. It's orders of magnitude more complex and we've been working on it, and we already had a head start. We started about three years ago down this path, but the NIST 800-171 is formidable and it's being driven at us as flow-downs from all the military primes. Fortunately,

it doesn't have to kick in now, but soon everybody is going to have to do it," he said. "To the earlier point about the military being more commercial in terms of pricing, this NIST 800-171 is going to be an unbelievable barrier to entry. I don't know how a lot of people are going to have the infrastructure and the capability to comply with it. They're either going to have to close their eyes when they self-certify, or they're just going to be completely non-compliant and hope it will go away. NIST 800-171 is huge, and I'm surprised a lot of people aren't talking about it yet. That will be a big challenge. We're doing pretty good. We should be compliant before the end of this year."

Regarding how long it takes to go through that compliance process, Turpin said it depends on how mature the organization is. "For us, we currently have only two sites, and we're getting ready to add a third. If you are a multi-site organization, or you've got the challenge that Scott does in terms of kind of a virtual organization, it's unbelievably difficult because very specific hardware issues must be dealt with. I can't even begin to talk about it. I mean, I've got a whole team that's dealing just with this compliance."

But isn't this industry overregulated already? Absolutely not, according to Turpin. He said that there is such a disparity in terms of the



John Rolle, Lenthor Engineering.

due diligence the companies in the mil/aerospace undertake, and it's absolutely needed.

"What a lot of companies do that I've seen, that we've audited, it's almost criminal the lack of protections they have, relative to firewall, file security, data security, who they send files to, how they store stuff. It's absolutely needed," he stressed.

Feedback System

Is there a feedback system in place between the suppliers, fabricators, assemblers, and customers in the mil/aero segment?

"From the Zentech side, 98% of everything we do is turnkey, build to print, complex assembly. We buy all the materials, we build it, we integrate it, we test it, we'll ESS^[3] it and then ship it off. We're almost exclusively working with a design that somebody else has put together. Sometimes it's ours, but 98% of the time it's somebody else's design," Turpin answered.

For Freedom CAD, Miller said there's not much process deviation between the commercial and the mil/aerospace world, in that they work closely with the board fabricators. "So much of what we design today is impedance-controlled or specialty materials. When we start the design process, we go and at least work with either the OEM themselves, who are the con-

duit to their fabricator, or with their fabricator to get a stack-up and make sure that it's manufacturable from their perspective, and going to meet the impedance and current-carrying capability or requirements that are defined in the statement of work," Miller explained. "From a process standpoint, we treat the process of design the same, whether it's consumer or commercial product or a military product. We have pretty rigid processes for placement sign-off, critical routing sign-off, and then for final package sign-offs. As we go down the process, we're trying to get as detailed a review from the customer as we can during the design process. And I know anybody that's in the design community understands 'as I can' as a statement because you have companies that say they review it. And you get further down the design pipe and you've now got things connected, and they come back and say, 'Oh, by the way, we need to move this component to the top of the board. We've got to change this or that.' So, you think you have something that's been signed off and approved, but in reality, until the product ships, it's a moving target."

Lead-free Issues Remain

The electronics manufacturing industry may have transitioned to lead-free years ago, but the military and aerospace markets are exempted from RoHS due to reliability issues. Electronics assembly providers working in such markets face the difficulty of sourcing advanced components in non-RoHS-compliant configurations.

According to Turpin, the leaded requirements for technology have become a lot more difficult to design in for one part, and then have become a challenge because it's harder to get the parts, it's more expensive, and the lead times are different. "The military has tried to embrace some level of RoHS commercial-type products, but for the hardcore aerospace and space, it's leaded," he said.

Miller agrees. "That makes sense, and you guys have to deal with re-dipping or re-balling components that aren't leaded to meet that requirement. We tend to try to follow what the customer wants to have happen, but we'll point out to them if we see a problem—something that's going to impact manufacturability downstream."



Matt Turpin, Zentech.

"From the EMS perspective, there are really two interrelated challenges and a lot of it does relate to lead. One is that all DOD stuff has embraced this concept of affordability and tried to drive affordability. I think some it's their own internal marketing to the government. But this concept of affordability falls down when you get to things like high reliability and leaded parts, where having new technology parts re-balled, re-dipped, and re-tinned adds cost and lead time to everything. And then you overlay that with an environment that is really IDIQ-driven [indefinite delivery/indefinite quantity] to where, even though everybody knows that the government's going to buy 200–400 units over X number of years, they will only buy 20, 40, or maybe 50 at a time because of the way the IDIQs work and other things. It leads to something compressed more than they need to be, and pricing that's higher than it otherwise should be," explained Turpin. "The other thing was obsolete components. Generally, it takes so long to bring something to market, particularly in the aerospace side that by the time it really starts to get past the IDIQ level into MRL level 4^[4], a lot of the components are already becoming obsolete. That creates a whole new challenge in terms of building parts affordably, quickly, and in a way that the customer likes."

"I would completely agree with that," said Lenthor's Rolle. "One thing that we see happening as a result of that is you will have some products with multiple plating finishes on them because of the selections that are made upstream for all those reasons. And I sometimes see that drives complexity and makes manufacturing plans or parts more challenging if you're doing HASL, ENIG, or something like that. I've seen several instances where we really have to figure out if that's the way to make the part because of those types of decisions, or limits of those decisions that are made upstream as well."

Business Expected to Increase

With the new administration in office, there's been talk of additional military spending. But has this translated to increase in business? Rolle said no, at least not yet.

"I think you see election-year business cycles where in some cases the overall fear of



John Vaughan, Zentech.

spending, even for programs that are funded, gets people very tepid, reticent to go ahead and spur that funding. They kind of wait and see where the chips lay. I think this was already mentioned, that the proposal was for a 10% increase in the defense budget, but really what that means to this segment of the market is not clear yet. There's a lot of business for hardware that goes on a soldier or person, whether that be homeland defense, etc. Our customer base in the military market is expanding to police force, Homeland Security or ICE, things like that, whereas before it was traditionally just the Army, Navy and Marines," he explained. "I don't know that we've seen that come through yet. It looks like things are moving again, but I don't know if that's just because the calendar turned over and things are starting to pick up like normal or it's post-election."

On the other hand, Turpin said they have seen an uptick since the election. "Almost twice the amount, I would say, in terms of what's been coming in, and it's all segments. Other people in our niche, EMS companies, are seeing similar things. I'd say, no question it's picked up. Now, that's just in terms of quotes. Last month was a really good month from a booking standpoint. It's probably too early to tell if they're turning into orders in a sustainable way, but from a quote activity, yes."

Zentech's John Vaughan explained, "It has

a lot to do with the business model you put in place. For four or five years, we've been what I call politically agnostic and bipartisan at the same time. The administration changes are going to be beneficial, but what's more important is to look behind the curtain at the programs and focus on pursuing and obtaining a seat at the table on programs that are funded. There are 40+ programs that we're active with for now, all funded through 2022. Regarding the changes in the administration, and you just

“The administration changes are going to be beneficial, but what's more important is to look behind the curtain at the programs and focus on pursuing and obtaining a seat at the table on programs that are funded.”

kind of peel through it, it starts with Trump, the China issue, North Korea, and the stated objective to pivot to the Pacific and increase our naval assets. Then you've got the CIA with Mike Pompeo, the new director, and that's highly focused on signals intelligence, which translates into a lot of higher technology, RF circuit builds and data collection. And General Mattis, Secretary of Defense, is a former commander in Iraq and at some point, with increased troops on the ground, that drives the IED defeat-and-detect market. Commander Kelly is the former commander of SOCOM (Special Operations Command). The administration is pro-military through and through and that certainly bodes well for those of us focused on the mil/aero/defense segments of the market. Then you roll all that together, coupled with a request in the DoD budget to increase it by 10%. That would take us back pre-sequestration levels and the appropriations dialogue should be complete by the end of this month. We should have a pretty clear picture of where the dollars are flowing soon. Again, from our viewpoint, it's been

proactive planning and striving to pick the programs and pick the technologies that are going to be required to support whatever effort the administration decides to lean toward.”

Towards Successful Partnership

When it comes to key criteria that OEMs should consider when evaluating an EMS partner for their next mil/aero project, here's what Turpin has to say:

“First and foremost, many of the mil/aero companies lack the funding and the time, and sometimes the expertise to properly qualify EMS companies. They have commodity buyers, and certifications are important. In our world, on the EMS side, obviously, the IPC has recently rolled out what they call a Validation Services QML (qualified manufacturers list) trusted source, which helps companies really understand that, not only does a company have a good quality management system, but they're able to produce good products. Zentech is one of maybe 10 companies in the U.S. with a trusted source process. Additionally, if you're a mil/aero company, you must make sure that the EMS company you deal with is ISO 9100 certified. Most EMS companies are not,” he added.

“I would say, separately, NIST 800-171 is also important, and I think it's going to be increasingly more important with all the cyber sensitivities out there. I'd say that would be one. Companies tend to focus on equipment, but any idiot with a dollar can buy equipment. It takes more than money to produce good products. What kind of processes and procedures do you have to operate equipment, solve problems for the customer and get it right.” **PCBDESIGN**

References

1. IRAD: Independent Research and Development. Government subcontractors use this term to identify when they are spending their own money on a project vs. fulfilling a government contract.
2. “Protecting Controlled Unclassified Information in Nonfederal Systems and Organizations,” [NIST Special Publication SP.800-171 Rev1.pdf](#).
3. Environmental stress screening test.
4. MRL: [Manufacturing Readiness Level](#).



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The International Paris Air Show with ASC's Anaya Vardya



by **Dan Beaulieu**

So many have wanted to attend, but so few have. The International Paris Air show is the *crème de la crème* of the world's trade shows. This is the big one, where all the aircraft, airline and defense aerospace companies meet to introduce new products, discuss the future of aviation, and make deals—big deals.

For the past few years, American Standard Circuits has been attending the Paris Air Show as part of an Illinois delegation, and they have found it a very worthwhile endeavor. Located in West Chicago, American Standard Circuits is one of North America's leading independent space, defense and aerospace printed circuit board producers.

This year I decided to talk to my friend Anaya Vardya, ASC's president and CEO, about the show, why he goes and what it's like.

Dan Beaulieu: Anaya, Thanks for taking the time out of your busy schedule to talk with me today. There are many us who are fascinated by

the International Paris Air Show. What is the show like?

Anaya Vardya: My pleasure, Dan. First, it is the world's largest and most important air show. It is also the oldest, which is interesting. The first Paris Air Show was held in 1909, and since 1949 it has been held every odd year. It is held at Le Bourget Airport which, by the way, is the same airport where Charles Lindbergh landed after his flight in 1927. The event starts with four professional days closed to the public; and then on Friday, Saturday, and Sunday the public is allowed in. More than 350,000 people attend every year, including dignitaries from all over the world. This year was no exception, with the show officially opened by new French President Macron. Many high-level U.S. officials attended, including the Honorable Uzra Zeya, Chargé d'Affaires of the Embassy of United States, the Honorable Elaine Chao, Secretary of Transportation, and many governors, senators, and congresspersons.



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Beaulieu: So, I would assume that the United States is well represented.

Vardya: Absolutely, the USA pavilion houses most of the US companies. More than 300 US companies were at the show and 2,000 companies were at the show, overall.



Beaulieu: You told me you were part of the Illinois Delegation; can you talk about that?

Vardya: Of course. We were part of the State of Illinois delegation and worked closely with the Illinois Department of Commerce & Economic Opportunity's Office of Trade & Investment. Seven companies in the Illinois booth spanned a variety of industries supporting the aerospace industry. The Rockford Area Aerospace Network (RAAN), which ASC is also a member of, was also represented in our booth.

Beaulieu: Did you manage to get some leads from people stopping by your booth?

Vardya: The thing that is different about this show is that you cannot count on gaining leads via people stopping by your booth. You really need to do prep work to set up meetings ahead of time. You also need to walk the show and find additional leads.

The show is large and it is not possible to walk all the halls unless you have many people that go with you. Strategic targeting becomes important. You must plan your time carefully by making appointments ahead of time. You cannot count on just meeting people randomly and striking up a beneficial business conversation. You must intentionally plan every minute of your time there.

Beaulieu: Did you attend many events and talks as well?

Vardya: Yes, I was with our VP of Business Development and our rigid-flex expert Dave Lackey, and together we had the opportunity to attend a number of networking events in the evenings. This is an important part of the Paris Air Show experience, but it makes for a very long day.

Beaulieu: I'll bet there were many cool things to see as well.

Vardya: That's the fun of attending the show. There are always talks and conferences going on throughout the four days on a variety of aerospace topics. In addition, the fun part of the show is to watch the various planes

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doing maneuvers. A daily flight schedule is distributed, which tells you what planes are flying and when. Dave had the opportunity to see Lockheed Martin's fifth-generation F-35 fighter plane doing many maneuvers. There are also static displays of planes, rockets, tanks, etc. I had the opportunity to tour the latest Qatar Airways business suite and view the latest in luxury commercial flying.

Japan's new Mitsubishi Regional Jet, or MRJ, which is considered the next-generation in regional jet, was present. Besides that, you also get to see some of the new fighter planes going through their maneuvers.



Beaulieu: You have attended this show twice now. Is it your plan to keep attending in the future?

Vardya: Yes, you know we are growing our aerospace business every year, so it behooves us to stay well-informed as to what is going on in that industry. It is also an opportunity to visit our European customers as well.

Beaulieu: Are you doing much business in Europe?

Vardya: We are focused on growing our business both domestically and overseas. We have made great inroads in other parts of the world over the past few years. We are currently hiring independent sales reps and growing our sales coverage there. We are very optimistic about our future in Europe.

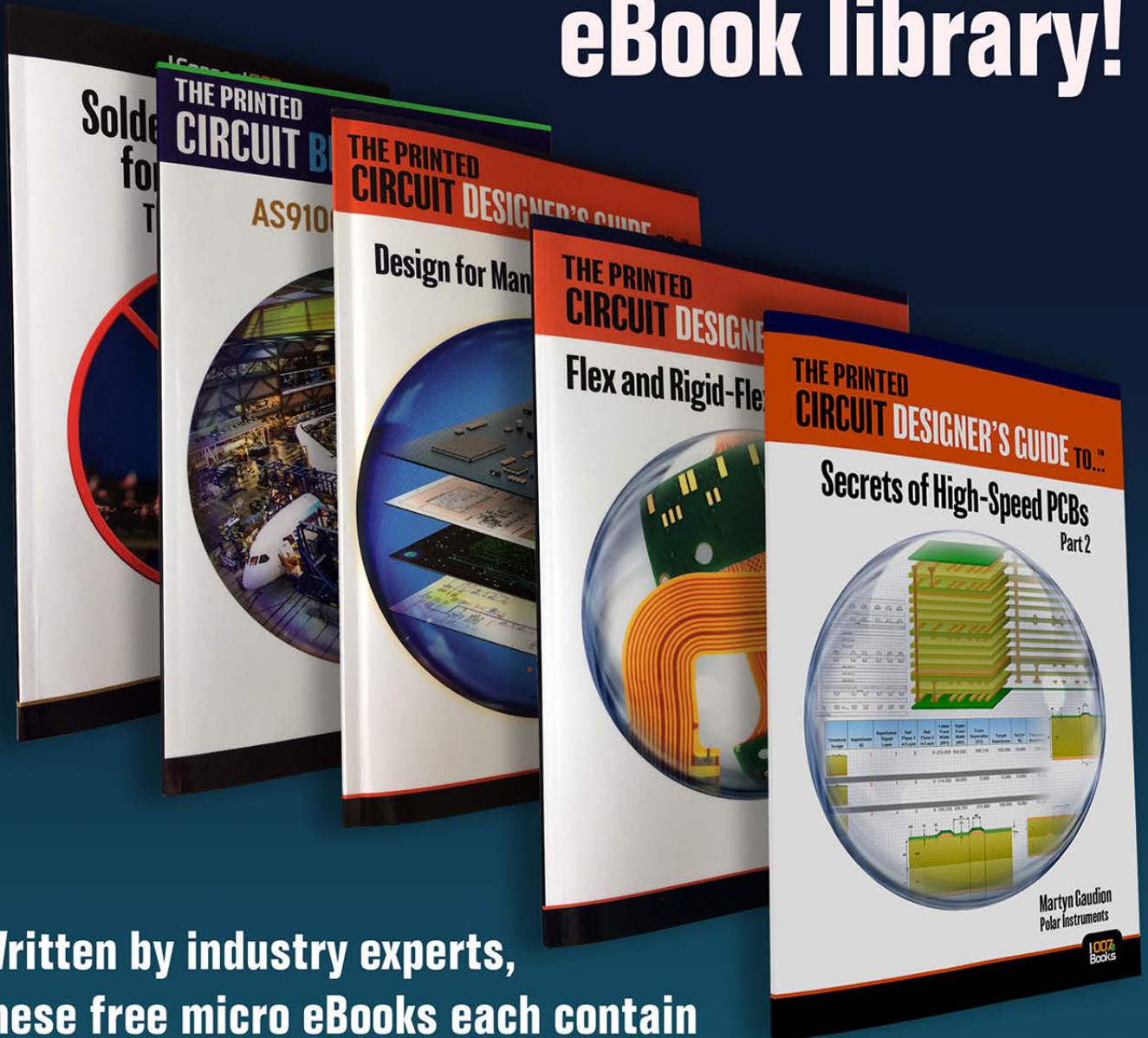
Beaulieu: Sounds great. Once again, thanks for talking to me today, this has been very interesting. Now I only have one more question for you.

Vardya: Okay, what's that?

Beaulieu: Can you take me with you next year?
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Trilogy Circuits: MilAero Demands Technological, Regulatory Expertise

by Andy Shaughnessy
I-CONNECT007

In the 16 years since its founding, Trilogy Circuits has become one of the go-to companies for mil/aero PCB design and manufacturing. I spoke with Charlie Capers, president and founder of the Richardson, Texas firm, about how he keeps ahead of the game. As he explains, succeeding with mil/aero PCB work requires not only mastery of the technological side, but of the regulations and certifications as well.

Andy Shaughnessy: Charlie, why don't you start out with a little background on Trilogy Circuits. How much of your business today is military and aerospace?

Charlie Capers: Trilogy started as a PCB design service bureau in 2001 and then expanded into a full-service EMS company in 2004, specializing in military and government applications. Roughly 60–75% of our business is some type of government project.



Shaughnessy: I understand that your circuit boards end up in some pretty interesting military applications.

Capers: True. Some of our customers provide very vague descriptions of what a certain product does, while others will share more details. It helps us develop a more robust product if we have some idea about the operating conditions and environment the product will be used in. We design and manufacture some interesting systems for major players in the military and aerospace sector.

Shaughnessy: In our recent mil/aero survey, some people said that keeping up with changing regulations is one of the toughest parts of the job. What are we up to now? ITAR, NIST, AS9100...and a new AS9100 rev is coming.

Capers: This is one of the most complex areas when dealing with government contractors. ITAR registration with the State Department is a given these days and requires a lot of training and awareness when dealing with sensitive information. Compliance to a new cybersecurity



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mandate will be required by the end of 2017, which includes DFARS 252.204-7012 and NIST SP 800-171. These impose heightened security safeguards and mandatory reporting requirements and subcontractor flow-downs on DoD contractors handling Covered Defense Information (CDI). AS9100 Rev D is here, and any audits conducted after June 15, 2017 will have to be to the revision D standard. Revision D takes this registration to a whole new complexity level. Transition audits must be completed by September 15, 2018. Revision C certificates will become invalid after that date.

Shaughnessy: A few survey respondents said their mil/aero customers were worried that their boards would wind up being manufactured overseas because of the lack of transparency. Is that a widespread problem? We thought ITAR would curtail a lot of that.

Capers: Great question. Fact of the matter is, they should be worried. Just about anyone can obtain an ITAR registration. Understanding ITAR and actually complying is where things get fuzzy for most people. Even though several board houses and brokers claim to have ITAR facilities overseas, we really don't know how the product data is handled after you click the "send" button. We are very cautious when handling sensitive data and use only U.S.-based manufacturers for our military bare boards. The penalties and fines for sending data beyond our physical borders is enough to put most small companies out of business and the owners in federal prison.



Shaughnessy: And yet it seems like everyone in the PCB world wants to be in mil/aero now. What are some of the biggest obstacles for companies who are considering moving into mil/aero?

Capers: As I mentioned before, compliance with all the regulations is the big one. Counterfeit mitigation is big as well. Ensuring that all your materials come from franchised distribution is critical. We are not allowed to purchase anything from non-franchised sources. This can be very difficult when dealing with EOL or obsolete components. The sales cycle is a long and drawn out process also. Time and patience are what it takes to get in as a supplier. To expect results in weeks or months is a fantasy. You can also expect a lot of facility visits and extensive audits of all your processes. Remember, the government loves paperwork. The





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Shaughnessy: Switching gears now, we've been covering the "graybearding" of the design industry for some time. And now we're seeing even more EEs coming into the PCB design world. What do you see for the future of PCB design in North America?

Capers: We are already seeing a lot of ups and downs. EEs are trying their hand at PCB layout with mixed results. Most lack the knowledge of the actual manufacturing and assembly process and produce designs that are problematic, if not impossible to build. PCB design service bureaus seem to be shrinking or are being transformed or merged into small EMS companies. It's difficult and cost-prohibitive to survive as a stand-

alone service bureau these days, although some contractors seem to stay pretty busy. PCB layout work is also becoming a commodity as prices are being driven down by overseas designers who work for a few nickels a day. I do see a lot of really good designers working as direct employees for the military contractors, as this seems to be a pretty safe place to work as far as job security and good pay. But the true design gurus of the past are quickly evaporating.

Shaughnessy: Is there anything you'd like to add?

Capers: Change is inevitable and constant. In the last 15 years, we've seen price erosion across the board as our products and services have become a commodity. Even in the military and aerospace sector, buyers tend to just go with the low price, regardless of qualifications, certifications, processes and quality. We spend tens of thousands of dollars each year to ensure our certs are up to date and our facility will support the demands of producing quality products for our soldiers and our country only to be beaten down on price by an unqualified competitor or buyer. However, there are some customers that understand quality and value, and price is never the main issue in their purchasing decisions. Thank goodness! **PCBDESIGN**



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Stephen V. Chavez Talks Mil/Aero PCB Design



by Andy Shaughnessy
I-CONNECT007

Stephen V. Chavez, CID+, is the lead PCB designer for the Electronic Systems Center division of UTC Aerospace Systems (UTAS), a military contractor that builds all manner of cutting-edge tools for the American warfighter. He's been designing military and aerospace PCBs for decades, and he's a veteran of the United States Marine Corps.

"Steph," as he likes to be called, is also the vice president of his local IPC Designers Council chapter in Phoenix, a CID instructor with EPTAC, and a Designers Council Executive Board member at large. And each year at IPC APEX EXPO, he's a regular speaker during the Design Forum event.

So, for our mil/aero issue, I wanted to get Steph's insight into PCB design at a leading defense contractor. I caught up with Steph and asked for his thoughts on designing PCBs for the military and aerospace markets, and what sort of regulatory and cybersecurity hoops military contractors like UTAS must jump through.

Andy Shaughnessy: Steph, tell the readers a little about UTC Aerospace Systems and what your job there entails.

Stephen Chavez: Sure, Andy. At UTC Aerospace Systems we design, manufacture and service systems and components and provide integrated solutions for a variety of aircraft: commercial, regional, business and military aircraft, helicopters and other platforms. We are also a major supplier to international space programs. Our customers include OEMs that build aircraft and helicopters, engine manufacturers, and airlines, as well as defense agencies and contractors.

As for my job within UTAS, I am a technical lead of PCB design, which entails many areas of PCBs, ranging from design, fabrication, and assembly, from prototypes to production. This also includes being a very active team member in global activities with other UTAS strategic business units, as well as adding my leadership, experience and continued education within our internal global community of practice regarding all subject areas related to PCBs.

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Shaughnessy: What sort of products do your PCBs wind up in? What are some of the “cool” applications you’ve been involved in?

Chavez: Basically, our PCBs go anywhere within the aircraft from nose to tail, as well as within the test equipment we design in-house. I have been very blessed to work on many cool applications here at UTAS, but unfortunately, I am not at liberty to disclose any of these details or specific information.

Shaughnessy: What do you think is the biggest challenge related to designing boards for military use—the design process itself, or all the attendant issues, like the bidding process, regulations and security?

Chavez: In my opinion, the process of designing boards, at its core, is basically the same, no matter if it’s for a military, commercial, aerospace, space, or medical device. For me, the challenge often comes from adhering to regulations, such as International Trade Compliance requirements. At the same time, while these requirements can make the process more complex, they are necessary to maintain security and ensure the proper handling of technical data.

Shaughnessy: It seems as if cybersecurity is getting tougher for military contractors, with NIST 800 and other regulations coming online all the time. Does that seem to be the case?

Chavez: In today’s world, cybersecurity is a major priority for military contractors, especially as technology and security threats continue to evolve, and regulations continue to proliferate to help protect against them. While it can be a challenge to keep up with the rapid change of pace associated with cybersecurity, it’s of the



Stephen Chavez

utmost importance that military contractors do so at all cost. In general, companies are adding more and more layers of security to increase their own cybersecurity.

Shaughnessy: A lot of PCB companies would like to get into military work. What are some of the hurdles that these companies would have to overcome to get into military electronics?

Chavez: Hmmm...I am not really sure. Every company I have worked for already handled military work before I started working there. I have never worked for a company that did not do military work. I

would say that if a company wants to go after military work, U.S. citizenship is a must-have for all of its employees, but specifically for those employees who would be working on that military project. They must follow all required laws and regulations regarding military work. I’m sure there may be more requirements and regulations to follow and meet.

Shaughnessy: Is there anything else you’d like to add?

Chavez: I want to thank you, Andy, for this interview and allowing me this opportunity. I hope you and your readers find my responses insightful, and that they are well received. As always, I am eager to be a positive and very active participant in our industry as it continues to evolve.

Shaughnessy: Thanks, Steph.

Chavez: Thank you, Andy. **PCBDESIGN**

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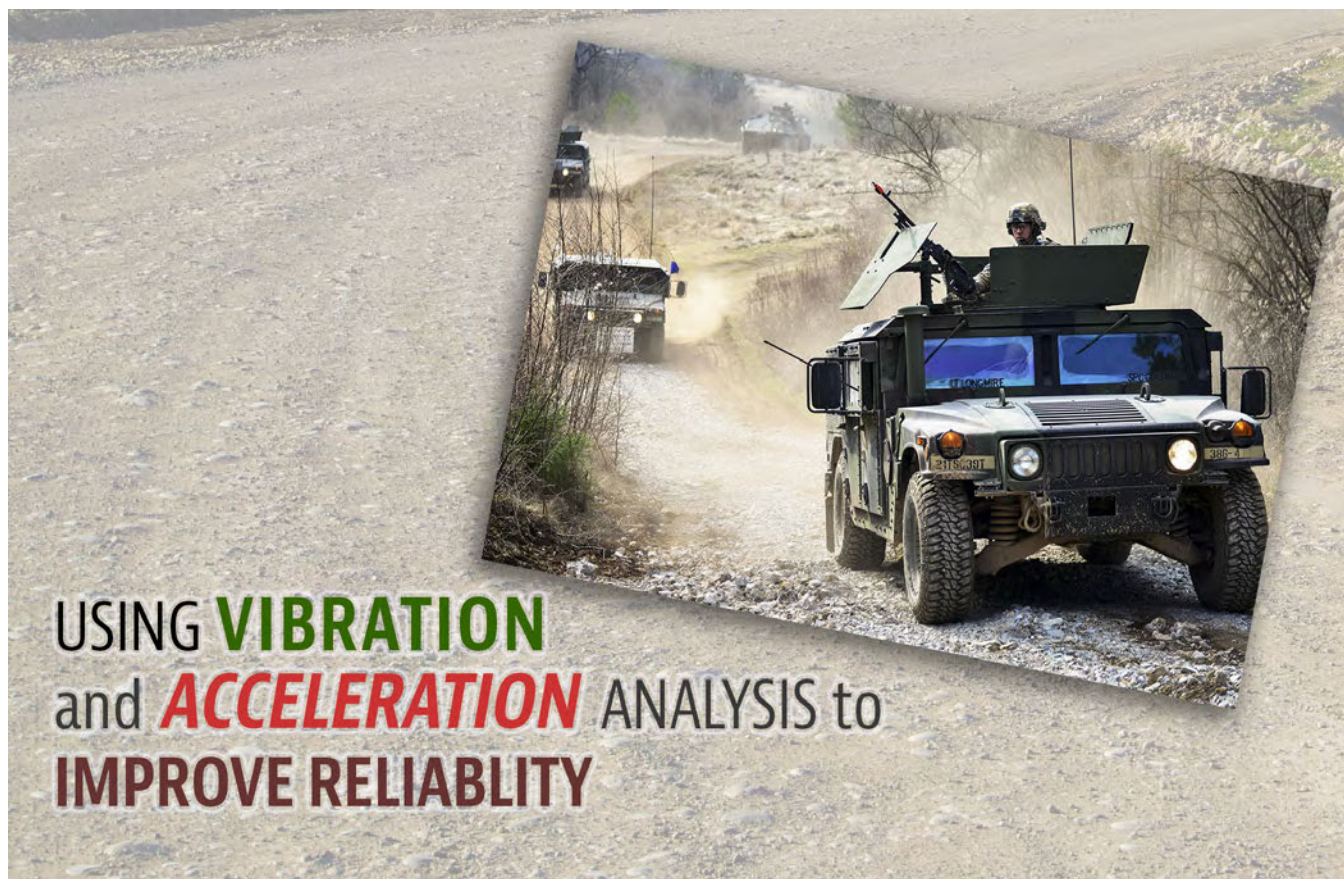
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by **Craig Armenti**

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Deriving the physical constraints and fatigue issues for a design prior to manufacturing is essential to reducing board failure and thereby improving product quality. In harsh environments, fatigue can be responsible for up to 20% of failures. The need to design a reliable product is, of course, not a new concept; however, it has begun to receive greater attention in recent years. Customers have come to expect reliability across the industry spectrum no matter where actual production occurs.

Companies that are known to produce reliable products are rewarded in the marketplace with increased purchases as compared to their non-reliable counterparts. Reliable products have less risk of failure, less field returns and less warranty claims, all of which contribute to higher profitability. It is a given that every product is expected to fail at some point, however premature failures can be mitigated through proper design with attention to potential issues due to vibration and acceleration (Figure 1).

Common Methods of Validation

Industry statistics indicate field failure rates of up to 15–20% in the first year of newly launched electronic products. Most design teams rely on physical testing to determine reliability issues. Physical vibration and acceleration testing, also known as Highly Accelerated Lifecycle Testing or HALT, provides a clear mechanism to ensure reliability of a product and identify potential failures due to environmental factors. This is accomplished by applying a much higher fatigue than the actual product will undergo, thereby forcing failures and identifying weak spots.

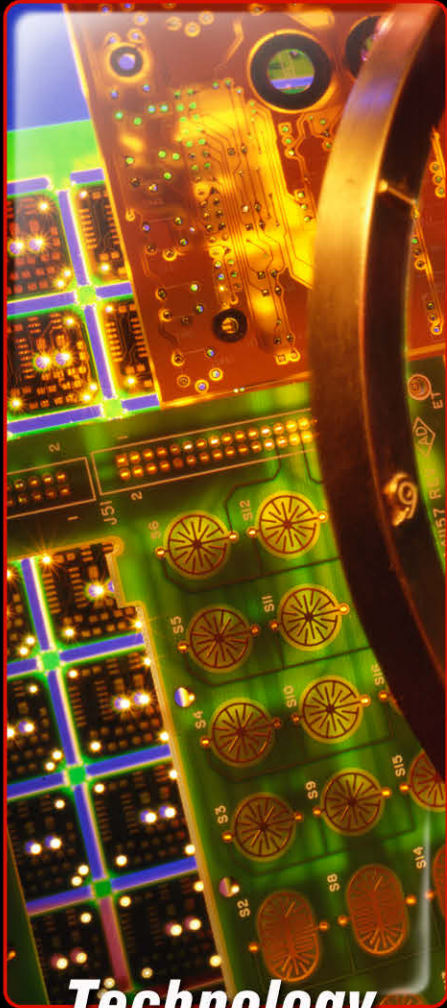
The process, however, is costly and destructive, potentially taking months per design to complete. Furthermore, results can vary between testing chambers, possibly concealing accuracy and functional limitations on components that could then fail in the field. With the high cost and increased time-to-market, only a few prototype designs actually go through physical vibration and acceleration testing.

The aforementioned cost and time issues associated with physical testing have resulted in

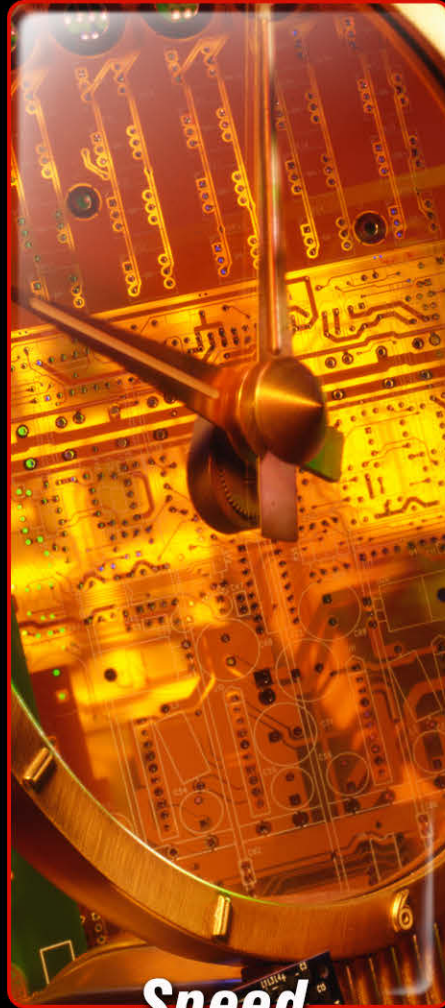
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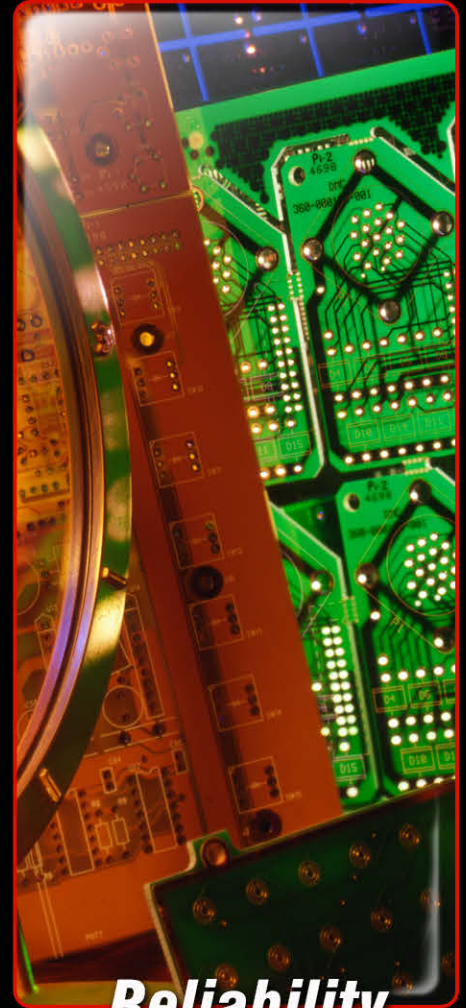
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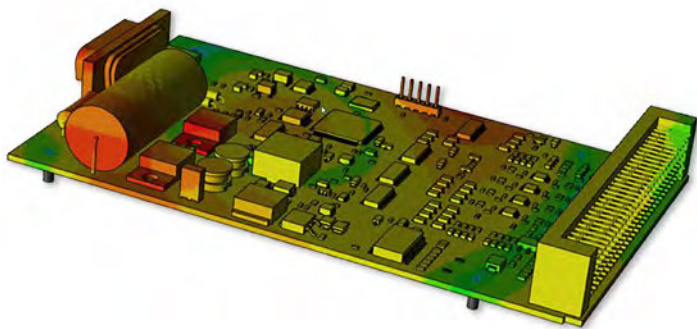


Figure 1: Virtual HALT simulation.

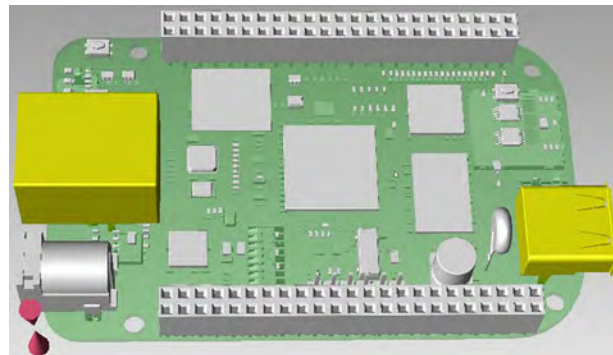


Figure 3: Vibration and acceleration simulation.

many design teams adding a mechanical analysis step to the product development process in order to better validate reliability. While this added step improves the process, it still has limitations, including:

- Extensive library/model development
- Lengthy setup and simulation cycles
- Simulation results that are not tuned to the specific printed circuit board

All of this means that, even with a specialist, mechanical analysis is still unable to achieve 100% test coverage.

Improving Validation by Simulating During Design

To optimize the process and minimize time between finding and correcting issues, simulation of vibration and acceleration should be added into the design stage (Figure 2). To be clear, this does not eliminate the need for physical HALT, however by eliminating early failures through simulation in the layout domain design teams can reduce HALT expenses and ensure that reliability specialists have more time to focus on hidden issues.

To predict which parts will fail due to vibration, engineers need to identify the failure frequency or natural modes in the design. Engineers and designers should also be able to determine the safety factor of components due to stress. During vibration and acceleration simulation (Figure 3), an acceleration load should be applied in all directions, thereby defining where the board will have stress during commercial use.

For efficiency, the analysis must be tightly integrated and easy to use in order for tests to be performed concurrent with component placement. The simulation should allow the user to directly view the harmonic frequency and applied stress on all components that could potentially result in a failure. As a best case, two options for quick design simulation should be available:

1. Vibration that calculates relative stress and deformation values to pinpoint weak links in contact areas of leads and pins of components. The results could later be translated to probability of potential component failure.
2. Constant acceleration that provides for a linear static analysis which allows constant ac-

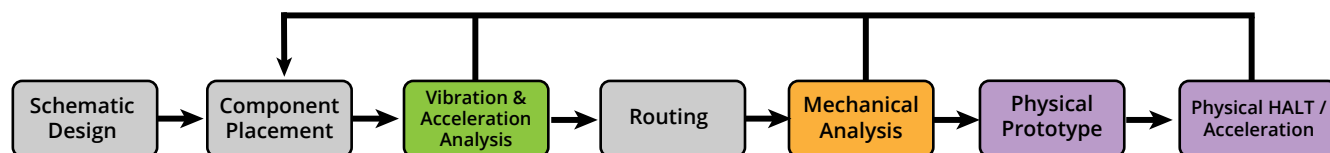


Figure 2: In the optimal process, analysis is integrated within the design stage.

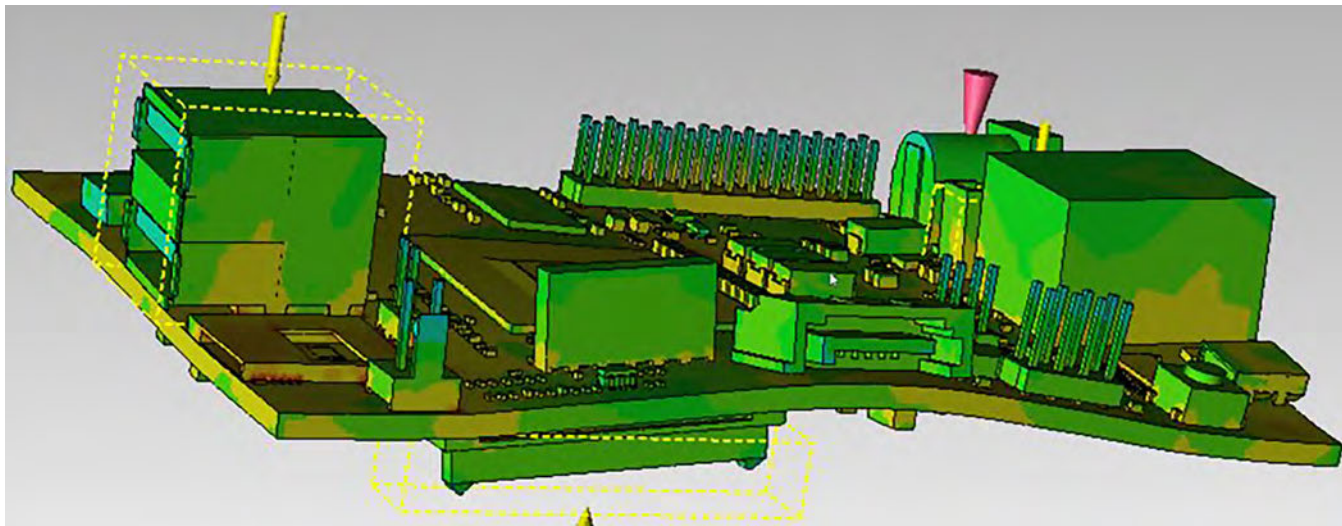


Figure 4: Simulation results should be available in a post-processor for each simulation.

celeration to be applied to the design to calculate von-Mises stress, deformation, and safety factors, all of which could later be translated to pass/fail values for components.

Once the failed parts have been identified, a post-processor interface with full animation should be available to help determine the exact variables and factors causing the part failure. A simplified post-processor view should highlight problematic parts allowing users to detect and correct potential component failures (Figure 4). This would allow an engineer or designer with no product reliability expertise to easily decipher fatigue and vibration issues within their design. An advanced view mode should provide the ability to dig deeper and identify the direct cause of the product failure. The advanced view should plot relative stress intensity distribution in the component pins, balls, or leads, resulting from the simultaneous six axes of random vibration during vibration or linear static acceleration stress analysis.

Reliability Equals Managed risk

There are many challenges that today's products must face and overcome in rugged environments. With vibration and acceleration simulation included in the product development process, a design team will be able to identify critical issues before the product goes

into production. Furthermore, by adding virtual vibration and acceleration simulation during layout the design team will realize:

- Reduced design iterations
- Reduced time-to-market
- A less expensive product
- The ability to simulate all designs as opposed to just high-risk designs
- Increased reliability managing the risk of potential failures

Think of any recent product field failure that has been in the news. The warranty claims, loss of business, and potential loss of market share can devastate even the largest of corporations. The ability to run virtual simulation on every board while in the layout domain enables engineers and designers to detect issues early in the product development process before the board is sent to the manufacturer, thus improving the design quality, decreasing the time-to-market and managing the risk for the product. **PCBDDESIGN**



Craig Armenti is a PCB marketing engineer for the Board Systems Division of Mentor Graphics. Armenti has more than 25 years of experience in the EDA industry.

I Never Realised it Was so Complicated!

How many designers or assemblers have ever set foot in a PCB fabrication shop? Nowhere near enough! An initiative by SMART Group and Amphenol-Invotec gave a group of engineers from design, assembly and quality assurance positions the opportunity to learn a little about the realities of high-end PCB manufacture.

Fein-Lines: Virus, Phishing, Ransomware...Oh My!

Malware, the collective name for viruses, Trojan horses and other malicious software that can infect your computer, has been in the news lately, probably more than at any time I can remember. Over the years, malware has evolved; it can affect smartphones and tablets as well as all computers.

Deep Into Technology at Compunetics

There aren't many printed circuit companies in my neck of the woods. There is one, however, that has always fascinated me, and that is Compunetics, in Monroeville, Pennsylvania, a suburb of Pittsburgh. Having worked with them on the electrophoretic photoresist, a PPG product, many years ago, it was great to stop by and catch up with CTO Tim Schmitt and others.

HDP User Group 2017 European Meeting Highlights Technology Progress

The conference facility at the offices of Oracle, in the royal burgh of Linlithgow in West Lothian, Scotland, was the venue for the 2017 European meeting of the High Density Packaging User Group. I was delighted and privileged to be invited once again to sit in on the open session, an intense programme of technical presentations and discussions, project reviews, status updates and new project proposals.

Mitch Altman Discusses Bringing Youth into the PCB industry

Publisher Barry Matties is joined by Mitch Altman, creator of TV-B-Gone, a device that can turn off TVs in public, and co-founder of Noisebridge, an educational hackerspace based in San Francisco. In this

interview, they discuss the importance of bringing youth into the PCB industry and how Noisebridge has inspired people of all ages to get started creating their own electronics.

Global Impact on European PCB Fabrication: EIPC Summer Conference 2017, Day 1

Electronics industry professionals from 13 countries, mainly from Europe and Scandinavia, others from the USA, but some from as far away as India and Japan, gathered in Meriden, the centre of England, for the EIPC Summer Conference.

Innovator Bob Tarzwell Retires from PCB Industry to Focus on New Career in Art

I have known Bob Tarzwell for more than 18 years, since he first called me looking for some help with his company. His first words to me were, "Hi, my name is Bob Tarzwell and I own a shop in Carleton Place, Ontario. I need your help."

All About Flex: Back-Bared Flexible Circuits

Back-bared pad flexible circuits are a distinctive type of single-sided flexible circuit providing some advantages over more standard circuits. In the printed circuit industry, back-bared pad circuit designs are also referred to as dual-access or reversed bared.

14th Electronic Circuits World Convention

The 14th Electronic Circuits World Convention (ECWC14) started in Seoul to the usual fanfare after the opening ceremonies of KPCA 2017. The ribbon-cutting ceremony was conducted by KPCA's Jung Bong Hong and the representatives of the other WECC members.

Eltek Appoints Kathy Nargi-Toth as President of Eltek USA Inc.

Eltek Ltd., a global manufacturer and supplier of technologically advanced solutions in the field of printed circuit boards, has named Kathy Nargi-Toth as president of Eltek USA Inc., the company's US subsidiary, effective June 5, 2017.

SPECIAL COVERAGE



IMPACT 2017

IPC IMPACT Washington, D.C. – May 1 - 3



image: Martin Falbisoner - Wikimedia

IMPACT Washington, D.C. 2017: You Had to Be There!

Introduction by Patty Goldman

At every opportunity, I made it a point to tell everyone I came across that this was the year to attend IPC's IMPACT event in Washington, D.C.—and I was right. This was the year, as you will learn while reading what your colleagues who attended had to say. Apparently, the new administration managed to very quickly spread the word throughout the many government departments that manufacturing is a good thing—and it's about time.



U.S. senators and representatives, along with their staffs, seem to be scheduled very tightly with lunch often skipped to squeeze in more meetings with constituents and time on the congressional floors. Ditto for the numerous government bureaucrats (the non-political appointees who run the myriad departments). Despite that, IPC's Washington contingent managed to put together an outstanding program of speakers and meetings with the most significant departments of greatest interest to our industry. These included the Departments of Education, Defense and Commerce; the EPA, the White House, and numerous senators and congressmen. While occasionally staffers were the ones we met, more often it was the actual official—like Scott Pruitt, the new head of the EPA. (What? Talking with people from electronics manufacturing, one of the most heavily regulated industries and yeah, once upon a time, polluters? That never happened before.)

All in all, it was a very uplifting, exciting 2+ days, as anyone who attended will tell you and as you will read in this special section. Every person who spoke to us and with us had the same message: Tell us what you need. Tell

us how we can help you. Business and manufacturing is now respected as more and more people (inside and outside the government) come to the realization that real jobs are not created by government but by businesses and especially small businesses just like yours. We are no longer the enemy and no longer looked down upon. Our thoughts, opinions, and needs are being recognized.

Sorry you didn't go? You should be—it was truly a golden opportunity. But there are still things you can do. You can talk with your congressional representatives, you can send in comments to IPC, you can ask IPC to help you schedule site visits by your representatives, and you can visit government websites and learn more. I know dealing with government officials is often distasteful, but now is the time to make the leap and do it.

Of course, I talked with as many of our group as I could while at IMPACT. But this time I was also able to interview Congressman Bill Johnson (R-OH) from Ohio, who spoke at the Monday night kick-off dinner. Congressman Johnson is a true champion of our industry, in fact IPC presented him with an award at last year's IMPACT meeting. This was a great way to kick things off, as his words were all encouraging. Washington is not like what you read in the papers or see on TV.

I have put all the interviews in order so you can feel the progression through the meetings and events. I was not able to speak and record Congressman Johnson until a few weeks after the event, so I have placed him last in the lineup, but his remarks were very similar to what we heard then. **PCBDESIGN**

IMPACT INTERVIEWS

Brad Heath VirTex

Near the end of the first full day of meetings I got a chance to talk with Brad Heath, president and CEO of the EMS company VirTex.

Patty Goldman: Brad, I understand this is your first IMPACT event. At the end of our first full day, what are your impressions?

Brad Heath: It's like drinking from a fire hose. It's a full day, with full sessions. Just very comprehensive.

Goldman: What did you think of this morning's speakers?

Heath: I thought they were great. They addressed all the different areas that really impact what we're doing. We had discussions with the Department of Education, the Department of Commerce, and the Department of Defense. It was truly impactful.

Goldman: I was impressed because they all said, "We need to hear from you." Every one of them said, "We want to hear from you. Here's what we can do. Here's how you can contact us."

Heath: We heard the same thing up at the EPA, where they said, "We need to make stuff move faster." We tell them the problem and they say, "Why did we do that? We need to consider why we put this regulation in place." If it doesn't impact [the environment], if it doesn't change anything, but you spend

a lot of time and effort doing paperwork for it, that doesn't make sense. It should only be applied to the people who need to go do it. For one example, they took the reporting level from

25,000 pounds down to 100 pounds. All types of people must report now, who didn't before.

They're looking at, "How can we do it differently?" Again, I hadn't been here before, but I've been really surprised by how receptive people from the different departments were—wanting to hear what the industry has to say, and wanting to understand our concerns, our needs, and how they can make a difference to help us create more jobs.

Goldman: I can understand a little bit better this morning why they were working with us, but with the EPA there certainly has been an adversarial attitude in the past.

Heath: You bet. What I've been told is that since the new administration came in, the time to get a meeting, the willingness to take meetings, and the willingness to do things, listen and move stuff forward, is just remarkably different.

Goldman: You know, I told a lot of people, "This is the year to go to IMPACT." This is the best opportunity to get our message across, with everybody so willing to listen, and almost begging for information.

Heath: Right. They're saying, "Here's my email, if you have ideas send me this information. We don't know enough about this. You need to send us the information you have so we can look at what we can do about it."

Goldman: I wanted to ask the fellow from commerce, if it made a difference to hear from individuals versus, say, IPC representing everybody. IPC represents the whole industry, but does it make a difference to hear from individuals? My guess is yes. The more individuals they hear from, the more companies they hear from and the bigger the impact.

Heath: I would guess that's probably especially true if they start hearing the same patterns and the same trends over and over from different individuals. Even though most of us in



Brad Heath

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Scott Pruitt (left) greets Shane Whiteside (right).

the industry are doing similar things—companies are different sizes, in different locations—but the headaches we’re dealing with are pretty much the same, like workforce development, skills gap, over-regulation, taxes, healthcare, all those things.

Goldman: Hearing it from all over the country has got to make an impression.

Heath: Yes. My guess is it’s not the first time they’ve heard any of these issues pop up. They probably would hear it as they talk to other industries as well.

IPC will be presenting two awards tonight to senators.

Goldman: Excellent. We’ll have two people from the Senate hearing from us and we’ll be hearing from them. It’s really a two-way street. You pick up a lot from them and we learn their views and a little inside info on the workings on the Hill.

Heath: Then tomorrow we’re going to head to the Hill. Go pound the message into the Senate, I guess. We’ll have some group sessions and then I’ll stay over tomorrow afternoon and I’ll have some meetings with individuals from Texas and Wisconsin, which is where we have our facilities.

Goldman: You’ll be able to speak with both. That’s wonderful.

Heath: That’s the hope. That’s what they (IPC staff) are trying to get set up.

Goldman: You can imagine all the other industry groups that are also pulling at them, which has got to make it tough for scheduling. That’s why we don’t always get to speak to the senators and representatives themselves.

Heath: That’s so true. But it’s amazing when you get them out into your facilities. Over the last four or five months now, we’ve had the staffers from several of our Congressmen’s office come through our Texas and Wisconsin facilities. We had Congressman Michael McCaul come through the Austin facility. That was great—we’re getting in front of them. When they come through and look at it they’re saying, “We had no idea this is what electronics manufacturing was like.” They had no clue.

Goldman: It’s possible they’ve never been in manufacturing facility at all. They think it’s going to be dirty and smelly and rough; manufacturing is a dirty word to them, I suppose.

Heath: Well, they see the pictures of the facilities where people are putting stuff down by hand. That’s what they think you’re doing.



Alexander Gray (right), special assistant to the president, with John Mitchell (left).

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Goldman: It's nice to show them something different.

Heath: But in manufacturing there's a big cross-section. It's Anglo, it's Hispanics, it's Asians, it's African-Americans, it's Indians, you name it. There's probably no broader cross-section of a workforce than the manufacturing workforce. It's extremely diverse. It's diverse in terms of age. It's diverse in terms of gender. It's diverse in terms of ethnicity. You name it, it's there in manufacturing.

Goldman: That's true—and manufacturing is a very broad term itself. It's ranges from somebody doing the same thing repeatedly to people who push buttons and oversee things being built. Big things happen. Anything else come to mind here?

Heath: Looking forward to tonight and Day Two. For as busy as today was, I'd just as soon go to my bed tonight, but I'm going to the dinner.

Goldman: Oh, you definitely want to go to dinner because there will be two senators who will be worth listening to. You want to hear from more than just your own Congressmen.

Heath: A day like this will wear you out, but it's worth doing. Somebody has got to do it.

Goldman: It is definitely worth it. These people seem to run from one thing to the other, though. Apparently, they're very tightly scheduled. They've got no extra time.

Heath: They seem to run from one appointment to another—and they do this every day.

Goldman: No wonder it's difficult to get things scheduled. IPC did a fantastic job getting people from Education, Commerce and DOD this morning and then the top guy at EPA and staffers from Pence's office this afternoon.

Heath: They did. It's a great town here [Washington, D.C.].

Goldman: Thank you so much for your time, Brad.

Heath: You bet. Absolutely. **PCBDISEIGN**

Mikel Williams Targus

After meetings all day Tuesday, there was an awards dinner that evening. IPC presented awards to two senators. Before we got started, I chatted a few minutes with Mikel Williams, president and CEO of Targus.

Patty Goldman: Mikel, we've listened to a lot of speakers today, and I understand you guys had great afternoon. Tell me about your impressions.

Williams: Yes, we did and I have several. First, it seems as though with every year, IPC's IMPACT days get better and better. We're generally known as a standards organization. We're now gaining footing in public affairs, coming to Washington and trying to weigh in on public policy. The early days were a little rough; now we're much better. The staff does a great job organizing it, and we get great meetings.

It's clear that the administration is still settling in, but in fact, I had a little side meeting with somebody from the foreign affairs committee between the dinner here and the last one with Vice President Pence's staff, and I said, "You know, for the first time in a number of years you go into these meetings and you're not being treated like a bad, guilty business guy com-



Mikel Williams

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ing in.” This trip, the people we met with know we care about environmental and labor issues and things like that, which of course we do, and they’re actually trying to help us also improve our country’s economy and our businesses.

Goldman: And they’re asking for help from us, and information.

Williams: Yes, they want to help do things that will be good for our economy and good for jobs and everything else, so it’s refreshing this year, in that regard, although still early in the new administration’s term. Hopefully, a year from now, we’ll have healthcare, tax reform, and a bunch of other things, if not done, well in hand.

Goldman: I guess the other thing you learn is that nothing happens very fast in Washington—fortunately and unfortunately.

Williams: That’s true. Sometimes, getting it done in a hurry is not getting it done right.

Goldman: Of the speakers this morning, is there anybody in particular that stood out to you?

Williams: I thought all of them were good. I enjoyed Congressman Bill Johnson (R-OH) at dinner last night.

Goldman: He’s great to listen to.



Earl Comstock (left), Office of Policy & Strategic Planning, and Bhawmesh Mathur (right) of Creation Technologies.

Williams: He’s funny and yet also insightful and committed to our country. I remember calling on him when he had just won his first term, and I’ll say, as with IPC developing its presence and skills over time, so has he. He has done a very good job, and he is a very good spokesman for many of our causes. I’m happy to have him involved with our program and support us by coming out like that.

Goldman: Yes, he’s really supporting us. Mikel, thank you for the quick chat.

Williams: Thank you. **PCBDESIGN**

Tony Revier Uyemura

One of the best parts of IMPACT for me is meeting and getting to know people in our industry that I haven’t met before. While hors d’oeuvres were coming around before the Tuesday evening awards dinner, I found a quiet corner to talk with Uyemura USA President and CEO Tony Revier.

Patty Goldman: We’re nearing the end of the first day at IMPACT, and I want to get your impression of today, Tony.

Revier: I think it’s been terrific. This is my third event. I didn’t get to come last year; I had some other customer issues, but of the three I’ve come to, this is by far the best. This is really a great meeting, and I’ve met a lot of folks. Last night was great, listening and talking with congressman Bill Johnson from Ohio.

Goldman: Yes, he’s the best, one of our industry’s champions.

Revier: I’ve been coming to the Hill for about 20 years, not just with IPC, but also on the metal finishing industry, with the National As-

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sociation for Surface Finishing (NASF). We do a legislative day once a year too. In all the years that I've come, it's nice now that people here are talking about manufacturing.

Goldman: Do you feel that is new this year?

Revier: Well, it's been coming, but now of course they're embracing it big time. We saw that certainly with having a chance to meet with Scott Pruitt, the head of the EPA. He's somebody we can talk to now.

Goldman: He's asking you for feedback, right? That must be new.

Revier: Absolutely. Before that, I can tell you, we're in a specialty chemical industry, so we know those guys quite well. When you talked about chemicals with those people in the past, they were not on the favorable side of things. You can see from Scott's point of view, he's very open to working with manufacturing, with industry, and really understanding what it is that we're trying to do and accomplish. One of those things that are holding us back is regulation and over-regulation. The problem is that so many of the people out there, regulators, media, etc., have no clue what we do and that we know how to handle the chemicals we use.

Goldman: We already have good regulations, but they keep upping the game.

Revier: Right, and if you look at our industry as a whole, near and dear to our heart is chemical processing, whether it's the copper plating process, electroless copper plating, ENIG, ENEPIG, and everything related to that; we're in the chemical processing business. We're highly regulated on many different fronts, not just by the EPA. We're now involved with the DEA because of the sodium hypophosphite issues, which just kind of drives us crazy. Mainly because what we're selling is a liquid containing the sodium hypo, and they're all about the hypo material itself. We're not selling the raw hypo. We're

selling a mixture. In their infinite wisdom, when I talk to senior level people at the DEA, they agree with us that we should not have been included in the 2011 revamp of the ruling, but then they laugh and say, "But you are. Live with it."



Tony Revier

Goldman: They don't quite understand the additional burden. That means nothing to them.

Revier: No, they have no idea. I have to register all my facilities. If I have a warehouse (which has the product containing hypo), and no matter where in the U.S., I have to register with the DEA, get permits, and pay an annual fee. Ah, it's always about the money, right? Then, of course, we have TSCA rules and we have OSHA regulations, but it seems to me now, though, we have an administration that is willing to really talk about these things and how to possibly change things. How can we relieve some of the unnecessary burden on industry?

Goldman: Hopefully how we can improve it, without compromising any of the important things.

Revier: We always say, "Look, our families live in these areas. We've got children. We've got grandchildren, and we want to be able to provide clean air or clean water." I mean, it's just absurd when they look at it and say, "Oh, you guys, you just want to roll things back and pollute." We've made such great progress, and a lot of the things that have happened on wastewater treatment and cleaning up the environment is because our industry has been very proactive in that stance.

Goldman: I was really impressed by Kim Ford this morning. She was so enthusiastic.

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Revier: I was interested in listening to the new EPA chief, Scott Pruitt, but I was certainly impressed at beginning of the meeting with Kim Ford. I didn't expect much, but the way she went around to meet everybody at the beginning of her presentation, was cool.

Goldman: She shook everybody's hand and introduced herself to everyone present. Such enthusiasm, too.

Revier: She said really positive things about trying to understand our skill needs. What do we need from an educational standpoint? How do we get people where they need to be? It was very refreshing. She seemed very genuine about what she was talking about.

Goldman: Yes, her focus was: "Tell us what you need; let us help you." The website she talked about, the Perkins Collaborative Resource Network (PCRN), is easily found on Google. It popped right up for me (cte.ed.gov). There is a lot of useful information on it.

Revier: Yes, it seemed very interesting. You know, by and large our industry is all about technology. If you look at our company, we're a more international corporation, and I've been with UIC now for 29 years. The reason I came here in the very beginning was about technology. Our parent company is in Japan. We still have, even to this day, 70 people involved in research and development. We just invested about \$70 million in a brand new central research facility in Hirakata, Japan. We are totally committed to technology for the future. I mean, it's all about what we do.

Goldman: It's in your blood, so to speak.

Revier: And it's what sets us apart too. We're all about technology. Where's it going? What are the customer needs? How do we advance the industry? At the same time, back in 1997, we made the commitment to set up our own technical development center in Southern Con-



Robert Irie (right), Office of Undersecretary of Defense, with John Mitchell.

necticut. That's our UIC tech center, where we can support customers with failure analysis and ordinary samples. We do pilot plating there as well and some development work. We are excited that we just recently received our first UIC developed patent. Also, we do some very precise, small-scale production there. Then we have blending facilities in other areas of North America.

Goldman: What made you choose Connecticut?

Revier: In 1992, we took over the precious metal plating product line from a company called Degussa. At that time, we had not been in that area of the plating industry. We had not been in precious metals, but we had a long relationship on several different avenues with Degussa, which is now called Umicore. We took on that challenge in '92, and we picked up a number of great people and a facility in Connecticut.

Later, we decided that we really needed to do more than that. We decided to build our own facility in Southington. We built it from the ground up; it's a 45,000 square-foot facility where we can do everything we really need

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to do, and we can expand it too, if the business warrants it.

Goldman: Well, we're looking forward to a lovely evening here, I think. How was the afternoon? The EPA was great, but how about everything else?

Revier: The EPA was great. Then our other meeting was near the White House with some very strategic people that work for President Trump. It just kind of continued the excitement with people that are engaged in manufacturing and regulatory issues that affect what we're doing. It's very clear from meeting with those guys this afternoon that they're committed to listening to our issues and acting on them.

Goldman: We'll see how that action part works.

Revier: We'll see. I think the challenge obviously for President Trump; he said it was a swamp, but I think that he's finding out that it's not like running a business where you can get things done.

Goldman: Exactly. I mean, you're the boss, but you're not the boss.

Revier: But you got to navigate the way.

Goldman: Like they said this morning, nothing really happens that fast in Washington.

Revier: No, and I'm sure it's frustrating for him.

Goldman: Yes, because you're right. He's used to doing things fast.

Revier: At the same time, he's learning his way; the exciting part of it is he's putting together the right people to get the job done. I think Mike Pence as his VP was a perfect choice, and I think they're a good pair. They work together as a great team. They seem to be very symbiotic that way. I hope that continues.

Goldman: Well, thanks Tony. Maybe we'll get a chance to talk again. Right now, we're going to eat our hors d'oeuvres.

Revier: Absolutely. **PCBDESIGN**

Shane Whiteside Summit Interconnect

During Tuesday night's dinner I also had a chance to talk with Shane Whiteside, Summit Interconnect's president and CEO.

Goldman: Shane, it's good to see you. Is this your first time at IMPACT?

Whiteside: This is my first IMPACT. I've missed it in previous years, but I'm very pleased to be here.

Goldman: Tell me what you've learned in the past day and a half, since arriving.

Whiteside: I've been impressed with how IPC has organized a very effective event, and I think that's not only my impression, but other attendees as well. The people that we've met today reflect the influence that IPC has gained in this town, from EPA administrator Scott Pruitt to one of Vice President Pence's senior advisors, Darius Meeks. It's just an incredible lineup here today and I think what was really gratifying to me is understanding how much the new administration is aligned with a promoting a very positive industrial policy.

Goldman: It seems everybody is aligning with that, shall we say, and quickly.

Whiteside: There is a lot of enthusiasm with respect to the potential resurgence of U.S. manu-



Shane Whiteside

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facturing. I think that a lot of the people that we met today represent not only new faces, but a new approach as well. The tone is much different, from what I understand, from previous eras. And we're very much looking forward to the support and the commitments that were made here today to create positive change in our industry.

Goldman: I'm going to put you on the spot a little bit. This morning, a couple of people, including Kim Ford and Robert Irie from the Department of Defense said, "Get back to us with information—with your needs." Are you going to act on anything?

Whiteside: I think Kim Ford's challenge was to get back to her department with what sort of educational needs we can articulate to IPC and their membership can support, or she can support. I think IPC has increased their focus on members' training needs and is in the best position to respond to Ms. Ford, we will continue to work with IPC in this area. And with the DoD's request, they've spent a lot of time assessing the electronics supply chain in the U.S. and they have a very pragmatic assessment of where the risks are in the supply chain. Where I am concerned about the supply chain is in bare printed circuit board manufacturing, and unfortunately the government's assessment is still "TBD." This is due to a 2016 Department of Commerce study that will take until November 2017 to get the results for and allow anyone to really develop an opinion on how to go forward.

Goldman: They presented some preliminary information in February at IPC's Executive Forum.

Whiteside: Yes, I saw that at the IPC APEX EXPO Executive Forum, but it was very preliminary and nobody could really tell us, "What does this mean? What are you going to do with this?" My message that I was able to communicate to some of the people we met today was that some of the most advanced printed circuit board technology being produced in the world today is not



Shane Whiteside and Phil Titterton (TTM).

produced in the United States, whether from a circuit density HDI standpoint, or materials—a lot of the expertise that exists in the world to create the world's most advanced printed circuit boards resides in China. It doesn't reside in the U.S.

If the amount of technology that exists in today's smartphone needs to be immediately employed in the next generation of weapon systems, communication systems for defense, etc., you would need to take the most advanced pitch BGA device and pin that out on a circuit board in today's world, and build that circuit board in the United States. Currently, you can't build that here. We don't have the capital equipment set, we don't have the expertise, and we don't have the materials know-how, because for the past 15 years it's all been completely invested in outside of the United States. I've conveyed that message a few times here today, and I hope that that message has been received.

Goldman: Several people today said that things don't happen quickly. But as we know, in our industry things happen awfully fast. Much faster than they do in this town.

Whiteside: From my experience, that's usually due to changes in commercial business, whether some fall-down somewhere or something unanticipated happens. I don't know if anything is going to happen quickly inside the Defense Industrial Base that is part of the normal course

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of business, particularly in Washington, DC. I think it's just always going to be slow change. I'm hopeful that it can be faster than it has been, but even if everybody were to figure everything out in the next week with the budget—we're still in a stub-period with this—I don't know if it's a continuing resolution or whatever this thing is that we're at, but we don't have a full budget yet. Even if everything were to be figured out, by the time that funding and everything flows down to the component level in our supply chain, I don't look for anything to happen very soon.

Goldman: Quickly on another subject, I keep hearing about the shortage of copper; is that hitting you, and are you watching it?

Whiteside: The shortage of copper foil for PCB laminate is something that is affecting the industry globally, but much more so in Asia as I understand it. If it endures longer term I would look for the domestic impacts to become more severe.

Goldman: Thanks for your time, Shane.

Whiteside: Yes, thank you. I appreciate the opportunity to speak with you. **PCBDISEIGN**

Dave Raby STI Electronics

After dinner concluded and we were returning to the hotel, I spoke with Dave Raby, president and CEO of STI Electronics.

Patty Goldman: Dave, it's good to see you again. How was your day at IMPACT?

Dave Raby: Today has been great. I didn't know what to expect, judging from the ongoing news coverage of how horrible things are in D.C. and all that. But we found a whole different attitude:

People were happy to see us! They wanted to know what they could do for us. They were receptive to ideas. They wanted input.

Goldman: And it wasn't a forced thing. They were genuinely interested, though of course nothing happens overnight, as they said.

Raby: That is true, and we'll see what the results are. Nothing we said today is going to change a law tomorrow, but I felt good about the people we visited and those who spoke with us.

Goldman: Me too. We started out with Congressman Bill Johnson (R-OH) last night, a champion for our industry. He makes you feel good about your country and that things are not so bad in Congress as we hear.

Raby: Yes. I like him.

Goldman: Does anyone in particular stand out for you today?

Raby: They were all impressive, they really were. It was great to meet with Scott Pruitt who is the administrator of the EPA and a member of President Trump's cabinet. We also met with Daris Meeks who is Deputy Assistant to the President and Director of Domestic Policy for Vice President Pence. It was hard not to be overwhelmed by those offices and all of the surroundings.

Personally, I was most impressed by Alexander Gray who is Special Assistant to the President and Director of the White House Domestic Policy. He had a true understanding of our industry and the issues we face and was committed to finding solutions. He understood how a supply chain and business works. I had not experienced that before or least not from someone who could articulate their understanding. He had an appreciation for every step along the way and was interested in how the government could help or



Dave Raby

IMPACT Interviews

stay out of the way. He asked us to email him if we were facing a reduction in force due to a government regulation change. That impressed me.

Goldman: You've gone to more of these IMPACT events than I have, but it seems that we're seeing perhaps a higher level of people within the administrations.

Raby: We are and, continuing with the theme, they really did seem genuinely interested in what we had to say.

EPA Administrator Pruitt knew some of what we were talking about but would look to his deputy for help on other issues and ask IPC to send him more information on others. IPC has done a lot of work on environmental issues but this was our first time to get to meet with the Administrator and he seemed genuinely happy to see us and get our input. We were not treated like we were the enemy.

Mr. Meeks was also very welcoming. He was receptive to IPC's position and stressed his mandate to help us create jobs (everyone we talked with seemed to understand that government does not create jobs) and had a particular interest in high-tech and space which are both near and dear to my heart.

Goldman: I was impressed by Kim Ford, the deputy assistant secretary for Education, and her enthusiasm and interest in what we do and

how her department can help.

Raby: Yes, she was great. It was funny. John [Mitchell] was trying to get the meeting started and she was going around the room shaking hands with everybody and introducing herself. She was just bubbling and seemed so excited to be with us. She was in that job during the last administration, but she didn't come speak to us and we didn't see her. I may be wrong on this but my impression was she seemed to have been freed to do her job and was very excited at the prospect. She understood what was going on in our industry regarding skills gaps and was quick to say (even being from the U.S. Department of Education) that not everyone needs to go to college. She also recognized that some of that skills gap is a basic education of what is expected from an employee.

Goldman: And as she said, part of it is Johnny coming to work every day.

Raby: Yes. Well, that's the thing you know. "Do I really have to be there at 8:00 every morning?" "Yeah you do." I was impressed with everybody we met today. What really stands out in my mind though is their enthusiasm, willingness to listen and genuine interest in finding solutions for our industry.

Goldman: I wonder, the administration has been in office about a hundred days, as they keep telling us. Did these people and departments really change that quickly? Or was it like this before and it was just suppressed?

Raby: I don't know the answer to that. It would be guessing on my part, because we didn't meet with these people before. Everyone we met with today seemed to be committed to working with industry to solve the problems we have, and the status quo in many cases is the problem.

Goldman: And I'm sure we wouldn't have gotten to talk with the head of the EPA last year. I don't know, but my guess is no.



IMPACT Interviews

Raby: There's a hundred reasons or more as to why you don't get to meet somebody because of all the schedules and the changes up here. I don't know how IPC put a schedule together but they do an amazing job.

Goldman: I don't either, and maintain it. It's amazing how everyone down here seems to run from one thing to the other. But they did make time to speak to us.

Raby: They did, and then personally, I always enjoy hanging out with all the other execs who are here. Some of them I know from previous years or from other places. Some of them I just met this morning or last night at dinner for the first time. But it's always nice to hang out with somebody in a similar position because you have the same issues all the time, and it's just always good to hear how they think of things. That helps me tremendously, whether I really get a solution from them or I just see somebody else survived it.

Goldman: There's a light at the end of the tunnel. Anything else you'd like to discuss?

Raby: I appreciate you being here, because this is good for our industry. It really is. The things that we're trying to accomplish are good for all of us, and you being here, your people supporting you being here, is supporting our industry.

Goldman: Well that's our motto, you know, "Good for the Industry." I believe everyone in our company is committed to this industry. It's our life. I guess a lot of people might be sorry that they aren't here; this was the opportunity this year. Then tomorrow, do you have more to come?

Raby: Tomorrow we're meeting with three senators in the morning and then I'm meeting with two representatives and a senator from my home state.

Goldman: That's a lot of congress people, all in one day.

Raby: The first three in the morning I don't know, but I'm sure I'm going to learn a lot. The three in the afternoon represent me, so I'm happy to get to talk with them and look forward to that.

Goldman: Do you invite them to your facility?

Raby: Yes, two of the three have been to our facility and both know us well. It's our representative and then the representative from the district just south of us where some of our workers live. The other one is a new senator that has only been in office since February. He is the replacement for Senator Sessions, who became the Attorney General. I have not had a chance to meet him, but I'm looking forward to that tomorrow.

Goldman: You can extend an invitation to visit your company.

Raby: I absolutely will.

Goldman: And IPC can help set that up. Dave, it's been great talking with you, as always.

Raby: Thank you. Thanks for all you do. **PCBDISEIGN**

Suzy Sterner SAIC

While my discussion Wednesday morning with SAIC's VP of Government Affairs Suzy Sterner was brief, it was to the point and an excellent testimony to the success of this year's IMPACT event. Suzy has been in the defense industry for quite a while, making her comments particularly significant.

Patty Goldman: Suzy, you've been to IMPACT before. After this second full day, what is your impression of the speakers and meetings that were held yesterday?

IMPACT Interviews



Suzy Sterner

Suzy Sterner: Yesterday was very impressive with the level of people from the administration that we had an opportunity to meet with, to the insights they shared with us.

Goldman: I understand you're quite involved in the defense industry. What are your thoughts on what Robert Irie (from the Office of the Undersecretary of Defense for Acquisition, Technology and Logistics) had to say?

Sterner: First, he was exactly the right person to be here because he handles all the electronics industrial base issues within DoD. He was very forthright on what he needs to help continue to support the Executive Agent for Printed Circuit Boards and Interconnection Technology sponsored by the Navy in Crane (Indiana). They want input from us and they want a dialogue.

Goldman: Is that a new thing, based on your previous experience here?

Sterner: This is my second IMPACT, but I've worked in Washington for more than 25 years. It's a little bit more open than it was in the previous Administration. We had the right people here, especially considering that not all the political positions have been filled. When political positions weren't available, we had very high senior-level civil servants who will be there when the new political person comes in, and they made it clear they will still be willing to work with us.

Goldman: That's great. I hear the meeting with the EPA was good yesterday.

Sterner: It was very good. It was a completely different—I was going to say environment, which sounds ironic to say about the EPA—but

it was a very different atmosphere than we've dealt with in the past. Administrator Pruitt was welcoming and interested in what we had to say; he took notes and he gave assignments for follow-up to his staff member assisting him. You can't ask for more than that.

Goldman: And there was a meeting at the White House also?

Sterner: Yes, we met with high-level staff from Vice President Pence's office. That was very worthwhile. In addition to defense, I cover space issues, and we got insights into what they're doing with the National Space Council. It's been a very productive day.

Goldman: Yes. Everyone seemed impressed with Kim Ford yesterday morning. She was very enthusiastic and welcoming as you said.

Sterner: Kim Ford was very impressive. They're really inviting industry to engage, and this was a great opportunity to do that.

Goldman: Yes. I think everybody was overjoyed about all of that.

Sterner: They should be. It was a highly productive day.

Goldman: Suzy, thanks so much for your input.

Sterner: Thank you. **PCBDISEIGN**



IMPACT Interviews

Mark Wolfe John Deere Electronic Solutions

An interesting participant at IMPACT was Mark Wolfe, director of supply management with John Deere Electronic Solutions. We spoke briefly Wednesday morning before things got started.

Patty Goldman: It's nice to meet you, Mark. We're starting the second full day of IMPACT, and I thought it would be good to get your perspective. First, you told me yesterday that the majority of your business is for John Deere, but you also assemble for other companies as well.

Mark Wolfe: Correct. Most of our business is for John Deere. We do have a component that's external and commercial with other OEMs with similar needs to John Deere, but are non-competing. They give us the opportunity to keep our competitiveness outside of being a captive supplier.

Goldman: So how did you feel about Monday night and yesterday? Has this been helpful to you?

Wolfe: It's been helpful. I've enjoyed it. I think it's been refreshing. I haven't been here the last few years, but certainly there was an undertone of largely positive change that was coming out of the different meetings and discussions we've had so far. There seemed to be less rhetoric. I guess time will tell if the actions follow through on things, but from the attitude of the people we met with, it was quite positive overall.

Goldman: The attitude was very positive. What did you hope to learn or gain from coming here?

Wolfe: I hoped to be a little more connected to where our new leadership for the country is headed, but at the same time I'm a long-stand-

ing IPC member and participant. So it's also as much as anything to support the efforts of IPC and all of the members.

Goldman: As far as you're concerned, that worked out this time.

Wolfe: Yes, I believe so.

Goldman: Good to hear. Thanks for your thoughts.

Wolfe: Thank you very much. **PCBDISEIGN**



Mark Wolfe

Fern Abrams IPC

I wanted to get the inside story on the meeting with EPA that occurred Tuesday afternoon and who better to talk with than IPC's Fern Abrams. I was able to chat with her Wednesday morning.

Patty Goldman: Fern, as director of regulatory affairs for IPC, you are deeply involved with IMPACT, on the environmental end of things, especially. Tell me about yesterday.

Fern Abrams: We had a meeting with EPA Administrator Scott Pruitt, and his Deputy Chief of Staff for Policy, Byron Brown. I think I would speak accurately for everyone if I say it was an excellent meeting. I heard one of our attendees say that it was our best meeting of the day—but I'm biased.

Goldman: Well, the fact that you spoke with the top person there says a whole lot.

Abrams: In a career of almost 20 years working in environmental policy, this is the third EPA

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IMPACT Interviews

administrator I've had the privilege to meet, and I would say this was just a delightful meeting.

Goldman: Wonderful. What did he have to say?

Abrams: IPC's president, John Mitchell, kicked off the meeting by telling the administrator about IPC, what we do, the members we represent, and also letting the administrator know that we had a proud history of working with the EPA. He talked a little bit about our involvement in the Design for the Environment program and mentioned that one of our staff, David Bergman, had been recognized by the EPA for his work in helping the industry transition out of ozone-depleting chemicals, but that was a long time ago, quite frankly. We are looking forward to working with this administration on cooperative environmental protection that is based on science and is cost-effective.

Goldman: Are there any hot buttons right now?

Abrams: We talked about three. The first is the recycling of byproducts and what I would say is the unfair treatment of them under the Toxic Substances Control Act, where industry has worked very diligently to find beneficial reuses of byproducts. But now under TSCA they're treated as new chemicals and so companies that choose to recycle them have the burden of reporting and the liability of that complicated reporting if they don't get it just right. Whereas, if they'd chosen to simply dispose of it they would have neither the TSCA reporting nor the liability. This has been an issue for our members for some time. Since the mid-2000s we tried to work with EPA to address this and they've been rather intransigent. That's why we worked with Congress. You

heard Congressman Bill Johnson (R-OH) speak two nights ago about this issue and you heard it mentioned last night, both by Mr. Shimkus (R-IL) and Mr. Reed (R-NY), both of whom we worked with.

Under the legislation in the Lautenberg Chemical Safety Act that was signed last summer, the EPA is required to conduct a negotiated rule-making. That's where all parties involved sit down—EPA, industry, environmental groups, recyclers, all get a seat at the table—and we try to find common ground. The EPA will take that input and then, under the law, propose a rule in three years and finalize a rule in three-and-a-half years. We talked about that, and the process is already underway. The first public meeting will be next week and IPC will be represented by myself and Bret Bruhn. Bret is the environmental operations manager with TTM, in Oregon. He also chairs IPC's EHS committee.

We mentioned that to the administrator and said we were looking forward to working with him on that. The reason for bringing it up was to reinforce our hope that EPA will be a good faith participant in the negotiated rule-making. In the past, as I've mentioned, they've been somewhat intransigent on this issue. We had many meetings where they'd say they'd do something, agree with us and say it sounds reasonable...

Goldman: And then nothing happens.

Abrams: Exactly. So we're looking forward hopefully to a new attitude, new beginning with this administration. That was the first issue that was raised. The second one is the reporting of lead under the Toxic Release Inventory. It's part of the Emergency Planning and Community Right-To-Know Act. It's purely a reporting exercise. There's no actual environmental protection and as we pointed out to EPA, the reporting threshold is based on used, processed or stored. So a lot of our EMS members, in fact 32% of all companies that reported to TRI, reported zero pounds released. They spend, by EPA's estimate, about \$9,000 per facility. Bhawmesh Mathur,



Fern Abrams

IMPACT Interviews

President of Creation Technologies and Chair of the IPC GR Committee, said he has six facilities that all filed that they had reported zero pounds and they must do that every year.

Goldman: That's a substantial cost.

Abrams: He said he thinks that cost is much higher, that it's underestimated. In any case, as the administrator said, "So every year you do this to tell us every year that you release no pounds?" We said, "Yes." He noted that 100 pounds was a pretty low threshold. We said it used to be 25,000 pounds until EPA lowered it, and he asked what the basis was for that.

Goldman: There was none.

Abrams: Well, I think I might have gotten the quote of the day when I said "junk science." More accurately, it was inappropriate or manipulated science, but junk science just makes a much better sound bite. He said he'd look into that. Then Phil Titterton of TTM raised a third issue, which is the RCRA Hazardous Waste Generators Rule. These are the requirements for companies that generate hazardous waste on their facility—often very small amounts. Most of our members are very small quantity generators or small generators. This was, I should say, a rule that was issued by EPA in November 2016 to consolidate 40 years of generator requirements that were here, there and everywhere in the regulations. Most of the rule we like. It brings clarity. It's much easier to read. But in that reorganization EPA took many of what used to be requirements and put them as conditions of exclusion. Meaning, exclusion from treatment as the most serious of hazardous waste facilities, a hazardous waste treatment storage and disposal facility (TSDF), which requires an operating permit. This is a very serious thing.



Goldman: That is serious.

Abrams: Well, these are the companies normally that take in waste, store it, and treat it.

Goldman: They're separate from generators, right?

Abrams: They should be. However, the way that this was organized, if you fail any of these conditions of exclusion, you've violated your conditions and EPA can enforce against you as

an illegal treatment, storage and disposal facility that's not meeting all these things and is unpermitted. It could be as simple as the label on a drum. Instead of saying "Hazardous waste June 2017," maybe you said, "Waste/Hazardous."

This is a very serious liability matter. We joined eight other trade associations in filing a suit against the EPA on this issue in January, but we would like very much not to litigate. We filed to preserve our legal options, but as we told the administrator yesterday, we would like very much to work with the EPA on a new rule that addresses just this small part of the rule.

Those were the three issues that we raised during the meeting. The administrator [Scott Pruitt] was responsive on all of them and talked for a bit.

Goldman: Others said he made assignments to staff?

Abrams: Just to look into it. That would be accurate. He talked a bit just about his perspective and added that you can have a business environment and still protect the environment. He talked a little bit about America's history and growth and how we've managed to grow and clean up the environment at the same time. It was just very refreshing.

Goldman: What's next on the environmental front?

IMPACT Interviews



Everett Frank, Optimum Design Associates.

Abrams: Recently, as part of their implementation of Executive Order 13777, the EPA has had a series of listening sessions, at which I testified. The small business ombudsman had a meeting last week, April 22 and 23, for small businesses to talk about regulations they'd like to see addressed. Then on Monday [May 1], I spoke at the Office of Chemical Safety and Pollution Prevention. Next week someone else will be representing IPC at the Office of Land and Emergency Management, highlighting that same RCRA issue that we were just talking about. EPA is also taking formal comments, which we'll be submitting by the May 15th deadline.

We will also, of course, follow up with the administrator's staff on these issues. Then next week, we have the first meeting of the committee on the negotiated rule meeting on byproducts. Busy times.

Goldman: I know things don't happen fast. It seems everybody's very busy, and yet I know things take a while to actually happen.

Abrams: That is accurate. To talk about some of these rules on the byproducts issue, we've been working on this issue since 2006.

Goldman: That's more than ten years.

Abrams: Nothing happens overnight.

Goldman: Any other thoughts here today?

Abrams: Well, we've been talking about the administration. Obviously, we have an agenda on the Hill too and the members are meeting with some key legislators right now. You'll probably be interviewing other people on that, I presume.

Goldman: Yes, basically I get pretty general, but great feedback on those. To me, the attitude of the people that have been speaking to us seems so much more positive.

Abrams: I agree. You know, it's the beginning of an administration. Washington is where hopes come to die (laughs). No, that's not fair. Things take a while. Consensus is hard to reach. We have a democracy. It's set up to have debate and let everybody be heard and so nothing is done immediately. I think a new administration comes to town and they're fresh and they're excited, and that's exciting.

Goldman: Apparently, some amount of that has filtered out across the different departments.

Abrams: We've seen that in meetings we've had at the EPA and other agencies. We're excited, we're hopeful, and we're ready to work.

Goldman: Thanks so much for your time. Much appreciated.

Abrams: My pleasure. **PCBDESIGN**

Joe O'Neil
OAA Ventures

Around lunchtime on Wednesday, the second full day, I was able to sit with Joe O'Neil, OAA Ventures. As a veteran of many IMPACT

IMPACT Interviews

meetings, his was a good perspective of the event.

Patty Goldman: Hi, Joe. It's good to see you. I understand you have a consulting firm now. Were you representing a particular company here at IMPACT?

Joe O'Neil: No, we had the entire IPC board of directors here for a board meeting on Monday. We have board members now from Europe, Asia—all over the world. They all came into town and then some of us stayed to support the IMPACT event and go out and kind of spread the word and build a foundation.

In prior years, we've been in different parts of the legislative cycle and had a specific set of bills or language where we could come here and have very definitive asks. I think we were successful then because in prior years it was much like what we're doing in this visit, which is foundational; we are getting our name in front of the freshman senators or congressmen. There are some things that are in play right now. Conflict minerals are in play. Healthcare is very much in play. Tax reform is maybe a little bit further out. But those are things that affect our membership and our voice needs to be in the mix.

Goldman: Might as well get in the beginning, right?

O'Neil: Yes. When there is something important that comes up, we were here supporting them, and now it's their time to support us when we call; they kind of know who we are. Through the year—I remember Capitol Hill Days 15 years ago or more—we've gone from circuit boards that no one could understand to bringing samples and giving them things that they looked at and touched. Now, with that education, I think they are beginning to understand the electronics industry. They understand that our membership ranges from major defense contractors and OEMs, the brand names throughout the world, to the electronic manufacturing services and print-

ed circuit board fabricators to the laminate and chemicals, and all the way through the supply chain.

They have recognition of that and they understand that those 4,000 member companies have a million employees just in the United States, and our training programs train hundreds of thousands of people a year. They see the value of that. For the most part, they are supportive, and hopefully that's going to be reflected in legislation that comes up.

Goldman: I suppose it helps that everything you use any more has electronics in it.

O'Neil: Absolutely. Including the listening devices throughout this town (laughs).

Goldman: So how did you find this morning's sessions? I know there were several meetings.

O'Neil: We had several senate meetings. In past years, we would have maybe one or two senate meetings and a lot over on the congressional side, since we have members in pretty much every district in the United States. The senate meetings were a little harder to get—a little higher level. This morning alone, I think we've had four or five senators and then we got to go over and meet with the rules-setting committee over on the congressional side. And that was very interesting to see how every bill that comes up goes through this small 12-person group.

It was very different to hear that bills come out of committee, but that little body can add or subtract anything they want before it goes to the floor. They had some interesting perspective in terms of how Washington is and how this is going to play itself out. It's a lot of change. It's still early. The talk of the town is still, you know, "the first hundred days" kind of references. We've heard everything from people who are giving the President an A+ to F- and below.



Joe O'Neil

IMPACT Interviews



Joe O'Neil chats with Kim Ford, Deputy Asst. Secretary for Mgmt. and Planning, U.S. Dept. of Education.

Goldman: For the same things, I'm sure!

O'Neil: There's pressure, as I think it probably is with any transition that ever comes out of the gate running. And so the whole town seems to be running. The voice of business is being heard. People are taking meetings. People are actively engaged in conversations. I think that is very promising. And there's hope that the two political parties are going to find a way to work together on some things. One consistent thing is that it's not going to be easy. Both sides are saying that.

Goldman: Well, everybody that we talked with seemed to think that it's a good idea that they should all be talking to each other. And yet...

O'Neil: Yes, it's consistent that both sides are pointing to the other as the part that needs to be changed.

Goldman: "We'd like to work with them, but they don't want to work with us."

O'Neil: And I think that the interesting thing is that's just kind of the way the town works. Things do get done. Things get done every week. Things got done already this week. Things got done last week. And the sensationalism isn't

there when things actually get done. That stuff doesn't get really reported with the same vigor as the gridlock of the fight.

Goldman: You always hear the bad news more than the good news.

O'Neil: Absolutely. And we also had a meeting over at the EPA yesterday with the director, Scott Pruitt. The work the EPA does, they made a big impact over the last few decades on the environment, and I think in the last decade or so it has become more paperwork than advancement. But the new mentality seems to be "we're going to continue to safeguard the environment. We're going to look for every opportunity to do it in a smarter, more streamlined manner; basically, for every new piece of legislation or new rule that gets enacted something has to come off the books." I think that's smart.

Goldman: I've always advocated that, in everything.

O'Neil: There are so many rules and regs, and not just the EPA; the enforcement is almost impossible and non-existent in many cases.

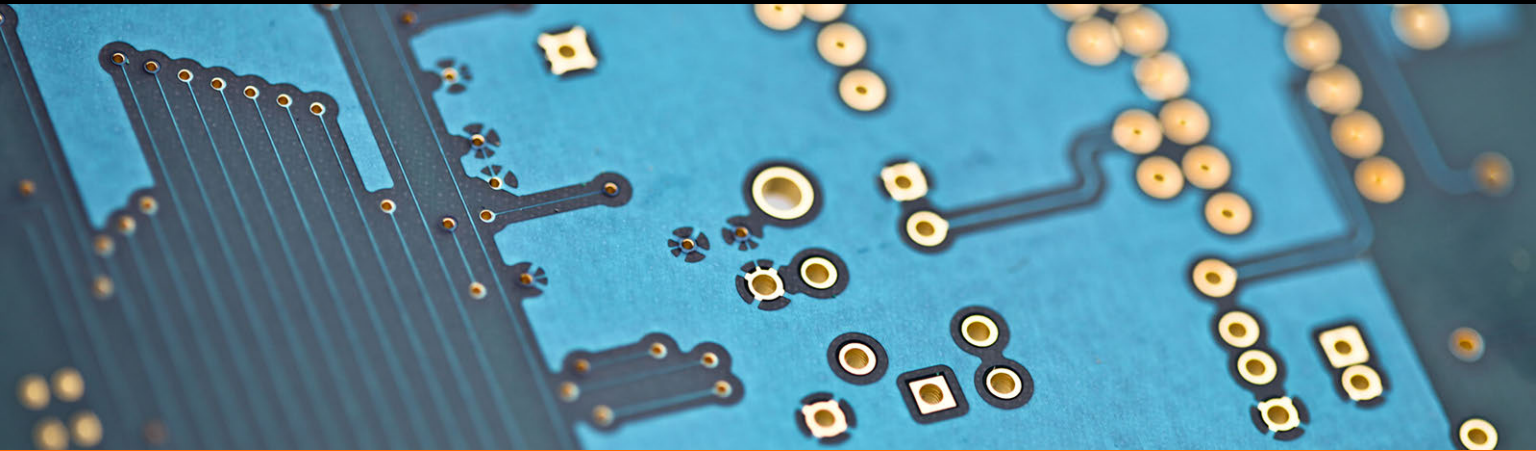
Goldman: And it is sometimes arbitrary, as you know.

O'Neil: Absolutely. I'd much rather have a set of fewer rules and regulations and have them made clear enough that they can be enforced with vigor. Then I think the impact would be greater than the volumes of misunderstood or unknown rules and regs that don't get enforced.

Goldman: Currently, they tend to put more stock in paperwork than in actual work.

O'Neil: Or impact.

Goldman: It's the same with conflict minerals, for as much money as is spent on the paperwork, if that were all somehow channeled to the people being oppressed, wouldn't that be



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more useful? And yet, it's totally non-productive as you know. You spend all that money on producing paperwork and it's gone.

O'Neil: Absolutely, it is a waste. It's interesting; we've made great strides in getting that 1502 [Dodd-Frank Act, Section 1502 on conflict minerals] frozen and the enforcement somewhat curbed, because I don't think anyone is going to stop the implementation of conflict-free. I think the good news is, we didn't come in with a "just get rid of it because we want to buy less expensive things" attitude. We came in with a belief in the intent of the legislation. We believe there's a better way to achieve those means even at the smelter level, and don't make the three-person firm dedicate one of those three people to just doing the paperwork.

Goldman: But they bring up this conflict minerals, but in reality, you need the particular minerals. Our industry needs these minerals. But they seem to say these minerals are by association conflict minerals as opposed to just the ones from a certain area. That's what I seem to hear from the feedback. We need gold. We know that there are other sources, but somehow, they lump it automatically as all gold is a conflict mineral. They say to just stop using it but you can't stop using it.

O'Neil: The tungsten, gold and the tantalum. Those are the minerals that are classified as being conflict-managed. There are some money operations in the DRC [Democratic Republic of Congo] which are following horrific practices that others aren't, and by avoiding the region in total it makes reporting easy, but everyone in the region suffers.

Goldman: Then you'd be getting your gold and tantalum elsewhere.

O'Neil: And even then, you're not sure because a lot of the gold and a lot of the metals that we use, a portion of those are recycled. So they're reclaimed.

Goldman: Do they count that too?

O'Neil: Well, that's part of the challenge, and that's why there's never been an enforcement activity.

Goldman: Well if there were, then there could be a challenge to it. Then whole thing would get knocked down.

O'Neil: Exactly.

Goldman: And so they don't do that. They just hold it over your head all the time.

O'Neil: The town seems to be very open to reworking versus repealing, and so I think reworking Dodd-Frank seems to be something that looks like it's going to get done, especially in the conflict minerals.

Goldman: Well hopefully in a reasonable amount of time. I wish they would regulate the energy industry as tightly as they regulate our industry. Every time I hear about another coal mine superfund site, all that drainage and the underground fires, or another government nuclear energy superfund site, I think, wait a minute...

O'Neil: Where were they then?



Sen. Tammy Duckworth (D-IL) speaks with attendees at IMPACT Washington, DC 2017.

IMPACT Interviews

Goldman: Joe, thanks for your time today. Good to talk with you.

O'Neil: Thank you. Off to the next meeting!
PCBDISEIGN

Anaya Vardya American Standard Circuits

I spoke with Anaya Vardya, president and CEO of American Standard Circuits, a few days after the conclusion of IMPACT. I especially wanted his views as a first-timer there.

Patty Goldman: Anaya, as a first-time visitor to IMPACT, what were your impressions of the event?

Vardya: I thought it was a great event. I was very pleased that we were able to participate. Both Chairman Gordhan Patel and I participated. It's been on our radar for several years, but we've always ended up with scheduling conflicts; this year we were fortunate not to have one.

It was very beneficial for us. It's kind of a two-way dialogue, right? You get to listen to what the government is thinking of, you get to go participate, talk to the government representatives, your competitors, and your customers.

Goldman: A little bit of everything for everyone.

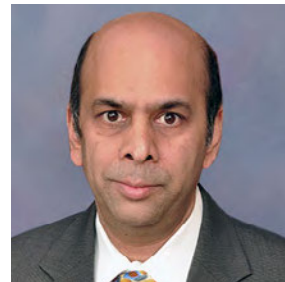
Vardya: Yes, there was a lot of interaction.

Goldman: Well, you picked a good year to come. I thought all the people who were invited to speak to us really were looking for information from us, and I don't remember that from last year. This year, they were so forthcoming and said, "Please tell us how you're doing, tell us what you need, we want to know." That was really great. Did you enjoy the trip to the EPA?

Vardya: I loved the trip to the EPA. It was good to meet administrator Pruitt. I thought he was

a good listener and that he was keen on understanding what some of our issues were, and intent on trying to get regulations removed that didn't make sense or that weren't based on science.

At the end of the day, we all want clean water and clean air. That's important to all of us because we live in the communities where our businesses are. But I think there are some regulations that don't need to be the way they are, and I felt like at least he was open to listening to us and was very engaged with our group.



Anaya Vardya

Goldman: In my opinion, it seems a big step forward to have been able to speak with the top person there. I don't recall EPA being on the agenda last year, so IPC must not have been able to get anybody to talk with our group. So to be able to speak to the top guy, I think that's very good.

Vardya: I was excited about that, for sure.

Goldman: Do any of the other speakers stand out in your mind?

Vardya: Well, I was quite impressed by Kim Ford, from the Department of Education. It was interesting to see that level of enthusiasm for what's going on today with their department, especially because she's been in the Washington, DC system for a very long time, and throughout the previous administration.

Goldman: Yes. I found that website she mentioned. It's interesting and there's a lot of useful information on it. Let's see, who else did we talk with? Senator Tammy Duckworth (D-IL), who's an amputee; that was pretty good, too.

Vardya: She was very impressive. And it's interesting, one of the things that I noticed is that on a lot of these core issues that impact our

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industry, I think the Democrats and the Republicans aren't that far apart, especially when it comes to job training and things like that. Job training is going to be a critical thing, and since we want to try to grow the manufacturing base in North America, employees are going to be the key to our success. Everybody needs to be trained. We need to have people that are actually going to work in factories.

Goldman: It's nice to see that Washington is recognizing that need. I was really impressed with the bill that she was going to introduce, where you could have this little fund set aside, sort of like an IRA—I believe she called it a “manufacturing RA” or something like that. A business could set aside money, tax-free, to purchase equipment or train people. I thought that was pretty nifty.

You can't just say, “Hey, we're going to bring back manufacturing” without having that whole other part: people trained and available to staff it and the capital equipment available with a fast depreciation schedule, along with everything else.

Vardya: I thought that was a very novel concept, I really did. I agree with you. We'll have to learn more about it.

Goldman: Did you get a chance to talk with your own senators and representatives on Wednesday afternoon?

Vardya: Yes, on Wednesday, after we had a couple of staff meetings, we met staffers from Senators Tammy Duckworth and Dick Durbin (D-IL). We talked to both of their staffs, and we talked a lot about conflict minerals. The other thing we discussed was tax reform. We focused on those two aspects, because obviously, tax reforms are important to all businesses. It is a key thing, and I think tax reform can really help people improve business in general.

We also had a quick meeting with one of the local representatives from the House of Representatives, Dr. Raja Krishnamoorthi (D-IL) from District Eight. We talked about some of these

same issues. He was very receptive; I think a lot of people are focused on getting more manufacturing jobs, for sure.

On Tuesday afternoon after the EPA visit, we met with Vice President Pence's Senior Domestic Policy Advisor, Daris Meeks, and it was very interesting. He basically said, “It's all about jobs, jobs, jobs, and we've been told that we need to listen to the people in industry and understand what the barriers are to creating more jobs.”

Goldman: There seems to have been an attitude change in DC.

Vardya: You participated in the lunch discussion, right? It seems like the administration is trying to do a lot to really encourage jobs, to try to help with breaking down barriers, and things like that, so I thought that was very encouraging.

Goldman: Yes, I noticed this year everybody seemed to be focused on businesspeople, people with businesses, in manufacturing and such. We seem to be the good guys this year. It was good all the way around.

Vardya: I thought the IPC team did an outstanding job of putting together a great lineup of people to speak to us and with us. We talked with the administration, members of Congress—Republicans and Democrats. So we got a diverse set of perspectives and a very diverse set of views from the meetings that were set up. I have to commend IPC on doing such an excellent job of



Congressman Shimkus (R-IL) talks with attendees.

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Rep. Ken Schrader (D-OR) is presented with the IPC U.S. Government Impact Award in recognition of his bipartisan leadership on issues of importance to our industry. Presented by Phil Titterton (left), TTM, and John Mitchell, IPC.

putting the whole event together. Again, given the fact that this was my first time, I was really impressed with all the briefing materials they put together and the whole package of information. I'm very impressed, and it was very good.

Goldman: They put together a tremendous amount of information for us: bios on all the speakers as well as everyone in our group, the briefing materials on the various departments (education, commerce, military, EPA), the key issues that we focused on. Then scheduling all the speakers during the day and at luncheons and dinners (including the awards dinner), and setting up meetings for everyone with their representatives. No spare time for us, right? It was quite a full schedule. And then to speak with your senators and representatives live, or perhaps their staff—that was a tremendous amount to coordinate, especially when you understand how packed their schedules seem to be. IPC staff supports so well, like you said, with all the briefing materials; but also, there's somebody at your side wherever you go to help you through the discussion and talking points if you need it.

Vardya: In fact, the other thing that I will add that was interesting is a small group of us broke away and met with one of the senior staffers in the Rules Committee. We met in the congressional building and we talked a lot about how

the rules work and what goes on, how bills come to the floor, and it was very insightful and interesting. Then, we got to go over and spend a few minutes in the actual House Chamber. That was a neat little tour that we ended up getting.

Goldman: That's great. It was quite a two-and-a-half days, really. I'm glad you went, and I'm glad I went. Hopefully, you'll go next year, schedule permitting.

Vardya: I absolutely will. I would really like to do that.

Goldman: Anaya, thanks so much for your time and thoughts.

Vardya: You're welcome. **PCBDDESIGN**

Bill Johnson Congressman (R-OH)

Congressman Bill Johnson (R-OH) gave a great talk during the Monday evening dinner at the very beginning of IMPACT. I think if there had been a way to vote for him for any office, everyone at the dinner would have done so. I interviewed the congressman a week after the event, and he shared his views on the way things are going in the Capitol today. He also asked me to call him Bill—not Mr. Johnson or Congressman. Just Bill.

Patty Goldman: Bill, Monday evening you spoke about how President Trump is doing and things that are happening in Congress that affect business. If you could revisit those subjects for our readers, I would appreciate it.

Bill Johnson: Sure, I think this goes all the way back to the November election, when the American people made a conscious choice to go in a different direction. They want to see, and they're still wanting to see, the greatness of

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America return: innovation, competition, and leadership on the global stage. I believe that what you have seen happen over the first four to five months of President Trump's presidency is a move in that direction.

If you look at the number of bills that Congress has passed this session since the last election, it is more than any that have passed in the first 100 days since George H. W. Bush was president, far more than President Obama during his first term. If you look at the number of bills that have been signed into law by President Trump, it's far more than President Obama or any of the three previous predecessors to that.

There is no question that President Trump has hit the ground running, trying to do the very things that he promised that he was going to do during his campaign: regulatory reform; restore healthcare to the American people and take it out of the hands of unelected bureaucrats in Washington, D.C. Now, some of these things are still a work in progress, but by and large, we've seen the markets respond very favorably to President Trump's message of returning to America's greatness. Within a few weeks of the election, the stock market saw a major rally. These are historical moves by the American free-enterprise system to validate what the American people are asking for.

If you look at the number of Congressional Review Act measures, for example, I think there have now been 13 Congressional Review Act measures that have been signed into law, keeping one of the promises that President Trump made to roll back onerous regulations that are stifling job growth and slowing economic growth here in America. If you look at how many jobs have been created, I've seen various numbers, but certainly in excess of 350,000 jobs have been created just since the president took office.

Looking at our border security, we're at a 17-year low, a 61% drop in attempted border crossings on our southern border. The president is setting about doing what he said he was going to do and we're working very hard in the House to give him the avenue legislatively to



Representative Bill Johnson (R-OH) speaks to IMPACT attendees at the kick-off dinner.

do those things, so I'm very optimistic about the direction we're going. Now, have we solved everything? No, we haven't. We have not completed the healthcare reforms. That's still a work in progress. We passed it out of the House and it will soon go to the Senate so that the Senate can begin that work in earnest.

We've already made significant progress down the road on tax reform. Everybody acknowledges that letting the American people keep more of what they earn, letting businesses keep more of what they earn so that they can invest in research and development and new innovations, new products, that's going to make America that much more competitive on the global stage. Look at the budget that was just released by the President, a budget that balances. When was the last time we saw a budget come from the President that actually balances?

Goldman: It balances? How did he do that?

Johnson: That's something that we've got to talk about. There's no question about that. That doesn't mean that it's going to get a rubberstamp here in the House because we too in the House want to see a balanced budget. That's what we have supported for the last seven years. I have voted numerous times for a balanced budget amendment to the Constitution and I believe that the federal govern-

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ment should balance the budget. I think that should be a requirement, but be that as it may, we've certainly got evidence now that we have a President that understands the importance of bending that spending curve in the other direction, to begin addressing America's national debt and the rising deficits. There's a lot to be optimistic about.

Goldman: That's all good to hear. I will say we talked with you Monday night and the next day we had several speakers from Education, Commerce and Defense Departments. The IMPACT group also visited the EPA and the White House. In every case, every person we talked with was very receptive. They all said, "Tell us what's going on. Tell us what you need." It was different than it's been in the past. They met with the head of the EPA, Scott Pruitt, and he took notes and he assigned follow-ups to his staff, which was good. In our industry, we've often been considered the enemy. It was different to have all the people that we spoke with be receptive or interested in our side of it, so we were happy.

Johnson: Patty, this may sound a little bit melodramatic, I don't mean for it to, but it really comes down to whether you see the glass as half full or half empty. I think under the Trump administration, it is very clear that from an American leadership perspective, America's po-

tential to lead on the economic stage, on the international and diplomatic stage, on the military and national security stage, that the Trump administration looks at the glass as half full versus leading from behind, which is what we saw during the previous administration for eight years—indecisiveness creating uncertainty, leaving doubt in the minds of our friends and allies across the globe as to where we stood on particular issues, creating business uncertainty and a very business-unfriendly climate. I think it's a matter of seeing the glass as half full and I think the Trump administration sees that.

Goldman: I think we're all optimistic, even more optimistic after having been to IMPACT and speaking with these various agencies and seeing their interest in what business people have to say. It was very refreshing.

Johnson: One of the things I talked about there that I would probably like to get the word out on is that I think that there is a cultural, societal shift that is occurring because of a phenomenon that we've seen before. One of the things that's great about the American system of government is that every generation gets to write the next chapter of America's amazing journey. Every generation believes that they can do it better than the previous generation. I love that about the American attitude, the American fiber of our being, but at the same time, oftentimes we must learn and relearn the same lessons from history all over again.

When I talk about a societal, cultural shift occurring, it reminds me of what happened in the '60s, back during Vietnam. If you can recall, Vietnam was the first war that was brought into the American living room in real time. Prior to Vietnam—World War II, Korea, other conflicts that America was involved in—the American people only saw the war from a distance. They saw it in newsreels if they happened to go to a movie or they read it in a newspaper that might come out on Sunday, if they happened to read the newspaper, but it wasn't in their face day after day after day.



IMPACT attendees meet with EPA Administrator Scott Pruitt.

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Rep. John Shimkus (R-IL) is presented with the IPC Government Impact Award by Bhawneesh Mathur and John Mitchell.

The Vietnam War was different because we sat in our living rooms in the evenings and we listened to Walter Cronkite give the body count. We saw the horrific scenes coming back from the battlefield of American soldiers being shot, enemy soldiers being shot, and the carnage that was occurring there. The American people saw war in all of its inhumanity up close and personal, and they didn't just observe it. They engaged in it.

They engaged in it and it played out on our college campuses. It played out in the streets of our cities and it changed who America was. It had a cultural, societal-shaping impact here in America. Now, roll the clock forward. About 10 years ago, with the advent of the social media platforms—Facebook, Twitter, MySpace, Instagram, etc.—and a 24-hour-a-day opinion. I started to say “news cycle,” but it's more of an opinion cycle. The American people today are seeing inside of the American political and governing machinery from a perspective that they've never seen before.

Goldman: This is true.

Johnson: Much like they saw war for the first time during Vietnam, they're now seeing the sausage being made inside the American governing system and they don't like what they see because it's contentious. It's frustrating. It's agonizingly painful. It is slow. Sometimes it defies

common sense about why you can't move one way or another on a piece of legislation. Now you've got 300+ million people who are now not just observing the American political and governing process, but they're engaging it.

Just like they did in the Vietnam War. How are they engaging in it? Well, they're demanding action. They're demanding that things get done. Is that an unreasonable demand? Absolutely not, but I think what we have failed to do as a nation is remember that historically, our system was not designed to move fast. Our system was designed to be debated, to be deliberate, to be slow moving, and I think the testimony to that is the fact that we're over 240 years old and yet we have seen very little change to our Constitution.

Look at how many countries throughout the world where the president resigns, they abolish the legislature, and they rewrite the constitution. America isn't set up like that. We don't have an exit ramp that way, so we have to make the system work that we have because that's the way we were built. It was built as a pass-fail system and we must work together to pass. The problem comes in because of the instant gratification environment we've created for ourselves; let's think about it for a second.

Today, you don't have to plan what you're going to have for dinner. You don't have to buy it. You don't have to prepare it. You don't have to grow it. All you got to do is pull up in front of the marquee at the McDonald's or the Wendy's or the Burger King and three minutes later, you've got your meal in a bag, and you've not had to do much of anything except pay for it. You get that instant gratification. Same thing applies when I can order my dog food online and it shows up at my house literally within 24 hours. Everything has got to be right now. So the American people, and I'm as guilty of that as anybody, get frustrated with the slowness of our system in fixing big problems.

I think sometimes we believe that the contentiousness that we see inside of our governing machine is new phenomenon. Well, it's not. It has always been that way. It has always been contentious and hard to govern the greatest na-

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tion on the planet. Let me give you an example, starting at the very, very beginning.

That was the summer of 1787 with James Madison and George Washington, two of our most prominent founders. George Washington is the father of our country, our first president, and James Madison, one of the architects of the Constitution. They went into that summer, that Constitutional Convention, very, very close allies. They were in lockstep. They were friends. They were working together, and thank God that they did because look at the document that it produced. But at the same time, it created a lot of anxiety between the two of them to the extent that not too long after that summer ended, George Washington and James Madison never spoke to each other again for the rest of their lives. The point I'm making is: Governing is hard business.

It is not easy. Relationships are broken and alliances are built among people that you never thought you would build an alliance with to get movement forward, because if we allow the far left and the far right to dictate the governing process, those groups are extreme. If a number of people in the middle aren't willing to sit down and put relationship aside, like Washington and Madison did, like Ronald Reagan and Tip O'Neill did to get big things done, then we're going to stay in a quagmire. Do you understand what I'm saying?

Goldman: Yes, I certainly understand. I've read enough history to know that you're right. If it were easy or if it happened quickly, that would mean we had a dictatorship. That's how things happen quickly. Somebody says, "This is the way it is," but we don't work that way. We don't want that.

Johnson: I'm not sure how healthy it is to a representative form of government where 300 million plus people think that they need to or should engage on every micro decision that is made. Because that's not the way representative government works. Representative government works when we elect a president and members

of the House and members of the Senate to be our voice. If we don't like the job that they're doing, our voice is communicated in the ballot box with who we send there to do the things that we want them to do, but I think when we start having people take to the streets and protesting, that brings us down to the level of some other countries where there's no confidence and trust in the system of government anymore. I think it's a very tenuous place to be.

If I had a message for the American people, it would be "Let's again start looking at the glass as half full." If you're the biggest nation, the most powerful nation on the planet, that means that your problems, your issues are



Walking to Capitol Hill.

IMPACT Interviews

manifold bigger than any other country on the planet. Those are big, big issues to resolve. You don't want to impulsively address those issues. You want to do it the right way and you want to do it in a way that's going to make it good for all Americans and protect and defend American values and American interests. I would urge everybody to just take a deep breath and not believe necessarily everything that comes across the social media platforms and the 24-hour-a-day opinion cycle about what's working and not working in our nation's capital. One of the greatest examples of two great, patriotic Americans that understood this phenomenon was Tip O'Neill and Ronald Reagan. During the day, the world spun around them, the media. I remember Sam Donaldson was Ronald Reagan's nemesis in the media. He always loved to try and catch Ronald Reagan with a tough question.

I can tell you about Ronald Reagan and Tip O'Neill. Many people did not realize that in the evenings after the legislative day was finished that Tip O'Neill would grab a bottle of Irish whiskey, two cigars and go over to the White House. They would sit there in the White House theater and watch cowboy movies and talk about the things that mattered in the big scheme of things. Things like how to bring the Soviet Union to its knees and bring down the Iron Curtain, how to bring about tax cuts that produced one of the best economic growth periods in American history.

That's what they were doing behind the scenes. We need American governing agents to be able and have the intestinal fortitude to do the same kinds of things.

Goldman: I agree, absolutely. Bill, thank you so much for your time. I really appreciate it. I could listen to you talk all day because it's very encouraging and very uplifting. Thank you so much.

Johnson: Thank you very much, Patty. It's good talking with you. Have a great day.

Goldman: You too, thank you. **PCBDESIGN**

Ending Thoughts by Patty Goldman

As I said in the title, you had to be there. All the interviews, all the thoughts, impressions, comments from the group cannot nearly capture the enthusiasm, the willingness to listen, the subjects discussed, the essence of the meetings with departments, representatives, and senators. You really had to be there.

Washington, D.C. is an impressive city with massive white stone government buildings everywhere. The energy is unmistakable and it's easy to get caught up in it. But if you think elected officials sit in pretty offices all day gabbing, arguing or eating fancy meals, you are mistaken. More than once we saw our speakers rush off, a staff person with schedule beside them, and neither able to join us for lunch because another meeting was scheduled immediately following ours.

More impressive was that IPC could coordinate the schedules of (by my count) 10–12 significant speakers, group meetings at the EPA, White House and up on the Hill, and individual meetings with numerous individual senators and representatives, all within a two-day window and without conflicts. For those of you who attended, you know how valuable this was. For those of you who didn't, you missed one heck of an event. **PCBDESIGN**



Bhawnessh Mathur shakes hands with EPA Administrator Scott Pruitt (right).



2017 Programs

July 12

Wisdom Wednesday

Highlights of IPC's PCB Technology Trends 2016 Study

For Members Only

Webinar

July 26-27

IPC Technical Education

Chicago, IL, USA

Workshop

September 16-21

IPC Fall Committee Meetings

*Held in conjunction with SMTA International
Rosemont, IL, USA*

Meeting

October 3-4

IPC & WHMA Wire Harness Manufacturing Conference

Paris, France

Conference

October 3-4

IPC Technical Education

Paris, France

Workshop

October 9-10

IMPACT Europe

Brussels, Belgium

Meeting

October 17-18

IPC Flexible Circuits-HDI Forum **Conference**

*Tutorials and Technical Conference
Minneapolis, MN, USA*

November 8

IPC Technical Education

*held in conjunction with PCB Carolina
Raleigh, NC, USA*

Workshop

November 14-17

IPC Committee Meetings

*held in conjunction with productronica
Munich, Germany*

Meeting

November 14-17

IPC Hand Soldering Championship **Competition**

*held in conjunction with productronica
Munich, Germany*

December 6-8

HKPCA International Printed Circuit & APEX South China Fair

Shenzhen, China

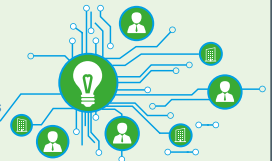
Conference and Exhibition



Technical Education

Professional development for engineering staff and managers

July 26-27 in Chicago, IL



IPC Technical Education — BEST PRACTICES IN DESIGN

EMI Control: Grounding, Power Distribution, Board Stack-up and More

Rick Hartley, Principal Engineer for RHartley Enterprises

The knowledge gained from this workshop can significantly reduce product develop time and cost, as well as improve product performance.

Design Challenges: Fine Pitch BGA Design; and Using Best Design Practices to Produce a More Manufacturable Board

Susy Webb, Sr. PCB Designer for Design Science

This class is two-in-one!

- 1) Explore the complexities of using fine pitch BGAs in designs.
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Register



Transmission Line Losses

by Barry Olney

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As digital systems evolve and demand for new technology pushes the envelope for smaller and faster systems, transmission line losses, previously considered to be negligible, are becoming a primary design concern. Pragmatic effects such as frequency-dependent losses come into play at clock frequencies above 1 GHz and are of particular concern for fast rise time signals, with long trace lengths, such as multigigabit serial links. This frequency dependence causes rise time degradation and reduces the upper bandwidth of the signal resulting in reduced channel data transfer. In this month's column, I will look at the impact of transmission line losses on signal integrity.

In an ideal world, where transmission line losses are independent of frequency, the entire signal waveform would uniformly decrease in amplitude, over distance, and the rise time would remain constant. This reduction in amplitude could easily be compensated for by applying gain (cranking up the volume) at the receiver. However, in practice, as signals propagate along a lossy transmission line, the amplitude of the high-frequency components is reduced, in magnitude, whereas the low-frequency components are unaffected. This selective attenuation, of high-frequency components, is the root cause of intersymbol interference (ISI) and collapse of the signal eye as in Figure 1.

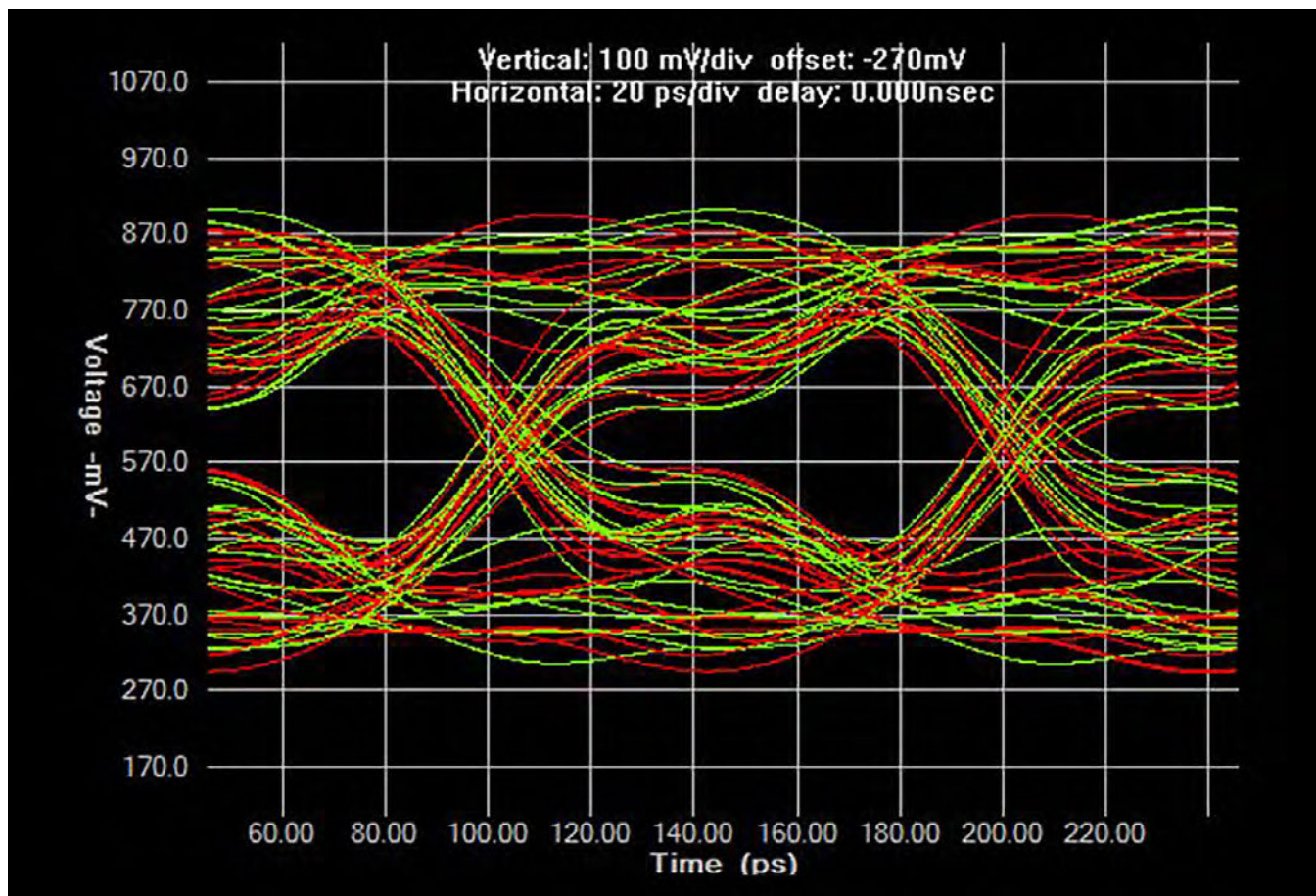
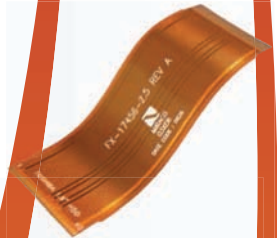
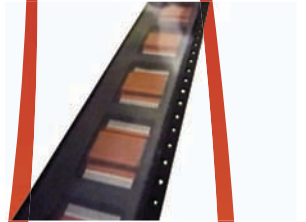


Figure 1: Lossy transmission line with collapsing eye (simulated in HyperLynx).

Engineering And Providing Balanced Interconnect Solutions



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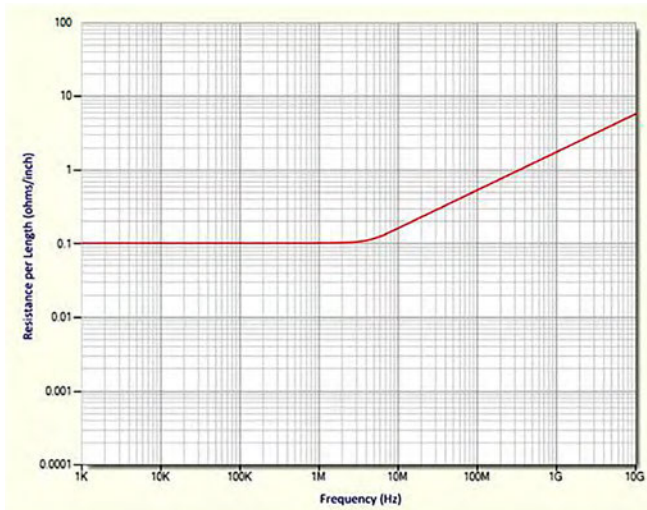


Figure 2: Resistance vs. frequency (5 mil, 1 oz, 50 ohm trace).

The capacitive and inductive properties of the transmission line do not, in themselves, absorb the high-frequency components of the signal but rather, the energy is reflected back to the source creating ringing and overshoot unless absorbed by a source termination.

To quantify the RF losses of a transmission line, one needs to consider the attenuation of each mechanism that can be broken down into at least four major components that are accumulated: metal loss, dielectric loss, conductivity of the dielectric and stray radiation.

The flow of charge through a material causes energy dissipation. The loss in both microstrip (outer layer) and stripline (inner layer) conductors may be broken down into two components: DC and AC losses. DC, in this context, is anything below 1 MHz. Although DC losses are not generally applicable to high-speed design, resistive drops can encroach on logic threshold levels and noise margins of multi-drop systems

such as long DDR3/4 address, command and control bus routing associated with SODIMM memory modules. However, on-board memory has typically less than three inches of signal length, and as such does not exhibit this issue.

For a typical 5 mil-wide trace, of 1.4 mil thickness (1oz Cu), one inch in length, the resistance, in the signal path at DC, is typically 0.1 ohm/inch. The bulk resistivity of copper—and most other metals—is constant with frequency until frequencies near 100 GHz. However, it is the skin effect that imposes a frequency dependency on conductors as shown in Figure 2.

AC—frequency-dependent—conductor losses can be resistive or inductive. At low frequencies, the resistance and inductance assume DC values, but as the frequency increases, the cross-sectional current distribution, in the transmission line and reference plane(s), becomes non-uniform and moves to the exterior of the conductor. The current is forced into the outer surface of the copper, due to the skin effect, dramatically increasing loss. This redistribution of current causes the resistance to increase and the loop inductance per length to decrease. As frequency increases beyond 1GHz, the resistance continues to increase while the loop inductance reaches a limiting value—the external inductance. The higher the frequency, the greater the tendency for current to flow in the outer surface of the conductor. The AC resistance will remain approximately equal to the DC resistance until the frequency increases to a point where the skin depth is smaller than the conductor thickness.

In a microstrip structure (Figure 3, left) the current (blue) will flow under the trace closest to the reference plane and only use the copper to the skin depth of the applicable frequency. However, in a stripline structure (right), the current will flow on both the top and bottom of

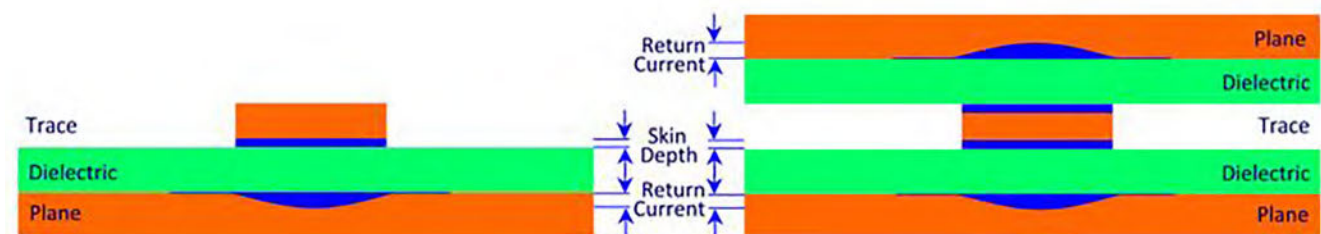


Figure 3: Skin depth of microstrip (left) and stripline (right) traces.

the trace and the proportion will depend on the proximity, of the trace, to the upper and lower reference planes that will share the return current. Essentially, routing in symmetric stripline structure doubles the current carrying capacity, of conductors, at high-frequencies.

There are two frequency-dependent processes that attenuate signals in a transmission line: the series resistance through the signal and return path conductors, and the shunt resistance through the lossy dielectric material.

Dielectric losses can also be broken down into two components: DC and AC losses. Since dielectric materials, used to fabricate PCBs, are not perfect insulators, there is a small DC loss associated with the DC drop across the material, between a signal conductor and reference plane(s). The direct current that flows in the capacitor, formed by the structure, is referred to as leakage current. However, the conductor losses are dominant and the DC loss is usually negligible. But as frequency increases, the AC loss also increases. Subsequently, it is important to understand the fundamental mechanisms that cause the dielectric losses to vary with frequency.

AC dielectric loss is the dissipation of energy, through the movement of charges, in an alternating electromagnetic field as polarization switches direction. When a voltage is applied across a capacitor, an electric field is generated.

This field will cause the dipoles, in the dielectric, to align with the field. The motion of these dipoles, alternating from one electrode to the other, appears as a transient current through the material. At high frequency, the conductivity increases due to the increased motion of the dipoles. The measure of the number of dipoles, in a material, and how far each can rotate, in the applied field, is called the dissipation factor (Df) or loss tangent (δ) of the material.

Another important property of dielectric materials is the dielectric constant (Dk) or relative permittivity (ϵ_r). Dk is the ratio of the amount of energy stored in a material by an applied voltage, relative to that stored in a vacuum. If a material with a high dielectric constant is placed in an electric field, the magnitude of that field will be measurably reduced within the volume of the dielectric. Therefore, a lower ϵ_r is desirable for high-frequency design. Also, dielectric loss tends to be lower in materials with lower dielectric constants—which is also beneficial.

With so many materials to choose from, which are the best for your specific application? There are a number of factors to be considered:

- Low cost generally means low quality.
- The price of poor yield drives up the final material cost.

Category	Manufacturer	Material Name	Glass Type	Resin (%)	Dielectric (mils)	Thickness (um)	Frequency	Dielectric Constant	Loss Tangent (Df)	Glass Trans Temp (Tg C)	Description	Com
Default	Taiwan Leader	FR4135	1-2116	50	4.0	101.6	1MHz (500ns)	4.8	0.022	140	FR4135 FR-4, 1-2116, Rc=50%, (1MHz)	Tg=
Default	Isola	Chronon	4-2116	60.5	20	508	20GHz (25ps)	3.64	0.0033	192	Chronon, 4-2116, Rc=60.5% (20GHz)	Tg=
Default	Isola	I-Speed (Spread Glass)	1-1035	67	2	50.8	20GHz (25ps)	3.55	0.0059	180	I-Speed, 1-1035 MS, Rc=67% (20GHz)	Tg=
Default	Isola	I-Speed (Spread Glass)	1-1080	60	2.5	63.5	20GHz (25ps)	3.70	0.0060	180	I-Speed, 1-1080, Rc=60% (20GHz)	Tg=
Default	Isola	I-Speed (Spread Glass)	1-1067	72	2.5	63.5	20GHz (25ps)	3.45	0.0059	180	I-Speed, 1-1067 MS, Rc=72% (20GHz)	Tg=
Default	Isola	I-Speed (Spread Glass)	1-1080	66	3.0	76.2	20GHz (25ps)	3.57	0.0059	180	I-Speed, 1-1080, Rc=66% (20GHz)	Tg=
Default	Isola	I-Speed (Spread Glass)	2-1037	66	3.0	76.2	20GHz (25ps)	3.57	0.0059	180	I-Speed, 2-1037 MS, Rc=66% (20GHz)	Tg=
Default	Isola	I-Speed (Spread Glass)	1-1086	62	3.0	76.2	20GHz (25ps)	3.66	0.0060	180	I-Speed, 1-1086 MS, Rc=62% (20GHz)	Tg=
Default	Isola	I-Speed (Spread Glass)	1-1086	66.5	3.5	88.9	20GHz (25ps)	3.56	0.0059	180	I-Speed, 1-1086 MS, Rc=66.5% (20G...	Tg=
Default	Isola	I-Speed (Spread Glass)	2-1037	70.5	3.5	88.9	20GHz (25ps)	3.48	0.0059	180	I-Speed, 2-1037 MS, Rc=70.5% (20G...	Tg=
Default	Isola	I-Speed (Spread Glass)	2-1067	62	3.5	88.9	20GHz (25ps)	3.66	0.0060	180	I-Speed, 2-1067 MS, Rc=62% (20GHz)	Tg=
Default	Isola	I-Speed (Spread Glass)	1-3313	52	3.5	88.9	20GHz (25ps)	3.89	0.0061	180	I-Speed, 1-3313, Rc=52% (20GHz)	Tg=
Default	Isola	I-Speed (Spread Glass)	1-1078	69.5	3.5	88.9	20GHz (25ps)	3.50	0.0059	180	I-Speed, 1-1078 MS, Rc=69.5% (20G...	Tg=
Default	Isola	I-Speed (Spread Glass)	2-1035	67	4.0	101.6	20GHz (25ps)	3.55	0.0059	180	I-Speed, 2-1037 MS, Rc=66% (20GHz)	Tg=
Default	Isola	I-Speed (Spread Glass)	2-1067	66	4.0	101.6	20GHz (25ps)	3.57	0.0059	180	I-Speed, 2-1067 MS, Rc=66% (20GHz)	Tg=
Default	Isola	I-Speed (Spread Glass)	1-3313	57	4.0	101.6	20GHz (25ps)	3.77	0.0060	180	I-Speed, 1-3313, Rc=57% (20GHz)	Tg=

Figure 4: Taiwan Leader, FR4135 vs. Isola, I-Speed material (Source: iCD Design Integrity).

- Different materials are available locally compared to offshore.
- Materials are cheap in mass production compared to prototypes.

As an example, a low-cost FR-4 material such as Taiwan Leader FR4135 core has a Dk of 4.8 and Df of 0.022 specified at 1 MHz. On the other hand, a high-speed, 20 GHz material, Isola I-Speed (spread glass weave) material has a Dk of 3.55 and a Df of only 0.0059. Spread weave glass also helps eliminate skew and has far less loss than the standard FR-4 material. Selection of the most appropriate dielectric material is in important consideration for product performance. Figure 4, shows the properties of both materials in the iCD Dielectric Materials Library of over 31,000 rigid and flexible materials to 100 GHz.

Finally, while radiation loss is important, when it comes to electromagnetic compliance (EMC), in practice the amount of energy lost to radiation is very small compared to other loss processes, and this mechanism will have little impact on the received signal.

As frequencies increase, engineers and PCB designers not only have to contend with technical challenges such as system timing, coupling, impedance discontinuities and radiation, but must also deal with a significant number of frequency dependent variables. However, choosing the right stackup and the most appropriate dielectric material, for your application, are a good start to reliable performance by increasing bandwidth and improving signal and power integrity.

Points to Remember

- The frequency dependence of transmission lines causes rise time degradation and reduces the upper bandwidth of the signal resulting in reduced channel data transfer rate.
- As signals propagate along a lossy transmission line, the amplitude of the high-frequency components is reduced, in magnitude, whereas the low-frequency components are unaffected.
- High-frequency components are reflected back to the source, creating ringing and overshoot unless absorbed by a source termination.
- The skin effect imposes a frequency de-

pendency on conductors.

- As the frequency increases, the current is forced into the outer surface of the copper, due to the skin effect, dramatically increasing loss.

- The AC resistance will remain approximately equal to the DC resistance until the frequency increases to a point where the skin depth is smaller than the conductor thickness.

- Routing in symmetric stripline structure essentially doubles the current carrying capacity, of conductors, at high-frequencies.

- AC dielectric loss is the dissipation of energy, through the movement of charges, in an alternating electromagnetic field as polarization switches direction. At high frequency, the conductivity increases due to the increased motion of the dipoles.

- A low Dk is desirable for high-frequency design. Also, dielectric loss tends to be lower in materials with lower dielectric constants—which is also beneficial.

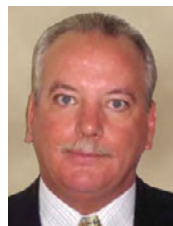
- Selection of the most appropriate dielectric material is in important consideration for product performance.

- The amount of energy lost to radiation is very small compared to other loss processes.

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References

1. Barry Olney's Beyond Design columns: [Transmission Lines—from Barbed Wire to High-Speed Interconnects](#), [Material Selection for SERDES Design](#).
2. Transmission Line Losses—Microwaves 101.
3. [Signal and Signal Integrity Simplified](#), by Eric Bogatin.
4. [High-Speed Digital System Design](#), by Stephen Hall.



Barry Olney is managing director of In-Circuit Design Pty Ltd (iCD), Australia. The company is a PCB design service bureau specializing in board-level simulation, and developed the iCD Design Integrity software incorporating the iCD Stackup, PDN and CPW Planner. The software can be downloaded from www.icd.com.au.

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Off-the-Shelf Power-Generating Clothes Are Almost Here

A lightweight, comfortable jacket that can generate the power to light up a jogger at night may sound futuristic, but materials scientist Trisha Andrew at the University of Massachusetts Amherst could make one today. They have invented a way to apply breathable, pliable, metal-free electrodes to fabric and off-the-shelf clothing so it feels good to the touch and transports enough electricity to power small electronics.

Eltek Inks Distribution Agreement with NCAB Group Italy

Eltek Ltd., a global manufacturer and supplier of technologically advanced solutions in the field of printed circuit boards, announced today an agreement with NCAB Group Italy to distribute Eltek's products in Italy.

Tucking in to NIST's '3D Printer' Testbed

3D printing of metal objects is a booming industry, with the market for products and services worth more than an estimated \$2.3 billion in 2015—a nearly five-fold growth since 2010.

Faster, More Nimble Drones on the Horizon

There's a limit to how fast autonomous vehicles can fly while safely avoiding obstacles. That's because the cameras used on today's drones can only process images so fast, frame by individual frame. Beyond roughly 30 miles per hour, a drone is likely to crash simply because its cameras can't keep up.

DARPA Picks Design for Next-Generation Spaceplane

DARPA has selected The Boeing Company to complete advanced design work for the Agency's Experimental Spaceplane (XS-1) program, which aims to build and fly the first of an entirely new class of hypersonic aircraft that would bolster national security by providing short-notice, low-cost access to space.

Compunetics and Circuits, LLC Announce Acquisition

Compunetics Inc. is pleased to announce it has concluded an agreement with Circuits, LLC to acquire the assets of Circuits, LLC, a flexible printed

circuit board manufacturer located in Murrysville, Pennsylvania.

American Standard Circuits Earns Key Military Qualification MIL-PRF-50884F and Expands MIL-PRF-31032

American Standard Circuits' CEO Anaya Vardya announced recently that his company has officially received its military qualification for flex and rigid-flex printed circuit boards: MIL-PRF- 50884F and MIL-PRF-31032C, QPL/QML Product Assurance Level, FSC 5998: Cage Code 4AA34: CN056313, VQ (VQE-17-031438).

Beyond Scaling: an Electronics Resurgence Initiative

The Department of Defense's proposed FY 2018 budget includes a \$75 million allocation for DARPA in support of a new, public-private "electronics resurgence" initiative. The initiative seeks to undergird a new era of electronics in which advances in performance will be catalyzed not just by continued component miniaturization but also by radically new microsystem materials, designs, and architectures.

UQ Partners with Lockheed Martin to Develop Next-Gen Computers for Aerospace Applications

University of Queensland researchers have partnered with global technology leader Lockheed Martin to develop next generation computers for aerospace applications. ARC Future Fellow and project lead Professor Warwick Bowen said the partnership would develop a new approach to computer technology, with the potential for future commercial impacts in the aerospace industry.

All Flex Expands Primary Production Facility

All Flex, a manufacturer of flexible printed circuit boards and flexible heaters, recently completed an expansion of its primary production facility in Northfield, Minnesota, increasing its fabrication footprint by 10%. With two facilities in Northfield, the company invested \$400K in consolidating its headquarters into one location, freeing up needed space for production capacity, fabrication processes, and improved material flow.

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Resins: Cutting Through the Technical Jargon

by **Alistair Little**
ELECTROLUBE

You only have to visit my company's website to find out that resins come in many forms, with a list of properties that would challenge even a chemist graduate. Well, I do appreciate that most PCB manufacturers have little time to dwell on the subtleties—they just want a resin that will do the job. But with so many products on offer, how do you find time to wade through the jargon, make your choice and be confident that it will perform as expected?

Unquestionably, product detail is important to the user and will be his or her initial guide to making an appropriate choice; however, this month, I'm going to cut through some of the more heavy-going tech-speak, taking a few of my customers' more frequently asked questions about resins to try to help you refine your selection process. There's a lot of ground to cover, but for the purposes of this column, let's concentrate on the PCB's operating environment, caring for the components that are to be encapsulated, and the special needs of applications like LED lighting and RF systems.

Q. *What exactly constitutes “general purpose” protection? Can we take this to mean that a general-purpose resin will meet most environmental conditions, or should we be more cautious if the operating environment is a little more challenging?*

A. “General purpose” means that the resin offers good protection against the effects of temperature and humidity over a broad range, as well as

providing good resistance to a wide range of chemicals. They also provide protection against vibration and shock, but when it comes to making a choice, you will need to be specific about the resin chemistries—polyurethane or epoxy—as they differ in terms of the types of protection they offer. In general, polyurethanes are better at protecting against vibration/cyclic mechanical shock and thermal cycling within an operating temperature range, as they retain their flexibility over their working life. Epoxies, on the other hand, can tolerate higher operating temperatures than polyurethanes, but they are more rigid and brittle when cured. While they are able to withstand higher mechanical shock, they are not as effective under conditions of high vibration or cycling shock.

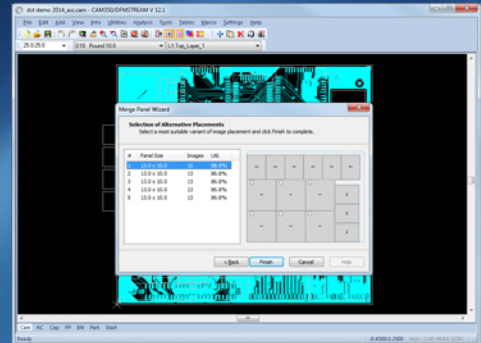


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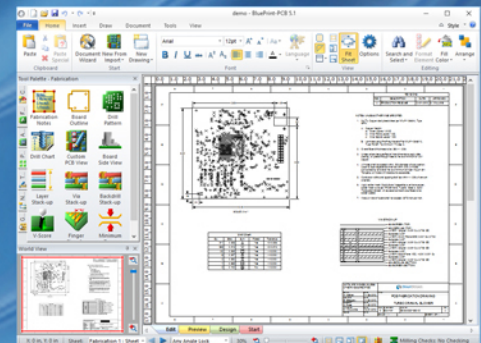
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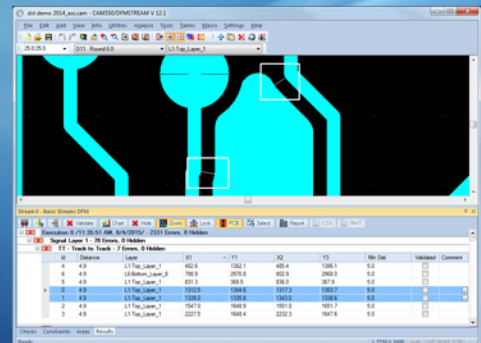
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Q. *What are the main parameters to consider when making a resin selection and what pitfalls should I look out for?*

A. The size and geometry of a PCB assembly are important parameters to consider before you choose an encapsulation/potting resin. Size will dictate the required useable life and gel time of a two-part resin, and it will also have quite a big impact on cure time.

Usable life and gel time data are typically calculated on a 100g mix size at room temperature (20-23°C). Short gel times are good for rapid turnaround of units, but may cause problems by allowing air to be released; long gel times, on the other hand, can extend production cycle times and introduce bottlenecks into the manufacturing process.

It is important to note here that very small volumes of resin will take longer to cure and special care should be taken to ensure that the correct mix ratio is maintained. In the case of larger volumes of resin, while the cure times will be reduced, the user must consider the corresponding rise in temperature of the resin/hardener mix, the “exotherm,” which may be high enough to damage vulnerable components. Epoxy resins are much more exothermic than polyurethanes.

With complicated geometries, the flow of the resin around the components and wiring must be taken into account. Vacuum potting should be considered where there are lots of components and/or wiring and a void-free encapsulation is required.

Essentially, try to match the thermal and physical properties of the resin to the components and the substrate. Ideally, you want all three to have very similar thermal properties to minimise the stresses and strains on the PCB assembly during potting/encapsulation and subsequent curing.

Q. *What are the most sought-after resin requirements for LED lighting?*

A. When choosing a resin for LED encapsulation, optical clarity is the prime consideration, closely followed by toughness. We have a variety of options that have achieved considerable success

in these applications, and can even provide a diffused lighting effect, for example.

Air entrapment is the bane of any LED lighting encapsulation as it will degrade the performance of a lighting unit. I offer a key tip here: An often-overlooked property is the mix viscosity of the resin, which will affect the way it flows around the components. The greater the number of components in a given area, the greater the chances of turbulent flow and subsequent air entrapment.

Q. *With RF applications, it is important that the resin does not attenuate the RF signal. How are resins formulated to achieve this?*

A. A polymer resin itself is transparent to radio frequencies, it is the fillers that are added—usually to render the cured resin flame retardant—that can cause RF signals to be scattered and attenuated. Clearly then, the best performance is obtained with resins with little or no filler in them (epoxies such as ER1137, and polyurethanes such as UR5048 are suitable for RF applications). We also have an epoxy, ER2141, which is filled with nickel and acts as an RF shield.

Q. *What are the steps for effective product selection? Are there any hard and fast rules or do these steps vary?*

A. Every customer and customer project is different; while we can advise a customer as to which products are best suited to their needs based on our years of experience, it all boils down to the unit, the dispensing method/equipment to be used, the curing times, and the temperature limitations that may be imposed during the production process. And the more information that the customer can provide regarding the resin's ultimate operating conditions—temperature range, likely chemical exposures and so on—then all the better. **PCBDESIGN**



Alistair Little is technical director for Electrolube's Resins Division.

Laser Stripping Powers Protons

Many large-scale accelerators deliver short, powerful pulses of proton beams. Creating the beams involves accumulating multiple lower power beam pulses to produce a single high-power beam pulse. Today, the achievable proton beam powers are limited by the technology used to merge the incoming pulses into a final beam pulse. To resolve this limitation, scientists demonstrated a new technique, called laser stripping. The approach uses a high-power laser and two magnets.

The new approach could revolutionize how high-power proton beams are generated in accelerators. Scientists use the beams to answer tough questions about materials. Industry uses the beams in medical and security applications. Laser stripping means next-generation accelerators with significantly higher beam powers. Higher beam powers result in increased rates of particle production and higher particle collision rates.

The conventional method of merging beam pulses starts with an incoming pulse of energized

hydrogen ions, H⁻, or a proton with two electrons, merges the ions with a circulating proton beam in a ring, then strips the H⁻ ions of their electrons to leave only protons in the beam. These stripper foils degrade at high temperatures. The degradation limits the achievable proton-beam power density. The laser stripping technique is a novel method of removing the electrons from an energized H⁻ beam without any material interaction.

In the experiment recently conducted at the Spallation Neutron Source accelerator, scientists demonstrated the laser stripping technique for a 10-microsecond pulse of a 1 gigaelectronvolt energy H⁻ beam using commercial laser technology. The achieved electron stripping efficiency was greater than 95 percent, comparable to typical efficiencies in the conventional foil-based method. This was the first demonstration of the technique for realistic time-scale beams in an accelerator. The technique was a factor of 1000 increase in pulse duration compared to a previous demonstration where less realistic scales were used.

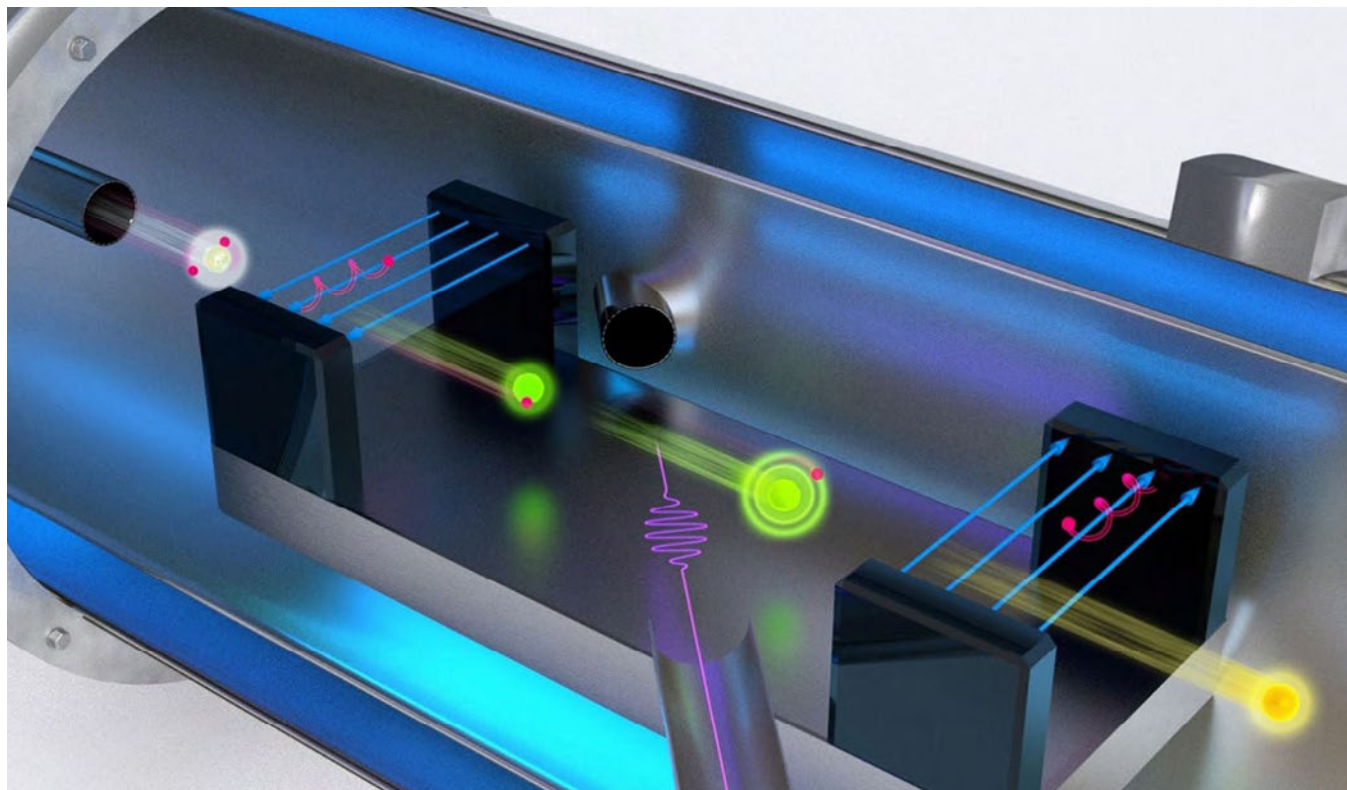


Image courtesy of Oak Ridge National Laboratory/Jill Hemman.

Stepping into the Great Unknown

by Tim Haag

CONSULTANT

"It's time for you to go," my flight instructor said.

I answered, "Well, it's getting kind of late and the weather is starting to drop. Maybe we should put this off until..."

"Go now!" my instructor said.

My earlier jovial mood was now punctured by anxiety. But there was no way around it. It was time for my first solo flight as student pilot on June 8, 1990.

Many years ago, I was given the opportunity to switch my career path from senior circuit board designer to CAD systems administrator. I wasn't certain that I wanted to give up the comfort of being a designer; after all, I had been one for a long time. But I knew that I wanted to grow in my career and this transition would help my overall knowledge base of everything CAD-related, as well as better position me in my quest for a management position. So, I pulled the trigger and accepted the new job even though the idea of stepping into the great unknown like that was very intimidating.

Walking to the plane I begin to mentally rehearse everything that I needed to do. I tell myself, "No pressure!"

After all, the only thing that could go wrong here is that any number of mistakes could result in my drilling a house-sized crater in the ground, leaving nothing but a grease stain for my family and friends to remember me by.

"No, stop it! Don't think about stuff like that." I admonish myself. "Don't let your imagination get the better of you." I force those thoughts down as I begin my pre-flight check.

Stretching and growing is an important part of life. Yes, it is tempting to stay where it is safe and warm, but that kind of life won't help us to reach new heights. You can take a sailboat out onto the pond and use the motor to scoot around, but don't kid yourself. You won't really be sailing until you get onto a river or a lake and open up the full potential of the boat by unfurling the sails in a brisk wind.

You may feel fear as the boat heels over in the wind, but under an experienced hand, that fear will transform into an incredible experience. And just like sailing, in order for us to become more than we are today we sometimes have to embrace the strong winds of change head-on, no matter how scary.

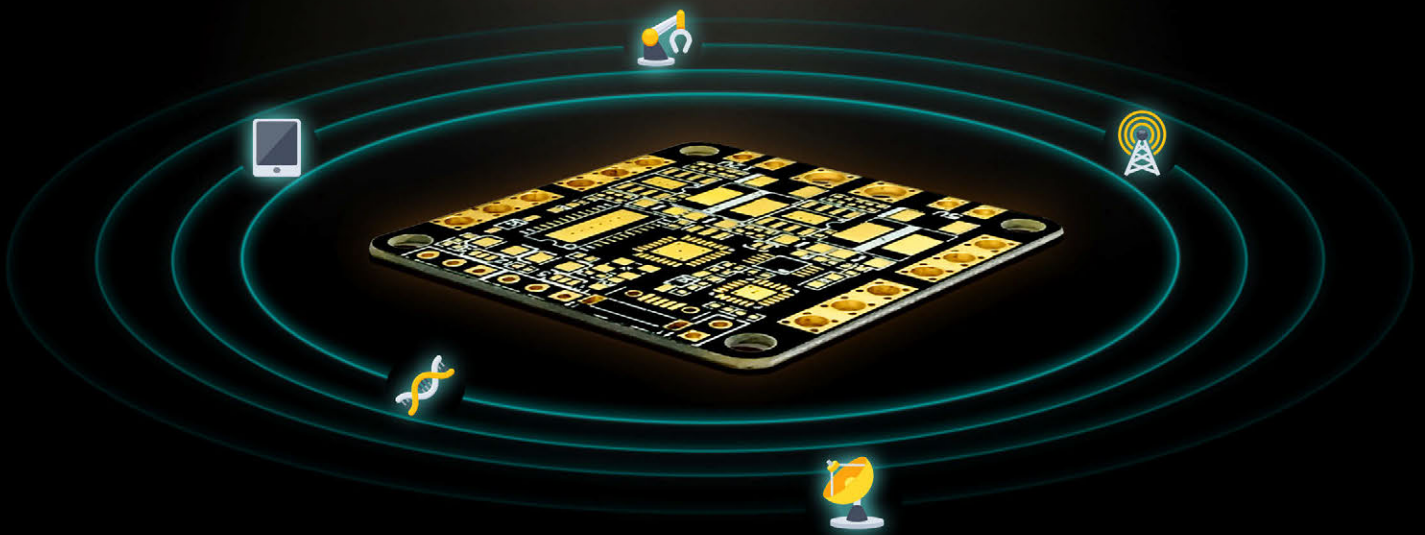
I completed the engine start checklist, fired her up, and taxied to runway 17. I stood on the brakes and tested my magnetos. After adjusting the altimeter, I announced in the blind to Aurora Unicom my intention to take off (this was many years before the tower was built). The take-off checklist was complete, and it was time to go. I was nervous, but my training and my instructor's confidence told me that I was ready. Carb heat off, no flaps, and I slowly advanced the throttle, took one last look to confirm that we were clear, and I pulled onto the active runway. I lined the plane up,



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gave it full throttle, and down the runway I went, picking up speed. At 55 mph I began to pick up the nose wheel and soon we floated off. I established a positive rate of climb at around 75 mph when I noticed something different; I was talking to myself. But that's OK, if that was what I needed to do to get through this safely. "Keep looking for other traffic," I continued, "and begin your turn to the left." So far, so good.

So, congratulations. You've been taking little steps into the great unknown for a long time now, but you probably didn't realize it. But sometimes we all need to purposely make that first big scary step, much like I did when I accepted that position as a CAD systems administrator. Yes, it could result in disaster, but you will never know until you try.

"OK, let's continue this left turn, you're doing good," I told myself. I was now at pattern altitude and I backed the power off to 2500 rpm, set the mixture to lean and trimmed the elevator. My heart rate and respiration actually calmed down a little. Time to get back on the radio. "Aurora traffic, Cessna 232 is downwind for runway one-seven."

I had no idea when I took the CAD systems administrator position that years later I would be working for a CAD software company. It never occurred to me at the time that one day I would be helping customers in a variety of environments and on many different types of design systems. But when it came time, I was able to rely on my experience as a systems administrator in order successfully install and configure my customer's design software.

As I passed the end of the runway on the

downwind leg of the pattern, my heart rate and respiration began to creep up again. It's time to configure the plane for landing, and for a student pilot the landing is the most difficult and most important maneuver to master. After all, take-off is optional, but landing is mandatory. "You can do this," I say, "Mixture to rich—check, carb heat on—check, flaps 10 and throttle back—check." With the plane slowing, I began my descent and keyed up the mike again. "Aurora traffic, Cessna 232 is turning base for runway one-seven." Lowering the flaps to 20, I turned left onto my base leg while the plane slowed even more.

But being able to help customers with their installations and configurations was not the only benefit that I realized from my time as a systems administrator. I also learned a lot about

working with people and resolving their problems. This helped me immensely later on as I supported customers on their CAD software. And helping other team members as an admin also taught me how to instruct people in the use of their software, which gave me a solid foundation to build on years later as a technical instructor for CAD software.

I started another left turn and announced to Aurora traffic that I was on final approach. Now it's all about landing the airplane. "Flaps to 30—good. You're a little low so give it a bit more throttle. You're starting to drift now so give it a little right rudder—that's good, straighten it out. Watch the airspeed; it's a bit fast so pull back the yoke just a tad. One last look around for traffic, and we're good." I realized that one day I would be embarrassed to tell people that I was talking to myself, but at this moment I just don't care.

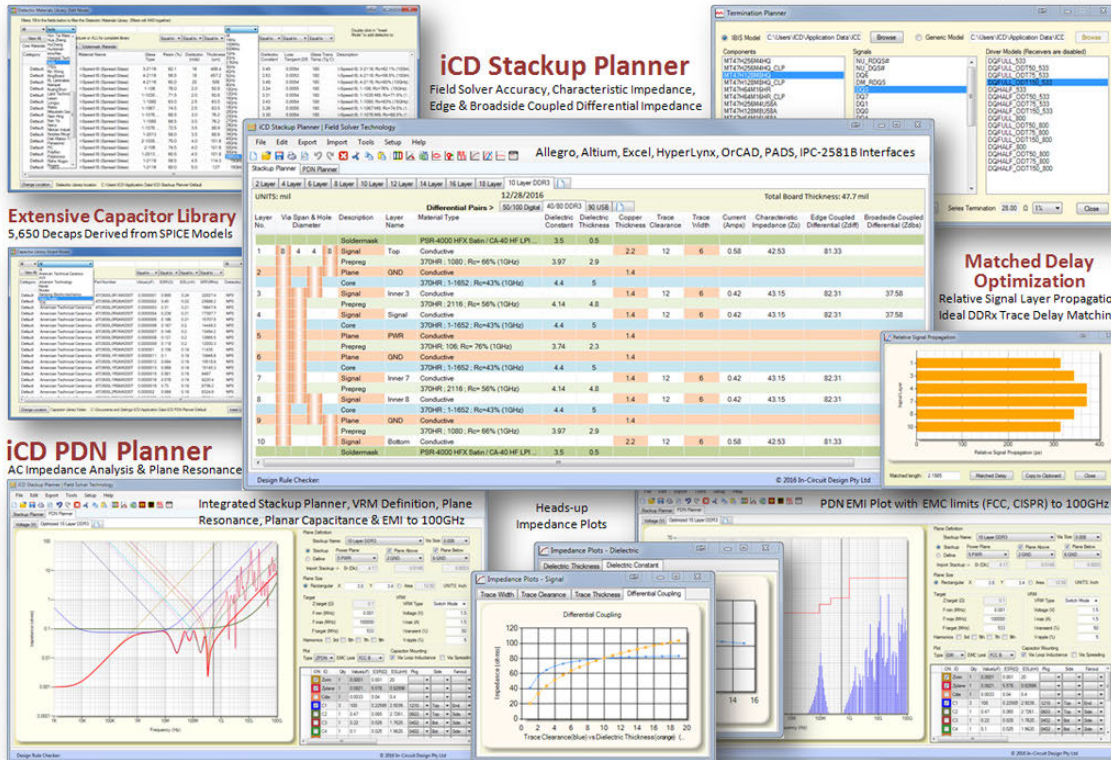


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"iCD Design Integrity software features a myriad of functionality specifically developed for high-speed design."
- Barry Olney



I owe a lot to that decision to take a risk with the systems administrator position, but it was difficult at the time. I didn't have the advantage of knowing what I know today, that the skills I learned would help me in ways that I could never have dreamed of. All I could see at the time was the need to provide for my family, and I didn't know if this decision would hurt me or help me in that goal. But I knew that it was better to move forward instead of standing still, so I took the step.

I was very low to the ground now at 65 mph, which is right where I should be. As I crossed over the numbers on the end of the runway, I leveled out and held the plane a few feet off the ground. With the throttle at idle, the air speed bled off and I pulled back the yoke to flare for landing. The main wheels thumped onto the runway and my anxiety turned into overwhelming relief as I

was once again on terra firma. As I taxied off the active runway and headed towards the ramp, I realized that it was OK to start breathing again. After parking and shutting the plane down, I took a moment to reflect; I've just successfully completed my first solo flight. I didn't know what's next, but somehow it all doesn't seem as daunting as it did 10 minutes ago.

Stepping into the great unknown can have very rich rewards. Watch out for that first step; it can be a real doozy! **PCBDISIGN**



Tim Haag is a senior PCB designer with many years in the industry, supporting and training users, and managing various design groups. You can reach Tim by clicking [here](#).

Power of Light: Research Team Finds Light is Key to Promising Material

A Florida State University research team has discovered that light can significantly alter the structure of a promising material that scientists believe could make more efficient light-emitting diodes, lasers and other photon-based technologies.

In the journal *Angewandte Chemie International Edition*, FAMU-FSU College of Engineering Associate Professor Biwu Ma explains how light can change a material called organometal halide perovskites from a 1-D to a zero-dimensional structure.

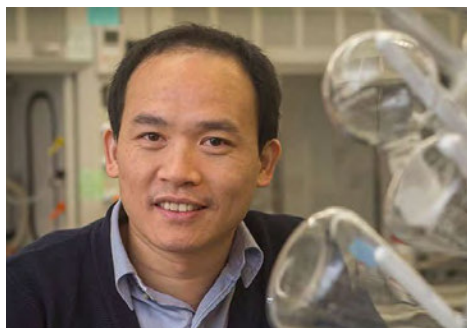
Computational studies suggest this zero-dimensional structure is more energetically and thermodynamically stable than the 1-D structure, and thus could make for more effective technologies.

Ma and his team have been working on organometal halide perovskites for the past few years with the hope to discover new functional materials that outperform

conventional optoelectronic materials. A perovskite is any material with the same type of crystal structure as calcium titanium oxide, and hybrid metal halide perovskites have received increased attention in recent years for their potential applications in various types of photon-related technologies such as light-emitting diodes and lasers.

While much work has been carried out in the field of organometal halide perovskites in recent years, the focus has been mainly on 3-D and 2-D structures, with 1-D and zero-dimensional structures significantly underexplored. As part of this process, Ma's team discovered that light was actually capable of changing some of the 1-D crystals to a zero-dimensional crystal structure.

"Our work not only shows our capability of producing low dimensional perovskites with high yields, but sheds light on the critical photostability issues of organometal halide perovskites," Ma said.



DIBBLE 4 LEADERS

THE FOUR NEW AGREEMENTS FOR SUSTAINABLE SUCCESS



Profitability is more about leadership and management than any other factor.

Any business can be transformed quickly, easily and sustainably with the proven methods we use. Contact us today for an initial consultation to learn how to get started on the path of doing the right things to allow profitability to happen.



[click to read](#)

Learn more about the roadmap used to build great companies with a high level of profitability in this article from the March 2016 issue of **The PCB Magazine**.

For 25 years we have been doing Four New Agreements consulting and training, significantly improving businesses. This stuff really works!

—David Dibble



CAREER OPPORTUNITIES



Senior Salesperson— Automotive Electronics

CheckSum is a leading supplier of PCBA test and on-board programming systems and fixtures to the worldwide electronics manufacturing industry. Our technology sets the industry standard in high-throughput solutions for automotive electronics with innovative solutions that meet the quality, speed, and economic requirements of the industry. Founded in 1987, CheckSum is a profitable private company with a broad customer base and a large market opportunity.

Position: CheckSum is seeking a senior salesperson to help us add new automotive electronics customers. We will shortly launch a new technology solution to further our throughput advantage and open doors with new customers.

Requirements:

- Proven sales performer with a track record of landing new accounts and growing existing relationships
- Five years of experience selling CapEx electronic equipment required
- Experience selling automated board test equipment preferred
- General technical knowledge of electronics required
- Demonstrated ability to network to develop leads and multiple relationships at target accounts
- Salesforce fluency
- Strong communication skills
- Self-starter with a sense of urgency and an ability to work independently

Compensation: Negotiable depending on experience.

Contact: Please send resume and cover letter. To apply, click below.

[apply now](#)



ROYAL FLEX
CIRCUITS

Sales Professional \$200k Package

Royal Flex Circuits is a So-Cal-based company specializing in manufacturing flex circuits, rigid flex circuits and HDI PCBs for the military, medical and consumer markets. Royal Flex enjoys a 30+ year history in the PCB industry and has just completed a \$2M investment in new technology (lasers, LDI, vision drilling, AOI, etc.) and new engineering & production talent which has positioned the company for the next 10 years.

We are looking for an experienced sales professional capable of bringing in new accounts north of \$3M per year. We are not interested in a behind the desk, theory spouting, strategy creating sales manager. We want someone that has been in the PCB industry, has strong relationships, and can bring in business.

We offer a generous base salary of \$120k per year, with an attractive commission program which should push the total compensation to \$200k–\$250k. We have the best-in-industry medical, dental and vision insurance, with 90% of premiums paid by employer, as well as a fantastic 401k plan. Our biggest benefit is that we have a stellar reputation and incredible work ethic and integrity.

Please send resume and cover letter explaining why you are that perfect match for our company.

[apply now](#)

CAREER OPPORTUNITIES



LENTHOR ENGINEERING

MAKING THINGS FLEXIBLE IN A RIGID WORLD®
311 Turquoise Street Milpitas, CA 95035 (Phone) 408-945-8787

PROCESS ENGINEER

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

Duties include but are not limited to:

- Participate in the evaluation of processes, new equipment, facility improvements and procedures
- Improve process capability, yields, costs and production volume while maintaining safety and improving quality standards
- Assist in employee training and certification
- Work with customers in developing cost effective production processes
- Engage suppliers in quality improvements and process control issues as required
- Generate process control plan for manufacturing processes and identify opportunities for capability or process improvement
- Participate in FMEA activities as required
- Create detailed plans for IQ, OQ, PQ and maintain validated states as required
- Participate in existing change control mechanisms such as ECOs and PCRs
- Perform defect reduction analysis and activities
- Participate in technology roadmap planning
- Participate in new materials, processing or other developments as required

Experience & Education:

- BS degree in Engineering
- 2-5 years of proven work experience
- Excellent technical skills

Competitive salaries based on experience, comprehensive health benefits package, 401(k) and Quarterly Gain Sharing bonus available to eligible employees.

[apply now](#)



Technical Service Specialist— Electronics

RBP Chemical Technology, a world-class supplier of proprietary chemicals and delivery devices for the printing, electronics, PCB, and medical implant industries, is looking for a technical service specialist in electronics.

This position is responsible for providing technical expertise to external and internal customers in the use of company products for the circuit board and PCMI industries; overseeing and conducting field installations; conducting process audits and developing reports; regularly visiting customers to present technical aspects of products and perform troubleshooting; consistently interfacing with sales and informing customers of updated information; training and facilitating lab personnel in use of pilot lab regarding product applications.

Travel required: 50–70%. We prefer position to be based in the Milwaukee, Wisc. area.

Qualifications:

- Bachelors degree in Chemistry or related field required
- Minimum of 5 years' experience in circuit board manufacturing or a related technical service area
- Proficient in all areas of wet processes used in PCB manufacturing
- Excellent verbal/written communication skills
- Excellent troubleshooting skills
- Demonstrated knowledge/understanding of Windows-based software including Word, Excel, and PowerPoint
- Applied knowledge of customer service principles/processes
- Demonstrated problem solving/interpersonal skills

RBP offers competitive compensation as well as a comprehensive benefits package, including medical/life/disability and other insurance, 401(k).

[apply now](#)



Application Engineer

The application engineer is the first contact for our customers who have technical questions or issues with our product. We value our customers and wish to provide them with highest quality of technical support.

Key Responsibilities:

- Support customer base through a variety of mediums
- Log, troubleshoot, and provide overall escalation management and technical solutions
- Create various types of topic based content, such as online help, online user guides, video tutorials, knowledge base articles, quick start guides and more
- Distill complex technical information into actionable knowledge that users can understand and apply
- Continually develop and maintain product knowledge

Requirements:

- Understanding of EDA electronic design software, schematic capture and PCB layout software
- Bachelor's degree in electronics engineering or equivalent experience
- Sales engineering and/or support engineering experience
- Circuit simulation and/or signal integrity experience
- Understanding of ECAD/ MCAD market segments
- Understanding of micro controllers, SoC architecture and embedded systems market
- Database experience preferred (i.e., MySQL, PostgreSQL, Microsoft Access, SQL, Server, FileMaker, Oracle, Sybase, dBASE, Clipper, FoxPro) etc.
- Experience with PLM/PDM/MRP/ERP software (Program Lifecycle Management) preferred
- Salesforce experience a plus

Salary based upon experience. Comprehensive benefits package and 401k plan. Openings in USA, UK, and Germany.

For more information, contact Altium.

[apply now](#)



Designed for Brilliance. Engineered for Production.

Embedded Engineer— Portland Oregon

ESI, a pioneer and leading supplier of world-class production laser systems that help microtechnology customers achieve compelling yield and productivity gains, is looking for an embedded engineer.

As a software engineer, you are designing and delivering the embedded software that drives ESI's leading-edge manufacturing systems. The successful candidate will join a multi-disciplinary team focused on developing cutting edge technology in a fast-paced and technically challenging environment. Primary responsibilities will include embedded real-time system development, low-level machine control, system-level troubleshooting, and some supporting application level development.

Desired experience includes:

- Highly proficient in C/C++ programming
- Proficient in working with and programming DSPs or microcontrollers
- Experience designing software for embedded systems with constrained resources
- Knowledge of different embedded runtime environments (Linux, bare metal, RTOS)
- International travel to support ESI system installations (<10%)
- Engineering degree with to 5–7 years of related experience, or equivalent combination of education and experience
- Fundamental engineering knowledge (basic physics, calculus, problem solving)

Interested? Please apply below.

[apply now](#)

CAREER OPPORTUNITIES



Arlon EMD, located in Rancho Cucamonga, California is currently interviewing candidates for **manufacturing** and **management positions**. All interested candidates should contact Arlon's HR department at 909-987-9533 or fax resumes to 866-812-5847.

Arlon is a major manufacturer of specialty high performance laminate and prepreg materials for use in a wide variety of PCB (printed circuit board) applications. Arlon specializes in thermoset resin technology including polyimide, high Tg multifunctional epoxy, and low loss thermoset laminate and prepreg systems. These resin systems are available on a variety of substrates, including woven glass and non-woven aramid. Typical applications for these materials include advanced commercial and military electronics such as avionics, semiconductor testing, heat sink bonding, high density interconnect (HDI) and microvia PCBs (i.e., in mobile communication products).

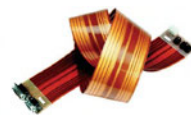
Our facility employs state of the art production equipment engineered to provide cost-effective and flexible manufacturing capacity allowing us to respond quickly to customer requirements while meeting the most stringent quality and tolerance demands. Our manufacturing site is ISO 9001: 2008 registered, and through rigorous quality control practices and commitment to continual improvement, we are dedicated to meeting and exceeding our customer's requirements.

[more details](#)



Advanced technology manufacturer of printed circuit boards in Huntington Beach, CA is looking for manufacturer's representatives in Southern California. Please forward inquiries to Crystal Barrett. (585) 254-2989 ext. 225

[apply now](#)



all flex
Flexible Circuits • Heaters • Assemblies

HELP WANTED

In order to support its continued growth and leadership position, All Flex Flexible Circuits and Heaters is seeking a TECHNICAL APPLICATION SALES ENGINEER for our inside sales team. Candidates are to have 5+ years in the PCB industry including a minimum of 2 years with flexible circuitry and/or flexible heaters. Experience in component assembly and flexible heater design is a plus.

The position involves providing extremely high responsiveness and follow-up to assigned accounts and new prospect inquiries. Although primarily an inside sales service provider, the individual must also be able to travel several times per year to support tradeshow and in-person customer support. The position provides technical application knowledge to assist customers in the design and use of flexible circuits, heaters, and assemblies, a key service that All Flex provides.

Background to include:

- Success in a team environment
- Managing large customers – ideally in medical, military, aerospace, and industrial markets
- Proficiency in Microsoft Office Suite with good typing/keyboard skills
- Attention to detail
- Good organization skills in handling multiple activities at the same time
- Professional telephone and e-mail communication skills
- Experience working trade shows
- Good listening and customer management abilities

This position is located in Northfield, MN.

[apply now](#)

CAREER OPPORTUNITIES



ventec
INTERNATIONAL GROUP
騰輝電子

OEM Account Manager USA (IMS Materials)

Want to work for a globally successful and growing company and help drive that success? As a US-based key member of the global OEM Marketing Team, your focus will be on IMS (Insulated Metal Substrates) materials that deliver exceptional thermal performance, reliability and quality, particularly demanded by automotive and other LED lighting and DC power conversion applications. Combining your strong technical PCB manufacturing and design knowledge with commercial acumen, you will offer OEM customers (buyers, designers, reliability engineers and the people that liaise directly with the PCB manufacturers) advice and solutions for optimum performance, quality and cost.

Skills and abilities required for the role:

- Technical background in PCB manufacturing/design
- Solid understanding of IMS Materials
- Sales knowledge and skills
- Excellent oral and written communication skills in English
- Experience in making compelling presentations to small and large audiences
- Proven relationship building skills with partners and virtual teams

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

Please forward your resume to:

[apply now](#)

Mention "OEM Account Manager USA" in the subject line.



MacDermid
PERFORMANCE SOLUTIONS

Do you have what it takes?

MacDermid Performance Solutions, a Platform Specialty Products Company, and daughter companies manufacture a broad range of specialty chemicals and materials which are used in multi-step technological processes that enhance the products people use every day. Our innovative materials and processes are creating more opportunities and efficiencies for companies across key industries – including electronics, graphic arts, metal & plastic plating, and offshore oil production. Driving sustainable success for companies around the world, and at every step of the supply chain, takes talent. Strategic thinking. Collaboration. Execution.

The people of MacDermid Performance Solutions stand united by a guiding principle: That if it doesn't add value, don't do it. This belief inspires a unique culture where each team member has opportunities to imagine, create, hone and optimize. Do you have what it takes? Join our growing team of over 4,000 professionals across more than 50 countries with openings in research, finance, customer service, production and more.

MacDermid Performance Solutions and its affiliates are Equal Opportunity/Affirmative Action Employers.

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Experienced Sales Reps Needed

Candor is an advanced printed circuit board manufacturer with a unique manufacturing process. We can genuinely stand out among conventional board shops due to our unique Simplified Process.

Join the Candor team, targeting rapid high quality prototype PCB manufacturing.

We are looking for industry experienced sales reps to manage current customers and find new leads in the USA. Candor is in a unique position to hire onto our team using a very generous sliding commission rate. Contact Sunny Patel for details.

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CAREER OPPORTUNITIES



ZENTECH

Zentech Manufacturing is Hiring!

Looking to excel in your career and grow professionally in a thriving business? Zentech, with locations in Baltimore, MD and Fredericksburg, VA is rapidly growing and is seeking experienced professionals in all areas: engineering, manufacturing engineering, program management, testing, QA and SMT operations. Zentech offers an excellent benefit package including health/dental insurance and an employer matched 401(k) program.

Established in 1998, Zentech holds an ultimate set of certifications relating to the manufacture of mission-critical printed circuit card assemblies, including ISO:9001, AS9100, DD2345, ISO 13485, maintains an IPC 610 Trusted Source QML status, J-STD 001 with Space Certification and is ITAR registered.

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[Click for drone video tour of Zentech Facility](#)



PCB Front End CAM Engineer

Associates degree or better is required. Must have a minimum of 3 years of experience working for a printed circuit board manufacturer. Must have Valor Genesis software experience. Scripting knowledge is beneficial but not required. This is a full time salaried position on 1st shift. Pay commensurate with experience.

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eptac

TRAIN. WORK SMARTER. SUCCEED.

Become a Certified IPC Master Instructor

We are growing! EPTAC, a leading provider in the electronics training industry is looking for some great people to join our team. If you love teaching, choosing the classes and times you want to work, and being your own boss, this may be the career for you. We are looking for instructors who have a passion for working with people to develop skills and knowledge. If you have a background in electronics manufacturing and an enthusiasm for education, drop us a line or send us your resume. We would love to chat with you. Opportunities available across U.S. and Canada, especially in our growing markets of California, Florida and New England. Some travel involved. IPC-7711/7721 or IPC-A-620 CIT certification a big plus.

[apply now](#)



MivaTek

Global

Application/Sales Engineers

Positions available in the Eastern, Midwest and Western United States. Positions will focus on supporting sales and applications development for Miva Technologies' DLP direct imaging system within the PCB and micro-electronics markets. Experience with photoresist and imaging preferred, but not required.

Service Technicians

Positions available for Eastern and Western United States. Service technicians will support our rapidly expanding installed base of Miva Technologie's DLP imaging systems and other systems sold by the company.

Send resume and contact information for both jobs to Brendan Hogan.

[apply now](#)

CAREER OPPORTUNITIES



Outside Sales/ Key Account Managers

NCAB Group USA is adding to our existing outside sales team in various U.S. locations:

- Ontario, California
- Itasca, Illinois
- Irving, Texas
- Vancouver, Washington

This is a sales position that requires the ability to convert those cold calls into high-value customer meetings. What we are looking for:

- A "hunter" mentality
- The ability to create solid customer relationships
- A desire to excel and not settle for mediocrity
- 5+ years of experience in the PCB or semiconductor industry
- An excellent ability to present a product and do the "deep dive" during customer visits by asking open ended questions and identifying customer pain points
- The energy to move from prospecting to cold calls to getting the win
- Knowledge of "SPIN" selling
- A college degree
- Willingness to travel, domestically and globally
- U.S. citizens with a valid U.S. passport

Interested? Send your resume.

[apply now](#)

Visit us at www.NCABGroup.com



Looking for an energetic **OUTSIDE SALES REPRESENTATIVE** Entry-level candidates welcome

Job Description: Grow business by setting up meetings with customers and handling presentations, selling products, and meeting customer needs. Required to meet customers face to face on weekly basis.

Territory: All U.S. states and parts of Canada.

Skills/Qualifications: Great communication skills; customer hospitality; meeting sales goals; closing skills; territory/account management; prospecting skills; negotiation; travel scheduling; computer and network skills (intermediate level); self confidence; presentation skills; client relationships; motivation for sales; motivation to learn; loyalty to company; respect to customer and team member; patience; due obligation.

Plus Aspects:

- Bachelor or higher degree
- Experience in outside sales
- Knowledge of print circuit boards

MicroCraft offers:

- Domestic travel allowance
- International travel allowance
- 401(k) with company match
- 90% coverage on health insurance and dental insurance for the employee
- Life, AD&D, short term and long term disability for the employee
- PTO and holidays
- Good environment/helpful coworkers
- The opportunities to expand your knowledge

Salary: \$40,000 to \$75,000 or more. Your salary depends on your sales performance. This figure includes sales commission.

[apply now](#)

Contact: Kohei Maekawa

CAREER OPPORTUNITIES



TECHNICA, U.S.A.

Fulfilling Manufacturing Needs
Throughout the Electronics Industry

Southern California Territory Sales Engineer

Technica, USA, a Western regional manufacturer's representative/distributor, has an open sales position for our Southern California territory. The position will be responsible for selling and servicing our entire product line within the specified territory to the PCB manufacturing industry.

This position requires a highly self-motivated, hands on, confident individual of the highest integrity.

Required Skills:

- BA/BS degree-desired, in a technical area is preferred
- Two years of outside/inside sales or manufacturing experience in the PCB manufacturing environment is desired
- Self-motivated self-starter with the ability to initiate and drive business with little supervision
- Independent worker with a strong commitment to customer satisfaction
- Understanding of consumable sales process
- Ability to organize activities and handle multiple projects simultaneously with effective and timely follow-up
- Ability to solve problems and make decisions for which there are no precedents or guidelines and be resourceful in nature
- Positive attitude while operating under pressure and be an independent problem-solver
- Computer skills in Windows, Outlook, Excel, Word and PowerPoint
- Must have a valid driver's license with good driving record

Please send resume.

[apply now](#)



TECHNICA, U.S.A.

Fulfilling Manufacturing Needs
Throughout the Electronics Industry

Western Regional Equipment Service Technician

Technica, USA, a Western regional manufacturer's representative/distributor has an opening for an equipment service technician covering the Western USA, including but not limited to, California, Oregon, Washington, Utah, Colorado, and Arizona. The position will be responsible for servicing our PCB fabrication equipment product line, including installation, troubleshooting, repair service, rebuild service, etc. This position requires a highly self-motivated, hands on, confident individual of the highest integrity.

Key responsibilities are to install and service equipment, conduct equipment audit, and provide technical service when appropriate to solve problems.

Required Skills:

- 2+ years of experience in a PCB manufacturing environment or similar
- Willing to travel
- Positive "whatever it takes" attitude while operating under pressure
- Self-motivated self-starter with the ability to initiate action plans
- Ability to work independently with a strong commitment to customer satisfaction
- Excellent communication and interpersonal skills
- Strong ability to use all resources available to find solutions
- Computer skills with ability to write detailed service and equipment reports in Word
- Understanding of electrical schematics
- Able to work in and around equipment, chemical, and environmental conditions within a PCB manufacturing facility

Please send resume.

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CAREER OPPORTUNITIES



LENTHOR ENGINEERING

MAKING THINGS FLEXIBLE IN A RIGID WORLD®

311 Turquoise Street Milpitas, CA 95035 (Phone) 408-945-8787

SALES ACCOUNT MANAGER

This is a direct sales position responsible for creating and growing a base of customers. The account manager is in charge of finding and qualifying customers while promoting Lenthor's capabilities to the customer through telephone calls, customer visits and use of electronic communications. Experience with military and medical PWB/PWA a definite plus. Each account manager is responsible for meeting a dollar level of sales per month and is compensated with salary and a sales commission plan.

Duties include:

- Marketing research to identify target customers
- Initial customer contact (cold calling)
- Identifying the person(s) responsible for purchasing flexible circuits
- Exploring the customer's needs that fit our capabilities in terms of:
 - Market and product
 - Circuit types used
 - Quantity and delivery requirements
 - Competitive influences
 - Philosophies and finance
 - Quoting and closing orders
 - Bonding
- Submitting quotes and sales orders
- Providing ongoing service to the customer
- Problem solving
- Developing customer information profiles
- Developing long-term customer strategies to increase business
- Participate in quality/production meetings
- Assist in customer quality surveys
- Knowledgeably respond to non-routine or critical conditions and situations

Competitive salaries based on experience, comprehensive health benefits package and 401(k) Plan.

[apply now](#)



Experienced PCB Sales Professional

With more than 30 years of experience, Prototron Circuits is an industry leader in the fabrication of high-technology, quick-turn printed circuits boards. Prototron of Redmond, Washington, and Tucson, Arizona are looking for an experienced sales professional to handle their upper Midwest Region. This is a direct position replacing the current salesperson who is retiring after spending ten years with the company establishing this territory.

The right person will be responsible for all sales efforts in this territory including prospecting, lead generation, acquiring new customers, retention, and growth of current customers.

This is an excellent opportunity for the right candidate. Very competitive compensation and benefits package available.

For more information, please contact Russ Adams at 425-823-7000, or [email your resume](#).

[apply now](#)

Process Engineer (Redmond, Washington)

With more than 30 years of experience, Prototron Circuits is an industry leader in the fabrication of high-technology, quick-turn printed circuits boards. We are looking for an experienced PCB process engineer to join the team in our Redmond, Washington facility. Our current customer base is made up of forward-thinking companies that are making products that will change the world, and we need the right person to help us make a difference and bring these products to life. If you are passionate about technology and the future and believe you have the skills to fulfill this position, please contact Kirk Williams at 425-823-7000 or [email your resume](#).

[apply now](#)



Proposal Coordinator— Saline Lectronics

Saline Lectronics provides electronic contract manufacturing to the commercial, medical, aerospace and telematics industries by delivering exceptional quality and value to achieve long-term, successful partnerships with our clients.

We are seeking to add an 'Excel Whiz' proposal coordinator to our Quoting Group.

Primary Function: The proposal coordinator will be responsible for responding to all incoming quotations in a timely manner. Day to day work may include identifying sources from vendors needing specific components, and successfully researching new sources for vendors to meet customer requirements. This role requires a candidate who is extremely comfortable with Microsoft Excel and can use V-Lookups and formulas with ease.

Work Performed: Supports all quoting activity; maintains knowledge of what information is required to obtain accurate quotes and ensures that the required information is available, or requests it from the account manager/sales engineer responsible for the given quote; prepares quote packages and solicits quotes from the supply base; analyzes quotations submitted for the best possible outcome for both companies; reviews final quotations with Saline Lectronics' president; organizes and submits quotations to the account manager/sales engineer for submission to customer.

[apply now](#)



PCB Process Planner

Accurate Circuit Engineering (ACE) is an ISO 9001:2000 certified manufacturer of high-quality PCB prototypes and low-volume production for companies who demand the highest quality in the shortest time possible. ACE is seeking a skilled individual to join our team as a PCB process planner.

Responsibilities will include:

- Planning job travelers based on job release, customer purchasing order, drawings and data files and file upon completion
- Contacting customer for any discrepancies found in data during planning and CAM stage
- Consulting with director of engineering regarding technical difficulties raised by particular jobs
- Informing production manager of special material requirements and quick-turn scheduling
- Generating job material requirement slip and verify with shear clerk materials availability
- Maintaining and updating customer revisions of specifications, drawings, etc.
- Acting as point of contact for customer technical inquiries

Candidate should have knowledge of PCB specifications and fabrication techniques. They should also possess good communication and interpersonal skills for interfacing with customers. Math and technical skills are a must as well as the ability to use office equipment including computers, printers, scanners, etc.

This position requires 3 years of experience in PCB planning and a high school level or higher education.

[apply now](#)

TOP TEN



Recent Highlights from PCBDesign007

1 Mentor Introduces Unique Valor NPI Automated Technology Solution to Ease PCB DFM

With the increasing complexity of PCB technology, there is a greater burden put on manufacturers to create useful DFM rules. Unlike traditional DFM methods that limited DFM technology use to subject matter experts, with the new Valor NPI, designers can benefit from DFM without having to be an expert.



2 A Deep Look Into Embedded Technology

We set up a conference call with the goal of uncovering the challenges and opportunities related to embedded technology. Invited were a handful of the industry's heavy hitters in the embedded world: Retired technologist and I-Connect007 Contributing Editor Happy Holden, and Ohmega's Technical Director Daniel Brandler and Design & Test Engineer Manuel Herrera.



3 Orange County Chapter of IPC Designers Council Lunch 'n' Learn Meeting July 19

For the July Lunch 'n' Learn meeting on July 19, speakers will explore the advances in embedded passives, which can benefit many designs today. Speakers include Bruce Mahler of OhmegaPly Technologies and Jin Hyun Hwang of DuPont.



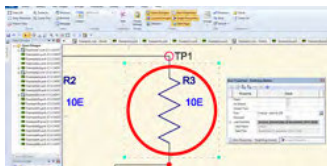
4 Beyond Design: The Dark Side—Return of the Signal

Barry Olney has written about current flow actually being a round trip—the current must return to the source to complete the loop. What about crosstalk in the return path of the reference planes as the current weaves its way back through the expansive wasteland of copper? This month's column elaborates on crosstalk in the unseen "dark side" of the signal.



5 **Zuken Improves Team Communication and High-Speed Design Support with CADSTAR 18**

The latest version of its CADSTAR desktop PCB design software also supports industry requirements for high-speed design, and includes across-the-board performance enhancements and ease-of-use features. One highlight is developments in the industry-leading Activ-45 router.



6 **PCB Design in the Age of IoT**

From the early days of printed circuit boards, the electronics industry has made huge strides in board materials, copper printing methods, miniaturization, rigid-flex, ELIC, EDA, and much more. And in 2017, we are poised to shift from evolution to revolution, driven by the idea of the Internet of Things.



7 **Romania's PCB Design Students Compete at TIE 2017**

The 26th Interconnection Techniques in Electronics (TIE) show was held recently at the Gheorghe Asachi Technical University in Iasi, Romania. This convention for the Romanian electronic packaging community included a series of actions designed to draw smart young students to the electronics industry, which is clearly growing.



8 **Printed Circuit Broker Elmatica Encourage Development of New Language**

Elmatica is currently taking charge in developing a new language for PCB fabrication data. The development of the language will be by an independent international task group with members from the entire supply chain. If the industry is up for the challenge, the result can be both cost-efficient and a vital time saver in production.

ELMATICA®

9 **Stella Corporation Implements Ucamco's Gerber X2 Input and Output**

Japanese PCB software company Stella Corporation has completed its support for Gerber X2 in Stella Vision. The output has been fully verified by Ucamco, who confirm it conforms to the current X2 specification.



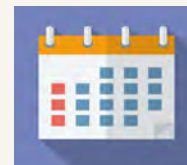
10 **Launching a New PCB Design Curriculum in Serbia**

"You don't need to know how to manually solder electrical parts or how to design printed circuit boards," our professor lectured. "It is important that you understand the formula for charge carrier currents in a p-n junction." At my first job, I was soon designing PCBs, and no one ever asked me about charge carriers and p-n junctions.



PCBDesign007.com for the latest circuit design news and information—anywhere, anytime.

Events



For IPC Calendar of Events,
[click here](#).

For the SMTA Calendar of Events,
[click here](#).

For a complete listing, check out
The PCB Design Magazine's
[event calendar](#).

IPC Technical Education— Best Practices in Design

July 26–27, 2017
Chicago, Illinois, USA

PCB West

September 12–14, 2017
Santa Clara, California, USA

24th FED Conference

September 15–16, 2017
Bonn, Germany

SMTA International 2017 Conference and Exhibition

(IPC Fall Committee meetings held in
conjunction with SMTAI)
September 17–21, 2017
Rosemont, Illinois, USA

IPC Fall Committee Meetings

September 17–21, 2017
Rosemont, Illinois, USA

electronicAsia

October 13–16, 2017
Hong Kong

IPC Flexible Circuits: HDI Forum

October 17–19, 2017
Minneapolis, Minnesota, USA

TPCA Show 2017

October 25–27, 2017
Taipei, Taiwan

productronica 2017

(IPC Committee meetings held in conjunction
with productronica)
November 14–17, 2017
Munich, Germany

HKPCA/IPC International Printed Circuit & South China Fair

December 6–8, 2017
Shenzhen, China

47th NEPCON JAPAN

January 17–19, 2018
Tokyo Big Sight, Japan

DesignCon 2017

January 30–February 1, 2018
Santa Clara, California, USA

IPC APEX EXPO 2018 Conference and Exhibition

February 27–March 1, 2018
San Diego, California, USA

Medical Electronics Symposium 2018

May 16–18, 2018
Dallas, Texas, USA



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barry@iconnect007.com

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

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

EDITORIAL:

MANAGING EDITOR: **ANDY SHAUGHNESSY**
(404) 806-0508; andy@iconnect007.com

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

MAGAZINE PRODUCTION CREW:

PRODUCTION MANAGER: **SHELLY STEIN**

MAGAZINE LAYOUT: **RON MEOGROSSI**

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myconnect007.com

EDITORIAL CONTACT

Andy Shaughnessy
andy@iconnect007.com
 +1 404.806.0508 GMT-5



mediakit.iconnect007.com

SALES CONTACT

Barb Hockaday
barb@iconnect007.com
 +1 916 365-1727 GMT-7



www.iconnect007.com