THE pcb design MAGAZINE

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MARCH 2017

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"Flexdude" Tom Woznicki Celebrates Company's 25th Anniversary p.20

American Standard Circuits Releases eBook on Designing Flex and Rigid-Flex p.28

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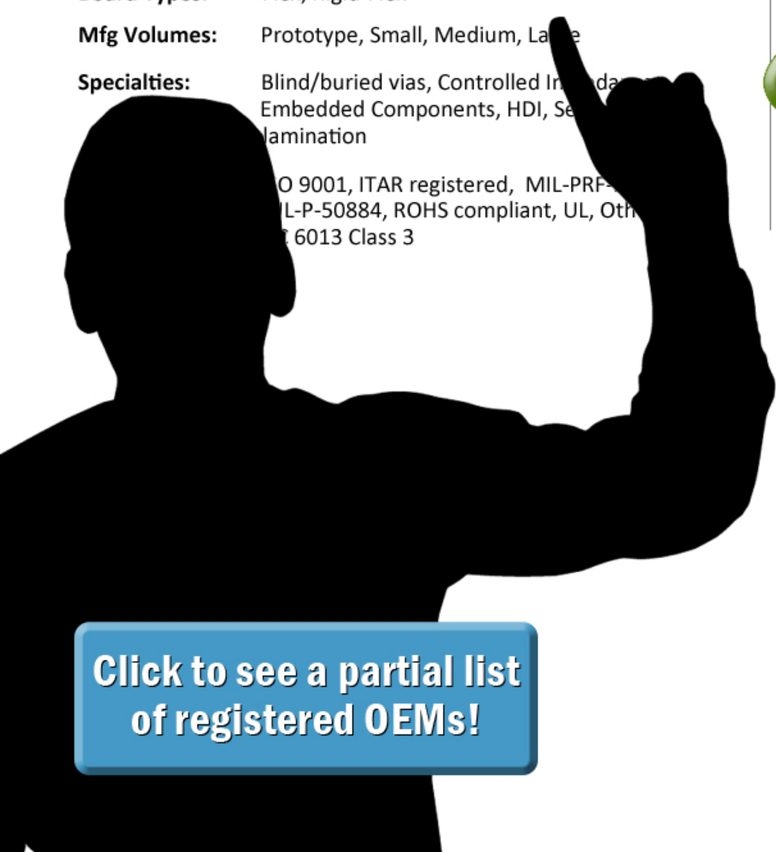

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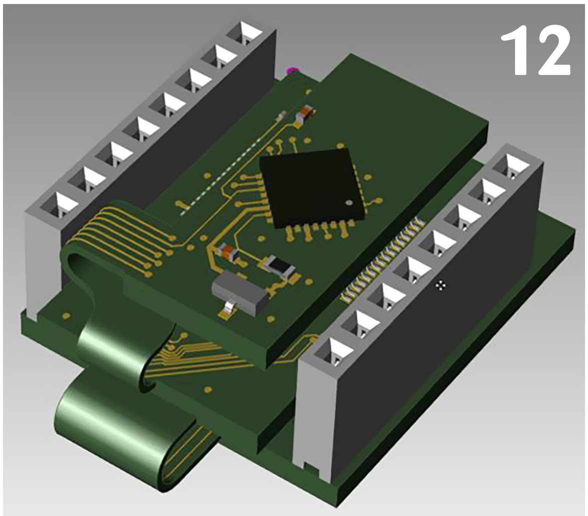

The Flex Issue

It wasn't that long ago that flex and rigid-flex were considered expensive specialty circuits. But times have changed, and flex circuits are now found in most of our personal electronic devices. This month, we focus on designing flex and rigid-flex circuits. In our feature story, Craig Armenti of Mentor Graphics offers a variety of rigid-flex design tips and best practices. Tom "Flexdude" Woznicki of Flexible Circuit Design Company discusses the changes he's seen in flex design during his company's first 25 years in operation. And American Standard Circuits' Anaya Vardya and Dave Lackey tell us about their new book, *The Printed Circuit Designers' Guide to…Flex and Rigid-Flex Fundamentals,* published this week by I-Connect007. We also have columns by our contributors Barry Olney of In-Circuit Design, Bert Simonovich of Lamsim Enterprises, Tim Haag of Intercept Technology, and Alistair Little of Electrolube.

185HR

High-Tg, Low-CTE Materials with High Thermal Reliability

FEATURES

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- T288: >15 minutes
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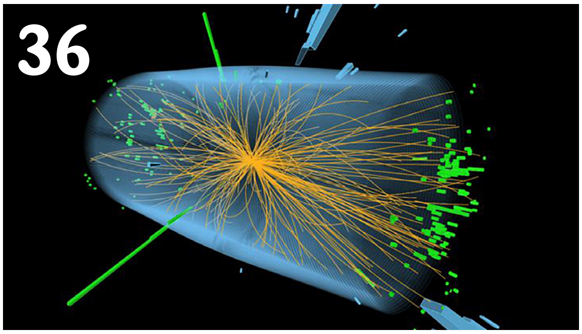
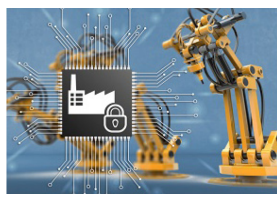




We Have to be Marketers for Our Industry

by Andy Shaughnessy
I-CONNECT007

Each year, I enjoy checking out the Design Forum during IPC APEX EXPO. You never know what to expect, and the event gives you a good feel for what's on designers' minds. Every few years, attendees are, ahem, critical of IPC and the Designers Council and their outreach programs, or lack thereof. This was one of those years.

Speaker Stephen V. Chavez, lead electrical designer with UTC Aerospace Systems and a CID+ instructor, discussed efforts to grow the Designers Council, add new chapters, and draw more young people into PCB design careers. This is where the conversation went off the rails. It wasn't exactly argumentative, but everyone in the room seemed to have a different opinion about what IPC and the Designers Council were doing right and wrong, especially when it comes to attracting talented young people. And as designers, they're not shy about sharing these opinions. (PCB designers remind me of the old joke about French politics: How do you get five different French political opinions? Ask four Frenchmen.)

One attendee asked why IPC was still virtually unknown on some college campuses, even those with solid electronics curricula. Another asked why IPC didn't have a rep for each college. I think the sheer numbers of colleges would make that a tough way to go, but it was a good question.

What is the answer? How can we reach the next generation of PCB designers? What can be done to get smart high school and college students interested in designing, fabricating, or assembling circuit boards?

How can we get guidance counselors to start recommending a career in PCB design or manu-

facturing? How can we get kids excited about a career in electronics, period? It shouldn't be this tough, really. Kids have iPhones in fourth grade, and play video games in kindergarten. They've been exposed to cool electronics their whole lives. Why don't more of them want to join our industry? I'd really like to know.

It's a problem that's been ongoing for decades. Here we are, working with great people in an industry that provides the backbone for electronic products, and most young people don't know it exists as a career choice.

IPC has been working for decades to get the PCB curriculum into colleges. But a few designers at the Design Forum shared their opinions that IPC and the Designers Council are just not doing enough to market the DC and attract more people, especially young students, to a PCB design career. That's IPC's responsibility, right?

But wait. Isn't it our responsibility? It's our industry; shouldn't we see to it that our industry gets the respect it deserves, and that the next generation can't resist joining us and working on some of the coolest technology around?

What if everyone who attended IPC APEX EXPO went home and visited the schools in their neighborhood, spreading the word about our industry? What if everyone who attended DesignCon, DAC, IMS and PCB West did the same? I bet the locals who attend CPCA are already doing this.

Why are we waiting for someone else to take care of this problem? Why don't we all just visit our local schools and talk with the guidance counselors and students? Do a presentation. Organize a field trip to a board shop; you know that kids would love that nasty smell. Show them this magazine. Hell, show them all of the PCB design and manufacturing websites and magazines, print and online. Let the kids know that this industry is full of people who make a decent dollar doing what they love. Many of these people will be retiring in the next 10 years, and their positions will be opening up. Actually, they're already opening up; at APEX, I spoke with a half-dozen company owners who were having trouble finding qualified employees. Some have had vacant positions for months.

So, why don't we spread the word about circuit boards? We know all about this industry and the many careers it supports, careers that put food on our tables and put our kids through college.

As the old saying goes, "We're all in marketing." Why don't we all start marketing our industry?

Make an appointment for Career Day. Tell the kids stories about circuitry. Tell a few stories about the road—well, not *those* stories from the road. Talk about Bell Labs, and the demise of the captive shops. Tell them a Dieter Bergman story, or a Martin Cotton story.

Sure, the technology is fantastic, but it's the people that make this industry what it is. And it's time for we, the people, to start focusing on attracting new blood to this industry.

Flexy Time

Flex and rigid-flex used to be specialty products, but that's not the case anymore. This month, we focus on designing flex and rigid-flex circuits. In our cover story, Craig Armenti of Mentor Graphics offers a variety of rigid-flex design tips and best practices. Tom "Flexdude" Woznicki of Flexible Circuit Design Company discusses the changes he's seen in flex design during his company's first 25 years in operation.

Anaya Vardya and David Lackey of American Standard Circuits celebrate the release of their new I-Connect007 micro eBook, *The Printed Circuit Designers' Guide to…Flex and Rigid-Flex Fundamentals*, which we published this week. We also have columns by our contributors Barry Olney of In-Circuit Design, Bert Simonovich of Lamsim Enterprises, Tim Haag of Intercept Technology, and Alistair Little of Electrolube.

There's a bit of a lull between trade shows now, but I'll be at SMTA Atlanta and the Designers Roundtable in April. Hope to see you there! **PCBDESIGN**

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.

FEATURE

Rigid-flex

Design Tips and Best Practices

by Craig Armenti
MENTOR GRAPHICS

As rigid-flex design becomes commonplace across many industry segments, education on terminology, requirements, processes and best practices are all critical in order to ensure a high probability for first-pass success. As the name indicates, rigid-flex circuits are comprised of a combination of rigid and flexible board technologies. These types of designs consist of multiple layers of flexible circuit substrates attached internally and/or externally to one or more rigid boards.

By combining the advantages of the two technologies, designers have more options when working with dense designs that must conform to a specific form factor. Rigid-flex is a truly enabling technology that lets product development teams cost-efficiently apply greater functionality to a smaller volume of space while at the same time providing the mechanical stability required by most applications.

Prior to the advent of rigid-flex design, when a product required a flex PCB (or multiple flex PCBs), the flex and rigid PCBs were designed separately. Each PCB contained one or more physical connectors in order to assemble the individual boards into a product-level design. In this design methodology, the flex designs were assigned to a specialist who was familiar with stackup and material options along with the best practices and requirements for flex-specific items such as bend regions and stiffeners. There is, after all, a certain science to flex design that, when properly applied, can help ensure first-pass success. While this traditional "design-separately-then-assemble" approach minimized potential issues with the flex portions of the product, it also had several inherent disadvantages. These include the cost associated with the physical connectors; the space required for the physical connectors; the need to properly manage interconnects that have to transition between the separate rigid and flex PCBs (through the connectors); and, of course, the time and cost associated with assembly. The move to the current generation of rigid-flex technology mitigates these issues; however, they are replaced with a different set of challenges and concerns. The good news is these challenges and concerns can be alleviated simply by following some key best practices and guidelines.

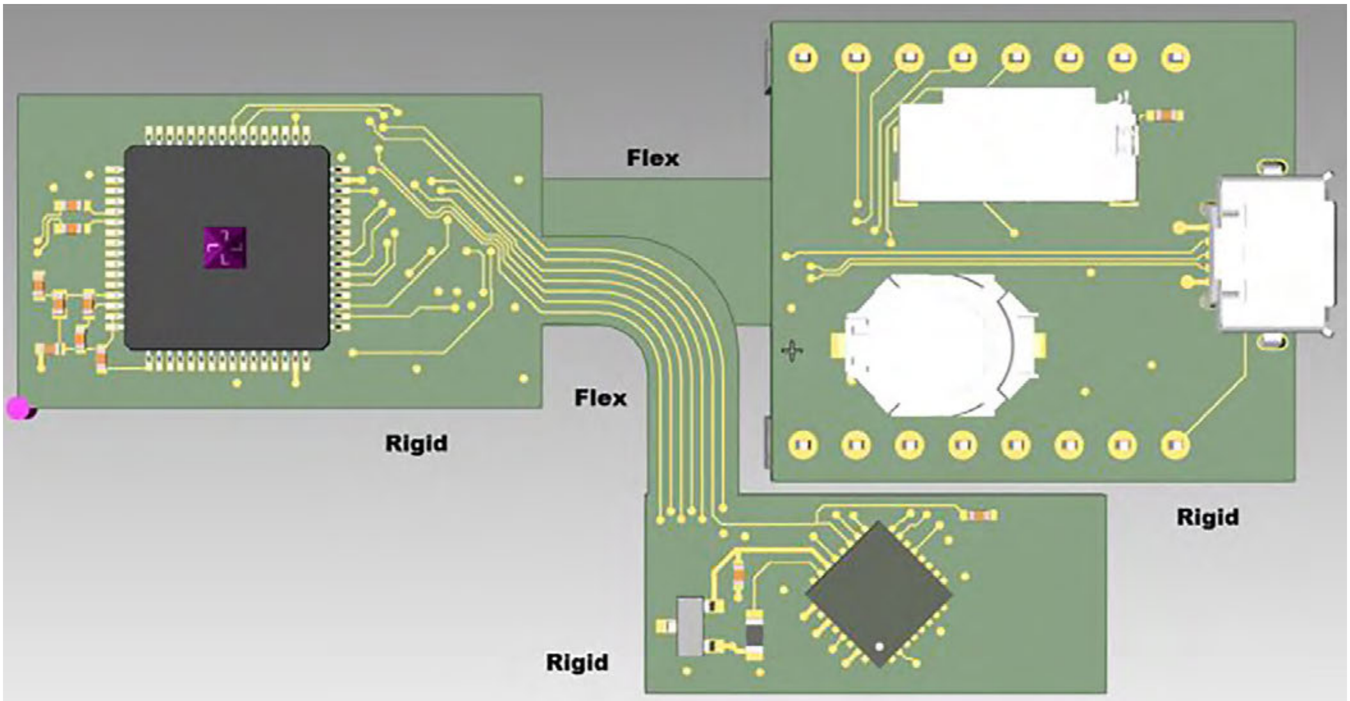


Figure 1: Three rigid boards and two flex PCBs as viewed in their flat state.

Rigid-flex Benefits and Challenges

Current-generation rigid-flex designs are typically found in mobile phones, LCD televisions, digital cameras and laptops, to name just a few. Basically, whenever a product needs to be compact and/or lightweight and/or flexible, then rigid-flex technology will most likely be applied. The benefits of rigid-flex technology include:

- Reduced cost and increased reliability through the elimination of the physical connectors used in the traditional “design-separately-then-assemble” approach.
- Improved signal integrity through the elimination of cross-sectional changes to the conductors (removal of physical connectors and their associated solder connections).
- Reduced space requirement as parts can be placed, and traces can be routed, in three dimensions.
- Improved electromechanical functionality including dynamic bending, vibration and shock tolerance, heat resistance, and weight reduction.

In order for product development teams to realize these benefits, designers who traditionally were solely proficient in rigid technology have to very quickly expand their knowledge base to now include rigid-flex technology. These designers need to work through both their individual learning curve and the various rigid-flex technology challenges, either of which has the potential to derail a project and cause costly design failures. Unfortunately, the rigid-flex technology challenges themselves can be further exacerbated if the ECAD tools being utilized by the design team do not facilitate and ensure process compliance.

Best Practices and Guidelines

As previously mentioned, education on terminology, requirements, processes and best practices are all critical in order to mitigate the challenges associated with rigid-flex design. Some of the fundamental challenges, along with the associated best practices and guidelines to address those challenges are as follows:

- **Stackup management:** The stackups for the rigid and flex PCBs will almost always vary, as such the designer needs to manage them efficiently and ensure they are properly conveyed to the fabricator. An ECAD tool that supports region-specific stackups (not ideal) or board-specific stackups (preferred) will help simplify this complex task.

- **Board outline management:** The multiple boards in a rigid-flex design need to be properly configured and managed throughout the design process. Rigid-flex designs are in fact electromechanical projects that require collaboration between the electrical and mechanical domains. The ability to import and automatically create multiple (and potentially complex) board outlines from mechanical CAD data will both save time and reduce the potential for errors.
- **Fabricator interaction:** This aspect of rigid-flex design cannot be stressed enough. Feedback from the fabricator on stackup, material, keepout regions, bend requirements, stiffeners, etc., will help ensure the design can be properly fabricated with high reliability.
- **Signal and power integrity analysis:** Most signal integrity and power integrity tools assume a single PCB with a uniform stackup. For rigid-flex designs the analysis tools must recognize flex-specific layers and local stackups in order to ensure correct analysis results.
- **3D design and verification:** The ability to define the bend parameters (bend radius, bend angle, and bend origin), edit the design in 3D, view the design in the context of the enclosure, and perform 3D rigid-flex aware design rule checks (DRC), cannot be overstated. 3D design and verification ensure that the design team is taking advantage of open real estate in all three dimensions while, at the same time, identifying potential design issues.

As previously mentioned, since flex design requirements will most likely be new to the first-time rigid-flex designer, some of the fundamental flex-specific best practices and guidelines are as follows:

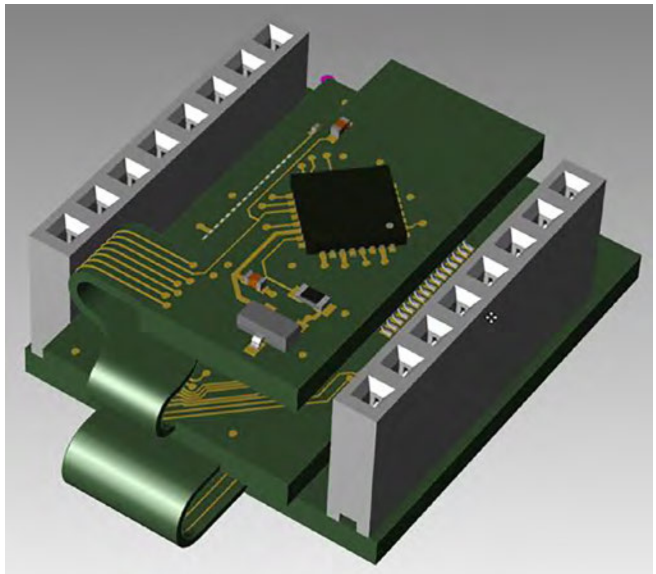


Figure 2: Three rigid and two flex PCBs as viewed in their 3D state.

- Ensure that the trace width and trace spacing are both as large as possible.
- Traces should be routed using round corners. Ninety-degree corners should be avoided. Furthermore, the round corners must be true arcs. Segmented arcs will create stress fractures. In most cases, the trace contour should mimic the flex board outline contour. An ECAD tool that allows the trace routing to automatically follow the board outline contour will help save time.
- If there is a need to route on more than one layer, stagger the traces for adjacent conductors.
- Cross-hatch power/ground planes as permitted by electrical requirements (cross-hatching a plane has significant impact on the impedance of any conductor using it as a return path).
- Stiffeners should be used if any portion of any flex requires a part such as a flex connector, plug, or jack.

Finally, the area of the flex that will bend or twist, also known as the flex bend region, has its own set of fundamental best practices and guidelines in order to maximize reliability:

- Do not change the width of the traces within the region.
- Distribute traces evenly.
- Route traces perpendicular to the bend direction (any lack of symmetry increases the chance of stress buildup).
- No vias permitted within the region.
- Hatched power/ground planes should be parallel with the region. As previously noted, cross-hatched power/ground planes are preferred, however the cross-hatch pattern should be at a 45° angle in relation to the bend line. An ECAD tool that can calculate the cross-hatch angle in relation to the bend line when creating the plane fill will save time and effort, especially for designs with odd angle bend lines.
- Most importantly, the bend radius calculation is perhaps the greatest challenge associated with the bend region, and as such, will require close collaboration with the fabricator. The bend radius requirements will vary based on the application. Generally speaking, the flex will either be static (bend once during installation) or dynamic (bending can occur numerous times throughout the products lifespan). Static flexes will require a tighter bend radius than dynamic flexes. The bend radius is critical in order to avoid compression (area inside of the bend) or tension reliability issues.

The above best practices and guidelines are introductory in nature, and as such, are not intended to be all inclusive. These are the areas that the first-time rigid-flex designer needs to focus on and become familiar with as quickly as possible. They are all unique to the technology and almost all will come into play for even the simplest rigid-flex design. For reference, other items that will need to be reviewed with the fabricator include; impedance control, hole to interface distance (where the flex interfaces with the rigid), construction options, laminates and bonding materials, surface finish, and cover layer design.

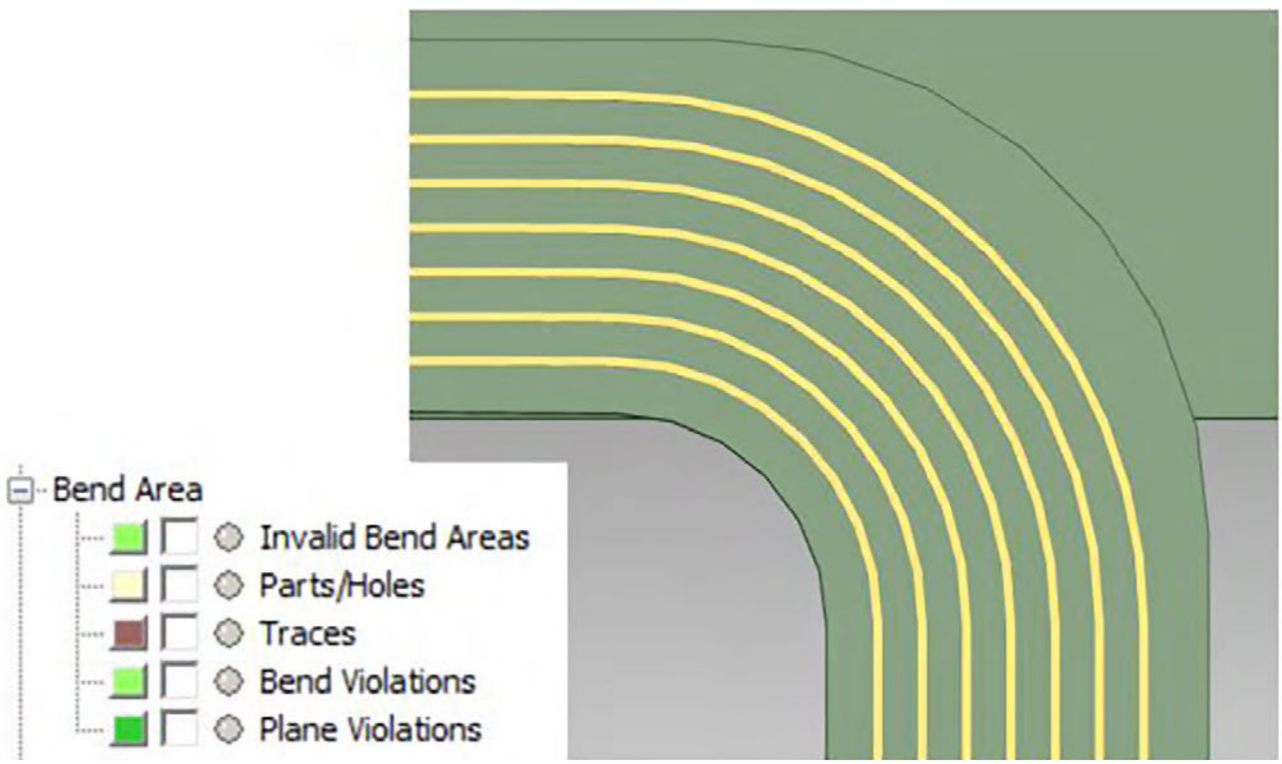
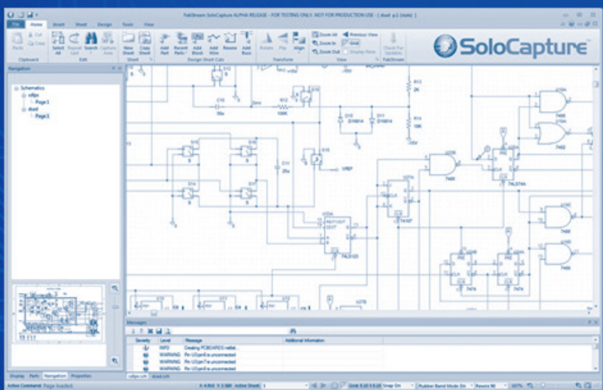


Figure 3: Rigid-flex bend area DRCs can help ensure process compliance.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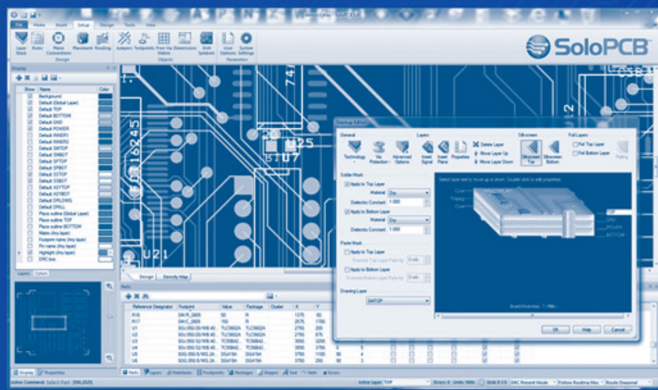
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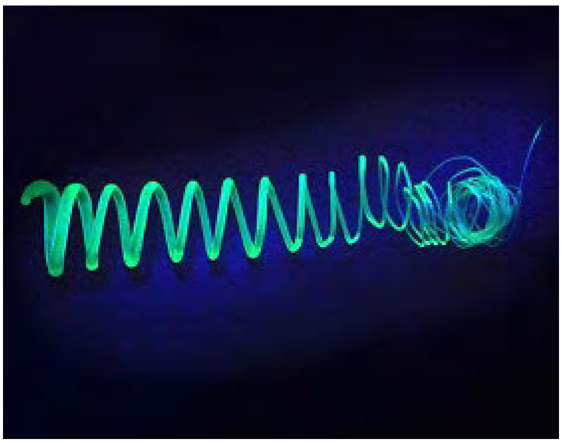
Tools Should be Enablers

As mentioned throughout this article, design of a rigid-flex product is significantly different from the design of a rigid-only product. The ECAD design realm has seen huge advances in the last decade. As the more traditional "design-separately-then-assemble" approach moves to current-generation rigid-flex design, product development teams need to leverage and take advantage of these advances in order to improve productivity and reduce development costs. Proper education on rigid-flex terminology, requirements, processes, and best practices, combined access and proper utilization of tools that facilitate rather than hinder both process compliance and correct-by-construction design are equally important. Education combined with tool enablement will ease the development process and ensure a high probability for first-pass success. **PCBDESIGN**

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. He has held Marketing and Application Engineering positions with several major telecommunication and software companies.

A Perfect Team for Nanoelectronics

Researchers at the Technical University of Munich (TUM) have, for the first time ever, produced a composite material combining silicon nanosheets and a polymer that is both UV-resistant and easy to process. This brings the scientists a significant step closer to industrial applications like flexible displays and photosensors.



Similar to carbon, silicon forms two dimensional networks that are only one atomic layer thick. Like graphene, these layers possess extraordinary optoelectrical properties. Silicon nanosheets might thus find application in nanoelectronics, for example in flexible displays, field-effect transistors and photodetectors.

"Silicon nanosheets are particularly interesting because today's information technology builds on silicon and, unlike with graphene, the basic material does not need to be exchanged," explains Tobias Helbich from the WACKER Chair for Macromolecular Chemistry at TUM. "However, the nanosheets themselves are very delicate and quickly disintegrate when exposed to UV light, which has significantly limited their application thus far."

Now Helbich, in collaboration with Professor Bernhard Rieger, Chair of Macromolecular Chemistry, has for the first time successfully embedded the silicon nanosheets into a polymer, protecting them from decay.

Its flexibility and durability against external influences also makes the newly developed material amenable to standard polymer technology for industrial processing. This puts actual applications within an arm's reach.

The first successful application of the nanocomposite constructed by Helbich was only recently presented in the context of the ATUMS Graduate Program (Alberta / TUM International Graduate School for Functional Hybrid Materials): Alina Lyuleeva and Prof. Paolo Lugli from the Institute of Nanoelectronics at TU Munich, in collaboration with Helbich and Rieger, succeeded in building a photodetector based on these silicon nanosheets.

To this end, they mounted the polymer embedded silicon nanosheets onto a silicon dioxide surface coated with gold contacts. Because of its Lilliputian dimensions, this kind of nanoelectronic detector saves a lot of both space and energy.

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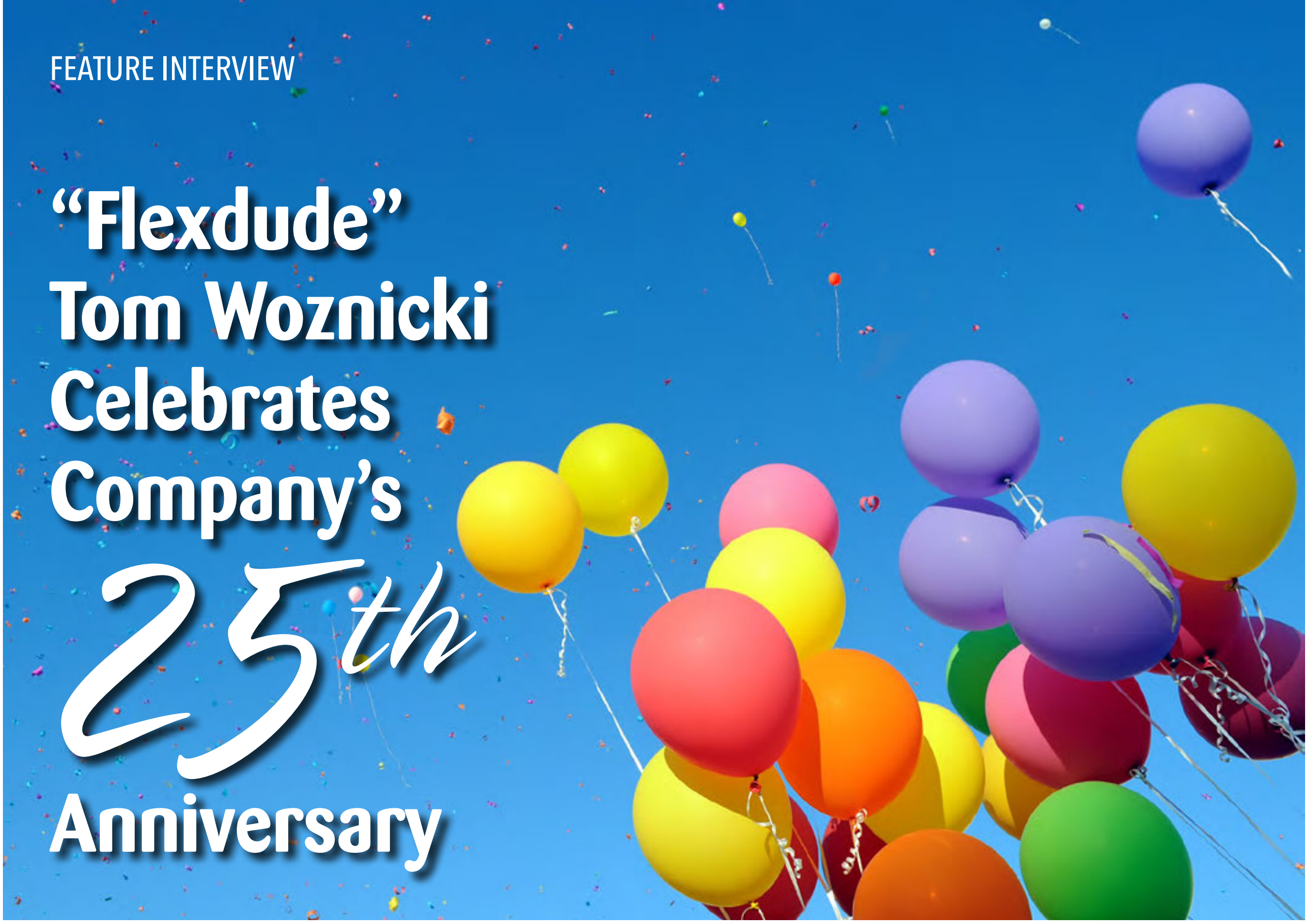


"Flexdude" Tom Woznicki Celebrates Company's 25th Anniversary

by Andy Shaughnessy
I-CONNECT007

Twenty-five years ago, Tom "Flexdude" Woznicki got laid off. A lot of people did, back during the mini-recession that helped bring Bill Clinton into the White House. So, he launched his own flex circuit design bureau and never looked back. Since then, he's designed flex circuitry for everything under the sun, including the Mars Rover; the flex circuits he designed are visible in many of the Rover photos. I ran into Tom at DesignCon 2017 and we discussed the benefits of flex circuits, the expansion of the flex market, and his company's first quarter-century in operation.

***Andy Shaughnessy:** I'm here with Tom Woznicki of the Flex Circuit Design Company.*

Tom Woznicki: Guess what we do!

***Shaughnessy:** And you're the founder…*

Woznicki: Founder, owner, president, janitor, maintenance guy, all rolled into one. Andy, it's good to see you.

***Shaughnessy:** You too, Tom. Give us a brief background on the company.*

Woznicki: We've been a service bureau that specializes in flex circuit design and this is our 25th year in business. It started back in 1992 when I got laid off from Rogers Corporation. You know, necessity is the mother of adventure and invention. I was a technical sales engineer for Rogers and they went through a re-organization and I got laid off. But I had been taking some CAD courses at night on the side because I'm a mechanical engineer by education. I thought I'd find my millions in technical sales. I fell into some design work and said, "I think I can do this," and hung out a shingle and here we are 25 years later.

***Shaughnessy:** And you were using tools that were in no way designed for flex right?*

Woznicki: Well, no actually. Back then Rogers was associated with Smart Flex. I don't know if you remember Smart Flex, but the designer at Rogers was using AutoCAD to design flex circuits. So I had taken a course in AutoCAD. I admit, a company who is still headquartered here,

whose software I still use, CAD Design Software, makes something called Electronics Packaging Designer, which sits atop AutoCAD and then makes AutoCAD do the circuit board designing.

Whereas most board tools will only do 45° angles, this can make any shape or trace you want. Then just press the button and it burps it out into Gerber. So I've used that tool ever since. As the years have gone on, I've purchased other tools like Allegro and Altium too, because that's what customers have required.

***Shaughnessy:** It used to be that flex was so expensive that people didn't use it. When I first started in the '90s covering this industry, flex was kind of like an afterthought.*

Woznicki: You only used flex if nothing else would work. To a large extent that is still the same because, I mean, a cable harness and a rigid board will always be cheaper than a flex circuit.

You've got to have another reason to use flex. Either weight or reliability, it's got to bend or it's got to fold, or you need really fine traces, finer that you can make on a rigid board. There's got to be a reason for it, but it's much more a commodity than it used to be, that's for sure.

***Shaughnessy:** And the prices of stiffeners and all these things, did they all come down too?*

Woznicki: Stiffeners add very little to the cost. The cost of the materials have gone down quite a bit, just from the sheer volume of flexes that are being made, and of course all the Asian manufacturing.

***Shaughnessy:** I hear about some people starting with flex because it has signal integrity benefits compared to copper.*

Woznicki: It does. Your dielectric constant is a little bit lower; it's right around 3, and some people say 2.7, but it's definitely a lot lower than the 4.3 that you usually associate with FR-4. You can make a lot finer traces with it because the material is so smooth. You don't have that orange peel look on FR-4 that you get from the weave of the glass and the epoxy filling in. The film is just smooth, so you can etch two-mil lines, one and a half-mil lines if you have to, and even tighter.

***Shaughnessy:** It's funny we just, we see flex all the time now. I guess there's standards now?*

Woznicki: Yeah, there are standards.

***Shaughnessy:** IPC has some flex standards. They're not everywhere but you see rigid-flex in every camera.*

Woznicki: Oh yeah. You take your smart phone apart and you've got a good eight or 10 flex circuits, rigid-flexes in there.

***Shaughnessy:** It seems like fabricators are getting better at building it too.*

Woznicki: Oh, my goodness, yes. I was thinking about this the other day because flex circuits, at least like you were saying back in the day, were very expensive so you had to be pretty careful. If you made a bad batch of flex circuits, that's a pretty expensive pile of scrap. But now, like you said, it's a little bit more of a commodity item, especially in the Asian market. You've got so many people anxious to build it for you and build it at a real low cost. There's a lot more trial and error, so they'll get somebody and it's not a very good design but it half works so they

say, "OK, we'll go back and we'll fix what didn't work. And we'll do it again."

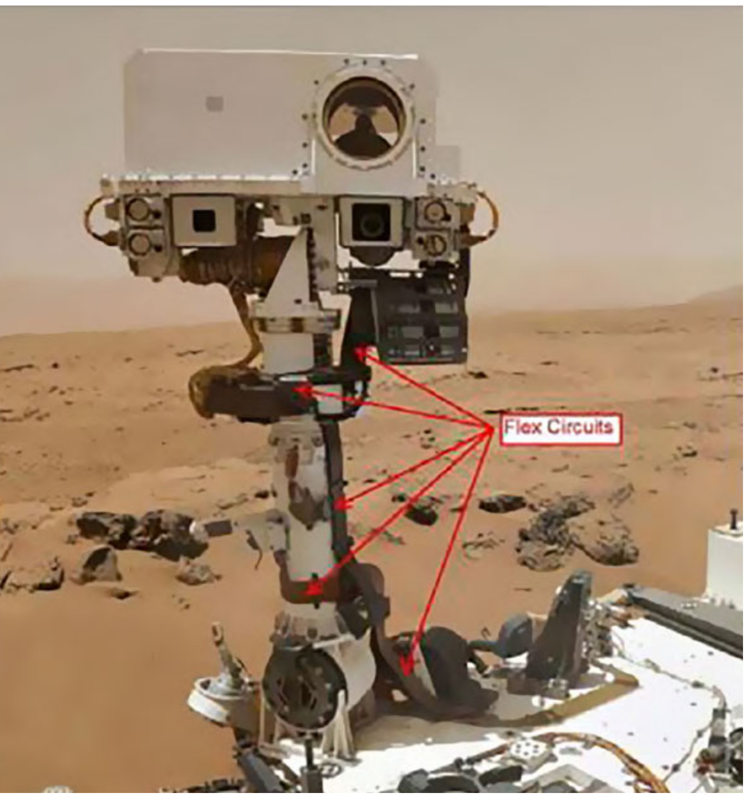
Shaughnessy: That's wild. It's funny it's been such a sea change over the last 10 years or so.

Woznicki: Oh yeah, very much so. The other interesting thing, especially in materials, you're seeing materials from the Far East that you can't necessarily get here in the United States, and that concerns me a little bit.

Shaughnessy: What kind of materials, for example?

Woznicki: I was doing a design for a telecommunications product. It was a pretty intricate flex circuit that had to fold over a couple times and it was a four layer in the flex sections because you had a ground plane, two signal planes, and a ground plane and it was all Faraday caged because it was an RF product. This one cusp, I had specified adhesive-less base materials, 1 mil polyimide with 9-micron copper on either side. This company from Korea came back and said they had this product that's a half-mil polyimide with 9-micron copper on either side. Half-mil polyimide base material. You can't get that from DuPont. I touched base with my friend Robert John over at Altaflex and he says, "Yeah we can get that from several manufacturers, it's not uncommon." So we designed it in and it solved a stiffness problem. And shielding films, for example. Remember the article we did a couple, I guess about a year ago, ninja flex circuits? Where we were talking about shielding films.

I was looking around and those are only available from Asian suppliers. They're wonderful products because you can add a layer of EMI shielding or you can have a reference plane for controlled impedance without adding another copper layer. I'm looking at an application right now where we need that. I've got a customer who wants a flex circuit to last 100,000 cycles and they want controlled impedance too. So just slapping a piece of shielding film, which is like 5-6 microns, on there and you've got your reference plane for controlled impedance, but you've still got your copper in the neutral axis. So it preserves all the dynamic qualities you want. So those products are not available from U.S. manufacturers either. It's a little disconcerting.



Shaughnessy: Interesting. There's an article right there.

Woznicki: There you go.

Shaughnessy: So, have you been following what Trump has planned for the military? You think he's going to beef up NASA again?

Woznicki: I hope so.

Shaughnessy: Seems like it. I know NASA kind of changed their mission and said they weren't going to worry about the delivery system. They were only going to worry about the payload, and let other entities build the rockets. There's no upside in rockets for NASA anymore.

Woznicki: Well there's certainly a number of people pursuing rockets between Elon Musk and Jeff Bezos. If they're successful, yeah, let NASA worry about the payload or what's going to be on the other end. It'd be nice to go back

to the moon or do some other interesting things.

Shaughnessy: ***The XPRIZE people have a rocket or two.***

Woznicki: I know what you're talking about. Is that the one where they had the driverless vehicles that go through the desert?

Shaughnessy: ***Right, all kinds of cool stuff.***

Tom "Flexdude" Woznicki

Woznicki: But yeah, it'd be interesting to see what happens under the Trump administration.

Shaughnessy: ***The military contractors are pretty happy now.***

Woznicki: Yeah, as well they should be.

Shaughnessy: ***That sequestration freaked them out a couple of years ago.***

Woznicki: That is certainly a necessary part of our country.

Shaughnessy: ***Very good. Anything else you want to add? Congratulations on 25 years, staying off the dole and being fully employed.***

Woznicki: Yeah, no kidding. It's like, wow, how did I get here? It's been wonderful, because the palatial corporate headquarters is my upstairs bedroom and it's been wonderful being at home, watching your kids grow up at the same time, working a hell of a lot of hours because work is always right there.

Shaughnessy: ***It never goes away. I'm ruined. I could never work in an office again. How would my laundry get done?***

Woznicki: Me too, I'm too spoiled and I have too many other things that I like to do. I haven't been mud running in a long time, in fact my brother wants me to go out and we've had all these rains here in California so there's going to be some good mud at the four-wheel part.

Shaughnessy: ***Sure. In Atlanta, we call four-wheeling "getting squirrely."***

Woznicki: Getting squirrely? I haven't heard that. My wife and I are on this grand midlife adventure and we're building a hobby farm down in Gilroy, California. When the real estate dipped a while back, we found a cheap piece of farmland for sale so we've got a small herd of beef cattle running out there. So we get to play out there with the cows and the tractors and skip loaders and such.

Shaughnessy: ***That's cool. It's always a pleasure speaking with you, Tom. Thanks again.***

Woznicki: You too, Andy. Thank you. **PCBDESIGN**

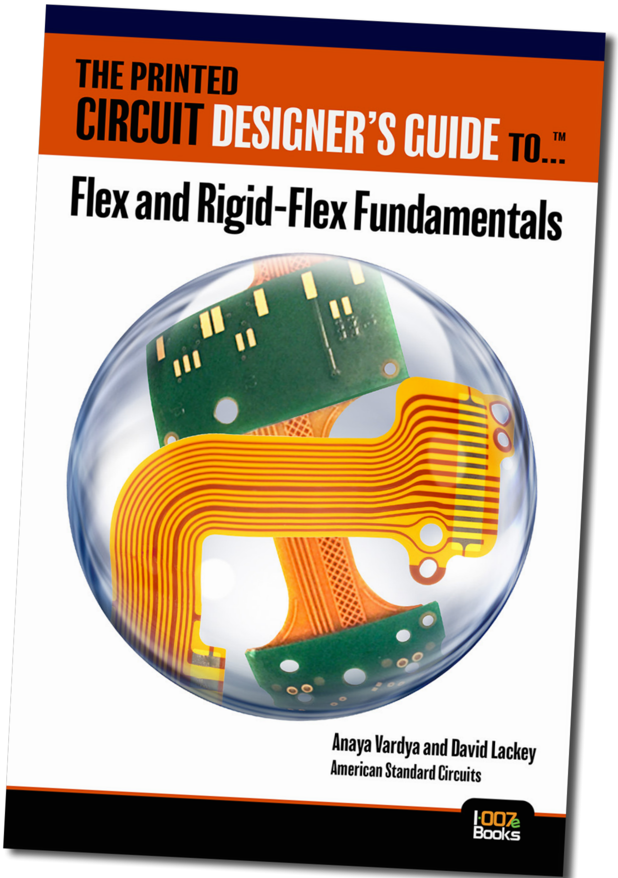
Towards Mastering Terahertz Waves with Graphene

Researchers at the University of Geneva (UNIGE), working with the Federal Polytechnic School in Zurich (ETHZ) and two Spanish research teams, have developed a technique based on the use of graphene, which allows for the potentially very quick control of both the intensity and the polarization of terahertz light.

Working within the framework of the European project Graphene Flagship, scientists have made a graphene-based transistor adapted to terahertz waves.

Today, the UNIGE research team's focus is to move on from the prototype, and develop practical applications and new opportunities by controlling terahertz waves. Their objective is to make terahertz waves industrially competitive in the next few years.

There are two main areas of application for this innovation, the first being communications. This would present a significant advantage in telecommunications. The second sphere of application is that of imaging. Being non-ionising, terahertz waves do not alter DNA and therefore are very useful in medicine, biology and pharmacy.



American Standard Circuits Releases eBook on Designing Flex and Rigid-flex

by Patty Goldman
I-CONNECT007

American Standard Circuits' VP of Business Development Dave Lackey and President/CEO Anaya Vardya have co-authored *The Printed Circuit Designer's Guide to…Flex and Rigid-Flex Fundamentals*, published by I-Connect007.

American Standard Circuits is an industry leader when it comes to high-technology printed circuit boards, especially flex and rigid-flex printed circuit boards. So, it was natural that they would write about flex and rigid-flex for I-Connect007's new "Guide to…" e-book series.

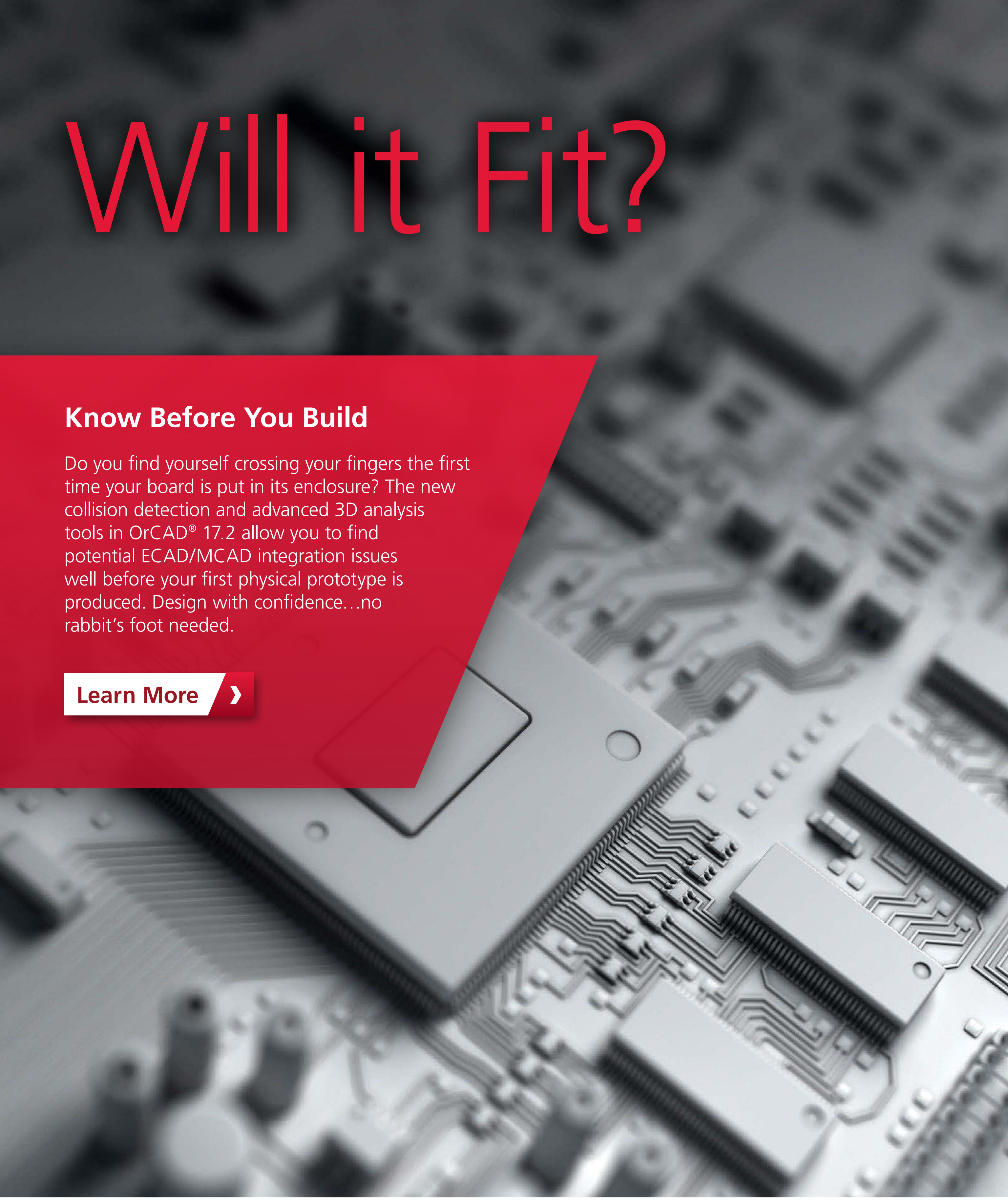
***Goldman:** Gentlemen, congratulations on the book. Tell me a little bit about what it covers and why you chose this subject.*

Lackey: We work so closely with designers all the time that we felt it would be a good idea to write this book for designers. We wanted to cover some of the more common fundamentals that we work on together. We focus on things like dos and don'ts of designing flex and rigid-flex boards, design guidelines, construction tips, and anything else we can help them with during the design process rather than while parts are being built.

Vardya: Our philosophy at American Standard is to help our customers in any way that we can. We want to be their experts and make it easy for them to get their boards built. Over the last few years, we have seen more designers venturing into the flex and rigid-flex arena. There are several differences between these boards and regular rigid PCBs. We wanted to share our knowledge with them and alert them to various items in the design process where they would want to consult with their PCB fabricator. We felt that this book was a perfect way to do this.

***Goldman:** I know you wrote it for PCB designers. How do you expect this book to help them?*

Lackey: It is critical for designers to work closely with their PCB fabricator when designing flex and rigid-flex PCBs. We wanted to educate them on several issues where they would want to collaborate with their fabricator while educating them about the various nuances of these circuit boards. If there is anything we can do to make building flex and rigid-flex boards more


Will it Fit?
Know Before You Build
Do you find yourself crossing your fingers the first time your board is put in its enclosure? The new collision detection and advanced 3D analysis tools in OrCAD® 17.2 allow you to find potential ECAD/MCAD integration issues well before your first physical prototype is produced. Design with confidence…no rabbit's foot needed.
Learn More ›


Dave Lackey

productive and economical, we want to help them do that.

***Goldman:** Who else stands to benefit from the book?*

Vardya: Just about anyone who has anything to do with flex and rigid-flex PCBs should find this book useful, including engineers, program managers and even buyers, as well as PCB designers. It should also be helpful to those who are not yet buying or designing flex boards but are thinking about it. This will give them a good idea of what is involved.

Lackey: I'd like to add that we were especially interested in helping younger designers who are new to the industry and the technology. We are seeing many instances of PCB designers coming right of school with a lack of real understanding of the complexities of the products they are designing. Our goal is to help by educating them.

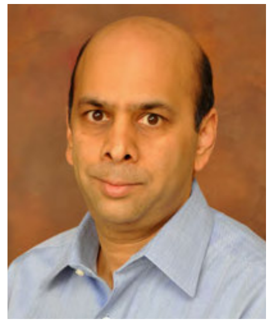
***Goldman:** So, what is your background and how long have you been in our business? Anaya, let's start with you.*

Vardya: I have been in boards for more than 30 years, working for a number of larger companies like IBM, Continental Circuits, Merix and Coretec. I have held several key management positions before I came here to American Standard Circuits 10 years ago as CEO.

Lackey: Well, I'm 37 years in the industry and counting. I've been in this business working with several shops here in the Chicago area. For 33 of those years I have been working with flex and rigid-flex circuits. I have worked in all areas of manufacturing and engineering before eventually moving into upper management.

***Goldman:** Now, tell me a little bit about American Standard.*

Vardya: We like to say that we are the best independent fabricator in the country. We provide just about all technologies of PCBs to our customers. We have development processes as well and hold many patents. Our goal is to grow through service by providing our customers with the best service, the best technology and perhaps even the best R&D in the business.


Anaya Vardya

***Goldman:** Can you give me some examples from the book as to what is different about flex and rigid-flex boards compared to rigid PCBs, especially designing them? What should designers watch out for?*

Lackey: I think one of the most valuable parts of the book is the one on material selection. This is an area that many designers do not have a good understanding of so they are asking for our help. I think they are going to find that part of the book especially valuable. We also discuss functionality and costs and how that differs from rigid PCBs.

***Goldman:** I am hearing and reading a lot more about flex technology these days and it is considered the fastest growing PCB technology. Why is that?*

Vardya: Because it is so useful as a technology. Flex and rigid-flex boards are so adaptable to space constraints. They can go around corners, they can bend, they are much more reliable than connecting two or more rigid PCBs with a connector. It is an idea whose time has come.

Lackey: They are also lighter and more functional, and they work well in all markets, from medical to aerospace, and from military to computer. There is a flex board in every laptop computer, for example.

***Goldman:** What are your thoughts about the future? Do you feel that that the demand for flex and rigid-flex technology is going to continue to grow?*

Lackey: Yes, absolutely! If you look at all the

market statistics from IPC, this is indeed the fastest growing market segment. So it is a great technology to invest in and a great product to design in. We have invested in both equipment and people to be able to provide our customers with all the flex and rigid-flex boards they need today and are going to need in the future.

Vardya: As Dave stated, they are now being used in essentially every market and in just about every electrical product being designed today.

Goldman: When is this book coming out and how can people get it?

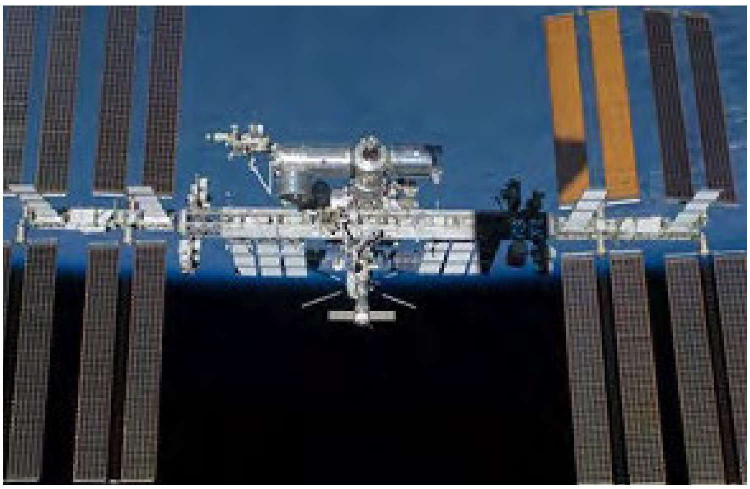
Vardya: The book is being released March 6, and it will be available for free download on a special website that we are designing for it.

Goldman: Once again, congratulations on this effort and on behalf of the industry, thank you and American Standard Circuits for giving this guide to us.

Vardya: Thank you. **PCBDESIGN**

For more information about *The Printed Circuit Designers' Guide to…Flex and Rigid-Flex Fundamentals*, click here.

RIT Helps Advance Space Camera Being Tested on ISS



Imaging technology advanced by researchers at Rochester Institute of Technology and Florida Institute of Technology is being tested on the International Space Station and could someday be used on future space telescopes.

A new twist on the charge injection device camera, originally developed in 1972 by General Electric Co., fine tunes the array of pixels for improved exposure control in low light conditions. The enhanced technology could give scientists a new method for imaging planets around other stars and improve the search for habitable Earth-like planets.

Zoran Ninkov, professor in RIT's Chester F. Carlson Center for Imaging Science, and Daniel Batcheldor, head of physics and Space Sciences at FIT, designed the charge injection device camera to capture contrasts between light emitted by astronomical objects.

"CID arrays offer considerable promise in many applications due to the focal plane architecture that allows random pixel access and non-destructive readout," said Ninkov, a member of RIT's Center for Detectors and Future Photon Initiative. "In addition to improving presently available devices, the development of next-generation imaging arrays promise considerable flexibility in read-out and on-chip processing for the future."

A SpaceX Falcon 9 rocket, on Feb. 19, carried the charge injection device to the International Space Station in the cargo of supplies and science experiments. Astronauts have installed the camera on a platform outside the space station. They will test the camera for six months.

"We expect to start seeing results by the end of April," said Batcheldor, lead scientist on the project. "A complex test pattern will be sent from a successfully operated camera through the ISS systems and down to the ground. A successful demonstration of CIDs on the International Space Station will put this technology at the NASA Technology Readiness Level 8, which means it's ready to fly as a primary instrument on a future space telescope."

2017 Programs

January 18
Wisdom Wednesday — **Webinar**
IPC Members Only

February 11–16
IPC APEX EXPO 2017 — **Conference and Exhibition**
San Diego, CA, USA

March 15
Wisdom Wednesday — **Webinar**
Improved Product Reliability with Functional Testability
Louis Ungar of A.T.E. Solutions
IPC Members Only

April 5
Wisdom Wednesday — **Webinar**
Reliability Fundamentals: Failure Mechanisms and Success
Mike Carano, RBP Chemical Technology
IPC Members Only

April 25–27
The 14th Electronic Circuits World Convention — **Conference**
KINTEX, Goyang City, S. Korea

April 26–27
IPC Reliability Forum: Manufacturing High-Performance Products — **Conference**
Chicago, IL, USA

May 1–3
IMPACT Washington D.C. 2017 — **Meeting**
Washington, D.C., USA

May 10
Wisdom Wednesday — **Webinar**
IPC Members Only

May 16
IPC Committee Meetings — **Meeting**
Nuremberg, Germany

June
IPC Summer Committee Meetings — **Meeting**
Minneapolis, MN, USA

June 7
Wisdom Wednesday — **Webinar**
IPC Members Only

June 27–28
IPC Reliability Forum: Emerging Technologies — **Conference**
Dusseldorf, Germany

July 26–27
Technical Education — **Workshop**
Chicago, IL, USA

September 17–21
IPC Fall Committee Meetings — **Meeting**
Held in conjunction with SMTA International
Rosemont, IL, USA

October
IPC WHMA Cable and Wire Harness Technical Conference — **Conference**
Paris, France

October
IPC Technical Education — **Workshop**
Paris, France

October
IPC Technical Education — **Workshop**
Minneapolis, MN, USA

October 17–19
IPC Flexible Circuits-HDI Forum Tutorials and Technical Conference — **Conference**
Minneapolis, MN, USA

November
IMPACT Europe — **Meeting**
Brussels, Belgium

November 8
IPC Technical Education — **Workshop**
Raleigh, NC, USA

November 14
IPC Committee Meetings — **Meeting**
Munich, Germany

December 6–8
HKPCA International Printed Circuit & APEX South China Fair — **Conference and Exhibition**
Shenzhen, China

For more information, visit www.IPC.org/events

PCB007 Highlights

Help Wanted! Our 2017 Industry Hiring Survey

This month we conducted an industry survey on plans for hiring during the year. We started by simply asking, "Do you plan to hire additional people this year?" More than half of the respondents answered yes, while about a third said no—which we take as an optimistic sign that our industry plans to expand in 2017.

Flex Talk: Final Surface Finish—How Do You Choose?

There are so many final surface finish options to choose from today. How do you decide which is best? HASL—both tin-lead and lead-free—immersion tin, immersion silver, ENIG, OSP, and ENIPIG are the primary finishes used in PCB fabrication.

Weiner's World—January 2017

This month's column is a bit shorter than usual as we prepare for next month's IPC APEX EXPO and its Executive Forum for PCB fabricators and their supply chain. This month also marks the 65th anniversary of Epec LLC in New Bedford, Massachusetts. The company, founded in 1952, is the oldest printed circuit fabricator in North America.

Cirtech Names John Stine as Vice President of Operations

John will oversee the day-to-day operations to support the growth and profitability of Cirtech. John will focus on strategic planning and goal setting, as well as provide leadership to enhance our overall performance and customer service experience.

All About Flex: Creating a Flexible Circuit Cutline

The perimeter dimensions of a flexible circuit are often referred to as the cutline. While rigid printed circuits are often rectangular and generally a less complex outline, the requirement for a flexible circuit to be an integrated part of the product packaging often involves unusual sizes, shapes and features in the circuit perimeter.

Electroplated Copper Filling of Through-holes: Influence on Hole Geometry

The process consists of a two-step acid copper plating cycle. The first step utilizes periodic pulse reverse (PPR) electroplating to form a conductive copper bridge across the middle of a through-hole and is followed by direct current electroplating to fill the resultant vias formed in the bridge cycle.

AT&S Provides PCB Technology and System Integration Expertise to World's Smallest Speaker

Graz-based start-up USound, in partnership with several Fraunhofer Institutes (IDMT, ISIT, IIS and IZM) and utilizing PCB technology together with system integration expertise from AT&S, has developed what is not only the world's smallest speaker, but also the first based on micro-electro-mechanical systems (MEMS).

Time-Lapse Video: The IPC APEX EXPO 2017 Show in Under Seven Minutes!

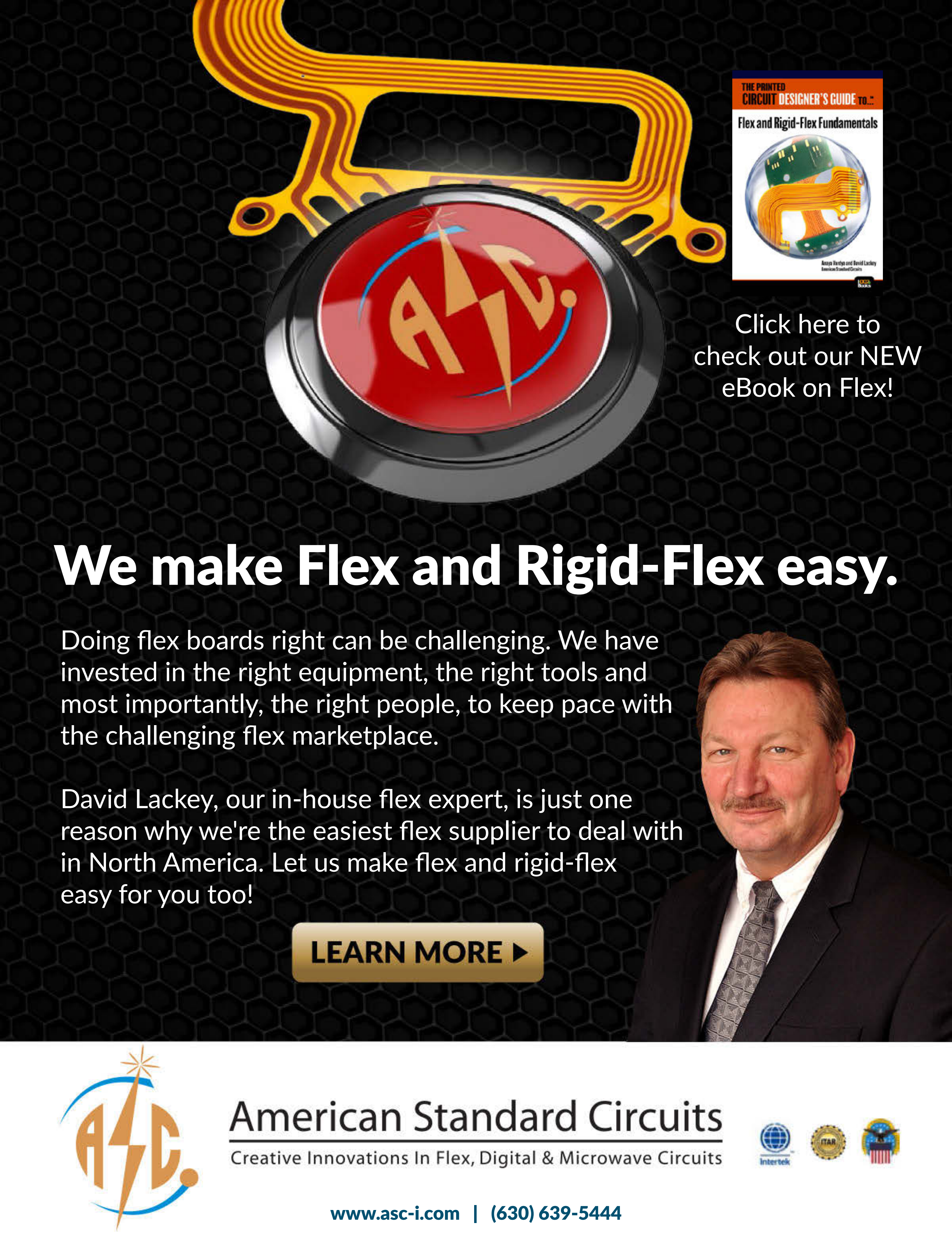
During IPC APEX EXPO 2017, I-Connect007 had time-lapse camera running from setup to closing. The camera was positioned high in our studio, where we conducted our RealTimewith...IPC APEX EXPO video interviews, aimed down the main aisle.

TTM Technologies Posts Sales of $706.5M in Q4 Fiscal 2016

Net sales for the fourth quarter of 2016 were $706.5 million, compared to $668.9 million in the fourth quarter of 2015 and $641.7 million in the third quarter of 2016.

EPTE Newsletter: 47th INTERNEPCON JAPAN

The 47th INTERNEPCON Japan electronics trade show was held on January 18 at Tokyo Big Sight. I attended the three-day NEPCON show in hopes of discovering the next electronics breakthrough, and examine the business trends within a shrinking electronics industry.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We make Flex and Rigid-Flex easy.
Doing flex boards right can be challenging. We have invested in the right equipment, the right tools and most importantly, the right people, to keep pace with the challenging flex marketplace.
David Lackey, our in-house flex expert, is just one reason why we're the easiest flex supplier to deal with in North America. Let us make flex and rigid-flex easy for you too!
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Microstrip Coplanar Waveguides

by Barry Olney
IN-CIRCUIT DESIGN PTY LTD / AUSTRALIA

The classic coplanar waveguide (CPW) is formed by a microstrip conductor strip separated from a pair of ground planes pours, all on the same layer, affixed to a dielectric medium. In the ideal case, the thickness of the dielectric is infinite. But in practice, it is thick enough so that electromagnetic fields die out before they get out of the substrate. A variant of the coplanar waveguide is formed when a ground reference plane is provided on the opposite side of the dielectric. This is referred to a conductor-backed or grounded CPW. CPWs have been used for many years in RF and microwave design as they reduce radiation loss, at extremely high frequencies, compared to traditional microstrip. And now, as edge rates continue to rise, they are coming back into vogue. In this month's column, I will look at how conformal field theory can be used to model the electromagnetic effects of microstrip coplanar waveguides.

Simplistically, space has three dimensions. Picturing a box, we observe the three dimensions of width, height and depth (x,y,z). But, there is an obvious fourth dimension–time. The box will only exist for a certain period of time. These three spatial dimensions plus the temporal dimension are referred to as space-time. But in the intricate world of quantum physics, there can be as many as 26 dimensions used to model the complexities of quantum fields.

In 1921, Theodor Kaluza, a mathematician, proposed that our intuition has misled us and suggested that space-time actually has five dimensions. Kaluza adapted Einstein's General

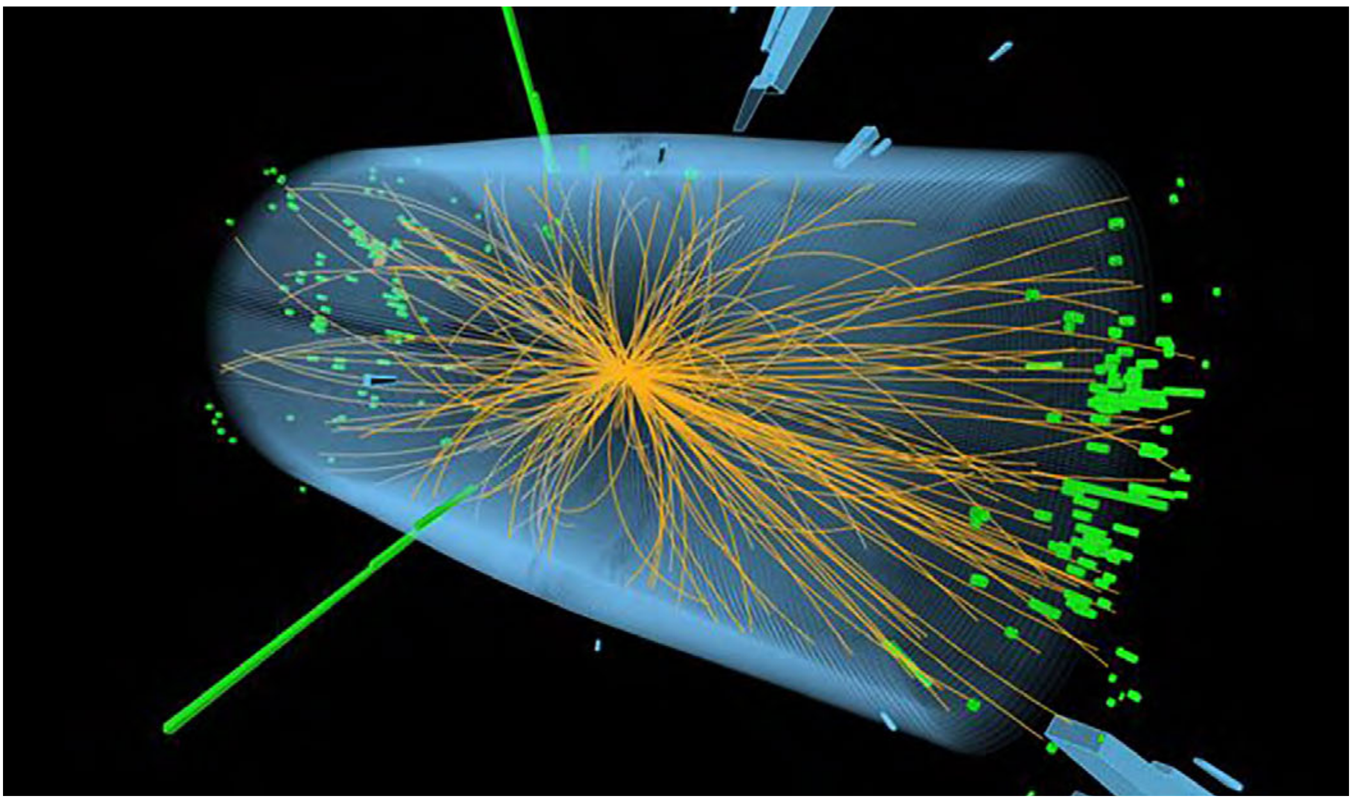

Figure 1: A Higgs boson quantum fireworks display (source: CERN).

Theory of Relativity that was formulated to the familiar four dimensions, and rewrote it to apply to five. Surprisingly, these terms corresponded precisely to the description of electromagnetism that James Clerk Maxwell had published decades before. By adding the extra dimension, Kaluza had unified gravitation and electromagnetism–two of the fundamental forces of nature.

This fifth dimension is not apparent to us at the macro scale, as it is a minuscule curling spatial dimension bound by the other larger dimensions. The analogy generally used, to help wrap your head around the concept, is to consider the large dimension to be like a drinking straw. At distant scales of magnification, it appears to be just a straight line. But close up, it has a perpendicular circumference that is curling around the central line of the dimension. This is the compactified small dimension. This fifth dimension represents the varying electric and magnetic fields that radiate at right angles to the central line.

Quantum theory defines the action of particles at the subatomic level. And general relativity has more to do with larger scale forces of nature (e.g., gravity, etc.). But, there is a gray area where these theories merge. Alternatively, string theory seeks unification, of these two theories, by replacing particles with the minute motion of strings. In string theory, the motion of a string has what is known as "conformal symmetry." This basically implies that if you've worked out a valid trajectory for a string, you can then generate another valid trajectory by warping the string, in a way that preserves angles, on the (imaginary) surface as the string sweeps out. The part of the calculation that is inconsistent, when the string trajectory is warped, is called the conformal anomaly. It's made up of the sum of the different forces with a contribution coming from each dimension of space-time. But if you pick the dimension just right, the aggregate of the anomaly adds up to zero.

Physicists then extended this theory from just gravity and electromagnetism to include additional forces of nature–the weak and strong nuclear forces. In superstring theory, there are 10 dimensions, consisting of nine spatial dimensions and one temporal dimension. In M-Theory, there are 11 dimensions: nine spatial dimensions, one temporal dimension and one energy dimension. These are:

1. Length
2. Width
3. Height
4. Time
5. Gravity/energy/electromagnetism

6-10. These are hypocritical and theoretically exist due to string theory concept.

11. This is M-Theory that proves that all the above dimensions are true if you look from this dimensional point of view.

The bosonic string theory requires 26 dimensions. This describes the Higgs boson particle, recently discovered at CERN's Large Hadron Collider particle accelerator in Switzerland (Figure 1), for example. It interprets all four fundament forces of nature and our perceived reality with space, time, matter and motion.

Conformal mapping techniques (CMT), first utilized by C. F. Gauss in 1820 whilst observing the effects of electricity and magnetism, is another approach that can be effectively used to evaluate semi-infinite conformal symmetry. Different types of solvers are optimized for solving different kinds of structures and this technique is accurate for symmetric microstrip structures. By choosing an appropriate mapping function, one can transform complex polygon geometric shapes into a much more convenient form,

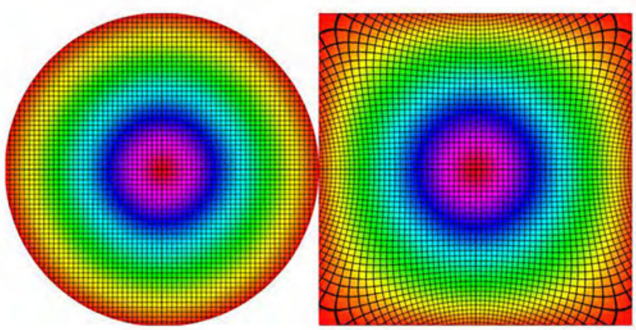

Figure 2: A circle is mapped into a square (source: flickr.com).

where they are easier to solve, and find the solution. For instance, a circle can be transformed into a square (Figure 2). Or an open geometry like that of planar traces (traces referenced to planes), on a PCB, can be transformed into a closed geometry. The CMT equivalent is a coordinate transformation and is applicable to both planar and non-planar transmission lines. CMT are ideal for analyzing coplanar waveguides (CPW) particularly those that lack a ground reference plane.

All electrical systems function based on the action of electric fields produced by charges, and magnetic fields produced by currents. To understand the working principle of these systems, the field lines, that envelop them, must be evaluated, allowing a spatial visualization of the phenomena. These maps typically represent flux, equipotential surfaces and densities distributions, having information about field intensity, potential difference, energy storage, charges and current densities.

The conformal mapping or transformation of two intersecting curves from the z-plane to the w-plane (fifth dimension), preserves the angles between every pair of curves. That is, if two curves in the z-plane intersect at a particular angle, the corresponding transformed curves will also intersect at the same angle, although the curves in the w-plane may not have any resemblance to the original curves.

The z-plane (x,y) coordinate system is an orthogonal one. And for an analytical function, the w-plane's (u,v) coordinate system, is also orthogonal. So, an elliptical electromagnetic field, can be transformed into a more useable geometry and still maintain consistency as in Figure 3. This is an example of a set of curves mapped into a set of straight lines which greatly simplifies the analysis.

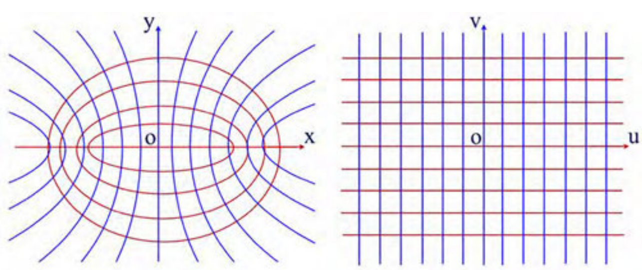

Figure 3: Electromagnetic fields in the z-plane, left, mapped to the w-plane, right (source: Gibbs).

The electrostatic energy in both the (x,y) and (u,v) coordinate systems remains space-time invariant. Consequentially, the capacitance, of a system of conductors, remains unchanged on the transformation of the arrangement of conductors. Under the conformal mapping transformation, there is a change in the geometrical shape of the conductor's arrangement without any change in the capacitance. This is a very important property for the analysis of the transmission line parameters.

CPW expressions are derived using these conformal mapping techniques and elliptic integrals to calculate the impedance of strip configurations. A conventional CPW on a dielectric substrate consists of a center strip conductor with semi-infinite ground planes on either side. This structure supports a quasi-TEM (resembling the transverse electromagnetic wave) mode of propagation. A quasi-TEM wave only exists in a microstrip line–on the outer surface of a PCB. In this mode, electric fields and magnetic fields are perpendicular to each other and perpendicular to the direction of propagation.

The CPW offers several advantages over a conventional microstrip transmission line:

- Simplifies fabrication
- Facilitates easy shunt as well as series surface mounting of active and passive devices
- Eliminates the need for via holes and wraparound (ground plating on the edge of a substrate to provide a low inductance path)
- Reduces radiation loss at very high microwave frequencies

Furthermore, the impedance is determined by the ratio of trace width to clearance, so size reduction is possible without limit, the only penalty being higher losses. In addition, a virtual ground plane exists between any two adjacent lines, as there is no field at that point. Hence crosstalk effects, between adjacent lines, are very weak.

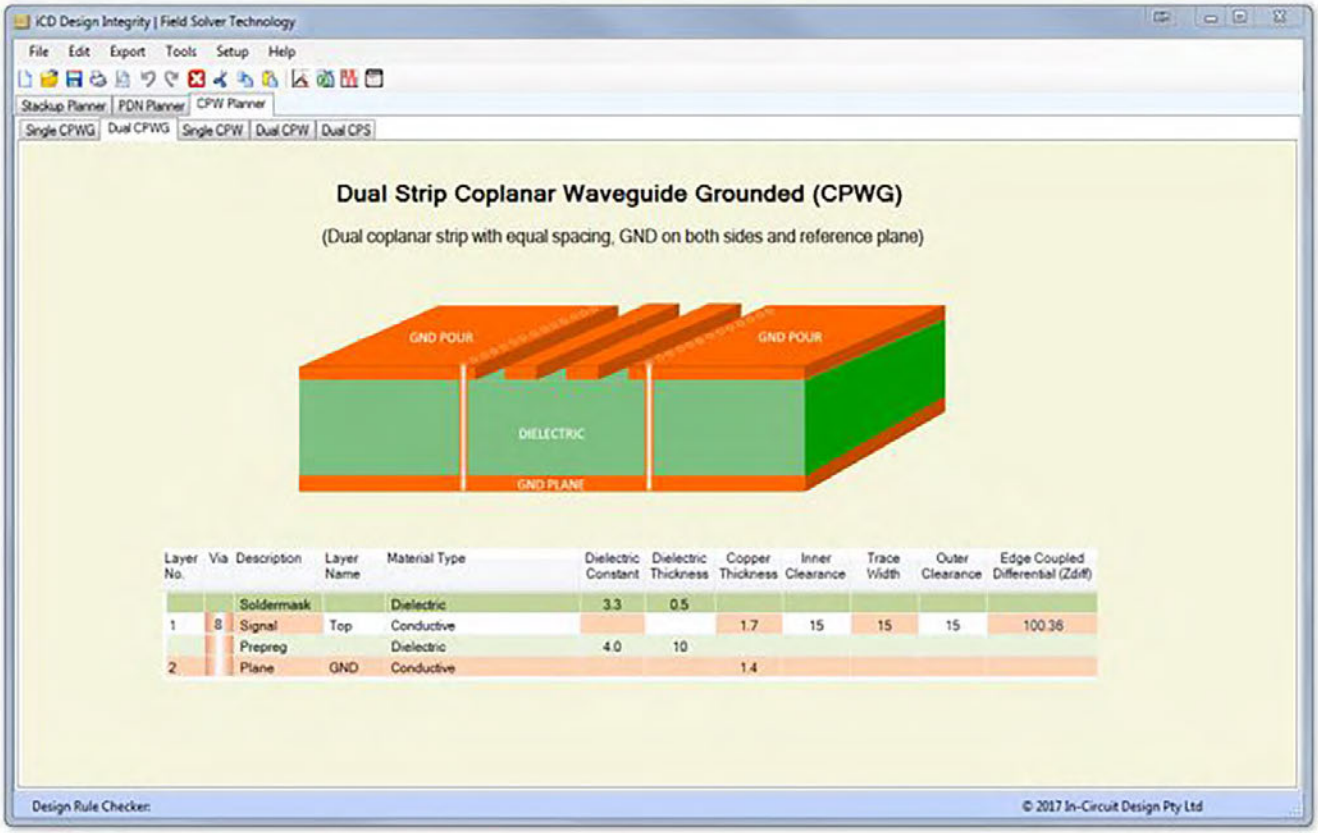

Figure 4: Dual strip coplanar waveguide grounded (source: iCD Design Integrity).

Figure 4 illustrates a dual (or differential) coplanar waveguide, analyzed in the iCD CPW Planner. This structure has equal gaps and ground pours on each side of the strips. The strips are also referenced to a solid ground plane below. Note the fence of stitching vias that are placed at less than a quarter wave length apart, close to the edge of the GND pours. This structure is used to improve isolation between components that would otherwise be coupled by electromagnetic fields. It consists of a row of plated through via holes that, if spaced close enough together, form a barrier to electromagnetic wave propagation. Planar strips readily couple to each other when in close proximity, an effect called parasitic coupling. The coupling is due to fringing fields spreading from the edges of the strip and intersecting adjacent lines or components.

Even if you are not involved in RF or microwave design, the use of CPWs is extremely useful when dealing with isolated differential strips without a ground reference plane as in Figure 5. In this case, the ground plane is cleared around a gigabit Ethernet connector to provide isolation from the outside world. So, a plane cannot exist in this area although the differential pair must maintain 100 ohms impedance to match the line. Good design practice for Ethernet ports requires over-voltage and over-current protection devices in addition to proper component creepage distances and electrical trace clearances for both sides of the Ethernet I/O connections, i.e., the line connector and driver (physical layer, or PHY) sides.

Loosely and tightly coupled grounded coplanar waveguides (CPWG) circuits respond differently to the application of conductors with and without a plating–such as electroless nickel immersion gold (ENIG) finish. A tightly coupled CPWG circuit, with an ENIG finish, will suffer greater conductor loss than a loosely coupled CPWG circuit with the same ENIG finish.

At approximately 2.7GHz, the resonant

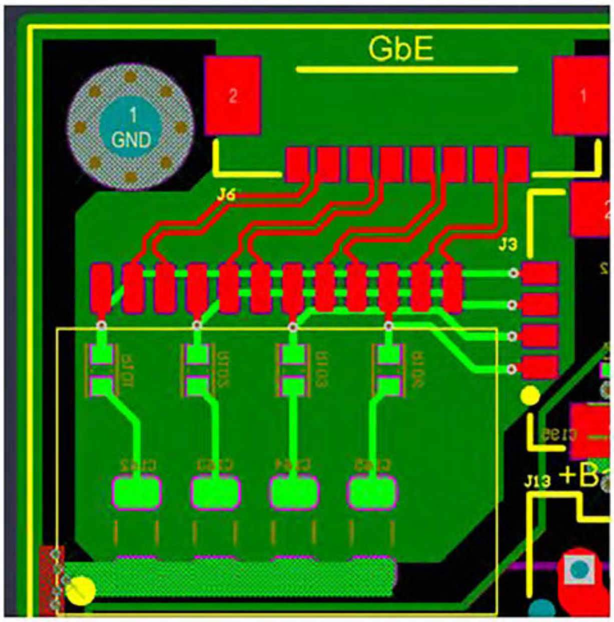

Figure 5: Dual coplanar strip, isolated.

behavior of the nickel component in ENIG increases insertion loss. This resonance is attributed to the ferromagnetic properties of the nickel layer. It is therefore wise to avoid using full body ENIG coating of microstrip and CPW traces at high frequencies. In fact, it may just be an odd 3rd or 5th harmonic, which falls on this particular lossy region, that causes radiation with much lower fundamental frequencies. Therefore, solder mask over bare copper (SMOBC) processing should be considered for all high-speed designs.

In conclusion, conformal transformation is a technique that allows one to take difficult problems, map them into a coordinate system, where they are convenient to solve, and then find a relatively simple solution. Having the property to modify only the geometry of a polygonal structure, preserving its physical magnitudes, conformal mapping is an exceptional tool to solve electromagnetic problems with known boundary conditions.

Points to Remember:

- CPWs have been used for many years in RF and microwave design as they reduce radiation loss, at extremely high frequencies, compared to traditional microstrip.
- Space-time has three spatial dimensions plus the temporal dimension.
- Kaluza adapted Einstein's General Theory of Relativity, which was formulated to the familiar four dimensions, and rewrote it to apply to five.
- By adding the extra dimension, Kaluza had unified gravitation and electromagnetism.
- This fifth dimension is not apparent to us at the macro scale, as it is a minuscule curling spatial dimension bound by the other larger dimensions. It represents the varying electric and magnetic fields that radiate at right angles to the central line.
- String theory seeks unification of quantum theory and general relativity by replacing particles with the minute motion of strings.
- Conformal mapping techniques is another approach that can be effectively used to evaluate semi-infinite conformal microstrip symmetry.
- All electrical systems function based on the action of electric fields produced by charges, and magnetic fields produced by currents.
- The conformal mapping or transformation of two intersecting curves from the z-plane to the w-plane, preserves the angles between every pair of curves.
- The capacitance of a system of conductors remains unchanged on the transformation of the arrangement of conductors.
- A conventional CPW, on a dielectric substrate, consists of a center strip conductor with semi-infinite ground planes on either side.
- CPWs reduce radiation loss at very high microwave frequencies.
- CPW impedance is determined by the ratio of trace width to clearance, so size reduction is possible without limit, the only penalty being higher losses.
- Grounded CPW structures should have a fence of stitching vias that are placed at less than a quarter wave length apart to form a barrier to electromagnetic wave propagation.
- The use of CPWs is also extremely useful when dealing with isolated differential pairs without a ground reference plane.

• A tightly coupled CPWG circuit with an ENIG finish will suffer greater conductor loss than a loosely coupled CPWG circuit with the same ENIG finish.

• At approximately 2.7GHz, the resonant behavior of the nickel component in ENIG increases insertion loss. Therefore, SMOBC processing should be considered for all high-speed designs.

• Conformal transformation is a technique that allows one to take difficult problems, map them into a coordinate system, where they are convenient to solve, and then find a relatively simple solution. **PCBDESIGN**

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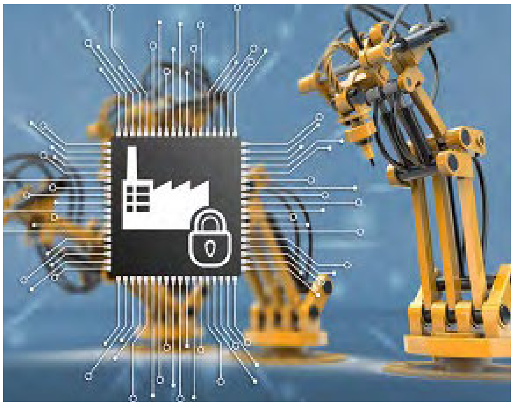
Barry Olney is managing director of In-Circuit Design Pty Ltd (ICD), Australia. This PCB design service bureau specializes in board-level simulation, and has developed the ICD Stackup Planner and ICD PDN Planner software. To read past columns, or to contact Olney, click here.

Updatable Chips for a Safer Internet of Things

Whether it's Industry 4.0, self-driving cars or smart home solutions – connected machines and high-value goods need security mechanisms that can be updated. The objective of the ALESSIO research is to develop and assess these security mechanisms. In this project under the leadership of Infineon Technologies AG, The Technical University of Munich (TUM) collaborates with companies like Siemens AG and the Munich-based Fraunhofer Institute for Applied and Integrated Security.



Every new connected device in the Internet of Things is a potential target: sensitive data and information that are not sufficiently protected could be captured and used for further attacks.

This is why reliable protection for safety-critical information is based on a combination of software and hardware. The hardware – a security chip – is comparable to a safe: a highly protected area in which data and security keys are stored separately from the software. But due to the long life-span of industrial facilities e.g. manufacturers need to be able to respond to changed or new attack methods. Hence the data and security-relevant information in these devices and industrial plants have to be updatable.

Within the next three years, the ALESSIO research partners will develop updatable security solutions for such embedded systems. One of the approaches is a conventional hardware-based Secure Element with updatable software. A Secure Element in complex, programmable logic devices (FPGA, field-programmable gate array) is also underway. In the end, three practice-oriented prototypes will show the solutions' feasibility and functional capabilities.

The project runs until the end of 2019 and is funded by the Federal Ministry of Education and Research with approximately Euro 3.9 million.

Obsessing Over Conductor Surface Roughness: What's the Effect on Dk?

by Bert Simonovich
LAMSIM ENTERPRISES

You know you have an obsession when you are flying six miles over Colorado and you look out the window at the beautiful scenery, and all you can think about is how the rocky mountain topology reminds you of conductor surface roughness! Well, call me obsessed, because that's exactly what I thought on my way to DesignCon 2017 in Santa Clara, California.

For those of you who know me, you know that I have been researching practical methods to model conductor surface roughness and its effect on insertion loss (IL). I have presented several papers on the subject over the last couple of years. It's one of my pet projects. This year at DesignCon, I presented a paper titled "A Practical Method to Model Effective Permittivity and Phase Delay Due to Conductor Surface Roughness."[1] Everyone involved in the design and manufacture of PCBs knows that one of the most important properties of the dielectric material is the relative permittivity (ε_ρ), commonly referred to as dielectric constant (D_k). But in reality, D_k is not constant at all. It varies over frequency as you will see later.

Figure 1: Rocky mountain high over Colorado, and mulling over conductor surface roughness.

We often assume the value reported in manufacturers' data sheets is the intrinsic property of the material. But in actual fact, it is the effective dielectric constant (D_{keff}) generated by a specific test method. When you compare simulation against measurements, you will often see a discrepancy in Dkeff and IL, due to the increased phase delay caused by surface roughness. This has always bothered me. For a long time, I was always looking for ways to come up with Dkeff from data sheet numbers alone. Thus the obsession and motivation for my recent research work.

Since phase delay, also known as time delay (TD), is proportional to Dkeff of the material, my theory was that the surface roughness profile decreases the effective separation between parallel plates, thereby increasing the electric field (e-field) strength, resulting in additional capacitance, which accounts for an increase in effective D_k and TD.

The main focus of my paper was to prove the theory and to show a practical method to model Dkeff and TD due to surface roughness. By referencing Gauss's Law for charged parallel plates, I confirmed mathematically, and through simulation, how the dielectric thickness and permittivity are interrelated to e-field and capacitance. I also revealed how the 10-point mean (Rz)

roughness parameter can be applied to finally estimate effective Dkeff due to roughness. Finally, I tested the method via case studies.

In his book "Transmission Line Design Handbook," Brian C. Wadell defines D_{keff} as the ratio of the actual structure's capacitance to the capacitance when the dielectric is replaced by air. [2]

D_{keff} is highly dependent on the test apparatus and conditions of how it is measured. There are several methods used in the industry. One method that is commonly used by many laminate suppliers is called the clamped stripline resonator test method. It is described by IPC-TM-650, section 2.5.5.5, Rev C.[3]

In short, this method rapidly tests dielectric material for permittivity and loss tangent, over an X-band frequency range of 8-12.4 GHz, in a production environment. It does not guarantee the values are accurate for design applications.

Here's why:

The measurements are made under stripline conditions, using a carefully designed resonant element pattern card, made out of the same dielectric material to be tested. The card is sandwiched between two sheets of unclad dielectric material under test. The whole structure is then clamped between two large plates, lined with copper foils that are grounded.

Since the resonant element pattern card and material under test are not physically bonded together, there are small air gaps between the various layers affecting measured results. These air gaps are caused in part by:

- Removing the copper from the material under test, leaving the bare substrate, complete with the micro void imprint of the copper roughness.
- The air gap between resonant element pattern card and material under test, due to the copper thickness of the etch pattern.
- The roughness profile of the copper, on the resonant element pattern card and fixture's grounded foil reference planes, are different than would be in practice, unless the same foil type is used.

If D_{keff} and R_z roughness parameters from the manufacturers' data sheets are known, then the effective D_k due to roughness (D_{keff_rough}) of the fabricated core laminate can now be easily estimated by:

$$D_{keff\_rough} = \frac{H_{smooth}}{\left(H_{smooth} - 2R_z\right)} \times D_{keff} \qquad \text{Equation 1}$$

Where: H_{smooth} is the thickness of dielectric from data sheet; Rz is 10-point mean roughness from data sheet; and D_{keff} is the D_k from data sheet.

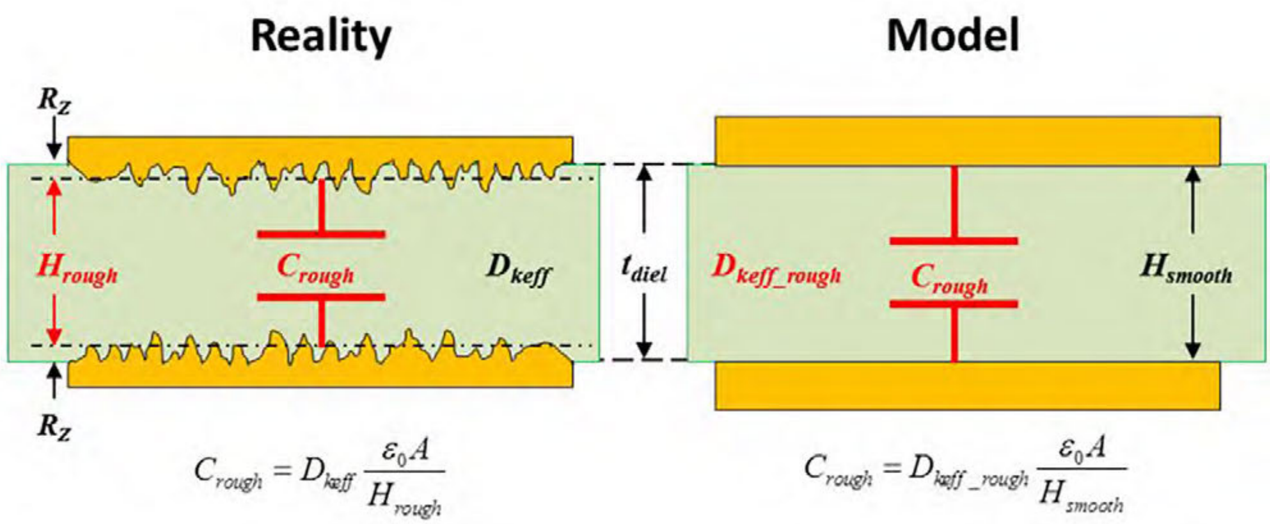


Figure 2: Effective D_k due to roughness model. Using D_{keff} with rough copper model (left) is equivalent to using D_{keff_rough} with smooth copper model (right).

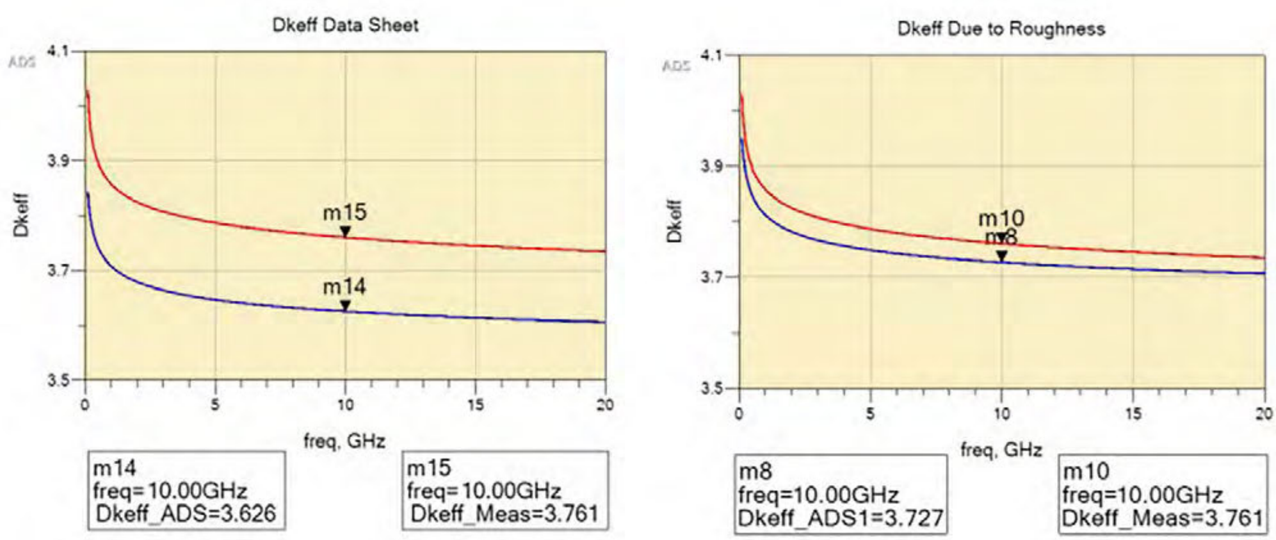


Figure 3: Measured vs simulated D_{keff} using FR408HR data sheet values for core and prepreg (left) and using D_{keff_rough} (right). Modeled and simulated with Keysight EEsof EDA ADS software.

With reference to Figure 2, using D_{keff} with rough copper model, as shown on the left, is equivalent to using D_{keff_rough}, with smooth copper model, as shown on the right. Therefore, all you need to do is use D_{keff_rough} for impedance calculations, and any other numerical simulations based on surface roughness, instead of D_k published in data sheets.

It is as simple as that.

For example, one case study I presented used measurements from a CMP28 modeling platform from Wild River Technology.[4] The PCB was fabricated with FR408HR material and reverse treated foil (RTF). Keysight EEsof EDA ADS [5] software was used for modeling and simulation. The results are shown in Figure 3.

The left graph in Figure 3 shows results when data sheet values for core and prepreg were used. D_{keff} measured (red) was 3.761, compared to simulated D_{keff} (blue) of 3.626, at 10 GHz. This gave a delta of ~ 4%. But when the D_{keff_rough} was used for core and prepreg the delta was within 1%.

The paper shows in more detail how Equation 1 was derived, based on Gauss' Law. In addition, I show how IL and phase delay is also improved when D_{keff_rough} is used instead of data sheet values. You can download "A Practical Method to Model Effective Permittivity and Phase Delay Due to Conductor Surface Roughness" and other papers on modeling conductor loss due to roughness from my website. "A Practical Method to Model Effective Permittivity and Phase Delay Due to Conductor Surface Roughness," DesignCon 2017, Lambert Simonovich, Lamsim Enterprises. **PCBDESIGN**

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1. "Transmission Line Design Handbook," Brian C. Wadell.
2. IPC-TM-650, section 2.5.5.5, Rev C.
3. Wild River Technology.
4. Keysight EEsof EDA ADS.

Bert Simonovich is an electronic engineering technologist. Over a 32-year career, working at Bell Northern Research/Nortel, in Ottawa, Canada, he helped pioneer several advanced technology solutions into products. After leaving Nortel in 2009, he founded Lamsim Enterprises Inc., where he provides innovative signal integrity and backplane solutions as a consultant. You can contact Bert through his web site at Lamsimenterprises.com.

MilAero007 Highlights

NASA Selects Proposals for First-Ever Space Technology Research Institutes

NASA has selected proposals for the creation of two multi-disciplinary, university-led research institutes that will focus on the development of technologies critical to extending human presence deeper into our solar system.

Trackwise Improved Harness Technology Achieves Major Milestone

Trackwise, a UK-based specialist manufacturer of products using printed circuit technology, is pleased to announce the successful completion of a major milestone in the development of Improved Harness Technology™—the manufacture of a 30-foot, 6-layer flexible multilayer PCB.

EuroTech: ENIPIG—Next Generation of PCB Surface Finish

MACFEST is a multi-partner project co-funded by Innovate UK to develop an electroless nickel/immersion palladium/immersion gold (ENIPIG) "universal surface finish" for printed circuit boards. Project partners are University of Leicester, MTG Research, C-Tech Innovation, A-Gas Electronic Materials, Merlin Circuit Technology and the Institute of Circuit Technology.

TTM Celebrates Grand Opening of Denver West, Colorado

TTM Technologies celebrated the grand opening of its Denver West Building in Littleton, Colorado with government officials, customers, TTM leaders, and employees. The Denver West Building allows TTM to expand its capacity and capabilities to better support customers.

Global Commercial Avionics Systems Market Posts Revenue of $25.34B in 2016

Transparency Market Research (TMR) has prognosticated the global commercial avionics systems market to take advantage of the rising investments and adoption of leading-edge technologies to register a CAGR of 3.5% between 2016 and 2024. By the end of the forecast period, the global market is envisaged to reach $31.07 billion. In 2016, the market had generated a revenue of $25.34 billion.

Accurate Engineering Purchases New Hot-Air Solder Leveler from New Technology Overman

Accurate Engineering has purchased a new NTO-1824LF HASL machine to upgrade that process and give their customers an unsurpassed surface finish.

Space Radio Could Change How Flights are Tracked Worldwide

NASA's powerful radio communications network allows us to receive data such as pictures of cryovolcanoes on Pluto—or tweets from astronauts aboard the International Space Station. But to send larger quantities of data back and forth faster, NASA engineers wanted higher-frequency radios that can be reprogrammed from a distance using software updates.

Engineers Build Robot Drone that Mimics Bat Flight

Bats have long captured the imaginations of scientists and engineers with their unrivaled agility, but their complex wing motions pose significant technological challenges for those seeking to recreate their flight in a robot.

EIPC 2017 Winter Conference Review of Day 2

Almost everyone made it back to the conference room for the start of the second day of the EIPC Winter Conference in Salzburg, even those who had enjoyed the late networking session into the early hours!

All Flex Adds IPC Expert Steven Bowles as Senior Engineer

All Flex expanded its product engineering talent pool by hiring Steven Bowles to join the company and relocate to Minnesota after spending two years at L-3 Fuzing and Ordnance Systems in Cincinnati, Ohio.


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Take Care of the People in Our Industry

by Tim Haag
INTERCEPT TECHNOLOGY

Does this sound like a familiar story?

Sarah was young and bright and had been at the top of her game in her previous role as a technician when she accepted an inter-company transfer to the design department. Her natural ability to master new skills quickly showed itself and it was obvious that she had a great future ahead of her as a designer. But something began to go wrong. She started missing work and the attention to detail and eagerness to learn that once was her hallmark now seemed to be diminished. She was still getting her job done, but everyone agreed that something was "off."

Unknown was that Sarah's marriage was in deep trouble and tragically, she didn't know how to deal with it or how to get help. Being a private person, she wouldn't talk about it, and without her knowing it, those problems she tried to hide began to manifest themselves in her behavior and attitude. As she turned inward with her struggles, her co-workers started keeping her at arm's length, and the once healthy work-relationships in the design group quickly soured. What the group saw as someone who was pushing everyone away was in reality a person who was lost and confused and unable to cope with the devastation in her personal life. It came as no surprise then when one day she accepted a position with a different company, where she hoped to find co-workers who were more understanding, while her previous co-workers were silently pleased to be rid of their dysfunctional problem.

This is a fictional story I've composited out of several different situations that I've observed over the years. But I'll bet there are portions of her story that sound similar to situations some of you have observed over time. So, what went wrong here? Why would someone like Sarah,

who seemed to have everything going for her, eventually get branded as a difficult co-worker who ended leaving for something better while no one was sorry to see her go?

On a management level, there are many methods available to evaluate, coach, and help a worker who is having work-related difficulties. In Sarah's story, her manager should have already been working with her to help her to resolve these difficulties. But I would like to suggest that there is another component to this story: the reaction from the rest of the group. Am I saying that the group is responsible for Sarah's personal problems? No, it is not the group's responsibility to fix Sarah's personal life. But just because they didn't do anything wrong doesn't mean that they couldn't have done better. Let me explain.

"No, it is not the group's responsibility to fix Sarah's personal life. But just because they didn't do anything wrong doesn't mean that they couldn't have done better."

The group was glad to be rid of someone that they thought no longer fit in, but did her resignation accomplish anything good? Sarah had already demonstrated that she was an excellent employee with a proven track record. She also had been at the company for quite some time in another department and therefore carried with her an ample amount of experience and corporate culture. As we all know, losing an employee for any reason carries with it a very real cost. Schedules slip which could affect future sales, and contract help may be required to fill in the gap for a missing employee. Unproductive time will get spent by employees dealing with the loss of a team-mate instead of doing their regular work, and then of course there's the time spent by human resources to find, hire and train a replacement for an employee who has left.

Everyone is going to have some kind of personal problems that will affect them at some point or another in their lives. And sadly, when those difficult times come, those problems will probably spill out into their work lives. Research has established an important correlation between a stable personal life and success on the job. One study (Turvey & Olson, 2006) linked successful personal relationships, such as a happy marriage, to reduced job turnover, lower absenteeism, higher motivation and better health. The survey suggests that positive employee personal relationships can improve a company's overall financial health, while ignoring their employees' problems can decrease a company's profitability. It could be surmised then that helping a co-worker through a difficult time could actually end up helping the company as well.

Therefore, in our hypothetical story of Sarah, how could the group have done better? The group was quick to judge what they saw in her behavior instead looking for how they could help. Obviously, no one should stick their nose into another's personal business if uninvited. But at the same time, we should be very careful to not come to a conclusion about someone based purely on observed behavior. Sarah's story might have been very different if instead of judging her for her behavior her co-workers had extended a helping hand of compassion instead.

Our country has gone through a very turbulent time lately with the 2016 presidential election, and this turbulence gives every indication of lasting for a while. Don't worry; I have absolutely no desire or intention of making any kind of political statement here. But I do want to comment that I have never before in my life seen as many judgmental opinions and personal attacks as I have lately due to disagreements in politics. The proliferation of social media has magnified this effect, and it seems like more than ever before people are willing to label each other as villains just because of differing political ideologies. This has made me wonder; how will these behaviors affect the working relationships within our companies? Are some people

being isolated because they think differently than the rest? Will people judge their co-workers as un-trustworthy, unworthy, or unreliable because of what political position they do or don't support? If this trend continues what will the end result be to the healthy inter-personal work relationships that are foundational in the work place, and by extension; the growth and success of our corporations?

In my opinion, I think that we would all do well to get back to the habit of treating each other with respect and compassion instead of judgement. As an example of co-workers doing their best, let me pass on the following: Many years ago, my brother lost his first wife to cancer. It was a horrible experience for his family, and it affected many others as well. And yet in the midst of all that pain, there was an incredible outpouring of care and compassion by his co-workers. Being a school teacher, my brother had only so much personal time that he could use, and it got used up very quickly as he spent more and more time with his sick wife at the hospital. To help him his co-workers gathered together and donated some of their own personal time to him so that he could spend the time where he needed it most; with his family during this difficult period.

Perhaps if Sarah's co-workers had been more like my brothers' the outcome would have been different and she would have stayed in her job. As we've already discussed, the financial benefit to the company would have been much better to retain such a great employee, and the personal benefit to Sarah to be surrounded by supportive co-workers could have made a life-changing difference.

How many of us could also do better if we would just take the time to discover the root of someone's problem instead of quickly reacting to what we see? Whether at the office or walking down the street, none of us know when the next Sarah will come along in our lives. But we can be ready for her when she does.

Just because we spend a good portion of our time in the high-tech automated world of work doesn't mean that we have to react to each other like automatons. The choice of how we interact with each other is one that we are privileged as human beings to make for ourselves. Let's make that choice a good one.

Remember: It's still all about the people! **PCBDESIGN**

Tim Haag is manager of customer support and training at Intercept Technology.

Metallic Atomically-Thin Layered Silicon

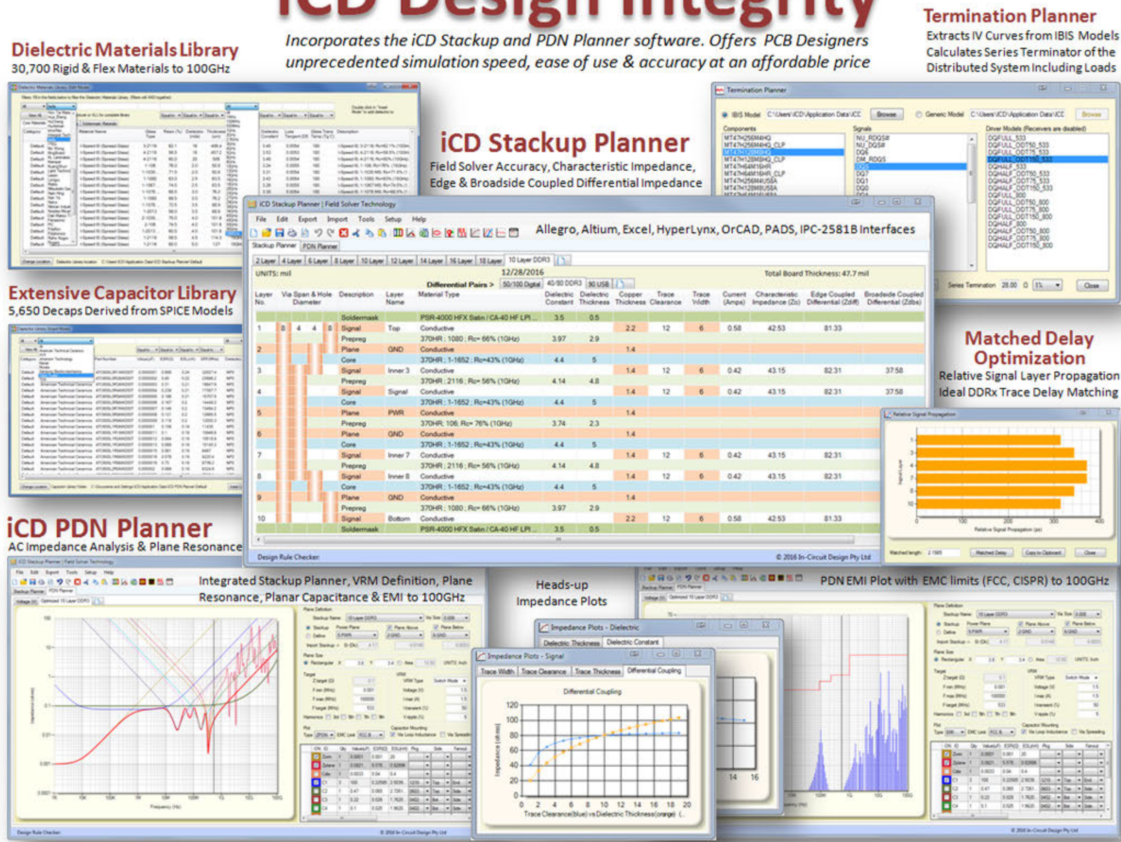
A new metallic silicon (Si) nanostructure has been discovered by researchers from the London Centre for Nanotechnology, the Japan Advanced Institute of Science and Technology (JAIST), and the Brookhaven National Laboratory (BNL), USA.

The new Si nanostructure is found to form an atomically-sharp edge with the 2D silicene sheet and could enable the development of native electrical contacting, an important step to realising functional devices based upon silicene and other 2D materials.

As the size of conventional semiconductor devices approaches the fundamental limit at the atomic scale, quantum mechanical effects begin to dominate their behaviour. One avenue of promise is research into materials that are only a few atomic layers thick. The first of these so-called "atomically-thin 2D materials" to be realised in a laboratory was graphene, which is a single layer of carbon atoms. Since the discovery of graphene, a wide range of other 2D materials have been found that have a broad array of potentially novel properties.

Recent work has shown that silicene can be incorporated into a conventional field effect transistor and other 2D materials. However, a challenge that remains is how to precisely electrically contact external wires to the silicene sheet without destroying the electronic properties that we desire.

iCD Design Integrity



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- Characteristic impedance, edge-coupled & broadside-coupled differential impedance
- Relative Signal Propagation with 'Matched Delay Optimization'–ideal for DDRx design
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- Unique Field Solver computation of multiple differential technologies per signal layer
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- Interfaces–Allegro, Altium, Excel, HyperLynx, OrCAD, PADS, Zmetrix TDR, Zuken & IPC-2581B

iCD PDN Planner - Analyze multiple power supplies to maintain low AC impedance over entire frequency range dramatically improving product performance

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- Definition of plane size, dielectric constant & plane separation
- Extraction of plane data from the integrated iCD Stackup Planner
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"iCD Design Integrity software features a myriad of functionality specifically developed for high-speed design."
- Barry Olney

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Casting a Spotlight on Resin Applications

by Alistair Little
ELECTROLUBE

Over the last few columns, I've given readers pointers on virtually every aspect of potting and encapsulation resins, ranging from their formulations and special properties to their applications, benefits and limitations. It's probably high time, therefore, to take a step back from the dos and don'ts and focus instead on how these resins are bringing very real benefits to practical electronic and electrical engineering applications. A good starting point is to look at the special requirements of an industry that is enjoying explosive growth: LED lighting.

With this rapid growth, has come a pressing need among LED lighting manufacturers to make the right selections where potting and encapsulation are concerned, to maximise the life and performance of LED lighting units. In short, this comes down to two things: recognising the importance of proper thermal management—including measures to ensure maximum heat dissipation from LED luminaires and lighting assemblies—and understanding how correct resin product selection can have significant impacts upon the aesthetics, ambience, lighting qualities and long-term environmental protection of LED lighting assemblies.

Offering a more efficient and longer-life alternative to halogen, incandescent and fluorescent lighting systems for both interior and exterior applications, as well as providing greater freedom of expression in terms of product design and installation, LED lighting has become a market phenomenon. Expected to grow into a $70 billion industry by 2020, and due to turn its market share from a current 18% to 70% in a little over five years, the LED industry is increasingly turning to companies like mine for solutions to the sorts of problem areas I've outlined above. And we have not been slow in responding, as I hope to demonstrate with some recent

projects undertaken for a couple of prominent international market players.

The French company Odeli (On Demand Lighting) is a young, dynamic company who provide specialist bespoke LED lighting solutions. They contacted us after receiving an urgent lighting contract for an outdoor sports stadium. They required a resin to encapsulate their design as quickly as possible; it had to protect the LEDs from the environment (rain, wind, dust, etc.) yet be suitable for use in their production process. There were also aesthetic considerations, and a diffuse light was required. The use of a hazy resin can give a diffuse light due to the particles inside the resin causing the light to be scattered, rather than being emitted as a single continuous beam.

"The use of a hazy resin can give a diffuse light due to the particles inside the resin causing the light to be scattered, rather than being emitted as a single continuous beam."

It was for just this sort of application the UR5635 was developed. The timeline for the project was tight as there were only three months from the awarding of the contract to the opening of the stadium, which was for the European Games in Baku, Azerbaijan. We were able to supply samples the next day so that they could complete their own four-week test program. Working with Odeli, we could meet their requirements both in terms of product performance, but also to supply the resin for production within a three-week delivery slot, in fact we delivered the required material ahead of schedule.

Once we had full specifications and an explanation of requirements with regard to the encapsulant for the stadium lighting, we invited Odeli to carry out some tests on the UR5635 transparent hazy polyurethane resin based on the real conditions in which the lighting was destined to operate. UR5635 was duly tested and approved for the application, and the appropriate processes installed, all within one month of our preliminary meeting. Odeli required large quantities of resin for this project and fortunately we were able to satisfy that demand at short notice, which went a long way to helping them meet their rather tight deadline.

UR5635 is a two-part, semi-rigid resin material formulated with a hazy/cloudy appearance. The product is ideal for decorative applications that need environmental protection, and is particularly suitable for lighting applications where there is a desire for a dispersive lighting effect. As for the Odeli project, it achieved the desired effect, producing an excellent level of luminosity combined with a very pleasing aesthetic finish. When the 6,000 athletes from 50 countries were performing at their peak in Baku, our resins were likewise performing well in illuminating their achievements.

As previously mentioned, the use of LEDs has opened a world of different possibilities for designers as to how to use lighting in different ways. Our Indian colleagues had an urgent call from Rockforest Technologies India, who were looking for a potting resin to protect a decorative strip lighting for outdoor use in a shopping mall complex. The company not only needed to meet a very tight project deadline but also achieve a specific "neutral white" (4,000K) colour from the lighting, and there was little or no room for manoeuvre on this. In addition, the material had to cope with both outdoor conditions as well as the footfall of pedestrians, as the lighting was planned for installation at ground level under a walkway. No pressure then!

Our Indian office jumped into action and conducted some initial trials, potting the strip luminaires to the specified depth of 5.5mm using our UR5634 semi-rigid, optically clear polyurethane resin which, being highly UV resistant, is especially useful as an encapsulant for applications exposed to direct sunlight.

Unfortunately, the resin caused a colour shift from the specified 4,000K (neutral white) to "cool white" (6,500K). Rockforest was under considerable pressure to solve this problem;

apart from the fact that the 4,000K colour was non-negotiable, their customer requested that a new on-spec reference sample be made available for re-testing in just 24 hours. Electrolube India General Manager Padmanabha Shaktivelu sought advice from our UK-based technical support team who subsequently suggested two different approaches that Rockforest might consider to solve the problem.

The first was a recommendation that they use an LED that provided a colour temperature below the specified colour temperature, in this case, one operating in the 2,500K to the 3,000K range. By potting these with the UR5634 resin to the specified 5.5 mm depth, it could potentially bring the light back to the desired colour. The second option was that Rockforest assesses the amount and type of resin they were using for this project to see if a thinner layer of resin over the top of the LED array would reduce the colour shift effect.

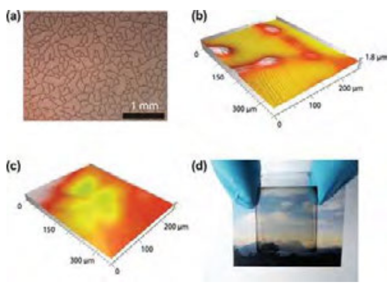
In the end, Padmanabha recommended that Rockforest switch to our UR5635 semi-rigid "hazy/cloudy" polyurethane resin, which provided the required environmental protection as well as offering a useful light dispersing property. Indeed, the diffused light produced by this resin meant that an additional diffuser medium was no longer necessary, allowing the customer to save costs while achieving the required aesthetic appearance and, through trials with various resin potting depths, the specified colour temperature, and achieved to a tight deadline!

These are just a couple of examples of resins bringing very real benefits to practical electronic and electrical engineering applications, more notably here for LED applications, and how important it is to work closely with your supplier so you can move fast when circumstances demand it.

Look out for my next column in April when I hope to take a closer look at some top trending resin queries from our technical support team. **PCBDESIGN**

Alistair Little is global business/technical director for Electrolube's Resin Division.

Uncompromising on Organic Solar Cells



Semi-transparent organic solar cells (OSCs) have potential for providing low-cost, large-area energy conversion devices for various applications such as windows, roof covers and greenhouses. However, it is challenging to achieve semi-transparent OSCs with high power conversion efficiency (PCE) and high transparency at the same time. Usually, the active materials of OSCs consist of a binary blend of a visibly absorbing donor polymer and a fullerene acceptor. The average visible transmittance (AVT) of the cell can be increased by decreasing the binary film thickness; however, this goes at the expense of the PCE because less sunlight is absorbed by a thinner layer.

In a Science and Technology of Advanced Materials (STAM) study, a team led by Mohammed Makha from the Swiss Federal Institute for Materials Science and Technology bypassed this tradeoff between transparency and efficiency of OSCs by using a ternary mixture.

The team added to a visibly absorbing binary polymer-fullerene blend a dye as a third minority component. The dye absorbs light exclusively in the near-infrared (NIR) wavelength region and therefore does not reduce the visible transparency of the OSC. Due to the additional current generated via NIR absorption, the polymer content could be reduced without compromising the cell performance. Semitransparent OSCs with a uniform AVT or 51% and a PCE of 3% were demonstrated.

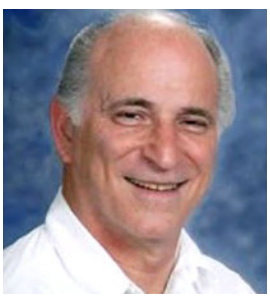
The team believes that their ternary blend performs so well because of a specific intermixed phase between the NIR dye and the fullerene; therefore, the system could successfully work with other polymers.

Recent Highlights from PCBDesign007

1 Kelly Dack and Mike Creeden: Are We in a PCB Design Renaissance?

During IPC APEX EXPO, Technical Editor Kelly Dack and San Diego PCB founder Mike Creeden discuss some of the trends they're seeing in the PCB design community, including a slight increase in young people becoming designers and more EEs doing design work.

2 Gary Ferrari Earns Dieter Bergman IPC Fellowship Award



In recognition of his ongoing leadership in developing and promoting IPC standards on a global basis, IPC has bestowed the Dieter Bergman IPC Fellowship Award upon Gary Ferrari of FTG Circuits. For more than four decades, Ferrari has donated countless hours to IPC and the PCB design community.

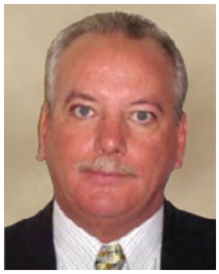
3 Exciting New Technology: Thermal Risk Management

Two years ago, I entered into a collaboration with Dr. Johannes Adam, from Leimen Germany. Johannes has written a software simulation tool called Thermal Risk Management (TRM). We used it to look at the thermal characteristics of PCB traces under a variety of conditions, and it is hard for me to contain my excitement and enthusiasm for what it does and what we learned about traces using it.

4 Altium Vault 3.0 Harnesses PCB Design Data to Unlock Engineering Innovation

Altium has launched an all-new version of its PCB component and design data management solution with Altium Vault 3.0. As a complement to their leading PCB design software Altium Designer 17, Altium Vault furthers the brand's commitment to fueling creativity by giving the engineer more control over their design data.

5 Beyond Design: PDN–Decoupling Capacitor Placement



The impact of lower core voltages and faster edge rates has pushed the frequency content of typical digital signals into the gigahertz range. Consequently, the performance of decoupling capacitors must also be extended up into this range. However, rudimentary design rules, adequate for frequencies below 100MHz, may not be suitable for today's high-speed digital circuits.

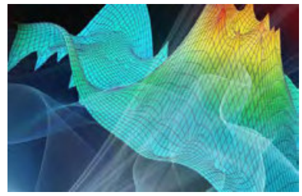
6 Mentor Graphics Reports Fiscal Q4 Results

Mentor Graphics Corporation announced financial results for the company's fiscal fourth quarter ended January 31, 2017. The company reported record revenues of $478.0 million for Q4, For the full fiscal year, revenues were up 9% to $1.282 billion.

7 Selling PCB Design Services in a First-World Country

As the business operations manager for Better Boards Inc., I have a front row seat to the critical problem facing a PCB design services company: How do we sell these services back to the companies who have cast off their own skilled employees? How do we sell PCB design services into small companies that can barely afford the one overworked electrical engineer that they hired last year?

8 Cadence Sigrity 2017 Delivers Fast Path to PCB Power Integrity Signoff

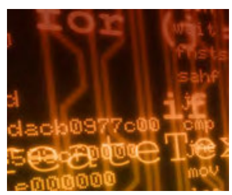


Cadence Design Systems has announced availability of the Sigrity 2017 technology portfolio, which introduces several key features specifically designed to speed up PCB power and signal integrity signoff. Among the features included in the newest version of the Cadence Sigrity portfolio are the Allegro PowerTree topology viewer and editor, which enable designers to quickly assess power delivery decisions early in the design cycle.

9 The Evolution of PCB Design and Designers

According to Rainer Asfalg of Altium, VP Sales EMEA, EDA companies owe it to their customers to provide much more than just a standard design tool. I met with Rainer at the recent electronica show to discuss the continued evolution of the design process towards automation, and what this might mean for the education and overall requirements of PCB designers going forward.

10 EMA Releases Ultra Librarian for OrCAD



EMA Design Automation has just released Ultra Librarian for OrCAD providing symbols, footprints, and 3D models for an expanding library of currently over 8 million parts. "Symbols, footprints, and 3D models are the building blocks of any electronic board design," said Manny Marcano, president of EMA Design Automation.

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.

SMTA Atlanta 21st Annual Expo
April 19, 2017
Duluth, Georgia, USA

14th Electronic Circuits World Convention
April 25–27, 2017
Goyang City, South Korea

IPC Reliability Forum: Manufacturing High Performance Products
April 26–27, 2017
Chicago, Illinois, USA

KPCA Show 2017
April 25–27, 2017
Goyang City, South Korea

IMPACT Washington D.C. 2017
May 2–3, 2017
Washington, D.C. USA

Thailand PCB Expo 2017
May 11–13, 2017
Bangkok, Thailand

JPCA Show 2017
June 7–9, 2017
Tokyo, Japan

IPC Reliability Forum: Emerging Technologies
June 27–28, 2017
Düsseldorf, Germany

SMTA International 2017 Conference and Exhibition
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
October 25–27, 2017
Taipei, Taiwan

productronica 2017
November 14–17, 2017
Munich, Germany

HKPCA/IPC International Printed Circuit & South China Fair
December 6–8, 2017
Shenzhen, China

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