APRIL 2018

I-Connect007

DESIGN007 MAGAZINE

FUTURE VEHICLES
Driving Design for Reliability

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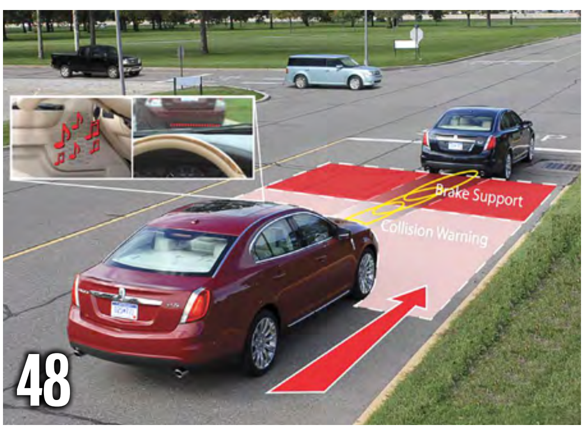

Future Vehicles: Driving Design for Reliability

We're headed into a brave new world, with autonomous and electric vehicles leading the way. We asked our expert contributors to discuss the world of automotive electronics, and what all of this innovation means for PCB designers.

APRIL 2018 • ADDITIONAL CONTENT

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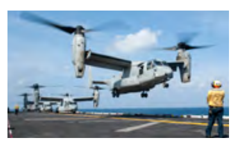


DEPARTMENTS:

Baby, You Can Drive My Car

The Shaughnessy Report

by Andy Shaughnessy, I-CONNECT007

The first car I remember riding in was our 1962 Plymouth Valiant. It was an ugly blue, awkward-looking car with the outline of a spare tire emblazoned on the trunk. But it had a super cool push-button automatic transmission and an AM radio that was also tuned by pushing buttons. For a toddler, this was a jackpot.

I was told to never play with any of these buttons. Naturally, I wanted to push those buttons every time I rode in the car, and since there were no seat belts, I did what I wanted to do. And I wanted to be a gear-changing, radio-tuning toddler! I'd start pushing the buttons until I was threatened with bodily harm, which was how parenting was conducted in the '60s.

Overall, I remember thinking, "What will they come up with next?" Of course, we now know that push-button automatic transmissions didn't work as planned. The linkage was prone to breakdowns. Mechanics hated them. They largely disappeared by the late '60s and were replaced by the very uncool automatic shifter on the steering column. Not every idea is a good idea.

For another 25 years or so, the radio remained the only piece of electronics in most cars. Then came the advent of on-board computers, and soon there were all kinds of "idiot lights" that would tell you if you were nearly out of gas, or if your door wasn't closed properly.

Now, we're all driving computers on wheels. My girlfriend's inexpensive 2015 Mazda has an entertainment system that no one could have dreamed of not long ago. The collision avoidance system makes it almost impossible to have an accident. It beeps if you touch the center line, or if another car is coming while you're backing up. It slows you down if the car ahead of you slows down. With her car's cruise control, you hardly ever have to use the brakes (I try to see how far I can go without using the brakes, which makes her nervous). There's supposed to be a crash alert system that will stop the car if you're about to slam into an overpass, but we haven't tested that out.

Electronics is the biggest "driver" (no pun intended) in the automotive market right now. The highlight of the 2018 Consumer Electronics Show autonomous vehicles and the artificial intelligence (AI) and electronics related to their development. And now, 134 years after Thomas Parker built the first production electric car in London, electric vehicles are finally going mainstream. Tesla gets points for having an autonomous electric car.

What does all this mean for the PCB industry? It's good news, overall. We've all seen the predictions that electronics will make up 50% of the cost of every new car in 10 years or so. But there are a lot of challenges ahead, many of which we're still trying to understand. We don't know what we don't know, as former Secretary of State Don Rumsfeld once said.

For this issue, we asked our experts to discuss the automotive electronics market and what all of these changes mean for PCB designers, design engineers, and product developers. In our experts interview, Editor Dan Feinberg reviews the evolution of AI, autonomous cars, and electric vehicles, including what he's seen in years of covering CES for his column. Zuken's Humair Mandavia discusses the company's EDA tools and focus on the automotive electronics market. Thomas Wischnack of Porsche Engineering Services explains how Porsche approaches PCB and hardware development, and offers tips for new PCB designers. James McLeish of DfR Solutions highlights his company's high-reliability test software that is used by automotive electronics developers.

Next, Tarun Amla of ITEQ discusses ITEQ's focus on developing PCB materials for autonomous and electric vehicles, as well as 5G technology. Pete Christiansen of Magi Scitech shows us the company's new graphene heat sink, which offers thermal management capabilities for automotive and household electronics. And EDADOC's William Zhou and Wen Ling discuss their longtime design of automotive PCBs, which has made the company one of the biggest forces in the automotive electronics industry in China.

Automotive electronics is evolving, almost daily, and there's a lot of confusion. Sometimes it's difficult to get an accurate snapshot of where we are technologically in this segment. At Design007 Magazine, we'll keep our ear to the ground so we can bring you the latest in the technologies of today and tomorrow.

See you next month! **DESIGN007**

Andy Shaughnessy is managing editor of *Design007 Magazine*. He has been covering PCB design for 18 years. He can be reached by clicking here.

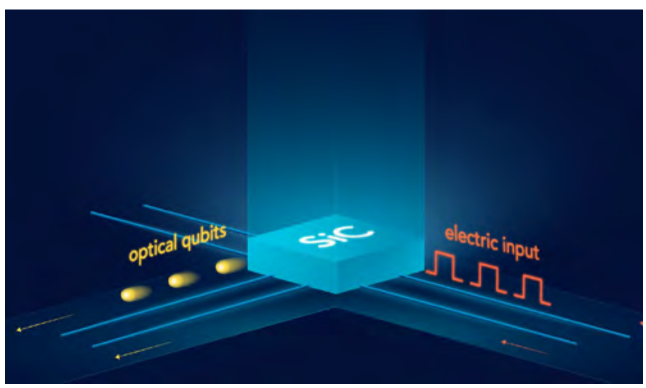
Physicists Reveal Material for High-Speed Quantum Internet

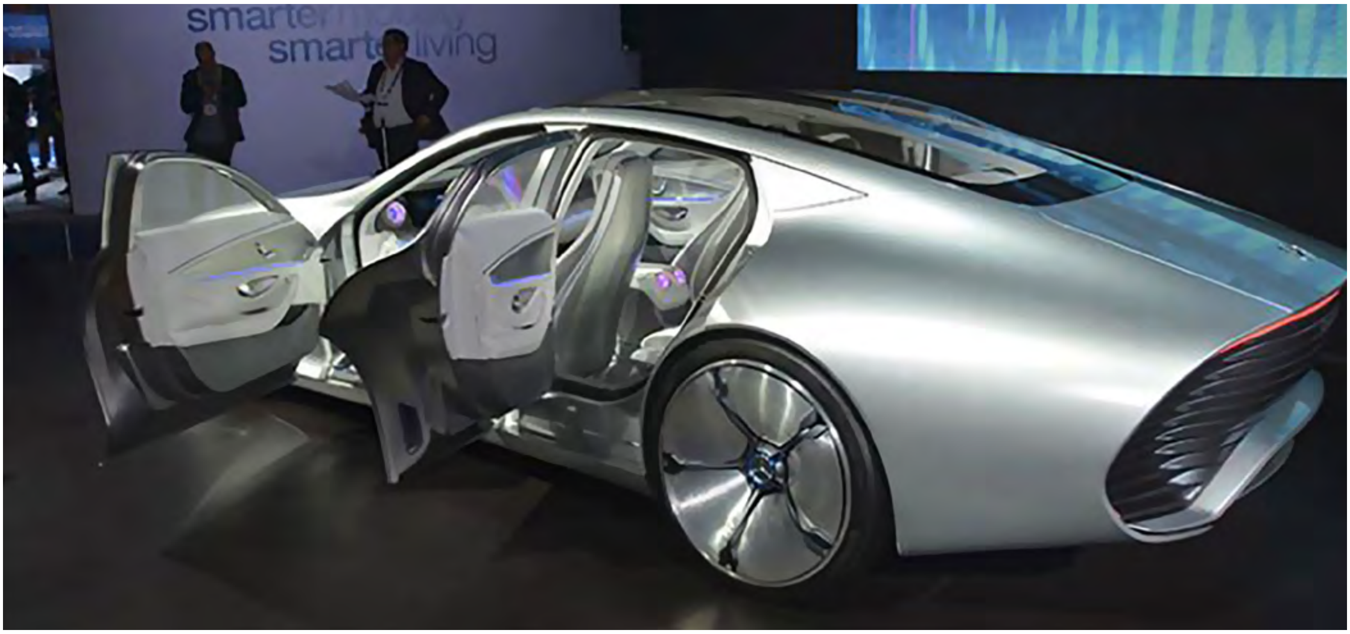
Researchers from the Moscow Institute of Physics and Technology have "rediscovered" a material that can lay the foundation for ultrahigh-speed quantum internet. Their paper published in *npj Quantum Information* shows how to increase the data transfer rate in unconditionally secure quantum communication lines to more than 1 gigabit per second, making quantum internet as fast as its classical counterpart.

The greatest expectation about the quantum computer is that it could break the security of all classical data transfer networks. Today, sensitive data such as personal communication or financial information are protected using encryption algorithms that would take a classical supercomputer years to crack. A quantum computer could conceivably do this in a few seconds.

Photons are the best carriers for quantum bits. The principle of single-photon generation is quite simple: An excited quantum system can relax into the ground state by emitting exactly one photon.

This process is at the heart of the electrically driven single-photon source. Using their theory, the researchers have shown how a single-photon emitting diode based on silicon carbide can be improved to emit up to several billion photons per second. That is exactly what one needs to implement quantum cryptography protocols at data transfer rates on the order of 1 Gbps. This makes silicon carbide by far the most promising material for building practical ultrawide-bandwidth unconditionally secure data communication lines.





Experts Discussion:
Dan Feinberg on Automotive Electronics

Feature by the I-Connect007 Editorial Team

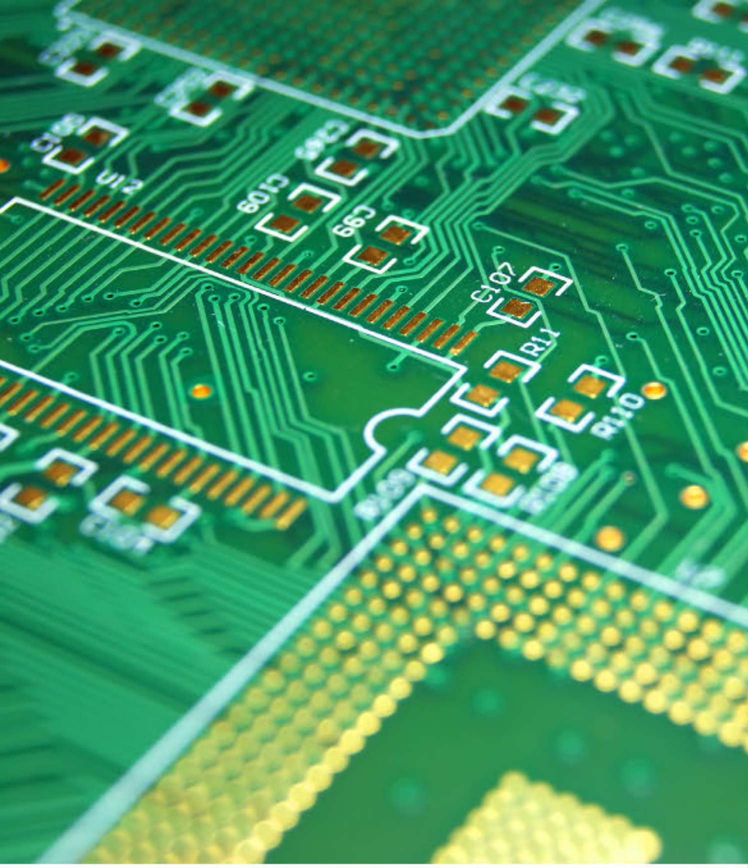
When we began planning the automotive issue, we reached out to one of our automotive experts, Dan Feinberg. A fixture at the Consumer Electronics Show, Dan has been covering autonomous, hybrid and electric vehicles for years, along with the rapid growth of high-tech electronic gadgetry in traditional vehicles. In this freewheeling experts discussion, Dan spoke with Barry Matties, Patty Goldman, and Happy Holden about the future of auto electronics and what it all means to the PCB industry.

Patty Goldman: Dan, you covered the Consumer Electronics Show for us, and you found quite a bit of automotive stuff on display. Tell us what you learned about automotive electronics at CES.

Dan Feinberg: Basically, the advances in artificial intelligence and the advances in computational and quantum computing are enabling total autonomous driving at a much faster rate than was anticipated even five years ago. The main thing that I am learning about automotive electronics concerns autonomous driving and the effects of disruption. Think about it: You have a couple cars coming at each other and there's going to be an accident; the human beings involved must decide. Am I going to hit the car? Am I going to hit the tree? Am I going to go over the cliff? Am I just going to do a gut reaction? You never know how a human being is going to react. The autonomous driving artificial intelligence is going to have to decide, "I'm going to have an accident. Which one will kill the fewest people?" It's going to have to decide who is going to get killed and who isn't.

Goldman: That sounds scary, having a vehicle make decisions like that.

Feinberg: It's kind of scary. It may be the best decision; it probably will be. I would expect that if the whole country were autonomous driving, the accident rates and the fatalities and so forth would go down significantly. But it's still scary because it really is the first step toward AI taking over control of things that human being typically control.



And there's lots more in regard to automotive electronics, besides autonomous driving; what's coming up is absolutely amazing, and the announcements that have been made by NVIDIA at CES and the announcements that they're about to make with regard to their 2000 series of graphics cards that are using some of their newer chips, that haven't even been announced yet, make this all so very possible and so quickly.

The other thing that I think that we should think about is the population of California. If any state's going to do it first, it will be the state that thinks they know what's best for you, and that's California. I would predict there will be major freeways in California within some short number of years where you will not be allowed to drive. You will have to go on an autonomous vehicle. A human being will not be allowed to take control. And I would say the next generation after the millennials you're probably going to have a significant fraction of them that will never drive an automobile.

Barry Matties: Another interesting thing I've seen is that in India and that region, there is a push for all-electric vehicles, and that's going to be another disruptive change in the automotive supply chain overall. What are your thoughts on the all-electric cars, Dan?

Feinberg: When your only choice was a Prius I was dead set against them. But now we're starting to get some real cars that are going to survive more than a 30-mile-per-hour crash and so forth, and I'm not so much against them. I just got a new car and I looked at a Tesla, but it bored the crap out of me—and that's why I didn't get one. But for most vehicles…think about nano-crystal power transmission. It's another technology that's going to be hitting us quickly. So you're thinking about nano-crystal power transmission, where an electric car will not have to carry much in the way of batteries and will have virtually unlimited range. In other words, they would be transmitting the power to run your vehicle over the airwaves.

Go back 100 years and think about being able to transmit music over the airwaves. If you wanted to hear music, you had to go to a live group, or there were a couple of ways to very primitively record music, but you had to be there with it. Now, we've all grown up with radio and TV. We're going to be able to transmit power over the airwaves using nano-crystal power transmission. The younger generation is going to see total electric driving, but without carrying all these big battery packs. There would probably be just enough battery to let the vehicle get through an area where there may not be good signal strength.

Happy Holden: I've driven a hybrid car for the last five years. About 30,000 of my 80,000 miles have been under battery. One interesting car that I saw was the BMW electric car; it's a hybrid in that it has a three-cylinder diesel engine that is hooked up to a generator. It can do 300 miles all electric, but it generates its own electricity. It's like a diesel electric locomotive and at a lower emission rate because the generator runs optimally all the time and just keeps topping off or supplying additional current when the car demands it. But an all-electric car with a limited amount of batteries is like a miniature diesel electric locomotive.

Feinberg: And you don't need a diesel engine anymore because the power is being transmitted to you via, I'll call it radio waves, although it's not radio waves, it's over the air.

Holden: Yeah, but that's going to take infrastructure time to implement.

Feinberg: Maybe 15-20 years. I think it's the way things are going. The percentage of electric cars is jumping up and again if you live in California, we're paying close to four bucks a gallon for gas.

Matties: In China there's a very expensive licensing fee to buy your license plate for a car—up to $10,000 to $15,000, and they're waiving that fee for electric cars. They want it for the environmental aspect, the noise factor, and I don't know what that does to their economy in terms of jobs, but it certainly brings in a lot more electronics.

Feinberg: We're seeing some of that here too. The electric hybrids and electric cars get free access to the toll roads in some cases, and free access to the high-occupancy lanes.

Matties: I think that's really it. You're starting to see incentives, and their capability is exponentially greater than the first Honda hybrid.

Feinberg: Circling back to nano-crystal power transmission via airwaves, there is a lot more going on than most people realize.

Goldman: How does this affect designers and PCB manufacturers? What do you see us needing to prepare for?

Feinberg: 5G is going to be a part of it because of the very rapid and significant rate of data transmission, but the rate of autonomous driving—the introduction—is going to do nothing but go up. We covered it at CES. The van comes by your house and there's nobody in it, but it just opens the door and you pick out the stuff you want, and it automatically bills you and it drives off to the next person. That's very doable right now. That's going to make the whole thing of autonomous driving more acceptable to people.

Holden: Patty, I'm in a special committee with Michael Carano. We're seeing massive failures on military warheads from stacked microvias, and none of it is being reported, and there are no IPC tests for it. It appears all the IPC scanning criteria are ineffective at picking these things out, and the automotive guys are beginning to see the same failure modes.

You should see the military stuff that's 3 + 8 + 3. I was flabbergasted that the military uses such sophisticated microvia structures and that so many of them failed. I didn't think they'd allow them that complex, but apparently, they have been, and they've just been living with massive failures. Especially for the Navy because some of these are MIRVS in ballistic submarines, sailing under the polar ice caps, so they could never be launched. They're dead in their tubes.

Matties: They'll talk about it when there's a disaster, won't they?

Feinberg: You know, that's a good question for me to raise with a couple of the guys at NVIDIA. They don't really talk about reliability very much. They talk as if the reliability is there, but I wonder.

Matties: Another thing regarding reliability is that the types of boards being produced for automotive transport in general are changing. I'm hearing that we're going to see more HDI boards entering the automotive stage. We've never really seen that in the past that I'm aware of. Also, there is a need for boards that can handle the high voltage and high amps of the cars that are coming out. What impact do you think that's going to have in the automotive marketplace?

Feinberg: If reliability becomes a public topic and lack of reliability becomes an accepted issue, I think it's going to have a big effect on the marketplace.

Goldman: In the past, if it didn't work perfectly and your car didn't start, it was an issue, but it wasn't as huge an issue as if your car was driving itself down the highway and something blinked. It becomes a whole different level of issue.

Holden: GENTEX is working on some of the artificial intelligence radar and camera-based, including night camera, autonomous driving and parking technology. Their current prototype suppliers don't have the technology. They're talking about 35-micron lines and spaces and .4-millimeter pitch and 6 oz. copper, and the ability to last 15 years under heavy load. Feasibility is not what we normally talk about.

Feinberg: Again, I honestly think that it goes back to nano-crystals. I think it's going to make a big difference, and sooner than you think. Not this year, but I think it could be. It's just like when you go back to the '60s, with the amount of oil that we had left, we thought cars would be out of gasoline by 1985. It ended up not being a problem because the average car that got 12 miles per gallon now gets 25, and so on.

Holden: A lot of the automotive electronics is not done by EMS companies. The automotive electronics people like GENTEX and Bosch have their own assembly, and I wonder... because automotive is so much more rigorous in terms of reliability, why do these OEMs do their own assembly instead of outsourcing it to EMS companies?

Matties: That's a good question. What do the Ford factories and all these other car factories look like? How are they setting them up? I just heard they're bringing billions of dollars into the automotive space in America.

Holden: Everyone here in Western Michigan is bustling because of the purchase of automated equipment for the new automotive factories.

Matties: We've heard these predictions that 50% of the value of a car is going to be in its electronics by 2025 or so. Those features are driving this segment, and when you look at things like global positioning and diagnostics, it adds up to a lot of electronic consumption.

Feinberg: They really are. And you notice on your phone that you've got one tire that's getting low when you haven't been in the car all day.

Matties: Security is a big issue when you can start hacking into cars, and it's already been proven with keyless entry.

Holden: I read a good article on that, and it said an autonomous car will have 100 million lines of code, all of which doesn't have any security because the automotive people haven't adopted the sophistication of the military in terms of coding.

Matties: Did anyone hear about Google laying their new line under the ocean to Japan? It's supposed to be 10 million times faster than a modem; they say it can handle 80 million high-definition video conference calls between the continents at once. That's amazing. That's going to affect automotive, because they're all going to be talking to each other. We're talking about 5G, but when we're talking about 50G, which probably isn't so far off, that's going to be great.

Goldman: Well, does anyone have anything else?

Feinberg: I think that's everything.

Matties: Dan, thank you. It's great having you on the team.

Feinberg: Thank you so much. **DESIGN007**

Zuken Pulling Ahead in Automotive PCB Design

Feature Interview by Andy Shaughnessy
I-CONNECT007

Zuken has been developing PCB design tools for the automotive market for years. With automotive electronics worth over $200 billion globally, and growing every day, Zuken is preparing for a brave new world of smart cars, and autonomous and electric vehicles. I spoke with Humair Mandavia, chief strategy officer with Zuken, and asked him about the challenges facing automotive PCB designers, and the trends he's seeing in this constantly evolving segment of the industry.

Andy Shaughnessy: Humair, tell us a little bit about Zuken's work with automotive PCB design. I was at Zuken Innovation World a few years ago, and all of these automotive people were there, from Ford to Continental Automotive Systems, and the attendees were from all around the world.

Humair Mandavia: We're fortunate to be working with most of the major OEMs and the tier one suppliers supporting the automotive industry globally. Zuken has been engaged in this market for over 20 years now, and it's been an area of significant growth year-over-year. As part of that growth, there are three key technology concentrations that have been part of our enablement to support the automotive market. First, we have the CR-8000 solution for PCB and electronic system design; second, there is the E3.series for electrical system design; and lastly, DS-2 for engineering data management. Our technology and partnerships with leading automotive companies have helped us deliver products to the market that allow these companies to collaborate intelligently and securely anywhere in the world between engineering teams or their suppliers. With our core focus expanding from PCB design to the complete electronic and electric system design, working with key partners in the mechanical and CAE space to offer a best-in-class engineering platform and bridging PCB design to new engineering disciplines, automotive companies are placing their trust in Zuken, and that is evident with their growing presence at our annual ZIW event.

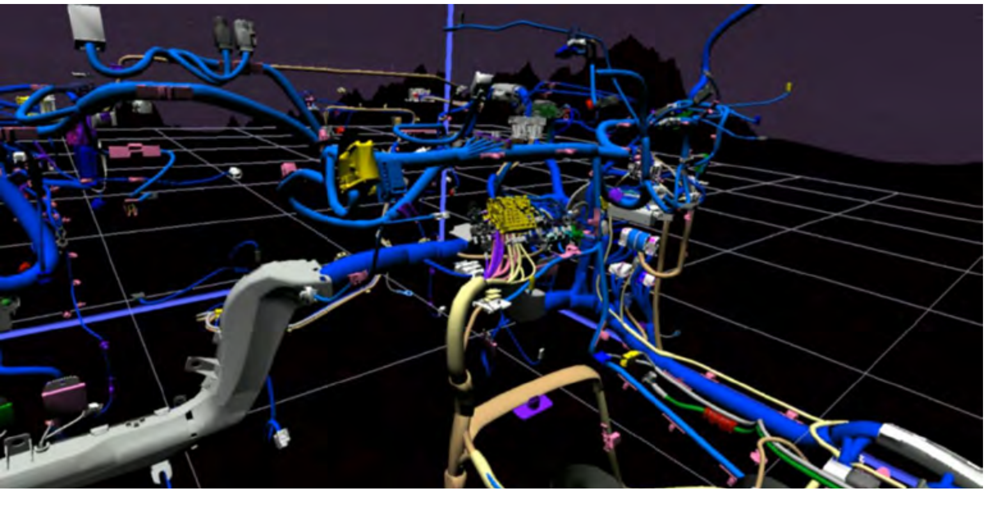
To support the design process for automotive, we have been focusing on four key areas for the last 10 years or so: automotive compliance, traceability and documentation, linking new engineering disciplines, and tighter integration with mechanical. Zuken was the first EDA company to offer ISO 26262 verification for PCB design with CR-8000 to help companies achieve their compliance requirements. Engineers can easily design and manage assembly variants necessary to support their customers or suppliers, with complete traceability of any design element throughout the process. To support model based design, we are linking MBSE (model-based system engineering) solutions to our architectural planning tools to enable a seamless flow from conceptual design and requirements definition to detailed product design. CR-8000 allows easy collaboration for electromechanical design with the ability to bi-directionally exchange and accept complete PCB and mechanical data models, and author your PCB in a native 3D environment with accurate MCAD models.

Shaughnessy: Which segment of automotive do you think is driving the electronics market right now?

Mandavia: In the past, we had infotainment systems and collision detecting sensors driving the increase of electronics in a car. With the collaboration between traditional OEMs and companies in Silicon Valley, the push for autonomous vehicles and having integrated "smart" features for safety, entertainment, and fuel efficiency is driving the growth for electronics in automotive. We're seeing more sensors, cameras, and wireless applications, along with better integration with other electronics that many drivers already own. I am personally amazed by how some companies are evolving and dominating new markets in the semiconductor market. Take Nvidia, for example. They have not only dominated the big data and AI, but they are leveraging their GPU technology to drive autonomous systems. We see most chip makers focusing many of their new products on automotive in response to expanding demand and implementation of electronics in this area.

Shaughnessy: What do you think are some of the biggest challenges, if you're a PCB designer working on a board for automobiles today?

Mandavia: There are three key areas that can be considered major issues. The first issue is around high-speed/RF design. Design teams need to continuously design and verify the electrical and physical performance of a PCB or system during the product design cycle, including SI, thermal, EMC, stress/structural, and more. The second issue is around system connectivity management and optimizing placement of electronics to balance cost, performance weight and other factors. Due to the increasing PCBs and IOs in the system from all the new ECUs, GPUs, and other processing devices, it has become too complex to manage the interconnection of a system on a spreadsheet. Engineers need an intelligent and 3D visual approach to help with this.



We also see companies struggle with the implementation and optimization between new ICs, packages and PCBs within the electronic system. As processing, memory and bandwidth demands increase to support all the technologies in current and future automotive systems, design teams and suppliers can no longer afford to work in isolation, instead, they are shifting to a co-design methodology that allows all the domains to be designed and simulated as one complete system. Other issues, such as compliance verification, reliability and the use of non-standard materials are even more challenges designers are facing. At the end of the day, vehicles are expected to last many years in operation, so that compounds the challenges PCB designers are faced with. I believe we have addressed these challenges by working with our customers to develop system hardware architecture and advanced PCB design solutions.

Shaughnessy: I understand that EMC testing is really important when you're dealing with new cars with so many PCBs.

Mandavia: It comes down to reliability. I remember being asked in a past panel discussion how can we use more wireless technology to reduce some of the weight with cables in an automotive system. For example, if you can eliminate multiple harnesses in a car that can help with fuel efficiency. My argument has been that if you have wireless brakes, would you feel comfortable knowing that there could be interference with your system as you're hitting the brakes on a car? Now, can we have wireless brakes in the future? I believe we can, but there's so much more verification that needs to be done to get there as our driving environment continues to change and we have more wireless applications functioning at the same time.

Shaughnessy: It's a new world now. It seems like five years ago there were one or two boards in a car. I don't know what the average number of circuit boards is in a car now.

Mandavia: It's getting to a point where a basic car, five or 10 years from now, is going to have all the bells and whistles we see now on the high-end vehicles that many of us can only dream about – that's going to be the standard. I think it's also a case of economies of scale. You want to be able to define a configuration to realize efficiencies. You can still buy a car without all the new features, but it's getting more difficult, but there's a reason for it. It's not cost-effective anymore to make a car without all the cool features that are available today.

It's not cost-effective anymore to make a car without all the cool features that are available today.

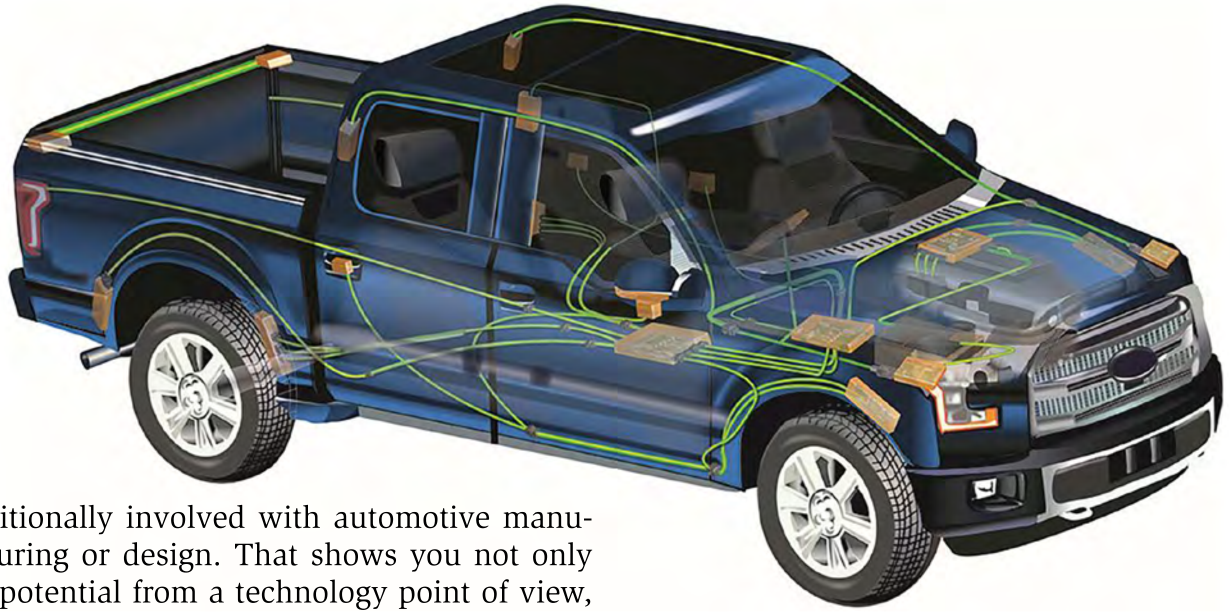
Having to deal with volume and demand, it's more effective to simplify the number of variants for each model. With all the features and functions required and in demand, we will continue to need more electronics, and that's great for our industry. We want more electronics, more engineers doing more amazing things. It's good for the PCB industry as a whole.

Shaughnessy: I've seen estimates that 15–20% of a new car price is electronics and in 10 years it's going to be 50% of the price of the car. It's all good for us. The car is becoming a computer.

Mandavia: It's going to be more and more of an electronic system and less of an electrical system. It's going to be exciting with more new challenges for our industry during this shift.

Shaughnessy: My girlfriend's Mazda is two years old, and there is so much of her navigation system that we've never used. And it's a lower-priced car. It does everything but drive the thing for you, but I guess that's next.

Mandavia: All it takes is another system change and it'll be possible. Consider what Tesla is doing with just a software download, and all of a sudden it has self-driving functions—that's just amazing! So many companies are investing in autonomous technology that were never



traditionally involved with automotive manufacturing or design. That shows you not only the potential from a technology point of view, but from a business point of view. I think a lot of companies see great profit opportunities by investing in all the different areas around automotive. It'll be interesting to see how things pan out in the next five years.

Shaughnessy: Are your customers using Zuken tools on autonomous or electric vehicles, or do you expect them to?

Mandavia: That is already being done in various capacities. Our customers are designing their electronics and electrical systems using our tools today. I think most OEMs are already either directly working with or partnering with other companies like Nvidia or Google to start solving some of the key challenges around this capability. The electronics are already being worked on, and they have been for the last few years. There is clearly a sense of urgency in the automotive space, so I think most everyone has already started doing that work.

We do have several customers designing the electronics for these technologies. What we're seeing on our side, because of autonomous technology, is model-based systems engineering and architectural planning, and the need to co-design across disciplines. It's already hitting critical mass for the electronic side. You can't effectively design these complex electronic systems without clear requirements, the traceability of those requirements, and being able to do quick validation with changes from the architectural planning side for your model-based design. Many of our customers are already pushing us to make sure of that, either at the detail stage, at the planning stage or at the MBSE stage.

Shaughnessy: I noticed that your design environment for automotive is 3D. Do you think 3D is here to stay? That it's not an option anymore, but kind of the standard?

Mandavia: If you consider all the challenges and constraints involved in PCB design for automotive, a native 3D environment is a necessity. From conceptual and prototype designs, to final production implementation, designers need to consider the interaction and relationship of their PCB to other PCBs in the system, chip and package design, mechanical design, and the ability to understand the complete assembly within the ECAD environment to optimize the design and performance of the PCB and the system. Working in a 2D environment with post-processed 3D views is no longer sufficient. Zuken's CR-8000 is the only native 3D design environment with support for system-level and multi-domain design required for automotive.

Shaughnessy: What do you think is going to happen in the next three or five years or so regarding automotive electronics?

Mandavia: Well, I'm hoping to see flying cars in my lifetime (laughs), but in the next three to five years, you will see the maturity of autonomous technology for automotive, and changes to our infrastructure engaging with our vehicles to enable more features to improve traffic flow and safety. If there is further communication between a vehicle to the infrastructure, that will require more electronics and sensors in the system.

Shaughnessy: Well, it should be interesting to watch, and it's all good for the industry.

Mandavia: I can't wait to buy my flying car!

Shaughnessy: Is there anything else you would like to add?

Mandavia: It will be interesting to see the change in approach and methodologies and design in automotive in the coming years. As we see convergence of traditional OEM companies and Silicon Valley shaping the future of automotive, we are seeing the clash and evolution of the approach on how an automotive system is defined. We are all seeing new approaches being implemented, and more changes around the corner.

Shaughnessy: It's a fun time, it really is, and it's only going to get better.

Mandavia: Thank you, Andy, for making the time to speak with me today.

Shaughnessy: Thank you. **DESIGN007**

Twisting Laser Light Offers the Chance to Probe the Nano-Scale

A new method to sensitively measure the structure of molecules has been demonstrated by twisting laser light and aiming it at miniscule gold gratings to separate out wavelengths.

The technique could potentially be used to probe the structure and purity of molecules in pharmaceuticals, agrochemicals, foods and other important products more easily and cheaply than existing methods.

Developed by physicists at the University of Bath, working with colleagues at the University of Cambridge and University College London, the technique relies on the curious fact that many biological and pharmaceutical molecules can be either "left-handed" or "right-handed."

Notoriously the morning sickness drug Thalidomide caused birth defects and deaths in babies before it was pulled from the market in the 1960s. Investigation showed that the drug existed in two mirror images; the right-handed form was effective as a morning sickness drug, but the left-handed form was harmful to fetuses.

The research team from the Centre for Photonics and Photonic Materials, and the Centre for Nanoscience and Nanotechnology at the University of Bath, used a special white-light laser built in-house and directed it through several optical components to put a twist on the beam. The twisted laser beam then hits a nano-scopic U-shaped gold grating which serves as a template for the light, further twisting the beam in either a right or left-handed direction.

The study, published in the journal Advanced Optical Materials, demonstrates the technique as a proof of principle.

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Porsche Engineering...by Design

Feature Interview by Barry Matties
I-CONNECT007

Thomas Wischnack of Porsche Engineering is currently designing the high-power charging infrastructure that will go inside the next generation of automobiles. Thomas was a keynote speaker at AltiumLive 2017 in Munich, Germany. I met with him to learn about Porsche's hardware and circuit development and what Porsche does to continually bring new designers into the fold.

Barry Matties: Thomas, before we discuss the keynote you delivered here at AltiumLive 2017, please give our readers a little on your background.

Thomas Wischnack: Since 1993, I've dealt with electronics development, hardware and software development, which at that time meant 8-bit microcontrollers—everybody did it. During those years, speed has gone up, so frequencies are higher. Systems are getting more complicated. I started by developing multimedia systems and high-end audio systems, and now, it's high-power charging infrastructure.

Matties: How many years now have you been at Porsche Engineering?

Wischnack: Fifteen years.

Matties: Automobiles are arguably one of the harshest environment for boards to function in, correct?

Wischnack: That's true. The automotive environment is hard. Especially if you're dealing with these infotainment systems, because they are mounted in the dashboard and just 50 centimeters away is the antenna, which is giving the RF signal to the ECU unit and for a clean radio reception, there needs to be a very, very clean design not to disturb your cell phone. And this is very hard stuff.

Matties: And more and more with all the wireless technology onboard...


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Wischnack: The wireless technology is not the big issue because normally you get a quite clean spectrum from this and frequencies are not disturbing each other. The bigger problem is if you have these high-speed systems, display systems, they give you this EMC fog, which is very broadband, and you cannot control it, and this gives a bad interference. Nowadays we have the new modulation technologies, DAD, and so on, so if you just have one peak from one system it doesn't hurt you. It just gets filtered out, but on the analog side it's very bad.

Matties: Now when you look at automobiles today, they're just rolling computers. The amount of electronics they contain is incredible.

Wischnack: Yeah, I think you can say it's a computing center with four wheels.

Matties: And our phone is no longer a phone.

Wischnack: Right, that's the same. And people always try to get more comfort electronics, everything they're used to having at home they try to have in the car. I remember very well when the iPod came along. Everybody wanted to have it in the car and needed a special iPod connector. And now, no one's talking anymore about this iPod connector, but in cars they're still present. So maybe sometimes it's good to think: What is the valuable part? Is it the iPod or the car in the end?

Matties: When you're designing for the automobile industry, what's your greatest challenge?

Wischnack: I think it's the automobile industry itself because it's sometimes blocked by non-dynamic processes; everything must be approved and validated and so on, and the creativity is missing. If you want to do something the right way, sometimes you must leave the processes and go a little bit next off the beaten path. And to convince people just to leave the beaten path and do something that's not very common. That's a very challenging thing. It's not the technological side, that is straightforward, but getting things done is sometimes very hard.

Matties: In terms of the actual manufacturing onboard electronics that you had some refer-

Thomas Wischnack presenting his keynote: "The PCB Doctor: Diagnose and Treat Common Design Challenges" at AltiumLive in Munich, Germany.

ences to, more fabricators and expectations and what you would look for, why don't you just share some of your thoughts about that?

Wischnack: That's a very interesting thing. Many of the things that developers do, they are required by these fabricators because they have done it the last 20 years, and there are only a few fabricators that really moved forward and accepted to get new technologies and get rid of old stuff they have done all along. You carefully must choose. So if you have a fabricator who says, "No, you can't do this because I cannot do it. I cannot fabricate it," you need a different fabricator. This morning we had a good session by Lee Ritchey and there was this question about the 15%. His answer was, "You need a different supplier. It's the wrong supplier for you." And that's true. Give up your old suppliers if they don't follow. If you're faster than your supplier, you need a different supplier.

Matties: The other issue that we see in the design community is an aging population, and there aren't a lot of young people moving into the design community. How does Porsche address that issue and attract young people to the industry?

Wischnack: We have a lot of trainees and a lot of students. We have a good relationship with many universities to get the students into our company. We try to get them very early so that they get familiar with the way we are working, so we can do some basic education. Not just teaching all the formulas and all this stuff at university, but also getting to, "What is real life? What can I do with all the stuff they teach me at the university?" And after they have been a trainee in our company, very often they get their final grade with some things they do in our company, and at the end they get employed. So many of my colleagues have been trainees around my laboratory, and meanwhile I know six or eight people just come from my department, who are now employees in the company. And there are many others who started as trainees. Getting young people in the company is the most beneficial thing you can do.

Matties: Is it that there are just not a lot of young people interested in this field, because there are so many other glamorous fields out there?

Wischnack: You're right. Most of the young people do become hardware developers, or they want to do software, or maybe the business stuff. But we have some students that agree to do the hardware because they want to have a job at Porsche, and at the end they are good hardware developers because suddenly they got to know all about doing hardware. So it can be nice—you get a product at the end, and if you really understand what you're doing, you're successful, you get a successful product, and you're doing something no one else can understand. Suddenly, they are hardware developers for the rest of their lives.

Matties: There's probably a real advantage to taking that hardware development and bringing the circuit design together.

Wischnack: For sure, but we have to make clear that the hardware design we do is mainly not for our own cars, so this is always done by suppliers for many, many reasons. Our main job is to do the troubleshooting, not just for our cars, but for our external customers. We are close to production and if a product is not working, then we are asked to do it. One of our special duties is to be very fast, to do it in one shot, and not to have three, four, five, or six samples until it's finished. So normally we get one or two samples that need to be finished. We don't need two years for the development. It's three months maybe. That's our benefit, but I don't think we can compete with Asian companies. They work for 10% of the money that we can, so we must be special, and I think this is the best way we can give. So, we are fast, we are precise, and in the end the product is working.

Matties: In your presentation, you talked about some of the physics and laws that exist. When you're bringing somebody in for design, what sort of educational standard do you look for?

Wischnack: That's a good question. It's not a standard of education. I don't care primarily about education. Of course, you need to know what's math and what's physics—you should have heard about this. But in the end, it's more important that you're open-minded, that you have your own creative ideas, and things you want to do. That you are somehow aggressive in finding solutions, you don't give up if something fails, and if it doesn't work you don't sleep at night because you want to find a solution. If it's five o'clock in the morning and you're still in the lab, as long as is allowed, this is much more important than being from a famous university and having worked for famous companies. So I always look at these people. I don't care for grades. I don't care for the companies they have worked at before, I try to find the people and try to find out if they're really interested in what they're doing.

Matties: Is that a tough quality to determine if somebody has, until you work with them?

Wischnack: And this is why it's beneficial to have young students as trainees, and you have them for at least half a year. Half a year is a long enough time to get to know someone and to find out what's on their mind, how are they thinking, how are they working, and then you can decide if they will be a good member of your next team.


Thomas Wischnack

Matties: You started off talking a little bit about the environment in which you work. How many designers are at Porsche and how does the team work together?

Wischnack: In hardware, we have about 10 to 15 designers. There is no strict rule about how we work together because everybody's right for the project and we are individuals, but sometimes colleagues work together and on the next project you have someone else. We have different departments with strong cooperation between them, so it's very open, depending on the type of project. As we are an engineering service company, we always have to adapt to the requirements from the customer and not just to our own philosophy of whatever we want to do.

Matties: It sounds like you've had an interesting career at Porsche. What have some of the highlights been for you?

Wischnack: That's a good question—there are so many. First, one of the most challenging projects happened a couple of years ago, when I had to recover a project. It was one of the infotainment systems for our cars and somehow, they failed to do the development in Asia. They assisted one of our suppliers. They already had been working on it for two years and we got four months to do it from scratch: new hardware, software, a very complex multimedia system. And to see this running at the end, to see that the cars are produced with the systems after only four months was a good thing. I had some good colleagues on that team, and we had good fun.

I think the other thing, which has even more risk, is the high-power charging stuff. Two years ago, I was asked, "Maybe you can look at how we could do it? Take care of this project, and maybe we can do something." And together with one of my colleagues we started to investigate how to make high-power charging, something nobody had heard of before. Meanwhile, it's a department of 45 employees and we are the leader for this topic. Then the VW group officially announced that we have the first stations now out in the field and things are getting produced. So going from zero to all out mass-production in two years with a totally new product where we could define the base all over the world. So we're going to distribute it all over the world and everybody now starts to define concepts according to what we defined two years ago. This was nice, something you can do as an engineer maybe once in your life, where you really define the stan-

dard, and it becomes a part of the future for the world.

Matties: That's really what you're talking about, because we're at the ground level of this and the standards are being created now.

Wischnack: Yes, and this is really challenging. The first quotes were incredibly expensive for this stuff. We tried to find our own solutions and at the end, we ended up at 20% of the initial cost and now it's even lower just by using the brain and leaving the beaten path as I said before. Not just choosing companies everybody would choose but trying to find the small innovative companies with a clear mind and the good ideas and even having some of our own ideas making patents on the stuff. This was very challenging and two hard years to be honest, but for an engineer maybe the best years you can have.

Matties: And coming in at 20%, that's fantastic. When you're designing boards, as people know, there are so many ways to do it. What's on a layer, where you put things, etc. How do you define best practice for designers?

Wischnack: Best practice for me is not having strict design rules. I've met a lot of companies that have strict design rules, sometimes several hundred pages, just defining how to make a board. This is not best practice. This is strict, this is a limitation, and you cannot fix dynamic problems by static solutions. This does not work. So best practices are get a good cup of coffee, lean back, and try to think about the system. Try to arrange the components and functions of the board. And as soon as you have a clear understanding, what you really want to do, then you can try to arrange components, try to find components, and so on. Do it a dynamic way. Every board is different, because every challenge is a different challenge. So not limiting yourself is good practice. Don't rely on defined things. Try to do the best for the board and for the solution and not just follow rules that have worked for another board.

Matties: I was just listening to Mike Creeden in his talk, and he said that if you're not doing HDI now, you're going to be doing it very soon. How is that in the automotive sector?

Wischnack: We have never used this; until now, it has not been necessary.

Matties: And do you see a need for HDI in the near future?

Wischnack: It depends. I think if the frequency increases much more, if the component density increases, it will be necessary. So I won't say we won't ever need it. Of course, we need it; it's a proven technology, and it's good that we get it, but up to now we haven't needed it.

Matties: You know some people would say that by utilizing HDI, generally you lower costs. And others are that it increases costs. There seems to be some discrepancy there.

Wischnack: It's a big difference in what you have to pay for a PCB and the benefit you get out of it. I had to say this a couple of years ago when I wanted to use embedded capacitance, which is an amazing thing. And everybody said, "Yeah, but the board is $2 more expensive." Yeah, but I don't need all this capacitance and I know it's a better physical behavior. So, don't just think about board costs. Always look at the overall costs and if you get a good product. I you can save one EMC measurement with the whole setup, you can get a lot of boards which are much better just by saving this EMC measurement.

Matties: What advice would you give to a young designer today? I know you talked about not being on the beaten path, is there anything else that you would share with somebody who's considering a career in PCB?

Wischnack: Yes, switch off the smartphone and use your brain. The truth is not the Internet. Wikipedia is not the solution. The solution is valid as soon as you have a clear understanding what you want to do, and if you don't understand something, find one of your colleagues and ask questions. Don't stop asking questions until you get all the answers, and if they can't give you the answers, try to find someone who can give you the answers. Most of the problems that come up are because there is no one you can ask. So at most of the companies where I do some consulting, they have no one to ask. Suddenly I come up and they start to ask questions they've always wanted to ask for many, many years. And it's two or three hours just asking questions they always wanted to ask because there was no one. So, never give up in finding someone who can help you. It's not a shame not to know something, but it's a shame not to ask for a solution.

Matties: Is there anything that we haven't talked about that you feel like we should share with the industry?

Wischnack: The biggest problem is accepting that people are not all perfect. Not every engineer is perfect, especially in this industry. They're making mistakes, boards are bad, designs are bad, but it's not good blaming them for doing bad boards; the real approach is helping them to improve. That's a big problem, especially in Europe, I think. If someone fails, he's always the loser, but no one really tries to help him. It would be much better to engage someone like me who could try to fix his issue, teach the people, and next time they might be great engineers. This is something the industry must learn. It's not worth having green flags

It's not a shame not to know something, but it's a shame not to ask for a solution.

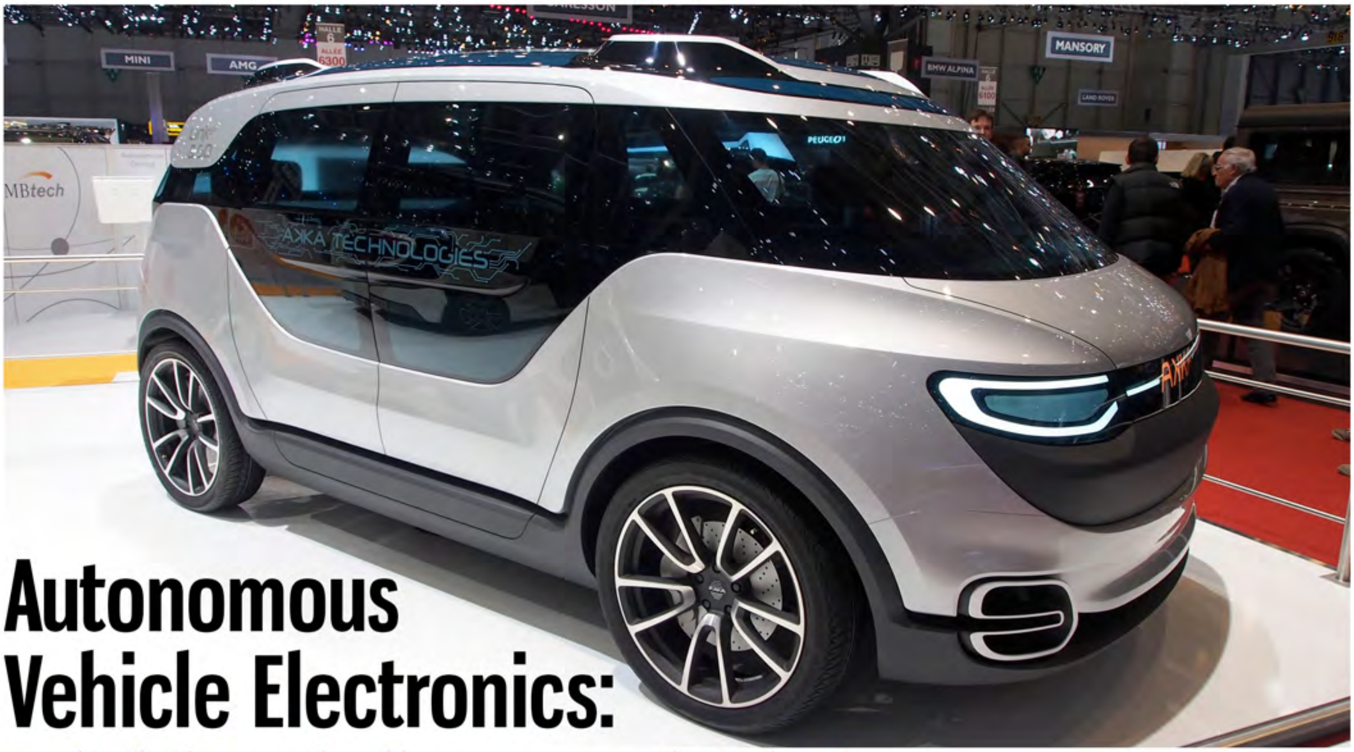
everywhere when the product is not present and two years later we get it. So be open, tell the truth, speak up about problems, ask for help early and soon, and don't blame someone because he has made something wrong. Help him to improve.

Matties: Thomas, that's great advice. Thank you so much for spending time with us today.

Wischnack: Thank you. DESIGN007

Audi, Italdesign and Airbus Combine Self-Driving Car and Passenger Drone

Pop.Up Next is a modular concept to solve traffic problems in cities. The ultra-light, two-seater passenger cabin can be attached either to a car module or to a flight module. The dominant interior feature is a 49-inch screen, while interaction between humans and the machine is performed by speech and face recognition, eye-tracking and a touch function. In this video, listen to Italdesign's CEO, Jörg Astalosch talk about the progress that was made with PopUp over the past year. This concept for a modular air and ground transportation system is aiming to reduce traffic jams in megacitites of 2030.



Autonomous Vehicle Electronics:
Reliability Challenges and Solutions

Feature by James McLeish
DFR SOLUTIONS

The era of artificial intelligence-enabled autonomous vehicles is rapidly approaching. Numerous articles and papers have been written about the many technical challenges that need to be solved to achieve consistent functionality, performance, safety and dependability in autonomous vehicles. Extensive resources are being expended to address these "physics of success" issues that involve issues such as:

- Sensor and data fusion required for situational awareness that includes high-resolution mapping, better vision systems, and high-capability LIDAR at reasonable costs
- Co-existence with extreme weather conditions, aggressively rule-breaking humans, interference from other vehicles, pedestrians, animals, and large road debris
- Ethics in unavoidable accidents
- Hacking/jamming prevention
- Achieving complex navigation capabilities on all road and traffic conditions

After these operational issues are addressed, the next challenge will be achieving reliability and durability for years of service under harsh automotive conditions for the advanced electronics technology that autonomous vehicles require. Hardware reliability-durability challenges that need to be considered in AVs and other advanced vehicle electronic systems that will be discussed in detail are:

1. Flat no-lead/near-chip scale integrated circuits
2. Large, higher power, hotter-running integrated circuits
3. Warpage issues

1. Flat No-Lead/Near-Chip Scale Integrated Circuits

Flat no-lead (FNL) IC packages are probably the most popular semiconductor package today because of their low cost, small outline/low profile form factor, and excellent electrical and thermal characteristics. Various versions and names of FNL IC exist such as:

- DFN (dual flat no-lead)/QFN (quad-flat no-lead)

- VQFN (very thin quad flat no-lead)
- UQFN (ultrathin quad flat no-lead)
- SON (small outline no-lead)
- USON (ultra-thin small outline no-lead)
- LLP (leadless lead-frame package)

FNL construction consists of an IC die on an over-molded lead frame with or without a bottom thermal pad and with sawed or punched terminated solder bond pads exposed on the bottom. The pads are arranged along either two or four sides of the package in one to three rows. The small solder pads of these devices are configured to produce small, thin bottom terminated solder joints that combined with the small height of these devices results in a very low-profile package that makes them highly desirable for cell phone, tablets, and other portable electronics.

However, FNLs are near-chip scale devices in which the silicon die dominates the package resulting in a low coefficient of thermal expansion for the package, typically in the range of 6-8 parts per million (ppm) per degree C. This results in a large CTE mismatch with the 14-17 ppm/˚C CTE of printed circuit boards that FNL ICs are soldered to. The CTE difference combined with the thin solder joint results in high in-plane sheering angles during thermal cycling resulting in a sheering stress-strain relationship that reduces the number of thermal cycles that can be endured before solder attachment fatigue failures occurs.

When the temperature is elevated from the neutral state, the higher CTE of the PCB will cause it to expand more than the lower CTE component, and the solder joints will have a strain applied to them. The strain can be represented by the sheering angle produced in the solder joint due to the CTE mismatch, the temperature change (delta T) the solder joint thickness, and the distance to the solder joint to neutral point. When the temperature is decreased from the neutral state, the PCB will contract more than the component and the solder joints will again have a strain applied to them. Any time the temperature changes, the solder joints are stretched one way or another. The solder joints at the components corners that are typically the furthest from the component's neutral point experience the greatest sheering strain which typically causes them to be the first to experience fatigue failure.

In a typical automotive module board level reliability (BLR) thermal cycling test of -40˚C to 125˚C, the mean cycle life of QFN ICs (depending on size is only 1000 to 3000 thermal cycles before solder fatigue failures occur). This is comparable to a mean thermal cycle life of over 10,000 thermal cycles for typical gull-wing, leaded-quad, fine-pitch (QFP) ICs used in automotive electronics and the 3,000 to 8,000 thermal cycles automotive ball grid array (BGA) ICs can endure. FNL ICs started appearing sparingly in automotive electronics 5-8 years ago many small QFNs such as those low power devices in packages sizes under 7x7 mm are not a concern, however their challenges will increase as higher power and larger versions are used. (Figure 1)

2. Large, Higher Power, Hotter-Running Integrated Circuits

As vehicles with advanced telecom and AI autonomous capabilities start to appear, the large high-power BGA ICs these systems require

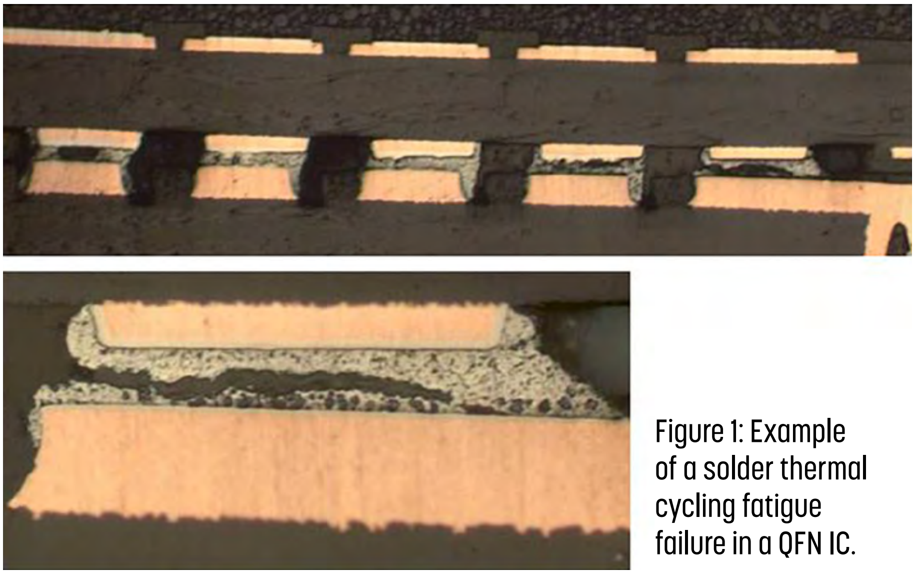
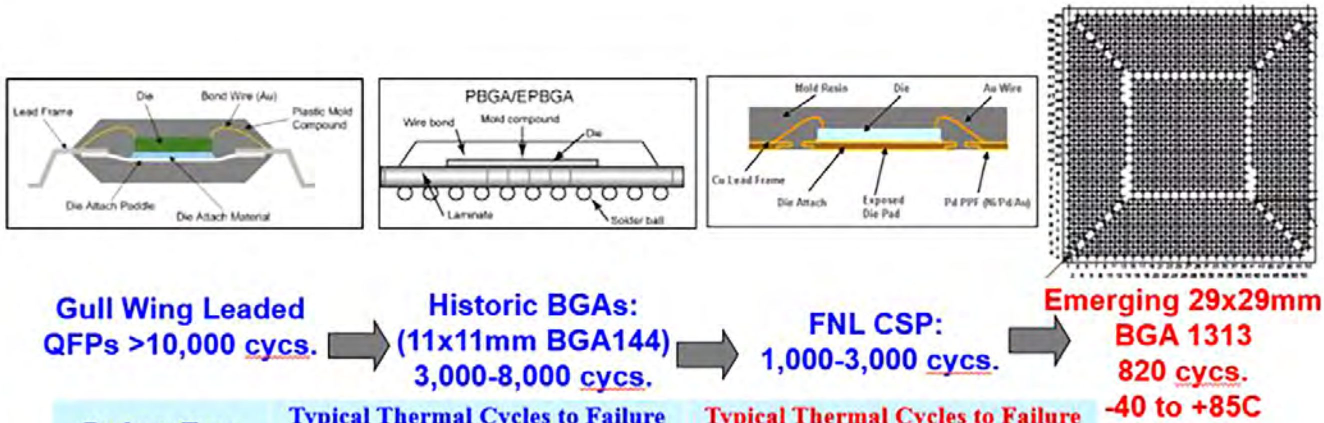


Figure 1: Example of a solder thermal cycling fatigue failure in a QFN IC.



Package Type	Typical Thermal Cycles to Failure (-40C to 125C)	Typical Thermal Cycles to Failure (-40C to 85C)
QFP	>10,000	
Hist. BGA	3,000 – 8,000	
QFN	1,000-3,000	
Large BGA		820

Figure 2: Comparative IC package thermo-mechanical cycling solder fatigue durability.

are producing reliability challenges from the opposite end of the IC size scale. These ICs will have a longer displacement to their neutral point and they can have higher power dissipation self-heating temperatures which increases the sheering strains in their outer solder balls. As previously noted, current automotive BGAs are capable of a mean life of 3,000 to 8,000 thermal cycles from -40˚C to 125˚C. These BGAs are in the 11-15 mm square packages with 144 to 225 solder balls. But advance automotive application will be requiring much larger ICs such as 17x17 mm BGA-400, 23x23 mm BGA-760 and 29x29 mm BGA1313.

The latter of which is projected to be capable of a mean life of only 820 thermal cycles under the reduced temperature range of -40˚C to 85˚C (Figure 2).

3. Warpage Issues

The previous thermal cycling solder fatigue examples dealt with thermal cycling conditions that produced stresses in x-y plane of a PCB. When thermo-mechanical cycling stresses are limited to the x-y plane of the PCB, solder attachment are under compressive loads. Solder is similar to concrete in that it is stronger and more durable under compressive loads.

However, due to the larger CTE of PCBs compared with the effective expansion of the components or inherent warpage of either the PCB or the components, warping curvature can also be encountered that produce z-axis stresses. Such warpage of either a PCB, components, or both can also be a life limiting factor especially as components get larger and PCBs get more complicated. Warpage conditions apply z-axis stress to solder attachments. During portions of the thermal cycle, the solder can experience tensile stresses which produce a tearing strain that can tear solder apart in a tenth of the number of cycles needed to produce fatigue failures under compressive thermal cycles. Cooling to extreme temperature can induce plastic strains,

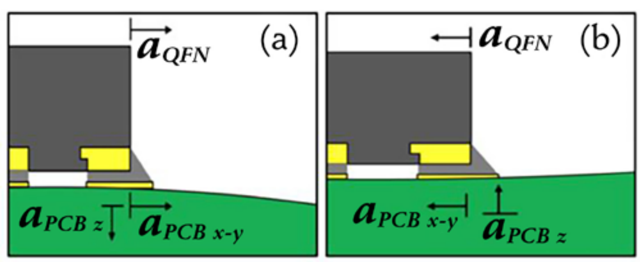


Figure 3: Examples of thermal cycling-driven PCB and component warpage. Direction of board and package expansion around the corner joint in QFN at (a) low and (b) high temperatures.

while solder joints under high temperature extremes can experience creep strain accumulation (Figure 3).

Thermo-mechanical Fatigue Solution

Depending on the application and the automotive company involved, evaluating if an automotive electronic module is susceptible to the thermo-mechanical fatigue issues discussed in items 1-3 would traditionally require 700-1,200 hours accelerated thermal cycling life testing that when combined with other durability evaluations often require 12-16 weeks of testing.

These days, physics of failure research has produced CAE tools that accurately perform durability simulations for thermo-mechanical fatigue and other reliability risk issues of electronic products. This results in a virtual reliability growth capability that rapidly identifies failure risks that need to be corrected, interactive with design creation, that saves the time and high expense of physical durability-reliability testing. The use of durability simulation for automotive electronics aligns with the overall use of CAD and CAE tools in the automotive industry, which have reduced vehicle development times from five years to 24 months (or less). One example of CAE durability simulation tools is DfR Solutions' Sherlock Automated Design Analysis software, which won a "Best of Innovation" award at IPC APEX EXPO 2018.

Similar benefits have been reaped in the aerospace industry, which has led the Society of Automotive Engineering and Automotive and Aerospace divisions to collaborate in developing the new standard SAE-J3168 Process for Reliability Physics Analysis of Electrical/Electronic Equipment, Modules and Components. This effort is intended to define best practices for durability simulations of electronic modules and assemblies. **DESIGN007**

James McLeish is a senior member of the DfR Solutions technical staff. He has 30 years of automotive electrical/electronics (E/E) experience, having worked in systems engineering, design, development, production, validation, reliability and quality assurance of both components and vehicle systems.

The Raw Power of Human Motion

Autonomy is a much-anticipated feature of next-generation microsystems, such as remote sensors, wearable electronic gadgets, implantable biosensors and nanorobots. KAUST researchers led by Husam Alshareef, Jr-Hau He and Khaled Salama have developed small standalone devices by integrating maintenance-free power units that produce and use their own fuel instead of relying on an external power source.

Triboelectric nanogenerators (TENGs) capture mechanical energy from their surroundings, such as vibrations and random motion produced by humans, and convert it into electricity. In these tiny generators, frictional contact between materials of different polarity creates oppositely charged surfaces. Repeated friction causes electrons to hop between these surfaces, resulting in electric voltage.

They incorporated nanogenerator and miniaturized electrochemical capacitors into a single monolithic device encased in silicone rubber. The leak-proof and stretchable shell provided a flexible and soft bracelet that fully conformed to the body. Fluctuations in the skin-silicone separation altered the charge balance between electrodes, causing the electrons to flow back and forth across the TENG and the microsupercapacitor to charge up.

In addition to exhibiting longer cycle life and short charging time, MXene microsupercapacitors can accumulate more energy in a given area than thin-film and microbatteries, offering faster and more effective small-scale energy storage units for TENG-generated electricity.

"Our ultimate goal is to develop a self-powered sensor platform for personalized health monitoring," says Ph.D. student Qiu Jiang, the lead author of the self-charging band project.

ITEQ Ready for Autonomous and Electric Vehicles of the Future

Feature Interview by Andy Shaughnessy
I-CONNECT007

During DesignCon 2018, I spoke with Tarun Amla, the executive vice president and CTO of ITEQ. We discussed ITEQ's future plans, including the development of materials for cutting-edge technology needs, such as autonomous and electric vehicles, as well as 5G technology.

Andy Shaughnessy: How are you doing, Tarun? For anybody who's not familiar with ITEQ, why don't you give us a quick background?

Tarun Amla: Good to see you, Andy. ITEQ is headquartered in Taiwan. It started in 1997, so we just recently celebrated our 20th anniversary, and it's grown very rapidly. We are approximately 21 billion NT, which is about US$700 million in revenue. We have facilities in China—one in Wuxi, and another in Dongguan, and both are copper clad laminate manufacturing facilities. Additionally, we have a flexible copper clad laminate factory and an HDI factory in Guangdong, and then in the same area we have a mass lam facility. We are placed probably sixth globally in terms of revenue. It's been a story of great growth for us at ITEQ.

Shaughnessy: I understand you have some pretty interesting things you're working on for 2018.

Amla: Yes. What we're really excited about is that whatever's happening in the economy on a global scale—there's buoyancy out there. There's a lot of new technology coming to the fore. There's 5G deployment that's going to start somewhere around '19, '20, and there's autonomous driving, which is finding root; a lot of people are investing in it, and it creates demand for new materials that didn't exist before. Our roadmap is aligned to come up with new products which basically enable these technologies.

When the cloud revolution was happening, and people were installing these server farms, they needed lower-loss products, and that's what ITEQ had been focused on developing in the last few years. Now we've moved towards developing products that enable extremely high digital speeds up to 56 gigabits per second and beyond, 112 gigabits per second with the change in signaling and coding.

On our drawing board now are products that are going to enable autonomous driving, for

radars going into the millimeter wave, products for 5G applications, products for cell phone applications, and for the EV revolution, because the electrical vehicles are taking over. A lot of governments have made commitments, like in China and Europe, and most of these cars will require a lot of fast charging stations, which, again, puts a huge demand on the material itself; these stations will be pushing electrical current at very high voltages through materials that must withstand these voltages without dielectric breakdown.


Tarun Amla

What is a problem for the industry is an opportunity for us, so we're trying to create materials that can withstand these high stresses and enable the use of these technologies. We're very excited about this. The same thing is happening out there in the space industry, requiring materials which are lighter, faster, and more durable.

Shaughnessy: It seems like electric and autonomous vehicles would use more heavy copper.

Amla: Yes. There's going to be a heavy copper, but there are also technologies where people are learning to do more with less, so that's been the theme so far. When the high-speed digital revolution started, copper was supposed to be able to stand only five gigabits per second, and now we're approaching 112 Gbps. The same thing is happening here; where they needed six and 12 oz. copper, people have innovated and started using 3 oz. copper instead. That's happening.

Shaughnessy: Where are your customers, primarily?

Amla: Most of the end-users continue to be in the Western Hemisphere. They are still in the United States and are driving a lot of growth. The technology, such as AI and machine learning, are going to drive needs for huge amounts of sensors and the IoT type of infrastructure, and to get there, you need new materials. So the end-product is going to be for the Western market, but, as far as 5G is concerned, that's a global phenomenon. It's going to happen everywhere. Yes, there are China-centric products, but it's a global thing. You're going to see that, and in fact it's going to drive more local content because I can't foresee these systems being built in China for let's say road infrastructure in the U.S. It'll have to be sourced locally. I don't know whether U.S. and Europe have the infrastructure for that or not.

Shaughnessy: What do you think is driving the materials market right now?

Amla: The cloud is happening. AI/machine learning, that's driving, again, the need for high-speed systems, supercomputing, and data crunching. Now what you're seeing is even mom-and-pop shops are going in for analysis of their data, and they're requiring systems which are almost at the supercomputer level. There's going to be a lot of that, so that's one of the hottest sectors. Automotive is another one, and then we are seeing some new technologies emerge on the 5G side with millimeter waves. 5G means a step change in wireless data rates, which, when it is implemented, will create demand for products and services that don't exist yet, because the enabling technology is not there. I think, other than that, it's basically the trend that the regular electronics industry is, again, moving forward. It's continuing its march, especially on the smartphone and mobility side. You're seeing an increase in price of the products, which is a phenomenon that hasn't happened across the industry for a long time. This is good news, so people want more functionality and they're willing to pay for it.

Shaughnessy: Were you seeing any problem in getting the raw materials? In the past we've seen slowdowns here and there in the supply chain.

Amla: Copper has been a major thorn, in the sense like it's something we haven't planned for because it's going into another industry, so with the rise of EVs, the copper that was originally destined for our laminate industry is going into batteries. That was creating shortages until recently, where they saw parity in pricing on very smooth copper as the pricing on the automotive side started going down, so we're seeing those pressures. We're also seeing pressure from the glass industry, because, again, there are alternative uses for it, and the same thing goes for resin.

Somehow for the industry to survive and thrive there will have to be more sharing of the profits all the way upstream. If not, then there will be supply chain pressures and availability of raw materials will become an issue. There are more lucrative outlets for these raw materials right now. It's a dynamic situation where if we get parity in pricing, then we'll be able to get raw materials; if not, then the supply will shift to the alternative market.

Some of this can be also related to shutdowns and other things that happen on a periodic basis, such as what we've seen with the furnace shutdowns that happened recently. That's a maintenance-related issue. That happens with the glass manufacturers.

Shaughnessy: Well, it sounds like you all have a good plan going. I appreciate your time.

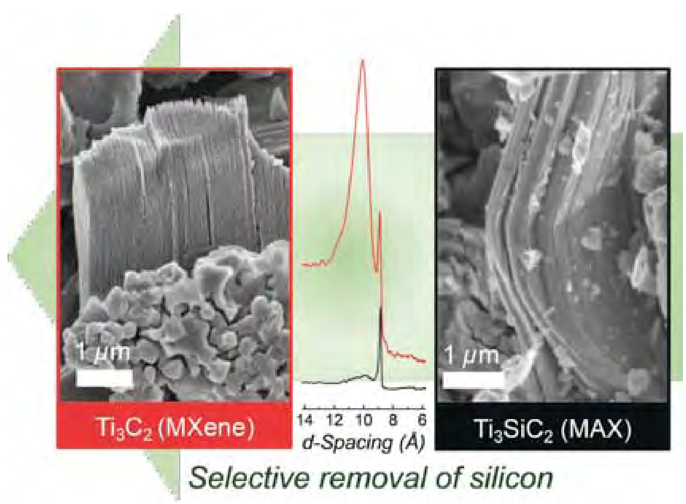
Amla: Thanks, Andy. **DESIGN007**

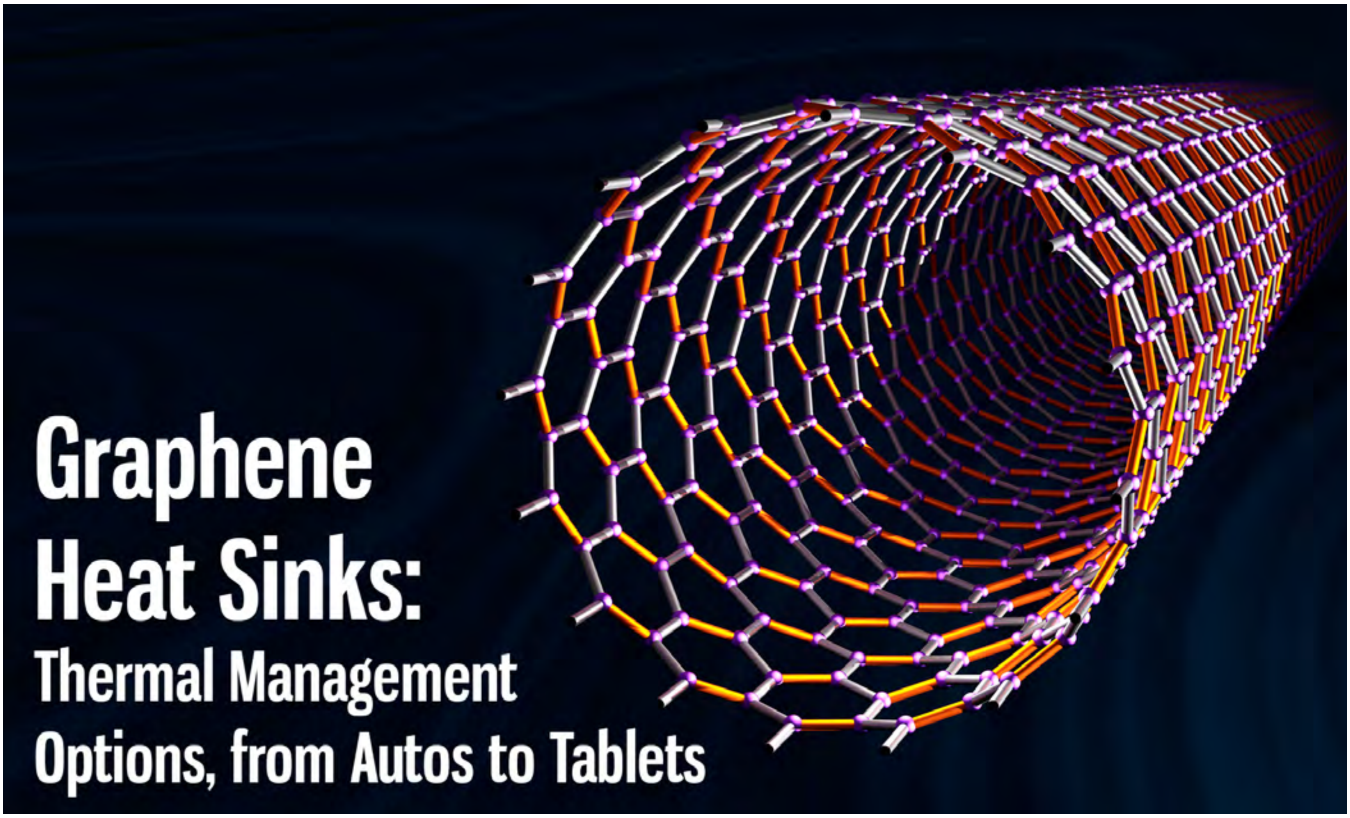
A New Way to Atomically Thin Materials

Metallic conductivity and hydrophilicity of MXenes have established them as electrodes in rechargeable batteries and supercapacitors, as well as other applications, including photothermal cancer therapy, electromagnetic shielding, water purification and gas sensing. In the journal Angewandte Chemie, researchers have now introduced a new production method. Instead of using conventional, yet more expensive, titanium aluminum carbide, they selectively etch silicon out of titanium silicon carbide, a cheaper and more common precursor, to synthesize titanium carbide.

Two-dimensional materials, consisting of extremely thin layers that are a few atoms thick, have unique properties that are completely different than the normal three-dimensional versions. A prominent example of this is graphene, which is made of single layers of carbon atoms. In 2011, a new class of two-dimensional materials was synthesized at Drexel University in Philadelphia (Pennsylvania, USA). Known as MXenes, the materials are made of transition metal carbides and nitrides, where the M stands for a transition metal, such as titanium, vanadium, or molybdenum, X can be carbon and/or nitrogen, and many compositions are available (about 30 have already been experimentally demonstrated and dozens more are expected). One such MXene is titanium carbide, Ti3C2.

A team led by Yury Gogotsi at Drexel University has now developed a successful variation of this process. By adding an oxidizing agent, the researchers could weaken the silicon bonds and oxidize silicon. Using mixtures of hydrofluoric acid and an oxidizing agent like nitric acid, hydrogen peroxide, or potassium permanganate, the team produced titanium carbide MXene by selectively removing silicon out of Ti3SiC2.





Graphene Heat Sinks:
Thermal Management Options, from Autos to Tablets

Feature by Pete Christensen
MAGI SCITECH

With the higher signal frequencies common to most PCBs, and thus greater heat generated inside them, planar thermal management has become an increasingly important issue. While engineers have tried various types of thermal pastes, substrates, and different forms of heat sinks (aluminum, copper, etc.), the electronics industry is still searching for a better, more effective, and economical solution that takes up less space. By combining carbon nanotechnology with the very efficient thermal conductivity of graphene, Magi Scitech has come up with a breakthrough in planar thermal management technology that is nano-thin, offering thermal management options for everything from autonomous vehicles to tablets and other personal devices.

For those not yet familiar with graphene, it is an allotrope (form) of carbon consisting of a single layer of carbon atoms bonded together by a repeating pattern of hexagons that form a lattice. It is the basic structural element of many other forms of carbon such as: graphite, diamonds, charcoal, carbon nanotubes, and fullerenes. Graphene is one million times thinner than paper; so thin that it is actually considered two dimensional. Graphene's flat honeycomb pattern grants it many unusual characteristics, including the status of being the strongest material in the world. Its strength is derived from its unbroken hexagonal pattern and the strong bonds between its carbon atoms. These strong bonds are also very flexible. They can be twisted, pulled, and curved to a certain extent without breaking, which means that graphene is bendable and stretchable. A list of graphene's revolutionary material properties includes: the strongest material ever measured; the thinnest material known to science; highly flexible and extraordinarily light; the most impermeable material on earth; record thermal and electrical conductivity; and incredibly energy efficient.

With the advent of automated, self-driving cars, the automotive applications for this new graphene film will expand. As these types of cars will be using more computer power and will have greater CPU power consumption for the console, onboard Internet, wireless net-

IT-170GRA1

COME SEE US AT IMS
BOOTH #2413

IT-170GRA1 Value Proposition

- Halogen Free
- Best in class performance in its space
- Best in class CAF performance
- Very attractive price to performance ratio
- Pass MRT-6 requirements
  - -CAF > 1000 hours
  - -0.65mm pitch equivalent, no thermal issue
- Available with RTF and 2μ copper which provides additional performance on a very solid platform
- Df = 0.0075 @10GHz

Intel Purley Mid-Loss Solution – IT-170GRA1

Futures

Halogen free mid loss, Df < 0.01
Tg 180°C by DSC, low CTE

Applications

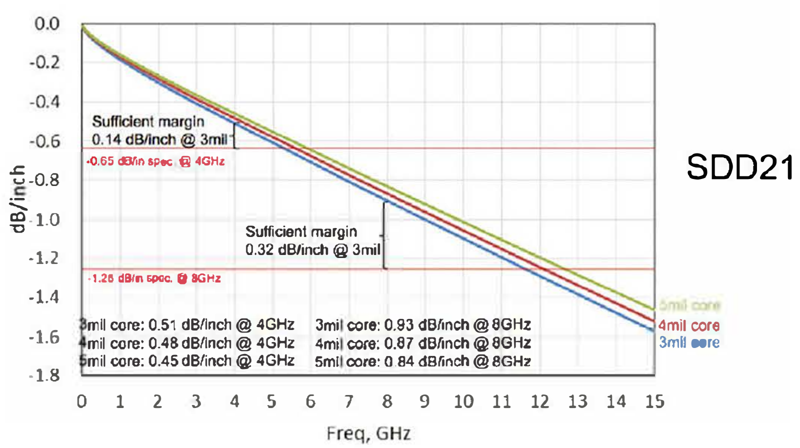
Server/Storage/Switch (10G, 40G)
Backplane, Telecom
Base station

Feature — *Purley Platform Mid-Loss Solution – Hi Tg*

General Properties

Items	Methods	IT-170GRA1
Tg (℃)	DSC	180
T-288 (w/ 1 Oz Cu, min)	TMA	60+
Td-5%(℃)	TGA 5% loss	380
CTE (%), 50-260℃	TMA	2.4
Peel strength (lb/inch)	1 oz	7.0
Water absorption	D-24/23	0.1
Dk: 2-10 GHz	Bereskin	3.96 – 3.99
Df: 2-10 GHz	Bereskin	0.0073 - 0.0075

IT-170GRA1 Insertion Loss



ITEQ

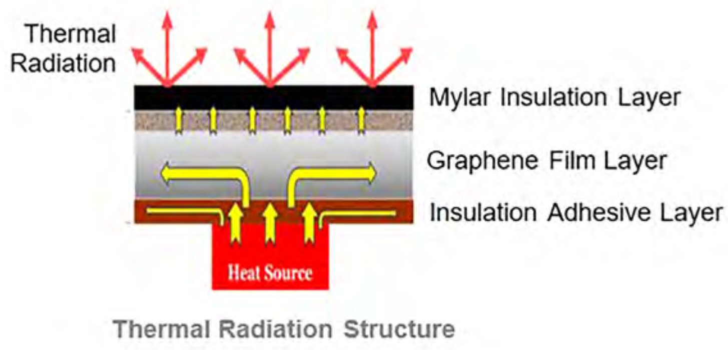


Figure 1: One possible thermal radiation structure that utilizes the new graphene film heat sink.

working, and an array of sensors, there will be a reciprocal augmentation in the amount of heat generated by these various features.

Therefore, there will be an increased need for thermal dissipation. Instead of using a conventional aluminum heat sink that will enlarge the size of the console and other related computer/electronic systems in the car, this new graphene film heat sink will not only provide a much thinner planar thermal management solution, but also a much more effective one.

Graphene is highly adaptable to planar thermal management and electronic packaging applications. It can be dispersed in solutions for spray inks and coatings and mixed with polymers to provide substantial enhancements to its thermal characteristics. Knowing this, researchers have taken the unique thermal conductivity capabilities of graphene and added carbon nanocapsules, along with diamond powder particles, to greatly augment its thermal performance. Moreover, the diamond powder particles mitigate the electrical conductivity of the graphene, which in turn will not pose any electromagnetic interference (EMI) issues for PCBs and electronic devices.

This patented engineering method integrates graphene with the diamond powder particles into a reticular structure allowing thermal conduction without any interruption. In addition, the holes of the structural mesh are filled with the carbon nanocapsules (that have a thermal radiation divergence of 0.98) to increase the thermal radiation efficiency. This graphene film heat sink with unequaled high heat conductivity on both the x and y planes, combined with the efficient transformation of infrared heat radiation from the carbon nanocapsules on the z plane, can transmit the heat out in 3D form. While graphite film's thermal conductivity is limited to the x and y planes, the new graphene film has excellent thermal spreading capability on the z plane as well. Therefore, the film's planar thermal management performance is much better than a graphite film heat sink, not only on the x and y planes, but also on the z plane.

The high polarizability of these nano materials enables them to spread evenly on the surface of the film, which maximizes the thermal radiation cooling effect. The graphene film's nano structure strengthens its electrical insulation so that it can withstand voltage above 2KV. The thermal spreading layer has a high level of heat emission ability through infrared radiation, and thus increases the thermal emission even in a confined space. Depending upon the product's requirements, adding a metal layer beneath the film speeds up the heat emission to the nano structure layer, facilitating greater thermal radiation.

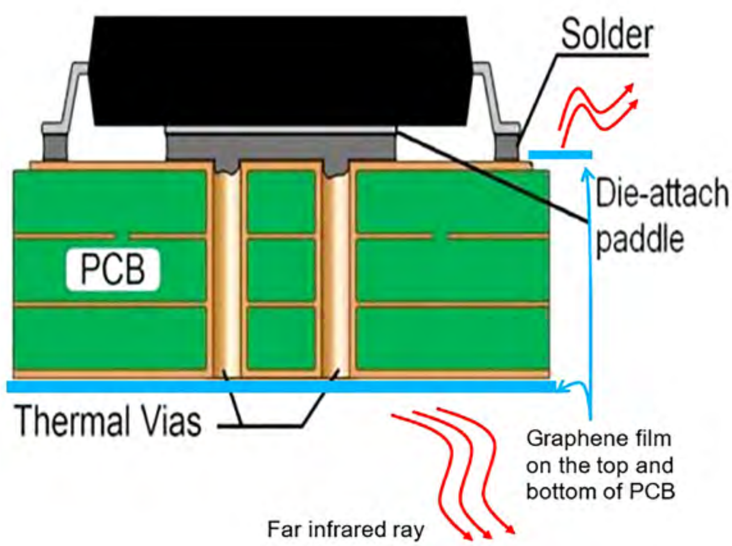


Figure 2: Graphene film can also be applied to the top and bottom of a PCB.

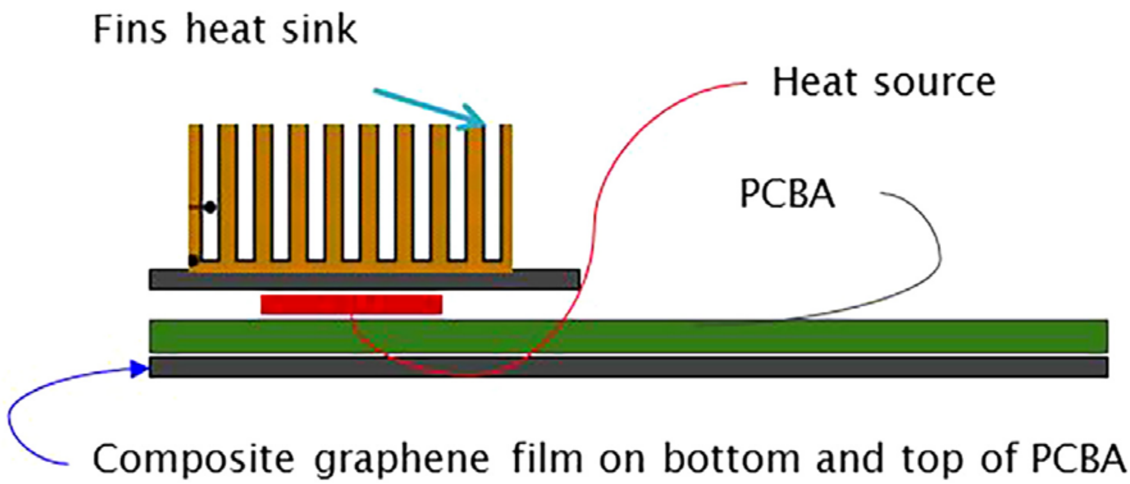


Figure 3: Add graphene film to the existing aluminum heat sink to improve the heat dissipation, or just use graphene film instead of the aluminum heat sink.

The thickness of this graphene film heat sink ranges from 25–210 um, which is very thin as compared to conventional heat sink towers. The film can contain a layer of anywhere from a few um to tens of um of graphene along with a layer of tens of um of aluminum or copper, or it can simply contain a layer of graphene. This thin and lightweight heat sink film is very suitable for thermal dissipation for smartphones, iPads, tablets, and other small portable devices as well as small components such as ICs, LEDs, and DDR memory.

The graphene film is normally attached to the surface of the heat source, and/or to the top and/or bottom of the PCB. One can apply the film on the inside of the entire front or back of the enclosure covers of various types of phones, or above and/or below the heat source. The film won't interfere with the antenna performance, so it can be applied to the antenna area too, if necessary. Of course, the real application arrangement will depend upon the layout of the device and the location of the heat sources.

Focusing further on PCBs, since the heat of the chip radiates through its pins and die top area, it is a good idea to use copper traces, ground planes, and thermal via to speed up the heat transfer and radiation through the graphene film. The larger the film area, the better,

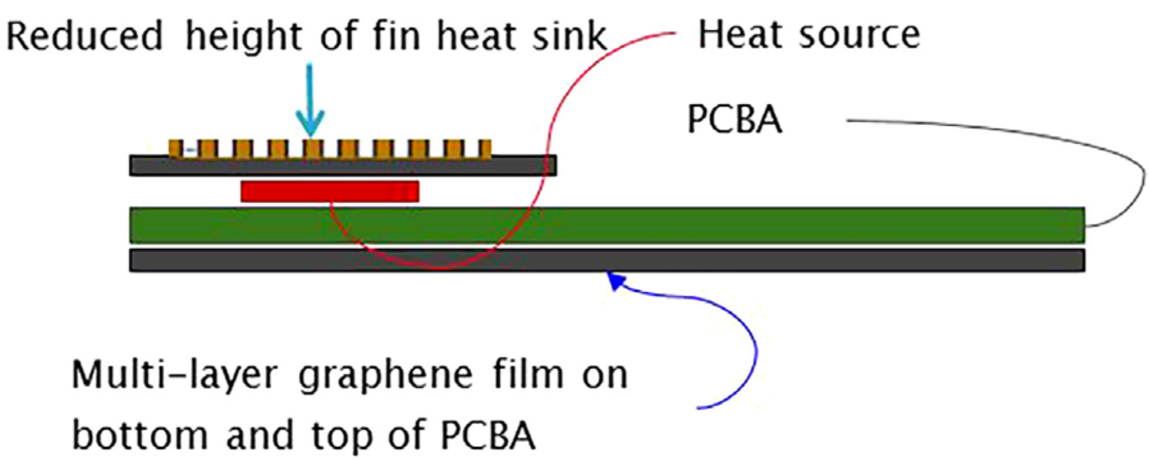


Figure 4: Adding graphene film on one side or on both sides of the PCB will reduce the size of the aluminum heat sink.

and the attached film should be near the heat source. For an existing PCB undergoing testing, the protective paint (which has high thermal resistance) should be removed before attaching the film. For production, there should be no protective paint coating on the graphene film area. It is important to vacuum any air bubbles between the film and the PCB to achieve the best results. The film surface has an electrical insulation coating, so it is salient to handle it carefully to not scratch off the coating. Finally, one should apply the film to both sides of the PCB, if possible. If not, apply it to the side with fewer components and create holes in the film to expose the areas occupied by the components. Using these application methods can solve one's thermal issues and significantly improve thermal package performance.

Extensive testing of this graphene film heat sink has been conducted over the last four years, with impressive results. The film has been tested on smartphones with glass covers and with metal cases, LED lights, tablets, and notebooks, etc. Analyses have demonstrated a dramatic reduction in the operating temperature of the various electronic devices of anywhere from a 23% up to a 52% decrease, depending upon the device tested.

The company is continuing to innovate and improve its graphene film, and they are also capable of customizing the film for their customers. In addition, they have developed a graphene spray ink that can be sprayed on metal surfaces such as stainless steel, aluminum, and copper at a thickness of 5 um to 20 um (which is the most effective range of thickness for the spray ink) to increase thermal conductivity. **DESIGN007**

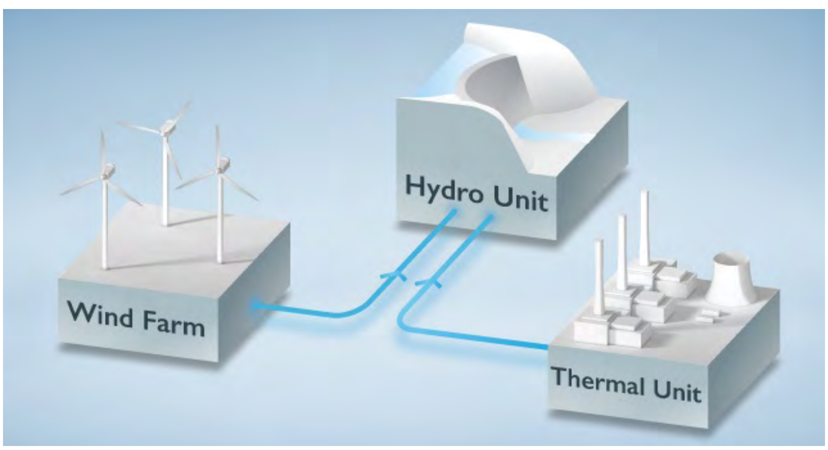
Pete Christensen is the vice president of sales and marketing for Magi Scitech. He has over 35 years of sales, business development, management, and marketing experience. He can be contacted by clicking here.

Powering the Bottom Line

Optimizing the operation of a mixed-technology power plant is vital to making such power generation profitable and reliable. While optimization schemes have been proposed for such virtual power plants (VPPs), the existing approaches take a rigidly risk-neutral approach to dealing with uncertainty in future conditions.

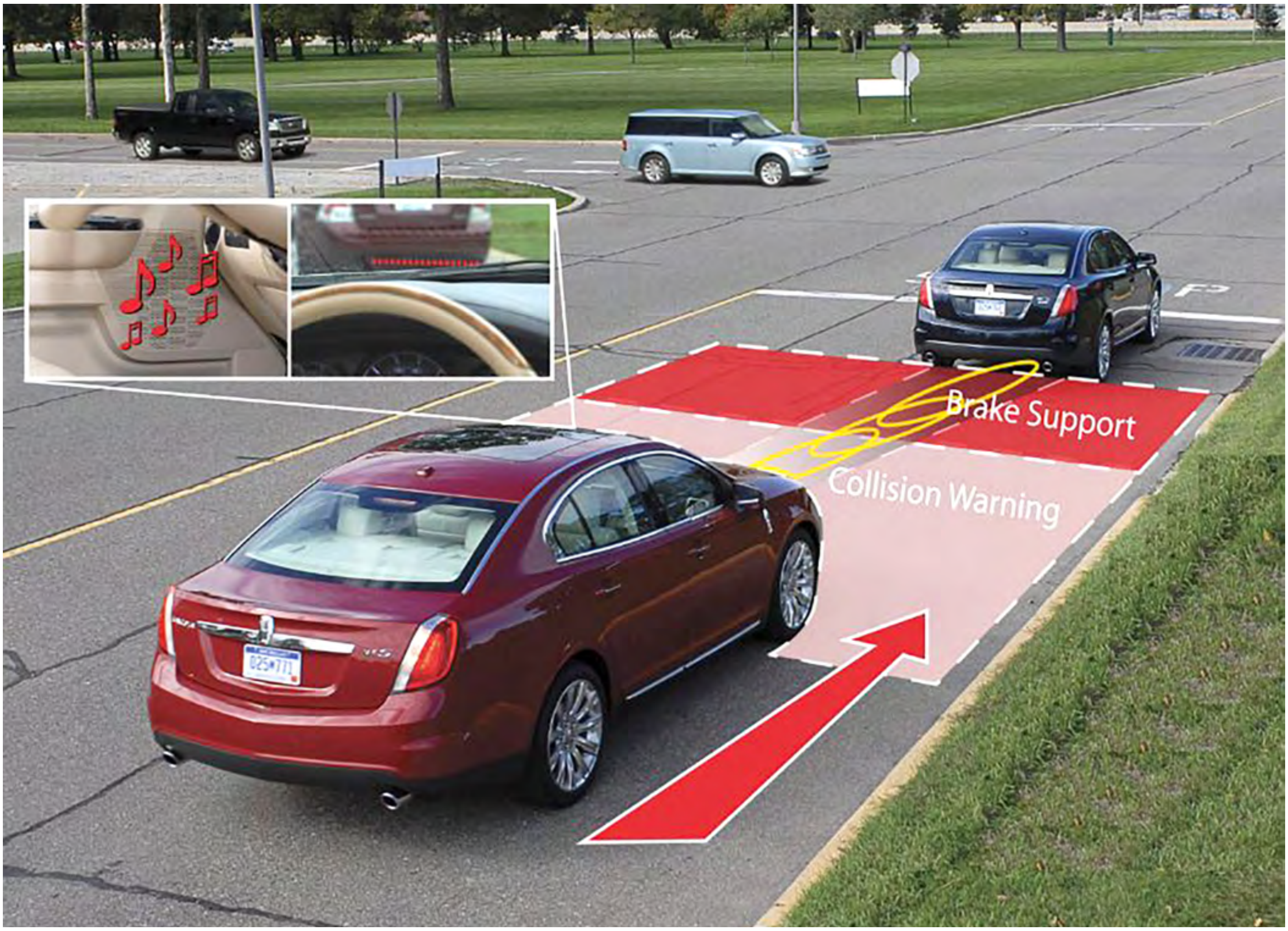
Now, by integrating risk parameters into an efficient optimization program for VPP operation, Ricardo Lima and colleagues Omar Knio and Ibrahim Hoteit from KAUST have developed a platform that allows the system to be tweaked for better reliability and profitability.

The problem considered by Knio's team is the optimization of operations and electricity market participation for a VPP comprising a thermal unit, such as a conventional gas-fired power plant, a wind farm and a pumped storage hydro unit for energy storage. The goal of the calculation is to predict the optimal energy output of the thermal unit and input/output from the hydro unit.



"The key issue for optimization is always the balance between level of detail of the model and the capacity for obtaining optimal solutions from it," says Lima.

This is a large-scale calculation problem with many variables even before the inclusion of risk, which presents significant challenges for finding the most accurate solution. The result is a framework that can accommodate both conservative risk-avoidance and aggressive risk-seeking approaches to maximize VPP profits.



EDADOC a Driving Force in China's Automotive Electronics Design

Feature Interview by Edy Yu
MANAGING EDITOR, PCB007 CHINA

EDADOC is one of the biggest providers of PCB design and manufacturing services in China, with a long history in automotive electronics design and manufacturing. I recently conducted an email interview with EDADOC R&D Technical Research Manager William Zhou and Brand Planning Specialist Wen Ling, who collaborated on their answers. We discussed the challenges related to designing and fabricating automotive PCBs, the opportunities in this segment, and the trends they see in the market for autonomous and electric vehicles.

Edy Yu: Please tell us about your company and how you serve the automotive electronics segment.

EDADOC: EDADOC Co. Ltd. was established in 2003, and our focus is high-speed PCB design, PCB panel manufacturing, SMT processing and supply chain services. We also have a long history in automotive electronics. In terms of regulation compliance, our facilities can manufacture PCBs and SMT assemblies that comply with the RoHS initiative and halogen-free requirements. We also offer lead-free reflow soldering processes. Our facilities have established very effective quality management systems.

Our PCB facility and SMT facility have passed IATF 16949 qualification for the automotive industry, which strictly controls production processes. We also have partner relationships with many well-known automotive electronics manufacturers. Our product portfolio covers all systems of automotive electronics and we now

have design engineers who specialize in that area; there are engineers and technicians in our PCBA facility who only work on automotive product.


William Zhou


Wen Ling

Yu: Are you primarily designing electronics for the domestic Chinese auto market, or for the global auto market?

EDADOC: Today, our customers are mainly China mainland automotive electronics manufacturers, or subsidiaries of global automotive electronics manufacturers located in China. The Chinese government now attaches great importance to the automotive electronics industry, especially new-energy vehicles. China is now the biggest R&D country, with new products and technologies emerging every day.

Yu: What are some of the biggest challenges you face in designing PCBs for automobile electronics?

EDADOC: There are three main challenges. The first one is line density and cost. Generally, the size of automotive electronics PCBs is small, and layer count is not high. Therefore, the footprint is rather limited, and the line density must be high. Sometimes, HDI design is implemented, but this increases the cost and the amount of PCB design challenges.

The second challenge is thermal and power integrity. As mentioned earlier, due to the limited layer count and space, power supply lines often use thick copper or buried copper to meet the power integrity and thermal requirements. Since automotive electronics are increasingly more powerful, the required current is also greater, and the power plane and return path capability will naturally be more challenging. Not enough current will lead to voltage instability, resulting in an unstable electronic system. To make things worse, this will also increase the generation of heat. The power integrity and thermal requirements will also be a major challenge in conventional PCB designs later, not just in automotive electronics.

The third challenge is electromagnetic compatibility (EMC) and safety. The extent of this issue involves a wide range of areas. For most consumers, reliability and safety are the most important factors related to automobiles, and safety includes electromagnetic radiation safety. Electromagnetic radiation is not visible, but it is there, and passengers are surrounded by radiation in the vehicle. The exact effect of a car's electromagnetic radiation on humans has yet been determined, but many of our automotive electronics customers have begun to pay attention to electromagnetic compatibility issue.

Yu: On the other hand, what are some of the opportunities you see in this segment?

EDADOC: In PCB design, the other side of the coin is the opportunity. We believe that automotive PCB design will gradually develop to a more specialized direction in the future. This is an opportunity for all of us. To seize the opportunity, we must first learn all of the existing problems in the design of automotive electronics, so that we can solve these.

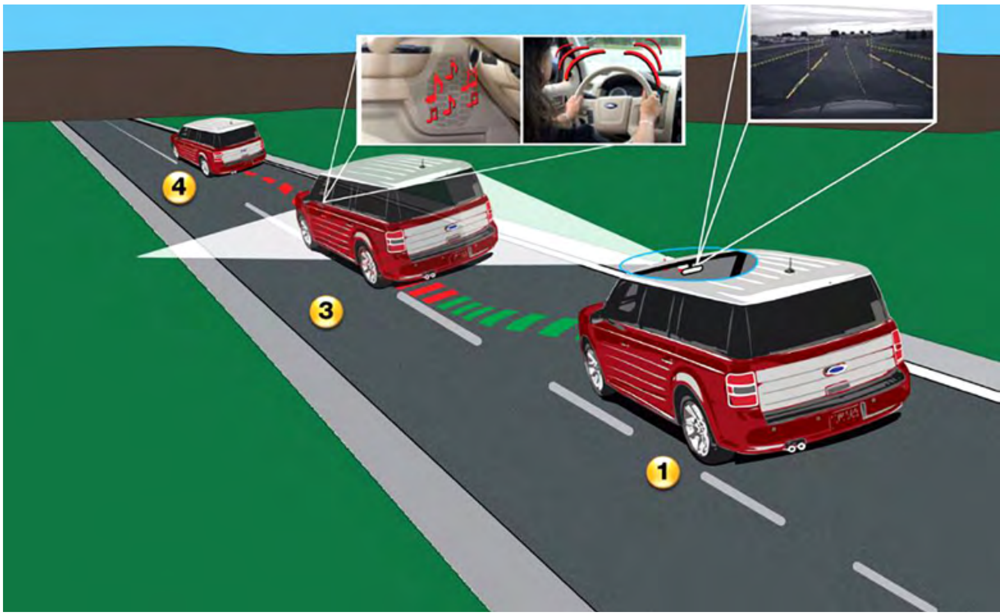
We design tens of thousands of PCBs every year, with very different customer requirements for every kind of product. Among these are many HDI designs and cost-saving ones. This knowledge can be applied to automotive electronics as well. We believe that we already have a fair amount of technology accumulated and are applying it in automotive electronics. In the meantime, we are doing case studies of HDI and automotive electronics design and conduct internal trainings and presentations. This is a requirement for companies designing automotive electronics today.

We solve power integrity and thermal problems by doing power integrity analysis. We have a specialized technical department to do this, and we also help our customers to solve a lot of PI problems every year. We also provide power supply design specifications for designers' reference. For high-current power supplies, we perform a voltage drop and current simulation and look at the thermal conditions of the actual copper to avoid instability in the power supply.

We provide design specifications in electromagnetic compatibility to avoid EMC problems. We run EMI simulation aside from SI and PI simulation to eliminate EMI issues from a very early stage. Electromagnetic compatibility involves a wide range of factors, but it is mainly due to chips, PCBs, lines, power supply, ground, and shielding. It is a systematic problem; every factor needs to be taken into consideration. In a PCB design, it is essential to consider the signal impedance, reflection, bounce, and crosstalk, which would cause EMI radiation if not done properly. Power noise is another source of EMI radiation, but it can be mitigated by SI and PI optimization. Our technical knowledge on SI and PI has come a long way; we design and build a few test boards each year to ensure the accuracy of our simulation. We also cooperate with our customers to do tests and compare the test result to the simulation result to ensure the accuracy of our simulation. We believe that only accurate simulation can properly guide PCB design.

Yu: What trends do you see in the market for collision avoidance systems, autonomous vehicles, and driverless vehicles?

EDADOC: In recent years, autonomous vehicles have become a rather hot topic, and many big players have joined this arena, including Google. However, autonomous vehicle technology is still under development and testing, and not yet commercially available. Autonomous vehicles still have a long way to go. Many people confuse the advanced driver-assistance systems (ADAS) with artificial intelligence/full self-driving. To be precise, ADAS is not that; this is a very important technology path for accomplishing full self-driving. You could say that ADAS is the technology precondition of full self-driving. The vehicle collision avoidance system is a part of the advanced driver assistance system, which also includes FCWS, distance monitoring, reverse rear-view system (collision avoidance and parking assistance).



Today, ADAS has a high market concentration, market penetration remains to be improved. However, as technology becomes more developed, cost decreases and consumers realize that safety is most important, we believe that advanced driver assistance systems will grow for a long time. The market penetration will be much better by then. We can see this trend by our increasing demand for ADAS hardware development and manufacturing from our customer.

Yu: Thank you for your time.

EDADOC: Thank you. **DESIGN007**

PCB007 Highlights

All About Flex: FAQs on UL Listings for Flexible Circuits ▶

The requirement for flexible circuitry recognition is driven by the end-product specification as flexible circuits themselves are not sold directly to the consumer. The applicable UL spec for flexible circuits is UL796.

EPTE Newsletter: Taiwan Snapshot–Things are Good! ▶

Taiwan continues to exceed expectations as the manufacturing hub for consumer electronics. Trends for the global electronics market can be forecasted by analyzing shipments of printed circuits from Taiwanese manufacturers.

Advanced Circuits Upgrades Free PCB Design Software ▶

Advanced Circuits has released version 4.0 of PCB Artist. The free design software offers many features and functionality found in paid PCB design packages without the price tag.

It's Only Common Sense: Who is the Customer? ▶

If you buy into the golden rule, "Do unto others as you would have them do unto you," then just about everyone you deal with is your customer, which means that you should treat them as such. Let's look at our business and talk about who our customer really is.

RTW IPC APEX EXPO: Candor Industries' History and Advanced Circuit Constructions ▶

Founder and president Yogen Patel shares Candor Industries' history and describes some of the non-standard approaches to PCB production the company uses to make advanced circuit constructions.

All About Flex: Avoiding Trace Fracturing in a Flexible Circuit ▶

Flexible circuits are used in applications requiring millions of flex cycles. But this does not suggest they never experience failures due to flex life. In fact, occurrences of performance issues as the result of fractured traces have been experienced in a variety of applications.

IPC Volunteers Honored for their Contributions at IPC APEX EXPO 2018 ▶

IPC—Association Connecting Electronics Industries—presented Committee Leadership, Distinguished Committee Service and Special Recognition Awards at IPC APEX EXPO 2018 at the San Diego Convention Center. The awards were presented to individuals who made significant contributions to IPC and the industry by lending their time and expertise through IPC committee service.

SCL PCB Solutions Group to Centralize PCB Manufacturing ▶

SCL PCB Solutions Group announced that it will centralize the United Kingdom PCB manufacturing facilities, namely Spirit Circuits and Lyncolec.

RTW IPC APEX EXPO: Prototron Moves Offshore ▶

Prototron's Dave Ryder and Russ Adams discuss the company's recent decision to begin manufacturing high-volume jobs overseas. They also discuss some of the partner shops' capabilities, including flex and rigid-flex, which are driven by customer demand.

Refining Output Data Packages for Fabricators

The Bare (Board) Truth

by Mark Thompson CID+, PROTOTRON CIRCUITS

One of the biggest issues PCB fabricators face is the completeness (or incompleteness) of the data output package we receive from customers on a new PCB. In this column, I am going to present what is needed, from a fabricator's perspective, for a good output package and why.

An Industry-wide Problem

In a recent I-Connect007 column, *The Perfect Customer,* my colleague Dan Beaulieu said that fabrication packages are frequently incomplete, thus delaying the quote process. I believe that this statement is true for ALL board fabricators! Dan also pointed out that many larger customers that previously had their own in-house PCB fabrication no longer have that ability, and as such, much of the tribal knowledge that was shared between their in-house fabrication and the engineering group in those days has disappeared. So, a lot of this board fabrication knowledge has not been passed on to the new generation of engineers and designers. This leads to incomplete or inaccurate output packages that lead to clarification questions prior to quote, which delay the quote process.

In this column, I will discuss which files are needed for fabrication and why.

The Basic "Must Haves"

Let's start with the obvious.

Image Data

Many design software packages have multiple output types of image data. The four most common and accepted are the following:

1. **ODB++** is Mentor's data transfer format. Some of the benefits of outputting ODB++ are:
   a. The IPC netlist is embedded in the data and need not be sent as a separate file.
   b. Fabricators using Genesis are looking at a true apples-to-apples comparison; what I see on my screen is the same as what the end-user creating the ODB++ data sees. Oddly shaped pads rotated at unusual angles are not always interpreted correctly with some of the older CAM systems, but this is not an issue with ODB++ data.
2. **Gerber 274X,** Gerber data with embedded apertures is by far the most common output.
3. **Gerber X2** is the newest form of Gerber output. Not all fabricators are able to use this type of data. Much like the 274X data, X2 has the apertures embedded, and additional attributes added as well.
4. **Gerber 274D** is one of the older types of Gerber output. It requires the designer to send a separate aperture file list or wheel, and is a little more cumbersome than the X types of Gerber with the apertures embedded. With this type of Gerber data, the aperture list must be complete or you will get a phone call from the fabricator for potential unassigned D-codes in the file list or wheel.

NC Drill Files

This is the file with the hole sizes, plating status (plated or not) and the X and Y hole coordinates.

Usable file types for the NC drill file are as follows:

1. Excellon 1
2. Excellon 2
3. An ASCII text drill file
   a. Note: Please do not mix output formats on the NC drill and route files. Stick with a single convention. For example: 2:4 trailing zero suppression and inch units. Do not mix imperial and metric units on the same file (i.e., inch tool sizes, but with metric increments for position or vice versa). Do not mix formats either (i.e., one file output as 2:4 trailing zero but another in the same output package as 1:5 leading zero).
   b. If the job has blind vias or epoxy-filled vias that are regional (not all one tool size), please output a separate file denoting just hose that need to be filled. The same goes for any blind or buried vias in the design; output a separate NC drill file for each blind or buried scenario that exists. For example: All tools that will go from layers 1-2 of an 8-layer board can be on the same file, but not mixed with other blind vias or through-holes that may be necessary.

Drawings in the form of a DXF, PDF or Gerber

Drawings should include at a minimum:

1. A board outline with a dimensioned hole or feature plus overall dimensions. This is necessary to be able to place the image within the outline file; many times, the origins of the output files differ.
2. Tool chart showing plating status (plated on non-plated) with tolerances.
3. Material type.
4. Solder mask, ID type, and color, plus any information about minimum or maximum thickness.
5. Surface finish type and thickness plus tolerance.
6. A board stack-up must be included if the board is either impedance or dielectrically controlled. Be sure to include copper weights for all layers stated as either starting or finished weight.
7. Any required testing notes, such as standard electrical test, IPC netlist compare, etc.
8. Impedance particulars: The width of traces that are controlled, the layers they reside on, the threshold (50 ohms, 100 ohms, etc.), and tolerance.

Drawing Confusion

Here are some examples of discrepancies or conflicting notes on a drawing that will require clarification:

- Example 1: Notes say all inner layers to be half-ounce clad, but stack-up depicting 1 oz. copper internally
- Example 2: Notes say all .005" traces on layers 1, 3, 6 and 8 to be 50 ohms. But Gerber image data shows no such size being used
- Example 3: NC drill file provided does not match the drawing drill table for either hole count, plating status or hole size

As always, a quick cursory look to make sure you have no conflicting notes is advised to minimize or eliminate delays at the quote stage.

IPC Netlists

Should you have either an AS9102, IPC class 3 6012 multilayer board, or even just a simple two-layer board and you want to make sure the files emulate the electrical design parameters, please provide an IPC netlist for net comparison.

As fabricators we are obligated to run an IPC netlist against your provided image data for any class 3 6012 or AS9102 parts, or any parts that specify that a netlist compare must be done on the drawing.

What exactly is an IPC netlist? This is an electrical version of your design parameters to be compared with your exported image data. It is not a file to be "generated" by a fabricator based on your image data. If we create a netlist based solely on your Gerber data, at no point would we ever find a mismatch, which may result in nonfunctional boards being built successfully, tested and shipped. Care should be taken to not assign net points to things that should not be electrical nets, such as non-plated holes or targets.

Before any fabrication edits have been performed, a netlist compare is performed. Any known or otherwise intentional shorts or opens should be noted on a "read me" file Word document or on the drawing itself. For example: "AGND to DGND short net000 is intentional by design."

Then, after any manufacturing edits such as drill compensations or etch compensations are performed, the netlist is run again to ensure the fabricators has not created any electrical anomalies. Some of the most common netlist types for fabrication are IPC D356, IPC D356A and a Mentor neutral file.

Lastly, any specific panelization requirements such as the addition of text for part marking, fiducials of a specific size, or sub-panel tooling of a specific size should be negotiated with the fabricator prior to quote. If no sub-panel drawing can be provided, you will want to, at the very least, indicate to a board fabricator areas of either part overhang or feature proximity where you DO NOT wish frame tabs to be located. This will keep you from having to go back into CAM to move tabs or add cutouts in the frame.

Conclusion

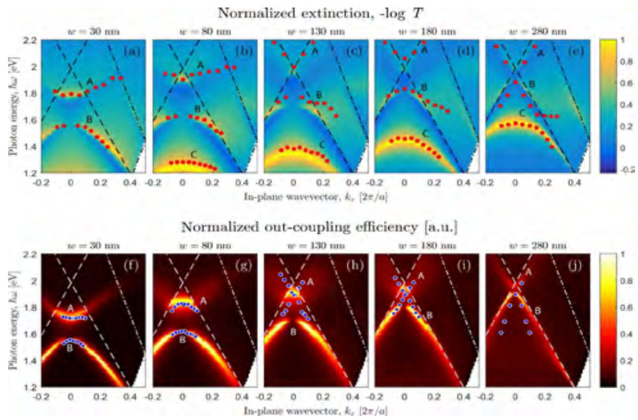
PCB fabricators are basically an extension of our customers, and for this relationship to be successful both sides need to work collaboratively. It all starts with the output package. Following these guidelines is the critical first step to assuring product quality and reliability.

As I've said before, your best bet is to communicate with your fabricator early on. **DESIGN007**

Mark Thompson is in engineering support at Prototron Circuits.

Gold Changes the Photoluminescence of Silicon Quantum Dots

Silicon quantum dots have a wealth of potential applications in cell biology and medicine thanks to their selective cell penetration capability and luminescence. Biosensors based on silicon quantum dots can be used as an early diagnosis tool for various diseases, while silicon nanocrystals hold great potential for developing silicon-based light-emitting devices and producing highly efficient solar cells.



Scientists from the theoretical nanophotonics team led by Skoltech Professor Nikolay Gippius jointly with researchers from Moscow State University and the Royal Institute of Technology (KTH) in Stockholm demonstrated that gold nanostripes are capable of changing the extinction and photoluminescence spectra of silicon nanocrystals. The researchers' findings are of particular value for practical applications of silicon nanocrystals, as they provide scientists with a novel tool for controlling the quantum dots' properties. Interestingly, the use of silicon quantum dots in photocells would significantly reduce technical losses in the solar power industry and help to avoid using arsenic, lead and other toxicants in solar cells production.

"Derived from the interaction between a sample of silicon quantum dots and gold nanostripes is a quasi-particle called the 'waveguide plasmon polariton.' This leads to a change in the optical properties of silicon nanocrystals. If we wish to use them in solar batteries or light emitters, we should have a metal electrode and know how to control the extinction and emission spectra. Gold nanostripes are a solution to both issues," said Sergey Dyakov, the main author of the study and a Skoltech researcher.

A Review of HyperLynx DRC

Beyond Design

by Barry Olney, IN-CIRCUIT DESIGN PTY LTD / AUSTRALIA

There is an old saying, "You get what you pay for." Does this mean that you should not expect too much from free software? After all, free software usually comes at a price: the results might be inaccurate, the software might be time-consuming to set up and use, and the tool might overlook issues that require a revision to mitigate.

But HyperLynx DRC is the exception to the rule. In this month's column, I will review Mentor's new HyperLynx DRC Free Edition, which provides analysis tools that complement any PCB layout tool that can export ODB++ or IPC-2581B formats.

Amazingly enough, this software is free. You'll need to confirm registration annually, but that is not a problem; the tool remains free. There is also a more comprehensive, affordably priced Gold Edition.

HyperLynx DRC is an electrical design rule checking (DRC) tool that can automate the verification of complex digital design rules that are not easily detected, such as rules for traces crossing split planes and electromagnetic compliance (EMC). It does not require expert knowledge and can literally save hours of manual inspection. The tool helps one avoid costly errors and oversights, directing the novice high-speed PCB designer to the source of signal integrity (SI), power integrity (PI) and EMC issues.

Even experienced designers make mistakes and overlook small issues that can become major headaches further down the design,

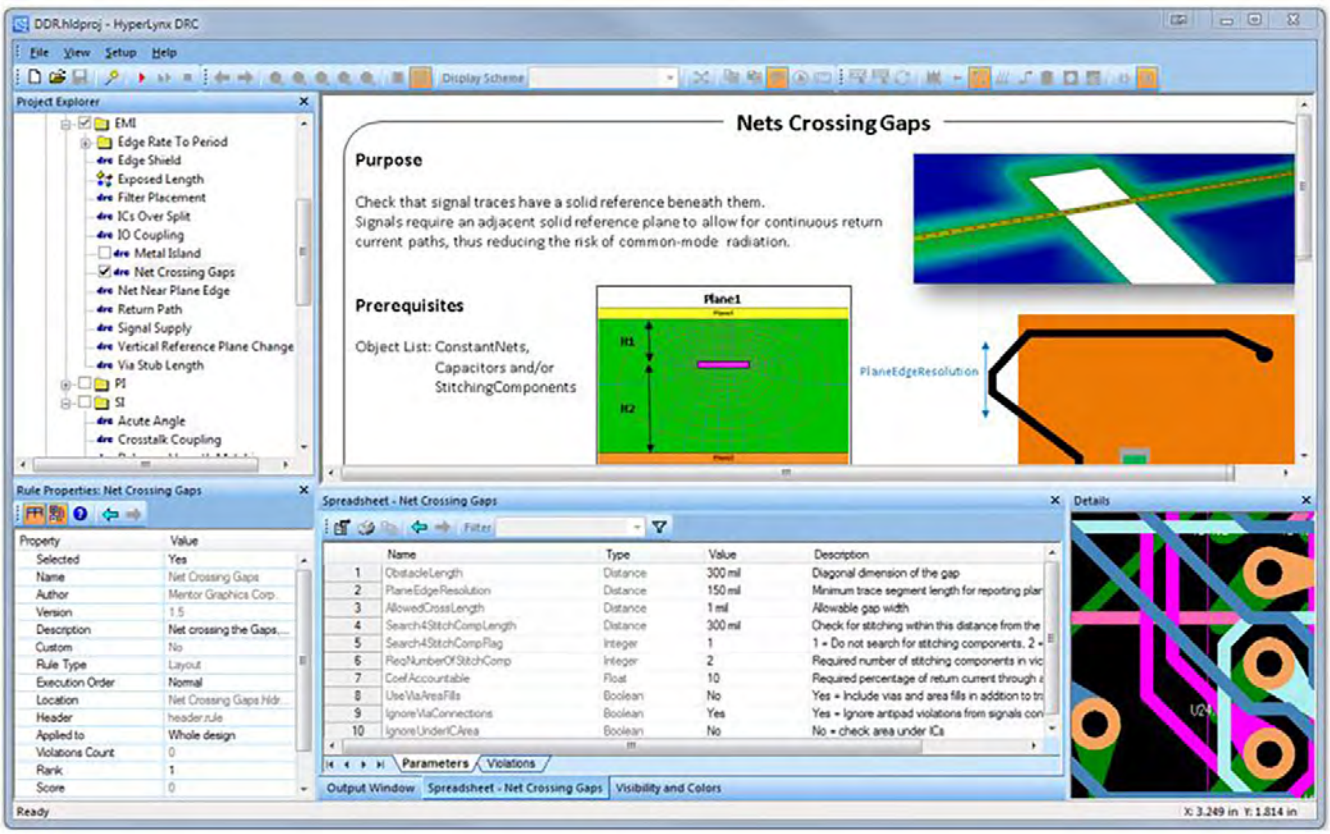


Figure 1: Setting up EMI rules for nets crossing gaps in HyperLynx DRC.

assembly, test or production processes. This is particularly true with complex, high-speed designs that have multiple planes and return paths, requiring elaborate constraints on every class of technology. Sure, we can enter hundreds of rules to constrain copper pours, placement and routing, but there is always some manual adjustment that needs to be made as each design is different and has specific requirements. Online DRCs in EDA tools are a great safeguard, but they do slow the design process somewhat. They warn you when a physical or electrical rule is violated and allow the designer to steer clear of common obstacles.

Although the complete list of design rules is very broad, one must manage the following constraints at a minimum:

- Placement
- Clearance
- Routing
- High-speed signals–impedance and differential pairs
- Plane and copper pours
- Test points (if required)
- Manufacturing

Impedance discontinuities and crosstalk can be controlled to some extent by PCB designers during the routing phase if they understand these concepts, which many, unfortunately, do not. Although pre-layout analysis detects issues before they occur, signal integrity, power integrity and EMC issues cannot be properly evaluated until the design has been completed and a post-layout analysis is implemented.

For instance, the most common cause of radiation from a multilayer PCB is a deviation or break in the return current path of a signal as in Figure 1. Electromagnetic fields couple the signal trace to the reference plane(s), and a gap in the return path will increase the loop area which typically causes radiated emissions. Nets crossing split planes can be examined manually but it is a very error-prone process particularly when there are multiple power supplies on multiple layers. Additionally, the gap in the plane area or the break in the return path may not necessarily be in the nearest stackup layer. If poorly designed, the return path may be in a faraway layer.

Many independent designers find it difficult to check their own work. They become blind to crucial design details. When you assess your own work, your brain already knows your intention and subconsciously skips the detail. Critiquing someone else's work is much easier because looking through another's eyes brings a fresh perspective. What is needed is a totally unbiased, automated check that considers only the established high-speed design rules.

This is where HyperLynx DRC can complement your EDA layout tools. It specifically scans for violations of signal integrity, power integrity and EMI rules. And, let's face it, these

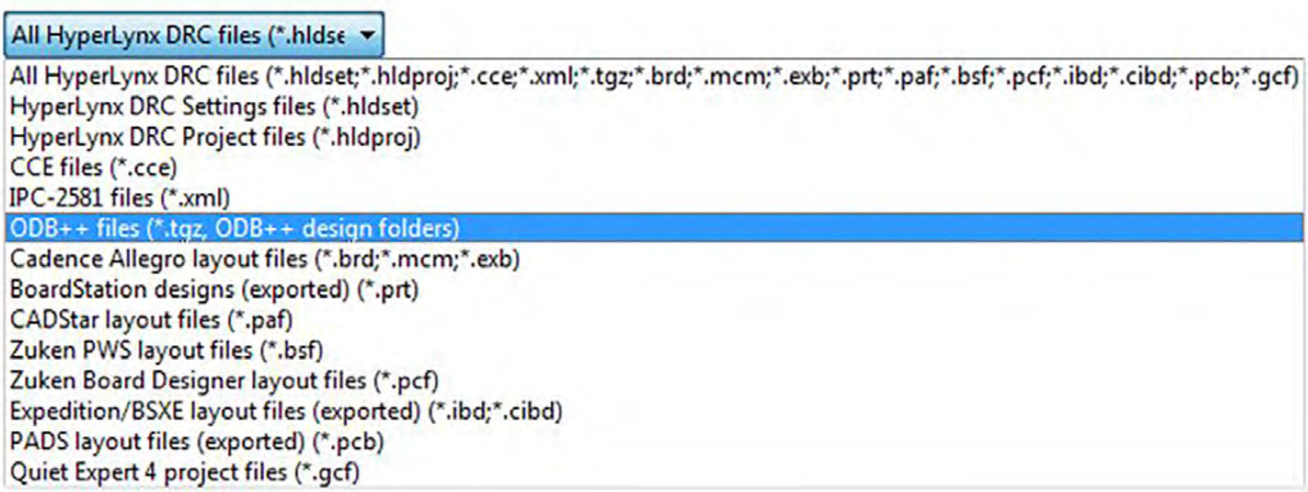


Figure 2: Available import formats to HyperLynx DRC.

are the issues that most of us do not understand. Many enterprise-level EDA tools feature an expert system that performs this function. HyperLynx DRC Free Edition brings some of those capabilities to everyone's desktop. It is like having an SI engineer sitting next to you, nudging you in the ribs whenever he notices that you have missed an aspect of the design that you may want to reconsider.

One would assume that an export to HyperLynx DRC would be streamlined in Mentor's own PCB layout tools, Xpedition and PADS, so for this exercise I exported the ODB++ format from Altium Designer. This creates an ODB directory in the current folder. The available import formats are listed in Figure 2.

Once the database has been loaded, the design rule parameters need to be set. One might think this to be a daunting task. However, HyperLynx DRC was specifically developed for the novice designer, so the guys at Mentor have done all the hard work for you.

The Project Setup Wizard walks you through, and explains in detail, the entire setup, which you can adjust to on the fly, if you have the knowledge. Alternatively, you can just accept the defaults, which seem to work fine unless there are specific requirements.

You also need to verify that the software correctly recognized the components, signals and stackup data. There are filters already set up for components by reference designator and differential pairs, single-ended signals and power nets by their naming convention. These can easily be modified by substituting an "IC" for "U," etc. But, my design had no such issues—too easy!

Now that the layout database is loaded, verified and all the rules have been set up, the DRC

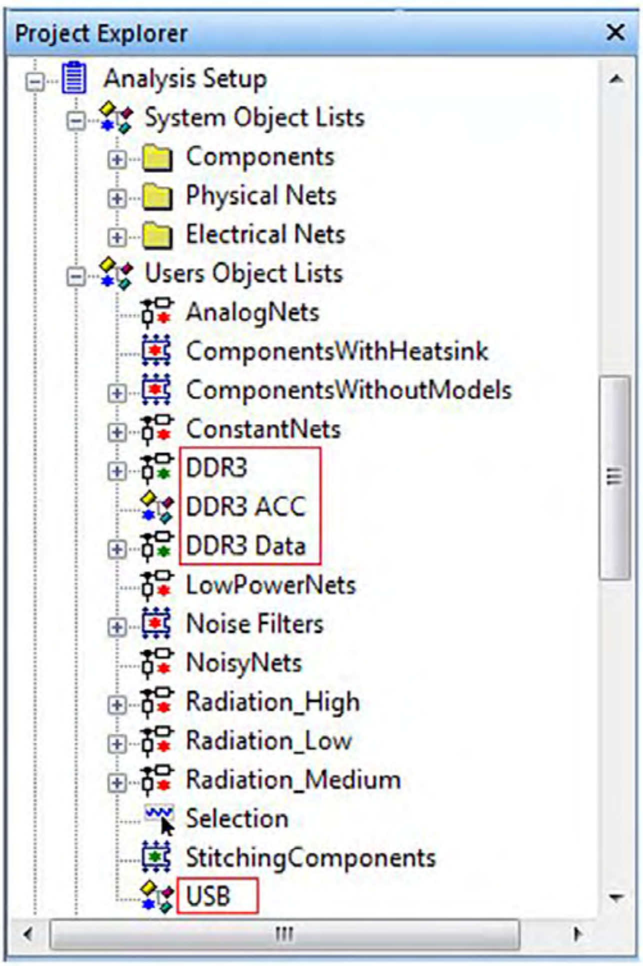


Figure 3: Analysis setup.

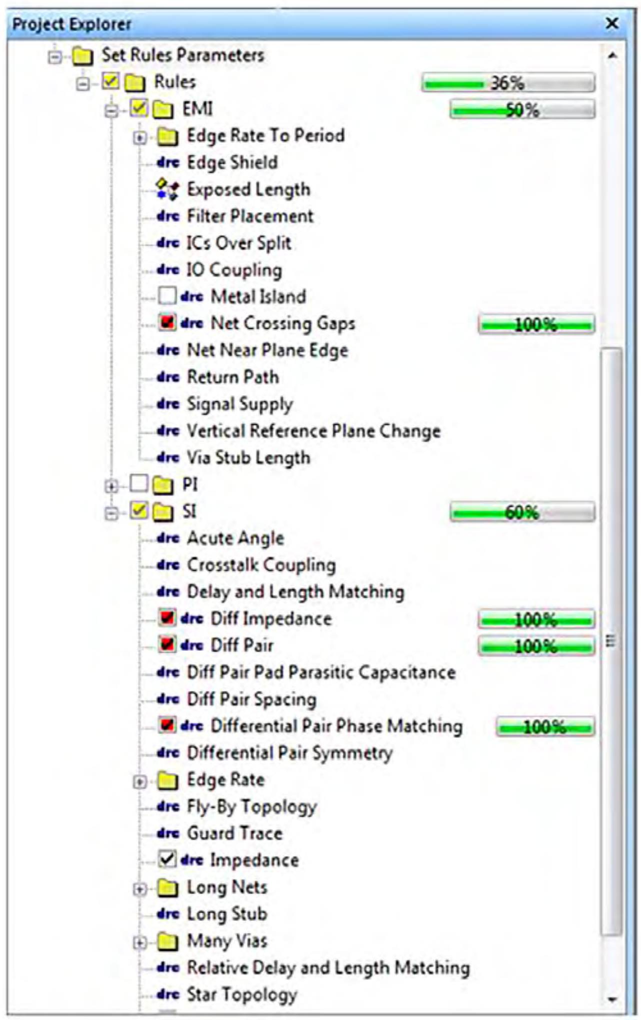


Figure 4: Executing batch mode DRCs.

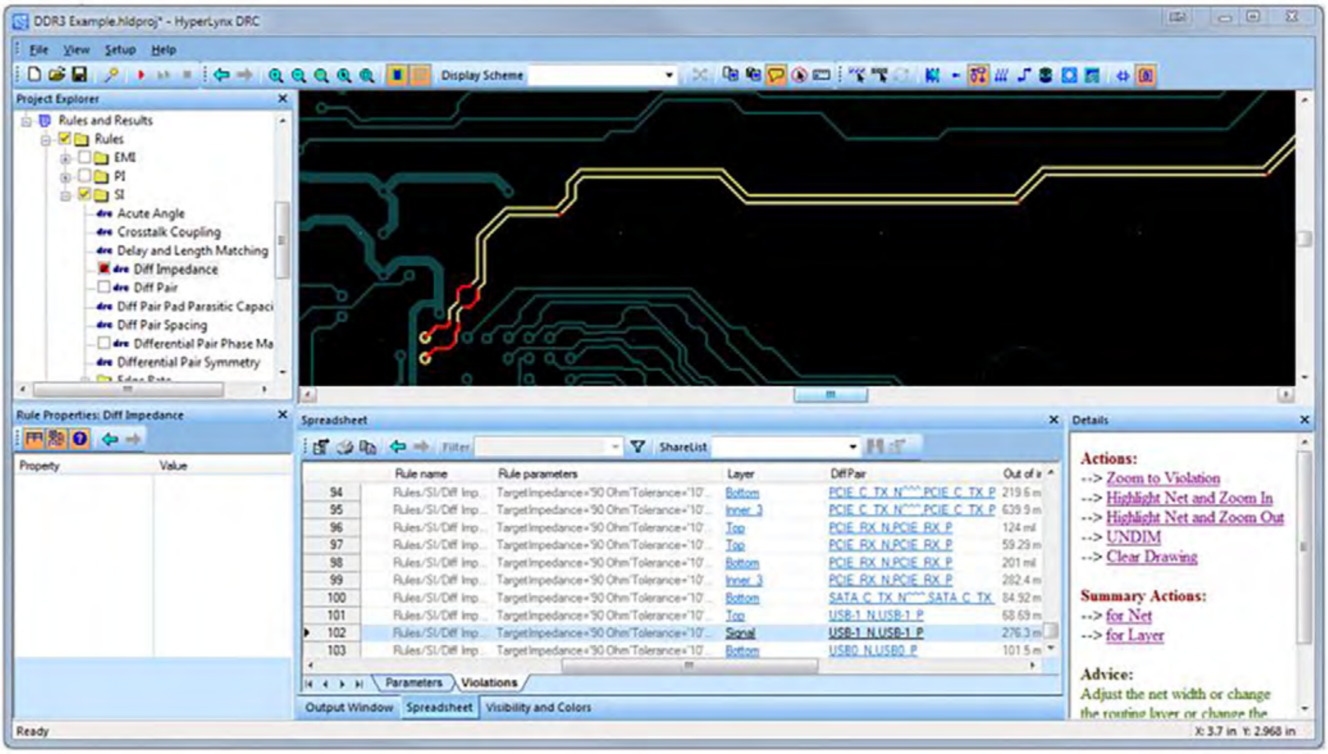


Figure 5: Uncoupled length of differential pairs.

can be launched. However, in order to avoid producing a large number of violations in batch mode, the number of enabled rules can be initially limited. Further rules can be gradually added to increase the scope as violations are eliminated.

The scope of the checks can be defined using a specific group of design objects. I set up "User Objects" for DDR3, DDR3 ACC, DDR3 Data and USB which are similar to Net Classes in EDA tools (Figure 3). Then a DRC can be run on that particular group of signals, so that the violations can be checked in subsets, which simplifies the process.

Alternatively, all DRCs can be run in batch mode and each violation can then be evaluated in succession (Figure 4). However, the individual lists present more control over the parameters. For instance, the differential impedance can be modified from 80ohms for DDR3 to 90ohms for USB between checks.

Figure 5 shows the results of the uncoupled length check for differential pairs. This image highlights where the USB pair loses coupling and increases in impedance, so you can visualize where the variations occur. In this case, it is an acceptable violation.

Keep in mind that the flagged violations are not necessarily errors. In this age of design complexity and limited time to market, there are always compromises that one has to accept due to schedule and other restrictions. HyperLynx DRC identifies violations of the established rules enabling the designer to quickly make a decision on the acceptability or not of the violation.

Once DRCs are completed, the errors can be selected individually, from the violation listing, for viewing. In addition, Sharelist reports containing the image, violation details, coordinates and user comments can be generated in HTML for broader team review.

Additionally, customers have free access to the HyperLynx DRC Community. This forum provides the benefit of trouble shooting technical issues and discussing ideas, with fellow designers, regardless of your layout tool, or level of expertise.

HyperLynx DRC complements most EDA layout tools and does not require high-speed design expertise. It quickly identifies and highlights possible design inconsistencies and puts the novice high-speed designer in control of common SI, PI and EMC issues. Even experienced designers can benefit. I will certainly use the software to analyze my future designs and I believe it would be an invaluable addition to any PCB designer's tool box. In this case, you absolutely do get something, extremely useful, for nothing—it's a no brainer. **DESIGN007**

References

1. Design Rule Checks for High-Speed PCB Design, by Patrick Carrier.
2. A Design Rule Check List, by Eric Bogatin.
3. Mentor Graphics' HyperLynx DRC software and documentation.

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

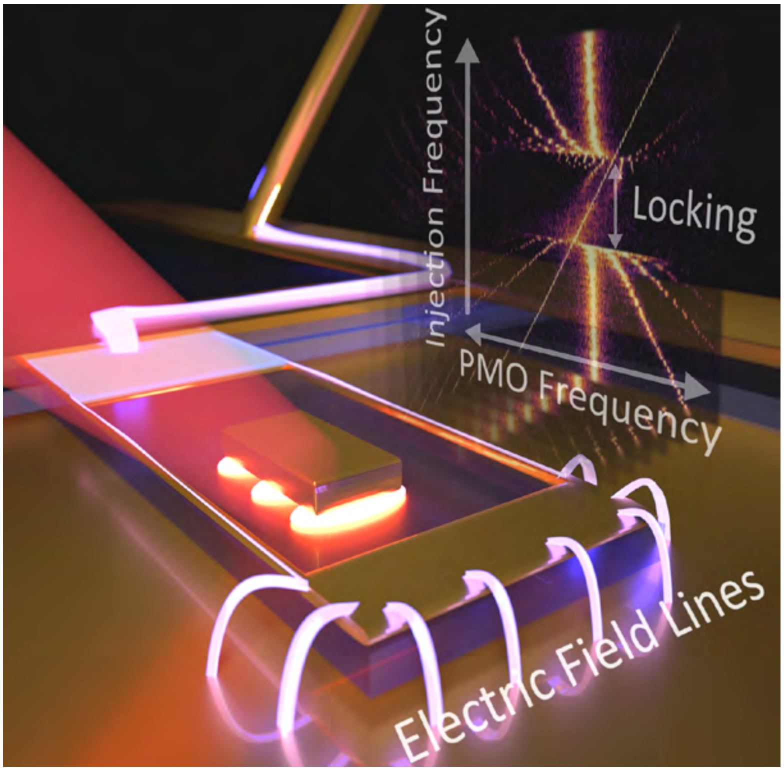
New Device Modulates Light and Amplifies Tiny Signals

By taking clever advantage of the interplay between light, electrons on the surface of metals, and heat, researchers at the National Institute of Standards and Technology (NIST) have for the first time created a plasmomechanical oscillator (PMO), so named because it tightly couples plasmons–the collective oscillations of electrons at the surface of a metal nanoparticle–to the mechanical vibrations of the much larger device it's embedded in.

The device consists of a gold nanoparticle, about 100 nanometers in diameter, embedded in a tiny cantilever–a miniature diving board–made of silicon nitride. An air gap lies sandwiched between these components and an underlying gold plate; the width of the gap is controlled by an electrostatic actuator–a thin gold film that sits atop the cantilever and bends toward the plate when a voltage is applied. The nanoparticle acts as a single plasmonic structure that has a natural, or resonant, frequency that varies with the size of the gap, just as tuning a guitar string changes the frequency at which the string reverberates.

When a light source, in this case laser light, shines on the system, it causes electrons in the resonator to oscillate, raising the temperature of the resonator. This sets the stage for a complex interchange between light, heat and mechanical vibrations in the PMO, endowing the system with several key properties.

The team also demonstrated for the first time that if the electrostatic actuator delivers a small mechanical force to the PMO that varies in time while the system undergoes these self-sustaining oscillations, the PMO can lock onto that tiny variable signal and greatly amplify it. The researchers showed that their device can amplify a faint signal from a neighboring system even when that signal's amplitude is as small as ten trillionths of a meter. That ability could translate into vast improvements in detecting small oscillating signals.



Avoiding Conformal Coating Failures

Sensible Design

by Phil Kinner, ELECTROLUBE

In this, the first of what I hope will become a useful series of "how to" columns on the selection and application of conformal coatings, I'm going to explore why conformal coatings sometimes fail in service and the steps that you can take to avoid failure in the first place.

I am a realist. I know that on occasion, conformal coatings can fail. In this column, I will discuss some of the most common reasons for coating failure. Our investigations at Electrolube are thorough, and to list our findings here in any detail is somewhat beyond the scope of this column. However, some of the more common root causes of failure pop up frequently, and for the purposes of my first column, I'd like to run through these issues, offer some tips and dispel the odd myth. As in previous columns, I will present them in our usual Q&A format.

What are the reasons for coating failure?

Coatings fail for any number of reasons—some common and some uncommon. Here are five fundamental reasons for failure, which are generally the result of poor product selection and/or application, an underlying problem arising from insufficient surface preparation, or some chemical activity going on beneath the coating that is entirely unrelated to the coating chemistry:

1. *The coating formulation is simply not tough enough for the job.* For example, it fails to maintain an adequate level of insulation when the PCB is subjected to a humid environment and condensation occurs. Many products resist these sorts of conditions and therefore this type of problem can be avoided by making an appropriate material selection at the outset.

2. *The coating has not cured properly and therefore hasn't had the opportunity to develop its protective properties to the full.* I really cannot emphasise the importance of the application process and progression to the cure. Get this key element right and you could solve not only this, but a raft of problems in one hit!

3. *Poor coverage or insufficient thickness.* Sharp edge coverage can be difficult to achieve with many coatings, and it can be hard to ensure sufficient thickness in these areas to maintain protection. A combination of material selection and application technique/workmanship will remedy these sorts of issues. I'll examine coating thickness a little later in this column.

4. There is an unexpected interaction with some other process material used to prepare/build the PCB. Flux residues are particularly illustrative of this type of problem. In a no-clean process, for example, these can inhibit the cure of some types of coating or lead to a loss of insulation of the system, greater than either material in isolation, which can result in current leakage and short circuit formation.

5. Other factors are at play indirectly related to the coating. Unless there has been meticulous attention to preparation or pre-coat cleaning regimes, corrosive residues bridging the PCB's conducting tracks can cause failures over time. It is worth noting that whilst the coating may delay failure for many years, at some point failure will inevitably happen.

What are your top tips for avoiding coating failure?

As highlighted in the previous section, choose the right material for the protection required, apply and cure it well. Check for interactions with other process chemistries, and thoroughly clean the assembly prior to coating.

When it comes to application, would a thicker coating be less likely to fail?

It depends. Thicker can be better up to a point, but at some stage the coating material will be too thick and will either crack itself, or even cause cracking of the coated components themselves—during thermal shock or thermal cycling, for example. Depending on the type of coating material used, solvent entrapment (i.e., the solvent not having enough time to evaporate from the coating film before it hardens) can become an issue, leading to poor properties or the formation of bubbles, neither of which are good for protection.

In addition to this, by adding unnecessary amounts of coating material you are in effect wasting it, adding to costs and, importantly for some applications, adding weight. Compromised thermal management issues can also arise as it may prove difficult to dissipate heat away from thickly coated components.

It is well to remember that above a certain thickness, which does vary according to the material being applied, any increase is likely to deliver diminishing returns. Get the advice of a reputable supplier: they have laboured hard to establish optimum coating thicknesses for their products in all kinds of operating environments.

How important is the application method to the reliability of coatings?

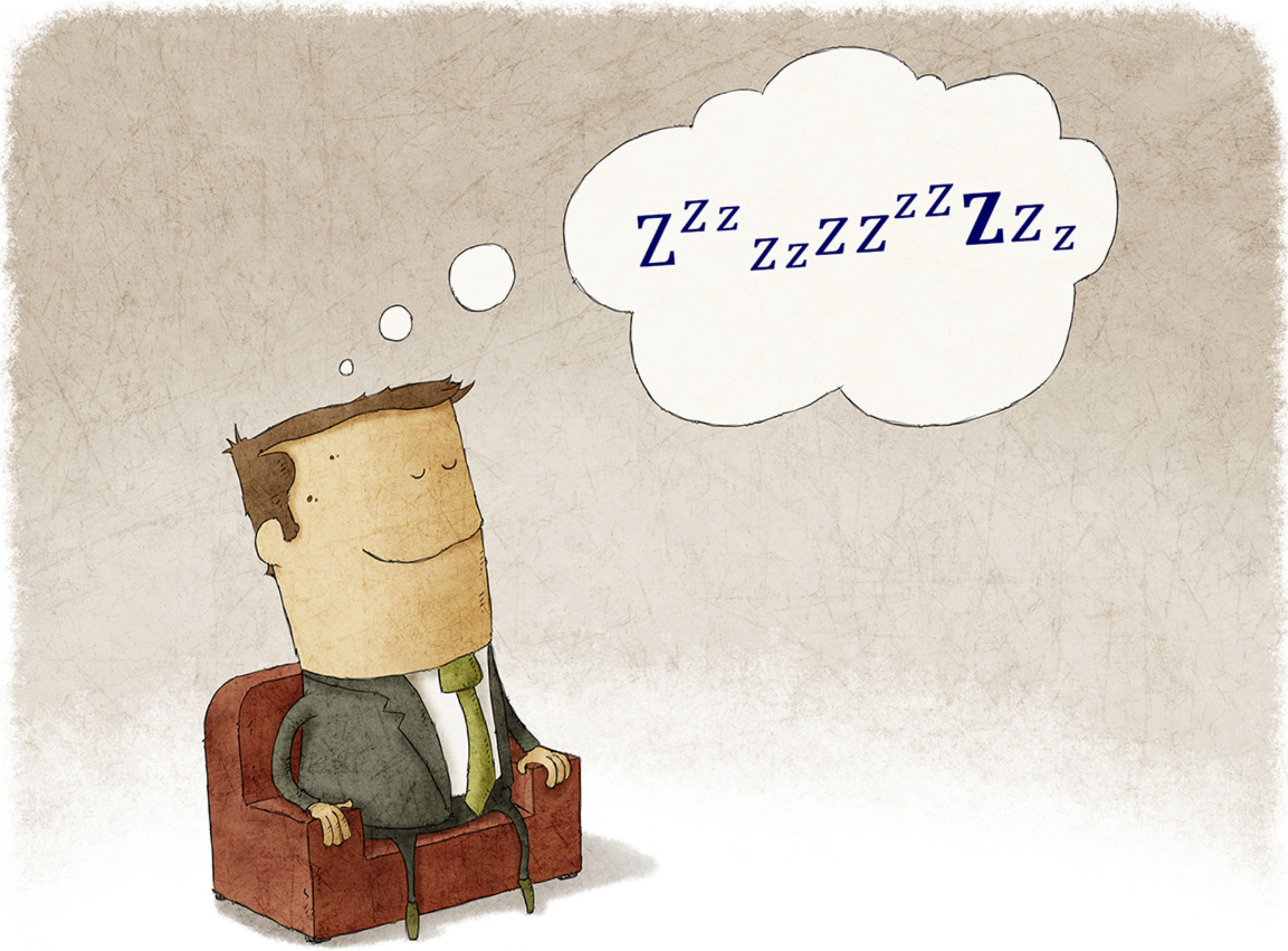
Good question! This is probably the number one determinant of success. Often a poor material applied well can be just as good as or sometimes better than a material with great properties that is applied badly. At the end of the day, coating is about getting sufficient coverage of the sharp edges and metal surfaces without applying the material too thickly elsewhere. Of course, some materials apply better than others and make this process as easy and fool-proof as possible. But in the end, the performance of liquid applied coatings will always be determined by how well they were applied.

Are some PCBs impossible to coat by virtue of their design?

Nothing is impossible if you have enough time and money, but design is important in determining suitable application methodology and therefore the cycle times and the costs involved. Some simple things, like trying to keep connectors or other no-coat areas on the same edge of the assembly, can make a huge difference to the ease of coating an assembly, the cost of coating that assembly and, of course, the overall reliability of that assembly.

Well, hopefully, this column has kicked off the series to a great start. Look out for my next column which will focus more closely on a different area of conformal coatings. If you have any questions in the meantime, please send them to us by clicking here. We appreciate your feedback. **DESIGN007**

Phil Kinner is the global business/technical director for the Coatings Division of Electrolube. He is also the author of *The Printed Circuit Assembler's Guide to... Conformal Coatings for Harsh Environments.*



Not All PTFE Laminates are the Same

Lightning Speed Laminates

by John Coonrod, ROGERS CORPORATION

Polytetrafluoroethylene (PTFE) laminates are the original high-frequency laminate, and they have been around for many decades. I have heard people talk about PTFE laminates as if they are all the same and have the same capabilities and limits, but that is very misleading. I'll give a few examples of the many things to consider when choosing a PTFE laminate.

A couple of issues to consider are circuit board fabrication and high-frequency performance issues. If a board is made with pure PTFE, it could have exceptional high-frequency performance. However, making a PCB out of a pure PTFE laminate is not a trivial matter, for a variety of reasons. It is very soft, which means dimensional stability is highly questionable and drilling can be difficult. If smear occurs during the drilling process for a PTFE laminate, the only option is to throw away the board because nothing can desmear PTFE. It has extremely high coefficient of thermal expansion (CTE) so PTH via reliability and soldering can be a concern. Nothing likes to adhere to PTFE, which means having electroless copper adhere to a drilled hole-wall can be challenging. The thermal coefficient of Dk (TCDk) is very high, which means the Dk will change significantly with a change in temperature. Also, the thermal conductivity is very low, which for some high-power applications can be detrimental to thermal management. And there are more considerations. However, if you mix the right stuff with PTFE, you can overcome most of these obstacles.

The first attempt to make PTFE friendlier to the PCB fabrication process was to have it reinforced with layers of woven-glass fabric, fiberglass. The woven-glass reinforcement certainly helps the mechanical aspect of dimensional stability, and it significantly improves the CTE. Additionally, the glass may

give a minor improvement to the drilling process and electroless copper adhering to the through hole-wall for preparation to copper plating. The glass reinforcement may improve the TCDk and thermal conductivity properties of the laminate.

Over time, there have been other improvements to PTFE laminates. For instance, adding ceramic filler was a really good idea. However, it can't be just any ceramic filler; if the right ceramic is not selected, some properties will benefit, and other properties will degrade. When the right ceramic filler is used, the CTE is improved dramatically, TCDk improves greatly, and thermal conductivity increases. The improvement to CTE allows these types of laminates to be used in multilayer applications where PTH reliability is important. The presence of the ceramic filler can also improve the copper plating preparation steps.

When the right ceramic filler and woven-glass are combined in a PTFE-based laminate, the circuit board fabrication and RF performance issues can be overcome.

When the right ceramic filler and woven-glass are combined in a PTFE-based laminate, the circuit board fabrication and RF performance issues can be overcome. The woven glass helps to rigidize the laminate and make it more dimensionally stable. The proper combination of ceramic filler and woven glass can improve the CTE, TCDk, and thermal conductivity, and allow simpler drilling and PTH preparation processing.

Here are a couple of examples. A PTFE-based laminate that has been around for decades, RT/duroid 5880, is made up mostly of PTFE and a small percentage of micro-fiber glass. This laminate has been the gold standard in the industry for many years due to its excellent high-frequency performance. However, it does have several inherent drawbacks due to the formulation being dominated by PTFE.

When using this material, the application and interconnect processing capabilities must be considered. The RT/duroid 5880 has excellent high-frequency performance but the Z-axis CTE is about 240 ppm/°C, the TCDk is -125 ppm/°C, thermal conductivity is 0.21 W/mK and the PTH hole preparation must be done with an aggressive wet chemistry. In contrast, the RT/duroid 6202PR laminate is PTFE-based however the formulation uses the right ceramic filler and woven-glass reinforcement. The Z-axis CTE for this material is 30 ppm/°C, the TCDk is -15 ppm/°C, thermal conductivity is 0.68 W/mK and the through hole preparation can be done with a special plasma process which is typically easier to implement than the wet chemistry used to prepare the PTH.

Just to provide some reference to these numbers, a good rule of thumb for CTE is to be at 70 ppm/°C or less, while keeping the TCDk at 50 ppm/°C or less, and thermal conductivity is considered good when it is higher than 0.50 W/mK. Avoiding the appropriate wet chemistry for PTH preparation can benefit circuit manufacturing yields.

The circuit board designer must be aware of the different properties of these materials to ensure they are used in applications and PCB fabrication processes which are appropriate for the material. Communicating with your laminate supplier and PCB fabricator early in the design process is more critical than ever when working with PTFE and PTFE-based materials. **DESIGN007**

John Coonrod is technical marketing manager for Rogers Corporation. To contact him or view past columns, click here.

MilAero Highlights

One World, One Industry: Electronics Industry Advocacy More Important than Ever ▶

The future of the electronics manufacturing industry is shaped in many ways by government policies. This will be especially true in 2018, as legislators and regulators are eyeing policy decisions on issues such as technology research and development, taxes, workforce skills, and the environment.

Cross Border Deals: What to Look for and How to Manage ▶

My firm has been approached by foreign firms several times this year and in 2017 who want to acquire PCB, PCBA, or other electronics companies in North America.

RTW IPC APEX EXPO: Annual Update for IPC Validation Services ▶

Randy Cherry, director of validation services, provides an annual update for IPC validation services, including QML and QPL supplier listings.

IPC Honors Rockwell Collins and Northrop Grumman with Corporate Recognition Awards ▶

IPC bestowed its highest corporate honors on two companies, Rockwell Collins and Northrop Grumman Corporation, during a luncheon at IPC APEX EXPO 2018.

The Sum of All Parts: Defining Your Customer ▶

These are the most typical ways in which someone will ask us who our customers are. Many times, the purpose is to see whether we work in the same spaces as them or as a way of gauging whether we are worthy of having them as a customer.

NASA's Robert Cooke Wins IPC President's Award ▶

Long-time IPC volunteer, Robert Cooke, NASA Johnson Space Center, was presented with the IPC President's Award at IPC APEX EXPO 2018.

Three New Mars2020 Rover Technologies: What Powers the "Body Parts" on the Mars2020 Rover? ▶

The Mars2020 Rover Mission, designed by JPL, is the next NASA Mars Exploration Program mission that is planned to launch in 2020.

IPC Issues Position Paper on Priorities for an Ambitious EU Industrial Policy Strategy ▶

IPC—Association Connecting Electronics Industries—has issued a position paper, "IPC Priorities for an Ambitious EU Industrial Policy Strategy," in support of EU Industry Day.

RTW IPC APEX EXPO: Ventec's Jack Pattie on New Materials, Industry Upswing ▶

Ventec International Group's Jack Pattie comments on continuing growth in sales, investment in manufacturing and distribution, and new product developments in polyimides, no-flow pre-pregs and thermally conductive materials.

Interview: Incoming and Outgoing Presidents of Polar Instruments

Interview by Andy Shaughnessy
I-CONNECT007

Polar Instruments has hired some talented technologists recently, including a new president, Dorine Gurney. I had the opportunity to interview Dorine, and Ken Taylor, Polar's outgoing president, during DesignCon 2018. We talked about Dorine's objectives for the company and Ken's plans for life after Polar.

Shaughnessy: Dorine, nice to meet you. I'm sure you'll enjoy working with Polar. They're great people to work with.

Dorine Gurney: It's been great to be here at DesignCon to see all the excitement around Polar and all the customers we have. We had even competitors coming and talking about our products and how great they are. It was a really good experience.

Shaughnessy: You've worked at Mentor, and you've worked at quite a few companies that readers will have heard of. Tell us a little bit about your background.

Gurney: I have been in the industry for about 30 years, mostly on the IC and the test and measurement sides of the industry. I worked at Mentor for 11 years and at Tektronix for 13 years, where I held positions in management, engineering management, and product marketing.

Shaughnessy: What's your background? Are you an engineer?

Gurney: Well, I am an engineer at heart. I like to solve problems. That's what I like to do, but I think through the years I've learned to understand that sometimes there are problems you can't solve. Sometimes to solve problems, you need help from others. So I've learnt through the years that engineering is one aspect of creating products and getting the progress going. And you also need some aspects of business and dealing with people and exchanging ideas and helping each other.

Shaughnessy: I know you just got to Polar three weeks ago, but what do you have planned?

Gurney: I don't want to discuss my plans too much. I'm still on a learning curve. I want to learn a lot about Polar and "the Polar way" in my first 30 days. I'm observing and asking a lot of questions. I'm trying to learn how Polar operates and understand the customers and what their problems are. I don't expect to change things dramatically initially, but I see some opportunities to improve things and I'd like to test some of these ideas with Polar and discuss them with the whole company. I mean, I'm not a dictator. I want to work as a group and decide together where the most important things to be done are.

Dorine Gurney

Shaughnessy: I'm sure Ken's sort of been walking you through.

Gurney: Yes, Ken has been tremendous. It's hard to fill his shoes. He has so much experience. He's so polished in the way he speaks and presents things. He's a great advisor. I'm so happy to have him as a mentor and I'm hoping and excited that he decided not to retire too quickly. I'm hoping he will visit and take my phone calls and give me advice when I'm in the middle of a situation.

Ken Taylor: Well, this must sound like a mutual admiration society. I have to say that Dorine is extremely modest about both the breadth and depth of her engineering experience, and add to that, her marketing experience. I think, if I'm to pat myself on the back for anything, it would be persuading Dorine to come to Polar in the first place—it wasn't her intention. I did a great sales job on her. I was so much looking forward to this show because I was confident that we'd have a lot of what I would call Polar admirers, from current users coming by the booth to say hi, and to meet Dorine, and to tell her what a great company Polar is in so many ways. I feel vindicated in that.

Shaughnessy: Dorine, had you worked on anything before with Polar?

Gurney: I never had a chance to work with them directly, but I had heard about Polar when I was working at Tektronix. I worked with Ken's wife but not directly with Polar products.

Shaughnessy: That's good. So, you sold the job, Ken.

Taylor: I first started talking about retiring seven years ago but I wanted to stay here because it's such a great place to come every day. But a couple of years ago, I realized it was time to find somebody with, I'll say, skills and aptitudes that I don't have and would never attain. I started asking around and at some point, my wife mentioned Dorine. Then I started snooping around Tektronix and hearing about her. She knows what I heard; I've told her. That's what caused me to decide to try to persuade her to come in our direction.

Shaughnessy: Are you going to have to relocate?

Gurney: No, that's the nice thing about this new position. It's not even two miles away from Tektronix.

Shaughnessy: You're in the Pacific Northwest?

Gurney: Yes. We're based in Beaverton and close to Portland, Oregon. It rains a little too much, although in the summer it's all green.

Taylor: Yes, the location is no accident. You probably know that there's a lot of ex-Tektronix people like Dorine in the area.

Shaughnessy: Ken, what are some of your highlights of your time at Polar?

Taylor: The highlights are, I'd say, almost impossible to think of, because every day at Polar has been a great pleasure. That's the reason that I stayed on so long after retirement time, so to speak. We have a joke, but it's true, that we have an ex-Tektronix guy who retired from Polar three times, but he kept coming back at our invitation. We told him this last retirement he was not going to get a fourth party if he came back again. Polar's a good place to be.

We did have a fellow who left at Christmas to follow a completely different career in teaching, working with troubled kids mostly. He said to me, "I want you to know, Ken, I have never had a Monday morning feeling. It's always been great." That's what I call "Big Polar" spirit.

Shaughnessy: You all have always been easy to deal with. Everyone at Polar loves their job, and everybody's just happy to be there.

Taylor: Yes. If you're good at something, and you enjoy it, you get better at it so it kind of feeds on itself into a happy person.

Gurney: There's so much to learn from our customers by exchanging with them. It's tremendous. There's so much knowledge in our customer base and we're happy to listen to them and learn from them as well.


Ken Taylor

Shaughnessy: You all have written several books, which we've been fortunate enough to work with you on.

Taylor: Yes, I know Martin Gaudion is working on another one now.

Shaughnessy: Well, I'm sure you'll have a great time at Polar, Dorine.

Gurney: Thank you very much.

Shaughnessy: Ken, you're staying on for a little while and you had a big meeting, and some shows…

Taylor: We had a big meeting in January, but we've got these couple of shows. I said to Dorine, "I don't give advice; you can have an opinion and you do what you want. You're the boss."

Gurney: I'm the boss. Yep.

Taylor: That's how it's been so far. The company likes the way everything is going.

Shaughnessy: Ken, any plans for retirement? Are you going to take up fishing, pottery or golf?

Taylor: I'm not a golfer. The only plans we have is to travel. We have a motor home and we'll move around in that. I don't care where we go. I just love Oregon. I don't see any need to leave Oregon. Do you want me to sell Oregon [laughs]?

Shaughnessy: Is there anything else you want to talk about?

Taylor: I'd like to close with just a super welcome to Dorine. She's marvelous. Everything that we could have hoped for is working. We very much enjoy her.

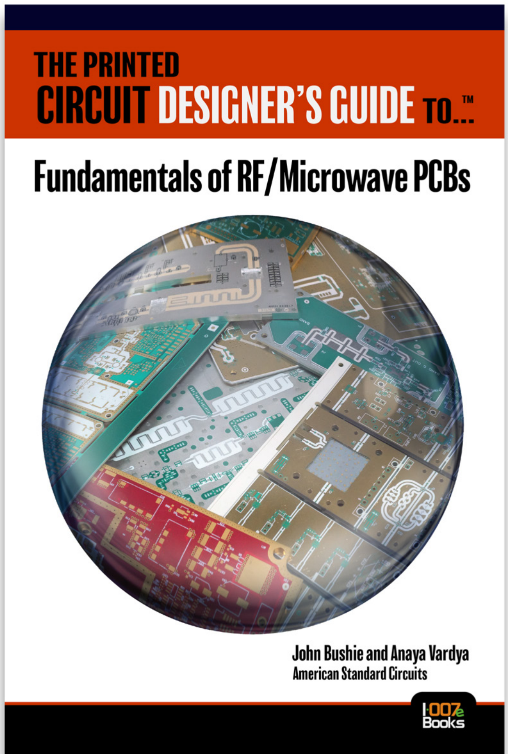
Gurney: Thank you. I appreciate it. Thank you, Ken.

Shaughnessy: Thank you both. DESIGN007

American Standard Circuits Discusses New RF/Microwave eBook

Interview by Andy Shaughnessy
I-CONNECT007

During DesignCon 2018, I met with Anaya Vardya and John Bushie of American Standard Circuits. Anaya and John recently co-wrote an eBook, published by I-Connect007, titled *The Printed Circuit Designer's Guide to Fundamentals of RF/Microwave PCBs.* We discussed their goals and the scope of this handy microbook, which features plenty of information that even high-speed digital designers can benefit from.



Andy Shaughnessy: How are you all doing? It's good to see you again.

Anaya Vardya: Great to see you, Andy.

Shaughnessy: You've brought a copy of your new book, The Printed Circuit Designer's Guide to Fundamentals of RF/Microwave PCBs. It's been great working with you guys on the book, and a lot of fun. I learned quite a few things when I was editing it.

Vardya: I hope you did.

Shaughnessy: That was the point of it, right? So what made you decide to write a book?

John Bushie: Basically, we wanted to take all the experience we've gathered working with engineers throughout the years. Anaya has been in the industry for 30+ years. I have been around RF microwave for over 20 years, both on the fabrication and the laminate side of the business. Since we get to work with so many designers on all their varieties of projects, it was nice to be able to share some of that knowledge with a wider audience-

Shaughnessy: Especially now that the digital people are seeing a lot of the same problems that the RF guys have been dealing with.

Bushie: The data rates go up, the relative frequencies go up. They're dealing with the same challenges.

Vardya: I think one thing that is important to note is that this is our second book. We actually started out writing a book on flex and rigid-flex. And we had a lot of designers who were asking us a lot of questions. We have to go back to the designers and say, "We need you to redo some things." Everybody was collectively losing a lot of time in the process.

So we felt that book was very successful. I think it really reached out. So, we decided we wanted to do the same in the RF microwave sector, as John was saying.

Bushie: The reality is, most of this stuff was written 100 times for a variety of different engineers working on all these different projects. And by capturing it in one compendium, while not the be-all, end-all of knowledge on the subject, we believe that it will be a good primer for a lot of people touching into these areas of circuit design.

Vardya: Again, at the end of the day, it is a microbook, so it's not meant to be a textbook. It's not very, very detailed. But I think we tried to touch high level on a variety of different points and on points that we tend to have to help RF designers out on.

Shaughnessy: That's the thing. The designers don't necessarily know everything, even with 30 years of experience, because you can't know absolutely everything. The may not know much about RF and microwave.


John Bushie

Vardya: A lot of designers don't really understand how printed circuit boards are manufactured. There are a lot of things you can do in your design software, but, when you get down to brass tacks of actually getting it done on the manufacturing floor, that's when you run into tons of difficulties.

We've illustrated several cases where things like that happen. We also make the point that it's important for designers, especially when you're starting to design some complex circuit boards, to really work with a PCB fabricator, because that combination can really help save a lot of time and energy for everybody involved, and also save a bunch of expenses.

Bushie: And you're right. The reality is we have to make some effort to be able to educate people on what causes issues and understanding how these different aspects help their design impact the manufacturability. That was really the driving force.

Shaughnessy: A lot of fabricators say they'll get designs in, and electrically, they are sound, but it is the mechanical side, the simple stuff, that causes the phone call at 5 pm Friday. It's things like placing features too close to the edge. It seems basic, but the designers are all slammed for time.

Bushie: Sure. Everybody is pressed for time.

Vardya: And the PCB design is always the last part, right? It's always running behind. All the long lead components have already been ordered, but usually on some of the more complex stuff, it's the PCB design that comes in last.

Shaughnessy: It was a really great book. I like how you have some of the theory but then you have some examples, too. And you got it all in a small book.

Bushie: The smaller the better, actually. We want people to be able to read it. It needs to be very accessible, and I think we achieved that goal.

Shaughnessy: If you hand somebody a giant handbook…

Bushie: Yes, 300 pages. The chances that I might read it would be very slim.

Shaughnessy: Is there anything else you want to discuss?

Bushie: If you want a good overview of a majority of the issues that face a PC board fabricator, then this book gives you a very good picture of what we have to deal with. We have even started using the term "tripping point" to describe a fabulous design that's completely manufacturable, except for one point. That's where we have to really struggle. You can come up with creative solutions to a wide variety of problems, but if there are multiple areas on a board that make it virtually unmanufacturable, I think the designers need to understand this.

Shaughnessy: The RF and PCB designers are almost speaking two different languages. They're doing the same thing, but they look at antennas differently, and then you have tuning issues and all this other stuff that for PCB designers is foreign to them.

Bushie: You're right. On the other hand, there's some similarity to both designs nowadays. We see them moving together into very similar design aspects, with similar features, edge plating and cavities, heat sinking or coining a board. It is amazing how we see these technologies kind of converging as well.


Anaya Vardya

Vardya: It's interesting, because as people were giving us feedback on the book, one of the criticisms of the book was that we titled it an RF/microwave book, but it really applies to a lot more than RF microwave. A lot of the principles that we discuss in the book probably applies to a lot of complex, even high-speed digital printed circuit boards.

Bushie: It could be more accurately termed "issues we face on complex circuit boards."

Vardya: But, again, at the end of the day, 90% of what we talked about are issues we face on RF boards day in and day out. With over 50% of our business being RF/microwave, which is why we tended to focus in on that. Yes, high-speed digital has some of the same things but not as prevalent as it is in RF microwave space.

Shaughnessy: RF sounds like a really interesting area to be working in. It sounds like a lot of fun, too.

Bushie: We have really enjoyed it. Anaya and I have been doing it for a long time. I have to say thank you to all the people I have been able to work with over the years because they've taught me so many things. I've worked with some of the most brilliant minds in this industry.

Vardya: Yes, I think our customers and suppliers have been instrumental in getting us to a point that we were able to write the book. We acquired a lot of knowledge from our suppliers. We've also worked with all kinds of interesting designs with our customers. I think that combination really got us to the point that we ended up writing this book.

Bushie: This gave us the ability to basically share that information with not only the people we have dealt with but some of the newer engineers who are coming up in the industry.

Shaughnessy: And we are seeing young people coming into the industry. Slowly, but it is happening.

Bushie: We keep hoping that we will get a greater influx of young engineers coming into this area.

Shaughnessy: I appreciate your time, gentlemen. Thank you.

Vardya: Thank you, Andy.

Bushie: Thank you. **DESIGN007**

Related Content

Visit I-007eBooks to download your copies of American Standard Circuits' micro eBooks today:

The Printed Circuit Designer's Guide to... Fundamentals of RF/Microwave PCBs ▶

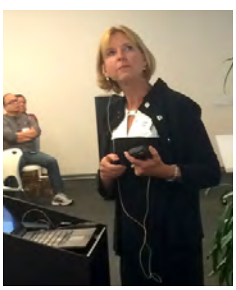
The Printed Circuit Designer's Guide to... Flex and Rigid-Flex Fundamentals ▶

Recent Highlights from Design007

1 Worldwide Systems Consulting: Tools, Process, People ▶

Editor Andy Shaughnessy and Publisher Barry Matties sat down with Mentor's Jay Gorajia, director of worldwide systems consulting. Gorajia discussed Mentor's systems consulting business, their focus on the "digital twin," and how their acquisition by Siemens is benefitting Mentor and their customers.

2 Julie Ellis: TTM's Interface Between Designer and Fabricator ▶



As a field application engineer for TTM, Julie Ellis sees the problems that can occur between circuit board designers and manufacturers. Barry Matties spoke with Julie at the AltiumLive event in Munich about the age-old problem of throwing designs "over the wall," the trend towards HDI, and what advice she would give new designers.

3 Cadence's Sigrity Automates Power Integrity Simulation Earlier in Design Cycle ▶

During DesignCon 2018, Kelly Dack met with Sam Chitwood, a product engineer with Cadence. Sam explained how the Cadence Sigrity simulation software now allows users to make decisions early in the design process, and how this can help optimize the design of the power delivery network and ensure signal integrity in complex PCBs.

4 DownStream Webinar: The Benefits of Design for Manufacture ▶

Relying on the design rule checking function of your PCB CAD system is a good start to finding manufacturing issues, but it's simply not enough. The DRC of most CAD systems is inadequate for analyzing a design against the many nuances of the fabrication process. On Tuesday, April 17, DownStream Technologies will be holding a webinar that can answer many PCB designers' DFM questions.

5 SnapEDA Harnesses Technology in Providing Verified Parts ▶

Five years after SnapEDA was launched, the company continues to expand its library parts and symbol creation services, with the help of some of today's most cutting-edge technology. Andy Shaughnessy recently caught up with Natasha, and we discussed how her team utilizes technology that has helped SnapEDA to become a major player in this space.

6 EMA Provides Free Access to Ultra Librarian ▶

"Today's engineers don't have the time or the desire to do the tedious work of creating library parts," said Manny Marcano, president and CEO of EMA. "By providing free access to the world's largest library of verified EDA component models, we can help them maintain focus on their primary task of designing circuits."

7 Bridging the Customer-Supplier Gap ▶

For the February issue of *Design007 Magazine*, we interviewed Nolan Johnson of Sunstone Circuits, and Dan Beaulieu of DB Management—our regular columnist—on the topics of knowing your customers, the challenges in dealing with customers, and providing excellent customer satisfaction.

8 New *Show & Tell Magazine:* Complete Coverage of IPC APEX EXPO ▶

Show & Tell is packed with complete coverage of IPC APEX EXPO 2018. Inside you will find great show photos, *Real Time with*...IPC APEX EXPO 2018 video highlights, and other featured content, including: exclusive interviews with the IPC Hall of Fame Inductee and other IPC Award Winners, results of the I-Connect007 Student Photo Contest, insights from our Q&A with attendees and industry professionals, and expert opinions from our columnists.

9 Orange Co. DC Chapter Meeting: Flex and Rigid-Flex are Hot Topics ▶

On March 29, Scott McCurdy, president of the Orange County Chapter of the IPC Designers Council, hosted the quarterly Designers Council meeting at Harvard Athletic Park in Irvine, California. The two presentations focused on flexible circuit design, drawing 80 people to this Lunch and Learn event.

10 IPC-2581 Demo Draws a Crowd at IPC APEX EXPO ▶

During IPC APEX EXPO 2018, the IPC-2581 Consortium held a demo of this open-source data transfer standard, attracting numerous designers, fabricators and assembly providers. Jim Pierce of Axiom Electronics and Bob Miklosey of Aegis Software sat down to discuss the demo and their involvement with the consortium.

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- Prepare action plans for sales leads and prospects
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- Possess the ability to calm a situation with customers, initiate a step-by-step plan, and involve other technical help quickly to find resolution

Hiring Profile

- Bachelor's Degree or 5-7 years' job-related experience
- Strong understanding of chemistry and chemical interaction within PCB manufacturing
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- Ability to process DRC/DFMs
- Excellent customer/people skills
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- Provide feedback to management regarding performance
- Create and conduct customer technical presentations
- Develop technical strategy for customers
- Possess the ability to calm difficult situations with customers, initiate a step by step plan, and involve other technical help quickly to find resolution

Hiring Profile

- Bachelor's degree or 5-7 years' job-related experience
- Strong understanding of chemistry and chemical interaction within PCB manufacturing
- Excellent written and oral communication skills
- Strong track record of navigating technically through complex organizations
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The FAE will support the VP of Sales and Service for North America in equipment installation, training, maintenance, and other services at field locations. The FAE will provide technical/customer support and maintain positive relationships with existing and future customers.

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Career Opportunities

Career Opportunities

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

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

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- Outside sales background
- Residency on the West Coast to manage West Coast sales
- Knowledge of wet process equipment
- Sales experience with capital equipment (preferred)

Compensation will include a base salary plus commission, dependent upon experience.

more details

Events Calendar

2018FLEX Japan ▶
April 19–20, 2018
Tokyo, Japan

KPCA Show 2018 ▶
April 24–26, 2018
Kintex, South Korea

Thailand PCB Expo 2018 ▶
May 10–12, 2018
Bangkok, Thailand

Medical Electronics Symposium 2018 ▶
May 16–18, 2018
Dallas, Texas, USA

IMPACT Washington, D.C. 2018 ▶
May 21–23, 2018
Washington, D.C., USA

2018 EIPC's 50 Years Anniversary Conference ▶
May 31–June 1, 2018
Bonn, Germany

JPCA show 2018 ▶
June 6–8, 2018
Tokyo, Japan

IPC E-Textiles 2018 Workshop ▶
September 13, 2018
Des Plaines, IL, USA

electronica India productronica India ▶
September 26–28, 2018
Bengaluru, India

electronicAsia 2018 ▶
October 13–16, 2018
Hong Kong

SMTA International ▶
October 16–17, 2018-01-26
Rosemont, Illinois, USA

TPCA Show 2018 ▶
October 24–26, 2018
Taipei, Taiwan

electronica 2018 ▶
November 13–16, 2018
Munich, Germany

Additional Event Calendars

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

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

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

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

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

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

MAGAZINE LAYOUT: **RON MEOGROSSI**

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

TECHNOLOGY SPECIALIST: **BRYSON MATTIES**

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