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Growing Your Workforce

You may have noticed a few open positions at your company, or among other companies in our industry. In this issue, we explain how to plant the seeds to grow your workforce. Our expert contributors discuss current trends in hiring, including what the next generation wants in a career. We also cover a variety of ways to ensure that you are hiring the best person for the job, as well as how to “sell” your company to recruits.

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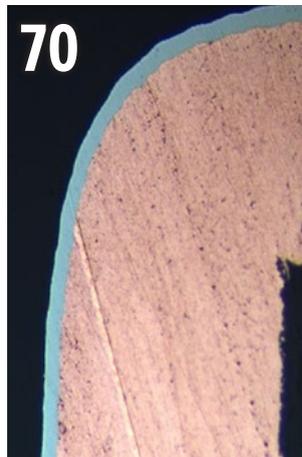
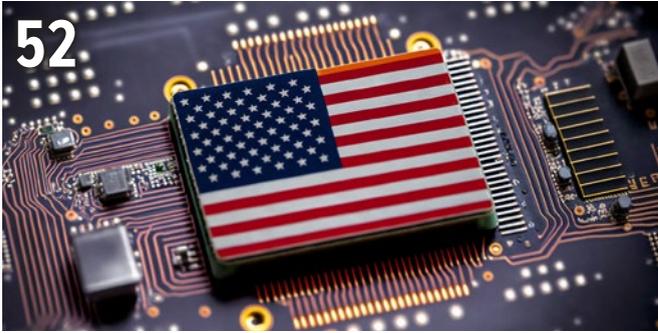
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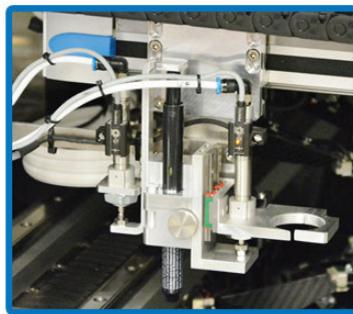
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Help Wanted

The Shaughnessy Report

by Andy Shaughnessy, I-CONNECT007

You may have noticed a few open positions at your company, or among other companies in our industry. You also may have wondered why it's so hard to fill these seats.

Many fabricators and suppliers have had multiple positions vacant for months, and unlike even five or 10 years ago, most companies don't have a stack of resumé to choose from.

Why are there so many open positions in this industry anyway? After all, this is one of the most exciting times to be working in electronics. The headlines are full of news about advances in artificial intelligence, autonomous vehicles, and wearable medical devices—technologies that were once only seen in Heinlein and Asimov novels.

But many of our co-workers have retired, and there's another batch of technologists

planning to pull the pin within the next five years. We've seen millions of working-aged people just quit the workforce for good.

So, what do you need to do to fill these seats? As we learned while planning this issue, there are young people out there, eager to go to work in circuit board manufacturing. But they're not going to come to you; you will have to go out and find them. Your company must become attractive to these young people, like a peacock spreading its feathers.

You must have an effective hiring strategy if you want to attract—and retain—skilled workers. Does your company have such a strategy? If not, we have the information you need to get your hiring plans up and running.

In this issue, our expert contributors discuss current trends in hiring, including what the next generation wants in a career. We also



cover a variety of ways to ensure that you are hiring the best person for the job, as well as how to “sell” your company to recruits.

We start with a feature article by Brian Wallace, who explains that employers need to engage with new hires well before they join the company. Dr. John W. Mitchell posits that many companies need to basically start over and “fire” their hiring habits. Hannah Nelson shines a light on the wants and needs of the young employees who will, hopefully, be working with you. PCB design student Paul Farquhar discusses his recent Palomar College class,

and what hiring managers are seeking in new hires. And we have an interview with application engineer trainee Joseph LaRosa, who discusses what attracted him to this industry and robotics in particular.

I hope your summer is going well. Take some time off. You’ve earned it! **PCB007**



Andy Shaughnessy is managing editor of *Design007 Magazine* and co-managing editor for *PCB007 Magazine*. He has been covering PCB design for 20 years. He can be reached by [clicking here](#).

Engineering Graphene-based Quantum Circuits With Atomic Precision

Imagine having a building made of stacks of bricks connected by adaptable bridges. You pull a knob that modifies the bridges and the building changes functionality. Wouldn't it be great?

A team of researchers led by Professor Aitor Mugarza of the Catalan Institute of Nanoscience and Nanotechnology (ICN2) and ICREA, together with Professor Diego Peña from the Center for Research in Biological Chemistry and Molecular Materials of the University of Santiago de Compostela (CiQUS-USC), Dr. Cesar Moreno, formerly a member of ICN2's team and currently a researcher at the University of Cantabria, and Dr. Aran Garcia-Lekue, from the Donostia International Physics Center (DIPC) and Ikerbasque Foundation, has done something analogous, but at the single-atom scale, with the aim of synthesizing new carbon-based materials with tunable properties.

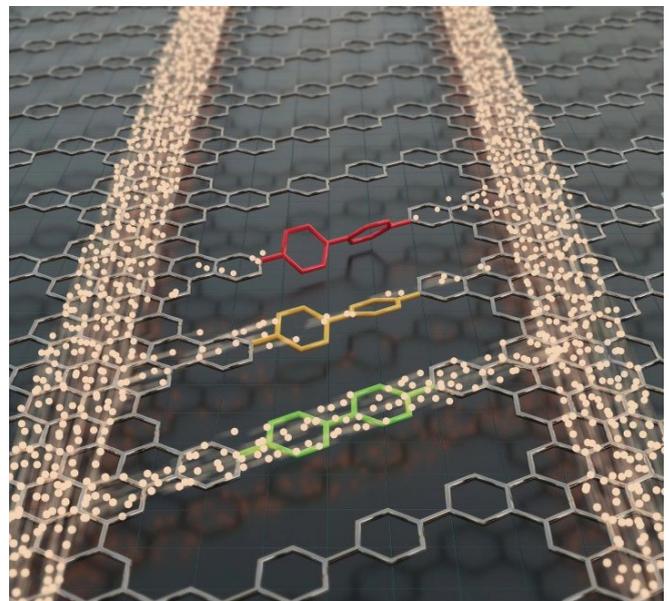
As explained in a paper just published in the *Journal of the American Chemical Society* (JACS), this research is a significant breakthrough in the precise engineering of atomic-thin materials—called “2D materials” due to their reduced dimensionality. The proposed fabrication technique opens exciting new possibilities for materials science, and, in particular, for application in advanced electronics and future solutions for sustainable energy.

The authors of this study synthesized a new nanoporous graphene structure by connecting ultra-narrow graphene strips, known as “nanoribbons,” by means of flexible “bridges” made of phenylene moieties. By modifying in a continuous way the architecture and

angle of these bridges, the scientists can control the quantum connectivity between the nanoribbon channels and, ultimately, fine-tune the electronic properties of the graphene nanoarchitecture.

The potential applications of the approach proposed in this study go beyond future electronic devices and computers. In fact, it could also lead to the development of thermoelectric nanomaterials, which can have an important impact in renewable energy generation and waste heat recovery, therefore addressing another crucial societal challenge.

Source: Centro Singular de Investigación en Química Biológica y Materiales Moleculares (CIQUS)





Engagement Begins **Before** Employment

Feature Article by Brian Wallace
HR STRATEGIES NOW

Employee engagement is a major contributor to an organization's productivity and results. In fact, it's crucial for the long-term success of any business. That's because an employee who is truly engaged tends to be more productive, committed to, and loyal to their employer. They typically bring more discretionary effort to the table and create less risk than their disengaged counterparts. Raise your engagement levels and you'll tend to produce better results.

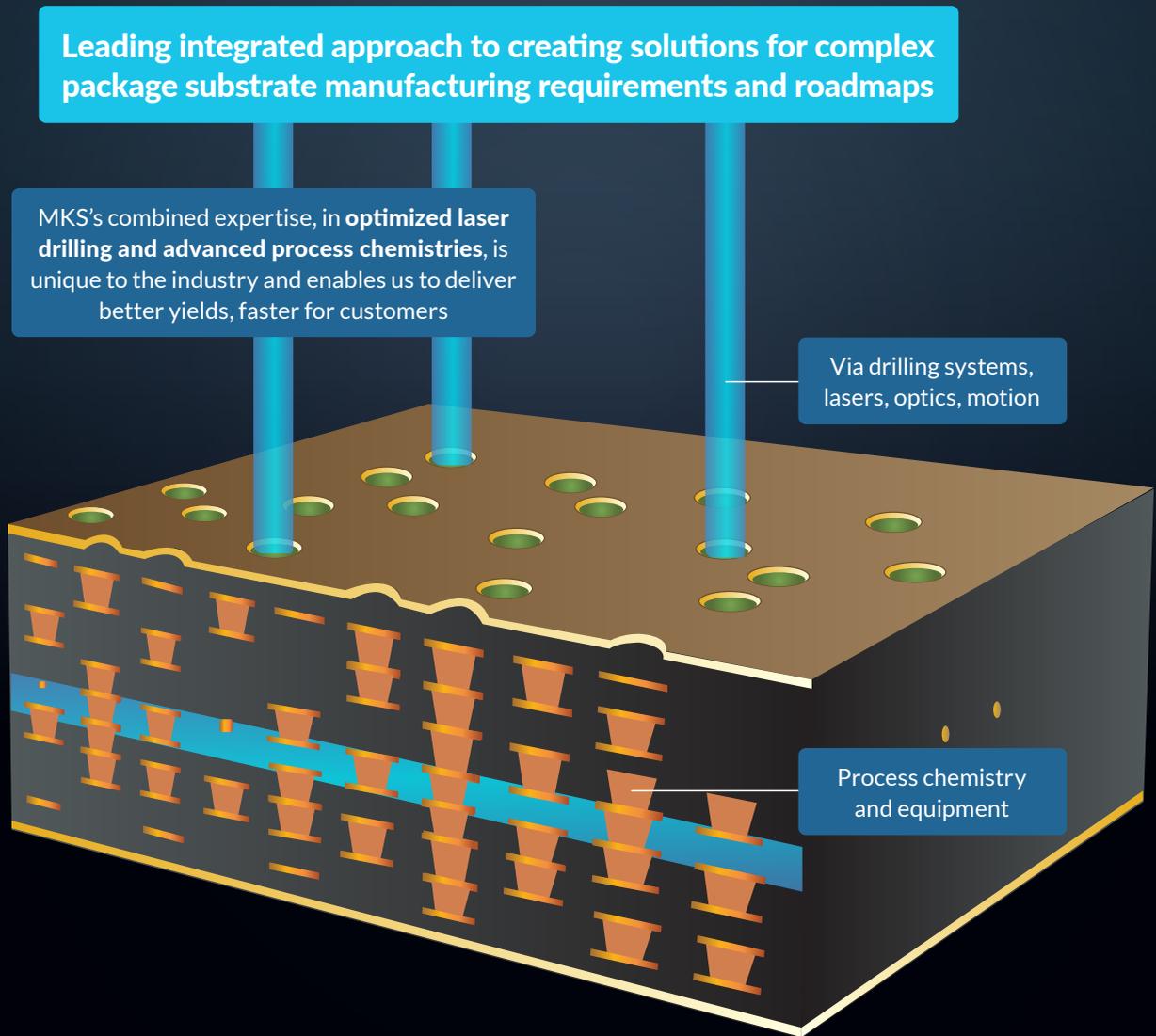
Some believe that engagement begins on an employee's first day of work. But that's a myth. The truth is that engagement begins before employment.

Engagement at a Glance

Employee engagement is the emotional commitment and connection that an employee has to their work, organization, and co-workers. It's the driving force behind discretionary effort, productivity, and perseverance. It influences an employee's motivation, enthusiasm, and investment in their work and, therefore, the success of the organization. It also significantly influences employee loyalty.

Unfortunately, according to Gallup¹, the levels of employee disengagement today are high and active disengagement is higher than ever. But the good news is that you can create prac-

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tices during the interview and selection process that can decrease these levels.

Engagement Drivers

During the pre-employment process, your future employees ask themselves seven key questions. Every interaction that they have with the organization (especially during the interview process) will shape their answers and their future engagement levels.

- Do I believe in where you are going, and can I successfully contribute?
- Am I interested in the responsibilities, team, and culture?
- Can I trust what I am seeing and hearing? Will my experiences match the promise?
- Do you care about me as an individual?
- Can you help me accomplish my goals?
- Will I have a positive experience as an employee?
- Is your organization a smooth-running machine (or a bucket of headaches)?

If you want to build and drive higher engagement levels, it's important to focus on intentionally creating an experience that is going to lead them to answering those questions affirmatively and believing, "This is where I belong."

Create an Effective Employment Brand

Your ideal applicants want to know who you are as an employer; it's important to present a clear and accurate description of what you stand for. Your employment brand should communicate your purpose (mission), values, culture, and opportunities in a manner that resonates and helps them envision themselves as part of the organization.

There is tremendous value in presenting this information clearly and authentically across your job postings, application system, social media channels, and recruitment materials. It focuses the applicant's attention on becoming part of an organization rather than simply finding a job. It also enables a candidate to identify whether its purpose is aligned with theirs.



Remember, this is about building a connection that moves from their head to their heart. People typically long to be a part of something they believe in. This is where you set that stage.

Build a Positive Candidate Experience

A candidate's perception of how they are treated during the interview and selection process will influence their belief about how they will be treated as an employee. So, make sure it's a positive experience. Clear and proactive communication, an organized (and reasonably easy) process, and professionalism go a long way. The objective is for the candidate to perceive that you value them and the potential that they bring to the table.

This is an opportunity (perhaps the best opportunity) to capture their attention by communicating a compelling vision of the future and their role in it. They need to perceive that they have the potential to become part of something bigger than themselves.

Conduct the Interview

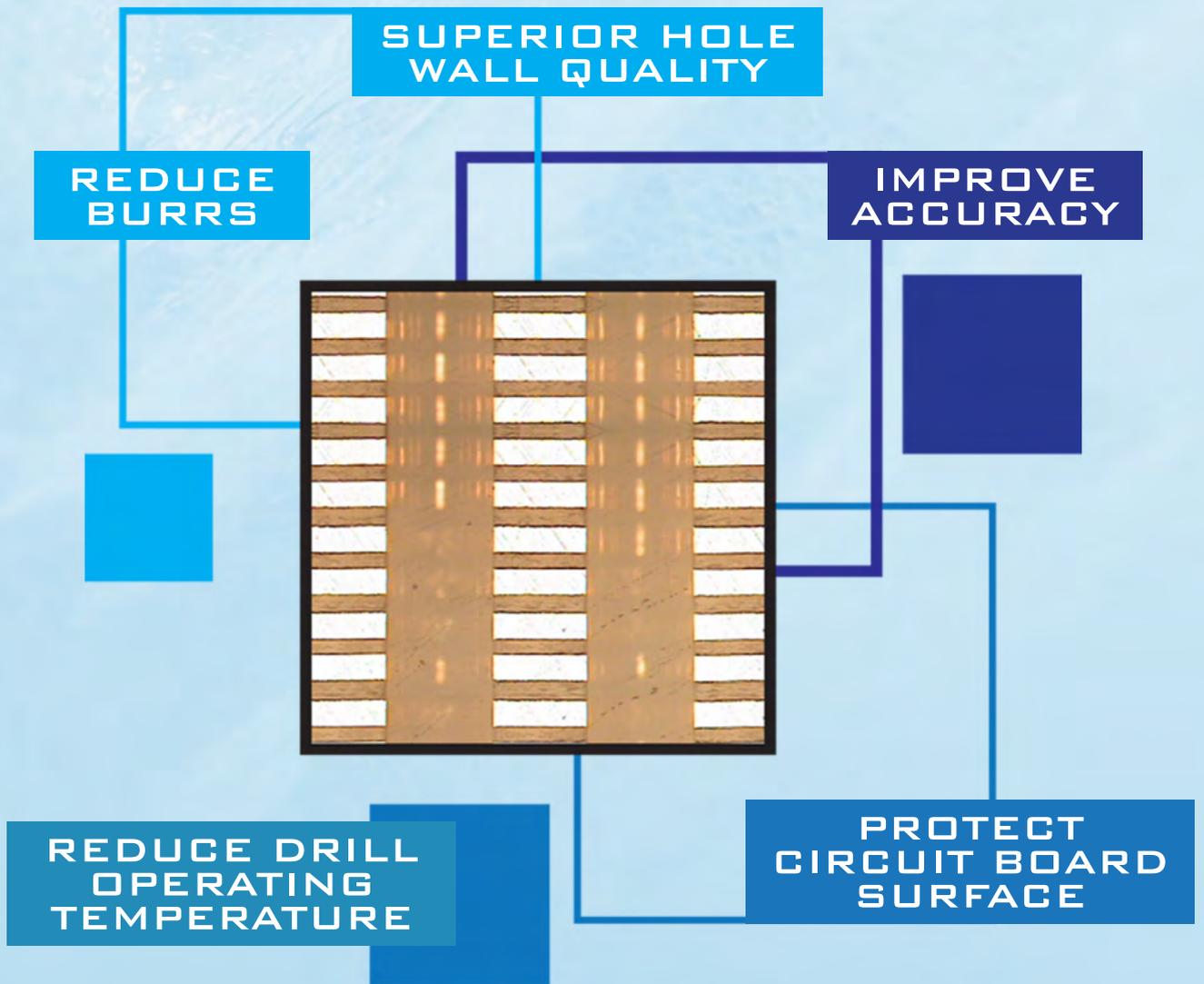
The interview is the best opportunity to truly connect with the applicant, open lines of communication, and build a trust-based relationship. It also places your values and culture on display. Here are a few recommendations for this stage that reach beyond the interview questions:

- Make sure they know what to expect—meeting participants, directions, what to do when they arrive, etc.



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- Ensure the applicant perceives that they are important. Show that you and the team are prepared for the meeting.
- Take the time to really connect and learn about their goals and ambitions.
- Clearly speak to the organization's values and culture by building their desire to be part of it.
- Be careful of your personal biases that may derail the quality of the conversation.
- Ensure that you are open and honest in describing both the opportunities and challenges of the position, its rewards and demands.

Remember, this is about building a relationship that goes beyond a transaction.

Extend the Offer

This is an exciting moment for both the candidate and your organization. It's important to remember that this is an opportunity to strengthen the relationship between the two. To continue building the engagement level, consider:

- Ensuring that all details of the offer are clearly laid out so the candidate understands what they are agreeing to.
- Highlighting the elements of the job that the candidate expressed particular interest in during the interview process and discussing related opportunities.
- Helping them understand why they were chosen for the role and what you hope they will bring to the table.
- Expressing how you believe they will fit into the team.
- Ensuring there is transparency and open communication in the event any questions arise.
- Helping them begin making the transition mentally by discussing next steps.

Enthusiasm is important in your delivery. Focus on encouraging the candidate to say to themselves, "I believe in where we are going and I'm excited to help the organization get there."

Reinforce Their Decision

You've asked them to marry you. Now continue to date.

The offer has been accepted and it's time for your future employee to begin their transition. But transitions aren't always easy. In fact, some can be tumultuous, and they can allow doubt to creep in and cast a shadow on the bright days ahead. An encouraging message or two positively reinforcing their decision to join your team helps to maintain the forward momentum (and engagement level). The key is to encourage the candidate to maintain their focus on the future and their place in the organization as an important member of the team.

Consider sending them information before their start date that reflects:

- Your team's enthusiasm for having them on board
- What they should expect during their onboarding process
- The values of the organization

Conclusion

When candidates feel valued and respected during the hiring process, they are more likely to have a positive view of the company and be more engaged in their role once they start working. Smart hiring practices connect a candidate with the culture, values, and direction of the organization at a deep level and build a high level of trust, the foundation for that engagement and long-term success. **PCB007**

Reference

1. "U.S. Employee Engagement Needs a Rebound in 2023," by Jim Harter, Jan. 25, 2023, Gallup.



Brian Wallace is the founder and CEO of HR Strategies Now, a human resources consulting firm based in Cypress, Texas. He holds a master's degree in management and an SPHR certification from the Human Resources Credentialing Institute. He has led transformative HR initiatives across five industries for more than 20 years.

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Fire Your Hiring Habits

Feature Interview by Barry Matties

I-CONNECT007

The title of Dr. John W. Mitchell's new book, *Fire Your Hiring Habits*, says it all. Hiring and retaining talent is an ongoing challenge for our industry that requires unconventional thinking, casting a wider net, and addressing the real issues at hand. John shares his thoughts behind the book and why we need to rethink the entire hiring process.

John, congratulations on your new book. The title is interesting, so let's start there. What habits need to be fired?

I spend quite a bit of time talking with industry leaders, as well as reviewing IPC's various sentiment surveys. What I see is we're doing the same things we've done for 20 years even

while the world around us has changed. We need to act differently now from how we might have in the past. In our industry, we've always had challenges with our workforce, especially in finding the right talent. This book is about two big pieces that align strongly with IPC's mission in workforce development: finding and keeping the right people. At one point, we thought about titling the book, "Finders Keepers." The entire appendix of the book is a white paper about building electronics better by solving these workforce challenges.

It is written in an approachable, fun way for those who are trying to hire and retain talent; it's really meant for them. Anybody that hangs around me for a while will probably hear me quote more than one movie line, and so you'll

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Dr. John W. Mitchell

find some of those in the book. We wanted to keep it fresh and easy to read, but still provide valuable tools you need.

There was an era when you found a job, signed up for the pension, and happily retired 30 or 40 years later. Those days seem to be long gone.

Yeah. The companies that do that are few and far between.

Corporate culture seems to have shifted as well. Where do you see the shifts in culture?

The largest section of the book—if you include diversity, equity, and inclusion—talks about how keeping the right people means first finding the right people. It’s about the kind of organization you are—that’s your culture. It’s not something you buy off the shelf or create by putting up a few posters. It’s about who you are, what you do, and how you treat your team.

What type of company culture is most successful at attracting and, more importantly, retaining top talent?

Workers today are choosier. They have different expectations than even a decade ago. You also have the culture of a multi-generational workforce where you could have four or five demographic groups working together. You need to consider that culture when you’re hiring. It can be an adjustment; it’s not all the same.

It doesn’t mean they can’t all work together, but you have more to consider. Let’s say, for example, I’m looking for a QA manager. Maybe I’m looking for a Baby Boomer with a lot of experience, so when I advertise, I will emphasize different aspects of the benefits of our company culture than if I was advertising to a Gen Xer or Gen Z. I feel like we could talk for the rest of the day about the different aspects of culture, but the main thing is that there’s a choice. We heard about the “great resignation” after the pandemic, but in the book, we termed it as the “great re-prioritization.” When so many had a lot of time to think, they realized, “Hey, I have other things in my life that are interesting or important to me.”

That’s a good spin on that, absolutely.

You need to make sure your corporate culture aligns with the priorities of individuals as they come along.

Twenty or 30 years ago, we were all watching the same TV shows and news programs on a few broadcast networks. It was the water cooler talk, if you will. Now, information comes all at once from every perspective. In terms of culture, how do you bridge that generational span inside a corporation?

You need to embrace that people are different; in many ways, that’s a benefit. Having a diverse group, whether it’s gender, ethnicity, geography, experience, age, and so forth, helps you come up with better solutions. Think about polymaths—people who’ve mastered at least three distinct, separate, skill areas—who are highly sought after because they can draw on



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various thought processes; they find unique solutions or apply different patterns to a specific problem. The same goes for your teams and your corporate culture: Don't look at diversity as a challenge. Of course, when a group is not homogenous, you will have some challenges, but there are benefits as well. You get a whole different perspective, better solutions, and ones that incorporate more people.

When we talk about hiring, we should not overlook, and maybe develop further, the upskilling of our current workforce.

Definitely. When we hire, we want to find people with as many applicable, diverse skills as possible. In the book, we talk about two methods for successfully retaining your workforce. First, share a pathway: "This is not just a job; it's a career path and here's how you can progress along the path." Along that path, there should be opportunities for upskilling. Our team is our greatest resource, and we should invest in that as we compete in the electronics industry. If I have an EMS factory and I can buy the same machines and parts that anybody else can, then I should differentiate my company by investing in hiring better people and giving them the skills to help us do better.

Some managers only see education and training as just another expense, and it's not true. You can actually see a return to your bottom line by having a better team. Upskill your staff so they know how to leverage the latest technology, and so they develop more than just one skill. These things can happen periodically along the path we talked about.

Remember when you wrote a research paper by hand, then typed it up? If you wanted to add a sentence in the middle of it, you had to retype every page after that. Along came the word processor and that typing problem went away. Now you have ChatGPT that does ideation and can save a lot of

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time. Does your team know how to use that? Do you know how to do data analytics for all the data you're collecting? As you're moving along your pathway to your career, those are skills your team can adopt so that they bring the best value to your organization.

That leads right to my next topic. What are the new roles in industry today? You're talking about the AI and software roles. How does a company stay in tune with those new roles?

There will always be evolution and revolution in our industry, and there will also be some basic, stable positions. The QA manager, for example, isn't going away, but some of the necessary skill sets might need to be more advanced. You can continue to invest in that. There are new roles in data analytics. We have the ability through tools like CFX and others to gather tremendous amounts of data about our processes and how we build electronics.

To do that, we need to do something with that data. It can't just sit there at a storage farm or in the cloud; otherwise, it's pretty much useless, a wasted investment. We see new positions like that with skill sets that aren't terribly different. They're just using a different set of skills to do the same thing. It's process improvement, inventory optimization, and supply chain management. You have new, fresh, data-rich tools that can turn things around faster. The whole isn't completely different, it's just a different way to be advanced.

Automation tools, whether it's data collection on your factory floor or setting up new automated processes, might be some of the new roles.

Agreed. Production line workers used to place almost every single component. We still have those line workers, but what they do is different. There are still some components they place manually, but now it's turning into inspection. They're looking at the work of robots placing components even too small for tweezers to hold.

That's interesting. So, to find this new talent, we look at recruitment, and that sure has changed over the years. There are so many ways to attract talent. Talk about what a reader might learn in your book on this topic.

In *Fire Your Hiring Habits*, I provide some checklists and new ways to recruit.

Let me share just a couple of thoughts. If you're having trouble finding the right people, you might realize you're always "fishing in the same ponds" and it's time to fish in a different one. Many organizations focus on having a diverse mix, but how do you create that? How do you find more of type X or type Y?

If you say, "We haven't employed enough women," or "I have only women working in my place of business," maybe you should start recruiting where a different gender is more likely to find or see your job opening. Similarly, with cultural or age group differences, you can seek different sources to find those hires. Don't expect them to always visit the places where you traditionally advertise.

So, rather than the traditional, "Here's a job, here's what we expect," in this competitive environment even the messaging has changed. It's more about culture, career path, and those sorts of things.





sustainability in logistics



The most obvious area of concern for logistics sustainability is the reduction of the carbon footprint. But Christian Wendt, marketing and communications department head at Siemens Digital Logistics, suggests that there is much more than simply fossil fuel costs. Wendt explains a wide variety of logistics-related areas to consider in this edition of *On the Line with...* brought to you by I-Connect007.



LISTEN NOW

Using the right language and signaling helps open the eyes of individuals looking for jobs who might now say, “This is the kind of place I would like to be in.” In your job descriptions, you might focus more on today’s hot technology, such as AI, robotics, or additive manufacturing. Talk about the culture and make sure that’s prevalent and easily found on your website so that potential hires visiting your site won’t say, “Oh, I won’t feel comfortable in this place.”

That’s what you’re really looking for—talented individuals who will feel comfortable in your company’s environment. You want them to be all in, as opposed to holding back. For instance, if I’m a Muslim and I pray at certain times during the day, will my company allow for that? Your website can show a culture that supports that. When you do, you open up to a whole group of individuals who might never have been interested in applying to your company before.

That’s great advice, but we’re a manufacturing industry and it isn’t as glamorous as tech or others. How do we overcome that challenge? What are your recommendations?

I think you must point out the skills someone can learn within the roles you offer. You need to be truthful, of course, but there are great things happening in manufacturing plants—the skills they can learn, the investments being made in employees. Many of our factories are utilizing the technology I’ve just mentioned, as well as things like data analytics. These skills are transferable.

In the book, I share the story of a basketball coach from a small university who was having

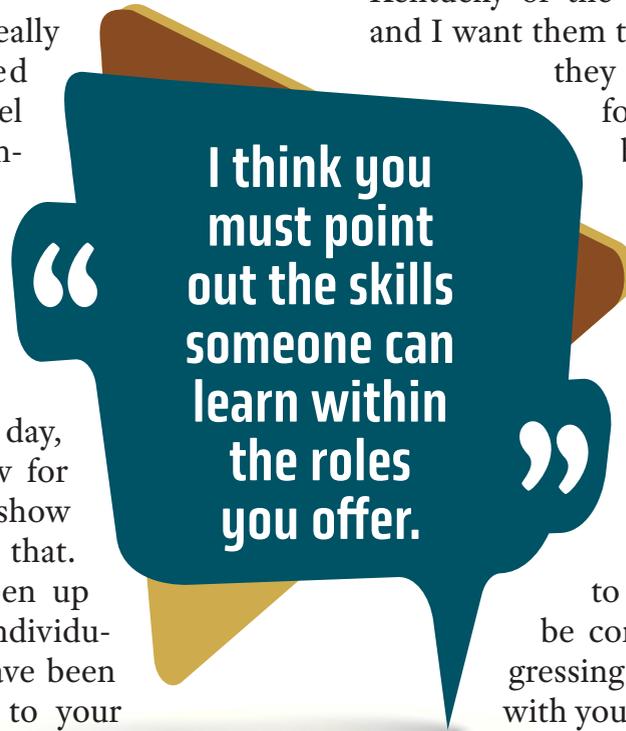
great success. He was frequently asked, “How did you succeed against all these big schools?” He would respond, “Obviously I had talented players, but I had an amazing coaching staff.” When they asked about the significance of his coaching staff, he would say, “Here’s the thing. The reason I can get a fantastic coaching staff is they know that I’m here and I’m hoping that, after working with me for a couple of years, they’ll go after my job, or maybe they’ll go to Kentucky or the NBA. I’ve got their backs, and I want them to be the best they can be so they have a better career going forward. They’re not blocked by me.”

We need to stop thinking, “When I hire someone, I expect them to work here for the rest of their lives.” It’s okay if you get three to five years from someone; you’ve helped build their skills, and their attitude is, “Wow, this is a great place for me to launch to the next thing.” We need to be comfortable with people progressing. They don’t have to work with you forever.

Right, good point. You have the benefit of traveling around the world. What’s your global perspective in terms of the hiring process and needs in other regions?

The needs exist everywhere; it’s a global issue. You have different needs in different regions. I might look at Asia and think they mainly have issues with production workers. But even as I think that, I’m also realizing it’s not completely true. Asian companies are doing data analytics and AI—all the higher-level things in terms of management, and research and development. There are needs everywhere as you go forward.

Do you need to take similar approaches in hiring?



Yes, many of these approaches apply, but each country is slightly different. For instance, in Germany, there's a fantastic hybrid education system developing a pipeline of talent. You learn and work in companies at the same time. The Fraunhofer-Gesellschaft Institute has done a fantastic job in working in different aspects of the industry to develop groups and individuals to support that.

They have set up a pipeline that doesn't exist here in the United States at all. China has a feeder system for production work, an area where North America is lacking in terms of developing a pipeline. The book talks about how we can address that. IPC has been working through the IPC Education Foundation to develop our pipelines for the industry here and across the globe. It's not just about developing that talent, either. There are worldwide challenges, such as energy needs, finding the right location, and so forth. It's a mixed bag depending on where you go.

Well, good. Again, congratulations on this book. It's extremely timely and no doubt will be well received. Do you have any final thoughts that you'd like to share with industry?

The electronics industry has always struggled with closing the skills gap, finding the people who are prepared, and ready to do the job that we need. Maybe it's time to give up on that hope, recognize we need to hire for the fundamental skills, and build the rest internally as we go.

That's a good thought to ponder. John, I certainly appreciate your time.

Always a pleasure. **PCB007**

Fire Your Hiring Habits, by Dr. John W. Mitchell, is officially released on June 20 and is available on [Amazon](#). Proceeds will benefit the IPC Education Foundation.



Mexico and IPC on the Move



There's a saying that highly successful people have three things in common: motivation, ability, and opportunity. The same can be said for electronics manufacturing and assembly in Mexico: We have the motivation, the ability, and the unique opportunity to take this industry to the next level.

For many years, Mexican companies have reliably produced various products for global markets, and together with more recent investments in homegrown talent, have positioned Mexican manufacturing to take advantage of recent shifts in global supply chains and consumer markets.

Similarly, IPC has a long history with Mexican companies, providing standards and certification to a largely labor-based workforce. There are nearly 140 IPC member companies with facilities in Mexico.

As the electronics industry grew in Mexico, IPC recognized it must train and certify not only labor-intensive roles, but the more technical roles, such as inspection, design, and engineering. In early 2020, immediately prior to the global COVID pandemic, IPC personnel traveled to Mexico and met with numerous companies in our industry.

To read the rest of this article, which appeared in the Spring 2023 issue of *IPC Community*, [click here](#).

(Source: Lorena Villanueva, Director, IPC Mexico)

It's a Brave, New Workforce

The New Chapter

Feature Column by Hannah Nelson, TEXAS INSTRUMENTS

What qualities must employers possess to attract and retain some of the brightest talent in today's ever-changing workforce environment? How can companies reevaluate their hiring processes and offerings to meet those expectations? As the workforce evolves, I believe companies desperately need to change their traditional hiring strategies if they want to attract the next generation, which has different expectations and priorities when it comes to choosing the right career.



As I have closed out my college career and now enter the workforce, I can reflect on the expectations I had for my future employer and what made me choose my new career path. (I'm starting a new job as a validation engineer at Texas Instruments this month.) It is important that employers understand these priorities and adapt their hiring techniques accordingly.

Offer a Work-Life Balance

A priority for the next generation of skilled workers is a work-life balance. As employees, we spend 40+ hours of our week at work. We want to be treated like a valued employee. We are looking for flexible work schedules, possible options to work remotely, and balance between our personal and professional lives. Dolly Parton says, "Never get so busy making a living that you forget to make a life." That is exactly it: This new generation wants to "make a life." We want time to travel, see family, and relax when we can. When that work-life balance doesn't exist in a company, burnout rises and overall job satisfaction quickly declines. As the Harvard Business Review states, "88% of knowledge workers say that when searching for a new position, they will look for one that offers complete flexibility in their hours and location."¹

When choosing my first job, I researched and analyzed organizations that had a good reputation for work-life balance. I knew I would need a flexible work schedule in order to see my now long-distance family. To accom-

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Source: I-Connect007



moderate for a new work-life balance, employers should offer flexible work schedules that allow employees to balance their personal and professional lives.

Make it Meaningful, Not Just Busy

The next generation of workers values meaningful work, not just busy work. We yearn for the opportunity to truly make a difference in our work and contribute to meaningful causes. We want to know there is a sense of purpose that follows the work we are doing every day. As *Forbes* states, “Younger employees want to believe in the value of their work and their company’s purpose. They’re willing to work very hard to reach meaningful goals and contribute to meaningful achievements.”²

As I looked at potential companies, it was important to me that employees at the company liked their work and found it meaningful. Employers can promote this type of work environment by highlighting the company’s mission, values, and the testimonials their employees make about the work they do.

Remember the Value of Teamwork

The next generation values collaborative work environments. They seek out companies that prioritize organizational teamwork and open communication. Again from *Forbes*, “Studies have shown that this new generation of employee not only thrives in highly collaborative workplaces, but is now making this a key requirement in selecting where to work.”³ We seek workplaces that foster community and promote collaboration across departments. Employers can promote and encourage collaboration by creating a positive work culture that allows for teamwork and a healthy work-life balance.

Provide Avenues for Growth

Finally, we value lifelong learning as a way to invest in our own career development. This could take several forms, including more technical training, leadership training, pursuing outside interests, etc. This is a way to invest into the company we work for, stay up-to-date with current systems, and invest in our future careers.

Harvard Business Review states, “82% of employees and 62% of HR directors believe that workers will need to hone their current skills or acquire new ones at least once a year in order to maintain a competitive advantage in a global market.”¹ What’s a better way to attract talent than by helping them stay competitive in the ever-changing market?

I remember hearing in my senior design class that to stay competitive as an engineer we must always be learning. When looking for my first job, I asked about the opportunities companies offered to keep their employees competitive in today’s job market. Attracting top talent can be possible by offering opportunities for training and development, which allows us to learn skills and advance in our careers within the company.

Conclusion

Traditional notions of success in the workplace have been linked to financial stability, but the next generation of workers seeks careers

that offer work-life balance, personal growth, and purpose. To both draw in talent and allow us to thrive in our new roles, employers should be seeking opportunities for growth. Align to the evolving needs of the workforce and you’ll attract and retain the top talent you seek. You will become a driver for success in the dynamic landscape of the future. **PCB007**

References

1. “What Your Future Employees Want Most,” by Tim Minahan, May 31, 2021, *Harvard Business Review*.
2. “What Do New Generations Of Employees Want, And Can Your Business Adjust?” by Liz Kislik, Jan. 28, 2022, Forbes.com.
3. “Gen Y and the Collaborative Workplace,” by Bill Patterson, May 29, 2012, Forbes.com.



Hannah Nelson is a validation engineer at Texas Instruments and in her third year of IPC’s Emerging Engineer Program. She is a former IPC Student Board Member. To read past columns, [click here](#).

Quantum Sensing in Your Pocket: Using OLEDs to Image Magnetic Fields

Researchers from the ARC Centre of Excellence in Exciton Science at UNSW Sydney have demonstrated that OLEDs, a type of semiconductor material commonly found in flat-screen televisions, smartphone screens and other digital displays, can be used to map magnetic fields using magnetic resonance.

Sensing of magnetic fields has important applications in scientific research, industry and medicine. Published in the prestigious journal *Nature Communications*, this technique is able to function at microchip scale and does not require input from a laser.

The majority of existing quantum sensing and magnetic field imaging equipment is relatively large and expensive, requiring either optical pumping (from a

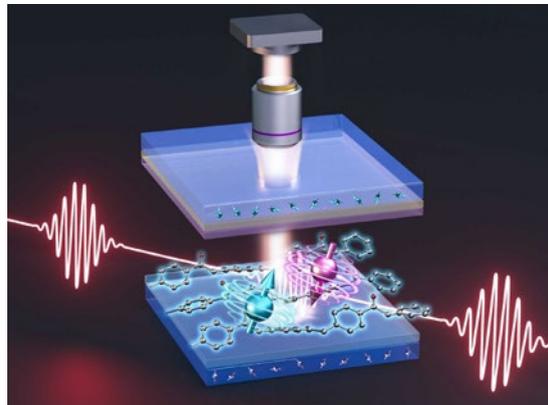
high-powered laser) or very low cryogenic temperatures. This limits the device integration potential and commercial scalability of such approaches.

By contrast, the OLED sensing device prototyped in this work would ultimately be small, flexible and mass-producible.

Professor Dane McCamey of UNSW, who is also an Exciton Science Chief Investigator, said, “Our device is designed to be compatible with commercially available OLED technologies, providing the unique ability to map magnetic field over a large area or even a curved surface.”

Professor McCamey said that a patent has been filed (Australian Patent Application 2022901738) with a view toward potential commercialisation of the technology.

(Source: Exciton Science)



Solutions for Better Etch Uniformity

The Chemical Connection

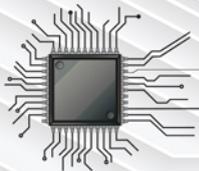
Feature Column by Christopher Bonsell, CHEMCUT

In my very first column, “[Etch Uniformity and The Puddle Problem](#),” I wrote about a phenomenon in the PCB etching process called the “puddle effect,” which causes large PCB panels to have varying etch quality across the board, typically on the top side. This variation exists because as you are spraying etchant onto the top of a panel, you begin to accumulate spent etchant. It creates a layer that inhibits the fresh etchant from reaching the board’s copper surface that needs to be etched.

With this problem, often the edges of panels will have the fastest etching while the middle has the slowest. This is because the flow of etchant as it accumulates onto the top of

the panel will run out to the sides and fall through. Hypothetically, if someone were trying to etch large PCBs or a sheet of multiple PCBs on a single stock panel, they could place through-holes around the panel. If holes could be created through the middle parts of the panel, to provide another area for the etchant to escape, then the puddle effect would be significantly reduced. Of course, in most cases, this is not realistic for PCB manufacturers. Since the solution is not so straightforward, manufacturers often must depend on wet processing technology that focuses on obtaining better etch uniformity. Here are some of today’s technologies to approach the puddle effect.





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- Chemical Milling
- Electroforming
- Glass Tooling

Optimized Spray

Optimized spray is not necessarily an anti-puddling measure on its own, however it is still a technology implemented inside etching machines to provide better uniformity. Optimized spray describes an attribute inside the main etch chamber. Functionally, it means that the spray tube pressures are calibrated and adjusted with the expectation that etching will vary across the panel. In practice, this means that spray tubes located over the edges of your panels must be adjusted to provide a less aggressive etch in comparison to the middle spray tubes. Optimized spray is highly important for all matters of etch uniformity. Without good baseline spraying, using any additional counter-puddling technology will just make the process more complicated and may even exacerbate variations.

Etch Adjust

Etch adjust is a process that can be used to counteract the puddle effect. This process focuses on side-to-side uniformity of panels. Side-to-side uniformity refers to the edges of a panel that are parallel to the conveyor side rails. Etch adjust functions in a similar way to optimized spray in that it allows you to make spray zones and provide them with a spray pressure that would reduce any variation caused by the puddle effect. The etch adjust module differs because it's a unit of operation separate from the main etching chamber. It can target more refined spray zones and thus give you greater control over the side-to-side variations. This type of process can be useful if you copper plate your own panels. Depending on how your plating process operates, the stock material for your PCBs can have thicker copper on one end. With etch adjust, you can more easily compensate for this variation than you could with optimized spray alone.

Intermittent Spray

Intermittent spray is a counter-puddling measure that you can take if you want to

improve the etch uniformity of your PCBs from the leading-to-trailing edges. This refers to the edge perpendicular to the direction of travel. The leading edge enters the horizontal etching machine first, while the trailing edge enters last. Variation on this part of the panel is the most difficult to control because of how the panel gets pulled through the etching machine. When you adjust for side-to-side variations, the solution mostly likely is having higher spray pressures in the middle than on the edges. These can continuously spray and target the areas you want to change.

With leading-to-trailing uniformity, you cannot simply have a continuous spray and improve uniformity (at least not with today's technology). To achieve leading-to-trailing uniformity, etching must start and stop only in the middle; this is effectively what intermittent spray does. To improve leading-to-trailing uniformity, intermittent spray uses a sensor to indicate where the first edge of a panel is located in an etching machine. Once the panel is partially through the module, intermittent spray initiates and targets a spray of etchant only in the middle of the panel, shutting off before reaching the trailing edge. By doing this, you gain greater control over the middle sections that tend to be under-etched.

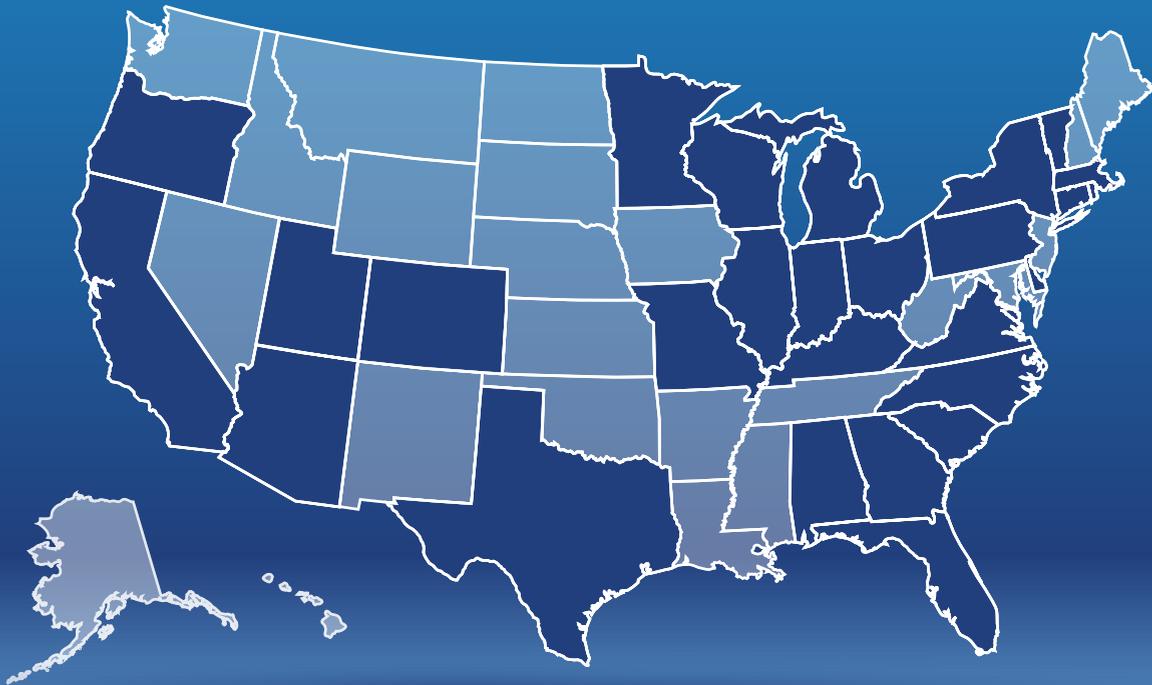
Conclusion

There are many different tools available to approach etch uniformity. The few that were shared in this column only touch on a handful of options that are available to you. With this information, you should now be aware of some of the etch uniformity technology that exists today and what exactly each option does. **PCB007**



This is the final column for **Christopher Bonsell**, who has left Chemcut for a new position with Tecomet. This column will continue under a different writer from Chemcut. To read past columns, [click here](#).

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What Are Hiring Managers Looking For?

Feature Interview by Andy Shaughnessy

I-CONNECT007

Paul Farquhar recently took a few PCB design classes from John Watson, who doubles as a Palomar College professor when he's not working at Altium. John teaches classes on basic and advanced PCB design, and he works to help students land jobs afterward.

I asked Paul to discuss what he learned in John's classes, as well as where he hopes to work afterward and how John and the college are working with industry to provide trained designers for the many open PCB designer positions.

Paul, tell us a little about your background. What made you decide to be a PCB designer?

I was in the Navy for 20 years, most of that time working as an electronics technician. As part of my job I was taught how to replace missing or broken components and/or traces on damaged circuit cards. I think that is when I first became interested in how PCBs work. Since I left the Navy, I have continued to work in the electron-

ics industry, mostly on electronic and mechanical assemblies for various Navy contracts. At my current position, the product I build seems to be updated every couple of years due to obsolete parts or assemblies. When this happens, all the electronics, including

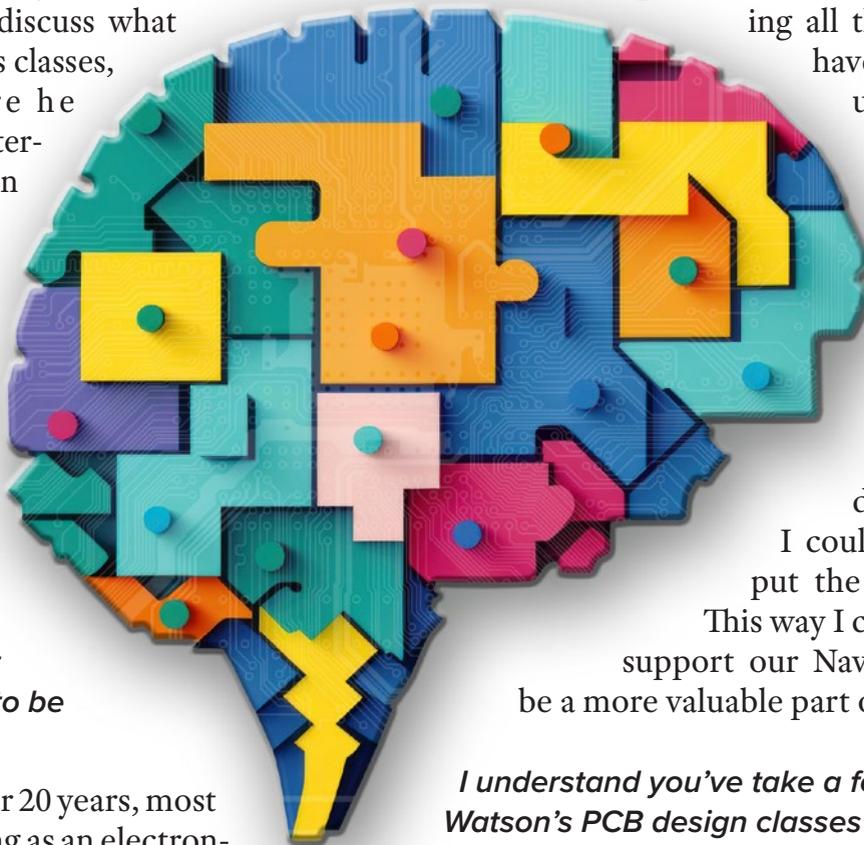
all the circuit cards, have to be changed/updated. I do not have an EE degree, but I thought that if I could learn how to design the circuit cards then the EEs could do the design work and

I could take over and put the PCBs together.

This way I could continue to support our Navy customer and be a more valuable part of the team.

I understand you've take a few of John Watson's PCB design classes at Palomar College. Tell us about the classes and some of the skills you're learning.

The classes I have taken at Palomar College are DT-226 and 227, Printed Circuit Board Design I and II. Through each 16-week class you learn how to design a PCB from the ground up using



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Altium Designer. We started off with learning how to do a schematic diagram and on to the importance of maintaining the library. We learned about board stacks and the materials that go into making the layers of a PCB. We learned how to place the components and wire them up. Lastly, we learned how to have the reference designators/silkscreen on the board. In the final weeks we learned how to put multiple boards together to form a system and wiring harnesses. We learned so much over those 32 weeks—this just scratches the surface.

John has been in the PCB design industry for years, so he knows first-hand what it takes to get hired. At this point, what are some of the skills that hiring managers are looking for in a PCB designer?

From what John has told us, there is a looming shortage of PCB designers in the field and companies are looking for people who want to join the industry. Some companies would be willing to teach people how to be designers from the beginning. However, you at least need basic computer skills and knowledge of PCBs so you can understand what you will be doing. Some soft skills, like problem-solving and being able to see the end-result as you are starting the process of making the PCB, also come in handy. I tell people that to be good at PCB design you have to like solving puzzles so that you can problem solve when you run into issues. Also, if you play chess and you can see multiple moves ahead, this is really valuable; you can imagine the completed board as you are putting components on the PCB.

What segment of the industry would you like to work in? Medical, aerospace, automotive, industrial controls, etc.?

I am currently working for a company that supports the military and I would like to continue to



Paul Farquhar

support the Navy. But if other opportunities present themselves, I would be open to other fields such as medical or aerospace.

Palomar College is known for helping grads obtain jobs in their respective career paths. What assistance do they offer in finding a job?

Palomar College has a job assistance program. I am not sure exactly what they offer because I have not used them, but John tells us that he gets a lot of emails and contacts from companies looking for good PCB designers. When we got into the advanced class, John started sharing some of those job opportunities with us. He has offered to write a letter of recommendation for us when we apply for jobs. John is also working to start a paid internship program for PCB designers at Palomar College, with the college paying up to 50% of the salary for the internship. John is actively looking for companies that would be willing to sign on to have PCB students work at the company under the paid internship.

What advice would you give other new PCB designers?

Don't stop learning. Don't stop reading. Take classes. There are a lot of free resources out there from various PCB design companies and organizations. Sign up and watch the videos. Check to see if your local community college offers PCB design classes. And look into classes offered by the Printed Circuit Engineering Association (PCEA), Nine Dot Connects, or any other PCB design organization.

Also, don't be afraid to ask questions. If you are not sure of something, stop and ask. It is better to ask questions from the beginning of the process than to get almost done with the project and have to restart because you didn't ask.

Thanks for your input, Paul. Good luck!

Thanks, Andy. Nice speaking with you. PCB007

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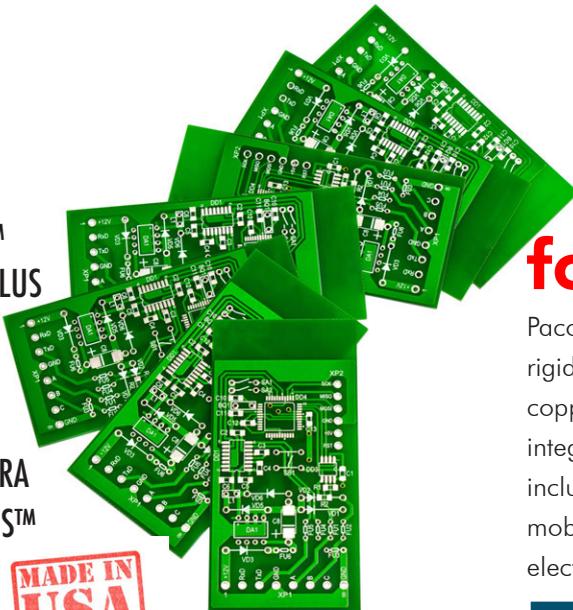
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Joseph LaRosa: 'I've Never Been Interviewed Before'



Feature Interview by Barry Matties

I-CONNECT007

Meet Joseph LaRosa, a young application engineer at OMRON who is passionate about robotics and automation. I recently interviewed Joseph (his first one) about his choice to work in the electronics industry and his advice for others looking for a career path. I really admire Joseph's ambitious nature and drive to be the best at what he does. If you're going to do it, you might as well be the best at it, he says.

Let's start with your position at OMRON.

I am an application engineer trainee, and I focus on robotics. In the future, I will be working with account managers and customers in both pre- and post-sale. My job is to help them

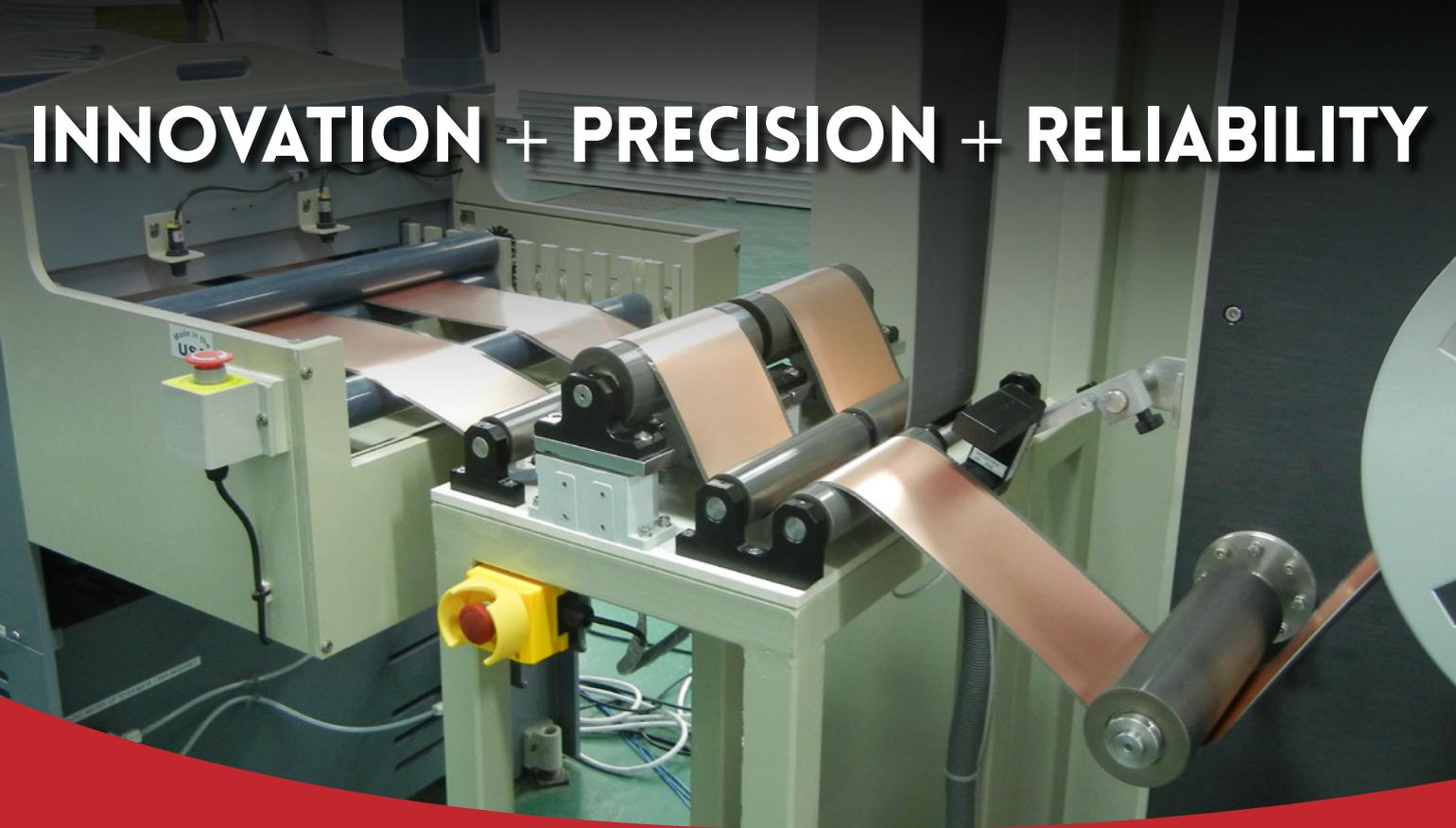
learn that robotics is feasible and how this technology works with their application.

I'm curious—why did you choose a career with OMRON?

I always wanted to be involved with industrial automation. Right out of school I got a job as a technician at Novo Nordisk. They package insulin pens and I was a line tech. The vision systems used at Novo Nordisk were from OMRON. The system would inspect the pens and find problems with labels—maybe they were crooked, too high, too low, or it wasn't positioned correctly.

Initially, I thought OMRON was only about vision systems. While pursuing new opportu-

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nities in engineering, I went to LinkedIn and found OMRON. They have everything—robotics, vision, motion, safety, industrial automation, and more. As a young engineer, I thought, “Okay, that’s perfect. I can learn everything.” I had an interview with Carrie Lee (who’s now my manager), and then an interview with the vice president of sales. Those were great conversations. I knew it would be a great place to work, and it has been. All the engineers said that it’s a great place to be. I believed them. It’s been almost a year now and it’s true.

Obviously, the electronics industry is going through a transformation into more robotics, and this is an exciting time. It’s a good time for you to be launching your career in this area. Are you seeing a lot of interest in robotics?

For sure. A robot can replace repetitive tasks with accuracy and repeatability; that’s really where they shine.

What advice do you give a customer who wants to bring more robotics into their factory?

When you hear robotics, you might think there are a lot of crazy equations to figure out, like, “How would that motion work?” But it’s not as tough as you might think. There is a learning curve, of course, but in my experience, it’s not terribly hard to pick up.

Tell us about the path that led you here to this industry, and what advice would you have for a young person looking to start a career path?

It’s always been my goal to be in industrial automation. I’ve always liked robotics. I am pretty blessed, and I got lucky with how things turned out for me. Something big that gets in people’s way, especially young people, is the imposter syndrome. You hear that a lot. You don’t think you know enough to actually be in that career field. But I can tell you firsthand that you don’t have to be a genius to get into industrial automation because you’ll realize that whatever you need to know you learn on the job. You’ll never know exactly what you need to

know when you first begin. A lot of people just get scared.

How important is the company that you choose to work for? It sounds like OMRON is supportive, giving you a lot of advice, mentors, and training.

I would say it’s definitely important.

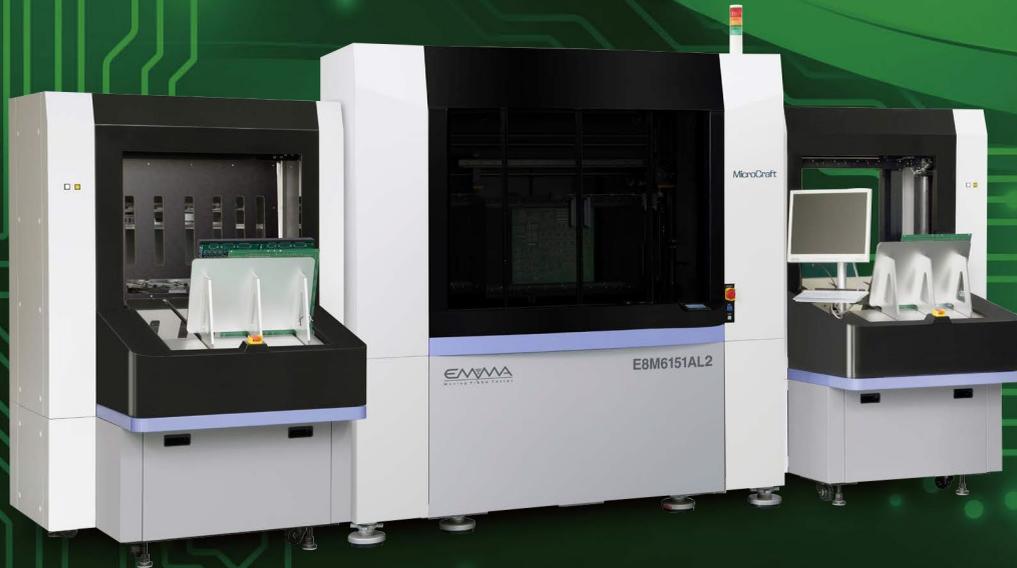
I can’t speak about other companies, but at OMRON, they assigned a mentor to me and he’s a great guy. I keep in touch, and he still helps me out when I need it. The training program here is great. I want to learn and be as good as him.

In your first year, what has been the greatest challenge for you?

There’s just so much. I have it in my head that I always want to be number one, I want to be the best at what I do. I understand that I’m new and I’m not there yet. But just learning everything has been the challenge. I don’t like not knowing how to do something, especially when it pertains to my career. There’s just so much to know, which I’m sure is true for any job.

“ A robot can replace repetitive tasks with accuracy and repeatability; that’s really where they shine. ”

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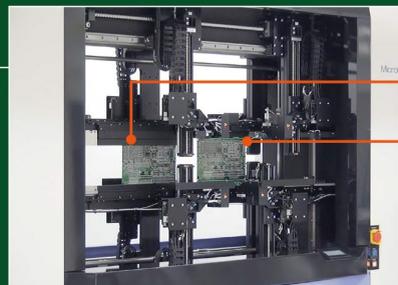
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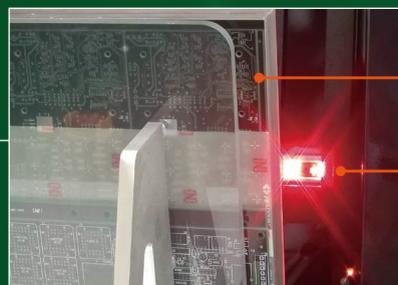


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Joseph LaRosa

Absolutely. Now, what's your educational background and did you know you wanted to be in automation or robotics?

I went to Old Dominion University where I got my bachelor's in mechanical engineering technologies. I wanted to be in something really industrial. I grew up watching "How It's Made." I just love that kind of stuff. I watch YouTube videos and processes. You know, it's kind of cheesy, but I love it. If I put something together, those puzzle pieces work perfectly to create what I want to create. I just like that feeling. It's very rewarding.

Fast forward 10 or 15 years and tell me what you see in your future career?

I want to be at OMRON for years to come. I'm still young in my career and I can't say I want to

be anywhere but the lead engineer of the entire company. You gotta shoot as high as possible. Always.

That's ambitious.

Yeah, of course. But if you ask someone in the NFL, "So, do you think you'll win the Super Bowl this year?" Of course, they always say yes. But if they were to say no, then you can guarantee they won't win that year. You've got to aim high.

What final thoughts do you have to share?

At OMRON's technology kickoff, we had a guest speaker, Dr. Philip Voglewede, a professor of mechanical engineering at Marquette University. He said that in your work, you will fail a lot. That's pretty important to remember—things might blow up in your face before you finally have a successful product.

You will learn from those mistakes, for sure.

Exactly. I've made mistakes that I'll hopefully not make again, because I have actually experienced that failure.

Right, that's the point. We can learn more from our mistakes than we do our successes, as it turns out. Joe, I appreciate your time.

This is a really awesome experience. I've never been interviewed before, so this is really cool. I appreciate it. **PCB007**



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Teaching Coding to Kids: The UK's **Micro:bit** Tool

Happy's Tech Talk #20

by Happy Holden, I-CONNECT007

I recently learned about the micro:bit programming tool, and an important initiative in the UK to teach coding to young students. It made such an impression on me that I purchased the training set, went through the tutorial and plan to send it to my 10-year-old grandson. He told me he's already eager to start.

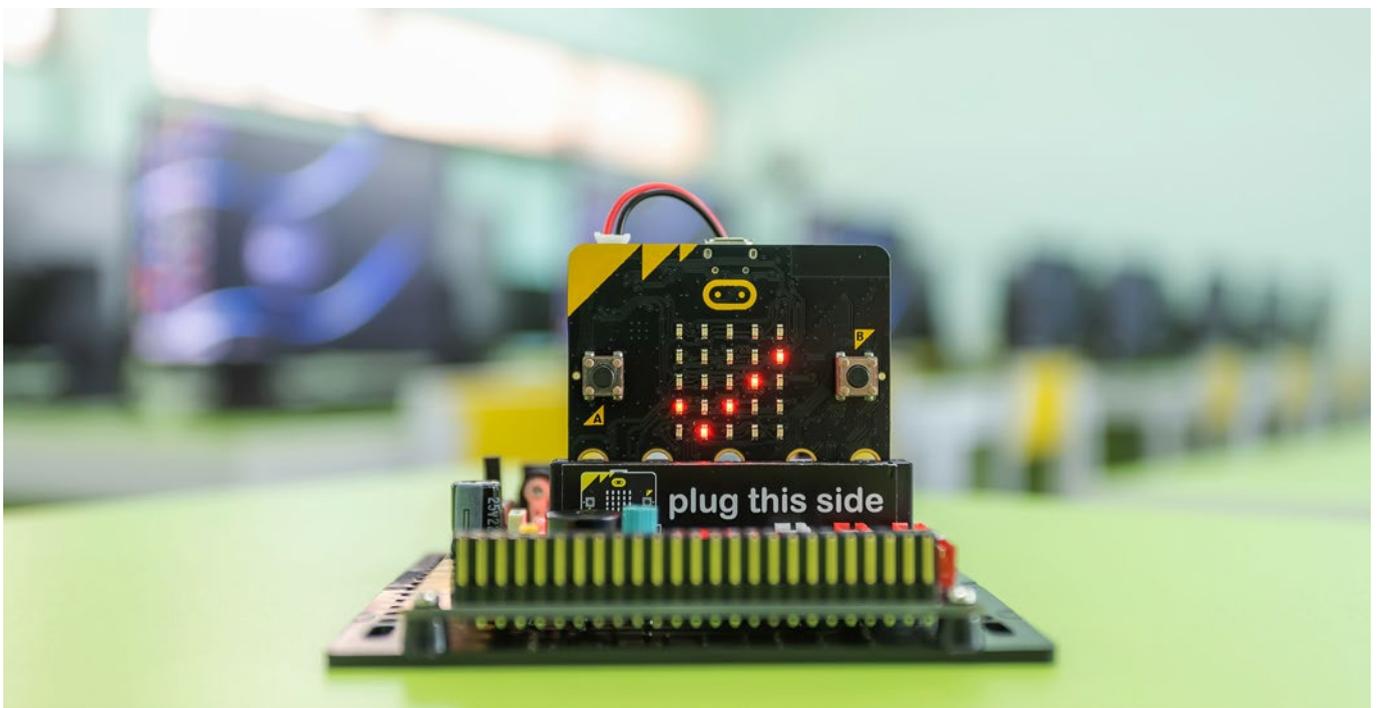
First, I showed it to my son and asked him to start learning to use it so he can help his son if he has any questions. It's about \$18 to get the complete system, so it's not too expensive and I hope to see it spread more widely in the United States.

The micro:bit tool is exceptionally well-designed to appeal to students and allow them to create items they want without the need to

purchase any other items. With Bluetooth and wireless radio built in, it offers network-building from a battery-powered device that could also be a piece of jewelry. But how did this get started?

A New Initiative

In 2015, the BBC launched the Make It Digital initiative¹, aiming to inspire a new era of creativity using programming and digital technology. Simultaneously, the initiative would support the UK's mandate to teach computer science concepts at all grade levels. The BBC micro:bit evolved from that initiative. It is a small programmable and embeddable computer that is designed, developed, and deployed



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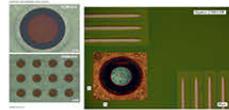
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BGA Missing Legend Soldermask breakage Pinhole Defect Under SM Soldermask Peeling

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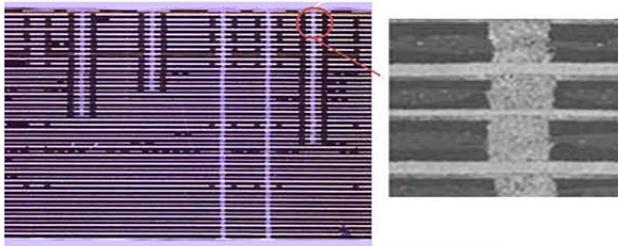
APOLLON A11
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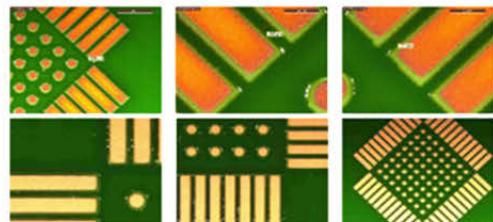
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by the BBC and 29 project partners. It will go to approximately 700,000 middle (Grade 7) school students this year. This invention refers back to the BBC Micro Computer². The BBC described micro:bit as its “most ambitious education initiative in 30 years, with an ambition to inspire digital creativity and develop a new generation of tech pioneers.”³

Continuing a constructionist approach to computing education with simple hands-on tools, the BBC micro:bit has moved from a local educational experiment in the UK to a global effort driven by the Micro:bit Educational Foundation (MEF), a nonprofit organization established in September 2016. To date, there are over 39 million micro:bits in over 60 countries with many hardware, content, and education partners participation. MEF’s goal is, “Education with the micro:bit is about kids inventing things and expressing themselves,

with technology as a tool,” and “Inspiring every child to create their best digital future.”

Past Columns

This is not my first column about technology toys for kids. In August 2006, I wrote a column for *CircuitTree Magazine* titled, “If You Want Smarter Kids, Buy Them Smarter Toys.”⁴ Figure 1 shows the four robotic constructions you could buy to construct a robotic vehicle in addition to the LEGO MINDSTORMS. The Australian “VIPER” was extremely interesting as all the various robotic parts were plated-through PCBs with edge through-holes turned into castellations that permitted them to be electrically connected as well as mechanical.

A Strong Micro:bit History

The BBC has focused on early programming literacy since 1978. Continuous research led

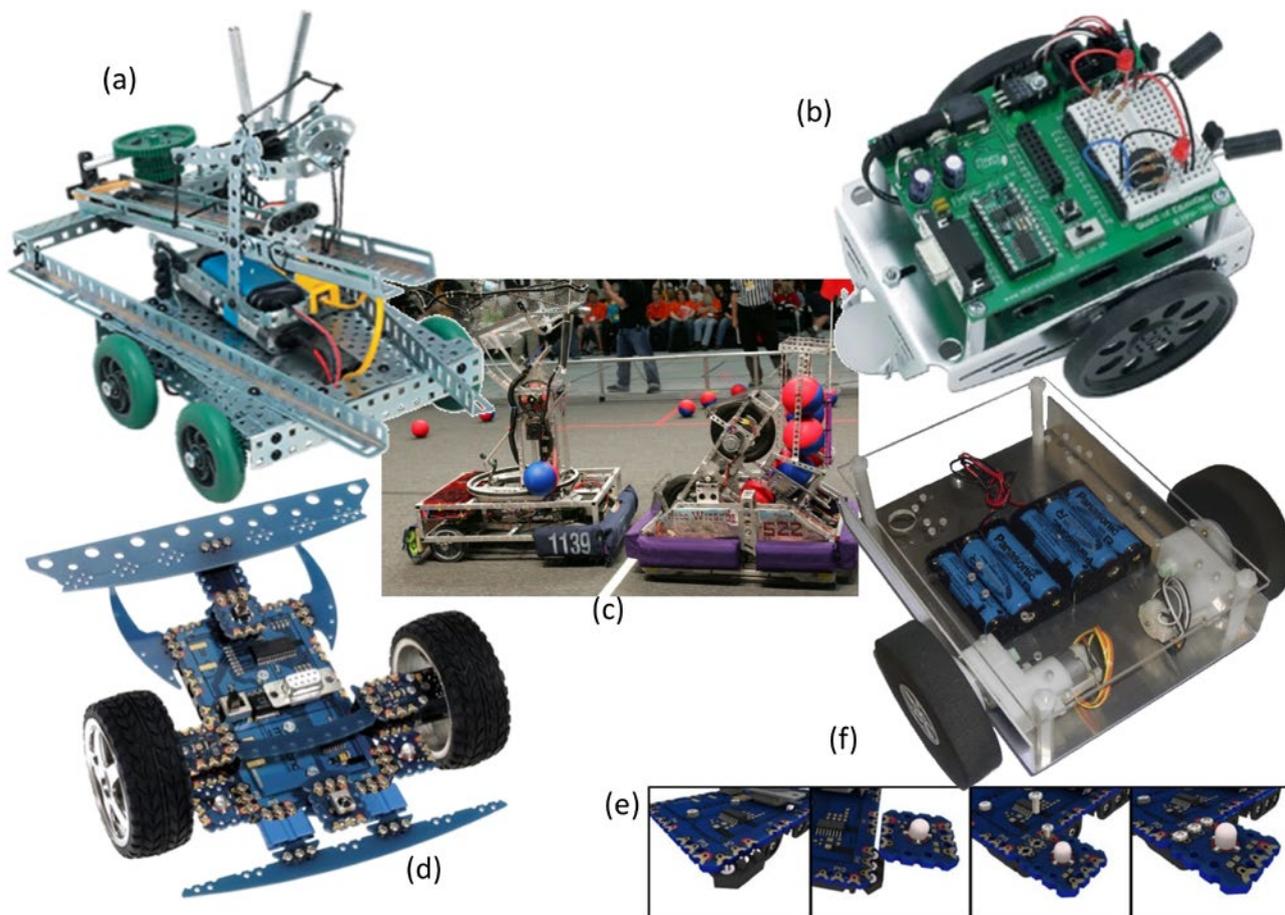


Figure 1: a) Radio-Shack’s Vex; b) Parallax’s Boe-Bot; c) FIRST Robotic competitions; d/e) VIPER from Australia uses PCB boards as elements; f) Oregon State University’s TekBot.

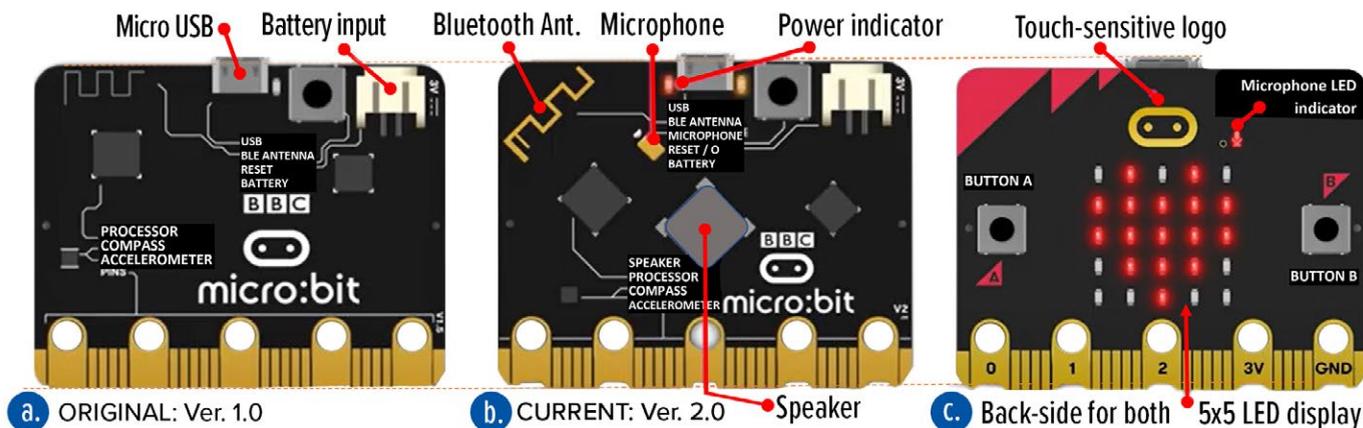


Figure 2: Version 1 is USB- or battery-powered and filled with sensors: a) The original device; b) Another version with more capabilities; c) Both versions have the buttons and the 5x5 LED display on the back.

the UK to embrace computer coding as early as Grade 7. Thus, the BBC helped form the MEF with other interested technologists and educators. They determined that just robotic programs and Maker electronics like the Arduino and the Raspberry Pi occurred too late in a student's learning and excluded too many students who weren't ready for hands-on construction projects.

The MEF mission is to enable and inspire all children to participate in the digital world, with particular focus on girls and those from disadvantaged group, make the micro:bit an easy and effective learning tools, collaborate

with educators to create exceptional curriculum, and build and support communities of educators and partners to remove barriers to learning digital skills.

Hardware

The micro:bit is only 51.6x42.0 mm (2.0"x1.7") and powered by two AA batteries. It uses two current ARM 32-bit Cortex microcontrollers with FPU and memory and Bluetooth wireless radio (Figure 2).

The hardware functional diagram is seen in Figure 3.

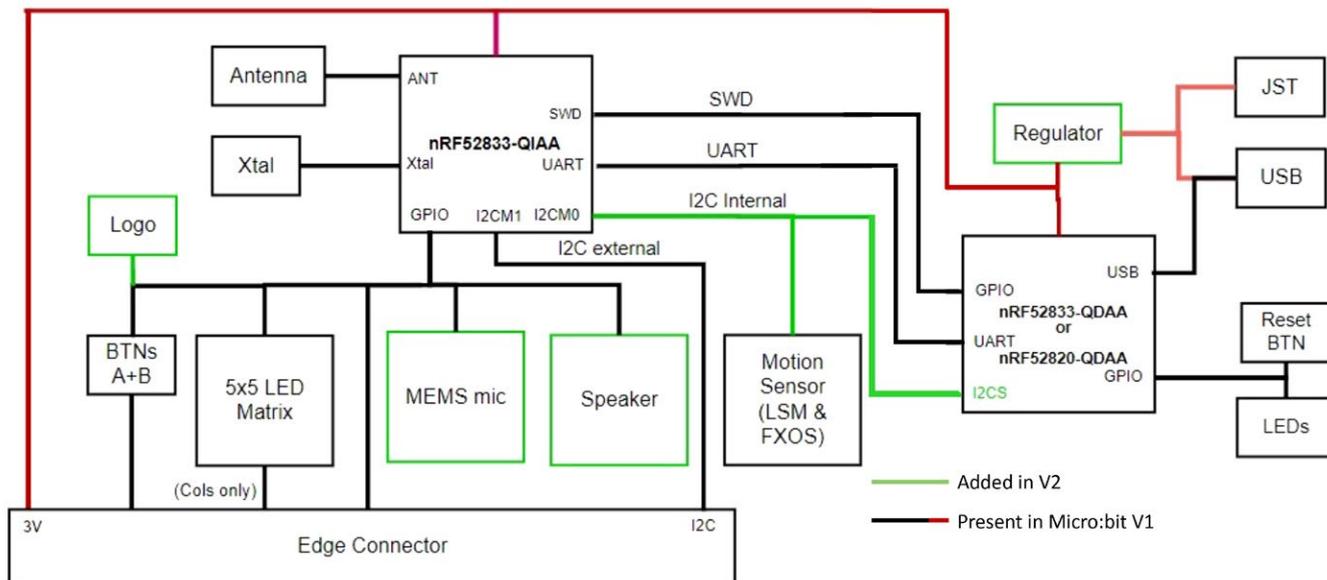


Figure 3: Micro:bit hardware diagram, Version 2⁵.

Programming

For a middle school student (Grade 7), learning to code may be a challenge. Fortunately, the BBC and the MEF spent years experimenting and researching the best way to engage young students. With the help of Microsoft, they created the programming learning tool—MakeCode (Figure 4).

Software

Software and coding is where the micro:bit really shines. Four coding languages are provided with debugging, editors, and simulation tools:

- Microsoft’s graphics language, MakeCode (Blocks), for beginners
- MIT’s Scratch
- MicroPython for high schoolers
- JavaScript for advanced students

These additional software editors/tools are provided:

- Mu: A Python editor
- Espruino: A JavaScript interpreter

- EduBlocks: A block editor for MicroPython

Other programming languages that are supported for continued use into college and industry including Free Pascal, Simulink in MATLAB, C++, Forth, Lisp, Rust, Ada, Swift, BASIC, and Zephyr.

Student Examples

The technical paper, “The BBC micro:bit—from the UK to the world,”² discussed some of the seven examples of student projects grouped into four broad classifications:

- Wearables and interactive play
- Digital crafting
- Science and measurements
- Interconnected devices

Fabrication Processes

Unlike other hardware projects, the open nature of the micro:bit includes source code, the PCB design files (Altium and EAGLE Gerber files), suggestions for future revisions,

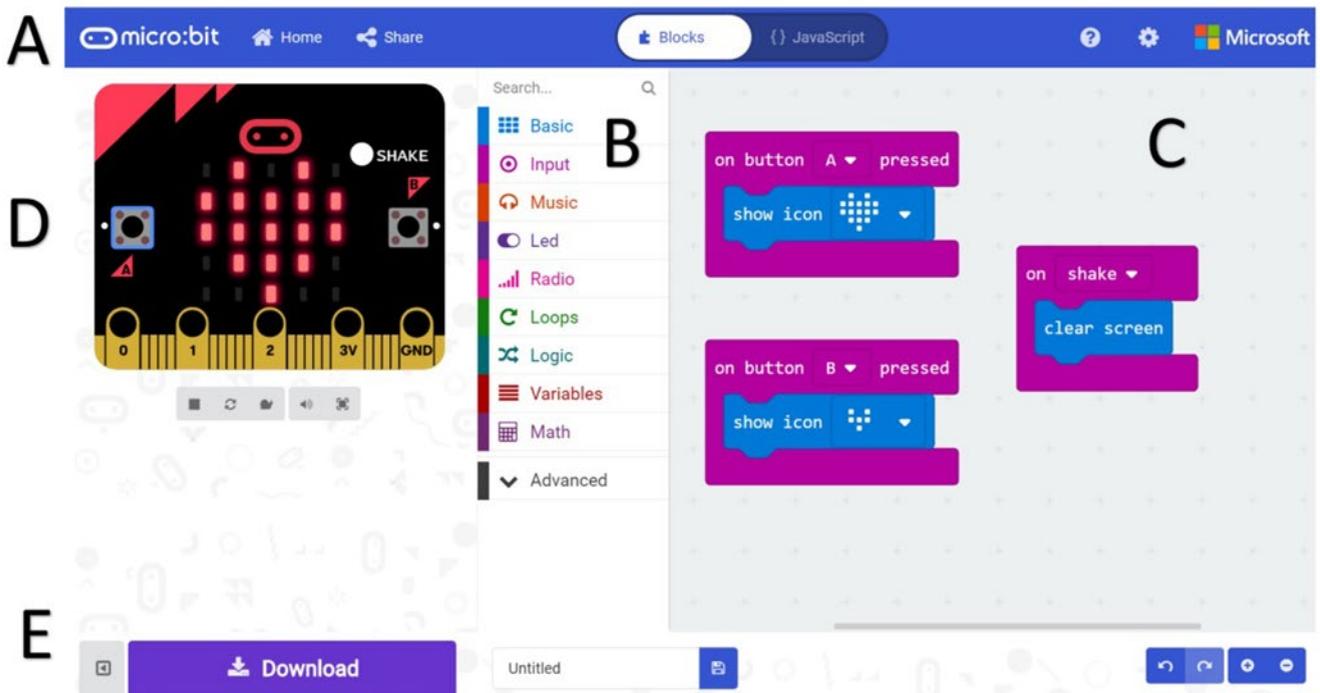


Figure 4: The Microsoft MakeCode web application for the micro:bit unit.

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Figure 5: Example projects: a) the reaction game; b) light-reactive cardboard robots; c) a Bloodhound model rocket car instrumented with a micro:bit; d) measuring soil moisture via micro:bit pins².

and all the drawings and mechanics. The MEF truly wants your help in making this a better, less costly, and more inspiring tool for engaging students. **PCB007**

References

1. The BBC Make It Digital Initiative.
2. "The BBC micro:bit—From the UK to the World," by Jonny Austin, Howard Baker Thomas Ball, et al, 2018.
3. "The Legacy of the BBC Micro Effecting Change in the UK's Cultures of Computing," by Tilly Blyth, May 2012.

4. "If You Want Smarter Kids, Buy Them Smarter Toys," by Happy Holden, *CircuiTree Magazine*, August 2006.

5. Micro:bit Technical information available at tech.microbit.org.

To Learn More

The BBC micro:bit hardware and software assets are open source. Learn more here:

- [Github.com](https://github.com)
- [Microbit.org](https://microbit.org)
- [Microbit.org/resellers](https://microbit.org/resellers)



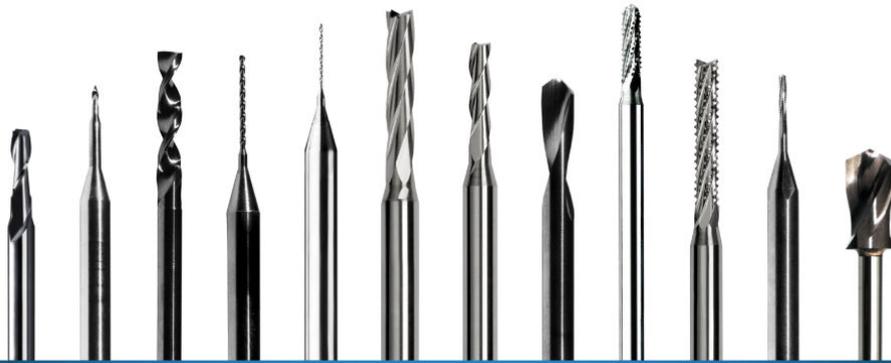
Happy Holden has worked in printed circuit technology since 1970 with Hewlett-Packard, NanYa Westwood, Merix, Foxconn, and Gentex. He is currently a contributing technical editor with I-Connect007, and the author of *Automation and Advanced Procedures in PCB Fabrication*, and *24 Essential Skills for Engineers*. To read past columns or contact Holden, [click here](#).



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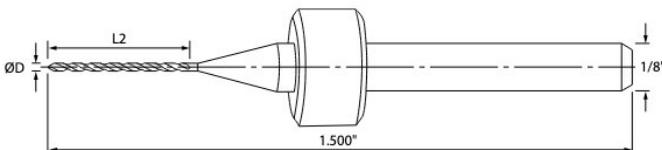


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4 Facet Point Geometry

REPOINTING will be a new service offered by Insulectro through Kyocera. The company has recently invested in automated, state-of-the-art equipment and all repointing will be done in Southern California.



MilAero007 Highlights



American Made Advocacy: Taking the Fight to Capitol Hill ▶

Two decades ago, the United States had more than 2,000 companies designing and manufacturing printed circuit boards to satisfy 30% of the global demand. Today that number is less than 150 companies, representing only 4% of PCB production.

Carol Handwerker Appointed to NIST Advisory Committee ▶

We often hear words and phrases that naturally go together: Salt and pepper, touch and go, trace and space. When it comes to the work of IPC member Carol Handwerker, however, the collocations are much more nuanced, deeper, and have greater significance. You're more likely to think of phrases such as standards and technology, lead-free and solder, or advanced packaging and heterogeneous integration.

[Men•tor]: A Wise and Trusted Guide ▶

Christina Trussell of Blue Origin was new to her career and eager to learn. Garry McGuire of NASA Marshall Space Flight Center was an established contributor to dozens of IPC standards. After they met at an IPC APEX EXPO Newcomers' Reception, the two built a strong mentor/mentee relationship.

NASA's New Detectors Could Improve Views of Gamma-Ray Events ▶

Using technology similar to that found in smartphone cameras, NASA scientists are developing upgraded sensors to reveal more details about black hole outbursts and exploding stars—all while being less power hungry and easier to mass produce than detectors used today.

Teledyne FLIR Defense Delivers 1,000th MTRS Inc II (Centaur) Robot to U.S. Army ▶

Produced at the FLIR Defense facility in Elkridge, Maryland, the MTRS Inc II ground robot (also known as Centaur) is used by Explosive Ordnance Disposal (EOD) teams to disable improvised explosive devices, landmines, and unexploded ordnance and to perform similar dangerous tasks.

Developing Trustworthy AI to Inform Decisions When Every Moment Counts ▶

DARPA has selected performers for the In the Moment (ITM) program to create the foundation for trusted algorithmic decision-making in challenging domains, such as medical triage. ITM has two phases that address decision-making at different degrees of complexity. The first phase will look at triage for small military units in austere environments, and the second phase will scale up the complexity of decision-making by looking at triage for mass casualty events.

Raytheon Gives Airlines New Insights Into System Health with Connected Galley Inserts ▶

Collins Aerospace, a Raytheon Technologies business, is introducing a cost-effective wireless connectivity solution for airplane galley inserts (the appliances used to prepare inflight food and beverage), providing operational efficiencies and cost savings for airlines while also supporting improved passenger service.

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The Revival of Domestic PCB Fabrication

Material Insight

by Preeya Kuray, AGC MULTI MATERIAL AMERICA

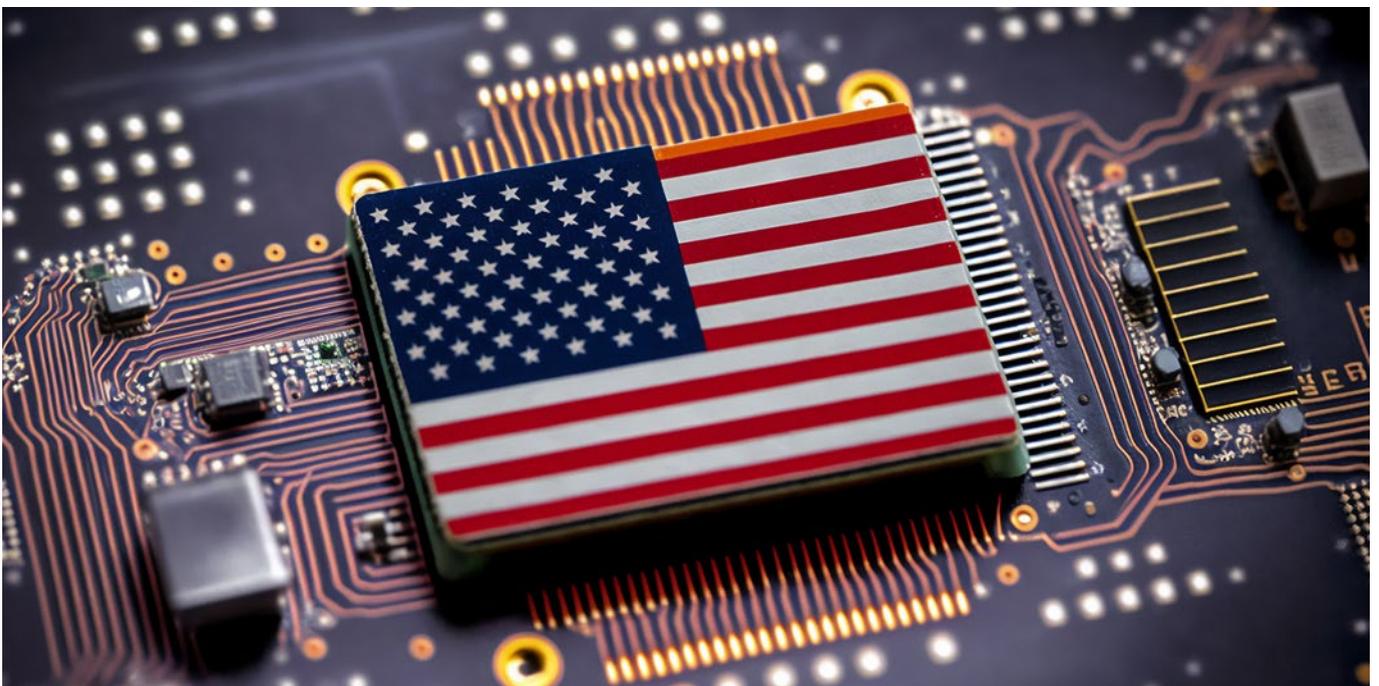
Harken back to the start of the millennium, which rung in several historically defining events: Ramifications of Y2K were dispelled (to global relief), George Bush defeated Al Gore in the 54th U.S. presidential election, and AOL combined with Time Warner in a \$165 billion merger, signaling the convergence of old and new media. This significant moment in history also marked the onset of decay for PCB fabrication in America.

Just a few decades prior, the United States had been dominating the electronics industry. Innovation and manufacturing were done symbiotically on home soil; improvements of one led to reform of the other. Advancements, such as surface mount technology (SMT), were developed in the late 1980s, which not only improved integrated circuit board perfor-

mance, but significantly reduced manufacturing costs by allowing for automation of assembly processes.

The advent of EDA software allowed for designs to be saved as computer files and input directly into manufacturing machinery to produce PCBs (instead of relying on photographs). Finally, the arrival of ball-grid array technology in the 1990s enabled higher board complexity and densification. Manufacturing reached new heights. This synergy between research and manufacturing (coupled with the growing demand for consumer electronics) allowed the U.S. PCB industry to reach its apex by the late 1990s, where it was valued at \$11 billion (30% of the global share) with over 2,000 operating board shops.

By the start of the millennium, however,



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PCB fabrication plants in the U.S. started closing. OEMs began offshoring manufacturing to reduce operating costs. Today, U.S. PCB manufacturing is valued at \$3 billion (3% of the global share) while board shops have dwindled to less than 200.

What happened in the past three decades? How did the United States lose its manufacturing prowess? What are the impending ramifications for R&D and innovation?

To answer these questions, consider that in the beginning of PCB manufacturing in America, OEMs owned their fabrication facilities. However, by the mid-1990s, OEMs were being pushed to maximize profit margins and restructure company finances. The most promising fiscal gain came from offshore manufacturing, where labor costs were orders of magnitude cheaper.

“There were some companies that did not want to do this,” says Brian Sinclair, technical marketing analyst at AGC Multi Material America. “Higher tier technology companies like HP, IBM, and Motorola spent decades becoming powerhouses by investing in cutting edge manufacturing technologies, processes, and methods. A significant portion of their money was spent on R&D to keep these processes state-of-the-art.”

And rightfully so. Technological improvement often led to major changes in the manufacturing process. When through-hole design was being phased out in favor of SMD, the manufacturing process was changed accordingly: Soldering pins were now replaced with thermal adhesives that bound SMDs to the PCB surface. When manufacturing is offshored, advances in production become severed from R&D. As a result, long-term innovation stag-

nates as state-of-the-art manufacturing processes are no longer developed on home soil.

“Unfortunately, the fiscal gains attained from outsourcing were tremendous,” Sinclair continues. “At this point in time, western OEMs were achieving record-setting financial results thanks to the low wages, the endless supply of workforce, lack of environmental regulations, and the duty-free taxation that came from offshoring to places like China.”

What led to China’s shift to manufacturing dominance? Former Chinese president Deng Xiaoping ordered a series of economic reforms in the late 1970s that opened the doors of a free market to China for the first time.

This reform also created designated zones dedicated solely to manufacturing.

Today, several of those zones have evolved into entire cities devoted to manufacturing, sustained by decades of cultivating production know-how and expertise. Shenzhen, for example, is a zone-turned-city that produces 90% of the world’s electronics.

Unsurprisingly, from the manufacturing advancements made over the last four decades (as well as the fact that most raw materials are imported domestically), China dominates global PCB production, currently controlling 30% of the market share (\$37 billion). With the steady permeation of AI into consumer electronics and modern society, the demand for PCBs with higher complexity, finer pitches, and new materials will be higher than ever before. This will inevitably call for more advanced equipment, production lines, and manufacturing processes. The message is clear: Investment in advanced manufacturing is a necessity for long-term growth of the domestic PCB industry.

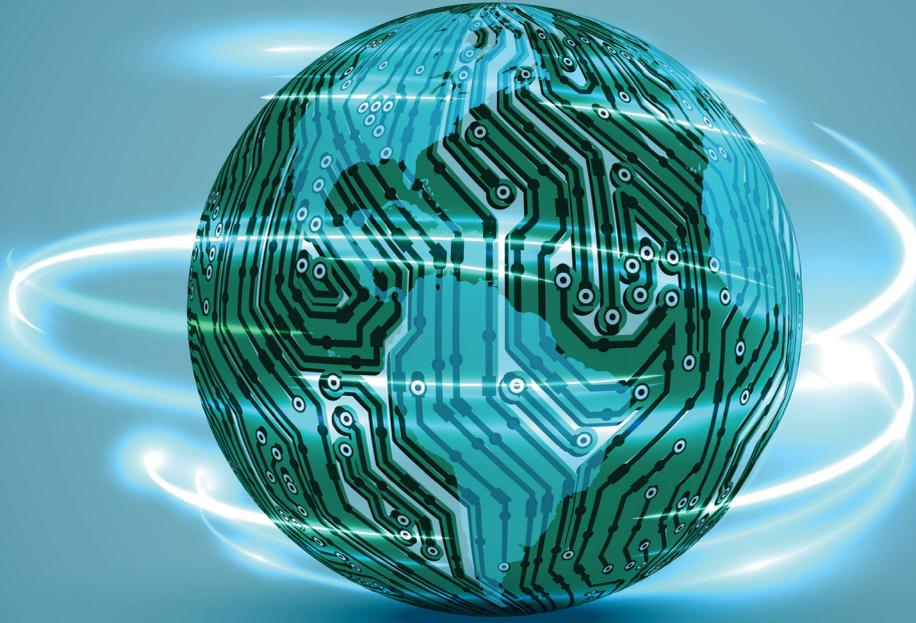
Where does that leave us now? Is funding domestic manufacturing the key to reclaim-



“Technological improvement often led to major changes in the manufacturing process.”



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ing the industry market share? How will this impact R&D and innovation?

The answer is complicated, but the tides are turning. With the passing of the Defense Production Act in March 2023, President Biden announced \$50 million in investment toward domestic PCB manufacturing. On May 11, 2023, Congress reintroduced the Protecting Circuit Boards and Substrates Act of 2023, which would allocate \$3 billion to domestic PCB manufacturing and provide 25% tax credit for purchases of American-made PCBs and substrates. Public awareness is also slowly changing. On social media, PCBs are getting the attention they deserve from trending hashtags like #chipsdontfloat. Finally, there are pathways that manufacturing plants can take now to offset operating costs and improve capabilities, such as taking advantage of R&D tax credits that may help fund advanced fabrication equipment.

Reinvesting in manufacturing may be a necessary component for the growth and prosperity of the domestic PCB industry. It will require continued dialogue and communication between industry and government. It will require training the new generation to carry on production knowledge and know-how. The solution is not straightforward; but from this vantage point, the future looks promising. **PCB007**

Resources

1. "The History of High Density Interconnect," by Amit Bahl, Sierra Circuits, Sept. 30, 2015.
2. "The Changing World of PCBs," NCAB Group, Nov. 23, 2020.
3. "The Development of China's PCB Manufacturing Industry in the World," NextPCB, April 21, 2021.
4. "What Will the PCB Act Mean to Electronics Manufacturers?" by Terri Enborg, PRIDE Industries, May 24, 2022.
5. "The History and Evolution of Printed Circuit Board (PCB) Designs." By G. Ken, EDN, April 18, 2022.
6. "The Exodus of Chinese Manufacturing: Shutting down 'The World's Factory,'" by Prince Ghosh, forbes.com, Sept. 18, 2020.

7. "A History of the Printed Circuit Board (PCB)." 911EDA.

8. "Comparing PCB Industry in China and the United States, How Small and Medium-Sized Enterprises Can Do Better, by Kerstin," PCBA Manufacturers, Sept. 27, 2022.

9. "Legislation Introduced to Restore America's Printed Circuit Board Industry after Two Decades of Decline," Yahoo! Finance, May 11, 2023.

10. "PCB History and Development Trends—Moko Technology," by Will Li, MOKO TECHNOLOGY: Your Trusted Electronic Manufacturing Services Partner, Nov. 11, 2021.

11. "Circuit Board Manufacturing: USA vs. Asia," by Isaac Maw, Engineering.Com, Aug. 18, 2018.

12. "NTI 100: The Unsinkable, Unstoppable PCB Market," by Hayao Nakahara, *Printed Circuit Design & Fab Online Magazine*, July 28, 2022.

13. "Leadership Lost? Rebuilding the U.S. Electronics Supply Chain," by Joseph O'Neil, IPC, January 2022.

14. "US Congress Proposes Support for American PCB Manufacturing," by Zachariah Peterson, Altium, May 13, 2022.

15. "The History of PCBs from 1870 to Today," by Edwin Robledo, *Fusion 360 Blog*, May 10, 2022.

16. "A Look inside Shenzhen's High-Tech Empire," by Wade Shepard, *Forbes*, July 14, 2016.

17. "How Did R+D Disappear from American Electronics Manufacturing?" by Brian Sinclair, *Micro-wave Product Digest*, July 21, 2021.

18. "Who Killed US Manufacturing?" by Ruth Strachan and Shehadi Sebastian, *Investment Monitor*, May 12, 2021.

19. "America's Defense Electronics Supply Chain Is Dangerously Thin and Falling Behind," by Eric Tegler, *Forbes*, June 30, 2021.

20. "Chips Don't Float: Reviving Semiconductor Manufacturing Alone Won't Assure America's Security," by Eric Tegler, *Forbes*, Jan. 7, 2022.

21. "Top 10 Largest Printed Circuit Board Manufacturers in the US," *IndustrySelect*, July 2021.

22. *Summary of the Protecting Circuit Boards and Substrates Act*, U.S. Congress, Reps. Blake Moore and Anna G. Eschoo.



Preeya Kuray, PhD, is a material scientist at AGC Multi Material America. To read previous columns, [click here](#).

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Burkle North America: Service With a Smile

Interview by Nolan Johnson
I-CONNECT007

It's a given: Capital equipment, especially equipment that runs hard, will need service. The larger the installed base of equipment, the more service support that will be required. Burkle North America's Schmoll Service Manager, Evan Howard, discusses how Schmoll North America has grown its service organization in response to equipment sales in the region, a conversation that touches on hiring, training, spare parts logistics, and potential future growth. It's clear that this company intends to keep its service team ahead of the curve.

Evan, your customer service team has been busy implementing a lot of changes. What has driven that change?

Everyone has seen success. There have been many machine purchases, and that has driven much of our service demand. In 2018, we serviced roughly 90 machines in North America; today, we have about 360 machines. That growth has driven the demand for service.

Is this growth a result of added capacity or new capabilities?

It's a combination of both. With respect to capacity, you're seeing more boards built in America. Technology is moving faster than we can keep up with it. For example, our machines are running with linear motors instead of AC motors. There's also the demand of special

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I have a background in capital equipment for semiconductor, so I recognize that moving to a linear motor gives you a lot more positional accuracy.

You'll gain accuracy as well as speed which is, effectively, instant positioning. Linear motors in the Z-axis have been a source of growth for Schmolz. We are replacing a lot of old equipment.

Added capacity is encouraging, but customers are also looking for new capabilities. What do customers want in their drill machines?

The demand in drill machines is speed because speed is money. It's a massive benefit if they can make more boards in less time. If your machines are holding accuracy a little bit better than some of the older machines, now you're making boards faster and with better quality.

In the last three years, you've installed something like 200 new machines; that's a lot more to service. How has the service department changed? What have Burkle and Schmolz done regarding overall serviceability for these new machines?

When you work on a Schmolz machine, there's a lot to learn. It's at least a year before you feel comfortable as a service technician. When we hire new staff, we fly them around the country, giving them exposure to how it all works. They shadow one of our service engineers, then always travel to the factory in Germany to learn.

It's hard to justify hiring enough service technicians until you have enough machines to keep them all busy. But our management understands that we need to hire staff early. We have many machines on order, being built,



Evan Howard

and sent here, so there is a lot of demand for service. At times, we feel like we're behind with our hiring, and it's due to the long training process. Developing our service department has been delicate.

I started with Schmolz by building machines in Germany, then moved into service, and was relocated back to North America. In 2018, it was just me and two other service engineers. Now, our department has 13 engineers. That's a big increase in just a few years. Not only that, but these technicians are more specialized in products like laser, direct imaging, X-ray, and post-etch punch machines, in addition to the drill machines. North America is big, and our engineers must be cross-trained in multiple machines.

To bring on that many, you must have created a formalized training program.

For our training, we have them shadow someone more experienced for about three months, so they get comfortable on the machines. Interestingly, all of us walk around with smartphones that contain PCBs, but the general public doesn't really understand printed cir-

cuit boards. We've found that we could hire someone with a master's in engineering, but they don't understand printed circuit boards, solder mask, or applications like back-drilling. These terms are completely foreign. As much as the training is directly on the machines, it's equally about understanding the industry terminology, chemistry, and so forth.

The new hire will typically spend a month in Germany, going into the factory, taking the machines and motors apart, and getting a solid foundation of the platform. At that point, they can go deeper into the vision software and some of the alignments and accuracy of the machine.

Once they come back from Germany, we send them into the field, supervised by a senior engineer. Even though you've taken apart the machines, there's more you haven't seen, and you don't learn until you're on the job fixing something. Much of this training is learning by doing.

Do you have an internal certification program? Do you sign off on their skill set?

Yes. There are so many parts of the machine, so we list them all out and have the engineer go through them all.

How about preventative maintenance and working with the onsite operators and maintenance departments with customers? How has that changed?

Most of our customers have signed a service agreement that brings a trained service engineer onsite to do a full check of the machine every three to six months. During that preventative maintenance, many customers bring in

their own maintenance techs to shadow us so they can gain exposure to things they may not regularly see. A big struggle for their maintenance techs is in maintaining multiple makes of machinery. It's a lot to learn just one machine, let alone multiple machines.

Having regularly scheduled maintenance increases reliability. As a result of these service contracts, we have seen the number of emergency service calls drop dramatically. About

70% of our customers are now on service agreements. We have service techs based in places like New Hampshire, Massachusetts, New Jersey, New York, Chicago, Texas, California, Utah, and Denver. The better we can minimize emergencies, the better it is for everyone.

That's a good reason for the service contract. Ultimately, the goal is to keep that customer's facility punching out boards and making money.

When the machines are running, nobody thinks about it. If we're scheduled a year in advance and visiting every three to six months, the machines get the attention they deserve. Scheduling and doing preventative maintenance is one less thing that the customer needs to worry about.

How do you tie spare parts together with the service contract?

We have a preventive maintenance kit that includes several consumable parts. On a drilling machine, this would include air and water filters; on a laser machine, we clean or replace the optics inside that beam path. All our systems come with a preventative maintenance kit.

We've also increased our spare parts stocking. Once you have a lot of machines, you know

“**Having regularly scheduled maintenance increases reliability.**”

that many of them start aging. If we don't have a spare parts inventory to support that, then it could be days or even weeks to get a part, and that's unacceptable. Since 2020, our spare parts inventory has tripled.

We added more spare part inventory at our headquarters in Greensboro, North Carolina, as well as in Southern California, to improve our shipping response times. We track our spare parts, so we know how much we are actually shipping vs. the factory. That's a good gauge of whether we have the right parts in the right quantities. In our last review, we found we shipped about 80% of our North American part orders from our North America stock locations. We're doing a really good job having the right parts, but we know we can always improve.

I've been hearing about a field service software called Visual Planning. How does that tool contribute to your team's performance?

As the department grows, so does the demand to be organized. We need to use technology to our advantage. There are many software options when it comes to field service. I have spent a lot of time with multiple software companies trying to find the right fit for what we're doing.

In March, we released our field service software, called Visual Planning, and it's available to all our technicians. They will arrive onsite with iPads and their schedules, fill out their service reports, and the customer can immediately sign off on the service report on the iPad. It adds a level of professionalism that Excel sheets and manual tracking couldn't deliver.

How does the Visual Planning tool improve the experience for your customer?

The service quoting process is more streamlined and more organized. The invoicing process is far more organized. There's less opportunity for a dropped ball or forgotten quote, and now we have a ticketing system.

When we started our hotline a few years ago, one of our struggles was keeping track of all the open cases. I might be on the hotline and tracking the cases. But what if I go on vacation the next week or I'm out doing service calls? Someone else is managing the hotline and if a customer calls back, they have to explain their problem all over again and go through all the troubleshooting steps. We wanted to be able to pick up where we left off.

We now have a ticketing system that captures the information I'm doing this week, so that next week when one of our other engineers is on the hotline, he can pick up where I left off, and there's no information gap. You don't misplace service calls either. Sometimes the issues from callers aren't because a machine is down; it's more of something that's nagging. A proper ticketing system puts pressing issues front of mind.

What is the service team's role within the greater organization of the company globally? How does the North American team fit?

Customers today are buying machines not only due to quality of the machine, but also the reputation of the service organization for the machine. We have a reliable service department and that is what's driving sales. Customers have the comfort of knowing there's a plan to keep their machines running. The service department is now a major contributor to the success of Schmolz in America.

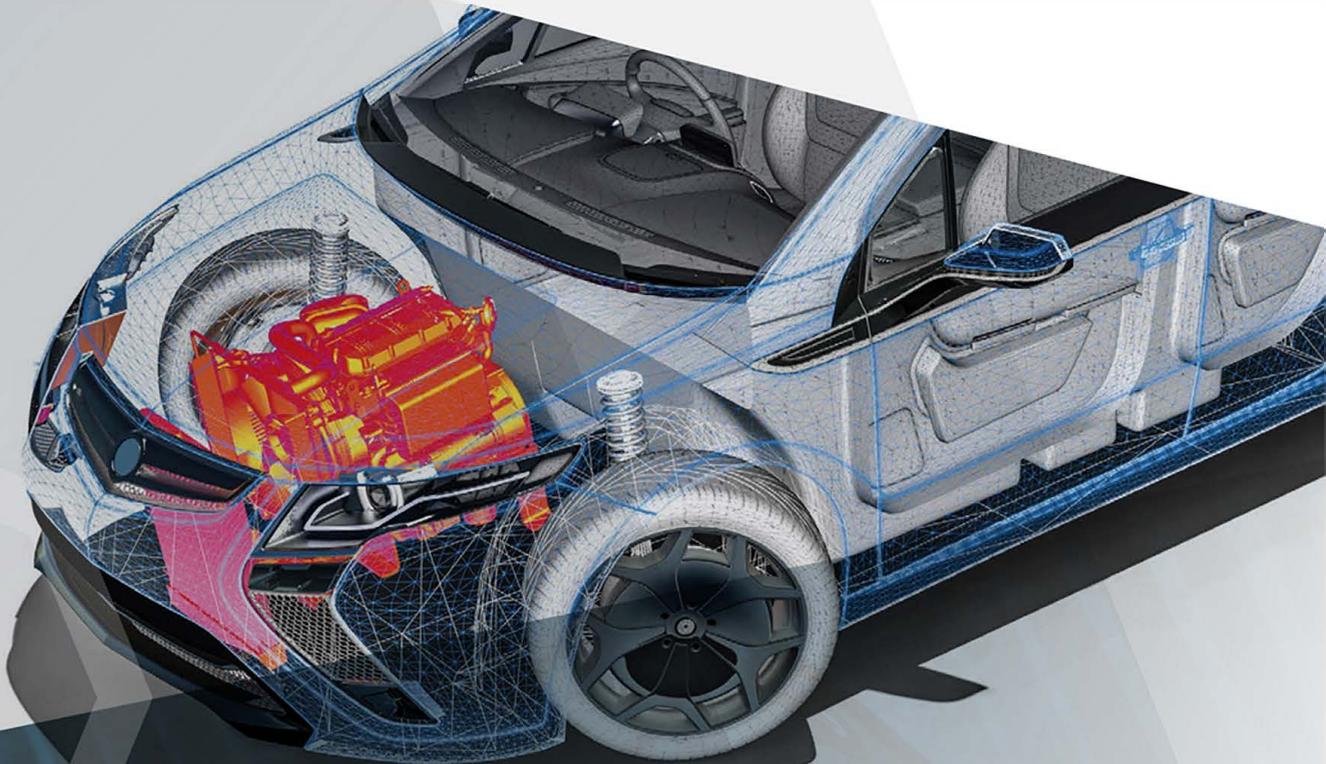
How big do you think your team will be in two years?





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We have plans to hire four to six additional technicians by the end of 2024. The demand is still there; we are still selling machines. Customers are also retrofitting old machines, adding some special functions to an already existing machine, like a second measurement system, which allows them to do non-conductive back-drilling applications or touch probes. This allows for a small tolerance, pocket milling. That demand is driving the growth of our service department.

Service is regional, but it's global as well. How does your team interact with the other service teams around the globe?

The development of our service department here is fueled by Schmoll in Germany. They send many of their service and application engineers to North America to help build up our knowledge base. North America is a big driver of the world industry. Schmoll realizes that and is increasing its presence in North America. It's a totally different market here compared to the norm in Europe.

We've done a really good job of hiring guys who are just clever. They're clever with

mechanics and with software as they build confidence in the machine. We're seeing guys who naturally move toward applications. They seem to have a more analytical brain vs. someone who's handy with mechanics.

How much of the R&D effort will be modifying either the operator software, automation, or the hardware itself, to respond to these challenges at the customer site? Is there a conscious effort in design to make it easier to maintain and operate?

There's a lot of automation in the programming. Customers will have a database of scripted programs to pull down to the drill machine. You can see scripting and programs that are automating some of the things operators used to do. Every button clicked by an operator is a potential for scrap. That's less pressure for the operator who may be on his second week of work.

We've created an applications department specifically for supporting customers. As part of our service department, we find that the applications and the ideas coming from customers need to be supported just as much as part replacements.

Where is the market headed, specifically with your products?

We constantly see and hear more about automation with the push to Industry 4.0, and that difficult turnover of operators, process engineers, and even the pressure of technology. You can see a lot coming from this. It's all headed toward more automation and more consistency. Schmoll is putting massive effort into automation. I see that being a big piece of the future.

We appreciate your time today, thank you so much.

Great. Thanks a lot. PCB007



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PCBAA Member Profile: Frank Medina

President and CEO, Technica USA

American Made Advocacy

PCBAA

As a supplier, what stands out in your many years in the industry?

Besides all the technological advancements I have observed in my 40+ years of being in the business, I saw for the second time what happens when government and industry don't work well together.

I am originally from the Youngstown, Ohio area, which used to be steel country. Watch-

ing what happened to the PCB industry in the U.S. in the mid- to late-1990s and into the early 2000s was a repeat of what happened to the steel industry. It was frustrating because we didn't get the support and cooperation of the government to preserve manufacturing as the backbone of our country. Our government began to enforce regulations that hampered our industry; many American companies just couldn't compete and went out of business. Work moved overseas, chasing low wages and the big government subsidies offered mostly in the Asian countries.

What has changed in the past year?

Geopolitical concerns have driven this issue into the halls of Congress. With the supply chain risks generated by COVID and political uncertainty in other countries, lawmakers finally saw the danger presented by over-reliance on other nations. The CHIPS Act addressed chips at the top of the technology stack and now the Protecting Circuit Boards and Substrates Act is calling attention to the rest: PCBs and substrates.

We can't afford to waste any more time debating whether our industry needs government support. PCBs are everywhere, from the devices we use in everyday life to critical infrastructure. To maintain our economic and national security, we need reliable domestic sources to protect that infrastructure.

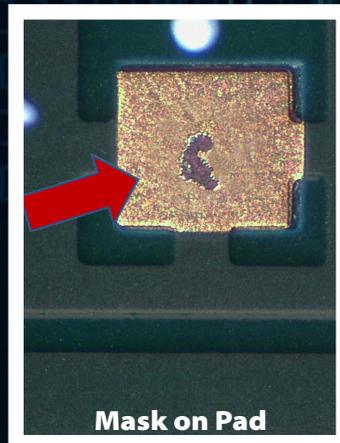
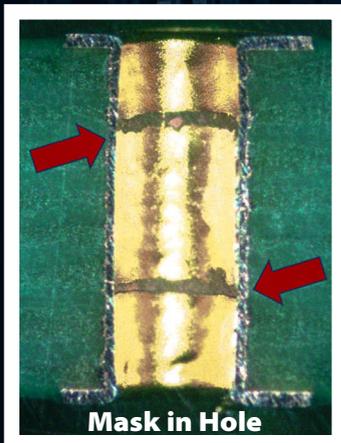


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How can we draw new workers into the industry?

Like most of the manufacturing verticals, we suffer from a generation of young people who don't view manufacturing as a viable career choice. They were told it wasn't important. But from my 40 years of personal experience, I can tell them that there are exciting challenges and many different roles one can play in this critical industry, especially as we begin converting our PCB manufacturing operations into Smart factories. PCBAA and our members need to push hard to attract younger workers. That infusion of energy will revitalize our industry and make us more competitive on the world stage.

What is your message to Congress?

I would tell them that supporting this ecosystem is a necessity, not a nice-to-have. Our economic and national security depends on how they legislate to support us. PCBs are in every electronic device you can think of. I was glad to see PCBAA formed to give this industry a dedicated voice in Washington. The more voices we get, the better our impact will be for the entire ecosystem: PCB and substrate manufacturing, assembly, and services for the OEM market. **PCB007**

Femtosecond Laser Improves Bismuth Film Quality for Ultra-broadband Photodetection

The researchers from Changchun Institute of Optics, Fine Mechanics and Physics of the Chinese Academy of Sciences and Peking University have developed a new technique for upgrading the quality of topological insulator bismuth films for use in ultra-broadband photodetectors. The study was published in Optics Express.

The researchers used femtosecond laser treatment to significantly improve the photoelectric conversion and carrier transportation of bismuth films, which previously limited the optoelectronic properties of the material.

Bismuth is a type of topological insulator, a class of materials that have unique properties such as gapless edge states and insulating bulk states. These properties make them promising for fabricating room-temperature, wide bandwidth, and high-performance photodetectors that can span the ultraviolet

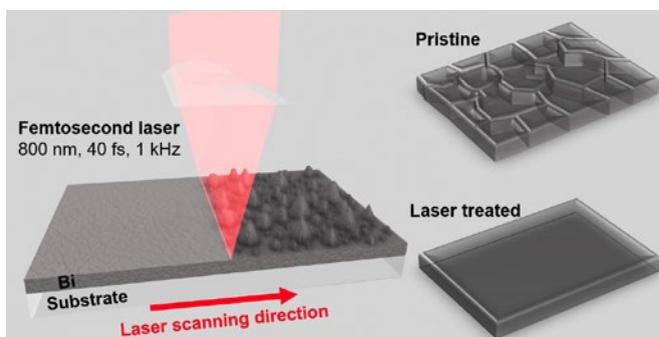
to the far-infrared and even terahertz ranges. However, bismuth films often suffer from high surface roughness and obvious grain boundaries, which can affect photoresponsivity, a key factor for topological insulator ultra-broadband photodetectors.

To overcome this challenge, the researchers used femtosecond laser treatment to modify the surface morphology and physiochemical properties of bismuth films.

Femtosecond laser is an intriguing approach that can provide non-contact high precision manufacture on various materials due to its ultra-high peak power and ultra-short time duration characteristics. By tuning the laser parameters such as pulse energy and scanning speed, the researchers were able to reduce the average surface roughness to sub-10 nm, while eliminating grain boundaries on the interface.

The researchers then fabricated an optoelectronic device on a large surface area of the efficiently treated bismuth film with cylindrical focusing conditions. The researchers suggest that this method can be further used for improving the quality of other topological insulators, which could promote their application in the field of ultra-broadband photoelectric detection. They also hope that their work can inspire more studies on femtosecond laser processing for modulating topological quantum materials.

(Source: Chinese Academy of Sciences)



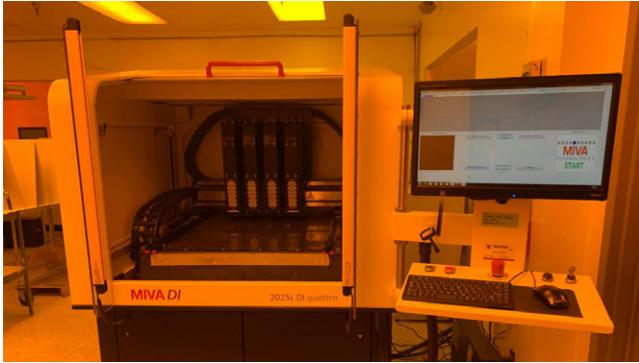


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Reduction Assisted Immersion Gold for ENEPIG Surface Finish

The Plating Forum

by George Milad, UYEMURA

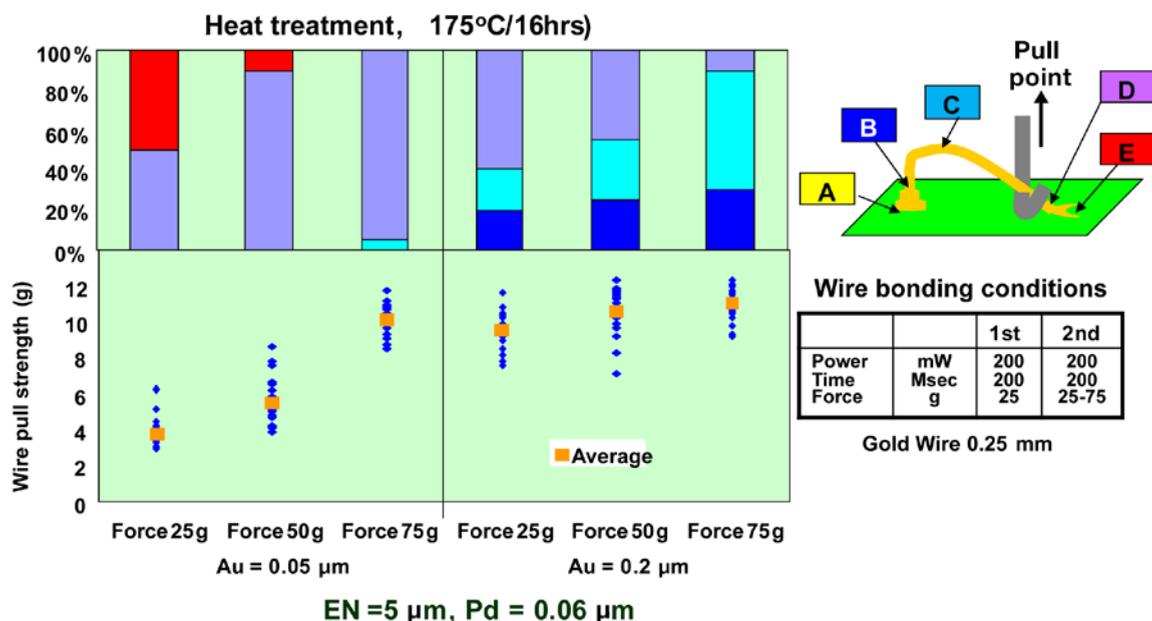
RAIG was introduced a few years ago to meet the requirements of newer designs. Since its inception, more gold finishes are finding RAIG to be a viable alternative to standard immersion gold. RAIG is a mixed reaction bath that functions as an immersion gold and, with the added reducing agent, it also functions as an electroless (autocatalytic) bath.

The immersion reaction initiates the gold plating with the introduction of the substrate (nickel, palladium, or copper) into the electrolyte. The deposited immersion gold layer will trigger the electroless reaction. Being a displacement reaction, the immersion reaction will diminish with time as the substrate becomes less available with deposition. The elec-

troless reaction will continue, as it relies on the reducing agent present in the electrolyte and not on substrate availability. RAIG is limited on how much gold it can deposit, as compared to a pure electroless gold. It is ideally suited for thicknesses of 3–8 μm .

Limiting the immersion reaction and allowing gold thickness to build up autocatalytically opens the operating window by allowing thicker gold to deposit without nickel corrosion. A thicker gold layer (3–8 μm), which is beyond the capability of standard immersion gold electrolytes, is desirable as it widens the operating window for gold wire bonding.

Figure 1 shows the relationship between gold thickness and the strength of the wire



At gold thickness of 0.2 μm , the strength of the bond is not determined by the bonding force. At 0.05 μm bond strength is bonding force dependent.

Figure 1: The effect of gold thickness on the operating window of the bonding force.



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bond. Two thicknesses of gold—0.05 μm (2.0 μins) and 0.2 μm (8.0 μins)—were bonded using a 0.25 μm gold wire at three different bonding forces (25, 50, and 75g force). Ultrasonic power (mW) and time (sec) were held constant. The wires were then pulled and the break point in the wire was recorded. Bond lifts (E) and brakes at the heel of the bond (D) were indicative of weak or non-reliable bonds. Break points (B and C) were indicative of a reliable bond.

The data shows that both thicknesses were capable of producing robust joints. However, the thinner (0.05 μm) gold required a higher gram force to make a reliable bond. The thicker gold (0.2 μm) produced reliable bonds at lower gram force, opening the operating window for the bonding parameter.

For gold wire bonding applications, designers prefer to specify a gold thickness of 3–5 μins . This thickness is beyond the capability of an immersion gold. Increasing dwell time in an immersion gold bath is the leading cause of nickel corrosion.

ENEPIG With RAIG

ENEPIG forms the most reliable solder joint with lead-free solder and is a gold wire-bondable surface. It is presently specified in cases where both soldering and gold wire bonding are the chosen methods of connectivity.

Immersion gold on palladium in EN-EPIG deposits is limited in thickness, due to closeness of the Au and Pd in the EMF series. The driving force of the reaction is much lower than the driving force for the immersion of gold on a nickel surface, as in the case of ENIG. Achieving a thickness in excess of 1.2 μins of gold on Pd will require an extended time in the immersion gold bath which, in turn, would increase the probability of nickel corrosion under the palladium layer. If nickel is corroded under the Pd, the wire bond strength will be

compromised and this would lead to bond lift failure at the nickel palladium interface.

As ENEPIG gains market share, it has become evident that the gold wire bonding operating parameters are successful in a relatively narrow range. During assembly, the wire bonding parameters (heat, ultrasound frequency, and gram force) must be closely monitored for successful bonds to occur. “Wire pull” studies have shown that increasing the gold thickness would widen the window of operation and would statistically improve the yield and reliability of the of the bonds formed. Many designers now specify gold thickness in excess of the IPC-4566A specified range for gold thickness.

Nickel corrosion is mainly attributed to imperfections in the palladium layer coupled with an extended dwell time in a corrosive (low gold concentration) immersion gold electrolyte. Under such conditions the immersion gold ions in solution will have access to the underlying nickel and will be reduced to gold metal. The gold metal will deposit on top of the palladium layer and the nickel will corrode.

The ENEPIG data set in Figure 2 shows clearly that RAIG eliminated any possibility of

Calibr. Std. Set 1 standard tools						
n=	1	Au 1 =	8.19 μm	Pd 2 =	4.51 μm	NiP 3= 204.3 μm
n=	2	Au 1 =	8.80 μm	Pd 2 =	3.83 μm	NiP 3= 196.7 μm
n=	3	Au 1 =	8.33 μm	Pd 2 =	4.39 μm	NiP 3= 194.4 μm
n=	4	Au 1 =	8.34 μm	Pd 2 =	4.39 μm	NiP 3= 194.9 μm
n=	5	Au 1 =	8.41 μm	Pd 2 =	3.89 μm	NiP 3= 191.9 μm
n=	6	Au 1 =	8.44 μm	Pd 2 =	4.23 μm	NiP 3= 191.1 μm
n=	7	Au 1 =	8.43 μm	Pd 2 =	3.86 μm	NiP 3= 191.0 μm
n=	8	Au 1 =	8.32 μm	Pd 2 =	4.15 μm	NiP 3= 192.0 μm
n=	9	Au 1 =	8.28 μm	Pd 2 =	3.95 μm	NiP 3= 193.0 μm
n=	10	Au 1 =	8.54 μm	Pd 2 =	4.17 μm	NiP 3= 191.5 μm
n=	11	Au 1 =	8.19 μm	Pd 2 =	4.09 μm	NiP 3= 192.9 μm
n=	12	Au 1 =	8.26 μm	Pd 2 =	4.51 μm	NiP 3= 191.7 μm
n=	13	Au 1 =	8.50 μm	Pd 2 =	4.23 μm	NiP 3= 192.6 μm
n=	14	Au 1 =	8.14 μm	Pd 2 =	4.53 μm	NiP 3= 191.2 μm
n=	15	Au 1 =	7.85 μm	Pd 2 =	4.15 μm	NiP 3= 190.0 μm
n=	16	Au 1 =	8.30 μm	Pd 2 =	3.73 μm	NiP 3= 192.2 μm
n=	17	Au 1 =	8.22 μm	Pd 2 =	4.08 μm	NiP 3= 191.7 μm
n=	18	Au 1 =	7.65 μm	Pd 2 =	4.15 μm	NiP 3= 190.3 μm
n=	19	Au 1 =	7.62 μm	Pd 2 =	3.95 μm	NiP 3= 189.0 μm
n=	20	Au 1 =	8.23 μm	Pd 2 =	4.27 μm	NiP 3= 191.7 μm
		Au 1 μm	Pd 2 μm	NiP 3 μm		
Mean		8.251	4.148	192.7		
Standard Deviation		0.281	0.242	3.233		
CoV (%)		3.41	5.84	1.68		
Range		1.18	0.801	15.3		
Number of readings		20	20	20		
Maximum time		25	---	---		

Figure 2: ENEPIG data set showing RAIG eliminates any possibility of nickel corrosion and maintains excellent wettability during soldering.

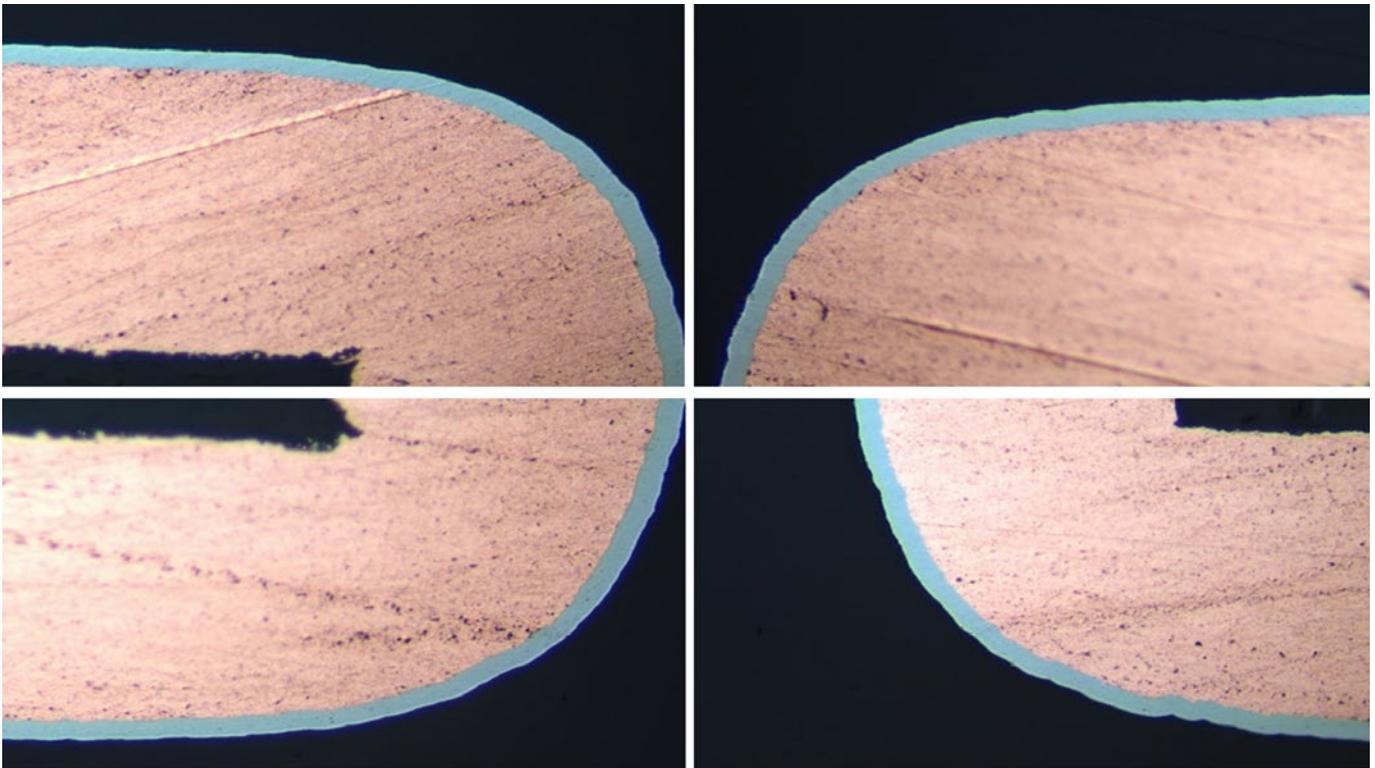


Figure 3: Corrosion evaluation per IPC-4552B, ENIG Specification.

nickel corrosion and maintained excellent wettability during soldering. Nickel corrosion was evaluated using the method specified in IPC-4552B. Wetting balance was used to evaluate wettability.

The data shows that the use of RAIG in place of immersion gold yielded a reproducible thickness of 8.0 μm s of gold, on top of the palladium and nickel. Thickness data came from 20 different pads (60 x 176 mil). The added

gold thickness enhances the gold wire bonding ability of the ENEPIG surface, as it widens the operating window of the bonding parameters.

Corrosion evaluation was done by following the method outlined in IPC-4552B, ENIG Specification. Cross-sections in Figure 3 from different locations were evaluated at 1000x magnification and were examined for any corrosion spikes. The micrographs show “zero” corrosion level.

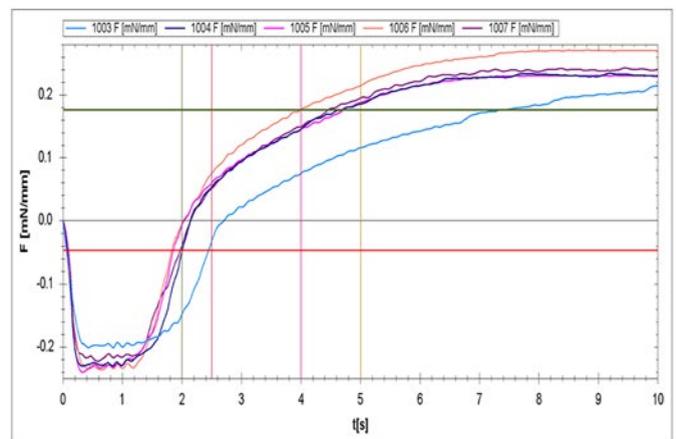
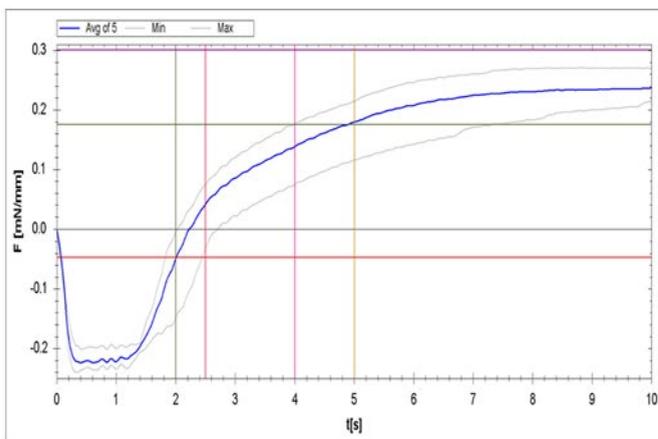


Figure 4: The results of wetting balance per J-STD-003C, WAM2, 2x reflow.

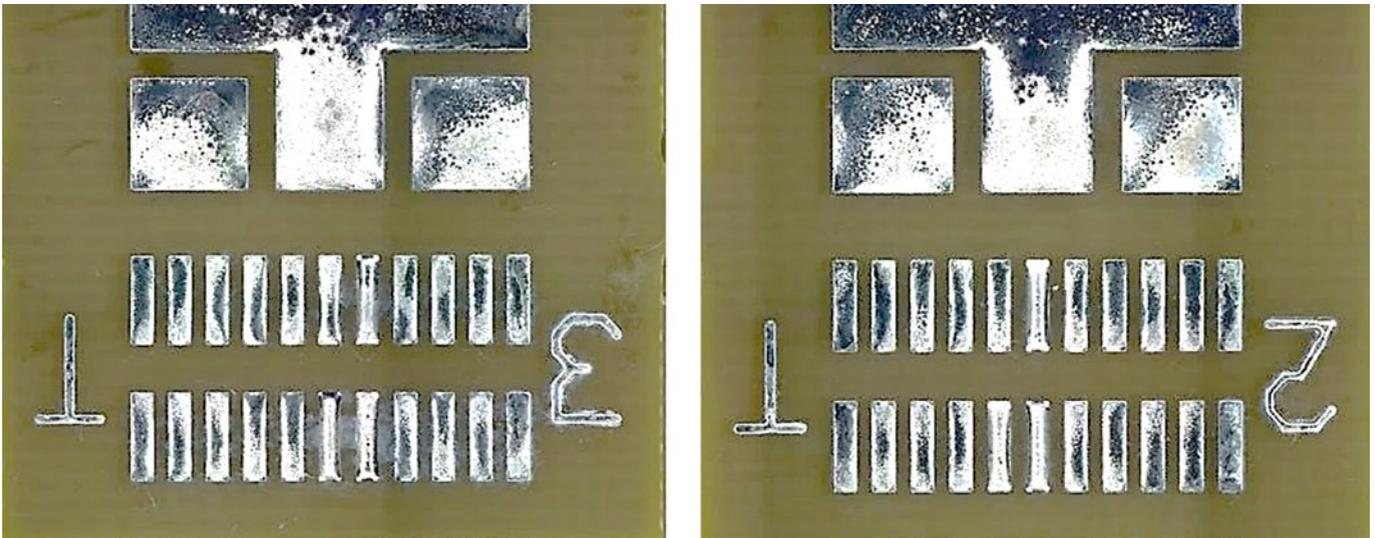


Figure 5: Edge dip per J-STD-003C, WAM2.

Solderability was evaluated per JSTD-003C WAM 1&2 Specification.

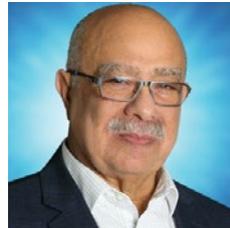
Wetting balance Time (≤ 2.5 seconds) = Avg. is 2.25 seconds, Pass.

Wetting balance Force ($> 0.17\text{mN/mm}$) = Avg. is 0.22 mN/mm , Pass.

The thicker gold layer meets J-STD-003C WAM1&2 specification and shows no evidence of non-wetting or de-wetting.

The use of RAIG in place of standard immersion gold will allow for the deposition of a thicker gold layer, thus overcoming the limitations of immersion gold on palladium. The

RAIG thicker gold layer had no adverse effects on solderability. An added benefit to the use of RAIG is that the probability of nickel corrosion under the palladium layer is eliminated. PCB007



George Milad is the national accounts manager for technology at Uyumura. To read past columns, [click here](#).



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Dan's Biz Bookshelf: 'Talent Tectonics'

Book Review by Dan Beaulieu

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With all the challenges of finding, hiring, and keeping the right employees these days, it is important that you provide them an opportunity to develop a career path in your company and keep them engaged in and passionate about their work.

This means walking in their shoes and looking at things from their point of view. What would engage employees? What would make them enthusiastic about their work? What kind of company mission would inspire them?

The book, *Talent Tectonics: Navigating Global Workforce Shifts, Building Resilient Organizations, and Reimagining Employee Experience*, focuses on:

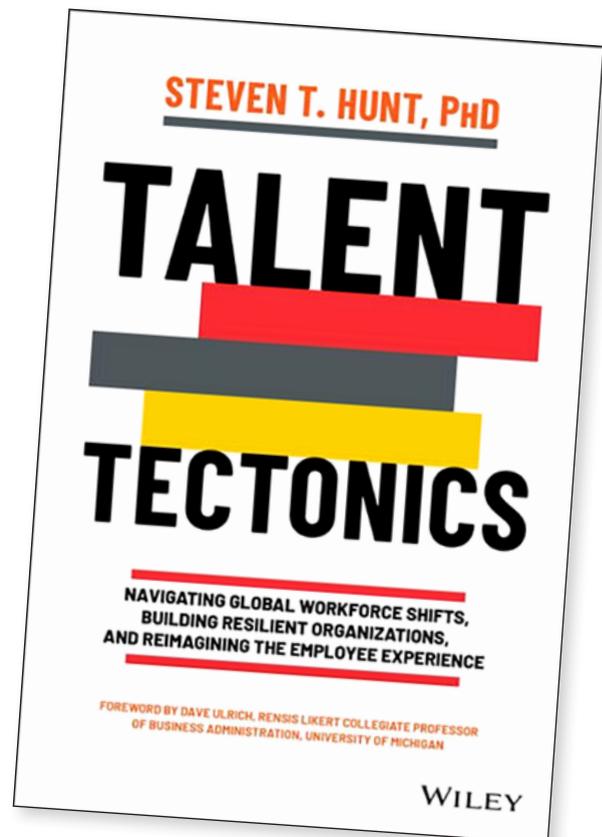
- The forces that are reshaping work and workforces
- Activities that large companies need technology for
- Organizational design that impacts the employee experience
- Elements of the employee experiences that promote learning and growth

Instead of talking about job descriptions, which traditionally have focused on what the employer wants rather than on what employees need to be successful, author Steven Hunt comes up with the idea of “job design” to maximize employee experience. Job design centers on the purpose of the job, with whom the

employee works, and when and where people work. Other considerations include:

- How does the job support employee development?
- What resources are employees provided?
- What additional benefits or perks are offered?
- What career advancement opportunities are available to employees?
- Why do people join organizations?

Hunt addresses how job design affects the employee experience from the design of groups, teams, and departments to manage-



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ment structures and leadership. He also discusses a topic I find vitally important: How to manage restructuring and downsizings with experience in mind.

“Given the risks, companies should not downsize unless it is absolutely necessary,” he writes. “Downsizing decisions should not be based solely on job titles, salaries, and demographics. They should also consider employee skills, experience, relationships, and capabilities. If it is necessary to reduce the size of the workforce, it is better to do one large reduction rather than several small ones.”

With all the difficulties we are experiencing in finding the right people, we should certainly tread very carefully when it comes to letting employees go.

Finally, the book discusses promoting personal growth. Employees want to learn and grow in the future. Elements of employee experience that play a critical role in doing that:

- **Context:** Design jobs that encourage and enable development by giving employees the time, opportunity, and motivation to build new capabilities.
- **Capabilities:** Help employees identify what knowledge, skills, and experiences to develop to achieve their goals and prepare for the next chapter of their careers.
- **Content:** Provide employees with access to development resources they need to build new capabilities.
- **Culture:** Create an organizational environment that supports employee development, particularly the role that managers play in supporting employee development.

Hunt stresses that technology has the potential to create a future in which people no longer worry about having to work for a living. Instead, people will focus on living a fulfilling, purposeful life that includes work. What matters is how we choose to use it. Let us choose wisely.



Dan Beaulieu

With its very timely advice, *Talent Tectonics* is one of those books that you need to put on your bookshelf and keep there to read again and again. **PCB007**

Dan Beaulieu is president of D.B. Management Group and an I-Connect007 columnist. To read past book reviews, [click here](#). To read past columns, [click here](#).

Title: *Talent Tectonics: Navigating Global Workforce Shifts, Building Resilient Organizations and Reimagining Employee Experience*

Author: Steven T. Hunt, PhD

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Pages: 320 pages

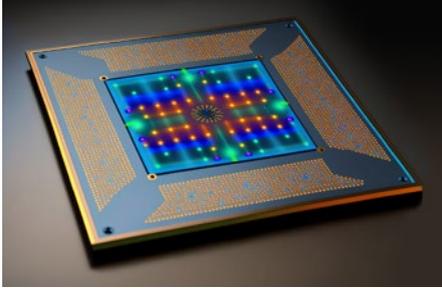
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A Focus on Ultra HDI

John Johnson is relatively new to American Standard Circuits, but definitely not new to the technology. In fact, he was hired to focus on business development for ultra-high-density interconnects. John explains more about the process and where it's taking ASC.

The Birth of the Printed Circuit Board

Every industry has a beginning, and we are lucky to have Rex Rozario here to share the story of how the printed circuit board industry got its start. I-Connect007 chatted with Rex recently about how he became involved with circuit board inventor Dr. Paul Eisler.



Fein-Lines: AI—Here and Changing the World

In this column, I will introduce Chat AI, generate some questions and in some cases I will let AI answer.



When you see commentary in quotations you will be reading the exact response that I get when I ask ChatGPT or Edge/Bing AI the same question. I'll also review additional AI capabilities that will soon be available with Bing AI Chatbot being one of the latest, at least for now.

Punching Out: With M&A Deals, Timing is Everything

Business owners frequently ask whether the time is right to sell their business. Timing can make all the difference in getting a premium value for your business. If all signs are positive, more buyers will be interested, investors and lenders will feel that, and deals will go more smoothly. But getting the timing right is tricky and depends on many variables that I will review here.



Trouble in Your Tank: Electrodeposition of Copper, Part 4—Addition Agents



I've spent a good part of my career working on disciplines such as process control and technology management, and troubleshooting complex issues in electronics manufacturing. I also spent quite a bit of time formulating chemical processes and understanding the underlying principles of what makes these processes function the way they do.

The New Chapter: A Mini Manufacturing Ecosystem

A manufacturing facility is set up like a miniature business ecosystem. Within it, a product is handed from one department to another, with more features and materials added in each step in the process. Most of the time, one process will greatly affect those that follow it.



Where Are Freight Costs Going?



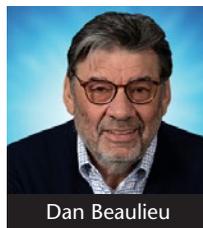
For some electronics manufacturing companies, lower freight costs are likely to be their most significant cost savings this year. Decreased demand and improving supply chain dynamics are pulling freight costs down, a trend that should continue throughout this year. Downward cyclical pressures will curtail volume, which should keep prices in check.

PFAS: Sounding the Alarm

Man-made chemicals known as PFAS have regulators busy trying to address previous releases and prevent future releases of this chemical into the environment from widespread uses in manufacturing processes and products.

It's Only Common Sense: What Do Sales Reps Want?

As I continue my series on closing the gap between independent sales reps and their principals, I thought the next step would be to talk about what reps are looking for in an ideal rep-principal partnership. I talk to a lot of sales reps, and they frequently tell me they tend to be treated as outsiders by the companies they represent. Once they bring in the accounts and the company's team takes over, they feel forgotten.



Dan Beaulieu

Electronics Industry Leaders Call on Congress to Support \$100M in PCB Sector Funding

Senior executives of 26 electronics manufacturing companies from across the United States are calling on the U.S. Congress to support robust funding for reinvigorating the PCB manufacturing sector.

For the latest news and information, visit PCB007.com

Career Opportunities



Find Industry-experienced Candidates at jobConnect007

For just \$975, your 200-word, full-column ad will appear in the Career Opportunities section of all three of our monthly magazines, reaching circuit board designers, fabricators, assemblers, OEMs, suppliers and the academic community.

In addition, your ad will:

- be featured in at least one of our newsletters
- appear on our jobConnect007.com board, which is promoted in every newsletter
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Career Opportunities



ventec
INTERNATIONAL GROUP
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Director of Sales Ventec Central Europe, Germany

We are looking for a self-motivated Director of Sales—Ventec Central Europe, ideally with experience in the PCB industry. You have a known skill set to work with major global OEM and PCB manufacturing customers, where building relationships with purchasing, design and technical personnel are key to providing the highest level of customer service and support.

You will be leading and supporting the regional key accounts team, working as a key member of our Global Sales Team to support Ventec in developing new business. You will have sales and business development responsibility for existing and new products and will act as subject matter expert for the product range, achieving challenging sales and growth targets and goals.

Skills required:

- Extensive sales, product management, product application experience
- European citizenship (or authorization to work in Europe/Germany)
- Fluency in German and English language (spoken & written)
- Ability to work well both in a team and independently
- Good user knowledge of common Microsoft Office programs
- Full driving license essential

We offer excellent salary and benefits commensurate with experience. This is a fantastic opportunity to become part of a successful brand and leading team with excellent benefits. Please apply in the strictest confidence, enclosing your CV to frank.lorentz@ventec-europe.com.

[apply now](#)



THERMAL SYSTEMS

Sales Engineer SMT North Mexico

Rehm Thermal Systems, a leading German manufacturer of reflow soldering systems with convection or condensation and drying and coating systems, has produced energy-efficient manufacturing equipment for the electronics and photovoltaics industry since 1990. We also offer tailor-made applications related to the soldering, coating and hardening of modules.

Responsibilities:

- This position is responsible for expanding our customer network and maintaining existing customer relationships in the Northeast Mexico region. The Sales Engineer would work closely with the German headquarters and the General Manager Rehm Mexico to implement the sales strategy.
- A candidate's proximity to Monterrey, Mexico, is a plus.

Qualifications:

- An Engineering degree or comparable qualification with a strong technical background is required.
- Sales-oriented attitude, good communication skills and willingness to travel frequently within Mexico is essential.

We offer innovative products, a great dynamic work environment and exciting training opportunities in our German headquarters.

To learn more about Rehm Group please visit our website at www.rehm-group.com.

Please send resumes to: **Mr. Luis Garcia** at luis.garcia@rehm-group.com.

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Career Opportunities



Europe Technical Sales Engineer

Taiyo is the world leader in solder mask products and inkjet technology, offering specialty dielectric inks and via filling inks for use with microvia and build-up technologies, as well as thermal-cure and UV-cure solder masks and inkjet and packaging inks.

PRIMARY FUNCTION:

1. To promote, demonstrate, sell, and service Taiyo's products
2. Assist colleagues with quotes for new customers from a technical perspective
3. Serve as primary technical point of contact to customers providing both pre- and post-sales advice
4. Interact regularly with other Taiyo team members, such as: Product design, development, production, purchasing, quality, and senior company managers from Taiyo group of companies

ESSENTIAL DUTIES:

1. Maintain existing business and pursue new business to meet the sales goals
2. Build strong relationships with existing and new customers
3. Troubleshoot customer problems
4. Provide consultative sales solutions to customers technical issues
5. Write monthly reports
6. Conduct technical audits
7. Conduct product evaluations

QUALIFICATIONS / SKILLS:

1. College degree preferred, with solid knowledge of chemistry
2. Five years' technical sales experience, preferably in the PCB industry
3. Computer knowledge
4. Sales skills
5. Good interpersonal relationship skills
6. Bilingual (German/English) preferred

To apply, email: BobW@Taiyo-america.com with a subject line of "Application for Technical Sales Engineer".

[apply now](#)



IPC Instructor Longmont, CO

This position is responsible for delivering effective electronics manufacturing training, including IPC certification, to adult students from the electronics manufacturing industry. IPC Instructors primarily train and certify operators, inspectors, engineers, and other trainers to one of six IPC certification programs: IPC-A-600, IPC-A-610, IPC/WHMA-A-620, IPC J-STD-001, IPC 7711/7721, and IPC-6012.

IPC instructors will primarily conduct training at our public training center in Longmont, Colo., or will travel directly to the customer's facility. It is highly preferred that the candidate be willing to travel 25–50% of the time. Several IPC certification courses can be taught remotely and require no travel or in-person training.

Required: A minimum of 5 years' experience in electronics manufacturing and familiarity with IPC standards. Candidate with current IPC CIS or CIT Trainer Specialist certifications are highly preferred.

Salary: Starting at \$30 per hour depending on experience

Benefits:

- 401k and 401k matching
- Dental and Vision Insurance
- Employee Assistance Program
- Flexible Spending Account
- Health Insurance
- Health Savings Account
- Life Insurance
- Paid Time Off

Schedule: Monday thru Friday, 8–5

Experience: Electronics Manufacturing: 5+ years (Required)

License/Certification: IPC Certification—Preferred, Not Required

Willingness to travel: 25% (Required)

[apply now](#)

Career Opportunities

Prototron Circuits

Sales Representatives

Prototron Circuits, a market-leading, quick-turn PCB manufacturer located in Tucson, AZ, is looking for sales representatives for the Southeastern U.S. territory. With 35+ years of experience, our PCB manufacturing capabilities reach far beyond that of your typical fabricator.

Reasons you should work with Prototron:

- Solid reputation for on-time delivery (98+% on-time)
- Capacity for growth
- Excellent quality
- Production quality quick-turn services in as little as 24 hours
- 5-day standard lead time
- RF/microwave and special materials
- AS9100D
- MIL-PRF- 31032
- ITAR
- Global sourcing option (Taiwan)
- Engineering consultation, impedance modeling
- Completely customer focused team

Interested? Please contact
Russ Adams at (206) 351-0281
or russa@prototron.com.

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Regional Manager West Region — Two Positions

General Summary: Manages sales of the company's products and services, Electronics and Industrial, within the Pacific Northwest or Southwest Region. Reports directly to Americas Manager. Collaborates with the Americas Manager to ensure consistent, profitable growth in sales revenues through positive planning, deployment and management of sales reps. Identifies objectives, strategies and action plans to improve short- and long-term sales and earnings for all product lines.

DETAILS OF FUNCTION:

- Develops and maintains strategic partner relationships
- Manages and develops sales reps:
 - Reviews progress of sales performance
 - Provides quarterly results assessments of sales reps' performance
 - Works with sales reps to identify and contact decision-makers
 - Setting growth targets for sales reps
 - Educates sales reps by conducting programs/seminars in the needed areas of knowledge
- Collects customer feedback and market research (products and competitors)
- Coordinates with other company departments to provide superior customer service

QUALIFICATIONS:

- 5-7+ years of related experience in the manufacturing sector or equivalent combination of formal education and experience
- Excellent oral and written communication skills
- Business-to-business sales experience a plus
- Good working knowledge of Microsoft Office Suite and common smart phone apps
- Valid driver's license
- 75-80% regional travel required

To apply, please submit a COVER LETTER and RESUME to: Fernando Rueda, Americas Manager

fernando_rueda@kyzen.com

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Career Opportunities



Technical Marketing Engineer

EMA Design Automation, a leader in product development solutions, is in search of a detail-oriented individual who can apply their knowledge of electrical design and CAD software to assist marketing in the creation of videos, training materials, blog posts, and more. This Technical Marketing Engineer role is ideal for analytical problem-solvers who enjoy educating and teaching others.

Requirements:

- Bachelor's degree in electrical engineering or related field with a basic understanding of engineering theories and terminology required
- Basic knowledge of schematic design, PCB design, and simulation with experience in OrCAD or Allegro preferred
- Candidates must possess excellent writing skills with an understanding of sentence structure and grammar
- Basic knowledge of video editing and experience using Camtasia or Adobe Premiere Pro is preferred but not required
- Must be able to collaborate well with others and have excellent written and verbal communication skills for this remote position

EMA Design Automation is a small, family-owned company that fosters a flexible, collaborative environment and promotes professional growth.

Send Resumes to: resumes@ema-eda.com

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MACHINES FOR PRINTED CIRCUIT BOARDS

Field Service Engineer

Location: West Coast, Midwest

Pluritec North America, Ltd., an innovative leader in drilling, routing, and automated inspection in the printed circuit board industry, is seeking a full-time field service engineer.

This individual will support service for North America in printed circuit board drill/routing and X-ray inspection equipment.

Duties included: Installation, training, maintenance, and repair. Must be able to troubleshoot electrical and mechanical issues in the field as well as calibrate products, perform modifications and retrofits. Diagnose effectively with customer via telephone support. Assist in optimization of machine operations.

A technical degree is preferred, along with strong verbal and written communication skills. Read and interpret schematics, collect data, write technical reports.

Valid driver's license is required, as well as a passport, and major credit card for travel.

Must be able to travel extensively.

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Career Opportunities



Technical Service & Applications Engineer

Full-Time – Flexible Location

Koh Young Technology, founded in 2002 in Seoul, South Korea, is the world leader in 3D measurement-based inspection technology for electronics manufacturing. Located in Duluth, GA, Koh Young America has been serving its partners since 2010 and is expanding the team with an Applications Engineer to provide helpdesk support by delivering guidance on operation, maintenance, and programming remotely or on-site.

Responsibilities

- Provide support, preventive and corrective maintenance, process audits, and related services
- Train users on proper operation, maintenance, programming, and best practices
- Recommend and oversee operational, process, or other performance improvements
- Effectively troubleshoot and resolve machine, system, and process issues

Skills and Qualifications

- Bachelor's in a technical discipline, relevant Associate's, or equivalent vocational or military training
- Knowledge of electronics manufacturing, robotics, PCB assembly, and/or AI; 2-4 years of experience
- SPI/AOI programming, operation, and maintenance experience preferred
- 75% domestic and international travel (valid U.S. or Canadian passport, required)
- Able to work effectively and independently with minimal supervision
- Able to readily understand and interpret detailed documents, drawings, and specifications

Benefits

- Health/Dental/Vision/Life Insurance with no employee premium (including dependent coverage)
- 401K retirement plan
- Generous PTO and paid holidays

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Arlon EMD, located in Rancho Cucamonga, California, is currently interviewing candidates for open positions in:

- Engineering
- Quality
- Various Manufacturing

All interested candidates should contact Arlon's HR department at 909-987-9533 or email resumes to careers.ranch@arlonemd.com.

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

Our facility employs state of the art production equipment engineered to provide cost-effective and flexible manufacturing capacity, allowing us to respond quickly to customer requirements while meeting the most stringent quality and tolerance demands. Our manufacturing site is ISO 9001: 2015 registered, and through rigorous quality control practices and commitment to continual improvement, we are dedicated to meeting and exceeding our customers' requirements.

For additional information, please visit our website at www.arlonemd.com

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Career Opportunities

INSULECTRO

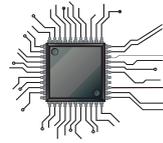


Are You Our Next Superstar?!

Insulectro, the largest national distributor of printed circuit board materials, is looking to add superstars to our dynamic technical and sales teams. We are always looking for good talent to enhance our service level to our customers and drive our purpose to enable our customers to build better boards faster. Our nationwide network provides many opportunities for a rewarding career within our company.

We are looking for talent with solid background in the PCB or PE industry and proven sales experience with a drive and attitude that match our company culture. This is a great opportunity to join an industry leader in the PCB and PE world and work with a terrific team driven to be vital in the design and manufacture of future circuits.

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MivaTek

Global

Field Service Technician

MivaTek Global is focused on providing a quality customer service experience to our current and future customers in the printed circuit board and microelectronic industries. We are looking for bright and talented people who share that mindset and are energized by hard work who are looking to be part of our continued growth.

Do you enjoy diagnosing machines and processes to determine how to solve our customers' challenges? Your 5 years working with direct imaging machinery, capital equipment, or PCBs will be leveraged as you support our customers in the field and from your home office. Each day is different, you may be:

- Installing a direct imaging machine
- Diagnosing customer issues from both your home office and customer site
- Upgrading a used machine
- Performing preventive maintenance
- Providing virtual and on-site training
- Updating documentation

Do you have 3 years' experience working with direct imaging or capital equipment? Enjoy travel? Want to make a difference to our customers? Send your resume to N.Hogan@MivaTek.Global for consideration.

More About Us

MivaTek Global is a distributor of Miva Technologies' imaging systems. We currently have 55 installations in the Americas and have machine installations in China, Singapore, Korea, and India.

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Career Opportunities



eptac
TRAIN. WORK SMARTER. SUCCEED.

Become a Certified IPC Master Instructor

Opportunities are available in Canada, New England, California, and Chicago. If you love teaching people, choosing the classes and times you want to work, and basically being your own boss, this may be the career for you. EPTAC Corporation is the leading provider of electronics training and IPC certification and we are looking for instructors that have a passion for working with people to develop their skills and knowledge. If you have a background in electronics manufacturing and enthusiasm for education, drop us a line or send us your resume. We would love to chat with you. Ability to travel required. IPC-7711/7721 or IPC-A-620 CIT certification a big plus.

Qualifications and skills

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

Benefits

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

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American Standard Circuits
Creative Innovations In Flex, Digital & Microwave Circuits

CAD/CAM Engineer

The CAD/CAM Engineer is responsible for reviewing customer supplied data and drawings, performing design rule checks and creation of manufacturing data, programs and tools required for the manufacture of PCB.

ESSENTIAL DUTIES AND RESPONSIBILITIES

- Import Customer data into various CAM systems.
- Perform design rule checks and edit data to comply with manufacturing guidelines.
- Create array configurations, route, and test programs, penalization and output data for production use.
- Work with process engineers to evaluate and provide strategy for advanced processing as needed.
- Itemize and correspond to design Issues with customers.
- Other duties as assigned.

ORGANIZATIONAL RELATIONSHIP

Reports to the engineering manager. Coordinates activities with all departments, especially manufacturing.

QUALIFICATIONS

- A college degree or 5 years' experience is required.
- Good communication skills and the ability to work well with people is essential.
- Printed circuit board manufacturing knowledge.
- Experience using Orbotech/Genflex CAM tooling software.

PHYSICAL DEMANDS

Ability to communicate orally with management and other co-workers is crucial. Regular use of the phone and e-mail for communication is essential. Sitting for extended periods is common. Hearing and vision within normal ranges is helpful for normal conversations, to receive ordinary information and to prepare documents.

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Career Opportunities



APCT, Printed Circuit Board Solutions: Opportunities Await

APCT, a leading manufacturer of printed circuit boards, has experienced rapid growth over the past year and has multiple opportunities for highly skilled individuals looking to join a progressive and growing company. APCT is always eager to speak with professionals who understand the value of hard work, quality craftsmanship, and being part of a culture that not only serves the customer but one another.

APCT currently has opportunities in Santa Clara, CA; Orange County, CA; Anaheim, CA; Wallingford, CT; and Austin, TX. Positions available range from manufacturing to quality control, sales, and finance.

We invite you to read about APCT at APCT.com and encourage you to understand our core values of passion, commitment, and trust. If you can embrace these principles and what they entail, then you may be a great match to join our team! Peruse the opportunities by clicking the link below.

Thank you, and we look forward to hearing from you soon.

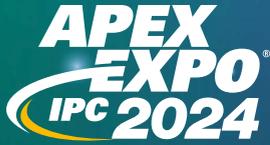
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CONFERENCE & EXHIBITION

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WHAT'S NEXT BECOMES NOW

CALL FOR PARTICIPATION

IPC invites engineers, researchers, academics, students, technical experts, and industry leaders to submit abstracts for the **Electronic Circuits World Convention 16 (ECWC16) Technical Conference** hosted by IPC APEX EXPO 2024.

TECHNICAL TRACKS

- Quality, Reliability, Test and Inspection
- Design
- PCB Fabrication and Materials
- HDI, uHDI and Substrates
- Electronic Assembly Materials
- Assembly Processes
- Factory of the Future Implementation
- High Reliability for Extreme Requirements
- Sustainability for Electronics
- Emerging Technologies
- Market Trends and Outlook

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AUGUST 28, 2023

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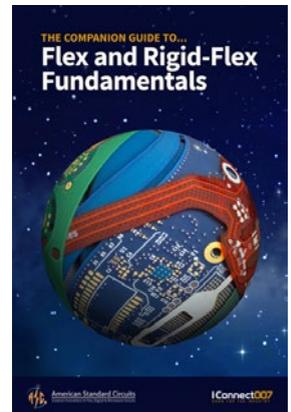


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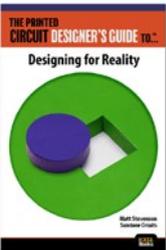


NEW!**THE COMPANION GUIDE TO... FLEX AND RIGID FLEX FUNDAMENTALS**

I-Connect007 and American Standard Circuits are proud to announce the launch of the companion guide to the immensely popular *The Printed Circuit Designer's Guide to... Flex and Rigid-flex Fundamentals*. This short guide, written by topic experts at American Standard Circuits, is designed to provide additional insights and best practices for those who design or utilize flexible and/or rigid-flex circuit boards. Topics covered include trace routing options, guidelines for process optimization, dynamic flexing applications, rigid-to-flex transition and more. Visit I-007ebooks.com to download your copy.

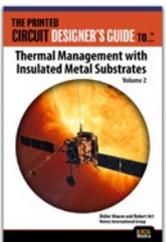


I-007eBooks The Printed Circuit Designer's Guide to...

***Designing for Reality***

by Matt Stevenson, Sunstone Circuits

Based on the wisdom of 50 years of PCB manufacturing at Sunstone Circuits, this book is a must-have reference for designers seeking to understand the PCB manufacturing process as it relates to their design. Designing for manufacturability requires understanding the production process fundamentals and factors within the process. [Read it now!](#)

***Thermal Management with Insulated Metal Substrates, Vol. 2***

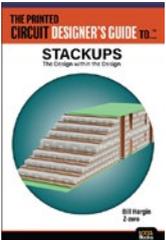
by Didier Mauve and Robert Art, Ventec International Group

This book covers the latest developments in the field of thermal management, particularly in insulated metal substrates, using state-of-the-art products as examples and focusing on specific solutions and enhanced properties of IMS. [Add this essential book to your library.](#)

***High Performance Materials***

by Michael Gay, Isola

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***Stackups: The Design within the Design***

by Bill Hargin, Z-zero

Finally, a book about stackups! From material selection and understanding laminate data-sheets, to impedance planning, glass weave skew and rigid-flex materials, topic expert Bill Hargin has written a unique book on PCB stackups. [Get yours now!](#)

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

MANAGING EDITOR: **ANDY SHAUGHNESSY**
(770) 315-9901; andy@iconnect007.com

EDITOR | COLUMNIST COORDINATOR: **MICHELLE TE**
michelle@iconnect007.com

CONTRIBUTING EDITOR: **PATRICIA GOLDMAN**
(724) 299-8633; patty@iconnect007.com

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

CONTRIBUTING TECHNICAL EDITOR: **DAN FEINBERG**
baer@iconnect007.com

CONTRIBUTING TECHNICAL EDITOR: **HAPPY HOLDEN**
(616) 741-9213; happy@iconnect007.com

SALES MANAGER: **BARB HOCKADAY**
(916) 365-1727; barb@iconnect007.com

BUSINESS DEVELOPMENT: **TAMARA SITES**
tamara@iconnect007.com

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

ART DIRECTOR/PRODUCTION MGR.: **SHELLY STEIN**
shelly@iconnect007.com

MAGAZINE LAYOUT: **RON MEOGROSSI**

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

CREATIVE TECHNOLOGIST: **BRYSON MATTIES**

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