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Don't Just Survive, Thrive

If we are to be relevant and prosper during these next critical decades in electronics, we must do more than survive. As an industry, we can and must thrive. What does it take to remain viable and grow and prosper during so much change? In this issue, our contributors explore these concepts meant to help take your business to the next level.

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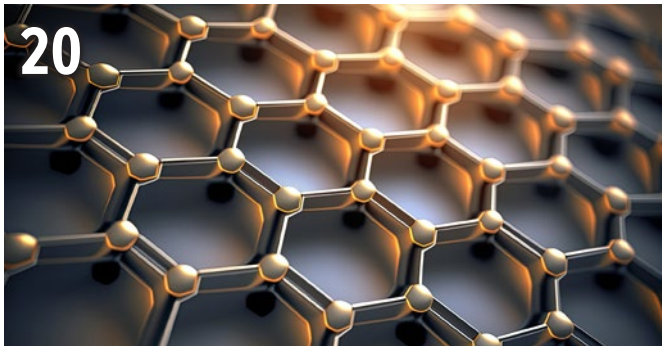
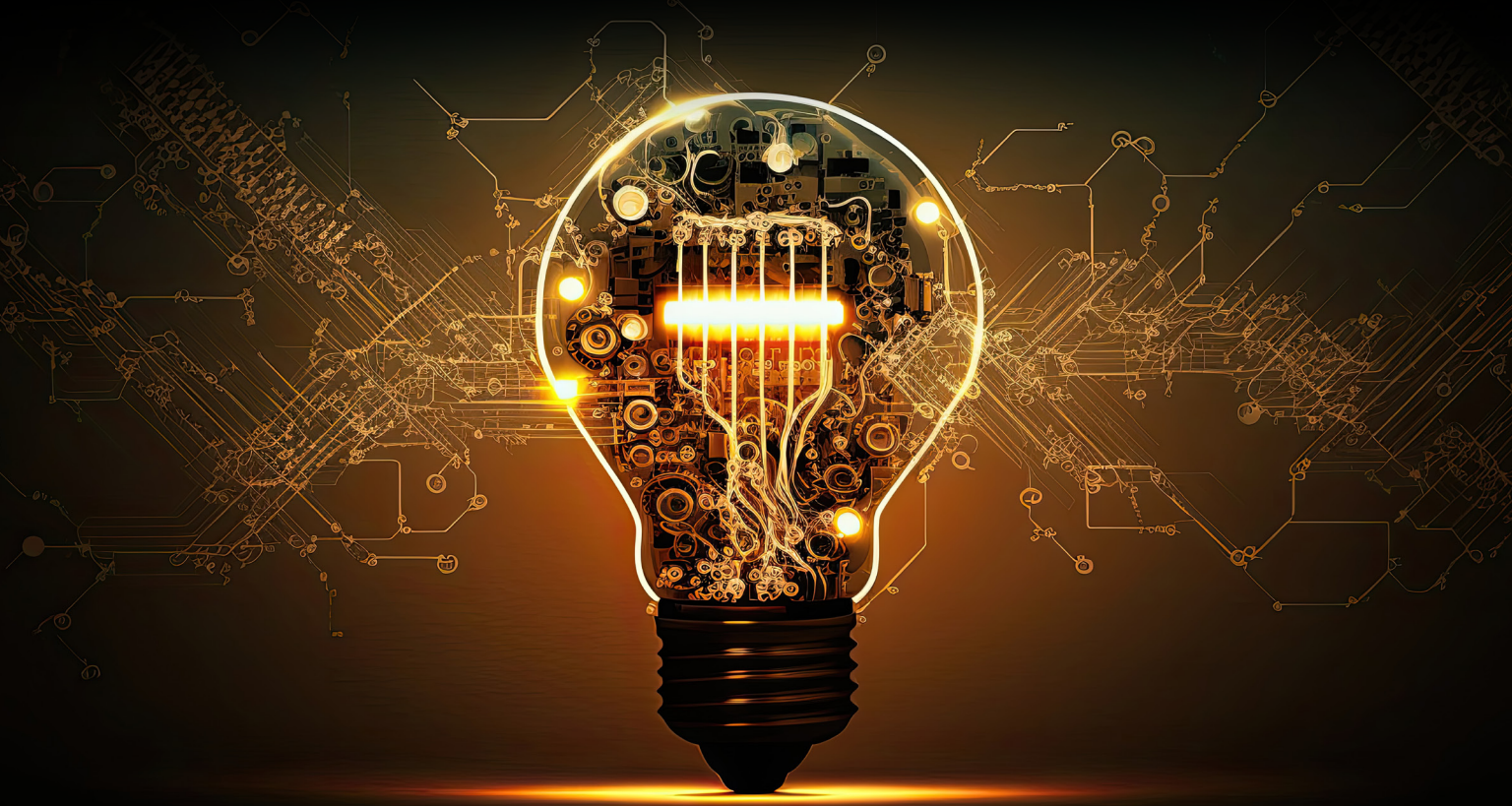


SMART FACTORY DESIGN



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The Art, Science, and Reality of Thriving

Marcy's Musings

by Marcy LaRont, I-CONNECT007

By all accounts, the global electronics industry is thriving and has done so in a relatively short historical period marked by momentous technological advancement. Since the invention of the working transistor in 1947—just 77 years ago—our area of electronics alone has seen the first printed circuit board, the advent of plated through-hole technology, microvias and laser drilling, and printed electronics. Particularly considering the technology we support, this technical arc is staggering and should inspire a sense of accomplishment, appreciation, and perhaps even awe.

With technology expected to advance at an exponential pace over the next 20 years, our industry must step up to the need for commensurate development, reinvention, and expansion. If we are to be relevant and prosper during these next critical decades in electronics, we must do more than survive. As an industry, we can and must thrive.

What does it take to remain viable and grow and prosper during so much change? It takes resilience, which includes commitment, vision, positivity, and a willingness to adapt. Resilience is key to thriving over the long term—from an individual to a company, industry, and nation.

Defined as a psychological response to trials and challenges, the primary tenets of individual resilience are acute self-awareness, self-control, good problem-solving skills, and having a supportive social network (human connection). Interestingly, positive psychology (the study of human flourishing) cites mindfulness, inner strength, and human connection, along with a strong sense of gratitude, as being primary to achieving increasing levels of happiness. These things are often present in resilient individuals and groups.

When I think of cultural resilience, I think of my grandparents who were born circa the turn of the last century, and lived through two world wars and the Great Depression. In America, they have been deservedly crowned "the greatest generation" and embody resiliency in a way that their descendants can never fully understand. That generation collec-

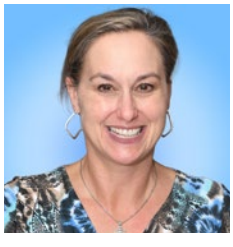
tively possessed a determination and positivity that we define as "grit," and which ultimately resulted in their great professional and financial success.

Our industry has continuously illustrated similar resiliency. Necessity is the mother of invention, and the drive to survive can indeed lead to thriving, which has been true for our industry. But the degree of evolution and reinvention displayed by our companies over the last 77 years is impressive, and we should be collectively proud. Our industry possesses so many intelligent, optimistic, determined professionals who use their vision—and their grit—to keep moving forward despite the challenges inherent in a global supply chain.

In this issue, I asked Schmoll America, American Standard Circuits, and Alpha Circuit: "What does it mean not only to survive but thrive?" I know you will appreciate how they explain what it means to thrive in their organizations.

Also in this issue, columnist Paige Fiet of TTM-Logan weighs in on how she's thriving in her own life and career, an excellent follow-up to her last column on problem-solving. Jesse Ziomek of DIS illustrates thriving through innovation and expansion via automation, and Alex Stepinski displays the characteristics of ingenuity and reinvention as he lays out a new model for a much less expensive PCB startup. Our talented columnists Don Ball, Happy Holden, and Mike Carano add their intellect to the mix, making this issue thrive with abundant value. Finally, I welcome Shane Whiteside, representing PCBAA and Tom Yang with CEE as new columnists this month.

Here's to thriving. **PCB007**



Marcy LaRont is the editor of *PCB007 Magazine*. Marcy started her career in PCBs in 1993 and brings a wide array of business experience and perspective to I-Connect007. To contact Marcy, click here.

GLOBAL CITIZENSHIP:

Bringing Two Cultures Together in PCB Manufacturing

by Tom Yang

Welcome to my new column. My name is Tom Yang, and I am the CEO of CEE PCB, a family-owned global printed circuit board business. I was actually educated in California, earning my bachelor's and master's degrees in finance at Cal State. After graduating, I worked in investment banking for a while, then came to work at CEE, where I have been ever since.

We are a family-owned business. My dad is the founder and chair of the company; my uncle heads the sourcing team. I first joined the purchasing team in 2019 when our Zhuhai factory was in the early stages of construction. I watched it being built and helped by selecting and installing all the new equipment. For the past three years, I have spent most of my time at the headquarters in Huizhou, as well as visiting clients in mainland China and around the world once COVID restrictions were lifted.

Over the years, we have put together a great team at CEE. Our team works on the principle of "family-by-choice"; whether or not we are actually related, we operate as one big family, and we have valued these efforts over the years very much.

During my years in America, I came to realize that many of the impressions we have in China about Americans are misconceptions. That same thing applies for the impressions that Americans have about China. In truth, I have found myself in the middle. I have spent much time trying to explain Chinese business culture to Americans and American business culture to Chinese businesspeople, especially those in our industry.

To continue reading this column, click here.

To Thrive, Surround Yourself with Good People

One World, One Industry

Feature Column by Dr. John W. Mitchell, IPC PRESIDENT AND CEO

At various times in my career, I have been asked how to be successful or to thrive in business. There are many answers to this question, which differ depending on the situation you find yourself in. Some of the basics I have heard most often include working hard, staying focused on just a few things, always doing the right thing—it will ultimately pay long-term dividends—and many others.

But if I could pick just one thing that would make the biggest difference for your company and your individual success, it would be to surround yourself with people who are better than you are.

Sadly, there are people out there who find this threatening and who believe that if the people on their team are smarter, better, faster (cue the "Six Million Dollar

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> “Teams that have great players on them tend to win, and people like winners.”

Man” theme music) than they are, they will not be around very long. I believe the opposite is true. Teams that have great players on them tend to win, and people like winners. If you feel threatened by those you work with, you should think about how you can improve to become the best contributor in your area for your team.

On the other hand, what a great joy it is to have those around you impressing you with their dedication, ingenuity, passion, and creativity. This is not only personally satisfying but tends to lead to excellent outcomes. When you get great outcomes, that’s a team worth investing in.

How do you find such great players to join your team? Well, that is the real challenge of this suggestion. It is not just about offering more money. You need to provide a vision of where you are trying to go. What is the mountain you are looking to climb? Share how this person will help to make that daunting objective a reality. When you get them on board, you need to clear obstacles from their path (and those will keep popping up internally and externally) and then get out of their way.

Clearing obstacles for great employees means finding ways to ensure that they stay, know they are valued, and that you will put the time and effort into their careers to encourage them to continue working for you. One important key to retaining your best people is ensuring that you train, retrain, and upskill them. Loyal and satisfied employees are those who have the right tools to do their jobs, are given options for growth within the company, and feel valued for what they provide to the company.

If you don’t develop, train, upskill, and offer pathways for growth to your best people, you risk losing them. Upskilling provides employees who have mastered basic skills the necessary new expertise for today’s positions and jobs. Pathways ensure that employees know that their job has a path forward and that with hard work and an openness to learning new skills, there is a clear track for career growth.

I cannot overstate how important it is to invest in development and training for your team. It’s a clear sign that you value them and that they have an important place in your company. Building a culture of inclusion, acceptance, and lifelong learning will help your employees grow and improve your bottom line. Are you truly “seeing” your employees as individuals and recognizing what they bring to your organization? Engaged, valued employees are more productive, and less likely to look elsewhere for a new job.

Working with great talent makes the tasks before us—as insurmountable as they sometimes may seem—more approachable and achievable. When you surround yourself with great people, you will be pushed to do better and greater things. In my book, that is the secret of success. **PCB007**

Dr. John W. Mitchell is president and CEO of IPC. To read past columns, click here.

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Are You Ready to Thrive? Keep an Open Mind

Feature Q&A With Anaya Vardya

Anaya Vardya joined American Standard Circuits in 2007, and his leadership strategy has focused on teamwork, technological advancement, and a strong marketing strategy. He leans on his extensive industry background and is inspired by former Intel CEO Andrew Grove, whose philosophy centered on proactive adaptability and emphasized thriving over mere survival.

Anaya champions a management style rooted in trust, empowerment, and change readiness, ensuring continuous growth and innovation in the competitive PCB manufacturing sector.

Anaya, what was your biggest challenge when you came to ASC, and how did you manage it?

The company was started in 1988, and I came in 2007. At that time, we had two facilities shipping about $10 million. The majority of the product was very basic technology. One of the two facilities also had RF capabilities. However, a majority of that business was in 4–5 volume part numbers. There was little or no marketing at that time, and most of the sales were made word-of-mouth. My role was to modernize the systems, update

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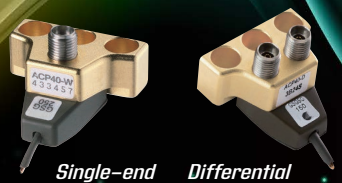

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Anaya Vardya

the technology, and grow the business. I had previously worked at several larger PCB facilities, such as IBM, UCI Continental Circuits, Merix, and Coretec, so I had developed a good experience base that helped me develop a clear vision of what American Standard Circuits could be.

We made a change early on: consolidating the two operations. This was an interesting experience since one was run like a mom-and-pop shop, and the other was a MIL-certified facility. Early on, we needed to navigate the clash of cultures.

We then worked on improving and growing our technology. Our first challenge was implementing flex and rigid-flex PCBs. Since then we have been continuously engaged in improving our technology offerings.

From your perspective and professional experience as a business owner, what does it mean to "not only survive but thrive?"

That is a phrase we often use at ASC. So often companies in our industry have been only focused on survival. Personally, I consider this a losing game of being reactive instead of proactive. Nothing great comes out of just trying to survive. When you choose to thrive, it establishes a vision for excellence and a posture of constant re-invention. To thrive, a company has to stay ahead of the pack. They have to be not only better than the competition but better for the industry as well. They must always have a long-term vision.

As you look back, what has been key to your continuing to adapt and grow your business? What have you learned?

First and foremost, our success has been driven by our people. Their teamwork and can-do attitude have been essential, allowing us to thrive. Therefore, it is crucial to build a strong team and cultivate a culture of collaboration and mutual respect.

Another key factor in our growth has been technology. As we advance technologically, we attract more interest, gain more customers, and see our business expand. We prioritize listening to our customers to understand their current and future needs, and we strive to meet those needs. By being proactive, we often let our customers shape our future strategic directions.

One of the key lessons I've learned is the value of marketing and the distinction between sales and marketing. The companies I previously worked for didn't emphasize marketing; they relied on a "build it, and they will come" approach. However, at ASC, our exponential growth has been influenced by our extensive marketing efforts. From value-added content and newsletters to advertising and publishing focused e-books, all these activities have significantly enhanced our market presence and overall sales.

What is your philosophy on change management? Has this changed for you as a business owner over the years?

I have learned to trust my team. I not only listen to them, but I also hear them. I solicit their opinions and ideas, and I incorporate them

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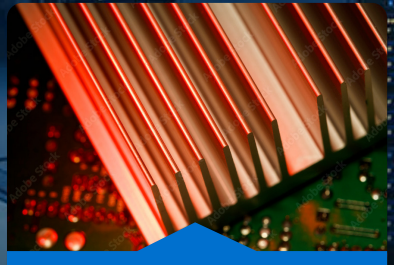

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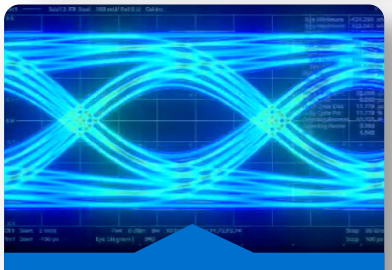

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into the company's vision and strategic direction. A good manager is only as good as his team, and the team is only as good as he allows them to be. I strive to nurture my team to greatness. The better they perform, the better our company performs. Management is all about empowerment.

What philosophy or role model has been influential on your management style and your ability to be resilient?

Andy Grove's *Only the Paranoid Survive* profoundly influenced my philosophy by instilling the importance of vigilance and adaptability in the face of change. His insights into strategic inflection points emphasized that complacency is a business's greatest enemy, and his experiences taught me that anticipating and embracing change, rather than fearing it, is crucial for sustained success. His principle, "Success breeds complacency, and complacency breeds failure," became a cornerstone of my approach, driving me to continuously innovate and remain alert to shifts in the environment, ensuring long-term resilience and growth.

You seem to have a solid grasp of positioning yourself in a dynamic market. Please discuss your strategy.

We believe in "Collaborate to Win." This is the first thing we tell our customers and our suppliers. Our marketing campaign is ultimately tailored to educating the industry and discussing the interactions between designers and fabricators. The better we work together, the less painful it is for all parties.

We leverage a robust digital presence, utilizing targeted online marketing campaigns, social media engagement, and informative content to reach and educate our audience. Our brand narrative highlights our commitment to innovation, customer service, and expertise, differentiating us from competitors. By fostering strong relationships with industry influencers and participating in key trade shows and conferences, we enhance our visibility and credibility. This comprehensive strategy enables us to adapt quickly to market changes, effectively communicate our value proposition, and maintain a competitive edge.

What words of wisdom do you have for an individual or company that wants to thrive in the coming years?

Have an open mind. Be open to new ideas and directions. Listen to your customers; they will tell you what they want. Try new things. Fail intelligently. If you are not making mistakes, you are not trying enough new things. Find your own way. Focus on your company and your company's direction. Do not be influenced by what you hear. Do not ever let the news dictate where your company is going. Always move forward. Measure and then measure again. Let the facts—your data—dictate how your company is doing today and how that will influence how you will do in the future.

Finally, as the company leader, be strong enough to listen to and trust your teammates but also strong enough to clearly establish your company's direction and vision. If you don't determine your future someone else will. **PCB007**

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Processes to Support IC Substrates and Advanced Packaging, Part 5

Trouble in Your Tank

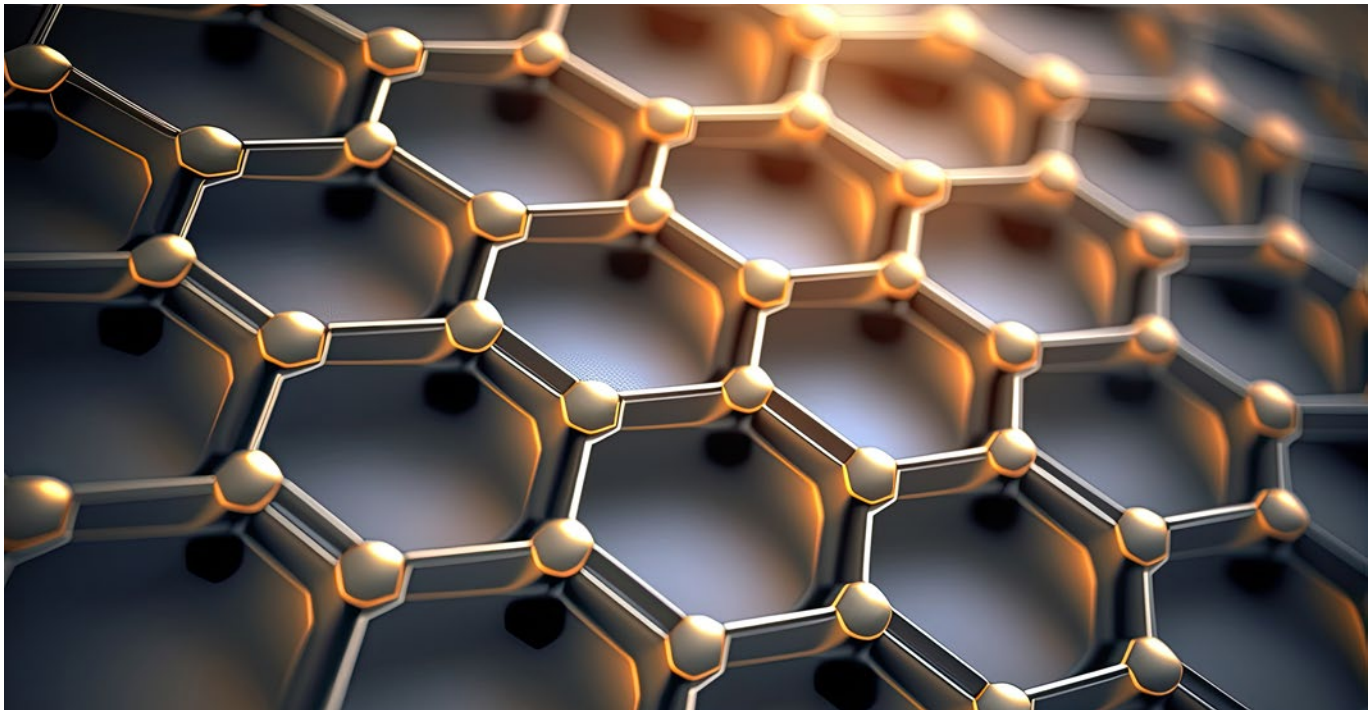
by Michael Carano, IPC CONSULTANT

Direct metallization systems based on conductive graphite or carbon dispersion are quickly gaining acceptance throughout the world. Indeed, the environmental and productivity gains one can achieve with this process are outstanding. In today's highly competitive and litigious environment, direct metallization reduces costs associated with compliance, waste treatment, and legal issues related to chemical exposure. What makes these processes leaders in the direct metallization space? This is detailed below.

The Carbon-based Systems (Graphite and Carbon Black)

While both are carbon-based materials, graphite and carbon black have a few differences. The graphite process is based on a very fine and stable aqueous dispersion of synthetic crystalline graphite. The graphite particle, by virtue of its crystalline structure, is highly conductive. Carbon black is an amorphous material with the ability to conduct current. Both materials are well-represented in the global market for printed circuit board fabrication. So, what makes these two carbon-based processes ideal for thin material metallization and plated through-holes?

Both processes are quite versatile in their ability to deposit the carbon or graphite on non-conductive materials. These carbon-based systems can be likened to a coating technology; surface topography is not an issue to adhere to the resin materials.



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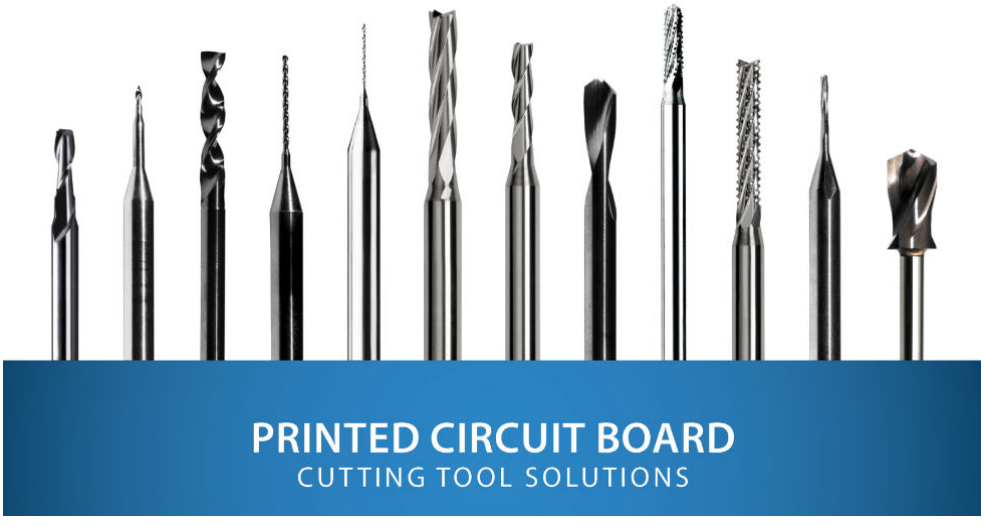

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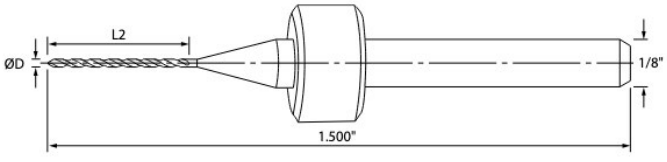

4 Facet Point Geometry

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.

This fact is especially important today as the industry's material suppliers push the envelope to produce higher-performance resins and laminate composites. With each incremental enhancement in materials properties, such as coefficient of thermal expansion (CTE), temperature of decomposition (Td), signal integrity, and glass transition temperature (Tg), these materials become more difficult to process. These higher-performance materials are highly cross-linked and are more chemically resistant to processes such as alkaline permanganate desmear.

In contrast to the carbon-based systems, conventional electroless copper requires a micro-roughened resin surface to effect sufficient adhesion of the copper to the resin. A precious metal catalyst (most commonly palladium) is required to bring about the oxidation of formaldehyde (the reducing agent most commonly used in electroless copper formulations). Essentially, electroless copper is composed of two half-cell reactions, with several process steps required to provide a void-free copper deposit. In addition, during the copper plating process, hydrogen gas has evolved. The production of hydrogen gas produces bubbles that can lodge in small diameter through-holes and blind vias. If the hydrogen gas bubbles are not efficiently evacuated from the vias, plating voids will result. The overall electroless copper reaction is shown below:

"If the hydrogen gas bubbles are not efficiently evacuated from the vias, plating voids will result."

Overall Reaction: $Cu(EDTA)2- + 2HCHO + 4OH- \rightarrow Cu + H2 + H2O + 2CHOO- + EDTA4+$

Second, the manufacturing cycle time to metallize a printed circuit board through a conventional electroless copper process is 45–55 minutes. CapEx requirements aside, direct metallization offers faster throughput and, in turn, reduces energy costs as well as greenhouse gas

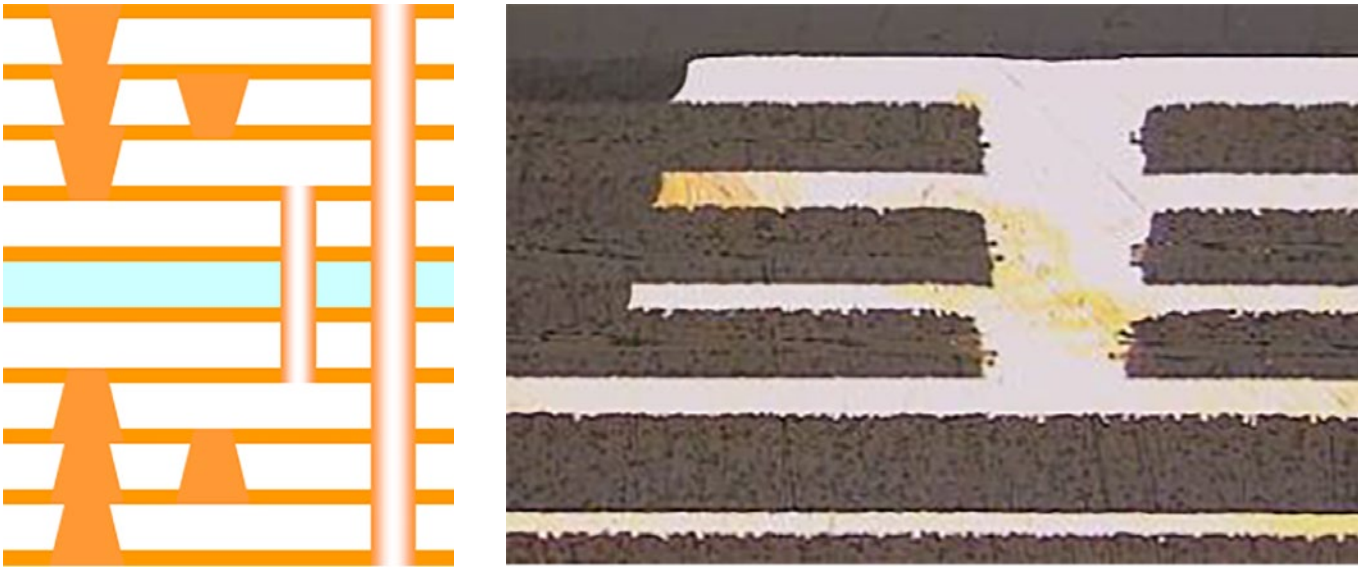

Figure 1: Examples of stacked vias.

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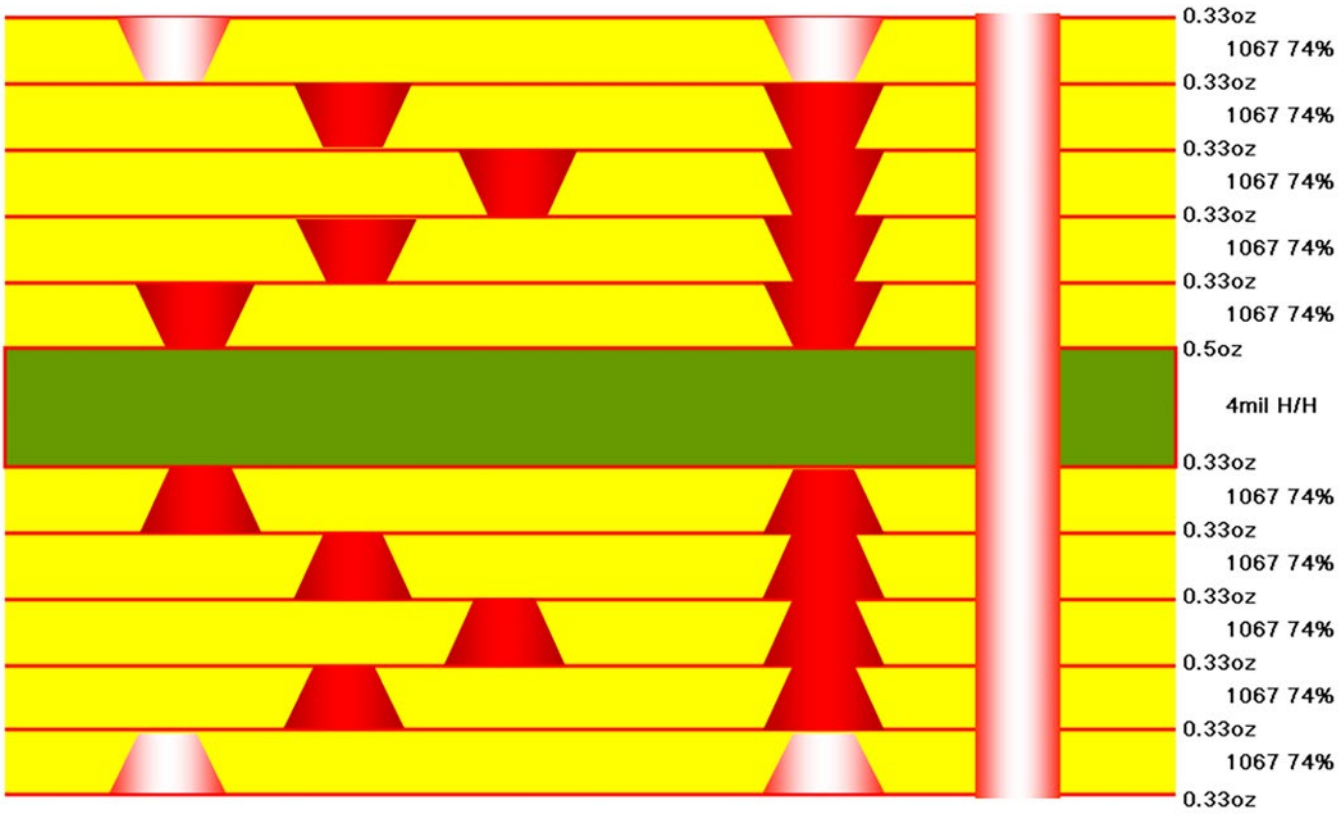

Figure 2: The ELIC process.

emissions. Certainly, sustainability should be on everyone's list going forward. If one simply calculates the amount of energy required to heat process tanks and the time it takes to process a circuit board through any one process, it can be shown that processes that reduce production time and use less energy will reduce the carbon footprint and thus greenhouse emissions. More on this in a future column.

Ideal Applications for Direct Metallization

With more emphasis on HDI and ultra HDI, ease of use and speed are critical operational must-haves. Advanced packaging is driving higher densities for IC substrates, interposers, and product boards. This necessitates the increased complexity of these boards and substrates with ever finer lines and spaces, multiple sequential laminations, and smaller diameter blind vias. The carbon and graphite-based direct metallization systems are ideally suited for these challenges.

The level of complexity is depicted in Figure 1. In addition, the every layer interconnect (ELIC) process is also practiced in the industry (Figure 2).

With proper material selection, the constructions shown in Figures 1 and 2 will improve long-term reliability and withstand the multiple laminations required. The key here is to select materials with low CTE and higher temperatures of decomposition.

The direct metallization process described in this column will enable faster productivity through primary metallization in contrast with conventional electroless copper. **PCB007**

Michael Carano brings over 40 years of electronics industry experience with special expertise in manufacturing, performance chemicals, metals, semiconductors, medical devices, and advanced packaging.

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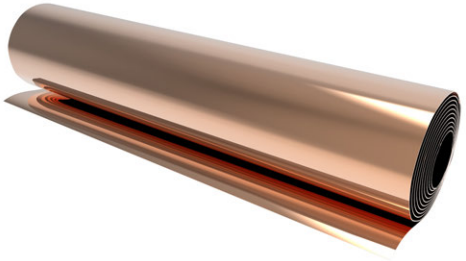

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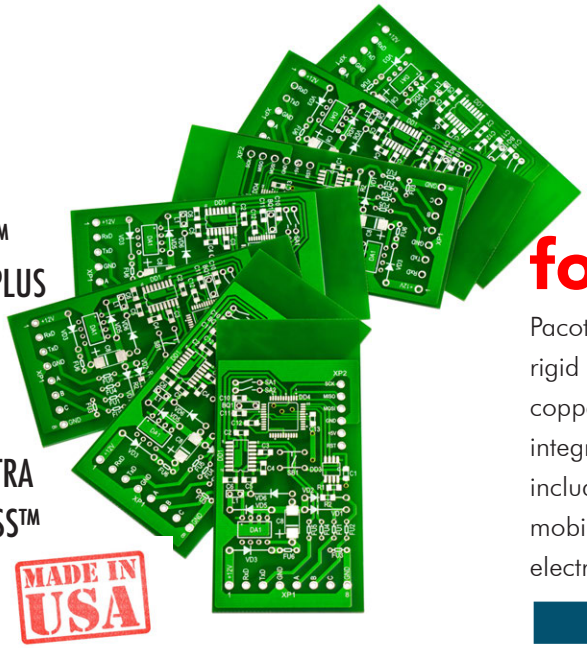

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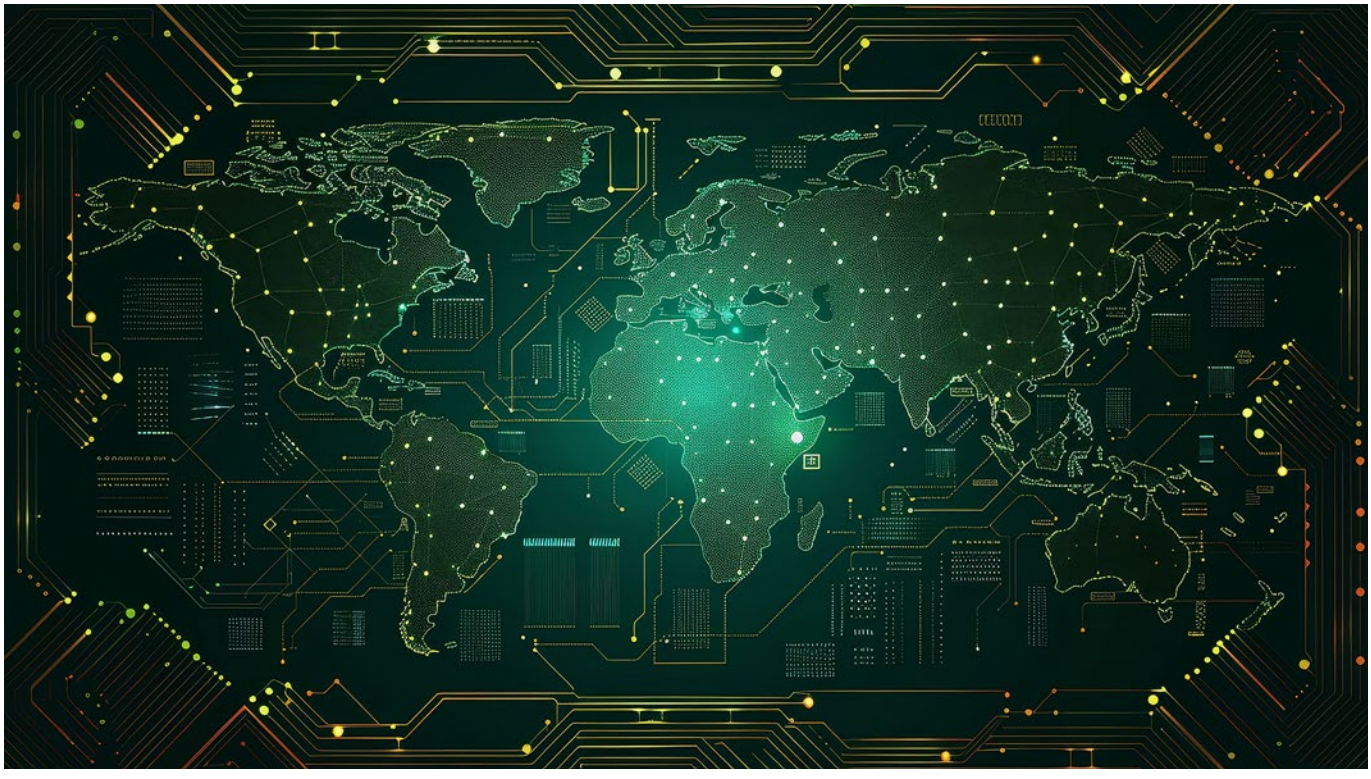

Thriving in the Global PCB Market

Feature Interview by Marcy LaRont
I-CONNECT007

As we examined what it means to thrive in our industry, it only made sense to reach out to Kurt Palmer, president of Schmoll America. The new business expansion was created from Schmoll Maschinen to focus on and better serve the expanding North American PCB market. Professionally, Kurt has been in this business for decades. He explains what thriving looks like for Schmoll America as the company moves forward into this new venture and what he is most looking forward to in the years ahead.

Marcy LaRont: Kurt, from the perspective of you and Schmoll, what does it mean to "not only survive, but to thrive?"

Kurt Palmer: The PCB industry is mature and very competitive, as you know. In some ways, I suppose "thriving" is relative. To me, thriving means we are thought of by customers as a go-to partner to exchange thoughts and ideas, and we take those best exchanges and use that knowledge to develop new products with advanced features. It also means having our eye squarely on the ball to develop our team into experts in those areas needed by our customers. That means a relentless drive to hire and develop our people. In the end, it means if we stay focused on the needs of our customers, we should be around for a long time. Schmoll America and Schmoll Maschinen are proud to be considered an industry leader in the segments we serve.

You recently announced Schmoll America as a distinct business entity, which is a significant and strategic business move. What led to that decision?

Making the decision for Schmoll to come directly into the North American PCB mar-

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Kurt Palmer

ket was long overdue. We knew by directly supporting the market, we would be able to get closer to customers, expand those relationships, and get that direct feedback needed to develop our technology, not to mention it would enhance our direct technical support and after-sales service. What drove us to make this decision now is the positive momentum we're seeing in the North American PCB market. We must be well-connected to our customer base now more than ever.

To this end, in just our first three months, we've added three field technicians with a plan to hire three more in Q3. We have introduced our new series of Schmoll Technology Seminars and embarked on our plan to integrate the Schmoll Germany technical team into the market alongside the Schmoll America team. I think the momentum we have internally also speaks to our thriving.

Professionally, you have seen a lot of change over the past few decades. How do you feel about where we find ourselves globally and in the Americas?

Globally, the PCB market is in a solid position. Demand for PCBs is expected to grow 4–5% per year, resulting in a global market of $100 billion by 2030. In the medium term, the U.S. is expected to receive more than its share of that growth, mainly due to the geopolitical winds blowing our way. In the past 25 years, manufacturing has migrated to Asia, mainly China, and today, less than 4% of boards are produced in North America. This is the first time in over 25 years that investment in PCB manufacturing is coming back in an impactful way.

As a result, we are seeing sizable investment in U.S. PCB capacity. I recently spent time in Washington, D.C., working with PCBAA, asking for further government support for our industry. Without exception, every government contact we met supports legislation to bring more manufacturing back to the U.S. In fact, PCBAA has been able to get co-sponsorship commitments from several congressmen for H.R. 3249. I'm confident that government support of the investment into electronics manufacturing will continue as well.

What is your philosophy on change management, and has it changed over the years?

Earlier in my career, I'd probably describe my philosophy toward change management as non-existent. I was more of a top-down manager focused on day-to-day activities, not looking at the bigger picture. I put little effort into anticipating changes that, down the road, might affect the business.

Today, we spend a good deal more time on continuous improvement and learning. I'd like to think we are an organization that has trained our people to look for change, embrace it, and adapt to it. At the same time, we spend time on contingency planning every year.

Workforce challenges are a consideration for most of us right now. Good workers, especially technical people, are hard to find, and you do not want to lose the good ones you have. What are your thoughts on workforce, and do you have a strategy for recruiting and retaining talent?

Like most employers, we struggle to find technical people. Since I joined Schmoll in 2019,

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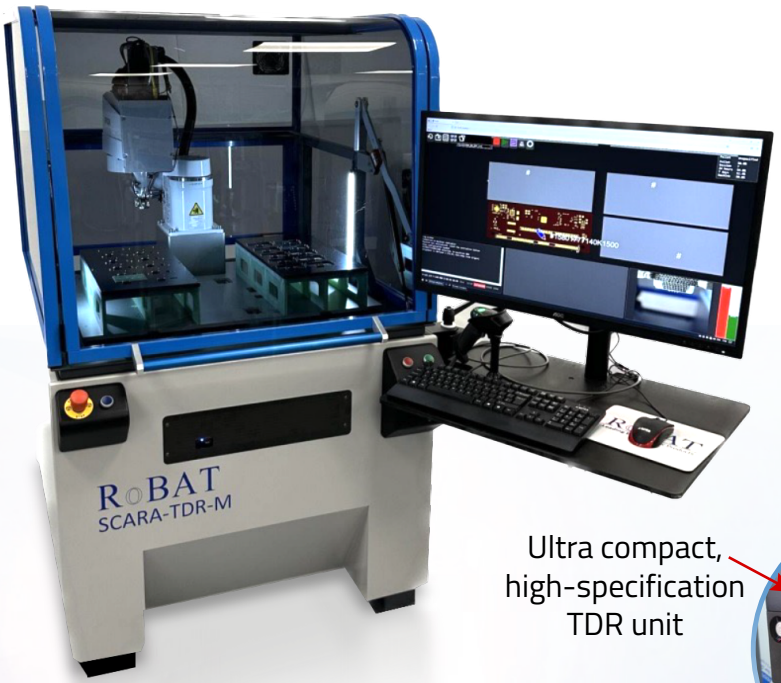

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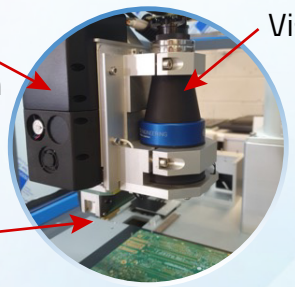

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we've been continually looking for people to join our team. Just when I feel we're at the right personnel level, I'm reminded we're not, and we are looking again.

That said, we've been relatively successful in bringing people on board and retaining them. There are three key areas we focus on to attract and retain good technical people:

1. Our job postings are honest. They describe the most interesting aspects of the position, but we are brutally honest about the downsides, such as the travel involved. We insist that a candidate take a couple of days to discuss the travel requirements with those people who are important to them. They need to be part of the decision, or else it doesn't work. We've had more than a few great candidates decline our job offer after thinking about it over the weekend. We would much prefer they figure it out before they take the position rather than a year or two into the job.
2. Having mechanical or electrical competence is a given, but technicians also need soft skills. Technicians with good people and communication skills will be more successful and, therefore, more satisfied in the position. We spend a lot of time and effort figuring this out during the recruitment process.
3. Our technicians continually receive new training. Whether it's focused, on-the-job training shadowing our experienced technicians or the once-per-year trip to the factory in Germany, we put training at the top of our priority list for our employees.

The job is rarely boring, and that helps our retention too.

> "I expect advances to come out at an even faster pace as we utilize AI."

What are you most looking forward to over the next few years?

Schmoll has always been a technology leader, whether it be with advanced back-drilling techniques for mechanical drill, or development of very fine line imaging systems. What will be really exciting going forward is to see how AI will accelerate further development. We are embracing AI in a big way, and I'm excited about new technologies coming down the pike that haven't even been thought of yet. I expect advances to come out at an even faster pace as we utilize AI.

From a big-picture market perspective, we are in a period where the big influences are more geo-political than typical global supply and demand. Overall, PCB demand will continue to grow, but where will that demand come from? Where will the investment go, and how much will be influenced by politics? Will there be regions of over-supply, and how might that impact the overall market condition? Bottom line, I'm looking forward to more stability in the market.

What advice do you have for anyone feeling fearful about changes ahead in our industry? What thoughts can you share with an individual or company that wants to thrive in the next decade?

If I had to do it all over again and was starting right now, I'd jump in with both feet. The market is growing at 5% per year. Sure, there are crazy things happening that are out of our control, but the craziness is affecting many advanced industries across the globe, not just ours. These are exciting times. But also, don't just get lost in the excitement; stay in tune with the market. Things are sure to change, and we will have to adapt.

Kurt, great insight. Thank you.

You're welcome. **PCB007**

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I've Found My 'Why'

The New Chapter

Feature Column by Paige Fiet, TTM-LOGAN

I often think about the phrase, "Excellence is born when someone shows they care." We each have reasons for choosing a certain career path and then deciding whether to stay on that path or leave and go another direction. Those reasons often stem from our ability to care about the work we do.

Lately, I've been reflecting on my reasons for starting a career in electronics. For me, it comes down to a passion for what I do. However, passion cannot be the only driving force. If it was, I probably would have become a potter or a professional hiker. To determine your "why," we should balance our passions, expected compensations, and the value-add or meaning of our work. We should be intentional in our reasons for the career(s) we pursue. If you're working on your "why" or determining what path you'd like to take, please consider these recommendations.

Passion

There's a saying, "If you like what you do, you'll never work a day in your life." Personally, this seems a bit idealistic. It's important to enjoy what you do for 2,080 hours each year but it's ignorant to believe none of those hours will feel like work. Passion doesn't mean we will "like" what we are doing all the time. Hiking for the views is a big passion of mine, but I

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don't always enjoy hiking up the mountain. I do, however, love the view from the top. Work draws parallels to hiking for me. Some days may be stressful, but seeing the end product is always worth it.

Compensation

If compensation weren't important to our "why," most of us would make our hobbies our careers. Unfortunately, most of us have needs that require adequate compensation for the work we do. But it's important not to let compensation grow too high on our priority list. I imagine that if I worked in an industry that included a lot of manual labor in a hot climate just for compensation, I wouldn't be happy.

Meaning

The purpose or meaning of our careers is closely tied to our passions and compensation levels. It's natural for us to seek out a sense of purpose in the communities we live and work in. The meaning behind our work is what drives most of us out of bed every morning. I find meaning by thinking about the people that the products will serve. It's exciting for me to see PCBs in the medical devices used by my doctor or to think about the PCBs in the car on my daily commute. These are reminders of the good I am doing beyond myself.

Value Alignment

Our "why" isn't just important in determining what we do. Even more critically, it's important to where we choose to work. When I think of "why" I choose to work at a company or in an industry, the decision tends to be drawn from my value alignment with the company. For example, I value honesty. It would be hard for me to work in an environment in which coworkers lied to their customers, vendors, and, worst of all, themselves.

Future Opportunity

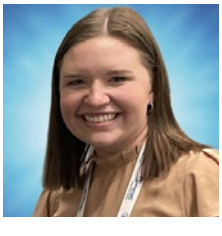
Sometimes, roles are just steppingstones for a larger one down the road. Sometimes, our current roles are meant for a finite time, and that's okay. I went to college so I could pursue greater opportunities down the road. When I started college, I knew that I did not want to be a college student for the next 40 years. Knowing my "why" in that situation helped me understand my motivations for attending classes and completing my homework.

> "Sometimes, our current roles are meant for a finite time, and that's okay."

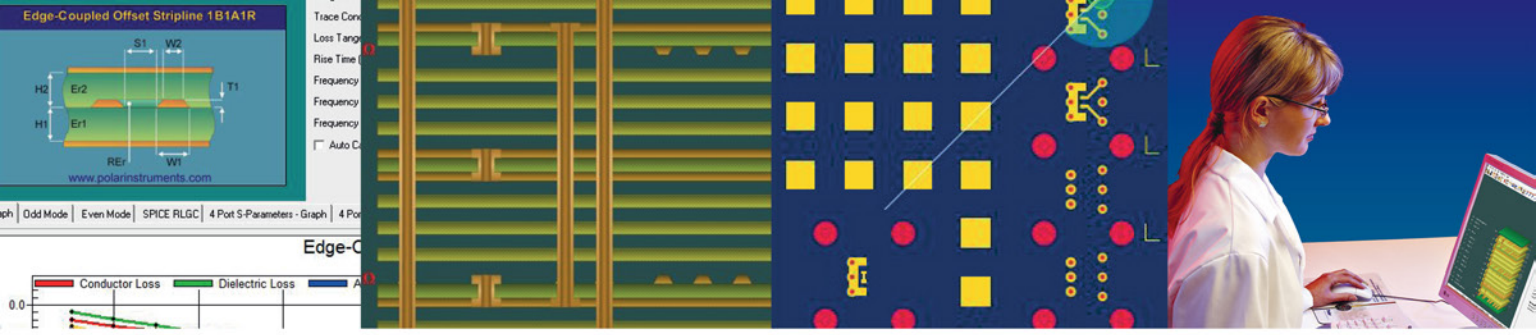
Balance

A "why" can be as simple as desiring balance. As society progresses technically, we understand the need for more balance. We all need time to rest and recharge to be our best selves. I'm currently in a stage of life where I don't want an 80-hour work week. Instead, I enjoy balancing my work and home life with a 40–50-hour work week. This "why" led me to choose opportunities in which balance is valued.

Knowing the "why" behind our decisions is imperative to accelerating our success. There are feelings attached to our reasons that can lead to a path of excellence. Understanding our reasoning helps us to understand our motivation for the way we interact with our careers. Our lives are too short, and our working years are too long not to align our careers with our personal "whys." I challenge you to think about your "why" and how it drives you to thrive. **PCB007**



Paige Fiet is a process engineer at TTM-Logan, and in the IPC Emerging Engineer Program. To read past columns, click here.



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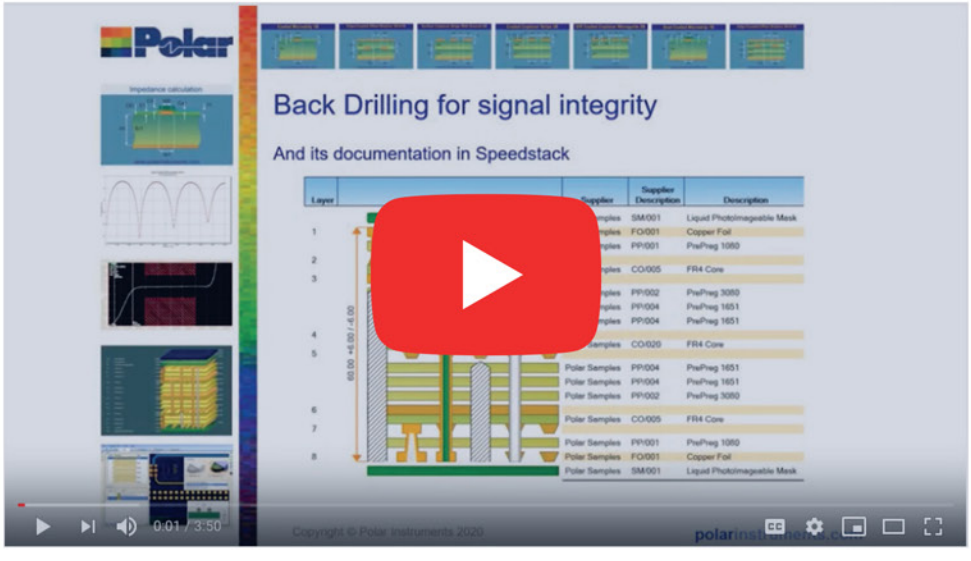

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Technology Adoption and the Role of Automation

Feature Article by Happy Holden
I-CONNECT007

In a recent paper[1] at the SMTA Pan Pacific Strategic Electronics Symposium 2024, Auburn University professors highlighted their findings from their 2023 "Smart Manufacturing Adoption Study" Technical Report 23-01[2]. The paper emphasizes five points that are important for the adoption of advanced technologies:

1. Small- and medium-sized manufacturers (SMMs) face significant barriers to adopting Industry 4.0 technologies, such as AI, due to a lack of awareness, proven business cases, and a skilled workforce.
2. The leading challenges for manufacturers in adopting smart technologies are having an operations workforce, operational efficiency, and the presence of an engineering workforce.
3. Forty percent of manufacturers rank automation as their No. 1 technology solution, followed by 3D printing, sensors/IoT, and predictive analytics. AI is also gaining interest as a top technology solution.
4. AI and ML have various application areas in electronics manufacturing, including equipment reliability, quality improvement, cost reduction, demand forecasting, inventory optimization, and overall process efficiency.
5. The implementation of AI in electronics manufacturing is still in its early stages, with only 30% of companies believing they are generating value through AI applications.

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Awareness

The study found many obstacles in adopting advanced manufacturing technologies (Industry 4.0) and broke their study down into five phases and six advanced technologies:

Phases

1. Awareness
2. Research
3. Evaluation
4. Implementing
5. Using

Advanced Technology

1. 3D printing
2. Artificial intelligence
3. Automation
4. Big data
5. Sensors/IoT
6. Predictive analytics

The results in Table 1 show that AI has the highest awareness (26%) but the lowest usage (6%) and 3D printing has the highest (36%). Of the six applications, these two are easiest to implement and use from just purchasing the device. The main inhibitors to adoption are a lack of skilled workers, costs, concerns about data security, and the lack of clear evaluation criteria for AI and advanced solutions.

Of the many successful implementations of automation and artificial intelligence, most agreed on the following approach.

1. Start with a strategic roadmap.

Establishing a return on investment (ROI) for automation and AI/ML applications is not always straightforward. First, it is essential to clearly define the organization's business objectives, customer needs, use cases, and measurement of value. A clear operating model and leadership support that empowers flexible culture and experimentation is needed.

AI may be an organization's top priority, but other essential activities must come first. Don't try to reinvent the wheel. Leverage what others have done, but don't necessarily copy other organizations. It is important to identify the right business cases for your organization. Performing buy vs. build analyses can speed implementations[3].

2. Assemble talent and prepare the organization.

Rather than conduct random projects, it is helpful to centralize the effort so overall guidance and adherence to the roadmap can be maintained. Ensure that the project teams have the necessary knowledge and talent to execute the initiative, including business and data science expertise.

Considering the workforce issues today, it can be more productive to upscale your current employees rather than trying to find experts who are scarce. Train the team and those affected by the project to improve tech-

Table 1: Smart manufacturing technology adoption (n = 100)

2023	3D Printing	Artificial Intelligence	Automation	Big Data	Sensors/IoT	Predictive Analytics
Using	36%	6%	34%	9%	26%	7%
Implementing	16%	8%	17%	21%	21%	25%
Evaluating	10%	23%	20%	19%	27%	23%
Researching	12%	26%	21%	24%	12%	20%
Awareness	26%	37%	8%	27%	14%	25%

nology adoption. The Technology Acceptance in a Manufacturing Environment (TAME) tool can help gauge the readiness of each work unit to accept and utilize advanced technologies (AI/ML technology). Be proactive in change management to reduce the impact on the workforce and invest in reskilling and upskilling your employees.

3. Understand the application and implement the technology.

The most critical step is to make sure that the problem to be solved is completely understood. First, you must have the data. Connect the processes on the production floor. Successful companies have created connectivity for real-time access to data sources in production and measurement tools and sensors, auxiliaries, facilities, and others. With a general lack of system interoperability, achieving closed-loop status can be challenging. To overcome this, digitalization must be implemented. Take advantage of cloud-based systems and capabilities. Look for opportunities to implement edge computing to reduce data lag time. Develop processes, controls, and accountability. Ensure data security and responsible use of the data. Partner with trusted solutions and service providers.

4. Ensure good data.

The data application and platform must be AI-ready. If the system's capability to support the data needs is questionable, upgrade the technology infrastructure. Identify the relevant data, perform the appropriate analysis, and then develop, fine-tune, and deploy the AI/ML model. All data is not necessarily applicable to the process. Identify the appropriate data. Put robust data governance processes in place.

5. Start with the intent to scale.

Build the use cases from the beginning with an eye toward scaling. Focus on using best practices across all initiatives. Consider integrating them into existing workflows.

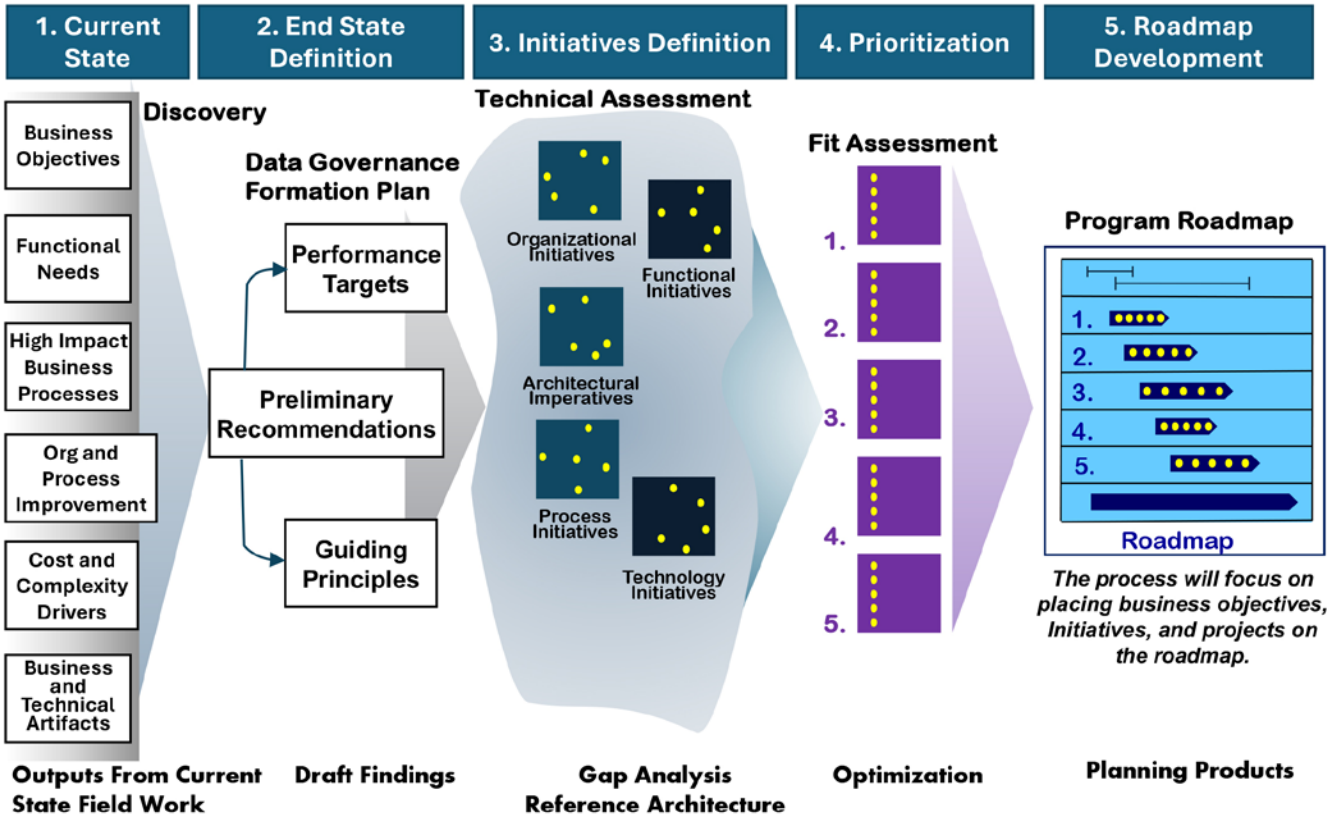

Figure 1: The phases and activities to create a strategic roadmap for an organization[3].

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The *NovaBond PX-S2* chemistry seamlessly combines nano-roughening through selective etching with the benefits of chemical adhesion promoters. In contrast to conventional methods, this innovative approach preserves trace geometry and line width with unparalleled precision. The result is a signal integrity (SI) performance on par with untreated conductors, together with exceptional thermal reliability and bond strength – all essential attributes for applications that demand unwavering performance under various operating conditions.

Precision is key

Precision is the cornerstone of advanced manufacturing. The *NovaBond PX-S2* process achieves this with remarkable accuracy. Its hybrid bonding technique strikes a delicate balance that enables precise control of nano-roughening while maintaining line thickness. Innovative processes carefully create nano-cavities that allow for superior bonding at the molecular level without compromising line-width reduction. The unique capability enables manufacturers to easily meet the demanding requirements of today's applications by producing detailed components with unmatched precision and reliability.

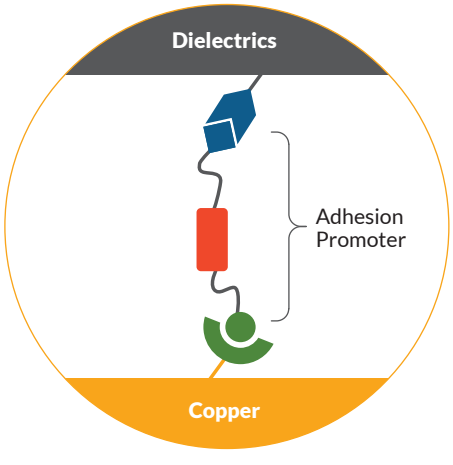
Outstanding bonding performance

Central to the *NovaBond PX-S2* solution is its highly oriented adhesion promoter – a true game-changer in improving bonding performance. The promoter ensures superior adhesion properties critical to a wide range of applications and facilitates optimal absorption of organosilane coatings. Its reliability in the most demanding environments is underscored by its resistance to even the most rigorous reliability tests. Through a synergistic blend of mechanical interlock and interfacial chemical bonding, it forms strong bonds that can withstand various stresses and conditions, thereby ensuring the longevity and reliability of the bonded structures.

High signal integrity – minimal loss

In the world of high-speed communications, signal integrity is crucial – and the *NovaBond PX-S2* process meets the challenge. Its ultra-low roughness results in significantly reduced signal absorption, a critical attribute for applications where minimal signal loss is essential. Maintaining signal integrity with minimal loss enables seamless and efficient communication between systems and devices, enhancing performance in critical signal reliability scenarios.

Overall, the *NovaBond PX-S2* process is a breakthrough technological innovation. It redefines the landscape of high-speed signal transmission and adhesion promotion in PCB manufacturing. Advanced performance, precision design, and unmatched signal integrity make this technology the foundation for innovation and reliability in electronics. As the industry marches forward into the future, *NovaBond PX-S2* is ready to lead the way into a new era of bonding enhancement technology that reshapes traditional high-speed signal transmission and ultra-low roughness adhesion promotion.



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6. Learn from each step.

Take the implementations one step at a time. Quick and successful implementation sprints can generate a lot of success and create a virtuous cycle of rapid learning and excitement in the organization.

7. Exploit the process.

Once you have a successful project and ROI, use that experience to train more of your people and exploit the enthusiasm that it will create.

Table 2: Process for automation and advanced PCB technologies selection and implementation[3].

PHASES	ACTIVITIES	DELIVERABLES
1. Start with a strategic roadmap	• Establish a return on investment (ROI) for automation and AI/ML applications. • AI can be the organization's top priority, but other essential activities come first. • Leverage what others have done. • It is important to identify the right business cases for your organization. • I-Connect007 has an eBook that covers roadmapping, technology awareness, benchmarking and 'Creating the Business Plan' as well as 20 other important topics for you to use.[3]	• First, it is essential to clearly define the organization's business objectives, customer needs, use cases, and measurement of value. • Establish a clear operating model and leadership support that empowers a flexible culture and for experimentation. • Performing 'buy versus build' analyses can speed implementations.
2. Assemble talent and prepare the organization	• Centralize the effort so overall guidance and adherence to the roadmap can be maintained. • Ensure that the project teams have the necessary knowledge and talent, including business and data science expertise. • Be proactive in change management to reduce the impact on the workforce and invest in reskilling and upskilling your employees.	• It can be more productive to **UPSCALE** your current employees rather than trying to find scarce experts. Train the team and those affected by the project to improve technology adoption. • The Technology Acceptance in a Manufacturing Environment (TAME) tool can help gauge the readiness of the work unit to accept and utilize advanced technologies (AI/ML technology).
3. Understand the application and implement the technology	• Make sure that the problem to be solved is completely understood. Connect the processes on the production floor. *Most importantly, you must have the data!* • Digitalization must be implemented. Take advantage of cloud-based systems and capabilities. Look for opportunities to implement edge computing to reduce data lag time.	• Connectivity for real-time access to data sources in production and measurement tools and sensors, auxiliaries, facilities, and others. • Develop processes, controls, and accountability. Ensure data security and responsible use of the data. Partner with trusted solution suppliers and service providers.
4. Ensure good data	• Update the data application and platform to be AI-ready. • Upgrade the technology infrastructure. All data is not necessarily applicable to the process as far as the model is concerned. • Identify the appropriate data.	• Identify the relevant data, perform the appropriate analysis, then develop, fine-tune, and deploy the AI/ML model. • Put robust data governance processes in place.
5. Start with the intent to scale	• Build the use cases with an eye toward scaling from the beginning. • Make sure to consider integration into existing workflows.	• Focus on the use of best practices across all initiatives.
6. Learn from each step	• Take the implementations one step at a time.	• Quick and successful sprints for implementation can generate a lot of success and create a productive cycle of rapid learning and excitement in the organization.
7. Exploit the Process	• Once you have a successful project and ROI, use that experience to train more of your people and exploit the enthusiasm that it will create.	• Make sure the 'process' is documented and that training can be implemented internally.

Conclusion

Artificial intelligence plays an increasingly important role in our lives and economy and already impacts our world in many ways. Some have projected that AI will add nearly $10 trillion to global GDP over the next 10 years.

The future of advanced manufacturing, whether you call it Industry 4.0 or Smart Manufacturing, particularly in the electronics industry, is the utilization of connectivity to enable automated optimization. Automation and AI/ML systems, when properly created, can process massive data sets that provide insights into process trends and potential quality escapes and use the information created to make decisions.

The Smart Manufacturing Adoption Survey results in Table 1 show that AI has the highest awareness but the lowest implementation and use. Leaders in AI have an enterprise strategy aligned with business goals and use cases that bring business value. They have robust organizations that emphasize efficiency, data and skills readiness, well-planned governance, and optimize the application of technology. AI leaders emphasize reducing business risk and the implementation of policies and processes to enforce responsible and secure AI practices and principles. They are reallocating budgets to enable spending on AI projects because they believe in the potential benefit to the bottom line.

Table 3: Process for automation and advanced PCB technologies selection and implementation[3].

PHASES	ACTIVITIES	DELIVERABLES
1 ENVIRONMENTAL ASSESSMENT (4-8 weeks)	• Conduct Systemization Review (flow, quality, etc.) • Conduct "The CAD/CAM Audit" • Perform "The Process Scan" • Perform organization review • Analyze business forecast	• Profile of systemization/mechanization opportunities • CAD/CAM systems specification input • Assessment of organizational impact • Rationale for cost/benefits analysis model
2 PROGRAM STRATEGY (6-10 weeks)	• Perform macro-level stimulation for CBA • Establish performance targets • Create CIM strategy and automation plan • Develop documentation methodology for CIM system	• Documented CIM strategy and implementation plan • CIM architecture • Organization and staffing plan • Database mapping of functional processes
3 CONCEPTUAL DESIGN (6-10 weeks)	• Exploration of preliminary process equipment and automation alternatives • Initiation of requests for information (RFI) • Develop conceptual specs for MFG support systems • Organize manufacturing technology teams	• Budget profiles on equipment/software development created • Documented conceptual specifications for functional approvals
4 DETAILED DESIGN AND REQUIREMENTS SPECS (13-26 weeks)	• Generation of detailed process/equipment designs • Generation of detailed manufacturing support sizing of system specs • Involvement with technology suppliers • Creation of integration plans • Execution of simulation model on automation alternatives • Creation of RFP specs for supplies	• Transaction (I/O level) design document for manufacturing system • REF Specification with functional sizing of system • Detailed cost/benefits model document • Implementation plan
5 DEVELOPMENT (Cycle depends on Phase 4 scope)	• Selection of equipment, hardware and software suppliers • Implementation of development hardware and software • Software programming • Debug and test subsystems	• Completed system software • Installed, operational equipment
6 IMPLEMENTATION (Cycle depends on Phase 4 scope)	• Construct ATP • Execution of system test • Construct system and user documentation • Execute ATP • Trainer of end-users	• Acceptance of test procedures • Operational CIM systems • Technical and user documentation

Operations must provide excellent quality, reliability, and productivity output to obtain good OEE scores. Digitization awareness and AI/ML provide real-time visibility into processes, allowing for optimization to achieve the desired high OEE scores. AI can adapt to perturbations in the system, isolating the issues and reacting to re-optimize the processes in real-time.

To learn more about roadmap strategy, read *24 Essential Skills for Engineers,* Chapters 15 and 17. **PCB007**

References

1. "Technology Adoption Issues for Small and Medium Sized Manufacturers and the Role of AI and ML to Improve Adoption Rates," by Gregory Harris, Industrial and Systems Engineering Department, Auburn University, SMTA Pan Pacific Electronics Symposium, January 2023.

2. "Smart Manufacturing Adoption Study 2023," by A. Yarbrough, C. Peters, G. Harris, Auburn University ICAMS, Technical Report 23-01, December 2023.

3. *24 Essential Skills for Engineers,* by Happy Holden.

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, click here.

Thriving With New Processes and Technologies

Feature Interview by Barry Matties
I-CONNECT007

What does it take to really thrive in today's business environment? Will it require big changes, or can you make small, incremental improvements? Jesse Ziomek, global sales director and product manager at DIS, Inc., a company that designs and manufactures automation equipment, focuses on strategies for thriving in the PCB industry by emphasizing cost reduction through smart robotic solutions and addressing bottlenecks to optimize yields. He keys in on registration issues, clean manufacturing processes, and advancing manufacturing capabilities, and highlights automation and consistent manufacturing practices as crucial for industry growth.

Barry Matties: We're talking about how to thrive in the industry, and part of that strategy is about lowering costs, an area where DIS has some new solutions. What should a bare board fabricator be thinking about if they want to thrive?

Jesse Ziomek: Thriving seems to encompass three areas within the lay-up process. First, customers are looking to solve registration issues, which ultimately increase yields; high yields equal good profits. Second, customers want to know not only how to advance their technology but of what I'll call "clean" manufacturing. What other tools and resources are available to break away from the conventional

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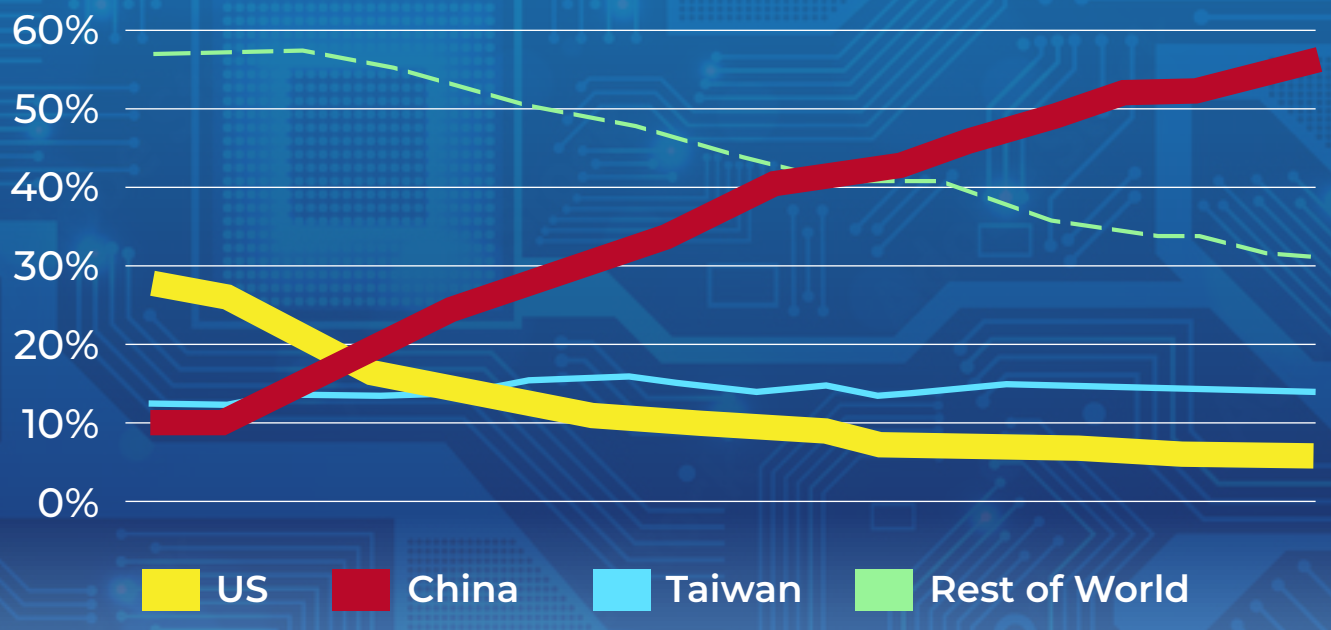

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methods of hard tooling—like old-school hammer and pins and heavy plates—which carry a lot of regular maintenance costs and are labor intensive? How do we change that environment and make it a more streamlined manufacturing process that is less labor intensive?

A better work environment helps with employee retention. One can also hire a different type of employee. For example, maybe one doesn't need a super-strong employee who can pick up 45-pound-plus caul plates because we've eliminated that need with our pinless process and blocking plate technology. That's the kind of hidden reality that comes into play.

Jesse Ziomek

The third area is advancing a manufacturer's technical capabilities. If you can introduce new technology that addresses one pain point, increases yields, introduces a more streamlined manufacturing process, and a safer working environment, the third jewel in the crown is advancing technology capabilities.

When customers advance their capabilities, they can enter new PCB markets, gain new customers, and strengthen existing business relationships by offering new products.

To level up, customers need new tools, resources, and education on the new processes and technologies available. That's where automation comes in. So, there is actually a fourth area, which is how we actually go about automating our processes.

The first step to thriving is getting your house in order. Understand and optimize your manufacturing processes. Then, start looking at the bottlenecks and pain points and creating some improvement strategies.

Correct. I have the privilege of traveling to many different manufacturing facilities across the world, which gives me an advantage because I see how it's done with pretty much every application and in every country. When I'm talking to customers, we identify the critical pain points and then figure out how we can provide a solution to that challenge.

When I ask a customer what their capabilities are, I get a lot of big answers: 20, 30, 40 layers. Then I ask, "What's your yield on that?" That's when the room goes silent, and you start hearing about the pain points. It's how we get to the truth of the situation. Now, we can work on solutions where DIS can really make an impact, and that's our focus.

Jesse, do you have any final words of wisdom for fabricators who want to create a plan to thrive?

Yes, do your homework. Become educated. We want to be sure all our customers are well-educated. When we're talking about a process change—and there's a lot of new technology out there—none of this equipment is plug-and-play. Each customer uses a different material and likely a different process or technique. Each customer requires a somewhat customized approach with the technology, the equipment, and the solution. I hope customers don't blindly buy or do something simply based on a relationship. That old-school business gets you in trouble, from what I've witnessed. That's my advice for anyone looking at a new process or technology.

That's a good note to end on, Jesse. Thank you so much.

Thanks, Barry. PCB007

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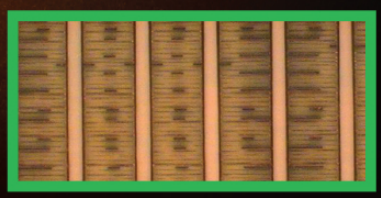

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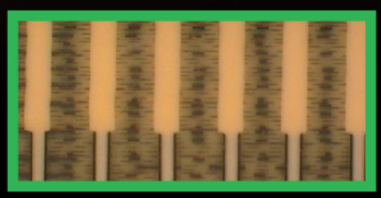

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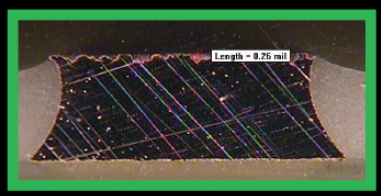

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A Less Expensive PCB Fab Startup

Article by Alex Stepinski

Editor's note: Investing in a new printed circuit board fabrication startup is not for the faint of heart or the light of wallet. Standing up a new "high-tech" PCB fab facility capable of becoming qualified for aerospace and defense work typically takes a minimum investment of $50 million. However, Alex Stepinski says entering the defense and aerospace markets with a new PCB fabrication start-up facility far under this cost benchmark is possible when good partnerships, innovation, and sound engineering design enter from the beginning. In this article, Alex Stepinski outlines just how this can be achieved.

While industrial policies will hopefully result in a more competitive landscape for defense procurement by copying established processes from East Asia, they do very little to promote actual value innovation (i.e., communism didn't create Silicon Valley). The best we can hope for are products at a 3-10x premium over what East Asia can do because this is the achievable equilibrium of just taking overseas process equipment while not accepting the cultural and organizational aspects that drive cost efficiency there.

We have also found that investors are more focused on de-risking by copying rather

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Alex Stepinski

than de-risking by innovating. This is largely because PCB fabrication is a low-innovation industry in general. Expectations are low, domain knowledge is scarce, and group-think dynamics around legacy solutions are high. Every project has consultants and experts who bring together all the best-established ideas. But where are the new ideas?

To address this deficiency, we have been developing a U.S.-centric business model that allows domestic investors to enter the defense and aerospace market with a much smaller and more efficient investment protocol. Instead of investing $40–$80 million upfront in a copy-paste fab facility, one can build a fab with similar capabilities to what is being done at the higher capital procurement levels for far less by focusing on more efficient process solutions.

In partnership with innovation-driven suppliers in the market, we have recently developed a defense and aerospace starter fab package with overall process kit investment levels in the $8–$24 million range and with a mature IRR of 16–35%. These numbers exceed hurdle rates for most VC/PE investors without the need for government funding and can be stood up and commissioned in about 12 months, followed by a 12–18-month qualification period to achieve stable revenue. Based on lessons learned from recent domestic fab investments, we are combining multiple established technologies in an innovative way to achieve a high return, with some of the key components described below.

Consolidated Vertical Wet Processes

In a typical U.S. fab shop, the wet process floor consists of a combination of horizontal and vertical equipment, with the subtractive steps mostly done horizontally and the additive steps mostly done vertically. For the substrate industry, carrier-based vertical processing dominates and is being implemented in the new taxpayer-funded investments we currently see going up in the U.S. One of the challenges of this kit is that it is not integrated very well and is either labor-intensive to operate and maintain, or capital inefficient to automate/integrate. To address this, we have recently partnered with Integrated Process Systems (IPS) in Cedar City, Utah, to develop a product line of vertical equipment with such a high level of efficiency that one operator, one chemist, and one technician can operate the entire wet floor within a factory in the $12–$40 million annual turnover range building high-mix products with negligible setup time. The secret lies in using a vertical hoist platform and mak-

ing vertical cells for each process step: Developing is a cell, etching is a cell, oxide is a cell, etc. We then break up the process into three vertical hoist lines. One line does inner layer processing with an inert carrier, one does most additive and semi-additive steps with a galvanic flight bar, and one does immersion/electroless finishes with a laminar flow basket. We even integrate UV bumps, plasma cleaning, and bakes directly into the line to control the timing of these important steps.

The combined cost of the equipment is similar to a horizontal wet process kit from China. Still, the system complexity is much lower, and the process capability is much higher for high-mix applications. We have about three times the number of controls vs. any horizontal process as well. This vertical equipment also has less than 1% of the number of physical parts compared to the equivalent horizontal equipment and a much lower risk of failure/maintenance downtime as a result. Additionally, it can all be directed from one central position managing the panel handling for all three lines. Finally, due to the batch nature of the process, the chemical controls and repeatability are far higher.

These new systems leverage established product technology already qualified for UHDI and substrate applications at defense primes in the U.S. The innovation lies not in the technology itself, but in how it is combined to achieve single-piece flow efficiency.

Diverse Application Laser Drilling

Very recently, if you wanted to do 25–50-micron laser vias, 300-micron laser vias/trenches, cavity/flex routing, and a wide range of materials (all of which can be seen across the defense and aerospace product portfolio), you would have needed two to four different laser drill machines—each with a different combination of laser source and optical path technology—to get the job done. We are happy to report that all these applications have been consolidated into a single tool. By merging pico-green and CO_2 sources into a s ingle platform with beam expanders to adjust

the spot size, these applications are now covered by one machine from Schmoll with a similar capital investment to a single traditional UV/YAG, with a much smaller heat-affected zone.

MBSE and Recipe Development

Over the years, the pace of recipe modeling capability improvement has been very slow in the PCB fab industry. Inner layer scaling and dielectric prediction are relatively mature nowadays, but copper patterning tolerances and metal/mask coating thicknesses remain a challenge. In this case, the challenge lies in the sensor quality deficiencies in building the models, as well as a low level of control over the processes. Recently, multiple fabs have implemented 3D interferometric and confocal microscopy technologies which are capable of profiling surface features very effectively. At the same time, the use of specialized throwing power test coupons to optimize and monitor health of lines for plating through-holes has created the feedback sense loop the market has been missing. By designing in these new sensing techniques and incorporating the feedback into a basic machine learning system, while also adopting a galvanic Cu process with onboard complex controls, it is very possible to exclude most trial-and-error test panels from fab sites.

In addition, despite being very complex systems, systems engineering documentation is entirely lacking in most PCB fab operations. As a result, change simulation and impact across operations are almost never understood. Recently, we have developed a multi-domain interface model in lifecycle modeling language (LML) with a custom microelectronics grammar which allows for documentation and Monte Carlo yield/cycle time simulation of the whole fab process/product interaction in PCB fab, thus allowing parameterization and simulation of new processes and products prior to release to avoid test panels. On complex products, this new method is a game-changer.

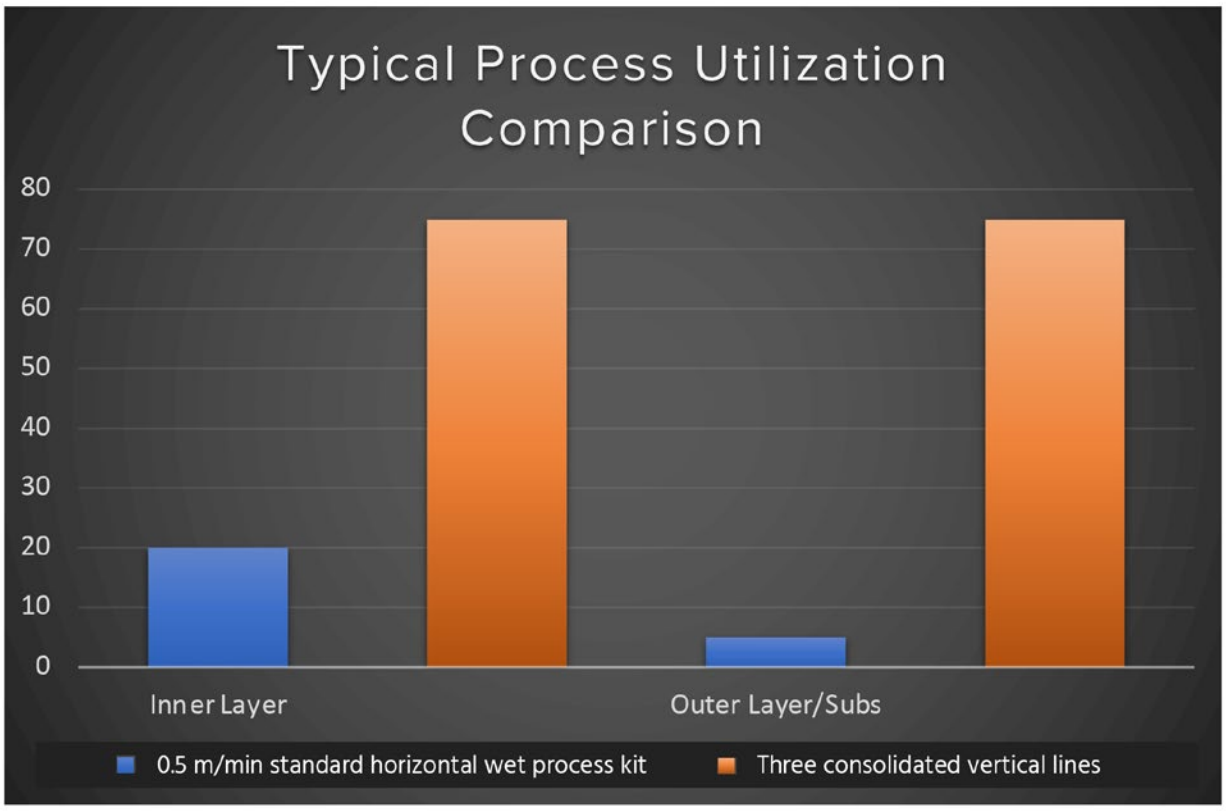

Figure 1: Comparison of typical process utilization.

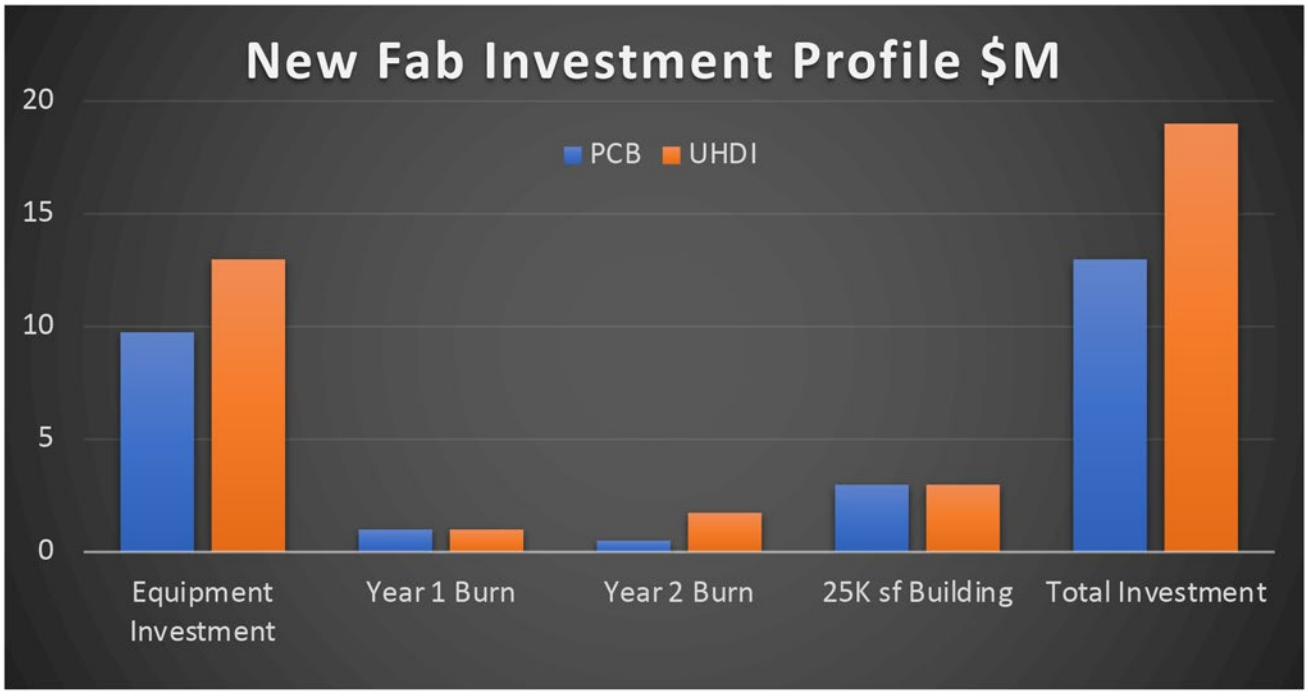

Figure 2: New fab investment profile.

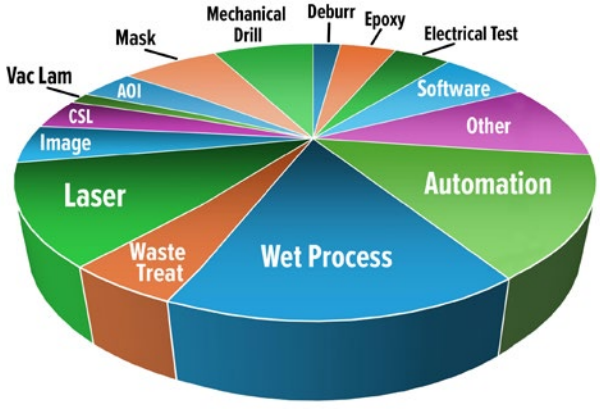

Figure 3: UHDI/NPI PCB fab kit decomposition.

UHDI Defense & NPI High Mix/Low Volume Greenfield Fab

Revenue ($M)				
Year 1	Year 2	Year 3	Year 4	Year 5
0	5	12	25	31
%IRR				
Year 1	Year 23	Year 3	Year 4	Year 5
0	0	7%	22%	32%

%IRR assumes 5% of original investment is ongoing annual capex

Figure 4: UHDI defense plus NPI high mix/low volume greenfield fab.

Synopsis

Experienced PCB fab personnel can clearly see the potential opportunity in implementing the above-mentioned systems using a design engineering approach. Leveraging these innovations and others, in 2024, a 20–30 panel/day high-product-mix fab operation can operate with only 10–12 people at a time. This is inclusive of tooling and yield-appealing annual returns when designed from the beginning for this target performance in the defense/aerospace/NPI sector. Figure 2 shows a financial summary of data, including annual growth capital beyond the initial capacity target, as well as closed-loop wastewater recycling from a recent due diligence project in North America. **PCB007**

Alex Stepinski is principal at Smart Process Design.

A Visit to RoBAT

Article by Pete Starkey
I-CONNECT007

It was the beginning of July, on an English summer's day—overcast and raining—as I drove up to Cheshire the pretty way, across the Derbyshire dales, to avoid the traffic problems on the M6 motorway. It was well worth the journey when I arrived at the premises of RoBAT Ltd., in Macclesfield, to meet with Managing Director Bruce Nockton.

RoBAT has a long-established name in high-speed signal integrity testing of complex assemblies and, more recently, has offered a fully automatic impedance tester for bare boards. I was curious to learn more, and Nockton was happy to enlighten me.

I confessed at the start that I was basically a chemist who knew a bit about making PCBs but not a lot about the electronics of signal transmission, although I was aware of the increasingly critical importance of establishing the right combination of material properties and the precision of fabrication to achieve a product with specific electrical characteristics. Nockton kindly stayed with the basics and avoided getting too theoretical with his account of the development of RoBAT's extensive product portfolio.

Describing the origins of the company, he explained that his early experience was with the design and manufacture of specialty test fixtures, particularly for large backplane assemblies. But by the late '90s, frequent design revisions resulting from the rapid evolution of mobile phone infrastructure were making it uneconomical to produce dedicated fixtures for this type of assembly, creating an opportunity for an alternative approach. Flying probe testing had its mechanical limitations when using its typically long probes to consistently and reliably contact features like vertical pins and certain female connectors.

In 2003, Nockton and his colleagues devised a solution which he described as a cross between a test fixture and a flying probe, with an X-Y-Z-axis gantry system picking up individual "tools" from a magazine, which were effectively "mini test fixtures." He showed me

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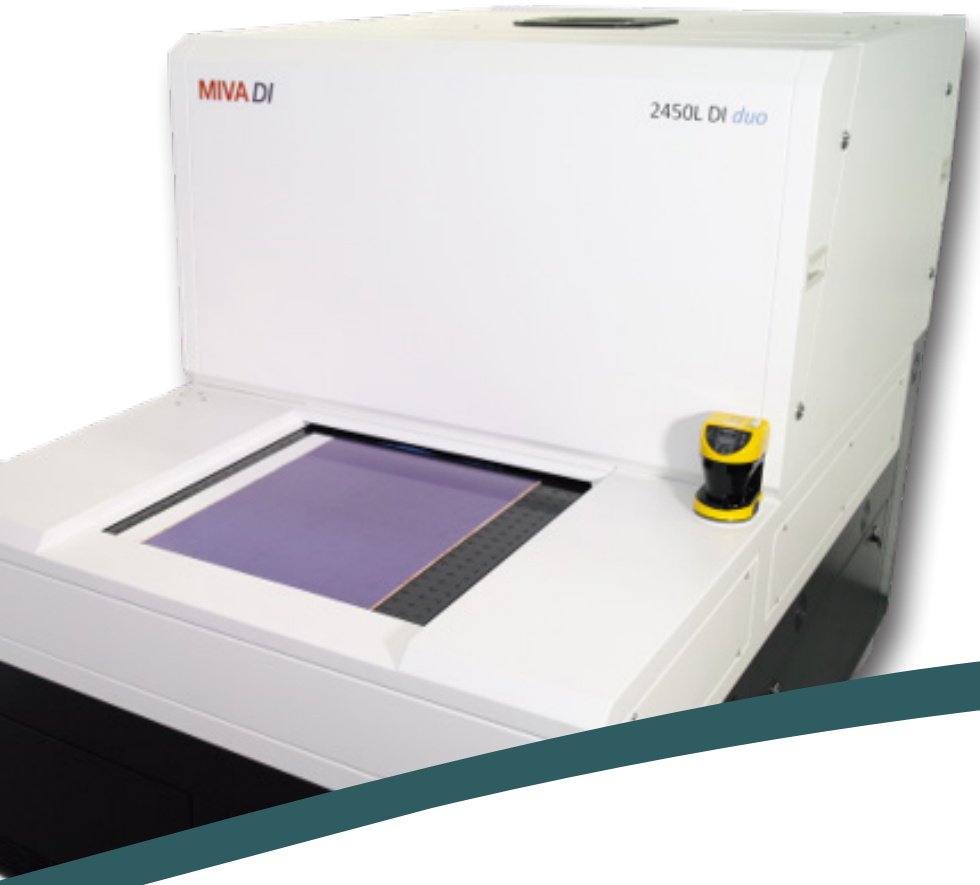

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a selection of these tools, uniform in overall shape but each having probes on one face matching a specific connector on the backplane, while on the opposite side was a common interface to the testing machine.

Using these tools, they were performing capacitance testing, shorts and opens testing and, by attaching a camera, they could check that all the pins were straight before plugging in the fixture. A digital multimeter enabled some component measurement, and they could even add a touch probe for making mechanical measurements. Together, this offered a versatile system for electrical, AOI, and mechanical testing of backplanes. The system was effectively future-proof because specific tools could be designed for specific tasks, even custom sockets for edge connectors.

Bruce Nockton

The equipment's adaptability and versatility continued to evolve over the next several years. Out-of-sight defects associated with press-fit compliant pins presented a further challenge, which was overcome with the development of an X-ray version.

I commented that RoBAT appeared to be characterised by a lateral-thinking culture and a positive approach to progress: "That sounds like a good idea—let's do it."

Nockton substantiated my observation, explaining, "We've always tried to maintain a certain structure that facilitates making those sorts of decisions and then moving quickly to develop the ideas into products."

And what was the derivation of the RoBAT name? "Ro for robotic, B for backplane, A for automated, and T for testing—probably no longer appropriate as we move on."

And move on he did with his review of RoBAT's history. Established in 2001, the company shipped its first machine in 2003 to a UK customer, which happened to have a facility in China where another machine went the following year. This led to the establishment of RoBAT's Chinese operation, now an extension of the UK manufacturing and servicing resource, and was the beginning of a service and support network in Asia and North America.

Looking at the current product range, I remarked how extensive it was. Nockton reiterated that the footprint of their basic S1 backplane test machine was adaptable to several functions, and its variants constituted a popular ongoing part of the portfolio. But the catalyst for a new generation of test equipment has been RCI—robotic controlled impedance—released in 2013. A suggestion from one of the lateral thinkers: "We should be looking at TDR; maybe we could automate something?"—led to the purchase of a pair of commercial TDR units and hooking them up to the robotic heads of the machine. (Note: TDR is time domain reflectometry, a technique used to determine the characteristics of electrical lines by observing reflected pulses.)

The result was an automatic TDR machine for assembled backplanes, and the common interface was now composed of coax connectors. But a significant limitation was the length of the interconnecting cables, resulting in a considerable loss of resolution. Because each TDR unit has only two ports, testing a backplane took a long time, and because the TDR unit was a big black box, it was not practicable to mount it on a head of the machine. So, RoBAT designed its own compact TDR units, eventually making them small enough to be mounted inside the robotic head, and with a much shorter interconnecting cable. Soon, three 8-port units could be mounted in one head, giving 24 ports, one per channel, with no

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need for switching. At this stage of its development, the machine was capable of identifying a lot of issues on assembled backplanes and became a very popular piece of test equipment with major contract electronics manufacturers.

Analysing lots of test results, it became apparent that the machine, for which the primary objective had been to detect faults introduced during the assembly process, was finding a disturbing number of faults attributable to the bare board—in some cases as many as 70% of the total—a good justification for the development of a bare-board tester. This was around 2019.

Several challenges had to be addressed. It wasn't practical to use spring probes because of the deleterious effect of the spring on the signal, and RoBAT also wanted to maintain the principle of multiple connections per insertion. Because the development machine was basically a version of the high-end system for testing assemblies, it would not be cost-competitive in the bare board industry.

> "New developments are evolving."

Then came COVID, which restricted travel and effectively shut RoBAT off from their market. But isolation presented an opportunity for the innovators and lateral thinkers to consider what applications they could envision that capitalised on the attributes of their own compact TDR unit. The outcome was a suite of eight new products, from a benchtop unit for testing small, high-speed bare boards and coupons to a series of SCARA-based machines, which included a fully automatic TDR tester for bare and assembled PCBs.

I was curious to know what "SCARA" signified. Nockton explained that it was an acronym for a particular type of industrial robot, "Selective Compliance Articulated Robot Arm," referring to its ability to move freely and maintain stiffness in three axes while being compliant in the final axis. In the context of RoBAT's bare board TDR tester, the robot takes the place of the substantial X-Y-Z-axis gantry that is featured in their mainstream equipment. Functionally, the SCARA machine used RoBAT's "mini test fixture" tools, with modules customised in pitch and style of a high-speed connector to correspond with the work being tested. Tool changing is automatic, and the system is capable of a full range of TDR tests and measurements.

Importantly, the adoption of the SCARA principle substantially reduces the manufacturing cost and enabled this new equipment to be offered at prices that make it attractive to bare board manufacturers.

When Nockton showed me around the Macclesfield facility, I was amazed at the extent of capability and self-sufficiency that exists under one roof. All the way from design to finished product, the knowledge, the skills, and the equipment are there. New developments are evolving. It's a really nice set-up, and the sort of environment I would enjoy working in.

I thanked Nockton most sincerely for making me welcome and for being so generous with his time and explanations. He tolerated my ramblings and reminiscences as we swapped anecdotes, realised how many people we both knew, and agreed what a small world it is in the electrical testing business.

I set off to drive home in the rain, reflecting on a most interesting and informative couple of hours. **PCB007**

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Pete Starkey is a technical editor for I-Connect007.

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From Concept to Reality: Building Alpha Circuit

Feature Interview by Barry Matties
I-CONNECT007

You've just sold your pharmaceutical business and have a lot of extra cash. Where would you spend it? "On a new 45,000-square-foot factory to manufacture high-tech printed circuit boards," said one man.

Meet Prashant Patel, one of the industry's newest PCB fabricators. Prashant was a pharmacist for his entire career and did very well. Surrounded by friends with decades of PCB industry experience who willingly shared their outlook on the industry, Prashant decided to acquire Alpha Circuit in Elmhurst, Illinois, in 2021. Alpha Circuit was established in 1981, where the primary focus had been on low-tech. That has all changed.

Prashant and his team broke ground on a new 45,000-square-foot building in Schaumburg, Illinois—meaning this factory was being built from the ground up. Keep in mind that Prashant had no experience in PCB fabrication and had to learn everything, literally, from the ground up. After spending a few hours with him, it's easy to see he is a good student.

The following interview highlights Prashant's PCB journey.

Barry Matties: We're here at Alpha Circuit's brand-new facility, a project that has taken three and a half years. Prashant, tell us about the journey of setting up this new facility. Why did you undertake it this way, and how was the process of bringing it together?

Prashant Patel: I wanted to do something in the manufacturing industry, where I have an extensive network of friends and family. We purchased this building, and everything other

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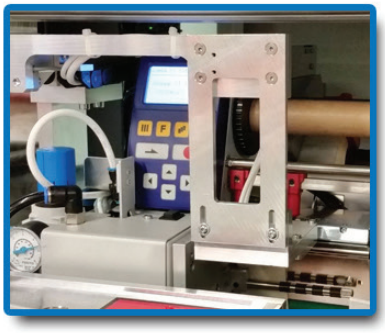

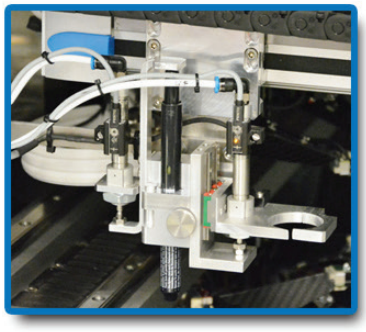

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Prashant Patel

than the four walls is brand new, including the flooring, lights, HVAC, roof, and equipment.

We did the factory floor layout and sourcing of equipment ourselves. With over 25 years of experience and expertise in the industry, our engineering team knew what they were looking for. You have to know the right questions to ask for each process. If it's a wet process, how do we want the nozzles? How do we want the angles? How do we want the brushes? They are the experts, so I let them define exactly what we wanted and needed. My part was to find the manufacturers that could give us the best equipment that met all our requirements, including what kind of service they would offer. How soon can a technician get to you if something is not working? Service was the second most important consideration. After those two variables, it was lead time. When could we get the equipment? What can we live with, and what can't we live with?

You bought the nearby Alpha Circuit facility in Elmhurst in January 2021 and then started building this. Are you building this facility so that you can offer high-tech, leading-edge products that will be built here?

This new facility is almost 46,000 square feet compared to our other location, which is about the same size. Yes, this new facility is meant for more high-tech work—smaller lines and spacing, smaller BGAs. The new equipment we have can do all of it.

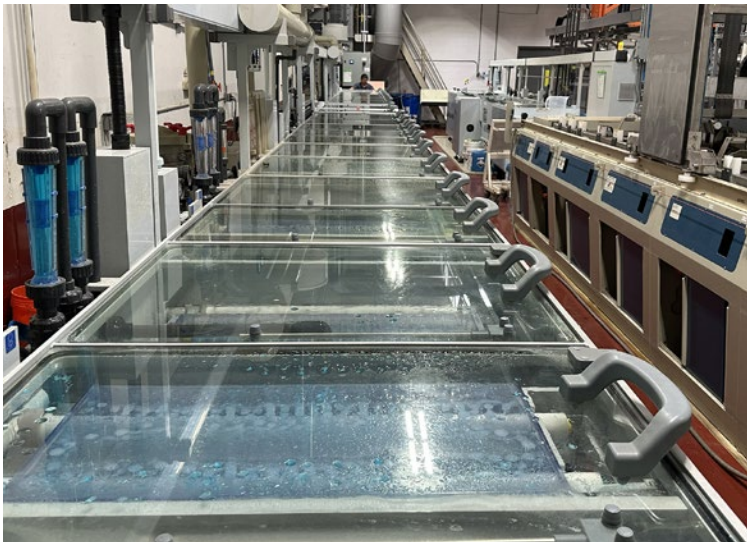
Of course, the equipment doesn't always run itself. You need capable people and a good management team in place to run it. Our general manager, Steve Smith, came from APCT, where he oversaw all their plants in all their locations. We are currently doing engineering trial runs on the equipment before we take on live production orders.

How long have you been running and testing the equipment?

The equipment has been tested between nine and 12 months. We have worked on calibrating and certifying all to our standards. Customers have toured the facility, and we are now in the process of doing pilot runs for them. We want to make sure we are not putting customers at risk.

That's smart. Obviously, you're bringing people over from your other facility, and they're trained in the different manufacturing disciplines. Talk a little bit about your onboarding and training processes.

Our training is mostly done in our Elmhurst location, which is our live location. When some-



body new is onboarded, a current employee is assigned to them. It's a 90-day training period. After 90 days, they're evaluated on what they know and what they don't. Then, it becomes about what else that employee can learn in the manufacturing process.

We want people to multitask. It's not just one process or one location that an employee is certified for. We want people who can do several things; we want them to be cross-trained. It is not only good for the company; it is good for them as well. If somebody calls in sick, you need a backup. So, we go through rigorous training, get them certified at Elmhurst, and then we bring them here to the new facility and get them used to this new equipment. By this time, they should have a baseline understanding of what these processes are, what products should look like coming out of their line, and what things to look for from a quality and inspection standpoint.

Tell me about your green approach to your waste treatment.

We truly believe in going green. Seventy percent of the water we use in this building is reused as DI water. So, we regenerate our own DI water from our rinses, which then goes back to our waste treatment system.

That's a huge financial savings right there.

Yes, especially with the rising cost of utilities. Of course, the system wasn't inexpensive, but the return on the cost for that system will be quick.

Aren't customers looking for more green or sustainable partners?

That is an industry trend, and it's the right thing to do. Besides that, more of our customers will be looking for manufacturers that are good global citizens.

When you look at the path you're on today, what would you do differently if you had to do it all over?

I would probably buy an existing shop that was fully operational and change out the equipment as needed. Going the route we did to get all the infrastructure in place takes a long time. Bringing in and setting up new equipment can take months. Having an existing shop to start with may provide an opportunity for some cash flow while you build out. But here we are. We are heavily invested and just about to start producing. It's been over three years, and it will likely be four years by the time we are completely done and production ready. It has been a huge investment of money, time, and

effort as well. But I believe strongly that, in the end, it will be worth it. From what I am told, there are not many people out there willing to make this kind of investment.

You were also delayed more than a year with COVID, so you're a bit behind schedule.

Yes, COVID put us back 18 months from the standpoint of equipment availability and deliveries, personnel, getting the electrical breakers wired, and having power. That kind of thing put us back substantially.

That is certainly nothing you can project when you start off on an endeavor like this. Who would ever have thought a world pandemic would have been a delay factor? You also mentioned that you were surprised by how much you had to learn personally.

Not being from the industry and trying to set up a brand-new facility was a personal challenge, learning about the equipment—even just the wet process equipment—the other processes, the chemistry, talking to the vendors, and getting a feel for what you treat, what you batch process, and what you pH adjust. I had to set up all this stuff myself. It was a steep learning curve. But I also had a very good team that guided me, and I had access to some very good resources that helped my learning curve substantially.

Having just experienced the tour you took me on, I would never have known that you are new to the industry. You are obviously a great student of the subject matter. Tell me about how you planned the flow of the production process.

The best thing about setting up a building from scratch is that you can build it for optimum manufacturing process flow. We designed it so that process A is next to process B because you don't want somebody walking five minutes down the hall just to get to step B. It's a waste of time. We have a well-thought-out process flow where you have minimal movement, or "dead time," as we call it.

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You have some automation in this new facility, but it is not fully automated. What is your strategy there?

We absolutely have the room to put in more automation. Right now, our priority is to get this building up and running and fill the capacity to a certain level before we look at further automation. That is our automation strategy. We can build the boards that we are promising the market we can build. Once we have the baseline bookings every month, we will examine the areas that need more or less automation.

That makes sense. I see you brought in some equipment from Taiwan. You have some nice equipment in your drilling and routing areas, and you have laser technology back there as well. Are you direct imaging.

We are direct imaging. We're small. We have a MIVA coming in about 30 days for a second machine.

I saw some Orbotech equipment as well. You've made some nice equipment choices, a nice package. A lot of the conveyor lines are from one supplier, which makes spare parts and things easier to manage.

Spare parts, service, availability. We also always keep one set of everything in stock, so there is no downtime.

Do you have any final thoughts you'd like to share with the industry?

We're excited to get going, and show the market what we can produce. We want to play with the best of the best in the industry. Building a new facility like this goes beyond the business itself to the point of being a true mission. We wanted to have an outstanding facility with outstanding equipment and people developing processes and technologies for not only today but the future as well. Our goal was to build a factory of the future today, and I feel that we are very close to accomplishing that.

It is a beautiful facility. Congratulations. I wish you the best of luck. **PCB007**


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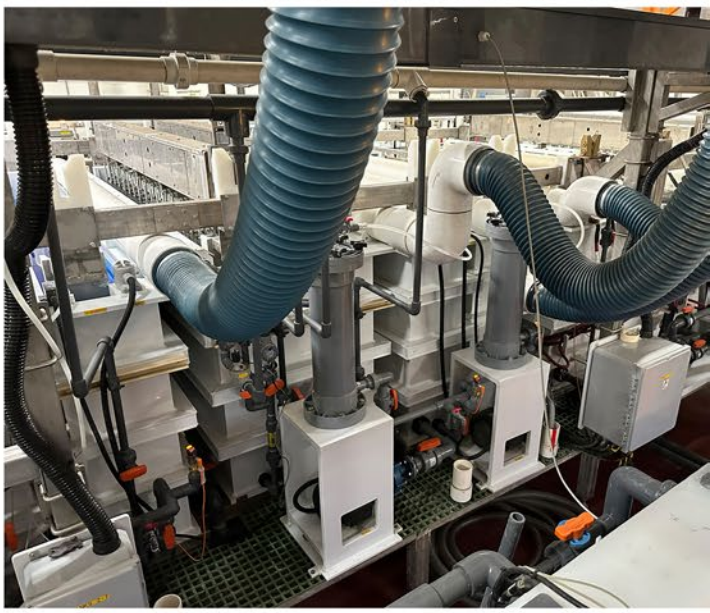



CIMS

Domestic Manufacturing Takes Center Stage on Capitol Hill

American Made Advocacy

by Shane Whiteside, PCBAA

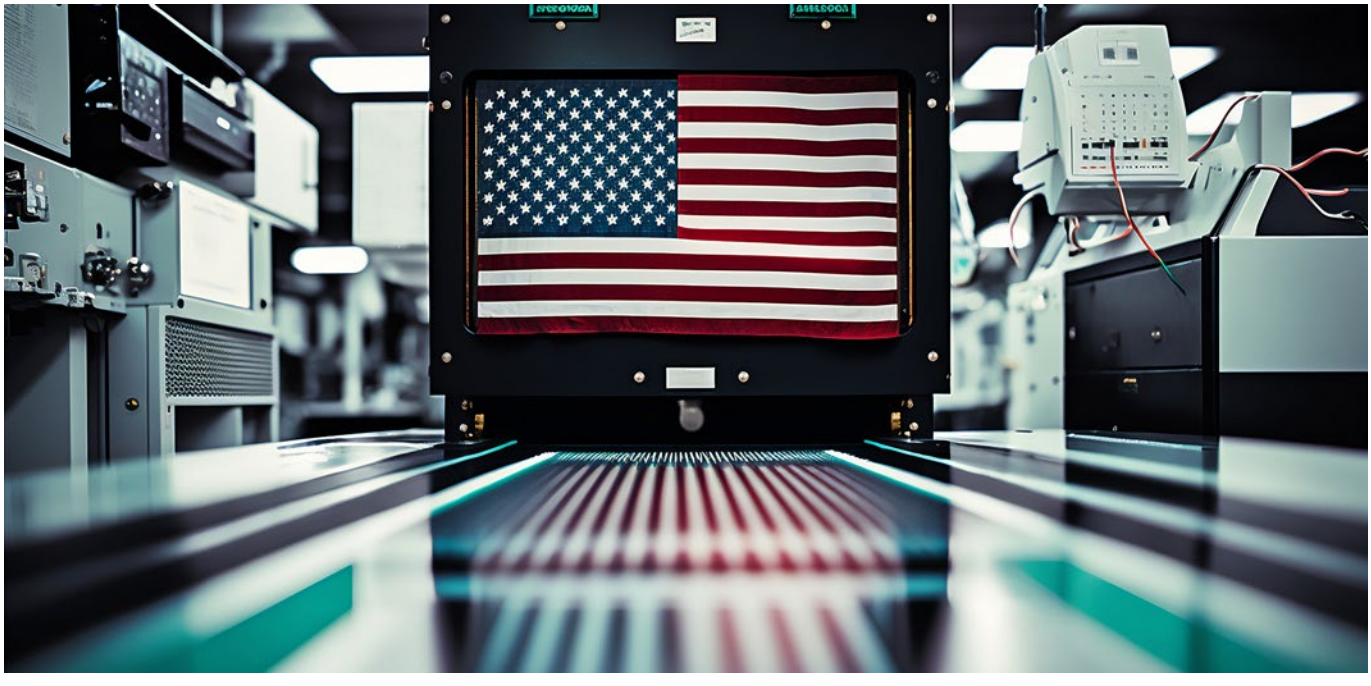
Last month, I had the pleasure of presiding over PCBAA's third annual meeting—and my first as chair of the association. We spent two days in Washington, D.C., engaging with government officials, elected representatives, and thought leaders to educate, advocate, and legislate for American manufacturing.

Those sessions provided unique insights, and the chance to network with colleagues throughout the supply chain was invaluable. I was gratified to see so many executives from around the country and across our ecosystem. PCBAA membership has grown by more than a factor of 10 since we established the association with five companies in 2021; we now have members in 28 states.

We had dozens of meetings on Capitol Hill advocating for our industry and securing additional cosponsors for H.R. 3249, the PCBS Act. There is still a need to educate policymakers about the entire electronics ecosystem. Many in Congress understand that we need to make more chips in America, but as we say, chips don't float.

After three decades of steady contraction, our government recognizes the need to create solutions to reverse our dependence on long and vulnerable supply chains. America must scale up microelectronics manufacturing to protect ourselves from the impact of political decisions, armed conflicts, and/or natural disasters that could choke off access to the technologies our economy depends on.

The importance of technology in our everyday lives underscores the need for robust American manufacturing capacity. From arti-



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ficial intelligence to national security and critical infrastructure, there is incredible demand for the next generation of microelectronics. While we may acquire some of what we need through nearshoring or friend-shoring, a long-term solution must include increased domestic capacity for the technologies that power our way of life.

One sector where we have seen progress is national defense. The Pentagon understands the importance of substrates and PCBs for mission-critical applications. Defense Production Act (DPA) investments have been awarded to several of our member companies, and PCBAA and IPC are jointly focused on sustained and robust funding of the DPA account.

But national security is more than defense. One of our legislative goals is to change the narrative to include the trusted electronics powering telecommunications, banking, the power grid, water systems, medical systems, air traffic control, and many others. This is why Congress must look past the CHIPS Act and invest in substrates and PCBs. We've seen hundreds of billions of dollars of private money follow public action, and now is the time to support the rest of the technology stack.

In the years ahead, we will meet with legislators, policymakers, think tanks, and reporters to tell our story. Remember, the CHIPS Act took almost five years to become law. That is why we need to communicate our issues clearly and consistently year over year.

Don't sit on the sidelines as we fight to restore American manufacturing; now is the time to join our association and make your voice heard in Washington. **PCB007**

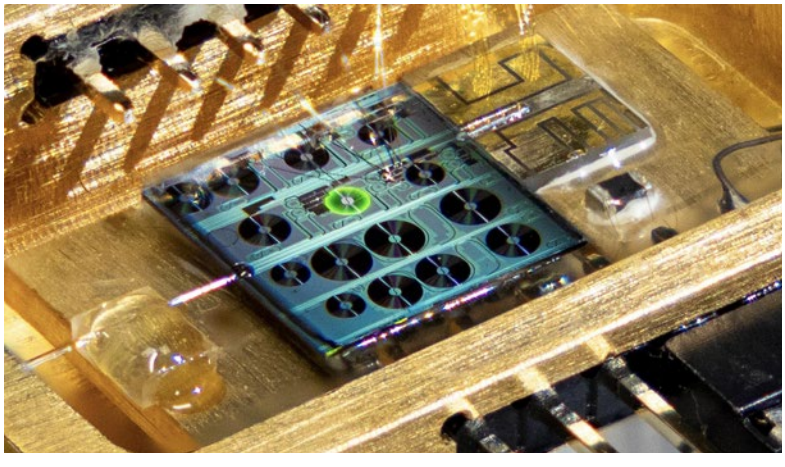
Shane Whiteside is chair of the Printed Circuit Board Association of America and president and CEO of Summit Interconnect. To read past PCBAA columns, click here.

Miniaturizing a Laser on a Photonic Chip

Lasers have revolutionized the world since the 1960s and are now indispensable in modern applications, from cutting-edge surgery and precise manufacturing to data transmission across optical fibers.

There is a growing market for fiber lasers, which are currently used in industrial cutting, welding, and marking applications. They use an optical fiber doped with rare-earth elements (erbium, ytterbium, neodymium, etc.) as their optical gain source. They emit high-quality beams, they have high power output, and they are efficient, low-maintenance, durable, and typically smaller than gas lasers. Fiber lasers are also the "gold standard" for low phase noise, meaning that their beams remain stable over time.

But despite all that, there is a growing demand for miniaturizing fiber lasers on a chip-scale level. Erbium-based fiber lasers are especially interesting, as they meet all the requirements for maintaining a laser's high coherence and stability. But miniaturizing them has been met by challenges in maintaining their performance at small scales.



Now, scientists led by Dr Yang Liu and Professor Tobias Kippenberg at EPFL have built the first ever chip-integrated erbium-doped waveguide laser that approaches the performance with fiber-based lasers, combining wide wavelength tunability with the practicality of chip-scale photonic integration. The breakthrough is published in *Nature Photonics*. (Source: EPFL)

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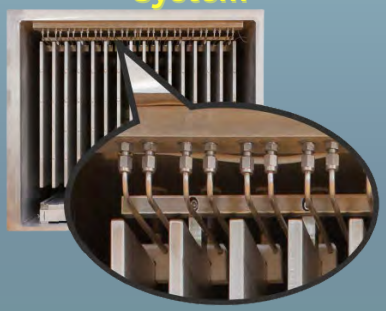

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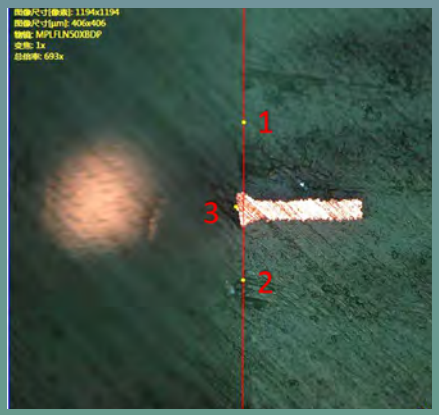

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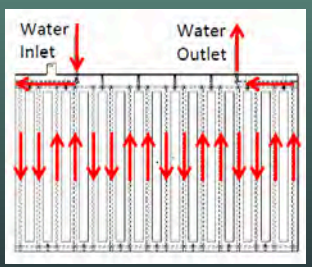

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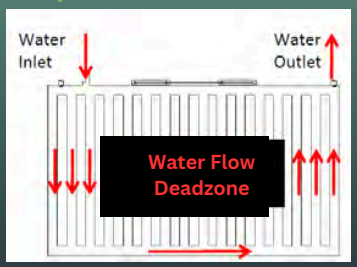

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Controlling an Alkaline Etch Bath With Low Copper Loading

The Chemical Connection

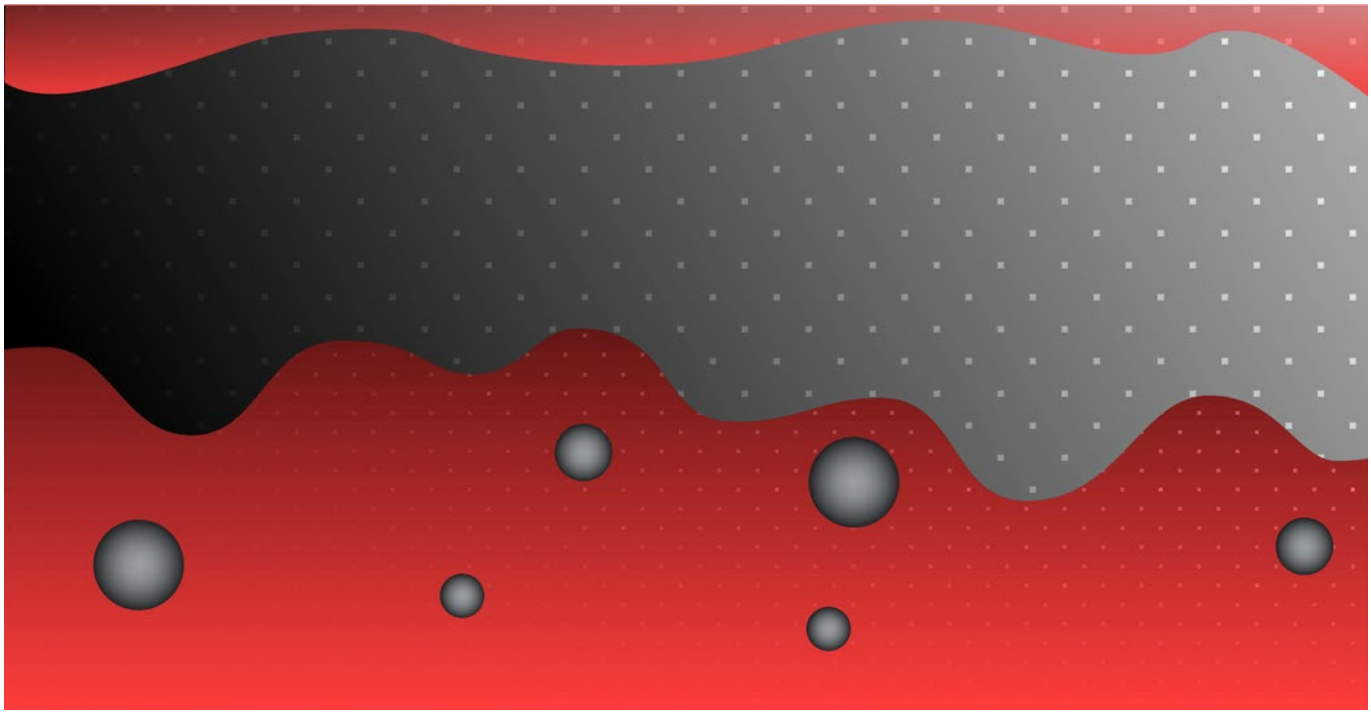
by Don Ball, CHEMCUT

This month, I continue my discussion on how much process control is actually needed for high-density circuit production. However, in the last month, I have been called on to help with a specific process control problem: how to control an alkaline etch bath when you're not etching much copper. This problem has been cropping up more frequently as smaller shops (and a few larger ones) concentrate on low-volume, high-value plated through-hole panels such as prototypes, resistor cores, etc.

Alkaline etchants were introduced in the early 1970s as production of double-sided and multilayer boards requiring plated through-holes began to increase. The advantage of alkaline etchant over the alternative etchants was that the Cu^{+1} etching byproduct could be re-oxidized back to Cu^{+2} to maintain a steady etch rate. The alternatives were all batch etchants that required frequent make-up of new baths and, especially in the case of chrome/sulfuric acid etchant, were environmentally unfriendly.

Alkaline etch has three etchant parameters that must be controlled to keep everything in a delicate balance:

- **Specific gravity:** This is the main control point. Copper is etched and dissolves into the etchant, raising the specific gravity. When the specific gravity increases to the specified control point, replenisher fluid is added to the system until the specific gravity falls below the set point. The replenisher fluid is basically etchant with



no copper in it and excess amounts of ammonia and ammonium chloride (to replace losses of those two commodities during the etching process), keeping everything in balance. The system works well as long as there is a steady supply of copper to be etched. If the supply of copper is not steady, such as small lots of prototype panels with long periods of time between lots, or resistor cores with not much exposed copper to be etched, then the system begins to break down.

- **pH:** The pH continues to fall, even when the system is not in use, because the ammonia molecule is very small and volatile and will continue to escape no matter how well you think everything is sealed. To get the pH up again and avoid the dreaded sludge-out (low pH causing the copper to crystalize out of solution) more replenisher solution is manually added to the system. Unfortunately, the amount of replenisher that needs to be added to get the pH back to spec lowers the specific gravity to the point where the etch rate is significantly changed. It then becomes necessary to etch more copper (either scrap or dummy panels from the plating shop) to get the copper levels back up to spec.
- **Ammonium chloride:** Now you are using up the ammonium chloride without replacement since the specific gravity is too low to trigger the replenisher flow and the pH continues to fall again. You must manually add more replenisher solution to both raise the pH and replace the chlorides which, of course, drops the specific gravity again and so on until everything is completely out of control.

What can be done? Here are a few things that could help keep the alkaline etch system under control.

One of the most important and least understood parts of the system is venting, which is needed to not only control ammonia fumes, but to draw air into the etcher for the reoxidation process to get the Cu^{+1} complex back to the Cu^{+2} complex. There is such a thing as too much venting. Too much venting will pull more ammonia up the stack and contribute to the pH problem. To set the proper venting the draw on the vents on the etch chamber or after the replenisher rinse should be set so there is negative pressure in the etch chamber. This can be checked by closing the vent at the etcher entrance and holding a rag with the end soaked in hydrochloric acid to the etcher entrance. In the presence of ammonia, the rag will give off a white vapor. Open the vents until the vapor is just drawn into the etch chamber and no more. This should be enough to keep the ammonia fumes in the etcher. The vent at the entrance of the etcher should be set so any stray fumes are captured but not enough to interfere with airflow into the etcher.

Aqueous Ammonia

Use aqueous ammonia (30% ammonium hydroxide) to raise the pH. This will still cause some drop in the specific gravity of the etchant but not nearly as much as using replenisher solution. Aqueous ammonia should be available from any industrial chemical supply company in various size containers. Industrial grade is okay; it doesn't need to be laboratory grade.

Ammonium Chloride Crystal

Get some ammonium chloride crystal to control the chloride content without affecting the specific gravity of the etch solution. Weigh out the amount of crystal you need to bring the chloride level back into spec and place it in a bucket. Draw some hot etchant from the etch sump into the bucket and stir until the crystal is dissolved, then pour it back into the etcher. Just dumping the crystal into the etcher will cause most of it to settle to the bottom and take a significant time to dissolve. This should also be available from any industrial chemical supplier as well in 20- to 50-pound bags. Again, industrial grade is good enough.

Prepping for More

If you've finished one lot but plan to do others that day, leave the heat on, but shut off all sprays, including water rinses and the dryer if the system has one. Close the vent valves to minimize ammonia loss. The butterfly valves provided by most equipment suppliers for venting do not close 100% so there will still be enough vent to control fumes if the spray is off.

When you are done for the day but plan to run the next day, follow the same procedure as above but turn off the heat. Also, remove the pH probe and put it into some 6M KCl storage solution overnight.

It's probably okay to leave the etchant in the etcher for up to a week if the venting is completely closed or shut off and the solution is up to specifications in terms of the specific gravity, pH, and chloride levels. For longer periods between running, it would be wise to consider putting the etchant back into the original drums and sealing them tight.

Final Tip

Alkaline etchant is notoriously hard on pH probes. Its viscosity is so low that it will inevitably backflow into the probe. When this starts happening, it is best to recalibrate the probe before the first run of the day at a minimum and, even better, twice per shift. **PCB007**

Don Ball is a process engineer at Chemcut. To read past columns or contact Ball, click here.

BOOK EXCERPT:

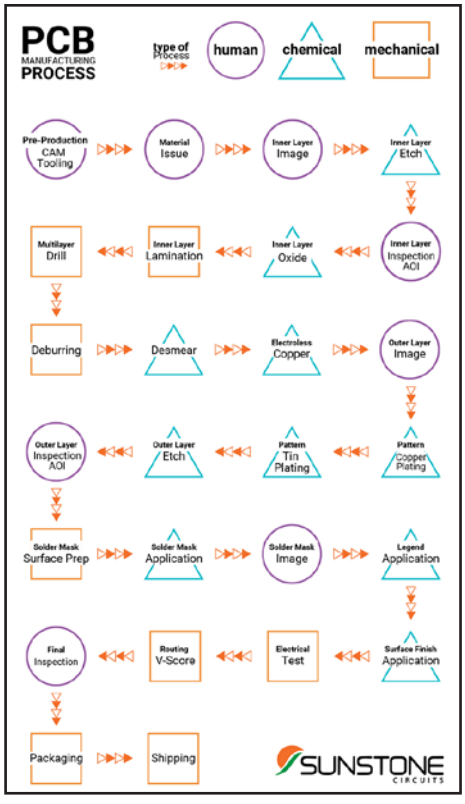
The Printed Circuit Designer's Guide to... Designing for Reality

Chapter 3: Introduction to PCB Manufacturing

PCB manufacturing combines mechanical functions like drill and rout, chemical processes such as electroplating and copper etching, and hybrid processes like lamination that use both chemical and mechanical production methods. These processes are arranged to convert the raw materials and your CAD design into a fully functional circuit board that will transmit electrical signals as designed.

This chapter will lay out the production process at a high level.

The first step in PCB production should be to check the board design requirements and print notes before submitting a request for quote (RFQ) or online order. A thorough double-check of your order form will ensure that the right specifications—such as panelization method, finish type, and solder mask color—are quoted properly. Any extraneous information provided at this stage could lead to confusion, delays, or extra costs in the quote. If your prototype doesn't need all of the specifications on the prints, do not provide them. Best practice is to only provide what is needed for the build at hand.



From there, it's critical for the designer to confirm that the quote or order form specs are aligned with the design. It would be great if the manufacturer could read minds, but all they can read is the order form and the information provided in the files. The manufacturer will build to the specifications on the order, so if they are not accurate, the board might not be manufactured as the designer intended. If a manufacturer offers a CAD tool with DFM rule check module, it would be wise to use it. This will help avoid tooling holds and production delays.

Continue reading...

MilAero007 Highlights

Lockheed Martin Awarded Contract To Develop Artificial Intelligence Tools For DARPA ▸

Lockheed Martin has been awarded a $4.6 million contract by the Defense Advanced Research Projects Agency (DARPA) to develop Artificial Intelligence (AI) tools for dynamic, airborne missions as part of its Artificial Intelligence Reinforcements (AIR) program.

Airbus Built, Copernicus Sentinel-2C Climate Satellite Heading for Launch Site ▸

After road transport from Airbus in Friedrichshafen to Bremen on 2 July, the Airbus-built Sentinel-2C satellite, the third Copernicus Sentinel-2 satellite, is about to be shipped to the European spaceport in French Guiana.

Airbus Awarded German Armed Forces Prime Contract for Military Communications Satellite System ▸

Germany's armed forces, the Bundeswehr, has awarded Airbus the SATCOMBw 3 prime contract for the next generation secure military satellite system which includes geostationary satellites as well as ground segment, launch and operation for 15 years. The spacecraft are due to be deployed before the end of the decade and the contract value amounts to €2.1 billion.

Taiwan to Receive AV's Switchblade 300 Loitering Munition Systems ▸

The U.S. Department of State announced approval of a possible foreign military sale of AeroVironment (AV) Switchblade® 300 loitering munition systems to Taiwan for an estimated $60.2 million. The proposed sale will bolster Taiwan's defensive capabilities and supports U.S. national security and economic interests in the Indo-Pacific region.

Stellantis Invests Additional $55 Million In Archer Following Recent Flight Test Milestone ▸

Stellantis N.V. and Archer Aviation Inc., a leader in electric vertical takeoff and landing (eVTOL) aircraft, announced Archer has received an additional $55 million investment from Stellantis under the companies' strategic funding agreement following the achievement of its transition flight test milestone last month.

CACI Awarded $2 Billion Task Order to Provide Modern Digital Solutions to NASA ▸

CACI International Inc announced that it won an eight-year contract valued at up to $2 billion to provide digital solutions technology to standardize and centralize 11 of NASA's IT services under the NASA Consolidated Applications and Platform Services (NCAPS) award.

Airbus Awarded German Armed Forces Prime Contract for Military Communications Satellite System ▸

Germany's armed forces, the Bundeswehr, has awarded Airbus the SATCOMBw 3 prime contract for the next generation secure military satellite system which includes geostationary satellites as well as ground segment, launch and operation for 15 years.

DESIGN TIPS #124:

ETCH COMPENSATION

What is minimum space and trace? The answer depends on the starting copper weight.

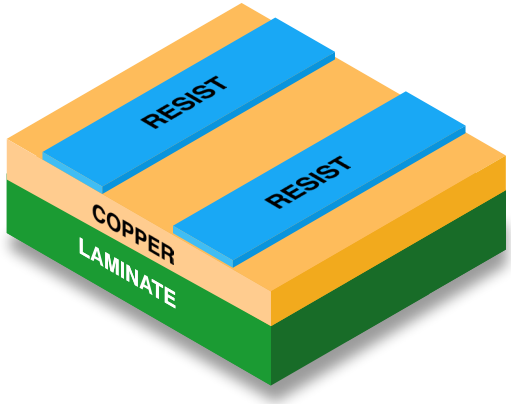
This is because we must do an etch comp on the traces in CAM to compensate for known etch loss. The space between traces after compensation will play a role in whether a board can be manufactured.

The lower the spacing width, the higher the cost. Designers don't always account for the proper starting copper weight after edge compensation.

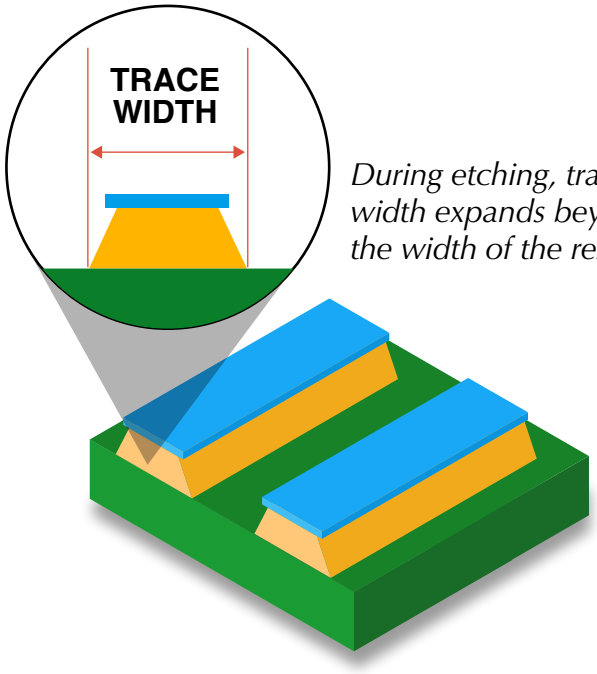
Design tips:

- For accurate starting copper weight, **add a half mil (.0005″) to all copper features**.
- **Start with 3/8 or 1/4 oz. foil**, reducing etch comp and less likely to cause a spacing issue.
- **Boards that call for full body electrolytic gold are not comped** to avoid gold slivers occurring during the etching process.

Before etching



After etching



During etching, trace width expands beyond the width of the resist.

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Thriving Through Partnership:

Alpha Circuit's Journey With IPS

Feature Interview by Marcy LaRont
I-CONNECT007

In this illuminating conversation with Mike Brask of IPS, we explore IPS's involvement in the transformative journey of Alpha Circuit. (To read full interview with Prashant Patel of Alpha Circuit, go to page 60.)

Mike explains the strategic partnership between the two companies. He reveals the crucial decisions and investments that were made to improve their manufacturing capabilities, particularly in copper plating. The discussion also touches on the changing technological landscape, emphasizing IPS's commitment to innovation and client support, which has greatly contributed to Alpha Circuit's growth and operational excellence.

Marcy LaRont: Mike, let's talk about your partnership with Alpha Circuit in building the new fabrication facility. Barry Matties recently toured Alpha's new facility, and Alpha CEO, Prashant Patel, took Barry through the journey of standing up the facility from the lens of an industry outsider. Tell us about what you put into place for them.

Mike Brask: When we started working with Alpha Circuit on its new facility, Prashant

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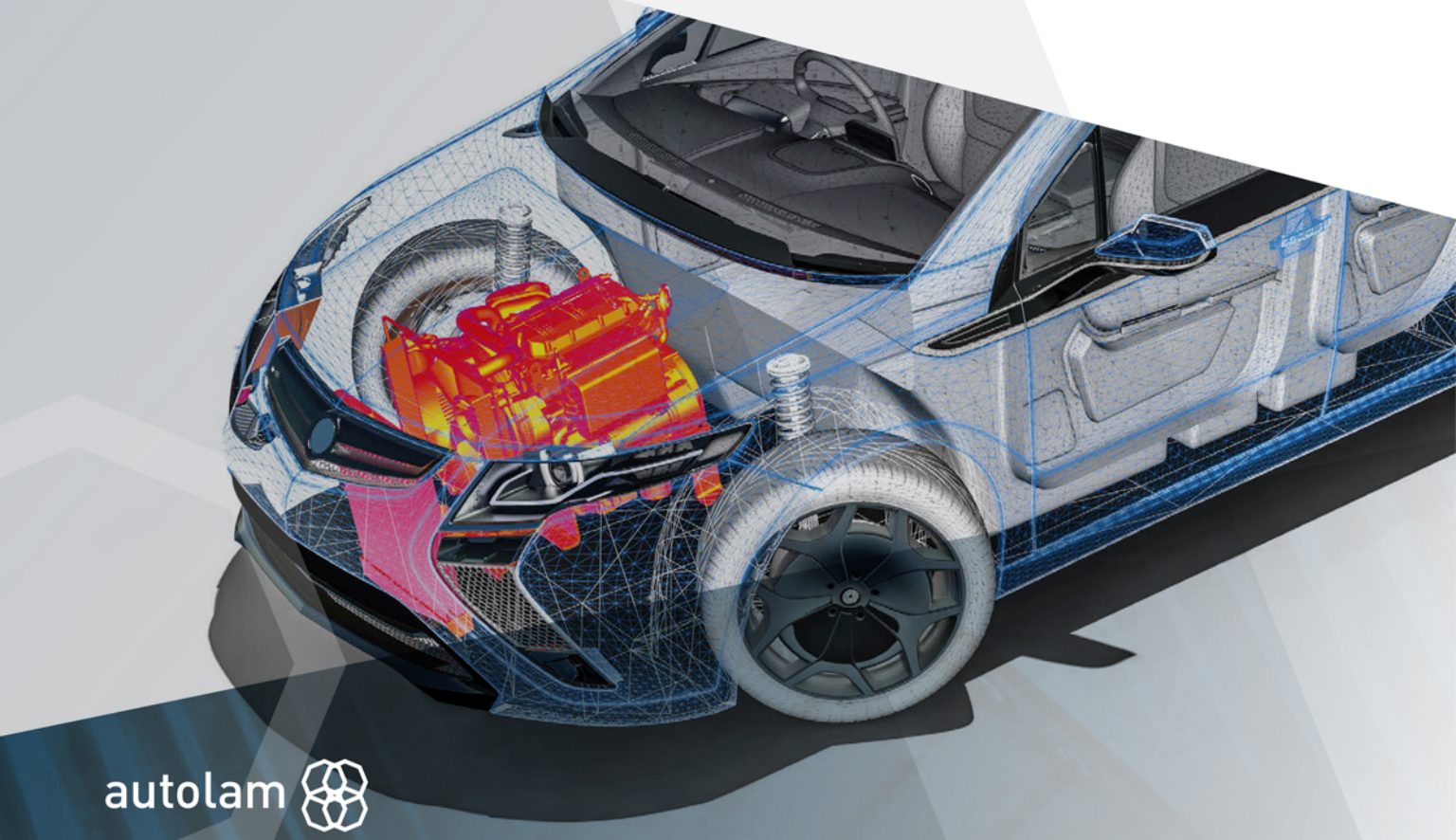

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Mike Brask

was transparent and resolute about his needs. Being new in the marketplace, he surrounded himself with an excellent team of professionals who provided insight into where he could save money and where he should spend it.

Prashant replaced smaller pieces in his shop at lower costs using offshore buyers because he expected a shorter lifespan. He knew they would be easier to change out. Meanwhile, for a large, high-end plating line, he was encouraged to use a U.S. manufacturer.

He also still owned the older facility, Alpha Circuit One, which was running in parallel to this new facility being built. In that, he had a lot of dated equipment. Based on that, he knew copper plating was an area where Alpha Circuit needed to enhance its capabilities and where Prashant knew they needed a strong supplier partner. He selected IPS because we have a good reputation with bigger lines and, importantly, the service and support that goes along with keeping something that large running. We right-sized the line for his shop, not just for his immediate needs, but for his future growth, putting in via fill and other high-end features that they are already taking advantage of.

After the line was installed, we stayed in close contact and worked through different technology issues as they were learning how to run the new shop. Lately, we've been working with them on increasing plating speeds and providing alternative solutions, such as adjusting certain consumable parts which have allowed them to increase the ASF and reduce plating times. They're just implementing those things now. We've been available days, nights, and weekends to support them when and where it's needed.

In implementing an expansion, it is critical to have a supplier that will be there.

Whether it's Prashant who calls me or any of his key people, they all get the same high level of attention and response.

About a year ago, IPS had begun networking its equipment and offering data management to customers. Is this a high-demand area for IPS?

Our customer base is evolving hard into that area. We have a significant advantage in that we don't subcontract our programming. So, when we get a challenging request like a customer wanting to query some specific data or tie into

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their database and MRP systems, our programmers are in-house and able to respond. It is not intimidating for us to make commitments that vary from the norm. Many software suppliers often respond negatively if you hit them with a little bit of a change or a special request. The data acquisition and management part of these processes has always been a challenging gray area. If the copper on your boards doesn't come out right, what happens? Having a time stamp of everything that took place with that process, a clear record of the chemical additions to maintain the process, and a tight hysteresis between the tanks so you get repeatability in all the cells is a huge deal when you are making production quantities. We open up those highways so that customers can query the system and get the data they need. Alpha Circuit has implemented this in its new facility.

In the PCB industry, we have struggled not only with getting the data but with exactly what to do with it when we have it. It's good to see this developing.

Our industry has always been a little bit trendy. The now commonly used term, "Industry 4.0," initially sparked a lot of curiosity, but there's still an incomplete understanding of what that is, and especially, how a specific fabricator can implement it in their facility. Customers are starting to ask me about how to be "Industry 4.0 compliant." So, it is about the evolution of working with your customer base to streamline their needs, and some of that will naturally lead to a conversation about chemical handling and the management of these systems.

What is in the Alpha Circuit line, how big is it, and what is it allowing them to do in terms of their technology?

From a technology standpoint, Alpha has the complete capability to program all their recipes and vary the cycles any way they want on any single flight bar. They are now able to do higher aspect ratios, improve their copper distribution and uniformity, and do VFL—all automatically.

Tell me about the automation piece.

These are typical automated cranes that move flight bars through a Betty Crocker process of a recipe. The tank attributes are what separate it from older technology and plating tanks. Prashant introduced inert anodes at Alpha Circuit vs. anode baskets, and copper oxide instead of copper balls—methods which provide better, more consistent Cu distribution across the board.

Now Alpha is working on increasing plating speed. We introduced some new anode types to Prashant and demonstrated that they would facilitate plating speed. After doing some tests,

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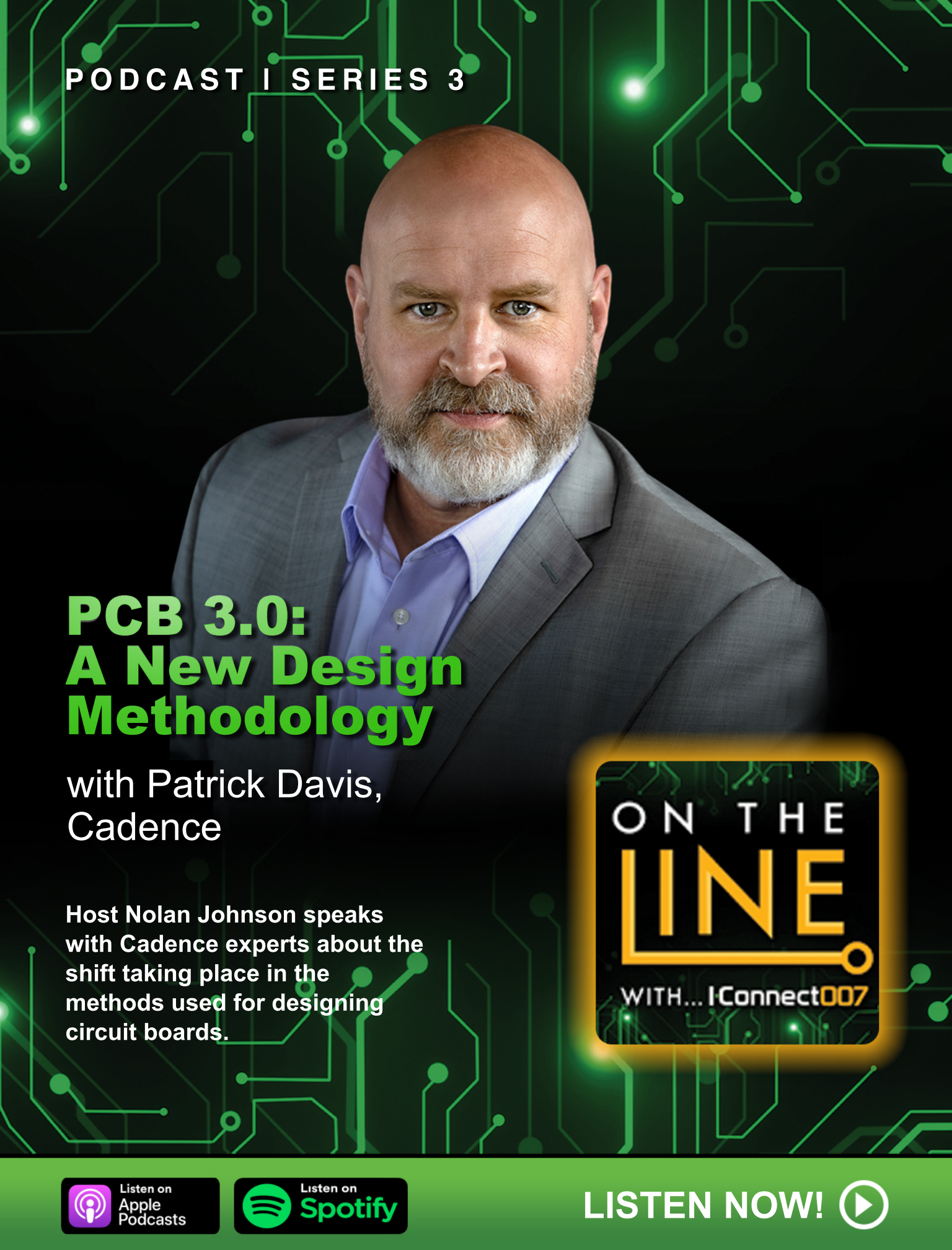

PCB 3.0: A New Design Methodology

with Patrick Davis, Cadence

Host Nolan Johnson speaks with Cadence experts about the shift taking place in the methods used for designing circuit boards.

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he found that he's been able to double his ASF, which shortens his plating time and gives him more throughput capacity on that piece of equipment. So, now he is working on that balance of how far he can push the speed and still get the quality he needs.

I know you'll be with him every step of the way.

We want our customers to be successful. We can't afford a circuit board shop in North America not to be. Anything that we can do to help, we will do it.

What about corollary benefits like reducing waste and water usage?

The line definitely has water-saving features as far as controlling the rinse water and the amount of water that goes through it. Alpha did a lot of work on its waste treatment and working toward better water recycling, to the tune of 70%. It's fairly cost-effective to get to that 70-80% recycling mark. It gets really expensive to go that last 20%. Prashant and Alpha have done a nice job with that. They have oodles of good water, and it is now less important for him to control it at the plating line because he's catching it on the back end and recirculating it there.

Through this experience with Alpha Circuit's new facility, what would you say they have done really well?

Prashant and the Alpha Circuit team did a really good job on the discovery side in their due diligence to know what they wanted to put into the new facility and understanding exactly where they wanted to be in the marketplace. If you add up the years of experience that group has been making circuit boards, it's a very long time. When your customers are where they want to be, that's when you feel we've done everything right by them. Being there to service and support them is the biggest thing.

Service is everything in this business. Mike, do you have any closing thoughts?

We are really proud of our partnership with Alpha Circuit, the way we could work with them, and how they worked with us. It led to some other opportunities with the used equipment side of our business where we were further able to support them.

I would like to acknowledge our excellent team and IPS's approach to service. I like to compare our support to the fire department. If you have a big fire, you send the big ladder truck and a bunch of smaller trucks. If it's a small thing, then you send out the brush fire truck. Every situation is different. The advantage we have on the support side is that we can respond appropriately depending on the skill set the customer needs. We have a deep and qualified pool of talent to draw from, to put the right guys together to accomplish whatever it is they want. Our shops are all vertically integrated. We bring the parts with us, and we are very proactive with our customers.

Congratulations to IPS on a job well done, and thank you, Mike, for your time today.

Good to talk to you, Marcy. **PCB007**

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Novel Ultra HDI Architectures

Happy's Tech Talk #31

by Happy Holden, I-CONNECT007

Ultra HDI has become the focus for many fabricators, especially as the follow-on for the 40-year-old conventional HDI. But there is more to UHDI than just finer traces and spaces. Novel architectures have been developed that complement the new dense lithography. Figure 1 shows four of them:

1. Swing blind microvias[1]
2. Vertical conductive structures (VeCS)[2]
3. Integrated mesh power systems[3]
4. Power mesh[4]

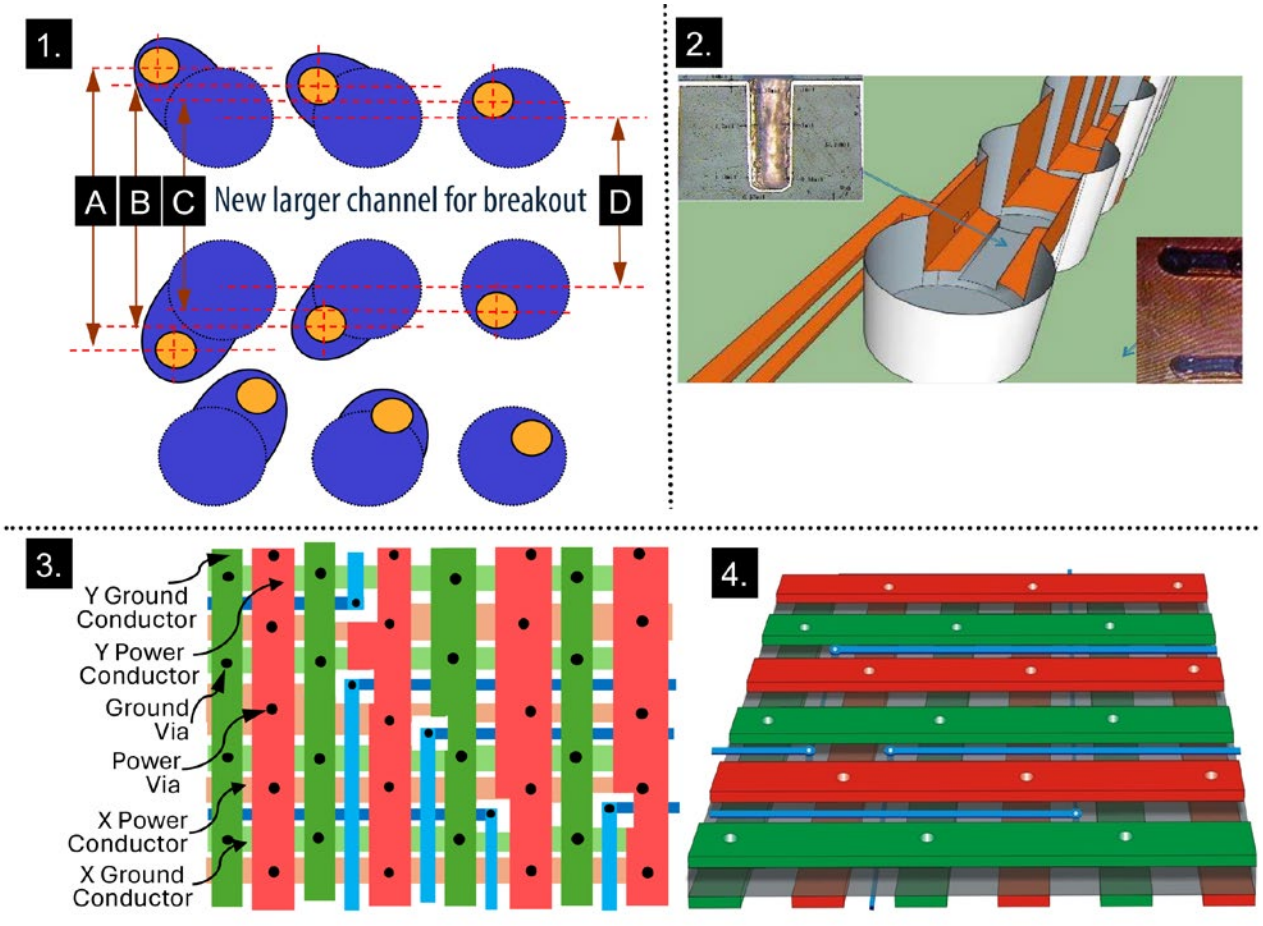

Figure 1: 1) When using microvias for BGA breakout, the smaller size allows the vias to be "swung" to create larger channels on the inner layers for routings, as seen in A–C; 2) VeCS is a 3D architecture for connections to any inner layer without sequential lamination or plating; 3) IMPS uses the finer traces/spaces and microvias to reduce the total layers to only two coplanar layers; 4) Power mesh is similar to IMPS but GND is kept as a return reference layer and the inner layers route signal and power.

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A-BGA Pitch (mm)	Alt.	0.4	0.5	0.65	0.8	1.0
B-SMT Land (mm)	a.	0.22	0.25	0.30	0.40	0.50
	b.	0.20	0.22	0.25	0.35	0.45
	c.	0.18	0.20	0.22	0.30	0.40
C-Via Land Dia (mm)	a.	0.2	0.24	0.26	0.28	0.3
	b.	0.16	0.2	0.21	0.23	0.25
	c.	0.12	0.16	0.16	0.18	0.2
D-Pad Space (mm) X-Y	a.	0.18	0.25	0.35	0.40	0.50
	b.	0.20	0.28	0.40	0.45	0.55
	c.	0.22	0.30	0.43	0.5	0.6
E-Pad-Land Space (mm) Diag.	a.	0.346	0.457	0.619	0.731	0.914
	b.	0.366	0.487	0.669	0.781	0.964
	c.	0.386	0.507	0.699	0.831	1.014
F-Via Dia. (mm)	a.	0.146	0.257	0.419	0.531	0.714
	b.	0.166	0.287	0.469	0.581	0.764
	c.	0.186	0.307	0.499	0.631	0.814
G-Pad-Pad Space (mm)	a.	0	0.01	0.065	0.12	0.2
	b.	0.04	0.05	0.115	0.145	0.22
	c.	0.08	0.09	0.165	0.175	0.25

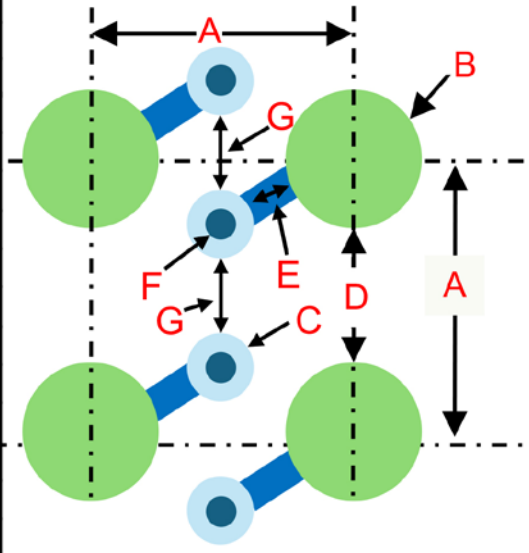

Table 1 (left): Swing microvias based on BGA pitch and SMT land sizes
Figure 2 (right): Swing microvias' geometries.

One of the major advantages of HDI, and especially ultra HDI, is the miniature features of the process. Since the microvias and lands are so small, they can be swung around at various angles between the BGA lands, as seen in Figure 2. The angles and distances (Table 1: E, G) will depend on the BGA pitch (Table 1: A) and where the microvia is placed relative to the BGA SMT land (Figure 3).

HDI Stackups

Chapter 3 of the HDI Handbook[1] shows multiple stackups that provide for distributed capacitance and X-Y routing layer pairs (Figure 4). The finer geometries of UHDI and HDI require thinner dielectrics to maintain their impedances, which can also lower crosstalk and improve signal integrity and PDN impedances.

Boulevard Routings

The biggest gains from these HDI structures are the additional routings available on inner layers (Figure 5). By concentrating the

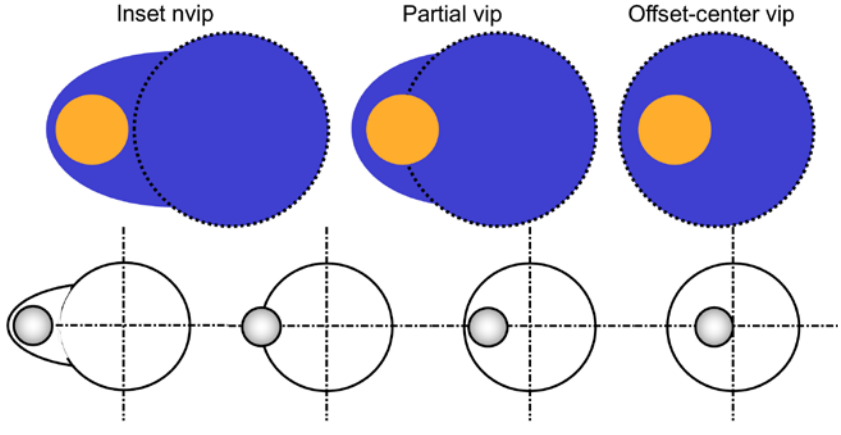

Figure 3: (Near)-via-in-pad techniques can have multiple angles depending on the BGA pitch and land size, the microvia's land size, and where the microvia is placed. These can be a dog-bone, an inset uvia, partially in the microvia and fully in the microvia (but not in the center).

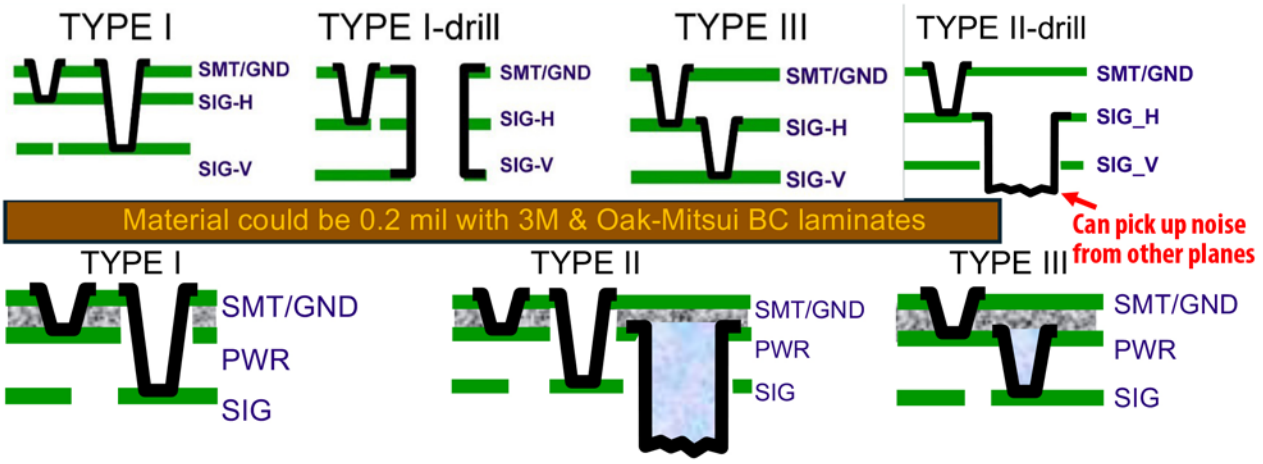

Figure 4: Trying various stackups for the HDI construction allows the use of UHDI geometries, especially if controlled impedance transmission lines are important, as the dielectrics will be thin. Using horizontal/vertical routing pairs with microvia connections will provide the best signal-integrity performance.

BGA breakout microvias together, many additional routing channels are opened up. This allows many more traces for the breakout that could not be achieved with the conventional N-S-E-W dog-bone breakout structure and with only two laminations. This is coupled with the ground plane moved to the surface for improved return paths. Complex and high-density BGA can be connected with very few build-up layers, increasing reliability and ease of construction (Figure 6).

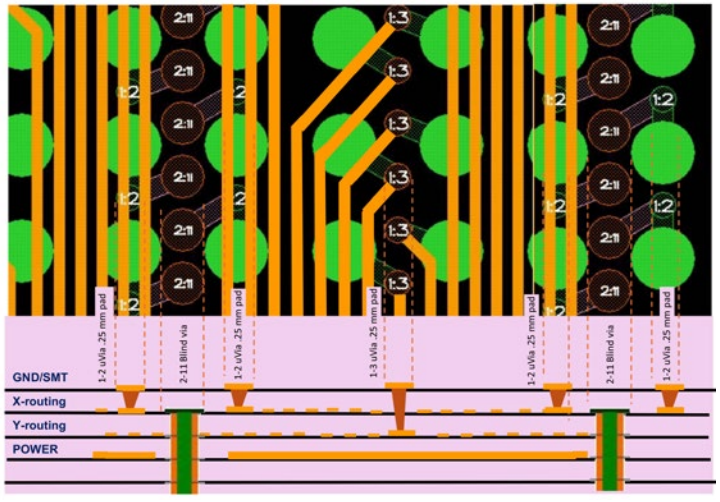

Figure 5: Top and side view of swing microvias showing the increased routing and break-out density available by creating routing boulevards.

Vertical Conductive Structures (VeCS)

VeCS was developed by NextGIn Technologies from the Netherlands in 2017. The innovative, true 3D structure provides for vertical layer connections to layers without sequential lamination by using routed trenches. The trenches are made during drilling with new, special drill/router bits produced at various controlled depths. The trenches allow metallization and plating, as seen in Figures 1 and 7a.

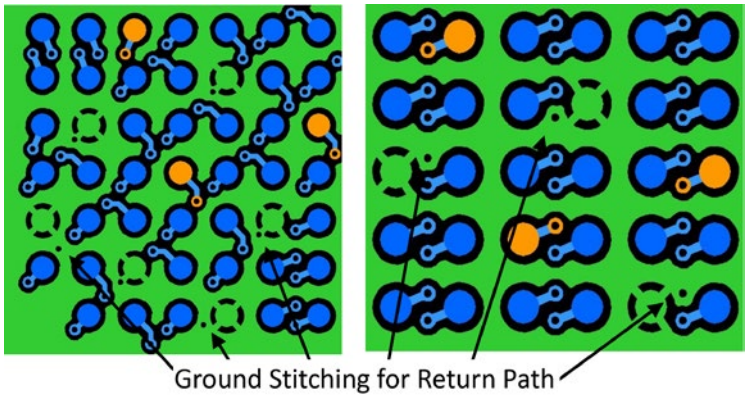

Figure 6: Examples of swing microvias used for a fine-pitch, complex BGA breakout where the GND return path is merged with the SMT land patterns to provide for higher density and improved signal integrity.

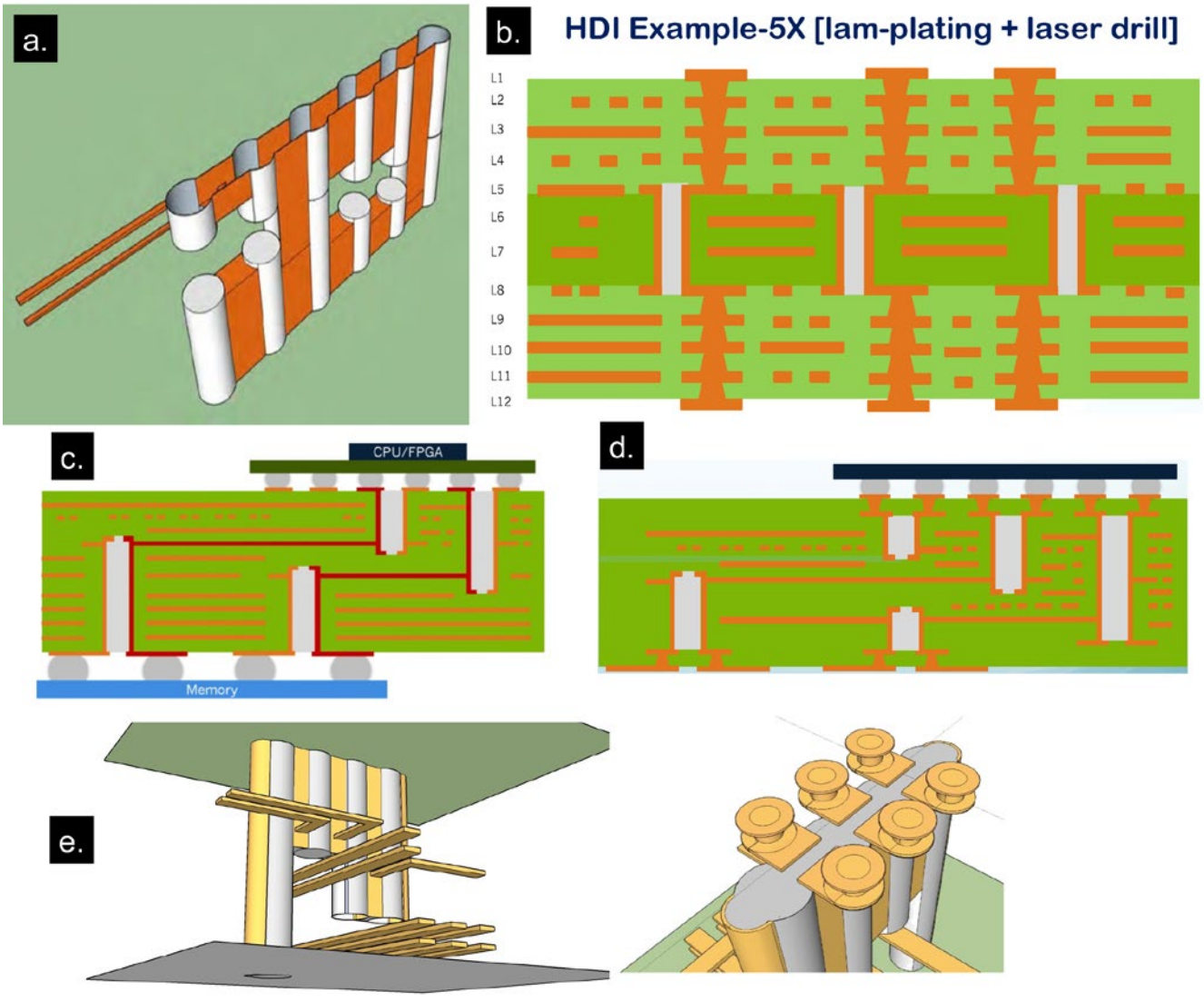

Figure 7: a) VeCS are a true 3D architecture brought about through the use of drill/router slots that allow metallization and plating, and then the slot vertical connectivity is isolated by secondary drilling; b) HDI example of 4+4+4 replaced with (c) by drilled slots or (d) microvias plus VeCS core; e) Connections are made to the plated slot-edge view and top view[2].

As an example, my TechTalk #1[2] provides an example of a 4+4+4 (Figure 7b) HDI build-up replaced by the VeCS example in Figure 7c with only one lamination and no laser-drilled microvias or in Figure 7d with the use of microvias over the VeCS core.

VeCS is used for interconnections by creating a routing channel (slot) in the printed circuit that then can be metallized and plated easier than high-aspect ratio vias and will allow connection to inner layers. The channels can be created by existing PCB fabrication equipment. This allows HDI densities without significant added costs yet easier fabrication processes and higher electrical performance and reliability. The process and applications already developed by NextGIn Technologies are: VeCS-1, -2, and -HDI. The three main combinations of their interconnect slot technology:

- VeCS-1: Where the channel (slot) goes through the substrate
- VeCS-2: Where the slot is formed as blind or in a hybrid-blind and through-slot combination
- VeCS-HDI: Laser-drilled microvias are used for fine-pitch utility on ultra-fine-pitch components

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With channels (slots) formed from both sides, the 3D vertical traces provide greatly increased density without sequential laminations. Replacing larger through-hole with slots provides better power integrity for new power-hungry chips while lowering inductance and capacitance for improved signal integrity.

The Channel or Slot

The all-important step of metallizing and plating the typical 0.3-mm blind slot (Figure 7a) is shown in the column of various depths and lengths (from depths of 0.47 mm to 1.23 mm and lengths of 0.6 mm to 1.8 mm). Some of the smaller aspect ratios have insufficient chemical exchange but the majority have excellent chemical exchange for normal plating baths. The new alternative drill/router bits have successfully created channels of 0.1 mm with straight walls and no burring.

Fabrication Process

The VeCS fab process starts with a conventional through-hole multilayer. The process has eight steps:

1. Create slot
2. Plate slot
3. Alignment in BGA pin field
4. Resin fill PR slot and PR stencil
5. Drill CR slots
6. If vertical traces are used, drill BR slots
7. BR/CR stencil
8. Resin fill BR/CR slot

First, after drilled vias are completed, the primary cross-rout (CR) slots are put in. Here, a special drill/router bit uniquely suited for this operation is used. Much work and experimentation were conducted to perfect an ideal drill/router bit for this task. Then metallization and copper plating are performed. Resin is now used to fill the CR slots. Curing is the important step of cross-routs that create the vertical interconnects. If vertical traces are used, drill/rout out the back-rout (BR) slots. Then, selected vias and slots are resin-filled and cured. In step 7, for pattern plating, the normal process resumes of imaging, plating, stripping, and final etching. In the final panel, the board would be solder masked, with any final finishes and fabrication.

Figure 7e shows a 3D cut plane view and the inner layer connection and surface connection views for VeCS.

Integrated Mesh Power Systems (IMPS)

In the late 1990s, thin-film multichip modules (MCM-D) were to be the salvation of the interconnect industry. Fine-line lithography would allow miniaturization with ease. Unfortunately, the four or five metal layers to which integrated circuits were wire-bonded proved to be too expensive compared to printed circuit multilayers and the emerging silicon integration on ball grid arrays.

IMPS technology was created to reduce the cost and metal layers on thin-film and ceramic multichip modules. The IMPS topology can reduce the metal layers to only two or three. This results in a substantial cost reduction and simplification while not affecting electrical performance.

Background: IMPS

The scientists at the High-Density Electronics Center (HiDEC) of the University of Arkansas, Fayettville, invented IMPS in the mid-1990s. IMPS allows a low inductance coplanar power and ground distribution, as well as dense, controlled-impedance, low crosstalk signal transmission in only two wiring layers. Figure 1[3] shows the basic IMPS technology.

The conventional metal wiring topology is to have signals on one metal layer and power and ground on separate metal layers. The resulting usage of these expensive metal layers is quite low. Signal layers may have only 50–60% utilization and power/ground layers only half that amount when either the coarse mesh or fine mesh is utilized.

They may be made smaller (if signal losses can be tolerated), but the spacing cannot. High-speed, fast rise-time signals are sensi-

tive to crosstalk, so the signals still must be separated. IMPS uses that separation to route power and ground. To prevent current starvation at devices, an adjacent metal layer running orthogonal is connected by buried vias at each junction where the two layers cross each other. This layer-pair topology is an "interconnected mesh" that can thus provide all the power/ground connections without voltage loss and connect the signal for these devices.

IMPS Design

IMPS was developed in the late 1990s for MCM-D design using thin-film metallization on liquid dielectrics. Fortunately, PCB technologies have improved in the last 30 years such that UHDI technologies can now achieve these thin-film geometries. The various SAP metallization on polyimide film or ABF organic films can be employed, including the use of metal-backed thermal laminate.

The architecture is based on the current use of a power mesh in integrated circuit design. But instead of the single metal use, IMPS employs two metals and adjacent layers, connected by vias, to form the mesh (Figure 8). In Figure 8, L1 and L2 are the ground mesh, while L1: VCC–L2: VCC and L1: VDD–L2: VDD shows the power mesh. The two are merged with the open area of X-Y routings, as seen in L1: signal–L2: signal.

High-density MCM-BGA Application

In 1996, HiDEC used flexible film and tape BGA (TBGA) technology along with microvias and the IMPS topology, to create an MCM-L with only two metal layers instead of the conventional four metal layers of an MCM-D. This test vehicle puts two IMPS metal layers, which provide signal wiring and power distribution, on the two sides of a polyimide film. One side contains mounting pads to which the dies are

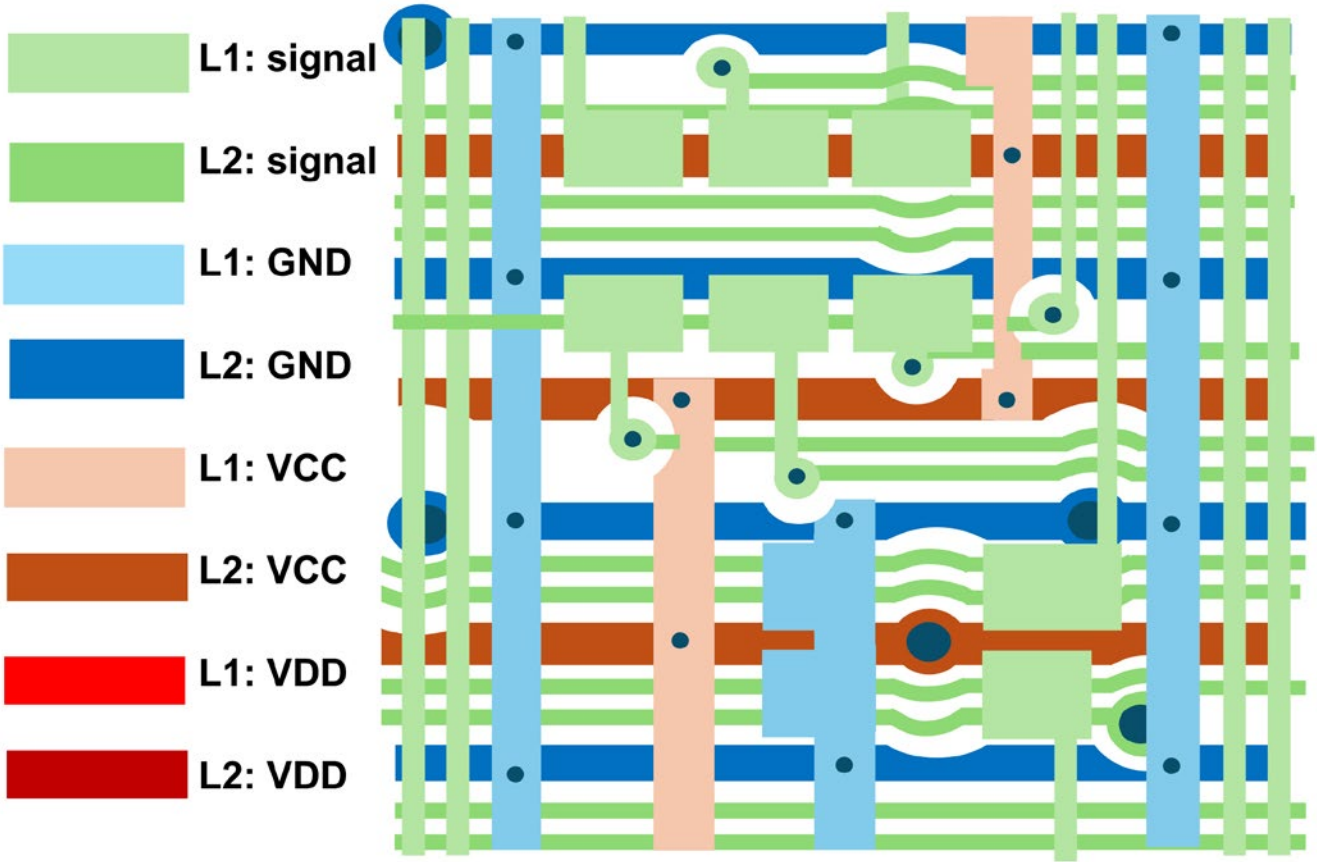

Figure 8: The IMPS design steps using only two metal layers composed of the IMPS two-metal layer mesh of ground; the two-metal layers mesh for power distribution; and two-metal layer-pair conductors on the organic substrates all integrated.

wire bonded and discretes are soldered. This side is encapsulated. The other side has the lands in a ball grid array pattern. A part of the IMPS artwork is shown in Figure 8.

The test vehicle was built on 2-mil Sheldahl adhesiveless polyimide film, ViaThin™. The basic design rules are 50 µm lines and spaces, 150 µm via target lands over 25 µm laser drilled vias. The IMPS mesh consisted of 200 µm lines and 50 µm spaces, with the lines offset from the via row or column centers. Wirebond pads consisted of 200 µm x 350 µm rectangles on both metal layers, tied together with two vias.

Power Mesh Architecture (PMA)

The power mesh architecture was derived from the interconnected mesh power system (IMPS) developed and patented by HiDEC[5]. The IMPS topology was created to reduce the cost and metal layers on thin-film and ceramic multichip modules.

The power mesh architecture (PMA) for PCBs is presented in Figure 9. My Tech Talk on IMP[5] has impedance tables as well. The initial application of PMA is shown, as well as an application that helps develop the wiring density model for PMA.

In 1993, a large electronics OEM had the problem of having to redesign the control board of their largest 3.5" hard disk drive. The boards were a standard 3.87" x 5.45" but their problem was that they wanted to cut a 2.8" diameter hole in the board so that another platter could be added to the drive. This would enable the drive to have a capacity of 16 GB, quite a capacity for 1993. The solution to the loss of nearly 5.8 square inches out of 17.5 square inches was to employ microvias and microvia-in-pads. The new microvia board (called Lynx) was designed with a reduced surface area and as a six-layer design (1+4+1), two fewer layers than the original.

Reading about the IMPS topology from HiDEC in 1994, the Lynx board was again redesigned to a four-layer construction. To minimize the microvias, the outer two layers (1 and 4) were flooded with ground and only power

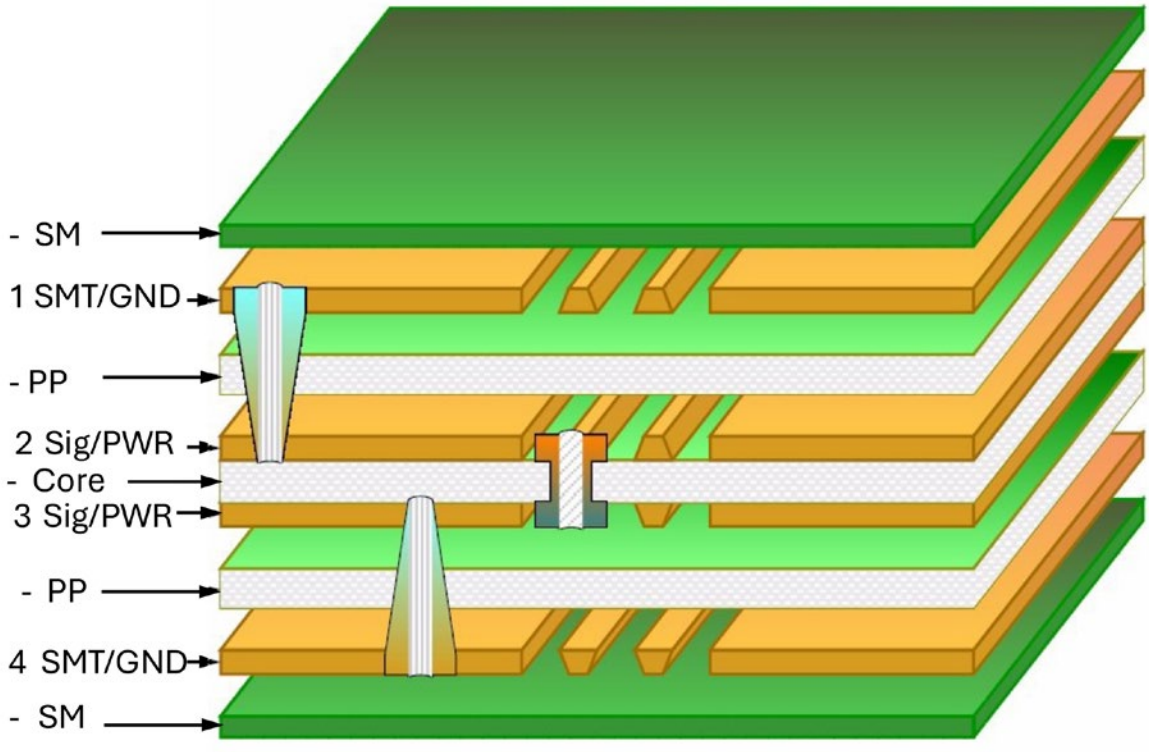

Figure 9: Power mesh was adapted from the IMPS architecture but does not route GND bussing. Power mesh is an offset coplanar stripline transmission model [5].

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and signals were placed on the inner layers. Figure 1[4] shows the new power-signal routing architecture, which was called power mesh to differentiate it from IMPS.

Electrical Model

The original Lynx board was not controlled impedance, but additional PCB designs that used power mesh were. The consensus is that power mesh is an offset coplanar stripline. Figure 9 shows the cross-section and stack-up for the PMA.

The crosstalk model indicates that the power mesh architecture creates a naturally low crosstalk condition. Each signal trace of X-width is approximately 3X or 4X distance from the next signal, depending on the power trace width. This creates horizontal crosstalk of less than 2%. The vertical crosstalk is extremely low. From 15 mV/V for thin cores (0.012") to 2.6 mV/V for a thick core (0.051").

Wiring Model

In 1994, StorageTek, an OEM in Colorado, conducted performance benchmarking with microvia designs and fabrication. The successes of that program contributed to its continued use of microvias. In 1998, it became apparent that they required some wiring model to indicate that a microvia structure was required. In performing that model development, a power mesh benchmark was designed for one of the microvia boards. Figure 5 in Tech Talk #28 shows the two inner layers of the four-layer power mesh structure and two of the six inner layers from the original eight-layer through-hole design. The wiring density model for the power mesh architecture is:

Power mesh = 17 to 40 signal inches per square inch per layer*

- Calculate the statistical wiring density using Coors, Anderson & Seward[4]
- Calculate the Manhattan wiring density using Wd = 0.0068(X)^2 – 0.1644(X) + 35.1, where X is the Coors statistical wiring density
- Calculate the routability index for power mesh
- Calculate the layout efficiency using L.E. (%) = 4.0642(RI)^ – 1.189, where RI is the routability index

* *Dependent on trace width and spacings*

Summary

The new microvia topologies of swing vias, VeCS, IMPS, and power mesh have demonstrated that applications to simplifying complex multilayer, PBGAs, and MCMs to UHDI are available. VeCS can reduce process costs; IMPS can reduce the structure to a two-metal interconnect, while power mesh uses a four-layer, reinforced laminate structure. These results show that these topologies have the capacity of positively impacting how electronic products are packaged and interconnected. **PCB007**

References

1. Chapter 3: Swing Vias, *The HDI Handbook,* by Happy Holden, I-Connect007.
2. Happy's Tech Talk #1: Vertical Conductive Structures (VeCS), by Happy Holden, *PCB007 Magazine,* October. 2021.
3. I have written nine articles on VeCS for *PBC007 Magazine*.
4. Happy's TechTalk #27: Integrated Mesh Power System (IMPS) for PCBs, by Happy Holden, *PCB007 Magazine,* March 2024.
5. Happy's Tech Talk #28: The Power Mesh Architecture for PCBs, by Happy Holden, *PCB007 Magazine,* April 2024.

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, click here.

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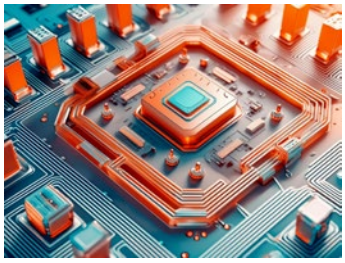
TOP TEN

EDITOR'S PICKS



Beyond Prepreg: The Glassless 'Revolution'

As our industry rallies around the call to action for HDI and UHDI, we find unparalleled and myriad laminate options. This abundance is rivaled only by the question surrounding them: Can they measure up to the high technology packaging demands required in our near future? Unsurprisingly, recent developments in FR-4-esque materials for high-speed and high-density designs, as well as newer, glassless technology for replacing traditional glass-impregnated laminates and prepreg, are garnering much interest.

Overcoming Workforce Challenges from Onboarding to Upskilling

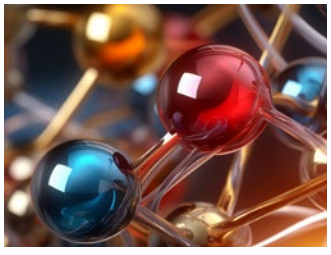
Everyone seems to be talking about workforce and staffing, but after the pandemic, staffing for manufacturing jobs became an even greater challenge. In April, IPC published a white paper, "Building Electronics Better: A Plan to Address the Workforce Challenges Facing the Electronics Manufacturing Industry." The paper addresses myriad issues surrounding workforce recruitment, development, and retention while outlining a specific approach to tackle these challenges.

Forty Years of Innovation at Electra Polymer

Don Monn

Don Monn, national sales manager at Electra Polymers, talks about the company's 40th anniversary and recent developments in inkjet solder mask technology. Don shares insights on the company's history, commitment to innovation, and the environmental benefits of its products. He discusses the challenges and advancements in the circuit board industry since the 1990s, emphasizing the importance of education and mentorship.

The Chemical Connection: Can the Limits of Subtractive Etching Be Extended?



Subtractive etching has been the technology of choice since the era of PCBs began in the mid-1950s. I can remember TV ads for one manufacturer that claimed their TV sets were of much higher quality claiming, "We use wires to make the connections for our television sets, not cheap printed circuit boards." Imagine that. Many alternative technologies have been tried—e.g., conductive inks applied with an ink jet printer, direct metallization, and semi- and fully-additive manufacturing—but none have been able to match the low cost and high productivity of the subtractive process.

Webinar Review: Women Reshaping the Engineering Landscape

IPC celebrated International Women in Engineering Day with "Bold Breakthroughs: Women Reshaping the Engineering Landscape," a webinar moderated by Teresa Rowe, IPC senior director of assembly and standards technology.

New IPC Europe Report, Advocacy Campaign

In the European Union, as in the United States, today's geopolitical realities are shaping a new approach to the region's industrial strategy. The wars in Ukraine and the Middle East, as well as tensions in East Asia and actions being taken in other regions to support key industries, are heightening Europe's focus on measures to close productivity and innovation gaps, especially where they raise security concerns.

Revolutionizing PCB Prototyping With ML and AM

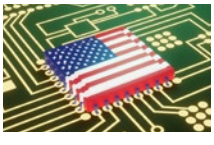
When it comes to printed circuit board (PCB) development in particular, traditional methodologies are being reshaped by the convergence of additive manufacturing (AM), machine learning (ML), and artificial intelligence (AI), and propelling the evolution of electronics manufacturing to unprecedented heights. Traditional methods have typically involved intricate design iterations, extensive manual labor, and significant material waste.

It's Only Common Sense: Saving a Great Customer When Things Go Wrong


Dan Beaulieu

Handling a serious problem with a long-time customer, especially when both parties share some blame, requires a delicate balance of diplomacy, accountability, and strategic thinking. The goal is to resolve the disagreement without sacrificing the valuable relationship. The last thing you want to do is win the battle and lose the war.

American Made Advocacy: Changing Leadership and Three Years of Advocacy in D.C.



This month, my term as chair of PCBAA ended, and I turned over those responsibilities to Shane Whiteside, CEO of Summit Interconnect. We have representation from companies and individuals in manufacturing, assembly, and materials. I look forward to working with Shane in his new role at PCBAA.

Material Insight: Diversifying PCB Manufacturing Through Nearshoring

In recent years, there has been a notable shift in the electronics manufacturing supply chain landscape. However, the global supply chain for the domestic PCB industry has been steadily shifting since the 1980s, when the United States began offshoring PCB manufacturing to other countries. But because of the quality control issues, rising international tariffs, and unclear intellectual property protection involved in offshoring, reshoring has become a particularly hot topic.

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- Create and maintain unique company culture to promote great work performances
- Develop and improve the company's human resources evaluation processes and promotion policies

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- The satisfaction of knowing you're making a real difference in our customers' lives

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- Excellent problem-solving and analytical skills
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3. Serve as primary technical point of contact to customers providing both pre- and post-sales advice
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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".

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The Test Connection, Inc. is a test engineering firm. We are family owned and operated with solid growth goals and strategies. We have an established workforce with seasoned professionals who are committed to meeting the demands of high-quality, low-cost and fast delivery.

TTCI is an Equal Opportunity Employer. We offer careers that include skills-based compensation. We are always looking for talented, experienced test engineers, test technicians, quote technicians, electronics interns, and front office staff to further our customer-oriented mission.

- Candidate would specialize in the development of in-circuit test (ICT) sets for Keysight 3070 (formerly Agilent & HP), Teradyne/GenRad, and Flying Probe test systems.
- Strong candidates will have more than five years of experience with in-circuit test equipment. Some experience with flying probe test equipment is preferred. A candidate would develop, and debug on our test systems and install in-circuit test sets remotely online or at customer's manufacturing locations nationwide.
- Proficient working knowledge of Flash/ISP programming, MAC Address and Boundary Scan required. The candidate would also help support production testing implementing Engineering Change Orders and program enhancements, library model generation, perform testing and failure analysis of assembled boards, and other related tasks. An understanding of stand-alone boundary scan and flying probe desired.
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TTCI is an Equal Opportunity Employer. We offer careers that include skills-based compensation. We are always looking for talented, experienced test engineers, test technicians, quote technicians, electronics interns, and front office staff to further our customer-oriented mission.

Associate Electronics Technician/ Engineer (ATE-MD)

TTCI is adding electronics technician/engineer to our team for production test support.

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- IPC certification a plus, but will certify the right candidate

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- Training and certifications provided and maintained by EPTAC

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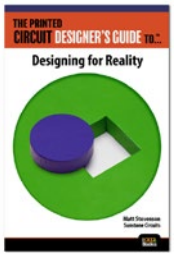
I-007eBooks The Printed Circuit Designer's Guide to...

Manufacturing Driven Design

by Max Clark, Siemens

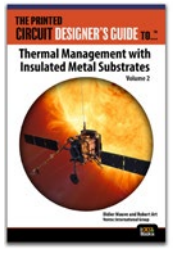
This book introduces a new process workflow for optimizing your design called Manufacturing Driven Design (MDD) and is a distinct evolution from DFM. Manufacturing certainly plays a critical role in this process change, and manufacturers do certainly benefit from the improved process, but it is design teams that ultimately own their overall product workflow; they are the ones who need to drive this shift. **Get empowered now!**



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.**

Flex and Rigid-Flex Fundamentals

by Anaya Vardya and David Lackey, American Standard Circuits

Flexible circuits are rapidly becoming a preferred interconnection technology for electronic products. By their intrinsic nature, FPCBs require a good deal more understanding and planning than their rigid PCB counterparts to be assured of first-pass success.

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