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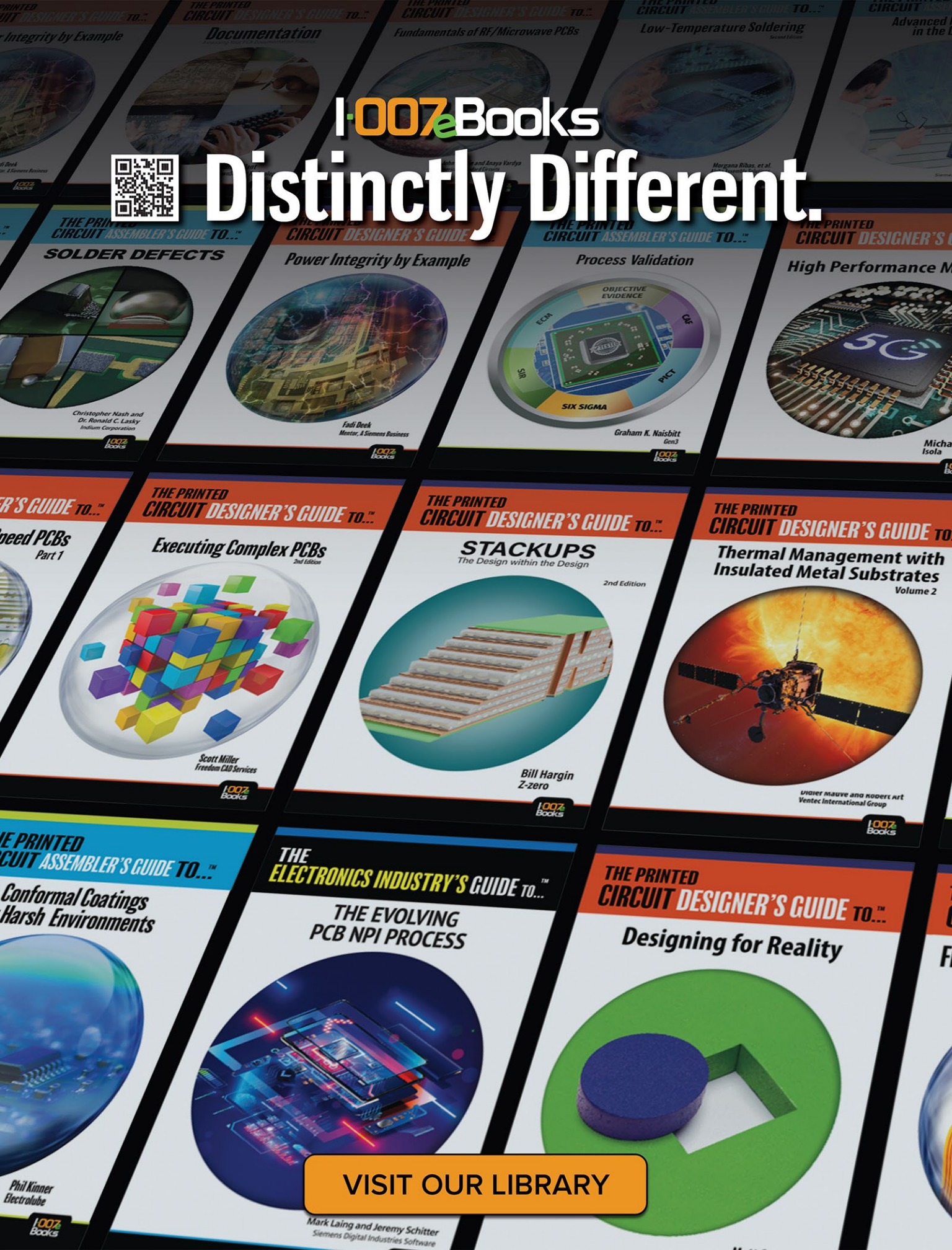


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# PCB007

## MAGAZINE

### Amp Up Your Business

It's time to amp up your business with your newfound knowledge. In this issue of *PCB007 Magazine*, our expert contributors provide methodologies for you to create your own post-show plan of action, and identify the important points to consider within that plan. We also provide ways to implement these process steps. Readers will learn various paths for implementing their post-show plan across multiple teams within their company.

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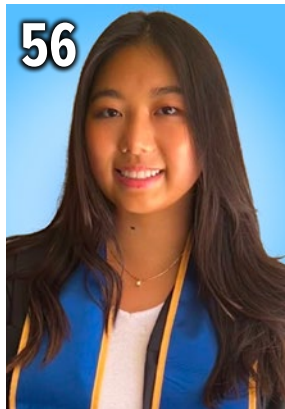


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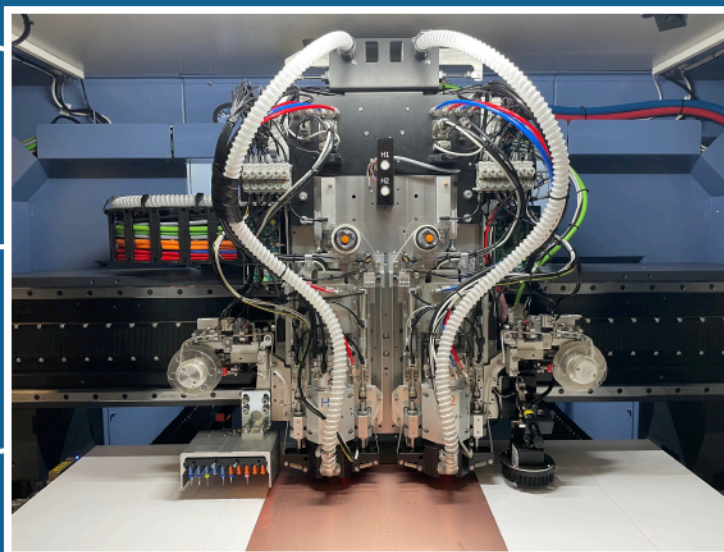
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# After the Show, **Now What?**

## The Shaughnessy Report

by Andy Shaughnessy, I-CONNECT007

You've spent a good part of your month either planning for, attending, or traveling home from a trade show, most likely. Now you have a pocketful of new business cards, and your company has a whole slew of leads for potential customers. You've learned a few things at conference classes and met a few dozen experts that you plan to chat with ASAP.

You've networked so much that your voice is just about gone. You actually sound like a sick bullfrog, but hopefully you've at least tested negative for COVID. (Not mentioning any names.)

It's tempting to kick back for a while, especially with all that goes into attending a trade show.

I'm sure we're all guilty of this over the years: You get home from the airport and sleep for four hours. Then you attend the one meeting that you can't miss, hit the high spots on your

emails, finish off whatever you were working on before the show started, start a load of laundry, and go back to sleep.

Sure, you've earned a little R&R time. But in the meantime, you need to do some serious trade show follow-up. The impact of the show does not end when the show closes its doors. A good post-show plan may not guarantee success, but it puts you on a good path.

How do you carry the momentum you felt during the trade show, when you had that "a-ha" moment and knew you were onto something really new and innovative? You can't let up. You have to be relentless, because all of your competitors are being relentless. You can't take your foot off the gas.

Your company spent some money sending you to the show; what are you bringing back to justify your trip and your likely frequent visits to the bar? What was the biggest takeaway?

What were your rivals doing? And what's the best way to disseminate the new technical information you learned at the show to the rest of your team? You'll probably have to be the champion responsible for that.

How do you and your company build upon what you've learned—and the new relationships you've built—and move forward for the rest of the year? In an industry like ours, relationships are everything.

As we learned from our experts this month, one thing is certain: Your marketing campaign shouldn't end when the trade show does. Avoid the temptation to pull back your marketing. In fact, post-show marketing is an important tool in your toolbox.

In this issue of *PCB007 Magazine*, our expert contributors provide us with methodologies to create your own post-show plan of action and identify the important points to consider within that plan. We also provide ways to implement these process steps. Readers will learn various paths for implementing their post-show plan across multiple teams within their company.

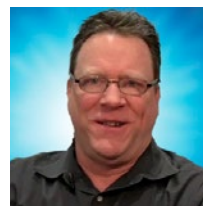
First, columnist Dan Beaulieu explains how to set up a solid pre-show plan—one that leads you directly into your post-show follow-up actions. Next, Barry Matties presents a plan of action for all those juicy leads you gathered during the trade show. IPC instructor Kris Moyer explains how to pass on the new knowledge that you acquired during the technical classes. Taiyo's Kiki Shemomae lays out a post-show

plan that includes maintaining a constant presence on social media—something that many “old school” folks in our industry often neglect.

If you came home from IPC APEX EXPO with a plan to launch a start-up fabrication facility, columnist Christopher Bonsell has what you need to know about setting up wet processing in your new venture, from workplace layout through waste processes. Another interesting perspective is the one offered by columnist Hannah Nelson, who explains why we need volunteers like you to join the standards committees that meet at shows like IPC APEX EXPO, and how to get involved and make a difference in this industry. We also have columns from Happy Holden and Mike Carano, as well as an interview with John Hendrickson, Frank Harrill, and Jessi Hall of Schweitzer Electronics.

So, after you do your laundry, it's time to act—and act fast—while the show is still fresh in everyone's minds. Eventually, the inexorable march of time wins out. There will be another show, another conference, and customers to visit, and these ideas will all take precedence over that special week at the show.

You put in a lot of effort, and now it's time to take advantage of it. **PCB007**



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

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# Post-show Plans Depend on Solid Pre-show Strategies

Feature Interview by Andy Shaughnessy

I-CONNECT007

If you've come home from IPC APEX EXPO with a bag chock-full of business cards and a scanner full of leads who stopped by your booth, now what do you do? How do you keep the ball rolling and turn it all into new orders?

I asked I-Connect007 columnist Dan Beau-lieu to weigh in on this topic. If you've read Dan's columns, you already know that he offers straight talk, aka "common sense," about sales. It's safe to say that few of us in the PCB community study marketing and sales techniques as avidly as he does.

I had a feeling that Dan plans for a trade show the way Eisenhower planned for D-Day, and I wasn't far off. Whether you're exhibiting, attending the conference, or just walking the show floor, there's advice for you here.

*Dan, you're pretty well known for your marketing savvy, so I imagine you probably have a checklist of goals and objectives on hand when attending a show like IPC APEX EXPO.*

Absolutely. As a consultant to possibly everyone and every company in the room, I am more like an insurance salesman at a Christmas party. Just about everyone there is a potential customer.

A few months before the show, I start setting up meeting dates. While some are current customers, others are potential customers, while yet more are prospective customers with deals that we've decided to finalize at IPC APEX EXPO. Of course, there are several old friends that I meet up with once a year at the show as well.



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I make a list of everyone I plan to meet and prepare a full meeting schedule, including the day and time we'll be meeting and what we need to accomplish. I also have a list of things I need to learn more about—information to gather, so to speak. To be honest, I don't waste a single minute at IPC APEX EXPO or any other show. Of course, I also work with I-Connect007 to schedule several interviews that you all might want me to conduct.

Most importantly, I check in with my customers who are exhibiting and I spend time with them in their booths to see how things are going. I check out what's working, what's not, and how we can improve their show presence and effectiveness next time.

On the day of the show, I arrive before opening time. I use my exhibitor's badge from one of my clients to get onto the show floor and I walk the show to get the lay of the land and find out where people are. I will also chat with the early birds who are already sitting in their booths having coffee. It's a great time to meet new people.

It's a very busy time for me. My fitness tracker, which I always wear, usually indicates that I've walked eight to 10 miles on show days.

***After the show is over, what's next? After a trade show is in the history books, what are your follow-up plans?***

It's all about the follow up. After the show is when everything happens. Whether we're talking about me or other people and companies, this is when you convert your leads into customers. When companies ask me to help them get a good ROI from a trade show, I insist that they plan ahead and do organized and timely—that's the key word here—follow-up. In fact, very often I will have my clients do a



Dan Beaulieu

follow-up in the evening of the same day they met a potential customer.

***How can an exhibitor best take advantage of the leads they've generated at the show?***

This is what the show is all about, isn't it? The "raison d'être" of the show is to get leads and then convert those leads into customers—and revenue. I urge my customers to follow up immedi-

ately and frequently while a meeting is still fresh in everyone's mind. I urge them to develop a follow-up "touch schedule," including a time release series of touch times using emails, texting, and "snail mail" letters to make sure they convert those leads into customers.

I also urge them to track everything from initial customer contact to quotes to orders, and then to track the revenue from that customer. This will give them a very solid return on investment from the show.

***How big a role does social media play in your post-show plans?***

Social media is an integral part of any marketing initiative, both before and after the show. Before the show, you should use social media such as LinkedIn and Constant Contact to let people know you will be at the show and why they should visit your booth. Explain what you have to offer them, provide good reasons for attendees to meet with you, and be sure to include your booth number. After the show, use social media to stay in touch with your new contacts. You have their contact information, so add them to your marketing newsletters and your LinkedIn connections. Most importantly, stay in touch with them. If you did a good job at the show, and you do a good job of following up, you will guarantee a very sound ROI.

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## Congratulations Dieter Bergman IPC Fellowship Award Winners!

- Curtis Grosskopf
- Nick Koop
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The Dieter Bergman IPC Fellowship Award is given to individuals who have fostered a collaborative spirit, made significant contributions to standards development, and have consistently demonstrated a commitment to global standardization efforts and the electronics industry. Each recipient will be eligible to bestow the Dieter Bergman Memorial Scholarship upon the university or college of his/her choice.

## A Conversation With 'The Space Gal'

Michelle Te and Dylan Nguyen  
Michelle Te and Dylan Nguyen had a conversation in aerospace...  
Michelle Te: Emily, thank you for joining us today. I understand you didn't have a traditional path into science. How did you get into a STEM field?  
Emily: I am the first person in my family to pursue a degree in STEM. I grew up in West Virginia, and I knew I wanted to go to college. But as a young woman, I didn't have a lot of role models in STEM. I was inspired by a video of a woman who had worked in aerospace, and I decided to follow her path.

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## Shawn DuBravac: What's New in Tech

Article by Pete Starkey • I-CONNECT007  
During an exciting packed house luncheon with the members of IPC APEX EXPO 2023, IPC Chairman Shawn DuBravac gave a keynote address titled "What's New in Tech: The Micro World Beyond the Power of Electronics" with an introduction by IPC President and CEO John W. Mitchell.

- Interviews
- Photo galleries
- Awards coverage
- Commentary

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***Some companies in our industry seem to lose steam after a trade show, when that may be the best time to be reaching out to their new contacts. What advice would you give these companies?***

Simple: Wake up! You just spent a fortune on this show, if you add up all the show fees, and inflated hotel and restaurant prices, not to mention flying your people out, renting cars, booth costs, and marketing. You have spent a lot of money and it will all go to waste if you don't capitalize on the leads you should have picked up at the show. Do everything I just said, and more. If you don't plan on doing all of these, then don't bother going to the show.

***Is there anything you'd like to add?***

Oh, you bet! You've got me going now. Here are some final ideas:

1. Develop a plan that covers all aspects of the show and what you are going to do there.
2. Plan early and often. In the case of a large show like IPC APEX EXPO, you should be planning for next year the minute this year's show is over.

3. You can have fun at the show, but you have to work too. It's not only about dinners and golf. Those days are over. Today, sales is all about selling your services and products, not buying someone a steak.
4. When you're in the booth, work it. Don't play with your phone, and don't hang out with your friends in the booth either. Research shows that many show attendees will not interrupt exhibitors who are busy. Many potential customers won't feel comfortable stopping to talk about something important; they'll just move on because they don't want to crash your party.
5. Be intentional. It's literally show time, right? Act like it.

***It's always a pleasure, Dan. Thanks.***

Thank you, Andy. PCB007

#### **Further Reading**

If you would like a free copy of Dan's trade show planning guide, contact him at [danbbeaulieu@aol.com](mailto:danbbeaulieu@aol.com).

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## Post-pandemic Labor Force Dynamics

**By Shawn DuBravac, IPC chief economist**

It has been three years since the start of the pandemic-induced recession. After an abrupt, but short downturn, the economy—and especially the electronics industry—has experienced record growth. The economic recovery has had a pronounced impact on the labor market. As we enter 2023, there are several unique labor market dynamics to watch.

The COVID-induced recession of 2020 was one of the most severe economic downturns in U.S. history. Overall employment fell over 14%. Roughly one in every seven workers lost their job. More-

over, the peek-to-trough decline happened in about 60 days, an unprecedented rate. Prior to this downturn, the worst decline in employment was the decline during the financial crisis of 2007–09. Peek-to-trough decline in employment during that recession was 6.3%. Roughly one in every 16 people lost their jobs, but it took 26 months for the economy to reach that level so job loss was much slower during that downturn.

During the COVID recession, the electronics manufacturing sector held up much better than other segments of the economy. This article appeared in *IPC Community*. To read the rest of the article, [click here](#).

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# Wet Process Start-up Considerations

## The Chemical Connection

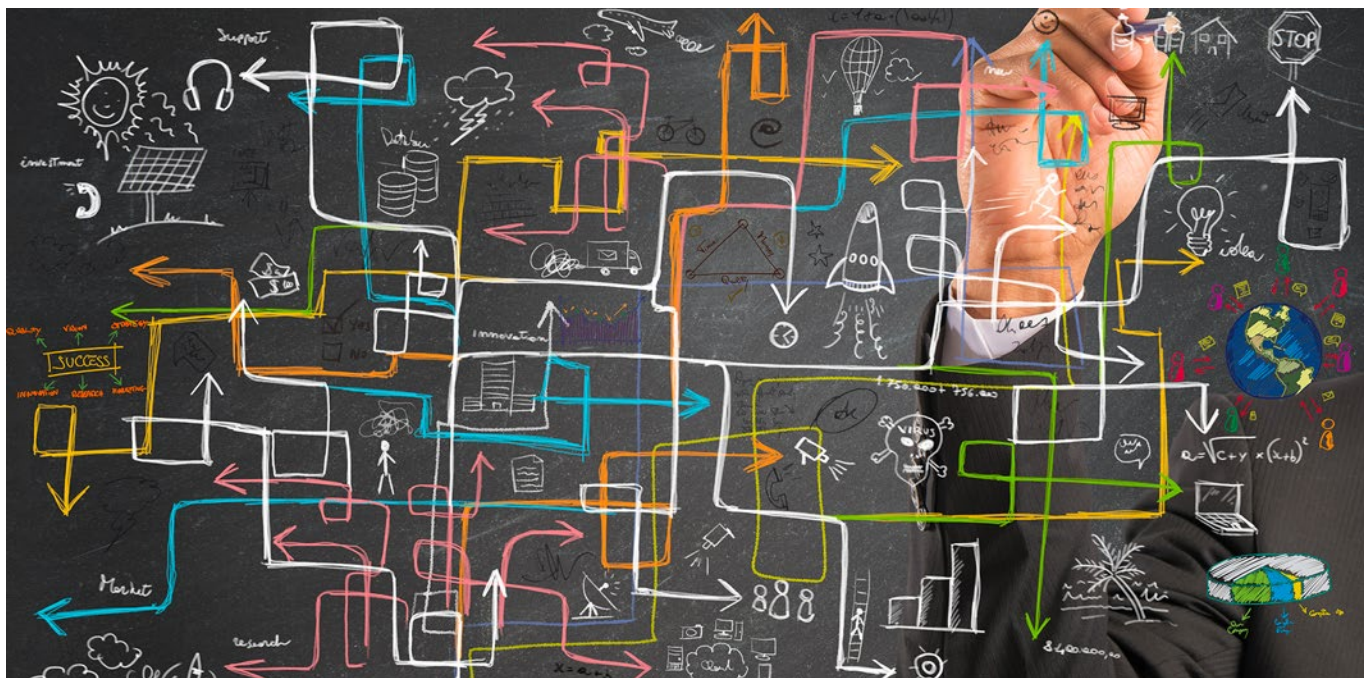
Feature Column by Christopher Bonsell, CHEMCUT

Are you (or your company) considering starting your own PCB fabrication process? After the most recent IPC APEX EXPO, maybe you've made connections to help you with your start-up, but do you have a solid game plan? If you are new to managing a PCB shop, the first thing to know is that wet processing is essential in making PCBs. Wet processing steps—such as cleaning, developing, etching, and stripping—are among the many steps in the PCB fabrication process that require thorough planning. When you are just getting involved in this industry, keeping track of all this can feel overwhelming. If you fit in this category, it's best to start with the basics and work your way up. Here are a few considerations and base essen-

tials to aid you in starting up the wet processes for your new facility.

## Scale of Production

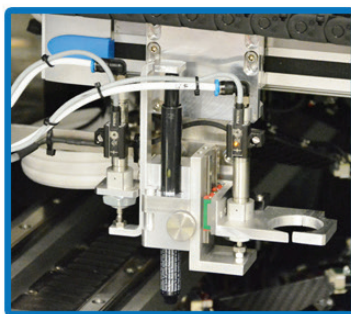
Before you start planning out how you want your PCB shop to function, you will need to lay out your goals. For instance, it's important to know the type of circuit boards you plan to make, as well as how many you want to make and how quickly you want to produce them. Knowing this information is vital because it will drastically shape your manufacturing process. Depending on your products, you may have to utilize different photoresists and wet processing chemicals (i.e., different cleaning, developing, etching, and stripping solutions).



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Figure 1: A Chemcut CC800 etching machine equipped with two full-size etch chambers. Although the image depicts two etch chambers, additional etch chambers can be stacked to increase etch capacity.

In addition, you need to know the scale of your production so you can ensure that you get the suitable equipment for your level of manufacturing. For example, if you are planning to run a facility with a large output of panels per day, a multi-chambered etch machine may be something to consider (Figure 1). This is because the longer the etch chamber, the faster you can run the conveyor speed while maintaining the same processing time. This increased conveyor speed with a larger etch chamber means that more panels can be inside the etch chamber at the same time. Keep in mind that a larger machine also means that it will take up more floor space; the trade-off for increasing production is committing to a capital investment and sacrificing some space.

## Utilities

When you are planning a PCB shop, you need to consider not only what equipment you'll need, but also the basic utilities required and how those will be connected. The primary utilities/base necessities are electricity, water, and ventilation. Typically, utilities run 15–20% of equipment cost. Although these utilities are a necessity for any manufacturing facility, some situations may need additional considerations. For instance, when it comes to your electrical needs, not only do you have to ensure you get the power you need to run the equipment, but you need to consider where electrical cabinets should be located. If you are utilizing an alkaline etcher, you'll need something to help regulate the airflow through the machine to ensure optimal etching.

# Rogers' RF solutions: Paving the way for assisted and autonomous driving

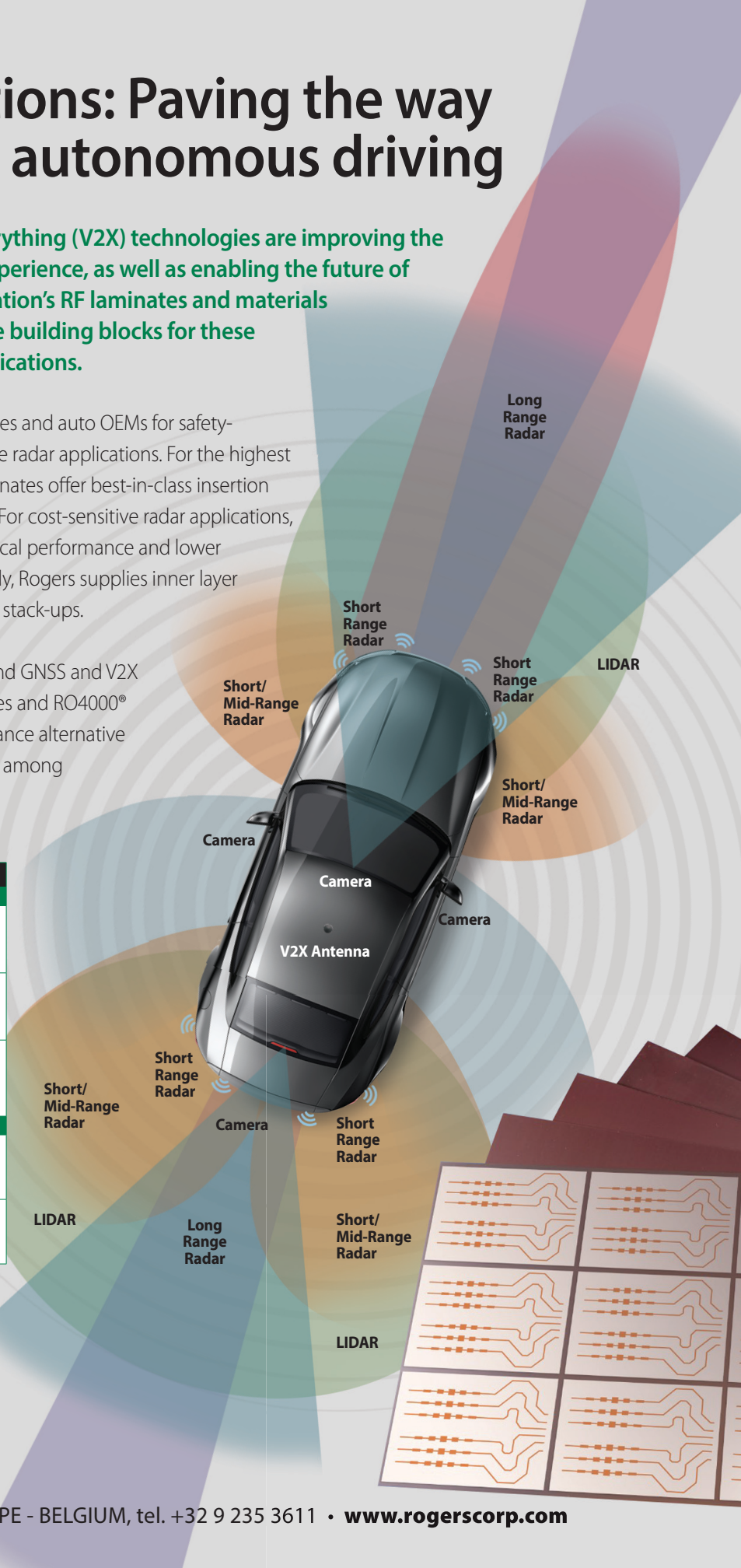
Automotive radar and vehicle-to-everything (V2X) technologies are improving the safety and enjoyment of the driver experience, as well as enabling the future of autonomous vehicles. Rogers Corporation's RF laminates and materials provide cost-effective, proven-reliable building blocks for these demanding automotive antenna applications.

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<b>GNSS / V2X ANTENNA MATERIALS</b>	
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## Available Workspace

As I mentioned, the floor space requirements of your equipment should be a major consideration when planning your facility. When deciding on the equipment you will need to meet production goals, you must find a balance between available floor space and how to meet your production needs. When working on the layout of your facility, keep in mind that you'll need to reserve additional space to ensure that people can easily run and maintain your equipment. Poor manufacturing floor design can create inconvenient situations for operation and maintenance, which can negatively impact the longevity and efficiency of your equipment. Having an awareness of space is vital when planning your process because you need a layout that will get your equipment inside the facility and leave enough space for it to be operated efficiently.

## Process Locations

When planning out your wet process, you may want to consider its location relative to other equipment. This is because corrosion is a given with etching equipment. Although the equipment safely contains the etching chemicals, the process tends to create a corrosive environment; anything metal in the area that lacks some form of corrosion resistance will experience corrosion over time. Etching equipment is often kept in its own room to account for this phenomenon. Therefore, if you have an expensive machine testing your printed circuit boards, you do not want it in the same room as your etching machine.

## Waste Management

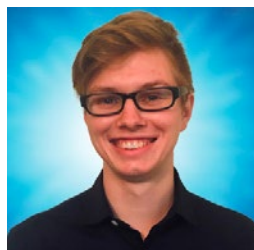
Producing PCBs generates many different forms of waste. For wet processing, contaminated rinse water and excess etchant are common waste streams. As you process a panel through one of the wet processes, it's normal to rinse it before it goes to the down-

stream processes. These rinse waters become contaminated with wet processing chemicals and need to be treated before disposal. This is something that you can do in-house, but how you do it may depend on the wastewater regulations in your area. You may be required to precipitate any heavy metals out of the water to make it meet your discharge permit limits. In this case, the precipitated metal sludge is another waste stream that will need to be handled. Typically, this sludge is filtered off from the water, dried, drummed, and sent off to a waste treatment facility.

Excess etchant is another waste product you need to plan for. As you etch your PCBs and make chemistry adjustments, you will accumulate etchant in your etching machine over time. This excess etchant needs to be pumped out before the level gets too high in your etcher bath. Since the excess etchant usually doesn't meet quality requirements for reuse, and because it is concentrated, it is common practice to pump the excess etchant into a barrel that will get shipped to a waste treatment facility.

## Conclusion

If you are looking for a good place to start planning your PCB fabrication process, I hope the information I've provided here gives you a better idea of what to expect. Knowing about these matters and preparing for them ahead of time can make planning your wet process—and your job—much easier. **PCB007**



**Christopher Bonsell** is a chemical process engineer at Chemcut. To read past columns, [click here](#).

# TAKING IT TO THE EXTREME

# HIGH HEAT

BY TAIYO



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# A Collective Stake in American Microelectronics

## American Made Advocacy

by Travis Kelly, PCBAA

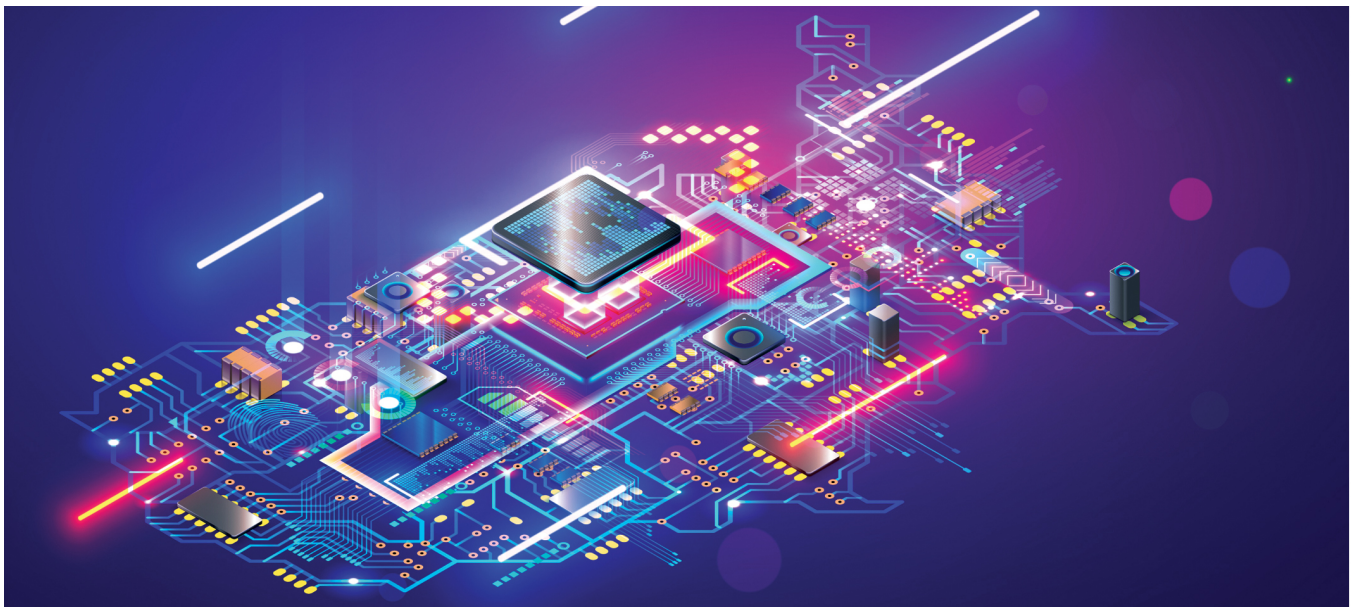
Early last month, hundreds of thousands gathered in Las Vegas for the annual Consumer Electronics Show, where amazing new tech was rolled out—everything from razor-thin TVs to smart robots that clean your home. As an executive in the materials science space, I was struck not just by the pace of innovation, but also by the incredibly complex supply chains that were necessary to bring those products from the drawing board to reality.

I grew up when robots were pretty much confined to the pages of science fiction. My kids and the generations that follow will see self-driving cars, autonomous floor scrubbers, and a host of other technologies powered by artificial intelligence. Next generation semiconductors, high density interconnect, advanced packaging materials, and new

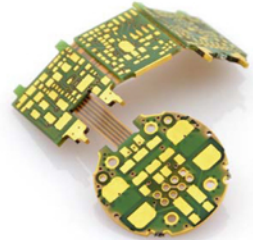
printed circuit boards will all be necessary to bring these technologies to market.

Microelectronics truly make our modern life possible. But there is so much more at stake than being able to buy the latest TV or smartphone. In addition to the consumer products we use every day, we need trusted and reliable sources of microelectronics for the national power grid and sectors like banking, medical, telecommunications, and national defense, to name a few. Our national and economic security depend on these devices.

Right now, we don't have a sufficient pipeline of trusted American-made printed circuit boards and their component materials; we only make 4% of the world's supply. Unless strong legislative and policy actions are taken soon, the semiconductor industry will have to



# Focused on Flex

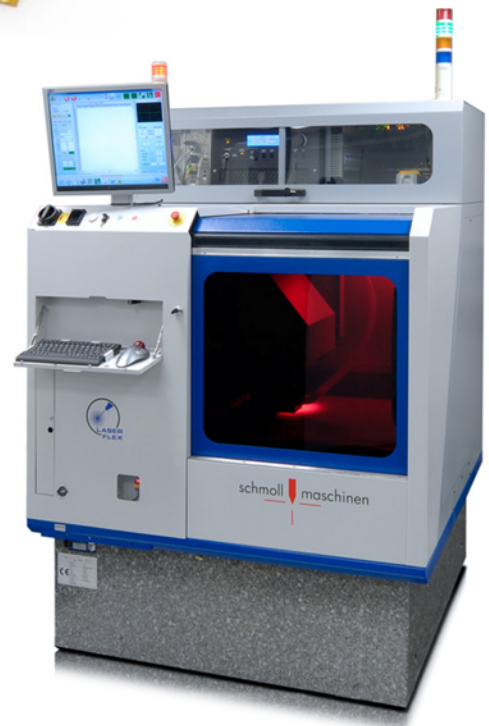


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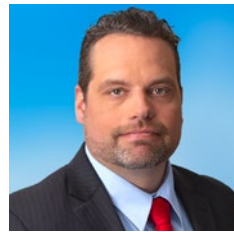
grapple with the reality that the supply chain is still running through Asia as they bring new fabs online over the next few years.

America must invest in and protect our critical infrastructure. We cannot afford to continue offshoring our know-how and manufacturing, or we face a future even more dependent on other nations—not all friendly—to operate the systems that make our modern life possible.

As leaders from across the microelectronics space gathered for IPC APEX EXPO convention in San Diego last month, I spent time talking with other business leaders and sharing what needs to be done in Washington, D.C., to restore a level playing field for American manufacturers. I did this in addition to my focus on workforce and technical issues because I believe in its importance.

Congress took an important first step with the passage of the CHIPS and Science Act,

but that is only the first step, not the end of the road. As we reintroduce legislation in the new Congress, the Printed Circuit Board Association of America (PCBAA) and its member companies will be working hard to get the support of key members of Congress to pass a bill that will bring PCB manufacturing back to America and truly create a balanced and resilient supply chain. If you haven't joined PCBAA, now is the time. There is strength in numbers, and we need your partnership at this critical time. The PCBAA was formed to educate, advocate, and advance legislation with this goal in mind. **PCB007**



**Travis Kelly** is CEO of Isola Group and current chairman of the Printed Circuit Board Association of America. To read past columns, [click here](#).

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## Printed Circuit Boards Have Champions on Capitol Hill

House Resolution 7677 from the 2021/22 Congressional session may have run out of time before the election cycle, but that hasn't ended the effort to help fund the printed circuit board industry alongside the semiconductor industry.

IPC vice president of global government relations, Chris Mitchell, shared this letter, sent to DOD on Wednesday by Reps. Anna Eshoo (D-CA) and Blake Moore (R-UT), which insists DOD must “leverage all available resources, including the use of Title III of the Defense Production Act (DPA), to increase domestic production of PCBs and IC substrates.”

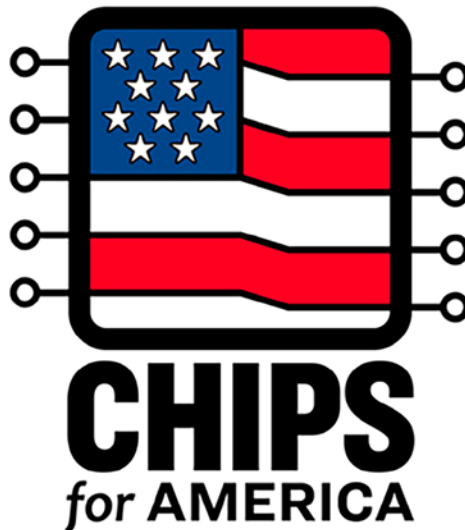
“U.S. investments in semiconductor manufacturing will not provide greater security and resiliency without complementary initiatives to bolster the printed circuit board (PCB) and

integrated circuit (IC) substrate-manufacturing base,” they stated in their letter.

“Thanks to Reps. Anna Eshoo and Blake Moore for urging DoD to leverage the Defense Production

Act and other programs to support a resurgence in U.S. production of printed circuit boards,” stated Mitchell in response to this letter. He continued, “Rebuilding this base is important to U.S. defense needs and supply chain resiliency but also to achieving the goals laid out in the CHIPS and Science Act. Silicon drives changes across the electronics manufacturing industry, and thus investments in silicon must be paired with investments in other strategically important segments of the

electronics industry, including printed circuit board fabrication and assembly.”





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# Making the Most of Trade Show Leads

Feature Article by Barry Matties

I-CONNECT007

The show is over and it's time to count the leads. We all know that a tall stack of trade show leads can feel like a sugar high. For many, that tall stack is proof that your trade show investment was well worth it, and if leads are the measure, then you'll aim to collect as many as possible. However, the true ROI measure is new business, so more important than the number of leads is identifying the quality of leads in the stack.

Of course, your leads will need to be sorted, preferably into different groups ranging from "ready to sign a deal" to "will never sign a deal," or from hot to not. Once sorted, they can bring your initial focus to the low hanging fruit. It's the other groups that will require your team to be a bit more strategic.

You can expect your competitors to be chasing the same leads. After all, the prospect visited the show to look at all their options, so a smart marketing approach as a follow-up will give you an advantage. Your immediate action should be to contact your prospects with a simple thank-you note expressing your appreciation for taking the time to visit your booth and meet with your team. While this is a good first step, you should have a specific follow-up process beyond the thank-you note.



When you sort your leads from hot to not, also consider where each prospect fits into your sales process or funnel. It's important to note if they are a current or past customer; if they aren't or haven't been a customer, sort by whether they are a current prospect in your sales process or a completely new contact. Your follow-up strategy will vary depending on the prospect type. Regardless, follow-ups should be personalized; be sure to avoid generic form letters or mass emails. Let each prospect know that you appreciate the time that they spent with you and your team.

Here are some additional suggestions based on the type of prospect you've identified:

**Current customer:** If they are a current customer, you have a clear advantage over your competitors because a customer should have a good working relationship with your company. In your follow-up, you want to make sure they know and feel like you have really listened to their needs. It's too easy to make assumptions and miss this part.

**Past customer:** If they are a past customer, determining why they stopped doing business with you is important.

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If they left due to disappointment, this may be your chance to re-establish a working relationship. After all, their stop at your booth indicates that there is at least some interest in re-engaging on their end. As with current customers, the most important part of the follow-up is making sure they feel heard and that you understand their needs. Beyond that, if you can identify any past issues that may have impacted their decision to stop working with you and directly address those with demonstrable solutions, this will help strengthen your relationship. Keep in mind that a prospect that is a past customer is a current customer of your competitor, so to win this business, you will need to be on your “A game.”

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**As with current customers, the most important part of the follow-up is making sure they feel heard and that you understand their needs.**

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**Already a prospect:** If you have a visit at your booth by someone who is already in your sales process, you will likely advance them to the next step of the process—but this is not guaranteed. They may have found some competing products at the show that gained their attention, or perhaps their needs have shifted. Your follow-up should verify that their needs have not changed and that your products still meet that need. As we know, with any sales funnel, a prospect can fall out at any point.

**New prospect:** If they are a new prospect, they—just like any other prospect—must feel like you have really listened to their needs, that you have solid solutions available, and that you

have expert answers to their questions. In addition, you need to make sure they understand who you are, what you stand for, and the value you bring to them. They need to feel confident that you are the kind of company that they want to do business with. From the moment they stepped into your booth, they began to form an impression of you. If they went as far as giving you their contact info, they must feel comfortable exploring the next step.

Regardless of the prospect’s category, it’s important for you to present yourself as a thorough and technical leader. This is where your post-show marketing voice is critical. Be sure to take part in highly visible trade show coverage in trade journals. This can be in the form of press releases announcing activities from the show, interviews with your team, or ads promoting the technology your prospects have just seen at your booth. Ads with third party testimonials are especially powerful here. Ideally, you should do all the above.

Social media is also an important tool in follow-up. One of the first questions to ask is if your prospect is already connected to you at some level. If they are, connect with them through that platform. Invite them to see your coverage in the trade journals, read a technical blog, or download your whitepaper. If they are not connected, reach out and invite them to connect.

Arranging a personal visit is arguably the strongest form of follow-up. It gives you a chance to spend focused time without the noise of the trade show in the prospect’s own environment. It also is an indication that this prospect is very serious about moving to the next step in the process.

Now that the trade show is over, it’s time to put all the pieces together. It’s good practice to have a detailed and documented follow-up plan. The plan should include all the above steps, as well as a specific timeline attached to each activity. Your timeline should be fast-moving with key metrics. Time is of the essence; if you are not

# Congress Needs to Support American Made Printed Circuit Boards



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well prepared, your trade show investment will be nothing more than a sugar high.

To my point about generic or mass emails, I just received the following email from a company that I have never done business with—even though they say I am their customer:

*Dear Barry,*

*Looking back on the past year, we realize we have a lot of reasons to be grateful for.*

*You are one of them.*

*We would like to take this opportunity to say thank you for the business you have given us throughout the year. We hope you will continue being one of our valued customers in 2023.*

*All the best for the holiday season and see you in 2023!*

*Best wishes,*

*(I have removed their name, as there is no reason to embarrass them further.)*

Generic messages are transparent, and the above email tells me that this company does not understand their selling process. I appreciate the well wishes, but this email feels less than sincere.

Don't leave your own prospects feeling like this—take the time to do your research and follow up with personalized communications that make them feel valued and understood. **PCB007**

This article originally appeared in the February 2023 issue of *SMT007 Magazine*.

## U.S. Department of Commerce Announces CHIPS for America Leaders and Staff

The U.S. Department of Commerce announced leaders and staff joining the CHIPS for America team who will play key roles implementing the bipartisan CHIPS and Science Act's historic investments in the semiconductor industry. The CHIPS for America team pulls together talent from across the public and private sectors, including leaders with experience managing large federal programs, experts from the semiconductor industry, and executives with financial sector experience.

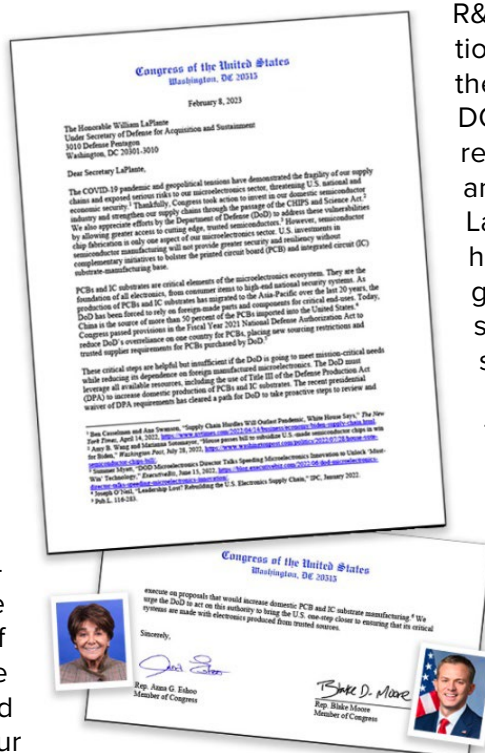
"We are building a team of experienced experts who will ensure CHIPS for America spurs manufacturing and innovation and revitalizes our domestic semiconductor industry, while being good stewards of taxpayer dollars," said Secretary of Commerce Gina M. Raimondo. "This group of accomplished leaders brings the diversity of experience, ideas, and backgrounds needed to secure our position as the global leader in semi-

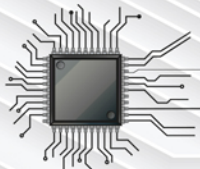
conductor manufacturing and R&D for decades to come."

"CHIPS for America will put our country at the forefront of semiconductor innovation, R&D, and technology implementation, and we are excited to welcome these accomplished individuals to DOC and NIST," said Under Secretary of Commerce for Standards and Technology and NIST Director Laurie E. Locascio. "These leaders have decades of experiences across government, industry, and the R&D space and will play an essential role standing up this historic program."

The Biden-Harris administration previously announced key leaders charged with guiding implementation of the CHIPS and Science Act, including Director of the CHIPS Program Office Mike Schmidt and Interim Director of the CHIPS Research and Development Office Eric Lin.

(Source: Department of Commerce)



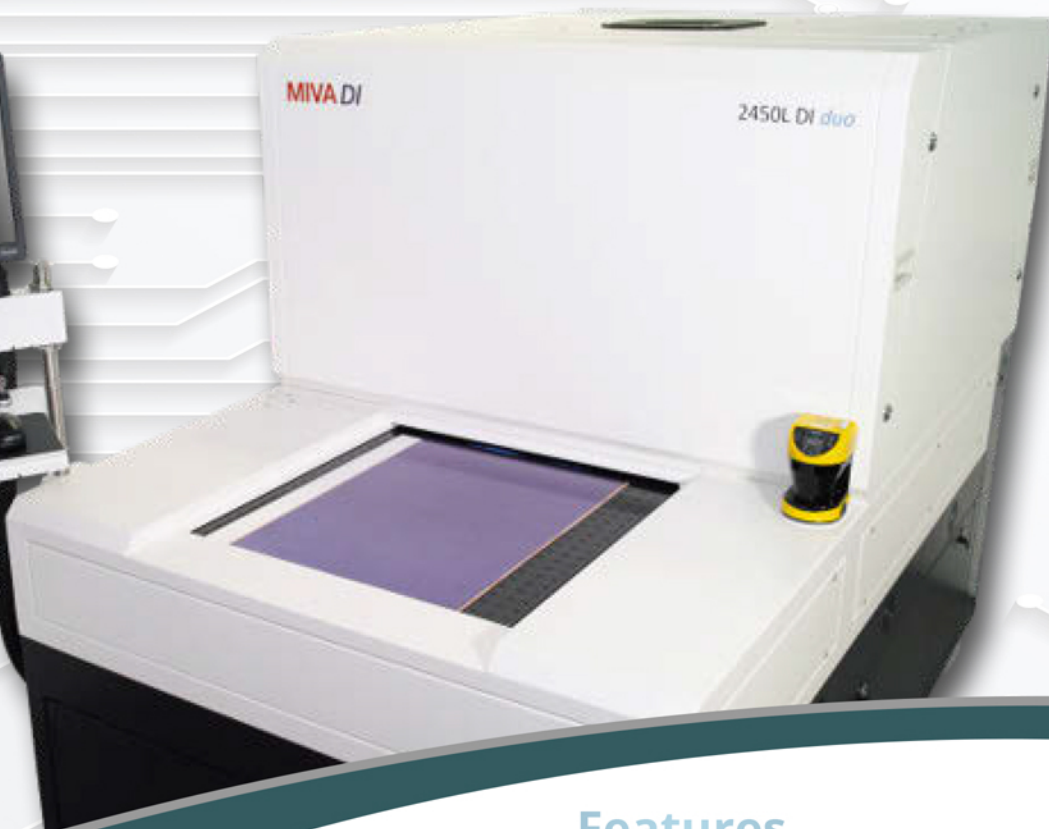


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# MilAero007 Highlights



## Northrop Grumman, NASA to Shape Future Integration of Uncrewed Autonomous Systems ▶

Northrop Grumman Corporation is collaborating with NASA to develop and test solutions for integrating large, uncrewed aircraft systems into the National Airspace System (NAS).

## IPC Welcomes New Director of North American Government Relations ▶

IPC announces the addition of Jeffrey Goldberg as director of North American government relations to its staff at IPC's offices in Washington, D.C. In this role, Goldberg will help lead IPC's federal advocacy work in collaboration with IPC's Government Relations Committee and IPC's Vice President of Global Government Relations Chris Mitchell.

## Heart Aerospace Selects Siemens Xcelerator for New Electric Airplane ▶

Electric airplane maker Heart Aerospace has selected Capital from the Siemens Xcelerator portfolio to support its E/E system design, development, and certification of zero emission electric aircraft. As part of the extensive electrification in these aircraft, Heart Aerospace must address the complexity of the Electrical Wiring Interconnect System (EWIS) while also addressing electrical system compliance risk.

## Raytheon Intelligence & Space Awarded Missile Track Custody Development Contract ▶

Raytheon Intelligence & Space has been awarded a prime contract to develop a proto-

type Missile Track Custody system for the U.S. Space Force. MTC is the service's first Medium Earth Orbit missile tracking system.

## U.S., Japan Sign Space Collaboration Agreement at NASA Headquarters ▶

During an event hosted by NASA Administrator Bill Nelson and Deputy Administrator Pam Melroy at the agency's headquarters in Washington Friday, representatives from the United States and Japan gathered to sign an agreement that builds on a long history of collaboration in space exploration between the two nations. Known as the "Framework Agreement Between the Government of Japan and the Government of the United States of America for Cooperation in Space Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, For Peaceful Purposes."

## Satcom Direct Installs Prototype Terminal for Inmarsat's Jet ConneX Inflight Broadband Service ▶

Satcom Direct, the business aviation solutions provider, has completed the installation of the first Plane Simple Ka-band antenna on the company's SD Gulfstream G550.

## DARPA Kicks Off JUMP 2.0 Consortium Aimed at Microelectronics Revolution ▶

DARPA, along with the Semiconductor Research Corporation (SRC) and industry and academic stakeholders, is kicking off the Joint University Microelectronics Program 2.0 (JUMP 2.0). The SRC-led effort expands on the original JUMP collaboration aimed at accelerating U.S. advances in information and communications technologies.

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# An After-show Plan

Feature Interview by Nolan Johnson

I-CONNECT007

You've just attended a trade show, spending time in conference classes, seeing some new ideas that you think could help your company. What's your next step? I asked IPC design instructor Kris Moyer to share his thoughts, and he explained how to best share your new-found information, convince management to adopt what you've learned, and build on this momentum.

***Kris, staff members have attended conference classes at the trade show, learned some new techniques and processes, so what's next?***

It's simple: You present and disseminate it to your co-workers. First, the individual who learned that technique at the trade show might have a small get-together with senior design

engineers and say, "Here's what I saw. This is my understanding of it. Does this look like something that would be useful to us?"

Then you have a working lunch. Maybe you contact the company or the individual who presented the new information, and see about bringing them in as a consultant to teach the technique to your company. In some bigger companies, management may have to approve in-house training. But a lot of times you just go to the show, get the information, bring it back, and you disseminate it.

***I'm sure it would help to have a prep meeting with management before the show so you could set expectations about what to look for and pay attention to.***



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Exactly. Have a prep meeting with your manager before the show. I worked with a fairly large company once, and they basically said, “As soon as you get back, give us a write-up of what you saw, and what you thought would be beneficial to the company.” Then management would have their own meeting and hopefully say, “Oh yeah, this does sound cool; we want more information on this kind of thing.”

But sometimes, the information may not be as applicable to your company as you thought. You think, “This is really more for a fabricator. They would be more interested in this than we are. I’ll talk to my fabricator about it, but it’s not really something I need to analyze now.”

***Exactly. Let’s say you’re a designer and you’ve been speaking about the design side. Compare and contrast how this works on the manufacturing side. How does the process differ?***

On the fabrication side of things, as well as for assembly companies, materials providers, and so on, it’s really the same.

Maybe you learned a newer technique for calculating the intermetallic bond strength of ENIG, or gold bond. Maybe you took a course on reduction of glass fracturing during the lamination process. Whatever you learned, present it.

If the course you took is a fit for your niche, you just take it back to your company. After that, you might consider online courses on this topic, or bring the presenter in as a consultant to give you more hands-on specifics for manufacturers.

***Now, you may have junior-level people who are going back home and presenting this content to managers two or three levels higher at their company, trying to convince them to adopt this new technique or process. How does one handle that?***



Kris Moyer

Junior-level people usually have a little bit more of an uphill battle convincing management. But overall, even with them, it’s been my experience that as long as they can demonstrate how this process would be beneficial to the company, most managers are pretty good about paying attention, depending on what you’re asking for. Does this new process reduce the number of respins? Maybe management doesn’t want you to take four months off to take a college course, but they would be more than happy to have you come in and take in-house training or online classes.

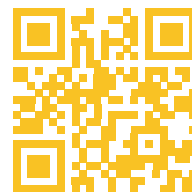
One of the things I’ve heard from every company I’ve ever worked with: The junior-level people come in and say, “I saw this cool, new thing!” You have to get past the “new and cool” and provide a technical rationale for why this is beneficial. It can’t be just because it’s new and cool.

***Thanks for your time, Kris.***

I enjoyed it. Thank you. PCB007



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*Jennie Hwang* | 7/11 to 7/20

Learn more about our [PCB Design Courses](http://edu.ipc.org/pcb-design).

# Step Up and Volunteer

## The New Chapter

Feature Column by Hannah Nelson, VALPARAISO UNIVERSITY/IPC STUDENT DIRECTOR

As we jump into 2023, we should adopt a “new year, new me” mentality. But have you ever thought how changing to a “new you” could come through volunteering? We just finished up IPC APEX EXPO 2023, where we had many opportunities to give back to our com-

munities. From STEM events to standards groups, there are many ways to grow as individuals while helping others in the manufacturing space. Integrating volunteering into your post-show plan is vital in both pushing the manufacturing space forward and creat-

ing a spark in the next generation of problem solvers.

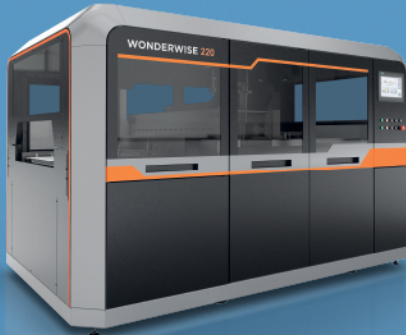
Standards groups provide the building blocks of change within the industry. Without standards, companies are limited in showcasing their product’s acceptability to customers. Standards reassure customers that the product they need is high quality and approved by professionals. As the organization that markets these standards, IPC guides the creation and revision of standards by committees of industry experts for the industry. This process allows for input based on problems and solutions that occur in their everyday jobs. IPC standards provide the industry and world with common ground.

Sometimes these standards groups are formed not just from the workforce. As the IPC Education Foundation has shown, students are welcome and encouraged to join IPC standards groups. By allowing them to join standards groups, students find this opportunity to be a valuable tool in launching their careers. Students within standards groups are

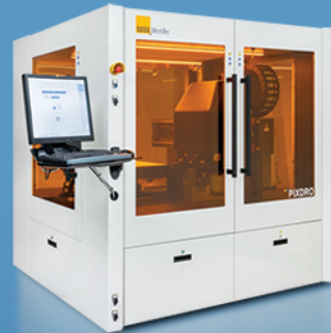


Hannah Nelson (center) with her high school FIRST robotics team.

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Hannah Nelson (front row, second from right) with her high school FIRST robotics team. Her mentors' faith in her abilities to design and build a robot led her to explore an electrical engineering major in college.

given the opportunity to learn and create a real change in their specialty; they provide a new perspective within the manufacturing space.

Volunteering within the manufacturing space does not need to be limited to renovating standards, however; inspiring the next generation of engineers is an excellent way to create change within our STEM world. With today's ever-changing technology, a stronger workforce is more important than ever before. We are in dire need of a generation of innovators to create the "factory of the future."

How will this generation come about? I believe volunteering is one of the most powerful ways to spark interest in the minds of our youth. Some organizations have positioned themselves at the forefront of helping youth in STEM fields, including the IPC Education Foundation (which puts students into the man-

ufacturing space), and FIRST robotics, which opens students' minds to the world of mechatronics. These organizations are providing students with exciting opportunities that lead toward incredible careers in STEM.

Before I joined my high school's FIRST robotics team, I had no idea what an engineer was. I thought an engineer was a super-brained rocket scientist, and I was incredibly intimidated by the thought of becoming someone like that. But as soon as I joined the robotics team, I found out that engineering is a way for real people to solve some of the world's most challenging problems by creating the change they want to see in our world. My FIRST robotics mentors showed me this; they were real people solving real problems in my community. My mentors had faith in my abilities to design and build a robot that would crush the competition, even when I was sometimes discouraged by my abilities. This faith led me to explore an electrical engi-

neering major in college, where I believe I took on some of our world's most challenging problems. Without the mentors who volunteered their time with our robotics team, I may have never studied engineering or have been given the opportunity to advocate for the next generation of engineers.

Important points to remember when thinking about volunteering:

## 1. Why do you want to volunteer?

The first step toward volunteering is finding out why you want to do it. Are you seeking to make a difference within your workspace? Is there something you've noticed within your job that needs to change? Do you want to give back to your community? Maybe you noticed something that needs to change, and you want to be the one to make a change. Your answers



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will help you determine whether you are longing to put your effort into volunteering.

## 2. Where do you want to volunteer?

The next step to setting up your post-show plan is to figure out where you are drawn to volunteer. Is there a specific area that you are interested in placing your time? Standards? STEM advocacy? Or is there something else?

## 3. How will you change the future?

Are you looking to volunteer for selfish reasons, or do you truly want to make a difference in your community? Before you volunteer, think about the time you set aside for the organization and prepare some ideas to help create a change within that organization. Our life experiences can be incredibly vital in helping us form a new perspective toward volunteering, so don't be afraid to speak up. You will get out of volunteering what you put into it.

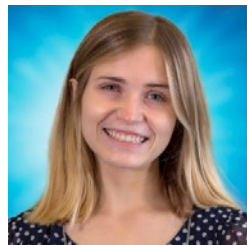
## How to Volunteer

Reach out. Many organizations are yearning for new expertise to enter the discussion. The IPC Education Foundation is always

looking for fresh insight for students heading into careers in the manufacturing space. IPC solicits experts in their fields to provide expertise regarding industry standards. Don't hesitate to get involved; you could make the next change in the industry.

## Conclusion

Volunteering within this industry is necessary to keep it growing. Volunteering spreads ideas, contributes to new developments, and inspires today's youth to become more than they might believe they can. Volunteering is for everyone, both the overqualified and underqualified. Everyone who volunteers is capable of learning more about their career and themselves as mentors. Maybe it's time to consider volunteering as part of your plan this year. **PCB007**



**Hannah Nelson** is a student at Valparaiso University, and a member of the IPC Emerging Engineer Program. To read past columns, [click here](#).

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# IPC APEX EXPO Wrap-up

by Andy Shaughnessy

IPC APEX EXPO 2023 is over, and I think it was a successful show no matter how you slice it.

There was barely a break in traffic on the show floor on Tuesday and Wednesday, and even on Thursday I saw people sprinting to close one more deal. Some committee meetings had nearly 200 participants; the meetings I sat in on were anything but boring. These people are passionate about their work, and they voted for changes in standards by waving green cards, like they were at a crazy auction

Almost everyone I spoke with was upbeat; the tech layoffs and inflation were barely mentioned during the

show. Many companies are having a fantastic year. And we all enjoyed being able to talk face-to-face without N95 masks this year.

The Professional Development and Technical Conference classes were well attended. I spoke with a few dozen class attendees, and I was surprised at how much of the fabrication and assembly content focused partially on the PCB designer's needs.



One of my favorite parts of the show was getting to play guitar almost every day with my cohorts, Managing Editor Nolan Johnson, Technical Editor Dan Feinberg, and columnist Kelly Dack. We only play together once a year, but we've found about 10 songs that work really well.

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# Can You Build EVs Like PCs?

## Happy's Tech Talk #17

by Happy Holden, I-CONNECT007

### Introduction

You probably haven't heard of Foxtron, but if you follow electric vehicles (EVs), you will soon. This is Foxconn's EV startup, created in partnership with Yulon Group (YLM), a Taiwanese car manufacturer of NISSAN designs. In 2021, the company introduced three EV models in Taiwan: a sedan Model E (sold by Yulon), a sport utility vehicle (SUV) Model C (Figure 1), and a passenger-transit bus Model T. In 2022, Fox-

tron introduced a new all-terrain utility pickup Model V and a lower-cost Model B sedan.

Though the company will begin producing these vehicles in Taiwan, the company has plans to roll out production on a global scale. Its bigger plan is to pivot into a hyper-flexible company that focuses on working behind the scenes to become the No. 1 EV manufacturer, even if nobody knows who built the vehicle they're driving.



Figure 1: Foxtron, a joint venture between Foxconn and Yulon via the MIH Consortium, prototype vehicles in 2021 and 2022<sup>1,2</sup>.

### The Big Picture

This is organized by a Foxconn consortium called Mobility in Harmony (MIH). The MIH Consortium runs the Open EV Alliance, a new conglomerate built on the principles that Foxconn pioneered in building consumer products like PCs and smartphones. MIH hopes to foster innovation and collaboration to lower entry barriers for alliance partners. As Foxconn passed \$216 billion in revenue, there is a lot of confidence that this success story can be duplicated in EVs.

### My Perspective

I am writing about this topic from a unique point of view, as I was a chief technology officer in one of Foxconn's business units for several years—one of the few non-Chinese employed by Foxconn. I was also one of the few Westerners to meet Terry Gou in Taiwan in 1983 when he was just starting out in the electronics component business. At the time, I was managing

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Hewlett-Packard's Application Center in Taiwan. Gou eventually became chairman and CEO of Foxconn.

I didn't hear a lot about Hon Hai, the company that would become Foxconn, until 2008, when I got a phone call from my old HP boss at HP-Taiwan, who had just become the executive vice president of Hon Hai and needed some help in China. From then on, I would learn a lot about Foxconn and Terry Gou.

How Did Foxconn Start?

Foxconn started in the 1970s by making plastic items for TVs. In the 1980s, when the IBM PC started growing, Foxconn pivoted to making connectors and cables for PCs. This turned out to be a smart move; as the volume grew, so did the gross margin—to over 36%.

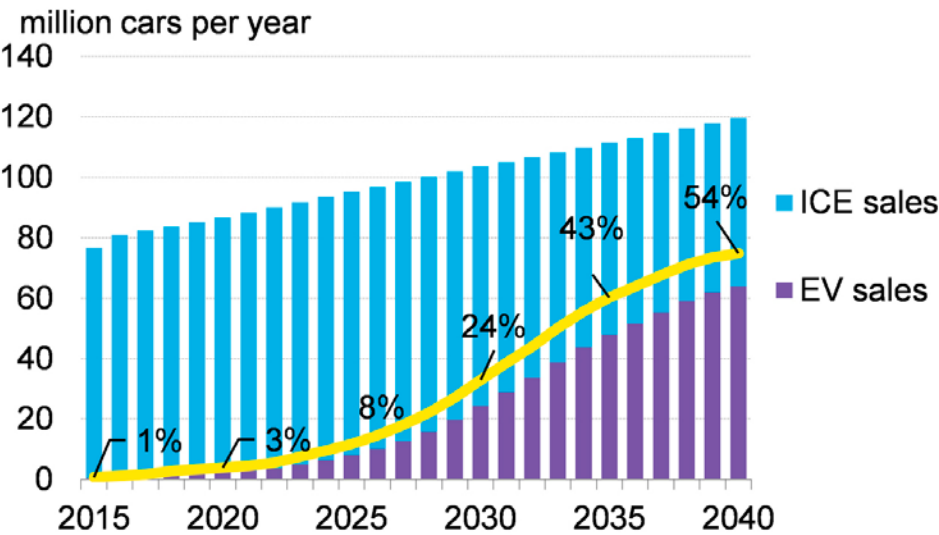
As it diversified its manufacturing portfolio, Foxconn became even nimbler and more adept in positioning itself as a leader in whatever it does. Thus, in 2020 when the company entered the EV market, its worldwide sales quickly jumped to \$240 billion.

Unlike traditional car builders, Foxconn believes that simple EVs can be built like PCs, as modular elements; to explore that possi-

bility, the company formed the MIH Consortium, which now has over 2,376 members in 64 countries. Through the MIH Consortium, Foxconn will supply startup EV companies with referenced EV designs and all the necessary components to make a new EV (battery, motors, electronics, displays, wiring, software, IC chips, and the body) with full assembly available as an additional service. A real “PC on wheels,” all at high margins for Foxconn.

Foxconn as an ODM

From my vantage point, Foxconn doesn't hesitate to spend money. It is “vertically oriented” and will develop or build as many component parts for electronics products as it can, including video displays, power supplies, plastic molding machines and cast metal parts, PCBs, flex, connectors, RF/networking, earphones, cameras, etc. Foxconn is the owner of the two largest PCB/flex fabricators in the world: Zhen Ding Technology (valued at over \$5 billion) and FIH Mobile Limited (100% cap-tive but over \$4 billion in sales)<sup>3-4</sup>. Expect these two to dominate electronics component production in their EVs, with EV sales projected to total over 40 million vehicles by 2030. Now, that's a lot of electronics (Figure 2).

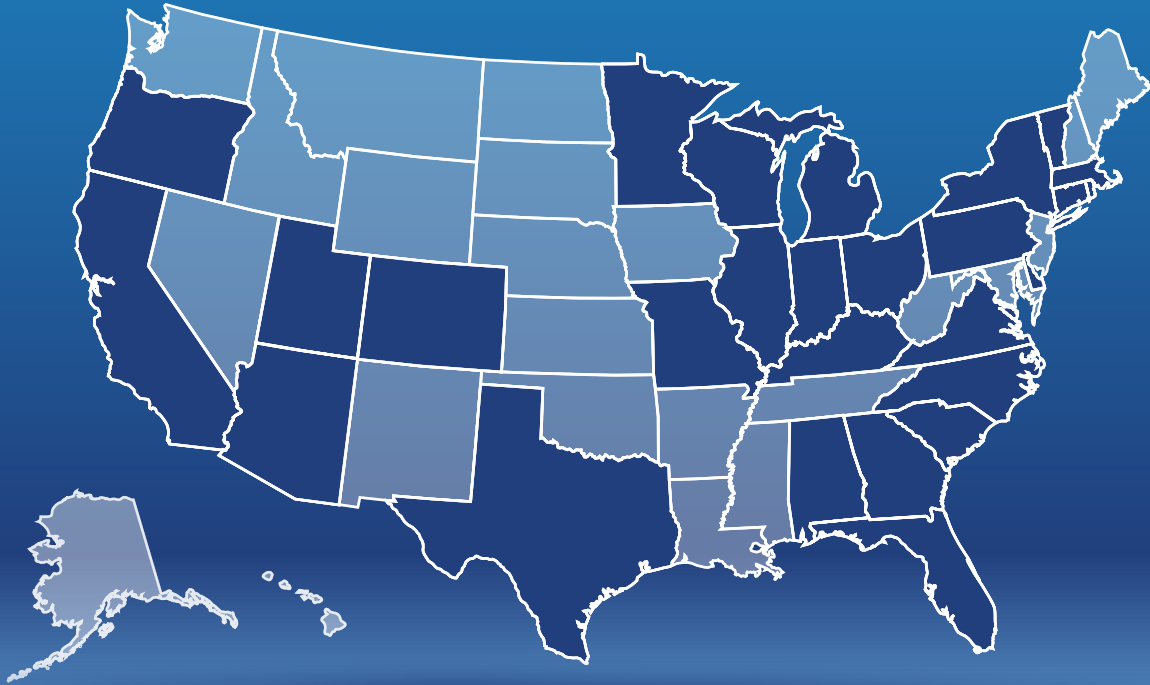


Source: Bloomberg New Energy Finance

07/06/2017 Press Release

Figure 2: Projected annual global light-duty vehicle sales from 2015 to 2040<sup>5</sup>.

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Foxconn designs many of the smartphones that other OEMs are marketing in China. They also now build a multitude of robots, many of which are used in their own assembly. This lineup will undoubtedly be expanded to include the larger robots used for chassis assembly, painting, and welding. Foxconn has purchased HP's inkjet module business and even assembles their inkjet printers. Due to automotive demands, Foxconn has purchased a semiconductor fabricator and partnered with NVIDIA for CPU chips, and the company is building a new wafer fab in Malaysia.

In 2001, Intel chose Foxconn to manufacture its Intel-branded motherboards and CPU modules. Next came the smartphone revolution, and it rode that wave with Apple from the very beginning by building iPhones. By keeping its exponential growth under the radar, Foxconn found its way into everyone's household *without* becoming a household name.

If Foxconn wanted to finally step out from behind the curtain of obscurity, it had two options: buy consumer brands or move into entirely new industries. It chose to do both. But the real question is: Can all this verticaliza-

tion for consumer electronics be extended to the EV business?

### Can You Build EVs like PCs?

The PC market exploded because Intel essentially gave away its base PC design provided you purchased an Intel CPU; AMD has since followed suit. Now, just a few engineers can put together a working PC. At the time, Microsoft also made Windows software available at a very low price. Compare this situation to the current landscape with EVs. An EV is more than just a motor and a battery; there are many different electronics systems at play, including battery and charging systems, motor control, lighting, steering, braking, air conditioning, wipers, anti-collision and safety systems, entertainment, interior systems, body frame systems, and soon, autonomous 5G communications.

Other factors to consider in putting a car on the road:

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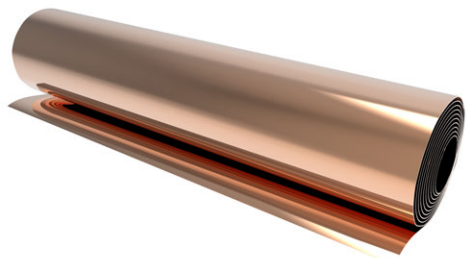
Figure 3: The technical services offered by the MIH Consortium<sup>6</sup>.

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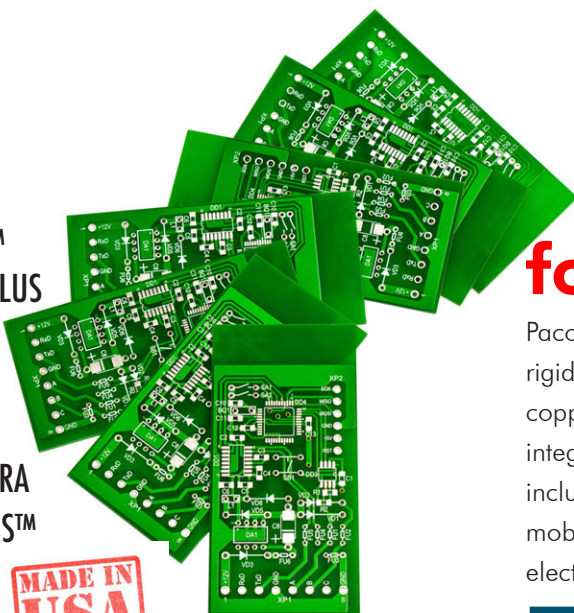


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- The need for geographic assembly
- Foxconn's reliance on Taiwanese management in foreign countries

To be successful, EV companies will need to differentiate their models to attract customers, requiring even single-EV companies to initiate periodic model changes and updates.

It took 30 years for Taiwan OEMs/ODMs (TSMC, Hon Hai, PCB fabricators) to build the infrastructure necessary to launch this initiative, and all while no one was watching. The Big Three automotive infrastructures (U.S., Germany, and Japan) have been building for 120 years and already have a multitude of component and parts suppliers, as well as the universities needed to educate EV creators. China and Taiwan, in contrast, are just getting started—but Foxconn has already made

great strides toward making China and Taiwan major players on the EV stage.

Foxconn plans to ship 500,000 to 750,000 EVs by 2025, mostly to Asian customers; that's up to \$34 billion or \$45,000 per vehicle. It plans to take the modular approach used for electronics and robotics to assemble the frame and put all the modules into these EVs.

MIH EV Design LLC, Foxconn's joint venture with Lordstown (Ohio) Motor Corp. (LMC) will use the Mobility in Harmony (MIH) Open EV Platform to co-design and develop EV programs for the global commercial vehicle market by leveraging the services seen in Figure 3. Foxconn invested \$230 million, with \$100 million to start up, and gave LMC a \$45 million loan "to support its initial capital commitment," according to an LMC announcement<sup>8</sup>. Foxconn owns 55% of the new company and LMC owns 45%<sup>9</sup>.

Foxconn recently acquired a major LMC factory where it will help Fisker Inc. begin pro-

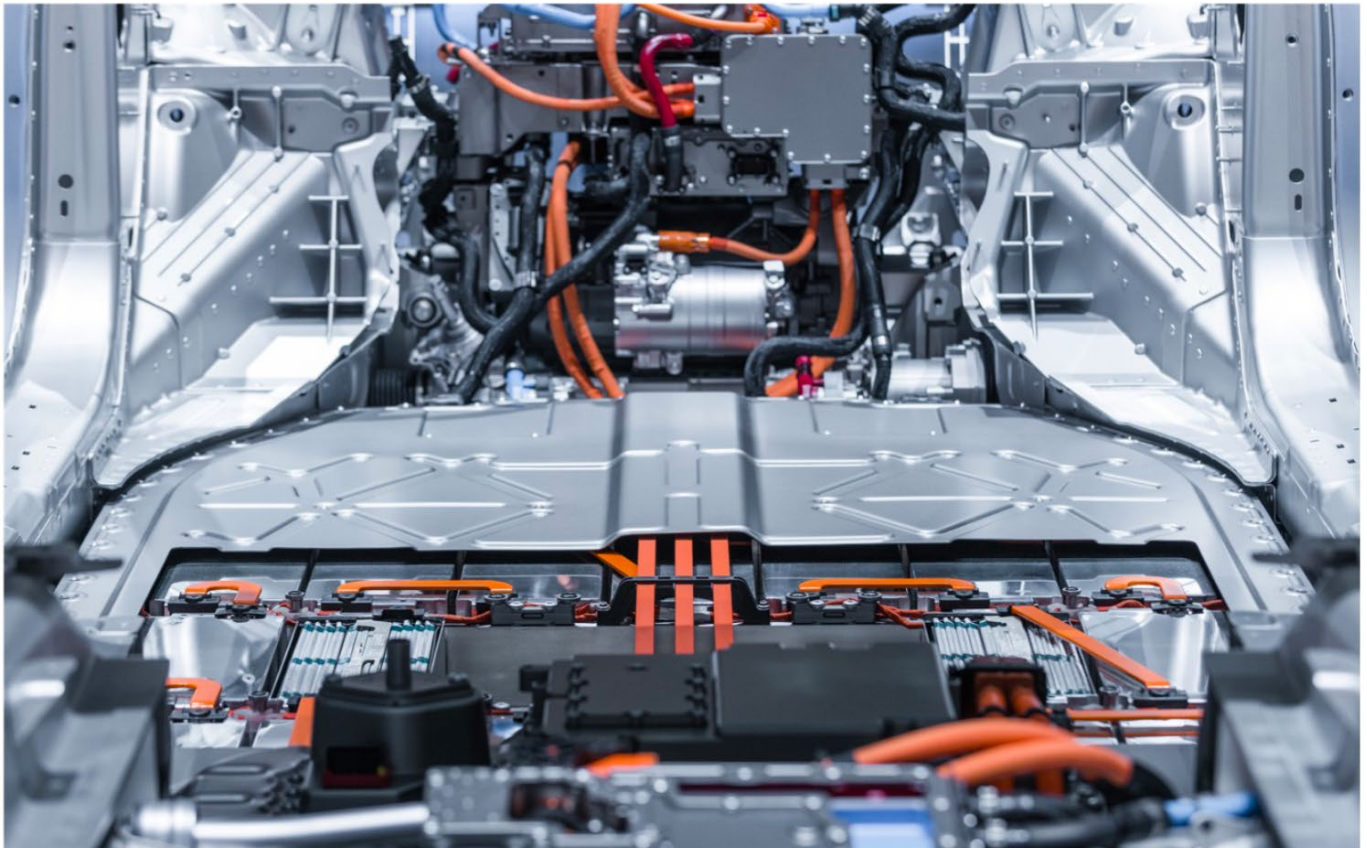


Figure 4: Ultium power train and battery<sup>7</sup>.



Figure 5: Pre-production Lordstown Endurance electric pickup trucks being tested at the Lordstown Motors facility in Farmington Hills, Michigan.<sup>8</sup>



Figure 6: The Lordstown Endurance electric pickup began production in the third quarter 2022, with deliveries in the fourth quarter 2022.<sup>8</sup>

ducing its PEAR model EV in 2024. An estimated 250,000 PEAR units are slated to be produced per year. Through the partnership, LMC is on schedule to begin producing an all-electric pickup truck, the Endurance, later this year. This will undoubtedly be the training plant for automotive engineers as Foxconn and China do not currently train automotive engineers like the U.S., Japan, and Germany.

## Strong Competition

Foxconn has just announced a plan to spend \$201.9 million to build a battery cell R&D and trial mass production center at the Kaohsiung Hofa Industrial Park in Taiwan, with a goal to begin mass-producing lithium iron phosphate batteries in the first quarter of 2024.

But Tesla, with its multiple new plants and battery operations, has a long head start on



Figure 7: GM's five large dual-wheel power modules and five smaller single-wheel power units<sup>7</sup>.

the competition. Compare Tesla's website to MIH's—Tesla is already taking orders. Current internal combustion engine (ICE) manufacturers have also started working on EVs; 18 companies have introduced EVs to the market. GM has four models on the road, in addition to a very impressive EV architecture that the company has termed the ULTIUM program. GM's offerings include five power trains for dual-wheel power with five additional power modules for single-wheel drive and dozens of battery configurations (Figure 4). They have also secured the cooperation of LG Energy Systems to build three new GM battery plants in North America.

## What's Happening Now

There are currently 57 EV startups, with most in Asia, and specifically 20 in China; several companies in China have produced ICE vehicles for many years. I believe many of these startups will flock to Foxconn to get access to its EV Reference Design and to start mastering the many technologies necessary to build a functioning EV. Established ICEs with their own manufacturing, on the other hand, are likely to stay away due to the fear of having to share their hard knowledge with all the newcomers. But issues of product design security and IP will be a major challenge for MIH, as new products must be introduced almost every year to keep the public interested in

their product. EnergyStartups has compiled a list of the "Top 10 Electric Car Startups" which ranks 95 companies by value.<sup>10</sup>

## Summary

Only time will tell if Foxconn can deliver on its plans. Its success in the PC and smartphone business was aided by the small size of these electronics and the large effort by North America and the EU to outsource electronics manufacturing. Automotive and transportation are now national priorities for these regions, so duplicating the consumer electronics growth may be a tough road to follow.

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**Only time will tell if  
Foxconn can deliver  
on its plans.**

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Times have changed in the last 30 years; innovation is rampant. Already, many are trying organic adhesives to replace spot welding, while newer plastics have strength greater than aluminum with lower weight. Fuel cell technology for large trucks may be miniaturized for autos. The industry is also focusing on small, super-efficient hydrogen-powered electric generators as a means to produce the electric-

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ity these EVs need without the weight and cost of lithium batteries. As this industry continues to grow, I'm sure we'll see a flurry of new ideas take shape in the next few years. Whether Foxconn succeeds in dominating that process remains to be seen.

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**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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# Real Time with... Show & Tell 2023 Now Available for Download

I-Connect007 is thrilled to announce the release of the sixth edition of *Real Time with... IPC APEX EXPO Show & Tell Magazine*, an exclusive review of IPC's annual trademark event. In this issue, you'll find insightful articles, interviews with authors of cutting-edge technical papers, interviews with award winners, and reviews of the speakers, conferences, and courses.

You'll also learn more about the IPC Design Competition and gain insights from our show reviewers. Experience IPC APEX EXPO 2023 through our hundreds of high-quality images, hear from our many technical experts, and watch fun videos that capture the flavor of the entire event.

"We specifically designed this issue so that whether or not you attended the event, you would be able to get a compre-

hensive feel for the whole show," says Michelle Te, managing editor of *Real Time with... IPC APEX EXPO 2023 Show & Tell Magazine*. "There is so much to see and do while you're there, it's impossible to experience it all. We wanted to provide an immersive experience through words and images. There's definitely something for everyone."

To read this issue of *Real Time with... IPC APEX EXPO 2023 Show & Tell Magazine*, [click here](#). Our comprehensive coverage of this event is the perfect resource for anyone looking to learn about the latest trends and developments in the electronics manufacturing industry.

We have enjoyed putting this issue together and truly hope you will enjoy it as well. Please share it with your colleagues and friends!





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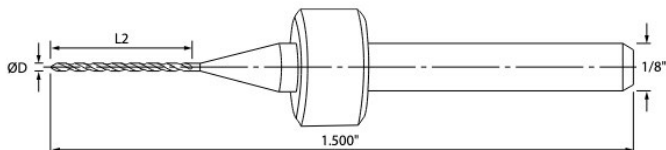


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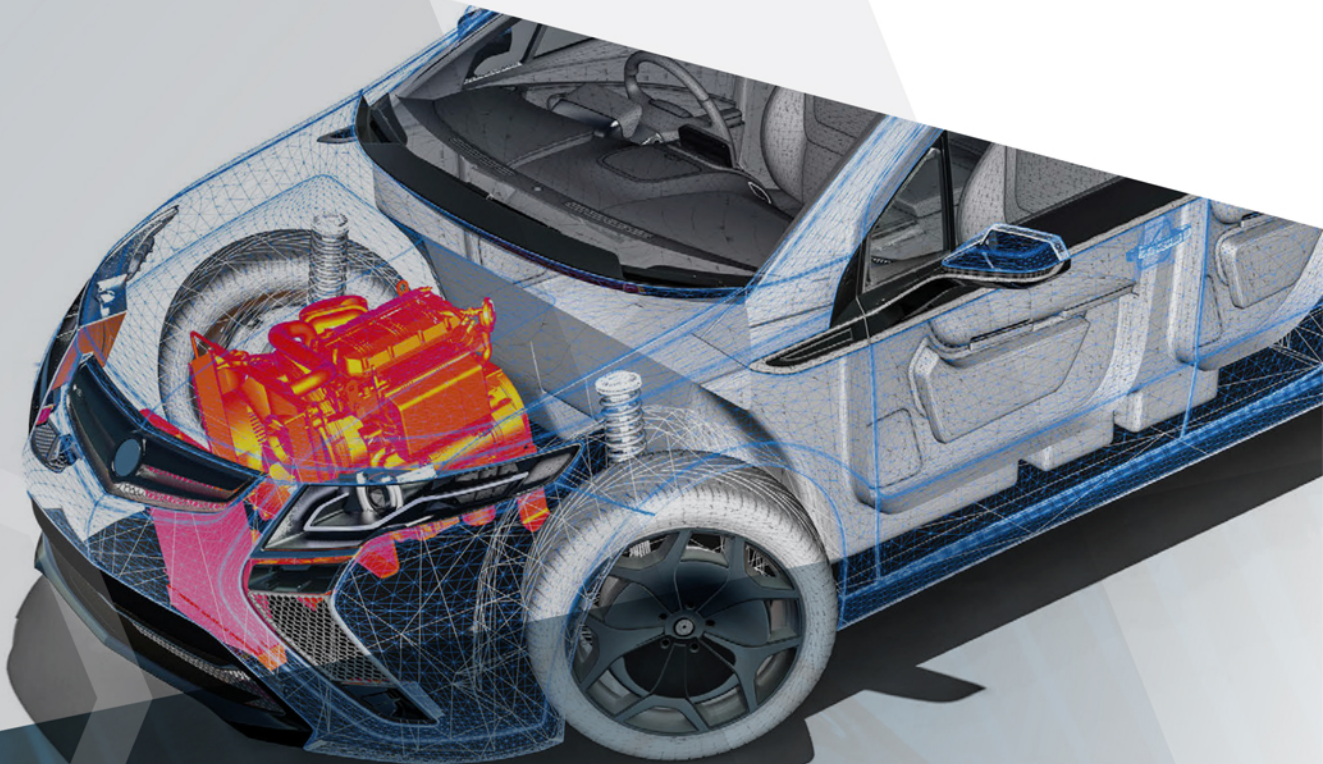
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***After the show, then what? What are your follow-up plans once a trade show is in the history books?***

I plan to keep showing up digitally, being consistent, and being reachable in many different ways. It may sound simple, but I believe you shouldn't forget about the basics to keep building and developing your brand identity. A trade show is fun and exciting, but it can be very overwhelming, with lots of information, people, and events. It's hard for everyone to remember all the information they get from the show. Depending on the location of the trade show, my follow-up to-do list can vary.

***How do you take advantage of the leads you generated at the show?***

The leads are a great resource that you can take full advantage of. Whether the contact is someone you've known for a while or a new customer, you never know the possibilities behind them. I will always follow up with them, but I try not to be boring. I try to be creative; I think this is the best way to grab a new customer's attention and keep that customer with us.

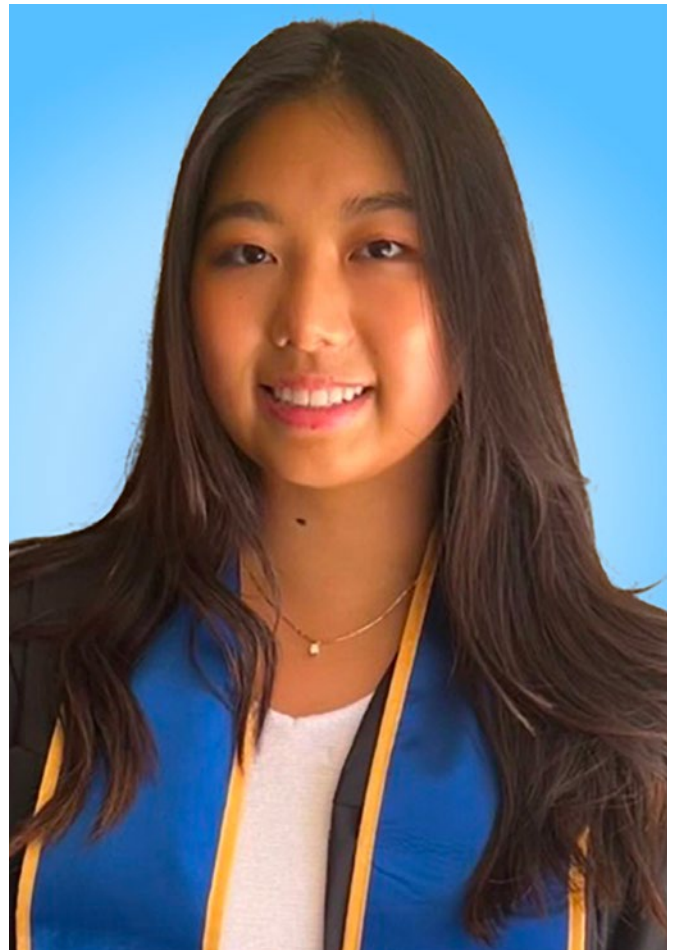
***How much does social media play into your post-show plans?***

Social media plays a huge role in Taiyo's marketing both pre- and post-show. Social media and the internet are the easiest ways to get information nowadays. Especially after the show, I'm sure that social media can function not only as a way to communicate and stay in touch but also as a reminder tool that Taiyo is here for you to all the people who visited our booth.

***Some companies say, "The marketing doesn't end when the trade show does."***

***Do you agree?***

Yes, I agree with that statement 100%. Marketing can have a huge impact, both pre-show and



Kiki Shimomae

post-show. Just as the sales team tries to maintain a good, strong relationship with their customers, good marketing takes time to accomplish.

***Do you have any advice you would like to share regarding trade show follow-up?***

Whether your company is big or small, it's always important to be visible and accessible digitally. Take 100% advantage of the power of the internet and social media. Social media is free, and has a lot to offer.

***Thank you, Kiki.***

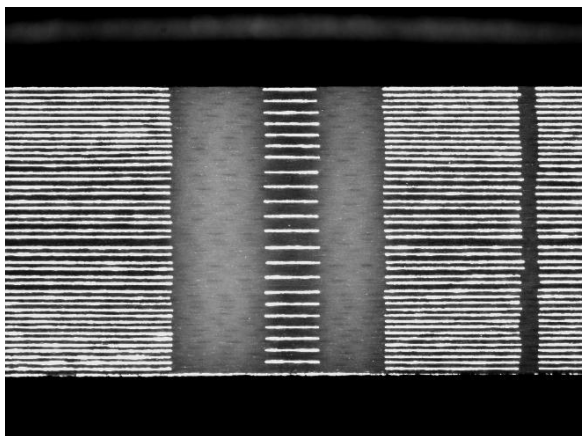
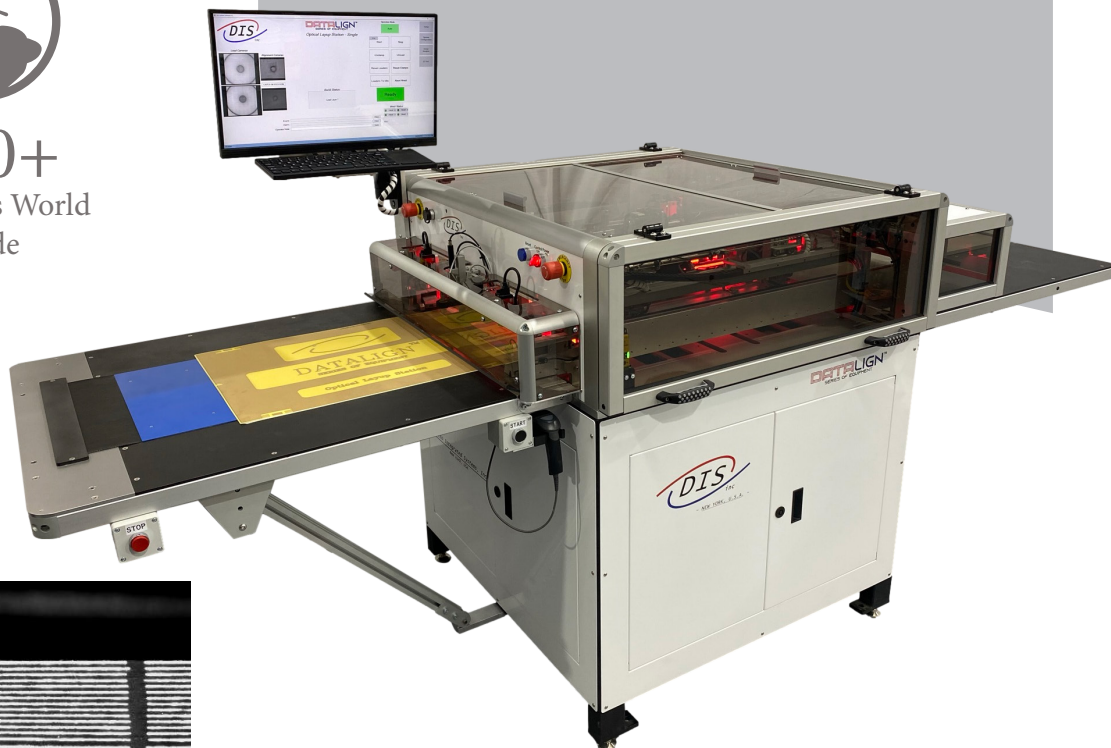
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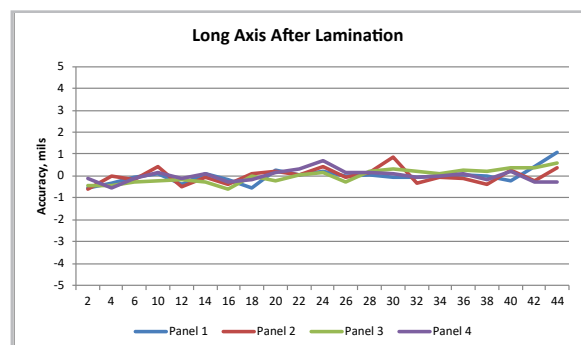
### 46-Layer Stack-Up

- 22 Cores
- 21" x 26" Panels

### Long Axis

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(After Lamination)





A Wise dry film stripper with Technosystems automation.

# The Automated Future of PCB Fabrication

Interview by Dan Beaulieu  
D.B. MANAGEMENT GROUP

I have always felt that automation has the potential to make a big difference in our PCB industry, especially domestically, where labor is at a premium. Only a few short years ago, Multicircuits in Oshkosh, Wisconsin, was considered a “plain vanilla” PCB fabricator holding its own in our industry; now it has suddenly assumed a true leadership position in the industry in terms of capability, technology, operations, and profitability. How did this happen? You guessed it: Automation was one of the most significant factors in shaping Multicircuits into the company it is today.

This is not only the story of how they did it, but an incredible partnership between a supplier (a rep), and a customer. Mike Thiel, director of operations, and Jeff Brandman, owner of

the TFE and rep/agent for Technosystem of Spain, played key roles in the success of automating this company.

*Thanks for taking the time to talk with me today. The story of your partnership and what you have accomplished over the past few years can serve as a real source of inspiration to other companies by showing them where they should be going in the future. Mike, can you tell us something about yourself? What is your background?*

*Mike Thiel:* My background is in computer science and operations. I was hired at Multicircuits in 1991, immediately after graduating from UW Oshkosh, to write our ERP soft-

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Mike Thiel

ware. I needed to learn the business, so I spent the first part of my career on the production floor running product in all areas and, eventually, supervising many of the process areas. I also worked as the primary process engineer, with a few years in quality.

In 2009, I was promoted to director of operations.

Multicircuits was incorporated in 1990 in Oshkosh, Wisconsin, with many of the assets purchased from Marquette Electronics. From those humble beginnings, we've evolved through the years from single- and double-sided product to the highly complex product we produce today. We are a high-mix, high-reliability PCB manufacturer with an efficient manufacturing process and dedicated workforce that allows us to deliver both quick turn and production orders with an OTD rate of 99.6% over the past seven years. Our markets include aerospace, medical, military, telecommunications, and industrial.

***Jeff, what's your background? Talk to us about Technosystem and the Benmayor Group.***

***Jeff Brandman:*** I started working in the Canadian PCB industry in 1997 for a company named TFE, which supplied consumable materials and manufacturing equipment to the PCB industry. The owner of the company, Tom Friedl, was a PCB industry veteran in his mid-70s, and he was looking for a young individual to take over his business. In 2001, I purchased the business and continued looking for new technologies to help my customers grow. In 2011, at the productronica show in Munich, Germany, I contracted with the Benmayor

Group and started representing their PCB thermal laminate from Aismalibar; later, I also took on Technosystem automation. Eduardo, the president of the Benmayor Group, has always been very passionate about PCB automation; he saw it as the future for European and North American PCB fabrication, and his passion inspired me to focus on Technosystem automation.

***Mike, please tell us about the idea of automating Multicircuits. How did that start? What was the goal?***

***Thiel:*** Using my engineering background, I've always looked for ways to improve our processes by reducing waste and improving consistency, productivity, and ergonomics. I had my first glimpse of automation at an IPC show around 2008 or 2009. At the show, Technosystem had a robot that was feeding an LDI, and I was hooked. It took a few years, but in 2012, we purchased our first Technosystem robot along with an Orbotech Paragon LDI for our primary imaging. While there were automated imaging systems at the time, I believe we were the first in the United States to automate an LDI using a 6-axis robot.

Initially, our goal for the automation was to improve handling. Our cores were getting thinner, and we needed a way to handle them effectively without creating defects. We also hoped to redistribute labor to other process areas that needed attention. It was a significant investment, but we knew we needed to prioritize the long-term benefits over a short-term ROI. We simply needed a better process.

The results of the installation, while not unexpected, were exceptional. We were able to increase our throughput by 80 to 100% while reducing handling scrap and exposure defects by 70%. Of course, the LDI was a significant improvement for our exposure, but the addition of the automation was a key driver in achieving our goals.



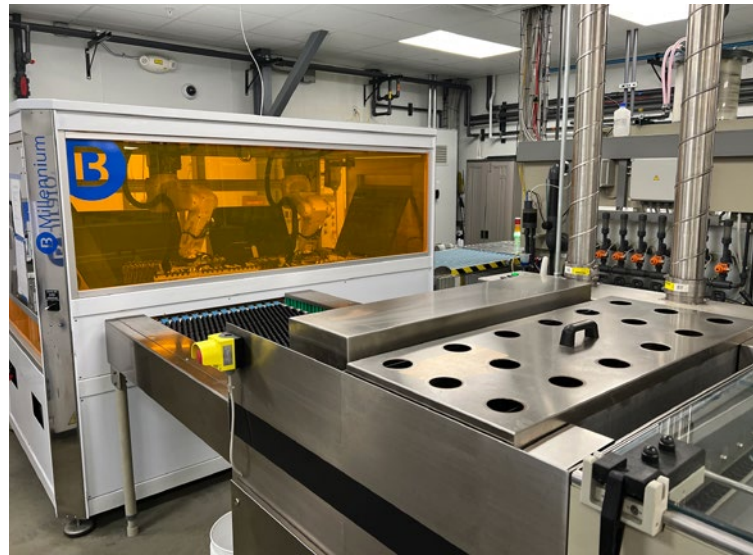
Wise system for inner and outer layer developing.

***Is that when you reached out to Jeff's company?***

**Thiel:** How that happened is kind of interesting. Initially, I reached out to Technosystem directly, as neither Jeff nor Rich (Richard) Hegg, TFE's representative in the Midwest, represented them at the time. When I didn't get a response from the company, I contacted Orbotech, since they had their LDI paired with the automation at the IPC show. Fortunately, they were able to connect me with Eduardo at Technosystem to get the process started.

**Jeff, I'm surprised you weren't representing Technosystem at that time. Tell us that story. Did you start representing them after you heard from Mike?**

**Brandman:** It's a funny story. I started learning about Technosystem automation during Eduardo Benmayor's second visit to North America for Aismalibar. Eduardo and I made a road trip and we drove in my Honda Element (Eduardo called it a "tractor") over 10 days to Montreal, Toronto, Detroit, and Chicago. In the context of Europe, this was a very long drive, but in terms of North America, it was all pretty close together. During this drive, Eduardo was going back and forth with Multicircuits on the



Dry film strip unloading and outer layer loading.

first automation opportunity for their LDI. Eduardo asked if we could go visit them, but we had such a tight schedule and Multicircuits was a three-hour drive north of Chicago—each way. During this trip, Eduardo explained to me that he believed the future of sustainability for the PCB industry in North America and Europe was in automation. Once the Multicircuits line was installed and I saw how sophisticated automation could go beyond the simple loaders and loaders we've seen for decades, I became as passionate as Eduardo. To this day, Eduardo asks if I still have the "tractor" and when we're going on our next long road trip.

**Mike, exactly when did you decide to automate your company?**

**Thiel:** I've seen automation used in several industries and always thought that we would be able to achieve something similar, but I hadn't seen others in our industry using it until the IPC show in 2008. In the beginning, I was skeptical that we would even be able to implement automated systems due to cost and the fact we were just a small PCB company, but I knew we had to start somewhere. Our plan was to start with the process that would give the most bang for our buck, and that was our primary imaging process.



Jeff Brandman

***How do you help clients determine this “most bang for your buck?” Do you do process evaluations for your clients?***

***Brandman:*** When we discuss automation with our customers, we ask them to focus on two areas: first, which area is pro-

ducing the most amount of scrap due to handling, and second, which area is the greatest manpower bottleneck. Asking these questions helps us determine where we need to focus our efforts. Automation is a big word, and many people can be overwhelmed when planning how to retrofit an existing factory for automation. We believe that when we focus on these two points, our focus areas become clear.

***Mike, deciding to start putting automation in your facility, especially over 10 years ago, was a courageous leap of faith. What finally pushed you to take that leap?***

***Thiel:*** We wanted a complete system. We didn't just want to replace our old equipment to improve our capabilities while still running that equipment the same way we always had. I wanted to improve the whole process, including the handling and setup of the job. Interestingly, we were not able to achieve all our goals with the first LDI automation. Trying to get the equipment manufacturer to adjust and create automation protocols to achieve our complete vision just wasn't in the cards.

***The term “automation” may seem self-explanatory, but a lot more goes into it than most people realize. Can you explain automation? What, exactly, do we mean by that?***

***Thiel:*** When I think of automation, it's more than just handling equipment. Standard handling equipment has been around for a long

time, and it's very effective at what it was created to do, which is eliminate the manual feeding and catching panels on a conveyORIZED line. However, there are limitations with standard loader/unloader solutions, such as limited flexibility (i.e., panel sizes and thicknesses). I was looking for a complete solution that would not only act as an effective loader/unloader, but also make decisions on process flow, eliminate setup, and improve handling by only transporting panels using the panel edge.

***Jeff, how do you define automation?***

***Brandman:*** I define automation as the use of technology to perform tasks without the direct intervention of a human. This considers handling, software, communication, etc. As Mike said, automation is a complex idea far beyond basic loaders and unloaders.

***Mike, was automation a project you deployed all at once or did you target one area at a time?***

***Thiel:*** We knew that it would be a single-process-area-at-a-time project. We simply did not have the floor space, finances, or engineering resources to handle multiple projects at the same time.

***How did you handle the implementation of so many processes?***

***Thiel:*** The implementations were a close collaboration between Multicircuits, the equipment manufacturer, and Technosystem, the automation experts. Automation is not a one size-fits-all approach. Every company has different scenarios that need to be managed. Each company needs to work with the automation vendor to help determine their priorities and needs and what will work best in their environment.

***How long did all this take?***

***Thiel:*** It's not something you do overnight. We have been on our automation journey for

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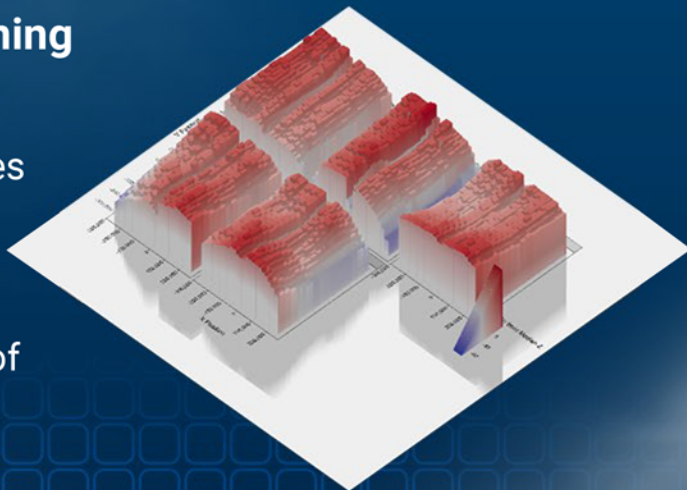
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Inner and outer layer imaging with an Orbotech Paragon 9800.

the past 10 years. We are not anywhere near completion, and we continue to consider the automation potential of all our processes.

#### ***Why did you start with Technosystem?***

*Thiel:* As you heard from Jeff's story earlier, we first started looking at Technosystem because they had been providing automation to several industries for many years. They had and continue to have the technical expertise and experience to help guide companies with their automation projects. When we first started in 2012, Technosystem did not have any robotics systems in the U.S.—we were their first. As such, during those early years, we dealt directly with the company. However, as Jeff was becoming more involved in the automation side of Technosystem, he brought Eduardo to our facility. The visit was beneficial for both of us, as Technosystem had the opportunity to get a better feel for our facility and the challenges we faced. We have been working with Jeff (TFE), Rich, and Technosystem ever since.

#### ***How did you actually start this process? What operation did you focus on first?***

*Thiel:* We focused on the area that was contributing most to our scrap, which was the inner and outer layer imaging operation.

#### ***Describe what the operation was like before and after the installation.***

*Thiel:* The process prior to the automation was two in-line Bacher systems with a flipper between. The units were single-sided exposure units that had a vision system for aligning artwork to the panels. The system was mostly automated with loaders/unloaders. It was a pretty good system, but it had limitations.

Because we were still using mylar images with the machines, we had contact issues between the glass, artwork, and panel. To keep the panel from damaging the artwork as it progressed through the equipment, we coated the film with a 0.25-mil protective film, which often introduced off-contact issues with warped panels or those that had significant image transfer due to heavy copper or low-pressure areas on inner layers. In addition, the loaders, unloaders, and printing equipment were not able to consistently handle very thin or very thick panels. We experienced panel jams or damaged panels due to the limited flexibility.

When we looked at automation, we wanted to address as many of the limitations of the existing equipment as possible. Using the automation alongside the LDI, we were able to eliminate or minimize the handling issues with thin and thick cores and eliminate the off-contact defect. We were able to dramatically increase our productivity with the automation because we were able to eliminate artwork setup time as well as load multiple jobs in the robot and allow the machine to run unattended for significantly longer periods of time.



# Automation and Advanced Procedures in PCB Fabrication

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A Wise etcher with Technosystems automation.

***I heard that the story of how you automated the SES line is an interesting one. Can you talk about that?***

**Thiel:** What makes that story so interesting is that we approached the traditional DES/SES processes differently than how they are normally structured. Due to limited floor space and the faster etching speed of ammonia, we had always combined the inner and outer layer etching on a single line. We wanted to continue with that model by creating a fully automated DES/SES line. Since our goal for automation was to eliminate operator setup, we had to configure the line with flexibility to run inner layers in a different path on the same line as the outer layers. We did that by creating a circular equipment pattern with the ability to handle four different process paths. To etch product, the operator simply selects the job on the com-

puter and prints a barcode. Using job information from pre-production, as well as data gathered from prior processes such as dry film type used, the computer will select the appropriate recipes to control the etcher, tin stripper, dry film stripper, and three separate robots as well as multiple diverters to properly route the product. The operator only applies the barcode to the job, loads the panels, and presses start.

***Is the shop fully automated now?***

**Thiel:** While not fully automated, we have automated several other key areas over the years. These areas include drilling, pumice scrub, solder mask imaging, etch/strip/tin strip, inner layer chemical clean and lamination, outer layer lamination, copper plating, copper via filling, legend inkjet printing, electrical test, and scoring.

### ***How long did it all take?***

**Thiel:** The planning and execution of our automation projects have been ongoing over the past 10 years.

### ***What have been the results? Fewer people? Faster and more efficient operations/processes?***

**Thiel:** The results have been remarkable. Over the past 10 years we have doubled our revenue, while our workforce has decreased by about 15%, mainly due to attrition. We have consistently maintained high yields while increasing the complexity of the product and have achieved an average 99.4% OTD since 2012.

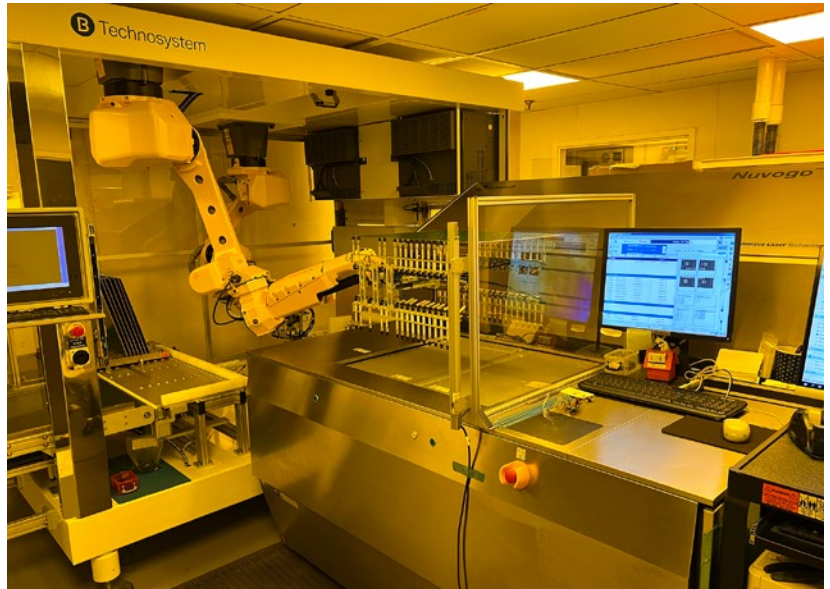
### ***I would consider that a very successful initiative, wouldn't you?***

**Thiel:** Absolutely. I'm confident that we would not have been able to achieve all that we did without automation. The benefits are numerous, including improved product and process consistency, easier troubleshooting, reduced material costs from less rework, in addition to labor and other efficiencies.

### ***Do you have any closing thoughts?***

**Thiel:** I'm a firm believer in purposeful automation. While it would be wonderful to completely automate every process, most companies like us simply don't have the resources available to do so. We need to focus on the areas that will provide the most benefits from automation and/or may not need as much technical expertise or financial resources to automate. In addition, we can't ignore other areas of automation that don't necessarily involve equipment, such as business process automation—but we'll save that for another day.

**Brandman:** I absolutely believe automation in the PCB industry is the way of the future. If North America and Europe want to be able



Solder mask imaging with a Nuvogo 600 LDI Orbotech system.

to compete with Asia, we need to leverage the Smart factory concept by exploiting automation on all levels. It's not necessarily about reduced manpower; the idea is to create significant growth through technology, which in the end will create more jobs.

***This has been tremendously interesting, not just for me but, I am sure, for the people in our industry with whom you are sharing your story. Thanks for talking with me, and thanks for showing us the way when it comes to automation as the future of the PCB industry.***

**Thiel:** My pleasure, Dan. Thanks for reaching out.

**Brandman:** Yes, thanks for helping us tell our story, Dan. **PCB007**



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



# Schweitzer: The Captive Partnership

Feature Interview by Nolan Johnson

I-CONNECT007

Schweitzer Engineering Laboratories (SEL) is in a unique position as a greenfield captive facility that both fabricates and assembles boards. The approach at SEL is reminiscent of the vertically integrated electronics giants of the past, like Hewlett-Packard, Tektronix, IBM, Zenith, and so many others. Now, as some companies are beginning to dip boards back into hometown tanks, SEL's long-standing commitment to becoming a captive facility has bolstered its position in the market.

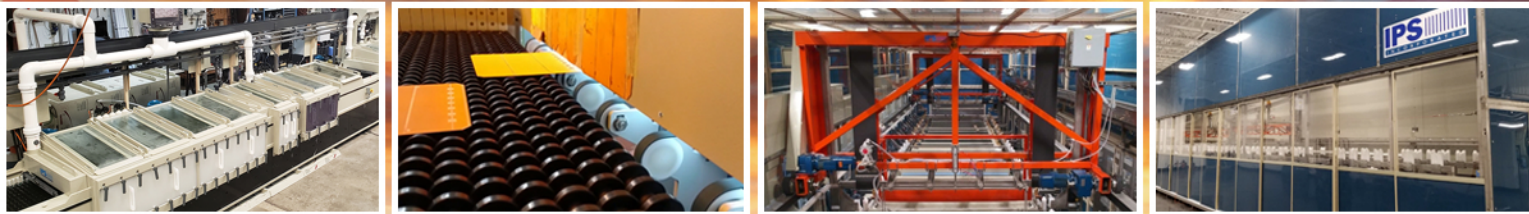
In this conversation with SEL, we spoke with John Hendrickson, engineering director; Frank Harrill, vice president of security; and Jessi Hall, senior director of vertical engineering. We wanted to learn more about the best practices they developed while specifying, selecting, and preparing to install an entire

facility's worth of equipment all at the same time.

*You just went to the trade show, and you bought new equipment—what comes next in this process? SEL is probably one of the most active purchasers of equipment in North America right now. Walk us through the process you use to identify which equipment fits your specifications. How do you move from deciding what you want to accomplish to determining the specific equipment you need to meet that goal? What are the feature sets in that? How do you build out your integration plan?*

*John Hendrickson:* The biggest thing I've learned on this project is that it's all about

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having the right partners. Pick the right partners and things will go well for you. When it comes to the specification piece, we've collaborated with our partners to specify the equipment and features. We have a lot of new engineers, and our partners have been instrumental in teaching our team the importance and details of those processes. This close collaboration is important not only for today's needs, but future needs; we want to look beyond today's technologies. An example of this is additive technologies. How can we set ourselves up today—how can we select the equipment with the right features—that will allow us the flexibility to move into that space in the future without having to buy our base equipment all over again? We might not have all the equipment sets today, but if we can lay that groundwork now, we can avoid having to make significant investments from scratch at a future date.

***SEL does its best to source things from North America, specifically the U.S. Does that commitment include your capital equipment?***

***Hendrickson:*** North America is definitely our first choice, if available; if not, we'll look at other areas.



John Hendrickson

***You said having a good working relationship with your supplier is critical. Is that more critical than capabilities? Would you choose the partnership working relationship over immediate capability? Tell me about the balancing act.***

***Jessi Hall:*** They both have to be there; however, say we have a relationship with a certain supplier, and they may not quite have the technology we need yet. We want them to have the opportunity to work with us to develop the technology we need in partnership with us. That is how we operate in our assembly facilities today, and that is the way that we're approaching the PCB factory as well.

***Selection is based on how comfortable you feel with that particular partner's technical capabilities, and what their future capabilities are. Regarding equipment, SEL is the expert in how to integrate equipment into a line on both sides. On the equipment side, I'm sure you've gone through a process of bringing in a lot of equipment and setting it up. What have you learned, and what are the best practices to ensure the equipment gets set up properly and becomes operational?***



An operator running the horizontal electroless copper plating line.



The desmear line at SEL.

**Hall:** We're in a somewhat rural location, so in addition to having the right partner, we want to ensure that we have employees who are ready to support our equipment and facilities from start-up to obsolescence. Our maintenance and engineering teams are extremely involved in all aspects of equipment selection and installation. Our first step is ensuring we have the right folks in place who are eager to learn and teach and that they have the training they need to succeed. That's an area where John's team really shines.



Jessi Hall

interact with the equipment really start to pay off. Integration is a big challenge because there's not just one standard out there on how to communicate with a piece of equipment. Every supplier has their own method, and in some cases, we're having to interact directly with the PLCs of the equipment itself to be able to automate the process.

**Frank, as you know, so much of what we do is transitioning to a digital model. Digital twin and the like are moving data around digitally, which must make security more important than ever.**

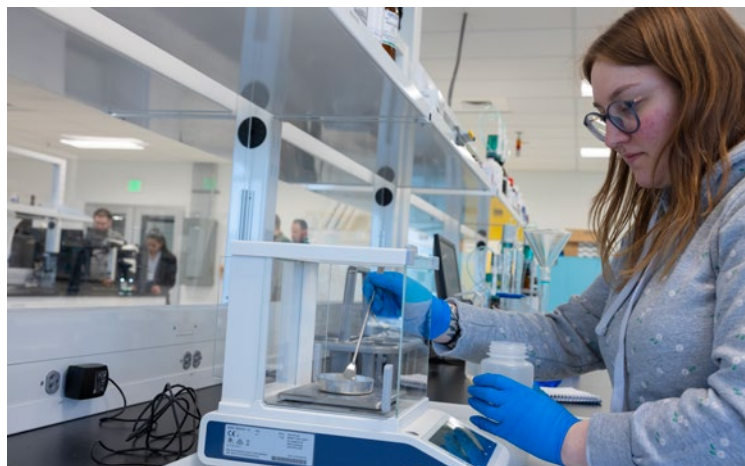
**Hendrickson:** I completely agree. A lot of shops in the United States today don't have the resources or strong maintenance teams, so that's another benefit we have. Our teams have shown that they're capable of doing things right. There have been plenty of struggles in this process, but our team has been very resilient and flexible. Our maintenance team's main job is to focus on equipment; to be successful in this project, they've had to be plumbers, electricians—you name it, they've stepped up and done it.

The level of integration that we want poses the biggest challenge, and that's where our resources and the security we put in place to

**Frank Harrill:** One of the nice things about this project is that it's a greenfield effort. We can instantiate every control that we need from the ground up, and we've done that here. Both John and Jessi worked very hard to make that happen. One technology that we are applying is software-defined networking, which is a technology SEL developed and refined specifically for operational technology environments. We're able to use that technology to ensure that all flows are visible, and only expected communication with the appropriate permissions are permitted across our networks.



Technician working in the wet laboratory.



Another technician working in the wet laboratory.

The second thing is—and this goes right back to supplier partnerships—we have very stringent security standards around how to communicate with the equipment that we use. For instance, we won't allow equipment manufacturers to connect to our environment for maintenance absent strict controls and observation. Explaining those requirements and rationale for them is a central part of the relationship we cultivate with each supplier; we let them know both what we expect and, more importantly, why we have that expectation. That joint awareness is especially important in today's threat environment. Again, understanding the customers that we serve, their expectations, and our responsibilities—especially our grave responsibility to ensure that what we're delivering is exactly what they and we expect—all that begins right on the manufacturing floor with what traverses our digital networks. We also make sure that the people who enter our controlled spaces are aware of our standards and expectations from the very outset. That's been a real success story for us.

***What's your advice right now to other shops looking at equipment? Most of them are***



***probably brownfield rather than greenfield, but out of all the aspects to this process, what's the one key lesson you would want them to know?***

***Hall:*** Pick the right partner. Make sure they align well with you.

***Hendrickson:*** I would agree with that. I would add that in today's environment of component availability shortages and logistics issues, planning is critical in ensuring the success of your project. Everyone is having supply issues with all kinds of components, and that's challenging, so plan for and expect delays in today's environment.

***Harrill:*** That goes hand-in-hand with the one message we could expound upon all day: the cultivation of our close supplier partnerships spans years and requires constant communication to build and sustain trust, especially when there's a need to communicate bad news. You want to hear often and early about any challenges a supplier may be facing; we're all suppliers and customers to somebody and being that good partner on the other end means ensuring that bi-directional transparency is always there. This is something we have practiced for decades, and it continues to pay off.

***This has been very helpful.***

***Hall:*** Thank you for the opportunity, Nolan. We appreciate it.

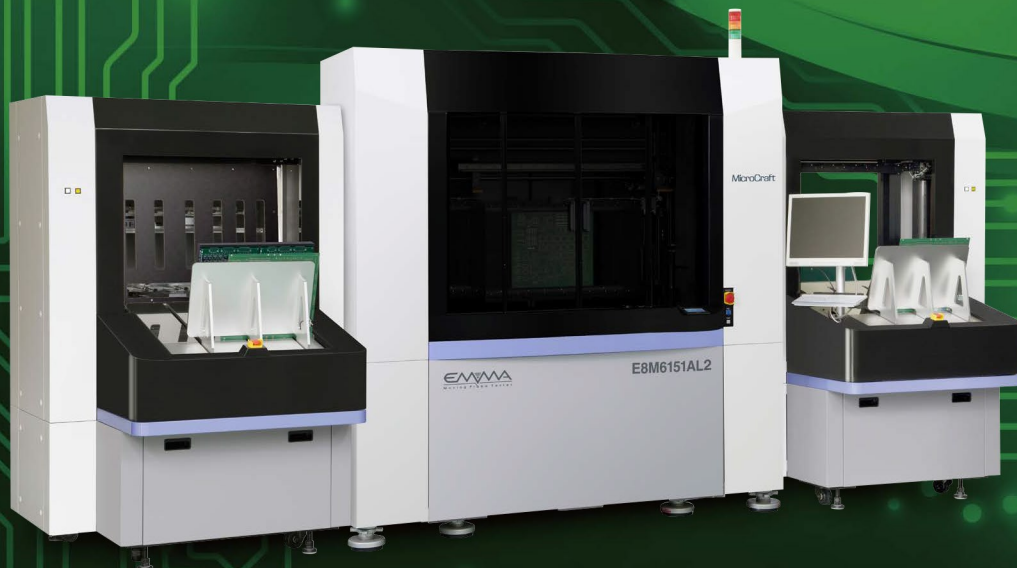
***Harrill:*** Thank you, Nolan.

***Hendrickson:*** Thank you. PCB007



The horizontal electroless copper plating line.

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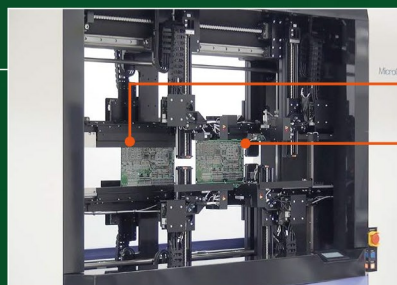
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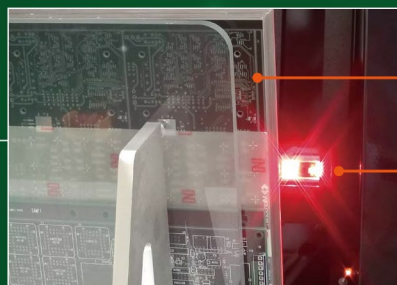


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# Supporting IC Substrates, Advanced Packaging, Part 1

## Trouble in Your Tank

by Michael Carano, RBP CHEMICAL TECHNOLOGY

### Introduction

There has been much written and discussed over the last 18 months relating to semiconductor fabrication and the well-founded concerns that the U.S., in particular, has fallen behind in domestic chip manufacturing. In response to this issue, the U.S. government has enacted the CHIPS and Science Act. Funding under this legislation is designed to drive more chip fabrication domestically. While this is all fine and good, once these advanced chips are manufactured, where will they go? As has been said ad nauseum, “Chips don’t float.”

These chips require packaging and, in turn, advanced PWBs to support those packages. The PWB and the IC substrates are the physical platform to which these chips, micro-processors, capacitors, memory, logic, etc., are mounted and interconnected. Without a high-reliability, high density platform, the chips have nowhere to go. This is precisely why critical technologies, processes, and materials

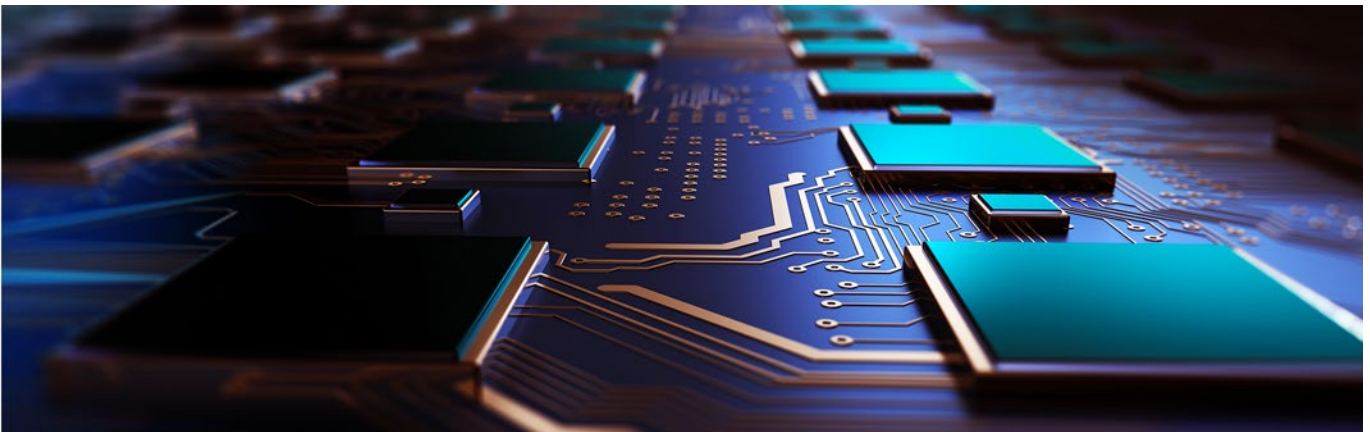
must be adopted to support chip production and advanced packaging.

The subject of this month’s column is to delineate critical areas in which fabricators in the PWB world must both embrace and master to support advanced packaging. These are:

- Tooling and materials selection
- Small hole drilling/via formation
- Desmear and metallization
- Advanced photolithography and fine-line etching
- Blind-via plating/blind and buried via hole fill
- Signal integrity
- Quality control and qualifications

Part 1 of this article will focus on the following areas:

- Tooling and materials selection
- Small hole drilling/via formation
- Desmear and metallization



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## **HS-2L**

*High-speed, 2-station drill or router  
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Table 1: Three types of challenges for high-speed HDI boards<sup>1</sup>

Challenges	Solutions	Enabling Technologies
Rise time degradation, ISI, collapse of the eye diagram	Minimize dissipation factor Minimize parasitics	1. Low loss laminates 2. Integrated passives 3. Chip scale packages
Rail collapse	Minimize PDS impedance	4. Thin laminate
High-speed design gets harder	More efficient design tools	5a. 3D Full-wave solver 5b. Four port VNAs

## Tooling and Materials Selection

HDI boards are characterized by smaller features and tighter registrations. To this end, feature compensation and scaling are much more important than on regular boards. HDI boards are also used for high-frequency applications, and thus, solving these demands creates new challenges for an engineering/tooling department. Table 1 shows three major challenges in engineering high-frequency boards.

Materials selection is equally important, especially because of lead-free assembly temperatures and their effect on laminate delamination and reliability. Important new capabilities to embrace are:

1. Impedance calculations and stackups for high-frequency boards using “co-planar waveguides” and co-planar stripline models.
2. Characteristics and scaling/feature compensation for the newer phenolic-epoxy and halogen-free FR-4s.
3. Ability to add local fiducials to align laser drilling CCD cameras.
4. System to store laser drilling parameters based on diameter, depth, and materials types.
  - › Characteristics of via-plugging to determine if placement of buried vias will create problems<sup>1</sup>.

From a materials standpoint, low Dk and low loss laminate materials are the laminates of choice. Signal integrity and impedance matching are required. Minimizing signal loss at high frequencies is paramount to IC substrate technology that supports advanced packaging. This brings one to gain a better understanding of via formation and desmear/metallization.

## Small Hole/Microvia Formation

Although HDI is normally associated with laser drilling, small blind vias can also be formed by mechanical drilling and chemical etching. What’s important is a process that guarantees each board will receive the correct microvia drilling parameters. Ideally, the shape of the formed via will show a wider opening at the top of the via before gradually tapering down (Figure 1).

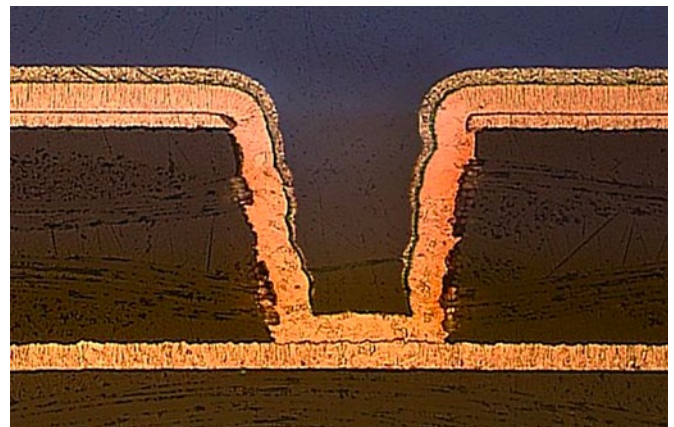


Figure 1: Ideal microvia formation shape with plated copper.

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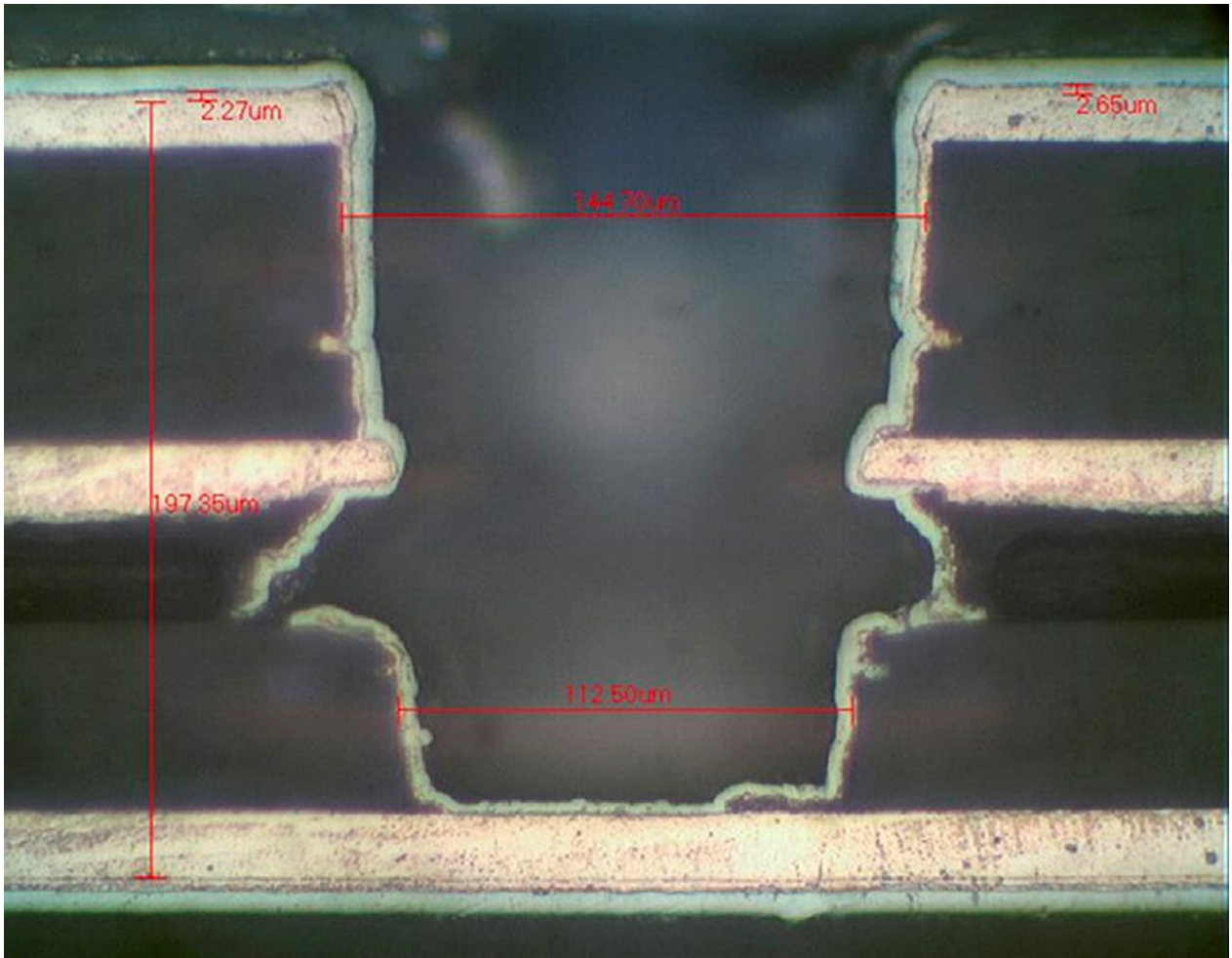


Figure 2: Non-ideal via formation.

The shape of the via is critical to enable uniform copper plating. The fluid dynamics of the plating operation require the constant replenishment of key plating additives to ensure that fresh electrolyte is exchanged to reduce concentration polarization. With concentration polarization, the diffusion layer is starved of copper ions and other additives.

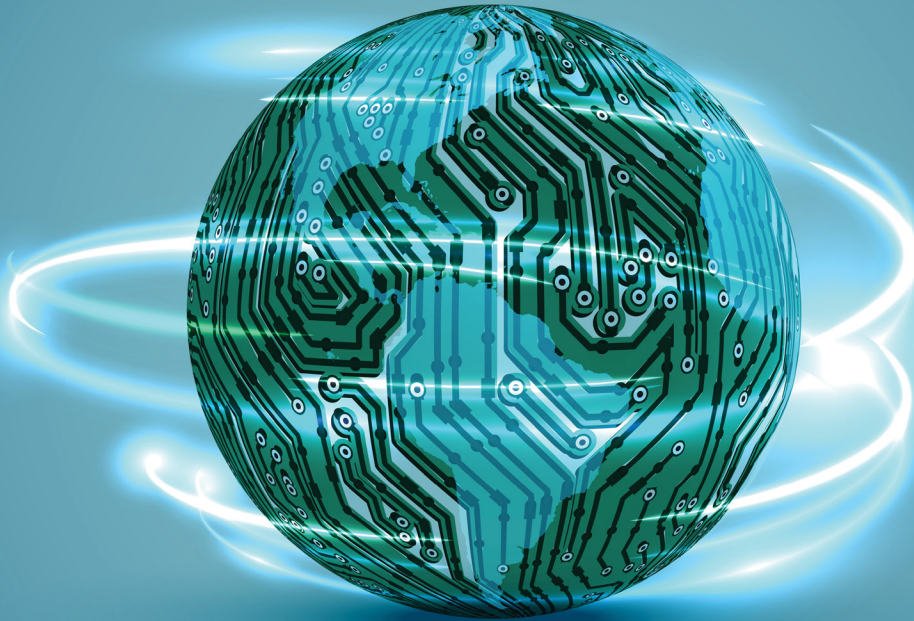
A non-ideal via formation is shown in Figure 2. Note that the diameter of the blind via is slightly narrower at the top. In addition, the quality of the overall via is compromised, as evidenced by the excessive removal of the adhesive material. With a situation such as this, laminar flow of the electrolyte to the blind via is disrupted, further impacting uniform plating.

Other important considerations and conditions to be mastered include:

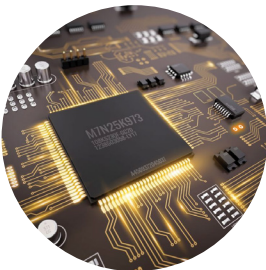
1. Ensure consistent lamination thicknesses for outer layers, otherwise laser drilling will be seriously affected.
2. Use caution on energy levels so that delamination or epoxy residue is not produced at the bottom of the blind vias.
3. Make careful selection of dielectrics to be laser drilled (laser-drillable prepreg).
4. Check the depth of field of the laser drill to verify the thickest board that can be laser drilled.
5. Fabricators must invest in latest registration and via formation equipment.
  - › Hole and via positional accuracy is a possible issue
  - › Systems available to predict material movement



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## Desmear and Metallization

From a pure materials standpoint, these higher performance resins are more difficult to desmear and metallize. Because the modulus is higher, the materials are more brittle. These materials are also more chemically resistant to chemical processes, including alkaline permanganate chemistries. One cannot rely on the high surface area and honeycombed texture on the resin that is common with lower Tg materials.

However, ensuring that drill smear and other debris are removed, the alkaline permanganate process must also activate both the resin and glass to enable the adhesion of subsequent copper plating. Loose debris and a smooth resin surface will not provide the necessary adhesion sufficient to withstand thermal excursions and mechanical shock.

In Part 2 of this series, I'll be taking a deeper look at metallization. **PCB007**

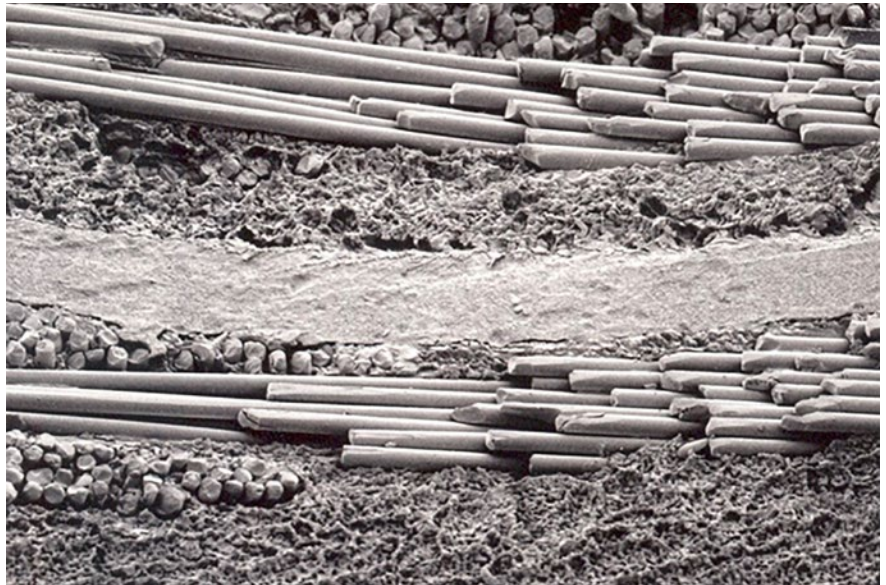


Figure 3: Honeycomb texture after alkaline permanganate desmear (low Tg material).

### References

1. *Getting Started in HDI Fabrication*, by Happy Holden and Michael Carano, internal publication, Feb 2021.



**Michael Carano** is VP of quality at Averatek. To read past columns, [click here](#).



# BURKLE

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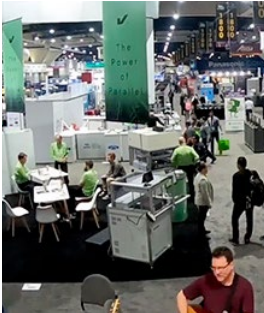
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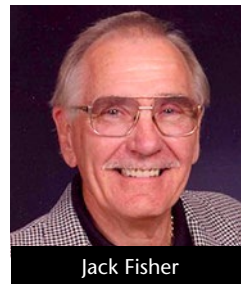
## Don't Blink: The IPC APEX EXPO Time-lapse Video

It's a tradition here at I-Connect007 to set up a time lapse for IPC APEX EXPO. There's something satisfying, mesmerizing even, to watch the show floor build out and see the moment when the doors open and visitors fill the exhibit hall. Based on what others have said over the years, I know I'm not the only one whose favorite part is when the carpet gets rolled out and the whole character of the exhibition changes. This time lapse starts on the Saturday prior and continues through the Thursday tear-down phase.

## Caution Advised on Global PCB Outlook for 2023

2022 was an outstanding year for the global PCB industry. Global industry output reached USD 88.2 Billion with 3.2% annual growth despite pressure from unpredictable factors such as geopolitics, high inflation, and high inventories. The negative factors are likely to continue playing a confounding role in 2023, but there is a chance it might perform a duck and jump. The economy and consumer demand will hopefully recover in the second half of the year to drive slight growth in global PCB. Industry output is expected to fall between 3% and -4%.

## In Memoriam: Jack Fisher Remembered



Jack Fisher

Long-time electronics interconnect industry icon Jack Fisher passed away on Jan. 20, 2023. Design007 Editor Andy Shaughnessy remembers working with Jack in the late 1990s. "He was always a great guy to work with,"

Shaughnessy said. "He would tell you if something was a good idea for a magazine article or not. Jack was really a 'Jack' of all trades...he was a source of knowledge about fab and assembly. We went rafting down the Chattooga River a few times, and he had all kinds of crazy stories from the early days of PCB manufacturing. We'll miss him."

## Real Time with... IPC APEX EXPO 2023: Reduction Assisted Immersion Gold

In this interview, Richard DePoto, business development manager at Uyemura, explains how his company has overcome the challenges presented by world circumstances during the past two years, and discusses developments in specialist metallic finishes to benefit high-frequency and high-reliability applications.



## Nolan's Notes: The Trade Show Is Over—Now What Do You Do?

When you're new to your career, your role, or even new to the industry, the pressure can be immense. Then you find yourself at a trade show representing your company, tasked with bringing information back to your organization. But take heart, at least you're not Harrison "Jack" Schmitt. Jack really understood pressure.

### IPC Debuts First Issue of *IPC Community* at IPC APEX EXPO 2023



Monday at IPC APEX EXPO 2023, IPC, in partnership with IPC Publishing Group, launched an industry-specific quarterly publication (a digital publication with a special print edition for show participants), "IPC Community."

The publication celebrates member success while sharing the important work being done

within the association to better serve its members and the global electronics manufacturing community.

### Foundations of the Future: IPCEF's Scholarships, Awards and Student Opportunities

There is no better way to end 2022 than by recognizing the hardworking students and educators who are driven to invest their time and energy in the electronics manufacturing industry. Through the IPC Scholarship and Awards program, we can help students invest in their future and reward the accomplishments of those who have dedicated themselves to bettering themselves and the industry. IPC recently awarded a total of \$54,000 in scholarships and awards.

### Why Gold Layer Thickness in ENIG Matters for Soldering

The main task of the final finish is to protect the copper pad from tarnishing or oxidation while simultaneously keeping the surface active for the assembly. Electroless nickel/immersion gold (ENIG) is a widely accepted finish in the market that provides a good solderability and capability for AI-wire bonding. A main function of the gold layer is to prevent the oxidation of the nickel layer.

### Real Time with... IPC APEX EXPO 2023: Challenges of New Product Development

John Ekis, market segment director, Aerospace and Defense, Rogers Corporation, discusses the importance of close applications engineering relationships in understanding and responding to the requirements and challenges of specialist new product development.

### Punching Out: Here's the Deal About 2022

Last year turned out to be a fairly slow year for mergers and acquisitions (M&A) in the North American PCB and EMS sectors. We counted just seven completed or announced deals in the PCB sector last year, compared to 13 in 2021, nine in 2020, and eight in 2019. Firan Technology Group announced two of 2022's seven deals with a 2023 target for completion for both.

For the latest news and information, visit [PCB007.com](https://www.pcb007.com)

# Career Opportunities



## Find industry-experienced candidates at jobConnect007.

For just \$750, your 200-word, full-column ad will appear in the Career Opportunities section of all three of our monthly magazines, reaching circuit board designers, fabricators, assemblers, OEMs, suppliers and the academic community.

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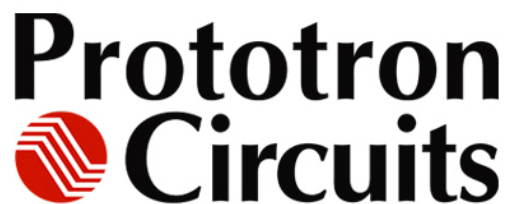
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# Career Opportunities



## Sales Representatives

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

### Reasons you should work with Prototron:

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

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

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**THERMAL SYSTEMS**

## Sales Engineer SMT North Mexico

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

### Responsibilities:

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

### Qualifications:

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

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

To learn more about Rehm Group please visit our website at [www.rehm-group.com](http://www.rehm-group.com).

Please send resumes to: Mr. Luis Garcia at  
[luis.garcia@rehm-group.com](mailto:luis.garcia@rehm-group.com).

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# Career Opportunities



## Sr. Test Engineer (STE-MD)

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.
- Some travel required. Positions are available in the Hunt Valley, Md., office.

Contact us today to learn about the rewarding careers we are offering. Please email resumes with a short message describing your relevant experience and any questions to [careers@ttci.com](mailto:careers@ttci.com). Please, no phone calls.

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## Europe Technical Sales Engineer

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

### PRIMARY FUNCTION:

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

### ESSENTIAL DUTIES:

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

### QUALIFICATIONS / SKILLS:

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

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

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# Career Opportunities



## IPC Instructor Longmont, CO

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

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

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

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

### Benefits:

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

**Schedule:** Monday thru Friday, 8–5

**Experience:** Electronics Manufacturing:  
5+ years (Required)

**License/Certification:** IPC Certification—  
Preferred, Not Required

**Willingness to travel:** 25% (Required)

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## Technical Sales Manager

### Objectives

Provide sales leadership and management for a regional sales territory. Responsible for retaining current customers as well as developing and attracting new customers and markets. Responsible for selling current and new products, keeping abreast of new technologies, market trends, and customer product needs.

### Essential Functions and Responsibilities

- Develop and service assigned geographic region
- Actively and consistently seek new customers
- Visit customers and potential customers to develop relationships, deliver sales presentations, follow up on leads, and close sales
- Provide technical support and product recommendations in person, by email, and phone
- Manage major accounts; establish long-term, ongoing relationships with key individuals
- Provide feedback to Chemcut as well as sales peers regarding competition, pricing, and marketing opportunities

### Qualifications

- Bachelor's degree in mechanical, electrical, chemical engineering or related fields
- 3-5 years of field sales experience with technology driven industrial products
- Well-developed sales and customer relations skills
- Ability to make decisions and evaluations to determine customer needs
- Ability to travel up to 50% of the time
- Excellent oral and written communication skills
- Knowledge of target market industries

To apply, please submit a cover letter and resume to [hr@chemcut.net](mailto:hr@chemcut.net).

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# Career Opportunities



## Test Engineer, Electronics Engineer

Keytronic is a dynamic, team-based contract manufacturer with facilities worldwide. Innovation defines us. Come join us in Spokane, Washington! We invite you to bring your engineering expertise and passion for excellence. In turn, we provide meaningful opportunities for you to implement these attributes to their fullest while working together to bring our customers high-tech automotive, aerospace, medical and commercial products to full production.

We encourage you to apply to one of our open positions below if you enjoy being challenged, working in a dynamic work setting and being a part of a team creating products to improve our world.

- **Test Engineer**—You will assist in conducting electrical test engineering support involving automation, assembly, maintenance, and data collection.
- **Electronics Engineer**—You will work on a team creating electronic circuitry, writing firmware for microprocessors and interfacing with customer development teams producing a wide array of products.

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## Regional Manager Midwest Region

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

### DETAILS OF FUNCTION:

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

### QUALIFICATIONS:

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

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

[fernando\\_rueda@kyzen.com](mailto:fernando_rueda@kyzen.com)

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# Career Opportunities



## Application Engineer

Flexible Circuit Technologies (FCT) is a global supplier providing design, prototyping and production of flexible circuits, rigid flex circuits, flexible heaters and full assembly services.

### Responsibilities

- Gain understanding for customer/specific project requirements
- Review customer files, analyze - application, design, stack up, materials, mechanical requirements; develop cost-effective design to meet requirements
- Quote and follow-up to secure business
- Work with CAD: finalize files, attain customer approval prior to build
- Track timeline/provide customers with updates
- Follow up on prototype, assist with design changes (if needed), and push forward to production
- Work as the lead technician/program manager or as part of FCT team working with an assigned application engineer
- Help customer understand FCT's assembly, testing, and box build services
- Understand manufacturing and build process for flexible and rigid-flex circuits

### Qualifications

- Demonstrated experience: flex circuit/rigid-flex design including design rules, IPC; flex heater design +
- Ability to work in fast-paced environment, broad range of projects, maintain sense of urgency
- Ability to work as a team player
- Excellent written and verbal communication skills
- Willing to travel for sales support and customer support activities if needed

Competitive salary, bonus program, and benefits package. Preferred location Minneapolis, MN area.

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## Technical Marketing Engineer

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

### Requirements:

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

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

Send Resumes to: [resumes@ema-eda.com](mailto:resumes@ema-eda.com)

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# Career Opportunities



MACHINES FOR PRINTED CIRCUIT BOARDS

## Field Service Engineer

**Location: West Coast, Midwest**

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

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

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

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

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

**Must be able to travel extensively.**

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**ventec**

INTERNATIONAL GROUP

騰輝電子

## European Product Manager Taiyo Inks, Germany

We are looking for a European product manager to serve as the primary point of contact for product technical sales activities specifically for Taiyo Inks in Europe.

### Duties include:

- Business development & sales growth in Europe
- Subject matter expert for Taiyo ink solutions
- Frequent travel to targeted strategic customers/ OEMs in Europe
- Technical support to customers to solve application issues
- Liaising with operational and supply chain teams to support customer service

### Skills and abilities required:

- Extensive sales, product management, product application experience
- European citizenship (or authorization to work in Europe/Germany)
- Fluency in English language (spoken & written)
- Good written & verbal communications skills
- Printed circuit board industry experience an advantage
- Ability to work well both independently and as part of a team
- Good user knowledge of common Microsoft Office programs
- Full driving license essential

### What's on offer:

- Salary & sales commission--competitive and commensurate with experience
- Pension and health insurance following satisfactory probation
- Company car or car allowance

This is a fantastic opportunity to become part of a successful brand and leading team with excellent benefits. Please forward your resume to [jobs@ventec-europe.com](mailto:jobs@ventec-europe.com).

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# Career Opportunities



## Technical Service & Applications Engineer Full-Time — Midwest (WI, IL, MI)

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

### Responsibilities

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

### Skills and Qualifications

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

### Benefits

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

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

- Engineering
- Quality
- Various Manufacturing

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

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

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

For additional information please visit our website at [www.arlonemd.com](http://www.arlonemd.com)

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# Career Opportunities

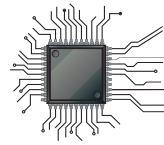


## Are You Our Next Superstar?!

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

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

[apply now](#)



**MivaTek**

**Global**

## Field Service Technician

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

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

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

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

### More About Us

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

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# Career Opportunities



## eptac

TRAIN. WORK SMARTER. SUCCEED.

### Become a Certified IPC Master Instructor

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

#### Qualifications and skills

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

#### Benefits

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

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American Standard Circuits

Creative Innovations In Flex, Digital & Microwave Circuits

### CAD/CAM Engineer

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

#### ESSENTIAL DUTIES AND RESPONSIBILITIES

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

#### ORGANIZATIONAL RELATIONSHIP

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

#### QUALIFICATIONS

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

#### PHYSICAL DEMANDS

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

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# Career Opportunities



**U.S. CIRCUIT**

## Plating Supervisor

Escondido, California-based PCB fabricator U.S. Circuit is now hiring for the position of plating supervisor. Candidate must have a minimum of five years' experience working in a wet process environment. Must have good communication skills, bilingual is a plus. Must have working knowledge of a plating lab and hands-on experience running an electrolytic plating line. Responsibilities include, but are not limited to, scheduling work, enforcing safety rules, scheduling/maintaining equipment and maintenance of records.

Competitive benefits package.

Pay will be commensurate with experience.

Email to:  
mfariba@uscircuit.com

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**APCT**  
Passion | Commitment | Trust

## APCT, Printed Circuit Board Solutions: Opportunities Await

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

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

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

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

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See you next year in Anaheim, California at IPC APEX EXPO 2024.

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

### *Designing for Reality* by Matt Stevenson, Sunstone Circuits

Based on the wisdom of 50 years of PCB manufacturing at Sunstone Circuits, this book is a must-have reference for designers seeking to understand the PCB manufacturing process as it relates to their design. Designing for manufacturability requires understanding the production process fundamentals and factors within the process that often lead to variations in manufacturability, reliability, and cost of the board. Speaking of making better decisions, [read it now!](#)



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

by Didier Mauve and Robert Art, Ventec International Group

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



### *High Performance Materials*

by Michael Gay, Isola

This book provides the reader with a clearer picture of what to know when selecting which material is most desirable for their upcoming products and a solid base for making material selection decisions. [Get your copy now!](#)



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

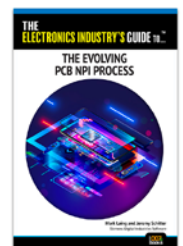
by Bill Hargin, Z-zero

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

### *THE ELECTRONICS INDUSTRY'S GUIDE TO... The Evolving PCB NPI Process*

by Mark Laing and Jeremy Schitter, Siemens Digital Industries Software

The authors of this book take a look at how market changes in the past 15 years, coupled with the current slowdown of production and delivery of materials and components, has affected the process for new product introduction (NPI) in the global marketplace. As a result, companies may need to adapt and take a new direction to navigate and thrive in an uncertain and rapidly evolving future. Learn how to streamline the NPI process and better manage the supply chain. [Get it Now!](#)



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COVER IMAGE: **ADOBE STOCK © PICTURE OFFICE**

# PCB007

M A G A Z I N E

PCB007 MAGAZINE®

is published by IPC Publishing Group, Inc.  
3000 Lakeside Dr., Suite 105N, Bannockburn, IL 60015

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February 2023, Volume 13, Number 2  
PCB007 MAGAZINE is published monthly  
by IPC Publishing Group., Inc., dba I-Connect007

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