

FEBRUARY 2018

I-Connect007

# PCB007

M A G A Z I N E



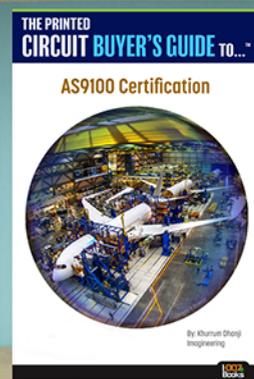
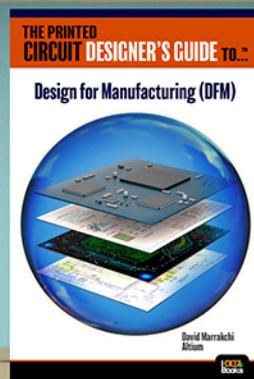
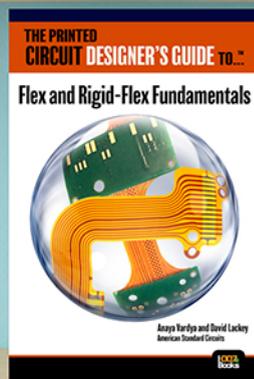
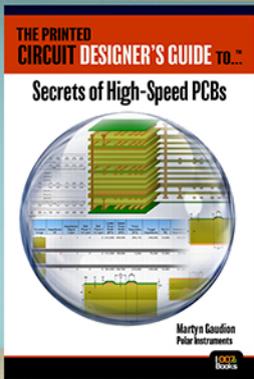
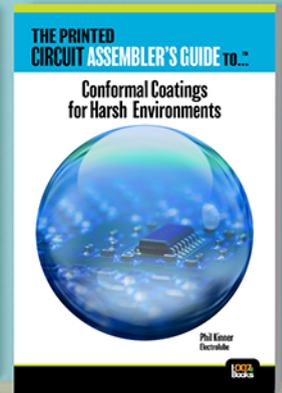
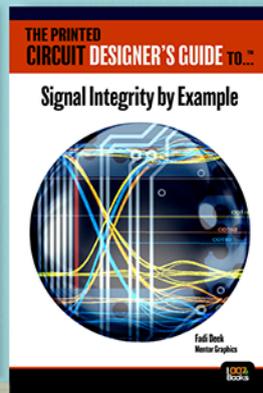
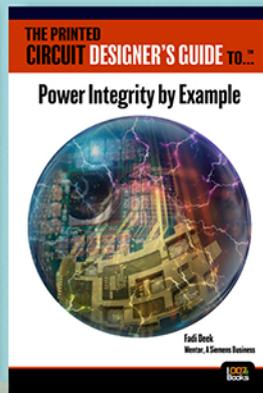
**WHO**  
is **YOUR**  
**CUSTOMER?**

Download free eBooks



I-007eBooks.com

# Download free micro eBooks from our library.



Written by industry experts, each book contains valuable information on relevant topics in an easy-to-read format.

Log in or register to access all of our premium content at: [myconnect007.com](http://myconnect007.com)



“ This concise, yet very thorough eBook is destined to become every RF and microwave engineer's PCB fabrication bible. ”



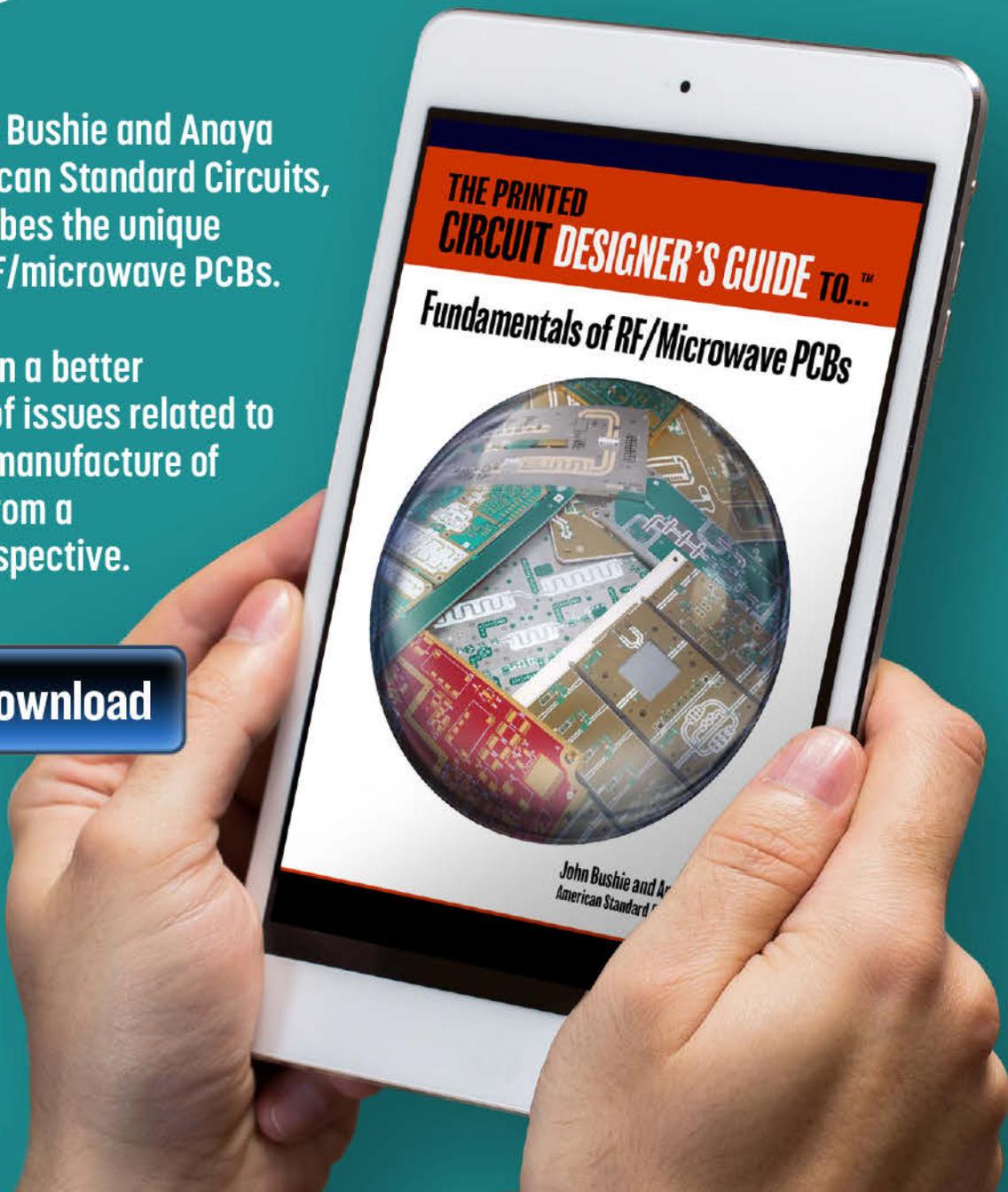
**Judy Warner**

Director of community engagement, Altium

Written by John Bushie and Anaya Vardya of American Standard Circuits, this book describes the unique challenges of RF/microwave PCBs.

Readers will gain a better understanding of issues related to the design and manufacture of these devices from a fabricator's perspective.

 **Free Download**



# PCB007

M A G A Z I N E



12

## Who is Your Customer?

Who is your customer? Isn't it more than that person who buys something from you or your company? After all, aren't the tables turned when you request something from that "customer"? Aren't you then the customer? Find out what our experts think this month. The answers may surprise you!



38

### 12 Defining Customer-Supplier Relationships and Customer Satisfaction

Interview with Steve Williams

### 18 Communications: Bridging the Customer-Supplier Gap

Interview with Nolan Johnson & Dan Beaulieu

### 38 Understanding Your Customers

by Steve Williams

### 44 One Great Customer Service Story

by Dan Beaulieu

### 60 Catching up with Dan Thau of Millennium Circuits Limited

by Dan Beaulieu



48

#### FEATURE COLUMNS:

### 34 Invited Guests to the Party

by Tara Dunn

### 48 Who is Your Customer?

by Dan Feinberg

### 54 Who is the Customer?

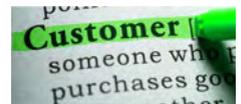
by Dan Beaulieu

### 58 Defining Your Customer

by Sam Sangani



60



Tachyon® 100G laminate materials have superior fill and flow compared to competitive products that require very high pressure (500psi) with proven sequential lamination and HDI structure performance.

1000-HOUR  
**PASSED**  
CAF

# Tachyon® 100G

Ultra-Low Loss Laminate & Prepreg

Tg: 200°C Td: 380°C

Ultra-low loss material with  
Dk: 3.02 and Df: 0.0021

Stable Dk over temperature range: -55 to 125°C  
and up to 100 GHz

Scalable solution for next generation designs of  
backplanes and daughter cards, enabling 10x  
improvements from 10 Gb/s data rates

1000-Hours CAF Tested

Low moisture absorption

0.8 mm pitch capable

6x 260°C reflow capable

6x 288°C solder float capable

RoHS Compliant

Multiple lamination cycles

HDI technology compatible

Tachyon® 100G  
**HIGH SPEED  
DIGITAL**

Designed for Very High Speed  
Digital Applications (>100 Gb/s)

© 2017 ISOLA GROUP. ALL RIGHTS RESERVED.

**AEROSPACE & DEFENSE • COMPUTING • STORAGE • NETWORKS • COMMUNICATIONS**

# isola

FOR MORE INFORMATION, CONTACT YOUR LOCAL SALES REPRESENTATIVE.

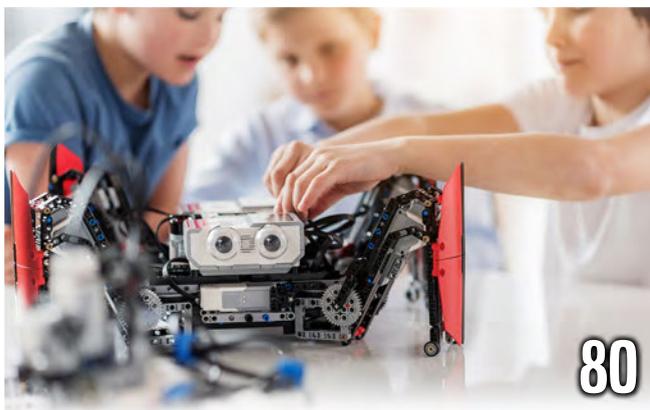
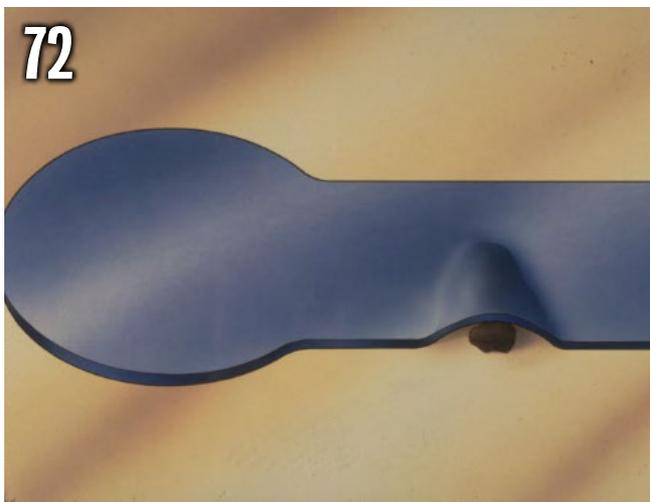
**Isola Group**  
3100 West Ray Road  
Suite 301  
Chandler, AZ 85226  
Phone: 480-893-6527  
[info@isola-group.com](mailto:info@isola-group.com)

**Isola Asia Pacific (Hong Kong) Ltd.**  
Unit 3512 - 3522, 35/F  
No. 1 Hung To Road, Kwun Tong,  
Kowloon, Hong Kong  
Phone: 852-2418-1318  
[info.hkg@isola-group.com](mailto:info.hkg@isola-group.com)

**Isola GmbH**  
Isola Strasse 2  
D-52348 Düren, Germany  
Phone: 49-2421-8080  
[info-dur@isola-group.com](mailto:info-dur@isola-group.com)  
Website: [isola-group.com](http://isola-group.com)

# PCB007

M A G A Z I N E



- SHORTS:**
- 42** Flexible, Water-Repellent Graphene Circuits for Washable Electronics
  - 50** Shape-shifting Organic Crystals Use Memory to Improve Plastic Electronics
  - 84** DARPA's Hallmark Seeks to Revolutionize U.S. Space Enterprise Command and Control

- BOOK RECOMMENDATION:**
- 78** Questions That Sell: The Powerful Process for Discovering What Your Customer Really Wants  
by Dan Beaulieu

**COLUMNS:**

- 8** Everyone is a Customer; Everyone is a Supplier  
by Patty Goldman



- 68** IPC 6012-DA Revisions: The Approach to Cleanliness, Thickness, Inspection, and Wicking  
by Jan Pedersen

- 72** Surface Preparation and Cleaning, Part 1  
by Michael Carano

- 80** Skilled Talent: Can We Meet Rising Demand?  
by John Mitchell

**HIGHLIGHTS:**

- 32** Supply Line
- 52** Markets
- 66** MilAero
- 86** Top 10 from PCB007



**DEPARTMENTS:**

- 90** Career Opportunities
- 100** Events Calendar
- 101** Advertiser Index & Masthead



# CIMS "All in One" AOI

- Multiple capabilities packed in one system



CIMS USA

[WWW.CIMS.COM](http://WWW.CIMS.COM)

Please join us at 2018 IPC show! (No.701 booth)



"We have chosen CIMS AOI equipment for its excellent performance and configuration flexibility. Using CIMS metrology solutions, which are integrated with AOI systems, has become the essential part of Whelen Engineering's fully automated PCB production process."

Alex Stepinski

Vice President at Whelen Engineering/Greensource Fabrication

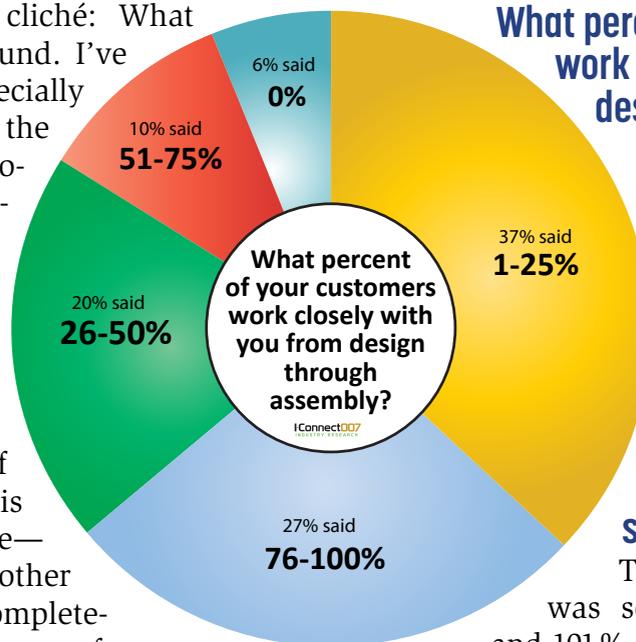
# Everyone is a Customer; Everyone is a Supplier

**Patty's Perspective**  
by Patty Goldman, I-CONNECT007

We've all heard the cliché: What goes around, comes around. I've always felt that was especially true in our industry, with the frequent job changes people make—much accelerated in recent years but always a factor, since I can remember. In my own small sphere, a co-worker at one company I worked for later became a customer of another of my employers, and this happened more than once—to different people. Another time, the tables were completely turned when a customer of my company became my supplier at another. So don't burn your bridges! You never know when this will happen to you!

Which brings me to our topic this month: Who's your customer? If you really think about it, it is more than that person who buys something from you or your company. Aren't the tables turned when you request drawings from that "customer?" Aren't you then the customer? We can also talk about internal customers—that person or department in the company who we supply parts or information to. It's easy to see how it circles around so that we are all customers (and suppliers) of each other. OK, now we're all confused, or clear, whichever the case may be.

In this month's survey on the topic of who is the customer, the answers were not surprising. Here's a sampling of those questions, and responses:



## What percentage of customers work closely with you from design to assembly?

A disappointing 37% said less than a quarter of their customers while just 27% claimed over 75% of their customers worked closely with them. We hear about "lack of communication" often.

## What is your customer satisfaction goal?

The most common answer was somewhere between 98% and 101%.

## What are the most important attributes of customer service?

It ran the gamut from price, quality and fast response to customer service, customer satisfaction and frequent communication. A few people also answered, "being proactive to meet customer needs."



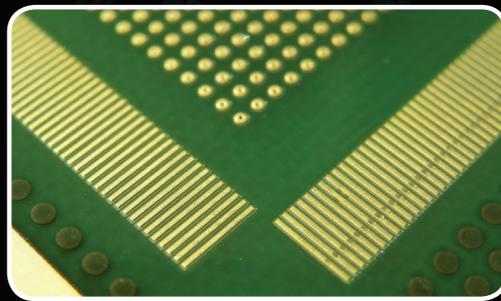
ENTER THE JET AGE

INKJET

BY TAIYO

INKJET SOLDER MASK

IJSR-4000 JM01



SEE YOU AT THE  
IPC APEX EXPO 2018

BOOTH #331, SAN DIEGO CONVENTION CENTER

MEETINGS & COURSES:

**FEBRUARY 24 - MARCH 1**

CONFERENCE & EXHIBITION:

**FEBRUARY 27 - MARCH 1**



Phone [775] 885-9959 • [www.taiyo-america.com](http://www.taiyo-america.com) • [info@taiyo-america.com](mailto:info@taiyo-america.com)

in

## What is the cost of not meeting a customer's needs?

Predictably, the most common answer was lost customer or lost business (although some one did answer "I don't know").

Perhaps the most important questions we asked had to do with feedback:

## What type of feedback do you like?

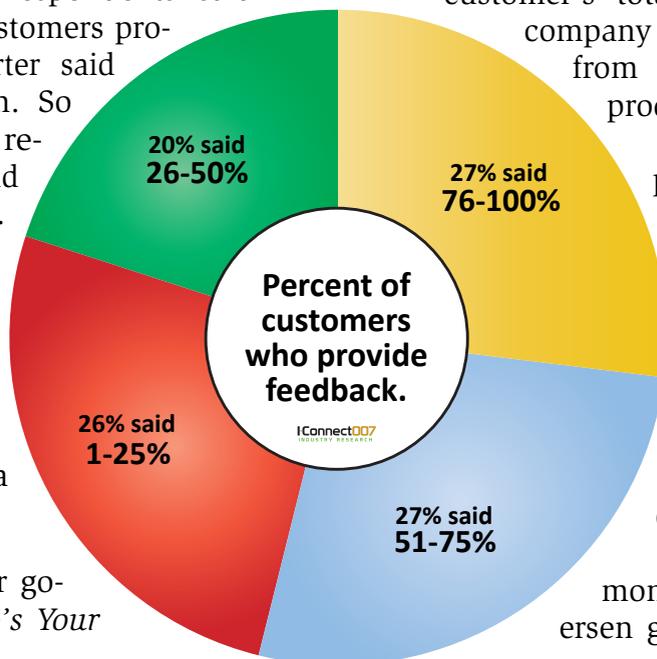
Responses ranged from "thank you," to testimonials, to learning customers' roadmaps, to getting repeat business. One person answered, "Successful first builds are the most rewarding."



## How many of your customers provide feedback?

This resulted in an even distribution, meaning a quarter of our respondents said 25% or less of their customers provided it, another quarter said 25–50%, and so forth. So just about 25% of the respondents could be said to get a lot of feedback. Many said that good feedback or good ratings were most important, but if you think about it, what you really want is the bad, otherwise you won't feel a need to improve.

So let's see what our go-to experts say on *Who's Your*



*Customer?* We talked with Dan Beaulieu and Sunstone's Nolan Johnson along with The Right Approach's Steve Williams (in a separate discussion) to get their thoughts on this question that is right up their alley. Not surprisingly, Dan and Nolan were totally focused on the external customer while Steve Williams considered the internal customer. Read more in our first two feature articles this month.

But Steve and Dan were just getting started. Steve came back with a short article on understanding your customer by expanding on the new ISO requirement of defining interested parties. Dan wrote his own column on "getting to know your customer" and also contributed a separate story on great customer service. Go Dan!

Several other columnists also found this topic intriguing. Omni PCB's Tara Dunn used the metaphor of customers as guests invited to a party, and then went on to explain how this considerably changes one's thinking as to who your customers really are (or perhaps who you want as customers).

Dan Feinberg (Fein-Line Associates) was inspired to jot down his thoughts on the topic. He looked at the question from the perspective of a person's career goals, illustrating with his personal experiences. PNC's Sam Sangani answered our topic question by pointing out that one sells much more than a product; the customer's total experience with your company is what sets you apart from the many others with a product to sell.

To further illustrate that point, we have an interview by Dan Beaulieu with Millennium Circuits' Dan Thau. The emphasis is all on customer service and consultative selling—being everything you can possibly be to your customer.

In other content this month, Elmatica's Jan Pedersen gives us a column on the



revisions underway to IPC 6012-DA, the Automotive Addendum. He discusses the four challenges the task group is currently facing, areas that need improvement. If you are in any way involved in automotive electronics then you probably need to be involved in this task group—which will be meeting at the upcoming IPC APEX EXPO.

Regular columnist Mike Carano of RBP Chemical Technology takes on basic surface preparation and cleaning. You must know the basics before moving on to high density and advanced circuitry.

Because this is a subject so near and dear to his heart, Dan Beaulieu has contributed a book recommendation that he felt was apropos to this month's topic of customers, customer service and getting to know your customer. The book he chose is one filled with practical advice for anyone at a customer-focused company. Check it out.

IPC's John Mitchell rounds out the issue with a discussion on skilled talent—yet

another piece of the puzzle for a company to fit in. John builds a case for the need for skilled workers, something most companies are coming to grips with as the economy expands. The frustration is that there are plenty of people but actual, qualified workers, from production through professionals, are in short supply. John tells us what steps our industry association is taking to address this problem.

And we are into February; IPC APEX EXPO is at the end of the month. If you are going—as I urge you to, to participate in standards activities and general networking—please do stop by our booth and say hello. You all are our customers, so give us some feedback! Hope to see you there! **PCB007**



**Patricia Goldman** is managing editor of *PCB007 Magazine*. To contact Goldman, [click here](#).



## Defining Customer-Supplier Relationships and Customer Satisfaction

### Feature Interview by the I-Connect007 Team

Steve Williams, president of The Right Approach Consulting LLC, and a veteran executive in the PCB and EMS industries, speaks with the I-Connect007 team about customer-supplier relationships, and how you can ensure customer satisfaction.

**Stephen Las Marias:** From your many years of industry experience, what are some of the challenges that you have seen when it comes to dealing with customers?

**Steve Williams:** Every company looks at their customers and they rank them, whether they use A, B, C, or the top 10 customers, whatever it is. They rank their customers based on revenue, ease of doing business, a whole bunch of attributes, and they do scale their service levels around where that customer falls in that ranking. The customers don't know about that. So, a lot of the challenge is keeping those customers satisfied, but still staying within the constraints of your organization and their expectations of how much time and effort you put into

the lower tier customers, if you will.

A lot of times, everybody says, "Well, the customer's always right," which we know is not true, but sometimes you make business decisions on whether you're going to keep this long-term customer happy as opposed to doing what's right for your organization. So, balancing that customer satisfaction versus what's in the best interest of the company, especially when you're talking about problems, quality issues, or product that may be suspect. If you're just watching out for your company, you think, "Well, the product is actually within specification." But knowing that this is an A customer or a top tier customer, you may treat that situation differently with those customers than you would a C level customer. Balancing that customer satisfaction versus keeping your business profitable is probably one of the biggest challenges.

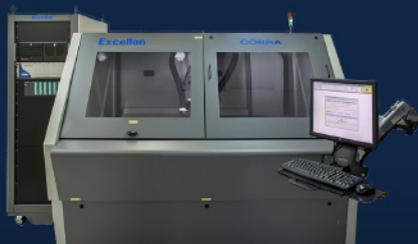
**Barry Matties:** I think this analogy also applies to internal customers as well. Does the guy in the drill room realize he's a customer and is he going to the supplier proactively? And if they're not nice people in the drill room, the

**APEX  
EXPO**  
IPC 2018

Visit us at Booth 519

# Excellon

*Manufacturers of precision Micro-Machining  
Solutions for over 50 Years*



## COBRA II

*Hybrid laser system*



## 689

*6-station precision drilling  
and routing system*



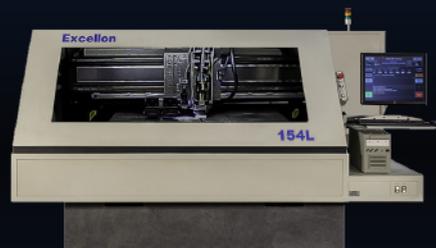
## HS-1L DS

*Single-station, dual spindle  
high-speed system*



## 136L

*High accuracy and speed*



## 154L

*Large panel applications*



## HS-2L

*2-station, high-speed*



## 129

*Single-station precision system*

**Move into the future with the latest innovations  
in Fabrication Technology from the Industry Leader!**

[www.excellon.com](http://www.excellon.com)

guy sliding the panels may not be as customer-centric as he could be or should be.

**Williams:** I think there's an aspect to that, in that scenario of the drill room. They're drilling panels and they're feeding the plating department. They've only got one customer. They have one internal customer that's going to get their product when they're done, but the dynamics between those two departments certainly influences that cooperation. That customer-supplier relationship is the same, whether you're talking about internal departments, raw material suppliers to your organization or between you and your external customer. I think the rules of engagement are the same with all those levels throughout the supply chain.

**Andy Shaughnessy:** How far would you go to please a customer?

**Williams:** It's interesting. I had that conversation recently with one of my PCB clients. They were talking about all this business they inherited and picked up when one of their competitors went out of business recently. The owner said, "You know, I guess we kind of know why they went out of business now." All these customers have low-level products, low technology, low quantities, but they're probably some of the most demanding customers of their entire customer base. The top customer, from a revenue standpoint, I mean they can be as nasty as they want to be and you're still going to treat them and bend over backwards to satisfy them. It all depends on how good of a fit they are for your organization, and what those rules are going to be in dealing with that customer.

And it all comes down to money, right? Right now, though we're coming off some decline in the industry, people were filling up their shops with whatever work they could find. Now that they're starting to get busier, a lot of the people I've talked to are starting to purge some

of those customers that they needed last year just to keep their head above water. And now that they've got some more preferred customers, they're no longer a good fit. So, I think that all kind of goes under the same bucket.

**Matties:** Being able to know how to define your customer, I think, is critically important.

**Williams:** Yes, that's a good point. Again, for the most part, a lot of companies know what a good fit is, but sometimes they're forced into taking business that they wouldn't otherwise take.



Steve Williams, The Right Approach Consulting LLC

**Matties:** What is your advice to our readers when it comes to customer service?

**Williams:** To me, if I'm reading something like we're talking about now, the takeaway I'd be looking for is how I will provide that service level that my customers are demanding. What's important to them? It's all about understanding what the customer's needs are and analyzing if we are currently

providing that or not—and how do we adjust if we're not? Whether that's an internal department hand-off, dealing with your supplier or your customer, it's understanding what they expect out of you as a supplier or a customer, and if you are giving it to them.

When I talk about customer service, I always use the automotive example. We've all gone into a dealership to have some work done, right? And you go to pick your vehicle up, and they tell you, "Hey, someone's going to call you in a day or so and ask you to take a quick on-the-phone survey." Then they tell you that, "You know what? It's going to look really bad for me if you don't give me a 10 all the way across the board." That kind of information makes you question all the customer service awards that the dealership has hanging in their lobby, because you know that they're influencing how customers are reacting. And they do

# Don't Let Your Temperatures Rise



## Let ROGERS' Thermal Management Solutions *Keep You Cool*

**COOLSPAN® TECA Film • 92ML™ StaCool™ Laminates • ML Series™ Laminates & Prepregs**

Heat can be damaging, especially when it is not managed. That's why Rogers Corporation invested so much time and energy into creating an array of material-based thermal management solutions to keep heat rise to a minimum in printed circuits. From automotive circuits to LED modules to power supplies, ML Series laminates and prepregs effectively conduct heat away from the source, while COOLSPAN thermally & electrically conductive adhesive (TECA) materials enhance the thermal management of new and existing designs. And for that extra cooling edge, 92ML StaCool laminates feature a thermally conductive metal bottom plate to enhance the heat dissipation.



Product	Thickness	Thermal Conductivity (Z-Axis), W/mK	Thermal Impedance, C-cm2/W	Tg, C	CTE (Z-Axis), ppm/C		Dk, 1MHz	Df, 1MHz	Breakdown Voltage, kVAC	Flammability
					<Tg	>Tg				
92ML	8mils	2.0	0.52	160	22	175	5.2	0.013	>50	HF V-0



Advanced Connectivity Solutions

[www.rogerscorp.com/acs](http://www.rogerscorp.com/acs)

USA - AZ, tel. +1 480-961-1382

EUROPE - BELGIUM, tel. +32 9 235 3611

**Don't let your temperatures rise. Use Rogers' thermal management solutions.**

that so they can announce that they've got the highest customer satisfaction ratings compared to their competitors, but it's not really information that's going to help the company get better. And that's what people want to know. How do you figure out what your customers really want from you in a meaningful way? That's what I think is missing from a lot of the customer analysis that we do. People tell you what you want to hear, or it's skewed by a recent experience and that's not always helpful to the business.

**Matties:** How much resource do you allocate to a customer? Is 10% of what a customer spends goes back to servicing that customer? What sorts of rules of thumb are out there?

**Williams:** I don't know if they allocate a particular level of service that way. You've got certain customers that it doesn't matter what they're asking for, or what they're expecting from you. The customer calls, you drop everything, and it doesn't matter how many other customers you've got waiting on you. That customer gets top priority no matter what the situation. It

---

## That customer gets top priority no matter what the situation.

---

kind of filters down from there. There's always a bandwidth issue, and customer service is very segmented into who's most important and who's less important. A lot of times, if they're a big enough customer, they get their own person full-time. It all depends on how you're structured. To answer your question, I think 20% of spending is a solid number, where that's one of the top 10 customers for anybody. If they're 15 to 20% of your revenue, they are at the top tier. And then, now you've got to remember, the customer is going to be reading this too, it's not just us manufacturers that are going to be reading it. The people that we're trying to satisfy are going to be reading this, so you've got to be sensitive to that as well.

**Shaughnessy:** What do you think are some of the best methods for measuring customer satisfaction? We asked the board shops, and they said they don't worry about any customers unless they do one job and never come back. And then they call, "Hey! Why didn't you come back?" So, what do you think is the best or some of the better methods to measure customer satisfaction?

**Williams:** Well, right now, it's a bit unique for me as a consultant. If I get a referral from a customer to another client, that's a huge customer satisfaction bonus for me. A simple "Job well done" or "Our business is better, we're glad we hired you." Those kinds of things. It's a little different from a manufacturing customer, where they are constantly judged on product quality and response and service. In a past life, obviously, you're right. Customers, for the most part, don't put a lot of time and effort into demonstrating their satisfaction for the supplier unless it's bad. They don't go out of their way to call you and say, "Hey, great job," and "Keep up the good work." They'll call you in a heartbeat if you make a mistake. You know, I guess that's a good point in itself. One of the biggest problems in our industry is getting feedback from customers on how we're doing.

**Matties:** If they come back and order a second, third, fourth time, that is demonstrating a level of satisfaction.

**Williams:** Absolutely. A couple of my clients, we talk about that, and they say 'You know, if I don't hear from a customer, that's good news. If I don't hear from a customer, and they just keep placing orders then everything's great, I have no concerns, and it is business as usual.'

**Las Marias:** Alright! Thank you very much, Steve, for your insights.

**Williams:** Thank you! PCB007

# How important are your connections?



**Plasma to improve reliability –  
no bad connections!**

- > **Desmear**
- > **Etchback**
- > **Panel Cleaning**

#### **Plasma treatment in PCB Manufacturing:**

- Removing resin smear
- Removing carbon byproducts from blind vias
- Efficient, economical and environmentally benign

**Contact us now to learn more.**

+1-800-326-1151  
+1-925-827-1240  
info@nordsonmarch.com

**nordsonmarch.com**



**VIA™ Series  
Plasma System**

**Nordson**  
MARCH



**Feature Article by Andy Shaughnessy,  
Patty Goldman, and Stephen Las Marias,  
I-CONNECT007**

For the upcoming issue of our I-Connect007 magazines, we interviewed Nolan Johnson of Sunstone Circuits, and Dan Beaulieu of DB Management—our regular columnist—on the topics of knowing your customers, the challenges in dealing with customers, and providing excellent customer satisfaction.

Johnson has been with Sunstone for about 12 years now. His background is in computer science and then in capital equipment and display technologies, as well as PCB manufacturing. Currently, he is a project marketing manager at Sunstone. He's also on special assignment to their in-house sales team and doing some special projects around for that.

Beaulieu, meanwhile, has been in the consulting business for 20 years now. He works with PCB companies and contract manufacturers, helping them with their strategies, and sales and marketing, primarily for growth.

**Patty Goldman:** One of the things we hear in our ongoing expert meetings is that there is

not enough communication between the different parts of the supply chain—the supplier and customer. There is a lack of communication; working together is not what it should be.

**Beaulieu:** It's very interesting because what's going on lately is that even my customer's customers are starting to come to me. I've had a few calls where a long-time buyer at Draper Labs, which is one of the highest technology buyers in the country, told me he has such a problem with board shops. And I told him it's because he doesn't communicate with them as well as he should. Going back to the old days when our customers, the Martin-Mariettas and the Raytheons, used to literally move into a board shop and work side-by-side with us on products that "no one" could build. And that's kind of gone by the wayside as we get into the no-touch stuff, which I picture as a kind of counter communication, if you will. And it's not the fault of the people that offer the no-touch service, it's kind of the fault of the corporations.

This is the way I envision it: it's almost like down in the basement of one of the large companies are designers and engineers who don't want to go upstairs to the traditional



# Integrate QA Solution

**Because everyone's QA needs are just a little bit different.**

Integrate is a fully customized solution, and no two contracts are exactly the same. No matter what size customer you are, we can tailor AOI, testing, final inspection, or a combination of all three services to fit you. And you only pay for the product that actually passes quality assurance, not on panels produced or tested.

Find out if our Integrate solution is right for you!  
[www.gardien.com/why-integrate](http://www.gardien.com/why-integrate)

**APEX  
EXPO<sup>®</sup>  
IPC 2018**

Visit us at  
**Booth 241**



GLOBAL FOOTPRINT  
WITH A LOCAL PRESENCE



30 YEARS OF PCB  
INDUSTRY EXPERIENCE

buying channels and go through all the bureaucracy of buying boards. So, they simply whip out their credit cards and buy boards online or use design services online. And there's nothing wrong with that. But what happens is as that board is elevated and goes upstairs to the traditional buying systems, the people who end up building the boards, the more traditional board shops, have not gone through the development phase with the customer. That's where the communication breaks down. That's an aspect I'm working on a lot right now. When you start dealing with companies that are literally building products that the world has never seen, including circuit boards with technology that the world has never seen, it's time that somebody talks to somebody.



Nolan Johnson, Sunstone Circuits

**Johnson:** Well, this gets to be kind of fun because I do live and breathe in the area that Dan is calling the no-touch. We tended to find that this area is where the prototypers are doing their work, and Dan touches on something that's particularly important. If you're a prototyper, you're looking for a shop that can get you your prototype in a couple of days, quickly, in small quantities, and can be nimble and make changes alongside you to keep your design team moving forward until you get your prototype ready to go and to optimize it for production. Then once you've optimized it for production, maybe you've taken it from a 4-layer prototype down to a 2-layer prototype where you changed the dimensions or cleaned up the DFM warnings and you are ready to go into production and get some good deals out of your overseas production shop or your major production shop in the U.S.

Once you're there, it does change and there's information that we have established as the prototype partner that needs to be transferred over to the production shop to keep everything flowing properly. That's something that we see with our customers on a regular basis. We see

it from the other way. We start handing things off, moving things over, trying to help the customers get their designs moved over into production and have things fall down on their face for the first couple of runs while they're getting up and going. So Dan's point is exactly right. How do we get that key step from helping with the prototype, all that knowledge we've built

up because we're spinning that board with the customer and then getting it over into production where it can stay put and be stable with high yield and high profit for a long time for this customer? That's a key thought.

We've been working to develop some relationships with some production houses in order to be able to create a communication channel to do that. It's interesting from our

perspective that it's difficult to get the attention of the production houses to do that. We're in a place where we're working with a lot of prototypers on a lot of different levels. Everything from the breakers that Dan mentioned, and down to university teams, individual entrepreneurs, and hobbyists and makers. Many of these projects are turning into production products at some level, maybe small, maybe huge, but that transfer over into production is an area where we're struggling to get that information passed over consistently and heard. I think there's some room for some protocols around that.

**Stephen Las Marias:** How is it in the contract manufacturer or EMS space, Dan?

**Beaulieu:** There is more conversation there by far. But for the most part, it's a longer quote cycle with parts and putting the package together, and there is much more conversation going on there. You just have to be closer. I work with one right now, for example, where I watch the project managers go back and forth for literally two or three days with the customer. Especially as you've got the quote cycle, which needs the

customer to be at the table; and once wherever it will be placed, then a great deal more conversation takes place.

Two things are key on a contract manufacturing level. They actually measure their sales people on the number of NDAs they bring in to get signed—that's number one. And then number two is plant tours. Plant tours to contract manufacturers are far more important. They're important to board shops, but they're far more important to contract manufacturers—because on the board side, you're literally building one part of a product, whereas the contract manufacturer is going to build the entire product. So, it is a much closer relationship. Several of my friends own quick-turn CM shops and I know they do a great job. They do things faster. They're much more streamlined but there are things like understood parts—part substitutions that are understood—because of speed. It's like they'll settle, they'll build the first pieces, but they don't always stay there. After the prototype is done, they might go to a part that's harder to get, that has a longer lead time but is a better part for it; but they wanted to see that the first builds work. But I find there's less of this breakdown in communications, if that's the shorter answer.

**Goldman:** What we're all hearing here is that regardless of who your customer is—and customer can be defined rather broadly, internal, external down the stream a bit—but the big thing is communication. Would that be true?

**Beaulieu:** Absolutely. And also, in what Nolan was talking about, I understand the need for that type of enclosed no-touch business. I've talked to one of the presidents of our country's largest no-touch and he told me that a lot of his business comes, believe it or not, on Christmas Eve, and on Christmas Day. Because that's what a lot of designers do. Not at the higher level, but at the NPI and hobbyist level; they really do not want to communicate, you know? I worked with one company—that we all know as a traditional company—that's got a call center and also has no-touch. I was running its

sales force. I asked why my sales guys couldn't have the list of the no-touch customers. And the boss said, "Are you kidding? Those people would go berserk if somebody called them up. They don't want to be called up." It was very interesting.

I managed designers for years and I know the sales guy that I am. One of my friends advised me to tone it down when talking to designers because they're just a much more methodical group who doesn't want some back-slapping sales guy talking to them.

**Johnson:** I think you're right Dan. We have plenty of customers who just don't even want to be contacted, and then we have other customers who are perfectly willing to start having that conversation. For me, what I'm discovering is that if they're thinking production, they're more likely to want to talk to us and keep the information flowing. There's a reason that Sunstone also keeps a 24/7/365 customer support line going. We have our custom-

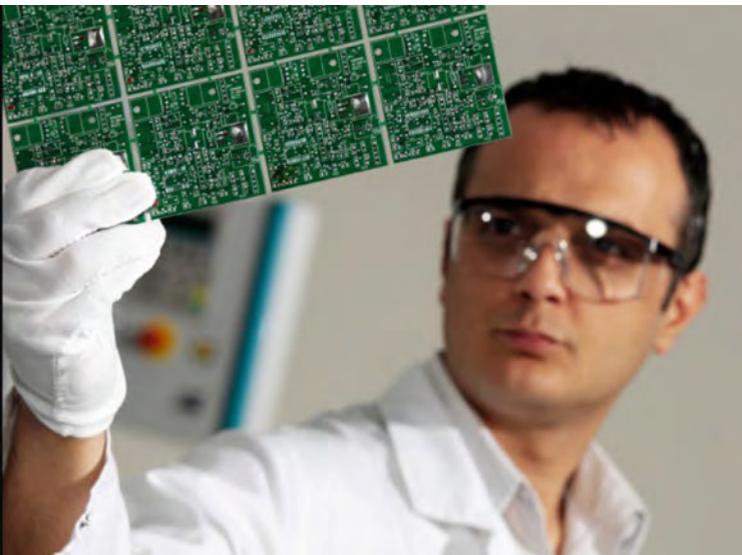
---

## There's a reason that Sunstone also keeps a 24/7/365 customer support line going.

---

ers who are placing orders on holidays. You know, introvert type designers hiding out from their family on Thanksgiving; while the turkey is being cooked, they are making their design order. We see this all the time, which is a key part of how this business operates. But it's interesting, what I was hearing from this whole communications bit, the further downstream you are, closer to production, the more likely communication is to happen.

We're in a unique spot. We're at the very front of that whole manufacturing chain where there are a lot of things being sorted out. We do learn a lot of things, but the next step down doesn't necessarily mean that everybody's ready to hear from upstream. I think that's the point I'm trying to make there. The



further downstream you get, the more likely the communication is to settle in. We're living up in the spot where the BOM is changing, where the design is changing. There is a lot of flux going on, as you settle it out. And maybe there's too much noise there. But at the point that we're finished and handing it down, there should be enough signals to make it useful to the next step.

**Beaulieu:** Yes, I think you're right. The other extreme I see is this: a more traditional PCB prototype company that has a barrel full of testimonials from customers who praise them for calling them up and saying this is wrong and things like that. By the same token, they have an equal barrel full of customers who are furious, who say "just shut up and build a board, quit bothering me." The same group of salespeople went to one of the major fabricators located in New Mexico, and they had a group of designers there that said when they were trained, they were told never listen to the board shops, they don't know what they're doing, designers are what you want. This PCB company ended up doing a lunch and learn. Another PCB company I work with also ended up doing a lunch and learn, and they were very, very well-received. They both came up with rooms full of people anxious to understand what goes on in a circuit board shop. And don't forget, most of us around this table grew up when people visited circuit board

shops. But times have changed. When I managed designers for ASI, I had 30 designers. ASI had a board shop, and just three of them had ever been in that board shop. They were all 20-year people. That's the kind of communication that I'm really struggling to make happen—going to a PCB shop and understanding how a board is made. It's not a plastic card, you know?

**Johnson:** We have plenty of customers who are angry at us because we're calling them back to ask and not just making the part, and then we have other customers who are trying to figure out why we aren't talking to them more often. That's never going to go away for us. It's always about how to walk that line. And you're right, Dan. I have a customer that I've been working with here for the past year or so. Sunstone's done a case study on them; the company is Eagle Harbor Technologies, out of Seattle. When I first started talking with them, they were giving us designs that were effectively unmanufacturable, and I was digging into them about why. It took talking to the customer. What I learned from them was that they're a startup. They're a team of physicists. None of them are EEs. They're all high-end physicists and they're building very fast switching, high voltage power supplies. This is some really cutting-edge stuff that they're doing, and the boards that they're turning in look like they should be automated test equipment probe cards. They're circular, nothing's on an angle. They're all over the place as far as that goes, and the DFM rules are really stressed when you're checking on them to see if they're manufacturable.

And yet we talked it through. Helped them understand exactly what the chemistry is going on inside the facility. Got them so that they had a real-world vision of what's happening once they finish their design. It helped change their perspective. It's not just, "Well, if I can define it in the CAD tool, it's got to be manufacturable, right? The tolerances and precision on everything is perfectly infinite." No, it's not. And as they understood that more, they started changing their designs. As they changed their



**ELECTRA**

**High Performance Coatings  
for the Electronics Industry**

# **Soldermask for the Digital Era**

- **Electraj<sup>®</sup> InkJet**
- **EMP110 Direct Image Exposure**

**Visit us at IPC APEX - Booth 410**

**[www.electrapolymers.com](http://www.electrapolymers.com)**

designs, we were able to get them working prototypes with fewer turns and they were quicker to market. So, that part of the communication and education to our customers is huge. It is amazing how few designers even understand what's going on once they send an ODB++ file over to the manufacturer.

**Beaulieu:** I think there's a need for it, without a doubt. Based on the columns I did recently about customers. My friend Bob St. Pierre, who's a long-time buyer and now a consultant at Draper Labs, has agreed to work with me and put together some give-and-take columns on it because he was one of those people saying that.

So, in the spirit of getting at least the high-tech customers together with board shops, we're going to start conversations that hopefully you guys will publish and take it from there. Maybe even do a traveling road show with it. Because I think it's needed. Especially with the high-end guys like Lincoln Labs, and Draper, the guys who are committed to having to be in the United States, by the way. They can't go offshore with the stuff they build. So there's a desire there for us to get this solved and to get the vendor and the customer closer together.

**Andy Shaughnessy:** What are some of the lengths you guys would go to for a customer?

**Beaulieu:** I can talk to that on a personal basis. I'm just open day and night. That's my business. I had a family Christmas party and I was on the phone with two customers for an hour upstairs in my sister's house. That's just that personal advisor, trusted advisor part of my business. I worked with this supplier for a long time, I still do. One of the things that came out of it, and I think it applies to all vendors of frankly, the American circuit board industry, is that right now, the American circuit board industry is very nervous of their vendor

base. It's not a big secret, because you can sell 80 laser drills in China, whereas you might sell only three in the U.S. So who are you going to service?

One of the bases that I used with that company was that you're not just selling them a solder mask, you're selling them a complete service. Because the board houses just don't have the engineering base they used to have. Our suppliers in the circuit board industry



Dan Beaulieu, DB Management

have to engineer and they have to help us. All the good suppliers do. And we're going to need even more of that as time goes on because the vendors are our engineers, particularly in the \$5 - 10-15 million board shops. They rely on their vendors to support them and that means doing everything. If you're selling solder mask you need to be their solder mask expert. If you're selling drills, whether they be

mechanical or whatever, you have to be the expert. You have to do that service for them. It goes way beyond the selling. They are intimately involved now. All suppliers should be intimately involved with their customers. You could apply the exact same thing to people who are selling assembly equipment. It's really the ones that stay and service that do well. Not only service, but make that correlation, that synergy between putting this piece of equipment into the whole production line and making sure it all fits above and below where it lies in the production line.

**Johnson:** Yeah, at Sunstone we call that Lean. We call that 5S. And we actually have been doing a lot of work to do exactly that. Moving that expertise from the vendors into our shop to help out and make us more expert overall has been a side effect of lean and 5S.

**Shaughnessy:** What are some of the craziest things that people have asked you to do at Sunstone, Nolan? What are some of the horror stories?

**Johnson:** Being where we're at in the process, our challenge has a lot to do with how familiar is our customer with the actual jobs we do. I've shared this story before. I grew up here in the Portland, Oregon, area in the '60s and early '70s, and that's when Tektronics employed 30,000 people and they manufactured everything in the Beaverton campus. Nuts and bolts, the ceramics to make the displays, they did everything on campus. And if you wanted to understand what was going on with a particular project that was under development, it was my grandma's house for Sunday night dinner. Because my dad worked in the warehouse and then moved over to Electro Cam. My mom worked as a secretary watching what was going through procurement. My grandmother was an assembler. My uncle was an engineer. My aunt was another assembler. I mean, we had family members spread out through the departments of the company.

And the status report on the product went around the table with the mashed potatoes. If we didn't have an answer there, just walk down the street because some neighbor actually worked in the department you were looking for. If you were a designer and you wanted to know if this board was going to be manufacturable, you walked across the street into the fab clan and talked to the guys there. That was how you did it. That's how you had all that knowledge inside your company so you could do that.

As we streamlined and moved into the world we're in now, designers don't have that touch. They don't have that understanding of what's going on. They don't see it. They don't have the opportunity to figure out what goes on with that and work with the technology. So they end up sending stuff in that becomes unrealistic on the shop floor. And to answer your question Andy, the example I gave you with Eagle Harbor was one of the craziest examples of that. Because we were ready to lose that customer. They thought that we just couldn't build what they were doing at all. What it became was an ongoing conversation to help them understand what they were doing that was going to be a problem for anybody, and to help bring

up their sense of knowledge. Helping a team of theorists become engineers is really what was going on there. And it was an interesting conversation for all of us. Education is a big part of this. Helping people understand, in this world, where the designers just do not know what's going on with the chemistry and the dynamics of that.

One of the projects I've been working on the past couple of months is putting together a series of short videos that spends some time on each individual manufacturing step of the process at Sunstone. These are something we want to use to help do exactly what we learned with Eagle Harbor. We want to help all our customers be able to plug into the manufacturing steps. See it in action. Get a little information about what the context is, why the particular stuff is used, what we're doing, what that means to your board, and give some specs and some tolerances, and do all of that in 45 seconds.

---

**We're spending quite a bit of time to get this boiled down to the essence of it, so our customers can spend 10–11 minutes, watch the videos and at least get a sense of it.**

---

We're spending quite a bit of time to get this boiled down to the essence of it, so our customers can spend 10 – 11 minutes, watch the videos and at least get a sense of it. And then this goes right back to the comment that was made early in the whole conversation. I think getting a customer tour of your facility is an underrated milestone in the sales process, which is of course a challenge for those of us who specialize in no-touch.

**Beaulieu:** I agree with that. Even more than a planned tour, I mean go back to the way things were done before. I know a number of

programs that were worked on in my career, the lantern project for Marietta. Those people came from Florida and literally lived at ASI, which was the company I worked with years ago. Because nobody could build those boards, their engineers and our people worked side by side on the board.

Even going back further than that, Rockwell and Motorola worked on the Viking project with the same thing. I mean, I can go back so far that I was a kid when I watched them measure impedance for the first time. We were doing the 16-layer board and I would deliver them to these two guys. One was from Burroughs in Pennsylvania, the other was at Maine Electronics. And they would look at the boards, they'd check the boards and they'd say, "Nope, throw these away. They're no good." I didn't even know what they were doing. And it was the first time I heard of impedance and that was like early in the '80s.

But all these stories go back to one thing, and that's where the customer was in the shop with the people building the boards and had a complete understanding. And keep in mind, years ago our customers all had board shops. All the OEMs had their own board shops. So the people we dealt with knew something about boards. They built their own. And the people who were used in the support groups for buying boards were people who had built boards. Those are all gone. How long has it been since

there's been a captive board shop? The newer generation had never been in a board shop. They've never worked with a company that had a board shop, and that's what causes a disconnect.

Our technology stabilized for a long time, but in the last few years, it started taking off again and really taking off to the point where we can't get away with this gap any longer. The customer has to come to the shop. The engineer has to come to the shop, and I'm seeing a time when those customers are going to have to invest in the shop. I see that happening, where a lot of the companies, the smaller shops, just do not have the bandwidth financially to be buying the equipment that they're going to need to build the boards for these companies building products of the future.

So, I see right now a crossroads, a time where we're going to have to break through this thing. We're going to have to teach designers and we're going to have to invite designers into the board shops to give plant tours. Also, that's a two-sided thing. It's not all about that direction. There's also the direction of the board guys are going to have to open up their minds and listen to the designers and find out what they're trying to do. What the end product is and what they're trying to accomplish. We're going to have to do that as well. So that there's real give and take between the two. A true partnership that'll help the whole electronics industry move forward.



**Johnson:** Dan, I agree with you. I see that there are increasingly two communities emerging. There are the customers that are, just as you're speaking about, needing to get closer to the board shops and figure out how to do the designs they're doing. There is a definite statistical increase we're seeing in our customers for wanting to do HDI technologies, and at that point there's a lot more interactive discussion with the board shop to make that happen.

There is still though, a very large community of people who will back off that cutting edge who are doing very conservative work with basic SMT, or even still through-hole technology. Those customers tend to also be the ones



**TECHNICA, U.S.A.**

Fulfilling Manufacturing Needs Throughout the Electronics Industry



# Direct Imaging System

**BOOTH 219**  
**APEX**  
**EXPO**  
**IPC 2018**



For more info, contact  
**Najib Khan**  
*(formerly of Maskless)*  
Product Manager for Imaging Products  
Nkhan@technica.com  
408.240.5950

**Affordably Priced at \$450,000 (includes 3 print heads)**  
**Formerly Maskless**

- Production proven technology with over 50 units installed worldwide.
- A true drop-in, simple-to-operate digital solution.
- Patented hole/marking free inner layer side-to-side registration.
- Combo alignment target recognition on the fly.
- Only DI supplier with a fully functional demo lab in the U.S.A.
- Best "Stich" control of any DLP system.
- Ability to print directly to diazo and silver halide film.
- Fastest data download and setup time for any digital imaging system.
- Field service and technical support located in California and New Hampshire.
- Original Maskless R&D team on board.
- Accepts all data formats.

Available exclusively through Technica, U.S.A.  
**1-800-909-8697 • www.technica.com**



**C B T**

who don't want to talk so much. So, depending on where they fall in the technology scale, you could be in a place where they need to reach out, we need to reach out; there needs to be plenty of conversations and plenty of work behind there that is basically commodity work. Not everybody necessarily needs to go work directly with their board shop on every project but that is on the increase, I will agree with that.

**Beaulieu:** I'll tell a story here I've run across. I'm helping a company out of Brooklyn, New York, NYU guys, who are building boards with 3D printers. And the interesting thing is I asked them why they're doing this. These are NYU graduate students who won a technology contest by building a neat device, which is controlling a keyboard with your eyes, if you can believe that. I asked, "Okay, you went off in that direction, why did you get involved in 3D printing of circuit boards?" And they said because while they were building their project, it was so darn hard to find circuit boards, and so hard to get good circuit boards, they decid-

---

**These are NYU graduate students who won a technology contest by building a neat device, which is controlling a keyboard with your eyes, if you can believe that.**

---

ed there's got to be a better way. This, as you know, is a long way from 28-layer blind and buried via boards, but on the same token that was the perception of smart graduate students coming into an industry where they would make boards. Believe it or not, their educational gap was such that they're graduate students. I asked them what their biggest problem is, and they said the ink. They were using station-

ery ink and I introduced them to Taiyo. They didn't even know about Taiyo. And I talked to my friend John Fix at Taiyo and he said he'd be there tomorrow. Because they're looking for that too, and you've got to realize, nothing against anybody here, it's just that people are working in a vacuum, in terms of circuit boards. I have a friend who's an instructor at British Columbia Institute of Technology and he uses Bob Tarzwell's PCB 101 handbook for his students, saying since he has a whole two-year course, these students might spend a day on circuit boards and then move on. So we've got to all work on that.

**Las Marias:** In some of our conversations with contract manufacturers, they're also saying that designers should also consider speaking with them because sometimes, what these designers are designing are just not manufacturable, and quite difficult to adapt to whatever SMT system they have set up in place. So, they're saying that it's also important for them to talk to the assemblers. In fact, when we ask some people, they're saying that in their 12-20 years, they've had only one designer that came to them and talk to them about the design that they're going to do. Just one in that many years. But it turned out that the final output of the product is quite good. So they're saying that's also important.

**Beaulieu:** Absolutely. I was at one last week and it was the same thing. Everything from basically ease of production to one of the important ones, which is component selection. Because there are certain parts that have longer lead times, that are more expensive, and they can be substituted with another part. And that drives the price up, it drives the lead time up, and it's much better when they coordinate. When I said they talk to each other, that's one of the things they're talking about.

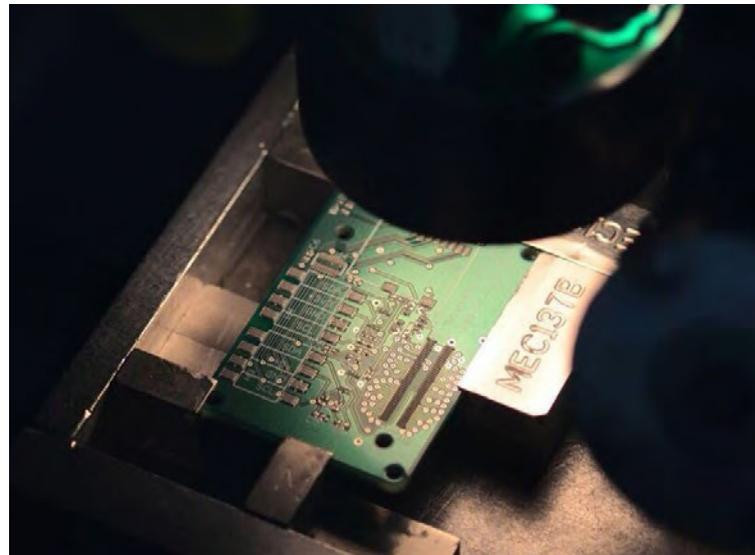
If you look at my friends who have quick-turn production manufacturing shops, that's what they're doing. They get trusted for component substitution, even have little matrices that point out this part can do the same as this part and they figure it out that way. But if you

think about it, when you're building a box or a product, there are things that happen when you're actually building it, such as if this screw was moved one eighth of an inch, they would be able to fit this in. That kind of stuff, that's important too.

I worked on a project years ago where it was a board part, but it was a part assembly with a copper core with two polyamide skins over it. The core was live, so the boards had to connect through the core. Those boards cost almost \$3,000. The designers called us in and asked why these boards cost so much, and what can we do. My partner simply went up to the boards, drew a picture of the core, drew a little slot in it, said "You put a connector over the top here and it won't hit the dimension of the board. And now these boards will cost like \$600 and you're getting everything you need." I've seen contract manufacturers doing a lot of that. That one necessarily is on boards, but they're doing a lot of that kind of insight to help the customer who's fighting for nickels and dimes, lead time, and time to market. It does apply as well to contract manufacturers. Sometimes even more.

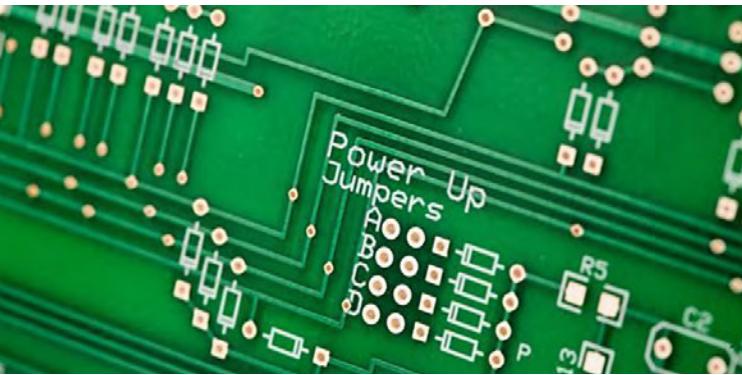
**Johnson:** That's a great point, Dan. That's why you're using contract manufacturer nowadays, because they are doing that sort of work. They have that experience. They have a lot of other jobs from a lot of other customers. They've done all of this before. They can often have the practical experience that can tell you how to do it better.

From my perspective. I'll just speak from my perspective on this one. I represent PCB123, at Sunstone as well, so that's the PCB schematic capture, physical layout, has an autoplacer, autorouter in it. We just came out with a new version that connects to a startup called SnapEDA. And part of the whole part substitution issue is understanding if the part is a new part, or it has just been given a warning that it's going obsolete, or it is on a long lead time to get supply from the manufacturer. All the statuses for this and how it is going to affect your project. It's one thing to be having the conversation with the assembly houses and



sitting there with your bare board, and they're telling you that the part is on a 12-week delay; and the other one is actually knowing that information when you're designing your board. If you can get some of that information into the CAD tool, you can make adjustments to supply issues. If you can make the designers aware of that, then they can make some adjustment decisions while it's still cheap, while they're laying out the board, before they've committed to something.

And that's exactly what we've been trying to do at PCB123. I saw this years back when I started my career at Mentor Graphics, and we were working with PCB123. We have the bill of materials that we've built up as you're laying out your design and, right now, you've got one source. You can query DigiKey to get a sense of the pricing and availability of the parts in your bill of materials, right inside the CAD tool as you're designing. Just go over and click a button and it gives you some information about that. If you've got a serious issue, you could figure it out. One of the side effects for our customers, is when they come back to a design they did a year or two ago, it's a one click process to find out what things of their bill of materials have gone away. Sent to them in seconds. In September, we introduced support for SnapEDA, a great product in the sense that the SnapEDA team is out there building a cloud-based library of parts definitions for schematics, physical layouts, 3D, working with



the part manufacturers to supply their parts directly to the library, and crowd sourcing with engineers to get new parts in the library. We've got millions of parts and it's a couple of clicks to download them out of the library, out of SnapEDA, into your CAD tool. They're supporting most of the major CAD tools including PCB123. And that process means that it's like using iTunes to get your parts definitions and know that you've got good ones that have been certified and validated as correct. Giving me, the designer, up-to-date information as far as how available that part is and the peace of mind that you didn't just spend two days defining a brand-new footprint for your library that is wrong.

So those are some of the places where I think that's a little bit overlooked through the manufacturing supply chains. The more we can get those decisions to be made well in the CAD tool, the fewer conversations we have to have further down the street. At least that's one way that we've been approaching it with PCB123.

**Las Marias:** Dan, what is your advice for our readers when it comes to ensuring 100% customer satisfaction? Maybe you can talk from the perspective of PCB fabrication and the contract manufacturer's side.

**Beaulieu:** It's an understanding and it's listening. I like to tell my guys to make sure they not only understand the product they're building for, whether it be a box build or it be the board itself, but also understand the customer. What does the customer need for success? What is their market? Whether it is medical, defense or security, or commercial where it's very com-

petitive. Get the characteristics of the customer and apply those to the product in the end and it makes a lot more sense. I also like to encourage people, say it's a circuit board for example, to think what that circuit board is seeing when it enters the customer's facility. Even to the point of the receiving, because as you know, documentation has become more vital now than ever.

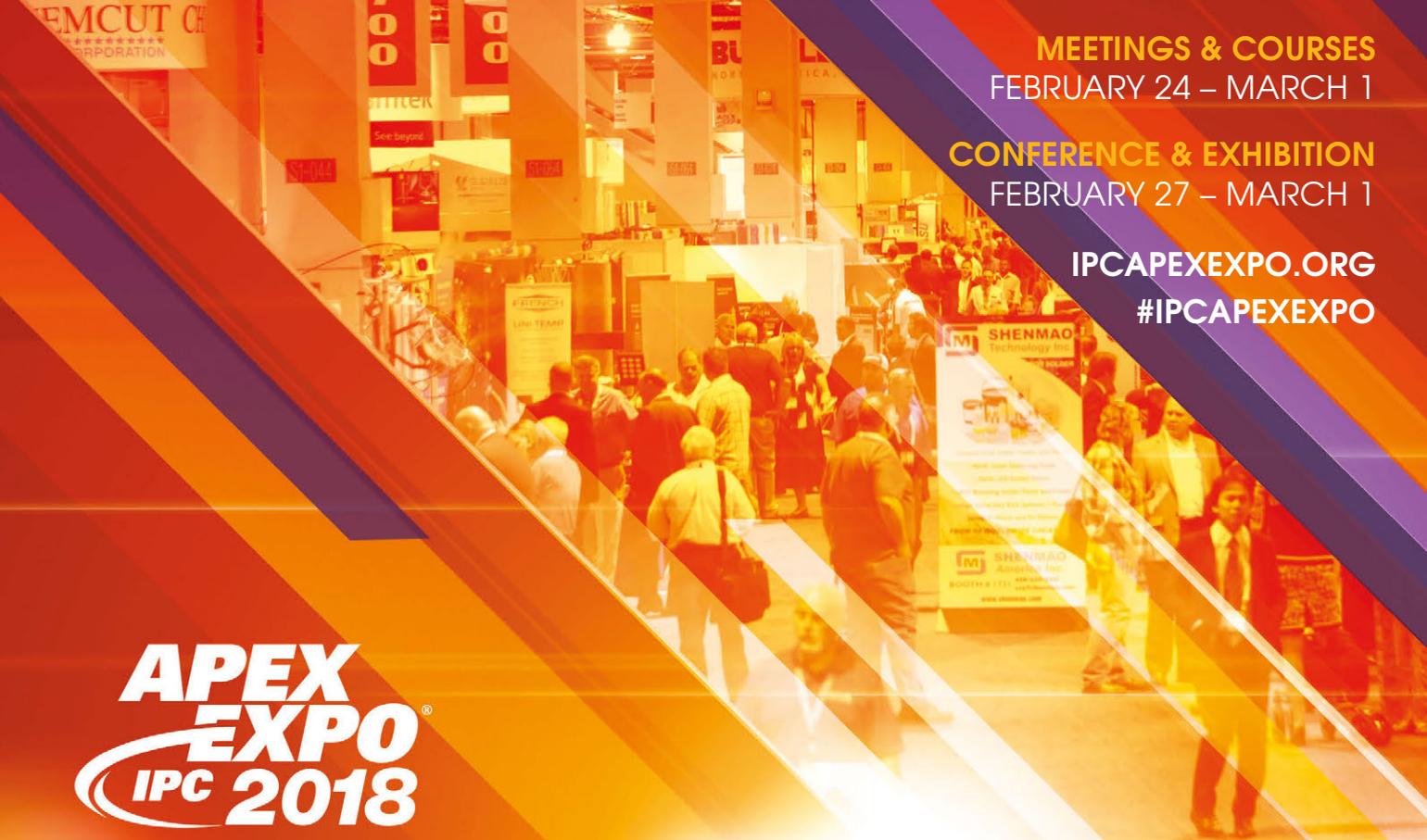
Put yourself in the customer's shoes. Seeing what the customer faces, what their challenges are, and what it takes for them to be successful in their marketplace. Because if you do that, you become completely valuable to your customer. And if you do that enough, after a while, that customer is going to give you leeway on pricing. I used to say when that hotshot accountant shows up and says that your solder mask is 20% more per kilo than the other guy, you'll want the guys in solder mask and engineering to tell him to shut up and talk about all the value they're getting with that product. And it's the same thing with circuit boards. Supercede the pricing with value.

**Johnson:** I think Dan's right on the money there. One of the things that I talk about with our team often is just pulling one of Steven Covey's seven highly effective methods, and that's "if you wish to be understood, seek first to understand." There needs to be a dialogue that we create in both directions. Not just us understanding our customers, but also helping our customers stop and step back and seek to understand what happens as soon as they've handed their design over. That dynamic, once you have that going on in your relationship with your customer, then everything that Dan was discussing starts to happen pretty organically.

**Las Marias:** Gentlemen, thank you very much for your time and insights. We greatly appreciate you speaking with us.

**Beaulieu:** Thank you.

**Johnson:** Thank you very much. **PCB007**



**MEETINGS & COURSES**  
FEBRUARY 24 – MARCH 1

**CONFERENCE & EXHIBITION**  
FEBRUARY 27 – MARCH 1

**IPCAPEXEXPO.ORG**  
**#IPCAPEXEXPO**

**APEX  
EXPO<sup>®</sup>**  
**IPC 2018**

**SUCCEED  
AT THE VELOCITY  
OF TECHNOLOGY**

**THE SHOW FLOOR WILL ACCELERATE YOUR INNOVATION**

In 2018, your leading opportunity to stay on top of electronics industry innovation is on the IPC APEX EXPO show floor. Join thousands of your industry peers as you uncover new solutions that will move you in the right direction to capitalize on tomorrow's opportunities!

- » Explore and compare equipment from more than 450 of the industry's top suppliers.
- » Discover new processes to gain greater efficiency.
- » Start your year with new suppliers that can save you both time and money.

**VISIT [IPCAPEXEXPO.ORG](http://IPCAPEXEXPO.ORG) FOR MORE INFORMATION**

**NEW THIS YEAR!**

**WIN WITH OUR PASSPORT TO PRIZES GAME**

Travel around the show floor collecting stickers from exhibitors, and enter for a chance to win an exciting prize!

**SAN DIEGO  
CONVENTION CENTER  
CALIFORNIA > USA**

# Supply Line Highlights

## Isola: Evolving with the Market ▶

In this interview from productronica 2017, Isola's Karl Stollenwerk discusses the decline of the laminate market in Europe over the past 17 years, current demands on raw materials, and Isola's new strategy to remain competitive.

## Automation and Traceability Critical for High-Throughput Probe Testing ▶

Peter Brandt, atg's director of sales for Europe, India and Japan, joined Barry Matties at productronica to share his views on regional variations in electrical testing requirements, automation, traceability, and the future demands of the market. GM manager Dr. Jochen Kleinertz also comments on the need for close cooperation with customers.

## Lamination to Drilling in Minutes: It's New and it's Not ▶

Barry Matties met with Lino Sousa at productronica to check out Pluritec's new Pluricut HPL machine, which offers an all-in-one solution for flash routing, beveling, measuring, and corner routing.

## Schmid: Bringing Integrated Solutions to the Market ▶

Schmid's Laurent Nicolet and Demitry Kostouros recently sat down with Barry Matties to talk more about recent market shifts and Schmid's introduction of their new vertical line.

## Prototron Circuits Chooses Frontline's InSight PCB Pre-Cam Solution ▶

InSight PCB to be integrated into Prototron's pre-production CAM environment to accelerate their quotation and CAM processes.

## The Benefits of Coming Together to Form a Global Reach ▶

At productronica, Patty Goldman talks with Rich Retallick, MacDermid Enthone Electronics Solutions, about the newly integrated company.

## TUC Announces Plant Expansion and Financial Report ▶

TUC is expanding capacity for high-speed substrates, spending NT140 million on property and expected to invest NT1.46 billion to build the state-of-the-art plant. Operations to begin in 2019.

## Isola Group Transfers Ownership to Investment Group Led by Cerberus Capital Management ▶

Isola Group announced today that it has completed an agreement to successfully transfer its equity ownership to an investment group led by Cerberus Capital Management, L.P. and its affiliates and the Company's senior secured lenders.



# VISION

**APEX EXPO**  
IPC 2018  
Visit us! Booth 207

## MULTIPLE PLATFORMS



Drill/Rout/Optimizer  
X-Ray Vision

[MORE INFO](#)



Drill/Rout Multi-Spindle  
CCD/RGB Vision

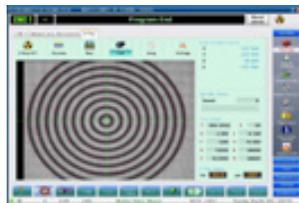
[MORE INFO](#)



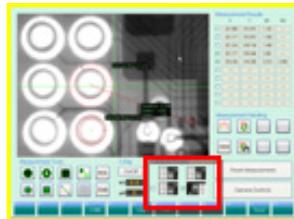
Dual Spindle All in One  
Vision System

[MORE INFO](#)

## SEEING IS BELIEVING



X-Ray - 8X Faster!  
with NEW concentric target



See inside your PCB  
measure your results!



Drill/Rout/Optimize  
Entry level "Smart Drill"

[MORE INFO](#)

## TIME-TESTED FEATURES

Vision Simplifies

Post Etch Slot/Drill

X-Ray Optimization

CCD Camera Optimization  
"Smart Drill"

BarCode Job  
Data Management

Panel Marking/Serialization

1700 Tool Library per spindle

Control Depth Drilling and  
Routing to 15  $\mu$ m

Lights out Automation

Up to 6 Spindle  
Configurations

Automated Panel Prep  
(Flash Routing, Edge  
Beveling, Corner Chamfer,  
Panel Thickness Measuring)



# pluritec

www.pluritec.com | info@pluritec.com

# Invited Guests to the Party

## Flex Talk

Feature Column by Tara Dunn, OMNI PCB

Hanging on the wall in my office is this quote from Jeff Bezos: “We see our customers as invited guests to a party, and we are the hosts. It’s our job every day to make every important aspect of the customer experience a little bit better.”

For this column, following the theme of “Who is my customer?”, I am going to use this quote to explain my thoughts on how we define who our customers are and how we interact with our customers. I am sure the people that know me well and have attended one of our Geek-A-Palooza events are shaking their heads and thinking, “Of course she is going to talk about a party!”

### Invited Guests

Isn’t it interesting to think of our customers as invited guests? As someone in PCB sales, I have a quick answer to the question “Who is my customer?” My reply is anyone who is using printed circuit boards. From there it is traditional to break that down by industry sector, or company size, or technology. Once that scope is narrowed down, marketing and sales craft their message to best reach those defined segments. Sales people identify a list of target companies, find prospects at those companies, and work hard to differentiate

their technology or services to purchasers of printed circuit boards.

But what if “who is my customer?” was broken down using the criteria/framework of invited guest? Wouldn’t this change the traditional model of salesperson trying to win over the prospect to one of two people, or two companies, working together in a mutually beneficial relationship? While we are ruminating over this, let’s expand the definition of customer to people that can influence the customer’s decisions and expand our guest list and invite them to the party also.

When you plan an event, whom do you invite? People whom you enjoy being around, people whom you trust, people whom you respect? And in our industry, isn’t that who you would want to buy from and sell to? I cannot think of one customer whom I would not “invite to the party.” I don’t know if it has been a conscious

or subconscious effort, but my customers are people I truly enjoy working with. There is mutual respect and trust between us.

Working with custom products that often push the limits of technology, we are always going to have difficulties and issues that come up, but working with people whom you like,



# IT-988G SE / IT-988G

COME SEE US AT IPC  
BOOTH #133

## IT-988G

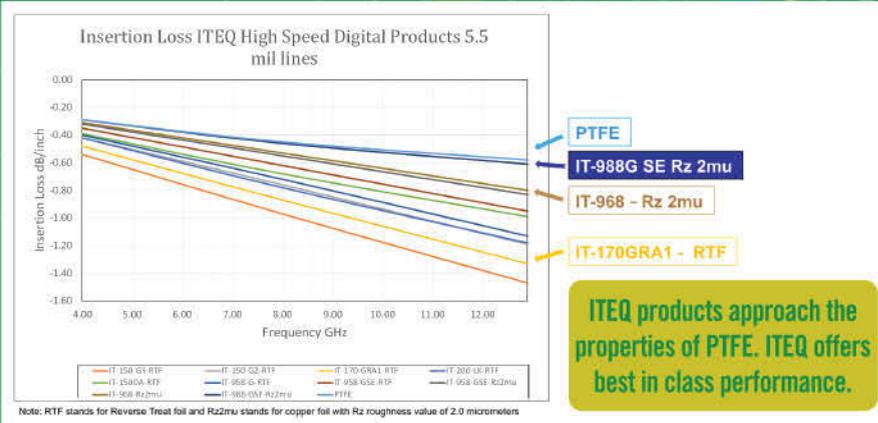
- Halogen Free
- $T_g = 190^\circ C$
- $T_d = 405^\circ C$
- $D_k = 3.46 @ 10GHz^*$
- $D_f = 0.0025 @ 10GHz^*$
- Available with low Dk Glass - IT-988G SE

## IT-988G SE

- Halogen Free
- $T_g = 190^\circ C$
- $T_d = 405^\circ C$
- $D_k = 3.24 @ 10GHz^*$
- $D_f = 0.0014 @ 10GHz^*$

Ultra high speed > 56 Gbps per channel, NRZ (PAM2), PAM4 applications

## Insertion Loss - Measured



ITEQ products approach the properties of PTFE. ITEQ offers best in class performance.

## IT-988G SE

- High  $T_g$  / Lead Free / Halogen Free
- Ultra Low Loss Laminate & Prepreg
- 100G / 400G Solution
- Lower Dk (<3.24 @ 10GHz)
- Ultra low Df (<0.0014 @ 10GHz)
- Very Stable Dk-Df across frequency
- HDPUG MRT-6 - LRC and HRC passed all thermal requirements
- HDPUG MRT-6 - LRC and HRC passed CAF requirements

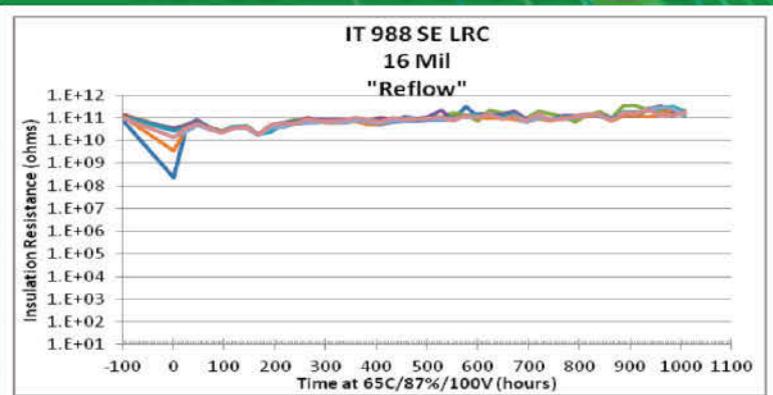
## Sequential Lamination

7 Lamination cycle data

Lamination	DMA	DSC	TMA	T300 with CU	Solder Dip PCT: 1h @ 121°C	Td 2wt% / 5wt%
1	213	187 / 187	182	> 60	> 60	408 / 435
2	216	194 / 199	193	> 60	> 60	417 / 438
3	214	186 / 192	185	> 60	> 60	417 / 442
4	216	193 / 194	184	> 60	> 60	424 / 443
5	217	194 / 199	190	> 60	> 60	418 / 442
6	218	191 / 197	188	> 60	> 60	405 / 436
7	218	190 / 197	194	> 60	> 60	425 / 444

No thermal degradation observable after 7 lamination cycles

## HDPUG MRT-6 LRC CAF Data



ITEQ has the leading solutions for High Speed Digital applications with the extremely cost-effective IT-170GRA1 and IT-968 to the ultra high speed IT-988G and IT-988G SE for the highest end designs beyond 56 Gbps.

\*53% resin content

# ITEQ

trust and respect goes a long way to resolving those issues quickly and easily.

Instead of targeting customers based on industry sector, company size or technology, what if we targeted potential customers based on how they like to do business and how they fit in with how we like to do business?

---

## There are customers who build long-term relationships, and suppliers who see beyond short-term issues and operate with the long-term goals in mind.

---

Some customers like detailed negotiations, and salespeople who thrive on negotiating price and terms. Some customers don't spend time on those details and want to work with someone they can trust to run with the program and handle the details; there are salespeople who prefer being a trusted resource and not having to negotiate all the finer points. There are customers who view business transactionally, and suppliers who do the same. There are customers who build long-term relationships, and suppliers who see beyond short-term issues and operate with the long-term goals in mind.

### Hosting a Party

The host of a party is ultimately responsible for making sure that their guests are enjoying themselves. Isn't that what we want for our customers too? We want them to have a favorable, positive experience and do business with us again. Have you ever hosted a party hoping your guests would think it was average? Of course not!

Have you ever used a football party as a reason to go get that big-screen TV? How about serving your guests fancy hors d'oeuvres butler-style instead of a traditional buffet? Maybe have live music at the party as a treat when

people aren't expecting it? For all of you Geek-A-Palooza attendees, how about the ring toss as an unexpected party game? Aren't these added touches similar to the added value services we like to provide to our customers? Do the added-value services we provide add to the overall customer experience? How can we do better?

In the PCB industry, how do we ensure our customers have an unexpectedly positive experience? It is very easy to focus on product, but for this discussion, let's take that out of the equation and assume that high-quality product is delivered on time. What are the other intangible things that are important to our customers that could make their job a little easier and provide a chance to really wow them?

The success of any event lies in the details. Do we take enough time to dig into the details with our customers? What are the different touchpoints that our customers have with us? What is important to them? What is the message that we send? Do we make it easy for our customers to share the things that are important to them? Do we put the same level of thought and planning into our customers' experience that we would into hosting and planning an event?

Isn't our marketing program similar to inviting them to the party? All our communication, from advertising to our website, to customer service, should be consistent and engaging, exactly like an event invitation would be.

Working in an industry that manufactures custom products, we naturally place the focus on the product and technology. But, we can't forget the people and that business is built by people interacting with each other. The next time your customer places an order will they experience "the beer is in the fridge, help yourself, I'll be on the couch watching the game" or will they have an unexpectedly positive experience that they talk about for days to come? **PCB007**



**Tara Dunn** is the president of Omni PCB, a manufacturer's rep firm specializing in the printed circuit board industry. To read past columns, or to contact Dunn, [click here](#).

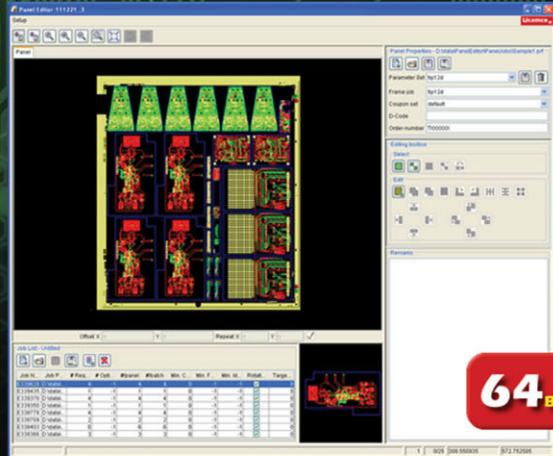
Software

# Multi Job Panelizer

High-yield multi-job panel generation made easy ...

- Combines different PCBs into a production panel
- Optimizes material utilization
- Reduces material costs
- Interactive or 24/7 automated operation
- Hotlinkable to ERP or Planning systems

[Read more](#) →



64 Bit

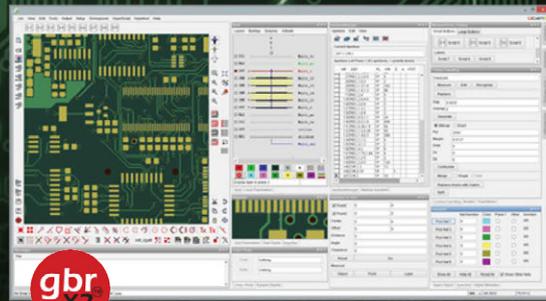
Software

# UcamX

New ground-breaking CAM Software

- For Rigid, Flex and HDI PCBs
- New Graphical User Interface with Workspaces
- Optimal performance using Parallel Processing
- Multi Job Processing via load balanced Sessions
- Support for Gerber version 2 (X2) format

[Read more](#) →



gbr X2

64 Bit

Multi Core

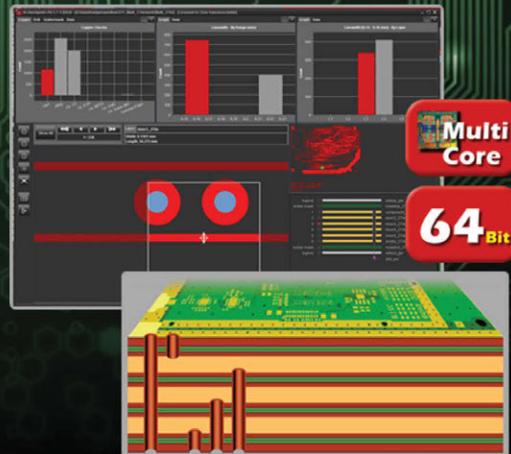
Software

# Integr8tor

Automated data entry and design analysis

- Ucamco's 9th Generation Sales & Engineering Tool
- Field proven with more than 250 installations in daily production
- Seamless integration into any environment

[Read more](#) →



Multi Core

64 Bit



# Understanding Your Customers

**Feature Article by Steve Williams**  
THE RIGHT APPROACH CONSULTING

## Introduction

Understanding your customers may seem like a no-brainer, but conversations with company leaders across various industries the past five years have demonstrated to me just how difficult this can be in practice.

## ISO Can Help

One of the newest requirements to both ISO 2015 and AS9100 2016 is expanding the whole concept of who is a customer. The traditional definition of a customer is an organization that pays us for our product. The new requirement is to define the *interested parties* to the business, and to identify their needs.

Interested parties are defined as any party who has an interest in how your company performs. This includes traditional customers, but also adds parties such as owners/stakeholders,

employees, suppliers, banks, and the community. Only *parties* that have an *interest* in how your company performs and impact the QMS need be examined, although this should be a very short list. As I preach to my clients, a “B” can be functionally swapped out for the “Q” in QMS, as it is actually a business management system for the entirety of the organization.

How can this help? Excellent question, because any requirement comes with the expectation that something must be done. A simple analysis at the next management review meeting will suffice, using a tool such as my Interested Parties Worksheet (Figure 1). Refreshing this activity then becomes an annual exercise.

## What do customers want?

What customers want is very simple. They want the core product or service of your business to meet their needs and expectations. If you are a PCB manufacturer, they want a board that works, delivered on time, at a fair

# BURKLE

NORTH AMERICA, INC.

## LAMINATION SYSTEMS FOR PRINTED CIRCUIT BOARDS

STATE-OF-THE-ART SOLUTIONS FOR THE PCB INDUSTRY  
INCORPORATING THE LATEST TECHNOLOGY.



### Solutions for the PCB Industry

High quality and well proven presses and handling equipment



Contact:  
**Dave Howard**  
**714-379-5090**

# INNOVATIVE POWER 4U

[burkleamerica.com](http://burkleamerica.com)



		<b>Interested Parties Worksheet</b> This Analysis looks at Individuals and other entities that add value to THE COMPANY
Interested Parties	Needs and Expectations	Criteria Examples
Customers		Quality, price, & delivery of products and services
Owners / Shareholders		Sustained profitability Transparency
Employees		Good work environment, Job security, Recognition and reward
Suppliers		Long-term relationship, Mutual profitability
Partners (Banks, etc.)		Mutual benefit and continuity
Society		Environmental protection, Ethical behavior, Compliance with statutory and regulatory requirements
xxx...		

Figure 1: Interested Parties worksheet.

value for their money. So, if wanting stuff that works, when you need it, is not an unreasonable expectation, then why are consistently high marks for customer satisfaction so difficult to reach and maintain?

Because customers *expect* these things, they are called *order qualifiers*, or in other words, the price of admission. Satisfying these core areas will not create loyal customers or cause them to tell others how good you are. However, if you don't meet these basic objectives, they most certainly will tell anyone who will listen how bad you are.

---

**Satisfying these core areas  
will not create loyal customers  
or cause them to tell others  
how good you are.**

---

*Order winners*, the things that will drive loyalty, additional business, and turn customers into your best sales people, are the little ex-

tras—things that most companies fail to either realize, or don't place as much value on. The following are a list of things that your customers really want that will turn them into fans for life!

**Customers want:**

- Ease of doing business. Answering the phone, simplifying the order process, proactive communications and easy product returns are key to making it as easy as possible to do business with.
- Warm and friendly interactions. With every phone, email or face-to-face contact, customers want a warm response. It can still be professional, but you and your people need to look and sound friendly and likeable. It amazes me to see just how many customer service folks are just not that friendly.
- To feel important. Although they realize that you have many other customers, they want to be treated as if you didn't.
- To be listened to. It is not hard to give the impression that the person dealing with them is not really listening. Effective listening is a learned skill that takes diligence and commitment.

- The *Cheers* experience: someone who knows their name. A person's name is one of the sweetest sounds he'll ever hear. If you use a customer's name when you talk to him, it indicates that you have taken the time to acknowledge and remember him.

- Flexibility. Customers hate to hear the words "No" or "It can't be done," especially in today's challenging economic environment. While it's not always possible to say "yes," it is extremely important to be as flexible as you can and tell them what you "can" do.

- Recovery. When things go wrong, and we all know they will, customers want you to solve their problems quickly. No excuses or blame; just present solutions. Customers often judge the quality of your product or service by the way you recover and not from the actual issue.

## Internal Customers

This list of what customers want applies just as much to internal customers as it does to external ones. Internal customers are the most *overlooked* and *underappreciated* group of interested parties of all. Internal customers can be found in every function of the company: the customer service representative that hands off the new order to their production customer, the drilling department that provides panels to their plating customer, or the quality department that services a plant full of customers. Every single person in an organization is both a supplier and a customer. Understanding the needs of internal customers is just as important as understanding the needs of your paying customers. How you treat your internal customers will have the same positive or negative impact on your relationship as with your external customers.

## Perception is Reality

Whether measuring satisfaction to your internal or external customers, you have to look in the mirror and ask yourself, "Am I measuring my performance accurately?" (Figure 2) How many times do we see a company promoting itself as being a world-class manufacturer of widgets, or as having been voted best-in-class in customer service? Who voted? Again,



Figure 2: What do you see in the mirror and is it real?

the "truth in advertising" dilemma. What often happens is a Dilbert cartoon in the making; a group of senior managers get together and declare, "You know, we do a pretty respectable job in our business; let's begin marketing ourselves as world-class."

I recently had this very discussion with some friends regarding customer service at automotive dealerships. During checkout after some recent mechanical work, the agent told me that I would be receiving a call from the customer service department with a quick phone survey regarding my experience. He then said to me, "The questions will be on a 1 – 5 scale, and if I receive anything less than a 5 on a question I'll catch hell from my boss, so I would really appreciate 5s across the board." One thing is for sure: whether you give the kid all 5s or subconsciously rate him harsher than you should, the survey is tainted. Makes you question all the customer service awards hanging on the showroom walls!

## What is value?

In understanding our customers, one of the first questions that needs to be answered is "what are we providing that is of value to our customers?" And the first mistake that organizations make is trying to answer this question themselves. This question can only be answered by the customer (remember the whole perception is reality thing?) and any answer that is not directly correlated to customer input will not improve your ability

# “What do our customers want?”

to satisfy the customer. Understanding a customer's needs goes far beyond product and features; it includes a variety of subjective attributes such as service levels, key customer satisfaction drivers, and the degree of perceived value from your core business activities.

Organizations spend a great deal of money in time and resources on strategic planning to develop the short- and long-term goals that will guide the company going forward. It never ceases to amaze me how often these goals and plans are developed without any input from the customer base. Most senior-level planning sessions are bottom-line focused, with most of the discussions being focused around revenues, balance sheet results, head-count, forecast, etc. Make no mistake: I fully appreciate the need for a bottom-line mentality at the senior management level, but equal time needs to be granted for the underlying foundation that directly affects these numbers: customer satisfaction.

When the discussion does turn self-reflective, questions like “What do we make?”, “What market are we in?” and “Who are our customers?” are staples of American management

strategic planning sessions. Missing are questions like “How do our customers see us?”, “What products and markets do our customers want us to be in?”, “What do our customers think we do well, and more importantly, not do well?”, and “What about our internal customers?” These are the questions that need to be not only answered, but acted upon on a regular basis for an organization to be able to achieve a quantum leap in their level of customer satisfaction.

## Sage Advice

Many companies tend to become complacent over time, especially if they are at the top of their game. I remember having a rather animated conversation many years ago with my good friend Will Rogers about the challenges of understanding and meeting customer needs. My friend Will always had a way of breaking down a complicated situation into its most basic form, and we were discussing the false sense of security many companies have about how happy they feel their customers are. And in his typical, plainspoken way, I think Will hit the nail on the head when he told me, “Steve, if you're ridin' ahead of the herd, look back every now and then to make sure it's still there.” **PCB007**



**Steve Williams** is the president of The Right Approach Consulting LLC. To read past columns, or to contact Williams, [click here](#).

---

## Flexible, Water-Repellent Graphene Circuits for Washable Electronics

New graphene printing technology can produce electronic circuits that are low-cost, flexible, highly conductive and water repellent. The nanotechnology “would lend enormous value to self-cleaning wearable/washable electronics, resistant to stains, ice, and biofilm formation,” according to a recently published



paper.

“We're taking low-cost, inkjet-printed graphene and tuning it with a laser to make functional materials,” said Jonathan Claussen, an Iowa State University assistant professor of mechanical engineering, an associate of the U.S. Department of Energy's Ames Laboratory and the corresponding author of the paper recently featured on the cover of the journal *Nanoscale*.

Visit us at the  
Matrix Booth #539

# MEGTRON7

Laminate **R-5785(N)**  
Prepreg **R-5680(N)**

H-VLP2 Cu and Low Dk  
Glass-Cloth Specifications

### Features

- H-VLP2 copper foil and Low Dk glass-cloth allows for 30% loss improvement than MEGTRON 6
- Glass transition temperature (T<sub>g</sub>): 200°C (DSC)
- Reduce process cost (Improve drill processability and ENIG (Electro-Nickel Immersion Gold))

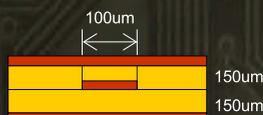
	Dk	Df
R-5785(N) + H-VLP2 Cu and Low Dk glass-cloth	3.4	0.002 @ 12GHz
R-5775	3.6	0.004 @ 12GHz

### Applications

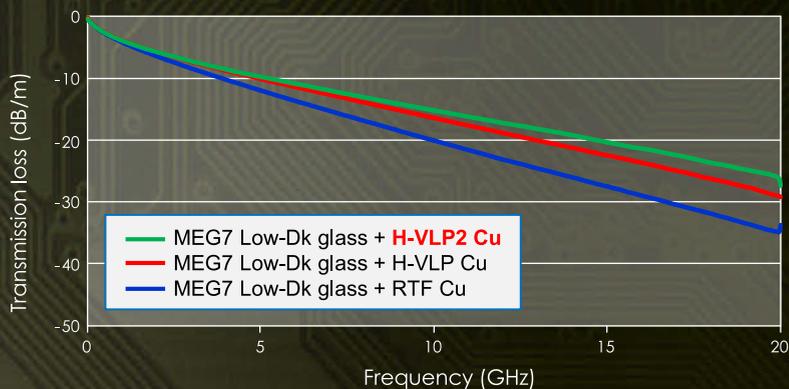
- High-end servers, High-end routers, Supercomputers, and other ICT infrastructure equipment, Antenna (Base station, Automotive millimeter-wave radar), etc.

### Transmission Loss

- Construction



Line Length	1000 mm
Impedance	50 Ω
Copper Thickness	18 μm
Inner Cu Treatment	No-surface Treatment
Core	#1078 (RC67%) x 2ply
Prepreg	#1078 x 2ply



Contact us



More information



DISTRIBUTOR IN NORTH AMERICA

**MATRIX USA INC.**

TORONTO • SANTA ANA • SANTA CLARA • CHICAGO • MINNESOTA

Visit our website at [www.matrixusa.us](http://www.matrixusa.us)

Partnering to go beyond.

**Electronic Materials**  
Panasonic Corporation



# One Great Customer Service Story

## Feature Article by Dan Beaulieu

Over the years I have been involved with many customers and many rescue missions. A rescue mission occurs when a shop screws up so much and hurts the customer so badly they have to do something extraordinary to get the customer out of hot water and not lose the account.

Many great PCB vendor/customer relationships have been forged in adversity. Great company reputations can be made when a vendor handles its problems when they occur. The worst thing a vendor can do when adversity strikes is to argue about whose fault it is. The right thing to do is take care of the problem first and then perform the autopsy later. The customer is usually in a whole lot of hurt and needs his problem solved immediately. There will be plenty of time later to wade through the events and figure out who did what to whom.

Then there are the great customer service stories, occasions when a PCB vendor went so far and above the normal expected per-

formance the story becomes part of that company's legendary history, a story that contributes to that company's definition of customer service.

Here is one of those stories. This was in the late '70s when eight weeks was standard lead time and six weeks warranted premium dollars; two weeks (10 working days) was too impossible to even consider. The company was Rockwell's Maine Electronics, a great shop when it came to technology; these folks could build boards 40 years ago that most companies can't even build today. But as good as they were at technology, they were weak on delivery. Catch-back schedules (remember those?) were part of their everyday life. They could build great stuff but on-time delivery was a stranger to that facility. And two weeks? Well, that wasn't ever going to happen.

One day, the sales manager received a call from the head of procurement of one of their high-tech customers. This man sounded desperate. One of his buyers had neglected to place an order for a program that consisted of



# WET PROCESS LINE



***Etchers***



***Scrubbers***



***Developers***



***PTH***



***Oxide Replacement***

**THIN CORE HANDLING • PC CONTROL • RELIABLE • LOW COST**

**CLICK TO VIEW OUR UCE WET PROCESS LINE**



The leading European PCB Equipment and Parts Supplier

[www.vikingtest.com](http://www.vikingtest.com)  
[sales@vikingtest.com](mailto:sales@vikingtest.com)



14 part numbers, all 12- and 14-layer boards, in quantities of 100 each. This was intriguing enough, but the real kicker was that he needed the boards in exactly 14 days, 10 working days. And as customers are apt to do in this situation, he would pay anything if the company could commit to building these boards and delivering them on time. This was on a Friday, and he said that if we agreed and settled the

---

**And as customers are apt to do in this situation, he would pay anything if the company could commit to building these boards and delivering them on time.**

---

deal right away, he would have the artwork sent up from Boston where the company was located.

But he needed all part numbers, all quantities, at his facility at exactly noon sharp two weeks from the next day. To add to the challenge, he was so serious about getting the boards there at noon that he added a bonus as an incentive to make sure he got his boards on time. Apparently, there would be a team of incoming inspectors ready to receive and accept the boards and then pass them along to the assembly lines.

As he talked to the sales manager, who had called the division director into the room, they looked at each other and nodded in agreement and told him to send the artwork, they were going to do it! They asked him to stick around into the evening, so they could quote the boards and settle the deal. Three hours later the artwork arrived, and they set to work quoting the boards. These were tough boards, which was the reason they had come to them with this challenge; most other shops could not have handled this technology. They quot-

ed the entire project and added four times premium for doing it.

They developed a plan that involved taking one of their second shift supervisors and putting him on the project exclusively. He would spend the all his time tracking the boards and making sure they were never held up anywhere, always keeping them moving. The entire shop was put on high alert and this project became a companywide initiative. The idea of the money was great, of course, but the real driver of this project was everyone working together on something that no one had ever done before. Not this technology, not this amount of part numbers, or these quantities.

There was certainly a lot of drama along the way. They scrapped out one entire part number and had to start it over from scratch, which meant that it was built in five working days! And then, get this, there was a nor'easter the Saturday the boards were due to be delivered and they were not sure the driver would be able to make it down to Boston. He had a terrible time making the delivery by noon. In fact, several sections of the Maine turnpike were closed, so our driver had to get on old Route 1 for much of the trip. These were pre-cellphone days, so everyone waited anxiously for that phone call he had promised to make back to us telling us that we had officially done it.

Noon came and went, and then another 30 minutes and then another 15 minutes and the phone in the sales managers office rang. We had delivered the boards in time; he had been at their dock at 11:58! He had been so happy that he forgot to call, and it was only once he was back on the highway that he remembered and then had to find a payphone. They had done it. The boards were there, and everyone lived happily ever after!

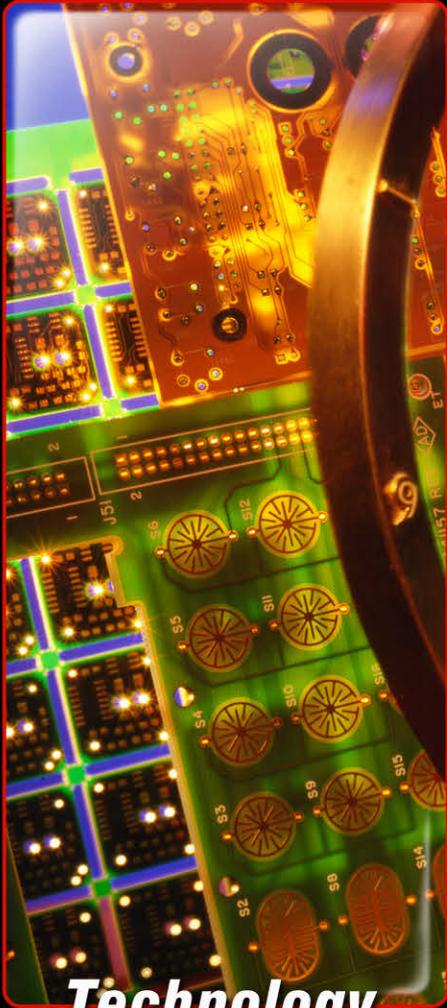
I'll save the worst customer service story I ever heard for another time. **PCB007**



**Dan Beaulieu** is co-founder of D.B. Management Group. To read past columns or to contact him, [click here](#).

# We Take the Time to do it Right

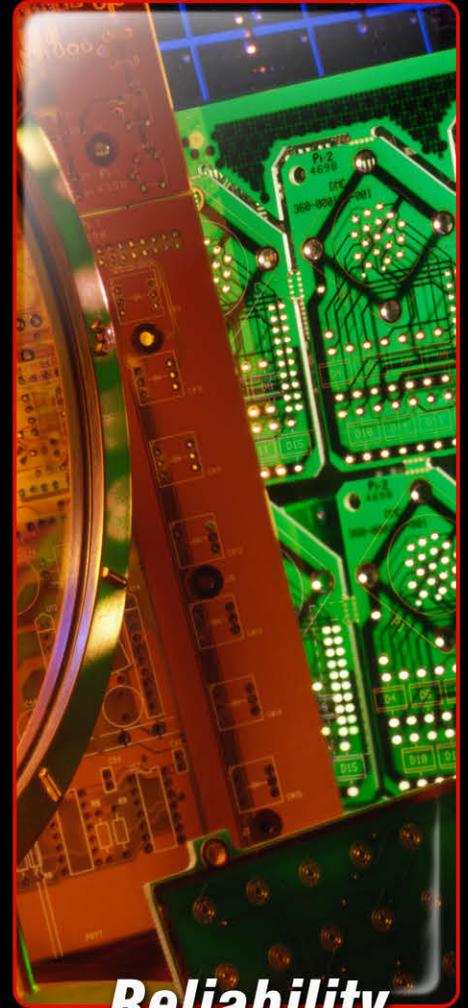
*because you don't have the time to do it over.*



***Technology***



***Speed***



***Reliability***



# Prototron Circuits

High quality quick turn manufacturing, just another reason we are  
**America's Board Shop**

**Redmond Facility**

15225 NE 95th Street, Redmond, WA 98052  
Toll: 888.847.7686 Phone: 425.823.7000

**Tucson Facility**

3760 E. 43rd Place, Tucson, AZ 85713  
Toll: 800.279.5572 Phone: 520.745.8515

# Who is Your Customer?

Fein-Lines

Feature Column by Dan Feinberg, FEIN-LINE ASSOCIATES

Who is your customer? The answer depends on your goal and whether you're talking about the short term or the long term. Are you in sales or marketing and therefore looking to sell or assist in selling your company's products? If so, then you might say that your customer is XYZ Circuits or ABC Assembly or even Ace Distribution. But are they really your key customer?

What is your goal? I would bet, at least initially, that it is earning a living, increasing your income through salary, and the commission associated with selling your company's product. But what is your medium- or long-term goal? It is never too early to consider this. If all you want is to do is earn a living, then identifying the customers and then selling the product to the customers for that product makes it easy to answer the question, "Who is the customer?"

But if your goal is to climb the corporate ladder, eventually get into sales management, junior executive status, become president, build and grow your own company, increase your company's sales and your career, then you have to separate the customers into at least three categories.

## Customer Categories

The first category is obvious: A customer is a candidate to buy your company's products.

The second is your boss or your board of directors. It is imperative that you always have this category in mind. Helping your boss and your senior management team to progress by supporting their goals, making them look good and gaining their respect will pay huge dividends as opportunities

arise. I realize that there will be times that you will be in competition with others in your company for those valuable positive relationships; you may find yourself on the opposite side of an issue or strongly feel that the wrong path is being followed. You may even have to speak out in opposition. Sometimes you may even have to leave and strike out on a new path for yourself.

Just be sure that you always keep this category (call it "key personal customers") in mind and do not make your decisions in haste.

The third category is far less obvious. Sometimes the customers in this category are your competitors and/or rivals. Sometimes it can pay huge dividends to "respect while you oppose." It is very possible to beat your competition for an account (category 1), or beat your colleague for a promotion or disagree with your boss in a respectful or private way and still gain their respect (category 2), or take business from a competitor and still gain their respect. Perhaps you do it by truly earning it



**APEX  
EXPO<sup>®</sup>**  
**IPC 2018**

**FEB 27-MAR 1**  
**SAN DIEGO, CA**

**Visit us at**  
**BOOTH # 539**



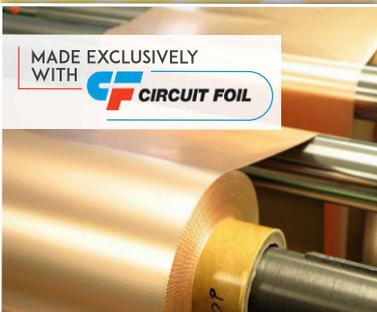
**MATRIX**  
CIRCUIT BOARD MATERIALS

# The Gold Standard in PCB Materials and Services



**Panasonic**

Multilayer & Flex  
Laminates



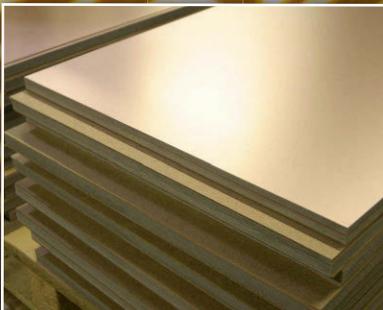
MADE EXCLUSIVELY  
WITH **CIRCUIT FOIL**

**ADVANCED COPPER FOIL**

High Quality ED  
Copper Foils



Drills, Routers & Endmills



**KB**  
KINGBOARD

Rigid CCL



**Hakuto**

Film Laminators

**1-800-668-5447 • [www.matrixusa.us](http://www.matrixusa.us)**

TORONTO • SANTA ANA • SANTA CLARA • CHICAGO • MINNESOTA • OSAKA

or by building a better relationship and gaining the business even though your product may not be superior. Or perhaps it is by helping the career of an internal competitor even though it was you who got the promotion. Sometimes you can work with a competitor on an industry project for the common good.

When you beat someone for the sale, or perhaps for a key promotion, or you work with them on a common project, you have a great opportunity to gain the respect of the competition who may have just lost to you. Find a way to then help them and take advantage of the opportunity. Years later I will bet that you will be glad you did.

I can recall situations in my career where all of these situations helped me get to where I wanted to go. Remember the path does not end when you make the sale. The marketing plan is a life-long path and there will be times when some people you never expected to do so will become your customers. **PCB007**



**Dan Feinberg** is president of Fein-Line Associates and a contributing editor for I-Connect007. To read past columns or to contact him [click here](#).

## Shape-shifting Organic Crystals Use Memory to Improve Plastic Electronics

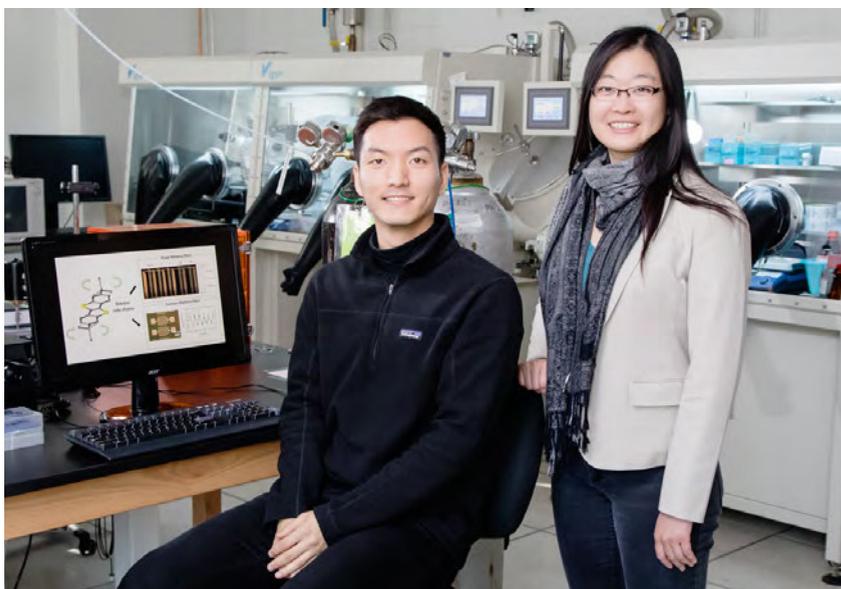
Researchers have identified a mechanism that triggers shape-memory phenomena in organic crystals used in plastic electronics. Shape-shifting structural materials are often made with metal alloys, but the new generation of economical and printable plastic electronics is poised to greatly benefit from this recently identified phenomenon, too. Shape-memory materials science and plastic electronics technology, when merged, could open the door to advancements in low-power electron-

ics, medical electronics devices and multifunctional shape-memory materials.

Devices such as the expandable stents that open and unblock clogged human blood vessels use shape-memory technology. Heat, light and electrical signals, or mechanic forces pass information through the various devices, telling them to expand, contract, bend and morph back into their original form. They can do so repeatedly, like a snake constricting to swallow its dinner. This effect works well with metals,

but remains elusive in synthetic organic materials because of the complexity of the molecules that are used to create them.

“The shape-memory phenomenon is common in nature, but we are not really sure about nature’s design rules at the molecular level,” said Professor of Chemical and Biomolecular Engineering and Co-author of the study, Ying Diao. “Nature uses organic compounds that are very different from the metal alloys used in shape-memory materials on the market today,” Diao said.



# The Road to Outsourcing CAM Engineering is Paved with VALUE!



	In-House	With Entelechy
Availability	48 weeks	52 weeks, 24/7
Overhead Cost	>30%	0%
Scalability	Limited	Unlimited
Redundancy	Variable	100% Bulletproof
Operational Efficiency	Status Quo	Continual Improvement
Total Cost	Fixed	Significantly lower

“ In our company, the CAM department was the bottleneck. As a result of our working with Entelechy, we can now accept orders that we had to refuse in the past.”

-Thomas Hofmann, CEO/Owner

**HOFMANN**  
LEITERPLATTEN

**Click here to check out our risk-free Quick Start program»**

We deliver the highest quality PCB CAM and Mechanical CAD engineering services to customers around the world.



**ENTELECHY GLOBAL**

www.entelechyglobal.com

# Electronic Industry News and Market Highlights

## IoT Data Traffic Per Node: The New Critical Metric for IoT System Designers ▶

The best IoT message bandwidth planning may not survive the first contact with real-world data as IoT System Integrators (SIs) and network planners face the challenge of developing a project concept while at the same time anticipating the data traffic use case requirements.

## Wearable Technology Market to Grow Over \$25B in 2018 ▶

In its new report titled “Wearable Technology Market 2018-2028: Forecasts and Analysis by Product Type (Wristwear, Headwear, Bodywear), Application (Consumer Electronics, Healthcare, Enterprise & Industrial, Others) and Geography, with Analysis of Leading Companies,” Visiongain forecasts the global wearable technology market to reach past \$25 billion in 2018.

## What’s Coming in 3D Printing Technology in 2018 ▶

First, the arrival of extrusion metal printing. Today’s extrusion printers are the most pre-

valent and, arguably, user-friendly 3D Printers in the market. Now, after years of there being zero metal extrusion printers, there will be two in the new year from Desktop Metal and Markforged. These technologies promise new materials and a higher degree of user friendliness for metal printing.

## Artificial Intelligence a Game Changer for Personal Devices ▶

Emotion artificial intelligence (AI) systems are becoming so sophisticated that Gartner Inc. predicts that by 2022, personal devices will know more about an individual’s emotional state than his or her own family.

## Global Smartphone Production Growth Will Drop to Only 5% in 2018 ▶

According to the latest research by TrendForce, Chinese smartphone brands have continued the prior year’s strong growth momentum in 2017, bringing the global smartphone production to 1.46 billion units, an increase of 6.5% compared with 2016.

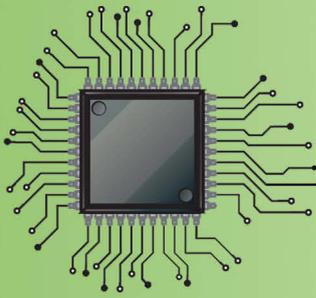
## IHS Markit Identifies the Top 8 Technology Trends for 2018 ▶

From the Internet of Things to the cloud to artificial intelligence, industries are seeing a new wave of technologies that have the potential to transform and significantly impact the world around us.

## Swallowable Sensors Reveal Mysteries of Human Gut Health ▶

The trials by researchers at RMIT University have uncovered mechanisms in the human body that have never been seen before, including a potentially new immune system.





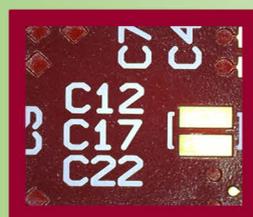
# MivaTek

**Global**



## **LED Direct Imaging**

***We give a dam...2.0 mil solder dams***



- > 2.0 mil solderdams
- > 4 mil mask defined pads
- > Colors: GRN, WHT, BLK, BLU, RED
- > Excellent camera registration
- > Legend printing using white SM
- > Inner and outerlayer imaging
- > Extensive North American support
- > 20 machines sold in North America

*MivaTek Global, LLC formerly Kuper Technology, LLC*

**Now Hiring** : Sales Engineers, Applications Engineers and Technical Support

MivaTek Global, LLC, PO Box 893, Concordville, PA 19331, Ph: (610) 620-3795

Eastern US: Brendan F. Hogan, M:(610) 620-3795, B.Hogan@MivaTek.Global

Western US: Kurt Weber, M:(714) 767-6367, Kurt@MivaTek.Global

**MIVA: LED DIRECT IMAGING**

# Who is the Customer?

**It's Only Common Sense**  
Feature Column by Dan Beaulieu

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

First, you have your traditional customer, the guy you sell stuff to so that he in return can give you money that makes your business work. Some would say you have to be nice to this guy or you will go out of business. The first reason to treat this transactional customer like gold is because the other golden rule applies: he has the gold and you want it, so give him something. We get that, and it’s called business.

But customer service goes far beyond that. The thing is, when running a business, we do not want just one deal, one transaction, with any of our customers. We want to gain our customers’ business for life. Take the grocery business, for example. Grocers take the long view when it comes to their customers. They figure out how much the customer spends in the store every week, and they multiply that by 52 weeks; then they multiply that by 10 years and they get the true value of a customer. That’s why they offer you all those handy-dandy discount cards and other loyalty programs. It also doesn’t hurt that by getting you to join their loyalty clubs they also get to know everything about you, including what you buy and



**“As an expert in loyalty, Fido will create an emotional bond with each customer.”**

# Mentor<sup>®</sup>

A Siemens Business

Speed up your  
**PCB design verification**

by up to **90%**

**Get HyperLynx DRC for**

**FREE**

for 12 months

**COMPATIBLE WITH ANY PCB LAYOUT TOOL!**

[www.mentor.com/get-drc](http://www.mentor.com/get-drc)

how often you buy it; this is incredibly valuable information that they then sell to big data companies for a lot more than the measly discounts they are passing along to you, their customer. But the important thing is that they spend time, effort, and money to study their customers, learning their buying habits to get to know them better, and to service them better. That's not a bad thing.

---

**But the important thing is that they spend time, effort, and money to study their customers, learning their buying habits to get to know them better, and to service them better.**

---

In our business, we have to find other ways to do this. We must find ways to learn everything we can about our customers including their buying habits. We should find out the following:

1. What do they spend every year on our product?
2. What are their buying habits? When do they place their orders?
3. When do they decide who their suppliers are going to be?
4. What is their criteria for choosing a supplier?
5. What really matters to them in terms of what they get from a supplier?
6. What is the size of an average order?
7. Who else are they buying from? Who is our competition?
8. Do they have a high supplier turnover?
9. Do they have a high employee turnover?
10. Do they communicate well with their suppliers?
11. What kind of business are they in?

12. What does it take to be successful in that business?
13. What position do they hold in their marketplace?
14. Are they industry leaders?
15. Do they have a great product?
16. Do they have a product with a future?
17. Are they innovators?
18. What is their business strategy?
19. Where will they be in one year? In five years?
20. What services can we provide to help them be successful in their business?
21. What do they look for in supplier?
22. What do they consider an outstanding supplier?
23. How difficult or easy are they to do business with?
24. What problems have they had with suppliers in the past?
25. If our business is building custom products, what do their tools (the data they provide you to build their products) look like?
26. Is the company profitable?
27. Do they pay their bills on time?
28. Do they understand and appreciate total value or are they all about price?
29. Are they likeable? (This is much more important than you think.)
30. Do we believe we can have a future with them? Can they be a customer for life?

And one more, because we always under-promise, and over-deliver (a great customer service tactic on its own): Is there chemistry between your two companies? Do you fit in well together? Can you work as partners in the future, sharing the same ideas, values, and goals? If you have that, you have everything.

If you ask all these questions diligently and you get all the right answers, chances are you will have a good idea as to not only who your customer is, but everything else about them, and that will help you provide great service and outstanding products. And that, after all, is the goal of being a great vendor.

It's only common sense. **PCB007**

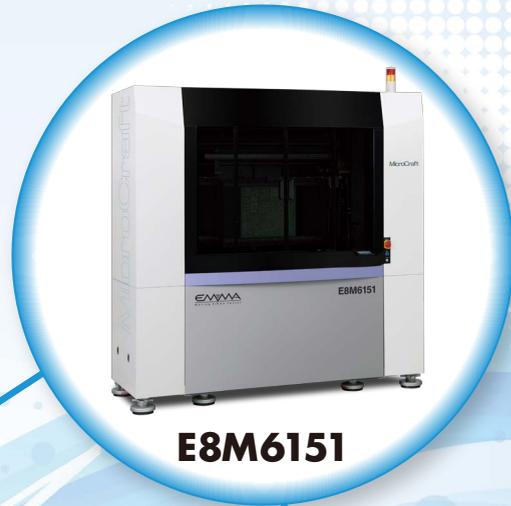
# NEED FASTER THROUGHPUT?

## MicroCraft's Latest Solutions for Quick Turn Shops



**CPT6151**

Both **solder resist** and **legend**  
inks are printed with 1 machine.



**E8M6151**

**3x** faster than previous models



**SC6151**

**10x** faster final bake

# Defining Your Customer

The Sum of All Parts  
Feature Column by Sam Sangani, PNC INC.



“What’s your clientele like?”

“What industries do you serve?”

“What type of customers do you generally see?”

These are the most typical ways in which someone will ask us who our customers are. Many times, the purpose is to see whether we work in the same spaces as them or as a way of gauging whether we are “worthy” enough of having them as a customer. The approach to a customer, though, should not be focused on a certain industry or a certain aspect of the manufacturing sector. It should fill a need, one that is broad and encompasses a wide variety of industries—from at-home appliances to aerospace parts.

It is our responsibility, as the providers of a product or service, to treat an individual or group as a customer *before* they give us their money. To treat them any other way seems conspicuously selfish. The cliché of the aggressive, borderline-rabid salesperson is just that: a cliché. People are less and less inclined to being “pitched.”

Webster’s dictionary defines a customer as “one that purchases a commodity or service.” On the face of it, that seems like a reasonable definition. What happens, though, when 100

or 1,000 other businesses offer the same commodity or service as you? You make every effort to set yourself apart from the competition. We’ve done this by redefining what a customer is to us.

It is no longer about the product we’re selling; now it’s also about the experience. Ask yourself this question: If price was not an issue, why would your customers pick you? Even in a predominantly B2B industry such as ours, experience matters. Sellers often forget that they are not only selling a product—they’re selling themselves. Trust is the single-most important thing a person or a business can buy from you. From there, the price of the product arguably becomes inconsequential.

So, to answer the question in so many words, our customer is anybody who comes to our business looking not just for a product, but for an experience that will allow us to demonstrate why you should pick us and not the other guys. **PCB007**



Sam Sangani is president and CEO of PNC Inc.

# Innovation: it's what leaders do.

For over a decade, the world's top flex PCB processors have relied on ESI's advanced laser processing solutions to drive innovation and stay ahead.

Can you afford to make the wrong decision? Future-proof your investment in flex PCB with ESI's family of laser processing solutions, and maintain your innovation advantage.

Align yourself with the industry leader and let ESI take care of your flex PCB drilling needs.

A man with a beard and short hair, wearing a dark blue suit jacket over a light blue button-down shirt, stands with his arms crossed and a slight smile. The background is a blurred office or industrial setting.

**esi**®

ESI's family of FPC laser processing solutions.

**5335**  
**GemStone**

**Flex5335**  
**LodeStone**

**5335xi**  
**RedStone**



For more information, visit us at [www.esi.com](http://www.esi.com)



## Catching up with Dan Thau of Millennium Circuits Limited

### Feature Interview by Dan Beaulieu

Millennium Circuits Limited is one of the fastest growing printed circuit board suppliers in our country today. Located in Harrisburg, Pennsylvania, this company has grown exponentially since it began some 12 years ago. I visited with Dan Thau, the owner, and his team last month and was pleasantly surprised at how organized and well-run this company is. In fact, this is one company that positively differentiates itself from the crowd with their outstanding customer service and technical support. I was impressed by the number of referrals, not to mention testimonials, that they have received in the past several years. MCL is one of the most customer-centric companies I have ever seen, and it is no surprise that their customer-vendor bond is one of the strongest in the industry. These guys don't lose customers—they just acquire them.

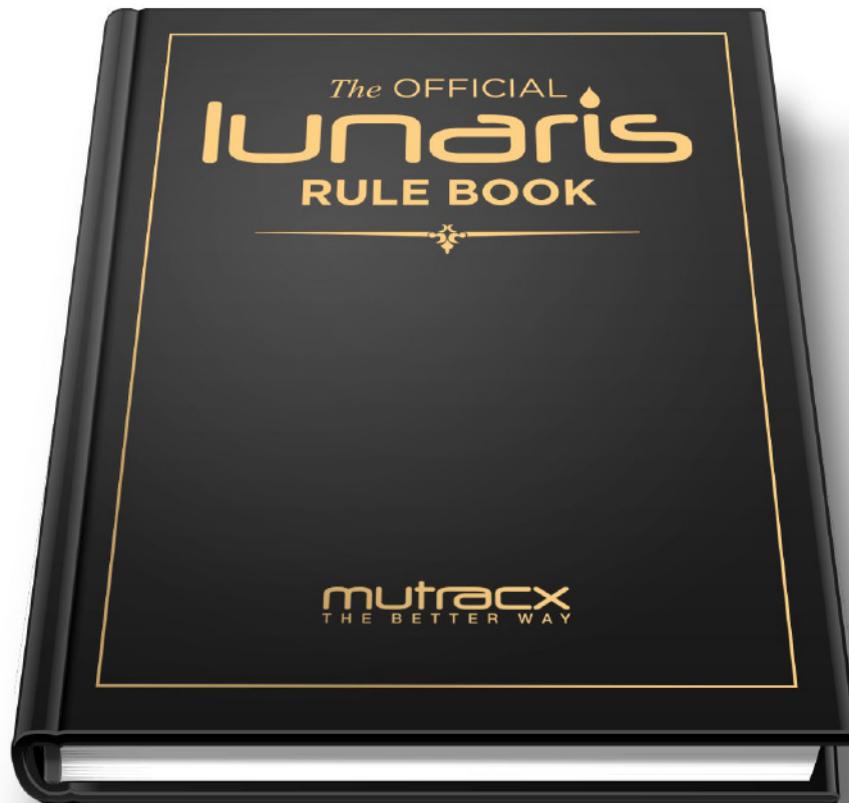
**Beaulieu:** Dan, tell me the story of how this company came about.

**Thau:** I founded MCL in January of 2005. Coming from the central Pennsylvania area, I saw a chance for this region to become an integral part of the electronics industry. We started by approaching local Pennsylvania companies first, because I could see that some of these local companies were struggling to get good quality PCBs at competitive prices from their current suppliers. I saw a need to find a better solution, so I did some research on the industry. Armed with that knowledge, I took a two-month trip to Asia to see if I could find the right companies to partner with, companies who could provide better overall value including quality, price and delivery. The trip was successful and I partnered with a Chinese company and provided my local customers with a better PCB solution. From



Dan Thau

# A new set of rules for PCB production



Less process steps. CAM to etch in minutes instead of hours. Maximum yield. Minimal environmental impact. These are just a few of the PCB production rules that Lunaris has redefined.

We've put together a complete set of all the new rules made possible by Lunaris ...get yours today!

Download all the new rules:  
**The Official Lunaris Rulebook**

CLICK HERE TO DOWNLOAD



**mutracx**  
THE BETTER WAY

[www.mutracx.com](http://www.mutracx.com)

there we went national which is where we are today, selling to companies all over the country.

**Beaulieu:** Tell me about your services and capabilities.

**Thau:** We provide our customers with a wide array of PCBs, including aluminum, high-current and heavy copper as well as other specialty boards. We can provide PCBs to customers in niche markets including RF microwave, HDI, high-speed digital and ceramic PCBs. Additionally, to assist our customers with preparing for their assembly process, we provide them with defect-free SMT stencils. Our capabilities allow us to build everything from the simplest to the most complex PCBs and at very competitive prices.

**Beaulieu:** Now let's talk about customer service. I know this is an area where MCL thrives.

**Thau:** Yes, absolutely. Our motto is "Redefining Customer Service" which is something we excel at. The internal processes we have in place and our partnerships with our customers and manufacturers allow us to accomplish this and fulfill our motto because, unlike many of our competitors, we pride ourselves on being proactive. This is especially true when something happens; when something does not go according to plan such as when shipments are late, or manufacturing delays occur, we make sure that our customers are kept informed as soon as possible. We also spend a lot of time talking with our customers about board design,

materials and specifications to ensure quality PCBs and ease of manufacturing. The resources that MCL bestows on our customers as well as our personalized attention, is something that makes us outstanding—and sadly something that is lacking in our industry.

**Beaulieu:** Define great customer service for me.

**Thau:** Great customer service is providing open and honest communications with our customers no matter their size. We have always been very proactive when it comes to customer communications and that has been a contributing factor to our growth. We always tell our customers what is going on whether it would be upcoming Chinese holidays where factories close—where we will still find a way to get our customer their boards—to telling them when a problem occurs, we always are there protecting our customers by first telling them about the problem and then solving it for them.

Communication is always the key to a successful partnership with our customers. It boils down to treating customers the way they should be treated, as our most valuable asset. Without customers we have no business. It's as simple as that.

**Beaulieu:** What about technology and quality? Can you say something about those disciplines?

**Thau:** The success of MCL has been based on being able to service a wide variety of market niches and high-tech market segments. We support everything from laser blind and buried vias, to ceramic PCBs, to metal core boards, to flex and rigid-flex boards to RF microwave boards. We can literally provide any technology PCB to any customer in any market segment. We are not bound by brick and mortar which gives us a significant advantage when it comes to fully servicing a wide range of customers. Being a value-added distributor allows us to provide our customers with any technology, and any service they might need. This also includes any specifications and qualifications they need as well.



Figure 1: MCL headquarters, Harrisburg, PA.

**Beaulieu:** Dan, what would you say makes your company stand out?

**Thau:** Our mission is to be “a strategic partner committed to growth of our customers by offering high-quality products at competitive prices, innovative solutions and industry leading support services.” Our competitors have simple buyer/seller transactions with their customers, which is fine, but it does not really provide true value to their customers. We are in constant communication with our customers. We talk to them about every order, no matter the size of that order. By being a strategic partner to our customers, we are a source of information about not only manufacturability of their product, but also best practices. Our customers often say they are surprised by the amount of attention we pay them. At MCL we are heavily invested in the service we provide along with the product. We consider this all part of a great overall package. Our salespeople are really customer specialists who are dedicated to the success of their customers. If our customers succeed, so do we.

**Beaulieu:** Who are your customers? What kinds of companies use your services?

**Thau:** Our customers are primarily companies who appreciate the value we bring them through our consultative sales initiatives. While we do offer competitive prices, we are not always the lowest-priced PCB solution. Our true customers and the ones we target are those who place a greater importance on value more than price. MCL doesn't believe it is ethical to simply source the cheapest boards possible. We provide a greater value in being a resource and partner to our customer. Our customers want a board shop they can rely on, bring questions to, and with whom they can have a more than just a transactional relationship.

**Beaulieu:** What do you see as a challenge in today's market?



Figure 2: Team photo, summer 2017.

**Thau:** Today, this industry is moving so fast that the challenge is to stay ahead of the curve. MCL is focused on continuous improvement and by doing that we are constantly challenging our team with cutting-edge designs and demands from our customers. We thrive on change and we succeed by providing our customers with tomorrow's technology today.

**Beaulieu:** Continuing with that line of questioning, how do you see the market today?

**Thau:** As I mentioned, it is an ever-changing market and it is our responsibility to keep up with those changes. Our strategic partnerships are based on technology. Whether a customer is looking for a single or double-sided PCB or an HDI microvia board, they know they can come to us and get the best value-based solution on the market today. Our belief is that if a customer is looking for just a lower price they will find it no matter what. Especially if that is all they care about, that to us at MCL is not value. For us to have a good working partnership with our customers, they have to see and appreciate the value in what we do.

In terms of technology, it is always advancing and now more than ever, at a very rapid pace, so the PCB supplier who chooses to stand still will be out of business in a very short time. To succeed, today's value-added distributor has to stay up to date in what he

has to offer. Otherwise it just will not work. Our customers are counting on us to always be there for them providing them with whatever technology they will need to be successful.

**Beaulieu:** How do you sell at MCL?

**Thau:** We use the consultative approach to sales. We want our customers to feel educated, prepared and comfortable with their decision to use MCL. We want them to trust us which means trusting their salespeople. Everything is fully transparent when you deal with us. We have no hidden fees. We have a full in-house support team, so our customers will never have to worry about language issues or talking to someone overseas because we handle all of that for them.

**Beaulieu:** How about marketing? How do you get your name out there?

**Thau:** MCL gets a lot of referrals, which tells us that we are living our mission statement. We also make what we call “warm calls” to potential customers and consult them from a manufacturing standpoint about their new designs that are coming up. We have produced many pages of useful industry content and put it on our website. This drives customers to our website since they are always looking for information about the technology they require both today and in the future. As I mentioned before, we are in the business of educating our customers, which is a service they truly seem to value.

**Beaulieu:** Where would you like to see your company in five years?

**Thau:** Our plan is to continue growing in the PCB marketplace. We plan to do this by continuing to bring on top quality vendors that can supply our customers with the highest technology boards they require. We will continue to stay on the cutting edge of technology that



Figure 3: A peek inside MCL.

will keep us at the forefront of the industry. We'll continue to grow into niche markets, always seeking new ones to penetrate. Our plans include growing our business in this Central PA facility. In terms of technologies, we have noticed an increasing need for ceramic PCBs that have higher thermal conductivities and we are making investments in time

and relationships to support those needs.

**Beaulieu:** Are you looking for new vendor partners?

**Thau:** Yes, of course we need good vendor partners. We don't just accept any new vendor as a partner. All our vendors must operate with the same mindset in which MCL operates, which is being a strategic partner down through the line. We are also always looking for good and passionate salespeople as well. Our growth has been consistently substantial enough to keep us on the lookout for good people to service our customers.

**Beaulieu:** Dan, do you have any final thoughts?

**Thau:** We at MCL have noticed a growing need and demand for a PCB distributor who is highly knowledgeable and willing to take the time to consult with his customer base, helping them to make informed decisions. This is especially vital during the beginning phases of the design process. Done right from the start, this will help customers save a lot of time and money in the end. As technologies and materials continue to push the envelope, PCB suppliers will have to adapt and adapt quickly, making their sure they can assist their customers by being their PCB experts.

**Beaulieu:** Well said. Once again, thank you for your hospitality and especially for having this talk with me today.

**Thau:** It was my pleasure. **PCB007**

# Unrivaled Test Speed with Full Automation



Introducing the newly designed atg A8a with 8 test probes and a new high speed “lights out” automation for unrivaled throughput.



## Highlights:

- Small footprint (6 square meters)
- Dual shuttle pick & place automation
- High accuracy combined with high test speed
- Pen or label marking option

[Watch video](#)

[Get more info](#)

**atg Luther & Maelzer GmbH**

Zum Schlag 3 • 97877 Wertheim • Germany  
Phone +49-9342-291-0 • Fax +49-9342-395 10  
sales@atg-lm.com • www.atg-lm.com

**APEX  
EXPO<sup>®</sup>** BOOTH  
**IPC** 2018 **#207**

**atg<sup>®</sup>**  
**LUTHER & MAELZER<sup>®</sup>**  
an **Xcerra** company



# MilAero Highlights

## Standard of Excellence: 5 Things a Total Global Solutions Supplier Can Provide ▶

Our world now extends far beyond the traditional brick and mortar of the domestic board suppliers of yesteryear. Now our customers demand that PCB fabricators provide them with a complete and total printed circuit board solution, from domestically built ITAR-registered defense and aerospace boards to high-volume, offshore solutions.

## Coast to Coast Circuits Adds CW Cernosek to Leadership Team ▶

Coast to Coast Circuits Inc. has added CW Cernosek to their leadership team as corporate business development and marketing manager.

## NASA 2017: A Year of Progress and Poised for the Future ▶

Throughout 2017, NASA's Space Technology Mission Directorate (STMD) made noteworthy progress in maturing and demonstrating technologies to bolster America's space agenda, while setting the stage for vital advancements within the next several years.

## APCT Holdings Acquires Cartel Electronics & Affiliate Cirtech ▶

APCT Holdings has acquired the Southern

California based company Cartel Electronics and its affiliate company, Cirtech. With this acquisition, APCT now becomes one of the largest privately held printed circuit board manufacturers in North America.

## European Aerospace Firm Acquires Nano Dimension DragonFly Pro 2020 3D Printer ▶

Nano Dimension Ltd. today announced that a leading European aerospace and defense supplier has purchased the company's DragonFly 2020 Pro 3D Printer for professional electronics manufacturing.

## Ventec Passes AS9100 Revision D Transition Audit in China and UK ▶

Ventec International Group is pleased to announce that the company headquarters in Suzhou, China and its European headquarters in the United Kingdom have both successfully passed the transition audit to AS9100 Revision D with zero non-conformances in accordance with the Aerospace Supplier Quality System Certification Scheme.

## Global Electronic Warfare Market to Reach \$17.7 Billion by 2027 ▶

The global electronic warfare market is expected to be valued at more than \$13 billion in 2017, and will grow at a CAGR of more than 2.6%, to cross \$17.5 billion by 2027.

## Soft Materials Bring a Human Touch to Robotics ▶

Soft robotics has many promising applications. It brings a list of capabilities absent in most other robotics, including dexterity, flexibility and safe physical interaction with humans. Soft robotics refers to robotics that are comprised of either soft materials, soft joints or soft layers over hard armatures.



*Flexible, reliable Supply  
Chain Solutions  
high quality copper clad  
laminates & prepreg  
bonding materials*



**ventec**  
INTERNATIONAL GROUP  
騰輝電子



Ventec International Group is a world leader in the production of high quality and high performance copper clad laminates and prepregs, with full R&D and product development capabilities. Our global distribution means we can readily supply our products to all markets in all geographic areas.



VISIT US IN  
**BOOTH #818**

**Ventec - wherever technology  
takes you, we deliver**

**Ventec International Group**

179 Ward Hill Ave,  
Ward Hill, MA 01835,  
United States

**T:** 978-521-9700

**E:** [ordersCA@ventec-usa.com](mailto:ordersCA@ventec-usa.com)

**Follow @VentecLaminates**

[www.ventecclaminates.com](http://www.ventecclaminates.com)

# IPC 6012-DA Revisions: The Approach to Cleanliness, Thickness, Inspection, and Wicking

The PCB Norseman  
by Jan Pedersen, ELMATICA

IPC's Automotive Addendum task group was started in November 2014 and the first edition of IPC 6012-DA was released in April 2016. We are now working on the revised version, and expect a release in Q2 2018. As standards need to evolve, develop and follow the needs of the industry, this work is continuous. This column will address some of the challenges the group faces and some of the issues we want to avoid by revising IPC 6012-DA. The automotive industry is an industry with high-volume production; this needs to be considered when developing a standard further.

## The First Challenge: Cleanliness

We have so far focused on four areas for improvement. One of these are the requirements and test methods for cleanliness in printed circuits. The test requirements for cleanliness or ionic contamination used today date to the '80s and don't fill the demands for today's printed circuits, as these consist of more advanced technology and requirements than in

the '80s. However, new ways and equipment to test cleanliness have recently been developed. As soon as the methods have been thoroughly tested, they can be implemented as a demand in IPC 6012-DA. Close communication with the IPC task group for cleanliness and continuous monitoring of the development and progress is the way to move forward. However, the group have decided that the methods are so promising, that we will implement them in the revised addendum—as a recommendation, not a demand.

## Changes with Industry 4.0

When the automotive industry embraced Industry 4.0 the demands for more complex and small-scale electronics increased. Smaller and more complex printed circuits naturally increase the need for cleanliness testing as well. The challenge is when the test methods are not equally developed and as advanced as the printed circuits. It's like building a new kitchen but keeping the old and malfunctioning



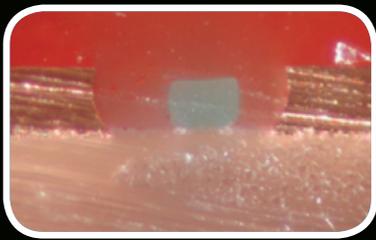
# LIQUID PHOTOIMAGEABLE SOLDER MASK



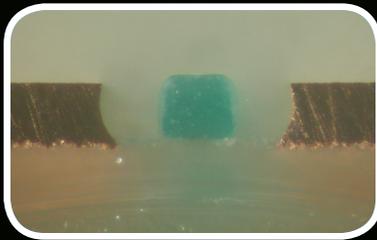
## DIRECT IMAGING

PSR-4000 BW01DI, PSR-4000 BN HF DI & PSR-4000 GP01EU DI

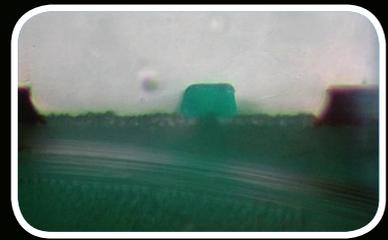
- Ⓜ DIRECT IMAGING
- Ⓜ EXTREMELY FAST PHOTO SPEED, < 100 mJ
- Ⓜ GREEN GLOSSY FINISH
- Ⓜ WITHSTANDS ENIG & IMMERSION TIN
- Ⓜ FINE DAM RESOLUTION
- Ⓜ COMPATIBLE WITH LEAD-FREE PROCESSING
- Ⓜ HALOGEN-FREE



PSR-4000 BW01 DI



PSR-4000 BN HF DI



PSR-4000 GP01EU DI

**TAIYO  
AMERICA**  
Your Ultimate Solution

Phone [775] 885-9959 • [www.taiyo-america.com](http://www.taiyo-america.com) • [info@taiyo-america.com](mailto:info@taiyo-america.com)

in

appliances. The methods were designed for process control, not for the qualification of a production lot, as many believe and expect them to do. In reality, we still don't have a sufficient and fast test method to do a proper lot qualification.

Another issue that has recently been brought up in discussions with test laboratories and internally in the Automotive Addendum task group is the ability to test local areas. Today's methods measure the cleanliness of the entire printed circuit and are not able to find and locate local contaminated areas. To control quality and reliability you need the ability to measure cleanliness in those critical areas. New tools will make this possible, and it is a priority for the task group to evaluate and qualify improved methods to check the cleanliness of a specific area.

In addition to new test methods, we are also discussing at what time in the production process we should do the testing. Performing a cleanliness test of your printed circuit before soldering may provide a result contaminated by natural substances from solder mask. We believe this will vary by solder mask curing and will be hard to control. A solution on how to avoid this could be to send the bare PCB through a reflow process and perform a test on this one, since reflow will give the PCB an additional cure. This theory has been supported by a test report provided by Bosch.

## A Standard for Thickness

The second challenge we spend much time on these days is the thickness of solder mask. The industry currently operates with two standards: standard a and b, referring to application methods. The group has reached the conclusion that this is not optimal. We consider adding a demand for a specific thickness, suitable for all application methods—a demand that will meet the requirements and still be manufacturable.

## Expect Better Inspection

Our third challenge and area of focus is the level of inspections and inspection methods on the finished board. IPC requires that

the inspections are after certain AQL (acceptable quality limit) demands. Automotive production requires 100% visual inspection. With the volume in this industry, and with increased miniaturization, a 100% visual inspection by an operator is not practical. Implementation of automated visual inspection is under discussion in the task group and will be added to the standard as a recommendation.

## How do we measure wicking?

The fourth challenge that has been addressed by the task group lately is wicking, and how this is measured. According to our experience, the parameters provided by IPC are at best confusing. IPC requires that wicking is measured from the drilled hole edge to the point where the wicking ends. This might result in a false result where you don't measure the wicking itself. In the new and revised edition of the Automotive Addendum, we will be precise that the measurement should start and stop where the wicking starts and stops. Only then will the results be correct.

Standards for PCB production specifications need to be alive and kicking, facilitating a modern production that meets the demands of today, not the ones in the past. As chair and member in several task groups, I know how much work lays behind a standard. The whole idea with task groups is to work diligently towards an improvement, assuring that all needs and consequences are considered and monitoring the challenges from all stages of production. We need to extract knowledge from production files and convert it into useful information to improve the standards so they match the demands not only from IPC, but also the industry.

With that in mind, I believe we also need a digital article specification that picks up requirements from all bits in the supply chain, but that is another topic. **PCB007**



**Jan Pedersen** is Senior Technical Advisor at Elmatica. This column was originally published as a blog on the Elmatica website and reprinted here with permission.

# Get the spark you need to tune up your sales team.

When an engine doesn't fire on all cylinders,  
performance is limited. The same goes  
for your sales team. We provide  
the spark to get your  
sales to the next level  
...and beyond.



We've helped dozens  
of companies big and small  
improve their bottom line.



Learn how we can help YOU 

 207-649-0879  danbbeaulieu@aol.com

# Surface Preparation and Cleaning, Part 1

## Trouble in Your Tank

by Michael Carano, RBP CHEMICAL TECHNOLOGY

### Introduction

Surface preparation and cleaning are essential aspects of metal finishing and printed circuit board fabrication. The printed circuit board fabricator has several processes that fit the broad category of cleaning and surface preparation in its toolbox. It is critical that the engineer carefully evaluates these methods and processes to determine the most effective way to optimize yields.

### Overview

In general, surface preparation is done to assure good adhesion of metal, dielectric, photoresist, or soldermask to the prepared surface, although avoiding excessive adhesion could also be the object. Take the example of surface preparation before dry photoresist lamination:

- Failure to achieve good adhesion in a print-and-etch process will cause etchant attack under the resist and ultimately create an “open” defect
- Failure to achieve good adhesion in a plating process will cause tin/lead underplating, ultimately leading to “shorting” defects (shorts)

- Failure to achieve good release of unexposed resist during development can cause etch retardation in a print-and-etch process, ultimately leading to shorts
- Failure to achieve good release of unexposed resist during development can cause poor adhesion of the plated copper to the copper base (“copper-to-copper peelers”) in a plating process
- Failure to achieve good release of exposed resist in a print-and etch process on innerlayers can inhibit the formation of multilayer bonder on such a copper surface
- Failure to achieve good release of exposed resist in a plating process can cause etch retardation
- Failure to remove residues including chromates, organic soils (including resin spots) will adversely affect innerlayer bonding and plating quality

Figure 1 depicts an example of both an open and short due to improper surface preparation leading to poor adhesion. Figure 2 shows a schematic of poor adhesion leading to resist lifting. As a result, the poor adhesion leads to etching away of copper.

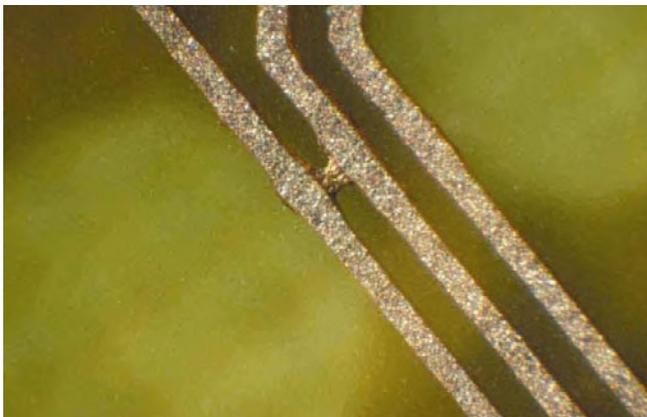
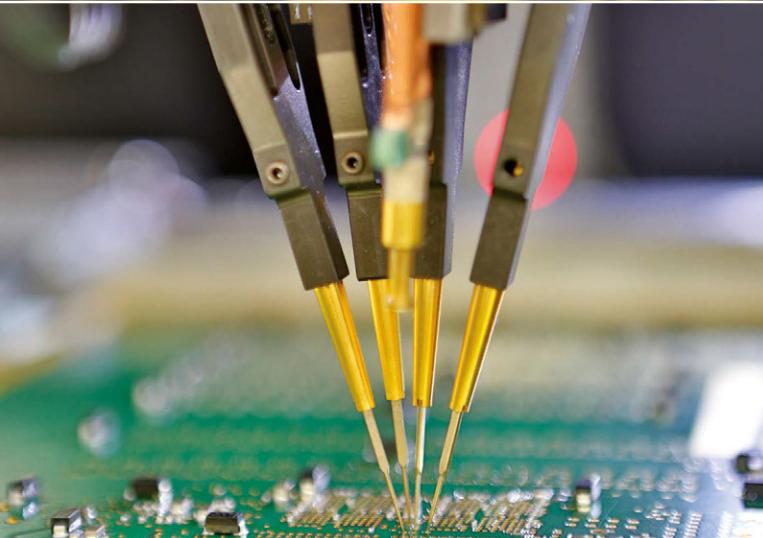
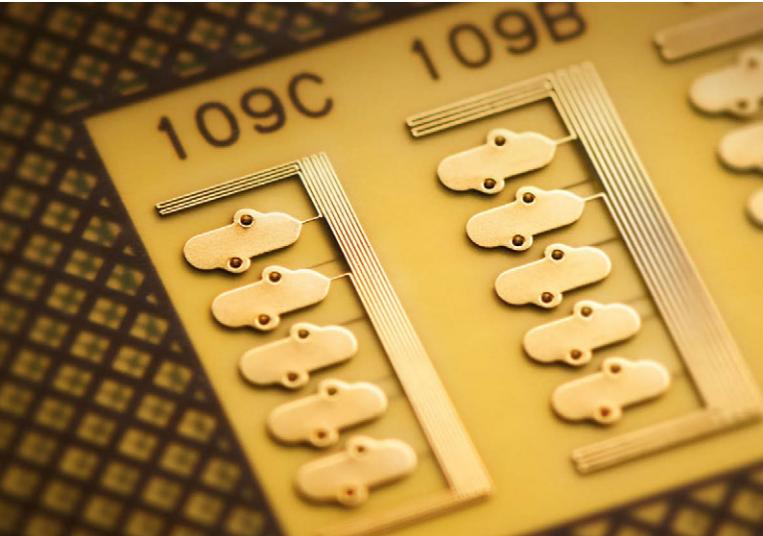


Figure 1: Short circuit (left) and open circuit (right) due to insufficient resist adhesion.

# cicor

## Your technology partner



Cicor is a global engineering and manufacturing partner with innovative technology solutions for the electronics industry. With about 1900 employees at ten production sites, Cicor manufactures highly complex printed circuit boards, hybrid circuits and 3D-MID solutions and offers complete electronic assembly and plastic injection molding.

**The Group supplies customized solutions from design to finished product for international customers.**

Follow us:



[www.cicor.com](http://www.cicor.com)

[info@cicor.com](mailto:info@cicor.com)

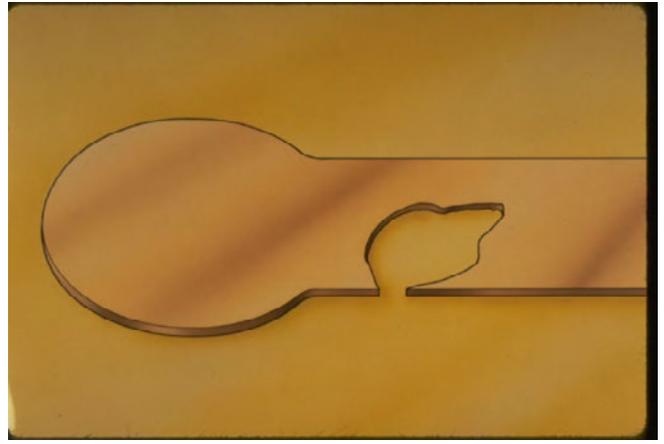
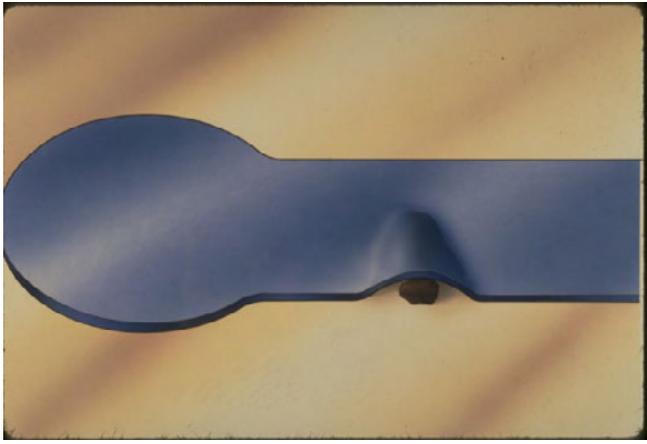


Figure 2: Innerlayer showing poor resist adhesion (left) and result after etching (right).

### Understanding Surface Preparation Issues

To fully grasp some of the surface preparation issues encountered in the PCB fabrication process, a short primer on the copper foil manufacturing process follows. This will enhance the reader's understanding of the composition and topography of standard electrodeposited (ED) foils and reverse-treated foils (drum-side treated foils).

Copper foil is manufactured in a reel-to-reel continuous electrodeposition process (Figure 3). After the copper foil is formed the foil unwinds and passes through several treatments in a treater line. Copper dendrites are first grown on the rough side. These dendrites are brittle and need to be encapsulated with more ductile

copper in a second step. This sequence is repeated, creating dendrites on top of dendrites. A zinc coating, or alternatively a brass coating, is then deposited, followed by the encapsulation with silane coupling agent, which forms strong bonds with the resin.

On the smooth (drum) side, a very thin zinc (nickel) barrier is deposited, followed by a chromate/zinc coating. The nickel barrier prevents the formation of copper/chrome intermetallics that are difficult to remove with acid cleaners. In the past, thickness and chemical composition of chromium layers were not well-controlled and could lead to poor resist adhesion and low yields. Great progress has been made in controlling the conversion coating. The de-

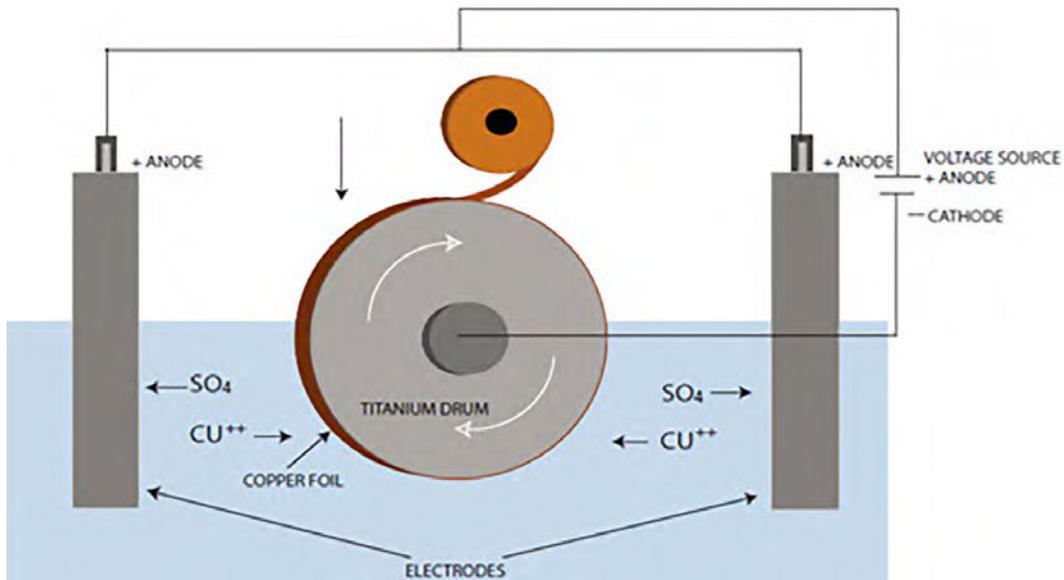
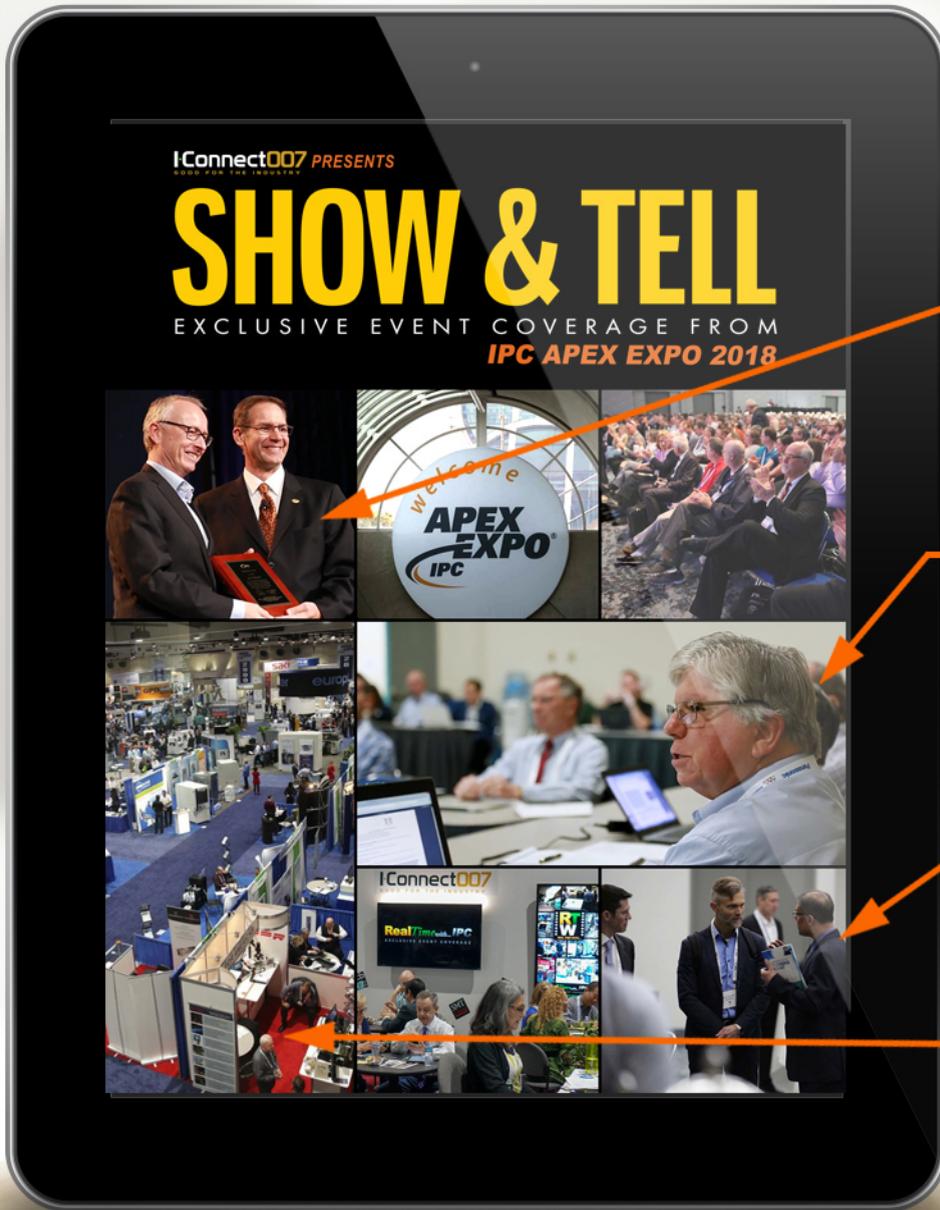


Figure 3: Manufacturing of electrodeposited copper foil. (Source: Oak-Mitsui Copper Company)

PROUDLY INTRODUCING OUR PREMIER ISSUE

# IPC APEX EXPO Show Coverage Magazine



Special coverage of the IPC Awards and Hall of Fame Inductees

Exclusive attendee and expert Q&A with designers, fabricators, and assemblers

Our columnists put the show into perspective

Our cameras take you to the show floor and beyond

[Register Now](#)

sirable stain-proofing properties are balanced against the ability to remove a fair portion of the chromium layer with a simple process step such as treatment with 10% sulfuric acid.

One should note that chromate levels may vary for any number of reasons. There is no perfect chromate thickness or amount on the surface of the copper foil.

Regardless, removing the chromate from the foil surface is the first step to enhancing photoresist adhesion. The chromate conversion coating serves as an anti-tarnish to preserve it and slow down the copper oxidation process. The chromium phase is actually a contiguous, hydrated  $\text{Cr}(\text{OH})_3$  phase, with chromium predominantly at the oxidation state  $\text{Cr}^{+3}$ , with interspersed zinc. The degree of hydration is critical to the removal of this layer in acid. Typical chromium coverage would be about  $5 \text{ mg/m}^2$ .

Occasionally, suppliers also apply organic anti-tarnishes such as benzotriazole. It is debatable why and to what extent these conversion coatings should be removed prior to lamination. In the case of chromate conversion coatings, there is ample evidence that most dry films do not adhere too well to such a surface. Also, in most innerlayer production processes, prelamination cleaning serves a dual purpose: the removal of chromate serves film adhesion but is also necessary to assure good oxide formation for multilayer bonding.

In addition, failure to effectively remove chromates and other soils will lead to what we call differential etching. Essentially this means that during the surface roughening step (after chro-

mate and soil removal) employing a microetch formulation, the roughening will be less than optimum due to incomplete chromate and other soil removal. This in turn negatively impacts adhesion of resists. Understandably, in those areas where organic soils and chromates remain, the microetch will have compromised ability to provide a uniformly structured surface.

## In-House Evaluation and Data Gathering

Due to the importance of surface preparation in printed circuit board manufacturing, the PCB fabricator should embark on an evaluation of current chemical and mechanical processes available. Some of the evaluations will require working closely with the dry film and chemical suppliers.

When evaluating the effectiveness of surface preparation for primary imaging, there are several data points listed below that will influence the success or failure of dry film adhesion:

- Surface profilometry with different microetches
- Effect of chromate removing chemistry on surface cleanliness and topography
- SEM analysis of treated copper surface (utilizing different microetch chemistries)
- Film/mask peel tests after chemical treatment
- Sidewall SEM analysis after development (comparing differing chemical prep methods)

Examples of generic chemistry performance on copper surfaces are shown in Figure 4.

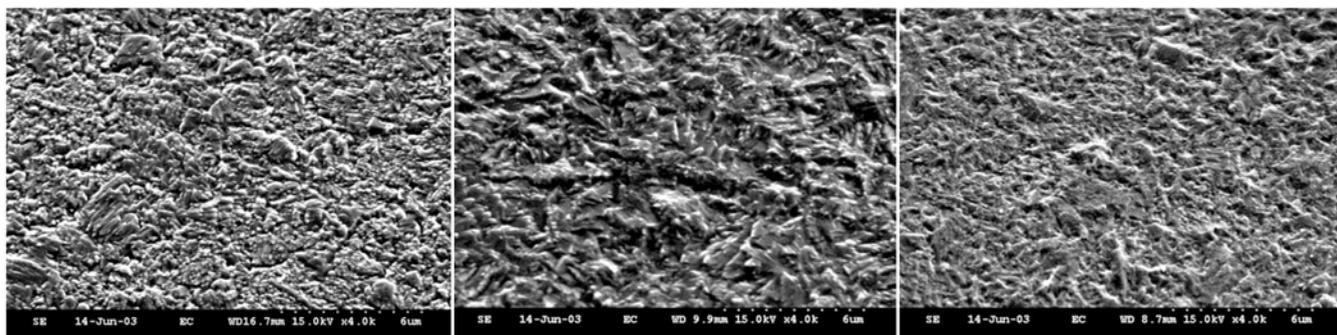


Figure 4: Examples of microetched surfaces. Hydrogen peroxide/sulfuric acid microetch (left); oxone (middle); sodium persulfate (right).

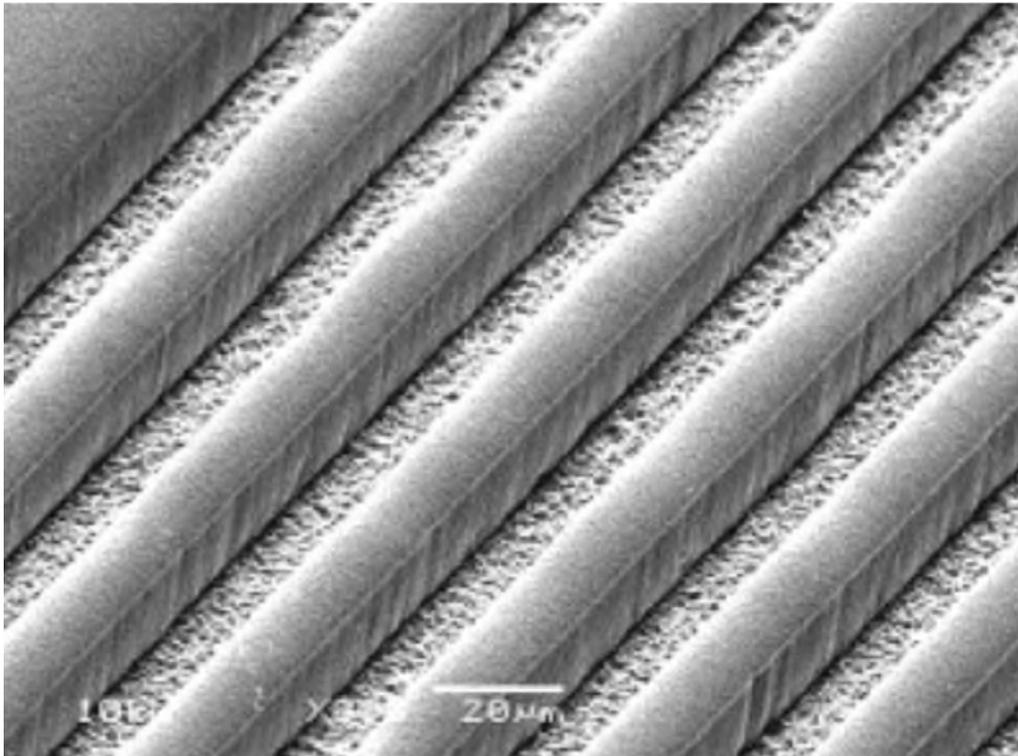


Figure 5: Sidewall of developed photoresist (20-micron line = 0.8 mil).

As shown in Figure 4, the various generic microetches impart stark differences in topography. One must take these differences into account when evaluating chemical clean processes and adhesion. In a future column, we will explore soldermask adhesion issues. This is critical due to the aggressive nature of several final finishes including ENIG and immersion tin.

## Desired Outcomes

The overarching task for the fabricator is to optimize the cleaning and surface preparation processes of the copper surfaces. The engineer will also need to finalize data including supporting documentation as to differences in the grain structures of different microetch formulations and their effect on the copper foils.

Recognizing these differences, the engineer will provide recommendations as to which combination of cleaners and microetches provides optimal surface profiles to meet current industry criteria, including but not limited to:

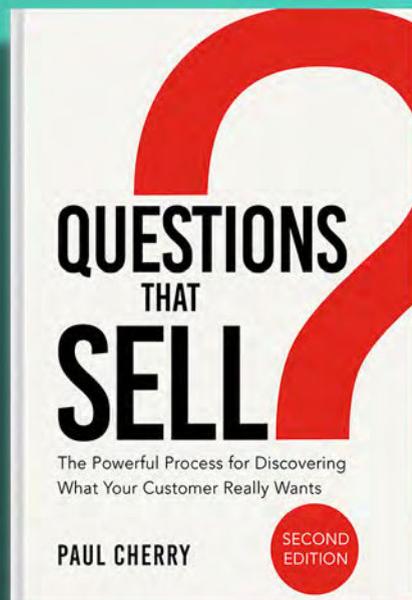
1. Adhesion performance for sub 5-mil lines and spaces for primary resist (Figure 5)

2. Ability to hold soldermask dams
3. Improve soldermask adhesion under various conditions including the ability to withstand lifting when exposed to ENIG and immersion tin plating processes
4. Documented yield improvements from customers willing to share data

In the end, lines and spaces are only getting finer. Sub 4-mil lines and spaces are becoming mainstream. Simply relying on laser direct imaging will not mitigate issues related to less than optimal adhesion of film to the surface. Ensuring that the copper foil surface has been properly cleaned of soils and chromates is the first step in ensuring good photoresist adhesion. This is then followed by surface roughening with chemistry to provide sufficient topography for the film to adhere. **PCB007**



**Michael Carano** is VP of technology and business development for RBP Chemical Technology. To reach Carano, or read past columns, [click here](#).



# Book Recommendation

from Dan Beaulieu

## Questions That Sell: The Powerful Process for Discovering What Your Customer Really Wants

Author: Paul Cherry, 2018 [Amacon](#). Price: \$17.95

This is a great book to help salespeople learn how to win over their customers and an even better book for helping companies, particularly their inside salespeople, to create customers for life.

Creating a customer-focused company is all about knowing everything possible about your customers and the best way to find out everything about your customers is to ask them.

Author Paul Cherry, who is president and CEO of one of the country's foremost sales and leadership training organizations, shows his complete mastery of the art of the question in this book. He focuses not only on the right questions to ask in the appropriate situations but also how to ask those questions, at the right time, in the right place and even with the right pace. He makes us realize that questioning is an art, a craft that must be studied and perfected.

### Have you ever been in any of these situations?

1. You're talking to a prospect and you need to get her talking. How do you do that?

2. You're in deep trouble with a customer. Your company has really screwed up this time and that customer is really mad. How do you handle that situation with questions that will not only get to the heart of the matter and solve the problem, but also calm the customer down?
3. You need to tell a customer that if they don't start paying you will have to cut them off. How do you best express these touchy messages?
4. You need to know if you are going to get that big order next month that is so vital to your company. How do you find out now?
5. You know the buyer is stalling you for some reason, but you don't know why. How do you find out?

Besides demonstrating to the reader how to handle these situations and many more, the author also provides lists of actual questions designed to help you develop your own line of questioning for all these situations and just about every situation you may come up against. This book will not only help you sell, but more importantly, develop a long-lasting and productive relationship with your customers. **PCB007**

# Productive Fabrication Equipment



MDI-DT



WorkCell<sup>2</sup>



CombiDrill



## MDI Micromirror-Digital-Imaging

- Cost-efficient & high-quality DDI
- High-power UV-LEDs & DMD-technology
- Operator-friendly concept w/compact footprint
- Modular machine concept & field upgradable
- Flexible number of heads and head distances for shortest exposure times
- Multiple wavelength concept

## Vacuum Lamination System

- Even pressure across the platen surface
- State-of-the-art heating system
- All-steel construction
- Modular machine concept & field upgradable
- User-friendly visualization system
- Affordable initial investment

## Hybrid Laser Drilling/Cutting System

- Microvia drilling 50-300 $\mu$ m diameter
- Space saving compact design
- Best power/size ratio in market
- Pulse Stabilizer
- European technology center and USA support center

Bürkle North America supplies a full complement of productive equipment for fabricating printed wiring boards. From imaging through metrology inspection, Bürkle North America's equipment offering sets the standard in the industry for Imaging, Registration, Lamination, Mechanical or Laser Drill/Routing and Feature Metrology Inspection.

**BURKLE**  
NORTH AMERICA, INC.  
11105 Knott Ave., Cypress, CA 90630



Contact **Dave Howard**  
for more details.

Visit us at **APEX EXPO**  
**IPC 2018**  
**Booth 801**

[www.burkleamerica.com](http://www.burkleamerica.com)

Phone: 714-379-5090

# Skilled Talent: Can We Meet Rising Demand?

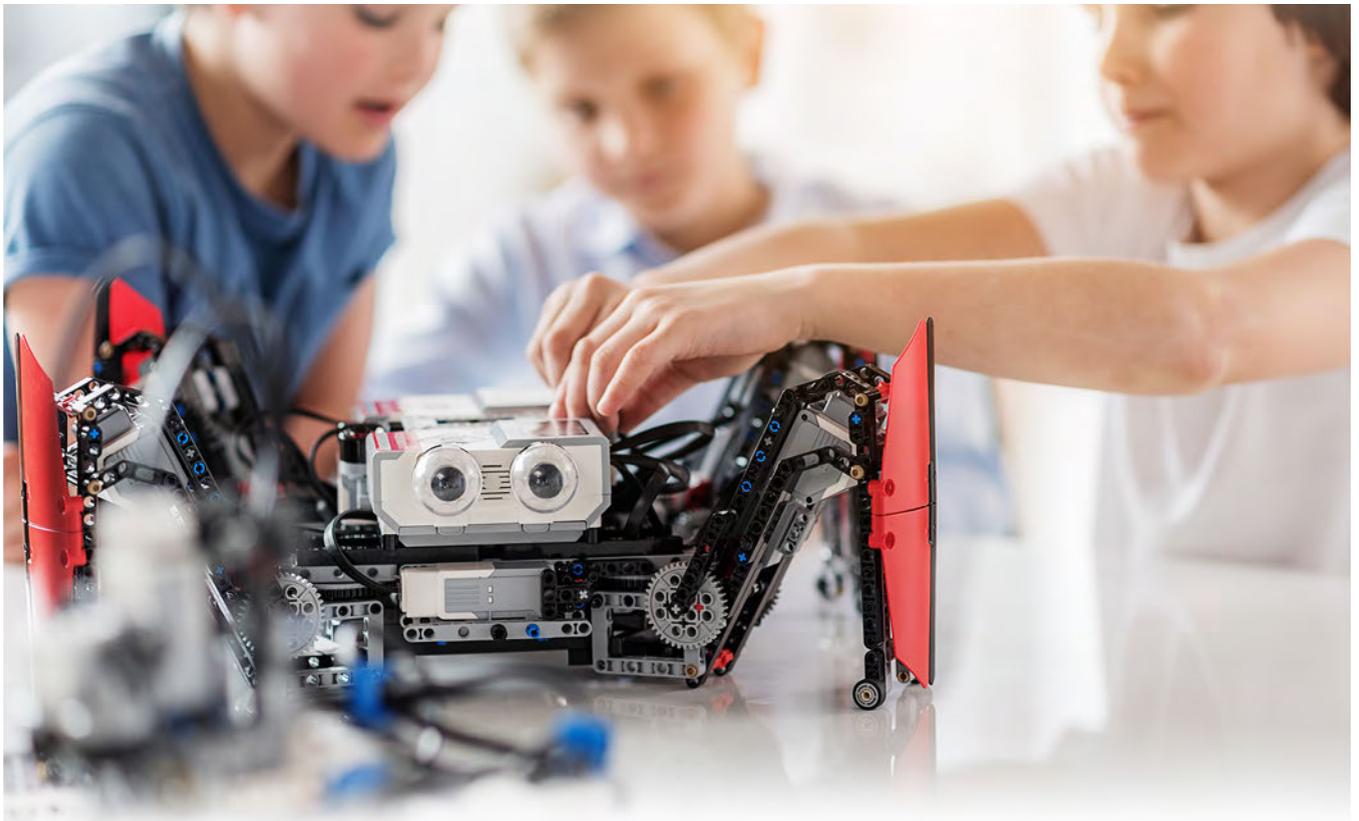
## One World, One Industry

by John Mitchell, IPC-ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES

December 2007 marked the start of the Great Recession, which was followed by the loss of more than 8 million jobs, half the value of the Dow Jones 500, and trillions of dollars in retirement accounts. One decade later, America's economy experienced 3% growth<sup>[1]</sup>, building on one of the longest economic expansions in the United States since World War II<sup>[2]</sup>. In 2018, the U.S. GDP is expected to continue its rise, while unemployment rates are expected to drop further. Experts agree that the global economy is also showing signs of strengthening. The Economist Intelligencer<sup>[3]</sup> attributes this to lax monetary policy around the world and accelerated growth in China, Japan, and the Euro zone.

Naturally, this growth is expected to buoy the manufacturing industry. In fact, our industry is forecast to increase faster than the general economy<sup>[4]</sup>. A recent survey<sup>[5]</sup> by IPC revealed a bullish outlook for most segments of the electronics industry, especially for equipment manufacturers and PCB fabricators. Although this progress is promising, a major challenge looms over us: Does our industry have enough skilled talent to meet rising demands and does this talent have the right skills?

According to a study by the Manufacturing Institute, over the next decade, nearly 3.5 million manufacturing jobs are expected to become available in the United States. But more than 2 million of those jobs will remain unfilled





**THE RIGHT APPROACH  
CONSULTING<sub>LLC</sub>**

**I guarantee that you  
will upgrade and simplify  
your QMS in just 6 months.**

*In today's increasingly competitive market,  
Quality Management is more important  
than ever. I can help you upgrade to  
ISO 9001: 2015 or AS9100 Rev D in six  
months - guaranteed!*



**CLICK HERE TO LEARN MORE  
ABOUT MY CERTIFICATION  
GUARANTEE!**

[TheRightApproachConsulting.com](http://TheRightApproachConsulting.com)



due to a lack of available skilled talent. Another survey<sup>[6]</sup> of IPC companies found that most are having a hard time recruiting qualified production workers, and an even harder time finding qualified engineers and other technical professionals. Executives also noted<sup>[4]</sup> a lack of problem-solving skills, basic technical training, and math skills. This common lack of foundational skills has an unfortunate impact on manufacturing companies across the nation.

To address this issue, IPC offered its support for the Apprenticeship and Jobs Training Act (S.1352)<sup>[7]</sup> as well as the Strengthening Career and Technical Education for the 21<sup>st</sup> Century Act (H.R. 2353)<sup>[8]</sup>. Both aim to support career education programs which prepare workers to fill highly skilled manufacturing jobs.

Previously, I've written<sup>[9]</sup> that combating the skills gap would be no small feat. But, we can start by taking a critical look at our education system. For several years, U.S. high school students have ranked below average when it comes to math and science. Only 40% of U.S. high schools offer advanced science courses like physics, according to an Education Week Research Center analysis. Among the students that pursue a STEM major in college, only half actually pursue a STEM career post-graduation.

These statistics are a stark reminder that science, technology, engineering and math edu-

San Diego high schools will have the chance to attend IPC APEX EXPO, learn about various career options within the electronics manufacturing industry, take part in panel discussions with industry experts, and participate in a private tour of the show floor.

Organizations like the STEM Education Coalition<sup>[11]</sup>, of which IPC is a proud member, are working to inform federal and state policymakers on the vital role that STEM education plays in the future of economic success. Among its core policy principals, the STEM Education Coalition believes that effective policies that promote STEM education should be a bipartisan national priority. Currently, educational policies such as the "Common Core" standards, which have been adopted by more than 40 states, cover only language and math, not science. There must be a state-based effort to implement not just Common Core Math but also Next Generation Science Standards, among other college- and career-ready standards in STEM fields.

Culturally, there is a long-standing, but false, notion that the only "successful" education is a traditional four-year degree from a university. While a growing number of colleges across the country are offering world-class STEM majors, technical and trade schools are also a viable option for students. Many noble and lucrative careers can be had by those who learn trades and technical specialties. To ensure that America's economy remains competitive on a global scale, we must raise the educational bar and build a stronger emphasis on STEM education and technical training.

In an effort to better address a growing skills gap, and to ensure access to relevant training for a larger global population, IPC launched IPC EDGE<sup>[12]</sup>, a new cloud-based learning management system in July 2016. IPC EDGE delivers the education needed to acquire and develop the competitive skills necessary to excel in the electronics industry. Through white papers, webinars, IPC standards, skill development and foundation courses, users gain the flexibility to learn the skills needed to advance their careers and improve the industry. Currently, IPC EDGE consists of dozens of IPC's

---

**These statistics are a stark reminder that science, technology, engineering and math education should be a national priority.**

---

cation should be a national priority. It is our duty to introduce STEM topics as early as possible, both at home and in the classroom. To that end, during IPC APEX EXPO 2018, we will introduce a STEM outreach program<sup>[10]</sup> for high school students. This year, students from two

# Why Choose Fein-Line?

Because there is a Fine Line between winning and the alternative.

**Fein-Line Associates** is a consulting group serving the global interconnect and EMS industries, as well as those needing contact with/information regarding the manufacture and assembly of Printed Circuit Boards. The principal of Fein-Line Associates, Dan (Baer) Feinberg, formally president of Morton Electronic Materials (Dynachem) is a 50+ year veteran of the printed circuit and electronic materials industries. Dan is a member of the IPC Hall of Fame; has authored over 150 columns, articles, interviews, and features that have appeared in a variety of magazines; and has spoken at numerous industry events. He covers major events, trade shows, and technology introductions and trends.

Mr. Feinberg and his associates specialize in:

- management consulting
- technology transfer
- new product market entry
- merger and acquisition due diligence
- market information and market research
- expert witness assistance and seminars regarding all aspects of printed circuits
- electronic assembly manufacturing and marketing



Dan (Baer) Feinberg

**Fein-Line Associates, Inc.**

P.O. Box 73355

San Clemente, CA 92673

Telephone: (949) 498-7866

Email: [baer@feinline.com](mailto:baer@feinline.com)



[www.feinline.com](http://www.feinline.com)

most popular courses. This library is continually growing as additional courses are created regularly. From entry level personnel to executives, IPC EDGE users are provided with knowledge that will support learning goals that applied directly to their work. This includes preparation for CIS (Certified IPC Specialist) certification, the most recognized IPC certification in the electronics industry.

IPC EDGE courses instruct on topics such as: Electrostatic Discharge (ESD), Control for Electronics Assembly, Introduction to Hand Soldering, FOD Prevention in Electronics Assembly, Surface Mount Solder Joint Quality Standards, Counterfeit Components, and Component Identification, among many others. New courses are in development to provide the knowledge and skills needed to prepare the next generation of workers for success in the electronics industry and close today's skill gap. **PCB007**

## References

1. U.S. third-quarter economic growth fastest in three years, Reuters, Nov. 29, 2017.
2. Current U.S. economic recovery may end up as longest ever, MarketWatch, July 19, 2016.

3. The pace of growth in the global economy is unlikely to be sustained, The Economist, December 13, 2017.
4. The Skills Gap in the U.S. Manufacturing, 2015 and Beyond, Deloitte Manufacturing Institute.
5. IPC Pulse Survey Reveals Bullish Outlook for Equipment and PCB Manufacturers, October 26, 2017.
6. IPCs U.S. Skills Gap Study Reveals Skills and Qualifications in Short Supply, April 27, 2017.
7. 115<sup>th</sup> Congress/Senate Bill S.1352 – Apprenticeship and Jobs Training Act of 2017.
8. H.R. 5587–Strengthening Career and Technical Education for the 21<sup>st</sup> Century Act.
9. One World, One Industry: Three Ways to Close the Skills Gap in U.S. Manufacturing.
10. IPC to Launch STEM Outreach Program at IPC APEX EXPO 2018.
11. STEM Education Coalition.
12. IPC EDGE.



**John Mitchell** is president and CEO of IPC-Association Connecting Electronics Industries. To read past columns or to contact Mitchell, [click here](#).

## DARPA's Hallmark Seeks to Revolutionize U.S. Space Enterprise Command and Control

The growing complexity of space operations, coupled with an increased need for timely decisions, demands innovative approaches to help battle management command and control (BMC2) technologies. To help ensure future U.S. technological and strategic superiority, DARPA's Hallmark program seeks to develop revolutionary tools and technologies to plan, assess, and execute U.S. military operations in space.

The program has completed initial research and awarded Phase 1 contracts to 11 organizations, which both augment existing com-

mercial technologies and pursue entirely new capabilities. Hallmark has released a Broad Agency Announcement seeking additional technologies for potential inclusion.

"Twenty-first-century space BMC2 must enable commanders to quickly understand and handle situations by optimizing delivery and presentation of crucial information aimed at making decisions, and then provide flexible options for effective, timely response," said Lt. Col. Jeremy Raley, program manager in DARPA's Tactical Technology Office (TTO).





Account

Profile

Company

1

2

3

During this process please don't use your browsers back button.

Your Email \*

Confirm Email \*

Password \*

Minimum of 8 characters

Password Confirm \*

Minimum of 8 characters

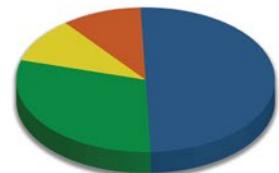
Company Name

## Why Register?

 [Log In](#) | [Register](#)

By joining my I-Connect007, you will be able to:

- Manage all your I-Connect007 subscriptions
- Create your own custom industry news alerts
- Contribute your expertise to our publications
- Get instant access to premium 'members-only' e-books, industry surveys and more



[myconnect007.com/register](http://myconnect007.com/register)



## Recent Highlights from PCB007

### 1 IPC-1401 Listed Amongst Top 10 Chinese Corporate Social Responsibility Standards ▶

IPC-1401, Supply Chain Social Responsibility Management System Guidance was listed as a top-10 standard in 2017, for Chinese Corporate Social Responsibility (CSR).



### 2 Punching Out! Survey on State of the North American PCB M&A Market ▶

Recently, my firm surveyed about 20 PCB manufacturers in North America with an estimated greater than \$10 million in revenue. Quite a few replied, and we have spoken with many others throughout the year, which gives us a good view on the state of the PCB market.



### 3 The Right Approach: Culture Shift is Key to Quality Improvement ▶

Any major initiative, whether implementing ISO, lean manufacturing or introducing a new product, requires culture change. How this change is managed will be the difference between success or failure of the project. This column will offer some fundamental elements that will help navigate your next major implementation by shifting the culture.



### 4 All About Flex: Copper Grain Direction ▶

Many materials have different characteristics depending upon the orientation of the material. For example, woven textile materials have a warp and a weft direction. The warp direction is the longitude direction and the weft is the transverse.



## 5 CES 2018, Augmented Reality and Much More ▶

The actual CES show is spread across many locations in Las Vegas. The main exhibit halls are at or near to the Las Vegas Convention Center with three buildings, two floors each, all filled with hundreds of booths.



## 6 It's Only Common Sense: 6 Ways to Guarantee a Great 2018 ▶

Here we are again. The beginning of a brand-spanking new year—2018! Who would have thought we would make it this long? But we did, and the North American PCB business is still alive and kicking.



## 7 CES 2018 Showstoppers: Launchit and Press Event ▶

“ShowStoppers LaunchIt is about giving innovative entrepreneurs a shot at getting the attention of angel investors on the lookout for innovation and new ventures. It’s also about gaining additional visibility with other industry influencers and dealmakers, as well as with the press who are always looking for the ‘what’s new’ story at CES.”



## 8 In Terms of Experience, a 10,000-foot View of China ▶

In the past 30+ years of PCB manufacturing in China, you would be hard-pressed to find someone more connected to the pulse of the Asian market than Gene Weiner. Barry Matties met with the industry veteran at HKPCA to get his take on the show, the current and future market conditions of China, and any effect the new U.S. administration might have on trade relations going forward.



## 9 It's a Long, Winding and Exciting Road for Automotive Electronics ▶

It was truly a delight to talk with Alun Morgan at productronica this year. He may be the most enthusiastic person in the field of electronics that I have ever met, as you will certainly understand as you read this interview.



## 10 It's Only Common Sense: Asking the Right Questions Will Lead to Sales ▶

Are you asking the right questions? When you are face to face with a customer, especially a new prospect, do you have a list of the right questions to ask? Are you like a good lawyer, asking penetrating questions that are not only designed to gather information but also to lead to a conclusion you want to reach?

**For the Latest PCB News and Information, Visit: [PCB007.com](http://PCB007.com)**

# Career Opportunities

**Pssst!**  
**Are You Looking**  
**for Someone?**



---

## Place your notice in our Help Wanted section.

For just \$500, your 200 word, full-column—or, for \$250, your 100 word, half-column—ad will appear in the Help Wanted section of all three of our monthly magazines, reaching circuit board designers, fabricators, assemblers, OEMs and suppliers.

Potential candidates can click on your ad and submit a résumé directly to the email address you've provided. If you wish to continue beyond the first month, the price is the same per month. No contract required. We even include your logo in the ad, which is great branding!

**To get your ad into the next issue, contact:**

**Barb Hockaday at [barb@iconnect007.com](mailto:barb@iconnect007.com) or +1.916.608.0660 (-7 GMT)**

**I-Connect007**  
GOOD FOR THE INDUSTRY





## Work where you live!

The I-Connect007 China team is seeking an experienced salesperson to generate and manage a revenue stream for our Chinese publications.

### Key Responsibilities include:

- Sell advertising contracts for monthly magazine
- Develop and cultivate new business
- Keep timely and accurate records
- Generate and follow up on all leads
- Manage contract renewals
- Account management: work with local and international team to provide customer support
- Phone and email communications with prospects
- Occasional travel

### Qualifications

Successful candidates should possess a university degree or equivalent, experience with managing and cultivating leads, projecting, tracking and reporting revenue. We are looking for positive, high-energy candidates who work well in a self-managed, team-based, virtual environment.

### Compensation

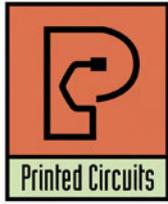
This is a base salary-plus-commission position. Compensation commensurate with experience.

### Requirements

- Must be located in China Mainland, South China area preferred
- Good command of Chinese language, proficient with English speaking and writing
- Able to follow established systems and learn quickly
- Able to maintain professional external and internal relationships reflecting the company's core values
- 2-5 years' sales experience
- Experience with Microsoft Office products
- Must be highly motivated and target-driven with a proven track record for meeting quotas
- Good prioritizing, time management and organizational skills
- Create and deliver proposals tailored to each prospect's needs
- Experience in the electronics industry desirable

[QUALIFIED CANDIDATES: CLICK HERE TO APPLY](#)

# Career Opportunities



THE FUTURE OF RIGID FLEX CIRCUITRY

## Sales Administrator

### Purpose:

To assist the Sales Department in entering and tracking customer orders, supporting sales and marketing functions, and growing Printed Circuits customer base and sales.

### Nature of Duties/Responsibilities:

- Provide point of contact for customers' quotes and orders
- Enter purchase orders
- Check orders for accuracy and completion
- Resolve order errors and inaccuracies
- Handle customer emails and phone calls
- Track and expedite customer requests and inquiries
- Work with customers to resolve outstanding questions and/or issues
- Report on open orders
- Keep customer contact database current
- Work with Engineering and Quality Assurance to meet customer expectations
- Complete other sales and/or marketing tasks as required

### Education and Experience:

- At least 2 years of previous customer service center experience
- Ability to work with Microsoft (MS) Office, with focus on demonstrated working knowledge of MS Excel and Word
- Ability to work well in time-sensitive situations where customer satisfaction is the goal
- Ability to apply creative problem-solving techniques to situations using sound business judgment
- Excellent verbal and written communication skills
- Ability to multi-task in an effective, timely and professional manner
- Proven ability to apply attention to detail, role-related accuracy and task follow-through
- Willingness to learn new software products such as ACT!
- Bachelor's degree a plus

[apply now](#)

# saki

The Future in Focus

## Field Application Engineer

Saki America Inc., headquartered in Fremont, CA, a leader in automated inspection equipment, seeks two full-time Field Application Engineers (FAE), one in the Fremont headquarters and the other for the Eastern and Southern United States.

The FAE will support the VP of Sales and Service for North America in equipment installation, training, maintenance, and other services at field locations. The FAE will provide technical/customer support and maintain positive relationships with existing and future customers.

Strong analytic abilities and problem-solving skills are a must in order to understand customer applications and troubleshoot issues. The FAE will perform demos and presentations for customers and agents as well as assisting in trade show activities. Candidate must have a minimum of a two-year technical degree, experience in AOI, SPI, and X-ray inspection, and strong verbal and written communication skills. The position requires the ability to travel about three weeks per month. Must be a US citizen and be able to lift up to 40 lbs.

[apply now](#)

# Career Opportunities



## Become a Certified IPC Master Instructor at EPTAC

### Job Summary:

We are growing! EPTAC, a leading provider in the electronics training industry is looking for some great people to join our team. 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. 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 an enthusiasm for education, drop us a line or send us your resume. We would love to chat with you. Opportunities available across U.S. and Canada, especially in our growing markets of California, Chicago, Minnesota and New England. Some travel involved. IPC-7711/7721 or IPC-A-620 CIT certification a big plus.

### Qualifications and Skills:

- A love of teaching and an enthusiasm to help others learn new concepts and skills
- Background in electronics manufacturing
- Previous soldering and/or electronics/cable assembly experience
- Previous 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 time, work as often as you like
- IRA retirement matching contributions after one year of service
- Training and certifications provided and maintained by EPTAC

[apply now](#)



## Chemical Process Engineer

Chemcut, a leading manufacturer of wet-processing equipment for the manufacture of printed circuit boards for more than 60 years, is seeking a Chemical Process Engineer. This position is located at Chemcut's main facility in State College, Pennsylvania. Applicants should have an associate degree or trade school degree, or 4 years equivalent in chemical process engineering.

### Job responsibilities include:

- Developing new industrial processes
- Providing process criteria for both new equipment and modifying existing equipment
- Testing new processes and equipment
- Collecting data required to make improvements and modifications
- Assisting in investigating and troubleshooting customer process problems
- Ensuring that equipment works to its specification and to appropriate capacities
- Assessing safety and environmental issues
- Coordinating with installation/project engineers
- Ensuring safe working conditions and compliance with health and safety legislation

### Key Skills:

- Aptitude for, and interest in chemistry, IT and numeracy
- Analytical thinking
- Commercial awareness
- Ability to perform under pressure
- Communication and teamwork
- Problem-solving

Experience with circuit board processes is a plus.

Contact Arlene at 814-272-2800 or by clicking below.

[apply now](#)

# Career Opportunities



## PCB Equipment Sales

World-class manufacturer of wet process equipment for the PCB and plating industries, Integrated Process Systems Inc. (IPS) is seeking qualified candidates to fill a position in equipment sales. Potential candidates should have:

- Process engineering knowledge in PCB manufacturing
- Outside sales background
- Residency on the West Coast to manage West Coast sales
- Knowledge of wet process equipment
- Sales experience with capital equipment (preferred)

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

[more details](#)



## PCB Assembly Supervisor— full time Accurate Circuit Engineering— Santa Ana, CA

**Position Summary:** Responsible for all assembly processes to ensure continued growth as directed by management.

### Essential Job Functions:

- Create, implement, and supervise in-house manufacturing facility
- Recruit, hire, train, and supervise assembly floor personnel
- Extensive hands on experience with all aspects of PCB assembly
- Understanding of IPC-A-610 standards
- Research and acquire additional assembly resources
- Gather data on product shortages, lead times, price changes, etc.
- Coordinate the assembly activities with sales to ensure 100% on-time delivery
- Create, implement, and supervise daily quality processes to ensure 100% accuracy
- Document, monitor and review progress of the business unit
- Respond to internal and external customers in a timely manner
- Coordinate walk-through, site audits, etc.

### Qualifications:

- Minimum 3 years as operations supervisor of electronics assembly house
- 5+ years' experience in the electronics industry
- Previous experience as a quality or operations supervisor preferred
- Ability to solve practical problems using pre-established guidelines
- Strong facility in Microsoft Office applications
- Excellent verbal and written communication skills
- Ability to work with people of diverse backgrounds
- Highly organized/excellent time management skills
- Ability to perform at the highest level in a fast-paced environment
- Valid California driver's license.

[apply now](#)

AD SPACE  
AVAILABLE  
NOW

For information, please contact:  
BARB HOCKADAY  
barb@iconnect007.com  
+1 916.365.1727 (-7 GMT)

**I-Connect007**  
GOOD FOR THE INDUSTRY

# Career Opportunities



## Electronics Expert Engineer

Orbotech is looking for an Electronics Expert Engineer to handle various hardware activities, including communication, data path processing, device interfaces and motion, as well as system supporting functions in a multi-disciplinary environment.

### What Will Your Job Look Like?

- Providing cutting edge hardware solutions for challenging product line needs
- Developing board design and Logic in VHDL
- Defining and managing interfaces (software, algorithm, mechanics and electricity)
- Successfully integrating hardware with other product disciplines
- Supporting the product needs during and following release

### What Do You Need to Succeed?

- BSc in electronics engineering
- At least 5 years of R&D experience in complex board design, mainly FPGA (communication interfaces, DDR controller, algorithm implementation)
- Experience in an Altera/Xilinx development environment
- Experience in ECAD design tools (DxDsigner, ModelSim) is an advantage
- Knowledge in laser interfaces, RF and analog is an advantage

### Who We Are

Virtually every electronic device in the world is produced using Orbotech systems. For over 30 years, Orbotech has been a market leader in developing cutting edge inspection, test, repair, and production solutions for the manufacture of the world's most sophisticated consumer and industrial electronics.

[apply now](#)



## PCB Process Planner

Accurate Circuit Engineering (ACE) is an ISO 9001:2000 certified manufacturer of high-quality PCB prototypes and low-volume production for companies who demand the highest quality in the shortest time possible. ACE is seeking a skilled individual to join our team as a PCB process planner.

### Responsibilities will include:

- Planning job travelers based on job release, customer purchasing order, drawings and data files and file upon completion
- Contacting customer for any discrepancies found in data during planning and CAM stage
- Consulting with director of engineering regarding technical difficulties raised by particular jobs
- Informing production manager of special material requirements and quick-turn scheduling
- Generating job material requirement slip and verify with shear clerk materials availability
- Maintaining and updating customer revisions of specifications, drawings, etc.
- Acting as point of contact for customer technical inquiries

Candidate should have knowledge of PCB specifications and fabrication techniques. They should also possess good communication and interpersonal skills for interfacing with customers. Math and technical skills are a must as well as the ability to use office equipment including computers, printers, scanners, etc.

This position requires 3 years of experience in PCB planning and a high school level or higher education.

[apply now](#)

# Career Opportunities



## **Business Development Representative at Altium**

New Logo Business Development representatives are highly motivated and hardworking with an upbeat can-do attitude. They work with our New Logo Sales Team to displace our competition in accounts by offering Altium's unified PCB development tools within a defined region.

The New Logo Developer's (NLD) main responsibilities will be qualifying leads and prospecting into competitive lists, searching the web, and utilizing internal sales tools (Inside View, LinkedIn, Marketo, Salesforce) to uncover and work with opportunities for the New Logo Closer to close. They are expected to meet or exceed monthly, quarterly & annual quota.

### **Responsibilities:**

- Develop lead opportunities by collecting information that includes business pains/needs, timelines, authority and project teams, budget, competitive information, etc.
- Aggressively drive daily prospecting calls to build pipeline of prospective clients and occasionally closing smaller deals
- Develop relationships with key partners in their territory to identify new business opportunities
- Plan and prioritize personal sales activities in conjunction with the New Logo Closer, with the goal of achieving sales targets
- Work alongside inside sales teams on specialized projects such as call-out campaigns, promo drives and webinar fulfillment
- Once trained, maintain an in-depth knowledge of Altium products and technologies, competitive products, and industry trends.

apply now



## **Field Service Technician**

Chemcut, a leading manufacturer of wet-processing equipment for the manufacture of printed circuit boards for more than 60 years, is seeking a high-quality field service technician. This position will require extensive travel, including overseas.

### **Job responsibilities include:**

- Installing and testing Chemcut equipment at the customer's location
- Training customers for proper operation and maintenance
- Providing technical support for problems by diagnosing and repairing mechanical and electrical malfunctions
- Filling out and submitting service call paperwork completely, accurately and in a timely fashion
- Preparing quotes to modify, rebuild, and/or repair Chemcut equipment

### **Requirements:**

- Associates degree or trade school degree, or four years equivalent HVAC/industrial equipment technical experience
- Strong mechanical aptitude and electrical knowledge, along with the ability to troubleshoot PLC control
- Experience with single and three-phase power, low-voltage control circuits and knowledge of AC and DC drives are desirable extra skills

To apply for this position, please apply to Mike Burke, or call 814-272-2800.

apply now

# Career Opportunities



## Electronics Team Leader

Orbotech is seeking an Electronics Team Leader to join our electronics team, which develops multi-disciplinary systems, including vision/laser, image processing, and control and automation missions.

### What Will Your Job Look Like?

- Lead a team of electronics engineers in a multi-disciplinary environment
- Lead electronic activities from requirement phase to development, integration and transfer, to production
- Be the focal point for other disciplines and projects managers
- Maintain and improve existing electronics platforms

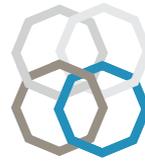
### What Do You Need to Succeed?

- BSc/MSc in electronic engineering/ computer science from a well-recognized university
- 5+ years' experience in digital board design, high-speed links, computing embedded systems, and HW/SW integration
- 2-3 years' experience in leading a team of engineers
- Solid skills in complex FPGA design with multi-modules
- Solid skills in high-speed board design, DDR3/4, PCIE, USB, IO, and optic links
- Ability to design and execute end-to-end solutions

### Who We Are

Virtually every electronic device in the world is produced using Orbotech systems. For over 30 years, Orbotech has been a market leader in developing cutting-edge inspection, test, repair, and production solutions for the manufacture of the world's most sophisticated consumer and industrial electronics.

apply now



ventec  
INTERNATIONAL GROUP  
騰輝電子

## Ventec Seeking U.S. Product Manager for tec-speed

Want to work for a globally successful and growing company and help drive that success? As a U.S.-based member of the product and sales team, your focus will be on Ventec's signal integrity materials, tec-speed, one of the most comprehensive range of products in high-speed/low-loss PCB material technology for high reliability and high-speed computing and storage applications. Combining your strong technical PCB manufacturing and design knowledge with commercial acumen, you will offer North American customers (OEMs, buyers, designers, reliability engineers and the people that liaise directly with the PCB manufacturers) advice and solutions for optimum performance, quality and cost.

### Skills and abilities required:

- Technical background in PCB manufacturing/ design
- Solid understanding of signal integrity solutions
- Direct sales knowledge and skills
- Excellent oral and written communication skills in English
- Experience in making compelling presentations to small and large audiences
- Proven relationship building skills with partners and virtual teams

This is a fantastic opportunity to become part of a leading brand and team, with excellent benefits.

Please forward your resume to [jpattie@ventec-usa.com](mailto:jpattie@ventec-usa.com) and mention "U.S. Sales Manager—tec-speed" in the subject line.

apply now

# Career Opportunities



## IPC Master Instructor

This position is responsible for IPC and skill-based instruction and certification at the training center as well as training events as assigned by company's sales/operations VP. This position may be part-time, full-time, and/or an independent contractor, depending upon the demand and the individual's situation. Must have the ability to work with little or no supervision and make appropriate and professional decisions. Candidate must have the ability to collaborate with the client managers to continually enhance the training program. Position is responsible for validating the program value and its overall success. Candidate will be trained/certified and recognized by IPC as a Master Instructor. Position requires the input and management of the training records. Will require some travel to client's facilities and other training centers.

For more information, click below.

[apply now](#)



## Technical Sales Engineer

**Positions available in the Chicago area and California**

Do you want to advance your career by joining a globally successful and growing world class CCL manufacturer and help drive that success? As a California-based member of the technical sales team, your focus will be on Ventec's core market segments: mil/aero, automotive and medical, offering a full range of high-reliability materials including polyimide, IMS and thermal management products.

### ***Skills and abilities required:***

- Drive & Tenacity!
- 7 to 10 years of experience in the PCB industry in engineering and/or manufacturing
- Detail-oriented approach to tasks
- Ability to manage tasks and set goals independently and as part of a team
- Knowledge of MS office products

Full product training will be provided. This is a fantastic opportunity to become part of a successful brand and a leading team with excellent benefits.

Please forward your resume to:

[jpattie@ventec-usa.com](mailto:jpattie@ventec-usa.com) and mention "Technical Sales Engineer - California Based or Chicago area" in the subject line.

[apply now](#)

# Career Opportunities

## **Altium**

### **Application Engineer**

The application engineer is the first contact for our customers who have technical questions or issues with our product. We value our customers and wish to provide them with highest quality of technical support.

#### **Key Responsibilities:**

- Support customer base through a variety of mediums
- Log, troubleshoot, and provide overall escalation management and technical solutions
- Create various types of topic based content, such as online help, online user guides, video tutorials, knowledge base articles, quick start guides and more
- Distill complex technical information into actionable knowledge that users can understand and apply
- Continually develop and maintain product knowledge

#### **Requirements:**

- Understanding of EDA electronic design software, schematic capture and PCB layout software
- Bachelor's degree in electronics engineering or equivalent experience
- Sales engineering and/or support engineering experience
- Circuit simulation and/or signal integrity experience
- Understanding of ECAD/ MCAD market segments
- Understanding of micro controllers, SoC architecture and embedded systems market
- Database experience preferred (i.e., MySQL, PostgreSQL, Microsoft Access, SQL, Server, FileMaker, Oracle, Sybase, dBASE, Clipper, FoxPro) etc.
- Experience with PLM/PDM/MRP/ERP software (Program Lifecycle Management) preferred
- Salesforce experience a plus

Salary based upon experience. Comprehensive benefits package and 401k plan. Openings in USA, UK, and Germany.

For more information, contact Altium.

[apply now](#)



## **MacDermid**

PERFORMANCE SOLUTIONS

### **Do you have what it takes?**

MacDermid Performance Solutions, a Platform Specialty Products Company, and daughter companies manufacture a broad range of specialty chemicals and materials which are used in multi-step technological processes that enhance the products people use every day. Our innovative materials and processes are creating more opportunities and efficiencies for companies across key industries – including electronics, graphic arts, metal & plastic plating, and off-shore oil production. Driving sustainable success for companies around the world, and at every step of the supply chain, takes talent. Strategic thinking. Collaboration. Execution.

The people of MacDermid Performance Solutions stand united by a guiding principle: If it doesn't add value, don't do it. This belief inspires a unique culture where each team member has opportunities to imagine, create, hone and optimize. Do you have what it takes? Join our growing team of over 4,000 professionals across more than 50 countries with openings in research, finance, customer service, production and more.

MacDermid Performance Solutions and its affiliates are Equal Opportunity/Affirmative Action Employers.

[apply now](#)

# Career Opportunities



## FPGA Design Expert

Orbotech is seeking a FPGA Design Expert to join our electronics team, which develops multi-disciplinary systems including vision/laser, image processing and electro-optics.

### What Will Your Job Look Like?

- Lead image acquisition and processing activities in the team
- Engage in all aspects of FPGA design activity: requirement phase, coding, synthesizing, verification support and LAB bring up
- Participate in system definitions for current and next generation products
- Collaborate with other teams: SW, algorithm and QA

### What Do You Need to Succeed?

- BSc/MSc in Electrical Engineering from a well-recognized university
- Extensive knowledge of VHDL
- 5+ years of FPGA development experience (requirement, architecture, RTL coding, simulation, synthesis, timing analysis, P&R, board level integration and verification)
- Experience in designing and implementing low-latency, high-throughput FPGA designs utilizing PCIe Gen2/3, Gigabit Ethernet, SERDES, DDR3/4
- Experience in complex FPGA such as Altera Stratix-II and Arria 5&10 devices
- Authoring documentation experience such as FPGA specifications and FPGA verification plans

### Who We Are

Virtually every electronic device in the world is produced using Orbotech systems. For over 30 years, Orbotech has been a market leader in developing cutting-edge inspection, test, repair, and production solutions for the manufacture of the world's most sophisticated consumer and industrial electronics.

[apply now](#)



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

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

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 9001:2008 registered, and through rigorous quality control practices and commitment to continual improvement, we are dedicated to meeting and exceeding our customer's requirements.

[more details](#)



# 2018 Programs

**March 14** **Webinar**

Wisdom Wednesday  
for IPC Members only

**March 20** **Workshop**

IPC Technical Education  
EMI Control-Grounding, Power Distribution, Board  
Stack-up and More  
*Tempe (Phoenix), AZ, USA*

**March 20** **Meeting**

IPC Day  
Complimentary event, network and learn more about IPC  
*Tempe (Phoenix), AZ, USA*

**March 21** **Workshop**

IPC Technical Education — Using Best Design Practices  
to Produce a More Manufacturable Board and The  
Complexities of Fine Pitch BGA Design  
*Tempe (Phoenix), AZ, USA*

**March 28** **Webinar**

Wisdom Wednesday  
for IPC Members only

**April 10** **Meeting**

IPC Day  
Complimentary event, network and learn more about IPC  
*Boston, MA, USA*

**April 10** **Workshop**

IPC Technical Education — PCB Fabrication Basics: Process  
and Specification  
*Boston, MA, USA*

**April 11** **Workshop**

IPC Technical Education — Advanced Troubleshooting  
*Boston, MA, USA*

**April 11** **Webinar**

Wisdom Wednesday  
for IPC Members only

**April 16–17** **Workshop**

IPC Europe Technical Education  
in English  
*Ingolstadt, Germany*

**April 18–19** **Workshop**

IPC Europe Technical Education  
in German  
*Ingolstadt, Germany*

**April 24** **Workshop**

IPC Technical Education — SMT Design for Manufacturing:  
Principles and Practice, Problems and Promises in a Lead  
Free World  
*San Jose, CA, USA*

**April 24** **Meeting**

IPC Day  
Complimentary event, network and learn more about IPC  
*San Jose, CA, USA*

**April 25** **Webinar**

Wisdom Wednesday  
for IPC Members only

**April 25** **Workshop**

IPC Technical Education — BGA & BTC Design and  
Manufacturing Challenges With Emphasis on Reflow  
Profiling, Backward Compatibility and Head on Pillow  
*San Jose, CA, USA*

**May 2** **Workshop**

IPC Technical Education — PCB Layout — Place and Route  
In conjunction with Del Mar Electronics and  
Manufacturing Show  
*San Jose, CA, USA*

**May 8** **Workshop**

IPC Technical Education  
In conjunction with Electrical Wire Processing  
Technology Expo  
*Milwaukee, WI, USA*

**May 9** **Webinar**

Wisdom Wednesday  
for IPC Members only

**May 15–17** **Conference**

IPC Reliability Conference  
*Linthicum (Baltimore), MD, USA*

**May 21–23** **Meeting**

IMPACT Washington, D.C.  
An executive-level, members-only event  
*Washington, DC, USA*

**May 23** **Webinar**

Wisdom Wednesday  
for IPC Members only

**June 4–5** **Conference**

Automotive Electronics Reliability Forum  
*Nuremberg, Germany*

**June 4–5** **Meeting**

IPC PERM International Meeting No. 36  
*Glasgo, UK*

**September 13** **Conference & Exhibition**

IPC E-Textiles 2018  
*Rosemont, IL, USA*

**October 13–19** **Meetings**

IPC Fall Standards Development Committee Meetings  
co-located with SMTA International  
*Rosemont, IL, USA*

**November 13–15** **Conference**

IPC/SMTA High-Reliability Cleaning and Conformal Coating  
*Schaumburg (Chicago), IL, USA*

For more information, visit [www.IPC.org/events](http://www.IPC.org/events)



# Events Calendar

## MD&M West ▶

February 6–8, 2018  
Anaheim, California USA

## 2018FLEX ▶

February 12–15, 2018  
Monterey, California USA

## IPC APEX EXPO 2018 Conference and Exhibition ▶

February 27–March 1, 2018  
San Diego, California, USA

## China International PCB and Assembly Show (CPCA) ▶

March 20–22, 2018  
Shanghai, China

## KPCA Show 2018 ▶

April 24–26, 2018  
Kintex, South Korea

## Thailand PCB Expo 2018 ▶

May 10–12, 2018  
Bangkok, Thailand

## Medical Electronics Symposium 2018 ▶

May 16–18, 2018  
Dallas, Texas, USA

## IMPACT Washington, D.C. 2018 ▶

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

## 2018 EIPC's 50 Years Anniversary Conference ▶

May 31–June 1, 2018  
Bonn, Germany

## JPCA show 2018 ▶

June 6–8, 2018  
Tokyo, Japan

## electronica India productronica India ▶

September 26–28, 2018  
Bengaluru, India

## SMTA International ▶

October 16–17, 2018  
Rosemont, Illinois, USA

IPC  
Calendar  
of Events



SMTA  
Calendar  
of Events



iNEMI  
Calendar  
of Events



PCB007  
Calendar  
of Events



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

SALES MANAGER: **ANGELA ALEXANDER**  
(408) 489-8389; angela@iconnect007.com

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

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

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

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

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

MAGAZINE LAYOUT: **RON MEOGROSSI**

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

INNOVATIVE TECHNOLOGY: **BRYSON MATTIES**

COVER: **SHELLY STEIN**

COVER IMAGE: © KLETR, ADOBE STOCK

**PCB007**  
MAGAZINE

PCB007 MAGAZINE®  
is published by BR Publishing, Inc.,  
942 Windemere Dr. NW, Salem, OR 97304

© 2018 BR Publishing, Inc. does not assume and hereby disclaims any liability to any person for loss or damage caused by errors or omissions in the material contained within this publication, regardless of whether such errors or omissions are caused accidentally, from negligence or any other cause.

February 2018, Volume 8, Number 2  
PCB007 MAGAZINE is published monthly,  
by BR Publishing, Inc.

## ADVERTISER INDEX

atg Luther & Maelzer GmbH.....	65
Burkle North America.....	39, 79
Cicor.....	73
CIMS.....	7
DB Management.....	71
Electra Polymers.....	23
Entelechy Global.....	51
ESI.....	59
Excellon.....	13
Fein-line Associates.....	83
Gardien.....	19
I-Connect007.....	75, 85
I-Connect007 eBooks.....	2, 3
IPC.....	31, 99
Isola.....	5
ITEQ.....	35
Matrix USA.....	49
Mentor, a Siemens Business.....	55
Microcraft.....	57
MivaTek Global.....	53
Mutrack.....	61
Nordson March.....	17
Panasonic Electronic Materials.....	43
Pluritec.....	33
Prototron Circuits.....	47
Rogers Corporation.....	15
Taiyo America.....	9, 69
Technica USA.....	27
The Right Approach Consulting.....	81
Ucamco.....	37
Ventec International Group.....	67
Viking Test.....	45

## Coming Soon to PCB007 Magazine:

**MARCH: NEW TECHNOLOGIES**  
What's coming in 2018?

**APRIL: AUTOMOTIVE ELECTRONICS**  
What's driving the automotive electronics industry?

# I-Connect007

GOOD FOR THE INDUSTRY



FREE SUBSCRIPTION



[myconnect007.com](http://myconnect007.com)

**EDITORIAL CONTACT**

**Patty Goldman**

[patty@iconnect007.com](mailto:patty@iconnect007.com)

+1 724.299.8633 GMT-4



[mediakit.iconnect007.com](http://mediakit.iconnect007.com)

**SALES CONTACT**

**Barb Hockaday**

[barb@iconnect007.com](mailto:barb@iconnect007.com)

+1 916 365-1727 GMT-7



[www.iconnect007.com](http://www.iconnect007.com)