

APRIL 2020

IConnect007

PCB007

MAGAZINE



The Impact of COVID-19



OUR LIBRARY
IS ALWAYS
OPEN

Registered members of
my I-Connect007 have 24/7 access
to our ever-growing library
of eBooks, which now includes
a wide range of topics from
DFM to complex PCBs.

Enrich your mind and expand your
knowledge! Download these popular
titles with just a click.

They're pretty awesome!



I-007eBooks.com



Mitigate the Effects of Tin Whiskers

Expert Phil Kinner explains how conformal coating and cleaning can protect your boards from corrosion and mitigate against the effects of tin whiskers!

LEARN HOW



ELECTROLUBE
THE SOLUTIONS PEOPLE

PCB007

M A G A Z I N E

The Impact of COVID-19

The global population reacts to a viral threat. The electronics manufacturing industry moves to the center of the response even while individuals find new ways to work safely. This issue of *PCB007 Magazine* brings you select news and updates on how our industry is responding and contributing to this fight.

FEATURES:

32

A Sustainable Supply Chain for Lowest Total Cost
by Harry Kennedy



50

Supply-chain Recovery: Plan for Now and the Future
by Steve Williams and Fane Friberg

62

Advances in Medical Diagnostics Using LoC and LoPCB Technologies
by Pete Starkey and Happy Holden



96

COVID-19: Economic and Microelectronics Industry Impacts—Insights From McKinsey & Company
by Michael Hall

FEATURE COLUMNS:

18

Electronics Industry Advancements Have Prepared Us for COVID-19
by Dr. John Mitchell



28

Our Finest Hour
by Dan Beaulieu

11

SHORTS:

Würth Elektronik Circuit Board Technology Produces PCBs for Ventilators



17

ICM Controls Remains Open

27

Coronavirus Crisis Statement From Ventec International Group

44

NCAB Group Update: Supply Chain Situation Due to the Coronavirus

86

ControlTek Inc., Critical Manufacturer of Medical and Aerospace and Defense Products, Will Maintain Operations

94

Elvia PCB Group Is Working Non-stop to Fight COVID-19



104

Zero Defects International and Skyla Providing Uninterrupted Cam Services

112

Cirexx Ordered to Remain Open During COVID-19 Crisis



pluritec

INTERNATIONAL SUPPLIES



powered by Occleppo

Machines for Printed Circuit Boards

Spray Coatings & Ovens

- Precision Spray Coating
+/-5 μ m Thickness Control
- Up to 6 Colors on Demand
- Self Cleaning Spray Guns
- System Fully Automated
with Process Control Logs
- 15 Minute FAST TACK OVEN

Drilling & Routing Systems

- Optical Drilling & Routing
- X-Ray Assisted Drilling & Routing
- X-Ray Optimizer
- Marking & Traceability
- Automated Flash-rout/Bevel

Prep, Plating & Finishing

- Pumex & Scrubbex
- 30+ Years of Service
- Digital Process Controls
Deliver Precision,
Accuracy & Repeatability:
 - DES & SES Lines
 - MecEtch & Multibond
 - Direct Metalization
 - OSP & ENIG
 - Electroless Tin/Silver



pluritec

www.pluritec.com | info@pluritec.com

PCB007

M A G A Z I N E

INTERVIEWS:

- 12** Dr. John Mitchell:
IPC's Ongoing Efforts
Related to COVID-19



- 22** Interview With IPC's
Dr. Shawn DuBravac:
COVID-19 Global Industry Update

- 40** Isola's Travis Kelly: Maintaining
Continuity of Supply



- 58** Freedom CAD's Scott Miller:
Taking Care of Customers and Staff

- 78** Gene Weiner: Lessons
Learned From COVID-19



- 82** IPC Standards Work Continues
to Move Forward
Interview with David Bergman
and Teresa Rowe

- 90** Dan Beaulieu: Business as
Usual at D.B. Management



- 100** Mentor's Oren Manor on Automation
Business Adjustments

- 108** Matt Stevenson on Sunstone Circuits'
Current Operations

- 116** EMA President Manny Marciano:
Software Tools Are Essential



COLUMNS:

- 10** Sometimes, You Have to Shout
'Stop the Presses!'
by Nolan Johnson



- 46** It's Not Easy Being Green (or Is It?)
by Todd Kolmodin

- 120** Conductive Anode Filament (CAF)
Formation
by Michael Carano

- 130** Can Better Guidelines on Cosmetic
Failures 'Save' Functioning PCBs?
by Jan Pedersen

ARTICLE:

- 124** Improving Copper Distribution
in Pattern Plating Using
Simulation Software
by Pete Starkey



HIGHLIGHTS:

- 88** PCB007 Suppliers
106 EIN007 Industry News
128 MilAero007
136 Top 10 from PCB007



DEPARTMENTS:

- 139** Career Opportunities
148 Events Calendar
149 Advertiser Index & Masthead





ventec
INTERNATIONAL GROUP
騰輝電子

autolam: Base-Material Solutions for Automotive Electronics



autolam 

Automotive electronics technologies are evolving at an increasing rate. Paying attention to the properties of materials at the substrate level is the first step towards achieving the most stringent performance targets of today's automotive manufacturers. autolam offers the solutions demanded by the diverse and unique requirements of automotive applications today and in the future.



venteclaminates.com

PCB007

M A G A Z I N E

INDUSTRY LETTERS



Responses to COVID-19 Outbreak

- 39** Burkle North America
- 45** DownStream Technologies
- 49** Gardien
- 61** Lenthor Engineering
- 76** American Standard Circuits
- 81** Blackfox
- 87** Insulectro
- 93** Freedom CAD Services

- 95** APCT
- 105** atg Luther & Maelzer GmbH
- 107** Ucamco
- 114** International Electronic Components (IEC)
- 119** Koh Young Technology
- 123** Taiyo America
- 129** BEST Inc.
- 135** Elmatica



Distance learning: download your free books today!

- 21** The Printed Circuit Assembler's Guide to... Process Validation
- 31** The Printed Circuit Designer's Guide to... Assessing Your PCB Documentation Process
- 43** The Printed Circuit Assembler's Guide to... Conformal Coatings for Harsh Environments
- 57** The Printed Circuit Designer's Guide to... Executing Complex PCBs
- 75** Automation and Advanced Procedures in PCB Fabrication

- 89** The Printed Circuit Designer's Guide to... Producing the Perfect Data Package
- 99** The Printed Circuit Assembler's Guide to... Advanced Manufacturing in the Digital Age
- 103** The Printed Circuit Designer's Guide to... Fundamentals of RF/Microwave PCBs
- 113** The Printed Circuit Designer's Guide to... Thermal Management With Insulated Metal Substrates
- 133** The Printed Circuit Assembler's Guide to... Low-Temperature Soldering

Computer-aided Production Proofing Raises Yield and Profitability

New exciting computer simulation technology for PCB CAM, production, and design engineers to validate plating thickness and automatically add copper balancing.



Sometimes, You Have to Shout 'Stop the Presses!'

Nolan's Notes

by Nolan Johnson, I-CONNECT007

I-Connect007 was working diligently to research and report on “Going Green” for the April issue. Although it was a good topic, sometimes, the world has other plans.

As the COVID-19 outbreak went global, all plans changed for the electronics industry. As I write this column, orders for medical devices—ventilators, respirators, and viral detection equipment, especially—are the manufacturing priority, all while a large portion of the world’s population shelters in place (as the U.S. tends to call it) to slow and eventually stop the viral spread. All the while, Wuhan—and China as a whole—start to reemerge. Seemingly overnight, we pivoted to respond to a health crisis.

We’re inundated by pandemic news on the mainstream media. We know what’s happening in the U.S., China, Taiwan, Spain, Italy, the U.K., and elsewhere around the globe. There is hardly a conversation to be had on any topic that doesn’t include mention of the pandemic. While going green was our original topic, current events demanded that we pivot, devoting this issue to the breaking news and changing dynamics COVID-19 has brought us.

Around the world, we shelter in place and wait. We work from home and take over the frontline duties of educating our children. In

some ways, with some people, we are coming closer together. In other ways, we are enacting strict social distancing to keep each other safe.

And yet, we still find new ways to reach out. I live in a building with about 90 loft-style apartments in a mostly-urban neighborhood on the west coast of the U.S. Before the outbreak, my neighbors were consistently aloof.

Now, though, it’s different. We keep our physical distance, sure, but we stop when we encounter a neighbor and check on one another. Are they in need of something? A walk down the hallway will now regularly include bags of groceries or household items left on a neighbors’ doorstep by someone else in the building. Human connection means so much during this time, and we’re helping each other by sharing our resources.

Read IPC’s Dr. John Mitchell’s most recent interview in this issue, and you’ll find the same story amongst those of us in the industry. These times demand teamwork among rivals—an immediate stop to business as usual on the competitive front because, right now, we all need to work together.

Mitchell also shares some anecdotes he’s heard—some of which IPC found itself directly involved in—where companies have banded together to help everyone. A prime example



is a weekly teleconference hosted by IPC—the Executive Forum. On this call, industry leaders and company executives share insights, pass along breaking information, and support each other.

At I-Connect007, our role is to bring you news, information, and content you can use (and share). Updates on a rapidly unfolding chain of events that threatens how we do business while simultaneously calling upon us to work harder and faster than ever before to save lives simply deserve a call to “stop the presses” and cover the news. But that’s not all we’re bringing you.

Form often follows function, so this month, you’ll see a somewhat different arrangement for *PCB007 Magazine*. To respond to the situation, the I-Connect007 team changed our newsgathering processes. We shifted to short, focused audio interviews with industry leaders that we could deliver to you quickly and created the “[Industry Leaders Speak Out](#)” page. Here, we share select company statements that provide updates on how they are responding to the current and which we could distribute effectively. Other contributors also pivoted to talk about the news at hand.

And while you’re sheltering and working from home, now might be a good time to brush up on something new you’ve been too busy to learn.. To help you with that, we’ve highlighted some of I-Connect007’s eBooks that are currently available for free download. What better opportunity than now to do a little self-taught cross-training or go deeper into a topic?

This is the time to rethink anything and everything related to processes. We see the world differently now. The COVID-19 outbreak has given us all the opportunity to restart, recover, and revamp. So, stop the presses and go a different direction, indeed. **PCB007**



Nolan Johnson is managing editor of *PCB007 Magazine*. Nolan brings 30 years of career experience focused almost entirely on electronics design and manufacturing. To contact Johnson, [click here](#).

Würth Elektronik Circuit Board Technology Produces PCBs for Ventilators

The worldwide spread of the coronavirus is not only increasing the demand for personal protective equipment, but also for medical ventilators. In order to ensure the supply in Germany, the German government has placed several orders for ventilators with different manufacturers at short notice—and this is where the PCBs from Würth Elektronik Circuit Board Technology (CBT) come into play.

Würth Elektronik CBT produces PCBs for the manufacturing of intensive care ventilators and mobile ventilators.

“Thanks to our three production sites in Germany, we can supply the manufacturers of the ventilators with PCBs in a wide range of technologies at short notice,” explains Thomas Beck, managing director of sales and marketing. “We are in a position to accept orders at short notice, produce them smoothly, and deliver them reliably. As one of the leading PCB manufacturers in Europe, Würth Elektronik CBT thus makes a valuable contribution to securing the supply chain in this medical emergency.”

In the three German plants in Niedernhall, Rot am See, and Schopfheim, all types of PCBs are manufactured in three shifts—from basic technologies to complex HDI PCBs and sophisticated flex-rigid boards.

This strength now comes into its own, especially in times of the COVID-19 pandemic. This is because the production sites have the necessary resources and materials to accept orders for system-relevant products and manufacture them with the utmost care. To ensure that production at the German plants remains secure, strict protective measures and hygiene regulations were introduced and implemented for all employees weeks ago. These will be adapted as required.

(Source: Würth Elektronik)



Dr. John Mitchell: IPC's Ongoing Efforts Related to COVID-19

Interview by Barry Matties
I-CONNECT007

On April 14, IPC president and CEO, Dr. John Mitchell, described IPC's ongoing efforts related to COVID-19 with I-Connect007 Publisher Barry Matties.

From a standpoint approximately 30 days into the U.S. shutdown, Mitchell reported that 94% of the executives attending the executive forum are expressing concern. He also outlined many of the chaotic drivers and influences in the industry, including shifting over to different, mandated products; supply shortages; potential declining demand for normal products; and increased shipping costs. Worker and staffing shortages have also become an emerging concern.

Mitchell's opinion was that there are numerous indicators that an economic comeback is in the offing, but with some "drag" on the system as it restarts. The industry is responding well overall.

While ventilator manufacturing is a high priority, only properly qualified manufacturers can build medical equipment. Nevertheless, Mitchell pointed out that there are shifts in the market that touch everyone. As the ventilator needs wane in the coming weeks, the market will likely move closer to normal. Mitchell noted that China today shows a market engage-



Dr. John Mitchell

ment closer to 90% or 95%—not quite fully recovered but well on its way.

Lastly, Mitchell shared his pride in the cooperative response to this challenge shown by the electronics manufacturing industry and offered a reminder to pay attention to the real numbers and the statistics—not just the fear.

Barry Matties: Welcome. Today, I'm speaking with John Mitchell, president and CEO of IPC. During the global shutdown, which has reached about 30 days here in the U.S., we've talked to John several times regarding the state of the industry today. We're getting another update. John, welcome, and thanks for taking the time for this interview.

John Mitchell: Thank you, Barry.

Matties: Let's start with an overall update on the state of the industry, please.

Mitchell: As you know, we're doing an executive forum where we invite the executives from across the industry globally to join us and share in a very safe environment the challenges they're facing, their concerns, and what other people are doing so that the industry can



STRIVE FOR **EXCELLENCE**

www.emctw.com | EMC.INFS@mail.emctw.com

EM-890/ EM-890K
Green Laminates
are ready to transcend
your future 200G and
400G applications

**INDUSTRY'S FIRST HALOGEN FREE
ULTRA LOW LOSS MATERIAL**



World's largest producer of environmental
friendly advanced laminate materials



**The Best-in-class SI
Performance**

At least 5~10% lower
insertion loss than
competition



**Ideal for multiple
lamination cycles
(>5x)**



**Compatible with
FR-4 Hybrid Design**
for economical Hybrid
solutions with EM-827
or EM-370(Z)



**Excellent Thermal
Properties for Ultra
Fine BGA Pitch**
(Pass 10X LF260 IR
Reflow and IST > 1K
cycles with min. BGA
pitch < 0.7mm)



**Outstanding
Anti-CAF
performance**
(Pass 85°C/ 85% RH/
50~100V/ 1K hours with
0.8mm BGA pitch)



TECHNICA, U.S.A.

North American Master Distributor
1-800-909-8697 • www.technica.com

learn faster from each other to respond to this pandemic crisis. At the one that we just finished, the concern at the executive level was higher than it's ever been. We did a quick poll, and 94% were either somewhat or extremely concerned. That is way up, as you can imagine, with a lot of these shelter-in-place rules.

There are several things that the industry is concerned about. One, of course, is weak demand. We've seen a lot of shifting back and forth in terms of demand for specific products, but also having to shift focus over to different products that are in higher demand now and being mandated. You have a very large concern from the majority of the group on weak demand for their current products and services. There's also a very strong concern about supply shortages.

Another thing is about a third of them are facing is worker shortages. Many are under shelter-in-place orders. Most of what I've heard from electronics manufacturing facilities and factories is they are making it optional for their employees to come and work in the factory. Now, they've changed the layouts of those factories to try to be safer and maintain social distancing within the factory. They've also changed boundaries for people as well as the timing of various shifts. Instead of having a half-hour to an hour overlap, you might have a half-hour to an hour gap between shifts, more staggered lunch breaks, and things like that to try to keep people safer.

But with that, we already were very strained in the industry. We have been for years in terms of having worker shortages. Now, this just adds more to that. If you have an employee who's concerned, they might not want to come out during the shelter-in-place. And as we've talked about on other occasions, there's still some confusion and disparity between states and the way certain shelter-in-place rules are being put into place; all of that is coming together.

The last area is shipping costs. We have one factory that has been asked to help build PCBs for the ventilator shortage that is happening in North America. They're building those boards, but once they built them, they're shipping them to another manufacturer in China to

have them populated because they're more capable of doing that. They populate them there, and then they're shipping them back. Not only does that add delays, but with shipping costs being higher, it's also driving up costs. There's a large, chaotic set of circumstances that are keeping the entire industry on its toes and making everybody's life not only challenging but ever-changing.

Matties: That's certainly the case.

Mitchell: That was a long answer.

Matties: That's quite all right. It's comprehensive, and as we're moving into the conversation of the economy re-engaging, there are going to be new challenges. You've mentioned a few supply chain employees. What challenges, aside from those, do you think we'll face as the economy re-engages?

Mitchell: I'm an optimist. I have to just say that upfront. My view of things tends not to be as doom and gloom as maybe some others might be. I'm actually seeing some rays of sunshine starting to sneak through the slats of people shuttering their doors—little positive signs where people are saying, "This is starting to happen," or, "We're looking to do this or we're re-engaging in this fashion," that I see as positive indicators that, in some states, people are claiming the curve has flattened. The cases are dropping, and the rate is slowing—that sort of thing. I'm encouraged that there could be a shift to come back. But even when that happens, there's going to be a little bit of drag on the system. It's not like everybody turns around and goes, "Great, everything's normal next week. Let's go back to the way we were operating." As you mentioned, the supply chains have to make sure that all those products are available, and then demand has to pick up.

There's been a big scare across the globe, especially as you think about consumer products. People have to get comfortable with, "I can act normally again," as opposed to, "I'm just trying to worry about whether I can buy toilet paper." Some of those attitudes have to

Electronics Coatings for the Digital Era



ELECTRA

ELECTRAJET® EMJ110 **Inkjet Soldermask**

- SM840 and UL V-0 approved
- High resistance to ENIG, Tin and lead-free processes
- Suitable for rigid & flexible substrates
- Optimised ink characteristics for sharp printing and excellent cosmetics
- Wide jetting window to maximise print strategy options
- Universal product suitable for a range of print heads including Konica Minolta 1024i Series and Dimatix Samba™
- Fully additive process with substantial environmental improvements in energy usage and VOC emissions

EMJ110 is a high performance, high reliability soldermask specifically designed for application by inkjet. Using over 35 years' experience in developing and supporting soldermask products, Electra has rigorously formulated EMJ110 to meet or exceed industrial standards and PCB manufacturing process demands.



T +44 (0)1732 811118
info@electrapolymers.com
www.electrapolymers.com

change for things to flow back. But I am confident that we are responding well. There are still areas that we need to improve. I use the example of ventilators. There's still a demand for those, and there is a challenge in trying to find qualified manufacturers that can build the parts for it in the proper way. It's not like you can go down to any board shop and say, "Build this for us." You'd need to be doing it in the proper way because you don't want to have that ventilator break down on you.

There are still challenges, but we are hopefully moving more toward handling those challenges and then, soon thereafter, trying to move things back to a little bit more normalcy. The challenges will be in, first—as the industry pointed out—how quickly will the demand return will be the big question. Once you have the demand, getting the right parts going forward will be a concern.

There are still challenges, but we are hopefully moving more toward handling those challenges and then, soon thereafter, trying to move things back to a little bit more normalcy.

Matties: We've mentioned it several times, but ventilators and medical products are strong drivers in our industry right now. And those orders will start to subside as the curve flattens and the need for ventilators diminishes. What sort of forecast does IPC have for once that happens?

Mitchell: We don't have a specific forecast for that. That's a great question. Maybe it's something that I can ask in our upcoming meeting in terms of how you will respond if you're not building ventilators. Not everybody is building ventilators, though. Let me maybe respond to

it in that fashion. There are only certain organizations that have the credentials to work on these products. As far as I'm aware, no one has come out and said, "We're willing to release our quality standards on ventilators so that anybody can build them," because that's not going to help anyway. If your life depends on a ventilator, and suddenly it fails because it didn't go through the right reviews and quality regulations, then that's a problem. Only certain organizations can do that, but there are a lot of shifts that are going on in the marketplace. If that changes in two weeks or a month and we suddenly have enough, a million ventilators will have been created, and supply will be at parity.

At that stage, there will be a little bit more calming in the market, and people will begin to return to shipping normal goods. With the workforce shortage will, I don't expect things to go back to 100% right away. I just shared an update on the China piece on LinkedIn. Today, China is somewhere between 85% and 98%. In February, they were trying to get to 50%, and in March, they were flirting with the goal of 80%–85%. Now, we are mid-April, and they're still not 100%, so it's going to take some time to ramp up for all those same reasons. People don't want to have a relapse of the virus, so there's still limited transportation and changing how you work, but it will come back.

Matties: Regarding ventilators, it's not just the actual bare board fabricators, but it's the base materials and components. It's a strong driver throughout the entire supply chain for us right now. It will be interesting to see what your committees or teams come up with to that forecast or what impact they feel it will have. I know you're an optimist, but what sort of concerns do you have for the industry right now?

Mitchell: One of my concerns is that, right now, people need to pay more attention to the real numbers as opposed to the fear. It is a disease or a virus or a pandemic that can impact you. But when we look at the actual numbers, the U.S. has become the most infected country in

terms of cases. But what are the real risk factors, and how are we mitigating those? We've seen several different, more famous people in the news saying, "So and so has contracted it." I haven't seen any case where those people have died from it. We're figuring out how to manage it. If we can manage that fear, then we can come back. But if we can't manage that fear, it's just going to slow things down. And my concern, frankly, is fear sells in the larger news pieces. If we can't start reporting on here's how to be safe, such as success stories and survival cases, then we're just going to propagate that fear even further, longer.

Matties: Do you have any closing thoughts or stories of humanity, if you will, that you want to share?

Mitchell: At some point, this is going to touch all of us personally. I have a nephew and a cousin who contracted it, and they've weathered the storm. I joked with them and said, "We need to get your little antibody badge so that you can walk around and everybody can say, 'That person is safe.'" Please don't take my advice as being from a medical professional at all. We're all going to be impacted in some way by this, I imagine. We need to recognize that. In our

case, fortunately, no one has been fatal in our organization. I am impressed by and proud of this industry. We are stepping up and helping be part of the solution. People aren't quibbling about, "This is my business or that business," at all. The industry is sharing best practices with each other in trying to help each other.

Now, this is not an unusual thing. This has been going on, but in this time of crisis, we've seen it highlighted even more in how the heads of these organizations that build the electronics, save lives, make our day to day better and are working together to try to make sure that everyone as an industry is successful so that, in turn, the world can get back to being a safer, happier place.

Matties: Those are great thoughts, John. Again, thank you very much for taking the time to help keep our industry well-informed.

Mitchell: My pleasure. PCB007

Audio File Available



Click here to listen.

ICM Controls Remains Open

ICM Controls, a leader in the manufacturing and supply of electronic controls, was classified as an essential service provider by NY State and granted exemption status; therefore, we are "not subject to the required 100% workforce reduction [mandate]" pursuant to the Governor's revised Executive Order 202.6. The move allows the company of more than 250 employees to remain operational in full support of other essential service providers standing on the front lines in the battle against COVID-19.

"We manufacture essential products and controls for multiple companies that are providing other essential medical and telecom equipment being used to combat the spread of COVID-19," said Andy Kadah, president of ICM Controls.

Kadah touted the flexibility of ICM Controls' vertical-integrated manufacturing facility and vowed to support

as many other essential service providers and our infrastructure as possible to help keep hospitals, government agencies, telecom sites, FEMA trailers, quarantine RVs, and other businesses open and the economy moving. This includes major corporations that have had their supply chains decimated as a result of the global pandemic, as well as the essential contractor trying to keep the heat on at a medical facility or nursing home.



Electronics Industry Advancements Have Prepared Us for COVID-19

One World, One Industry

by Dr. John Mitchell, IPC—ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES

Before today, the last unforeseen national crisis the U.S. endured was the 2008 financial crash. It shocked all of us, and many suffered; millions of Americans lost their jobs, homes, and businesses. Twelve years later, we are experiencing another unpredictable crisis with COVID-19. The virus outbreak has caused factories to shut down and people to quarantine, which will result in significant economic damage. According to the Center for Strategic & International Studies (CSIS) ^[1], the global GDP growth rate is expected to be around 2%—the lowest in 30 years. Analysts also predict it will take China—the largest trading partner of the U.S.—up to six months to recover.

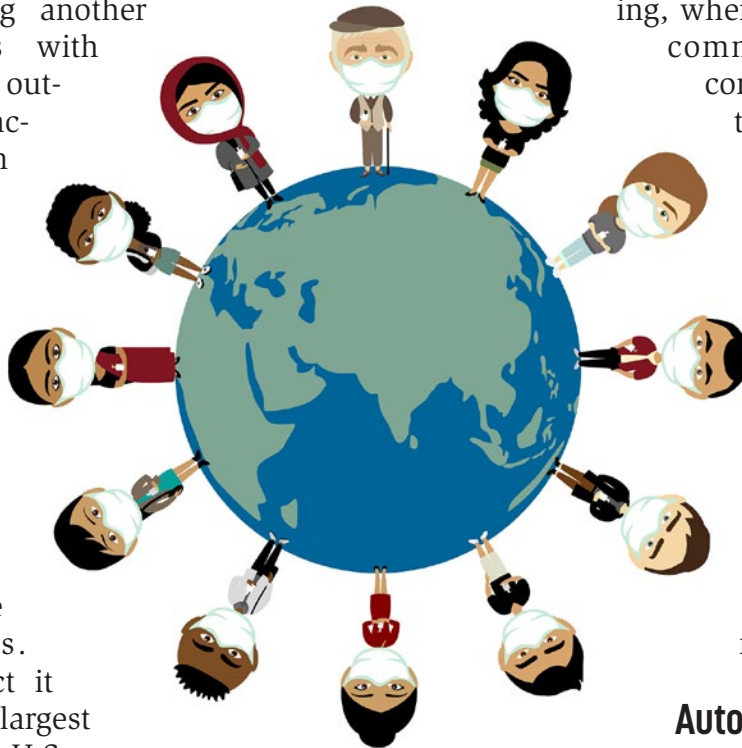
The electronics industry will also feel the impacts of the coronavirus. In an IPC survey, “The Impact of the Coronavirus (COVID-19) Epidemic on Electronics Manufacturers,” most manufacturers expect sales to decline in the

first and second quarters of this year and, overall, for the calendar year ^[2]. To manage the situation, most in the industry are identifying alternative sources of inputs, and 30% of firms are encouraging remote working, where possible, to prevent community spread and continue business operations.

In the U.S. and across the world, we are facing economic headwinds and short-term hardships. However, things could be worse if we didn’t have factory automation, standards, and telework to keep manufacturing resilient.

Automation

Automation has picked up over the last decade or two, providing products at a lower cost, and producing them more consistently. Factories are far from the dirty sweatshops of 70+ years ago. These facilities are using robotics, 3D printing, and machine learning to deliver the products



Universal ASF (ENEPIG)

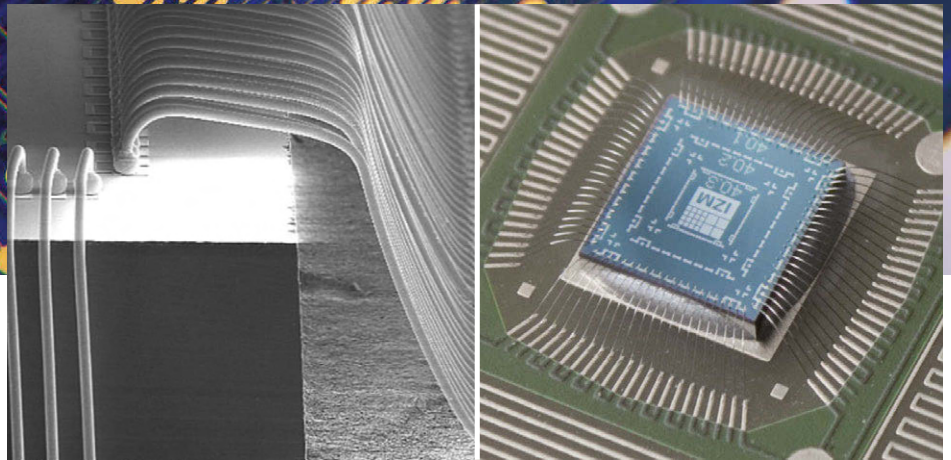
Excellent finish with highest reliability



The ENEPIG
choice for OEMs

4

MTO life time of palladium
and semi-autocatalytic gold



For gold wire bond application (source: Fraunhofer IZM)

Universal ASF is a multi purpose surface finish employing palladium instead of thick gold layers for top reliability. Atotech offers both Pd-P and pure Pd that have market leading stability attributes. The process solves extraneous nickel and skip plating. It offers market leading stability and minimizes nickel corrosion. Universal ASF can be combined with semi autocatalytic gold (ENEPAG) having an excellent bath stability and 4 MTO lifetime.

Atotech Group
+49 30 349850
info@atotech.com



Global head office

atotech.com

we need on a day-to-day basis. The “factory of the future” is just down the road from us and operating at full speed today. This not only shows how far we have come in terms of human well-being and technology but also demonstrates our ability to adapt and strive for normalcy as we cope with these uncertain times. This convergence between information technology and operational technology is paving the way for this next industrial revolution.

These facilities are using robotics, 3D printing, and machine learning to deliver the products we need on a day-to-day basis.

Standards

Throughout this experience, common communication is necessary for telework to be effective, meaning the language and network among team members, like standards and industry credentials. These provide a common understanding of what needs to take place for manufacturing and products to be developed correctly. Machines need to talk to machines, just like people need to talk to people, for operations to run smoothly. The products that we rely on every day—such as computers, telephones, and cars—could not have been made without common communication, standards, and the sharing of information, which continue to grow and expand.

Telework

Lastly, as we evolve through these uncertain times, our workforce will need to adapt to become generalists. We already see this trend among the younger generation as they

become well-versed in science, technology, engineering, and math (STEM), coupled with good communication abilities. As a workforce, we are emerging as a generation that understands STEM initiatives and socializes remotely, which allows people to be flexible as new situations and opportunities arise.

As people transition to telework, message team members on Zoom or Microsoft Teams, and perhaps even operate a part of a factory from their home, I’m optimistic about what our future will hold. We’re surrounded by and pinged with messages saying that facilities are shutting down, but we are more ready to adjust and adapt than we think.

While the spread of COVID-19 seems inevitable, automation, technology, and communication have come a long way and will speed our response to the needs of the future. In the next decade, when smart factories are fully implemented across industries, we will leverage digital twins and artificial intelligence to achieve virtual engineering and operation enhancement, allowing us to be more resilient in the future.

As we navigate the waters of this pandemic, I’m confident the framework we have laid will help push us through and show us what we’ve learned about our resilience—not only of our global industry and each country but also of ourselves. **PCB007**

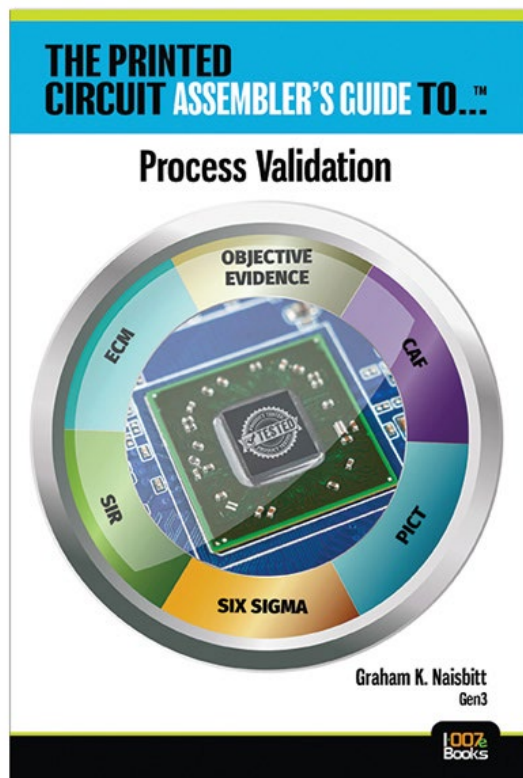
References

1. S. Segal & D. Gerstel, “The Global Economic Impacts of COVID-19,” CSIS, March 10, 2020.
2. IPC, “The Impact of the Coronavirus (COVID-19) Epidemic on Electronics Manufacturers: March Update,” March 2020.



Dr. John Mitchell is president and CEO of IPC. To read past columns or contact him, [click here](#).

The Printed Circuit Assembler's Guide to...™ Process Validation



by Graham K. Naisbitt, Chairman and CEO, Gen3

Given the current trends toward smart infrastructures, industrial internet of things (IIoT), and connected and electric vehicles, electronic circuit boards are deployed into humid and potentially corrosive environments arguably to a greater extent than ever before; hence, they are at greater risk of failures due to electrochemical migration (ECM). Written by Graham Naisbitt of Gen3, this book explores how establishing acceptable electrochemical reliability can be achieved by using both CAF and SIR testing. This is a must-read for those in the industry who are concerned about ECM and want to adopt a better and more rigorous approach to ensuring electrochemical reliability.

[FREE DOWNLOAD](#)[PRINT ON DEMAND](#)

“A must-read for everyone who wants to deal responsibly with the subject of humidity robustness and electrochemical reliability of electronics with the now new, valid, state-of-the-art for material and process qualification.”

— Dr. Lothar Henneken, Sr. Expert and Six Sigma Blackbelt, Robert Bosch GmbH

ABOUT THE AUTHOR



Graham K. Naisbitt is a specialist in conformal coating, cleaning, SIR and CAF testing, electrochemical reliability issues, solderability, and process control matters; has authored over 100 technical papers; and given presentations around the world. He is also the current vice-chair of IPC 5-30 Cleaning and Coating Committee that embraces 15 test standard groups and a maintenance leader with IEC TC91 for SIR, CAF, ionic contamination testing, and solderability. Graham is chairman and CEO of Gen3, which continues to be a successful, family-controlled business.



Interview With IPC's Dr. Shawn DuBravac: COVID-19 Global Industry Update

Interview by Barry Matties
I-CONNECT007

On March 23, IPC Chief Economist Shawn DuBravac, Ph.D., CFA, spoke with I-Connect007 publisher Barry Matties in an exclusive phone interview immediately following DuBravac's online briefing to IPC member attendees.

This interview presents a rather detailed look at Dr. DuBravac's situational analysis and projections with respect to the COVID-19 outbreak's short-term and long-term effects on the global electronics manufacturing industry. Dr. DuBravac makes some comparisons to consumer economic pressures and also discusses some of the U.S.-based actions taken by the Federal Reserve to smooth the U.S. economy into, and out of, the economic impact of this outbreak.

Before his role with IPC, Dr. DuBravac served as chief economist for the Consumer Technology Association, a U.S. trade association representing more than 2,000 consumer tech companies. Dr. DuBravac is also the author of the *New York Times* bestseller, *Digital Destiny: How the New Age of Data Will Transform the Way We Work, Live, and Communicate*.

Barry Matties: Today, I'm speaking with Shawn DuBravac. He's IPC's chief economist. Shawn is a global tech trends expert and joined the IPC in September of 2019. Of course, back in September, nobody would have predicted that

we're in the condition that we are here today, and—obviously—a lot has changed in the last couple of weeks or so with the COVID-19 outbreak. To help the IPC members have a better understanding of the financial impact on our industry, today Shawn conducted a financial focus webinar for members. Shawn, thanks for taking the time to talk with us today. And why don't we just get started, if we can, with a brief overview of today's webinar, please.

Shawn DuBravac: Sure. So one of the things that I have started to do for IPC since joining them is to monitor both what's happening within and around the industry, as well as what's happening more broadly in the economy. So leading up to the coronavirus outbreak and COVID-19, we were already monitoring a number of facets of the economy and looking at how the industry is performing in this economy. And so a lot of what we covered in the webinar is just a quick look at where we are today and where we think things will progress over the next year.

Matties: What sort of concerns or questions did the attendees have today in the webinar?

DuBravac: I think if you look at what's happening, this obviously started as a supply shock. And we saw facilities in Asia that normally

Leverage technology for competitive advantage:

it's what leaders do.

CapStone™ is the culmination of ESI's
decades of laser-material interaction
expertise and technology leadership
in flex PCB processing.

*Double your throughput and dramatically
decrease your per-panel processing costs.*

Adopt CapStone's new technology early...
and stay ahead.

CapStone™



ESI is now part of MKS. On February 1, 2019, ESI became part of MKS Instruments, Inc. The combination will leverage the respective companies' strengths and expertise to provide rich and robust solutions that meet the challenges of our customers' evolving technology needs.

For more information
about CapStone,
visit us at www.esi.com



will close down for about a week, as it relates to the lunar new year, extend that period and were closed for several weeks in addition to the regular one week delay. The regular one-week lunar holiday is well known within the industry, obviously if you're in any type of manufacturing, but certainly, within electronics manufacturing, you're aware of that, and you plan around it.

As that extended to include several weeks, companies began doing what the companies in the supply chain do very well actually, and they respond to these events very well by increasing the information flow within the supply chain, understanding what's going on, understanding where they might be hindered with regard to further production and what steps they need to take essentially to ensure that they can continue to produce. So they ramped up communications, they started to look for alternative sourcing options, they curtailed business travel, they started to look for alternatives. If the business travel, for example, was related to new product introductions, how they could continue to accelerate new product introductions while not traveling to Asia.

And then obviously what has transpired in recent weeks is that initial supply shock has dissolved into a demand shock as well. And as a result of countries across the globe, not just the United States and North America but also throughout Europe, closing down essentially to help fight the spread of the virus, you've seen a very significant demand shock go into effect, and that will push us into recession. We're probably in recession now in the U.S. and throughout Europe. We're probably quite close to a global recession or at least global growth very near zero. And we expect that to continue through probably about the third quarter, calendar Q3 of 2020. And then we'll start to see things build out of the recession as we move into Q4 and into 2021, which is in many ways a standard response to an economic shock, to one of these exogenous shocks, and to a recession. And so while every recession is unique, we see the economy respond in very similar ways.

Matties: A lot of people are speculating the speed at which the recovery will happen. Some say it's going to be slow; others are saying a V-shaped recovery. What's your expectation?

DuBravac: Well, what you tend to have, certainly what we had after 9/11, what we had in the 2007 to 2009 period, we had a lot of uncertainty. And so we're all feeling that right now, and you have a lot of uncertainty. You see a wide separation, I'll call it a diversion, in the forecasts that are being produced because of that uncertainty. And again, the way we tend to measure economic growth is looking at quarter over quarter at an annualized rate. So you start to see that recovery in the back half of the year, the fourth quarter of the year, for a couple of reasons. One is because you're comparing it to the down quarters of the second quarter and the third quarter. And we do expect to see a very steep decline in the second quarter of the year looking at macroeconomic variables.

So whether we're looking at the overall economy or even anything else—consumer spending, you name it, unemployment—and all of those will get materially worse in the second quarter. And then as we start to return to normal as businesses reopen, as we presumably have some response to this or at least, if you will, we've addressed the initial cause of the decline being the virus here, then you'll start to see businesses come back, you'll start to see consumers come back. They won't necessarily come back to the same levels of output and consumption that they were prior to that. But because they're coming back and because we're measuring growth, you'll start to see some of that recovery begin in the fourth quarter. So it depends on how you're looking at it. Yes, we see, at least for right now, a relatively short recessionary period that will last probably from about now until the end of the third quarter or so. And then you start to see the economic recovery. But it will take some time before we return to the levels of production that we were enjoying prior to the onset of this recession.

Matties: So when you look at the current situation, what do you feel is the most immediate or critical financial concern we should have in our industry?

DuBravac: Well, one of the things that we are seeing now, which is a good sign, is that the Federal Reserve is implementing a number of tools. Obviously, they cut their target interest rates early as this started to materialize into much more than just a supply shock. But they also dusted off their toolkit from the 2007 and 2009 period, and they begin to look at everything that they used then and what they could use now. And they were quick to implement some of those tools. Even this morning, the tools were expanded that they had in place. Some of these, we did not see until the eighth or ninth month of the financial crisis in 2007, 2008. Some of these were not implemented until late in 2008. And so I do see a quick response. We're using the tools that worked well during that period.

I think those are all very good signs that remove some of the uncertainty, that we've seen the Fed respond very quickly, using tools that have worked in our recent past in the last recession, so that's a good sign. What I am monitoring closely and what I talk to companies about frequently is how their lines of credit are looking. Because if you think about the lines of credit that businesses are using, often they might finance a warehouse or other equipment on any real estate, typically office buildings and in factories, warehouses tend to be financed on five-year balloons. Every five years, they have to either refinance that loan or pay it off, and often they're just refinancing it with the current issuer of that loan, be it a bank or someone else.

What we saw during the financial crisis was that even a company that was doing well, operating fine, they were still selling product, they were able to make their payments, those loans were being called in. So when they were due at five years, they weren't being extended. And that left businesses running to find alternative lending sources or being forced in some cases to sell this asset, sell warehouses, sell facilities.

And so we watched those types of things very closely because even a company that is operating well and operating fine in this type of difficult environment could run into trouble if they have difficulties on the financing side of it.

Now a lot of what the Fed has implemented is to help address some of those things. And we haven't heard from any companies yet that are facing these types of challenges, but I definitely am always asking about these types of things and always on the lookout for companies that might be facing any type of financial hardships as a result of this. Somebody should be checking with their bank; they should be ensuring that they have good lines of credit, that those lines of credit are secure, that they'll be able to tap those if needed, that they'll essentially have the liquidity that they'll need should they run into financial constraints that are out of their control.

Thus far, it looks like a lot of the manufacturers continue to operate "as normal." And I say "as normal" in quotes. Obviously, this is a very strong shock that we've seen. And from the beginning, electronics manufacturers and suppliers were impacted by this because they were having to adjust everything as new information was coming out. But at least as of last week, we were hearing from companies that they continue to operate at close to full capacity. In some instances, if they're within the medical supply chain, they're seeing new orders come in. Other companies report that they are ramping up production and also inventory builds just in case they run into any operating constraints or issues. For example, warehouses closing down or other things like that. Transportation is becoming more difficult. They want to be able to turn to additional inventory that they may have on stock to be able to provide and service the sales that they have coming in.

So the electronics manufacturing sector, at least for right now, seems to be intact, seems to be operating at close to full capacity here in North America. And what we're hearing from Asia is that things have quickly come back online and by the end of the month they'll be at or very near full capacity as well.

Matties: And if that's any indication what's happening in Asia, it's kind of a model timeline for us to consider here in North America and other parts of the world.

DuBravac: I think that's fair. I think it looks like North America and Europe, to some extent, are four to six weeks behind Asia, with respect to closures and other impacts from the spread of this virus. And so I would expect that Europe and North America would follow that similar timeline. And again, it's never perfect. There are lots of dynamic situations that are continuing to develop and will develop over those six weeks. For example, in February, about 8% of container shipment capacity was unutilized essentially, was offline. That's all coming back online this month and making the major container shipping companies anticipate being at full capacity in March, by the end of March. But that period in February where they weren't at full capacity creates issues. You have the buildup of empty container cargo containers that end up building up outside of the port, or they're left on train cars and on side rails and other things like that.

And so the transportation network starts to get inhibited to some degree. About half of their freight is carried by passenger flight. So as passenger flights have been canceled out, that has taken a lot of air freight offline. And so companies have had to find other freight options and other things that they could do in place of that now. We are starting to see American Airlines, Delta, and others announce that they'll be running cargo-only flights. So that should help some of the air freight situation that we've seen over the last couple of weeks. But those are all the things that companies will have to be dealing with probably at least for the next two or three months.

Matties: Overall, you've mentioned supply chains and shipping and all sorts of aspects around that. What do you think the long-term impact will be? What lessons have we learned?

DuBravac: Well, I think every time we have an event like this, it tests the resiliency of the supply chain. And so in many ways, this is what

the supply chain is designed to do, is to respond to shocks somewhere in the system, and to make adjustments in the supply chain within that system so that consumers and businesses that are at the far end of that don't feel that. And I would argue that the supply chains have done a pretty good job, at least from what I can tell, thus far, at doing that. We had a major supply disruption when you had trying to go offline—essentially, the entire country go offline—from a consumption and a production standpoint for several weeks. And yet you didn't see a lot of electronics manufacturers in Europe or North America also go offline as a result of not being able to secure the right inputs and components and supplies that they needed to continue to produce. So they were able to adjust to those shocks.

Now, obviously, that's probably not true in all cases, in absolute cases, but the large number of companies that I spoke with were able to adjust to the shock that they saw and make other arrangements and look for alternative sourcing and alternative productions. And you haven't seen consumers talking about, or businesses talking about the inability to get certain products. Definitely, you have seen certain orders delayed as it relates to consumer electronics. I know that for certain, and primarily it's in the consumer electronic space, smartphones and laptop configurations were impacted, but by and large, you haven't seen entire classes of categories impacted.

Matties: Very good. To close, Shawn, what sort of advice would you offer the industry at this point?

DuBravac: Well, I think the advice I would offer is to remain resilient. Manufacturers should continue to stay online. Obviously, following all of the direction that we're being given by the CDC here in North America and other similar agencies more broadly. Look to make adjustments within your manufacturing processes if you can, in order to abide by these guidelines. But continue to be resilient. I've been very impressed with the companies that I've spoken with and the resiliency that they've shown to address the issues that they're confronted with and to make adjustments. And so continue to

make those adjustments. Communication flow is extremely important in these types of periods. So not only should you be communicating with your financial institutions, banks, and lenders, but you should also be communicating up and down the supply chain as frequently as possible with the most accurate information as possible.

I think one of the things we always find in these events is that accurate information tends to be highly correlated with current information and the frequency of information. And we always want the most up-to-date information that we can get during these types of periods. So continue to share that information, it's very important. And that's really, I think, one of the overarching goals of trade associations during these periods, companies or groups like IPC

is to disseminate that information quickly to membership to ensure that members are working off of the same information and the most accurate information that's available at that time.

Matties: Well, Shawn, we certainly appreciate your time today, and your expertise, and we'll look forward to some future updates with you. Thank you very much.

DuBravac: Great. Thanks. PCB007



Coronavirus Crisis Statement From Ventec International Group

The electronics industry is playing a major role in supporting increased requirements for critical medical devices during the current COVID-19 health emergency. As such, Ventec International Group (Ventec) has been identified by key PCB manufacturers around the world as a critical supplier of materials and services to support these activities. Ventec states that it is completely separate from and unconnected to Ventec Life Systems Inc.—the company based in Seattle, Washington, currently working with General Motors to produce medical ventilators.

Ventec, a world leader in the production of polyimide and high-reliability epoxy laminates and prepregs and specialist provider of thermal management and IMS solutions, has a critical role supplying its materials to companies and consortia currently making various types of equipment to help handle the global COVID-19 crisis.

Today's medical devices—including ventilators and equipment for many other roles—contain one or more electronic subsystems for functions, such as sensing, system control, and power conversion. In the fight against COVID-19, initiatives are underway worldwide to increase the production of equipment to existing designs or accelerate the introduction of new and more effective products. As a consequence, there is currently an increased demand for certain materials—particularly VT-481 and VT-47 laminate and prepreg for 4-, 6- and 8-layer PCBs, which require urgent airdrops to support customers in the U.K., Europe, and

the USA to supplement the local inventories.

Airfreight costs are rising considerably, and available freight capacity is being restricted by the airlines. The Ventec team is working incredibly hard to secure the necessary immediate airfreight capacity, whilst minimizing where possible the added costs that need to be passed on. At the same time, Ventec has already started shipping extra volumes of these critical materials by sea container in order to further build up regional inventories.

Ventec COO EMEA and USA Mark Goodwin said, "Technology companies around the world are responding vigorously to this crisis, delivering equipment for various roles such as administering treatment, protecting caregivers, and assisting research. Ventec is proud to be a part of the unprecedented global response, as we continue to strive for the upper hand over this threat."

With strict infection control procedures in line with government advice implemented at Ventec's facilities around the world, the company's robust supply chain is helping ensure the materials for fabricating essential circuit boards for critical subsystems arrive at manufacturing locations on time, meeting high quality and performance standards. These include laminates and prepregs, and thermally enhanced substrates. The company's technical experts are also available around the clock to provide advice on their design and use.

(Source: Ventec)

Our Finest Hour

It's Only Common Sense

by Dan Beaulieu, D.B. MANAGEMENT GROUP

“Do not let us speak of darker days; let us speak rather of sterner days. These are not dark days; these are great days—the greatest days our country has ever lived.”

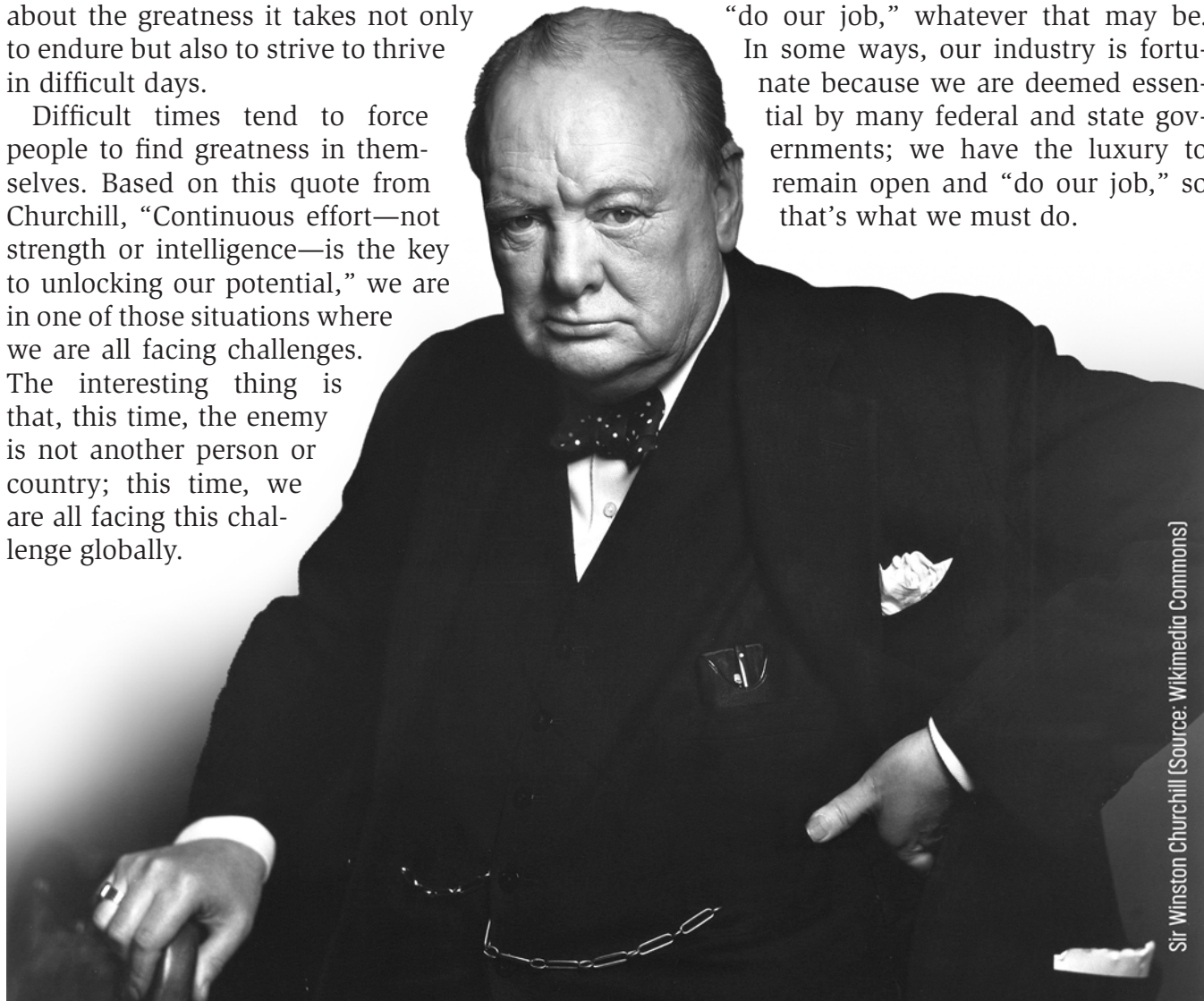
—Winston Churchill

The great orator was talking about the bombing of London when he said these words—a time far more serious and frightening than what we are going through right now. Instead of talking gloom and doom, he talked about the greatness it takes not only to endure but also to strive to thrive in difficult days.

Difficult times tend to force people to find greatness in themselves. Based on this quote from Churchill, “Continuous effort—not strength or intelligence—is the key to unlocking our potential,” we are in one of those situations where we are all facing challenges. The interesting thing is that, this time, the enemy is not another person or country; this time, we are all facing this challenge globally.

If, at any time in your life, you wondered how you would have reacted in a difficult situation—and if you have read books, watched movies, or heard stories of brave men and women doing courageous deeds of heroism, and thought about what you would do—this is your time to find out. Rise above the fray, and face this difficulty. Show your courage, strength, and endurance in the eye of the storm and stand up to the challenge.

It's simple; we need to find a way to “do our job,” whatever that may be. In some ways, our industry is fortunate because we are deemed essential by many federal and state governments; we have the luxury to remain open and “do our job,” so that's what we must do.



Sir Winston Churchill (Source: Wikimedia Commons)

Under development

Halogen-free Ultra-low transmission loss
Multi-layer circuit board materials

Halogen-free MEGTRON6

NEW

Laminate **R-5375(N)* R-5375(E)**

Prepreg **R-5370(N)* R-5370(E)**

*Low Dk glass cloth type

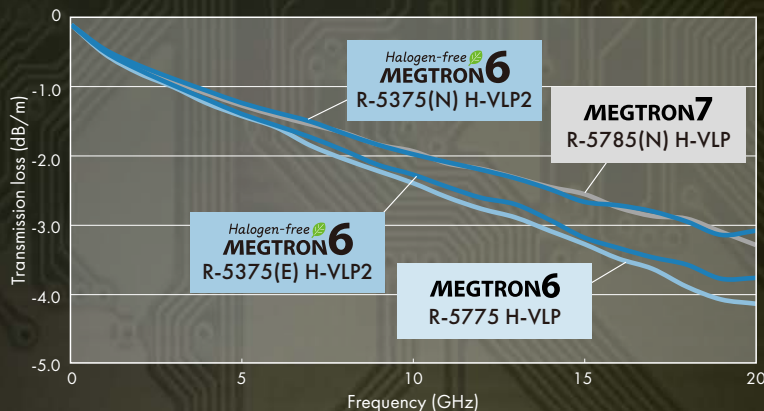
Features

- Excellent HDI and thermal performance **with Halogen free**
- High speed and ultra-low loss material
- Low transmission loss

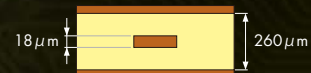
Applications

- ICT infrastructure equipment, High speed networking(High-end server/ router, Optical network, switch), High layer count PCB, etc.

Transmission Loss



Construction



Line length	200mm, 100mm
Line width	125μm
Impedance	50Ω
Inner Cu treatment	No-surface treatment
Core	0.13mm
Prepreg	#2116 56% x 1ply



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

Partnering to go beyond.

Electronic Materials
Panasonic Corporation

Many of the companies I work with, and others I hear about, are doing this right now; they are open for business and producing products. Surely, those who are at risk are invited to work from home, and they are doing that as well. But alas, a PCB cannot be plated in someone's living room, and no one has a pick-and-place machine in their kitchen. Consequently, many people have to go to their workplace to do their job. This means that they do so with a certain amount of risk, and we should thank and appreciate them for that.

To those in sales and marketing, many of us working from home, we also need to do our job and keep things moving forward. We need to be creative, innovative, and persistent enough to stay in front of customers—no matter the ways we find to do so.

These are good times to:

1. Stay in touch with your current customers:

Send them short updates and news flashes about what is going on with your company. Let them know you are still working on their products and services.

2. Find new customers: Create an “ideal customer profile” and then go online using tools, such as LinkedIn, to find those prospects.

3. Develop and implement a plan to reach out to those prospects: Connect with them on LinkedIn. Send them short introductory newsletters via Constant Contact, HubSpot, or some other method.

4. Work on your company's branding and marketing plan: There has never been a better time to do this. Right now, you have the time. Work on your company's story and develop a means of conveying it.

5. Advertise: If you are already advertising, then work on your ad messaging, making it appropriate for these times. If you are not advertising, then you need to start advertising right now. Our current world situation will rush us along into becoming even more of a global economy, and

people are looking for solutions globally. Someone out there is looking to buy something from you. Your job is to be found.

6. Communicate with one another all the time:

We are so lucky that we have smartphones, conference services, and the internet at our disposal. Use them wisely to communicate with one another to keep business as usual. I know that these services are getting overused and overcrowded at times, so take a tip from the CEO of Free Conference Calls, and plan your meetings during off-hours in the evening or early in the morning. Also, set the meeting time at odd times instead of on the hour or half-hour. It works!

7. Plan for the future: This too shall pass. The sun will come out tomorrow, and we will be all the better for what we have been through, so plan for that sunny day. Visualize what the world will look like, and then plan on how you are going to meet the challenges and opportunities that that new world order will bring us.

8. Find a way to keep your spirits up: As I said earlier, this is our time. Generations will judge how we dealt with this situation. We will be remembered for what we did when the world was at a crisis point and how, in the end, we came out of it as better people, companies, countries—and ultimately, a better world.

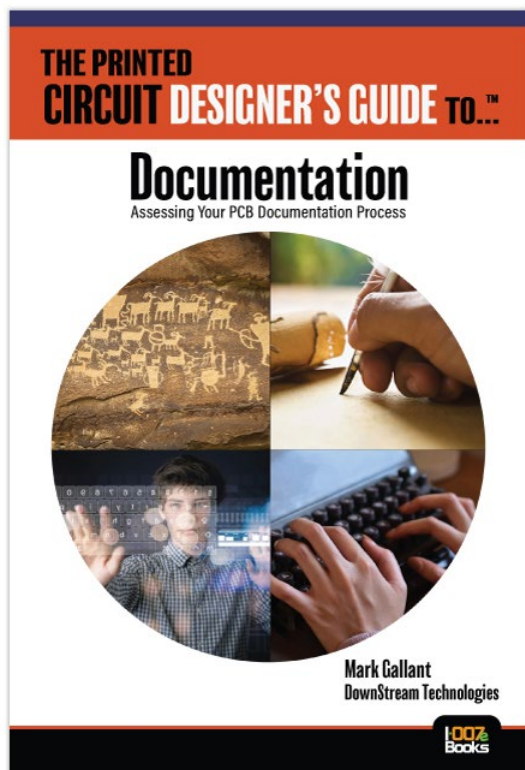
I'll leave you now with another quote from Sir Winston Churchill: “Let us, therefore, brace ourselves to our duties, and so bear ourselves, that if the British Empire and its Commonwealth last for a thousand years, men will still say, ‘This was their finest hour.’”

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



Dan Beaulieu is president of D.B. Management Group.

The Printed Circuit Designer's Guide to...™ Assessing Your PCB Documentation Process



by Mark Gallant, DownStream Technologies

When the PCB layout is finished, the designer is still not quite done. The designer's intent must still be communicated to the fabricator through accurate PCB documentation. Documentation can be an error-prone task—one that may take up to 20% of the total PCB design cycle time. Many designers still utilize documentation strategies that date to the '80s and '90s. Mark Gallant of DownStream Technologies explains how the automated documentation solutions of today can eliminate post-processing errors and speed up time to market. This book is a must-read for any PCB designers or design engineers who would like to adopt 21st-century PCB documentation processes.

[FREE DOWNLOAD](#)[PRINT ON DEMAND](#)

“This book explains how information embedded in a PCB design layout database can be leveraged to efficiently and dynamically output more accurate PCB design documentation.”

— Kelly Dack, CIT, CID+, PCB Designer, Instructor, and Manufacturing Liaison

ABOUT THE AUTHOR



Mark Gallant has been involved in PCB design and fabrication for 39+ years. When PADS-PCB was introduced, he was one of its first 100 users. Soon after, Mark joined the ranks of PADS Software as a technical support engineer. During his 20 years with PADS and ultimately Mentor Graphics, Mark served in several key roles. His predominant role was product marketing and definition for the PADS schematic, PCB design, and autorouting products. In May of 2011, Mark joined DownStream Technologies as senior product marketing manager.



Jenny Zhang, sustainability manager, NCAB Group China, checking chemical handling and storage during a sustainability audit.

A Sustainable Supply Chain for Lowest Total Cost

Feature by Harry Kennedy
NCAB GROUP

Typically, when sustainability is mentioned, it refers to how a product is disposed of after its usable life. But being green is more than keeping pollution out of the environment; sustainability has many different aspects to it, but some are overlooked.

One example is social impacts like employee treatment. For a process like PCB manufacturing, thinking sustainably is important—since the process can result in a lot of wasted material and chemicals that can negatively impact the environment—but it's also so much more; it includes an entire business model and strategy.

If you're not set up for long-term success within the supply chain, you, your customers, and your suppliers are all at risk. The entire supply chain must be built into this strategy.

A Strategy Built Around a Sustainable Supply Chain

When choosing a PCB supplier, how do you differentiate between the available options

that may look the same at first glance? Do they produce reliably with a quality-first approach? Further, one very important question that should be highly considered is what if you need to move products from a particular factory for some reason? Is there an ability to do this seamlessly, or will your production line be held up?

Having to move PCB products from one factory to another is more common than it may seem. There are various reasons for this. Perhaps the quality at a specific factory or within a specific technology is beginning to cause a defective product, or maybe there's a trade war or other geopolitical issue that impacts the product availability or cost. There could also be a catastrophic natural disaster impacting a factory's ability to produce, leaving the supply chain exposed at a critical time. We must be able to respond to situations that are out of our control by proactively implementing a sustainable solution that we can control.

Again, if there's a natural or political disaster—and a certain region in the world is impacted where businesses must cease operations—do your supply chain partners have



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

INNOVATIVE POWER 4U

burkleamerica.com



Contact:
Kurt Palmer
714-379-5090





Jenny Zhang, sustainability manager, NCAB Group China, checking factory grounds during a sustainability audit.



NCAB Group team members performing visual inspection at a partner factory.

alternatives to move products from one factory to another seamlessly? With the COVID-19 outbreak, I have seen this become the most important factor of our business recently. It's the most sustainable way to operate to be able to still function and produce by having a robust network of supply chain partners built up throughout the world.

When certain areas in China were initially affected by the coronavirus, it was important to be positioned to mitigate risk. As of now, we see production is ramped back up in China and other areas of the world, including Europe and the U.S.—which are experiencing the effects of the COVID-19 outbreak. We see immensely increased lead times, and—in some cases—prioritizing critical applications over others. With a reduced workforce in the U.S. and increased demand, factories must take this action.

In many instances, the biggest advantage to sustainably operate your business is to have options with your suppliers. If a factory shuts down that is producing a complex PCB, you need to be proactive about mitigating the risk that comes with this. There is so much time and cost involved with sourcing, approving, and monitoring a new factory. If the proper time and resources are not built into this process, you will have quality issues and will not be able to produce a reliable product. A business model needs to be diversified and include multiple options able to manufacture a PCB; it's the sustainable way to operate.

Yes, when you move products—even with a fully-audited and approved factory—there is the potential for variances. Even two factories that are fully audited can have different manufacturing methods for the same PCB. There needs to be a process involved; it's not just a simple transfer. To mitigate risk, work does need to be done on the back-end. A customer may not be aware or have visibility into this process, but working in the background to ensure product conformity and quality must be implemented. For example, available material and material lead times can vary with different factories. PCB suppliers should always advocate on behalf of their customers by checking this and reconfirming with customers that everything is in sync.

The advantage of having options with your partnerships applies throughout the supply chain—not just a PCB supplier. The need to adapt to any changing environment is key. A contract manufacturer needs to keep all its components in stock. An OEM/ODM needs to make sure their assembly shop has multiple locations for long life cycle products.

The Right Product in the Right Factory

Carefully choosing long-term partners and working closely with them to maintain and develop a sustainable business needs to be implemented in a successful strategy. PCB technology, manufacturing knowledge, close relationships and communication with cus-



Team members of NCAB Group Italy during a visit at a partner factory.



Visual PCB inspection and testing performed at a partner factory.

tomers and factories—as well as experience—all contribute to the lowest cost. This includes a well-defined process for identifying, evaluating, and selecting potential factories. To maintain process control, an approved factory should continue to be monitored with an added level of control until there is confidence that the performance during the probationary period has met expectations.

At NCAB, we evaluate each factory's capability and approve the areas where we are convinced the factory will be able to deliver excellence, irrespective of what the factory itself claims it can produce and deliver. This enables us to select the factory best suited to the technical and commercial requirements of each specific customer product. When the right PCB is in the right factory from the start, this again leads to less waste and a lower cost overall.



A sample of chemicals used in PCB production.

Once a factory and its processes and technology are improved, the work can't end there. We must monitor work to improve the processes and enhance production control. When quality engineers work together with factory employees and continuously monitor activities, this improves the ability to prevent quality issues from arising during production, further reducing the lowest total cost. That's a big part of what sustainability means—not just being able to source and approve, but maintaining the quality and the relationship.

Design Optimization for Production and Product Quality

A sustainable approach to product development starts with the design of the PCB. To reduce time-to-market and avoid pitfalls later in the production process that could contribute to reduced yields and the need for recovery actions, it is important to ensure that the design is as robust as possible without compromising any level of functionality or building in any unnecessary complexity. This includes all aspects of DFM from material selection to layout.

Doing it right the first time not only relates to quality, but it is also a mindset that helps us to reduce our environmental impact. We know that improved product quality means less scrap, less waste, less energy, and smaller volumes of chemicals used in production. Creating a functioning, optimum solution from



NCAB Group Sweden Technical Manager
Kenneth Jonsson at NCAB Group lab.



Team members at NCAB Group lab
performing testing.

the start will lower the total costs for everyone involved in the project.

A Responsible Approach to Waste and Recycling

Even though you may not be the design authority or own the finished product, to minimize waste, you have to take full responsibility regarding your part of the product life cycle. With the start of the life cycle, you must do what you can to ensure that your circuit boards last.

One of the main strategies to do this is by thinking with a quality-first mentality by engaging with your customers and helping them design products that utilize advanced capabilities, which are not unnecessarily complex. This helps to ensure that waste is minimized within the factories and during its working lifetime.

While the boards are being processed, it's always a good idea to report yields against factory targets; whenever out of control events are identified, investigate them with the same diligence as an investigation into a non-conformity. It's also imperative to monitor electronic waste according to the local waste laws so that it may be recycled.

Three Key Factors

Collaboration, knowledge-sharing, and proactivity are key factors when developing quality work. We should all focus on finding ways of improving a method of working to better handle customer requests and resolve any is-

sues even more efficiently. This is to ensure that the end result takes us closer to delivering defect-free PCBs.

Objectives should be set in place to ensure that we are well-placed and capable of meeting the technical needs and expectations of the customer and the evolving market, as well as to ensure that the “tools” we have and the ways of working are as effective and efficient as they need to be to properly service and support customers. Everyone benefits from a continued commitment to personnel development and providing training in all disciplines. In collaboration, teams should be integrated so that sales, quality, and engineering are able to work together and develop best practices.

For example, to create awareness, dialogue, and cooperation for sustainable development, NCAB Group communicates through many dif-



NCAB-designated equipment at a partner factory.

Get the Facts About Testing Your High-Reliability Boards

Today's high-reliability electronics require accurate test methods. Learn to achieve electrochemical reliability and more with the latest offering in the I-007eBook library: *The Printed Circuit Assembler's Guide to... Process Validation*.



**I-007e
Books**

Download Now

I-007eBooks.com/pv



Equipment and circuit boards during the production process at a PCB factory.

ferent channels. We have published a variety of videos, including advice on sustainability and how to work in a sustainable way, illustrations of the production process, and technical FAQs. We have also conducted hundreds of technical seminars to educate our customers, and we have had our customers visit our factory partners. Sharing this knowledge has helped efficiency for both our customers and our partners.

Conclusion

To implement all of these strategies into long-term success, since 2014, NCAB Group has built a sustainability strategy, which specifies our long-term goals and focus areas. With clear priorities, the strategy guides us in the right direction to gain sustainable business growth and achieve the positive changes we want to see in our industry.

We have divided our sustainability work into three focus areas in relation to our prioritized stakeholder groups: customers, employees, and factories. It illustrates how our sustainability work strengthens and adds value to these relationships. For increased credibility, we have based our strategy on ISO 26000 (Guidance on Social Responsibility)—an international standard that provides guidance on how a business may operate in a sustainable way. Our internal and external ISO audits also includes ISO 26000.

Working together with both customers and factories, the goal is to produce high-quality PCBs in a sustainable way. This is typically thought of as an extra cost, but our method to implement sustainability helps the customer achieve the lowest total cost. In the product development phase, we engage with our customers to develop a sustainable design and then select the best factory for each project with the ability to move a project from one factory to another seamlessly. It's important that we leverage our strong relationships to increase profitability for our customers, the factories, and us.

From getting the design right from the start all the way through to shipping the PCBs, sustainability initiatives result in more profitability for our customers. We encourage all of our customers to learn more about sustainability, including ways to improve costs using sustainable methods. If we continue to collaborate, share knowledge, and work with a quality-first mindset, the resources we invest in our sustainability strategy more than pay for themselves. **PCB007**



Harry Kennedy is a field application engineer at NCAB Group.



March 12, 2020

Dear Valued Customers & Partners –

When I assumed the position as President and CEO of Burkle North America late last year, I did so with great expectations for a solid 2020. I remain optimistic about all of the industry markets that we serve at BNA.

The current COVID-19 pandemic has, however, impacted all of us personally as well as our business. This situation will be resolved; in the meantime, business will not be “as usual.” In an effort to protect our business family, as well as do our part to contain the spread of the virus, we will be reducing travel amongst our BNA team members. Until we know more about the virus, I have asked our BNA account managers and service technicians to consider other options instead of travel, such as conference calls, Skype meetings, and Team Viewer online sessions. In critical cases where travel appears to be the only solution, travel will be allowed if the risk is considered to be low. During this time, our goal is to minimize any impact upon our mutual business while keeping the health and safety of all people as the top priority.

In this uncertain period, I have every confidence in our business communities’ ability to pull together with care and concern for the common good.

Thank you for your support.

Sincerely,

Kurt Palmer



President and CEO
Burkle North America



Isola's Travis Kelly: Maintaining Continuity of Supply

Interview by Barry Matties
I-CONNECT007

On April 9, Barry Matties spoke with Travis Kelly, Isola president and CEO. Travis gave an update on Isola's responses to the COVID-19 challenges in materials manufacturing.

Travis pointed out that Isola's products fill a critical need in the switch to medical equipment manufacturing for ventilators and related products. He also spoke to the three keys to maintaining continuity of supply.

The new Isola facility in the Phoenix, Arizona, area is steadily coming up to speed, and Travis shared the latest news on that transition.

Barry Matties: Today, I'm speaking with Travis Kelly, president and CEO of Isola. Isola is a global supplier, providing PCB manufacturers around the world with laminate and prepreg materials. Travis, the recent COVID-19 outbreak has impacted the supply chains around the world. Please share with our listeners how this has impacted our industry.

Travis Kelly: One thing we've been focused on is maintaining the continuity of supply from our vendors and continue to be 100% operational at all our global facilities. There are three key pillars that are very important that have allowed us to remain open, and I would imag-

ine many of the other businesses within our industry. First and foremost, we have a diverse global supply chain that has allowed us to ensure we have the materials that we need to produce our laminate. At this point in time, it's extremely important to have very close communication with our supply base, and that has been essential to the overall strategy around continuity of supply—making sure that we're very transparent and collaborative relative to what we need and when we need it and as well as where we need it.

And then, as it pertains strictly to Isola, our global manufacturing footprint has allowed us to move and share raw materials as necessary to ensure we have the right materials in the right location. This is one thing that is very strategic to the way Isola operates; by having that global manufacturing footprint, we can share raw material across borders, and get the material where we need it at the right time.

Matties: What sort of trends are you seeing in the supply chain? Is there an increase in demand, or have you noticed a reduction in orders?

Kelly: Specific to Isola, we've seen a very large increase in demand. Part of that is the overall

Excellon

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



COBRA II Hybrid Laser

*UV and CO2 lasers
Blind via, flex cutting, cavities*



HS-4L

*Low-cost, 4-station precision drilling
or routing system with large panel option*



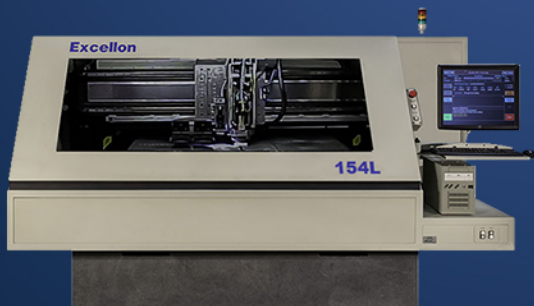
HS-1L DS

*Single-station, dual spindle high-speed
drilling/routing with Intelli-Drill Vision*



136L

*High-Speed, precise accuracy
drilling/routing with Intelli-Drill Vision*



154L

*Large panel size precision drilling/routing
Single station with vision options*



HS-2L

*High-speed, 2-station drill or router
w/populated board routing option*

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

medical industry, where a lot of our laminate is used—especially when you get into the pandemic, such as COVID-19, with the need for ventilators. We’re seeing a pretty large spike in demand for certain material grades that are used in that type of equipment. We’ve been extremely busy, not just in the United States, but at our global sites as well in China and Taiwan.

Matties: Now, to the supply chain issue. The last time we talked, you indicated that progress is being made in the new facility in Arizona. Give us an update on where that’s at and how that’s aiding in the supply chain.

Kelly: We’re very excited about our new facility. We just finished the buildout of the state-of-the-art R&D facility. As you recall, the last time you and I spoke, we had moved the corporate employees into the new world headquarters. And this is all housed under one roof. The corporate employees moved in last year, and then the R&D facility was just finished this week, which is very exciting. One thing that we’ll be able to do is with the lab that’s part of the R&D facility, we all have the right office space for our scientists and lab techs. But then we built out a completely new lab that’s fully operational by tomorrow and will provide Isola with the tools and capabilities to continue our leadership around innovation and working with our business partners to solve problems.

The next and last phase is the completion of the quick turnaround manufacturing space. If you can envision this very large, 130,000-square-foot facility in Chandler, Arizona, houses all the world headquarters employees as it relates to Chandler. It also houses the R&D employees as well as the lab. The final phase is this quick turnaround facility. The hot presses are actually being set this week, which is one of the major milestones in the building that will be QTA.

Once we install all the support equipment, we can start verifying the equipment run rates and start producing at volume. Work continues on the layup and material handling systems, which is being produced in Taiwan. Now, as we talk about supply chain and the impact of

COVID-19, we have seen the impact in terms of some of this equipment. It has caused many challenges as it relates to the collaboration between Isola and the equipment manufacturer that’s based in Taiwan.

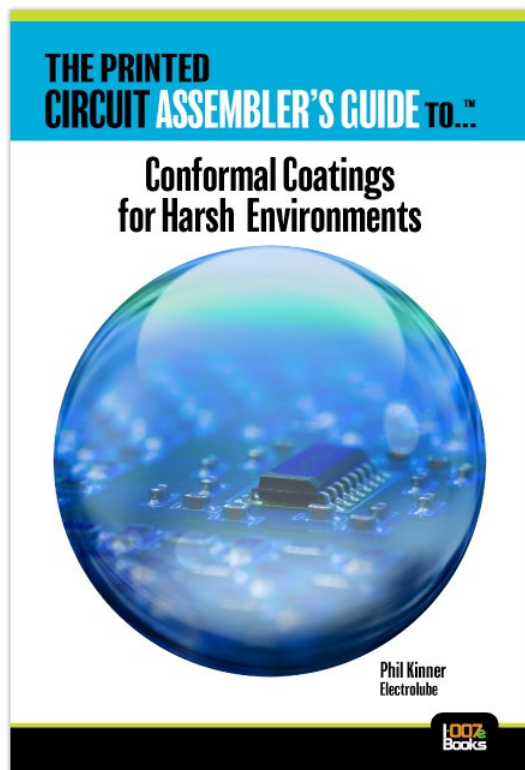
However, our team has utilized video conferencing and other technologies where the equipment supplier can take us out on their floor in a virtual environment so we can actually see various pieces of equipment operate. This is all very state-of-the-art equipment. It’s been designed based on our specs working in collaboration with the manufacturer of the equipment. It’s very important that that collaboration continues. Even though there’s a lot of travel restrictions and it’s very difficult to go global at this point, we’re able to utilize certain technologies, which gives us the opportunity to continue to collaborate on those designs.

Matties: That’s great, and it’s amazing how technology is really stepping in to keep things moving. Related to that end, there has been a lot of support in the industry to help each other to get through these challenging times. What sort of stories of support are you hearing out there?

Kelly: Yes. As I said a little bit earlier, as we talk about supply chain, Isola is actively involved in supplying critical material to many of our customers that are manufacturing medical equipment to fight COVID-19. And, arguably, even some new OEMs—as people have seen GM and some of the automotive companies—are now producing ventilators. Isola is treating all material orders that are needed to assist during this pandemic as the top priority. What does that mean? That means to the extent possible, we break into production schedules and move raw materials around the globe at our expense to support emergencies or to help save lives.

Isola is committed to fighting this pandemic alongside our business partners. And we will continue to utilize the full strength of our company to provide quality material in an expedited fashion. There are many examples—especially over the last several weeks—where there’s a

The Printed Circuit Assembler's Guide to...™ Conformal Coatings for Harsh Environments



by Phil Kinner, Electrolube

Much time, energy, and resources go into designing, building, and manufacturing various electronic components. How can technologists protect critical components that operate in adverse environments? The answer is conformal coatings. Phil Kinner addresses a myriad of conformal coating materials and process considerations for achieving reliable performance in harsh environments. Kinner also simplifies the many available material types and application methods and explains the advantages and disadvantages of each. This handy eBook is a must-read for anyone in the electronics industry who wants a better understanding of conformal coatings.

[FREE DOWNLOAD](#)[PRINT ON DEMAND](#)

“This micro eBook offers a comfortable approach to the selection, implementation, and testing of protective coating processes. It would be especially helpful for starters to use as a checklist for operational implementation.”

— Dr. Helmut Schweigart, Technology Development Head, Zestron Europe

ABOUT THE AUTHOR



Phil Kinner, Electrolube's global business and technical director (International Conformal Coatings Division), has more than 16 years' experience within the conformal coating industry covering both materials and equipment. Using his wealth of knowledge, Phil specializes in new product development and has master's degrees in both chemistry and business administration. Phil is also an active member of the IPC Conformal Coating Task Group, a regular speaker at IPC and SMTA events, and a member of the technical committee of the U.K. SMART group.

huge pickup in demand for certain grades of our material that are needed in a lot of these different medical devices. We are doing everything humanly possible, and having our teams across the globe work many days and shifts to provide this material as quickly as possible to those manufacturers to get the material in a place where they need it and when they need it.

Matties: What advice would you give the industry during these challenging times?

Kelly: I wish I had great advice to give the entire industry. But one thing that we're focused on is understanding and constant communication with our employees. This is an unprecedented time in our history. We constantly remind one another that we have faced significant challenges in the past. We will remain disciplined and vigilant in all that we do.

One thing that we're focused on is our unwavering focus on employee safety and engagement, and supporting our business partners, which means both our vendors and our customers to contribute in their own innova-

tion and success. Once again, it's a very difficult time for everyone—businesses and personally. A lot of people are scared out there, so we focus on over-communicating with our constituents and trying to remain focused on the things and the items we can control. And that's one thing that I think has helped us be somewhat successful over the last several months—maintaining that focus on execution.

Matties: Great. Travis, thanks for taking the time to help keep our industry well-informed today. We greatly appreciate that.

Kelly: Thank you, Barry, and thank you for the opportunity.

Matties: Once again, you have been listening to Travis Kelly, president and CEO of Isola. **PCB007**

Audio File Available



Click here to listen.

NCAB Group Update: Supply Chain Situation Due to the Coronavirus

As the coronavirus has taken hold of the world, the best thing we can do together is to be proactive, stay informed, and know there are some things we cannot control.

The factories we work with, and our offices in China were affected by this situation first. It was a perfect storm of events. The Chinese Lunar New Year has been called the largest annual human migration in the world. Once it began to spread in China, people had already traveled across the country to be with their families and were unable to travel back.

As the virus spread throughout the globe, it became even more important than ever to continue to be proactive and stay informed. Internally, we have our own corona-

virus task force consisting of management from various countries. This task force meets at least twice a week, developing actions to combat this crisis.

One of our main concerns is for social responsibility: the safety of our employees and communities. We began taking measures at the beginning in China and then rolling those measures throughout all our offices around the world. Precautions included requiring most of our employees to work from home. NCAB Group does produce critical infrastructure and medical products, so we do still have some employees working onsite with quality and logistics, with additional precautions taken for them.

On a positive note, we have seen the production at our Chinese factories increase back up to 80% capacity, and lead times are significantly improving. Again, we see communication as a helpful tool in managing through these difficult times. For further information on our actions, impacts, logistics, and more, please visit [this page](#), which is updated at least once a week.





A Note to Our Customers and Industry

This past week our world has been rocked by the spread of the coronavirus. During this difficult time, our employees and customers remain the top priority. DownStream has implemented a remote working policy for all our employees to work at home.

We are doing everything we can to keep things running “business as usual.”

Our employees are working diligently to meet any and all of your needs and requirements. We are still offering online seminars, plus online/phone support and sales.

We pledge to you, our valued customers and industry professionals, that we are doing all we can to keep the same level of support you are accustomed to from DownStream.

We hope each and every one of our customers, partners, and industry professionals are healthy and safe during this unsettling time.

We appreciate your business, friendship, and support.

We will make it through this worldwide crisis together.

Thank you,

Rick, Joe, Ken, and the DownStream Team

It's Not Easy Being Green (or Is It?)

Testing Todd

by Todd Kolmodin, GARDIEN SERVICES USA

“It’s not easy being green,” are well-spoken words from our amphibian friend, Kermit the Frog. Now, more than ever, there is a focus on being green. Whether the topic is climate change, greenhouse gasses, recycling, or just plain conserving, the topic surfaces in headlines as we move around in our daily lives. It all comes down to how we impact our environment and what we can do to help Mother Earth maintain her beauty and sustainability for millennia to come.

For some, this is a big leap of faith. Conservation is one thing, but letting go of some of the axioms we or others have used for years isn’t easy. For consumers, the “green” mindset may be about recycling, followed by perhaps composting. It could also incorporate lighting changes to efficient LED bulbs, driving less, or finding a more economical vehicle to drive. All of these actions impact our environment.

For manufacturing, the same applies to some extent. Better means for chemical reclaim, bet-

ter monitoring of down spaces to conserve lighting and HVAC, use of more environmentally friendly materials—such as lead-free solder—and streamlining processes to reduce waste and scrap ([click here](#) to read my recent column on waste.)

All of these combined have a significant impact, but it doesn’t stop there. One of the largest—if not the largest—contributor to waste is paper. As a consumer, we are bombarded by paper waste every day. One just has to open their mailbox at home, and you are spammed by every imaginable form of advertising. There are days where I don’t even receive anything to our home mailbox but a bunch of advertising papers that all have the basic theme—1-800 or “www.buymystuff”—which, most times, go straight into the recycling bin.

I’m definitely not supporting those advertisers’ marketing budgets. How many of you are with me? You know who you are. Some of these advertisers have evolved and taken it to



THE NEXT BIG THING IS HERE



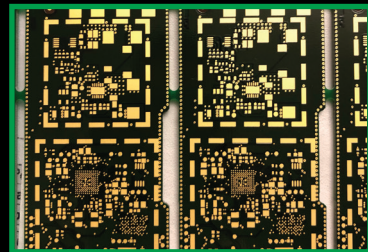
INKJET SOLDER MASK

SOLDER MASK

IJSR-4000 JM SERIES

🌱 JMO2DG, JMO3G

- Excellent Processing
- Available in Multiple Colors
- Available for Rigid and Flex



IJSR-4000 JM03G

LEGEND INK

IJR-4000 SERIES

🌱 IJR-4000 FW100 / FW200

- Flexible White Legend Ink

🌱 IJR-4000 LW100

- Rigid White Legend Ink Cured by LED

🌱 IJR-4000 MW300 / MW301

- Rigid White Legend Ink



IJR-4000 MW300



IJR-4000 FW100



the next level and gone online. Online ads are one reason it takes so long to load your favorite web pages. At least we are not wasting paper—just your time—but that is another story.

The difficulty is letting go of paper. So many of us depend on hard copies that going paperless is a step that, for some, is that leap of faith. With the internet, there really isn't a need for most consumers to have that hard copy any longer. Almost all utilities offer paperless billing and online account processing. For the most part, that is the largest reduction we as consumers can embrace.

The difficulty is letting go of paper. So many of us depend on hard copies that going paperless is a step that, for some, is that leap of faith.

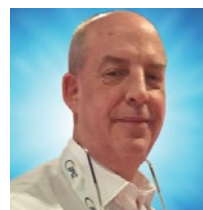
For the workplace, this can be more difficult, or is it? With the cloud at your disposal, your options endless. One of the major ways I've seen paper reduction is the use of paperless shop order systems. Using our company as an example, we use a virtually paperless system to process work through our facilities.

What were once multi-page traveler packets were reduced to a one-page service order containing a barcode. All equipment in the facilities have a unique barcode, as well as any of the fixtures that are in use. This has reduced a significant amount of paper traffic. Programs and tooling are online and on-demand and can be acquired by a simple scan of a barcode. Paper is only generated where needed, such as certificates of compliance, packing lists, and serialization reports. However, even these can be saved electronically and emailed when necessary. By embracing electronic media and the cloud, there no longer remains the necessity for file boxes, closets, and even warehouses to store these reams of paper that were once a necessity.

Data retention is the caveat and no longer a problem either. Most systems, like the system created by Gardien, utilize database back-ends where data is stored for retention and easy on-demand access. With the use of cloud-based backup, retention is indefinite. Customer information can be provided electronically and added to the job records, or if paper is supplied, it can be scanned into electronic media and retained. Libraries of work instructions, procedures, and industry specifications can all be converted to electronic on-demand documents. In fact, most industry specifications are available as online documents.

Security should also not be a concern or a deterrent either, as many cloud-based vendors supply security and encryption complying and/or exceeding the requirements of the Department of State (ITAR), Department of Defense, and General Secure Hash Algorithms (SHA) encryption requirements. Remember that online libraries don't burn down. You don't have to walk or drive to them to retrieve historical information, and you can set your own retention policies. Expired documents are purged, and when it's a large operation, this eliminates tons (literally) of paper waste that goes to the shredders or incinerators.

Today, paper waste still remains the most likely commodity that we can attack to reduce. Next time you're about to click the "print" button, look at your options. Instead, when you get that important document, think of clicking "save as" rather than "print." Don't create that new physical folder for a customer, vendor, or employee; create that folder online, scan the document if necessary, and keep it electronic. It's a change in mindset. And what about the cost? Using the cloud versus renting that warehouse or wasting space that could be more productive is an exercise I'm going to leave for you. **PCB007**



Todd Kolmodin is VP of quality for Gardien Services USA and an expert in electrical test and reliability issues. To read past columns or contact Kolmodin, [click here](#).



Valued Customers and Partners, Concerned Employees and Family Members

March 26, 2020: Singapore/Hamburg Germany

Thank you for your continued loyalty and support, even during these uncertain times, our thoughts go out to all of you who have been affected by this unprecedented situation.

In light of the COVID-19 pandemic, Gardien has taken—and continues to take—serious measures at both the national and international levels. Our primary concern continues to be the health and safety of colleagues and their families, customers, our business partners, and the local communities. All public health measures advised by governments are being followed in support of efforts to contain the spread of the virus in all our locations, and we are complying with local advice in order to safeguard the health of staff, customers and the wider community.

Gardien operates 19 service centres in six countries (Germany, USA, Canada, Japan, China, and Taiwan), and we are closely monitoring the pandemic situation in each of these regions and taking immediate and necessary steps in assuring the safety of our workforce, their families, and our customers and partners.

As of now, Gardien remains operational across all its 19 centres to support our customers by following the protocols directed by local authorities in that particular region. With valuable lessons learned from China, Gardien is also aligning its strategy to minimize the risk of this pandemic. As the COVID-19 pandemic escalates, Gardien will endeavour to respond in an efficient manner as possible, whilst maintaining high performance of its services to ensure timely deliveries to our valued customers and business partners.

The Gardien Group welcomes the efforts of local authorities to coordinate a common response, reinforce public health safety measures, and minimize the socioeconomic impact. We follow the following measures taken by every local authority to minimize the spread of the coronavirus infection:

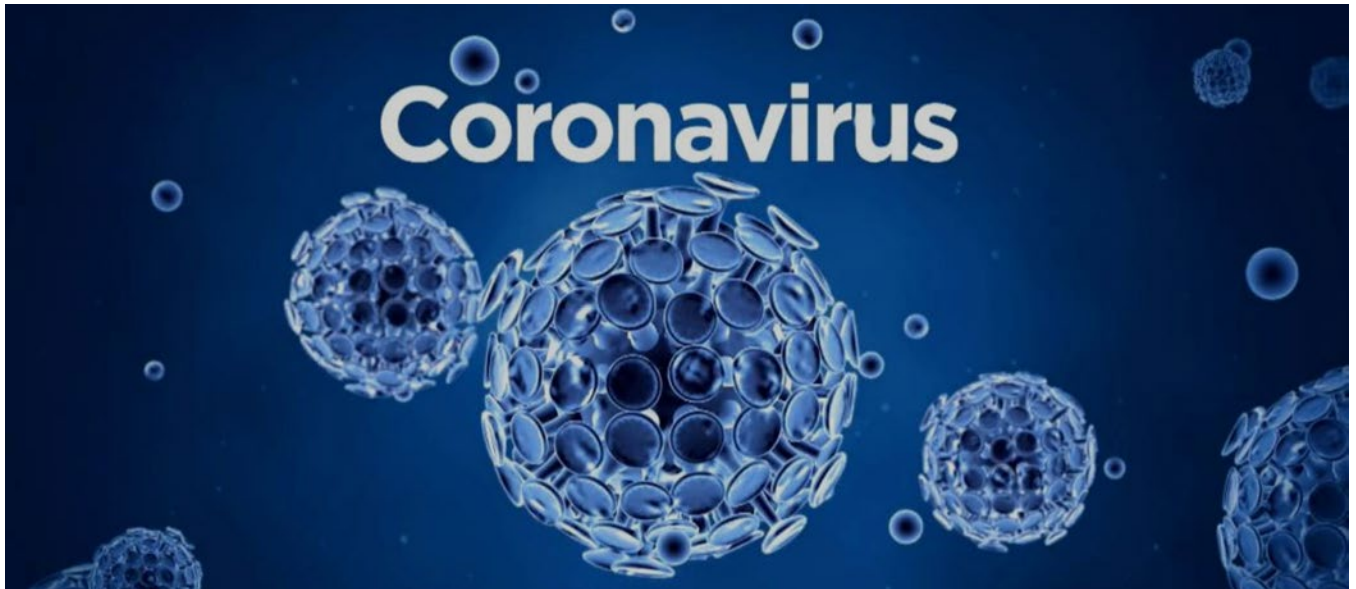
- Social distancing
- Encouraging sick employees to stay home
- Encouraging employees to take safety precautions
- Thorough employee screening
- Perform workspace cleaning
- Ceasing travel and external customer visits

Due to the continuously evolving spread of this pandemic, Gardien may be required to close individual service centres, depending on the national/international mandates. We will be in close contact with our local customers, and any queries will be answered by the local service centre.

In the meantime, we would like to take this opportunity to thank you personally for your support. As many wise people have commented lately, we will come through this if we pull together. We look forward to better times ahead.

Sincerely,

Roland Valentini
COO Gardien Group



Supply-chain **Recovery:** Plan for Now and the Future

Feature by Steve Williams,
THE RIGHT APPROACH CONSULTING,
and Fane Friberg, CEPHAS LLC

Introduction

We are living in unprecedented times related to the ongoing spread of the coronavirus and its impact on our day-to-day lives. Individuals, families, businesses, and entire communities have been affected in unparalleled ways. As difficult as the situation has become, it's critical for business leaders to step forward. In a time of crisis, understanding current and future logistics capacity by mode—and their associated trade-offs—will be even more essential than usual, as will prioritizing logistics needs in required capacity and time sensitivity of product delivery. Actions taken now to mitigate impacts on supply chains can also build resilience against future shocks.

First Things First: Protective Measures

Although information, direction, recommendations, and government-imposed sanctions

are changing by the hour, there are several commonsense fundamentals we can encourage all employees to follow to minimize the chance of getting ill and further spreading the virus.

Basic protective measures against the coronavirus ^[1] include:

- Wash your hands frequently for a minimum of 20 seconds
- Maintain social distancing (3 feet minimum)
- Avoid touching eyes, nose, and mouth
- Practice respiratory hygiene
- Work from home if at all possible
- Avoid large gatherings, particularly those with an international audience
- Rethink your travel plans if traveling by plane
- Stay aware of the infection rates in cities, states, and countries (and avoid them)
- If you have a fever, a cough, and difficulty breathing, seek medical care early
- Follow advice given by your healthcare provider
- Stay informed on the latest developments about COVID-19

Are you getting to the bottom of your via?

**Prevent connection
failures in thick PCB
substrates with
plasma treatment**

New **VIA™ Series 2.5**
cleans deep, narrow
vias where other
processes can't go

Contact us now to learn more
+1-925-827-1240 / info@nordsonmarch.com

nordsonmarch.com



VIA™ Series 2.5
Plasma System

Nordson
MARCH

Insights From the Institute for Supply Management

On March 11, the ISM revealed the first-round results of a survey focused on the impact of coronavirus disease 2019 (COVID-19) on businesses and the supply chain. Notably, nearly 75% of companies report supply chain disruptions in some capacity due to coronavirus-related transportation restrictions, while more than 80% believe that their organization will experience some impact because of COVID-19 disruptions. Of those, one in six (16%) companies report adjusting revenue targets downward an average of 5.6% due to the coronavirus ^[2].

“Use this current state situation to address some ‘fundamental blocking and tackling’ to preemptively ready your organization for a new normal as we exit this pandemic—specifically within your supply chain.”

Take a Deep Breath: Then Review Your Core Business Processes

The stock market is extremely uncertain right now, with traders selling based on fear instead of sound strategy. This is also having a direct impact on the global economy and will for the foreseeable future. However, this slowdown in demand can also be seen as an opportunity to examine and take necessary operating safeguards within your supply chain and quality management systems.

A gallon of gas in our neighborhood today is below \$1.85/gal. Even if it continues to go down, we all know at some juncture in the not too distant future, we will have the privilege of paying close to \$3.00/gal again. While the prices of some products like gas are falling, others may be rising and difficult to procure amid supplier shutdowns and part allocations. Now is the time to look at your business in areas that may not have received the amount focus and/or attention that you, as a leader, know are needed for long-term success within the markets you serve.

Preemptive Measures

- Go back and look at your quality management system (QMS). Why quality? Since a



QMS includes every business process from quoting through shipping, it is actually a business management system (BMS) that requires changes to the following processes:

- Organizational risk management: Most companies perform a SWOT (strengths, weaknesses, opportunities, threats) analysis as part of their risk management process, but it would be surprising to find a pre-COVID-19 SWOT that considered any kind of biochemical threat
 - Purchasing/sourcing: A comprehensive review is needed to expand the provisions for supply chain disruptions due to natural disasters to include biochemical threats; be prepared for some guidelines/standards/requirements for supplier receipts and shipment of goods from your factory
 - Resource management: Workforce safety programs will look vastly different moving forward than they did three months ago
 - Regulatory process: If you don't already, consider adding a regulatory process to your QMS, including an intelligence source for real-time updates on health, safety and travel situations that could impact the business
 - Management review: The current situation of entire states shutting down all non-essential businesses has not been a consideration during these strategic planning meetings in the past, but must be now
- Ensure you are “doing what you say” and are consistent with your policies, procedures, and practices
 - Review your EHS policies, procedures, Gemba walks, and personal protection equipment within your factory and offices to ensure they are still appropriate for today's volatile environment
 - Total productive maintenance, including but not limited to preventative maintenance
 - Weekly sales and operations planning (S&OP) activities using real-time informa-

tion on the impact this pandemic is having on your demand, such as supply key performance indicators:

- Formal demand changes from your customers
 - Forecasted demand changes (quantity and period-of-performance) from your customers
 - Bull-whip effect that demand change has on your suppliers and inventory levels
 - What is the impact on your supply chain, based on man-machine-method-and materials availability?
 - The resulting impact to on-time delivery from your suppliers, including transit time depending on point-of-origin/manufacturing
- Rough-cut capacity planning (RCCP)
 - Real-time inventory status and positioning (stay diligent on cycle counts and stock rotation)
 - Supplier scorecards (consider adding a supply continuity metric)
 - Constraint management based on manpower, materials, machine, and method
 - Cybersecurity with the more people working remotely and within your supply chain
 - Real-time order status from your suppliers (i.e., released, WIP, pack and ship, transit, and delivery date, ideally via an advanced ship notification, or ASN)
 - Get real-time information from your logistics partners on capacity and delivery times
 - Facilitate full transparency with your suppliers, employees, and customers (send one clear and concise message that avoids ambiguities)
 - Based on financial impacts, will you offer any considerations to your customers and/or suppliers necessary to support some level of recovery and economic flexibility?

Update Your Business Continuity Plan

A business continuity plan (disaster recovery plan, etc.) is a living document that is put

in place to protect businesses against scenarios exactly like COVID-19, and if you don't have one, develop one right now. The last update to your plan was probably a few years ago to address cybersecurity and IT threats, but it probably does not consider the unique consequences of a biological threat like this. We weathered past virus pandemics such as the H1N1 swine flu with virtually no disruption in business or supply chain.

Your business continuity plan needs to be updated to consider the effects of a biochemical threat on both your ability to manufacture products and the impact on the supplier chain, especially if it is global. Service companies

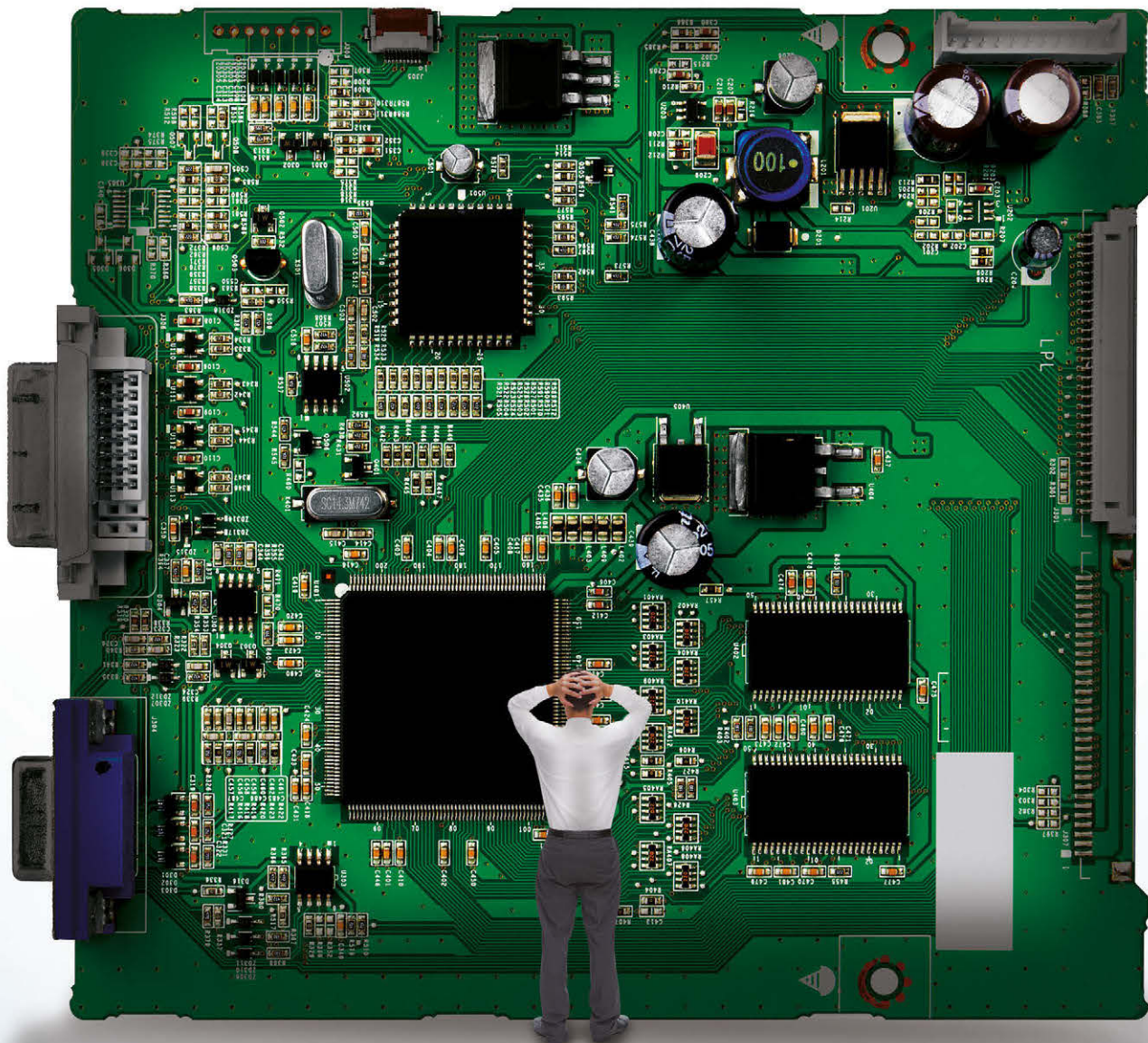
“Your business continuity plan needs to be updated to consider the effects of a biochemical threat on both your ability to manufacture products and the impact on the supplier chain—especially if it is global.”

can typically let employees work remotely, but workers have to physically show up to manufacture products. Some of the questions that need to be asked and addressed when updating your business continuity plan include:

- Are we protecting our employees while they are at work?
- Are we taking any special sterile and PPE precautions for employees to entering, working in, and exiting the building?
- Have we identified the business functions that can work remotely and those that are mission-critical to be physically present?
 - Can those be isolated and still be effective?
- Do all of our suppliers have their own business continuity plans?
 - Do we have a copy?
 - Are we protected?
- Do we have backup suppliers located in different cities/states/countries?
- Do we have agreements with any competitors to build our product if we have to shut down operations?

Use this time for supply chain integration strategies from an internal and external perspective to prepare your enterprise to lead





NO PROCESS CHALLENGE IS TOO **BIG** TO OVERCOME.

IPC TECHNOLOGY SOLUTIONS HAS YOUR BACK

IPC Technology Solutions helps EMS providers and suppliers tackle increasingly complex operations and manufacturing challenges head-on with our five-prong approach:

INVESTIGATE PROCESS

TROUBLESHOOT

PROBLEM-SOLVE

EDUCATE

FOLLOW UP

Once an IPC Technology Solutions Expert uncovers the root cause of your issue and pinpoints the appropriate corrective action, they'll deliver a confidential technical report with recommendations for process improvements. They'll even educate your team on how to implement and sustain those improvements, and then follow up several months later to ensure our solutions are still working for you.

- ▶ Enhance your operations.
- ▶ Solve supplier challenges.
- ▶ Improve your bottom line.

For more information, connect with the IPC Technology Solutions Experts at techsolutions.ipc.org.



your market sector to greater efficiencies, effectiveness, and customer satisfaction. Go back and review your fundamental strategic imperatives and key performance indicators to beat your competition in reaction time/time to market and customer experience. Being pragmatic in your understanding that any distresses within your supply chain may take a period of time to proliferate through your business and other complexities of operations for your customer. While we cannot avoid business disruptions, any early warning signals or proactive measures you take will yield minimized interconnected repercussions through the value chain.

This Too Shall Pass: Be Ready

The challenges presented by the COVID-19 outbreak are difficult, but they won't last forever. At that time, business and manufacturing will return at a speed that will be unprecedented, and we all need to be prepared for it. Post-pandemic, what will be the new "normal?" If you have scaled back on your number of workers, will they be available to return at a moment's notice? What will you do if they're not? If you have shut down operations, how fast can you get your equipment back up and running? As the world slowly begins to return back to normal, the demand for all products and services will hit with the force of a tsunami. Will you be prepared to handle it? Have a plan.

Conclusion

Experience has shown us that supply chain operations can evolve into complex activities. It will take a little time for you to get back into your pre-virus rhythm and to re-establish the necessary robustness to your operations. When you do, though, your employees, customers, and shareholders will thank you for your vision, lead-

ership, and exceptional quality and delivery performance. Help prepare your team for the "heavy lifting" ahead, potentially sooner than we may think. Lead them to be the very best version of themselves, and everything else will fall into place.

If you're interested in creative, pragmatic supply-chain solutions that both solve issues and differentiate manufacturers to command sustainable price premiums, contact us. **PCB007**

References

1. World Health Organization, "[Coronavirus Disease \(COVID-19\) Advice for the Public.](#)"
2. Institute for Supply Management, "[COVID-19 Survey: Impacts On Global Supply Chains,](#)" March 11, 2020.

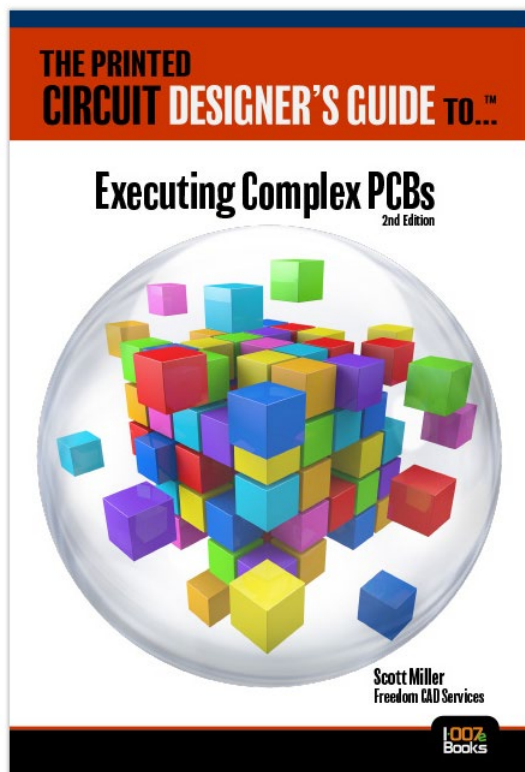


Steve Williams is the president of The Right Approach Consulting and can be reached at Steve@tracQMS.com.



Fane Friberg is the principal of Cephas LLC and can be reached at fane@cephasllc.com.

The Printed Circuit Designer's Guide to...™ Executing Complex PCBs



by Scott Miller, Freedom CAD Services

Designing a complex circuit board today can be a daunting task. Never before have PCB designers on the cutting edge faced more formidable challenges, both electrical and mechanical. This book, written by Freedom CAD COO Scott Miller, provides a set of guidelines for designing the most complex, high-speed circuit boards. He and his veteran PCB design team share real-world examples that can help designers sharpen their game, from the planning stages and schematic capture through documentation and successful data handoff. Readers will learn how to design complex boards correctly the first time, on time. This book is a must-read for anyone designing high-speed, sophisticated PCBs.

[FREE DOWNLOAD](#)[PRINT ON DEMAND](#)

“The author shows great insight into the many details and collaboration required for creating complex PCBs as well as the most important aspect of a successful design team, in my opinion—communication.”

— Stephen V. Chavez, Chairman, The Printed Circuit Engineering Association (PCEA)

ABOUT THE AUTHOR



Scott Miller has spent 40+ years in the electronics industry. His early career focused on the interconnect field of high-performance connectors and PCBs. Scott joined Freedom CAD Services in 2004 after a 20-year career with Teradyne Connection Systems (now Amphenol TCS) in sales and marketing. Drawing on his experiences from the high-speed connector and PCB industries, Scott has helped Freedom CAD to develop its services beyond PCB layout to include electrical, mechanical, and signal and power integrity engineering services as well as prototype PCB fulfillment.

Freedom CAD's Scott Miller: Taking Care of Customers and Staff

Interview by Andy Shaughnessy
I-CONNECT007



Andy Shaughnessy speaks with Scott Miller, COO of Freedom CAD Services, who shares an update on the company's current level of business operations under COVID-19 restrictions.

Miller explains that Freedom CAD remains fully operational during the COVID-19 quarantine. Staff members have been telecommuting for years, so the company's day-to-day operations are relatively unchanged. He also discusses the company's plans to help employees and customers during this time, and Miller asks anyone with design questions—customers or not—to contact the company any time.

Miller is the author of *The Printed Circuit Designer's Guide to... Executing Complex PCBs*. Visit I-007eBooks.com to download this book and other free, educational titles.

Andy Shaughnessy: Hi, I'm Andy Shaughnessy for I-Connect007. I'm talking with Scott Miller, COO of Freedom CAD. How are you doing, Scott?

Scott Miller: I'm doing great, Andy, considering everything.

Shaughnessy: These definitely are interesting times. You have offices all around. How has the government regulations and restrictions on COVID-19 caused you to change your operations or your business model, or has it?

Miller: Actually, Andy, it has had very little impact on our business. We've been a work-from-home company for almost all of our total 17 years. We've built an infrastructure. Our business is printed circuit board design, both engineering and layouts, so this is the computer work, and we use web-sharing capabilities like GoToMeeting or Zoom to do video conferencing and share the designs. We've been doing this really since the inception of Freedom CAD 17 years ago. We have an infrastructure that supports it.

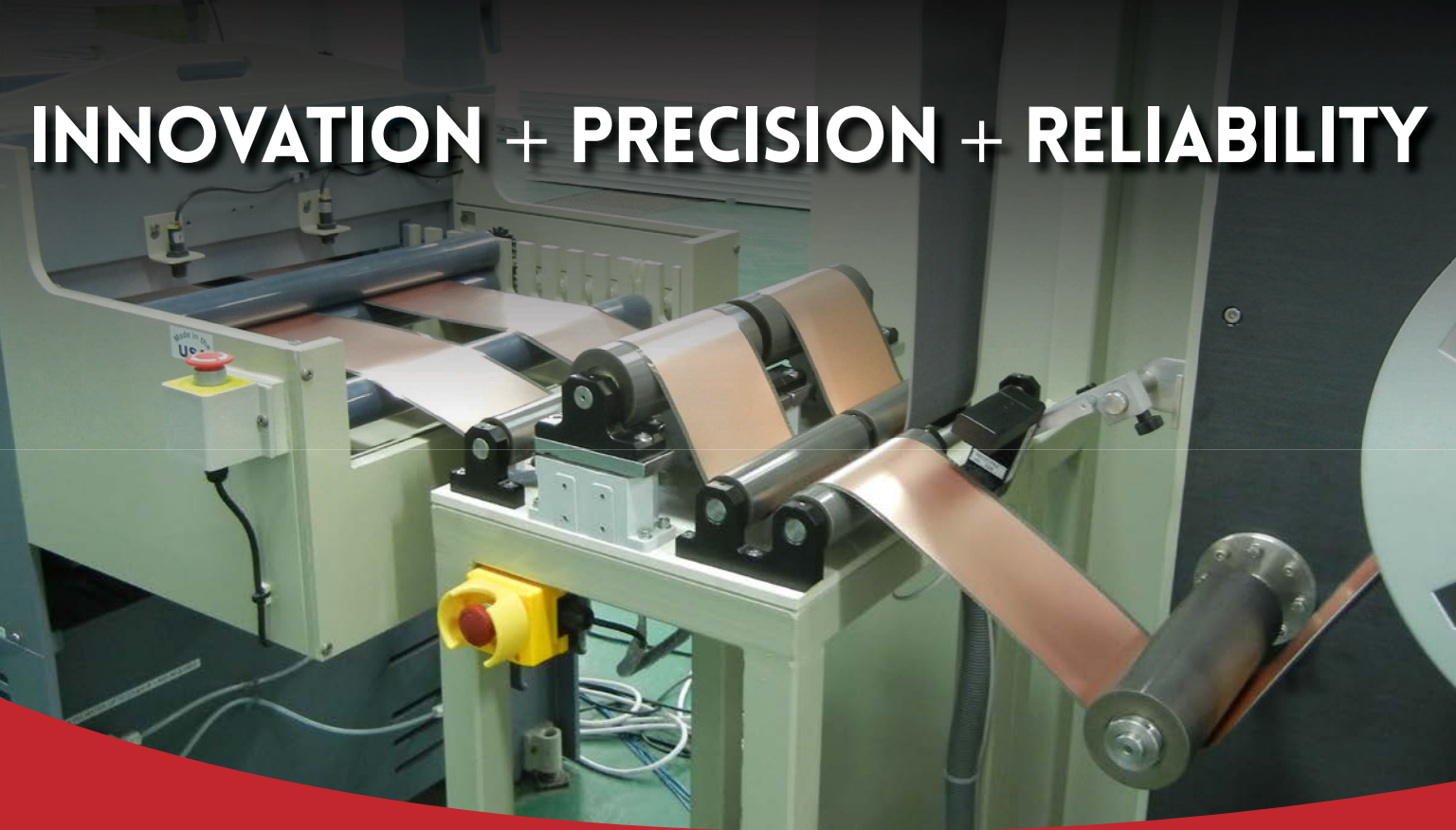
We're ITAR-compliant and NIST 800-171-compliant, so it has had very little impact on our business. Fortunately, none of our employees have been affected by it, which is a blessing, and we've been able to have the business as usual without skipping a beat. Like everybody, all of our employees are sequestered to their homes, but that's the world we are all living in now.

Shaughnessy: It's not quite business as usual, but you're pretty much going along like before.

Miller: Yes, all of our processes are set up, and we really are continuing to work the way we've always worked.

Shaughnessy: That's good. Is there any message that you'd like to send to your customers?

INNOVATION + PRECISION + RELIABILITY



ROLL-TO-ROLL PROCESSING

- Processing for metals, thin foils, flexible glass and films
- Resist developing applications
- Cleaning applications
- Etching processes, including titanium and glass
- Aqueous based resist stripping
- Electroless plating processes
- Spray or immersion stations available for most applications

www.chemcut.net
sales@chemcut.net

 **CHEMCUT**
BOUNDLESS INNOVATION | UNBEATABLE PRECISION

Miller: The only thing I would say is that we know that a lot of our customers have been impacted by this, and they aren't typically set up to work from home. We've seen projects that have been slowed in pace because they're trying to get their employees set up. Even on the financial side of the business, we've seen kind of an increase in the overdue payments because customers' accounting departments aren't set up to deal with things from home. We're keeping a close eye on that aspect of the business as well. I probably get three or four letters a day from customers asking for feedback on how COVID-19 is affecting our business. Is it going to create any delays for our customers? Some are surveys, and some are just quick email responses, and I'm happy to report that it's really not affecting our business or how we support our customers.

Shaughnessy: Do you have anything that you'd like to share with the rest of the industry?

Miller: Just a little story. We've been telling our employees not to travel or go out. Here's one of the things we did as a company: We've instituted a policy to extend to employees some additional funding of \$250 per employee to shop from home as a way to encourage them not to go out in public or the shopping center and put themselves at risk. We've tried to be progressive in that way and really encourage our employees. We keep reminding them, "You're the front line for us. Take care of yourselves, don't put yourselves at risk, wash your hands, follow the guidelines, and now you can shop at home for a bit."

Shaughnessy: Great idea. It's all about everybody helping each other.

Miller: Right, especially in these difficult times.

Shaughnessy: What would you say is your greatest concern right now?

Miller: We're one of the largest independent design service bureaus in the country, as you know, and we touch on a lot of industries. I think the biggest concern is how long this COVID-19 pan-

demic will last. Right now, we have a vision of it being a month out or maybe six weeks out. If it extends a lot longer, I'm concerned about the viability of our customers. Fortunately, we do a fair amount of work for the defense industry, and we do some work for the automotive, medical, and data and telecom industries.

We're distributed pretty well, and that gives us a lot of buoyancy in these rough waters to hopefully ride this out. But we are seeing some customers pull back on projects, which is to be expected as they refocus their priorities. I expect that's going to continue, but I'm hopeful that for everybody's benefit that this doesn't extend for too long and lead us into a real recession.

Shaughnessy: I think we all agree on that. Is there anything else you'd like to share with the industry? Any last thoughts?

Miller: We're here. If customers are in a bind, and they've had difficulty with keeping their schedules on schedule due to the disruption of this, if we can be of any help—and I'm not trying to turn this into a plug—but we're here, and we can help to keep our customer's schedules on schedule; we're there for them. I think that's the biggest thing; we're all trying to help each other out through this, and if there's something we can do to help some company out, just talk to them.

Shaughnessy: All right. Scott, I appreciate your time. I know you have a lot of work to do, so I appreciate it. Good luck with everything.

Miller: Thank you very much, Andy.

Shaughnessy: Again, I've been speaking with Scott Miller of Freedom CAD. I'm Andy Shaughnessy for I-Connect007. Thanks for listening.
PCB007

Audio File Available



Click here to listen.



March 30, 2020

Lenthor Engineering Announces Demand to Remain in Full Operational Mode During COVID-19 Advisories

Lenthor Engineering Inc.—a California-based designer, manufacturer, and assembler of rigid-flex and flex PCBs—announced actions being taken resulting from the COVID-19 advisories.

To continue in an operational status, Lenthor is using several exemption rules provided under both the support of essential businesses and the need to maintain essential internal operations for the business.

Many of our military and medical product customers have sent letters of confirmation to these exemptions. With their support, Lenthor Engineering has been able to maintain full production in all areas of manufacturing while still allowing for proper social distance standards.

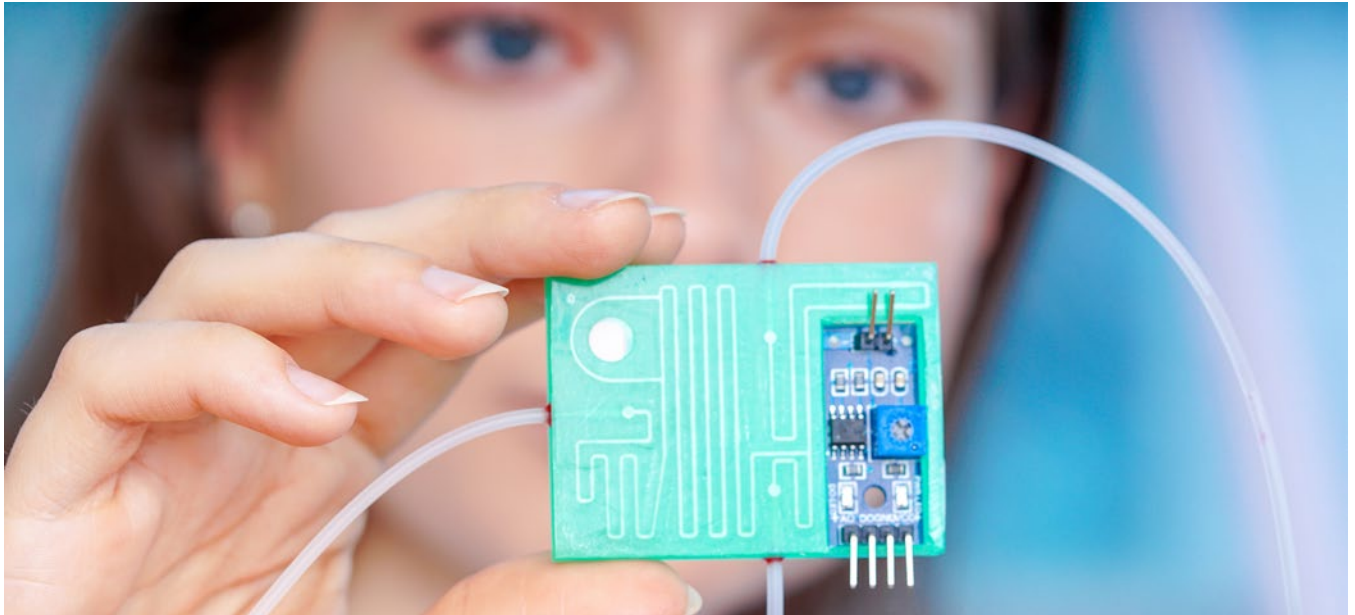
This action ensures that Lenthor is able to continue to move products and continue to deliver against the vital needs of our customers. We are fully open for business and ready and willing to support your requirements.

We have enabled all of our front-end sales support functions and personnel, sales, sales engineering, CAM engineering, and production planning to be fully functional should we need to work remotely. This action will enable us to continue to serve all of our customer's needs with new design reviews, technical support, quoting, accepting your purchase orders, design review DFM, and production planning.

Be assured that we have put in place all of the practical workplace habits being emphasized by our health professionals. These measures are being enacted in order to mitigate the potential risk of exposure to our employees, their families, and our community as a whole.

Mark Lencioni
CEO/President Lenthor Engineering

For additional information, contact:
David Moody
Director Sales/Marketing
Corporate Headquarters: 311 Turquoise Street, Milpitas, CA 95035
(408) 957-3487



Advances in Medical Diagnostics Using LoC and LoPCB Technologies

Feature by Pete Starkey and Happy Holden
I-CONNECT007

Introduction

“The Coronavirus: A Global Pandemic” has become the universal headline. As of mid-March, the World Health Organization characterized the coronavirus as a pandemic, which had already spread to almost 150 countries, areas, and territories, with hundreds of thousands of confirmed cases.

Coronaviruses (CoVs) are a large family of viruses that cause illness ranging from the common cold to more severe diseases such as the Middle East respiratory syndrome (MERS-CoV) and severe acute respiratory syndrome (SARS-CoV). COVID-19 is a new strain that was discovered in 2019 and had not been previously identified in humans.

In an outbreak of a new virus, it is imperative that epidemiologic and clinical investigations are carried out as early as possible, and the recent emergence of COVID-19 precipitated a crucially urgent need to understand transmission patterns, severity, clinical features,

and risk factors for infection. Effective testing can both confirm the presence of the disease in an individual and indicate the location, extent, and development of the outbreak.

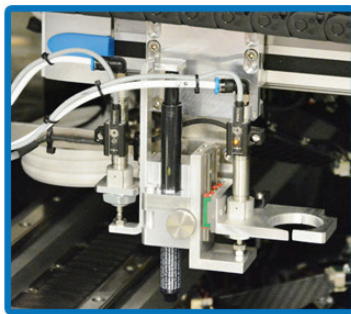
Several techniques for detection and diagnosis of COVID-19 are currently under development, some of which may detect the novel virus exclusively; others may also detect strains that are genetically similar. A detection kit recently announced uses technology based on a portable lab-on-chip (LoC) platform capable of detecting, identifying, and differentiating MERS-CoV, SARS-CoV, and COVID-2019 in a single test, which integrates two molecular biological applications: polymerase chain reaction (PCR) and DNA microarray screening. Whereas traditional PCR coronavirus detection kits can take a day to produce results, the latest LoC detection kits can produce results in about two hours, and LoC technology may be the key to powerful new diagnostic instruments and point-of-care testing devices.

An LoC is a device that integrates one or several laboratory functions on a single integrated circuit. LoC devices are microelectrome-

Unrivalled Test Speed with Full Automation



Introducing the newly designed atg A8a with 8 test probes and a new high speed “lights out” automation for unrivalled 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
klaus.koziol@cohu.com • www.atg-lm.com



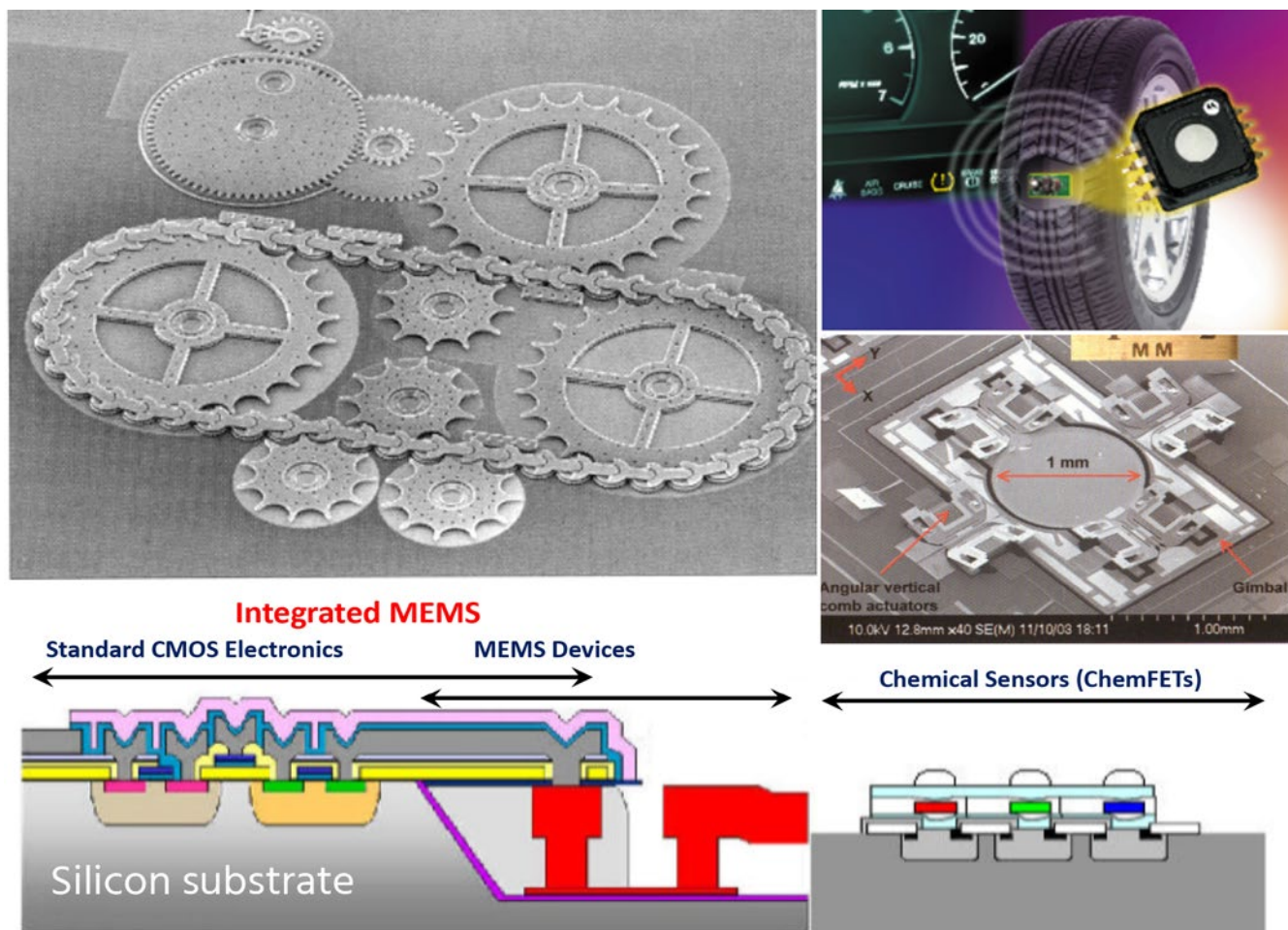


Figure 1: (a) MEMS; (b) MEMs integrated into tires for pressure sensing; (c) MEMS used as micromirrors for image projection and communications; (d) integrated MEMS.

chanical systems (MEMS) devices (Figure 1) that function as “micro total analysis systems” (μ TAS), generally using microfluidics principles to manipulate minute amounts of fluids. In practical terms, microfluidics is about doing chemistry on a tiny scale and trying to emulate nature. Biomedical microelectromechanical systems (BioMEMS) have emerged as a subset of MEMS devices for applications in biomedical research and medical microdevices, with an emphasis on mechanical parts and microfabrication technologies. Applications include disease detection, chemical monitoring, and drug delivery. There has been rapid market growth for bioMEMS technologies, and many bioMEMS devices are already commercially available; a familiar example is a blood-glucose sensor. There is also great potential for large-scale commercialization of microfluidic-based LoC technologies.

LoC is not new. In fact, as long ago as the late 1990s, advances in microfabrication technology had enabled the development of a fully automated LoC, designed to integrate sample preparation, fluid handling, and biochemical analysis. Techniques derived from semiconductor manufacturing enabled the translation of experimental and analytical protocols into chip architectures comprising interconnected fluid reservoirs and pathways (Figure 2). By driving fluids in a controlled manner through selected pathways by electrokinetic or pressure forces, it was possible to create the functional equivalent of valves and pumps capable of performing manipulations, such as dispensing, mixing, incubation, reaction, sample partition, and detection.

The first commercially available LoC product was introduced in 1999 for the analysis of DNA and RNA biomolecules, as well as

protein and cell assays, with worldwide sales of more than 7000 instruments. These LoC bioanalyzers could handle nucleic acids, proteins, and cells on the same platform using sample-specific reagents and chips and set an industry-standard for RNA analysis and sequencing. LoC for integrated chemical and biochemical analysis has also grown dramatically in the past decade. Although the primary focus has been on medical uses, the basic technology is applicable to a wide variety of analytical and monitoring functions and fits very logically into the concept of a connected world (Figure 2).

Microfluidic devices can be fabricated a variety of materials—including glass, rigid polymers, and elastomers—using techniques such as CNC milling, injection molding, and photolithography. The original material was silicon since the fabrication techniques had been derived from semiconductor manufacture, and several alternative processes have been developed because of requirements for specific material properties, as well as lower production costs and faster prototyping. A wide variety of sophisticated chips are increasingly being demonstrated, but it is believed that few of these will be seen on the general market because of the lack of established commercial manufacturing technology. 3D printing has recently emerged as an alternative approach for the fabrication of fluidic devices and may replace soft lithography as a preferred method for rapid prototyping. But existing technologies are not unified, and it remains to be seen which processes and

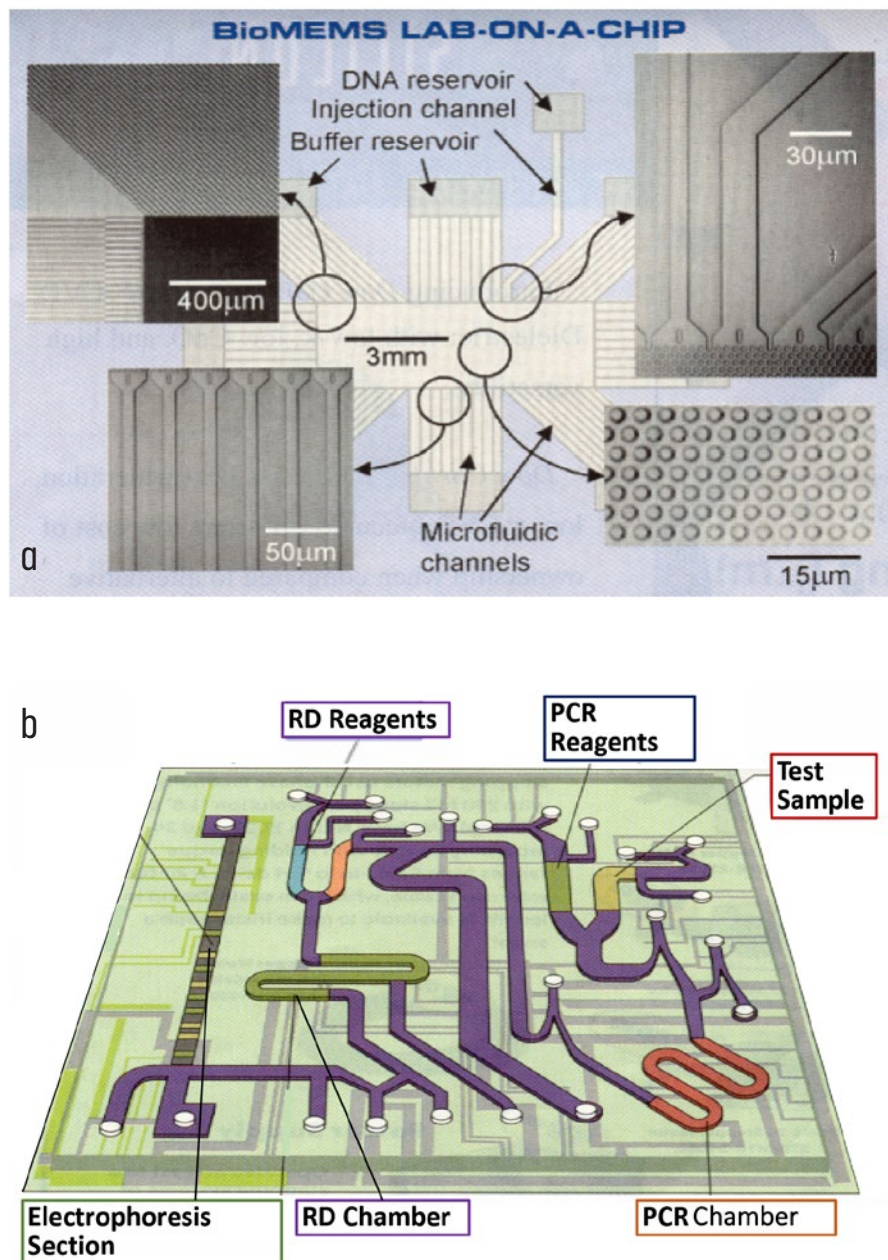


Figure 2 (a & b): BioMEMS LoC. (Source: HP Laboratories, 1995)

materials will eventually be adopted for high throughput diagnostics.

Basic Components of an LoC

The component devices that make up an LoC are (Figure 3):

1. Electrophoresis: Separation columns
2. Microfluidics: Channels, valves-pumps & mixers
3. Chem-bio detectors and sensors
4. Microfluidic chips

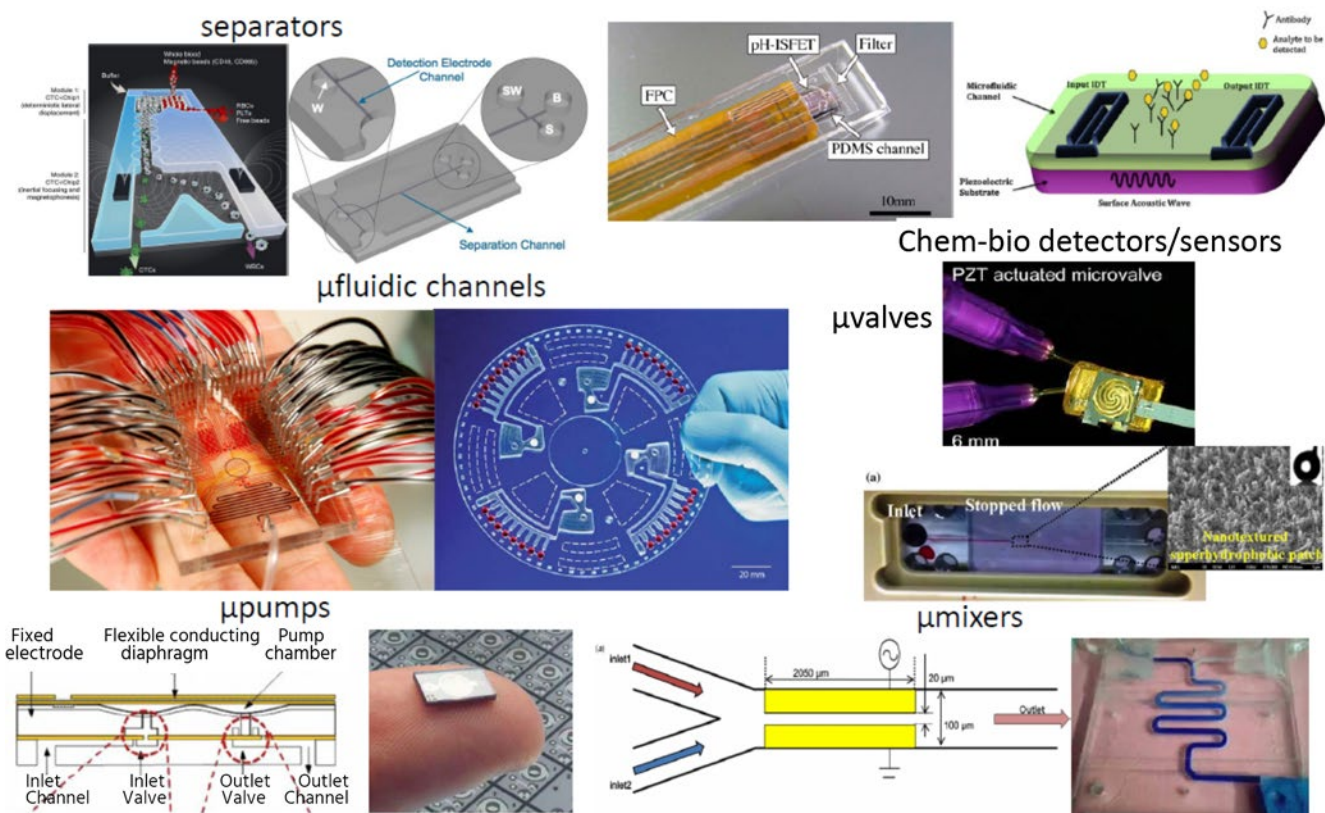


Figure 3: LoC elements ^[1].

1. Electrophoresis

This is a method of separating large molecules (i.e., DNA fragments, blood, or other proteins) from a mixture of similar molecules by passing an electric field toward an electric pole (anode or cathode) in a liquid on various media (e.g., paper, glass, gel, liquid). It is used to separate and purify biomolecules. Each molecule travels through the medium at a different rate—depending on its electrical charge and size—and toward either the anode or the cathode at a characteristic speed (Figure 4).

2. Microfluidics

This custom application of fluidic technology is applied with conventional micromachining techniques, such as wet etching; dry etching; deep, reactive ion etching; sputtering; anodic bonding; and fusion bonding to make flow channels, flow sensors, chemical

detectors, separation capillaries, mixers, filters, pumps and valves for various LoCs (Figure 4).

Flow in microchannels is laminar, which allows selective treatment of cells in microchannels, or arrays, as well as biochemical reactions. The integration of microelectronics,

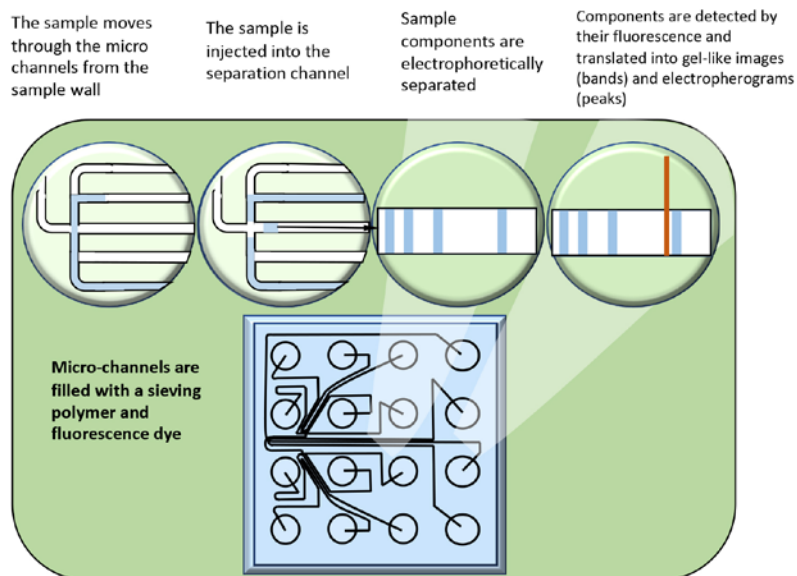


Figure 4: LoC analysis sequence using electrophoresis in microfluidic.

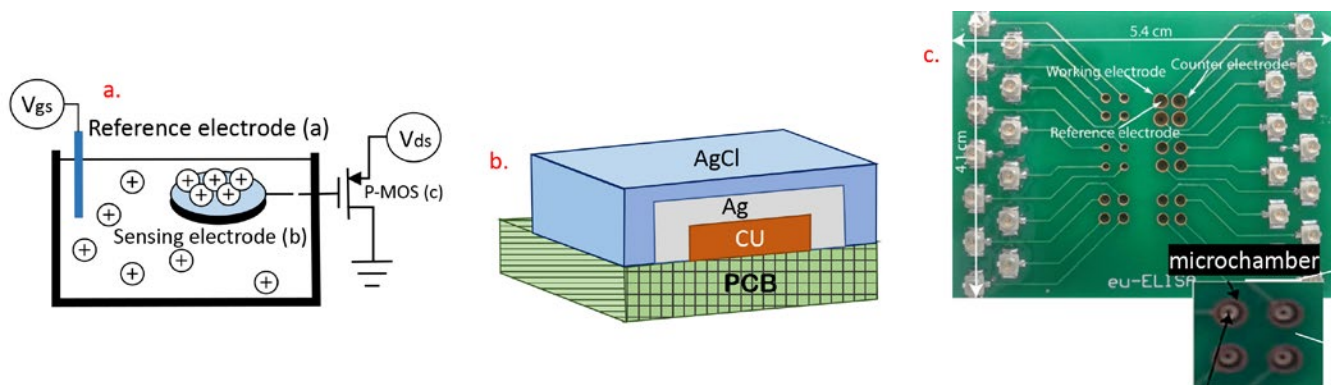


Figure 5: P-MOS Bio-FET sensors channels and photodetectors ^[2]; (a) Reference electrode; (b) Ag/AgCl plating on a PCB; (c) plated PCB ^[3].

micromechanical, and microoptics onto the same substrates allows automated device control, which reduces human error and operation costs.

3. Chem-Bio Detectors and Sensors

Detectors, sensors, and electrodes can be ChemFET and BioFET C-MOS devices with special membranes or diffusions to make them sensitive to chemical or biological molecules. The sensors and electrodes are electrical elements that are sensitive to various chemical or biological molecules, plated with gold, silver, platinum, palladium, etc., and their salts (Figure 5).

4. Microfluidic Chips

A microfluidic chip is a set of microchannels etched or molded into a material (glass, silicon, or polymer, such as PDMS). Microchannels form the microfluidic chip connected in order to achieve the desired features (mix, pump, sort, control bio-chemical environment, etc.). Networks of microchannels are connected to the outside by inputs (inlets) and outputs (outlets) pierced through the chip (interface between the macro and micro world).

LoC Materials

Over the years, several materials have been developed for use with LoC. It started in the late 1990s with silicon, as the microelectronics industry developed various methods of micromachining silicon (MEMS) for accelerom-

eters for airbag sensors. From silicon wafers, the materials branched out to glass and then polymers. The most recent interest has been in PCBs and the use of various paper materials.

Silicon and glass have several advantages for fabricating an LoC, while being the most expensive. Polymers and especially PCBs are a new choice because of various materials available and the integration of electronics and various printing technologies. While paper is coming into focus for research, its use is only just beginning. Table 1 lists several characteristics of each of these materials.

1. Silicon-based

Silicon started the LoC point-of-care (PoC) diagnostic uses. Figure 6 shows one of the first on the market—the Agilent 2100 Bioanalyzer System—for DNA, RNA, serum protein, and infectious disease analysis.

Figure 6: Agilent Technology has been involved in the life sciences since 1995. Their “nanolab chips” are used to analyze DNA, RNA, SARS, and other infectious disease proteins ^[2].

2. Glass-based

Glass is a lower cost material if electrical components and circuitry are not required. Glass can be fabricated into microchannels and deposited with many substances such as gels and coating. The glass device seen in Figure 7 is an Agilent 3100 Bioanalyzer Automated LC/MS that comes in numerous forms to separate

SILICON	GLASS/Ceramic	POLYMERS	PCBs	PAPER
<ul style="list-style-type: none"> Semiconductor fabrication techniques Sophisticated microelectronic devices/circuits Commercialized components 	<ul style="list-style-type: none"> Semiconductor fabrication techniques Transparent, biocompatible Commercialized components 	<ul style="list-style-type: none"> Cost-effective Easy polymer processing Elastic, flexible, transparent, biocompatible, versatile 	<ul style="list-style-type: none"> Cost-effective Sophisticated microelectronic devices/circuits Commercialized components 	<ul style="list-style-type: none"> Cost-effective Printable 3D, passive microsystems
<ul style="list-style-type: none"> World-to-chip interfacing Cleanroom facility required Footprint limitation Hermetic sealing 	<ul style="list-style-type: none"> Electronics/biosensor integration Expensive material and processing Hermetic sealing 	<ul style="list-style-type: none"> Electronic/biosensor integration Process standardization Difficult metalization/hermeticity 	<ul style="list-style-type: none"> World-to-chip interfacing Electronic/biosensor integration Standard processes/materials Semi-hermetic sealing 	<ul style="list-style-type: none"> Electronics integration Detection sensitivity Minimum feature size defined by printing Non-hermetic sealing Moisture-sensitive
<ul style="list-style-type: none"> High-spec applications 	<ul style="list-style-type: none"> Optofluidics 	<ul style="list-style-type: none"> Microfluidic chips 	<ul style="list-style-type: none"> Qualitative applications 	<ul style="list-style-type: none"> Qualitative analysis

Table 1: Base materials for LoC formations.



Figure 6: Agilent Technology has been involved in the life sciences since 1995. Their “nanolab chips” are used to analyze DNA, RNA, SARS, and other infectious disease proteins^[2].

chemicals and biological samples into micro-spray streams for use with liquid chromatography/mass spectrometry (LC/MS).

3. Polymer/PCB-based

Many polymers are also optically transparent and can be integrated into systems that use optical detection techniques such as fluorescence, UV/Vis absorbance, or Raman method. Moreover, many polymers are biologically compatible, chemically inert to solvents, and electrical insulating for applications where strong electrical voltages are necessary, such

as electrophoretic separation and the surface chemistry of polymers. This can also be modified for specific applications. The most common polymers used in bio-MEMS include PM-MA, PDMS, OSTEmer, and SU-8.

So, what could be achieved using PCB technology? Of recent years a lab-on-printed circuit board (LoPCB) approach has been suggested. The PCB industry is mature, well-established worldwide, and has standardized fabrication processes, materials, and production equipment currently dedicated to electronics applications, but with the potential to become a

Your circuit boards delivered...

**1
DAY
LATE**

**2
DAYS
LATE**

**3
DAYS
LATE**

WHAT'S THE COST TO YOU WHEN YOUR BOARDS ARE DELIVERED LATE?

With Prototron, you don't have to ask that question. Serving customers for over three decades with a 98% on-time delivery record, we understand that providing you with high-quality PCBs on time, and right the first time, is critical.



Prototron Circuits
America's Board Source

www.prototron.com

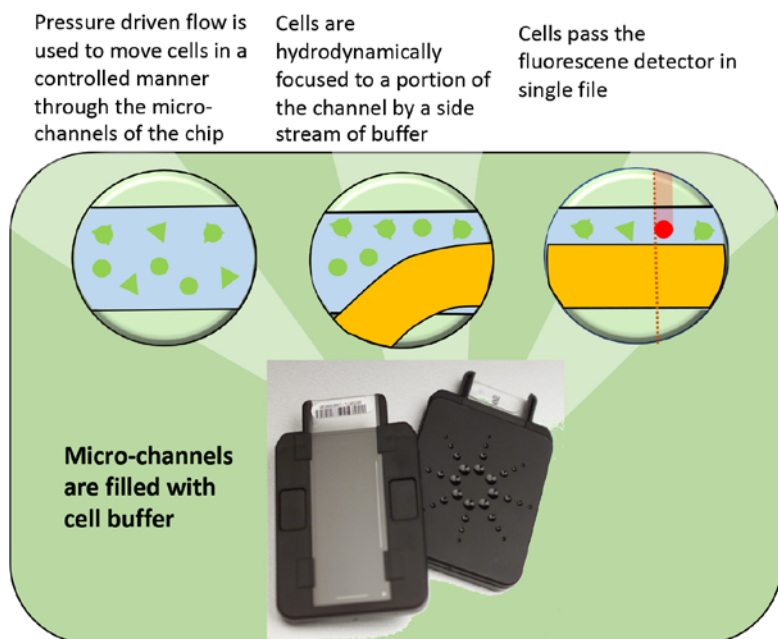


Figure 7: LoC sequence using glass microchannels for micro LC/MS of medical samples^[2].

natural partner for LoC development and the scope to be straightforwardly up-scaled.

Enter Dr. Despina Moschou, a researcher at the Centre for Advanced Sensor Technologies, Department of Electronic and Electrical Engineering at the University of Bath in the U.K. Dr. Moschou is a frequent speaker at printed circuit events like AltiumLive [1], EIPC Conferences, and the ICT Conferences. Fortunately, for us, she has taken the time to prepare summaries of her, and the many others in this field, work on LoC and LoPCB μ TAS approaches.

Early experimentation was focused on bio-electrodes for PCBs and on the microfluidics compatible with PCB fabrication. Figure 8 shows a test vehicle. This was a two-sided FR-4 PCB with gold plated copper traces and sensor electrodes. Two different gold were tested. One was a soft gold—the Metalor R MetGold Pure ATF process, plated 2.57 μ m layer of 90 HV hardness. For the hard gold, the Metalor R EnGold 2015CVR process was followed, providing 2.41 μ m of gold on top of 3.41 μ m of nickel with a final hardness of 140–180 HV.

To handle the delicate microfluidics, the properties of dry film photoresist (like DuPont RistonTM, or DFR) was employed. This photo-

sensitive material, with proper curing, can be stabilized for long life, and—in some applications—can be used as a photosensitive adhesive. Too bad that the dry-film solder mask (DFSM), like DuPont VacrelTM, was no longer available. A thin FR-4 layer (200 μ m) was laminated with a 50 μ m DFR, that was patterned using standard PCB photolithography, developed and cured for two hours to drive off any solvents. Then, adhesive-based flexible cover coating of PMMA film was laser micromachined to provide for larger fluidic supply channels (~ 5 mm), and the stackup laminated to the FR-4 sensing layer.

Dr. Moschou's recent work is shown in Figure 9, which is a three-layer multilayer experiment where

the construction is:

- Layer 1: Reference layer plated with copper, silver, and silver chloride (Figure 5b&c)
- Layer 2: Sensing electrodes plated with hard gold
- Layer 3: the microfluidic layers for the sample solution

A 3D exploded view, as well as the plated layers, are also shown. The experimental test board proved very successful, so a full LoPCB substrate was designed (Figure 10). This fully integrated PCB cartridge (4.6 cm x 5.7 cm) includes the microfluidic channels for handling the sample, reference electrodes, and working electrodes. It is designed to measure the biomarkers for the test for tuberculosis. In addition to the three-layer construction, the cartridge contained:

- PCI express electrical interfacing
- Six channels (four standard curve points within the clinical range, one negative control, and one sample)
- 10 μ L reaction chambers
- Three amperometric sensors per channel
- Full assay implemented on the PCB

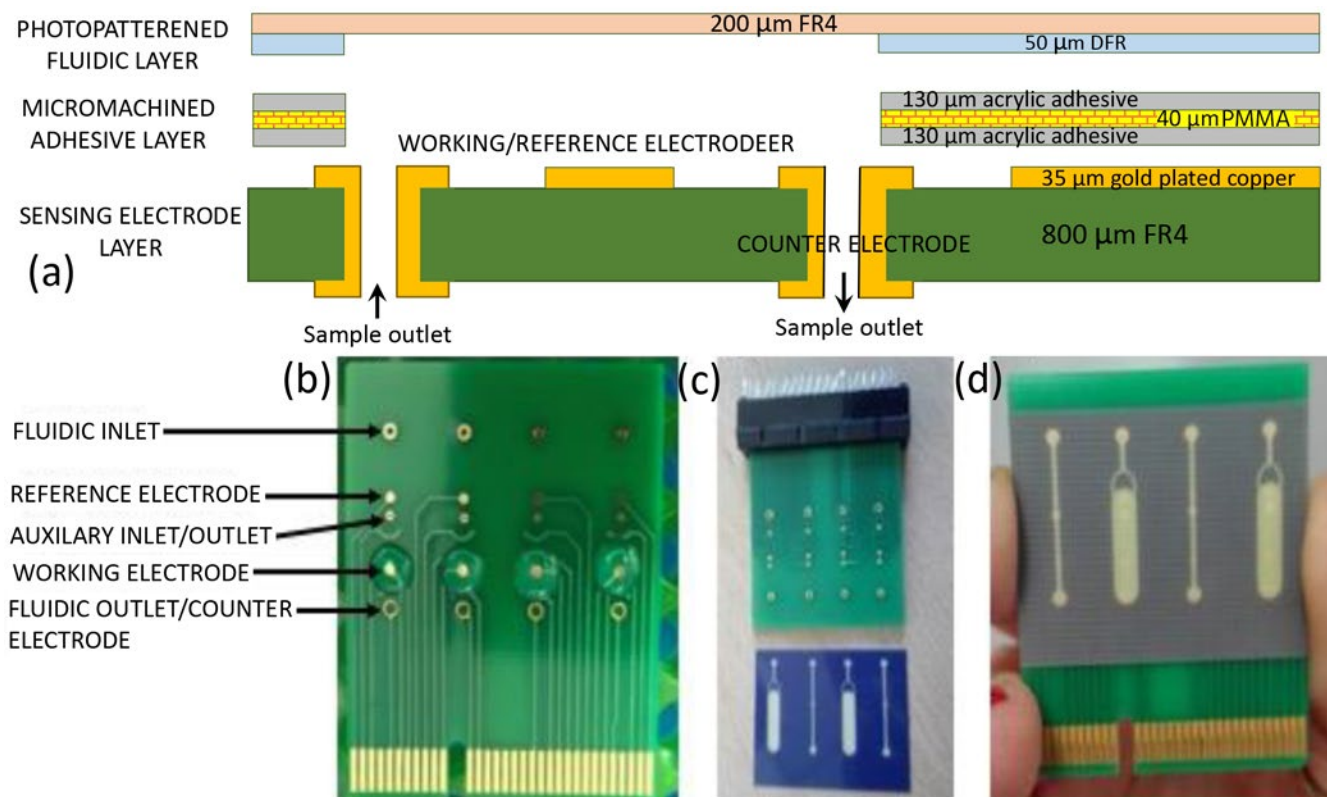


Figure 8: The experimental LoPCB biosensing platform; (a) integrated LoPCB stackup; (b) electrochemical impedance spectroscopy electrode configuration; (c) commercially fabricated PCB biosensing platform; (d) sample delivery microfluidics^[4].

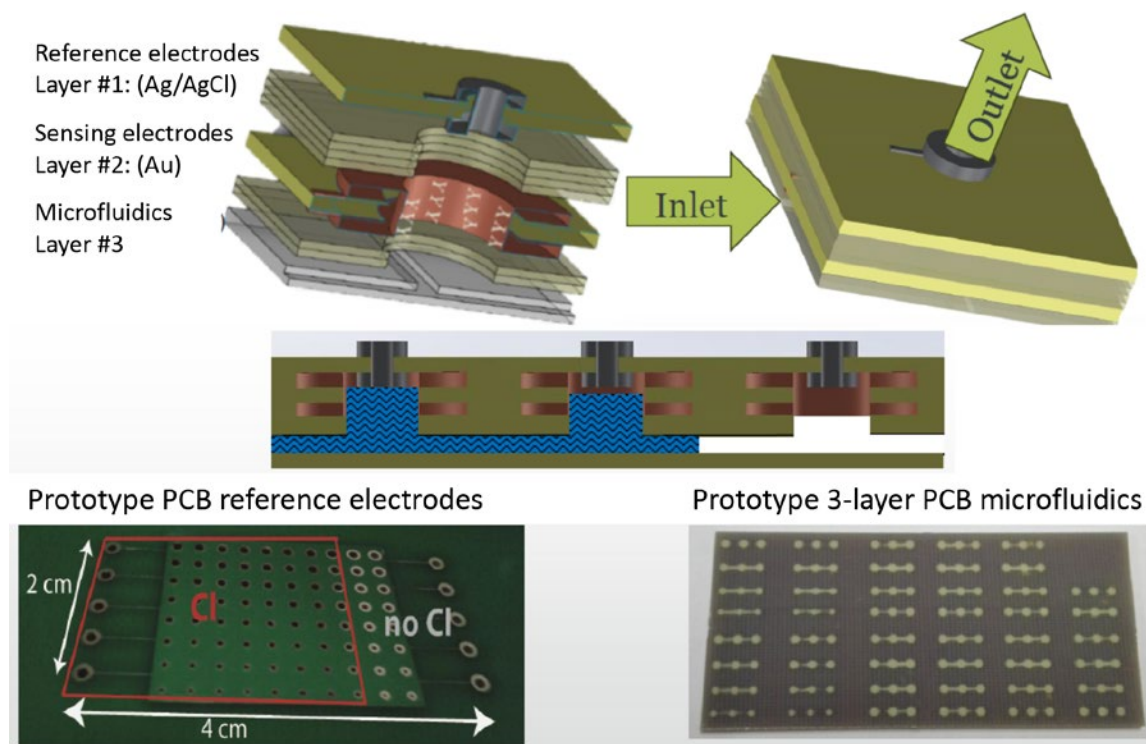


Figure 9: A three-layer PCB design that includes a microfluidic on one layer, implemented in a dry-film photoresist (Riston™), with integrated AgCl and gold electrochemical sensors^[5].

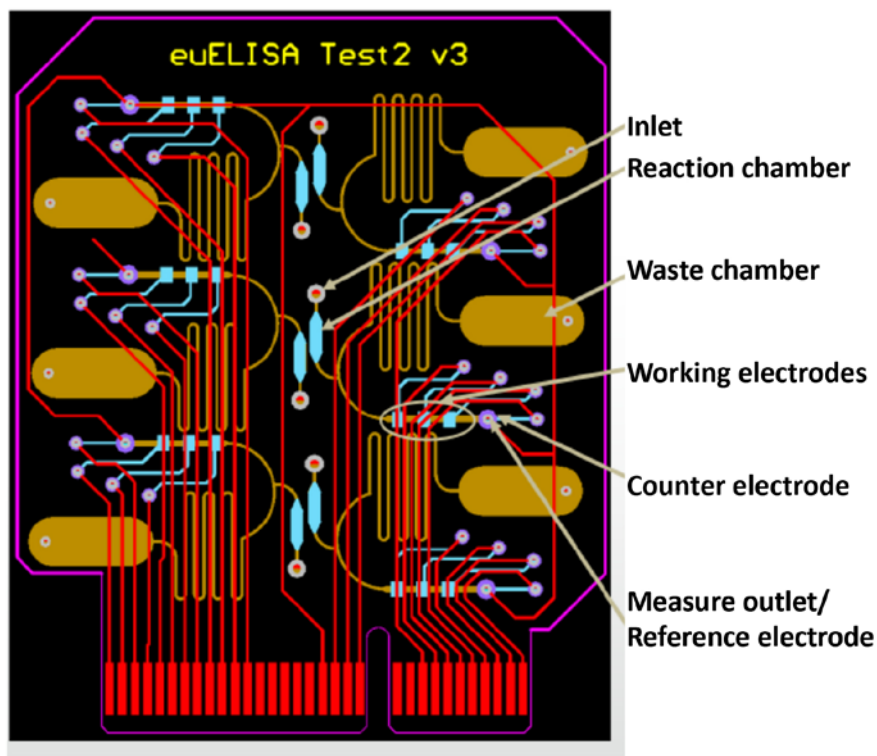


Figure 10: Fully integrated PCB cartridge with microfluidics, reaction chambers, and sensors ^[5].

This LoPCB proved to be very successful. The optical and electrochemical electrodes (sensors) provided data equal to those measured in laboratory test and in some cases, even more sensitivity—plus, there were no fluidic leaking.

Figure 11 shows the three layers of this cartridge before and after lamination. Also shown is the cartridge prepared to accept the medical fluids and human test sample. Other researchers on LoPCB have performed similar experiments and designed similar modules. Figure 12 illustrates a portable microfluidic diluter with a variable and actively controlled dilution ratio suitable for PoC implementations. It is fabricated entirely using the developed

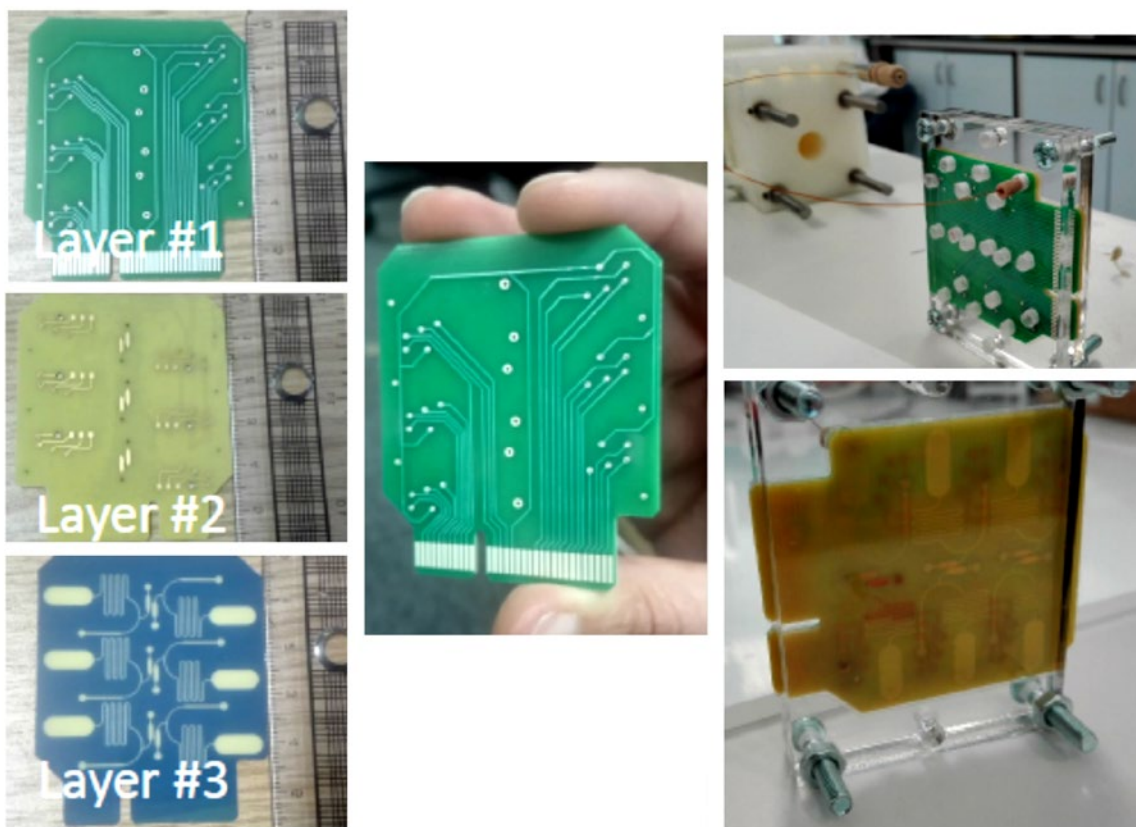


Figure 11: The three layers of the ELISA LoPCB cartridge before lamination, the finished PCB multilayer, and the LoPCB prepared for testing with biofluids and the human serum ^[1].

LoPCB manufacturing technology by the same PCB manufacturers. A standard microfluidic network (Figure 12a) comprising two inlets and two outlets was designed and fabricated (Figure 12b, c, & e), where the resulting dilution ratio is thermally regulated using a power MOSFET as a heating element (Figure 12c) [6].

The manufacturing process has been developed to produce a three-layer printed circuit utilizing FR-4 laminate. The stackup utilizes a top, middle, and bottom layer. The top layer is silver plated, with the vias as pseudo reference electrodes, if pre-chlorinated. The middle layer is gold plated; thus, vias can be used as sensing electrodes since enzymes, antibodies, cells, and microorganisms can be immobilized onto the gold electrode surface, making them effective biosensors. The bottom layer serves as the microfluidic network, interconnecting the inlet and outlet vias of the PCB. The microchannels are formed in dry photoresist (Figure 13).

Conclusion

As this technology evolves, more materials are introduced to see if the overall cost of these devices could be brought down. As seen in Table 1, paper was introduced as well as ceramics, polymers, and then PCBs. Today, 3D printing, printed electronics (PE), and various

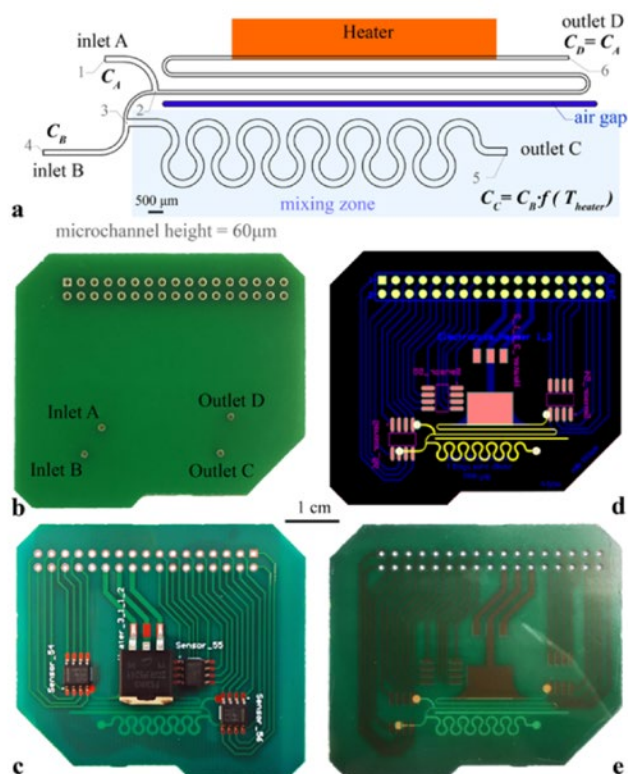


Figure 12: The PCB-based active control diluter; (a) the diluter design with the heating element and the thermal insulation air gap; (b) the PCB prototype—the top layer comprising inlet and outlet vias; (c) the bottom layer with functional electronics; (d) a microfluidic layout representation for the device; (e) the bottom layer of the microfluidic layer [6].

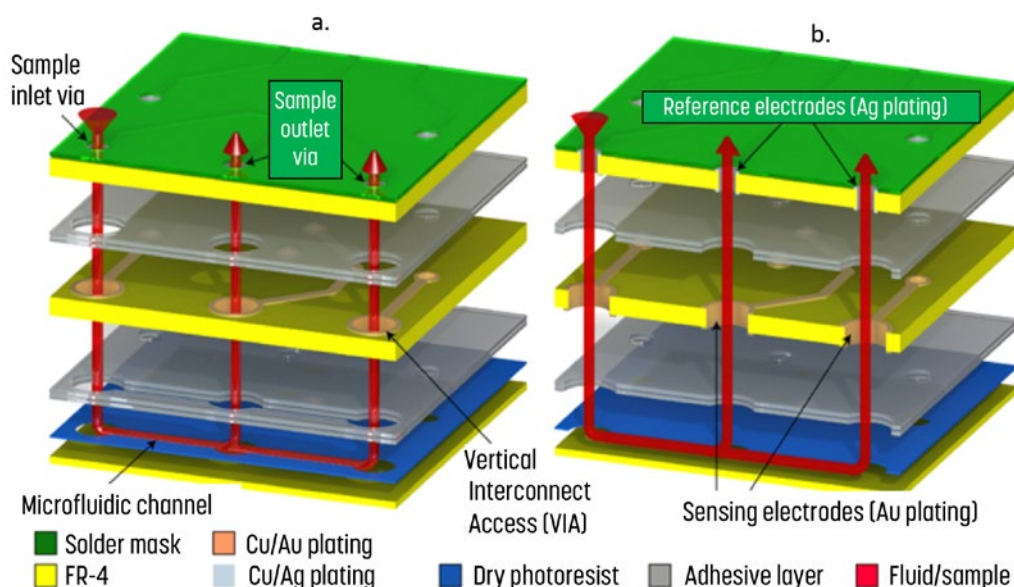


Figure 13: The PCB-based active control diluter stackup of the developed LoPCB; (a) exploded view; (b) cross-sectional view along the microfluidic channel [6].

inkjet technologies are being investigated to make LoPCB cost less and more accurate for more applications.

In fact, during the month of March 2020, the U.S. Food and Drug Administration (FDA) issued emergency use authorization (EUA) to six firms to allow them to use their SARS-CoV-2 EUA test for the fastest available molecular point-of-care (PoC) test for the detection of novel coronavirus (COVID-19). These six firms are:

- 1. Roche Holding AG** (March 13) ^[7]: The test uses Roche's fully automated Cobas 6800 and Cobas 8800 systems. With this authorization it will have millions of tests available each month for use on the two Cobas systems.
- 2. Thermo Fisher Scientific** (March 14) ^[8]: The test can be run on and is optimized for use on the Applied Biosystems 7500 Fast Dx Real-Time PCR instrument. 150,000 test kits are available today, and TFS expects to ramp up to 5 million a month by April.
- 3. Hologic Laboratories** (March 16) ^[9]: Tests run on the automated, high-throughput molecular diagnostic platform, the Panther Fusion, which can provide results in less than three hours and process up to 1,150 coronavirus tests in 24 hours.
- 4. Quidel (March 17)** ^[10]: Noted that its Lyra product (Lyra SARS-CoV-2 assay for the detection of the coronavirus that causes COVID-19) line offers PCR reagent kits that can be used by laboratories equipped with molecular testing instrumentation, such as the Applied Biosystems 7500 Fast DX platforms from Thermo Fisher Scientific.
- 5. Laboratory Corporation of America** (March 23) ^[11]: Can perform on-site serological and molecular tests for COVID-19, using Cepheid's recently announced GeneXpert System "Xpress SARS-CoV-2 Molecular Test" for up to 20,000 tests per day.
- 6. Abbott Laboratories** (March 27) ^[12]: The test runs on the m2000 RealTime Molecular

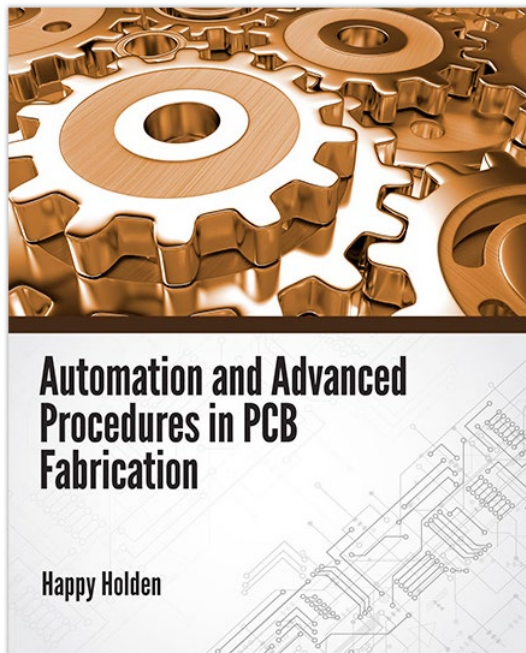
System for centralized lab environments combined with ID NOW controller. It can provide positive results in five minutes and negative results in 13 minutes. Abbott is prepared to produce 50,000 test devices per day.

Other molecular PoC testing platforms from Agilent Technologies, Alere Toxicology, Acelis Health, and Sony Micronics may not be far behind. **PCB007**

References

1. D. Moschou, "The Challenges of Redesign for Lab-on-PCB," AltiumLive Conference, Munich, Germany, October 2018
2. Agilent 2100 Bioanalyzer Product brochure.
3. D. Moschou, "Commercial PCB Technology Is Advancing Point-Of-Care Medical Diagnostics," *Electronics World*, June 2019.
4. J. Pawan, J. Rainbow, A. Reqoutz, P. Estrela, & D. Moschou, "A PNA-based Lab-on-PCB diagnostic platform for rapid and high sensitivity DNA quantification," Centre for Biosensors, Bioelectronics, and Biodevices, Department of Electronics and Electrical Engineering, University of Bath, U.K.
5. D. Moschou & A. Tserepi, "The Lab-on-PCB approach: Tackling the uTAS commercial upscaling bottleneck," *Journal of the Royal Society of Chemistry*, Vol. 17, 2017, pp. 1,388-1,405.
6. N. Vasilakis, K.I. Papadimitriou, D. Evans, H. Morgan, & T. Prodromakis, "A Commercially Available Lab-on-PCB Technology for Affordable, Electronic-Based Point-of-Care Diagnostics," Nanofabrication Centre, School of Electronics and Computer Science, University of Southampton, U.K.
7. Roche, "Roche's cobas SARS-CoV-2 Test to detect novel coronavirus receives FDA Emergency Use Authorization and is available in markets accepting the CE mark," March 13, 2020.
8. 360DX, "Thermo Fisher Coronavirus Test Gets FDA Emergency Use Authorization," March 14, 2020.
9. 360X, "FDA Grants Emergency Use Authorization for Coronavirus Assays From Hologic, LabCorp," March 16, 2020.
10. Genomeweb, "Quidel Nabs FDA Emergency Use Authorization for Coronavirus Assay," March 17, 2020.
11. Laboratory Corporation of America, "LabCorp Developing Options to Prioritize COVID-19 Testing for Inpatient Population in Support of Guidance from the White House Coronavirus Task Force," March 23, 2020.
12. Abbott, "Detect COVID-19 in as Little as 5 Minutes," March 27, 2020.

Automation and Advanced Procedures in PCB Fabrication



by Happy Holden, consulting technical editor, I-Connect007

Written by Happy Holden, I-Connect007 consulting technical editor with over 47 years of industry experience, this book provides an in-depth look at automation, computer-integrated and computer-aided manufacturing, mechanization, and chemical monitoring and control. Happy provides examples and descriptions of numerous devices, processes, and systems that can be easily implemented into the supply chain.

[FREE DOWNLOAD](#)[PRINT ON DEMAND](#)

“Happy takes a textbook-style approach using easy-to-follow language. He provides step-by-step points for the DIYer, especially for making your own chemistry controllers, while providing examples from his past experiences.”

— Alex Stepinski, VP, GreenSource Fabrication

ABOUT THE AUTHOR



Happy Holden is the retired director of electronics and innovations for GENTEX Corporation. Formerly, he was the chief technical officer for the world's largest PCB fabricator—Hon Hai Precision Industries (Foxconn). Prior to Foxconn, Holden was the senior PCB technologist for Mentor Graphics and advanced technology manager at Nan Ya/Westwood Associates and Merix. He previously worked at Hewlett-Packard for over 28 years as director of PCB R&D and manufacturing engineering manager. He has been involved in advanced PCB technologies for over 47 years.



American Standard Circuits

Creative Innovations In Flex, Digital & Microwave Circuits

March 18, 2020

COVID-19's Effect on PCB Supply Chain

American Standard Circuits Inc. Customers:

Given the rapidly changing circumstances resulting from the COVID-19 outbreak, ASC has implemented more frequent and stringent cleaning procedures necessary to protect the health and well-being of our employees and customers and our community.

ASC's management will continue to provide periodic updates to our employees and customers as we work through the coming weeks and months. Undoubtedly, there will be more changes that will challenge us going forward, but rest assured, we will pass along all updates as they emerge.

To date, we are happy to report that the health of our staff is excellent. Currently, there has been no employee reporting out for any type of illness.

At this point in time, ASC has taken the following steps:

- We have temporarily suspended the use of the employee's time clock.
- All meetings that involve more than three employees are to be held in the conference room to help with social distancing.
- Lunches and breaks have been staggered to reduce the number of people in the break room at any given time.
- We have implemented extra cleaning of the breakroom between each break session along with extra cleaning of the conference room table as well as all door handles.
- Alcohol-based hand sanitizers are now provided throughout the workplace and in common areas. Cleaning sprays and wipes are also provided to clean and disinfect frequently touched objects and surfaces such as telephones and keyboards.
- We will be flexible with employees that may have special scheduling constraints due to the current situation.
- We are discontinuing all non-essential meetings.
- Most office employees have been set up to telecommute and have been given this option.

This unprecedented shutdown of civic offices and business operations pose unique challenges and obstacles to all of us. ASC is diligently working with our suppliers to alleviate any and all foreseen disruptions in our supply chain. It is important to note that ASC continues to operate at 100%, running three shifts daily and continuing to offer quick-turns on your NPI/prototype requirements.



For those of you who are using our offshore solutions, our Asian partners are all operating at 100%, but the lead times are extended due to a large backlog of orders created by the extended shutdown.

With that said, we want all our customers to understand; given this unique situation, the most proactive way to avoid supply chain delays is to submit your orders as soon as possible. This will allow ASC to procure laminates and pre-pregs as soon as possible, will ensure your printed circuit boards are manufactured and delivered without delay. Not knowing when this situation will subside, now is the time to review your forecast and place your orders now to alleviate delays.

American Standard Circuits does maintain a vast inventory of materials; however, there are limits to what we have in our inventory. Although we make every attempt, it is simply impossible for us to have exact or enough materials in stock. For these instances, we rely on our long-standing relationships with our suppliers to help fulfill unexpected demand(s).

ASC is committed to working with your team to get your PCBs shipped when you want them.

March 23 Update:

Pursuant to our open letter last week regarding our continued business operations at American Standard Circuits amid the COVID-19 outbreak, we wanted to provide the following update to our customers:

- American Standard Circuits is classified as an essential business in the State of Illinois and will continue to operate as normal running three full shifts daily until further notice.
- Aside from the previously known shortages of specific materials, there are currently no other material shortages resulting from the COVID-19 outbreak. Our management team remains in constant contact with our suppliers to ensure that any additional lead-time required for laminate materials are minimized and accurately quoted.
- We are continuing our diligent efforts to ensure that all our employees are working in a clean and safe environment.

If you have any questions or concerns regarding existing or placing new orders, please contact your customer service and or field sales representative for immediate response.

Anaya Vardya
President and CEO
American Standard Circuits

Gene Weiner: Lessons Learned From COVID-19

Interview by Barry Matties
I-CONNECT007



Barry Matties speaks with Gene Weiner, president and CEO of Weiner International Associates, about the electronics industry's continued operation under COVID-19 restrictions and some of the lessons learned during this pandemic. One such lesson: Companies and nations must do a better job of sharing information to help prevent this from happening again.

Weiner describes his view of the current situation as "mixed," and he faults the world's governments for being unprepared for such a pandemic. But he believes the world—and especially the U.S.—is set to rebound after the smoke clears, and he credits IPC President and CEO John Mitchell with showing leadership during this crisis.

Barry Matties: Today, I'm speaking with Gene Weiner—a man who has over 50 years of experience in our industry. Gene is the president and CEO of Wiener International Associates. He is also an IPC Hall of Fame member. Gene, welcome. And let's start with your view of the current condition of the industry.

Gene Weiner: Well, the view is mixed. We have not seen anything like this, although we have

experienced over the decades a number of severe recessions as well as rapid increases. This, though, caught everybody not by surprise, but in a way that was unexpected as it exploded in just a few months' time from an unknown source around the globe to wreaking havoc on the world economies. And it is as yet unclear as to how or when it will be controlled in the future.

What is certain is that there has been a total lack of preparation or foresight by various governments around the world, although this type of thing had been predicted by a number of people publicly in talks and so forth a number of years ago—five, six, seven years ago. The way it affected the United States is rather unexpected, too, as the United States did have—and does have—the ability to rebound quickly but had not maintained its emergency stockpile of ventilators and other materials and research programs that would enable to confront this type of coronavirus rapidly. And also because the electronic industry, which is the heart of almost everything we touch, if you take printed circuits, semiconductors, and the software that joins it all together, it affects everything from a refrigerator to the car you drive to the TV you watch and the cellphone in your pocket or hand.



WATCH VIDEO

GET MORE INFO

Need to test large boards?

Our G90 series of Flying Probes accommodate board sizes ranging from 31.9" x 31.9" up to 63" x 39.4"

G90	G90L	G90XL	G90XXL
31.9" x 31.9" 812mm x 812mm	39.4" x 39.4" 1000mm x 1000mm	47.2" x 47.2" 1200mm x 1200mm	63" x 47.2" 1600mm x 1200mm
<ul style="list-style-type: none">> Fixtureless testers developed, designed and assembled in Germany> High accuracy across entire test area ensured by glass scale system> Motor-driven movable lower frame for easy loading of all board sizes		<ul style="list-style-type: none">> Speed and repeatability with hi-speed lead screw driven motion system> Optional 4-wire Kelvin option for accurate low resistance measurements> Utilizing FPX software with all its features and benefits	

Want to learn more?
Complete G90 Series info

Matties: Interesting.

Weiner: The critical effect of a global supply chain is really what has become quite evident here. Because of the supply chain, all of the materials, boards, circuits, and assemblies of what we use in everyday life are truly global. And no one country is totally independent of it—save possibly China, and we know what happened there.

**Because of the supply chain,
all of the materials, boards,
circuits, and assemblies of
what we use in everyday life
are truly global.**

Matties: In large part, the shortage of medical devices is what's keeping our industry very busy right now. What do you see around that?

Weiner: I see a tremendous effort by America's printed circuit manufacturers, their assembly companies, and OEMs, to quickly rise to the occasion and produce not only test kits for finding the virus—in the way Abbott Laboratories and others quickly came up with quick solutions or short-term solutions to find out if someone has been affected—but the construction of the ventilators, which is a rather complex piece of equipment, rebounded quickly.

But what was surprising to me is that no one agency of the government had any record as to who was capable of producing ventilators quickly and marshalling all the forces to put it together. For example, asking GM to produce it quickly—when there are a number of EMS companies that are better equipped to do this—was surprising to me. And it was surprising to me that no one had brought this forward quickly enough. However, IPC—under

the leadership of Dr. John Mitchell—has really risen to the challenge and pointed out how to fix the problem, share solutions, share equipment, share parts, and keep things going in a way that was totally unexpected. It has shown what IPC can do in an emergency to help everyone everywhere.

Matties: What lessons do you think our industry has learned or needs to learn?

Weiner: Our industry has learned that we need to share a number of pieces of information and facilities and capabilities with each other, as we have often done in past decades through trade associations such as IPC. It's amazing how everyone has stepped forward and shared the solutions they have found and offered to help other companies—whether it's a quick-turn circuit for a ventilator, a test kit, or the availability of providing electrical test equipment for new pieces of equipment that are required. It's interesting to see how the workers in our industries have stepped forward and gone to great lengths to put themselves at risk—24/7, in some factories—to solve the problems and keep the factories running and provide critical needs for the national emergency.

Matties: Gene, we certainly appreciate your 50 years of industry experience and you taking the time today to share your thoughts with our listeners.

Weiner: It's been a pleasure to share our experiences and what we learned with others, and that is part of the lessons that we've learned.

Matties: Once again, you've been listening to Gene Weiner, the president and CEO of Wiener International Associates. **PCB007**

Audio File Available



Click here to listen.

**Blackfox and IPC Working to Minimize the Impact of COVID-19 on Training and Certification for Our Industry**

Dear valued Blackfox customer,

Blackfox recognizes the challenges that the COVID-19 pandemic has created for the electronics manufacturing industry. Blackfox is taking steps to maintain a healthy training environment for our students, and IPC has made a few temporary modifications to their policies to make it easier to remain certified without interruption.

There is great concern about the coronavirus and how quickly it can spread. We want to assure our customers their health and well-being is our top priority. As extra precautions, our cleaning service is currently using a disinfectant according to the CDC that will kill the virus. They are paying special attention to doorknobs, light switches, and all hard surfaces. The restrooms are also being cleaned with this product. We have included hand sanitizer in all of our classrooms and restrooms.

If you are feeling ill, we encourage you to not attend classes until a later date. There will be no penalty for rescheduling. We have informed all of our staff to stay informed, aware, and protected during this situation.

IPC Certification Extensions

Effective immediately and upon request, IPC will temporarily authorize 90-day extensions to those who have expiring certificates. CITs need to request an extension to an expiring certification through the Certification Help Desk. When completing the form, please select the "Extension Request" in the "Request Type" field.

CISs that are seeking an extension should make a request to CIT or MIT that conducted their training. The CIT or MIT will complete the "CIS Extension Form" that has been added to the "Training Resources" section on IPC EDGE. Forms must be filled out completely and emailed to certification@ipc.org.

The certification expiration date will still follow the current policy for all certifications that were obtained by the temporary extension. IPC will currently only process extensions for certifications that expire within the months of March or April. IPC will reevaluate the situation in early April.

Future IPC Remote Testing Option

IPC has engaged with several organizations that offer remote proctoring services to universities and certification bodies. IPC is currently in the process of integrating one of those services into IPC EDGE. IPC is working to make this available as soon as possible. IPC's goal is to begin internal and Beta testing as early as next week, but there are still many details to be worked out. We will send another email out with details when available.

As always, the health, safety, and well-being of our customers, our associates, and our communities is of paramount concern. We continue to monitor this quickly evolving situation and are here to assist our customers as needed. Thank you for being a Blackfox customer!

Sincerely,

Sharon Montana-Beard
Vice President, Sales
Blackfox Training Institute



David Bergman



Teresa Rowe

IPC Standards Work Continues to Move Forward

Interview by Barry Matties I-CONNECT007

On April 3, 2020, Teresa Rowe, IPC's director of assembly and standards technology, and David Bergman, vice president, talked to Barry Matties about ongoing standards activities during the global COVID-19 outbreak.

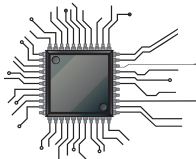
Rowe and Bergman reported that, where one might think that standards committees would be negatively affected, standards work seems to be going stronger than ever. More people seem to be finding time in their workday to get involved in the standards meetings when in-office demands on their time may have otherwise kept them away. IPC is still planning on different standards, white papers in design, PCBs, materials, assembly pieces, cybersecurity, and more, and its ongoing work on standards will continue to move forward.

IPC has been operating as a mostly remote organization for a number of years, so the various shelter-in-place orders are not hindering

IPC work. IPC Works—a task force communication tool—has been widely embraced by the committees. Bergman noted that even though suddenly everyone is working from home, work is progressing. The standards process, he said, has been found to be worth the industry's attention even while we work from home.

IPC and participants are learning the power of words “you can't show people on a teleconference; you have to explain it.” Rowe pointed out that standards are about using words to standardize, and committees seem to be re-learning the power of precise explanation. By getting more people involved in the teleconferences, the input has been more diverse.

Barry Matties: Today, I'm speaking with IPC's Dave Bergman, vice president of standards and technology, and Teresa Rowe, director of assembly and standards technology. Thanks for joining us, both of you. With the outbreak, it certainly hasn't been business as usual, and at IPC, I know that there is a lot of response going



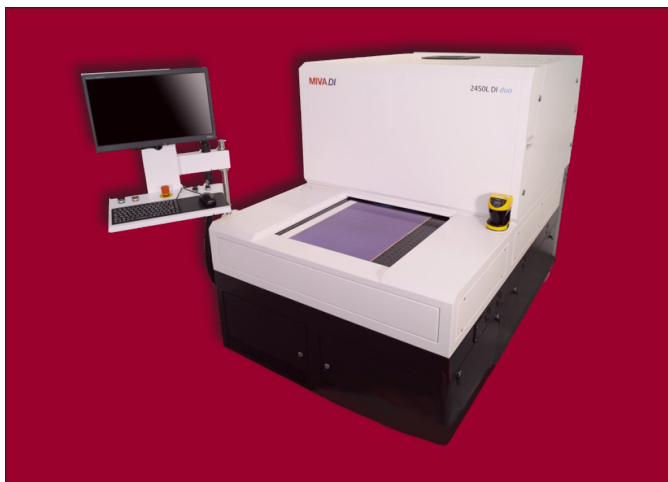
MivaTek

Global

Quad-Wave... Images Everything

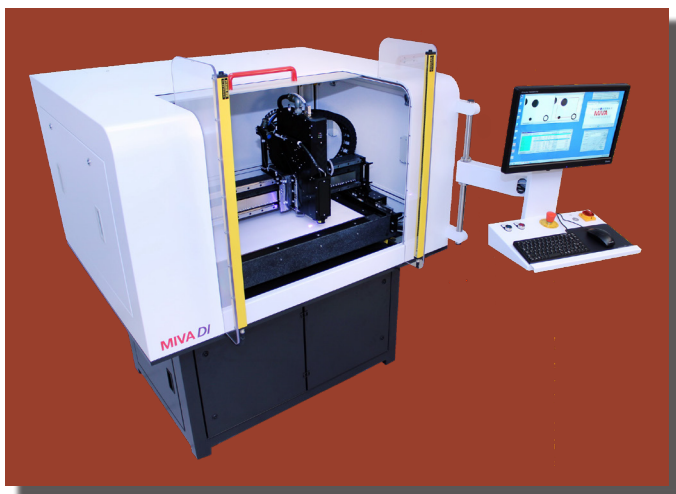
Inner, Outer, Solder Mask, Legend

Printed Circuit Board Direct Imaging



2400 Dual Tray Direct Imager

- ◆ 50 μ , 25 μ , 10 μ Features
- ◆ 12 μ A/B Registration
- ◆ Up to 6 Light Engines
- ◆ Up to 140 Panels/ Hour
- ◆ Full Automation Available



2000L Entry Level Direct Imager

- ◆ 50 μ , 25 μ , 10 μ Features
- ◆ 12 μ A/B Registration
- ◆ Up to 3 Light Engines
- ◆ Up to 80 Panels/ Hour



3000 Large Format Direct Imager

- ◆ 50 μ , 25 μ , 10 μ Features
- ◆ 25 μ A/B Registration
- ◆ Up to 3 Light Engines
- ◆ 30" x 60" Table Size

MIVA:Quad-Wave **LED** DIRECT IMAGING

on right now around the COVID-19 outbreak. But in terms of the other ongoing activities at IPC, Teresa, can you give us an overview of the impact that's taking place on the daily workload there?

Teresa Rowe: Certainly. Staff liaisons have a number of projects that they've been working on for a while that are due to be released this year and even out into 2021, and work goes on with those. What we're noticing is that with people indoors and at home, they have extra time, and since standards development is volunteer, we see them call into meetings when we may not have had them on the calls before because they have other responsibilities at their job. This is evidenced by a call that we had just earlier this week where the group that normally would be about a dozen people, we had 41 on the call, and it represented more than 10 countries from around the world. We're really excited to be able to have their presence, although sad for the reason why we have them there.

Matties: That must be quite a bit to manage on a call like that.

Rowe: It is, but we have strong leaders who are able to work through the issues with the communications. We have ways of voting online through our Zoom links. All in all, it's a very positive outcome, and things are moving forward.

Matties: Now, Dave, you've been in standards for a while and also a virtual association. What sort of changes are people taking into the standards meeting? Is there more direction around one standard than another? Give us an update on the actual topics.

Dave Bergman: It runs the full gamut. I guess what I'd like to then at least start with, about four years ago now, IPC essentially became a virtual office. Our headquarters has always been in the Chicago area. We still have a presence in the Chicago area, though the office is significantly smaller than it was at one point, with staff being dispersed around the country

and the world. Because of that change, IPC became very comfortable at the staff level in working in a virtual environment. We're working from home. We work from the road, so it's basically second nature to us now. We've gone through a series of tools, and we've settled on our current tool and use it very heavily in staff-to-staff communications.

We have then been rolling that out in work with our committee members, and they seem to be getting additionally comfortable in the virtual meetings. Depending on the committee, typically, they would meet in face-to-face meetings once or twice a year, which has been our historical trend, but more increasingly—because of the amount of work and the need for accelerating the development of some of the standards—there will be committees that meet biweekly or weekly for a shorter period of time so that they can deal with their committee efforts in smaller chunks. There will be staff liaisons that have regular weekly meetings with their individual committees.

From a topic standpoint, Teresa, we have over 30-some standards currently in the pipeline that we expect to release this year? Did I remember that number correctly?

Rowe: That is correct. It's standards, white papers, guidelines, and handbooks. It runs the gamut as well.

Bergman: Barry, it's not just one specific topic; it is all areas. We're focusing on design, printed circuit boards, the materials, and the assembly pieces. We are now starting to toy or not, but we're working to develop additional activities in cybersecurity. That's a new project. That's not one that we would expect to be published this year, but it all wraps around efforts that our members and the industry have brought up as topics of interest.

Matties: It's a really serious matter, so I'm glad to hear that you are working in the cybersecurity realm.

Bergman: With cybersecurity, we've kind of been on the fringes based on some of the in-

terest. We had intellectual property standards, and then that kind of grew into a trusted source where we were working with some of the DOD groups to try and develop a list of trusted suppliers and what they might need to do to make sure that they can be considered a trusted supplier. Then, cybersecurity is a further extension of that.

You mentioned early on Smart factories, and the IPC Standard 2591-CFX Standard will, I believe, play a role in smart factories. And security played a major role in the decision as to what made the backbone of that standard. Because you're expecting your factory is going to be running with more digital input, more digital sensors, more data coming in and out and so you need to be able to control that information. We believe that CFX will play a role in the smart factory in the future for electronics manufacturing.

Matties: Teresa, during all of this, what lessons do you think the industry is learning right now?

Rowe: From the standards development piece of it, I think that we're experiencing learning the power of words and communication. We can't show somebody; we have to explain it. That's really important when you talk about standards development. I'm seeing more along the lines of people communicating on teleconferences saying, "Let me explain what I mean." They don't jump up and try to draw a picture, or they don't just say, "You know what I mean. Let me show you in the book." It's not like that. They're explaining, and by getting more people involved who don't normally attend our teleconferences, we're also getting more diverse input at times. I think, all in all, we're learning that this method of communication is really benefiting and will benefit the industry in the long run.

Also, in March of 2019, we introduced a new platform called IPC Works for our task groups to communicate. Our groups have embraced it, and they're using more and more and more of the tools inside of it: surveys, polls, comment forums. They're sharing files and sending

messages, even messages of concern. They're becoming a more gelled group as much as a group like this can be. All in all, it is positive that the lesson they're learning, as I said, is the power of words and communication, and that's what standards are. We're just communicating with words.

Matties: It's really interesting that you're mentioning communication and that we can't just stand up and start drawing on a whiteboard the way we normally do. While there may be a need to slow down, there's probably some need for people to even rethink the way that they do communicate as well and kind of relearn, if you will. You probably see that in your meetings.

Rowe: We have, and we also have heard, "Now, I understand why the staff liaisons are emailing me at 11:30 at night because you work virtually. Suddenly, I realize that I have followed this time, and I'm focused on something, staying focused on, and getting my action items and tasks done." Yes, the communication piece is huge to this.

Matties: Great. Dave, what advice would you have to share with the industry at this point?

Bergman: As we were talking, my mind was going back to 30 + years ago when somebody was submitting a comment to a document, and they mailed an envelope from Shenzhen, China, to Northbrook, Illinois. You can imagine how long that took to get that set of input from that company from one portion of the world to the other with no additional review. By the time I got that and got it to the committee, it might have been six months. Now, I look at it from my standpoint, and we have systems and tools in place where you can have people from multiple continents participating and resolving comments in real-time. Going from really not doing that as a business as usual, yes, people were using it, but three weeks ago, people weren't working from home; now, everybody's working from home.

The projects still move forward, so that's the fulfilling piece of it is that this is a global worldwide sales challenge. People have stepped up. They have found ways to continue to get their work done. We're not on vacation. People are working from home, and they're working. The standards efforts are important enough to deserve the attention, or they show through their participation that the standards efforts deserve their attention and that they are contributing their expertise in support of electronics manufacturing. That has been something very fulfilling to see.

Matties: Do you have any final thoughts that you would like to share with our listeners?

Rowe: I just wish everyone well and hope that everyone stays safe, and we'll all get through this together.

Matties: Great. Those are great words to end on. Thank you both so much for taking the time to share. Your insights are greatly appreciated. Once again, you've been listening to Dave Bergman and Teresa Rowe of IPC. **PCB007**

Audio File Available



Click here to listen.

ControlTek Inc., Critical Manufacturer of Medical and Aerospace and Defense Products, Will Maintain Operations

Electronics manufacturer ControlTek Inc. announced its Vancouver, Washington, manufacturing facility would remain open while implementing additional safety measures to maintain production support for critical manufacturing sectors, including medical and military.

ControlTek has been designated a critical supplier of medical and aerospace and defense (ASD) products by the Washington Military Department, Emergency Management Division (EMD). The company has been working closely with its medical customers to assist with supply chain challenges and ramp up the production of critical care devices. According to IPC, as many as 69% of manufacturers have experienced or expect to experience delays due to the virus.

"Right now, our main focus is on supporting our customers and employees, as well as keeping a close eye on the supply chain, so we are ready and able to quickly address any disruptions that as a result of COVID-19 related closures and delays," says Sean Neill, VP of operations.

In addition to assisting current customers, ControlTek is also offering help for EMS companies needing assistance during the crisis, whether they need help bringing on additional capacity to meet the urgent demand for medical products or finding new sourcing solutions for hard to find components.

"When this began, it caused supply chain delays across Asia that exacerbated earlier challenges resulting from last year's tariffs," says Neill. "That's the bad news. The good news is that we've spent much of last year working to diversify our supply chain so that we are better prepared to meet these challenges head-on."

To maintain the safety of staff during operation, ControlTek has taken proactive measures to protect customers and staff and to limit the impact of business disruption. This includes employee training, remote working expansion, and closing the facility to outside visitors. The manufacturing floor has also been updated to provide greater social distancing, as well as staggering breaks and shifts to decrease contact between staff.

"Our employees are doing an amazing job, and we are incredibly grateful for their contribution," says ControlTek Principal Stacey Smith. "Their work to build these products that directly support the COVID-19 relief effort is nothing short of Herculean, and they do it all while caring for their own families in an uncertain time."

ControlTek is a family-owned and operated Service Disabled Veteran Owned Small Business (SDVOSB). The company provides a full range of custom electronics design and manufacturing services for the defense, military, aerospace, and aviation industries.



Insulectro Remains Open to Support Fabricators' Critical Infrastructure Business Demand

March 25, 2020

As another week of stress and uncertainty, due to the spread of the coronavirus, continues for individuals, families, communities, businesses, and our nation, Insulectro continues to place the safety of its teammates in top priority as we remain open to supply our customers' needs.

To provide a safe working environment to its teammates, vendors, customers, and shipping partners, Insulectro follows the recommendations of state and federal officials—especially the Centers for Disease Control (CDC). The company has restricted travel and has redeployed office teammates to work from home where possible. Access to facilities is restricted to protect on-site distribution center teammates. The company requires social distancing and cleans and disinfects its distribution centers regularly. Those feeling ill are required to stay at home.

The electronics industry is a major player in the battle against COVID-19, and Insulectro's 11 distribution centers are open to meet the demands of its customers who are engaged in "essential" business as defined by the Department of Homeland Security's Critical Infrastructure Sectors. Many of Insulectro's customers create PCBs used in the manufacturing of a whole array of military and medical devices, including the very critical breathing ventilators that are in short supply. Many of these fabricators are working 24/7 to mitigate crucial shortages.

Insulectro's supply chain team—experts in matching supply with demand—are in constant communication with suppliers to help ensure the rapid movement of PCB materials from manufacturing on to avoid bottlenecks and delays in this critical time.

We are all in this together. Insulectro continues to step up its responsibility to deliver the best materials in the fastest way possible—a result of the commitment made by all Insulectro teammates across North America.

Insulectro and its customers are helping to forge the path to the other side of this crisis.

Patrick Redfern
President and CEO



Supplier Highlights



Insulectro Remains Open to Support Fabricators' Critical Infrastructure Business Demand ►

As another week of stress and uncertainty, due to the spread of the COVID-19 virus, continues for individuals, families, communities, businesses, and our nation, Insulectro continues to place the safety of its teammates in top priority as we remain open to supply our customers' needs.

IEC and Partners Address COVID-19 ►

All of us at IEC, Eternal, Kodak, RBP, and Rogers want you to know that we are here to continue servicing and supplying you with our products. With the acceleration of COVID-19, we thought it best to provide you with an update of our manufacturing and supply chain status.

Language of Electronics: Transitioning From Contact Exposure to DI Solder Mask ►

In the first of the commentaries from Orbotech West domain experts, Raanan Novik, our PCB process and Orbotech Diamond expert, will address one of the biggest issues faced by imaging engineers in PCB manufacturing facilities: the difficulty of exposing solder mask with increasingly tighter clearances and smaller features. The intent of our series is to provide customers and others with knowledge and tips for maximizing the value of manufacturing systems. Here, Raanan discusses the key motivators for transitioning to directly imaged (DI) solder mask exposure and ways to do so successfully.

Ucamco Offers Additional UcamX Full Seat to Current Customers ►

With the difficult times ahead caused by COVID-19, it is important to be able to count on business partners. Because of this, Ucamco is

extending a helping hand by offering an additional free UcamX full seat to all customers with a maintenance contract.

Congratulations to Mike Carano! Dieter Bergman IPC Fellowship Award Recipient ►

Patty Goldman spoke with Mike Carano about being awarded the Dieter Bergman IPC Fellowship Award, what that means to him as someone who was inspired by Dieter, and after 40 years in the industry, what keeps him excited going forward. Talking with Mike, one can feel his enthusiasm for IPC and the industry, which is contagious.

With DIS, Accurate Registration is Everything ►

Pete Starkey and Jesse Ziomek, VP of sales for DIS, discuss how the company achieves ultimate accuracy in layer-to-layer registration, not just in rigid multilayers, but also in flex and rigid-flex builds. Jesse also comments on keeping technology exciting enough to attract young engineers into the industry.

atg Luther & Maelzer Continuity of Supply Update During COVID-19 Epidemic ►

Due to the global increase in the outbreak of the COVID-19 virus, it is important to safeguard the well-being of our partners—employees, customers, and vendors alike. We are also taking prudent steps to continue to provide the highest level of service and maintain proper business relationships with our customers and vendors.

Elsyca Introduces New Simulation Tools for PCB Copper Balancing ►

Copper plating is a very complex process that is impacted by the PCB design itself, by the panel layout, and by the production configuration.

The Printed Circuit Designer's Guide to...™ Producing the Perfect Data Package



by Mark Thompson, Prototron Circuits

For PCB designers, producing a comprehensive data package is crucial. If even one important file is missing or output incorrectly, it can cause major delays and potentially ruin the experience for every stakeholder. Written by Prototron Circuits' Mark Thompson, an industry veteran with over 38 years of experience, this book describes what a PCB fabricator requires in a design output package and explains the consequences of providing incomplete or inaccurate information. Mark also highlights the importance of earlier communication between the designer and fabricator. Readers will learn effective ways to eliminate discrepancies and errors, ensure project success, and ultimately reduce costs and wasted time.

[FREE DOWNLOAD](#)

[PRINT ON DEMAND](#)

“Mark does an outstanding job detailing what needs to be included in the handoff between the board designer and fabricator. Understanding and following his advice will lead to a smooth transition between these two functions. His new book should be required reading for every designer.”

— Douglas Brooks, Retired Engineer, Ph.D.

ABOUT THE AUTHOR



With 38+ years of experience, Mark Thompson, engineering support and CID+ at Prototron Circuits, has reviewed thousands of data packages and worked with customers' designers and engineers to help them hand off better data. Over his career, he has become one of the most trusted names in the industry when it comes to advising customers on how to productively work with PCB vendors. Mark believes that PCBs will only be as good as the data it takes to build it.

Dan Beaulieu: Business as Usual at D.B. Management

Interview by Nolan Johnson
I-CONNECT007



Nolan Johnson gets an update from Dan Beaulieu, president of D.B. Management Group. Dan is a 40+ year veteran of the electronics manufacturing industry and has been an industry consultant for 25+ years.

Dan shares an update on current business operations for D.B. Management, including how—like his clients—he may be at home, but it's still business as usual. Dan also offers his perspective on how our industry will weather and emerge from this challenging time.

Nolan Johnson: Hi, Nolan Johnson here for I-Connect007, and I am currently talking with Dan Beaulieu, who is the president of D.B. Management Group. Dan has 40+ years of industry experience in electronics manufacturing and 25 years or more as a consultant in that space. Dan, thanks for joining us on the call.

Dan Beaulieu: My pleasure, Nolan.

Johnson: In your role as a consultant to a lot of companies in the electronics manufacturing space, how has the government-issued virus containment order—or orders, depending on whether it's state or local government—caused you to change your business model?

Beaulieu: Well, I'm sitting at home and for the first time in over 25 years. I have no pending

plane tickets. I normally travel two weeks a month at a minimum and always have trips planned a couple of months out. I am settled in here and kind of like a call center, advice center, whatever. I'm doing a lot of work at home, talking to people, and I'm actually busier than ever, following the rules. I live in Maine, so it's a little bit quieter here. I think we have 150 cases and people are off the street. I just feel there's less danger here; there are only a million people in the entire state, and it's the largest state on the East coast.

So, we're doing okay. It's funny not to fly. I haven't flown in two weeks, but I'm catching up on things, catching up on people, and helping people out. I'm getting a lot of people who are calling me and asking for advice in terms of the government rules. I'm not a doctor, so I'm just doing what they say for me to do. That's what I'm doing. I know we could still fly, but I don't really want to do that right now. That's pretty much where I'm at.

Johnson: With all of those calls and all that communication going on, what message are you sending to your customers?

Beaulieu: I am sending that within the circumstances it is business as usual, as much as we can do. I work a lot directly with sales teams, and I talked to them about it. I try to cut down

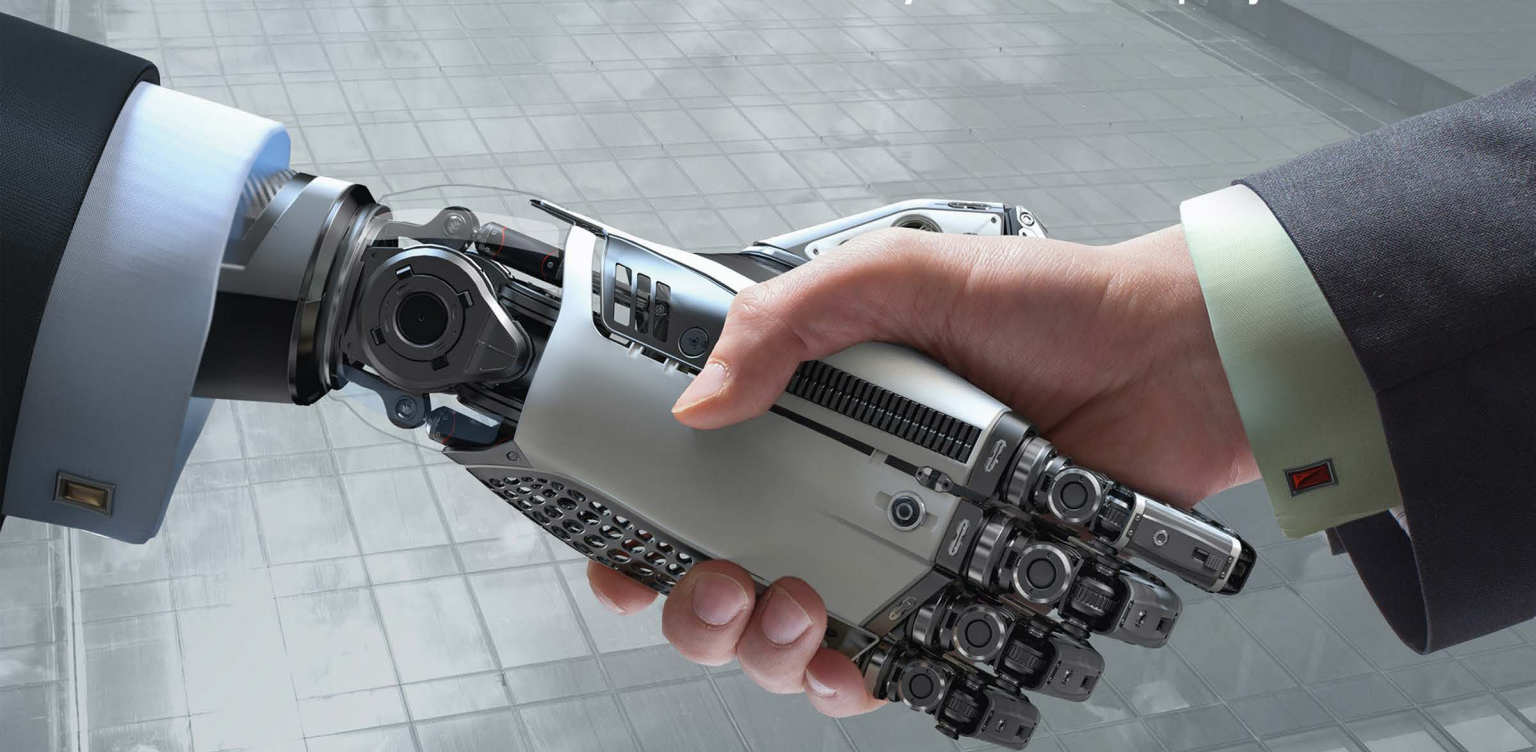


Market leader in
PCB CAM and Pre-CAM Software
Laser Photoplotters
Direct Imaging Systems
www.ucamco.com

iamcam

Intelligence Aided Manufacturing

Artificial intelligence | Next level of automation | Global web access
Fewer human errors | Faster delivery | Lower cost per job



AI automation shortens
delivery times

Free your brain resources
for complex jobs

iamcam.ucamco.com

the excuses, “But we can’t fly, but we can’t be in front of customers,” that kind of thing. And I say, “Find a way, find a way. It’s a good time to catch up on your marketing. It’s a good time to learn social media if you don’t know it. Reach out to your customers; chances are they’re all probably working out of their home as well.”

There are shortages right now. Actually, the domestic companies I work with are very busy. I mostly work with salespeople and company presidents, and I’m telling them, “Try as much as possible to keep business as usual and not get all around the axle of what’s going on in the world. We know what we can do, what we can do of obeying the rules. On the same token, if we get creative and innovative, we can get through this. And I believe in the end it’s going to be a better world. And a better economy, especially in our space.” So, that’s pretty much it. That’s the message I’m getting out there.

Johnson: In your role as a consultant, your job essentially is to provide guidance and coaching and help with direction. What sort of messages would you like to share with the industry around this issue?

Beaulieu: This is my theory: The world is flattening. As Thomas Friedman said 15 years ago, now, even more than ever, people are going where they need to go. We found out how big a part of our industry China is, for example. And what happens if China is excluded. I think what we have to understand is it’s a global economy. Frankly, I think we went too far with China. I think China is necessary, Asia is necessary, Europe is necessary, Vietnam is coming on, the world is flattening. We’re in a global economy, and this is going to drive it to that even more. And my message is to work with that. To make sure our domestic companies are able to service the domestic economy. They will probably start selling to other countries, as well, like Europe.

I think of that. I also think that we have a warning here; “We probably went too far with dependency on China,” which is kind of the

bleeding obvious. But we need to look at preserving our culture as well as our dollar. I used to say, and I’ll say it now; although we don’t sell Blu-ray players very much, but we really need a \$20 Blu-ray player, when we will pay \$60 for it, as an example. Companies were doing anything to get 3 cents off a circuit board, to the extent that it hurt our domestic business as well. Where now our defense department, it has a shortage of American circuit board companies that can build ITAR boards, that can build defense and aerospace boards. So, I think we’re going to have to be a little more careful about that once we come out of this crisis. And I think that’s really important.

I’m not saying to avoid buying from China. I think China is critical or Vietnam, or Taiwan, or India. I’m just saying we have to be in moderation on how much we do there. There are products they can do for us. There are also products that we should be doing here, and we should have done a better job of sustaining, particularly those products that can only be built in the United States. That’s the message I’m giving, particularly when I talk to company owners and presidents. And I do try to shout that out as much as I can. I’m probably ineffective to the large guys. Because the large OEMs really did this, really were the ones who put 90% of our business in China. I think they have to be careful about sustaining the American supply chain as well.

Johnson: Dan, what’s your greatest concern right now?

Beaulieu: My greatest concern is more personal, to be blunt. Let’s get that out of the way. I have a kid in Ohio and one in Connecticut. I have a 92-year-old mother, so that’s personal. And not only, of course, for their health, but for their own economy. Who knows what’s going to happen? So, that’s my greatest concern, as I’m sure everybody who’s listening to this is their greatest concern. If we want to talk about the PCB industry... Boy, I don’t want to sound rose-tinted glasses, but I think we’re going to come out of this okay. I don’t think it’s going to be forever. I don’t think it’s going to be as



COVID-19/Coronavirus Preparedness

Over this past week, the growing threat of the coronavirus (COVID-19) has become a global issue that is impacting all of our lives. The management at Freedom CAD Services would like you to know that we are taking every precaution to minimize its impact on our employees and our ability to service our customers.

All Freedom CAD employees are set up to work remotely, and we have implemented a “no business travel” policy to minimize the potential exposures of our employees to the virus. Also, we have secure network and design services processes that are NIST 800-171 compliant to support our ITAR projects via secure remote desktops. Finally, should members of our staff become impacted, we have documented risk management plans for our critical personnel that can be implemented when necessary to keep our business running seamlessly.

Our top priorities are to keep our employees safe, and our customer data secure so that we can continue to provide world-class service to our customers during this difficult time.

If you have any concerns with any of your existing projects or if you need engineering services for future projects, please contact us to let us know how we might help.

We are committed to doing our part to contain the spread of this virus and return some normalcy to all of our lives again.

Posted on March 18, 2020, by Brian White

short as the President says, but I don't think it's going to be as long as the doomsayers say.

We will come out of this. And I'm already seeing signs of people working harder. They're trying to make it work. People are cooperating better with each other. Some of my clients are calling me to meet other clients who can help them in operations—people who they didn't talk to before. I'm seeing that. I think we're going to come out of this better and so I don't have any great concerns about the business. Of course, things are tough right now. But on the same token, the clients I'm working with are doing well. They don't know how long you're going to be doing well. And, of course, if they get hit with the virus, we're all concerned about that. If you want to talk economy and all that, we're going to have some tough times, but I think we are going to come out strong.

Johnson: Thank you. Anything else you'd like to share before we wrap up?

Beaulieu: I'll say it again. Please, business as usual. I've been reading, I can't remember the name of it, but the latest book on Churchill. I wrote my column this week on that. Because it was about the worst days in England

when they were really getting bombed, and the Americans weren't in yet, it was pre-Pearl Harbor. And the hard times they were having. If you're feeling like that, and what Churchill was going through at that time, it's very similar to this these times, practically. Well, worse, bombs aren't dropping on our houses. But I'm getting a lot of insight from him. People ought to read Churchill right now and learn some of his quotes because this is where we are. I don't mean to make light of it, it's serious, but I think this will pass and we will come out stronger.

Johnson: Fantastic. Thank you for taking the time to speak with us. I have been speaking with Dan Beaulieu, President of D.B. Management Group. I appreciate your time, Dan.

Beaulieu: Oh, my pleasure, Nolan. Anytime.

Johnson: And this is Nolan Johnson with I-Connect007. Thank you for listening. **PCB007**

Audio File Available



Click here to listen.

Elvia PCB Group Is Working Non-stop to Fight COVID-19

Elvia PCB Group—the leading European manufacturer of high-reliability PCBs—has been working non-stop since the beginning of the current COVID-19 pandemic.

The health and safety of its employees is, as always, the top priority. The necessary preventative measures were implemented quickly and efficiently, and production is continuing in order to safeguard jobs and to ensure that Elvia continues to support its customers at this critical time.

Faced with the spread of the coronavirus, a consortium of four major industrial groups has committed to manufacturing 10,000 medical ventilators by mid-May.

Elvia's facility—located in Normandy, France—is making a valuable contribution to this critical project by manufacturing the PCBs—a crucial part of the medical ventilators in record time.

Elvia PCB Group President Bruno Cassin said, "Elvia is proud to be supporting this vital endeavor. We have succeeded in delivering the first batch of 500 PCBs, which were manufactured in just four working days."

Further production volumes of 1,500 PCBs are in preparation, and even larger volumes are expected.

(Source: Elvia PCB Group)





Date: March 20, 2020

RE: APCT Impact from Coronavirus (COVID-19)

To: Our Valued Customers

Many questions are starting to arise regarding the recent announcements by the State of California, business closures, and stay home orders. While these measures had already been implemented in Santa Clara County, they now have become effective statewide.

Under these mandates, APCT is deemed "essential" as a key supplier for contracts and programs rated under the United States Department of Defense DPAS System, securities, telecommunications, and other programs vital to the nation to support our national defense and infrastructure. This DPAS system is used to prioritize national defense related programs and contracts throughout the U.S. supply chain in order to support critical military, energy, homeland security, emergency preparedness, and infrastructure requirements.

APCT is taking our social responsibility seriously and has implemented reduced hours throughout all our facilities and transitioned all associates capable to working remotely from home. Our overall capacity will be impacted, but we remain at 75–80% efficiency with current conditions.

We are monitoring the status of the coronavirus with our local and national health organizations, as well as our customers and suppliers, as the situation evolves, and advisories are updated. As of today, all our facilities remain operational, and we are prepared to support your needs.

Putting our people first will always be our core value.

The health and safety of our customers and associates will always be our top priority.

Respectfully Yours,

Steve Robinson - President/CEO
APCT

APCT.com

APCT Santa Clara HQ

3495 De La Cruz Blvd.
Santa Clara, CA 95054
Phone: 408.727.6442

APCT Anaheim

250 E. Emerson Ave
Orange, CA 92865
Phone: 714.921.0860

APCT Orange County

1900 Petra Lane
Placentia, CA 92870
Phone: 714.993.0270

APCT Wallingford

340 Quinpiac St. #25
Wallingford, CT 06492
Phone: 203.269.3311

APCT Global

340 Quinpiac St. #25
Wallingford, CT 06492
Phone: 203.284.1215



COVID-19: Economic and Microelectronics Industry Impacts—**Insights** From McKinsey & Company

Feature by Michael Hall, SEMI

For five days in the latter half of March, the pall of the heavy human and economic toll COVID-19 has exacted in China appeared to be lifting. The epicenter of Wuhan reported no new coronavirus infections through domestic transmission. And in an initial step to loosen its nationwide lockdown, China began reversing restrictions on travel within its borders.

Now, in another sign of progress, the region's idled factory workforce is preparing to return to the production lines. Outside of Hubei province, home to Wuhan, most manufacturing workers are expected to be back on the job by the end of this month, with the proportion of manufacturing employees returning to work in Hubei cities except Wuhan reaching 70% by then, said Didier Chenneveau—partner, supply chain practice, McKinsey & Company—in a late-March webinar presented by the business consultancy and SEMI.

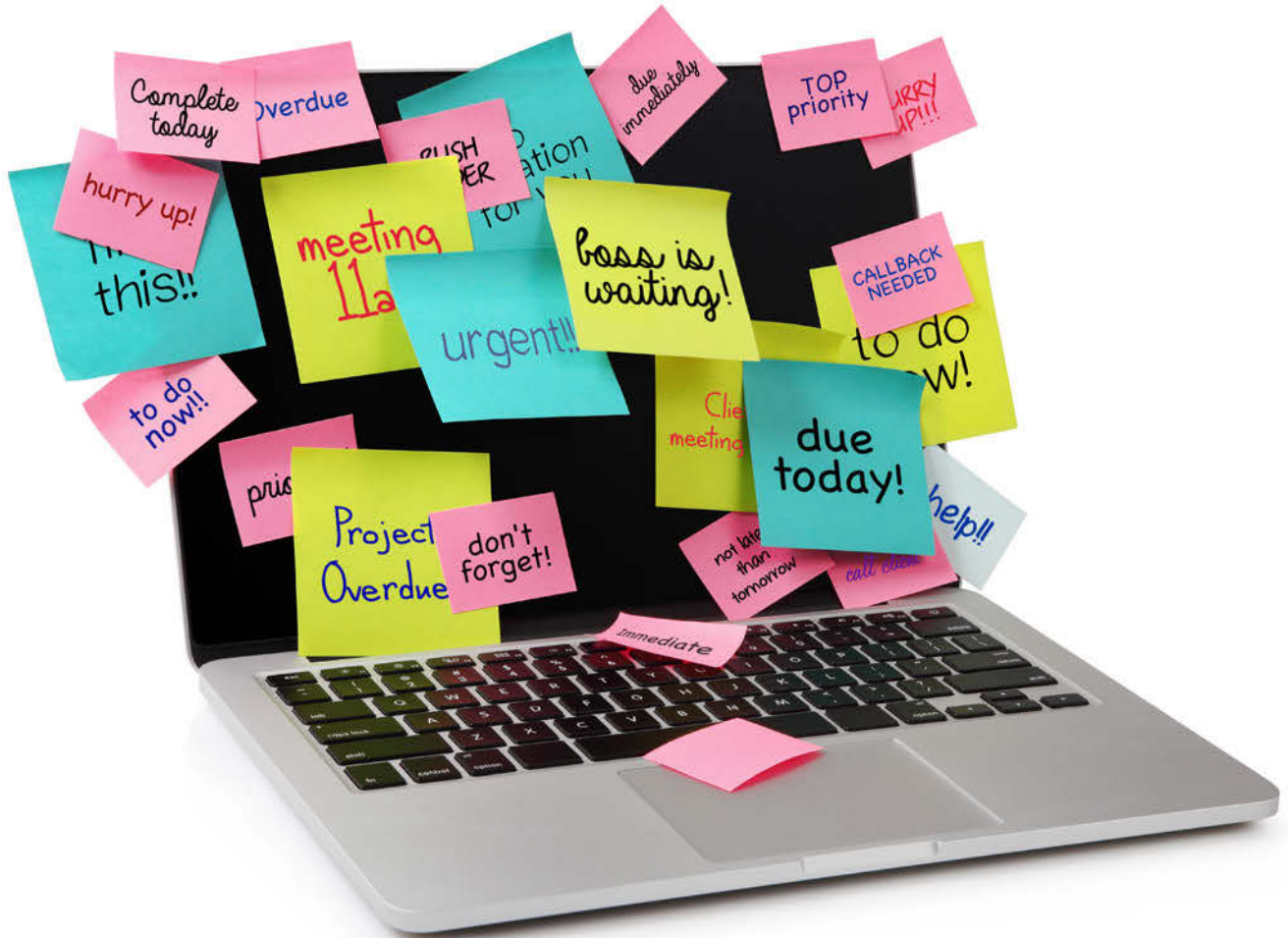
McKinsey is also “seeing evidence of a rebound in demand led by China’s online sales” as rising consumer confidence, and a surge in the popularity of work-from-home policies spur strong spending on laptop computers, Chenneveau said.

The turnaround stands in stark contrast to the unprecedented drop in demand McKinsey saw across retail and durable goods in China early in the year. Over the first two months, passenger car sales plunged 90%, smartphone receipts 40%, and retail sales 21%, leading to what Chenneveau calls a whiplash effect that could disrupt supply chains as manufacturers and shipping companies scramble to meet pent-up demand once a recovery takes hold.

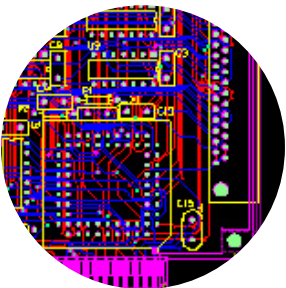
As the outlook for China’s factories and suppliers brightens, concerns are shifting to the ripple effect of its deep manufacturing pullback on demand for goods in the United States and Europe. Sharp disruptions to global supply chains caused by labor shortages and knotty logistics challenges have also become worrisome. And while China is buoyed by the prospect of normalizing its workforce and manufacturing capabilities, parts shortages are bottlenecking production.

In the United States and Europe, where 60% of air freight is carried in cargo holds of passenger aircraft, logistics concerns loom large with the widespread flight groundings. “Logistics must be a priority in any crisis war room because it’s a big challenge,” Chenneveau said.

Having trouble keeping up with front-end demand? **We have people for that.**



Here are six ways that outsourcing CAM and related front-end work can help manufacturers not only stay in business but also help them thrive:



- **Increased on-demand capacity**
- **Improved automation**
- **Faster turn-around times**
- **Reduce costs**
- **Improved quality**
- **Ability to build redundancy in critical areas**

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

Find out how we can help you >



www.entelechyglobal.com

Asia Semiconductor Supply Chain Impacts

In Asia, the semiconductor supply chain is working to overcome intractable challenges caused by COVID-19, including sourcing raw materials for chip manufacturing and maintaining assembly and test operations, Mark Patel—senior partner and semiconductor practice lead, McKinsey & Company—said at the webinar. Those problems cascade to foundries and IDMs even as they confront the compounding issue of a shortage of fabrication operators and engineers. Downstream, the inability to package, test, and qualify product risks exacerbating the supply constraints.

Patel said another acute challenge is that most semiconductor manufacturers and suppliers are operating under restricted practices, making it harder to sustain engineering activities vital to new product introductions, new process development, and capital equipment expansion. In the longer term, the supply chain fallout holds implications for product life cycles and investments in capacity and next-generation technology—factors that analysts will need to monitor in evaluating the economic impact.

Returning Workers Key to Economic Recovery

Issuing shelter-in-place orders have been an effective antidote to the spread of COVID-19, but a double-edged sword as nations worldwide sustain the economic blowback. Discretionary consumer spending on items such as automobiles has dropped by 45% globally so far this year, business investment has fallen, and trade has seen a sharp slowdown, said Sven Smit—chairman and director at the McKinsey Global Institute—speaking at the webinar.

A lockdown for as little as a month can slash aggregate global GDP by as much as 10%—a scenario McKinsey expects to play out in the second quarter of 2020. The drop would be the deepest since World War II and larger than the plunge in the first quarter of the Great Depression, raising the question of how

long governments can afford to keep workers holed up at home.

“The economic shock is unprecedented,” Smit said. “We’ve never sent people home to not work. Even in World War II, next to the front lines, people were harvesting food.”

China offers a potential blueprint for economic recovery. McKinsey estimates that China’s rigorous containment efforts could help its economy bounce back in as little as six months—a V-shaped rebound. Western nations generally have not been as forceful with their containment measures. For them, the fight against the pathogen could be prolonged, deepening the economic damage.

Yet, even with the best protective lockdowns, a new challenge arises: The longer shelter-in-place orders remain in effect to contain the spread of the virus, the longer the economic impact drags on. “Until the path to return to work becomes clearer, people will not be confident to spend,” Smit said.

Confronted with that reality, governments worldwide must strike the delicate balance between safeguarding the lives of people—critical forces of economic growth through consumer spending—and limiting the economic shock. The faster the virus can be brought to heel, the softer the impact on economies around the world. And the stronger the return-to-work protocols in place once COVID-19 has been brought under control, the faster workers can get back to their jobs.

Smit believes resolving both issues simultaneously is not only possible but necessary for a return to normalcy. “That’s the imperative of our time,” he said.

This story was originally published as a [SEMI blog](#) by Michael Hall.



Michael Hall is a marketing communications manager at SEMI.

The Printed Circuit Assembler's Guide to...™ Advanced Manufacturing in the Digital Age



by Oren Manor, Director of Business Development,
Valor Division for Mentor, A Siemens Business

Industry 4.0 has the power to drive quantifiable change in the manufacturing industry and transform how companies work, collaborate, and serve their customers; it can also create a positive, cultural shift across an organization. Written by Oren Manor of Mentor, A Siemens Business, this book explores the most important steps to consider when building a digital manufacturing company that transforms Industry 4.0 concepts into reality. This is a must-read for anyone looking for a holistic, systematic approach to leverage new and emerging technologies. The benefits are clear: fewer machine failures, reduced scrap and downtime issues, and improved throughput and productivity.

[FREE DOWNLOAD](#)[PRINT ON DEMAND](#)

“This book is a must-read for those embarking on their IIoT journey; it provides a very accurate description of preparation requirements and risks to consider and avoid, not just technologically, but also organizationally.”

— Farid Anani, VP of Operations, Computrol Inc.

ABOUT THE AUTHOR



Oren Manor serves as the director of business development for Mentor's Valor division. His responsibilities include business ownership of Valor's engineering and pre-production tools, as well as partnerships and OEM engagements. Oren brings over 15 years of experience in the sales and marketing of embedded and industry software. Previously, he was the global sales and marketing director for Jungo's embedded connectivity business unit and the VP of sales and marketing of Signature-IT, a SaaS cloud-based solution for configuring, pricing, and quoting (CPQ) of heavy-industry mechanical products.



Mentor's Oren Manor on Automation Business Adjustments

Interview by Barry Matties
I-CONNECT007

Oren Manor, director of business development at Mentor, a Siemens Business, shares an update with Barry Matties on the recent COVID-19 outbreak. Manor describes how Mentor's automation business operations have adjusted, including:

- All online automation training for customers is free-of-charge for the next 30 days
- Additional virtual support options
- More collaboration tools available to interact and troubleshoot customer installations
- Plans to accelerate cloud infrastructures

Manor also provides some projections on how manufacturing may need to adjust as the global economies come out of this time.

Manor is the author of *The Printed Circuit Assembler's Guide to... Advanced Manufacturing in the Digital Age*. Visit I-007eBooks.com to download this book and other free, educational titles.

Barry Matties: Welcome. Today, I'm speaking with Oren Manor. He's the director of business development for Mentor Siemens business. Oren, why don't you start by telling us how this virus outbreak has changed your business.

Oren Manor: Sure. Thank you for having me. Obviously, this is having a significant impact on the Mentor and Siemens business. This, of course, will probably have an effect for many years to come. We are probably only at the beginning of this change, and this will create a revolution in a lot of different aspects of our life, and one of them is also how people deploy software around factories and how they design them and implement them. We can't just change all the business models in one day, so that does have a limit. But what we have done, first of all, is to offer all of our online training free of charge. We understand that we cannot go on-site to train customers.

And since we are, we work physically with our manufacturers, and we typically do a lot of training face to face and on-site. And people like that, the training comes in five days, he builds the relationship. Of course, this is completely impossible now. And that's why we've really taken a lot of our online training, which we sell as a subscription and we're giving it at the moment 30 days free of charge for all of our customers. If they have any questions, they can get it there. If they were planning training, they could get it there. And also if the capacity has gone down a little bit and maybe they're breathing now and to have some spare time they can

5G: Higher Frequencies!

Do you have the **right** circuit materials?

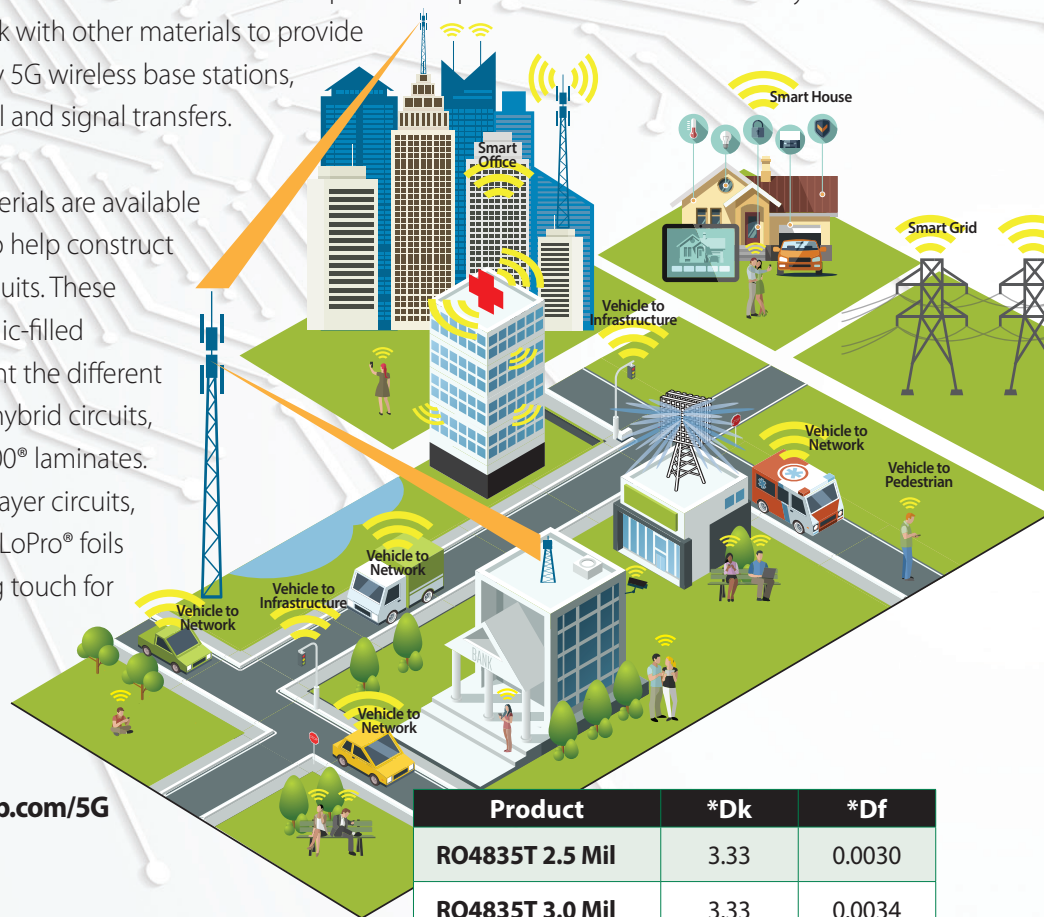
Frequencies at 28 GHz and higher are being used in Fifth Generation (5G) wireless communications networks. 5G infrastructure depends on low-loss circuit materials engineered for high frequencies, materials such as RO4835T™ laminates and RO4450T™ bonding materials from Rogers Corporation!

Rogers RO4835T spread-glass-reinforced, ceramic-filled laminates are low-loss materials in 2.5, 3.0, and 4.0 mil thicknesses. They are well suited for millimeter-wave frequencies as part of the inner cores of 5G hybrid multilayer PCBs. They can work with other materials to provide the many functions needed by 5G wireless base stations, including power, signal control and signal transfers.

Rogers RO4450T bonding materials are available in 3, 4, and 5 mil thicknesses to help construct those 5G hybrid multilayer circuits. These spread-glass-reinforced, ceramic-filled bonding materials complement the different materials that will form these hybrid circuits, including RO4835T and RO4000® laminates. And for many 5G hybrid multilayer circuits, Rogers CU4000™ and CU4000 LoPro® foils will provide a suitable finishing touch for many hybrid multilayer circuit foil lamination designs.

5G is here! Do you have the right circuit materials?

Learn more at www.rogerscorp.com/5G



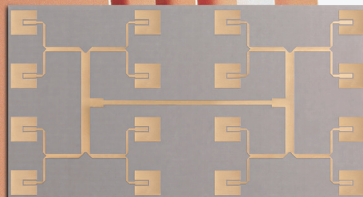
Product	*Dk	*Df
RO4835T 2.5 Mil	3.33	0.0030
RO4835T 3.0 Mil	3.33	0.0034
RO4835T 4.0 Mil	3.32	0.0036
RO4450T 3.0 Mil	3.23	0.0039
RO4450T 4.0 Mil	3.35	0.0040
RO4450T 5.0 Mil	3.28	0.0038

* IPC TM-650 2.5.5.5 Clamped Stripline at 10 GHz - 23 °C



Advanced Connectivity Solutions

USA - AZ, tel. +1 480-961-1382 • EUROPE - BELGIUM, tel. +32 9 235 3611
www.rogerscorp.com



get online and get better at using our product. And we're also giving much more virtual support. So obviously we can't send our application engineers and support engineers on-site either.

We're doing much more virtual support, and we're using different kinds of collaboration tools to try and get a common language with our customers. Because, traditionally, you would go in the shop there, and you would say, "Okay, this machine is causing the problem." Now, we can't do that. But we can create some simulation of the factory and use that as we do with that. And we've been developing products for the cloud. Everybody is; it's not a big secret. I think this is a big sign that we have to accelerate, right? If we had many more cloud platforms, we could easily support our customers now with installations, with upgrades, with modifications. The fact that a lot of this software is installed on-premise, on traditional servers and runs in factories, when these things happen, it's very challenging. I think this is going to cause us to invest even more in the very short future in bringing more and more tools to the cloud.

Matties: What message would you like to share with the customer of the industry right now?

Manor: Well, we've been talking to our customers, and there's a mix. Our customers in China always seem to be ahead of the curve, they're up and running. And they're up and running at about 80–90% capacity. We've been closing deals in the last couple of days in China even, which is completely extraordinary. There, the message is, "We're with you. We'll support you remotely, and we can't come to it now, but we'll give you all the support as you ramp up production, and you start getting everything and going, and we're going to be helping you." Some of our other customers in Germany and Italy have been much more hit by this and are down to 20–30% capacity or even closed for a week or two.

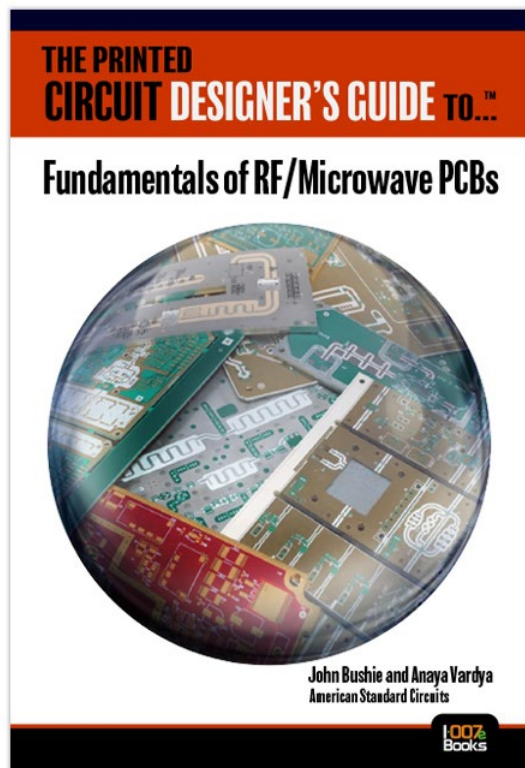
Our message is, "Stay safe, and Siemens as being a big company probably has the capacity to withstand this kind of a crisis. We'll be there for you, we'll work with you, and we'll

help you." And then we have the mixed customers where production is down to let's say 50%, and they're up from 10 lines to five lines. They have fewer people in the factory and everybody who can work remotely, they do bring the essential people in and then we're supporting them. I imagine we're going to see a big decrease in the number of new product introductions once this is over because none of us are going to run now and buy a new iPhone, right? Or none of us are going to go and change our smart television once this is over because we all understand that, you know, there is economic uncertainty. So consumers are going to probably stay a little bit behind and also companies are going to probably ramp up production of existing designs, but I don't see a lot of NPIs. But because of all of the impacts of this virus on the supply chain, we are expecting a significant shortage of components.

So, that means that if I was making my device using some capacitors, I might not be able to get them anymore, and the capacitors available might be very similar but not identical. So I expect an increase in product revision. I expect customers are going to have to do the fine tweaking and are going to have to put a lot of effort into strategic sourcing to get enough components and have to probably mix multiple suppliers and vendors in order to get to the volume that they want. This means changes in engineering and bringing these revisions to production, making the tweaks and the different program, and if you want to stay with the same level of quality, that does require some effort. And we have the engineering tools; we have specific wizards that were being developed for this type of new product revision to make it very smooth and not have to create the full NPI cycle because you've just switched a couple of components and might have made a couple of changes in order to accommodate that.

I also believe we're going to see our customers have to go for higher mix because again, if I was going to make 10,000 of these products, but I simply can't get the components, then I'm going to have to make a batch of 2,000 or 5,000, and I'll make a batch today and a batch in 10 days when I do get the components. Even

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



by John Bushie and Anaya Vardya, American Standard Circuits

Today's designers are challenged more than ever with the task of finding the optimal balance between cost and performance when designing radiofrequency (RF)/microwave PCBs. Written by John Bushie, director of technology at American Standard Circuits, and Anaya Vardya, president and CEO, this micro eBook provides information needed to understand the unique challenges of RF PCBs. The authors answer two main questions: what is the correct material to use for a particular project, and what can be done at the design stage to make a product more manufacturable? Readers, especially RF PCB designers, will gain a better understanding of issues related to the design and manufacture of RF/microwave devices from a PCB fabricator perspective.

[FREE DOWNLOAD](#)[PRINT ON DEMAND](#)

“The definitive guide to navigating the unique challenges one faces when fabricating RF PCBs.”

— Mike Carano, VP of technology and business development, RBP Chemical Technology

ABOUT THE AUTHOR



John Bushie has over 20 years of experience in the PCB industry, with an extensive background in problem-solving and process engineering. It is this close relationship with customers that drives his passion for new product design and DFM.



Anaya Vardya with over 33 years of experience in global electronics manufacturing and over a decade of executive management experience, the president CEO of American Standard Circuits has a vast understanding of every aspect of PCB manufacturing operations, including quality control and supply chain management.

our customers in the industry, which has been more on the high-mix, low-volume, high-mix, mid-volume are probably going to have to go into, and they're going to have to go into lower volumes, and more mix, which means again changeovers and that is always a hard transition for anybody to go from low-mix, high-volume to do a production with more changes. And if you want to keep the process intact and you want to make sure that the quality isn't impacted, you have to deploy smart manufacturing solution, stuff around Industry 4.0 so we're going to work with our customers who want to do that to do more digitalization of the shop floor, and we'll probably have an opportunity to engage with additional customers who until today didn't really have the need and who would work with us.

It's probably not going to be an issue about capacity. I don't see capacity as such a big impact that for the first time as we come out of these lockdowns, but it's going to be an issue of how you're more agile, you can mix production and stuff like that. I think this type of epidemic has shown us that you have to be agile, and you have to be able to move production around because just as China was going into lockdown, you wanted to move all the production away, maybe initially to Southeast Asia. Then as the coronavirus approached Malaysia, Thailand, you probably wanted to move it to Europe. Now, suddenly, you can't really manufacture in Western Europe, so you want to move it quickly back to China. But we know that even if you tried to, production environments are never identical.

And so you need digitalization tools which allow you to quickly move these products between the factories. I mean, I think our customers in the industry have to understand that these types of things can happen. And if you have five factories globally, you can probably continue capacity quite well if you have the ability to move the products between the different factories in a very efficient way. If you don't have to repeat the NPI cycle, then you don't need to contact personally the different people because they might not be available for the first couple of days as they're migrating from working in the office to working at home and stocking up on supplies, and stuff like that. I think we all have to understand that we need to deploy these types of digitalization solutions because we need to be more agile and be able to move the production globally as these things kind of transition through the different countries and different continents.

Matties: Oren, we certainly appreciate your insight and your time today, and we'll look forward to some future updates. Thank you very much for spending your time with us today.

Manor: Thank you. PCB007



Zero Defects International and Skyla Providing Uninterrupted Cam Services

Zero Defects International [ZDI] and its strategic partner, Skyla, announced measures taken to maintain and, as necessary, increase their PCB front-end engineering CAM service capabilities in response to demand from their North American customer base. Due to shelter in place restrictions, many companies are in need of extra CAM capacity to fulfill the demand for defense, aerospace, and medical products. Accordingly, ZDI/Skyla will continue to provide services with nor-

mal response times and at high levels of quality.

In California, ZDI has configured operations to safely protect employees as well as all customers to which services are provided remotely as usual. In Erode, India Skyla has also reconfigured its operations to be in compliance with India's comprehensive business and social shut-down requirements. Importantly, all data security protocols remain solidly in place.



March 16, 2020

atg Luther & Maelzer Continuity of Supply Update During COVID-19 Epidemic

Dear Valued Business Partner,

We appreciate the trust you put in our people when doing business with atg Luther & Maelzer. We certainly hope this message finds you, your loved ones, and your colleagues all well and safe.

Due to the global increase in the COVID-19 outbreak, it is important to safeguard the well-being of our partners—employees, customers, and vendors alike. We are also taking prudent steps to continue to provide the highest level of service and maintain proper business relationships with our customers and vendors.

atg Luther & Maelzer's manufacturing and development facilities and field offices remain open worldwide and supporting customers. We are taking measures to safeguard the continuity of supply of goods and services and ask for your understanding in working with us to minimize future disruption:

- We are restricting visitors to atg Luther & Maelzer facilities and enforcing the use of virtual meetings.
- We are asking our employees, including all who interact with customers, to take appropriate preventive hygiene and health measures.
- We are encouraging any employees who do not feel well to stay home and avoid interacting with customers and colleagues.
- We have increased the cleaning and sanitizing of all company facilities.
- While continuing to support our customers' operations regionally with localized field service and applications engineering, we are restricting international employee travel and most domestic travel and prohibiting any travel to those locations identified as having widespread, sustained transmission—CDC Level 3.
- To reduce possible work-related exposure and health risk, our operations have implemented a combination of staggered shifts and telecommuting that increases the "social distancing" of our workforce and provides for better functional redundancies.
- We are working with and closely monitoring our supply chain to ensure adequate levels of materials in the event of a disruption.

Other measures have been implemented to safeguard our employees and maintain business continuity, and as always, we will comply with local government regulations and our partners' specific access restrictions. Your atg Luther & Maelzer sales, field service, applications engineering, and supply chain management contacts remain available to answer any questions.

In summary, we are taking all reasonable steps globally with the goal of preserving our manufacturing and support capabilities for our customers. On behalf of atg Luther & Maelzer employees, we thank you for your partnership, and we are standing by to continue supporting your business needs.

Sincerely,

Jochen Kleinertz
General Manager
atg Luther & Maelzer Group

atg Luther & Maelzer GmbH
Zum Schlag 3
97877 Wertheim
Germany

Sitz Wertheim, Armstgericht Mannheim HRB 705702
Geschäftsführer Dr. Jochen Kleinertz, Ian von Fellenberg

Phone: +49 9342 291-0
www.atg-LM.com | www.cohu.com

ein Electronics Industry News and Market Highlights



COVID-19 To Have Significant Effect on Semiconductor Market According to IDC ►

IDC report analyzes a range of critical factors that will affect the semiconductor market this year and presents the most likely scenario to help clients navigate this emergency.

Rolls-Royce Launches New Electronics Manufacturing Capability at Purdue to Support U.S. Defense Engines ►

Rolls-Royce has created a new engine control capability near the campus of Purdue University to support its U.S. defense business, including the F130 engine competing for the U.S. Air Force B-52 program.

Memory Cards for Data Protection ►

Where data storage solutions are required for industrial applications, the key selection criteria must include robustness, durability, fail-safety, and long-term availability of the flash storage media. Noteworthy too: demanding security requirements can be addressed with special versions that feature WORM (write-once-read-multiple) or cryptography functionality.

TrendForce Presents Latest Analysis of COVID-19 Pandemic's Impact on Global High-tech Industries ►

As the COVID-19 pandemic continues to accelerate and cause damage to the global economy and consumers' purchasing power, TrendForce has compiled its latest report on the statuses of key electronics component and downstream industries, with data last updated on March 26, 2020.

Successful Launch for Airbus' Bartolomeo ►

The Airbus-built Bartolomeo platform has been successfully launched on March 6 from Cape

Canaveral, Florida, U.S. Bartolomeo is now on its journey to the International Space Station and will be installed outside of the Columbus Laboratory, the European module of the ISS built by Airbus.

Tecore Networks to Rip and Replace Huawei and ZTE Infrastructure in the U.S. ►

Tecore Networks, a U.S.-based manufacturer and global supplier of innovative mobile network infrastructure, applauds President Trump in signing into law the Secure and Trusted Telecommunication Network Act.

Robotic Process Automation Market Size to Witness a CAGR Growth of 33% During 2019 to 2029, Opines Fact.MR ►

Organizations worldwide are identifying processes that can be automated. This is in response to the increase in productivity and efficient use of resources that robotic process automation offers.

WAGO Products Join Amazon Web Services Partner Device Catalog and IoT Greengrass ►

WAGO is pleased to announce that their Touch Panel 600 and Generation 2 PFC200 have been listed as part of Amazon Web Services (AWS) Partner Device Catalog for AWS IoT Greengrass 1.10.0.

L3Harris Technologies Introduces New Reflector Antenna Tailored for Smallsat Missions ►

L3Harris Technologies has introduced a new small satellite reflector antenna that will help decrease the size, weight, and overall time to produce smallsats.



Ucamco Remains at Your Service

Dear and valued customer,

Following the measures taken by increasingly more governments, we confirm that Ucamco remains fully operational, even during these difficult times.

We have numerous possibilities to ensure the continued service for all software-related affairs via remote assistance (e.g., TeamViewer). Your trusted contacts are available for all your questions and support.

Our photoplotters, direct imaging, and AOI operations remain ongoing as well. Your contacts at Ucamco are at your service, as always, to offer both telephone support and remote support. We also remain available to ship out spare parts.

Possible interventions at your plant can take place to the extent possible if they can happen safely and within the restrictions imposed by your and our governments. The safety and health of both our employees and our customers is a top priority for Ucamco and will be taken into account in every decision we make.

No matter the circumstances, Ucamco prides itself on finding solutions to every issue—small or large. We encourage all our stakeholders to think positive and do the same. Together, we will get through this.

Stay healthy,

Ucamco



Matt Stevenson on Sunstone Circuits' Current Operations

Interview by Nolan Johnson
I-CONNECT007

Nolan Johnson speaks with Matt Stevenson, VP of marketing at Sunstone Circuits, who shares an update on the company's current level of business operations under COVID-19 restrictions.

Stevenson confirms that Sunstone Circuits is classified as an essential function industry and provides a run-down of the HR policies and company culture changes to comply with social distancing and cleaning. The company continues to be open, available, and responsive to customers' potentially changing needs.

Nolan Johnson: Hi. Nolan Johnson here for I-Connect007. I'm talking this afternoon with Matt Stevenson, director of marketing for Sunstone Circuits, to talk about what's going on with the impact of the COVID-19 outbreak and how Sunstone Circuits is reacting to all of the changing situations. Matt, thanks for joining me.

Matt Stevenson: Good to be here, Nolan. Thanks for the invite.

Johnson: As always, you're welcome. Let's just start off with how the recently issued government orders for virus containment have affect-

ed you and your business. As we're having this conversation, Oregon Governor Kate Brown has just issued an executive order doing a stay at home order, effectively, and shutting down non-essential businesses. How do you see that affecting you in Sunstone right now?

Stevenson: Well, luckily, we've had about a week or so to kind of get ready for this announcement. It was just a matter of time when Kate Brown was going to make that announcement. So over that week, we've been able to draft the two plans and learn from some of our key customers and key partners that we are in their supply chain as an essential part of their supply chain, some of our military customers, medical customers, et cetera. And as a result, we are actually classified as an essential business.

So that being said, Sunstone will be operating its manufacturing facility as per normal, as best as possible. Obviously, our employee health and our employee welfare being paramount among those. As long as we're able to keep our employees healthy and unimpacted from the coronavirus, we will continue to operate our manufacturing facility as per normal. We will be taking a lot of our support-type

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@feinonline.com



www.feinonline.com

functions, customer support, marketing, etc., and probably running a lot of those remotely from home just to keep as many people out of harm's way and potential exposure risk as possible. And we've had to really up our cleaning and social distancing practices over the last several weeks, mandating some cleaning schedules and some of the other things that are kind of requisite.

We had to make a really big push that if you're sick, stay home. Sunstone has not always enforced that rule quite so predominantly. But now, anybody that's showing any signs of illness is required to stay at home. We also have implemented some other social distancing type things. We're no longer holding meetings. We've done a lot more video conferencing. We actually had our first two interviews via video last week for an important hire that we have coming up. So, we're trying to do all the right things to keep our employees healthy and operate our business without too many negative impacts on it.

So, we're trying to do all the right things to keep our employees healthy and operate our business without too many negative impacts on it.

Johnson: I'm just curious, Matt, where are you right now? Are you in the office, or are you working from home?

Stevenson: I am in the office. Most of our executive team has been out with illness or travel plans. So, as one of the senior members of the team, having an in-person resource is kind of the role that I've been filling over the last couple of weeks.

Johnson: You're holding down the fort.

Stevenson: Exactly. With spring break coming, we have a vacation planned too, but we had to cancel our trip; however, we'll still be around.

Johnson: Well, that just sets up the next question for you. What is the message, what are the updates that you are giving your customers right now with all of this dynamic business environment?

Stevenson: So, we are trying to portray to our customers that we are still open, that we are here to do any business that you may need. We're really flexible in terms of requirements and cut-off times. We're trying to really work with our customers to help meet them where they need us, but we're also giving them the message that we're really concentrating on trying to keep our employees healthy, that we're doing all the right things out there to ensure that our employees, which is our number one asset, are healthy and aren't impacted by this pandemic.

Johnson: Sure. And that's the most critical part. Is there any other message that you'd like to make sure that you share with the industry or colleagues in manufacturing?

Stevenson: It's really just the humanistic aspect of it, that a lot of printed circuit board manufacturers, we all consider ourselves competitors most of the time. During this time, it really humanizes everything, that when we come out of this, we all still want to have the same competitors. We don't want this type of reason to be why some of our competitors are no longer competitive in the business. We want to make sure that everybody gets through this okay and that we're all able to continue on with our business and our competition when we get through it. So, do whatever's necessary to keep your employees and your business safe.

Johnson: Good. Matt, as we have this talk right now and in the process of all of this, what's your greatest concern?

Stevenson: Obviously, the health of my family and the employees at Sunstone is really the

HE HELPS YOU MIND
YOUR **STANDARDS.**



**Introducing the IPC Certified Standards Expert—
the know-it-all your business needs.**

When it comes to ensuring consistent quality and reliability, IPC standards are the backbone of the electronics manufacturing industry. With Certified Standards Experts (CSEs) on your team, you'll have in-house subject matter experts on specific IPC standards who can navigate the ins-and-outs of those standards quickly and efficiently. They draw upon the same knowledge as Certified IPC Trainers (CITs) but are not required to train. Your CSEs will be the know-it-all go-tos for questions, issues, updates and best practices on standards specific to your organization.

**Change your standards operating procedure—learn more about the
CSE program at ipc.org/cse.**



thing that keeps me up at night. Are we doing all the right things? Even though we're an essential supplier, is that in the best interest of our people and our employees and all of their families to continue manufacturing? I think it is. It helps keep people's brains active. And obviously, the financial impacts of not working for a lot of people outweigh the potential health risks. But just, are we doing enough as a business leader, to ensure that all 120 of our employees and their families are going to get through this healthy and happy and alive?

Johnson: Great. Matt, thank you for taking the time to talk.

Stevenson: You're welcome. It's a very top of mind topic, and this is one that is near and dear to all of us, I'm sure, throughout the whole entire country and any perspective that I can give you, I'd be happy to.

Johnson: Thanks for that. I appreciate it. **PCB007**

Audio File Available



Click here to listen.

Cirexx Ordered to Remain Open During COVID-19 Crisis

Cirexx International announced that despite a California lockdown order, the company was notified by several defense contractors and the Department of Defense that they need to remain open and operational during the COVID-19 crisis due to the number of DPAS DX and DO rated orders and critical medical components orders for the electronic health care industry. Workers not directly related to printed wiring board manufacturing are working from home, but the Cirexx production operation is at nearly 100%.

Philipp Menges, Cirexx President and CEO released the following statement:

During this time of uncertainty as our country grapples with the COVID-19 virus situation, I want to reach out to you and ensure you that Cirexx International is committed to the continued support of requirements that relate to our National Security and National Health infrastructure for the benefit of our country and our customers.

Over the past several weeks, we have quickly adopted significant strategic measures specifically designed to address this crisis. As a result, Cirexx currently has the resources necessary—a strong-tenured and available staff, the highest technology equipment, and an ample supply of raw materials—for the smooth continuity for our production efforts. We have custom-

er service personnel available to discuss every aspect of your printed wiring board quotes and orders. Cirexx is also working very closely with its supply chain to assure uninterrupted service of all necessary raw materials and consumables necessary for our operation.

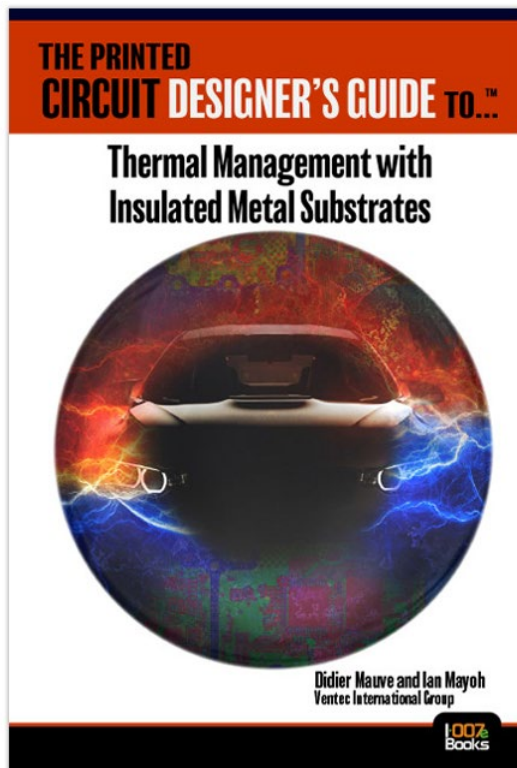
My staff stands prepared to assist you with any aspects of your PWB requirements and ensure that you get the full force of the Cirexx advantage to meet your needs. I am confident in their abilities, and our collective will to support your programs. Please feel free to contact me concerning any issue related to this situation. Thank you for your time and interest in Cirexx International.

We are specifically well stocked with a significant number of "exotic" and hard to obtain raw materials, including rigid and flexible dielectric/copper combinations from manufacturers such as Rogers, Dupont, Isola, Panasonic, and Arlon. These materials allow us to meet most, if not all, of the critical existing and new requirements that are necessary during this crisis in a quickturn mode.

Customers can contact their salesperson for updates on production status or for new item quotations and evaluations or visit cirexx.com.

(Source: Cirexx)

The Printed Circuit Designer's Guide to...™ Thermal Management With Insulated Metal Substrates



by Didier Mauve and Ian Mayoh, Ventec International Group

Considering thermal issues in the earliest stages of the design process is critical. Written by Didier Mauve, sales and marketing manager at Ventec International Group, and Ian Mayoh, technical support manager, this book highlights the need to dissipate heat from electronic devices. The authors provide essential information required to understand the thermal, electrical, and mechanical characteristics of insulated metal substrate laminates. The book also aims to aid PCB designers in the selection and specification of materials for particular applications, which will contribute to more reliable and cost-effective designs. Readers will develop a comprehensive awareness of the physical realities of insulated metal substrates and their applications in the thermal management of electronic assemblies.

[FREE DOWNLOAD](#)[PRINT ON DEMAND](#)

“A comprehensive tour through the world of thermal management. Required reading for designers and end-users wishing to understand the science and practice of using insulated metal substrate materials.”

— Alun Morgan, Chairman, EIPC

ABOUT THE AUTHOR



Didier Mauve joined Ventec in 2015 to strategically drive European sales. His many years of expertise and interest in thermal management has been instrumental in helping Ventec become a global leader for high-tech and high-reliability materials.



Ian Mayoh joined Ventec in 2011 as technical support manager covering the European, Middle Eastern, and North African markets. He is a key member of the global technical team with direct support from Ventec International Group's headquarters in Suzhou and a Fellow of the U.K.'s Institute of Circuit Technology.



*International
Electronic
Components*

To our valued customers,

We first want to say thank you for your continued business and support. All of us at IEC, Eternal, Kodak, RBP, and Rogers want you to know that we are here to continue servicing and supplying you with our products. With the acceleration of COVID-19, we thought it best to provide you with an update of our manufacturing and supply chain status.

IEC

At this point, our Northern California, Chicago, and Canadian operations remain open and fully operational. We are working with our third-party warehouses, and they too remain open and have been deemed essential.

At present, we are not experiencing any direct impacts from our materials suppliers. However, the current situation is both complex and dynamic, and we remain in frequent communication with our direct suppliers located here and abroad to ensure the delivery of materials as planned.

Regards,
Shawn Stone
Chuck Williams

Eternal

Our Richmond plant remains fully operational. 95% of all dry-film supplied to North American customers comes from this location. We supply a small amount of film from Japan and Taiwan along with some raw materials. To date, none of these sites or supply chains have been disrupted. Further updates include the following:

- The state of Virginia has shut down “non-essential business,” but our manufacturing plant is exempt. We are also a critical supplier to electronics, medical devices, and the military, and we will continue to be allowed to operate as normal.
- We have no employees who, to date, have tested positive for the coronavirus.
- We are strictly following “social distancing” rules, canceling all non-essential visitors, and providing face masks and plenty of hand sanitizer throughout the plant.
- We are also working remotely and canceled all noncritical travel.

Regards,
Bob Ferguson

RBP

Our Milwaukee plant remains in full operation to service all of North America. To date, none of our suppliers or supply chain partners have been disrupted. We are in constant contact with both our suppliers and IEC, and our supply chain remains robust. Further updates include the following:

- The state of Wisconsin’s “Safer at Home” order of March 25 has shut down “non-essential business,” but our manufacturing plant is exempt. We maintain critical supplier status as we serve the electronic, medical device, graphic arts, and military industries, and we will continue to operate as normal.
- We are strictly following “social distancing” rules, canceling all non-essential visitors, and providing face masks, hand sanitizers, and appropriate controls throughout our operation.
- To date, no employees have tested positive for the coronavirus.

Most of our administrative staff are working remotely, and we have canceled all travel unless deemed absolutely critical.

Regards,
Ernie Litynski



Kodak

New York State ordered all non-essential businesses in the state to close effective 8:00 p.m. on March 22. We received the following exception: "Thank you for seeking designation as an "essential business" pursuant to the New York State Executive Order 202.6. Based on the information you have provided, your business enterprise is an essential business, and your business location is not subject to the required 100% workforce reduction pursuant to Executive Order 202.6."

- All facets of PCB film manufacturing are in Rochester, New York, and remain at 100% capacity.
- We are doing everything to minimize the number of people on the site and conduct best practices regarding cleanliness and social distancing.
- All non-essential travel has been canceled.
- We are taking steps to allow only essential visitors to enter Kodak buildings.

We continue to monitor the coronavirus situation and take steps guided by recommendations from official resources, such as the World Health Organization, the U.S. Centers for Disease Control and Prevention, and local medical professionals.

Regards,
Tom Brennan

Rogers

Rogers' first priority is always the health and safety of our employees. With the continued acceleration of COVID-19, this commitment has never been more important to us.

As of March 24, all factories continue to operate with the additional safety precautions that have been put in place. Please see the following for updates regarding the most frequently requested information.

Employee Safety and Well-Being

- Our pandemic site teams and the global pandemic leadership team continue to meet daily, collaborating to prioritize employee safety.
- We are offering additional flexibility in our attendance policy and providing monetary support for employees to care for primary dependents, including childcare coverage.
- All out-of-pocket costs will be waived for the COVID-19 test and associated office visits.

Manufacturing

- We are following evolving government safety regulations in the global regions where we operate our manufacturing facilities.
- Operations are being managed as needed to ensure compliance with local guidelines.
- We are continuing to update and implement our contingency plans daily to respond to the developing situation.

Supply Chain

- The majority of our suppliers are operating their manufacturing facilities with required precautions and no major delays.
- Currently, there are no known material shortages.
- Extended lead-times in transportation continue due to capacity constraints and local government restrictions.

Rogers' Global operations and supply chain infrastructure provide a level of flexibility that we are leveraging during this time to minimize any negative impact on you, our valued customers. We appreciate your ongoing support and wish you well as we all navigate through this uncertainty.

Regards,
Mark Burns

EMA President Manny Marcano: Software Tools Are Essential

Interview by Andy Shaughnessy
I-CONNECT007



Andy Shaughnessy speaks with Manny Marcano, president of EMA EDA Automation, who shares an update on the company's current level of business operations under COVID-19 restrictions.

Marcano explains that EMA is classified as an essential business due to its work with the defense segment and that employees are now working from home. He also discusses the company's free work-from-home license offer and why he is available to help any designers or design engineers who have questions during these changing times.

Andy Shaughnessy: This is Andy Shaughnessy for I-Connect007. I'm speaking with Manny Marcano, the president of EMA Design Automation. Welcome, Manny.

Manny Marcano: Good afternoon from bright and sunny Rochester, New York.

Shaughnessy: That ties in with what we're talking about here. You're based in New York, which has some of the more restrictive COVID-19 regulations in the country. Why don't you start off by telling us a little bit about how have the COVID-19 restrictions affected your company and your business model?

Marcano: What we decided to do was, first of all, send everybody home. We are considered an essential business by the government because of who we support in the milaero community. Most of my folks are doing fine at home, and they're actually more productive than here. I may close down some of the office space.

Shaughnessy: Right!

Marcano: I'm just kidding. It's an interesting situation because obviously, we want to protect our staff. But with the commitment and the productivity that I've seen just in 10 days now, the team is working harder than in the office, and I have absolute faith that they'll continue the productivity.

Shaughnessy: That seems to be the thing. We talked to a lot of people who are not used to working from home, but they're finding out that they're getting at least as much done at home. What message would you like to send to your customers?

Marcano: As far as the message to my customers, it's business as usual to the best of our ability. I'm really pleased to say that because

DRY-FILM PROCESS YIELDS GOT YOU FEELING DOWN?



**Time to try Eternal's latest generation
dry-film photoresist - quality and precision
to pick you up... and your yields too.**

**IMPROVED ADHESION / FINER LINE
RESOLUTION / GREATER CONFORMANCE**



Eternal Technology Corporation
1800 Touchstone Road
Colonial Heights, VA 23834 U.S.A
TEL: +1-804-524-8555
<https://www.eternal-group.com>
bob.ferguson@eternal-us.com



*International
Electronic
Components*

International Electronic Components Inc.
809 Aldo Avenue, Unit 104
Santa Clara, CA 95054 U.S.A.
TEL: +1-855-225-9333
<https://www.ieccan.com>
chuck.williams@iecus.com

of the offer I made to our customers for free licensing. We had well over 250 customers request a license, and they are productive at home because of our ability to execute. I just want to make sure that everybody knows that whatever else they need from EMA, we're here to support you.

Shaughnessy: Do you have any other message you'd like to share with vendors, suppliers, or anybody else in the industry?

Marcano: The biggest message I can offer is we'll do whatever we can do within reason to help keep other people in business. As you're well aware, we've been a business for 30 years. There's been numerous ups and downs, and it's my customers that are my job security. I can help them get through this mess, and I'm sure that they'll remember and take care of us down the road.

The biggest message I can offer is we'll do whatever we can do within reason to help keep other people in business.

Shaughnessy: If you look out here, what would you say is your greatest concern right now?

Marcano: The greatest concern is that this is going to continue for a long time and destroy our economy. In general, from a macro perspective—and, obviously, from a personal perspective—it's going to impact cash flow. We're in a fortunate position that we have critical mass, and we can sustain ourselves and take care of our employees. The longer-term—anything over 90–120 days—is going to be pretty painful for everybody.

Shaughnessy: I think a lot of people would share that feeling. Is there anything else that you'd like to share with the industry?

Marcano: As an undying optimist, I'm absolutely convinced that this too shall pass, and we will come out of it stronger; we'll thrive once this is resolved. Not only will EMA be stronger, but the economy will be stronger, and these things happen. It's a cycle, and we will certainly come out of it eventually.

Shaughnessy: That's what I'm thinking. When this does end, it's going to be a rocket. I can't even imagine what the industry is going to do when this is all over. It's going to be positive.

Marcano: Absolutely. From somebody in my position, we do the best we can in these circumstances so that our customers can stay in business and our customers and engineers can continue being productive so that they can get their products to market. An interesting aspect is that there are lots of industries, especially medical, where new products will be innovated. There will be all sorts of interesting things that come out of this. Like in any tragedy, there will be good to come from it. We will all survive.

What else I can offer the industry is this: My offer was to work with customers, but certainly if there's any design engineer who's in pain that we can help with a free license at home, feel free to communicate with EMA or me personally, and we'll do whatever we can for any engineer—whether they're a current customer or not.

Shaughnessy: Very good, Manny. I appreciate your time.

Marcano: Thank you. PCB007

Audio File Available



Click here to listen.



True  Smart Factory Solutions,
Powered by AI



March 05, 2020

Subject: Proactive action update to control the Coronavirus (COVID-19)

As a global company, Koh Young Technology is taking this matter seriously and continues to monitor the Novel Coronavirus (COVID-19) closely. I would like to inform each of our business partners about the measures we have implemented in response to the Coronavirus outbreak.

Our top priority is still protecting the well-being of our employees and partners, while supporting our customers as the COVID-19 situation continues to evolve. Therefore, Koh Young Technology Management Team has taken the following immediate actions to establish a business continuity plan:

1. Machine deliveries will remain as scheduled. We have secured a safety stock for spare parts and machinery for production over the next three months. Our two manufacturing centers are running without any interruptions. However, should they be affected, we have established alternative manufacturing sources.
2. Company-wide remote WFH (Work from Home) program was enabled. Maintaining a minimum number of employees in the main office, while most others are working through a well-established remote access system.
3. International travel is temporarily on hold. Instead, we will leverage our video conference system to provide seamless support our customers and business partners.
4. Use our team of over 150 employees in our branch offices strategically located across the globe to deliver necessary technical support and training.
5. Social and networking events are temporarily on hold. Company dinners, group meetings, technical conferences, and trade fair exhibitions are cancelled temporarily.
6. Increase the frequency of cleaning and sterilizing the headquarters.

We continue to closely follow the relevant notices from multiple government agencies and ensure a minimal impact on our customers, as well as the employees and partners who help support us all. 'Safety First' is our utmost priority at this time.

We appreciate your continued support and valued partnership. As the situation evolves, I will keep you updated on any changes to the safety protocols. In the meantime, if you have any concerns and questions, please reach out to your local Koh Young contact or email us directly at info@kohyoung.com.

Sincerely yours,

KOHYOUNG TECHNOLOGY INC.


CEO / Kwangill KOH

KOH YOUNG TECHNOLOGY INC.

14F Halla Sigma Valley, 53 Gasandigital 2-ro, Geumcheon-gu, Seoul 08588 Korea
Tel. +82-2-6343-6000 Fax. +82-2-6343-6001 E-mail. info@kohyoung.com

Conductive Anode Filament (CAF) Formation

Trouble in Your Tank

by Michael Carano, RBP CHEMICAL TECHNOLOGY

Introduction

There are two additional concerns fabricators must understand and reconcile as the circuit technology continues on the high-density curve along with the plethora of new materials to meet the technological demands: conductive anode filament (CAF) formation and wicking.

CAF Versus Wicking

While both issues may lead to electrical failure in a PCB, there are some subtle differences worth mentioning. In addition, CAF is typically related to the resin and glass material while wicking is more process related. More about wicking in a future column.

CAF commonly occurs between adjacent vias (i.e., plated through-holes) inside a PCB, as the copper migrates along the glass/resin interface from anode to cathode. CAF failures can manifest as current leakage, intermittent electrical shorts, and even dielectric breakdown between conductors in PCBs^[1]. This often makes CAF very difficult to detect, especially when it occurs as an intermittent issue.

There are a few things that can be done to isolate the fault location and confirm CAF as a root cause of a failure. If the issue is intermittent then putting the sample of interest under combined temperature-humidity-bias (THB) may help re-create the failure mode. In addition, techniques such as cross-sectioning can be used to identify the failure^[2].

CAF is caused by the glass fiber and the dielectric resin separating from each other within the laminate material itself. This is sometimes seen as a hollow glass fiber (Figure 1) that acts as a conduit, allowing process chemistry and moisture to travel along the opening. Moisture and ionic residues can access the void and enable conductive copper filament growth along the glass fiber reinforcement, leading to shorts.

At the end of the day, there are three things required to cause CAF:

1. A pathway, such as hollow glass fibers or separation of the resin from the glass
2. Bias (applied electric field)
3. Moisture and other ions

With a pathway, as shown in Figure 1, along with moisture and ionic species from various chemical processes—such as electroless cop-

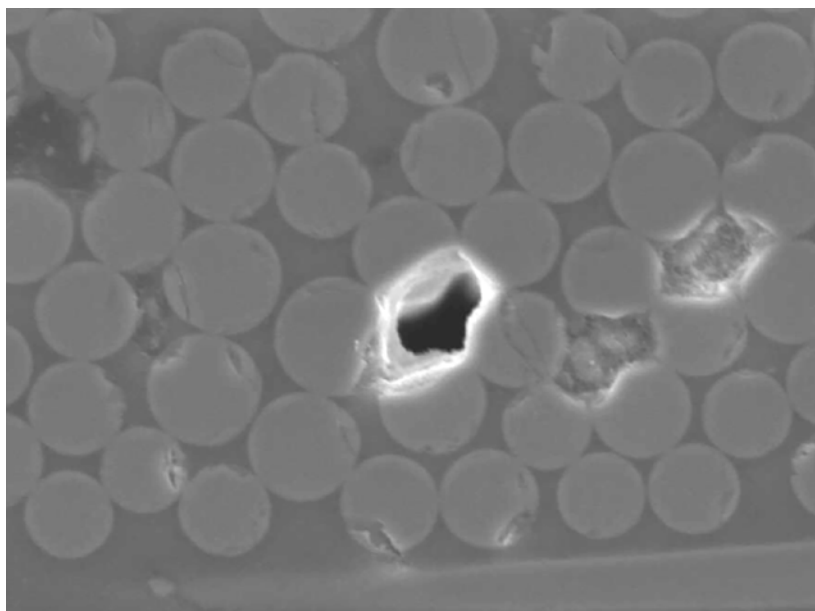


Figure 1: Hollow glass fiber.

Need better thermal management techniques?



Download now.

FREE EBOOK



100%
Books

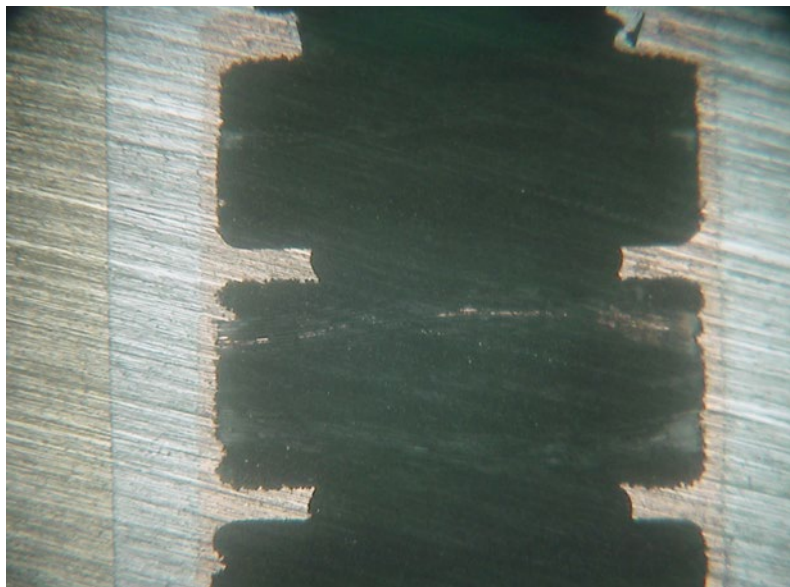


Figure 2: CAF bridging from one side of the via to an adjacent via.

per—under a bias, there will be migration of copper along this pathway. Essentially, under these conditions, an electrochemical cell is created. Corrosion products move from anode to cathode thanks in part to the pathway created by the hollow fiber.

There are several known causes attributed to separation of the fibers from the resin. Typically, the majority of these have the root cause within the laminate manufacturing process. The glass sizing used to enhance the resin's bond to the glass cloth may have been defective. In addition, resin moisture absorption and overall less than adequate resin encapsulation of the glass fabric are often to blame. From the bare board fabrication side, fracturing of the glass bundles during drilling will leave exposed fiber ends and the dreaded pathway for ions to creep along. Figure 2 shows an example of CAF bridging.

In recent years, there has been a better awareness of CAF, and the IPC-4101B standard was recently released driven by concerns of some OEMs. Individual companies, however, continue to use their own test conditions and vehicles. A number of organizations, including the HDP User Group, have published various studies on this subject. There is recognition that not all resin systems or laminate suppliers are created equal when it comes to CAF.

These studies have supported the theory that lead-free assembly and HUE (harsh use environment) contribute to CAF.

How to Prevent CAF Formation

There are several suggestions below for mitigating CAF formation:

- Better control of ionic impurities in the rinse processes during PCB fabrication (high levels of ionic impurities contribute to CAF)
- Improved glass-to-resin bond strength
- Low moisture ($< 0.3\%$) pick-up resin properties
- Improved hole formation methods and care with drilling.
- With the introduction of lead-free processing, it is necessary to select thermally robust materials, such as phenolic-cured resins. However, phenolic-cured resins are more brittle, leading to fractures at drilling, so care is needed with drill-bit selection and drill speed

As circuit densities increase and harsh use environment (HUE), as well as lead-free assembly, is used, fabricators and circuit board designers must cooperate to ensure CAF resistant materials are carefully selected. **PCB007**

References

1. IPC TM-650 2.6.25 Conductive Anodic Filament (CAF) Resistance Test: X-Y Axis.
2. C. Hillman, "A Novel Approach to Identifying and Validating Electrical Leakage in Printed Circuit Boards Through Magnetic Current Imaging," Proceedings from the 30th International Symposium for Testing and Failure Analysis, November 14-18, 2004, Worcester, Massachusetts.



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



March 18, 2020

Subject: Coronavirus – Taiyo America finished goods

Dear Valued Customer,

We have received many enquires over the past couple of days regarding Taiyo America's ability to supply finished products due to coronavirus outbreak in the United States. We are pleased to inform you that Taiyo America is at full production and building extra inventories for your solder mask, via fill and legend ink needs. We will update you if there are any major changes.

We thank you for your continued support of Taiyo America products and wish you a safe and healthy 2020.

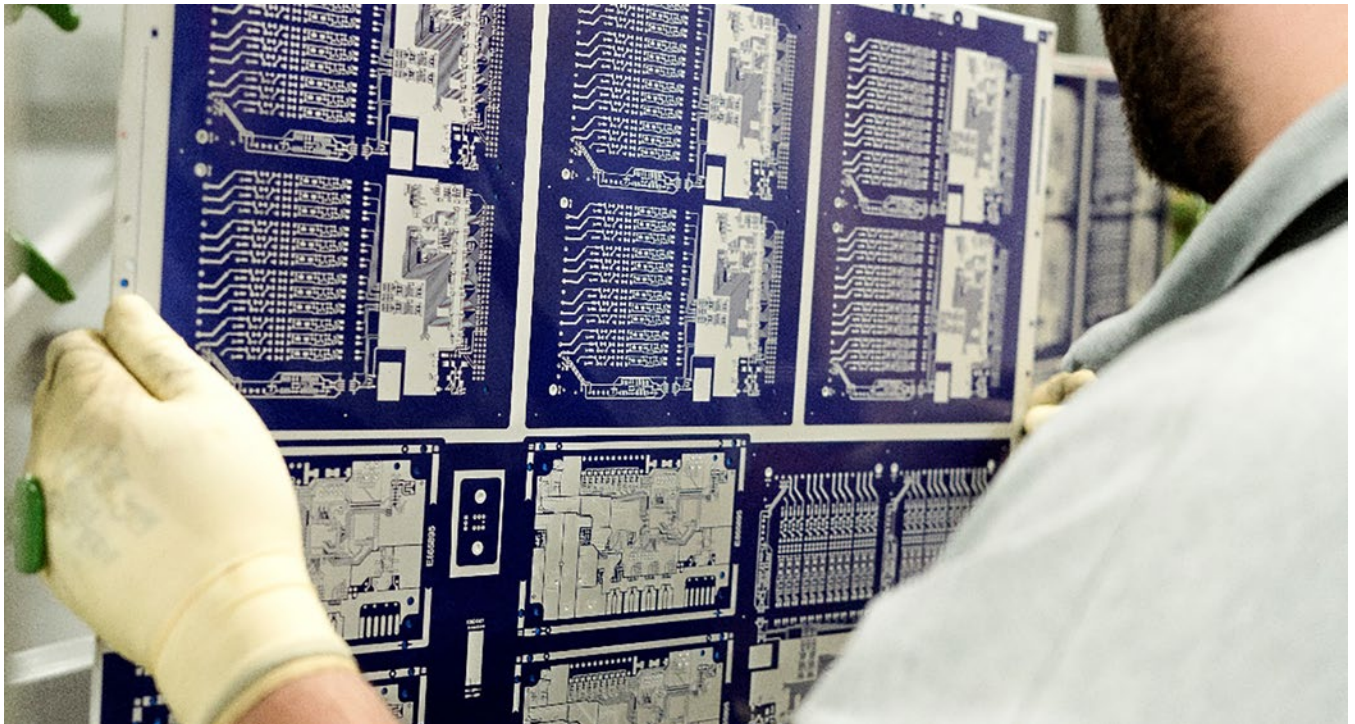
If you have any questions, please feel free to contact us.

Sincerely,

John Fix

John Fix

**Manager & Director,
Sales and Marketing**
Taiyo America, Inc.



Improving Copper Distribution in **Pattern Plating** Using Simulation Software

Article by Pete Starkey
I-CONNECT007

DFM guidelines may offer some qualitative rules about aiming for uniformity of copper distribution within a layer and maintaining symmetry in a stackup, but generally, these refer to inner-layer copper and relate to avoiding pressure differentials in the laminating press and bow-and-twist in the reflow oven.

What about the outer layers if the design is to be manufactured by pattern plating, particularly if conductor cross-sections and plated-through-hole finished diameters are critical? Does the PCB designer understand the principles of pattern electroplating? Circuit features in sparsely populated areas will take more than their nominal share of the deposited copper (Figure 1).

And what about panelisation? Is the design required to be delivered as a multiple on an as-



Figure 1: Panelisation planning starts as early as the PCB design phase.

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

sembly panel? Or is it cost-effective to manufacture only if incorporated into a multi-image production panel—whether of the same design or a mixture of designs?

From the point of view of the PCB fabricator, it is clearly bad practice to interfere with a customer's design by adding balancing copper as non-functional areas within the layout, unless this is done in consultation with the designer and formally approved before the design is signed-off.

But on a panel, balancing copper—alternatively termed “copper thieving”—may be legitimately added to the panel border and in the spaces in between individual boards in order to improve the uniformity of electroplated copper thickness distribution by effectively stealing some of the plating current that would otherwise tend to be concentrated on sparse features.

From a production standpoint, if the individual boards in a multi-image panel have an uneven copper distribution, or if two or more designs are incorporated in the panel, there could be some benefit in arranging their relative positions and orientations to improve the uniformity of electroplating. Maybe counterintuitively, the yield might be improved by putting fewer images on the panel with more space between them to allow for thieving.

Who carries the responsibility? As long as the designer has reasonable sympathy for the process engineer responsible for the pattern-plating line, it generally depends on the experience of the pre-production engineer sat at their CAM station to make a best-guess compromise with the objectives of satisfying the acceptance specification and minimising the anxieties of the quality engineer. What if the pre-production engineer could rely on the help of a software tool to eliminate the guesswork and offer a consis-

tent and repeatable solution? One less thing to worry about.

I had the opportunity to sit in on a webinar presented by Robrecht Belis, manager of the surface finishing business unit at Elsyca—a Belgian company specialising in the simulation of electrochemical processes. He demonstrated plating simulation software designed to assist the PCB pre-production engineer in identifying plating problem areas, optimising panel layout, and applying auto-intelligent copper balancing as part of the CAM process to provide a right-first-time solution for production. Although the primary objective of panelisation was to have as many PCBs as possible on the panel, there was no benefit unless every PCB was within specification for copper thickness (Figure 2).

Belis commented that a straightforward Windows laptop computer had adequate performance to run the simulation software (significant in the circumstances, as he was required to be working remotely from his office because of social-distancing regulations). In his live demonstration, he began by inputting Gerber-

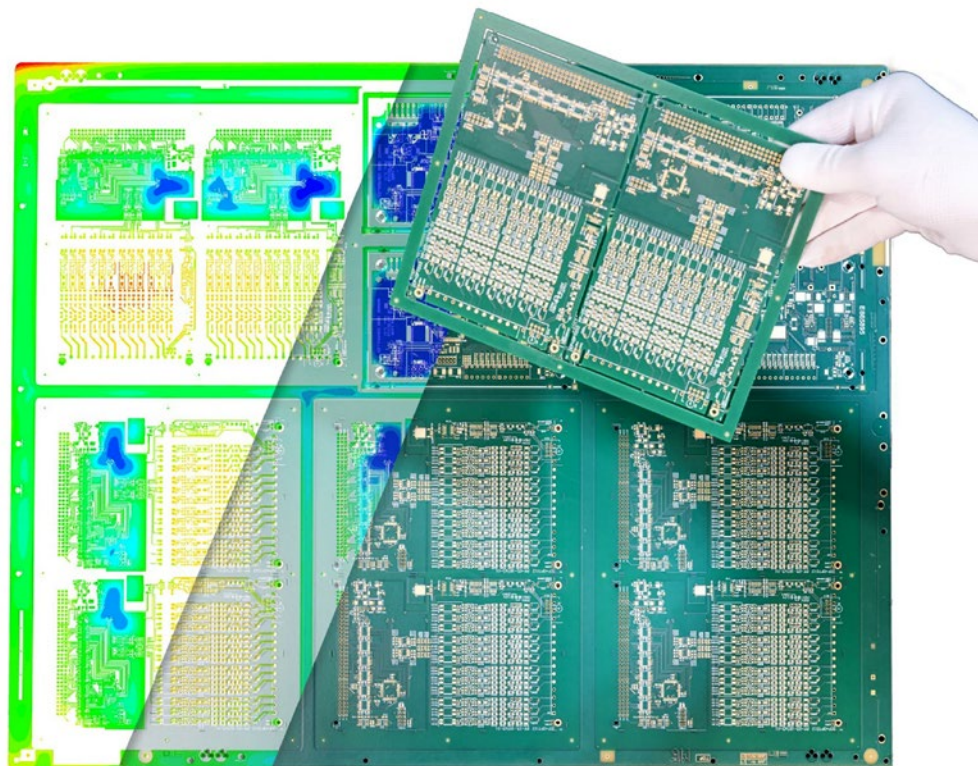
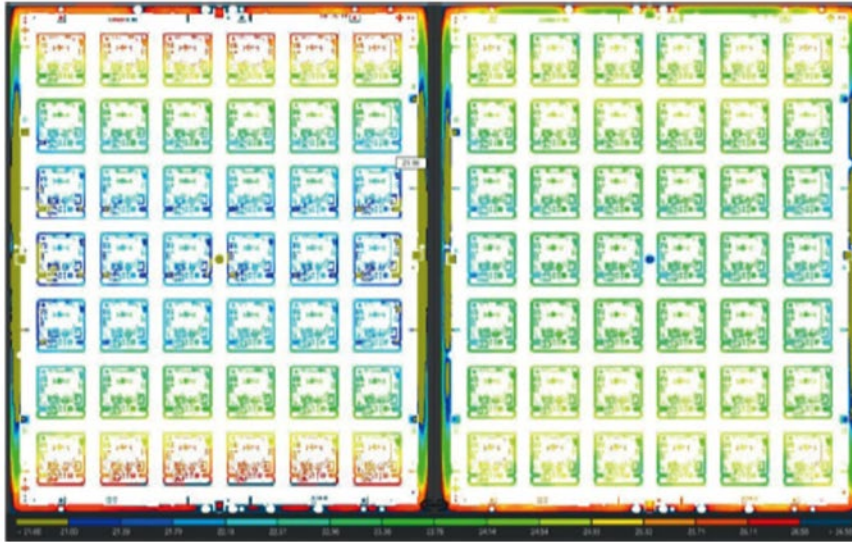


Figure 2: Elsyca's software is designed to assist the PCB pre-production engineer in identifying plating problem areas.

Active copper fraction of a PCB panel, imported in Elsyca PCBBalance from a Gerber file.



Total active copper fraction of PCB panel (including the copper balancing layer), ready for export from Elsyca PCBBalance into a Gerber file.



Figure 3: An example of a copper balanced panel following simulation and optimisation.

format files for Side 1 and Side 2 of the panel layout and defining the target plating thickness and upper and lower limits. The system gave a colour-coded indication of the expected thickness distribution, showing where it was and was not within specification limits. It was possible to display both sides on the same screen, and many other analytical and statistical functions could be selected. The software could be configured to relate to a fabricator's particular electrolyte and plating cell geometry.

Bellis commented that the only control factors accessible to the CAM engineer were current and time. The process engineer at the plating line can control more parameters, like tooling, the amount and position of panels on flight bars, etc. But beyond those parameters, the uniformity of plating depended on how the panel was laid out in the CAM operation and could be predicted by simulation software. On the screen, the copper plating thickness at any point could be seen by simply pointing the mouse cursor at it.

Was there a requirement to improve the copper thickness distribution? How could this be done? Maybe the distribution could be enhanced by modifying the panel layout? Any changes could be quickly validated by the simulation software, and the panelisation process

repeated until an acceptable layout had been achieved.

Alternatively, the automated copper balancing facility could be used, with the CAM engineer defining the limits of the required thickness distribution and specifying the no-go zones and minimum clearances from the active PCBs. The software was also capable of “improving” the design of active PCBs, but this was a matter for discussion with the design authority, as mentioned previously (Figure 3).

Using the simulation software, Belis demonstrated the improvement that had been achieved by the addition of balancing copper, emphasising that the system had been very selective in adding it only where it was needed. The data was still in an editable form should any further information require to be included and could subsequently be output as part of the normal manufacturing package.

An impressive demonstration! In my days as a technical manager in a PCB fabrication shop, I would have been delighted to have had access to such a facility. Having been raised in the wet-processing area, I would be inclined to disagree with Belis's claim that his simulation software can “make every CAM engineer a plating expert” since he makes no mention of buckets or Wellington boots. PCB007



MilAero007 Highlights



SMT007 Magazine: Exclusive Interview With Burt Rutan, Aerospace Legend ►

If you follow advancements in aerospace technologies and expeditions, then you know the name Burt Rutan. Described by Newsweek as “the man responsible for more innovations in modern aviation than any living engineer,” Rutan is a bold visionary with a passion for the advancement of technology, who has designed 46 aircraft throughout his career. Following his IPC APEX EXPO keynote presentation, Rutan stopped by the I-Connect007 booth and shared his thoughts on a wide variety of topics.

Zentech Manufacturing Inc. Acquires CAMtek Inc. ►

Zentech Manufacturing Inc. is pleased to announce the acquisition of CAMtek Inc.

Ventec Re-certified to AS9100 Revision D in the U.K. ►

Ventec International Group Co. Ltd. announced that the company’s European headquarters in Leamington Spa, U.K., has successfully been re-certified with AS9100 Revision D in accordance with the Aerospace Supplier Quality System Certification Scheme EN 9104-001:2103 by SGS.

Defense Speak Interpreted: Be Prepared for CMMC ►

If you are a current or future Defense Department contractor or subcontractor, you need to be prepared for the next cybersecurity requirements coming online during 2020. This is the Cybersecurity Maturity Model Certification, or CMMC, in Defense speak. Dennis Fritz explains how there will be five levels of cybersecurity requirements for various amounts of Controlled Unclassified Information (CUI) you

handle, with increasing requirements from one (least) to five (most).

What It Takes to Be a Milaero Supplier, Part 2 ►

The decision to pursue military and aerospace certification impacts every facet of the organization, and not every shop is prepared to make this transformation. In Part 2, Anaya Vardya focuses on what it takes to be a milaero supplier in the areas of engineering and CAM.

Lockheed Martin’s HELIOS Laser Weapon System Takes Step Toward Ship Integration ►

Lockheed Martin and the U.S. Navy moved one step closer to integrating a laser weapon system onto an Arleigh Burke destroyer after successfully conducting a Critical Design Review for the High Energy Laser with Integrated Optical-Dazzler and Surveillance (HELIOS) system.

Sweat Sensor Detects Stress Levels: May Find Use in Space Exploration ►

Wei Gao, assistant professor of medical engineering at Caltech, has produced a wireless sweat sensor that can accurately detect levels of cortisol, a natural compound that is commonly thought of as the body’s stress hormone.

Military Exercise Highlights Multi-function Capabilities and Operational Readiness of Semiconductor Technology ►

In a recent military exercise attended by representatives from multiple research labs and military service branches, BAE Systems successfully demonstrated new, powerful, small-form-factor semiconductor technology.



Dear BEST Customers:

Thanks for your ongoing support.

BEST has been deemed to be an essential and necessary business to the manufacturing of defense industry products. Under the State of Illinois exemption for “manufacturers of products for critical products and industries,” BEST Inc. has been asked to stay operational by its military and aerospace client base.

Not having these BEST Inc. manufactured and repaired products available would interrupt the supply chain and cause the U.S. military distress in defending against the COVID-19 outbreak is critical and essential.

At this time, BEST Inc. will continue to remain open to manufacture and repair these essential and critical products.

The health and human safety of our employees are very important to us. We are sanitizing our facility often and have instructed our employees who would show any COVID-19 symptoms to stay home and self-quarantine for 14 days.

Let us know how we can be of service at this time.

Respectfully,

Bob Wettermann
BEST Inc.

Can Better Guidelines on Cosmetic Failures ‘Save’ Functioning PCBs?

The PCB Norsemen
by Jan Pedersen, ELMATICA

Sitting in my home office, writing this month’s column due to social distancing caused by the COVID-19 outbreak, I realized it was March 18th: Global Recycling Day. April’s topic could not be more suitable. Should we go green, recycle more PCBs, or save working ones from being scrapped?

Green manufacturing has been on everyone’s lips for a long time. However, it feels like one of those buzzwords that just doesn’t get the buzz it deserves. In Norway—particularly in Oslo—over the last years, we have seen “the green wave” hit us. The world experienced the leadership and “young green enthusiasm” of Swedish Greta Thunberg. The green wave is

sweeping the world, but are we missing an easy and quick fix in the industry to be even greener?

RoHS and REACH teach us that substances and chemicals used in electronics are not to be thrown away and can be toxic to nature. We create laws and standards that restrict us from using metals from restricted mines and smelters and substances that can infect nature when disposed of. At the end of the life of any electronic product, we have rules on how to separate the most toxic elements. Home appliance electronics are taken back by the shops and manufacturers, and we dismantle and recycle them. The process goes on.

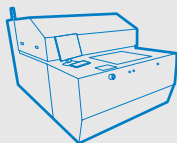


Jan Pedersen.

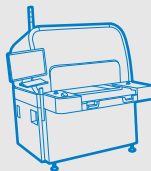
Designing THE FUTURE OF **PCB**



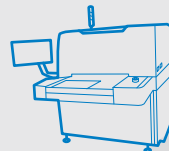
INNOVATIVE SOLUTIONS FOR PCB MANUFACTURING



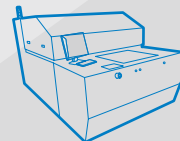
Direct Imaging



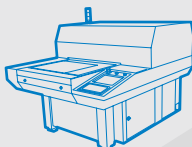
Automated Optical
Inspection



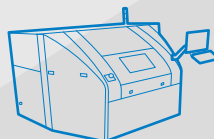
Automated Optical
Shaping



Solder Mask DI



Legend Printing
and Serialization



UV Laser Drilling



Orbotech
Smart Factory



CAM & Engineering

FOR MORE INFORMATION, CONTACT:

nikki.schulte@orbotech.com | URL: www.orbotech.com/pcb

Why Do We Reject Good Products?

Why does the electronics industry reject good products when it's not always needed? Every year, fully functional PCBs are scrapped due to cosmetic "failures" that are not approved. Is this right, or do we need to make an even more precise set of rules on how to handle this not only to avoid unnecessary claims but also to save the environment? Can a more conscious approach and education on what to be considered as failures help make the industry to be greener?

Form, Fit, and Function: Not Functioning?

The defects I'm addressing in this column can be small scratches, solder mask discolorations, minor copper residues, inclusions, and other defects. All of these are minor and accepted by IPC-A-600 and IPC-610 or not mentioned. Why are such issues not in the standard?

If you look at IPC-A-600, it focuses on issues that affect form, fit and function. A rule that is

repeated in almost every chapter is acceptability—unless it reduces the spacing, hole diameter, or line width below the limits specified in the procurement documentation. This means that the designer should give restrictions for minimum insulation distances allowed on the finished PCB.

My experience is that very few designers provide this information, which means we should follow default rules according to the IPC standards. But that also brings us to all the open questions IPC calls AABUS, or "as agreed between user and supplier." IPC requires these questions to be discussed between the user and the supplier, which is worth a separate column itself. In addition to these documented issues, we have a cosmetic "gray zone."

Cosmetic Defects Related to Solder Mask

Most of the cosmetic defects we observe today are related to solder mask. Such issues could be discoloration caused by thickness variations or small scratches that come from handling in the PCB factory or during transportation, unpacking at the customer site, inspection, or even the assembly process. It could be solder mask defects over dielectric areas—inclusions of small particles that meet IPC A-600 but are rejected by the inspector.

What Is the Risk of Using a Product With Cosmetic Defects?

Defining risk is never easy. Some industries are clear on risk, such as medical, automotive, and defense. Still, we have a term in the medical standards that calls for judgment: ALARP, which stands for "as low as reasonably practicable." There's also ALARA, which means "as low as reasonably achievable"—a term often used in the regulation and management of safety-critical and safety-involved systems.

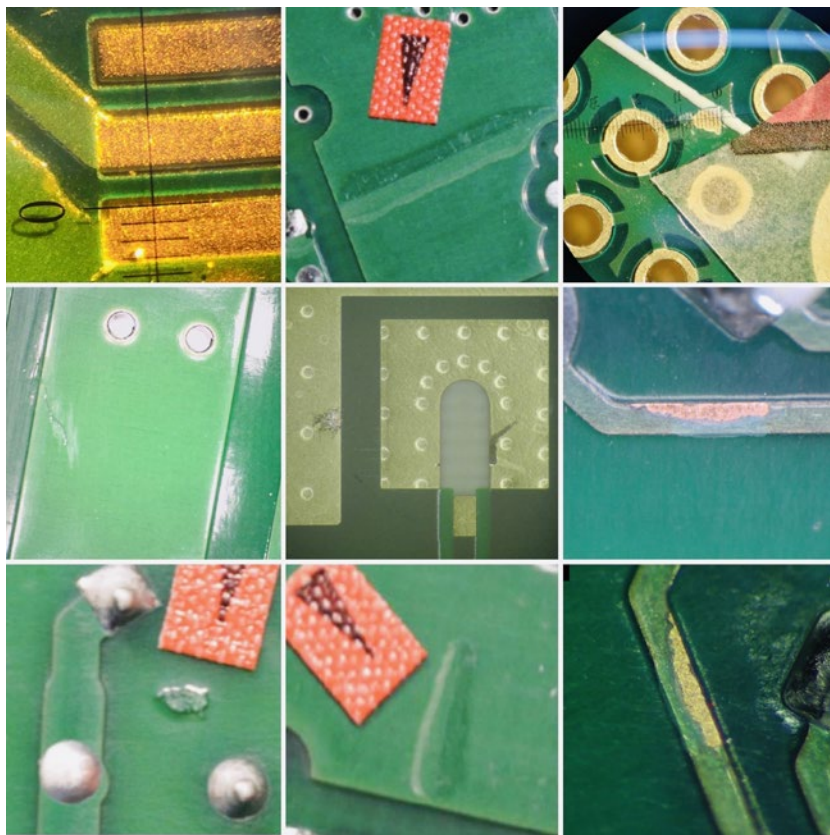
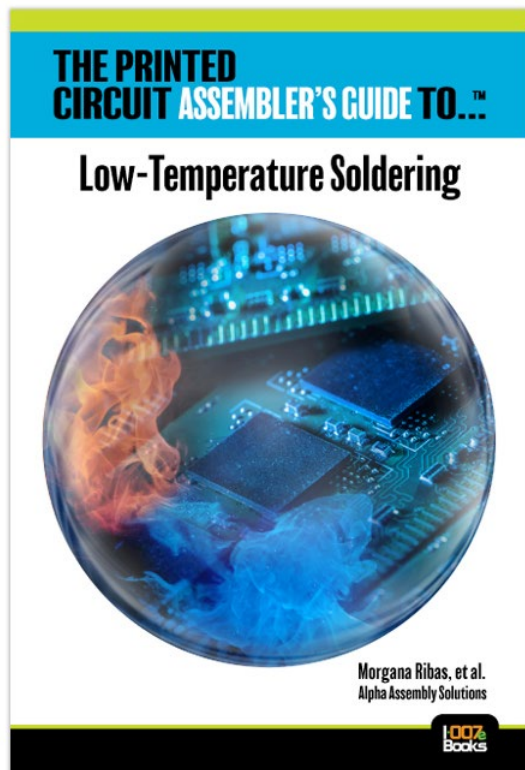


Figure 1: Do fully functionable PCBs really need to be scrapped?
(Source: Elmatica)

The Printed Circuit Assembler's Guide to...™ Low-Temperature Soldering



by Morgana Ribas, Ph.D., et al., Alpha Assembly Solutions

With the move to lead-free solder, the electronics manufacturing industry now has the opportunity to explore and implement assembly solutions that take advantage of lower temperature materials and processes. Written by Morgana Ribas and other expert authors from Alpha Assembly Solutions, this book provides an introduction to the evolution of modern low-temperature soldering, illustrates the importance of chemistry when developing low-temperature solders, and discusses advanced and emerging applications where lower melting point alloys can provide unique assembly solutions. Readers will learn the benefits low-temperature alloys have to offer, such as reducing costs, creating more reliable solder joints, and overcoming design limitations with traditional alloys.

[FREE DOWNLOAD](#)[PRINT ON DEMAND](#)

“This book does a good job of distilling out the chaff and focusing on the most relevant, valuable information available, including main drivers for the current worldwide interest in low-temperature soldering, the history of solder paste alloys and flux developments, as well as various applications for these materials.”

— Raiyo Aspandiar, Ph.D., Senior Engineer, Intel Corporation

ABOUT THE AUTHOR



Morgana is a metallurgical engineer with a master's degree in extractive metallurgy from UFRGS in Brazil and a Ph.D. from Rice University in the United States. Currently, Dr. Ribas is the manager for the metals technology group at Alpha Assembly Solutions. Her work has appeared in more than 50 publications, including technical journals, conference proceedings, and patents. The other contributing authors for this book are Tom Hunsinger; Traian Cucu, Ph.D.; Ramakrishna H V, Ph.D.; Garian Lim; and Mike Murphy.

The ALARP principle is that the residual risk shall be reduced as far as reasonably practicable. If the medical sector accepts this, we should be able to use this method for most of our PCBs for those gray-zone areas where the standard leaves customers and suppliers to find solutions themselves. As mentioned, IPC uses the term AABUS. If you read the IPC standard, you will find this term used all over, causing much frustration.

Why Is This Important?

We all want clear rules to avoid conflicts between the customer and supplier; however, things are not always that simple. Some cases need to be discussed to be able to come up with good solutions.

Often, the challenge can arise when the customer is not the decision-maker. The product owner has strict requirements, and to be on the safe side, the electronic supplier that assembles the PCBs prefers to be even a bit stricter than their customer.

Some might be reluctant to ask for approval of defects not directly mentioned in his customer quality requirements. That's when the acceptability grey zone develops to a challenge between the two.

At the end of the day, the customer often wins these discussions, and we end up throwing away good products that could have been used.

Can We Continue Wasting Good Products?

In a world where a clean nature is getting increasingly rarer, we must look at every way to avoid pollution. Even if we are able to remove a lot of the toxic substances, we will never be able to remove all of them sufficiently. Electronics with their bromides, heavy metals, and other substances harmful to nature will, from time to time, leak out.

Of course, the challenge with throwing away fully functional electronics can be seen as a minor issue, when tons of plastic and electronics are thrown away by the consumers every day. Still, all efforts count. We have no good reason to waste good products.

A Shout-out for a Greener World

If all of us accept the risk level, such as the medical sector's ALARP, we should be able to reduce this unnecessary pollution by accepting minor cosmetic defects, as well as rework of minor solder mask defects, such as scratches, pinholes, and exposed copper. None of this increases the risk of failure in assembly or in the final application. I am not talking about defects that can affect soldering or product function. We should never jeopardize product quality.

Cooperation and Improvement

To improve today's situation, we need to juggle two thoughts at the same time: accept cosmetic defects (that are within IPC standards), but at the same time, talk with one another and find good solutions. We need to work with continuous improvements, use automatic screening tools, and accept rework before the boards are shipped.

As an advisor between customers and PCB suppliers, I work with improvements every week. My target is to reduce such cosmetic errors to a minimum, but I still have to accept the fact that PCB production might involve cosmetic issues. In my opinion, the best way to avoid this is 100% automatic production and better cleanroom conditions.

The ultimate scenario would be a production without the "green oil" (my Chinese friend's word for solder mask) that causes so many issues, but we are still years away from that. However, it's all about the baby steps toward better decisions, more knowledge around the level of acceptance of cosmetic failures, better guidelines, and—eventually—less scrapping of functional PCBs.

After all, a small step toward a greener industry is better than no step at all. **PCB007**



Jan Pedersen is a senior technical advisor at Elmatica. To read past columns or contact The PCB Norsemen, [click here](#).



ELMATICA®

Dear Customer,

First of all, please allow me to thank you for your understanding during these challenging times. For all of us at Elmatica, you—our customer—is the most important element of the supply chain.

I understand that one can be frustrated, have questions, and want clear answers and precise dates for delivery. However, this is an unprecedented situation and a challenging time for the global electronics industry. This will, unfortunately, have a negative impact on the entire supply chain.

Orders are delayed, confirmed, and re-confirmed. We have been working closely with all our manufacturing partners on a global scale these last few months in order to secure your orders and deliveries. Sometimes, it feels like taking two steps forward, then one step back. However, our values—namely transparency, predictability, and integrity—are always leading our priorities and focus.

What are we doing?

I wanted to briefly inform you what we at Elmatica are doing to secure your orders and facilitate your requests.

Our management and officer team have weekly meetings to discuss the latest development and ensure that everybody is up to date on the latest information. A task group was established over one month ago, and they have a minimum of two weekly internally and external updates on the situation.

We are in daily contact with the management of our Asian and European manufacturers to get the latest updates, prioritize, and negotiate capacity. We can ensure our customers with urgent demand transfer to other suppliers as non-China alternatives, like Taiwan, Singapore, South Korea, Japan, the U.S., and Europe.

We are constantly monitoring the situation in Europe, making sure our colleagues are safe, taking precautions, and developing new internal routines. Even if the situation seems to get back on track in China, our manufacturers operate with 80% manpower, but the backlogs from Chinese New Year and the COVID-19 situation are causing extra lead times from 4–8 weeks.

What can you do?

The situation with reduced production output does not only impact PCB manufacturers but raw material manufacturers—such as laminate and chemical suppliers—also face the same challenge. We strongly advise you to place orders as early as possible to secure production priority and material availability. We anticipate that the raw material supply can experience challenges in the coming months when inventory on stock depletes and when PCB manufacturers recover from the low production output.

How to stay updated?

We understand you have questions regarding your orders. This is why we have updated our system with live tracking of order confirmation to you, so one can easily click a link and get an overview of all your orders and their respective status.

Our customer service team is continuously monitoring all the orders and conveys any news to you. They also work closely with our global logistic partners to ensure that the shipping capacity is fully utilized. We continuously update our Q&A with new information on our website.

On behalf of the Elmatica team and myself, I wish to thank you for your understanding during these extraordinary times.

Didrik Bech
CEO



Editor Picks from PCB007

1 Audio Interview With IPC President and CEO Dr. John Mitchell: COVID-19 Global Industry Update ▶

On March 20, Dr. John Mitchell, IPC president and CEO, spoke with I-Connect007 publisher Barry Matties in an exclusive phone interview with updates on COVID-19-related current events in the manufacturing industry. In this information-packed 14-minute audio interview, Dr. Mitchell shared key takeaways from Friday's IPC Executive Forum conference call.



2 I-Connect007 Researchers Survey Industry on COVID-19 Outbreak Effect ▶

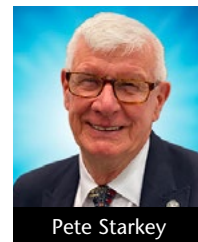
We surveyed our readers regarding the coronavirus (COVID-19) outbreak and its effect on our industry. After reviewing the first 100 survey responses primarily from North America and Europe, one-third of the respondents reported that the outbreak was having at least a small effect on their orders. Two-thirds of our readers have yet to see any effect on their orders.

3 IPC Chief Economist Dr. Shawn DuBravac Shares Industry's Financial Outlook ▶

On March 23, IPC Chief Economist Shawn DuBravac, Ph.D., CFA, spoke with I-Connect007 publisher Barry Matties in an exclusive phone interview immediately following DuBravac's online briefing to IPC member attendees.

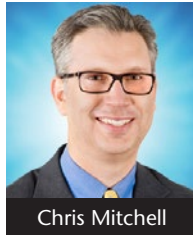
4 2020 EIPC Winter Conference, Day 1 ▶

Pete Starkey recaps how the 2020 EIPC Winter Conference, held in mid-February, attracted around 90 delegates from a dozen European countries—as well as a few from North America—to an outstanding learning and networking experience for members of the PCB community. The theme of this year's event was: "The Needs for Next-Generation Electronic Devices and Changes in Fabrication Solutions for PCBs, PCBAs, Materials, and Technologies."



5 The Government Circuit: An IPC Roadmap to Economic Recovery ►

As the COVID-19 pandemic exacts a growing toll, public and private actors worldwide are marshaling resources to combat the spread of the virus and save the lives of those who are critically ill. In this unprecedented crisis, Chris Mitchell explains how IPC supports a sustained and bold policy agenda to help us all weather the economic downturn resulting from sweeping restrictions on business activity.

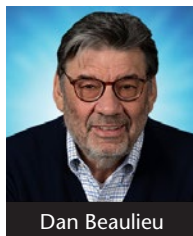


6 Standard of Excellence: Successful R&D With Your PCB Partner ►

Now, more than ever, we have to rely on our PCB partners to help us with new product development. A great deal of trust and confidence in our PCB vendors is required to create and fulfill this type of partnership fruitfully. Anaya Vardya shares eight things that must be in place to have a successful R&D relationship with your PCB partner.

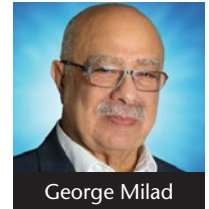
7 It's Only Common Sense: Business as Usual ►

Mark my words, no matter how bleak things are right now, or how impossible it seems to be able to do business, people are going to find ways to not only survive but thrive. Dan Beaulieu shares three ways to “think different,” work in the world as it is today, and make money while doing so.



8 The Plating Forum: EPIG—A Nickel-free Surface Finish for Next-generation Products ►

In recent years, chip-size package (CSP) used inside electronic devices have been miniaturized, and the spacing between the lines continues to diminish every year. Some of the latest packages have spacing as little as 15 μm or less. If electroless nickel electroless palladium immersion gold (ENEPIG) is used with an EN thickness of 5–6 μm , only 5 μm of spacing would be left, increasing the risk of shorts between the traces. George Milad explains.

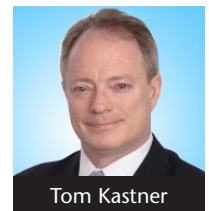


9 Keep Up to Date With “Industry Leaders Speak Out: COVID-19 Outbreak” Forum ►

I-Connect007’s “Industry Leaders Speak Out: COVID-19 Outbreak” forum continues to provide a central location for company updates and reports. Check here regularly for the latest information. We invite you to share your news as well. Just use the submit button at the bottom of the page to send us your latest status.

10 Punching Out! What Is a Quality of Earnings Report? ►

Whether the seller’s financials are audited, reviewed, compiled, in QuickBooks, or on the back of a napkin, a Q of E report helps buyers become more comfortable with the seller’s numbers and identifies risks in the business. Tom Kastner explains.



For the latest COVID-19 industry updates, [click here.](#)

Career Opportunities



Looking for the purrrrfect applicant?

Find industry-experienced candidates at I-Connect007.

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

In addition, your ad will be featured in at least one of our newsletters, and your posting will appear on our **jobConnect007.com** board, which is also promoted in every newsletter.

Potential candidates can click on your ad and submit a resume directly to the email address you provide. 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!

Don't delay, contact us right meow!

To get your ad into the next issue, contact:

Barb Hockaday at barb@iconnect007.com or +1.916.608.0660 (-8 GMT)

I-Connect007
GOOD FOR THE INDUSTRY



Career Opportunities



Process Engineering Director

Whelen Engineering Co., Inc. seeks full-time process engineering director in Concord, NH, to develop, plan and execute GreenSource Fabrication, LLC Div.'s process technology business strategy; manage process engineering activities, staff and compliance; improve process design, cost, quality and resource utilization; interact w/ customers and incorporate feedback; develop financial capital and labor projections; travel internationally for conferences, supplier and customer visits (15-25% worktime); write white papers, IP applications and give talks re. Division's products/processes.

Min. req.: U.S. Bachelor's or foreign equivalency in environmental science or engineering; min. 10 yrs. work exp. in: PCB fabrication process engineering; comprehensive and current experience in PCB fabrication/substrate markets w/ SAP tech; developing chemical and mechanical processes, chemistries and equipment for PCB manufacturing demonstrated by international experience implementing complex processes; ability to direct and troubleshoot PCB manufacturing problems; min. 5 years exp. leading, managing and training process engineering teams, developing and executing process technology business strategies and plans in worldwide PCB markets, including Japan, Taiwan, China, Europe; min. 3 years exp. giving talks, writing and presenting white papers; ability to travel internationally (15-25% worktime).

Send CVs to: Corinne Tuthill,
ctuthill@greensourcefab.com
or GreenSource Fabrication, LLC,
99 Ceda Road, Charlestown, NH 03603.

[apply now](#)



Talent for Hire

Have a position to fill? D.B. Management has the people you're looking for. Candidates currently available include:

- **Director of Operations, PCB and CEM**
Grew previous operations to over \$100 Million.
- **Technical Field Applications Engineer**
Over 15 years of experience working in the U.S. with offshore companies.
- **Two Highly Experienced Front End Engineers**
Over 25 years of experience. Will work remotely.
- **Four Experienced Sales Professionals for Both PCB Fabrication and Assembly**
All four exhibit successful growth records.

Let D.B. Management help you with your staffing needs. Contact us now by calling Dan Beaulieu at:

207-649-0879
or emailing him at:
danbbeaulieu@aol.com

[more details](#)

Career Opportunities



Sr. PCB Designer–Allegro

Freedom CAD is a premier PCB design service bureau with a talented team of 30+ dedicated designers providing complex layouts for our enviable list of high-tech customers. Tired of the commute? This is a work-from-home, full-time position with an opportunity for overtime at time and a half.

Key Qualifications

- EXPERT knowledge of Allegro 16.6/17.2
- Passionate about your PCB design career
- Skilled at HDI technology
- Extensive experience with high-speed digital, RF and flex and rigid-flex designs
- Experienced with signal integrity design constraints encompassing differential pairs, impedance control, high speed, EMI, and ESD
- Experience using SKILL script automation such as dalTools
- Excellent team player that can lead projects and mentor others
- Self-motivated, with ability to work from home with minimal supervision
- Strong communication, interpersonal, analytical, and problem solving skills
- Other design tool knowledge is considered a plus (Altium, PADS, Xpedition)

Primary Responsibilities

- Design project leader
- Lead highly complex layouts while ensuring quality, efficiency and manufacturability
- Handle multiple tasks and provide work leadership to other designers through the distribution, coordination, and management of the assigned work load
- Ability to create from engineering inputs: board mechanical profiles, board fabrication stack-ups, detailed board fabrication drawings and packages, assembly drawings, assembly notes, etc.

apply now



CAM Engineer

Eagle Electronics is seeking a CAM engineer specific to the printed circuit board manufacturing industry. The candidate should have a minimum of five years of CAM experience and a minimum of two years of experience in Frontline InCAM software. The candidate should also be fluent in PCB and CAM language pertaining to customer and IPC requirements. The ideal candidate has experience with scripting Frontline InCAM software.

This is a first-shift position at our Schaumburg, Illinois, facility; this is not a remote/off-site position. Any offer would include relocation costs to the Schaumburg, Illinois, area along with competitive salary and benefits.

If interested, please submit your resume to HR@eagle-elec.com and include "CAM Engineer" in the subject line.

About Eagle—Since 1979, Eagle Electronics has provided customers with the highest quality printed circuit boards at fair and competitive prices. From providing customers with short standard lead times to very low premiums on quick turns, Eagle strives to provide the best total value in high technology rapid turn-around PCBs in the industry.

apply now

Career Opportunities



West Software Application Engineer

This position reports directly to the Orbotech West software support manager and works with customers to support Orbotech's pre-production software products. Acts as a focal point for technical issues, manages product implementation projects, provides customer training, and supports the sales process. Advanced knowledge of Frontline PCB products, including InCam, InPlan, InStack, InSight, Genesis, and Genflex. Ability to travel and manage time to maximize results. Requires both written and oral technical communication skills. Skilled in the use of scripting languages, including C-Shell, Perl, or Python. Knowledge of relational databases and HTML/XML highly desirable. Knowledge of PCB manufacturing processes. Familiar with the processes used in front-end engineering departments at PCB fabrication sites. Requires use of project management skills to organize and complete projects that involve the implementation of sophisticated software tools used in printed circuit fabrication facilities.

An expected average of 35%+ travel. College degree or equivalent technical education, in addition to a minimum of five-plus years of related experience. Experience supporting sales and sales activities is a plus. U.S. citizen with the ability to work and travel within the U.S., Canada, and internationally.

[apply now](#)



ventec
INTERNATIONAL GROUP
騰輝電子

OEM Sales Manager Chicago/Home-Office-Based

Want to advance your career by joining a globally successful and growing world-class CCL manufacturer and help drive that success? We are seeking to hire an OEM sales manager to grow and manage key customer accounts with OEM's and Tier 1 manufacturers in the USA, focusing 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 for the role:

- Non-negotiable: Drive and tenacity!

Required:

- 7 to 10 years' experience in the PCB industry in engineering and/or manufacturing
- Detail-oriented approach to tasks
- Ability to manage tasks and set goals independently as well 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 leading team with excellent benefits.

Please forward your resume to
jpattie@ventec-usa.com and mention
"Technical Sales Engineer—Chicago"
in the subject line.

[apply now](#)

Career Opportunities



Advanced Connectivity Solutions

Senior Development Engineer

Rogers Corporation is seeking a senior development engineer accountable for the development of more complex products and processes, the establishment of sound technical bases for these developments, and effective interaction with technology, process, and platform innovation; operations; sales and marketing; and process engineering personnel to commercialize these developments.

Essential Functions:

- Design and conduct experiments and interpret the results
- Report on projects in both written and verbal formats at all levels of the organization
- Perform technical troubleshooting of new products and processes; act as new product/concept incubator for new technologies and platforms, identifying opportunities for improvement and incorporation design for manufacturing requirements resulting in a viable, scalable product
- Provide ongoing process and manufacturing support to newly launched products as applicable
- Provide support in terms of analytical equipment maintenance, methods development, material analysis, and documentation of new process or products
- Manage capital projects for the purchase and installation of new process or support equipment; train employees in new processes

Required Education and Experience:

Ph.D., Ch.E., M.E., or material science, or B.S. or higher in a technical discipline with accomplishment in product development and project management.

Rogers Corporation provides equal employment opportunities to minorities, females, veterans, and disabled individuals as well as other protected groups.

[apply now](#)



Gardien Is Hiring!

The Gardien Group, a leading solutions provider in the PCB industry, is looking to fill multiple openings in their China, Japan, Taiwan, and United States service centers.

We are looking for electrical engineers, operations managers, machine operators, and sales executives. Prior experience in the PCB industry is beneficial but not essential. Training will be provided along with excellent growth opportunities, a benefits package, and periodic bonuses.

Our global teams are from diverse cultures and work cohesively as a tight-knit unit. With performance and initiative, there are plenty of opportunities for professional growth.

Gardien is an equal opportunity employer. Employment decisions are made without any regard to race, color, religion, national or ethnic origin, gender, sexual orientation, age, disability, or other characteristics.

Interested candidates, please contact us with your resume and a cover letter. Kindly note that only shortlisted candidate will be contacted.

[Apply at careers@gardien.com.](mailto:careers@gardien.com)

[apply now](#)

Career Opportunities



eptac

TRAIN. WORK SMARTER. SUCCEED.

Become a Certified IPC Master Instructor

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

Qualifications and skills

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

Benefits

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

[apply now](#)



Technical Account Manager Chicago/Minneapolis

Insulectro, the largest national distributor of printed circuit board materials, is seeking a talented sales superstar for a Technical Account Manager role based out of either our Chicago or Minneapolis office. This role will focus on maintaining the existing customer base and developing new business within the assigned territory in both the printed circuit board and printed electronics industries. We are looking for the perfect fit of education, experience, and attitude that matches our company culture and enhances the service level to our customers.

Qualifications:

- A self-motivated business professional who is driven to succeed with a minimum of 3 years outside sales experience in the PCB or PE industry
- Proven sales/business development record
- Excellent communication and interpersonal skills
- OEM and electronic assembly experience is a plus

We offer:

- Competitive salary and commission plan with a comprehensive benefits package
- A fun, high-energy company with an entrepreneurial spirit
- A great group of people to work with!

[apply now](#)

Career Opportunities



APCT, Printed Circuit Board Solutions: Opportunities Await

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

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

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

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

[apply now](#)



Development Chemist Carson City, NV

Develop new products and modify existing products as identified by the sales staff and company management. Conduct laboratory evaluations and tests of the industry's products and processes. Prepare detailed written reports regarding chemical characteristics. The development chemist will also have supervisory responsibility for R&D technicians.

Essential Duties:

- Prepare design of experiments (DOE) to aid in the development of new products related to the solar energy industry, printed electronics, inkjet technologies, specialty coatings and additives, and nanotechnologies and applications
- Compile feasibility studies for bringing new products and emerging technologies through manufacturing to the marketplace
- Provide product and manufacturing support
- Provide product quality control and support
- Must comply with all OSHA and company workplace safety requirements at all times
- Participate in multifunctional teams

Required Education/Experience:

- Minimum 4-year college degree in engineering or chemistry
- Preferred: 5-10 years of work experience in designing 3D and inkjet materials, radiation cured chemical technologies, and polymer science
- Knowledge of advanced materials and emerging technologies, including nanotechnologies

Working Conditions:

- Chemical laboratory environment
- Occasional weekend or overtime work
- Travel may be required

[apply now](#)

Career Opportunities



Multiple Positions Available

The Indium Corporation believes that materials science changes the world. As leaders in the electronics assembly industry we are seeking thought leaders that are well-qualified to join our dynamic global team.

Indium Corporation offers a diverse range of career opportunities, including:

- Maintenance and skilled trades
- Engineering
- Marketing and sales
- Finance and accounting
- Machine operators and production
- Research and development
- Operations

For full job description and other immediate openings in a number of departments:

www.indium.com/jobs

[apply now](#)



SMT Field Technician Huntingdon Valley, PA

Manncorp, a leader in the electronics assembly industry, is looking for an additional SMT Field Technician to join our existing East Coast team and install and support our wide array of SMT equipment.

Duties and Responsibilities:

- Manage on-site equipment installation and customer training
- Provide post-installation service and support, including troubleshooting and diagnosing technical problems by phone, email, or on-site visit
- Assist with demonstrations of equipment to potential customers
- Build and maintain positive relationships with customers
- Participate in the ongoing development and improvement of both our machines and the customer experience we offer

Requirements and Qualifications:

- Prior experience with SMT equipment, or equivalent technical degree
- Proven strong mechanical and electrical troubleshooting skills
- Proficiency in reading and verifying electrical, pneumatic, and mechanical schematics/drawings
- Travel and overnight stays
- Ability to arrange and schedule service trips

We Offer:

- Health and dental insurance
- Retirement fund matching
- Continuing training as the industry develops

[apply now](#)

Career Opportunities



U.S. CIRCUIT

Sales Representatives (Specific Territories)

Escondido-based printed circuit fabricator U.S. Circuit is looking to hire sales representatives in the following territories:

- Florida
- Denver
- Washington
- Los Angeles

Experience:

- Candidates must have previous PCB sales experience.

Compensation:

- 7% commission

Contact Mike Fariba for
more information.

mfariba@uscircuit.com

[apply now](#)



ZENTECH

Zentech Manufacturing: Hiring Multiple Positions

Are you looking to excel in your career and grow professionally in a thriving business? Zentech, established in Baltimore, Maryland, in 1998, has proven to be one of the premier electronics contract manufacturers in the U.S.

Zentech is rapidly growing and seeking to add Manufacturing Engineers, Program Managers, and Sr. Test Technicians. Offering an excellent benefit package including health/dental insurance and an employer-matched 401k program, Zentech holds the ultimate set of certifications relating to the manufacture of mission-critical printed circuit card assemblies, including: ISO:9001, AS9100, DD2345, and ISO 13485.

Zentech is an IPC Trusted Source QML and ITAR registered. U.S. citizens only need apply.

Please email resume below.

[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](#)



YOUR
JOB
AD
HERE

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

I-Connect007
GOOD FOR THE INDUSTRY



IPC Events: COVID-19 Updates for 2020

We at IPC sincerely hope that you and your families are staying safe during this unprecedented global crisis. The effects of COVID-19 are creating new challenges as we adjust to sheltering in place. You can find current information on scheduled events as well as IPC's response to the crisis on the [COVID-19 \(Coronavirus\) Update](#) page on IPC.org.

Because the health and safety of our attendees, speakers, exhibitors, sponsors, and employees are of utmost importance, some of IPC's planned events for 2020 have been either postponed or transformed into virtual events.

The current updates are as follows:

- **High-Reliability Forum**

Scheduled for May 2020,
has been rescheduled for May 11-13, 2021.

- **Electronics Materials Forum**

Scheduled for June 2020, has been postponed.
New date to be announced soon.

- **IPC/ITI Conference**

Scheduled for June 2020, will now be
a virtual event. Date to be announced soon.

Upcoming Events

The events listed below are scheduled as planned, and we are closely monitoring the situation for all in-person events. Changes to the schedule will be reflected on the [IPC Calendar](#) and announced on the [COVID-19 \(Coronavirus\) Update](#) page. (Source: IPC)

Wisdom Wednesday Webinar:

Building Synergies in Power Electronics (members only)
April 8, 10:00 a.m.–10:45 a.m. CDT

IPC SummerCom | Raleigh, NC

June 13–June 18

IPC Cares | Global Virtual Event

June 14–June 20

IPC E-Textiles 2020 | Minneapolis, MN

September 29–September 30

High-Reliability Cleaning and Conformal Coating Conference, in cooperation with SMTA

November 3–November 5

M-EXPO Wire Processing Technology

October 14–October 16

IPC APEX EXPO 2021

January 23–January 28

MANAGING EDITOR: **NOLAN JOHNSON**
(503) 597-8037; nolan@iconnect007.com

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

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

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

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

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

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

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

ASSOCIATE EDITOR: **KIERSTEN ROHDE**
kiersten@iconnect007.com

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

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

MAGAZINE LAYOUT: **RON MEOGROSSI**

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

CREATIVE TECHNOLOGIST: **BRYSON MATTIES**

COVER: **SHELLY STEIN**

COVER IMAGE: **ADOBE STOCK**
© **ROMOLO TAVANI, © ELNUR**

PCB007
MAGAZINE

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

© 2020 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.

April 2020, Volume 10, Number 4
PCB007 MAGAZINE is published monthly,
by BR Publishing, Inc.

ADVERTISER INDEX

atg Luther & Maelzer GmbH.....	63
Atotech.....	19
Burkle North America.....	33
Chemcut.....	59
DB Management.....	125
Electra Polymers.....	15
Elsyca.....	9
Entelechy Global.....	97
ESI.....	23
Eternal Technology Corporation.....	117
Excellon.....	41
Fein-line Associates.....	109
Gardien.....	79
I-007e Micro Webinars.....	3
I-007eBooks.....	2, 37, 121
IPC.....	55, 111
MivaTek Global.....	83
Nordson MARCH.....	51
Orbotech	131
Panasonic Electronic Materials.....	29
Pluritec.....	5
Prototron Circuits.....	69
Rogers Corporation.....	101
Taiyo America.....	47
Technica USA.....	13
Ucamco.....	91
Ventec International Group.....	7

I-Connect007

GOOD FOR THE INDUSTRY



FREE SUBSCRIPTION



myiconnect007.com

EDITORIAL CONTACT

Nolan Johnson

nolan@iconnect007.com

+1 503.597-8037 GMT-7



mediakit.iconnect007.com

SALES CONTACT

Barb Hockaday

barb@iconnect007.com

+1 916 365-1727 GMT-7



www.iconnect007.com