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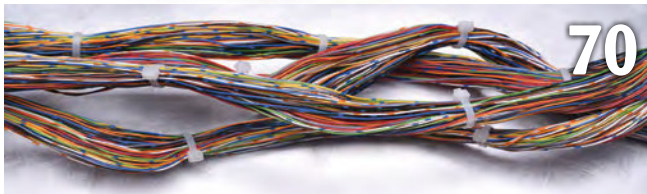
This month, *SMT Magazine* looks into the latest technology trends, new manufacturing challenges, and outlook for the military and aerospace markets, and how they are impacting the PCB assembly industry.

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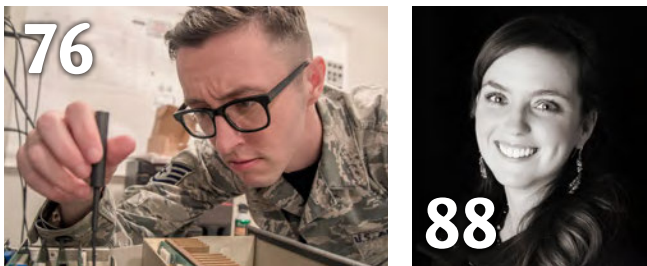


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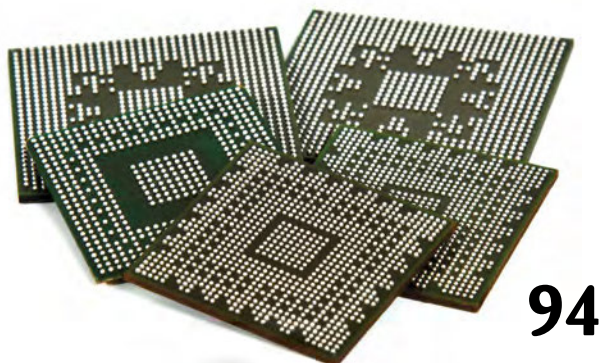


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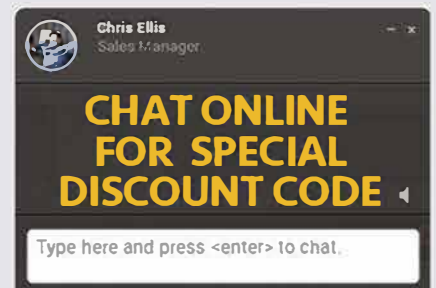


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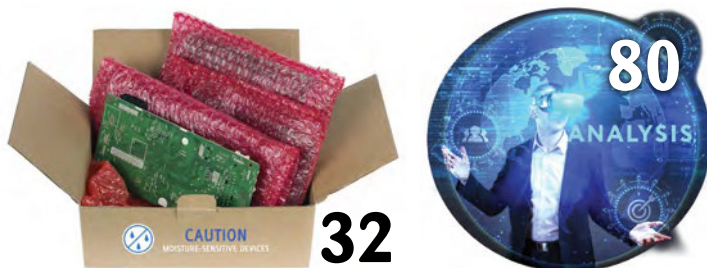
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Today's Mil/Aero Enemies: Counterfeits, Obsolescence and Failure

by Stephen Las Marias

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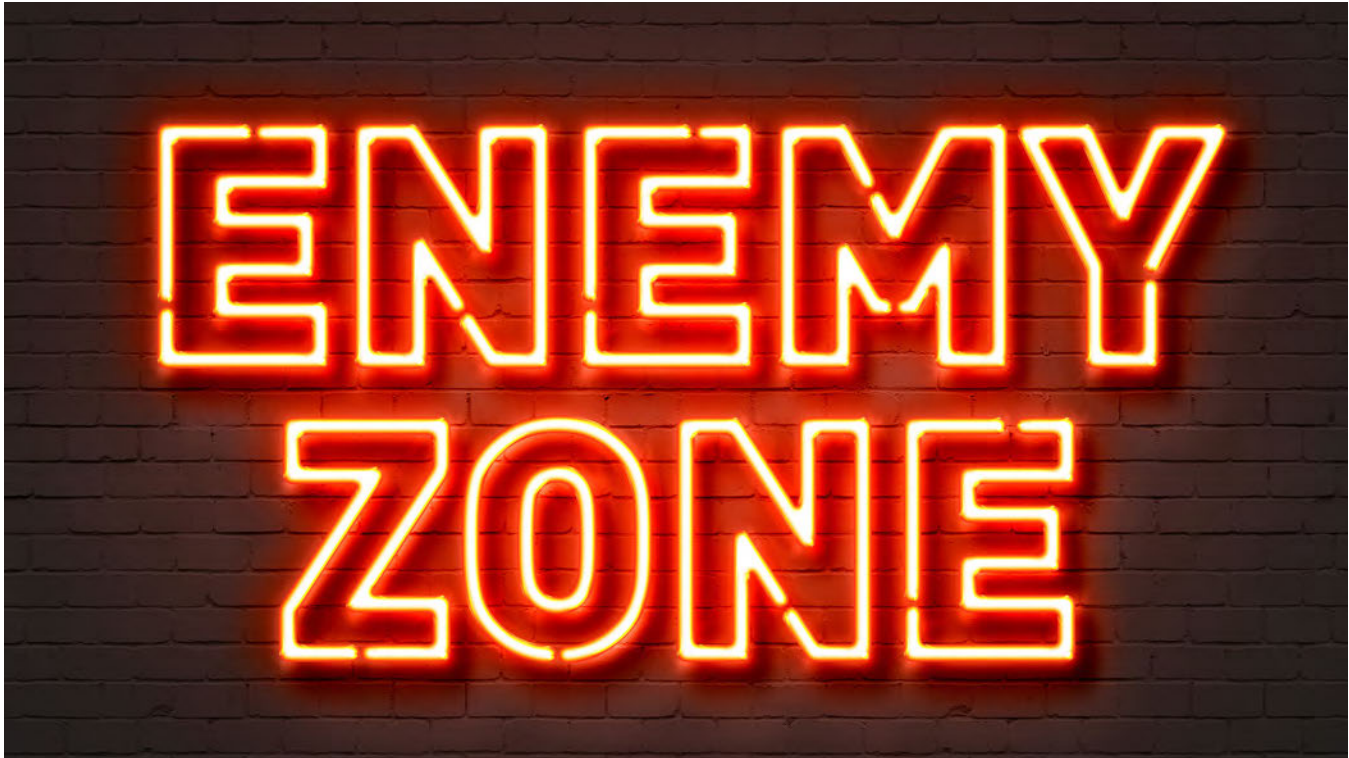
The military and aerospace markets require high-reliability electronics, components and assemblies that can perform in harsh operating conditions involving extreme temperatures, vibration, and moisture, to name a few. These issues continue to challenge electronics assembly providers. These are on top of current manufacturing issues such as the miniaturization of products, shrinking component sizes, higher density board assemblies, and the obsolescence of electronic components, as these systems, such as fighter jets and commercial planes, must function for up to 20 years.

In our recent survey on military and aerospace, a majority of the respondents point to obsolete parts and components—and also the dwindling number of sources for legacy parts—as among their biggest issues in military/aero-

space electronics assembly. Another issue is the reliability data of commercial technology components and how they can be used in military and aerospace products.

Raw material and component lead times are also an issue, along with increasing requirements from customers such as inspection and documentation, and compliance to multiple regulatory standards, such as ITAR, DFARS, AS9100, and NADCAP.

One of the compliance issues highlighted in our survey, and also discussed during our interview with the team of mil/aero experts who helped us plan this issue, is cybersecurity. This group included Freedom CAD's COO Scott Miller, Lenthor Engineering's VP of Marketing Dave Moody and VP of Sales/Engineering John Rolle, and Zentech's CEO and President Matt Turpin



ENEMY
ZONE

and VP John Vaughan. Our experts focused on cybersecurity, in particular, the NIST Special Publication 800-171, published by the National Institute of Standards and Technology, which describes the US government security controls for unclassified information in non-federal information systems and organizations.

According to NIST, the US government increasingly relies on external service providers to help carry out a wide range of missions and business functions using state-of-the-practice information systems. Many federal contractors routinely process, store, and transmit sensitive information to support the delivery of essential products and services to federal agencies, including those contractors developing communications, satellite, and weapons systems. NIST 800-171 was developed to protect the confidentiality of controlled unclassified information residing in these contractors' information systems. I think this will be another thorn in contract manufacturers' sides; they will have to ensure that all their information systems are compliant to the said requirements.

The electronics manufacturing industry may have transitioned to lead-free years ago, but there are still several market segments, such as mil/aero, that are exempted from RoHS due to reliability issues. Electronics assembly providers working in such markets face the difficulty of sourcing advanced components in non-RoHS compliant configurations. Hence, the reason lead-free will remain an issue, at least in defense and aerospace applications. To enlighten us on this subject, one of the articles in this month's issue of *SMT Magazine* comes from David Hillman of Rockwell Collins, who discusses the utilization of lead-free BGAs in a tin/lead soldering process.

Manufacturers also need to ensure counterfeit components do not enter their manufacturing supply chain to ensure the reliability of the subassemblies. You can find inside an article by Martin Goetz and Ramesh Varma of Northrop Grumman Corp., which is about a case study on counterfeit electronic components identification. Meanwhile, in an interview, Davina McDonnell of Saline Lectronics talks about strategies to address counterfeits, and to ensure the security of your component supply chain.



Jerry Sidone of Alpha Assembly Solutions, on the other hand, writes about a thermal indicator technology for quality control—specifically, ensuring a reliable solder joint—in aerospace wire harness assemblies.

This month, we are also featuring our coverage of the recent IMPACT Washington, D.C. event by the IPC. My colleague Patty Goldman, who is the managing editor of *The PCB Magazine*, attended the event. You can find inside her discussions with several companies in the EMS industry, among others.

Of course, *SMT Magazine* is not complete without our expert columnists writing about the latest issues and developments in their neck of the woods. Find the latest columns inside from Tom Borkes of The Jefferson Project, Bob Wettermann of BEST Inc., and Rich Heimsch of Super Dry-Totech EU.

I hope you enjoy this month's issue of *SMT Magazine*. Next month, we will look into the importance of training and education in your workforce, and the benefits that you get in ensuring that your operators, engineers and supervisors have the proper knowledge and skill sets to perform at their peak levels, day in and day out. **SMT**



Stephen Las Marias is managing editor of *SMT Magazine*. He has been a technology editor for more than 12 years covering electronics, components, and industrial automation systems.



Mil/Aero Electronics Supply Chain Facing New Challenges

By Stephen Las Marias
I-CONNECT007

For this month's issue of our publications at I-Connect007, we invited a sampling of professionals whose experience centers on the electronics industry in the military and aerospace world, including experts from design, PCB manufacturing, and the assembly arena to sit down with us for a frank discussion. Joining us were Freedom CAD's COO Scott Miller; Lenthor Engineering VP of Sales/Engineering John Rolle and VP of Marketing Dave Moody; and Zentech's CEO and President Matt Turpin and VP John Vaughan.

Our discussion centered on the challenges associated with military work, including the new regulatory requirements for cybersecurity, dealing with leaded vs. lead-free components, and the differences and similarities with the commercial world.

The discussion started on the PCB design perspective, whether the challenges are more technical or more centered on the administrative side, such as on regulations.

"I can tell you from our perspective, this year and going forward, the rules of engagement have really begun to change because of cybersecurity, and that's having a huge impact on the engineering services community—how to comply with cybersecurity requirements that are now being mandated to us as external suppliers," explained Freedom CAD's Miller. "It's something we're spending a lot of time on. We've got work to do. We are ITAR-compliant, but cybersecurity compliance is a far deeper level of compliance than ITAR information management. That's huge. We're engaging with a consultant to help us understand how we can fulfill those requirements. And I think that's going to be a game changer for a lot of the smaller companies that currently participate in the mil/aerospace marketplace, because there are some serious costs associated with cybersecurity management.

"It's a year-end objective. They want to have a supply base compliant, or at least have identified where the holes are, the weaknesses are, as far as we can tell, but there's a huge impact. Assuming we overcome and address that, the oth-

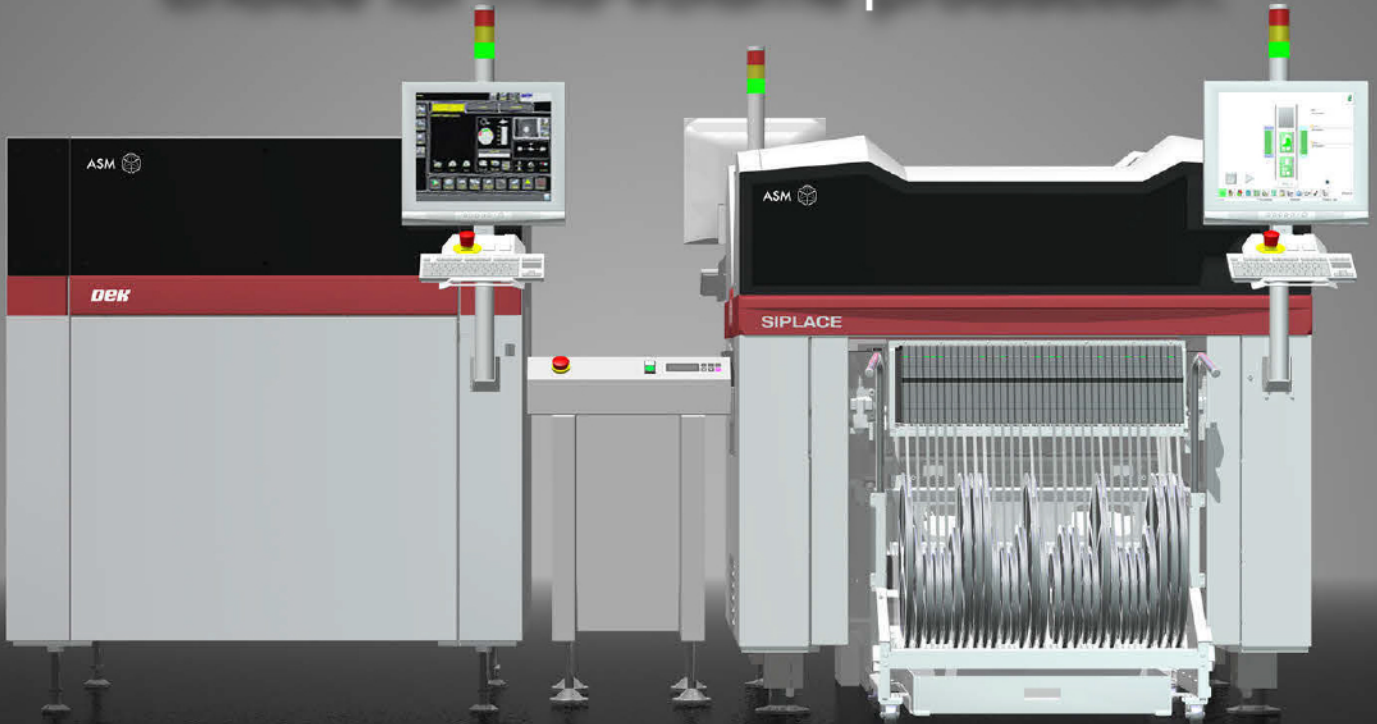


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er thing that has been kind of a mystery, and I'm sure everybody along the path sees this, is the defense budget, the DoD or Homeland Security, or whatever—any kind of government program—the defense budgets and understanding how the administrative change is going to slow down. Obviously, it looks like there's going to be more spending in that area, but it's not clear. Getting accurate forecast information or project information is difficult to do. We do our best to try to communicate with the customer and the subcontractor, etc., but they can only tell you so much because they only know so much.

Miller said that as the device types continue to get smaller and pin pitches get tighter, meeting traditional Class 3 requirements becomes increasingly difficult. "You can't meet Class 3 in certain applications, so you're consistently asking for a deviation or a waiver. Just because of the physics involved, you just can't physically meet Class 3 in some cases. And if it's a rigid requirement, then you have to work with the customer's engineers to fit the components that will allow you to meet that. From the standpoint of technology and architecture, we do things that are just as challenging in mil/aerospace, with fine lines and impedance matching, etc., that drive the consumer commercial world as well. From a technology standpoint, I don't think there's that big a gap in terms of what we're seeing as design requirements. It's been interesting to see how the government and the IRAD^[1] product development drives a lot of new technology as the government subcontractors try to figure out how to do things to differentiate their capabilities, and that kind of flows into the consumer world eventually, and vice versa; the commercial consumer world is developing technologies that are now being adopted readily in the mil/aerospace."

Lenthor's Moody next explained the challenges from a PCB fabricator's viewpoint. "There are a couple, though John might have some different perspectives from an engineering standpoint. The requirements in the mil/aero defense industry are mirroring what is available everywhere else. The perception that there are cost advantages or margin advantages for fabricators to work in the military industry are going away



Scott Miller, Freedom CAD.

and have been disappearing for quite some time. There's a demand from a business standpoint on their end to buy more smartly—and better. So, the days where everybody thought, 'I'm going to participate in this military business because I can make more money at it' are kind of gone. There is a protection, to some degree, for the domestic fabricators because of ITAR content, so that remains as a competitive advantage on the business side for companies, domestically, who are trying to do business in this industry. But it is from the other aspects, such as design requirements, delivery requirements, etc."

Rolle added, "It's certainly challenging from a business perspective, because the expectation is to be competitive and then to continue to reduce that pricing. At the macro level, more dollars are being spent all the time. I'll build off what you were talking about earlier. Will it play down even to the fab level, where even if you're successfully participating in a contract with really good schedule performance and very low defects, the expectation is that costs will reduce if you want to entertain the next bid on the contract? I think in some cases those contracts are summarily rejected if you came back to the same price. So, I think that's the challenge. I don't know that it is different from other large programs in other industries. However, I just want to add on to what Dave was saying, that our experience has been a difficult one.

According to Rolle, another challenge when it comes to engineering and tooling perspective,

are the drawings with existing requirements.

“You’re trying to comply with the drawing and you’ll have situations, like you were mentioning. You have to get a waiver, to do something differently, or something’s very cost-prohibitive due to an impact to yields. Getting changes through is always one of the supreme challenges. Even in cases where you provide a good service and your customer agrees to what you’re requesting, often there’s no funding in the program to pay for your engineering change. We’ve come across that recently where we all agree with this, it makes a lot of sense, and it’s going to help you reduce costs, but nobody’s going to pay you any money to fix that. Or cases where it does go through, but the length of time it takes to go through automatically puts the entire program on schedule jeopardy and puts immense pressure on the entire supply chain to perform to levels that maybe are unreasonable or difficult to come out looking good, when really you were just trying to do the right thing and build to print or reduce costs,” he said. “Those are some challenges as well. I’ve seen many cases where jobs go on hold for three months, and then of course everyone needs it tomorrow. And I certainly understand that, no matter who that customer is. Everyone is making a product, and we’re all feeding upwards towards some goal, and you can’t recover that lost time. I’d say to Dave’s point, there are certainly business challenges with that. I think change management, where it changes, and their impact on the overall schedule is also a challenge that’s worth noting.”

From an EMS standpoint, Zentech’s Turpin also mentioned the need to comply with the new cybersecurity rules. “The NIST 800-171^[2] guidelines are complex. It’s night and day. ITAR is really nothing compared to the cyber rules. Complying with ITAR would be maybe a three, and to comply with the NIST 800-171 is more like an 83. It’s orders of magnitude more complex and we’ve been working on it, and we already had a head start. We started about three years ago down this path, but the NIST 800-171 is formidable and it’s being driven at us as flow-downs from all the military primes. Fortunately, it doesn’t have to kick in now, but soon everybody is going to have to do it,” he said. “To

the earlier point about the military being more commercial in terms of pricing, this NIST 800-171 is going to be an unbelievable barrier to entry. I don’t know how a lot of people are going to have the infrastructure and the capability to comply with it. They’re either going to have to close their eyes when they self-certify, or they’re just going to be completely non-compliant and hope it will go away. NIST 800-171 is huge, and I’m surprised a lot of people aren’t talking about it yet. That will be a big challenge. We’re doing pretty good. We should be compliant before the end of this year.”

Regarding how long it takes to go through that compliance process, Turpin said it depends on how mature the organization is. “For us, we currently have only two sites, and we’re getting ready to add a third. If you are a multi-site organization, or you’ve got the challenge that Scott does in terms of kind of a virtual organization, it’s unbelievably difficult because very specific hardware issues must be dealt with. I can’t even begin to talk about it. I mean, I’ve got a whole team that’s dealing just with this compliance.”

But isn’t this industry overregulated already? Absolutely not, according to Turpin. He said that there is such a disparity in terms of the due diligence the companies in the mil/aero-space undertake, and it’s absolutely needed.



John Rolle, Lenthor Engineering.

“What a lot of companies do that I’ve seen, that we’ve audited, it’s almost criminal the lack of protections they have, relative to firewall, file security, data security, who they send files to, how they store stuff. It’s absolutely needed,” he stressed.

Feedback System

Is there a feedback system in place between the suppliers, fabricators, assemblers, and customers in the mil/aero industry?

“From the Zentech side, 98% of everything we do is turnkey, build to print, complex assembly. We buy all the materials, we build it, we integrate it, we test it, we’ll ESS^[3] it and then ship it off. We’re almost exclusively working with a design that somebody else has put together. Sometimes it’s ours, but 98% of the time it’s somebody else’s design,” Turpin answered.

For Freedom CAD, Miller said there’s not much process deviation between the commercial and the mil/aerospace world, in that they work closely with the board fabricators. “So much of what we design today is impedance-controlled or specialty materials. When we start the design process, we go and at least work with either the OEM themselves, who are the conduit to their fabricator, or with their fabricator to get a stack-up and make sure that it’s manu-

facturable from their perspective, and going to meet the impedance and current-carrying capability or requirements that are defined in the statement of work,” Miller explained. “From a process standpoint, we treat the process of design the same, whether it’s consumer or commercial product or a military product. We have pretty rigid processes for placement sign-off, critical routing sign-off, and then for final package sign-offs. As we go down the process, we’re trying to get as detailed a review from the customer as we can during the design process. And I know anybody that’s in the design community understands ‘as I can’ as a statement because you have companies that say they review it. And you get further down the design pipe and you’ve now got things connected, and they come back and say, ‘Oh, by the way, we need to move this component to the top of the board. We’ve got to change this or that.’ So, you think you have something that’s been signed off and approved, but in reality, until the product ships, it’s a moving target.”

Lead-free Issues Remain

The electronics manufacturing industry may have transitioned to lead-free years ago, but the mil/aerospace industry is exempted from RoHS due to reliability issues. Electronics assembly providers working in such markets face the difficulty of sourcing advanced components in non-RoHS compliant configurations.

According to Turpin, the leaded requirements for technology have become a lot more difficult to design in for one part, and then have become a challenge because it’s harder to get the parts, it’s more expensive, and the lead times are different. “The military has tried to embrace some level of RoHS commercial-type products, but for the hardcore aerospace and space, it’s leaded,” he said.

Miller agrees. “That makes sense, and you guys have to deal with re-dipping or re-balling components that aren’t leaded to meet that requirement. We tend to try to follow what the customer wants to have happen, but we’ll point out to them if we see a problem—something that’s going to impact manufacturability downstream.”

“From the EMS perspective, there are really



Matt Turpin, Zentech.

two interrelated challenges and a lot of it does relate to lead. One is that all DoD stuff has embraced this concept of affordability and tried to drive affordability. I think some it's their own internal marketing to the government. But this concept of affordability falls down when you get to things like high reliability and leaded parts, where having new technology parts re-balled, re-dipped, and re-tinned adds cost and lead time to everything. And then you overlay that with an environment that is really IDIQ-driven [indefinite delivery/indefinite quantity] to where, even though everybody knows that the government's going to buy 200–400 units over X number of years, they will only buy 20, 40, or maybe 50 at a time because of the way the IDIQs work and other things. It leads to something compressed more than they need to be, and pricing that's higher than it otherwise should be," explained Turpin. "The other thing was obsolete components. Generally, it takes so long to bring something to market, particularly in the aerospace side that by the time it really starts to get past the IDIQ level into MRL level 4⁴, a lot of the components are already becoming obsolete. That creates a whole new challenge in terms of building parts affordably, quickly, and in a way that the customer likes."

"I would completely agree with that," said Rolle. "One thing that we see happening as a result of that is you will have some products with multiple plating finishes on them because of the selections that are made upstream for all those reasons. And I sometimes see that drives complexity and makes manufacturing plans or parts more challenging if you're doing HASL, ENIG, or something like that. I've seen several instances where we really have to figure out if that's the way to make the part because of those types of decisions, or limits of those decisions that are made upstream as well."

Business Expected to Increase

With the new administration in office, there's been talk of additional military spending. But has this translated to increase in business? Lenthor's Rolle said no, at least not yet. "I think you see election-year business cycles where in some cases the overall fear of spending, even for programs that are funded, gets people very tep-



John Vaughan, Zentech.

id, reticent to go ahead and spur that funding. They kind of wait and see where the chips lay. I think this was already mentioned, that the proposal was for a 10% increase in the defense budget, but really what that means to this segment of the market is not clear yet. There's a lot of business for hardware that goes on a soldier or person, whether that be homeland defense, etc. Our customer base in the military market is expanding to police force, Homeland Security or ICE, things like that, whereas before it was traditionally just the Army, Navy and Marines," he explained. "I don't know that we've seen that come through yet. It looks like things are moving again, but I don't know if that's just because the calendar turned over and things are starting to pick up like normal or it's post-election."

On the other hand, Zentech's Turpin said they have seen an uptick since the election. "Almost twice the amount, I would say, in terms of what's been coming in, and it's all segments. Other people in our niche, EMS companies, are seeing similar things. I'd say, no question it's picked up. Now, that's just in terms of quotes. Last month was a really good month from a booking standpoint. It's probably too early to tell if they're turning into orders in a sustainable way, but from a quote activity, yes."

Vaughan explained, "It has a lot to do with the business model you put in place. For four or five years, we've been, what I call, politically ag-

nostic and bi-partisan at the same time. The administration changes are going to be beneficial, but what's more important is to look behind the curtain at the programs and focus on pursuing and obtaining a seat at the table on programs that are funded. There are 40+ programs that

.....

“The administration changes are going to be beneficial, but what's more important is to look behind the curtain at the programs and focus on pursuing and obtaining a seat at the table on programs that are funded.”

.....

we're active with for now, all funded through 2022. Regarding the changes in the administration, and you just kind of peel through it, it starts with Trump, the China issue, North Korea, and the stated objective to pivot to the Pacific and increase our naval assets. Then you've got the CIA with Mike Pompeo, the new director, and that's highly focused on signals intelligence, which translates into a lot of higher technology, RF circuit builds and data collection. And General Mattis, Secretary of Defense, is a former commander in Iraq and at some point, with increased troops on the ground, that drives the IED defeat-and-detect market. Commander Kelly is the former commander of SOCOM (Special Operations Command). The administration is pro-military through and through and that certainly bodes well for those of us focused on the mil/aero/defense segments of the market. Then you roll all that together, coupled with a request in the DoD budget to increase it by 10%. That would take us back pre-sequestration levels and the appropriations dialogue should be complete by the end of this month. We should have a pretty clear picture of where the dollars are flowing soon. Again, from our viewpoint, it's been proactive planning and striving to pick the programs and pick the tech-

nologies that are going to be required to support whatever effort the administration decides to lean toward.”

Towards Successful Partnership

When it comes to key criteria that OEMs should consider when evaluating an EMS partner for their mil/aerospace project, here's what Zentech's Turpin has to say:

“First and foremost, many of the mil/aero companies lack the funding and the time, and sometimes the expertise to properly qualify EMS companies. They have commodity buyers, and certifications are important. In our world, on the EMS side, obviously, the IPC has recently rolled out what they call a Validation Services QML (qualified manufacturers list) trusted source, which helps companies really understand that, not only does a company have a good quality management system, but they're able to produce good products. Zentech is one of maybe 10 companies in the U.S. with a trusted source process. Additionally, if you're a mil/aero company, you must make sure that the EMS company you deal with is ISO 9100 certified. Most EMS companies are not.

“I would say, separately, NIST 800-171 is also important, and I think it's going to be increasingly more important with all the cyber sensitivities out there. I'd say that would be one. Companies tend to focus on equipment, but any idiot with a dollar can buy equipment. It takes more than money to produce good products. What kind of processes and procedures do you have to operate equipment, solve problems for the customer and get it right.” **SMT**

References

1. IRAD: Independent Research and Development. Government subcontractors use this term to identify when they are spending their own money on a project vs. fulfilling a government contract.
2. “Protecting Controlled Unclassified Information in Nonfederal Systems and Organizations, [NIST Special Publication SP.800-171 Rev1.pdf](#).”
3. Environmental stress screening test.
4. MRL: [Manufacturing Readiness Level](#).

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Jabil to Manufacture Innoviz Technologies' After-Market LiDAR System

Innoviz Technologies, a provider of LiDAR intelligent sensing solutions designed for the mass commercialization of autonomous vehicles, has entered into an agreement with Jabil to mass produce its InnovizPro, an after-market LiDAR solution designed for testing and R&D of autonomous driving technology.

Esterline Selects Joe Baddeley as President for Interface Technologies Business Group

Esterline Corp. has announced that Joe Baddeley has been selected to serve as president for the company's Interface Technologies business platform.

Kitron Officially Opens New Facility in Jönköping

Kitron ASA recently celebrated the official opening of its new facility at Torsvik in Jönköping, Sweden.

Zentech Joins Discussion on Strengthening US Manufacturing at IMPACT Washington, D.C. 2017

Matt Turpin, president and CEO of Zentech Manufacturing Inc., and other senior executives from leading electronics manufacturing companies, all members of IPC, gathered in Washington, D.C. for IMPACT Washington, D.C. 2017 to advocate for a pro-growth, pro-advanced-manufacturing policy agenda.

EMS Player Virtex Continues on Its Investment in Talent Drive

The latest investment in talent comes in the form of Gary Heimlich, who was recently promoted to Materials Manager.

Nortech Systems Names New COO

Nortech Systems Inc.'s board of directors has appointed Matt Mahmood as the company's new chief operating officer (COO).

FLIR Appoints James Cannon as President and CEO

James Cannon's extensive and varied leadership experience, together with his proven operational

expertise and ability to adapt business strategies to meet evolving market needs, makes him ideally suited to lead FLIR and its portfolio of innovative technology-based products and applications.

Speedboard Assembly Services Earns ISO 9001:2015 Certification

Speedboard Assembly Services, a UK-based contract electronics manufacturer (CEM) serving customers in a variety of sectors including industrial, defense, communications, and security, has been certified to the new ISO 9001:2015 standard.

Logic PD's Ciudad Juarez Facility Earns ISO 9001 and AS9100 Certifications

Logic PD has been awarded new quality management certifications for its newest manufacturing plant in Ciudad Juárez, Mexico.

Former Senator Kelly Ayotte Joins Cirtronics' Board of Advisors

Cirtronics, an employee-owned EMS firm in New Hampshire, has named former Senator Kelly Ayotte to the company's Board of Advisors. Ayotte is widely recognized as an advocate for employee ownership, receiving the 2013 Employee Stock Ownership Plan (ESOP) Advocate of the Year Award by the ESOP's Association New England Chapter.



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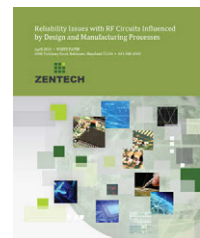
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Counterfeit Electronic Components Identification: A Case Study



by **Martin Goetz and Ramesh Varma**
NORTHROP GRUMMAN CORP.

Abstract

Counterfeit electronic components are finding their way into today's defense electronics. The problem gets even more complex when procuring DMS (diminishing manufacturing source) parts. This paper will provide a brief introduction to counterfeit prevention and detection standards, particularly as they relate to the aerospace and defense sector. An analysis of industry information on the types and nature of counterfeit components will be discussed to illustrate those most likely to be counterfeited, followed by a specific case at a major defense contractor.

The case involved two circuit card assemblies failing at test, whereby their root cause for failure was identified as "unable to write specific addresses at system speeds." The error was traced to a 4MB SRAM received from an approved supplier. Fifteen other suspect parts were compared with one authentic part directly purchased from a supplier approved by the part manufacturer. Defects or anomalies were iden-

tified but not enough to unequivocally reject these parts as counterfeit as the defects could have also happened in the pre-tinning process, which is a program-specific requirement if the parts were stored for more than three years. Through the subsequent analysis, subtle differences between the authentic and suspect parts were identified and isolated. The methodologies and process chosen to identify counterfeit parts will be reviewed and an assessment of the results will be presented along with the defects found in relation to the defect types reported in relevant test standards.

Introduction

The Defense Federal Acquisition Regulations DFARS 252.246-7007 Contractor Counterfeit Electronic Part Detection and Avoidance System defines a counterfeit part as:

An unlawful or unauthorized reproduction, substitution, or alteration that has been knowingly mismarked, misidentified, or otherwise misrepresented to be an authentic, unmodified [electronic part](#) from the original manufacturer, or a source with the express written authority of the original

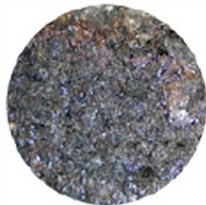
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manufacturer or current design activity, including an authorized aftermarket manufacturer. Unlawful or unauthorized substitution includes used [electronic parts](#) represented as new, or the false identification of grade, serial number, lot number, date code, or performance characteristics.¹

Highlights for the DFARS Case 2012-D055 final rule include:

- Applying requirements to the acquisition of electronic parts and assemblies containing electronic parts, including commercial items (COTS)
- Defining “Counterfeit” and “Suspect counterfeit”, is limited to electronics, including embedded software and firmware
- The costs of counterfeit electronic parts or suspect counterfeit electronic parts and the cost of rework or corrective action that may be required to remedy the use of inclusion of such parts are unallowable (unless electronic parts were provided as GFE and timely notice of discovery was provided by contractor)

Based on the highlights for the ruling and the impact that counterfeit parts could have on the performance of fielded systems, it should be obvious in terms of the importance of understanding, identifying and addressing suspect counterfeit parts in the aerospace and defense industry. Although the current definition and ruling applies to electronics, the expectation is the definition will eventually broaden to include non-electronics (i.e. optics, mechanics, MEMs, and materials). Therefore, a robust process to ensure parts that are received and used in systems to support the aerospace and defense industry is paramount to not only the business and industry, but to the users of the products that rely on these systems, especially the warfighter.

Counterfeit Parts Business is a Multibillion Dollar Industry

The discussion of recognizing that counterfeit parts have been introduced into the supply chain is not new, with various companies, and technical journals publishing as early in 2002^{2,3}.

In a 2006 article published by Pecht and Tiku⁴ and noted in the UK Electronics Alliance (UKEA) position paper, “UKEA Position on Counterfeit Electronic Components”:

Alliance for Grey Market and Counterfeit Abatement (AGMA), based in the USA, estimates that, in 2006, up to 10% of technology products sold worldwide are counterfeit, which amounts to \$100 billion of sales revenues. However, this does not take into account consequential losses. In 2007, the US Patent and Trademark Office estimated that total ‘counterfeiting and piracy (activity) drains about \$250 billion out of the US economy each year and 75,000 jobs’⁵.

A primary driver of counterfeit parts has been part scarcity, or diminishing manufacturing source and material supply (DMSMS). Realizing that as the consumer market began to grow exponentially in the 1980s and 1990s, the supply base for manufacturing parts rated for military and high-reliability applications was having a difficult time keeping up with demand, and part availability was becoming more difficult. These market forces drove the opportunity to introduce counterfeit parts into the supply chain through ‘gray market electronics brokers’. According to a 2001 article on fake parts, “One U.S. independent distributor, which asked to remain anonymous, said it paid a broker in China \$70,000 for 1206 case-size ceramic capacitors about three months ago. The 90-cent parts, which under less-constrained market conditions would have cost 20 cents, slipped through two quality inspections before arriving on the OEM’s production floor”⁶.

Bad Parts are not Always Counterfeit

It is important to recognize that, just because there are anomalies identified on electronic parts, it does not signify that the parts are counterfeit. It does, however, require the incoming inspection organization to assume the responsibility to make initial determination as to whether there is enough evidence to suggest the parts from a lot or shipment should be evaluated for additional anomalies. Three important points to consider when creating a system to screen for counterfeit parts are:

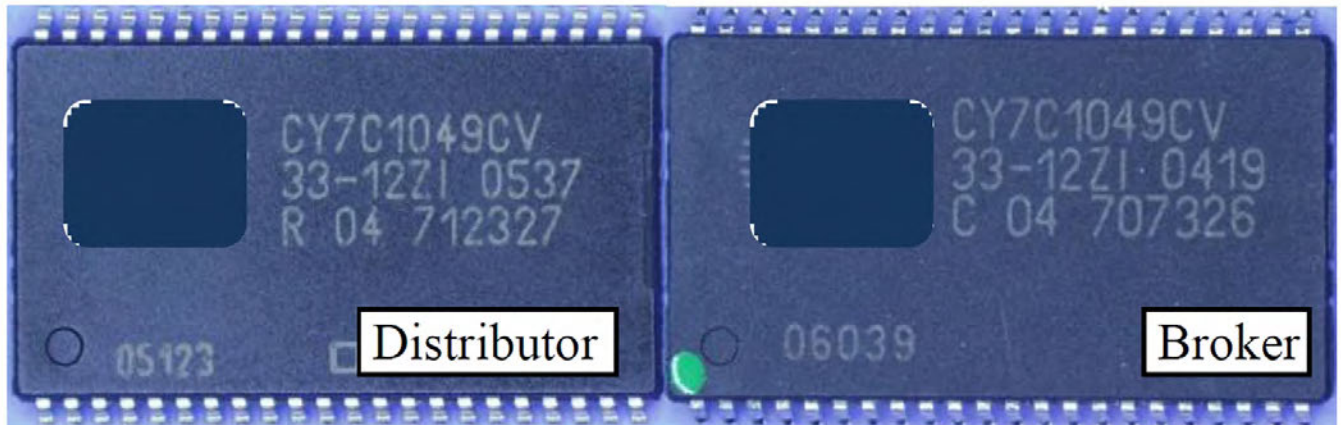


Figure 1: Comparison of two SRAM parts with different lot numbers.

- They are not easy to identify, even with sophisticated analytical methods
- They are in the supply chain, even with authorized distributors
- They are more of an issue with obsolete parts

Background on Case Study

During functional test of control module boards used in a multiple sub-array of a testable antenna, two boards failed. The root cause for the failures was identified as “unable to write specific addresses at system speeds.” When diagnosing the issue, it was narrowed down to an SRAM that was supplied by an electronics part broker. The parts in question were procured from the broker, an approved diminishing material supply (DMS) supplier, due to unavailability from a franchised distributor of the original components manufacturer (OCM). When reviewed by the internal Failure Review Board, it was determined that a comparison of SRAM parts supplied by the broker should be compared with parts from the distributor to determine if there were any observable differences in the parts.

Analysis Approaches and Techniques

A total of seven different methods which ranged from nondestructive to destructive were used to make a determination about the SRAM parts being suspect counterfeit. Any individual analysis does not make a clear case on its own merits. However, to make a legal case for sus-

pect counterfeit, enough due diligence is necessary. The following outlines the seven analyses used to make the case:

1. Visual inspection by optical microscopy
2. X-ray
3. De-capsulation
4. Scanning acoustic microscopy
5. FTIR
6. Electrical test
7. Discussions with OCM

Visual Inspection by Optical Microscopy

Once the failure occurs on a component or subsystem, typically there is an optical inspection to determine if there was any physical damage to the part either before or during testing. Damage can occur from a variety of sources including handling, testing conditions and setup, foreign object damage or debris (FOD), fixturing, etc. Figure 1 shows a comparison of an SRAM received by an authorized distributor and the broker in question. It was noted that the lot number of the broker part was not in the OCM database.

In and of itself, this does not constitute a smoking gun, but it does inspire one to continue the investigation. Upon further visual inspection, it appeared the workmanship, or quality of the part around the leads suggested a difference in mold processing (Figure 2). Because visual inspection is subjective and directed by any given customer requirements, incoming inspection (5-10X at AQL) easily can miss the in-

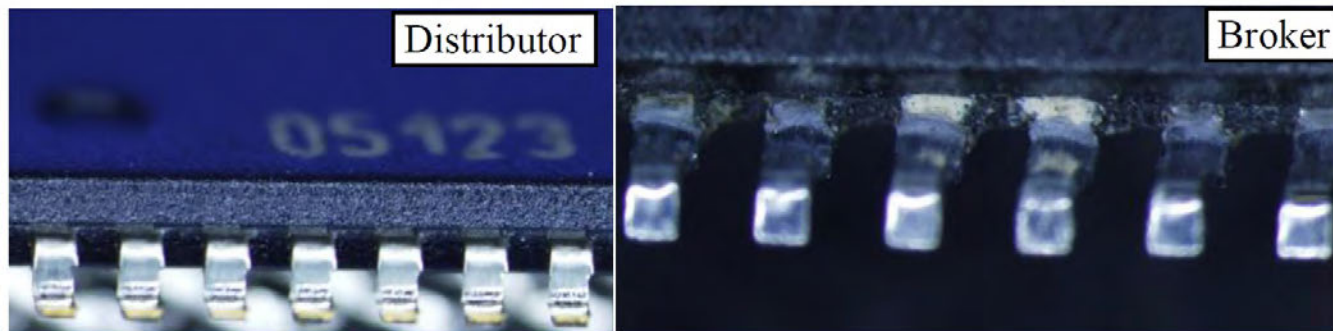


Figure 2: Lead and mold inspection. Different mold interface and pin width.

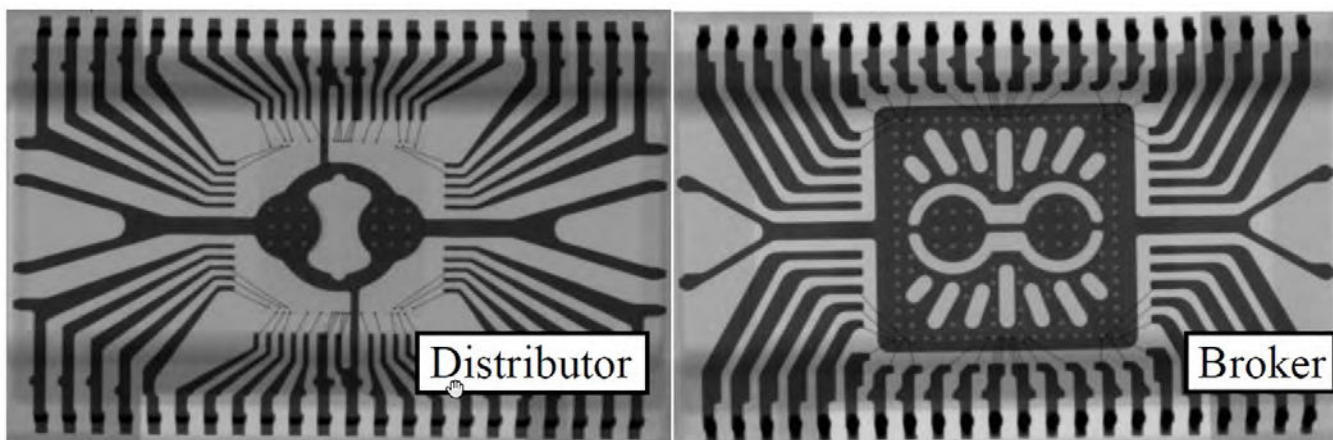


Figure 3: X-ray of leadframe with different lead and die paddle design.

consistencies. This is especially true when suspect counterfeit parts are mixed in the same delivery packaging and 100% inspection is not performed.

Finally, there was a measurement of pin width between the two different leads. The leads from the distributor parts were on the order of 14.5 mils wide, whereas the lead width from the broker parts was 12 mils. The difference led to the next step in the investigation, namely X-ray.

X-Ray

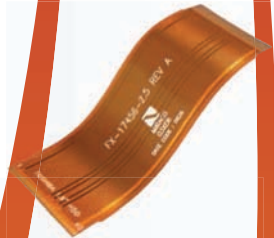
A real-time X-ray inspection system, a common instrument used in manufacturing from incoming inspection, through assembly and failure analysis also comes in handy when performing investigations of suspect counterfeit parts. In this investigation, X-ray quickly revealed two different leadframes were being used for assembly of the memory device. Figure 3

shows not only design differences in the lead design but also the die paddle design. It is interesting to note that the broker shipped parts used the same leadframe design as the distributor on one delivery date, while a different leadframe three months later. The difference in leadframe geometry could contribute to the electrical performance of the SRAM through contributions of parasitics, including wirebond length and location.

C-SAM

C-Mode scanning acoustic microscopy (C-SAM) is another tool used to detect anomalies within an electronic device. It is a form of ultrasound that uses cyclical sound waves to determine density differences within a sample and has been demonstrated to be an effective anti-counterfeiting screening tool. C-SAM allows a planar view of the interfaces between materials with intent to determine delamination. Using

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Figure 3 as a reference, the left leadframe used by the distributor and the broker (in some lots) showed acceptable delamination between the mold compound and the leadframe. However, there was significant delamination between the interfaces in the right leadframe. Delamination provided a source for trapping moisture in the part, which could lead to electrical issues including short circuits.

Decapsulation

Decapsulation of the packaged devices exposes the internal components of the package. Opening devices by decapsulation allows inspection of the die, interconnects and other features typically examined during failure analysis. Device failure analysis often relies on the selective etching of polymer encapsulants without compromising the integrity of the wire bonds and device layers. This is achieved by using microwave plasma to cleanly remove encapsulant material⁷. Figure 4 reveals that through decapsulation two different die were used for this SRAM. Although revealing, it does not immediately suggest counterfeit, as it allows that there may have been die shrink. The date codes from

the packages indicate the die and leadframe came from a part manufactured two years earlier, with a different revision, and were therefore not for the same part. This is another indicator that using older parts with a new date and lot code suggest counterfeiting.

The decapsulation results led to another evaluation of the mold compound to determine if the package mold was replaced after re-use. Two areas were inspected, the mold compound surface and the laser marking. Figure 5 shows the texture of the mold compound surface of two packages, one from the distributor, and the other from the broker. It is clear under high magnification that there is a difference, suggesting two different mold compounds were used to encapsulate the die within the package from the two different sources.

Evaluating laser marking to identify anomalies involves close inspection of the surface of the mold compound. According to one OCM:

In the process of adding a mark, the laser can cause damage to the underlying die or wires if it gets too deep into the package or compound. Basically, the laser creates a groove by burning away

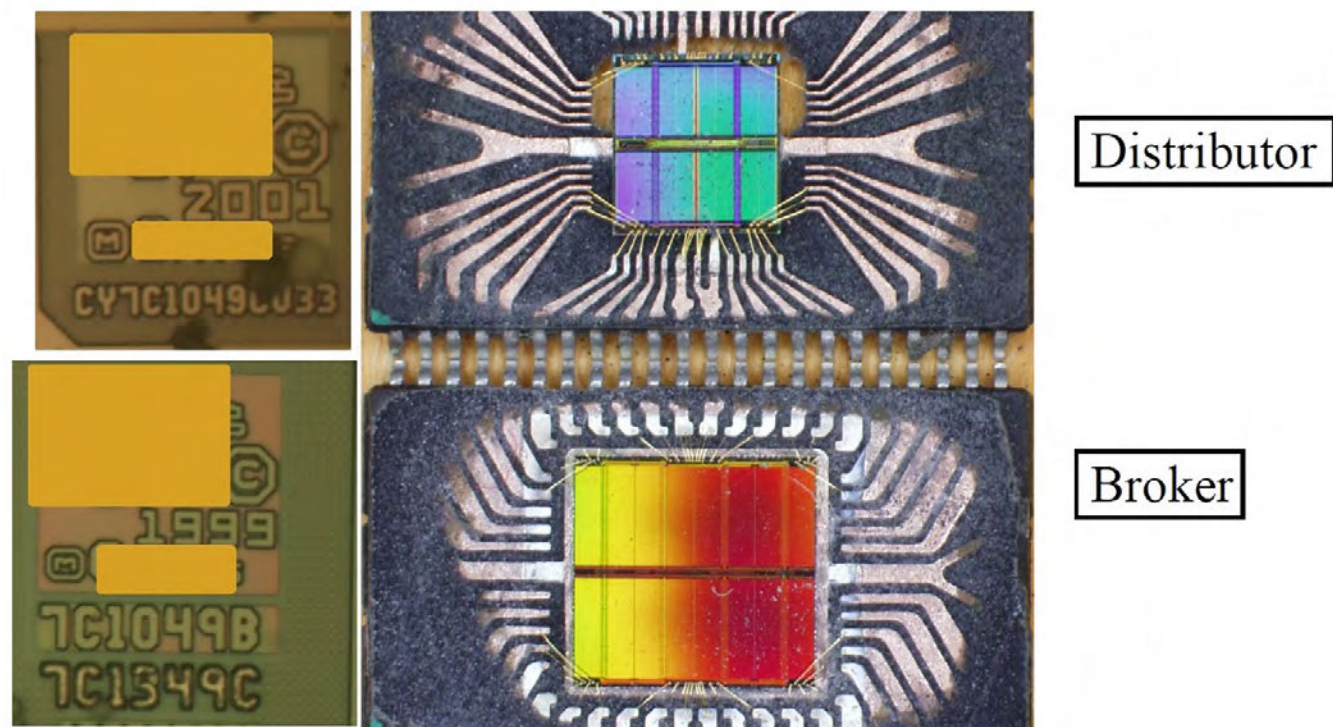


Figure 4: Decapsulation of SRAM parts. Different leadframe, different die.

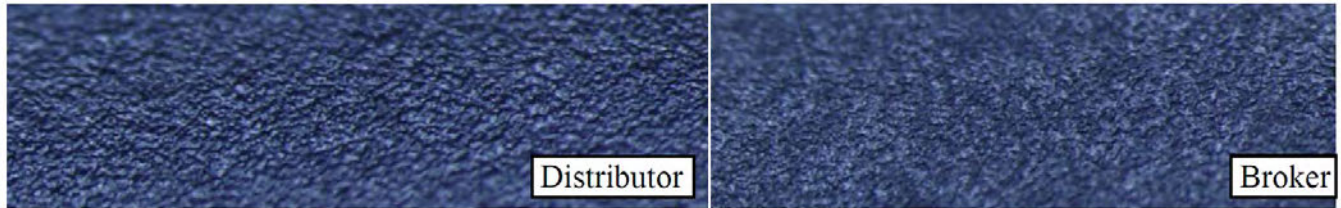


Figure 5: Mold compound surface with different texture, color and consistency.

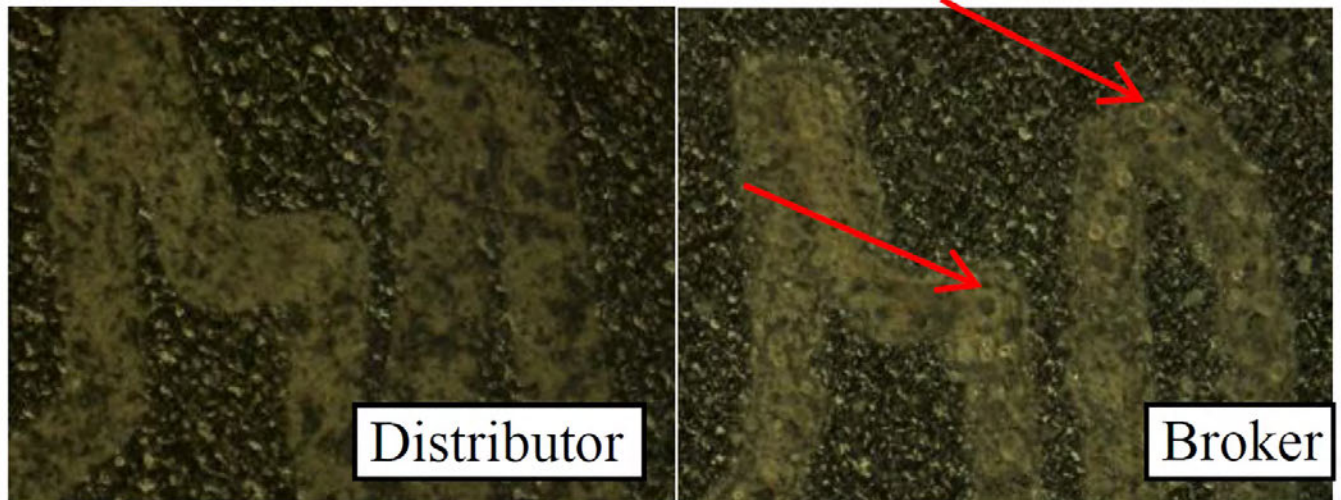


Figure 6: Laser marking on mold compound, with smooth surface versus rough.

the mold compound in order to make a visible marking. The groove or depth can vary depending upon the speed, power, and pulse rate of the laser marker. To measure this, special depth measuring equipment is required due to the small dimension of the groove⁸.

As indicated by Figure 6, a clear difference is noticed by the texture of the marking. Since the depth of the etching or removing of mold compound can be detrimental to the function of the semiconductor device, it is important to control the depth. The marking from the distributor part is smooth, whereas the marking from the broker is coarse and the presence of glass beads in the marking area indicate improper marking.

FTIR

Fourier transform infrared spectroscopy (FTIR)⁹ is a technique used to obtain an infrared spectrum of absorption or emission of a solid, liquid or gas. A FTIR spectrometer simultane-

ously collects high spectral resolution data over a wide spectral range. This confers a significant advantage over a dispersive spectrometer, which measures intensity over a narrow range of wavelengths at a time¹⁰. For this evaluation FTIR was used to evaluate the integrity of organic mold compound. When a blacktopping process is used to re-mark previously used parts, FTIR provides the ability to distinguish between two different materials. The materials that comprise the component body and any blacktopping material used to hide the evidence of counterfeiting are all organic polymers. As indicated by the spectroscopy measurement in Figure 7, there is a clear difference in response between parts. Using the distributor part as the baseline, the response from the broker parts suggests a different material is present. Blacktopping material is added to the baseline material and therefore would create a different response from the baseline. This measurement is one more indication of inconsistency between two different supplier parts.

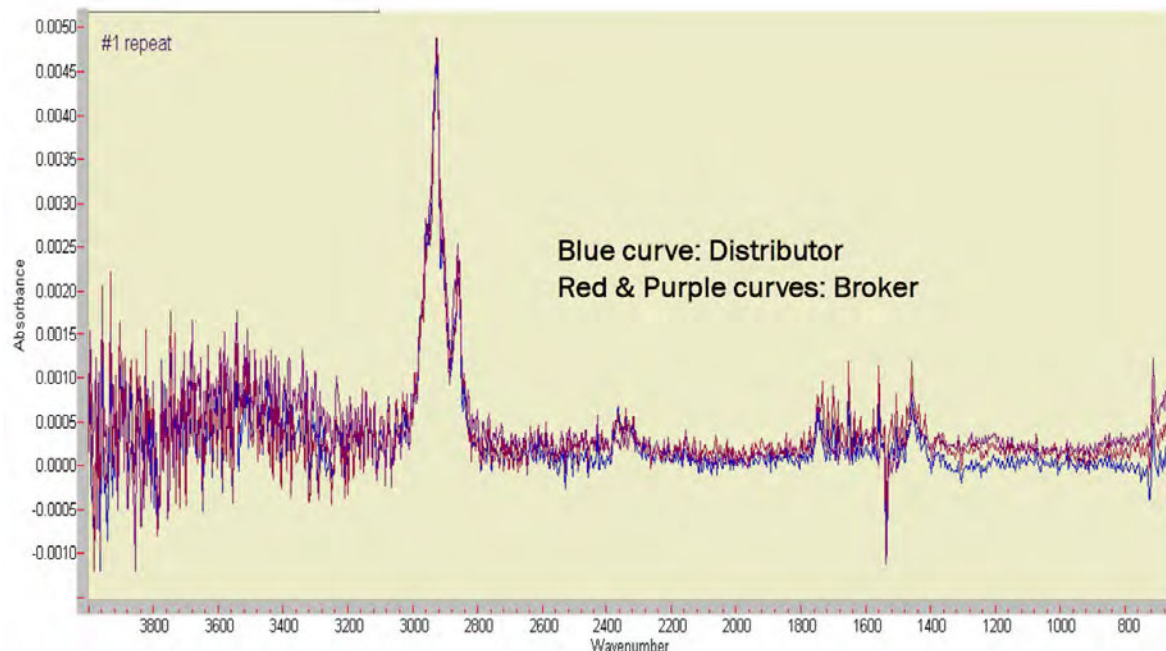


Figure 7: FTIR spectroscopy graph. Blue identifies mold compound spectra as received from distributor, red and purple from broker.

Electrical Test

Engaging an outside source for electrical test provided an independent assessment of the part performance. The outside source identified multiple configurations of die from the electrical testing, however, few parts failed retest. Test requirement specifications should have triggered some concern in acceptance at Receiving Inspection. However, since parts received met MIL spec. requirements as evidenced by a certificate of compliance, and the internal procurement criteria called out only MIL spec. for parts purchased out of the distribution chain, they were accepted.

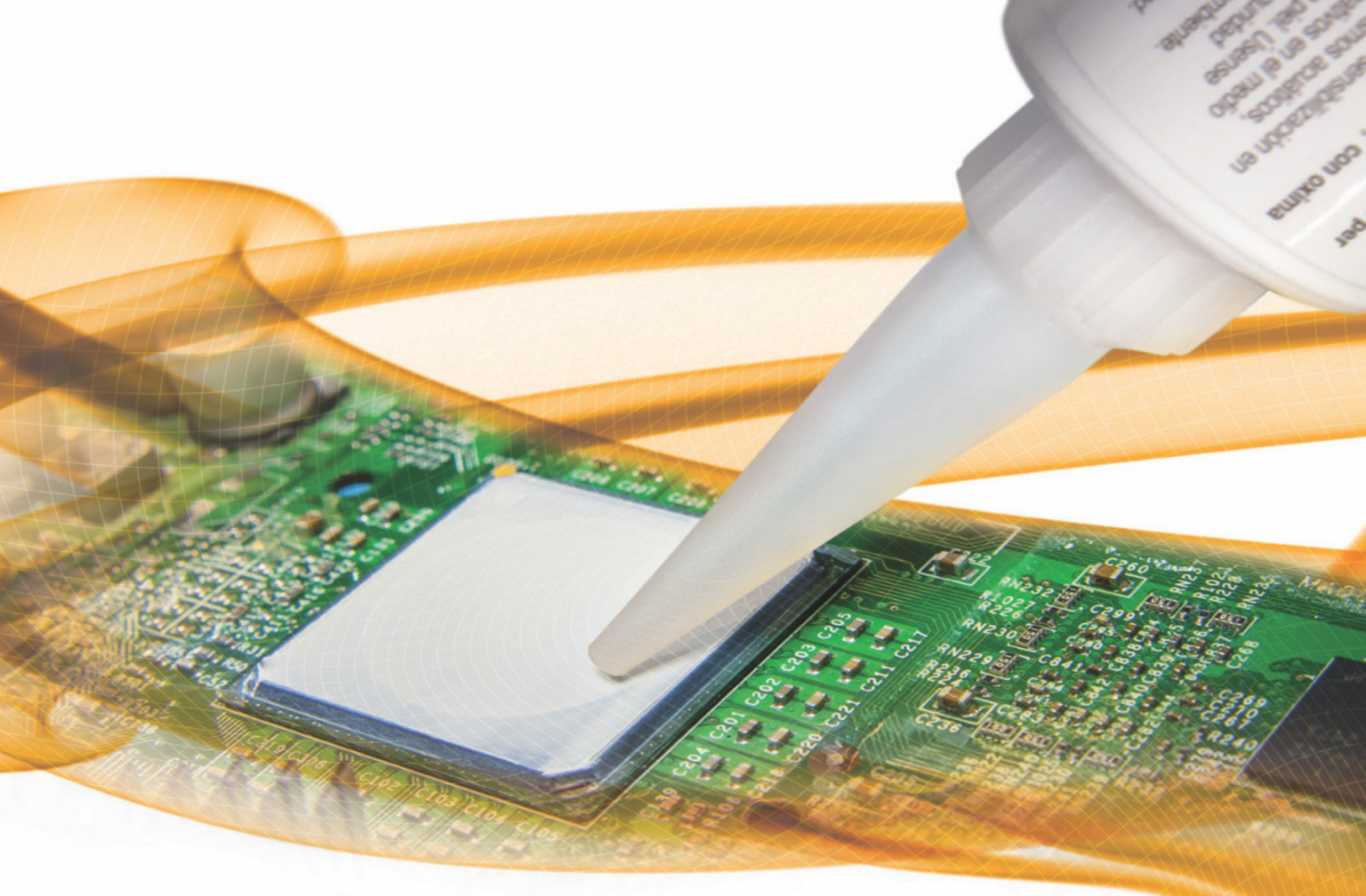
Discussions with OCM

After contacting the OCM to make some determinations about the discrepancies, Broker part number CV7C1049CV and lot number 06039 did not match with the OCM database. The OCM stated that parts with the larger die size would have a different part number CY7C1049BV33 showing the revision of the part. The two types of die seen in the broker parts were manufactured by the OCM in 1999 and 2001 respectively. The OCM suggested retention of original labels on the reel and containers

for authentication check. The distributor generally removes these and re-labels with new distributor or customer part numbers. The broker however retained the numbers and therefore these numbers could be used to track against the OCM database.

Summary and Conclusions

After the analysis was performed, it was determined by the internal failure review board (FRB) that all parts from the broker were not suspect and therefore, small lot testing may not catch counterfeit parts. It was not clear if suspect packages were harvested or re-packaged since there was evidence that both were possible through previous versions of devices as well as suspected blacktopping of the package surface. Clearly, counterfeit identification by inspection and testing is very difficult unless resources are committed to evaluate virtually 100% of parts being supplied. Records tracking were difficult because the distributor did not keep the labels and paperwork from the original manufacturer, although they could be found through diligence before re-labeling occurred. Since the SRAMs were used for high reliability applica-



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Figure 8: Press release of U.S. Department of Justice lawsuit against electronics distributor.

tions, the parts were scrapped. The U.S. Department of Justice filed a lawsuit against the broker after determining that enough evidence suggested counterfeit parts were sold, primarily to defense contractors. Figure 8 shows a press release of the lawsuit with the following excerpt:

A December 2009 sale of 350 counterfeit OCM Semiconductor ICs to a company in New York in fulfillment of a contract with a major US defense contractor for integration into a beam steering control module board within the multiple sub-array of a testable antenna for the U.S. Navy Replacement Program (ballistic missile defense).¹¹

Through the due diligence process, inspection, analysis and discussions with the OCM, distributor and broker, it was found that enough evidence suggested action be taken internally through legal channels in reporting these SRAM components as suspect counterfeit parts. Once the U.S. Department of Justice was notified and action was taken, the broker was removed from the list of possible sources for electronic devices

by at least one defense contractor. Ongoing vigilance would be the only means of protecting defense related assets from being polluted with potentially defective parts from the ever-present counterfeit market. **SMT**

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Dr. Ramesh Varma is previously a senior advisory engineer at Northrop Grumman Corp. He retired from the company at the end of 2016.

Global Military Spend on Exoskeletons to Grow by 119.5% Annually

A new report from Juniper Research forecasts that revenues from exoskeleton rental and sales will increase from just \$53 million in 2017 to \$559 million by 2022, a year-on-year growth of over 900%.

The research found that despite compelling new applications in healthcare and workplace settings, military will continue to dominate exoskeleton deployments over the next five years.

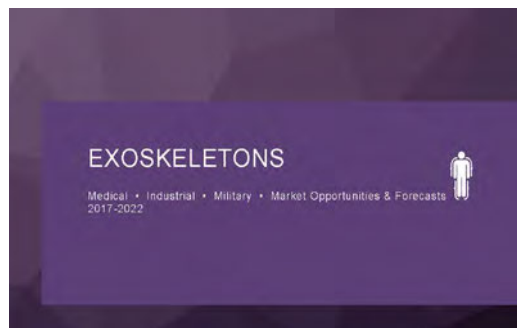
According to the research, military exoskeletons will make up over 80% of exoskeleton shipments by 2022. It found that in the short to medium term, unpowered exoskeletons such as the Marine Mojo developed by 20KTS+ will make up the majority of deployments.

Powered exoskeletons, the focus of much attention for this industry, will be initially restricted to naval deployments, where power supplies are more readily available than for other

armed forces. The research notes that the arrival of advanced powered exoskeletons in other contexts is still several years away.

"By 2019, we should see more sophisticated military exoskeletons being tested and deployed," said James Moar, report author. "Although these will account for a small percentage of deployments, this – and more widespread implementation of mid-range models such as the Lockheed SKD – will see a dramatic uplift in average pricing, resulting in a sharp rise in the overall value of the market."

In addition, the research argued that other industries need to make a business case for deploying exoskeletons to accelerate adoption. In some industries, like construction, this is relatively simple, as their value can be quantified through the savings made in time, productivity and work safety.



PCBs are MSDs

by Rich Heimsch
SUPER DRY-TOTECH EU

Guidelines for the proper storage, handling and moisture protection of electronic components can be found in IPC standards (IPC/JEDEC J-Std-033C). Though these date back to 1999, there were no published standards for storage and moisture protection for printed boards until 2010, and their proper handling is still often overlooked. But with the correct storage control and the use of suitable drying methods, considerable manufacturing advantages can be gained; PCBs will remain solderable for a much longer time and damage during reflow due to moisture can be eliminated.

The IPC-1601A (2016 revision) Printed Board Handling and Storage Guidelines states that “If process controls are ineffective, and printed boards have absorbed ex-

cessive moisture, baking is the most practical remedy.” It goes on to state, “However, baking not only increases cost and cycle time, it can also degrade solderability of the printed board which requires extra handling and increases the likelihood of handling damage or contamination. In general, both the printed board fabricator and the user should strive to avoid baking by practicing effective handling, packaging, storage, and process controls...”

In addition to moisture management at key steps in the fabrication process, 1601 also makes clear that boards should be protectively packaged to limit their exposure to ambient humidity during processing and storage. And packaged only after determining that their moisture content is below the maximum acceptable mois-



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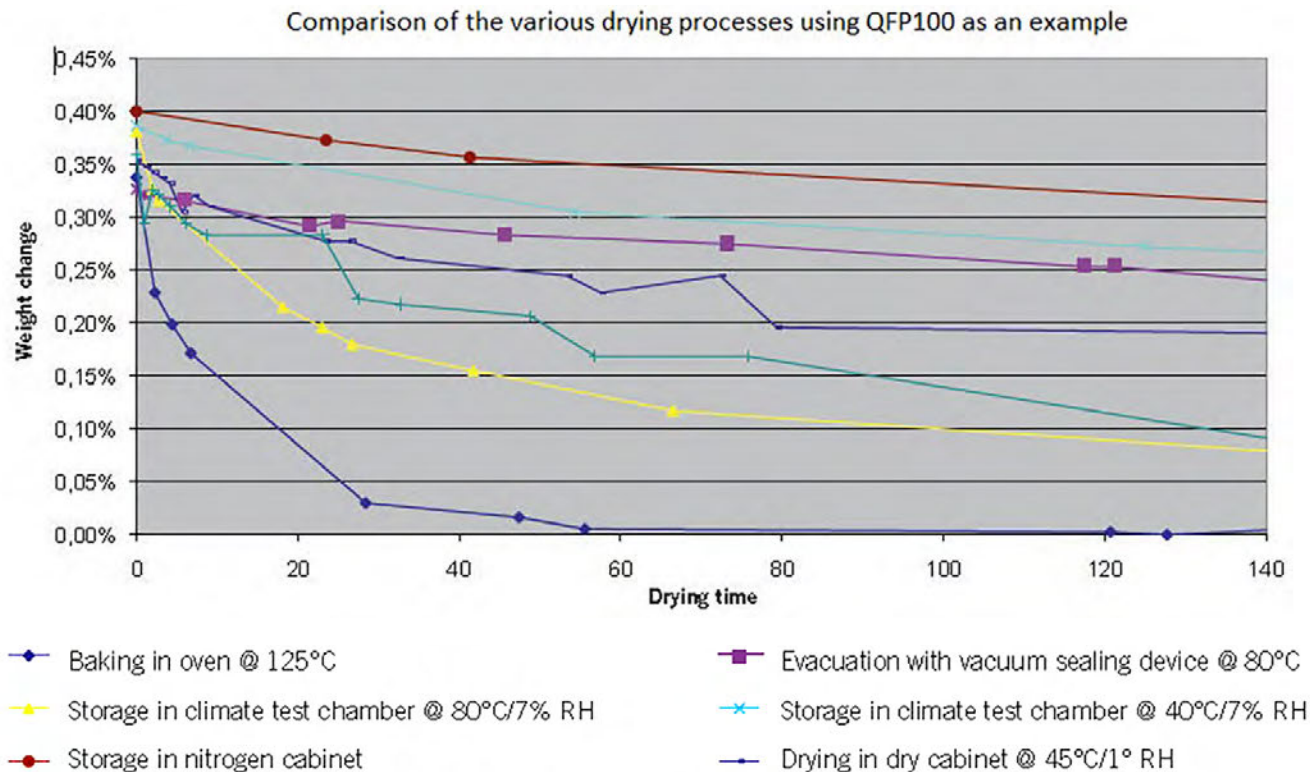


Figure 1: Chart and legend QFP.

ture content (MAMC) level, which is typically between 0.1% and 0.5% moisture weight to resin weight.

The document also states “Baking is not recommended for OSP coatings, as it deteriorates the OSP finish. If baking is deemed necessary, the use of the lowest possible temperature and dwell time is suggested as a starting point.”

Organic solderability preservative (OSP) coatings are among the leading surface finish options in lead free soldering because they provide an attractive combination of solderability, ease of processing and low cost. Compared to alternatives, however, they tend to be the most prone to oxidation. The cause for this lies in the pure copper surface protected only by the OSP coating layer. Under normal climatic conditions in a manufacturing process, after only a few minutes there will be a separation of a water film at the surface (3–5 atom layers). This then starts a diffusion process which leads to a vapor pressure balance through the OSP coat. Baking also accelerates solid diffusion between

metals, and increases intermetallic growth. This can lead to a “weak knee” or other solderability issues if the intermetallic layer reaches the surface and oxidizes. Effects upon other finishes (immersion tin, immersion silver, ENIG) are further detailed in the guidelines.

Just as with components, 125°C baking temperatures degrade the solderability of PCBs. 1601 warns that as little as 4–6 hours at that temperature can render HASL finished boards unsolderable. Over the decades that passed since the J-STD-033 standard was created, new technologies were developed and proven to safely reset component floor life using low temperatures and ultra-low humidity without requiring extensive time. These 40–60°C and <1% methods were first adopted in Europe, and their recognition and use has now spread to North America.

The same methods were applied to PCBs, and engineers from the company SMT and Hybrid GmbH published their findings in “Production of Printed Circuit Boards and Systems”¹.



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They stated, "Circuit board manufacturers are extremely hesitant at providing instructions on drying their circuit boards. Information from the ZVEI² should also be regarded critically. The cardinal problem is the high temperature which is recommended for tempering. If this is applied, the result is often de-lamination and distortion of the circuit boards. Corrosion and the formation of intermetallic phases of the metallic surfaces are also to be expected."

Their research investigated "whether gentle drying at 45°C or 60°C and at low relative humidity achieves the same result as tempering at high temperatures."

They began first with QFP components, which were saturated and then dried in seven different environments, referencing J-STD-033 standards in their report.

They then selected four PCB types and repeated the same procedures of saturation then drying and weighing to 0.1% water weight. This was done using 60°C at <1%, 45°C at <1%, and 125°C at 5%. Their summary results were that "125°C demonstrates the shortest drying time, however, oxidation of the soldering pads and board warpage make it unsuitable for the particular board types tested."

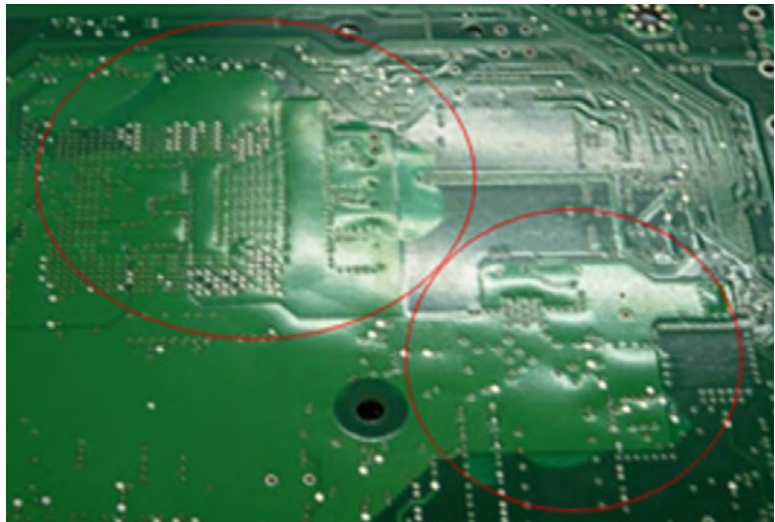


Figure 3: In addition to extending the safe storage time, defects and damage such as popcorning and delamination during the reflow process caused by moisture can be avoided.

Conclusion

Their research was conducted just prior to the publication of IPC 1601, which now provides detailed guidelines for the packaging and storage of PCBs, both from the PCB manufacturer and at the assembler's manufacturing floor. It also describes the solderability risks associated with high temperature baking. Ultra-low RH and low temperatures can significantly mitigate those risks while preventing moisture damage during reflow. **SMT**

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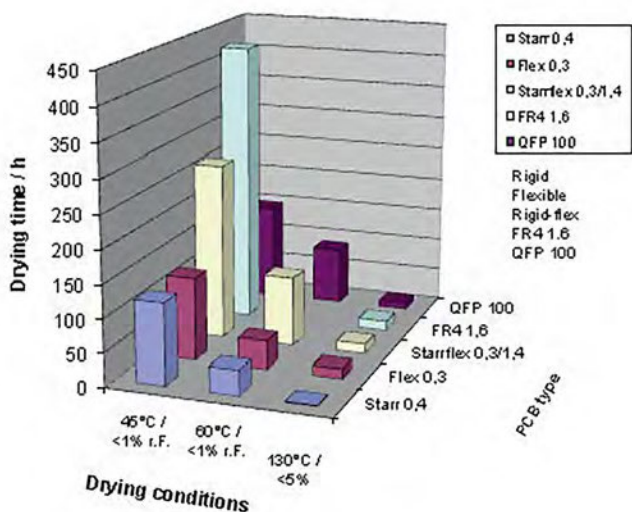


Figure 2: PCB drying chart.



Rich Heimsch is a director at Protean Inbound and for Super Dry-Totech EU in the Americas. To read past columns or to contact Heimsch, [click here](#).

SPECIAL COVERAGE



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IMPACT 2017

IPC IMPACT Washington, D.C. – May 1 - 3



IMPACT Washington, D.C. 2017: You Had to Be There!

Introduction by Patty Goldman

At every opportunity, I made it a point to tell everyone I came across that this was the year to attend IPC's IMPACT event in Washington, D.C.—and I was right. This was the year, as you will learn while reading what your colleagues who attended had to say. Apparently, the new administration managed to very quickly spread the word throughout the many government departments that manufacturing is a good thing—and it's about time.



U.S. senators and representatives, along with their staffs, seem to be scheduled very tightly with lunch often skipped to squeeze in more meetings with constituents and time on the congressional floors. Ditto for the numerous government bureaucrats (the non-political appointees who run the myriad departments). Despite that, IPC's Washington contingent managed to put together an outstanding program of speakers and meetings with the most significant departments of greatest interest to our industry. These included the Departments of Education, Defense and Commerce; the EPA, the White House, and numerous senators and congressmen. While occasionally staffers were the ones we met, more often it was the actual official—like Scott Pruitt, the new head of the EPA. (What? Talking with people from electronics manufacturing, one of the most heavily regulated industries and yeah, once upon a time, polluters? That never happened before.)

All in all, it was a very uplifting, exciting 2+ days, as anyone who attended will tell you and as you will read in this special section. Every person who spoke to us and with us had the same message: Tell us what you need. Tell

us how we can help you. Business and manufacturing is now respected as more and more people (inside and outside the government) come to the realization that real jobs are not created by government but by businesses and especially small businesses just like yours. We are no longer the enemy and no longer looked down upon. Our thoughts, opinions, and needs are being recognized.

Sorry you didn't go? You should be—it was truly a golden opportunity. But there are still things you can do. You can talk with your congressional representatives, you can send in comments to IPC, you can ask IPC to help you schedule site visits by your representatives, and you can visit government websites and learn more. I know dealing with government officials is often distasteful, but now is the time to make the leap and do it.

Of course, I talked with as many of our group as I could while at IMPACT. But this time I was also able to interview Congressman Bill Johnson (R-OH) from Ohio, who spoke at the Monday night kick-off dinner. Congressman Johnson is a true champion of our industry, in fact IPC presented him with an award at last year's IMPACT meeting. This was a great way to kick things off, as his words were all encouraging. Washington is not like what you read in the papers or see on TV.

I have put all the interviews in order so you can feel the progression through the meetings and events. I was not able to speak and record Congressman Johnson until a few weeks after the event, so I have placed him last in the lineup, but his remarks were very similar to what we heard then. **SMT**

Brad Heath VirTex

Near the end of the first full day of meetings I got a chance to talk with Brad Heath, president and CEO of the EMS company VirTex.

Patty Goldman: Brad, I understand this is your first IMPACT event. At the end of our first full day, what are your impressions?

Brad Heath: It's like drinking from a fire hose. It's a full day, with full sessions. Just very comprehensive.

Goldman: What did you think of this morning's speakers?

Heath: I thought they were great. They addressed all the different areas that really impact what we're doing. We had discussions with the Department of Education, the Department of Commerce, and the Department of Defense. It was truly impactful.

Goldman: I was impressed because they all said, "We need to hear from you." Every one of them said, "We want to hear from you. Here's what we can do. Here's how you can contact us."

Heath: We heard the same thing up at the EPA, where they said, "We need to make stuff move faster." We tell them the problem and they say, "Why did we do that? We need to consider why we put this regulation in place." If it doesn't impact [the environment], if it doesn't change anything, but you spend

a lot of time and effort doing paperwork for it, that doesn't make sense. It should only be applied to the people who need to go do it. For one example, they took the reporting level from

25,000 pounds down to 100 pounds. All types of people must report now, who didn't before.

They're looking at, "How can we do it differently?" Again, I hadn't been here before, but I've been really surprised by how receptive people from the different departments were—wanting to hear what the industry has to say, and wanting to understand our concerns, our needs, and how they can make a difference to help us create more jobs.

Goldman: I can understand a little bit better this morning why they were working with us, but with the EPA there certainly has been an adversarial attitude in the past.

Heath: You bet. What I've been told is that since the new administration came in, the time to get a meeting, the willingness to take meetings, and the willingness to do things, listen and move stuff forward, is just remarkably different.

Goldman: You know, I told a lot of people, "This is the year to go to IMPACT." This is the best opportunity to get our message across, with everybody so willing to listen, and almost begging for information.

Heath: Right. They're saying, "Here's my email, if you have ideas send me this information. We don't know enough about this. You need to send us the information you have so we can look at what we can do about it."

Goldman: I wanted to ask the fellow from commerce, if it made a difference to hear from individuals versus, say, IPC representing everybody. IPC represents the whole industry, but does it make a difference to hear from individuals? My guess is yes. The more individuals they hear from, the more companies they hear from and the bigger the impact.

Heath: I would guess that's probably especially true if they start hearing the same patterns and the same trends over and over from different individuals. Even though most of us in



Brad Heath

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Scott Pruitt greets Shane Whiteside.

the industry are doing similar things—companies are different sizes, in different locations—but the headaches we’re dealing with are pretty much the same, like workforce development, skills gap, over-regulation, taxes, healthcare, all those things.

Goldman: Hearing it from all over the country has got to make an impression.

Heath: Yes. My guess is it’s not the first time they’ve heard any of these issues pop up. They probably would hear it as they talk to other industries as well.

IPC will be presenting two awards tonight to senators.

Goldman: Excellent. We’ll have two people from the Senate hearing from us and we’ll be hearing from them. It’s really a two-way street. You pick up a lot from them and we learn their views and a little inside info on the workings on the Hill.

Heath: Then tomorrow we’re going to head to the Hill. Go pound the message into the Senate, I guess. We’ll have some group sessions and then I’ll stay over tomorrow afternoon and I’ll have some meetings with individuals from Texas and Wisconsin, which is where we have our facilities.

Goldman: You’ll be able to speak with both. That’s wonderful.

Heath: That’s the hope. That’s what they (IPC staff) are trying to get set up.

Goldman: You can imagine all the other industry groups that are also pulling at them, which has got to make it tough for scheduling. That’s why we don’t always get to speak to the senators and representatives themselves.

Heath: That’s so true. But it’s amazing when you get them out into your facilities. Over the last four or five months now, we’ve had the staffers from several of our Congressmen’s office come through our Texas and Wisconsin facilities. We had Congressman Michael McCaul come through the Austin facility. That was great—we’re getting in front of them. When they come through and look at it they’re saying, “We had no idea this is what electronics manufacturing was like.” They had no clue.

Goldman: It’s possible they’ve never been in manufacturing facility at all. They think it’s going to be dirty and smelly and rough; manufacturing is a dirty word to them, I suppose.

Heath: Well, they see the pictures of the facilities where people are putting stuff down by hand. That’s what they think you’re doing.



Alexander Gray, special assistant to the president.

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Goldman: It's nice to show them something different.

Heath: But in manufacturing there's a big cross-section. It's Anglo, it's Hispanics, it's Asians, it's African-Americans, it's Indians, you name it. There's probably no broader cross-section of a workforce than the manufacturing workforce. It's extremely diverse. It's diverse in terms of age. It's diverse in terms of gender. It's diverse in terms of ethnicity. You name it, it's there in manufacturing.

Goldman: That's true—and manufacturing is a very broad term itself. It's ranges from somebody doing the same thing repeatedly to people who push buttons and oversee things being built. Big things happen. Anything else come to mind here?

Heath: Looking forward to tonight and Day Two. For as busy as today was, I'd just as soon go to my bed tonight, but I'm going to the dinner.

Goldman: Oh, you definitely want to go to dinner because there will be two senators who will be worth listening to. You want to hear from more than just your own Congressmen.

Heath: A day like this will wear you out, but it's worth doing. Somebody has got to do it.

Goldman: It is definitely worth it. These people seem to run from one thing to the other, though. Apparently, they're very tightly scheduled. They've got no extra time.

Heath: They seem to run from one appointment to another—and they do this every day.

Goldman: No wonder it's difficult to get things scheduled. IPC did a fantastic job getting people from Education, Commerce and DOD this morning and then the top guy at EPA and staffers from Pence's office this afternoon.

Heath: They did. It's a great town here [Washington, D.C.].

Goldman: Thank you so much for your time, Brad.

Heath: You bet. Absolutely. **SMT**

Mikel Williams Targus

After meetings all day Tuesday, there was an awards dinner that evening. IPC presented awards to two senators. Before we got started, I chatted a few minutes with Mikel Williams, president and CEO of Targus.

Patty Goldman: Mikel, we've listened to a lot of speakers today, and I understand you guys had great afternoon. Tell me about your impressions.

Williams: Yes, we did and I have several. First, it seems as though with every year, IPC's IMPACT days get better and better. We're generally known as a standards organization. We're now gaining footing in public affairs, coming to Washington and trying to weigh in on public policy. The early days were a little rough; now we're much better. The staff does a great job organizing it, and we get great meetings.

It's clear that the administration is still settling in, but in fact, I had a little side meeting with somebody from the foreign affairs committee between the dinner here and the last one with Vice President Pence's staff, and I said, "You know, for the first time in a number of years you go into these meetings and you're not being treated like a bad, guilty business guy com-



Mikel Williams

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ing in.” This trip, the people we met with know we care about environmental and labor issues and things like that, which of course we do, and they’re actually trying to help us also improve our country’s economy and our businesses.

Goldman: And they’re asking for help from us, and information.

Williams: Yes, they want to help do things that will be good for our economy and good for jobs and everything else, so it’s refreshing this year, in that regard, although still early in the new administration’s term. Hopefully, a year from now, we’ll have healthcare, tax reform, and a bunch of other things, if not done, well in hand.

Goldman: I guess the other thing you learn is that nothing happens very fast in Washington—fortunately and unfortunately.

Williams: That’s true. Sometimes, getting it done in a hurry is not getting it done right.

Goldman: Of the speakers this morning, is there anybody in particular that stood out to you?

Williams: I thought all of them were good. I enjoyed Congressman Bill Johnson (R-OH) at dinner last night.

Goldman: He’s great to listen to.



Earl Comstock, Office of Policy & Strategic Planning.

Williams: He’s funny and yet also insightful and committed to our country. I remember calling on him when he had just won his first term, and I’ll say, as with IPC developing its presence and skills over time, so has he. He has done a very good job, and he is a very good spokesman for many of our causes. I’m happy to have him involved with our program and support us by coming out like that.

Goldman: Yes, he’s really supporting us. Mikel, thank you for the quick chat.

Williams: Thank you. **SMT**

Tony Revier Uyemura

One of the best parts of IMPACT for me is meeting and getting to know people in our industry that I haven’t met before. While hors d’oeuvres were coming around before the Tuesday evening awards dinner, I found a quiet corner to talk with Uyemura USA President and CEO Tony Revier.

Patty Goldman: We’re nearing the end of the first day at IMPACT, and I want to get your impression of today, Tony.

Revier: I think it’s been terrific. This is my third event. I didn’t get to come last year; I had some other customer issues, but of the three I’ve come to, this is by far the best. This is really a great meeting, and I’ve met a lot of folks. Last night was great, listening and talking with congressman Bill Johnson from Ohio.

Goldman: Yes, he’s the best, one of our industry’s champions.

Revier: I’ve been coming to the Hill for about 20 years, not just with IPC, but also on the metal finishing industry, with the National Associa-

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tion for Surface Finishing (NASF). We do a legislative day once a year too. In all the years that I've come, it's nice now that people here are talking about manufacturing.

Goldman: Do you feel that is new this year?

Revier: Well, it's been coming, but now of course they're embracing it big time. We saw that certainly with having a chance to meet with Scott Pruitt, the head of the EPA. He's somebody we can talk to now.

Goldman: He's asking you for feedback, right? That must be new.

Revier: Absolutely. Before that, I can tell you, we're in a specialty chemical industry, so we know those guys quite well. When you talked about chemicals with those people in the past, they were not on the favorable side of things. You can see from Scott's point of view, he's very open to working with manufacturing, with industry, and really understanding what it is that we're trying to do and accomplish. One of those things that are holding us back is regulation and over-regulation. The problem is that so many of the people out there, regulators, media, etc., have no clue what we do and that we know how to handle the chemicals we use.

Goldman: We already have good regulations, but they keep upping the game.

Revier: Right, and if you look at our industry as a whole, near and dear to our heart is chemical processing, whether it's the copper plating process, electroless copper plating, ENIG, EN-EPIG, and everything related to that; we're in the chemical processing business. We're highly regulated on many different fronts, not just by the EPA. We're now involved with the DEA because of the sodium hypophosphite issues, which just kind of drives us crazy. Mainly because what we're selling is a liquid containing the sodium hypo, and they're all about the hypo material itself. We're not selling the raw hypo.

We're selling a mixture. In their infinite wisdom, when I talk to senior level people at the DEA, they agree with us that we should not have been included in the 2011 revamp of the ruling, but then they laugh and say, "But you are. Live with it."



Tony Revier

Goldman: They don't quite understand the additional burden. That means nothing to them.

Revier: No, they have no idea. I have to register all my facilities. If I have a warehouse (which has the product containing hypo), and no matter where in the U.S., I have to register with the DEA, get permits, and pay an annual fee. Ah, it's always about the money, right? Then, of course, we have TSCA rules and we have OSHA regulations, but it seems to me now, though, we have an administration that is willing to really talk about these things and how to possibly change things. How can we relieve some of the unnecessary burden on industry?

Goldman: Hopefully how we can improve it, without compromising any of the important things.

Revier: We always say, "Look, our families live in these areas. We've got children. We've got grandchildren, and we want to be able to provide clean air or clean water." I mean, it's just absurd when they look at it and say, "Oh, you guys, you just want to roll things back and pollute." We've made such great progress, and a lot of the things that have happened on wastewater treatment and cleaning up the environment is because our industry has been very proactive in that stance.

Goldman: I was really impressed by Kim Ford this morning. She was so enthusiastic.

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Revier: I was interested in listening to the new EPA chief, Scott Pruitt, but I was certainly impressed at beginning of the meeting with Kim Ford. I didn't expect much, but the way she went around to meet everybody at the beginning of her presentation, was cool.

Goldman: She shook everybody's hand and introduced herself to everyone present. Such enthusiasm, too.

Revier: She said really positive things about trying to understand our skill needs. What do we need from an educational standpoint? How do we get people where they need to be? It was very refreshing. She seemed very genuine about what she was talking about.

Goldman: Yes, her focus was: "Tell us what you need; let us help you." The website she talked about, the Perkins Collaborative Resource Network (PCRN), is easily found on Google. It popped right up for me (cte.ed.gov). There is a lot of useful information on it.

Revier: Yes, it seemed very interesting. You know, by and large our industry is all about technology. If you look at our company, we're a more international corporation, and I've been with UIC now for 29 years. The reason I came here in the very beginning was about technology. Our parent company is in Japan. We still have, even to this day, 70 people involved in research and development. We just invested about \$70 million in a brand new central research facility in Hirakata, Japan. We are totally committed to technology for the future. I mean, it's all about what we do.

Goldman: It's in your blood, so to speak.

Revier: And it's what sets us apart too. We're all about technology. Where's it going? What are the customer needs? How do we advance the industry? At the same time, back in 1997, we made the commitment to set up our own technical development center in Southern Connect-



Robert Irie, Office of Undersecretary of Defense, with John Mitchell.

icut. That's our UIC tech center, where we can support customers with failure analysis and ordinary samples. We do pilot plating there as well and some development work. We are excited that we just recently received our first UIC developed patent. Also, we do some very precise, small-scale production there. Then we have blending facilities in other areas of North America.

Goldman: What made you choose Connecticut?

Revier: In 1992, we took over the precious metal plating product line from a company called Degussa. At that time, we had not been in that area of the plating industry. We had not been in precious metals, but we had a long relationship on several different avenues with Degussa, which is now called Umicore. We took on that challenge in '92, and we picked up a number of great people and a facility in Connecticut.

Later, we decided that we really needed to do more than that. We decided to build our own facility in Southington. We built it from the ground up; it's a 45,000 square-foot facility where we can do everything we really need



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to do, and we can expand it too, if the business warrants it.

Goldman: Well, we're looking forward to a lovely evening here, I think. How was the afternoon? The EPA was great, but how about everything else?

Revier: The EPA was great. Then our other meeting was near the White House with some very strategic people that work for President Trump. It just kind of continued the excitement with people that are engaged in manufacturing and regulatory issues that affect what we're doing. It's very clear from meeting with those guys this afternoon that they're committed to listening to our issues and acting on them.

Goldman: We'll see how that action part works.

Revier: We'll see. I think the challenge obviously for President Trump; he said it was a swamp, but I think that he's finding out that it's not like running a business where you can get things done.

Goldman: Exactly. I mean, you're the boss, but you're not the boss.

Revier: But you got to navigate the way.

Goldman: Like they said this morning, nothing really happens that fast in Washington.

Revier: No, and I'm sure it's frustrating for him.

Goldman: Yes, because you're right. He's used to doing things fast.

Revier: At the same time, he's learning his way; the exciting part of it is he's putting together the right people to get the job done. I think Mike Pence as his VP was a perfect choice, and I think they're a good pair. They work together as a great team. They seem to be very symbiotic that way. I hope that continues.

Goldman: Well, thanks Tony. Maybe we'll get a chance to talk again. Right now, we're going to eat our hors d'oeuvres.

Revier: Absolutely. **SMT**

Shane Whiteside Summit Interconnect

During Tuesday night's dinner I also had a chance to talk with Shane Whiteside, Summit Interconnect's president and CEO.

Goldman: Shane, it's good to see you. Is this your first time at IMPACT?

Whiteside: This is my first IMPACT. I've missed it in previous years, but I'm very pleased to be here.

Goldman: Tell me what you've learned in the past day and a half, since arriving.

Whiteside: I've been impressed with how IPC has organized a very effective event, and I think that's not only my impression, but other attendees as well. The people that we've met today reflect the influence that IPC has gained in this town, from EPA administrator Scott Pruitt to one of Vice President Pence's senior advisors, Darius Meeks. It's just an incredible lineup here today and I think what was really gratifying to me is understanding how much the new administration is aligned with a promoting a very positive industrial policy.

Goldman: It seems everybody is aligning with that, shall we say, and quickly.

Whiteside: There is a lot of enthusiasm with respect to the potential resurgence of U.S. manu-



Shane Whiteside

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facturing. I think that a lot of the people that we met today represent not only new faces, but a new approach as well. The tone is much different, from what I understand, from previous eras. And we're very much looking forward to the support and the commitments that were made here today to create positive change in our industry.

Goldman: I'm going to put you on the spot a little bit. This morning, a couple of people, including Kim Ford and Robert Irie from the Department of Defense said, "Get back to us with information—with your needs." Are you going to act on anything?

Whiteside: I think Kim Ford's challenge was to get back to her department with what sort of educational needs we can articulate to IPC and their membership can support, or she can support. I think IPC has increased their focus on members' training needs and is in the best position to respond to Ms. Ford, we will continue to work with IPC in this area. And with the DoD's request, they've spent a lot of time assessing the electronics supply chain in the U.S. and they have a very pragmatic assessment of where the risks are in the supply chain. Where I am concerned about the supply chain is in bare printed circuit board manufacturing, and unfortunately the government's assessment is still "TBD." This is due to a 2016 Department of Commerce study that will take until November 2017 to get the results for and allow anyone to really develop an opinion on how to go forward.

Goldman: They presented some preliminary information in February at IPC's Executive Forum.

Whiteside: Yes, I saw that at the IPC APEX EXPO Executive Forum, but it was very preliminary and nobody could really tell us, "What does this mean? What are you going to do with this?" My message that I was able to communicate to some of the people we met today was that some of the most advanced printed circuit board technology being produced in the world today is not



Shane Whiteside and Phil Titterton.

produced in the United States, whether from a circuit density HDI standpoint, or materials—a lot of the expertise that exists in the world to create the world's most advanced printed circuit boards resides in China. It doesn't reside in the U.S.

If the amount of technology that exists in today's smartphone needs to be immediately employed in the next generation of weapon systems, communication systems for defense, etc., you would need to take the most advanced pitch BGA device and pin that out on a circuit board in today's world, and build that circuit board in the United States. Currently, you can't build that here. We don't have the capital equipment set, we don't have the expertise, and we don't have the materials know-how, because for the past 15 years it's all been completely invested in outside of the United States. I've conveyed that message a few times here today, and I hope that that message has been received.

Goldman: Several people today said that things don't happen quickly. But as we know, in our industry things happen awfully fast. Much faster than they do in this town.

Whiteside: From my experience, that's usually due to changes in commercial business, whether some fall-down somewhere or something unanticipated happens. I don't know if anything is going to happen quickly inside the Defense Industrial Base that is part of the normal course

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of business, particularly in Washington, DC. I think it's just always going to be slow change. I'm hopeful that it can be faster than it has been, but even if everybody were to figure everything out in the next week with the budget—we're still in a stub-period with this—I don't know if it's a continuing resolution or whatever this thing is that we're at, but we don't have a full budget yet. Even if everything were to be figured out, by the time that funding and everything flows down to the component level in our supply chain, I don't look for anything to happen very soon.

Goldman: Quickly on another subject, I keep hearing about the shortage of copper; is that hitting you, and are you watching it?

Whiteside: The shortage of copper foil for PCB laminate is something that is affecting the industry globally, but much more so in Asia as I understand it. If it endures longer term I would look for the domestic impacts to become more severe.

Goldman: Thanks for your time, Shane.

Whiteside: Yes, thank you. I appreciate the opportunity to speak with you. **SMT**

Dave Raby STI Electronics

After dinner concluded and we were returning to the hotel, I spoke with Dave Raby, president and CEO of STI Electronics.

Patty Goldman: Dave, it's good to see you again. How was your day at IMPACT?

Dave Raby: Today has been great. I didn't know what to expect, judging from the ongoing news coverage of how horrible things are in D.C. and all that. But we found a whole different attitude:

People were happy to see us! They wanted to know what they could do for us. They were receptive to ideas. They wanted input.

Goldman: And it wasn't a forced thing. They were genuinely interested, though of course nothing happens overnight, as they said.



Dave Raby

Raby: That is true, and we'll see what the results are. Nothing we said today is going to change a law tomorrow, but I felt good about the people we visited and those who spoke with us.

Goldman: Me too. We started out with Congressman Bill Johnson (R-OH) last night, a champion for our industry. He makes you feel good about your country and that things are not so bad in Congress as we hear.

Raby: Yes. I like him.

Goldman: Does anyone in particular stand out for you today?

Raby: They were all impressive, they really were. It was great to meet with Scott Pruitt who is the administrator of the EPA and a member of President Trump's cabinet. We also met with Daris Meeks who is Deputy Assistant to the President and Director of Domestic Policy for Vice President Pence. It was hard not to be overwhelmed by those offices and all of the surroundings.

Personally, I was most impressed by Alexander Gray who is Special Assistant to the President and Director of the White House Domestic Policy. He had a true understanding of our industry and the issues we face and was committed to finding solutions. He understood how a supply chain and business works. I had not experienced that before or least not from someone who could articulate their understanding. He had an appreciation for every step along the way and was interested in how the government could help or

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stay out of the way. He asked us to email him if we were facing a reduction in force due to a government regulation change. That impressed me.

Goldman: You've gone to more of these IMPACT events than I have, but it seems that we're seeing perhaps a higher level of people within the administrations.

Raby: We are and, continuing with the theme, they really did seem genuinely interested in what we had to say.

EPA Administrator Pruitt knew some of what we were talking about but would look to his deputy for help on other issues and ask IPC to send him more information on others. IPC has done a lot of work on environmental issues but this was our first time to get to meet with the Administrator and he seemed genuinely happy to see us and get our input. We were not treated like we were the enemy.

Mr. Meeks was also very welcoming. He was receptive to IPC's position and stressed his mandate to help us create jobs (everyone we talked with seemed to understand that government does not create jobs) and had a particular interest in high-tech and space which are both near and dear to my heart.

Goldman: I was impressed by Kim Ford, the deputy assistant secretary for Education, and her enthusiasm and interest in what we do and

how her department can help.

Raby: Yes, she was great. It was funny. John [Mitchell] was trying to get the meeting started and she was going around the room shaking hands with everybody and introducing herself. She was just bubbling and seemed so excited to be with us. She was in that job during the last administration, but she didn't come speak to us and we didn't see her. I may be wrong on this but my impression was she seemed to have been freed to do her job and was very excited at the prospect. She understood what was going on in our industry regarding skills gaps and was quick to say (even being from the U.S. Department of Education) that not everyone needs to go to college. She also recognized that some of that skills gap is a basic education of what is expected from an employee.

Goldman: And as she said, part of it is Johnny coming to work every day.

Raby: Yes. Well, that's the thing you know. "Do I really have to be there at 8:00 every morning?" "Yeah you do." I was impressed with everybody we met today. What really stands out in my mind though is their enthusiasm, willingness to listen and genuine interest in finding solutions for our industry.

Goldman: I wonder, the administration has been in office about a hundred days, as they keep telling us. Did these people and departments really change that quickly? Or was it like this before and it was just suppressed?

Raby: I don't know the answer to that. It would be guessing on my part, because we didn't meet with these people before. Everyone we met with today seemed to be committed to working with industry to solve the problems we have, and the status quo in many cases is the problem.

Goldman: And I'm sure we wouldn't have gotten to talk with the head of the EPA last year. I don't know, but my guess is no.



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Raby: There's a hundred reasons or more as to why you don't get to meet somebody because of all the schedules and the changes up here. I don't know how IPC put a schedule together but they do an amazing job.

Goldman: I don't either, and maintain it. It's amazing how everyone down here seems to run from one thing to the other. But they did make time to speak to us.

Raby: They did, and then personally, I always enjoy hanging out with all the other execs who are here. Some of them I know from previous years or from other places. Some of them I just met this morning or last night at dinner for the first time. But it's always nice to hang out with somebody in a similar position because you have the same issues all the time, and it's just always good to hear how they think of things. That helps me tremendously, whether I really get a solution from them or I just see somebody else survived it.

Goldman: There's a light at the end of the tunnel. Anything else you'd like to discuss?

Raby: I appreciate you being here, because this is good for our industry. It really is. The things that we're trying to accomplish are good for all of us, and you being here, your people supporting you being here, is supporting our industry.

Goldman: Well that's our motto, you know, "Good for the Industry." I believe everyone in our company is committed to this industry. It's our life. I guess a lot of people might be sorry that they aren't here; this was the opportunity this year. Then tomorrow, do you have more to come?

Raby: Tomorrow we're meeting with three senators in the morning and then I'm meeting with two representatives and a senator from my home state.

Goldman: That's a lot of congress people, all in one day.

Raby: The first three in the morning I don't know, but I'm sure I'm going to learn a lot. The three in the afternoon represent me, so I'm happy to get to talk with them and look forward to that.

Goldman: Do you invite them to your facility?

Raby: Yes, two of the three have been to our facility and both know us well. It's our representative and then the representative from the district just south of us where some of our workers live. The other one is a new senator that has only been in office since February. He is the replacement for Senator Sessions, who became the Attorney General. I have not had a chance to meet him, but I'm looking forward to that tomorrow.

Goldman: You can extend an invitation to visit your company.

Raby: I absolutely will.

Goldman: And IPC can help set that up. Dave, it's been great talking with you, as always.

Raby: Thank you. Thanks for all you do. **SMT**

Suzy Sterner SAIC

While my discussion Wednesday morning with SAIC's VP of Government Affairs Suzy Sterner was brief, it was to the point and an excellent testimony to the success of this year's IMPACT event. Suzy has been in the defense industry for quite a while, making her comments particularly significant.

Patty Goldman: Suzy, you've been to IMPACT before. After this second full day, what is your impression of the speakers and meetings that were held yesterday?

IMPACT Interviews



Suzy Sterner

Suzy Sterner: Yesterday was very impressive with the level of people from the administration that we had an opportunity to meet with, to the insights they shared with us.

Goldman: I understand you're quite involved in the defense industry. What are your thoughts on what Robert Irie (from the Office of the Undersecretary of Defense for Acquisition, Technology and Logistics) had to say?

Sterner: First, he was exactly the right person to be here because he handles all the electronics industrial base issues within DoD. He was very forthright on what he needs to help continue to support the Executive Agent for Printed Circuit Boards and Interconnection Technology sponsored by the Navy in Crane (Indiana). They want input from us and they want a dialogue.

Goldman: Is that a new thing, based on your previous experience here?

Sterner: This is my second IMPACT, but I've worked in Washington for more than 25 years. It's a little bit more open than it was in the previous Administration. We had the right people here, especially considering that not all the political positions have been filled. When political positions weren't available, we had very high senior-level civil servants who will be there when the new political person comes in, and they made it clear they will still be willing to work with us.

Goldman: That's great. I hear the meeting with the EPA was good yesterday.

Sterner: It was very good. It was a completely different—I was going to say environment, which sounds ironic to say about the EPA—but

it was a very different atmosphere than we've dealt with in the past. Administrator Pruitt was welcoming and interested in what we had to say; he took notes and he gave assignments for follow-up to his staff member assisting him. You can't ask for more than that.

Goldman: And there was a meeting at the White House also?

Sterner: Yes, we met with high-level staff from Vice President Pence's office. That was very worthwhile. In addition to defense, I cover space issues, and we got insights into what they're doing with the National Space Council. It's been a very productive day.

Goldman: Yes. Everyone seemed impressed with Kim Ford yesterday morning. She was very enthusiastic and welcoming as you said.

Sterner: Kim Ford was very impressive. They're really inviting industry to engage, and this was a great opportunity to do that.

Goldman: Yes. I think everybody was overjoyed about all of that.

Sterner: They should be. It was a highly productive day.

Goldman: Suzy, thanks so much for your input.

Sterner: Thank you. **SMT**



IMPACT Interviews

Mark Wolfe John Deere Electronic Solutions

An interesting participant at IMPACT was Mark Wolfe, director of supply management with John Deere Electronic Solutions. We spoke briefly Wednesday morning before things got started.

Patty Goldman: It's nice to meet you, Mark. We're starting the second full day of IMPACT, and I thought it would be good to get your perspective. First, you told me yesterday that the majority of your business is for John Deere, but you also assemble for other companies as well.

Mark Wolfe: Correct. Most of our business is for John Deere. We do have a component that's external and commercial with other OEMs with similar needs to John Deere, but are non-competing. They give us the opportunity to keep our competitiveness outside of being a captive supplier.

Goldman: So how did you feel about Monday night and yesterday? Has this been helpful to you?

Wolfe: It's been helpful. I've enjoyed it. I think it's been refreshing. I haven't been here the last few years, but certainly there was an undertone of largely positive change that was coming out of the different meetings and discussions we've had so far. There seemed to be less rhetoric. I guess time will tell if the actions follow through on things, but from the attitude of the people we met with, it was quite positive overall.

Goldman: The attitude was very positive. What did you hope to learn or gain from coming here?

Wolfe: I hoped to be a little more connected to where our new leadership for the country is headed, but at the same time I'm a long-stand-

ing IPC member and participant. So it's also as much as anything to support the efforts of IPC and all of the members.

Goldman: As far as you're concerned, that worked out this time.

Wolfe: Yes, I believe so.

Goldman: Good to hear. Thanks for your thoughts.

Wolfe: Thank you very much. **SMT**



Mark Wolfe

Fern Abrams IPC

I wanted to get the inside story on the meeting with EPA that occurred Tuesday afternoon and who better to talk with than IPC's Fern Abrams. I was able to chat with her Wednesday morning.

Patty Goldman: Fern, as director of regulatory affairs for IPC, you are deeply involved with IMPACT, on the environmental end of things, especially. Tell me about yesterday.

Fern Abrams: We had a meeting with EPA Administrator Scott Pruitt, and his Deputy Chief of Staff for Policy, Byron Brown. I think I would speak accurately for everyone if I say it was an excellent meeting. I heard one of our attendees say that it was our best meeting of the day—but I'm biased.

Goldman: Well, the fact that you spoke with the top person there says a whole lot.

Abrams: In a career of almost 20 years working in environmental policy, this is the third EPA



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administrator I've had the privilege to meet, and I would say this was just a delightful meeting.

Goldman: Wonderful. What did he have to say?

Abrams: IPC's president, John Mitchell, kicked off the meeting by telling the administrator about IPC, what we do, the members we represent, and also letting the administrator know that we had a proud history of working with the EPA. He talked a little bit about our involvement in the Design for the Environment program and mentioned that one of our staff, David Bergman, had been recognized by the EPA for his work in helping the industry transition out of ozone-depleting chemicals, but that was a long time ago, quite frankly. We are looking forward to working with this administration on cooperative environmental protection that is based on science and is cost-effective.

Goldman: Are there any hot buttons right now?

Abrams: We talked about three. The first is the recycling of byproducts and what I would say is the unfair treatment of them under the Toxic Substances Control Act, where industry has worked very diligently to find beneficial reuses of byproducts. But now under TSCA they're treated as new chemicals and so companies that choose to recycle them have the burden of reporting and the liability of that complicated reporting if they don't get it just right. Whereas, if they'd chosen to simply dispose of it they would have neither the TSCA reporting nor the liability. This has been an issue for our members for some time. Since the mid-2000s we tried to work with EPA to address this and they've been rather intransigent. That's why we worked with Congress. You

heard Congressman Bill Johnson (R-OH) speak two nights ago about this issue and you heard it mentioned last night, both by Mr. Shimkus (R-IL) and Mr. Reed (R-NY), both of whom we worked with.

Under the legislation in the Lautenberg Chemical Safety Act that was signed last summer, the EPA is required to conduct a negotiated rule-making. That's where all parties involved sit down—EPA, industry, environmental groups, recyclers, all get a seat at the table—and we try to find common ground. The EPA will take that input and then, under the law, propose a rule in three years and finalize a rule in three-and-a-half years. We talked about that, and the process is already underway. The first public meeting will be next week and IPC will be represented by myself and Bret Bruhn. Bret is the environmental operations manager with TTM, in Oregon. He also chairs IPC's EHS committee.

We mentioned that to the administrator and said we were looking forward to working with him on that. The reason for bringing it up was to reinforce our hope that EPA will be a good faith participant in the negotiated rule-making. In the past, as I've mentioned, they've been somewhat intransigent on this issue. We had many meetings where they'd say they'd do something, agree with us and say it sounds reasonable...

Goldman: And then nothing happens.

Abrams: Exactly. So we're looking forward hopefully to a new attitude, new beginning with this administration. That was the first issue that was raised. The second one is the reporting of lead under the Toxic Release Inventory. It's part of the Emergency Planning and Community Right-To-Know Act. It's purely a reporting exercise. There's no actual environmental protection and as we pointed out to EPA, the reporting threshold is based on used, processed or stored. So a lot of our EMS members, in fact 32% of all companies that reported to TRI, reported zero pounds released. They spend, by EPA's estimate, about \$9,000 per facility. Bhawmesh Mathur,



Fern Abrams

IMPACT Interviews

President of Creation Technologies and Chair of the IPC GR Committee, said he has six facilities that all filed that they had reported zero pounds and they must do that every year.

Goldman: That's a substantial cost.

Abrams: He said he thinks that cost is much higher, that it's underestimated. In any case, as the administrator said, "So every year you do this to tell us every year that you release no pounds?" We said, "Yes." He noted that 100 pounds was a pretty low threshold. We said it used to be 25,000 pounds until EPA lowered it, and he asked what the basis was for that.

Goldman: There was none.

Abrams: Well, I think I might have gotten the quote of the day when I said "junk science." More accurately, it was inappropriate or manipulated science, but junk science just makes a much better sound bite. He said he'd look into that. Then Phil Titterton of TTM raised a third issue, which is the RCRA Hazardous Waste Generators Rule. These are the requirements for companies that generate hazardous waste on their facility—often very small amounts. Most of our members are very small quantity generators or small generators. This was, I should say, a rule that was issued by EPA in November 2016 to consolidate 40 years of generator requirements that were here, there and everywhere in the regulations. Most of the rule we like. It brings clarity. It's much easier to read. But in that reorganization EPA took many of what used to be requirements and put them as conditions of exclusion. Meaning, exclusion from treatment as the most serious of hazardous waste facilities, a hazardous waste treatment storage and disposal facility (TSDF), which requires an operating permit. This is a very serious thing.



Goldman: That is serious.

Abrams: Well, these are the companies normally that take in waste, store it, and treat it.

Goldman: They're separate from generators, right?

Abrams: They should be. However, the way that this was organized, if you fail any of these conditions of exclusion, you've violated your conditions and EPA can enforce against you as

an illegal treatment, storage and disposal facility that's not meeting all these things and is unpermitted. It could be as simple as the label on a drum. Instead of saying "Hazardous waste June 2017," maybe you said, "Waste/Hazardous."

This is a very serious liability matter. We joined eight other trade associations in filing a suit against the EPA on this issue in January, but we would like very much not to litigate. We filed to preserve our legal options, but as we told the administrator yesterday, we would like very much to work with the EPA on a new rule that addresses just this small part of the rule.

Those were the three issues that we raised during the meeting. The administrator [Scott Pruitt] was responsive on all of them and talked for a bit.

Goldman: Others said he made assignments to staff?

Abrams: Just to look into it. That would be accurate. He talked a bit just about his perspective and added that you can have a business environment and still protect the environment. He talked a little bit about America's history and growth and how we've managed to grow and clean up the environment at the same time. It was just very refreshing.

Goldman: What's next on the environmental front?

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Everett Frank, Optimum Design Associates.

Abrams: Recently, as part of their implementation of Executive Order 13777, the EPA has had a series of listening sessions, at which I testified. The small business ombudsman had a meeting last week, April 22 and 23, for small businesses to talk about regulations they'd like to see addressed. Then on Monday [May 1], I spoke at the Office of Chemical Safety and Pollution Prevention. Next week someone else will be representing IPC at the Office of Land and Emergency Management, highlighting that same RCRA issue that we were just talking about. EPA is also taking formal comments, which we'll be submitting by the May 15th deadline.

We will also, of course, follow up with the administrator's staff on these issues. Then next week, we have the first meeting of the committee on the negotiated rule meeting on byproducts. Busy times.

Goldman: I know things don't happen fast. It seems everybody's very busy, and yet I know things take a while to actually happen.

Abrams: That is accurate. To talk about some of these rules on the byproducts issue, we've been working on this issue since 2006.

Goldman: That's more than ten years.

Abrams: Nothing happens overnight.

Goldman: Any other thoughts here today?

Abrams: Well, we've been talking about the administration. Obviously, we have an agenda on the Hill too and the members are meeting with some key legislators right now. You'll probably be interviewing other people on that, I presume.

Goldman: Yes, basically I get pretty general, but great feedback on those. To me, the attitude of the people that have been speaking to us seems so much more positive.

Abrams: I agree. You know, it's the beginning of an administration. Washington is where hopes come to die (laughs). No, that's not fair. Things take a while. Consensus is hard to reach. We have a democracy. It's set up to have debate and let everybody be heard and so nothing is done immediately. I think a new administration comes to town and they're fresh and they're excited, and that's exciting.

Goldman: Apparently, some amount of that has filtered out across the different departments.

Abrams: We've seen that in meetings we've had at the EPA and other agencies. We're excited, we're hopeful, and we're ready to work.

Goldman: Thanks so much for your time. Much appreciated.

Abrams: My pleasure. **SMT**

Joe O'Neil
OAA Ventures

Around lunchtime on Wednesday, the second full day, I was able to sit with Joe O'Neil,

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OAA Ventures. As a veteran of many IMPACT meetings, his was a good perspective of the event.

Patty Goldman: Hi, Joe. It's good to see you. I understand you have a consulting firm now. Were you representing a particular company here at IMPACT?

Joe O'Neil: No, we had the entire IPC board of directors here for a board meeting on Monday. We have board members now from Europe, Asia—all over the world. They all came into town and then some of us stayed to support the IMPACT event and go out and kind of spread the word and build a foundation.

In prior years, we've been in different parts of the legislative cycle and had a specific set of bills or language where we could come here and have very definitive asks. I think we were successful then because in prior years it was much like what we're doing in this visit, which is foundational; we are getting our name in front of the freshman senators or congressmen. There are some things that are in play right now. Conflict minerals are in play. Healthcare is very much in play. Tax reform is maybe a little bit further out. But those are things that affect our membership and our voice needs to be in the mix.

Goldman: Might as well get in the beginning, right?

O'Neil: Yes. When there is something important that comes up, we were here supporting them, and now it's their time to support us when we call; they kind of know who we are. Through the year—I remember Capitol Hill Days 15 years ago or more—we've gone from circuit boards that no one could understand to bringing samples and giving them things that they looked at and touched. Now, with that education, I think they are beginning to understand the electronics industry. They understand that our membership ranges from major defense contractors and OEMs, the brand names throughout the world, to the electronic manufacturing services and print-

ed circuit board fabricators to the laminate and chemicals, and all the way through the supply chain.

They have recognition of that and they understand that those 4,000 member companies have a million employees just in the United States, and our training programs train hundreds of thousands of people a year. They see the value of that. For the most part, they are supportive, and hopefully that's going to be reflected in legislation that comes up.



Joe O'Neil

Goldman: I suppose it helps that everything you use any more has electronics in it.

O'Neil: Absolutely. Including the listening devices throughout this town (laughs).

Goldman: So how did you find this morning's sessions? I know there were several meetings.

O'Neil: We had several senate meetings. In past years, we would have maybe one or two senate meetings and a lot over on the congressional side, since we have members in pretty much every district in the United States. The senate meetings were a little harder to get—a little higher level. This morning alone, I think we've had four or five senators and then we got to go over and meet with the rules-setting committee over on the congressional side. And that was very interesting to see how every bill that comes up goes through this small 12-person group.

It was very different to hear that bills come out of committee, but that little body can add or subtract anything they want before it goes to the floor. They had some interesting perspective in terms of how Washington is and how this is going to play itself out. It's a lot of change. It's still early. The talk of the town is still, you know, "the first hundred days" kind of references. We've heard everything from people who are giving the President an A+ to F- and below.

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Joe O'Neil chats with Kim Ford, Deputy Asst. Secretary for Mgmt. and Planning, US Dept. of Education.

Goldman: For the same things, I'm sure!

O'Neil: There's pressure, as I think it probably is with any transition that ever comes out of the gate running. And so the whole town seems to be running. The voice of business is being heard. People are taking meetings. People are actively engaged in conversations. I think that is very promising. And there's hope that the two political parties are going to find a way to work together on some things. One consistent thing is that it's not going to be easy. Both sides are saying that.

Goldman: Well, everybody that we talked with seemed to think that it's a good idea that they should all be talking to each other. And yet...

O'Neil: Yes, it's consistent that both sides are pointing to the other as the part that needs to be changed.

Goldman: "We'd like to work with them, but they don't want to work with us."

O'Neil: And I think that the interesting thing is that's just kind of the way the town works. Things do get done. Things get done every week. Things got done already this week. Things got done last week. And the sensationalism isn't

there when things actually get done. That stuff doesn't get really reported with the same vigor as the gridlock of the fight.

Goldman: You always hear the bad news more than the good news.

O'Neil: Absolutely. And we also had a meeting over at the EPA yesterday with the director, Scott Pruitt. The work the EPA does, they made a big impact over the last few decades on the environment, and I think in the last decade or so it has become more paperwork than advancement. But the new mentality seems to be "we're going to continue to safeguard the environment. We're going to look for every opportunity to do it in a smarter, more streamlined manner; basically, for every new piece of legislation or new rule that gets enacted something has to come off the books." I think that's smart.

Goldman: I've always advocated that, in everything.

O'Neil: There are so many rules and regs, and not just the EPA; the enforcement is almost impossible and non-existent in many cases.

Goldman: And it is sometimes arbitrary, as you know.

O'Neil: Absolutely. I'd much rather have a set of fewer rules and regulations and have them made clear enough that they can be enforced with vigor. Then I think the impact would be greater than the volumes of misunderstood or unknown rules and regs that don't get enforced.

Goldman: Currently, they tend to put more stock in paperwork than in actual work.

O'Neil: Or impact.

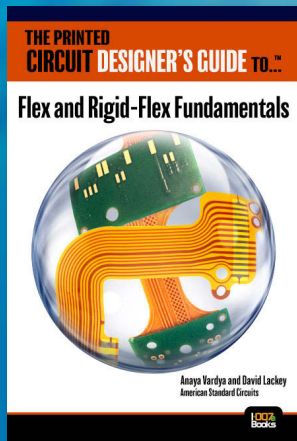
Goldman: It's the same with conflict minerals, for as much money as is spent on the paperwork, if that were all somehow channeled to the people being oppressed, wouldn't that be

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more useful? And yet, it's totally non-productive as you know. You spend all that money on producing paperwork and it's gone.

O'Neil: Absolutely, it is a waste. It's interesting; we've made great strides in getting that 1502 [Dodd-Frank Act, Section 1502 on conflict minerals] frozen and the enforcement somewhat curbed, because I don't think anyone is going to stop the implementation of conflict-free. I think the good news is, we didn't come in with a "just get rid of it because we want to buy less expensive things" attitude. We came in with a belief in the intent of the legislation. We believe there's a better way to achieve those means even at the smelter level, and don't make the three-person firm dedicate one of those three people to just doing the paperwork.

Goldman: But they bring up this conflict minerals, but in reality, you need the particular minerals. Our industry needs these minerals. But they seem to say these minerals are by association conflict minerals as opposed to just the ones from a certain area. That's what I seem to hear from the feedback. We need gold. We know that there are other sources, but somehow, they lump it automatically as all gold is a conflict mineral. They say to just stop using it but you can't stop using it.

O'Neil: The tungsten, gold and the tantalum. Those are the minerals that are classified as being conflict-managed. There are some money operations in the DRC [Democratic Republic of Congo] which are following horrific practices that others aren't, and by avoiding the region in total it makes reporting easy, but everyone in the region suffers.

Goldman: Then you'd be getting your gold and tantalum elsewhere.

O'Neil: And even then, you're not sure because a lot of the gold and a lot of the metals that we use, a portion of those are recycled. So they're reclaimed.

Goldman: Do they count that too?

O'Neil: Well, that's part of the challenge, and that's why there's never been an enforcement activity.

Goldman: Well if there were, then there could be a challenge to it. Then whole thing would get knocked down.

O'Neil: Exactly.

Goldman: And so they don't do that. They just hold it over your head all the time.

O'Neil: The town seems to be very open to reworking versus repealing, and so I think reworking Dodd-Frank seems to be something that looks like it's going to get done, especially in the conflict minerals.

Goldman: Well hopefully in a reasonable amount of time. I wish they would regulate the energy industry as tightly as they regulate our industry. Every time I hear about another coal mine superfund site, all that drainage and the underground fires, or another government nuclear energy superfund site, I think, wait a minute...

O'Neil: Where were they then?



Sen. Tammy Duckworth (D-IL) speaks with attendees at IMPACT Washington, DC 2017.

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Goldman: Joe, thanks for your time today. Good to talk with you.

O'Neil: Thank you. Off to the next meeting! **SMT**

Anaya Vardya

American Standard Circuits

I spoke with Anaya Vardya, president and CEO of American Standard Circuits, a few days after the conclusion of IMPACT. I especially wanted his views as a first-timer there.

Patty Goldman: Anaya, as a first-time visitor to IMPACT, what were your impressions of the event?

Vardya: I thought it was a great event. I was very pleased that we were able to participate. Both Chairman Gordhan Patel and I participated. It's been on our radar for several years, but we've always ended up with scheduling conflicts; this year we were fortunate not to have one.

It was very beneficial for us. It's kind of a two-way dialogue, right? You get to listen to what the government is thinking of, you get to go participate, talk to the government representatives, your competitors, and your customers.

Goldman: A little bit of everything for everyone.

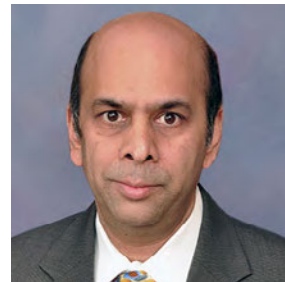
Vardya: Yes, there was a lot of interaction.

Goldman: Well, you picked a good year to come. I thought all the people who were invited to speak to us really were looking for information from us, and I don't remember that from last year. This year, they were so forthcoming and said, "Please tell us how you're doing, tell us what you need, we want to know." That was really great. Did you enjoy the trip to the EPA?

Vardya: I loved the trip to the EPA. It was good to meet administrator Pruitt. I thought he was

a good listener and that he was keen on understanding what some of our issues were, and intent on trying to get regulations removed that didn't make sense or that weren't based on science.

At the end of the day, we all want clean water and clean air. That's important to all of us because we live in the communities where our businesses are. But I think there are some regulations that don't need to be the way they are, and I felt like at least he was open to listening to us and was very engaged with our group.



Anaya Vardya

Goldman: In my opinion, it seems a big step forward to have been able to speak with the top person there. I don't recall EPA being on the agenda last year, so IPC must not have been able to get anybody to talk with our group. So to be able to speak to the top guy, I think that's very good.

Vardya: I was excited about that, for sure.

Goldman: Do any of the other speakers stand out in your mind?

Vardya: Well, I was quite impressed by Kim Ford, from the Department of Education. It was interesting to see that level of enthusiasm for what's going on today with their department, especially because she's been in the Washington, DC system for a very long time, and throughout the previous administration.

Goldman: Yes. I found that website she mentioned. It's interesting and there's a lot of useful information on it. Let's see, who else did we talk with? Senator Tammy Duckworth (D-IL), who's an amputee; that was pretty good, too.

Vardya: She was very impressive. And it's interesting, one of the things that I noticed is that on a lot of these core issues that impact our

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industry, I think the Democrats and the Republicans aren't that far apart, especially when it comes to job training and things like that. Job training is going to be a critical thing, and since we want to try to grow the manufacturing base in North America, employees are going to be the key to our success. Everybody needs to be trained. We need to have people that are actually going to work in factories.

Goldman: It's nice to see that Washington is recognizing that need. I was really impressed with the bill that she was going to introduce, where you could have this little fund set aside, sort of like an IRA—I believe she called it a “manufacturing RA” or something like that. A business could set aside money, tax-free, to purchase equipment or train people. I thought that was pretty nifty.

You can't just say, “Hey, we're going to bring back manufacturing” without having that whole other part: people trained and available to staff it and the capital equipment available with a fast depreciation schedule, along with everything else.

Vardya: I thought that was a very novel concept, I really did. I agree with you. We'll have to learn more about it.

Goldman: Did you get a chance to talk with your own senators and representatives on Wednesday afternoon?

Vardya: Yes, on Wednesday, after we had a couple of staff meetings, we met staffers from Senators Tammy Duckworth and Dick Durbin (D-IL). We talked to both of their staffs, and we talked a lot about conflict minerals. The other thing we discussed was tax reform. We focused on those two aspects, because obviously, tax reforms are important to all businesses. It is a key thing, and I think tax reform can really help people improve business in general.

We also had a quick meeting with one of the local representatives from the House of Representatives, Dr. Raja Krishnamoorthi (D-IL) from District Eight. We talked about some of these

same issues. He was very receptive; I think a lot of people are focused on getting more manufacturing jobs, for sure.

On Tuesday afternoon after the EPA visit, we met with Vice President Pence's Senior Domestic Policy Advisor, Daris Meeks, and it was very interesting. He basically said, “It's all about jobs, jobs, jobs, and we've been told that we need to listen to the people in industry and understand what the barriers are to creating more jobs.”

Goldman: There seems to have been an attitude change in DC.

Vardya: You participated in the lunch discussion, right? It seems like the administration is trying to do a lot to really encourage jobs, to try to help with breaking down barriers, and things like that, so I thought that was very encouraging.

Goldman: Yes, I noticed this year everybody seemed to be focused on businesspeople, people with businesses, in manufacturing and such. We seem to be the good guys this year. It was good all the way around.

Vardya: I thought the IPC team did an outstanding job of putting together a great lineup of people to speak to us and with us. We talked with the administration, members of Congress—Republicans and Democrats. So we got a diverse set of perspectives and a very diverse set of views from the meetings that were set up. I have to commend IPC on doing such an ex-



Congressman Shimkus (R-IL) talks with attendees.

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Rep. Ken Schrader (D-OR) is presented with the IPC U.S. Government Impact Award in recognition of his bipartisan leadership on issues of importance to our industry.

cellent job of putting the whole event together. Again, given the fact that this was my first time, I was really impressed with all the briefing materials they put together and the whole package of information. I'm very impressed, and it was very good.

Goldman: They put together a tremendous amount of information for us: bios on all the speakers as well as everyone in our group, the briefing materials on the various departments (education, commerce, military, EPA), the key issues that we focused on. Then scheduling all the speakers during the day and at luncheons and dinners (including the awards dinner), and setting up meetings for everyone with their representatives. No spare time for us, right? It was quite a full schedule. And then to speak with your senators and representatives live, or perhaps their staff—that was a tremendous amount to coordinate, especially when you understand how packed their schedules seem to be. IPC staff supports so well, like you said, with all the briefing materials; but also, there's somebody at your side wherever you go to help you through the discussion and talking points if you need it.

Vardya: In fact, the other thing that I will add that was interesting is a small group of us broke away and met with one of the senior staffers in the Rules Committee. We met in the congressional building and we talked a lot about how the

rules work and what goes on, how bills come to the floor, and it was very insightful and interesting. Then, we got to go over and spend a few minutes in the actual House Chamber. That was a neat little tour that we ended up getting.

Goldman: That's great. It was quite a two-and-a-half days, really. I'm glad you went, and I'm glad I went. Hopefully, you'll go next year, schedule permitting.

Vardya: I absolutely will. I would really like to do that.

Goldman: Anaya, thanks so much for your time and thoughts.

Vardya: You're welcome. **SMT**

Bill Johnson Congressman (R-OH)

Congressman Bill Johnson (R-OH) gave a great talk during the Monday evening dinner at the very beginning of IMPACT. I think if there had been a way to vote for him for any office, everyone at the dinner would have done so. I interviewed the congressman a week after the event, and he shared his views on the way things are going in the Capitol today. He also asked me to call him Bill—not Mr. Johnson or Congressman. Just Bill.

Patty Goldman: Bill, Monday evening you spoke about how President Trump is doing and things that are happening in Congress that affect business. If you could revisit those subjects for our readers, I would appreciate it.

Bill Johnson: Sure, I think this goes all the way back to the November election, when the American people made a conscious choice to go in a different direction. They want to see, and they're still wanting to see, the greatness of

IMPACT Interviews

America return: innovation, competition, and leadership on the global stage. I believe that what you have seen happen over the first four to five months of President Trump's presidency is a move in that direction.

If you look at the number of bills that Congress has passed this session since the last election, it is more than any that have passed in the first 100 days since George H. W. Bush was president, far more than President Obama during his first term. If you look at the number of bills that have been signed into law by President Trump, it's far more than President Obama or any of the three previous predecessors to that.

There is no question that President Trump has hit the ground running, trying to do the very things that he promised that he was going to do during his campaign: regulatory reform; restore healthcare to the American people and take it out of the hands of unelected bureaucrats in Washington, D.C. Now, some of these things are still a work in progress, but by and large, we've seen the markets respond very favorably to President Trump's message of returning to America's greatness. Within a few weeks of the election, the stock market saw a major rally. These are historical moves by the American free-enterprise system to validate what the American people are asking for.

If you look at the number of Congressional Review Act measures, for example, I think there have now been 13 Congressional Review Act measures that have been signed into law, keeping one of the promises that President Trump made to roll back onerous regulations that are stifling job growth and slowing economic growth here in America. If you look at how many jobs have been created, I've seen various numbers, but certainly in excess of 350,000 jobs have been created just since the president took office.

Looking at our border security, we're at a 17-year low, a 61% drop in attempted border crossings on our southern border. The president is setting about doing what he said he was going to do and we're working very hard in the House to give him the avenue legislatively to do those



Representative Bill Johnson (R-OH) speaks to IMPACT attendees at the kick-off dinner.

things, so I'm very optimistic about the direction we're going. Now, have we solved everything? No, we haven't. We have not completed the healthcare reforms. That's still a work in progress. We passed it out of the House and it will soon go to the Senate so that the Senate can begin that work in earnest.

We've already made significant progress down the road on tax reform. Everybody acknowledges that letting the American people keep more of what they earn, letting businesses keep more of what they earn so that they can invest in research and development and new innovations, new products, that's going to make America that much more competitive on the global stage. Look at the budget that was just released by the President, a budget that balances. When was the last time we saw a budget come from the President that actually balances?

Goldman: It balances? How did he do that?

Johnson: That's something that we've got to talk about. There's no question about that. That doesn't mean that it's going to get a rubberstamp here in the House because we too in the House want to see a balanced budget. That's what we have supported for the last seven years. I have voted numerous times for a balanced budget amendment to the Constitution and I believe that the federal govern-

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ment should balance the budget. I think that should be a requirement, but be that as it may, we've certainly got evidence now that we have a President that understands the importance of bending that spending curve in the other direction, to begin addressing America's national debt and the rising deficits. There's a lot to be optimistic about.

Goldman: That's all good to hear. I will say we talked with you Monday night and the next day we had several speakers from Education, Commerce and Defense Departments. The IMPACT group also visited the EPA and the White House. In every case, every person we talked with was very receptive. They all said, "Tell us what's going on. Tell us what you need." It was different than it's been in the past. They met with the head of the EPA, Scott Pruitt, and he took notes and he assigned follow-ups to his staff, which was good. In our industry, we've often been considered the enemy. It was different to have all the people that we spoke with be receptive or interested in our side of it, so we were happy.

Johnson: Patty, this may sound a little bit melodramatic, I don't mean for it to, but it really comes down to whether you see the glass as half full or half empty. I think under the Trump administration, it is very clear that from an American leadership perspective, America's potential

to lead on the economic stage, on the international and diplomatic stage, on the military and national security stage, that the Trump administration looks at the glass as half full versus leading from behind, which is what we saw during the previous administration for eight years—indisiveness creating uncertainty, leaving doubt in the minds of our friends and allies across the globe as to where we stood on particular issues, creating business uncertainty and a very business-unfriendly climate. I think it's a matter of seeing the glass as half full and I think the Trump administration sees that.

Goldman: I think we're all optimistic, even more optimistic after having been to IMPACT and speaking with these various agencies and seeing their interest in what business people have to say. It was very refreshing.

Johnson: One of the things I talked about there that I would probably like to get the word out on is that I think that there is a cultural, societal shift that is occurring because of a phenomenon that we've seen before. One of the things that's great about the American system of government is that every generation gets to write the next chapter of America's amazing journey. Every generation believes that they can do it better than the previous generation. I love that about the American attitude, the American fiber of our being, but at the same time, often-times we must learn and relearn the same lessons from history all over again.

When I talk about a societal, cultural shift occurring, it reminds me of what happened in the '60s, back during Vietnam. If you can recall, Vietnam was the first war that was brought into the American living room in real time. Prior to Vietnam—World War II, Korea, other conflicts that America was involved in—the American people only saw the war from a distance. They saw it in newsreels if they happened to go to a movie or they read it in a newspaper that might come out on Sunday, if they happened to read the newspaper, but it wasn't in their face day after day after day.



IMPACT attendees meet with EPA Administrator Scott Pruitt.

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Rep. John Shimkus (R-IL) is presented with the IPC Government Impact Award, which recognizes bipartisan leadership on issues facing our industry.

The Vietnam War was different because we sat in our living rooms in the evenings and we listened to Walter Cronkite give the body count. We saw the horrific scenes coming back from the battlefield of American soldiers being shot, enemy soldiers being shot, and the carnage that was occurring there. The American people saw war in all of its inhumanity up close and personal, and they didn't just observe it. They engaged in it.

They engaged in it and it played out on our college campuses. It played out in the streets of our cities and it changed who America was. It had a cultural, societal-shaping impact here in America. Now, roll the clock forward. About 10 years ago, with the advent of the social media platforms—Facebook, Twitter, MySpace, Instagram, etc.—and a 24-hour-a-day opinion. I started to say “news cycle,” but it's more of an opinion cycle. The American people today are seeing inside of the American political and governing machinery from a perspective that they've never seen before.

Goldman: This is true.

Johnson: Much like they saw war for the first time during Vietnam, they're now seeing the sausage being made inside the American governing system and they don't like what they see because it's contentious. It's frustrating. It's agonizingly painful. It is slow. Sometimes it defies

common sense about why you can't move one way or another on a piece of legislation. Now you've got 300+ million people who are now not just observing the American political and governing process, but they're engaging it.

Just like they did in the Vietnam War. How are they engaging in it? Well, they're demanding action. They're demanding that things get done. Is that an unreasonable demand? Absolutely not, but I think what we have failed to do as a nation is remember that historically, our system was not designed to move fast. Our system was designed to be debated, to be deliberate, to be slow moving, and I think the testimony to that is the fact that we're over 240 years old and yet we have seen very little change to our Constitution.

Look at how many countries throughout the world where the president resigns, they abolish the legislature, and they rewrite the constitution. America isn't set up like that. We don't have an exit ramp that way, so we have to make the system work that we have because that's the way we were built. It was built as a pass-fail system and we must work together to pass. The problem comes in because of the instant gratification environment we've created for ourselves; let's think about it for a second.

Today, you don't have to plan what you're going to have for dinner. You don't have to buy it. You don't have to prepare it. You don't have to grow it. All you got to do is pull up in front of the marquee at the McDonald's or the Wendy's or the Burger King and three minutes later, you've got your meal in a bag, and you've not had to do much of anything except pay for it. You get that instant gratification. Same thing applies when I can order my dog food online and it shows up at my house literally within 24 hours. Everything has got to be right now. So the American people, and I'm as guilty of that as anybody, get frustrated with the slowness of our system in fixing big problems.

I think sometimes we believe that the contentiousness that we see inside of our governing machine is new phenomenon. Well, it's not. It has always been that way. It has always been contentious and hard to govern the greatest na-

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tion on the planet. Let me give you an example, starting at the very, very beginning.

That was the summer of 1787 with James Madison and George Washington, two of our most prominent founders. George Washington is the father of our country, our first president, and James Madison, one of the architects of the Constitution. They went into that summer, that Constitutional Convention, very, very close allies. They were in lockstep. They were friends. They were working together, and thank God that they did because look at the document that it produced. But at the same time, it created a lot of anxiety between the two of them to the extent that not too long after that summer ended, George Washington and James Madison never spoke to each other again for the rest of their lives. The point I'm making is: Governing is hard business.

It is not easy. Relationships are broken and alliances are built among people that you never thought you would build an alliance with to get movement forward, because if we allow the far left and the far right to dictate the governing process, those groups are extreme. If a number of people in the middle aren't willing to sit down and put relationship aside, like Washington and Madison did, like Ronald Reagan and Tip O'Neill did to get big things done, then we're going to stay in a quagmire. Do you understand what I'm saying?

Goldman: Yes, I certainly understand. I've read enough history to know that you're right. If it were easy or if it happened quickly, that would mean we had a dictatorship. That's how things happen quickly. Somebody says, "This is the way it is," but we don't work that way. We don't want that.

Johnson: I'm not sure how healthy it is to a representative form of government where 300 million plus people think that they need to or should engage on every micro decision that is made. Because that's not the way representative government works. Representative government works when we elect a president and members

of the House and members of the Senate to be our voice. If we don't like the job that they're doing, our voice is communicated in the ballot box with who we send there to do the things that we want them to do, but I think when we start having people take to the streets and protesting, that brings us down to the level of some other countries where there's no confidence and trust in the system of government anymore. I think it's a very tenuous place to be.

If I had a message for the American people, it would be "Let's again start looking at the glass as half full." If you're the biggest nation, the most powerful nation on the planet, that means that your problems, your issues are



Walking to Capitol Hill.

IMPACT Interviews

manifold bigger than any other country on the planet. Those are big, big issues to resolve. You don't want to impulsively address those issues. You want to do it the right way and you want to do it in a way that's going to make it good for all Americans and protect and defend American values and American interests. I would urge everybody to just take a deep breath and not believe necessarily everything that comes across the social media platforms and the 24-hour-a-day opinion cycle about what's working and not working in our nation's capital. One of the greatest examples of two great, patriotic Americans that understood this phenomenon was Tip O'Neill and Ronald Reagan. During the day, the world spun around them, the media. I remember Sam Donaldson was Ronald Reagan's nemesis in the media. He always loved to try and catch Ronald Reagan with a tough question.

I can tell you about Ronald Reagan and Tip O'Neill. Many people did not realize that in the evenings after the legislative day was finished that Tip O'Neill would grab a bottle of Irish whiskey, two cigars and go over to the White House. They would sit there in the White House theater and watch cowboy movies and talk about the things that mattered in the big scheme of things. Things like how to bring the Soviet Union to its knees and bring down the Iron Curtain, how to bring about tax cuts that produced one of the best economic growth periods in American history.

That's what they were doing behind the scenes. We need American governing agents to be able and have the intestinal fortitude to do the same kinds of things.

Goldman: I agree, absolutely. Bill, thank you so much for your time. I really appreciate it. I could listen to you talk all day because it's very encouraging and very uplifting. Thank you so much.

Johnson: Thank you very much, Patty. It's good talking with you. Have a great day.

Goldman: You too, thank you. **SMT**

Ending Thoughts by Patty Goldman

As I said in the title, you had to be there. All the interviews, all the thoughts, impressions, comments from the group cannot nearly capture the enthusiasm, the willingness to listen, the subjects discussed, the essence of the meetings with departments, representatives, and senators. You really had to be there.

Washington, D.C. is an impressive city with massive white stone government buildings everywhere. The energy is unmistakable and it's easy to get caught up in it. But if you think elected officials sit in pretty offices all day gabbing, arguing or eating fancy meals, you are mistaken. More than once we saw our speakers rush off, a staff person with schedule beside them, and neither able to join us for lunch because another meeting was scheduled immediately following ours.

More impressive was that IPC could coordinate the schedules of (by my count) 10–12 significant speakers, group meetings at the EPA, White House and up on the Hill, and individual meetings with numerous individual senators and representatives, all within a two-day window and without conflicts. For those of you who attended, you know how valuable this was. For those of you who didn't, you missed one heck of an event. **SMT**





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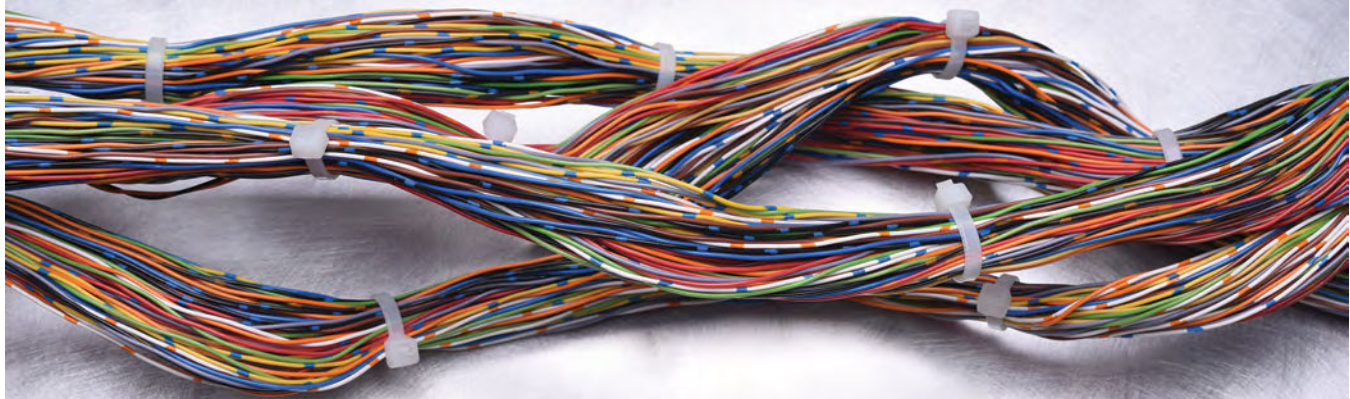
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Thermal Indicator Technology for Aerospace Wire Harness Assemblies

by **Jerry Sidone**

ALPHA ASSEMBLY SOLUTIONS

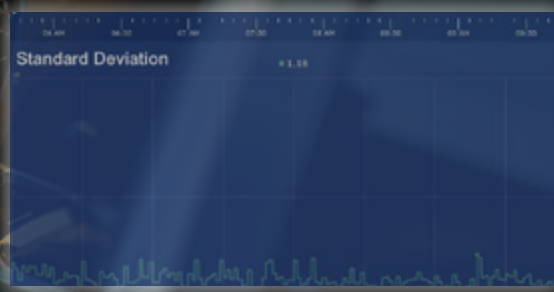
Solder preform sleeves are designed to fit any wire termination. They are used in aerospace wire harness assemblies for wire splicing, RF cable assembly and pin and connector terminations. Most often you will see them integrated with heat shrink tubing. The heat shrink tubing provides an environmental barrier for the solder connection.

Solder sleeves of different alloys are used because of many factors. These can include location in the aircraft and the operational temperature for the connection. For example, an operating temperature rating of 125–150°C (deploying SnBi, SnPbCd, and SnPb) are for aircraft wings and body and 175°C ratings (deploying SnAg4) are used near the engines. Solder alloys are classified as low and high temperature alloys. It is extremely important for the solder operation to be done correctly and be verifiable. Reliability of the solder joint is directly related to safety. Whenever possible, eutectic alloys are used because their liquidous and solidus tem-

peratures are the same, leaving little doubt to the operator when the solder is molten. This is the first indication to the operator that they are reaching proper melting temperatures. However, to form a reliable solder joint, temperatures should reach 20–30°C above the melt temperature range of the solder alloy.

Determining if a solder joint was formed correctly can be very subjective and difficult to regulate, especially in a mass production environment with multiple operators involved. Various industry specifications describe methods to test for a good interconnection both electrically and mechanically, but these methods (especially mechanical tests) are not conducive to a production environment.

For example, mechanical pull tests are conducted during the development phase of the cable assembly to determine the strength of the solder joint. However, they are not intended to be used at assembly since most of the testing is destructive. Most often, visual aids such as sketches or photos depicting good and bad solder joints are used as visual go/no-go gauges. In many cases, OEMs require that preform sol-



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der sleeves be integrated with crimp connectors to provide a redundant fail-safe solution due to the catastrophic failure that can occur.

The necessity of having a reliable solder joint in a cable or wire harness cannot be understated in aerospace applications. In addition to selecting the right alloy, you must take into account what makes a good solder joint: (1) the right type and amount of flux; (2) an adequate amount of heat; (3) correct amount of time; and (4) correct volume of solder. All are required to form a good intermetallic solder joint. Too much heat or applying the heat too long allows the solder to wick up the wire and under the insulation, reducing the amount of solder and weakening the joint. Too little heat will cause a cold solder joint where an intermetallic between the solder and the conductor is not completely formed and produces a solder joint susceptible to cracking or failure. Either of these can be disastrous at 40,000 feet.

Thermal indicator technology was developed into solder sleeves many years ago and has proven to be an effective means of providing visual indication of a reliable solder joint. There are two types of thermal indicators used in aerospace applications today: thermochromic dyes

and solder fuse rings. Both the thermochromic dyes and fuse rings activate at a specified temperature above the base solder's melting temperature range indicating sufficient heat and time have been applied to generate a good solder joint. The benefit of this type of technology is that it is an obvious signal to the operator during the soldering process that the solder joint is complete and the heat can be removed. An added benefit of thermal indicator technology allows quality control to perform spot inspections at any time.

Thermochromic dyes are designed to change color at specified temperature range. Thermochromic dyes are integrated into the external flux coating of the sleeve and forms the base color of the sleeve. When the solder sleeve reaches its melting temperature range, the dye begins to transition to a different color known as the activation color. When the dye on the solder sleeve finishes its color transition to the activation color, the solder joint is complete. The most popular thermal indicator dye used in aerospace today transitions from red to clear.

Most recent advances in thermochromic dye technology are providing a more durable finish, more brilliant and contrasting base and activa-

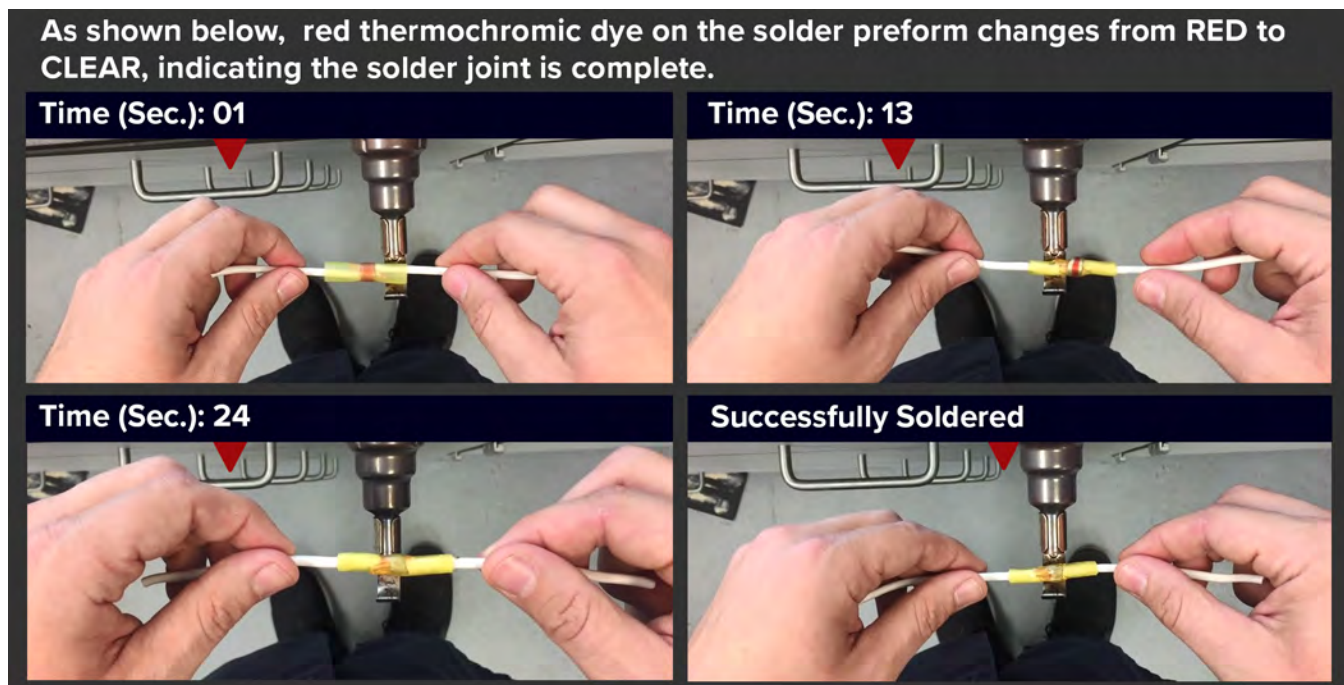


Figure 1: The thermal indicator technology in solder sleeves is an effective means of providing visual indication of a reliable solder joint.



Wire harness assemblies for aerospace applications.

tion colors which are giving users many more color options. The color options are a function of the dyes' temperature activation ranges and therefore cannot be randomly selected to fit a user's desired color change pallet. The user should contact the solder preform provider to determine the available color options for their solder melting range. In some instances, multiple color activation ranges are available at the same transition range providing a wider selection of color options.

Fuse alloy rings integrated into the solder sleeve are another type of thermal indicator used in the aerospace industry. The fuse alloy ring is integrated with the solder sleeve and used as the visual indicator to the operator or quality inspector. The solder sleeve and

fuse alloy rings are made from different alloys. A solder ring of a higher melt point alloy is fitted over the outside circumference of the base alloy sleeve. The solder ring's melt temperature range is a specified set temperature above the base solder sleeve alloy. When the solder ring melts, the base sleeve alloy has melted properly and the solder joint forms. The fuse alloy ring can be dialed into any temperature range but are most commonly used with SnAg and SnPb alloys.

Thermal indicator technologies used with solder preforms are an effective means for determining a cable interconnection has been soldered correctly. They provide a visual indication to the operator and quality control inspector that adequate soldering temperatures have been reached. Thermal indicators provide a more accurate and visual verification of the solder joint than using a photo or sketch as a gauge for inspection. Recent advancements in thermal dye indicator technology are providing a more durable coating and brilliant color selections. **SMT**



Jerry Sidone is Alpha's Engineered Materials Product Manager for all the Americas and European regions.

UQ Partners with Lockheed Martin to Develop Next-Gen Computers for Aerospace Applications

University of Queensland researchers have partnered with Lockheed Martin to develop next generation computers for aerospace applications. ARC Future Fellow and project lead Professor Warwick Bowen said the partnership would develop a new approach to computer technology, with the potential for future commercial impacts in the aerospace industry.

UQ made a recent multi-million-dollar investment in nanofabrication tools capable of building devices with features only a few tens of atoms in size. The project is part of the University of Queensland Precision Sensing Initiative, a joint initiative of the Schools of Mathematics and Physics and of Information Technology and Electrical Engineering.

[RTW NEPCON CHINA: Mycronic Meets High-volume Demand with Solder Jet Printing](#)

Mycronic VP for Global Dispensing and Managing Director Clemens Jargon discusses how the flexibility of solder jet printing helps reduce downtime in the line, thus increasing total line speed and enabling it to keep up with high-volume demand.

[Business and Technical Developments at Super Dry Totech](#)

At the recent SMT Hybrid Packaging show in Nuremberg, Germany, I-Connect007 Technical Editor Pete Starkey visits Super Dry Totech and spends a few minutes with CEO Jos Brehler and Sales Manager Terry Morgan to talk about the rationale behind ASYS Group's acquisition of stake in Super Dry Totech, as well as the latest technology developments happening at the company.

[Nordson Showcases Test and Inspection Systems at SEMICON West](#)

Nordson DAGE and Nordson YESTECH, divisions of Nordson Corporation (NASDAQ: NDSN), announce plans to exhibit in Booth #5644 at SEMICON West, scheduled to take place July 11-13, 2017 at the Moscone Center in San Francisco, California.

[Lord Adds Ellsworth Adhesives to Its Electronic Materials Distribution Team](#)

Lord Corp. has announced that Ellsworth Adhesives will now sell its electronic materials product line.

[Zestron Technical Workshop Tackles Next Generation of Cleaning](#)

Zestron recently held a technical workshop in Alabang, Muntinlupa City in the Philippines to help users address their cleaning challenges amid advancements in semiconductor device packaging.

[Electrolube India Awarded ISO 9001-2015 Certificate](#)

Electrolube India has received one of the world's most recognized standards, the ISO 9001-2015. This standard is based upon verification of a number of quality management principles demonstrated by an organization. ISO 9001-2015 requires a

strong customer focus and a culture of continual improvement.

[VJ Electronix to Relocate Facility to Chelmsford, Massachusetts](#)

VJ Electronix Inc. has announced that effective July 1, the company is moving to a new facility in Chelmsford, Massachusetts. The new centrally located building is approximately 10 miles north of the existing Littleton facility.

[Indium's Bernard Leavitt to Present at IMAPS HiTEN 2017](#)

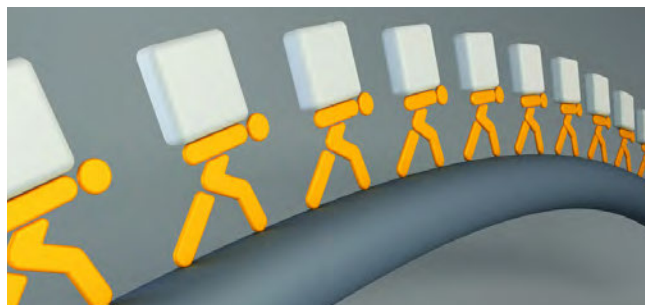
Indium Corporation's Bernard Leavitt, Product Specialist, High-Temperature Applications, will present at IMAPS High Temperature Electronics Network 2017 (HiTEN 2017), July 10-12 in Cambridge, United Kingdom.

[RTW NEPCON CHINA: Teknek Discusses Contact Cleaning Technology Trends](#)

Stephen Mitchell, managing director of Teknek, a contact cleaning solutions provider, discusses the latest trends in contact cleaning technology. He provides his outlook on China's electronics manufacturing industry and intelligent manufacturing, and talks about how Teknek's contact cleaning systems are helping customers address their defects and productivity issues.

[Alpha to Highlight New Material Set Combinations at SMTA Ohio Expo & Tech Forum](#)

Alpha Assembly Solutions will feature its new material set combinations at the upcoming SMTA Ohio Expo and Tech Forum to be held on July 13, 2017 at the Embassy Suites Cleveland-Rockside in Independence, Ohio.



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Field Failure is Not an Option

by **Stephen Las Marias**

I-CONNECT007

Audra Gavelis, director of marketing and investor relations at IEC Electronics Corp., discusses with *SMT Magazine* the current challenges in electronics assembly for the military and aerospace markets and the new requirements they are getting from their customers. She also talks about strategies in dealing with component obsolescence and lifecycle issues, new compliance issues that contract manufacturers are facing, and how they can ensure the quality and reliability of their products and solutions for the military and aerospace markets, because field failure is not an option.

Stephen Las Marias: What do you think are the biggest challenges when it comes to electronics assembly for the military and aerospace markets?

Audra Gavelis: It is dependent on where the product is in its lifecycle. For new products, companies are constantly innovating with new technology and engineering highly complex designs to meet the needs of their customers, especially in communications. We are constant-

ly expanding our technical capabilities, applying our expertise, and helping them solve technical challenges when defining the manufacturing process.

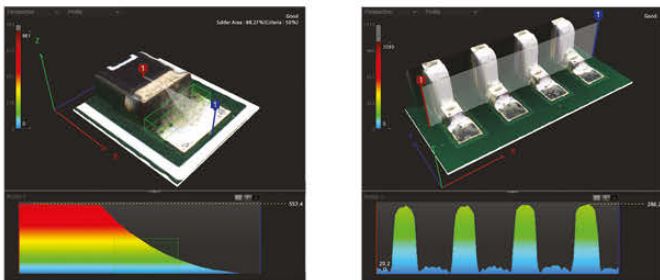
On the opposite side of the spectrum, many products have long lifecycles and therefore the challenge is providing them a robust supply chain in terms of sourcing components that may no longer be available. The electronics industry is evolving at a rate faster than our customer's designs, therefore it critical to strategically source and work with our distribution partners to minimize lead times while ensuring maximum flexibility to work with their demands.

Las Marias: What new demands are you getting from your customers?

Gavelis: Continuing to minimize their supply risk while also maximizing manufacturing flexibility are probably the two largest demands. Two specific areas of focus have been in tin and counterfeit component risk mitigation in terms of product quality. In addition, particularly within the military and defense sector, program funding and forecasts are often volatile and unpredictable. Our customers are look-



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ing for us to be very responsive to their dynamic end-market demands.

Las Marias: What are your strategies to address these issues?

Gavelis: From a counterfeit risk mitigation perspective, IEC is the only EMS with an on-site Analysis & Testing Lab (ATL) that has been approved by the Defense Logistics Agency (DLA) for their Qualified Testing Supplier List (QTSL) program. What this means is that we have established quality systems to minimize the supply chain risk to our customers through risk mitigation strategies, processes, and capabilities. Having the on-site lab allows us to perform a wide range of tests required to ensure the appropriate inspection, test, and authentication (IT&A) methods are followed as outlined in DFARS 252.246.7008, which was issued in August 2016. The lab is ISO 17025 accredited and can perform destructive physical analysis (DPA) testing per MIL-STD-1580 as well as testing per AS5553, AS6081, and AS6171 which are other industry approved standards.

IEC can be highly responsive to our customer's end-market demands with its vertical manufacturing services. Beyond PCBA, IEC offers precision metal-working and interconnect solutions, allowing us to control the cost, time, and quality for our customer's high-level assemblies.

.....

“IEC can be highly responsive to our customer's end-market demands with its vertical manufacturing services.”

.....

In addition, beyond manufacturing, we deliver a full spectrum of solutions such as design and test development including custom functional test design, reliability testing, high level assembly services, and logistics management to simplify our customer's supply chain.

Las Marias: What are the critical issues to consider right now when it comes to electronics assembly supply chain for the mil/aero market?

Gavelis: The critical issues facing the military and aerospace supply chain are volatile end market dynamics, industry compliance and lifecycle/obsolescence.

Las Marias: Regarding component obsolescence, how do you ensure the availability of obsolete parts?

Gavelis: Strategic sourcing begins with the product design just as much as the final delivery. We provide component engineering services with industry leading databases to assess component lifecycle and risk. If a component is identified as nearing end of life, we provide a strategic sourcing strategy, which may include a last-time buy, as well as provide an overall risk mitigation test plan if needed. The last step would be for our Analysis & Testing Lab to develop a full inspection, test, and authentication (IT&A) plan, including the option of screening commercial parts to an industrial component at our manufacturing site.

Las Marias: What about traceability?

Gavelis: Because IEC is involved in the medical sector, traceability down to the board/component level is an area in which we have a lot of experience in. With A&D, using the DFARS as guidance, we are aligned with the three-tiered approach of sourcing electronic parts and can provide the expertise when recommending what type of inspection, test, and authentication may be required.

Las Marias: How do you ensure the security and reliability of your supply chain?

Gavelis: Supply chain programs and partnerships are key to ensure security and reliability for our customers. IEC has been in business for more than 50 years and has developed key strategic partnerships with trusted global distributors. Just as our customers demand excellence from their partners, we also hold our suppliers

to high expectations because of the life-saving and mission critical products that we support.

Las Marias: What about cybersecurity? What strategy do you have in place to address this issue?

Gavelis: IEC is completing actions to be compliant with DFAR 252.204-7012 and flow-downs for contract data security. NIST SP 800-171 R1 and SP 800-53 R4 are large portions of the standard that will be required by December 31, 2017. The first DFARS controls in the works are called the Center for Internet Security (CIS) 20 Critical Security Controls (CSC 20). These are broken into 171 out of 277 DFARS controls that are applicable to IEC and are on track for completion by the required date. Cybersecurity is a very real thing for us at IEC. We treat our own and our customer's data very seriously.

Las Marias: How do you deal with OEMs trust issues when it comes to fear of their roadmaps or strategy being shared with other OEMs?

Gavelis: IEC understands that as with any relationship, it takes time and trust. When we first engage with a customer, we recognize that we are now an extension of their company. Our goal is to minimize their supply chain risk and deliver solutions to make them more successful. We show them that the small things matter to us just as much as it does to them. We recognize that we are a partner, not just a supplier. Over the years, IEC has developed several long-term customer relationships in which the trust has grown over time and it is a true partnership.

Las Marias: What are the key factors that OEMs should consider when choosing an EMS partner?

Gavelis: Key factors that OEMs should consider when choosing an EMS partner are: 1) What is the challenge I am trying to solve for



Audra Gavelis

my supply chain and how does this company address that? In many cases, OEMs are looking for an EMS that can help to solve challenges, minimize supply chain risk, and deliver solutions, not just manufacture the product. 2) Do they have the experience with the types of highly engineered/mission critical products that require a sophisticated level of manufacturing capabilities? Being a partner to A&D companies requires more than just an SMT line, it requires the know-how and advanced capabilities such as design & test engineering and vertical manufacturing to truly maximize the efficiency and responsiveness for their business.

Las Marias: What is your outlook for the overall military/aerospace industry market this year and the next?

Gavelis: Given the current global political climate, we see growth opportunity in the military and aerospace industry. With sequestration as well as recent international tensions, it is imperative that companies are ready to respond to the dynamic global market.

Las Marias: Do you have any final comments?

Gavelis: IEC's mission is to be the most customer centric manufacturing partner by minimizing supply chain risks and solving complex technical challenges for life-saving and mission critical products. As a 100% US-based small company, that is over 50 years old, we are focused on continuing to deliver solutions to the aerospace and defense industry because we understand that field failure is not an option.

Las Marias: Thank you very much.

Gavelis: You're welcome. **SMT**

Analyzing the Cost of Material in Today's Global Economy, Part 2

by Tom Borkes

THE JEFFERSON PROJECT

Last month we began a discussion on the cost of material associated with electronic product assembly.

It was recognized that any increase in material cost based solely on an assembly operation's geographic location could cause a condition that would not allow a turnkey electronic product assembler to successfully compete on the global landscape.

Previous research has uncovered the fact that material price variation of this kind does exist. The disparity cannot be explained by shipping costs or differences in the overhead costs of a particular component manufacturer or distributor's location.¹

Considering that material is typically 70–90% of the total recurring production cost of a product, even small disparities in material cost as a function of geographic location can bury the effect of labor rate differences. Regardless, it is differences in labor rates that seem to get all the press attention.

So, let's drill down into material cost and try to understand all the variables involved, both those that can be controlled and those that cannot.

Before putting the drill in the chuck, however, a definition of terms will be needed to maintain our sanity. Specifically, how we have historically used the terms *manufacturing*, *production* and *assembly*, as they apply to electronic products has vexed me for about 30 years. It is the inconsistency in use that has been a source of confusion and annoyance. Here is how I have proposed to use these three terms:

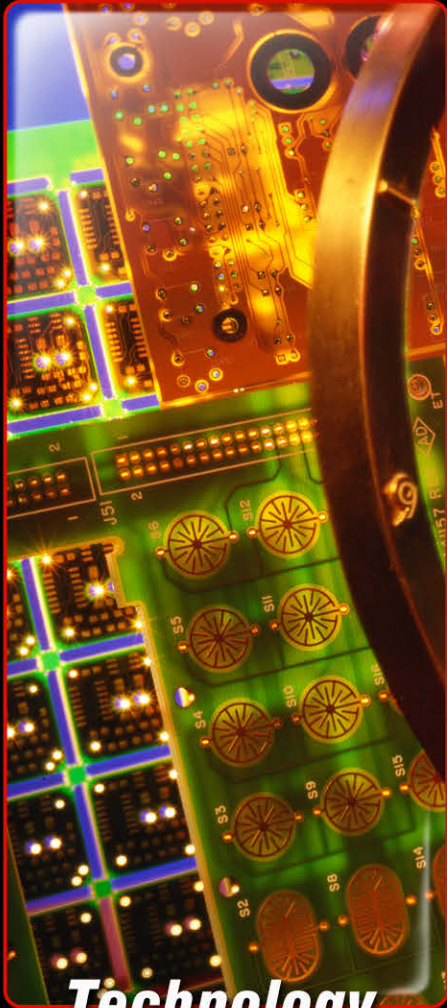
Production: An overall collection of processes used in creating a product that can be sold to an end user. It includes components of *manufacturing and assembly*.

Manufacturing: A process or series of processes that use material fabrication techniques to create a largely inseparable part or component. It is an irreversible process. For electronic products,

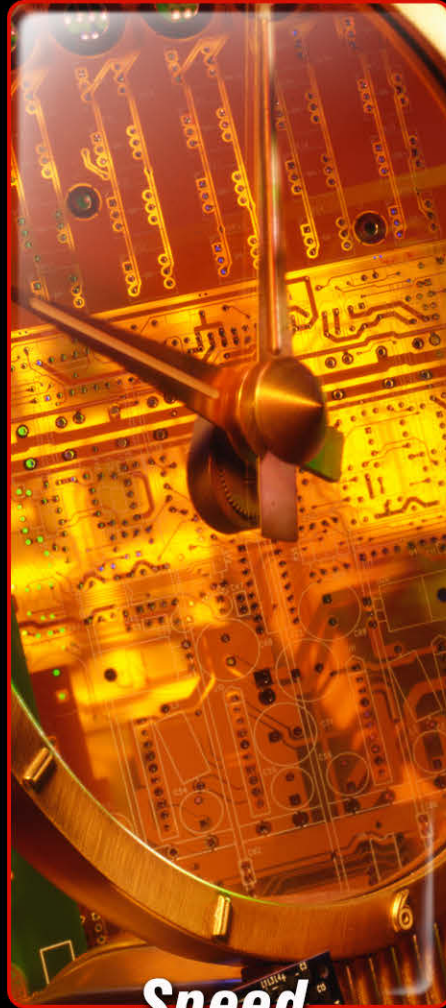


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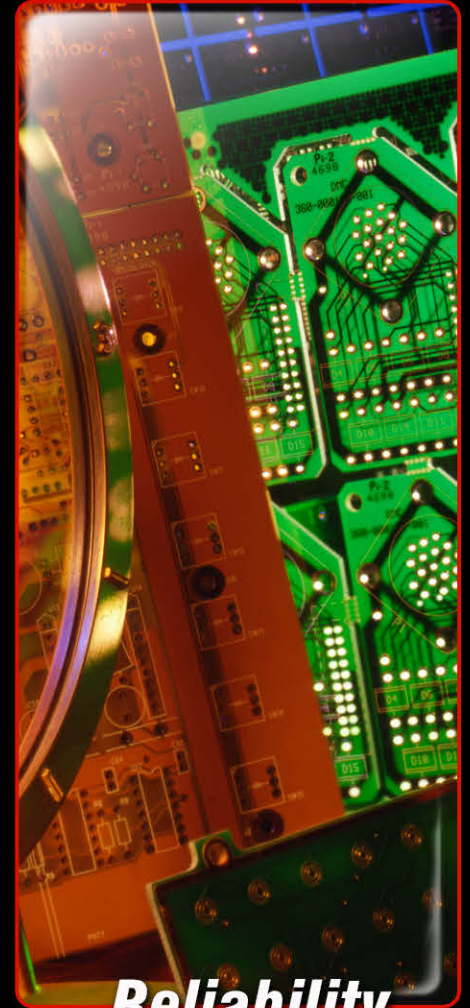
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the fabrication techniques include thick- and thin-film wafer processing, wire bonding, machining, molding, casting, coil winding, potting, encapsulating and component testing.

Assembly: The process of putting together manufactured components or parts into a definable configuration. This may include electronic testing as a step in the assembly process. The *final assembly* of a product may include the joining of several *sub-assemblies*. *Assembly* processes use value-added labor and/or automation (i.e., machine labor), to create a subassembly or the final product. It is generally a reversible process.

In the current parlance when we speak about a loss of manufacturing jobs, we really mean a loss in *production* jobs; this would include jobs in manufacturing and assembly.

The elitist brain trusts in government and academia who came up with the acronym STEM: Science, Technology, Engineering and Math² should have included *production*, or STEMP. However, product production has never gotten the respect it deserves. It is the reason that in the States, the VCR could be invented (1962, RCA Model TR-22), but the U.S. never developed a commercial version nor produced it in volume.

In a sense, it is analogous to the relationship between a company's direct labor force and their management. This relationship has been discussed previously in this column: Direct labor pays for indirect and overhead costs such as management and indirect engineering, in a similar way that mass-produced products pay for the theoretical science, technology, engineering and mathematics that they incorporate.

Production deserves a place of its own at the top of the Mount Rushmore of technical education—next to science, technology, engineering and mathematics. STEM subjects have always been more theoretical than practical.

However, there is no question as to the importance of pure science, classroom technology, design engineering, and pure mathematics. One does not have to be a rocket scientist to understand the seminal role these technological tools play in the development of a firm foundation for the proper execution of applied high-tech electronic product production.

However, teaching how to *apply* the theory in production can never be effectively taught in the ivory tower.

Yet, high-tech product production relies on:

1. Automation science and physics (motion control, etc.)
2. Material science (solder paste rheology)
3. Chemistry (solder paste and cleaning)
4. Heat transfer and thermodynamics (wave and reflow soldering)
5. Statistics for developing a successful assembly process (process validation and meta process control) and understanding a process with non-random variation that is beginning to trend toward an upper or lower control limit

A deep understanding of all these sciences, along with other classical subjects, is required for a production engineer to be successful.

This is where the learning for earning part comes in. Those applied production skills and the associated sciences need to be taught in a real-world setting, concurrently.

With the high-tech contributions of advanced packaging automation incorporated in the manufacturing and assembly of today's electronic products, production should be a science on the same level as subjects classically taught in an engineering curriculum. However, production cannot be successfully taught in an antiseptic classroom.

One example of what the education community holds up as high academic achievement can be found by looking at the 90th Scripps National Spelling Bee that has just been concluded. The final round was held on June 1, in Maryland. This event was televised with all the hoopla of a major sports event. Mini-bios of the finalists from the field of 291 entrants, aged 6–15, were inserted in the coverage as the contenders sought to be enshrined at the top of this spelling Mount Olympus.

The contestants' friends and families were present, forming the gallery—cheering, hoping and praying for a successful conclusion to what must have been countless hours of memorizing lists of obscure words.

The entrants always ask the same questions after being given their word to spell: "What is the country of origin? Are there any alternate pronunciations? Please use the word in a sentence." Then, they inevitably ask the moderator to repeat the answers to all those questions all over again!

These are beautiful young people. But, you can't help but wonder what the psychological effect is on them—even the winner? I don't mean to sound unkind, but is this the kind of academic achievement we want to celebrate and emphasize?

It seems it is. And, it is consistent with what academia subconsciously praises as academic achievement as students move from the primary to the secondary to the post-secondary segments of the educational pipeline. It is success built largely on the skill to "memorize, regurgitate and forget," as Murray Gell-Mann, world-renowned particle physicist, Nobel Prize winner, and co-proposer of the existence of the Quark, credited upon receiving his Doctorate in Physics from MIT.³

Genuflecting at the altar of an academic grade point average that is built primarily on learning for learning, without regard for learning for earning, is not in the student's (i.e., academia's customers, best interest).⁴

What are the basic cost variables that influence the ability of an electronic product producer to compete?

Labor

1. Raw labor (\$/hr.)
2. Indirect labor (\$/hr.)
3. General & administrative cost (\$)
4. Rework labor cost (\$/hr.)
5. Overhead (controllable & uncontrollable) (\$)

Material

1. Raw material (\$)
2. Material markup (\$)
 - a. Material attrition
 - b. Material scrap
 - c. Material handling

Raw (direct) labor costs are established by some combination of the laws of economics

and local labor laws. They are dependent on where the labor is utilized.

The material that the applied labor adds value to (i.e., inspection, kit, prep, assembly and functional test) is almost all manufactured in the same few geographic regions (Pacific rim, Mexico, India). However, unless a Tier 1 or 2 assembler is using huge quantities of components from the same manufacturer, they are purchased from distributors, not the manufacturer.

The distributor will buy material from many manufacturers, stock the material, mark the material up and sell the material to an assembler. The price that the distributor establishes is based on:

1. The cost that the component manufacturers charge
2. The distributor's overhead cost that must be loaded and absorbed in the component price
3. The quantity the assembler orders
4. The currency that will be used to pay for the material (e.g., US dollar (USD), Yuan, etc.)
5. Any applicable import and export tariffs
6. The location where the material is shipped (although not publicized)

A more direct example of pricing disparity based on geographic location is the price of automated assembly equipment. Consider what the same automated component placement machine (i.e., pick and place) made by the same equipment company has sold for in China and the U.S.—a significant price disparity exists. Why? Is it number 4 or 5 or 6, above? Is it the costs associated with shipping this large, heavy item? If it is F.O.B. point of shipment, this item is not included in the equipment price anyway. Or, is it some combination of the above factors? Considering number 4, 5 and the shipping costs does not result in pricing parity.

Let's examine item 4: "The currency that will be used to pay for the material..." As an example, consider the purchase of a reel of 5000, 0603 SMT resistors in both U.S. and China.

The resistors are manufactured and put on tape and reel in China.

Further, assume the price for the reel of re-

sistors from the distributor is 340 yuan (note: the yuan is the basic unit of the Chinese currency that is called the Renminbi, literally “people’s currency”).

The current exchange rate between the USD and the yuan is: 1 USD = 6.8 yuan. Or 1 yuan is worth 0.147 USD.

So, the reel of resistors will cost \$50 USD.

If the yuan depreciates with respect to the USD, what happens? Let’s say a USD will now buy 10.0 yuan instead of only 6.8 yuan or 1 yuan is worth 0.100 USD instead of 0.147 USD. The yuan is depreciated or devaluated with respect to the USD by 32%.

What is the impact on buying the reel of resistors? The price of the reel is still 340 yuan, but the price in USD is now \$34.00 instead of \$50 USD.

The opposite is true if the yuan appreciates in value with respect to dollar. The material for the U.S. product assembler will cost more.

The material purchased from distributors in the U.S. should be less expensive if the yuan is artificially kept down or devalued!

So why has the U.S. government complained about a manipulated undervalued yuan? If a U.S. company wants to sell a product it manufactures into China with the yuan at an artificially low level, let’s say at a price of 100 USD, the Chinese consumer will have to pay more yuan making the U.S. made product less competitive.

But, here is the fallacy. Since the components made in China and purchased with USD costs less with a devalued or undervalued yuan, the U.S. assembler should be able to reduce the

overall price of the product and make it more attractive to not only the Chinese consumer, but to consumers worldwide. This is especially true with material being 70–90% of the total electronic product cost and most of that material coming out of Asia. This should be significant.

But, the material is not less expensive when purchased for assembly in the States with a strong dollar and a weak yuan. Why?

We will continue next month.

Hey, what do YOU say? I’d like to hear your thoughts, reactions and opinions. **SMT**

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2. T. Borkes, “The STEM Trap,” *SMT Magazine*, July 2016.

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4. T. Borkes, “Moving Beyond Paideia: Learning for Earning,” *SMT Magazine*, August 2016



Tom Borkes is the founder of the Jefferson Project and the forthcoming Jefferson Institute of Technology. To read past columns or to contact Borkes, [click here](#).

Growing Demand for Precision Weapons Prompts Order for Additional BAE Systems Laser-Guided Rockets

The U.S. Navy has awarded BAE Systems a \$180.5 million contract to continue producing Advanced Precision Kill Weapon System (APKWS) laser-guided rockets to meet the growing U.S. and international demand for the systems.

APKWS rockets are seeing increasing use in theater because they deliver cost-effective precision strikes with reduced potential for collateral damage. The latest order, funded under the recently announced indefinite

delivery/indefinite quantity contract, will help BAE Systems to meet increased demand.

APKWS laser-guided rockets allow militaries to leverage existing munitions and weapons systems investments with minimal effort and training. The APKWS mid-body guidance kit transforms standard unguided Hydra 70 (2.75-inch) rockets into highly accurate precision munitions by easily screwing into place between the warhead and the motor.

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Electronics Industry News

Market Highlights



Worldwide Enterprise-Grade SSD Shipments Up 4% in Q1

Global shipments of enterprise-grade SSDs for the first quarter of 2017 grew against seasonal headwinds by 3-4% compared with the prior quarter to reach around 6 million units, says DRAMeXchange, a division of TrendForce.

TrendForce Projects Contract Prices of Server DRAM Modules to Increase in Q3

The average contract price of server DRAM modules rose sequentially by nearly 40% and 10%, respectively, for the first and second quarters of 2017 due to tight supply, according to DRAMeXchange, a division of TrendForce. In the third quarter, the average contract price of 32GB server DRAM modules for first-tier customers is projected to arrive to around \$260, while the average contract price of 32GB modules for second-tier customers may be higher than that threshold.

Flexible PCB Market Industry Trends and Developments

The demand for flexible printed circuit boards by manufacturers of smartphones, other mobile devices, LCD display, connectivity antennas, and rechargeable batteries, is currently on the rise, according to new report by Future Market Insights.

Where is the Semiconductor Manufacturing Sweet Spot?

Two recent Semico Research Corp. studies provide the information to not only determine the overall semiconductor manufacturing sweet spot but to dig even further to find which products and technologies are the driving forces behind the growth or decline.

Demand for PCBs in Consumer Electronics to Drive Global SMT Equipment Market

Transparency Market Research estimates that the global surface mount technology equipment market was valued at \$4845.7 million in 2016 and is anticipated to reach \$7075.8 million by 2025, exhibiting a CAGR of 4.4% from 2017 to 2025.

Global Semiconductor Sales Up 21% YoY in April

Worldwide sales of semiconductors reached \$31.3 billion for the month of April, an increase of 20.9% from the April 2016 total of \$25.9 billion, and up by 1.3% from the previous month's total of \$30.9 billion, according to the Semiconductor Industry Association (SIA).

U.S. RFID Tags Market to Witness Intense Competitive Trends

According to Transparency Market Research, the U.S. RFID Tags Market is expected to be worth \$1.67 billion by the end of 2025 from \$809.4 million in 2016. The market is expected to surge at a CAGR of 8.5% during the 2017–2025 forecast period.

Automotive Touch Screen Shipments to Top 50 Million Units in 2017

Automotive touch panel shipments are expected to top 50 million units in 2017, up 11% from 45 million units in 2016, according to IHS Markit.

Worldwide Shipments of AR/VR Headsets Gain Momentum in Q1

Worldwide shipments of augmented reality (AR) and virtual reality (VR) headsets continued to soar with a total of 2.3 million units shipped in the first quarter of 2017, according to the International Data Corp. (IDC).

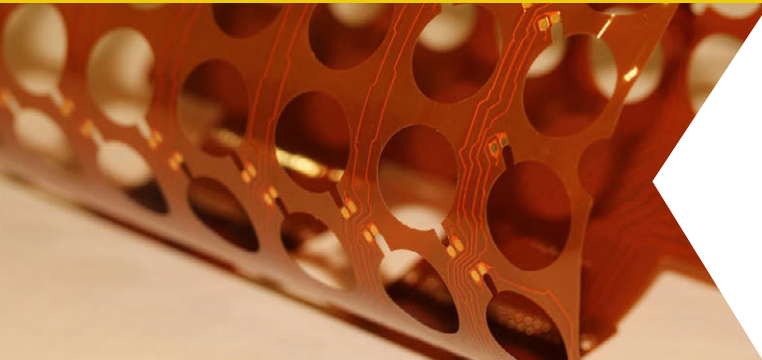
Global Artificial Intelligence Market to Grow at a CAGR of 51% Through 2021

Technavio market research analysts forecast the global artificial intelligence (AI) market to grow at a CAGR of close to 51% from 2017-2021.



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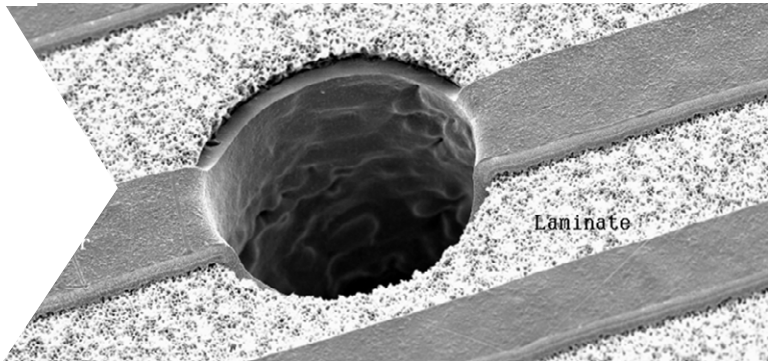
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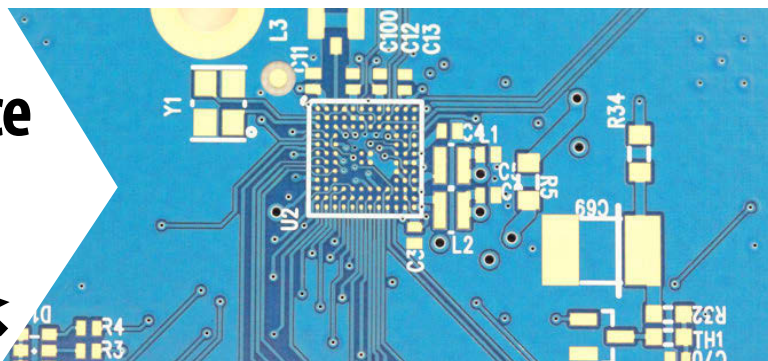
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Mil/Aero Assembly Success



by **Stephen Las Marias**

I-CONNECT007

Michigan-based EMS firm Saline Lectronics counts the military and aerospace industries among its key markets. The company provides PCB assembly, SMT, testing and inspection, and electromechanical box build services, and is certified to AS9100 and ITAR registered to guarantee customers that their products are manufactured with the most rigorous quality standards.

For this month's issue of *SMT Magazine*, Davina McDonnell, director of marketing, discusses the latest technology and business trends driving the military and aerospace industries, the challenges in these markets—including supply chain issues such as obsolete parts and counterfeit components—and their strategies to stay ahead of the competition.

Las Marias: From your perspective, what are the biggest challenges when it comes to electronics assembly for the military and aerospace markets?

Davina McDonnell: The biggest challenge for many of our military/aerospace clients is making sure that we can get the required material in-house within a timely fashion. A lot of the custom components on these type of PCB assemblies have long lead times, which can make it difficult for us to deliver completed units within a timely fashion. With many of our clients, we encourage them to quote the project as soon as possible—that way we can give them an accurate picture of what to expect for lead time.

Las Marias: What new demands/requirements are your customers putting on you?

McDonnell: For critical applications, our military and aerospace customers need full transparency—they need to know everything that happens to their product during the manufacturing process from the very beginning to final packaging. With a lot of these products, we have to fully validate the manufacturing process and thoroughly document through PPAPs or other manufacturing controls that all of the



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requirements for that product have been met and followed. We need to ensure that we have full traceability of the supply chain, and the manufacturing process (including testing results).

Las Marias: What does Saline Lectronics do differently to address these challenges or requirements?

McDonnell: Beyond meeting the basic requirements to build these types of products, such as ITAR registration and AS9100 certification, we also have a full team of engineers, including electrical, mechanical, test and quality engineers, who work to establish clear product realization processes (PRPs) for each specific project and customer. These PRPs will include all the customer's requirements for a build and detail exactly what needs to be done at every step of the project.

For traceability, we utilize Cogiscan's Track, Trace and Control system to provide full traceability of the circuit board assembly. With this system, we offer traceability to the reference designator. We also perform any ESS testing in-house and work closely with our customers to guarantee that we're following their requirements perfectly. Additionally, we offer conformal coating and potting in-house, which is atypical for other EMS providers of our scale.

Las Marias: Given the long period for developing wins in military/aerospace electronics contracting, how does Saline Lectronics balance that strategic business development effort in military/aerospace with more immediate opportunities in non-military markets you serve like commercial, medical and telematics?

McDonnell: While the sales cycle for aerospace/defense may be longer than other product lines, in general, it's not that much longer than other customer types. It takes a lot of trust



Davina McDonnell

and certainty to contract out the manufacturing of a circuit board assembly, which typically leads to a longer sales cycle. In general, we see a sales cycle of about more than six months—which can vary depending on customer and project—to land a production order. Our sales team does an excellent job of keeping our customer base diverse. They intentionally target customers in a wide variety of industries to keep up our diversification spread.

Las Marias: Component obsolescence continues to be a problem in military/aerospace markets. How do you ensure the availability of obsolete parts?

McDonnell: Without control over the product's design, we're often at the whim of what's available in "broker land" to locate obsolete components. Luckily, many of our military/aerospace customers know about the obsolete components and engage in a last time buy, and provide those components to us for the actual build. If that's not an option, we only work with certified brokers who can provide complete counterfeit testing to source any obsolete components. This is usually performed in conjunction with our customer. Any components from a broker that are needed for a military/aerospace application pass rigorous testing and approval from the customer before we procure them.

Las Marias: Counterfeit components are also a growing problem in military/aerospace supply chains. What are the things Saline Lectronics is doing to help mitigate the risk of receiving or installing a counterfeit part?

McDonnell: Saline Lectronics recognizes the risk associated with counterfeit parts and has the standard policy of always using franchised distributors unless directed by and approved by our customers. When an independent dis-

tributor is used, we are very selective! We take the following into consideration: Is this distributor a member of the Independent Distributors of Electronics Association (IDEA)? And do they have a certified quality management system? The distributor gets bonus points if they have the capabilities to properly process components such as IDEA-ICE-3000 certified inspectors, in-house X-ray and testing capability, marking testing, decapsulation; and if needed, third party facilities to provide further testing. We also perform rigorous inspections to parts that come in from independent distribution channels.

Las Marias: How do you ensure the security and reliability of your supply chain?

McDonnell: Not only do we validate our supplier's certifications when we first initialize a relationship, but we also recheck them on a recurring basis through our supplier database system. We're always monitoring our supplier delivery and quality performance. This helps us mitigate any minor issues from turning into major ones. Lastly, for risk mitigation we do our best to eliminate redundancy where possible within our supply chain.

Las Marias: What about cybersecurity? What strategy have you got in place to address this issue?

McDonnell: Our IT infrastructure has several safeguards to protect both on the periphery of our networks and within. These are under regular review by our IT Department in line with current standards that are appropriate for our business. We take data handling very seriously and have restrictive measures of control placed on different data categories particularly those pertaining to military/defense/aerospace information. In addition, we have regular training for our staff regarding IT security awareness to ensure that all in our company remain vigilant to cybersecurity threats.

Las Marias: Are there any regulations that are impeding you from getting more military/aerospace business?

McDonnell: We haven't come across any regulations that have prevented us from fulfilling contracts that we've quoted. We're able to fulfill of our current military/aerospace customers' needs with our ITAR Registration and AS9100 Certification as well as our Class 3 capabilities.

Las Marias: OEMs don't fully trust EMS providers with their complete product roadmaps for fear portions of it or their strategy might be shared with competing OEMs that the EMS provider also serves. How do you see the EMS industry moving past this trust issue?

McDonnell: If EMS providers are being trusted with the critical job of actually putting together these sensitive products, then it seems a little silly that OEMs are unwilling to provide full visibility on that project's roadmap. We take our NDAs very seriously and would never share any information about a product—it's not worth jeopardizing our relationship with our customer nor it is worth ruining our reputation. In fact, as OEMs ask for more visibility from EMS providers, it's only fair for OEMs to respond in kind. The more information that we have about a product, the better equipped we can be to develop a long-term, strategic, and pro-active plan to manufacture that product. Without full visibility we're only reactive, and that puts everyone at a disadvantage.

Las Marias: What are the key factors that OEMs should consider when choosing an EMS partner?

McDonnell: Transparency, traceability and expertise. Transparency: is your EMS partner willing to be transparent about their manufacturing process? Will they openly share information about their supply chain? Quality controls? Traceability: can your EMS partner provide you with the appropriate data that shows exactly what happened to your product during the assembly process—from the very beginning to the very end? Ask for sample reports! Find out the traceability process controls that they utilize. Do those align with your expectations? Expertise: Has your EMS provider built other complex products within this military/aero-

space market? Can they provide references? Do they have an engineering team to support obsolescence issues, design changes, or testing concerns?

Las Marias: What current technology trends do you see driving the military/aerospace industry?

McDonnell: Currently, many of our military customers are being awarded contracts for UAV type projects as well as jobs to update current, outdated military vehicles with newer technology. Another big project push within the field is for data recording assemblies that can store large amounts of data.

Las Marias: What is your outlook for the overall military/aerospace industry market this year and the next?

McDonnell: Incredibly positive. We have already seen a large increase this year with our current customers, and we are working on other opportunities with new customers in this market.

Las Marias: Thank you, Davina.

McDonnell: You're welcome. **SMT**

DARPA Picks Design for Next-Generation Spaceplane

DARPA has selected The Boeing Company to complete advanced design work for the Agency's Experimental Spaceplane (XS-1) program, which aims to build and fly the first of an entirely new class of hypersonic aircraft that would bolster national security by providing short-notice, low-cost



access to space. The program aims to achieve a capability well out of reach today—launches to low Earth orbit in days, as compared to the months or years of preparation currently needed to get a single satellite on orbit. The program's success would revolutionize the Nation's ability to recover from a catastrophic loss of military or commercial satellites, upon which the Nation today is critically dependent.

The XS-1 program envisions a fully reusable unmanned vehicle roughly the size of a business jet, which would take off vertically and fly to hypersonic speeds. The vehicle would be launched with no external boosters, powered solely by self-contained cryogenic propellants. Upon reaching a high suborbital altitude, the booster would release an expendable upper stage able to deploy

a 3,000-pound satellite to polar orbit. The reusable first stage would then bank and return to Earth, landing horizontally like an aircraft, and be prepared for the next flight, potentially within hours.

If successful, the program could help enable a commercial service in the future that could operate with recurring costs of as little as \$5 million or less per launch—a small fraction of the cost of launch systems the U.S. military currently uses for similarly sized payloads.

To achieve these goals, XS-1 designers plan to take advantage of technologies and support systems that have enhanced the reliability and fast turnaround of military aircraft. For example, easily accessible subsystem components configured as line replaceable units would be used wherever practical to enable quick maintenance and repairs.

The XS-1 Phase 2/3 design also intends to increase efficiencies by integrating numerous state-of-the-art technologies, including some previously developed by DARPA, NASA, and the U.S. Air Force.

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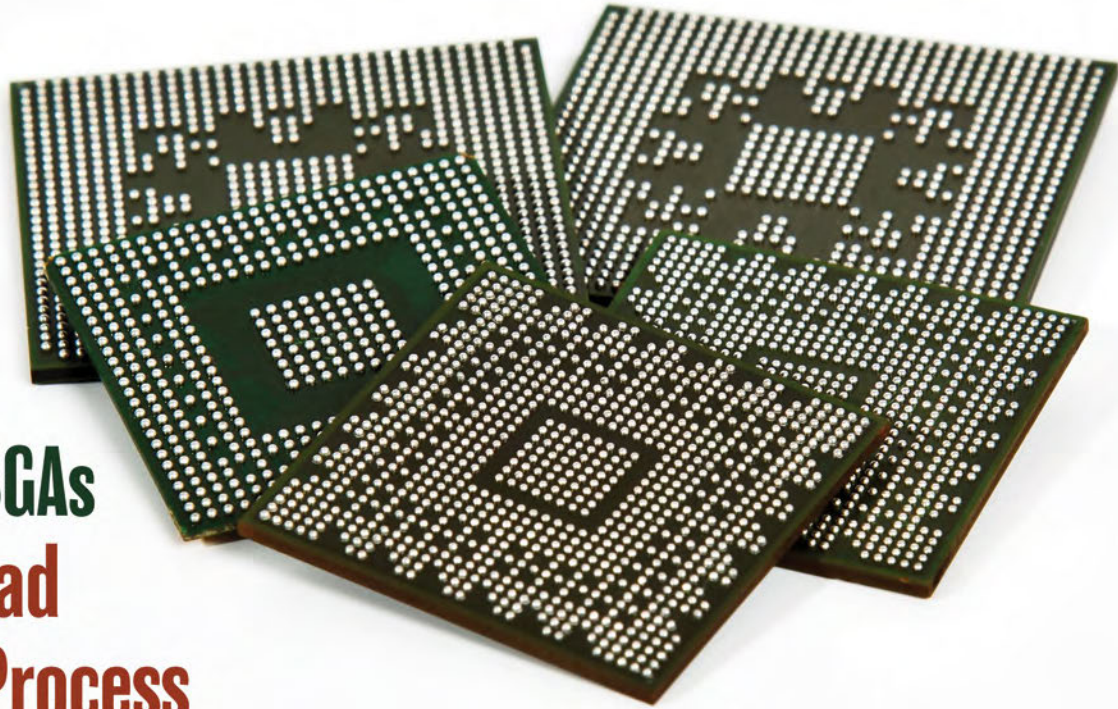


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Using Lead-Free BGAs in a Tin/Lead Soldering Process



by **David Hillman**
ROCKWELL COLLINS

Several electronic market segments remain exempt from lead-free material restrictions such as Restriction of Hazardous Substances (RoHS) legislation. These market segments tend to be electronics used in harsh environments and/or that have life/system critical functionality. While these market segments, which include avionics, can use solder containing lead, it is increasingly difficult to procure advanced components in non-ROHS compliant configurations. Product design teams that continue to use tin/lead soldering processes are faced with the dilemma of how to use ball grid array (BGA) components that are only available with lead-free solder spheres in their assembly processes. This paper discusses several aspects of having lead-free BGA components in a tin/lead soldering process: (1) mixed metallurgy; (2) solidification; (3) tin whiskers. The possible methodologies of utilization without compromising product integrity will be discussed.

The Mixed Metallurgy Concern

Environmental legislation has caused significant impact to the electronic industry in terms of the material sets used in electronic products. The prohibition of materials such as cadmium, hexavalent chromium, mercury and lead has eliminated a number of electronic components and material processes that were historically used in producing electronic products. The removal of lead for solder alloys has arguably the greatest impact on electronic products due to its role as the primary mechanical and electrical functionality material. Figure 1 illustrates how global solder usage trends show the replacement of tin/lead solder alloys with lead-free solder alloys since 2004 as tracked by the IPC Global Solder Statistical Program^[1].

Product design teams that continue to use tin/lead soldering processes are faced with the dilemma of how to use BGA components that are only available with lead-free solder balls. The combination of a tin/lead solder paste alloy with a BGA component with lead-free solder balls results in a “mixed metallurgy” solder

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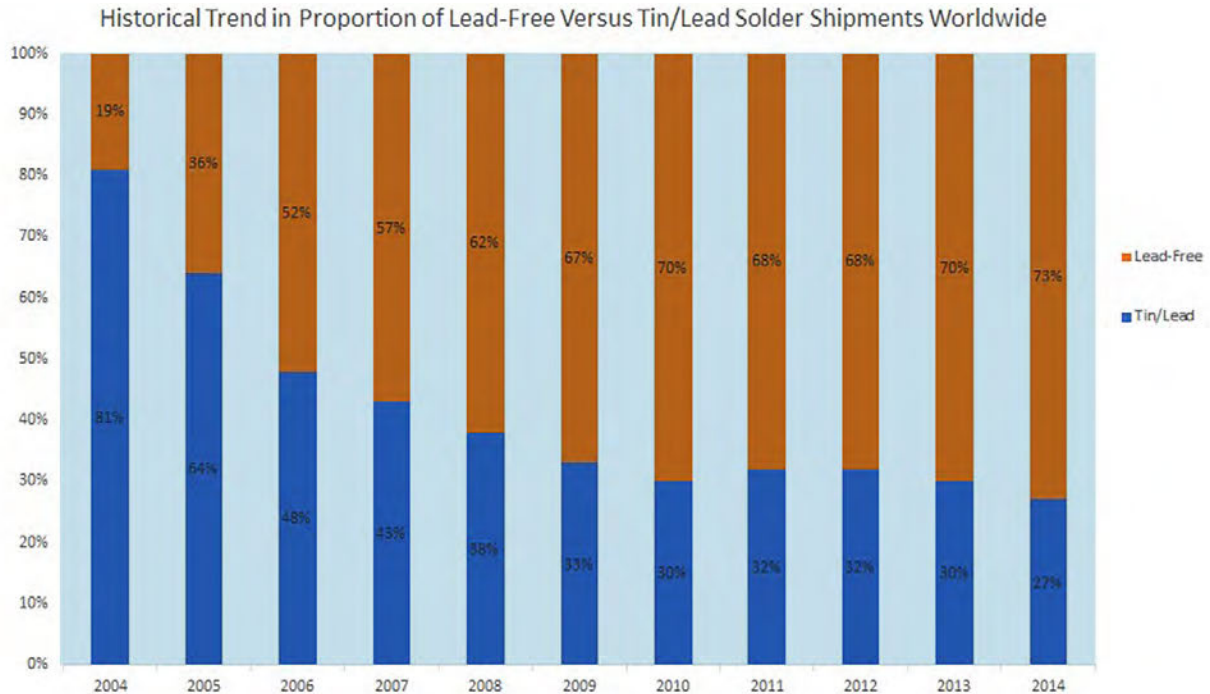


Figure 1: Global solder usage trends.

joint microstructure that has poor solder joint integrity in many product use environments. Three industry solutions have emerged as acceptable methodologies to address the potential solder joint integrity issue of a mixed metallurgy (i.e., lead-free parts used on a tin/lead assembly, condition). The first solution is to send the lead-free BGA component to an external service provide to be “reballled” (i.e., the lead-free solderballs are removed and replaced with tin/lead alloy solderballs). The reballing process has been shown to be reliable, provided that strictly controlled process procedures are followed^[2, 3]. The advantage of a reballed BGA component is that it is transparent to a tin/lead soldering process; the disadvantages are the cost and time required to reball the BGA component.

The reballing of a BGA component requires the control of several key process parameters: moisture sensitivity level, solderball removal/attachment temperature/time and cleanliness of the reballed BGA component. Functional component testing is necessary to ensure that no process or component defects result from the reballing process. The following example illustrates how conducting functional assessment

due diligence prevents the introduction of defective reballed BGAs into products.

A BGA component was found to have functional errors during engineering prototype testing. The BGA component in question had been procured from the component supplier as a lead-free BGA and was subsequently reballed using a eutectic tin/lead solder alloy. An X-ray of the suspect BGA revealed excessive solder joint voiding. Industry investigations^[4] have shown that BGA voiding, in general, is not a solder joint integrity issue but is a clear indicator of a pad design or soldering process problem. The BGA pads did not contain any microvia technology so it was initially believed that an issue relating to a solder paste deposit or reflow profile was the voiding root cause. Figure 2 shows the excessive voiding observed in the BGA solder joints during X-ray assessment.

Metallographic cross-sectional analysis was conducted to verify that the observed solder joint voiding was a solder process issue. The cross-sectional analysis revealed component copper pad thicknesses so thin that, during the assembly reflow process, the molten solderball made contact with the BGA laminate material,

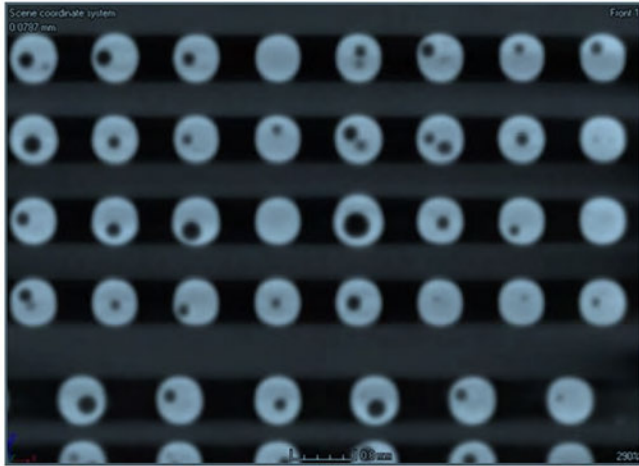


Figure 2: X-ray image of suspect BGA.

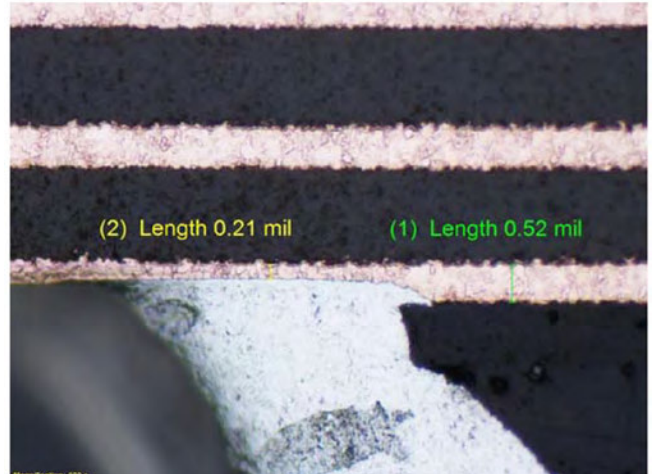


Figure 4: Damaged BGA pad plating structures, micro view.



Figure 3: Damaged BGA pad plating structures.



Figure 5: Cross-sectional view of reballed solder-ball and component pad interface revealing pre-existing degraded conditions prior to assembly reflow process.

which resulted in outgassing that created the void. Measurement of the copper pad plating revealed a nonexistent nickel plating barrier, which allowed 50%–100% copper plating dissolution of the BGA pad (Figures 3 and 4).

A cross-sectional analysis of the reballed BGA component prior to assembly reflow soldering revealed damaged and degraded BGA pad plating that was exacerbated by the BGA reballing process. Figure 5 illustrates the observed reballed BGA component pad condition. Functional testing of the BGA prevented a potential solder joint integrity field defect.

A second methodology for using lead-free BGA components is to utilize a hot reflow profile during the tin/lead soldering process to harmonize the BGA solder joint microstructure and minimize solder joint microstructure segregation. Traditionally, the industry uses tin/lead solder paste reflow profiles with a maximum

temperature limit of 200–225°C. Solder paste flux formulations and component fabricators have characterized and tested their construction materials to not degrade up to this temperature range limit. However, the typical lead-free solder reflow profile has temperature excursions in the range of 235–260°C, which easily exceeds the 200–225°C tin/lead solder process reflow profile limit. Many component fabricators will void their tin/lead component warranties if the 225°C temperature is exceeded. Some high-performance product design teams have conducted testing and worked with their component fab-

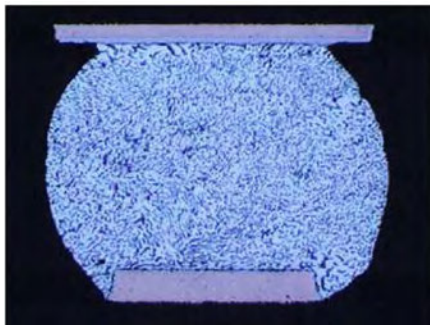


Figure 6: BGA solder joint: tin/lead alloy in a tin/lead process.

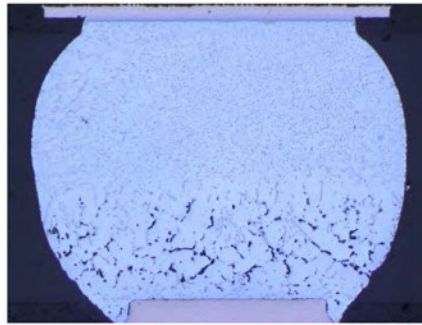


Figure 7: BGA solder joint: mixed metallurgy (lead-free alloy in a tin/lead process).

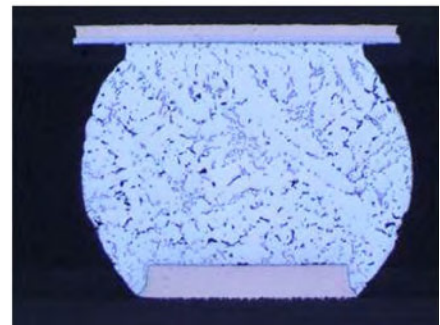


Figure 8: BGA solder joint: hot profile, lead-free alloy in a tin/lead process.

indicators to develop acceptable hot reflow profiles that do not introduce component integrity concerns^[5, 6]. The advantage of using a hot profile is minimal process parameters changes and low cycle time impact. The disadvantages of using a hot profile are the time/costs associated with the additional due diligence testing and laborious reflow profile generation necessary to demonstrate component/solder joint integrity acceptability. Figure 6 and Figure 7 illustrate a typical tin lead solder joint with uniform microstructure and a lead-free solder joint with mixed metallurgy microstructure with segregated regions of lead-free and tin-lead solder. Figure 8 illustrates the solder joint microstructure resulting from a hot profile.

A third methodology to address the mixed metallurgy concern is to use the lead-free BGA component in a tin/lead soldering process and then underfill it. The resulting BGA solder joints will have various degrees of segregated solder joint microstructure dependent upon the size and density of the BGA component population on the printed circuit assembly. However, the application of an underfill material reduces the impact of coefficient of thermal expansion (CTE) mismatch stresses on the solder joints by directly coupling the BGA component to the printed circuit board^[7, 8]. The advantages of using an underfill approach are the reduced costs and better availability of standard lead-free BGA components as well as minimal soldering process changes. The disadvantages of using an underfill material are the costs/time

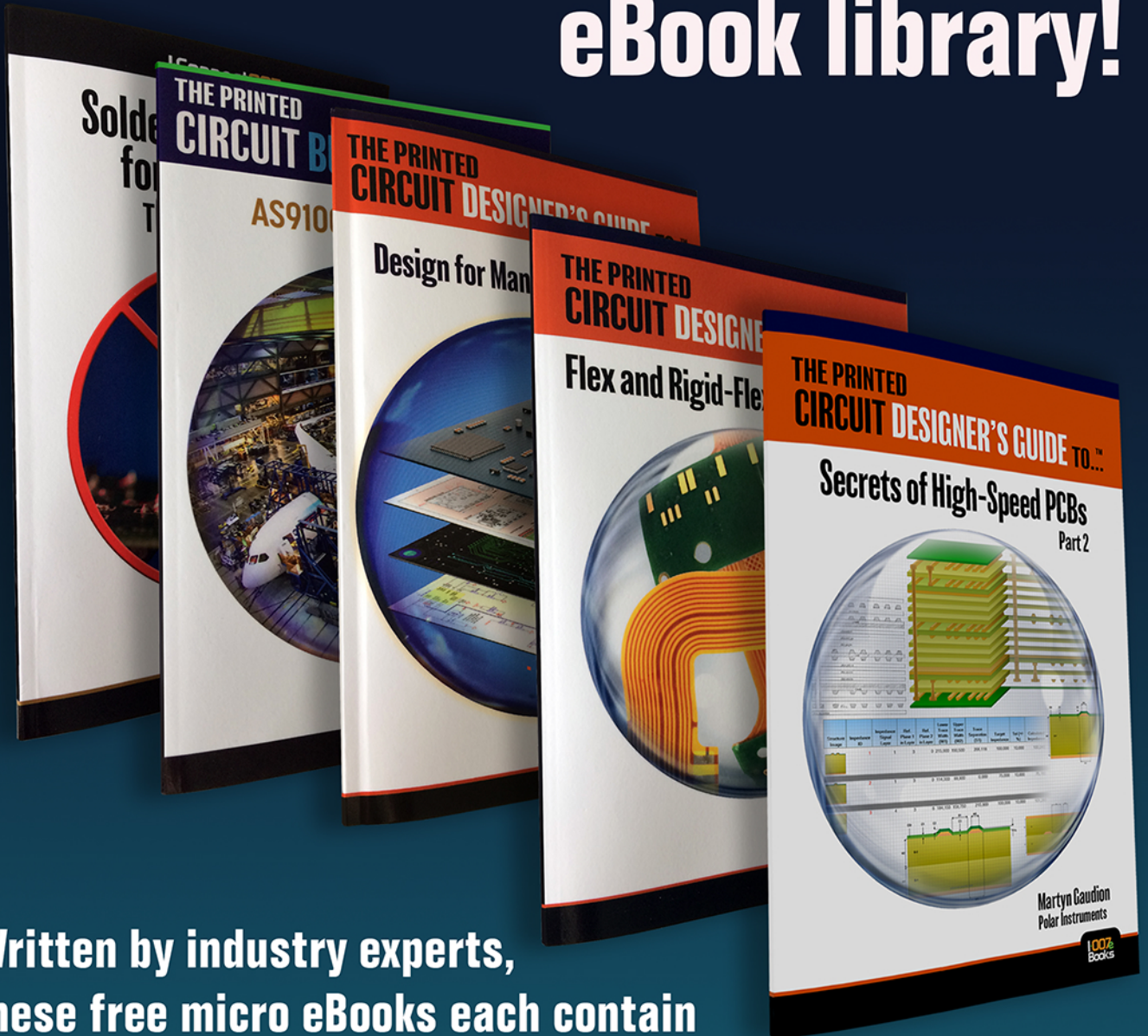
associated with the additional assembly process step of underfilling components and the potential need for using a nonreworkable underfill material, i.e., the printed circuit assembly becomes a non-repairable item. Rockwell Collins uses the underfill methodology to address lead-free BGA components processed in a tin/lead soldering process. The additional assembly process step has been demonstrated to be a low-cost impact in comparison to the procurement cost/availability of tin/lead BGA components for product designs.

The Solidification Concern

It is no accident that the electronics industry has traditionally used the Sn63Pb37 and Sn60/Pb40 solder alloys as the assembly alloy materials of choice. These two tin/lead solder alloys are eutectic in their solidification behavior. In a eutectic composition, the mixture of metals changes from a solid to a liquid at a single temperature. This solidification behavior is extremely beneficial in creating solder joints and processing of electronic assemblies. Most metallic alloys change from a solid to a liquid over a range of temperature, often described as having a “pasty range,” which can complicate the handling/motion of in-process electronic assemblies. Since the primary lead-free solders being used today are not eutectic alloys, additional processing due diligence is required. Additionally, a non-eutectic metal alloy can often form solidification shrinkage voids. Figure 9 illustrates a BGA solder joint, which contained



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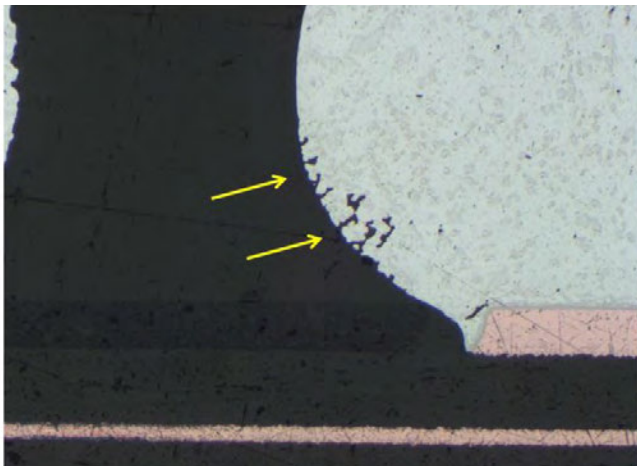


Figure 9: Shrinkage voids in a lead-free BGA solder joint.

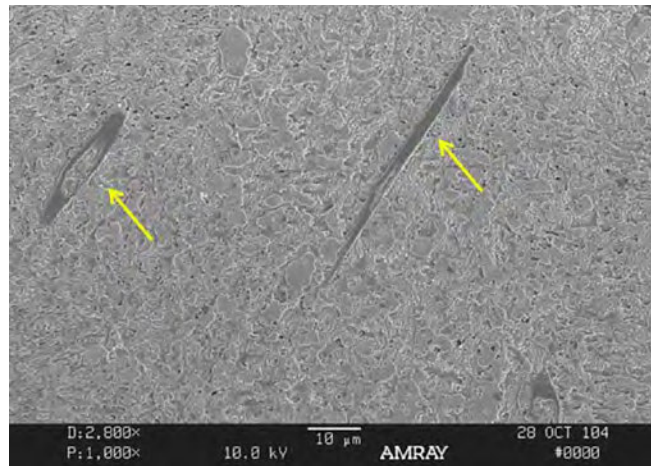


Figure 10: Large Cu6Sn5 IMC structures in a Sn63Pb37 solder joint.

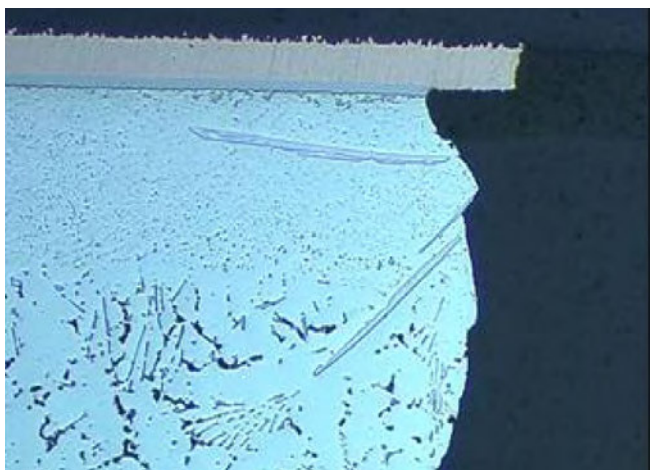


Figure 11: Large Ag3SnSilver/Tin IMC structures in a mixed metallurgy solder joint^[9].

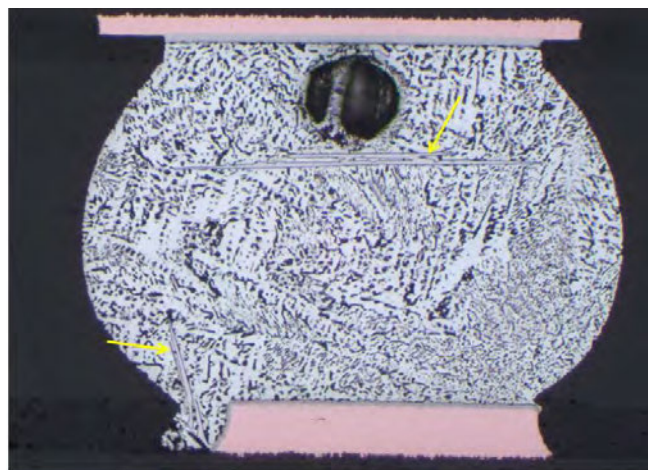


Figure 12: Large Cu6Sn5 IMC structures in a SAC305 solder joint.

shrinkage voids that had been subjected to a total of 1,000 -55°C to 125°C thermal cycles in accordance with the IPC-9701 specification. Initially, there was industry concern that the shrinkage voids would be a solder joint crack initiation site, but industry testing^[9-12] has demonstrated these concerns were unfounded.

An equally contentious industry debate is the influence of large intermetallic compounds (IMCs) on solder joint integrity. The primary IMCs found in the typical tin/lead solder joint are tin/copper, usually Cu6Sn5 structures (Figure 10). These large tin/copper IMC structures do not degrade solder joint integrity and are

the result of a reflow profile that used excessive time/temperature parameters. The use of adequate thermal profiling eliminates their presence in most assemblies.

With the introduction of lead-free solder alloys, it is not unusual to have tin/copper, tin/nickel, silver/tin and even tin/gold/copper IMC structures in the solder joint microstructure. There is one camp of thought that the IMCs assist solder joint cracking and another camp of thought that the IMCs blunt solder crack growth. Figure 11 and Figure 12 are two examples of lead-free solder joints containing large IMC structures that have undergone 2000 thermal

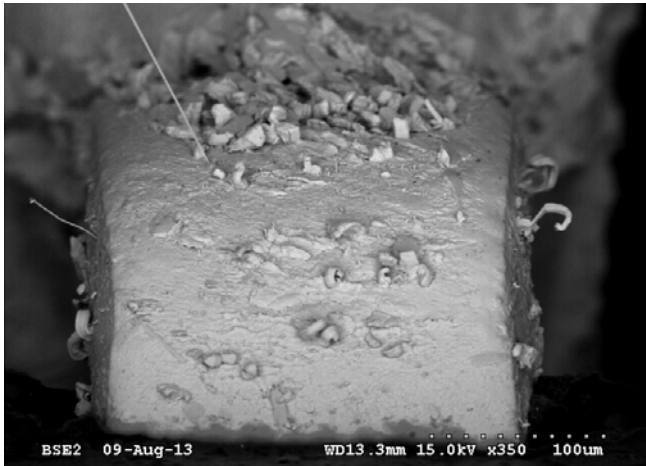


Figure 13: Tin whiskers on solder fillet/component lead interface. (Courtesy of P. Snugovsky, Celestica)

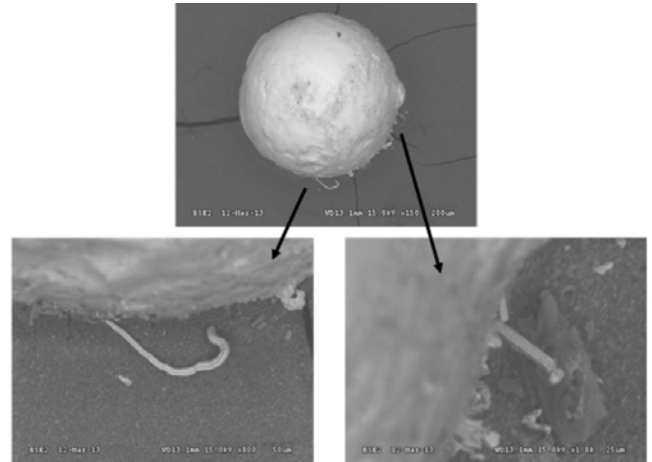


Figure 14: SEM image of tin whiskers produced using a REE/SAC105 solderball soldered with SAC305 solder paste. (Courtesy of P. Snugovsky, Celestica)

cycles per the IPC-9701 specification using a -55°C to 125°C temperature range. In both cases the large IMC structures did not initiate solder joint cracking and failure of the solder joint.

Large IMC structures are an indication that the reflow profile can potentially be improved to reduce or eliminate their presence. However, the presence of large IMC structures in solder joints does not necessarily indicate a need for their rework.

The Tin Whisker Concern

The topic of tin whiskers has been the single focus of entire technical conferences and continues today to be a topic of significant discussion. In general, there is industry consensus that tin whiskers do not initiate and grow from solder surfaces under standard conditions. A number of industry investigations have documented solder joints with high ionic content and/or corrosion situations^[13, 14, 15] that initiated tin whisker growth. These tin whiskers have been shown to originate at the edges of component pads or solder joint fillet/component lead interfaces where the solder is very thin and behaves like tin plating rather than a bulk solder alloy. Figure 13 illustrates tin whiskers in this thin solder region for a surface mount component^[16].

However, industry investigations have documented how the addition of rare earth ele-

ments (REEs) as constituent additions to lead-free solder alloys does result in the initiation and growth of tin whiskers^[17-23]. The REEs combine with tin to form REE/Sn intermetallic phases that segregate to the solderball surface. As these REE/Sn intermetallic phases oxidize, the oxide increases the volume, which creates compressive stresses that lead to tin whisker formation. P. Snugovsky and S. Meschter^[21] conducted 85C/85%RH humidity testing of BGAs with SAC105 solderballs that included 0.01% cerium and were soldered using a SAC305 solder paste. These solderballs produced tin whiskers up to 70 microns in length after 4,000 hours. Figure 14 illustrates an example of the tin whiskers resulting from their testing.

Many high-performance electronic industry segments such as avionic, defense, and space applications have restricted the use of BGA components that have solderballs with REE additions to avoid the introduction of BGA tin whisker issues.

Conclusions

The impact of having BGA components transitioning from tin/lead solderball alloys to lead-free solderball alloys has created significant challenges for product design teams. Issues such as mixed metallurgy, alloy solidification and tin whiskers require the implementation of

new design rules and alternative manufacturing protocols. It is anticipated that similar component related impacts will be realized as lead-free solder technology implementation in harsh environment electronic conditions.

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Using Paste Flux for Rework

by Bob Wettermann

BEST INC.

What properties should paste flux have?

When using a hot air or IR rework system where the reflow cycle is mimicking the original SMT reflow profile, and when using flux for re-attachment, paste flux otherwise known as gel or tacky flux is the correct type of flux to use. The extended time above the solder liquidus temperature causes liquid flux to expire and not be effective during the complete reflow cycle. Paste flux, on the other hand, due to its high viscosity and tack properties, prevents components from being moved during hot-air reflow while being able to remain active for the complete time-temperature period. This prevents disturbed solder joints, which are a defect for all three classes of product, from forming (IPC-A-610F). It also prevents ultra-miniature, low-mass parts from being blown off the board if using a hot air rework source. Typically, the rule of thumb for the reflow cycles is to make sure the tin-lead solders are 30–45 seconds above liquidus whereas the lead-free solder alloys are 60–90 seconds above liquidus. Tacky fluxes are designed to be active for this length of time. Using the properly-formulated lead-free or tin-lead version will ensure that the flux remain active during the entire reflow profile.



In addition to the property of being able to remain active during an extended rework cycle time, the flux chemistry is also important. No clean flux residues are intended to be benign after reflow on a PCB when processed properly and are intended to NOT require any post application cleaning. Conversely, water-soluble paste fluxes are generally more active and are designed such that the residues need to be cleaned off the PCB post rework.

While water soluble fluxes are aggressive, giving the rework technician a wider process window, it often bonds with the PCB itself or other metal surfaces, and as a result will require thorough cleaning. It is important to get the cleaning right especially when conformal coating needs to be applied to the PCB. It is also important to clean off the residues when probe testability is important—that is the electrical probe needs to make good electrical contact with the pads.

One of the other advantages of using gel flux is the ability to control the application and hence the area requiring cleaning after soldering. When using liquid fluxes, the material, due to its low viscosity, can spread onto multiple areas of a PCB. This becomes a problem when the flux spreads out from the soldering location and does not experience the full localized reflow temperature cycle. These contam-



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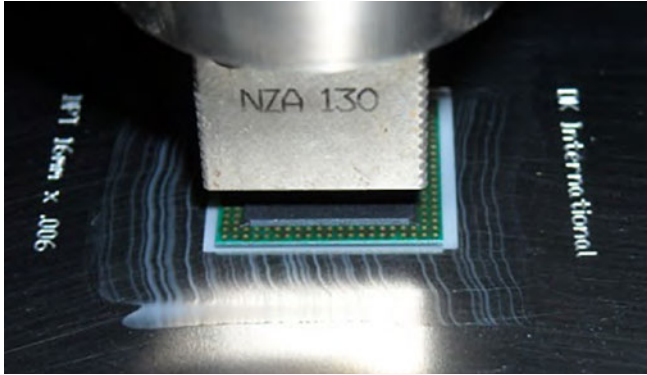


Figure 1: Solder paste dipping of POP package into dipping well for paste flux application.

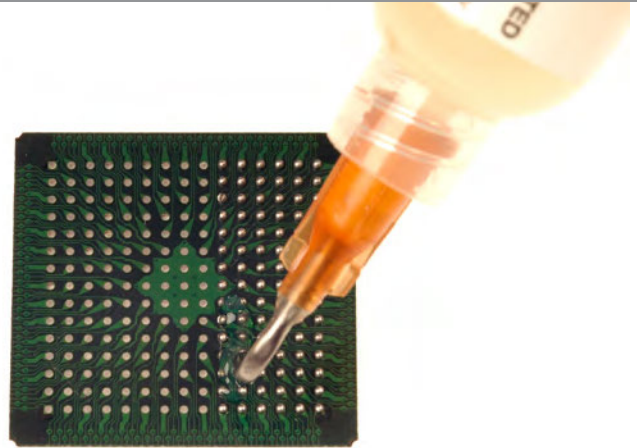


Figure 2: Dispensing of paste flux onto BGA for rework.

inants left behind can potentially cause electromigration of these soils, which can cause reliability problems later in the life of the assembly. Conversely, the high-viscosity gel fluxes, when dispensed or stencil printed, stay in the area where they were applied. One must be careful of the application of the gel flux as too much flux volume can make the lead or ball float off the pad during the soldering process.

What does paste flux do?

Like all fluxes, the paste fluxes used in rework serve two basic functions. The first job of the flux is to make sure that the oxides are cleaned up from the area to be soldered. It should form an oxidation barrier which allows the BGA ball or paste to coalesce and form a homogenous solder joint. Its other function is to make sure that proper wetting is achieved so that the solder fillet can be formed properly to meet the acceptability requirements.

How does paste flux get applied?

There are a multiple paste flux application methods for the rework of BGAs and other complex components. In some cases, the simplest form of application of the tacky flux is by using a flux dip of the part into a flux bath. This bath is a reservoir slightly oversized compared to the package outline dimensions. The depth of the reservoir is approximately 60% of the ball diameter which allows more than half of the ball to be covered in paste flux when the

device bottoms out in the fixture. If the reservoir is kept full of fresh paste flux, the process works well. In another application method, paste flux is simply applied to the board area where the device rework location resides. This can be accomplished with a brush, gloved-finger or even selectively applied via a miniature stencil.

The stencil has the added benefit of not having excess flux residues on the PCB to clean off post reflow. Alternatively, dispensing paste flux on to the pads of the device area being reworked has benefits similar to that of stencil printing. Finally, the part may be selectively printed with the paste flux by using the properly-sized rework fixture. In this paste flux application method, the part is held in to an inverted fixture which holds and aligns the part. The bottom side of the component is then stencil printed with the paste flux such that the solder balls, component leads or pads are printed with paste flux,

By using the right type of paste flux in both area array and leadless device rework, consistent, acceptable results can be achieved. **SMT**



Bob Wettermann is the principal of BEST Inc., a contract rework and repair facility in Chicago.



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An Alternative Approach to Vertical Integration in Manufacturing

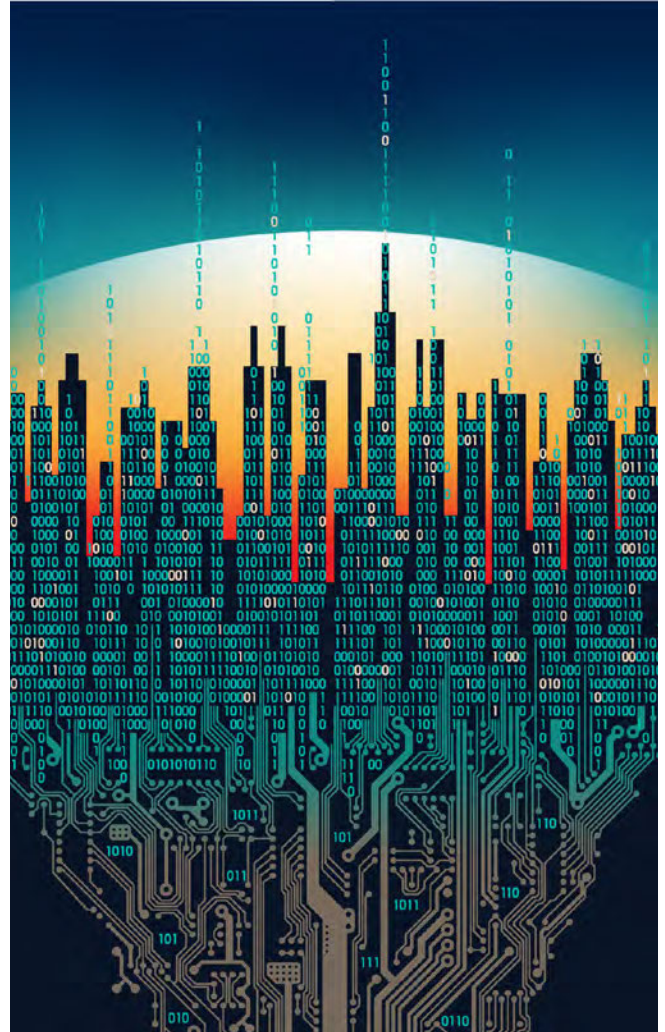
by **Richard Kelly**
MC ASSEMBLY

The past 50 years have seen the emergence of the EMS industry as OEMs outsourced increasingly more of their product to various global contract manufacturers. Originally concentrated in the United States, the industry has blossomed into nearly \$600 billion in sales and their growth shows no indication of slowing in the near future.

The EMS industry was fed by acquisitions of manufacturing concerns from OEMs in the 1990s, followed by mergers of many EMS players in the 2000s. The worldwide manufacturing landscape has changed forever. The days of OEMs owning large vertically integrated manufacturing assets are gone and will probably never return. Oddly, the large vertically integrated manufacturing capability of the OEMs started to be dismantled by the emergence of the EMS companies. Now, some of these same EMS companies are adopting the same, vertically integrated solutions themselves.

Changes in EMS—ODM & Vertical Integration

Even within the EMS world, the past 10 years have witnessed two significant changes. First, there was the emergence of the original design manufacturer (ODM) as third parties participated more in the design and engineering of product on behalf of the OEMs, and then the merger of the ODM capability into the EMS players either through acquisitions or in-house devel-



opment of the capability. Second, there was the broadening of manufacturing capability within EMS through vertical integration. Again, the vertical integration originated from the EMS' acquisition of existing technology manufacturers (such as metal fabrication and plastic injection molding) or the in-house development of the capability.

ODM

The ODM factor immediately draws in the unwanted complication of intellectual property (IP) rights and protection of them. The fear of losing IP to competitors through undisciplined or unscrupulous ODMs is sufficient to justify customers' staying clear of EMS partners who rely heavily on this capability for revenue. The larger Tier-1 EMS players are heavily invested in customers with consumer products where small design developments can be a differentiation, but the life cycle of their product is so short, the need to maintain intellectual property security is less critical. However, these same Tier-1 players have some customers who are not part

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Figure 1: MC Assembly process lines demonstrating high complexity mechatronics assemblies. Note the metal fabrication and cables that are fed from MC integrated partners.

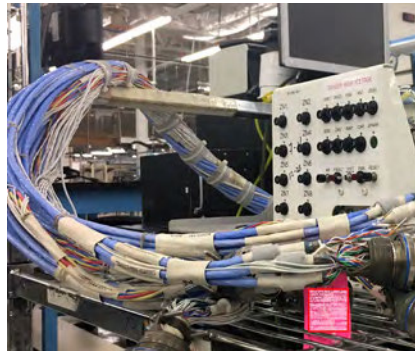


Figure 2: High complexity wire harnesses from MC integrated partners being staged for next step assembly.



Figure 3: Fan assembly being integrated in enclosure from MC integrated partner.

of the consumer market yet the financial support of the ODM infrastructure within the Tier-1's corporate structure is still burdened over the broader base of their corporate costs. MC Assembly prefers to invest in engineering resources dedicated specifically to processes like design for manufacturability (DFM) and design for excellence (DFX) where the output is not directly sold to its customer, but rather their customer benefits from the associated cost reductions gained from the improved efficiencies in the manufacturing processes.

Vertical Integration in EMS

The vertical integration factor is a little less straightforward. Initially, the movement towards vertical integration of manufacturing capability was limited to the exceptionally large EMS companies and, at first, was usually the result of them acquiring an auxiliary manufacturing capability as part of the acquisition of circuit board assembly and surface mount technology (SMT) from an OEM.

The added capability did improve the marketing concept of “womb-to-tomb” manufacturing but also burdened the EMS company with large capital machinery assets that could not be easily relocated and manufacturing technology that was foreign to EMS companies. Over time, many of the larger EMS companies were better able to harness the technology and by investing even further into the different technologies

associated with manufacturing, they could offer their customer base the concept of a “one-stop shop” for the supply chain needed to build their customer's product.

The expansive EMS corporate campuses we see in China today are the hyper-outgrowth of this vertical integration. In cities such as Shenzhen, vast industrial areas, walled-off and secured from the public eye dominate the landscape. Supporting employee populations larger than most cities in the United States, these manufacturing entities are the apex of vertical integration in the EMS world.

Despite the bad press received over the poor working conditions of these mega-factories, the manufacturing model seems to be working particularly for high-volume consumer products where the repetitive manufacturing nature of the product and the ability to dedicate capital machinery to single product minimizes set up costs long term. Plus, the ability to stack margins on the multiple layers of the product bill-of-materials (BOM) enhances the overall profitability of the company and is less transparent to the end customer.

Vertical Integration in Low-Volume EMS

When you apply the same model to lower-volume manufacturing, directionally the results become much more problematic. The profitability equation for any capital-intensive manufacturing machinery is utilization and set-up minimization.

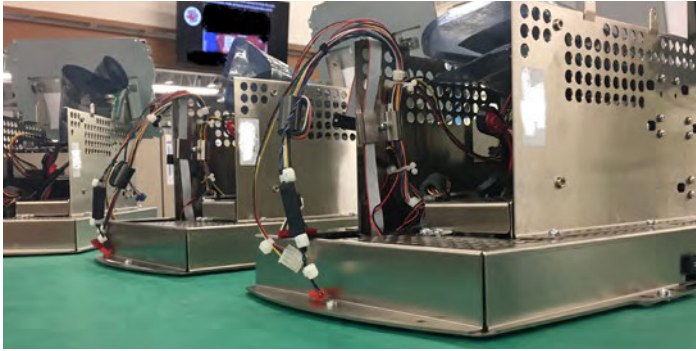


Figure 4: Enclosures and harnesses in queue at MC waiting final integration.



Figure 5: Supermarket at MC with enclosures waiting for pull by final assembly.

As EMS companies brought in vertical integration, the need to optimize the utilization of their newly gained machinery often outweighed the needs to support the required service level of the customer. Obviously, the practice of meeting customer's needs unprofitably is a solution that is doomed for long-term failure for a business. Adding to this is the often-heard statement within these vertically integrated EMS companies: "My internal manufacturing teams that feed me components are my worst suppliers. You would think I have greater leverage since we wear the same badge but in reality, they are more driven by their own P&L and since I am a captive customer, they know I cannot fire them."

Vertical Integration in HMLV

When you now apply the same model to the high-mix/low-volume (HMLV) manufacturing environment, directionally, the results become dismal. This is the environment that MC Assembly matriculates as does most EMS mid-tier companies. Strict dedication of capital-intensive manufacturing machinery is impossible.

Our customer base values flexibility and responsiveness. They look for EMS partners instead of EMS suppliers and seek supply chain solutions that integrates their consumption with the EMS Partner's production.

Vertical Integration in Mid-tiered EMS

Curiously, vertical integration has seeped further and further into the EMS world, even to



Figure 6: A worker can be seen inspecting the final boards for quality.

some mid-tiered EMS companies. Not understanding their business plans, it is difficult to judge this move as right or wrong.

Instead of trying to be the best in every manufacturing technology, it's preferable to develop suppliers who are best-in-class for their respective technology. Even within specific technology groupings, differentiations such as press size, cosmetic capability, labor costs, and site locations are factors that differentiate one from another. Ultimately, this "virtual" integration may probably be a better solution for the mid-tier EMS companies versus a "vertical" integration solution. **SMT**



Richard Kelly is the vice president of Supply Chain Management at MC Assembly.



Senior Salesperson— Automotive Electronics

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Embedded Engineer— Portland Oregon

ESI, a pioneer and leading supplier of world-class production laser systems that help microtechnology customers achieve compelling yield and productivity gains, is looking for an embedded engineer.

As a software engineer, you are designing and delivering the embedded software that drives ESI's leading-edge manufacturing systems. The successful candidate will join a multi-disciplinary team focused on developing cutting edge technology in a fast-paced and technically challenging environment. Primary responsibilities will include embedded real-time system development, low-level machine control, system-level troubleshooting, and some supporting application level development.

Desired experience includes:

- Highly proficient in C/C++ programming
- Proficient in working with and programming DSPs or microcontrollers
- Experience designing software for embedded systems with constrained resources
- Knowledge of different embedded runtime environments (Linux, bare metal, RTOS)
- International travel to support ESI system installations (<10%)
- Engineering degree with to 5–7 years of related experience, or equivalent combination of education and experience
- Fundamental engineering knowledge (basic physics, calculus, problem solving)

Interested? Please apply below.

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TECHNICA, U.S.A.

Fulfilling Manufacturing Needs
Throughout the Electronics Industry

Southern California Territory Sales Engineer

Technica, USA, a Western regional manufacturer's representative/distributor, has an open sales position for our Southern California territory. The position will be responsible for selling and servicing our entire product line within the specified territory to the PCB manufacturing industry.

This position requires a highly self-motivated, hands on, confident individual of the highest integrity.

Required Skills:

- BA/BS degree-desired, in a technical area is preferred
- Two years of outside/inside sales or manufacturing experience in the PCB manufacturing environment is desired
- Self-motivated self-starter with the ability to initiate and drive business with little supervision
- Independent worker with a strong commitment to customer satisfaction
- Understanding of consumable sales process
- Ability to organize activities and handle multiple projects simultaneously with effective and timely follow-up
- Ability to solve problems and make decisions for which there are no precedents or guidelines and be resourceful in nature
- Positive attitude while operating under pressure and be an independent problem-solver
- Computer skills in Windows, Outlook, Excel, Word and PowerPoint
- Must have a valid driver's license with good driving record

Please send resume.

[apply now](#)



TECHNICA, U.S.A.

Fulfilling Manufacturing Needs
Throughout the Electronics Industry

Western Regional Equipment Service Technician

Technica, USA, a Western regional manufacturer's representative/distributor has an opening for an equipment service technician covering the Western USA, including but not limited to, California, Oregon, Washington, Utah, Colorado, and Arizona. The position will be responsible for servicing our PCB fabrication equipment product line, including installation, troubleshooting, repair service, rebuild service, etc. This position requires a highly self-motivated, hands on, confident individual of the highest integrity.

Key responsibilities are to install and service equipment, conduct equipment audit, and provide technical service when appropriate to solve problems.

Required Skills:

- 2+ years of experience in a PCB manufacturing environment or similar
- Willing to travel
- Positive "whatever it takes" attitude while operating under pressure
- Self-motivated self-starter with the ability to initiate action plans
- Ability to work independently with a strong commitment to customer satisfaction
- Excellent communication and interpersonal skills
- Strong ability to use all resources available to find solutions
- Computer skills with ability to write detailed service and equipment reports in Word
- Understanding of electrical schematics
- Able to work in and around equipment, chemical, and environmental conditions within a PCB manufacturing facility

Please send resume.

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CAREER OPPORTUNITIES



LENTHOR ENGINEERING
MAKING THINGS **FLEXIBLE** IN A RIGID WORLD®
311 Turquoise Street Milpitas, CA 95035 (Phone) 408-945-8787

SALES ACCOUNT MANAGER

This is a direct sales position responsible for creating and growing a base of customers. The account manager is in charge of finding and qualifying customers while promoting Lenthor's capabilities to the customer through telephone calls, customer visits and use of electronic communications. Experience with military and medical PWB/PWA a definite plus. Each account manager is responsible for meeting a dollar level of sales per month and is compensated with salary and a sales commission plan.

Duties include:

- Marketing research to identify target customers.
- Initial customer contact (cold calling).
- Identifying the person(s) responsible for purchasing flexible circuits.
- Exploring the customer's needs that fit our capabilities in terms of:
 - Market and product
 - Circuit types used
 - Quantity and delivery requirements
 - Competitive influences
 - Philosophies and finance
 - Quoting and closing orders
 - Bonding
- Submitting quotes and sales orders.
- Providing ongoing service to the customer.
- Problem solving
- Developing customer information profiles.
- Developing long-term customer strategies to increase business.
- Participate in quality/production meetings.
- Assist in customer quality surveys.
- Knowledgeably respond to non-routine or critical conditions and situations.

Competitive salaries based on experience, comprehensive health benefits package and 401(k) Plan.

apply now



Experienced PCB Sales Professional

With more than 30 years of experience, Prototron Circuits is an industry leader in the fabrication of high-technology, quick-turn printed circuits boards. Prototron of Redmond, Washington, and Tucson, Arizona are looking for an experienced sales professional to handle their upper Midwest Region. This is a direct position replacing the current salesperson who is retiring after spending ten years with the company establishing this territory.

The right person will be responsible for all sales efforts in this territory including prospecting, lead generation, acquiring new customers, retention, and growth of current customers.

This is an excellent opportunity for the right candidate. Very competitive compensation and benefits package available.

For more information, please contact Russ Adams at 425-823-7000, or [email your resume](#).

apply now

Process Engineer (Redmond, Washington)

With more than 30 years of experience, Prototron Circuits is an industry leader in the fabrication of high-technology, quick-turn printed circuits boards. We are looking for an experienced PCB process engineer to join the team in our Redmond, Washington facility. Our current customer base is made up of forward-thinking companies that are making products that will change the world, and we need the right person to help us make a difference and bring these products to life. If you are passionate about technology and the future and believe you have the skills to fulfill this position, please contact Kirk Williams at 425-823-7000 or [email your resume](#).

apply now



Proposal Coordinator— Saline Lectronics

Saline Lectronics provides electronic contract manufacturing to the commercial, medical, aerospace and telematics industries by delivering exceptional quality and value to achieve long-term, successful partnerships with our clients.

We are seeking to add an 'Excel Whiz' proposal coordinator to our Quoting Group.

Primary Function: The proposal coordinator will be responsible for responding to all incoming quotations in a timely manner. Day to day work may include identifying sources from vendors needing specific components, and successfully researching new sources for vendors to meet customer requirements. This role requires a candidate who is extremely comfortable with Microsoft Excel and can use V-Lookups and formulas with ease.

Work Performed: Supports all quoting activity; maintains knowledge of what information is required to obtain accurate quotes and ensures that the required information is available, or requests it from the account manager/sales engineer responsible for the given quote; prepares quote packages and solicits quotes from the supply base; analyzes quotations submitted for the best possible outcome for both companies; reviews final quotations with Saline Lectronics' president; organizes and submits quotations to the account manager/sales engineer for submission to customer.

[apply now](#)



PCB Process Planner

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

Responsibilities will include:

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

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

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

[apply now](#)

TOP TEN



Recent Highlights from SMT007

1 Flex Announces 2017 Preferred Supplier Award Recipients

EMS firm Flex recently honored the recipients of its 2017 Preferred Supplier Awards at this year's Global Supplier Summit, hosted at the Flex Customer Innovation Center, in the heart of the Silicon Valley.



3 SMTA and CALCE Seeking Abstracts for 3rd Annual LED A.R.T. Symposium

The SMTA and CALCE are pleased to announce the LED Assembly, Reliability, and Test (A.R.T.) Symposium will take place November 28–30, 2017 at the Archie K. Davis Conference Center in Research Triangle Park, North Carolina.



2 Kimball Electronics Receives 2016 Quality Improvement Excellence Award from Nexteer Asia

Kimball Electronics was recognized with the 2016 Quality Improvement Excellence Award by Nexteer Asia.



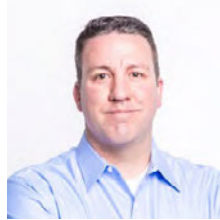
4 Libra Industries Sponsors Local AWT RoboBot Competition for Middle and High School Students

Libra Industries recently participated in and sponsored the Alliance for Working Together (AWT) Annual RoboBot Competition.



5 Stadium Group Appoints Tim Taylor as VP of Sales for North America

Stadium Group has appointed Tim Taylor as VP Sales, Stadium Group Inc. Based in Salt Lake City, Utah, Tim will represent all three Stadium Group technology product businesses in North America and Canada, covering connectivity, power and HMI.



6 Valuetronics Reports 28% Net Profit Growth for FY2017

EMS firm Valuetronics Holdings Ltd has announced net profit of HK\$154.1 million (\$19.77 million) for the fiscal year 2017, up by 27.9% year-on-year.



7 Exception EMS Restructures Management Team for European Growth

Exception EMS recently restructured its management team, with Steven Healings promoted to managing director, taking responsibility of the UK manufacturing site; Noel Murphy to group financial officer in the UK; and Mark O'Connor to VP, European Development, at Fabrinet, responsible for the CEM business outside of the UK.



8 Enics Sweden Negotiating Plans to Ramp Down Malmö Facility

Enics Sweden AB has initiated a consultation process with Swedish employee unions to discuss the plan to transfer the Malmö factory business to other Enics Business Units, consolidate the Swedish operations in Västerås, and execute a controlled ramp-down of the Malmö operations without disturbing customer relations.



9 Prism Electronics Achieves ISO 9001:2015 and ISO 14001:2015

Cambridgeshire contract electronics manufacturer (CEM) Prism Electronics is one of the first CEMs to be awarded their quality and environmental certifications to the new international standards ISO 9001:2015 and ISO 14001:2015.



10 SMTA International Conference Program Finalized and Registration Now Open

The Surface Mount Technology Association (SMTA) is pleased to announce that the program for the SMTA International Conference and Exhibition, taking place September 17-21, 2017 at the Donald Stephens Convention Center in Rosemont, Illinois, is finalized and available on-line at www.smta.org/smtai, and registration is now open.



SMT007.com for the latest SMT news and information—anywhere, anytime.



Events

For IPC's Calendar of Events, click [here](#).

For the SMTA Calendar of Events, click [here](#).

For the iNEMI Calendar, click [here](#).

For a complete listing, check out [SMT Magazine's full events calendar here](#).

[IPC Technical Education— Best Practices in Design](#)

July 26–27, 2017
Chicago, Illinois, USA

[NEPCON South China 2017](#)

August 29–31, 2017
Shenzhen, China

[24th FED Conference](#)

September 15–16, 2017
Bonn, Germany

[SMTA International 2017 Conference and Exhibition](#)

(IPC Fall Committee meetings held in conjunction with SMTA)
September 17–21, 2017
Rosemont, Illinois, USA

[IPC Fall Committee Meetings](#)

September 17–21, 2017
Rosemont, Illinois, USA

[electronicAsia](#)

October 13–16, 2017
Hong Kong

[IPC Flexible Circuits: HDI Forum](#)

October 17–19, 2017
Minneapolis, Minnesota, USA

[TPCA Show 2017](#)

October 25–27, 2017
Taipei, Taiwan

[productronica 2017](#)

(IPC Committee meetings held in conjunction with productronica)
November 14–17, 2017
Munich, Germany

[HKPCA/IPC International Printed Circuit & South China Fair](#)

December 6–8, 2017
Shenzhen, China

[47th NEPCON JAPAN](#)

January 17–19, 2018
Tokyo Big Sight, Japan

[DesignCon 2017](#)

January 30–February 1, 2018
Santa Clara, California, USA

[IPC APEX EXPO 2018 Conference and Exhibition](#)

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

[Medical Electronics Symposium 2018](#)

May 16–18, 2018
Dallas, Texas, USA



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