

# SMT

AN I-CONNECT007 PUBLICATION

JANUARY 2013

Choosing Between  
Turnkey and Consignment  
Manufacturing p.18

Global Company,  
Local Advantage p.26

Counterfeit Electronics:  
Risks and Mitigation p.32

What's Really Wrong with  
Corporate America? p.38

## MANAGEMENT

### It's *Not* Monkey Business!



The character of a manager as a monkey is purley fictitious; any resemblance to real persons, living or dead, is purely coincidental.

Offshore & Domestic PCB Manufacturing  
**BBG**  
We Make Circuit Boards Easy.

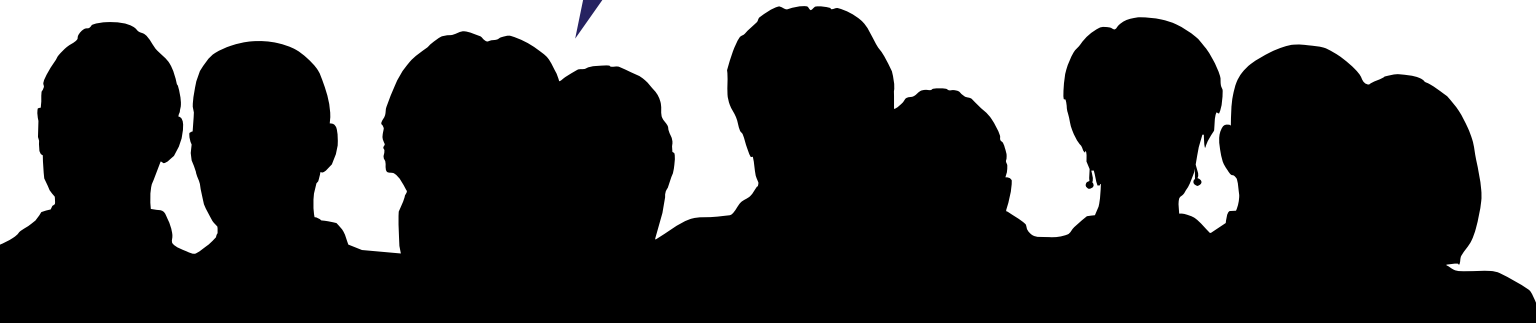
# the **pcb**list™

***THE* best way to find a PCB fabricator, anywhere.**

How did you find the  
right PCB fabricator?

I found them on  
***THE* PCB List!**

Yes, ***THE* PCB List**  
is the best place to find  
a PCB fabricator!

- 
- Free access to the definitive directory of PCB fabricators
  - The most comprehensive list from around the world
  - In-depth profiles of PCB fabricators
  - Easy to use, with intuitive navigation
  - Quick searches to locate the right fabricator
  - In-depth searches for specific capabilities

**www.thepcblist.com**





# Offshore and Domestic PCB Manufacturing



## We Make Printed Circuit Boards Easy.

*Now Available in Dine-In and Take-Out!*

- ITAR registered for both **domestic** & **offshore** manufacturing
- ISO, TS 16949, Mil 55110, NADCAP, AS 9100 approved
- Offices: Florida, Silicon Valley, Canada and Taiwan
- Wide variety of materials & finishes, 1- 42 layers
- Protos in 3-10 days, production 3-5 weeks
- Mil/Aero, RF, medical, commercial, auto
- Multiple stocking and logistic options



Bare Board Group  
8565B Somerset Dr  
Largo, FL 33773

For more info reach us at:  
**727-549-2200**  
[sales@bareboard.com](mailto:sales@bareboard.com)



# MANAGEMENT

What better way to start the New Year than with a focus on management? The January issue of *SMT Magazine* has every aspect covered: Business trends in electronics assembly; managing low-volume, high-mix production; management tools, including inventory and production management; process control; and supply chain issues, including counterfeit components and vendor assessment and management.

All this, industry news highlights, and upcoming events can be found in this month's issue of *SMT Magazine*.

### 18 Choosing Between Turnkey and Consignment Manufacturing

*by George Henning*



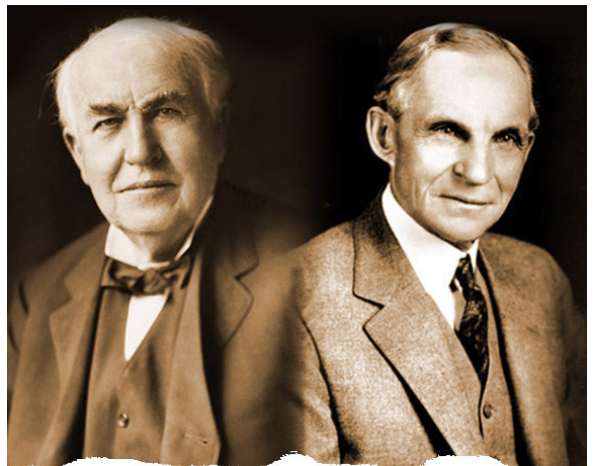
### 32 Counterfeit Electronics: Risks and Mitigation

*by Mike Archenhold*



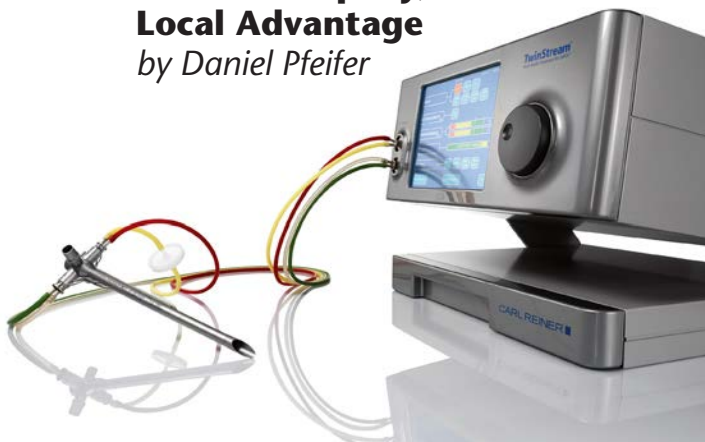
### 38 What's Really Wrong with Corporate America?

*by Michele Nash-Hoff*



### 26 Global Company, Local Advantage

*by Daniel Pfeifer*





## Huge feeder capacity pick & place for high mix/zero changeover



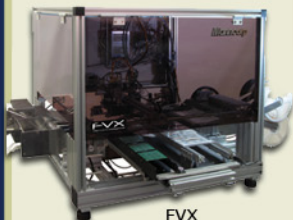
MC388

MC-388 pick and place for high-mix production holds up to 256 feeders, allowing a full range of components to be kept resident on the machine for near-zero job changeover times. Places up to 10,500 cph. Placement area of 408 mm x 1200 mm accommodates large boards and wafer trays.

**MC388. \$99,995.**

[MORE INFO](#)

## Benchtop FVX pick & place for 0201s, CSPs, BGAs, QFPs ±0.01 mm accuracy



FVX

Revolutionary alignment intelligence simplifies programming without sacrificing precision. Extremely simple set up and short learning curve gets the FVX up and running quickly for fast payback. Perfect for prototyping, pilot production, and short runs with frequent rev changes.

**FVX \$29,995.**

[MORE INFO](#)

## GROW YOUR BUSINESS WITH INTEREST-FREE FINANCING



MC-1400

MC-392

CT-90L

CR-5000F

## 0% financing for 12 months on all turnkey assembly lines

Benefit from bringing production in house or expanding your existing production capabilities sooner rather than later while preserving your working capital. SMT assembly lines available for prototyping through high speed/high mix and special applications. [View eligible assembly lines](#)



Sherlock-300F

## Decrease failure rates & increase yields with benchtop AOI

Sherlock-300F is a redesign of benchtop AOI that eliminates the standard front-loaded drawer and puts a large, multi-touch display front and center, with iPad®-like gestures for operation & programming. Ideal for low- to mid-volume assemblers with military, medical and other high-end products. Verifies component presence, placement and value on parts down to 01005s, inspects solder joints & does 2D solder paste inspection. **Sherlock-300F \$38,995** [MORE INFO](#)



## Protect against moisture-related defects and costly field failures

ULTRA-DRY desiccant dry cabinets provide a cost-effective, safe and reliable way of ensuring that moisture-sensitive devices are protected from ambient humidity. Available as standard dry cabinets for storage and baking dry cabinets for both storage and restoration of exposed components. **From \$1,995 to \$11,995.** [MORE INFO](#)



ULTIMA TR2

## Highly advanced selective soldering that fits the benchtop & budget

The ULTIMA TR2 Benchtop Selective Soldering System includes a high-precision PCB handling system fully programmable in the X, Y, and Z axes, a compact solder pot and pump assembly with extremely responsive, programmable flow control, and a wave nozzle with integral nitrogen preheat; features that guarantee fast, consistent, high-quality soldering of through-hole components to SMT boards.

**ULTIMA TR2 \$49,995** [MORE INFO](#)

## Full-size reflow oven features & performance in space-maximizing footprint



CR-4000C

CR-4000C reflow oven features four independently controlled convection heating zones capable of producing a delta T of just  $\pm 2^{\circ}\text{C}$  across the surface of the PCB. 79"-long reflow oven includes computer control, profile prediction, and a 16" pin conveyor over 20" mesh belt. Lead-free ready. **CR-4000C. \$22,995.**

[MORE INFO](#)

## Take January Inventory with Fast & Accurate Counter



2000

Automatic component counter performs accurate inventory of taped SMD components at speeds that blow manual counting out of the water: a 7", 5000-part reel can be counted—and double-checked—in just 90 seconds.

**2000 \$1,895**

[MORE INFO](#)

## CONTENTS

### ARTICLES

- 44 Choosing a Low-Cost Alternative to SAC Alloy for PCB Assembly**  
*by Brook Sandy and Ronald C. Lasky*



- 56 Impact of E-commerce on the Electronics Component Supply Chain**  
*by Steve Martin*



- 64 Europlacer Responds to BAE Systems' Call for Help**  
*by Chris Round*

- 68 Preventing Lead-free SMT Soldering Defects**  
*by Peter Biocca*



### SHORTS

- 11 Graphene Proves "Green"**
- 25 Amplifying Magnetic Fields in High Energy Density Plasmas**
- 82 Exploring Optomechanical Interactions**

### TOP TEN MOST-READ NEWS

- 36 Market**
- 52 Supplier/New Product**
- 76 Mil/Aero007**
- 84 SMTonline**



### COLUMNS

- 8 PE: The Glass is Half-Full**  
*by Ray Rasmussen*



- 12 Outlook for the New Year**  
*by Dr. Jennie S. Hwang*



- 60 You Are Discharged**  
*by Eric Klaver*

- 78 Quality Decisions**  
*by Karla Osorno*



### VIDEO INTERVIEWS

- 25 Firstronic Pushes Program Management**
- 51 Printing Up Print Data at Indium**



### EXTRAS

- 88 Events Calendar**
- 89 Advertiser Index & Masthead**





# Power of the **Quoting Revolution** in the palm of your hand!

At a click of a button  
we will find the best  
price in the market  
compiled in one easy  
to read spreadsheet  
...just like your BOM.

CLICK FOR VIDEO  
PRESENTATION



**PCBnet.com**



Join the Revolution  
Happening Now @

**www.PCBnet.com**

847-806-0003    sales@PCBnet.com

ITAR, I SO 9001:2008, UL Approved



## THE WAY I SEE IT

# PE: The Glass is Half-Full

by Ray Rasmussen

I-CONNECT007

**SUMMARY:** *With IPC jumping into the PE standards game last year and with most OEMs and their suppliers paying closer attention to the opportunities printed electronics provides—and when you see all the dollars flowing into development—it's not a matter of if PE will take a bite out of the PCB apple, but when.*

Not to overstate the implications, but I believe, as those who've been reading my columns already know, that printed electronics (PE) will take a bigger and bigger bite out of the PCB apple each year as the material sets mature and PE products move into mainstream electronics. With IPC jumping into the PE standards game last year and with most OEMs and their suppliers paying closer attention to the opportunities PE provides—and when you see all the dollars flowing into development—it's not a matter of if, but when.

It's been frustrating for me over the years to watch the progression of this emerging circuit technology and realize that our industry was nowhere to be seen. A few folks could see the potential, but most had their collective heads in the sand. In a good year, I might see one fabricator walking the floor at Printed Electronics USA, held in Santa Clara, California. But this year, instead of seeing just one fabricator, I actually ran into three or four and heard that a few more (including Viasystems) were in attendance. Still, the numbers of the missing are troubling.

I had a chance to spend time with Rocky Catt (see sidebar) of Sunstone Circuits and Nilesh Naik of Eagle Circuits this year. Both were attending the show for the first time. For Naik, it was both frightening and exciting. The potential to displace the PCB as we know it was certainly evident along with the opportunities of new markets and possibilities for fabricators.

Two obvious and immediate applications for PE technologies were being exhibited on the show floor. The first is flex. Plenty of flex circuits are already being made by the billions (literally). Over a billion RFID tags were sold in 2012. Single-sided, roll-to-roll systems for antennas, RFID tags, along with other simple circuits, comprise most of the market today. One exhibitor alluded to the fact that some of their PE circuits were being evaluated for an upcoming Apple product. They're dramatically cheaper and significantly lighter (when grams matter).

The second application was for QTA prototypes. Being able to test a board design in hours by sending the file either to your in-house system or to a service center down the street should have great appeal



**Figure 1:** From left to right: Nilesh Naik, Eagle Circuits; Joe Fjelstad, Verdant Electronics; and, Mike Dubois, Caledon Controls.





AqueousTechnologies.com

# Clean



**PE: THE GLASS IS HALF-FULL** *continues*

to those building tomorrow's products. Shaving days off the development time is worth a lot to these guys. In this case, you'd send the file and have to wait for approximately 10 to 20 minutes, depending on whether you wanted an eight-layer or 16-layer board. I'm sure there are still some kinks to work out with substrates and inks before systems like these will be mainstream, but they're close now.

Some of the systems we were looking at ran from \$300,000 to 500,000, but a few companies were selling print heads for inkjet printers, which would allow companies to experiment with some of the PE technologies for just a few thousand dollars. Screen printing is another way to dabble without investing too much. I really encourage companies to start playing around with these simple PE systems to get a feel for what's possible.

What struck me at this year's show was the number of universities and research organizations in attendance or being represented. From PARC to Cal Poly, from Clemson to Georgia Tech, these institutions were peddling their latest and greatest innovations. I don't remember seeing them at previous shows.

As in years past, the folks at IDTechEx produced a solid conference with speakers from a variety of companies producing PE or looking for PE opportunities within their sectors or specifically for their companies' products. Presentations from military contractors like United Technologies and Boeing discussed the need to reduce weight and enhance capabilities while consumer product companies like P&G were looking for smarter, more enticing packaging solutions.

Years ago, I came across an article quoting a guy from Motorola about how they were looking to use the inside of their cell phone casings to apply the circuits, eliminating at least one of the PCBs. At this conference I heard it again in a talk by United Technologies. It's an obvious opportunity for product designers looking to reduce the size and weight of their products. Jetting a circuit onto a 3D surface is doable in the PE world. Component assembly systems

are being adapted to support these configurations, as well. As soon as they get the reliability they're looking for, it'll be a done deal. It seems like they're almost at that point.

At the show this year, the organizers ran a concurrent conference and show on graphene, an amazing new material discovered in 2004. If you're not aware, here a few of the properties that have plenty of folks really excited: Nano-ribbons of graphene are 100x more conductive than copper; graphene has high thermal conductivity and is the strongest material ever measured. It's 200 times stronger than structural steel.

One of the offshoots of graphene is carbon nanotubes, which brings us back to printed electronics. There are carbon nanotube inks on the market today, with more on the drawing board. And to really make things interesting, one research group has figured how to align the tubes to make them even more conductive. It's pretty cool stuff. This wonder material will find its way into more and more electronic products in the coming years. Everyone's working on this. It's a game-changer and it's now closely linked to printed electronics.

**PE: Not for Everyone**

Well, yes and no. PE technologies have some distance to go before they'll take a big bite out of our industry, but it's coming. Make no mistake. Watch for hybrid PCB, PE systems in the near future, as more and more fabricators look for ways to differentiate their offerings to their customers. Staying on top of the progress of printed electronics will open the door to more opportunities for our industry. Certainly, the glass is half-full.

In response to my request for his impressions of the show, Sunstone's Rocky Catt had this to say:

*To summarize, here are my thoughts.*

*To a degree, I felt like a bit of an outsider at first because most attendees and exhibitors were already connected to the industry. They know the products, processes, and terminology, and have specific applications in mind. To me, the obvious question is not only*



**Figure 2:** Rocky Catt (at right) of Sunstone Circuits.



**PE: THE GLASS IS HALF-FULL** *continues*

*what this means to the PCB fabrication industry, but specifically to Sunstone, which I describe as a low-volume (<100 pcs.), high-mix organization.*

*It was also clear, to which most of the exhibitors attested, that the industry is following many paths, and not one process has emerged as the leader. However, due to the variety of production processes, coupled with endless applications for the final product, this might be acceptable, perhaps expected. It's easy to see the differences in requirements between printed panels for a car's dashboard versus a cell phone versus a throw-away medical patch. They are all different with varying performance and price requirements.*

*The real question for Sunstone is: Can we satisfy customers' (current and future) needs as we all move into the near future? Will we satisfy those needs by ourselves or partner with someone?*

*The real take-away for me was that there are potential solutions. I started to feel more a part of the process when I realized that we can approach this from different levels, or progress through the levels:*

- *Level I: For approximately \$2,000, prototype kits using a standard desktop inkjet printer are available.*
- *Level II: For approximately \$7,000, you can get a desktop graphics printer with software.*
- *Level III: For \$25,000+, you can get an inkjet printer, or a screen printer.*
- *Level IV: For \$60,000+ you can get an aerosol jet printer.*

- *Level V: The sky is the limit for specialized lines.*

*Throughout these levels, services are available to assist.*

*Obviously, these solutions are probably not for those already directly involved in the industry, but do provide an avenue to test something or learn more about the processes. Also, different inks are to be considered, some needing a secondary process (sintering) and some that that do not.*

*Aside from our first exposure (the meetings in Irvine, California last year), this was Sunstone's first glimpse at process equipment and materials. It was an excellent introduction to exploring the possibilities. While events like this lead to more questions rather than solutions, it is keeping us on the path, and that's what's exciting.*

*Thanks again for the introductions—much appreciated.*

*We'll be in touch,  
Rocky SMT*



Ray Rasmussen is the publisher and chief editor for I-Connect007 publications. He has worked in the industry since 1978 and is the former publisher and chief editor of *CircuiTree Magazine*. Contact Rasmussen [here](#).

## Graphene Proves "Green"

Graphene has been shown to be an effective rustproofing agent for both steel and copper. The research was conducted to find an environmentally-friendly method compared to chrome electroplating.

Sarbajit Banerjee, Ph.D., an assistant professor, and Robert Dennis, a Ph.D. student at the University of Buffalo, determined that graphene's hydrophobic and conductive properties made

it an ideal candidate for preventing corrosion. "Our product can be made to work with the existing hardware of many factories that specialize in chrome electroplating, including job shops in Western New York that grew around Bethlehem Steel," explains Banerjee in the Phys.org article. "This could give factories a chance to reinvent themselves in a healthy way in a regulatory environment that is growing increasingly harsh when it comes to chromium pollution."

For more information, click [here](#).

# Outlook for the New Year

by Dr. Jennie S. Hwang, CEO  
H-TECHNOLOGIES GROUP

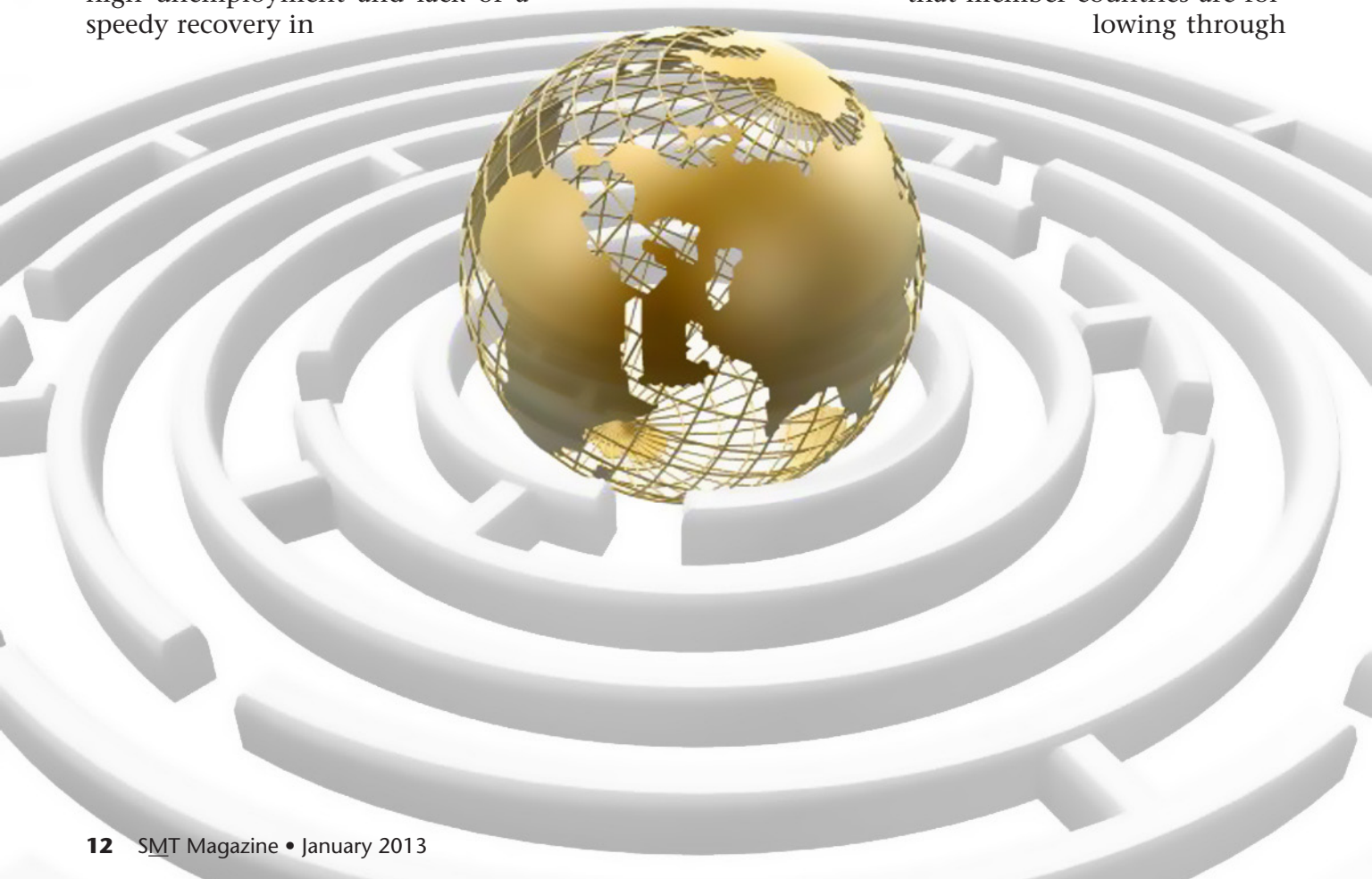
**SUMMARY:** *After protracted high unemployment and lack of a speedy recovery in the U.S., and in the absence of clear solutions to the Eurozone's financial crisis and China's lower manufacturing activities in 2012, will the grim global economic outlook extend to 2013?*

Once again the time to look at the year ahead has arrived. In this month's column, I will take a long view on market thrusts in the anticipated global economic landscape, as well as technological trends in selected areas deemed critical and relevant to the industry. Each of these areas will be highlighted, but more detailed discussions will be addressed in my future publications and presentations. After the protracted high unemployment and lack of a speedy recovery in

the U.S., and in the absence of clear solutions to the Eurozone's financial crisis compounded with China's lower manufacturing activities in 2012, will the grim global economic outlook extend into 2013? Is there light at the end of the tunnel? How will the global economy affect business?

## Global Economic Outlook

The two largest economies of the world, the U.S. and China, are showing signs of improvement in Q4 2012, a trend expected to continue into 2013. Alarming news from the Eurozone has surfaced, although solutions—economic, financial, or political—are to be concocted and implemented. Common mechanisms to ensure that member countries are following through







ENGINEERED TECHNOLOGIES

Toll Free: (888) 995-5171

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

Stay Connected



► DELIVERING QUALITY SINCE 1952.

## InstantPCBQuote™ fast.easy.24/7.

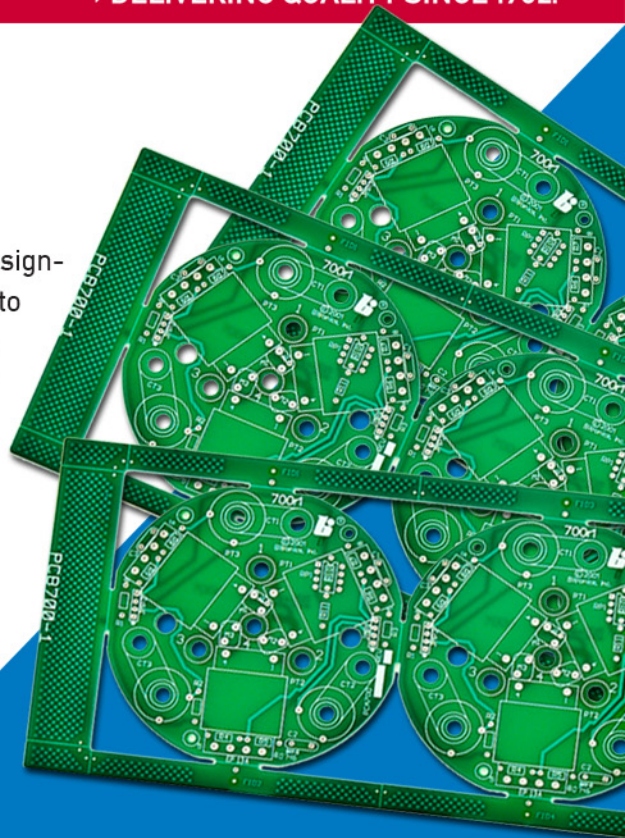
### ► QUOTE & ORDER YOUR RIGID PCBs ONLINE

Our dynamic online PCB quoting program allows you the option of designing the rigid printed circuit board that you need, not the one we want to build. Build your quotes online 24/7 at your convenience. Every quote created is saved in your InstantPCBQuote™ profile, which can easily be viewed, compared, ordered, and re-ordered at any time.

- Quote and Order From 1-16 Layers
- 24 Hour Quick Turn PCB Orders
- Pricing is Available for 1-20 Day Deliveries
- Variety of Laminates and Surface Finishes
- No Minimum Quantities
- Prototype to Production Size Order

**TRY IT NOW!**

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



## InstantFLEXQuote™ fast.easy.24/7.

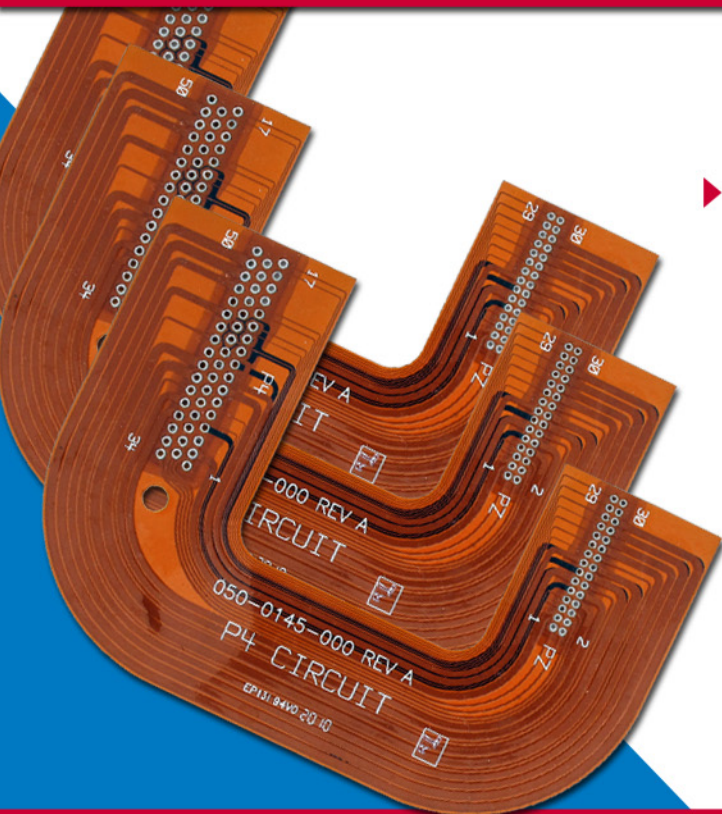
### ► QUOTE & ORDER YOUR FLEX PCBs ONLINE

Our online flex circuit quote and ordering tool is a must see for anyone in the industry who deals with flexible PCBs. There are not many other online sites designated for flexible circuits on the Internet with the capability to quote and order flexible circuit boards up to 4 layers.

- Quote and Order From 1-4 Layers
- 7 Day Quick Turn Flex PCB Orders
- Pricing is Available for 7-20 Day Deliveries
- Variety of Materials and Coverlay Options
- No Minimum Quantities
- Prototype to Production Size Order

**TRY IT NOW!**

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



**OUTLOOK FOR THE NEW YEAR** *continues*

on fiscal plans and an agreeable banking regulatory framework are yet to be formulated. The sense is that when any viable solution is in sight it will be a great relief to the market. The region's strongest economy, Germany, saw its central bank issue a downbeat forecast. As the third largest economy, Japan is expected to mildly contract from the 2012 level to below 2.0% GDP, due largely to the country's large export component and continued strength of the yen. An uptick in South America is expected in 2013. Globally, IMF forecasts a GDP rate of 3.2%, which is still below the average of 3.5%.

At the time of this writing, political hurdles in both the U.S. and the Eurozone have yet to be overcome: A fiscal cliff still looms for the U.S. and the Eurozone's debt crisis has yet to abate. Pro-growth political resolutions and economic policies in either the U.S. or Europe, or both, will brighten global growth prospects and drive a faster recovery. If these hurdles are not conquered, the global economic outlook in 2013 will suffer.

Heading into 2013, the unemployment rate in the U.S. will decline. The general consensus points to a U.S. GDP of 2.5% or better. If the belief that economic stimulus is justified when unemployment is above 6.5% and inflation is lower than 2% is put to work, we can also expect further stimulus by the U.S. central bank.

In corporate America, where and how cash-rich multinational corporations (collectively holding more than \$1 trillion in cash) will invest—overseas or domestic, dividend increase or share buyback—will impact the job market and the U.S. economic outcome, pending government policies and tax reforms. The continued spending inertia by hoarding cash and taking a conservative stand appears to be the course of action.

China, along with the U.S., will lead the way out of the global economic malaise. Asia con-

tinues to be a high-growth region as the world's economic engine. China will play a dominant role, enhancing the realization of the China factor by exerting its influence in both inside and outside the continent.

Overall, sign posts, hard indicators, and soft inferences signal mild economic growth during 2012, but do not expect an exciting 2013.

**The China Factor**

Yes, there is a China factor. A leadership change has occurred in China once every decade. The new seven-member Chinese leadership selected by credentials and seniority was elected November 2012. This new leadership is the very first generation with no involvement in the revolution that occurred from 1949 to the 1960s. Will this transition of power steer different economic and political policies? My

sense is that these new leaders will shape the country's needs with the priority of balancing domestic consumption and exports, harmonizing urban and rural societies, containing inflation, and make a better effort to meet the demands of the people while exercising assertive foreign policies. With all three of the country's largest trading partners in either recession or a slow growth mode, China has more reason to pump up its consumption-oriented economy to spur long-term growth and social stability.

The Chinese government may set its GDP target at 7% (lower than the 7.5% of 2012). If so, it implies that the new government is willing to accept a slower economy by morphing into a consumption-oriented economy in lieu of investments. This strategy will serve as a stepping stone to a long-run wholesome economy on the world stage. In the range of 6 to 8% GDP, a higher percentage does not necessarily translate into a more robust economy. Quality does count.

The country's twelfth Five-Year Plan, spear-

“  
***With all three of the country's largest trading partners in either recession or a slow growth mode, China has more reason to pump up its consumption-oriented economy to spur long-term growth and social stability.***  
”



**OUTLOOK FOR THE NEW YEAR** *continues*

headed by the State Council, the Ministry of Industry and Information Technology, and the Ministry of Science and Technology of the People's Republic of China, stipulates seven national strategic industries: Energy-saving and environmental protection, alternative energy, alternative-fuel cars, high-end equipment manufacturing, biotechnology, new-generation information technology, and advanced materials. China has indicated that it would provide financial and tax support to these industries over the next decade in hopes of making these sectors account for approximately 8% of China's GDP by 2015 and 15% by 2020.

Heightened emphasis on innovation and technology is embedded in the Five-Year Plan. Also embedded is the construction of "smart" cities, low-carbon emission vehicles, information technology infrastructure, and an environmentally-friendly water and energy system. The goal is to make non-fossil fuel account for [more than 11% of primary energy consumption](#).

The country has made enormous strides, yet much more remains to be done. The country is well aware of the need to build world-class companies with leading global brands at the expense of state-owned or controlled enterprises.

As China becomes the world's largest consumer of semiconductor products, mobile devices, smart phones, PCs, LEDs, solar panels, medical devices, home appliances, and construction equipment, the demand for various industrial, consumer, medical, energy, and information technology-related products and services will escalate, requiring new materials, advanced manufacturing infrastructure, and high-performance electronics.

### **Electronics Industry: Hardware**

Several major events are expected to propel the electronics market. First, a movement toward a "smart" world will continue to drive electronic hardware in product innovation and manufacturing efficiency, with mobility and wireless being the primary thrusts.

In the semiconductor sector, Intel, the top captive semiconductor manufacturer, continues its commitment to capital expenditure to advance manufacturing prowess. In parallel, the No. 1 pure-play semiconductor foundry,

Taiwan Semiconductor Manufacturing Company (TSMC), has set aside US \$10 billion for capital expenditure in 2013, making it the No. 2 capital spender in the world semiconductor industry, after only Intel Corporation. The majority of capital spending in manufacturing will occur in Taiwan, China, and Korea.

Technologically, efforts and commitments to scale-up wafer size and shrink transistor circuitry will continue. The multi-billion dollar plan to build chips on 450 mm wafers is moving forward by both OEMs (Intel, IBM) and foundry manufacturers (TSMC) with a target volume production date of 2018.

A plan to manufacture below 22-nanometer transistors processors is in the works by both OEMs and foundry houses using legacy immersion lithography technology on 10 nm and 16 nm transistors while extreme ultraviolet lithography is being developed with high potential down the road.

Migrating to a 450 mm wafer is a major technological move to further shrink transistors below 22 nm. These plans and commitments will lead to further advances in the chip industry to deliver increased functionalities and reduced cost in electronic and optoelectronic products that serve a broad spectrum of industries.

As ICs move to below 22 nm, production of the next level of connections calls for new designs and new materials in second-level IC packages and third-level PCB connections. No new forces are on the horizon for second and third levels of interconnections, yet activities are abundant to offer graduate technological advances including optical interconnections, embedded passives, and printed electronics. Development in high-density packages, including 3D packages, system-in-package, and BTC packages will continue. Thermal stability of PCBs, under the high manufacturing temperature imposed by the assembly process, continues to be the most critical performance parameter. Although a PCB possessing a higher glass transition temperature (Tg) is readily available, Tg does not represent the PCB's heat tolerance ability. Other properties, such as thermal decomposition temperature, thermal expansion over a temperature range, out-of-plane and in-plane thermal expansion, and moisture absorption all

**OUTLOOK FOR THE NEW YEAR** *continues*

contribute to the overall performance, i.e., internal structure integrity.

Additionally, in new product introduction, market seasonality has begun to shift. Foundry manufacturers are expected to increase shipments of new designs from the third to second quarter to provide OEMs a longer sale period, as driven by the market demand of smartphones and tablets.

Indeed, the market has spoken.

### **Electronic Hardware Manufacturing**

What challenges await the electronic hardware manufacturing sector? The broad answer is how to produce high-quality, reliable products at a competitive cost in a competitive amount of time while generating a target operating margin and profit at any locale in the world. Specifically, attention should be paid to the following areas for OEMs and EMS providers alike:

- Strategic alignment with core competency in niche areas;
- Moving up operating margin through niche services;
- Time-to-market from design to end-use customers;
- Manufacturing flexibility from design to production flow to supply chain agility;
- Supply chain infrastructure and execution;
- Inventory management and optimization;
- Physical proximity to customers;
- Partnership with customers;
- Partnership between OEMs and EMS providers;
- Innovative capability;
- Ability to foresee emerging technologies;
- For OEMs: Outsourcing versus insourcing;
- For EMS providers: Offshoring versus onshoring; and
- Tie-in with advanced manufacturing.

In the context of competitiveness in the global marketplace, advanced manufacturing will gain further momentum in 2013. I define advanced manufacturing as manufacturing capability and leadership capacity to sustain,



grow, and excel in the global landscape to meet both anticipated and unpredictable challenges by leveraging technologies and business model. This topic will be discussed in future columns.

Addressing inventory management is imperative to the success of a manufacturing operation and its optimization is paramount to a healthy balance sheet and cash flow. Companies must keep track and control of days of inventory as well as the actual dollar value of inventory. Doing well in this area mitigates the mishap of production outpacing demand and eschews a cash flow trap.

The success of an EMS provider hinges on how well it can formulate a strategic and technology partnerships with an OEM to collaboratively tackle end-market challenges by formulating strategic solutions.

When assessing outsourcing versus insourcing for an OEM and offshoring versus onshoring by an EMS, the cost is not the sole variable in the equation. The cost of ownership drives the business model.

### **Solar Photovoltaic Market & Technology**

The reality is beginning to set in. A rebalancing, consolidation, and shakeout are expected to continue in 2013, but with much less drama. Despite today's market turbulence, the bottom-line is that solar global GW installation will increase although some countries (Japan, the U.S., China, Canada, and Australia) will see a high growth rate and those in Europe (Ger-



**OUTLOOK FOR THE NEW YEAR** *continues*

many) will remain in a stagnant growth mode in 2013.

As the result of the fast decline of module prices, solar panels become more attractive. The Chinese National Development and Reform Commission (NDRC) set a new domestic installation target of 21 GW by 2015 from its original 5 GW. This quadrupling of the domestic installation target came after its already increased revision from 5 GW to 15 GW in May 2012.

This upward revision of targets will support prices, help absorb an excess supply of panels, and will further stimulate the rapid growth of China's PV market from 2013 to 2015, although benefits may not be evenly distributed and beneficiaries may vary.

In technology, activities are alive and well in advancing thin film efficiency and reliability. Thin film still has much future potential. In 2013, thick-film crystalline silicon technology should remain prevalent in the marketplace.

Again, a viable solar operation requires a business plan positioned to weather the industry's boom-and-bust cycle. It takes four core competencies to do business in the solar space: Technology capability, manufacturing prowess, operational agility, and strategic foresight. They are key to the future of a company, be it a cell and module maker or a materials and device supplier. Sustained success requires these integrated forces to defy the impact of unwanted external conditions. After all, these requirements are not that different from running a viable business in other industry sectors.

In the solar space, some market segments are in distress while others are thriving. When taking all factors into consideration, the industry remains rewarding, perhaps one of few that have reachable, handsome growth prospects in the visible future.

### **Environmentally-friendly Lead-free Electronics & Regulatory-compliant Manufacturing**

The industry, technology, and manufacturing are expected to move smoothly with incremental improvements. Introduction of new or modified lead-free solder alloy materials will continue. The medical electronics sector will join the world of lead-free electronics.

The New Year will be the first calendar year that the Securities and Exchange Commission (SEC) rule requires supply chain diligence and specialized reporting by companies that manufacture or contract to manufacture products that contain certain minerals originating from the Democratic Republic of the Congo and adjoining countries. And the first required report must be filed by May 31, 2014.

This conflict mineral disclosure requirement includes specific elements: Tungsten, tantalum, tin, gold, and their derivatives. Environmental stewardship for global sustainability continues to be an important corporate business policy for 2013. **SMT**



Dr. Hwang will present a lecture on "Preventing Assembly Defects and Product Failures" at IPC APEX EXPO, February 18, 2013, in San Diego, California.

Dr. Hwang, a pioneer and long-standing contributor to SMT manufacturing since its inception as well as to the lead-free development, has helped improve production yield and solved challenging reliability issues. Among her many awards and honors, she has been inducted into the WIT International Hall of Fame, elected to the National Academy of Engineering and named an R&D Stars to Watch. Having held senior executive positions with Lockheed Martin Corporation, Sherwin Williams Co., SCM Corporation and IEM Corporation, she is currently CEO of H-Technologies Group providing business, technology and manufacturing solutions. She is a member of the U.S. Commerce Department's Export Council, and serves on the board of Fortune 500 NYSE companies and civic and university boards. She is the author of 350+ publications and several textbooks and an international speaker and author on trade, business, education and social issues. Her formal education includes four academic degrees, as well as the Harvard Business School Executive Program and Columbia University Corporate Governance Program. Contact her at (216) 577-3284; e-mail [jennieHwang@aol.com](mailto:jennieHwang@aol.com).



# Choosing Between Turnkey and Consignment Manufacturing

**by George Henning**  
OCM MANUFACTURING

***SUMMARY:** George Henning explains, compares, and evaluates consignment and turnkey manufacturing to help small- to mid-sized companies select the electronics manufacturing outsourcing strategy that best fits their needs.*

To remain agile, stay ahead of the market, and react quickly to disruptive changes in the technology environment, many companies outsource the manufacturing of their electronics products. Making the decision to outsource, however, is only part of the choice these companies face—they must also decide on an outsourcing methodology. Two common models are consignment manufacturing and turnkey manufacturing.

## Consignment Contract Manufacturing

Consignment manufacturing can be best thought of as “partial” outsourcing. In the case of electronics manufacturing, it describes a model in which the technology producer maintains some portion of the overall manufacturing supply chain in-house—typically, purchasing and/or system assembly (box and build). Under a consignment model, in-house purchasing, shipping, and receiving groups are responsible

to obtain materials, sort and package them for production, and deliver them to the contract manufacturer for assembly.

Emerging companies often choose to begin production of their electronic components under a consignment model. They may be unaware of the existence of turnkey contract manufacturers, or they may believe that no turnkey contract manufacturer can properly handle their particular component or small order sizes, or they may have made an investment in in-house manufacturing supply chain resources that they wish to recoup.

## Turnkey Contract Manufacturing

Turnkey manufacturing describes a complete manufacturing function that provides all manufacturing and supply chain services, including material acquisition, assembly, test, and aftermarket service and warranty support. Product design and design for manufacturing may also be services that are provided by the contract manufacturer (CM). In other words, the organization outsources all inventory control, receiving, kitting, and production management functions—and possibly all design and warranty service as well—to a third-party contract manufacturer who is responsible for manufacturing all aspects of the product in question.



# 2013 COURSE CALENDAR

January	February	March	April
S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28	S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
May	June	July	August
S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
September	October	November	December
S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

[CLICK TO VIEW CALENDAR ONLINE](#)

All courses are for Instructors (CIT)  
and Operators (CIS)

[REGISTER ONLINE](#)



DOWNLOAD  
REGISTRATION  
FORM



JOIN OUR EMAIL LIST  
FOR NEWS & UPCOMING EVENTS



## BLACKFOX

The Premier Training & Certification Company



Follow Us! [f](#) [in](#)

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



contact: Sharon Montana-Beard  
[sharonm@blackfox.com](mailto:sharonm@blackfox.com)  
(303) 684-0135

**CHOOSING BETWEEN TURNKEY AND CONSIGNMENT MANUFACTURING** *continues***Advantages of Turnkey Manufacturing:**

- Access supply chain and production economies of scale.
- Minimize inventory risk.
- Take advantage of latest technology without capital expenditure.

**Figure 1:** Advantages of turnkey manufacturing.

Some of the most innovative companies choose a turnkey model right from the start, recognizing that their business model will be driven by the sales and marketing of innovative products and not by the infrastructure-intensive manufacturing of those products. This model allows new companies to avoid risk, keep a low overhead, and move quickly to meet market demands.

**Which is Better?**

The consignment model is today becoming less popular as companies focus on reducing costs and remaining agile to address rapidly changing markets. That said, in some cases it may make sense, such as when a product relies on a highly-specialized component that may be supplied specifically for that company or in cases where a company's intellectual property is contained in a component or board.

But for the majority of product marketing companies in which manufacturing is not a core business practice, turnkey manufacturing is the wisest choice over the short- and long-term. By outsourcing all manufacturing functions to a third-party CM, these companies can focus on their core competencies while taking advantage of the production economies of scale offered by an established contract manufacturer.

While some companies may feel vulnerable in relying on a third party to meet delivery commitments to customers, high-quality turnkey manufacturing is more likely to improve product delivery because established and proven

processes are used. Companies relying on turnkey manufacturing also tend to innovate and produce new products more quickly, as they are free to focus on market research, product development and sales and are unhindered by costly manufacturing infrastructures. A CM's entire focus is on manufacturing, while a tech company will often find that its resources are pulled in many directions when difficulties arise or when delivery crunches occur.

**Cost-Benefit Analysis**

In addition to offering enhanced process, quality assurance, and delivery capabilities, turnkey manufacturing helps electronics manufacturers reduce production costs by lowering or eliminating many of the supply-chain and overhead costs associated with the manufacturing process. Many of these costs are overlooked or not well understood when companies initially decide to use a consigned model.

To calculate the true cost of managing materials under both a consignment and turnkey model, we must first examine all overhead, hard costs, and assumed risks involved in the production supply chain. That supply chain must necessarily involve extensive administrative functions: Accounts payable, purchasing, inventory control, receiving and kitting, and management overhead. In each of these areas, the company assumes human resources overhead, hard costs associated with salaries, financing, and risk.

The information shown in Figure 2 is based on a company with \$1.5 million in materials expenditures and 2.5 inventory turns per year. Some key points for this company to consider when assessing its true cost of consignment include:

- The significant cost of controlling one's own inventory. The hard cost in this area includes inventory financing, shrinkage costs, and salary overhead.
- The human resources trade-off. Because only part-time staffing is required in this situation, the company must choose between three suboptimal scenarios: Try to find and manage suitable part-time staff; hire one staff member to perform multiple jobs, likely without proper



With more than 30 years' experience setting the pace in stencil, screen and squeegee technologies, there is one clear leader...

Visit us at:  
**APEX  
EXPO™**  
IPC 2013  
Booth #1215



and then there is  
everyone else.

Keep your business  
at the forefront...

Go with the leader!

Sign up to  
receive our free  
Photo Stencil  
newsletter

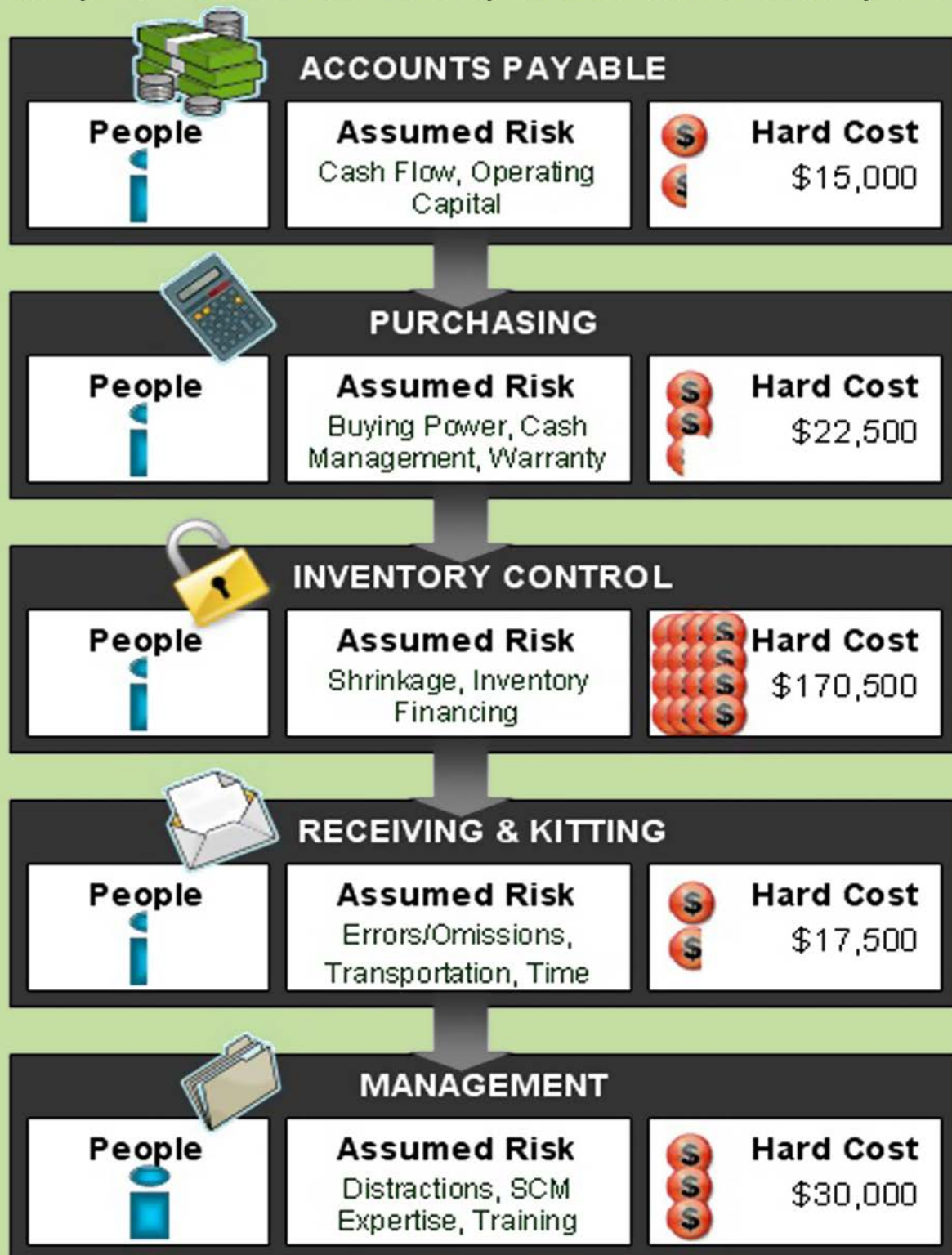


**PHOTO  
STENCIL**

**Ask the experts!** Contact us **TODAY** to schedule your free consultation to discuss your challenging printing application.  
Call: +1 719-599-4305 or email: [info@photostencil.com](mailto:info@photostencil.com)  
[www.photostencil.com](http://www.photostencil.com)

# True Costs of Consigned Manufacturing

Example: \$1.5M annual materials expenditures with 2.5 inventory turns



**Figure 2:** Diagram of the true cost of managing materials in a consignment model.



# Faster, Easier, Smarter Jetting



The next generation delivers it all –  
The NexJet™ System featuring the innovative Genius™ Jet Cartridge

*The easy-to-remove Genius Jet Cartridge's built-in memory tracks and stores usage data, thereby increasing quality and consistency in exacting manufacturing applications.*

You can rely on our award-winning support network. Contact us now to find out more.

USA: info@nordsonasymtek.com  
Tel: 1.800.ASYMTEK or +1.760.431.1919

China: info-china@nordsonasymtek.com  
Beijing: +8610.8453.6388  
Guangzhou: +8620.8554.0092  
Shanghai: +8621.3866.9166

Europe: cs.europe@nordson.com  
+31.43.352.4466

Japan: info-jp@nordsonasymtek.com  
+81.3.5762.2801

Korea: info@nordsonasymtek.com  
+82.31.765.8337

India: info@nordsonasymtek.com  
+91.44.4353.9024

Singapore: info@nordsonasymtek.com  
+65.6796.9515

Taiwan: info@nordsonasymtek.com  
+886.229.02.1860

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

Get the quality dispensing you need with the Genius™ Jet Cartridge\* and NexJet™ System\*. Invented by the leaders in jetting technology... Nordson ASYMTEK.

- Easy to Use – the one-piece Genius™ Jet Cartridge is removed quickly, without tools, for easy cleaning or replacement, saving time and money
- Smart – the Genius Jet Cartridge intelligently communicates with the dispense system to monitor usage and indicate replacement
- Flexible – innovative design widens your process window to support a broad range of fluids and applications
- Capable – software programmable fluid jetting to center the process window for clean, precise results
- Applications include flip chip, CSP, and PoP underfill, precise coating, and adhesive dispensing



\* PATENTS PENDING

**Nordson**  
ASYMTEK

See Nordson ASYMTEK at IPC APEX Booth #3115

## CHOOSING BETWEEN TURNKEY AND CONSIGNMENT MANUFACTURING *continues*

expertise in any of them; or outsource to various consultants, likely at higher cost.

- Significant risk is assumed at each stage of the supply chain.

In addition to eliminating much of the risk, a company such as the one profiled here stands to save more than \$107,000/year by using a turnkey model rather than a consigned approach. The most impressive cost savings will be found in three key areas:

### Receiving/Kitting

Under the typical consignment model, companies outsource only the assembly portion of the manufacturing process. Thus, organizations must prepare the products for manufacturing in-house, resulting in added in-house kitting costs—including labor, and redundant shipping and receiving costs (the parts must be delivered to the CM).

Contract manufacturers already have the infrastructures in place to prepare products for assembly, so their cost is spread over a number of customers and products. In addition to adding costs, the consignment model can result in duplicated effort at this stage if the products are not prepared properly for the contract manufacturer's particular processes. In such cases, the manufacturer must adjust the materials or return the components to the company—resulting in wasted time and added costs. Component quality issues and kitting errors cause production delays on the assembly line—it is always best for the CM to receive, test, and prepare the components that it will assemble.

### Inventory Financing & Labor Costs

By spreading inventory financing and labor costs across multiple projects, a contract manufacturer's cost-per-product is always less than the same costs dedicated to a single company or product. CMs also offer economies of scale as well as various inventory financing options that assist with cash flow.

While the turnkey model offers significant

inventory and labor cost savings, many early-stage companies that have already invested capital in these areas believe that they must retain their existing supply chain assets to recoup their investments. This cost analysis, however, demonstrates that a contract manufacturer can offer lower per-project labor and inventory financing costs than an in-house team, since the manufacturer specializes in those areas and the costs are spread across multiple projects.

**Contract manufacturers already have the infrastructures in place to prepare products for assembly, so their cost is spread over a number of customers and products.**

### The Right Decision

My company has observed that turnkey contract manufacturing is the ideal manufacturing model for most early-stage companies and small- to mid-size companies. Even many established companies with in-house supply chain departments are switching to a turnkey model for their new product ideas, or will “test the waters” of turnkey outsourcing with established products that are in maintenance mode.

Offering significant labour and inventory cost savings and allowing companies to focus on innovation and their core competencies, the turnkey manufacturing model is a viable choice for companies that have made the decision to outsource the manufacturing of their electronics products to a contract manufacturer. **SMT**



George Henning is president of OCM Manufacturing, an Ottawa-based EMS provider specializing in high-mix, low-volume products. He has seen the company through lead-free implementation, ISO 9001 registration, the implementation of a new ERP system, and several production automation upgrades. Henning is a graduate of the Electronics Engineering Technology program at Georgian College and received an MBA from Queen's University.



## Video Interview

# Firstronic Pushes Program Management

by Real Time with...  
SMTAI 2012



Firstronic is a regional EMS provider that has pioneered automating the program management process through its proprietary software, ProManage. Guest Editor Susan Mucha talks with Firstronic President Rick Herndon about the paper he presented at the Contract Manufacturing Symposium that focuses on how this systems strategy is force-multiplying their team.



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



## Amplifying Magnetic Fields in High Energy Density Plasmas

Magnetic fields can significantly alter the properties of plasmas and can be a key tool in fundamental studies of plasma dynamics. Magnetizing the high energy density plasmas created in laser-driven implosions requires ultra-high magnetic fields, which are difficult to create. For the first time, those large fields have been produced and used to reduce the thermal conductivity of such plasmas.

Magnetic fields in high energy density plasmas can be used to study a variety of basic science phenomena from collisionless shocks to magnetic reconnection, as well as to improve the performance of inertial fusion implosions.

The Office of Fusion Energy Sciences has supported basic research at the [University of Rochester](http://www.ursi.edu) to explore and con-

trol the properties of high energy density plasmas. Given the ultra-high pressures of tens of gigabars of such plasmas, controlling their properties has always been an outstanding challenge. Using magnetic field compression as a tool to generate ultra-high magnetic fields, the group has successfully produced a hotter core of a laser-driven capsule by magnetizing the central plasma heated by an imploding shell. An initial seed magnetic field is embedded in a tiny spherical shell imploded by a high-energy laser. The magnetic flux is frozen in the ionized gas inside the shell and then self-amplified as the target implodes.

In this way, a magnetic field of 20 megagauss is achieved from a 50 kilogauss seed field. The compressed field magnetizes the electrons and reduces the heat losses thus increasing the temperature and fusion reactivity of the compressed core. The ability to control the properties of these plasmas with a magnetic field opens the way to many exciting studies with applications to astrophysics and fusion energy.



# Global Company, Local Advantage

by **Daniel Pfeifer**  
ESCATEC

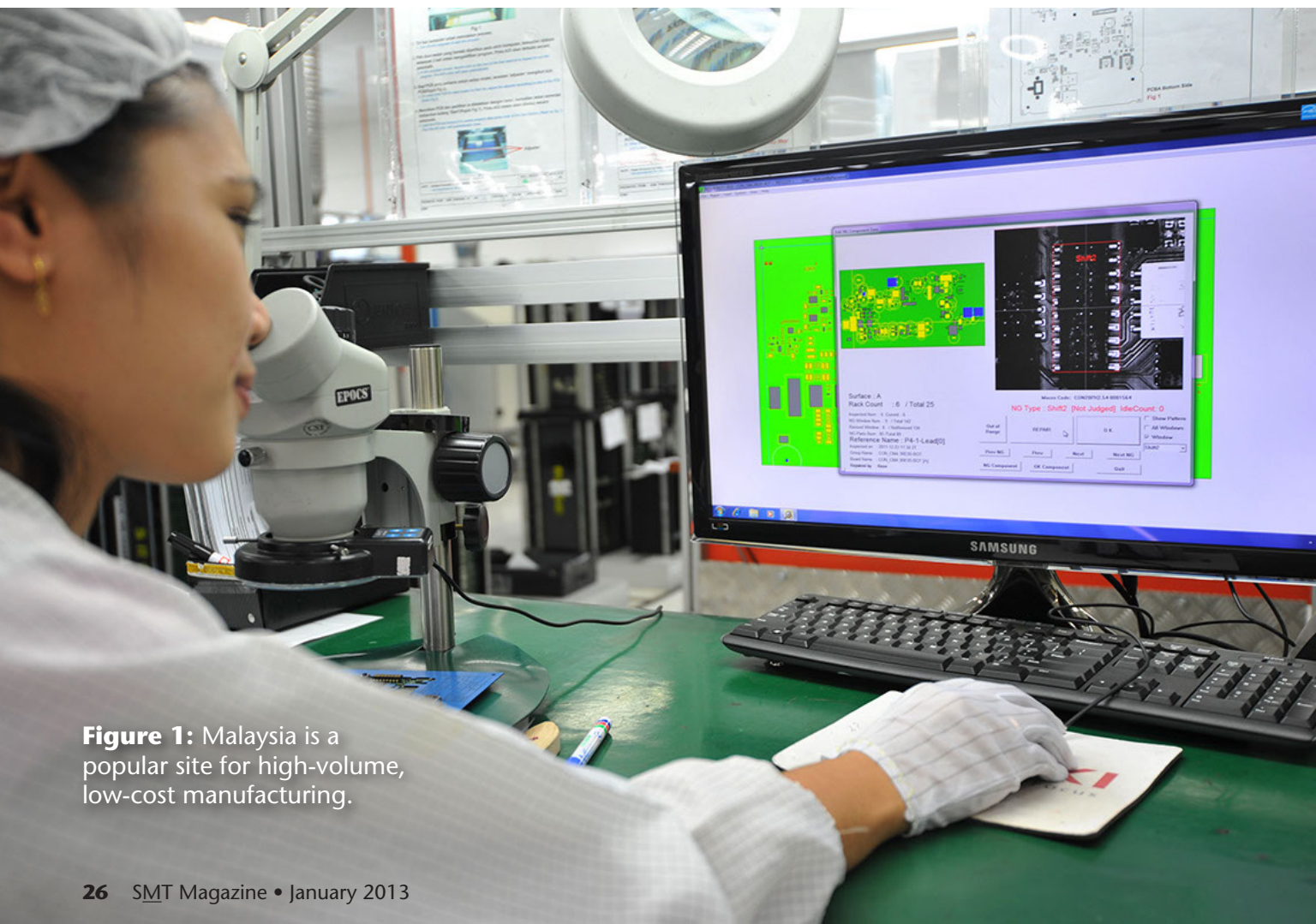
**SUMMARY:** *How do you balance the geographic locations of various team members for optimal customer support, performance, and cost efficiency? Daniel Pfeifer assigns key jobs to a graph for a customized solution.*

Presenting a friendly, local face helps to ensure a close, successful, and long-term relation-

ship with customers. Problems can be addressed quickly, before they become serious, which leads to the development of trust between the customer and the supplier. However, in the real world, you are unlikely to have a factory next door to your customers—especially if they are in a high-operating-cost country.

The solution is to balance the location of different resources within an EMS operation so that they are easily accessible to the customer, if needed, with the rest located in a low-operational-cost area. ESCATEC has one end of its business located in Switzerland, giving a central European location to service customers, while the other is located in Malaysia for high-volume, lost-cost manufacturing.

So how do you balance the geographic locations of various team members for optimal customer support, performance, and cost efficiency? Key jobs can be assigned to a graph with the following three dimensions:



**Figure 1:** Malaysia is a popular site for high-volume, low-cost manufacturing.





# MAGICALLY TURN DROSS INTO USABLE METAL

## NEW FORMULA – EASY TO USE

- *Reduce Solder Purchases 70 - 85%*
- *Easy To Use and Non-Hazardous*
- *Available Globally*
- *Choose On or Off Line Process*
- *Do It Yourself Equipment Available*

To effectively compete in today's complex market, savvy companies implement all the cost saving methods possible while eliminating waste.

**MS2<sup>®</sup>** Molten Solder Surfactant fits perfectly into this strategy by eliminating dross and adding cash to your bottom line.

**Don't delay, contact us today for a free in-house evaluation.**

[sales@pkaymetal.com](mailto:sales@pkaymetal.com)

**PK**  
M·E·T·A·L

P. Kay Metal, Inc.  
2448 E. 25th Street  
Los Angeles, CA 90058

**(323) 585-5058**



**Covered by U.S.  
and Global Patents**

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

**GLOBAL COMPANY, LOCAL ADVANTAGE** *continues*

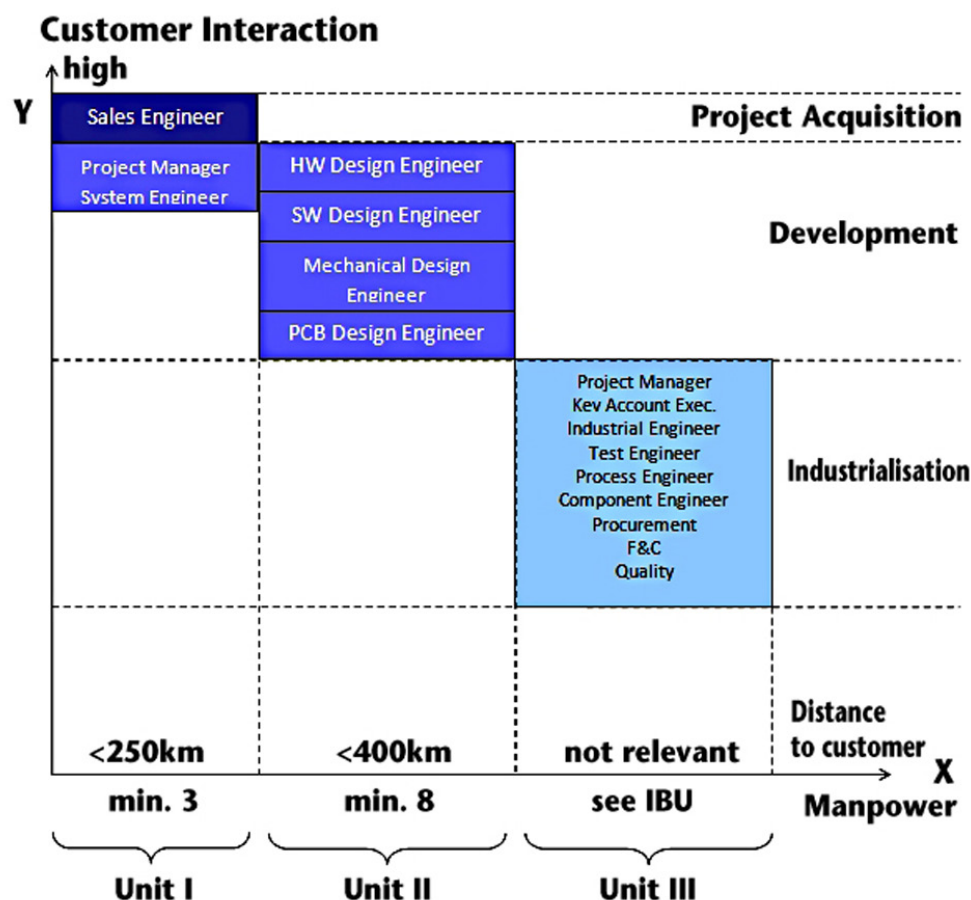
- The Y axis shows the increasing level of customer interaction: How important and how intensive is the involvement of the customer?
- The X axis shows the distance to customer in km and also shows the level of manpower needed to realize the project.

The result is three distinct groups split by level of customer interaction and distance to customer. Unit I has the most direct customer interaction, i.e., the sales engineer who finds the projects and then maintains the customer relationship to ensure it is running smoothly in conjunction with the project manager and systems engineer. Ideally, there should be a Unit I group in every country where the company is doing business to provide local support in the

local language. Good locations are near customers' R&D headquarters and near airports with international locations.

These satellites feed into Unit II, which includes the design engineers who work on the actual project. This unit will need to be close to Unit I and staffed by highly-experienced engineers. It may be expensive to locate Unit II in central Europe, but it can also be cost-effective, as Unit II's expertise means that designs accurately meet customer requirements and can be performed much faster due to a short feedback loop. A central location in the heart of Europe means that journeys to customers only take a few hours and are in the same time zone. Unit II should also be located near a university to provide access to cutting-edge technologies and young talent.

Unit II focuses on three areas. First is the technical support for the Unit I team on various projects. The second is design services—an increasingly important service to customers. As a contract R&D operation, it provides the first stage in a complete “soup-to-nuts” service where the company is responsible for all stages, from initial product design through prototyping to volume production. This avoids problems caused by the typical business model with various stages being performed by different companies with handovers that can create problems such as the need for redesigns, delays, and additional risk. A vertically-integrated approach of providing complete service from concept to manufacture ensures that



**Figure 2:** This graph can help balance geographic locations of various team members for optimal customer support, performance, and cost efficiency.





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

*Fulfilling the Manufacturing Needs  
Throughout the Electronics Industry*

*North American Master Distributor*

**Heraeus**



**WORLD LEADER IN  
CONTACT CLEANING**

**teknek**



**ORPRO  
Vision.**



**ROOTED IN THE ELECTRONICS  
INDUSTRY FOR OVER 25 YEARS**

*Technica, U.S.A. • 2431 Zanker Road, San Jose CA 95131 • PH: 800-456-2970 • FAX 408-943-8115*

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

**GLOBAL COMPANY, LOCAL ADVANTAGE** *continues*

products are designed for manufacturability from the beginning and cover all aspects from mould design through to ensuring that components are not likely to go end-of-life in the near future.

Third, Unit II has prototyping and low-volume lines that serve several purposes. Prototypes can be viewed quickly by the customer so that feedback can be implemented to shorten the design cycle. This can then move into the initial, low-volume production using the same production lines and programs that ensure trouble-free ramp up. For some products, the low-volume capacity may be sufficient especially if they are high-value items for use in medical or military equipment.

If high-volume production is required, Unit III can be located anywhere with low-cost labor, such as Asia. The country features a mix of labor from low-cost production line workers up to the higher-cost engineers who perform process, test, quality control, etc. Some of the workforce, such as procurement staff, supports not only Unit III, but also Unit II to give the benefits of centralization.

Having a high-volume manufacturing Unit III in Asia also means that the unit is located close to components suppliers, toolmakers,

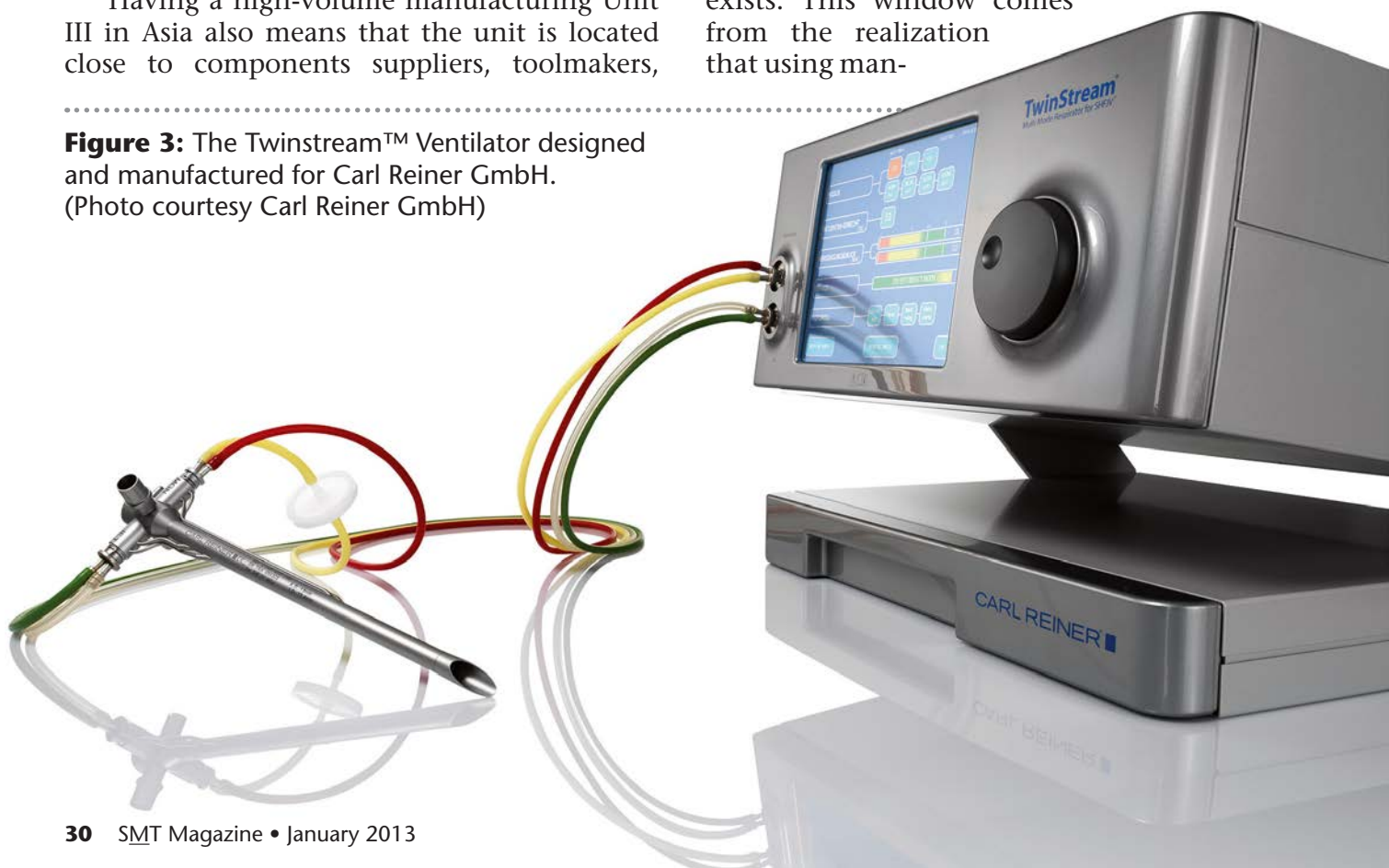
plastics, etc., to ensure rapid response times and a high level of supplier support.

To enable production to be easily moved from Unit II to high volume in Unit III, the same production equipment is used in both facilities. Software programs perfected in Unit II for manufacturing machines can be run on the exact same machines in Unit III so that production can be rapidly transferred.

The assigned project manager in Unit I oversees not only Unit II design and low-volume production, but also high-volume production, if moved to Unit III, to ensure seamless continuity for product production at all stages. This builds a close relationship with the customer as they have the same, single point of contact for every stage, from concept to industrialization, to ensure that the requirements of quality, functionality, time-to-market, unit price, and development costs are consistently met.

In summary, pure EMS companies need to expand their offerings to become more competitive and offer customers a complete, one-stop service especially now that a market opportunity to pull back business lost to China exists. This window comes from the realization that using man-

**Figure 3:** The Twinstream™ Ventilator designed and manufactured for Carl Reiner GmbH. (Photo courtesy Carl Reiner GmbH)





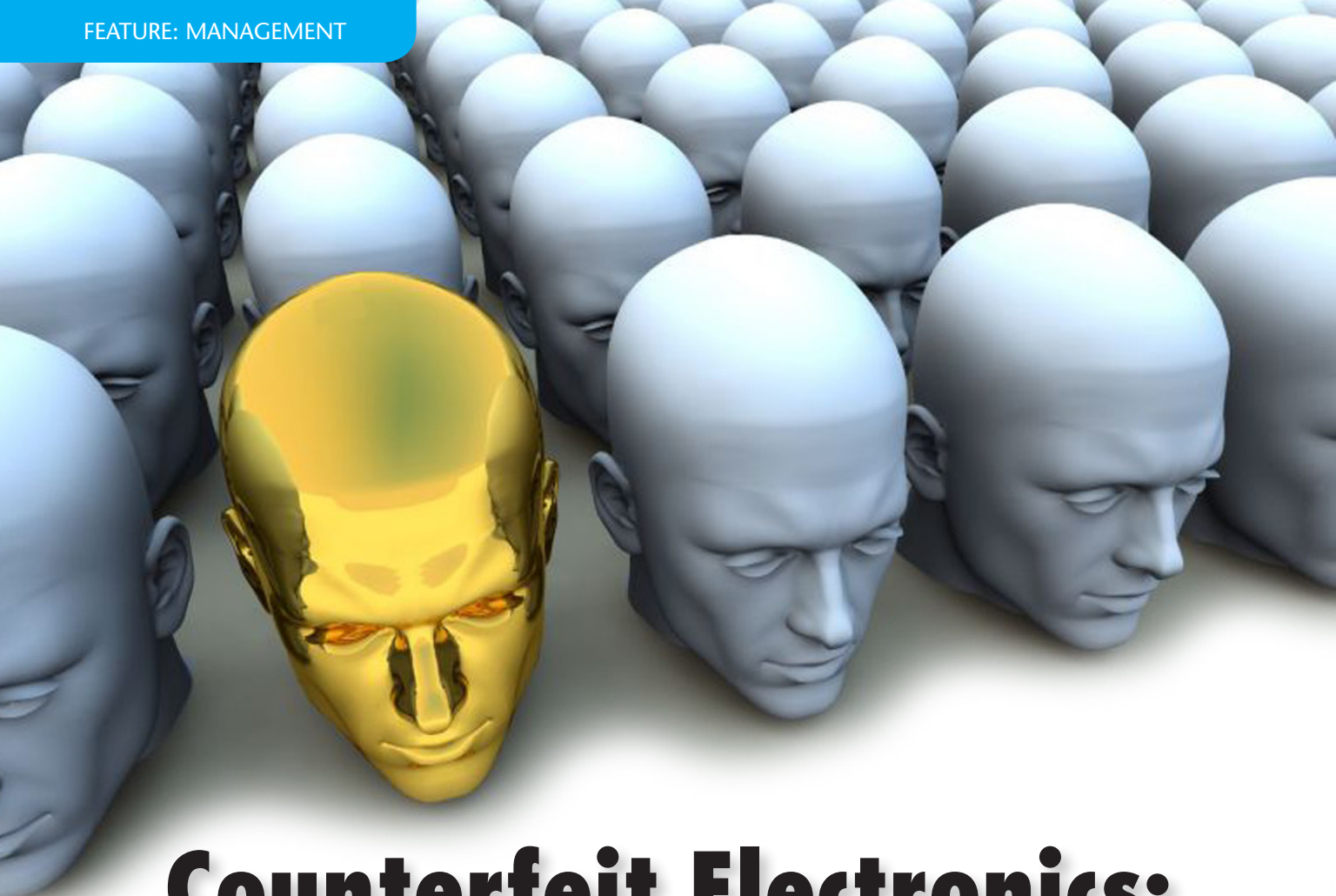


**Figure 4:** ESCATEC's high-volume manufacturing facility in Penang, Malaysia.

ufacturing facilities in China can be fraught with problems that are not initially apparent, such as consistent quality control, IP leakage, language misunderstandings, unauthorised component swaps, etc. Large multinationals solve most of these problems by having their own teams in China to supervise every stage, but this might not be feasible for smaller companies. By expanding operations from just manufacturing to a complete service that removes coordination headaches and risks by taking responsibility for all stages, EMS companies have the opportunity to differentiate themselves and grow by providing a real value add—not by endlessly trying to shave prices on a race to the bottom that no one really wins. **SMT**



Daniel Pfeifer is global R&D manager for ESCATEC. He joined ESCATEC Switzerland as an R&D engineer from Munich University where he obtained a Dipl.-Ing., Electrical Engineering and Information Technology in 2003. Over the past 10 years he has worked in various positions within the R&D division and, in 2011, was appointed global R&D manager.



# Counterfeit Electronics: Risks and Mitigation

by **Mike Archenhold**  
PLEXUS CORPORATION

**SUMMARY:** *The number of counterfeit electronics parts has quadrupled since 2009. Plexus' Mike Archenhold outlines the risks and ways to fight back.*

The topic of counterfeit electronics has been one of the most discussed and analyzed in the electronics industry and there seems to be no end in sight to the problem. The counterfeit electronics industry is now savvier than ever, with perpetrators finding novel ways to smuggle illegal goods into the supply chain.

The reasons counterfeit parts surface are numerous, but companies must be particularly vigilant during supply chain constraints, where low levels in the supply chain increase the need to use the open market.

Counterfeit components can cause significant damage, compromising performance and safety when they malfunction, and also carry the potential threat of fatal errors that can disrupt critical functions. The subsequent impact to brand image can be significant and have ramifications on future sales and growth opportunities.

OEMs are conscious of the danger of increasingly sophisticated counterfeits and the numbers prove them right: Recent figures confirmed the negative trend and, according to IHS iSuppli, reports of counterfeit electronics parts have soared dramatically in the last two years, with the number quadrupling since 2009 [1].

In 2010, U.S. Department of Commerce data suggested that over 1,800 cases of counterfeit parts had been found in weapons—equating to over 1 million individual parts, of which 70% came from China. The flaws of the duplicates



are often invisible to the naked eye and get distributed for exceptionally low prices, since counterfeiters reduce enormous R&D costs.

To reduce the risk of obtaining counterfeit or substandard parts, OEMs should follow one simple rule: Know the source. Recent reports have been a real eye-opener, fuelling concerns over which supplier to trust when it comes to sourcing electronic components. OEMs are becoming wary of rogue suppliers.

### Understand Your Supplier Choice

When it comes to sourcing electronic parts, four options are available to OEMs:

The manufacturer, authorised/franchised distributors, independent distributors, and brokers. Understanding the differences and risks involved in purchasing from these sources is key to avoid the bad guys:

- An original components manufacturer (OCM) manufactures products/components and has ownership of the intellectual property (IP), copyrights, or trademark.
- Authorised/franchised distributors are suppliers authorised by the manufacturer they have on their line card. In contrast, an independent distributor can also be authorised to sell from some manufactures on their line card; however, this is not obligatory. It's crucial for OEMs to thoroughly check an independent distributor's internal quality processes.

- On the other side of the spectrum are the brokers who primarily move inventory and are not authorised to sell those lines. They store very little, if any, inventory. And the stock that comes in the door usually goes out the same day.

- The safest way to proceed is to buy directly through an OCM or authorised/franchised distribution and only work with independent distributors who guarantee product authenticity and/or have the capability to test components prior to shipment.

### Third-party Sourcing: Implementing Robust Purchasing Controls

With an expert partner on its side, sourcing parts through a third party can give an OEM peace of mind. However, simply handing the sourcing matter to any partner is not advisable. Instead, OEMs should invest time into verifying an EMS partner with renowned anti-counterfeit credentials and internal quality control processes in place.

An EMS provider should offer full turn-key manufacturing solutions, including supply chain design and component sourcing.

However, not all EMS providers are created equal and OEMs should ally with a partner that has strong relationships with manufacturers and franchised distributors. Partners should also have the ability to optimizing supply chain programs to further reduce the risk for counterfeit components. Programs should be designed to meet specific customer requirements for service and total cost balancing.

If a shortage should occur, escalation procedures should quickly communicate the need to their supplier network. Deployment models should be used to analyze demand variability

to establish inventory service

goals based on the variability and lead-times for each component. This process would establish reorder points and reorder quantities to provide coverage for variability, reducing the need for shortages due to inadequate forecasting processes. As brokers are considered to be dubious sources, conscientious EMS providers should block order placements for all brokers until the customer completes a review and management approval is received. The counterfeit knowledge and expertise of an experienced customer team is indispensable and a first line of defense.

Transparency of the suppliers' internal processes is crucial; having full visibility as to where the parts are coming from provides an OEM

“  
***As brokers are considered to be dubious sources, conscientious EMS providers should block order placements for all brokers until the customer completes a review and management approval is received.***  
”

**COUNTERFEIT ELECTRONICS: RISKS AND MITIGATION** *continues*

with the tracking control it needs to make an informed decision.

Global trade association memberships are also useful indicators of a company's quality control measures. By joining an organization that provides members with access to a list of known counterfeit components in the supply chain, companies can protect themselves against the risks of purchasing rogue parts. Many trade associations conduct risk assessment on all listed suppliers, highlighting those attracting negative attention.

In line with trade associations, testing standards provide a reliable seal of quality sources. To ensure the highest possible standard of counterfeit testing, the Independent Distributors of Electronics Association (IDEA) has established IDEA STD 1010. This is highly recognized within the electronics industry and provides a fundamental checklist. Benchmark testing standards are key to ensure the authenticity of electronic components and the standard raises quality-conscious, reputable independent distributors to a higher level in the market.

### **Proactive Management**

As supply chain sources are constrained, the development and availability of counterfeit components rise. Proactive management of a product's bill of material (BOM) can substantially decrease counterfeit component risk. Through partnering with a reputable EMS provider, tools can be utilized to analyze a BOM's electronic components for obsolescence concerns, developing a life cycle analysis and identifying potential alternates. This information, when analyzed on a reoccurring basis, allows engineering visibility into the future.

By proactively eliminating upcoming obsolete components near the end of their life cycle, the risk for manufacturing a product with counterfeit components is reduced. Should a com-

ponent be such that it is critical to the design of the program and cannot be proactively designed off of a product; a life cycle analysis can still provide invaluable information. A data-based quality control plan can be implemented to develop incoming quality alerts for high-risk components.

“

***To ensure the highest possible standard of counterfeit testing, the Independent Distributors of Electronics Association (IDEA) has established IDEA STD 1010. This is highly recognized within the electronics industry and provides a fundamental checklist.***

”

### **No Need for Pessimism**

Providing an in-depth inspection of every part in the supply chain is an impossible task, but today's counterfeit prevention is not about checking every part. The more people that take the time to look into their supplier sources, the higher the opportunity to deter savvy counterfeiters. Combined with objective industry standards this can make a real difference.

The message that needs to be spread to the market is simple: Continued development and improvement of all related control processes for the prevention of counterfeit material is imperative. OEMs should invest time in researching all options and only turn to a partner that meets the highest quality control standards. **SMT**

### **Reference**

1. To view the IHS iSuppli report, click [here](#).



Mike Archenhold is director of sourcing for the Europe, Middle East, and Africa (EMEA) regions at Plexus Corporation, an industry-leading provider of optimized product realization solutions within the electronics engineering and manufacturing services industry. As a 27-year veteran in the supply chain management industry, Archenhold is responsible for the development of a network of suppliers within the region to support the continued growth of the company.



Standard FR4 Material · High Reliability · Lead Free Assembly  
Signal Integrity · Halogen Free · Special Applications · Thermal Management  
Flex-Rigid & Heat Sink Bonding



# Lead Free Assembly

## PRODUCTS

### VT-481

Phenolic Cured / Filled FR4 Tg 150

### VT-47

Phenolic Cured / Filled / Low CTE FR4 Tg 180

### VT-441

Halogen Free / Phenolic Cured / Filled FR4 Tg 150

### VT-447 180

Halogen Free / Phenolic Cured / Filled /  
Low CTE FR4 Tg 180

Our global resources and local distribution network put the products you need in your hands at the right time and at the right cost. Consistency and value. Where and when you need it.

**Wherever technology takes you, we deliver.**



Accredited  
AS9100 Rev C

# ventec



Ventec Europe  
[www.ventec-europe.com](http://www.ventec-europe.com)

Ventec USA  
[www.ventec-usa.com](http://www.ventec-usa.com)

Ventec International Group  
[www.ventecclaminates.com](http://www.ventecclaminates.com)

# Top Ten Market News Highlights



## **Windows 8 to Miss Expected Users**

While the vast majority of consumers (96%) own a Windows PC, only two in five (39%) of these are likely to upgrade to Windows 8. The survey also revealed that when it comes to Windows operating systems, Windows 7 is a clear favourite, with over a quarter of consumers (28%) selecting this version as their preferred choice—this represents double the proportion who chose the newly launched Windows 8 (14%).

## **Smartphones to Take Larger Share of Flash Memory Usage**

Approximately 792 million flash memory units, including both NOR and NAND varieties, will ship in 2013 to smartphones, compared to 703 million units for feature phones, according to an IHS iSuppli Memory On the Move Market Brief from information and analytics provider IHS. This compares to a total of 790 million units this year for feature phones, and 613 million units for smartphones.

## **Global Economy to Make Hesitant & Uneven Recovery**

"The world economy is far from being out of the woods," OECD Secretary-General Angel Gurría said during the Economic Outlook launch in Paris. "The U.S. 'fiscal cliff,' if it materialises, could tip an already weak economy into recession, while failure to solve the euro area crisis could lead to a major financial shock and global downturn. Governments must act decisively, using all the tools at their disposal to turn confidence around and boost growth and jobs, in the United States, in Europe, and elsewhere."

## **China's GDP Increase to Fuel Demand for Consumer Goods**

The recently concluded 18th China Communist Party Congress, which saw outgoing President Hu Jintao deliver a report on China's economy and a roadmap for the next decade, will jump-start key industries including the information and communications technology (ICT) sector, where a projected doubling of the 2010 GDP and per capita income for urban and rural residents is expected to create strong demand for consumer goods.

## **Industrial Electronics Semiconductor Market Outlook Dims**

Revenue for industrial semiconductors, used in a wide array of application markets from home automation to aeronautics and military purposes, is projected to finish the year at \$31.4 billion, up 3% from \$30.5 billion in 2011. This year's meager expansion contrasts with the solid 9% increase of last year and the exuberant surge of 35% in 2010 immediately after the recession. It also represents a significant downgrade from the previous forecast of 7.7% growth issued in July.

## **Semiconductor Equipment Sales to Hit \$38.2B in 2012**

After a 151% market increase in 2010 and a 9% increase in 2011, the equipment market is expected to contract by 12.2% in 2012. Growth is expected in just two regions in 2012: Taiwan (12.7% increase over 2011) and South Korea (10.7% increase). In 2012, Taiwan and South Korea each will reach equipment sales of \$9.6 billion, with North American sales totalling \$8.0 billion. Rest of World (ROW), Europe, and Japan are the most negatively impacted in 2012.

## **Semiconductor Equipment Sales to Hit \$38.2B in 2012**

SEMI projects that worldwide sales of new semiconductor manufacturing equipment will reach \$38.2 billion in 2012, according to the year-end SEMI Semiconductor Equipment Consensus Forecast, released here today at the annual SEMI-CON Japan exposition. Following a multi-year expansion period, semiconductor equipment sales are expected to moderate before posting low double-digit growth in 2014.

## **Home Automation Services Market Sees Strong Growth**

"Home automation adoption is moving into the mainstream as a combination of home connectivity, standardization, and a range of new sensors and devices bring an ever expanding number of players into the market," says Jonathan Collins, principal analyst, ABI Research. "Meanwhile existing players are adapting their offerings and a host of technologies and connectivity options are battling to become de facto standards."

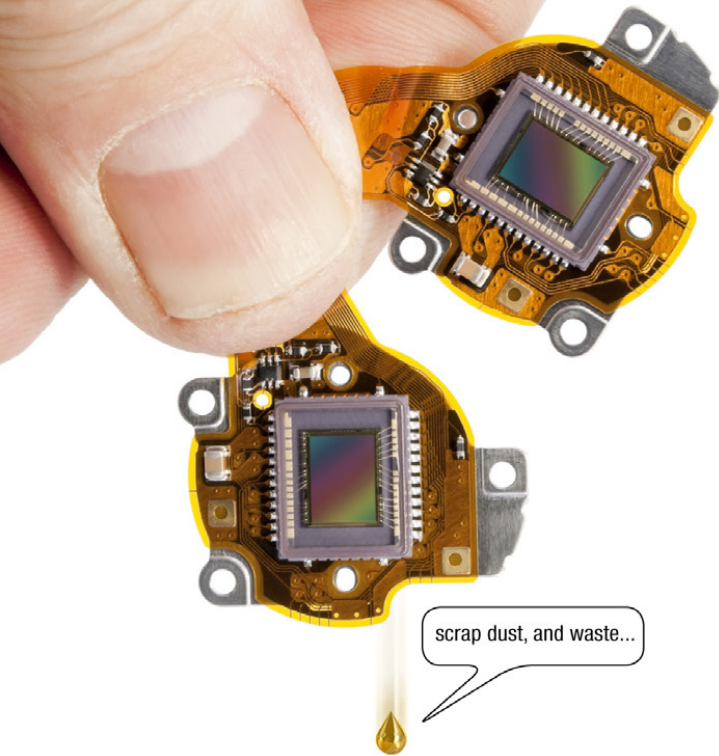
## **Medical Electronics Market Poised to Hit \$4.1B by FY 2012**

The medical electronics market remains a steady source of revenue growth in semiconductors and is expected to reach nearly \$4.1 billion in global revenue for FY 2012. Over the next few years sales will accelerate at a steady rate of 9% on average thanks to rapidly aging populations and a greater emphasis on preventative care which will spur demand for even smarter and more sophisticated medical devices, especially those of the home and implantable varieties.

## **Global Display Market to Hit \$164.24B by 2017**

According to a new market research report published by MarketsandMarkets, the total global display market is expected to reach \$164.24 billion by 2017, at a CAGR of 3.1% from 2012 to 2017. The major technologies that will contribute to the global display market are OLED, E-ink, DLP, and LCoS, expected to grow at a CAGR greater than 30%, while TFT-LCD and LED technologies will grow at a CAGR of less than 20%, all from 2012 to 2017.





scrap dust, and waste...



=



## What are you losing in lost scrap?

At Stebgo Metals when you send us your manufacturing waste you can trust we'll do everything to get the most precious metal from your scrap to refine and return every ounce back to you with honesty and integrity. Trust the Stebgo advantages for your scrap refining and we'll help you stop throwing money away.

### The Stebgo Advantages

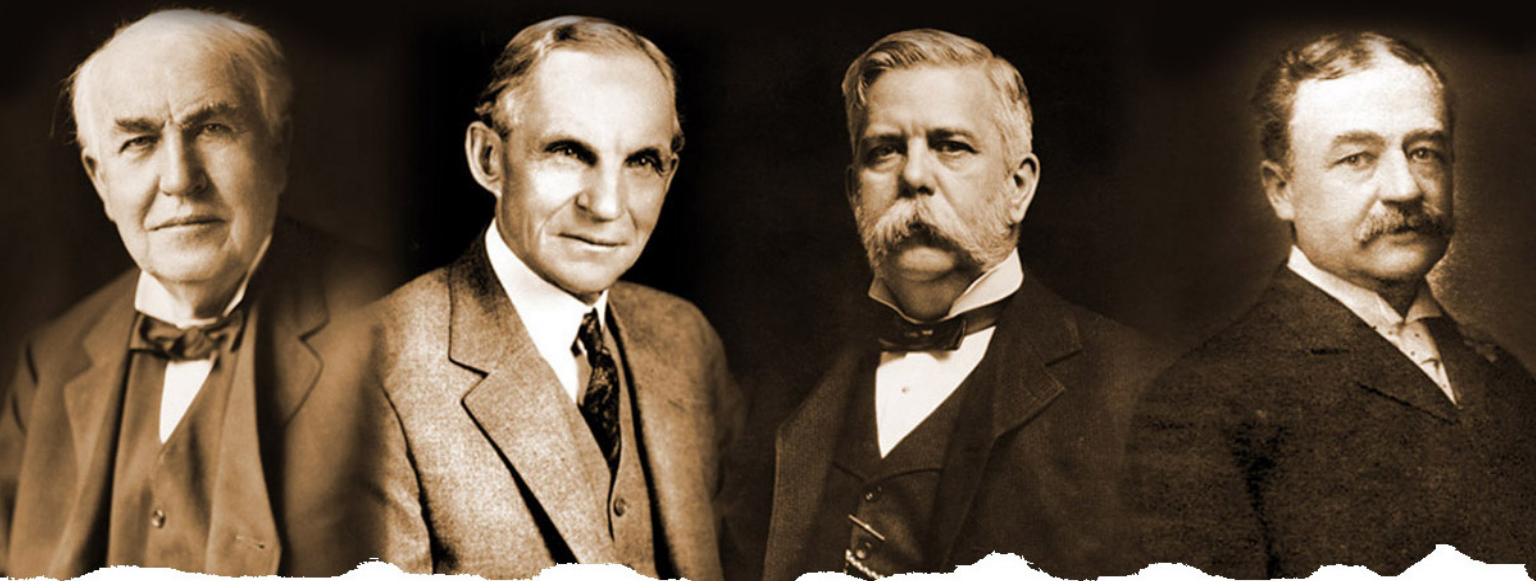
- Certified independent scales
- Accurate measurement and reporting
- 99.999% refining of precious metals
- Fully insured
- FREE Stone Removal
- FREE assay on first job
- Advances, E-Payments & Market Lock Options
- Fast Turnaround
- 99% of solids jobs settled within 4 days

TRUSTED REFINERS SINCE 1978



800-289-0138 / [www.stebgo.com](http://www.stebgo.com)

250 Bridgepoint Drive, South St. Paul, MN 55075



# What's Really Wrong with Corporate America?

by **Michele Nash-Hoff**  
ELECTROFAB SALES

**SUMMARY:** *In today's marketplace, a company must provide or add value to acquire a place in the global supply chain of goods and services. Michele Nash-Hoff discusses a book that guides companies in ways to design or redesign their organization for the sake of others. The book is "a guidebook on how a private or public company can achieve its true purpose in the world."*

The purpose of a business is to maximize profits—a company has to make a profit to stay in business, grow, and prosper, but I don't think this should be the main purpose of a company. Most entrepreneurs have some kind of vision or bigger reason for starting a company, whether it's to produce a new product that will benefit others or to provide a service they feel they can provide better than others.

What's wrong with companies today—especially publicly traded corporations—is that they have lost their soul, their vision or bigger reason for being a company. They have become too focused on the bottom line of maximizing profits and forgotten the real reason the company was founded. Our history as a country is filled with men and women of vision who

changed the world by the products or services they invented or provided—Thomas Edison, Henry Ford, George Westinghouse, and Aaron Montgomery Ward.

Today, you must be able to either provide or add value to have a place in the global supply chain of goods and services. If you don't provide or add value, you won't be able to stay in business in the long run. Providing or adding the maximum value possible is the goal behind all of the steps and tools used to become a Lean Six Sigma company whether you are a manufacturer or a service provider. You focus on the customer by removing wasted and non-value-added steps to become lean and reduce variation and improve quality to achieve the Six Sigma level.

However, this renewed focus on the customer by becoming a Lean Six Sigma enterprise won't restore the soul of a company. To do this, you need to create or revive the concept of "for the sake of others"; that is, serving others by what you do or make. This is the main concept presented in Dr. Tony Baron's book, [The Art of Servant Leadership](#). This book shows you how to design or redesign your organization for the sake of others and is "a guidebook on how a private or public company can achieve its true purpose in the world." The book has a lofty pur-



***Can software create business intelligence without you?***

*Aegis knows it can't...*

*Drive your factory by joining real-time and historical data with YOUR business intelligence — whenever and wherever it's needed.*

## Putting Data into the Hands of Those Who Need It.

Aegis FUSION Analytics delivers information through real time dashboards, mobile device apps, emailed reports, and interactive visualization through collaborative tools. Best of all — **you** create your dashboards and reports from the vast store of data within the Aegis system — no SQL, scripting, or IT knowledge necessary — just drag, drop and view.

Your business is unique and only you know the information needed to improve it. Shouldn't you deploy the only system that joins your insight to data to create real business intelligence?



*Learn more at [www.aiscorp.com](http://www.aiscorp.com).*

[▶ View Screenshot Tour](#)

**AEGIS**   
S O F T W A R E

## WHAT'S REALLY WRONG WITH CORPORATE AMERICA? *continues*

pose: “To equip, inspire, and encourage those we influence in order to make a profound positive difference in the world.”

In a 1970 *Time* magazine article, the economist [Milton Friedman](#) argued that businesses’ sole purpose is to generate profit for shareholders, as long as it is doing so legally and ethically. In contrast, Dr. Baron believes that the “sole goal of a business is to exist for the sake of others.”

The book provides “a case study of the principles and practices Art Barter used as a servant leader to reform Datron and transform lives inside and outside the company.” [Datron World Communications, Inc.](#) (DWC) is a privately-owned company located in Vista, California. For over 40 years, Datron has provided tactical military and public safety radio equipment to a diverse worldwide customer base doing business in over 80 countries through an international sales representative network and regional support centers.

Part 1, “The Need for a New Kind of Leader,” discusses leadership and the common misguided use of applied power versus true power in the first chapter. Chapter 2 examines a leader’s epiphany or defining moments that transforms him/her into a servant leader. In Barter’s life, his father’s example, his work at Disney Company as a young man, and the teachings of Ken Blanchard and John Maxwell led to his being ready to become a servant leader with the guidance of Dr. Baron.

In Chapter 3, we learn that a leader often is best revealed by adversity, and we discover details about the distress that contributed to the transformation of Barter and Datron. Barter started at Datron in 1997 as chief financial officer, assumed the position of general manager after Titan Corporation bought Datron in 2001, and purchased Datron in 2004 during the depths of adversity.

Chapter 4 considers the fact that most corruption and disruption in a corporation results

from leaders’ failure to lead themselves, and the seven essential elements of leading yourself before leading others.

The end of each chapter features “Table Talk” questions you can ask yourself and others as you use the book as a guide to help you transform yourself or your company. For example, after Chapter 1, Dr. Baron asks, “What is your organization’s story? Who are your leadership role models? How did they shape your beliefs about leadership?”

Part 2 provides “The Formula for Success: Living for the Sake of Others,” beginning with how to create a servant leadership culture in a company or organization in Chapter 5. Dr. Baron’s definition of corporate culture “is a way of life cultivated over time through shared experiences, values, and behaviors.” He states that every corporation must share the following at a minimum to sustain a healthy environment:

Shared beliefs, shared experience, and shared expressions; that is, “a verbal commitment to do what they know they can do.”

In Chapter 6, “Cultivating a Servant Leadership Culture,” Dr. Baron writes that the four components necessary for transformation within an organization are:

- Cultural Architect – A person with the highest level of positional power within the corporate circle of influence.
- Commitment level – A personal commitment of belief, behavior, values, and vocational activities that align with servant leadership by the cultural architect.
- Climate control – Creating an atmosphere of balance with the right people, opportunities, and resources.
- Culture formation – Based on new experiences repeated and reinforced through modeling, teaching, affirming, and rewarding to transform people and the business.

“  
***He states that every corporation must share the following at a minimum to sustain a healthy environment: Shared beliefs, shared experience, and shared expressions; that is, “a verbal commitment to do what they know they can do.”***  
 ”





*"We are happy to be able to respond to and serve our customer's needs in every way possible."*

**Mike Fariba, US Circuit**

- ✓ **Commercial PCBs**
- ✓ **Military PCBs**
- ✓ **Over 400 customers**
- ✓ **Consistently High Levels of Performance in:**
  - On Time Delivery
  - Quality
  - Customer Service



U. S. Circuit, Incorporated  
 2071 Wineridge Place  
 Escondido, CA 92029  
 Ph: (760) 489-1413  
 Fax: (760) 489-2965  
[www.uscircuit.com](http://www.uscircuit.com)

## Superior Quality Superior Service

Call for a Quote: (760) 489-1413 or  
 email: [rsojitra@uscircuit.com](mailto:rsojitra@uscircuit.com)



ITAR Registered



ISO 9001:2008



MIL-PRF-55110G

## WHAT'S REALLY WRONG WITH CORPORATE AMERICA? *continues*

Dr. Baron writes, "Because most corporations have taught that profitability is the sole purpose of the organization, the workforce has lost its faith in business and in people. They have lost the confidence that leaders have their best interests in mind when considering corporate decisions that affect the bottom line. They have lost trust. I don't blame them. Over the last 20 years in various boardrooms around the country, I have seen executives choose to receive their year-end bonuses over keeping employees on the payroll."

Teaching servant leadership progresses through four stages:

1. Instruct – Solid instruction on the principles of servant leadership.
2. Invest – Use the principles with varying degrees of success.
3. Influence – High discussion and consensus building.
4. Incarnate – The servant leader is building other servant leaders.

Chapter 7 considers "Vision, Values, and Virtues." Dr. Baron writes, "In corporate language, vision describes the vivid mental image created by a leader so that people will have the experience of truly seeing into the future." The vision statement of Datron states the company's purpose is "a self-sustaining, profitable communications company which positively impacts the lives of others today and in the future." Dr. Baron laments that so many Fortune 500 companies don't consider that "their primary mission is to exist for the sake of others" outside of their shareholder family. He believes that "the stakeholders for every company are our local, national, and global community."

The book concludes with the chapter on "Extending the Servant Leadership Culture to the Community," describing how Art Barter, his wife, and the employees at Datron have worked "for the sake of others." Shortly after acquiring Datron, Barter and his wife set up a charitable fund with a donation of \$600,000. Datron employees can submit a request for donations to a charity of their choice. From 2004 to 2010, over \$2.5 million dollars was

contributed to causes as diverse as the Boys and Girls Club, an orphanage in Kenya, the Special Olympics, Breast Cancer Research, AIDS research, and women's shelters. Datron also founded the [Servant Leadership Institute](#), headed by Dr. Tony Baron, whose mission is "to create servant leaders who will transform organizations."

Datron has been able to make these contributions because of its financial success, increasing revenue from \$10 million in 2004 to \$200 million in 2010, while being organically funded internally and debt free. New products introduced include the Scout Air Reconnaissance System unmanned vehicle designed to capture and transmit high-quality video and images in the field and the PRC7700H variant of its high-frequency, software-defined radio.

Longtime employee Mark Sattel said, "Although the transformation was difficult at times, servant leadership is gaining at Datron." A new employee recently told me that working at Datron is different than working at any other company: "It works as if the pyramid is upside down, with the president at the bottom. Everyone keeps asking 'What can I do to help you?'"

Every American has the choice of using your talent and experience for the sake of others by becoming a servant leader. Doing so would make American great again and make the world a better place. What's your choice? **SMT**



Michele Nash-Hoff is the President of ElectroFab Sales, a sales agency specializing in helping manufacturers select the right processes for their products. She is past President of the San Diego Electronics Network, the San Diego Chapter of the Electronics Representatives Association and the High Technology Foundation. She is the author of two books, "For Profit Business Incubators" and "Can American Manufacturing Be Saved? Why We Should and How We Can." To contact Nash-Hoff, click [here](#).



# Some companies tell you they are great. We let our customers speak for us...



**Thank you!**

You guys are terrific! I had my proto boards fabricated by you when I worked at Honeywell and you do first class work. Many of those proto designs ended in aircraft from the C-17, Air Force One, to the Presidential Helicopter! Once those designs were proven the production house handled the load. But many of your boards went up 40,000+ feet to start the certification process. Mark, you do great work getting the information we need!

Steve White, Sr. P.C. Designer C.I.D.  
Verathon

I want let everyone know what a great job Prototron Circuits is doing as a vendor for Cypress Semiconductor as circuit board fabricator. You and your staff take the time required for attention to detail that creates your high quality and on time delivery. A well deserved recognition for you.

Sincerely,

Ron Plocinski  
Cypress Semiconductor



America's Board Shop

**Prototron  
Circuits**

Quality printed circuit boards

Redmond, WA 425.823.7000

Tucson, AZ 520.745.8515

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

# Choosing a Low-Cost Alternative to SAC Alloys for PCB Assembly

by Brook Sandy and  
Ronald C. Lasky, Ph.D., PE  
INDIUM

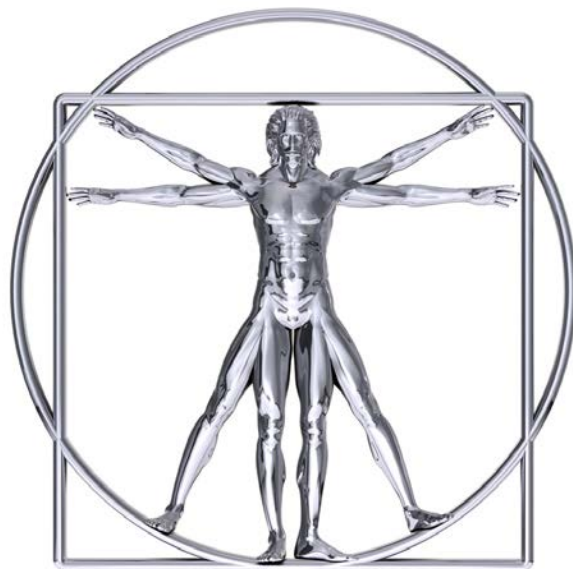
**SUMMARY:** *How much do subtle variations in alloy composition affect the performance and process requirements of PCB assembly? This paper from Brook Sandy and Ron Lasky, Ph.D. compares alternative lead-free alloys to SAC305 to determine if existing processes should be modified.*

*Editor's Note: This paper was originally presented at IPC APEX EXPO 2012.*

## Abstract

Developing low-cost alternatives to near-eutectic SAC alloys for lead-free assembly is crucial to continue producing affordable electronics products. Metals prices, especially silver, have been on the rise, and will likely stay at their near historic high levels. Solder alloys with lower silver content have been considered with trade-offs in performance, but are there alternatives?

There are many reasons to consider alternative lead-free alloys to SAC305. Several new alloys have been recently introduced, while others, which had little popularity in the past, are showing more potential due to changes in the industry. The question is: How much do subtle variations in alloy composition affect the performance and process requirements of PCB assembly? This paper will compare some of these alloys side-by-side and discuss whether existing processes need to be modified for alternative alloys.



## Introduction

Numerous groups studied lead-free solders in the late 1990s to early 2000 timeframe in anticipation of the enactment of RoHS legislation in 2006. It was shown that tin-bismuth-based solders may not be desirable due to potential fillet lifting in wave soldering. In addition, the poor mechanical properties of tin-bismuth solders, when alloyed with even small amounts of lead, were a concern as lead might still be in component leads or PWB pad finishes. Tin-zinc solders were also rejected due to the short shelf life of such solder pastes. Hence, tin-silver-copper (SAC) seemed to be the solder alloy of choice.

It was natural that those evaluating SAC solders would focus on eutectic or near eutectic solders, as the industry had experienced nearly 100 years of success with eutectic tin-lead solder. The main advantage, among several, being that a eutectic solder has the lowest melting point in its alloy family. This consideration was not a minor one as the melting point of SAC solders is about 34°C higher than tin-lead eutectic solders. It is interesting to remember that the exact composition of eutectic SAC solder is not necessarily agreed upon, but it is near Sn95.5/Ag3.8/Cu0.7 (SAC387), so this composition was chosen by some of the early pioneers. In 2001, Motorola started producing mobile phones with SAC387. They started early, to take advantage of SAC's poor spreading in SMT assembly, enabling closer lead spaces without the concern for shorts.

By about 2005, some assemblers were using SAC305. SAC305 is off the eutectic and has



a “pasty range.” This lack of a sharp melting point minimized tombstoning of passive components and saved a little money by involving less silver. By about 2007, the IPC’s Solder Products Value Council declared SAC305 the “preferred” lead-free solder alloy.

From the mid-1990s to about 2005, it could be argued that the defining electronics product was the laptop computer. Although still important, the laptop has almost certainly relinquished this title to the mobile phone. With 5.6 billion mobile phone subscriptions in a world of 7 billion people, it is truly the ubiquitous electronics device. With this increase in mobile products came a new concern: drop shock failures. Investigations into this failure mode indicated that SAC105 was more robust. By the late 2000s, SAC105 was becoming the dominant lead-free solder choice for mobile products.

By 2010, work by Henshall et al [1] and Coyle et al [2] had demonstrated that SAC105 was superior to tin-lead solder in thermal cycling. This work locked in SAC105 as a reliable solder for mobile products.

Around the same time, Lee et al [3] performed work showing that SAC105 with “dopant” levels ( $<<0.1\%$ ) of manganese or cerium was significantly superior to plain SAC105

in both drop shock and thermal cycle performance.

By 2011, in addition to this positive news, the world was now five years into RoHS. Trillions of dollars of electronics products have now been manufactured and sent into the field with no major reliability or manufacturability issues. But by April of 2011, silver was above \$40/oz., four times its price on the date of RoHS’s enactment (Figure 1). It was time to look at low- or no-silver solder alloys.

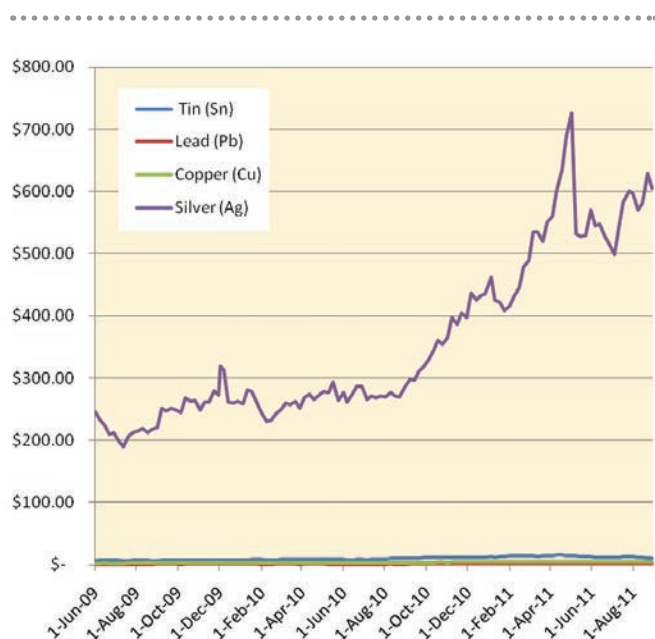
### Considerations for Alloy Selection

After the lead-free transition, many users adopted SAC alloys, specifically SAC305, or the closer-to-eutectic SAC387. However, as the industry researches and uses lead-free alloys more pervasively, and as further generations of flux chemistries and alloys are developed, it becomes clear that just one alloy cannot provide the best properties for all processes and applications. Other pressures also force the consideration of alternatives from early de-facto choices.

In the past year, precious metals prices have been on the rise, causing silver, gold, tin, and other metals to skyrocket in price. As a logical result, solder prices have risen considerably, causing some to look for less expensive alternatives. Even though silver comprises a small percentage of alloy composition, its value comprises most of a solder alloy’s metal value (Figure 2). Therefore, small changes in composition, or eliminating silver altogether, are tantalizing propositions. Different parts of the industry have adopted different approaches to regulating material costs, while maintaining optimal performance.

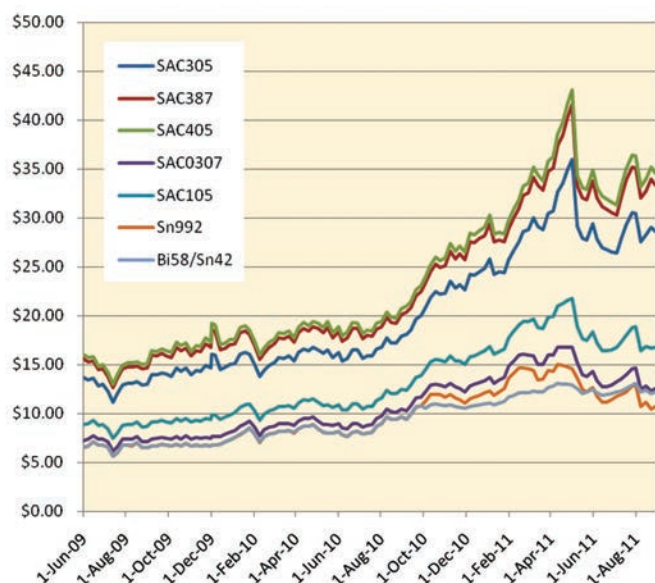
With an increasing number of alloys to choose from, it is helpful to group lead-free alloys into a few distinct families. First are the near-eutectic tin-silver-copper alloys (SAC305, SAC387, and SAC405) which contain 3 to 4% silver. These alloys were originally chosen for their robustness in thermal cycling, while still balancing performance with good drop shock resistance. Other important qualities are shininess for automatic inspection, compatibility with surface finishes, and reasonable reflow performance.

The second family is low silver alloys such as SAC105 and SAC0307. These alloys have gained



**Figure 1:** Metal prices 2009-2011.

## CHOOSING A LOW-COST ALTERNATIVE TO SAC ALLOYS FOR PCB ASSEMBLY *continues*



**Figure 2:** Alloy costs 2009-2011.

in popularity because of better drop shock performance and smaller amounts of silver. The trade-off with less silver is decreased thermal cycling performance. For some applications, compromising on reliability is not feasible because of higher temperature environments or longer product lifetimes. Ideally, for these customers there would be another alloy to enhance reliability without additional silver.

The third family is doped alloys. In order to improve the properties of the second family of alloys, additional metallic constituents are added in small amounts. To compensate for trade-offs in performance, dopants can improve properties like wetting, appearance, and reliability, yet maintain similar reflow characteristics. It seems that each supplier has its own variety in this family, such as SN100C, SACX, SACMn, or Sn992. Each of these alloys has a different mix of dopants, and it is suggested slightly different levels of performance, although it is difficult to characterize how much.

Other alloys worth considering don't fit into these groups. For instance, BiSnAg (Indalloy® 282) has favorable properties for many applications. This alloy's liquidus is 140°C, in comparison to SAC alloy's liquidus, which is approximately 220°C. BiSnAg would be especially

suitable for temperature-sensitive applications or for attaching additional components after primary board assembly. Depending on parameters for thermal cycling tests, this alloy can offer acceptable reliability for applications at ambient to low temperatures. However, BiSnAg alloys do not have acceptable drop shock performance for mobile products.

### Screening Alternative Alloys in an Existing Lead-Free Process

With so many alloys to choose from, screening several alloys can take a lot of resources. Some testing is time or labor intensive, but there are some comparisons that can be useful for initial testing. Not all alloy changes can be a drop-in replacement for a near-eutectic alloy, but testing a new alloy in the current process can help understand how different these alloys are, and how different a new process would be.

In this example, two different alloys, SAC387 and Sn992, were tested in the same flux vehicle. (Note: This might not be the case for all testing, depending on how different the alloys are.) Both pastes were printed and reflowed on the same type of board using the same two reflow profiles. One profile was the typical process profile used, the other reflow profile was chosen to be harsh, meaning a higher than usual peak temperature as well as a longer time above liquidus, to differentiate if there were differences.

The first characteristic to test for was wetting. Alloy choice and its compatibility with the surface finish will greatly influence wetting. In this test, paste was printed onto a copper panel without defined pads. The expectation is that the reflowed solder will stay in the shape of the deposit, and uniformly cover the area.

As seen in the Figures 3a and 3b, both SAC387 and Sn992 look comparable and displayed good and even wetting.

Another performance aspect to look at would be defects that are caused by excessive oxidation. These include, but are not limited to, solder balling and graping. These phenomena are not solely influenced by alloy choice, but they can be a good indicator of the match between alloy and flux vehicle, as well as how the alloy works in the current process.



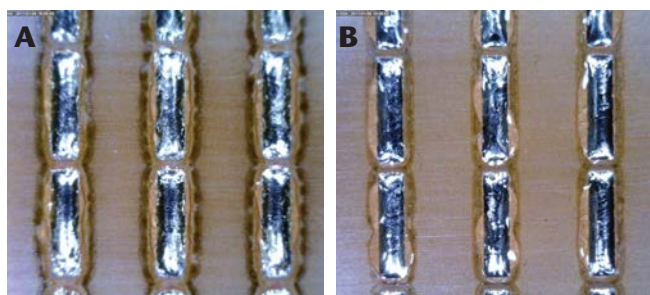
# THE **Future** OF **Surface Finish**

**SPF™ (Semblant Plasma Finish)**

-  **Replaces or Enhances Gold/Silver**
-  **Reduces Process Costs**
-  **Environmentally Responsible**
-  **Mitigate Creep Corrosion**
-  **Pb-Free Solderability**
-  **Flux Containment**

 **Semblant**

## CHOOSING A LOW-COST ALTERNATIVE TO SAC ALLOYS FOR PCB ASSEMBLY *continues*



**Figure 3a:** Wetting pattern for testing SAC387.

**Figure 3b:** Wetting pattern for testing Sn992.

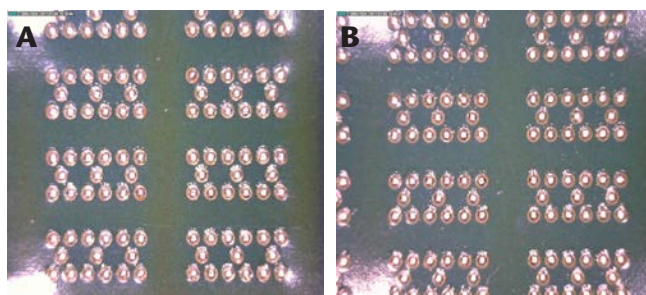
To test this, almost any type of aperture pattern will work. After printing and reflowing a board using the current lead-free process, it is important to carefully inspect all solder deposits for signs of these phenomena. Solder balling will appear as small metallic satellites. These are oxidized powder particles which did not coalesce into the solder joint. Graping is a defect on the surface of the joint that might look similar to cold solder, but will look like bumpiness on the surface. Ideally all reflowed solder deposits would appear shiny and uniform (see Figures 4a and 4b).

### Notes on Reliability

Before RoHS, the main reliability requirements were: 1) thermal cycling for typical use type products such as computers, televisions, stereos, and 2) the more severe thermal cycling and special shock and vibration testing for auto and military/aerospace applications. It is interesting to consider that since the enactment of RoHS, a new reliability requirement has emerged: Drop shock testing (3) for mobile products, such as mobile phones and portable music devices.

So there are now at least three reliability arenas in which solder joints must be evaluated (the different IPC classes are described in Table 1):

- Reliability requirements for 1) are typically evaluated with thermal cycle testing from 0 to 100°C. These products are usually IPC Class 2 products.
- Reliability requirements for 2) are



**Figure 4a:** Small deposits visually inspected for coalescence for SAC387.

**Figure 4b:** Small deposits visually inspected for coalescence for Sn992.

typically evaluated with thermal cycle testing from -55 to 125°C and perhaps specific MIL- or SAE-specified testing. These products are usually IPC Class 3 products.

- Reliability requirements for 3) are typically evaluated with thermal cycle testing from 0 to 100°C and also drop shock testing such as JEDEC JESD22-B111. These products are usually IPC Class 2 products.

Reliability test results of the lead-free solders are compared against tin-lead eutectic solder as a control. For 1), tin-bismuth solders may be considered as a substitute for the more commonly used SAC305. In addition to having no silver, Sn58/Bi42 has a low melting point of 138°C, which can be attractive for assembling and acceptable if use conditions are in the home or office. However, Sn58/Bi42 does not have good drop shock resistance and must be avoided when drop shock is a concern. For 3), doped SAC105 has been shown to be the current alloy of choice.

The high reliability requirements of 2) have earned an exemption from RoHS for automobile and military/aerospace products. So, tin-lead solder will still normally be used for these products.

### Reliability and Microstructure

Aspects of microstructure can indicate the potential reliability of solder joints. A well-

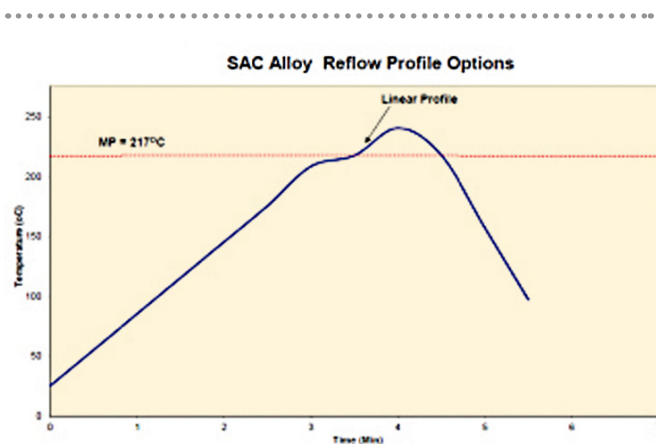


**CHOOSING A LOW-COST ALTERNATIVE TO SAC ALLOYS FOR PCB ASSEMBLY** *continues*

<b>Class 1 — General Electronic Products</b>
Includes products suitable for applications where the major requirement is the function of the completed assembly.
<b>Class 2 — Dedicated Service Electronic Products</b>
Includes products where continued performance and extended life is required, and for which uninterrupted service is desired but not critical. Typically the end-use environment would not cause failures.
<b>Class 3 — High Performance Electronic Products</b>
Includes products where continued high performance or performance-on-demand is critical, equipment downtime cannot be tolerated, end-use environment may be uncommonly harsh, and the equipment must function when required, such as life support or other critical systems.

**Table 1:** Classes of electronics.

formed solder joint will have a uniform texture in SEM images and an intermetallic (IMC) layer formed with copper substrates. This IMC layer is more brittle than the bulk of the solder joint, and often is the origin of joint failure. This layer forms as copper from the substrate migrates into the solder as it is molten, and will continue to mature over time, or is accelerated by aging at temperatures below the liquidus.

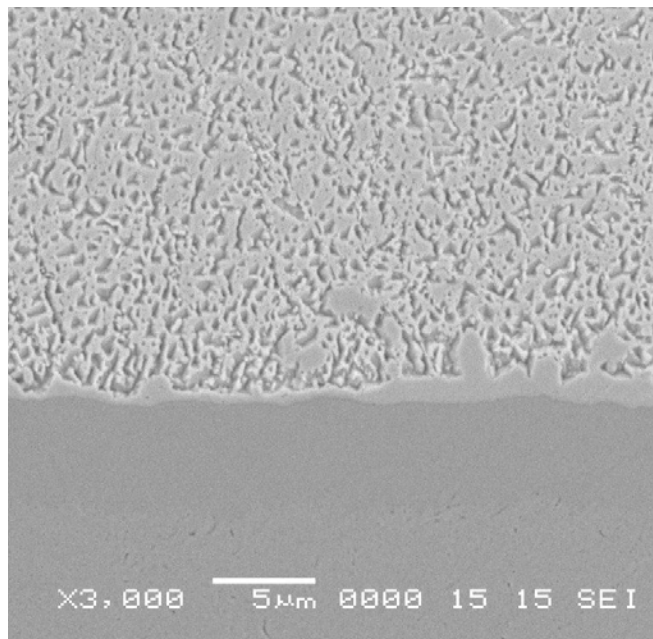
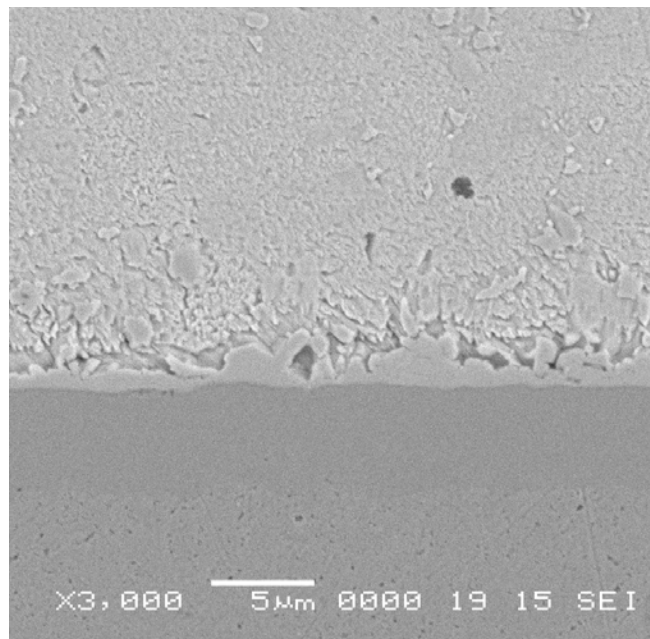
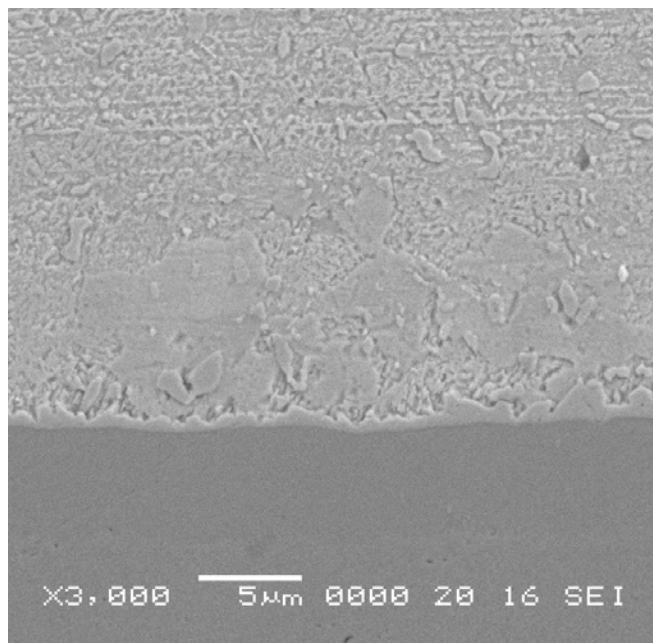
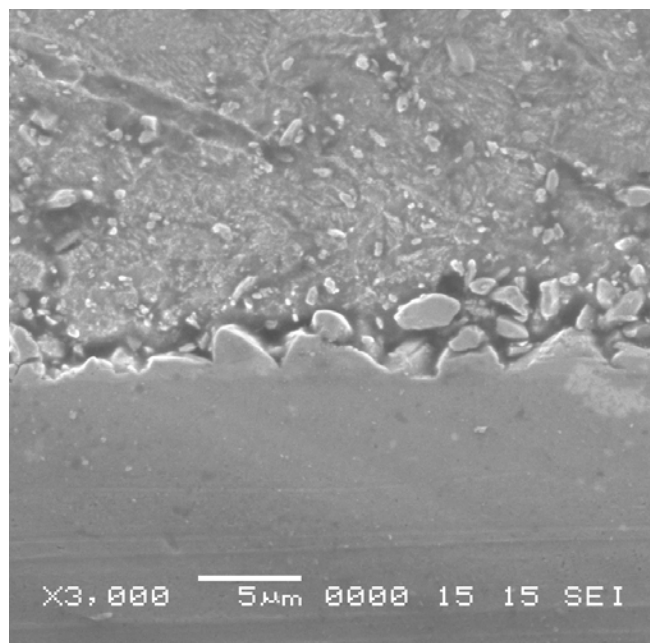
**Figure 5:** Typical SAC305 linear reflow profile.

As alternative lead-free solders have been considered, particularly those containing little or no silver, one reason they are less desirable is because they have liquidus temperatures up to 10°C elevated from SAC305. This would indicate that the peak temperature or time above liquidus for these alloys would need to be elevated, causing concern about the temperature tolerance of components on the board. One of the reasons it is assumed that the reflow profile must be modified is to ensure adequate IMC layer growth.

In this investigation, alternative alloys were reflowed, along with SAC305, using the same “typical” lead-free reflow profile (Figure 5). In this case, QFN components were used and only solder joints around the outside of the component were investigated. These samples were cross-sectioned and etched to make the IMC layer more visible.

Figures 6a, 6b, 6c, and 6d are SEM images comparing the IMC layer of SAC305 to those of SAC105, SAC0307, and Sn992. Despite differences in microstructure inherent to each different alloy, IMC layer formations seem to be of a similar thickness on the order of 1µm.

As the reliability of SAC305 and SAC105 have been researched and have shown sufficient properties for many different applications, these results seem to indicate that SAC0307 and Sn992 could perform similarly in typical lead-free processing conditions. Further research will look into how this IMC layer grows in each alloy after elevated temperature aging. In addition, more measurements should be taken to determine the variance in IMC layer thickness statistically.

**CHOOSING A LOW-COST ALTERNATIVE TO SAC ALLOYS FOR PCB ASSEMBLY** *continues***Figure 6a:** An etched SAC305 solder joint.**Figure 6c:** An etched SAC0307 solder joint.**Figure 6b:** An etched SAC105 solder joint.**Figure 6d:** An etched Sn992 solder joint.**Conclusions**

In the foreseeable future, it will become necessary for the near-eutectic lead-free alloys to be replaced by lower cost alloys with comparable properties. As many different alloys emerge with favorable properties, there is once again a struggle to find the best option. In order to ensure

equivalent comparisons, more work will need to be done to test alloys side by side in the same processes. Further investigations into IMC layer formation with alternative lead-free alloys are already underway, along with thermal cycling and drop shock testing. We expect to report the results of this work in the future. **SMT**



**CHOOSING A LOW-COST ALTERNATIVE TO SAC ALLOYS FOR PCB ASSEMBLY** *continues***References**

F. Song, S.W.R. Lee, "Investigation of IMC Thickness Effect on the Lead-free Solder Ball Attachment Strength: Comparison between Ball Shear test and Cold Bump Pull Test Results," IEEE ECTC, 2006.

B. Salam, N.N. Ekere, D. Rajkumar, "Study of the Interface Microstructure of Sn-Ag-Cu Lead-Free Solders and the Effect of Solder Volume on Intermetallic Layer Formation," IEEE ECTC, 2001.

1. Henshall, Greg; Fehrenbach, Michael, et al, "Low Silver BGA Sphere Metallurgy Project," SMTA International, Orlando, Florida, October, 2011.

2. Coyle, Richard; McCormick, Heather et al, "The Effect of Silver Content on the Solder Joint Reliability of a Pb-free PBGA Package," SMTA International, Orlando, Florida, October, 2011.

3. Liu, Weiping; Lee, Ning-Cheng et al, "Achieving High Reliability Low Cost Lead-Free SAC Solder Joints Via Mn or Ce Doping," ECTC, 2009.



Brook Sandy, product support specialist, PCB Assembly Materials for Indium Corporation, acts as a technical liaison between customers and internal departments to ensure the best quality and selection of products. She also provides support in improving informational materials to assist PCB assembly materials customers. Contact Sandy at [bsandy@indium.com](mailto:bsandy@indium.com).



Ronald C. Lasky, PhD, PE, senior technologist for Indium Corporation and holder of the prestigious SMTA Founder's Award, is a world-renowned process expert and an Instructional Professor at Dartmouth College. He has over 25 years of experience in electronics and optoelectronic packaging and assembly. He has authored or edited five books and numerous technical papers and holds several patent disclosures. Contact Dr. Lasky at [rlasky@indium.com](mailto:rlasky@indium.com).

**Video Interview****Printing Up Print Data at Indium**

*by Real Time with...*  
**SMTAI 2012**



Brook Sandy-Smith is a chemical engineer at Indium, but she's also a writer. She joins Editor Andy Shaughnessy to discuss a booklet she's written that presents print data in a user-friendly format for use by engineers. Indium seems to bring out the inner writer in its employees: Just ask bloggers Dr. Ron Lasky and Rick Short.



***realtimewith.com***



# Top Ten Most-Read Supplier/ New Product Highlights



## **Cookson Detaches Performance Materials Division; Forms Alent**

Cookson Group plc proposed to demerge its Performance Materials division to form a new London-listed specialty chemicals company, called Alent plc. These proposals were approved by the Court Meeting and General Meeting of Cookson shareholders November 26, 2012.

## **Lackwerke Peters Releases Book on Conformal Coatings**

In recent years, the issue of protective coating of electronic assemblies has received increased attention within the electronics sector, becoming a more and more complex subject. Depending on the requirements, conformal coatings, thick film lacquers or casting compounds may be employed for the purpose of protecting electronic assemblies against climatic load.

## **Avnet to Acquire Assets of USI Electronics**

"This acquisition is of strategic importance as it enhances our competitive position in the higher value defense and aerospace segment," said Ed Smith, president Electronics Marketing, Americas. "USI is a respected leader and established player in the space with a strong emphasis on providing business partners a best-in-class experience. Their value proposition complements our strategy as we extend our leading position in serving the electronic component needs of this vital segment."

## **Koh Young Sells 4,000th Inspection System**

Koh Young Technology announces the delivery of their 4,000th 3D in-line Inspection (SPI) system to Magic LCD, located in Guangzhou, China. The system sold was a Zenith 3D AOI system. Magic LCD is a leading provider of parts manufacturing services for TFT-LCD and LED Back Light Unit (BLU) in Korea. Magic LCD operates 10 factories and branch offices in Korea and China, employing 1,500 workers.

## **Henkel's Conductive Die Attach Film Wins Global Award**

"Device manufacturers around the world are quickly realizing the huge design and process advantages Henkel's conductive die attach film can deliver," says Shashi Gupta, director of global marketing for Conductive Film. "Winning this award is very gratifying and further proof that LOCTITE ABLESTIK CDF 200P is a significant advancement for the semiconductor packaging market."

## **Multitest Equipment Suitable for MEMS Oscillator Testing**

Multitest announces that its equipment fully supports the advantages of MEMS oscillators—considered to be a favorable alternative to the long-established, quartz crystal oscillator technology. Today, MEMS oscillators represent approximately 1% of the timing market, but significant growth is expected in the future.

## **NBS Installs VJ Electronix Summit Rework Systems**

"The addition of the Summit rework systems demonstrates NBS' commitment to providing the highest quality in all aspects of the services they offer," said Mel Herrera, regional sales and key account manager for VJ Electronix. "The new Summit systems include the latest technologies for both large and small assemblies, including non-contact site dressing and plated (pin) through-hole rework."

## **PVA, MJB Partner to Increase Presence in France**

Precision Valve & Automation Inc. (PVA) has announced a new agreement with established French distributor of electronics manufacturing and assembly product lines, MJB. This agreement continues PVA's plan to develop and expand their position globally. The new partnership will see MJB supporting the full line of conformal coating, fluid dispensing, and custom automation equipment for sales and new business development opportunities throughout France.

## **Arrow Names Eastman President of Americas Components**

Arrow Electronics, Inc. has announced that Jeffrey Eastman will become president of Americas Components, effective January 1, 2013. He will succeed Vinnie Vellucci, who retires after nearly 44 years with Arrow. In this role, Eastman will be responsible for continuing to expand the company's value proposition to customers and suppliers through all stages of their product and service needs.

## **Intertronics Launches Polytec PT Range of Adhesives**

New from Intertronics is the Polytec PT range of state-of-the-art polyimide adhesives. These polyimide-based chemistries provide excellent thermal resistance, superior to other typical organic adhesives. The products are characterised as modified polyimide single component, solvent containing adhesives and coatings which are applicable in the temperature range from 240°C to 500°C.





PROTOTYPES • PRODUCTION RUNS • TURNKEY ASSEMBLY • THERMAL MANAGEMENT

## In Today's Demanding World of PCB Design It Pays to be Flexible...

For over 30 years, Basic Electronics, Inc., has provided its clients with engineering accuracy, manufacturing excellence, cost savings and prompt delivery, service and follow up.

Our manufacturing specialists are trained and certified to J-STD-001 & IPC-610.

- Single/Multilayer Rigid, Flex and Rigid Flex
- Extended Pin
- Connectorless Flex
- Impedance Matched Flex



**AS9100/2009 C and Mil-P 50884 E Certified; IPC and ITAR Registered**

Basic Electronics, Inc.  
11371 Monarch St.  
Garden Grove, CA 92841

+1 714-530-2400  
email: [info@basicinc.com](mailto:info@basicinc.com)  
[www.basicelectronicsinc.com](http://www.basicelectronicsinc.com)



# The ULTIMA Series benchtop selective soldering system sets new standards for performance, ease-of-use, and affordability

Manncorp's new ULTIMA Series benchtop selective soldering system represents an exciting new approach for PCB assemblers looking for a highly reliable, yet simple and affordable, solution for soldering connectors and other through-hole components to SMT and mixed technology boards. The unique and innovative design of the ULTIMA TR2 selective soldering and ULTIMA SP selective fluxing machines brings features and performance to the benchtop that, until now, could only be found in equipment twice the size and twice the cost.

Key to the design of the ULTIMA TR2 is a high-precision PCB positioner that holds boards or pallets up to 330 x 250 mm (460 x 380 mm optional) with speed and position that are fully programmable in the X, Y, and Z axes. This allows the compact 16 kg solder pot and pump module to remain stationary for maximum wave stability and also dramatically simplifies the TR2 construction. The module is easily accessible for loading of bars or pellets, includes a low solder level alarm, and slides in and out in seconds for routine maintenance.

The highly responsive solder pump allows precise and virtually instantaneous control of wave height by varying the pump speed (rpm) and acceleration/deceleration (rpm/s); programmable parameters critical to the prevention of bridging, icicling, and other defects. This feature, in conjunction with the programmability of the PCB motion, affords limitless control of parameters that ensure perfect, repeatable, point-to-point or continuous linear soldering functions.

To prevent oxidation, an exclusive nitrogen micro-heater, controllable to 400°C, is located within the hood surrounding the wave nozzle. Close proximity of the heater to the nozzle ensures a stable wave temperature as nitrogen flows through the hood and shrouds the molten solder joint. A high-definition witness camera, focused at the top of the nozzle, is also included and allows operators to view and record soldering operations in real-time. A wide variety of high-quality, polished stainless steel nozzles are available in sizes to suit virtually any application.

The Windows®-compatible software accepts direct numeric or Gerber data input, or even scanned JPEG images of PCBs for easy offline program creation on any PC or laptop. Programs are then downloaded to the system via USB connection. Programs created for the ULTIMA TR2 are also easily converted to selective fluxing programs that can also be downloaded to the ULTIMA SP selective fluxing unit.

The ULTIMA SP utilizes a high-precision, pressurized air atomization nozzle and X-Y drive mechanism with programmable speed for highly controllable selective fluxing. Among the many advantages of separating soldering and fluxing operations into separate machines are 1) the ability to keep overspray and sticky flux residue away from the soldering mechanism and PCB positioner, 2) simplified maintenance, and 3) increased throughput by allowing soldering and fluxing to be performed simultaneously (in fact, a single SP can serve as many as three TR2 systems).

Studies have shown that, based on speed alone, the ULTIMA Series and a single operator can be two to three times as efficient as manual soldering operations, while improving quality and consistency, eliminating damage to PCBs and components, and reducing the overall cost of solder material.

Learn more at [www.manncorp.com/selective-soldering](http://www.manncorp.com/selective-soldering).





# Decrease failure rates and increase yields with advanced Sherlock-300F benchtop AOI system

Manncorp introduces the new Sherlock-300F, a benchtop automated optical inspection (AOI) system that has a radical new design with advanced features to provide comprehensive defect coverage even on densely populated boards with components as small as 01005s.

Sherlock-300F eliminates the drawer design typical of benchtop AOI systems. Assemblies are fed into the machine on the built-in conveyor instead. This minimizes machine footprint and allows the system's oversized display to be positioned directly in front of the user rather than set back or off to the side.

All program setup and operation is done directly on the display using multi-touch gestures, similar to using an iPad®. Unlike the iPad®, the Sherlock-300F's touchscreen is responsive even through gloves, a requirement for many electronics manufacturing environments.

Inspection programs are able to be generated from pick-and-place files in addition to CAD data import, simplifying the process for manufacturers who don't have access to the PCB assembly's CAD data file.

Geared toward low- to mid-volume electronics assemblers who require close-to-0% failure rates for military, medical and other high-end customers and products, the Sher-

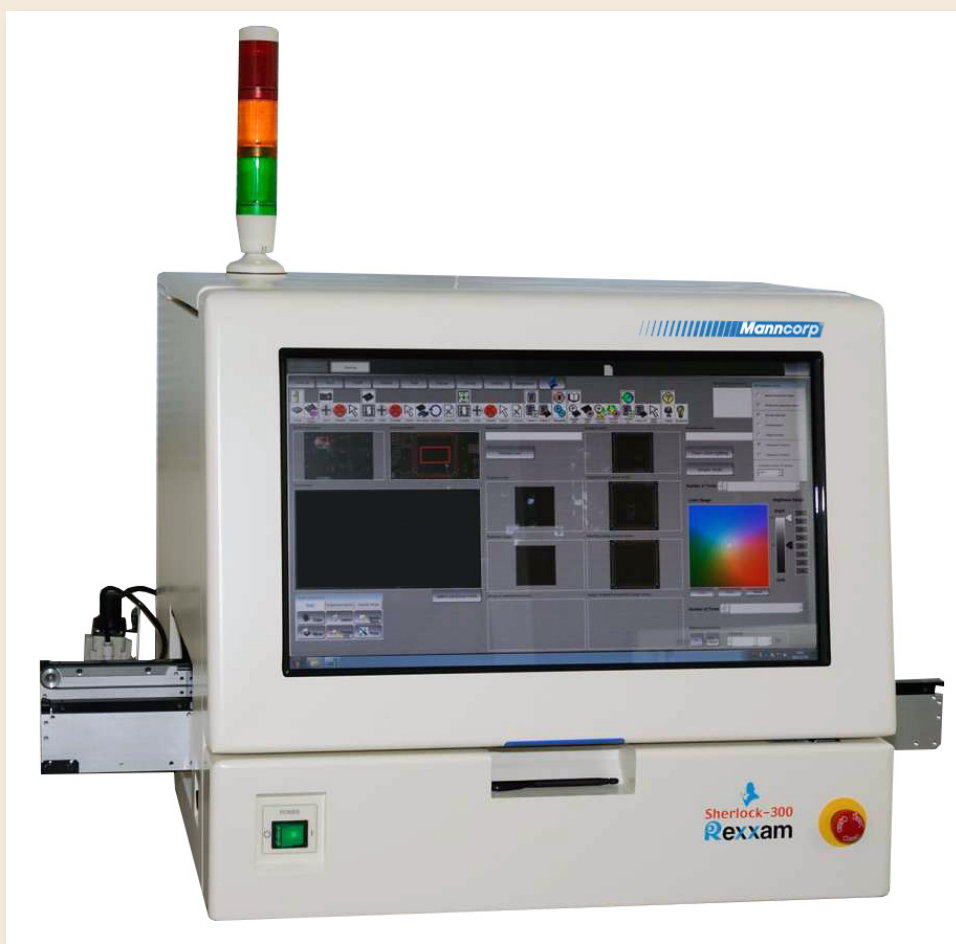
lock-300F helps manufacturers decrease their failure rates and move yields from an average of 60-70% to nearly 100%.

Sherlock-300F can be used after stencil printing for 2D solder paste inspection, after placement for component presence, placement and value verification, and after reflow or wave soldering for solder joint and final assembly inspection. Single and double-sided surface mount, through-hole and mixed-technology assemblies are handled equally well. Board warp and flexible substrates are automatically corrected for, eliminating the need for time-consuming manual adjustments.

Manncorp makes the Sherlock-300F available through a partnership with Japanese manufacturer Rexam, who have developed and tested the Sherlock systems for their own manufacturing needs and use the systems daily to inspect their own products.

The Sherlock-300F is priced under \$40,000 and for a limited time includes two days of installation and on-site training, free, anywhere in the U.S.A., Canada and Mexico.

Learn more at [www.manncorp.com/aoi/sherlock-300f](http://www.manncorp.com/aoi/sherlock-300f).



# Impact of E-commerce on the Electronics Component Supply Chain

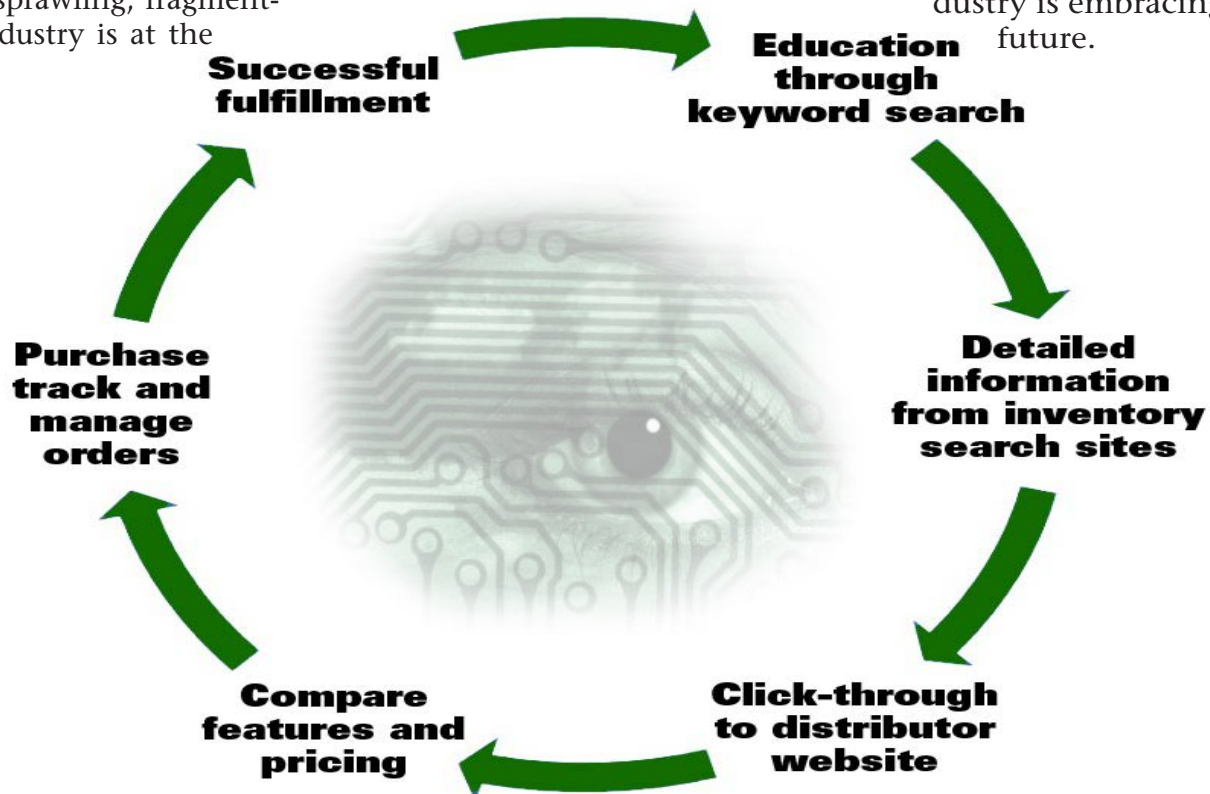
by **Steve Martin**  
COMPONENTS DIRECT

**SUMMARY:** *E-commerce is definitely gaining momentum. Some industry sources state that nearly half of all sales are coming from e-commerce platforms, an indication that the electronics component industry is embracing its future.*

According to an October 2012 IBISWorld research report, the global supply chain for electronics and semiconductor components is a \$676 billion behemoth, employing over 3.4 million people across almost 40,000 companies. This sprawling, fragmented industry is at the

beginning of an exciting evolution in which e-commerce will play a significant role.

New entrants to the market are beginning to exploit opportunities in the supply chain to deliver more flexibility and efficiency via e-commerce targeted to engineers and buyers. Online distributors are responding to concerns about counterfeit parts by partnering directly with manufacturers to ensure a secure supply chain and satisfying purchasing experience. As a result, e-commerce is gaining momentum, with some industry sources stating that nearly half of overall sales are coming from e-commerce platforms, clearly indicating that the electronics component industry is embracing its future.



**Figure 1:** The virtuous cycle of e-commerce in the electronics component industry.





**Are your customers asking  
for Environmental Materials  
Declarations?**

**LEARN MORE**

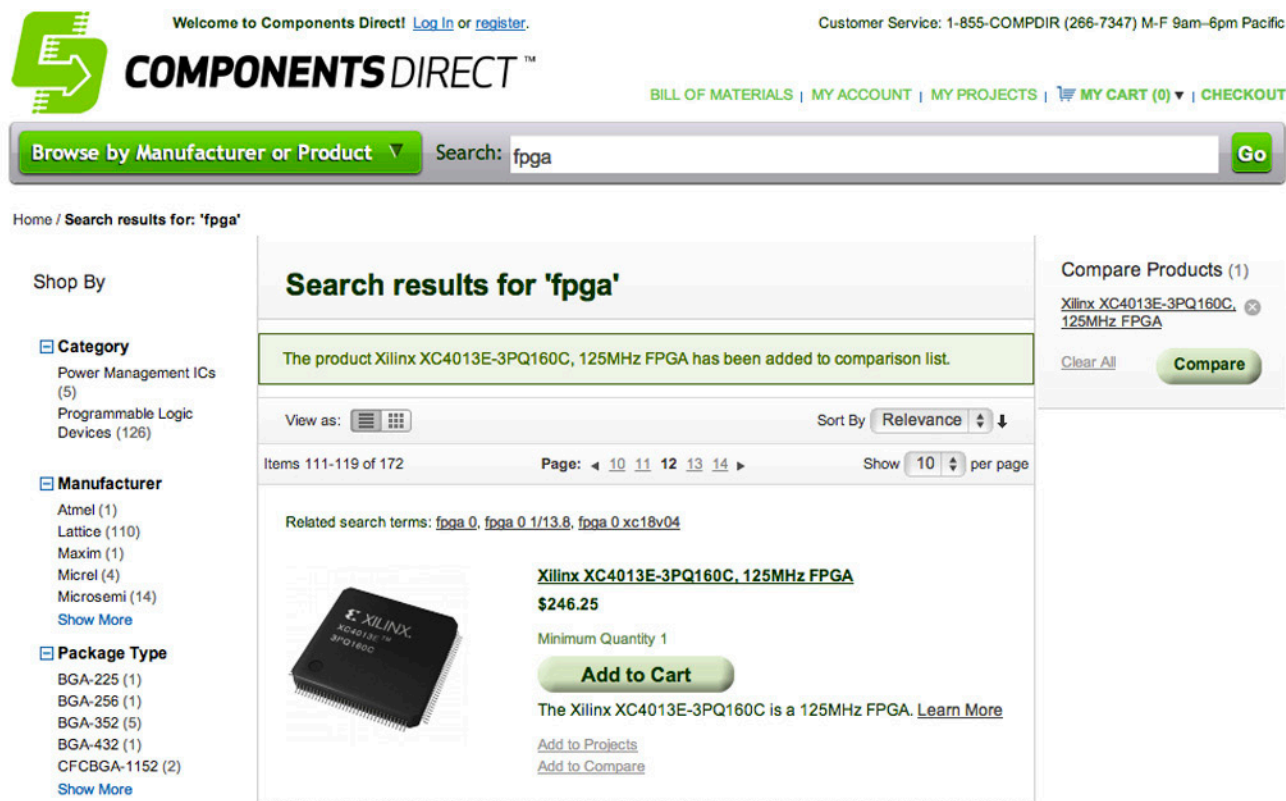
>> Stay compliant with component data on demand. Find out how our services and tools can help you.

**Product Features:**

- > Environmental Compliance Reports for RoHS, REACH, and more
- > IPC-1752A reporting format
- > Conflict Minerals reporting
- > Integrate with your current system with custom data exporting
- > Obsolescence management of electronic components



## IMPACT OF E-COMMERCE ON THE ELECTRONICS COMPONENT SUPPLY CHAIN *continues*



**Figure 2:** A sampling of the unique tools e-commerce provides.

### Keyword Search Begins the “Virtuous Cycle”

The evolution of e-commerce in the electronics component industry can be viewed as a “virtuous cycle”—each step in the process feeds the next, culminating in new purchasing habits which are self-sustaining.

The first step is education, through a keyword search. By now, the Internet is a part of everyday life and for engineers and buyers, conducting a Google search to obtain basic product information is increasingly the first stop in their research and buying process. Statistics show that the volume of these electronics and semiconductor industry-specific keyword searches is increasing. In a recent study, Components Direct highlighted findings that correlate keyword searches to where buyers are in the purchasing process. For example, generic keywords, such as “processor ic” and “connectors,” receive over 2 million searches a month, while specific part number search-

es, PAS5001-NM3-LF, or long tail keywords, such as SCSI bus termination ICs, while low in search volume, often originate from searchers further along in their design or buying process.

This “education phase” is an important first step on the path to full online purchasing and is fueling the rise of a new class of inventory search sites that has emerged to provide more detailed information, such as pricing, availability, and fulfillment lead time. With the rapidly proliferating number of components being offered, these search sites, such as Findchips, Datasheets.com, and Octopart, provide a breadth of information and an efficient format for locating specific components that cannot be matched by an engineer consulting multiple distributors. The product information on the search sites is updated daily by affiliated distributors. When the desired component is located, the engineer is able to click directly to the distributor’s website.



### Importance of Buying from Authorized E-commerce Distributors

The next step, and perhaps the most important, in the virtuous cycle is the rise of fully featured and authorized e-commerce websites where buyers can confidently evaluate, comparison shop, and buy authorized components. Just as buyers are welcoming e-commerce as a complement to their personal relationships with distributors, e-commerce websites are also providing more features and content to deliver unique, compelling value to their customers.

Figure 2 illustrates the ease-of-use and unique tools e-commerce provides. On this website, engineers and buyers can browse by product category, manufacturer, and package type. They can compare features and prices of various components, search by various attributes, and download datasheets.

When the buyer is ready to purchase, full-service e-commerce websites offer a multichannel ordering process so buyers can choose to conclude purchases online or speak to a salesperson to negotiate price and delivery times. Registered users can also track and manage their orders, upload a BOM, and speak to a customer service agent at any time. Features like these are helping enthusiasm for e-commerce spread throughout the electronics components sector, with some industry sources stating that 50 to 75% of new business, and nearly half of overall sales, are coming from e-commerce platforms, with an anticipation of significant future growth.

### Avoiding the Counterfeit Trap

Although the Internet has lowered the bar for engineers and buyers to find and source components, it has also reduced the time and cost of creating a storefront. In less than a day, anyone can register a domain, build an e-commerce storefront, and promote themselves as components distributors. Given the growing threat of unauthorized and/or counterfeit parts, buyers must be extra vigilant in validating the legitimacy of an e-commerce website. Savvy e-commerce providers recognize this and ensure that their websites are as safe for purchasing authentic parts as traditional methods.

Many distributors have responded to counterfeit concerns by offering 100% direct manufacturer traceability, with stringent requirements for inventory and successful fulfillment, the last step in our virtuous cycle. Industry certifications are one way e-commerce providers are signaling the quality of their products and operations to purchasing professionals. Legitimate e-commerce providers will ensure that their processes and operations comply with the most stringent industry quality standards, such as ISO 9001, ISO 14001, ESD 20:20, and TAPA. Furthermore, leading e-commerce providers guarantee same-day shipment of small lots and high-volume orders and provide world-class customer service to reinforce the personal relationships that buyers enjoy. Buyers are increasingly becoming convinced that they will not have to sacrifice any of the benefits of their direct relationships when buying from an e-commerce platform that meets their unique needs while helping them avoid counterfeit parts.

Distributors that offer an efficient and productive e-commerce experience—with guaranteed direct manufacturer traceability, industry recognized quality control certifications, and a convenient, easy-to-use ordering interface—are more likely to earn repeat business and the loyalty of buyers. The move to e-commerce is accelerating, with every part of the global electronics supply chain beginning to embrace and reap the benefits of participating in the virtuous cycle. **SMT**



Steve Martin is executive vice president of sales at Components Direct, where he has responsibility for all facets of the sales channel incorporated with both upstream supplier and downstream customer business.

Most recently, Martin was in charge of running the Western region for a leading independent distribution company, which provided fulfillment and supply chain programs to EMS and OEM companies. He has also held senior sales and supply chain management roles at Solecron and TTI. Martin began his career in the electronics industry in 1992.

# You Are Discharged

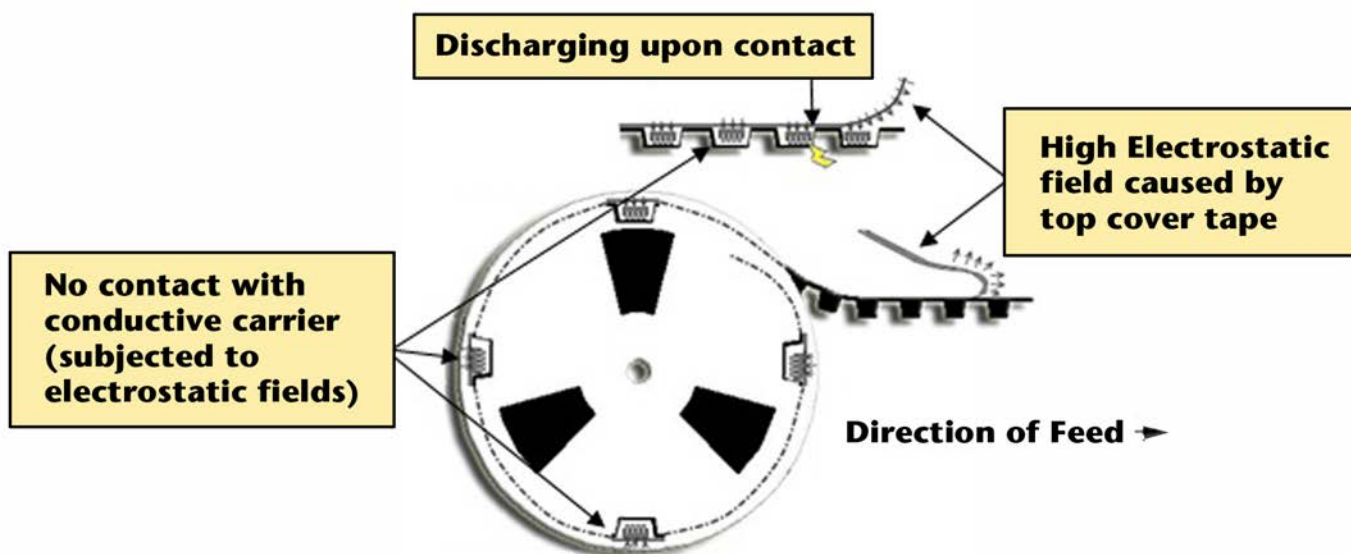
by **Eric Klaver**  
ASSEMBLÉON

**SUMMARY:** *Hearing the phrase, "You are discharged," is great when leaving the hospital, but for manufacturers the phrase has a completely different meaning.*

It can be difficult to determine the exact costs related to electrostatic discharge (ESD) for any particular industry or how much impact the issue may have on a brand image. ESD, however, is still an important reliability problem concerning electronic circuits. Articles found on the Web suggest that one-third to one-half of all field failures are related to ESD, with some reports suggesting it costs some industries millions of Euros per year. With newer technologies leading to smaller circuits and smaller components, ESD failures have become an even greater concern. If you are producing high-quality products, or if warranty costs and recalls simply cost too much, it is important that you check whether or not your components are packaged in ESD-safe packaging.

Many manufacturers take precautions when handling electronic components: Protective clothing, ESD wrist-wraps, special carpets, shoes, etc. Not so obvious is how the components are handled and transported and how they behave right up to the moment they are picked by equipment before being placed on the PCB. At this point they might already be defective, something your pick-and-place equipment simply cannot determine, and you end up with a defective end-product. Even worse, the product will become defective when in use (shortened lifetime) and come back as a warranty claim.

In non-conductive packaging, components shifting (shaking) within their chambers will become more charged than those that are stationary. Components in larger pockets are more sensitive to static discharge damage than those in narrow pockets, as are components in sticks that slide back and forth. Using conductive (ESD-safe) material will solve many of the



**Figure 1:** Charge and discharge of components as a result of exposure to high electrostatic fields.



# Make the Right Move with **Eagle Circuits**

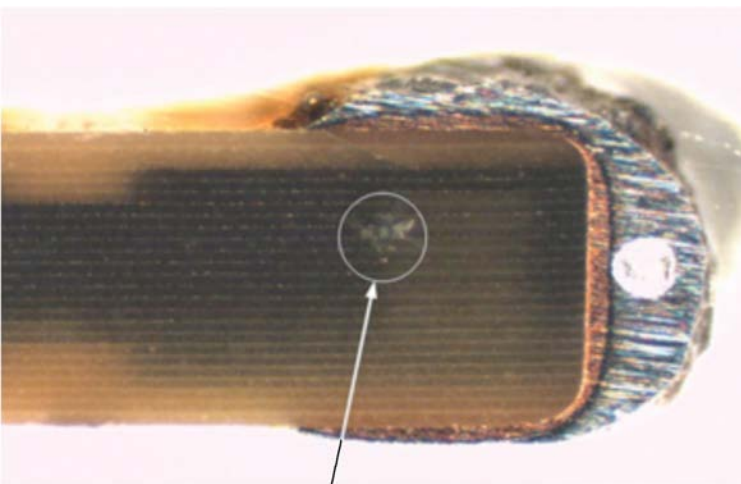


We understand that “time-to-market” is critical to the success of any product launch, and we are dedicated to helping our clients achieve their goals by bringing unprecedented consistency and reliability to our manufacturing quality standards. Our goal is to be available to our customers whenever they need us. We will schedule our production based on your requirements and do whatever it takes to meet your schedule.



10820 Sanden Dr. • Dallas, Texas 75238  
Phone: 214.349.0288

**WWW.EAGLE-CIRCUITS.COM**

**YOU ARE DISCHARGED** *continues*

**ESD Damage to ESD Capacitor SMD 0603 Package (magnification X 100) "Horizontal Grind"**

**Figure 2:** ESD damage to SMD 0603 package. (Source: [www.incompliancemag.com](http://www.incompliancemag.com))

problems, but you have to consider all packing items.

A conductive carrier is generally used with tape and reel to protect ESD-sensitive micro-electronic devices. It is often not clear to users which kind of cover tape should be used to protect against ESD. The same is true for stick components, where the tube may be ESD-safe, but not the stoppers. Most believe that just using ESD-safe carriers will protect components sufficiently, but insulating cover tape can have electrostatic potentials of over 10,000 volts.

Using non-conductive covers can generate high electrostatic fields. No charge will occur on the microelectronic devices as long as their terminals stay in contact with the conductive carrier tape. However, the moment the device terminals no longer contact the conductive carrier they are subjected to the electrostatic field. The moment the device contacts the carrier again, a sudden discharge can occur. This all happens during transportation and handling of the tape and reel, long before it ends up on pick-and-place equipment. Even when on the equipment (Figure 1), it is rotated as the reel unwinds and gravity ensures that components are randomly positioned in their chamber (pocket).

A large voltage peak also occurs when the

cover tape is separated from the carrier tape, which may not only damage components, but also attract them to the cover tape. That causes the component to "stick" to the cover tape, resulting in the equipment being unable to pick the component. On the machine, you will see a drop in your pick rate. The faster the peel-off speed (e.g., for turret equipment which have an index time of 40 to 60 minutes and, thus, very fast peel speeds), the higher the voltage peak, increasing the chance of charging components which are likely to discharge elsewhere. So, while the pick rate is of great concern, the issue of ESD should be a top priority.

Components flipping out of their pockets, following the cover tape, rotating in their pockets, or turning upside down are visible symptoms detected and known by many. Suppressing the phenomena (solving it in hardware) will allow a component to remain in the pocket correctly and be mounted reliably—increasing the pick rate. It is not, however, enough to prevent your component from being exposed to all the negative effects of static fields.

To eliminate static field exposure facilities must ensure that all handling is according to ESD protection guidelines, especially when dealing with safety-critical electronics. Without ensuring that components are in ESD-safe packaging your end-product may already be defective before it leaves the facility. **SMT**






Eric Klaver was born in Roseme-re, Quebec, and, via Oklahoma, he moved with his family to Holland at the age of 12. After finishing school, he became a radio officer for the merchant navy. After studying computer science where he learned how to program and design ICs Klaver enjoyed a career at Philips. This was followed by a move to Assembléon in 1998. As commercial product manager he translates high-level technical developments into easy-to-understand commercial material. Klaver specializes in vision technology and feeding and is currently the chairman of IEC work group TC40WG36, which specializes in component packaging.



# Make the Right Move with **One Source Group**



## **EXCELERATE TO MARKET WITH INTEGRATED MANUFACTURING SOLUTIONS**

-  **Time:** One Source offers integrated, end-to-end electronics manufacturing solutions, managed through one point of contact on a single campus. By optimizing the entire process, we can meet your production schedules, not vice versa.
-  **Focus:** From design through delivery, One Source has created leading edge efficiencies and parallel processes that allow us to meet even the most aggressive schedules, built exactly to specs. And because we do it all from one point of contact, your job is easier. No more managing multiple vendors. No more bottlenecks. Just one integrated management solution.
-  **Cost Savings:** One Source is a leader in electronic manufacturing. We employ the most skilled people, the latest processes and state-of-the-art equipment to deliver speed, quality and reliability of the highest caliber. By leveraging these strengths and services our manufacturing process is seamless. We offer increased speed to market and better quality control with less time invested by you. Increased quality, decreased cost.



10810 Alder Circle • Dallas, Texas 75238 • Phone: 214.349.0288

**[WWW.ONESOURCE-GROUP.COM](http://WWW.ONESOURCE-GROUP.COM)**

# Europlacer Responds to BAE Systems' Call for Help

by **Chris Round**

EUROPLACER

**SUMMARY:** *A strong partnership proved its value after the Susquehanna River floods BAE Systems' Johnson City facility in 2011. Chris Round tells the story of how two companies worked together to overcome a devastating situation.*

A little over one year after floodwaters devastated BAE Systems' Johnson City, New York facility, Bob Opeka, SMT process owner at BAE Systems, praises Europlacer North America for the support the company provided during the recovery effort.

As storms pushed over the Northeast portion of the United States on September 8, 2011, small towns were threatened with rain and consequent flooding. The Village of Johnson City, a town of approximately 15,174 residents, was overcome when the nearby Susquehanna River breached, resulting in significant flood damage there and across the region.

One local resident who was interviewed at the time said, "In 2005, we had the 100-year flood and, in 2006, we had the 500-year flood. What year flood is this?"

Helicopters were busy rescuing residents from their rooftops, as highways that had just opened after Tropical Storm Irene were promptly



**Figure 1:** BAE Systems, Johnson City, New York, September 8, 2011.



closed again. All surrounding rivers were filled to new, historically high levels. In nearby Wilkes-Barre, Pennsylvania, the Susquehanna River had reached a record 42.66 feet, almost two feet higher than the National Weather Service had predicted.

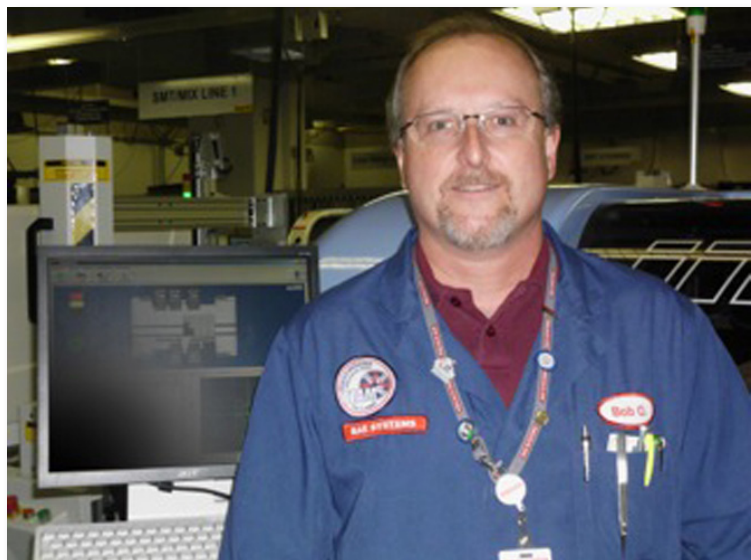
The Johnson City manufacturing facility was home to a division of BAE Systems, a large, global company that makes a broad range of products for the military, cyber intelligence, commercial aviation, security, commercial transit bus, and defense industries. As floodwaters poured into the region, employees were fearful for their homes, personal belongings, and livelihoods. Additionally, the engineering and manufacturing teams at BAE Systems were concerned about the technical ramifications of an impending disaster, given the inherently precise equipment used in their manufacturing processes.

"Honestly, this is not a time I wish to relive or rethink. It took endless hours of hard work and dedicated people coming together to eventually return to a normal set of business conditions," said Opeka.

BAE Systems engineers knew that they could not move the machines before building evacuation became a necessity. They decided to prepare for the worst and applied their best protections, including power-down, equipment prep, and standard emergency procedures. BAE Systems' preparation paid off. After an agonizing 24 hours, the water level began to recede, leaving the team faced with planning immediate recovery efforts. Europlacer's IINEO machine and four Finesse machines eventually emerged from under 42" of standing water.

In addition to the machines, Europlacer's tape trolleys were entirely submerged. Within 24 hours, Opeka contacted Europlacer to explain the situation and enlist coordinated support. Europlacer North America immediately sent kits of potential replacement parts that might be needed during recovery.

"We did not require a purchase order at that time. In fact, there was not even time to process the order through either company's system. Purchase orders were not on anyone's mind," said Chris Ebborn, Europlacer North America's technical support manager. "We were simply



**Figure 2:** Bob Opeka, SMT process owner, BAE Systems.

focused on a fast, effective recovery plan for BAE Systems."

It became immediately apparent that BAE Systems needed its key suppliers to act quickly in a coordinated recovery effort.

"We hoped that our equipment suppliers shared our eagerness to work together," Bob recalls. "Europlacer, led by Chris Ebborn, was ready to help. He immediately arrived to effectively plan recovery efforts, with our best interests in mind. Over a three-month span, Chris and Europlacer North America treated us as their number-one priority with frequent on-site support."

"Initially, we spent many days just trying to assess the damage. With everything submerged, the first recovery phase was somewhat difficult to assess," said Ebborn. "We were challenged many times over the five month duration of this recovery effort."

Europlacer's IINEO and Finesse machines were moved to a warehouse that served as a recovery staging area. The machines were cleaned thoroughly, from top to bottom, and then all machine surfaces were lubricated. Each subsystem was analyzed with mechanical setup fixturing and test equipment. The machines were practically rebuilt and prepared for power-up, with emphasis placed on the computers first, and progressing through the entire power distribution system.

EUROPLACER RESPONDS TO BAE SYSTEMS' CALL FOR HELP *continues*

**Figure 3:** BAE Systems' Endicott PCA Team.

"We were all very safety conscious, particularly when the main power was applied," said Ebborn. "We took extreme care to make sure everything was dry before proceeding through power-up."

"Throughout the entire recovery process, we were testing, troubleshooting and maintaining a log of each day's progress. We were encouraged to discover that all placement heads had not been submerged, which was a very good sign," Ebborn continued.

After replacing four out of the five main computers, the crew proceeded to make sure that each contact on each power terminal was clean, secure, and fully functional. Once the power distribution system was completely tested, the first IINEO machine burst into life.

"We continued to check and double-check each step, ensuring that each successive power-up was just as successful as the first," said Ebborn.

He continued to explain how difficult it is to comprehend the amount of water and the exposure of the equipment throughout this process.

"As we were changing out some screws on the base of a machine support, I noticed a bit of rust on one screw," said Ebborn. "As I unscrewed and pulled away, water started just streaming out of the frame. After about 20 minutes, there was at least a half-gallon of water drained into a bucket."

In parallel with machine recovery efforts, a recovery contractor was employed to clean

the mechanical assemblies. Tony DiRado, BAE Systems, led the effort to analyze and repair trolleys. All of Europlacer's 50 trolleys had been completely submerged and it was difficult to assess visually, yet the repair effort resulted in 80% of the equipment being recovered and usable.

After weeks of stable operation and requalification of machine performance, many spare parts were returned to stock at Europlacer North America's Tampa, Florida office with no questions asked.

Opeka remembered, "Europlacer really defined 'True Partnership.' Many companies claim to partner with us, but there was no better partner than Chris Ebborn and Europlacer's recovery team."

Opeka continued by saying that the company showed superior customer service by acting quickly with no questions asked. "Europlacer came in, assessed the situation and created a replacement kit, which shipped ASAP. Chris Ebborn was basically locked down with BAE Systems for five months, until we had completed our recovery exercise."

"A year later, I would do it all again," said Ebborn. "We genuinely value our strong relationship with BAE Systems. They are a great team of people to work with, and we are thrilled that we were able to come through for them. Successful recovery of BAE Systems' Europlacer equipment is a testament to the inherent quality of the machines our company manufactures."

"Our golden rule in customer support is to exceed expectations at all times, but especially when situations like this arise. This is how I would want to be treated, so we strive to do the same for all our customers," concluded Ebborn.

Since the September 8, 2011 flood, BAE Systems has executed a full business recovery and today remains in full operation in nearby Endicott, New York. **SMT**



Chris Round is Global Marketing Manager at Blakell Europlacer Group.



# SMTA 2013 Event Schedule

## January 15 & 22

**Webtorial: Design and Assembly Process Challenges for Bottom Terminations Components (BTCs) such as QFN, DFN and MLF in Tin-Lead & Lead Free World**

Instructor: Ray Prasad, Ray Prasad Consultancy Group  
Contact: Patti Hvidhyld, [patti@smta.org](mailto:patti@smta.org)

## January 22 - 24

**Pan Pacific Symposium 2013**

Makena Beach and Golf Resort Maui, HI  
Contact: JoAnn Stromberg, [joann@smta.org](mailto:joann@smta.org)

## January 24

**Carolinas Expo and Tech Forum**

Location: Embassy Suites, Concord, NC  
Contact: Emmy Garner, [emmy@smta.org](mailto:emmy@smta.org)

## February 6 & 13

**Webtorial: Reliability and Failure Analysis of Electronics**

Instructor: Bhanu Sood, CALCE  
Contact: Patti Hvidhyld, [patti@smta.org](mailto:patti@smta.org)

## March 12

**Dallas Expo and Tech Forum**

Location: Plano Center, Dallas, TX  
Contact: Seana Wall, [seana@smta.org](mailto:seana@smta.org)

## March 14

**Houston Expo and Tech Forum**

Location: Stafford Civic Center, Stafford, TX  
Contact: Emmy Garner, [emmy@smta.org](mailto:emmy@smta.org)

## April 16

**Huntsville Expo and Tech Forum**

Location: Von Braun Center, Huntsville, AL  
Contact: Emmy Garner, [emmy@smta.org](mailto:emmy@smta.org)

## April 17-19

**South East Asia Technical Training Conference on Electronics Assembly Technologies**

Eastin Hotel, Penang, Malaysia  
Contact: Patti Hvidhyld, [patti@smta.org](mailto:patti@smta.org)

## April 18

**Atlanta Expo and Tech Forum**

Location: Gwinnett Center, Duluth, GA  
Contact: Seana Wall, [seana@smta.org](mailto:seana@smta.org)

## May 14-17

**ICSR- International Conference on Soldering and Reliability**

Location: Sheraton Airport Hotel, Toronto, ON  
Contact: Patti Hvidhyld, [patti@smta.org](mailto:patti@smta.org)

## May 16

**SMTA Toronto Expo and Tech Forum (In Conjunction with ICSR)**

Location: Sheraton Airport Hotel, Toronto, Canada  
Contact: Seana Wall, [seana@smta.org](mailto:seana@smta.org)

## June 20

**Upper Midwest Expo and Tech Forum**

Location: Embassy Suites Hotel, Bloomington, MN  
Contact: Emmy Garner, [emmy@smta.org](mailto:emmy@smta.org)

## July 11

**Ohio Expo and Tech Forum**

Location: DoubleTree Hotel, Cleveland South Independence, OH  
Contact: Seana Wall, [seana@smta.org](mailto:seana@smta.org)

## Dates: TBD

**IWLPC Conference & Tabletop Exhibition**

DoubleTree Hotel, San Jose, CA  
Conference Contact: Patti Hvidhyld, [patti@smta.org](mailto:patti@smta.org)  
Exhibit Contact: Seana Wall, [seana@smta.org](mailto:seana@smta.org)

## September 26

**CTEA (Austin) Expo and Tech Forum**

Location: Norris Conference Center, Austin, TX  
Contact: Seana Wall, [seana@smta.org](mailto:seana@smta.org)

## October 13-17

**SMTA International Conference & Exhibition**

Location: Fort Worth Convention Center  
Fort Worth, TX  
Conference Contact: JoAnn Stromberg, [joann@smta.org](mailto:joann@smta.org)  
Exhibit Contacts: Seana Wall, [seana@smta.org](mailto:seana@smta.org) & Emmy Garner, [emmy@smta.org](mailto:emmy@smta.org)

## October 15-17

**SMT Processes and Six Sigma/Green Belt Certification**

Location: In conjunction with SMTAI, Fort Worth, TX  
Contact: Patti Hvidhyld, [patti@smta.org](mailto:patti@smta.org)



# Preventing Lead-free SMT Soldering Defects

**by Peter Biocca**  
KESTER

**SUMMARY:** *The lead-free process differs from a 63/37 process in many ways. A good understanding of these differences when using SAC alloys enables process engineers to incorporate the necessary changes to the process to reduce soldering defects, increase reliability, and maintain production yields.*

Tin-silver-copper alloys are the primary choice for lead-free SMT assembly. Although other options are available, such as alloys containing bismuth or indium and other elements, tin-silver-copper solders, also known as SAC alloys, are by far the most popular. They are used by approximately 65% of users, as last surveyed by Soldertec in 2003.

The lead-free SMT process differs from a 63/37 process in numerous ways. A good understanding of these differences when using SAC alloys will enable process engineers to bring about the necessary changes to the SMT process and reduce soldering defects, increase lead-free assembly reliability, and maintain production yields.

Often when a manufacturer transitions to lead-free soldering an increase in defects is

noticed. This is often the result of improperly implementing the process. A well-defined, optimized, and controlled lead-free process will not augment defect rates.

The main differences between a leaded and lead-free SMT process are:

- Solder physical properties, melting point, surface tension, oxidation potential, metallurgy, and metal leaching potential;
- Higher peak temperatures;
- Higher preheat temperatures;
- Lead-free finishes for boards and components (preferred);
- Solder cosmetics and surface effects;
- Solderability differences, such as speed of wetting and spread; and
- Less self-centering or alignment of components.

The liquidus temperature of SAC alloys is 217 to 220°C; this is about 34°C above the melting point of eutectic 63/37. This higher melting range requires peak temperatures to achieve wetting and wicking to be in the range of 235 to 245°C. Lower peak temperatures can be used with SAC solders such as 229°C. This lower peak



temperature often can only be used for boards with lower overall thermal masses or assemblies, which do not have a large thermal mass differential across the board. This lower peak temperature may also require extended times above liquidus (TAL).

Higher reflow profile temperatures will require the use of new solder paste flux chemistries. Solder paste flux accounts for nearly 50% of the solder paste volume. Its ingredients characterize the paste's rheological properties, its ability to print, avoidance of cold and hot slump, tack life, stencil life, and abandon time. As the preheat is engaged during reflow, the flux system will prevent hot slump, prevent oxidation of the metals to be joined, deoxidize the solder powder, and remove oxides of the metals to be joined. The flux system insures an oxide-free solder surface as to give the lowest surface energies to enable spread and wicking of solder.

After reflow is complete the flux system must be easily removed in water if it is a water-washable paste or remain benign if it is a no-clean type paste. With some no-clean solder pastes the residue must not undergo complete polymerization as to remain pin-probeable.

The basic ingredients in a solder paste flux can be summarized as:

- Resins solid and liquid types;
- Activators, organic acid, and/or hydrohalides;
- Solvents and co-solvents;
- Gelling agents;
- Surfactants; and
- Chelating agents.

Solder paste manufacturers have had to revisit most of these ingredients to account for the higher temperatures experienced in the reflow operation. Most of these ingredients are organic compounds and thermal stability up to 245°C is essential to avoid issues of decomposition, oxidation, and polymerization of paste flux during reflow.

Lead-free solder pastes designed for lead-free alloys and also alloy specific will function best and help prevent solder defects.

Typical defects associated with lead-free reflow soldering are:

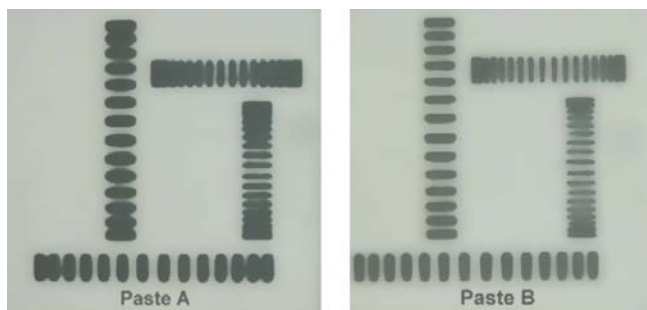
- Bridging;
- Solder balls;
- Mid-chip balling;
- Poor wetting;
- Voids;
- Tombstoning; and
- De-wetting.

### Bridging, Solder Balls & Mid-chip Balling

The first three defects, bridging, solder balls, and mid-chip balling, can arise from the solder selection process. Since preheats are higher with lead-free, the hot slump character of the paste is critical; solder pastes with good hot slump at higher temperatures such as 185°C are needed. Traditional 63/37 paste has already melted and flowed at these temperatures; the gelling material has also broken down.

Figure 1 demonstrates this quite well. Two SAC solder pastes are shown.

Both pastes were run through a reflow oven at 180°C. Paste B has better hot slump properties than Paste A and would be less likely to cause bridges, solder balls, or mid-chip balling. For fine-pitch components it is critical to select a lead-free paste with a heat-stable gelling agent.

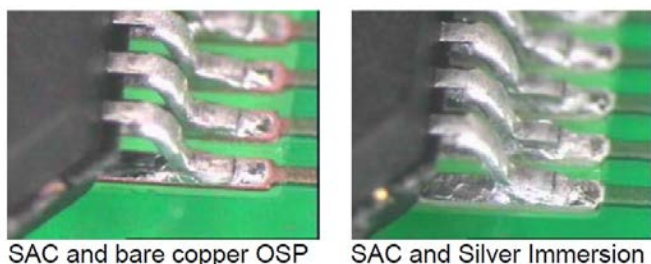


**Figure 1:** Two SAC solder pastes: Paste A and Paste B.



**Figure 2:** A paste with a heat-stable gelling agent is critical for fine-pitch components.

## PREVENTING LEAD-FREE SMT SOLDERING DEFECTS *continues*



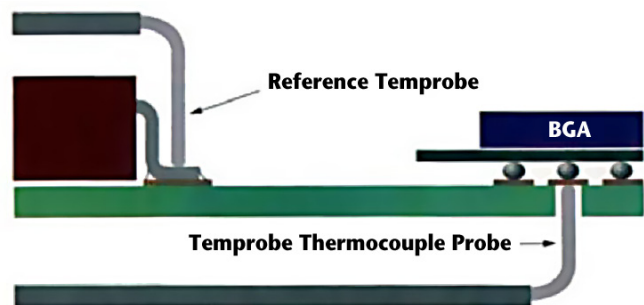
**Figure 3:** On the left: SAC alloy on copper; on the right: SAC alloy on silver immersion. Both QFPs were reflowed in air, using a SAC no-clean paste ROLO-type flux.

### Poor Wetting of Terminations & Pads

Non-wetting or insufficient wetting is also encountered. It must be understood that different metallization will exhibit differing spread and wicking characteristics and also flux activity will play an important role. Lead-free SAC alloys during solderability testing using wetting balance instruments demonstrated the best wetting when water washable flux systems were used. No-clean flux systems containing less activator and/or free of halides demonstrated lower wetting speeds and lower maximum force readings.

Bare copper OSP boards, which have seen more than one thermal cycle, are prone to incomplete pad wetting while pure tin silver immersion finishes exhibit better solder spread. Ni/Au, if the nickel is not affected with impurities or oxides, will normally solder well.

Poor solderability, insufficient wetting, poor wicking of solder, and large contact angles can also result from an inadequate thermal profile. It is very important to achieve good thermal equilibrium across the whole board, this becomes more important with lead-free since the peak temperature window is narrower. SAC alloys melt at 217°C while the



**Figure 4:** The proper way to measure the heat applied to the balls in the grid array.

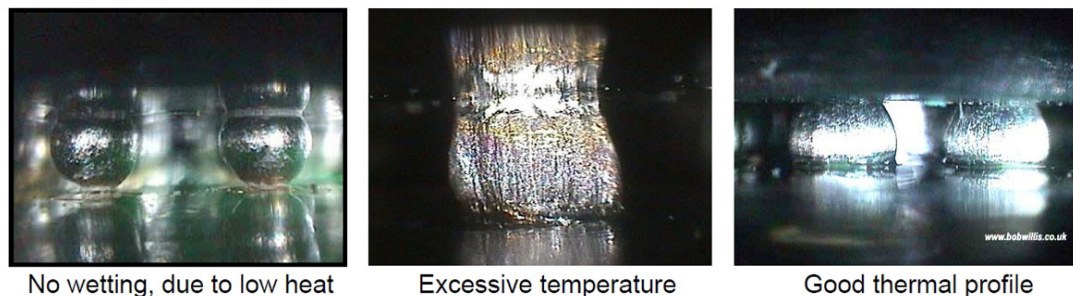
peak temperature needs to be in the range of 235 to 245°C.

If BGAs, which act as heat sinks, are present on the lead-free assembly the solder paste may not completely reflow under the BGA, while other smaller components may show good soldering. It becomes very important to establish good thermal profiling points across the board, including under BGAs. To properly insure wetting has occurred completely, optical or X-ray inspection may be necessary.

A test board is essential for the first lead-free assembly to insure thermal requirements are met across the board.

Figure 5 (left) shows balls that have not undergone reflow due to insufficient heat. By measuring the temperature accurately at the ball site, this can be avoided. The temperature at the ball site had not seen 217°C the melting point of SAC balls.

Figure 5 (center) shows what happens when excessive temperature is seen by the BGA; in this



**Figure 5:** Ensuring thermal requirements are met is essential in lead-free assembly.



# PE4

## PRECISION ECONOMICAL POST ETCH PUNCH

- 4 camera system
- New software
- Faster cycle time
- Improved visuals
- Fixed die technology

The Pinlam PE4 maximizes accuracy and improves yield of multilayer production. Designed for simplicity, easy to use and maintain, set up is simplified, making the Pinlam PE4 much faster and easier.



Contact **Gary Weidner**  
+1 269 962 2231  
[gweidner@capicard.com](mailto:gweidner@capicard.com)

**PREVENTING LEAD-FREE SMT SOLDERING DEFECTS** *continues*

case the temperature was measured at approximately 265°C at the ball site. Figure 5 (right) shows the proper collapse of lead-free balls with the thermal profile properly set. The standoff distance may be higher with lead-free SAC due to its higher surface tension.

The main causes of poor wetting during lead-free reflow are:

- Solder paste activity level is too low;
- Excessive preheat temperatures;
- Too long a preheat;
- Difficult to solder finishes;
- Insufficient time above liquidus temperature; and
- Excessive oxidation of parts to be joined.

Lead-free solder pastes require activation to be sustained beyond traditional tin-lead systems up to 217°C and beyond for SAC alloys. Like traditional 63/37 no-clean pastes, such as ROLO types, the prevention of oxidation to parts and boards is critical. Flux classifications such as ROM1 may contain halides and are therefore better able to cope with oxides or difficult to solder parts.

Tin-silver-copper solders wet most metal surfaces more slowly and adequate times above the melting point of the solder is needed to achieve good wicking and solder spread. Normally the range is 60 to 90 seconds with peak temperatures from 235 to 245°C.

If soldering is jeopardized by oxidation of parts to be soldered, this can be verified using solderability test methods such as the wetting balance test.

### **Voids in Lead-free Joints and BGAs**

Much has been written about void prevention when soldering with lead-free solder pastes containing tin-silver-copper. Excessive solder voids can create a reliability issue especially in applications where the lead-free assembly will be exposed to thermal cycling conditions or in applications where the assembly will be exposed to vibration or flexing during box builds. Voids can also reduce thermal performance and electrical integrity.

It must also be stated that smaller voids can, in some cases, increase reliability by chang-

ing the crack pattern. Studies have shown that there is no reduction in reliability when voids are present to up to 25% by volume in the joint. Voids can act as stress relievers due in part to the compressive nature of air pockets.

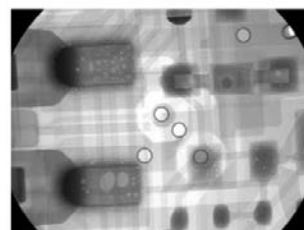
This is documented in the technical paper, "Voiding: Occurrence and Reliability Issues with Lead-free," by Martin Wickham of National Physical Laboratory (NPL).

Causes of voids in joints are:

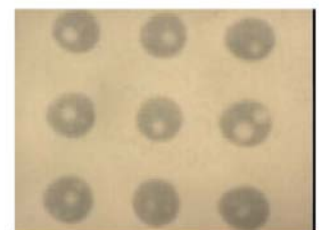
- Solder paste chemistry;
- Solder surface tension effects;
- Thermal profile;
- Oxidation of the outer surface of solder joints;
- Termination geometries, joint shape;
- Metallization of finishes for boards and components; and
- Component board outgassing during reflow.

Lead-free alloys, such as SAC alloys, have slightly higher surface tensions when compared to 63/37. It is important to select a solder paste which has a flux chemistry designed for the higher preheats and peak temperatures. Choosing a solder paste that does not contain resins and activators which decompose at these higher temperatures is the primary factor in void reduction. Good solder paste manufacturers are designing flux systems for lead-free alloys. The voiding potential information is often available for use during the paste selection process.

Optimizing the reflow profile as to remove any volatiles by extending the preheat times and increasing the time above liquidus will also help in reducing void entrapment. Insur-



X-Ray, Voids in QFP joints



X-Ray, Voids in BGA's

**Figure 6:** Two examples of voids via lead-free.





CONFERENCE & EXHIBITION  
**February 19-21, 2013**  
San Diego Convention Center

*IPC APEX EXPO is "THE SHOW" ... to attend valuable courses and see new equipment that will help you and your company see new possibilities, improve your efficiencies and cut costs. Keep your competitive edge.*

Mario Dion  
Manufacturing Engineer Specialist  
Trilliant Networks

## INFORMATION that INSPIRES INNOVATION

Join **thousands of your colleagues** from more than **50 countries** and more than **400 exhibitors** at **IPC APEX EXPO 2013**. Learn about **new technologies and processes**, see **new products**, work on **industry standards**, network with **industry experts** and participate in the **world's premier technical conference** for electronics manufacturing. **Register today!**

**[www.IPCAPEXEXPO.org](http://www.IPCAPEXEXPO.org)**



Scan for your chance to  
win a three-night hotel stay or  
an MVP registration.

**design | printed boards | electronics assembly | test  
and printed electronics**

**PREVENTING LEAD-FREE SMT SOLDERING DEFECTS** *continues*

ing components and boards are free of moisture and plating contaminants will also help to reduce voids. It has been shown that copper OSP tends to produce slightly higher volume of voids when compared to Ni/Au and silver immersion, which produce much less.

In some cases joint geometries are contributors. Components such as leadless chip carriers or large flat surfaces perpendicular to the board will prevent out-gassing during the soldering process; this results in void increases. Solder flux by-products both liquid and gases, will have to slowly make their way upward. Component geometries, which prevent the proper upward flow, will usually result in an increase in voids.

**Tombstoning Defects with Lead-free**

Lead-free may increase the uplifting of smaller components. This is due in part to the reduced wetting behavior of lead-free alloys. Component placement is more important with lead-free alloys since less centering will occur during reflow. This can increase the incidence of tombstones.

SAC305 tends to reduce tombstones, this alloy has a concentration of 96.5 tin, 3.0 silver, and 0.5 copper and has melting range of 217 to 220°C. Because of the small pasty range the component prone to tombstone is tacked by the initial melting phase of the alloy.

A solder paste that exhibits excessive outgassing during the initial stages of the melting of the solder powder will also increase tombstone defects. The paste manufacturer must carefully choose resins and solvents, which do not decompose or vaporize at the melting point of the alloy.

**De-wetting with Lead-free**

De-wetting is often due to a lack of flux activity. This behavior rarely occurs with water-washable type pastes since these pastes are highly activated. Lower activity solder pastes in the category of ROLO, halide-free no-clean pastes, tend to create this on more difficult finishes such as bare copper OSP or on Ni/Au where the nickel base metal may have experienced oxidation or plating contamination.

Figure 7 shows test coupons on which SAC no-clean paste was applied to two surfaces.



SAC De-wetting

SAC Good wetting

**Figure 7:** SAC no-clean paste as applied to two surfaces on test coupons.

The test coupons were then reflowed in air using the manufacturer's recommended thermal profile. The image on the right shows de-wetting while the image on the left exhibits good wetting. The pooling of the solder was due to the base metal being difficult to solder to. The molten solder initial spread across the surface but not a good enough intermetallic bond was formed, resulting in surface tension pulling the solder away.

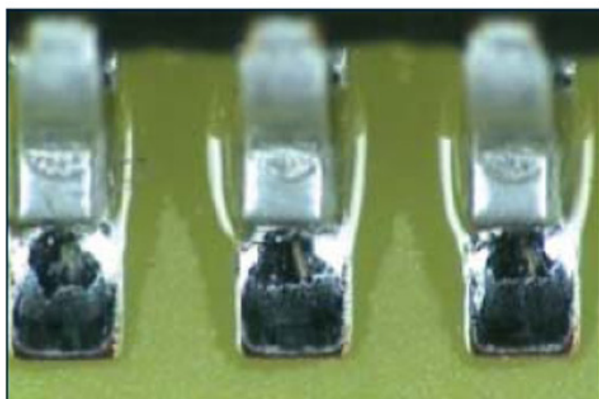
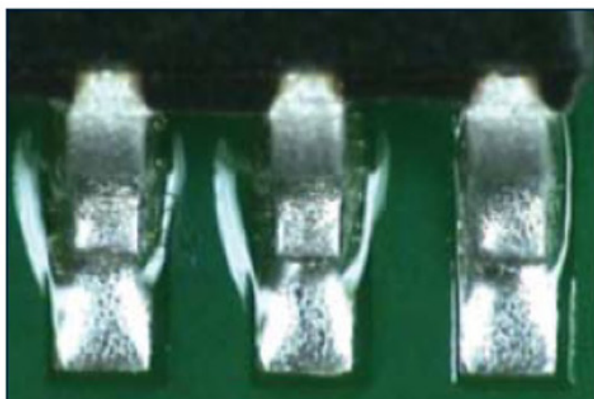
Ways to reduce or prevent de-wetting with lead-free SMT include:

- Select a paste with excellent activity up to the melting point of the alloy, 217°C for SAC alloys;
- Use a more active flux system;
- Insure metals to be joined are as oxide-free as possible;
- Insure base metals are solderable with the selected flux type;
- Reduce the preheat time or temperatures as to preserve flux activity; and
- Increase time above liquidus (217°C), if flux activity is good.

**Excessive Dullness & Surface Effects with Lead-free**

SAC alloys offer solder joints which are less reflective than 63/37; the contact angles tend to also be higher and spread is less. These are not considered defects, but simply a cosmetic issue.



**PREVENTING LEAD-FREE SMT SOLDERING DEFECTS** *continues***63/37 Solder in air****SAC Solder in air****Figure 9:** 63/37 solder in air (left); SAC solder in air (right).

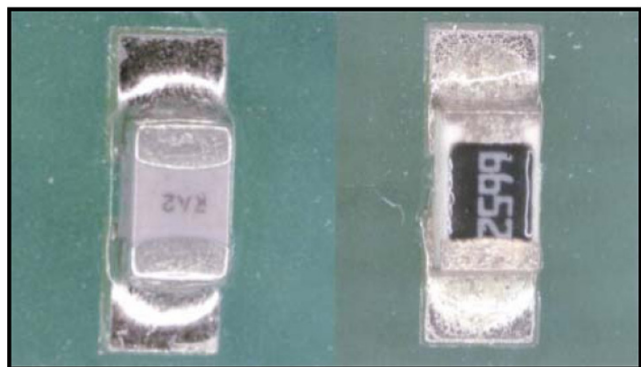
If air reflow is used, SAC joints will be less bright and show surface effects such as crazing which are due to intermetallics within the solder and oxidation effects. If nitrogen reflow is used the joints will be more reflective and spread will be enhanced. Below are two photos. The one on the left is 63/37, while the other shows joints done with SAC305 alloy.

Lower peak temperatures and lower times above liquidus will reduce both intermetallic growth, but also increase the overall brightness of the solder joints.

Proper training will be required when transitioning to lead-free assembly. Operators will need to be given quality acceptance criteria for solder joints that will look quite different from traditional leaded systems. **SMT**

**Acknowledgements and References:**

1. OK International: Photos of BGA optical inspection and cosmetic joint comparisons.
2. Bob Willis U.K.: Photos of BGA with SAC alloy.
3. Gintic Manufacturing Consortium, Singapore: Lead-free report.
4. Kester, Des Plaines, Illinois, Applications Laboratory: Photos of paste slump and spread tests.
5. Martin Wickham, "Voiding: Occurrence and Reliability Issues with Lead-free," National Physical Laboratory, U.K. Lead-free Electronics, 2004 Edition, Sanka Ganesan; Michael Pecht, Calce Press.

**Figure 8:** 63/37 solder in air (left); SAC solder in air (right).

Peter Biocca, a certified SMT process engineer, is a senior market development engineer with Kester in Des Plaines, Illinois. He is a chemist with 24 years' experience in soldering technologies and has presented around the world in matters relating to process optimization and assembly. Biocca has worked with lead-free for over seven years and has been involved in numerous consortia, assisting many companies implement lead-free successfully. He is an active member of IPC, SMTA, and ASM and is the author of many technical papers delivered globally.

# Top Ten Most-Read Mil/Aero007 Highlights



## **TT electronics Nets Majority Assets of ACW Technology**

TT electronics plc, a global provider of performance critical technology solutions to leading manufacturers, announces it has acquired the majority of business and assets of ACW Technology Limited (in administration) and agreed to the transfer of associated production from ACW Technology (Zhuhai) Limited to TT electronics' facility in Suzhou, China.

## **Nortech's Sales Drop Hits Plant Utilization & Profitability**

"Our diverse customer base is a definite strength because each customer is experiencing the current economic situation differently," said Mike Degen, president and CEO. "Some appear to be gaining momentum, while others are still making inventory adjustments or delaying orders."

## **Spectral Response Earns AS 9100C Certification**

"When combined with Spectral's earlier achievement of ISO 13485 Certification, it demonstrates further evidence of Spectral's ability to consistently produce high-reliability products across many diverse industries. This was the logical next step in our pursuit of excellence for all the services we provide our clients," said Steve Pudles, CEO. "Plus, it will further motivate our already enthusiastic employees, and should enhance the overall efficiency and productivity of our company."

## **IEC Electronics Nets \$5.1 Million Award**

IEC Electronics Corporation recently received an order from one of its military customers valued at approximately \$5.1 million. Deliveries are expected to commence during IEC's fiscal 2013 second quarter and continue into fiscal 2014.

## **Suntron Phoenix Marks 30th Anniversary**

"Suntron is the kind of American business that will lead our country's long-term economic recovery. The company has fought to keep manufacturing jobs in the United States despite the economic challenges facing the industry," stated Congressman Ben Quayle. "I congratulate Suntron and its employees on their 30 year anniversary and wish them great success in the future."

## **Ducommun Lands \$15M in Contracts from Raytheon**

Ducommun Incorporated has received \$15 million in follow-on contracts from Raytheon to continue producing a variety of interconnect and electronic assemblies for the U.S. Navy's Tomahawk cruise missile. The awards extend the company's work on the program through 2015; Ducommun LaBarge Technologies is a Raytheon preferred supplier and recipient of Raytheon's Six Sigma Relationship Award as well as the prestigious Leadership Excellence Award.

## **Axis Electronics Receives SC21 Silver Award**

Axis Electronics has been awarded a SC21 Silver award. The assessment covered all aspects of business in line with Business Excellence (EFQM) and Manufacturing Excellence. To attain silver, the company had to prove 12 month rolling average on-time, in-full delivery (OTIF) of greater than 95% and quality better than 99.5% for participating customers.

## **API Wins \$1.9M Order for EMI Filtering Solutions**

API Technologies Corporation, a trusted provider of RF/microwave, microelectronics, and security solutions for critical and high-reliability applications, has received an additional \$1.9 million order for critical EMI filtering solutions in support of a major U.S. Department of Defense weapons platform.

## **Thermacore Secures DARPA MACE Contract with U.S. DoD**

Thermacore, Inc., a leading provider of advanced thermal solutions, is offering a new generation of compact, custom-built, high-performance air-cooled heat sinks, the result of a multimillion-dollar development contract from the Defense Advanced Research Projects Agency (DARPA), which ended on September 30, 2012.

## **ControlTek Redefines Web Presence**

"This project was collaborative throughout the creative process," says Outlier co-founder Ben Friedle. "ControlTek has a unique story that sets them apart from other manufacturers in the industry. Teaming up with ControlTek and Word Lions, we designed and built a site that reflects the qualities that make ControlTek such a powerful manufacturing partner for their clients."



# **VERTICALLY INTEGRATED MICROELECTRONIC SOLUTIONS DC TO 50 GHz**

*Hunter assembles complex, high-rel microwave circuitry for defense and medical firms. Hunter's engineering team is dedicated to specialized areas of microwave, electrical, process and mechanical areas. ISO and AS9100 certified processes along with technical expertise drive a company that utilizes in-house capabilities and vertical integration.*

*From PCB Assembly to Clean-Room wire-bonding and die-bonding to complete system level assembly and test, HunterTechnology is the supplier of choice for industry leading OEMs.*



**BOARD LEVEL ASSEMBLY**



**MICRO-ELECTRONIC  
ASSEMBLY**



**MODULE ASSEMBLY**



**COMPLETE TURNKEY  
SYSTEM LEVEL ASSEMBLY**

**CLICK HERE FOR  
MORE INFORMATION**



**HUNTER  
TECHNOLOGY CORP**  
Reliable. Solutions. Delivered.

+1 (408) 245-5400 sales@hunter-technology.com [www.hunter-technology.com](http://www.hunter-technology.com)

# Quality Decisions

by **Karla Osorno**

EE TECHNOLOGIES, INC.

**SUMMARY:** *Those operating production lines play a critical role in the quality of the product being assembled. How can one ensure operators are making the right decisions when it comes to manufacturing? Karla Osorno explains.*

On production manufacturing lines, operators who handle the product play a critical role in the quality of finished goods. Every decision an operator makes directly impacts quality. These decisions have long-term consequences.

So how can the process be designed to ensure operators make the right decisions? Three key actions provide controls and guide the operator to make the right decision: Be specific in the requirements, differentiate between standard training and assembly documentation, and use control plans.

## Be Specific in the Requirements

One of the first considerations to take into account is that the sum of all probabilities is one (1). What makes perfect sense to an engineer in an office with all the background information of a project and formal training in a technical field may not seem so clear to the operator. The operators are working in real-world environments where they are faced with several sub-conditions to achieve the desired output.

Imagine a part with instructions from the engineer to “clean after processing.” This blanket state-

ment opens the door to a variety of opportunities that could be potentially detrimental to the function of the final part. Here are just a few of the potential decisions an operator could make:

- Using cleaning agents that contain contaminants.
- Using cleaning agents that physically damage parts.
- Using water-based cleaners that do not effectively remove processing agents.
- Using cleaners that react with downstream processing.
- Using cleaning agents that degrade the life of the part in the field.
- Using a wipe that leaves particulates.
- Using an air blower that leaves the device unclean.

Which decision is correct for a particular assembly? The engineer preparing the assembly documentation will know and can communicate specific requirement instructions so there is no room for erroneous operator decisions.

Clearly defining the requirements, process, and tools will help limit potential opportunities for variables to appear in manufacturing processes. The processes have already been researched, designed, and validated to produce a reliable product that complies with specification. Minimizing variation by clearly defining the requirements is a necessary process control.





# *The Art of* Fume Extraction



 **EasyBraid Co.**

*Where Engineering Meets Art* <sup>TM</sup>

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

**QUALITY DECISIONS** *continues***Differentiate Between Standard Training & Assembly Documentation**

A clear distinction must be made between standard training and operator-level assembly documentation. Most companies use industry standards to help define acceptability criteria for the finished product. These criteria are critical to meeting customer requirements and must be used in the manufacture of the products. Putting all of these requirements in the assembly documentation for each assembly would result in excess information. This situation could result in obscuring critical details and be as detrimental as having no documentation at all.

It is important that a company define what standards must be taught to operators via training versus what must be included in assembly documentation. It must also be clear what additional standards are required and where this additional documentation will be located so it is accessible to operators.

As an example, imagine inserting a steel pin into a plastic part. The assembly documentation should contain the parts required for the operation: The machine, tooling, program, and/or settings to be used; the standard to which the parts will be produced and inspected; and any special characteristics. By keeping the information unique and critical to the assembly clear and uncluttered, it will be readily available and easy to use when needed.

The operator should be trained on the use of the machine, the manufacturing standard, and the inspection or validation method. And the documentation for these items should be separate, but available for reference, to the operator to supplement training.

As part of the training program, it must be determined at what level of expertise the documentation will be prepared to support. If the documents are heavy on engineering terms and standards the training needs to ensure operators using this documentation have the skills to in-

terpret the documentation accurately. If a more basic technical level is used the engineers must be sure that the documents have fully captured the critical elements during the translation process and that the results will be the same using these simplified documents.

Distinguishing between training documentation and assembly-specific operator-level documentation is a strong process control and helps the operator to be prepared to make right decisions.

**Use Control Plans**

In the automotive industry control plans (CPs) are used as a tool to further control operator decisions. Several steps are used to develop a CP and developing a strong CP has a significant impact on decisions made by operators. The process flow is first defined and the failure modes and effects analysis (FMEA) is created. The FMEA reflects the flow of the process and the control plan is, in turn, aligned to the FMEA.

The control plan covers each step and inspection point and defines the operator's action to any item that varies from target conditions. These actions may be a simple "go, no go" process or may be staged using statistical methods where the operator will continue to run full production if the results are within a certain range.

Outside of this first range there may be a secondary limit where the parts are still within tolerance and meeting specifications, but are not in statistical control. The operator may be prompted to take a defined corrective measure to adjust the process at this level of performance, but outside these ranges the operator is instructed to stop the process and follow an escalation path for immediate resolution.

In the example of the steel pin in the plastic part, the control plan might specify that for the machine operation step "press in part XYZ at 50N +/- 2N." Between 49.5N and 50.5N pro-

“  
**By keeping the  
information unique  
and critical to the  
assembly clear and  
uncluttered, it will  
be readily available  
and easy to use  
when needed.**”





## SAVE THE DATE!

### Upcoming IPC Professional Development Events

#### February 6–7, 2013

IPC Conference on Solderability and Reliability for Electronics Assemblies  
Budapest, Hungary

#### February 19–21, 2013

IPC APEX EXPO® Conference & Exhibition  
San Diego, CA

#### May 20–23, 2013

ESTC — Electronic System Technologies Conference & Exhibition  
Las Vegas, NV

#### June 11–13, 2013

IPC Conference on Flexible Circuits  
Minneapolis, MN

#### August 18–22, 2013

IPC APEX India™  
Bangalore, India

#### September 10–12, 2013

IPC Conference on Component Technology:  
Closing the Gap in the Chip to PCB Process  
Chandler, AZ



#### IPC Conference on Solderability and Reliability for Electronics Assemblies

6–7 February 2013 | Ramada Aquaworld, Budapest, Hungary

Join internationally recognized experts at this new conference — and learn about standards, processes and solutions that can help you meet deadlines, contain costs and satisfy your customers. Here is your opportunity to:

- Build your technical knowledge on critical areas of the assembly process
- Gain an understanding of environmental regulatory compliance
- Discover new technologies and services to make your job easier
- Network with colleagues in the electronics manufacturing industry
- And more!

Bring the entire team! With great packages and prices, it's easy for everyone to attend.

[www.ipc.org/europe-conference](http://www.ipc.org/europe-conference)

**More Information**

[www.ipc.org/events](http://www.ipc.org/events)

Questions? Contact IPC registration staff at +1 847-597-2861 or [registration@ipc.org](mailto:registration@ipc.org).

*Strengthening & Advancing Electronics Manufacturing Globally*

**QUALITY DECISIONS** *continues*

duction continues. Between 48.5N and 49.5N or 50.5N and 51.5N the operator may be instructed to verify air pressure and machine lubrication systems and correct them as required. Once the force is below 48.5N or above 51.5N, the operator's instructions may be to stop the process and immediately notify engineering.

In this way the process is stopped before out-of-specification product is produced and the operator is clear on what action to take and when, which keeps the responsibility for making decisions with the process designers. This is an example of a control plan providing the control to support correct operator-level decisions.

**Conclusion**

By clearly defining processes, roles, responsibilities and training requirements, the number of on-the-spot decisions can be minimized or eliminated and processes can be made capable of reliably producing compliant product in a dynamic environment.

By having the discipline to use these methods during process development, the costs as-

sociated with poor quality can be reduced. Cost reductions result in additional competitive edge for companies. Competitive companies are profitable and profitability allows more resources for the operators to produce quality products and, ultimately, is the best decision for quality. **SMT**



Karla Osorno is business development officer for EE Technologies, Inc., an EMS provider delivering complete engineering and manufacturing services with locations in Nevada and Mexico.

With education and more than 20 years' experience in finance and operations, Osorno drives completion of projects in marketing, business development, operations, and process improvement. Her passions are to educate and empower others to make changes and a daily difference in the world. Contact Osorno [here](#).

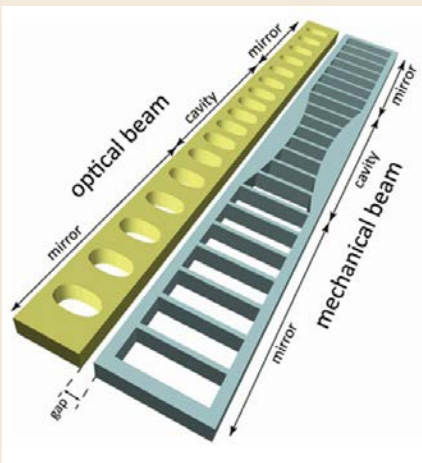
## Exploring Optomechanical Interactions

Researchers from the [NIST Center for Nanoscale Science and Technology](#) and Caltech have developed a new design platform for measuring and exploiting strong interactions between light confined in a nanoscale structure and an adjacent nanomechanical system. The versatile platform opens new approaches for fabricating sensitive light detectors and for converting wavelengths for use in quantum information science. Previously, the Caltech team used silicon "optomechanical crystals" in which radiation pressure from light drove mechanical vibrations within a single, doubly-clamped silicon nanobeam. In the new work, the CNST-Caltech collaborators developed a design for observing similar effects in silicon ni-

tride, which has a much broader optical transparency window than silicon, but for which radiation pressure interactions within a single nanobeam are expected to be much weaker.

The new approach uses a pair of nanobeams held side-by-side and separated by a nanoscale gap, with one beam supporting a mechanical mode which has a specific vibration pattern and frequency, and the other supporting a confined optical mode which

has a specific spatial field distribution and optical frequency (see illustration). Crucially, while the properties of the optical mode are largely controlled by only one of the two beams, it is concentrated in the small region in-between the beams, ensuring that the radiation pressure interaction with the mechanical mode in the other beam is strong. Electromagnetic simulations show that the optomechanical interaction strength increased by nearly a factor of three relative to the single beam case.







January 22-24, 2013  
Maui, Hawaii

# Microelectronics Symposium

Plenary Speaker: Rolf Aschenbrenner, Fraunhofer IZM

## Panel Level Packaging

Manufacturing Solution for Cost Effective Systems



Special Focus on Electronics Industry Roadmaps  
Why roadmaps are so important to product competitiveness

[smta.org/panpac](http://smta.org/panpac)

# TOP TEN

*SMTonline  
News*

## Most-Read News Highlights from SMTonline this Month

### ① **IPC's NCEDAR Aims to Boost India's Electronics Industry**

Technical conference sessions focused on six areas of advanced electronics: Design, simulation, and modelling; electronic components, RF and optoelectronics; PCB assembly and manufacturing technology; materials and processing; reliability and quality control; and advanced packaging, including interconnections.

### ② **Flextronics Acquires Saturn Electronics**

Flextronics has acquired Saturn Electronics & Engineering, Inc., a supplier of EMS, solenoids, and wiring for the automotive, appliance, consumer, energy, and industrial markets. Based in Rochester Hills, Michigan, Saturn Electronics & Engineering most recently reported more than \$300 million in annual revenue.

### ③ **Phil Carmichael to Lead IPC China**

IPC – Association Connecting Electronics Industries® announces the appointment of Philip S. Carmichael as its new president of IPC China. Carmichael is an experienced business professional who has served in five Fortune 500 companies since 1983, building successful, sustainable businesses in China, Japan, and across the Asia-Pacific region.

### ④ **Sparton Completes Acquisition of Onyx**

"The addition of Onyx meets the criteria of our growth strategy by providing further expansion regionally into the Minneapolis medical device corridor, diversifying our customer base through both existing programs and a strong business development pipeline, and to continue to increase the number of complex sub-assembly and full device programs within Sparton." commented Cary Wood, President and CEO of Sparton Corporation.



**Stay for FREE and dine with our team  
when you tour one of our facilities!**

*Greetings from*  
**RENO**  
*Nevada*



*We love giving tours of our two  
world-class, state-of-the-art  
facilities located in Reno, Nevada  
and Empalme, Sonora, Mexico. But  
our tours don't stop at the end of  
the line; you're invited to dine with  
our team and enjoy complimentary  
lodging when you visit us. For more  
information, please contact us today!*



USA

**EE Technologies Inc.**

*Empalme, Sonora, Mexico*

**EE Technologies Inc.**

**EE Technologies, Inc.**  
9455 Double R Blvd.  
Reno, NV 89521

Empalme, Sonora  
Mexico



**Click for introductory  
impact movie.**



**Click here to request  
more information.**

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

**ISO/TS 16949:2009**



Electronic Evolution Technologies  
Registered to ISO/TS 16949:2009  
Certificate Registration Numbers:  
US: 10000767  
Mexico: 10003616

## 5 IEC Reports Revenue Increase in Q4 & Fiscal 2012

For the quarter, the company reported revenue of \$37.1 million and net income of \$2.0 million or \$0.20 per diluted share. This compares with revenue of \$34.9 million and net income of \$2.6 million, or \$0.26 per share in the fourth quarter of the prior year. In the fourth quarter of fiscal 2011 approximately \$1.1 million or \$0.08 per share stemmed from a positive adjustment related to Southern California Braiding (SCB). Fourth quarter 2011 EPS excluding this adjustment was \$0.18.

## 6 PartnerTech Expands Operations in China

"We have been present in China for some time now offering both production and supply chain services and there is an increasing demand from our customers for a more complete offering of low-cost manufacturing. In these new premises we can offer a more complete range of services locally and also provide better service to customers who want to enter or expand their business in China," said Thorwaldsson.

## 7 Plexus Expands UK Operations

Plexus Corporation announces its intention to expand its Livingston Design Centre to larger premises at the Pyramids Business Park, in Bathgate. Having worked closely with Scottish Enterprise on funding support, Plexus will expand its UK manufacturing footprint by opening a new manufacturing facility at the same location.

## 8 Celestica Boosts Healthcare Segment; Adds Advisory Council

The company has announced that its growing healthcare segment Celestica HealthTech has formed an Advisory Council to provide critical guidance as the company continues to focus on helping healthcare OEMs accelerate their success. Celestica's appointed Advisory Council members each possess deep experience and expertise in healthcare technology innovation, product lifecycle and supply chain management, market globalization, regulatory trends and healthcare reform.

## 9 Artaflex Reports 11% Sales Increase in 2012

Sales increased 11.0% to \$20,983 in 2012 compared to \$18,899 in 2011. For the year 2011, sales to the company's four largest customers represented an aggregate of 57% (2011 - 77%) of the company's total sales. Sales attributed to the purchase of Adeptron accounted for an estimated increase of \$9,371.

## 10 Cicor and CEO Part Ways

Cicor, a high-tech industrial group and international leader in the fields of PCBs, microelectronics, and electronic solutions headquartered in Boudry, Switzerland, has announced that Dr. Roland Küpfer, CEO of the Cicor Group, has left the company. Patric Schoch, acting CFO of the Group, will manage the Group until further notice.



**smtonline.com**  
**For the latest SMT news—**  
**anywhere, anytime.**



# Your Competitive Advantage: Don't Waste It



## You never get a second chance to make a first impression.

Today, everything links to your website—business cards, ads, webinars, brochures, etc. Your website is an incredibly powerful sales tool, and can perform as well as or better than any other tool you have.

The key is to determine how effective your website really is. We can help with a comprehensive website review, based on our collective marketing, programming and industry experience.

We make step-by-step recommendations to tune the site into a formidable selling tool that will help you increase your business.

Why would we do this? Because you win with a great website and we can help.

We at I-Connect007 have been focused on e-marketing for years, and are happy to share our knowledge and experience with you.

To read our in-depth article about not wasting your competitive advantage, [click here](#).

To schedule a website review, please contact Barb Hockaday at +1 916-365-1727.

# EVENTS

For the 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 of events, check out *SMT Magazine's* full events calendar [here](#).

## **2013 International CES**

January 8-11, 2013  
Las Vegas, Nevada

## **Printed Circuit Board Assembly Cleaning & Contamination Defect Webinar**

January 10, 2013

## **42nd INTERNEPCON Japan**

January 16-18, 2013  
Tokyo Big Sight, Japan

## **18th Annual Pan Pacific Microelectronics Symposium**

January 22-24, 2013  
Maui, Hawaii

## **Topical Workshop & Tabletop Exhibition on Wire Bonding**

January 22-23, 2013  
San Jose, California

## **DesignCon 2013**

January 28-31, 2012  
Santa Clara, California

## **43rd Annual Collaborative Electronic Warfare Symposium**

January 29-31, 2013  
Pt. Mugu, California

## **SEMICON Korea 2013**

January 30-February 1, 2013  
Seoul, Korea

## **SPIE Photonics West 2013**

February 2-7, 2013  
San Francisco, California

## **6th Annual Mobile Deployable Communications**

February 7-8, 2013  
Amsterdam, The Netherlands

## **Medical Design & Manufacturing**

Feb 11-14, 2013  
Anaheim, California

## **Electronics Manufacturing Korea 2013**

February 13-15, 2013  
Seoul, Korea

## **IPC APEX EXPO® Conference & Exhibition 2013**

February 19-21, 2013  
San Diego, California

## **CMSE - Components for Mil & Space**

February 20-21, 2013  
Los Angeles, California

## **Embedded World**

February 26-28, 2013  
Nurnberg, Germany

## **MEDTEC Europe**

Feb 26-28, 2013  
Stuttgart, Germany

## **IEEE CPMT Advanced Packaging Material**

February 27-March 1, 2013  
Irvine, California

## **Medical Devices Summit**

February 28-March 1, 2013  
Boston, Massachusetts





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

PUBLISHER: **RAY RASMUSSEN**  
(916) 294-7147; ray@iconnect007.com

SALES MANAGER: **BARB HOCKADAY**  
(916) 608-0660; barb@iconnect007.com

**EDITORIAL:**  
GROUP EDITORIAL DIRECTOR: **RAY RASMUSSEN**  
(916) 294-7147; ray@iconnect007.com

MANAGING EDITOR: **HOLLY COLLINS**  
(252) 288-2751; holly@iconnect007.com

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

**EDITORIAL ADVISORY BOARD:**  
**BILL COLEMAN, PH.D.**, Photo Stencil  
**HAPPY HOLDEN**, Gentex Corporation  
**CRAIG HUNTER**, Vishay

**EDITORIAL ADVISORY BOARD—Continued:**  
**DR. JENNIE S. HWANG**, H-Technology Group  
**MICHAEL KONRAD**, Aqueous Technologies  
**GRAHAM NAISBITT**, Gen3 Systems & SMART Group  
**RAY PRASAD**, Ray Prasad Consultancy Group  
**STEVE PUDLES**, IPC  
**S. MANIAN RAMKUMAR, PH.D.**, Rochester Institute of Technology  
**ROBERT ROWLAND**, RadiSys Corporation  
**DONGKAI SHANGGUAN, PH.D.**, National Center for Advanced Packaging, China  
**VERN SOLBERG**, Independent Technical Consultant  
**GARY TANEL**, Electronics Alliance  
**HARALD WACK, PH.D.**, ZESTRON America

**MAGAZINE PRODUCTION CREW:**  
PRODUCTION MANAGER: **SHELLY STEIN**  
shelly@iconnect007.com  
MAGAZINE LAYOUT: **RON MEOGROSSI**  
AD DESIGN: **SHELLY STEIN, BRYSON MATTIES**  
INNOVATIVE TECHNOLOGY: **BRYSON MATTIES**  
COVER ART: **BRYSON MATTIES AND SHELLY STEIN**

**SMT**

SMT® (Surface Mount Technology) is published by BR Publishing, Inc., PO Box 50, Seaside, OR 97138  
©2013 BR Publishing, Inc. does not assume and hereby disclaims any liability to any person for loss or damage caused by errors or omissions in the material contained within this publication, regardless of whether such errors or omissions are caused accidentally, from negligence or any other cause.

January 2013, Volume 28, Number 1 • SMT® (Surface Mount Technology®) is published monthly, by BR Publishing, Inc.

## ADVERTISER INDEX

Aegis.....	39	Nordson Asymtek.....	23
Aqueous Technologies.....	9	One-Source Group.....	63
Basic Electronics.....	53	P Kay Metal.....	27
BBG.....	3	Photo Stencil.....	21
Blackfox.....	19	Prototron.....	43
CA Picard.....	71	Semblant.....	47
Eagle Circuits.....	61	SMTA.....	67
EasyBraid.....	79	SMTA (Pan Pacific).....	83
EE Technologies.....	85	Stebgo.....	37
EPEC.....	13	Technica.....	29
Hunter Technology.....	77	The PCB List.....	2
I-Connect007.....	87	Total Parts Plus.....	57
Imagineering.....	7	US Circuit.....	41
IPC.....	73, 81	Ventec.....	35
Manncorp.....	5		

## Next Month in SMT Magazine

The February issue of *SMT Magazine* will address cleaning and coating: How clean is clean?; the definition of "clean" for different markets; how to choose the correct cleaning process; efficiency of cleaning processes, including low-standoff components; cleanliness testing; cleaning process control; cleaning and the environment; and conformal coatings.

The February issue will also include our exclusive IPC APEX EXPO Product Preview in addition to complete coverage of technical conference sessions, standards development meetings, certification programs, IPC Buzz Sessions, a Real Time with video overview, and much, much more.

If you're not yet a subscriber, don't miss out! Click [here](#) to receive *SMT Magazine* in your inbox each month.

See you in February!