Upcoming Show Season

Engineer-Speak

IMAPS UK – MicroTech 2018

Altek Electronics Partners with Ersa

GLOBAL LEDS/OLEDs

Smart LED Lighting

High Brightness LED

INTERVIEW INSIDE
Dr. Subodh Kulkarni, CyberOptics
- Press fit, THD pins, Connector pins
- Up to 40mm pin height
- Adaptable to shiny, rounded pin top
- Measurable: Height, Offset, Missing etc
- Auto focusing by Z-axis control

- Bottom side inspection without panel flip
- Minimize panel handling & machine footprint
- Optimized for solder joint inspection after wave, selective soldering
- True 3D image for specular solder joints by virtue of laser scan
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Getting Ready for a Busy Show Season

No sooner is APEX behind us than preparations start in earnest for a string of Spring shows and events.

As I write this editorial, NEPCON Shanghai looms on the horizon next week. The Hermes Standard will be making their official Asia debut, having added a large number of participating suppliers since Productronica. Rumors suggest that over 50 companies now adhere to The Hermes Standard. In Shanghai, they will be announcing the latest developments and no doubt we will be hearing similar overtures from the IPC CIX Standard, which was launched with such fanfare at APEX in February.

Following Nepcon Shanghai, Global SMT & Packaging will be hosting its own one-day eSmartFactory conference in Sunnyvale, CA on May 24th in association with SMTA. This one day event in the heart of Silicon Valley has attracted a number of excellent presentations by some of the leading thought leaders in the industry. Be sure and join us!

In June, we will be heading over to Europe for SMT/Hybrid/Packaging. This is the most consistently successful annual event in the European calendar and early indications are that this year will be no exception. Global SMT & Packaging will be broadcasting a range of in-depth panel discussions on a variety of topics affecting the industry.

July 7th is the deadline for our world famous Global Technology Awards 2018. This event highlights the very best innovations from the previous 12 months and this year the winners will be celebrated at our Awards ceremony at SMTAI in Rosemont IL in October.

The final event to round out the first half of the year is Semicon West in CA. Last year, this event started to exhibit a new lease of life on the back of the increasing using of automation and Artificial Intelligence in the industry. As backend packaging moves towards 7nm and 5nm nodes, there is plenty of packaging related issues that still need to be resolved.

It has been an extremely busy first half of the year and Global SMT & Packaging continues to bring you the latest news, trends and technologies from around the world.

– Trevor Galbraith
Editor-in-Chief
editor@globalsmt.net
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Alpha expands reclaim capabilities in Mexico

Alpha Assembly Solutions received from the Government of Mexico a license to export nationalized soldering material scrap to the United States, expanding Alpha’s reclaim capabilities and services to customers in Mexico. The license was issued by SEMARNAT (Secretaría de Medio Ambiente y Recursos Naturales), the Department of Environment and Natural Resources in Mexico. Alpha has been importing reclaim materials from Mexico under the Immex program for many years. However, this new license expands the scope of services that Alpha can offer to customers by allowing the handling and transport of nationalized scrap solder paste, solder paste debris, solder dross and other tin bearing materials. “Alpha is committed to sustainability throughout our business channels,” said Mitch Holtzer, Director of Reclaim Business. “This license expands the positive impact Alpha’s reclaim program can have on the rapidly expanding electronics assembly market Mexico”.

www.alphaassembly.com

KIC promotes Ryan Wilshusen to R&D Manager

KIC announced the appointment of Ryan Wilshusen as its R&D manager. He joined the company in 2016 with more than 16 years of experience as an electrical engineer with respected companies, such as HP, and various industries, including medical, industrial, aviation and consumer. Wilshusen has demonstrated strong management capabilities with a consistent track record of anticipating consequences of new designs, initiating solutions, and completing specifications on the first attempt. KIC’s President Bjorn Dahle states: “We are fortunate at KIC to have a world-class talent like Ryan Wilshusen to guide our R&D to deliver never-before experienced smart factory technologies. We are entering a period of data-driven sensor technologies that significantly reduce production cost and will enable manufacturers to run their operations far more effectively, while sharing with their customers the process control and traceability data they now demand.” Wilshusen is detail-driven with outstanding communication skills and proven success of managing up and down, and interfacing with peers, customers and third-party vendors.

www.kicthermal.com

AIM appoints Product Manager Angelo Elyassi

AIM Solder announced the appointment of Angelo Elyassi to the position of Product Manager. With a Bachelor of Science degree in chemistry and post-graduate experience in international marketing, Angelo has excelled in a wide range of roles including lab tech, chemist, product development, sales and marketing for large, well-known global companies. As AIM’s Product Manager, Angelo will form an important link between the industry and technical departments of the company. This includes managing products throughout the product lifecycle, gathering and prioritizing product and customer requirements, defining the product vision, and working closely with the Research & Development team to continue delivering winning products.

www.aimsolder.com

Indium Corporation adds two technical support engineers

Indium Corporation has welcomed two new technical support engineers to its global support team. Meagan Sloan and Miloš Lazić are responsible for providing expert technical assistance and guidance to Indium Corporation’s customers and potential customers in the Americas to resolve soldering process related issues. Prior to joining Indium Corporation, Sloan served as a laboratory technician at Anoplate, an electroplating company that serves the aerospace, computer, and defense industries. Before that she was a laboratory assistant at Syracuse University, where she prepared and wrote experiments for students, and managed and ordered materials for inventory. Lazić previously worked at Radio-Television Nis in Serbia, where he held the position of deputy technical director. He also served as an electrical engineer for Montelektro, where he designed electrical installations for industrial, commercial, and residential applications. He co-founded, “Urban Youth Forum,” a non-profit organization designed to help primary and high school students plan, develop, and execute projects that recycle electronic waste. Lazić earned his bachelor’s degree in Electrical Engineering and his Master of Engineering in Electronics.
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Metcal appoints new Manufacturers’ Representative

Metcal has appointed R.E. Stronics Northland to provide sales, service and support for its customers in Minnesota and the Upper Midwest. R.E. Stronics Northland will represent Metcal’s complete line of world-class soldering tools and equipment for production assembly. R.E. Stronics Northland has been supporting the electronics and hi-tech industries in the Minnesota region for more than 35 years. Ralph Savage, Managing Partner, along with Todd Ness and Char Thomas have established successful relationships in the PCB/electronics assembly industry in the region. The territory includes Minnesota, western Wisconsin, the Dakotas, Iowa and Nebraska. Ralph Savage commented, “We are extremely excited to be a part of a team that leads the industry in soldering technology and is one of the few innovators in that field.” Ian Orpwood, Director of Sales for Metcal, added, “We are pleased to announce the addition of R.E. Stronics Northland to service the Upper Midwest. Their knowledge of the local markets and ability to recommend solutions that solve application challenges will be invaluable to our clients.”

Kurtz-Ersa awards Murray Percival Co. ‘Rep of the Year’

Murray Percival Company today announced that they have been awarded the Kurtz Ersa Rep of the Year Award for the second consecutive year. The Murray Percival Company represents Ersa’s award-winning selective soldering and rework equipment throughout the Midwest. The Murray Percival Co. scooped the award based on total dollar revenue of sales for Kurtz-Ersa’s machine division. Presenting the award at this year’s IPC Apex show, Ernie Grice, Kurtz-Ersa VP of Sales, commented, “It’s a truly great pleasure to again present The Murray Percival Company with this year’s Award. 2017 was yet another record-setting year for Kurtz Ersa in North America, and The

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■ Miloš Lazić

Engineering from the University of Nis, in Serbia, He also earned the title of Energy Efficiency Engineer by passing the proficiency exam of the Serbian Chamber of Engineers in Belgrade. www.indium.com
Murray Percival Company earned the top selling rep award with their hard work, dedication and in-depth knowledge of the Kurtz Ersa systems and the selective soldering process. The two companies have long enjoyed a close relationship. Established in 1960, Murray Percival Company has been serving the electronics manufacturing industry in its region for almost 60 years and has established a reputation for technical expertise and honesty. “We are pleased to represent Kurtz-Ersa in our territory” said Murray Percival Jr, President at The Murray Percival Company. “As an industry leader, they have some of the best Representatives in the market and we are proud to be among them. The selective soldering equipment market is exceptionally buoyant right now driven by challenges of shrinking component size, and rising component complexity and density. The market-leading Kurtz-Ersa range has allowed our knowledgeable sales team to deliver competitive and reliable solutions to help our clients overcome these challenges.”

Murray Percival Company provides a wide array of equipment, processes and consumables to the printed circuit board assembly and repair industries. Representing over 60 different manufacturers, they maintain a multi-state technical sales force and provide on-demand shipping of thousands of products throughout the continental United States from their Michigan based warehouse.

www.murraypercial.com
www.ersa.com

**Mycronic’s 2017 Annual and Sustainability Report**

Mycronic AB (publ) has published the 2017 Annual and Sustainability Report. The Annual and Sustainability Report is available on the company website as a PDF and will also be available as a web solution within short. A printed version of the Annual and Sustainability Report is distributed to shareholders who have asked to receive this. The 2018 Annual General Meeting, AGM, will be held Tuesday 8 May, 2018. A notice has been published in a press release and is also be available on the website.

www.mycronic.com

**STI recognizes Randy Baumgarden’s anniversary**

STI Electronics, Inc. announced Randy Baumgarden’s 30-year anniversary. Baumgarden’s anniversary was celebrated with a cake shared with all his colleagues at STI. Baumgarden is responsible for procurement for the manufacturing operations of the Engineering Services Division. David Raby, President/CEO, presented him with a certificate in appreciation of his 30 years of dedicated service. “Randy’s loyalty and willingness to take on different tasks has been demonstrated many times over the last 30 years,” said David Raby, President/CEO. “Randy is the only employee (without the Raby name) to have achieved this significant milestone and we are honored to recognize this fact.”

www.stiusa.com
**IPTE expands location in Oradea, Romania**

IPTE Factory Automation has expanded its production location in Oradea, Romania. The Romanian team, which consists of 24 members, moved into a new building. The new location in Oradea has now a size of 1,400 square meters in total. Test fixtures for in circuit, functional and RF test, test racks as well as assembly for IPTE’s EasyLine board handling system are developed and produced here. Moreover, a complete service unit for Romanian clients with capacities for all IPTE products is based in Oradea. IPTE’s first activity in Romania was the founding of a service unit back in 2005. Already in 2006 the location in Oradea was established. In the recent year 2017 more than 300 test fixtures have been produced in the Romanian factory. “With the expansion of the location in Oradea IPTE is strengthening its presence in the important Eastern-European market.”

www.ipte.com

**Intertronics launch F4500N large area benchtop robot**

New from Intertronics is the Fisnar F4500N Dispensing Robot which shares all the technical advantages of the F4000 range in an expanded format of 500x500mm, still in a convenient benchtop design. The F4500N is a full function robot that enables cost effective automation of liquid dispensing operations, allowing increased productivity and consistent output. Integrated with dispensing equipment from the extensive Intertronics range, the Fisnar F4500N can dispense beads, dots, arcs and infills in three dimensions, with a positioning resolution of 0.001mm/axis. Robust and reliable, it is suitable for use in continuous manufacturing environments, as well as in production development. By adding the appropriate dispensing setup to the robot (which might include syringes, valves or pumps) it can be configured for the application of form-in-place gaskets, adhesives, coatings, potting and encapsulation materials, sealants, filling and RFI/EMI shielding, and can handle single part or multi-component materials.

www.intertronics.co.uk/f4500n

**Flex invests HUF 3 bn in Zalaegerszeg car part plant**

Flex, formerly known as Flextronics, will expand its car industry manufacturing plant for HUF 3 billion, creating 100 jobs. Foreign Minister Péter Szijjártó said at a press conference in Zalaegerszeg on Friday. The government of Hungary will extend a HUF 769 million non-repayable grant for the U.S.-owned company, Szijjártó said. The investment will allow Flex to introduce a state-of-the-art surface treatment technology, increasing the overall supplier capacity of the car industry, which is a leading segment in Hungary, he added. American-owned companies number 1,700 in Hungary, making the U.S. the second largest investor after Germany, Szijjártó said.

www.flex.com

**AWS Group expands automotive hall in Slovakia**

AWS Electronics Group has recently installed an additional Surface Mount automotive line in its dedicated automotive hall based at its low-cost manufacturing facility in Námestovo, Slovakia. The new line mirrors the original automotive line with four SMT machines, In-Line Laser Marking, AOI and routing, alongside specialist automated Pin Insertion. This 50% expansion in size of the automotive hall, coupled with the achievement of the internationally recognised TS 16949 approval last year, has contributed to significant growth for AWS in the automotive sector. This year AWS expects to assemble 3.7M PCBAs at its dedicated automotive hall for a wide range of leading global automotive manufacturers. Rob Lackey, AWS Group Technical Director, comments: “The volume automotive sector is an intensely competitive arena, where low cost and zero defects are fundamental drivers. Through our continued targeted focus on lean principles, precision engineered solutions and a high degree of automation, we meet both these core challenges head on, enabling us to keep our costs to an absolute minimum and contributing positively to the growth of the AWS Electronics Group.”

Alongside its TS 16949 certification, AWS Slovakia has achieved a variety of other accreditations including: ISO 9001; ISO 14001; ISO 13485 and most recently, AS9100. The AWS Group also has an additional manufacturing facility in the UK.

www.awsselectronicsgroup.com

**USI’s PRISM-500 selected for precision coating ap**

Ultrasonic Systems, Inc. (USI) announced the installation of its PRISM-500 high-speed, high performance spray coating system at a European-based medical company that sells instruments used to perform medical diagnostic tests. USI’s patented, nozzle-less tCAT ultra-Thin Coating Application Technology was chosen to apply an activation agent (coating) to the surface of a biomedical diagnostic instrument carrier that holds multiple test samples. USI’s tCAT ultrasonic spray technology is a novel application method that deposits an ultra-thin, uniform and defect-free coating to the test substrates, which are about the size of a playing card and contain multiple test locations used for diagnostic testing. With coating transfer efficiency of up to 99% and finished film thicknesses as low as the sub-micron range, the PRISM-500 handles high-precision applications.

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A good leader should communicate in the language of his or her employees. A good leader should be the one to adjust dialect and language. This is well accepted wisdom. The problem is that “should” is a rather meaningless word. “Should” doesn’t require, nor does it instruct. “Should” implies obligation, but doesn’t imply action or consequence of not taking action.

Expecting a superior or colleague to speak in your language only ensures that you “should” be able to communicate, not that you will. Relying on “should” is a lot like relying on luck. You give up control when you rely on luck or “should.” It’s fine if you don’t care, but not if you do.

It shouldn’t be a surprise that effective communication is a vital part of surviving and advancing in the business world. Without it, no one knows what you do or what your worth is to them.

In this context, “shouldn’t” is an appropriate word. The usage here is that the argument is common enough knowledge that it’s reasonable to assume that a reasonable person would agree. It doesn’t imply, nor need to imply any action or consequence.

This isn’t an article about “managing your boss. I’ve seen enough of those, and have always thought them rather presumptuous. “Managing your boss” is really more manipulation and exploitation than it is about managing — and I’m not a fan of manipulation. What you can do, and will benefit from, is to manage the communications with your boss and coworkers.

Managing Communication

It’s great if you have a boss that knows how to communicate. Not everyone does, and even for those that do, it can be pretty helpful to share the job of effectively communicating.

One of the easiest illustrations is in the contrast between a visual person and a numbers person. The numbers person needs to see metrics in spreadsheet or table form. The visual person needs the same information in chart and graph format. Trying to get one to accept the other often results in little or no actual communication and lots of frustration.

If your boss is a visual person, and you hand in a table with all of the data, plus rows and columns of only distant-related numbers, they will have a hard time with it. Their brain wants to be able see structures at a glance. Instead, you’ve given them a jumbled mess of indistinguishable black and white hieroglyphs.

On the other side, if you give your numbers-person boss a nice bar chart, they will see a bunch of fluffy colors that do little more than obscure the details. They need to see not only the numbers they’re interested in, but also the data behind the numbers.

But shouldn’t a good leader be the one adjusting language, you ask? Again, I’ll compare the word “shouldn’t” in this context to luck.

Jargon & Communication Styles

Good leaders do adjust their language, and listen carefully. They are putting in the effort, and what you are trying to say is (presumably) important. Why would you not do as much as you can to complement their effort? Good leaders have also hired you, in part, for your communications skills. Assuming the leader will do the majority of the work is doing them a disservice and is a failure to live up to your commitment as an employee.

The same holds when dealing with colleagues you don’t report to. It may seem like you’re partly doing their job if you adjust your communication to fit their style, but if your message is important enough to give, it’s important enough to justify the extra work toward clarity.

Duane Benson

Don’t Judge a Co-Worker by their Engineer-Speak

Expecting a superior or colleague to speak in your language only ensures that you “should” be able to communicate, not that you will. Relying on “should” is a lot like relying on luck.
A good example would be in the use of acronyms and jargon with a new coworker. Communication problems happen quite often when one person has a background from a large, tightly structured company, and the other is from a smaller company.

Jane joins a small start-up company from a large multinational corporation. Her former company spent a lot of time studying lean manufacturing, the Toyota Production System and other process improvement systems. Bob at the small company doesn’t have the same language.

Jane is aghast when she suggests a Poka-yoke process and Bob doesn’t understand her. She drops her jaw and wonders what kind of a mess she got herself into when she took the job. She’s surrounded by bozos that don’t know the most basic of business processes.

In this scenario, it turns out that Bob is a brilliant user experience designer and considers mistake proofing to be just about the most important aspect of a design. Jane and Bob are on the same page; they both strongly believe in mistake proofing products. However, since Jane didn’t take into consideration the possibility that Bob might not have been exposed to one specific set of business terms, she feels he must be incompetent. Both Jane and Bob would be well served to accommodate the language of the other.

I’ve found over my career, that there are an astounding number of terminology differences between different corporate cultures. There are terms that have different meaning altogether, and there are different terms used to describe the same thing. Even the basics like “margin” can be used differently in different organizations.

Jargon and acronyms are okay, as long as you never assume that the person you’re communicating with has the same jargon dictionary in their head as you do.

– DUANE BENSON

Duane Benson is the Chief Technology Champion at Screaming Circuits, a prototype PCB assembly electronic manufacturing company in Canby, Oregon.
The auspicious occasion was marked by a Gala Dinner in the Founders building where Malcolm Penn, Future Horizons gave a ‘Walk through 50 years of micro-electronics in the UK’. In practice, the presentation also took a broad look at the bright future the industry has, which was evidenced by the high turnout of many new, younger members of the Society.

The Conference

The conference was chaired by Peter Barnwell, who has enjoyed a long history with IMAPS and had the dubious honour of serving on separate occasions as President of IMAPS-UK and then later, IMAPS in the United States.

The keynote speech was delivered by E. Jan Vardaman, TechSearch International. Jan reminded the audience that first iPhone in 2007 had two wafer level packages in it, but was followed in later years by the iPhone 7 which had 44 WLPs. The latest models contain considerably more functionality within each WLP, but still number around 40 packages in total.

Another interesting anecdote from Vardman’s presentation was that the main driver for package reduction was to allow space for the battery. Battery life is a big deal for phone users and therefore space for the battery is a priority.

At the packaging level, Vardaman predicted SIP will reach 25 billion by 2020. She also stated that while wire bonding devices have not decreased in number, all the growth is taking place in the flip chip arena, highlighting the fact there is a definite shift from wire bond to flip chip for DRAM. In fact, 80 percent of SAMSUNG DRAM will be flip chip in 2018.

In other predictions, semiconductor fabs are moving towards 7nm and 5nm nodes and the use of Fan-out wafers will increase. The average cost of car sensors will go from $150 per car to $850 per autonomous car and include a number of LIDAR sensors. In automotive testing, manufacturers are now demanding test cycles to 175 degrees C for 1,000 hours.

Vardaman concluded by noting that CAPEX is expanding every year. The average cost per fab is currently 2.2 billion, which is causing some vertical integration and some Industries merging. The eventual winners will be those that design entire systems.

Josef Sedlmaier from F&K Delvotec had the unenviable task of following E. Jan Vardman with a presentation on wire bonding. Although he acknowledges some of the trends towards flip chip, he did observe that wire bonding was expanding in power electronics.

It is also being employed in some more novel applications, such as laser welding batteries together. This technology is still expanding and 10mm bonding ribbons under development.

Wire bonders are unable to successfully bond on silicon die yet, but the industry hopes to get there soon. Other future bonding technologies include Laser inducted metal bonding (LIMBO), which F&K Delvotec is developing in association with the Fraunhofer Institute.

Among other presentations during the day, a representative from PRIMOCELER described a novel VCSEL glass package with BGA interconnects for high reliability applications such as smartphones, auto sensors, VR and AR.

Tony Winston from Henkel presented a high thermal die attach paste using silver based semi-sintered material, which improves thermal conductivity dramat-
ically. During his presentation he commented that the industry is moving away from silver towards copper for reduced cost and more reliable compatibility with the mold compounds.

After lunch, the conference resumed with a panel discuss, moderated by Grace O’Malley from iNEMI on “Future direction, challenges and technologies”. On the panel were; E. Jan Vardaman, President - TechSearch International, Rich Rice, Snr. VP Business Development – ASE Group, Ron Huemoeller, Corporate VO, WWRD & Technology Strategy – Amkor Technology and Trevor Galbraith, Editor-in-Chief – Global SMT & Packaging magazine.

Towards the end of the day, David Bernard delivered a short treatise on the history of x-ray and how it worked, followed by a presentation detailing the importance of voiding in LEDs, which contributes to the thermal excursions from the package. A major concern in LED solid state electronics.

There was a lot of energy in the room and a keen interest in new and developing packaging trends. Most of the delegates stayed through till the end of the day and all agreed that it was a well-organized, informative and successful event.

–TREVOR GALBRAITH
Altek Electronics Partners with Ersa

Continuing to provide customers with quality products on-time and cost effectively

BY JOYCE MUSE, BUSINESS DEVELOPMENT EXECUTIVE

Altek Electronics is a family-owned company that strives to provide customers with the best quality at the best prices, without compromising its values.

A veteran-owned small business privately held by three family members (Stephen Altschuler, David Altschuler, and Sabrina Altschuler Beck), Altek Electronics, Inc. manufacturers printed circuit board assemblies and box builds for many industries including medical, military, industrial and telecommunications. Altek Electronics has been providing PCB assembly services to companies who manufacture high-cost capital equipment since 1972. Altek Electronics can assemble boards on a turnkey or consignment basis. The company supports customers at every stage of the product lifecycle, from prototype to PPAP, production run to end of life. Altek Electronics prides itself on having close relationships with and being committed to its customers. Every decision is designed to satisfy customers, not shareholders.

Altek Electronics uses lean manufacturing principals and Six Sigma practices to achieve more than 99 percent on-time delivery and customer acceptance. The company’s first pass yields are greater than 98 percent and Continuous Flow Manufacturing enables Altek Electronics to reduce internal costs. Altek Electronics is certified to AS9100D and ISO 9001:2015. Its soldering operators are certified to IPC-610 and the J-STD, and cable and harness operators to IPC-620. Altek Electronics believes in a culture of continuous improvement through lean manufacturing and Six-Sigma methodologies. It uses the Plan-Do-Check-Act principal to ensure continuity and sustenance of initiatives. Its lean culture starts with generating value through customers’ eyes and continues with empowering its employees through training and teamwork. Six Sigma methodologies are used to reduce variations in its processes through the DMAIC process. Additionally, the company has certified Lean Leaders and two Six Sigma Black Belts on staff to ensure its continuous improvement way of life.

Its PCBAs are used in mammography machines, elevators, cutters for the garment industry, fan cooling systems used in cell phone towers, MRI machines, medical diagnostic equipment, hand controls for the military, test stations for flight simulators, mail sorting machines, gas detection systems, among many other innovative and important products. Because of the sensitive environment in which its PCBAs are used, it is important to Altek Electronics that it partners only with companies who share its same rigorous quality beliefs and standards. One of its newest partners is Kurtz Ersa North America, and it recently added Ersa’s Smartflow 2020 selective soldering system to its line of surface mount assembly equipment.

Ersa’s Smartflow 2020 requires less than 3 m² of space, thus fitting optimally into Altek Electronics’ production environment. Due to its universal pallet fastening, the Smartflow can handle PCB sizes of up to 508 x 508 mm (20” x 20”). The Smartflow 2020 is smart and compact without compromising quality.

Sabrina Beck, VP at Altek Electronics, commented, “Real estate is expensive — it’s important to optimize our factory space. The Smartflow 2020 allows us...”
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to do that. We’re very pleased with the quality of the soldering, as well. It’s a win-win.”

Altek Electronics’ state-of-the-art factory offers customers flexibility with both prototype PCB and production requirements. The company manufactures all circuit board assemblies in accordance with three classes of the Acceptability of Electronic Assemblies (IPC-A-610). Its SMT placement lines can produce either RoHS compliant lead-free assemblies, or it can use traditional tin-lead solder in the printed board assembly process. Circuit boards are assembled with exceptional quality, using the latest technology in surface mount equipment. SMT component placement sizes range from 01005 to 2.2”, enhanced by a placement accuracy of 15 µm at 3 Sigma.

Whether prototyping circuit boards or producing medium to high volumes, Altek Electronics is committed to quality and continuous improvement. Its capabilities include automated and detailed visual assembly inspection, cleaning and functional testing.

“Altek Electronics is dedicated to offering the highest quality electronics to the industries we serve at the most competitive price we can without compromising our core beliefs. Period,” added Beck.

Industries served by Altek Electronics are wide-ranging, and include:

- Medical: The company has extensive experience manufacturing printed circuits boards for the medical industry. Its reputation for delivering quality boards that work out of the box, on-time, and at competitive prices, has positioned it as a key supplier to many of the premier manufacturers of medical devices, and medical diagnostic and treatment equipment.
- Industrial/Commercial: Altek Electronics has the engineering expertise and manufacturing capabilities to support customers from the preliminary design phase into low rate pre-production, through full-rate production. The company has a consistent track record of delivering quick-turn prototype builds on-time, and is uniquely balanced to support surge capacity with minimal notice. It has the capabilities to support defense traceability requirements and process controls while offering market-competitive prices.
- Aerospace: The company was one of the first organizations to adopt and certify to both the AS 9100 “C” level and AS 9100 “D” level. Altek Electronics understands flight-critical standards and has robust processes and capabilities in place to support these standards. Currently, it provides circuit boards and turnkey assemblies that support flight simulators and aerospace test equipment.
- Defense: Altek Electronics has the engineering expertise and manufacturing capabilities to support customers from the preliminary design phase into low rate pre-production, through full-rate production. The company has a consistent track record of delivering quick-turn prototype builds on-time, and is uniquely balanced to support surge capacity with minimal notice. It has the capabilities to support defense traceability requirements and process controls while offering market-competitive prices.
- Telecommunications: The company offers printed circuit board assembly services to OEMs who sell products used in the telecommunications industry. Experienced in the highly complex world of telecommunication, it supports both prototype and production runs, from 10 pieces to 10,000. Altek Electronics understands the critical importance of superior quality and rapid turn times. Therefore, it works closely with customers to ensure all requirements are met on time, every time.

Beck concluded, “We keep on top of customer issues and concerns so we can deal with those issues quickly and continually evolve to meet our customers’ changing needs. Customers come to Altek Electronics because they’re frustrated by poor quality, under pressure from tight deadlines, and disappointed they aren’t getting the best overall value. They stay with Altek Electronics because we deliver quality products, on-time, at market-competitive prices.” Adding Ersa as a business partner helps Altek Electronics continue delivering on that promise.

For more information, contact Altek Electronics, Inc. at 89 Commercial Blvd, Torrington, CT 06790; 860-482-7626; Web site: www.altekelectronics.com. To find out more about Kurtz Ersa North America, contact Ernie Grice, Vice President of Sales – North America at 1779 Pilgrim Rd., Plymouth, WI 53073; 920-893-1779; E-mail: ernie.grice@kurtzersa.com; Web site: www.ersa.com.

Colin Fuoco, Machine Operator: Wave/SS at Altek Electronics
Don’t blink or you’ll miss it. SQ3000™ CMM is the World's Fastest.

Verify measurements in seconds, not hours. Our SQ3000™ CMM 3D scanning and inspection technology leaves traditional CMMs in the dust.

Fast and highly accurate, repeatable and reproducible measurements for metrology applications in the manufacturing of a wide variety of products such as PCBs, semiconductors and consumer electronics.

The new SQ3000™ CMM system, powered by MRS technology utilizes CyberCMM™. This comprehensive software suite of 3D inspection and coordinate measurement tools provides highly accurate, 100% metrology-grade measurement on all critical points much faster than a traditional CMM, including coplanarity, distance, height and datum X, Y to name a few.
World manufacturing growth continued to slip in March (Chart 1) but manufacturing activity still remained well in positive territory (PMI>50). Growth continues, but at a more subdued pace.

In our last column we noted a large drop in February China/Taiwan electronics output due to both seasonality and weaker post-holiday season mobile phone activity. However March 2018 rebounded driving a 13.2% global increase in electronic equipment sales vs. March 2017 and an 11.8% sequential sales rise over February 2018 (Chart 2).

Electronic equipment looks to be on track for another good year (Chart 3) – more modest growth compared to 2017, but still respectable.

Semiconductor sales are predicted to rise again this year bolstered by both memory and non-memory (Chart 4). Wafer foundry revenues rebounded sharply in March (Chart 5) signaling continued solid industry demand.

Printed circuit board revenues (in US$) also are increasing, both due to end market need and the currency effect of converting stronger non-dollar currencies to weaker dollars, thus amplifying US$ denominated growth.

2018 looks to be on track for another decent year. Hopefully global political unrest won’t create too many detours.

**End Markets**

**GENERAL**
- Global IT spending is expected to grow 6.2% y/y to $3.7 trillion in 2018. –Gartner
- South Korea’s information and communication technology industry output increased 8.6% y/y to new high of 468 trillion won in 2017. –Ministry of Science and ICT

**MOBILE COMMUNICATIONS**
- Australian mobile phone market shipments increased 15.7% y/y to 3.36 million devices in 4Q17. –IDC
- Mobile substation market value is expected to grow at 7.6% CAGR from an estimated USD 789 Million in 2018 to USD 1,140 Million by 2023. –MarketsandMarkets

**COMPUTERS & PERIPHERALS**
- Device (PCs, tablets and mobile phones) shipments are forecast to grow 1.3% y/y to 2.3 billion units in 2018 after declining 3% y/y in 2017. –Gartner
- PC shipments declined 1.4% y/y to 61.7 million units in 1Q18. –Gartner
- Traditional PCs (desktop, notebook, and workstation) shipments recorded 0% y/y growth in 1Q18, remaining at a total of 60.4 million units. –IDC

**CONSUMER PRODUCTS**
- Smart camera market expected to grow at 18.7% CAGR from US$ 4500 million in 2016. –Future Market Insights

**NETWORK EQUIPMENT**
- 5G network equipment market value is expected to expand at a 59% CAGR from $1.1 billion in 2019 and to more than $18 billion in 2025. –Persistence Market Research
- Cloud IT infrastructure revenue from sales of infrastructure products (server, storage, and Ethernet switch) for cloud IT, including public and private cloud, grew 27.3% y/y $12.8 billion in 4Q17. –IDC
- IT infrastructure products (server, enterprise storage, and Ethernet switches) total spending for deployment in cloud environments is expected to grow 10.9% y/y to $52.3 billion in 2018. –IDC
- Public cloud services market is projected to grow 21.4% y/y to $186 billion in 2018. –Gartner
- Server shipments reached 3.66 million units (based on motherboards shipped) in 4Q17. –Digitimes Research

**AUGMENTED & VIRTUAL REALITY AND ARTIFICIAL INTELLIGENCE**
- Augmented and virtual reality consumer content and apps market grew by 72% y/y to $3.2 billion in 2017. –IHS Markit
- Augmented reality and virtual reality headset shipments will grow at 53% CAGR from 12.4 million units in 2018 to 69 million units in 2022. –IDC
- Cognitive and artificial intelligence systems spending will increase by 54% y/y to $19 billion in 2018 and then continue to expand at 46% CAGR to $52 billion in 2021. –IDC

**AUTOMOTIVE**
- Electronics market projected to grow beyond $290 billion by 2024. –Hexa Research
- Cockpit electronics market will expand at 12% CAGR from USD 31 billion in 2013 to USD 62 billion in
2020. – Persistence Market Research

- In-Dash navigation system market will grow at 11% CAGR from $10.5 billion in 2016 to $22 billion by 2023.
  – Allied Market Research

- Head-Up display market value is expected to expand at 30% CAGR from USD 1.27 billion in 2018 to 4.7 billion USD by 2023.
  – Markets and Markets

- Adaptive front lighting market value will grow at 52% CAGR from US$7.7 billion in 2016 to US$354 billion by 2025.
  – Market Research Hub

INTERNET OF THINGS

- IoT Healthcare market value is growing at 28% CAGR from USD 28 billion in 2015 to USD 337 billion by 2025. – Wise Guy Reports

- IoT security spending will increase 28% y/y to $1.5 billion in 2018.
  – Gartner

ROBOTS/AUTOMATION

- Consumer Robotics hardware revenues will grow from an estimated $6.4 billion in 2018 to nearly $23 billion by 2022. – Juniper Research

- North America robots total sales reached $1.896 billion for 34,904 total units in 2017.
  – Association for Advancing Automation

- Service robotics market shipments are forecast to grow at over 20% CAGR to USD 22 billion by 2024.
  – Global Market Insights

- Smart home devices shipments grew 28% y/y to 433 million units in 2017 and are expected to grow at 19% CAGR to 939 million devices shipped in 2022. – IDC

WEARABLES

- Wearable devices shipments will grow 15% y/y to 133 million units in 2018 and continue growing at 13% CAGR to 219 million units in 2022.
  – IDC

- Europe’s wearable medical device market value is expected to grow from $1.4 billion in 2015 to $3.3 billion by 2020. – Market Data Forecast

EMS, ODM & Related Assembly Activity

Top 50 EMS providers sales increased 11.4% y/y to $300 billion in revenue in 2017. – Manufacturing Market Insider

PCB and multi-chip module electronic design automation industry revenue grew
Moving Forward

Chart 3: Electronic Equipment Production Growth

<table>
<thead>
<tr>
<th></th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
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<td>7.3</td>
<td>6.5</td>
<td>1.8</td>
<td>7.6</td>
<td>6.4</td>
</tr>
<tr>
<td>N America</td>
<td>5.6</td>
<td>5.5</td>
<td>1.9</td>
<td>6.4</td>
<td>5.9</td>
</tr>
<tr>
<td>Europe</td>
<td>6.9</td>
<td>5.8</td>
<td>-1.5</td>
<td>6.7</td>
<td>5.7</td>
</tr>
<tr>
<td>Japan</td>
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<td>4.2</td>
<td>-1.7</td>
<td>5.4</td>
<td>3.4</td>
</tr>
<tr>
<td>Asia</td>
<td>8.3</td>
<td>7.1</td>
<td>2.8</td>
<td>8.4</td>
<td>6.9</td>
</tr>
<tr>
<td>China</td>
<td>8.9</td>
<td>7.3</td>
<td>3.2</td>
<td>8.5</td>
<td>6.7</td>
</tr>
</tbody>
</table>

Henderson Ventures 3/2018

Chart 4: World Semiconductor Sales

- **Non Memory**
  - 2014: 342.4 billion, 8.5%
  - 2015: 334.9 billion, 6.3%
  - 2016: 343.5 billion, 3.0%
  - 2017: 419.7 billion, 9.4%
  - 2018: 451.0 billion, 13.7%
  - 2019: 444.0 billion, -12.9%
  - 2020: 448.9 billion, -10.2%
  - 2021: 477.7 billion, 10.2%

- **Memory**
  - 2014: 6.3%
  - 2015: -1.3%
  - 2016: 1.1%
  - 2017: 64.3%
  - 2018: 13.7%
  - 2019: -12.9%
  - 2020: -10.2%
  - 2021: -10.2%

Gartner 1/18

2.4% y/y to $241 million in 4Q17. –ESD

Smartphone ODM and EMS assembly shipments decreased 13.8% y/y in 4Q17. –IDC

U.S. medical sector contract electronic manufacturing market revenue is expected to grow at 8.8% CAGR to $20 billion by 2023. –Market Research Future

ACDi added a Nordson Asymtek select coat SL940E machine in Frederick, Maryland.

AWS Electronics Group installed an additional SMT automotive line in Námestovo, Slovakia.

Bomin Electronics acquired Juntian Hengxun for RMB 1.25 billion.

Celestica purchased Atenne Integrated Solutions.

Compal Electronics increased its 2018 capex to NT$6 billion (US$206 million) to purchase automation equipment.

Creative Hi-Tech added a Nordson Novo 102 selective solder machine.

Datatest introduced its newly acquired VJ Technologies 225kV Microfocus CT Lab and has a new website at www.datest.com.

EC Electronics opened an electronics assembly facility in Petrosani, Romania.

Éolane relocated into a new building in Tallinn, Estonia.

Fabrinet UK added a Class 8 clean room to its On-Demand facility in Calne.

Flex
- sold its Multek’s China operations to Multi-Fineline Electronix for $273 million.
- spent HUF 3 billion to expand its car industry manufacturing plant in Zalaegerszeg, Hungary.

Flextron Circuit Assembly added a Nordson Yestech F1S AOI system and two 3D SPI systems from Koh Young Technology.

Foxconn/ Hon Hai
- received U.S. approval for duty exemptions for its planned Wisconsin TV manufacturing facility in Mount Pleasant.
- subsidiary, FIT Hon Teng acquired Belkin, which also owns Linksys, Phyn and Wemo brands.
- plans to expand development of automotive, industrial networking, and smart home manufacturing services in India.

Hindley Circuits acquired Magnum Electronics.
IEC Electronics invested more than $20 million to relocate and construct a 150,000 SF facility in Newark, New York.

Jabil is spending $67.3 million to remake its HQ in St. Petersburg, Florida.

Libra Industries promoted Tim Bell to Production Manager.

Microart Services added an additional factory in North Tonawanda, New York.

Milwaukee Electronics added an X-SPECTION 6000 system from Scienscope to their facility in Oregon and another for their facility in Mexico.

Northern Coatings moved into new facilities in Orangeville Ontario.

OSI Electronics increased its production space from 3,250 to 5,100 m² with purchase of a new building virtually next door in St Neots, UK.

Plexus named Ex. VP, CFO and Treasurer of National Instruments, Karen Rapp to their Board of Directors.

Protolabs purchased a 152,000 SF facility in Brooklyn Park, Minnesota.

Sanmina received FDA registration for its manufacturing facilities in Chennai, India.

SMTC appointed Steve Waszak, CFO and Sr. VP of Mergers and Acquisitions.

Solve Direct Electronics invested in Seamark Cutting-Edge Rework System in South Africa.

Stadium Group appointed Gabriel Iancu as Quality and Test Manager and Paul Adgar as Sr. Test and Technical Engineer for its Hartlepool UK electronics assembly plant.

Sumitronics Manufacturing (Cambodia) set up a factory in Poipet Special Economic Zone.

TactoTek added an Essentec Paraquda multi-functional pick-and-place system.

Time Chain Holding acquired Fittec from Camsing International for HK$140 million.

Z-AXIS added more than $250,000 worth of PCBA equipment to its factory near Rochester, New York.

PCB Fabrication

FPCB market is growing at 11% CAGR from US$13.5 billion in 2016 to US$33 billion by 2025. –Research Report Insights
Moving Forward

Substrate-like PCB market is estimated to grow at CAGR 64% from US$1.9 billion in 2016 and US$2.24 billion by 2023.

- Yole Développement


Advanced Circuits appointed Michael Ekladyose to succeed retired Jim Hellmer as Director of Technical Support.

APCT named Greg Elder EX. VP, Finance.

Aspocomp acquired a production facility in Oulu, Finland from Technopolis.

Chart 5

Taiwan Wafer Foundry Composite vs. Global Semiconductor Revenues

<table>
<thead>
<tr>
<th>NT$ (Billions)</th>
<th>World Chip Shipments US$ 3M Avg. (relative)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>20</td>
<td>25</td>
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<td>120</td>
<td>110</td>
</tr>
<tr>
<td>140</td>
<td>130</td>
</tr>
</tbody>
</table>

Calendar Year

14 Taiwan Company Financial Releases & SIA

Chart 6

World PCB Shipments (with forecast)

$ Billions

Growth calculations:
- Europe = Eurostat “Wiring Device”
- Japan & N. America from JPCA & IPC data
- Taiwan/China: 46 rigid & flex company composite
- S Korea from NT Information, company composites & KPCA

Note:
- Historical data harmonized with IPC World Market reports 10/30/17
- Actual & Forecast

Source: Custer Consulting Group - 2010 base year expanded by monthly growth of N. American, European, Japanese, Korean & Taiwan/China monthly PCB shipments

Cirexx International installed two Orange Engineering Manufacturing high temperature lamination press systems.

Enigma Interconnect added a new line, which offers double sided selective and flash/full body electroplating in hard gold options.

Guangzhou Hi-tech subsidiary, Jiangxi Hong Hi-Tech is building a new facility with annual output of 600,000 SM of high-multi-layer, high-precision HDI circuit boards and 5 million PCBA intelligent terminal products.


SCL PCB Solutions Group appointed Nicolae Mihoc as Plant Manager at their BATM Systems SRL production facility in Craiova, Romania.

Shennan Circuit Tongzhou built a new PCB manufacturing plant with 1.25 million SM/year capacity.

Zhuhai Chongda Circuit Technology is building a PCB manufacturing site in Zhuhai, China.

Materials & Process Equipment

Polyimide film is forecast to increase at 10% CAGR from USD 1.7 billion in 2018 to USD 3.1 billion until 2023.

- HNY Research

Conductive inks market value will expand at 7% CAGR from US$2.3 billion in 2016 to US$4.3 billion by 2025.

- Transparency Market Research

Conformal coatings market value will grow at 5.6% CAGR to $15.7 billion by 2024.

- Grand View Research

Electrodeposited copper foils market value is estimated to expand at 12% CAGR from 6.6 billion in 2017 to US$ 16 billion in 2025.

- Persistence Market Research

Photoresist market size will grow at 6% CAGR from USD 4.7 billion in 2017 to USD 6.7 billion by 2023.

- HNY Research
VJ Electronix Summit 1800i

Everything You Liked About Summit 1800 is Still There PLUS MORE!

- Same “1-2-3 Go” Software
- Same Profile Development
- Available 80MM Capability
- Improved Micro Passive Performance
- Even Higher Reliability
- Improved Price/Performance Ratio

We already made Component Counting Easier, now we made it Faster!

XQuik II Auto Load with AccuCount Technology

XQuik with AccuCount Technology combines VJ Electronix’ X-ray imaging with AccuAssembly’s image processing and inventory management to provide a highly accurate count of components stored in tape-and-reel and waffle packs.

- MES data integration
- 7” through 15” reels
- Integrated barcode printing
- >99.7% part count accuracy
- Substantially speed up part counting process
- May also be used for electronics inspection
- Automated Reel Handling
- Automatically “counts” components as small as 01005
- No programming required, One button operation
- No need to remove reel from antistatic moisture barrier bag for counting

Bohemia, NY  Suzhou, China  Paris, France  Budapest, Hungary  Bengaluru, India

VJ Electronix
19 Alpha Rd.
Chelmsford, MA 01824-4124
www.vjelectronix.com
Email: electronixsales@vjt.com
Tel: +1 631 589 8800

VJ ELECTRONIX
Process Control Solutions
CONFIDENCE DELIVERED
Selective soldering equipment market is projected to reach $68 million by 2024.
– Strategyr.com

**3M** appointed Kristen Ludgate Sr. VP, Human Resources and Sarah Grauze, Treasurer and VP, Finance.

**Arlon Electronic Materials** received IPC-4101 QPL for all polyimide specification sheets.

**ASM Pacific Technology** acquired **TEL NEXX** from **Tokyo Electron**.

**BASF** set up 20,000 SM R&D facility in Mumbai, India.

**Chemence** bought electronics adhesives business from **Supreme Resources**.

**Dover** named Richard Tobin, CEO.

**Dow Electronic Materials** expanded its Asia CMP Manufacturing and Technical Center in Hsinchu, Taiwan.

**Gelest** promoted Jonathan Goff to VP of R&D and named Youlin Pan, Sr. Research Fellow.

**Indium Corporation** appointed Andy Seager, European Sales Manager and Michael Schmitt, Production Supervisor for its Rome facility.

**IPTE Germany** opened a new production facility in Fürth, Bavaria.

**JBC** opened a new sales and support office in Chennai, India.

**KIC** promoted Ryan Wilshusen to R&D Manager.

**Kulicke & Soffa** opened a China Demo Center at their Suzhou manufacturing facility.

**Nano Dimension** appointed Gilad Reshef as Regional Director in Hong Kong.

**Nordson** appointed Lara Mahoney as VP of Investor Relations & Corporate Communications.

**Panasonic Factory Solutions Company of America** began doing business under the name **Panasonic System Solutions Company of North America, Process Automation**.

**Physik Instrumente** named Thomas Bocher, Marketing Segment Head, Microscopy & Life Sciences in Karlsruhe, Germany.
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**LED TAIWAN 2019**
Taipei, Taiwan
www.ledtaiwan.org

**SEMICON SOUTHEAST ASIA 2019**
Kuala Lumpur, Malaysia
www.semiconsea.org

Visit www.semi.org/events
Sono-Tek Corporation promoted Bennett Bruntil to VP, Sales & Marketing.

Versum Materials opened a R&D facility in Rush Township, Schuylkill County, Pennsylvania.

VITRONIC France SAS established as service and sales office in Rungis, France.

Zhongxiaoshan Group is investing 2 billion yuan to build a copper foil plant with annual output of 50,000 tons of high-precision copper strip copper foil and 2 million SM of copper clad laminate in China’s Guanjia Village.

Semiconductors & Other Components

Semiconductor revenues grew 21.7% y/y to US$429 billion in 2017, the highest y/y growth in 14 years.

–IHS Markit

Top-5 semiconductor suppliers accounted for 43% of the world’s semiconductor sales in 2017, while top-50 suppliers represented 88% of the total $445 billion worldwide semiconductor market.

–IC Insights

SEMICONDUCTOR FAB EQUIPMENT

• sales increased 37% y/y to $56.6 billion in 2017 and spending is expected to grow 9% y/y in 2018 and 5% y/y in 2019. –SEMI

• spending from Chinese players will double from $3.6 billion in 2017 to $7.1 billion in 2018 and increase to over $11 billion in 2019. –Bernstein Research

• North American Semiconductor equipment industry billings increased 22.2% y/y to $2.37 billion in February 2018. –SEMI

• South Korea became largest semiconductor equipment market in 2017 with US$17.95 billion in equipment sales. –SEMI

Semiconductor photomask market increased 13% y/y to record high $3.75 billion in 2017 and is forecast to exceed $4.0 billion in 2019. –SEMI

China’s IC packaging and testing generated $29 billion in revenue in 2017, making the country the world’s largest consumer of packaging equipment and materials. –SEMI

IC market growth forecast raised from 8% to 15% y/y for 2018 with DRAM and NAND flash markets driving expansion. –IC Insights

AUTOMOTIVE APPLICATIONS

• ECU market value is projected to grow at 6% CAGR from at USD 45 billion in 2016 to USD 96 billion by 2025. –Markets and Markets

• IC market is estimated to surpass US$40 billion in 2018 after surging 11% y/y to US$35.7 billion in 2017 from US$32.2 billion.

–Digitimes Research

• microcontrollers market estimated to grow at 14% CAGR from USD 990 million of 2018 to USD 1.9 billion in 2023.

–HNY Research

• GaN power business value is forecast to expand at 79% CAGR from about US$12 million in 2016 to US$460 million by 2022.

–Yole Développement

• semiconductors devices market is expected to grow at 17% CAGR from USD 711 million in 2017 to USD 1.8 billion by 2023.

–Market Insights Reports

• Automotive connectors market size will expand at CAGR 7.6% from USD 5 billion in 2018 to USD 7.4 billion until 2023.

–HNY Research

• Optoelectronics, Sensors/Actuators, and Discretes’ total revenues climbed 11% to $75 billion in 2017 with market being driven by high demand for sensors, actuators, CMOS imaging devices, light sensors, laser transmitters, and power discretes. –IC Insights

SENSORS

• Smart sensor market value is growing at 19% CAGR from $20.8 billion in 2016 to $82 billion by 2024, with automotive industry revenue expanding at 19% CAGR from $4.9 billion in 2016.

–Estcast Research & Consulting

• Image sensor market value is projected to grow at 9.8% CAGR from USD 14 billion in 2017 to USD 25 billion by 2023.

–Research and Markets

• Nanosensors market is expected to grow at 69% CAGR to $5,550 million by 2024 from $85 million in 2016. –Fior Markets

• Connector industry sales expected to grow 6.8% to over $64 billion in 2018.

–Bishop & Associates

• Power electronics market size will grow at an estimated 4.7% CAGR from USD 4.4 billion in 2017 to USD 5.6 billion by 2023.

–HNY Research

• Wiring harness market value to grow at 7.6% CAGR from USD 42.7 billion in 2017 to USD 7.4 billion by 2023. –HNY Research

• Industrial 3D printing market is estimated to grow at 27% CAGR from USD 1.7 billion in 2018 to USD 5.7 billion by 2023.

–MarketsandMarkets

DISPLAYS

• Chinese AMOLED capacity will rise at 145% CAGR from 228,000 SM/yr. in 2016 to 8.3 million SM/yr. in 2020. –IHS Markit

• Electronic display market value will grow at around 8% CAGR from approximately USD 119 billion in 2017 to USD 191 billion by 2023.

–Zion Market Research

• Flexible displays market value is expected to grow at 27% CAGR through 2025 from USD 5 billion in 2016. –Research and Markets

• Worldwide brand motherboard shipments slipped 15% y/y to less than 13 million units in 2017 and shipments are expected to drop another 10% in 2018. –Digitimes

• Printed electronic market will grow at 22% CAGR from USD 3 billion in 2015 to USD 10 billion in 2021.

–Zion Market Research
Smart LED Lighting Requires New Communications Strategies

High Brightness LED Market’s Surging Demand

Advanced Packaging, X-Ray Inspection and the Humble LED

High Performance Electronic Interconnect Materials Characterization – Techniques & Challenges
Smart LED Lighting Requires New Communications Strategies

BY RUSS SHARER, VICE PRESIDENT OF GLOBAL MARKETING AND BUSINESS DEVELOPMENT, FULHAM CO., INC.

Solid-state lighting is opening up new possibilities for smart buildings and smart cities. Everyone is buzzing about the Internet of Things (IoT) and the possibilities of remote provision and management of lighting systems. The biggest challenge has been communications. LEDs already have embedded programmability to control intensity, hue, temperature, and other characteristics – what we call clever lighting. For intelligent lighting you need communications as well. There are multiple lighting communications and control standards, including DALI, ZigBee, BACnet, Z-Wave, and others, but they aren’t interoperable. IoT offers a common platform for communications. This article will discuss two possible strategies for implementing smart lighting – one wired using Ethernet and the other wireless using Bluetooth mesh. Each approach has benefits in terms of efficiency and reducing energy consumption.

Everyone is talking about smart lighting but who is doing something to make it a reality? There is technology available to add intelligence to LED lighting systems, but the real question becomes how do you connect the luminaires? There is no one dominant standard for lighting communications, and no one wants to commit to the wrong technology. After years of “nearly there” promises, there are finally some open standards approaches such as Bluetooth Mesh and Ethernet that provide lighting controls today and make an ideal platform for smart lighting or the Internet of Things (IoT) in the future.

Energy savings are usually the first benefit achieved with smart lighting. According to the U.S. Energy Information Administration, 17 percent of the energy used in commercial buildings goes to lighting (see Figure 1). Commercial building managers have been saving energy by switching to LED; overall electricity consumption due to lighting dropped from 38 percent to 17 percent between 2003 and 2012. Gartner predicts that energy savings from smart lighting could ultimately be as much as 90 percent.

But the potential benefits only start with energy savings. Having a common standard for smart lighting systems also opens up a host of possibilities for both building automation and smart cities. In any building, light fixtures are the most prevalent piece of electrical equipment, outnumbering wall sockets. The same is true for city streetlights. Imagine the possibilities of equipping those lights with sensors to monitor conditions in the immediate area as well as providing centralized lighting controls. Lighting moves from illumination to a value add system.

To make this shift you need both lighting intelligence and control. Intelligence can be incorporated into the LED luminaires themselves, but control has to be both distributed and centralized. Let’s start with a look at smart luminaires before we review the challenges of adding communications.

From clever lighting to smart lighting

Solid-state intelligence is the first step toward smart lighting systems. Embedding programmability in LED fixtures makes it easy to control the LEDs at the luminaire level, adjusting for characteristics such as hue, light intensity, dimming, and energy consumption. We have labelled these programmable LED fixtures “clever” lighting; luminaires that can be individually programmed at the factory, when they are installed, or when they need to be adjusted over their lifetime. To become smart or intelligent lighting, you only have to add communications.

When you say “lighting control” to most people they think of a simple dimmer switch. For some time now, we have had four basic types of lighting controls:

1. Manual – The simplest lighting controls are an on/off switch or a manual dimmer switch.
2. Timer controls – Adding a timer
to simple lighting controls dictates when the lights turn on or off for energy-savings.

3. Occupancy controls – Using motion sensors to detect room occupancy; when a room is empty the lights remain off to save energy.

4. Light harvesting – Using light sensors to detect ambient light and adjusts room lighting accordingly, e.g. less artificial lighting is needed for a room with windows on a sunny day.

All of these strategies offer the simplest type of lighting control. Using programmable LED components allows you to customize the luminaires to a limited degree but control is still highly localized, usually to just a single room. It’s less expensive to install, but offers limited functionality, makes adding or changing luminaires difficult, and presents a single potential point of failure.

Intelligent lighting uses a centralized building automation control system. It can be initially more expensive to install but offers many more long-term benefits. For example, you not only gain control of energy management for the entire infrastructure, but you can tune specific fixtures or an entire space from a single location. Centralized lighting controls also provide more detailed data about energy consumption and luminaire performance to monitor energy savings and can even issue an alert when a light is ready to fail.

Now consider the possibilities of using intelligent lighting as part of an overall building management platform. Sensors can be placed anywhere there is a light fixture, and those sensors can provide information for applications such as HVAC, motion detection to prevent intruders, smoke detection, triggering an alarm, activating automatic door locks, providing emergency lighting, monitoring air quality, etc. You even can extend this model to entire municipalities using sensors mounted in streetlights can be used to monitor traffic and control traffic lights, monitor weather conditions, and light specific areas on demand, as well as managing energy consumption.

The sensor may be programmable – clever – and can be adapted for a variety of uses but they still need to communicate with the central controller to be considered smart lighting. But what is the best communications strategy and how do you ensure different communications protocols are interoperable?

Enter the Internet of Things

The Internet has become the common communication platform for almost everything, including machine-to-machine communications. The IoT promises to revolutionize monitoring and control of devices, including lighting. In fact, lighting provides the ideal skeleton for an IoT infrastructure:

- Light fixtures are installed at regular intervals and can readily be equipped with IoT sensors.
- Building lighting system connect to a single, stable power source; a potential central control point.
- Light fixtures are more prevalent than any other electrical system in a commercial building, including power outlets.

Sensors mounted in luminaires can carry all sorts of data traffic back to a central control console. Since lighting is ubiquitous it’s ideal for IoT. However, Internet Protocol (IP) controllers will have to find a way to interoperate with established lighting control and communications standards such as:

- DALI – The Digital Addressable Lighting Interface (DALI), which is growing as one of the preferred standards for digital lighting controls including LEDs.
- ZigBee – ZigBee, a wireless standard that provides control over various types of devices, including lighting, and has been endorsed by the Connected Lighting Alliance.
- TALQ – Designed for outdoor lighting systems as a common management software standard.

These are just some of the most popular lighting communications standards. These standards are not designed to work together and they also are not mutually exclusive. Rather, they tend to interoperate as hierarchical standards (see Figure 2). In building automation, for example, controls are layered using different control protocols at each layer. BACnet, the protocol for integrating building automation, provides the primary control bus for automation controls, but secondary layers of communications support other protocols for machine-level communications.

IoT will likely evolve in much the same way, as a common aggregation platform for other control protocols. To support IoT, the existing lighting standards and luminaires need to be compatible and interoperable.

Bluetooth Mesh Brings Wireless Connectivity

In addition to interoperable standards, smart lighting solutions are going to need a connectivity platform. Rather than rip out and replace existing lighting systems, smart lighting will likely be built on wireless standards such as ZigBee, Wi-Fi, and Bluetooth Mesh. We believe that Bluetooth Mesh in particular offers some interesting possibilities for smart lighting applications.

Bluetooth Mesh was created in 2015 and adopted as a networking standard in 2017 as an extension of the Bluetooth Low Energy (BLE) radio standard. Bluetooth Mesh provides many-to-many networking for large-scale device networks, such as asset tracking, wireless sensor networks, and building automa-

![Figure 2](image-url)
Smart LED Lighting Requires New Communications Strategies

Bluetooth Mesh Under the Hood

Bluetooth Mesh operates as a “flood network” where every incoming packet is shared with every outgoing link so the data proliferates across the entire mesh.

Messages can be up to 384 bytes long but most messages fit in a single 11-byte segment. Each message starts with an opcode of one byte (for special messages), 2 bytes (for standard messages) or 3 bytes (for vendor-specific messages). Machine-to-machine communications tends to require smaller data packets so Bluetooth mesh can readily handle the data traffic.

Each message also has a source and destination address, and a sequence number to prevent replay attacks. And each message is encrypted and authenticated for security. There are two keys to secure Bluetooth Mesh messages: 1) network keys that are allocated to a single mesh network and 2) application keys that are specific to an application function, such as turning on a light as opposed to reconfiguring a light.

First, let's consider the specific advantages of adopting Power over Ethernet (PoE). As specified in the IEEE 802.3 standard, both power and communications data are transmitted across the same Category 6 network cable, which is connected directly to the networked devices including DC-powered solid-state luminaires. Given the gains in lumens per watt improvement with LEDs, while the PoE may not have been enough to power fluorescent luminaires, it is certainly sufficient to power LEDs, which eliminates the need for less efficient AC-to-DC conversion. Since the DC power is connected directly to the LED circuitry no drivers are needed.

The Promise of Power over Ethernet

Wireless networking may be the best solution for lighting retrofits, but what about new construction, or areas that do not want to introduce additional wireless networking? As smart lighting starts to take hold, wiring lighting using 10BASE-T Ethernet cable could offer a better approach for both power and lighting controls.

When it comes to new construction, consider replacing conventional power with 10BASE-T Ethernet cable. The computer network can be used to power and manage the building's lighting infrastructure and lay the groundwork for other connected devices. It's a matter of which comes first, IoT or smart lighting. If you start with the computer network, then it's the smart lighting that actually delivers IoT.
LEDs ARE THE FUTURE OF LIGHTING.
YOU NEED AN ASSEMBLY PROCESS THAT PROVES IT.

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What’s Holding Back IoT

Installing more IoT-enabled sensors doesn’t necessarily mean that existing lighting control systems have to be replaced. As IoT-enabled lighting fixtures are being retrofitted, IP-based controls will become more prevalent, but there will still be legacy lighting control standards. Control protocols such as DALI and BACnet can operate concurrently with IoT.

With DALI, for example, up to 64 luminaires can be connected into a single network to control individual light fixtures or groups. DALI offers more granular control of light dimming and other characteristics, such as dimming from 0-10V or dimming to off. However, IPv6 can still be used as a common communications protocol for an IoT infrastructure, with layers of communications to support and interconnect existing systems such as DALI.

What is going to delay IoT adoption for lighting control isn’t standards incompatibility or technical issues; delays will come from timing. IoT certainly promises to solve a number of integration and automation issues, but most of the luminaires installed today will be in service for another five to 10 years. Until they fail there is no reason to replace them with new smart luminaires. The commercial lighting market has a mature supply and deployment strategy with plenty of “dumb” luminaires in the pipeline. The industry clearly isn’t ready to start installing smart luminaires that can support IoT.

It’s obvious that the first smart luminaires to make their way into the channel will have wireless support such as Bluetooth Mesh for retrofit. Sales of LED luminaires for retrofits are expected to make up 50 percent of the LED lighting market through 2024, which isn’t surprising when you consider that half of commercial buildings in use today are more than 60 years old.

Hard-wired intelligent lighting, such as that required for PoE, will likely become part of new construction, but will be slower in coming. There has only been 7-8 percent new construction in overall commercial space since 2000. However, the potential energy savings and granular building controls from smart Ethernet lighting is eventually going to drive demand. For now, retrofitting fluorescents with “dumb” LED luminaires is already delivering substantial energy savings without the benefit of smart lighting controls.

For smart lighting systems to gain market momentum, manufacturers are going to have to take the lead by offering LED luminaires equipped with IoT-ready sensors that are simple to install and offer a relatively fast ROI. With smart light sensors already in place, installers can add intelligence via wireless or hard-wired connections at some future date. Once two-way communications are in place we will start to see the real returns on smart lighting, and the evolution of new IoT-enabled buildings.

Russ Sharer is Vice President of Global Marketing and Business Development for Fulham Co., Inc., is a business leader with over 25 years of experience in B2B marketing and sales, including successful software and network equipment start-ups. Fulham is a manufacturer of innovative and energy-efficient lighting sub-systems and components for lighting manufacturers worldwide.

HVAC, window blinds, etc. PoE is a great way to “future-proof” your building at the same time it opens up a wide range of IoT possibilities.
High Brightness LED Market

Sector to witness massive gains with surging demand for energy-efficient lighting technology

High brightness LED market has established its bearings significantly in today’s world, with LEDs gaining precedence over CFLs. Depleting energy resources and increasing carbon emissions have directed the demand for energy conservation to top the priority lists in all sectors. The government and regulatory bodies across the globe are strictly implementing energy conservation norms, which in turn is triggering heavy deployment of energy saving lighting sources.

An ordinary light bulb transforms 100 Joules of electric energy into 5 J of light energy and 95 J of heat energy, in which case, the latter is a complete waste. In comparison, the energy saving light bulb saves 50% to 70% of energy and increases the life span of the device, which is in the range of 50,000 hours to 100,000 hours, thus offering huge potential. The extended life cycle of these bulbs leads to lower replacement and maintenance costs, which in turn is driving high brightness LED market size. As per a report by Global Market Insights, Inc., “High Brightness LED industry is set to witness a revenue of over USD 22 billion by 2023, at a y-o-y growth of 4.9% over the period 2016-2023.”

These popular high brightness LED technologies are already commercially available in a range of new products in the automotive, backlight, mobile, and lighting applications. Increasing smartphone penetration and demand for related mobile devices have led the mobile segment in high brightness LED industry to snowball. The mobile segment is foreseen to exceed USD 3.60 billion by 2023, increasing at an annual growth rate of 5.1% over the period of 2016-2023.

Rise in sales due to swift penetration of HB LEDs in downlights, replacement lamps, outdoor lights, commercial, and industrial products is likely to propel the lighting application market to register a CAGR of 6% between 2016-2023. High brightness LED industry from the lighting application is estimated to generate a revenue share of over USD 7.4 billion by 2023. Absence of infrared radiation in HB LEDs is resulting into its growing application for food and textile illumination, thereby showcasing a positive swing in global high brightness LED industry dynamics.

Growing concerns regarding energy saving and rising number of initiatives toward increasing green construction are expected to provide ample growth prospects in the regional landscape of high brightness LED industry. Asia Pacific high brightness LED market is projected to register a CAGR of 5.5% over the period of 2016-2023. China and Japan are the prominent countries which are actively seeking a fundamental shift in their energy policies by encouraging improved LED manufacturing, attractive initiatives, and huge financial subsidies.

Europe high brightness LED market is poised to witness an exponential growth at a rate of 4.4% from 2016-2023, due to the vast presence of industries in the region. Analyzing the opportunistic growth in the global high brightness LED industry, number of players are entering in the marketplace. These players are likely to offer end-to-end solutions to gain competitive advantages. The existing players will be focusing on their brand value for strengthening the prominence overseas. Several other players are working on reforming their business models to achieve a gradual decline in the price trend, which will lead to a brighter future for this industry. Prominent high brightness LED industry players include Samsung Electronics, Cree, Broadcom, Moritex, and Seoul Semiconductor.
Advanced Packaging, X-Ray Inspection and the Humble LED

by Keith Bryant, Global Sales Director, Electronics, Yxlon International

The excellent recent Microtech 2018 Conference, organized by IMAPS UK to celebrate the 50th anniversary of their founding, had very strong papers reflecting the developments of advanced electronic packaging over the last 50 years and the drivers and needs for advanced packaging’s future. In other words, ‘where have we been and where are we going?’ In this regard, as advanced packaging continues to develop to support novel and emerging technologies, the need for, non-destructive, test and inspection continues to be vital to ensure the quality and assurance of their functionality, be it simple or complex in nature, wherever, and in whatever harsh environment, the package may end up. This is made ever more difficult as package complexity increases, whilst the feature sizes within continue to decrease. X-ray technology has long been an important part of the non-destructive inspection protocol over the history of advanced packaging and will continue to play an ever more important part in the future. The advances made in both 2D and 3D X-ray inspection over recent years and the new opportunities that are now starting to be available, especially within 3D, or CT, inspection, will enable our 120-year-old X-ray technology to remain relevant to, and be supportive of, the future needs of advanced packaging.

To highlight where X-ray inspection has, can and will support the needs of advanced packaging applications, an obvious case study would be to consider the humble LED. LEDs are a great example of the remarkable developments in packaging and technology over the last 20 years, let alone the last 50. Their need to use higher power, produce better light, contain ever shrinking features and customer demand for increased reliability for expanding manufacturing volumes, intensify the need, today and tomorrow, for higher quality, more consistent production output. Flaws cannot be accepted, especially as higher operating powers typically mean higher package operating temperatures which, in turn, then requires very good thermal conductivity and heat
Without good heat dissipation then heat stresses at the interfaces can cause delamination or die fractures, leading to early product failure and / or reducing LED lifetimes. The presence of voids, particularly at the die to package interface, create air gaps that reduce heat transfer efficiency. As many LEDs are potted, or encapsulated, the only non-destructive test option to check for voiding, and other faults that are shown below, is by using 2D and CT X-ray analysis. Without implementing suitable test and inspection procedures, such failures may be only an inconvenience when an LED is within a home light bulb, but it may be much more serious when the device is located within an automotive application. The automotive industry’s necessary, long-established, and well-known focus on product quality, especially for safety critical applications, is well known, as is their extremely tight manufacturing quality demands on their suppliers.
Advanced Packaging, X-ray Inspection and the Humble LED

**X-ray Developments**

The developments in X-ray technology over the last 20 years that have resonance for LED and other advanced packaging applications include the following:

- Better transmission-style X-ray tubes, giving high magnification capabilities that is necessary for inspecting the tiny features within LEDs.
- Improved X-ray tube resolution, providing better clarity in the 2D X-ray images to enable better analysis of smaller features.
- The ability to image at oblique angle views without losing the available magnification, else analysis of the small joint interfaces is likely to be obscured by the bulk of the joint.
- The use of 3D X-ray, or CT, techniques to provide ultimate failure analysis by being able to take ‘virtual 2D X-ray micro-sections’ through any plane of a sample as well as produce and manipulate 3D rendered visualisations.
- The availability and relatively low cost of incredible computing power in GPUs that are located within high end imaging cards developed for gaming applications on fast home PCs. These permit much quicker CT reconstructions and CT volume manipulation as well as provide the opportunity for new, and better, CT reconstruction algorithms to be used. An example of this is the use of helical CT scanning to produce the CT model as an alternative to the cone beam, or FDK, CT algorithm.
- The emergence of the Partial CT (PCT), or limited angle CT, X-ray technique where 3D analysis can be achieved at higher magnification fields of view on much larger samples than can be achieved in ‘full’ CT.

**Flaws in LEDs**

The earliest NIR LEDs were commercially available in the 1960s. Thereafter, LED development concentrated on moving towards producing light at shorter wavelengths. However, it was not until the late 1990s, when high power blue LEDs became commercially available, that it could be said that today’s ubiquity of the LED started. Without the blue/UV light, it is not possible to produce white light. White light can be produced, either through the blending of red, green and blue light (RGB method), as found in an LED TV, or using the phosphor method where blue/UV light excites a yellow phosphor, as found in high brightness LEDs used for illumination.

Although LEDs are relatively simple devices and single LEDs have a low individual cost, failures can still occur which, if not corrected during production can cause substantial wastage and yield loss. Image 1 shows X-ray images of two different single-LEDs. On the left is an example of what we would expect
to see, the small wire bond connecting the die to the package. However, the image to the right shows a wire break at the wedge bond (highlighted). A 3D representation, created by CT, of a good ball bond on a single LED is shown in image 2.

High brightness LEDs are also still relatively simple devices. However, as discussed earlier, they may be part of a larger, and much more expensive assembly and/or part of a safety critical component. Therefore, test and inspection becomes more important. Image 3 shows a top down view of a board containing 3 high brightness LEDs together with an oblique angled view of one of the LEDs. Voiding can be seen in the joint interfaces as the white ‘bubbles’. This is particularly clear in the oblique angle view. This level of voiding is small and may be very hard to eradicate completely. However, it is unlikely to affect device performance. This may not necessarily be the case for the high brightness LED sample seen in images 4 and 5. Image 5 shows substantial voiding under the die of one of the LEDs compared to the other three. This may affect the thermal performance of the device. Whilst an indication of this issue is helpful from the X-ray image, some X-ray systems are also able to provide a calculation of the voiding level, as seen in image 6.

Other failures that can be seen in LEDs include movement of the wires after molding. An example is shown in image 7. Here a short has almost been created and this problem is often called a wire sweep issue. Automated calculation of the level of wire sweep can be provided by some X-ray systems by indicating the percentage deviation of the wire from a straight line when viewed from above.

A final example of a potential failure in LEDs is shown in image 8. Here, there is an absence of plating material in the through hole substrate which will cause an electrical open.

**Conclusion**

The humble LED shows how the complexity and development of electronic packaging has evolved in recent years. X-ray inspection techniques have offered, and will continue to offer, non-destructive inspection and analysis capabilities for these and other advanced packages, as well as for those packages yet to come. The author would like to thank the entire applications team at Yxlon International for supplying the images for this article.

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High Performance Electronic Interconnect Materials Characterization – Techniques & Challenges

BY NICHOLAS HERRICK, AMIT PATEL, GYAN DUTT AND RANJIT PANDHER ALPHA ASSEMBLY SOLUTIONS, SOUTH PLAINFIELD, NJ, USA

High-power and LED devices generate significant heat that, if not efficiently removed from the assembly, leads to lower operating efficiency and/or lower luminous flux and shorter lifetime. Because the majority of heat is transported through the device interconnect layer, the thermal resistance of the heat path significantly impacts overall device performance. Higher thermal conductivity interconnect materials significantly decrease the thermal resistance of the stack. The effects of high performance interconnect materials are easy to observe and affect end user performance and reliability (e.g. by increasing total luminous flux, efficiency, and color stability). These effects become more pronounced as these devices are over driven and are particularly important in power electronics and UV LED applications.

In this study, a series of interconnect materials, including sintered nano-silver, SAC305 and a hybrid silver sintering epoxy, were used to assemble high-power AlGaNp/Si LEDs for laboratory testing. Junction temperature, thermal resistance, thermal conductivity, total luminous flux, peak wavelength, and efficiency were measured according to JESD51-1 and LM-79-08.

In this paper we discuss the technical and design challenges associated with making accurate thermal resistance measurements across a multi-layered stack. The results of this laboratory study show the comparative performance of identical devices assembled with a variety of interconnect materials. A field example showing enhanced UV LED device performance with high thermal interconnect material is presented.

Introduction

Proper cooling of LEDs during operation requires high performance interconnects to conduct heat away from the p-n junction (the light generating region). Doing so lowers the junction temperature of the LED and increases the efficiency. While 20-60% of the electrical power is converted to photons, the remainder is converted to heat. In laboratory settings and in luminaires convection across the die is negligible or non-existent. Instead, nearly all the heat moves through the die, die attach layer, substrate trace, dielectric, and then the substrate base material (typically FR4, aluminum, or copper, see Figure 1). It then moves through the thermal interface material and into the heat sink where it is exhausted to ambient. Any of these layers can serve as a bottleneck for the heat transfer, but especially layers towards the top of the materials stack where the cross sectional area is still small. Therefore, these layers must have high thermal conductivity to effectively cool the LED. The thermal performance of the whole LED stack is measured as thermal resistance (Rth) in units of degrees Kelvin/Watt (or, equivalently, degrees Celsius/Watt).

Sintered silver as die attach material

The sintered nano-silver paste used here is designed for pressure-less die attach and assembly of electronics components, including high power LEDs. The material uses typical SMT manufacturing processes such as printing and dispensing. It must, however, be sintered at high temperature in an oven. During high temperature sintering the silver paste bakes off its solvents.
while adjacent nanoparticles diffuse together to form a porous structure as shown in Figure 2.

Once the silver paste is printed, dispensed, or stamped, the LED is placed on the deposit via a standard SMT pick-n-place machine or a die bonder. This is possible because this sintered silver paste is so-called pressure-less – meaning many kilograms of pressure aren’t needed during the sintering process in order to make the silver bond.

The thermal conductivity of bulk silver is 429 W/m·K, but because of nano-pores the expected thermal conductivity of sintered silver is lower. Nano-flash thermal conductivity measurement of bulk sintered silver is approximately 230 W/m·K. A sintered silver die attach layer’s thermal conductivity will be based on the size of the nano-silver particles, the solvents and resins used in the paste, assembly pressure, and sintering temperature and duration.

Hybrid silver sintering materials

Another high-performance die attach technology is known as hybrid silver sintering. These are epoxy-based materials that combine the high thermal conductivity of nano-silver sintered materials and the adhesion properties of silver-filled epoxies. They are composed of micron-sized silver flakes and organic and polymer components. During curing they pull adjacent flakes together promoting increased contact and sintering. They have high thermal conductivities (up to 150 W/m·K) but are assembled pressure-less and adhere to bare substrates (whereas solder and nano-silver sintering pastes require metallized surfaces). Curing hybrid silver sintering materials is done in two steps in a box oven, with typical peak temperatures of 200-250 °C for 1-2 hours.

Substrate design for high performance measurements

Compared to all other LED thermal stack materials, dielectrics have high thermal resistance. This limits the junction temperature measurement precision and completely precludes measurement of high performance die attach materials. Using a metal substrate with an active pedestal eliminates the dielectric layer and permits a direct heat path from the LED to the heat sink (see Figure 3).

In our high performance interconnect studies we use dielectricless substrates. High-power vertical LEDs are attached directly to the metal substrate via a die attach material. Heat conduction from the die then moves in approximately a one-dimensional fashion into the substrate. By varying the thickness of the die attach layer we can isolate its contribution to the material stack.

Substrates are clamped to a thermoelectric heat sink held at a constant 25 °C. A thin ribbon of highly-conformable indium (thermal conductivity $K = 81.8$ W/m·K) is used as the thermal interface material.

Measurement techniques

OVERVIEW

The thermal resistance of an LED stack can be measured directly via electrical and optical tests. Both have established industry standards. Depending on the sophistication of the test equipment greater precision and accuracy can be achieved. Higher precision methods measure the thermal conductivity of a layer, such as the die attach material.

JUNCTION TEMPERATURE

The junction temperature of the LED is the temperature of the p-n junction. This shouldn’t be confused with the solder point temperature, which is the temperature of the solder pad. We measure the junction temperature of LEDs via the dynamic voltage method outlined in JESD 51-1. To calculate the junction temperature it is necessary to first measure the temperature sensitivity parameter of the LED, which is also known as the k-factor.

The k-factor is determined by measuring the voltage across an LED at a series of known temperatures when operated at low power. To avoid self-heating, the current through the LED should be below the self-heating threshold of the diode. JESD 51-1 specifies this value as below the knee of the diode’s IV curve.

For best results, and in all but the most simplified circumstances, LEDs should be placed in an oven to ensure a known
Die Attach Material Comparison

![Figure 4. Junction temperature measurements of LEDs assembled with different die attach materials. For each material the ideal bond line thickness was used (see Table I).](image)

silver materials show an 8% difference in junction temperature at 3.0 Watts. These are compared to hybrid silver sintering epoxy which is 5% higher at the same electrical power input and SAC305 which is extrapolated to be 10% higher. Differences between die attach materials become more pronounced the higher the electrical power.

<table>
<thead>
<tr>
<th>Material</th>
<th>BLT Range</th>
<th># of LEDs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solder (SAC305)</td>
<td>53-68 um</td>
<td>10</td>
</tr>
<tr>
<td>Hybrid Sintered Silver</td>
<td>13-35 um</td>
<td>6</td>
</tr>
<tr>
<td>Sintered Silver 1</td>
<td>20-32 um</td>
<td>9</td>
</tr>
<tr>
<td>Sintered Silver 2</td>
<td>20-32 um</td>
<td>8</td>
</tr>
</tbody>
</table>

Table I. Die attach material BLTs and sample quantities used in Figure 4.

**BOND LINE THICKNESS**

The thickness of the die attach layer, alternately referred to as the bond line thickness (BLT), is a key property of an LED assembly. Thicker BLTs relieve thermal stresses, but contribute to higher overall thermal resistance. We measured the BLT of our LEDs in two ways, via cross section and a vertical measuring microscope.

Cross sectioning - The LED is cross sectioned to allow direct optical inspection of the bond line. This is the most accurate way to measure bond line thickness, but does not allow for die tilt measurements because it is a single slice through the die. Figure 3 is an example of an LED assembly cross section.

Vertical measuring microscope – A measuring micro-

---

**Junction Temperature Measurements**

Junction temperature measurements of LEDs show an 8% difference in junction temperature at 3.0 Watts. They are compared to hybrid silver sintering epoxy which is 5% higher at the same electrical power input and SAC305 which is extrapolated to be 10% higher. Differences between die attach materials become more pronounced the higher the electrical power.

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**Theoretical Framework**

- **Junction Temperature (C)**
  - Solder (SAC305): 29°C, 33°C, 39°C
  - Hybrid Sintered Silver: 27°C, 31°C, 35°C
  - Sintered Silver 1: 29°C, 31°C, 35°C
  - Sintered Silver 2: 25°C, 31°C, 35°C

**Figure 4. Junction temperature measurements of LEDs assembled with different die attach materials. For each material the ideal bond line thickness was used (see Table I).**

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**High Performance Electronic Interconnect Materials Characterization – Techniques & Challenges**

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**BOND LINE THICKNESS**

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Vertical measuring microscope – A measuring micro-

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**Die Attach Influence on Junction Temperature**

Figure 4 shows a comparison of die attach materials used in the assembly of high-power vertical red LEDs on dielectricless substrates. These samples were constructed identically with only the die attach material differing. The bond line thicknesses of the samples were chosen to represent the ideal process conditions for that particular material so as to form a better picture of in-use performance (see Table I).

Nano-silver particle size, paste rheology, and processing parameters all determine the ultimate thermal performance of the sintered silver die attach materials. In Figure 4, two sintered
scope was used to optically measure the bond line thickness of an intact LED assembly. This type of microscope has a very narrow depth of field and a calibrated focus axis. By focusing the microscope on a surface, zeroing the z-axis, and then refocusing on a new surface, the user can measure the vertical distance between the two.

This procedure requires knowing some information about the LED package, specifically the thickness of the LED die and the planar location of the bottom of the die attach layer. If these are known, then by measuring the vertical distance between the two and subtracting the die thickness we can calculate the BLT. Performing these measurements for all four corners gives an indication of the die tilt. In practice, this method is accurate to within +/-5 µm.

THERMAL RESISTANCE RESULTS

We measured the junction temperature of 80 high-power vertical red LEDs assembled on dielectric-less substrates. As in Figure 4 (a subset of these samples), dies were assembled identically except for the die attach material.

Plotting these LEDs’ thermal resistances versus their BLTs shows comparative performance of the thermal stacks, shown in Figure 5. The slope of the fitted lines are proportional to the thermal conductivity of the die attach materials. Sintered silver shows the lowest thermal resistance values – especially at high BLTs where the effect is exaggerated. The measurements overlap at low BLTs. This is likely due to low measurement accuracy because Figure 4 showed a clear difference between die attach materials at high electrical powers. Generally, though, thinner bond lines have better thermal performance and smaller differences between die attach materials.

In addition to measuring the junction temperature and thermal resistance, there are a few optical measurements that are useful in the LED industry. These measurements were performed in an integrating sphere according to LM-79-08.

A 0.5 m diameter integrating sphere was used in 2π mode, meaning that the LED was placed on the edge of the interior of the sphere as shown in Figure 6. For calibration, two radiometrically calibrated halogen lamps were used to serially calibrate the integrating sphere and then thermoelectric heat sink’s test surface and mounted LED (Figure 7).

A linear CCD-spectroradiometer gathered light via a small satellite sphere and optical fiber. The spectroradiometer had a spectral range of 360 - 1000 nm. After the LED was illuminated it was required to stabilize to within 0.02 C for 15 seconds.

MEASURED OPTICAL PARAMETERS

The following optical parameters were acquired for each current level:

- Emission Spectrum - was measured from 360-1000 nm. Peak, center, and dominant wavelengths can be extracted from the emission spectrum.
- Optical Power - is the total amount of light emitted by the LED and measured in Watts.
- Luminous Flux - measures the total optical power of the LED as seen by the human eye. It is expressed in Lumens and is calculated by multiplying the photopic response of the human eye by the radiometrically calibrated emission spectrum.
- Efficiency - communicates the conversion rate of electrical power (in Watts) to optical power (also in Watts) of the LED. It is expressed as a percentage. When this parameter includes the efficiency of the power driver and electronics it is referred to as wall plug efficiency.
- Efficacy - is measured in Lumens/Watt and is an indicator of how efficiently the LED converts electrical...
Optical parameters were measured using a satellite sphere and optical fiber. The spectroradiometer had a linear CCD-spectroradiometer gathered light via a small socket. We utilized a secondary sphere as the fiber output instead of a cosine-collector. Two radiometrically calibrated lights were used to calibrate first the sphere and then the LED and socket.

Optical tests show a clear and significant impact of die attach material on LED emission. Figure 8 shows that LEDs assembled with sintered silver have 30% higher luminous flux at 0.7 A (approx. 1.6 W) than LEDs assembled with SAC305. Figure 9 shows a trend among all LEDs towards lower efficiencies as electrical power increases. This is typical among LEDs. However, LEDs assembled with sintered silver had 22% higher power efficiency than those assembled with SAC305 when operated at 0.7 A (~1.6 W). The spectra plotted in Figure 10 show significantly higher radiant emission from an LED assembled with sintered silver versus an LED assembled with SAC305. Furthermore, SAC305 samples showed a shift in peak wavelength at higher operating currents than sintered silver LEDs.

Figure 8. The average luminous flux of LEDs assembled with SAC305 and sintered silver die attach materials. Luminous flux is a measure of the total light output of an LED.

Figure 9. The average efficiency (measured in Watts/Watt) of LEDs assembled with SAC305 and sintered silver die attach materials. As the electrical power increases all LEDs experience lower efficiency. This effect can be somewhat mitigated by using higher thermally conductive die attach layers, such as sintered silver, as shown.

Figure 10. Emission spectra of two LEDs assembled with SAC305 solder and sintered silver die attach materials with equal bond line thickness. The LED assembled with sintered silver showed higher radiant flux and a smaller peak wavelength temperature shift than the LED assembled with SAC305.
The dies were manufactured by SemiLEDs, model EV-sintered silver die attach material and a silver-filled epoxy.

**SILVER APPLICATION**

**FIELD EXAMPLE – UV DIE ATTACH SINTERED**

This study presents significant cost- and energy-savings to consumers. Considered over the lifetime of typical LEDs, the use of end-users regarding overall LED efficiency and brightness. These results are significant and point to clear benefits to proceed with higher thermally conductive die attach materials. As the electrical power increases, all LEDs experience lower efficiency. This effect can be somewhat mitigated by using higher thermally conductive die attach materials. InGaAlN on metal alloy UV LEDs onto 3535 packages.

**Figure 11.** Packages (left) and UV dies (right) assembled with sintered silver.

**Figure 12.** Packages (left) and UV dies (right) assembled with silver-filled epoxy.

**Field example – UV die attach sintered silver application**

For this field example we assembled four vertical InGaAlN on metal alloy UV LEDs onto 3535 packages.

**Figure 13.** Voiding on the L1 and L2 layers of a UV LED assembled with silver-filled epoxy on a soldered package. The L1 layer is silver-filled epoxy, the L2 layer is solder.

**Figure 14.** Radiant power of UV LEDs assembled with sintered silver and silver-filled epoxy die attach materials.

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**Figure 15.** Radiant Power of UV LEDs

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- Sintered Silver, LED 1
- Silver Epoxy, LED 1
- Sintered Silver, LED 2
- Silver Epoxy, LED 2

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**Figure 16.** Small shift in color coordinates for sintered silver samples. Note that these LEDs appear to run with 24% higher efficiency than silver-filled epoxy.
This is because the LEDs are operating at higher radiant power at 0.7 A than LEDs assembled with silver. LEDs assembled with sintered silver show 18% higher than luminous flux, is communicated here because these are thermoelectric heat sink held at 25 C. Radiant power, rather than luminous flux, is measured until they reached thermal equilibrium with a die bonder and then sintered in a box oven. The packages were then soldered to a substrate. The LEDs in this study came from two different lots. The sintered silver dies had a k-factor of -1.19 mV/C and silver-filled epoxy dies had a k-factor of -1.51 mV/C.

VOIDS

Voids were measured using an x-ray inspection system. In each case voiding was minimal, but we observed voiding on both interconnect layers (see Figure 11 and Figure 12):

- L1 – The die attach layer composed of sintered silver.
  Two LEDs were assembled with sintered silver paste, and two LEDs were assembled with silver-filled epoxy.
- L2 – The package attach layer composed of solder paste.

X-ray void analysis of these samples showed both L1 and L2 voids (see Figure 13). L2 voids are classic solder voids and appear with rounded edges and high contrast. They are located throughout the L2 interconnect pads. L1 voids are only on the periphery of the die attach layer. They are smaller and don’t have the nice rounded edges of classic solder voids. It is especially easy to spot the difference between these two features because L2 voids will extend across the edge of the die (because they are on the layer below the die), while L1 voids only appear under the die.

OPTICAL RESULTS

The UV LED packages were placed in an integrating sphere as described above and illuminated with 0.1, 0.35, 0.5, and 0.7 Amperes until they reached thermal equilibrium with a thermoelectric heat sink held at 25 C. Radiant power, rather than luminous flux, is communicated here because these are UV LEDs and emit outside the visible spectrum. LEDs assembled with sintered silver show 18% higher radiant power at 0.7 A than LEDs assembled with silver-filled epoxy while also consuming 8% less power (Figure 14). This is because the LEDs are operating at higher efficiencies, as shown in Figure 15. Sintered silver samples run with 24% higher efficiency than silver-filled epoxy samples at 0.7 A.

Lastly, Figure 16 shows a smaller shift in color coordinates for sintered silver samples. Note that these LEDs appear to be from different production lots because they have different color coordinates. However, the relative shift in their coordinates still communicates relative performance.

CONCLUSIONS

The choice of die attach material significantly affects the thermal performance of LEDs, and therefore the optical performance. High thermal conductivity materials, such as sintered silver, reduce junction temperatures, increase radiant power and optical efficiency, and stabilize thermally-induced color shifts. Measuring the precise performance of these materials can be challenging and requires the use of dielectricless substrates. However, observing the influence of high performance interconnects on end-use applications (such as UV LEDs) is easier because the influence on final device performance is large. LEDs operating at high electrical powers especially benefit from high performance interconnects.

Nicholas.Herrick@AlphaAssembly.com
REFERENCES


The World’s Preeminent LED Exhibition Series
**LED CHINA 2018 Shanghai – September 19-21 2018**
Shanghai New International Expo Center

Organizer
UBM Trust is a joint venture company of UBM Asia Ltd., which is owned by UBM plc listed on the London Stock Exchange.

UBM Asia Ltd. is the largest trade show organiser in Asia and the largest commercial organiser in China, India and Malaysia. Established with its headquarters in Hong Kong and subsidiary companies across Asia and in the US, UBM Asia Ltd. has a strong global presence in 24 major cities with 31 offices and 1,300 staff.

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- SIGN CHINA 2018·Shanghai
- Future Sign Academy Annual Summit
- Innovation Theatre
- VIP Buyer Onsite Sourcing Programme

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Learn from the Experts and Make your Factory eSMAR

eSMAR FACTORY conference 2018
May 24th, 2018
Plug 'n Play - Sunnyvale, CA, USA

PROGRAM AGENDA

6:00PM Pre-conference tour (FREE) at LabONE on Wednesday, May 23rd

8:00AM REGISTRATION OPENS on Thursday, May 24th

8:30AM KEYNOTES: 'Ahead of the Curve: Digital Reinvention in Electronics with Intelligent IoT' Christophe Begue and Laura Ong, IBM

9:00AM 'AI and Machine Learning disrupting the manufacturing of your products’ Albert Yanez Asteelflash, USA Corp.

9:30AM 'The eSmart Factory - Plug And Play Edition' Michael Ford, Aegis Software

10:00AM COFFEE BREAK

10:30AM 'Artificial Intelligence: doom for humanity or enabler of advancement? - a deep dive’ Jay Gorajia, Mentor Graphics Corporation

11:00AM 'A practical roadmap to the Smart Factory' Francois Monette Cogiscan Inc.

11:30AM 'Applying Industry 4.0 methods to Electronic Assembly Reflow and Cleaning Processes’ Tom Forsythe, KYZEN Corporation

12:00PM LUNCH

1:00PM 'Industry 4.0 for Inspection in electronics industry’ Ragnar Vaga, YXLON International GmbH

1:30PM 'Smart Manufacturings Next Act’ Benjamin Lichtwardt, ViTrox

2:00PM 'Lights Out in the Inventory Room - The Evolution Towards a Fully Automating Material Management' Bill Cardoso, Creative Electron

2:30PM COFFEE BREAK

3:00PM 'Smart Manufacturing Framework for a Connected Enterprise’ Gregory Vance, Rockwell Automation

3:30PM 'Printing 3D Sensors & Antenna Directly onto High Value Products’ Mike O'Reilly, Optomec, Inc.

4:00PM 'Strategies for Smart Factory implementation' Panel Discussion

5:00PM CONFERENCE ENDS

$250 EARLY BIRD SPECIAL ends on May 1st

SOME OF THE TOP EXHIBITORS:
BTU, Siemens, Mentor, Asteelflash, Aegis, Optimal Plus, Photo Etch, Shenmao, Supply Frame, Essemtec
CyberOptics Interview –
Dr. Subodh Kulkarni

Trevor Galbraith interviewed Dr. Subodh Kulkarni, President and CEO, CyberOptics at IPC APEX and discussed the importance of metrology in the inspection process.

You have added the 3D CMM to your SQ3000 AOI system. Please explain what that is and how it works?

We have taken on proprietary multi-reflection separation 3D sensing technology that we commercialized in SQ3000, our 3D AOI system. We have now added CMM functionality. CMM stands for Coordinate Measuring Machine. Essentially what we have done is come up with an in-line CMM that can measure things, not just visually inspect things, very accurately, very fast and in a very easy to use manner. We believe it is the world’s first in-line CMM that can measure any object in less than ten seconds. You can get hundreds of thousands of dimensions all at the same time. So it is a truly unique product.

And actually very necessary because with smart factory integration and the need for improving the processes, you need to use real data.

You’re right. With the smart factory, there is the need for, not just saying whether the part is good or bad, but if it is bad, why is it bad, what precise measurements are bad, and you need to feed that data back to the root cause as soon as possible, so you do not create further defects.

You have noticed looking at these machines, the resolution is quite incredible and some of the capability is staggering. Can we get a demonstration of how this works?

We’ll show you how to put any part here and inspect it. What you will see on the screen is a typical socket metrology application. In socket metrology, we are taking thousands of pins that are on a circuit board and before a CPU or GPU is mounted, you want to make sure all those pins are correct in heights, dimensions and angles. These are what measurements are needed. So it critical in the future smart factories to have measurements, not just inspection.

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You must make sure the pins are in correctly so that you get the right contact and conductivity and everything else.

Correct. You want to make sure that all those thousands of pins are accurate before you bring the CPU/GPU in play.
Moisture Absorption Ratio (Weight %)

Chip LED stored in ambient environment (30°C, 60% RH) for 168 hours.

After 11 hours of storage in this environment, it was left for 13 hours in a dry box at <3% RH. This process was repeated 5 times from Monday to Friday and left for 61 hours in a dry box at <3% RH.

After baking, the LED chip was stored in a dry cabinet capable of maintaining 3%RH.

This is a similar condition with an LED chip that is stored in a dry cabinet right after opening a moisture barrier bag.

Experimental
Data on moisture absorption and dehumidification of chip LEDs

Example: LED3025 (3.0mm×2.5mm×11.3mm)
floor life 168h
Pre-treatment: 48-hour Baking Process at +60°C
(LED makers' baking guideline)

1. Chip LED stored in ambient environment (30°C, 60% RH) for 168 hours.
2. After 11 hours of storage in this environment, it was left for 13 hours in a dry box at <3% RH. This process was repeated 5 times from Monday to Friday and left for 61 hours in a dry box at <3% RH.
3. After baking, the LED chip was stored in a dry cabinet capable of maintaining 3%RH.

Storing ICs packages and LEDs in a dry storage cabinet.

When IC package and chip LEDs are left on the pick and place, they will absorb moisture from the atmosphere and may popcorn due to heat expansion in the reflow process.

The floor life can be stopped when IC packages and chip LEDs are stored in a dry cabinet capable of maintaining 5%RH or less by following the IPC/JEDEC J-STD 033C guidelines.
Normally, what is being done today is a CMM type operation where they are doing a sampling of the pins which takes hours and it is not accurate enough and you still do not get a 100-percent inspection. With CMM inspection, you can get 100-percent inspection of all those hundreds of thousands of pins in the span of 10 or 15 seconds and you assure everyone the pins are in the correct position before you bring the CPU/GPU in play.

In the demonstration, we are taking a look at a few pins and you can see the ones with the red heights are obviously off-scale, those are the bad pins and the ones where the shape looks good, those are the good pins. You are able to very quickly inspect and measure which pins are good and which are not and if they are not good, how they are not good. That’s what we are doing.

So that is the first 3D metrology in-line CMM. You also have another new machine here which is the SE3000 3D SPI system. What are the key features of this new machine?

We are very proud of launching the new 3D SPI avatar MRS proprietary sensing technology. We have leveraged a sensor technology which gives us the highest-resolution, accuracy and speed – all at the same time. We have put it in a SPI system where the value proposition is significantly better for gauge R&R – reproducibility and repeatability. High-end SPI systems, including our own, usually run at about four- to five-percent gauge R&R @ 6 sigma. This system is running at less than two-percent R&R @ 6 sigma. The smaller the number, the better. So a factor of two to three better than the best SPI systems out there right now. This can also measure very small pads. For high-end customers who have extremely advanced electronic circuits, where the pads are getting smaller, the components are getting smaller and at the same time, the reproducibility and accuracy has to be extremely high, this is the answer for their needs.

The beauty of the CyberOptics systems is that you develop your own sensors so you have complete control of that part of the process.

Correct. We are fundamentally a sensing technology company. Our focus is really on 3D, high-precision, proprietary sensing technologies. Our secret sauce is the algorithms we have in our high-precision 3D sensors. That is what differentiates us from the generic competition.

A very innovative company and it is great to see you here breaking new ground with the metrology system here. Thank you very much for showing it to us and thank you for joining us.

Thank you and we appreciate your interest.

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Building on the leading BERGQUIST brand thermal management portfolio, Henkel has developed a brand new liquid GAP FILLER material that offers the rare advantage of thermal interface material (TIM) reworkability without sacrifices in thermal conductivity or automation performance. BERGQUIST GAP FILLER TGF 1500RW delivers these three valuable benefits in a single material, extending even greater process flexibility and post-assembly adaptability. Henkel’s new TIM is a one-part, cure-in-place liquid gap filler allowing use with automated dispensing equipment for high-volume manufacturing operations. Because the material is applied as a liquid, it is ideal for miniaturized, high-density assemblies and complex architectures, penetrating small gaps for complete coverage. Once cured, the material provides optimized surface contact and thermal transfer with a 1.5 W/m-K thermal conductivity.

Techsil’s new methyl acrylate adhesive has wide appeal

Techsil introduced a new two-component high-performance structural adhesive from Panacol: Penloc GTN is an easy-to-process, methyl acrylate based, low-odour adhesive that can be used in a wide variety of applications. Penloc GTN adheres especially well to brass, ceramics, steel, aluminium, PVC and similar materials. The performance adhesive boasts a high power transmission capability and excellent thermal stability. It is both flexible and offers superior adhesion. Compared to other methyl acrylate adhesives, it has the advantages of a low-odour formation and a long processing time of ten to 15 minutes. To allow effective monitoring of blending quality, the two components of Penloc GTN have different colours that, applied thinly, change to a grey, almost colourless surface as the blend cures.

Multitest contactors for automotive test applications

Multitest’s customized high voltage contacting solutions have been well accepted for volume production. Multitest received a significantly increased order volume from automotive customers for its Blue Line Cantilever Technology sockets: nano Kelvin, Dura Kelvin, and Econ. Multitest high voltage contactors have proven best performance for reliable high voltage testing at full specification values. To optimize the contactors’ performance for high voltage testing, the Multitest Interface Product Group leveraged drew from decades of own experience in high voltage testing, as well as, synergies with the Multitest Handler Group. The sockets and also some of the change kit parts of the handler are designed based on the voltage requirements of the device.

Rogers Corporation introduces AD300D and IM Series

Rogers Corporation is pleased to introduce two new products: AD300D laminates and IM Series laminates. AD300D fourth generation, commercial microwave and RF laminate material extends the capabilities of the successful AD300 product grade. This ceramic-filled, glass-reinforced, PTFE based material provides the controlled dielectric constant (2.94±0.05), low loss performance (0.0021 at 10GHz), very good passive intermodulation response (-159dBc at 0.030” thickness), and good circuit process ability required for mobile infrastructure microstrip antenna applications. This PTFE composite material combines a cost-effective construction with unique chemistry and processing to offer RF and Microwave designers an option for improving electrical and mechanical performance without the additional costs traditionally associated with higher performance material options. The IM Series high frequency laminates are an outstanding Passive Intermodulation (PIM) performing version of our AD300D, AD255C, and DiClad 880 antenna grade laminates.

INSPECTIS: The best microscope requires the best lighting

The best Full HD Digital Microscope technology isn’t providing optimum results if its image is compromised by less than the best lighting technology. To get the best inspection results and imagery out of the powerful INSPECTIS system, the lighting has to be up to snuff. That’s why INSPECTIS AB announces the availability of its new HD-024-B White LED Ring Light. The all new HD-024-B provides the best light matched to the capabilities of the INSPECTIS system, and also makes the light easier to use and adjust. In keeping with the clean, simple equipment approach of INSPECTIS, it also prevents wire clutter. The new HD-024-B is powered directly from the INSPECTIS camera that’s being used via the AUX power outlet found at the top-right side of the camera housing.
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ASSOCIATION NEWS

Don Dupriest to chair IPC Standards Committee

Don Dupriest, Lockheed Martin Missiles & Fire Control, has been elected chair of the IPC Technical Activities Executive Committee (TAEC) for a two-year term. Dupriest succeeds Chris Mahanna of Robison Laboratory, Inc., who held the role for IPC’s top standards development oversight committee for the past two years. As a Lockheed Martin Fellow on Lockheed Martin’s Technical staff, Dupriest provides leadership in interconnected technology development for electronic manufacturing and is responsible for advanced technology, process development and product manufacturability for electronic systems. An active IPC volunteer for more than 25 years, Dupriest has provided invaluable service to IPC. A previous chair of the TAEC, he is also a member of IPC’s Hall of Fame and President’s Award recipient. Dupriest currently co-chairs the IPC D-35 Printed Board Storage and Handling Subcommittee. Dupriest was elected to the TAEC post while attending a mentorship meeting for IPC Emerging Engineers. “I have to admit I was surprised to hear I was elected – I guess this is what happens when you miss your first TAEC meeting in twenty plus years,” he joked. “The committee voted to change the rules to allow a second term.” Dupriest added, “I am honored to be chosen and trusted by my peers to lead and serve as the first second term chairman of the TAEC.” Citing his goals for chairmanship, Dupriest stated, “I typically jump right in when approaching any task, so I plan to do that with the TAEC. We now have greater use of task groups within committees to speed up creating content and resolution of requirements under development, but there is always room for improvement. “I’d like to see what else we can do to better execute standards development by revising the Project Initiation Number (PIN) process for each new document at IPC. I’d like the process to better describe potential influences on other general committees and documents; i.e., requirements that might be impacted by the new PIN, giving general chairs a broader idea of activities outside their purview that may be impacted by new document development. I am also interested in keeping the communication lines open between general chairs so that we keep one another informed.” Mentioning his commitment to mentoring the next generation of engineers, Dupriest indicated his interest in bringing emerging engineers to TAEC meetings to give them an idea of what to expect once they are members of IPC.

www.ipc.org/TAEC.aspx

North American PCB Industry Rebound Continues

IPC — Association Connecting Electronics Industries announced today the February 2018 findings from its North American Printed Circuit Board (PCB) Statistical Program. Year-over-year shipment and order growth continued in February, and the book-to-bill ratio climbed to 1.17. Total North American PCB shipments in February 2018 were 8.8 percent compared to the same month last year. This year to date, shipments are 9.3 percent above the same period last year. Compared to the preceding month, February shipments decreased 0.9 percent. PCB bookings in February increased 7.2 percent year-over-year, raising year-to-date order growth to 15.9 percent above the same period last year. Bookings in February were down 7.1 percent compared to the previous month. “The North American PCB industry continued its robust recovery in February, with positive year-over-year sales growth for the sixth consecutive month,” said Sharon Starr, IPC’s director of market research. “The outlook is also positive, based on strong order growth in recent months, and on the PCB book-to-bill ratio, which is above parity (1.0) for the 13th consecutive month and reached a new 12-year high in February.” 02_1820ipc-book-to-bill20graphs Detailed Data Available The next edition of IPC’s North American PCB Market Report, containing detailed first-quarter 2018 data from IPC’s PCB Statistical Program, will be available next month. The quarterly report presents detailed findings on rigid PCB and flexible circuit sales and orders, including separate rigid and flex book-to-bill ratios, growth trends by company size tiers, demand for prototypes, and other timely data. This report is available free to current participants in IPC’s PCB Statistical Program and by subscription to others. More information about this report can be found at www.ipc.org/market-research-reports. Interpreting the Data The book-to-bill ratios are calculated by dividing the value of orders booked over the past three months by the value of sales billed during the same period from companies in IPC’s survey sample. A ratio of more than 1.00 suggests that current demand is ahead of supply, which is a positive indicator for sales growth over the next three to twelve months. A ratio of less than 1.00 indicates the reverse. Year-on-year and year-to-date growth rates provide the most meaningful view of industry growth. Month-to-month comparisons should be made with caution as they reflect seasonal effects and short-term volatility. Because bookings tend to be more volatile than shipments, changes in the book-to-bill ratios from month to month might not be significant unless a trend of more than three consecutive months is apparent. It is also important to consider changes in both bookings and shipments to understand what is driving changes in the book-to-bill ratio. IPC’s monthly PCB industry statistics are based on data provided by a representative sample of both rigid PCB and flexible circuit manufacturers selling in the USA and Canada. IPC publishes the PCB book-to-bill ratio at the end of each month. Statistics for the current month are normally available in the last week of the following month.

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