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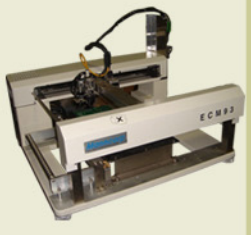

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THE WAY I SEE IT

Bits and Pieces— Viasystems, IPC Pres., Nakahara, DDi & Mitt Romney

by Ray Rasmussen
I-CONNECT007

SUMMARY: It's been a busy last few weeks in the industry and in this month's column Editor Ray Rasmussen takes a look at the big stories and events that caught his attention.

Viasystems Buys DDi Corporation

Viasystems is on the move, again. After a decade-long hiatus when the company went from financial roll-up artist in the 1990s to corporate villain, as their intense consolidation strategy came unglued with the dotcom bust in 2001 and the global shift of manufacturing to China, the company seems to be getting back on track. In the past year, they've bought Merix and now DDi Corporation, building what would seem to be a challenger to TTM's dominance in military PCBs serving the U.S. market.

Is Viasystems reinitiating their plans baked back in the '90s to become the dominant industry player? If so, we should see a major Asian acquisition soon. From the press announcement, Viasystems stated, "The transaction allows Viasystems, already a leading market player in the automotive segment, to increase its market share in the technically-demanding military and aerospace market and the growing industrial and instrumentation market while broadening its customer base." You can read more about the acquisition here.

New IPC President

John Mitchell has been hired to head up IPC, replacing Denny McGuirk who left the IPC last fall to run SEMI. After a six-month search, the IPC Board has settled on an outsider, skipping over several IPC veterans. Although I would have liked for IPC to pick one of our own to lead the organization, I'm sure the board had solid reasoning for the direction it took.

In any case, Mitchell comes to the IPC with some good credentials with stints at GE Aerospace, Alpine Electronics, and Bose Corporation. I'm sure he'll do a good job for us. I don't think he'll have the decade of challenges that Denny had to work through, but it should be interesting nonetheless. I look forward to working with him. Read more about Mitchell's appointment here.

Naka on China

Whenever I get an e-mail from Dr. Hayao Nakahara (Naka), he's either telling me that what I've written is "bullshit nonsense" or he's sharing insights from his latest adventure in China. In late March, he dropped me a note with some comments about his travels in China (which was a relief). As usual, he digs into the details as he visits PCB factories. His insights are priceless. We titled his latest piece *To Understand China, You Have to Visit China*. Here's a quote from the report: "The direct

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BITS AND PIECES *continues*

labor cost of PCB manufacturing used to be 4%. Today, it's about 8% of the 'selling' price, but 11% of the 'manufacturing cost.' China's government makes it mandatory to increase pay by at least 13% each year. At this rate, the wages will double in four to five years if my math is correct."

For anyone interested in what's going on in China, take a few minutes to read Naka's e-mail. Naka is an industry gem and I hope he never retires. Who's going to fill his shoes?

Bob Neves and Hamed El-Abd Discuss China

With a similar theme—the rising costs of doing business in China—IPC's newest board member and CTO of Microtek Labs, Bob Neves, talks with Hamed El-Abd, WKK distribution president, about their experiences and observations living and working in this dynamic and very important market. Watch this very interesting discussion here.

DDi, Bain Capital, and Mitt Romney

It was interesting reading about our industry in the national press in January when DDi Corporation's relationship to Bain Capital took center stage in a contentious battle between two candidates from the Republican Party. Newt Gingrich was attacking Mitt Romney's record as a job creator claiming Romney to be more of a corporate opportunist and destroyer of companies and jobs when he ran Bain Capital back in the 1990s.

FactCheck.Org took a look at the Bain/DDi relationship in response to a video published by Gingrich's Super PAC. It calls out the inaccuracies in the video, but, for the purposes of this column, it gives us a look into the background behind the relationship between Bain Capital and DDi. In Bain's case, timing is everything. The company made a bundle taking DDi public and then selling most of its shares within a few years. Not many saw the dotcom bust coming, which ultimately pushed DDi into bankruptcy, leaving Bain unscathed.

Bob Willis' New Book

PiHR, or pin-in-hole reflow, is not a new technology, but Willis compiles his many years of experience into the pages of this free e-book with a few tricks for the expert and a great overview of the technology for the novice. To download your free copy, visit the PiHR Technology website.

SMT Magazine's April Issue on Military

I have to mention the April issue of *SMT Magazine*, which features a series of articles focused on military and aerospace applications. As with *The PCB Magazine*, *SMT Magazine* seems to improve with every issue, but this one stood out for me. The content is over the top! If you haven't seen it, visit the site and check it out.

Well, that's all the bit and pieces I have for this month. As always, I look forward to your comments or suggestions. **SMT**

Ray Rasmussen is the Publisher and Chief Editor for I-Connect007 Publications. He has worked in the industry since 1978 and is the former Publisher and Chief Editor of CircuiTree Magazine. Please send questions or comments to Rasmussen here.

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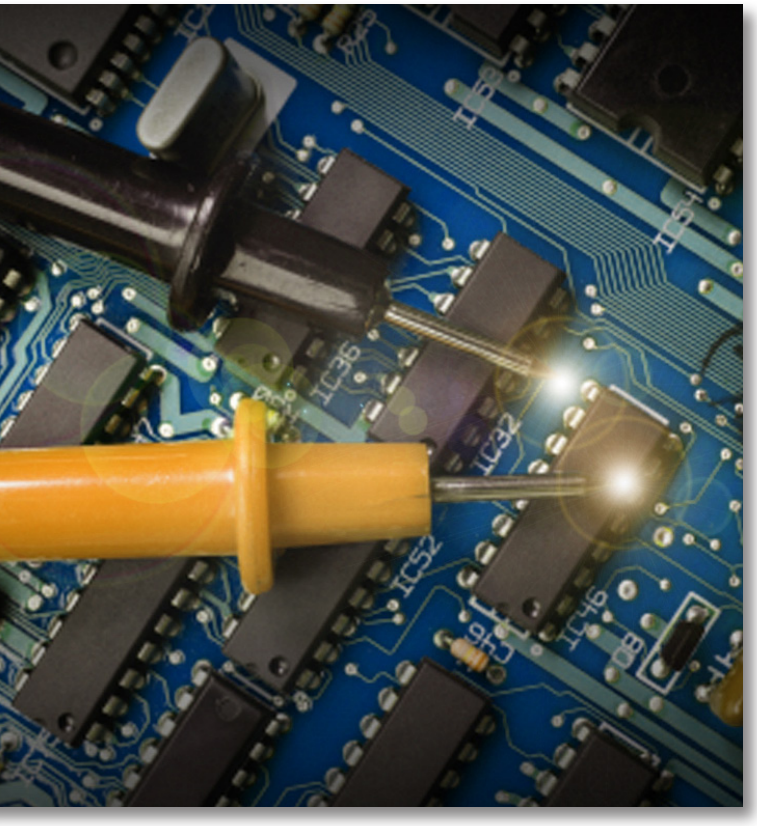
SMT PERSPECTIVES AND PROSPECTS

RELIABILITY OF A LEAD-FREE SYSTEM: Grid Array Solder Joint Reliability, Part VI

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

SUMMARY: *Dr. Hwang continues her exploration of the SAC solder system this month. Now that mechanical and physical properties have been addressed, she moves on to review the scientific fundamentals behind the solder's properties and overall performance.*

Last month's column outlined the correlation of general mechanical properties and physical properties (specifically melting temperature and liquidus temperature) to the Ag dosage and Cu dosage, respectively, in the SAC solder system. What is the scientific basis behind this correlation as exhibited by the test results? Better yet, how do the scientific fundamentals anticipate the solder's properties and performance? The information below outlines the key points of the underlying principles and operating phenomena.



In a SnAgCu system, metallurgical reactions between Sn and the minor elements, Ag and Cu, are the primary resources in determining the application temperature and the mechanism of solidification, thus microstructure, which, in turn, controls mechanical properties. The metallurgical reactions referred herein may or may not be an alloying mechanism.

There are three probable binary eutectic reactions among the three components of Sn, Ag, and Cu. A reaction between Ag and Sn forms a eutectic structure of Sn-matrix phase and e intermetallic compound phase (Ag_3Sn) at 221°C. Cu reacts with Sn to form a eutectic structure of Sn-matrix phase and h intermetallic compound phase (Cu_6Sn_5) at 227°C. Ag can also react with Cu to form a eutectic structure of Ag-rich a phase and Cu-rich a phase at 779°C.

However, no phase transformation at 779°C was detected in the solidification thermal measurement for the SnAgCu ternary compositions as studied (H-Technologies Group Internal Research Report, 1998). This indicates that it is less likely for Ag and Cu to directly react in the ternary composition range as discussed herein. Instead, it is more thermodynamically favorable and kinetically feasible for Ag or Cu to react with Sn to form Ag_3Sn or Cu_6Sn_5 intermetallic compounds. Therefore, the SnAgCu ternary reaction is expected to consist of Sn-matrix phase, e intermetallic compound phase (Ag_3Sn), and h intermetallic compound phase (Cu_6Sn_5).

The relatively hard Ag_3Sn and Cu_6Sn_5 particles in the Sn-matrix of SnAgCu ternary alloys can effectively strengthen the alloy through building a long-range internal stress. These hard particles can also serve as the most effective blocks for fatigue crack propagation. The

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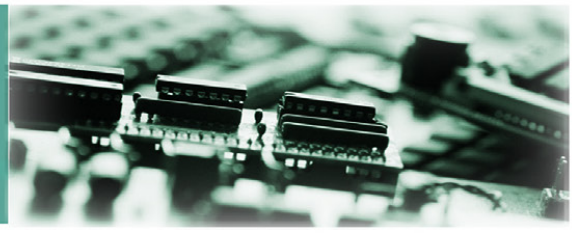

RELIABILITY OF A LEAD-FREE SYSTEM, PART VI *continues*

formation of Ag_3Sn and Cu_6Sn_5 particles can partition finer Sn-matrix grains. The finer the Ag_3Sn and Cu_6Sn_5 particles are, the more effectively they partition Sn-matrix grains, resulting in the overall finer microstructure. This, in turn, facilitates grain boundary gliding mechanisms which accounts for the extended fatigue lifetime under elevated temperatures when the grain boundary gliding is a dominating mechanism barring the presence of other extraneous failure mechanisms.

The correlation of the mechanical properties to Ag content and Cu content, respectively is summarized as follows: When Ag is around 3.0 to 3.1%, both yield strength and tensile strength increase almost linearly with Cu contents up to approximately 1.5% Cu. Beyond 1.5% Cu, the yield strength decreases with any further increase in Cu, but alloy tensile strength remains steady. Overall the alloy plasticity is high for the compositions having the Cu in the range of 0.5 to 1.5% and then decreases with further increase in Cu. With respect to Ag content (at a range of 0.5 to 1.7% Cu), both yield and tensile strength increase almost linearly with Ag up to 4.1%; but the plasticity decreases with Ag.

At the Ag content around 3.0 to 3.1%, the fatigue life reaches the maximum at the Cu content of 1.5%. It is also found that an increase in Ag content from 3.0% to a higher level (up to 4.7%) does not offer any enhancement in mechanical properties. When both Cu and Ag are in higher dosages, the plasticity suffers. These test results support the underlying principles as outlined above.

Since Ag at 3.5 to 4.0% and Cu at 0.4 to 1.0 constitute the near-eutectic composition, it should be noted that the lowest melting temperature that can be achieved in SnAgCu system, 217 to 219°C, fall in this range of compositions.

At the extreme case of the lower Ag compositions, that is when Ag reaches zero, the SAC becomes SnCu system having a eutectic composition of 99.3Sn0.7Cu with a melting temperature of 227°C. In parallel, SAC becomes SnAg system with a eutectic of 96.5Sn3.5Ag at melting temperature of 221°C. Their relative properties in comparison with SAC are summarized as below.

SAC Versus 96.5Sn3.5Ag

When compared with the long-established 96.5Sn3.5Ag alloy, the SAC compositions (within the specified ranges) perform better in strength and fatigue life. However, on plasticity, the compositions containing both higher Ag and Cu exhibit lower plasticity than 96.5Sn3.5Ag.

SAC Versus 99.3Sn0.7Cu

The SnAgCu compositions (within the specified ranges) with Ag at more than 0% and Cu at 0.5 to 1.5% also offer the better performance in strength and fatigue, but lower plasticity than 99.3Sn0.7Cu. **SMT**

Dr. Hwang, a pioneer and long-standing contributor to SMT manufacturing since its inception as well as to the lead-free development, has helped improve production yield and solved challenging reliability issues. Among her many awards and honors, she has been inducted into the WIT International Hall of Fame, elected to the National Academy of Engineering and named an R&D Stars to Watch. Having held senior executive positions with Lockheed Martin Corporation, Sherwin Williams Co., SCM Corporation and IEM Corporation, she is currently CEO of H-Technologies Group providing business, technology and manufacturing solutions. She is a member of the U.S. Commerce Department's Export Council, and serves on the board of Fortune 500 NYSE companies and civic and university boards. She is the author of 300+ publications and several textbooks and an international speaker and author on trade, business, education and social issues. Contact her at (216) 577-3284; e-mail JennieHwang@aol.com.

Dr. Hwang will present two lectures, "Lead-Free Performance and Reliability: Current and Future" and "Array Package Interconnection: Forward/Backward Compatibility and Reliability," at the SMT/Hybrid/Packaging International Conference and Exhibition in Nuremberg, Germany, May 8, 2012.

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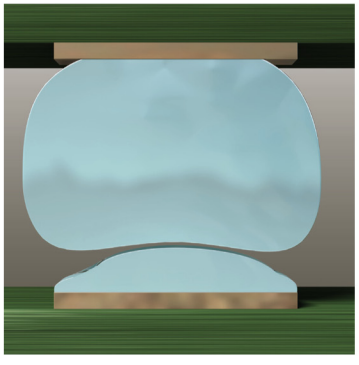

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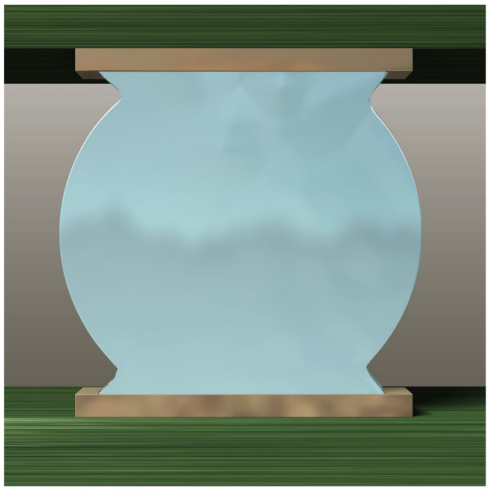

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Ensuring Testing of Next-Generation Portable Devices

by Michael Smith
TERADYNE, INC.

SUMMARY: ***More powerful products that consume less battery life—this is what consumers want. What's the best way to test these ever-evolving portable devices? Using traditional voltage levels with modern-day devices could compromise the safety of the test. Michael Smith walks you through the proper electrical testing process.***

As technology continues to make huge advancements, so do the capabilities of the consumer end-product. Portable device manufacturers are faced with the challenge of delivering faster and more powerful products with improved battery life by consuming less power. Tablets are now using four-core NVIDIA Tegra 3 processors; smart phones are equipped with ARM Cortex-A9 chips; and the latest ultrabook features flash memory drives and the soon-to-be-released 22nm Ivy Bridge Intel processors which will deliver a 37% performance increase over its 32nm Sandy Bridge sister.

Reduced power consumption can be obtained by reducing the operational voltages. In the case of the Ivy Bridge 22nm device, a 200mV drop in voltage gives the same junction speed as the older 32nm device, but with a substantial drop in its power requirement (Figure 1). Both Intel 22nm and 32nm devices work at 0.6 to 1 volt, but the 22nm devices can switch at 0.4 volts, allowing it to trade off performance for lower power consumption by using the lowest possible voltages (Figure 2).

The NVIDIA device uses the ultra-low power (ULP) GeForce GPU, which allows the cores to run at a much lower operating frequency and voltage (0.8V down from 1.1V) and achieve significant power savings. These devices are at the forefront of silicon technology, but as the high-end processors move to the latest 22nm technology, the support chips race to keep up as they also move from 65nm to 45nm, 32nm and the microscopic 22nm transistors to take advantage of reduced power with greater speed.

What Damages These New Devices?

Using traditional voltage levels or even voltage levels based on 1.5 volts in any form of electrical testing with modern-day portable devices would be completely incompatible and could

compromise the safety of the test. Devices such as the Sandy Bridge, with its 32nm transistors, have proven to be very sensitive to over-voltage conditions resulting in device failures and shortened life cycles.

To extract performance from these devices, computer hardware hackers attempted to over clock the processor by increasing the operational voltages. As you can see in Figure 2, as you increase operating voltages, the transistor gate delay decreases and the processor can be clocked at higher speeds. Many discussions can be found in online chat rooms about the limits of this technique of extracting more computing power from the personal computer, but they also warn that it is easy to "fry" the PC or reduce its life expectancy with the voltages only just beyond recommended operation voltages.

With proven sensitivity to over-voltage conditions, it is important that voltage logic levels are the correct values, which is of course dependent on the operation voltages that are programmable. On any board there could be numerous logic levels required that a test system would need to emulate. One size does not fit all as a test signal that is not correct can either wrongly fail the device by not switching the gate, or overstress the input pin. Damage can be done by using incorrect logic values or even small voltage spikes that exceed the operational voltages and can cause an immediate failure or contribute to shortening the life expectancy of the device.

This damaging effect has been well documented. As the supply voltage is lowered, the transistor turn-on voltage, or Vgson, of the FET is also reduced. One way to lower the turn-on voltage is to reduce the gate oxide layer.The gate oxide layer is a thin insulating material that lies between the controlling gate and the channel of the field-effect transistor. The Tri-Gate 22nm devices try to overcome some of that limitation seen with earlier devices. Figure 3 shows that the thinner oxides are more fragile and can break down with modest overvoltage stress.

These thin gate oxide layers can be easily damaged by over-voltage conditions. The silicon dioxide layer can either be immediately punched through by the application of a large voltage that exceeds the dielectric withstanding potential of the material, or it can be latently damaged through a mechanism that is called time-dependent dielectric breakdown. Time-dependent dielectric breakdown begins with an over-voltage condition that can be quite small in duration, such as a voltage spike or transient.

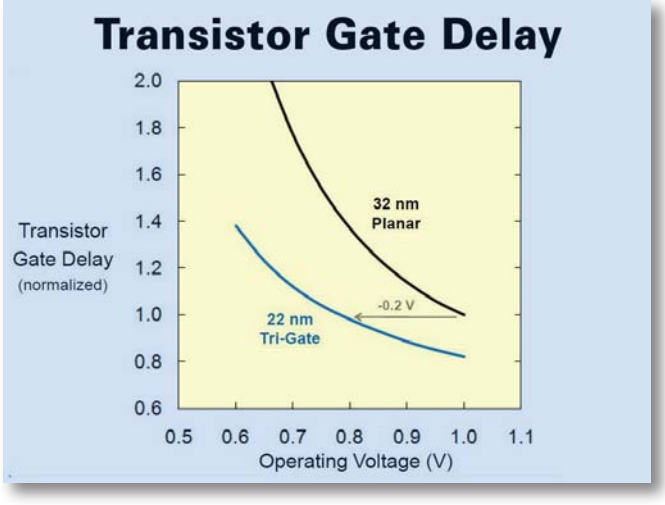

Figure 1: The 22nm transistor gate delay. 22nm 3D tri-gate transistors can operate at lower voltage with good performance, reducing active power by more than 50%.

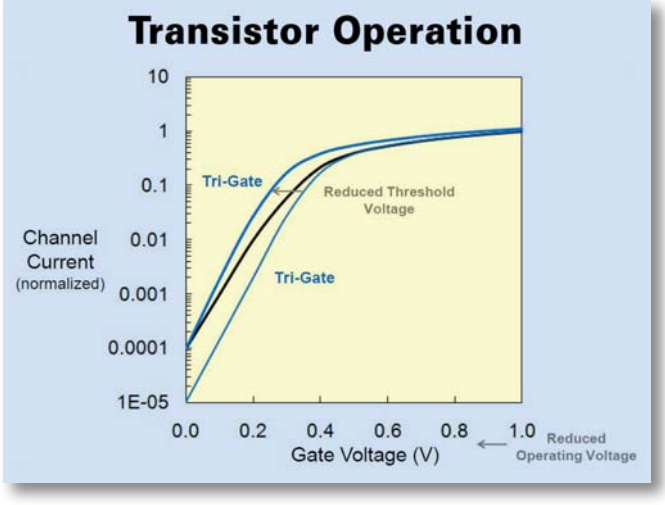

Figure 2: The 22nm transistor operation. The steeper sub-threshold slope can also be used to target a lower threshold voltage, allowing transistors to operate at lower voltage to reduce power and/or improve switching speed.

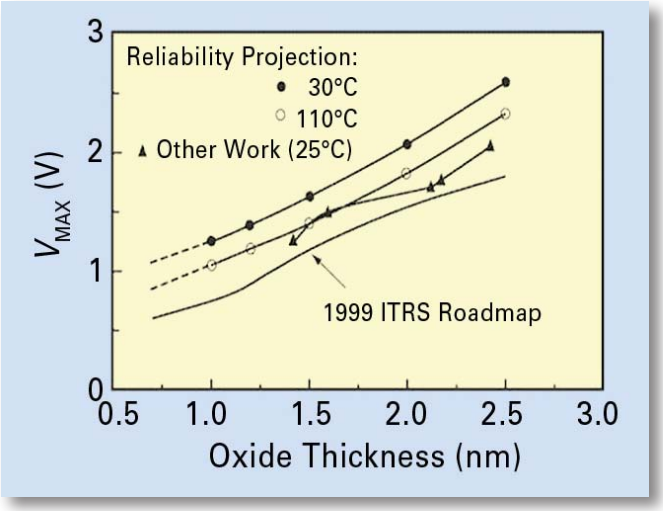

Figure 3: Ultra-thin gate oxides break down rapidly with modest over-voltage stress showing 100ppm failure rate.

This over-voltage condition generates hot carriers (Figure 4) that are accelerated to velocities high enough to enter the gate oxide layer and generate electron-hole pairs. These electron-hole pairs generate a trapped charge in the dielectric layer of the transistor. Over time these traps attract other trap sites and accumulate in a local area.

As time progresses, the trap sites begin to form a conductive path from the controlling gate and the channel that lies below. When this happens, there is a temperature rise in this section of the dielectric which causes the process to speed up in a positive feedback manner. Eventually, a silicon filament results and causes a latent short of the gate to channel, which renders the transistor inoperable.

Time-dependent dielectric breakdown (that doesn't fail immediately) can be an insidious failure mechanism because it is latent in nature. As a result, you may not find time-dependent dielectric breakdown at in-circuit, functional or at final burn-in testing on the manufacturing line because it typically takes weeks or even months for the wounded device to fail, normally when the product is in the hands of the customer.

Electrical Test System Features Needed to Test Modern Portable Devices

Regardless of whether an electrical test system is testing from the edge connector, through boundary scan, or via in-circuit nodal access, it needs to provide the correct voltage levels for the devices being tested. Edge connector testing is easier to set up, but nearly all electrical test systems need some access to internal nodes on the board under test. In-circuit test has to deal with the most complex situation and, therefore, we will consider what an in-circuit test system needs to test ultra-low-voltage devices, which

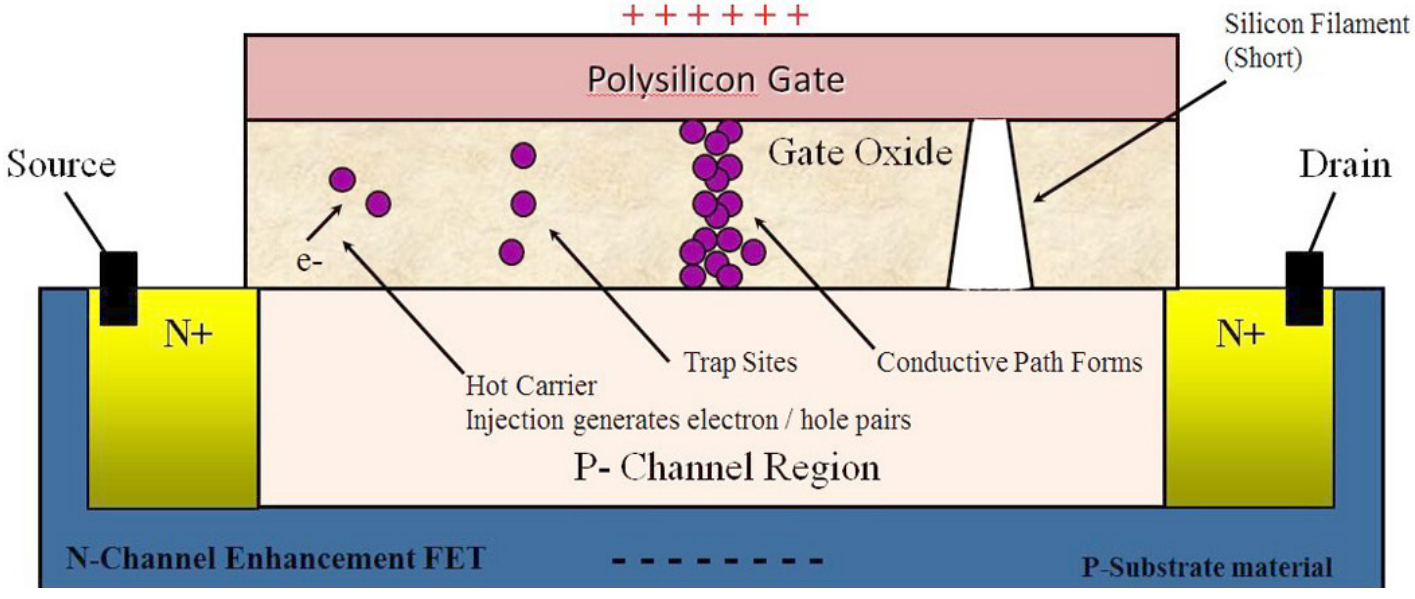

Figure 4: FET transistor gate oxide damage.

will be applicable to both edge connector testing and boundary scan to some degree.

To examine the features a tester needs, we can divide the answer into software tools and hardware requirements. The software tools should be reproducible in all test systems and hardware requirements must be designed into the test system with the thought of avoiding obsolescence.

Tester Software Tools

Test software that helps generate tests for low-voltage devices must be able to program the correct voltages. It must either be easy to manually program the multiple logic levels required, or library elements should be available that not only describe the digital vectors needed to test a device, but also determine the correct voltage levels that should be applied. Human programmers can make mistakes, so the more automated this process is, the less likely it will be to program the wrong voltage. If there is no method to verify that the voltage for the device is being applied on the test hardware, then it is very important that the software is 100% correct as both over-voltage and under-voltage can cause either damage or false failures. At the same time, as voltage levels are programmed the expected current and current limits should be available to set the correct limits when debugging the tests and in production testing. It is also preferable to set the optimum slew rate to minimize any potential over-voltage continuation based on the logic family.

With in-circuit test, the circuit analysis software will normally automatically add digital disable or inhibits to inputs to control any outputs on the PCB connected to nodes that are being used to test a device or cluster. This capability is critical to avoiding potentially harmful voltage spikes from feedback loops or floating inputs, that can cause time dependent dielectric breakdown or CMOS latch up. This is more important for ultra-low-voltage devices as the voltage thresholds are measured in 10mVs not 100mVs and they do not have the voltage buffer above the switch levels that the older devices have (Figure 5).

Therefore, it is important to inhibit and disable devices, preferably all the way to the edge connector to stop feedback loops and the effects of "floating/tri-state" inputs that can pick up noise from many sources including RF sources such as cell phones (Figure 6).

Tester Hardware Resources

Tester pins or driver/sensor pins have to be accurate, and it is normal to expect accuracy of 10x the programmed voltage. For example, if you need to program a voltage source at 300mV, you would expect at least a 30mV accuracy which would mean you are programming between 270mV and 330mV. Most in-circuit test systems tend to be around 100mV accuracy due

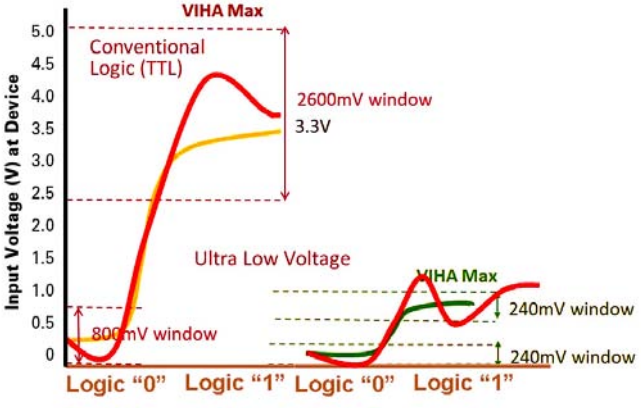

Figure 5: Comparison of 5V logic to ultra-low logic.

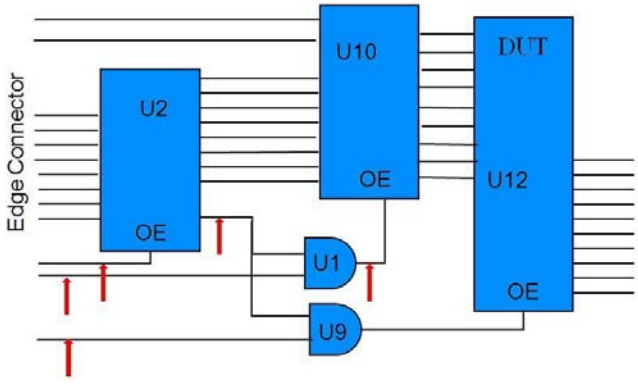

Figure 6: Multi-level digital inhibits (in testing U12, the tester controls the nodes indicated to keep the board electrically quiet).

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to the high-current capability that is needed when back driving. This is the normal compromise on voltage accuracy for high-current capability.

To test an ultra-low-voltage device where 100mV is barely acceptable, but the problem gets worse under load condition, the current requirement increases and the in-circuit pins become less accurate. To minimize this error, the pin needs basic accuracy much greater than 100mV and, under load, the pin needs to be a closed-loop design with very low output impedance drivers. Ideally, this should be zero, but, in reality, anything less than 1 ohm will be acceptable for ultra-low-voltage devices to maintain the accuracy required.

Tester pins must allow individual, rather than group, programming of logic level thresholds. Per pin programmable capability allows the programmer and test generation software to assign logic levels appropriate for each pin on the device. It avoids test compromises that can occur with shared logic level assignments which could produce over-voltage and under-voltage conditions. Even if the system software has preconfigured fixture wiring to compensate for group logic assignments, it is assumed that all the information on a device will be available at the test generation stage and the voltage settings are 100% correct. This cannot consider the many factors that can affect the voltage level required on a loaded board and can lead to voltage level compromise, which does not happen if each pin can have a different assigned logic voltage family. With each voltage level, the slew rate also needs to be programmable for that pin to allow the device to switch cleanly and not compromise the voltage levels. The pre-set level should come from the automatic test generation software, but must be changeable when the board is being debugged to compensate for fixturing and other nodal loading that could affect signal integrity. Figure 5 shows that overshoot must be minimized to prevent any potential damage.

Once the voltage level and slew have been programmed for each logic family, the maximum current and time allowed for digital testing on each device pin needs to be set. This is the key in protecting ultra-low-voltage device's technologies from being overstressed if the wrong voltage is applied by mistake. Again, each pin may have a different current limit depending on the device driving the node, so it must be programmable on a per pin capability. The default value should be set by the automatic test programming software, but in debug it is important to be able to record the "real" current level, check it is acceptable, and then use it to calculate a new limit on a test channel by test channel basis. This ability to measure current while in the debug phase allows the tester to verify that a device has been tri-stated correctly and doesn't have missing or inadequate device isolation. Missing or inadequate device isolation means a device can be overdriven during tests and if the tester can't set the curren limits, up to ½ of one amps may be forced out of each output, which on a parallel digital bus could correspond to several amps being drawn by the device. However, the most important feature of current measurement during debug is to detect any incorrect voltage settings. Too high input voltage on the device will exceed the current limit and will be flagged, while a low-voltage setting will not test the device correctly. A complete review of the current requires the testing of each device which may highlight many problems that could affect the stability of the tests and potential damage to sensitive devices.

> ***"The most important feature of current measurement during debug is to detect any incorrect voltage settings."***

At test time, the real-time current measurement capabilities, using the predefined limits, can prevent damage to both the device being tested and other devices on the node while helping to identify defects not normally detected by systems without this feature, such as faulty enabled pins and marginal output transistors. It is possible that a defect condition on the board can cause either an over-voltage or over-current condition that could stress the ultra-low-voltage part and the current limits will help prevent any damage being done to the devices.

During the production testing of PCBs, it's important to make sure the input signals are

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providing the exact voltage swing as well as making sure the outputs are working correctly because of the closer margins in ultra-low-voltage devices. The test system needs to detect both high and low levels with the correct voltage thresholds rather than use a single threshold to detect values. If a tester pin driver, with poor accuracy, has a single voltage threshold measurement or no driver verification, it cannot guarantee that it has achieved the voltage switch threshold and potentially fail a good device. As seen in Figure 5, the tight switch thresholds of ultra-low-voltage devices means the tester must verify that the test system has provided the correct switch threshold voltage without exceeding the operational voltage levels.

During a production test, to minimize stress to devices, the tester should execute each of the tests as quickly as possible. A dedicated digital controller can rapidly execute digital test vectors with consistent and repeatable test timing. Testers with this feature benefit from the faster digital test throughput, less potential back drive stress, and more stable test results. Non-specific digital controllers, such as general-purpose PCs, tend to be loaded with other tasks and could decide to install software updates during a digital test sequence or just run a program that could affect test timing.

Conclusions

A number of challenges arise when performing digital testing on ultra-low-voltage devices. To accurately, safely, and reliably test low-voltage technologies, a tester should feature independently programmable, high-accuracy pin electronics, real-time back drive current measurement and control, multiple level digital isolation capabilities, and fast test program execution times.

As shown, electrical test, and especially in-circuit test systems, must have driver accuracy below 50mV and output impedance of less than 1 ohm to successfully test ultra-low-voltage devices. It must also have per pin programming for voltage, slew, and back drive current; otherwise it risks damaging parts by poor test programming techniques or defect induced over current voltage conditions. If the test system has these features, it is capable of accurately testing today's ultra-low-voltage technologies, whether from the edge connector or with in-circuit back drive conditions, and it is well-equipped to handle the challenges of future ultra-low-voltage devices. **SMT**

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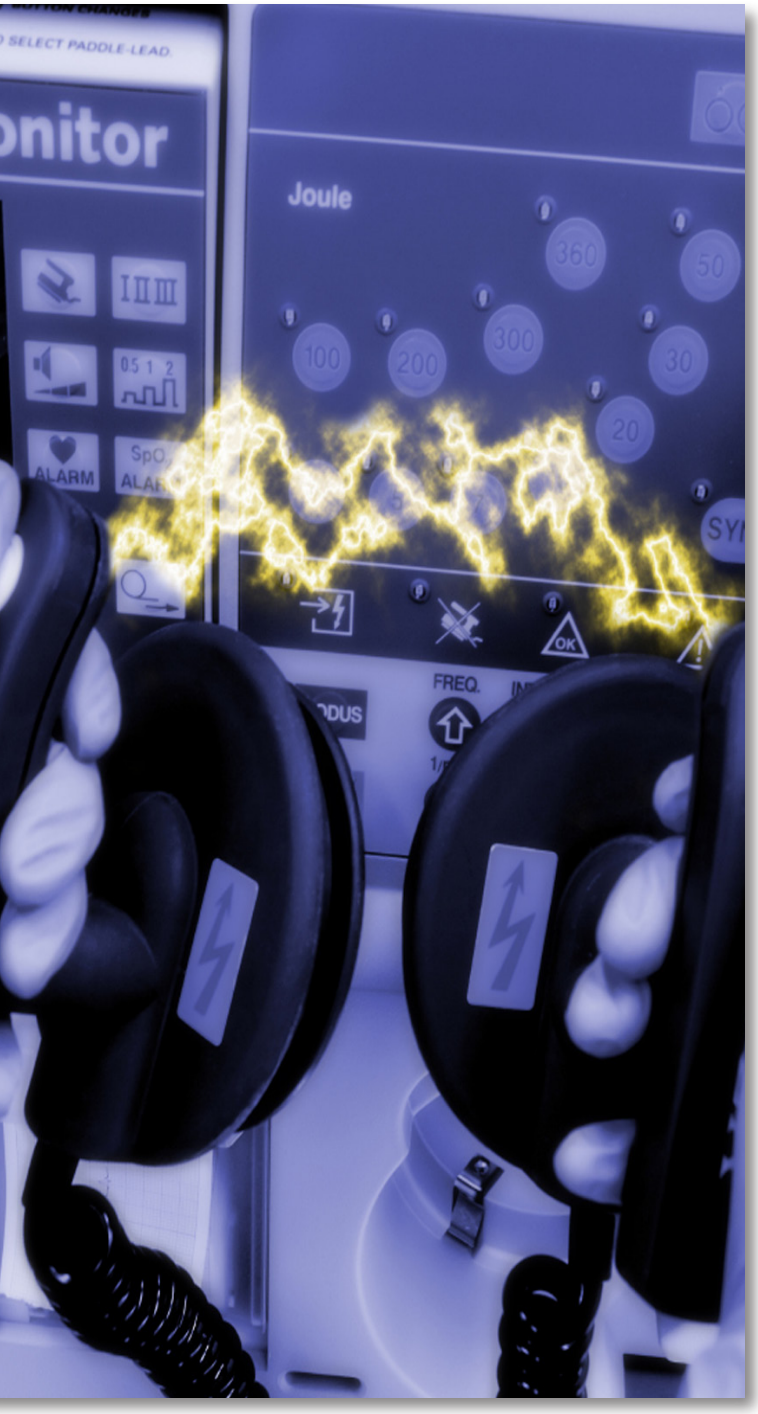

by Dr. Markus Riester
MARIS TECHCON

SUMMARY: ***Building a medical electronic device poses specific and significant challenges for the individual supply chain partner, the supply chain at large, and the OEM. Dr. Markus Riester addresses these challenges.***

Manufacturing of electronics for medical devices is a business spanning various target markets—very different types of products with very different requirements toward the performance of products. As the requirements for product performance vary, so do the processes for manufacturing those products. Medical electronic products can have very simple circuitry, with single-sided circuit board technology, some active and passive components, sensors and actuators, A/D conversion, or logic and memory to enable function. Large medical equipment has requirements that reach toward industrial power electronics. Such machines may require high power, high voltage to be married with sophisticated sensing, A/D conversion, and digital circuits.

From an applications point of view, medical electronic devices reach their technical climax in high-reliability, high-performance devices for life-sustaining applications like implantable pacemakers, defibrillators, cochlear implants, or neurostimulation devices. In addition to technical challenges, the market for implantable medical products is subject to regulation, and government authorities impose a systematic approach toward maintaining a high level of control over the manufacture, testing, and distribution of these devices.

From a technical point of view, many concurrent topics influence the design of a medical

electronic product. Performance considerations with respect to lifetime, quality, and usability, as well as regulatory and environmental challenges, should be taken into account. Specifically for portable and implantable devices, miniaturization is a critical success factor, both in terms of reduced volume and in increased functionality per volume. Medical electronics leverage the advances in miniaturization triggered by other markets, e.g., the mobile phone market, and large medical device OEMs are investigating the use of state-of-the-art technologies for packaging and PCBs through the implementation of wafer level packaging, embedding technology (actives and passives), and 3D packaging (through-silicon vias TSV).

In addition, many applications have low-power requirements that must be fulfilled to ensure operation of the device during the designated product lifetime. This is particularly true for implantable products that are often created using technologies that were developed nearly 20 years ago. These have remained largely untouched by advancement along the lines of Moore's Law. The long development cycles, approval times, and product lifetimes in this sector have a direct influence on the structure of the supply chain. Supply chain partners should align their technical processes and capabilities, but also their IT systems so data transfer, e.g., for traceability, can be performed in a simple fashion.

A technical challenge of a different kind for the medical electronic device industry is the switch to lead-free assembly. Many high-end medical electronic devices are still exempt from lead-free assembly [1]. Some components used in current designs are lead-free, while some may not be. This could lead to a situation where lead-free assembly will become the favored option for the sake of component availability. Thus, building a medical electronic device poses specific challenges for the individual supply chain partner, the supply chain at large, and the OEM.

> ***"Most PCB base material suppliers do not explicitly approve their materials to be used in medical products or in implantable medical devices."***

The Medical Device Manufacturing Supply Chain

It is becoming increasingly difficult to identify companies in the supply chain willing to engage in medical electronic device manufacturing, especially for class III devices. The reasons for adverseness many: Low- to mid-volumes, perceived (and real) risk of liability, required certifications, and, last but not least, regulatory burden.

Considering the special requirements for the manufacturing of medical devices, suppliers along the supply chain engaged in this field need to be able to apply processes that might not be commonplace in their industry. For PCB manufacturers this could mean installing ESD-safe workplaces, enhancing cleanliness of operations, and preparing larger samples in inspection. For EMS companies this could mean installing test equipment that allows customer-simulated operation, installing special burn-in equipment, and using state-of-the-art automated assembly lines.

Material and Component Availability

Most PCB base material suppliers do not explicitly approve their materials to be used in medical products or in implantable medical devices. Moreover, many suppliers explicitly state that their materials may not be used in implantable devices; however, some materials may be used in non-life-sustaining devices upon notification. The reason for this caution is that suppliers are unwilling to expose their business to the perceived risk of being connected to a situation where a device fault would be attributable to their product. Dealing with this situation is difficult, as product designs are usually done with materials and components that are extremely well known. Thus, they are an excellent basis for use in high-reliability applications. One answer to this dilemma could be standardization, another clear regulation on liability.

Discussions with passive component manu-

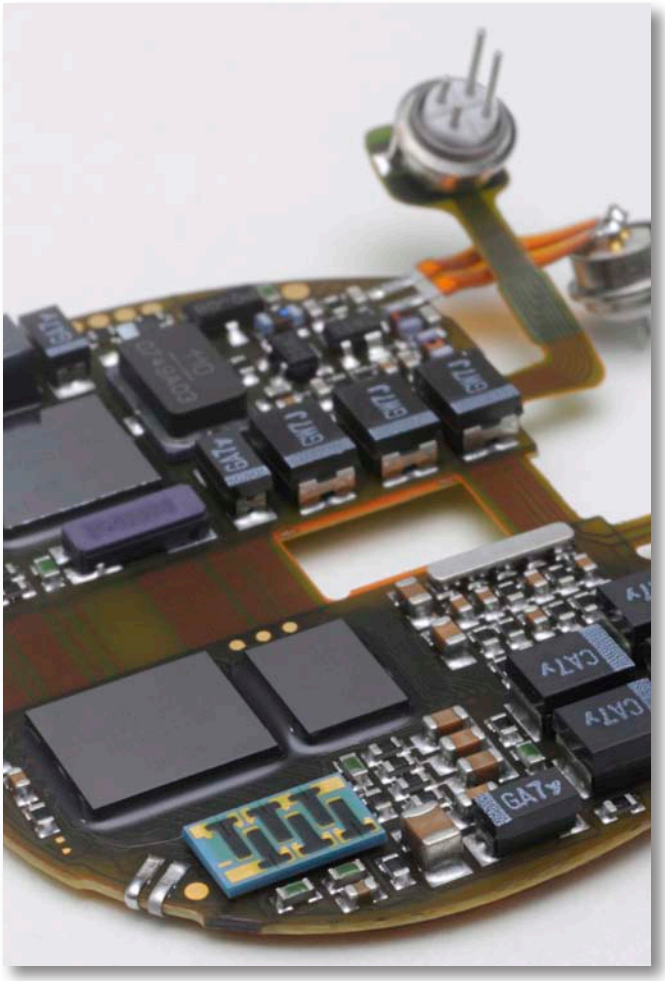

Figure 1: Assembled substrate for implantable device. Picture courtesy Micro Systems Technologies GmbH.

facturers show that it is very hard to control the use of components if they are not directly supplied to the OEM, but through distributors. In reality, control over the end-use of their product seems to be limited, even if its use was specifically disapproved.

Packaged component availability can also be a critical topic in manufacturing. Large packaging houses with the latest packaging technology available are often unwilling to serve the relatively small volumes demanded by the medical electronic manufacturers. A consequence of manufacturing of high-reliability "custom" packages for the medical electronics market could be a potential future opportunity for creating tailored products for this specific market.

Process Control and Traceability

Advanced manufacturing execution systems (MES) are useful tools for providing current data on the performance of individual equipment, processes, and product quality. They allow the tracking of goods along the manufacturing process and provide the foundation for a key element of medical device manufacturing: Traceability. Traceability encompasses the tracking of a product, its components, and the manufacturing process. These data can be used for optimizing a particular manufacturing process. This is particularly important in case of an identified fault in a device during manufacturing and even more important should a field return occur. Such data will allow the manufacturer to attribute the failure to a specific process or a situation that occurred during manufacturing.

In the best case, the supplier will be able to demonstrate which actions are required for alleviating the situation. He will also know if other product may be affected and quickly be able to salvage the situation by taking adequate measures. While traceability is mandated for the OEM, the suppliers, likewise, are forced to comply with traceability requirements. In addition to providing data to the OEM, they can also leverage the information gathered for optimizing processes. In the long run this will improve overall yield and allow suppliers to become more predictable in their performance.

The Foundry Concept

The manufacture of medical electronics was previously in the hand of the OEM, but outsourcing of manufacturing, sourcing, test, and even design has now reached this market segment. The main objective of outsourcing is to leverage the technical and regulatory know-how of an existing supply chain to gain quick access to volume production. In addition, this would enable flexible scaling of volumes to acute demand from the market.

Most attractive is the steep learning curve for companies with a concept for a medical device, but with no manufacturing capability. The future outsourcing model might enable fabless medical device companies, like many existing start-ups, to have designs built at a "medical device foundry." This foundry would provide

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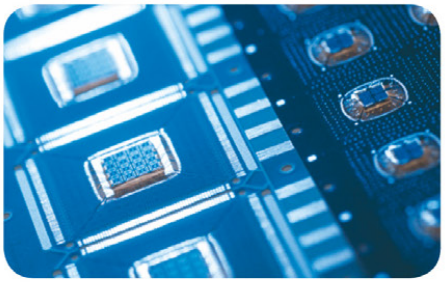

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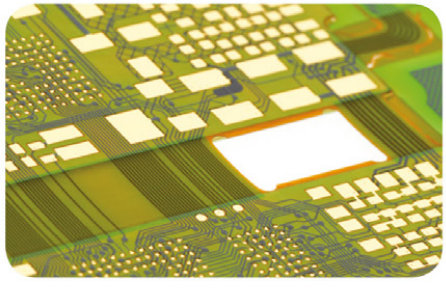

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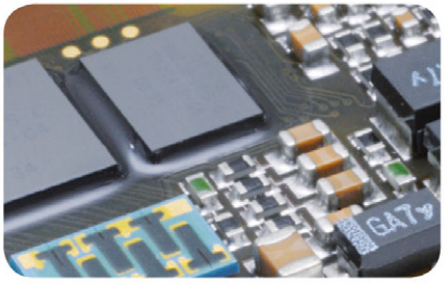

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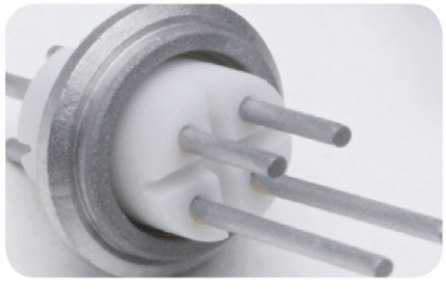

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all required knowledge in design, traceability, manufacture, and regulatory topics, and also allow access to qualified component suppliers. This model has worked for the semiconductor industry for many years and has been helpful in establishing the large manufacturing landscape of consumer products like mobile phones, smart phones, and other mobile devices.

Medical electronics should be able to leverage the same benefits—increasing device quality and reduced time to market while ensuring all regulatory aspects are dealt with in a professional manner. The value of this model has been discussed previously and seems to be becoming more attractive over time. For many medical products this is a real possibility already and it will become more attractive for the medical electronics market as well. For the OEM, the adoption of this model would result in a shift of focus away from managing manufacturing lines toward managing suppliers and the supply chain—keeping focus on the performance of their suppliers.

Economy of Scale

When electronics manufacturing is discussed, often the very large-volume, "killer" products like mobile phones or smart phones are mentioned as reference. While receiving lots of attention and contributing a large portion of revenue in the EMS market, their set of technical requirements and compliance requirements differs dramatically from the medical electronic devices industry in many ways and cannot be seen as a role model for understanding the specific requirements of medical electronic device manufacturing. Most sophisticated medical electronic products are manufactured in volumes small volumes: From 10,000 cochlear implants to 100,000 pacemakers per year. In addition, those devices are not manufactured by a single company, but by many smaller companies (amongst a few large ones). Each company performs its own proprietary design, sourcing, and manufacturing capacity. As a consequence, they are unable to leverage economies of scale. As prices have started to play an increasing role in medical electronic device manufacturing, applying the foundry model could likely be a successful path for future medical device manufacturing in the U.S. and Europe.

Regulatory Issues

While EMS companies rarely market medical devices, they are diligently audited by their customers toward compliance with the regula-

Figure 2: Fully automated test line for implantable electronic modules. Picture courtesy Micro Systems Technologies GmbH.

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tions with which the OEMs themselves must comply. For the EMS supplier, this leads to the need to understand those requirements and put measures into place that ensure customers comply with the appropriate regulations.

A main difference with manufacturing electronic products for "normal" use versus medical use is the regulatory jungle that manufacturers must conquer. In addition to conquering the technical requirements, where guidance is sought from the known standards from IPC, ISO, and JEDEC, an encompassing set of regulations exist that requires an in-depth knowledge by the manufacturer on steps to take for marketing a medical electronic device for use in the treatment of humans.

Medical devices are classified into Class I, II, and III. Regulatory control increases from Class I to Class III. The device classification regulation defines the regulatory requirements for a general device type. Most Class I devices are exempt from Premarket Notification 510(k); most Class II devices require Premarket Notification 510(k); and most Class III devices require Premarket Approval [2]. The latter Class includes implantable devices that are life-sustaining, such as pacemakers and defibrillators.

Conquering these regulations is challenging and using services from a notified body will be helpful in many cases. These services could also be included in a foundry model, where the regulatory affairs could be managed for the OEM.

Standardization

The use of standardized processes and components for medical device products is a prime example where cost in testing of components and qualification of products can be saved both on the side of the OEM and in the supply chain. iNEMI [3] has launched three collaborative R&D projects that aim to address the identified needs of the industry that can be solved in a collaborative manner:

- Defining reliability requirements for implantable medical devices;
- Qualification methods for portable medical products; and
- Component specifications for medical products.

Companies and institutes participating include Boston Scientific, Cochlear Limited, Dry Solutions, DYCONEX, EIT, Exponent, IMEC, IST, Fraunhofer IZM, Kemet, Med-El, Micro Systems Engineering, NIST, UL Medical, and Valtronics. Currently, iNEMI is extending the work with three new teams beginning the initiative phase covering medical supply chain optimization, MRI/X-ray compatibility with implantable devices, and flexible substrates for medical devices. Other organizations, like the Association for the Advancement of Medical Instrumentation, have identified similar obstacles and they also are suggesting standardization as a measure that is immanent for improving the current cost situation [4].

A Glimpse into the Future

The electronics manufacturing industry is constantly creating novel concepts for advancing the use of electronic devices. In the future, trends like 3D integration, smart systems integration, MEMS technology for sensing and actuation, printed electronics-enabling polymer-tissue interfaces, or even artificial ion channel electronics could play an increasing role in medical electronics. Besides the demonstrations that have been carried out, real applications will arise with increasing knowledge of the functional interaction between the sensor and the body or tissue.

Paradigm shift changes can also be expected. Examples like ultra-miniaturized pacemaker swarms, forming ad-hoc body area networks, demonstrate that concepts known outside the medical world could provide potentially-useful therapies. Novel printed sensors and actuators will lead to improved cardiac therapies, allowing balloon catheter-based sensor matrices to monitor information in three dimensions and with temporal resolution. This will allow improved cardiac ablation therapy by providing finer resolution of imaging current patterns in the heart in real-time. Each of these examples uses state-of-the-art and leading-edge technologies. They fulfill the demand for less device volume and low power consumption, less stimulation current, while being easier to administer and to use.

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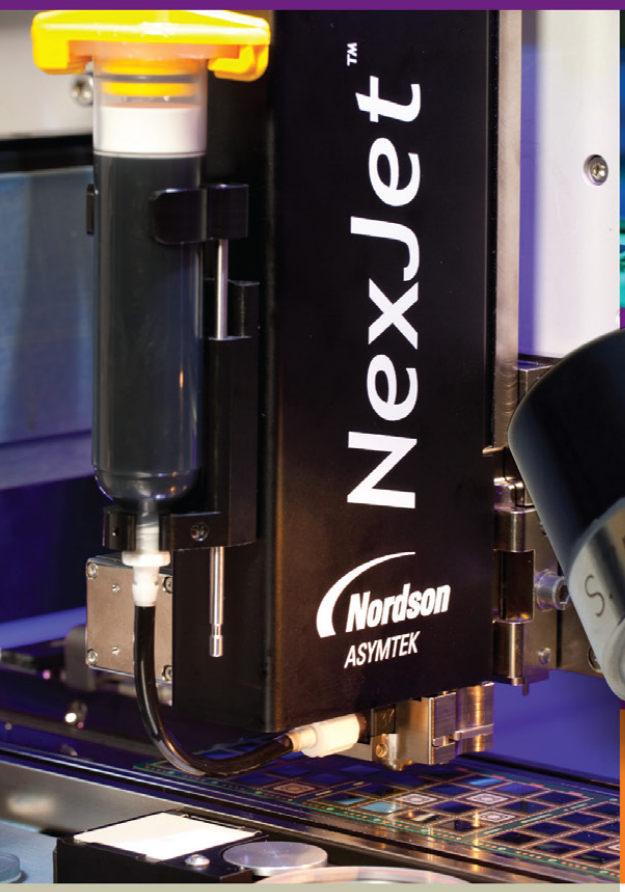

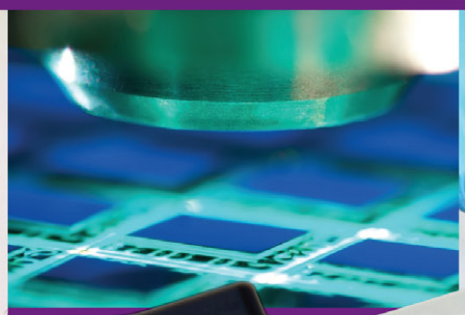

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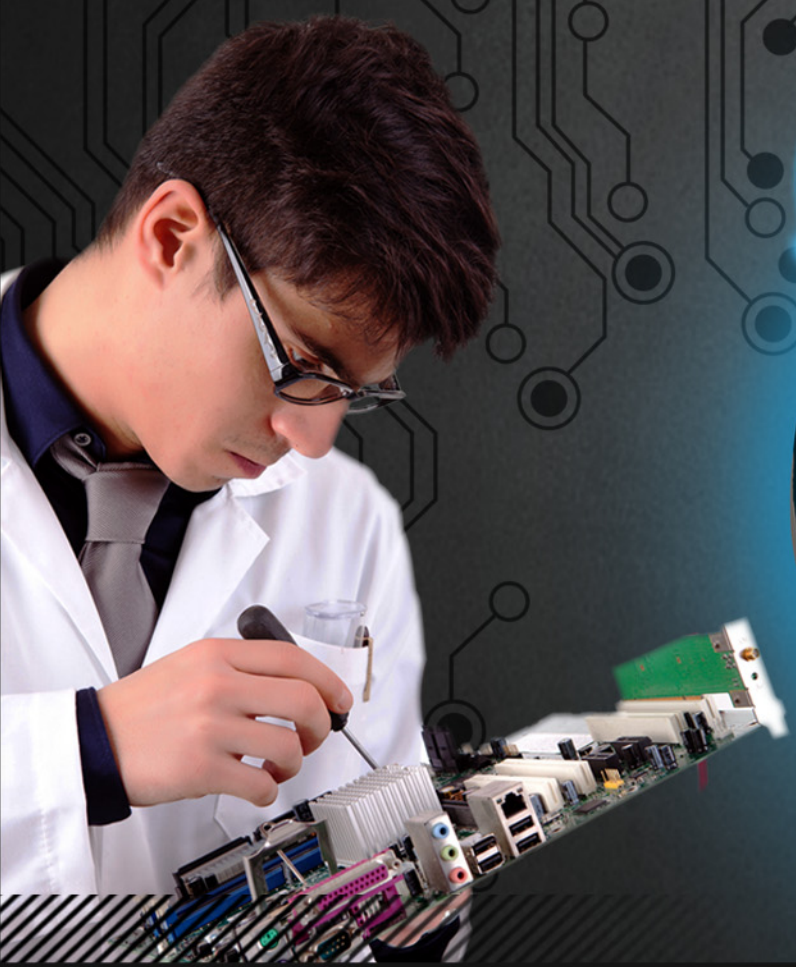

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by Sjef van Gastel
ASSEMBLÉON NETHERLANDS B.V.

SUMMARY: ***Basic quality improvement theory applies wholesale to electronics production. When setting up a process, you need to look at real issues, which include the cost of waste over the equipment life. Continually improving the assembly process eliminates the sources of error that cause expensive and, especially in the case of medical equipment, potentially life-threatening production defects.***

A single key requirement, ultra-repeatable assembly, dominates medical electronics production. While obvious for pacemakers and other implantable devices, it is essential for wearable devices like hearing aids, too. Poorly performing products can lead to instant rejection from users, leading them to prefer their original, bulky, but reliable, devices. Older patients particularly have difficulty coming to terms with new technology and can have little tolerance for a new device if it doesn't work properly the first time out of the box. Repeatability is also critical for equipment like MRI scanners. Many diseases need early treatment and patients cannot afford the delays introduced by an expensive machine lying idle because a component on one of the boards was poorly soldered.

Quality and repeatability can't be inspected in products. These features must be designed in, which involves working on each part of the process to reduce variation. That, incidentally, also reduces costs. In every step of the manufacturing process, detecting a defect costs 10x more than the previous step. Costly automated optical inspection (AOI) and test equipment can filter out defects as early as possible, but, even then, at least 10% of defects still go undetected. Figures from various industries show that over 60% of returned products were subject to earlier rework. And, as miniaturization progresses, rework is often no longer an option and that significantly increases scrap costs.

Medical production also has to be flexible to keep pace with regular high-mix product changes. Production needs traceability and effective enterprise resource planning (ERP) software to integrate management information throughout

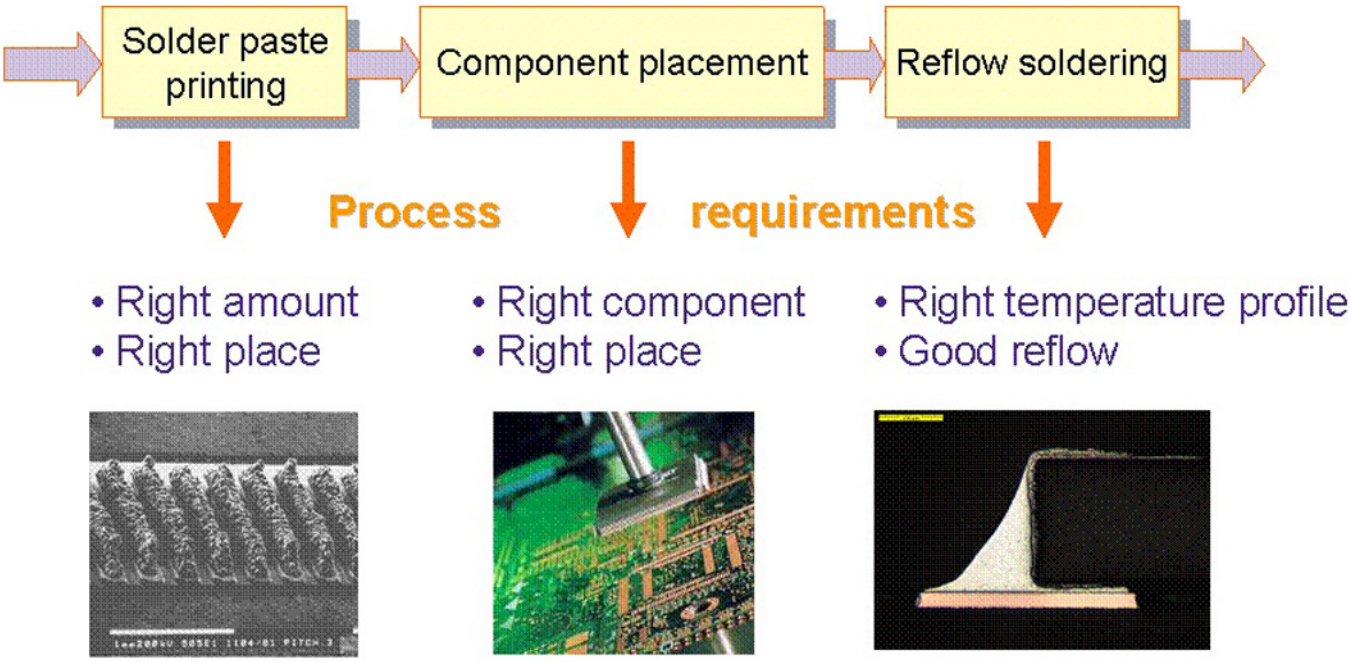


Figure 1: Process requirements for each of the three major SMT process steps.

the organization. Most importantly, though, medical production must give a first-pass yield of virtually 100%. That means optimizing each of the three major surface-mount processes shown in Figure 1: Stencil printing, pick-and-place, and reflow soldering (the best solder technique for high-density electronics production).

Solder Paste: Right Amount, Right Place

As solder lands and resulting screen aperture sizes become smaller and more closely spaced, new factors are affecting solder paste deposition. Unless screen printers incorporate special features, large components can be left with too little solder and small components like 0201 (0603 mm) types with too much. (Table 1 shows the major screen printing related defects.)

That can be serious—defective solder printing has been estimated to cause over 50% of equipment defects. Even small process variations can affect repeatability, particularly squeegee blade angle and speed. Stencil printers need features like variable attack angle printing to maintain constant solder pressure independent of the stencil thickness. The final solder paste layer should be flat with even thickness across the deposit, and with the correct shape (pattern resolution).

Pick-and-Place: DPM is the Real Figure of Merit

In practice, the major influence on production quality is the pick-and-place machine. IPC standards, particularly IPC-A-610D, IPC-9261A,

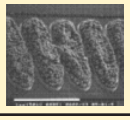
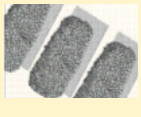
Solder Paste Error	Causes	Result	Image
Bridging	Contact between neighboring deposits.	Smearing and, after reflow, solder bridges and short circuits.	
Misalignment	Positional *offset* between solder paste deposit and solder land.	Short and open circuits.	

Table 1: Typical solder paste related errors during screen printing.

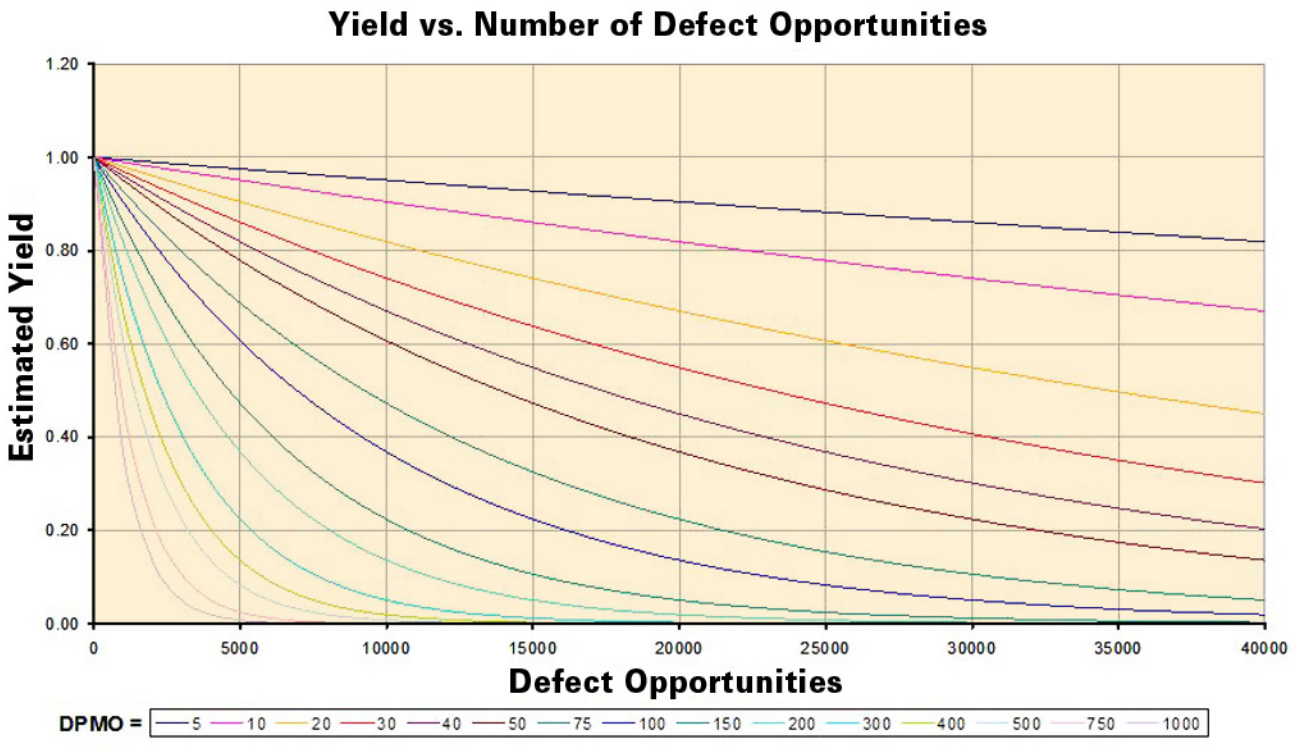


Figure 2: The relation between defect opportunities, DPMO, and estimated yield. Yield very quickly drops to zero for complex boards for poorly controlled processes.

and IPC-7912A, distinguish four classes of SMT defect. Each component has a number of defect opportunities: It may be incorrectly oriented or placed, for example, and any of its terminations may be faulty (the total is normally dominated by the total termination count). Estimating production yield starts with counting the number of possible defect opportunities in each board, with the key figure of merit for an assembly line being the number of actual defects per million defect opportunities: The defects per million opportunities (DPMO). The major types of pick-and-place defects are shown in Table 2. As the processes become less well controlled the yield drops increasingly steeply to zero as component count increases (Figure 2).

The most repeatable of the pick-and-place techniques is single-pick/single-place where many independent heads place components in parallel. That gives a much steadier and more controlled action than sequential placement, where a single head places components at high speed—with increased vibration and greater chance of components shifting on nozzle tips. Field data show that single-pick/single-place machines have DPM below 10, against up to 50 and above for sequential placement. That routinely gives a yield of around 95 to 99%, instead of some 70 to 80%.

Component Densities on the Rise

The difference in yield is largest for high-pin-count ICs and micro-miniature components and these are the real tests for a machine's repeatability. Although large ICs like ball grid arrays (BGAs) are the most obvious components on a PCB, there are often only three or four of them compared to a hundred or more chip components. So, the chip components and their interspacing largely determine packing density. Medical equipment does not generally call for high component densities, with the exception of implantable and portable equipment. These types now already concentrate over 50 components/cm^2, and this is predicted to rise to near 80 over the next 10 years.

This rise requires chips like 0201 and 01005 sizes. Measuring only 0.4 mm x 0.2 mm, 01005

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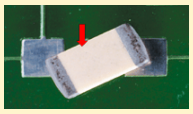
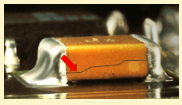
Pick-and-Place Error	Causes	Result	Image
Part misalignment	Fiducial read errors, poor machine calibration, placement or component alignment errors, etc.	Solder bridging or tombstoning after reflow.	
Incorrect part selection	Wrong part feeder loading, tape splice errors.	Wrong component mounted on substrate.	
Damaged parts	Damaged by parts supplier or by too high a pick-and-place force.	Component cracked or tilted components, open circuits.	
Wrong polarity of polarity sensitive devices like diodes	Placement programming errors incorrect (rotated) tray loading.	Wrong circuitry.	
Extra or missing parts	Parts gained or lost during pick-and-place.	Wrong circuitry.	

Table 2: Typical pick-and-place-related assembly errors.

chips are difficult to see clearly, let alone place reliably. They are now regularly used in semiconductor modules or single in-line packages (SIPs), which are increasingly concentrating the most dense (and high-frequency) electronic circuits. Components are often placed with only 50 microns component spacings (giving local densities of 300/cm^2). Many manufacturers see the move to 01005 as virtually impossible for mainstream production with their current equipment. No such problem exists with single-pick/single-place, though, which achieves a single-digit DPM for both 0201 and 01005 chips.

Machine accuracies within 40 microns are usually sufficient for even micro-miniature chip components. However, this will change for two of the next major production developments: embedding chips into PCBs and placing them underneath ICs. The copper terminations of these passive devices will have solderless copper-to-copper contacts. As these components will not self-align, the accuracy for placing chip components may need to be 20 microns or better.

Assembléon has just finished test placements of 20-micron thin components (dies) for embedding into an ultra-thin PCB used in a medical device. Researchers from other organizations involved were surprised at the success, because no other pick-and-place vendor has been able to place the components at full speed without cracking the dies.

In addition to tighter accuracy requirements, these delicate components must have low placement forces to prevent component cracking. Electronic components are fragile and need precise placement forces to prevent cracking. Impact force is determined by head velocity at impact, the mass of the head, and the head contact stiffness. Parallel placement heads have lower masses and it is easier to reduce the velocity of the nozzle in the "safe zone" before placement to eliminate impact force. Placement forces have to be down to 1.5 N or so.

Error-Free Software

Set-up verification and autocalibration are needed for repeatability. Production programs must be error free before production begins. In addition to intelligent setups and NPI tools, automatic visual checks of part orientations in tapes and other packaging and automated teaching of first component pickup locations are needed. Offline program simulation is essential, and when programs are reused, only verified and released data must be reloaded to a line.

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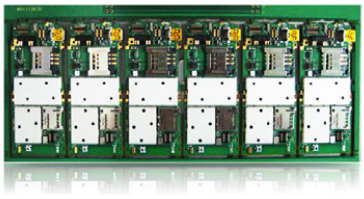

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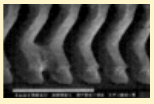
Reflow Soldering Errors	Causes	Result	Image
Tombstoning	Asymmetry in solder paste melting, part misalignment on the solder lands.	Open circuit.	
Bridging	Contact between neighboring deposits.	Short circuits between a group of adjacent leads.	
Opens	No joint.	Open circuits.	
Board warpage	Overheating.	Component cracking, variable solder deposits.	
Solder beading (solder balls forming around a device)	Capillary effect pulling paste under the component and squeezed out during reflow.	Open or short circuits.	
Poor wetting	Incorrect tin/lead thickness applied to the pad surface.	Poor solderability on tin/lead boards, "orange peel."	
Voiding: Cavities in solder joints	Gas inclusions.	Long-term reliability issues.	

Table 3: Typical reflow soldering related assembly errors.

A single tool is needed for planning, scheduling, and distributing programs over lines from different manufacturers. Software has to control the entire line, including equipment from multiple manufacturers. For new product introductions (NPI), it is important to produce samples on the same line as will eventually be used for volume production. That means no differences in heads, camera types, equipment software, nozzles or anything else, and, particularly, no different software versions that may influence process parameters.

Packages should have CAD importers, intelligent Gerber tools, and tools that can simulate and verify production offline first. Virtual sticky tape runs production in a virtual environment that shows the actual placement result on an image of the PCB. Basic errors such as wrong part type or shape, part shift, rotation, orientation, or polarity are detected and corrected before the programs are actually sent to the line, ensuring the maximum possible real-life production throughput.

When a product recall is inevitable, costs must be kept to an absolute minimum. Here, accurate recording and storage of all relevant process and traceability data is key. Open data interfaces are needed to include manufacturing execution systems from other equipment makers.

A company involved in the production of medical devices should offer services, tools, and training to verify that placement accuracy and placement force remain accurate. This is needed if manufacturers must prove that their equipment is qualified for manufacturing each year.

Reflow Soldering: Right Profile, Good Reflow

If components have been placed properly and the reflow temperature profile is right, few problems should occur during reflow. The temperature profile of the reflow oven has to be accurately controlled until the solder paste reflows (heating zone), while the flux agent is activated (soak zone), and again until the molten solder solidifies (cooling zone). The type of defect helps trace back to faults at a particular point in the process (Table 3).

Continually working on the process in this way helps further reduce process control limits (what the process is producing) and inside specification limits (what the customer is asking for). Keeping well within specification limits (high-process capability) means that processes can drift, but still produce good equipment while faults are corrected. This is basic quality improvement theory, but it is critical to successful (and profitable) electronics manufacture. **SMT**

Sjef van Gastel is manager of Advanced Development at Assembléon Netherlands B.V. He is responsible for technology roadmapping and for technology investigations leading to new machine concepts and for competitive dynamics. From 1979 to 1998, he held several positions in leading manufacturing equipment engineering design groups at Royal Philips Electronics. He holds 12 international patents/patent applications in the field of SMD assembly. He is principal author of the book "Fundamentals of SMD assembly." van Gastel has also made presentations at several international conferences, including IPC APEX EXPO, CMMF, and productronica, in addition to teaching classes on SMT. He holds a Masters degree (honors) in Mechanical Engineering from Eindhoven University of Technology (Netherlands).

ESA Unveils Space Initiatives

Reliable Internet access on the moon, near Mars, or for astronauts on a space station? How about controlling a planetary rover from a spacecraft in deep space? These are just a few of the pioneering technologies that ESA is working on for future exploration missions.

What do observation or navigation satellites orbiting Earth have in common with astronauts sending images in real time from the International Space Station? They all need to send data back home. And the complexity of sharing information across space is set to grow.

"We are researching how today's technical standards for devices like mobile phones, laptops and portable computers can be applied to a new generation of networked space hardware," says Nestor Peccia, responsible for ground segment software development at ESA's Operations Centre in Darmstadt, Germany. "But our future focus goes well beyond just networking; we're looking at how agencies like ESA and NASA cooperate in orbit and how to interchange data in real time between different organizations' spacecraft and ground stations, as well as reliable technical standards for spacecraft navigation and flight control."

In the future, inter-satellite communication requirements are predicted to grow, and spacecraft should be capable of establishing powerful radio links with each other—even while orbiting Mars at thousands of kilometers per hour.

"Setting technical standards and communication system architecture isn't the most high-profile part of space exploration, but it's absolutely vital for ensuring that the high-profile efforts, like sending an astronaut to Mars, will work as planned when that time comes," says Nestor.

Innovations, More Outsourcing Models Drive Medical Electronics Industry

by Richard Ayes
I-CONNECT007

SUMMARY: SMTC Manufacturing Corporation's Executive Vice President, Operations, Paul Blom, speaks with our editor about the key drivers for medical electronics industry growth—including supply chain issues, certifications and manufacturing.

SMT Magazine: What opportunities are you seeing in the medical electronics industry, and how do you see this market developing this year and next?

Paul Blom: We are seeing a new wave of innovative high-tech medical products coming through our channels. These new opportunities are the focus at our San Jose and Toronto facilities. The medical segment is an important market for us and it currently represents 5% of our business. We see this segment of our business growing steadily over the next few years. SMTC has continued to retain and attract new businesses and this is largely due to our engineering expertise, quality standards, and certifications, as well as our use of customer-focused teams. The new introduction of Medizone at our Toronto facility highlights these qualities and we can only see this growing both this year and next.

SMT: What are the main drivers for growth when it comes to medical electronics?

Blom: We see several key drivers for growth in medical electronics. First, traditional medical OEMs continue to move more toward an outsourcing model to drive cost, time-to-market and leverage the engineering, supply chain, and geographic capabilities of EMS companies.

Second, we are seeing the emergence of many new companies taking innovative medical products to market. These companies are

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adopting the virtual manufacturing and supply chain model of EMS providers from the start. And, finally, as the outsourcing of medical products is maturing, medical OEMs are finding they achieve improved results by aligning their requirements and the size of their spending with the size and capabilities of the EMS provider with which they partner.

SMT: With regard to process requirements in medical electronics assembly and the supply chain, what challenges have emerged?

Blom: The requirements of medical OEMs tests the capabilities of the EMS provider in the areas of engineering, supply chain, quality management, data management, and manufacturing. SMTC brings strength to the table in each of these areas. Strict adherence to the customer-approved materials source plan is key. SMTC's copy-exact systems and processes ensure materials are procured in line with our OEMs specifications. In addition, mapping out the data collection and reporting requirements for each customer is a key requirement.

Although the ISO 13485 standard defines certain requirements, a level of unique data collection and reporting customization is required by each customer. Again, by using customer-focused teams, SMTC is well positioned to address each customer's unique requirements.

SMT: What can you say about the plethora of standards, certifications, and relevant licenses required for EMS companies when it comes to medical electronics manufacturing and assembly?

Blom: As a highly-successful and established EMS provider, we are continuously investing in our people and processes to ensure we deliver the best in quality, cost, and support services to meet customer go-to market plans. We have achieved ISO 13485 certification at our Toronto, Mexico, and San Jose facilities.

ISO 13485 is an internationally-recognized quality management system and standard for the manufacture of medical devices. This standard is governed by the International Organization for Standardization (ISO). In 2011, we completed the required compliances and received licensing by the State of California Food and Drug Branch (FDB) to manufacture Class 1 and Class 2 medical devices at our San Jose,

California, facility. More recently, we expanded our services to medical customers with the implementation of a Class 10000 clean room environment for both assembly and packaging capabilities in our San Jose and Mexico facilities.

We view our certifications as a starting point, or as "table stakes" for providing EMS services to our medical electronics customers. We further broaden the customer experience through our engineering, quality management, and supply chain solutions.

SMT: How does the company ensure that its supply chain cannot be penetrated by counterfeit components?

Blom: The risk of introducing counterfeit components into the supply chain increases dramatically when the OEM or the EMS companies deviate from a disciplined source plan with top-tier, well-managed suppliers. Use of secondary and broker markets, as well as excess inventory markets for electronics components, increases this risk. We hold to the materials source plan, which is reviewed and agreed to by each customer—ensuring consistent quality and reduced risk of counterfeit parts. SMTC's procurements systems ensure compliance in executing the procurement process.


PCBA Testing

SMT: What are the latest strategies in medical electronics assembly?

Blom: Medical OEMs have been outsourcing PCB assembly in volume for over a decade. Recent trends include a greater outsourcing of full product assembly, EMS order fulfillment to distribution networks, and increased use of in warranty and beyond-warranty repair services. In addition, medical OEMs are turning to EMS for greater involvement in DFX, as well as component selection which enables an increased product life cycle. These requirements are front and center as we work with medical OEM customers.

SMT: What challenges will EMS companies continue to face while providing medical electronics assembly services in the next 18 to 24 months?

Blom: The growth and expansion of new technology emerging within this segment will always be a challenge, as technological advances and devices become more intelligent. In addition, as medical electronics segments become more competitive globally, time-to-market and cost will increase in importance over time. With strong technical capabilities and global footprint, we are well positioned to meet these challenges.

SMT: SMTC has facilities in the United States, Canada, Mexico, and China. Do you have what could be considered as a medical electronics assembly center, or do these facilities have medical electronics expertise for said regions?

Blom: All SMTC facilities adhere to the "copy exact" methodology—every SMTC facility employs the same manufacturing equipment, supply chain systems, software, and data collec-

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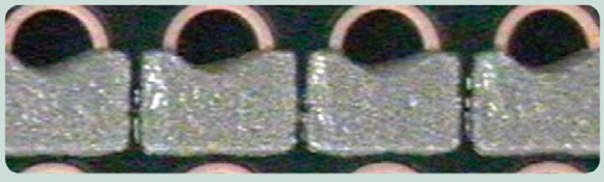

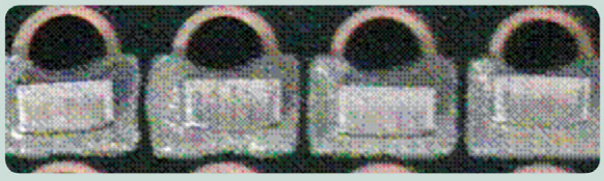

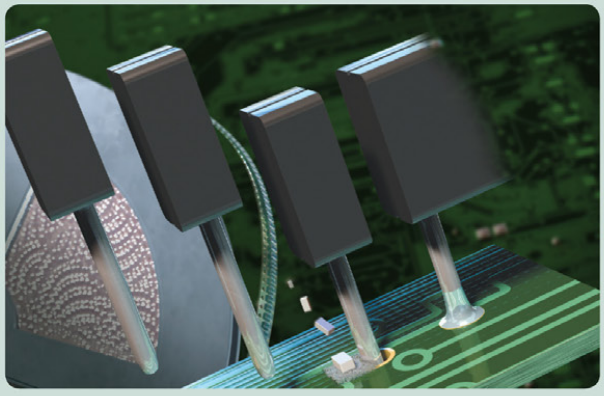

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tion systems and follows the same standardized processes and direction. Copy exact allows for a seamless and timely transition of production between facilities helping customers reach their cost and volume targets faster. This methodology allows us to provide a consistent service from each location.

Currently we see our San Jose and Toronto locations providing the customer entry point for most medical customers, with a Mexico providing regional cost reduction for North America medical OEMs.

SMT: In which regions do you see demand for medical electronics devices growing rapidly?

Blom: We are currently seeing large demand from within the United States and Canada. The adaptation of new technological advances and government R&D support programs is helping with this rapid growth.

SMT: Any final comments?

Blom: We are thrilled to be working within this segment as the medical device market continues to grow and expand at a rapid rate. Investments we have made over the years in copy exact supply chain and manufacturing systems has helped to excellently position our service offering for medical OEM customers. **SMT**

As Executive Vice President, Operations, of SMTC Manufacturing Corporation, Paul Blom is responsible for engineering, manufacturing operations and supply chain management on a global basis. Prior to joining SMTC, he was a founding executive of Celestica and served as Senior Vice President, Global Supply Chain. Blom holds a Bachelor of Science in Mechanical Engineering from the University of Toronto and a Master's in Business Administration from the Rotman School of Business.

Video Interview

Flextronics Meets SI Needs for Customers

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Vice President of Flextronics' Advanced Engineering Group, Murad Kurwa, profiles the functions and operational objectives of his group, which include new and evolving services in the area of signal integrity analysis and verification, in the company's ongoing effort to better serve customer needs.

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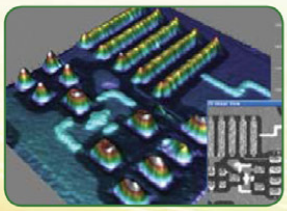

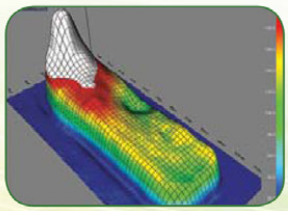

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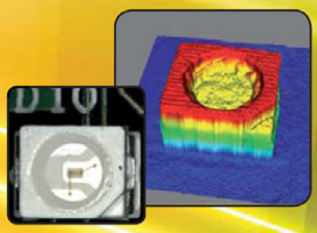

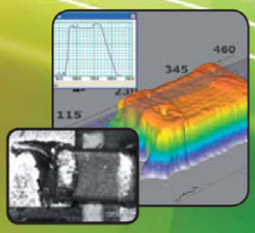

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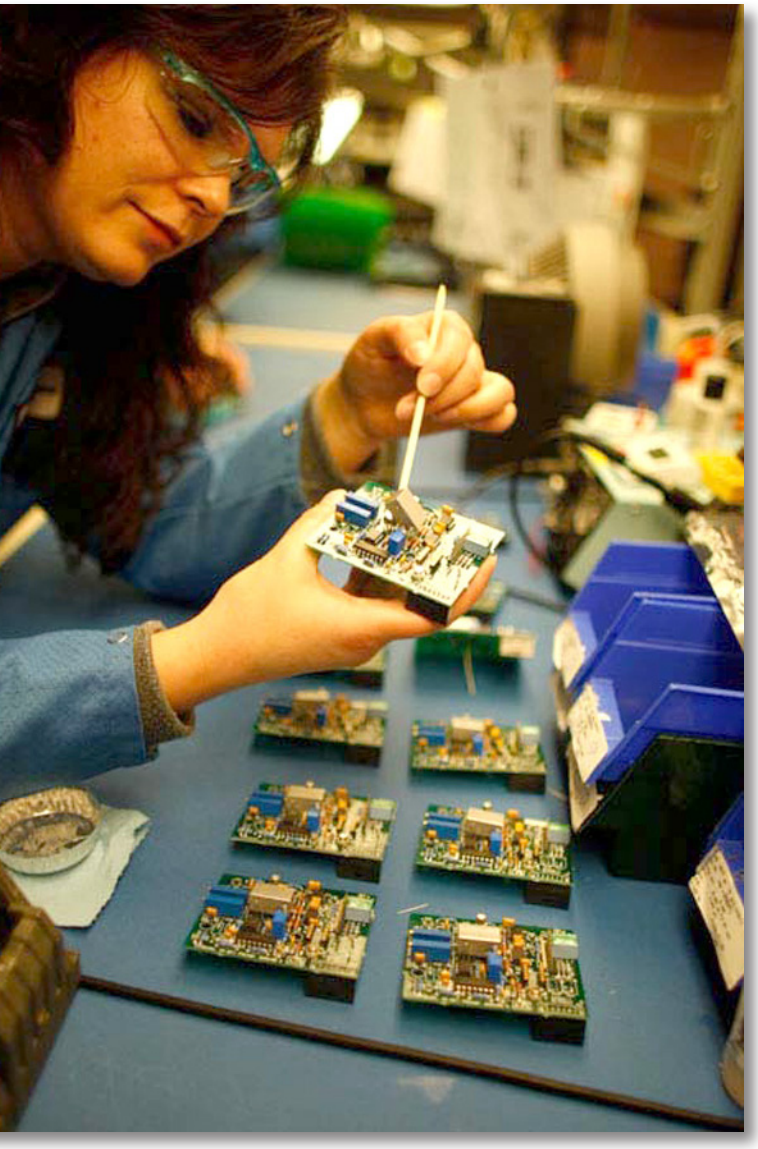
Nortech Highlights Focus on Medical Electronics

by Richard Ayes
I-Connect007



SUMMARY: *What are the latest developments, initiatives and technologies found in the booming medical electronics device industry? Nortech Systems' Director of Business Development Dave Kuklinski tells SMT Magazine in this informative interview.*

In an interview with SMT Magazine, Dave Kuklinski, director of business development for EMS firm Nortech Systems, discusses the latest developments in, and initiatives and efforts of, his company to address the growing opportunities and widen Nortech's presence in the medical electronics field.

SMT Magazine: What opportunities in the medical electronics industry exist for Nortech and how big is the segment for your company?

Dave Kuklinski: Overall, 29% of Nortech's business is related to the medical industry, which includes both wire/cable and EMS. The EMS portion is probably closer to 10 to 12% of our overall business and it's the fastest-growing segment.

We're pursuing opportunities in both the Tier 1 and Tier 2 OEM environments—PCBAs and medical devices or subassemblies. Our quality systems support the build of both Class II and III medical devices and PCBAs. We also have extensive experience with the regulatory requirements related to the manufacture of medical devices and PCBAs.

We're going after new products coming on the market. We've developed a specific strategy for supporting the start-ups developing many of the new and innovative medical devices today. It's estimated that smaller companies are responsible for between 60 to 75% of the new devices coming onto the market. We've developed a package of engineering services designed to help these start-ups. We can augment their resources, helping them bring their products to market quickly and at the necessary cost point. We can support them from a design standpoint, with both PCBA layouts and device design work. We have strong capabilities in those areas.

And we also offer engineering services from the device manufacturing set-up, documentation management, and supply chain establishment, to supporting the product through the

FDA and other regulatory hurdles and finally into the market.

SMT: How was the medical electronics business for the company last year? How do you see the market developing this year and the next?

Kuklinski: Nortech really started getting into the medical electronics business on the EMS side with the acquisition of Trivirix International Corporation in May 2010. Since then, we have improved the capabilities of that facility by investing in sales and marketing.

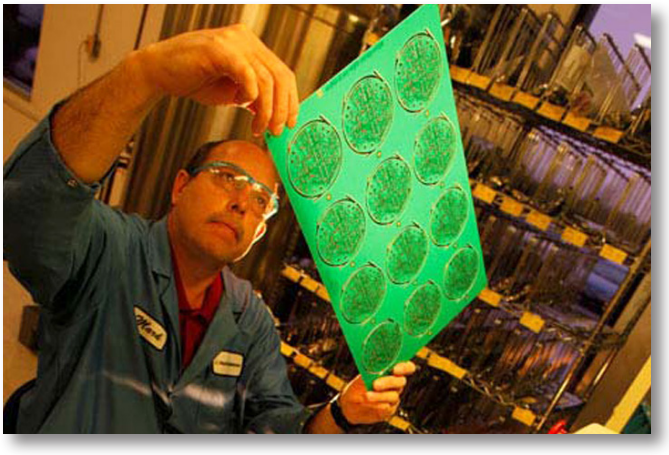
We've also integrated Winland Electronics, acquired in January 2011, which is another ISO 13485 facility experienced in medical devices. It took time to integrate those into the Nortech family, while also beefing up the management and technical teams in both organizations. As a result, 2011 did not see a lot of growth while we were solidifying our business to be successful in this market.

Now we're pleased to be seeing a number of opportunities. Our pipeline looks very good and we've got a number of proposals out there. Already in 2012 we closed on three very nice projects for electromechanical medical devices. We're optimistic about the future. We're starting to see a lot more happening in the marketplace—more activity and more opportunities. I credit the investments and improvements I described, along with the overall economy, to this success.

While we're fully committed to the industrial and defense markets, medical is our number-one corporate focus because of the growth potential. We're currently evaluating which of our other corporate facilities will pursue ISO 13485 certification for wire and cable. Then we'd have the full medical offering—boards, wire and cable, and devices.

Margins are not necessarily better than in other markets, but EMS firms find the medical growth and stability attractive. Once you win medical device business, you'll likely keep it because customers find it cost-prohibitive to move around.

SMT: What are the main drivers for growth when it comes to medical electronics?



Kuklinski: I see four main drivers for growth:

- **Demographics** – The aging population increases the demand for devices to support the prevention, treatment, and management of chronic diseases.
- **Globalization** – Growing demand from emerging markets and economies.
- **Outpatient and home-based care** – Devices designed for patients to administer their own care, without needing a medical technician or doctor visit. Types of systems might include drug delivery and patient monitoring.
- **Convergence across products** – For example, drug-delivery devices and diagnostics are combined into one device. Information technology is making an impact too: We're working on devices that can deliver monitoring information to a localized server that sends reports to the physician.

We're seeing a lot of opportunities in these segments. We're already enjoying relationships and/or business activity with a diverse group of customers. Our location is a hotbed for medical device OEMs and innovation, with many major players located in Minnesota.

SMT: What are the biggest challenges when it comes to process requirements in the segment and how does Nortech address these issues?

Kuklinski: RoHS requirements are a challenge because they've impacted the markets for PCBAs and components. As many non-RoHS

components are going obsolete, we're spending time on obsolescence reviews and substituting RoHS-compliant components. Initial component selection is crucial—both for availability and RoHS reasons. We don't want to be in the position where something's gone obsolete and we don't have enough supply to satisfy customer requirements.

For managing obsolescence, when we're engaged with an emerging customer or product, we could be building just a handful of parts or devices. From that point until we move into higher-level production could be several months or a year. There's a fine balance in securing the right quantity of parts at the proper time while watching obsolescence and managing the supply chain.

We have software tools we use to help us manage this process, to examine each component that's on a customer's PCBA and understand its product life cycle, so we can look at alternatives when necessary. We carefully monitor and manage our customers' BOMs to make sure we're alerting them early and often about changes in component availability.

In some cases, we'll do last-time buys on components and then help a customer re-layout and redesign their boards. This buys time until the new necessary replacement components can be incorporated. Depending on the device's classification, a component change on an approved BOM can be a big deal—impacting timing, costs and product flow. Additional regulatory filings may be required, particularly for Class III devices. We've got a number of different strategies for managing this process and customers find our expertise very helpful.

SMT: In relation to the previous question, among the biggest issues in medical electronics assembly is the relevant certifications required for EMS companies. Please give your thoughts on this and cite the international standards certifications acquired by Nortech.

Kuklinski: We have the obvious certifications, ISO-9001 and ISO-13485, and we're also FDA registered. I don't know why a prospective customer would choose an EMS firm without these capabilities and background. It's like a stamp of approval.

Beyond passing the necessary examinations and audits, however, we also bring the years of experience and knowledge we've accumulated. That high level of understanding is the key to success with medical devices. Customers need someone who fully comprehends the regulatory environment and helps them anticipate and resolve potential problems quickly.

It's easy for EMS companies out there to say, "We do medical devices," and we see new competition whenever other market segments get slow. But there is a lot of regulatory and quality expertise necessary to properly build and support the building of medical devices and PCBAs.

SMT: How does the company ensure parts are high-reliability components?

Kuklinski: We have partnerships with established Tier 1 component distributors and direct

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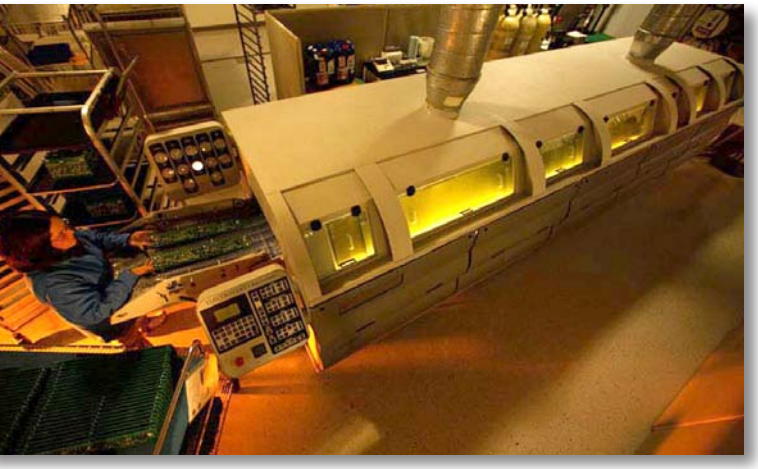


component manufacturers. We avoid broker buys due to potential counterfeit risks.

SMT: What are the latest trends in medical electronics assembly? Do new manufacturing strategies exist?

Kuklinski: Our FOCUS Initiative is Nortech's Lean/Six Sigma program, and we're using many Lean tools to make us more efficient and smarter, helping to reduce cost. Six Sigma tools help eliminate variability in our processes. The overall goal is continuous improvement. We often partner with customers in these efforts. On a recent board project, our customer's engineering team participated with our production team on the manufacturing floor to develop and monitor the process.

The medical device market has become more competitive in recent years, with more pressure on margins. Customers are much more cost-conscious today. They want partners who are using Lean and Six Sigma tools, providing on-time shipments, quality, and first-time acceptance rates at 99.8% or better.

SMT: How different is manufacturing for a medical electronics customer as compared with any other market segment?

Kuklinski: At Nortech Systems, we strive to build quality into everything we make and the same applies to our high standards of service and delivery. Our approach to process development, process management, and Lean manufacturing is pretty similar across all segments. For medical customers, a big difference is the traceability and documentation requirements. We have to trace all the components and serialize all the boards.

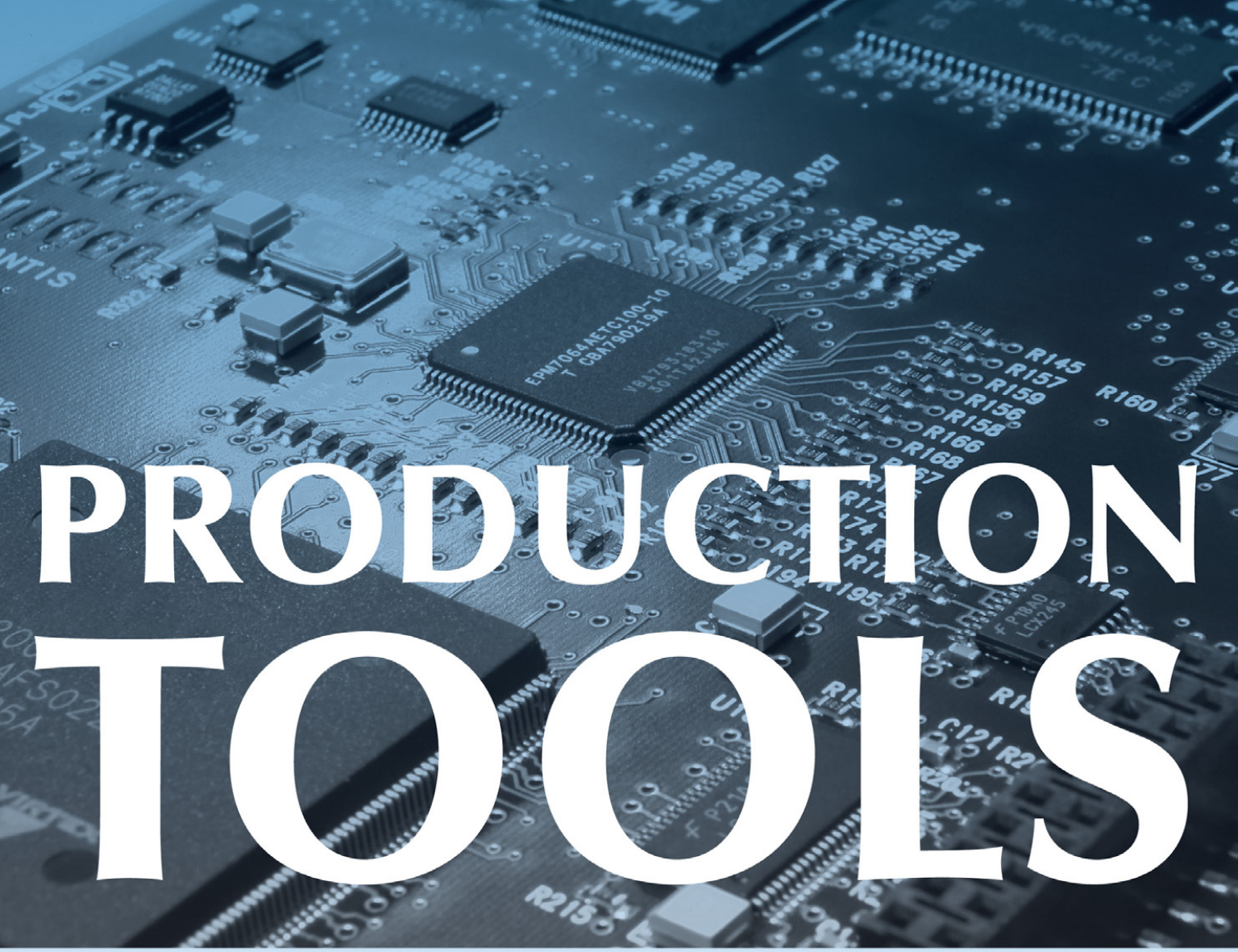
SMT: What persistent challenges do you think will continue to face EMS companies catering to the medical electronics market?

Kuklinski: Cost challenges and new competitors will always exist, whether established players or emerging contract manufacturers. Probably the biggest challenge is staying on top of the Obama administration's impact and the evolving regulatory environment. The FDA is more active lately, changing regulations on the PMA and 510(k) processes. Other possibilities include a flat tax on medical devices. No one knows what the ground rules will be in six months or a year…it's a moving target.

SMT: On a global perspective, which regions do you see demand for medical electronics growing rapidly?

Kuklinski: The focus is shifting away from the U.S. and Europe to emerging markets like India and Asia. If you look at the major medical OEMs here in Minnesota, for example, many have brought in new management teams with strong experience marketing products in these regions. Those areas have the strongest growth. **SMT**

David Kuklinski is director of business development with Nortech Systems Inc., a full-service EMS provider headquartered in Wayzata, Minnesota. He joined Nortech with the acquisition of Winland Electronics' EMS operation in January 2011. At Winland, he served as vice president of sales and marketing. Kuklinski has a 20-plus year career in the EMS industry, including senior customer/program management, engineering management, and business development roles with Solectron, Jabil Circuit, and Benchmark Electronics. He can be reached at dkuklinski@nortechsys.com.



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2012 MEDICAL DEVICES OUTLOOK

by Matthew Scherer and Brice Esplin
DATABEANS INC.

S*UMMARY: The entire medical semiconductor market has largely followed the same ups and downs as the rest of the semiconductor industry, with total shipments declining slightly in 2011 after spiking in 2010. However, over the next several years, the market is projected to grow, with demand spurred on by a wave of new government-approved ultra-portable and implantable products and booming regional demand.*

Despite claims to the contrary, the medical electronics semiconductor market has hardly been recession-proof, especially with regard to the high-volume home medical segment. In fact, the entire medical semiconductor market has largely followed the same ups and downs as the rest of the semiconductor industry, with total shipments declining slightly in 2011 after spiking in 2010. Also, for 2012, year-to-year growth should be much in line with the previous year. However, over the next several years it is projected that this will continue to be a high-growth market, with demand spurred on by a wave of new government-approved ultra-portable and implantable products and booming regional demand from emerging areas such as Brazil, Russia, India, and China (BRIC), as well as sustained demand from more mature regions such as the EU, Japan, and the U.S.

While innovation is crucial in this market, medical electronics must be primarily designed for the long term, with many applications requiring long-life platforms that are available for 10 years or more. With this in mind, system developers must select those components that will not only have a life cycle through the longer-than-usual design cycle (which can exceed 12 months), but also through a potentially lengthy FDA approval and as many as 10 years of production. Safety and reliability are two other features that must be included in component designs, as failure could have potentially life-threatening repercussions for the consumer. Finally, chip suppliers must also contend with the high operating and R&D costs, rising competition, and stringent government regulations in this industry. But despite these restraints, the medical market will continue to be a lucrative and fast-growing source of sales for those firms that choose to remain.

The most prevalent area of innovation includes portable medical electronics, in which most products are currently going through

lengthy governmental approvals. Many of these items, such as the new Withings Blood Pressure Monitor, are meant to improve patient monitoring while they are separated from physicians. The Withings monitor is on the leading edge of a large group of medical devices that will be aimed at keeping a large amount of real-time statistics for physicians to analyze. A majority of these innovations are being integrated into cell phone applications to improve accessibility. This adoption of portable monitoring equipment is contributing to the growth in medical sensors revenue. The sensors and MEMS segment will likely experience a 9% compound annual growth rate (CAGR) over the next five years.

The high level of innovation currently taking place in the mobile computing and smart phone market is having a trickle-down effect on the implantable medical market. Specifically, advances in IC miniaturization/integration, lower power operation and architectures, and a greater cost savings are being extended into the implantable industry. For example, specialty semiconductor supplier Cactus Semiconductor, a specialist in the design of ICs for both implantable and portable medical devices, recently partnered with Freescale Semiconductor to focus on the design of SoCs specifically for an innovative new generation of active implantable medical devices (AIMDs). While the market for implantable medical products still isn't very large, $352 million by the end of 2012, it is expected to experience rapid growth with a 10% CAGR over the next five years.

The microcontroller (MCU) segment is also a strong growth market with regard to medical semiconductor revenues. Specifically, most medical suppliers favor 16-bit and 32-bit MCUs more than their 8-bit counterparts, due to their higher performance benefits and, in recent years, rapidly falling costs. It is expected that revenue for microcontrollers in the medical market will reach $505 million in 2012. Recent MCU products for this market include the new Kinetis L series from Freescale, announced in March 2012, which is targeted specifically at portable medical systems. This MCU family combines the peripheral sets, enablement, and scalability of the existing Kinetis line of 32-bit MCUs while leveraging the inherent low-power and high-performance features of the ARM Cortex architecture. This product exemplifies the overall semiconductor industry trends that also are in the medical market, namely, moving toward smaller and more precise energy-efficient chips.

Sensors are another high-growth segment, and growth rates here only trail the MCU and optoelectronics markets. Optoelectronics, including LEDs and optocouplers, leads the medical market with an 11% CAGR and is expected to reach $255 million by the end of 2012. Innovations in the imaging sector, such as Phillips' recently FDA-approved combined PET/MRI scanner, are in high demand because of their flexibility and cost-saving attributes. On the distant horizon, technologies such as the integration of CLI technology into endoscopes, which can increase resolution of PET scans, will make a dramatic impact in optoelectronics. Semiconductor suppliers would be wise to take advantage of chips and innovations in medical optoelectronics because it's the market's strongest growth segment and there are multiple ICs that are required to be used in conjunction with the specialized optoelectronics products.

In terms of regional trends, the U.S. remains the single largest market for medical electronics spending. Even so, the country still boasts some of the highest health care costs in the world which result from its higher administrative and care costs, while in most other advanced countries health care prices are lower through government regulations. However, 2012 will mark a

	2009	2010	2011	2012	2013	2014	2015	2016	2017	CAGR%	12/11
$M	3,107	4,113	4,121	4,186	4,679	5,038	5,530	6,090	6,520	9%	2%
MU	5,855	7,610	7,416	7,425	8,298	9,432	10,652	11,896	13,020	12%	0%
ASP	$0.53	$0.54	$0.56	$0.56	$0.56	$0.53	$0.52	$0.51	$0.50	-2%	1%

databeans Estimates

Table 1: Worldwide medical semiconductor market forecast.

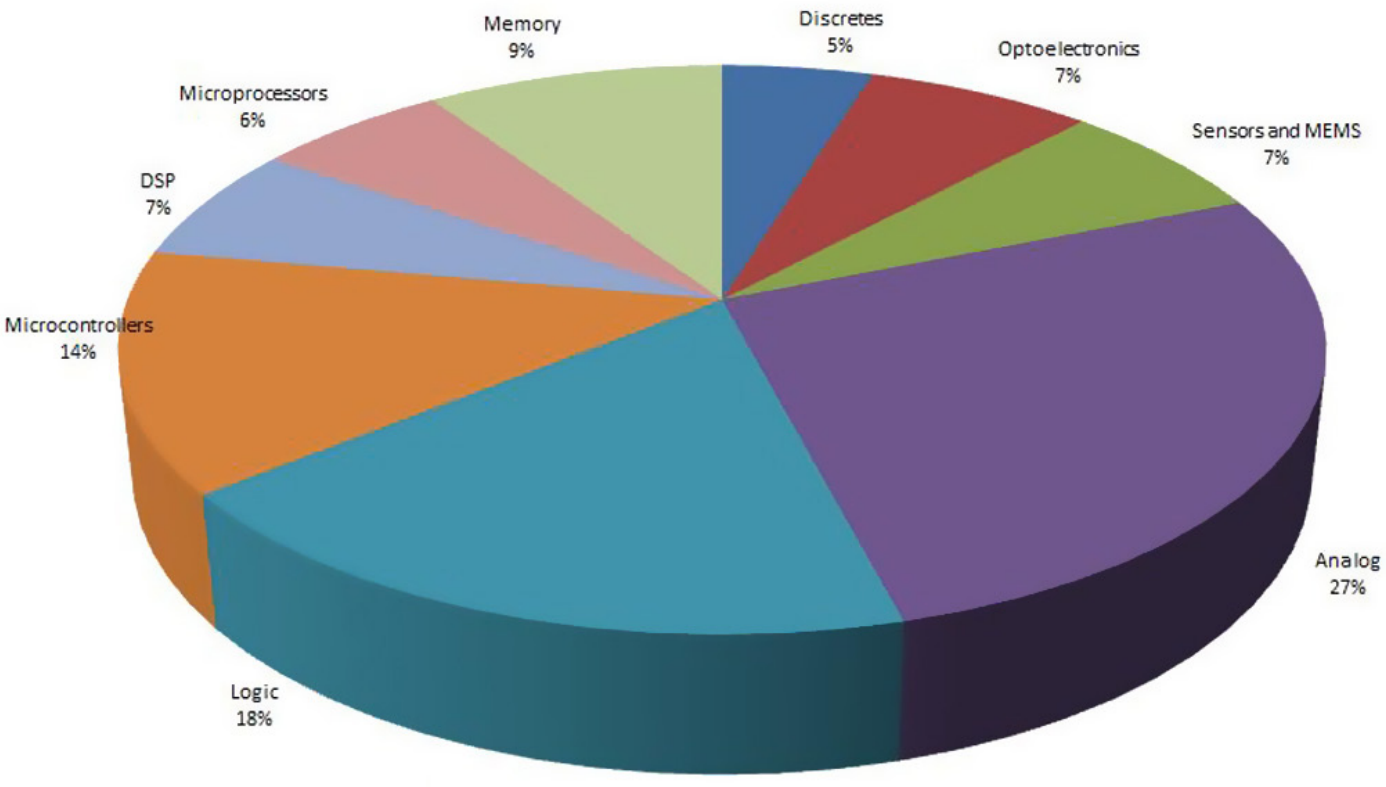

Figure 1: 2012 worldwide medical semiconductor revenue share by product type. databeans Estimates

major shift for the U.S. healthcare market which will come as a result of the enormous pressures to cut costs, improve care, and prepare for the changes tied to the upcoming federal healthcare overhaul. Specifically, the recently passed federal legislation, which creates new health insurance marketplaces and requires most people to carry coverage, could lead to a spike in demand for health care once it takes effect in 2014. And even if the U.S. Supreme Court ultimately unwinds part of the law, the industry-wide changes that are now occurring will likely continue on as the increased pressures to reduce prices in health care coverage will persist.

In response, many major care providers are changing their roles, while many hospitals are increasing spending, building up extensive new doctor workforces, or increasing their mergers and acquisitions (M&A). For example, in October 2011, Cigna, a major global health services company, announced that it would pay $3.8 billion to buy HealthSpring, which effectively gives it a foothold in the booming senior-citizen and Medicare markets. Meanwhile, to prepare for any changes to the U.S. healthcare payment system, many medical insurance agencies are purchasing healthcare providers or producing new cooperative deals and payment models that can help share the risks of health coverage. It is reasoned that this general industry consolidation will eventually benefit patients by allowing a single, large organization to deliver a broader range of care in more locations.

Europe is another high-value regional market for the medical device industry, as three of the five top countries for medical device spending are in Western Europe and include Germany, France, and the UK. Two major factors are affecting this region in 2012. For one, in the short term, this market is being influenced by the European fiscal crisis, as this region is dominated by trade between EU members. In fact, imports account for more than three-quarters of the medical device market in the EU, most of which are produced by neighboring members. Reduced consumer demand will particularly affect Germany, the region's largest economy, which relies heavily on European demand for its medical products. However, it is expected that as austerity measures take effect and the

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macroeconomic environment improves in the second half of 2012, the European device export market should likewise improve.

The other major factor affecting Europe's market growth is potential changes in the regulatory environment or government measures which are expected to happen over the next year. This was spurred on after a safety scare over faulty silicone breast implants in late December 2011 from French firm Poly Implant Prothese (PIP), after which, the French government called for tighter regulations of the medical device industry in Europe. The scare also prompted several other governments, including England, Australia, and Columbia, to call for similar actions. At the same time, the EU's health chief blamed the situation on Europe's weak regulations on medical devices, and in February 2012 called for an urgent review of the 70 to 80 regulatory agencies that are responsible for approving high-risk medical devices in Europe, most of which are manufactured by private companies. This situation could end up having a major impact on the Europe's medical devices market in the future, as the European Commission is scheduled to review its Medical Devices Directives in the first half of 2012, and could end up creating deeper-than-anticipated reforms for the sector.

> ***China, despite its huge population, is still relatively meager with regard to medical device spending per citizen.***

China, despite its huge population, is still relatively meager with regard to medical device spending per citizen; however, this is rapidly changing. In January 2012, the Chinese Ministry of Industry and Information Technology (MIIT) unveiled its latest Five-Year Plan, which illustrates key objectives related to government investment in the pharmaceutical and medical device sectors. Specifically, the MIIT has pledged to increase the gross industrial output of its drug and medical device industries by 20% annually, with a major emphasis on export and push for the development of more than 50 Chinese made medical devices to be designed this year. Domestically, China's medical device market is expected to boom thanks to a growing middle class, an increased standard of living, and incentives and reforms coming from the public sector. In particular, there will be strong demand from Chinese hospitals, which will result from larger purchasing budgets and planned infrastructure upgrades. This is expected to not only benefit local manufacturers, but foreign manufacturers as well, as multinational companies currently dominate the Chinese market, led by players such as GE, Medtronic, Johnson & Johnson, Phillips, and Siemens Healthcare. Many smaller international players are expected to make a major push into this growing market in 2012, as compliance with the quality system requirements of foreign nations is also accepted in China. However, device classification in China is not as straightforward of a process and end up requiring greater investments in time and money. Also, while domestic suppliers have a smaller presence, they too are increasingly competitive thanks to the passing of favorable government tax benefits.

Beyond the numerous product innovations

$M	2009	2010	2011	2012	2013	2014	2015	2016	2017	CAGR%	12/11
Americas	1,492	1,963	1,942	1,984	2,086	2,240	2,459	2,667	2,856	8%	2%
Europe	712	921	944	929	1,049	1,126	1,236	1,352	1,447	9%	-2%
Japan	597	786	775	758	861	937	1,029	1,157	1,239	10%	-2%
Asia Pacific	307	443	460	516	683	735	807	913	978	14%	12%
Total	3,107	4,113	4,120	4,186	4,679	5,038	5,530	6,090	6,520	9%	2%

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Table 2: Worldwide medical semiconductor revenue forecast by region.

and regional constraints, there are still many challenges in the medical market, and despite its high growth rates, the market has been affected by macro factors that have also influenced the consumer and computing markets. Namely, generally weak demand and slowing shipments have led to excesses in IC inventory supply and caused manufacturers to slash their capacity to salvage their margins. This factor is the main reason year-over-year (YoY) growth in the medical segment was weaker than usual, at only 2% YoY for global revenue and flat in terms of shipments. What's more, despite innovation, the medical market continues to face unique governmental regulation and approval process factors that force product engineers to attempt to plan for potential trends years in advance. Finally, as wireless networking takes a bigger role in mobile medical equipment and monitoring devices, consumers are also becoming concerned with potential privacy issues. Although it is not currently a major problem, this is something that OEMs must keep in mind in the near term when designing consumer medical devices. **SMT**

Matthew Scherer, a semiconductor market research analyst at research firm Databeans Inc., received his bachelor's degree in English with an emphasis on Technical Writing from the University of Nevada, Reno. He has worked in the semiconductor analysis industry for four years, tracking the latest trends in all major IC categories and end-markets. However, he is primarily focused in consumer electronics, audio, industrial, and embedded markets. Scherer also publishes a monthly newsletter for Databeans Inc.

Brice Esplin is marketing manager for Databeans Inc., a market research firm focused on the semiconductor and electronics industry, and a comprehensive source of information throughout semiconductor product categories and markets. For more information, e-mail brice@databeans.net.

Chips as Mini Internets

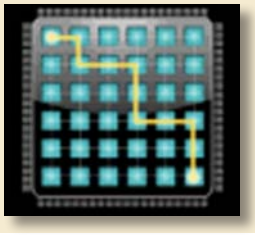
Computer chips have stopped getting faster. To keep increasing chips' computational power at the rate to which we've grown accustomed, chipmakers are instead giving them additional "cores," or processing units.

Today, a typical chip might have six or eight cores, all communicating with each other over a single bundle of wires, called a bus. With a bus, however, only one pair of cores can talk at a time, which would be a serious limitation in chips with hundreds or even thousands of cores, which many electrical engineers envision as the future of computing.

Li-Shiuan Peh, an associate professor of electrical engineering and computer science at MIT, wants cores to communicate the same way computers hooked to the Internet do: By bundling the information they transmit into "packets." Each core would have its own router, which could send a packet down any of several paths, depending on the condition of the network as a whole.

At the Design Automation Conference in June, Peh and her colleagues will present a paper she describes as "summarizing 10 years of research" on such "networks on chip." Not only do the researchers establish theoretical limits on the efficiency of packet-switched on-chip communication networks, but they also present measurements performed on a test chip in which they came very close to reaching several of those limits.

Peh and her colleagues have developed two techniques: One is something they call "virtual bypassing; the other technique is called low-swing signaling. The researchers have more work to do, Peh says, before their test chip's power consumption gets as close to the theoretical limit as its data transmission rate does. But, she adds, "If we compare it against a bus, we get orders-of-magnitude savings."



Top Ten Most-Read Supplier/ New Product Highlights

Henkel Develops Electrically-Conductive Adhesive

Henkel Electronic Materials has developed an electrically-conductive adhesive (ECA) that overcomes the drawbacks of older generation ECAs and extends the material's advantages to multiple applications. HYSOL ECCOBOND CE 3103WLV provides contact resistance stability on surfaces such as OSP copper and Sn alloys—metals which have previously been challenging for ECAs.

SigmaTron Implements Agilent Solutions

SigmaTron says the new Agilent solutions help the company meet a wide range of test requirements, including stringent cost, quality, and shipping targets. This has enabled SigmaTron to expand its business amid a challenging and uncertain worldwide economy. The company says the usage of multiple test solutions is a key strategy for their business.

Onodera to Lead Business Development in Japan for ECT

Hidenori Onodera joined Everett Charles Technologies (ECT) in January as the company's new Business Development Manager overseeing new business development activities in Japan. In his new role, he will report to Chan Pin Chong, President of ECT, and will work with the R&D and Engineering departments.

Fuji Unveils NXT IIc Machine

The NXT IIc is a modular scalable placing platform just like the NXT II, but manages to squeeze the same advanced mounting technology into an even more compact body. The result is a performance of 59,000 cph per square meter. The NXT IIc machine is ideal for assembling PCBs for a variety of products, especially those found in many of today's mobile devices.

Avnet to Acquire Ascendant Technology

"Avnet's acquisition of Ascendant Technology is expected to accelerate our global solutions distribution model," said Phil Gallagher, global president. "It supports our strategic focus on enhancing our services and software capabilities to drive growth for our suppliers and value-added resellers."

New ALPHA® LED Materials Featured at Strategies in Light

Alpha will introduce its new line of LED specialty materials technologies at the Strategies in Light Expo & Conference, May 22-24, 2012 in Shenzhen, China. These new product technologies reach across levels one through five of the LED lighting system manufacturing process: Die attach and package, package on board, luminaire module, power driver/supply, and control systems.

LPKF Demos Latest Laser Tech at SMT Nuremberg

The SMT in Nuremberg has traditionally been an important trade show for LPKF. This year laser systems will be shown on three stands and a world premiere will demonstrate LPKF's innovative power as the specialist in micro material processing with lasers.

Henkel Expands MACROMELT Portfolio

MACROMELT MM6208, has all of the inherent benefits consistent with MACROMELT technology, but has a high (95°C) relative temperature index (RTI) rating making it ideal for certain automotive, consumer, and appliance applications where a very high RTI rating is required for good thermal stability. The product carries the highest RTI rating in its class of materials.

Totech Displays Super Dry Oxidation-Free MSD Cabinets

Super Dry by Totech has launched an oxidation and inter-metallic-free alternative to oven baking of moisture-sensitive components and PCBs that will be on display at the upcoming Del Mar Electronics and Design Show. The Super Dry XSD cabinets can dry PCBs and other moisture sensitive devices at high speeds without the oxidation and inter-metallic growth induced by baking.

Manncorp Expands Website; Adds PCB Cleaners Section

Manncorp has expanded its website section dedicated to PCB cleaners. Included are updates of existing models and a new inline board cleaning and defluxing system for water-soluble fluxes that combines higher throughput with exclusive operational and ecological benefits.

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WHAT THE DOCTOR ORDERED

by Martin Nicholson
TEKNOFLEX

SUMMARY: As in many other technology areas, the medical industry now demands smaller, lighter, and more functional products. The demand for higher levels of interconnect and packaging density increases have driven technology into increasingly complex, sequentially-laminated flex-rigid multilayers, microvias, and associated reduction in track and gap geometries.

Since the 1950s, the global medical devices and equipment industries have followed the general trends in electronics to smaller, lighter, more functional products while retaining the absolute requirements for safety and reliability.

As product envelopes shrink and component densities increase, the demands on inter-component and inter-board wiring to occupy less space and add less weight have continued relentlessly.

The Solution

Flexible circuit technology offers a range of complexity options to suit most requirements from simple single-layer interconnects requiring only one layer, but nevertheless being very thin and flexible, through to complex multilayer structures providing high-density component support and associated interfaces within the final assembled unit.

The demand for higher levels of interconnect and packaging density increases have driven the technology into increasingly complex, sequentially-laminated flex-rigid multilayers, microvias, and associated reduction in track and gap geometries.

In addition to the mainstream flex and flex-rigid multilayer technologies, a number of peripheral, but important, technologies have emerged over the years including sculptured circuits, regal flex circuits, multi-chip modules and all the associated developments in through-hole and surface-mount assembly with ever-decreasing pitch devices.

Whilst each and every one of these technologies has its own market position and applications, there are instances where the solution to a complex interconnection and packaging requirement can only be satisfied by a highly-customised combination of these technologies into what can best be described as a hybridised interconnection system.

Advantages

The major advantages of deploying a flex circuit solution include:

- Space saving;
- Low mass;
- Reliability;
- Repeatability; and
- Cost effectiveness.

All are generally applicable in the medical market yielding benefits in performance and patient comfort.

Circuit Technologies

Flexible Circuits

As the name implies, these products are normally single, double-sided or multilayer circuits comprising a dielectric film, typically polyimide or polyester, containing copper on one or both sides, which is configured through a photo imaging and etching process to derive the necessary conductor geometry for a given application.

Double-sided circuits normally have plated through-holes and both single- and double-sided circuits usually feature conductors protected by a printed covercoat or bonded coverlay, and may also have rigidised sections for component mounting, etc.

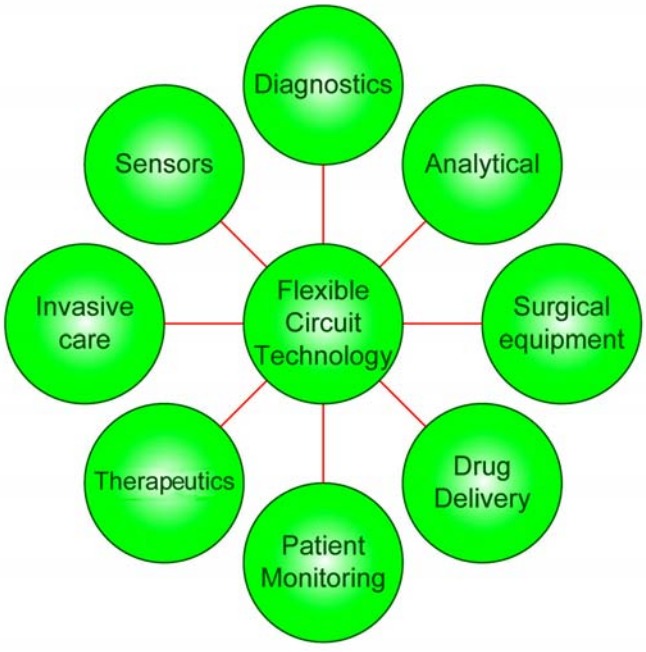

Figure 1: Summary of potential flexible circuit technology uses in medical electronics applications.

Multilayer flexible circuits are effectively a combination of the above with three or more conductor layers progressing up to eight to 10 layers. It should be noted that as the layer count increases the flexibility of the finished circuit decrease. However, there are design features which can be deployed to reduce this effect if bend requirements are an important consideration.

Sculptured Circuits

Sculptured circuits are differentiated from flexible circuits by having variable copper thicknesses within the circuit conductor pattern. This enables the conductors to be thicker, for example, where robustness, rigidity, unsupported fingers, or high current-carrying requirements must be met and thinner copper where flexibility of the circuit is required.

The heavy copper employed has two main functions:

1. To enable mechanically robust features to be incorporated into the circuit; i.e., eliminating a connector and additional interconnects.

2. To enable the circuit to carry higher current.

For power circuits, the capability of carrying 100 amps or more is possible using sculptured flex technology. Termination pads can be left at full thickness, enabling raised contact points or formed fingers to be produced, which can be suitably plated and used as points of interconnection with other circuits creating novel, low-profile connector technologies. These have already been utilised widely in many demanding applications. For high-energy applications, such as medical imaging equipment and power control devices, this technology can be particularly useful for designers.

For reasons associated with the manufacturing process, sculptured circuits have previously been restricted to single-layer constructions which have, in some instances, proven to be a limiting factor in the design. Teknoflex has developed the capability of producing double-sided plated through-hole sculptured circuits and a technique combining sculptured circuits with flexible circuits, thus mixing signal and power capabilities in one circuit.

Flex-Rigid Multilayer (FRM)

As the name implies, FRMs are a combination of layers of flexible circuitry and rigid circuitry bonded together in the manufacturing process to produce often complex products with many levels of interconnection and high packaging densities. The circuits often have a number of multilayered areas, with the flexible inner layers providing the means to connect between these areas in a foldable, three-dimensional configuration. The lamination of the multiple layers of circuitry is usually performed using a combination of pre-preg bond films and rigid caps with circuit layer counts frequently exceeding 10. Blind and through vias can be created at the inner or sub-multilayer stages and plated through to increase the connection density, provide screening layers or power or thermal planes.

Many construction options are available for FRMs which utilise both FR-4 and polyimide/glass-rigid or high-speed/frequency laminates in conjunction with adhesive or adhesiveless flexible laminates. The most common structure used today is based upon a polyimide/adhesive/copper foil flexible base laminate. Typical adhesives are acrylics, epoxies, and, for higher performance applications, adhesiveless flex circuit materials can be used.

Rolled annealed (RA) copper foil is common with the adhesive based laminates, whilst electrodeposited foil is common with the adhesiveless laminates.

The processes involved in the production of FRMs are of course similar to those used in the manufacture of regular flexible circuits.

> ***Whilst the processes involved in manufacturing high-layer-count regal flex circuits are similar to those used in the manufacture of FRMs, the technology is differentiated in that there are no polyimide or acrylic materials in the multilayer area.***

Regal Flex

This technology was developed as a solution to the problems associated with the phenomena known as barrel cracking in high-layer-count FRMs (greater than eight layers).

Whilst the processes involved in manufacturing high-layer-count regal flex circuits are similar to those used in the manufacture of FRMs, the technology is differentiated in that there are no polyimide or acrylic materials in the multilayer area. It is these materials which, for reasons associated with their high coefficients of expansion and moisture absorption, give rise to the aforementioned barrel cracking phenomena.

By eliminating these materials from the multilayered areas, these problems which usu-

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ally occur during connector or component assembly are eliminated.

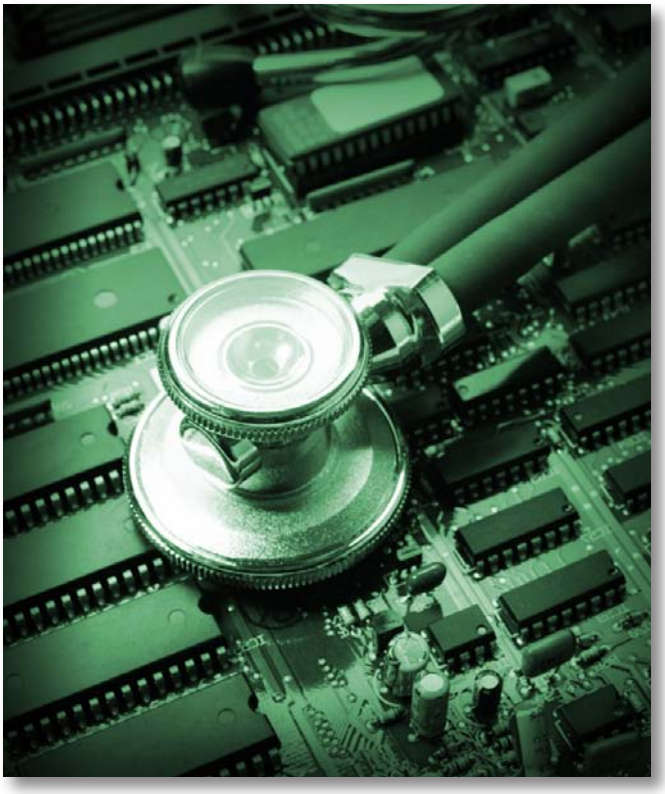
Modular Flex

Modular flex is a technique which involves the use of all the above technologies together with perhaps multilayer rigid circuits to produce an interconnection system which can be fully assembled when delivered to the customer or can be supplied as individual piece parts for assembly by the customer or their chosen subcontractor.

This approach is more than just an alternative to a single complex flex-rigid multilayer in that it offers the user the consider array of benefits provided by all these different technologies.

The most significant of these are:

- Use of thin substrate single- or double-sided flexis made with the most appropriate and ductile copper to achieve maximum flexibility and highest density of conductor geometry.
- Use of sculptured circuits for robust interconnection points, unsupported features and maximum current carrying capability.



- Use of flex-rigid multilayer or regal flex technology to achieve the most desirable interconnection routing and component mounting.
- Use of pin-flex technology for reliable, robust, and replaceable interconnections.
- Infinite scope for redesign and "in service" repair, etc.

The total flexibility and adaptability of a modular flex approach makes this technique attractive to many market sectors and applications.

Hybridised Interconnections

As will be apparent to the reader, all the above technologies have their applications and offer their unique benefits.

There are, however, occasions where a particular interconnection and packaging problem demands the design and construction of a unique circuit in which a combination of the above technologies are brought together in a fully bonded, hybridised construction. Examples of this include circuits that are required to carry both signal and heavy current capability. Also, there are instances where the number of soldered or mechanical interconnections must be minimised for reasons of reliability or packaging density, or where there is perhaps a need for a high level of robustness or rigidity in one or more of the "flying tails" extending from a multilayered area.

These constructions can therefore be a combination of flex-rigid multilayer technology with pin-flex circuits and sculptured circuits bonded as inner layers into the package and fully plated through.

The design of these products is highly specialised with considerable consideration needing to be given not only to the mechanical and electrical performance of the finished product, but to the complexities involved in the manufacture of the circuit itself.

Medical Applications

The use of flexible circuits in medical equipment as simple interconnects, as component carriers, or both, are mainly limited by the designer's imagination. Typical applications in

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which flexible circuit technology is currently used include:

- Pacemakers/defibrillators;
- Blood/urine analysers;
- Drug delivery systems, including syringe drivers/infusion pumps;
- Surgical equipment and tools;
- Medical and dental X-ray equipment;
- Patient monitoring equipment;
- Medical prosthetics;
- Sports injury treatment/diathermy;
- Hearing aids;
- Endoscopic cameras;
- Surgery/operating room lighting and cameras; and
- Antennae.

As can be seen from the above list, the spectrum of available flexible circuit technologies is sufficiently wide to provide an ideal platform for many medical electronics applications.

In summary, the use of flexible circuits as an interconnect approach in this market can facilitate the following key benefits for medical devices:

- Greater integration;
- Higher reliability;
- Improved packaging density;
- Improved current capability;
- Cryogenic performance;
- Direct component attachment;
- Simplified device assembly by reducing the number of technologies employed;
- Better patient comfort; and
- Lower mass. **SMT**

Martin Nicholson is applications engineering manager at Teknoflex Limited, Chichester, UK. He graduated in 1975 with a degree in Physics, Math and Electronics and subsequently held a number of positions in technical sales and applications engineering. He joined Teknoflex in 1991 and is currently responsible for the technical oversight of new business opportunities.

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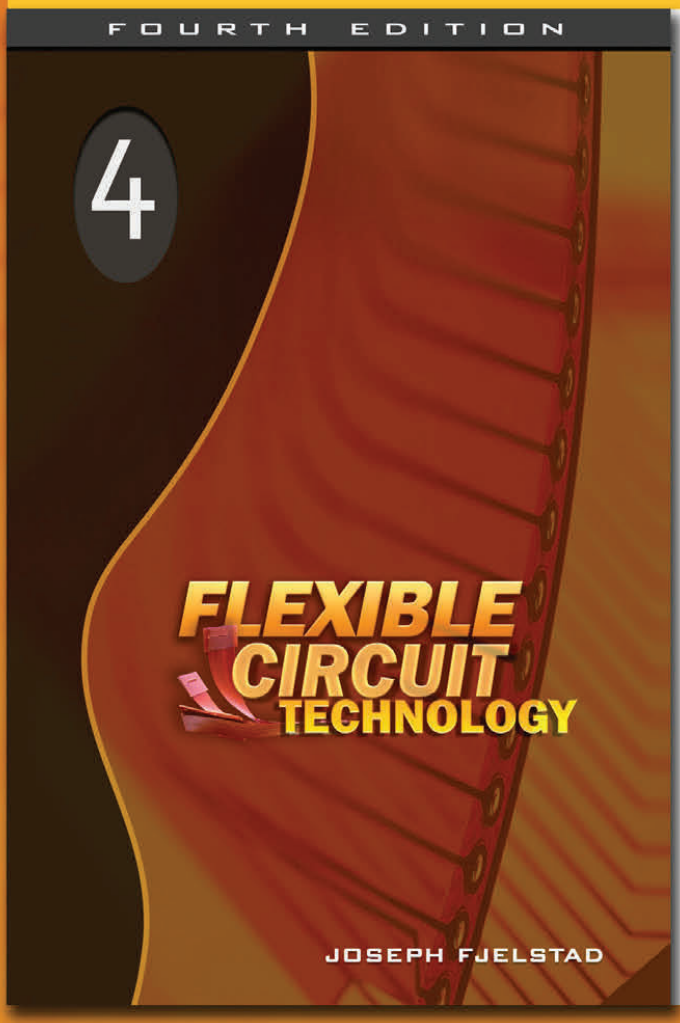

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THE SUPPLY SIDE

How Well Do You Know Your Supplier?

by Christopher Torrioni
SENSIBLE MICRO CORPORATION

SUMMARY: ***The amount of unwanted correspondence and solicitations purchasing professionals get on a daily basis is enough to issue a restraining order for stalking. The non-stop onslaught of marketing and begging for business seems go on forever. But there's hope. Doing some quick online investigating and asking the proper questions can save you from potential supply chain disasters.***

The cold calls never seem to stop. You have a stack of line cards on your desk thicker than the extended version of *War and Peace*. Then there's always those creepy, overly friendly and persistent e-mails from a distributor you talked to six months ago who just won't get the hint. The amount of unwanted correspondence and solicitations purchasing professionals get on a daily basis is enough to issue a restraining order for stalking. Whatever it may be, the non-stop onslaught of marketing and begging for business seems go on forever when it comes to the amount of independent distributors within the electronics manufacturing industry and buyers should choose wisely.

It's apparent why all types of OEM and EMS providers choose the crème de la crème of franchised component distribution—Arrow, Avnet, and Future Electronic—to ratchet in fair pricing, favorable schedules, in-house stores, engineering support, and quality solid product. But what about the other guys? The smaller, niche-serving distributors who fill in the gaps when the big boys drop the ball?

Whatever the case may be, at some point you've done enough homework to form a viable group of "go to" distributors for all types of sourcing needs. Every company has a different approval process. Some will add a new supplier at the drop of a hat and others take careful measures to ensure the integrity of the supplier fits their quality objectives. So, how well do you know your supplier? I pose this question because I constantly see new distributors popping up and claiming tons of industry accolades, including quality certifications and thousands of lines of stocking inventory. In my experience, doing some quick online investigating and asking the proper questions can save you a world of potential supply chain disasters.

Two words can grossly change how you look at a new supplier—Google Earth. Recently, we were looking at adding a new supplier to our approved vendor list (AVL), but quickly changed our mind after inputting the company address into Google Earth and confirming they were misrepresenting who they were. The prospective supplier had boasted to me that he had over 30,000 line items of stock on hand. Google

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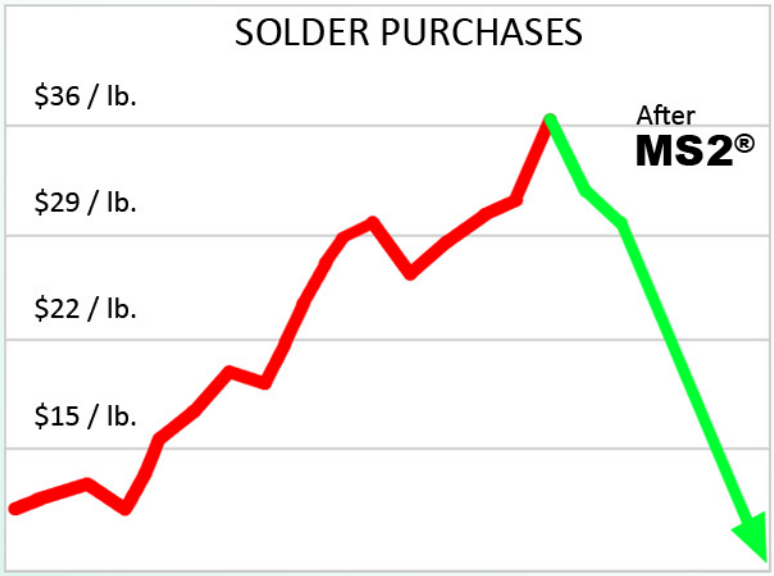

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HOW WELL DO YOU KNOW YOUR SUPPLIER? *continues*

Earth told us a different story. The company address was legitimate…only it was to an apartment complex.

Google Earth gives you the ability to view the actual satellite image closely to confirm the company is really what it's presenting itself to be, showing building size and location. We've also found many times, and this is my personal favorite, a location showing up as "UPS Store." I am guessing that's for the distributor on the go who only has enough time to switch out packing slips and forgo any QA inspections.

Now, to claim that any distributor working out of their home or apartment has less integrity than a company working out of an actual office/warehouse would be insulting and untrue. A few very good home-based brokers do have key relationships that afford them an industry niche not requiring high-level inspection equipment, racks of inventory, or supporting staff. They typically trade direct from authorized or factory channels and are usually transparent with their customer base about their capabilities.

But, I've also seen the flip-side of the coin—larger stocking distributors with nice buildings and tons of employees that deliver highly questionable product. There are well over 1,000 independent distributors in North America actively supplying parts today and buyers need to be savvy when it comes to truly understanding who they are dealing with. Below are a few areas that should be examined closely when adding a new, independent supplier.

Obtain Industry References

Even newer companies should be able to produce decent references. If the supplier you are looking to do business with has any level of credibility, don't just take their word for it; ask for a list of OEM or EMS customers that can confirm a high level of quality, service, and support. If they aren't willing to produce references, consider that a red flag.

Obtain Quality Documents

If the supplier is claiming to be ISO 9001, ANSI S20.20, or AS9120 certified, ask for an actual copy of their certifications. Be wary of companies claiming to be "ISO-compliant." As many of us know, getting ISO certified and maintaining that certification, as well as following procedure on a daily basis, is not an easy task. I find it hard to believe organizations would be compliant to the strictness of ISO standards if not being held accountable by an outside audit company on an annual basis. You should also request a copy of their Quality Management System for review to make sure what they are preaching is documented.

If you are dealing with an independent that does not have a documented anti-counterfeit procedure in place, I would consider that extremely risky. If they do have such a procedure, ask for a copy and make sure it meets your inspection and screening objectives.

Scheduled Site Audit

Nothing beats seeing your supplier's facility firsthand. By visiting and inspecting in person, one can see a supplier's quality team in action and get an excellent understanding of that organization's level of expertise and capabilities in supporting needs properly.

Get it in Writing

Negotiating for payment and warranty terms are hugely important in today's buying market. Make sure you are asking for a longer return policy in the event of faulty product. Companies

HOW WELL DO YOU KNOW YOUR SUPPLIER? *continues*

who give you a very small window of time for returns are doing that because they don't have faith in the product or have done little on their end to confirm the integrity of the parts.

Stop Googling Part Numbers

I cringe when I hear stories of buyers putting a part number into Google and using that information for vendor selection. If that is your plan for sourcing obsolete or allocated components, please call me because I have a bridge for sale that you'd be interested in purchasing.

Instead, align yourself with suppliers that can demonstrate how and why they can protect you from receiving substandard product. Just because a company is certified or affiliated with an industry organization doesn't necessarily mean they have all the answers or are practicing a diligent approach. Set the criteria with your internal quality managers and hold suppliers accountable for those set processes.

The Internet and trading platforms have made it easier for buyers to find new vendors. If a deal seems too good to be true, it probably is. Make sure you are performing a diligent approach when searching and selecting a new supplier for your AVL and hold those suppliers to a standard that has been well thought out and signed off by internal quality engineers and managers. **SMT**

Christopher Torrioni is President and co-founder of Sensible Micro Corporation, a professional stocking distributor and sourcing partner to hundreds of global OEM and EMS manufacturing companies. He obtained his Bachelor's Degree from the University of Central Florida and brings 11 years of industry knowledge and experience in electronic component supply, market news, procurement pitfalls and quality assurance standards. Torrioni is also a corporate sponsor to the SMTA Tampa Bay Chapter, as well as the Tampa Chamber of Commerce and Tampa Bay Technology Forum.

Solar Cell Turns Windows Into Generators

Imagine a world where the windows of high-rise office buildings are powerful energy producers, offering their inhabitants much more than some fresh air, light and a view. For the past four years a team of researchers from Flinders University has been working to make this dream a reality. As part of his just-completed Ph.D., Dr. Mark Bissett from the School of Chemical and Physical Sciences has developed a revolutionary solar cell using carbon nanotubes.

"Solar power is actually the most expensive type of renewable energy, in fact the silicon solar cells we see on peoples' roofs are very expensive to produce and they also use a lot of electricity to purify," Dr. Bissett said. "The overall efficiency of silicon solar cells are about 10% and even when they're operating at optimal efficiency it could take eight to 15 years to make back the energy that it took to produce them in the first place because they're produced using fossil fuels," he said.

Dr. Bissett said the new, low-cost carbon nanotubes are transparent, meaning they can be "sprayed" onto windows without blocking light, and they are also flexible so they can be woven into a range of materials, including fabric—a concept that is already being explored by advertising companies. While the amount of power generated by solar windows would not be enough to completely offset the energy consumption of a standard office building, Dr. Bissett said they still had many financial and environmental advantages.

Dr. Bissett said the technology mimics photosynthesis, the process whereby plants obtain energy from the sun. If all goes to plan, the material could be on the market within ten years.

Medical Device Market and Technology Trends

by Alex Richardson
QUAL-PRO CORPORATION

SUMMARY: Countries around the world are all facing the same types of healthcare issues: Obesity, diabetes, cardiac arrhythmia, and other illnesses associated with an aging population. Currently, leading manufacturers deliver 80% of their products to the U.S. market, but soon we will see a radical shift in these metrics as demand in Brazil, Russia, India, and China is supported by reimbursement infrastructures.

OEMs such as Boston Scientific, Medtronic, and St. Jude Medical (often referred to as "The Big Three") are the world's leading manufacturers for cardiac management and neuro-stimulation devices. They meet roughly 85% of the global demand for these types of devices—approximately 80% of which is being delivered to the U.S. market. Other countries, such as Brazil, Russia, India, and China (BRIC), are facing the same healthcare issues we deal with here in the U.S.: Obesity, diabetes, cardiac arrhythmia, and other ailments of an aging population with declining health conditions. Over the next several years we will see a radical shift in these metrics as the BRIC demand is supported by reimbursement infrastructures.

While BRIC reimbursement frameworks continue to be negotiated and crafted, it is evident that the need for lower-priced devices be quickly developed to fill this demand. It will only be a matter of time before the developing markets in the BRIC countries (low-cost countries) are afforded low-cost competition from

localized or near site offerings. The rush is on from U.S. sources to maintain market positions and offer products meeting price-point targets. We will undoubtedly see the re-introduction of previous generation products from U.S. OEMs that are less-feature driven, and lower cost, be revived to meet foreign demand.

The market will be confronted with a host of questions about changes in philosophies, architecture, and materials to meet this challenging demand. The right combination of paths will certainly pay rewards in this fast-growing niche market.

Established high-reliability components or lower-cost commercial-grade components? This question, an age-old dilemma, is stirring again as commercialized cost structures and risk aversion again chip away at the two philosophies. Polarized in the two distinct paths, manufacturers of medical devices, such as pacemakers, defibrillators, neuro-stimulators, and implantable drug pumps, are challenged with deciding which path will prevail. Balancing between reliability, cumulative damage, and cost, the jury is still out. The topic is very hot in today's market as BRIC country opportunities are driving devices to unseen price-model objectives.

> ***While BRIC reimbursement frameworks continue to be negotiated and crafted, it is evident that the need for lower-priced devices be quickly developed to fill this demand.***

Emerging BRIC countries are spawning new demand and creating reimbursement infrastructures; the bar on cost structure is plummeting. Less feature-driven products are resurfacing to more closely meet needed cost points, but the still-eroding cost targets are grinding away at margins.

Electronic components, which typically make up a significant portion of a bill of materials (BOM), are drawing the crosshairs a prime targets for cost reductions. In many cases, the established reliability testing of components can drive their price to 10x the cost for the same commercial component. OEMs who control a significant portion of the device content are struggling with these opposing models. They typically do not have (or desire to have) the internal systemic handling capabilities to support both philosophies. The potential risk of mixing lots of components (with the same manufacturers' part numbers), the added FDA scrutiny to material systems, and necessary modifications to source control drawings, all add up to a strong argument against the fight for cost-saving solutions. Added to logic, statistics, and math, there are inborn philosophies and emotional ties to practices in place and reticence to change. Additionally, for medical devices in this arena, change comes at a high price tag with re-qualification efforts.

This is where a contract manufacturer (CM) can shine. Suitable CMs have the infrastructure to handle a myriad of component mixes, even within the same manufacturer part number. Their systems are intentionally designed to be able to manage a multitude of components, often having the same manufacturers' part number, but differentiated by diffusion lots, quality clauses, or date codes. Up-screening at an assembly level can also often be performed by the CMs, eliminating the need to screen components pre-assembly. This service, of course, can potentially add risk (costs) to assemblies not passing at assembly level due to infant mortality of the components. A well-crafted acceptable quality level (AQL) component screening plan and reliability program can often eliminate this risk, as the mean of failures in commercial components is by percentage often better (lower) than "established reliability components."

Many of the components contained in current established reliability programs are passive devices (capacitors, resistors, and inductors), as many active devices (semiconductors and ASICs) have set processes that cannot be altered for purposes of reliability screening. Lot acceptance testing (LAT) is often used. The use of MIL-STD programs, combined with highly competent component engineering and statisti-

cal quality programs is imperative. Not all CMs will embrace these value-added tasks as they do not fall within their core or the CM may see these efforts as a distraction to their ongoing business or production models. Whichever component reliability path is taken, choosing the right manufacturing partner with aligned, long-term strategies is equally important.

Flexibility within the CM to adapt to the myriad of customer/product specific details necessary to become an extension of OEM resources and still meet objectives is a tight balance. Needed customer-centric attention typically either comes with a cost proposition or push back in larger CM models.

Medically-implantable appliances and their supporting external devices not only improve the quality of life, but also sustain it. It is essential that the reliability of these devices exceed Six Sigma. The CM partners servicing this market must have regimented quality systems sufficient to satisfy not only ISO 13485 requirements, but also the standards of the OEMs and in some cases, the FDA.

Manufacturers of components add another dimension to this clouded matter. Established reliability components, typically on OEM-controlled source control drawings, bring value-added services, which equate to added margin. In today's market, this margin is seen as the "carrot" that makes it equitable to participate in the implantable market with its obvious and perceived risk factors. Many component manufacturers have pulled away from support or prohibit direct sales to OEMs trying to pursue the commercial use/assembly up-screen path. Here again, CMs may afford an amenable path. Coordinating efforts with the OEM, the CM can procure commercial parts and establish a well-controlled custom program with distribution partners.

Microelectronics assembly (chip and wire) has been a widely used technology in implantable devices for several decades. Here, ASICs and die-level components are attached using die attach/wire-bond technology. This has been great solution for volumetric efficiency where many connection points can be made in a very small envelope or area. In the past, gold ball bond was the standard, where processes were adopted from historical hybrids used in space, military, and high-reliability programs. The issue of this adoption over the last decade boils down to cost and consistency. The historical processes were typically used for military and space-level applications where volumes were low and costs were not as sensitive to more commercialized volumes. Current requirements of medical implantable devices with higher rate production demand not only lower costs, but also support high rate manufacturing processes.

The selective thick gold build-up necessary for gold ball bonding (with controlled class, grade, and Knoop of the gold) limited the number of available suppliers for the substrates. Escalating gold costs in the last few years have forced many substrate manufacturers to outsource the selective plating processes. Losing the internal controls at many of these available board fabricators has further limited available options on sourcing.

Over the last several years, great successes have been made using aluminum wedge bonding on more standard substrate finishes, such as electroless nickel immersion gold (ENIG), or electroless nickel electroless palladium immersion gold (ENEPIG), that do not require the selective thick gold build-up. The measurement of the critical process performance (reported in CpK values) using these more common finishes with aluminum wedge bonding have met or exceeded the results of the standard gold ball bonding on the expensive and limited selective plating boards. The obvious advantage here is a much wider offering of substrate manufacturers

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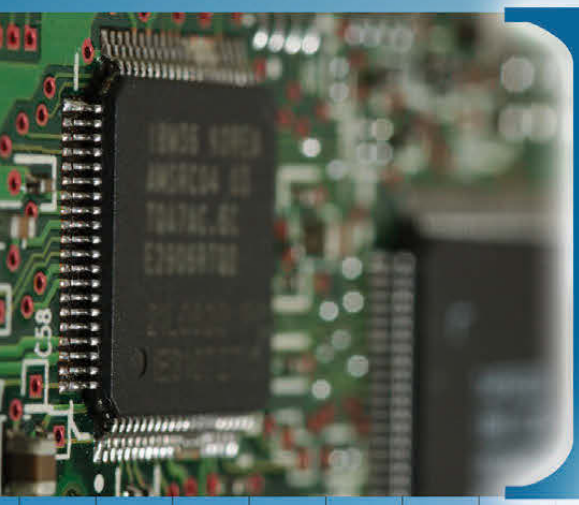

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and mainline processes that provide substantial improvements in consistency, both bringing significant cost improvements.

Ceramic substrates were a historically common choice as a hybrid substrate material, for complex signal routing or radio frequency (RF) applications in microelectronics (chip and wire) processing. Ceramic substrates typically have a fabrication cycle time of greater than 4x the cycle time of standard organic circuit boards with higher risk though yields. Hence, cost structures often have similar factors applied. The main cost driver, however, is in the processing at the assembly level, where the ceramic substrates are typically built as "one-up" devices. The ceramic substrates typically do not have the ability to be separated by conventional methods like depaneling processes in organic PCB substrates. This means that instead of building in economical panel arrays these devices need special tooling to hold them through the manufacturing processes and test, foregoing most volume/scalable efficiencies.

With improved technology in organic substrates over the last decade, including laser direct imaging, refined line and spacing capabilities, microvia technology, blind/buried vias, a myriad of improved materials choices, the ability to mix layers, and wider support of rigid-flex-rigid, many of the older designs, which were on the costly ceramic substrates, have been converted to new designs in standard organic substrate materials, dramatically improving efficiency, time-to-market, and costs. Critical RF signal routing, combined on the same assembly as the power and digital processing, has eliminated the need for multiple assemblies and the associated interconnect. Elimination of these interconnects has afforded great opportunities to size down devices and create opportunities to integrate more features to the designs.

The adoption of microvia technology, coupled with micro ball grid array (uBGA), land grid array (LGA), and chip scale packaging (CSP) technologies have opened up a new area for "commercialization" where these high-density interconnects can often replace the microelectronics/chip and wire solutions significantly opening up the candidates for manufacturing. The dilemma here is losing the ability for 100% visual inspection of the wire-bonds in trade for more commercialized processes of eutectic solder joints (solder) which are, unfortunately, impossible to inspect 100% without utilizing cost-prohibitive scanning acoustic microscopy. The manufacturing processes and systemic controls for the eutectic approach must have tighter parameters than typically found in commercial environments.

The challenges ahead and the adoption of new processes will not be solved overnight, but it is imperative they be addressed quickly so as not to lose market position. Overall, the medical device market will experience challenging dynamics over the next decade. The recent deterioration/restructuring of our U.S. reimbursement model was only the tip of the iceberg. Low-cost BRIC demand, and looming new suppliers from emerging countries, will force new philosophies. The challenges of new product introductions are changing as well. Features are becoming less important than cost, new dimension OEMs must now embrace to maintain or capture share. Outsourcing may be one of the fastest and most efficient paths. Partnering efforts with capable and flexible CMs may be a growth trend on the horizon. Many efforts are firmly underway to evaluate and strategize ways to effectively capture the upcoming boom in demand in this multi-billion dollar and globally-growing market. **SMT**

Alex Richardson has nearly 30 years of engineering and sales experience in high-reliability electronics manufacturing. During this time, he has been a test, quality, and design engineer and has managed sales teams for a variety of electronics OEMs and EMS providers. Richardson has spent the last 15 years specializing in high-reliability electronics with an emphasis on the medical and military/aerospace market sectors and in implantable Class II and III devices, UAVs, military radios, counter-measures, and devices that push the envelope of today's technology. Before joining Qual-Pro, he had roles at many well-known companies, including Advanced Micro Devices, Jet Propulsion Laboratories, and ITT Gilfillan.

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ZULKI'S PCB NUGGETS

A Commitment to Greater U.S. PCB Manufacturing

by Zulki Khan
NEXLOGIC TECHNOLOGIES

SUMMARY: The industry must continue taking the initiative to boost its credibility and manufacturing prowess to make OEMs true believers. We also need to figuratively join hands with President Obama's manufacturing initiative to proactively promote greater U.S. PCB manufacturing and bring more jobs back home.

President Obama's "Blueprint for an America Built to Last" is indeed an ambitious initiative and should be highly supported to encourage "insourcing," create more manufacturing jobs in America, and help to significantly strengthen our economy.

There is no question that the U.S. has the know-how and technologies to manufacture virtually any product, as the president often emphasizes in his speeches on U.S. manufacturing. Our country is steeped in highly-trained professionals and has created amazing technologies that other countries are scrambling to imitate.

However, with the considerable and worthy attention the White House is placing on U.S. manufacturing, it's important to point out one key distinction. As most Americans know, the majority of consumer products we use daily are manufactured in the Far East and that's been happening for a few decades now. So, it's fair to say that those consumer products are best suited for overseas production since by their very nature they are extremely price driven.

Overseas manufacturers can produce these products in mass volumes at price points associated with profitability. But most U.S. manufacturers making these same products would be hard-pressed to be profitable. Hopefully, that business model can change in the long term as President Obama's initiative gains greater traction.

Aside from consumer products, a greater focus should be placed on U.S. manufacturing of commercial, industrial, medical, and mil/aero

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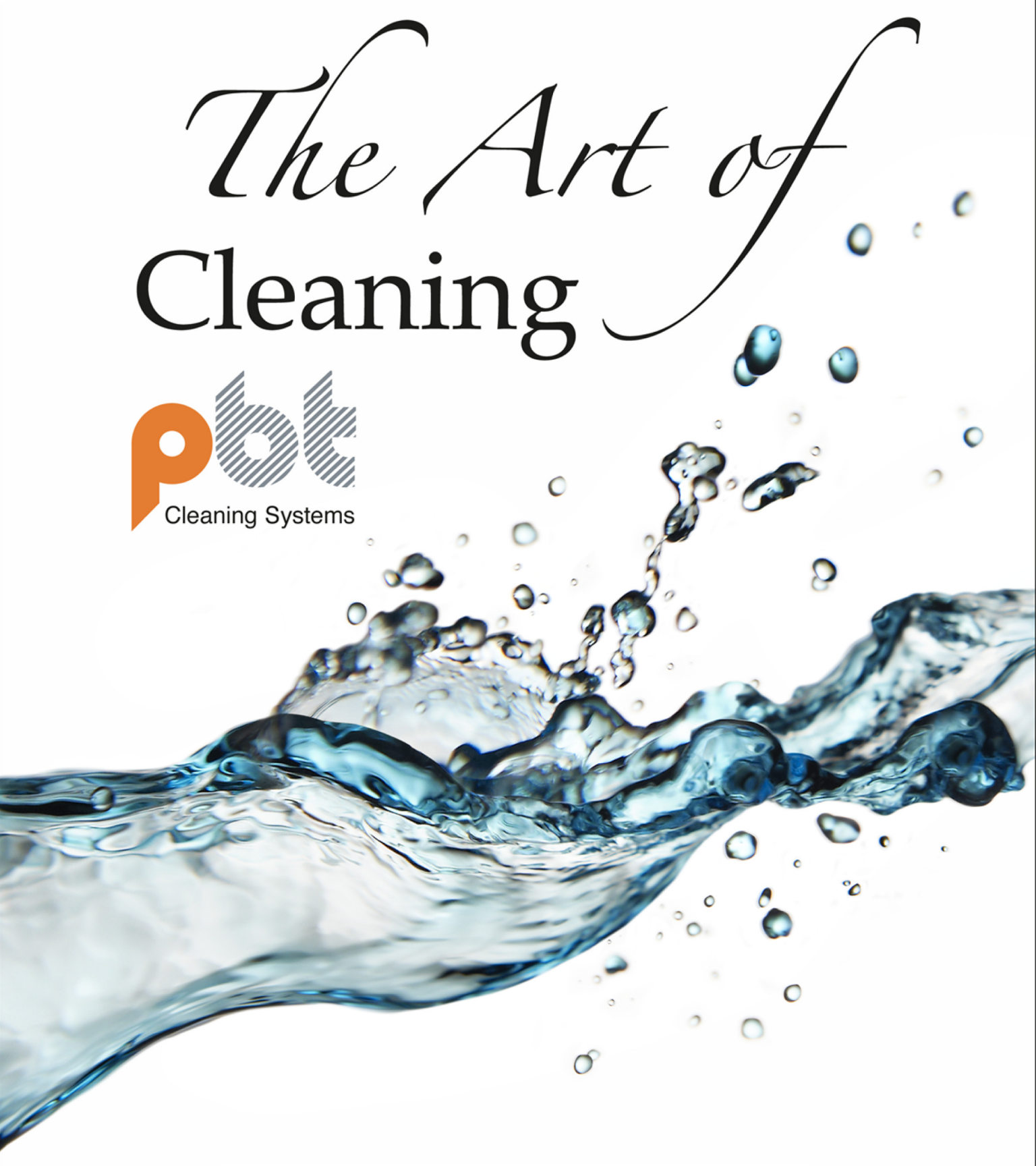

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A COMMITMENT TO GREATER U.S. PCB MANUFACTURING *continues*

systems where price is not the only driver. In these instances, we're talking about complex, high-end technology products and systems demanding manufacturing that is definitely not a walk in the park. Such powerful and advanced systems are challenging to design and build. The essential engineering expertise and advanced technology manufacturing to properly create these systems are found only in the U.S.

The same principle holds true for greater U.S. manufacturing of PCBs that are the underpinnings for advanced electronics systems. The argument can certainly be made for high-quality, extremely reliable PCBs in pilot- or medium-run U.S. production. In some cases, intellectual property (IP) theft becomes an offshore issue. U.S. companies find the products they spent huge amounts of resources on are available overseas at one-third the price, with similar features. But, at the same time, the chances are high of IP theft. Building a product overseas also involves losing some of the production and testing control for obvious reasons.

> ***U.S. companies find the products they spent huge amounts of resources on are available overseas at one-third the price, with similar features.***

U.S. OEMs getting their high-end PCBs and box-builds produced overseas face the costly challenge of return material authorizations (RMAs). With a system and its sub-assemblies produced overseas, considerable time and cost are involved. At the same time, quality issues emerge resulting from these RMAs. Consequently, an increasing number of U.S. OEMs are returning production to the U.S., not only to improve quality, but also to safeguard and control their IP. These OEMs feel they have considerably more leverage and control over the way their systems are built here.

Other OEMs with complex systems may have tried their hand with overseas production, but ultimately found those efforts unsuccessful, eventually bringing manufacturing back to the U.S. These companies may produce one particular piece of equipment with different versions and configurations for different applications and customers. Production runs were small, roughly 200 units divided into those different versions. As a result, production runs became difficult for overseas production companies accustomed to extremely high volumes. Hence, no business match existed and those American OEMs came back to the U.S. as a consequence.

These early adopters of U.S. manufacturing are setting the pace for the PCB industry to follow. We need to use our creativity, our ingenuity, and, best of all, our advancing technologies and better-trained engineers to improve manufacturing efficiencies. We need to make our processes much more automated. This allows us to leverage technology that, in effect, opens the doors to even higher quality and automatic assembly process repeatability. This way, advanced manufacturing equipment is doing the work and not necessarily the human interaction.

For example, take PCB testing. Yes, further automating testing costs more money, but if you automate the testing process, it will absolutely increase yields and decrease the amount of human interaction and risk of inducing errors. If our industry can automate most processes to overcome price disadvantages, and if products are mid- to high-tier, we can certainly increase the efficiency and overcome the price barriers.

Still, we have to remind ourselves to make certain all our i's are dotted, all our t's crossed when it comes to highly efficient manufacturing. We cannot afford to shortchange any vital and crucial step. We must make sure all manufacturing processes are in place from new product introduction (NPI) stages and that all kinks are taken out of manufacturing to mass-produce the product. This way, a product is designed correctly and not too much time is spent to make it DFM-friendly at a later stage. Here, I'm not talking about making 20,000 units in a week or a month. I am referring to products that can be made on pilot or medium production runs, which our industry can easily do.

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A COMMITMENT TO GREATER U.S. PCB MANUFACTURING *continues*

The burden is on us, the PCB industry. We must continue taking the initiative to boost our credibility and manufacturing prowess to make OEMs true believers of our capabilities. Plus, we need to figuratively join hands with President Obama's manufacturing initiative to proactively promote greater U.S. PCB manufacturing to bring more jobs back home. We have the wherewithal to aggressively pursue this new "insourcing" line of business. We've got the trained, well-qualified people, the unquestionable experience, and track record for successful production. Plus we've got American ingenuity creating better technology and advanced automated PCB assembly and manufacturing systems.

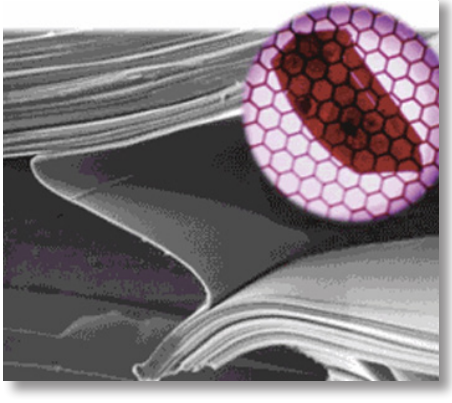
Our job is to let OEMs and all Americans know that the expertise and technology are right here at home—right in their backyards. It's our responsibility to help company executives and owners understand how they can adjust their business models to take advantage of U.S. PCB and box build manufacturing and, at the same time, stay profitable and continue growing. While moving headstrong in that direction, we stay committed and continue to strive to bring greater added value to our new and existing OEM customers. Our constant objectives are to increase yields, improve reliability, reduce costs, become more efficient with advanced manufacturing systems, and stay ahead of the curve when it comes to training our engineers and technicians. **SMT**

Zulki Khan is the founder and president of NexLogic Technologies, Inc., in San Jose, California, an ISO 9001:2008 Certified Company, ISO 13485 certified for manufacturing medical devices and a RoHS-compliant EMS provider. Prior to NexLogic, Khan was General Manager for Imagineering, Inc. in Schaumburg, Illinois. He has also worked on high-speed PCB designs with signal integrity analysis. He holds a B.S. in EE from NED University in Karachi, Pakistan, and an M.B.A. from the University of Iowa. He is a frequent author of contributed articles to EMS industry publications.

Non-Toxic Nanosheets Turn Waste Heat Into Power

Cornell materials scientists have developed an inexpensive, environmentally-friendly way of synthesizing oxide crystal sheets, just nanometers thick, which have useful properties for electronics and alternative energy applications.

The millimeter-length, 20-nanometer-thick sodium-cobalt oxide crystals were derived through a novel method that combined a traditional sol-gel synthesis with an electric field-induced kinetic de-mixing step. It was this second step that led to the breakthrough of a bottom-up synthesis method through which tens of thousands of nanosheets self-assemble into a pellet.



The material has fascinating properties, including high thermoelectric power, high electrical conductivity, superconductivity and potential as a cathode material in sodium ion batteries.

Usually oxide materials, like a ceramic coffee mug, aren't electrically conductive; they're insulating. Since the material is a conductive oxide, it can be used in thermoelectric devices to convert waste heat into power. Now that the researchers have made nanosheets, they expect the material's thermoelectric efficiency to improve, enabling the creation of more efficient alternative energy thermoelectric devices.

The nanosheets also show the ability to bend, sometimes up to 180 degrees. This is unusual for ceramics, which are normally brittle.

The material is based on common, abundant elements (sodium, cobalt, and oxygen), without toxic elements, such as tellurium, that are normally used in thermoelectric devices.

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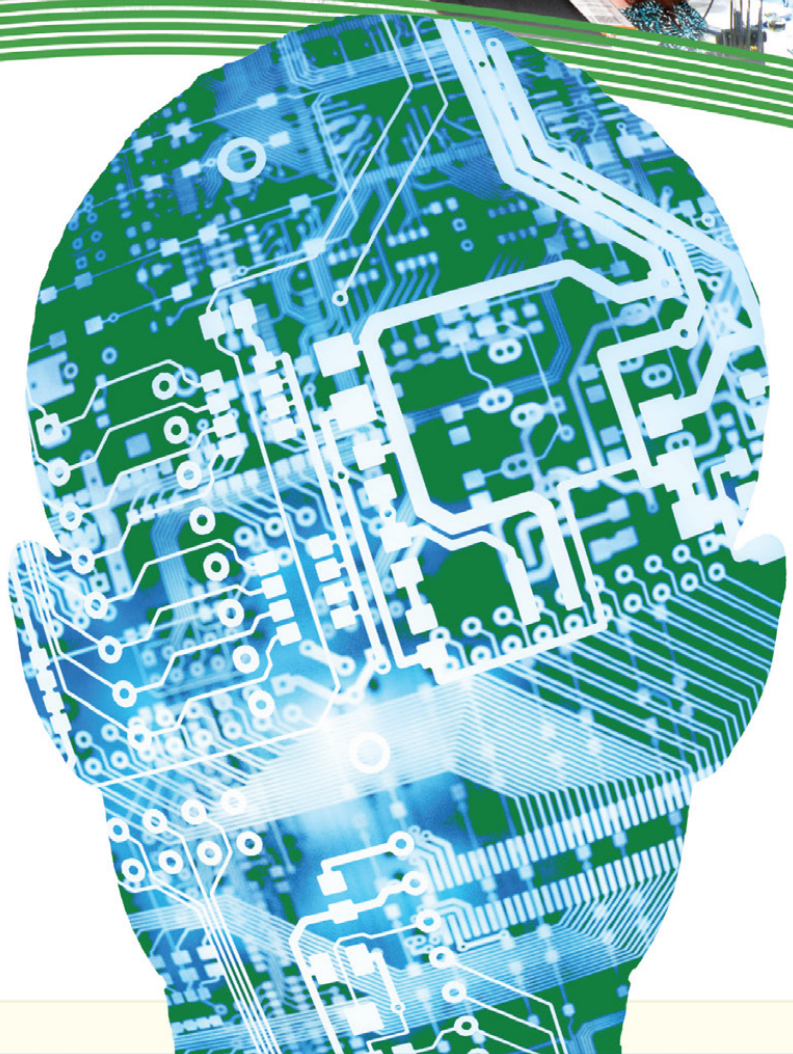

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Top Ten Most-Read MilAero007 Highlights

MTI Electronics Earns AS9100C Certification

The AS9100, Rev C is the quality certification standard for the aviation, space and defense industries. This certification reflects the commitment of MTI Electronics to meet and exceed customers' and industry quality requirements.

API Technologies Acquires Assets of RTI Electronics

API Technologies Corporation announced that it has completed the acquisition of substantially all of the assets of RTI Electronics for a total purchase price of $2.3 million in cash. Based in Anaheim, California, RTI is a leading manufacturer of passive electronic components, including thermistors, film capacitors, magnetic transformers and inductors, and audio power conditioning units.

Burton Industries Earns ISO 13485:2003 Certification

Burton Industries has received ISO 13485:2003 certification. The company also completed ISO 9001:2008 recertification. "A significant portion of our business focuses on medical customers. For years we aligned our quality system with the needs of that market. Pursuing ISO 13485 certification was the most appropriate next step to serve the requirements of our medical customers," said Monica Benson, director of quality assurance.

Sparton Key Partner to Goodrich's Threat Detection Program

Sparton Corporation has been recognized as a key partner to Goodrich Corporation's AN/AVR-2B (V) threat detection program. Sparton participated at a special event in December 2011 in Danbury, Connecticut to celebrate the delivery of the 1,000th AN/AVR-2B (V) laser detecting sent to the United States Army.

Sparton, USSI Secure $2.6M Direct Foreign Sales Contracts

"ERAPSCO/SonobuoyTech Systems is pleased to have been selected to assist Japan's efforts in protecting its borders by providing the leading-edge products developed by our joint venture partners," said Cary Wood, president and CEO of Sparton Corporation.

Suntron, Axiomtek Partnership Opens Opportunities

"Many companies have a need for specific hardware, but either don't have the capability, certifications, or time to integrate the solution," said Michael Oliveri, vice president of the System Solutions group at Suntron. "This partnership allows our customers to focus on their core competencies."

Sparton Wins $24.9 Million Sonobuoy Subcontracts

Sparton Corporation has announced the award of subcontracts valued at $24.9 million, for the manufacture of three types of sonobuoys for the United States Navy as part of the company's ERAPSCO joint venture. Production will be performed at Sparton's DeLeon Springs, Florida, facility and is expected to be completed by January 2014.

Raven Industries Creates Electronics Division for Growth

Raven Industries, Inc. has said it will realign the assets and team members of its Electronic Systems Division deploying them into the company's Aerostar and Applied Technology Divisions. This repositioning is expected to better align Raven's corporate structure with its mission and long-term growth strategies.

Hill AeroSystems Achieves AS9100 Rev C Certification

Hill AeroSystems has earned the AS9100 Rev C certification, awarded for improvement of product quality and cost reduction in the aviation and defense manufacturing industry. Hill AeroSystems passed its audit without any findings from the auditor.

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SMT TRENDS & TECHNOLOGIES

The Road Ahead: Single or Dual Lane?

by Sjef van Gastel
ASSEMBLÉON NETHERLANDS B.V.

SUMMARY: ***Until just a few years ago, most PCB transport systems featured a single lane, but valuable running time was often lost. A dual-lane system will reduce such losses, but how do you know which set-up works best for you? Sjef van Gastel takes a closer look.***

If you attended this year's IPC APEX EXPO in San Diego, you most likely noted the increased number of electronic assembly systems using dual-lane PCB transport. The key to selecting the right system for your company is to fully understand the background of this trend.

Until just a few years ago, most PCB transport systems featured a single lane. Using belt-driven segments as single-lane building blocks, a lot of (valuable) time is lost to running-in/running-out and clamping/unclamping boards. Typical losses are two to three seconds, reducing the time remaining for actual board assembly—an important fact if your line cycle time is 30 seconds or so. In this instance a dual-lane transport system will reduce transport time losses. While pick-and-place actions take place on the PCB that is positioned and clamped in lane X, a new PCB can enter lane Y and will be ready for board assembly as soon as the pick-and-place actions in lane X are complete. Because arrivals and departures of boards in both lanes will be independent of each other, this transport mode is referred to as asynchronous.

In this asynchronous dual-lane scenario, all boards fed into both lanes are of the same type; however, it can be very useful to use dual-lane transport with large variations of component counts over multiple PCB types. The best example is the assembly of mobile phone boards. In my last column, I gave the example of a well-known Asian cell phone brand with over 130 different models. Five main model types exist: Block phones, slider phones, fold phones, smart phones, and business phones.

A typical flow line might assemble both a block and smart phone. Both models might have a total component count of 400 components (top + bottom). For the block phone, only approximately 15% of all components will be on the top of the board (because both display and keys will be assembled on top, thus limiting the space left for SMDs), and approximately 85% on the bottom side. For the smart phone, the SMDs will be equally divided: Around 50% top and bottom. With a line placement capacity of 200,000 cph, a four-fold multiple board (4 x

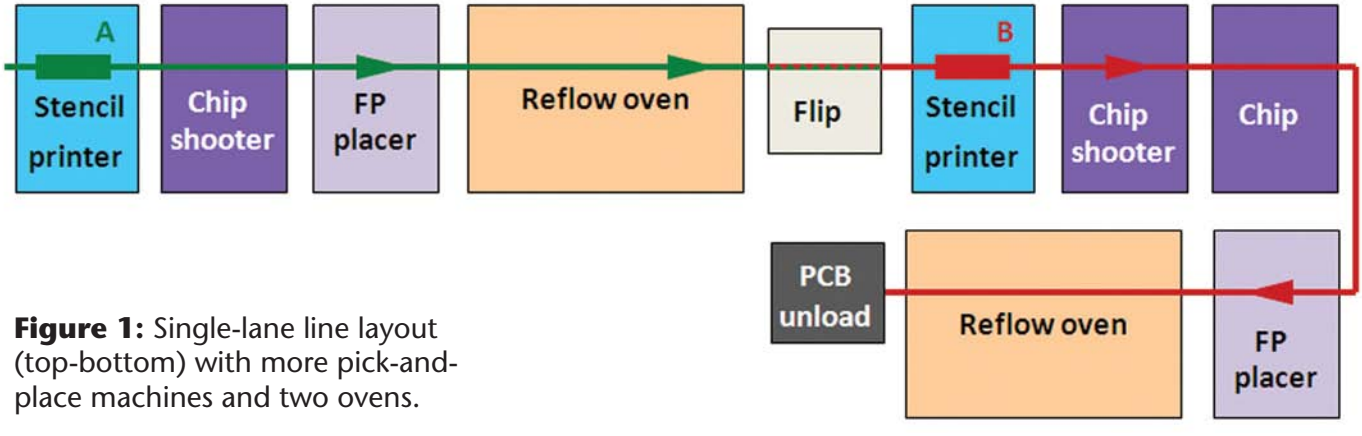

Figure 1: Single-lane line layout (top-bottom) with more pick-and-place machines and two ovens.

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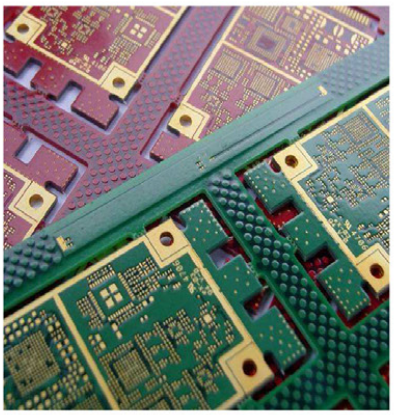

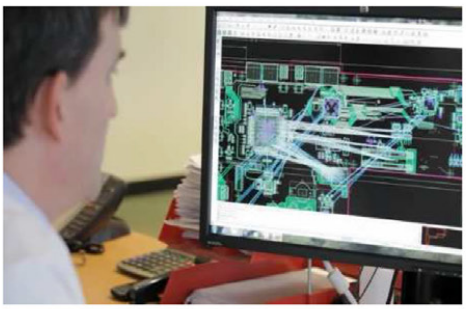

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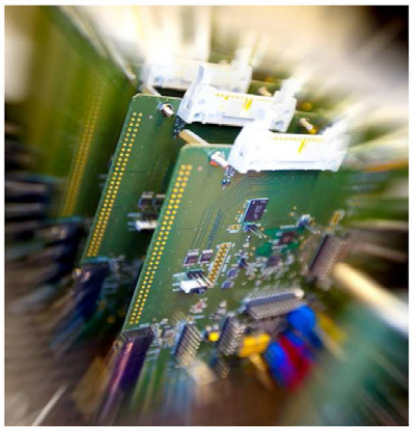

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THE ROAD AHEAD: SINGLE OR DUAL LANE? *continues*

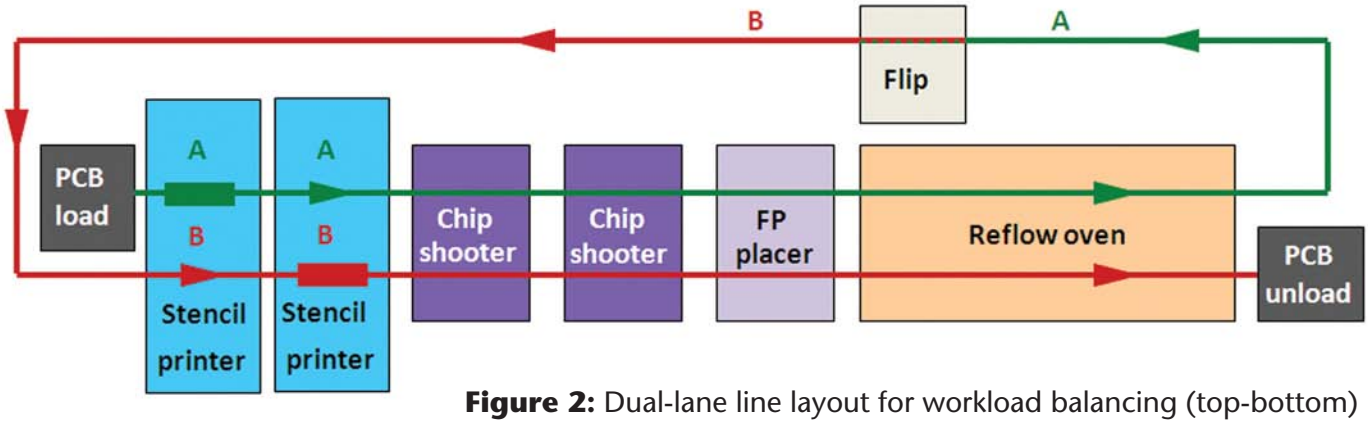

Figure 2: Dual-lane line layout for workload balancing (top-bottom) with less pick-and-place machines and only one oven.

400 = 1,600 components) will have a line cycle time of 28.8 seconds.

Producing both phone types on a single-SMT flow lane (Figure 1) will require two main segments: A top and bottom assembly line (each with a stencil printer, pick-and-place machines, and a reflow oven). Both line segments are divided by a board flipping module. Starting production of the block phone, the top segment needs to place 240 components in 28.8 seconds (at 30,000 cph), while the bottom segment will place the remaining 1,360 components in 28.8 seconds (170,000 cph). For the smart phone, components will be equally divided between top and bottom, so the placement capacity for both top and bottom segments will be 100,000 cph.

Now we have a problem: Either over-capacity in the top segment or under-capacity in the bottom segment! The reason is that we need to configure a flow line beforehand, not knowing exactly which board types will be assembled. To ensure sufficient production capacity is installed, we need to adapt the line capacity in the top segment to smart phone requirements (100,000 cph) and that of the bottom segment to block phone requirements (170,000 cph). That means installing an overcapacity of 70,000 cph into the single-lane flow line.

For dual lane (Figure 2), the top-side assembly is in lane A while the bottom side assembly is in lane B. As a result, the pick-and-place machines will combine both sides of the board into a single virtual board (Figure 3), always with a perfect workload balance. Less floor space will be needed for the dual-lane line, and only one dual-lane reflow oven is needed, which will reduce both floor space and energy consumption.

The third application for dual lane is in combining large production batches with small (NPI) production batches (Figure 4). Here, all component feeders for both product types should be configured on line. Normally the line will produce the "big runner" on both lanes. For the pilot product, one lane will produce the pilot board itself, while the other lane continues the big runner production. When all adjust-

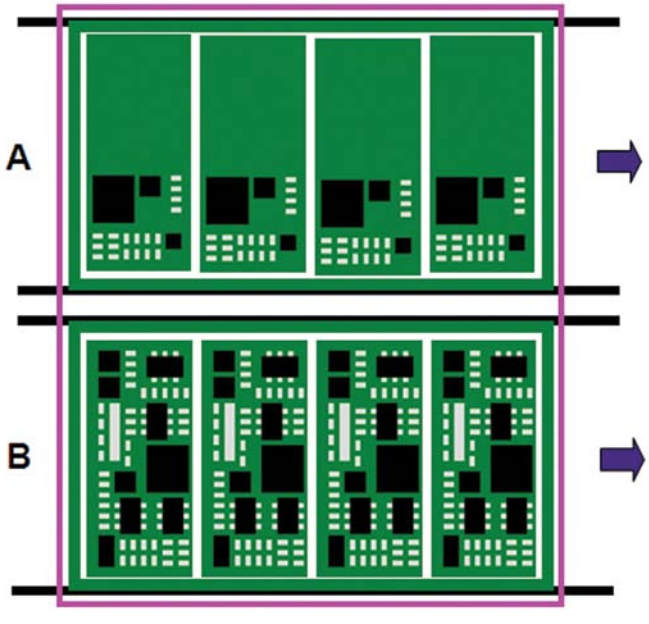

Figure 3: Workload balancing in a dual-lane flow (one virtual PCB).

THE ROAD AHEAD: SINGLE OR DUAL LANE? *continues*

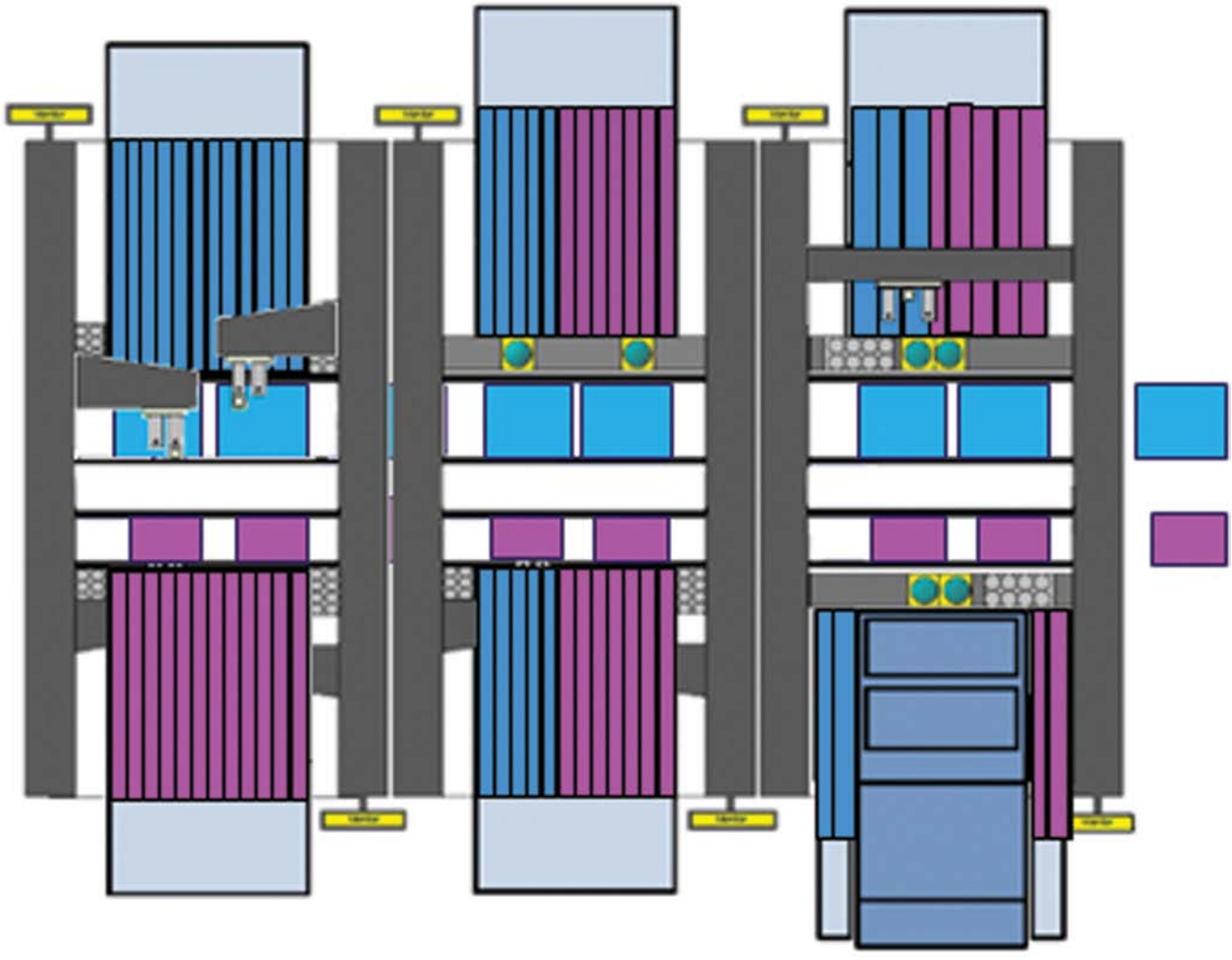

Figure 4: Dual-lane flow line combining large production batches with small production batches.

ments have been made, the pilot board batch will start in parallel with ongoing production of the big runner boards. After finalizing the pilot batch, this transport lane can be reset to the big runner boards or to another type. As a result, all pick-and-place machines remain in continuous production.

Single lane or dual lane? The choice is determined by the production scenario. If you need only limited manufacturing flexibility, you will likely go for the lowest investment costs and easy, transparent production support software, hence, single lane. If you really need manufacturing flexibility or want to minimize changeover losses, dual-lane manufacturing will appeal to you. **SMT**

In addition to playing the clarinet in two bands, Assembléon's Sjef van Gastel has another passion: SMT. He has been with the company since its start-up as a Philips division in 1979. As the current Manager for Advanced Development, he combines his experience as systems architect and machine designer to explore technical and business opportunities from emerging technologies. van Gastel holds many patents and is a frequent speaker at international conferences related to SMT. He is also the author of "Fundamentals of SMD Assembly," which has become a standard piece of literature in the industry.

Most-Read News Highlights from SMTonline this Month

1 Experts Tackle Tin Whisker Problem

"Tin whiskers have grown into a topic that never fails to arouse lively discussions amongst product designers and manufacturing personnel," says David Hillman, principal materials and process engineer, Rockwell Collins and conference speaker. "While the impact of tin whiskers is a very real phenomenon, predicting how and when they will occur still needs to be explored."

2 IPC Updates Assembly and Joining Handbook

"IPC-AJ-820A covers 14 topics in 289 pages, addressing everything from handling to design to component selection and soldering," says IPC Assembly Technology Manager Kris Roberson. "The handbook gives users basic data such as terms and definitions as well as the technical, more nitty-gritty, down-and-dirty information."

3 TTI to Acquire Sager Electronics

Upon completion of the acquisition, Sager Electronics will operate as a wholly-owned subsidiary of TTI, Inc. Frank Flynn will remain president of Sager Electronics and will lead the combined TTI and Sager post-acquisition teams. Flynn will report to Paul Andrews, CEO, TTI, Inc. Raymond Norton, current CEO Sager Electronics, will remain in an advisory capacity.

4 Catch the Wind, Sanmina Begin Volume Production of OCS

Under the terms of the manufacturing services agreement Sanmina will produce and assemble the OCS at its state-of-the-art manufacturing facilities in Kanata, Ontario. Sanmina will also provide technical, engineering, design, and other professional services related to the manufacture of the OCS.

5 CTS CEO to Retire; Board Unveils Succession Plan

The Board of Directors of CTS Corporation announced that Vinod M. Khilnani, chairman, president and CEO, has expressed his desire to retire. Thomas Cody, lead director, stated, "We have ample time to select an appropriate successor. It is our goal to have announced a successor by the end of 2012 to allow the person sufficient time to work alongside Vinod through 2013 to insure an orderly transition."

6 Flextronics Completes Stellar Microelectronics Acquisition

The acquisition extends Flextronics' service offering in advanced custom packaging solutions that utilize the latest microelectronics technologies for the aerospace, defense, and medical manufacturing markets and the ability to support customers with unique U.S. manufacturing needs such as AS9100C, ISO 9001:2008, and ISO13485:2003. The completion of this acquisition also increases the company's aerospace, defense, and medical customer portfolio.

7 Sypris' EMS Revenues Dive 41.5% in Q4

Revenue for our Electronics Group was $11.4 million in the fourth quarter compared to $19.5 million in the prior year period, while gross profit for the quarter was $0.5 million, or 4% of revenue, compared to $5.4 million, or 28% of revenue for the same period in 2010.

8 Expert Presentations Sought for IPC APEX EXPO 2013

IPC invites researchers, academics, technical experts, and industry leaders to submit abstracts for the 2013 IPC APEX EXPO at the San Diego Convention Center in San Diego, California. Expert presentations are being sought on all relevant design, PCB fabrication, and electronics manufacturing topics. Submissions dealing with lead-free processing, repair and reliability, high-speed PCB laminates, and new research in growing areas, such as green technology and printed electronics, are especially encouraged.

9 And the Winner Is...IPC Supports Student Research

As the density and speed of electronic components and assemblies continue to soar, many groups are encouraging schools and students to focus more on technical topics. IPC is helping in this effort by rewarding students and schools that support the interconnection industry. IPC recently rewarded three winners of the 2012 IPC International Academic Paper Competition with all-expenses paid trips to San Diego to attend the IPC APEX EXPO Conference and Exhibition.

10 Jabil/Telmar Executive Advisory Board Formed

Jabil has announced the formation of the Jabil/Telmar Executive Advisory Board comprised of esteemed communications visionaries. The Board will advise on global telecommunications industry drivers and provide input on global communications issues and challenges.

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THE SALES CYCLE

Does Social Media Work in B2B?

by Barry Matties
I-CONNECT007

SUMMARY: To tweet or not to tweet? This month, Barry Matties takes on the pros and (mostly) cons of mixing social media and business. Do the two really mix?

Social media might be the right choice if you're looking at electronically communicating with your current circle of friends, reconnecting with old friends, sharing your life with strangers, or starting a revolution, such as in Egypt. For those purposes, social media works great; but if used for business it could be a complete waste of resources. Well, maybe there's some value, but for most there's not enough to warrant the time spent on maintenance.

The social network really does work pretty well for staying in touch with those with whom you may or may not have regular contact. As far as revolutions go, I do not know if Egyptians have achieved what they really hoped from their Facebook-initiated revolution of last year. If you listen to the evening news it doesn't sound like they are living in the Utopia they had imagined when the social media revolution began. Certainly not the fault of social networking, I know, but social networking does have its downside, such as becoming a tool for crowd manipulation—perhaps the case in Egypt. But how does it really benefit businesses?

If you're looking to build a brand to a mass audience, social media may have its place, but in most business-to-business situations, beyond a one- to three-person business, social media seems to be a waste of time. Why could it work for a one- to three-person business? I am not sure it really does, but I'm thinking these businesses are usually driven by the personality of the owner who will take the large amount time needed to continually update a social media page and make sure their narrow customer base are "friends." It still seems to me that it's a waste of resources, unless your market is power users such as teenagers or those with a social media addiction. (There are special places to go to get help for the latter.) For most business in our sector, teenagers are not the target market. I have not checked, but I don't think Happy Holden updates his status on a wall. Why would he? I always think of him as Happy.

So, what benefit does social media offer? Do you really want a prospective customer going to one of your employees' pages to learn about your company? Even if your employee has a dedicated page for business, is that the impression you want? Let's say you go the route of dedicated employee pages. Who controls the content that goes on the page? Who controls the photos that appear? What is the message you want them to send out daily? How much time do you want them spending updating their employee social media page? Who is liable for the content if the wrong thing is said and a lawsuit follows? The real question, for me, is

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DOES SOCIAL MEDIA WORK IN B2B? *continues*

why would you want a prospective customer to ultimately go anywhere but to your own website to learn about your company?

Your website is the place where you want your customers and prospects to come to learn about your company, your people, your products, and services—all presented in a way that professionally represents the values and image you want to convey. If the Internet was brick and mortar, would you want the customer to walk into your store and be greeted by your team? Or, do you want them to walk into your neighbor's store to learn about you? In your neighbor's store, the prospect will not greeted by your team and no crystal clear messaging exists for your business.

In addition, there's the distraction of thousands of other branding messages in the same space, competing with yours. If I were selling an energy drink and trying to coax every last person on the Internet into purchasing the drink, social media sites might be one of many avenues I would pursue to reach my desired market. I hear radio commercials for car companies encouraging prospects to go to their Facebook page. Maybe this is because part of their target market spends so much time on Facebook, or it's just that they want to sound cool and current. When I'm shopping for a car I never think, "Oh, I need to visit Facebook." I go to the manufacturer's website. Or if I am I looking for news, I never wonder what Facebook is reporting today. I go to a dedicated news site.

Businesses are rushing to be on social media sites, but I think, right now, these sites are not truly geared for businesses, though they are trying to move in that direction. Maybe someday such sites will turn into a true business platform that can really help B2B companies. Until then, don't waste your time or money there. Focus on building your brand within your sector. How can you do that? Focus on the industry communities found at trade shows, conferences, associations, industry publications, and industry-specific forums. These are the places where your customers and targets are spending time. If you want to use the Internet to help market your business (and you should), then work on search engine optimization. Work on making sure you have a world-class website that perfectly conveys your message. Then, use social media in a strategic way.

I do believe social media can serve businesses, but not in a way that warrants spending too much time or money. I would look at getting customers and prospects to talk about you on their networks. If you publish a great article in a publication or have an important white paper, encourage readers to share it with their peers. If they are communicating with their peers through Twitter, encourage them to tweet about your article. If they have a Facebook page, encourage them talk it up in there. For us, we tweet out alerts to the titles of feature articles and important news items that we publish on a daily basis. The idea is to always drive traffic back to your site or, in our case, our online publications.

The daily tweet of article titles is nothing more than a conduit to what is going on in our publications, an extension of our table of contents. It does not supplant our daily newsletter—it promotes it. Though I must say after a year of tweeting, most of our readers do not rely on tweets; they open and read our daily newsletter and our other publications as

DOES SOCIAL MEDIA WORK IN B2B? *continues*

a matter of daily practice because they know what to expect. If your content is strong, your customers will do the same at your site. To ask our team to set up Facebook pages and spend time updating their pages is not necessarily the best use of our valuable resources. I think that in just about any B2B situation, this activity, when measured by return on investment, would be too low to justify the time invested.

It's not to say that it absolutely cannot work. The real problem is that most companies just don't have the depth or discipline to really maintain social media pages over time and make it work. But for those that do use social media sites to post blogs, I think the company has to take real responsibility for the information being published there. For example, I have visited several industry blogs that are filled with typos and poor grammar. It can leave a reader wondering if this is the kind of attention your company pays to all details. If your company name is on it, then it represents your company and it should go through a proofing process. And what if the views of this blogger are not aligned with your company's message or values? Do you think a disclaimer such as, *Content published here is not approved by [company name] and does not necessarily express or represent the views or opinions of [company name],* will convince the reader it is not the company's voice? Does this mean your employees can say whatever they want? No matter what the disclaimer reads, people will perceive it as the company's message, good or bad.

Another trend we are seeing with the use of social media is potential employers asking applicants for passwords to their social media accounts. Some are calling this an invasion of privacy and it very well may be; the courts will decide. But what happens when potential clients start looking at yours or your employees' public pages? Will that affect their decision on doing business with you? It very well may or already has. Social media sites can certainly have a downside on your life and business.

Disgruntled employees are also using social media to tarnish the reputation of their employers. Some have been fired and now these cases are making their way into the legal system. This is giving employers reason to add

strong social media policies to their employee handbook. Will employers be suing their employees for damages arising from postings on social media sites? Another question is over ownership of a blog and its followers. If your employee is posting a blog as part of their job function and has, say, 2,000 followers, and then leaves the company, who owns the blog and list of followers? That question will also be answered in the courtroom. One man was recently sued for over $300,000 as a result of this very issue.

Social media is a new frontier and, like anything new, that creates cultural shifts; good and bad sides are yet to be discovered. For businesses, I would say step wisely; don't just rush in or summarily dismiss it. Really look at how it might help you and make sure that you do it in a way that brings you value. Have a clear, defined metric to understand the return on investment that would be acceptable to you. Don't do it just for the sake of doing it. **SMT**

Barry Matties started in PCB manufacturing in the early 1980s and in 1987, co-founded *CircuiTree Magazine,* which sold nearly 13 years later as the leading industry publication. In the early 2000s, Barry and business partner Ray Rasmussen acquired PCB007, followed by *SMT Magazine* in July 2010. With his many years of business leadership skills, Barry now produces this column relating 25 years of successful business leadership, including marketing and selling strategies that really work. To contact Barry click here.

EVENTS

For the IPC's Calendar of Events, click here.

For the SMTA Calendar of Events, click here.

For the iNEMI Calendar, click here.

For a complete listing of events, check out *SMT Magazine's* full events calendar here.

Electronics SOUTH
May 2-3, 2012
Charlotte, North Carolina

SMT/HYBRID/PACKAGING 2012
May 8-10, 2012
Nuremberg, Germany

PCIM Europe
May 8 -10, 2012
Nuremberg, Germany

JISSO Forum
May 9, 2012
Nuremberg, Germany

KPCA Show 2012
May 15-17, 2012
KINTEX, Goyang, Gyeonggi-do, Korea

IPC Test and Inspection Conference
May 15-17, 2012
San Jose, California

Energy Harvesting & Storage Europe
May 15-16, 2012
Berlin, Germany

International Conference in Advanced Manufacturing for Multifunctional Miniaturised Devices
May 21-22, 2012
Wuhan, China

OPTATEC 2012
May 22-25, 2012
Frankfurt, Germany

Webtorial: Cleaning Agent & Cleaning Equipment Innovations Needed to Clean Highly-Dense Assemblies
May 22 & 29, 2012

Upper Midwest Expo and Tech Forum
June 7, 2012
Minneapolis, Minnesota

2012 Symposia on VLSI Technology and Circuits
June 12-14, 2012
Honolulu, Hawaii

NEPCON Malaysia
June 12-14, 2012
Penang, Malaysia

IPC International Conference on Flexible Circuits
June 12-14, 2012
Irvine, California

JPCA Show 2012
June 13-15, 2012
Tokyo, Japan

Intersolar 2012
June 13-15, 2012
Munich, Germany

National Electronics Week: North Africa 2012
June 13-14, 2012
Utica Tunis, North Africa

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SMT® (Surface Mount Technology) is published by BR Publishing, Inc., PO Box 50, Seaside, OR 97138

May 2012, Volume 27, Number 5 • SMT© (Surface Mount Technology©) is published monthly, by BR Publishing, Inc.

ADVERTISERS INDEX

Next Month in SMT Magazine

Electronics manufacturers learned long ago that it's much safer to be proactive with **thermal** issues throughout the product development process rather than face such issues when it's too late. So why do thermal issues still get the "Rodney Dangerfield" treatment? Find out in the June issue of *SMT Magazine.*

The issue features content from the best in the industry, including articles from **Heraeus; Mentor Graphics; Saturn Electronics; Sinkpad Corporation; Electrolube; Rehm Thermal;** and columns from **Dr. Jennie Hwang; Chris Torrioni;** and Editors **Ray Rasmussen** and **Barry Matties.**

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

See you in June!