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JUNE 2019
NORTH AMERICA

Supply chain disruption: look to the clouds
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ecia Connect. Influence. Optimize.

Editor's Word

Buying intelligence

For buyers who thought they were finally getting to grips with the process of purchasing IoT-style bills-of-materials, think again. Times are changing and as IoT starts to mature, the vacuum this is creating is starting to be filled by Edge AI.

I have to admit that my understanding of AI is pitiful, evidenced by the amateur questions I have to ask at seminars and press conferences. However, I will get there given time.

Right now I've decided to consider Edge AI as an IoT device which 'likes to learn' and share its findings.

So, what does this mean, if anything, for purchasing departments. For some buyers I imagine it could lead to a significant shake up regarding the nature of the components they need to buy and the type of company that will supply them.

Instead of a typical IoT assembly, which would employ minimums for everything (sensing, processing, power, communications) to 'just' get the job done, Edge AI will have to potentially employ viable maximums to gather and process enough data to 'learn'. Physically, IoT and Edge AI systems might look similar but under the hood they will be very different.

A trickle of AI optimized devices are already emerging, followed by a predicted flood. If the rollout follows the IoT time line we are looking at 20-years from 'reasonable idea' to mature. Prepare for your BoMs to shift accordingly.

Jon Barrett

N ES News

View current editions online – www.electronics-sourcing.com

Infrared LEDs spark high intensity interest

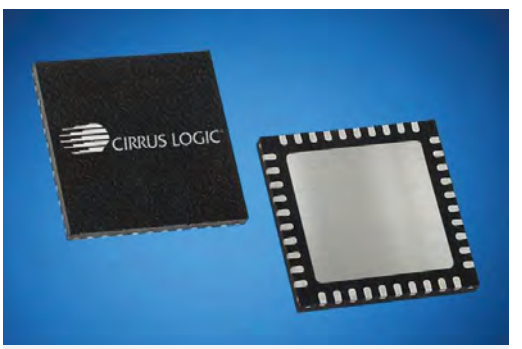
Luminus Devices has expanded its portfolio of high-power infrared LEDs with eleven emitters, designed to address automotive, consumer, machine vision, medical, and security applications.

The Luminus IR SST LEDs are now offered in three wavelengths–810, 850, and 940nm–and six beam angle options ranging from 40 to 130deg. Products boast high radiometric power output and low thermal resistance, which can reduce the number of emitters and overall footprint in a range of applications.

Nine of the new products are based on dual-junction technology, which makes it easier to develop solutions with high radiant intensity and compact designs. Specifically, the IR SST line delivers radiometric power up to 1,600mW typical at 850nm and 1A drive current, and radiant intensity in excess of 1,300mW/sr.

Senior director of global product marketing, Yves Bertic, said: "Our dual-junction technology allows us to double the power density in the same footprint. Now product designers can address applications that need longer reach and more intense and focused beams."

www.luminus.com



Exceptional audio solutions ready to roll out

Mouser Electronics is now stocking two new high-performance MasterHIFI digital-to-analog converters from Cirrus Logic claimed to deliver exceptional audio quality in a range of applications. Supporting sampling frequencies up to 384kHz, the 32-bit stereo audio CS43131 and CS43198 are ideal for smartphones, tablets, laptops, powered speakers, digital headphones, portable media players, and home theater systems.

According to Cirrus, the CS43131 and CS43198 DACs deliver exceptional reproduction of high-bandwidth, high-resolution digital audio sources without draining battery life. Built on an enhanced delta-sigma oversampling DAC architecture that includes auto mute detection and low clock jitter sensitivity, the two devices can help filter out unwanted noise for ultra-high-quality music playback.

www.mouser.com

Cut inventory with optimized supplies

New Yorker Electronics is set to simplify purchasing with the roll out of a new optimized power systems manufacturing initiative (OPSM) from N2Power Solutions. With an eye toward providing increased value, N2Power can now deliver on any power supply and build the sub-assembly.

Although modifications were always available on N2Power standard supplies, the new initiative ensures improved performance of N2 units without the need to change build requirements. Instead of purchasing an off-the-shelf unit and designing metalwork on which to build individual parts, OPSM allows New Yorker Electronics to supply a complete end solution. This helps reduce assembly time and decreases the bill of materials by creating just one line item.

Buyers receive complete custom power assemblies without having to purchase mounting brackets, nuts, bolts, stand-offs, screws, cables, connectors, external fans or other accessories.

www.newyorkerelectronics.com

Feedthru filters in stock

TTI is now stocking W2F and W3F series feedthru filters from AVX. Ideal for applications such as Vcc power line conditioning, EMI suppression, and broadband I/O filtering, this family of filters offers a feedthru capacitor construction with low parallel inductance and boasts excellent decoupling capability for all high di/dt environments. The two series are said to provide significant noise reduction in digital circuits up to 5GHz and are also AEC-Q200 qualified. They are available in 0805 and 1206 size packages with 50 and 100V variations. High-reliability screening options are available for spacecraft designs.

www.ttiinc.com

Sager Power Systems offers over 30,000 world-class AC-DC and DC-DC standard solutions, the widest range of modular power supplies available in North America and custom design services.

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N ES News

In Brief

Magnetics manufacturing added
Gowanda Components Group is expanding its capabilities by merging high reliability contract manufacturer, REM-tronics, into the group. The deal will enhance GCG's ability to design and manufacture high-reliability magnetic components and systems to address high-performance markets. REM-tronics will maintain its operations in Dunkirk, New York, under the new name Gowanda REM-tronics.
www.gowanda.com

Make buying decisions faster
Newark has launched an online connector reference tool showcasing connectors from more than 30 brands. The e-guide, which allows users to review and select interconnect products by photo or part number, intuitively displays associated accessories such as cable and wire, crimp tools and installation aids. This saves time by reducing research, helping users make buying decisions faster.
www.newark.com/connector-eguide

Enhanced resistor choice
Manufacturer of power, precision and shunt resistors, *Riedon* is to acquire manufacturer of wirewound resistors, KRL/Bantry Components. This will see Riedon offer a wider range of products, including temperature-sensing probes, wirewound resistor networks, cold-junction compensation networks and resistance standards. Riedon will also be able to supply custom resistors that can be tailored to meet specific requirements.
www.riedon.com

300 power cords ready to ship
ShowMeCables has launched a new line of NEMA and IEC power cords ideal for fulfilling power demands in IT, data center and OEM applications. The new line-up consists of 300 different cord types in multiple colors with features that include angled plugs, international configurations and hospital-grade ratings. All cables are fully tested and conform to RoHS, UL, WEEE, REACH and ISO 9001. Lengths ranging from one to 25 feet can be specified.
www.showmecables.com

Same-day shipping on custom low-PIM cables

Pasternack has expanded its low passive intermodulation coaxial cable assembly offering to include more connector options, with both standard and custom configurations shipping same-day.

The range of low-PIM coaxial cable assemblies now consists of 160 standard configurations that boast PIM levels of less than -160dBc. Assemblies are constructed with flexible, lightweight, UL910, plenum-rated, SPP-250-LLPL, RF coaxial cable which can operate in temperatures from -55 to 125°C. Cables boast low insertion loss and excellent VSWR, are 100 per cent RF and PIM tested and ship with the PIM test results marked on the cables.

This latest release adds both SMA and QMA-style connectors, including right-angle versions, to the options available.

Product manager, Steve Ellis, commented: "By offering more choice, we can now address even more applications that require custom low-PIM cables shipped the same day with test reports."

www.pasternack.com

Buy compact converters online

Rutronik has announced that the new REC15E-Z series DC/DC converters from Recom are available at www.rutronik24.com. Comprising fully specified 15W devices with wide input voltage ranges, the new converters are said to increase flexibility by accepting several standard bus voltages. With a compact one by one inch footprint, the converters are suitable for cost sensitive applications where board space is at a premium.

Rated for 600V DC isolation and output currents up to 4A, the new converters boast efficiency of up to 90 per cent and low ripple/noise, with no minimum load.

The wide 4:1 input voltage ranges accept nine to 36V or 18 to 75V to cover multiple supply options such as lead-acid or lithium batteries, or 12/24/36/48V industrial bus voltages. These inputs are protected against transients up to 100V and feature undervoltage lock out to protect batteries from being over-discharged.

www.rutronik24.com

New values added to shunt range

Stackpole Electronics has added new resistance values to its HCSM2818 range of molded, all-metal element shunts capable of handling up to 5W at temperatures up to 100°C. A 25 milliohm version with TCR of 25 ppm has now been added to the existing values of four, five, 10, 15, and 20 milliohm.

The expanded value range makes the AEC-Q200 compliant HCSM ideal for power supply and control applications, power modules and inverters, motor controls, battery backup systems, HVAC equipment, and current sensors for hybrid power sources.

Pricing depends on tolerance and ranges from $0.40 to $0.45 each in full package quantities.

www.seielect.com

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SOLA HD
TDK·Lambda
TE connectivity AUTHORIZED DISTRIBUTOR
Tektronix
TENMA
VISHAY
Weller
XILINX

Deal ensures cellular access for all

Digi-Key websites worldwide will now feature positioning and wireless technology products from u-blox following an expanded distribution agreement between the two companies. This will see the companies' existing North American agreement extend to a global arrangement.

Vice president of global supplier management at Digi-Key, David Stein, commented: "This expansion brings a powerful and innovative cellular, short range radio and GNSS product offering to our customers in every region around the world."

The collaborative partnership will extend the availability of u-blox technology, as well as making it more accessible to mid-sized companies and start-ups with rapid, global access through Digi-Key to evaluation kits, development boards and product samples.

With this agreement in place, Digi-Key aims to provide a one-stop shop for customers who need any type of cellular, timing, positioning or short range communications products.

www.digikey.com

New production facility ready for future demand

ERNI Electronics has broken ground on a new production and distribution facility in Chesterfield County, Virginia. The new site will be home to the company's Americas' headquarters as well as ERNI Production Virginia, which will manufacture a range of products supporting various industries including automotive and industrial automation.

Chairman of the board, Hans Erni, said: "This new home for ERNI US will be designed by us, according to our own present and future needs. It will be set up to support the American part of our strategic plan for the next ten years and beyond."

www.erni.com

Next-gen optics are looking good

Vuzix, a supplier of smart glasses and augmented reality products, has announced an exclusive display design and long-term supply agreement with Plessey. The agreement will support development of next-generation AR products and solutions that combine Plessey's microLED light source technology with Vuzix' expertise and IP in smart glasses and optics technologies.

Vuzix has already developed a family of smart glasses culminating in the Vuzix Blade smart display with a see-through viewing experience offered via proprietary waveguide optics. Formed from glass with precision nanostructures, the waveguide enables users to see high-resolution computer-generated graphics superimposed over images from the physical world.

Plessey's microLED solution will simplify the design of smart glasses by replacing existing optics with a single self-emitting display with integrated micro-optical elements. This will help address size, weight and power reduction, all of which are key considerations in the AR wearables market.

President of corporate and business development at Plessey, Mike Lee, said: "By overcoming the difficulties of manufacturing microLEDs on a commercial scale, Plessey is playing a central role in providing next-generation technology to the augmented reality and display markets."

www.vuzix.com

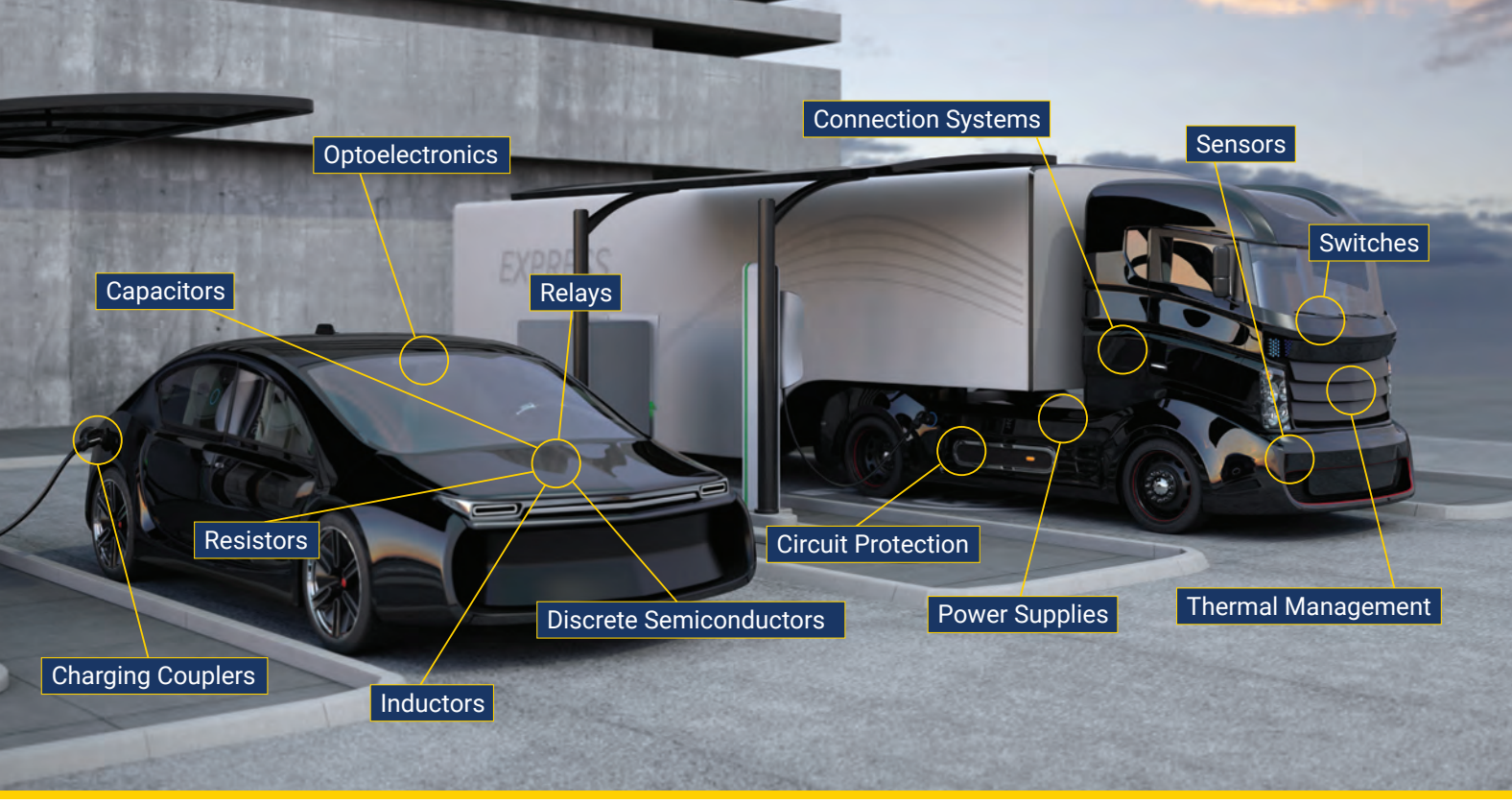
Partnership powers extended battery portfolio

Interconnect, power and e-mech specialist, *Sager Electronics*, has further extended its battery portfolio by signing a new distribution partnership with Power Sonic.

Director, supplier marketing and product management at Sager Electronics, Paul Kopp, commented: "The addition of Power Sonic into our power and thermal program expands our ability to provide customers with world-class battery solutions, including sealed lead acid and lithium iron phosphate batteries, for their unique application demands. As a leader in innovative battery solutions, Power Sonic is a natural complement to our IP&E line card."

President of Power Sonic Battery Division, Brian D Crowe, added: "Sager Electronics' specialized group, Sager Power Systems, is a perfect fit for the Power Sonic portfolio. Their focus on power and thermal solutions with a highly experienced team of power systems engineers, field sales representatives and a dedicated inside sales organization across North America will provide our customers the application expertise and delivery execution needed in today's competitive market."

www.sager.com



TTI has the High Voltage Components to Keep Your Production Rolling

North America's leading inventory of ready-to-ship electronic components

The Transportation Specialists at TTI have a broad and deep inventory of interconnect, passive, and electromechanical components for transportation systems ranging from 48-volt subsystems to fully electric vehicles. These parts are stocked where you need them:

- A 180,000 square-foot warehouse dedicated to transportation components in Fort Worth, Texas
- Our all-new 800,000 square-foot distribution center in Fort Worth, Texas
- One of our seven proximity warehouses in Mexico's major manufacturing centers

For conventional and plug-in hybrids, battery electric, or fuel cell vehicles, TTI Specialists have the components you need, when you need them at 1.800.CALL.TTI, or visit us online at ttiinc.com

ttiinc.com
1.800.CALL.TTI

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Expert advice is a powerful asset

Sourcing power supplies can be tricky with complex technical specifications and multiple price, availability and handling considerations. Access to expert advice can simplify the process, says Sager Power Systems

Every electronic application requires some form of power source, but designing and sourcing power supplies and batteries can be challenging. Solutions can be complex with long design cycles and extended lead times ensuring there are several key factors to consider when sourcing power-related products.

Power supply advice

Purchasers must weigh many factors when sourcing power supplies, including an understanding of the end application and any portability requirements. It's important to assess the size, output power, efficiency, and reliability needed, as well as any thermal management required, such as fan, convection, or conduction cooling. Be sure to research safety requirements and the level of protection required, as well as establishing whether interference an issue, such that the device requires EMI/RFI filtering. Finally, establish how long the device will run and what peak power loads are required. Will the application require an uninterruptible power source or a battery backup?

A technical power supply distributor such as Sager Electronics' Power Systems group can help customers address these design challenges to determine the correct power and battery backup solution. Recommendations may include several options, from off-the-shelf AC/DC supplies and DC converters, to modified standard products that range from simple modifications to highly complex designs.

Battery backup choice

The power grids across the United States face major challenges due to infrastructure age, intense weather, and the increase in demand for electricity. Electrical outages, brownouts, and surges are a reality, and these factors need to be considered when designing electronic systems. This is especially true for equipment manufacturers in the industrial and medical sectors where down time can lead to major financial loss or potentially life-threatening situations. Home health care devices like respirators, CPAP machines, power wheelchairs, and home dialysis equipment, for example, all require battery backup.

To address the demand for portable and backup power requirements, Sager has added RRC Power Solutions, a lithium-ion smart battery pack manufacturer, and Power Sonic, a leader in sealed lead acid and lithium-ion technology, to its line-card.

Powerful logistics support

Power sources tend to have a higher value and are often larger and heavier than other components, impacting shipping methods and costs. Batteries also present some additional buying challenges specifically around shelf-life, recycling, and shipping and handling regulations. Lead times should be monitored as extensions on power supplies and batteries can present a challenge. Price, availability and handling make proper planning crucial in the procurement of power supplies and batteries.

Sager's director of business development for Sager Power Systems, Rich Arieta, explained: "The Sager Power Systems program is unique. With a focus on power and synergistic technologies such as batteries and thermal management solutions, and the ability to provide configurable and custom value-add services, no other distributor offers customers this level of expertise in power and thermal. Additionally, we can further support customers' requirements with a comprehensive array of supply chain services."

In today's quick and complex market, access to knowledgeable technical advice, breadth of quality product, and reliable service is paramount to successful sourcing.

www.sager.com

Director, supplier marketing and product management, Sager, Paul Kopp

Sager has added Power Sonic, a leader in sealed lead acid and lithium-ion technology to its linecard

Smart battery pack manufacturer, RRC Power Solutions, is another addition to the portfolio

Industrial converters available in volume

Flex Power Modules has introduced several additions to its PKE series of DC/DC power converter modules for the industrial, test equipment and telecom sectors. Modules are sealed in encapsulated packaging to ensure they work reliably when subject to dust, moisture, severe vibration and other harsh conditions.

Both the PKE3000 and PKE5000 series claim to offer high-performance, rugged DC/DC solutions in an industry-standard one by one inch form factor, running from 12 or 24V nominal inputs for the PKE3000, and 24V or 48V nominal inputs for the PKE5000. Delivering up to 30W of output power at up to 92 per cent efficiency, the series also boast mean time between failures of up to five million hours and input-to-output isolation of 1,500V DC.

Head of product management at Flex Power Modules, David Xie, commented: "The PKE series is a popular package size in the industrial and test equipment market. Being designed to meet the requirements of demanding applications in these sectors alongside the telecom market too, these new variants further expand our support with products that are highly reliable and efficient."

flex.com

Hazard-safe supplies in stock

Traco Power has released the TIB 120-EX family of 120W DIN rail power supplies designed for harsh and hazardous environments with certifications for ATEX II3G and UL HazLoc Class I / Div 2 standards.

Billed as the vanguard of industrial power, the supplies feature: 12, 24, or 48V outputs; 94 per cent efficiency; and 150 per cent peak power for four seconds. Devices are also packaged in a ruggedized metal enclosure that is EN61373 qualified for railway shock and vibration.

In addition to various protection circuits and DC-OK LED indicators on both the front and side panels, the supplies also benefit from reduced heat dissipation, enabling a -40 to 60°C full load operating temperature range.

Products are in stock and available through distributors with manufacturing lead times of 12 to 14 weeks.

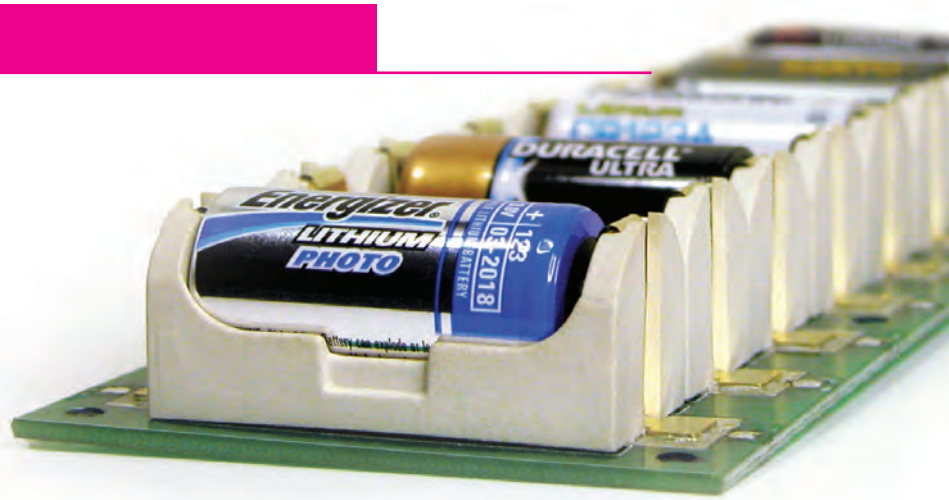
www.tracopower.us/tib-ex

The search is over for server-safe power

Bel Power Solutions has announced a new 2,500W power supply series claimed to bring titanium level efficiency to servers, storage and networking equipment. With AC/DC power-factor-corrected and high voltage DC-input variants, TET2500 supplies provide a main output of 12V DC for powering intermediate bus architectures.

Measuring 3.39 by 1.57 by 7.68in and delivering a power density of 62W/in³, the TET2500 series promises an efficient and feature-rich power source for servers running web and email applications, databases, games or providing storage, as well as for file servers, routers and network switches. This equipment is being used in the rollout of applications such as edge computing, blockchain processing, real-time communications, cloud services and in upgraded data centers.

belfuse.com/power-solutions



Battery holders secure cells firmly in place and facilitate fast battery removal at end-of-life

Green power explained

Adopting responsible practices that reduce e-waste and make economic sense can positively influence consumer brand preferences, explains Thomas Blaha of Memory Protection Devices

Product designers and procurement professionals need to be mindful that successful brands demonstrate a strong commitment to environmental protection and sustainability. Addressing the growing problem of used alkaline batteries is a good place to start. Americans purchase nearly 3.3 billion alkaline cells annually, a staggering amount, which could be dramatically cut by substituting rechargeable batteries and battery holders.

This environmentally-conscious approach also makes good business sense. For example, equipping a device with four AA rechargeable Lithium-ion batteries could cost up to $50 but provides in excess of five years of service with over 500 recharge cycles. Conversely, having to replace a set of four alkaline batteries multiple times over the life of the device could cost as much as $1,000, making it nearly 20 times more expensive.

Growing e-waste regulations

Over the years, increased regulatory controls have transformed battery manufacturing, recycling, and shipping. In 1996, Congress passed the Mercury-Containing and Rechargeable Battery Act to address the collection and recycling of NiCd cells along with certain small sealed lead-acid batteries intended for 'personal or household use' in cellular phones, laptops, personal computers, cordless power tools, video cameras, and uninterruptible power supplies.

The Battery Act required proper battery labeling that indicates consumer responsibility for appropriate recycling/disposal and requires easy battery access for removal at end-of-life. In addition, certain mercury-based chemistries were phased out, including most alkaline-manganese, zinc-carbon, and mercuric oxide batteries.

Since improperly packaged batteries can pose a fire hazard, the US DoT introduced Call2Recycle regulations that require all batteries to be individually bagged or taped prior to shipping. Li-ion batteries must be sorted separately from other recyclable batteries to ensure safe storage and shipping. If the shipping package is damaged, the batteries must be quarantined, inspected, and repackaged. Also, any package containing Li-ion batteries with a gross weight of over 66lb, must be marked 'LITHIUM BATTERY, UN 3090', carry the Class 9 miscellaneous hazard label, and be handled by specially trained shippers in accordance with US hazardous materials regulations.

Dozens of states have also passed some form of e-waste legislation, including mandatory electronics recycling and recovery programs for computers, peripherals, and other electronic devices. Battery manufacturers have independently funded the Rechargeable Battery Recycling Corporation, a non-profit organization dedicated to educating manufacturers, retailers and consumers about the benefits of rechargeable battery recycling. The RBRC has also established a national cadmium recovery facility in Ellwood City, PA.

Cheaper rechargeable batteries

Approximately 73 per cent of municipal solid waste is sent to landfill or incinerated. Intelligent practices are needed to ensure that batteries and other e-waste is properly disposed of or recycled to limit the amount of heavy metals and harmful chemicals, including many known carcinogens, that enter the food chain.

Fortunately, rechargeable batteries are becoming less toxic and less expensive, making them a cost viable alternative for consumer and industrial electronics. Battery holders offer additional benefits at minimal cost by firmly securing cells and enabling fast battery removal at end-of-life.

Since improperly packaged batteries can pose a fire hazard, the US DoT introduced Call2Recycle regulations that require all batteries to be individually bagged or taped prior to shipping

As the cost of rechargeable Li-ion batteries continues to drop, they are becoming an increasingly wise investment for OEMs that adopt a more consumer-focused approach, prioritizing environmental protection and a lower total cost of ownership over short-term profits. This is a winning strategy, as embracing corporate responsibility towards environmental protection and sustainability can serve to positively influence consumer brand preferences.

www.batteryholders.com

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BATTERIES

PRIMARY LITHIUM BATTERIES

LITH-8 3V Bulk CR123
LITH-22 3V Bulk CR2

- Dantona lithium batteries are known for high quality & and great value
- Dantona also has CR123, CR2 available in carded single and 2 packs in the Ultralast brand

* Other brands available from Dantona are Panasonic & Duracell.

BATTERIES

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* Other brands available from Dantona are Panasonic & Duracell.

BATTERIES

3V Ultralast Lithium Coin

UL2025 - 3V CR2025
UL2032 - 3V CR2032

- Ultralast Lithium Coin batteries are available in 13 sizes
- Ask your Dantona representative for pricing & model no's of other sizes

* Dantona also carries Panasonic Lithium Coin batteries.

BATTERIES

Lead Acid Batteries from EnerSys, Hawker, & Cyclon

0809-0012 - 6V 5000mAh
0819-0012 - 6V 2500mAh
Cyclon-D - 2V 2500mAh
Cyclon-X - 2V 5000mAh

- Lead acid replacement batteries for many Emergency Lighting applications and more.

* Ask your Dantona representative for pricing and model no's of other sizes.

BATTERIES

3V & 3.6V Lithium Batteries

COMP-4-SAFT - Saft LS14250BA battery
COMP-6-SAFT - Saft LS14500BA battery

- Also available Saft LS26500, LS33600, and many more
- Ask your Dantona representative for information on other Saft batteries from Dantona Industries

*Brands include Saft, Tadiran, FDK & Dantona import Lithium Batteries

BATTERIES

Emergency Lighting Batteries

CUSTOM-43 - Repl: Cooper 4TD-800AA-HP, Exit Light Co., BA-48R

- Dantona Emergency Lighting Batteries
- Over 20 other models available
- Call your Dantona representative with the battery that you are looking for to check availability

BATTERIES

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UL12DB - D size Bulk 12 Pack
UL129VB - 9V size Bulk 12 Pack UL40AAVP -AA Bulk 40 pack
ULA4AA - AA 4 pack Carded

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- AA/AAA Carded packs 2, 4, or 8 per card. Bulk AA/AAA packs in 10, 20, 40 or 100 per pack
- Bulk D in 12 packs. Carded C & D in 2 packs. Other sizes available AAAA,23A, 76A, 544A, N, and J
- Call your Dantona representative for more information
- Dantona has just about Every Battery for Every Application. Over 7000 models! Over 40 Categories!

BATTERIES

Dantona Custom Made Battery Packs

Custom Made Battery Packs

- With a sample or drawing, Dantona can make almost any battery pack that you need.
- Contact your Dantona representative and ask about custom made packs from Dantona

BATTERIES

PLC Batteries

COMP109 - 3V 850 mAh Allen Bradley 1747-BA, 1769-BA, & more
COMP153 - 3.6v Hitachi C52012, Mitsubishi MR-BAT, GT15-BAT

- Dantona has over 40 models of PLC batteries.
- Call your Dantona representative for your Dantona PLC replacement battery needs.

Distributors say tariffs could contribute to slower sales growth in 2019

Some distributors reported double-digit sales growth in the first quarter, but expect demand to taper off in second half

James Carbone

Slowing component demand, higher inventory levels and the trade war with China, including tariffs, are dampening sales growth in the electronics industry, according to electronics component and distribution executives attending the recent Electronics Distribution Show (EDS).

Most executives attending EDS said growth in 2019 would be slower than 2018, although distribution managers said component demand remained healthy in the first quarter, but showed signs of slowing.

Some executives say tariffs on components made in China as well as duties on goods sold in China is having a "chilling" effect on business and will contribute to slower component sales growth if trade issues between the U.S. and China are not soon resolved.

Many component and distribution executives noted that sales growth for the electronics industry had been strong for two consecutive years as many companies enjoyed double-digit increases in revenue. Because sales were so strong and the industry is cyclical, many were expecting slower sales in 2019.

"None of us thought strong growth was going to last two years," said one executive from a component manufacturer. "We thought it would last one year at best. I don't think we've ever seen such strong growth last for this long," he said. However, business has changed.

Back to reality

"We are back to reality after a couple great years of growth for the industry," said Karim Yasmine, corporate vice president, strategic supplier development at Future Electronics, based in Montreal. "We are back to a more normal environment." He said distribution is in a "short-term transition where inventory is a little bit more abundant out there."

Although business is slower than last year, it is still " pretty healthy around the globe," said Yasmine. "The actual end customer demand signals are pretty good. But China is showing signs of slowing down, which is a concern to a lot of people in the industry," he said.

However, all in all, business is still "pretty good. I think we are just seeing a little bit of a correction which everybody thought was going to happen," said Yasmine.

One distributor that saw continuing strong growth in the first quarter is Mouser Electronics, based in Mansfield, Texas. Mouser Electronics increased sales 40 per cent in 2018, "but this year is going to be different," said Glenn Smith, CEO of the Mansfield, Texas-based distributor. He said Mouser would grow sales about 10 per cent in 2019.

"We are on target for that," said Smith, noting that Mouser increased sales 12 per cent in the first quarter. He said that the number of component buyers and orders increased in the most recent quarter. Mouser has also added 14 per cent more part numbers to its stock compared to the first quarter of last year.

"Mouser increased sales 40 per cent in 2018, but this year is going to be different"

Glenn Smith, CEO of the Mansfield, Texas-based distributor.

He said while 45 per cent of Mouser's business is in the Americas, its business in Europe and Asia is growing the fastest. About 25 per cent of Mouser's sales are in Asia and 30 per cent in Europe.

Mouser's business in Europe and Asia is increasing because it is replacing some of the regional distributors that don't have the inventory levels that Mouser has, according to Smith.

Mouser's parent company, TTI, Inc., based in Fort Worth, Texas, also posted strong first quarter growth. "The year started off absolutely fantastic," said Mike Morton, chief operating officer for TTI. Speaking at TTI's annual breakfast meeting with suppliers, Morton said TTI's IP&E business increased 13.5 per cent from the first quarter of 2018. Its Americas' business grew 13 per cent; Europe, 16 per cent and Asia, 9 per cent.

He said he expects TTI to grow 13 per cent globally in 2019, including a 13 per cent increase is IP&E business, 76 per cent growth in its semiconductor division, and a 10 per cent rise in Mouser's business.

"However, there are some headwinds," Morton cautioned. Book-to-bill ratios are falling.

Although the book-to-bill ratio in the Americas was still positive, they were below 1 in Europe and Asia. "We had a wonderful start but we are eating a little bit into our backlog. Bookings have slowed a bit, especially in April," said Morton.

Slower growth rates

TTI is not the only distributor that is seeing an order slowdown. Murdoch Fitzgerald, vice president sales and engineering for Arrow Electronics, based in Centennial, Colo., said that growth rates for components are lower than last year. "Last year global components business was up 14 per cent, but sales were up 5 per cent" in Arrow's most recent quarter.

Arrow's Americas component sales were up 6 per cent year on year and "that's coming off 2018 for a full annualized year. So, the growth rates have come back down. In the Americas sales were about 2x GDP," said Fitzgerald.

He said while growth may not be as strong in 2019, Arrow is bullish about several customer segments including aerospace and defense. "I think we will continue to see solid growth from that vertical in 2019," said Fitzgerald. The industrial segment was "fairly flattish" in the low single-digit range.

One distributor that has not felt a slowdown in business so far is Electronic Connector Company (ECCO), based in Chicago. Bernard Gizzi, ECCO president, said business in the first quarter was up 14 per cent year-to-date as of May. Last year ECCO had a 12 per cent increase in sales. However, he is not sure how long strong sales growth will last.

"I don't have good indications of a slowdown yet. I have a strong backlog," he said. But the U.S. trade war with China and the imposition of tariffs could adversely impact business, said Gizzi.

He says ECCO buys components from American manufacturers in China. "I have more than 25 per cent of my cost of goods coming from factories in China. That is a lot for a small guy and we are paying tariffs."

He said when his company buys components from parts made in China, it has to either pass on the cost tariffs to customers or "partially take the hit," he said. If tariffs are not eliminated soon, "it will hurt our profitability, it will hurt investment and be a drag on business," said Gizzi.

Tariffs create uncertainty

Gizzi is not the only distribution executive concerned about tariffs. Dave Doherty, president and chief operating officer for Digi-Key, based in Thief River Falls, Minn., said tariffs are causing uncertainty in the market.

"Tariffs are affecting our customers exporting products. We don't know what effect it's having on demand, but certainly in Europe and North America it stands to reason the uncertainty around tariffs is causing people to be careful what they build," he said.

Digi-Key and other distributors have to pay 25 tariffs on parts that are purchased from manufacturers in China. "Our position has been not to put up any markup, but to pass them (tariffs) on as they were passed to us for U.S. shipments," said Doherty.

He said Digi-Key wants to be transparent to customers about what tariff costs are. "On our website, we designate which parts come from China and which ones are tariff eligible to help people make decisions during their component selection process," he said.

Tariffs may be having a negative impact on the business of component manufacturers, too. Dave Valletta, executive vice president-worldwide sales for Vishay Intertechnology, based in Malvern, Penn., said component sales have been impacted by slowdowns in various markets in Asia, particularly China.

Tariff-driven slowdown

"The slowdown to some degree is driven by tariffs or exacerbated by tariffs," he said. "There were already some issues in China and throw the tariffs on top of that and that was enough to really create a slowdown."

The slowdown is having the biggest impact on Vishay's distribution business. "Our direct business is okay. Segments are holding their own," he said. However, orders from distributors have dropped off since last year because distributors have plenty of inventory and so far, have not had to boost orders with component manufacturers.

"Distributors are getting the orders. They just are not placing orders on suppliers," said Valletta. "That is the essence of what's going on. Whether this continues for year or so is uncertain," he said. However, it's expected that inventory will burn off in the second half and business will pick up again, he said.

If trade issues with China are resolved and tariffs are eliminated , it would help boost business, especially in Asia, said Valletta. "China would start to flourish again and that would help," he said.

Murdoch Fitzgerald, vice president sales and engineering for **Arrow Electronics**.

"Last year global components business was up 14 per cent"

"The year started off absolutely fantastic"

Mike Morton, chief operating officer for **TTI** noting the distributor's IP&E business increased 13 per cent in the first quarter compared to the first quarter of 2018.

Are you seeing the bigger picture?

When sourcing PCBs from China, it's not just technical capabilities that count. Price, quality, reliable service and sustainability all come into the equation. Here's how NCAB tackles the selection process

An ever-increasing percentage of the world's printed circuit board production is concentrated in China. There are about 1,600 dedicated PCB factories, a figure which rises to 3,000, if we include those focused on specific sub-processes such as surface finishes, lamination or drilling.

Purchasers looking to source PCBs in China therefore have a wealth of options to choose from, yet finding the right factory, capable of meeting specific needs, can be a challenge. NCAB assesses various factors when sourcing factories, including their ability to deliver at the right price, with the right quality, whether they can deliver on time consistently and reliably, and how well the factory adheres to sustainability standards. It is also imperative to keep the sourcing process continuous by conducting audits and reviewing delivery, quality and service performance, as well as following up corrective actions.

Measuring performance

Using these guidelines, NCAB Group looks for the best factories in each of the growth areas it has identified. Throughout the process, it applies a points system, based on a number of criteria. The scoring covers all relevant parameters, which enables NCAB to zoom in on the best alternatives for each specific case. In any case, the first step is to evaluate the factory's performance in terms of factors such as quality, capacity, price and service. What is their customer support like and how are they structured? What are their objectives and how well does this match with NCAB's expectations?

With technology developing exponentially, it is also important to select factories that are investing in emerging techniques and processes. Solutions that were previously considered advanced are now becoming more prevalent, including high density interconnect, rigid-flex boards, multi-level microvias and buried vias. NCAB also sees increased demand for high-signal speeds, optimised power consumption and RF signals.

Miniaturisation is another important driving factor. With components shrinking in size and the consumer electronics industry driving a general trend towards miniaturisation, an increasing number of features having to be accommodated in a smaller and smaller space. Increasingly, this also applies to industrial electronics, with sensors found in consumer products such as smart phones, now found in various industrial applications. Audio-visual or tactile sensors, for example, offer growing levels of accuracy, thus improving the performance of electronic industrial equipment.

Supplier support

Lead times are always impacted when working with advanced technologies, and with reliability and quality also major factors, NCAB believes it's important to get the design right from the start. This includes working with your PCB supplier from the outset. A good supplier should highlight issues when a design is submitted, such as changes that could result in cost savings or any potential manufacturability issues, providing an accurate lead time that fits with requirements. Once the design is perfected, the manufacturing process will be seamless.

Ultimately, to be successful, it's imperative to team with a knowledgeable and reliable partner for your PCB needs. Continuously evaluate their performance and consistently be looking for increasing capabilities.

www.ncabgroup.com

Taking the long view

An emphasis on quality assurance has helped Chip 1 Exchange build a sustainable business that can endure market volatility. Electronics Sourcing spoke to CEO and co-founder, Sasan Tabib, to find out more

Q Firstly, congratulations on building Chip 1 Exchange to its current position. What were the biggest challenges along the way and how has the company adapted?

We began operations in 2001 and opened our USA office in 2007. As ever, market volatility is probably the greatest challenge for any distribution company, but because we are privately held, we have the luxury of taking the long view. We focus on building a sustainable business that can endure these changes.

At the core of the operation are our quality assurance labs, which allow us to deliver 100 per cent compliant product around the world. This builds customer trust which, in turn, creates repeat business.

Q Chip 1 has developed into a global company with offices around the world. How have the overseas divisions performed over the years and are buying habits different?

Under the guidance of Damon Pouya, the US office in particular has seen tremendous growth. Overall, our strategy is to provide customers with component experts in their local time zone and their native language. We are proud of the fact that over 20 languages are represented in Chip 1.

Most importantly, I believe that delivering quality products in a timely manner is universally valued.

Q With lead times still long on certain components, how does Chip 1 ensure smooth supply chain and logistics to support customers' production lines?

This is an excellent illustration of the long view I mentioned earlier. We invest on behalf of our customers by getting ahead of the market. Some of our tier one OEMs are barometers. Their buying patterns help us anticipate where the industry is going so we can adjust our large inventory in response.

Q Is Chip 1 100 per cent franchised or can you also offer procurement services?

Chip 1 Exchange is in the enviable position of being able to offer customers the best of both worlds. As a hybrid distributor, our sources include not only our factory authorised lines, but also trusted, global sources and, of course, our own stock. Again, our quality process ensures the integrity and condition of all products.

Q What percentage of Chip 1 sales are contract purchased compared to one-off buys and has this shifted over the years?

I estimate that about half of our business is tied to contracts, which is a major shift from prior years. This validates our approach of looking for long-term, sustainable revenue.

Q Which areas of the business are currently experiencing the most success and do you have plans to increase your footprint?

The USA operation, which covers North and South America, has been a bright spot. It has enjoyed over 200 per cent growth in the last year alone. Damon has invested in brand awareness, marketing, staff and facilities. We have recently added a team in the US to focus on the unique needs of the defence and aerospace industries. Our operation in Mexico has also been particularly successful. Look for upcoming announcements about additional office locations.

Q What kind of component testing is carried out by Chip 1 to ensure authenticity when components first arrive?

We adhere strictly to established international standards for validating the authenticity and condition of our products. Detailed visual, chemical, microscopic and radiological diagnostics are performed, along with additional testing such as electrical measurements and solderability. Our entire operation hinges on this critical function.

Q Finally, how do you envisage the electronics supply chain evolving in the next five years?

We see demand for our products remaining strong for the foreseeable future. In fact, the adoption of new technologies such as artificial intelligence will create new component demand. Companies that are not traditionally chip makers, such as Amazon, Google and Tesla, are developing their own AI silicon for example. Internally, we are building intelligent systems that will improve our ability to service our customers' needs. This is an exciting and rewarding time to be in the industry.

chip1.com

Chief executive officer and co-founder, **Chip 1 Exchange**, **Sasan Tabib**

Cost effective logistics are closer than you think

Component distributor, TTI, has invested heavily in streamlined logistics for manufacturing in Mexico, as TTI's director of integrated logistics services operations, Rick Harvey, explains

Competitive pressures are forcing many American companies to move production and manufacturing outside of the United States. For many, the closest and most viable alternative has long been Mexico. A shared land border makes truck and rail shipping fast and easy compared to overseas manufacturing. Lower labor, facilities and infrastructure costs, combined with similar time zones, also make Mexico an attractive manufacturing base with several potential savings.

Mexico, however, comes with its own challenges. Security issues and less than ideal transportation infrastructure in many areas, make centralized distribution difficult. There is also the matter of dealing with alternative taxation and customs laws. The component distribution model employed in the US can't be easily replicated in Mexico, which is why TTI created a sustainable model to fully serve this growing market.

Regional warehouses

TTI has had a dedicated presence in Mexico since before the turn of the century. Over the years we've become adept at distributing components from our US inventory to proximity warehouses located in manufacturing areas in the Mexican interior to ease the logistics burden. A working relationship with Mexican authorities has built up, along with an understanding of the way systems work south of the border. Investment in seven regional warehouses located throughout the country allows components to be moved from our Texas facilities into Mexico according to customer schedules, so parts can be staged for production while still in the care of TTI.

Customs know-how

An extensive understanding of the Maquiladora manufacturing and export (IMMEX) procedures allows customers to 'virtually import' components that are manufactured, transformed or repaired and then 'virtually export' the items without payment of taxes and compensatory quotas. This program can make manufacturing in Mexico especially lucrative and has benefitted many TTI customers.

Typically, TTI can bring components into the country as much as six months before transferring them to the customer, ensuring dependable lead times and consistent supply. Manufacturers are held to relatively tight turn times when using the component parts. In most cases, they must turn the product within six months of taking delivery of the components, but this is not usually difficult with modern, forecasting-based inventory and resupply programs. Adhering to this timeframe lessens processing costs and reduces the paperwork involved in importing components for production.

Admin expertise

TTI can also help customers save time and money by supporting the pedimento process — the customs form that tracks the movement of components and manufactured items in country. TTI consolidates each customer's pedimento into a single document each month that can then be completed and verified by a customs broker, rather than the customer being responsible for documenting each individual shipment and transaction and paying the associated fees each time.

When these advantages are combined with a TTI supply chain program that pipelines components into a customer's production line, working from their demand driven systems to order components, the full efficiency of the system can impact a manufacturer's bottom line in a big way. These factors can make it worthwhile to investigate Mexico versus a true offshore option in Asia or China.

www.ttiinc.com

TTI director integrated logistics services operations, **Rick Harvey**

Navigating Ports of Entry between the US and Mexico is part of a comprehensive logistics program.
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How to stay one step ahead of the weather

Freak weather conditions can seriously impact your supply chain, but with ample preparation and a strong continuity plan, it needn't be a disaster. Resilience360 recommends purchasers consider the following checklist of measures ahead of the hurricane season

1 Use weather data to increase awareness

Monitoring weather forecasts in real-time enables purchasing managers to pick up advanced meteorological warnings, even before storms become hurricanes. Armed with this information, it is possible to take mitigation measures as early as possible.

Purchasing managers should draw up a business continuity plan long before disaster strikes

2 Identify facilities in high-risk areas

It is important to know which locations and links in your supply chains are most likely to experience disruption as this is key to prioritizing and concentrating mitigation efforts. Locations close to the sea, such as ports, will be most vulnerable, but remember to consider any suppliers and warehouses near the coast, as well as in the immediate hinterland, which can also be affected by passing storms.

3 Increase safety stocks

Once information about the next big weather event is available and a disaster is imminent, it is crucial to take action to alleviate losses. Placing orders with key suppliers to increase buffer stocks near vulnerable facilities can help to bridge short-term supply shortages, but you should also consider placing orders outside high-risk areas to mitigate supply issues.

Identify facilities in high-risk areas most vulnerable to passing storms

4 Pre-position essential material

To avoid production outages during, or in the aftermath, of a disaster, you may need rapid access to essential material such as fuel supply and back-up generators for power generation. Pre-positioning vital equipment or supplies at your production and distribution facilities ensures you will be prepared for any power outages and fuel supply disruption.

5 Set up alternative communication systems

In an emergency situation, it's a good idea to have back-up communication channels that you can revert to for communication with employees, suppliers and customers. These can include Emergency Alert Systems, CB radio and even social networks and the press, which can be used to inform others of the mitigation actions you took.

Monitoring forecasts in real-time provides purchasing managers with advanced warning of extreme weather conditions

Draw up business continuity plans for key locations 6

Wise purchasing managers will have a business continuity plan in place well in advance before disaster strikes. This plan should address critical aspects such as identifying key team members and nominating a back-up during a crisis. It should also lay out clear responsibilities for those concerned, as well as listing key points of contact at critical suppliers, and identifying priority shipments.

Test business continuity plans 7

If they are to be of any use, continuity plans must be tested. Ideally this will involve representatives from all functions and parties to expose any gaps or weaknesses in the plan, such as ensuring responsibilities are met beyond normal working hours or accommodating staff shortages due to personal obligations during disasters.

The hurricane season can present real risks for seamless supply and production

Diversify manufacturing and distribution locations 8

To mitigate the effects of a disaster, customers should also consider diversifying to enlist supplier, manufacturing and distribution locations outside of high-risk areas. This can help to reduce the probability of complete production and/or distribution failure. For each individual location, there should ideally be an alternative supplier, warehousing option, production line or transportation route established in advance.

Mapping and survey tools provide transparency to highlight interdependencies in the supply chain

Use mapping tools for supply chain risk assessments 9

Mapping and survey tools can be a great help to companies seeking to create greater transparency and to understand the various interdependencies in their supply chains. Survey capabilities can also help purchasing managers to understand and monitor whether their sub-tier suppliers have their own business continuity plans in place.

Establish good supplier relationship practices 10

The chances of securing transportation capacity during a disaster can be significantly improved by establishing good, long-term relationships with providers. This may make it possible to book capacity on charter flights to move a crucial order to its final destination or from disaster areas when everybody is vying for space. www.dhl.com

Weighing up the alternatives

In the past decade, some major capacitor OEMs have ceased production or discontinued products, leaving purchasers in a tight spot. Marketing manager at API Capacitors, Annastasia Love, provides a guide to alternative sources

Q Why would someone need obsolete, discontinued or replacement parts?

A) Often, it's to refurbish or maintain older equipment or machinery. The problem is that equipment originally manufactured 10, 20 or 50 years ago will typically include components that have been discontinued.

Similarly, a part in a piece of equipment may have reached the end of its life or experienced a failure. In situations like this, end users may seek to buy a one-off part rather than placing a batch order, which would typically be the only type of order an original manufacturer will accept.

Although you may be safe if the required item is a legacy part, certain parts, for example diodes or fuses, are much easier to replace than an item such as a high voltage capacitor. Trying to find an exact replacement part can present obstacles including strict minimum order quantities and unknown specifications for discontinued items.

Q Where can I find electrical components that have been discontinued?

A) If you are in doubt about the availability of an item, call the original equipment manufacturer or a trusted distributor. Bear in mind, however, that the original manufacturer may not be too helpful when it comes to an obsolete part. An OEM will always try to sell a new part, rather than help you keep an obsolete part in your equipment design. You may just have to trawl the manufacturer's archive of old specifications and provide this to an alternative source manufacturer.

If a part is no longer available to buy through its original manufacturer, an alternative manufacturer may be able to match the design and produce an interchangeable part to fit the equipment that needs servicing.

Alternatively, in some instances it may be possible to source obsolete components from a distributor, often with a large mark up. If capacitors are stored correct to manufacturer's instructions, most types will not age, however if you are sourcing electrolytic capacitors from a distributor with an inventory of old stock, be aware there is a shelf life on this component type.

Q Is it possible to manufacture a direct replacement?

A) Some independent capacitor manufacturers can manufacture interchangeable parts to replace discontinued OEM capacitors. Typically, capacitors can be manufactured and designed to order as per application requirements, which means a solution can be provided for almost any spare or replacement capacitor request.

Q What information do I need to provide to my alternative source?

A) With the design or specification for the original part, your alternative source will be able to manufacture the part to your requirement with no problems.

If the original design or full specification is not available, it may still be possible to design an equivalent part, if you can provide details of the following:

- product and capacitor application
- required capitance and tolerance
- any temperature or humidity requirements
- whether the capacitor will be subject to any high current discharge
- the physical part measurements or size
- the rated voltage
- the actual working voltage which will be applied to the part

While some purchasers may not have these technical details, your engineering department will certainly know the conditions under which the part will need to perform.

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IoT: a solution fit for distribution

John Denslinger is a former executive VP Murata, president SyChip Wireless, and president/CEO ECIA, the industry's trade association. His career spans 40 years in electronics

This month John Denslinger explains why the myriad of hardware, software and services that underpin IoT applications are best sourced via the distribution channel

Internet of Things • By John Denslinger

Not too long ago, the talk of the industry centered on the coming IoT evolution, connecting everything to anything. The applications would be limited only by one's imagination and the benefits attained in knowledge and solutions beyond anyone's wildest dreams. Well, IoT is here. It truly appears to be that enormous market as predicted.

Across the globe, component manufacturers really stepped-up, investing heavily in the vital build-blocks supporting IoT functionality. With one eye on low cost and the other on low power consumption without sacrificing range, the componentry and core application software is there to create any backbone structure needed for an effective IoT roll-out.

But the real story might be distribution. Distributors recognized very quickly customers would need workable solutions, not just components and connectivity roadmaps. To their credit, distributors quietly amassed resource pools of notable suppliers, software experts, design/application specialists, as well as, service provider and EMS partnerships to complement that complete and seamless IoT build-out.

By all means, buyers and engineers tasked with sourcing IoT products should make it a point to discuss component specifications and application options with manufacturers. Their information is usually crisp and clear, but step two, talk to your distributor. There is a lot to know and understand in any IoT eco system and it seems distribution is your best solutions fit.

This editorial is not the first to write about IoT, but I do think it worthwhile noting again the complexities of a successful launch. The challenges are immense and the need for educating oneself is paramount. Just consider for a moment the tangential issues: component, software and system compatibility; security and privacy concerns; data management and extraction; system EOL; long term maintenance; ease of reconfiguration as technology advances; hacking vulnerabilities; systems quals to meet local/national/international operating standards; and overall communications reliability to name just a few. Talk to your distributor or visit their website for the education and resources you need to be successful.

All distributors seem have IoT products, services and application support listed on their websites. Some are better than others.

Here are a few good examples of educational and resources available:

Digi-Key–Inspiring the Future https://www.digikey.com/en/resources/IoT-resource-center/overview offers products, connectivity, cloud/services and tailored application solutions. They also have an excellent in-depth training tool Digi-Key IoT Studio.

Mouser Electronics–All Things IoT http://www.mouser.com/empowering-innovation/all-things-IoT features a video, application eBooks and blogs. I find this to be more of an introduction to IoT. Mouser also offers https://www.mouser.com/applications/internet-of-things/ showcasing applications, products, articles and technical resources.

Arrow–Solutions from Sensors to Sunset https://www.arrow.com/en/IoT lists applications, IoT building blocks, technologies available, videos, articles and featured stories

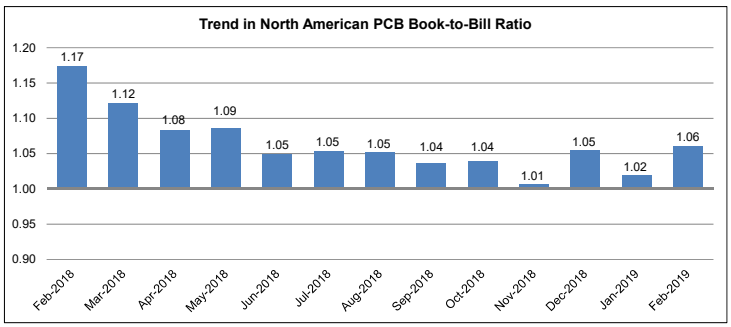
Avnet–IoT Services and Solutions https://www.avnet.com/wps/portal/us/solutions/IoT/overview/ promotes education via Avnet's in-house IoT Workshop and IoT University.

Future Electronics–Sense Connect Control https://www.futureelectronics.com/our-solutions/IoT-solutions offers applications, highlighted technologies, live chat and featured articles. Each technology has easy to read options with a substantial list of resource materials.

IoT is now and distribution is your best IoT solutions fit.

PCB growth makes a comeback

Sales and orders of printed circuit boards are both experiencing solid year-over-year growth, with promising signs for the months ahead



Note: The February 2018-March 2018 and January 2019 ratios have been revised since their original publication due to updated data from statistical program participants.

Despite what appeared to be a shaky start to the year, the IPC Association Connecting Electronics Industries has revealed that North American PCB business growth continues apace. The February 2019 findings from its North American printed circuit board statistical program show that sales and orders both experienced solid year-over-year growth in February, and with revised contributor data for January, it seems the industry results made a much stronger showing than originally indicated.

Welcome change

IPC's director of market research, Sharon Starr, commented: "Revised January data from the North American PCB industry brought welcome changes to the 2019 business results to date. After slowing growth in the latter part of 2018, strong growth has returned in 2019.
"The book-to-bill ratio also rebounded from a corrected level of 1.02 in January to 1.06 in February, indicating the likelihood of continued sales growth in the coming months."

Growth returns

Drilling down into the data, the IPC reports that total North American PCB shipments in February 2019 were up 13.9 per cent, following a 15.5 per cent rise in January, compared to the same months last year. Year-to-date sales growth in February was 14.7 per cent, although compared to the preceding month, February shipments decreased 5.2 per cent.

Year-over-year PCB bookings in February increased 10.7 per cent, after decreasing 1.7 per cent in January. Year-to-date order growth in February was up 4.4 per cent and with bookings in February up 8.8 per cent from the previous month, the outlook for the year ahead is positive.

The first-quarter 2019 edition of IPC's *North American PCB Market Report*, containing detailed data from the PCB statistical program, was published in May.
www.ipc.org

Making request for proposals work harder

Purchasing systems are often a source of lost productivity and wasted man-hours. Software company, DirectRFP, explains how an efficient 'request for proposal' process saves time and money for buyers and vendors alike

Let's start with the good news. The semiconductor portion of the electronics and technology industry is growing by leaps and bounds. It sped to a double-digit, 10 per cent growth rate in 2018 alone, and is now valued at $62.7 billion, according to semiconductor industry organization, SEMI.

Identify purchasing inefficiency

So, what's the bad news? For a technology sector on the fast track, purchasing systems are often mired in lost productivity, less-than-efficient practices, and a lack of data. A look at the numbers drives home the soft and hard costs of an inefficient request for proposal (RFP) process: on average a company will invest over 4,800 work hours, spending well over $300,000 annually preparing RFPs.

Vendors don't fare much better as they respond to these RFP opportunities. The same research reveals that a vendor will spend as much as $5,000 before even responding to an RFP. An active vendor responding to 10 to 20 RFPs annually can easily spend $50,000 to $100,000.

Yet data analytics and technology could transform this lost productivity and expense, creating a more efficient RFP process for both companies and vendors, while earning better outcomes.

Fortunately, the data, tools and best practices exist to transform the request for proposal process into a workflow-efficient practice with less expense for RFP responders and buying agents alike. The key to creating a better RFP, which ultimately means getting a better vendor response, is in pulling together the best information you can get to drive the process. Here's a road map.

Involve project stakeholders

Purchasing professionals have a systemized approach to building an RFP, however, system efficiency can sometimes come at the expense of critical information. The first stop on the road to RFP success is checking in with stakeholders; namely, the people most impacted by the project for which you're hoping to identify vendors. Get must-have insight from them, and you'll create a much more tightly defined, and efficient RFP.

The first of our six stakeholder groups is end users who will be impacted by the new service or product. This could be a single department, or it could be wide-reaching, involving IT, operations, sales, manufacturing, finance, legal, and HR.

For complicated projects or regulated industries, plan to get insight from a service area expert. Your in-house team has limited exposure to products and services, so recruit a managed service

Get must-have insight from all stakeholders to create a much more tightly defined, and efficient RFP

provider for technology or a group purchasing organization for medical purchases.

RFPs are costly to run and the projects they solicit are usually tied to large spending. In addition, the genesis of a procurement project will often be to save money on an existing contract. Involving the finance team will therefore be critical throughout your procurement process.

Involving key decision makers throughout the RFP process will ensure that final decisions are made quickly. Furthermore, although RFPs are not in themselves legal documents, the contracts you sign with future vendors are, so ensure that any RFP requirements include questions to protect your organization.

Last but not least, is the procurement team. If you are reading this article, then you are likely in a procurement or purchasing role. Your success will be based on successfully gathering the RFP requirements and completing the RFP preparation on time and on budget.

Create a better workflow

Without a workflow map, it is all too easy for an RFP to get lost in an administrative wilderness. There are, however, some simple steps you can take to build a tighter, more flexible workflow for the RFP process that tracks to your stakeholder needs.

1. Identify the steps in your current workflow process.

2. Figure out the time allotted to each step.

3. Ask yourself if this step adds value? If not, eliminate or change accordingly.

4. Determine if your goals have been met.

5. If not, add steps to the process to create an improved RFP process.

Build a better RFP library

RFPs tend to be reiterative. This can be helpful in streamlining the comprehensive parts of the RFP process, leaving you with more time to custom-design the key parts of the RFP which invite the right vendors to the table for a response. Cookie-cutter or incorrectly focused RFPs are the chief reason vendors waste thousands of dollars and man-hours responding to RFPs they're not suited for, while the 'right' vendor may not even realize they are a match, or be so daunted by the process they stay away.

Leverage your data base of past RFPs to determine which portions can be replicated turnkey, which RFP queries delivered the best vendor outcome, and which ultimately delivered a failed outcome or less than stellar selected vendor. Reviewing past-performance data and asking your stakeholders about the insight they have on hand will help to build a better RFP.

The process begins with two sets of goals: what does your best vendor look like, and what are your project goals. Tightly defined goals are the foundation of a solid RFP.

Next, write focused RFP questions, thinking about what you need precisely. Be succinct. Past data can be very helpful here, so consider what questions have served you well in the past for the RFP process and which have not.

Remember, the more specific, and less wordy you can be, the less chance a vendor will misinterpret your needs and respond incorrectly. Run-on sentences and multiple-part questions are a no-no.

Keep your questions as brief, concise and focused as possible. As you write the RFP, be sure to circle back and review everything to ensure you stay tightly focused on RFP goals.

Finally, weight and score your questions. This is the most important use of past RFP data and stakeholder input. All questions in the RFP process are not created equal so be sure to weight and score the most important questions in the RFP, so you can see at a glance which vendor is a natural fit for your project.

Prioritize efficiency

RFPs are a critical and growing part of any enterprise, particularly in the fast-growing electronics and technology universe. For companies seeking to purchase critical supplies and services, and vendors seeking to provide them, the creation of an efficient, targeted, and information/data-driven RFP is a holy grail that will serve all parties with gains in efficiency, revenues and overall enterprise performance.

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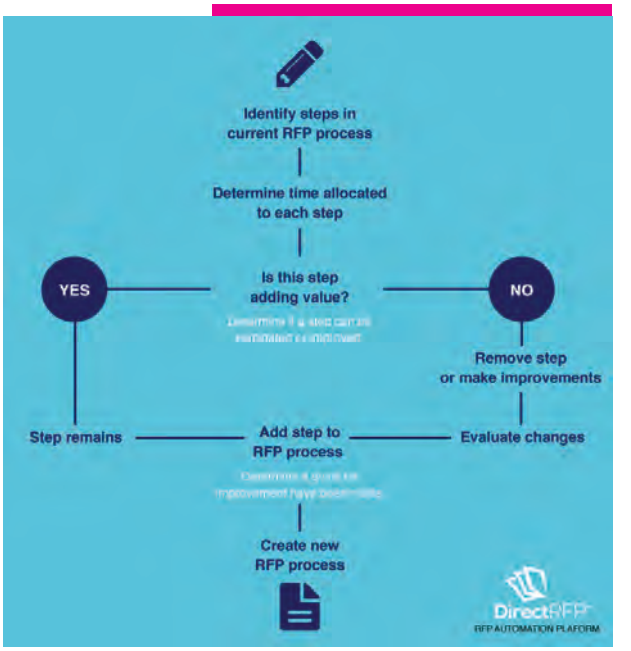
Leverage your data base of past RFPs to determine which portions can be replicated turnkey

Build a tighter, more flexible workflow for the RFP process



Robust sales growth for sensors will ease

Ample capacity and slowing demand means buyers can expect sensor tags to drop

James Carbone

While the worldwide sensors market grew about 10 per cent per year for the past 10 years, sales growth will lessen in 2019 and beyond due in part to slower growth in unit demand.

In fact, the slowdown in sales growth began in 2018 when the rate of growth fell to 7.9 per cent from 14.7 per cent in 2017 and 15.3 per cent in 2016, according to researcher IC Insights. The unit demand growth rate dropped from 16.1 per cent in 2017 to 7.6 per cent in 2018. In 2019, sensors revenue sales growth will further slow to 5.3 per cent as revenue will total $9.6 billion, the researcher said. Revenue will only increase 2.5 per cent to $9.9 billion.

Growth is slowing because of inventory adjustments by system makers, weakness in some key end-use markets, such as cellphones, and increasing concerns about the global economy, according to IC Insights.

The slowdown in growth is a big change. The sensors/actuators segment was the fastest-expanding semiconductor segment with a compound annual growth rate (CAGR) of 10 per cent from 2008-2018 compared to average annual growth rates of 6.6 per cent for integrated circuits, 7.7 per cent for optoelectronics, and 4.2 per cent for discretes, the researcher said.

While sales growth will slow over the next several years, it will remain healthy although not stellar. From 2018-2023 sensors will post a CAGR of 7.5 per cent.

The good news for buyers is that average prices for sensors will decline because of continued sluggish growth in unit demand and ample supply and capacity. Prices were flat from 2016-2018 but will decline 2 per cent in 2019 to $0.39 and 3 per cent in 2020, 2021 and 2022, according to Rob Lineback, senior market analyst for IC Insights. The CAGR for sensor prices will be -2.5 per cent from 2018-2023, he said.

Maturing demand

One reason for slower growth is because some products such as accelerometer, yaw, pressure, and temperature sensors are mature products and are used in mature, slower growth customer segments. Such sensors will grow less than 5 per cent per year from 2018-2023, said Dr. Richard Dixon, senior principal analyst sensors for IHS Markit in Munich, Germany. "However, classical applications are being replaced by some surprising new ones," he said.

Dixon noted that smart phones still represent the "bigger but now saturated part of the consumer sensor market by value." In fact, cell phones shipments declined from 1.886 billion in 2017 to 1.832 billion in 2018 and will decline to 1.814 in 2019, according to IHS Markit.

However, sensor growth has "recently moved to other accessories such as wireless earbuds from Apple," said Dixon. Such products use "multiple accelerometers and silicon microphones per set and functionality could eventually include vital sign monitoring and enhanced motion detection," he said. Higher-end smart watches will soon measure "not only the heart beat, but also oxygen saturation, heart rate variability and blood pressure," he said.

Dixon noted that relatively new products such as e- cigarettes and wearable electronics are also helping drive sensor growth. For instance, pressure sensors are used in e- cigarettes monitoring flow rate and motion.

"E-cigarettes, smart watches, wearables, glasses/ear buds, are all interesting new areas for sensors," said Dixon. The smart phone may no longer be driving sensing revenue, but the accessories are, he said.

"Autonomy" means more sensors

Automotive will continue to be a driver of sensors. "Electrification of the car is driving demand especially for current and temperature sensors, both silicon type and non-silicon-based sensors," said Dixon. Advanced Driver Assistance Systems (ADAS) and eventually autonomous driving will drive the requirements for cameras and radar based on silicon/CMOS sensors, he said.

By the Numbers

5.3%
The expected growth rate of the global sensors market in 2019. Source IC Insights

$9.6 billion
The expected size of the worldwide sensor market in 2019. Source IC Insights

8%
The forecasted growth in sensor unit shipments in 2019. Source IC Insights

2%
The rate that average selling prices of sensors will fall in 2019. Source IC Insights

$13.1 billion
The total revenue of the worldwide sensor market in 2023. Source IC Insights

Dixon added the "road to autonomy" will mean increased redundant system requirements under Functional Safety regulations ISO26262.

"This can be achieved by doubling or even tripling of sensors in systems," said Dixon. "Essentially it means more silicon area per application, which forces prices up and/or increases the overall sensors per system. "

Sensor use in industrial equipment will remain significant. For example, industrial and medical MEMS silicon sensors alone topped $2.1 billion last year, said Dixon. He added more and more devices are connected to collect data for predictive maintenance applications in industrial equipment, "essentially connecting certain aspects of machine-level and factory monitoring applications either at the Edge or at the Cloud."

IoT is helping to drive sensor growth and many IoT applications require sensors to gather data. Sensors are needed for measurement and monitoring, including electrical measurements of current and temperature in equipment. Sensors are also being used for newer measurements such as vibration levels, which can provide insight into the health of equipment and can identify potential problems, said Dixon.

"The question of the impact of IoT relates to some degree with how many of these devices are connected," he said. "Connected devices collect valuable information, and multiple connected sensors of different kinds adds further value with interpretation. However, the high computational powers needed are in the cloud," he said.

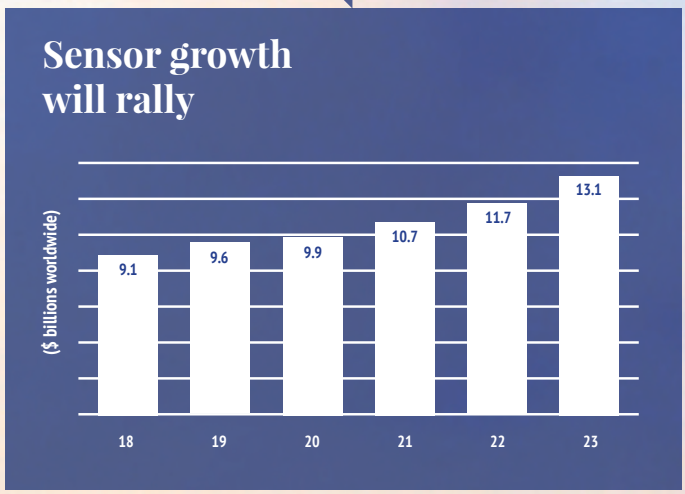
No supply challenges

Dixon added that while sensors are being used in more equipment, there are no serious supply issues although "there was a shortage of silicon microphone dies at a major manufacturer last year." Major sensors manufacturers such as Bosch, Infineon, STMicroelectronics and TDK have ample capacity to meet demand.

While there has been some consolidation among sensor manufacturers, it has not had an adverse impact on supply.

"TDK has begun to build a sensor powerhouse with acquisitions of five or six sensor companies that make pressure, inertial, magnetic sensors, which will help the company have a wide reach in automotive and other industries," said Dixon.

Sensor revenue will rebound to double-digit growth in 2022. Source: IC Insights



The average price for sensors will decline from about $0.39 in 2018 to $0.34 in 2023.
Source: IC Insights

Last year, TDK acquired Chirp Microsystems, which makes high-performance ultrasonic sensors. Such sensors are smaller and consume less power than traditional sensors. They are used in smart phones, vehicles, industrial equipment in our expected to also be used in virtual reality often reality applications.

"Our vision is to be the leading solutions provider of sensors for motion, sound, environmental elements (pressure, temperature and humidity), and ultrasonic sensors for the Internet of Things (IoT) era," said Noboru Saito, senior vice president, TDK and CEO of Sensor Systems Business Company. "Chirp's unique and high value-added 3D sensing technologies will fill out our lineup of sensor solutions, positioning TDK as the leader in ultrasonic MEMS technology.

In recent years, TDK also required Tronic Microsystems and InvenSense. Austrian company ams AG has acquired smaller companies that make gas and temperature sensors.

Some connector companies like Amphenol and TE Conductivity have "made acquisitions of sensor companies to give them access to new value chains such as automotive," said Dixon. For instance, last year, Amphenol announced it would acquire SSI Controls Technologies. the sensor manufacturing division of SSI Technologies, Inc., for approximately $400 million. SSI makes sensors for the automotive and industrial markets.

New markets for sensors

Dixon said the overall sensors market is healthy because the devices are used in many products and many customer segments. "While some areas wax and wane quickly, such as the consumer sector, new areas quickly emerge to keep the suppliers busy," he said. Automotive and industrial are "mainstays" for the sensors industry and will also help drive future demand.

He noted autonomous driving will help drive future demand but it is not the only market to watch.

Robotization of many vehicles is taking place inside warehouses, in drones for surveying and mapping and even for human support in logistics and warehouses," said Dixon. Those applications require sensors.

Agriculture is also requiring sensors for applications including drones, spray crops and to monitor soil conditions for acidity and moisture content.

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How does it work?

Principal Manufacturer launches New Component

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Blockchain seen as promising tool in fight against counterfeit parts

The track and trace capability of blockchain will provide a permanent, unchangeable record of components as they are sold in the supply chain

Don Tait, senior analyst blockchain and financial technology for **IHS Markit**

Counterfeit parts have long been a thorn in the side to electronics purchasers, especially during times of shortages when many buyers venture into the open market to purchase components from unauthorized distributors and brokers.

In many cases, buyers purchase components from reliable independent distributors that have invested in test and inspection equipment that help determine if a part is genuine or counterfeit. However, in some cases, buyers end up purchasing bogus parts from unauthorized sources that are not as diligent about the authenticity of parts.

While so far there has been no panacea to solve the counterfeit part problem in electronics, some analysts say blockchain technology will go a long way in stopping the proliferation of counterfeit components. Blockchain allows components to be tracked from the manufacturer to distributors and to OEMs and electronics manufacturing services (EMS) providers. The technology provides complete traceability of the part no matter where it is in the supply chain.

Blockchain is a distributed digital ledger technology that records various transactions involving a component from the time it is manufactured to when it goes end of life. Blockchain works with other technologies such as QR codes and RFID tags. Blockchain uses cryptography and timestamps that provides a permanent, unchangeable record of all transactions involving the component as it moves through the supply chain. When a component manufacturer builds a part, a blockchain is originated for the component.

Blockchains can be public or private. With a public block chain, there are no restrictions. Anyone with an Internet connection can participate in it. A private block chain is permission based and a person needs to be invited by network administrators join it. In electronics, it is likely blockchain would be private and permission based.

With a blockchain, when a component "comes off a manufacturing line, it gets entered into a ledger process," said Don Elario, vice president of industry practices for the Electronic Components Industry Association (ECIA). It's the beginning of the life journey of the part," he said. "The ledger provides an immutable record of every transaction concerning the part, including where and when it was sold and where it was shipped. So, if a manufacturer sells the part to a distributor and then the distributor sells the part to an OEM or EMS provider, each transaction would have a time stamped record.

If an OEM or EMS provider decided to sell the part to an independent distributor and that distributor offered the part for sale, a buyer could see every prior transaction involving the part and trace the part back to the component manufacturer. "If I'm a buyer and a member of the blockchain of the electronic component industry and I'm going to buy a component, I will go on that ledger and look up the history of that part before I buy it," said Elario.

All the data in the block chain will be stored in a data warehouse. The information is in a barcode and is loaded when the component is scanned. "Once the information is in the ledger, it is immutable," said Elario. "It cannot be changed." New information is added when the part travels through the supply chain as it is sold.

"It is obviously very important to get information in the ledger correctly" each time the part is sold, said Elario. If a company that is not part

> **Any technology, such as blockchain, that shows up-to-date, real-time information will certainly help reduce the number of counterfeit products on the global market just by the nature of its immutability**

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of the block chain buys the part, the traceability of the component is compromised.

Traceability is key

Many in the electronics industry say the transaction data resulting from the track and trace capability of block chain would be key to thwarting the proliferation of counterfeit parts.

Don Tait, senior analyst blockchain and financial technology with researcher IHS Markit, said the digital ledger of blockchain is the linchpin to anti-counterfeit efforts. With the ledger, a buyer not only sees previous transactions for the part within the supply chain but can see real time data if the part is being shipped across the globe or is at a port. "Any technology that shows that up to date, real-time information will certainly help reduce the number of counterfeit products on the global market just by the nature of its immutability," said Tait.

Blockchain technology was created about 10 years ago years but is still being developed for use in the electronics industry. "Blockchain is in its infancy," said Elario. "There are a lot of use and proof of concepts cases out there that are being coordinated with some very reputable firms, mostly outside of the electronic components," he said. For instance, Walmart implemented a block chain platform to track the goods it sells. If there is a product recall by a manufacturer, Walmart can identify where all the products are in hours rather than weeks.

"Over the last year the interest level in blockchain is much higher" among component manufacturers, distributors, OEMs and electronics manufacturing services providers, said Elario.

Interest is rising because of the track and trace capability that block chain can deliver, said Elario. However, he said he was not aware of "any actual applications that are in distribution or the electronic component industry yet. I do know that there are companies that are involved in use cases, and in the development," he said.

The ECIA has formed a blockchain working group of subject matter experts to study how blockchain could be implemented in the electronics industry. The working group is "looking at use cases and opportunities for our industry," he said.

Elario said if a blockchain is created for the electronics industry "everyone in the industry would probably want to be part of it and have visibility about parts." Block chain participants would be responsible for entering the correct information when they purchase a component. "The beauty of the data it is immutable," said Elario. 'It cannot be changed."

No hacking

He said it would be virtually impossible for someone to hack a blockchain. "Everyone is saying they are 99.9 per cent sure of blockchain cannot be hacked. With a block chain ledger there would be numerous entries concerning activity of the part.

"If anyone wanted to hack it, they would absolutely have to change every ledger entry at the same time, at the same point with the same information which is basically impossible," said Elario. "That's what they mean by immutable. The information is right and remain right through the life of the part," he said.

Tait added because blockchain by nature is distributed across nodes in the supply chain and geographical areas, it is virtually impossible for counterfeiters to hack it or create a counterfeit block chain.

"It could be done in theory but it would take a lot of time and effort set up of a bogus blockchain," he said. "The bad guys are not going to be able to play. If I am a buyer and I see anything in that block chain ledger process that's suspicious, I'm not going to buy that part," said Tait.

While interest in block chain is growing in the electronics industry, it is unknown when it will be deployed. Some companies are offering block chain products and solutions. Tait noted OpenPort, a Hong Kong based company, provides block chain logistics solutions for enterprise supply chain management. Its technology gives its customers enterprise resource planning (ERP) integrated shipment visibility and electronic proof of delivery from a road freight transporter and creates record of events from pick-up to delivery.

IBM offers companies some blockchain solutions including a system-on-a-chip microcomputer and TradeLens, an open and neutral blockchain platform that provides a shared ledger for shipping and logistics companies.

"This year we will move forward as an industry with some use cases, with some companies in the industry that have an appetite to work with some proof of concepts," said Elario. He expects by the end of the year there will be some use proof of concept cases underway with technology companies.

"From there we will learn what the next steps are" for block chain to become a reality in the industry, said Elario. "It's hard to say when

Don Elario, vice president of industry practices for the **Electronic Components Industry Association (ECIA)**

> **If I'm a buyer and a member of the blockchain of the electronic component industry and I'm going to buy a component, I will go on that ledger and look up the history of that part before I buy it**

you will see a live block chain in our industry, but I would definitely say five years is too long," he said.

While many in the electronics industry may be attracted to blockchain because parts can be traced, there are other benefits. Block chain would also provide a lot of other information about parts such as certificates of compliance (CoCs) to regulation environmental laws and regulations such as RoHS and WEEE as well as other regulations concerning components right now.

Such documentation is very "manually driven in the industry and very cost inefficient," said Elario. "Certificates of compliance is very paper intensive driven part of the industry. "Manufacturers have to produce a piece of paper" to show parts are in compliance with certain regulations and "customers and distributors have to handle the paper," he said. Often teams of people have to be involved with CoC paperwork.

"A lot of that goes away when you can develop a blockchain type solution where the information is accessible to anyone in the block chain," he said. "Blockchain will bring a ton of efficiency to the industry once we get ourselves on the path of implementation," said Elario. Blockchain will also create greater efficiencies in supply-chain management and logistics. "Shipping, inventory and warehouse management, transportation, and bills of landing are just some of the applications that block chain will improve," said Tait. " The key point with blockchain is you have to work out where it's actually adding value, where it is better than what is currently in place," said Tait.

The efficiency and traceability that blockchain technology will deliver will come at a price. There will be a cost to implement block chain, although right now it is not known how much it would cost or who would have to pay. It is likely that the cost would be spread throughout the supply. Once there is a blockchain in the industry, "I'm guessing there will be some type of fee associated to be part of it," said Elario. There might be a subscription fee or some type of member's fees or dues to be in an electronic components industry block chain for track and trace, he said.

While there will be a cost, "you have to counterbalance that against the cost of doing nothing with the current system" said Tait. Counterfeit parts cost the semiconductor industry billions of dollars per year. Tait noted that the International Chamber of Commerce estimates that by 2022 counterfeit parts including electronic components and will negatively impact the global economy by $4.2 trillion and put 5.4 million jobs at risk.

If counterfeiting could be stopped it would obviously be a huge savings for the industry and would pay for the cost of implementing block chain, he said.

Manufacturer	Distributor	Telephone	Website	Franchised Distributor (Y/N/M)	No. of Lines for Principle	Stock Value for Principle	Minimum Order Value	% Lead Free for Principle Range	No. of Technical Support Staff	Total No. of Staff	Pack and Hold
ACOUSTIC COMPONENTS											
BeStar Electronics Ind. Co. Ltd.	BeStar Technologies Inc.	520-439-9204	www.bestartech.com	Y	N/A	$250,000	N/A	100.00%	50	900	Y
CABLE & WIRING											
3M	Mouser Electronics	800-346-6873	www.mouser.com	Y	23235	N/A	$0	0.46	50	1,000+	Y
Alpha Wire	Mouser Electronics	800-346-6873	www.mouser.com	Y	8,106	N/A	$0	93.00%	50	1,000+	Y
Belden Wire & Cable	Mouser Electronics	800-346-6874	www.mouser.com	Y	5,863	N/A	$0	97%	50	1,000+	Y
Molex	ECCO	773-767-2200	www.eccoconnectors.com	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Molex	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
TE Connectivity	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
CIRCUIT PROTECTION											
Bourns	Mouser Electronics	800-346-6873	www.mouser.com	Y	4,462	N/A	$0	68.00%	50	1,000+	Y
Eaton	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
EPCOS	Mouser Electronics	800-346-6873	www.mouser.com	Y	3,487	N/A	$0	100%	50	1,000+	Y
Littelfuse	Mouser Electronics	800-346-6873	www.mouser.com	Y	28,790	N/A	$0	67%	50	1,000+	Y
Schurter	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Vishay	Mouser Electronics	800-346-6873	www.mouser.com	Y	31,445	N/A	$0	68%	50	1,000+	Y
DISPLAYS & LEDs											
BIVAR	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Broadcom	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Cree	Mouser Electronics	800-346-6873	www.mouser.com	Y	12,390	N/A	$0	99.00%	50	1,000+	Y
Dialight	Mouser Electronics	800-346-6873	www.mouser.com	Y	6,179	N/A	$0	84.00%	50	1,000+	Y
Displaytech	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Electronic Assembly	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Kingbright Company, LLC	Mouser Electronics	800-346-6873	www.mouser.com	Y	301	N/A	$0	100.00%	50	1,000+	Y
Lumileds	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Newhaven Display	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Osram Opto Semiconductors	Mouser Electronics	800-346-6873	www.mouser.com	Y	1,690	N/A	$0	100.00%	50	1,000+	Y
VCC	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Vishay	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
ELECTROMECHANICAL											
ALPS	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Apem, Inc.	Mouser Electronics	800-346-6873	www.mouser.com	Y	4,326	N/A	$0	83.00%	50	1,000+	Y
C&K Switches	Mouser Electronics	800-346-6873	www.mouser.com	Y	27,230	N/A	$0	90.00%	50	1,000+	Y
E-Switch	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Grayhill	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y

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ELECTROMECHANICAL *(Continued)*											
Honeywell	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
IXYS	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Keystone Electronics	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
NKK Switches	Mouser Electronics	800-346-6873	www.mouser.com	Y	13,976	N/A	$0	86.00%	50	1,000+	Y
Omron	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Panasonic	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Phoenix Contact	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
PUI Audio	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Schneider Electric	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Sensata	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
TE Connectivity	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Teledyne Relays	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
ENCLOSURES											
Bud	ECCO	773-767-2200	www.eccoconnectors.com	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bud Industries	Mouser Electronics	800-346-6873	www.mouser.com	Y	1,325	N/A	$0	80.00%	50	1,000+	Y
Hammond Manufacturing	Mouser Electronics	800-346-6873	www.mouser.com	Y	2,839	N/A	$0	82%	50	1,000+	Y
New Age Enclosures	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
FREQUENCY MANAGEMENT											
Abracon Corporation	Mouser Electronics	800-346-6873	www.mouser.com	Y	1,780	N/A	$0	100%	50	1,000+	Y
CTS Electronic Components	Mouser Electronics	800-346-6873	www.mouser.com	Y	3,889	N/A	$0	100%	50	1,000+	Y
ECS Inc	Mouser Electronics	800-346-6873	www.mouser.com	Y	2,070	N/A	$0	100%	50	1,000+	Y
Epson Toyocom	Mouser Electronics	800-346-6873	www.mouser.com	Y	178	N/A	$0	100%	50	1,000+	Y
IQD Frequency Products	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Kyocera	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Silicon Labs	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
ICs & SEMICONDUCTORS											
Analog Devices, Inc	Mouser Electronics	800-346-6873	www.mouser.com	Y	18,749	N/A	$0	95%	50	1,000+	Y
Broadcom Limited	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Central Semiconductor	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Central Semiconductor Corp.	Future Electronics	(800) 675-1619	www.futureelectronics.com	Y	N/A	N/A	N/A	N/A	N/A	N/A	Y
Cree, Inc.	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Cypress Semiconductor Corp	Mouser Electronics	800-346-6873	www.mouser.com	Y	1,325	N/A	$0	81.00%	50	1,000+	Y
Digi International	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Diodes Incorporated	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
FTDI	Mouser Electronics	800-346-6873	www.mouser.com	Y	94	N/A	$0	100%	50	1,000+	Y
IDT (Integrated Device Technology)	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Infineon	Mouser Electronics	800-346-6873	www.mouser.com	Y	1,580	N/A	$0	63%	50	1,000+	Y
Intel	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
ISSI	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
IXYS	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Lattice	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
MACOM	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Maxim Integrated	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Microchip	Mouser Electronics	800-346-6873	www.mouser.com	Y	5,800	N/A	$0	100%	50	1,000+	Y
Microsemi	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Monolithic Power Systems (MPS)	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Nexperia	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
NXP	Mouser Electronics	800-346-6873	www.mouser.com	Y	7,205	N/A	$0	100%	50	1,000+	Y
ON Semiconductor	Mouser Electronics	800-346-6873	www.mouser.com	Y	7,486	N/A	$0	96%	50	1,000+	Y
Power Integrations	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Qorvo	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Renesas Electronics	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
ROHM Semiconductor	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
SanDisk	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Silicon Laboratories Inc	Mouser Electronics	800-346-6873	www.mouser.com	Y	1,141	N/A	$0	100.00%	50	1,000+	Y
Skyworks	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
ST Microelectronics	Mouser Electronics	800-346-6873	www.mouser.com	Y	8,145	N/A	$0	96.00%	50	1,000+	Y
Swissbit	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Texas Instruments	Mouser Electronics	800-346-6873	www.mouser.com	Y	29,676	N/A	$0	94%	50	1,000+	Y

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Manufacturer	Distributor	Telephone	Website	Franchised Distributor (Y/N/M)	No. of Lines for Principle	Stock Value for Principle	Minimum Order Value	% Lead Free for Principle Range	No. of Technical Support Staff	Total No. of Staff	Pack and Hold
ICs & SEMICONDUCTORS *(Continued)*											
Toshiba	Mouser Electronics	800-346-6873	www.mouser.com	Y	800	N/A	N/A	N/A	N/A	N/A	Y
Vishay	Mouser Electronics	800-346-6873	www.mouser.com	Y	53,781	N/A	$0	77%	50	1,000+	Y
INTERCONNECTION											
3M	Mouser Electronics	800-346-6873	www.mouser.com	Y	23,235	N/A	$0	46.00%	50	1,000+	Y
Aero Conesys	ECCO	773-767-2200	www.eccoconnectors.com	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Amphenol	ECCO	773-767-2200	www.eccoconnectors.com	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Amphenol	Mouser Electronics	800-346-6873	www.mouser.com	Y	165,853	N/A	$0	31%	50	1,000+	Y
Anderson Power Products	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Aptive (Delphi)	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Cinch	ECCO	773-767-2200	www.eccoconnectors.com	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cinch Connectivity/Bel	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
ERNI Electronics	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
FCI	Mouser Electronics	800-346-6873	www.mouser.com	Y	3,394	N/A	$0	73.00%	50	1,000+	Y
Glenair	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Harting	Mouser Electronics	800-346-6873	www.mouser.com	Y	2,160	N/A	$0	51.00%	50	1,000+	Y
Harwin	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Hirose Electric	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
ITT Cannon	ECCO	773-767-2200	www.eccoconnectors.com	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ITT Cannon	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
JAE Electronics	Mouser Electronics	800-346-6873	www.mouser.com	Y	6,02	N/A	$0	100%	N/A	N/A	Y
JST	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
LEMO	LEMO	800-444-5366	www.lemo.com	M	N/A	N/A	N/A	N/A	N/A	1,500	N/A
LEMO	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Mill-Max	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Molex	Mouser Electronics	800-346-6873	www.mouser.com	Y	85,634	N/A	$0	89%	50	1,000+	Y
Neutrik	Mouser Electronics	800-346-6873	www.mouser.com	Y	1,563	N/A	$0	100%	50	1,000+	Y
NorComp	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Phoenix Contact	Mouser Electronics	800-346-6873	www.mouser.com	Y	30,044	N/A	$0	77.00%	50	1,000+	Y
Radiall	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Souriau	Mouser Electronics	800-346-6873	www.mouser.com	Y	10,744	N/A	$0	27%	50	1,000+	Y
Switchcraft Corporation	Mouser Electronics	800-346-6873	www.mouser.com	Y	300	N/A	$0	55%	50	1,000+	Y
TE Connectivity	Mouser Electronics	800-346-6873	www.mouser.com	Y	123,613	N/A	$0	69%	50	1,000+	Y
OBSOLESCENCE / HARD TO FIND											
	America II Electronics	800-767-2637	www.americaii.com	M	1,900	$1B	$0	75.00%	59	550+	Y
	Lantek Corp.	973-579-8100	www.lantekcorp.com	M	186,000	$22M	$0	75.00%	5	62	Y
	Chip 1 Exchange USA, Inc.	949-589-5400	www.chip1.com	Y	850,000	N/A	$0	85%	20	150	
	Rochester Electronics	978-462-9332	www.rocelec.com	Y		N/A	$250		10	400+	Y
OPTO ELECTRONICS											
Broadcom	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Cree	Mouser Electronics	800-346-6873	www.mouser.com	Y	582	N/A	$0	99.00%	50	1,000+	Y
Finisar	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Osram Opto Semiconductors	Mouser Electronics	800-346-6873	www.mouser.com	Y	1,927	N/A	$0	99%	50	1,000+	Y
ROHM Semiconductor	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Vishay	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
PASSIVES											
ABRACON	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
AVX	Mouser Electronics	800-346-6873	www.mouser.com	Y	42,454	N/A	$0	72%	50	1,000+	Y
Bourns	Mouser Electronics	800-346-6873	www.mouser.com	Y	38	N/A	$0	78%	50	1,000+	Y
Cornell Dubilier	Mouser Electronics	800-346-6873	www.mouser.com	Y	24,145	N/A	$0	71%	50	1,000+	Y
Coilcraft	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
EPCOS	Mouser Electronics	800-346-6873	www.mouser.com	Y	26,533	N/A	$0	98.00%	50	1,000+	Y
Fair-Rite	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Kemet	Mouser Electronics	800-346-6873	www.mouser.com	Y	77,568	N/A	$0	66%	50	1,000+	Y
KOA Speer	Mouser Electronics	800-346-6873	www.mouser.com	Y	34,078	N/A	$0	58%	50	1,000+	Y
Murata	Mouser Electronics	800-346-6873	www.mouser.com	Y	33,780	N/A	$0	99%	50	1,000+	Y
Nichicon	Mouser Electronics	800-346-6873	www.mouser.com	Y	20,389	N/A	$0	84.00%	50	1,000+	Y
Ohmite	Mouser Electronics	800-346-6873	www.mouser.com	Y	14,293	N/A	$0	55.00%	50	1,000+	Y
Panasonic Electronic Components	Mouser Electronics	800-346-6873	www.mouser.com	Y	14,948	N/A	$0	100.00%	50	1,000+	Y

Buyers' Guide

Manufacturer	Distributor	Telephone	Website	Franchised Distributor (Y/N/M)	No. of Lines for Principle	Stock Value for Principle	Minimum Order Value	% Lead Free for Principle Range	No. of Technical Support Staff	Total No. of Staff	Pack and Hold
PASSIVES *(Continued)*											
Taiyo Yuden	Mouser Electronics	800-346-6873	www.mouser.com	Y	4,620	N/A	$0	98.00%	50	1,000+	Y
TDK	Mouser Electronics	800-346-6873	www.mouser.com	Y	6,663	N/A	$0	100.00%	50	1,000+	Y
TT Electronics	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
United Chemi-Con (UCC)	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Vishay	Mouser Electronics	800-346-6873	www.mouser.com	Y	102,917	N/A	$0	64.00%	50	1,000+	Y
Wurth	Mouser Electronics	800-346-6873	www.mouser.com	Y	934	N/A	$0	99.00%	50	1,000+	Y
Yageo Corporation	Mouser Electronics	800-346-6873	www.mouser.com	Y	18,246	N/A	$0	100.00%	50	1,000+	Y
POWER & BATTERIES											
Artesyn Embedded Technologies	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Cincon	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Cosel	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
CUI Inc.	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Delta Electronics	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
MEAN WELL	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Mornsun	+1-978-567-9610/+1-978-293-3923		www.mornsunamerica.com			N/A	$0	100%	N/A	2000+	Y
Murata	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Phihong	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Phoenix Contact	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
RECOM	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Schaffner	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Texas Instruments	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
TDK Lambda	Mouser Electronics	800-346-6873	www.mouser.com	Y	405	N/A	$0	80.00%	N/A	N/A	Y
TRACO Power	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Vicor	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
REED SWITCHES											
HSI Sensing	HSI Sensing	405-224-4046	www.hsisensing.com	M	75	N/A	$200	100.00%	15	275	N
SENSORS											
ams	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Analog Devices Inc.	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Bosch	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Honeywell Sensing and Control	Mouser Electronics	800-346-6873	www.mouser.com	Y	12,059	N/A	$0	64.00%	50	1,000+	Y
Littelfuse	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Maxim Integrated	Mouser Electronics	800-346-6873	www.mouser.com	Y	1,379	N/A	$0	45.00%	50	1,000+	Y
Melexis	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Microchip	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
NXP	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
ON Semiconductor	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Omron	Mouser Electronics	800-346-6873	www.mouser.com	Y	4,915	N/A	$0	59.00%	50	1,000+	Y
Sensirion	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
STMicroelectronics	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
TDK	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
TE Connectivity	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Texas Instruments	Mouser Electronics	800-346-6873	www.mouser.com	Y	914	N/A	$0	65.00%	50	1,000+	Y
SWITCHES & KEYBOARDS											
OTTO	ECCO	773-767-2200	www.eccoconnectors.com	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TEST & MEASUREMENT											
B&K Precision	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Fluke	Mouser Electronics	800-346-6873	www.mouser.com	Y	1,008	N/A	$0	94.00%	50	1,000+	Y
Keysight	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Lascar Electronics		814-835-0621	www.lascarelectronics.com	Y	130	$602,000	$0	100%	10	175	Y
Tektronix	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	$0	N/A	50	1,000+	Y
Teledyne LeCroy	Mouser Electronics	800-346-6873	www.mouser.com	Y	194	N/A	$0	96.00%	50	1,000+	Y

Contract Manufacturers Buyers' Guide

Manufacturer	Telephone	Website	Turnover	Location	Employees	Number of Surface Mount Lines	Approvals	BGA Capacity	Lead Free Manufacturer	Prototyping	Design Capability	Full Turnkey	Cables and Harnessing
Pektron	1-248-677-4838	www.pektron.com	$66m	Michigan & UK	350	8	ISO9001, ISO14001, TS16949, BEAB, VCA, TUV, UL	Y	Y	Y	Y	Y	Y


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Amphenol
NXP
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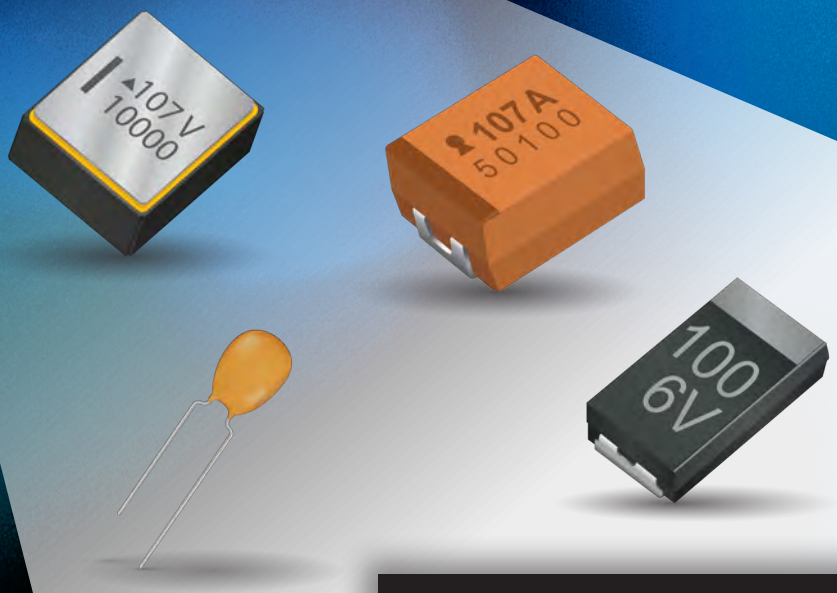

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