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On the cover – October 2022

Don't be afraid of reshoring semiconductor manufacturing

Editor's Word



Lessons will be learned

When you get to my age, you become numb to the phrase 'lessons will be learned'. It is normally applied to a negative event where the organization involved was found lacking and promises to do better in the future.

What the phrase should say is 'lessons have been learned and documented in our standard operating procedure so that all existing and future employees will be forever aware of past problems and the updated procedures designed to prevent them repeating'.

Sadly, given that I hear the simplified version repeated time-after-time from the same or similar organizations suggests lessons might have been learned by a handful of current employees but haven't been widely shared or passed forward.

The reason I mention this is that I'm wondering what is going to happen to the hundreds of thousands of supply chain lessons learned by purchasing professionals over the last three years?

Electronics Sourcing has done its bit, printing hundreds of articles explaining how component manufacturers, distributors, purchasers, CEMs and OEMs have handled the situation. All the issues are archived and available to read for free.

However, what is the industry as a whole doing? I hope: commercial enterprises are adding the lessons to their standard operating procedures; software vendors are embedding the lessons in their code; associations and federations are adding the lessons to their resources; and universities are using the lessons to create real lessons.

If you can record your lessons, please do so.

Jon Barrett

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New source for electrical, automation and control

Digi-Key Electronics has secured a North America distribution agreement with Schneider Electric, one of the world's largest suppliers of electrical, automation and control products.

Digi-Key's director of automation, Eric Wendt, said: "Together, Digi-Key and Schneider Electric are going the extra mile to provide the absolute best possible customer support. Digi-Key customers can now access much of Schneider's portfolio of high-quality products for a wide range of applications and markets, ranging from industrial automation to power management, and many solutions in between."

Schneider Electric's vice president of power products, Emily Heitman, added: "We are proud to grow our partnership with Digi-Key

Electronics in expanding our offering to include industry-leading solutions from our power, industrial automation and sensor product lines across their e-commerce platform.

"This partnership allows Schneider Electric to serve different types of customers and bring our solutions to new markets while providing innovative products and services they need, when and how they need them, to best support their business."

www.digikey.com

Growing sourcing, design and manufacturing expertise

TTI's Exponential Technology Group has acquired engineering design services firm, BGM Electronic Services.

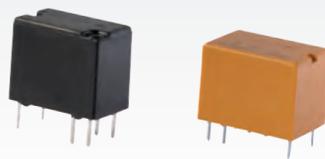
XTG president and TTI SVP business development, Michael Knight, said: "The acquisition of BGM is part of a larger business strategy to assist our customers with component selection and sourcing, product design and the transition of the finished design into manufacturing. BGM joins two other electronic design service firms that are part of XTG—Connected Development and Paragon Innovations—and brings our collective hardware, software and mechanical engineering headcount to over 80 people."

BGM founder, Terry Bishop, added: "We know and work closely with the component specialists at TTI and their subsidiaries, Mouser Electronics and the Exponential Technology Group. They get us and we get their vision for the electronic component supply chain of the future. The synergies are exciting, and our entire team is thrilled to join this world-class organization."

www.bgm-es.com
www.xponentialgroup.com

Introducing signal relays line

CUI Devices' Relays Group has introduced a new line



of signal relays. Ideal for low-level current switching in industrial applications, security devices and test/measurement equipment, the signal relays offer max switching currents of 2 or 3A in SPDT (1 Form C) or DPDT (2 Form C) contact forms.

Boasting industry-best lead times, these low signal relays feature: contact ratings of 120/125VAC or 24/30VDC at 1A; AuAg overlay contact material; and max switching voltages of 120/125/220VAC or 24/30/60VDC. Models are housed in packages from 10.2 by 7.4 by 10mm, while carrying coil power ratings from 150 to 450mW and coil voltages from 3 to 24V.

The relays are available immediately with prices starting at \$0.84 per unit at 100 pieces through distribution. Buyers should contact CUI Devices for OEM pricing.

www.cuidevices.com



1887

Emile Berliner receives the patent for the gramophone.

James Blyth builds the first electricity generating wind turbine.

Herman Hollerith receives a U.S. patent for his punch-card calculator.

Sager opens its first location in Boston, Massachusetts.



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In Brief

Accelerate GaN and SiC implementation

Allegro MicroSystems has completed its acquisition of Heyday Integrated Circuits, a specialist in compact, integrated isolated gate drivers that enable energy conversion in high-voltage GaN and SiC wide-bandgap semiconductor designs. Allegro's VP of Power ICs, Vijay Mangtani, said: "This acquisition will greatly accelerate our efforts to deliver a market leading energy efficient technology platform for high-voltage designs." www.allegromicro.com

Strengthening semiconductor leadership

Michigan governor Gretchen Whitmer joined business, state and local officials at the ribbon cutting of semiconductor wafer manufacturer SK Siltron CSS' new manufacturing facility in Bay City. Whitmer said: "SK Siltron's commitment to Michigan will help us bring the semiconductor supply chain home, cut down shortages and delays and create good-paying jobs for Michiganders in Bay City." www.michiganbusiness.org/semiconductor

Global growth projections lowered

Per IPC's August Global Sentiment of the Electronics Supply Chain Report, current conditions for the electronics supply chain remain challenging, with 86 per cent of electronics manufacturers experiencing rising material costs, while 76 per cent indicate labor costs are increasing. Supporting data from IPC's August Economic Report indicate a slowing economy. www.ipc.org

High thermal load capacity

With the X8G 150°C extension, Kemet is growing its high-temperature dielectric Class I portfolio. The company states the capacitor is a robust, reliable component for critical applications that require stability at higher operating temperatures. It is suitable for transient voltage suppression, safety-related circuitry, filtering/decoupling and bypass applications. www.rutronik24.com



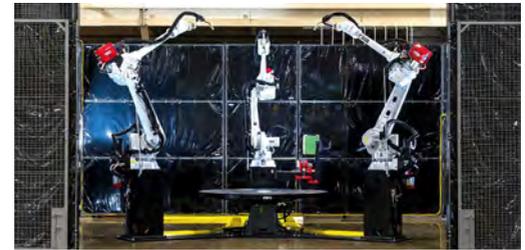
More space for power, battery and thermal support

Sager Electronics has announced an expansion into a new 175,650ft² facility in Lewisville, TX. Scheduled to be operational by the end of the year, the new facility will house Sager's new custom solutions center, distribution center and Southcentral service center.

Sager Electronics' senior VP of operations, Shannon Freise, said: "The company's growth in the power, battery and thermal space necessitated the need for a much larger facility. The Lewisville location allows Sager to scale the business to support the strong growth we continue to experience while further enhancing our custom solutions and distribution capabilities."

Sager Electronics' president, Frank Flynn, added: "The new building will be state-of-the-art, showcasing our strength in custom design capabilities as well as the newest technology in distribution operations. Ramping up our design and manufacturing services and distribution capabilities in this centrally-located facility will help us achieve our strategic objectives across the entire business."

www.sager.com



From power supplies to robotic vision

Allied Electronics and Automation has added Delta Electronics, KIPP, Murrplastik and OnRobot to its line card.

Delta Electronics supplies power electronics, thermal management and industrial automation solutions including switching power supplies with over 90 per cent efficiency, telecom power supplies with up to 98 per cent efficiency and photovoltaic inverters with up to 99.2 per cent efficiency.

KIPP develops products including ratchet handles, star grips, wing grips and cam levers, plus enclosure, rack and cabinet solutions, such as indexing and sprint plungers and locating pins.

Murrplastik is dedicated to injection molded cable management, control cabinet and industrial automation products. Products include: cable entry systems; drag chains and specialized conduits and fittings; universal marking and labeling solutions for single wires, control equipment, clamps, cables and conduits; and robotic dress packs for electronic wires, cables and hydraulic/pneumatic tubing with fastening, conduit and protection elements.

OnRobot solutions include: the OnRobot Eyes 2.5D vision system; palletizing and analytics software; electric, vacuum and magnetic grippers; and force/torque sensors and tools.

www.alliedelec.com

Microcontrollers optimized for sensing applications

Mouser Electronics is now stocking Microchip Technology's PIC16F18015/25/44/45 and PIC16F18126/46 families of microcontrollers. Specifically designed for applications requiring an 8-bit microcontroller to accompany a sensor design, these two families support sensor signal conditioning and real-time control functionality.

For more cost-sensitive sensor and control applications, the PIC16F18015/25/44/45 microcontrollers provide a balance of: flash memory (7 to 14kB); robust control and peripheral capabilities; and speeds up to 32MHz. Devices in this family include: up to 256 bytes of EEPROM; a 10-bit analog-to-digital converter with computation (ADCC), automated capacitive voltage

divider (CVD) techniques for advanced capacitive touch sensing; an 8-bit digital-to-analog converter (DAC) module; three PWMs with two additional capture/compare PWMs; a complementary waveform generator (CWG); and four configurable logic cells.

By contrast, PIC16F18126/46 microcontrollers are geared more toward higher-end sensor applications requiring additional digital functionality, higher resolution and precision timing. Features include: 28kB of program flash memory; a 12-bit differential ADCC; two 8-bit DACs; a 16-bit PWM peripheral; and a CWG.

www.mouser.com



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Jump-starting the US semiconductor industry

Symmetry Electronics' VP and general manager, Keenan Jeworski, explains how the recent Chip Act will benefit readers sourcing semiconductors in the future?

What benefits can buyers expect following approval of the Chip Act?

It is important to understand why the Chip Act was approved by Joe Biden. The Chip Act was passed to jump-start the US semiconductor industry and to make the US more competitive in comparison to countries like China, Taiwan, South Korea and Japan who are investing billions of dollars towards building new foundries. Today, about 75 per cent of semiconductors are manufactured in Southeast Asia. Approximately 65 per cent of the most complex semiconductors are being manufactured by one company in Taiwan, TSMC.

A benefit will be offered to US-based semiconductor companies like Intel, Texas Instruments and Micron who manufacture some of their semiconductors in the United States. Other companies that are fabless like AMD, Qualcomm and Nvidia who do not own domestic factories will receive less benefits due to them outsourcing their manufacturing to companies typically in Southeast Asia. It takes about three to five-years to build a fab. So, the actual benefit of the Chip Act to the supply chain will be years in the future. Additionally, manufacturing in the US will offer national security, allowing the US to be less reliant on other countries to build semiconductors.

Will the Act benefit the supply chain and in what way?

The semiconductor supply chain is very complex. There are hundreds of processes to build semiconductors. We all have been reading about and experiencing supply chain issues. Some of the disruptions are due to unprecedented demand for semiconductors from the wireless, IoT, automotive, industrial, military and medical markets. This has put a strain on finding qualified people and raw materials, along with logistics. This has also caused semiconductor prices to increase. The Chip Act will create jobs for companies designing and building fabs. Additional fabs will mean more opportunities for equipment companies to furnish them. All these benefits will not go into effect until the fabs are built and delivering more semiconductors.

What are the key trends of the last 12-months and how have they helped boost client relationships?

The last 12-months have been extremely busy for Symmetry, our suppliers and customers. We have been forward investing in additional people and inventory. Our on-hand inventory has doubled in the last 12-months. Symmetry is on a run rate this year to double the size of our company in three years. Our customers and suppliers appreciate our focus on

the wireless, sensor and antenna markets. They also value our ability to provide technical support, and of course being a stocking distributor. We have been successful in offering solutions to our customers who have been experiencing supply chain disruptions caused by some of their other distribution partners.

We are also continuing to grow our customer base through our investments in people and inventory. Customers are able to find hard-to-find parts on our website. In the last few months, we have seen parts with long lead times decrease for some suppliers. This is great news for our customers. We are striving to provide our customers with superior service and support during these challenging times.

www.symmetryelectronics.com



Symmetry Electronics' VP and general manager, Keenan Jeworski



Manufacturing in the US will offer national security, allowing the US to be less reliant on other countries



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Dove's Sales & Product Teams at their New York Headquarters

Reliable supply during uncertain times

Specialist Distributor Dove Electronic Components gives a market update on crystals & oscillators

The electronics purchasing community is still

struggling to come to terms with 'supply chain issues'. Price increases, allocation, super extended lead-times, EoLs, have all become part of the daily vocabulary. These

past two-years have been so unprecedented that the industry continues to ask how much longer this will continue and when will there be light at the end of the tunnel.

Dove Electronic Components is starting to see some improvements within the crystal and oscillator market. Perhaps not as quickly as would be liked but nonetheless a small glimmer

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of light is peaking through. Average lead times have come down slightly to 20 to 32-weeks. However, depending on IC and frequency, there are still parts continuing to run at longer lead times of 32 to 52-weeks.

Another improvement starting to be seen is some suppliers' taking parts off allocation. Dove anticipates further improvement in lead times between now and the first quarter of 2023. Higher frequency oscillators, along with certain MEMS oscillators, are still showing very long lead times and will probably continue to do so into 2023. Part of the problem with these lengthy lead times is that industry is still facing an overwhelming shortage of raw materials along with the popularity of many legacy crystal and oscillator packages—notably the 5 by 7mm package.

Of course, other factors have also led to, and continue to at times, cause disruptions to the supply chain. Examples include: geopolitical uncertainty; extreme weather events causing a factory to suddenly close; China's zero Covid policy in which parts of the country go in and out of lockdown; and the increase in labor and transportation costs. Due to some of these factors, plus the increase in raw materials costs, buyers are facing higher prices. However, customer demand is still steady as more industries are increasing their usage of chips for various applications. Dove is still seeing many customers continuing to place allocation orders simply to procure parts because of the long lead times.

Dove Electronic values the importance of communication in order to provide superior customer service and satisfaction. Part of the way in which the company achieves this is through its sales and product teams working very closely together. They are in constant contact with suppliers and with each other to provide the most accurate delivery and product updates to customers.

Early on in this incredible cycle, Dove's sales team made the decision to 'tell
Continues on page 12>



No Distributor Matches Dove's Offering of Authorized Frequency Control Suppliers

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Average lead times have come down slightly to 20 to 32-weeks

it like it is' to customers as bad as it may sound. This transparency has served the company well. Steady 'checking-in' with suppliers by the sales and product departments has made the difference in many cases. Once an update is received, good or bad, it is passed on to the customer to keep them informed.

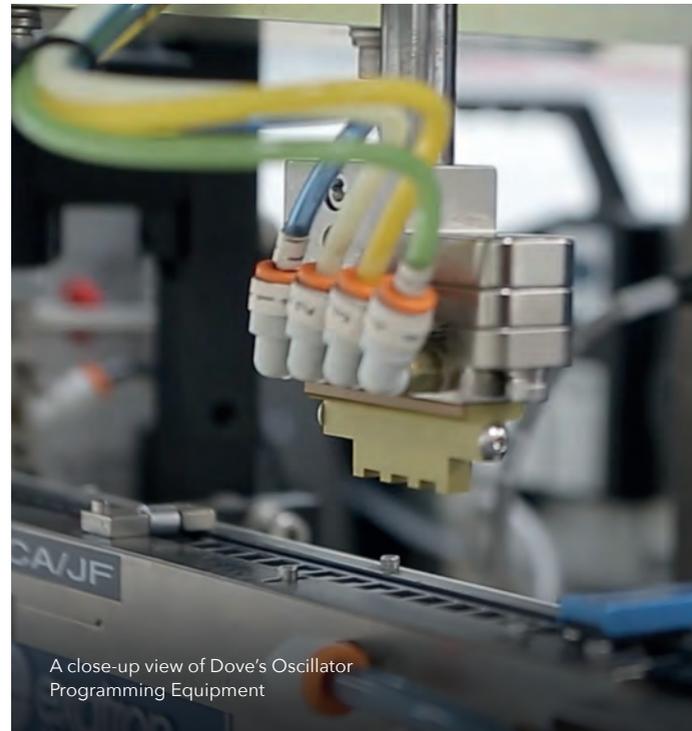
Historically for Dove, EoL notices for frequency control products were few and far between. Now they are a daily occurrence. The product team promptly notifies the sales team which informs users of the affected products. Suppliers often suggest a replacement that is proposed to the customer. Dove has this information ready to go when contacting the customer with the EoL notice.

Dove is fortunate to have its own in-house oscillator programming center which lets it configure the package and frequency a customer

needs. The company can even ship same-day, provided the un-programmed oscillator blank is in stock. Lead time on these blanks has been steady at 20-weeks. The programming department has seen a dramatic increase in orders during the super demand cycle these past two years.

Regarding new products, some suppliers put new product rollouts on hold, which is understandable. Some continued to roll out new products, particularly those that could satisfy multiple applications with one device in this challenging environment. An example is multi-voltage oscillators, where one device can satisfy three different popular supply voltages. Many suppliers have plans to resume and continue rolling out new timing products in 2023

www.doveonline.com



A close-up view of Dove's Oscillator Programming Equipment



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ALSO FEATURED ON PAGE 30 - The Perleno X2's hybrid combination of MPU and MCU offers developers unprecedented flexibility

ALSO FEATURED ON PAGE 20 - conduction cooled power

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Demand outgrows production capacity

Rutronik Electronics' VP product marketing, Thomas Ulinski, takes a deep dive into the ups and downs of power semiconductor supply and what this means for buyers

The term 'chip shortage' is on everyone's mind and the impact of delivery constraints has even reached the mainstream media. With some components, deliveries have kept up and the situation is starting to relax. However, for power semiconductors in particular, the market is still very hot.

Since the fall of 2021, delivery times for power semiconductors have increased dramatically. Lead times are currently between 26 and 104-weeks—an average increase of an additional 52-weeks. To keep up with demand, many manufacturers started investing in additional production capacities. However, long delivery times for production equipment obstructed those efforts. This is especially true for wafer fab production, where in addition to the complex equipment needed, construction of facilities for clean rooms etc, are compounding the production starts for new capacities.

In the past, manufacturers could decide between internal funding of additional production capacity or going to third party wafer foundries. Since the 2008 market downturn, where probably all manufacturers went through production idle times, we saw a movement

towards the latter. This is intensifying shortages, with many manufacturers looking to third party foundries for supply.

On the demand side, requirements for power semiconductors are driven by the electrification of transportation, 5G networking, renewable energy etc. In addition, Covid lockdowns created an unanticipated demand for laptops, video conferencing cameras etc, which compounded overall semiconductor demand.

On the supply side unexpected events such as mandated covid lockdowns, allocation of energy resources, weather events and transportation constraints conspired to further squeeze supply. This is likely to continue for the foreseeable future.

As with any economic scenario, when demand is high and supply is tight, prices begin to rise. Coupled with the higher cost of energy, transportation, raw materials etc, manufacturing margins are squeezed. Recent year-on-year inflation has made this even more impactful. Even if the market seems to be softening, with current drivers of power semiconductor demand, Rutronik

anticipates current market conditions will continue.

What does this mean for buyers? How can companies best plan and manage their strategies through these events? Clearly the end goal is a stable component supply chain at reasonable prices. How can this be achieved?

Rutronik believes the current situation for power semiconductors will continue through at least the midterm planning horizon. This is especially true for Mosfet transistors of all sorts and will remain a significant challenge. As a result, the company is working with customers and suppliers to help with the planning decisions needed to successfully navigate this environment. Some of those decisions may include: alternative engineering solutions; demand forecast management and logistics planning that cover demand beyond 12-months; inventory and safety stock of critical components; and more.

All players in the supply chain—from OEMs and EMS, to distribution and component manufacturers—need to be partners in these planning efforts. Communication is the key.

www.rutronik.com



Rutronik Electronics' vice president product marketing, **Thomas Ulinski**



This is intensifying shortages, with many manufacturers looking to third party foundries for supply



Distributors do a reset as industry contemplates possible downturn

Distributors continue to invest in new warehouses and automation systems even as they respond to growing signs of a general economic weakness

Mouser Electronics Inc. in August announced plans to increase its warehouse facilities by nearly one-third, adding to investments in automation made earlier this year, and placing the company on a good footing to address customer needs in a market that analysts believe may double by the end of the decade.

It is not alone. Also in August, Digi-Key Corp. opened an extension of its product distribution center, adding a massive 2.2 million square feet of warehouse space to its existing facilities and bringing the total to more than 3 million square feet. The new facility jacked up the number of packages Digi-Key can ship daily to nearly 80,000 units from 27,000 previously, according to president and COO Dave Doherty.

Across the industry, component distributors are racing to support a rapidly expanding customer base even while casting a wary eye over the weakening global economy. Demand for the services offered by distributors jumped strongly in the last two years, fueled partly by the Covid-19 driven shortages but also due to swiftly changing OEM needs for critical procurement functions and assistance supporting a market that is racing ahead of the manufacturing and crisis management capabilities of parts suppliers.

Component distribution warehouses have evolved dramatically since the beginning of the millennium and the latest of them look nothing like the stockkeeping sites companies like Arrow, Avnet, Digi-Key, Future Electronics and Mouser used to operate. An expanded physical space remains essential, but even more important to these companies today are the varied services offered within the warehouse and the efficiency with which stocks are received, processed and shipped out to customers.

Automation is now a key component of the modern distribution warehouse, according to executives at Mouser. The company's planned warehouse expansion outside Dallas-Forth Worth will be housed in a three-story building and fitted with the latest automation equipment like the systems it added earlier this year at the same location. Mouser said it installed 120 vertical lift modules and an "automated extractor to bring the components to the employee's workstation," helping to reduce "an employee's walking time by 45% or more. The new facility will be linked to the existing structure via a skybridge connector enabling the two to support about one million SKUs and products from an expanding pool of suppliers.

"The new facility jacked up the number of packages Digi-Key can ship daily to nearly 80,000 units from 27,000 previously"



Dave Doherty, president and COO, Digi-Key

"With a larger warehouse space and continuing investment into automation and staffing, Mouser is preparing for the future while ensuring the highest levels of customer service today," said Pete Shopp, head of business operations at Mouser, in a statement announcing the decision to expand the warehouse. "The tools and systems we've put in place offer another way we can help shorten our customers' time to market."

Industry executives said investments like these are being made today because demand for distribution services is expected to remain strong for the foreseeable future and because of the strong penetration electronics

are making into all segments of the economy. Although many of the largest OEMs are striking sourcing agreements directly with suppliers, distributors said this would neither hurt nor halt their investment plans because demand for electronics will remain strong from the thousands of other players who lack the volume and financial muscle to purchase components from chipmakers and other part suppliers.

As a result, they expect investments in automation, back-end services such as export controls, kitting and shipping to pay off. Still, the market that distributors started planning for two years ago when the industry was in the grip of acute shortages is not



exactly what is playing out now. Demand is more mixed today with signs of a general global economic weakness coupled with slowdown in certain electronic sectors mingled with strength in others.

Inventories are generally higher across the industry, which would have been great news months ago during the toughest period of the component shortages. Today, though, distributors are getting grilled by financial analysts who see elevated component stocks as dangerous in a weakening environment. Avnet Inc. CEO Phil Gallagher, for example, was taken to task about the company's swollen inventory when it announced fiscal 2022 fourth quarter results in August.

Avnet said it was expecting sales for the September quarter to be flat or up less than 2%, which analyst Jim Suva with Citigroup noted did not quite rhyme with the company's "materially higher"—year-over-year and quarter-over-quarter — inventory level. Was Avnet "holding wrong inventory or it's in the wrong place and then it's going to hurt you," Suva asked, following up on a question from fellow analyst Toshiya Hari with Goldman Sachs.

Inventories also rose at OEMs and at contract manufacturers,

noted another analyst, which could further hurt visibility into actual consumption across the industry, a potential headache for distributors. The implication is that the higher inventory could be the early signs of a drop in demand even as OEM and EMS order backlog begin to decline.

"We are doing the best we can to make sure that we're validating the demand," said Avnet's Gallagher. "We track our cancellations, and our [order] push outs. We are not seeing an increase of any significance, maybe slightly in some cancellations and in some push outs. That is surprising to many, but we're not seeing that backlog disappear. We have to work with our end customers to help them too. If they can't take the product right now, how do we help them with that?"

Mixed Signals

Distribution executives do not seem that worried about current market conditions because historical patterns favor them when the industry is sliding from a strong growth into a recession. The sector is typically the last to experience the effects of a weakening market but conversely also the last to begin to benefit from an upturn. In this case, though, the signs of a market downturn are still quite tentative. While the



"Mouser is preparing for the future while ensuring the highest levels of customer service today"

Pete Shopp, head of business operations, **Mouser Electronics**

PC and consumer electronics sectors have emerged as the immediate trouble spots, other segments are holding steady, according to industry observers.

The data and communications market, for instance, remains strong. Demand from the automotive industry also appears to be positive with OEMs laboring to catch up with orders recorded up to two years ago. In addition, demand for electronic vehicles remains strong, helping to offset weakness elsewhere. Although inventory levels are rising, different segments of the electronics industry are sending mixed demand signals, hence the caution from distribution executives about taking a position based on current market performance.

Average selling prices, for example, have remained strong and are still increasing in some markets with no signs of a sharp decline in any sector. The pricing condition also remains fluid partly because the cost of components being delivered today were negotiated months ago and at the height of the inventory shortages. Suppliers were cautious in negotiating terms of future deliveries since the beginning of the year when they agreed to expand manufacturing capacities at the

urging of OEMs, many of which prepaid for components at chipmakers or with foundries.

"There's still price increases," said Avnet's Gallagher, in response to persistent questions from analysts about the inventory situation and pricing conditions. "This is what is strange about what is happening. You just called out inventory days going up and these different mixed signals in the marketplace. Yet, we have north of 25 suppliers elevating prices in the last 30 to 45 days and some talk about more."

Indeed, it will take a while to determine the true direction of the market.



"We are doing the best we can to make sure that we're validating the demand"

Phil Gallagher, CEO, **Avnet**



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Engineered solutions: attractive, affordable, advantageous

Sager Power Systems' director of business development, Rich Arieta, explains how engineered solutions help customers get to market faster and more cost effectively

Purchasing agents of yesterday have given way to a new breed of specialists. Today's professionals are more involved in the procurement process and have better product knowledge, greater evaluation/risk assessment capabilities and more influence on component selection. This experience is beneficial when sourcing more complex products such as power supplies, batteries and thermal management solutions, especially when a standard, off-the-shelf product isn't easily available or doesn't meet design requirements.

What is an engineered solution?

From simple product modifications to more complex designs—assemblies, connectorization or configurable products etc—an engineered solution uses modified standard parts to provide a cost-effective product. Engineered solutions are tailored to fit an application's specific requirements, all with faster time-to-market

and higher reliability than a typical custom build.

Why choose an engineered solution?

Amongst the advantages of this approach, customers are guided through the engineering process, leveraging technical expertise, inventory position, BoM management, lower acquisition costs, quick-turn assembly and testing services. For example, a power supply or fan assembly BoM may be 100 to 200 line items, inventory that a procurement team must manage while engineering handles assembly and testing in-house. By opting for an engineered solution, inventory management, product assembly and testing is done by the partner, with the customer receiving a certified, tested, finished product, in one line item.

Where to source an engineered solution?

Some distributors provide solutions beyond traditionally defined value-add services. For maximum advantage, the distributor should be a one-stop shop comprised of engineering experts offering standard parts and modification capabilities. By working with an authorized

distributor structured to support engineering and purchasing, customers can capitalize on services, technical knowledge and a deep breadth of products.

Sager Electronics provides engineering expertise across power, battery and thermal technologies, plus rapid time-to-market, all at a better price point than purchasing in bulk or tapping into various areas of knowledge to complete a project. With a dedicated team of technical specialists, Sager reviews specifications before presenting unbiased options, ensuring customers the most efficient and safest solution. In addition to design services, Sager can support application requirements with its robust inventory of interconnect, power, electromechanical and thermal solutions, plus supply chain services such as vendor-managed and bonded inventory.

Sager currently supports its power, battery and thermal custom and engineered solutions from two centers in Texas and Illinois. A new 175,000ft² facility, opening later this year, will bring all these capabilities into one building, offering complete design, manufacturing and testing services in support of its power, battery and thermal



Sager Power Systems' director of business development, Rich Arieta

business, while expanding into sensors, circuit breakers, relays, solenoids and switches. The new Lewisville, Texas center is designed to provide greater opportunities for procurement teams to reduce workloads, reduce costs and access technical support.

Engineered solutions offer benefits including price, performance and quality, making them an attractive, affordable and advantageous solution.

valueadd.sager.com

Faster charging, less heat

Innoscence Technology has announced the Bi-GaN series of bi-directional GaN HEMT devices designed to save space and facilitate fast charging without suffering from reliability-limiting and potentially dangerous rises in temperature.

The company also revealed that consumer electronics and mobile communications company, OPPO, is using the new BiGaN

devices inside its phone handset to control the battery's charging and discharging currents. This is the first time that such protection, based on GaN technology, has been included in the phone itself—previously the circuitry had to be incorporated in the charger.

The first BiGaN device generally released by Innoscence is the INN040W0488, a 40V bi-directional GaN-on-silicon HEMT in the WLCSP

package measuring 2.1 by 2.1mm. The chip supports bi-directional switching with on-state resistance as low as 4.8mΩ. BiGaN targets applications such as overvoltage protection circuits for smartphone charging, high-side load switching circuits and switching circuits for multi-power systems.

www.innoscence.com



Focus on power density

Traco Power has announced its TMR12WI series of 12W DC/DC converters featuring a power density of 4.73W/cm³ in a standard SIP-8 package.

The series comprises 24 models offering 4:1 input ranges of 4.5~18, 9~36 and 18~75VDC. Output voltages are 3.3, 5, 12, 15, 24, ±5, ±12 and ±15V. Key features include: SIP-8 metal casing; efficiency up to 90 per cent; -40 to 85°C operating temperature range; remote on/off; and indefinite short circuit protection

Additional features include: 1600VDC isolation, and reliability calculated to be 960,000 hours per MIL-HDBK-217F ground benign. All models are safety approved to IEC/EN/UL 62368-1 and supported by Traco Power's three-year warranty. Traco states the converters' high density make them an ideal solution for space critical applications in communication equipment, instrumentation and industrial electronics.

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Solving military battery weight and supply chain issues

Ultralife Corporation's marketing executive, Robert Brown, discusses how the company's involvement in the US Army Land Warrior Program helped to tackle battery issues

Fifty years ago, military personnel had few electronic devices at their disposal, so did not need to acquire or carry many batteries. In the years since, as the number of devices grew, so did the number of batteries needed to power them, which started to impact the supply chain and the weight a soldier must carry.

Power is one of the most important considerations for soldiers on the modern battlefield, with the demand for portable power growing exponentially over the last half century. In the 1970s, soldiers had few items requiring batteries, usually equating to one short range radio and one night vision scope shared between the entire squadron. As mass-production

of military devices ramped up and affordability improved, individual soldiers were given their own radios and scopes, along with electronic sights, laptop computers, communications gear and rangefinders, plus a range of batteries to power them.

Equipped with this wealth of technology, soldiers on deployment aimed to be self-sustaining for up to 72-hours. However, to achieve this, power demands were huge. As an example, the PRC-154 Rifleman radio has a battery life of seven hours and each battery weighs 0.8lb (0.36kg). So, a 72-hour mission requires 8.8lb (3.99kg) of batteries just for that one radio. Considering all the other equipment, soldiers are carrying around 15 to 20lbs (6.80 to

9.07kg) of batteries just for one mission.

It is not just battery weight that poses a challenge. A 2013 report suggested that 'in a typical 72-hour mission in Afghanistan, US soldiers carry seven types of batteries'. Resupplying this number of batteries effectively is a logistical nightmare, especially for fragile military infrastructures. Therefore, the weight issue, combined with the supply chain issue, is why Ultralife participated in the Land Warrior program.

Although this program sought to modernize military kits in general, Ultralife's focus was on battery technology and how to address these issues. The solution was that, instead of

each military device needing its own power supply, one or two batteries could be used to power them all. To achieve this, a soldier power manager (SPM) is used to connect all the devices to the shared batteries and distribute power as and where it is needed. As less batteries are required, this eases the burden on the supply chain, but it also addresses the weight problem. The lightest of these aptly named Land Warrior batteries weighs just 1.15lb (525g) and the heaviest weighs 2.25lb (1.02kg); meaning that even two batteries together weigh at most 4.5lb (2.04kg).



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Now that prime contractors, distributors and end users are purchasing less batteries, they need to guarantee that the ones they choose are reliable, safe and high performance. Land Warrior batteries have been used in many current and future military programs because they have these qualities by design. For example, when it comes to reliability, SMBus or SBS compliant fuel gauges provide accurate state-of-charge information to the user, keeping them aware of how much power they have left. For safety, all six hip-mountable batteries contain SMART CIRCUIT

electronics to provide protection against over-or-under voltage, temperature fluctuations and short circuiting. Finally, the batteries have a high performance to weight ratio, boasting gravimetric energy densities of up to 206Wh/kg.

However, it is important to consider ergonomics that go beyond weight. Although most batteries in the Land Warrior range are placed on the hip, in the traditional manner, one battery was designed to be placed over the chest armor to distribute weight across the soldier and contour to the shape

of the body. This is a more comfortable prospect than a straight-edged battery pack and means that valuable space is freed up on the hip, which can be used to store critical equipment, such as handheld communication devices.

It is incredible to see how far military devices and their power requirements have developed over the last 50-years. Plus, advances in military technology show no sign of slowing down, which means that an increasing number of military devices are being manufactured and batteries must evolve to serve these ever-changing needs. I

doubt we have seen the end of programs like US Land Warrior.

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Equipped with this wealth of technology, soldiers on deployment aimed to be self-sustaining for up to 72-hours



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Digi-Key Expands Product Distribution Center to Continue Delivering Excellence Globally

By **Chris Lauer**, vice president, order fulfillment at **Digi-Key Electronics**



Chris Lauer, vice president, order fulfillment at **Digi-Key Electronics**

After five years of planning and building, we're proud to announce that in August we celebrated the ribbon cutting of our new, state-of-the-art Product Distribution Center expansion (PDCe) in Thief River Falls, Minnesota, by cutting tape from an official Digi-Reel. At 2.2 million square feet, Digi-Key's new PDCe is one of the 10 largest warehouses

in North America, combining with Digi-Key's existing headquarters to provide a total of 3 million square feet.

It's an important milestone for Digi-Key and our community, suppliers and customers. The new facility will help us continue to deliver excellence to our customers for many years to come, allowing us to pick, pack and ship nearly three times the previous daily average of 27,000 packages to customers in more than 180 countries around the world. As exciting as this expansion is for us, our hope is that our customers truly don't notice a difference – the transition for customers should be seamless and provide an even better customer service experience.

The opening of the facility comes at a time of record growth. In 2021, Digi-Key grew faster than ever with a 65% sales increase, and orders in 2022 are up more than 25% over last year. Supplier additions increased markedly as

well, with 250 suppliers already added this year.

The new facility is nearly fully automated; the only task that is truly done by hand is the actual physical picking of parts. Digi-Key has developed many proprietary systems to aid in ensuring our customers get the right part in the right quantity every time. The largest component of our newly automated system is the KNAPP Order, Storage and Retrieval (OSR) which provides the right parts to the picker every time, eliminating walk time and providing an ergonomically appropriate environment for the person doing the picking. This high level of automation improves efficiency by up to 35% for picking and improves packaging quality and efficiency.

The PDCe features two primary sorting systems to provide redundancy in the case of a breakdown and to enable future growth. Creating a team-friendly work environment while

also planning for scalability and growth were top of mind in the plans and design of the new building. There are over 27 miles of automated conveyor belt in the new facility, and an average order will travel more than 3,200 feet inside the building.

Sustainability was also considered during the planning and construction of the facility. The roof's white membrane reflects the sun's heat, sensor-activated LED lights minimize electricity usage and a specially designed conveying system maximizes energy usage and efficiency.

We thank our customers, suppliers and carrier partners for supporting Digi-Key's growth and expansion. We couldn't have done it without you, and we look forward to continuing to serve you as we fuel innovation around the globe with the highest levels of service and support you've come to trust during the last 50 years. Cheers to the next 50 years and beyond!





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Changing face and place of healthcare sensors

Brian Wellhouse, TTI supplier marketing manager, explores the concepts of healthcare internet of things (HIoT) and telemedicine, explaining how sensor technology lies at the heart of these changes

Medical sensor technology has already undergone significant changes. Devices today can accurately sense temperature, pressure, vibration, sound level, light intensity, load/weight, flow rate of gases and liquids, amplitude of magnetic and electronic fields, plus concentrations of many substances in gaseous, liquid or solid form. The data collected, analyzed and optimized is nothing short of amazing.

This new frontier of healthcare sensors is not only changing what can be done with data but also where it can be done—location of care—diverting away from traditional, critical care places like hospitals into homes where users can monitor and control their lives with greater freedom, ease and comfort: the benefits of telemedicine.

In larger, more formal settings such as hospitals where intense, life-and-death procedures and decisions are made on an hourly basis, the highest demands of sensor speed, accuracy and dependability are required, while also meeting FDA and other industry requirements for safety and reliability.

Hospitals have been the traditional places where vital sign monitoring tools, medical pump equipment, respiratory devices and minimally invasive technologies are used. With the extreme advances in sensor technology and the progress of HIoT capabilities, sensors are taking center stage in the connected healthcare ecosystem.

In the near future, sensors will be used everywhere from the air monitor system, which detects and reports any visitor who might transmit an airborne infection to a patient, to the table used in operating rooms, the gurney and the hospital bed—which will be the same piece of equipment that is wheeled around by robots.

As healthcare becomes more manageable and sensors develop greater functions, care will be moving away from hospitals to patients' homes. Sensors used here will be digital, wearable, simple software driven, low-battery powered and low current.

Imagine cardiovascular patients having their blood pressure and heart rate measured regularly at home and the data fed back to

cardiologists so they can better track patient care. Doctors can far more easily track everything from respiration rate, cardiac output, oxygen and carbon dioxide levels in the blood and body temperature.

In the future, healthcare from home will be commonplace as interactive video conferencing, educational programs and a broad range of sensors will provide healthcare at a distance, revolutionizing medical care and streamlining costs by reducing hospital readmission rates.

Sensor technology today is in its commercialization and optimization phase, and there are a lot of challenges for designers and manufacturers with greater demands for miniaturization, ruggedness, signal quality and more.

The sky is the limit for healthcare sensor technology—for both critical care in hospitals and telemedicine at home—as these connected medical applications help reduce costs, manage patient conditions, improve outcomes and enhance patient experiences.

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TTI supplier marketing manager, **Brian Wellhouse**



The data collected, analyzed and optimized is nothing short of amazing

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INVESTING IN TALENT IN THE SHORT TERM AND FOR THE LONG GAME

Few businesses have been unaffected by the recent chip shortage in the semiconductor industry. Supply of this essential technology remains unstable, but an even larger scarcity is looming – a shrinking workforce.

Competition for talent is intense, but the United States and manufacturers planning on expanding domestic semiconductor production are devising creative ways to close the gap. The solution they are pursuing is to invest in programs now to pave the way to the future.

How We Got Here and Where We Are Going

In the 1960s the U.S. semiconductor industry used fiscal spending and contracts from the Department of Defense (DoD) to build up the industry and enforce communication between firms. This enabled technology sharing and rapid, cost-effective innovation, but the industry quickly grew beyond the point of government regulation.

During the 1970s, DoD contracts and communication enforcement plummeted. The integration of technology on a global scale buoyed the semiconductor enterprise, but these changes facilitated a transformation in the industry.

Champion and asset-light design firms took over the landscape. Global competition increased and the U.S. focused on design over production. Fabless firms, which concentrate on design and sale while outsourcing fabrication to semiconductor foundries, were born, and supply chains became further dedicated to more well-funded companies.

Today, U.S. market share of electronic component production has dropped to 12%. However, expansion plans from some of the biggest names in semiconductors, plus changes in U.S. policy, are shifting the tides yet again.

While these developments are promising, questions remain about acquiring staff. Reports from talent management company Eightfold.ai project that the U.S. semiconductor

industry needs 70,000 - 90,000 new workers by 2025 to satisfy only the most critical workforce needs.

The competition from companies in the U.S. and abroad makes finding trained individuals daunting. The question is, how does the U.S. expand the candidate pool to fit the industry's needs?

How to Invest in the Future Workforce

On August 9th, 2022 President Biden signed the CHIPS and Science Act into law, allocating \$52.7B in federal subsidies to domestic chip manufacturing, with funds earmarked to grow the industry's workforce. High level incentives include:

- \$39B for manufacturing
- \$13.2B for R&D and workforce development
- \$10B to create regional innovation and technology hubs

To support the growth of science, technology, engineering and mathematics (STEM) jobs the U.S., National Science Foundation has pledged \$50MM to develop learning opportunities. Intel has also joined with universities and community colleges to devote around \$100MM over the next 10 years for STEM programs.

If companies hope to encourage students to pursue a career in the industry and work for them over the competition, they should invest in training programs, and where possible, allocate charitable giving to education programs.

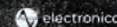
Bridging the Talent Gap

There are no quick-fix solutions to the semiconductor and manufacturing workforce shortage. It will take a significant investment of time, money and patience to bridge the gap between demand and personnel availability. If the U.S. hopes to reinvigorate the industry, the government and manufacturing companies will need to work together to build a strong future.

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2023 semiconductor outlook is complex; simultaneously promising and daunting

Governments are playing a bigger role in the evolution of the semiconductor as concerns about national security trump profit concerns

The semiconductor market has never been truly apolitical but anyone who has any doubts about politicians' growing interest in the world of chips should jettison the erroneous sentiment now. Politicians in developed economies all over the globe want a say in and are demonstrating an unusual willingness to influence the industry.

In the name of military and infrastructure security, national economic interests, and availability of supplies, political leaders are flexing their muscles to impact how and where chipmakers design semiconductors and who is allowed to buy high-value electronic components. In short, political players want to control the semiconductor design and supply chain to shape the ecosystem in their own interests and weaponize it for the achievement of national goals.

"Semiconductors power everyday lives — smartphones, cars, washing machines, hospital equipment, the Internet, electric grid, and so much more, including our national security," said U.S. president Joe Biden on September 9, at the groundbreaking ceremony for Intel's planned \$20 billion chip factory in Ohio. "America invented this chip. It powered NASA's

Moon mission. Federal investment helped bring down the cost of making these chips, creating a market and an entire industry. Unfortunately, we produce zero of these advanced chips in America. China is trying to move way ahead of us in manufacturing them. It's no wonder that the Chinese Communist Party actively lobbied U.S. business against [the Chips Act] law."

The high level of interest in the semiconductor market from forces outside the industry has enormous implications for the investment and management decisions made by everyone in the industry, ranging from design engineers to C-level executives, other managers, forecasters, analysts and investors to even the ordinary electronics equipment buyer interested in just simply enjoying technology devices such as Apple Inc.'s new iPhone 14, according to observers. Investment decisions in the U.S. and Europe, too, have come under the control, guidance and sponsorship of non-industry actors, they said.

"Amid heightened geopolitical tensions and growing challenges posed by disruptive innovation, European policymakers are seeking ways to strengthen

the continent's strategic autonomy particularly with respect to technology," said Paul Timmers of the Brookings Institute, in a recent report. "A key part of this effort is the EU Chips Act, which provides billions in financial support to set up factories for advanced chip production (so-called 'fabs') and step up semiconductor research in the EU. Just as U.S. policymakers are attempting to strengthen the American semiconductor

industry via the CHIPS and Science Act, lawmakers in Europe are attempting to build a more independent technology industry."

The immediate consequences of the intense politicization of the semiconductor market are noticeable in the cautious market outlook of prognosticators who are getting increasingly confounded by the glut of ambiguous information about the direction of the

Semiconductor revenue forecast, worldwide, 2021-2023

	2021	2022	2023
Revenue	594,952	639,218	623,087
Growth (%)	26.3	7.4	-2.5

(Millions of U.S. Dollars)
Source: Gartner (July 2022)



industry. For example, the forecasts for the second half of 2022 and 2023 vary widely as analysts struggle to understand the implications of a recent flurry of governmental rules, regulations, sanctions and sales prohibitions on certain regions and products.

Industry forecaster, Gartner Inc., for example is expecting the industry to grow 7.4 per cent in 2022, a sharp reduction in its earlier forecast for an increase of 13.6 per cent, representing a downward revision of \$36.7 billion in just a few months. The research firm attributed the lowering of its projection to the weakening global economy even as it acknowledged the impact of extraneous factors such as taxes, interest rates, higher energy and fuel costs controlled by regulators, governments and other private enterprises.

“Although chip shortages are abating, the global semiconductor market is entering a period of weakness, which will persist through 2023 when semiconductor revenue is projected to decline 2.5%,” said Richard Gordon, practice VP at Gartner, in a statement. “We are already seeing weakness in semiconductor end markets, especially those exposed to consumer spending. This is affecting spending on electronic products such as PCs and smartphones.”

Other forecasters are also cutting their once bullish projections for semiconductor sales. The World Semiconductor Trade Statistics (WSTS), for example, is standing by its forecast for a double-digit sales expansion for 2022, although it trimmed the numbers in mid-August to an increase of 13.9 per cent – to \$633 billion – from its earlier growth projection of 16.3 per cent for the year. It now expects 2023

sales to be up a modest 4.6 per cent, versus the earlier forecast for an increase of 5.1 per cent made only two months earlier.

Sanctions

But even the updated numbers may be revised before the end of the year because of several factors, including economic pressures and amid signs the U.S. government may be about to add to sanctions on China. Recent reports indicate the current U.S. administration plans to impose further sanctions on China, adding to steps previously taken to curb the export of leading-edge semiconductor manufacturing equipment to the Communist country by manufacturers such as ASML, the sole producer of extreme ultraviolet lithography machines. Even the distribution of funds from the Chips Act would be tightly monitored to ensure China does not benefit from the program, U.S. president Biden said at the Ohio event.

“We are going to make sure that companies that take taxpayers’ dollars don’t turn around and make investments in China to undermine our supply chain and national security. You know, we have the power to take back any federal funding if companies don’t meet these requirements,” he said. “This is about our economic security. It’s about our national security.”

Whatever politicians have to say and what they do about technology innovations, its funding and usage do not only impact the decisions executives make, but they also render forecasts less useful to planners. As a result, managers feel compelled to explore unorthodox means of determining not just the actual demand for their products but also who they could sell to and

whether they would be able to deliver components to assemblers in sensitive countries like China and Russia, analysts said.

The sanctions on China by the U.S. government will have implications for most of the industry’s top players, not just those based in America but also any company whose products incorporate American technologies. These include chip equipment manufacturers like the Netherlands’ ASML and competitors such as Applied Materials and Lam Research. Other semiconductor suppliers have been caught in the dragnet of U.S. sanctions, including Advanced Micro Devices and Nvidia, both of which recently said the government had imposed licensing restrictions on the devices they sell to Chinese and Russian companies. Nvidia disclosed in a Securities and Exchange Commission filing that the restrictions would primarily impact its AI chips.

“On August 26, 2022, the U.S. government, or USG, informed Nvidia that [it] has imposed a new license requirement, effective immediately, for any future export to China (including Hong Kong) and Russia of the Company’s A100 and forthcoming H100 integrated circuits,” Nvidia said, in the regulatory filing. “DGX or any other systems which incorporate A100 or H100 integrated circuits and the A100X are also covered by the new license requirement. The licensing requirement also includes any future NVIDIA integrated circuit achieving both peak performance and chip-to-chip I/O performance equal to or greater than thresholds that are roughly equivalent to the A100, as well as any system that includes those circuits. A license is required to export technology to



US president
Joe Biden

support or develop covered products. The USG indicated that the new license requirement will address the risk that the covered products may be used in, or diverted to, a ‘military end use’ or ‘military end user’ in China and Russia.”

What are the effects of this move on Nvidia? The company said its exposure is limited to about \$400 million in “potential sales to China” but noted that “the new license requirement may impact the company’s ability to complete its development of H100 in a timely manner or support existing customers of A100 and may require the Company to transition certain operations out of China.”



Authorized distributor



Semiconductors' about-face



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

John Denslinger explains most boardrooms see growing geo-political turmoil as too risky for status quo: hence, the need for an about-face regarding semiconductor manufacturing

If you believe recent editorials and opinion pieces, the decades long migration of semiconductor manufacturing eastward is about to come to an end. Until now, it was a model of efficiency where companies designed stateside, utilized fabs in Taiwan, then assembled in low-cost Asian countries like China, Indonesia and the Philippines. Even national security concerns and IP theft weren't considered significant enough deterrents to outweigh the benefits of this optimized supply model.

That system worked well until circumstances changed in July 2018 when a series of tariffs were levied at China. Escalation and retaliation that followed still continue to this day. Supply lines built on globalism held together, but barely. Questions of long-term viability set off alarms that rippled across the globe. Then Covid hit. With it came additional problems: raw material delays, labor shortages, factory shutdowns, shipping bottlenecks and flow disconnects everywhere. Deliveries extended to record lengths just as consumer demand skyrocketed.

Perhaps the situation would have stalled there and life would have continued unchanged, but Russia's unprovoked invasion of Ukraine seriously elevated America's awareness of supply dependence for a critical component: semiconductors. The warning bell continues to ring with China's provocative military posturing towards Taiwan. With nearly 75 per cent of chip making capacity located in China, Taiwan, South Korea and Japan according to SIA, the alarm is justified. For comparison, the US has just 12 per cent of the global capacity. Most boardrooms see the growing geo-political turmoil as too risky for status quo: hence, the need for change.

Over the past several months, major domestic and foreign companies have revealed plans to build new fabs, research and manufacturing facilities in the US. This is great news for America and American workers. The cumulative industry investments mentioned likely exceed \$100B. Adding to that, Congress, to their credit, finally passed the CHIPS+ Act

authorizing \$52.7B in semiconductor investment and tax credits. It's a welcomed commitment of course, but there is no such thing as free money. An August 18th WSJ article caught the comments of Commerce Secretary Gina Raimondo admitting 'there's a lot of strings attached in the 1054-page law'. The scary comment came from the National Economic Council director endorsing 'a command-and-control-industrial strategy'.

Please, please, please, let free markets determine economic decisions about where and when to invest capital not politicians, bureaucrats, lobbyists, and central planners. Still, it's not clear yet how and when the Commerce Department will review applicants, decide which projects and companies to underwrite and grant awards under what conditions. Regulators are not known for speedy decisions, but the midterm election cycle may be enough of a catalyst to force swift rulings.

With funding seemingly underway and plant sites already negotiated, billions will be spent in the next few years to expand US capacity. While the short-term demand outlook is weakening, semiconductor sales are still projected to double by the end of this decade. The slowdown offers an opportunity to rebalance supply and demand, but it does have its negatives as well: pushouts, cancellations and inventory adjustments. Managing up and down cycles is nothing new to these technology companies.

About-face is nothing more than a 180-degree turn, but it clearly describes the current state of semiconductor thinking. Investing directly in America and America's semiconductor capacity is a real about-face! Reshoring after many years in migration mode is another enormous about-face! Congress, realizing the national security implications of relying on foreign adversaries for critical chips and then passing the CHIP+ Act with bi-partisan support, is an unbelievable about-face! Both foreign based and domestic companies are committing huge corporate sums to vastly expand America's semiconductor production capacity. That capability will power generations of new technology for years to come. This is truly a welcomed and much needed about-face for America.



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Tel. +1 646 4371013
kvogelsang@tssworldwide.com

Manufacturer	Distributor	Telephone	Website	Franchised Distributor (Y/N/A)	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											
Bel Fuse	Bel Fuse	+1 201 432 0463	belfuse.com/circuit-protection	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A
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
KYOCERA AVX	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50+	1,000+	Y
KYOCERA AVX	Digi-Key	800-344-4539	www.digikey.com	Y	N/A	N/A	\$0	N/A	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
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

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Buyers' Guide

Manufacturer	Distributor	Telephone	Website	Franchised Distributor (Y/N/A)	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
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
METCASE Enclosures	OKW Enclosures, Inc.	(800) 965-9872	www.metcaseusa.com		322	N/A	\$0	N/A	10	20	Y
New Age Enclosures	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50	1,000+	Y
OKW Gehäusesysteme GmbH	OKW Enclosures, Inc.	(800) 965-9872	www.okwenclosures.com		2,450	N/A	\$0	N/A	10	20	Y
ROLEC Gehäuse-Systeme GmbH	ROLEC Enclosures Inc	(888) 658-5774	www.rolec-usa.com		1,960	N/A	\$0	N/A	4	6	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 AVX	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50+	1,000+	Y
KYOCERA AVX	Digi-Key	800-344-4539	www.digikey.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
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
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Buyers' Guide

Manufacturer	Distributor	Telephone	Website	Franchised Distributor (Y/N/A)	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
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
Bel Magnetic Solutions	Bel Fuse	+1 858 676 9650	belfuse.com/magnetic-solutions	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A
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
Cinch Connectivity Solutions	Bel Fuse	+1 507 833 8822	+1 507 833 8822	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A
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
KYOCERA AVX	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50+	1,000+	Y
KYOCERA AVX	Digi-Key	800-344-4539	www.digikey.com	Y	N/A	N/A	\$0	N/A	50+	1,000+	Y
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
Stewart Connector	Bel Fuse	+ 1 717 235 7512	belfuse.com/stewart-connector	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A
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

Lansdale	602-438-0123	lansdale.com	Y								
Lantek Corp.	973-579-8100	www.lantekcorp.com	M	186,000	\$22M	\$0	75.00%	5	62	Y	
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
KYOCERA AVX	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50+	1,000+	Y
KYOCERA AVX	Digi-Key	800-344-4539	www.digikey.com	Y	N/A	N/A	\$0	N/A	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
Signal Transformer	Bel Fuse	+1 516 239 5777	belfuse.com/signal	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A
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
Würth	Mouser Electronics	800-346-6873	www.mouser.com	Y	934	N/A	\$0	99.00%	50	1,000+	Y

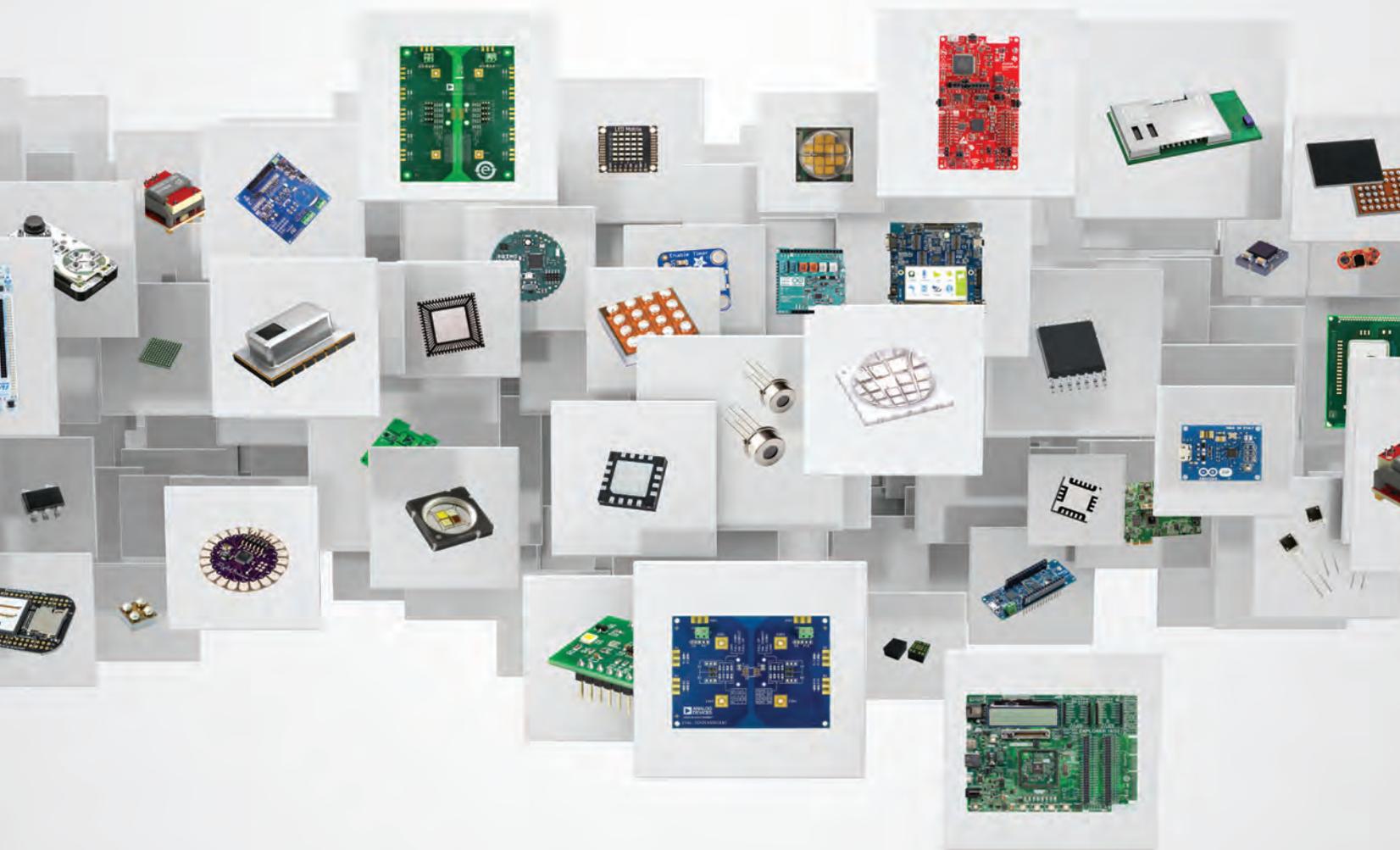
Buyers' Guide

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
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
Bel Power Solutions	Bel Fuse	Power & Batteries	belfuse.com/power-solutions	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A
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	N/A	\$0	100%	N/A	2000+	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
TRACO Power	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
KYOCERA AVX	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50+	1,000+	Y
KYOCERA AVX	Digi-Key	800-344-4539	www.digikey.com	Y	N/A	N/A	\$0	N/A	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
THERMAL MANAGEMENT											
Materials Direct	Materials Direct	+44 (0)1908 222 211	www.materials-direct.com	N/A	N/A	£1,000,000	N/A	N/A	5	55	Y
Universal Science	Universal Science	+44 (0)1908 222 211	www.universal-science.com	N/A	N/A	£1,000,000	N/A	N/A	5	55	Y
WIRELESS SOLUTIONS											
KYOCERA AVX	Mouser Electronics	800-346-6873	www.mouser.com	Y	N/A	N/A	\$0	N/A	50+	1,000+	Y
KYOCERA AVX	Digi-Key	800-344-4539	www.digikey.com	Y	N/A	N/A	\$0	N/A	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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High voltage resettable eFuse board developed in cooperation with Vishay for the safe operation of current up to 50 A at a maximum voltage of 800 V. The overcurrent threshold is adjustable and has a fast massive turn-off (~2.5 μs). Built for an optimal thermal design with passive cooling.

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- Pre-Charge Resistor **D2T035**
- Protection Diodes **1.5SMC480A**
- Linear Opto-Coupler **VOA300**
- Capacitive Energy Transfer via MLCC, **Series VJ OMD X7R**
- Opto-Coupler, **VOMA617A**
- DC/DC Converter IC **SIC464ED**
- IHLP®** Power Inductor



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