

ELECTRONICS

MARCH 2020

sourcing

NORTH AMERICA



MARCH 2020

TRADE NEGOTIATIONS: SHOW NO FEAR

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On the cover – March 2020

Trade negotiations: show no fear

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Buyers' Guide

All the facts and figures to help you buy



Now wash your hands

People laugh at my level of concern about the potential of viral pandemics to do harm. I have my reasons. One hundred and one years to the month my great uncle died of Spanish influenza. Having survived the horrors of fighting through the trenches of World War I, he wrote to his mother in November 1918 to announce his war was over and he would be heading home in February 1919 once his remaining sapper operations were complete. He never made it. He died in France of Spanish flu that same February.

As a child this story emphasized my parents rather Victorian approach that 'cleanliness is next to godliness'. I realized that no global military conflict can compare with the killing power of bacteria and viruses. It's why I get triggered by people walking out of public bathrooms without washing their hands.

Now stir in the rise in global population, plus lingering poverty, plus poor state governance, plus mass transit and I feel obliged to at least respect the potential of this bug.

As factories in China close and production facilities around the world start to reduce their output as part bins run empty, I wonder how many of those organisations' SWOT analysis paperwork included 'global pandemic' in the Threat Quadrant? Not many I bet.

Remember, if you chose to single source your supply of critical technologies from a distant land, you will one day pay a price. Just because it's a one-hundred-year event doesn't mean it can't be tomorrow.

Jon Barrett

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New facility delivers faster harness prototyping

Cyient has opened a new wire harness facility in its office in Peoria Heights, Illinois. The facility adds capabilities to support harness prototyping by increasing design process speed and iterative development for electrical systems. Adding this facility provides customers in North America with access to time-sensitive wire harness prototype products and field support.

The 1,100ft² lab is equipped with pneumatic crimping tools, including an ultrasonic splicer and braider, to facilitate quality production and prototypes for electrical wire harnesses. Harness rework, testing, field installation, and troubleshooting are additional services that Cyient will offer from the new facility. Although the facility has been launched with a single, nine-hour shift, the company will expand operations for 24/7 support in the future.

Commenting, head of Cyient's industrial business, Gordon Hilbun, said: "This is a critical addition to our portfolio and will help us offer full product life cycle support to customers, especially for time-critical new product introduction. Our new wire harness lab strengthens our electronics and electrical solution offering, addressing the demand for end-to-end support."

www.cyient.com

What's the key criteria for today's EMS provider?

New research by Global Market Insights has revealed that product quality is the most decisive differentiating factor when selecting an electronics manufacturing service provider. To ensure quality, EMS providers are undertaking several testing procedures such as x-ray inspection, in-circuit testing, automated optical inspection and shock test. Development of enhanced services will drive growth in the market, GMI indicates.

EMS providers have consistently enhanced manufacturing facilities and expertise, offering additional services like testing and logistics to help OEMs and major consumer brands achieve better profit margins, faster time-to-market and flexibility. Low labor costs in developing economies, especially in the Asia-Pacific region, have reinforced EMS expansion in the region.

One source for IoT expertise

Avnet has announced a new distribution agreement whereby it will sell Sequans' internet of things chips and modules and will exclusively promote and sell Monarch Go, an LTE-M/NB-IoT modem component designed for and certified by Verizon. Monarch Go enables new IoT devices to launch on Verizon with no additional testing, reducing time to market.

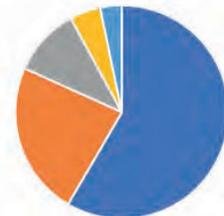
The agreement will combine Sequans' wireless components and Avnet's engineering expertise and distribution power. In addition to Monarch Go, Avnet will resell Sequans' other IoT module solutions, including those for IoT/ M2M, broadband/CBRS and associated evaluation and development kits.

Vice president of sales at Sequans, Nick Taluja, said: "Extending the reach of our chips and modules via Avnet's worldwide marketing channels will ensure that our IoT modules and solutions get to customers who need them as quickly as possible."

Avnet vice president of IoT, Lou Lutostanski, added: "Avnet helps customers put all the pieces of an IoT solution together from the device and the gateway to the software, data and insights. We welcome the opportunity to extend our global IoT ecosystem with Monarch Go and Sequans' extensive portfolio of IoT chips, modules and development platforms."

www.avnet.com

Global electronic manufacturing services (EMS) market share, by product, 2017

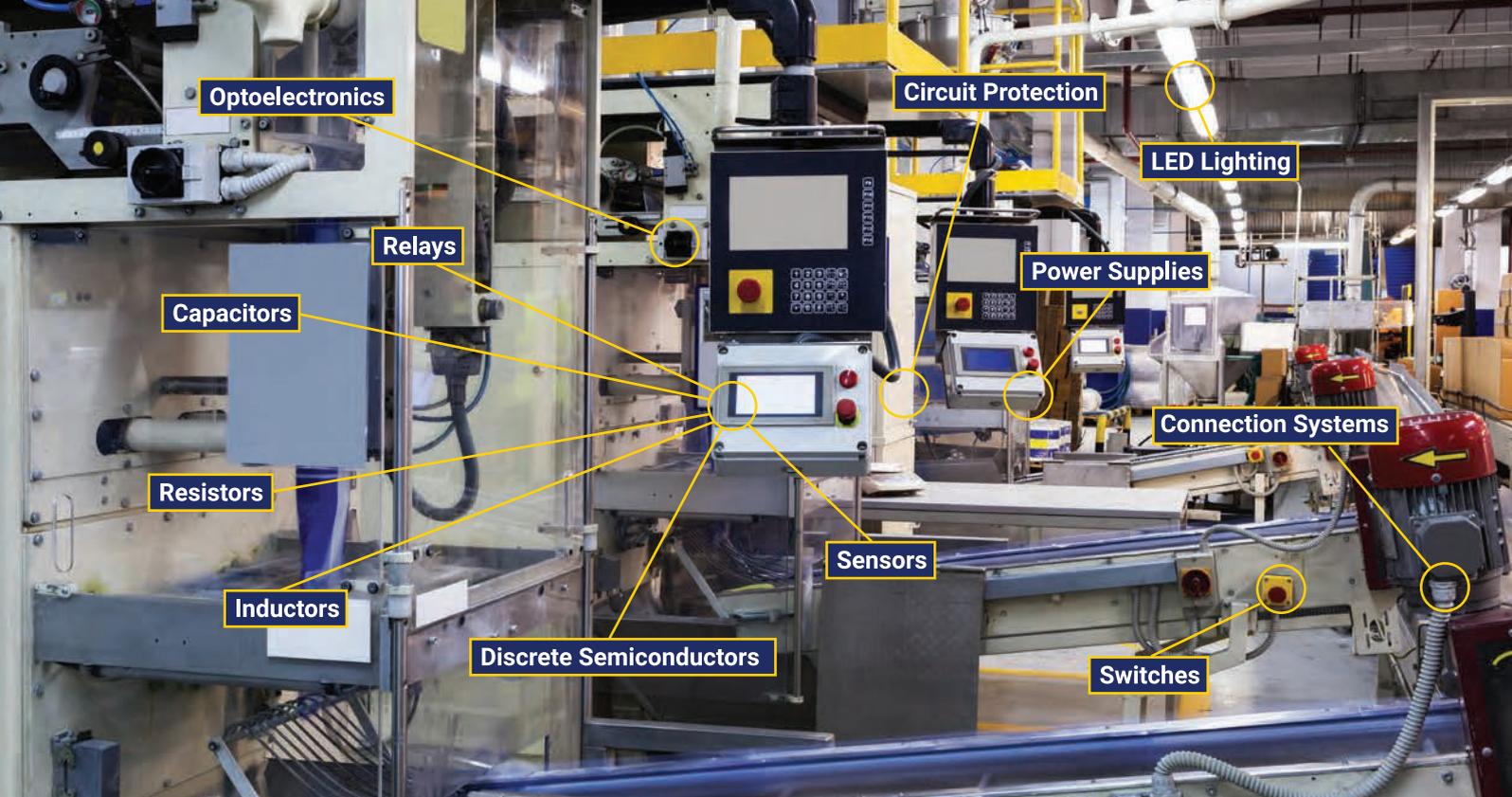


- Electronic Manufacturing
- Engineering Services
- Test & Development Implementation
- Logistics Services
- Others

In recent years, the APAC electronic manufacturing services market has grown tremendously owing to continuous introduction of new products, particularly smartphones. As mobile technologies are evolving at a rapid pace and becoming cheaper, it seems to be well established that most of these devices are manufactured by EMS providers in Asia.

The massive growth potential for consumer electronics in APAC is illustrated by Taiwanese EMS provider, Foxconn, which is expanding its semiconductor production operations in China. Foxconn is also demonstrating another trend among EMS companies by shifting from a single key income source to producing more diverse consumer electronic products.

www.gminsights.com



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In Brief

360deg images aid selection
Allied Electronics and Automation now offers 360deg imagery for more than 32,000 industrial control, sensing, switching and circuit protection products on its website. The images, which help users match specifications, allow customers to view products from all angles and zoom in to see details before buying. Allied expects to add more than 1,000 additional images per month, with a focus on popular and complex products.
www.alliedelec.com

Delivering microLED displays
Plessey, an embedded technologies developer, is partnering with wafer processing specialist, Axus Technology, to bring GaN-on-silicon monolithic microLED technology to the mass market. The investment will enable the wafer-scale bonding of microLED wafers to high-performance CMOS backplanes. Ultimately, this technology could make displays smaller, brighter and more power efficient.
www.plesseysemi.com

Current sense resistors in stock
Stackpole's CSS0201 all metal current sense resistor offers resistance values of 10 and 20 milliohm, in tolerances as low as one per cent and TCR of 200 ppm. These 0201 resistors meet demand for downsized electronics, especially portable electronic devices, which trend towards faster speeds and lower power. Pricing is \$0.15 each in full reel quantities with 10 milliohm resistance values currently in stock.
www.seielect.com

E-mech catalog reissued
Würth Elektronik has reissued its complete catalog of electromechanical components. This overview of connection technology, assembly, switches and keys can now be ordered in printed form, as a PDF or opened in the iOS Catalog app. Over 799 pages, purchasers will find quality standard components as well as REDFIT IDC SKEDD and REDCUBE solutions. Products are available from stock without a minimum order quantity, with free samples on request.
www.we-online.com



Embedded COMs now in stock

Mouser Electronics has announced a global distribution agreement with Kontron, a specialist provider of internet of things and embedded computing technology, and a premier member of the Intel internet of things solutions alliance. Through the agreement, Mouser will offer a range of Kontron computer-on-modules, including COM Express modules based on the Intel Atom E3900 series, Pentium processor N4200, and Celeron processor N3350.

Products now available include the scalable COMe-cAL6 series comprising COM Express Type 6 modules that combine image processing and graphics capabilities with real-time computing. The modules are available in dual-core and quad-core versions for applications, such as POS/POI systems, digital signage, gaming and medical PCs.

Other options include the COMe-mAL10 a series of credit card-sized COMs with up to 8GB of DDR3L memory. These IoT-ready modules are designed to maximize graphics and processing performance in a robust, energy-efficient, and standardized Type 10 COM mini form factor.

www.mouser.com

New line card available online

Sager Electronics has revealed a new line card detailing its interconnect, power and electromechanical components. The four-page, full-color line card provides a comprehensive listing of component suppliers for which Sager is an authorized distributor. In addition to an alphabetical listing, the line card is organized into thirty-six product categories, covering an array of different solutions.

The new line card is also now available in French and Spanish, as well as English, with in-language line cards serving customers across North America, from Canada to Mexico.

www.sager.com

Get ahead on greenhouse gases

BSI is calling on organizations to make changes to their sustainability strategy as the international standard used to independently verify a company's greenhouse gas emissions becomes more rigorous. Although the standard remains voluntary, BSI reports a marked increase in interest, with those looking to get ahead of the issue potentially reducing their reputational risk.

The standard, designated ISO 14064-1 greenhouse gases, now requires companies to report on emissions throughout their supply chain, replacing the earlier requirement to report only on direct emissions produced by the organization itself.

Although indirect emissions are almost always the most significant, at present most companies do not track and report emissions released throughout the supply chain.

Global head of sustainability and circular economy at BSI, Martin Townsend, said: "Meeting this new standard will signal a dramatic shift in the way most organizations measure their greenhouse gas emissions. External verification will help verify data from suppliers and provide a clear picture of the organizations' total emissions."

www.bsigroup.com



Seventeen current transducer models in stock

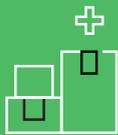
Danisense has signed a global agreement with distributor, Digi-Key, which is now stocking seventeen of Danisense's most popular models, plus accessories. The Digi-Key linecard now includes current transducers that span 50 to 2,000A. Devices in the range are based on Danisense's closed loop, flux gate sensor technology, said to result in highly accurate, stable and repeatable measurement.

Danisense sales and marketing director, Loic Moreau, said: "We believe Digi-Key's global penetration into key automotive, renewables and industrial sectors will help drive our business forward."

Digi-Key product manager, sensor technology, Shawn Martinsen, added: "Danisense will help to expand Digi-Key's broad portfolio of high accuracy current transducers for applications like e-mobility, power converters, oscilloscopes, multimeters, medical equipment, battery storage, and much more."

www.danisense.com

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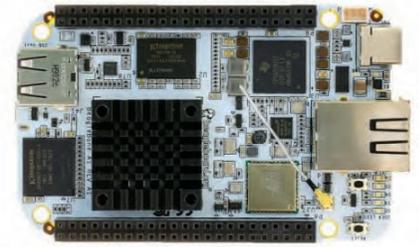
Thermoplastic enclosures offer protection as standard

RS Components has introduced the new Cardmaster and Piccolo ranges of ABS and polycarbonate enclosures from Finnish manufacturer, Fibox, for critical electrical and electronic equipment in hostile environments.

The Cardmaster range is intended for measurement, monitoring and process control equipment. Polycarbonate variants provide IP65 ingress protection, IK07 or IK08 impact protection, and are available to meet NEMA Type 1, 4, 4X, 12 and 13, the UL 746C 5V polymer safety standard, and the UL 508 standard for industrial control equipment. ABS versions can meet IP65, IK07, NEMA Type 1, 4, 4X, 12 and 13, plus UL 94 HB flammability standards.

The Piccolo range is designed specifically to house pushbuttons, terminal blocks and other control devices, and is also well suited for mounting components for controlling lifts and hoists. Piccolo is a single-chamber enclosure with polycarbonate versions meeting IP66/67, IK08, NEMA Type 1, 4X, 6, 12 and 13, UL 746C 5V and UL 508 requirements, while ABS enclosures offer IP66/67 and IK07 protection.

www.electrocomponents.com



Are you AI ready?

Newark, in conjunction with the element14 community, is expanding its range of artificial intelligence related products and resources. These include the BeagleBone AI single board computer and online resources to help overcome the complexity, cost and power challenges of developing for AI.

One of the newest AI products available from Newark, the BeagleBone AI provides a fast track solution for embedded machine learning. The single board computer facilitates everyday automation for industrial, commercial and home applications, with designs up and running within five minutes.

A free online course is available to support those working in AI, encompassing an overview of AI, algorithms, machine and deep learning, and typical AI applications. Customers can also access an interactive AI configurator tool to determine the most appropriate products, plus web content featuring element14 member projects.

Global head of technical marketing at Newark, Cliff Ortmeier, said: "We are committed to providing access to the latest AI products and resources, including free training, projects and tools to support customers throughout their AI design journey."

www.newark.com

that have disrupted supply, the US-China tariff, and the Coronavirus, which has caused the Chinese government to shut down companies operating in various cities to control the spread of the virus. Global supply chains relying on Chinese output will continue to be affected.

Although companies are attempting to remedy the short supply, with Samsung adding capacity to increase production of NAND wafers, it will still require a massive amount of time and effort for these components to recuperate the market.

fusionwww.com

Still struggling with the SSD shortage?

With manufacturers cutting NAND flash production in 2019, demand for storage capacity growing and unforeseen events affecting supply, manufacturers are still struggling to meet demand for solid state drives, explains sourcing specialist, Fusion Worldwide. As a result, lead times are stretching to a minimum of 10 weeks.

Fusion Worldwide's global finished goods commodity manager, Mavis Ong, explained: "With the rollout of 5G, increased IoT demand, hyperscale and gaming advancements requiring more storage, there are no signs of recovery for the SSD shortage. Buyers should expect high prices to remain while the shortage continues. Those who wait for prices to lower before purchasing could be in for a very long wait."

SSD supply has been affected by various unforeseen events including power outages



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Smoothing a bumpy ride

President of Digi-Key Electronics, Dave Doherty, explains how the company's core model helps purchasers ride the relentless cycle of expansion and contraction

I'd say we're at a dynamic time in our industry, but I'm an optimistic guy and always see the glass as half full. As a company, we're definitely at an exciting point—our new 2.2 million square foot expansion is about 95 per cent complete, and advanced automation systems will be installed and tested ahead of our planned June 2021 completion date.

Aside from the construction, we've added more than 200 suppliers and over 300,000 new products over the last two years. We introduced our DK IoT Studio tool and continue to make website enhancements, so customers have the information they need as quickly as possible.

Weathering industry cycles

But it hasn't been all sunshine for the industry, which went through one of its greatest expansions and contractions over the last 24 months. Digi-Key remained remarkably consistent in its new customer growth and line items shipped despite some minor pullback in 2019 due to product lead-time expansion and contraction.

The period of 2017 to 2019 was as volatile as any three-year period since I joined this industry 35 years ago. Lead times for passive products indicate the volatility that has

been experienced, depicting the disruption that occurred in 2017 and 2018 with a much steeper correction slope in 2019. This was a bit of a perfect storm, in particular with MLCC capacitors where the price point had been driven down to the point that suppliers were pulling out of that segment. This, combined with increased usage in areas such as automotive, caused disruption to the demand/supply balance.

An evolving industry

Our industry is characterized by newly developing markets that are engaged in innovative product introductions; this makes it difficult to predict customer acceptance and thus, actual demand. This reality will continue to make it challenging for suppliers to accurately predict and plan capacity requirements. Additionally, suppliers and traditional distributors are once again being pushed to reduce the amount of inventory they carry, placing even more burden on purchasing professionals.

A positive consequence of Digi-Key's core model, however, is that it has helped address this predicament. We continue to offer the broadest selection of product to support prototyping and NPI requirements. Because of increasing supplier minimum

order requirements and our conservative philosophy, which places high value on holding inventory for immediate shipment, Digi-Key's growth has accelerated with customer segments characterized by a 'low to mid volume/high mix' model with very high service level requirements. We see this segment as the fastest growing portion of the domestic electronics market, where speed and service are essential.

We also see a growing trend with customers seeking machine to machine connectivity to automate repetitive functions like order placement, stock check and quotes. Digi-Key's robust, real-time application programming interface solutions thereby save customers time and money.

In closing, Digi-Key offers more than 10 million products globally, with more than 2.2 million in stock and available for immediate shipment. We have a great group of people dedicated to providing the best service, and tools designed specifically to support electronics purchasing professionals. Now that's something to get excited about!

www.digikey.com



President of **Digi-Key Electronics**,
Dave Doherty



Tracking silicon trends

As the fundamental building material for semiconductors—the vital component in virtually all electronic goods—silicon wafer sales can highlight changes in component production and availability. ESNA looks at the trends

Silicon wafers serve as the substrate material on which most semiconductor devices, or chips, are fabricated. These highly engineered thin, round disks are produced in various diameters, from one inch to 12 inches.

Last year silicon wafer area shipments totaled 11,810

million square inches, compared to the previous year when the industry logged shipments of 12,732 million square inches in 2018. According to the SEMI Silicon Manufacturers Group, worldwide silicon wafer area shipments in 2019 declined seven per cent from the 2018 record high, as

the organization’s year-end analysis of the silicon wafer industry revealed.

Commenting on the shift, vice president of SEMI SMG and director, product development and applications engineering at Shin-Etsu Handotai America, Neil Weaver, said: “The 2019 decline in

Annual silicon industry trends indicate a dip in total wafer area shipments

worldwide semiconductor silicon volume shipments resulted from memory market softness and inventory normalization. Despite the volume dip, silicon revenue remained resilient.”

www.semi.org

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Area Shipments (MSI)	8,137	6,707	9,370	9,043	9,031	9,067	10,098	10,434	10,738	11,810	12,732	11,810
Revenues (\$Billion)	11.4	6.7	9.7	9.9	8.7	7.5	7.6	7.2	7.2	8.7	11.4	11.2

PCB purchasing on the rise

Printed circuit board sales remained strong to the end of 2019, placing the electronics industry on a solid footing—ready to buy and to build

With the IPC releasing the latest figures from its North American printed circuit board statistical program, it seems the industry ended 2019 on a high. Total North American PCB shipments in December 2019 were up 8.7 per cent compared to the same month last year. Shipment growth ended the year at 7.8 per cent and compared to the preceding month, December shipments increased 5.2 per cent.

PCB bookings were also looking good. December bookings increased 8.8 per cent year-over-year and 11.5 per cent from the previous month.

Commenting, the IPC’s chief economist, Shawn DuBravac, said: “While trade tensions created a volatile environment, the North American PCB industry closed 2019 on a solid footing. PCB shipments were strong through the final five months of the year. Moreover, orders at the end of the year suggest shipment strength should carry into the first quarter of 2020.”

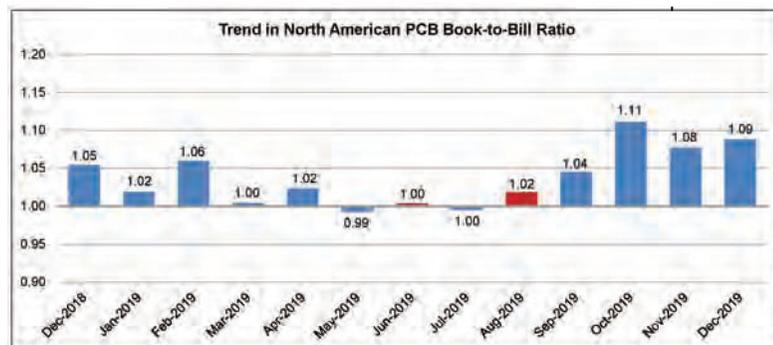
As Shawn highlights, these figures follow a strong Fall period with sales and orders of PCBs in November continuing to outpace last year.

IPC director of market research, Sharon Starr, agreed, commenting: “Business is booming for the North American PCB industry as sales and orders outpace last year’s performance by

Trends in the North American PCB book-to-bill ratio indicate continued growth

a substantial margin. A strong book-to-bill ratio following three months of positive ratios indicates the likelihood for continued sales growth into the year ahead.”

www.ipc.org



All set for lift-off in the 2020s

Vice president of the military and aerospace segment at TTI, Roger Raley, examines some long-awaited aerospace advances that will begin to be realized in the decade ahead

The perception is that aerospace technology is slow to change, but a look back at the events of the last decade makes it clear that this has not always been the case. In fact, things have happened relatively quickly.

After the Space Shuttle was retired in 2011, the United States had to rely on Russia to bring astronauts to and from orbit. Today, we're preparing for SpaceX and Boeing to fly crews to the International Space Station. In the last decade, the F-35 entered its second decade of development; today, more than 400 aircraft have been delivered. At the start of the 2010s only a handful of drones had been registered with the FAA; over 1.5 million have been registered today, with over 420,000 drones registered for commercial use.

As we look to the new decade, this pace of change is set to continue. Military expenditures are on the rise again, with global defense spending expected to grow three to four per cent. In the US, defense spending is up \$20 billion this year over 2019's budget, while foreign military exports increased 33 per cent in 2018 and another six per cent in 2019. Finally, private spaceflight has continued to grow: SpaceX now has nearly 200 satellites in low Earth orbit and plans to fly private citizens around the moon in 2023, while Blue Origin just opened a new engine plant in Huntsville, Alabama that it says will soon produce 42 engines per year.

Commercial air travel evolves

When we look back at this decade in the future, we'll

see 2020 as the point where key technologies crossed from the realm of possibility to practical reality.

As hybrids and electric vehicles make shipping and ground transportation cleaner, we're also on the verge of seeing electrification in aircraft, with hybrid-electric engines and improvements in battery technology making the future of air travel less damaging to our atmosphere.

In addition to the expanded number of commercial drones, we're coming closer to the development of urban air transport. While these might not be the 'flying cars' of science fiction, projects like Uber Elevate are bringing the idea of intra-urban air travel to cities including Dallas, Los Angeles and Melbourne. With these projects, and with

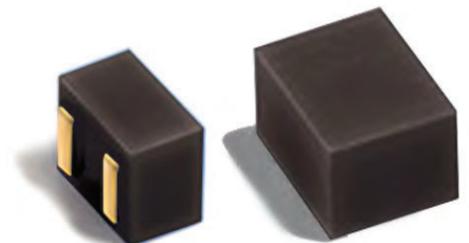


Vice president of the military and aerospace segment at TTI, **Roger Raley**

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technologies such as electric vertical takeoff and landing, we'll see new opportunities around environmental sustainability and urban planning as well.

As technologies improve airframe design and efficiency, the 2020s may also see the return of supersonic passenger jets, and the rise of more technology in the form of cockpit automation and the use of AI and predictive analytics to make travel safer and more efficient.

Air defense expands

Over 10,000 new defense aircraft will be delivered globally through 2029 as the nations of the world modernize and expand their air defense capabilities; 20.2 per cent of those deliveries are in competition.

In addition to aircraft, new technologies, including airborne cyber-warfare capabilities and hypersonic missiles, will provide additional protection to warfighters and civilian populations alike.

Technological advances will see increased spending on military technology. The US is upgrading and modernizing its nuclear arsenal along with the lower tier air and missile defense sensors, the next-gen radar for the Patriot missile defense system. Also, the US Air Force is moving to develop future jet fighters in five-year cycles using the best technology available today, versus the multi-decade design cycles of the past.

With the growth in connected computing on the battlefield,

these next-generation air defense systems will rely on networking and sensing technology that will keep drones and piloted aircraft aware of changing conditions in real-time.

A space economy emerges

From the growth of commercial space flight to the announcement of the new US Space Force, expect the next decade to bring revolutionary developments in both human and unmanned space flight.

Commercial space travel is moving toward viability, with planned suborbital tourist flights and trips to low Earth orbit. Meanwhile, NASA is preparing for the launch of the James Webb Space Telescope, the successor to the Hubble Space Telescope, ▶



Over 10,000 new defense aircraft will be delivered globally through 2029 as the nations of the world modernize and expand their air defense capabilities

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Fast. Advancements in technology should never take you by surprise. In the military and aerospace industry, if you're not on top of things, they're on top of you. To stay out front, you need a partner who's plugged into the industry - one who can react quickly to your needs, sometimes before even you know what those needs are.

Focused. It's Falcon's focus on the military and aerospace industry that has allowed us to forge long-term relationships with suppliers who are equally dedicated. Falcon's line card showcases superior, high-reliability product lines from the industry's top manufacturers - all with long-term Mil-Aero strategies - reducing the possibility of obsolescence.

It's Falcon's focus on our customer that enables us to become a dedicated partner. Whether managing individual inventory requirements, providing sophisticated levels of support, or supplying leading-edge technologies to meet rugged environmental demands, Falcon is committed to your success.

Falcon. Falcon Electronics is a Certified Small Disadvantaged Distributor of state-of-the-art semiconductor components, dedicated to the military and aerospace industry. Our suppliers have confidence in us. Our customers trust us. And Falcon is proud to be considered an ally of both.



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» and plans to return humans to the moon by 2024 in preparation for an eventual manned mission to Mars.

In fact, NASA itself predicts that the next economic revolution will happen outside Earth's atmosphere—a future that holds “a space economy built on mining, tourism, and scientific research that will power and empower future generations,” according to a statement on NASA.gov.

Mining asteroids for precious metals, or for resources needed to enhance life on Earth, may seem like the realm of science fiction, however, this decade will likely see technologies put into place that make those fantasies come to life.

Ready for take-off?

The technological groundwork that will be laid this decade will drive significant, rapid and almost unlimited advances in air, defense and space. The biggest of these daydreams—electric aircraft, urban air mobility, colonizing and working in space—have yet to arrive, but we can see glimpses of them on the horizon.

Electronics will be among the biggest drivers of our ability to achieve these advances; not only the components available today, but those in development and the new technologies engineers are just beginning to imagine. The technological breakthroughs of the 2020s will lead us to safer and cleaner air travel, sustainable space flight and more.

www.ttiinc.com

Space-qualified Ethernet devices speed time to lift-off

Microchip Technology has announced a space-qualified Ethernet transceiver, a radiation-tolerant device based on a commercial off-the-shelf solution now offering reliable performance for applications ranging from launch vehicles to satellite constellations and space stations. The devices will help meet growing demand for Ethernet in spacecraft to enable hardwired communication speed, support higher data rates, and facilitate interoperability between satellites and other spacecraft.

In addition to the VSC8541RT radiation-tolerant Ethernet transceiver, Microchip has also received final qualification for the new SAM3X8ERT radiation-tolerant microcontroller, its latest Arm Cortex-M3 core processor and embedded Ethernet controller. These are designed to support space industry demand for radiation tolerant devices separately or in combination.

Both devices are COTS-based parts with enhanced characterized levels of radiation performance and high reliability quality flow, available in plastic and ceramic packages.

Associate vice president of Microchip's aerospace and defense group, Bob Vampola, explained: "As the first to provide both a rad-tolerant transceiver and an enhanced rad-tolerant microcontroller for the rapidly-expanding, high-reliability Ethernet market, Microchip continues to support space industry developments and evolution with qualified and proven solutions. Microchip's COTS-based space-grade processing provides the right performance and the right level of qualification to meet evolving requirements from low-earth orbit constellations to deep space missions."

The VSC8541RT in plastic or ceramic package is sampling now, with the SAM3X8ERT qualified devices available in production quantities.

www.microchip.com

Hi-rel power ready for delivery

Newark has expanded its linecard with an increased range of XP Power products for high reliability applications available for same day shipping.

XP products are designed to deliver high performance and dependability combined with the latest safety standards at competitive prices. Units are ideal for hazardous environments, transportation and defense.

Recent additions to the XP power supply portfolio include high voltage DC/DC converters for applications requiring minimal size and weight. Benefits include stable, low noise output voltages between 100V and 10kV.

Other additions include the DSR series, a highly reliable, ultra-thin, low cost, high efficiency DIN-Rail power supply, rated at 75, 120 and 240W and available with 12, 24 and 48V outputs. The DSR series can be connected in parallel for higher power requirements or be configured to provide N+1 redundancy in critical applications.

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Buyers can expect stable prices and steady lead times for power management ICs

Demand and revenue for power management ICs declined last year, but the PMIC market will bounce back in 2020 as sales grow 7 per cent



James Carbone

The worldwide power management integrated circuit (PMIC) market will return to growth in 2020 after declining about 4.5 per cent last year because of weaker demand, high inventory levels and lower prices.

Last year, power management IC revenue declined to \$13.6 billion from \$14.3 billion in 2018, according to Semico Research. "There was lower demand in 2019. PMIC unit shipments fell from 69 billion in 2018 to 60.6 billion units in 2019," said Jim Feldhan, Semico president. Some of the decline was due to high inventory levels and some of it was "just because of weakness in the overall market," he said. While the PMIC market declined in 2019, it did not fall as much as the overall semiconductor market which decreased about 12 per cent.

One reason the power management IC market declined last year was smart phone shipments fell 2.3 per cent in 2019, according to researcher IDC. Mobile phones are a big driver of PMIC demand. Automotive is also a driver of PMICs and worldwide vehicle sales fell about 4 per cent, according to Fitch Ratings, a credit ratings agency.

"We had a bit of decline in PMICs in automotive," said Kevin Anderson, senior analyst, power semiconductors for researcher IHS Markit. Automotive PMIC business declined about 5 per cent in 2019, he said. While electronics content, including power management ICs, in automobiles is increasing, "vehicles sales were down enough to offset the growth in electronics content," said Anderson.

With weaker PMIC demand, inventory levels grew. "In Q3 and Q4 of 2018 there was a buildup of inventory, especially with some OEMs in China," said Anderson. Inventory continued to build into 2019 and there was a continued decline in demand in the first half of the year.

Normal lead times reached

However, by early 2020 high levels of inventory "dissipated and now are down to normal levels. Lead times are normal," said Anderson. "Factory utilization is somewhere in the mid-80s in general so the industry is poised to handle an upturn," if it occurs in 2020, he said.

In fact, many industry analysts forecast that PMIC demand will increase in 2020. Power management IC revenue will grow about 7 per cent in 2020 to

\$14.6 billion and will outperform the overall semiconductor market, according to Feldhan.

"Supply should be in balance in 2020 and that is one reason why our forecast is looking at about 7 per cent growth," he said. With high inventory levels being worked off, supply and demand are in balance. "We are starting to see some customers restock," said Feldhan.

The good news for buyers is that while PMIC demand will increase, prices will remain stable in 2020 after declining last year. Demand will rise across the board. PMICs are used in everything from cell phones and other portable electronics equipment to automobiles, including electric and hybrid vehicles, as well as industrial equipment and defense and aerospace systems.

By the Numbers



4.5%

The rate of decline for the worldwide power management IC market in 2019. Source: Semico



60.6 billion

The number of power management ICs that shipped in 2019. Source: Semico



\$13.6 billion

The size of the power management IC market in 2019. Source: Semico



5%

The rate that the automotive PMIC market declined in 2019. Source: IHS Markit



7%

The forecasted growth rate of global power management IC revenue in 2020. Source: Semico



\$14.6 billion

The forecasted size of the worldwide power management IC market in 2020. Source: Semico.



Power management ICs include AC/DC converters, linear and switching regulators, voltage references, rectifiers, thyristors and battery charging and management chips.

Switching regulators are the largest PMIC category, said Feldhan. "You find those in just about everything," he said. "They are used in most equipment for switching power off and on. Last year switching regulator revenue totaled \$5.6 billion, while total PMIC market was \$13.6 billion.

About 21 billion switching regulator units shipped in 2019, compared to 60.6 billion total PMICs that shipped. Switching regulators have higher average prices than most PMICs.

The average price for power management integrated circuit was 20.7 cents but switching regulator ASP is about 30.6 cents, said Feldhan. The second largest PMIC category is linear regulators which cost on average about 9.1 cents per device.

Battery charging management ICs have the highest ASP at about 35 cents. Last year about 6.2 billion battery charging management ICs shipped and revenue totaled about \$2.2 billion, said Feldhan.

In 2020, mobile phones will help drive demand for battery charging

management ICs and switching and linear regulators as mobile phone users upgrade to 5G handsets. However, that may not occur until the second half of the year, according to Anderson.

5G automotive will drive demand

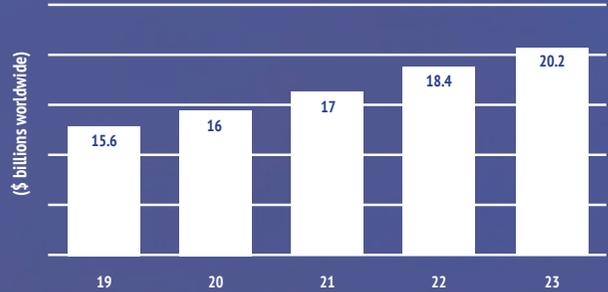
Prasanna Obala Bhuvanesh, product line marketing manager for Microchip's analog power and interface business unit, said key growth segments for PMICs this year and beyond will be 5G and automotive, particularly, powering at the "edge" for enhancing both smart and secure features of all connected consumer, industrial and automotive applications. These could range from IoT to Industry 4.0 to V2X, he said.

In fact, automotive will drive PMIC demand for five years, said Anderson. More power ICs will be needed for the advanced driver assistance systems (ADAS) and infotainment systems, he said.

Ali Husain, senior manager, corporate strategy and marketing for ON Semiconductor, said that autonomous driving will also increase demand for PMICs. "Automotive PMICs, especially for image sensors and other subsystems involved in autonomous driving, will be a very important growth area for PMICs in the next several years," he said.

The worldwide power management integrated circuit market will rise through 2023 driven by multiple end customer segments. *Source: IC Insights*

Power management IC market to post steady growth



Feldhan said that electric vehicles will also help drive the PMIC usage as electric car makers switch from silicon-based chips to silicon carbide (SiC) semiconductors.

Feldhan said the trend towards silicon carbide chips by EV manufacturers such as Tesla will result in greater need for power management ICs. SiC MOSFETs and IGBTs are being used in some EVs instead of silicon ICs because SiC chips can handle voltages up to 1200V and can operate more efficiently at high temperatures. They also have greater energy efficiency than silicon semiconductors.

Those characteristics make SiC semiconductors ideal for applications such as on-board chargers and inverters used within plug-in hybrid and full electric vehicles (EVs). Use of SiC semiconductors in such applications require more sophisticated power management and require more PMICs. "SiC is certainly a growing area that needs more sophisticated electronics and that will certainly help the power management ICs segment as well," said Feldhan.

Consumer electronics will also be a driver for PMICs. "We are talking about things like wearable electronics" such as smart watches and fitness devices, as

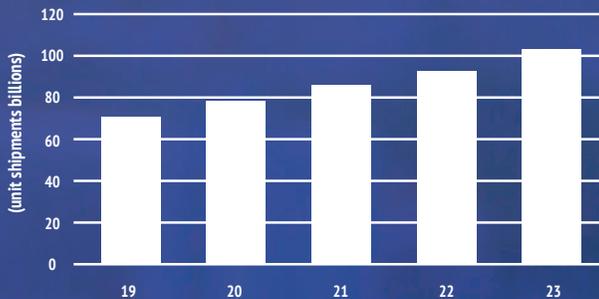
well as smart speakers, home automation applications said Anderson. He added industrial IoT is going to help drive growth as well.

Other markets that are expected to grow in 2020 and could drive PMIC demand include data centers and edge computing, according to Bhuvanesh. "If any or all these markets grow as anticipated, then demand for power management ICs will grow as well. If one or more of these markets were to grow very rapidly, then it could possibly strain supply and potentially push out lead times throughout the industry," he said.

With edge computing, computation and data storage is done closer to the devices where data is being gathered rather than a central location. This reduces latency and companies can reduce cost by having processing done locally and not in the cloud.

Ali said the "trend of increasing electric power, intelligence and connectivity in all industries will increase demand for PMICs steadily through the next decade."

PMIC shipments move upward



Smart phones, automobiles and portable electronics equipment will need more power management ICs over the next three years. *Source: IC Insights*

How to specify the perfect enclosure

Plastic versus metal is a familiar enclosures dilemma but Industry 4.0 has rewritten the rulebook. Here OKW highlights just how much choice purchasers now have, and explains how best to navigate the options available

Gone are old axioms like ‘plastic enclosures for indoors’, ‘metal housings for industry’. Plastic is now at home in today’s smart factories because they are spotlessly clean and less challenging. Conversely, chic brushed aluminum looks fabulous in modern home automation systems. But that’s not carte blanche to tear up the rulebook completely. Here, we explore three important questions to ask when specifying enclosure materials.

How tough should my enclosure be?

Plastic is surprisingly robust—think of riot shields molded from polycarbonate for example. Quality levels have also risen significantly, with specialist manufacturer, OKW Enclosures, increasingly choosing ASA or ASA+PC-FR over ABS thanks to its robust properties. ASA’s UV stability makes it better able to resist the weakening effect of the sun’s rays, while high-gloss ASA is easy to wipe clean, making it perfect for medical electronics and other hygiene-critical applications.

Need something stronger? Folded sheet aluminum is ideal for desktop and 19in rack cases because it is strong, light and easy to work. OKW’s metal enclosures division, Metcase, can manufacture customized enclosures in smaller batches because the tooling costs are low, with no need to alter molds or dies.

Stronger still, and highly waterproof, are Rolec’s diecast aluminum enclosures for challenging industrial

environments. Stainless steel is even tougher, although more work is required to make it waterproof.

But don’t write off plastic for industrial applications. Rolec’s glass-reinforced polyester enclosures offer excellent resistance to chemicals. The company also manufactures ASA+PC industrial enclosures, some of which are versions of its diecast aluminum cases.

How waterproof should my enclosures be?

First, ascertain the precise nature of the water ingress threat. Will your enclosure be splashed, fully immersed, or need to withstand high pressure water jets and/or steam cleaning?

Diecast aluminum and molded plastic enclosures will always have higher IP or NEMA ingress protection ratings than their folded aluminum counterparts because they comprise fewer case sections so there is less chance of leakage. Another critical factor is how well the sections clamp together.

Don’t assume, however, that extruded enclosures are waterproof simply because they have a one-piece main body; it all depends on how the ends are capped.

How much customization will be required?

Customizing a standard enclosure is always more cost-effective than specifying a fully bespoke housing, with new technology increasingly making it more cost-effective to customize cases in smaller

volumes. Reduce costs further by getting expert advice from an enclosure manufacturer to explore the specific customization options available for each model.

Folded sheet metal enclosures are easier to customize than molded or diecast cases, for example. Extruded aluminum cases can be cut to length easily, but you can’t change their width or height without incurring re-tooling costs.

Profile-based aluminum enclosures also offer a wealth of opportunities. Rolec’s multiPANEL and profiPANEL HMI/panel enclosures can be specified in any chosen size up to 800 by 800mm, as standard.

Combining plastic and aluminum

Still undecided? Why not combine aluminum and plastic to get the best of both worlds? This is precisely what OKW did to create its Synergy and Smart-Terminal enclosures. Applications include internet of things and industrial IoT, gateways, data systems engineering, network technology, medical electronics, measurement and control.

As OKW vice-president of marketing, Robert Cox, explained: “Materials have been at the heart of so many of our innovations but even so, combining aluminum with plastics in the way we did has enabled us to offer customers so many more benefits.”

www.okwenclosures.com



Metcase folded sheet metal Technomet enclosures can be made in any size



Diecast aluminum and molded plastic enclosures will always have higher IP or NEMA ingress protection ratings than their folded aluminum counterparts because they comprise fewer case sections so there is less chance of leakage

Opt for an enclosure with smart mounting options

Enclosures manufacturer, CamdenBoss is kicking off the new year with an addition to its range designed to provide multiple wall-mount options for maximum versatility

The new 1500 Series Universal Smart Enclosure features 45deg angles for optimum mounting flexibility. The enclosure is available in one size and three colour options: black, white and grey. It can also be supplied with a solid or vented base, making the 1500 series ideal for applications such as room sensors, access control, lighting management or smart temperature devices.

Moulded in a UL94-V0 material, the 1500 series comes with a top cover featuring a recess for overlays, keypad membranes or digital printing, along with a base that can be attached with a single screw for quick and easy assembly. Both halves are equipped with multiple mounting bosses at different levels to provide plenty of options when positioning PCBs.

In order to achieve maximum mounting flexibility, the corners of the base have been cut to leave 45deg angles, adding two more usable faces to the enclosure. This increases the diversity of potential applications as, with the use of a mounting bracket, the enclosure can be used in a corner mounting orientation. In some circumstances 90deg walls cannot be guaranteed and this creates problems, however, the 1500 series can be mounted on irregular walls without hassle. In addition to corner mounting, the 45deg mounting style also opens up avenues for tilted door entry systems such as keypads and biometrics or mounted above a door for motion entry.

Sold primarily as a kit with all the necessary components to get started, including the 45deg bracket and screws, CamdenBoss is on hand to help customers get the most out of this enclosure. In-house customisation such as digital printing, CNC cutting and coatings are available where required. Ongoing support in the form of informative videos also highlight the various features delivered by the 1500 series.

Information can also be found on the dedicated 1500 web page or on individual SKU pages. Alternatively, the CamdenBoss sales team are on hand to discuss any enquiries.

www.camdenboss.com



Enclosures are available in one size and three colour options

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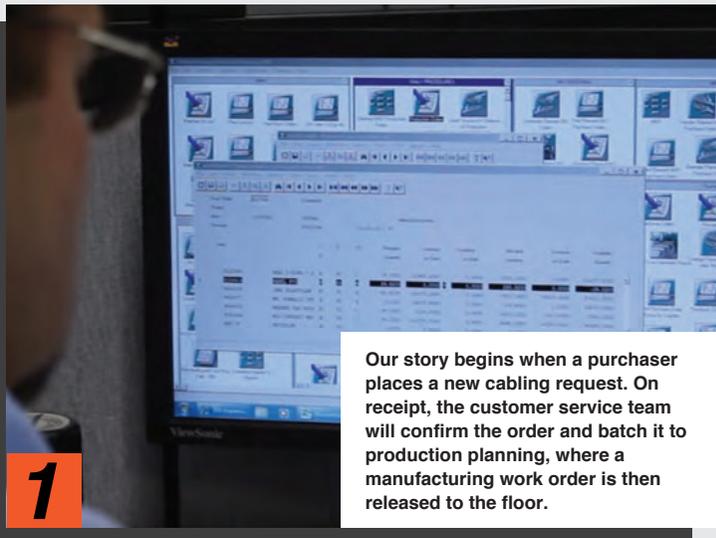
behind the scenes

From order to cordset: a guide to cable quality

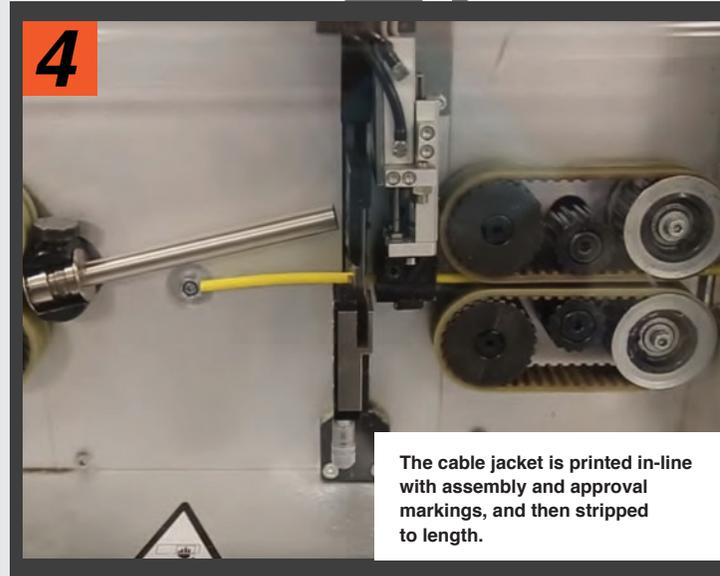
www.phoenixcontact.com/cordsets

Product marketing manager – industrial field connectors at Phoenix Contact USA, Nathan Owens, reveals what happens when you place an order for cable

Cables might seem uncomplicated but manufacturing reliable industrial cordsets to the standards required is anything but simple. Take a look behind the scenes to find out how your custom cable order is processed to provide the quality product you expect to see on delivery.



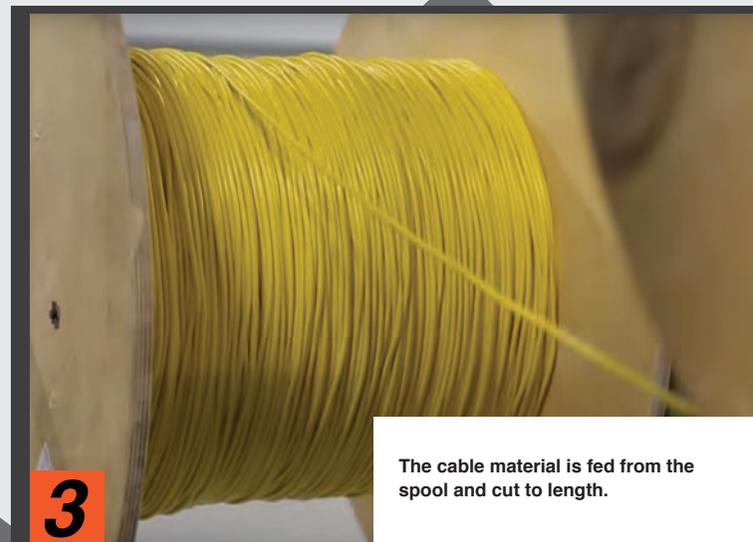
1 Our story begins when a purchaser places a new cabling request. On receipt, the customer service team will confirm the order and batch it to production planning, where a manufacturing work order is then released to the floor.



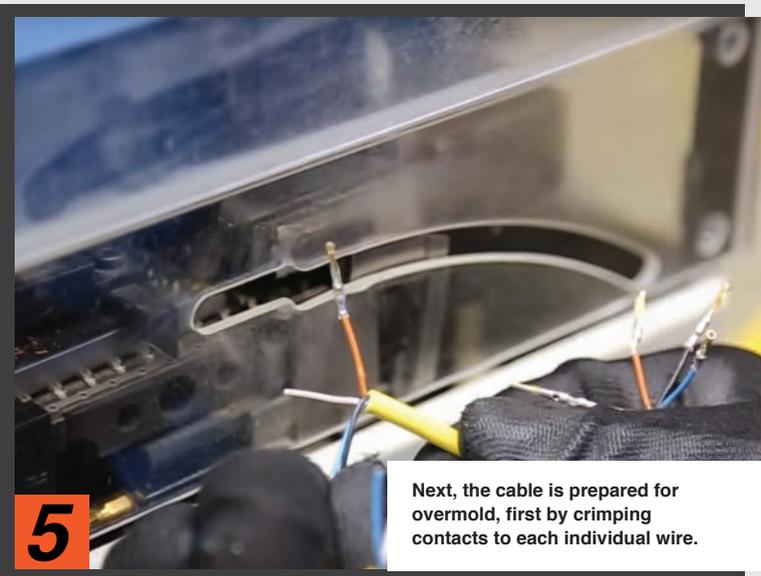
4 The cable jacket is printed in-line with assembly and approval markings, and then stripped to length.



2 Local manufacturing in the US, along with an extensive inventory of cable material and connector components, ensure fast delivery of finished assemblies, with lead times under two weeks.



3 The cable material is fed from the spool and cut to length.



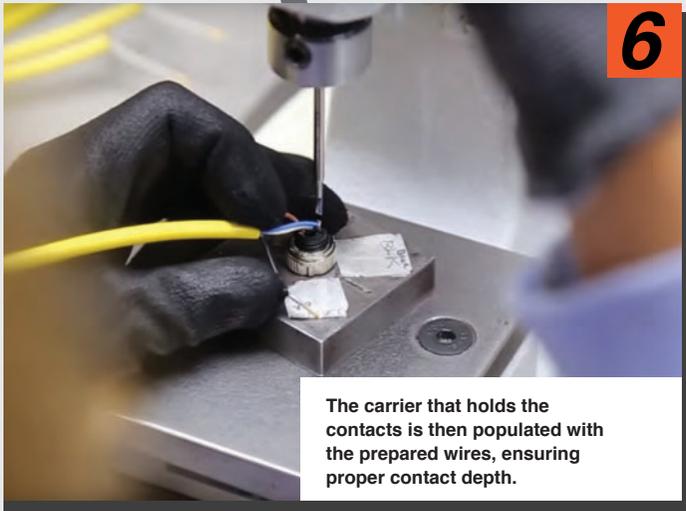
5

Next, the cable is prepared for overmold, first by crimping contacts to each individual wire.



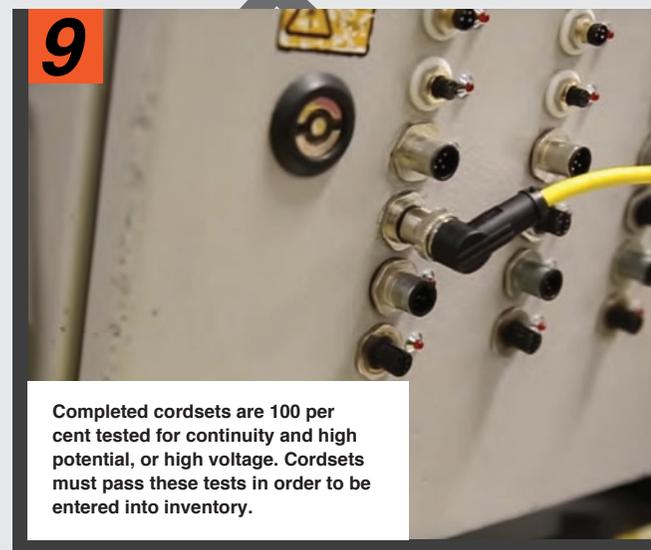
Once completed and approved, the product is then packaged and sent to a modern logistics center, where it is shipped out via automated retrieval to the customer's location.

10



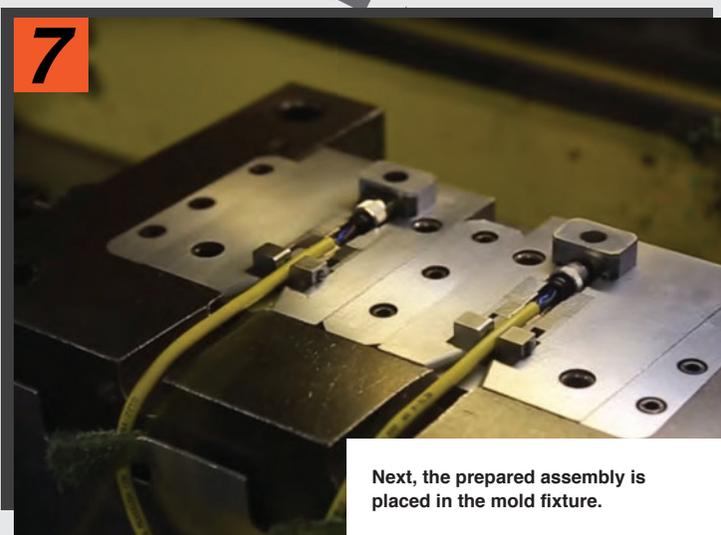
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The carrier that holds the contacts is then populated with the prepared wires, ensuring proper contact depth.



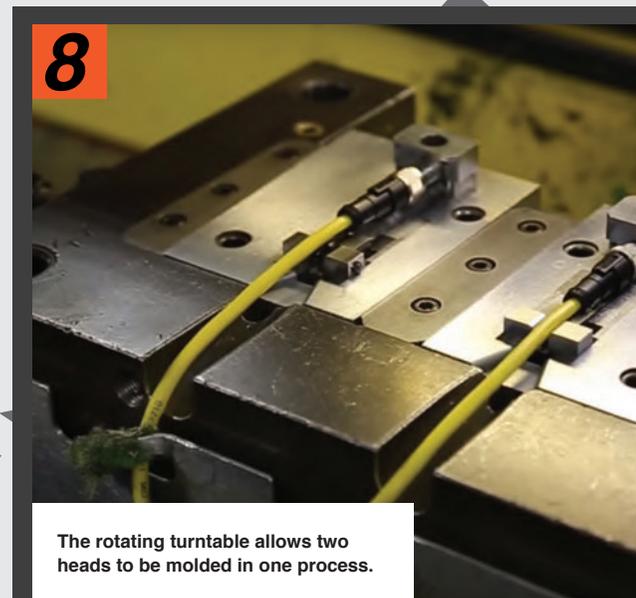
9

Completed cordsets are 100 per cent tested for continuity and high potential, or high voltage. Cordsets must pass these tests in order to be entered into inventory.



7

Next, the prepared assembly is placed in the mold fixture.



8

The rotating turntable allows two heads to be molded in one process.

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USMCA ushers in new trade era



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 presents the pros, cons and obligations of a new era of international trade

International trade • By John Denslinger

For too long, politicians and well-intentioned bureaucrats steadfastly championed the status quo when it came to international trading agreements. Despite overwhelming evidence of predatory trading practices and lopsided trade imbalances, meaningful change seemed all but impossible. Only after the imposition of (or mere threat of) economy-killing tariffs did the reality of a broken, global trading system finally get the attention of world leaders.

One can certainly argue the pros and cons of tariffs. Globalists and nationalists will have distinct opinions. Nevertheless, tariffs forced nations to discuss and ultimately amend outdated trade policies. USMCA is the first of these new agreements to be ratified by Congress and signed by the President. As such, it is the catalyst ushering in a new era of trade with several more deals in the works: China Phase 1, Japan, UK, South Korea and eventually the EU to name the majors.

USMCA is important not because it was the first re-negotiated agreement, but because it governs \$1.2 trillion of economic trade among US, Mexico and Canada, one of the world's largest trading blocs. It's likely much of the framework for this agreement will serve as the template for other bilateral negotiations.

So, what's new in USMCA? Pharma and farming aside, the agreements include: vital automotive industry protections; labor rate increases; labor rights provisions; IP protections; some environmental advancements; and streamlined dispute resolutions. Unchanged from NAFTA but included in USMCA are: currency manipulation protections; regulatory cooperation; digital trade; investment protections; and continuation of the sunset clause. In my opinion, USMCA appears to foster incremental enhancements to the 1994 NAFTA agreement rather than breaking new ground. That being the case, adoption should not disrupt established

supply chains, cost models and existing legal structures.

One area of particular note. If you are a small or medium-sized enterprise (SME), USMCA offers specific support for the first time in a US trading agreement. There is a whole chapter dedicated to fostering growth of SME that: establishes a SME Dialogue with admission open to any and all stakeholders; cuts excessive border-related red tape; offers digital trade provisions for e-commerce exports; invites small business participation in both US & Mexican government procurement opportunities; sets affordable IP protections; allows for cross border trade in services that eliminates a need of foreign offices; and establishes good regulatory practices giving particular attention to small business impact.

As I said earlier, USMCA ushers in a new era of trade. Now it's up to your legal, logistics and procurement teams to verify compliance. Understand the new rules of origin and changed customs laws, confirm that your contractual support for import-export operations qualifies under the new regs, review labor and employment agreements if your company has a physical presence in Mexico, and validate automotive content. The latter is critically important. It may require major realignment of your supply chains and raw material sourcing.

USMCA is the first of the new trade agreements reshaping international economics. Jay Timmons NAM President and CEO recently commented: "This agreement strengthens trade and restores needed certainty to our industry." Certainty is key. Let's hope the global goal of free and fair trade absent tariffs is realized sooner than later.

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Taking the pain out of power supply selection

Faced with thousands of power supply models, it can be hard to identify the right power supply for your application. Acopian's Alex Karapetian looks at how to combat indecision

Too much choice can be a bad thing, but there are ways to simplify power supply selection. The first filter is to look at the two main types of supply available: linear and switching.

Linear supplies

As the name suggests, a linear supply is one where a linear component is used to regulate the output. These power supplies have a relatively simple design and require few components. Linear regulated power supplies also have minimal ripple and output noise, also known as electromagnetic interference and radio frequency interference. Reducing electromagnetic noise emissions is important in equipment such as medical power supplies, audio devices, sensors and telecommunications.

Switching supplies

Switching power supplies, sometimes referred to as switch mode power supplies, regulate the output voltage using a high frequency switching technique that employs pulse width modulation and feedback. Here, power is supplied from the input to the output by turning on a switch until the desired voltage is reached. Once the output voltage reaches the predetermined value, the switch element is turned off and no input power is consumed.

Generally speaking, switching regulated power supplies are smaller and lighter in weight. For example, a 250W linear power supply would require

600in³ of mounting space and would weigh 26lbs, while a comparable AC/DC switching power supply would require 60in³ of mounting space and would weigh 2lbs. A linear power supply normally operates around 60 per cent efficiency for 24V outputs, whereas a switch-mode power supply operates at 80 per cent or more.

Form factor

Another thing that can help to narrow down power supply choice is the form factor and dimensions. Take a look, for example, at a few popular types designed expressly for mounting in 19in wide RETMA cabinet racks, a standardized frame for mounting multiple electronic equipment modules.

Where only minimal mounting space is available, Acopian's narrow profile power supplies are a great fit. Choices range from high performance models to general purpose options with output ratings up to 150V, and up to 3.5A.

Where designs call for a power supply that must function for many years without risk of failure, redundancy can provide a solution. Acopian's redundant power packages contain two identical power supplies with their outputs interconnected through a diode switching arrangement that will detect any fault condition, isolate it from the system output and pass only the output of the other supply with no interruption of output power during the transition.

Perhaps you're looking for a programmable power supply? Acopian's 1U family of programmable AC/DC power supplies is capable of wide adjust output voltages ranging from zero to five volts to zero to 135V and current capabilities up to 70A.

A custom fit

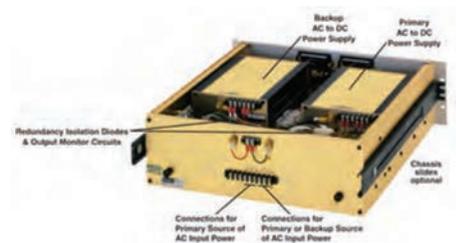
Acopian can also develop regulated power supplies to meet specific custom power supply challenges. Over the last 60 years, Acopian's power supplies have been used in ground support for NASA, mission critical test equipment for Boeing, Raytheon and Northrop Grumman, in amusement parks to power rides and in stadiums and arenas to power audio and lighting.

Helping to speed time to market are easy-to-use tools such as the online custom power supply system builder. Through a series of intuitive steps, users can custom design AC/DC and DC/DC power supplies, high-voltage, redundant systems and unregulated power supplies. Custom designed units are offered in every physical configuration, shipped fully wired and 100 per cent tested within three to nine days.

www.acopian.com



Where supplies must function for many years without failure, consider redundancy



Custom design supplies using Acopian's step by step system builder tool

Wondering which supply to specify?

Product manager, test equipment and accessories at Newark, Maureen Lipps, explains everything buyers need to know about selecting the right power supplies for industrial use

Power supplies are the backbone of any electronic system and play a major role in every piece of electronics equipment. The primary function of a power supply is to convert the AC voltage, coming into a plant or building, to a DC voltage, which is used by most electronic devices.

What type of power supply?

Power supplies fall into two major categories: linear and switching.

Linear power supplies are typically used in applications that require low noise or low power. They can often be bulky and inefficient, but their low noise characteristics and simple design make them a viable choice for audio, communications and low power consumer electronics.

Switching power supplies have superior efficiency and performance levels compared to linear supplies. A switch mode power supply regulates an output voltage with pulse width modulation, which creates high-frequency noise but provides a high efficiency rating in a small form factor. Switching power supplies are frequently used for industrial applications.

Power supplies can be further classified by their packaging. External AC power adapters, also known as 'wall warts' or 'wall adapters', are used in low power consumer electronics such as laptops. Bench power supplies are stand-alone desktop units for

test and measurement during the design process.

Which supply for my application?

For industrial applications there are three further packaging types suited to different kinds of application: open frame power supplies, enclosed power supplies and DIN rail power supplies. These are most often switching power supplies because of their efficiency and small form factor.

Open frame power supplies feature a partial mechanical enclosure and are often built into machinery or other equipment. The components are placed on a compact circuit board and can be easily installed in devices with existing housings. Open frame power supplies are usually small in size, cost effective and easy to keep cool. The GXE600 series from TDK Lambda is an open-frame programmable switching power supply that boasts up to 95 per cent efficiency. This series is particularly suitable for medical, information technology and communications applications as it meets international product specific IEC standards.

Enclosed frame power supplies are covered on all sides by a casing. These supplies protect components from elements such as dust and moisture and are most often used in hazardous environments. Many models integrate fans to compensate for heating problems.

A closed frame power supply, the CCH600PS28 from XP Power offers a switching power supply with efficiency of 90 per cent. This supply is suitable for a range of industrial applications as well as military COTS applications, as it meets military standards MIL-STD-461 EMC and MIL-STD-810 related to shock and vibration.

DIN rails provide the final option for securely attaching electrical and industrial control products, offering a cost-effective solution that also saves space by allowing for tight configurations. DIN rail supplies simply snap or slide into place on the rail. They are frequently used in control panels and electrical cabinets and are typically certified to UL standards. TDK-Lambda's DRB50 series DIN rail power supply has a stated efficiency of up to 91 per cent. This supply is typically enclosed in control panels where it can be isolated from the industrial environment making it suitable for industrial and hazardous settings.

Choosing the correct power supply is essential to ensure electronics products run smoothly and reliably. Whether looking to use linear or switching power supplies, external AC power adapters, or open frame, enclosed or DIN rail power supplies, consider how each can benefit your project.

www.newark.com



DIN rail power supplies such as TDK Lambda's DRB50241 provide a cost-effective option that also saves space



DIN rails provide the final option for securely attaching electrical and industrial control products, offering a cost-effective solution that also saves space by allowing for tight configurations

Maximize your purchasing power through partnership

Vice president and general manager Americas at Powerbox, Chris Lins, explains why purchasers should aim for more than a simple transactional relationship with suppliers

I'm not great at making decisions—I freely admit, it's not in my nature. Years ago, for example, I wanted to buy a TV. 'I am an electrical engineer', I thought to myself, 'it is just a TV, how hard can this be?!' I did exhaustive research, after which I knew more about the TV specifications than any department store salesperson.

This true story happened approximately 20 years ago, at which time I was 11 years into a professional, training intensive high-technology sales career. During that time, my peers and I were often directed to build strong relationships with customers, but we were not experienced enough to be effective. I was not really thinking about anyone's feelings during the sale, as much as I was trying to win it. Now, here I was in a store trying to buy a TV, and I just wanted to win; to buy the best TV for the lowest price.

Only human?

When *Electronics Sourcing* invited me to contribute an article, without hesitation, I wanted to share with readers what I learnt from my TV buying experience; how consultative partnerships add more value than simple transactional relationships. Here's why.

In my professional sales career of over 31 years, my biggest wins, my most heartfelt losses and my closest

customer relationships, all resulted from my choice to be a consultative partner for my customer, frequently even when my customer resisted. Why? Because while every customer/seller relationship begins as a transactional relationship, where price and delivery are the central focus, we are not machines.

We are humans, and to be human is to have emotion. Human beings make purchase decisions with emotions, justified by logic and reason. Transactional relationships are defined by short-term logic and reason, which is quite machine-like. Consultative partnerships, on the other hand, are defined by consistent emotional behaviors over time, supported by logic and reason.

There is a time and place for transactional relationships. When, largely depends on the items to be transacted, and the people involved. I do not see too many salespeople or sourcing managers investing time building consultative partnership relationships around PCB mounting hardware kits, for example. That is not to say that if they did, there would be no mutual benefit, especially in times of low supply and lengthy lead times.

Partnerships add value

Fast-forward 20 years from my infamous TV purchase

story, and I have arguably built a successful professional high-tech selling and sales leadership career by choosing to be a consultative partner, versus the 'price-and-delivery guy'. Even when you think you do not need a consultative partnership relationship; I suggest you consider re-framing the situation as if you do.

Why? Because had I done so when I was deciding which TV to buy, I may have been able to avoid the hilarious sequence of events whereby I purchased my top three TV choices, brought them all home, connected each to my home theater system, invited my closest friends for dinner to help me decide which one to keep, and then returned the other two. What? Doesn't everyone do that?

What begins as a transactional relationship, may well evolve into a consultative partnership, and the final outcome is amazing. How might you and your company benefit from a similar re-framing?

www.prbx.com



A consultative partnership can always add value, even for low cost items, especially in times of low supply and lengthy lead times



Transactional relationships are defined by short-term logic and reason, which is quite machine-like

How to source tomorrow's power solutions

Careful component selection can reduce costs in renewable energy applications. Rutronik's Wolfgang Sayer and Rohm Semiconductor's Aly Mashaly explain the benefits of silicon carbide power semiconductors

As our economy moves towards decarbonisation, an increasing number of applications, from solar generators through to high-end electric vehicles, rely on power conversion. This is where silicon carbide power semiconductors come in. Not only can they achieve greater efficiency than standard silicon semiconductors. They also enhance reliability and reduce cost, bringing the number of external components to a minimum and allowing the use of smaller and more affordable passive components. Let's take a closer look at some of these benefits.

The benefits of SiC

When compared to ordinary silicon, SiC has a bandgap about three times greater and a dielectric breakdown field strength roughly ten times greater. These properties support mosfets with a much thinner drift layer, which in turn translates into a lower on-resistance despite a high breakdown voltage. By contrast, an ordinary silicon mosfet would require a much higher RDS(ON) to achieve a similar breakdown voltage, which leads to greater conduction losses and lower efficiency.

In comparison with ordinary silicon, SiC also permits lower mosfet gate charge, enabling faster switching with lower energy loss. In addition, it brings other important benefits including greater stability over temperature and a higher maximum operating temperature, which reduces

thermal management-related costs without compromising device reliability.

A great fit for 'green' applications

Let's now look at a typical application where SiC semiconductors can really make a difference. Equipment such as solar inverters, industrial DC/DC converters and battery chargers often feature an auxiliary power unit. This runs off the main input to supply subsystems such as sensor modules, a display, and other control units or drivers. The main power switch must therefore withstand worst-case voltages applied across the drain and source terminals, which can exceed 1,300V. Different options are available when it comes to ensuring that the power transistor is able to withstand such worst-case voltages, some of which present clear disadvantages.

One possible solution, for example, is to source a power transistor that has high breakdown voltage. The problem is that ordinary silicon high-voltage transistors come with relatively high on-resistance, which translates into unnecessary conduction loss and heat dissipation. They also tend to have high gate charge, which causes high driving losses and leakage current, especially at high temperatures.

An alternative is to connect two 800V silicon mosfets in series, but this requires a more complex gate-driving circuit as well as a voltage balancing

circuit. Each mosfet also requires a heatsink, which increases the overall footprint.

By contrast, a single SiC mosfet combines high breakdown voltage of 1,700V with RDS(ON) ranging from one half to one eighth of a comparable 1,500V silicon mosfet. In addition, gate charge and input capacitance are reduced, which translates into higher switching frequency and smaller external components. And, SiC's ability to withstand higher operating temperature makes heatsinks unnecessary.

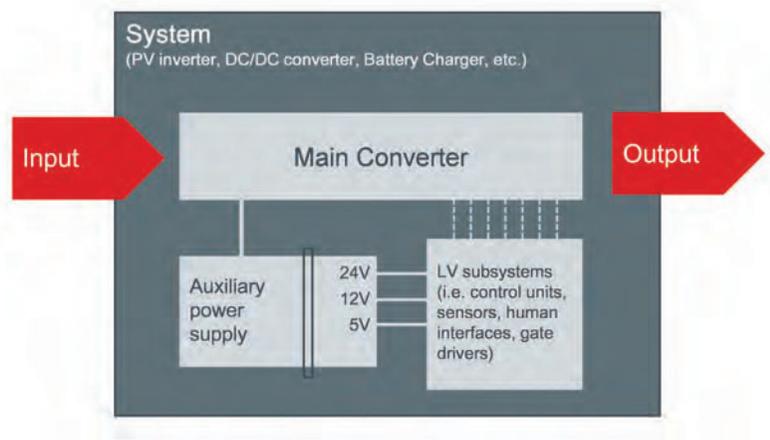
Increase efficiency

All these benefits show how switching to SiC can bring greater efficiency and significant savings. To demonstrate this, Rohm has built a 100W auxiliary power supply evaluation board that shows how efficiency rises to 88 to 92 per cent at the nominal power output for input voltages of 300 to 900V DC.

By enabling a combination of high breakdown voltage rating with low RDS(ON), as well as high switching speed, low switching loss, and high temperature capability, silicon carbide mosfets can lower materials costs in a range of applications.

www.rutronik.com

Equipment such as solar inverters, industrial DC/DC converters and battery chargers often feature an auxiliary power unit





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Distributors can help mitigate risk of obsolete parts

Dealing with obsolete parts is a continuing issue for electronics buyers who buy unique parts in industries that have long product life cycles



James Carbone

Component obsolescence has been and probably always will be a challenge for electronics buyers, but tools and services that distributors provide can help reduce the risk that buyers will have to scramble to find a part that goes end of life.

Most distributors keep track of end of life (EOL) notices issued by component manufacturers and send them out to customers. Some distributors will do lifetime buys on behalf of customers and hold the parts in stock until they are needed. Others will scrub bills of materials for customers to identify parts that are obsolete and offer online purchasing tools that identify components that are not recommended for new designs because they soon may go EOL.

Tools and services which can help reduce obsolescence risk may become even more important in the future because of shrinking lifecycles of some semiconductors and long lifecycles of electronics equipment in certain industries. In addition, more products are being designed with the capability to connect to the Internet so more companies that had not purchased electronics in the past are now purchasing components needed to connect their products to the web. Eventually those components will go obsolete and OEMs will need to find alternative parts.

"Obsolescence has always been a problem especially in industries that have long lifecycles," said Tom Treichel, senior director of assigned accounts for Digi-Key. "The longer your products are out there, the more of a chance a supplier will end of life one of the components in your products." Communications, medical and industrial OEMs have products with long lifecycles and are impacted by component obsolescence. "Certainly, military and aerospace have longer lifecycles," he said.

Rob Picken, global director at Converge, an Arrow company, said historically, "Aerospace and defense industries were the most heavily impacted by obsolescence" because life cycles of the systems built by OEMs in those industries can be excess of 30 years which cause challenges for any manufacturer to support. "Also, any changes to a design or a bill of material need to be submitted for approval, usually to the ultimate end customer and if approved, those redesigns needed to go through time-consuming recertification," he said.

Hi-rel parts go obsolete

Picken says that obsolescence is a challenge for any industry that requires high reliability parts because such parts may have a limited market. He notes that a component manufacturer producing a standard part may



Rob Picken, global director at **Converge**, an Arrow company

"Historically, aerospace and defense industries were the most heavily impacted by obsolescence"

technically be able to produce 1,000 variants of size, tolerance, voltage and other variables. However, OEM customers for high reliability parts may only want to use components at "the very edges of the component's operating capabilities, and usually with rugged or non-standard physical properties—massive operating temperature ranges, or radiation hardening for example," said Picken.

"This makes these parts low profitability for suppliers, and that means they are at risk of discontinuance during any merger activity," he said.

Picken points out that recent mergers in the electronics supply base have led to "product line rationalization, or in simple terms, obsolescence." A component manufacturer that acquires another parts maker often will discontinue some product lines of the acquired company if there is an overlap. However, consolidation is not the only reason. Environmental laws and regulations, such as the Restriction of Hazardous Substances (RoHS) directive and Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) law resulted in greater component obsolescence.



However, obsolescence often occurs simply because after a certain amount of time, certain components are no longer purchased in the same volumes as in the past. "It comes down to the usage of the parts," said Treichel. At some point usage of a component declines and the manufacturer determines it no longer makes sense to make the part even if there is still some demand for the component in some products, he said.

When designing a new product, "an engineer wants to use the latest and greatest technology and new parts" not older parts with less functionality even if there is still some demand for the part in certain products Treichel said.

Semiconductors are more often affected by component obsolescence. John Hunter, director of defense and aerospace for Avnet, said the more unique the component is, the more challenging it is to replace. "Field programmable gate arrays (FPGA) and microprocessors lead the way in complexity with RF analog devices following close behind. These complex devices also tend to be cost drivers which exacerbates the EOL challenge," he said.

However, passive components are also impacted by obsolescence. In recent years passives manufacturers have stopped making components in larger case sizes. One example is multilayer ceramic capacitors. Some capacitor manufacturers have opted to build MLCCs in small case sizes such as 0201 and the 01005 and ceased production of capacitors in larger sizes such as 1206 and 1812 because smaller case size parts are more widely used and more profitable.

Keeping up with EOL notices

Whether a part is an FPGA or ceramic capacitor, buyers are challenged in keeping up with end-of-life notices that are issued by manufacturers. Each year, manufacturers send out 3,000 to 5,000 EOL notices and each notice may have dozens of discontinued parts.

Distributors receive those notices and send out EOL information to customers that have purchased the soon-to-be obsolete parts. "We will notify the customer that a product is going end-of-life and give them some of the details when the last-time buy is," said Treichel. That gives the customer an opportunity to make a decision."

Tom Treichel, senior director of assigned accounts for Digi-Key



"Obsolescence has always been a problem especially in industries that have long lifecycles"

The customer may decide to redesign a product that uses an alternative to the EOL part. Or the customer may want to do a lifetime buy or find a similar part from a different manufacturer.

Treichel said that any customer that bought a part from Digi-Key in the previous two years will be notified if the component goes EOL. "Even if a customer has not bought from us, they can go to our site and punch in the part number and we will tell them if it is obsolete or not suggested for new designs and show them some alternatives," he said.

He said Digi-Key has quoting tools that identify EOL parts. "We don't scrub bills of materials (BOMs), but our online quoting tools allow customers to upload their BOMs and the tools will tell them what the lifecycle of the product is and if the part is not recommended for new designs. That will give them an early warning," said Treichel.

Of course, Digi-Key is not the only distributor that assists customers in managing EOL notices. For example, with Avnet's "Digital Portal", customers can sign up to receive EOL and product change notices for parts they purchase from Avnet, said Hunter. Avnet also has an internal "Light the

Target" process, in which "Avnet's sales team send EOL notifications to our customers on parts they currently buy from Avnet," he said.

"Our notification process will provide alternatives if the supplier has suggested replacements," said Hunter. "Additionally, our sales team will help our customers review options to support their EOL challenge. He added Avnet can also provide customers with a BOM analysis upon request using a SupplyFrame tool.

Avnet also supports customer last time buy requirements. "We work each opportunity to minimize the financial impact while ensuring continuity of supply, and our team will support efforts to locate EOL parts in support of our customers request," said Hunter.



"Our notification process will provide alternatives if the supplier has suggested replacements"

John Hunter, director of defense and aerospace for Avnet

Shrink EMI problems down to size

Conductive heat-shrink tubing can solve a variety of EMI/RFI issues without specifying custom cable shields or metal enclosures and without costly redesigns. President of Electronic Connector Company, Bernard Gizzi, explains

With the proliferation of high-speed communications in ruggedized equipment, the susceptibility to electromagnetic interference and radio frequency interference has become a growing challenge. This is usually manifested in one of two ways: conducted EMI/RFI causes the system to malfunction from within, or radiated EMI/RFI causes other nearby equipment to malfunction.

Today, EMI/RFI control is so important that the Federal Communications Commission in the US, the European Union, and other nations have imposed strict guidelines mandating allowable EMI/RFI limits in electronic systems. Designing for compliance can be complicated, with the EMI/RFI performance of a prototype often being different to the actual production unit. Consequently, manufacturers may not discover equipment is non-compliant until pilot production units have been built and tested.

Costly cable solutions

Shielded cable is often used to mitigate EMI/RFI, however EMI/RFI problems frequently occur at the junction between a shielded cable and its connector. Common solutions include using a metal or metallized plastic connector and soldering the cable shield to the connector or, alternatively, wrapping the junction with copper tape and then soldering it to the cable shield. More robust solutions involve metal

braided sleeving and tubular expandable braided cable shielding. Unfortunately, although these solutions work, they are costly, labour-intensive, and can produce inconsistent shielding performance.



Tubing features a metallic conductive ink coating on the inside of the tube

An easy-fit alternative

One alternative solution is to use shielded conductive heat-shrink tubing with a metallic conductive ink coating on the inside of the tube. The inner coating provides electrical continuity and EMI, RFI, and ESD shielding around the joints being connected. This can solve various EMI/RFI problems inexpensively and does not require in depth expertise.

In use, the appropriate diameter of tubing is simply placed over the components or assemblies to be shielded, and heat from a heat gun or oven is applied to the tubing. After shrinking, the

inner metallic layer provides an electrical connection between the outside surfaces of the objects that are joined, thereby creating a 360deg circumferential shield.

Heat-shrink tubing requires no soldering. This multi-purpose polyolefin is rated at MIL-STD-R-46846 and meets stringent aerospace specifications for outgassing such as ASTM E- 595, NASA SPR-0022A, and ESA PSS-010702. It can also be used with solderable and non-solderable surfaces such as stamped metals, plated finishes, and shielding paints. Standard inside diameters range from 1/8th of an inch to five inches, with custom materials available for application specific programs.

Although not all EMI/RFI cable shielding problems can be fixed with heat-shrink tubing, it can be a cost-effective and easily implemented solution to EMC challenges.

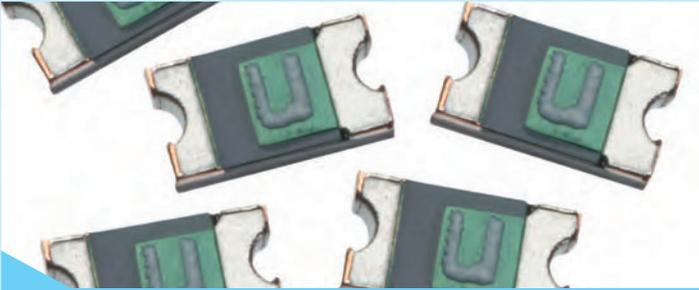
www.eccoconnectors.com



President of ECCO, Bernard Gizzi



In use, the appropriate diameter of tubing is simply placed over the components or assemblies to be shielded, and heat from a heat gun or oven is applied to the tubing



Resettable fuse range expanded

Bel Fuse-Circuit Protection has expanded its 0ZCM series of 0603 chip size surface mount PPTC resettable fuses. With this release, Bel Fuse claims to be the only manufacturer of AEC-Q compliant fuses with 10, 20 and 30mA offerings in this compact form factor.

Features include an operating range of 50 to 200mA, a maximum current of 40A, a maximum voltage of nine to 15V DC and an operating temperature of -40 to 85°C. The 0ZCM series boasts the low DCR resistance and fast trip time required for today's automotive applications, as well as being suitable for game console ports, PDAs and digital cameras, disk drives, CD-ROMs and other USB peripherals.

Packaging is 4,000 pieces in tape and reel and samples are available upon request. The 0ZCM series is in stock with Digi-Key, Mouser, Arrow, Heilind, Newark, Master Electronics, Farnell and Avnet EU.

www.belfuse.com



Making the case for wired electronics

OKW has extended its range of Style-Case handheld enclosures to include a version without a battery compartment, providing even more space inside for electronics. The new L version is ideal for wired connected electronics.

Perfect for remote controls, the Style-Case range is suitable in medical and social care electronics but also in a range of office, industrial and household controller applications. Its high-gloss finish is pleasant to touch and is also easy to keep clean with a recessed area in the top for a membrane keypad or product label.

The robust Style-Case offers ingress protection up to IP65. It is assembled using tamperproof Torx stainless steel screws, which is another important feature for medical and wellness applications.

Style-Case is available as standard in three sizes and two plastics, however, the new version size L is available only in traffic white ASA.

www.okwenclosures.com



Taking the stress out of Cat6 cable sourcing

ShowMeCables is now offering L-com category six rated, angled patch cables. These new Cat6 Ethernet cables showcase a patented design said to enable better cable management while protecting the connection within the cable.

Unlike non-angled patch cables that risk wire damage when bent near the boot, these L-com cables are fastened at a specific bend, which does not place stress on any internal wires. Tight-fit and dense connectivity applications, such as data centers, are the perfect setting for use.

ShowMeCables currently carries 14 angle variations, plus four color options and 10 length options in each cable.

www.showmecables.com



Composite wires now available

Reme Wire and Cable has introduced custom design and manufacturing capabilities for cable products. Known for its ability to manufacture custom cable designs, Reme has recently added capabilities to make hybrid composite constructions with fiber optic and copper cable under one jacket. The company has also expanded its insulation and jacket compound offerings to include cross-linked polyethylene and zero halogen.

The hybrid composite cables are becoming popular due to their ability to extend distances for data and power cable runs beyond the standard limits of PoE cables. The flexibility of running longer distances and the cost savings associated with needing fewer or no electrical power outlets are the key benefits. Reme is meeting this demand with its new Activate Powered Cable Solutions, a series of composite and Siamese fiber and copper cable constructions.

reme.com

Electronics supply base consolidation is changing

More mergers and acquisitions are occurring because suppliers want to add products or technologies that they don't currently have to reach out to new customer segments

Last November, many electronics component buyers were troubled by the news that passive powerhouse Yageo would acquire Kemet, another leading manufacturer of resistors, capacitors and other components.

The planned acquisition, which is expected to close later in 2020, would be good news for Yageo because it would make the company a \$3 billion per year passives behemoth. However, it appears to be bad news for passive component buyers, who would have one less supplier to choose from which would mean less competition and potentially higher prices.

Some buyers fear it could also mean more component obsolescence because if consolidating companies have overlapping product lines, one of the lines will likely be eliminated.

Buyers are concerned the Yageo-Kemet merger will cut down on parts availability because there could be less investment in new capacity by the consolidated company. They point out that while component manufacturers added capacity in 2016 it was not enough to meet demand in 2017 and 2018 which resulted in shortages of multilayer ceramic capacitors (MLCCs), chip resistors, power semiconductors and other discretes.

If investment in new capacity is not increased by Yageo and other component manufacturers, another round of shortages of capacitors, resistors and discretes is likely because component demand will increase over the next several years. They point out major trends such as development of more Internet of Things devices, continued growth of wireless technologies going into vehicles, industrial equipment, autonomous electric and hybrid vehicles and strong growth of cloud computing will drive component demand to new heights.

Yageo said the acquisition will make would make the company a one-stop shop that provides buyers with a wider choice of polymer, tantalum, ceramic, film and electrolytic capacitors, chip resistors, sensors, actuators and other components. The combined company would be better able to partner with long-standing customers worldwide through its combined 42 manufacturing plants and 14 research and development centers.

Industry analysts say Yageo's planned acquisition of Kemet is a recent example of the type of consolidation that has traditionally occurred in the electronics supply base over the years i.e. one supplier acquiring another to boost overall revenue, eliminate a competitor, and reduce cost by consolidating operations. Other examples in recent years include ON Semiconductor buying Fairchild, Infineon acquiring International Rectifier and Microchip buying Microsemi. Such acquisitions occurred frequently over the past 10 years.

However, in recent years, more mergers and acquisitions are occurring because one supplier wants to add products or technologies that it currently it does not have and to branch out to customer segments it does not serve. "In the M&A activity we have seen recently, one company acquires another company although the two companies don't have product overlap," said Kevin Anderson, senior analyst, power semiconductors for researcher IHS Markit. "They do it for reasons of diversifying their customer base or their market space. A good example is Infineon is in the process of buying Cypress," he said. Cypress has a differentiated portfolio of microcontrollers as well as software and connectivity components while Infineon products include power semiconductors, sensors and security solutions. "Those two companies basically have zero overlap in the markets that they serve," said Anderson.

There have been many other mergers involving companies that don't have overlapping product lines. For instance, in 2015, the microprocessor market leader Intel acquired Altera, which builds field programmable gate arrays, semiconductors that Intel did not previously make. In 2019 there were seven major mergers and many of them involved companies that looked to expand their product portfolios and reach new markets. For instance, graphics processor maker Nvidia bought Mellanox which makes adapters, switches and cables for high performance computers, while ON Semiconductor acquired Wi-Fi solutions supplier Quantenna Communications.

In some recent mergers and acquisitions, one company will buy a product division of another company, not the whole company. "A good example of that is NXP buying the Bluetooth radio business of Marvell," said Anderson. "We're seeing those kinds of transactions."

A sharper focus

Rob Lineback, senior market analyst for researcher IC Insights said some consolidation is due to companies wanting to "sharpen their focus on growth market applications, like the Internet of Things or machine-learning and artificial intelligence."

In some cases, the acquiring company starts a whole new company with the division that it acquired. One example is NXP selling its standard products group for \$2.75 billion to Chinese investment companies which then used the group to create Nexperia in the Netherlands. Nexperia now is selling more power transistors than it was when the operation was part of NXP, said Lineback.

In other cases, consolidation may occur because a semiconductor company just wants to get out the chip business. A recent example is Panasonic. Last November, Panasonic announced it was quitting the semiconductor business and selling its assets including the company's chip and product development units and its manufacturing facilities to Nuvoton Technology, a subsidiary of Winbond Electronics, based in Taiwan for \$250 million.

In fact, Panasonic has been divesting its semiconductor business for years. In 2014, it sold a 51 per cent stake in its chip manufacturing assets including a 300mm fab and two 200mm fabs to TowerJazz. UTAC bought its assembly/test facilities. It also sold its diode and transistor business to Rohm Semiconductor last year.

Anderson says that consolidation has probably resulted in less competition in some product areas. However, he notes that 20 years ago there were probably 15 or more memory IC manufacturers and now there are five, but there's still healthy competition and the remain five have aggressively invested in new technology and capacity.



Panasonic has been divesting its semiconductor business for years. In 2014, it sold a 51 per cent stake in its chip manufacturing assets including a 300mm fab and two 200mm fabs to TowerJazz

Less volatility

In fact, consolidation has had a positive impact on the semiconductor industry, according to some industry analysts. "If you look 20 years ago, the boom/bust cycles of semiconductors were more extreme than they are today. We still have peaks and valleys, but they aren't as severe," said Anderson. That is due in part to consolidation.

If there are 15 companies "chasing the same business versus five," it leads to oversupply. Those suppliers compete by overproducing and lowering prices to gain market share. However, when demand eases, revenue for chipmakers plummets. Chipmakers scale back on capital expenditures and when demand recovers, shortages result. Now with fewer suppliers "the market is more mature and there is more discipline" and less volatility in the industry, he said.

Less volatility is good for electronics purchasers because it can reduce the frequency of shortages and the duration, so buyers don't have to scramble on the open market to find parts and pay higher prices for them.

The risk of counterfeit parts is also reduced. During times of shortages, incidences of 

» buyers purchasing counterfeit parts increases because counterfeiters will flood the market with bogus parts.

While the industry may be mature and there are now fewer suppliers of memory chips, power transistors and other components than there were 20 years ago, it does not mean that consolidation is over. In 2019, there were more than 30 semiconductor acquisition agreements with a combined value of \$31.7 billion, a 22 per cent increase from \$25.9 billion in 2018, according to IC Insights. In addition, seven of the acquisition agreements totaled \$1 billion or more.

The average annual value of semiconductor industry mergers between 2015 and 2019 was more than 4x the average from 2010-2014. Prior to 2015, total value of acquisitions in a year were less than \$17 billion. From 2015-2019, total value of acquisitions was more than \$25 billion annually and that trend may continue for several more years, IC Insights said.

Many of the agreements involved companies that are developing or producing chips for high-growth products involving machine-learning and artificial intelligence, autonomous vehicles, human recognition, computer vision, virtual/augmented reality, and high-speed wireless connections to the Internet of Things, said Lineback.

The value of the acquisitions in 2019 was the third highest in semiconductor industry history. The record was set in 2015 when chip companies spent \$100.7 billion on mergers and acquisitions. The second highest was \$59.8 billion in 2016, according to IC Insights.

No records expected

However, it is unlikely there will be a

new record amount of dollars spent for acquisitions over the next several years because “the low hanging fruit with M&A has been plucked and companies that remain tend to be in better shape and more difficult to pick up because another supplier would have to pay a pretty high premium. It’s hard to find real bargains out there,” said Lineback. Smaller acquisitions are likely such as Diodes Inc., a manufacturer of discretes, logic, and other chips, acquiring Lite-On Semiconductor of Taiwan for \$425 million. The company also manufactures discretes and analog semiconductors. The deal is expected to close April.

Buyers concerned that there are fewer choices in the supply base and less competition may take heart in fact that there are new semiconductor companies being formed and venture capitalists are looking to invest in new chip companies, according to industry analysts.

For instance, China is trying to “bootstrap their local semiconductor business. There are a bunch of startup companies, although they are small,” said Lineback.

More venture capitalists are also looking to invest in new semiconductor companies, according to Anderson. That is a change. “Over the last three or four years, you could not get a VC interested. But now VCs are looking at investing. The whole artificial intelligence thing is really driving a lot of that,” he said.

The Internet of Things is also driving venture capitalist interest. “There is a lot of VC development interest on the sensors side,” according to Anderson.

Assess the risk

Analysts say while mergers and acquisitions can pose challenges for buyers, further consolidation is inevitable and buyers need to assess which of their suppliers are at risk of being acquired and determine what



James Carbone, Contributing Editor of Electronics Sourcing

the impact would be. For instance, a purchaser that has placed a relatively large amount of business with a smaller supplier may be important to that supplier. The supplier may offer discounts and be more responsive to special requests and offer better customer service. If that supplier is acquired by a larger company, the buyer’s company may not receive discounts and responsiveness from the larger supplier.

Assessing the vulnerability of a supplier to acquisition may be especially important for buyers purchasing more mature parts that have a limited supply base. If a supplier for such parts is acquired by another, the acquiring company may decide to discontinue producing the older parts because demand for them is limited and margins are low.

A buyer may need to qualify new suppliers for older parts or do a lifetime buy, find substitute parts and work with the company’s engineers to change a product design to use more readily available components.

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
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

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ELECTROMECHANICAL (Continued)											
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											
Abrakon 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
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

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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/es	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	
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	

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SEMICONDUCTOR

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)											
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
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

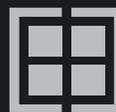


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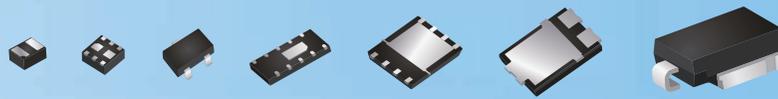




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Efficient circuit design
Fast delivering
Cost saving

