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On the cover – November/December 2019

Colourful solution to purchasing problems

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Buyers' Guide

All the facts and figures to help you buy



Editor's Word



Efficiency: a battle of attrition

As the climate change debate surges around me, I would like to thank one group of people for their contribution to a more sustainable world. These are the employees of the global electronics industry who work tirelessly, some across their entire careers, to steadily improve the efficiency of electronic components and then deliver them to the market.

Over the past 30-years I've never attended a press conference for a new electronic component where the presenter is pleased to announce they had reduced the efficiency of the new device. The opposite is always true.

However, the reason these people don't get more praise is that this is a battle of attrition. Every improvement it typically tiny and thus gains little attention. However, when you add all the efficiency gains, across all the new components, from all corners of the world, across decades of effort, the net results mount up.

Essentially, there is no end in sight for efficiency enhancement. Just as one technology appears to have reached its zenith, a new material or manufacturing process pushes it on again. Nano technology is a classic example of this evolution.

So thank you, continue the good work and keep press releasing your new, ever more efficient, components.

As a closing note I doubt the human race can take sole ownership of the earth's climate using the single lever of carbon dioxide. I fear its more complicated than that and wonder who gets to pull the lever, how far and how fast. All I can do is place my faith in people much cleverer than me.

Jon Barrett

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Shop online for next-gen converters

Distrelec has added Traco Power's TEC 2 and 3 WI series SIP-8 DC/DC converters to its web shop. Promising outstanding performance at an affordable price, these next-generation two and three watt converters are said to combine improved characteristics with reliability and cost-efficiency.

Head of high service distribution at Traco Power, Michael Bruderer, commented: "The four new DC/DC converter series enable a significantly increased efficiency. With the reduction of thermal loss, the operating temperature can be expanded, now covering -40 up to 95°C with derating."

The converter topologies also boast a greatly improved overall regulation of within 0.2 and one per cent. Moreover, the 4.5V DC input now reaches up to 18V DC. Engineered to meet safety standards IEC/EN/UL 62368-1 and UL 60950-1, the converters are well positioned to serve general purposes industries.

Chief executive officer at Distrelec, Steve Herd, added: "Distrelec's partnership with Traco Power, and our ability to stock their latest technology, is an example of our dedication to harvesting close relationships with suppliers."

www.distrelec.de

Energy harvesting converters in stock

Mouser Electronics has announced a global distribution agreement with Matrix Industries. The deal will see Mouser stock energy harvesting DC/DC boost converters and associated kits, perfect for IoT or wearables applications.

Matrix Mercury DC/DC boost converters are ideal for managing surplus energy from extremely low-input-voltage sources such as thermoelectric generators and thermopiles. The converters' impedance-matching feature enables up to 80 per cent peak conversion efficiency



More industrial interconnect choice

Heilind Electronics is expanding its industrial interconnect offering with Harting's new Han-Eco B series connector hoods and housings.

Compared to its metal-case counterparts, the corrosion-resistant thermoplastic Han-Eco B series provides an enhanced level of functionality to the industry-standard Han B line. Advanced features include the option of rear mounting the internal cable harness to the connector housing mounted to a switch cabinet. This helps simplify assembly and allows for manufacturing floor optimisation with pre-assembled harnesses.

For maximum flexibility, this series is compatible with standard inserts and modules, including Harting Han B industrial standard products, in conjunction with the hinged frames from the Han-Modular portfolio. Han-Eco B products are available in bulkhead, surface mount, cable-to-cable, side entry and top entry designs, as well as in sizes 6B to 24B, with cable gland sizes ranging from M20 to M40.

www.heilind.de

energy harvesting across the entire input voltage range while the ultra-low quiescent current of 700nA helps ensure fast charge times. Mercury supports input voltage as low as 10mV, while the output can be regulated up to 5V.

To support the range, Mouser is offering an evaluation kit and a rapid prototyping kit ideal for developing IoT sensor applications.

www.mouser.com



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In Brief

Lab ensures transducer accuracy

Danisense has established a DC calibration test lab at its Danish headquarters in Taastrup offering a free test service for its high voltage 500 and 10,000V current transducers. Units are 100 per cent tested and shipped with a certificate of calibration that details the actual current error, the error without offset and the linearity error.

www.danisense.com

Enhanced STEM support

Farnell is now stocking Kitronik accessories for micro:bit, Arduino and Raspberry Pi. Targeted at educators, students and hobbyists, Kitronik products will enhance Farnell's open-source educational and STEM product range and build on its position as the exclusive manufacturer of the BBC micro:bit. Farnell stocks everything required to get started in physical computing as well as providing free resources, including lesson plans and project ideas online.

www.farnell.com

Compliance made simple

SGS has launched a new service providing manufacturers and importers of electrical and electronics products with a one-stop solution to meeting various regulations on restricted substances in over 60 countries. The International Type Approval Restricted Substances Service offers a streamlined and cost-effective approach to demonstrating chemical compliance including testing and advice on regulatory requirements for different markets.

www.sgs.com

One-stop sensor expertise

TE Connectivity has completed its acquisition of Silicon Microstructures, combining SMI's micro-electro-mechanical systems sensor manufacturing capabilities with TE's operational scale and existing sensor technologies to provide a more comprehensive global sensing offering. SMI expands TE's expertise in pressure sensing, particularly in medical, transportation, and industrial applications.

www.te.com



Fast turn cable-assembly delivers miniature connectors fast

Nicomatic has announced a fast turn-around, one-stop-shop cable assembly service for its range of CMM, DMM and DLMM miniature connectors. With a new, standardised, easy-to-use ordering system, quotes can be turned around in a day, and lead times are also short.

The new cable service covers flying leads featuring a Nicomatic connector plus cable, back-to-back assemblies with the same connector on each end, or back-to-back reversed with signal contacts only. Nicomatic holds stocks of military cables and offers various options including back-potting, backshells and screening. Cable assemblies are subject to 100 per cent electrical continuity testing.

Nicomatic's Phil McDavitt commented: "Our new system means that getting quotes and designs produced and delivered has been simplified and assemblies are now available on very short lead times. We manage all the logistics, quality and control processes to IPC-A-620-C standards."

If customers require a more complex assembly, perhaps including other manufacturer's connectors, additional quote time may be required and lead times will vary.

www.nicomatic.com

One-touch kiosk brings purchasing to the shop floor

RS Components has launched a new procurement solution aimed at procurement and operations professionals working within maintenance, production and facilities management. This single sign-on touch screen kiosk provides access to multiple services from sourcing and purchasing to technical advice and managed inventory solutions.

Designed for use on the 'shop floor', the new RS ConnectPoint kiosk is powered by Raspberry Pi. It gives users a single terminal sign-on via a ConnectPass QR code or pin number.

For support with orders, enquiries and technical advice, the kiosk is connected to RS Live Chat, as well as linking with the RS Local Network. This means users can interact with their designated



Great timing for new distribution deal

Ricoh Electronic Devices and Digi-Key Electronics have announced a global partnership focusing on the distribution of Ricoh's power management and real time clock ICs. The agreement, which supports Ricoh products via an online distribution channel, provides purchasers with a one-stop shop service to select from a range of Ricoh devices for consumer, automotive and industrial applications.

The Ricoh semiconductor offering now available from Digi-key includes a variety of analogue ICs providing low current consumption, high accuracy, small sized packages and high reliability. Featured products include LDO voltage regulators, supervisory ICs, DC/DC controllers and converters, load switches and real time clock ICs.

www.e-devices.ricoh.co.jp/en/

RS Local branch for tailored support including part identification, managed inventory services and custom order solutions. Transactions in PurchasingManager, providing control over purchasing limits and spend across multiple users, can also be made via RS ConnectPoint.

Managing director, Northern Europe, Pete Malpas, explained: "This new solution illustrates our commitment to continually evolve our value-added services proposition. RS ConnectPoint can help save time and money, reduce downtime and streamline processes. These are important factors for procurement and operations professionals trying to create efficiencies that lead to bottom line savings."

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Future safety starts now

As electric vehicles accelerate and autonomous cars evolve, the number of electronic systems on board is set to multiply, yet the safety of next gen cars depends on components sourced today

Whether powered by gas electric, fuel cell electric, diesel electric, Li-ion polymer, or ultra-capacitor engines, electric vehicles are challenging automakers to address higher energy applications. Features such as battery management systems and on-board charging systems already require careful consideration, but with autonomous self-driving vehicles starting to make an appearance on the road, on-board electronics are set to increase.

Emerging automotive protocols

Vehicle connectivity is another area of stimulus, with internet access required to connect devices both inside and outside the car. A range of new protocols are emerging around this technology including: vehicle-to-vehicle (V2V) communications that notify the driver or vehicle to take evasive action when there is the potential for a collision; and vehicle-to-infrastructure (V2I) communications, which could, for example, allow traffic systems to collect data that can be used to control traffic light timing, allowing more efficient traffic flow.

Other emerging protocols include BroadR-Reach technology,

which allows multiple in-vehicle systems to access information simultaneously over unshielded single twisted-pair cable; and HDBaseT, which has historically been used in the consumer and high-end A/V market to provide high bandwidth, long-reach capabilities. Now, a new automotive version has been introduced to provide 6Gbps throughput for in-vehicle convergence of high-definition A/V, USB, ethernet, feature controls and power on a single pair of wires.

Ensuring automotive safety

Any automotive modules currently in development must meet the safety and test standards of these latest communication protocols. To help purchasers and designers across the industry meet this remit, TTI is working with supply partner, Littelfuse.

Littelfuse provides circuit protection solutions for a variety of automotive applications such as motor control, lighting, ignition systems, infotainment and navigation systems, e-calls, on board chargers and battery management systems. It also offers solutions for communications systems including LIN and CAN bus, as

well as for load dump protection, heating, ventilation and air conditioning and electrical cooling fans.

The company ensures appropriate support for all kinds of automotive systems, by offering a full AEC-Q101 and AEC-Q200 portfolio for automotive circuit protection including: fuses, surface mount reflowable thermal fuses, PPTCs, varistors, ignition IGBT, TVS and diode arrays.

In fact, since its first automotive fuse was invented in 1930, Littelfuse has partnered with many carmakers on circuit protection solutions that have become the industry standard. This means its experts are well-equipped to support customers' projects in accordance with worldwide automotive safety standards.

Its engineers can help purchasers understand which standards apply in terms of both the application itself and the geographical location for which it is designed, as well as offer guidance on how to meet those standards.

Certified circuit protection

To this end, the Littelfuse

portfolio offers a broad line of circuit protection devices certified compliant with standards such as the JASO and ISO 7637-2 surge test covering transient surges; ISO 7637-2 standard covering electrical disturbance by conduction and coupling; ISO 10605 standard covering electrical disturbances from electrostatic discharge; and standards relating to load dump, switching transients and ESD threats in the form of SAE J1113; GM 9105, ES-F2af-1316-AA Ford Visteon.

Other areas of expertise focus on electrical component qualification, with expertise on AEC-Q101 failure-mechanism based stress test qualification for discrete semiconductors in automotive applications and AEC-Q200 stress test qualification for passive electrical devices.

By contributing their own experience to the development of new standards, Littelfuse engineers are helping to ensure the safety and reliability of the next generation of automotive circuit protection products.

www.ttieurope.com





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AEC-Q101 & AEC-Q200 portfolio for Automotive Circuit Protection

Littelfuse offers a full AEC-Q101 & AEC-Q200 portfolio for Automotive Circuit Protection including: Fuses, Surface Mount Reflowable Thermal Fuses, PPTCs, Varistors, Ignition IGBT, TVS and Diodes Arrays.

Littelfuse specialists can help designers develop automotive modules that meet the safety and test standards of the latest communication protocols.

Littelfuse experts support customers' designs in accordance with worldwide automotive safety standards.

- Transient surges: JASO and ISO 7637-2 (Surge) test
- Electrical disturbance by conduction and coupling: ISO 7637-2
- Electrical disturbances from electrostatic discharge: ISO 10605
- Load dump, switching transients and ESD threats: SAE J1113; GM 9105, ES-F2af-1316-AA Ford (Visteon)

Littelfuse provides the right circuit protection solution for automotive applications like:

- Motor control
- Lighting
- Ignition Systems
- Infotainment and Navigation systems
- E-calls
- On board Chargers
- Battery Management Systems
- Communications systems: LIN, CAN bus
- Load dump protection
- Heating, Ventilation and Air Conditioning
- Electrical Cooling Fan





Mil/aero helps drive distributor sales

With increased defense spending, distributors that sell to the defense industry report robust component demand



James Carbone

While sales of semiconductors, passives and connectors have slowed this year compared to 2018, distributors that service defense and aerospace OEMs and their subcontractors say component demand from the mil/aero segment remains strong because of the increase in defense spending in the United States and foreign countries.

"Sales to the defense and aerospace market have increased significantly over the past two years," said Roger Raley, vice president for TTI's military/aerospace segment. TTI's sales to companies that build military aerospace systems and equipment increased 23 per cent in 2018 and were projected to rise more than 20 per cent in 2019.

"Defense spending both to domestic and foreign militaries has increased significantly over the past two years," he said. The Trump administration has increased spending and "our allies overseas also are allocating more of their budgets to defense spending, so it's a great time to be involved in the defense segment," said Raley.

To serve the military/aerospace segment, TTI continues "to invest in resources and expertise to allow us to stay focused on our core markets" including the military/aerospace market. The focused strategy is paying off and TTI is "building stronger, more focused partnerships that allow us to address the critical needs this market requires," said Raley.

TTI, which sells passives, connectors, electromechanical devices and specialised semiconductors, was founded 50 years ago to service military and aerospace manufacturers, Raley noted. "While our customers now include manufacturers involved in all areas of transportation, communication devices and industrial applications, a large percentage of our business continues to be in support of our mil/aero partners," he said.

TTI sells components into a wide range of military equipment including avionics, ground vehicles, aircraft, satellites, missiles, connected warrior applications and unmanned vehicles. "In fact, it would be hard to find a defense application where we don't provide component content," said Raley.

Expanded focus

He added that TTI has always had the broadest and deepest passive inventory in the industry to support the mil/aero segment. "However, over the past few years we really expanded our product focus and supplier relationships to include the broadest and deepest interconnect and electromechanical inventory profile in the industry. Because we're not focused on inventory turns like our larger competitors are, we invest well ahead of our customers' needs to ensure we have product on the shelf when they need it," Raley said.

Doing business with mil/aero customers is different than with commercial customers. "One



Roger Raley, vice president for TTI's military/aerospace segment

"Sales to the defense and aerospace market have increased significantly over the past two years"

reason is the products we sell may be required to operate only once but must operate without fail because lives are very literally on the line," said Raley. "Quality is paramount in all areas, whether it's documentation, counterfeit mitigation or additional inspection." TTI has the proper certifications, processes and expertise in place to ensure the highest reliability for our products, he said.

John Hunter, director of Avnet's defense and aerospace segment, said the defense business is also different than the commercial business because defense requirements are more stringent and there are more enhanced testing requirements, component preparation for

severe environments, and strict documentation control requirements. "In general, the stakes are higher, as battlefields and space deployments are higher risk, which means the technology has to work every time. Lives depend on it," said Hunter.

Avnet has been supplying to the defense and aerospace segment over the past 20 years and has seen growth, especially in recent years because of Department of Defense budget increases, overseas sales, strong commercial avionics, space and satellite markets, and overall increased electronic capability and content.

He said while business to the mil/aero segment has always been



strong, in recent years there has been growth in specific defense initiatives including smart munitions, unarmed air vehicles and satellite communications.

Distributors say there are challenges in supporting the defense market, including the high-mix, low-volume nature of many of many military programs. "This creates a challenge in our customers' ability to forecast," said Raley. TTI offsets this by having the "broadest and deepest IP&E inventory in the industry. We also work with our customers to pipeline inventory well ahead of when they need it," he said.

Another challenge is long lifecycles of defense systems. TTI needs to support defense programs that have lifecycles of 20, 30, 40 years or more, he said. "We work closely with our OEM partners to ensure product availability over the life of a program." When products do become obsolete TTI can offer alternative solutions because of its comprehensive line card.

The counterfeit risk

Hunter added counterfeit parts pose a greater risk in the defense sector than with commercial customers. "By the critical nature of the defense and aerospace customer applications, there is absolutely a greater risk for the segment. This risk is exacerbated

by the longevity of defense and aerospace programs and the costly reluctance to redesign," he said.

To combat the risk, Avnet only sells product from a franchised manufacturer or an authorised distributor, with traceability to the franchised manufacturer, Hunter said.

"Avnet has a robust returned material verification process, which ensures the product being returned is the exact material shipped," he said. The verification process includes, but is not limited to, customer information, quantity, date code, and packing integrity. "This helps ensure the authenticity of the parts and their manufacturer," said Hunter.

Another challenge is managing the use of more commercial off-the-shelf (COTS) components. Hunter said the trend to use more commercial off-the-shelf components in the defense industry has not made it easier for distributors to support the defense and aerospace sectors. "The reality is that the move to COTS has increased the support challenge for distribution as the defense and aerospace customers design in COTS components, then flow down the additional requirements," he said. These customers are not immune from cost down challenges, which

forces them to look for price and efficiency opportunities. As a result, distributors are being pulled into additional support functions such as low dollar procurement activities, quality support, and various value add support functions, he said.

Because of long life cycles and component obsolescence, many defense OEMs purchase components from independent distributors. For instance, independent distributor Smith, based in Houston, Texas, supplies components to customers "across all sectors of the aerospace and defense industry," said Tim McQuade, trading manager, aerospace & defense for Smith. "Our team specialises in sourcing critical, obsolete, and hard-to-find components."

He noted that as defense spending has increased over the past two years Smith has increased its sales to defense contractors and their subcontractors. "Our team sells all types of electronic components to aerospace and defense customers. Memory, LCD panels, and processors are especially popular commodity groups within the industry.

To meet the needs of its defense customers Smith has invested in aerospace-and-defense-specific certifications such as AS6081 and AS9120 at its distribution centers in Houston and Hong Kong, said McQuade. "Offering nitrogen storage capabilities for long-term requirements has also helped us earn more customers," he said. Value-added services, such as specialised testing, offer key supply chain support for EOL parts.

He said that aerospace and defense customers have even greater quality and testing requirements than customers in other industries. Most A&D

customers require certification to the AS6081 and AS9120 standards to ensure the proper mitigation of nonconforming product. These key certifications also outline the sourcing and traceability requirements and processes for distributors, which aerospace and defense customers rely on strongly to help keep their supply chains active."

"Strict date codes and lead times are a few of the aspects that can be challenging to navigate when working with defense customers. Sourcing obsolete components for A&D applications can pose a particularly acute challenge, which makes adherence to the AS6081 and AS9120 standards critical," said McQuade. Maintaining a strict supplier rating and management system is one of Smith's top priorities to ensure the highest-quality parts.

Doing business with defense contractors has become more challenging for independent distributors over the last 10 years because the aerospace and defense industry has tightened its procedures and sourcing policies for distributors to enter its supply chain. "The investment Smith has made in obtaining ISO certifications that are A&D specific, coupled with 35 years of experience and all of the peripheral value-add services we offer, has certainly opened doors for us," said McQuade.

He added overcoming barriers to entry can be quite steep in the A&D industry, but once those are satisfied, "opportunities to partner on a variety of supply chain services exist, and the customers tend to be very loyal."



"By the critical nature of the defense and aerospace customer applications, there is absolutely a greater risk for the segment"

John Hunter, director of Avnet's defense and aerospace segment



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Keep rail-related sourcing on track

With more electronic components used in rail applications than ever before, it's vital to stay abreast of evolving standards, keep up with new technologies, and steer clear of grey-market sourcing

Purchasing components for the rail industry can be challenging thanks to strict industry standards, coupled with the necessity for robust, rugged components. Sourcing for rail, rolling stock, infrastructure and signalling covers a surprisingly wide variety of electronic components. Various types of circuit breakers, sensors, power conversion, power supplies, magnetics, optoelectronics, capacitors, resistors, thermostats and motor protectors are all supplied by Charcroft Electronics into rail applications.

Stringent EMC standards

Industry standards for this sector are equally diverse. Products destined for rail applications may be required to achieve a variety of safety, fire and EMC approvals, such as EN50155, EN50121, EN61000, EN60695, BS6853, EN9100, EN45545, NFF16, and RIA12.

EMC certification, particularly for power supplies, is a key requirement of sourcing for rail applications. In recent years, with a greater prevalence of electronic components in rail applications, there is certainly more emphasis on these

more stringent requirements. For rolling stock, the standard EN50121-3-2 is required, while for trackside applications the increased field strengths of EN50121-4 are required.

Increased converter demand

Over the last 10 years, Charcroft has seen significant changes to the rail component sector, the greatest being the dramatic increase in the volume of electronic components required. With a large increase in the amount of electronic systems installed in rail applications, there has



Safety is a huge driver when sourcing for rail rolling stock and infrastructure



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been a shift from the traditional electromechanical components to electronic components instead. We are seeing features being incorporated into carriages such as Wi-Fi, LED lighting, sockets in seats and charging facilities, all of which require more electronic components.

This increase in subsystems is also creating increased demand for DC/DC converters. Most train battery voltages are 110V, so DC/DC converters are utilised to convert this to more manageable voltages for the various subsystems and functionalities, such as CCTV systems.

Modernising rolling stock

Electronic components are increasingly used in both new builds and in major maintenance overhaul. During maintenance refurbishment, safety critical components such as thermostats in heaters, ventilation and air conditioning systems are routinely changed, however, this is often seen as an opportunity to modernise the facilities and capabilities within the train by installing new systems, such as wi-fi and charging facilities.

Looking to the future, Charcroft, sees the main advances for rail and rolling stock as a move to greener power. With the UK government pledging to phase out diesel only trains completely by 2040, various other technologies are being developed, with the most likely replacement being hydrogen trains. Hydrogen trains are proposed to be introduced within the next two years on

certain lines, offering emissions-free rolling stock, more effective performance during acceleration, and nearly zero noise.

Rail-specific expertise

As with the rest of the electronics industry, lead times for rail components have been affected, and it can be tempting to consider sourcing outside of usual channels. Charcroft strongly recommends, however, that purchasers do not fall into that trap. Make sure you continue to rely on franchised sources, and ensure you use reputable distributors that know the rail industry and requirements.

An understanding of the approvals required, and the rugged components needed, can help specialist distributors offer alternatives that meet the required fit, form and function. Also, where possible, it provides the flexibility to offer customised solutions. These same factors should also be considered when dealing with obsolescence.

When parts are designed specifically for use in rail applications, manufacturers are generally aware of the necessity for a longer product life cycle, in line with the life cycle of the end application. As with any component, however, there will be natural obsolescence of certain parts. As an obsolescence specialist, Charcroft can assist with sourcing requirements for problem parts, bespoke solutions, and offer alternatives.

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An increase in rail subsystems is boosting demand for DC/DC converters

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A case for cyber securing our industry



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

This month John Denslinger argues for an 'operational alliance' within which electronics companies collaborate to cyber-secure the industry

Cyber security • By John Denslinger

Is the electronic component supply chain secure from cyber threats? That question came to mind as I read a recent article published in the *Harvard Business Review*. The author, Daniel Dobrygowski, head of governance & policy for the World Economic Forum Centre for Cybersecurity, is obviously a person with deep understanding of the digitally connected world. His article proceeds to highlight the hi-tech industry forming its own cybersecurity alliances and pacts. My immediate reaction: why isn't our government taking the lead? It would seem the consequences of cyber-attacks are of national interest. Our personal safety and critical infrastructure are at risk. So are institutional, financial and legal systems. Each is a ready target for bad actors. The reality is most western governments are still more focused on developing offensive capabilities than building responsive counter cyber measures to protect us and our businesses.

Let's face it, the future digital network will only increase in complexity and entice increasingly destructive cyber-attacks. Anyone familiar with our industry understands me completely when I say our companies tend to be fiercely competitive and keenly individualistic. That being the case, is it really possible to form meaningful alliances to tackle cybersecurity issues? If so, what kind of alliance makes the most sense?

To answer that question, let's draw from Mr Dobrygowski's experience and discuss two possibilities that might be appropriate for our industry:

Operational alliances—a small-group structure focused on intelligence and related technical data sharing. Information is exchanged freely to raise collective awareness of cybersecurity issues and speed adoption of counter security technologies.

Normative alliances—a structure of very large-platform companies targeting solutions to cybersecurity vulnerabilities with the intent

of creating a more secure, global digital environment for customers, institutions as well as nations.

To be clear, the global digital network transformed our industry and made us more productive. B2B, B2C and C2B eCommerce transactions take place 24/7/365. Uploads/downloads between business and customer systems is commonplace and the frequency continues to accelerate. Business is global. Speed is critical. Privacy is paramount. So too is reliability of transferred data sets. In the digital network, we are vulnerable. The next cyber target making headline news might be one of our own! If that happens, you know customers will demand counter-measures from every company and their supply chains.

With so much at stake, our industry should strongly consider banding together for the greater good. Protection from government cyber efforts can't be counted on. The industry must safeguard itself. IT solutions of one company may quickly recognize cyber threats, hacks and breaches. Another company may have developed state-of-the-art cybersecurity tools. Another may be capable of tracking digital footprints and identifying threat sources. And still another, the speed and resources to prevent cyber intrusions before any damage is done. What if we could share what we know and armed the industry with the best cyber safeguards? I think customers would value the concept greatly as it better protects them and their supply chain more comprehensively.

In my view, the Operational Alliance appears to be a good fit for our industry. ECIA might be the perfect forum to host such an alliance. It's about time we collaborate and cyber-secure our industry.

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Why custom isn't always costly

Resolving component shortage issues can involve custom test solutions, innovative design adaptations and serious troubleshooting. With the right skills it can also be cost-effective says general manager of Winslow Adaptics, Josh Mancey

Q What purchasing trends are you seeing in the test and development markets?

Demand for machined test sockets is increasing. The desire for smaller, fine-pitch, high-speed devices has significantly increased the choice in package types available to system designers. Due to high front-end tooling costs, it's becoming less viable for test socket manufacturers to provide a commercial, off the shelf test socket solution to meet demand and as a result the trend is towards machined test sockets.

Manufacturer consolidation and the inevitable obsolescence caused by newer technologies has created a surge in the requirement for legacy lines. Often these devices have been stored for some time and are not sourced from manufacturers' stock. When a COTS solution for test, emulation or prototyping isn't available a machined socket is often the only answer.

Q Doesn't custom mean expensive?

Cost will always be relative to the environment and the application, but custom doesn't always speak expensive. Very often it's the cost of not engaging with a specialist manufacturer that becomes prohibitive. It's crucial that your test socket is robust and reliable, and that the results you see are from the device under test, not the test socket.

Q Is it possible to reduce test costs?

You may want to consider whether it's necessary to

access all signals in a single test procedure. In practise it's feasible to reduce the pin count of a high density test socket for a high count BGA package to 25 or 50 per cent of the I/Os. This requires the user to write their test programme accordingly and to rotate the package in the socket to complete the test. Whilst slowing the test process, this can introduce a significant hardware cost saving that could be beneficial during counterfeit or post storage testing.

Custom machining will also facilitate the addition of multiple test cavities in a single clamshell design to increase test throughput. As an example, the Gate Driver LMG1205YFXR for Texas Instruments is a DSBGA12 measuring just 1.9 by 1.75mm. A single test socket can include 25 test cavities for this type of package providing cost benefits of up to 80 per cent. Sockets can be manufactured with both surface mount and through board interconnect.

Q How about leadtimes?

Often when a test socket is required, it's required urgently. Manufacturers who specialise in machined test sockets operate with design and piece part standardisation. This facilitates typical leadtimes of 20 working days, however this can be significantly improved when required. COTS production test sockets often have a five to eight week leadtime from the manufacturer.

Q Does size and form matter?

In a word, no. A mil-aero company had a number of obsolete Actel A1010 FPGAs that had been in storage for future use. The devices required full functional testing at -55 to 125°C prior to release for production. The package still had tie bars attached to the package leads which were therefore unformed. Machining a socket meant this could be accommodated with ease.

Q What information is needed from the customer?

The device part number or datasheet, test environment and test quantity. If the device is attached to a circuit board so, for example, an in-circuit test is required, then some detail of the position of neighbouring components is required.

www.winslowadaptics.com



General manager, **Winslow Adaptics**,
Josh Mancey



The basics of buying wire and cable

Wiring and cabling can be found everywhere from consumer applications to industrial equipment. Here, president of Memory Protection Devices, Tom Blaha, helps purchasers as they address performance and cost efficiency queries

When sourcing wire and cable products, purchasers will find a wide range of wire and cable products with variable characteristics, including: size or gauge measured in AWG or KCMIL; physical strength; radiation resistance; weight; electrical properties; chemical/oil/moisture resistance; flexibility; temperature rating; durability; sunlight resistance; flame resistance; and finally cost and availability. Prioritizing these characteristics will help determine the ideal solution, as trade-offs are often required.

What is wire?

A wire is a single conductor, usually copper or aluminum, while cable is defined as two or more insulated wires wrapped in one jacket. Multiple conductors not separated by an insulation layer are typically classified as a single conductor.

There are three types of cable: signal; power; and control. Signal cables are rated for low power, low current for applications such as TV cable, electronic cable, fiber optic cable, data cable, electromagnetic wire, low voltage power, and communications. Signal cables are usually shielded and carry data modulated power ranging from four to 20mA DC current.

Analog signal transmission typically consists of two-wire signal leads or three-wire signal leads. Where precision and accuracy are required, a third signal lead, or shield, is necessary. In the three-wire configuration, the shield is grounded at the signal source to reduce common-mode noise. Four types of signal cables are used to carry analog signals: plain pair, twisted pair, co-axial, and shielded-pair. These cables are normally single pair cable with a cross-sectional

area ranging from 0.5 up to 1.5mm².

Power or control cables come in larger gauges and typically deliver 24V DC or 110/230V AC unshielded to heavy-duty applications including mining, energy, transportation, infrastructure, or industrial machines. Control cable is usually insulated and sheathed with PVC and paired with a circuit protection device.

Understanding electricity

Electricity is measured in volts, amps and watts. Volts represent the amount of electrical force delivered, with the specific voltage determining insulation thickness requirements. Amps represent the quantity of energy delivered, with conductor size determined by the required amperage. Watts measure total energy using the formula: watts = volts x amps.



Network cable can be used for high speed data transmission and is typically available in twisted pairs to cancel out EMI



Coax combines a solid copper core with a tubular insulating layer surrounded by a tubular conducting shield and a plastic jacket

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Different applications are UL-rated for a specific voltage and current. Low voltage or low tension LT cable can be used up to 1000V while high voltage or high tension HT cable is used between 1000V and 11KV. Super tension or ST cable is suitable for use from 11 to 33kV and extra high voltage or EHT cable from 33 to 66kV. Finally, for applications above 66kV, specify extra super voltage or EST cable.

Common cable choices

Wire and cable are integral to many electronics applications from circuit prototyping and wire harnessing to Ethernet connectivity and high voltage power transmission. Electronic devices primarily use copper wire, which is considered an excellent conductor and relatively inexpensive, ensuring it is popularly used for transmitting both AC and DC current. Tinning can be used to alter the properties of wire as can annealing, a process where wire is heated to 700°F, then cooled to make it more flexible.

Popular wire products used in electronics include solid hook-up wire which comprises a single strand of insulated copper wire. While not very flexible, this is often used as magnet wire in transformers and motors or for prototyping on a breadboard. Stranded hook-up wire is more flexible making it ideal for use in tight spaces. It consists of a bundle of thin copper wires twisted or braided together to extend the life of the wire in high-vibration applications.

Another commonly specified product is coaxial cable. Coax combines a solid copper core with a tubular insulating layer surrounded by a tubular conducting shield and a plastic jacket. It is commonly used to transmit radio frequency signals that require protection from electromagnetic interference.

Network cable includes coaxial, as well as CAT3, CAT 5, CAT6, CAT 7 and fiber optic cable. It can be used for high speed data transmission and is typically available in twisted pairs to cancel out EMI. Finally, various types of computer cable are commonly available including ribbon, socket ribbon, male to female ribbon, USB data sync, ATX, extension cables, power charging cables, and more. A common requirement for these applications is the need for flexibility.

Products sold in the US usually carry Underwriters Laboratory registration, including: UL1007; UL1569; UL1423; UL94V; and ULVW-1. Other notable US approvals include MIL-C for military-grade cables and components, and CL2 / CL3 for audio cables and speaker wire.

Specifying jackets and insulation

Purchasers will be aware that jackets and insulation also offer many variables, including: wall thickness; electrical variables such as capacitance, insulation resistance, and dielectric strength; physical characteristics such as abrasion resistance or deformation; chemical/

environmental resistance; long-term reliability; flexibility; radiation resistance; and smoke and flame resistance.

Designed to help prevent shorting, insulation is a non-conductive material applied over conductors to provide electrical isolation between conductors. Jackets are applied over conductor insulation or a cable core to enhance its mechanical, chemical, or electrical properties. Versions include thermosetting; thermoplastic; fluoropolymer; elastomer; and rubber. Armoring

and shielding provides even greater protection.

Finally, any wire and cable products used in electronic assemblies need to be properly terminated and tested to ensure that a reliable electrical connection has been achieved. Through careful consideration of all these factors, purchasers will be better equipped to select, specify and buy the optimum cable for their application.

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Getting the timing right

Electronics Sourcing Europe asked vice president of global technical sales and marketing at ECS, David Meaney, what purchasers should prioritize when sourcing frequency control products



Vice president global technical sales and marketing at ECS, David Meaney

Q What should buyers look out for when sourcing frequency products?

When selecting and buying frequency control products or power inductors, look for a brand that is well known and respected. Most modern applications will require several clocks in the design and a good FCP manufacturer should offer an array of products including crystals, oscillators, voltage controlled oscillators, temperature compensated oscillators, oven controlled oscillators, as well as resonators and filters.

The product is only part of the equation, however, and manufacturers should also offer engineering and technical resources. A regional sales manager should be available to help with part numbers, pricing and delivery, plus a local manufacturer representative to provide real time support, and a strong sales channel with product held at distributors.

Q What are the differences between crystals and oscillators?

A crystal is a specifically cut and formed piece of quartz that will resonate at a pre-determined frequency when a voltage is applied. This is known as the Piezo-electric effect. These formed crystal blanks are connected to electrodes and placed in a hermetically sealed package. To form an oscillator circuit, the crystal is controlled by external capacitors and resistors.

An oscillator is self-contained and doesn't need outside components to generate a stable clock. Starting with the crystal blank, the manufacturer adds a capacitor to clean up power supply noise and an output buffer IC to take the incoming sinusoidal wave and convert it to a square wave. It may also multiply or divide the frequency to achieve the desired frequency of operation.

Q Are counterfeits a problem in the supply chain?

In this market there is always a risk that people with nefarious intentions will attempt to duplicate or

counterfeit product. The issue of counterfeit components can result in unnecessary inspection and testing, lost revenue, and field product failures. Purchasers are therefore encouraged to use an authorised distributor channel as this guarantees the highest quality products and technical support.

Q How are lead times holding up?

By following key market indicators, we can keep our lead times for products we don't stock at well below 10 weeks. We also offer 'just in time' delivery by keeping significant amounts of product in our distribution sales channel.

Q How do you see frequency products developing in the future?

Products today are compact, portable, battery powered, and connected to the internet. Demand for performance has not changed, but we must also focus on designing products that have a small form factor and use less power. In the future, systems will

still require stable quartz-based clocks to make them run smooth. Expect to see embedded FCP products as part of system on a chip components, wireless clocking modules, and products that are capable of multi-function operation. The future is unknown but for certain, there will be a need for quality timing products.

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Chipmakers' spending plans key to forecasting supply and price trends

Large investments by semiconductor suppliers often mean buyers can expect lower prices and short lead times for many chips

Many strategic semiconductor buyers spend a great deal of time trying to determine if prices and lead times for the crucial integrated circuits and discrete semiconductors that their companies need for production will increase or decline over the next 18 to 24 months.

Learning the capital expenditure (capex) plans of key chip suppliers and the current capital spending trends in the overall semiconductor industry can give buyers insight into future changes coming in supply, lead times and prices and help them develop strategies to manage those changes.

Big increases in capital spending often occur when component shortages occur and chipmakers determine that the shortages are likely to continue for a while. Semiconductor manufacturers then add more production lines, upgrade existing ones with new equipment to boost production or build entire new fabs.

In recent years, many chipmakers have been transitioning from 200mm wafers to 300mm wafers because they can produce more usable chips on larger wafers, thereby increasing capacity and supply.

Inevitably what happens is chipmakers add too much capacity, resulting in oversupply, short lead times and falling prices. When that occurs, suppliers reduce capex even if demand continues to be strong. Eventually, the declines in capex result

in tight supply, longer lead times, and in some cases shortages, as well as higher prices. Then suppliers increase capital spending and a new cycle begins.

Good supply times

In 2019 buyers are enjoying oversupply conditions that resulted from heavy investment in new capacity by chipmakers in 2017 and 2018. The good news is buyers can expect ample supply will continue for another year or more because of large investments in new equipment, production lines and fabs by semiconductor integrated device manufacturers (IDMs) and foundries over the past three years.

Semiconductor capital spending increased sharply from \$67.8 billion in 2016 to \$95.6 billion dollars in 2017. Investment in new fabs and equipment continued to grow in 2018 when capex reached a record \$109.5 billion, according to researcher IC Insights. As frequently happens during periods of capital spending growth, too much capacity was added for the amount of demand in the market, resulting in oversupply and falling prices for some chips.

As a result, chipmakers are now cutting back on capital expenditures (capex). In 2019, total semiconductor capital expenditures are forecast to slip 8 per cent to \$97.8 billion and 11 per cent to \$87.3 billion in 2021, according to IC Insights. The capex cutbacks will likely mean tighter supply, longer

lead times and potentially higher prices in late 2021 and 2022, but in 2020 chip supply will be ample as capacity will continue to rise because of investment made in 2017 and 2018.

For instance, DRAM capacity is expected to increase 1 per cent and be followed by a 3 per cent rise in 2020, the researcher said. It's expected that 3D NAND capacity growth will increase by 4 per cent and jump by double digits in 2020. Installed capacity for MPU is expected to increase by 3 per cent in both 2019 and 2020. Optoelectronics, (primarily image sensors) capacity will increase by 9 per cent in both 2019 and 2020, according to IC Insights.

"Currently the industry has a little too much capacity available," said Brian Matas, vice president of research for IC Insights. "The spending we've seen over the past two, maybe three, years has resulted in the industry not only meeting, but exceeding demand."

He said the industry will be "in good shape from a capacity standpoint" for at least another 18 months before supply-demand equilibrium is achieved. "Across all IC products, it should be a buyer's market throughout 2020 although there is a slight chance of some tightening of supplies for leading-edge memory and/or server processors in the second half of next year," said Matas. Later in 2020, suppliers will need to consider raising their capex budgets



DRAM capacity is expected to increase 1 per cent and be followed by a 3 per cent rise in 2020

again, he said.

Earmarking investment

Semiconductor companies typically earmark a certain percentage of their sales for capital expenditures in order to increase capacity. Capital spending as a percentage of sales was 19-21 per cent since 2010. “For 2017-2019, we have capex as a percent of sales at 21 per cent all three years,” said Matas. However, the percentage varies widely by supplier and IC type.

Typically, the big three DRAM suppliers, the big five flash suppliers, and the top four foundries, make the most capital expenditures. Memory IC manufacturers Samsung, SK Hynix and Micron invest in new equipment to make the next generation of ICs that are typically designed using smaller process geometries than the previous generations, according to Matas.

Newer designs often mean the chips use less power, provide more performance, and basically offer more bang for the buck. They also are physically smaller, which is what system OEMs want to place into their new boxes. These new devices bring higher profits, he noted.

In recent years memory suppliers have focused on 3D memory chips and have had to upgrade to new equipment including new lithography and etching equipment that

can make the deep aspect-ratio cells associated with 3D memory, Matas said. Moreover, using smaller process nodes requires more mask steps and more cleanroom space for new equipment.

Making 3D devices requires more mask layers, requires a larger footprint within the fab. That means existing fabs need to be retrofitted or memory suppliers have to build new fabs for 3D NAND or DRAM devices, he said.

Foundries, which build chips for multiple semiconductor companies, also need to invest a lot to keep up with design technology advances as more IDMs decide to outsource production of semiconductors because of soaring manufacturing costs. As a result, foundries must be prepared for the steady growth of their services, especially for leading-edge processes since many of their customers want their devices made using the smallest possible process nodes, according to Matas.

While the top five non-foundry suppliers—Samsung, Intel, SK Hynix, Micron, Toshiba/WD—collectively spent 26.6 per cent of sales on capex in 2018, the percent of sales on capex by the “big four” foundries has been “through the roof since 2010,” said Matas. The big four include TSMC, UMC, GlobalFoundries and SMIC.

TSMC’s capex as a per cent of its sales averaged 40 per cent per year since 2010. However, with oversupply, TSMC will cut back on its capital expenditures in 2019 to about 33 per cent of sales. The foundry average will be about 32 per cent sales in 2019, IC insights said. The overall semiconductor industry average as a percentage of sales will be about 22 per cent, the researcher said.

Memory makers invest the most

Capex as a percentage of sales is highest for foundries, but memory IC manufacturers overall account for the largest percentage of semiconductor capex investment. Memory is forecast to represent 43 per cent of total semiconductor industry capital spending this year, down from 49 per cent in 2018, according to IC Insights.

Samsung, SK Hynix, and Micron have added capacity for both DRAM and NAND flash, while Intel, Toshiba Memory/Western Digital/SanDisk, and XMC/Yangtze River Storage Technology all boosted 3D NAND flash capacity over the last year and a half. However, this year DRAM and NAND flash memory markets have entered a period of overcapacity and prices per bit have weakened, resulting in a cut back in capital spending to 2019, the

researcher said.

Capex for DRAM and flash is expected to drop 19 per cent in 2019 and 21 per cent in 2020. Total memory capital spending is expected to be \$41.6 billion in 2019, a decline of \$10.4 billion from last year, IC Insights said.

The cutbacks in spending are an attempt by memory IC manufacturers to stop price erosion. How far memory prices continue to fall will be determined in large part by how much memory suppliers cut capital expenditures and if the lower prices result in additional demand. Increased demand could result the cessation of price declines.

Capital expenditures by memory IC manufacturers and other IDMs and foundries are often used to equip new fabs or to upgrade existing ones with high-end machines used for advanced lithography ($\leq 10\text{nm}$) and 3D process technology for 3D NAND, 3D DRAM, said Matas. Such equipment is expensive and constitutes a “good share of the total amount of capex spending over the past few years,” he said.

TSMC, Samsung and, to a lesser extent Intel, SK Hynix and Micron are the primary buyers of this equipment and will likely be among the very few that will continue to allocate big money for high-end equipment purchases,

Semiconductor capex will bounce back



Capital spending by semiconductor manufacturers will decline this year and next increase again beginning in 2021. Source: IC Insights

said Matas. Other chipmakers are allocating money to upgrade to 300mm wafer manufacturing and/or to move their particular process nodes to the next generation on their roadmaps. For many, this means moving to ≤22nm process nodes, according to Matas.

Equipment investment falls

Because of cutbacks in capital spending, global sales of semiconductor manufacturing by original equipment manufacturers are projected to drop 18.4 per cent to \$52.7 billion in 2020 from last year's historic high of \$64.5 billion, according to trade association SEMI.

Wafer processing equipment sales will fall 19.1 per cent in 2019 to \$42.2 billion and other front-end segment, consisting of fab facilities equipment, wafer manufacturing, and mask/reticle equipment, is expected to decline 4.2 percent to \$2.6 billion this year, the association said. The assembly and packaging equipment segment will plummet 22.6 percent to \$3.1 billion in 2019. Semiconductor test equipment will drop 16.4 per cent to \$4.7 billion this year, said SEMI.

The decline will be short lived as sales are expected to increase 11.6 per cent in 2020 to \$58.8 billion on the strength of spending by memory IC manufacturers and

by increased purchasers of equipment by fabs in China. China's chip equipment capital spending will rise from \$11.69 billion in 2019 to \$14.5 billion in 2020, according to SEMI. Semiconductor equipment spending in Korea will increase from \$9.22 billion in 2019 to \$11.75 in 2020. While equipment sales in Japan will rise \$9 billion in 2020 from \$6.14 billion in 2019. The new equipment is needed because chipmakers will increase the number of semiconductor production lines over the next four years from about 136 in 2019 to 172 in 2023, the association said.

Much of the spending will be for 300mm fab equipment, as more chip production transitions from 8-inch wafers to 12-inch wafers. Such a transition means that chipmakers will increase supply as they can produce more chips on 300mm wafers than with 200mm wafers. The transition helps reduce the cost of production and lower prices for semiconductor buyers in addition to increasing semiconductor supply.

Like semiconductor equipment, shipments of silicon wafers will also decline in 2019 but bounce back in 2020, said SEMI.

"Silicon shipment volumes are expected to decline this year as the industry works through accumulated inventory and

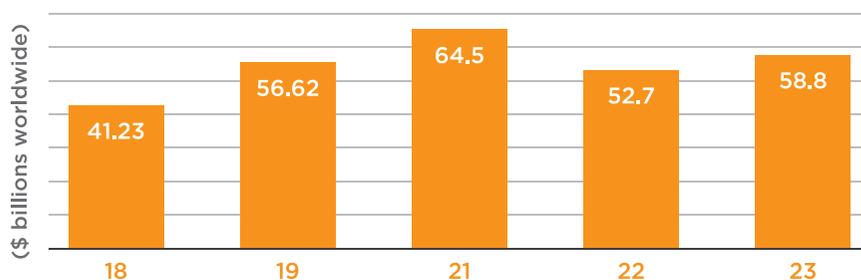
weaker demand," said Clark Tseng, director of Industry Research and Statistics at SEMI. "The industry is expected to stabilise in 2020 and regain growth momentum in 2021 and 2022."

Shipments of polished and epitaxial silicon shipments will total 11,757 million square inches in 2019 and rise to 11,977 million square inches in 2020, according to SEMI. Water shipments will increase to 12,390 million square inches in 2021, and 12,785 million square inches in 2022.



Silicon shipment volumes are expected to decline this year as the industry works through accumulated inventory and weaker demand

Chip equipment demand will resume growth in 2020



While the global market for semiconductor equipment will drop in 2019, it will recover in 2020 and continue to rise through 2023. Source: SEMI



Microprocessor market will bounce back despite slow PC growth

MPU demand will rebound in 2020 resulting in higher tags for processors used in computers and a return to sales growth



James Carbone

Weaker demand and oversupply will result in the global microprocessor market declining about 2 per cent in 2019 as revenue falls from \$54.1 billion in 2018 to \$53.25 billion in 2019, according to researcher Gartner Inc.

However, the MPU market will bounce back in 2020 when sales climb to \$54.5 billion and continue to grow steadily through 2023 when revenue reaches \$58.6 billion, the researcher said. Unit shipments will also rebound. Processor unit shipments in 2019 will fall to 486.9 million from 491.9 million in 2018. Shipments will rise to 500 million in 2020 and grow to 531 million in 2023, Gartner said.

Part of the decline in MPU revenue in 2019 is due to a weak PC market, which has been slowing for years. Despite slow growth in PCs, the MPU market had been growing steadily until 2018 because of strong demand for microprocessors used in servers for data centers run by

hyperscale cloud providers such as Google, Amazon, Microsoft, Facebook and Alibaba and others, said Alan Priestley, research vice president for Gartner Inc.

"They account for a huge volume of product. What happened in the second half of 2018 and the first half of 2019, the hyperscalers' slowed down their consumption" of servers impacting demand for microprocessors, he said.

"It looks like in the second half of this year server demand is coming back but for the total year, the microprocessor market will be down compared to 2018," said Priestley.

He noted the MPU market is comprised of the computer segment, which includes servers, desktops, mobile computers, and the embedded market, which includes microprocessors used in other types of electronics equipment.

"The embedded market is a lot smaller part of the market," said

Priestley. In 2018, the embedded market totaled about \$5 billion compared to \$49 billion for the computer market, according to Gartner.

"The embedded market is more fragmented and is much more affected" by economic conditions, said Priestley. As a result, the embedded MPU business has slowed because of declining economic growth worldwide.

The server market is more affected by the large cloud computing providers, which had been increasing purchases of servers, resulting in robust demand for MPUs and is not as dependent as much on strong overall economic growth.

Mixed pricing scenario

Buyers who purchase microprocessors for embedded applications can expect modest price declines through 2023. For instance, the average price for an MPU used in an embedded system will drop from \$23.70 in 2018 to \$22.00 in 2019 and

to \$21.50 in 2021. However, the average price for an MPU used in servers and PCs will rise from \$174.80 in 2018 to \$176.35 in 2019, then increase steadily through 2023 when the average price will be \$194.17.

MPU tags vary depending on the application performance level. For instance, the highest end Intel Xeon microprocessor for servers has a list price of more than \$17,000, while a low-end Celeron processor lists for \$42.

"The difference between these processors is core count," said Priestley. Microprocessors used in high-end servers have 28 cores while low-end Celeron MPUs have two cores. The higher the number of cores, the greater the workload the processor can handle. "Some workloads need a lot of cores and some don't," he said.

The average price for server microprocessors will increase because server manufacturers will use more powerful, higher-

By the Numbers



\$54.1 billion

The size of the global microprocessor market in 2018.
Source: Gartner



\$176.35

The expected average selling price of a server microprocessor in 2019.



486.9 million

The number of microprocessors that are expected to ship in 2019. Source: Gartner



\$58.6 billion

The forecast size of the worldwide microprocessor market in 2023. Source: Gartner



1%

The expected growth rate of servers in 2019.
Source: IHS Markit



performance microprocessors in systems. Such MPUs have higher prices and drive up the MPU average price. In fact, the long-term strategy of MPU makers Intel and AMD is to produce more processors in the mid-range and high-end, according to Shane Rau, research vice president, computing semiconductors for researcher IDC.

“That has had a positive effect to raise average prices,” he said. However, with demand being weaker than last year there has been some competition between Intel and AMD and “I’ve seen some pricing competition in the midrange and high-end,” said Rau. “In the second quarter, I noticed a notable sequential decline in processor ASP,” he said. However, it will likely be a short-term trend once microprocessor demand picks up.

Demand for MPUs will rise because server demand will increase next year. Server shipments will likely end 2019 rising about 1 per cent after growing 7.9 per cent last year. IHS Markit forecasts 8 per cent growth in server shipments in 2020.

Rau noted that microprocessors designed to be used in servers are used in other types of electronics equipment as well.

About 70 per cent of processors are actually used in servers, while the remaining 30 percent are used in other data center systems including storage, workstations and networking systems among others, he said.

More servers to ship

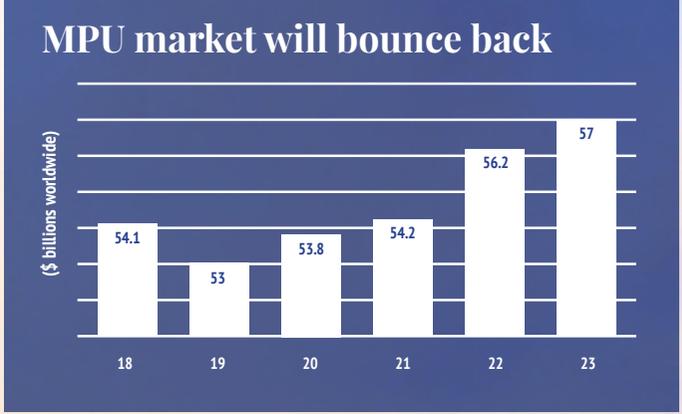
He said server processor revenue will decline 1.5 per cent this year to \$19.6 billion but will grow 2.9 per cent in 2020 to \$20.15 billion.

“Demand in 2019 was weak compared to 2018,” he said. In 2018, server processors grew 25 per cent because of robust demand by server manufacturers. But the very end of last year we noticed a significant slowdown in demand for server class components, including processors. That trend continued in the first half of 2019,” he said.

Enterprise OEMs and cloud service providers reduced their purchases of servers. Some companies were waiting for new server processors, such as Intel’s Cascade Lake Xeon processors and AMD’s new version of its Epyc processors.

There was expected to be a “significant increase in demand in the fourth quarter,” said Rau. That demand will carry over into 2020 and continue for several years. Rau expects server revenue to

The global microprocessor market will dip in 2019 but rebound and post steady growth through 2023. Source: Gartner Inc.



rise between 2.7 per cent and 4.1 per cent per year through 2023.

Also driving microprocessor demand over the next five years will be the growth of connected devices in Internet of things applications including the rollout of 5G technology, smart cards, artificial intelligence and machine learning techniques, said Vlad Galabov, principal analyst, data center compute and cloud research for IHS Markit. As a result, while the MPU market will decline in 2019, it will bounce back in 2020 and post a compound annual growth rate of 4.4 per cent through 2023, Galabov said.

The PC market will not be as much of a factor in MPU growth. “We expect a downward, sloping curve for the long run because the PC market is mature. People are doing more and more computing on their smart phones,” said Galabov.

Growth for application-specific MPUs

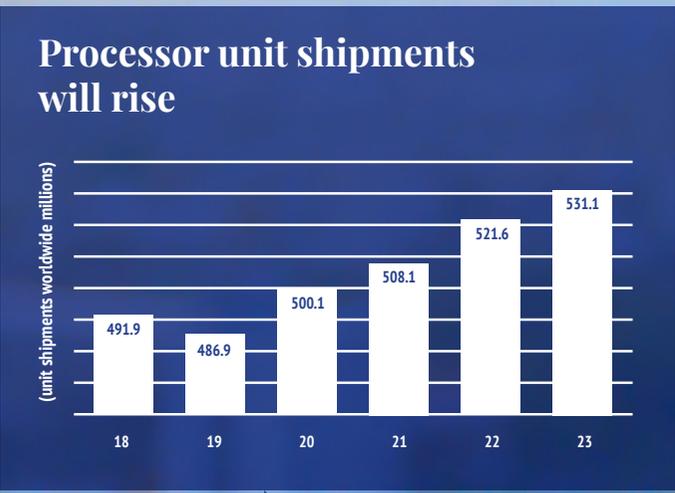
One segment of the MPU market that will contribute to microprocessor growth will be application-specific microprocessors. Revenue in the segment totaled about \$1.3 billion, “so it’s quite small compared to the overall MPU market,” said Galabov. However, the segment will

grow over the next five years. The compound annual growth rate for application-specific microprocessors will be 12.9 per cent,” said Galabov. They will expand beyond videogame consoles and will be used in automotive systems as well.

One unknown factor that could impact microprocessor sales, as well as sales of other semiconductors, is the ongoing trade dispute with China. Intel says rising trade tensions between the U.S. and China have led to increased tariffs and trade restrictions which have an impact on some of the chipmaker’s products.

“The U.S. has previously imposed, and continues to impose, restrictions on the export of U.S.-regulated products and technology to certain Chinese technology companies, which have included, and continue to include, certain of our customers,” Intel said in a financial filing. “These restrictions have reduced Intel’s sales and continuing or future restrictions could adversely affect our financial results,” the company said.

The restriction could result in some companies developing or adopt technologies that compete with Intel’s products, the company said.



Unit demand shipments of microprocessors will fall in 2019 but increase in 2020 as demand from server manufacturers rises. Source: Gartner Inc.



Mouser is an authorised distributor with the largest selection of Texas Instruments products in stock



Manufacturer	Distributor	Telephone	Website	Location	Franchised Distributor	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	Buffer Stock Facility
CABLE ASSEMBLY												
FTDI	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	100	N/A	0 €		50	1,500+	Y
Molex	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	300	N/A	0 €	97%	50	1,500+	Y
CIRCUIT PROTECTION												
Bourns	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	5,000	N/A	0 €	58%	50	1,500+	Y
EPCOS/TDK	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	5,000	N/A	0 €	58%	50	1,500+	Y
Littelfuse	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	35,000	N/A	0 €	67%	50	1,500+	Y
ENCLOSURES												
Bud	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	2,500	N/A	0 €	80%	50	1,500+	Y
Hammond	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	12,500	N/A	0 €	100%	50	1,500+	Y
Metcase Enclosures	OKW Enclosures	+44 (0) 1489 583858	www.metcase.com	EU	N/A	288	£40K	0 €	100%	5	22	Y
FREQUENCY												
ABRACON	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	1,000	N/A	0 €	91%	50	1,500+	Y
ECS	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	500	N/A	0 €	99%	50	1,500+	Y
Epson	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	500	N/A	0 €	59%	50	1,500+	Y
HEAT SINKS												
Aavid	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	700	N/A	0 €	67%	50	1,500+	Y
ICs & SEMICONDUCTORS												
Altera	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	1,600	N/A	0 €	60%	50	1,500+	Y
Analog Devices Inc.	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	9,500	N/A	0 €	83%	50	1,500+	Y
Atmel	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	1,700	N/A	0 €	58%	50	1,500+	Y
Avago Technologies	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	400	N/A	0 €	84%	50	1,500+	Y
Broadcom	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	100	N/A	0 €	69%	50	1,500+	Y
Central Semiconductor Corp.	Future Electronics	0049 40 547 277 000	www.futureelectronics.com	EU, UK	Y	N/A	N/A	N/A	N/A	N/A	N/A	Y
Cirrus Logic	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	300	N/A	0 €	80%	50	1,500+	Y
Cypress Semiconductor	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	1,400	N/A	0 €	63%	50	1,500+	Y
Diodes Incorporated	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	1,600	N/A	0 €	98%	50	1,500+	Y
Exar	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	1,100	N/A	0 €	95%	50	1,500+	Y
Fairchild Semiconductor	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	2,500	N/A	0 €	90%	50	1,500+	Y
Freescale Semiconductor	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	2,500	N/A	0 €	42%	50	1,500+	Y
FTDI	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	100	N/A	0 €	97%	50	1,500+	Y
IDT (Integrated Device Technology)	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	2,100	N/A	0 €	97%	50	1,500+	Y
Infineon	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	800	N/A	0 €	66%	50	1,500+	Y
Intel	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	500	N/A	0 €	78%	50	1,500+	Y
International Rectifier	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	600	N/A	0 €	87%	50	1,500+	Y
Intersil	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	1,900	N/A	0 €	50%	50	1,500+	Y
ISSI	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	700	N/A	0 €	98%	50	1,500+	Y
Lattice	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	700	N/A	0 €	69%	50	1,500+	Y
Maxim Integrated	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	11,200	N/A	0 €	67%	50	1,500+	Y
Microchip	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	12,600	N/A	0 €	91%	50	1,500+	Y
Microsemi	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	400	N/A	0 €	90%	50	1,500+	Y
Monolithic Power Systems (MPS)	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	600	N/A	0 €	40%	50	1,500+	Y
NXP	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	3,900	N/A	0 €	91%	50	1,500+	Y
ON Semiconductor	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	5,100	N/A	0 €	87%	50	1,500+	Y
Power Integrations	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	600	N/A	0 €	59%	50	1,500+	Y

Buyers' Guide

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Qorvo	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	300	N/A	0 €	90%	50	1,500+	Y
ROHM Semiconductor	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	1,400	N/A	0 €	55%	50	1,500+	Y
Silicon Laboratories	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	1,500	N/A	0 €	96%	50	1,500+	Y
Skyworks	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	300	N/A	0 €	91%	50	1,500+	Y
Spansion Inc.	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	600	N/A	0 €	93%	50	1,500+	Y
STMicroelectronics	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	4,500	N/A	0 €	99%	50	1,500+	Y
Texas Instruments	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	36,900	N/A	0 €	41%	50	1,500+	Y
Toshiba	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	500	N/A	0 €	100%	50	1,500+	Y
INTERCONNECTION												
3M	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	3,100	N/A	0 €	16%	50	1,500+	Y
Amphenol	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	25,600	N/A	0 €	53%	50	1,500+	Y
Amphenol	PEI Genesis	+44 8716060	www.peigenesis.com	EU	Y	N/A	£1.3m	10 €	N/A	N/A	85	Y
Anderson Power Products	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	800	N/A	0 €	50%	50	1,500+	Y
Cinch Connectivity Solutions	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	1,900	N/A	0 €	82%	50	1,500+	Y
Delphi Connection Systems	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	3,300	N/A	0 €	67%	50	1,500+	Y
FCI	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	4,300	N/A	0 €	94%	50	1,500+	Y
Glenair	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	1,900	N/A	0 €	76%	50	1,500+	Y
HARTING	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	4,700	N/A	0 €	31%	50	1,500+	Y
Harwin	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	2,200	N/A	0 €	79%	50	1,500+	Y
Hirose Electric	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	6,100	N/A	0 €	99%	50	1,500+	Y
Hirose Electric Europe B.V.		0031-(0)2 655 7460	www.hirose.com/eu	EU	Y	50,000	N/A	0 €	N/A	N/A	4,190	Y
ITT Cannon	PEI Genesis	+44 8716060	www.peigenesis.com	EU	Y	N/A	£1.3m	10 €	N/A	N/A	85	Y
JAE Electronics	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	1,200	N/A	0 €	32%	50	1,500+	Y
Kycon	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	700	N/A	0 €	99%	50	1,500+	Y
LEMO	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	2,900	N/A	0 €	65%	50	1,500+	Y
Molex	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	16,900	N/A	0 €	75%	50	1,500+	Y
Neutrik	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	1,000	N/A	0 €	86%	50	1,500+	Y
ODU		+49 8631 6156-0	www.odu.de	EU, USA, ASIA			N/A	0 €	N/A	50	1,650	
Phoenix Contact	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	12,000	N/A	0 €	99%	50	1,500+	Y
Switchcraft	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	2,200	N/A	0 €	69%	50	1,500+	Y
TE Connectivity	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	30,900	N/A	0 €	40%	50	1,500+	Y
OBSOLESCENCE / HARD TO FIND												
	America II Electronics	01462 707070	www.americaii.com	EU, G, UK	N	1,900	\$1B	0 €	75%	59	550+	Y
	Chip 1 Exchange	949-589-5400	www.chip1.com		Y	850,000	N/A	\$0	85%	20	150	
OPTO ELECTRONICS												
Avago Technologies	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	8,200	N/A	0 €	89%	50	1,500+	Y
Cree, Inc.	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	22,500	N/A	0 €	74%	50	1,500+	Y
Dialight	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	9,800	N/A	0 €	99%	50	1,500+	Y
Kingbright	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	3,100	N/A	0 €	100%	50	1,500+	Y
Lumileds	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	1,100	N/A	0 €	99%	50	1,500+	Y
Newhaven Display	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	700	N/A	0 €	65%	50	1,500+	Y
Osram Opto Semiconductor	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	2,800	N/A	0 €	99%	50	1,500+	Y
VCC	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	5,000	N/A	0 €	92%	50	1,500+	Y
Vishay	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	3,100	N/A	0 €	99%	50	1,500+	Y
PASSIVES												
AVX	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	70,700	N/A	0 €	58.00%	50	1,500+	Y

Manufacturer	Distributor	Telephone	Website	Location	Franchised Distributor	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	Buffer Stock Facility
Bourns	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	49,500	N/A	0 €	98%	50	1,500+	Y
Coilcraft	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	10,400	N/A	0 €	98%	50	1,500+	Y
Cornell Dubilier	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	33,000	N/A	0 €	65.00%	50	1,500+	Y
EPCOS / TDK	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	31,000	N/A	0 €	74%	50	1,500+	Y
Fair-Rite	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	1,000	N/A	0 €	94%	50	1,500+	Y
Kemet	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	135,800	N/A	0 €	93%	50	1,500+	Y
Kemet	RS Components	08457 201201	www.rs-components.com	EU	Y	N/A	£161m	0 €	N/A	50+	2,500	Y
KOA Speer	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	107,900	N/A	0 €	82%	50	1,500+	Y
Laird Technologies	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	1,800	N/A	0 €	50%	50	1,500+	Y
Murata	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	67,300	N/A	0 €	99%	50	1,500+	Y
Nichicon	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	21,600	N/A	0 €	47%	50	1,500+	Y
Ohmite	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	17,300	N/A	0 €	99%	50	1,500+	Y
Panasonic	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	67,900	N/A	0 €	69%	50	1,500+	Y
Taiyo Yuden	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	6,400	N/A	0 €	82%	50	1,500+	Y
TDK	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	25,300	N/A	0 €	85%	50	1,500+	Y
TT Electronics	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	32,800	N/A	0 €	55%	50	1,500+	Y
United Chemi-Con (UCC)	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	13,900	N/A	0 €	99.00%	50	1,500+	Y
Vishay	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	119,800	N/A	0 €	76%	50	1,500+	Y
Würth Electronics	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	4,500	N/A	0 €	63%	50	1,500+	Y
Würth Elektronik	Würth Elektronik	+49 (0) 7942 945 0	www.we-online.com	EU	Y	N/A	N/A	0 €	100%	250	4,000	Y
Yageo	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	45,300	N/A	0 €	99.00%	50	1,500+	Y
POWER & BATTERIES												
Bel Power Solutions	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	1,400	N/A	0 €	94%	50	1,500+	Y
Cincon	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	5,500	N/A	0 €	60%	50	1,500+	Y
Cosel	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	11,800	N/A	0 €	99%	50	1,500+	Y
CUI Inc.	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	3,900	N/A	0 €	100%	50	1,500+	Y
Mean Well	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	4,500	N/A	0 €	75%	50	1,500+	Y
Murata	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	5,200	N/A	0 €	93%	50	1,500+	Y
RECOM	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	23,300	N/A	0 €	92%	50	1,500+	Y
Sanyo Electronic Industries Co., Ltd	Sanyo Electronic Industries Co., Ltd.	+81 36699 8080	www.eta.co.jp	JP	N	1,000	€3000k	20 €	90%	10	100	Y
Schaffner	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	900	N/A	0 €	98%	50	1,500+	Y
SL Power	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	2,100	N/A	0 €	87%	50	1,500+	Y
TDK-Lambda	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	4,600	N/A	0 €	99%	50	1,500+	Y
TRACO Power	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	3,400	N/A	0 €	95%	50	1,500+	Y
SENSORS												
All Sensors	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	2,300	N/A	0 €	70%	50	1,500+	Y
ams	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	400	N/A	0 €	77%	50	1,500+	Y
Analog Devices Inc.	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	500	N/A	0 €	78%	50	1,500+	Y
Bosch	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	100	N/A	0 €	94%	50	1,500+	Y
Freescale Semiconductor	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	1,000	N/A	0 €	66%	50	1,500+	Y
Honeywell	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	15,500	N/A	0 €	80%	50	1,500+	Y
Maxim Integrated	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	900	N/A	0 €		50	1,500+	Y
Melexis	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	700	N/A	0 €		50	1,500+	Y
Omron	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	5,700	N/A	0 €		50	1,500+	Y
Sensirion	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	100	N/A	0 €		50	1,500+	Y
TE Connectivity	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	1,100	N/A	0 €		50	1,500+	Y
SWITCHES & KEYBOARDS												
ALPS	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	400	N/A	0 €	70%	50	1,500+	Y

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Manufacturer	Distributor	Telephone	Website	Location	Franchised Distributor	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	Buffer Stock Facility
Apem	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	700	N/A	0 €	96%	50	1,500+	Y
C&K Components	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	1,500	N/A	0 €	84%	50	1,500+	Y
Carling Technologies	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	300	N/A	0 €	87%	50	1,500+	Y
CHERRY	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	200	N/A	0 €	77%	50	1,500+	Y
CHERRY	RS Components	08457 201201	www.rs-components.com	EU	Y	600	N/A	0 €	N/A	50+	3,500+	Y
E-Switch	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	700	N/A	0 €	94%	50	1,500+	Y
Grayhill	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	400	N/A	0 €	84%	50	1,500+	Y
Honeywell	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	700	N/A	0 €	98%	50	1,500+	Y
NKK Switches	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	1,100	N/A	0 €	94%	50	1,500+	Y
Omron	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	900	N/A	0 €	68%	50	1,500+	Y
Rubbertech 2000	Rubbertech 2000	+44 1594 826019	www.rubbertech2000.co.uk	EU	N/A	N/A	£40k	100 €	N/A	N/A	25	Y
TE Connectivity	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	400	N/A	0 €	98%	50	1,500+	Y
THERMAL MANAGEMENT												
ADDA	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	800	N/A	0 €	59%	50	1,500+	Y
Delta Electronics	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	500	N/A	0 €	28%	50	1,500+	Y
ebm-papst	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	2,200	N/A	0 €	99%	50	1,500+	Y
Sanyo Denki	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	2,900	N/A	0 €		50	1,500+	Y
WIRELESS												
Anaren	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	100	N/A	0 €	86%	50	1,500+	Y
B&B Electronics	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	100	N/A	0 €	87%	50	1,500+	Y
Bluegiga Technologies	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	100	N/A	0 €	93%	50	1,500+	Y
Digi International	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	200	N/A	0 €	92%	50	1,500+	Y
Laird Technologies	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	100	N/A	0 €	76%	50	1,500+	Y
Linx Technologies	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	100	N/A	0 €	99%	50	1,500+	Y
Microchip	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	100	N/A	0 €	85%	50	1,500+	Y
Murata	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	100	N/A	0 €	100%	50	1,500+	Y
Panasonic	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	100	N/A	0 €	91%	50	1,500+	Y
Redpine Signals	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	100	N/A	0 €	94%	50	1,500+	Y
RF Digital	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	100	N/A	0 €	100%	50	1,500+	Y
Texas Instruments	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	100	N/A	0 €	75%	50	1,500+	Y
Wi2Wi	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	100	N/A	0 €	36%	50	1,500+	Y

PCB Buyers' Guide

Manufacturer	Telephone	Website	Service Provided (ie. Boiler, Manufacture &/or Repair)	Location	Approvals	Volume - Small, Medium, Large	Double-sided	Multi-layer 4-10/10-20-30	Metal PCBs	Flexi / Flexi-Rigid	Obsolescence Solutions	Modifications	Prototyping
Elvia PCB Group	+33 233 763 200	www.gepcb.com	M/B	France, Tunisia, China	AS9100, PRI-NADCAP, ISO-TS16949, ESA, UL, ISO9001, ISO14001	S/M/L	Y	1-30	Y	F, F/R	Y	Y	Y
Graphic Plc	00441363 774874	www.graphic.plc.uk	M	UK/China	AS9100, NADCAP, ISO 9001, AISI14001, OHSAS 18001, MIL 31032, MIL 55110, MIL 50884	S/M/L	N	4-10	Y	Y	N	Y	Y

Contract Manufacturers Buyers' Guide

Manufacturer	Telephone	Website	Turnover	Location	Approvals	Employees	Number of Surface Mount Lines	BGA Capacity	Lead Free Manufacturer	Prototyping	Design Capability	Full Turnkey	Cables and Harnessing
AWS Electronics Group	+44 (0)1782 753200	www.awselectronicsgroup.com	£40m	UK & Slovakia	AS9100, ISO9001, I3485, 14001, TS16949, IPCA-610 Class 3, NADCAP	430	11	Y	Y	Y	Y	Y	Y



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