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On the cover – January/February 2020

Rochester Electronics

Editor's Word



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Buyers' Guide

All the facts and figures to help you buy



Connectors: give them the respect they deserve

I've taken to binge-watching YouTube videos. My latest excursion is a channel called DiagnoseDan. Dan diagnoses faulty cars and fixes them. What makes this interesting and useful is that Dan tends to be the customers' last hope after other dealerships and independent specialists have given up. As an engineer, watching Dan's diagnostic process is fascinating. The rule is always expect the unexpected.

The reason that I'm writing about Dan is that too often, what appears to be a faulty assembly (circuit board assembly, module, motor etc) turns out to be nothing more than a broken connector or wire. If it's not a connector or wire, it's probably a sensor.

To me this is fascinating given that one of the first engineering articles I wrote, some 30-years ago, was about automotive reliability, with the data suggesting that at the time 90 per cent of vehicle vaults were related to wiring and connectors. Somethings never seem to change.

So, as a buyer, may I suggest you give the lines on the bill-of-materials which list connectors and wiring the respect they deserve. This is even more important given that connectors are now just as likely to be carrying signals as power.

Not all connectors and wires are created equally so take care when the thought of switching to a cheaper product looks appealing. Don't take my word for it, watch Dan at work and make your own mind up.

Jon Barnett

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Future-proof your IoT project

Arrow Electronics can now supply EnOcean's portfolio of patented energy harvesting wireless solutions. The initial focus will be on the company's internet of things range, which Arrow is integrating into its own end-to-end IoT offering.

Based on energy harvesting technology, EnOcean enables self-powered wireless sensor solutions for maintenance-free applications in buildings, industrial automation, smart homes and LED lighting control. It utilises energy harvested from motion, light or temperature differences to supply wireless sensor networks.

EnOcean's platform combines miniaturised energy converters, ultra-low power electronics and robust radio technology using open standards. The company has already enabled more than one million projects around the world relying on energy harvesting products.

Sales director of IoT at EnOcean, John Corbett, commented: "Our energy harvesting wireless solutions perfectly integrate into Arrow's IoT technology platforms, allowing customers to use our sensors in robust, future-proof system architectures."

www.arrow.com

Putting real time info at your fingertips

Electronic component distributor, Digi-Key Electronics, has renewed its partnership with start-up, Precogs, to deliver in-market offers directly to buyers' ERP in real time.

Paris-based Precogs pairs market data on individual component parts with customer needs based on their predetermined strategies for price, quality and availability. Precogs' solution is directly integrated with customer's enterprise resource planning software. This integration provides seamless movement of data, eliminating manual intervention to provide a fast, results driven product. In an industry worth \$1.3 trillion a year, this immediately improves profitability through pricing negotiation, purchasing efficiency and inventory management.

Precogs' chief executive officer and co-founder, Adrien Sandrini, explained: "It is critical for electronics manufacturers to have the proper tools to maintain maximum productivity. The ability to access Digi-Key's information via APIs in real time leads to infinite possibilities."

Two obvious benefits include access to the latest lead time information and accurate, up to date pricing, which can deliver immediate return on investment in a volatile market.

Precogs.com

Extended range ready for next day delivery

Farnell has invested in an even broader range of TE Connectivity products with customers in Europe now able to access over 100,000 TE Connectivity products, including more than 30,000 in stock for next day delivery.

The full TE Connectivity range includes connectors, relays, passives, cable and wire, as well as sensors and antennas with an emphasis on emerging technical trends in industrial, consumer devices, ITE, rail and transportation.

With access to over 950,000 products across the full Farnell range, purchasers seeking to purchase TE Connectivity products can streamline their buying processes and reduce costs by coming to Farnell for all their needs.

Global head of IP&E, Farnell, Simon Meadmore, said: "We are dedicated to providing our customers the means to be ready for tomorrow and helping them to participate in emerging industry trends such as electric vehicles, 5G, Industry 4.0 and robotics."

www.farnell.com



Better batteries ready to buy

RS Components has introduced the new Duracell Procell range of high-performance alkaline batteries, designed to replace the Duracell Industrial range used by OEMs and professional end users. The new Procell batteries boast higher capacity and greater longevity than Duracell's previous industrial batteries, resulting in fewer battery replacements and savings on associated operating costs.

The range comprises alkaline-manganese dioxide batteries in five standard formats. The PC1500 and PC2400 are 1.5V batteries in AA and AAA formats suitable for industrial remote control, sensor, security keypad and wireless mouse applications. The PC1400 and PC1300 are 1.5V batteries in C and D formats for use in sensors and security keypads. The PC1604 is a standard 9V battery for applications such as carbon monoxide detectors, smoke detectors, multimeters, medical devices and microphones.

uk.rs-online.com

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In Brief

Spring balancers made in Germany

Specialist distributor, Bürklin Elektronik, has acquired Aero-Motive, a Molex division. As a result, in addition to its distribution business, Bürklin will now also manufacture spring balancers for harsh industrial environments at its headquarters near Munich. The new subsidiary, Aero-Motive, was founded for this purpose with an emphasis on 'Made in Germany'.
www.buerklin.com

Investing in faster turnaround

Contract manufacturer, Eurocircuits has invested five million Euros to meet growth in its assembly service for PCB prototypes and small series, along with improved capabilities in its PCB production services and online tools. Improvements in PCB production mainly focussed on flexibility and quality with new capital equipment to support the company's goal of driving down delivery terms.
www.eurocircuits.com

German distribution drop

In line with the general components market and the German economy, sales in the German component distribution business declined in the last quarter. Sales of distributors in the German component distributors' association, FBDi, fell by 12.6 per cent. Orders declined by 34 per cent. The FBDi cites the root cause as a mix of reduced inventories, over-cautious planning and economic slowdown in some target markets.
www.fbd.de

Wiring website now in Spanish

The Wiring Harness Manufacturer's Association is now providing Spanish speakers with convenient access through a new Spanish-language website. The website, which contains the exact same educational content as the English-language site includes information on the WHMA's industry standard for requirements and acceptance of cable and wire harness assemblies, the IPC/WHMA-A-620.
www.whma.org



High-tech investment meets burgeoning memory demand

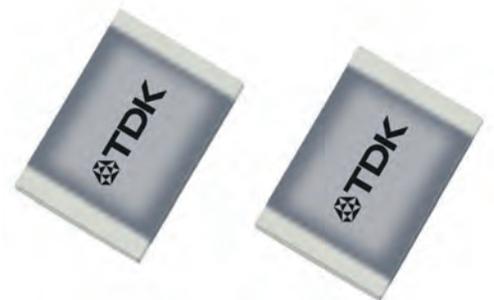
Swissbit has opened a new electronics production facility in Berlin, Germany, set to enhance production of the company's data-storage and security solutions for industrial applications and the internet of things. The investment has tripled Swissbit's production capacity, helping it to address increased device networking trends, which are driving demand for memory and embedded IoT solutions.

Taking just over a year to construct, the factory supports precision manufacturing of the latest memory and security modules for industrial use. The plant boasts almost 2,600m² of dedicated production floorspace where Swissbit produces the latest generation flash memory solutions and security products for embedded IoT applications.

At the opening event, a tour of the facility offered guests an insight into the latest manufacturing technology. In future, Swissbit will also offer access to its processes to other developers of high-tech products, as a service. This includes highly automated production equipment with continuous 300mm wafer handling and advanced 3D packaging capabilities.

Chief executive officer of Swissbit, Silvio Muschter, commented: "Normally, to experience similar facilities in action you would need to fly to Asia. Swissbit products have always been and will remain 'Made in Germany'."

www.swissbit.com



Looking for rechargeable batteries?

TTI can now supply surface-mountable, rechargeable, solid-state batteries produced by TDK.

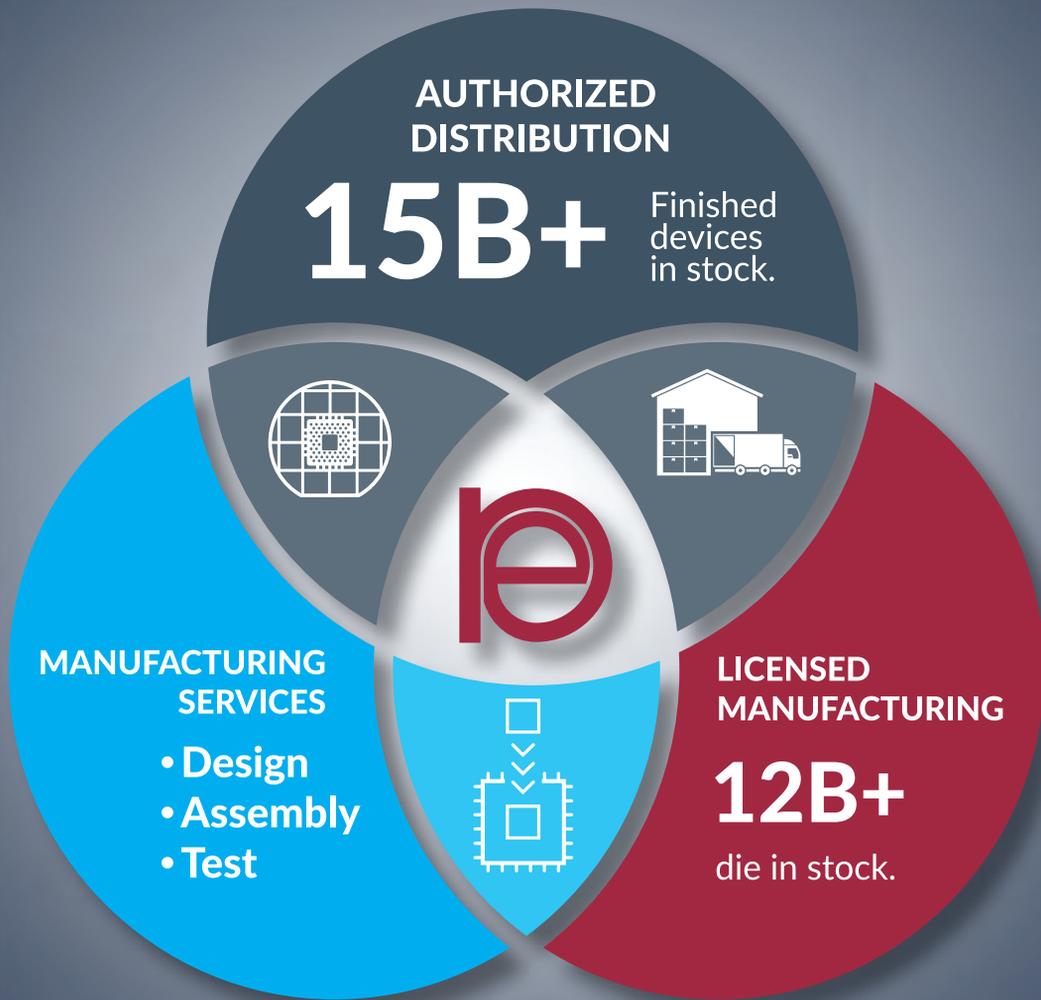
The TDK CeraCharge range merges aspects of lithium-ion battery and multilayer ceramic capacitor technologies to produce an all-ceramic, solid-state rechargeable cell suitable for reflow soldering. The parts can be used as backup batteries for real-time clock circuits, to store energy for internet of things devices such as beacons and energy-harvesting systems, and as sub-batteries that smooth out voltage and current variations in wearable devices.

According to TTI, the all ceramic-structure of the CeraCharge batteries means they cannot leak, burn or explode, and will work over wide operating temperatures, even in a vacuum. Parts are available in EIA case sizes.

Potential applications include smart meters and PLCs; in sensors, tags, shelf labels and robotics for supporting short-range RF beacon functions; and in wearable devices such as smart watches, fitness bracelets, and hearing aids.

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Why purchasers are demanding traceability

Vice president, operational excellence at Digi-Key Electronics, Teri Ivaniszyn, explains why provenance in the electronic components supply chain is vital for purchasers and distributors alike

Today's culture demands greater transparency from brands than ever before. Whether it's food, beauty, automotive, or electronic components—customers want to know where their products are from and what they're made of. They also want to know more about the companies they support—their operating procedures, the way they treat their employees and their commitment to sustainability. At Digi-Key, we share this desire for transparency, and when it comes to our suppliers, we demand the same level of information that our customers do.

What is traceability?

Information provided by manufacturers such as date codes, lot numbers, or serial numbers, enable anyone throughout the supply chain to trace components back to the original equipment manufacturer (OEM) should anything go wrong. Within the electronic components industry, traceability is quickly becoming a bigger focus than ever before.

Firstly, in an era where competition is stiff and gaining consumer confidence is vital, traceability is critical to protecting a brand's reputation. If a product is recalled or a malfunction occurs during testing, being able to trace the issue back to the manufacturer accurately and quickly can save customer trust and maintain a company's reputation.

In addition to bolstering a brand's reputation, sourcing traceable products can also save companies a considerable amount of money. If any faults arise

with a product, the OEM or subcontractor can get a recall notice out quickly—reducing legal costs and mitigating profit loss. Defects with genuine products can also be quarantined much easier than with counterfeit parts.

Demonstrating authenticity

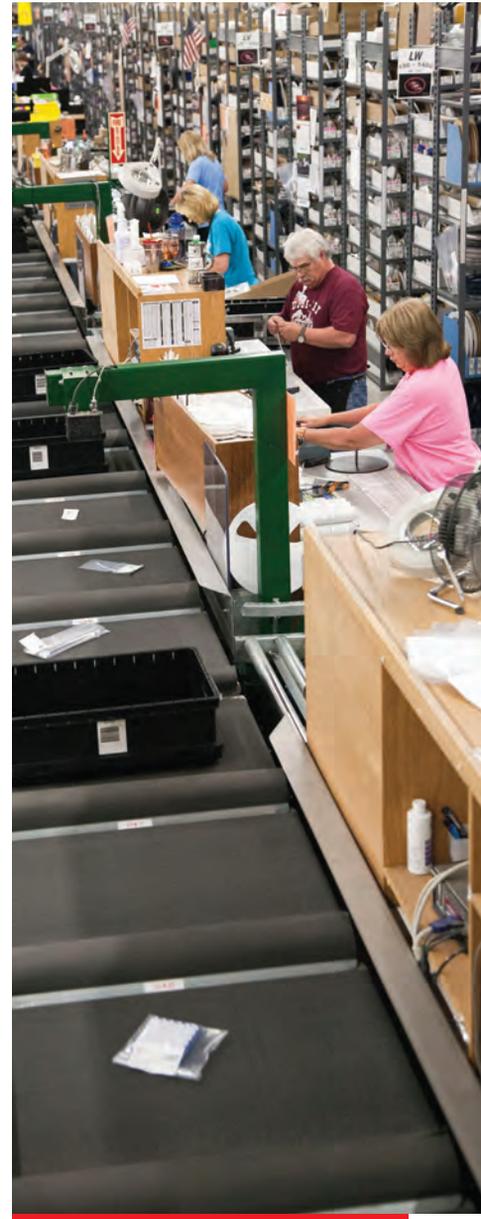
As the demand for traceability continues to grow, so does Digi-Key's commitment. We only buy direct from our 800-plus franchised manufacturers in order to ensure the component is new, authentic, and fully warrantable under the direct supplier. This also ensures that accurate, up-to-date technical information is readily available. For each of our more than 8.2 million components, Digi-Key holds documentation valid for 10 years that proves the traceability of the part and its authenticity.

In addition, Digi-Key has been certified to the Counterfeit Avoidance Accreditation Program. This proves our counterfeit controls have been verified by an external auditing company and ensures components are compliant to aerospace standard AS6496. Digi-Key also has controls for disposition, inventory control, receiving, and customer returns verification developed to adhere to the AS6496 counterfeit avoidance certification. In the event that suspect or confirmed counterfeit product is identified in the supply chain, Digi-Key has processes in place to quarantine the product, and report the findings to the supplier, relevant customers and appropriate authorities.

We also maintain the ISO 9001:2015, which certifies the purchasing, warehousing and distribution of electronic components to original equipment manufacturers and/or customer specifications. In other words, not only do we pursue transparency in our components, but also in our business practices and customer service.

Here at Digi-Key we're excited about the growing dialogue around traceability and the greater demand for authentic products. We look forward to continuing to equip purchasers across the globe with products that are 100 per cent traceable—from prototype to final product.

www.digkey.co.uk



Inventory controls and returns verification processes adhere to the AS6496 counterfeit avoidance certification

Ready for a double squeeze?

Managing director of marketing at Rutronik, Markus Krieg, believes the US China trade war could impact component availability while 5G growth may see lead times increase again

Q How do you envisage the NA electronic component industry will perform in 2020?

We are currently in a downturn phase for the semiconductor industry but also for passive components in North America. The World Semiconductor Trade Statistics figures show that the North American market is showing the deepest downturn in a global comparison. It is difficult to say when we will have passed the low point, but we do not expect a significant recovery until the end of Q2 2020.

Q What trends or shifts have you identified and predict will continue into next year?

The trade war between the US and China will leave clear marks. If the dispute becomes tougher, the components industry in North America will be one of the victims. With a world market share of over 40 per cent in the semiconductor market,

China is the most important trading partner of the US semiconductor industry. If there are further trade blockades, many high-tech jobs will be at stake. The longer the dispute lasts, the more regions will isolate themselves so, ultimately there are no winners in this fight.

Q How will lead times perform in 2020?

We currently expect stable lead times for the first quarter of 2020. Investment in the start of 5G production will significantly influence component supply. We expect a shortage of MLCCs in particular, potentially by the end of Q2 2020. The new 5G infrastructure in China will provide significant growth. Smaller markets will probably have to take a back seat in terms of supply. In addition to base stations, 5G infrastructure could also include the IoT infrastructure or the traffic control infrastructure in China. New digital business

models will be growth drivers contributing to fab capacity utilization.

Q What advice would you give to purchasing professionals for 2020?

We recommend timely planning in procurement and continuous observation of lead times. After all, it doesn't matter which component is missing to halt PCB production. Only regular contact with sales team brings secure information.

www.rutronik.com



The World Semiconductor Trade Statistics figures show that the North American market is showing the deepest downturn in a global comparison



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Semiconductor industry will recover in 2020

While the semiconductor industry will post single-digit growth in 2020, buying conditions will favor semiconductor purchasers as there will be ample capacity to meet demand



James Carbone

Buyers can expect plentiful supply, normal lead times and price declines for most integrated circuits and discretes in 2020, despite stronger chip demand and lower inventory levels compared to 2019.

While many semiconductor manufacturers have cut back on capital expenditures, there's still ample capacity for manufacturing expansion that occurred in 2018. The capacity that was added resulted in semiconductor inventory levels growing last year as shortages of some memory ICs and discretes were mostly eliminated.

Inventory levels fell back half in the second half of 2019, but there still is some excess inventory that has yet to be worked off. As a result, unless there is a huge spike of demand that continues for months, there should be more than enough supply to meet demand, especially in the first half of 2020, according to analysts. Prices for many chips should decline and lead times

should not be a problem in 2020. Chip buyers can expect price erosion for memory ICs, analog chips, sensors, optoelectronics and discretes in 2020.

High inventory levels, declining demand and lower prices resulted in worldwide semiconductor revenue falling 12.8 per cent to \$409 billion in 2019, according to World Semiconductor Trade Statistics (WSTS).

Much of the semiconductor revenue decline was due to falling sales for memory ICs and by a steep drop of chip prices in 2019, according to researcher IC Insights. For instance, the average DRAM price fell 44 per cent in 2019, resulting in a 37 per cent decline of DRAM revenue. By comparison, the average integrated circuit price fell 10 per cent, the researcher said.

The steep decline in semiconductor revenue in 2019 was due to a kind of perfect storm of events. First, demand for end products was weak,

said Len Jelinek, director and chief analyst for researcher IHS Markit. "Handsets were saturated, everyone has a PC, car sales declined" and data centers eased back on purchases of servers, he said.

Weak end equipment demand came after two years of increased capital spending and capacity expansion by chipmakers. Semiconductor fabs were optimised "and running at high volumes as end market demand slowed down," he said. "Inventories increased to high levels not only for the chip guys but through the channel," he said. As a result, chipmakers reduced prices hoping to stimulate demand. "Well, it did not work because there were only so many handsets and so many PCs and so many servers" to be built, said Jelinek.

Demand will bounce back

The good news for semiconductor companies is sales growth will return in 2020 and revenue should increase almost 6 per

cent from \$409 billion in 2019 to \$433 billion in 2020, WSTS said. Semiconductor revenue will rise 6.3 per cent in 2021.

While semiconductor demand and sales revenue will increase, it probably won't happen until the second half of the year, according to Jim Feldhan, president of Semico Research. He said declining chip industry sales will "bottom out in the March/April time frame and then things will improve, but it won't be a V-shaped recovery to start. It will be slow because we think the overall economy is going to be sluggish in 2020," he said. Feldhan forecasts about 3 per cent revenue growth for semiconductors and 8.7 per cent growth in unit shipments in 2020.

While all categories of integrated circuits declined in 2019, the trend will reverse in 2020. Analog chip sales declined 7.9 per cent in 2019, but will rise 5.3 per cent 2020, said WSTS. Memory IC revenue fell 33 per cent in 2019, but sales will increase

By the Numbers



\$408.9 billion

The size of the global semiconductor market in 2019. Source: WSTS



33%

The rate of decline of the total memory market in 2019. Source: WSTS



\$68.3 billion

The forecasted size of the industrial semiconductor market in 2023. Source: IHS Markit



8.7%

The expected rate of growth of semiconductor unit shipments in 2020. Source: Semico Research



\$460.2 billion

The total value of the global semiconductor market in 2021. Source: Semiconductor Industry Association



4.1 per cent in 2020. Logic sales dropped 4.3 per cent but will rise 6.5 per cent this year. Discrete semiconductors suffered just a .6 per cent decline in 2018 and will increase 3.8 per cent in 2020, according to WSTS.

The only two semiconductor categories that posted sales growth in 2019 and will rise again in 2020 were sensors and optoelectronics. Optoelectronics sales grew 7.9 per cent in 2019 and will post a 12.5 per cent increase in 2020. Sensor sales increased 2 per cent 2019 and revenue will rise 5.4 per cent in 2020, according to WSTS.

Analysts say sales growth for chipmakers will increase in 2020 because inventory levels will be lower than 2019, and demand will increase from key customers segments.

“The key drivers for the semiconductor industry will be 5G, servers, and automotive,” said Jelinek, “The largest and most significant driver especially in the short-term will be the transition to 5G” because it will be an enabling technology, he said. “The smartphone will be the immediate beneficiary of 5G technology and will receive the most attention, but as 5G networks become deployed they will serve as enabling platforms

for future growth across multiple market segments,” he said.

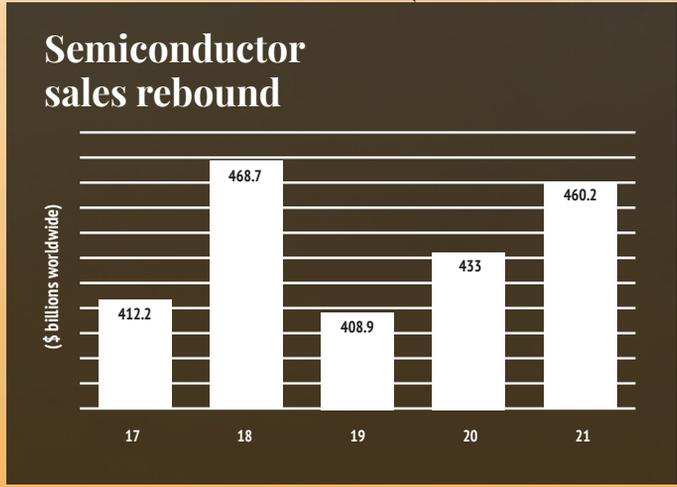
Wait until 2021

Some industry analysts say 5G will have a positive impact on the semiconductor industry, but 5G won't affect the industry too much in 2020. “It certainly will give sensors and discretives a little boost next year, but we're still early in the rollout of systems that can take advantage of the higher speeds and near instant transmissions of data through the network,” said Rob Lineback, senior market analyst for IC Insights. He said 4G LTE will continue to be the dominant cellular generation for several more years.

Feldhan said that 5G infrastructure is being built “but it has not gotten the momentum to have a major impact in the market this year.” There's a lot of 5G development and 5G networks are being built and there are a few 5G phones on the market today and we will see more coming out in 2020.

Feldhan noted that there are some 5G networks in large metropolitan areas. “It is a chicken or an egg thing. Service providers are starting to build 5G networks, but they don't want to do a whole buildout when there aren't really that many phones

After declining 12.8 per cent in 2019, semiconductor revenue will bounce back growing nearly 6 per cent in 2020. Source: WSTS



out there,” he said. The real impact of 5G will start in 2021 and continue through 2023.

Automotive will continue to be a driver for semiconductors in 2020 and beyond because of the proliferation of infotainment, advanced driver assistance systems (ADAS) and the development of the autonomous vehicle. However, automotive only represents about 9 per cent of all semiconductor sales. The segment will grow as a percentage of sales, but it will remain relatively small compared to other segments.

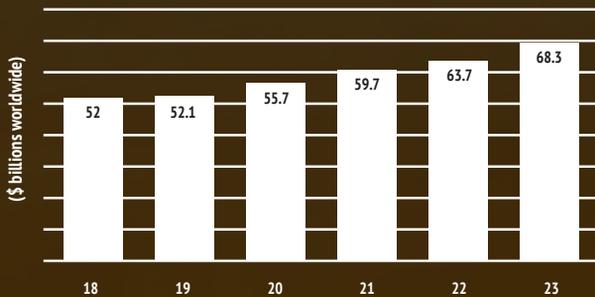
However, as more vehicles are equipped with infotainment systems, more advanced electronics and displays will be used so. “There is tremendous opportunity for growth,” for semiconductors sold to the auto industry, said Jelinek. “But is it enough to swing the dial in the total semiconductor industry,” asked Jelinek. “No, it isn't,” he said. However, it will be a growing segment for semiconductor companies that focus on the automotive industry and for companies that are supplying ICs for infotainment, and ADAS systems.

Semiconductor sales to automotive totaled about \$42 billion in 2019, according to IHS Markit. However, computer and storage semiconductor sales totaled \$145 billion, while wireless communication accounted for \$119 billion of chip sales.

Increased demand from 5G and automotive applications and other customer segments will result in less price erosion in 2020. DRAM tags will fall about 8 per cent, while NAND flash will increase 2 per cent. Prices for optoelectronics will decline 2.7 per cent, sensor tags will drop 3.9 per cent and the average price for discretives will decline 3.5 per cent, according to IC Insights.

Jelinek notes automotive uses a lot of mature semiconductors such as MOSFETs, and “those cost about \$.25-\$.30, so you are not talking about \$75-\$100 chips.”

Industrial semiconductor market to post steady growth



Internet of Things and 5G technology will help drive the industrial semiconductor market for the next several years. Source: IHS Markit



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An eye on 2020



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

To start the year, John Denslinger peers into his crystal ball to see how the triple impacts of 5G, IoT and the Cloud will drive growth in 2020

Future gazing • By John Denslinger

Usually 2020 indicates one has excellent eyesight: the natural ability to see far and near with equal clarity. Isn't foresight a wonderful gift? If only we had similar vision forecasting the coming year.

2019 might best be described as a year of retrenchment. Previous growth markets softened, new applications grabbed little attention, lead times remained extended, inventories stymied, and the book-to-bill stayed mostly negative throughout the year. Perhaps the biggest drag was the stalling out of 4G smart phone production and the demand fall-off left in its wake. 2020 looks to be another story.

For the record, I don't profess to have 2020 vision, especially the ability to see far into the second half with absolute clarity. My forecast is merely reading market conditions, applying typical component cycle trends, assessing the health of the global economy, and looking for potential roadblocks to progress. For the moment, let's assume suppliers invested in the appropriate technology, expanded their production capacity to meet increasing demand, and perhaps the greatest unknown, our industry avoids those tangential risks that hinder growth (more on this point later).

As for market conditions, look for three main drivers according to Dale Ford, chief analyst at ECIA: 5G, IoT, and 'the Cloud'. He describes it as the 'forces coming together'. I see it as a symbiotic relationship. The build out of every future infrastructure will incorporate, by necessity, all three technologies for seamless communications. Notice 5G captures most of the media headlines, but the ramp in component demand will likely not occur until late in the year. That means IoT will initially lead the way entering 2020. The demand for sensors of all types, wireless connectivity, gateways, microcontrollers, antennas, and energy enabling devices will be great. Closely following will be the Cloud. It too will

resume a major growth role in 2020 as more data centers are needed to handle massive amounts of data captured via IoT and transmitted through 5G communication networks. Processors, power management and sensors will be sought in volume. And coming back to 5G, while it may be slow coming, it will soon become the industry's tsunami. As production ramps, global demand for all components will be enormous. It may make the 4G component shortage of 2017-18 look small.

Adding further credence to this positive growth projection is semiconductors. According to Dale Ford, semis are about to start a new annualized growth cycle around mid-2020 typical of its four year trend history. That seems to fit the market conditions just described above assuring an upward path is likely.

As for the global economy, significant infrastructure build-outs will accelerate. Each will ultimately deploy all three technologies. The key deliverable driving the investment: leadership.... countries and companies seeking to establish dominant global, competitive advantages.

Lastly, I spoke of potential roadblocks and tangential risks that may stymie growth. Among those concerns are: expanded trade barriers; anti-competitive regulatory measures; cybersecurity intrusions; and disparate rules governing a free internet. Any one of these risks could negate the growth and benefit of 5G. Let's hope wiser heads prevail.

By now you might surmise 2020 should be a growth year and you would be right. But given the soft lead-in from 2019, 2020 Q1 will be flat with gradual acceleration starting mid-Q2.

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Unlike conventional twin axial cables, 3M Twin Axial Cable Assemblies offer a low-profile, foldable and longitudinally shielded solution. These high performance twin axial ribbon cables can make sharp turns and folds with little or no impact on electrical performance.

Manufacturer, 3M, states that the cable outperforms conventional cable constructions in bend radius, signal integrity, ease of termination and overall route-ability. As such, assemblies can be designed with folds that minimise airflow obstruction and, therefore, help reduce the cost, complexity and power consumption of system cooling.

With cables that can snake between processors, heat sinks and fans, it is possible to free up valuable space in the mechanical design of a unit for components or air flow.

To achieve these benefits, 3M Twin Axial Cable is less than 0.9mm thick and very pliable. Industry standard discrete pair internal high-speed cable assemblies typically found in high-performance computing servers are bulky—with some simple PCIe four-channel assemblies having a cable bundle as thick as six to 12mm.

Minimal impedance

Tests show that each fold with a 180deg fold at 1mm bend radius, impacts impedance at the fold location by approximately 0.5 ohms, which is well within the tightest impedance specification. The new 3M

cable is therefore suitable to be used in current and emerging high-speed serial transmission standards, such as SATA, SAS and PCI Express.

General purpose units at the front of the server are also easier to service because they are much easier to access in the rack. Customers reported monitoring, servicing and/or upgrading GPUs more often than any other components in their HPC environment, so the new cable design presents immediate advantages here.

Custom construction

To customise the 3M Twin Axial Cable technology, 3M engineers combine physical design with pre-production modelling and proof of mechanical fit. The process begins with a thorough understanding of the spatial demands.

Working with an assembly pinout, PCB designs, and a mechanical server model, engineers work closely with customers to devise solutions that minimise airflow disturbance, while also considering assembly manufacturability. Maintaining the required pinout for multi-ribbon assemblies through many folds is no trivial achievement.

In addition to customised solutions, the portfolio embraces standard high-speed cable assembly solutions for SATA, SAS, and PCI Express applications. 3M provides an array of innovative products and systems designed to enable greater speed, brightness and flexibility in today's electronic devices, while addressing

industry requirements for increased thinness, sustainability and longevity. The resulting high-speed cable assemblies are essential for the efficient operation of systems that process large volumes of data. For high-performance computing, routers, storage and switches, 3M has the cabling solutions required to connect devices with the latest industry standard physical interfaces. The company's internal SATA cable assembly, Series 5602, for example, offers a seven-position configuration with a straight and right angle connection featuring either passive or active latch. Signal wire size is 30AWG making the assembly suitable for SATA 100 ohm applications. Products are available with standard lengths up to one metre.

tti europe.com

Twin Axial SATA cable assembly can be supplied with latch fittings



3M cable is suitable for use in current and emerging high-speed serial transmission standards, such as PCI Express 2



- Utilizing 3M™ Twin Axial Cable technology: Highly routable, foldable, flexible
- Thin, low-profile ribbon cable allows more routing options within a case, and enables many packaging configurations
- Foldable ribbon construction allows for extremely tight bend radii with minimal performance impact

High-Routability Internal SATA Cable Assembly

5602 Series

3M™ Twin Axial Cables are thin, foldable and virtually resonance-free with bends and folds. For internal applications, as one of the thinnest available cables, 3M™ Twin Ax cables allow for more options in high-performance, dense servers. They are designed to offer cost savings by helping to avoid PCB upgrades and the need for repeaters.

For external applications, our thin, lightweight, flexible cables help enable unique cable management solutions and simplified serviceability.

Internal SATA Cable Assembly, Series 5602

- Supports SATA 1.0/2.0/3.0 Applications
- Exceeds SATA 3.0 requirement up to 1 meter
- Internal cable construction is thin and lower profile than other similar AWG twin axial cables
- Allows for dense routing and flexible routing options within a chassis
- Foldable - Allows for extremely tight bend radii
- Minimal performance impact of folding, and enables unique packaging configurations
- Saves time and cost during assembly



An intelligent approach to embedded expertise

Bringing together a whole host of experts from diverse industry segments, the Embedded World conference, running 25 to 27 February, is set to explore strategies for success in our increasingly connected world

As the global gathering place for the embedded sector, the Embedded World conference reflects the latest trends, with machine learning and artificial intelligence centre stage. Thanks to comprehensive networking we now have access to huge volumes of data that can be evaluated and analysed to determine future strategies for action. The balancing act between processing data on site and sending it to the cloud is one of the key topics up for discussion at the conference, which features an overall theme of 'Connecting Embedded Intelligence'. Naturally, the conference

will also devote plenty of attention to those hot topics that almost never lose relevance. They include hardware and software engineering that tries to strike a balance between cost pressure, innovation, quality and reliability. Another burning issue is the internet of things. No other topic attracted so many abstracts.

Overall, the 2020 programme is subdivided into ten conference clusters: internet of things; connected systems; embedded OS; functional safety and security; hardware; software engineering; embedded

vision; intelligent systems; embedded HMI and GUI; and system-on-chip.

The individual clusters are made up of sessions and classes. Sessions consist mostly of half-hour presentations, while classes are limited to smaller groups and are similar to training courses. Participants address a topic in detail and often complete practical exercises on the computer or on microprocessor circuit boards.

AI: a force for change

One highlight of the embedded world conference

is always the keynote address on the first day, which is also open to all trade fair visitors free of charge. This year, the speaker is Hassane El-Khoury, chief executive officer of Cypress, who will talk about the interaction between humans and machines.

The combination of the internet of things and smart technologies could change the interaction between human beings and the world more decisively even than the smartphone. As artificial intelligence learns the preferences and behaviours of humans and adapts itself to them, El-Khoury even

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refers to the ‘extension of the human spirit’. The resulting effects will make themselves felt in the car, industry, medicine, smart cities and smart homes.

Application-driven insight

Commenting on the program, professor Axel Sikora from the University of Offenburg, who is chairman of the *Embedded World* conference commented: “The conference has evolved to become the biggest and most important application-driven event for embedded systems. This will be impressively reinforced again in 2020 thanks to a programme of lectures unrivalled in its breadth and depth, with no less than 267 presentations by international experts in 48 sessions and 14 classes.

“This year, a key role will be played by topics on ‘embedded intelligence’ relating to potential architectures and solutions and the associated challenges. But the technical tracks on ‘traditional topics’ will also continue to be developed intensively.”

The programme, with abstracts and information on the speakers, is now available at www.embedded-world.eu, where you can also register for the conference.

Tailored displays conference

Running alongside the *Embedded World* conference is the *Electronics Displays* conference, 26 and 27 February 2020, which will explore the latest issues relating to OLEDs, touch screens and a whole lot more.

Chair of the conference advisory board, professor Karlheinz Blankenbach from the University of Pforzheim, said: “The electronic displays conference is without doubt the most important European B2B platform for display technologies. The conference will make the innovative strength and dynamism of the display industry abundantly clear and guarantees participants some insights into tomorrow’s technologies. The focus will be on information-sharing and professional dialogue between delegates and speakers.”

The conference in 2020 will once again demonstrate that displays are an innovative and key component of embedded systems.

Professor Blankenbach continued: “This year, the advisory board once again reviewed many outstanding submissions before making its selection for the first-class programme. Industry professionals will be able to see the calibre of the

presentations for themselves. The bridge from theory to practice will then be brought to life in the display area in halls one and three.”

Developers and users of electronic displays will once again find out about the latest display technologies like LCD, micro-LEDs, touch screens, optical bonding, display systems and automotive displays.

Discover display trends

Highlights of the 2020 event include keynotes on display trends, various sessions on automotive displays plus presentations on display measuring technology, display optimisation, AR/VR and GUI/HMI, and special applications. Always popular, the post-session author interviews offer a great opportunity to discuss the content of the presentations in a small group setting.



The bridge from theory to practice will be brought to life in the exhibition area

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Distributors expect a return to sales growth in 2020

Increased demand for components from industrial and defense and aerospace OEMs and their contractors, coupled with deployment of 5G networks will create greater demand for semiconductors, passives and other components in 2020



James Carbone

Distributors are cautiously optimistic that they will post single-digit sales increases in 2020 because high inventory levels in 2019 have been mostly worked off and component demand will increase after being sluggish last year.

Distributors say that component demand from industrial, transportation and defense and aerospace OEMs and their contract manufacturers will drive demand in 2020. In addition, the deployment of 5G technology is under way and will contribute to component demand for at least the next five years and most likely longer.

However, some distribution executives say that while component demand will rise in 2020, it could be impeded by slower economic growth in the U.S., China and Europe. Some executives say that a recession is possible, although not likely.

“Next year (2020), there is going to be a dichotomy, said Michael Knight, president, TTI Semiconductor Group. “On one hand there are a lot of things that will put energy into the market. On the other hand, there is this growing pessimism and fear that were going to slip into a recession, maybe a global recession. But I don’t think the U.S. is going to go into a recession,” he said.

Some distributors say while there

will be sales growth in 2020, it likely won’t occur in the first quarter and may not happen until the second half of the year. Knight said the first half of the year would be “bumpy. I think the second half of the year will be better than the first and we will start seeing nice momentum build going towards 2021,” he said.

Chris Stansbury, chief financial officer for Arrow Electronics, said “sales growth won’t return until the second quarter or even beyond. Inventories have largely come down, but there’s still more to come out although it is not a large amount,” he said.

He said Arrow’s business last year was “off across the board but we have done better than the market overall. That’s most pronounced in Asia because we continue to take share from regional distributors,” said Stansbury. He added while 2019 was an off year for Arrow, the distributor previously had 25 straight quarters of growth in Europe, Middle East, and Africa (EMEA) but that ended in the third quarter of last year.

Some distributors are not sure when business will get better. “No one knows exactly when the market will return to more favorable dynamics,” said Alex Iuorio, senior vice president of supplier development for Avnet Electronics Marketing Americas. “What we do know is that macro data, including the U.S. Purchasing Managers Index,



Michael Knight, president of TTI Semiconductor Group

“I think the second half of the year will be better than the first and we will start seeing nice momentum build going towards 2021”

or PMI, hit a 10-year low in September, and is now showing signs of improving. The most recent PMI data shows that in the U.S. the November PMI is at a seven-month high amid a stronger upturn in new orders,” he said.

He added as “we look towards the new year and beyond that to a new decade, we’re seeing mid- to long-term opportunities in retail and health care, and positive trends in defense and aerospace.” However, with other industries such as industrial and automotive,” we still see lingering impact from recent regional slowing such as that in EMEA. “But a new decade promises new

opportunity across all of Avnet’s key industries and geographies, said Iuorio.

A significant impact

One opportunity will be 5G technology. Stansbury said 5G will have a significant impact on business because it will make industrial IoT “easier to access.” He said Arrow has a lot of engineering capability and works with small and medium size customers on industrial IoT solutions.

“If you look at 5G deployment, it is obviously slow. I think there are also questions right now given the issues with Huawei.” The Chinese company builds





telecommunications equipment including 5G networks and smart phones. The U.S. has said that Huawei's infrastructure equipment may allow China to conduct surveillance on the U.S. and there have been calls for the U.S. to prevent the use of products made by Huawei. In 2018, the United States passed a defense funding bill that barred the federal government from doing business with Huawei because of security concerns.

Nevertheless, 5G technology will drive sales as networks and new 5G smart phones are built. However, there will be much more to 5G technology than smart phones. Len Jelinek, director and chief analyst at IHS Markit Technology, said IoT is a "technology platform that will enable a lot of things beyond handsets." For instance, the low latency and low power of 5G will enable a lot more IoT applications to be developed because a lot of data can be transmitted very quickly.

"It should enable some better form of autonomous driving," said Jelinek. "My belief is 5G will definitely be an enabler and will really benefit" the component industry, not just in the short term, but for five years.

Knight agrees. He said 5G will result in strong, steady growth for a long time. "I think 5G will be the story for the 2020s. As 5G comes into play there will be many other technologies applications that get enabled by that low latency such as telemedicine, telesurgery, vehicle communications, and autonomous driving" which will drive component demand, said Knight.

That will be welcome news to all distributors, including small-volume distributors that specialise in design and new product introduction such as Mouser Electronics. Kevin Hess, senior vice president of marketing for Mouser, said the distributor is expecting high single-digit growth in 2020. He noted that Mouser has increased its number of customers and has seen a rise in the number of component orders. IoT applications, 5G and new emerging artificial intelligence applications should contribute to sales growth over the next several years.

Mouser has expanded its warehouse adding more inventory and will be well-positioned to meet component demand, he said. Extra inventory may be needed because the electronics industry often grows four times

Chris Stansbury, Arrow chief financial officer



"Inventories have largely come down, but there's still more to come out"

GDP, according to Pete Shopp, senior vice president of business operations for Mouser. "If GDP is 2 per cent that means electronics should grow 8 per cent and if we do a couple things right, we will be at 12 per cent," he said. That should be our long-term average," he said.

Solving trade issues

Shopp said if trade issues with China can be resolved and the problem of Brexit can be settled, it should lead to more economic growth and have a positive impact on the electronics industry. Shopp said that the planned exit of the UK from the European Union and the trade war and tariffs with China have contributed to lower GDP.

GDP has been reduced by 1 per cent because of Brexit and the tariffs, said Shopp. So, if these issues are resolved it will boost overall economic growth which should mean greater sales growth for many distributors because large and medium-sized distributors sell globally and not just in North America. Hess notes that North and South America used to account for more than 50 per cent of Mouser's business. "Now it's about 36 or 37 per cent. Europe is about 26 or 27 per cent's and Asia the rest," he said. Mouser's business in Europe and Asia has

grown at a faster rate than the Americas with the exception of 2019. "Asia was down a little bit and Europe was relatively flat," he said.

Don Akery, president of TTI Americas, said the distributor was expecting mid-single-digit growth in 2020. "We have seen a few weeks where the bookings have been surprisingly strong," he said in late October.

"Five to seven percent growth is where we expect it to be next year. Mil-aerospace is a big part of our business," said Akery. And that's going to be in the double digits again although the commercial air piece of it may slow down due in part to the Boeing 737 MAX being grounded.



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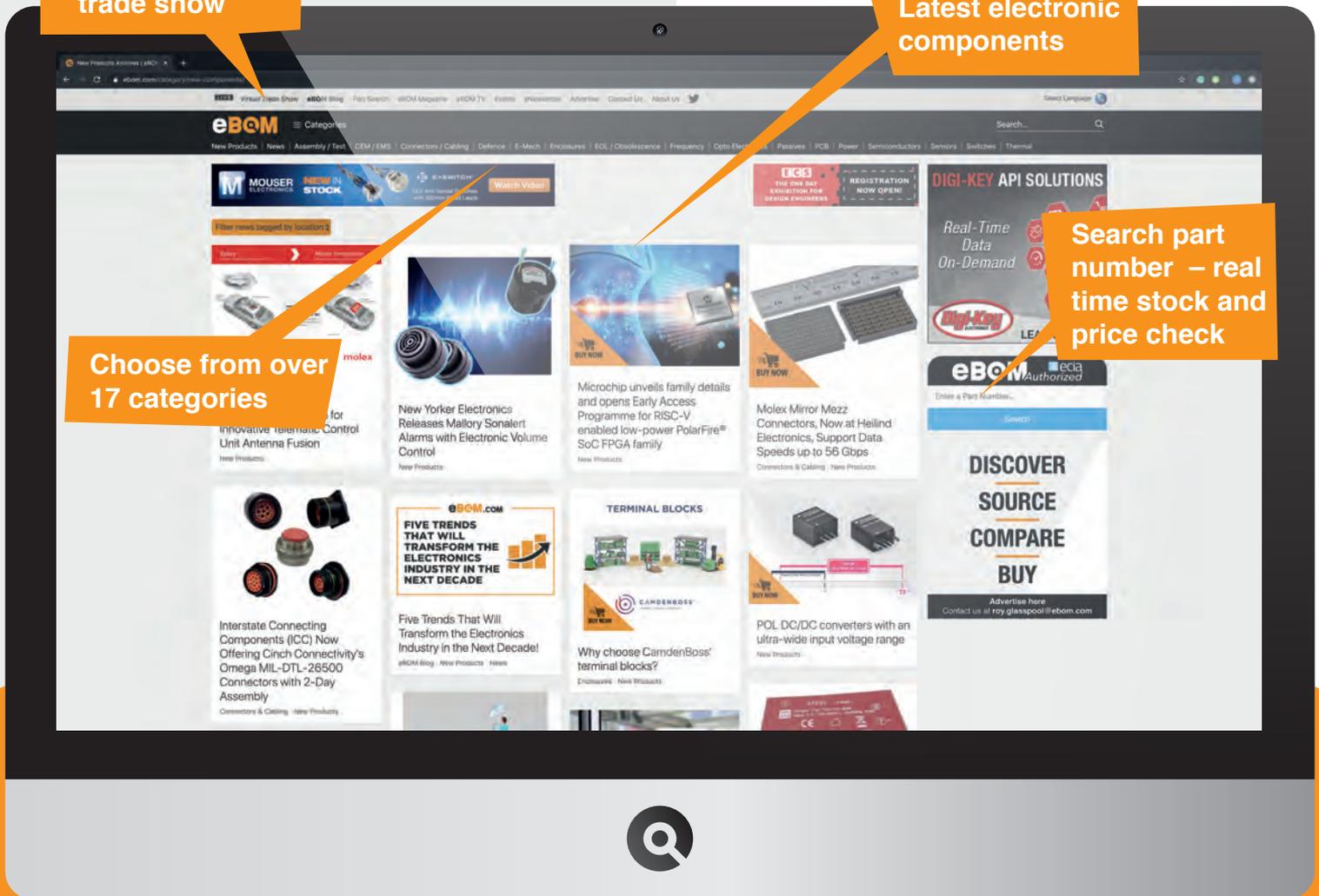
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Buyers face critical supply chain challenges as the new year begins

Constrained supply, diminishing sources of supply and higher than normal lead times for some components will be some key issues for buyers in 2020

Many OEM and electronics manufacturing services (EMS) providers buyers may feel that the purported ancient Chinese curse of “may you live in interesting times” applies to them as the new year begins.

While the semiconductor industry suffered double-digit revenue decline in 2019, the EMS industry grew its sales 10 to 13 per cent in 2019, the third consecutive year of double-digit growth for the industry, according to New Venture Research (NVR). (See story page 23) While EMS providers hope that healthy sales growth will continue in 2020, buyers will face a plethora of interesting supply chain challenges and risk management issues, including the trade war with China, continuing supply base consolidation and constrained supply for some parts.

EMS buyers must also deal with rising raw material costs, the continuing problem of counterfeit parts, and plan for the possibility that a natural disaster could stop production of key components as it did with the 2011 earthquake and tsunami in Japan and severe flooding in Thailand.

It is often the responsibility of EMS buyers to work with their OEM customers to mitigate such risks or manage those risks on behalf of OEMs. “A key part of the service we provide to our customers is to help manage and mitigate risk throughout the supply

chain,” said Graham Scott, vice president of global procurement for EMS provider Jabil Circuit. “We have a systematic process to address and manage risk from geopolitical uncertainty to natural disasters to ensure continuity of supply.”

One uncertainty involves component lead times. While shortages of multilayer ceramic capacitors and other components have eased compared to 2018, lead times for many capacitors, resistors and discretes “are longer than the historical norms,” according to Scott. There are several reasons including continuing supply base consolidation which has reduced the number of suppliers and could potentially impact pricing in 2020 and beyond, he said.

Rising labour costs and reduced labour-force growth in China and other traditional low-labour cost countries have contributed to supply constraints which will likely persist. For instance, China’s average annual wages rose by nearly 63 percent between 2011 and 2016, according to China’s National Bureau of Statistics. The impact of China’s one-child-per-family policy has been a slowdown in population growth and a decline in the size of the workforce, which has driven up wages and labour costs for the electronics industry and other businesses.

China’s workforce will continue to decline, according to the Chinese government. In 2017, China had an available workforce of 900 million people but the figure will drop by 200 million by 2030, the government predicted.

Over the long term, electronics buyers must develop strategies to minimize the effect of rising labour costs. A partner that has extensive global partnerships and manufacturing footprint will be essential to attain this, according to Scott.

Higher labour costs can impact component prices and so can rising demand for certain components from smart phone and portable equipment manufacturers. Increasing demand could contribute to tight supply in 2020.

Dealing with shortages

Another key challenge for electronics purchasers is component shortages. While electronics purchasers historically have had to deal with component shortages caused by a spike in demand and/or lack of investment by suppliers in new capacity, more shortages are occurring because of technological transitions by component manufacturers.

Increasingly, component manufacturers of critical components are transitioning production from lower margin mature components to higher



James Carbone, contributing editor for Electronics Sourcing



Higher labour costs can impact component prices and so can rising demand for certain components from smart phone and portable equipment manufacturers

functioning, higher price components. As a result, memory ICs, discretes and some passive components that are still widely used in electronics equipment that have long product lifecycles are becoming increasingly harder to find.

One example is multilayer ceramic capacitors (MLCCs). MLCC manufacturers have boosted production of capacitors in small case sizes such as 0201 and 01005. Such parts are used in smart phones, notebook computers, handheld video games among other products. At the same time, some capacitor manufacturers have ceased to make capacitors in larger case sizes such as 0603 or 1203. Larger case size parts are used in systems that have long product lifecycles such as industrial, medical and communications equipment.

While capacitor manufacturers may increase capacity overall, the increase tends to be for parts in smaller case sizes. Because capacitor suppliers are being more selective in the capacity investments that they make, buyers should be aware of the type of customer a component manufacturer supports.

Buyers need to work with suppliers on visibility issues to help suppliers plan and fulfill their component needs. In addition, with more

mature parts going end of life, buyers need to develop strategies that guarantee continuity of supply if a supplier decides to stop producing a needed part, according to Scott.

Trade war continues

One issue that buyers will continue to have to deal with in 2020 is the trade war and tariffs. "Rising tariffs are putting a painful squeeze on many U.S. electronics manufacturers," said Shawn DuBravac, chief economist for trade association IPC. "Many are facing supply-chain disruptions and steeper costs from the tariffs that have been imposed to date, and the impacts will grow as the trade war drags on," he said.

Randall Sherman, president of New Venture Research, added tariffs have become a significant headache and is causing redistribution of sourcing away from China." The findings of a recent IPC survey of the impact of tariffs on electronics manufacturers concur with that assessment.

Fifty-one percent of electronics companies responding to the IPC survey said they are now sourcing from countries other than China as a result of increased tariffs on Chinese imports. That means EMS buyers must work with OEM customers to find and qualify new sources of components and other

production materials.

The survey also found 86 per cent of U.S. electronics companies are troubled by the higher tariffs imposed by the United States and China on each other's imports and some are investing less in the United States and hiring fewer workers as a result. More than a third of companies report they cannot increase their prices to cover the cost of higher import tariffs due to various factors.

About 69 per cent of companies report lower profit margins as a result of increased tariffs, 21 per cent report they are reducing investment in the United States and 13 per cent say they are cutting back on hiring and/or reducing headcount, the IPC survey said.

Besides tariffs, many EMS buyers are challenged by a shrinking supply base caused by mergers and acquisitions. Buyers are feeling the impact of consolidation that has reduced the number of suppliers in the electronic components market, which has decreased parts availability. The bad news for buyers is M&A activity is continuing. In 2019 Infineon acquired Cypress Semiconductor, NXP bought Marvell's Wi-Fi connectivity portfolio, ON Semiconductor purchased Quantenna and Nvidia acquired Mellanox.

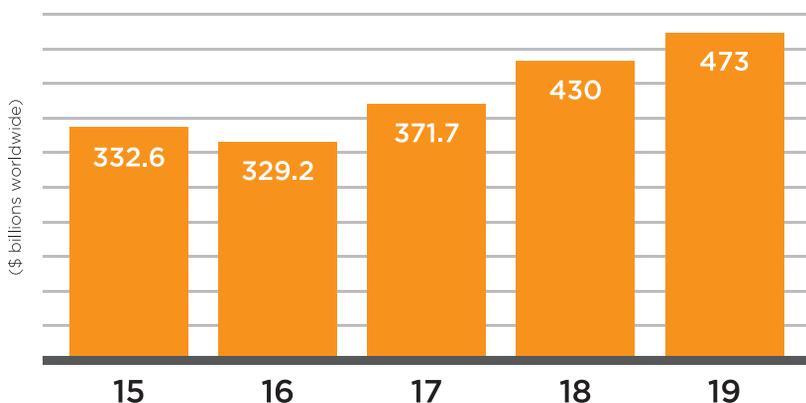


Randall Sherman, president of **New Venture Research**



Buyers need to work with suppliers on visibility issues to help suppliers plan and fulfill their component needs

EMS revenue rises again



Electronics manufacturing services revenue increased by more than 10 percent in 2019.
Source: New Venture Research

More consolidation is likely in 2020.

Consolidation in the supply base will continue to reduce the industry's investments into new production, leading to further supply constraints as demand starts to return to normal levels, said Scott. Due to this increased risk, it's critical for buyers to understand the supply base and its strategic/technology direction, he said. With the increasing consolidation of supply, buyers need to make sure they have few, if any single sources for parts, which would mean qualifying new suppliers.

Another supply chain issue buyers must deal with is rising labour costs. OEM buyers involved in outsourcing decisions must review their supply chains and assess emerging geographies where costs are lower. OEMs need to balance the risk and cost of moving production and supply chains to places like Indonesia, India, Mexico and new regions of China, said Scott.

Working with distributors

To manage supply chain risks, EMS providers often work closely with key component manufacturers to identify potential risks and develop strategies to address them. Electronics distributors are often part of material sourcing and risk management strategies of EMS companies.

Distributors often provide inventory flexibility for EMS providers. "Since distributors typically have multiple customers for commodity items, they can shift inventory to meet customer needs," said Scott. "In addition, they can bond inventory within their warehouses to support our customer's requirements."

Distributors can help EMS companies manage component obsolescence. Many have humidity-controlled facilities to store last-time buy inventory.

Distributors often support supply chain models such as consignment and vendor managed inventory (VMI) programs and distributors can manage some of the "more focused component lines," said Scott.

Many distributors have large customer bases and strong relationships with component manufacturers. "In cases where Jabil has limited transactions with a supplier, distribution plays a role in establishing a Jabil relationship with that component manufacturer," he said.

EMS providers often use distributor value added services such as parts programming, custom marking, and kitting, which are helpful in new product introduction production ramp phases.



OEM buyers involved in outsourcing decisions must review their supply chains and assess emerging geographies where costs are lower

EMS industry posts double-digit sales growth

The electronics manufacturing services (EMS) industry posted a third straight year of double-digit growth in 2019 as revenue increased from about \$430 billion in 2018 to \$473 billion in 2019, according to New Venture Research.

"There has been a good recovery in computers mainly as replacement sales of end-of-life products," which is helping the EMS industry to grow, said Randall Sherman, founder and president of NVR. He said telecom industry has continued its strong growth "as a result of 5G phones, routers, modems and other network gear being deployed." Communications and computer products will continue to be the segments driving the largest growth in the electronics industry. Those segments will continue to be strong for years because cloud computing, social media platforms, and real-time data and video streaming means more computer and wireless indication hard will be may needed.

Fifth-generation cell phone technology will be an important driver to the EMS industry, but it is unclear when 5G will have a big impact on EMS business. "It's not a question of whether it's going to happen or not. It's just a question of timing," said Revathi Advaiti chief executive officer & director of EMS provider Flex. The rollout of 5G so far has been "spotty," he said. "Europe and Asia have been slow. North America has ramped up a little bit faster. When it does happen, we're well-positioned I would say with all the major 5G providers," said Advaiti.

Sherman said the consumer market has been surprisingly good in North America with devices for the smart home and next generation gaming devices. The transportation industries have been steady with automotive adopting driver safety assistance technologies, according to Sherman.

One reason for EMS growth is OEMs that are dependent on EMS providers more than ever. "EMS providers have become the true partner of their OEM customers in all aspects of manufacturing. Most are investing in design services and prototyping that is being driven by 3D manufacturing technologies," said Sherman.

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

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
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
Spanion 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

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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
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

Buyers' Guide

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

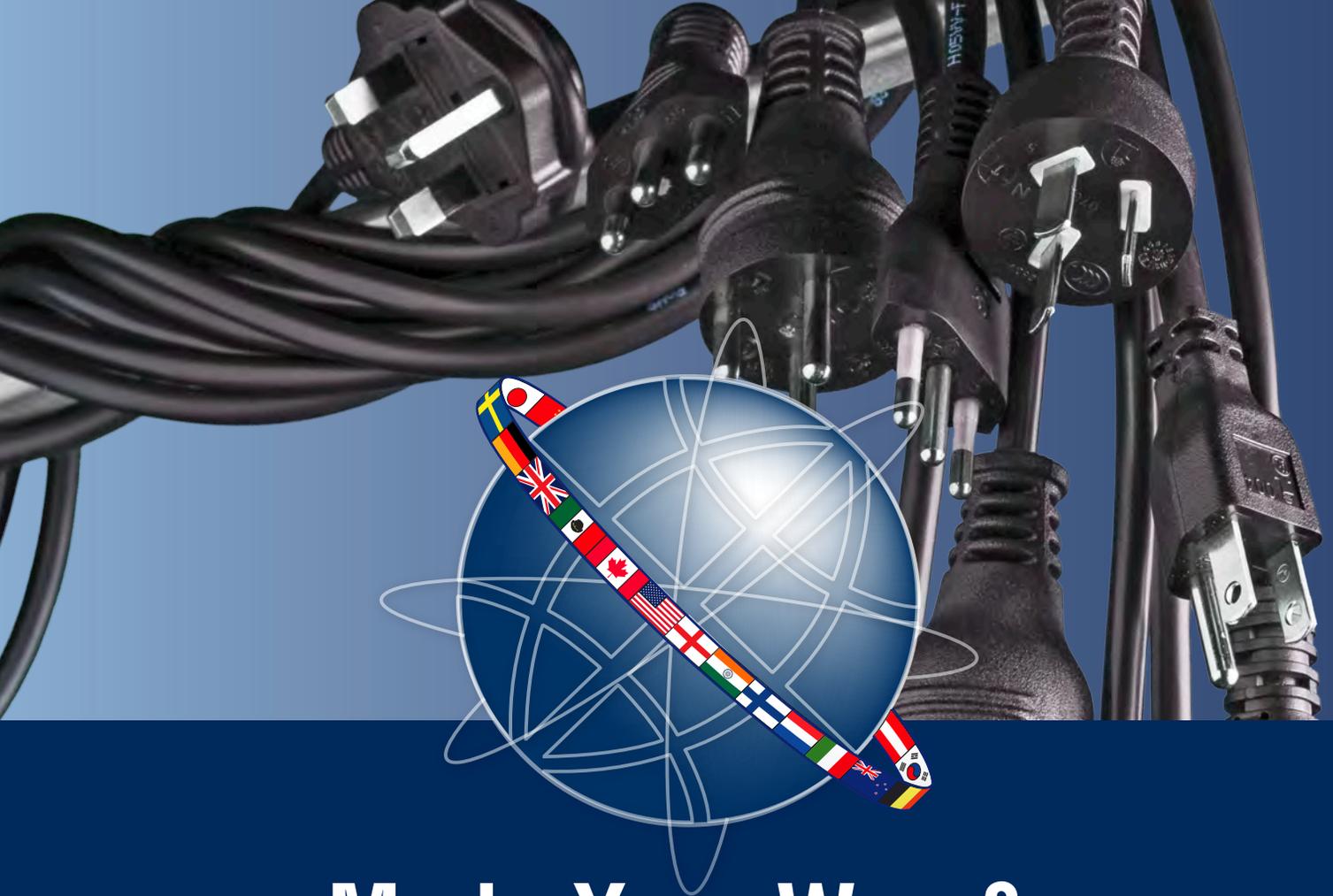
Anaren	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	100	N/A	0 €	86%	50	1,500+	Y
B&B Electronics	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	100	N/A	0 €	87%	50	1,500+	Y
Bluegiga Technologies	Mouser Electronics	0049 (0)89 520 462 110	www.mouser.com	EU	Y	100	N/A	0 €	93%	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 (i.e. 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	+33 233 765 200	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, AISI4001, OHSAS 18001, MI 31032, MI 55110, MI 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, 13485, 14001, TS16949, IPC-A-610 Class 3, NADCAP	430	11	Y	Y	Y	Y	Y	Y



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