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Buyers' Guide

All the facts and figures to help you buy



The hardest word to hear: no

From what I've read about the process the human brain goes through when decision making, I seem to recall that 'comparison' is an important element. Thus, when confronted with a decision, the brain trawls its memory to see if it has tackled similar decisions in the past and what the outcomes of its choices were.

For example, I'm a member of a rather exclusive club who held a mortgage in the early '90s when interest rates started at 10 per cent and headed for 15 per cent at one point. So, thanks to my age, I've never feared interest rate rises as all my financial planning is based on the probability that, one day in the future, mortgage rates will once again reach 15 per cent.

Applying that same logic to electronics sourcing, swap 'interest rate rises' for 'allocation'. Given that the world's markets are based on supply and demand, buyers have always faced ups and downs. Over recent years, such fluctuations have typically been limited to prices and delivery dates.

However, talking to some distributors, for certain component types, young buyers might start hearing the word 'no' for the first time in their career. No is a difficult word for a distributor to say and for a buyer to hear.

For what it's worth, my immediate solutions are simple. First, read this and future issues of *Electronics Sourcing*: I sense it's a subject we will be writing about regularly. Secondly, find a pair of distribution and purchasing professionals who have been in the industry long enough to remember the last time capacity hit the buffers. Buy them lunch and quiz them for two hours on what happened, that they did, what worked and what to avoid.

Memory is a powerful purchasing tool.

Jon Barrett

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In Search of End-to-End IoT Solutions



Victoria Kickham is a freelance writer specializing in manufacturing, distribution and supply chain issues

Wide-ranging demand for services spurs supplier investment in IoT capabilities; Avnet's acquisition of Dragon Innovation is the latest case in point

IoT • By Victoria Kickham

Electronic components buyers face a laundry list of challenges in the push to bring Internet of Things (IoT) projects to market faster, not the least of which is finding a supplier that combines the needed technical expertise with a broad enough line card to meet growing requirements. Suppliers are taking different routes to meet this demand, including forming innovative partnerships and looking for merger and acquisition opportunities. One of the newest industry examples combines both strategies in an effort to give large and small customers an end-to-end solution for IoT projects.

Earlier this fall, global electronic components distributor Avnet Inc. announced its acquisition of Dragon Innovation, a manufacturing solutions company that helps customers manufacture products at scale. The deal gives Dragon Innovation access to deep resources to grow its business—which employs 10 people in the United States and another 21 in China—while allowing Avnet to extend its design and supply chain activities to include the next step in the process: developing a manufacturing plan and putting that plan into action.

This is an especially important piece of the puzzle for start-ups, which comprise a large and growing portion of the IoT market and often have little to no experience in the production side of the business. Recognizing that need, Avnet partnered with Dragon earlier this year to develop Hardware Studio, a Kickstarter program that helps makers and other start-ups with design, supply, and manufacturing resources after they have met their crowdfunding goals. Hardware Studio was scheduled to launch in September and is aimed at connecting customers to design services and solutions, Avnet's broad line card, and Dragon's consulting services, which includes online tools designed to simplify the product development process. Folding Dragon into the Avnet family was a natural extension of the partnership.

"As we started to work with Dragon, we discovered there was a great synergy with Avnet," explains Dayna Badhorn, Avnet's vice president of emerging business. "We focus on supply and design chain, and Dragon offers something in the next step of the journey."

That "next step" may help Avnet deeper penetrate a whole new set of customers the firm gained via its acquisitions of Premier Farnell (and its element14 engineering community) and Hackster.io last year. The deals expanded Avnet's reach to more than two million customers and a community of 750,000 entrepreneurs, makers, and engineers, according to Avnet.

Larger, established customers can also take advantage of Dragon's services for smaller scale, prototyping solutions, according to Dragon's founder and CEO, Scott N. Miller.

"Big companies are waking up and realizing they need to start innovating," explains Miller, adding that some are venturing into new territory when developing hardware solutions and others are looking to test on a smaller scale the addition of IoT capability to existing products.

As a result, access to Avnet's customer base is a big win, Miller says.

"These are typically much larger customers [for us], but if our thesis is right, we can figure out which ones we can add value to," he adds.

Dragon brings experience in both industrial and consumer electronics markets, including emerging IoT segments such as home automation, wearables, robotics, and automotive. And perhaps most importantly, it brings those and other capabilities to work under one roof, Badhorn explains.

"Today I think you can go into a variety of places to do what we do and what Dragon does," she says. "We hope that by adding capabilities it gives [customers] one place to work with on a daily basis."

"I think it's a really exciting time in the industry. We're excited to engage with customers [at all levels]. If we can help our customers get to market faster and get to revenue faster, it's a win-win for everybody."

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Finding folding flat cable

Authorized 3M distributor, Heilind Electronics, recently added the manufacturer's new 7700 series 0.025in round conductor flat ribbon cable to its inventory of interconnect and cabling products.

The 7700 series supports insulation displacement contact termination and can be used in a range of controlled impedance low voltage differential signaling wire-to-board applications, including automated test and communications network equipment. This flat ribbon cable is constructed using 30 AWG solid conductors and polyolefin insulators, with an outer layer laminated with flexible foil to control impedance at 95 ohms. The design not only supports speeds of up to 20Gbps, but is also said to enable tighter folding with minimal performance impact.

www.heilind.com



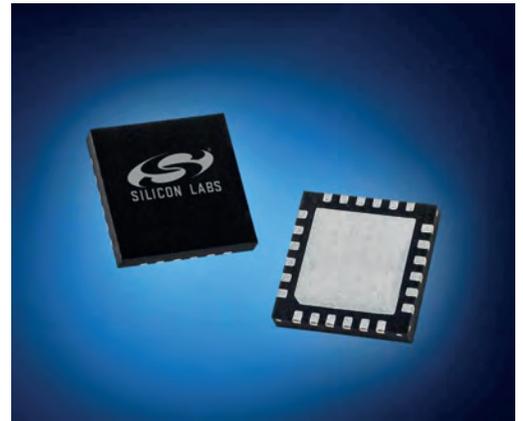
Inspiring healthy innovation

Digi-Key Electronics can now offer RayVio's portfolio of UVB and UVC LEDs for immediate shipment globally. Capable of delivering one to 70mW of power, the LEDs are ideal for health, hygiene, water and surface disinfection, skin care or phototherapy and horticulture applications.

Chief executive officer of RayVio, Dr Robert C Walker, said: "Access to the latest UV LED technology will allow products like humidifiers, water bottles and toothbrushes to incorporate disinfection capabilities."

Vice president, global semiconductor at Digi-Key, David Stein, added: "RayVio is our first lighting supplier to focus solely on UVB and UVC LEDs. It's an emerging market with unlimited applications in the health and hygiene industries."

www.digikey.com



Sourcing touch with ease

Mouser Electronics is now stocking CPT212B and CPT213B TouchXpress capacitive touch controllers from Silicon Labs. The controllers are designed to eliminate time-consuming firmware development, providing a simple turnkey solution for adding a low-power capacitive touch interface to products such as home appliances, medical equipment and consumer electronics.

The CPT212B device features up to 12 sensor inputs and boasts ultra-low-power operation, rated at 200µA in optimized active mode and 1µA in sleep mode. The CPT213B offers up to 13 sensor inputs and adds IEC 60730 Class B safety library support, designed to prevent unsafe operation of household appliances. The controllers' I2C interface helps track the status of touch sensors and an interrupt pin can wake the host processor from sleep after a proximity touch detection.

Mouser is stocking evaluation boards to showcase the capabilities of the TouchXpress controllers.

www.mouser.com

Stocking hot spot busting fans

Sager Electronics is now stocking ebm-papst's diagonal compact modules, designed to dissipate thermal loads in control cabinets while working as efficiently and quietly as possible. Options include AC 115V 60Hz and 230V 50Hz, as well as a GreenTech EC motor for 115V and 230V operation.

According to Sager, the module's diagonal impeller combines the positive features of axial and centrifugal blade designs. Running noise is also said to be lower than commercially available tube axial fans, with the diagonal outflow producing a more uniform flow through the control cabinet, reducing the formation of harmful 'hot spots' and extending service life.

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In Brief

More high-power choice

BlockMaster Electronics has published a 12-page catalog detailing its new HP and OTB series high power terminal blocks, ideal for transitioning larger wire gauge, high power mains to smaller gauge, lower power branch circuits. Each series is rated to 600V, from 115 to 380A. The 'one size fits all' HP series can also be used for lighter power applications. www.blockmaster.com

Orders up, sales down

The IPC has announced the July findings from its monthly North American PCB statistical program. Positive year-on-year growth in orders and negative growth in sales continued, driving the book-to-bill ratio up to 1.09. Compared to the preceding month, July shipments decreased 22.3 per cent but this reflects normal seasonal patterns, says the IPC. www.ipc.org

Create quotes faster

Master Electronics has entered into a partnership with CalcuQuote. The agreement enables electronics manufacturing services companies to search the distributors' database for pricing and availability information. CalcuQuote's cloud based quote management system is ideal for high-mix, low-volume EMS providers and is said to help deliver quotes with speed and precision. www.masterelectronics.com

Find packages easily

StratEdge's new mobile-friendly website details the company's semiconductor packages for microwave, millimeter-wave and high speed digital devices. The site provides information about the complete line of DC to 63+ GHz packages, proprietary post-fired and molded ceramic technology, complete with application notes. StratEdge's Amazon Store can also be accessed, offering a selection of off-the-shelf high-frequency packages. www.stratedge.com



Buying into safety

CDM Electronics has announced availability of TopFlight Components' commercial-grade, military-equivalent backshells and adapters, protective covers, connector accessories, harsh environment connectors and shield termination products. The parts, which can also be customized, are engineered to satisfy performance and safety requirements for the marine oil and gas, aerospace, military, transit and medical sectors.

Adapters are supplied in environmental, non-environmental and EMI/RFI termination, as well as in shrink boot configurations. Backshells, adapters, protective covers and electrical connectors can also be ordered in a composite configuration to protect mating surfaces, while sealing the terminated connector against particle and moisture contamination. Ultem 2300 PEI is the standard composite material as it is resistant to acidic solutions and satisfies a range of fluid susceptibility requirements in high-strength/high-heat environments. www.cdmelectronics.com

PLL ICs re-enter the market

Lansdale Semiconductor has announced continued availability of the ML145170 PLL frequency synthesizer circuit with serial interface. Originally designed and built by Motorola/Freescale Semiconductor, Lansdale has single-source rights to market and continue to manufacture Motorola's line of phase lock loop circuits.

Availability of the ML145170 single-chip synthesizer is critical to support a variety of applications including automotive products, programmable oscillators, transceivers, cellular phones and computers. A special architecture is said to make this PLL easy to program and either a bit- or byte-oriented format can be used.

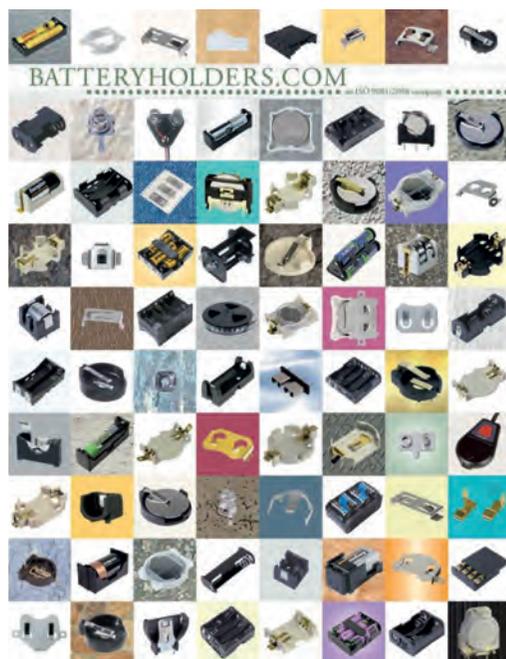
Lansdale's product life cycle management system is designed to guarantee form, fit, and function equal to the original manufacturer's design specifications. www.lansdale.com



Distributors are feeling positive

ECIA research reveals a healthy growth in distribution sales for North America in the second quarter of 2017. Sales were up 3.3 per cent compared to the first quarter of the year and up 7.8 per cent compared to the same period last year. Distributors also remain optimistic for the balance of 2017.

ECIA vice president industry statistics and business analytics, Jim Bruorton, commented: "With the Semiconductor Industry Association forecasting continued growth for the second half of the year, the opportunities around American infrastructure development and projected growth across most all business sectors, distributors have reason for optimism. Add to that a strong purchasing managers' index through the first six months of the year, and distributors are feeling positive about business for the balance of 2017." www.ecianow.org



Find battery holders fast

Memory Protection Devices has released a new and improved catalog detailing its battery holder products. The catalog has been redesigned to ensure users can quickly find the right battery holders for their projects with a structure to intuitively lead users to the best products for their application. Many new products have also been added, with battery holders for coin cell batteries taking center stage. An updated list of distributors helps users find parts for shipment, with distributors' current stocks displayed on the MPD website. Purchasers can download the catalog from the website or request a printed copy. www.memoryprotectiondevices.com



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The price of success

Lantek Corporation's general manager, Frank Cervino, alerts purchasers that with the market booming and lead times still increasing, semiconductor shortages are set to continue

The semiconductor industry is in great health; earlier this year, worldwide semiconductor sales reached \$31.9 billion. This figure, announced by the Semiconductor Industry Association, represents a 23 per cent increase compared to the same period in 2016. It seems the global semiconductor market has settled into a period of significant and steady growth, with the Americas leading the way by posting an increase of 30 per cent.

This is good news for distributors. After slow growth for the past couple of years, this sudden boom has moved the sector into positive territory, but for OEMs and CEMs, it isn't necessarily good news.

Longer lead times

A recent distribution report stated that sales from industrial customers rose

nearly 30 per cent last year. This, coupled with strong demand from the automotive sector and the continued implementation of internet of things technologies has seen lead times increase, with franchise channels suffering from widespread shortages.

This has impacted supply chains, not just logistically, but economically as well, because the cost of certain product lines is rising. Add instances of allocation into the mix and it compounds stress and price fluctuation in an already volatile marketplace. It's an environment that many in the industry have not seen in nearly a decade.

Research is necessary

This period of shortages is expected to continue until late 2018, especially in the ultra-competitive memory

sector. Thanks to demand outstripping supply and the resulting inflationary pricing, purchasers will have to conduct ample research to extract value when locking down quantities of memory products. A singular approach to supply chain management may quickly become an inefficient model to follow.

At base level, extended lead times are a consequence of demand outstripping supply, however, there is another factor at work here. After a relatively flat period, many semiconductor manufacturers have failed to invest in improving productivity and capacity levels. Because of this, several manufacturers have suffered an uneasy transition to new generation product lines and have been caught off-guard by a sudden spike in requests.



Lantek Corporation's general manager, Frank Cervino

This in turn has caused problems for authorized distributors and those purchasing departments that rely solely on these channels. Again, this is easing people away from traditional distribution and increasing their spending with reputable independent distributors.

Independent growth

The electronics industry is large enough to support both authorized and independent distributors, especially during periods of stress. In this market, it is beneficial to work with companies of both kinds and benefit from their respective strengths. Independent distributors, for example, can help secure a supply chain by scheduling orders over a twelve-month period, fixing pricing and guaranteeing stock in one swoop.

Overall, although the market may be growing and there are positives associated with this, the reality is that many of those at the end of the funnel are feeling the pinch. For the most cost-effective purchasing channels, a broad supply chain may help to avoid lead time problems and price spikes.

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James Carbone
contributing editor

Distributors have forged close relationships with many OEM and EMS customers, helping them solve design and supply chain problems *By James Carbone*

“Customer-driven” may be considered by some as a business jargon cliché, but it is a key characteristic of the electronics distribution business model.

Successful distributors carry the products their OEM and electronics manufacturing services customers need, but also listen to customers concerns about supply chain risks, end markets, lead times, inventory levels, time to market and new environmental, social responsibility, export and other governmental regulations. OEMs and EMS providers expect distributors to help them deal with those issues by providing insight, advice and services.

In fact, many distributors over the years have invested heavily to add or enhance their supply chain management and design capabilities. OEM and EMS providers leverage those capabilities using design, value-added, and supply chain services to reduce cost, mitigate risk, speed time-to-market, improve profitability, helping them compete in a global marketplace.

Many OEMs and EMS providers have become dependent on such programs, resulting in close

relationships with key suppliers with some forging alliances with their distributor partners.

Besides investing in services, distributors have learned to increase or maintain sales with existing customers and to attract new customers, they need to do business with customers the way customers want. For instance, while many traditional OEM and EMS providers may be comfortable calling distributors with questions about parts and placing orders or buying through a distributor’s website, others are looking for machine-to-machine communications and transactions to operate leaner and more efficiently.

Some customers want close-knit relationships with distributors and view them as supply chain partners. They may require a plethora of design, value-added, and inventory management services. Other distributors may have customers that purchase small volumes of components for new designs, prototype builds or small production runs. They may not require supply chain programs, but still expect a high level of customer service from their distributors.

“We have a large number of customers that are loyal, have dedicated customer service reps, dedicated technical support people that they talk to all the time and help them grow their business,” said Kevin Hess, senior vice president of marketing for Mouser Electronics



“What is great about our model is that we have 26 branches and those branches provide customer service,” said Kevin Hess, senior vice president of marketing for Mouser Electronics. Some customers call the branch and want to speak to the same person every time. Others may call looking to buy a part and “talk to a different person every time or they just want to go to our website and order,” he said.

“We have a large number of customers that are loyal that have dedicated customer service reps, dedicated technical support people who they talk to all the time and help them grow their business,” said Hess.

Looking for loyalty
In fact, more customers are becoming loyal to the distributors they do business with, according

to Scott Wing, vice president and general manager of Symmetry Electronics, which was acquired in July by TTI Inc.

Symmetry has partnered with some large tier 1 companies as well as smaller OEMs. “The bulk for sure are tier 2 and tier 3. There are tier fours and fives that we have to really do due-diligence to figure out if we are going to go down the road with them,” he said.

“I think customers are looking to partner with a distributor because of the whole digital age and with the Amazon.com kind of mentality out there,” said Wing. When customers find a distributor partner, they will “pay a little extra” because of the high level of service and expertise they receive from a distributor, he said.

Customers that design and build industrial automation and agricultural equipment and Internet of Thing products tend to have close relationships with Symmetry, he said.

Startup companies also like to have close relationships with distributors because startups frequently lack the technical and supply chain expertise to design, manufacture and bring a new product to market.

Ralf Buehler, senior vice president of sales and marketing for Premier Farnell, said in some cases, a startup customer has developed a board “but doesn’t know how to get manufacturing help. We help them get there,” he said.

He says Premier Farnell enables people with smart business ideas or a product idea to take it to production and to market.

“There’s a lot of handholding, almost business mentoring, training, networking sort of thing,” he said.

Customer needs vary
Dave Doherty, president and chief operating officer for Digi-Key, said customers want different

kinds of help from Digi-Key. Many customers just want an official web interface that allows them to place an order at any time while others want a machine-to-machine interface, he said.

“A customer may say ‘we don’t want to go to your website and order. We want our MRP system to be talking to your purchasing system. We want it completely autonomous.’ We are engaged with a growing number of customers from that aspect. It’s all about speed,” said Doherty.

He said with such relationships a distributor needs to have a “recognized service level and IT sophistication and a trust factor that says I’m just going to connect the systems and stand back,” he said.

Some companies want a machine-to-machine interface because they don’t want to invest capital into a purchasing person “who is looking at a shortage list and calling a distributor trying to source a part,” said Doherty. “Customers say ‘I’d rather reinvest that capital somewhere else to grow my business. And frankly I don’t want you investing with someone to receive the call from



Machine-to-machine interface with customers “is probably one of the most fastest-growing segments of the business,” said Dave Doherty, president and chief operating officer for Digi-Key

the purchasing person. Let’s just go machine to machine.’ That’s probably one of the fastest-growing segments of the business,” said Doherty.

The needs of customers often dictate the type of relationship they have with distributors. Distributors say different customers have different needs, which often dictate the type of relationship a distributor will have with the customer. Some customers have an engineering or supply chain focus. Others may focus on reducing costs, increasing value or reducing waste, said Steve Newland, president of Allied Electronics.

He added a distributor’s relationship with the customer “is always customer driven. You can’t walk up and tell them we want to be your partner. It starts on the customer’s part,” he said.

He said Allied has customers that the distributor considers to be partners.

“We have customers that look at us as the preferred distributor. Sometimes we could be a contract supplier for program but on the other hand we could be the

preferred distributor because we support” the entire business of the customer, said Newland.

He said customers that want to partner are looking to reduce their risk or want to create some unique value.

Often customers are looking for help with inventory, but they also want help from a “processing standpoint. The customer may ask ‘how do I shift some of my FTE (full-time equivalent) load and processing transactions and managing materials on to you,” he said.

Some company supply chain organizations are “very aggressive trying to find someone to shoulder most of the risks, labor, materials inventory to distributors,” he said. Most partnerships involve reducing total cost of ownership for the customers.

Newland said some large “upper echelon companies” will say ‘we have to grow your top line as well as reduce our bottom-line.’ But that’s unusual and very uncommon.”



“When customers find a distributor partner, they will pay a little extra” because of the high level of service and expertise they receive from a distributor, said Scot Wing, vice president of Symmetry Electronics

Keep cool in the face of choice

Most electronic devices require cooling, but with a variety of solutions on the market, choosing the right technology can be daunting. Sager Electronics walks buyers through the assorted options

Increasing power densities, product miniaturization and stringent industry standards are all driving development in the thermal management space. Devices require more power, efficiency and performance in increasingly small footprints. Controlling temperatures in these tiny environments helps optimize performance and improve device longevity.

Most electronic components have a heat threshold; consequently, an array of thermal management products exist to regulate unwanted

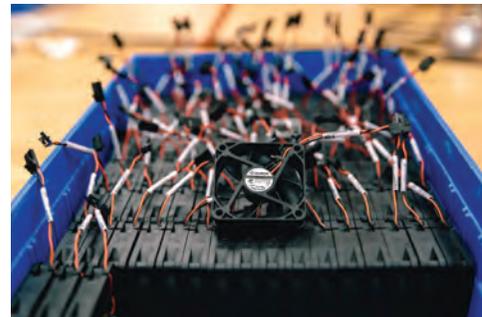
heat. The variety, complexity, and scope of these options can be overwhelming, but they all strive for a common goal — to dissipate heat. When specified appropriately, they help components perform at optimal levels and avoid burnout from taxing heat.

With many components increasingly vulnerable to heat, thermal management should be considered a strategic design-in purchase, but with such a wide assortment of cooling options available, selecting the right solution can seem challenging.

Cooling technologies

Fans and blowers may look the same, but are differentiated by their function within an electronic system or enclosure. Fans are more often used to draw hot air out of an enclosure, while blowers are typically used to blow air onto a component or pull cooler air into an enclosure.

Heatsinks are another familiar solution. Simply stated, heatsinks absorb and disperse heat away from high temperature components. These parts are typically cast,



Increasing power densities, product miniaturization and stringent industry standards are all driving development in thermal management

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stamped, extruded or machined, with both passive and active heatsink types available.

Heat pipes and vapor chambers work differently. Here a two-phase cooling solution quickly transfers heat from one point to another. They typically work in the form of a sealed vessel, with water as the working fluid. Heat is applied in one area, the liquid turns to vapor and moves to an area of lower pressure where it cools and returns to liquid form, whereupon it moves back to the heat source.

Another technology to consider here is the liquid cold plate. This heat spreader or heatsink consists of tubes filled with cooling fluids such as water or refrigerant. Cold plates are also referred to as cold sinks and microchannel heatsinks. Constructed with cross drilled holes or embedded heat pipes to transfer cooling liquid through a cold plate under the device, the heat from components is absorbed into the liquid and is then taken out of the plate and into the larger system.

A thermoelectric module, or Peltier cooler, is a semiconductor-based electronic component that functions as a small heat pump. By applying a low voltage DC power source to a TE module, heat will be moved through the module from one side to the other.

In addition to those technologies listed above, there are several kinds of thermal interface materials that can aid thermal management. Gap filler, grease or putty, adhesive and epoxy, as well as phase change, insulating or non-insulating, pads and films and thermal tape materials go between a heatsink and the device to be cooled. By increasing or securing contact between the two surfaces, thermal transfer is intensified.

Purchasing variables

When sourcing any of these thermal solutions, there are several factors that procurement professionals should consider. Availability, product shelf life, warehousing, storage and packaging can all introduce variables, as can any modified or custom products.

Although many thermal management solutions utilize standard products, modifications or custom solutions are common. Unfortunately, either one can impact availability. Ensuring a proper inventory strategy with a supply chain partner is therefore critical to reducing potential lead times. Another crucial factor is manufacturer location, since lead-times can be substantially increased when products are manufactured outside of North America.

Storage concerns

Despite the trend toward mini and compact fans and blowers, certain applications require large and extra-large frame solutions. Storage may be a concern if you require larger fans or blowers.

Additionally, certain thermal interface materials may require a temperature and moisture stable environment, so understanding warehousing

► continued on page 16

Most electronic components have a heat threshold

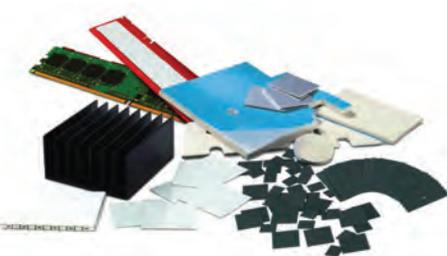


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The need for thermal management solutions is only expected to increase as technology advances



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Fans, blowers and thermal extrusions can range in size and weight dramatically

capabilities is essential. Many thermal interface materials have a shelf life of one to two years. In the case of thermal tapes, this can be impacted by the adhesives used to apply these materials. Products such as gap fillers tend to come in rolls and sheet form, while thermal pastes and putty are typically dispensed products stored in cartridges or syringes. These rolled, sheet and dispensed products can also be subject to shelf life issues.

Packaging issues

Fans, blowers and thermal extrusions range in size and weight dramatically, which means packaging can vary. Understanding how a product is packaged helps determine shipping methods. Proper packaging efforts by suppliers can ensure the integrity of the product during shipping however, packaging and minimum order quantity can also impact the purchase of products like fans and blowers.

Understanding carton sizes and quantities within those packages is a critical factor in maintaining the integrity of products during shipping. Identifying the proper standard packaging quantities can help in selecting appropriate shipping methods.

The weight of a product, for example, can impact the landed cost of heavier air-moving solutions. With most manufacturers of these solutions operating outside North America, utilizing airfreight can shorten lead times by four to five weeks,

but can also increase the landed cost of the product. Not only is product weight a consideration when importing, but it should also be considered when determining shipping within North America. These products are best shipped ground freight when shipping larger volumes to ensure product integrity.

Adding value

Manufacturers or qualified supply chain partners can add value to a thermal management solution by undertaking secondary operations. Adding connectors, shortening or replacing wires on fans and blowers, die-cutting specific thermal interface materials, or cutting thermal extrusions to proper lengths, are just a few of the value-added services that can be offered by partners.

With customization a common theme in thermal management, many products are single sourced, however, products like compact fans and blowers, board level heat sinks and certain thermal interface products can be multi-sourced.

With lead times historically long on most thermal products, proper planning can pay off. By considering the guidelines listed above and aligning with authorized distributors that specialize in thermal management, it is possible to significantly improve time to market while avoiding these potential obstacles in the procurement process.

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Plan for procurement success

Selecting the right fan is key to eliminating design issues, resulting in a more efficient and reliable system, says product line manager at WPG Americas, Sarah Ronkoske

Much of what determines an application's success rests on the shoulders of purchasing professionals; their product selections can create or eliminate system design issues. As with most components, this also holds true for cooling fans and blowers.

Barring a few exceptions, fan systems are the most dependable source for generating airflow and maintaining operational temperature in industrial and commercial applications. Varying enormously in dimensions and performance — from the tiniest micro fans to huge air conditioning systems — the fan is an essential component of many applications.

Forced-air cooling using an AC or DC axial fan can play a significant role in extending the operating life of a device and preventing premature failures. The need for cooling should therefore be determined early in the design to ensure good airflow around heat-generating components and to allow sufficient space and power for the cooling fan. Improper procurement however, can derail even the most well-planned design. Without correct fan selection,

manufacturers can face increased overheads and project delays due to higher commissioning, inefficient operation and expensive returns.

Procurement issues

Choosing oversized fan systems to avoid under-performance is one of the most common practices — as well as the biggest mistake. Unfortunately, oversized fans not only increase purchasing and operating costs, but also lead to performance problems. To mitigate these issues, a 'systems approach' to fan selection can result in a more efficient and reliable system and is often what distinguishes the best OEMs.

This approach provides a 360deg view of the entire system, considering the characteristics of each component, as well as the interactions among components across operating conditions. While striking the right balance between components requires effort, a systems approach can eliminate a lot of headaches down the road, as well as reducing system life-cycle costs.

Consider ratings

During fan procurement, there are several factors to consider to ensure the product is

efficient in terms of its performance and energy consumption. Understanding the environmental constraints of an application can help select a fan that meets and exceeds any external factors. That's where industry ratings come in handy, so it's important to know what they mean.

The IP code, or ingress protection marking, classifies and rates the degree of protection against intrusion into electrical enclosures. Applications that require a high IP code include food processing equipment, refrigeration, factory automation, telecom and horticulture, among others. For these applications, a cooling fan rated IP69K will be the optimum choice. This ensures that the fan has passed rigorous tests regarding high pressure, extreme temperature and water and dust ingress.

Knowing a fan's rating can help purchasing professionals match the right product with design and usage requirements. This will avert cost and performance issues that can stem from incorrect procurement. Of course, system design issues can surface later in the design process, but very often the seeds of the problem are sown at the procurement stage. By exercising proper caution and following the right procurement practices, such issues can be nipped in the bud.

www.wpgamericas.com



Product line manager at WPG Americas, Sarah Ronkoske

Barring a few exceptions, fan systems are the most dependable source for generating airflow and maintaining operational temperature in industrial and commercial applications



Cooling requirements should be determined early in the design process

Get ready for longer lead times

An ominous trend has emerged in electronic component sourcing: lead times are escalating — a fact that will present many challenges for the purchasing community. ECIA looks at how things are changing and why

For several years, sourcing electronic components simply involved 'a mouse click' leading to instant fulfillment. While that may still hold true for some products, today lead times are escalating and stability is not the norm. Unfortunately, there is no one cause. It's a complicated situation exacerbated by shifts in market demand, allocated capacities, investment constraints, de-emphasized older form factors and regional supply shortages.

ECIA companies provide interesting data on this subject by polling product, market and lead time trends on a quarterly basis in North America. When looking at the multi-year composite, abnormalities such as today's increasing lead times tend to pop out. So, let's look at two building-block components: capacitors and passives.

Capacitors

While tantalum and aluminum capacitors experience spotty delivery problems, most concern centers on multilayer ceramic capacitors. Significant

market forces are at work here. Automotive demands are escalating across all models and simultaneously, China mobile phone demand is shifting from standard features to smart devices, driving up device content. Unfortunately, MLCC manufacturing capacity was based on conservative forecasts and no volume manufacturer appears to have anticipated the demand surge caused by these two applications.

Demand is extreme for high capacitance MLCC caps. Bearing in mind that it takes more production equipment, floor space and capital to produce these components, margins likely dictated investment in high CV at the expense of standard MLCC.

Another factor at work here is standardization. De-emphasis of outdated form factors, like large case sizes, aligns with market demand where miniaturization drives new applications, however purchasers that need to retain legacy designs could find sourcing a nightmare.

Lead times have increased roughly two weeks on the average. Two factors have contributed to this. Firstly, in tight delivery situations manufacturers tend to supply direct customers first and distribution second, with little to none allocated outside that core. Secondly, at least one distributor took a more aggressive outlook on growth and stockpiled in anticipation. Although kudos is due, this stock only ensures continuous delivery to one company's core customers.

Resistors

When it comes to resistors, the focus is thick and thin film resistor deliveries. The Asian market is mainly supported by Taiwan suppliers who seem to be keeping up with demand but that is not the case in North America. Dominant suppliers here are Japanese and European who are more capacity constrained. Lead times in North America have gone from 12 to 16 weeks since the beginning of 2017. Historically, slim margins have made new capacity

investment unattractive, so, unless, the global capacity is re-balanced, shortages will be here for some time.

Remember, in times of short supply, manufacturers and distributors will serve long-term customers first. Those customers who 'shop the market' for price and delivery may find greatly extended lead times and real difficulty filling their production needs at any PPV.

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Visibility is a must-have

Clear two-way communication and demand visibility are key to sidestepping supply issues and maintaining availability, explains Future Electronics' corporate vice president, Rick Hawron

This year has seen the onset of demand-supply imbalances; this can be attributed primarily to exponential growth in the automotive industry, thanks to the increased electronic component content of vehicles, the proliferation of internet of things devices, and the fact that 2017 is a major Apple handset conversion year.

As a result, inventory and strategic supply chain solutions have become an increasingly essential element of Future's engagement with its global electronics manufacturing service partners. Future aims to achieve best in class results through supply chain performance optimization, so constant end-to-end communication and demand visibility are key prerequisites.

Available inventory
One vital element of the company's operational strategy is to maintain a high level of 'available to ship' inventory. A centralized and efficient planning organization ensures that 60 per cent of all inventoried products are

available to ship at any point in time. This is facilitated by a robust global IT platform, which enables timely and accurate visibility and access to product on a global basis.

Physical inventory, while being a liability for some, is viewed as a key asset by Future Electronics. It's something you can't fake — you either have it, or you don't.

Future's partnership programs have exhibited time and time again that clear two-way communication, maximum demand visibility, strong inventory and a robust IT platform are key enablers to effective risk management. They facilitate regular on-time deliveries and ultimately underpin customer satisfaction.

Understanding the place within the overall ecosystem that global EMS partners occupy, enables Future Electronics to tailor seamless supply chain solutions that deliver results.

www.futureelectronics.com



Corporate vice president, Future Electronics, Rick Hawron

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Take steps to manage obsolescence

When buyers encounter obsolescence issues, there are six main options available to resolve the problem. Here Winslow Adaptics explores what can be done

Bridge buy

If you have registered to receive end-of-life notifications from franchised distributors or component manufacturers you will be informed of the final purchase and shipment dates. This allows you to plan a last time buy, which is great if you can establish when your project end of life will be and how many components you are likely to need. It is also important to ensure a proper storage facility and test regime is set up and funded to care for the buys. Naturally, bridge buys are easier if the equipment has ceased production and you are in the maintenance phase, not still actively promoting the unit.

Grey market

The global grey market consists of surplus stock held at OEMs, CEMs and remaining stock at franchised distributors in other territories. This is a legitimate place to source components if you remember that many component manufacturers will not

provide technical support to components purchased outside of the regional franchise network.

Components may have no traceability, will not be supported by the manufacturer, have no evidence of storage conditions and may even be counterfeit. The risks can be significantly reduced however, by developing supplier relationships so that, although no formal paperwork is present, the source and condition of the components can be trusted and the components will be warranted. Testing is highly recommended to reveal whether the component is working to its specification, which just leaves the question of reliability. Is it better to use a component which may fail in a shorter time than no component at all?

Adapt

If the component has become obsolete but is still available in another package, then adapt is the best solution. You will

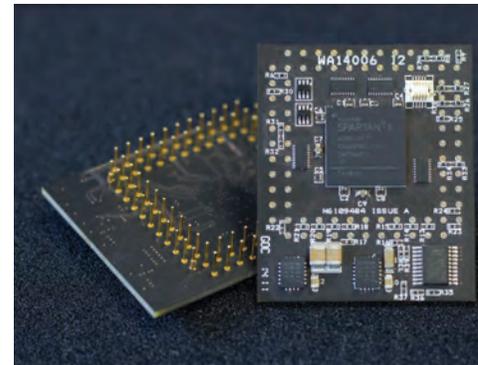
be using the same die at the same speed and characteristics and provided the adapter is made of the same material as the board onto which it will be mounted, then all other environmental considerations will be consistent with the use of the original device.

Reconfigure

I consider reconfigure as adapt plus. For example, when the only available component operates at a different voltage, or the memory device is larger than the original, then reconfiguration is a legitimate solution. This will be designed to the fit of the original and, with the addition of a few components, the function and form can be maintained.

Emulate

If reconfigure was adapt plus, then emulation is reconfigure plus. Here a form, fit and function solution will be established using a suite of different components. This solution is becoming more common



An ASIC has been reconfigured as an FPGA creating a sustainable solution for the medical industry

with the rise in 'intelligent' components becoming obsolete. Fortunately, due to the age of these components, they are often not intelligent by today's capability and are easily emulated using modern configurable devices. Depending on system complexity and environment, this type of solution certainly saves on the cost of re-design.

Re-design

Unplanned re-design can be a costly exercise hastened by unexpected looming deadlines. Knowing the value of your options and their associated risk and surety provides the tools to assess the short and long term commercial impact as you move into the next phase of your product lifecycle.

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Electronics supply chain: the next 12-months

We quizzed Mouser Electronics' senior vice president of products, Jeff Newell, to find out how the company is prepared for future demand

Senior vice president of products at Mouser Electronics, Jeff Newell

Q Are lead times extending?

A It's understandable that some manufacturing facilities are concerned about product availability and longer lead times. As products become harder to find, our significant inventory position means that more customers are coming to Mouser with confidence.

We are optimistic about the future, and are stocking more products than ever before; all signs indicate demand will continue, likely pushing lead times further.

Q What will happen over the coming year?

A If lead times extend and more product allocation becomes necessary, we may see more supply-chain issues in the next 12 months, especially in the Asia Pacific region. This is why it's important to deal with authorized distributors

like Mouser. We have the professionals and procedures in place to ensure an effective and efficient supply chain.

Q How can Mouser help?

A By maintaining our fast, efficient and responsive supply chain. Speed is important because our customers value fast service, but this must be balanced by efficiency, accuracy and the ability to respond quickly to market changes. Mouser takes pride in achieving the right balance to consistently provide extraordinary service.

Q What about inventory management?

A On-time delivery of the newest products is a priority at Mouser. We stock the widest selection of the newest technologies and electronic components from our 600-plus supplier partners.



Our products team is relentlessly managing inventory relative to market demand to ensure that the newest products from our supplier base are on the shelf, ready for same-day shipment across the globe. Not only this, our customer service representatives are trained professionals, ready to help buyers procure their parts.

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Speed is important because customers value fast service



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Redefining development tool ownership

As Microchip ships its two-millionth development kit, microchipDIRECT global sales manager, Martin Warmington, considers how the conventional model for accessing development resources is being redefined

Recent initiatives are changing the way original equipment manufacturers access development tools, bringing greater flexibility through new ownership models. These initiatives include a monthly subscription to access software development tools, a free cloud-based software development platform and the ability to manage multiple development tool licenses within a single account.

Traditionally, OEMs have purchased the appropriate development tools, with the associated code libraries and generators, as they are required for a project. Typically, these tools would be used for a limited time during evaluation or development and once the project was complete, the development tool would simply become a non-recurring engineering cost. Some would surface again, if future projects were based on the same components, otherwise the software could become obsolete.

Monthly subscriptions

To overcome the need to make a permanent investment in software development tools destined for short-term use, Microchip has introduced a monthly subscription license. This means customers only pay to access the tools while they are actively using them. The renewable monthly subscription for MPLAB XC

Pro compilers can be cancelled without penalties at the end of the development phase and reinstated when the next product reaches the software development stage.

Not only does this help customers minimize and spread their investment in software, it also means they will always access the latest version of the tool. In comparison, OEMs who make an up-front investment in software development tools may find their designers are relying on a legacy development kit, purchased for an earlier design.

Managing licenses

Managing development tool licenses can also be simplified by combining the registration information on multiple tools within a customer's microchipDIRECT account. The development licenses for any hardware or software tool, purchased from microchipDIRECT, can be accessed, reviewed, activated or updated at any time from a single account. This saves the time and frustration of searching for registration information associated to different tools and using multiple websites to manage the licenses.

Cloud-based development

Another major innovation in providing easy access to development resources is cloud-based development.

The MPLAB Xpress integrated development environment is a cloud-based development platform for PIC microcontrollers. By combining an easy graphical user interface with cloud-based access, the platform enables people of any technical ability to get started on PIC-based designs without being tied to a PC.

This initiative is particularly interesting for educators because of its compatibility with Arduino development tools, which enable students and academics to write their own software.

Clearly, the introduction of downloadable subscription-based development tools has gone a long way toward reducing OEM initial outlay on development resources, allowing a lower-cost entry into development. Now it is time for the industry to look at different ways to access these resources, which bring more flexibility to development tool ownership.

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Global sales manager
microchipDIRECT, Microchip
Technology, Martin Warmington

OEMs who make an up-front investment in software development tools may find their designers are relying on a legacy development kit



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Are programmable parts the answer?

President and chief executive officer of Dove Electronic Components, Matt Waite, offers advice on alleviating frequency control lead-time issues, suggesting that configurable parts can play a key role

Here we are again in a long lead-time environment and frequency control products are not immune. There are reports of devices with deliveries of over one year, although the worst that Dove has heard from its roster of frequency control suppliers is 20 to 25 weeks. Though long and certainly inconvenient, 20 to 25 weeks is not unmanageable. Furthermore, with over 30 authorized FCP suppliers, Dove offers enough options to come

up with a solution to lead-time constraints.

For the most part, the current situation is being driven by smaller crystals, with some random oscillators affected as well. In recent years, Dove has seen far more demand for basic crystals versus oscillators since, in many cases, customers can build their own oscillation circuit more affordably than buying an oscillator.

Dove can program and ship up to 10K oscillators per day from its programming center



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Where in the past manufacturers would add capacity to meet demand, in this cycle they are content to just sell out their production. There is also the dynamic that many FCP suppliers use the fabless production model. If too many FCP suppliers go to the same manufacturer this pushes out lead times.

To alleviate lead time issues, Dove suggests the following: approve at least two, even three, suppliers at the time of design-in with a crystal. When designing in an oscillator, design in at least two, making one of them a programmable.

Programmable positives

Programmable oscillators are well suited for the current long lead time environment. They bring the latest in technology and form factor and can be tailored to a customer's needs quickly and at a reasonable price.

Dove Electronic Components is no stranger to these oscillators, having installed its first mass production programming equipment nearly 20 years ago. The company now has four of these machines as well as multiple smaller programming setups for low volume, higher technology, parts. At its East Setauket New York headquarters, Dove can program oscillators from Abracon, Cardinal, Citizen, ECS, Epson and SiTime. Many suppliers on Dove's line card also have programmable oscillator capability at their factories.

It's clear that programmable oscillators have become an exciting area; performance is as good, equal, or better depending on the application. Issues of the past, such as power consumption, noise and general unreliability, have been put to rest. Epson Electronics remains a pioneer in programmable oscillators,



President and CEO, Dove Electronic Components, Matt Waite

with an expanding portfolio of these products, while SiTime with its MEMS (Microelectromechanical Systems) technology has rolled out great new products, many of which are field programmable.

With regards to lead times, the key to success with configurable oscillators is

having the unprogrammed 'blank' in stock. Dove therefore ensures it has stock on any blank oscillator that it promotes at its in-house programming facility. This enables the company to program and ship up to 10k oscillators per day from its programming center.

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Programmable oscillators are well suited for the current long lead time environment

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LED market growth will rebound despite continued price erosion

Robust demand will drive the global LED market to \$17.8 billion by 2021

By James Carbone

The global market for light emitting diodes (LEDs) will post modest 3.1 per cent growth in 2017, but robust revenue growth will return in 2018 as unit demand stays strong and LEDs supplant other lighting technologies in electronics equipment as well as in homes, business and municipalities.

The good news for purchasers is while unit demand will increase over the next four years, the average price per LED will continue to decline. Through July of this year, prices declined by about 5 per cent and will drop 4.4 per cent in 2018, according to researcher IC Insights.

With the average price declining, the LED market is forecast to increase from \$13.1 billion in 2016 to just \$13.4 billion in 2018. The global LED market will post a 6.2 per cent annual growth rate through 2021 when LED revenue will total \$17.8 billion, the research firm said. That is welcome news to LED manufacturers after sales dropped 8 per cent in 2016 as the average unit price declined 5.2 per cent.

"The glut of LEDs in the market has been a problem," said Rob Lineback, senior market research analyst for IC Insights. "The market fell in 2016 for the first time in 15 years because of price erosion

and the number of units shipped fell for the first time since 2001," he said.

One reason for oversupply is China. "China has been on a campaign since the beginning of this decade to become self-sufficient in LEDs," said Lineback. Prior to that, electronics manufacturers in the country had been buying LEDs from suppliers in other countries, but "the China government wanted to change that so they started to pump a lot of money into new LED factories and it caused the glut," he said.

Because the market fell in 2016, 2017 was expected to be a rebound year for LEDs. "But looking at the numbers for the first half of the year, the LED market is still down 3 per cent, but the market is kind of getting better," said Lineback.

LED manufacturers say market will continue to improve because so many lighting applications have or soon will transition to LEDs from fluorescent and incandescent because the cost of LEDs have dropped making it affordable for use in more applications.

More LED conversion expected
Steve Barlow, general manager of Lumileds' illumination business unit, said the LED business

continues to grow because there are "still a lot of applications out there that use legacy technology that have not yet been converted to LED technology."

He said further growth in the LED market will occur because of a combination of new applications that will use LEDs and replacement LED sales.

"I think the tipping point has been reached in virtually all lighting applications where the value proposition of LED technology makes it worthwhile," said Barlow. LEDs use less energy than other lighting technologies and last longer, so they don't have to be replaced as much.

He noted that municipalities have already transitioned to LEDs for streetlights and traffic lights, but many utilities have not.

"There are many light products owned by utilities and they are still in the process of converting" to LED technology which will help drive growth.

The retail industry will also use more LEDs. "Retailers often renovate their facilities every five years" and such renovations often include lighting systems, many of which use LED technology. LEDs

are also used by retailers to make merchandise look more appealing.

New office buildings will use LEDs and older buildings are transitioning LED technology further driving demand for LEDs.

Technical improvements to LEDs will attract new applications. "For example, spectrum enhancements should increase the level of participation that we have in the horticultural marketplace," said Barlow.

One of the major drivers for LED manufacturers is general lighting, which accounts for about one third of the overall LED market, according to IC Insights. Most homes and businesses have transitioned to LED lighting from fluorescent and incandescent.

"You can't get compact fluorescent lights anymore. They may become collector items," Lineback joked.

Automotive brightens LED market
Another strong growth segment for LEDs is automotive. LEDs illuminate dashboard displays and automotive interiors and "now they're moving into headlamps," said Lineback. Six per cent of LED sales are to the automotive segment and by 2021 that percentage will grow to 20 per cent, he said.

By The Numbers

Source: IC Insights

\$17.8 billion *The forecasted size of the global LED market in 2021*

183 billion *The number of LEDs that are expected to ship in 2017*

4.3% *The expected average price decline for LEDs in 2017*

Automotive is a growing part of Lumileds' business, said Barlow. "We are a big player in automotive. Our focus is on exterior lighting for vehicles, everything from taillights, stop lights, running lights to headlamps, daytime running lamps, fog lights, all those types of applications," he said.

Backlighting for televisions, cell phones, media players and monitors for PCs, notebooks and tablets account for about 30 per cent of the LED market.

"The television segment was the strongest segment for LEDs about 15 years ago, but that has fallen off partly because the number of TVs being shipped has been flat or a little bit down," said Lineback. In addition, backlighting technology uses fewer LEDs because LED manufacturers have improved light output so fewer LEDs are needed.

"They have ways to get more light out of units. There's also been a movement toward some other solid-state illumination sources rather than LEDs," said Lineback.

Improving output per LED enabling the use of fewer LEDs in an application is one reason there is oversupply, said Lineback. Another reason is the transition to larger size wafers in LED production.

LEDs had been manufactured on 75mm and 100mm wafers, but LED companies have transitioned to 125mm and 150mm wafers, said Lineback. Larger wafers mean that manufacturers can get more usable LEDs per wafer without adding production capacity.

"There've been some efforts to go to 200mm, which is an 8-inch wafer, but I think because there is oversupply there's not a lot of incentive to go to 200mm," he said.

More price erosion

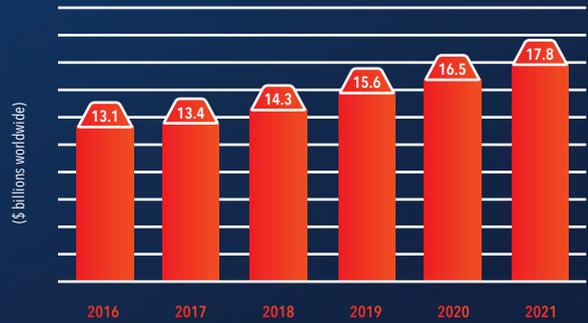
As a result of oversupply prices, will continue to fall indefinitely. Lineback noted that the U.S. Department of Energy (DOE) several years ago set goals for the industry in terms of reducing the cost of LEDs. DOE forecast 17-18 percent annual cost reductions and "that has been on track," said Lineback.

Despite price erosion, the LED market will grow for years. "It could be high single-digit growth for most years, but there may be some down years when there's too much capacity" which will slow growth, said Lineback. He said LED sales should grow 8 per cent in 2018 and 2019, 4 per cent in 2020 and 6 per cent in 2021.

While there has been a great deal of consolidation in the overall semiconductor industry, buyers should not be concerned that there will be diminished LED sources because of mergers and acquisitions at least in the near future.

"There's been very minor consolidation that took place in Asia," said Barlow. "There is an opportunity for consolidation long-term, but not in the short term."

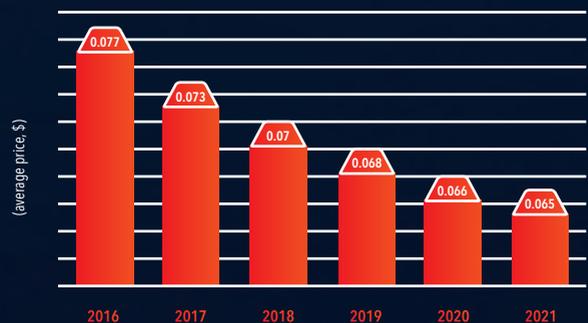
However, while there may not be a lot of consolidation, some LED companies may engage in joint ventures. For instance, earlier this year Cree announced a joint venture with San'an Optoelectronics Co., Ltd of China. The two companies plan to manufacture high-performance, mid-power lighting class LED packaged products for markets in North and South America, Europe, Japan and China.



LED outlook brightens: The global market for LEDs will grow from \$13.1 billion in 2016 to \$17.8 billion in 2021, a compound annual growth rate of 7.5 per cent *Source: IC Insights*



LED shipments rise: LED unit sales will increase about 9.8 per cent per year through 2021 when 273. billion LEDs will ship *Source: IC Insights*



LED tags to drop: Prices for LEDs will fall through 2021 when the average price for an LED is 6.5 cents *Source: IC Insights*

20% The percentage of all LEDs that will be used in the automotive industry in 2021

3.3% The average annual price decline for LEDs for the years 2016-2021

You get what you pay for

There's truth behind this age-old saying, as Digi-Key Electronics explains

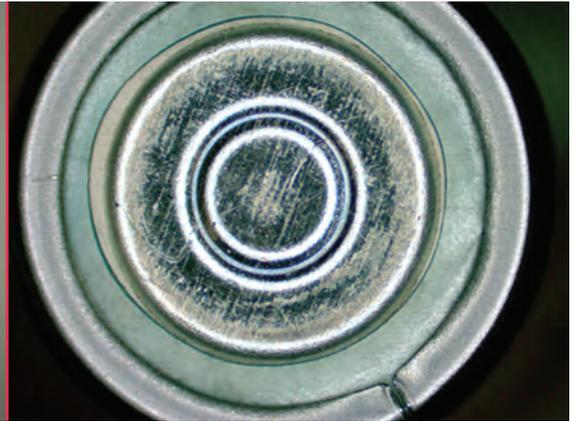
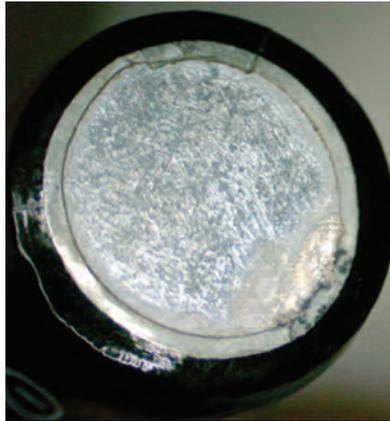
When purchasing power supplies, batteries, or electronic components in general, the axiom 'you get what you pay for' often holds true. Before placing an order with that cheap overseas shop, ask yourself if quality matters. Does it matter if you receive defective product? Does it matter if the product works for a time and fails upon reaching your customers?

Remember that low-cost suppliers will be making money somehow, often by sacrificing quality. It's commonplace for low-cost suppliers to use sub-standard

materials and construction techniques to produce a cheap and inferior product, often

styled to look like one from a reputable manufacturer. The photos show a genuine

The AAA look-alike cell is obviously inferior to the genuine cell



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product and an inferior imitation, which was bulging, leaking electrolyte and entirely unusable straight out of the supplier's packaging. It's a stark illustration of what you get when you do and don't pay for quality.

Future failures

Not all quality deficiencies are immediately obvious; sometimes they only show up after being in service for a while. The 'capacitor plague' of the early-mid 2000s is a good example. Electrolytic capacitors produced by numerous low-cost suppliers failed prematurely at a high rate, allegedly due to widespread use of a stolen electrolyte formulation that was incomplete. Several major computer equipment manufacturers were affected, with one reportedly incurring direct costs of several hundred million USD, plus additional intangible losses. This, for problems that didn't even pose much of a safety issue.

Bearing this in mind, it's worth taking time to understand the effects of component failures, the impact of those failures on your customers and the potential risks to your business that follow. Then, make a decision as to whether quality matters. If it does, two rules of thumb go a long way toward achieving it.

Quality matters

First, buy only from reputable manufacturers. If the company has been in business for over 20 years, invests in research and development and demands more than rock-bottom prices, there's a good chance it makes a quality product. If it also has a corporate presence in a jurisdiction accessible to your legal resources, this is a good indicator that they'll stand behind their product.

Expect the opposite from suppliers that imitate established brands; if they're unethical enough to leech off the credibility of those whose business they're undercutting, why would they bother conducting an honest business with customers?

Secondly, buy only through manufacturer-authorized sales channels. Franchised distributors are contractually obligated to acquire product directly from the manufacturer, to exclude counterfeit or subpar components and provide product traceability. No such controls exist in non-authorized brokerage channels wherein

deficient product is known to circulate.

In summary, know what you're paying for and pay enough for what you need. It's not much fun when getting what you paid for proves to be a bad thing.

www.digikey.com

The look-alike cell has undulating walls due to internal corrosion and rough print edges, while the genuine cell features smooth walls and a clear text outline



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Testing times

Ensuring your product is safe and reliable means thinking carefully about battery holder design. To help purchasers meet relevant standards, Memory Protection Devices has expanded its test capabilities

The quality of any battery powered electronic product will be judged insufficient, if it fails thanks to a faulty or flawed battery holder. This means the battery holder you specify must be up to the job. To help customers ensure this is the case, MPD has enhanced its test facilities by developing several custom test fixtures.

To test new battery holder designs MPD fabricated minimum and maximum sized battery slugs. This is important since the minimum and maximum length and width for common batteries is relatively wide.

The slugs save time and money by making it unnecessary to shop for several brands of batteries to confirm a design works with common batteries. They also weigh more than a regular battery, generating more force during drop testing. As well as being more durable, they have no power and will not short circuit, leak or require storage-handling precautions.

Meeting standards

So, just how are battery holders put to the test? The UL standard determines whether batteries will stay in a holder. It involves 50 insertion-extractions of the battery, followed by contact retention, conditioning, vibration and jarring tests. Coin cell battery holders are also subject to a 60in drop test using a fixture per UL2069.

MPD has developed test fixtures to work to the standard, using wing nuts for quick mounting the same PCB to either the jarring or drop test fixtures.

The EIA EIA-540J000 specification is another test methodology. Its purpose is to provide standard test methods, gages and performance requirements for battery holders regarding vibration, shock, contact resistance, solderability, temperature and humidity.

The major difference between the UL and EIA tests is that continuity is continually monitored during vibration and mechanical shock in the EIA specification. There are minor differences in contact resistance and solderability requirements and the EIA also has separate requirements for coin cell holders and cylindrical battery holders, under EIA-540J0AA and EIA540JAB.

User considerations

Clearly, there is much to consider when designing new battery holder products. When it comes to portable medical devices, such as glucose meters, thermometers or wearable drug delivery systems however, the stakes are even higher. They must be designed according to FDA-21 regulations, with a need to assess human factors, such as age and functional capabilities, that could impact the safe and effective use of the device.

Toy safety is another area where requirements are specific to the application. ASTM F963 standard focuses on markings, circuit protection and harness wiring with the emphasis on limiting access to batteries without tools. There are requirements for battery holders relating to the flammability of connectors and wires.

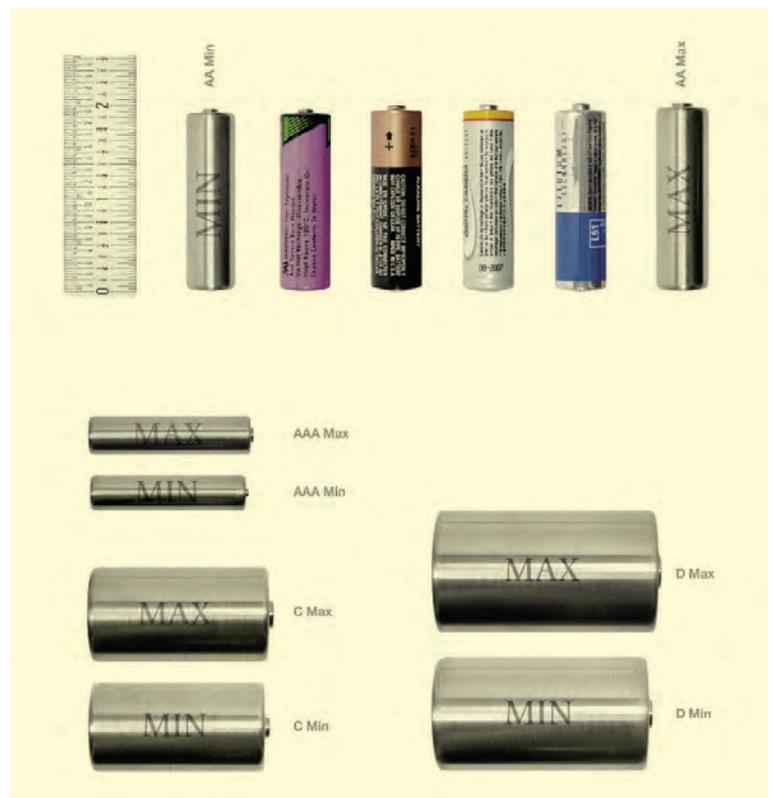
Finally, intrinsically safe apparatus is covered by UL913 which covers equipment destined for use in class one, two, three or division one hazardous locations.

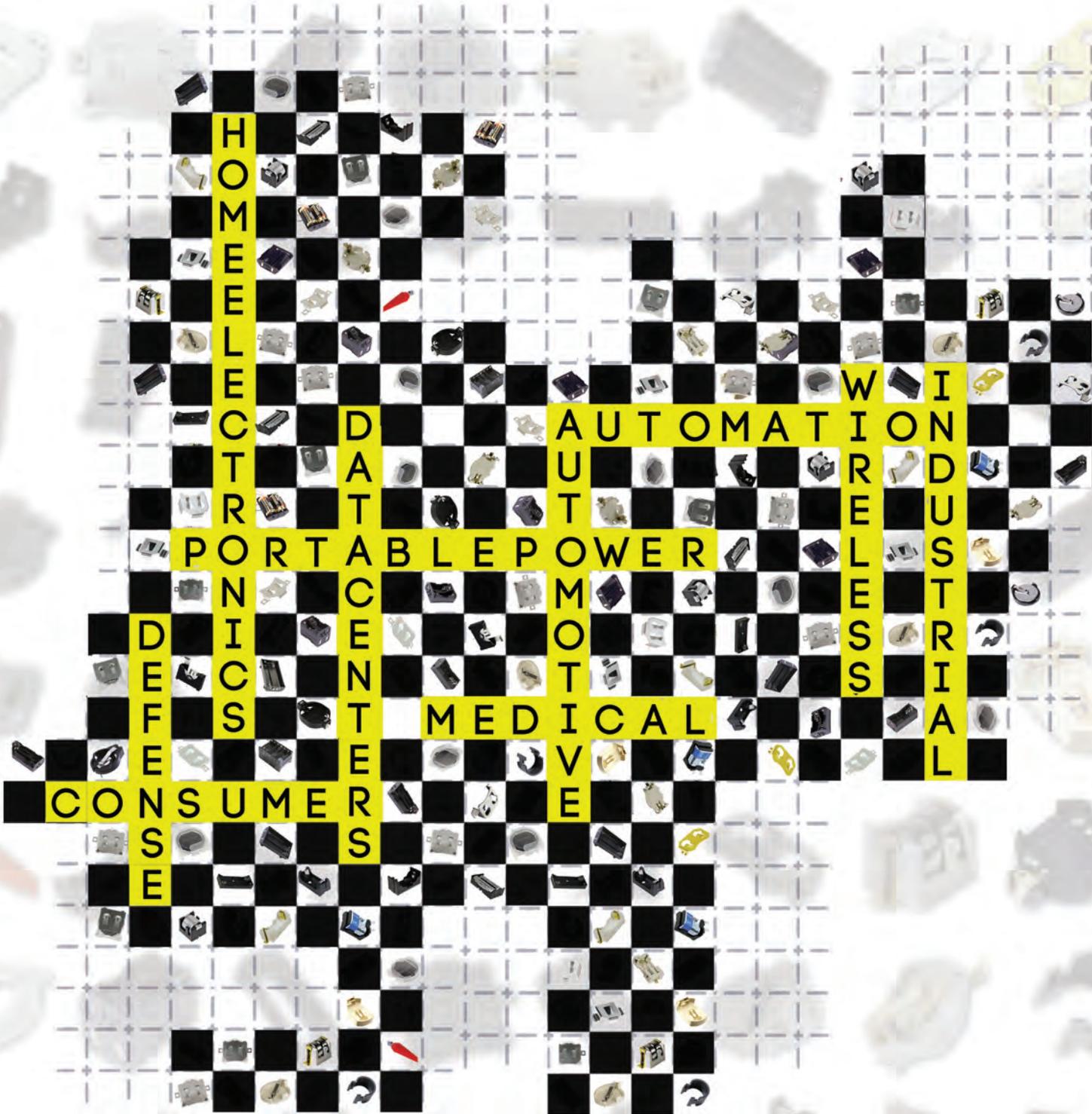
In any application, batteries are considered safety critical components by compliance laboratories. Plastic battery holders have safety requirements when part of a circuit containing any kind of battery or battery charging circuits. MPD therefore aims to help by providing drawings containing the necessary product safety information, ultimately making design and documentation easier.

memoryprotectiondevices.com

Plastic battery holders have safety requirements when part of a circuit containing any kind of battery or battery charging circuits

The minimum and maximum, length and width for common batteries is relatively wide





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Ultra-miniature modules save space

Minmax has introduced two new ultra-miniature encapsulated power module families, housed in a 1.0 by 1.0 by 0.64in PCB mount package. As well as being approved to EN60950-1 for use in IT equipment and EN60335-1 for household appliances, the three watt AAF-03 and five watt AAF-05 can help to reduce overall PCB layout area or add more features.

The families offer single output models of 3.3, five, nine, 12, 15, or 24V DC with efficiencies up to 83 per cent. All models feature: universal AC input; protection Class II operation; and I/O isolation of 3,000V AC with the highest reinforced insulation. Operating temperature range is -25 to 70°C with no minimum load required. Overload/voltage and short circuit protection are included, as well as a built-in EMC filter. This ErP ready design also features low no load power consumption of less than 150mW.
www.minmaxpower.com



Transformers power PoE expansion

Premier Magnetics has expanded its line of low-cost, high-performance transformers designed to support the full range of Power-over-Ethernet applications from IEEE 802.3af, IEEE 802.3at, Cisco UPoE and other higher-power PoE extensions up to 60W.

The devices operate over a wide frequency range, provide isolation to 1,500V and are available in forward and flyback topologies. They are designed for use with power management integrated circuits in both power sourcing equipment and PoE powered devices. Many parts are also a direct cross-reference with Pulse Electronics and CoilCraft devices.

Premier Magnetics PoE transformers are offered in two series: the EP series three to 27W devices and the EFD15 series one to 60W devices.

President of Premier Magnetics, Jim Earley, commented: "The range of applications for PoE has expanded to include phones, remote video cameras and even large high-definition displays. Our engineering expertise, responsive manufacturing and quality assurance offer customers the flexibility to bring designs to market quickly."
www.premiermag.com

Supply meets with medical approval

Power Partners has released what it describes as a cost effective, 36W AC/DC external power supply approved to the latest UL/EN 60601-1 medical safety standard, as well as 60601-1-2 fourth edition EMC requirements. The PEAMD36 series is offered in either a Class I or Class II version, featuring a body floating rating on the Class II version. The products also meet Department of Energy efficiency Level VI requirements.

Class I and Class II AC inlet options are C14, C6, C8 and C18 types. Single output voltages range from five to 48V DC. Additional features include less than 100µA at 264V AC earth leakage current, short circuit and overload protection, 5,000m altitude operation rating, 100 per cent burn-in/hi-pot testing and a mean time between failures of over100K hours per MIL-HDBK-217F.

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Amazon Business pushes to establish its role in electronics supply chain

Amazon Business is selling electronic components, but it is unclear if the company will become a go-to source for electronics purchasers or be a niche player in the supply chain

By James Carbone

While electronics purchasers buy most of the components that their companies need for production from parts manufacturers or authorized distributors, there are times when buyers use online marketplaces to search for and buy components.

Often buyers search online marketplaces when parts are in short supply or have long lead times. In other cases, they may try to find a better price for a component that they are currently purchasing from a distributor. Buyers use such sites as ECIAuthorized, FindChips, Octoparts, OEMsTrade to name a few. ECIAuthorized lists only parts from authorized distributors, but other online marketplaces may list parts being sold by non-franchised distributors as well as franchise distributors.

Some electronics buyers are using Amazon Business for production

parts, including semiconductors and passives, which is causing some consternation in the electronics supply chain, especially among distributors.

Amazon created Amazon Business in 2015 as a dedicated online marketplace for businesses to purchase products needed to run their companies as well as for materials needed for production.

Some view Amazon Business as a threat or a potential threat to distributors. Amazon has proven to be a formidable competitor to brick-and-mortar retail chains often selling merchandise for less than stores resulting in fewer sales and less profit for retailers. As a result, many national retailers have had to close stores as more goods are sold online through Amazon and other online marketplaces. Some electronics distributors are concerned that in the long-term, distributors

may face a similar fate if Amazon Business becomes the powerhouse in electronics that it is in retail.

However, others say that Amazon Business is not a threat because distributors provide much more value to both component manufacturers and OEM and electronics manufacturing services (EMS) customers. They point out that distributors assist customers with design, component selection, and provide value-added, inventory management and other supply chain services that help customers reduce cost, mitigate risk and compete, which Amazon currently cannot do. In addition, a relatively small percentage of components are sold through online marketplaces.

Other distributors view Amazon not as a threat but as an opportunity to reach new customers just as other online marketplaces bring some new customers to distributors.

Growing its product offering

However, Amazon Business is different than other online marketplaces. While it has not been selling electronics for a long time, it is a well-known brand and is increasing the number of products and suppliers on the site.

“We have been selling components on Amazon Business for several years, and we are continuing to grow our selection to meet the needs of business customers,” said Prentis Wilson, vice president of Amazon Business.

He said Amazon business has a “broad selection of electronics components, including resistors, capacitors as well as semiconductors such as microprocessors and memory chips in the marketplace. Buyers can purchase a range of quantities

►► *continued on page 36*

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► on Amazon Business, from single pieces to packs, bundles and reels.

The parts are offered by both component manufacturers and distributors, said Wilson. Sellers range in size from SBA-credentialed small businesses to large, enterprise organizations, he said.

Wilson said there are advantages for electronics purchasers to buy parts through Amazon Business. “One unique aspect of Amazon Business is the multi-seller marketplace,” said Wilson. Buyers can view multiple offers on a “single product page for price comparisons, as well as find sellers that consistently meet the performance and service requirements that businesses expect,” he said. Buyers can meet specific sourcing requirements by refining their search for sellers with specific quality and diversity credentials, such as ISO:9001, SBA, women-owned, or veteran-owned businesses, according to Wilson.

Amazon Business also provides tools to help buyers manage spend and buy online. For example, business customers have access to Amazon Business Analytics, which provides visibility into purchasing activity at the individual, purchasing group, or type of spend level, said Wilson.

Amazon Business provides free two-day shipping on eligible orders of \$49 or more. When customers purchase on Amazon Business, “they have access to features such as the Pay-by-Invoice program, which provides terms to support businesses’ primary payment processing needs,” said Wilson.

A cautious approach

Some buyers are purchasing small volumes of non-

production items from Amazon Business, but are taking a wait-and-see attitude concerning purchasing components and other production materials.

Steve McEuen, vice president of commodity management for EMS provider Creation Technologies, said his company is purchasing MRO items from Amazon Business.

“We are not implementing the production stuff yet. We are monitoring Amazon Business to see what they’re doing,” said McEuen. “They have introduced electronic components into their portfolio, but the sources and the manufacturers are not well defined.” He added that the quantities of components that Creation buys for production are “a lot higher than what Amazon is market competitive for. We don’t see Amazon Business as a near-term solution, but we are watching them to see where they’re going,” said McEuen.

He added that it appears the parts being sold on Amazon are mainly from distributors not manufacturers.

One distributor that lists its parts on Amazon Business is Future Electronics. Karim Yasmine, executive vice president, strategic supplier development at Future, said that Amazon Business is not currently a threat to the electronics industry, but is an opportunity for distributors to expand their customer base.

He notes that there are many online marketplaces and they are “all looking to get deeper into the industry because they see opportunity.” Some are referral sites which drive traffic to distributors. Others are referral sites such as Amazon Business and AliBaba that also try to fulfill business.

“Are they hurting our business or industry? Today they are not,” said Yasmine.

Educating Amazon

He said that Amazon Business today is in the “embryonic” stage. “Amazon Business in the world of electronics distribution is learning. They are educating themselves,” said Yasmine. They certainly want to get into this business. But at the same time, they understand the complexity of what we do as a broad line distributor is not simple,” said Yasmine.

Distributors do more than just sell parts. “There is the global presence, the technical support, there are the terms, the quality and compliance,” he said. “There are a lot of elements to distribution of components that are very specific to our industry.”

Yasmine acknowledges there is concern or fear about online marketplaces such as Amazon Business. Yasmine noted the electronics distribution industry management is “pretty seasoned and change makes them nervous.” But he said distributors that are “selling value, selling differentiated terms, differentiated supply chain and demand creation capabilities” don’t have to be too concerned about Amazon Business or online marketplaces because those marketplaces won’t offer those capabilities in the near-term future.

Yasmine added instead of looking at Amazon Business as a threat, “we are better off understanding what the model is and if there’s an opportunity there or find a way to make it an opportunity.”

He said Future was “looking at everything as an opportunity. Everything will have risk and the question is how do we make the best out of this online marketplace.”



We are monitoring Amazon Business to see what they’re doing. They have introduced electronic components into their portfolio, but the sources and the manufacturers are not well defined

- Steve McEuen, vice president of commodity management for Creation Technologies

Yasmine said one concern was that Amazon was “going to engage with manufacturers” and have agreements with them.

“But the reality is the majority of the manufacturing base is not looking to add more to their channel,” said Yasmine. “They are looking to streamline. For manufacturers, there is little to no value in that kind of engagement simply. “So, there is no upside there” for component manufacturers, he said

Find the upside

The upside with online marketplaces is for distribution. “The manufacturer does not want to get into the direct relationship of moving product, driving fulfillment part of the business and offering terms and supply chain capabilities,” he said. That’s what manufacturers’ distributor do.

The opportunity with online marketplaces is with distributors. “If you look at the big aggregator sites such as Octoparts, OEMstrade, FindChips etc. every distributor in the world is engaging with them because they have access to the customers’ purchasing community,” said Yasmine. “That drives customer expansion for your company.”

The key to success from a distributor perspective is “if you’re adding differentiated value that an online marketplace website cannot offer, distributors can use that website to drive customer expansion,” he said. But if you’re just moving boxes, you put yourself into a position that anyone can replace you,” he said.

TTI, which sells commodity passives, connectors and semiconductors, does not list parts on Amazon Business.

Besides its own website, TTI lists its inventory on ECIAuthorized.com because the site “has a lot of industry traffic and several features that we think are extremely important to the customer and supplier base,” said Michael Knight, senior vice president at TTI.

A key feature is that only authorized distributors are listed on the site, “virtually eliminating the chances of counterfeit product being sold on there.” In addition, the site is very strict about only posting inventory that a distributor owns and has in-house.

“This eliminates the practice of showing factory stock, or stock from another source, as if it were part of the posting distributor’s inventory,” said Knight. With many third-party sites, the inventory shown in the channel is often overstated with much of the quantity being shown as available for sale being double counted, or more because of this practice.”

No impact... so far

Knight said so far, Amazon has not had much of an impact on the electronics industry “but it would be a mistake not to continue to keep our eye on Amazon.”

He noted Amazon’s stated goal is to be the place that everyone goes to buy everything and that “certainly encompasses electronic components.” However, while Amazon Business sells electronic components, “they are generally excess parts of unspecified origin being posted by companies not affiliated with the manufacturer of the component. The same is true over on eBay,” said Knight.

He added that one of the hurdles for a web based reseller that is targeting the B2B supply chain business

supporting a company’s production line is that the “environment is very chaotic and sales support requirements are knowledge and relationship intensive.”

For instance, factory lead times for components can be very erratic and extreme with little to no warning.

“The difference between a customer’s production line staying up and running, or being shut down and idle, is the ability of the providers of the hundreds of different types of components that go into a typical piece of electronics gear to build inventory in front of these events,” said Knight. “That takes knowledge and understanding that only comes with experience,” he said.

In addition, providing adequate forecasts is challenging for most OEMs and EMS customers and as a result “what we have is a supply chain that is chronically out of sync,” said Knight. “Will big data, M2M and application programming interface one day pull everything together and make the supply chain more virtual, predictable and accurate, lessening the need for human knowledge, relationships and intervention? For sure, but that isn’t today, so today general-purpose e-commerce businesses remain disadvantaged when trying to sell electronic components in volume,” he said.



We have been selling components on Amazon Business for several years, and we are continuing to grow our selection to meet the needs of business customers

– Prentis Wilson, vice president of Amazon Business



Is Amazon hurting our business or industry? Today they are not

– Karim Yasmine, corporate vice president, strategic supplier development at Future Electronics

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Cree Wolfspeed
Crescent
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Crouzet
Crydom
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CSR PLC (Qualcomm)
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CTS Electronic Components
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Curtis Industries
Curtis Instruments
Custom Computer Services
CW Industries
Cynergy3
Cypress Semiconductor
D6 Labs
Daburn
Dale / Vishay
DAVE Embedded Systems
Davies Molding, LLC.
DecaWave
Delta Electronics
Delta Electronics / EMI
Delta Electronics / Fans
Delta Electronics / Power
Desco
DEUTSCH Connectors / TE Connectivity
DEUTSCH ICT / TE Connectivity
DFRobot
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Dialog Semiconductor
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Dielectric Laboratories (Knowles)
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EasyBraid Co.
Eaton
ebm-papst Inc.
Echelon
Econais
ECS Inc. International
EDAC Inc.
Elco (AVX)
Elcon Connectors / TE Connectivity
Electric Imp
Electro Corp (Honeywell Sensing and Productivity Solutions)
Electro-Films (EFI) / Vishay
Electronic Assembly GmbH
Electroswitch
Elna America
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Emerson Connectivity Solutions
Emerson Embedded Power (Artesyn Embedded Technologies)
EMIT
Energizer Battery Company
Energy Micro (Silicon Labs)
EnerSys
enmo Technologies
EnOcean
EPC
EPCOS
Epcos / RF360
Epson
Equinox Technologies
EREM
ERP Power
Essentra Components
ESTA / Vishay
E-Switch
E-T-A
Ethertronics
Eupec (Infineon)
Eveready (Energizer Battery Company)

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EverSpin Technologies, Inc.
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E-Z-Hook
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Fan-S Division / Qualtek Electronics Corp.
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FDK America
Fedco Batteries
FEIG ELECTRONIC
FERROXCUBE
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FIT (Foxconn Interconnect Technology)
Flamar - a Molex company
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Genuino (Arduino)
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Global Power Technologies Group
Global Specialties
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GWConnect - a Molex company
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Hakko USA
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Hirschmann
Hittite (Analog Devices)
Hoffman Enclosures, Inc.
Holsworthy Resistors / TE Connectivity
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Honeywell Sensing and Productivity Solutions
I/O Interconnect
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ICCNexergy (Inventus Power)
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Buyers' Guide

| Manufacturer | Distributor | Telephone | Website | Franchised Distributor (Y/N/M) | No. of Lines for Principle | Stock Value for Principle | Minimum Order Value | % Lead Free for Principle Range | No. of Technical Support Staff | Total No. of Staff | Pack and Hold |
|---|--------------------------|----------------|------------------------|--------------------------------|----------------------------|---------------------------|---------------------|---------------------------------|--------------------------------|--------------------|---------------|
| ACOUSTIC COMPONENTS | | | | | | | | | | | |
| BeStar Electronics Ind. Co. Ltd. | BeStar Technologies Inc. | 520-439-9204 | www.bestartech.com | Y | N/A | \$250,000 | N/A | 100.00% | 50 | 900 | Y |
| PUI Audio | PUI | 1-800-551-4405 | www.gopui.com | Y | 1,256 | N/A | \$50 | 99.00% | 5 | 33 | Y |
| CABLE & WIRING | | | | | | | | | | | |
| Alpha Wire | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 8,106 | N/A | \$0 | 93.00% | 50 | 1,000+ | Y |
| Belden Wire & Cable | Mouser Electronics | 800-346-6874 | www.mouser.com | Y | 5,863 | N/A | \$0 | 97% | 50 | 1,000+ | Y |
| Molex | ECCO | 773-767-2200 | www.eccoconnectors.com | Y | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| CIRCUIT PROTECTION | | | | | | | | | | | |
| Bourns | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 4,462 | N/A | \$0 | 68.00% | 50 | 1,000+ | Y |
| Cooper Bussmann | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 19,689 | N/A | \$0 | 42.00% | 50 | 1,000+ | Y |
| EPCOS | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 3,487 | N/A | \$0 | 100% | 50 | 1,000+ | Y |
| Littelfuse | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 28,790 | N/A | \$0 | 67% | 50 | 1,000+ | Y |
| Vishay | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 31,445 | N/A | \$0 | 68% | 50 | 1,000+ | Y |
| DISPLAYS & LEDs | | | | | | | | | | | |
| Avago Technologies | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 403 | N/A | \$0 | 100.00% | 50 | 1,000+ | Y |
| Cree | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 12,390 | N/A | \$0 | 99.00% | 50 | 1,000+ | Y |
| Dialight | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 6,179 | N/A | \$0 | 84.00% | 50 | 1,000+ | Y |
| Kingbright Company, LLC | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 301 | N/A | \$0 | 100.00% | 50 | 1,000+ | Y |
| LUMEX | Digi-Key | 800-344-4539 | digikey.com | Y | 7,714 | N/A | \$0 | 96.42% | 150 | 3,400 | Y |
| Osram Opto Semiconductors | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 1,690 | N/A | \$0 | 100.00% | 50 | 1,000+ | Y |
| SunLED Company, LLC | PUI | 1-800-551-4405 | www.gopui.com | Y | 1,351 | N/A | \$50 | 99% | 5 | 33 | Y |
| ELECTROMECHANICAL (continued on next page) | | | | | | | | | | | |
| AAVID | Digi-Key | 800-344-4539 | digikey.com | Y | 1,585 | N/A | \$0 | 60.44% | 150 | 3,400 | Y |
| ALPHA WIRE | Digi-Key | 800-344-4539 | digikey.com | Y | 25,593 | N/A | \$0 | 99.46% | 150 | 3,400 | Y |
| APEM | Digi-Key | 800-344-4539 | digikey.com | Y | 6,926 | N/A | \$0 | 99.99% | 150 | 3,400 | Y |
| APEX TOOL GROUP | Digi-Key | 800-344-4539 | digikey.com | Y | 2,649 | N/A | \$0 | 99.36% | 150 | 3,400 | Y |
| ARTESYN EMBEDDED TECHNOLOGIES | Digi-Key | 800-344-4539 | digikey.com | Y | 10,349 | N/A | \$0 | 89.32% | 150 | 3,400 | Y |
| B&K PRECISION | Digi-Key | 800-344-4539 | digikey.com | Y | 3,214 | N/A | \$0 | 99.94% | 150 | 3,400 | Y |
| BEL FUSE | Digi-Key | 800-344-4539 | digikey.com | Y | 4,207 | N/A | \$0 | 83.53% | 150 | 3,400 | Y |
| BERGQUIST | Digi-Key | 800-344-4539 | digikey.com | Y | 523 | N/A | \$0 | 95.98% | 150 | 3,400 | Y |
| BUD INDUSTRIES INC | Digi-Key | 800-344-4539 | digikey.com | Y | 4,161 | N/A | \$0 | 99.93% | 150 | 3,400 | Y |
| C&K COMPONENTS | Digi-Key | 800-344-4539 | digikey.com | Y | 29,271 | N/A | \$0 | 95.29% | 150 | 3,400 | Y |
| CHERRY | Digi-Key | 800-344-4539 | digikey.com | Y | 1,200 | N/A | \$0 | 92.25% | 150 | 3,400 | Y |

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| Manufacturer | Distributor | Telephone | Website | Franchised Distributor (VMM) | No. of Lines for Principle | Stock Value for Principle | Minimum Order Value | % Lead Free for Principle Range | No. of Technical Support Staff | Total No. of Staff | Pack and Hold |
|---|-------------|--------------|-------------|------------------------------|----------------------------|---------------------------|---------------------|---------------------------------|--------------------------------|--------------------|---------------|
| CNC TECH | Digi-Key | 800-344-4539 | digikey.com | Y | 4,553 | N/A | \$0 | 100% | 150 | 3,400 | Y |
| COMAIR ROTRON | Digi-Key | 800-344-4539 | digikey.com | Y | 616 | N/A | \$0 | 100% | 150 | 3,400 | Y |
| COPAL ELECTRONICS INC | Digi-Key | 800-344-4539 | digikey.com | Y | 4,121 | N/A | \$0 | 99.93% | 150 | 3,400 | Y |
| COTO TECHNOLOGY | Digi-Key | 800-344-4539 | digikey.com | Y | 1,071 | N/A | \$0 | 99.72% | 150 | 3,400 | Y |
| CRYDOM CO | Digi-Key | 800-344-4539 | digikey.com | Y | 5,459 | N/A | \$0 | 100% | 150 | 3,400 | Y |
| CTS CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 31,504 | N/A | \$0 | 87.78% | 150 | 3,400 | Y |
| CUI CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 15,168 | N/A | \$0 | 91.34% | 150 | 3,400 | Y |
| DANAHER CORPORATION (Pomona, Fluke, Portescap, Amprobe) | Digi-Key | 800-344-4539 | digikey.com | Y | 5,410 | N/A | \$0 | 96.65% | 150 | 3,400 | Y |
| DELTA PRODUCTS CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 2,063 | N/A | \$0 | 99.90% | 150 | 3,400 | Y |
| DESCO CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 3,500 | N/A | \$0 | 99.83% | 150 | 3,400 | Y |
| E-SWITCH | Digi-Key | 800-344-4539 | digikey.com | Y | 8,625 | N/A | \$0 | 99.99% | 150 | 3,400 | Y |
| EBM-PAPST INC. | Digi-Key | 800-344-4539 | digikey.com | Y | 1,779 | N/A | \$0 | 99.89% | 150 | 3,400 | Y |
| ESSENTIA COMPONENTS | Digi-Key | 800-344-4539 | digikey.com | Y | 16,594 | N/A | \$0 | 100% | 150 | 3,400 | Y |
| EXCELSYS TECHNOLOGIES LTD | Digi-Key | 800-344-4539 | digikey.com | Y | 616 | N/A | \$0 | 100% | 150 | 3,400 | Y |
| GENERAL CABLE CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 7,109 | N/A | \$0 | 98.51% | 150 | 3,400 | Y |
| GENERAL ELECTRIC CORPORATION (GE Critical Power) | Digi-Key | 800-344-4539 | digikey.com | Y | 1,751 | N/A | \$0 | 68.30% | 150 | 3,400 | Y |
| GRAYHILL INC | Digi-Key | 800-344-4539 | digikey.com | Y | 12,569 | N/A | \$0 | 96.26% | 150 | 3,400 | Y |
| HAMMOND CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 13,303 | N/A | \$0 | 99.47% | 150 | 3,400 | Y |
| INVENTUS POWER | Digi-Key | 800-344-4539 | digikey.com | Y | 514 | N/A | \$0 | 56.23% | 150 | 3,400 | Y |
| KEYSTONE ELECTRONICS | Digi-Key | 800-344-4539 | digikey.com | Y | 6,089 | N/A | \$0 | 98.80% | 150 | 3,400 | Y |
| MEMORY PROTECTION DEVICES | Digi-Key | 800-344-4539 | digikey.com | Y | 814 | N/A | \$0 | 99.63% | 150 | 3,400 | Y |
| MURATA CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 61,903 | N/A | \$0 | 99.72% | 150 | 3,400 | Y |
| NKK SWITCHES | Digi-Key | 800-344-4539 | digikey.com | Y | 21,343 | N/A | \$0 | 97.59% | 150 | 3,400 | Y |
| NMB TECHNOLOGIES CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 3,003 | N/A | \$0 | 98.80% | 150 | 3,400 | Y |
| OMRON CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 70,119 | N/A | \$0 | 95.28% | 150 | 3,400 | Y |
| ORION FANS | Digi-Key | 800-344-4539 | digikey.com | Y | 2,949 | N/A | \$0 | 100.00% | 150 | 3,400 | Y |
| PANASONIC CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 156,533 | N/A | \$0 | 93.83% | 150 | 3,400 | Y |
| PANDUIT CORP | Digi-Key | 800-344-4539 | digikey.com | Y | 23,108 | N/A | \$0 | 99.92% | 150 | 3,400 | Y |
| PHIHONG USA CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 1,450 | N/A | \$0 | 100.00% | 150 | 3,400 | Y |
| QUALTEK | Digi-Key | 800-344-4539 | digikey.com | Y | 209 | N/A | \$0 | 92.52% | 150 | 3,400 | Y |
| RECOM POWER CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 27,095 | N/A | \$0 | 100.00% | 150 | 3,400 | Y |
| SCHAFFNER EMC INC | Digi-Key | 800-344-4539 | digikey.com | Y | 2,111 | N/A | \$0 | 100.00% | 150 | 3,400 | Y |
| SCHURTER INC | Digi-Key | 800-344-4539 | digikey.com | Y | 9,910 | N/A | \$0 | 99.48% | 150 | 3,400 | Y |
| SL POWER ELECTRONICS MANUFACTURE OF CONDOR/AULT BRANDS | Digi-Key | 800-344-4539 | digikey.com | Y | 3,159 | N/A | \$0 | 88.76% | 150 | 3,400 | Y |
| SUNON FANS | Digi-Key | 800-344-4539 | digikey.com | Y | 1,850 | N/A | \$0 | 77.14% | 150 | 3,400 | Y |
| TDK CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 64,978 | N/A | \$0 | 99.30% | 150 | 3,400 | Y |
| TE CONNECTIVITY CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 437,107 | N/A | \$0 | 75.47% | 150 | 3,400 | Y |

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|--|--------------------|----------------|--------------------------|------------------------------|----------------------------|---------------------------|---------------------|---------------------------------|--------------------------------|--------------------|---------------|
| TECHFLEX | Digi-Key | 800-344-4539 | digikey.com | Y | 2,136 | N/A | \$0 | 99.72% | 150 | 3,400 | Y |
| ELECTROMECHANICAL (continued from previous page) | | | | | | | | | | | |
| TELEDYNE LECROY | Digi-Key | 800-344-4539 | digikey.com | Y | 628 | N/A | \$0 | 92.99% | 150 | 3,400 | Y |
| THOMAS RESEARCH PRODUCTS | Digi-Key | 800-344-4539 | digikey.com | Y | 1,361 | N/A | \$0 | 82.15% | 150 | 3,400 | Y |
| VICOR CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 195,706 | N/A | \$0 | 52.15% | 150 | 3,400 | Y |
| XP POWER | Digi-Key | 800-344-4539 | digikey.com | Y | 4,155 | N/A | \$0 | 100.00% | 150 | 3,400 | Y |
| ENCLOSURES | | | | | | | | | | | |
| Bud | ECCO | 773-767-2200 | www.eccoconnectors.com | Y | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Bud Industries | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 1,325 | N/A | \$0 | 80.00% | 50 | 1,000+ | Y |
| Hammond Manufacturing | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 2,839 | N/A | \$0 | 82% | 50 | 1,000+ | Y |
| New Age Enclosures | Mouser Electronics | 805-595-1310 | www.newageenclosures.com | M | 1,000+ | N/A | \$0 | 100.00% | 32 | N/A | Y |
| FREQUENCY MANAGEMENT | | | | | | | | | | | |
| Abracon Corporation | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 1,780 | N/A | \$0 | 100% | 50 | 1,000+ | Y |
| Citizen | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 1,723 | N/A | \$0 | N/A | 50 | 1,000+ | Y |
| CTS Electronic Components | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 3,889 | N/A | \$0 | 100% | 50 | 1,000+ | Y |
| ECS Inc | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 2,070 | N/A | \$0 | 100% | 50 | 1,000+ | Y |
| Epson Toyocom | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 178 | N/A | \$0 | 100% | 50 | 1,000+ | Y |
| Fox Electronics | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 325 | N/A | \$0 | 100.00% | 50 | 1,000+ | Y |
| ILSI-MMD, Ecliptek | PUI | 1-800-551-4405 | www.gopui.com | Y | 1,683 | N/A | \$50 | 99.00% | 5 | 33 | Y |
| Susumu Co Ltd | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 2,500 | N/A | N/A | N/A | N/A | N/A | Y |
| ICs & SEMICONDUCTORS (Continued on next page) | | | | | | | | | | | |
| ADAFRUIT INDUSTRIES | Digi-Key | 800-344-4539 | digikey.com | Y | 1,153 | N/A | \$0 | 98.70% | 150 | 3,400 | Y |
| ADVANCED PHOTONIX (LUNA OPTOELECTRONICS) | Digi-Key | 800-344-4539 | digikey.com | Y | 678 | N/A | \$0 | 29.94% | 150 | 3,400 | Y |
| ALLEGRO MICROSYSTEMS, LLC | Digi-Key | 800-344-4539 | digikey.com | Y | 2,867 | N/A | \$0 | 86.22% | 150 | 3,400 | Y |
| ALPHA & OMEGA SEMICONDUCTOR INC | Digi-Key | 800-344-4539 | digikey.com | Y | 2,830 | N/A | \$0 | 100.00% | 150 | 3,400 | Y |
| ALTERA | Digi-Key | 800-344-4539 | digikey.com | Y | 10,502 | N/A | \$0 | 100.00% | 150 | 3,400 | Y |
| AMS | Digi-Key | 800-344-4539 | digikey.com | Y | 2,911 | N/A | \$0 | 97.94% | 150 | 3,400 | Y |
| ANALOG DEVICES | Digi-Key | 800-344-4539 | digikey.com | Y | 50,633 | N/A | \$0 | 73.33% | 150 | 3,400 | Y |
| Analog Devices, Inc | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 18,749 | N/A | \$0 | 95% | 50 | 1,000+ | Y |
| APEX MICROTECHNOLOGY | Digi-Key | 800-344-4539 | digikey.com | Y | 432 | N/A | \$0 | 75.23% | 150 | 3,400 | Y |
| Atmel Corporation | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 3,840 | N/A | \$0 | 74% | 50 | 1,000+ | Y |
| ATP ELECTRONICS, INC. | Digi-Key | 800-344-4539 | digikey.com | Y | 191 | N/A | \$0 | 100.00% | 150 | 3,400 | Y |
| B&B SMARTWORX | Digi-Key | 800-344-4539 | digikey.com | Y | 2,414 | N/A | \$0 | 100.00% | 150 | 3,400 | Y |
| BIVAR | Digi-Key | 800-344-4539 | digikey.com | Y | 17,303 | N/A | \$0 | 100% | 150 | 3,400 | Y |

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|---------------------------------------|--------------------|----------------|---------------------------|--------------------------------|----------------------------|---------------------------|---------------------|---------------------------------|--------------------------------|--------------------|---------------|
| BRIDGELUX | Digi-Key | 800-344-4539 | digikey.com | Y | 1,177 | N/A | \$0 | 100% | 150 | 3,400 | Y |
| BROADCOM LIMITED (AVAGO) | Digi-Key | 800-344-4539 | digikey.com | Y | 13,051 | N/A | \$0 | 89.20% | 150 | 3,400 | Y |
| CALIFORNIA EASTERN LABORATORIES (CEL) | Digi-Key | 800-344-4539 | digikey.com | Y | 3,359 | N/A | \$0 | 85.23% | 150 | 3,400 | Y |
| CENTRAL SEMICONDUCTOR | Digi-Key | 800-344-4539 | digikey.com | Y | 5,526 | N/A | \$0 | 92.45% | 150 | 3,400 | Y |
| Central Semiconductor Corp. | Future Electronics | (800) 675-1619 | www.futureelectronics.com | Y | N/A | N/A | N/A | N/A | N/A | N/A | Y |
| CIRRUS LOGIC | Digi-Key | 800-344-4539 | digikey.com | Y | 2,759 | N/A | \$0 | 79.16% | 150 | 3,400 | Y |
| Cirrus Logic Inc | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 325 | N/A | N/A | N/A | N/A | N/A | Y |
| COMCHIP CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 6,678 | N/A | \$0 | 100% | 150 | 3,400 | Y |
| CREE INC | Digi-Key | 800-344-4539 | digikey.com | Y | 26,398 | N/A | \$0 | 100% | 150 | 3,400 | Y |
| CYPRESS SEMICONDUCTOR | Digi-Key | 800-344-4539 | digikey.com | Y | 26,030 | N/A | \$0 | 89.02% | 150 | 3,400 | Y |
| Cypress Semiconductor Corp | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 1,325 | N/A | \$0 | 81.00% | 50 | 1,000+ | Y |
| DIALIGHT | Digi-Key | 800-344-4539 | digikey.com | Y | 10,510 | N/A | \$0 | 74.29% | 150 | 3,400 | Y |
| DIGI INTERNATIONAL CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 4,015 | N/A | \$0 | 89.51% | 150 | 3,400 | Y |
| DIODES INC | Digi-Key | 800-344-4539 | digikey.com | Y | 32,186 | N/A | \$0 | 89.01% | 150 | 3,400 | Y |
| Etron Technology Inc | PUI | 1-800-551-4405 | www.gopui.com | Y | 1459 | N/A | \$50 | 99% | 5 | 33 | Y |
| EXAR CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 3,605 | N/A | \$0 | 99.97% | 150 | 3,400 | Y |
| FAIRCHILD | Digi-Key | 800-344-4539 | digikey.com | Y | 39,473 | N/A | \$0 | 98.81% | 150 | 3,400 | Y |
| Fairchild Semiconductor | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 8,654 | N/A | \$0 | 98.00% | 50 | 1,000+ | Y |
| FINISAR CORP | Digi-Key | 800-344-4539 | digikey.com | Y | 1,852 | N/A | \$0 | 98.38% | 150 | 3,400 | Y |
| Freescale Semiconductor | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 5,866 | N/A | \$0 | 70.00% | 50 | 1,000+ | Y |
| FTDI | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 94 | N/A | \$0 | 100% | 50 | 1,000+ | Y |
| FTDI | Digi-Key | 800-344-4539 | digikey.com | Y | 486 | N/A | \$0 | 100% | 150 | 3,400 | Y |
| IDT (Integrated Device Technology) | Digi-Key | 800-344-4539 | digikey.com | Y | 49,881 | N/A | \$0 | 63.29% | 150 | 3,400 | Y |
| Infineon | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 1,580 | N/A | \$0 | 63% | 50 | 1,000+ | Y |
| INFINEON TECHNOLOGIES CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 24,610 | N/A | \$0 | 73.25% | 150 | 3,400 | Y |
| International Rectifier Corp | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 1,980 | N/A | N/A | N/A | N/A | N/A | Y |
| Intersil Corporation | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 1,782 | N/A | N/A | N/A | N/A | N/A | Y |
| INTERSIL CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 24,063 | N/A | \$0 | 74.18% | 150 | 3,400 | Y |
| INVENSENSE | Digi-Key | 800-344-4539 | digikey.com | Y | 200 | N/A | \$0 | 100% | 150 | 3,400 | Y |
| IXYS CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 7,268 | N/A | \$0 | 99.55% | 150 | 3,400 | Y |
| KINGBRIGHT COMPANY LLC | Digi-Key | 800-344-4539 | digikey.com | Y | 3,358 | N/A | \$0 | 99.85% | 150 | 3,400 | Y |
| LATTICE SEMICONDUCTOR CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 6,946 | N/A | \$0 | 64.44% | 150 | 3,400 | Y |
| LINEAR TECHNOLOGY CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 36,207 | N/A | \$0 | 76.91% | 150 | 3,400 | Y |
| LINX TECHNOLOGIES INC | Digi-Key | 800-344-4539 | digikey.com | Y | 833 | N/A | \$0 | 91.72% | 150 | 3,400 | Y |
| LITE-ON INC | Digi-Key | 800-344-4539 | digikey.com | Y | 3,563 | N/A | \$0 | 99.49% | 150 | 3,400 | Y |
| LOGIC PD, INC. | Digi-Key | 800-344-4539 | digikey.com | Y | 195 | N/A | \$0 | 62.56% | 150 | 3,400 | Y |
| MACOM TECHNOLOGY SOLUTIONS | Digi-Key | 800-344-4539 | digikey.com | Y | 1,376 | N/A | \$0 | 97.53% | 150 | 3,400 | Y |

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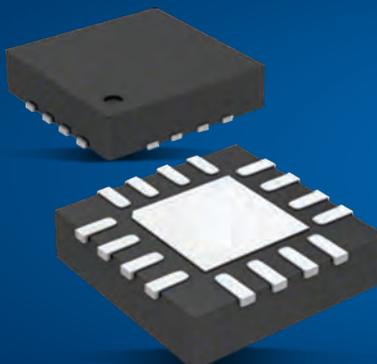


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|--|--------------------|--------------|----------------|------------------------------|----------------------------|---------------------------|---------------------|---------------------------------|--------------------------------|--------------------|---------------|
| MAXIM CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 65,795 | N/A | \$0 | 77.63% | 150 | 3,400 | Y |
| ICs & SEMICONDUCTORS (Continued from previous page, continued on next page) | | | | | | | | | | | |
| Maxim Integrated | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 9,200 | N/A | \$0 | 89.00% | 50 | 1,000+ | Y |
| MELEXIS TECHNOLOGIES NV | Digi-Key | 800-344-4539 | digikey.com | Y | 1,444 | N/A | \$0 | 94.94% | 150 | 3,400 | Y |
| MICRO COMMERCIAL COMPONENTS (MCC) | Digi-Key | 800-344-4539 | digikey.com | Y | 11,183 | N/A | \$0 | 97.43% | 150 | 3,400 | Y |
| Microchip | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 5,800 | N/A | \$0 | 100% | 50 | 1,000+ | Y |
| MICROCHIP CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 58,558 | N/A | \$0 | 90.13% | 150 | 3,400 | Y |
| MICRON CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 11,504 | N/A | \$0 | 88.34% | 150 | 3,400 | Y |
| Microsemi | Mouser Electronics | 800-346-6673 | Mouser.com | Y | 6,099 | N/A | \$0 | 50% | 50 | 930+ | Y |
| MICROSEMI CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 27,580 | N/A | \$0 | 80.18% | 150 | 3,400 | Y |
| MULTI-TECH CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 922 | N/A | \$0 | 99.46% | 150 | 3,400 | Y |
| NEWHAVEN DISPLAY INTERNATIONAL CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 707 | N/A | \$0 | 100.00% | 150 | 3,400 | Y |
| NIMBELINK, LLC | Digi-Key | 800-344-4539 | digikey.com | Y | 45 | N/A | \$0 | 100.00% | 150 | 3,400 | Y |
| NXP | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 7,205 | N/A | \$0 | 100% | 50 | 1,000+ | Y |
| NXP SEMICONDUCTOR CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 38,701 | N/A | \$0 | 99.27% | 150 | 3,400 | Y |
| ON Semiconductor | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 7,486 | N/A | \$0 | 96% | 50 | 1,000+ | Y |
| ON SEMICONDUCTOR CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 57,566 | N/A | \$0 | 79.85% | 150 | 3,400 | Y |
| OSRAM OPTO SEMICONDUCTORS INC | Digi-Key | 800-344-4539 | digikey.com | Y | 6,045 | N/A | \$0 | 96.33% | 150 | 3,400 | Y |
| PEREGRINE SEMICONDUCTOR | Digi-Key | 800-344-4539 | digikey.com | Y | 463 | N/A | \$0 | 99.57% | 150 | 3,400 | Y |
| POWER INTEGRATIONS | Digi-Key | 800-344-4539 | digikey.com | Y | 1,447 | N/A | \$0 | 87.49% | 150 | 3,400 | Y |
| POWEREX INC | Digi-Key | 800-344-4539 | digikey.com | Y | 3,395 | N/A | \$0 | 92.72% | 150 | 3,400 | Y |
| QUALCOMM TECHNOLOGIES INTERNATIONAL, LTD. | Digi-Key | 800-344-4539 | digikey.com | Y | 4,984 | N/A | \$0 | 100.00% | 150 | 3,400 | Y |
| RENESAS ELECTRONICS AMERICA | Digi-Key | 800-344-4539 | digikey.com | Y | 12,614 | N/A | \$0 | 84.65% | 150 | 3,400 | Y |
| RFMD CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 912 | N/A | \$0 | 87.17% | 150 | 3,400 | Y |
| SEGGER MICROCONTROLLER SYSTEMS | Digi-Key | 800-344-4539 | digikey.com | Y | 45 | N/A | \$0 | 100.00% | 150 | 3,400 | Y |
| SEMTECH CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 3,694 | N/A | \$0 | 87.63% | 150 | 3,400 | Y |
| SEOUL SEMICONDUCTOR INC | Digi-Key | 800-344-4539 | digikey.com | Y | 892 | N/A | \$0 | 88.98% | 150 | 3,400 | Y |
| SHARP CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 505 | N/A | \$0 | 62.18% | 150 | 3,400 | Y |
| SILICON LABORATORIES CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 17,747 | N/A | \$0 | 96.09% | 150 | 3,400 | Y |
| Silicon Laboratories Inc | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 1,141 | N/A | \$0 | 100.00% | 50 | 1,000+ | Y |
| SKYWORKS CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 2,311 | N/A | \$0 | 99.61% | 150 | 3,400 | Y |
| ST Microelectronics | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 8,145 | N/A | \$0 | 96.00% | 50 | 1,000+ | Y |
| STMICROELECTRONICS CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 43,448 | N/A | \$0 | 97.47% | 150 | 3,400 | Y |
| SWISSBIT NA INC | Digi-Key | 800-344-4539 | digikey.com | Y | 865 | N/A | \$0 | 100.00% | 150 | 3,400 | Y |
| TAOGLAS LIMITED | Digi-Key | 800-344-4539 | digikey.com | Y | 537 | N/A | \$0 | 100.00% | 150 | 3,400 | Y |
| Texas Instruments | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 29,676 | N/A | \$0 | 94% | 50 | 1,000+ | Y |
| TEXAS INSTRUMENTS CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 210,905 | N/A | \$0 | 89.60% | 150 | 3,400 | Y |

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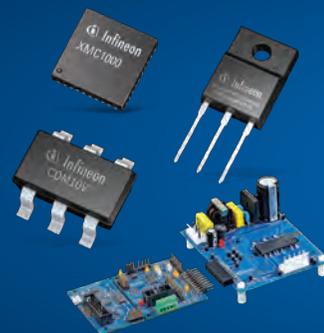
Buyers' Guide

| Manufacturer | Distributor | Telephone | Website | Franchised Distributor (Y/N/M) | No. of Lines for Principle | Stock Value for Principle | Minimum Order Value | % Lead Free for Principle Range | No. of Technical Support Staff | Total No. of Staff | Pack and Hold |
|-------------------------------------|--------------------|--------------|----------------|--------------------------------|----------------------------|---------------------------|---------------------|---------------------------------|--------------------------------|--------------------|---------------|
| Toshiba | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 800 | N/A | N/A | N/A | N/A | N/A | Y |
| TOSHIBA CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 12,097 | N/A | \$0 | 88.81% | 150 | 3,400 | Y |
| VERSALOGIC CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 444 | N/A | \$0 | 95.50% | 150 | 3,400 | Y |
| Vishay | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 53,781 | N/A | \$0 | 77% | 50 | 1,000+ | Y |
| VISUAL COMMUNICATIONS COMPANY (CML) | Digi-Key | 800-344-4539 | digikey.com | Y | 5,698 | N/A | \$0 | 96.12% | 150 | 3,400 | Y |
| XILINX INC | Digi-Key | 800-344-4539 | digikey.com | Y | 7,354 | N/A | \$0 | 51.78% | 150 | 3,400 | Y |

INTERCONNECTION (Continued on next page)

| | | | | | | | | | | | |
|---|--------------------|----------------|------------------------|---|---------|-----|------|---------|-----|--------|-----|
| 3M | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 23,235 | N/A | \$0 | 46.00% | 50 | 1,000+ | Y |
| 3M | Digi-Key | 800-344-4539 | digikey.com | Y | 54,086 | N/A | \$0 | 93.83% | 150 | 3,400 | Y |
| Aero Conesys | ECCO | 773-767-2200 | www.eccoconnectors.com | Y | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AMERICAN ELECTRICAL INC | Digi-Key | 800-344-4539 | digikey.com | Y | 1,140 | N/A | \$0 | 100.00% | 150 | 3,400 | Y |
| Amphenol | ECCO | 773-767-2200 | www.eccoconnectors.com | Y | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| AMPHENOL | Digi-Key | 800-344-4539 | digikey.com | Y | 426,945 | N/A | \$0 | 82.42% | 150 | 3,400 | Y |
| Amphenol | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 165,853 | N/A | \$0 | 31% | 50 | 1,000+ | Y |
| ASSMANN WSW COMPONENTS | Digi-Key | 800-344-4539 | digikey.com | Y | 10,433 | N/A | \$0 | 91.47% | 150 | 3,400 | Y |
| Cinch | ECCO | 773-767-2200 | www.eccoconnectors.com | Y | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| CONEC | Digi-Key | 800-344-4539 | digikey.com | Y | 7,793 | N/A | \$0 | 99.99% | 150 | 3,400 | Y |
| CW INDUSTRIES | Digi-Key | 800-344-4539 | digikey.com | Y | 8,384 | N/A | \$0 | 73.71% | 150 | 3,400 | Y |
| EDAC CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 9,720 | N/A | \$0 | 99.87% | 150 | 3,400 | Y |
| ELEKTRON TECHNOLOGY CORPORATION (Bulgin, ArcoLectric) | Digi-Key | 800-344-4539 | digikey.com | Y | 3,936 | N/A | \$0 | 100% | 150 | 3,400 | Y |
| FCI | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 3,394 | N/A | \$0 | 73.00% | 50 | 1,000+ | Y |
| Harting | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 2,160 | N/A | \$0 | 51.00% | 50 | 1,000+ | Y |
| HARTING | Digi-Key | 800-344-4539 | digikey.com | Y | 16,347 | N/A | \$0 | 99.96% | 150 | 3,400 | Y |
| HARWIN INC | Digi-Key | 800-344-4539 | digikey.com | Y | 10,186 | N/A | \$0 | 89.51% | 150 | 3,400 | Y |
| Hirose Electric | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 4,322 | N/A | \$0 | 86% | 50 | 1,000+ | Y |
| HIROSE ELECTRIC CO LTD | Digi-Key | 800-344-4539 | digikey.com | Y | 39,499 | N/A | \$0 | 91.53% | 150 | 3,400 | Y |
| ITT Cannon | ECCO | 773-767-2200 | www.eccoconnectors.com | Y | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| ITT CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 141,017 | N/A | \$0 | 27.97% | 150 | 3,400 | Y |
| JAE Electronics | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 6,02 | N/A | \$0 | 100% | N/A | N/A | Y |
| JAE ELECTRONICS | Digi-Key | 800-344-4539 | digikey.com | Y | 6,844 | N/A | \$0 | 100.00% | 150 | 3,400 | Y |
| JST | PUI | 1-800-551-4405 | www.gopui.com | Y | 1,225 | N/A | \$50 | 99.00% | 5 | 33 | Y |
| JST SALES AMERICA INC | Digi-Key | 800-344-4539 | digikey.com | Y | 4,320 | N/A | \$0 | 81.46% | 150 | 3,400 | Y |
| Kycon | PUI | 1-800-551-4405 | www.gopui.com | Y | 1,150 | N/A | \$50 | 99% | 5 | 33 | Y |
| LEMO | Digi-Key | 800-344-4539 | digikey.com | Y | 27,601 | N/A | \$0 | 100.00% | 150 | 3,400 | Y |
| MILL-MAX MANUFACTURING CORP | Digi-Key | 800-344-4539 | digikey.com | Y | 16,704 | N/A | \$0 | 61.28% | 150 | 3,400 | Y |
| Molex | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 85,634 | N/A | \$0 | 89% | 50 | 1,000+ | Y |

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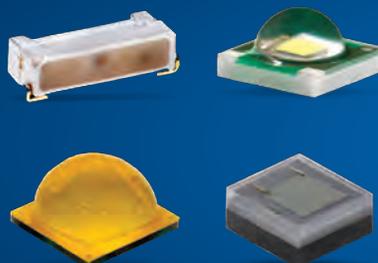
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Buyers' Guide

| Manufacturer | Distributor | Telephone | Website | Franchised Distributor (Y/N/M) | No. of Lines for Principle | Stock Value for Principle | Minimum Order Value | % Lead Free for Principle Range | No. of Technical Support Staff | Total No. of Staff | Pack and Hold |
|---|------------------------|--------------|--------------------|--------------------------------|----------------------------|---------------------------|---------------------|---------------------------------|--------------------------------|--------------------|---------------|
| MOLEX CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 123,772 | N/A | \$0 | 95.41% | 150 | 3,400 | Y |
| INTERCONNECTION (Continued from previous page) | | | | | | | | | | | |
| Neutrik | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 1,563 | N/A | \$0 | 100% | 50 | 1,000+ | Y |
| ON SHORE TECHNOLOGY INC | Digi-Key | 800-344-4539 | digikey.com | Y | 12,793 | N/A | \$0 | 99.99% | 150 | 3,400 | Y |
| PARLEX USA LLC | Digi-Key | 800-344-4539 | digikey.com | Y | 785 | N/A | \$0 | 98.34% | 150 | 3,400 | Y |
| PHOENIX CONTACT | Digi-Key | 800-344-4539 | digikey.com | Y | 49,643 | N/A | \$0 | 99.99% | 150 | 3,400 | Y |
| Phoenix Contact | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 30,044 | N/A | \$0 | 77.00% | 50 | 1,000+ | Y |
| SAMTEC INC | Digi-Key | 800-344-4539 | digikey.com | Y | 20,270 | N/A | \$0 | 99.91% | 150 | 3,400 | Y |
| Souriau | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 10,744 | N/A | \$0 | 27% | 50 | 1,000+ | Y |
| SOURIAU CONNECTION TECHNOLOGY CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 19,134 | N/A | \$0 | 89.06% | 150 | 3,400 | Y |
| SULLINS CONNECTOR SOLUTIONS | Digi-Key | 800-344-4539 | digikey.com | Y | 204,896 | N/A | \$0 | 97.59% | 150 | 3,400 | Y |
| Switchcraft Corporation | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 300 | N/A | \$0 | 55% | 50 | 1,000+ | Y |
| SWITCHCRAFT CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 4,228 | N/A | \$0 | 80.39% | 150 | 3,400 | Y |
| TE Connectivity | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 123,613 | N/A | \$0 | 69% | 50 | 1,000+ | Y |
| TENSILITY INTERNATIONAL CORP | Digi-Key | 800-344-4539 | digikey.com | Y | 1,209 | N/A | \$0 | 100.00% | 150 | 3,400 | Y |
| WEIDMULLER | Digi-Key | 800-344-4539 | digikey.com | Y | 42,770 | N/A | \$0 | 96.54% | 150 | 3,400 | Y |
| OBSOLESCENCE / HARD TO FIND | | | | | | | | | | | |
| | America II Electronics | 800-767-2637 | www.americaii.com | M | 1,900 | \$1B | \$0 | 75.00% | 59 | 550+ | Y |
| | Lantek Corp. | 973-579-8100 | www.lantekcorp.com | M | 186,000 | \$22M | \$0 | 75.00% | 5 | 62 | Y |
| OPTO ELECTRONICS (Continued on next page) | | | | | | | | | | | |
| Avago Technologies | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 7,165 | N/A | \$0 | 87.00% | 50 | 1,000+ | Y |
| Cree | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 582 | N/A | \$0 | 99.00% | 50 | 1,000+ | Y |
| LedEngin, Inc | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 437 | N/A | \$0 | 100.00% | 50 | 1,000+ | Y |
| Osram Opto Semiconductors | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 1,927 | N/A | \$0 | 99% | 50 | 1,000+ | Y |
| Sharp Microelectronics | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 1,415 | N/A | \$0 | 97% | 50 | 1,000+ | Y |
| PASSIVES (Continued on next page) | | | | | | | | | | | |
| ABRACON CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 28,548 | N/A | \$0 | 98.89% | 150 | 3,400 | Y |
| AMERICAN TECHNICAL CERAMICS | Digi-Key | 800-344-4539 | digikey.com | Y | 2,021 | N/A | \$0 | 84.02% | 150 | 3,400 | Y |
| API DELEVAN | Digi-Key | 800-344-4539 | digikey.com | Y | 28,483 | N/A | \$0 | 46.93% | 150 | 3,400 | Y |
| AVX | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 42,454 | N/A | \$0 | 72% | 50 | 1,000+ | Y |
| AVX CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 65,718 | N/A | \$0 | 83.48% | 150 | 3,400 | Y |
| BOURNS | Digi-Key | 800-344-4539 | digikey.com | Y | 59,314 | N/A | \$0 | 82.47% | 150 | 3,400 | Y |
| Bourns | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 38 | N/A | \$0 | 78% | 50 | 1,000+ | Y |
| CADDOCK ELECTRONICS INC | Digi-Key | 800-344-4539 | digikey.com | Y | 492 | N/A | \$0 | 98.78% | 150 | 3,400 | Y |

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|-------------------------------------|--------------------|----------------|----------------|------------------------------|----------------------------|---------------------------|---------------------|---------------------------------|--------------------------------|--------------------|---------------|
| CANTHERM | Digi-Key | 800-344-4539 | digikey.com | Y | 823 | N/A | \$0 | 100% | 150 | 3,400 | Y |
| CITIZEN SYSTEMS AMERICA CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 4,309 | N/A | \$0 | 87.42% | 150 | 3,400 | Y |
| CONNOR-WINFIELD | Digi-Key | 800-344-4539 | digikey.com | Y | 1,375 | N/A | \$0 | 98.62% | 150 | 3,400 | Y |
| Cornell Dubilier | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 24,145 | N/A | \$0 | 71% | 50 | 1,000+ | Y |
| Cornell Dubilier | PUI | 1-800-551-4405 | www.gopui.com | Y | 1420 | N/A | \$50 | 99% | 5 | 33 | Y |
| CORNELL DUBILIER ELECTRONICS | Digi-Key | 800-344-4539 | digikey.com | Y | 25,597 | N/A | \$0 | 75.97% | 150 | 3,400 | Y |
| CRYSTEK CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 1,721 | N/A | \$0 | 100% | 150 | 3,400 | Y |
| EATON CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 28,434 | N/A | \$0 | 86.49% | 150 | 3,400 | Y |
| ECS INC | Digi-Key | 800-344-4539 | digikey.com | Y | 8,236 | N/A | \$0 | 85.07% | 150 | 3,400 | Y |
| ENERGIZER BATTERY COMPANY | Digi-Key | 800-344-4539 | digikey.com | Y | 453 | N/A | \$0 | 63.13% | 150 | 3,400 | Y |
| EPCOS | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 26,533 | N/A | \$0 | 98.00% | 50 | 1,000+ | Y |
| EPSON CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 2,202 | N/A | \$0 | 82.60% | 150 | 3,400 | Y |
| FOX ELECTRONICS | Digi-Key | 800-344-4539 | digikey.com | Y | 617 | N/A | \$0 | 100% | 150 | 3,400 | Y |
| HEICO CORPORATION (Ohmite) | Digi-Key | 800-344-4539 | digikey.com | Y | 17,385 | N/A | \$0 | 64.94% | 150 | 3,400 | Y |
| HONEYWELL CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 26,319 | N/A | \$0 | 86.01% | 150 | 3,400 | Y |
| JOHANSON CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 5,039 | N/A | \$0 | 97.60% | 150 | 3,400 | Y |
| Kemet | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 77,568 | N/A | \$0 | 66% | 50 | 1,000+ | Y |
| KEMET CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 48,025 | N/A | \$0 | 90.12% | 150 | 3,400 | Y |
| KNOWLES CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 2,987 | N/A | \$0 | 91.16% | 150 | 3,400 | Y |
| KOA Speer | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 34,078 | N/A | \$0 | 58% | 50 | 1,000+ | Y |
| LAIRD CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 14,568 | N/A | \$0 | 97.21% | 150 | 3,400 | Y |
| LEM USA INC | Digi-Key | 800-344-4539 | digikey.com | Y | 377 | N/A | \$0 | 98.41% | 150 | 3,400 | Y |
| LITTELFUSE CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 86,652 | N/A | \$0 | 82.87% | 150 | 3,400 | Y |
| MALLORY SONALERT PRODUCTS INC | Digi-Key | 800-344-4539 | digikey.com | Y | 1,893 | N/A | \$0 | 92.92% | 150 | 3,400 | Y |
| Murata | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 33,780 | N/A | \$0 | 99% | 50 | 1,000+ | Y |
| NDK | Digi-Key | 800-344-4539 | digikey.com | Y | 936 | N/A | \$0 | 100.00% | 150 | 3,400 | Y |
| NESSCAP CO LTD | Digi-Key | 800-344-4539 | digikey.com | Y | 24 | N/A | \$0 | 100.00% | 150 | 3,400 | Y |
| Nichicon | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 20,389 | N/A | \$0 | 84.00% | 50 | 1,000+ | Y |
| NICHICON | Digi-Key | 800-344-4539 | digikey.com | Y | 35,421 | N/A | \$0 | 96.30% | 150 | 3,400 | Y |
| NVE CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 617 | N/A | \$0 | 60.25% | 150 | 3,400 | Y |
| Ohmite | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 14,293 | N/A | \$0 | 55.00% | 50 | 1,000+ | Y |
| Panasonic Electronic Components | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 14,948 | N/A | \$0 | 100.00% | 50 | 1,000+ | Y |
| PUI AUDIO, INC. | Digi-Key | 800-344-4539 | digikey.com | Y | 1,285 | N/A | \$0 | 75.55% | 150 | 3,400 | Y |
| PULSE CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 11,098 | N/A | \$0 | 93.56% | 150 | 3,400 | Y |
| RIEDON | Digi-Key | 800-344-4539 | digikey.com | Y | 3,411 | N/A | \$0 | 99.82% | 150 | 3,400 | Y |
| ROHM SEMICONDUCTOR CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 63,003 | N/A | \$0 | 99.85% | 150 | 3,400 | Y |
| Samsung Electro-Mechanics | PUI | 1-800-551-4405 | www.gopui.com | Y | 3,852 | N/A | \$50 | 99.00% | 5 | 33 | Y |

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|--|--------------------|----------------|--------------------|------------------------------|----------------------------|---------------------------|---------------------|---------------------------------|--------------------------------|--------------------|---------------|
| Samsung Electro-Mechanics | Digi-Key | 800-344-4539 | digikey.com | Y | 21,522 | N/A | \$0 | 100.00% | 150 | 3,400 | Y |
| PASSIVES (Continued from previous page) | | | | | | | | | | | |
| STACKPOLE CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 55,938 | N/A | \$0 | 99.49% | 150 | 3,400 | Y |
| STANDEX-MEDER ELECTRONICS | Digi-Key | 800-344-4539 | digikey.com | Y | 648 | N/A | \$0 | 99.69% | 150 | 3,400 | Y |
| SUMIDA AMERICA COMPONENTS INC | Digi-Key | 800-344-4539 | digikey.com | Y | 7,157 | N/A | \$0 | 86.24% | 150 | 3,400 | Y |
| SUSUMU | Digi-Key | 800-344-4539 | digikey.com | Y | 43,474 | N/A | \$0 | 99.98% | 150 | 3,400 | Y |
| TADIRAN BATTERIES | Digi-Key | 800-344-4539 | digikey.com | Y | 65 | N/A | \$0 | 100.00% | 150 | 3,400 | Y |
| Taiyo Yuden | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 4,620 | N/A | \$0 | 98.00% | 50 | 1,000+ | Y |
| TAIYO YUDEN | Digi-Key | 800-344-4539 | digikey.com | Y | 16,677 | N/A | \$0 | 99.96% | 150 | 3,400 | Y |
| TAMURA | Digi-Key | 800-344-4539 | digikey.com | Y | 1,355 | N/A | \$0 | 92.25% | 150 | 3,400 | Y |
| TDK | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 6,663 | N/A | \$0 | 100.00% | 50 | 1,000+ | Y |
| TRIAD MAGNETICS | Digi-Key | 800-344-4539 | digikey.com | Y | 1,608 | N/A | \$0 | 98.82% | 150 | 3,400 | Y |
| TRIPP LITE | Digi-Key | 800-344-4539 | digikey.com | Y | 3,646 | N/A | \$0 | 88.65% | 150 | 3,400 | Y |
| TT ELECTRONICS CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 8,975 | N/A | \$0 | 80.34% | 150 | 3,400 | Y |
| TXC CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 9,066 | N/A | \$0 | 100.00% | 150 | 3,400 | Y |
| United Chemi-Con | PUI | 1-800-551-4405 | www.gopui.com | Y | 1,145 | N/A | \$50 | 99.00% | 5 | 33 | Y |
| UNITED CHEMI-CON | Digi-Key | 800-344-4539 | digikey.com | Y | 16,160 | N/A | \$0 | 87.44% | 150 | 3,400 | Y |
| Vishay | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 102,917 | N/A | \$0 | 64.00% | 50 | 1,000+ | Y |
| VISHAY CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 275,942 | N/A | \$0 | 88.52% | 150 | 3,400 | Y |
| VISHAY PRECISION GROUP CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 28,238 | N/A | \$0 | 52.21% | 150 | 3,400 | Y |
| Würth | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 934 | N/A | \$0 | 99.00% | 50 | 1,000+ | Y |
| WURTH CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 22,245 | N/A | \$0 | 100.00% | 150 | 3,400 | Y |
| Yageo Corporation | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 18,246 | N/A | \$0 | 100.00% | 50 | 1,000+ | Y |
| YAGEO CORPORATION | Digi-Key | 800-344-4539 | digikey.com | Y | 141,986 | N/A | \$0 | 83.67% | 150 | 3,400 | Y |
| POWER & BATTERIES | | | | | | | | | | | |
| Emerson | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 358 | N/A | \$1 | 85.00% | N/A | N/A | Y |
| Lineage Power | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 301 | N/A | \$0 | 100.00% | N/A | N/A | Y |
| N2Power | PUI | 1-800-551-4405 | www.gopui.com | Y | 1,241 | N/A | \$50 | 99.00% | 5 | 33 | Y |
| Power-One | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 170 | N/A | \$0 | 60.00% | N/A | N/A | Y |
| TDK Lambda | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 405 | N/A | \$0 | 80.00% | N/A | N/A | Y |
| REED SWITCHES | | | | | | | | | | | |
| HSI Sensing | HSI Sensing | 405-224-4046 | www.hsisensing.com | M | 75 | N/A | \$200 | 100.00% | 15 | 275 | N |
| Standex-Meder Electronics | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 120 | N/A | \$0 | 82.00% | 50 | 1,000+ | Y |
| Standex - Meder | PUI | 1-800-551-4406 | www.gopui.com | Y | 2,123 | N/A | \$50 | 99.00% | 5 | 33 | Y |

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| Manufacturer | Distributor | Telephone | Website | Franchised Distributor (V/M) | No. of Lines for Principle | Stock Value for Principle | Minimum Order Value | % Lead Free for Principle Range | No. of Technical Support Staff | Total No. of Staff | Pack and Hold |
|---------------------------------|--------------------|----------------|------------------------|------------------------------|----------------------------|---------------------------|---------------------|---------------------------------|--------------------------------|--------------------|---------------|
| SENSORS | | | | | | | | | | | |
| Freescale | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 842 | N/A | \$0 | 97.00% | 50 | 1,000+ | Y |
| Honeywell Sensing and Control | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 12,059 | N/A | \$0 | 64.00% | 50 | 1,000+ | Y |
| Maxim Integrated | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 1,379 | N/A | \$0 | 45.00% | 50 | 1,000+ | Y |
| Omron | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 4,915 | N/A | \$0 | 59.00% | 50 | 1,000+ | Y |
| Standex-Meder Electronics | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 120 | N/A | \$0 | 82.00% | 50 | 1,000+ | Y |
| Texas Instruments | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 914 | N/A | \$0 | 65.00% | 50 | 1,000+ | Y |
| SWITCHES & KEYBOARDS | | | | | | | | | | | |
| Apem, Inc. | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 4,326 | N/A | \$0 | 83.00% | 50 | 1,000+ | Y |
| Apem, Inc. | PUI | 1-800-551-4405 | www.gopui.com | Y | 988 | N/A | \$50 | 99.00% | 5 | 33 | Y |
| C&K Components | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 27,230 | N/A | \$0 | 90.00% | 50 | 1,000+ | Y |
| Honeywell Sensing and Control | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 15,149 | N/A | \$0 | 73.00% | 50 | 1,000+ | Y |
| NKK Switches | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 13,976 | N/A | \$0 | 86.00% | 50 | 1,000+ | Y |
| Omron | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 10,669 | N/A | \$0 | 89.00% | 50 | 1,000+ | Y |
| OTTO | ECCO | 773-767-2200 | www.eccoconnectors.com | Y | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| OTTO | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 500+ | N/A | \$0 | 100.00% | 75 | 500 | Y |
| Panasonic Electric Works | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 2,748 | N/A | \$0 | 100.00% | 50 | 1,000+ | Y |
| Standex-Meder Electronics | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 120 | N/A | \$0 | 82.00% | 50 | 1,000+ | Y |
| Switchcraft Corporation | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 300 | N/A | \$0 | 55.00% | 50 | 1,000+ | Y |
| TEST & MEASUREMENT | | | | | | | | | | | |
| Fluke | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 1,008 | N/A | \$0 | 94.00% | 50 | 1,000+ | Y |
| Teledyne LeCroy | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 194 | N/A | \$0 | 96.00% | 50 | 1,000+ | Y |
| THERMAL MANAGEMENT | | | | | | | | | | | |
| Aavid Thermalloy | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 826 | N/A | \$0 | 73.00% | 50 | 1,000+ | Y |
| Aavid Thermalloy | PUI | 1-800-551-4404 | www.gopui.com | Y | 987 | N/A | \$50 | 99.00% | 5 | 33 | Y |
| Delta Products | PUI | 1-800-551-4406 | www.gopui.com | Y | 1,421 | N/A | \$50 | 99.00% | 5 | 33 | Y |
| Orion Fans | PUI | 1-800-551-4406 | www.gopui.com | Y | 1,242 | N/A | \$50 | 99.00% | 5 | 33 | Y |
| Sanyo Denki America, Inc. | PUI | 1-800-551-4405 | www.gopui.com | Y | 2,122 | N/A | \$50 | 99.00% | 5 | 33 | Y |
| STEGO, Inc | | 770-984-0858 | www.stegousa.com | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| WIRELESS SOLUTIONS | | | | | | | | | | | |
| Panasonic Electronic Components | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 48 | N/A | \$0 | 100.00% | 50 | 1,000+ | Y |
| RFM | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 312 | N/A | \$0 | 90.00% | 50 | 1,000+ | Y |

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