ELECTRONICS
# sourcing
AN MMG PUBLISHING TITLE
AUGUST 2023
NORTH AMERICA

# AUTOMOTIVE: LEAN MANUFACTURING AND STRATEGIC PARTNERSHIPS

# New look
# Same focus

We've refreshed our brand, but our commitment to customer-centric experiences remains constant.

And as always, our goal is to accelerate progress for every designer, buyer, and builder.

**Learn more at digikey.com**

DigiKey

we get technical


## On the cover – August 2023

Automotive: Lean manufacturing and strategic partnerships
page 18

# Editor's Word

## Opportunities for reshoring

I have no academic background in economics and whenever I delve into the subject I'm soon confronted by math that is so many pay grades above me I can't even see the top. Thus, I keep my observations at ground level.

So, when I witness reshoring trends, it triggers memories of the '80s when offshoring was the management guru's go to move. At the time, I recall researching offshoring and stumbling across the theory of comparative advantage. I ignored the math and went for the simplest explanation I could find.

Here goes: Imagine two countries would like access to commercial airliners and cruise ships. One has an abundance of aerospace engineers and the other has a long open coastline. The obvious solution is one country specializes in manufacturing commercial airliners, the other country specializes in manufacturing cruise ships and they exploit excess production capacity by trading products. Hopefully that description is right.

The fact the supply chain supporting such activity snapped a couple of years ago doesn't dissolve the logic of comparative advantage. Offshoring and reshoring will continue. However, the rate and direction depend on what different countries decide to specialize in.

That decision is split between political desire, culture, society and resources. In the world of manufacturing, resources surely must take the lead role: labor, IP, skills, raw materials, energy, space and more. Logically, if a country wants more manufacturing, a different sector will have to lose their share of such resources, voluntarily or by force.

I watch with interest as the battle lines are drawn, with labor and skills currently leading the charge.

Jon Barrett


## Contact

ELECTRONICS sourcing | mmg PUBLISHING US LTD

**EDITORIAL**
**Managing Editor:** Jon Barrett
jonb@electronics-sourcing.co.uk
**Contributing Editor:** Amy Barker
amyb@electronics-sourcing.co.uk

**ADVERTISING**
**Director of Sales:** Emma Evernden
emma.evernden@electronics-sourcing.co.uk
**Sales Executive:** Alex Mosqueda
alex.mosqueda@electronics-sourcing.com

**PRODUCTION & DESIGN**
**Production & Design Manager:** Jo McCarthy
jo.mccarthy@mmgpublishing.com
**Creative Artworker:** Tom Claydon-Smith
tom.claydon-smith@electronics-sourcing.co.uk

**CIRCULATION**
**Circulation Account Manager:** Liz Poole
liz.poole@electronics-sourcing.co.uk
**Data & Software Analyst:** Thomas Smart
thomas.smart@mmgpublishing.com

**PUBLISHER**
**Mark Leary**
mark.leary@electronics-sourcing.co.uk
**Director of Operations:** Denise Pattenden
denise.pattenden@mmgpublishing.co.uk

Issue 131, Vol.14 No.08

Published 12 times per year
by MMG Publishing US Ltd

MMG PUBLISHING US Ltd
Normandale Lake Center
8400 Normandale Lake Boulevard
Suite 920, Bloomington MN 55437
Tel: 866.364.0951
Fax: 952.378.2770
@Electrosourcing

Printed in the United States
ISSN 2835-0650



ELECTRONICS SOURCING IS INDEPENDENTLY ABC AUDITED 2005/2022

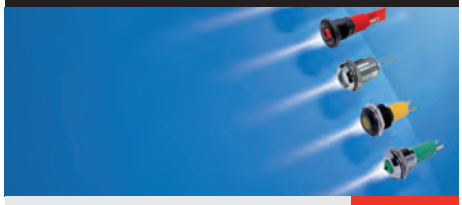
ecia
Connect. Influence. Optimize.



## NEWS

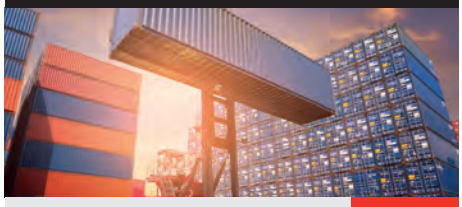



## DISPLAYS





## COMPONENT COMPARISON

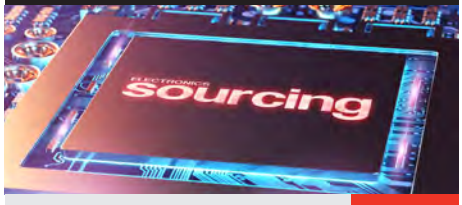




## WHAT'S NEW



## BUYERS GUIDE



# ES News





## Getting products to market

DigiKey has partnered with GroupGets to launch the Get MADE crowdfunding initiative, a collaboration that promotes and funds hardware creators. This program will allow startups to get hardware funded, produced and sold on DigiKey's website.

GroupGets is a crowd purchasing platform for group buying technology products that helps businesses and individuals launch their products by promoting, funding and distributing electronic devices across the world.

Through the Get Made program, GroupGets and DigiKey will cross promote qualifying devices through content, design, distribution and partial funding through DigiKey. On successful funding, GroupGets will work with the creators to manufacture the platforms and then DigiKey will list the platforms for sale on its website.

DigiKey's senior director of technical marketing, David Sandys, said: "The Get MADE program stemmed from the longtime supply partnership between DigiKey and GroupGets and became a call-to-action to further support makers trying to enter the market. By partnering together, we can bring interesting new solutions to market and fuel innovation in the hardware space."

*www.groupgets.com/getmade*

## Robotics hub reduces time-to-market

Arrow Electronics and eInfochips have established a Robotics Center of Excellence to help customers accelerate time-to-market for the development of automation solutions for manufacturing, digital factories and other industries. Arrow has teamed with Analog Devices, NVIDIA and Onsemi image sensors to develop reference designs and proof-of-concepts that robotics customers can leverage.

Arrow Electronics' senior VP of global marketing and engineering, Aiden Mitchell, said: "The rapid adoption of artificial intelligence at the edge as well as applications such as autonomous machines will revolutionize the digital factory to enable the deployment and growth of Industry 4.0. Arrow Electronics is proud to work together with ADI to create a center of excellence to empower the intelligent edge through design services capabilities, reduce technology complexities and accelerate time-to-market."

According to the International Federation of Robotics, robots and cobots in industrial manufacturing have doubled in the last five years.

*www.fiveyearsout.com*

## Overvoltage protection in three designs


The new Self-Control Fuse series from Eaton Bussmann is now part of Rutronik's range. The battery protection with three terminals allows surface mount – thanks to its flat, compact design – and suits single-cell and multi-cell battery packs.

The SCFs protect against overcurrent and overcharging. Applications include consumer, computer, power, industrial, home appliance, handheld and medical. They measure 4.0 by 3.0mm (12 to 22A), 5.4 by 3.2mm (12 to 30A) and 9.5 by 5.0mm (30 to 45A).

The SCF has an integrated heating element with fuse for IC/FET triggering capability that responds quickly to an unexpected cell or pack level overvoltage or overtemperature. For high efficiency in lithium-ion battery packs, the SCF series operates with a wide range of current ratings and low internal resistance.

Features include RoHS compliant, halogen free and easy pairing of rated current and battery cells in row. Applications include e-bikes, robotics, cordless tools, notebooks, energy storage systems and POS terminals.

*www.rutronik24.com*

SAGER POWER SYSTEMS
A SPECIALIZED GROUP WITHIN SAGER ELECTRONICS

# WHEN AN OFF-THE-SHELF SOLUTION JUST WON'T DO, YOUR **LATEST INNOVATION** MAY AS WELL BE A LUNCHBOX.

## LET US HELP

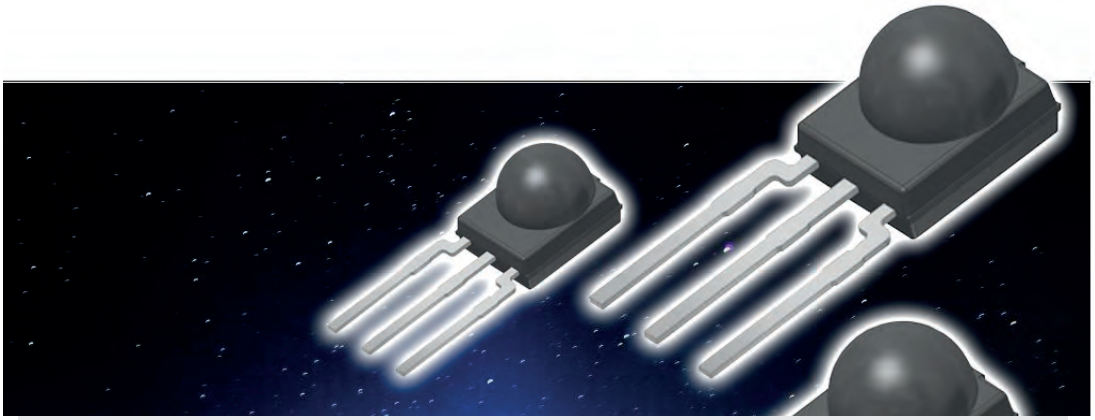
From simple modifications to high-complexity designs, ISO-certified Sager Electronics specializes in solving problems. As a trusted advisor, we go beyond fulfillment to add value in the areas of power, battery, thermal, connector and electromechanical for a wide range of markets and applications. With quick-turn prototyping, product safety testing, and assembly in the USA, our experienced team can guide you through the entire engineering process – all with faster time to market and higher reliability than a typical custom build.

**MODULAR POWER | POWER SUBSTATIONS | POWER BOARDS**
**BATTERY DESIGN & PACKS| THERMAL | DIN RAIL ASSEMBLIES**
**& ENCLOSURES | SIMPLE MODIFICATIONS**

SAGER ELECTRONICS

**sager.com**

# ES News



## In Brief

**Infrared dome LEDs available now**
Sager Electronics is now stocking Kingbright's new infrared dome lens surface mount devices. They broaden coverage in the invisible spectrum. Available in standard top emitting and right angle SMD LED packages, the narrow viewing angle of the dome lens enhances performance. They suit applications including machine vision, surveillance, remote control and smart home.
*www.sager.com*

**Big investment in SKUs**
DigiKey has expanded its portfolio in 2023 by adding over 175,000 new stocking parts year-to-date including nearly 40,000 newly introduced product SKUs across its core business. DigiKey's VP, global business development, Mike Slater, said: "DigiKey continues to add products and the newest technologies in key verticals including automation, power, wireless and automotive."
*www.digikey.com*

**Boosting opto production capacity**
To meet growing demand for opto-semiconductor products, Hamamatsu Photonics is constructing a new building to handle pre-processing. Completion is scheduled for June 2025. The building will nearly double production space. Besides current production for conventional 6in silicon wafers, the company will be running a line compatible with 8in diameter wafers in the new building.
*www.hamamatsu.com*

**Impending recession?**
Per IPC's June 2023 Economic Outlook report, the US economy has remained resilient through the first half of the year, despite significant headwinds. IPC's chief economist, Shawn DuBravac, said: "This resiliency probably will not last. The second half will prove more difficult, and we expect the economy to slip into recession."
*www.ipc.org*

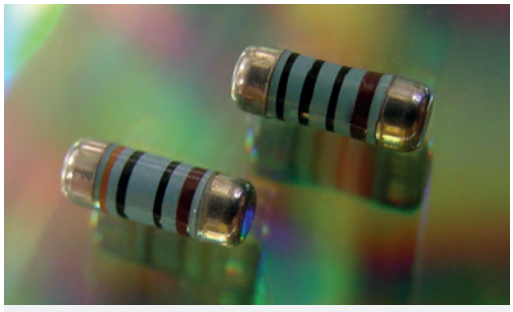
## Sensor modules reduce system costs

New Yorker Electronics has announced Vishay's release of two new fixed-gain infrared sensor modules designed to lower costs and increase stability for outdoor sensor applications. Offering typical irradiance of 1.3mW/m² in compact Minimold packages, the surface-mount TSSP93038DF1PZA and leaded TSSP93038SS1ZA are designed to provide robust operation in direct sunlight, while still providing enough sensitivity for light barrier applications.

Unlike high sensitivity fixed-gain IR sensor modules that require attenuators like dark panels, apertures and sunshades to protect them against sunlight–adding to overall solutions costs–the controlled sensitivity of these devices lets them operate in full sunlight without unwanted pulses.

The devices suit: distance sensing for toys, drones, robots and vicinity switches; presence detection for traffic control lights and parking lot, gateway access and water level sensors; and light barriers for sports racing and lawnmower robots. They may also be used as reflective sensors for hand dryers, towel/soap dispensers, water faucets, toilets, vending machine fall detection and security/pet gates.

*www.newyorkerelectronics.com*



## Automotive grade high reliability MELFs in stock

When designing high reliability applications, it can be challenging to find a resistor that meets the electrical demands at a reasonable cost and availability. If AEC compliance is required, the challenge is even greater.

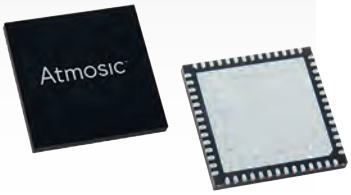
Stackpole is offering a solution with its MLFA series. These AEC-Q200 compliant MELF resistors are designed to offer exceptional electrical and environmental performance with low thermal resistance.

MLFA stability and reliability are ideal for applications such as audio equipment, power monitoring, precision/industrial/motor controls, automotive electronics, test equipment and instrumentation.

Pricing for the MLFA varies with size, resistance value, tolerance and TCR. More than 70 of the most popular values and sizes are in stock. Pricing for the MLFA is around $0.50 to $0.55 each for one per cent tolerance product.

*www.seielect.com*

## Servicing ultra-low power IoT




Mouser Electronics has announced a distribution agreement with Atmosic Technologies, a manufacturer of ultra-low power wireless solutions for IoT applications. The agreement covers Atmosic's Bluetooth 5 SoCs which suit industrial asset-tracking solutions, sensors, medical devices, personal wearables and automotive accessories.

The ATM32x1 SoCs combine a Bluetooth 5-compliant radio with an Arm Cortex M0 application processor. These devices support operation from a variety of energy harvesting sources, including RF, photovoltaic, thermoelectric generator and motion. They also support innovative wake-up mechanisms to enable further reduction in power consumption.

Atmosic ATM22x1 SoCs offer similar power management features, but without energy harvesting. They are designed to extend the battery life of IoT devices, as low-duty cycle operation support allows IoT systems to run longer without battery replacement.

Both series feature 256k ROM, suiting super high-volume applications. They also have an external Flash interface for applications that require additional external Flash support.

*www.mouser.com*

# It's The Human Component that sets TTI Apart

Sure, we warehouse more than 850,000 part numbers, but it's the Human Component that gives TTI an advantage others can't touch.

TTI Specialists add product knowledge, purchasing assistance, industry trends, design expertise, supply chain updates, the newest technology and more.

**See what you'd look like as a human component at ttipartsportrait.com**

The HUMAN COMPONENT

**Max Lalor**
Field Account Representative

**The Electronic Components Specialists**

1.800.CALL.TTI | tti.com

A Berkshire Hathaway Company

# Understanding LED life and performance

*In this article, CML walks buyers through the life and performance of LEDs, explaining how carefully balancing brightness and current can improve life expectancy*

**CML Innovative Technologies'** commercial manager, **Roger Neal**

The lifespan of an LED can range from 80,000 to about 120,000 hours depending on materials and manufacturing method. Generally, these estimates are based on perfect conditions. However, in reality the harsher the use the less the life expectancy. Eighty thousand hours equates to a little over 20-years if operating the device eight hours a day. Most products would be obsolete by the time a complete or catastrophic failure occurs.

Increasing demand for brighter LEDs is playing a role in life reduction. More and more we see a drive for daylight visibility in certain ranges of parts, products and components. If there is one thing directly impacting an LED's life expectancy it is current draw. Operating an LED at reduced current extends its life even further. At significantly reduced levels, an LED can last almost indefinitely. However, should it see current above the nominal rating its life will be much shorter. Unfortunately, the relationship between LED life and current is not linear unlike the relationship between current and brightness.

LED lighting can last a long time. However, that does not mean users should keep the lighting as long as there is not a catastrophic failure. Light output and color will degrade over time, with the application generally determining the level of acceptance.

LED technology has developed rapidly in recent years and should continue to. Innovations and improvements occur continuously. Good design and careful manufacturing techniques help increase the life and general performance of lamps.

CML's latest lamp products are available with data sheets that accurately reflect life and performance. They can be requested directly from the customer services team or by contacting CML's list of authorized distributors.

*www.cml-it.com*

FUSION
WORLDWIDE

# The Critical Link in Your Supply Chain

Fusion is your best source for quality electronic components.

Contact Us Today

# Celebrating a Level Up Mentality

*In this article, Women in Electronics introduces its 2023 Annual Leadership Development Summit, Level Up, designed to support the next wave of industry-leaders.*


Companies with diverse gender composition perform better in terms of returns on equity. In addition, companies with at least half female top management see returns on equity 19 per cent higher than average and boards with a higher percentage of women outperform those with fewer women by 36 per cent. (Forbes & Cloverpop). Currently, less than 10 per cent of vice president and above positions are held by women in the electronics industry, and the industrial industry looks to have even fewer than 10 per cent women in leadership roles. Women in Electronics is here to help change that.

Women in Electronics (WE) is a 501c3 non-profit organization dedicated to advancing gender parity results in the electronics industry, as well as the recent expansion into the industrial industry. Founded in 2017 by Jackie Mattox (Chief Executive Officer), along with Executive Team members, Monica Highfill (Founding Director and Vice President) and Amy Keller (Founding Director), WE provides leadership growth and development, a flagship global mentorship program, a health and wellness series, peer-to-peer knowledge sharing, valuable career resources, and a sense of community and belonging to its members.

In pursuit of growing the next wave of industry leaders, WE offers an annual leadership development program, which includes access to a mentorship program, monthly webinars, and an in-person Annual Leadership Development Summit.

The 2023 Annual Leadership Development Summit, Level Up, is intended to advance leadership skills and foster personal awareness through specifically curated keynote speakers, workshops, peer-to-peer roundtables and strategic networking opportunities. The first program kicked off in the UK in April and the next program takes place September 19 to 21 in San Diego, CA. The agenda includes a "Ladies in Leadership" Welcome Reception & Networking Dinner on day one with content curated for women leaders on day two. Industry leader, Lynn Torrel, from Flex, will deliver the opening keynote; Linda Johnson from DigiKey will chat with attendees regarding her leadership journey; Genein Letford will educate us on intercultural creativity; and change management specialist, Carla Howard, will present on the best practices for developing strong resiliency. The final day, we will participate in workshops and keynotes from Dr Shawn Andrews regarding the "Seven Superpowers of Men and Women" and leaders, Phil Gallagher from Avnet, Don Akery from Waldom Electronics, and Michael Knight from Endries Industrial will participate in impactful sessions for a demonstration of "WE United", creating the opportunity for all industry professionals to engage in thought leadership and collective development.

The Level Up program is a development opportunity to refresh and expand skills for seasoned leaders and build the path for long term success for early-mid career professionals. Attendees will return to their organizations with a sense of passion and a new motivation to apply the key takeaways, strategies, development tools and resources provided. For more information, visit the website at womeninelectronics.com or email questions to admin@womeninelectronics.com.

Women in Electronics is more than a mission, it's a movement working in unity with all industry professionals and colleagues to open the opportunities for members in the electronics and industrial industries in efforts to build the leadership pipeline, while incorporating the four organizational goals to empower, advocate, develop and celebrate members. All industry professionals and organizations are invited to join the movement to create a thriving environment for all.

WE is currently supported by leading organizations: Amphenol, Arrow Electronics, Avnet/Newark/Farnell, Kyocera/AVX, Altium/Nexar/Octopart, Cornell Dubilier, DigiKey, EETech, Flex Electronics, Galco Industrial Electronics, Littelfuse, Master Electronics, Molex, Rochester Electronics, Orbweaver, Plexus, RS, Rutronik, Samtec, Sourceability, Supplyframe, TTI Family of Specialists, Vishay, Waldom and YAGEO Group.

*www.womeninelectronics.com*

# Science, mystery, and challenges of obsolescence management

*Component obsolescence management is regaining attention in the electronics industry as more segments of the economy, including industrial equipment, digitalize their products. Distributors see opportunities to expand services and deepen engagement with OEMs*

Some OEMs lose very little sleep over component obsolescence issues. Companies serving the consumer electronics market, especially, do not spend a lot of time wondering how to ensure replacement parts would still be available many years after their products hit retail stores. In fact, for smartphone OEMs which thrive on the introduction of new devices every six months, component obsolescence is a very distant concern.

The reverse is the case for automotive, aviation, medical and industrial equipment manufacturers. Products in this segment are often in use decades after leaving the production plant—as many as 30 to 40 or more years—and ensuring there is an extended supply chain capable of assuring adequate cost-efficient maintenance is always high on the OEMs' to-do list. Customers always ask about long-term service, maintenance, and availability of parts decades into the future and OEMs must be prepared to answer these questions, according to industry observers.

"Manufacturers of highly advanced, complex equipment—such as aerospace and defense (A&D) companies or heavy-equipment OEMs—face a recurring challenge," said analysts at McKinsey & Co., in a research report. "Their products have extremely long lifecycles of 30 years or more, during which they need to provide legacy-parts support."

The problem has become even more complicated. In recent years, the number and variety of semiconductors used in heavy industrial equipment have grown exponentially. The infusion of electronics into equipment that previously used basic mechanical and hydraulic systems has forced new obsolescence challenges upon the manufacturers. The old sourcing problems have not gone away either even as semiconductors, which typically have shorter lifespans, are getting added into industrial equipment.

"The internal components for [industrial] systems, including semiconductors, electronic boards, and mechanical parts, have much shorter life cycles, in some cases less than five years," the McKinsey analyst group of Hugo Del Campo, Giuletta Poltronieri, Alessandro Simoncini, Alfredo Vaghi and Simone Vesco, said in the report, which focused primarily on the aerospace and defense industries. "Because of this disparity, components can become harder to source over time and even grow obsolete as suppliers struggle to source the raw materials or stop manufacturing them altogether."

**Distribution partnership for obsolescence management**

This is one area where electronics component distributors have shown exceptional support in the industry. Distributors have learned over the years to anticipate and support the long-term component requirements of OEMs that serve markets with lengthy product lifecycles. Mouser Electronics, for example, has an active obsolescence support program that starts during the design stage and continues through the product lifecycle. The company said it handles obsolescence management in various ways, including by providing lifecycle information on thousands of components on its website. It also provides end-of-life (obsolete lifecycle) notices and regularly sends product change notification (PCN) notices to customers who "have purchased a part in the last two years, or has the part saved into a project."

Companies like Arrow Electronics owned Silicon Expert also offer dedicated obsolescence management strategy services where they assist OEMs in assessing their exposure and develop plans for tackling identified challenges. Silicon Expert also helps companies identify alternatives to obsolescent products in addition to offering pricing information on "last time buy" programs aimed at reducing the impact of obsolescence challenges. "The most common methods of the past for managing electronic components have entailed very manual or reactive processes that lead to chaos, human error, long lead times and excessive costs to the organization," the company said, in a statement on its site. "The key to sustained profitability for effective and efficient obsolescence management is foresight and strategic process flow."

The semiconductor shortages that hurt automotive OEMs and other segments of the electronics industry in 2021 and 2022 caught many companies by surprise. In response, manufacturers turned to electronics components distributors for support and assistance navigating through the shortages. This pattern has played out for years with regards to obsolescence management, according to observers. All the leading distributors have extensive obsolescence management programs and work closely with OEM customers and electronics manufacturing services (EMS) providers to identify potential problem areas and develop plans for averting supply challenges, they said.

Distributors have identified other tools that can help reduce or eliminate problems related to component obsolescence. In addition to flagging end-of-life notices, they offer second-sourcing information for products that may need replacement and leverage their bill-of-materials (BOM) management tools to keep customers updated on developments that could spark obsolescence problems. None of these tools is more important than having a good relationship with the components manufacturers, however, according to distribution industry sources. A close and enduring relationship with suppliers is a prerequisite

John May, chairman and CEO, John Deere

for effective obsolescence management, analysts said.

**Curbing obsolescence management cost**

OEMs can be shocked by the ticker price of an inefficient obsolescence management program. When an OEM is forced to continue supporting specific equipment—for example, a leased, decades-old aircraft—the biggest expenses manufacturers often face are related to non-recurring redesign and engineering charges. When components are no longer being produced by the original supplier, the OEM could be compelled to redesign key parts of the equipment. The cost of doing this is typically higher and could run into multiples of the original charge, according to observers. In the case of the military market, for example, McKinsey analysts estimate non-recurring costs "in the range of $50 billion to $70 billion" adding, "the problem of non-recurring engineering costs is growing worse as technology cycles accelerate and supply chains become more interconnected."

Some distributors have stepped up with solutions that are more competitive, and which may, in some cases, eliminate the need for a product redesign. Rochester Electronics, for instance, offers a range of services that go beyond traditional component stocking. The company signs agreements with semiconductor companies to continue making some of their products when the original vendor terminates regular production of the components. "Rochester can replicate the original device, avoiding lengthy [and] expensive system re-qualification, re-certification or re-design," the company said, in a statement. "The end product is a form, fit and functional replacement guaranteed to the original data sheet performance.

Even so, the cost to the OEM of ensuring effective use of the original equipment can still be significantly higher than for the prototype. To ensure it can provide the "authorized product replication" service, for example, Rochester may have to acquire and stock the required wafers. The company offers long-term wafer storage service to ensure it can match the effectiveness of the original components. Test and assembly services may add to the buyers' costs although these would still be lower than if the OEM had to work on a complete redesign or re-engineering of the devices. Companies that engage with Rochester on services like this include Thyssenkrupp Elevator. One example where the two worked together was on a component from NXP Semiconductor designed into Thyssenkrupp elevators. Once the supplier sent the end-of-life notice for its NXP P80C592 single-chip microcontroller, Rochester said it "became Thyssenkrupp's key ally for a resolution." The distributor used the "original design and test data transferred from NXP," to replicate the chip, it said. "This allowed us to continue to support our customers without going through expensive and time-consuming redesign," said a Thyssenkrupp executive quoted by Rochester, in its report.

Even economic segments like the farming market have not been spared. Take the experience of John Deere & Company, a US-based vendor of agricultural machines, heavy equipment, diesel engines and forestry machinery. The company's products have undergone significant transformation in recent years as John Deere embraced electronics and automation. It has products that run on alternative energy and others that operate on a 24-hour basis without any direct manual control. Moving beyond the simple farming functions, John Deere said it has added what it called precision technology in the form of artificial intelligence into its equipment, a move that requires the inclusion of more semiconductors in each equipment. The objective, the company said in a statement on its web site, is to "deliver intelligent, connected machines and applications that will revolutionize production systems in agriculture and construction to unlock economic values across the lifecycle in ways that are sustainable for all." John Deere's customers have embraced technologies to improve productivity, the company said.

"Customers continued to adopt the latest in high-value precision technologies, many of which include autonomous capabilities," said John May, chairman and CEO of John Deere, in the company's annual filing with the U.S. Securities and Exchange Commission. "Deere is unleashing technological breakthroughs, transforming the industries we serve and bringing value to our customers that would have been scarcely imaginable not long ago." Like other industrial equipment manufacturers that have embraced innovations coming from the technology market, Deere too faced severe "supply-chain pressures and higher material costs," in its latest fiscal year. "Over the course of the year, many Deere factories experienced slowdowns or disruptions due to parts or component shortages," CEO May said.

Actions like this will become even more necessary in the future as electronics penetrate deeper into industrial equipment, according to analysts. While the main OEM equipment could last decades before being scrapped, the electronics in them would require constant updates. For hardware, this process may occur as frequently as every 5 years, but it may be much shorter for software upgrades. The McKinsey team identified 3 steps they suggest OEMs activate to manage obsolescence challenges. These are:

Step 1: Identify alternate suppliers for the component. The first step is to identify any potential alternate suppliers for a given component that faces obsolescence. This is the most attractive solution, as it avoids virtually all new engineering costs.

Step 2: Identify alternative components that can be modified. The second step is to find a similar component in the market—one that is close in fit, form, and function (FFF) to the component becoming obsolete—and then modify it as needed. This step allows companies to minimize nonrecurring engineering costs and avoid a full redesign.

Step 3: Redesign the component. The third option, if no exact or FFF replacements are available, is to redesign a new component while minimizing costs and reducing any disruption to the existing system design.

In the end, obsolescence management requires a multi-disciplinary approach. To succeed, companies must work together early in the product design process with suppliers and supply chain partners, including distributors, to identify potential challenges ahead and develop a plan for resolving these. Obsolescence management also requires a champion within the OEM organization. The individual must be able to influence, monitor and ensure decisions taken during the design phase are executed to help the organization avoid unpleasant surprises in the product lifecycle, according to Mckinsey.

"Designating 'obsolescence champions' in the organization can ensure that OEMs formally allocate responsibility for this issue to a single individual (or team) who can directly engage with suppliers to anticipate supply chain disruptions," they said. "OEMs of advanced industrial products should factor component obsolescence into the design of new offerings by identifying and addressing root causes in cooperation with engineering units, suppliers, and other stakeholders."

Exclusively sponsored by DigiKey

# Improving the **Purchasing Process** with **DigiKey's myLists**

by **David Stein,** vice president, semiconductors at **DigiKey**

DigiKey is making it easier than ever for sourcing and procurement professionals to purchase the products they need with our single list management and parts solution, myLists. We've taken the best, most useful capabilities from previous iterations of the tool, while also adding new features, controls and product information, to make myLists a one-stop resource.

## A Customizable Solution

One of the most, or maybe the most, useful aspects of myLists is that it's completely customizable. These features include:

- **Custom Views and Filters** – myLists allows users to control many variables, including what information they want to see as products are added or deleted to their bill of materials (BOM). Plus, with one click, users can narrow down what they're looking for – whether that's resistors, microcontrollers or integrated circuits.
- **Real Time Collaboration** – Lists, or BOMs, can not only be saved and referenced for future use, but teams and personnel within organizations can collaborate within the same list without needing to download or export files, ensuring everyone is working from the most up-to-date version. Then once ready, lists can be downloaded and customized in a user's preferred file format (e.g. XLSX, CVS, TAB).

## Streamlining the Purchasing Process

myLists makes it easy to create a product list, access part information, generate a quote, check the status of materials and more. Specific features include:

- **Substitution Recommendations** – myLists is able to recommend alternatives if a product is unavailable, soon to be obsolete or has a long lead time.
- **Easily Track Products and Details** – myLists offers a high level of detail on parts and products. Users can access information on country of origin, manufacturer quantities available, the status of raw materials, product lead times and more.
- **Ability to Generate Quotes** – Users can generate and reference quotes, locking in pricing for 30 days.
- **Obsolescence Checks** – Users can run through their active parts list and search for obsolete components on their BOM. At the same time, myLists can offer up alternative solutions.

## Now is the Time to be Proactive

While most electronic components and automation products are currently plentiful, it's a good time to think ahead and identify alternative parts through myLists rather than wait until it's crunch time or there's another supply chain issue. At DigiKey, we recommend reviewing BOMs every six months to a year.

## DigiKey as a Strategic Partner

DigiKey works directly with suppliers to gain insights into where they're planning to make changes, when they plan to introduce new products and what products may be discontinued. Engineers should be designing in the newest and most popular products and working alongside DigiKey will assist you in this effort.

DigiKey is continuously perfecting myLists by gathering supplier and customer feedback as well as listening to DigiKey's internal experts, ensuring myLists is the most holistic tool on the market. For more information on how DigiKey and myLists can improve your sourcing and procurement process, visit *www.digikey.com/mylists*

# EMC: opportunities and challenges 2023 and beyond

*As electronics advances, a common design concern centers on how electronic products perform in ever-changing EMC environments, Kyocera AVX explains*

Although engineering teams design EMC hardness into their systems early in the design process last minute changes or design additions can occur. This complicates the purchasing process given component lead times in today's post pandemic environment. Given the availability of EMC solutions could shut down manufacturing and shipping, a high-level discussion of EMC trends, solutions and industry efforts is in order.

## EMC challenges

Regulations and advanced semiconductors are two trends making it harder for design teams to meet EMC system requirements.

Firstly, government and regulatory agency performance requirements are generally expanding and getting more stringent over time. More device types fall into the regulation's intent and tighter requirements are being applied to some existing designs. Generally speaking, designers know what performances are needed but those goal lines are evolving over time.

Secondly, to achieve the added functionality typical in new electronic devices, designers might choose the latest, most powerful ICs. That may translate into lower voltage rails, faster speeds and smaller internal geometries—all rendering the system more likely to emit radiation and be more susceptible to radiation or transient effects. Even older ICs have potential for new EMC issues since manufacturers may shrink die sizes and geometries to cost reduce older technology ICs.

SMT MLV case sizes start at 0201 and are available in multi component arrays

Either scenario can translate to the first BoM sent to purchasing being revised late in the process due to changes implemented to pass EMC regulations. A possible worst-case scenario is no PCB room for revisions, requiring a board spin and new components.

## Opportunities

Several component manufacturers have noted the changing regulations and possibility of unforeseen design performance potentially creating a nightmare scenario for purchasing groups and design engineers.

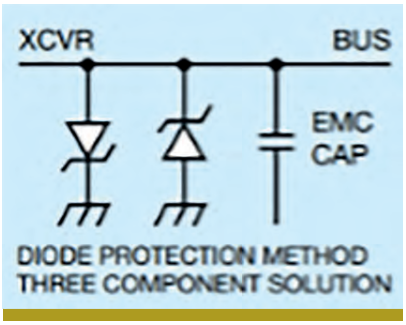
Multilayer varistors (MLVs) are a single package component with the equivalent performance of two discrete components: a capacitor and bi-directional transient voltage suppression (TVS diode). This combination lets designers achieve both EMC filtering and transient suppression without a board layout change.

MLVs have electrical advantages designers find attractive, such as a broad range of electrical characteristics, high current and transient energy capability. Quality teams find MLVs attractive since they offer increased reliability and multiple grades of certified quality performance. Board layout and manufacturing teams find MLVs attractive since two components are in a single package, saving pick and place time.

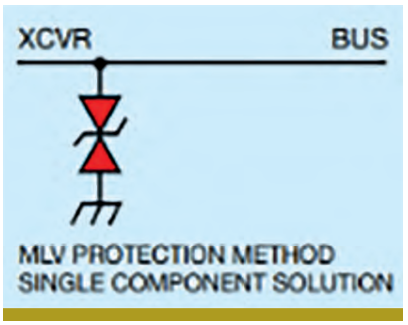
An example of before (three components) and after (one MLV) is shown opposite. The MLV can be placed on the capacitor pad and offers better electrical performance than the three components shown in the before configuration. Board space and weight is greatly reduced.

Finally, purchasing teams find MLVs to potentially be a cost reduction with multiple manufacturers and short lead times.

*www.kyocera-avx.com*




Before: two diodes, plus capacitor




Single component solution

**Generally speaking, designers know what performances are needed but those goal lines are evolving over time**

# Lean manufacturing and strategic partnerships

*NewPower Worldwide introduces the advantages of leveraging lean manufacturing techniques and strategic partnerships for sourcing automotive electronic components*

The automotive industry has entered an era of excitement, innovation and evolution, with consumer demand for emerging technology such as connectivity and electrification driving this evolving industry. A recent study revealed 48 per cent of car buyers now prioritize in-vehicle technology over traditional factors like brand name and performance. The world of cars is changing and consumers are eagerly embracing the choices that lie ahead.

However, this dynamic market comes with its own challenges. The pandemic's disruptive effects on global supply chains drove unprecedented shortages that created demand for agile, resilient supply chains. This trend is not slowing as geopolitical tensions are creating an air of regulatory uncertainty for supply chain professionals.

To meet escalating demand and navigate potential disruptions, automotive OEMs are revolutionizing their supply chains and focusing on lean methodologies and lean-minded partners. By working with suppliers who think this way, automakers are building customized programs to maintain their competitive edge.

Lean manufacturing has become essential to the automotive industry, helping automakers and suppliers stay competitive in a rapidly changing market. Fundamentally, it is based on highly flexible and efficient production through streamlined processes. Ultimately, delivering maximum value to the customer. With a customer-centric approach, OEMs learn what is and isn't valuable and deliver the best possible product with as few barriers as possible.

To bridge the gap in the microchip market, where consumer electronics manufacturers hold a 50 per cent share while automakers lag at 15 per cent, OEMs partner with lean-minded companies. These partnerships are crucial for creating custom programs tailored to the specific needs of automakers. Lean-minded partners bring valuable solutions, identifying potential threats and working together to mitigate their impact.

The advantages of collaborating with suppliers who prioritize lean principles are numerous. These partnerships provide OEMs with total control and flexibility, enabling quick adaptation to market changes. With access to global inventory visibility and 100 per cent supply assurance, automakers can make fast and efficient decisions, staying ahead of competition.

Today's auto landscape requires nimble thinking and innovative approaches to keep up with supply chain disruptions and the technology of tomorrow. If done correctly, this shift can bring a new level of efficiency and customization to consumers.

NewPower Worldwide understands the importance of lean-oriented partnership and supply chain optimization. Its expertise and dedication can help manufacturers navigate the ever-changing automotive industry.

*www.newpowerww.com*

# PROSEMI

## Premium Quality Testing
## Rapid Turnaround

Your trusted partner for electronics testing since 1998

**Our services:**

- Authenticity testing
- Electrical testing
- IC programming
- Tape and reel
- Baking

**Scan** to learn more

# Where supply chain meets value chain

*In this article, TTI business development manager, Steve Brahosky, explores what it takes for a supply chain partner to become a true value chain partner*

**TTI** business development manager, **Steve Brahosky**

An OEM is excited about a new project which includes innovative design ideas. However, several components are unavailable for months and there may be compatibility issues with integrating various parts. To compound the problems, the company's most trusted supplier rep has just retired.

Parts headaches, design hiccups and supplier hassles can turn any project into a nightmare. Instead of relying on multiple sources, unpredictable timelines and design dead ends, what if manufacturers had a primary source who could provide component design expertise, supply chain assurance and collaboration on future needs?

A value chain is defined as a series of consecutive steps that go into the creation of a finished product from initial design to arrival at a customer's door. As more companies face the challenges of supply chain disruptions, they are increasingly relying on full-service distributors that act as solutions consultants from design through delivery of components across multiple technologies and suppliers, coupling both value and supply chains. The following describes what these distributors provide.

## Available, quality parts

At a time when inauthentic and even counterfeit parts are entering the marketplace, finding a fully authorized distributor for available, reliable, high-quality components is critical. Additionally, while stocking inventory is fundamental to a distributor's value proposition, value can also be delivered by offering multiple supplier options across technologies for customer consideration.

Product availability, authenticity and multiple options provide a big advantage today when many supplier lead times are extending or unreliable. Knowing one can rely on a supply chain partner to get the right parts when needed may be a game changer.

## Design expertise

For today's technology driven projects with enhanced device, connectivity, data processing and user interface demands, literally hundreds of components are required, properly integrated in a functional design. It's not just about acquiring the parts, it's getting them to work together optimally.

Though most companies have in-house engineers, what if manufacturers had access to multiple personnel with different skills and levels of expertise who could assist from early conceptual development through the stages of design, prototyping and manufacturing, to the total satisfaction of all stakeholders? More distributors are offering this kind of product technical support to ensure optimal productivity and performance.

## An invested, trusted partner

The most effective distributors have supply chain solutions that are forward-looking, nimble and reliable. They deploy process tools constructed to provide timely, critical information so customers can plan or react accordingly. Since they know projects from their parts selections to complete function, they have inside knowledge and a vested interest in success.

These distributors become consultative partners, not just parts brokers. The results are seamless communication, greater efficiency, lower costs and enhanced overall performance.

TTI is a partner who collaborates with customers to see beyond the bill-of-materials and works with them to achieve the results they need.

*www.tti.com*

# Find the Right Part Faster


**Designed by Engineers for Engineers, our MAGPro™ DC-DC Optimizer helps you find the optimal power inductors for your converter designs quickly and easily, reducing your design cycle time.**

Coilcraft's MAGPro suite of online inductor analysis tools are designed to enable inductor selection and circuit optimization based on sound engineering principles and measured data.

The DC-DC Optimizer starts with your power converter parameters, calculates the needed inductor specifications, identifies off-the-shelf part numbers, and provides side-by-side performance analysis.

The tool identifies optimal inductors for buck, boost, and buck-boost converters. With just a few clicks you can go from $V_{IN}/V_{OUT}$ converter requirements to inductor selection complete with losses and saturation analysis, all based on verified inductor data.

Reduce your design cycle time with confidence at **www.coilcraft.com/tools.**

Coilcraft®

WWW.COILCRAFT.COM

# Semiconductor packaging: who will win the back-end wars?

*Foundries are offering advanced semiconductor packaging services in response to customer demands, setting up stiff competition with OSAT companies. It may be too early to say which group will prevail*

To the uninitiated, semiconductor packaging is the dull, unexciting, and commoditized last phase of the chip production cycle. It must be done. So fabless chipmakers and others hand it over to outsourced semiconductor assembly and test (OSAT) companies who handle the packaging, so chip manufacturers do not have to sweat the small stuff.

That was a view from the past, when semiconductor packaging—briefly defined—was simply the process of enclosing ICs in a form factor to make sure it can fit into a specific device and to guarantee its protection. Chuck aside that outdated view. Reality in the semiconductor packaging business is light years away from this simple spectacle. The world's biggest foundries, including one that is still in the embryo stage, have discovered opportunities in semiconductor packaging and are changing the face of the market. Behind the evolving state of the business is the phenomenon of advanced packaging, which is being introduced by a growing number of companies to address demands from chipmakers, according to industry executives and analysts.

"Packaging plays a critical role in enabling compute for all segments of the [technology] ecosystem, from high performance supercomputers to data in data centers to computing at the edge," said Tom Rucker, Intel Corp. vice president, technology development and director of assembly and test technology development integration, in a presentation to journalists. "The primary metrics that drive technical solutions are performance, scale, and cost. The amount of data and data transfer rates are aggressively increasing year over year. Packaging enables that transfer of data with the required speeds and excellent signal integrity."

In other words, this is no longer your grandfather's packaging environment, says McKinsey & Co., in a research paper. Advanced packaging is making all the difference in how chipmakers address their changing world, the consulting and research firm said. "Advanced packaging is helping to meet the demand for semiconductors that run emerging applications now going mainstream—for example, 5G, autonomous vehicles and other Internet of Things technologies, and virtual augmented reality," said McKinsey analysts Ondrej Burkacy, Taeyoung Kim and Inji Yeom. "These applications require high-performance [and] low-power chips that can rapidly process massive quantities of data."

Today, semiconductor packaging is chockful of innovations. As a result, competitors are locked in a raging war for dominance in a market seen growing in five years to $130 billion from the $95 billion projected for this year, according to Mordor Intelligence, a technology research firm. The factors driving extreme growth in the larger semiconductor market have also ignited growth and innovations in the packaging leg, forcing even companies that have been quiet about their efforts in the sector to speak out in a bid to demonstrate how different and unique they are. The increasing complexity of chip designs, miniaturization, advances in interconnects, system on chips (SoCs), chiplets, artificial intelligence and other innovations have resulted in packaging companies jacking up their games to meet stringent customer demands, researchers said.

"Packaging has witnessed a continuous transformation in terms of characteristics, integration, and energy efficiency of the product owing to the growing demand across various end-user verticals of the industry," Mordor analysts said. "Owing to this increasing demand, packaging has witnessed a continuous transformation in terms of characteristics, integration, and energy efficiency of the product."

Intel Corp., the world's biggest vendor of microprocessors that is also transforming into a foundry has begun showing its packaging credentials to a wider public. With companywide sales of more than $60 billion annually, Intel's packaging operation, if it were a standalone business, would be one of the industry's biggest players in the sector. As Intel begins to market its foundry operations more widely, it has also started telling the world about the capacities and innovations available within the division. One of the services Intel expects would help it stand out in the industry is packaging, according to company executives.

"In the mid-1990s, Intel led the industry in transitioning from ceramic to organic materials, significantly reducing cost and weight," Intel's Rucker said. "In 2010, we led the computer industry and combining multiple Dyna packages for volume production. This transition continues aggressively now, as we transition many product lines to our embedded silicon bridge technology. And now, we are also moving to 3D interconnects, which support stacking of die and where we can increase the die count drive to smaller geometries and get higher performance all within one package unit."

**Chiplets beyond Moore's Law**

Events outside the traditional semiconductor packaging industry are driving change within the market, as Intel's Foundry executives noted during their presentation. The term Advanced Packaging has joined the lexicon of the industry as semiconductor companies embrace renewed efforts to push the boundaries of Moore's Law. Chiplets, which is now the rage within the semiconductor industry, has also sparked innovations in the packaging business. By their nature, chiplets enable manufacturers to combine multiple smaller chips into a larger integrated circuit, breaking apart the SoC into composite functional blocks. This means manufacturers do not always have to make processors on a piece of silicon hardware with all the desired cores. The packaging of chiplets, as a result, is fundamentally different than packaging regular ICs, according to Intel.

"This is an exciting period in semiconductor packaging and

> **"Packaging plays a critical role in enabling compute for all segments of the technology ecosystem"**

**Tom Rucker,** VP technology development, director of assembly and test technology development integration, **Intel Corp.**

technology evolution," Rucker said. "Intel is transitioning from system-on-a-chip to system-on-a-package, a technical capability that has better cost structure, allows easier design reuse, [and] allows the mixing and matching of different silicon technology nodes to deliver flexible and high-performance products."

As part of its transition, Intel said it will be offering packaging services to external customers, including those whose chiplets were manufactured by competing foundries or at internally operated fabs owned by integrated device manufacturers. This means Intel foundry division will not only provide IC production services to the parent company and others, but it will also become a standalone vendor serving as an outsourced semiconductor packaging, assembly test (OSAT) services provider, according to Mark Gardner, Intel's senior director of foundry advanced packaging.

"Our first key solution as an Intel Foundry Services group is the open systems foundry where the foundation of it is really about secure supply, from geo-diversity to R&D," Gardner said. "This is true on the fab side but also on the assembly and test side. We're the most diverse assembly and test packaging company in the world in that regard."

It also means Intel will be taking on some of the world's biggest OSAT companies and even Taiwan Semiconductor Manufacturing Co. Ltd. (TSMC), the top global pureplay contractor to chipmakers. The group includes ASE Group, Amkor Technology, China's Jiangsu Changjiang Electronics Technology Co., Siliconware Precision Industries Co. Ltd., Powertech Technology Inc., and others like Samsung Electronics, Texas Instruments, and Fujitsu Ltd., companies that provide packaging services internally and occasionally to external customers. All these companies are watching events unfolding in the packaging industry and have been responding with similar innovations to stay competitive, according to analysts. TSMC, for example, has leveraged access to data from customers gathered over more than 20 years to develop some of the industry's leading and most innovative packaging offerings. The company mainly offers these services selectively to its direct semiconductor customers and has insisted always on not competing with its customers.

**Competition heats up**

Industry sources say Intel's announcement of its advanced packaging services takes direct aim at TSMC and its 3DFabric or 3D silicon stacking technology. TSMC made the initial move last year when it announced the formation of what it called the Open Innovation Platform 3DFabric Alliance. It said in a statement then that the alliance would consist of partners focused on accelerating the introduction of 3D IC ecosystem, which would facilitate the implementation of 3D silicon stacking and advanced packaging technologies. Advanced Micro Devices, Intel's main competitor in the microprocessor market, joined the TSMC alliance early and said it expected to take advantage of the opportunities offered by the foundry-led group.

"As a pioneer in both chiplets and 3D silicon stacking, AMD is excited about the introduction of TSMC's 3DFabric Alliance and the vital role it will play in accelerating system-level innovation," said AMD senior vice president of technology & product engineering Mark Fuselier, in a statement announcing the group. "We've already seen the benefits of working with TSMC and its OIP partners on the world's first TSMC-SoIC-based CPUs, and we're looking forward to collaborating even more closely to drive the development of a robust chiplet stacking ecosystem for future generations of energy-efficient, high-performance chips."

Intel is not unaware of the stir its entry into the OSAT business would create. Executives said they believe the company offers highly differentiated packaging systems, which it had used only internally but which it was now prepared to offer as a service to foundry customers. In Intel's case, the company is open to taking chiplets designed by competing foundries and do the packaging for them, they said. The customers can do the front-end design elsewhere while Intel would complete the work by doing the test and packaging, according to Gardner. "It used to be that you had to use all our manufacturing or none of it," Gardner said. "This time around, we are flexible. We can take silicon from a third party that is not Intel foundry, do all the packaging, assembly and test and then send it back. That makes us basically foundry agnostic."

How will the rest of the industry react to the growing presence and strength of foundries in the OSAT market? This is a challenge the companies anticipated, according to analysts. As the need for packaging, test and assembly services grew, it was inevitable that companies that were previously focused on basic semiconductor production would enter the OSAT business, they said. In addition, changing technology requirements as well as customers' need for one-stop shopping options forced foundries like TSMC to increase their packaging services. This trend will likely continue, forcing traditional OSAT companies to fight to retain market share, observers said.

"In order to meet the demand for continuous miniaturization and functional diversification of electronic products, the demand for chip integration is growing by the day," said Mordor Intelligence, in its report. "Not only is the process side improving chip circuit resolution, but it is also achieving higher-density circuit layouts to reduce product volume. The continuous evolution of packaging technology is also a big help, and the performance of packaging materials will be one of the main points of focus."

OSAT companies are actively raising their offerings too. Amkor, for instance, has been offering system in package (SiP) services, which the company says has been popular with its customers because they offer the double advantages of higher levels of integration and lower costs. The company has also been teaming up with customers to widen its footprint. Earlier this year, Amkor and GlobalFoundries formed a partnership to serve the European Union semiconductor supply chain in Porto, Portugal. The project was part of efforts to strengthen the electronics supply chain in Europe, the companies said.

# Rising demand drives current trends in EV components

*As the EV market emerges from major supply chain disruptions, demand is strong for power components and microcontrollers/ microprocessors. However, some shortages loom*

Analysts are optimistic that 2023 will wrap as a growth year for the EV industry. Demand for two major component families, power and MCUs/ MPUs, is on the rise.

Power electronic components play a key role in converting the battery's DC voltage into the AC voltage necessary to drive the electric motor. These inverters, together with AC/DC converters for onboard charging and various DC/ DC converters, rely on power semiconductors.

Examples are IGBTs, silicon power transistors, MOSFETs and SiC/GaN power devices. All have been in short supply since 2020 and remain the most constrained in the power stage portfolio. Many chip makers have announced plans to expand production and are looking to make long-term deals with ecosystem partners. For OEMs, distributors can be critical partners in helping navigate this shortage.

There is also a growing need for passive components and interconnect that can withstand the high voltages and power that need to be specially modified for EV power trains.

Considered the heart of an EV, the battery pack comprises numerous lithium-ion battery cells. Lithium is quite a rare element, although not technically a 'rare earth metal' as it is sometimes described. It's the most significant element in most rechargeable batteries, whether they're used in EVs or smartphones.

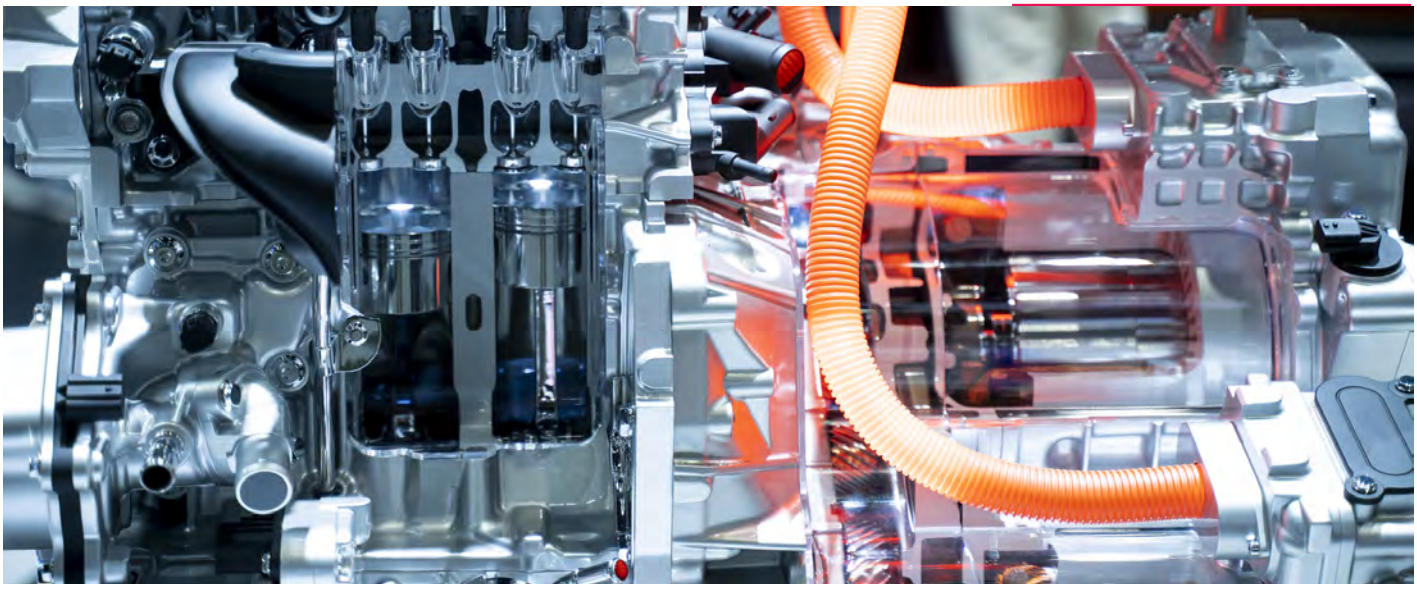
According to commodities price reporting agency Fastmarkets, EVs are likely to account for 73 per cent of all lithium demand. The firm expects 28 per cent year-on-year demand growth for lithium in 2023 and a further 24 per cent growth in 2024.

According to the US Geological Survey, Nevada is the only state to extract lithium and the US has access to just 3.6 per cent of global reserves. China has a lot more and analyst Wood Mackenzie estimates the country has 75 per cent of the world's lithium-ion battery manufacturing capacity. Argentina, Australia and Chile also have large lithium reserves.

Boston Consulting Group forecasts a lithium supply shortfall by 2030 and warns companies across the battery value chain must mobilize now to boost supplies and diversify their supply chains. In the short term, there seems to be plenty of lithium. Its price dropped dramatically earlier this year, but the EV industry and OEMs need to plan for longer-term potential shortages.

MCUs are ubiquitous in today's cars. More than 50 can be found in high-end models. They're used in infotainment and control systems with applications encompassing touchscreens, navigation systems, climate control,

SiC and GaN power devices, used to drive EV motors, are the most constrained components



connectivity features and advanced driver assistance systems.

In EVs, MCUs are also used in monitoring and managing the battery pack via the battery management system. This continuously monitors individual battery cells within the pack, ensuring their optimal performance, balancing their charge levels and safeguarding their overall health and longevity. They're also central to the vehicle's thermal management systems which regulate the temperatures of critical components such as the battery, power electronics and electric motor. They incorporate cooling fans, radiators and liquid-cooling systems to maintain ideal operating conditions.

Although the supply chains for automotive MCUs have been stabilizing, rapid growth in EV sales led to some shortages, particularly for high-end 32-bit MCUs. Compared with 8-bit and 16-bit parts, 32-bit MCUs are the dominant type in automotive applications. As higher-performance parts, 32-bit MCUs tend to be manufactured using more advanced process nodes, sometimes down to 22nm. This limits the choice of foundries for MCU makers and represents an additional supply chain risk.

Estimates say TSMC makes approximately 70 per cent of MCUs used in automotive applications. Based in Taiwan, the company also has wholly owned subsidiaries in the US, Japan and China. It has invested some $40 million in US fabs over the past two years, in part to mitigate its own geo-political risks.

Research And Markets points to one factor that may curb future demand for discrete automotive MCUs. There's a tendency to move toward more centralized controller architectures that use high-performance systems-on-chip (SoCs) to tackle increased functional complexity. Many MCU functions may be implemented within these SoCs, which will also feature new memory architectures and growing AI capabilities. While MCU vendors seek to differentiate their products, OEMs are establishing closer ties with them to drive chip standardization and greater supply chain security.

EV component supply chains have improved significantly in the last year, and it looks like the trend will continue at least through 2024. Shortages loom for wide-bandgap power components and 32-bit MCUs. Predicting further out is tough, but an understanding of industry structures for both components and the raw materials can help component buyers navigate a path forward. Ecosystem partnership will become more critical as companies endeavour to meet market demand.

*www.avnet.com*

**EV component supply chains have improved significantly in the last year, and it looks like the trend will continue at least through 2024**


MCUs are ubiquitous in EVs. There are some shortages of 32-bit MCUs

# Motoring toward the future, a look at EV charging

*Sager Electronics' technical support manager for power, Don Baldwin, summarizes EV charger growth opportunities and the component groups supporting charger manufacturing*

**Sager Electronics'** technical support manager for power, **Don Baldwin**

Across the globe, the electric vehicle (EV) market is experiencing significant growth. Stricter emissions regulations, declining battery costs, automotive manufacturer investment and increased government adoption are some factors driving upward trajectory and expansion.

In 2021, the US government enacted legislation on its 2050 net-zero emissions path by investing $7.5 billion in EV charging, $10 billion in clean transportation and over $7 billion in EV battery components and other materials. These investments are intended to support dozens of federal initiatives designed to drive US manufacturing while creating an EV charging network nation-wide.

The expansion of the EV charging network—including charging stations, fast-charging networks and home charging solutions—is essential for growth. As of 2020, there were two million EVs operating in the US. This number is expected to reach eighteen million in ten years. At that growth rate, a charger would be required for every 1.38 vehicles with charging stations located every fifty miles. Toward this goal, this past February, new standards were announced by the current administration pushing for the manufacture and installation of 500,000 made-in-USA EV chargers across the country by 2030—an effort that would further propel EV sales.

An EV charging station comprises electronic components that work together to facilitate the charging process including:

AC/DC conversion: Fast charging stations convert alternating current (AC) from the power source to direct current (DC) needed to charge the EV's battery. This conversion is performed by an AC/DC converter or rectifier.

Charger controller: Manages the charging process, including governing the power output, monitoring battery state and maintaining safety protocols. It communicates with the EV to determine the appropriate charging rate and duration.

Connectors and cables: Charging stations are equipped with cables and connectors that physically link the station to the EV. Common connector types include Type 1 (J1772), Tesla, and CCS (Combined Charging System).

Communication and data connectivity: Charging stations often include communication interfaces such as RFID (radio frequency identification), cellular networks, Bluetooth or WiFi to interact with the EV and transmit energy consumed during charging data, statistics and analytics to network operators, service providers or vehicle owners.

Safety features: EV charging stations incorporate safety mechanisms such as ground fault, surge, overcurrent and short-circuit protections to guard against electrical faults and ensure user safety.

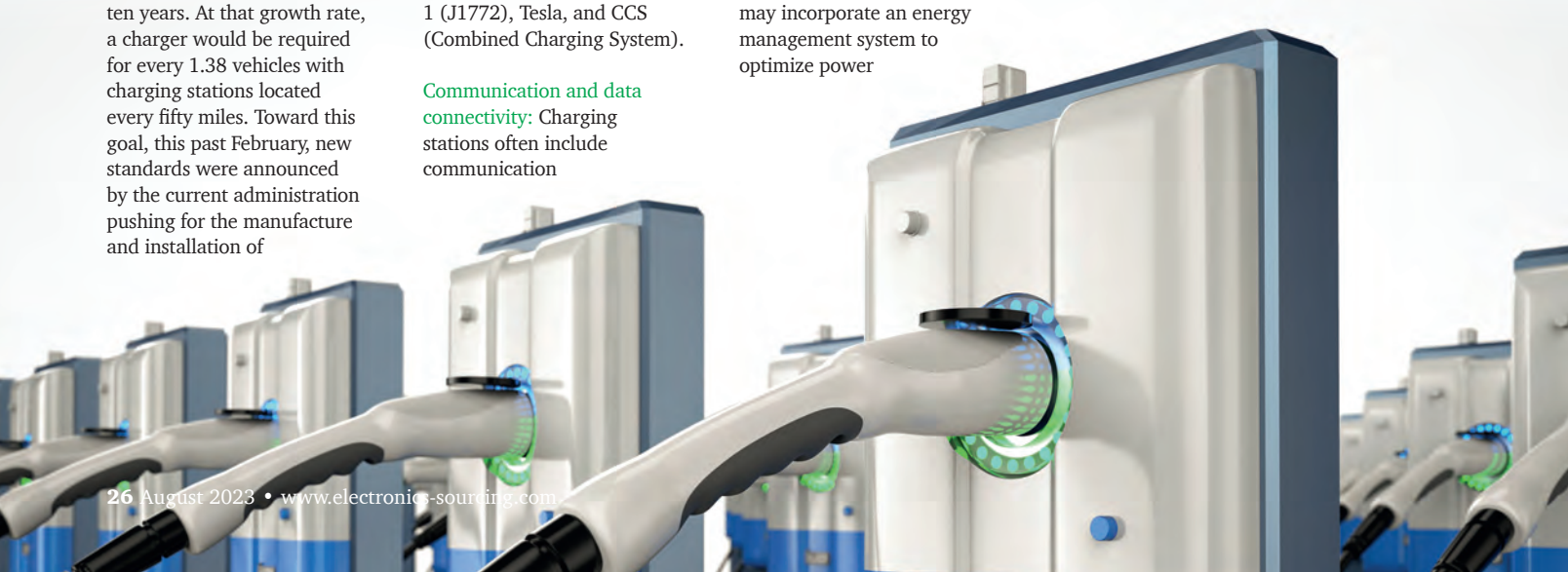
Thermal management: While lower-level charging doesn't generate a significant amount of heat, Level 3 components get extremely hot, requiring an air or liquid cooling solution.

Display and user interface: Charging stations often have a user interface which may include a display for charging status, user authentication inputs and user-friendly instructions.

Energy management system: Advanced charging stations may incorporate an energy management system to optimize power consumption, load balancing and integration with renewable energy sources.

As the global and local shift towards reducing emissions and combatting climate change continues to push the EV market forward, it is important to consider the quality, reliability, efficiency and compatibility of the component requirements when sourcing product for an EV charger application.

*www.sager.com*



# EV charging: sourcing automotive components

*DigiKey technical content developer, Nick Westra, takes a look at the automotive electronics component supply chain, past, present and future*

**DigiKey** technical content developer, **Nick Westra**

As the broad electronic market recovers after years of supply chain disruptions, some segments remain under stress, including automotive. Growth of electric vehicles and charging infrastructure is only increasing demand for components and strict requirements will further restrict supply. Fortunately, there are signs of improvement with changes to component supply.

The largest roadblocks to automotive IC availability are the numerous standards and requirements each component and manufacturer must meet to ensure quality. Consumer grade components don't suit harsh driving conditions. Even for charging station infrastructure, safety factors and power handling requirements make these a rare class of component.

Also impacting component availability are standards like AEC-Q100 for specifying component level testing and requirements, ISO 26262 for vehicle electrical systems functional safety ratings and process management standards like IATF 16949 for setting quality control management for manufacturing processes.

Multiple challenges facing automotive component buyers include stock shortages, part obsolescence and decreased manufacturing priorities—difficulties rarely faced before. Buyers can improve their supply chain resilience and avoid common pitfalls sourcing components. The first step is simply ensuring required components are available by keeping stock, whether holding excess inventory or contracting directly with manufacturers. Another step is ensuring there is a second source for critical components to allow for disruptions with one supplier.

Although this paints a somewhat bleak picture of increasing demand and shrinking supply there are signs of hope. Lead times for automotive grade electronics are generally improving as the demand for devices lessen and pandemic restrictions roll back. The passage of the CHIPS and Science Act of 2022 also encourages and helps promote semiconductor manufacturing in the United States. Most semiconductor manufacturing executives are optimistic component shortages will improve by the end of 2023 and normal supply of ICs will be available.

While there are still strong headwinds there are also signs of a bright future. Rising demand for electric powertrains and charging infrastructure promises increasing component demand. The Semiconductor Industry Association (SIA) recently announced that global sales of semiconductor products in 2022 had increased by 3.3 per cent compared to 2021, with the automotive IC segment growing by 29.1 per cent in 2022 to a record total of $34.1 billion in sales. While none of these measures promise immediate relief to part shortages and delays, they do indicate the market will be more vibrant in coming days.

*www.digikey.com*

# Anticipating EV component supply and demand trends

*A2 Global explains how EV manufacturers can mobilize quickly to secure the electronic components they need and mitigate risk in the face of market uncertainty*

**A2 Global Electronics'** CEO, **Frank Cavallaro**

After a record breaking 2022 for electric vehicle (EV) sales, 2023 is poised to see 35 per cent growth. At the Covid-era's peak chip shortage, these numbers would have been nearly impossible for chip manufacturers to meet. Over the last three years, manufacturers have been working to satisfy known demand forecasts created by consumer demand, plus federal calls for sustainability in infrastructure and pledges from automakers to have fully electric fleets over the next five years.

Currently, supply can satisfy known demand, save a few long-lead/constrained components. However, the market is delicate and situations can push this balance into a shortage. To avoid pain points, EV OEMs must develop strong sourcing strategies to ensure access to required components.

### Scenarios impacting supply and demand

Despite a few, highly specific components on long-lead times, the supply/demand structure for EV components is stable. Manufacturers can satisfy known demand and there is no significant increase in demand to force a pivot of a fabrication plant's resources. However, two situations can change this.

First is a hiccup in chip production. Chip manufacturers have limited production dedicated to producing EV components and would not be able to pull from other resources to compensate while still fulfilling demand for other industries. Examples include manufacturing difficulties, a sudden natural disaster or pandemic forcing a cessation of work.

Secondly, EV manufacturers' forecasted demand may be less than the actual demand for EVs. Although theoretically good news for EV makers, it is not so good for their supply chain professionals who will be scrambling to find semiconductors to fulfill new, under forecasted vehicle orders.

In either situation, it would be challenging to increase production capacity despite new global investment in chip production. Though the US and EU CHIPS Acts offer a promising future for component production capacity, they would offer no relief for a sudden shortage that EV OEMs may face. There are three reasons for this.

Fab construction time: Fabs are difficult and time consuming to build and would not be online and operating quickly enough to have immediate impact during a sudden shortage.

Long lead times planning new vehicle models: EV design periods can run five to seven-years before a new model becomes commercially available, so fabs will have to dedicate a substantial portion of their capacity to meet long-term demand rather than current needs.

Profit potential: To earn back the cost of fab production, component manufacturers prioritize production of chips with the highest margins. This typically means cutting-edge technology. However, if another industry has higher profit potential the cutting-edge technology and specific node production will pivot away from EVs. This leaves EV manufacturers in the same, constrained position as they started.

### What can EV manufacturers do now?

EV manufacturers cannot afford to be complacent during stable market periods. To ensure they are insulated during future, sudden disruptions, they must have a sound sourcing strategy which includes:

Building a supplier network: Supply chains have become more interconnected. Building a network of resilient suppliers (globally and close to base) gives EV manufacturers options when shortages arise and lowers the risk of disruption if an unexpected event occurs where the bulk of their components are produced.

Developing a short reaction time: Shortening reaction time by recognizing supply chain disruptions and adapting quickly, rather than waiting for it to build, is critical to a resilient supply chain strategy.

Purchasing safety stock: Purchasing extra inventory ahead of time can be challenging and costly, but when planned correctly, safety stock can significantly enhance supply chain resilience and prepare EV OEMs for the next shortage market. Despite the cost, it may make sense to purchase safety stock for the most critical or high-risk components.

Leveraging advanced analytics: Choosing reliable, up-to-date sources for market forecast information and consulting with multiple players in the industry—partners, suppliers, customers, and even competitors—helps gain a holistic approach.

*www.a2globalelectronics.com*

**To avoid pain points, EV OEMs must develop strong sourcing strategies to ensure access to required components**

**Automotive** • By John Denslinger

# *Greater EV adoption requires more innovation*

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

***John Denslinger discusses five key areas of innovation opportunity if the electrification of the US vehicle fleet is to match the expectations of consumers, manufacturers and government***

A March 2023 Gallup poll found four per cent of Americans currently own an electric vehicle, 12 per cent are seriously considering buying one, 43 per cent might consider it in the future and 41 per cent would not buy one. This is now, despite an onslaught of media hype, federal subsidies, state mandated conversion deadlines and environmental evangelism pushing EV adoption.

Nevertheless, sales of EV and plug-in hybrids are growing, albeit slowly. At the current rate, the US will surpass 1M units sold in 2023 but that figure remains less than 10 per cent of new car sales. Reaching the administration's target of 50 per cent EV market share in 2030 seems quite ambitious without plenty of breakthroughs. Seven years is not a lot of time to change perceptions.

The average consumer understands the need to move forward with electrification. At the same time, their pocketbook seeks greater assurances and more innovation. Consider the following:

Perceived cost: In May the average price for a new EV was $55,488 vs a similar combustion engine car at $48,528 according to Cox Automotive. Batteries are the most expensive component, so battery innovation is the focus. Investigations into lithium sulfur and sodium ion alternatives could reduce overall battery material costs by up to 60 per cent but there are substantial technological issues. Sulfur tends to corrode quickly, while sodium lacks the same energy storage capacity as lithium ion.

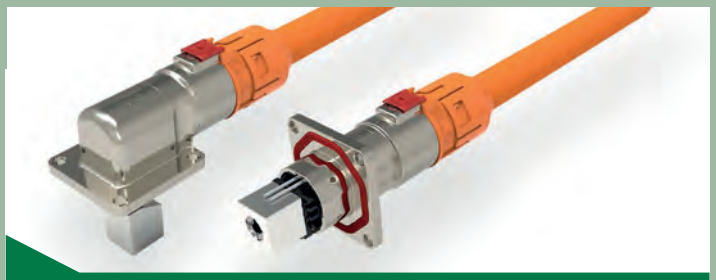
Range anxiety: A stat by Mobility Monitor suggests 40 per cent of potential EV buyers worry about the ability to charge their car on the road. It might be an unnecessary fear as the average US driver travels less than 40 miles/day. The top five longest EV ranges available today vary between 350 and 450 miles. Weather conditions affect range. Innovation in battery efficiency and further reducing weight/size, are keys to longer ranges.

Charging times: Base-line expectation is the gas pump. EV charging is not better, faster, cheaper. A June 2023 WSJ article identified the government's current definition of fast charging at 15-40 minutes. Innovation needs to focus on 10 minutes or less charge time. Toyota is working on a solid-state battery with 750-mile range and 10-minute charge time, planned for 2027.

Charging access: There are an estimated 126,000 Level 2, 20,000 Level 3 and 17,000 Tesla Supercharger public charging ports in the US. If the goal is 50 per cent EV market share by 2030, McKinsey & Company estimates a need for 1.2M public and 28M private charging stations. To date, the administration has dedicated just $7.5B for 500,000 EV charging stations. That is a substantial disconnect in capacity.

Grid reliability: While not specific to EV, consumers worry about the overall reliability of the electrical grid itself. The DOE's Building a Better Grid initiative dated January 2022 cites a need to expand electricity transmission systems by 60 per cent by 2030 and triple that again by 2050 with full electrification of society, but noticeably absent is a national electricity generation plan by source, by year, that fully supports the 2050 electrification goals.

Consumers have reason to be cautious, but innovation can remove the uncertainty. Innovation is the pathway to greater EV adoption.



## Easier vehicle electrification

TE Connectivity has developed Hivonex connector and charging solutions to help enable a seamless transition into the next generation of e-mobility. The portfolio provides a one-stop shop of modular, scalable products designed to withstand the harsh environments industrial and commercial vehicles operate in and includes the new PowerTube connector series for handling large electrical loads found in EVs.

TE's director of product management for the e-mobility product portfolio, Sebastien Dupre, said: "TE's Hivonex connector and charging products are designed to enable our customers' vehicle designs to be relied upon in extreme environments– empowering safe connectivity, supreme scalability and high voltages of power for those operating in the field."

The PowerTube connector series is comprised of modular and scalable connectors designed to handle large electrical loads. These connectors are manufactured to adapt to various designs and hold up to intense environmental demands.

*www.te.com*

## Improving switching power supply efficiency

Bel Fuse is expanding its line of EOS power supplies with the EPG300 and EPG500 series AC/DC power supplies based on new, efficient gallium nitride technology design.

The supplies accommodate a universal input voltage of 90 to 264VAC, delivering up to 300W and 500W of output power with forced air cooling. The supplies are available in six single output voltages ranging from 12 to 58V. Both can be used in a range of space constrained applications where minimal power loss and easy thermal management are required.

RoHS compliant and CE marked, the supplies are safety agency certified and meet the latest regulatory requirements. They fit traditional open frame power supply uses in situations where improved power density and increased power is needed. The benefits in tougher thermal environments suit these products to RF applications, 5G systems, industrial process control, automation/ monitoring, modern digital signage and video walls.

*www.belfuse.com*

## Enclosures now with flat or sloping front panels

Metcase's premium Technomet desktop/portable instrument enclosures can now be specified with or without a sloping front for easier viewing. The enclosures suit applications in medical/ wellness, industrial control, test/measurement, peripheral devices, interfaces, switchboxes, communications and laboratory equipment.

Diecast aluminum bezels front and rear fit flush with the main case body. Snap-on trims hide the case and front panel fixing screws. The anodized front panel (accessory) and removable rear panel are both recessed to protect keypads, displays, connectors and switches.

The internal chassis is pre-punched for three, five, seven or nine PCB guide rails. Circuit boards slide in and out for quick and easy installation, inspection and maintenance. There are four M3 PCB mounting pillars in the base. All case panels are fitted with M4 threaded pillars for earth connections.

Technomet is available in 11 sizes from 8.86 by 7.87 by 2.95in to 13.78 by 12.60 by 5.91in. Eight sizes can be specified with a bail arm as standard, enabling users to select the perfect viewing angle.

*www.metcaseusa.com*

## Drop-in encoder replacement

Bourns has released the PEC11J series encoder as a drop-in replacement for the discontinued Alps model EC11J series. This modified configuration of the Bourns PEC11S series should enable customers to continue to support existing applications with no changes to their mechanical or electrical layouts. Testing is recommended to ensure compatibility.

Bourns' PEC11J series encoders feature an IP40 rating, 100,000 rotational cycle rating and -10 to 70°C operating temperature range in a rugged, compact surface mount design. The encoders also offer an optional momentary switch function with standard and high actuation force capabilities that allow ease of adaptation to application-specific needs and different environments.

These features and capabilities suit this product to a wide range of applications including professional audio equipment and lighting consoles, white goods, test and measurement equipment and industrial automation controls.

*www.bourns.com*

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **CABLE & WIRING** | | | | | | | | | | | |
| 3M | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 23,235 | N/A | $0 | 0.46 | 50 | 1,000+ | Y |
| Alpha Wire | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 8,106 | N/A | $0 | 93% | 50 | 1,000+ | Y |
| Belden Wire & Cable | Mouser Electronics | 800-346-6874 | www.mouser.com | Y | 5,863 | N/A | $0 | 97% | 50 | 1,000+ | Y |
| Molex | ECCO | 773-767-2200 | www.eccoconnectors.com | Y | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Molex | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| TE Connectivity | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| **CIRCUIT PROTECTION** | | | | | | | | | | | |
| Bel Fuse | | +1 201 432 0463 | belfuse.com/circuit-protection | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Bourns | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 4,462 | N/A | $0 | 68% | 50 | 1,000+ | Y |
| Eaton | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| EPCOS | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 3,487 | N/A | $0 | 100% | 50 | 1,000+ | Y |
| KYOCERA AVX | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50+ | 1,000+ | Y |
| KYOCERA AVX | Digi-Key | 800-344-4539 | www.digikey.com | Y | N/A | N/A | $0 | N/A | 50+ | 1,000+ | Y |
| Littelfuse | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 28,790 | N/A | $0 | 67% | 50 | 1,000+ | Y |
| Schurter | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Vishay | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 31,445 | N/A | $0 | 68% | 50 | 1,000+ | Y |
| **DISPLAYS & LEDs** | | | | | | | | | | | |
| BIVAR | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Broadcom | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Cree LED | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 12,390 | N/A | $0 | 99% | 50 | 1,000+ | Y |
| Dialight | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 6,179 | N/A | $0 | 84% | 50 | 1,000+ | Y |
| Displaytech | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Hantronics | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Kingbright Company, LLC | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 301 | N/A | $0 | 100% | 50 | 1,000+ | Y |
| Lumileds | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Luminus | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Newhaven Display | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| ams OSRAM | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 1,690 | N/A | $0 | 100% | 50 | 1,000+ | Y |
| Tianma | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| **ELECTROMECHANICAL** | | | | | | | | | | | |
| ALPS | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Apem, Inc. | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 4,326 | N/A | $0 | 83% | 50 | 1,000+ | Y |
| E-Switch | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Grayhill | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Honeywell | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Keystone Electronics | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Littelfuse | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Nidec | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| NKK Switches | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 13,976 | N/A | $0 | 86% | 50 | 1,000+ | Y |
| Omron | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |

## Advert Index

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **CABLE & WIRING** | | | | | | | | | | | |
| 3M | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 23,235 | N/A | $0 | 0.46 | 50 | 1,000+ | Y |
| Alpha Wire | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 8,106 | N/A | $0 | 93% | 50 | 1,000+ | Y |
| Belden Wire & Cable | Mouser Electronics | 800-346-6874 | www.mouser.com | Y | 5,863 | N/A | $0 | 97% | 50 | 1,000+ | Y |
| Molex | ECCO | 773-767-2200 | www.eccoconnectors.com | Y | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Molex | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| TE Connectivity | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| **CIRCUIT PROTECTION** | | | | | | | | | | | |
| Bel Fuse | | +1 201 432 0463 | belfuse.com/circuit-protection | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Bourns | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 4,462 | N/A | $0 | 68% | 50 | 1,000+ | Y |
| Eaton | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| EPCOS | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 3,487 | N/A | $0 | 100% | 50 | 1,000+ | Y |
| KYOCERA AVX | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50+ | 1,000+ | Y |
| KYOCERA AVX | Digi-Key | 800-344-4539 | www.digikey.com | Y | N/A | N/A | $0 | N/A | 50+ | 1,000+ | Y |
| Littelfuse | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 28,790 | N/A | $0 | 67% | 50 | 1,000+ | Y |
| Schurter | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Vishay | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 31,445 | N/A | $0 | 68% | 50 | 1,000+ | Y |
| **DISPLAYS & LEDs** | | | | | | | | | | | |
| BIVAR | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Broadcom | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Cree LED | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 12,390 | N/A | $0 | 99% | 50 | 1,000+ | Y |
| Dialight | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 6,179 | N/A | $0 | 84% | 50 | 1,000+ | Y |
| Displaytech | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Hantronics | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Kingbright Company, LLC | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 301 | N/A | $0 | 100% | 50 | 1,000+ | Y |
| Lumileds | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Luminus | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Newhaven Display | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| ams OSRAM | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 1,690 | N/A | $0 | 100% | 50 | 1,000+ | Y |
| Tianma | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| **ELECTROMECHANICAL** | | | | | | | | | | | |
| ALPS | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Apem, Inc. | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 4,326 | N/A | $0 | 83% | 50 | 1,000+ | Y |
| E-Switch | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Grayhill | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Honeywell | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Keystone Electronics | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Littelfuse | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Nidec | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| NKK Switches | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 13,976 | N/A | $0 | 86% | 50 | 1,000+ | Y |
| Omron | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Panasonic | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Phoenix Contact | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| PUI Audio | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Schneider Electric | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Sensata | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| TE Connectivity | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Teledyne Relays | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| **ENCLOSURES** | | | | | | | | | | | |
| Bud | ECCO | 773-767-2200 | www.eccoconnectors.com | Y | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Bud Industries | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 1,325 | N/A | $0 | 80% | 50 | 1,000+ | Y |
| Hammond Manufacturing | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 2,839 | N/A | $0 | 82% | 50 | 1,000+ | Y |
| METCASE Enclosures | OKW Enclosures, Inc. | (800) 965-9872 | www.metcaseusa.com | | 322 | N/A | $0 | N/A | 10 | 20 | Y |
| New Age Enclosures | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| OKW Gehäusesysteme GmbH | OKW Enclosures, Inc. | (800) 965-9872 | www.okwenclosures.com | | 2,450 | N/A | $0 | N/A | 10 | 20 | Y |
| ROLEC Gehäuse-Systeme GmbH | ROLEC Enclosures Inc | (888) 658-5774 | www.rolec-usa.com | | 1,960 | N/A | $0 | N/A | 4 | 6 | Y |
| **FREQUENCY MANAGEMENT** | | | | | | | | | | | |
| Abracon Corporation | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 1,780 | N/A | $0 | 100% | 50 | 1,000+ | Y |
| CTS Electronic Components | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 3,889 | N/A | $0 | 100% | 50 | 1,000+ | Y |
| ECS Inc | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 2,070 | N/A | $0 | 100% | 50 | 1,000+ | Y |
| Epson Toyocom | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 178 | N/A | $0 | 100% | 50 | 1,000+ | Y |
| IQD Frequency Products | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| KYOCERA AVX | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50+ | 1,000+ | Y |
| KYOCERA AVX | Digi-Key | 800-344-4539 | www.digikey.com | Y | N/A | N/A | $0 | N/A | 50+ | 1,000+ | Y |

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SiTime | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| **ICs & SEMICONDUCTORS** | | | | | | | | | | | |
| Analog Devices, Inc | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 18,749 | N/A | $0 | 95% | 50 | 1,000+ | Y |
| Broadcom Limited | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Central Semiconductor | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Central Semiconductor Corp. | Future Electronics | (800) 675-1619 | www.futureelectronics.com | Y | N/A | N/A | N/A | N/A | N/A | N/A | Y |
| Digi International | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Diodes Incorporated | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| FTDI Chip | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 94 | N/A | $0 | 100% | 50 | 1,000+ | Y |
| Infineon | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 1,580 | N/A | $0 | 63% | 50 | 1,000+ | Y |
| Intel | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| ISSI | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Lattice | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Littelfuse | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| MACOM | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Maxim Integrated | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Microchip | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 5,800 | N/A | $0 | 100% | 50 | 1,000+ | Y |
| Monolithic Power Systems (MPS) | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Nexperia | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| NXP | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 7,205 | N/A | $0 | 100% | 50 | 1,000+ | Y |
| onsemi | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 7,486 | N/A | $0 | 96% | 50 | 1,000+ | Y |
| Power Integrations | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Qorvo | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Renesas Electronics | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| ROHM Semiconductor | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Silicon Laboratories Inc | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 1,141 | N/A | $0 | 100% | 50 | 1,000+ | Y |
| Skyworks | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| ST Microelectronics | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 8,145 | N/A | $0 | 96% | 50 | 1,000+ | Y |
| Swissbit | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Texas Instruments | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 29,676 | N/A | $0 | 94% | 50 | 1,000+ | Y |
| Toshiba | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 800 | N/A | N/A | N/A | N/A | N/A | Y |
| Vishay | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 53,781 | N/A | $0 | 77% | 50 | 1,000+ | Y |
| Wolfspeed | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 53,781 | N/A | $0 | 77% | 50 | 1,000+ | Y |
| **INTERCONNECTION** | | | | | | | | | | | |
| Bel | | +1 858 676 9650 | belfuse.com/magnetic-solutions | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| 3M | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 23,235 | N/A | $0 | 46% | 50 | 1,000+ | Y |
| Aero Conesys | ECCO | 773-767-2200 | www.eccoconnectors.com | Y | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Amphenol | ECCO | 773-767-2200 | www.eccoconnectors.com | Y | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Amphenol | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 165,853 | N/A | $0 | 31% | 50 | 1,000+ | Y |
| Anderson Power Products | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Aptive (Delphi) | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Bel Magnetic Solutions | | +1 858 676 9650 | belfuse.com/magnetic-solutions | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Cinch | ECCO | 773-767-2200 | www.eccoconnectors.com | Y | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Cinch Connectivity/Bel | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Cinch Connectivity Solutions | | +1 507 833 8822 | belfuse.com/cinch | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Eaton | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 10,744 | N/A | $0 | 27% | 50 | 1,000+ | Y |
| ERNI Electronics | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Glenair | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Harting | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 2,160 | N/A | $0 | 51% | 50 | 1,000+ | Y |
| Harwin | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Hirose Electric | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| ITT Cannon | ECCO | 773-767-2200 | www.eccoconnectors.com | Y | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| ITT Cannon | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| JAE Electronics | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 6,02 | N/A | $0 | 100% | N/A | N/A | Y |
| JST | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| KYOCERA AVX | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50+ | 1,000+ | Y |
| KYOCERA AVX | Digi-Key | 800-344-4539 | www.digikey.com | Y | N/A | N/A | $0 | N/A | 50+ | 1,000+ | Y |
| LEMO | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Mill-Max | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Molex | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 85,634 | N/A | $0 | 89% | 50 | 1,000+ | Y |
| Neutrik | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 1,563 | N/A | $0 | 100% | 50 | 1,000+ | Y |
| NorComp | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Phoenix Contact | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 30,044 | N/A | $0 | 77% | 50 | 1,000+ | Y |
| Radiall | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Samtec | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 123,613 | N/A | $0 | 69% | 50 | 1,000+ | Y |
| Stewart Connector | | + 1 717 235 7512 | belfuse.com/stewart-connector | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Switchcraft Corporation | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 300 | N/A | $0 | 55% | 50 | 1,000+ | Y |

# 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TE Connectivity | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 123,613 | N/A | $0 | 69% | 50 | 1,000+ | Y |
| **OBSOLESCENCE / HARD TO FIND** | | | | | | | | | | | |
| | Lansdale | 602-438-0123 | lansdale.com | Y | | | | | | | |
| | Lantek Corp. | 973-579-8100 | www.lantekcorp.com | M | 186,000 | $22M | $0 | 75.00% | 5 | 62 | Y |
| | Rochester Electronics | 978-462-9332 | www.rocelec.com | Y | | N/A | $250 | | 10 | 400+ | Y |
| **OPTO ELECTRONICS** | | | | | | | | | | | |
| Broadcom | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Cree LED | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 582 | N/A | $0 | 99% | 50 | 1,000+ | Y |
| Finisar | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| ams OSRAM | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 1,927 | N/A | $0 | 99% | 50 | 1,000+ | Y |
| ROHM Semiconductor | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Vishay | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| **PASSIVES** | | | | | | | | | | | |
| ABRACON | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Bourns | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 38 | N/A | $0 | 78% | 50 | 1,000+ | Y |
| Cornell Dubilier | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 24,145 | N/A | $0 | 71% | 50 | 1,000+ | Y |
| Coilcraft | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| EPCOS | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 26,533 | N/A | $0 | 98% | 50 | 1,000+ | Y |
| Fair-Rite | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| KEMET | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 77,568 | N/A | $0 | 66% | 50 | 1,000+ | Y |
| KOA Speer | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 34,078 | N/A | $0 | 58% | 50 | 1,000+ | Y |
| KYOCERA AVX | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50+ | 1,000+ | Y |
| KYOCERA AVX | Digi-Key | 800-344-4539 | www.digikey.com | Y | N/A | N/A | $0 | N/A | 50+ | 1,000+ | Y |
| Murata | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 33,780 | N/A | $0 | 99% | 50 | 1,000+ | Y |
| Nichicon | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 20,389 | N/A | $0 | 84% | 50 | 1,000+ | Y |
| Ohmite | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 14,293 | N/A | $0 | 55% | 50 | 1,000+ | Y |
| Panasonic Electronic Components | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 14,948 | N/A | $0 | 100% | 50 | 1,000+ | Y |
| Signal Transformer | | +1 516 239 5777 | belfuse.com/signal | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Taiyo Yuden | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 4,620 | N/A | $0 | 98% | 50 | 1,000+ | Y |
| TE Connectivity | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 6,663 | N/A | $0 | 100% | 50 | 1,000+ | Y |
| TDK | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 6,663 | N/A | $0 | 100% | 50 | 1,000+ | Y |
| TT Electronics | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| United Chemi-Con (UCC) | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Vishay | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 102,917 | N/A | $0 | 64% | 50 | 1,000+ | Y |
| Wurth | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 934 | N/A | $0 | 99% | 50 | 1,000+ | Y |
| Yageo Corporation | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 18,246 | N/A | $0 | 100% | 50 | 1,000+ | Y |
| **POWER & BATTERIES** | | | | | | | | | | | |
| Artesyn Embedded Technologies | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| B&K Precision | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Bel Power Solutions | | +1 866 513 2839 | belfuse.com/power-solutions | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Cincon | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Cosel | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| CUI Inc. | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Delta Electronics | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| MEAN WELL | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Murata | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Phihong | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Phoenix Contact | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| RECOM | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Schaffner | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| SL Power | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Texas Instruments | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| TDK Lambda | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | 405 | N/A | $0 | 80% | N/A | N/A | Y |
| TRACO Power | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |
| Vicor | Mouser Electronics | 800-346-6873 | www.mouser.com | Y | N/A | N/A | $0 | N/A | 50 | 1,000+ | Y |

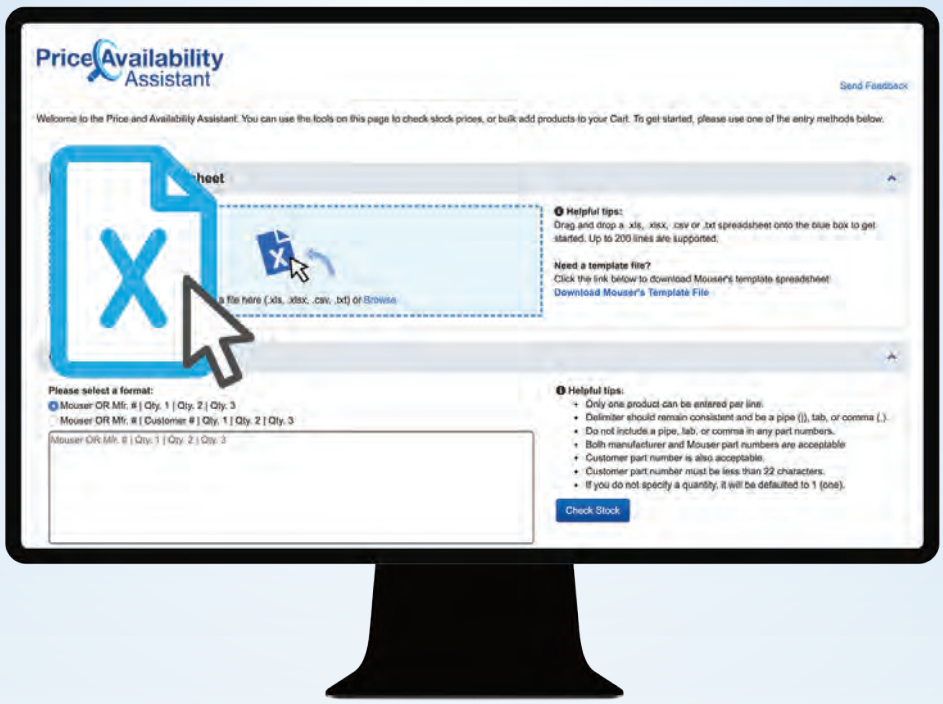
# Contract Manufacturers Buyers' Guide

| Manufacturer | Telephone | Website | Turnover | Location | Employees | Number of Surface Mount Lines | Approvals | BGA Capacity | Lead Free Manufacturer | Prototyping | Design Capability | Full Turnkey | Cables and Harnessing |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alan Anderson Manufacturing Ltd | +44 (0) 333 322 7222 | www.aa-manufacturing.co.uk | £21m | Hertfordshire UK | 40 | 2 | ISO9001:2015 , IPC-A-610 | Y | Y | Y | Y | Y | Y |
| Pektron | 1-248-677-4838 | www.pektron.com | $66m | Michigan & UK | 350 | 8 | ISO9001, ISO14001, TS16949, BEAB, VCA, TUV, UL | Y | Y | Y | Y | Y | Y |

# Easily check price and availability for every part you need

Price Availability Assistant

STOCK • PRICE • BUY




mouser.com/price-availability-assistant

MOUSER ELECTRONICS