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## On the cover – October 2018

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## Buyers' Guide

*All the facts and figures to help you buy*

## Editor's Word



### Great British make off

I'm going to make a bold statement. I think my newest 3D printer, an original Prusa i3 Mk3, is as easy to operate as any domestic appliance. Turn it on, let the self-calibration run, print. Add its compact size (it would easily fit in a standard kitchen unit) and almost silent operation, and I don't think it will be long before kitchen planners are offering 3D printers as a contemporary option.

Kitchens are used to make food, so I see no reason why they can't also be used to make things.

Imagine if every kitchen, in every UK household, was operating as a micro mechanical manufacturing facility. It doesn't really matter what people would make or even why they were making it. The real value is what they would learn.

I hazard a guess that many, if not all, the world's slickest inventions were the result of happy mistakes. So, imagine if the UK's 66 million population all took a few hours off their social media accounts each week and devoted the time to visualising a product in Tinkercad and then printing it. That's 66 million opportunities to learn how 'to' or just as importantly 'not' do something.

Taking it to its logical conclusion I see a TV programme called the Great British Make Off where contestants are confronted with a 'larder' of materials, a 'kitchen' of equipment and a race against time to design and manufacture an innovative product. Let's make!

Naturally I'm open to calls from TV production companies.

*Jon Barnett*

### Contact



#### EDITORIAL

**Managing Editor:** Jon Barrett  
jonb@electronics-sourcing.co.uk  
**Contributing Editor:** Amy Barker  
amyb@electronics-sourcing.co.uk  
**Editorial & Production:** Thomas Smart  
thomas.smart@electronics-sourcing.co.uk  
**Editorial & Production Assistant:** Ben Kitching  
ben.kitching@electronics-sourcing.co.uk

#### ADVERTISING

**Area Sales Executive:** Emma Poole  
emma.poole@electronics-sourcing.co.uk  
**Director of Sales:** Charlotte Morgan  
charlotte.morgan@electronics-sourcing.co.uk  
**Marketing Manager:** Amy Leary  
amy.leary@electronics-sourcing.co.uk

#### CIRCULATION

**Circulation Manager:** Vicky Leary  
vicky.leary@electronics-sourcing.co.uk  
**Circulation Account Manager:** Liz Poole  
liz.poole@electronics-sourcing.co.uk

#### DESIGN

**Graphic Designer:** Jeremy Roberts  
jeremy.roberts@electronics-sourcing.co.uk  
**Graphic Designer:** Josh Hilton  
josh.hilton@electronics-sourcing.co.uk

#### PUBLISHER

**Mark Leary**  
mark.leary@electronics-sourcing.co.uk  
**Office Manager:** Denise Pattenden  
denise.pattenden@mmgpublishing.co.uk

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# Pressures mount as global trade wars continue



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

Buyers should expect higher prices, longer lead times through the end of the year as demand remains strong and the threat of tariffs looms

Global Economy • By Victoria Kickham

**S**upply chain pressures continued into the fall, as businesses grappled with the ongoing global trade wars and impending tariff-related activity. Price increases are among the greatest concerns in the North American manufacturing sector, where raw material and component prices have been steadily increasing. As of August, the Institute for Supply Management's Prices Index had increased for the 30th straight month, for example. Although the increase had slowed somewhat compared with July, buyers across a range of industries reported paying more for a wide range of materials, including electronic components. And while pricing pressures continued to varying degrees elsewhere in the world, many organisations continue to blame tariffs—or the threat of them—for the growing cost of keeping up with business demands.

In an early September report on the manufacturing outlook in the Eurozone, economist at IHS Markit, Chris Williamson, said: "Worries about trade wars and the damaging impact of tariffs, as well as Brexit and other political worries, all contributed to a dampening of business optimism about the year ahead. On the price front, input cost pressures remained elevated, despite the rate of inflation easing to a three-month low."

IHS pointed to similar concerns in the United States, with tariffs and trade wars commonly cited as factors behind companies building safety stocks of inputs to ensure supply or lock-in lower prices, exacerbating supply shortages and also driving prices even higher. In a separate September report on the US manufacturing outlook, Williamson added: "Almost two-thirds (64 per cent) of companies reporting higher input prices explicitly blamed tariffs as the cause of increased costs. Almost one-in-three went on to cite tariffs as the cause of having to hike prices to customers."

The situation remained fluid in the electronic components industry heading into the fall. Digi-Key's president and chief operating officer, Dave Doherty, said the tariffs have not had as direct an impact on the company as he would have

expected by now and that Digi-Key will only pass along costs that touch it directly. He says he is more concerned about the growing list of end products affected by the tariffs and how that will play out among Digi-Key's customer base.

Doherty said: The full impact [of the tariffs] is yet to come, but it's clearly building. If there's a warning sign on the horizon, it is the tariffs on end products. Could [the tariffs] dampen the demand for our customers' products, then dampen the need for the electronic components required to produce their products? That's something I'm keeping an eye on."

As of early September, the United States had threatened to impose another round of tariffs on \$200 billion worth of Chinese goods, with China threatening reciprocal moves.

Avnet's global president, electronic components, Phil Gallagher, agrees that the tariff situation remains a moving target. Over the summer Phil said: "We're deciphering a lot right now," adding that, like others, Avnet will pass the cost of tariffs through to the customer. Phil added: "So far, the industry is navigating through it. We'll get through it. We always do."

Despite pricing concerns, buyers in the manufacturing community agree that business remains strong and is likely to continue on that path into 2019. Buyers surveyed for ISM's monthly *Report on Business*, for instance, continued to cite an increase in new orders and production levels throughout the summer, and also noted low unemployment levels across the industry. Such strong demand is affecting the channel's ability to keep supply lines flowing—another situation suppliers and distributors say they expect will continue into 2019.

Doherty said: "We're still seeing [that] lead times are not coming back in at all. Our suppliers are saying it will be [the first or second quarter of 2019]. Our customers should be cautious that there's still strong demand in the market overall."

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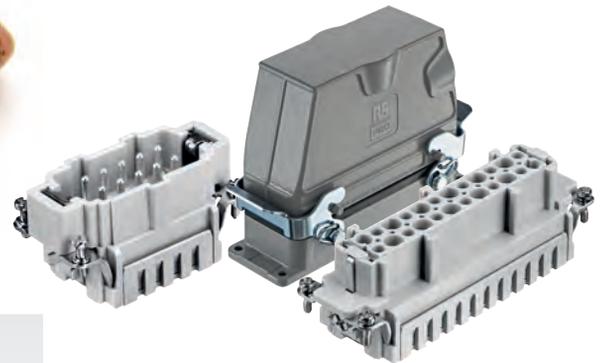
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## E-book explores the copper boom

Copper is becoming the new gold, with a growing range of applications making this metal increasingly valuable. Now, materials search engine, Matmatch, has released an e-book, entitled *Industry in Focus: Copper*. Available as a free download from the Matmatch website, the e-book outlines how copper's properties, such as conductivity and corrosion-resistance, make it a prime candidate for emerging and existing markets, including electric vehicle manufacturing and electrical distribution.

Head of growth at Matmatch, Ben Smye, said: "There are several reasons why copper demand is growing. For example, as more electronics are produced every year, an increasing quantity of copper is required to create components. In fact, the Copper Alliance reports that a single tonne of copper is critical in powering 60,000 mobile phones."

In addition to the e-book, Matmatch provides numerous online resources exploring specific copper applications such as the market in energy independent vehicles where copper-powered photovoltaic cells provide energy to the vehicle.

[matmatch.com](http://matmatch.com)

## Delivering value in heavy duty environments

RS Components has unveiled a new range of heavy-duty connectors including screw terminals, cage-clamp terminals and housings designed to offer value in industrial environments, especially sound and lighting applications and in the robotics and machinery sectors.

RS Pro A and B series inserts include screw terminals and cage-clamp terminals, said to offer excellent electrical and mechanical protection and UL approvals. All inserts have a grounded contact to stop incorrect polarisation and have contacts mounted in the insert, so no additional tooling is required. Inserts are available in a variety of popular contact-number sizes. Other features include: insulation resistance of not less than 1010 ohm; an ability to withstand more than 500 mating cycles; an operating temperature range from -40 to 125°C; and UL90V0 flammability rating.

The launch also includes two series of hoods and housings made from IP65-rated die-cast metal: the RS Pro A housing made from zinc die-cast metal; and the RS Pro B made from aluminium die-cast metal.

[www.rs-online.com](http://www.rs-online.com)

## Replication eliminates requalification costs

Rochester Electronics and Analog Devices have teamed up to help customers avoid the high cost involved in requalifying existing products by replicating an obsolete ADSP-2101 digital signal processor.

After the DSP went to end of life status, Rochester Electronics worked with ADI and an industrial customer to replicate the device to satisfy existing production requirements. Initially demand was satisfied with existing wafers, die and finished goods material. Once this was exhausted, Rochester Electronics was supplied with the source design, technology and test

databases to efficiently replicate and then ship the device, only nine months after receiving the intellectual property. This effort kept the customer's production schedule on time.

To achieve this streamlined approach Rochester Electronics' device replication process eliminates the time required to redesign, requalify or recertify older designs. Instead it utilises original manufacturer authorised IP to create a device that is form, fit and functionally equivalent to the original device with no software changes necessary.

[www.rocelec.com](http://www.rocelec.com)



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## In Brief

### Upskilling the trainer

Dynamic EMS is upskilling its team by investing in IPC 610 CIS training. Under the scheme, 23-year-old engineering trainee, Craig Stevens, will qualify as a certificated IPC trainer who can then train others to IPC CIT and CIS standards. Craig is the first team member that Dynamic EMS intends to put through IPC 610 CIS training. [www.dynamic-ems.com](http://www.dynamic-ems.com)

### Extending HMI reach

Human machine interface specialist, EAO, has confirmed a new distribution agreement with Digi-Key Electronics to distribute its products on a global basis. EAO's configurable panel mounted products will extend Digi-Key's reach in the industrial automation market, providing rugged solutions for existing designs or new panels. [www.eao.com](http://www.eao.com)

### One stop for motorsport

Lane Motorsport offers an interconnection package specifically for motorsport. Not only is the company an assembling distributor for Souriau's 8STA connectors, it also offers 8STA compatible heatshrink boots made by HellermannTyton and accessories by fellow Lodge Group company Weald Electronics, including nut plates, protective caps and gaskets. [www.lanemotorsport.com](http://www.lanemotorsport.com)

### Embedded expertise enhanced

Renesas Electronics is to acquire Integrated Device Technology, a supplier of analogue mixed-signal products including sensors, connectivity and wireless power. The move supports Renesas' embedded solutions by expanding its analogue lineup and strengthening its kit offerings, which combine IDT products with Renesas' microcontrollers, system-on-chips and power management ICs. [www.renesas.com](http://www.renesas.com)



## Rapid response on custom opto assemblies

TT Electronics' Quick Quote Program is a speedy new service centred on providing a 48-hour response to custom quotes for the company's Optek optoelectronic solutions. Designed to help customers move forward quickly on new projects and improve time-to-market, the program covers specific electrical and mechanical changes, housing modifications and test conditions.

Global product line director of optoelectronics at TT, Raymund Chua, said: "Quick Quote Program saves customers valuable time and empowers quick decision-making while providing peace of mind and expert guidance from a trusted supplier."

Electrical customisations covered by the program encompass binning, burn-in specifications, and temperature cycling and testing. Mechanical customisations include trimming and forming leads, custom cable lengths and external connector options. Also covered are housing modifications that do not affect electrical performance, such as adjustments to height or mounting tabs. Customers can also request specific test conditions for high-reliability or UL testing. [www.ttelectronics.com](http://www.ttelectronics.com)

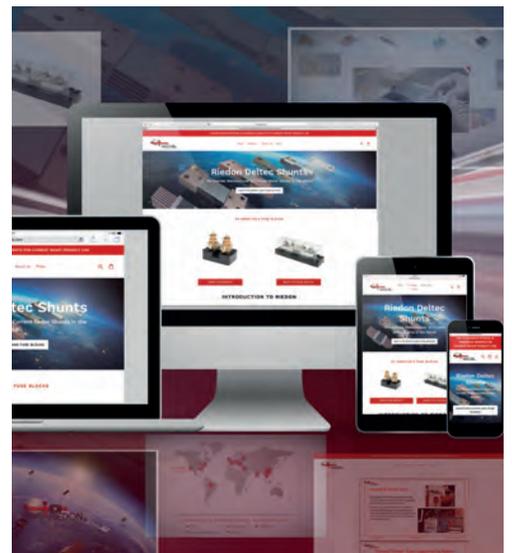
## Transceivers boxed and ready

Mouser Electronics has announced a global distribution agreement with Marvell Semiconductor, to distribute the company's Fast Ethernet and Alaska Gigabit Ethernet physical layer transceivers.

Notably, Marvell's Fast Ethernet PHY transceivers boast low power dissipation, small form factor and high performance. The octal Fast Ethernet family features low power consumption, under 150mW per port, which enables network systems manufacturers to reduce both power supply and fan requirements.

Alaska Gigabit Ethernet PHY transceivers also facilitate reduced power, as well as increased density and smaller package size. Alaska GbE PHYs offer integration in a thermally efficient package that enables fan-less and heat sink-less designs.

Vice president of supplier management at Mouser, Kristin Schuetter, commented: "Marvell has a history of delivering next-generation products that continue to revolutionise how customers move data." [www.mouser.com](http://www.mouser.com)



## Site gives buyers a shunt in the right direction

Riedon has launched an e-commerce site dedicated to sourcing current sense shunt and fuse block products. Shunts.com aims to simplify the identification and purchase of products used in a variety of applications, with orders placed on the site, typically dispatched within 24-hours.

Visitors to shunts.com can select shunts with ratings from 10 to 6,000A and fuse blocks rated from 110 to 400A. Both technologies are available in a variety of configurations and mounting options to accommodate a broad range of requirements. Visitors can also request further information or submit requests for custom configurations.

As well as the ability to purchase products for rapid delivery, Riedon's e-commerce site also offers tutorials on current sense shunts and fuse blocks. The 'Shunts 101' tutorial covers shunt operation and installation, typical use, how to choose the correct shunt resistor for a given application and standard and custom shunt options. Similarly, in the fuse blocks tutorial, visitors can find out how to specify fuse blocks alongside product and application examples. [www.riedon.com](http://www.riedon.com)



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# Innovation drives CM recovery

Over recent years, contract manufacturing has been in decline. Findings, however, reveal a recovery fueled by new technologies such as wireless infrastructure, as well as the continued rise of the ubiquitous smart phone

The findings published in New Venture Research's annual electronics manufacturing services report, *The Worldwide Electronics Manufacturing Services Market 2018 Edition*, make encouraging reading. Over the course of 2017, the worldwide contract manufacturing services market increased by 10.8 per cent in total revenue, resulting in a combined electronics manufacturing services and original design manufacturer revenue of \$471 billion. So after some years of decline, it seems the CM market recovered substantially in 2017.

## Recovery drivers

To identify these key trends, the report examines the leading 100 EMS and ODM suppliers across 52 countries, looking at 48 product industries and more than 900 manufacturing locations. From this research, New Venture reveals the CM market was sustained by strong demand for smart phones, which resulted in an increase in assembly revenue of \$14 billion in 2017.

Other strong growth areas include wireless infrastructure, where capital spending exceeded an additional \$3 billion in orders in 2017 as carriers prepare for the next-generation 5G networks. Enterprise LAN system assembly were also strong in 2017, with cloud computing prompting demand for distributed data centers worldwide.

Thanks in part to these growth segments, the industry was profitable for the eighth year in a row, coming in at \$8.4 billion for 41 EMS public companies and 18 ODM public companies. Foxconn remains the giant of the industry, accounting for nearly half of all the money made by the EMS industry in 2017 and EMS companies accounting for approximately 78 per cent of the total.

Overall, the outlook remained positive, with only four EMS companies and two ODM companies losing money in 2017. Looking at some of the other high flyers, we see that Pegatron ranked

second in net income for EMS companies at \$527 million, followed by Flex at \$320 million. In the ODM space, Quanta Computer, Delta Electronics and Qisda ranked highest in earnings.

## Right-sized for recovery

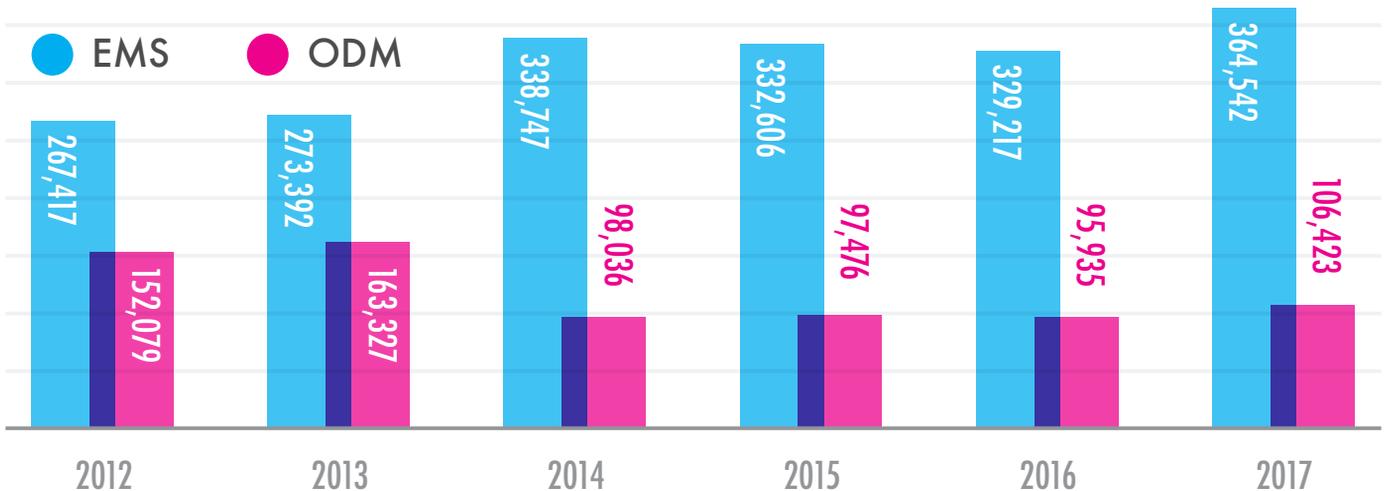
Reassuringly, plant closures were insignificant in 2017, as most companies appear to have right-sized their operations or closed facilities resulting from completed acquisitions. There were some new openings, which were clearly related to new business opportunities, while closures were driven by economic performance requirements such as right-sizing the company.

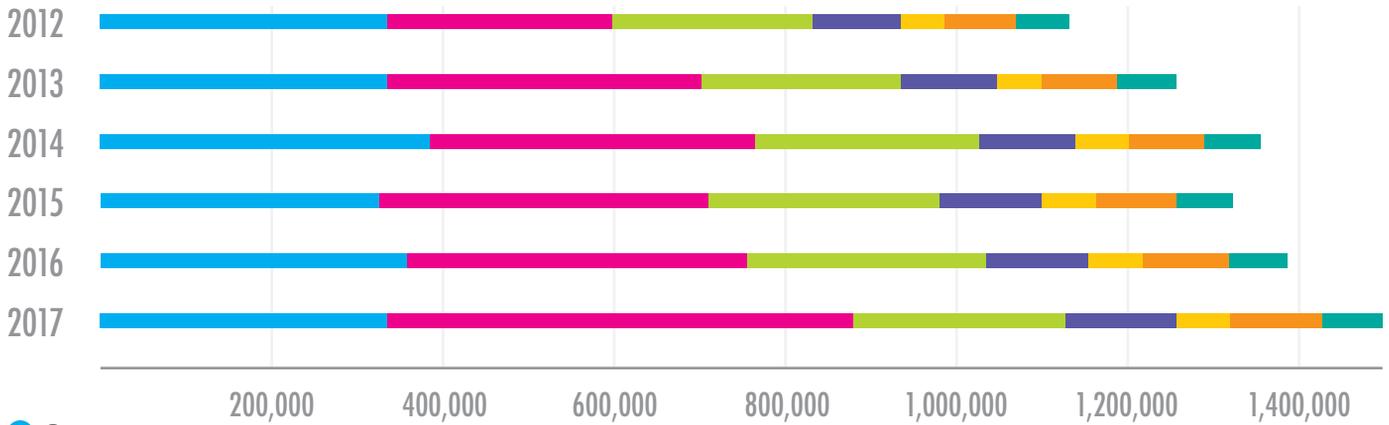
Looking to the future, it seems there's no let-up in this positive trend. Overall market demand for electronic products is projected to continue growing throughout the forecast period. In fact, New Venture Research expects overall combined market growth to be at a compound annual growth rate of 7.5 per cent over the next five years.



**Communications and computer products will continue to be the segments driving the largest growth in the electronics industry**

The worldwide contract manufacturing market from 2012-2017 (\$M)





- Computer
- Communications
- Consumer
- Industrial
- Medical
- Automotive
- Aviation/Defense/  
Other Transportation

Note the increasing importance of communications when we break down the total available market for electronics assembly from 2012 to 2017 by segment (\$B)

Communications and computer products will continue to drive the largest growth in the electronics industry. In 2022, the total industry is expected to reach \$1.7 trillion in annual assembly value, as consumption and replacement of electronic products continue, and new products stimulate demand.

In conclusion, although the trend to move price-sensitive manufacturing to low-cost regions has subsided, this will continue to impact the industry for all suppliers in the foreseeable future. Nevertheless, it seems outsourcing has become a critical element in keeping the electronics assembly industry expanding, with an ever-present goal to drive costs down each year.

[www.newventureresearch.com](http://www.newventureresearch.com)



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# Taking control of quality

*EMS providers handle thousands of different components for multiple clients every day. Control processes, such as barcoding, are essential, says sales and NPI director at Chemigraphic, John Johnston*

With OEMs under increasing pressure to produce and distribute products to ever decreasing timeframes and higher standards, ensuring manufacturing practices are seamless is a major priority. Handing the management of this process and of the materials required to a manufacturing partner is cost effective, but also requires manufacturers to put a great deal of trust in their electronics manufacturing services partner. Implementing flawless control processes is one way that EMS partners can reassure manufacturers that their products are in safe hands.

**Component identification** Many components, especially those used in surface mount technologies, are identical with no markings or visible differentiators. EMS firms service multiple customers and support a vast array of products and technologies, meaning there are thousands of parts in circulation. At Chemigraphic, for example, there are over 40,000 parts in play at any one time.

Despite this fact, it's vital to identify every component, as they each have a distinct function and purpose. Putting the wrong part in the wrong location can be catastrophic for the product,

causing immediate failure or remaining hidden as a latent fault only to be revealed years later.

In order to avoid such issues and keep on top of the exact identity and location of every component, it's crucial for EMS providers to implement strict control procedures throughout the manufacturing process. Chemigraphic is therefore meticulous about component control. Below are some of the processes used to maintain high quality standards for customers:

## 1. Sourcing

Robust systems around process governance mean Chemigraphic only sources components from reputable and approved suppliers. Any issues or non-conformities are managed with trackable documentation which is recorded and reviewed. A series of regular and thorough checks and balances help manage supplier quality and drive continuous improvement.

## 2. Automated barcoding

Chemigraphic operates an automated barcode generation system which barcodes everything in the factory: materials, equipment, personnel and products. The company's

enterprise resource planning system will only allow the movement of components and materials between each stage of the manufacturing process once the necessary criteria are fulfilled, allowing for full traceability. This data is carefully managed and is displayed on dashboards all around the factory and offices, enabling immediate identification and rectification of issues before they escalate.

## 3. Bespoke labelling

At printed circuit board level, the ERP software generates a unique serial number per product, which is automatically printed and placed by machine. This avoids any possibility of duplication, lack of serialisation, or inconsistency in placement or orientation. It is especially important when customer assembly or service personnel need to gain entry to the products through access hatches or similar.

As a further measure, all surface mount stock is managed by a fully automated kitting and storage system, which eradicates the risk and cost of operators picking parts from shelves.

[www.chemigraphic.co.uk](http://www.chemigraphic.co.uk)



Sales and new product introduction director, Chemigraphic, John Johnston



**It's crucial for EMS providers to implement strict control procedures throughout the manufacturing process**



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# Distributors double down on IoT

*Electronics distributors are providing technical expertise and services to OEMs to help them implement Internet of Things technology into their products*



James Carbone

Distributors say that while the Internet of Things (IoT) has yet to produce hockey stick-like growth in sales, it is still having a significant impact on business and will be responsible for up to 40 per cent of distributors revenue in the future.

To ride the expected wave of sales growth from IoT applications, distributors are not just providing customers with sensors, Wi-Fi modules, microcontrollers and other components needed to implement IoT. They are also offering services to help customers identify IoT applications with their products and to design IoT solutions and implement them. Some distributors have also partnered with carriers such as AT&T and Verizon to offer data plans needed for IoT.

Many distributors say sales growth from IoT has been modest because customers are trying to determine how best to use IoT technology. "Every business is trying to figure out how to use IoT to build better products and services," said Ashish Parikh, director of IoT platforms and solutions for Arrow Electronics, based in Centennial, Colo.

"Everyone is looking at using this technology of connected devices where you can remotely manage the devices, update them, and get information and insight to solve problems," he said.

He added Arrow is seeing more IoT business from customers in retail, industrial, healthcare and

transportation. "We have seen a pretty steady increase in the number of customers and in the footprint of what customers are buying," said Parikh. "Wi-Fi connectivity and sensor sales have been increasing."

IoT customers often buy sensors, Wi-Fi modules, microcontrollers as well as a range of interconnect, passives and electromechanical (IPE) devices. "It is estimated in the industry that probably 5 to 7 per cent of overall component sales are actually going into IoT applications," said Lou Lutostanski, vice president of IoT for Avnet, based in Phoenix. He said that percentage will likely grow in the coming years, but so far there has not been the stellar sales growth for components used in IoT applications, which some industry analysts and executives had earlier predicted.

"I think hockey stick growth is very possible, but not until companies go mainstream with IoT," Lutostanski said. "There are people doing IoT projects, but few of them are mainstream. I believe when IoT goes mainstream, there will be an incredible ramp up in sales for all semiconductors and IP&E products," he said.

Lutostanski added one thing that is slowing down IoT adoption is companies are confused about IoT technology and business applications for IoT. "IoT is not about technology, it's about business transformation," he said. Many companies are trying "to use IoT technology without understanding why they're doing



Lou Lutostanski, vice president of IoT for Avnet

**"It is estimated in the industry that probably 5 to 7 per cent of overall component sales are actually going into IoT applications"**

it," according to Lutostanski.

He said a company must first have a business case to use IoT successfully.

#### Make the IoT case

Having a business case for IoT is "the blueprint for everything else that you do and if you don't know why you're doing something, but you start doing it anyway, it's going to fail," said Lutostanski.

Some OEMs have identified business cases for IoT in their industrial products and equipment and other companies have invented new products that take advantage of IoT capability.

"In the industrial segment, IoT is all about predictive maintenance,"

said Robbie Paul, director of strategic program development - IoT for Digi-Key, based in Thief River Falls, Minn. By using IoT-equipped industrial equipment and factories, companies can identify problems with the equipment before they become serious. One example is motors.

"There are billions of motors of all kinds in factories and it turns out the predictive variable in motors is vibration," said Paul. If vibration levels for a motor exceed the acceptable spec, the motor will overheat and fail. Using sensors and other IoT technology, excessive vibration levels of motors can be detected so the motor can be replaced or repaired before it fails.



**Attracting new customers**

While industrial automation has been a traditional segment for distributors, IoT is attracting customers to distribution from other customer segments. One example is agricultural equipment. Some distributors are selling IoT related components to equipment manufacturers that make IoT capable farm equipment that helps reduce fertilizer, pesticide, herbicide and water costs for farmers.

Such equipment can monitor fertilizer, pesticide and water levels of soils and transmit that information to a computer or smart phone so the farmer can water crops or apply the necessary fertilizer or pesticides.

Some farmers are using small IoT-equipped robots on wheels to help eliminate weeds on farmland and reduce herbicide costs. The robot has a camera, GPS, and a computer and moves through rows of crops and distinguishes weeds from crops and sprays the appropriate amount of herbicide on the weeds and not the crops, said Paul. Herbicide cost is reduced by about 90 per cent because the spraying the weeds is precise and there is little waste, he said.

More industrial and agricultural equipment companies are finding ways to use IoT which will further drive sales for Digi-Key and other distributors over the next 5 to 10 years.

Paul said that IoT is already having a positive impact on Digi-Key's business. "IoT is one of the driving forces for increased electronic sales this year. Automotive is the other driver," he said .

He said Digi-Key's IoT sales were up 38 per cent year-over-year for the first half of 2018 and "that's a few points higher than Digi-Key sales overall."

IoT is also resulting in more customers for Digi-Key. "So far right now we have about 100,000 customers that buy what we consider to be IoT products. It is growing at a faster clip than overall customer acquisition for Digi-Key," said Paul.

**Enhancing IoT services**

Other distributors report that they are also attracting more IoT customers and are enhancing their capabilities to service those customers. The focus is not just on selling components, but also providing services to IoT customers to help them

Ashish Parikh, director of IoT platforms and solutions for Arrow Electronics



**"Every business is trying to figure out how to use IoT to build better products and services"**

implement IoT technology in their products.

For instance, Lutostanski said Avnet has a consulting service to help customers understand the business reason for doing IoT. He said Avnet's IoT advisory service can evaluate a customer's readiness and "develop a transformation roadmap with the customer on the front end for a fee. Avnet will also do "IoT device design and build services where we talk about manufacturing and the integration of inventory management of the devices being deployed," said Lutostanski.

Avnet also offers customers IoT cloud and digital services to help customers understand "the cloud platform, analytics, artificial intelligence, the machine learning ,the user interface the user experience and the IoT connectivity," he said.

Avnet helps deploy IoT in products and provides "firmware, security patches, technical assistance and field utilisation maintenance for all the devices to make sure that all devices maintain functionality and are upgraded over time," said Lutostanski.

He said by providing an end-to-

end solution for customers, Avnet hopes to accelerate the adoption of IoT and "once it becomes mainstream, there will be many opportunities for significant growth." Lutostanski said by 2030 IoT will be up to 40 per cent of the distributors' sales revenue.

Arrow also wants to make it easier for customers to implement IoT and a lot of its efforts focuses on connectivity. "Last year we introduced our connectivity services, which makes it easier for customers to not only procure the modules, but also services from us," said Parikh.

He said about four years ago, Cathy Morris, Arrow's chief strategy officer, "pulled the leadership team across Arrow Inc., and said IoT is not just about components. It's also about connectivity, the ability to analyze data and manage it."

As a result, Arrow's IoT strategy "pulls together the products and services across all business units," said Parikh. "Global components is one of the business units, but to build an IoT solution we need connectivity, the ability to manage where that data goes, how the devices are managed and how they are updated," he said.



**"In the industrial segment, IoT is all about predictive maintenance"**

Robbie Paul, director of strategic program development - IoT for Digi-Key

# Making the right connections

Seamless support and close attention to detail combine with an extensive portfolio and in-house manufacturing to ensure Telegärtner UK provides a vital one-stop-shop for all interconnect requirements

As part of the German Telegärtner Group, Telegärtner UK specialises in providing high quality electro-mechanical connectivity used in various market sectors including railway, medical, defence, marine, telecoms and industrial. Not only is Telegärtner UK a key supplier and distributor of coax, datavoice and multiway components, cables, speech communication products and connecting systems, it also manufactures bespoke cable assemblies, providing customers with a true one-stop-shop solution, together with flexible customer service and support.

## Vital interface

Telegärtner coax and datavoice components form the core of the company's product range, supported by a wide selection of connectors, cables, speech communication products and connecting systems from several high-quality manufacturers that Telegärtner UK represents. The company's policy is to provide a comprehensive service and vital interface between its customers and the manufacturers it represents, which include Binder, Provertha, FCT,

Hummel, Pei Tel, Pro Car, Habia Cable and Bedea.

Thanks to its industry knowledge and supplier relationship experience, Telegärtner can offer vendor reduction services, as well as utilising various ways of controlling the stocking and shipping of components. These can include kanban or buffer stock arrangements, consolidated or split shipments, forecast or call-off orders.

## Quality assembly

In addition to the component side of its business, Telegärtner UK also provides high quality, competitively priced cable assemblies for a variety of market sectors, such as telecommunications, industrial, medical, broadcast and marine. With over 30 years' experience in a range of markets, the company's expertise can be utilised to offer custom made assemblies according to customer requirements.

Telegärtner UK cable assembly capabilities cover coax, multiwire, overmoulded and panel assemblies as well as wiring looms. With production sites in the UK and Slovakia, the company can offer a rapid prototype

and pre-production service, backed by highly skilled production staff following IPC620C workmanship standards and continuous improvement in production and test equipment.

To complement the range and ensure customers can receive all support from one source, ISO 9001:2015 and ISO 14001:2015 certified Telegärtner UK also offers vendor managed inventory and supplier management services. Kitting, testing, design and subcontract services are also available, resulting in a complete solution from beginning to end.

Seamless commercial and logistical support and close attention to detail are just some of the qualifications that help Telegärtner UK meet the rigorous demands of the industries it supplies. This, combined with an extensive product range across resale components and in-house manufactured cable assemblies, ensures Telegärtner UK can offer a true one-stop-shop solution to help customers optimise their supplier base and logistics.

[www.telegaertner.co.uk](http://www.telegaertner.co.uk)

Telegärtner UK supplies coax, datavoice and multiway components, cables, speech communication products and connecting systems



In-house manufacturing includes multiwire assemblies



# Downsize without compromise

Connectors play a decisive role in the transmission performance of radio frequency signals between base stations or remote radio heads and antennas. Inevitably, mobile networks require RF signal transmission to be implemented with tighter space constraints, less losses and the lowest interference to passive

intermodulation, prompting Telegärtner to co-develop the 4.3-10 connector system.

Now, Telegärtner's 2.2-5 series has reworked the successful 4.3-10 concept in a smaller design. The 2.2-5 requires the same space as TNC series components; around 53 per cent less space than 4.3-10 and 70 per cent less than 7-16. Despite the clear

reduction in size and weight, the 2.2-5 series possesses comparable electrical and thermo-climatic properties to the 4.3-10 and can be used with 1/2in corrugated cable both indoors and outdoors. Components are available as screw, hand screw and push-pull options with the same jack.

[www.telegaertner.co.uk](http://www.telegaertner.co.uk)

The 2.2-5 requires around 53 per cent less space than 4.3-10 and 70 per cent less than 7-16





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# Bucking the obsolescence trend

*Technological growth and innovation have created massive demand for passive components, prompting component shortages and increased obsolescence. Senior application engineer at Knowles Precision Devices, Steve Hopwood, offers a solution*

New and evolving markets, including automotive, defence, mobile, industrial, and the internet of things, are creating surges in demand. Those verticals that traditionally used electronic components are using more, while other markets are adding electronic content to their products.

Demand from the automotive industry, for example, has grown significantly over the last five years. Developments in electric and hybrid vehicles have led to a four-fold increase in demand for electronic, specifically ceramic, components. Meanwhile in the consumer sector, the boom in smart home devices is boosting demand for low power and low voltage chip capacitors for products such as smart central heating controls. That's in addition to demand from mobile phones, just one of which can contain up to 1,000 small chip size capacitors.

## Component shortages

This explosion in demand has seen some manufacturers cease production of mature, unprofitable, lines, slimming ranges down, or phasing products out in favour of newer components. Current shortages focus on parts that have been around for 15 or 20 years, as suppliers push toward higher margin products. For example, ranges of larger chip sizes are disappearing as efforts focus on increasing capacity for smaller, high-demand capacitors.

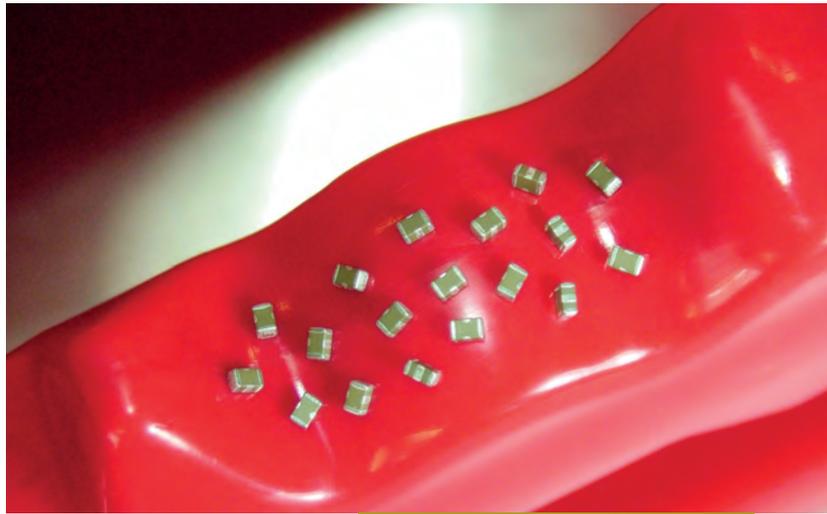
This, in addition to manufacturing changes

or altered die dimensions, means original component manufacturers are discontinuing more part numbers per year. Overall, the rate of component obsolescence has been increasing over the last 15 years, further exacerbated by government regulations, economic slowdowns and catastrophic events such as earthquakes and floods that knocked out some electronics production.

Consequently, component makers are now faced with some difficult decisions. Adding capacity is expensive, but not adding capacity could mean lost sales. It takes a while for capacity to catch up to demand and expansion requires a significant investment in time and equipment.

## Bucking the trend

Naturally, current shortages have caused nervousness in the market and concerns for what may lay ahead. Purchasers are trying to find multiple sources for larger cases, and with manufacturers putting customers on allocation, buyers are looking elsewhere. While large OCMs focus on smaller chip sizes, however, KPD is still focusing on specialist products such as high voltage, high temperature, high Q, electromagnetic interference filters and large case size capacitors. The three-terminal MLC chip in the 1806 size, for example, has been discontinued by many manufacturers. KPD still offers this part and in fact, due to demand, also supports the 0805, 1206 and 1812 case sizes.



E01 E07 0603 filters are designed to offer reduced inductance compared to conventional MLCCs

Another example is KPD's E01 and E07 ranges under the Syfer brand. These feedthrough MLCC chip 'C' filters are three-terminal chip devices designed to offer reduced inductance compared to conventional multi-layer ceramic capacitors when used in signal line filtering. Available in COG/NPO and X7R dielectrics, with current ratings of 300mA, 1A, 2A, 3A and voltage ratings of 25 to 200V DC, they are also available with FlexiCap termination, which is strongly recommended for new designs, to reduce the chances of mechanical stress failure. This meets automotive industry requirements and for this application, a range qualified to AEC-Q200 is available. KPD also offer feedthrough MLCC three-terminal chip devices in a Pi filter configuration.

As the pace of technological advancement quickens, the passive component market is beginning to implode, however, as these examples demonstrate, there are still some component manufacturers that can meet 'niche' requirements.

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**Developments in electric and hybrid vehicles have led to a four-fold increase in demand for electronic, specifically ceramic, components**



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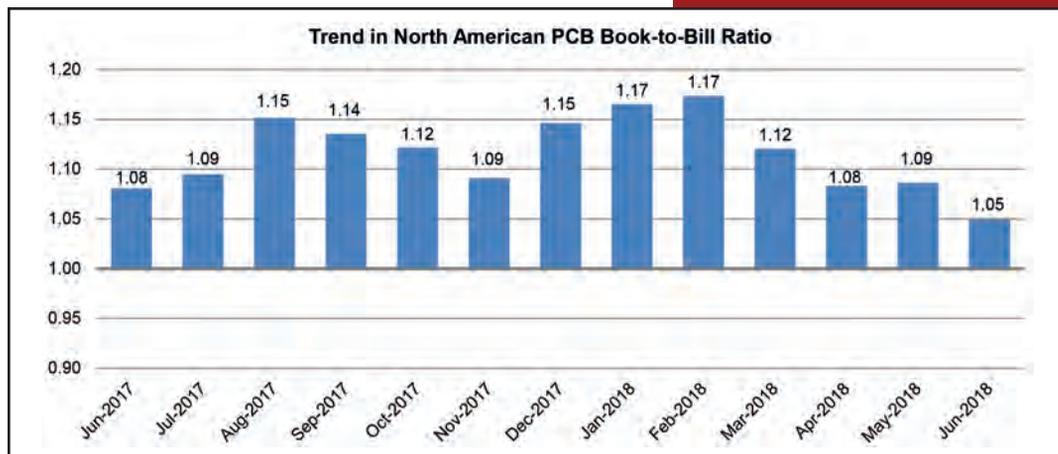
# PCB industry growth continues apace

Reassuring results from the IPC's North American printed circuit board statistical program indicate continued expansion in this sector

Industry shipments and orders continued to grow at a strong pace according to the June 2018 findings of the IPC's statistical PCB program in North America. Readers will be encouraged to learn that the overall book-to-bill ratio for June is 1.05.

Commenting on the findings, IPC director of market research, Sharon Starr, confirmed that the North American PCB industry growth trend continued in June.

Looking more closely at the results, total North American PCB shipments in June 2018 were up 12.6 per cent



compared to the same month last year. This year-to-date, shipments were 10.5 per cent above the same period

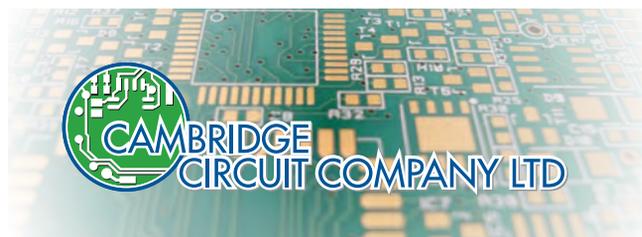
last year and compared to the preceding month, June shipments increased 18.0 per cent.



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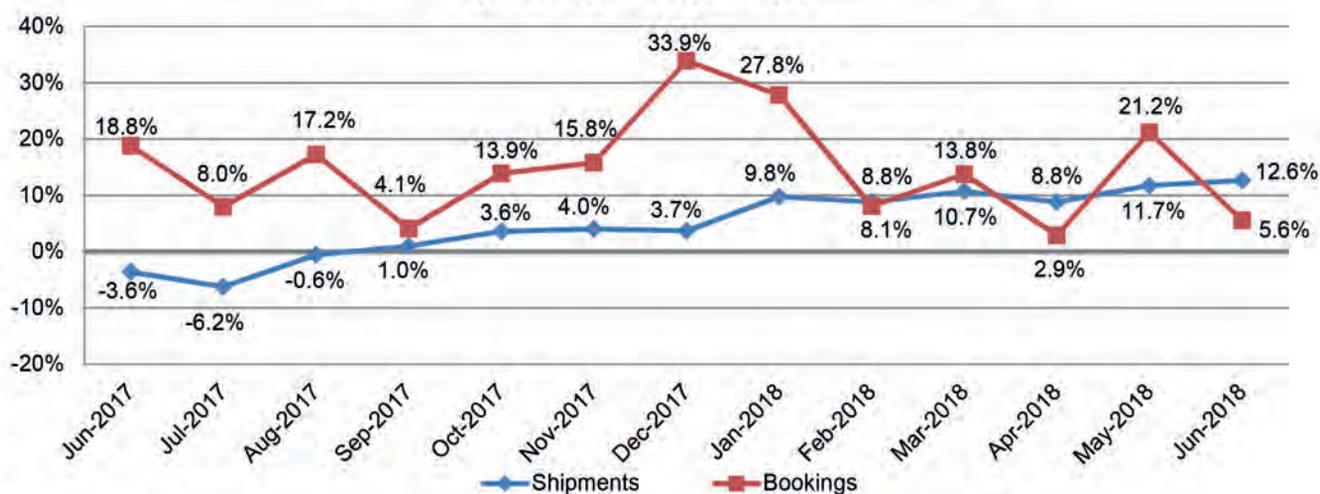
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### Growth Trends in Total PCB Sales and Orders in North America Year-on-Year Growth Rates



PCB bookings increased 5.6 per cent year-over-year and year-to-date order growth was 12.8 per cent above the same period last year. Encouragingly, bookings in June were also up 5.4 per cent from the previous month.

Sharon Starr commented: "Sales growth was positive year-over-year for the 10th consecutive month and order growth has been positive for the past 13 months. The book-to-bill ratio retreated in June due to stronger sales growth than order growth,

but it remains above parity for the 17th consecutive month, which is a positive indicator of continued growth for the remainder of this year."

[www.ipc.org](http://www.ipc.org)

The June 2017 and January to March 2018 growth rates have been revised due to updated data from statistical program participants

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# PCB supplier improves core offering

*Printed circuit board manufacturer, Multi-CB, offers a rapid six-day turnaround on aluminium core PCBs, which now feature improved thermal conductivity*

Thanks to a significant increase in demand facilitating price reductions, Multi-CB has improved its offer for aluminium core printed circuit boards. Not only are prices lower, but the company's PCB online calculator now offers high-quality aluminium core material with a thermal conductivity of 2.0W/mK and a production time of six working days as standard. Express production is possible from two working days.

According to Multi-CB, its standard aluminium core material, which provides 2.0W/mK with an insulation of 100µm, has up to 92.3 per

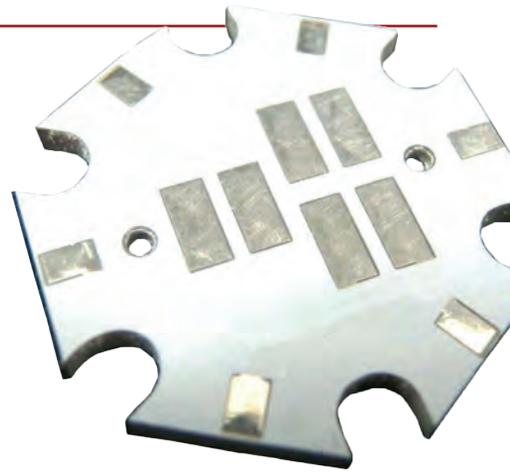
cent better heat dissipation than standard market materials that offer 1.3 to 1.6W/mK with an insulation of 100 to 125µm. This improved heat dissipation allows for higher packing density, more stable operating parameters, higher reliability and longer life.

Boards are backed by Multi-CB's years of experience with aluminium core PCBs, also known as insulated metal substrate PCBs. For example, aluminium core material with a thermal conductivity of up to 8.0W/mK is available for the highest demands and Multi-CB can also supply plated-through two-layer

aluminium core circuit boards.

All parameters can be viewed in the company's online calculator. Standard parameters include an aluminium core thickness of 1.5mm with 100µm insulation and 35µm copper. Boards are supplied with a hot air levelled lead-free surface, with white solder resist, scoring and milling included. Also inclusive are the e-test and an intensive design rule check, which can help to identify mistakes in advance and avoid problems down the line.

[www.multi-cb.eu](http://www.multi-cb.eu)



Boards with a thermal conductivity of 2.0W/mK are available within six working days as standard



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# Cutting the cost of power in harsh environments

System designers are under continual pressure to reduce costs and development times. One way to achieve this is by using commercial off-the-shelf hardware, says Solid State Supplies

COTS hardware has several advantages: it's readily available, reduces acquisition costs and can provide access to the latest technology. There are some weaknesses to commercial grade parts, however, such as product lifetime, input voltage and transient range, temperature range, and a limited ability to withstand severe environmental conditions such as temperature cycling, shock and vibration. The challenge is therefore to take advantage of commercially available hardware without sacrificing

system performance and reliability or redesigning the system only a few years into production.

To that end, VPT have based the VXR series of DC/DC converters and matching electromagnetic interference filters on designs that have proven themselves in mission critical systems for military, space and flight avionics, but without the cost of full MIL standard compliance.

The VXR series retains full performance over a temperature range of -55

to 105°C with no power derating and is available with single or dual voltage outputs from seven up to 250W. V-Shield epoxy encapsulation also minimises noise and allows a continuous input voltage range from nine to 60V DC with transients up to 100V DC. This makes it ideal for applications from ground vehicles to commercial and military aircraft, to the unique power needs of unmanned systems.

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**The challenge is to take advantage of commercially available hardware without sacrificing system performance**

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# Get to grips with fan specification

We asked John Roe of fan manufacturer, Micronel, what buyers really need to know about purchasing fan products; the technologies available and the choices on offer



Flat fans range from just a few pounds each up to the tens of pounds or more for complex types

## Q How should buyers determine the type and size of fan to use?

A) Thermal management determines the size, type and power of fan required. Firstly, it is important to understand how much heat is generated in the equipment under all conditions. The goal is to maintain an ambient temperature low enough to avoid cataclysmic equipment failure caused by overheating and to prolong lifespan through efficiency and effectiveness. Actual cooling requirements are determined once the maximum allowed temperature within the equipment is known and the heat generated has been derived. This in turns allows the airflow to be calculated.

drop can be measured using sensors, or for bigger, complex systems, modelled using computational fluid dynamics.

## Q What different types of fan and blower are available?

A) As well as being available in AC and DC voltage configurations, fans are generally categorised by the way the air enters and exits the fan. If the air exits in the same axis as it enters, it is termed an axial fan. Axial fans are predominantly suitable for applications where high airflow is needed in systems with low system impedance.

If the airflow leaves in a different plane, it is normally referred to as a centrifugal fan, or blower. In this product, the air changes direction inside the fan and is expelled in a different direction, usually 90 deg perpendicular to the intake. This type of blower effectively compresses the air, allowing it to deliver constant airflow under pressure. Centrifugal fans or

radial blowers offer lower free blowing airflow but can deliver against higher static pressure.

## Q Why is fan size important?

A) Once the airflow is known, the fan size can be determined. Generally, the larger the fan, the higher the free blowing airflow, although this doesn't necessarily apply to pressure. For instance, it may be possible to get the same airflow from a high speed 50 by 50mm fan as a low speed 60mm fan, but it may generate more noise because of its faster rpm. Both audible and electrical noise are considerations when selecting a fan.

## Q Are there any other important criteria?

A) The type of equipment and its application will determine the most important fan criteria. For instance, in high end audio equipment, low noise may be vital, whereas for a densely packed racking system in the basement, sheer cooling power, pressure and high

airflow might be the priority. Portable equipment will need low power consumption to preserve battery life while hand held equipment may need small size and low DC voltage. Alternatively, if the equipment will be in an inaccessible location, then lifespan will be paramount.

[www.micronel.co.uk](http://www.micronel.co.uk)



Micronel's John Roe



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## Advertorial

# Cutting plug size without compromising safety

New from Schurter, the DG11 IEC appliance plug with circuit breaker represents a logical evolution of the widely used Schurter 6135 power entry module. It combines the advantages of the existing DF11 with a particularly compact design.

The DG11 is available for almost every mounting variant with snap or screw mounting. The latter is available in a front or rear mount version. In addition, holes for the screws can be in either vertical or horizontal.

Included in the DG11 is a two-pole TA35 circuit breaker that provides the function of a device switch as well as thermal overcurrent protection. Thermal overprotection can be achieved with bimetal mechanism for only one or two poles and is available in finely graduated rated currents from 0.05 to 20A.



Available as standard with IP40 protection, the DG11 is also available with IP67 protection opposite the device. This ensures safe use in harsh dust or splash water environments thanks to a protective cover for the circuit breaker, plus sealing beads and four sealing screws for tight fastening of the base.

A filtered version, DG12, will be released shortly for increased electromagnetic compatibility requirements.

[uk.schurter.com](http://uk.schurter.com)

## DG11



### IEC appliance plug with circuit breaker

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# Become a fan of protection

*In industrial settings, protection for filter fans can be essential to prevent water or dust ingress. Stego's hose-proof hood offers an accessible and versatile solution*

The new FFH 086 hose-proof hood from Stego is an effective protective cover for filter fans, as well as intake and exit filters. With the hood in place, users can increase an application's protection level to IP56,

thereby protecting against penetration of dust and against water projected by a hose.

This means the FFH 086 hose-proof hood is ideal for outdoor use and for industrial applications with harsh environmental conditions. The use of stainless steel ensures protection against extreme or harsh weather conditions and improves impact resistance, while a food safe, external

silicone gasket facilitates cleaning.

As a further benefit, filter mat changes can be undertaken from outside. To change the filter mat, users have only to remove the hose-proof hood, making it unnecessary to open the control cabinet. Finally, the hood is approved for quality and safety through testing by institutes such as UL.

To simplify specification, the hose-proof hood fits perfectly onto Stego's filter fan series FPI 018, FPO 018 and FF 018 and, of course, to devices with standard dimensions from other manufacturers.

[www.stego.co.uk](http://www.stego.co.uk)



Stego's FFH 086 hose-proof hood is an effective protective cover for filter fans



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# Avoiding the cost of failure

*President of Memory Protection Devices, Tom Blaha, advises buyers to think long and hard about cutting corners on quality only to incur the risk of costly system failures*

Let's face it, there is a huge difference between a battery holder designed for use in a low cost advertising specialty item and a battery holder that is integral to a life-saving medical device or industrial application.

Cost is everything for an inexpensive trade show premium item, but if the device is intended for long-term use, especially in rugged environments, and is backed by a warranty and the reputation of your company, then you need to think long and hard about cutting corners on quality, only to incur the risk of

costly system failures. The results can include: angry social-media savvy customers; expensive repairs, rework and replacement costs covered under warranty; loss of business reputation; and even potential legal risks associated with a catastrophic product failure or a large scale product recall.

Battery holders are not created equal, so it's important to keep tabs on their design and manufacture, given that these items team up with the battery to ensure a reliable long-term power supply.

## Miniaturisation demands quality

As electronic devices continue to shrink in size, battery holders are becoming thinner and lower profile. In order to provide a reliable electrical connection with the smallest footprint possible, the quality of the raw materials used to manufacture these holders is becoming critical.

Since it is difficult to detect a money-saving mix of virgin and recycled materials, it is essential to verify that the highest grade of thermally stable plastics are being utilised in the injection molding process. Superior quality raw materials allow the battery holder to perform more reliably in extreme temperatures, or under shock and vibration conditions.

## Beware of counterfeits

Battery holders are often assembled by third party subcontractors, which increases the risk of counterfeiting. Purchasers therefore need to demand full



As electronic devices continue to shrink, battery holders are becoming thinner and lower profile



**Battery holders are not created equal, so it's important to keep tabs on their design**



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product traceability all the way from raw materials to finished assembly. This should include proper documentation that the battery holder has undergone rigorous quality control and quality assurance inspections throughout its manufacture, including environmental and vibration testing. In the case of medical devices, the product must conform to FDA CFR 21.

To further protect against counterfeiting, it's wise to perform random incoming inspections to ensure lot-to-lot consistency, including routine visual inspections for proper identification markings. Also, be on the lookout for excessive flashing that occurs when excess plastic extrudes through the mold, as this can prevent a battery from making a solid electrical contact.

Discolored contacts may be a sign of corrosion. Gold plating over nickel is preferable because it provides the greatest level of

corrosion resistance and helps protect against bi-metallic effects that can occur when two dissimilar metals come into contact. An acceptable compromise may be to specify contacts finished with nickel-plating over steel, as this adds some corrosion resistance at lower cost. Those that go this route, should make sure that the nickel plating is highly polished and that the plating thicknesses are as specified.

**Invest in quality**

Extreme vigilance is especially important for life-critical medical devices and industrial applications where product failure is not an option. If the contacts break easily, become easily disconnected, or twist out of position when modest pressure is applied, then you have a serious quality problem.

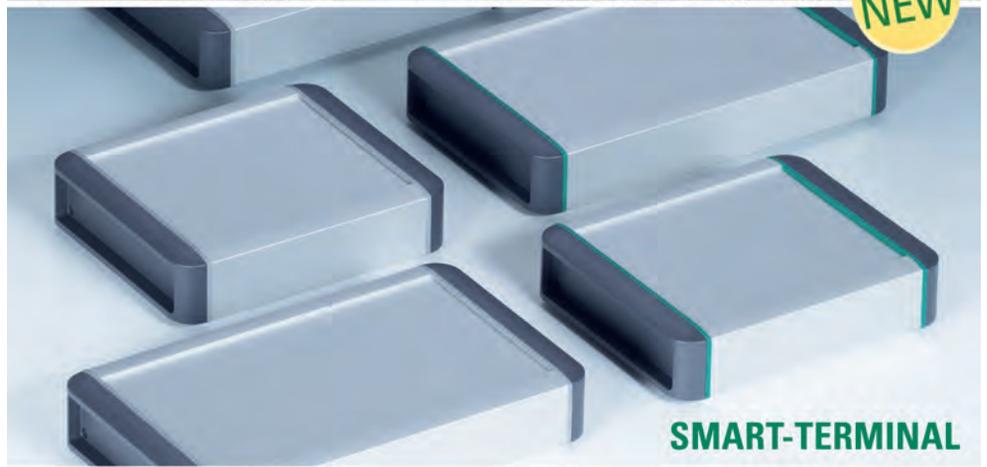
Trying to save a few dollars is always tempting and can

be very acceptable for certain low-risk applications, however, it is invariably a bad idea to cut corners if it leads to dissatisfied customers and potential lawsuits. It pays to invest a few cents more to ensure a better quality battery holder that meets and exceeds all customer and regulatory requirements and provides years of reliable performance.

[www.memoryprotectiondevices.com](http://www.memoryprotectiondevices.com)

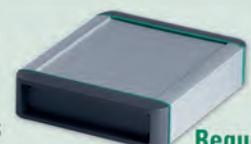


NPD offers a variety of Li-ion battery holders



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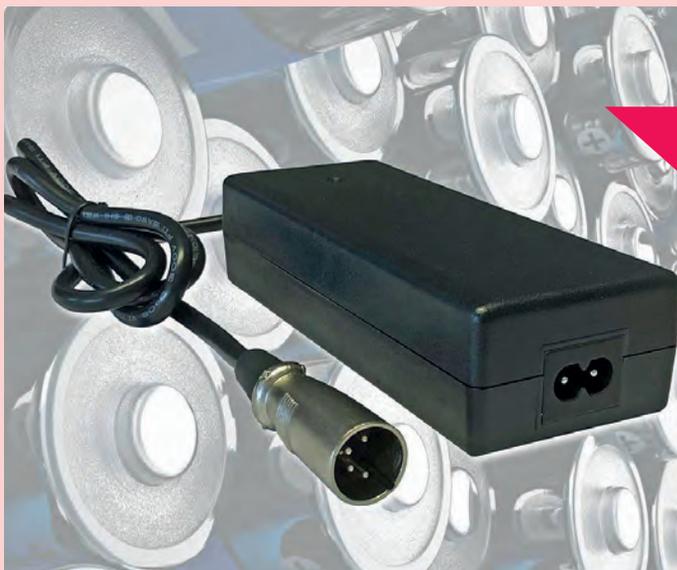
Powering industrial reliability

Authorised Yuasa battery distributor, Gresham Power Electronics, has announced availability of two high reliability industrial battery series. Described as an enhanced version of the NP series, the Yuasa NPL range offers a longer service life, from 10 to 12 years, and complies with IEC 60896-21+22. All other mechanical and electrical attributes are the same as the original NP series.

A flame-retardant version of the NPL battery is also available. Standard NPL case material is flame retardant to HBØ, while the flame-retardant NPL-FR meets UL94:VØ and complies with BS6290 Part 4.

Key features of the NPL rechargeable lead acid battery series include sealed leak proof construction and multipurpose performance in either float or cyclic applications.

Operations manager at Gresham Power Electronics, Karen Jay, commented: "We have been using Yuasa batteries in our own defence products for many years and are impressed with their reliability and operational life. We now fit NPL-FR batteries to all our own uninterruptible power supplies for even greater system security." [www.greshampower.com](http://www.greshampower.com)



Charger supports Li-ion battery packs

Powersolve has extended its battery charger offering with a compact charger designed specifically for 36V, 10 cell lithium-ion battery packs, such as those used in the burgeoning electric bike sector.

To accommodate this demand, the PFY105-42-2 operates from a wide AC input with a 2.5A output at 42V. At 105W, the new charger is said to effortlessly charge Li-ion battery packs, as well as popular LiFePO4 variants.

The unit is protected against overload, short circuit and has fused input protection. At no load, power consumption is just 0.21W. Housed in a 153 by 60 by 36.5mm case, connection is via a four-pin XLR connector. Furthermore, the PFY105-42-2 has passed a 90cm drop test, as well as being CE certified for electromagnetic compatibility and the low voltage directive. [www.powersolve.co.uk](http://www.powersolve.co.uk)



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# The importance of power factor correction

A good power factor is becoming increasingly important as more devices are fitted with switch-mode power supplies, explains Astute Electronics

Equipment fitted with switch-mode power supplies can sometimes present a non-linear load and create harmonics that potentially cause damage, lower efficiency and increase running costs. In an ideal world, the voltage and current would be in phase; resulting in a PF of 1.0. In other words, a device would consume all the power it draws.

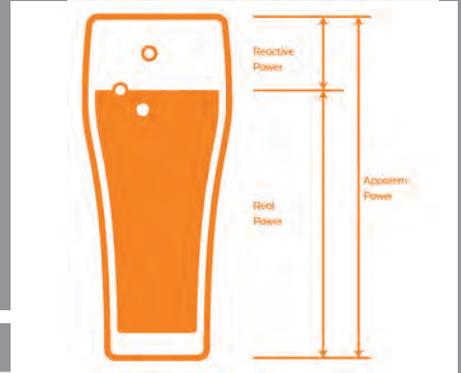
Power factor is best explained using this popular analogy. If you pay for a pint of beer (apparent power) you would hope that there would be more beer (real power) than froth (reactive power). If a pint was 75 per cent beer and 25 per cent froth, you would not get value for money. On the other hand, by correcting the flow of beer and gas, you could achieve better than 95 per cent beer, resulting in better value.

The same applies to power. For example, aircraft fuel is not only used to keep the plane flying, but to power all the electronics, so cockpit controls and lights can impact the amount of fuel burned. Simplistically, assume the aircraft needs 100kW of working power, but the PF is 0.8. The engines need to generate 125kW of apparent power just to keep everything working. If the PF is improved to 0.99, only 101kW is required, thereby saving fuel.

There are many regulations regarding power factor. Although equipment manufacturers must meet these requirements by law, it also makes economic sense.

astute.global

Power factor correction explained



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# Distribution: value added style

*During a tour of RS Components' new Titan II innovation truck, Electronics Sourcing discussed how the company is supporting the purchasing community with president EMEA, Mike England*

One of the by-products of the internet of things is that sophisticated electronic devices are being integrated into previously mechanical products. This is pulling new customers into the electronics arena for the first time.

Mike England explained: "The world is changing at an ever-faster pace, especially the rapid growth of connected digital devices. Customers in this space are asking us to help make their working lives easier. How can we help them make the right technology choices? How can we protect them from sourcing the wrong products? How can we help them innovate and add value?"

As the electronics market has grown, so has the number of sourcing routes, market places and comparison websites. On the downside, this introduces risks such as counterfeit products. It also increases the temptation to buy low, when buying low is likely to be the worst thing to do.

Mike added: "Our advice to buyers is to source the optimum product via an assured supply chain that comprises trusted partners, such as franchised distributors with the right quality approval processes in place. Buyers should be challenging their suppliers regarding the ease of sourcing products: is it in stock; can I find it easily on the website; is supporting technical information available; can I buy it in the quantity I need; is it going obsolete etc?"

## Buyer expectations

There is also a move towards mobile, so typical consumer buying expectations are migrating into the business-to-business environment. Buyers want to use their mobile phones to find solutions, order parts and ask for help, all in a paperwork-free environment.

Mike continued: "Customers have a thirst for innovation which drives a need for technical advice. RS is

bridging the gap between device manufacturers and customers, allowing us to play a key role in helping customers achieve tailored solutions.

"For example, we are working with organisations that are using our component management skills and experience to help them handle large quantities of parts via line-side storage and vendor managed inventory."

From what has been described so far it is clear that distributors that simply list and supply products, primarily based on price, won't survive. Distributors must listen to their customers and then design and deliver services that meet these ever-changing needs via genuine partnerships.

Mike said: "An example of this type of partnership approach is the work we are doing to offset problems regarding industry wide shortages of certain component types. To start, we work hard to predict

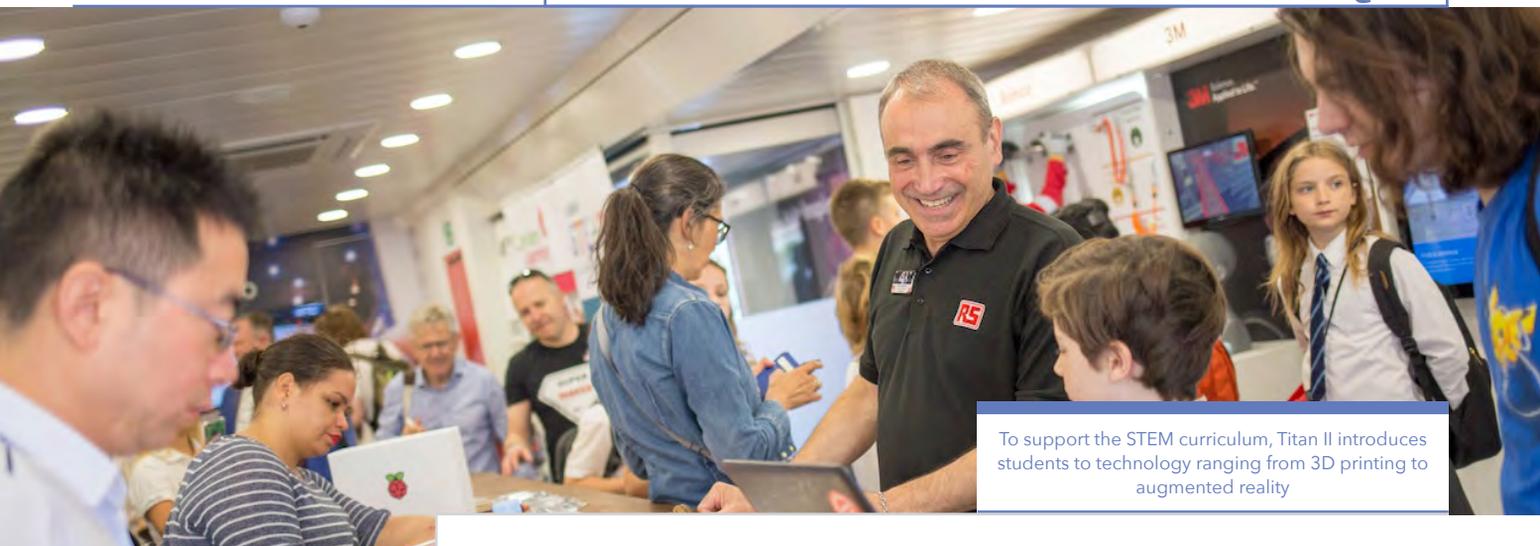
Titan II is a 35-tonne interactive truck designed to provide a mobile technology learning platform for students, customers and suppliers



## Customers have a thirst for innovation which drives a need for technical advice

which direction the market is moving. Then, as a global organisation we can use the advantage of businesses in the APAC and American regions to offer the opportunity of versatility regarding both what we stock and where we stock it."

Mike concluded: "Our biggest challenges for the future are: changing quickly enough to keep pace with the market; ensuring we are always listening to our customers; accurately predicting the direction the market is taking; and then adapting to those moves. We must keep innovating, trying new things, stretching boundaries, making bold investments and embracing new technologies like artificial intelligence and block chain. Future opportunities await businesses with clear vision, ambition and the confidence to make things happen."



To support the STEM curriculum, Titan II introduces students to technology ranging from 3D printing to augmented reality

## Titan of education

Titan II, a 35-tonne interactive truck, brings innovation to life by providing a hands-on experience of engineering and technology used in industry today. It showcases the latest innovations such as Raspberry Pi, 3D printing, robotics, the internet of things and thermal imaging, plus virtual reality and augmented reality.

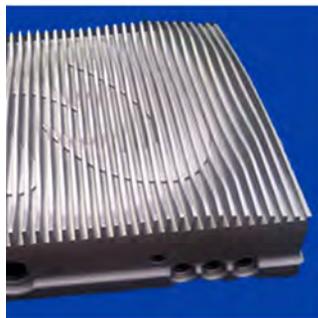
The truck is touring the UK and Ireland visiting schools, colleges and universities, exhibitions and events, as well as customers and suppliers.

Titan II replaced Titan I, which welcomed over 7,000 customers on board and enabled over 1,000 students to interact with technologies that support the STEM curriculum.

[uk.rs-online.com](http://uk.rs-online.com)



The truck is touring the UK and Ireland visiting schools, colleges and universities



[www.gelec.co.uk](http://www.gelec.co.uk)

# Getting the best from gaskets

*Electromagnetic interference can have serious effects if equipment is not adequately protected. Gaskets provide a solution, but there are a multitude of options available, as Kemtron's David Wall explains*

Think of electromagnetic interference as a form of pollution, or smog, that can affect electronic equipment that is not protected from its effects. EMI-related problems can range from annoying noises on the car radio, through to serious accidents when safety critical equipment is caused to malfunction.

## Protection as standard

The electromagnetic compatibility directive seeks to alleviate these issues. It came into force in 1992 with a transitional period ending in December 1995. The directive is designed to ensure that a device, equipment or system functions satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbance to anything in that environment.

Over the years, the directive has had a few changes, but

in principle, it remains the same. The latest iteration is EMC directive 2014/30/EU, which came into force in April 2016. Compliance is usually ensured by testing to standards or the manufacturer can provide a technical file to demonstrate compliance. Products also need to be CE marked before they can go to market in the EU.

## A mechanical fix

EMC shielding of an electronic enclosure is a mechanical fix for an electrical problem. The objective is to make the enclosure a Faraday cage, or to create lots of smaller Faraday cages within the enclosure. This is achieved using electrically conductive gaskets to seal any seams and gaps. It may also involve the use of components such as EMI shielded windows for shielding display devices, honeycomb ventilation panels, shielded cable glands

and metal cans for shielding components on the PCB. Filtering and absorption may be necessary and, of course, good design.

Various types of gaskets are available, and choice will depend on application. The most popular

are electrically conductive elastomers, which are silicones or fluorosilicones loaded with electrically conductive particles. These materials are available as extrusions in various standard or custom profiles, mouldings and sheets.

The most cost effective electrically conductive elastomer is nickel coated graphite in silicone, which boasts excellent shielding performance across a wide frequency range. Other fillers available are mainly silver based, such as silver-plated aluminium or copper. These materials are more electrically conductive but are considerably more expensive and the increase in shielding effectiveness is marginal, so they are best used in the most demanding of applications.

## Beryllium copper complications

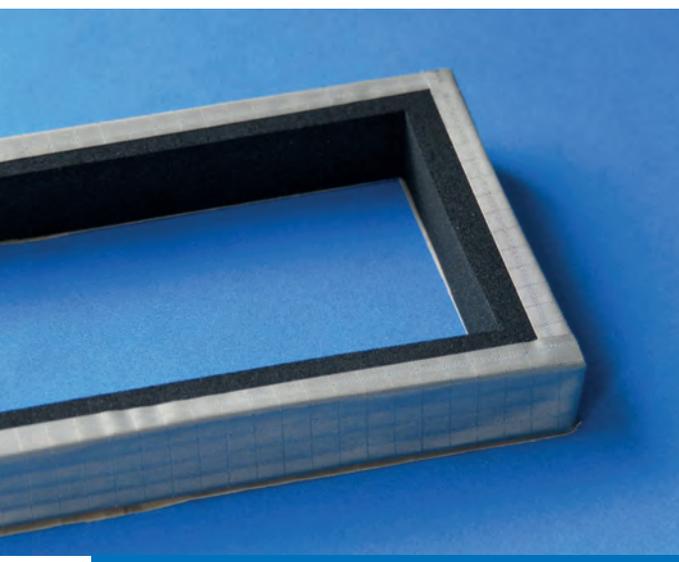
Beryllium copper fingers have been very popular, particularly for wiping applications such as card frames and knife edge door gaskets for shielded rooms. For other applications, however, alternative gasket



Knitted wire mesh is still widely used in the defense industry



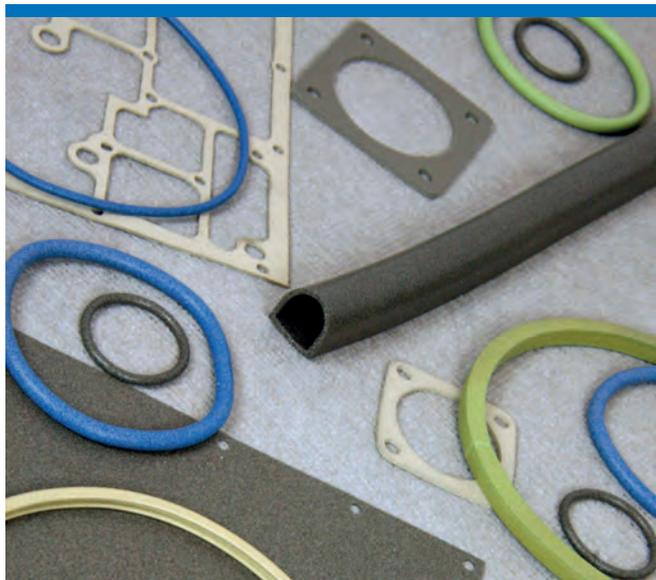
**Products need to be CE marked before they can go to market in the EU**



Electrically conductive fabric over foam gasket strip is popular in commercial applications



Conductive elastomers are available as extrusions in various standard or custom profiles, mouldings and sheets



types are becoming more popular.

Furthermore, there is a proposed EU ban of beryllium copper in the electronic products 'RoHS 2' regulation consultation pack 15. If this ban goes ahead, the impact on the electronics industry will be considerable as beryllium copper is used extensively in connectors, spring contacts and EMI/RFI shielding. There is currently no equivalent alternative that meets the electrical conductivity and spring characteristics of BeCu.

**Standard or custom profiles**  
Electrically conductive fabric over foam gasket strip is popular



in commercial applications. The material consists of a nickel and copper plated nylon over foam/sponge rubber. There are many standard profiles available to suit a myriad of applications. Bespoke half wrapped strips and fabricated gaskets give the added advantage of a galvanic neutral environmental seal.

In the defense industry, knitted wire mesh is still widely used for land systems where large profile metal gaskets are required for electromagnetic pulse applications. This is due to the high current carrying capability of knitted wire mesh. Knitted mesh is also still the most cost-effective EMC gasket, with the added advantage that it can be fabricated into complex gasket shapes when bonded to an environmental seal.

When sourcing EMC shielding products, it is important to talk to suppliers in the initial stages of a design as they will be able to help specify the correct profile and gasket material; one that can also address issues such as environmental sealing, galvanic compatibility, temperature range and chemical compatibility.

[www.kemtron.co.uk](http://www.kemtron.co.uk)

Beryllium copper fingers are particularly popular for wiping applications

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# Expect demand and capacity for organic light emitting diodes to increase

*More electronics manufacturers are opting to use OLEDs because the display technology delivers a superior picture and uses less energy than LCDs*



James Carbone

The global market for organic light emitting diodes (OLEDs) will post strong growth through 2022 as more cell phones, smart watches, televisions and other electronics equipment will use the display technology rather than liquid crystal displays (LCDs).

However, despite robust growth in demand for OLEDs, total OLED revenue will remain a fraction of sales of LCDs. The worldwide OLED market is forecast to increase from \$20.9 billion in 2018 to \$25 billion in 2019, according to researcher IHS Markit. Strong demand for OLEDs will continue over the next three years and the global OLED market will reach \$35 billion by 2022, the researcher said. At the same time, the LCD market will decline from about \$95 billion in 2018 to \$87.8 billion in 2022, IHS Markit said.

However, the OLED market has already eclipsed sales revenue of basic LEDs. The global LED market totaled \$13.2 billion in 2017 and will rise to \$19 billion in 2022, said IC Insights.

Jerry Kang, senior principal analyst, emerging display technologies and OLED for IHS Markit, said OLED sales are driven largely by the smart phones market. Brand name cell phone manufacturers, including Apple and Samsung have switched to OLEDs in their high-end phones such as the iPhone X and Galaxy 9, although OLEDs are more expensive than LCD displays.

The active-matrix OLED used in the iPhone X costs about \$110 and is the most expensive component in the phone, according to IHS. The OLED in

the Galaxy S9+ is also the most expensive component in the Samsung-built device, costing \$79, the researcher said.

Cell phone makers are switching from LCDs to OLEDs because OLEDs offer a better picture quality, a high contrast ratio and color representation compared to LCD. More OLEDs will also be used in other applications currently dominated by LCDs.

#### OLED use rises

OLEDs are increasingly being used in smart watches and other wearable electronics, computers, digital cameras and head-mounted displays, which are used in virtual reality devices.

However, smart phones are the biggest user for OLEDs, according to Claire Wen, principal research

analyst at Gartner Inc. More than 422 million active-matrix OLEDs were shipped for use in cell phones, compared to 30 million units for smart watches and 3.5 million for head-mounted displays in 2017, said Wen. About 1.7 million were shipped to television manufacturers.

"Smartphones are the main type of electronic equipment adopting active matrix OLEDs and will have a 63 per cent AMOLED adoption rate by 2021, up from a 22 percent adoption rate in 2016," said Wen

Demand for LEDs is rising in smart phones and other devices because compared to LCDs, OLEDs offer overall better image quality, higher brightness, a fuller viewing angle, a wider

## By the Numbers



**\$20.9 billion**

The size of the worldwide organic light emitting diode market in 2018. Source: IHS Markit



**1%**

The percentage of all organic light-emitting diode shipments that went to television manufacturers. Source: Gartner Inc.



**422 million**

The number of active-matrix OLEDs shipped to smart phone manufacturers in 2017. Source: Gartner Inc.



**40%**

The projected share of the worldwide global market that Chinese companies will have in 2021. Source: Gartner Inc.



**30%**

The amount OLED supply will increase each year through 2021. Source: Gartner Inc.



**\$35 billion**

The forecast size of the global OLED market in 2022. Source: IHS Markit



**22%**

The rate of use of OLEDs and smart phones in 2016



color range and much faster refresh rates, better durability and a broader temperature range, according to the website OLED-info. They can also be flexible and stretchable.

OLED uses a series of organic thin films and when electrical current is applied, light is emitted. They don't require a backlight, which LCDs do. LCD use LEDs for backlighting. Because backlighting is not required, OLEDs are more power efficient and slimmer than LCDs.

The downside of OLEDs is that they are more expensive to manufacture, have less of a lifetime than LCDs and can be hard to view in direct sunlight. But manufacturers are working to improve performance, reduce manufacturing costs and to extend lifetimes of the displays.

**Cost differences narrows**  
OLEDs are replacing LCDs in electronics equipment although they cost more, according to industry analysts. "The cost difference between LCD and OLED vary by the display specification," said Kang.

"Some rigid AMOLEDs for HD scale have started to catch up to LTPS (low temperature polysilicon LCD, but some flexible AMOLEDs

for QHD scale are 1.5 times higher than LTPS LCD," he said.

Kang added that panel makers don't want to equalise the price of AMOLED with LCD "anytime soon, because they believe AMOLED is superior" and is worth the higher price.

However, the cost of OLED's is declining which will make them more appealing to electronic equipment manufacturers and demand will increase over the next three to five years.

The good news for OLED buyers is that there is enough capacity in place to meet demand and more will be added over the next three years.

"Worldwide active matrix OLED supply will see a compound annual growth rate of 30 per cent from 2017 through 2021," said Wen. She said Samsung has been aggressively converting its existing LCD production lines into AMOLEDs.

**China eyes OLEDs**  
In addition, China is investing in OLED production. "China believes that AMOLEDs will give it an unprecedented opportunity to dominate a technology display supply chain," said Wen.

LEDs will have a compound annual growth rate of 7.5 percent through 2022 when the market will reach \$19 billion  
*Source: IC Insights*

### Steady growth for LEDs



She added, "if you look at capacity worldwide, Korean companies this year account for almost 80 per cent of worldwide capacity for active-matrix OLED," said Wen. China accounts for about 20 per cent.

However, China is investing more in OLED technology and manufacturing and in 2022, Korean OLED capacity share will be less than 50 per cent and China's share will increase to 40 per cent, according to Wen.

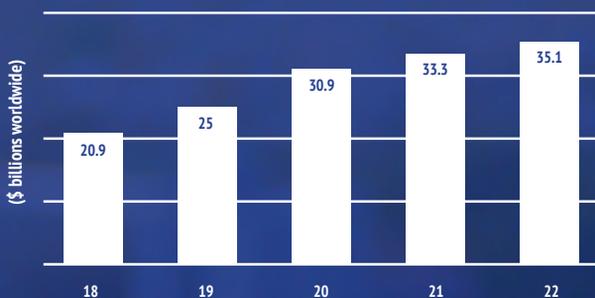
Most OLED capacity being added by manufacturers is for displays for smart phones and other smaller electronics equipment rather than larger devices such as televisions. However, eventually OLED manufacturers will produce larger OLEDs for televisions because of superior picture quality that will make OLED TVs more in demand. In 2017 only about 1 per cent of OLEDs were used in televisions, according to Wen.

Samsung, LG and EverDisplay are the leading manufacturers of OLEDs, but LG is the only manufacturer that is building OLEDs for televisions. In fact, LG is the leading manufacturer of OLED televisions, but it also supplies OLEDs to other TV makers.

Apple currently buys OLED from Samsung.

The company makes 55", 65" and 77" 4K OLED panels.

### OLEDs to post robust growth



The worldwide market for organic light emitting diode displays will rise steadily through 2022 when revenue will top \$35 billion  
*Source: IHS Markit*

# Eastern Europe viewed as alternative for low-cost electronics manufacturing

*Hungary, Bulgaria and other former Soviet Union controlled countries offer low-cost, state-of-the-art electronics manufacturing*

While the Asian-Pacific region is regarded by many in the electronics industry as the go-to location for low-cost labor, Eastern Europe has emerged as an alternative locale for the manufacturing of electronics equipment that will be sold in Europe.

Many OEM buyers involved in outsourcing decisions for their companies are finding that former Soviet-bloc countries such as Hungary, the Czech Republic, Poland, Bulgaria and others have competent workforces, reliable infrastructures and brand-name global EMS providers that offer the same manufacturing services that they do in North America and Asia.

As a result, the EMS industry in Eastern Europe is expanding and is forecast to grow from about \$34 billion in 2017 to \$43.6 billion in 2022, according to New Venture Research. "Poland is an attractive location because it's not only low-cost, but it has a good educational system and good infrastructure," said Randall Sherman, president and CEO of New Venture Research, based in Nevada City, Calif. Poland's electronics manufacturing services business totalled about \$3.4 billion in 2017, he said.

Hungary had the highest EMS revenue in 2017. Large global EMS companies such as Foxconn, Flex, Jabil and others provided about \$17.7 billion of manufacturing services for OEMs at facilities in Hungary. Flex has six manufacturing locations in Hungary, while Foxconn has four, said Sherman.

Romania had more than \$2.1 billion in EMS sales in 2017. Flex, Celestica, Plexus and Benchmark all have facilities in the country.

The equipment that EMS providers manufacture in Eastern European countries "is primarily for the European market," said Sherman. "They offer a low-cost alternative to Asia. They are capturing the assembly value," he said.

Sherman said EMS providers in Eastern Europe build a range of equipment for OEMs including industrial automation equipment, medical devices, automotive and aerospace systems among others. They also build some cell phones for the European market, but it's not a major focus.

EMS providers often do board assembly and box build for OEM customers in Eastern Europe. "They like to do box assembly, but with complex products that's not always possible," said Sherman. Complex electronic systems often have to be integrated and tested.

"That is something a lot of OEMs are not willing to give up," said Sherman.

## Outsourcing reluctance

In fact, many European companies are reluctant to outsource. "There is always the tendency to want to keep production in-house and not outsource," he said. Still many global and some European OEM choose to manufacture products in Eastern Europe that will be sold throughout Europe.

Some EMS providers have facilities in multiple Eastern European countries as well as in Western European nations. Case in point: Flex, based in Singapore, has more than 7.5 million square feet manufacturing space across 19 facilities in Europe, including factories in Hungary, Poland, Romania and Ukraine.

It operates design centres and manufacturing facilities and 10 logistics centres throughout Europe. "Generally, our design, engineering and innovation services are located close to customers, while manufacturing and to a lesser extent logistics services, tend to be carried out in Eastern Europe," said Radenko Prnja, Flex's vice president for EMEA region 1, which includes Italy, Hungary and Romania. "This facilitates the collaborative nature of our work with customers and offers a highly efficient and cost-effective manufacturing service.

He said growth of the Flex manufacturing footprint in Europe is the result of the EMS provider's growth in its core businesses of automotive, medical, energy and industrial. Such core business has driven manufacturing expansion in Hungary, Romania and Ukraine, according to Prnja.

Automotive is driving Eastern European business as more electronics are being designed into vehicles for driver assistance, safety, emissions control, electrification and connectivity, he said. "In the medical sector we see innovation in drug delivery systems and secure, real time monitoring and reporting on patient well being as a driver of new solutions" said Prnja,

He said while many of the products that Flex builds for OEMs in Eastern Europe are for local markets in Europe, others are designed in Europe and manufactured at other sites around the world.

One reason Eastern Europe is an attractive location for Flex is that it has an improving rail network including a link to China,



- Radenko Prnja, Flex's vice president for EMEA region 1

an excellent road system and a central position between the EU and Asia, said Prnja.

As a result, "Eastern Europe is witnessing a faster growth rate than its western counterpart or other emerging markets," said Prnja

He added that electronics manufacturing in Eastern Europe has now overtaken Western Europe in terms of value and is quickly becoming an attractive end market in its own right. "Because of the security, benefits and protections from European Union membership, and the lower inflation and increased consumer spending, we've witnessed some new consumer brands preferring to partner with Flex in Eastern Europe," said Prnja.

## Competition for labor

However, one challenge that could impact EMS business in Eastern Europe for Flex and other EMS providers is labor. "As the Eastern European countries prosper, unemployment

ELECTRONICS

# sourcing

## 2019 Industry Football Tournament

After the runaway success of 2018's tournament, the Electronics Sourcing Industry Football Tournament will be returning to Lancing's Culver Lane stadium for a third year on 23<sup>rd</sup> May 2019.

This is an open invitation to those who would like to participate in a day of sports and networking. Please contact the organiser – Electronics Sourcing's founder and publisher Mark Leary – at [sales@mmgpublishing.com](mailto:sales@mmgpublishing.com), or call 01892 613400 to confirm your registration.

Many thanks to GELEC and ECSN for sponsoring the event.



SAVE THE DATE – 23<sup>rd</sup> MAY 2019



## UK Electronic Components Industry Annual Dinner

In the evening Electronic Sourcing readers are invited to join us in Brighton for the ecsn dinner.

Guy Butters will provide an update on the football tournament and host an auction of football memorabilia, with donations going to a local charity "Albion in the Community"...



Our guest speaker is Brian Wood MC. Awarded the MC for gallantry in combat, Brian's engaging and inspirational talks take you into the battlefield during his experiences with the British Army



If you would like to join us and meet with friends, suppliers and colleagues please contact Jill Waite at [enquiries@ecsn-uk.org](mailto:enquiries@ecsn-uk.org)

levels decline and competition between employers for skilled people grows,” he said. While automation in the manufacturing process is increasing, that alone will not address a labor shortage.

“Collaboration between employers, governments, and universities is vital to ensure the flow of appropriately skilled applicants,” he said.

Another global EMS provider that has a large footprint in Eastern Europe is Jabil Circuit, based in St. Petersburg, Fla. The EMS provider has about 3 million square feet of manufacturing space in Europe, the Middle East and Africa including facilities in Poland, Hungary and Ukraine.

Bruno Solar, vice president of EMS Operations, Europe for Jabil, says Jabil’s facilities in Europe build systems for OEMs in the automotive and transportation, connected consumer technology and industrial segments.

Those facilities build “complete systems for OEM customers thanks to the integrated supply chain expertise Jabil has established,” said Solar.



**Today, our facilities are manufacturing state of the art telecommunications equipment and automotive electronics**

- Dietmar Guenther, executive vice president of Sanmina Manufacturing in Europe

While Flex and Jabil have facilities in multiple Eastern European countries, Benchmark

Electronics, based in Scottsdale, Ariz., has one factory in Brasov, Romania that has operated for the last 10 years. The factory, which employs between 600 to 700 workers, builds boards, subsystems and complete systems for medical equipment, industrial, and aerospace OEMs.

“For industrial, we do intelligence flow control, smart measurement systems,” said Mike Buseman, executive vice -president- global operations at Benchmark.” We are doing more and more complex integrated assembly work in that facility in the industrial sector.”

He added that Benchmark also builds patient monitoring equipment and other medical products at its Brasov facility. Medical will be a greater focus for Benchmark over the next several years.

“Benchmark’s engineers around the globe have a strong pedigree in medical products and we do the design work on a lot of the products” which are then built at Benchmark’s manufacturing facilities.

“We do everything from printed circuit board work to control circuitry to subassemblies that go into much larger systems,” for medical OEMs, said Buseman. He said that Benchmark will expand operations in Romania. “Our current view is focused on our footprint in Brasov. It is a very good location for us.” Buseman said he was “a big advocate of scaling” its existing facility rather than “having a number of smaller sites scattered all over.”

He added while Benchmark will expand its efforts in medical, industrial and aerospace, it has no plans to focus on telecom or computing sectors. “What we’ve seen so far is those customers are still designing in one global location and candidly still biased towards the Asian-Pacific region,” said Buseman.

Benchmark is also looking at building equipment for customers with “higher power applications.” Such applications could include alternative energy systems and industrial applications that are battery powered.



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- Mike Buseman, executive vice-president of global operations at Benchmark Electronics

**Growing supply base**

EMS providers say while their business is growing in Eastern Europe, so is the local and regional supply base. A local supply base has developed for many non-electronic production materials such as cable assemblies, plastic metal parts and enclosures.

“But electronic components are still the majority what we buy and those are imported from outside the region,” said Buseman.

However, sourcing semiconductors, passives and other electronics components is not an issue for EMS buyers in Eastern Europe because the electronics supply base is global, said Dietmar Guenther, executive vice president of Sanmina Manufacturing in Europe.

“Some electronic components such as connectors and some integrated circuits are manufactured in Europe,” he said. However, most semiconductors, passives and connectors are manufactured in Asia and are shipped to Europe and other locations, he said.

Guenther said when Sanmina designs a supply chain for an OEM customer, it focuses its on mechanical and larger components and sub-assemblies from suppliers in Europe. Benchmark purchases semiconductors, passives and other parts directly from component manufacturers, but also buys parts from global and regional distributors in Europe. “Depending on the distributor we use them in varying degrees

for supply chain services and supply chain design” as well as fulfillment, said Buseman.

**Sophisticated services**

Some veteran electronics industry executives say the EMS industry in Eastern Europe has evolved over the past 10 years and has become more technically sophisticated.

“Ten or fifteen years ago, when you considered Eastern Europe for manufacturing, you were probably thinking about low-cost, and high-volume operations,” said Guenther. “Today, our facilities are manufacturing state of the art telecommunications equipment and automotive electronics.”

He added that the printed circuit board assemblies produced are “incredibly complex,” requiring placement of 10,000 – 20,000 components per board. “These products require far higher levels of efficiency, quality and automation than 10 or 15 years ago.

Guenther said Sanmina has Eastern European facilities in Tatabanya and Miskolc, Hungary and Brno in the Czech Republic. The facilities manufacture the most complex telecommunications systems available today.

He said two of Sanmina’s Eastern European facilities also repair complex systems, including wireline and wireless communications systems, medical imaging, medical blood handling equipment, portable computers and retail scanning equipment.

Guenther added that all of Sanmina's facilities offer design for manufacturing services. "We have design managers in Europe who work with our design centres on PCBA and system design. We also help European customers with technology selection and supply chain design," he said.

Sanmina has been operating in Europe since 2000 and today employs almost 3,500 people in 10 facilities and nearly 1.4 million square feet of manufacturing space.

"Our focus is on highly-complex systems manufacturing. In Europe we manufacture some of the world's most advanced optical and RF telecommunications equipment," said Guenther. It also builds board and entire systems for OEMs in

the medical, aerospace and automotive markets.

For medical OEMs, Sanmina manufactures a range of complex systems including blood analysis, blood handlers, molecular diagnostics and navigated brain therapy and glucose monitoring devices.

In addition, automotive electronics systems manufactured by Sanmina are in some of the world's best-known automobiles. "We manufacture a wide range of automotive electronics including body controllers, infotainment systems and climate control systems, again with some produced on fully automated production lines," said Guenther.

He said automotive is a major growth area for Sanmina

in Eastern Europe. Because the auto industry is highly regulated, Sanmina's facilities are IATF 16949 certified. IATF16949 is a technical specification that defines quality management system requirements applicable in the automotive supply chain. "The need for high quality along with lower costs has driven Sanmina to implement several fully automated production lines for automotive subassemblies in eastern Europe," said Guenther.



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 Pycom  
 Q-Cee's / TE Connectivity  
 Qoitech  
 QT Brightek  
 Quadcept  
 Qualcomm  
 Qualcomm (RF360 - A Qualcomm &  
 TDK Joint Venture)  
 Qualtek Electronics Corp.  
 Quatech / B+B SmartWorx  
 Rabbit Semiconductor  
 (Digi International)  
 Radial Magnet, Inc.  
 Radiocrafts  
 RAF  
 RAFI  
 Ramtron (Cypress Semiconductor)  
 Raspberry Pi  
 Raychem Cable Protection /  
 TE Connectivity  
 RayVio

RECOM Power  
 Red Lion Controls  
 REDEL / LEMO  
 Renesas Electronics America  
 RF Digital  
 RF Solutions  
 RF360 - A Qualcomm-  
 TDK joint venture  
 Richco, Inc. (Essentra Components)  
 Richtek  
 Riedon  
 Rigado  
 Roederstein / Vishay  
 ROHM Semiconductor  
 Rose Bopla  
 Rose Enclosures  
 Rose+Krieger  
 Rosenberger  
 Roving Networks / Microchip  
 Technology  
 RPM Systems  
 Rubycon  
 RushUp  
 Sagrad  
 Samsung ARTIK  
 Samsung Electro-Mechanics  
 Samsung Semiconductor  
 Samtec, Inc.  
 Sanken Electric Co., Ltd.  
 Sanyo Denki  
 Sanyo Semiconductor /  
 ON Semiconductor  
 Schaffner EMC, Inc.  
 Schrack Relays / TE Connectivity  
 Schroff / nVent  
 Schurter  
 SCS  
 Seeed  
 Segger Microcontroller Systems  
 Seiko Instruments, Inc.  
 Semflex / Cinch Connectivity  
 Solutions  
 Semtech  
 Sensata Sensors Thermal Sensors  
 and Switches  
 Sensata Technologies  
 Sensata Technologies - Airpax  
 Sensata Technologies - BEI Sensors  
 Sensata Technologies - Crydom  
 Sensata Technologies - Kavlico  
 Pressure Sensors  
 Sensirion  
 Sensitron Semiconductor /  
 SMC Diode Solutions  
 Seoul Semiconductor  
 Seron Integrated  
 Serpac Electronic Enclosures  
 SGX Sensortech  
 Sharp Microelectronics  
 Sierra Wireless  
 Sigfox  
 Sigma Designs  
 Sigma Inductors / TE Connectivity  
 Signal Transformer  
 Silego Technology  
 Silicon Labs  
 SINE Systems / Amphenol  
 Siretta  
 SiTime  
 SkyTek  
 Skyworks Solutions, Inc.  
 SL Power Electronics - Manufacturer  
 of Condor / Ault Brands  
 SMC Diode Solutions  
 Soberton, Inc.  
 SOC Technologies (System-On-Chip  
 Technologies)  
 Socle Technology Corporation  
 SolidRun  
 Souriau Connection Technology  
 Spansion (Cypress Semiconductor)  
 SparkFun  
 Spec Sensors  
 Spectra Symbol  
 Spectra-Strip (Amphenol  
 Spectra-Strip)  
 Sprague Goodman  
 SSI Technologies, Inc.  
 SST Sensing  
 Stackpole Electronics, Inc.  
 Staco Energy Products Co.  
 Standex-Meder Electronics  
 Stanley Electric  
 Steinel  
 steute Wireless  
 Stewart Connector  
 STMicroelectronics  
 Storm Interface  
 Sullins Connector Solutions  
 Sumida Corporation  
 SunLED

Sunon  
 Susumu  
 SV Microwave (Amphenol SV  
 Microwave)  
 Swanstrom Tools  
 Swissbit  
 Switchcraft / Conxall  
 Syfer  
 Synapse Wireless  
 System-On-Chip Technologies  
 Tag-Connect  
 Taica Corporation  
 Taitien  
 Taiwan Semiconductor  
 Taiyo Yuden  
 Talema  
 Tallysman Wireless  
 Talon Communications, Inc.  
 Tamura  
 Taoglas  
 TAOS / ams  
 TDK Corporation  
 TDK InvenSense  
 TDK Micronas  
 TDK RF360  
 TDK Tronics (Tronics)  
 TDK-Lambda Americas, Inc.  
 TE Connectivity  
 TE Connectivity Aerospace Defense  
 and Marine  
 TE Connectivity ALCOSWITCH  
 Switches  
 TE Connectivity AMP Connectors  
 TE Connectivity Corcom Filters  
 TE Connectivity DEUTSCH Connectors  
 TE Connectivity DEUTSCH  
 INDUSTRIAL & COMMERCIAL  
 TRANSPORTATION  
 TE Connectivity Measurement  
 Specialties  
 TE Connectivity Potter & Brumfield  
 Relays  
 TE Connectivity Raychem Cable  
 Protection  
 TE Connectivity Raychem Circuit  
 Protection / Littelfuse  
 TE Connectivity's Agastat Relays  
 TE Connectivity's Axicom Relays  
 TE Connectivity's Buchanan  
 Terminal Blocks  
 TE Connectivity's CGS Resistors  
 TE Connectivity's CII  
 TE Connectivity's Elcon Connectors  
 TE Connectivity's Holsworthy  
 Resistors  
 TE Connectivity's Kilovac Relays  
 TE Connectivity's Neohm Resistors  
 TE Connectivity's OEG Relays  
 TE Connectivity's Products Unlimited  
 Transformers & Relays  
 TE Connectivity's Q-Cee's  
 TE Connectivity's Schrack Relays  
 TE Connectivity's Sigma Inductors  
 Teccor / Littelfuse  
 Techflex  
 TechNexion  
 Techno / Vishay  
 Techspray  
 TechTools  
 Telcodium  
 Teledyne LeCroy  
 Telit  
 Temp-Flex - a Molex company  
 Tensility International Corporation  
 Terasic Technologies  
 Test Products International (TPI)  
 TEWA Sensors LLC  
 Texas Instruments  
 t-Global Technology  
 Thales Visionix, Inc.  
 Thermometrics / GE Measurement  
 & Control  
 ThingMagic, a JADAK Brand  
 ThinXtra Solutions Limited  
 Thomas Research Products  
 TinyCircuits  
 TOKO / Murata  
 Torex Semiconductor Ltd.  
 Toshiba Memory America, Inc.  
 Toshiba Semiconductor and Storage  
 Touchstone Semiconductor  
 TPI (Test Products International)  
 TPK America LLC  
 TRACO Power  
 Transphorm

Trenz Electronic  
 Triad Magnetics  
 TRINAMIC Motion Control GmbH  
 Tripp Lite  
 Trompeter / Cinch Connectivity  
 Solutions  
 Tronics  
 TRP Connector  
 TSC (Taiwan Semiconductor)  
 TT Electronics  
 TT Electronics / BI Technologies  
 TT Electronics / IRC  
 TT Electronics / Optek Technology  
 TT Electronics / Welwyn  
 Tüchel / Amphenol  
 Twin Industries  
 TXC Corporation  
 Tyco Electronics  
 Tymphony (Peerless by Tymphony)  
 U.S. Sensor/Littelfuse  
 UD00  
 Ultra Librarian®  
 Ungar / Weller  
 United Chemi-Con  
 US-Lasers, Inc.  
 Varitronix International Ltd.  
 VCC (Visual Communications  
 Company)  
 VEAM  
 Vector Electronics & Technology, Inc.  
 Verivolt  
 VersaLogic Corporation  
 VersaSense  
 Vicor  
 Vicotree  
 Vifa (Peerless by Tymphony)  
 Viking Technology  
 Virtium Technology Inc.  
 Vishay  
 Vishay / BCcomponents  
 Vishay / Beyschlag  
 Vishay / Cera-Mite  
 Vishay / Dale  
 Vishay / Huntington Electric, Inc.  
 Vishay / Semiconductor -  
 Diodes Division  
 Vishay / Semiconductor -  
 Opto Division  
 Vishay / Sfernice  
 Vishay / Siliconix  
 Vishay / Spectrol  
 Vishay / Sprague  
 Vishay / Thin Film  
 Vishay / Vitramon  
 Visual Communications Company, LLC  
 Vitelc / Cinch Connectivity Solutions  
 Volgen (Kaga Electronics USA)  
 Volttronics (Knowles)  
 VPG Foil  
 VPG Micro-Measurements  
 VPG Sensors  
 Wakefield-Vette  
 Walsin Technology  
 Wandboard  
 WeEn Semiconductors Co., Ltd  
 Weidmüller  
 Weller  
 Welwyn / TT Electronics  
 Wickmann / Littelfuse  
 Wiha  
 WIMA  
 Winbond Electronics Corporation  
 Winchester Electronics  
 Wintec Industries  
 Wiss  
 WIZnet  
 Wolfsspeed - a Cree company  
 Woodhead - a Molex company  
 Würth Electronics  
 Würth Electronics iBE  
 Würth Electronics Midcom  
 Xcelite  
 Xeltek  
 Xilinx  
 XMOS  
 XP Power  
 Xsens  
 Yageo  
 Zentri (Silicon Labs)  
 Zetex Semiconductors  
 (Diodes Incorporated)  
 ZF Electronics  
 Zilog



**DIGIKEY.CO.UK LINECARD**

# Buyers' Guide

Manufacturer	Distributor	Telephone	Website	Franchised Distributor	No. of Lines for Principle	Stock Value for Principle	Minimum Order Value	% Lead Free for Principle Range	No. of Technical Support Staff	Total No. of Staff	Buffer Stock Facility
<b>CABLE ASSEMBLY &amp; HARNESSING</b>											
FTDI	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	100	N/A	£0	N/A	50	1,500+	Y
Molex	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	300	N/A	£0	97%	50	1,500+	Y
<b>CIRCUIT PROTECTION</b>											
Bourns	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	5000	N/A	£0	58%	50	1,500+	Y
EPCOS/TDK	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	5000	N/A	£0	58%	50	1,500+	Y
Littelfuse	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	35000	N/A	£0	67%	50	1,500+	Y
<b>DISPLAYS &amp; LEDs</b>											
Lascar Electronics		+44 (0)1794 884567	www.lascarelectronics.com/				£1		10	90	
NLT Technologies Ltd	Review Display System Ltd	01959 563345	www.review-displays.co.uk	Y	All	N/A	£0	N/A	6	25	Y
<b>ELECTROMECHANICAL</b>											
ALPHA WIRE	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	26,919	N/A	£0	97.04%	150	3500+	Y
CINCH CONNECTIVITY/Bel	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	31,120	N/A	£0	78.21%	150	3500+	Y
CUI INC	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	17,410	N/A	£0	92.21%	150	3500+	Y
DELTA PRODUCT GROUPS	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	3,215	N/A	£0	99.95%	150	3500+	Y
KEYSTONE ELECTRONICS	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	6,315	N/A	£0	95.17%	150	3500+	Y
Laird	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	15,187	N/A	£0	97.20%	150	3500+	Y
Murata	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	66,179	N/A	£0	99.79%	150	3500+	Y
OMRON ELECTRONICS INC-EMC DIV	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	74,369	N/A	£0	95.47%	150	3500+	Y
Panasonic	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	154,777	N/A	£0	94.42%	150	3500+	Y
TDK	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	60,769	N/A	£0	99.20%	150	3500+	Y
TE	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	338,106	N/A	£0	79.40%	150	3500+	Y
<b>ENCLOSURES</b>											
Bud	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	2,500	N/A	£0	80%	50	1,500+	Y
Hammond	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	12,500	N/A	£0	100%	50	1,500+	Y
Hammond	Switch Electronics	01482 862255	switchelectronics.co.uk	Y	500	N/A	£0	70%	2	6	Y
Metcase Enclosures	OKW Enclosures	01489 583858	www.metcase.co.uk	N	288	£40,000	£0	N/A	5	22	Y
OKW Enclosures Ltd	OKW Enclosures	01489 583858	www.okw.co.uk	N	1,955	£40,000	£0	N/A	5	22	Y
Rolec Enclosures	OKW Enclosures	01489 583858	www.rolec-enclosures.co.uk	Y	935	£40,000	£0	N/A	5	22	Y
Teko Enclosures	OKW Enclosures	01489 583858	www.teko.co.uk	Y	1,860	£40,000	£0	N/A	5	22	Y
<b>FREQUENCY MANAGEMENT</b>											
ABRACON	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,000	N/A	£0	91%	50	1,500+	Y
AEL Crystals Ltd	AEL Crystals Ltd	01293 789200	www.aelcrystals.co.uk	N	N/A	£200,000	£50	100%	3	15	Y
ECS	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	500	N/A	£0	99%	50	1,500+	Y
Epson	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	500	N/A	£0	59%	50	1,500+	Y
Golledge Electronics Ltd	Golledge Electronics Ltd	01460 256 100	www.golledge.com	N	N/A	£800,000	£0	100%	3	24	Y
Jauch Quartz	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	500	£250,000	0	100	15	130	Y
<b>HEATSINKS</b>											
Aavid	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	700	N/A	£0	67%	50	1,500+	Y
<b>ICs &amp; SEMICONDUCTORS</b>											
ALLEGRO MICROSYSTEMS, LLC	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	3,090	N/A	£0	87.22%	150	3500+	Y
Altera	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,600	N/A	£0	60.00%	50	1,500+	Y
ALTERA	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	10,901	N/A	£0	84.86%	150	3500+	Y



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# Buyers' Guide

Manufacturer	Distributor	Telephone	Website	Franchised Distributor	No. of Lines for Principle	Stock Value for Principle	Minimum Order Value	% Lead Free for Principle Range	No. of Technical Support Staff	Total No. of Staff	Buffer Stock Facility
<b>ICs &amp; SEMICONDUCTORS (continued)</b>											
ANALOG DEVICES INC	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	52,308	N/A	£0	73.79%	150	3500+	Y
Analog Devices Inc.	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	9,500	N/A	£0	83.00%	50	1,500+	Y
Atmel	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,700	N/A	£0	58.00%	50	1,500+	Y
Avago Technologies	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	400	N/A	£0	84.00%	50	1,500+	Y
AVAGO TECHNOLOGIES US INC	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	16,512	N/A	£0	91.38%	150	3500+	Y
Broadcom	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	100	N/A	£0	69%	50	1,500+	Y
Cirrus Logic	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	300	N/A	£0	80.00%	50	1,500+	Y
Cypress Semiconductor	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,400	N/A	£0	63.00%	50	1,500+	Y
CYPRESS SEMICONDUCTOR CORP	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	27,423	N/A	£0	92.54%	150	3500+	Y
DIGI INTERNATIONAL	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	4,355	N/A	£0	95.30%	150	3500+	Y
Diodes Incorporated	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,600	N/A	£0	98%	50	1,500+	Y
DIODES INCORPORATED	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	38,292	N/A	£0	90.02%	150	3500+	Y
Exar	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,100	N/A	£0	95.00%	50	1,500+	Y
Fairchild Semiconductor	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	2,500	N/A	£0	90.00%	50	1,500+	Y
Freescale Semiconductor	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	2,500	N/A	£0	42.00%	50	1,500+	Y
FTDI	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	100	N/A	£0	97%	50	1,500+	Y
FTDI	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	569	N/A	£0	100.00%	150	3500+	Y
IDT (Integrated Device Technology)	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	2,100	N/A	£0	97%	50	1,500+	Y
Infineon	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	800	N/A	£0	66.00%	50	1,500+	Y
INFINEON TECHNOLOGIES	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	28,850	N/A	£0	93.70%	150	3500+	Y
Intel	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	500	N/A	£0	78%	50	1,500+	Y
International Rectifier	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	600	N/A	£0	87.00%	50	1,500+	Y
Intersil	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,900	N/A	£0	50.00%	50	1,500+	Y
ISSI	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	700	N/A	£0	98.00%	50	1,500+	Y
Laird	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	15,187	N/A	£0	97.20%	150	3500+	Y
Lattice	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	700	N/A	£0	69%	50	1,500+	Y
LINEAR TECHNOLOGY	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	37,479	N/A	£0	77.62%	150	3500+	Y
Maxim Integrated	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	11,200	N/A	£0	67.00%	50	1,500+	Y
MAXIM INTEGRATED	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	68,021	N/A	£0	78.22%	150	3500+	Y
Microchip	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	12,600	N/A	£0	91.00%	50	1,500+	Y
MICROCHIP TECHNOLOGY	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	86,517	N/A	£0	86.12%	150	3500+	Y
Microsemi	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	400	N/A	£0	90%	50	1,500+	Y
Monolithic Power Systems (MPS)	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	600	N/A	£0	40%	50	1,500+	Y
NEXPERIA USA INC	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	23,513	N/A	£0	99.29%	150	3500+	Y
NXP	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	3,900	N/A	£0	91%	50	1,500+	Y
NXP USA INC	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	36,258	N/A	£0	93.55%	150	3500+	Y
ON Semiconductor	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	5,100	N/A	£0	87%	50	1,500+	Y
ON SEMICONDUCTOR	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	87,298	N/A	£0	85.61%	150	3500+	Y
Power Integrations	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	600	N/A	£0	59%	50	1,500+	Y
Qorvo	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	300	N/A	£0	90.00%	50	1,500+	Y
Rohm	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	55,139	N/A	£0	99.85%	150	3500+	Y
ROHM Semiconductor	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,400	N/A	£0	55.00%	50	1,500+	Y
Samsung	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	37,336	N/A	£0	100.00%	150	3500+	Y
Silicon Laboratories	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,500	N/A	£0	96%	50	1,500+	Y
SILICON LABORATORIES INC	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	19,667	N/A	£0	96.54%	150	3500+	Y
Skyworks	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	300	N/A	£0	91%	50	1,500+	Y
Spansion Inc.	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	600	N/A	£0	93.00%	50	1,500+	Y
STMicroelectronics	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	4,500	N/A	£0	99%	50	1,500+	Y
STMICROELECTRONICS	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	39,201	N/A	£0	97.79%	150	3500+	Y



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<b>ICs &amp; SEMICONDUCTORS (continued)</b>											
TDK	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	60,769	N/A	£0	99.20%	150	3500+	Y
Texas Instruments	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	36,900	N/A	£0	41%	50	1,500+	Y
TEXAS INSTRUMENTS	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	180,012	N/A	£0	91.94%	150	3500+	Y
Toshiba	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	500	N/A	£0	100.00%	50	1,500+	Y
Vishay	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	581,798	N/A	£0	87.71%	150	3500+	Y
XILINX INC	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	8,213	N/A	£0	51.46%	150	3500+	Y
<b>INDUSTRIAL GRADE MEMORY MODULES</b>											
InnoDisk	Simms	01622 852 848	www.simms.co.uk	N	300+	N/A	N/A	N/A	3	N/A	Y
<b>INTERCONNECTION</b>											
3M	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	3,100	N/A	£0	16%	50	1,500+	Y
3M	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	62,421	N/A	£0	93.42%	150	3500+	Y
Amphenol	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	25,600	N/A	£0	53%	50	1,500+	Y
AMPHENOL RF DIVISION	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	443,368	N/A	£0	75.92%	150	3500+	Y
Anderson Power Products	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	800	N/A	£0	50%	50	1,500+	Y
Cinch Connectivity Solutions	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,900	N/A	£0	82%	50	1,500+	Y
CINCH CONNECTIVITY/Bel	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	31,120	N/A	£0	78.21%	150	3500+	Y
Delphi Connection Systems	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	3,300	N/A	£0	67.00%	50	1,500+	Y
FCI	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	4,300	N/A	£0	94%	50	1,500+	Y
Glenair	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,900	N/A	£0	76.00%	50	1,500+	Y
HARTING	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	4,700	N/A	£0	31%	50	1,500+	Y
Harwin	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	2,200	N/A	£0	79%	50	1,500+	Y
Hellermann Tyton	Lane Electronics	01403 790661	www.fclane.com	Y	N/A	N/A	N/A	N/A	N/A	N/A	Y
Hirose Electric	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	6,100	N/A	£0	99%	50	1,500+	Y
HIROSE ELECTRIC CO LTD	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	37,215	N/A	£0	90.98%	150	3500+	Y
Huber+Suhner	Lane Electronics	01403 790661	www.fclane.com	Y	766	£116,000	£0	100%	6	38	Y
ITW McMurdo	Lane Electronics	01403 790661	www.fclane.com	Y	866	£219,000	£0	100.00%	6	38	Y
JAE Electronics	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,200	N/A	£0	32%	50	1,500+	Y
JST SALES AMERICA INC	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	5,109	N/A	£0	84.32%	150	3500+	Y
Kycon	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	700	N/A	£0	99%	50	1,500+	Y
LEMO	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	2,900	N/A	£0	65%	50	1,500+	Y
Molex	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	16,900	N/A	£0	75%	50	1,500+	Y
MOLEX, LLC	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	120,034	N/A	£0	97.98%	150	3500+	Y
Neutrik	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,000	N/A	£0	86%	50	1,500+	Y
Phoenix Contact	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	12,000	N/A	£0	99.00%	50	1,500+	Y
PHOENIX CONTACT	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	54,845	N/A	£0	99.99%	150	3500+	Y
Polamco	Lane Electronics	01403 790661	www.fclane.com	Y	218	£146,000	£0	100%	6	38	Y
Positronic	Lane Electronics	01403 790661	www.fclane.com	Y	N/A	N/A	N/A	N/A	N/A	N/A	Y
SAMTEC INC	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	427,448	N/A	£0	99.99%	150	3500+	Y
Souriau	Lane Electronics	01403 790661	www.fclane.com	Y	1,929	£806,000	£0	100%	6	38	Y
Switchcraft	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	2,200	N/A	£0	69%	50	1,500+	Y
TE	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	338,106	N/A	£0	79.40%	150	3500+	Y
TE Connectivity	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	30,900	N/A	£0	40%	50	1,500+	Y
<b>OBSOLESCENCE / HARD TO FIND</b>											
	America II Europe	01462 707070	www.americaiiurope.com	N/A	1,900	\$1B	£0	75%	59	500+	Y
	Cyclops Electronics	01904 415 415	www.cyclops-electronics.com	N/A	177,232	£5M	£100	75%	3	78	Y



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# Buyers' Guide

Manufacturer	Distributor	Telephone	Website	Franchised Distributor	No. of Lines for Principle	Stock Value for Principle	Minimum Order Value	% Lead Free for Principle Range	No. of Technical Support Staff	Total No. of Staff	Buffer Stock Facility
<b>OPTO ELECTRONICS</b>											
Avago Technologies	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	8,200	N/A	£0	89%	50	1,500+	Y
Cree, Inc.	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	22,500	N/A	£0	74%	50	1,500+	Y
Dialight	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	9,800	N/A	£0	99%	50	1,500+	Y
Kingbright	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	3,100	N/A	£0	100%	50	1,500+	Y
Lumileds	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,100	N/A	£0	99%	50	1,500+	Y
NEC	Review Display System Ltd	01959 563345	www.review-displays.co.uk	Y	200	£200,000	£0	100%	5	20	Y
Newhaven Display	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	700	N/A	£0	65%	50	1,500+	Y
Osram Opto Semiconductor	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	2,800	N/A	£0	99%	50	1,500+	Y
VCC	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	5,000	N/A	£0	92%	50	1,500+	Y
Vishay	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	3,100	N/A	£0	99%	50	1,500+	Y
<b>PASSIVES</b>											
ABRACON LLC	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	41,991	N/A	£0	100.00%	150	3500+	Y
AVX	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	70,700	N/A	£0	58.00%	50	1,500+	Y
AVX CORPORATION	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	70,131	N/A	£0	89.28%	150	3500+	Y
Bourns	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	49,500	N/A	£0	98%	50	1,500+	Y
BOURNS INC	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	59,314	N/A	£0	82.47%	150	3500+	Y
CINCH CONNECTIVITY/Bel	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	31,120	N/A	£0	78.21%	150	3500+	Y
Coilcraft	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	10,400	N/A	£0	98%	50	1,500+	Y
Cornell Dubilier	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	33,000	N/A	£0	65.00%	50	1,500+	Y
EPCOS / TDK	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	31,000	N/A	£0	74.00%	50	1,500+	Y
Fair-Rite	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,000	N/A	£0	94.00%	50	1,500+	Y
HONEYWELL MICROELECTRONICS & PRECISION SENSORS	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	28,560	N/A	£0	89.87%	150	3500+	Y
Kemet	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	135,800	N/A	£0	93%	50	1,500+	Y
KEMET	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	101,257	N/A	£0	91.57%	150	3500+	Y
KOA Speer	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	107,900	N/A	£0	82%	50	1,500+	Y
Laird	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	15,187	N/A	£0	97.20%	150	3500+	Y
Laird Technologies	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,800	N/A	£0	50.00%	50	1,500+	Y
LITTELFUSE INC	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	59,517	N/A	£0	91.54%	150	3500+	Y
Murata	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	66,179	N/A	£0	99.79%	150	3500+	Y
Murata	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	67,300	N/A	£0	99%	50	1,500+	Y
Nichicon	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	21,600	N/A	£0	47.00%	50	1,500+	Y
NICHICON	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	39,747	N/A	£0	96.70%	150	3500+	Y
Ohmite	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	17,300	N/A	£0	99.00%	50	1,500+	Y
Panasonic	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	154,777	N/A	£0	94.42%	150	3500+	Y
Panasonic	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	67,900	N/A	£0	69.00%	50	1,500+	Y
Rohm	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	55,139	N/A	£0	99.85%	150	3500+	Y
Samsung	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	37,336	N/A	£0	100.00%	150	3500+	Y
Taiyo Yuden	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	6,400	N/A	£0	82%	50	1,500+	Y
TAIYO YUDEN	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	21,540	N/A	£0	99.97%	150	3500+	Y
TDK	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	60,769	N/A	£0	99.20%	150	3500+	Y
TDK	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	25,300	N/A	£0	85.00%	50	1,500+	Y
TE	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	338,106	N/A	£0	79.40%	150	3500+	Y
TT Electronics	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	32,800	N/A	£0	55%	50	1,500+	Y
United Chemi-Con (UCC)	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	13,900	N/A	£0	99.00%	50	1,500+	Y
Vishay	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	581,798	N/A	£0	87.71%	150	3500+	Y
Vishay	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	119,800	N/A	£0	76%	50	1,500+	Y
Würth Electronics	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	4,500	N/A	£0	63%	50	1,500+	Y
WURTH ELECTRONICS INC	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	23,733	N/A	£0	100.00%	150	3500+	Y



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<b>PASSIVES (continued)</b>											
Yageo	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	45,300	N/A	£0	99%	50	1,500+	Y
YAGEO	Digi-Key Electronics	0800 587 0991	www.digikey.co.uk	Y	147,833	N/A	£0	84.31%	150	3500+	Y
<b>POWER &amp; BATTERIES</b>											
Bel Power Solutions	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,400	N/A	£0	94.00%	50	1,500+	Y
Cincon	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	5,500	N/A	£0	60%	50	1,500+	Y
Cosel	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	11,800	N/A	£0	99%	50	1,500+	Y
CUI Inc.	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	3,900	N/A	£0	100%	50	1,500+	Y
FRiWO Gerätebau GmbH	Haredata Electronics	01423 796240	www.haredata.co.uk	Y	250 - 500	€1M	£250	100%	7	14	Y
Jauch Quartz		01276 605900	www.jauch.com			£500,000	0	95	15	130	Y
Mean Well	Ecopac (UK) Power Ltd	01844 204420	www.ecopacpower.co.uk	Y	6,000	£2M	£0	100%	8	30	Y
Mean Well	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	4,500	N/A	£0	75%	50	1,500+	Y
Murata	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	5,200	N/A	£0	93%	50	1,500+	Y
RECOM	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	23,300	N/A	£0	92%	50	1,500+	Y
Schaffner	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	900	N/A	£0	98%	50	1,500+	Y
SL Power	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	2,100	N/A	£0	87%	50	1,500+	Y
TDK-Lambda	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	4,600	N/A	£0	99%	50	1,500+	Y
TRACO Power	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	3,400	N/A	£0	95%	50	1,500+	Y
<b>SENSORS</b>											
All Sensors	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	2,300	N/A	£0	70.00%	50	1,500+	Y
ams	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	400	N/A	£0	77%	50	1,500+	Y
Analog Devices Inc.	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	500	N/A	£0	78%	50	1,500+	Y
Bosch	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	100	N/A	£0	94.00%	50	1,500+	Y
Freescale Semiconductor	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,000	N/A	£0	66%	50	1,500+	Y
Honeywell	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	15,500	N/A	£0	80%	50	1,500+	Y
Maxim Integrated	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	900	N/A	£0	N/A	50	1,500+	Y
Melexis	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	700	N/A	£0	N/A	50	1,500+	Y
Omron	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	5,700	N/A	£0	N/A	50	1,500+	Y
Sensirion	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	100	N/A	£0	N/A	50	1,500+	Y
TE Connectivity	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,100	N/A	£0	N/A	50	1,500+	Y
<b>SWITCHES &amp; KEYBOARDS</b>											
ALPS	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	400	N/A	£0	70.00%	50	1,500+	Y
Apem	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	700	N/A	£0	96%	50	1,500+	Y
C&K Components	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,500	N/A	£0	84%	50	1,500+	Y
Carlting Technologies	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	300	N/A	£0	87%	50	1,500+	Y
CHERRY	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	200	N/A	£0	77%	50	1,500+	Y
EAO Ltd	EAO Ltd	01444 236000	www.eao.co.uk	N	5,000	£500,000	£150	100%	6	22	Y
E-Switch	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	700	N/A	£0	94%	50	1,500+	Y
Grayhill	EAO Ltd	01444 236000	www.eao.co.uk	Y	2,300	£150,000	£150	99%	6	22	Y
Grayhill	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	400	N/A	£0	84.00%	50	1,500+	Y
Honeywell	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	700	N/A	£0	98%	50	1,500+	Y
NKK Switches	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,100	N/A	£0	94%	50	1,500+	Y
Omron	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	900	N/A	£0	68%	50	1,500+	Y
TE Connectivity	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	400	N/A	£0	98%	50	1,500+	Y



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<b>TERMINAL BLOCKS</b>											
Marathon Special Products	Global Supply Services	01904 436 488	www.global-supply-services.com	Y	8,000	£800,000	£100	100%	3	11	Y
<b>THERMAL MANAGEMENT</b>											
ADDA	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	800	N/A	£0	59.00%	50	1,500+	Y
Delta Electronics	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	500	N/A	£0	28%	50	1,500+	Y
ebm-papst	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	2,200	N/A	£0	99%	50	1,500+	Y
Sanyo Denki	EAO Ltd	01444 236000	www.eao.co.uk	Y	300	£150,000	£150	99%	6	22	Y
Sanyo Denki	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	2,900	N/A	£0	N/A	50	1,500+	Y
Sunon	G.English Electronics Ltd	0208 855 0991	www.gelec.co.uk	Y	3,500	£1,000,000+	£0	100%	10	28	Y
Sunon	Thermaco Ltd	01684 566163	www.thermaco.co.uk	Y	3,500	£230,000	£100	100%	6	12	Y
<b>TRANSFORMERS &amp; INDUCTORS</b>											
Best Windings	Best Windings	0044 (0)1394 448424	www.bestwindings.co.uk	N	300	N/A	£100	N/A	2	14	Y
<b>WIRELESS SOLUTIONS</b>											
Anaren	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	100	N/A	£0	86.00%	50	1,500+	Y
B&B Electronics	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	100	N/A	£0	87%	50	1,500+	Y
Bluegiga Technologies	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	100	N/A	£0	93.00%	50	1,500+	Y
Digi International	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	200	N/A	£0	92%	50	1,500+	Y
Laird Technologies	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	100	N/A	£0	76%	50	1,500+	Y
Linx Technologies	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	100	N/A	£0	99%	50	1,500+	Y
Microchip	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	100	N/A	£0	85%	50	1,500+	Y
Murata	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	100	N/A	£0	100%	50	1,500+	Y
Panasonic	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	100	N/A	£0	91%	50	1,500+	Y
Redpine Signals	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	100	N/A	£0	94%	50	1,500+	Y
RF Digital	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	100	N/A	£0	100%	50	1,500+	Y
Texas Instruments	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	100	N/A	£0	75%	50	1,500+	Y
Wi2Wi	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	100	N/A	£0	36%	50	1,500+	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
AWS Electronics Group	01782 753200	www.awselectronicsgroup.com	£40m	UK & Slovakia	430	11	AS9100, ISO9001, 13485, 14001, TS16949, IPC-A-610 Class 3, NADCAP	Y	Y	Y	Y	Y	Y
Axiom Manuf. Services	01495 242130	www.axiom-ms.com	£40m	SW	300	3	ISO9001, AS9100, ISO13485, ISO14001, SC21, IPC610E, BSI Kitemark, NADCAP, ISO27001	Y	Y	Y	Y	Y	Y
Briton EMS Ltd (OSI Electronics)	01234 266300	www.britonems.co.uk	£12m	Bedford & Singapore	100	3	ISO: 9001, 13485, 14001, AS9100, BSI Kitemark IPC610	Y	Y	Y	Y	Y	Y
Challenger Solutions Ltd	01245 325252	www.challengersolutions.com	£5m	Essex/SE	55	7	ISO 9001, 14001, UL IPC-610, SC21	Y	Y	Y	Y	Y	Y
CML Innovative Technologies (uk) Ltd	01284 714700	WWW.CML-IT.com	£12M	UK/EU/China	65		ISO9001 TS16949 UL	N	Y	Y	Y	Y	Y
Contract Production Limited	01751 475950	www.contract-production.co.uk	£1.9m	North Yorkshire	20	2	ISO9001:2015, IPC-A-610 Class 3	Y	Y	Y	Y	Y	Y
Corintech Ltd	+44 (0)1425 655655	www.corintech.com	£7.5m	UK	72	3	AS9100, ISO9001, IPC-A-610 Class 3	Y	Y	Y	Y	Y	Y
CSI EMS Ltd	01376 500050	www.csiems.co.uk	£5m	Essex	50	3	ISO 9001, UL, IPC610	Y	Y	Y	Y	Y	Y
CT Production Ltd	01202 687633	www.ctproduction.co.uk	£4.5m	Poole, Dorset	55	3	ISO9001:2015, AS9100, SC21 Bronze Award	Y	Y	Y	Y	Y	Y
Custom Interconnect Ltd	01264 321321	www.cil-uk.co.uk	£14m	Andover (Hampshire)	130	6	ISO 9000, IPC610, ISO 13485	Y	Y	Y	Y	Y	Y
DJ Assembly	01904 436 456	www.djassembly.com	£1.25m	North Yorkshire	15	2	ISO9001:2008, IPC-A-610 Class 3	Y	Y	Y	Y	Y	Y
Dynamic EMS Ltd	01383 822911	www.dynamic-ems.com	£9m	Scotland	94	3	ATEX, ISO9001:2015, OHSAS18001, IPC-610-F class 3, ISO14001, ISO 13485, UL	Y	Y	Y	Y	Y	Y

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## Contract Manufacturers Buyers' Guide (continued)

Manufacturer	Telephone	Website	Turnover	Location	Employees	Number of Surface Mount Lines	Approvals	BCA Capacity	Lead Free Manufacturer	Prototyping	Design Capability	Full Turnkey	Cables and Harnessing
Electrica Limited	0161 343 7575	www.electricalimited.com	£1.75m	Cheshire	26	3	BSI ISO 9001:2015, IPC-A-610 to Class 3, IPC-J-STD-001, Cert IPC Trainer, UL	Y	Y	Y	Y	Y	Y
Electronic Technicians Ltd	01202 897722	www.etuk.co.uk	£3.5m	SE	55	2	AS9100, ISO9001, ISO14001, IPC610/620 Class 3	Y	Y	Y	Y	Y	Y
Elite Electronic Systems Ltd	028 6632 7172	www.elitees.com	£20m	UK	200	5	ISO9001, ISO13485, UL, IPC610/620 Class 3	Y	Y	Y	Y	Y	Y
Esprit Electronics Ltd	02380 455411	www.espritelectronics.com	£9m	S/Malaysia	80	4	ISO9001:2008, IPC610 to Class 3	Y	Y	Y	Y	Y	Y
Fabrinet UK	01249 814081	www.fabrinetuk.co.uk	£21m	UK/Thailand/US	210	5/31/2	AS9100/NADCAP/EN13485/OHSAS18001/14001/9001/TS16949/FDA/ATEX	Y	Y	Y	Y	Y	Y
FermionX Ltd	+44(0)1903 524600	www.fermionx.com	£5m	Worthing, W. Sussex	40	4	ISO9001, ISO14001, IPC-A-610	Y	Y	Y	Y	Y	Y
G&B Electronic Designs Ltd	01420 474188	www.gandbelectronics.co.uk	£4.2m	Hampshire	60	2	ISO9001, ISO13485, IPC-A-610, IPC-J-STD-001, IPC 7711/7721, BS EN 61340-5-1 (ESD)	Y	Y	Y	Y	Y	Y
Hallmark Electronics Ltd	01782 562255	www.hallmarkelectronics.com	£2m	M	26	2	ISO9000/UL, IPC610/D	Y	Y	Y	Y	Y	Y
Icon Electronics Limited	01423 798294	www.iconelectronics.co.uk	£6.5m	Hampshire & Yorkshire	70	6	AS9100, ISO9001, BS EN ISO/IEC 80079-34:2011 ATEX, IPC-A-610 Class3	Y	Y	Y	Y	Y	Y
Industrial Electronic Wiring Ltd.	+44(0)1793 694033	www.view.co.uk	£4.5 m	Swindon, UK	60	N/A	ISO9001:2008, IPC610, IPC620	N	Y	Y	N	Y	Y
Jaltek	01582578170	jaltek.com	£8m	UK	80	3	AS9100, ISO9001, ISO13485, IPC-A-610 Class 3, Certified IPC Trainer (IPC-A-610, J-STD-001 & J-STD-001 Space Addendum)	Y	Y	Y	Y	Y	Y
JJS Manufacturing Ltd	01455 555500	www.jjsmanufacturing.com	£35m	Bedford, Luttworth, (CZ)	420	3	ISO9001:2015, ISO14001:2015, IPC 610 A class 2&3	Y	Y	Y	Y	Y	Y
Lacon Electronic	+44 (0) 7836 338122	www.lacon.de/en	50m	Germany/Romania	500	13	ISO9001, ISO14001, ISO13485, TS16949, OHSAS18001, VG96927, UL	Y	Y	Y	Y	Y	Y
Nemco Limited	01438 346600	www.nemco.co.uk	£13.4m	SE	120	6	AS9100, ISO9001:2008, IPC610/620 to Class 3, ISO14001:2004, SC21	Y	Y	Y	Y	Y	Y
NOTE	01453 797580	www.note.eu	£100m	UK/EU/China	1,000	14	ISO9001, 13485, 14001, 18001, IPC-610 Class 3	Y	Y	Y	Y	Y	Y
M-TEK (Assembly) Ltd	01189 455377	www.mtek.co.uk	£2.4m	SE	30	4	ISO9001:2008/IPC-A-610 Class 3/WHMA-620/ISO14001:2004/IPC-7711/7721	Y	Y	Y	Y	Y	Y
Pektron	01332 832424	www.pektron.com	£50m	E-Midlands	350	8	ISO9001, ISO14001, TS16949, BEAB, VCA, TUV, UL	Y	Y	Y	Y	Y	Y
Protronix EMS	01582 418490	www.protronix.co.uk	£2.5m	Luton	10	2	ISO9001:2015, IPC-A610	Y	Y	Y	Y	Y	Y
Season Electronics Limited	02392 452222	www.seasongroup.com	£5m/£95m	Havant/Global	65/1800	2/18	(AS9100 & ISO9001 in UK) (TS16949 & ISO13485 at sister sites)	Y	Y	Y	Y	Y	Y
Simtek EMS Ltd	01843 233120	www.simtekems.co.uk	£6m	SE	60	3	ISO9001:2008, ISO13485, IPC-A-610 Class 3 & IPC-7711	Y	Y	Y	Y	Y	Y
Speedboard Assembly Services	01753 746700	www.speedboard.co.uk	£12.8m	Windsor, SE	99	4	IPC610 to Class 3, ISO9001:2015	Y	Y	Y	N	Y	Y
Tenkay Electronics Ltd	01903 855455	www.tenkay.co.uk	£4.1m	West Sussex	50	1	ISO 9001:2008, ISO 14001:2004, OHSAS 18001:2007	N	Y	N	N	Y	Y
TEXCEL TECHNOLOGY PLC	+44(0)132621700	www.texceltechnology.com	£14.5m	SE	126	7	ISO9001, ISO14001, IPC610 Class 3	Y	Y	Y	Y	Y	Y
Tioga Limited	01332 360884	www.tioga.co.uk	£15m	Derby	110	6	ISO 9001:2015, ISO 13485:2016, IPC 610, IPC 7711/7721	Y	Y	Y	Y	Y	Y
Trojan Electronics Limited	01792 469020	www.trojanelectronics.co.uk	£2m	South Wales	20	2	BS EN ISO 9001 2008, ISO 14001 2007	Y	Y	Y	Y	Y	Y
Wilson Process Systems	01424 722222	www.wps.co.uk	£12m	SE	100	4	ISO9001:2015, IPC-A-610 Class 3	Y	Y	Y	Y	Y	Y

## PCB Buyers' Guide

Manufacturer	Telephone	Website	Service Provided (ie Broker, Manufacture &/or Repair)	Location	Approvals	Volume - Small, Medium, Large	Double-sided	Multi-layer 4-10/10-20-30	Metal PCBs	Flexi / Flex-Rigid	Obsolete Solutions	Modifications	Prototyping
ABL Circuits Ltd	01462 894312	www.ablcircuits.co.uk	M	SE	ISO 9001:2008	SML	Y	4-10	Y	Y	Y	Y	Y
Cambridge Circuit Company Ltd	01223 423100	www.cambridge-circuit.co.uk	M	SE	ISO9001:2015, UL	SML	Y	4-16	Y	Y	Y	Y	Y
Daleba Electronics Ltd	+44(0)1992 510000	www.daleba.co.uk	B/M	SE	ISO9001:2008, TS, UL	SML	Y	4-30	Y	Y	Y	Y	Y
DK Thermal Ltd	+44(0)1992 514200	www.dkthermal.co.uk	M/R	UK, Europe, Asia, USA	UL, ISO9001:2008, TS16949:2009	SML	Y	N	Y	N	Y	Y	Y
GSPK Circuits Ltd	+44(0)1423 321100	www.gspkcircuits.ltd.uk	M/R	UK, Europe, Asia	BSEN, ISO9001:2008, TS16949:2009, UL, CECC release, Queens Award	SML	Y	4-16	Y	Y	Y	Y	Y
LEF Circuits	0116 2891122	www.lefcircuits.co.uk	M/R	M	ISO 9001:2008, UL	SML	Y	4-30	Y	F/R	Y	Y	Y
Photronix Group	01903 231901	www.photronix.co.uk	B	SE	ISO9001:2015, ISO14001:2004, AS9100-B, NADCAP, TS16949:2002	SML	Y	4-58	Y	F, F/R	Y	Y	Y
Prestwick Circuits GPS Ltd	01294 224631	www.prestwickgps.com	B	UK, Portugal, China	ISO 9001, ISO-TS16949, AS9100, IPC610 Class I/II, UL	SML	Y	4-48	Y	Y	Y	Y	Y
Stevenage Circuits Ltd	01438 761811	www.stevenagecircuits.co.uk	M/B	UK/China	ISO 9001:2008, ISO 14001, EN9100:2009, UL, IOSCAR	SML	Y	4-44+	Y	F, F/R	Y	Y	Y
Tate Circuit Industries Ltd	01889 583627	www.tatecircuits.com	B	UK/China	ISO 9001:2015, UL	SML	Y	4-20	Y	Y	Y	Y	Y
Tecbridge Circuits	0207 993 6503	www.tecbridgecircuits.co.uk	M Rep.	UK Europe	UL, TS16949(2009), ISO14001(2004), ISO9001(2008)	SML	Y	4-16	Y	N	Y	Y	Y

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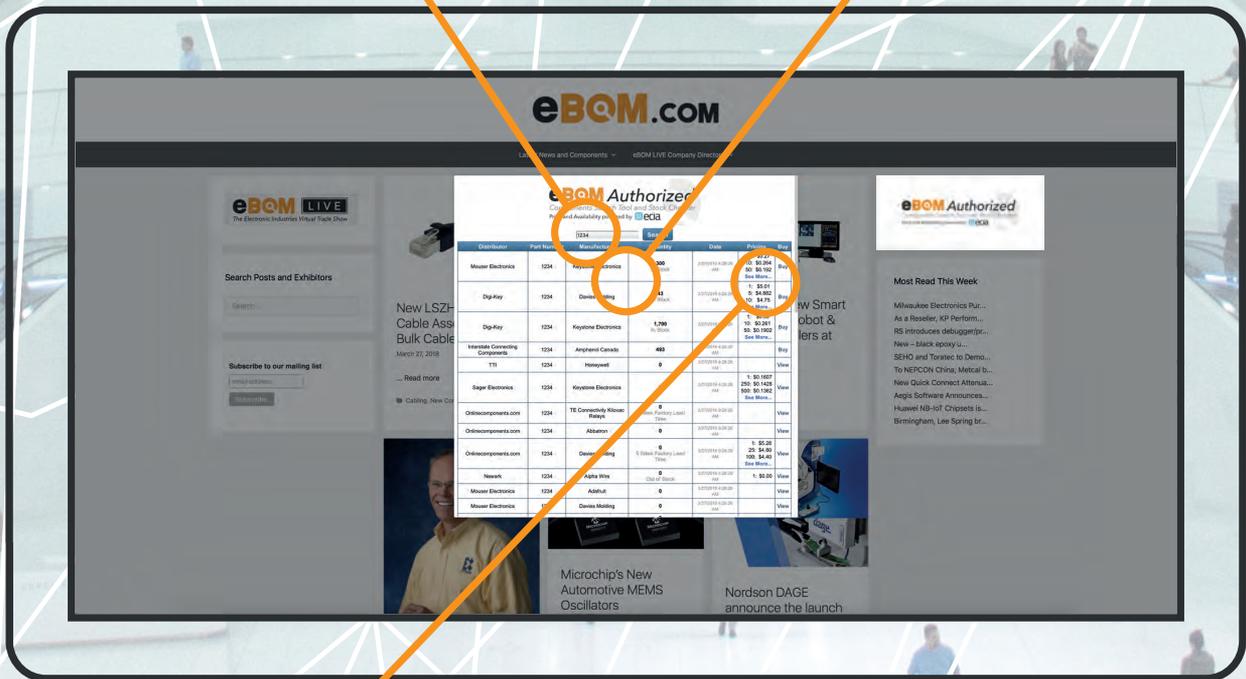
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