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ECIA MEMBER
Supporting The Authorized Channel



On the cover – April 2019

Keep rail-related sourcing on track
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Editor's Word



Peak gratefulness

I've come to the conclusion the whole world has turned into a giant moanathon. Given the opportunity, normally via social media, too many people seem ready and willing to moan about anything and everything.

Well, my fightback begins here and now. I've decided to live my life in a permanent state of peak gratefulness. I'm grateful that you, our readers, who have decided to swap your most valuable resource—time—to read what I and others have to say. I'm grateful to our advertisers for their faith in *Electronics Sourcing* as a trusted platform for their marketing messages. I'm grateful to all the public relations professionals for nudging me with ideas for articles and responding within minutes to requests for words and pictures.

I'm grateful to component manufacturers who risk everything ploughing their time, energy and money into research and development. I'm grateful to CEMs and OEMs for building their cathedrals of manufacturing excellence and I'm grateful to the entire distribution industry for oiling the wheels of this giant industry.

I'm grateful to MMG Publishing for providing me with the opportunity to do this work and I'm grateful to all the hardworking people who organise the shows and events which allow me to stay in touch with friends and colleagues face-to-face.

In summary, I'm grateful to everyone in this industry and I certainly feel a lot happier for it.

Jon Barrett

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Buyers' Guide

All the facts and figures to help you buy

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www.electronics-sourcing.co.uk



Buying into an efficient EV charging future

LEM has achieved the German Baumusterprüfbescheinigung certification for its EM4TII DC energy meters. Originally developed for railway applications, the meters could help address growing demand for efficient car charging, in line with the growth of the electric vehicle market.

Steadily increasing battery capacity has helped the EV market grow, but to make EV cars the vehicle of choice, a network of fast chargers is essential. From April 2019, new regulations will also require energy providers to only charge energy delivered to the car. Ultra-fast chargers provide direct current as they are connected directly to the battery, however, today only certified AC energy meters exist for billing electricity to the end user.

As a solution, LEM will introduce a new DC meter, providing a more compact version of the EM4TII. It claims this new meter will be accurate and universal, whatever the topology of the charging station, up to 600kW.

www.lem.com

Looking for rugged industrial products?

Crystal Display Systems has introduced its first embedded controllers built for the industrial automation and machine vision market. The company will now supply Taicenn products in the UK and Europe, including industrial and rugged embedded boxed PCs and industrial touch panel PCs. Other rugged solutions now available include IP65 stainless steel keyboards, with all products designed specifically for systems and applications that require excellent performance and high-level reliability, along with extended supply and support.

crystal-display.com



Integrated IoT module in stock

Mouser Electronics is now stocking the QPF4528 front end module from Qorvo. Designed for internet of things systems based on Wi-Fi 6, the 5GHz FEM boasts a compact form factor and integrated matching to minimize layout area in applications such as wireless routers, set top boxes and access points.

Qorvo's QPF4528 FEM integrates a 5GHz power amplifier, regulator, single pole double throw switch, low noise amplifier with bypass mode, RF coupler, and voltage power detector in a single device. It is also designed to boost linear power transmission without increasing power dissipation, enabling higher-performance Wi-Fi 6 enterprise access points in smaller form factor designs.

www.mouser.com

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In Brief

Gen up on battery buzzwords

Download Accutronics' booklet of must-know words and phrases that are changing the battery industry. It's essential reading for those involved in producing battery-powered devices in the medical, military and industrial sectors. Buzzwords relate to chemistry, cycle life and energy and address growth areas such as fuel gauging, battery management and modular systems.

www.accutronics.co.uk

Sourcing silicon solutions

CML Microcircuits is celebrating 50 years as a fabless semiconductor manufacturer. Having pioneered system on a chip technology, CML worked to meet growing demand for voice and data communications. Now the company has also invested in RF frontend and baseband technology, addressing analogue, digital and mixed-signal solutions for voice and data radio. In the future, CML plans to explore RF on silicon, which will open further opportunities around the world.

www.cmlmicro.com

Aerospace approved PCBs

GSPK Circuits has announced that its Boroughbridge printed circuit board manufacturing facility in the UK has been certified to EN9100:2018. This international aerospace quality standard signifies GSPK Circuits' commitment to stringent industry requirements for aerospace products in both civil and military markets. It joins the company's existing IATF16949:2016 accreditation, ensuring GSPK now holds both aerospace and automotive accreditations.

www.gspkcircuits.ltd.uk

Booming UK electronics sector

The UK electronics sector experienced the fastest growth of any manufacturing sector in 2018, according to a new report by Santander and Make UK. Despite representing less than five per cent of UK manufacturing output, the sector generated £19.4 billion in turnover and £8.4 billion in gross value added (GVA) in 2017.

www.santandercb.co.uk



Extended security offering

Arrow Electronics has extended its global secure provisioning service to cover silicon from Cypress, Infineon and Microchip, in addition to NXP Semiconductors Secure Elements, which was covered in the initial launch in 2018. The service supports the rapid deployment of internet of things edge nodes and gateways featuring hardware-based security features.

Vice president IoT, Arrow Electronics, Aiden Mitchell, explained: "Cybersecurity is a high priority for developers, particularly with requirements such as the European GDPR legislation and the responsibility it places on organisations to protect data and security. This means the ability to authenticate IoT devices and quickly establish trusted connections to the cloud is now an essential element of any product deployment."

Arrow's programming and provisioning technology is based on a highly secured chain of trust. This consists of relationships with global domain experts on device security and certificate authorities; the secured transfer of customer IP and security credentials; and highly secure programming platforms. Registration for device certificates is supported at multiple cloud service providers and certificate lifecycle management services are also available.

www.arrow.com

Adaptors carry latest medical approvals

RS Components has introduced two new plug-in power adaptor ranges carrying the latest international medical and healthcare safety approvals.

The Mean Well GSM60E and GEM60I adaptors are intended for use with home healthcare equipment, mobile medical equipment, and medical equipment that requires an interchangeable AC power supply for use in different parts of the world. Example applications include blood glucose meters, blood pressure meters, nebulisers, inhalers and sleep apnoea devices.



Your interactive guide to discretes

Anglia has released a new selection guide covering the company's full range of industry standard discrete semiconductor devices. The interactive document is internet-linked, with each product category featuring a website reference for an associated page on the Anglia Live website.

Technical director of Anglia, David Pearson, said: "We've created this guide to show the breadth of product now available and to help customers locate the right part for their design quickly and easily. It takes them straight to the website for comprehensive data and to order samples."

Published in PDF and paper form, the guide lists all the industry standard discrete and small signal semiconductors available from Anglia. Products include small signal diodes, standard rectifier diodes, Zener diodes, Schottky diodes, fast recovery diodes, bridge rectifiers and transistors. Many are supported through Ezysample, a free online sampling service.

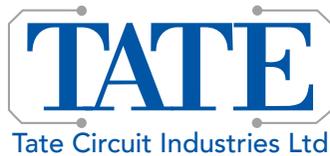
www.anglia.com



GSM60E adaptors offer a Class II double insulated power unit with a European standard two-pin plug. The GEM60I is an international version used with four interchangeable plugs for European, US, UK and Australian type AC outlets. Both adaptor types plug directly into a wall-mount AC outlet without the need for an AC cable, reducing total equipment cost and space requirement.

The adaptors accept AC input from 80 to 264V AC and are available with a variety of outputs.

uk.rs-online.com



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ELECTRONICS

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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 23rd 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, or call 01892 613400 to confirm your registration.

Many thanks to GELEC and ECSN for sponsoring the event.

SAVE THE DATE - 23rd MAY 2019

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

**UK Electronic
Components
Industry Annual
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

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Same day dispatch for Pi Compute

Premier Farnell is now shipping the Raspberry Pi Compute Module 3+ for same day despatch. This model is said to deliver the enhanced thermal performance and ease of use of Raspberry Pi 3 Model B+ in a smaller form factor, with a choice of memory variants suitable for a range of embedded applications including internet of things devices and industrial automation, monitoring and control.

The new module is based on the Broadcom BCM2837B0 64-bit application processor running at 1.2GHz, with 1GB LPDDR2 SDRAM. Developers can choose between eight, 16 and 32GB eMMC flash and a 'Lite' variant, with no eMMC flash, to match their storage requirements.

Global head of SBC and emerging business at Premier Farnell and Farnell element14, Hari Kalyanaraman, said: "Over a third of our Raspberry Pi customers are using the board for professional use. This new version delivers on ease of use, as well as providing enhanced thermal performance and increased flexibility through multiple memory variants. Developers can get their products to market faster than ever before."

The Raspberry Pi Compute Module 3+ will remain in production until at least January 2024.

www.element14.com

Long-term support for DDR3 memory

Smart Modular Technologies is to offer long-term support for a variety of its DDR3 legacy modules including SO-DIMMs up to 16GB, UDIMMs up to 16GB, VLP UDIMMs up to 16GB, Mini-DIMMs up to 8GB and RDIMMs/LRDIMM up to 32GB.

This will be particularly beneficial for customers in industries with long product lifecycles such as industrial computing and defence, where applications can utilise DDR3 legacy memory for up to two decades. When DRAM suppliers leave the legacy market, original equipment

manufacturers are forced to find and qualify alternative memory products, which can be costly. By providing long-term support for its DDR3 legacy modules, Smart can reduce the need to reengineer systems and minimise interruptions in the legacy memory supply chain.

Where re-qualification is required, the Smart Memory Test Lab can help reduce costs by undertaking testing for customers.

www.smartm.com



Help bring prototypes to life

Rutronik is now offering the Intel Neural Compute Stick 2, which is designed to build smarter artificial intelligence algorithms and for prototyping computer vision at the network edge. According to Rutronik, it can speed the development of deep neural networks inference applications.

The Intel NCS2 is powered by the latest Intel vision processing unit, the Intel Movidius Myriad X VPU. This supports deep learning neural networks like Caffe, Tensor Flow or MXNet, which can be integrated with the OpenVINO toolkit on the NCS2.

With a laptop and the Intel NCS2 running on a standard USB 3.0 port, Intel claims developers can have AI and computer vision applications up and running in minutes. The device enables users to convert and deploy PC-trained models to a range of devices and without internet or cloud connectivity. Whether developing a smart camera, a drone with gesture-recognition capabilities, an industrial robot, or the next smart home device, the NCS2 is said to support faster prototyping.

www.rutronik.com



High power current sense resistors ready to ship

Now available in Europe from TTI, Bourns' CSS series high power current sense resistors are offered in both two- and four-terminal versions. The two-terminal models are available in three different footprint sizes: 5930, 3920 and 2512. With resistance values as low as 0.2mohm, they have a range of low resistance options and power ratings of up to 15W. The four-terminal designs allow for high precision 4kelvin resistance measurements and are available in size 4026.

CSS claims the series benefit from excellent long term stability, low inductance, and low thermal electromotive force. Devices are also fully AEC-Q200 compliant. They are ideal for applications such as current sensing, battery management systems, power modules/motor controllers, as well as frequency converters.

www.ttieurope.com

Shared wisdom: how buyers benefit from trade associations

Recently appointed ECIA representative and ECSN chairman, Adam Fletcher, explains how trade associations provide purchasers with vital insight into their industry, both locally and internationally

Q Our readers know you as chairman of the Electronic Components Supply Network (ECSN). Now you are representing the US-based Electronics Components Industry Association (ECIA) and you are chairman of the International Distribution of Electronics Association (IDEA). What is your involvement with each association and what are the differences between them?

I joined the Association of Franchised Distributors of Electronic Components (AFDEC) in 2005. I inherited an organisation with a great reputation, a strong team and an excellent management record. Under my tenure members have transitioned from AFDEC to the ECSN, recognising the need to support the electronic components market from 'cradle-to-grave and re-birth.'

Both the ECSN and ECIA are country-wide business associations, supporting their members' needs in a geographic region; ECSN members operate in the UK and Ireland and ECIA members operate in

the US. However, many organisations are members of both associations. These international organisations run global operations but need the support of a local industry association to address local business issues, legislation, statistics, events, and promotion.

The International Distribution of Electronics Association (IDEA) is a group of local electronic components industry associations that coordinate their activities on international issues, statistics and best practice. As chairman of IDEA, I am supported by a team that includes leaders from all the local industry associations and some specialists. This structure of multiple local organisations, loosely coordinated internationally, maintains control locally whilst providing a collaborative structure where resources can be pooled, knowledge shared, and collective actions agreed.



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Q ECIA is relatively unknown in Europe, especially among purchasing professionals. What are your long-term goals and what do you hope to achieve representing ECIA in Europe?

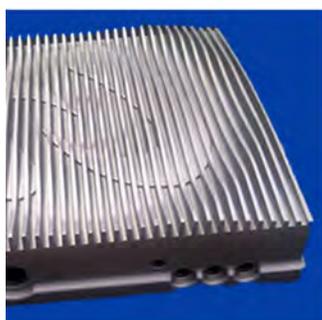
The aim of my appointment to support ECIA in EMEA is to complement both the existing local industry

associations and IDEA. ECIA is one of the larger industry associations in the USA in terms of the numbers it represents and can deploy its resources to help the development and promotion of the international electronic components markets. It represents many of the largest manufacturers and authorised distributors of electronic components

headquartered in the US but also has members who currently serve their domestic market and are looking to expand internationally. These organisations need to ensure that they understand what's happening in regional markets and how they can position their organisations to benefit from geographic expansion.



Chairman of the **Electronic Components Supply Network**, Adam Fletcher



Q What role will you be proving ECIA in Europe and how will this influence buyers of electronic components and distributors in the region?

My role is to meet the diverse needs and aspirations of industry association members, while providing accurate and timely commentary on what's happening in the electronic components market to the wider electronic systems community.

The US and EMEA electronic systems markets are very similar. The customer base is essentially in the industrial, medical, automotive, communications infrastructure, aerospace and defence sectors, with long product lifecycles and low to medium production volumes. The needs of these customers are very different from the consumer centric markets in Asia-Pac where product lifecycles are fast, and volumes are high.

Purchasers in the US and EMEA need consistent long-term multi-year support from flexible partners who understand their needs and can provide solutions. They

require product design and development support, across multi-geographic production locations, plus through life and end-of-life support. This can only be delivered by local component manufacturer personnel and authorised distributor partners. No other channel can provide this support. Procurement folks generally understand this concept—using component manufacturers and authorised distributors massively minimises risk within their electronic components supply network.

Q Next month it's the *Electronics Sourcing Five-a-side Football Tournament and ECSN Dinner*, on 23 May. Will you be playing this year and what's in store for readers that attend the ECSN Dinner?

Once again, I'll be risking life and limb on the pitch at the *Electronics Sourcing* football

tournament—perhaps this year I'll try not to be quite so competitive! The ECSN Dinner following the tournament will be well attended by a cross-section of the electronic components industry, making it a great opportunity to meet with friends, colleagues and competitors. This year our guest speaker is Brian Wood who was awarded

the Military Cross for his bravery and I'm sure he will inform and entertain us in equal measure. If readers want to attend the football tournament or the dinner, send a request to enquiries@ecsn-uk.org and we'll get you signed up.

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Using component manufacturers and authorised distributors massively minimises risk within the electronic components supply network

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Distributors expect single-digit growth in Europe in 2019

Distributors have posted 21 consecutive quarters of sales growth in Europe and expect the streak will continue through 2019



James Carbone

Although gross domestic product (GDP) growth in Europe is expected to decline in 2019, distribution sales are forecast to grow nearly 7 per cent because of healthy component demand from automotive and industrial customers and because of the building of LTE and 5G networks.

Distribution sales in Europe have grown over the past several years because of robust component demand and shortages of some passive components and discrete semiconductors. Component demand in 2019 may not be as strong as last year, but with more electronics being designed into more products, distributors are expecting demand to be solid, although not stellar.

Most distributors in Europe, had strong growth in 2018, according to Adam Fletcher, Electronic Components Industry Association's director for Europe, Middle East and Africa (EMEA).

"It was a stronger year than we thought it would be," he said. Distribution increased by about 6.9 percent and component demand was fairly strong across most industry segments, he said. Some of the growth was due to shortages of MLCCs and other components. Buyers increased orders to make sure their companies had enough parts for production.

Fletcher said while distribution revenue growth was robust last year, sales have risen for several years. "We have had 21 successive quarters of growth in Europe," he

said. "We have never seen that before. It is unprecedented," said Fletcher.

He said industrial, automotive, medical, and aerospace and defense are driving sales.

Slower growth forecast

Fletcher said there will continue to be sales growth in 2019, despite overall slowing economic growth in Europe. The International Monetary Fund (IMF) says that gross domestic product (GDP) in Europe will decline to 1.6 per cent in 2019 from 1.8 per cent in 2018.

Despite GDP decline, distribution sales in Europe should rise 5-6.5 per cent in 2019, said Fletcher. "We think Q1 will be reasonably good, Q2 will be a little bit flatter than normal and we will see growth in Q3 and Q4," said Fletcher. "This year will be more back loaded rather than front loaded," he said.

Electronics distributors and component manufacturers "are very positive about 2019 and sales growth will be just a little shy of where it was in 2018," according to Fletcher.

He added business would even be stronger in 2020 and "we will probably see double-digit growth. I think 2020 is going to be a really super year for our industry," he said.

5G is on its way

One reason Fletcher is optimistic about 2019 and 2020 is the building of LTE and 5G networks



Geoff Breed, vice president marketing Europe for TTI.

"The softening we are seeing is very likely, and predictably, a correction in the supply chain,"

in Europe. Fifth generation cell phone networks and handsets are "going to really drive the market through the roof. And that's going to suck products out of the market like you wouldn't believe. Lead times will go out," he said.

He noted 5G infrastructure will have to be built and more base stations will be needed for 5G than were needed for 4G. Over the next several years, cell phone manufacturers will build 5G handsets which will result in greater demand for semiconductors and passives. The extra demand will result in longer lead times and possibly shortages for many components.

"In 2020 5G will be rolling out and people will be clamoring

for mobile phones," said Fletcher. "I think there will be a big replacement cycle."

Automotive is also driving component demand. While vehicle sales slowed in 2018 and may further decline in 2019, more electronics systems are being designed into more vehicles, which is boosting component demand.

"We are seeing more high-end features in low-end cars," said Fletcher. "So, we're seeing a trickle-down effect. It has been a lot quicker in automotive than a lot people perceived it would be," he said.

Fletcher said distributors in Europe supply parts for



infotainment systems. He said a lot of infotainment systems are made by contract electronic manufacturers that are customers of distributors.

Slower sale growth

One distributor that is positive about its business in Europe is Mouser Electronics. It expects its sales to increase in 2019, but growth will not be as robust as 2018. "Europe so far this year is relatively strong and did not change a lot from of October/November/December to January," said Mark Burr-Lonnon, senior vice president global service and sales for Mouser. "I would say there are signs of slowing."

"Last year our sales were up close to 50 per cent in Europe. It was a banner year," he said. "It's unlikely we'll have a year like that again." Mouser's sales growth in Europe in 2019 should be about 15 per cent despite slowing GDP growth, Burr-Lonnon said.

"We've had growth in the 30s and 40s over the last eight years," he said. Last year was the highest ever. We probably would've been happy last year, 25-30 per cent growth."

One reason why Mouser has such growth is that its business model has become "part of the fabric in Europe," Burr-Lonnon said. Much of Mouser's business involves selling small quantities of

components to engineers who are designing new electronic systems.

As a result, Mouser's business is not dependent on overall economic growth and volume production of electronics products and systems. Electronics OEMs are always designing new products even when orders decline for existing systems.

"We don't play the volume game," said Burr-Lonnon. "For us our business goes up and down a lot on the basis of engineers continuing to design," he said.

23 quarters and counting

Arrow Electronics supplies parts for volume production and is affected by the strength of the economy, but its "European business is performing very well," said Chris Stansbury, chief financial officer for Arrow. "We've had 23 straight quarters of growth," he said. "Europe is pretty close to one third of the total business in our components business."

Economic conditions in Europe and other regions won't be as strong as in the past couple years. "But that said, we are still in a very healthy growth environment," said Stansbury. Arrow's business may not have double-digit growth in 2019 but "certainly healthy single-digit territory is very realistic," he said.

Chris Stansbury, chief financial officer for Arrow.

"Our European business is performing very well. We've had 23 straight quarters of growth,"



He said Arrow has the advantage of a very diversified customer base. The distributor does not have any customer that accounts for more than 2 per cent of sales.

"When we look at vertical performance, we track transportation, aerospace and defense, industrial and medical, he said. Transportation is Arrow's biggest vertical and accounts for less than 15 per cent of the sales .

"That data tells you is that we are heavily diversified. It's been a real focus point of ours," said Stansbury.

Momentum carry over

Another distributor that has a diversified customer base is TTI. TTI posted more than 20 per cent growth in Europe in 2018 and that momentum has carried over into 2019, according to Geoff Breed, vice president of marketing Europe. However, TTI has "begun to experience a few categories where product movement has slowed slightly as lead times approach normalised levels," he said. "The "softening we are seeing is very likely, and predictably, a correction in the supply chain."

The primary vertical markets of industrial, transportation/automotive and defense and aerospace will continue to drive business in 2019, but there are emerging areas of focus for TTI.

Within industrial, TTI is focusing on factory automation, IoT, and smart buildings. In transportation, electric vehicles, e-bikes, public transportation, commercial vehicles and the necessary infrastructure will help drive growth. Related to defense, aerospace and space low earth orbit satellites (LEO) will be an area of focus for TTI, said Breed.

Avnet is seeing a slowdown in sales in Europe, said Georg Steinberger, vice president of communications for Avnet EMEA. "Avnet's total business in EMEA grew 14.8% to 6.7 billion USD in fiscal 2018, but we have recently experienced a slight slowdown," he said. "The market here is making a soft landing after the huge growth from 2016 to 2018, and with some suppliers changing channel partners and others taking business direct, those things have had an impact," said Steinberger.

He added that Avnet was "watching continued developments with Brexit and the slowdown in Italy (the second largest electronics industry in Europe). We also are continually watching for regulatory changes to ensure compliance within our global supply chain. We don't see the effects of tariffs in Europe like in the U.S.," said Steinberger.

Duo-pack cartridge ensures precision dosing

TTI can now supply 3M epoxy adhesives in a convenient duo-pack cartridge, designed to ensure precise mix ratios for reduced costs and improved reliability in electronics applications

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The epoxies also feature a low-outgassing formulation, which has been specially developed for electronics applications where outgassing during the curing

process, or later, can lead to problems such as corrosion. 3M says the adhesives have been extensively tested for compatibility with electronics.

As a further aid to reliability, TC-2810 and TC-2707 adhesives are loaded with ceramic fillers that enable improved heat dissipation, such as from a component to a heat sink. This can help as power increases and components become more tightly packed. Excess heat

can lead to power drops, failures and reduced working life of electronic components. Being ceramic, the fillers are also not electrically conductive, thus preventing electrical discharge.

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Reducing waste: duo-pack cartridges ensure adhesives can be easily applied in the correct mix ratio

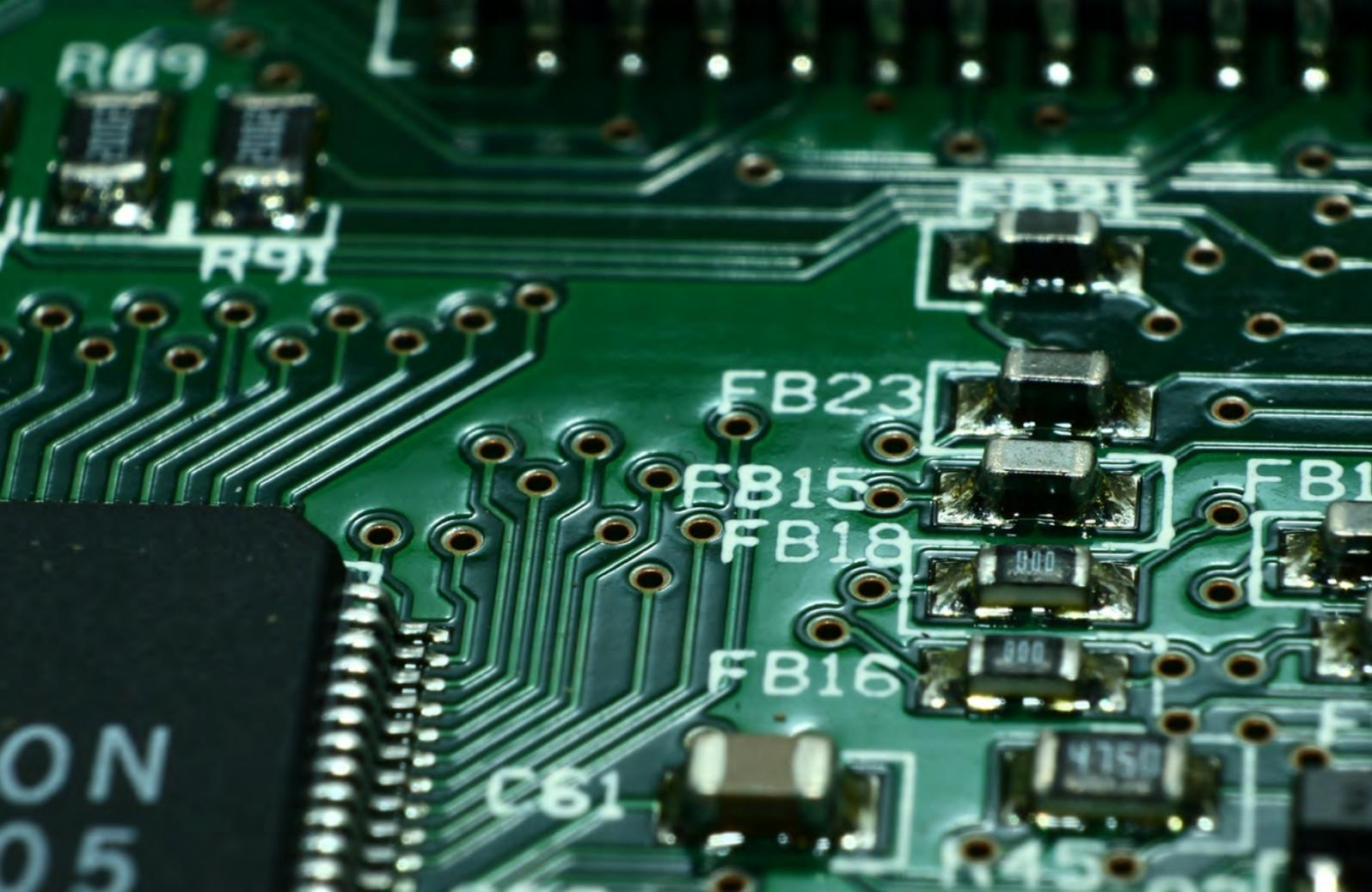
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Tariffs, the ultimate disrupter



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

Following recent research, John Denslinger takes a closer look at the impact of tariffs on the electronic component distribution chain

Tariffs • By John Denslinger

In tennis there's a term describing a totally self-induced, missed scoring opportunity called 'unforced error'. When it happens, the opponent immediately benefits. Tariffs, in my judgement, are akin to the unforced error, but unlike the tennis analogy the benefit is rarely immediate. Protecting intellectual property and opening the China market to more US goods and services is truly long overdue and gravely needed for a healthy global economy. To date, nothing else has brought Chinese leadership to the table, so maybe the tariff route will be the catalyst for that elusive win-win solution.

Tariffs invariably snag multiple industries firsthand or through duty retaliation. Unfortunately, our electronics industry is part of that collateral damage. The tariff battle has brought us to the front lines.

From the industry leaders I've talked with, IP protection seemed to be the one prize drawing the strongest support and worth enduring all the hardship it causes. Yet each executive also voiced similar concern on the short/long-term customer relationship impact. Customers appear to be understanding, but for how long? So, how are tariffs actually being managed in the supply chain?

Overall, it appears manufacturers and distributors are handling supply disruptions competently. Both seem to be: absorbing all indirect costs associated with monitoring regulatory adherence; managing supply system and logistic issues; increasing customer communications; and restructuring some agreements while passing only direct tariff rates onto customers. That being said, one would think a pass-through on tariffs might be simple, but the facts do say otherwise.

In January, ECIA surveyed its members to better understand how tariffs were being managed. Here's a quick baseline:

1) The overwhelming majority of manufacturer and distributor respondents reported charging tariffs to customers for three months or more. It should be noted, a small percentage said they are not charging or planning to pass-

through tariffs. I suspect, they're waiting it out hoping for an early settlement.

2) Again, an overwhelming majority said tariffs are invoiced per order basis.

3) About half of those charging tariffs, bill as a separate line item, but interestingly, a third reported amortising the tariff in the unit price.

Okay, invoices are sent, how does the payment side look? In one word... ugly!

1) Late payment exposure increased although manufacturers fare much better than distributors. One probable reason: the number of served customers is much higher through distribution. Accounting reconciliation across a broad customer base could explain much of the payment delay.

2) Non-payment exposure increased as well. Again, distributors feel the pain more than manufacturers. Here the problem is not that clear. It could be a breakdown in accounting, legal, procurement, communications, or just plain indifference.

One final point of note: the administration of tariffs is not straight forward. There are cumbersome issues that cause confusion and disrupt the established flow of commerce:

1) Duty drawback - no one likes to pay first then file for reimbursement.

2) Tracking and routing of product landed in USA destined for Canada or México production

3) Country of origin labeling & paperwork

4) Improper EDI transaction set up

None of us want to see the tariff situation continue for too long. Let's hope for an early, successful settlement and an end to this ultimate disruptor.



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Buyers may face more component obsolescence

Shorter product life cycles, technology changes and supply base consolidation could result in more components going end of life

Component obsolescence has always been a nuisance for electronics purchasers whose companies build systems with long product lifecycles.

When an original component manufacturer (OCM) discontinues a part that is used in a system, the OEM needs to determine whether it makes sense to redesign a board impacted by an obsolete part, do a lifetime buy, or source the part on the open market from independent distributors. In some cases, an OEM may opt to go to an aftermarket house to manufacture the part that has been abandoned by the OCM.

While component obsolescence is not a new issue, it appears to be becoming more acute. Recent consolidation in the supply base, coupled with transitions to new technologies, has resulted in a higher rate of component obsolescence, according to industry analysts and distributors.

The number of end-of-life (EOL) notices issued by component manufacturers increased from about 4,523 in 2015 to 5,230 in 2018, according to researcher IHS Markit. Greg Wood, director of parts content/product design for the researcher, said one reason for the increase in EOL notices is shorter product lifecycles due to changing demands of new systems.

For example, “handheld devices, smart watches, all those kinds of devices are going to be as low power as possible,” he said. As a result, they need components that require less power to function.

Larger systems, such as servers used in data centers, are also being designed to consume less power and generate less heat. They need lower voltage semiconductors including microprocessors. In the not-so-distant past, supply voltages of 5V and 3.3V were common, said Wood. “Now new part

introductions are focused on 1V or even less,” he said. There’s still plenty of the 5V and 3.3V chips available, but “clearly manufacturers are introducing parts they think are going to be well used in the future” and those are lower voltage parts, said Wood.

Changing technology

Technology changes also contribute to component obsolescence, said Todd Snow, vice president of global purchasing for N.F. Smith & Associates, an independent distributor based in Houston. “The emergence of 5G and IoT is also impacting obsolescence because trends like these change the sphere of products that are being manufactured, therefore altering the components used in products,” he said.

Consolidation can also impact component obsolescence, said Dale Lillard, president of aftermarket semiconductor manufacturer Lansdale Semiconductor, based in Phoenix.



When times are really good people don't have time to shut down product lines

Dale Lillard, president of Lansdale Semiconductor

If a company has low-volume lines and it merges with another company, it's common for redundant lines to be eliminated, he said.

Poor economic conditions can also impact obsolescence. “During a downturn, companies start to trim products because volumes are low,” he said.

“I have found that when times are really good people don't have time to shut down product lines,” said Lillard.



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“They’re too busy making the parts” that are in high demand.

Lillard said obsolescence is more of an issue today in the defense industry because years ago ICs built by military suppliers such as Motorola, Philips and Intel had second sources.

“So, if Motorola decided to stop making a particular component, there was a particularly good chance there were other suppliers” for the part, he said. Today there are fewer second sources.

In addition, many chipmakers ceased making military grade parts in the 1990s when the Perry initiatives directed that commercial off-the-shelf parts be used when possible. As a result, some IC makers got out of the military component market resulting in fewer sources and the impact is still felt today because military equipment has very long lifecycles.

For example, the F-16 fighter was built during the 1980s and is still flying so parts are needed to maintain the planes. Today, the Department of Defense is not buying airplanes and systems “in volumes like they did in the 1980s during the Reagan buildup,” said Lillard. “They are buying F-22s in the hundreds where they used to buy F-16s in the thousands and they’re still flying F-16s,” he said. So, parts used in F-16s are needed, but some of them are obsolete.

Not just semiconductors

While obsolescence impacts semiconductors, it also affects passive components and connectors. For instance, some capacitor manufacturers have ceased production of multilayer ceramic capacitors (MLCCs) in larger case sizes because most demand is for MLCCs in smaller sizes.

Older connectors also go end-of-life. Wood said there is EOL activity with some of the “older connectors that do board-to-board type connections or have a larger pin pitch.

However, a connector manufacturer is more likely to continue building an older connector even if demand is

limited, said Lynda Nolen, director of databases for connector industry researcher Bishop & Associates, based in Saint Charles, Ill. The end customer, such as a contract manufacturer or distributor, will be required to pay for a minimum run, she said.

The connector manufacturer “will continue to offer a part until some fixture that is used in some portion of the manufacturing

breaks,” said Nolen. “For instance, all connectors have some type of insulator. This insulator is molded or formed using some type of fixture,” she said. If the mold breaks, the connector manufacturer may choose not to have a new one made, but rather obsolete the particular part number that uses that mold depending how much demand there is for the part. “It doesn’t mean the whole product offering of that type of

product will be discontinued, generally just that particular size or layout,” said Nolen.

She noted the mold or press is very expensive to manufacture and spending the money to replace it may not be justified by the sales.

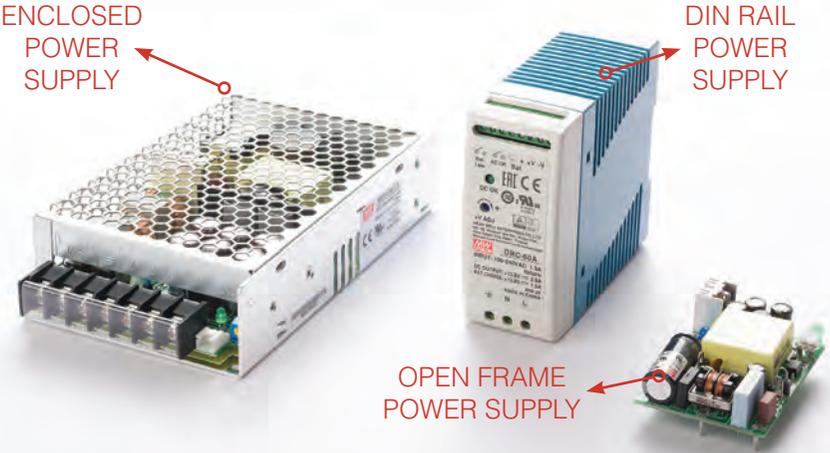
Longer lifecycles, more obsolescence

Obsolescence, whether it involves connectors, semiconductors

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or passives, is an issue for buyers in industries that have long product lifecycles including defense and aerospace, medical, automotive, telecommunications, factory automation. Electronics purchasers employ a number of strategies to manage obsolescence, although there is no one size fits all solution.

Buyers have to keep abreast of technology trends, keep apprised of EOL notices issued by suppliers, initiate life time buys with suppliers when necessary and perhaps look for help from distributors willing to manage and hold inventory for lifetime buy.

“The first thing is to understand when a part is going to become end-of-life. Getting the EOL notice is critical,” said Wood. The notice will tell buyers when the manufacturing of the part will discontinue.

“The EOL notice is an opportunity to do a little research and determine if there a drop-in replacement part available or if you need to do a last time buy and just try to keep a bunch of these parts in inventory,” he said.

Wood said if inventory of a lifetime buy has been exhausted, then the buyer may have to go to the open market and purchase from an independent distributor “that has a good reputation.”

“Maybe the independent distributor has a good testing facility in place,” said Wood. “You want to make sure to avoid counterfeit parts,” he said. Many counterfeiters target obsolete parts because the volumes are low and the prices are higher than many other components still in production.

“In one sense obsolete parts are perfect for the independent market because an obsolete device is not available from a manufacturer or authorised distributor,” said Paul Romano, chief operating

officer for Fusion Worldwide, based in Boston. “So, the only place to get the part is from a company like us.”

However, obsolete parts represent a small portion of Fusion’s business as well as the businesses of many other independent distributors.

Fusion can help customers address EOL parts. “We have access to all the EOL notices. If a customer asks us to look at what they’re building we can give them some insight into what parts may be potential problems,” he said.

He said Fusion can also make a lifetime buy on behalf of the customer and manage the inventory. “We can make the buy and charge a fee on top of the product cost to manage the inventory, store and ship it when they need the parts,” said Romano.

Smith offers customers inventory management solutions including those which support obsolete parts, said Snow.

The distributor has nitrogen-storage cabinets used specifically for customers who need to house obsolete components for extended periods of time, he said. In accordance with JDEC standards for MSL products. Smith can also offer nitrogen purging of packaging.

“We currently have programs in place with existing customers who are concerned about the lifecycles of certain product types, and we provide them appropriate notification alerts,” said Snow.

The obsolete problem

Andrea Klein, CEO of Rand Technology, based in Irvine, Calif., said that supplying obsolete parts is one of the roles that Rand and other independent distributors play in the supply chain.

“Our role is to solve problems. If you need a part that is obsolete, you cannot go to the factory or to a franchised distributor. It’s a big part of my channel’s

role,” said Klein.

She said Rand helps buyers find obsolete parts and can assist in managing the problem.

However, it’s hard to determine which parts are likely to go obsolete.

“Predictability of obsolescence is fairly easy when it comes to memory, storage, or CPUs,” she said. “But when you start looking at all of the rest of your components, it’s less predictable than people think,” she said.

She said that while obsolescence is an issue for defense and aerospace, it is also a challenge for manufacturers of industrial equipment.

“The industrial sector has problems because when they design a board, they will copy a part across different designs” so a part ends up in dozens of boards. If it goes obsolete, it impacts many products, she said.

While obsolescence is an issue for many industries, it may not be as critical for buyers in the automotive and cell phone industries. A lot of capacity is being devoted to automotive, because the product lifecycles are long so suppliers are virtually guaranteed healthy demand for their products for years. Handset manufacturers have very large volumes which is obviously attractive to component manufacturers.

The aftermarket option

While many electronics purchasers will buy EOL parts from independent distributors, some electronics OEMs will use an aftermarket component manufacturer. There are about a dozen such manufacturers in the United States that will manufacture a discontinued part for the customer, said Wood.

“It’s going to be more expensive, but a parts broker also marks up prices

significantly” for an obsolete part, said Wood.

Lansdale is a “semiconductor aftermarket pioneer” that continues to produce many semiconductors that integrated device manufacturers (IDM) no longer manufacture, said Lillard.

Over the past 39 years, Lansdale has acquired many mature IC product lines from IDMs. “We are licensed to manufacture and market thousands of ICs originally designed and previously produced by AMD, Fairchild, Freescale Semiconductor (formerly Motorola SPS), Harris, Intel, National, Philips and Raytheon,” said Lillard.

Lillard said the ICs that Lansdale makes are built with the original manufacturer’s tooling, specifications, and performance characteristics. Lansdale has close working relationships with the original IC manufacturers to ensure identical product performance and package configurations, according to Lillard.

The company’s ICs are certified by the Defense Supply Center as a Qualified Manufacturer of electronic military components under the MIL-PRF-38535 Qualified Manufacturing List (QML). The company is also an ISO 9001-2000) qualified supplier.

About 75 per cent of Lansdale’s business is for ICs used in defense systems while 25 per cent is for commercial parts.

“We have expanded our product lines to include ICs for the wireless and RF communications markets,” he said. For instance, the company makes phase locked loops (PLLs), prescalers, frequency synthesizers, transceivers, voltage-controlled oscillators (VCOs), FM subsystems, analog-to-digital converters and other parts for commercial customers.

Five statistics that will change your buying behaviour

Strategic choices about how and where electronics are manufactured have a significant impact on purchasing. Mentor Graphics presents five key facts that will make you rethink purchasing for PCB assembly

Manufacturing is an old process, yet new consumer buying patterns are increasingly putting pressure on factories to become more flexible. Innovations such as Industry 4.0 attempt to meet these market-force requirements with technology solutions, but in reality, the problem surpasses manufacturing and includes the whole business process, which has become entrenched in bad habits.

Here, we expose some of the shocking statistics in manufacturing, as well as highlighting the opportunities they present for agile companies and progressive purchasers.

1. 95% of manufacturing businesses focus on optimising just 1% of their total business cost

Looking at the latest technology products built today in China, the labour contribution to the final product retail cost can be

as little as one per cent. Why then, are companies so concerned with this, to the detriment of quality, flexibility, and risk?

Historically, when factories existed close to the market, labour represented most of the fixed cost of operation. Consequently, there was a move toward off-shoring manufacturing, but once all the major companies had followed this pattern, the once competitive edge of lower cost labour was lost. Now companies are fighting to reduce the last one per cent that labour contributes to the final price of fashionable high-tech products.

Unfortunately, during this process other cost contributors have been ignored. For example, if we look at a quality LED lightbulb, we find that it is available online with free shipping from a small Chinese supplier for around one fifth of its in-store retail

price. We can assume that the lower figure represents a fair price for the manufactured product, with a reasonable profit for the manufacturer, some profit for the Chinese sales company, and of course the real cost of postage.

Consumers can pay the higher price and have the bulb today or wait three to six weeks for the product to be delivered from China, saving 80 per cent of the cost. For many, it will be worth the wait. If customers are willing to buy goods on-line from China despite the wait and risks involved, wouldn't it be better if the factory was based close to home, using the same model as the Chinese sales company and shipping directly to customers?

An on-shore factory with direct shipping could have a far higher degree of success with a simple warehouse inside the factory, although of course, the factory would need to be flexible to respond



Collecting data directly from equipment helps to account accurately for usage and spoilage



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to more random shopping requests while still remaining productive. The labour cost in such an on-shore factory could be five to ten times that of the corresponding Chinese factory, but this will still be small compared to the cost saving from distribution.

2. SMT operations often run at as little as 20% absolute productivity

The important word here is 'absolute.' In high-volume manufacturing, when production lines were dedicated to a specific product and lines ran at full capacity, absolute productivity could be as high as 85 to 95 per cent.

Today, however, very few SMT operations operate in this way. With rapid technology evolution and multiple product variants, each with a limited lifecycle, consumer items have only a small window to attract premium pricing, after which there is rapid price depreciation.

The effect of this on the factory is a need to not only produce a high mix of products but also to cope with sudden changes in demand. These factors are the key cause of the low productivity currently seen in many SMT operations.

Factors such as changeover time, line balance losses, engineering setup time,

maintenance, and new product introduction time can all be used to boost the headline number. The reality is that many 'unavoidable' losses are effectively ignored, even though they may actually be avoidable. As product mix and demand volatility continue to increase, attention on these issues will be essential.

Many of these issues can be addressed, even in a high-mix and high-volatility scenario, for example, by using software tools to create common material feeder setups that adapt dynamically to customer-demand patterns, and optimising work-order sequences.

3. 75% of raw materials in an SMT factory need not be there

The adoption of lean material logistics is an essential part of providing flexibility in SMT production. By enhancing the accuracy and control of enterprise resource planning tools, especially for work in progress on the shop floor, lean material logistics can reduce the amount of buffer stocks in the factory.

Since SMT materials are supplied on bulk carriers, such as reels, many more materials are issued to production than are actually needed. In a high-mix environment, it can be that most materials issued will not be immediately consumed

by the targeted work-order. There can also be spoilage during the placement operation, both through the machine and manual operations. The amount of materials left unused after executing a work-order is therefore unknown.

Periodical stock checks often reveal the need to write-off significant amounts of materials, potentially at great cost. Furthermore, accumulated inventory inaccuracy brings unexpected internal material shortages, which in turn leads to the habit of instructing material requirement planning to over-order materials, creating a bloated warehouse inventory.

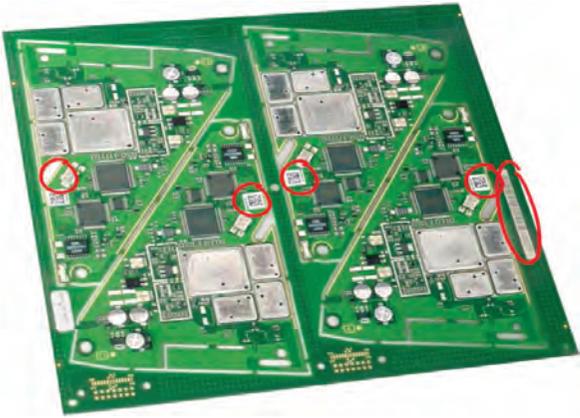
Introducing lean material management can eliminate 95 per cent of the material WIP on the shop floor because materials are issued only when needed and are returned to the warehouse when no longer required.

Collecting data directly from each SMT machine helps to account accurately for usage and spoilage. With material inventory accuracy maintained, internal material shortages are eliminated. MRP can then maintain buffer stock levels more accurately, according to real business needs. As a result, warehouse inventory can be reduced by as much as 75 per cent without risk of production shortages.

Inventory turns will double as warehouse space halves



The adoption of lean material logistics is an essential part of providing flexibility in SMT production



4. 30% of products leaving the factory were never tested

There are several different categories of product defect, from untestable defects to defects that pass tests in the factory, only to fail once the product has been in use for a while.

With a firm grip on the statistical situation, however, the emphasis moves away from test towards the manufacturing processes themselves. Manufacturing defects are most often caused by variations in the production process, some with a simple cause-and-effect, others as a result of two or more factors working together.

First, check each process to ensure that the setup and operational guidance was correct. Today's process preparation tools can create SMT programs, test and automated inspection data, as well as operation standards for manual processes, from a single product model. Next, ensure that all production operations are carried out as specified and that any variances are highlighted and eliminated. For most SMT operations, test and repair processes are the third and final step.

The most neglected tool, however, is the application of traceability data within manufacturing. If traceability data is accurate, complete, and timely, then information about defects is already available and could be used to identify potential risks before they leave the factory. Analysis of traceability data can, for instance, highlight PCBs that

were printed with solder paste but left too long before placement, increasing the risk of poor solderability.

It's impractical to think that every possible deviation from the normal operation of a production line can be addressed as it happens, but complete, accurate, and timely traceability data could be the ultimate quality tool, acting in a far more effective way than regular test processes.

5. 80% of factory management know these statistics, but feel powerless

In many cases, there is a different management process relating to the business of a product compared to the business of manufacturing. In an OEM company, manufacturing is usually treated as a non-profit operation, with factories working to a budget. This creates a barrier that can prevent investment in product performance-related issues. Using EMS services can make this barrier even larger.

Going forward, it's clear that with volatile patterns of customer demand and an increasing number of product variants, there is an inevitable need for extreme manufacturing flexibility. Considering the complete needs of the business and analysing all costs, of which manufacturing is only a part, it's clear that the operation and location of manufacturing processes need to be reassessed.

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More choice on LED connectors

Lemo has enhanced its range of Halo connectors with additional product sizes and models. Initially launched in the B series, Halo LEDs are now also available in the T series watertight IP68 connector. The three different designs are called LEG, LMG, which features a standby light, and LNG, which provides a narrow ring shape light.

Halo LEDs can be configured as required to program the status as on, off or blinking; light intensity; and colour. The multiplexed indicator consists of red, green and blue LEDs. Users can then combine the pulse width modulation of each colour to generate specific colours, with a choice of around 16 million colour shades. The indicator's behaviour can also be modified via software, providing maximum flexibility.

www.lemo.com

Sunlight spectrum LEDs match natural light

UK LED specialist, Selectronic, claims the Sunlight Spectrum 2835 SMD package from its Chinese partner, HongliTronic, offers artificial light that is close to actual sunlight.

Managing director of Selectronic, Kevin Dry, said: "The option to create lighting products that replicate daylight opens a new era of what can be achieved in closed-off rooms or underground environments, not to forget the health benefits in dark winter periods from creating artificial daylight, particularly when linked with a time clock to accurately reflect the various times of a bright sunny day."

The Sunlight Spectrum 2835 is said to produce perfect colour, measuring more than 95 in the range R1 to R15 with continuous saturation. The technology provides light that is close to the actual sunlight spectrum, but with much less blue light than conventional LEDs making it ideal for industrial or retail applications, as well as in business, office or home lighting products.

www.selectronic.co.uk



Custom control combines touch and physical feedback

Zytronic has enhanced its durable projected capacitive touch sensor offering with the introduction of Hybrid Touch technology, a custom solution integrating touch and physical controls in the sensor's active area. Tactile buttons or mechanical dials can be incorporated in the active touchscreen area, connected invisibly through the viewable area of the screen.

Sales and marketing director of Zytronic, Ian Crosby, said: "Touch sensors offer enormous flexibility and reliability, but physical controls offer much greater tactile feedback, which can be valuable in many situations. For example, industrial instruments are often operated with the user looking away from the screen. We've brought these two different forms of control together, blending tactile response with touch interactivity to give system developers the best of both worlds."

To create combined controls, Zytronic creates precisely machined apertures in the touch sensor, located and shaped to allow dials or switches to be placed where required. Zytronic then deposits power and data lines to the mechanical controls, embedded within the touch interface using a proprietary technique that ensures they are invisible to the end-user. These microfine traces lead to a flex tail at the edge of the screen for connection to the electromechanical controller.

Sensor electrodes in the screen are deposited around the physical holes required for the dial or switches. Touches around the holes are processed in the usual way, but custom firmware in the controller is programmed to ignore the area of the holes themselves.

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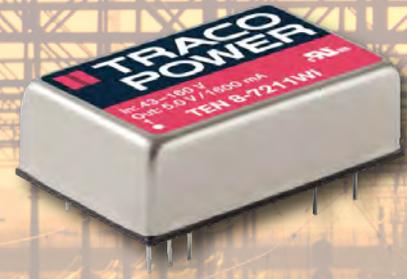
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- Regulated single outputs of 12V, 24V, 28V or 48VDC
- Operating temperature range -40°C to +85°C
- Excellent efficiency up to 90%
- Input filter meets EN 55032, class A
- Input to output isolation of 2250VDC
- Input under voltage lock-out circuit
- Protection against over voltage, over temperature and short circuit
- Output voltage adjust & remote on/off
- Remote sense on outputs
- Output LED indicator
- Convection cooling



TEQ300 WIR 300 Watts

- Compact extruded aluminium chassis 103 x 89 x 88mm
- EN550155 approval for railway applications
- Ultra wide 4:1 input range up to 160VDC
- Regulated single outputs of 12V, 24V, 28V or 48VDC
- Operating temperature range -40°C to +80°C
- Excellent efficiency up to 92%
- Input filter meets EN 55032, class A
- Input to output isolation of 3000VDC
- Over voltage, over temperature and short circuit protection
- Output voltage adjust & remote on/off
- Remote sense on outputs
- Output LED indicator
- Convection cooling
- Parallel operation of up to 3 units



Keep rail-related sourcing on track

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

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

Stringent EMC standards

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

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

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

Increased converter demand

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

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

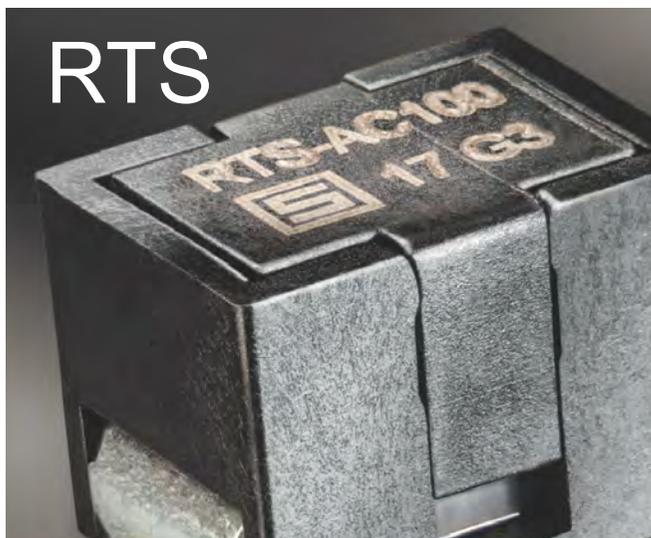
This increase in subsystems is also creating increased demand for DC/DC converters. Most train battery voltages are 110V, so DC/DC converters are utilised to convert this to more manageable voltages for the various subsystems and functionalities, such as CCTV systems.



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



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



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Modernising rolling stock

Electronic components are increasingly used in both new builds and in major maintenance overhaul. During maintenance refurbishment, safety critical components such as thermostats in heaters, ventilation and air conditioning systems are routinely changed, however,

this is often seen as an opportunity to modernise the facilities and capabilities within the train by installing new systems, such as wi-fi and charging facilities.

Looking to the future, Charcroft, sees the main advances for rail and rolling stock as a move to greener power. With the UK government pledging to phase out diesel only trains completely by 2040, various other technologies are being developed, with the most likely replacement being hydrogen trains. Hydrogen trains are proposed to be introduced within the next two years on certain lines, offering emissions-free rolling stock, more effective performance during acceleration, and nearly zero noise.

Rail-specific expertise

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

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

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

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SRAM market declines although bit shipments increase

The global SRAM market will drop over the next several years despite a slight increase in revenue in 2018 caused by tight supply and higher prices



James Carbone

While the global static random-access memory (SRAM) market has been declining for years, SRAM bit shipments are increasing by about 11 per cent per year as the memory chip continues to be used in a range of electronics equipment.

In fact, while the SRAM market has been declining steadily since 2010, revenue actually increased 1 per cent to \$406 million in 2018, according to researcher IC Insights. It was the first time the SRAM market registered positive sales growth since 2010 when revenue totaled \$1.6 billion. The market declined each year between 2010 and 2018, the researcher said. But the increase will be short-lived.

"Ten to fifteen years ago, the SRAM market was on fire when communications and networking equipment markets were rapidly expanding," said Brian Matas, vice president of market research for IC Insights. "But some of the same applications that powered SRAM market growth also led to its demise a few years later, when growth in communications

applications fell on hard times," he said.

While sales increased slightly in 2018, "the SRAM market is forecast to return to its downward-trending ways in 2019 when the market slips 3 per cent to \$394 million," according to Matas.

"The SRAM market has been declining since the smart phone came into being, probably around 2007," said Jim Handy, general director of Objective Analysis, based in Los Gatos, Calif. "There was this big change that smart phones brought about," that negatively impacted SRAM demand, he said.

Prior to smart phones, cell phone used software that was "relatively unsophisticated and was executed out of NOR flash" and SRAMs. Smart phones require more sophisticated software to run programs and used NAND flash and DRAM rather than NOR flash and SRAM. "So, the high-density SRAM market went away," said Handy.

Another reason for the demise of SRAM is being integrated into other system on chip (SoC) devices and processors. "Back in the day SRAMs were used for cache memory on computers," including PCs and notebooks, said Jim Feldhan, president of Semico Research. Now SRAM function is embedded on x86 and other processors for L1, L2 and L3 cache memory, he said.

"It's so much more advantageous to have SRAM on board the chip for performance reasons than having it external," said Feldhan. "In the higher performance categories, if it's embedded it's even faster." He said an external SRAM chip may be cheaper, but "from a performance standpoint" companies like Intel or Nvidia embed SRAM onto their processors to improve performance.

Still needed

However, while use of SRAM in computers and smart phones has diminished, other applications still use the memory chip. For instance, SRAM is needed for base stations, PBX systems, and central

office switches, said Feldhan.

Industrial applications use SRAM because it is less expensive than SoC. They don't have the volumes needed to pay for the "integration of an SoC so they are still using discrete SRAMs," said Feldhan. The same is true with Internet of Things (IoT) applications. "The SRAM functionality is still needed, but it's just cheaper to use a discrete SRAM," he said.

Feldhan said with portable applications it makes sense to integrate SRAM functionality into an ARM core SoC because space is limited.

"SRAMs are still used in a wide variety of end products," said Carl May, general manager, standard products operation for IDT. "They are used in everything including consumer electronics equipment, factory automation, medical imaging, and military and aerospace applications," he said.

May noted that many of IDT SRAM end applications "are fairly old legacy designs. Most of our business is repeat business on

By the Numbers



\$406 million

The size of the global SRAM market in 2018. Source IC Insights



\$1.90

The expected average selling price for SRAM in 2018
Source: Semico Research



\$295 million

The forecast size of the global SRAM market in 2023.
Source: Semico Research



11%

The increase in SRAM bit shipments. Source: Objective Analysis



\$1.6 billion

The size of the worldwide SRAM market in 2010.
Source IC insights





these designs and re-designs using the same circuits in the next generation design," said May.

IDT offers a line of high-speed, industry-standard SRAMs that are used in the communications market. The chipmaker said it maintains support for both fast and low-power SRAMs in RoHS-6/6-compliant (GREEN) packages in commercial and industrial temperature grades. IDT also supports several mature devices used in defense systems.

Its products include synchronous, asynchronous and zero bus turnaround (ZBT) SRAMs. ZBT SRAMs are aimed at networking applications which can benefit from elimination of wait states during write/ read transitions, according to IDT.

Bit shipments rise

Because there are many existing applications for SRAMs, bit shipments are rising even though prices and sales are declining, said Handy. "SRAMs are used in all kinds of applications that need either high-speed or low-power, especially things that used a button cell for backup power," he said.

While the number of SRAM bits per year is growing by about 11 per cent, the price per bit is declining about 3 per cent, said Handy. So, if bits are growing at 11 per cent and the price per bit is dropping about 3 per cent, then revenue will drop," said Handy.

Of course, SRAM is not the only memory chip that has declined over the years, noted Handy. NOR flash and EEPROMs revenue has also faded. "They just don't die off, they tend to wither slowly," he said.

SRAMs will also continue a slow decline because other than legacy products, there are few new designs that use SRAMs. As a result, the SRAM market will drop from \$406 million in 2018 to \$295 million in 2023, according to Semico.

Despite the market decline, prices won't fall as steeply. In fact, the average selling price increased last year to \$1.91 from \$1.68 in 2017, said Feldhan.

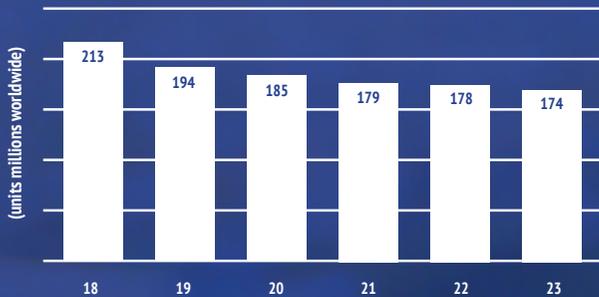
"Prices went up because of tight capacity, higher raw silicon wafer prices and less capacity devoted to SRAM," said Feldhan. He said

The worldwide SRAM market will continue to decline through 2023 when revenue will only total \$295 million. Source: Semico Research

SRAM market plummets



SRAM unit shipments slide



As more SRAM gets integrated into other semiconductors, the number of unit shipments will steadily fall. Source: Semico Research

supply will continue to be tight in 2019 and the average price will be about \$1.90 and increase to \$1.95 in 2020 before declining in 2021, 2022 and 2023. The price will be about \$1.70 in 2023, he said. The 2023 price will still be higher than it was 2016 when the average SRAM cost \$1.65, according to Semico.

The average price will remain higher than 2016 because of tight supply as some memory IC companies have left the SRAM market, while other memory chip companies "are putting less emphasis into SRAM and opt to use their silicon for other products," said Feldhan.

Bottoming out

While the SRAM market is declining, it will eventually bottom out, but not totally disappear. "There will still continue to be some applications for SRAM in niche markets," said Feldhan. "I don't think it will ever go down to zero at least not in the next 10 years.

While the overall SRAM market is declining, one bright spot of the

SRAM market is pseudo SRAM, according to Matas. "PSRAMs are essentially DRAMs with SRAM-like peripheral logic, he said. "They possess a one-transistor DRAM cell but feature an SRAM-like static interface."

The internal DRAM architecture gives PSRAM some strong advantages over low-power 6T SRAM including smaller die size and competitive pricing, according to IC Insights. With densities to 128Mb, low power consumption, and a small footprint, PSRAMs have replaced low-power six-transistor asynchronous SRAM in some cell phone designs.

Some manufacturers are combining SRAM and flash memory in a multi-chip package (MCP) or chip-scale package (CSP) to better serve the IC needs of handset OEMs in particular.

How to specify best match protection

Electronics installed in tough industrial environments are rarely threatened by just one hazard. When faced with an onslaught, selecting appropriate protection can be challenging, says Rolec

In harsh industrial applications, electronic devices may have to survive multiple assaults simultaneously including heavy impact, extreme temperatures, water ingress, dust ingress, or chemical attack.

That can make specifying enclosures a real challenge because to guarantee strength in one area, you may have to compromise in another. Unfortunately, that can be difficult; compromise may not be an option—especially

where the great outdoors is concerned.

Although it may not be your final choice, diecast rather than folded aluminium is usually the best starting point when considering enclosures. It is strong, light and easy to cast or machine and therefore cost-effective to customise.

Understanding ingress protection

Specify an enclosure with a high IP rating for superior ingress protection. Enclosures rated to IP 66 offer protection

against temporary flooding in environments such as heavy seas. IP 67 is required if the enclosure will be dipped in water up to 1m for a short period, while IP 69K protects against close-range high-pressure water jets and high-temperature spray downs.

It is wise to choose an enclosure which offers a range of IP seals. That way it's possible to upgrade later in the design process to seals with a higher rating if the working environment becomes more hazardous than first predicted.



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Lid closed installation

Another key feature is 'lid closed' installation, whereby enclosures feature separate screw channels for the lid screws and fixing screws. There's no point, for example, in specifying an IP 69K seal if the enclosure's lid has to be opened during installation in bad weather.

Rolec's aluCASE offers a lid closed solution for installation. It also features clip-on covers to protect the fixing screws. This is more than simply an aesthetic consideration; these plastic or aluminium covers provide added protection for the screws.

If an environment is seriously tough, however, then it is wise to spend as little time there as possible. In these situations, an enclosure with maximum protection and minimum installation time is essential, particularly if regular inspection or servicing is needed.

To meet this demand, aluCLIC enclosures click into place on a pre-installed bracket. The enclosure can be removed instantly by clicking a tab with a screwdriver, enabling the enclosure to be opened and inspected in a less hazardous location.

For those that require more security to deter tampering, a compromise between aluCASE and aluCLIC is aluSMART. This offers similar advantages to aluCLIC but it is secured to the pre-installed bracket by four easily accessible horizontal screws.

All three options, the aluCASE, aluCLIC and aluSMART, are available with IP 66, 67 or 69K seals.

Impact resistance

Where diecast aluminium isn't strong enough, in situations that demand higher impact resistance, stainless steel is the way forward—either grade A2 AISI 304 or A4 AISI 316L. Of the two, A4 has the lower carbon content. This offers



Where diecast aluminium isn't strong enough, in situations that demand higher impact resistance, stainless steel is the way forward



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Rolec offers three models in both A2 and A4 stainless steel: the inoCASE, available in standard sizes with the full range of IP seals and the inoCASE Mini, available in a range of small sizes and the full range of IP seals. Finally, it also offers a new universal industrial enclosure, the IP 66 rated inoBOX in standard sizes. Rolec's in-house laser processing centre means all three options can be supplied with cut-outs for mounting components.

Chemical resistance

Metal enclosures are not always the answer, however, particularly when looking for chemical resistance. Glass-reinforced polyester is robust, versatile and highly resistant to chemicals, as well as being cost-effective. Rolec's GRP enclosures are used in oil and petrochemical facilities all over the world.

Options include the polytope, an IP 66/67 rated enclosure featuring single-channel fastening to maximise interior space and a choice of polyamide lid screws. The polyKOM, available with IP 65 sealing, is manufactured in industry-standard sizes, making it interchangeable with other standard products. Options include external hinges, supporting hinges and mounting brackets. Lastly, the polyDOOR with IP 66 seals offers a hinged front lid, optional lid window and a choice of lid screws. These include standard slotted screws, triangular or square screws to deter tampering, and hand screws for easy access.

For explosive atmospheres, only ATEX certified enclosures will suffice. Rolec offers several solutions such as the polyKOM and its aluminium equivalent aluKOM, both of which can be specified as Ex-certified models, as can polyTOP and Rolec's 'round' aluminium enclosure, the aluDISC.

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Rittal has developed a roof-mounted version of its Blue e+ cooling units. Designed to save space and energy, units can be supplied as a bolt-on, or integrated in the VX25 enclosure

Ideal for control and switchgear applications where space is at a premium, Rittal's new roof-mounted Blue e+ cooling unit can be specified for enclosures of 800 by 600mm upwards, delivering a cooling output of 1.3kW. The units also feature in the new VX25 large enclosure system as an integrated solution.

Roof-mounted climate control is the top choice for control and switchgear where there is a lack of space on the front and side panels. Sometimes this is due to the location of the enclosures with minimal gangway clearance, other times an abundance of interlocks, switches or other controls restricts space for a wall mounted cooling unit.

Efficient cooling

According to Rittal, air routing within the enclosure is optimised. Cold air is

blown down the front of the enclosure and drawn back up the mounting plate, thereby dissipating the heat from top-mounted components such as frequency inverters.

Similar to existing wall-mounted units, the roof-mounted cooling Blue e+ series utilises a combination of heat pipe and conventional compressor technology. This helps ensure energy consumption is low because neither a compressor nor a pump is required when the cooling units are operating on the heat pipe; only the fans that circulate air need an electricity supply. This cooling method works particularly well if there is a large temperature difference between the inside of the enclosure and the surroundings.

The additional compressor within the cooling units

only kicks in when a larger cooling output is required. Furthermore, all active components operate with speed-controlled drives so the cooling output always matches what is required, ensuring less energy is consumed.

Overall, depending on the ambient conditions and the application, Blue e+ series units are said to use on average 75 per cent less energy than conventional compressor cooling units.

With this efficient cooling in place, lower temperature deviation within the enclosure helps extend the service life of the components installed. As an added benefit, the new units have a multi-voltage supply making them easy to operate at all common mains voltages and frequencies. This is particularly beneficial

for those who sell their equipment worldwide.

Ready for IoT

Blue e+ roof-mounted systems are designed for intuitive operation, using a touch display for basic settings and to read status messages. Blue e+ units feature in the new Rittal integrated VX25 enclosure solution with built-in climate control. Alternatively, they can be installed as an individual roof-mounted unit. In this configuration, the touch display is built into the enclosure door and the unit can be easily removed for maintenance.

An optional internet of things interface makes it simple to integrate the cooling unit in an Industry 4.0 environment.

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Teko Enclosures	OKW Enclosures	01489 583858	www.teko.co.uk	Y	1,860	£40,000	£0	N/A	5	22	Y
FREQUENCY MANAGEMENT											
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
HEATSINKS											
Aavid	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	700	N/A	£0	67%	50	1,500+	Y
ICs & SEMICONDUCTORS											
Altera	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,600	N/A	£0	60.00%	50	1,500+	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
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
Diodes Incorporated	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,600	N/A	£0	98%	50	1,500+	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
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



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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
ICs & SEMICONDUCTORS (Continued)											
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
Lattice	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	700	N/A	£0	69%	50	1,500+	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
Microchip	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	12,600	N/A	£0	91.00%	50	1,500+	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
NXP	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	3,900	N/A	£0	91%	50	1,500+	Y
ON Semiconductor	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	5,100	N/A	£0	87%	50	1,500+	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 Semiconductor	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,400	N/A	£0	55.00%	50	1,500+	Y
Silicon Laboratories	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,500	N/A	£0	96%	50	1,500+	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
Texas Instruments	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	36,900	N/A	£0	41%	50	1,500+	Y
Toshiba	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	500	N/A	£0	100.00%	50	1,500+	Y
INDUSTRIAL GRADE MEMORY MODULES											
InnoDisk	Simms	01622 852 848	www.simms.co.uk	N	300+	N/A	N/A	N/A	3	N/A	Y
INTERCONNECTION											
3M	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	3,100	N/A	£0	16%	50	1,500+	Y
Amphenol	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	25,600	N/A	£0	53%	50	1,500+	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
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
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
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
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
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



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INTERCONNECTION (Continued)											
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 Connectivity	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	30,900	N/A	£0	40%	50	1,500+	Y
OBSOLESCENCE / HARD TO FIND											
	America II Europe	01462 707070	www.americaiiieurope.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
Rochester Electronics	Rochester Electronics	+44.1480.408400	www.rocelec.com	Y	299	N/A	\$250		10	400+	Y
OPTO ELECTRONICS											
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
PASSIVES											
AVX	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	70,700	N/A	£0	58.00%	50	1,500+	Y
Bourns	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	49,500	N/A	£0	98%	50	1,500+	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
Kemet	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	135,800	N/A	£0	93%	50	1,500+	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 Technologies	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,800	N/A	£0	50.00%	50	1,500+	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
Ohmite	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	17,300	N/A	£0	99.00%	50	1,500+	Y
Panasonic	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	67,900	N/A	£0	69.00%	50	1,500+	Y
Taiyo Yuden	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	6,400	N/A	£0	82%	50	1,500+	Y
TDK	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	25,300	N/A	£0	85.00%	50	1,500+	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	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
Yageo	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	45,300	N/A	£0	99%	50	1,500+	Y
POWER & BATTERIES											
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



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POWER & BATTERIES (Continued)											
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
SENSORS											
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
Freescall 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
SWITCHES & KEYBOARDS											
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
Carling 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
TERMINAL BLOCKS											
Marathon Special Products	Global Supply Services	01904 436 488	www.global-supply-services.com	Y	8,000	£800,000	£100	100%	3	11	Y
THERMAL MANAGEMENT											
ADDA	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	800	N/A	£0	59.00%	50	1,500+	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
THERMAL MANAGEMENT (Continued)											
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		2,900	N/A	£0	N/A		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
TRANSFORMERS & INDUCTORS											
Best Windings	Best Windings	0044 (0)1394 448424	www.bestwindings.co.uk	N	300	N/A	£100	N/A	2	14	Y
WIRELESS SOLUTIONS											
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
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
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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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
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.etluc.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	230	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.iiew.co.uk	£5.5m	Swindon, UK	60	N/A	ISO9001:2015, 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, Luttenworth, (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.tenkayco.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)1322621700	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	Doubles-sided	Multi-layer 4-10/10-20-30	Metal PCBs	Flex / Flex-Rigid	Obsolescence 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	UK, Europe, Asia, USA	UL, ISO9001:2008, TS16949:2009	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
Fineline VAR Ltd	+44 (0)1249 815 815	www.fineline-global.com	B	UK / Global	ISO9001:2015 / UL / TS16949 / Nadcap / AS9100 / ISO14001	SML	Y	4-60	Y	Y	Y	Y	Y
GSPK Circuits Ltd	+44(0)1423 321100	www.gspkcircuits.ltd.uk	M/R	UK, Europe, Asia	IS 9001:2015, IATF 16949:2016, EN (AS) 9100	SML	Y	4-16	Y	Y	Y	Y	Y
LEF Circuits	0116 2891122	www.lefcircuits.co.uk	M/R	M	ISO 9001:2015, 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
Stevenage Circuits Ltd	01438 761811	www.stevenagecircuits.co.uk	M/B	UK/China	ISO 9001:2008, ISO 14001, EN9100:2009, UL, JOSCAR	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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