

ELECTRONICS

JULY 2019

Sourcing

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On the cover – July 19

A cool approach to sourcing enclosures
page 35

Contents

04

News

LED lighting accessories in stock

12

CEM Sourcing

What to look for in a CEM

24

Environment

Environmental compliance: being green

32

Enclosures

Suspension arms: light work of specification

44

Buyers' Guide

All the facts and figures to help you buy

Editor's Word



It's good to meet

I've spent the last 20 plus years travelling back and forth to South Wales to visit my in-laws. However, my most recent visit stopped short of Swansea, seeing me alight at Newport. The reason for this trip was to take a tour of the Compound Semiconductor Cluster and talk to those involved.

For readers not familiar with the subject, compound semiconductors comprise multiple elements such as gallium arsenide, gallium nitride and silicon carbide. This material technology represents the platform from which the next generation of high-performance semiconductors are being built.

It would be easy to assume that buying into this type of technology would require outsourcing to the US or Asia. Not so. This world leading facility is right on your doorstep.

The secret to entering this technology process is the cluster formation which starts with academic facilities at local universities and then extends to all aspects of the production and supply chain processes. Whether you represent a micro business with a novel concept or an existing blue-chip manufacturer developing your next generation systems, the cluster offers an appropriate onboarding point.

My visit got me thinking more about the benefits of clusters and the broader economic trade idea of comparative advantage. I have no doubt that as the world becomes ever more complex the clustering of government agencies, academic institutes, manufacturing facilities and supply chains will doubtless grow in importance.

Let's hope that the UK government understands and supports this.

Jon Barrett

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LED lighting accessories in stock

Anglia has added an extensive range of secondary optics to its LED lighting portfolio with the addition of Khatod reflectors, lenses, diffusers and other accessories for LED lighting, infra-red and ultra-violet applications.

A variety of products from the Italian manufacturer will be stocked, including Khatod's Reelenses optics for mid power LEDs supplied on tape and reel packaging for high volume manufacturing. Anglia will also be stocking silicone material lenses, which enable designers to seal lighting fixtures to IP ratings and also provide impact protection to IK standards.

Technical director of Anglia, David Pearson, commented: "Anglia offers a broad range of LED products for creating light - but that light still needs to be adapted, directed and optimised to the final application. Using appropriate optics can increase the amount of useable light available in the system and protect the light source against potential damage. This is what Khatod products do."

www.anglia-live.com

Free app simplifies inventory management

Mouser Electronics has introduced a free, web-based inventory management tool designed to help buyers manage and track their stock of electronic components and supplies. The tool can also be accessed via a companion mobile app for iOS and Android devices, which enables users to scan barcodes as well as print bin labels. To access the tool, purchasers simply log into their My Mouser account.

Initially created for Mouser's university-based customers to help manage in-house inventories, the tool can be used by any organisation that needs to manage small to medium size inventories.

Perfect timing for IoT

AEL Crystals has added SiTime microelectromechanical systems oscillators to its range, thereby adding to its existing portfolio for the internet of things. The new SiT15xx 32.768 kHz MEMs timing solutions are ideal for mobile, IoT and wearable applications, where space and power are critical. They boast high levels of integration, and new packaging options with surface mount and ultra-small chip-scale package choices.

This makes the oscillators ideal for IoT applications where increased miniaturisation and reduced power consumption are combined with a demand for reliable wireless frequency generation, operating over multiple protocols.

A particular benefit for IoT applications is the MEMs oscillators' clocking for monitoring circuitry. The real-time clock is always-on, contributing to extended battery life. Programmable technology ensures that samples are available from stock in all frequencies.

www.aelcrystals.co.uk



With the tool, users can manage part numbers and inventory levels, generate inventory reports, and import current product inventory data from spreadsheets. A simple online dashboard and set-up wizard support ease of use.

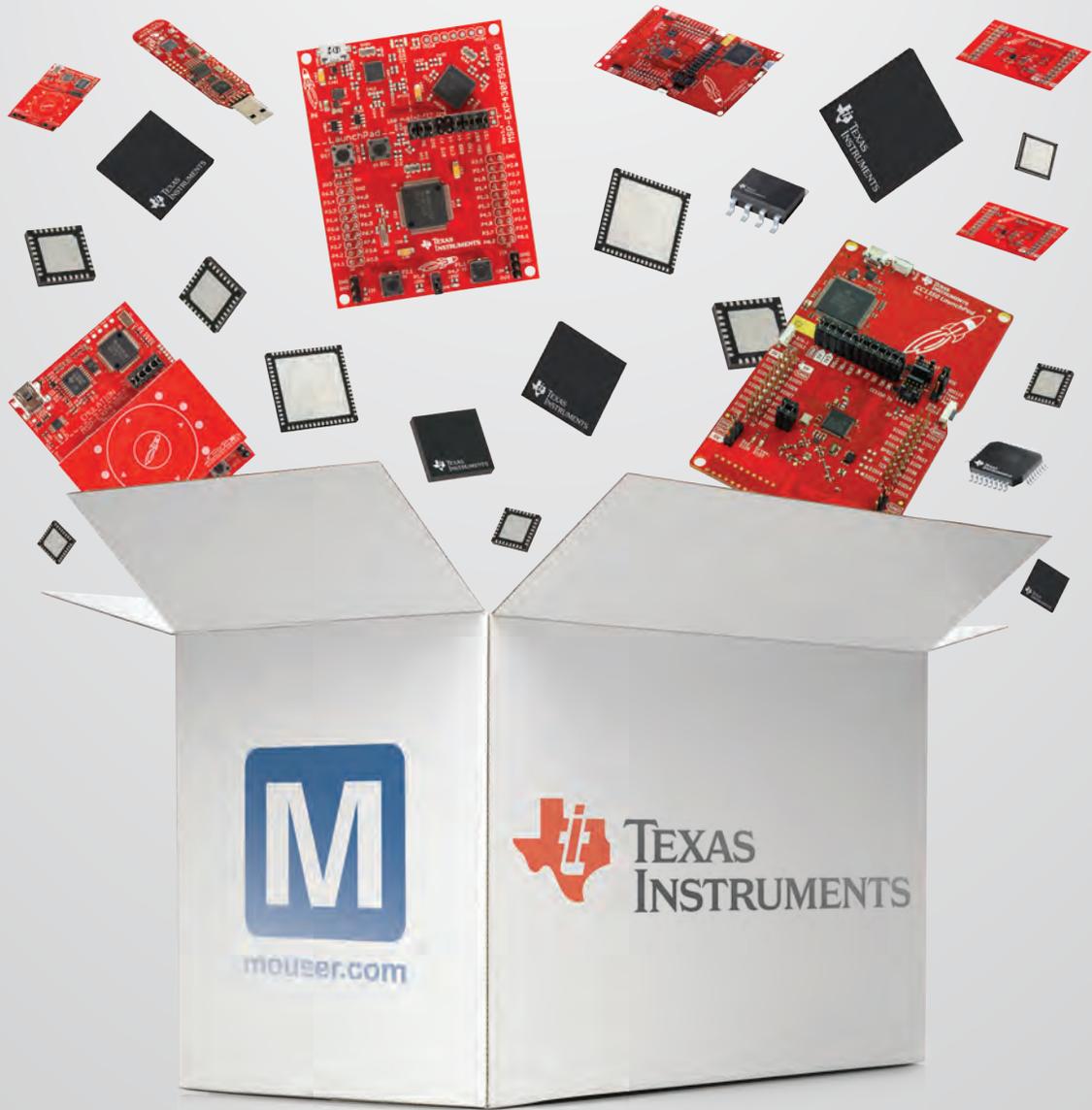
Customers using the tool on a web browser can also use Mouser Match, which links products to Mouser part numbers. This makes it possible to automatically synchronize product data, import product images for recognition on sight and quickly reorder products from Mouser.

www.mouser.com

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In Brief

Secure supply adds value

Astute Electronics is celebrating 30 years in business as an independent electronics distributor. True to its ethos of adding value in the supply chain, Astute continues to support many defence and aerospace customers. With component test labs in both the UK and US, Astute's anti-counterfeit avoidance programme incorporates AS6081 standards, helping customers deal with volatility in component supply, extended lead-times and rapid obsolescence cycles. www.astute.co.uk

Analogue line-up extended

Avnet Silica has added IDT to its supplier portfolio, introducing a range of mixed-signal analogue products including RF devices for communication systems, wireless power charging technologies, sensors for industrial automation applications, and high-performance clock and timing ICs for processor designs. This will enhance its offering in key markets such as building and home automation, as well as communications and automotive. www.avnet-silica.com

Reliable supplies in stock

Telonic Instruments is to distribute Delta Elektronika equipment in the UK. Power supplies manufactured by Delta Elektronika are said to combine longevity, high-end technical specifications and low cost of ownership. Its supplies also react quickly to load transients, with minimum audible noise and electromagnetic interference. All Delta Elektronika's DC power supply units are tested before dispatch. www.telonic.co.uk

Rail-ready connectors roll out

TT Electronics has announced two new products for rail and military vehicles: the SteadiShield reverse bayonet connector and the OcTrain 10Gb Ethernet contact, which meets ultra-high speed connection requirements to aid heavy data consumption in harsh environments.

Designed for extreme conditions, SteadiShield and OcTrain can be utilised in braking systems, trackside and signalling cables, and drivers' cabin equipment, as well as performing well in demanding telecom and industrial markets. www.ttelectronics.com



Expanded opto choice

Farnell has extended its line card by adding products from Osram Opto Semiconductor with a portfolio including LEDs, infrared emitters, photodiodes and optical sensors, amongst others.

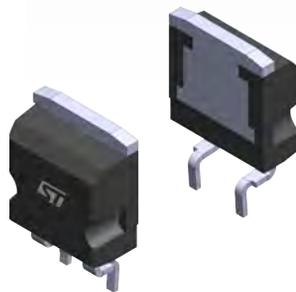
The additions, which will provide more illumination, visualisation and sensor solutions, will support applications in markets such as automotive, mobile, smart grid, metering, industrial, and energy management.

Key products to be stocked by Farnell include the Osram Black family of infrared LEDs, which is now available in dedicated automotive versions for exterior and interior applications such as driver monitoring, and seat occupancy detection. Other highlights include the Topled E1608 family of low-power LEDs ideal for automotive applications such as displays, ambient lighting and instrument backlighting.

www.premierfarnell.com

High temperature thyristors available online

Rutronik is offering STMicroelectronics' TN1605H-6G/6T thyristors, available now on www.rutronik24.com in SMD as well as through-hole-isolated and non-isolated packages. These high-temperature silicon-controlled rectifiers are designed to improve the reliability of applications such as overvoltage crowbar protection and motor control circuits. They can function as AC switches, AC phasing inverters, and AC/DC controlled rectifier bridges.



Key features of the TN1605H-6G/6T families are a voltage robustness up to 1,200V, a high noise immunity and low power dissipation at 150°C junction temperature. They are designed to facilitate strong and compact control circuit designs, which help reduce costs by using smaller heatsinks. Target applications are therefore voltage regulators in motorbikes, automotive stationary battery chargers, uninterruptible industrial power supplies, and motor drive applications.

www.rutronik.com

New LEDs target horticultural growth

RS Components has availability of a new selection of Luxeon LEDs from Lumileds that target horticulture applications. The SunPlus 2835 series has been purpose-built to deliver the precise wavelengths of light required to improve crop yield, either by complementing or potentially replacing natural sunlight.

Luxeon claims this is the only LED line that has been binned and tested to maximise photosynthetic photon flux, which determines the amount of photosynthetically active radiation provided by a light source each second. This is a key parameter used by gardeners and operators of indoor and greenhouse farming installations to monitor artificial lighting systems.



The series offers PPF/watt measurements from 1.84 for one of the purple LEDs, up to 2.32 for the 'deep red' and 'far red' LEDs, specified at 120mA current flow and a device junction temperature of 25°C. Other colours are available with varying levels of PPF/W.

uk.rs-online.com

Cleanroom set to expand UK-made mil-spec portfolio

Charcroft's franchised partner, frequency control specialist Euroquartz, has installed a new class seven cleanroom facility at its Somerset headquarters. This investment will support UK defence contractors, as well as military and aerospace purchasers, and is expected to help fulfil their requirements for surface mount oscillators.

Having been installed early in 2019, the cleanroom is currently being commissioned with hopes of adding a new range of SMD oscillators to the current through-hole range before the end of the year. The ambition is for Euroquartz to offer high-quality UK manufactured products to the aerospace industry, free from all ITAR restrictions.

Euroquartz director, Andy Treble, commented: "The ongoing turmoil of Brexit and other world events suggest that the timing for this significant investment is right. It is important to maintain manufacturing for critical frequency components in the UK, particularly for military and aerospace projects."

www.charcroft.com

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Feature

ELECTRONICS SOURCING INDUSTRY FOOTBALL MATCH 2019

On Thursday 23rd May 2019, the annual *Electronic Sourcing Industry Football Match* was held at the Sussex County FA stadium in Lancing. With twelve football teams competing for the *GELEC Cup* and *Electronics Sourcing Shield*, it was the largest football tournament to date.

The teams who competed for the title were GELEC, GB Electronics, NCAB Group, CCL, Rutronik, eBOM.com, Harwin, Avnet EMG, Photronix, Electronics Sourcing, GC Components and MMG.

At 10:30 am, the first round of games kicked off. With 15 minutes of football

per game, the electronic industry teams ambitiously competed with their opponents.

After many competitive 5-a-side matches had been played and tea/coffee consumed, the tense semi-finals got underway.

At 1:15 pm, the final for the *GELEC Cup* and *Sourcing Shield* kicked off. After many successfully played matches, Photronix was the proud winners of the *GELEC Cup*. With the tense battle of a penalty shoot-out between Sourcing and GC Components, the winners of the *Sourcing Shield* was GC Components after clinching it in sudden death.





Thanks to everyone's generosity at the Electronic Sourcing Industry Football and ECSN Dinner, the local charity 'Albion in the Community' raised a grand total of £5,435.00. The donations will be helping towards delivering high-quality accessible opportunities that improve the health and wellbeing, education and aspirations of our community.



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Distributors see increasing opportunities with automotive and transportation OEMs

Some distributors are focusing on automotive customers because high-tech safety and infotainment systems, rising shipments of electric vehicles and development of connected cars and driver-less vehicles are boosting electronic component demand



James Carbone

Most semiconductor, passive components and connector manufacturers say that automotive continues to be a growing segment for sales despite the fact that car and light truck shipments are expected to decline this year and be sluggish through 2023.

Automotive is also proving to be a burgeoning segment for electronics distributors, many of which sell components to tier 1 automotive suppliers for new product introduction as well as to tier 2, 3 and 4 automotive suppliers building electronic systems and subsystems for automakers.

Distributors point out that their business is not just with large auto companies and their supply chains, but also with transportation OEMs that design and build agricultural and construction vehicles, mass transit systems, all-terrain vehicles, and golf carts among other off-road vehicles.

Distributors' business with transportation OEMs is robust because many of the electronics-rich safety, convenience, and infotainment systems being designed into cars and light trucks are also being designed into off-road vehicles. As a result, component demand from transportation and automotive OEMs and their contract manufacturers is growing. For instance, a new report from connector industry research firm

Bishop and Associates says that connector sales to automotive will grow from \$15.7 billion in 2018 to \$21.3 billion in 2024, a compound annual growth rate of 5.8 per cent. That strong growth will occur although car sales are expected to decline in 2019 and 2021. In 2018, motorists in the U.S. bought about 17.2 million new automobiles and light trucks, according to researcher Statista.

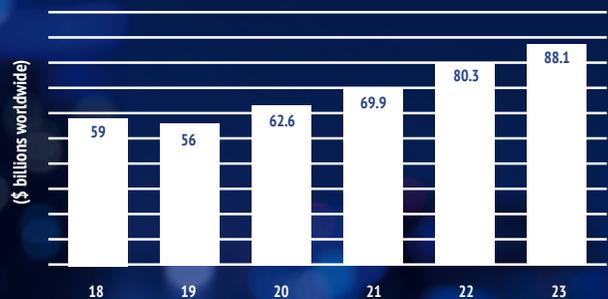
However, car sales in the U.S. will drop to 16.8 million and continue to decline in 2020 and 2021 before increasing to 16.8 million in 2022 and 17.3 million in 2023, the researcher said.

Automotive's appetite for semiconductors will grow and automotive will represent a higher percentage of semiconductor sales. Semico Research Corp. says that in 2018, automotive represented 12.5 per cent of semiconductor sales. By 2023, that percentage will grow to 16.7 per cent, the researcher said. In addition, chip sales to automotive will rise from \$59.2 billion in 2018 to 88.1 billion in 2023, said Semico.

A strategic segment

With electronics demand by automotive and transportation companies rising, distributors are focusing more resources on the segment. "Automotive is a strategic vertical for us," said Murdoch Fitzgerald, vice president sales and engineering at Arrow Electronics. "I have a

Demand for auto chips will rise



Sales of semiconductors for automotive applications will decline in 2019 but will rebound and reach \$88.1 billion in 2023. Source: Semico Research

dedicated team that services transportation," he said. Arrow provides supply chain global logistics and engineering services to transportation in automotive customers, said Fitzgerald. Its transportation customers include a wide range of customers ranging from tier 1 automotive companies as well as tier 2 through tier 5 OEMs.

With transportation customers, "we service companies like John Deere and Caterpillar, anything with wheels, we are servicing them," said Fitzgerald.

Fitzgerald said while unit shipments of vehicles is expected to decline this year, electronics

content in vehicles is increasing because more are being equipped with Advanced Driving Assistance Systems (ADAS). Such systems have features such as adaptive cruise control, collision avoidance, pedestrian crash avoidance, mitigation lane departure warning and automatic lane centering among others.

"Electrification" of vehicles is also driving component demand as more vehicles being shipped are electric vehicles (EVs) or hybrids. EV sales increased 81 per cent in 2018 as 361,307 EVs were sold in 2019, according to tracking site Inside EDVs.

"We are working with a lot of the



next new wave of automotive customers that could be the next Tesla out there," said Fitzgerald. "It's a pretty exciting prospect for us," he said. Besides EV and hybrids, EV charge stations will help drive Arrow's transportation business.

Innovation adoption

Innovations being made in automotive are being adopted by off-road transportation vehicles. Dave Doherty, president and chief operating officer for Digi-Key, said the Thief River Falls, Minn. distributor is involved with tier 1 automotive OEMs with new product introduction "whether it is safety, convenience or infotainment systems."

He added that Digi-Key also sells components for production when supply is tight as it was in 2017 and 2018 in part because of strong demand for semiconductors and passives from automotive OEMs and their suppliers.

"I don't think tier 1 automotive is unique from other tier 1 customers in other spaces such as networking, EMS etc.," said Doherty. Digi-Key's business model is not aimed at large volume production needs of OEMs and EMS providers, but the distributor is a "highly trusted source of supply," he said. "When shortages occur due to long lead times and/or unforecast demand,

we do see tier 1 customers across all of these spaces purchasing product through our digital model to manage potential disruptions to their supply chain," said Doherty.

He said that Digi-Key is careful in balancing the needs of customers looking for shortage parts with the needs of new product introduction customers. "It's a balance of offering some emergency support for today's needs while being cognisant of our role to support tomorrow's designs," said Doherty.

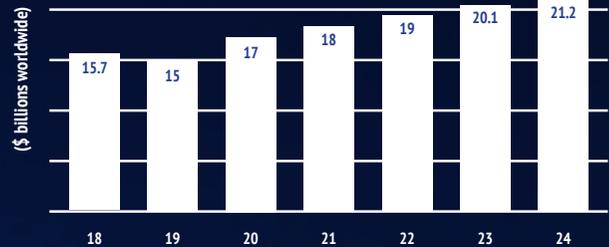
Doherty said that the broad category of transportation is a growth segment for Digi-Key. Transportation includes automotive but also farm and construction vehicles, recreational vehicles, boats, all-terrain vehicles and other forms of transportation.

Tech-filled tractors

He said that much of the growth in Digi-Key's transportation business is because off-road vehicles and farm equipment such as tractors which are being equipped with the same technology that's being used in automobiles.

"The sophistication that you get when you get into a tractor, you would think you're in a spaceship," said Doherty. You might see a tractor driver in a field reading a book while the tractor he is in

Automotive will need more connectors



Distributors expect to sell more connectors for automotive applications.

Source: Bishop & Associates

moves across the field with an accompanying driver-less tractor. "So essentially there are two tractors driving autonomously across the field," said Doherty. Autonomous driving technology is also used in construction vehicles such as the graders, he said.

Wanted: rugged components

Such vehicles require not only the latest technology, but also more rugged semiconductors and passives. Those parts are increasingly in demand from non-automotive, non-transportation applications, said Doherty.

Many OEM customers like the "the ruggedness of components" used in automotive because there are many non-automotive applications "that have a slightly rugged environment," he said.

Automotive has stringent quality requirements such as ISO 16949, a technical specification for development of quality management system to guarantee continual improvement, prevent defects and reduce variation and waste in the automotive industry supply chain.

Karim Yasmine, corporate vice president strategic supplier development for Future Electronics, said transportation/automotive is a big focus area for the Montréal-based distributor. "It is a growth engine for the

industry and has been for many years," he said. "There will continue to be a lot opportunity for growth in traditional automotive, as well as the new wave" of ADAS applications, EVs, hybrids, the connected car and autonomous driving cars, said Yasmine.

A connected car is equipped with Internet access, and usually with a wireless local area network that allows the car to share internet access with other devices both inside and outside the vehicle. Researcher IHS Markit forecasts that by 2023, worldwide sales of connected cars will reach 72.5 million units, up from 24 million units in 2015.

Sales of autonomous or self-driving vehicles will grow from about 600,000 units in 2024 to 21 million in 2035, according to IHS Markit.

He added that demand for components by automotive OEMs will continue for years because less expensive car models are being equipped with ADAS and infotainment systems. In the not so distant past, only high-end models were equipped with such systems.

"A Corolla has a lot of intelligence now; it's not just the Lexus," said Yasmine.

What to look for in a CEM

To get true value out of a CEM relationship, what should buyers be looking for—flexibility, capacity, engineering and purchasing support? According to Nemco, the answer is all of the above

When assessing which contract electronics manufacturer to enlist, buyers will consider several factors, from basic capabilities and breadth of services to industry-specific accreditations and added-value support services.

As UK CEM, Nemco points out all of these elements will be important in the decision-making process. That's why Nemco continues to invest in both people and equipment, building on its core offering of PCB population with added value services such as e-mech assembly, harness production and full product build.

Flexible services

In fact, many OEMs will require a mix of different services in order to meet their manufacturing needs. A flexible service package therefore allows customers to take advantage of any combination, from a single service to handling all aspects of the production and supply cycle.

From its 60,000ft² Stevenage plant, Nemco aims to cater

for any requirement, from procurement, through PCB population, full product assembly and test and packaging, right through to shipping direct to the customer's end user.

Six high-speed SMT lines provide the backbone of the company's PCB assembly offering, coupled with flow, selective soldering lines and a skilled conventional population team. Services range from simple PCB in a box assembly to complete prototyping and this is complemented by test and inspection facilities, including AOI, x-ray, functional test, ATE and flying probe equipment.

Expert advice

To offer a truly effective partnership, however, a CEM needs to offer more than just equipment. Expertise and advice have a huge role to play, which is why the Nemco family also includes procurement, design, engineering, and customer liaison professionals.

In response to the current challenging component

sourcing environment, Nemco has strengthened its procurement team to help chase down difficult to source parts. Communication with the engineering team is also paramount to a successful partnership and to support this Nemco allocates a specific engineering team member as a point of contact.

As managing director of Nemco, Dave Pearce, comments, these efforts are just some of the measures Nemco has put in place to ensure it creates successful, flexible partnerships. He concluded: "Our vision is to be the contract electronics manufacturer of choice and to set the standard for quality, delivery, and reliability. Investing in people as well as equipment is fundamental to this aim."

www.nemco.co.uk



A flexible package allows customers to take advantage of any combination of services



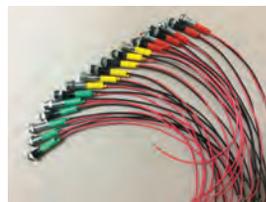
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Exciting times?

Sales manager at Wilson Process Systems, Steve Cooke, asks what post-Brexit Britain will look like if Government and industry don't collaborate to make electronics, and manufacturing as whole, an exciting career path

With ongoing speculation around whether the UK will eventually leave the EU and fear and uncertainty surrounding Britain's possible post-Brexit future, there doesn't appear to be any focus on the imbalance in our economy, which is weighted towards services, over and above manufacturing.

There are many, however, that believe opportunity for post-Brexit Britain lies in a structural shift in demand towards UK goods and UK manufacturing. That's something the UK electronics industry has been championing for quite some time, whether we leave the EU or not. Shouldn't current events provide a wake-up call to industry and politicians alike? If a post-Brexit future has any chance of success, the UK needs to step up its help towards UK manufacturers, to win back some of the business that has been lost to globalization.

Cutting EU red tape would reduce costs and open up new markets, and many SMEs' key skills, supported by immigration, will still offer a wealth of experience that can be passed on to British trainees. Meanwhile Government must increase its provision for vocational training to develop a competitive British workforce at grass roots level.

New talent is needed
This could be a problem, however, as education in schools often portrays UK

manufacturing jobs/roles as undesirable options; this would appear to be true in a number of areas within the electronics industry. In the 80s/90s and 2000s, a career in electronics, whether it be distribution, engineering or subcontracting, would be common place, but there now appears to be limited talent coming through the ranks.

Today, at engineering shows, you might see a group of students lucky enough to be on apprenticeships or associated courses, but in general, there still doesn't seem to be enough new blood being attracted into the electronics industry.

Perhaps the fundamental issue lies with UK manufacturing as a whole? I appreciate that many OEMs have relocated their manufacturing facilities to distant shores over the years, but there are still up and coming sectors, such as smart power, autonomous vehicles, robotic systems and green energy infrastructure, to name but a few. These emerging sectors require new talent, but the Government needs to do more to make careers in these areas more appealing to prospective candidates.

Schools and colleges also need to make the sector more attractive to ensure the UK continues to attract and inspire students to pursue careers in engineering and electronics to help stem the decline.

Whichever way Brexit plays out, the UK needs to take a serious look at making UK manufacturing more attractive to all industries. In my opinion, the service sectors won't be enough to see the UK through without creating greater division between north and south.

www.wps.co.uk



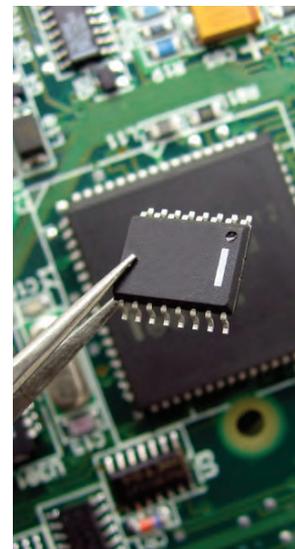
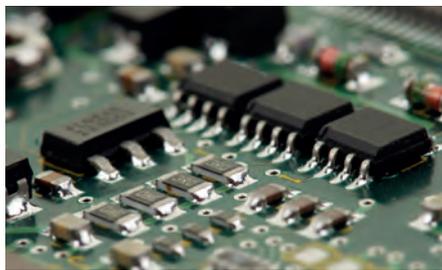
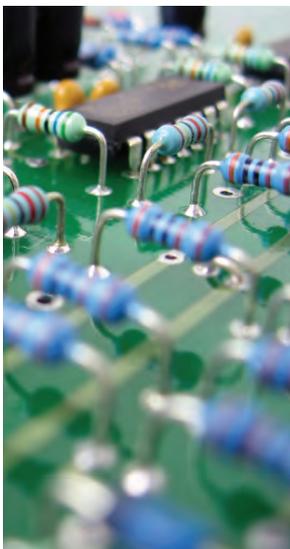
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“Whichever way Brexit plays out, the UK needs to take a serious look at making UK manufacturing more attractive”

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Looking in the right places

Whether you want to outsource manufacture of a component or full box-build, looking in the right places for the right CEM features can be crucial. Corintech suggests you start with procurement

When selecting a CEM provider, first consider the beginning of its process. Does it have a strong procurement system of its own? There are two features that can help identify this: a global network of supply options and close, long term relationships with chosen suppliers.

Having a global purchasing reach affords more opportunities for fully-traceable, low-cost sourcing, meaning your supplier will be able to keep bill of materials (BOM) costs as low as possible. This, in addition to having established relationships with key suppliers, can be vital in ensuring longevity in your project. It means suppliers will be able to provide letters of intent forecasting the future availability of components needed for your builds well in advance, so your CEM can plan accordingly to avoid business critical delays in supply.

Interrogate technical capabilities

Another important factor to consider when selecting a CEM provider is its technical capabilities. Does it have in-house engineering expertise? What production and inspection equipment has it invested in, and how will this benefit your needs? Does it have manufacturing facilities in the UK or abroad? It's great to get answers, but it is equally important to know

why looking for these things is important and how they can benefit your business.

First, consider what additional services are on-site and easily accessible. For example, on-site design engineering expertise enables fast peer review of your designs. A skilled team can provide design for manufacture recommendations and make quick assessments of alternative components when an obsolescence issue is on the horizon.

Also, consider the location of facilities. A CEM provider with UK facilities is beneficial as this enables face-to-face meetings and fast-turnaround prototyping and product batches, both of which can accelerate time-to-market for new product releases. It can also be advantageous if a CEM has manufacturing options overseas; this offers wider sourcing opportunities and low-cost manufacturing when scaling up to large production quantities. Choosing a supplier that can do both offers you the flexibility to meet the demands of your market easily – be it high quantity, or a sudden need for a fast-turnaround batch.

Consider quality control

In any CEM selection process, quality should always be key. Establish what quality accreditations your potential

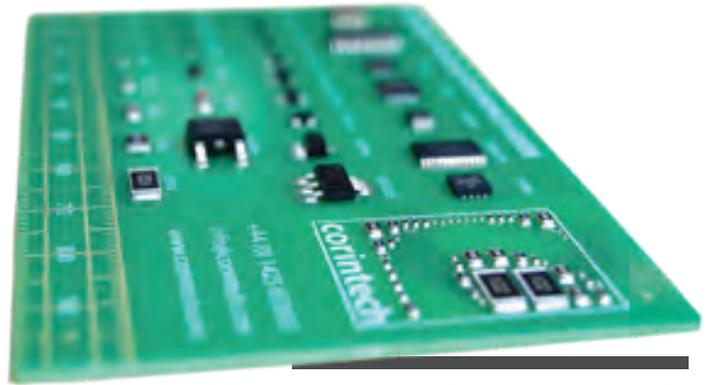
providers holds. ISO 9001 should be a minimum requirement, so it is wise to ask if it has any additional quality standards for specific industries.

It can be a bonus if the sub-contract manufacturer supplies the aerospace or defence industries, as these sectors have higher quality standards, including the AS9100 accreditation, which demands an additional 80 requirements and 18 amplifications on top of ISO 9001. These additional regulations will usually benefit all customers, not just those operating in these specified industries.

Next, ask which workmanship and inspection standards it adheres to? The *IPC J-STD-001 Requirements for Soldered Electrical and Electronic Assemblies* is the main authority for electronics assembly manufacturing. *IPC-A-610 Acceptability of Electronic Assemblies* is internationally recognised as the de facto product acceptance criteria for PCB assemblies.

With these criteria in mind, and a firm idea of what you are looking for and why, CEM selection needn't be a challenge, says electronics design and manufacturing specialist, Corintech.

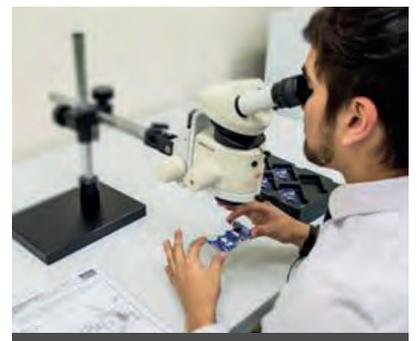
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Aerospace and defence accreditations benefit all customers, not just those operating in these specified industries



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CEM selection: why quality counts

There's no benefit in choosing the lowest quote, or even the flashiest facilities, if the product you receive fails to meet expectations. It's vital to put quality first, explains Protronix EMS

There are several factors to consider when selecting an electronics manufacturing partner. Proximity to your own business is of course significant, but accessibility can be just as important as overall mileage. For example, one major Protronix client is located over 150 miles away but deliveries are still next day and due to Protronix EMS' location, three miles from the M1 and close to the central rail station, geography has never been a barrier.

Modern equipment, in terms of package capability and performance, is a must. Those companies that have not invested are now struggling with the package sizes found on modern designs. Likewise, some entry level and/or older equipment may not have the placement speed to manage production should demand increase. Start-ups or those with a new product range, may believe they are working with an EMS that can cope with demand, but if demand increases, can the EMS scale up within the required timeframe?

Cheap can be costly

Quality should be the overriding factor when selecting which EMS to work with. After all, there is no benefit in working with the supplier who submitted the lowest quote, or who has the very latest facilities, if the product you receive fails to meet expectations. This is when 'cheap boards' become incredibly expensive.

Protronix EMS is ISO9001:2015 certified and works to the requirements set out in IPC-A610, with class three being the minimum accepted standard. But beyond this, its own expectations set the bar higher still. A lot of the intricate products produced have a hard life once they leave the factory in harsh and/or safety critical environments. Quality isn't a bonus for these customers and their products, dependability is crucial.

Right first time

The ability to proactively respond to demand is vital. If you have a product in development, chances are

somebody, somewhere, is not far behind. Getting your product to market in a timely fashion, whilst getting things right first time, is essential. Can the EMS provider you are considering ensure this happens?

Getting an EMS to provide some value analysis to your bill of materials can really improve commercial viability. Sometimes the designer has specified a part and their demand means purchasing thousands of that part. Protronix EMS may be using an alternative, of equal or higher spec, in much higher volume, enabling the customer to benefit from better pricing. Or there may be a similar part, which is either lower cost or has much greater availability, to that on the BoM. After all, there's no point specifying a part which is non-stocked and has a 26 week factory lead time. Once you have used the low volume 'catalogue stock' for NPI and need full batch quantities, you meet a barrier to market. Protronix EMS likes to give the customer options.

Of course, no EMS that can offer everything mentioned here can really be the 'cheapest' but providing the lowest figure on a quote rarely equals the best value. Conversely, the highest price doesn't assure the best quality and service, either. So, while costs must be in-line with the commercial viability of your product, this should not be the defining factor.

Naturally, it's a big decision and one that customers only want to make once, so it's essential to look at the overall package to ensure your EMS provides the absolute best levels of quality and service.

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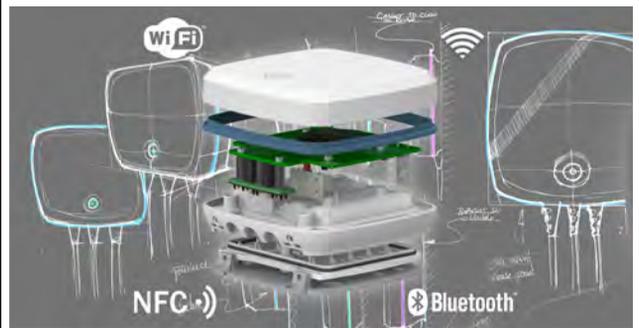
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More than just a supply chain vendor?

The best CEMs are more than a vendor in the supply chain—they should treat your products as their own, explains contract electronics manufacturer, Trizo

It can be a daunting process evaluating a CEM and the services it offers. It's important to make an informed decision and you must identify what is important to your business; location, cost, quality, on time delivery, or all of the above. In any case, the right CEM will recognise your products as if they were its own, will be thorough in its operations and diligent about quality and costs. The following guidelines will help you spot that perfect match.

Size and location

CEMs vary in size. A few just offer rapid prototyping for small batch quantities to prove a design. Small to medium sized CEMs give great service and work closely with customers offering flexibility to deliver a competitively priced product, while larger CEMs tend to concentrate on multimillion-pound contracts and may choose not to engage with smaller businesses.

During the early stages of any new business relationship, location is often high on the list of priorities, especially whilst navigating the prototyping phase. Meetings are vital to understand requirements and capabilities and the CEM should feel like an extension of your own business.

Quality standards

If your products are life critical, choosing a CEM that manufactures to a high quality level is essential. Accreditations



It's important to make an informed decision and you must identify what is important to your business



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to be aware of include the ISO9001 internationally recognised quality management system, AS9100 quality management standard for the aviation, space and defence industry, the National Aerospace and Defence Contractors Accreditation Program, and the ISO14001 environmental framework. There will be a cost associated with higher quality standards, but you will have the confidence that your finished product will meet requirements.

Selecting a CEM that is financially secure and continuously invests in machinery and technology can also impact quality with the ability to offer faster more accurate component placement as well as greater manufacturing flexibility. Request a list of production equipment, including SMT lines, AOI and x-ray inspection systems. Technology constantly evolves and it would be ill-advised to select a CEM that uses obsolete equipment.

Support services

Component availability has been a challenge in recent months, with a lot of parts going on allocation. Choosing a CEM with a dedicated team of procurement specialists will ensure good relationships with suppliers, plus the buying power to help reduce lead time and materials costs.

Other key points to consider include services such as design for manufacture, prototyping, conformal coating, off-shore manufacturing, testing options, and packing solutions.

To summarise, partnering with manufacturing experts that can offer you the services to build your products from design and prototyping right through to full turn key production is crucial. Find one that values your custom, has the capability to deliver on time and the flexibility to react fast to market conditions.

trizo.com

Why rebuild when you can replace?

'Rework' can be a false economy in manufacturing but as production automation continues to increase in speed and complexity, the decision to replace ball grid array components, rather than rebuild the entire board, can prove a more cost-effective solution. A BGA replacement option is useful for most OEMs, particularly small batch runs or where production down time can have a significant impact on sales.

That's why, in late 2018, FermionX invested in a Seamark ZM-R720 automated BGA rework station, suitable for

the repair of normal surface mount devices, such as BGA and QFN packages, and micro-SMD components. The system includes an accurate optical alignment system for precise mounting, as well as automatic placement and soldering/de-soldering options.

Boards can be repaired with free issue or procured components, in one-off quantities or 100-plus. This gives customers the option to rework a single component rather than remake an entire board, significantly saving on time, cost and complexity.

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Buy in to purchasing know-how

Contract electronics manufacturing partner, M-Tek, explains how an experienced purchasing team can bring vital skills to bear on any project

When potential clients first contact M-Tek, they soon discover that purchasing has a vital role to play. In fact, the M-Tek purchasing team is at the centre of all successful supply chain management. They form a key component in new and existing client builds, providing a value-added service which encompasses identifying customer's materials needs, cost saving requirements, and choosing a mix of suppliers that can provide the best prices and terms. This process is key to securing competitive pricing while obtaining the best lead times, minimising minimum order quantities and lowering the customer's risk exposure.

The team's expertise is applied from the get-go. M-Tek

believes the design stage is the optimum point at which the cost of making a product can be reduced while still coming in on time and budget.

For this process to be successful requires a collaborative practice between the design and purchasing teams. At M-Tek, these interdependent activities foster value engineering with a design for purchasing focus enabled by the purchasing team, which can provide a window on new component availability.

This collaborative process also allows the new product development team to set a target cost using information from the purchasing team on the cost, performance, market availability, quality, and

reliability of the components which may be used. With this in place, purchasing also works to identify and qualify potential suppliers, who are then invited to participate at an early phase in the sourcing exercise.

And as projects progress, M-Tek's purchasing team can also apply its expertise to challenges further down the line, from managing extended lead times to resolving end of life or obsolete component scenarios. Through careful supply chain management and a belief in unimpeded two-way information flow, M-Tek has been able to build the strong supplier relationships on which its purchasing team depends.

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M-Tek believes the design stage is the optimum point at which the cost of making a product can be reduced

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Environmental compliance: being green



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

In this article, John Denslinger takes a look at the electronics industry's environmental activities past, present and future

Environment • By John Denslinger

In the memorable words of Kermit the Frog: "it ain't easy being green". Forgive me for choosing a light-hearted analogy, but the words ring so true for our industry as well. 'It ain't easy' definitely describes the utter complexity and cost of pursuing a responsible environmental policy. Driven in part by necessity and part by a good stewardship desire, companies over time have institutionalized sizeable legal and environmental departments just to keep pace with lawmakers and regulatory oversight. For global companies, formulating and executing compliance plans, that effort is even more daunting. The rules are not always the rules. Continental, country and sometimes state interests and interpretations vary. It's just ain't that easy.

Green is the holy grail of environmentalism. Companies invest time, capital and human resources in energy conservation, electronic waste reduction and recovery, sourcing only verifiable/reputable suppliers, green supply chains, hazardous substance management, factory emissions, product labeling and documentation and just about everything else eco-centric until EOL. Each is addressed as a tangible, measurable event for any shareholder, employee, special interest or government to assess.

So how are we doing as an industry? Want to find out? Check social media, the intangible. With more than two dozen platforms connecting billions and billions of people worldwide offering commentary, judgement, photos, blogs and more, your company's reputation can change in an instant. A serious failure anywhere in the supply chain can alter opinion, factual or not, to you and everyone downstream.

The simplified flow chart below illustrates just that. Let's say you discover a company unknowingly introduced a conflict mineral from a restricted country into their production. One can easily see how

everyone along the supply chain must initiate containment actions, as well as countermeasures, preventing future use of that material, component and/or assembly.

Because of that, procurement plays a key role assuring a robust discovery and continuous review takes place. Buyers don't necessarily need to be eco-experts, but they should be well-acquainted with all the various rules and regulations when it comes to achieving environmental compliance.

So what are the most common regulations affecting the electronics industry? I would say (4) in particular: RoHS, Conflict Minerals, REACH and the forth-coming California Proposition 65. Both RoHS and REACH originated as European Union (EU) regulations but quickly spread to global adoption. Conflict Mineral regulation originated in the US with the passage of Dodd-Frank Wall Street Reform and Consumer Protection Act. Recently, the EU passed its version slated for 2021 adoption. Finally, remember I said earlier that states may affect commerce by implementing their own environmental rules, California Prop 65 is such a regulation targeting labeling and warning requirements. This law will affect component manufacturers and distributors the most not only in compliance but more so in shipping logistics. The law becomes effective late this summer and may be a matter of time before other regions consider the same.

Despite my 'it ain't easy being green' intro, our industry continually demonstrates incredible leadership in being green. Check out individual company websites for environmental responsibility statements.

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Sales drop as buyers use up Brexit buffers

Component sales figures for April reveal a disappointing start to 2019 as distributors and buyers struggle to keep pace with Brexit uncertainty, says the ECSN

Releasing the latest, audited UK and Ireland authorised distributor statistical data, Adam Fletcher, chairman of the Electronic Components Supply Network announced that the run of twelve consecutive periods of 'quarter-on-same-quarter-the-previous-year' growth was abruptly halted by an unexpected decline in billings in April 2019. Bookings increased by 4.2 per cent in the first quarter of this year compared to the same period 2018 but billings showed a 1.3 per cent decline. This disrupted the association's previous expectations of continuous sustained growth, which was predicted to run to the close of 2019.

Buffer inventory

These figures were not initially predicted by the industry, as Adam explained: "This is a disappointing result and well below the Q1 '19 billings growth of five to 11 per cent forecast by our members in December last year."

According to Adam, much of the decline is down to the fact that customers have been consuming the buffer inventory they stockpiled in response to the Brexit delay, and to tough market conditions.

He continued: "For the same reason, ECSN's AFDEC members have also been juggling their inventory in an attempt to hold it in-line with actual customer demand. But as the Brexit date remains fluid, all organisations will have to retain buffer inventory for a longer period than they expected, which will add significantly to their costs, until the extra inventory is finally consumed."

Statistics revealed

Total monthly billings in April declined by 16 per cent compared to the previous month but thanks to continued growth in the semiconductor sector, remained 'flat' compared to the same month 2018.

Overall bookings declined by

27 per cent compared to the previous month and also showed an 18 per cent decline on the same month 2018. The book-to-bill ratio in April declined by 14 points, with the polynomial trend

line suggesting a continuing 'flattening' as we progress into the second quarter of 2019. The sales by month 'three month moving average' for all electronic components is also suggesting

low growth into the second quarter of 2019, which remains broadly in-line with ECSN/AFDEC member forecasts.

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How to choose the right TFT display

TFT LCD displays are the de-facto standard for many applications, but with factors such as size, brightness, operating environment and interface all affecting your options, how do you choose the best display for your application?

Size is the initial starting point for most projects and although the choice is seemingly infinite, there are some factors that can narrow the field. Whether the application is handheld, HMI or kiosk, there are sweet spots where products have made the leap from commercial commodity to full industrial supported such as 3.5, 5, 7, 10.1, and 15.6in in the small and medium size range.

Another aspect to consider is format, with 16:9 or 4:3 options particularly relevant when upgrading an existing design. Wide format is a

growing trend with touch function replacing keypads for a modern look where existing 4:3 aspect ratio designs get a revamp without changing the chassis size.

Ease of use

Brightness, viewing angle and contrast ratio are important issues, and are governed by the environment in which your product is to be used, as well as how it is to be used. There are many technology variants, with twisted nematic, super-twisted nematic, reflective and in-plane switching governing the basics, and optical enhancements such as circular polarizers, O-film

and anti-reflective coating also playing a part.

Choices regarding brightness levels vary according to range and size and there are also technical options that can extend lifetime and reduce power. Also, many displays now offer integrated LED drivers, which reduces the number of external components required.

Viewing angle is mainly governed by LCD type but contrast enhancement mechanisms can play a role with IPS technology offering virtually a 180deg viewing capability.



Business development manager displays, Review Display Systems, Mike Fowle

Contrast ratio is the most important factor for optical performance with most losses seen in high ambient light conditions. There are many mechanisms available to manage this, from internal timing control to surface coatings such anti-reflection and optical bonding for outdoor conditions.

Interfacing

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embedded design or looking at a complete bespoke solution, interfacing is an important factor and one where there are multiple options.

TFT displays come in a variety of interfaces: RGB, LVDS, MIPI, SPI, parallel MCU and direct drive. Your choice will be determined by the resources available as they each put different demands on time and system requirements. Power consumption is dependent on the display type and backlight brightness required, as well as the interface drive type. If low power is a specific requirement, there are technologies to suit.

Environmental factors

Specifying an appropriate operating temperature range supports optimum lifetime performance. Most panels now offer operating ranges of around -20 or 30 to 70 or 80°C and again there are techniques to enhance this performance where required.

Form, function, fit, and compatibility often depend

on whether the manufacturer has incorporated this principle in their range development. TIANMA, for example, offers backwards compatibility in its NL range, even making the step between standard and wide format aspect ratio as easy as possible in terms of form and fit.

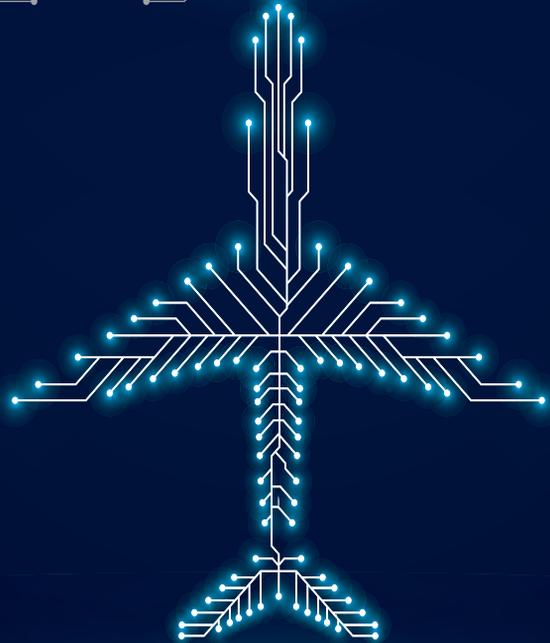
With more products being used outdoors, display enhancements such as surface coating, cover lenses and optical bonding have become a major factor. In the world of tablets and smart phones, intelligent user interfaces and touch functions are a prerequisite for most new designs. Cost-effective display enhancement options are therefore much more readily available.

Finally, price can be the ultimate arbiter in any decision and there are products to suit all pockets with TFT pricing now open to all applications. Whatever your requirement, RDS aims to offer the technical know-how, product range and service package to support.

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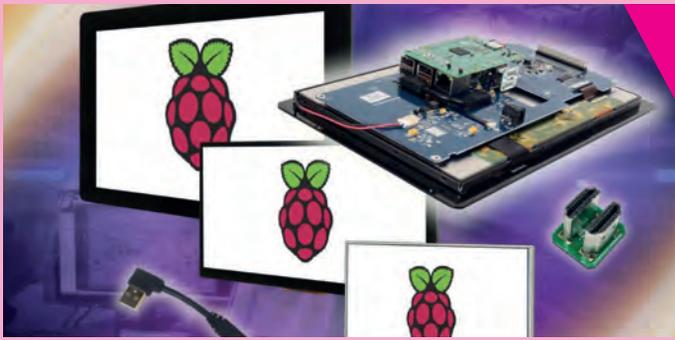


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Plug and play display ideal for prototyping

Midas Displays has announced a range of plug and play HDMI TFT display modules ideal for industrial equipment and embedded applications. Displays are available in three different size and resolution options and feature a fully integrated interface PCB.

With the addition of a Raspberry Pi single board computer, the modules can be used as a fully functional LCD monitor. The integrated interface PCB has a 40-pin GPIO interface and a standard 19-pin type-A HDMI interface connector, enabling direct connection of a Raspberry Pi SBC or other single board computer. These key features enable the HDMI TFT displays to be used with any external HDMI input source.

For enhanced connectivity, a bespoke HDMI to HDMI interconnect board connects the HDMI output of the Raspberry Pi to the display mounted interface PCB, while a Type-A USB to Micro-B USB cable enables touch-screen functionality to be implemented.

All three modules boast excellent optical performance, a high brightness white LED backlight, and a 16:9 landscape aspect ratio. The operating temperature range of -20 to 70°C supports reliable operation in extreme temperature environments.

For applications that require a dedicated graphical user interface, capacitive and resistive touch-screen options are available.

www.midasdisplays.com

Laser diodes get the green light

Osram Opto Semiconductors has introduced InGaN-based direct emission green laser diodes with wavelengths from 510 to 530nm for pico projection and other RGB or green-laser applications.

Mounted in a TO38cut or TO56 package with integrated photodiode, the diodes claim to offer excellent beam quality, making them particularly suitable as light sources for projectors and show lasers, as well as point and line lasers.

Designed to offer an important step toward powerful embedded projectors, direct emission green laser diodes end of the laborious method of producing green light by doubling the frequency of infrared lasers.

The wavelength of the new single-mode PL 520 laser diode, for example, is 515 to 530nm, the precise green for laser projection applications. Its optical output is 50mW and efficiency is typically five to six per cent. With a package diameter of only 3.8 mm these laser diodes are said to enable significantly smaller projection units.

www.oe-company.com

Go large on your order



Selectronic's large scale LED display screens are ideal for promotional and publicity uses, say the manufacturer.

Managing director, Kevin Dry explained: "Product promotion via large screens can enhance many retail environments but particularly larger spaces such as vehicle showrooms or warehouses. It provides a platform for product information and can be seen from long distances, highlighting what is being offered and drawing customers in."

LED screens can be built up in tile form to provide the size and resolution required, with flexible options available for curved type screens. The company claims this produces many possibilities including promotional and entertainment screens, which can also be provided for outdoor use, as well as for advertising hoarding at sporting and entertainment stadiums or on promotional vehicles at public events.

www.selectronic.co.uk



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Fifth generation cell networks will boost component demand

The rollout of 5G infrastructure could result in a 1.5 to 2 per cent increase in semiconductor sales and component demand will further rise when new applications that take advantage of 5G speed kick in

The construction and deployment of 5G networks is in its infancy, but chipmakers and industry analysts say the technology could be the next big driver for the electronics industry and result in a surge in component demand.

Semiconductor manufacturers and other component suppliers need to increase capacity to meet an expected swelling of demand over the next five years. The buildout of 5G base stations and other infrastructure and the manufacturing of 5G handsets will heighten demand for many components, including field programmable gate arrays, power management chips, memory ICs, analog chips, passives and connectors.

Depending on how quickly the 5G rollout occurs, component lead times could stretch and prices could rise for a number of semiconductors and other components unless suppliers add the necessary capacity.

Some electronics buyers are concerned that there could be tight supply for some components if 5G takes off quickly. The scenario could be similar to when component demand increased as automakers added electronics intensive safety and infotainment features to more models of vehicles.

Component demand by automotive OEMs and their suppliers surged leading to shortages of multilayer ceramic capacitors, chip resistors, MOSFETs and other components. The same situation could arise when 5G rolls out and buyers may find greater competition for supply.

However, the good news for electronics purchasers concerned about the possibility of constrained supply is that the deployment of 5G networks and handsets won't happen overnight.

Limited rollout in 2019

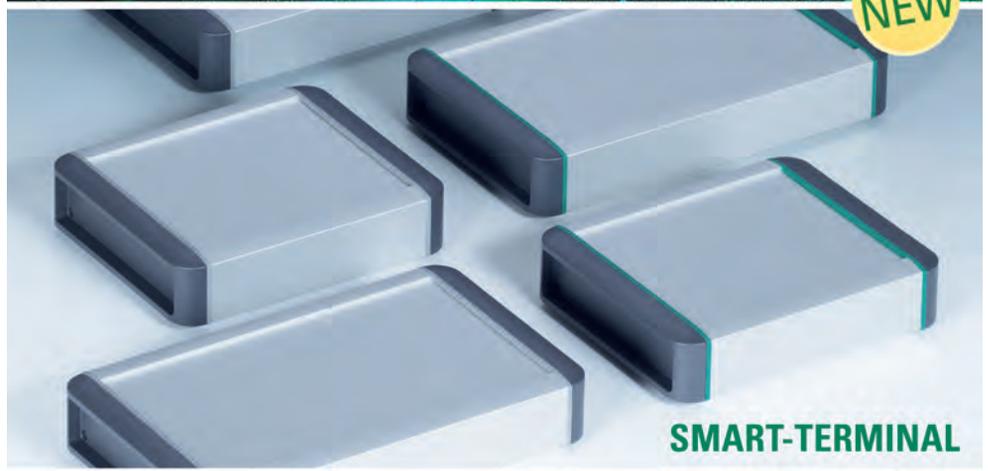
Phil Solis, research director, connectivity and smartphone semiconductors with researcher IDC, said 5G rollout "will be very limited" in the U.S. in 2019. However, there will be more broader coverage in South Korea and Japan, he said. Five-G

rollout will build in 2020, especially in the second half, according to Solis.

Researcher Strategic Analytics says

global 5G smart phone shipments will reach 5 million units this year. While that may seem like a lot, it only represents about 1 per cent of

smart phone shipments. However, shipments will gradually increase and in 2025 1 billion 5G handsets will ship, the researcher said.



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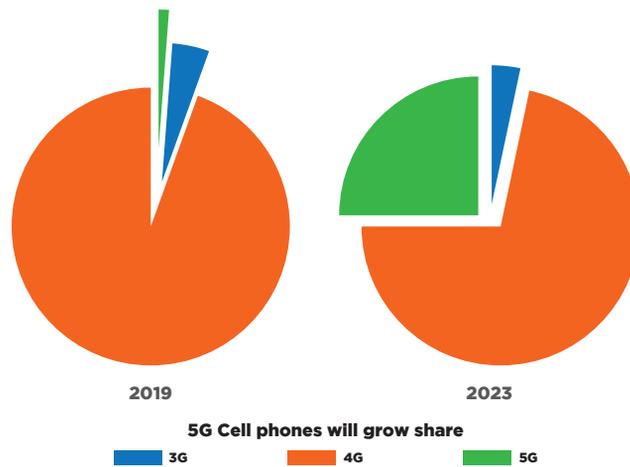


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Source: International Data Corp

By 2023 5G phones will represent 26 per cent of the market.

While 5G may take several years to ramp up, industry analysts say the transition from 4G to 5G may actually occur at a faster rate than the transition from 3G to 4G because 5G is such an enabling technology and offers many advantages over 4G.

For instance, transfer speeds are expected to be 10 times higher with 5G compared to 4G which means images and videos can be transmitted much faster. Latency is also greatly reduced with 5G so there would be virtually no delays in transmissions. Fifth generation cell phone towers will have greater capacity allowing more devices to communicate with each other at the same time.

Those improvements will mean faster and more efficient transmission for streaming and data cloud computing. Another benefit for consumers and businesses will be that 5G will present an alternative to cable or satellite television for entertainment and Internet, according to Jim Feldhan, president of Semicore Research. Consumers and businesses will be able to get an Internet connection through cell phone carriers and have “one service that provides your Internet connection, your mobile service and entertainment. I think that’s can be very competitive for the consumer,” he said.

Feldhan said during the transition from 3G to 4G, there was “not as much social media, streaming video, and cloud applications as there is now,” said Feldhan. “The need for bandwidth wasn’t quite the same” as it is now so there’s a great deal of interest in switching to 5G technology.

Mobile wireless carriers are starting to build the networks and cell phone

manufacturers are already shipping or planning to ship 5G or 5G capable phones this year.

More chips needed

Feldhan said that the new 5G networks will especially drive semiconductor demand over the next several years. It will not be possible to retrofit 4G base stations with 5G technology so new base stations will need to be built. In addition, 5G networks that use millimeter wave spectrum will need more base stations than 4G.

“The problem with 5G in terms of service providers is it is not like 4G where the base stations can be far apart,” said Feldhan. With a 5G millimeter wave technology 5-10 times more base stations will be needed because 5G transmissions do not go through buildings and walls as well as 4G, said Feldhan.

“From a semiconductor standpoint that’s great news because you have a lot more of these base stations deployed,” he said. “So, chip demand for all these base stations is going to be great,” he said. In addition, homes will need new 5G routers which will further drive chip demand, he said.

Fifth generation wireless technology will also enable more applications beyond cell phone communication. “Five G will expand cellular use to lots of other categories outside the telecom industry such as industrial and automotive, said Jon Erensen, senior director at Gartner Inc. He said 5G’s speed, low latency and higher quality of service “are attractive to other markets besides smart phones. That kind of expansion presents bigger opportunities,” he said.

Such opportunities could result

in more semiconductor and other component demand. One such opportunity is IoT applications.

With IoT, 5G will help “enable data to the cloud through a higher-speed communication link particularly on the factory for where you might have a data intensive manufacturing solution,” said Feldhan. “You can do that wirelessly with 5G and use that to connect that to your local server or to the cloud.

Wait until 2024

He said the rollout of 5G will begin in 2020, but the “hockey-stick type growth probably isn’t until 2024 or 2025. That’s when you will see things really spike up.”

The 5G rollout will likely occur first in larger metropolitan areas. Service providers like Verizon and T-Mobile have to build out the infrastructure. That will likely occur first in larger metropolitan areas “where you have a lot of people, the bandwidth is limited because of the dense population and you can deploy a lot of smaller base stations and still have a high utilisation rate,” said Feldhan. He added it will take a while before people upgrade their handsets.

However, handsets will have less of impact on the components industry than the investment in infrastructure. The buildout of 5G infrastructure “will be a real boom for the semiconductor industry. “When you look at a bill of materials for a base station, it pretty much uses the entire spectrum of semiconductors,” said Feldhan. Base stations use discrete, power products, radios, digital signal processors, memory, and field programmable gate arrays (FPGAs).”

In addition, wireless providers will

have to have 5 to 10 times as many base stations they do now to support 5G versus 4G, he said. He estimates that new 5G infrastructure could mean an extra 1.5 per cent to 2 per cent per year increase in sales growth for the industry in the short term.

New applications coming

Longer term, the increases in speed, bandwidth, and flexibility that 5G offers will result in more applications which will lead to great semiconductor demand and 5 per cent or even higher increase in chip sales. “I think we will see a plethora of new applications because of 5G that weren’t around with 4G,” said Feldhan.

For instance, 5G technology may make it possible for a doctor to perform remote surgery on a patient. Using dummies, trials have been done in which a doctor in one location uses a special sensor-equipped glove and a robot to perform surgery on a medical dummy in another location using 5G technology. Remote surgery could be possible because 5G has low latency so the lag time between a device addressing a network and getting a response is mostly eliminated.

Another application that will be possible with 5G technology is an autonomous driving. While self-driving cars are being developed by companies, many automakers and analysts believe that autonomous driving is not possible without 5G. Once 5G networks are built, the faster, more responsive network and pervasive coverage means vehicles will be able to use 5G to communicate with others on the road and sensors around the city to avoid collisions and help a driver find the quickest route around the city.

“One of the applications might be finding a parking spot in a downtown of a major city,” he said. The application coupled with the GPS, could tell a driver where the nearest parking spot is to his location and provide directions.

Fifth generation networks will also be used in agriculture on smart farms. The technology will help farmers know when to water crops, apply pesticides and fertilise crops. Information from the sensors embedded in animals, farm equipment and soil will communicate data through 5G networks so farmers will know how much water, pesticides and fertiliser crops need

Capacity investment needed

These new applications along with 5G infrastructure and handsets will require more semiconductors and other components. Electronics component manufacturers will need to invest more in research and development. In fact, major electronics companies, such as QUALCOMM, Broadcom, Intel, Texas Instruments have already made investments and will continue to make them to support 5G customers.

“All the different semiconductor manufacturers have a 5G initiative depending on what part of the semiconductor ecosystem they are involved in,” said Feldhan. In addition, companies are investing in capacity in the manufacturing of components for 5G infrastructure and handsets.

Fifth generation infrastructure and cell phone handsets will eat up capacity when 5G rolls out and more capacity will be needed, especially for logic chips manufactured by foundries.

“The vast majority of our manufacturing capacity is done by foundries such as TSMC, GlobalFoundries, UMC and others,” said Feldhan. “They continue to invest in system on chip. As demand ramps, they will make the major investments that are needed to provide the capacity,” he said.

Brian Matas, vice president of market research for IC Insights, said he expects there could be capacity issues “and not just processors. More memory ICs will be needed as well as power management ICs. “With 5G, there will be some power management type applications which will be needed to send signals reliably and be able to boost singles up or down,” he said.

Fifth generation handset shipments will result in a steady increase for some discrete sensors. “New RF power transistors and power management discretes, including transistors and diodes will be needed in 5G phones and systems connecting to 5G transmission services,” said Rob Lineback, senior analyst with IC Insights.

However, the real impact for sensors and discretes will be the

high-speed connection on other systems including Internet of Things applications, robotics, drones, and connected cars, according to Lineback.

“The advent of 5G connections to applications beyond smartphones will cause an increase in demand for sensors including image sensors and non-optoelectronics sensors for control, analysis, and artificial-intelligence processing in data centers through the cellular

networks and Internet,” said Lineback.

Analysts say that 5G will be a “disruptive” force in the industry. “I think it’s going to be disruptive in a good way,” said Feldhan. It’s going to give businesses and consumers an alternative technology and will eventually drive down the cost of bandwidth. When bandwidth gets cheaper people figure out how to use it.”



www.gelec.co.uk

Suspension arms: making light work of specification

Suspension arms are increasingly used to mount displays and enclosures in HMI and smart factory applications, but as Rolec highlights, there's plenty for purchasers to weigh up when adding this item to the BoM

1. What do you need to suspend?

Almost certainly a display, probably a touchscreen, but what kind? Buyers need to be alert to this since suspension arm manufacturers may offer a range of panel mounting adaptations designed specifically for leading displays such as Siemens, Beckhoff, or B&R.

Being able to specify a dedicated panel mounting adaptation as standard saves the time and cost of sourcing a custom component machined to your requirements.

2. How heavy is the load?

Today even small displays can be surprisingly heavy. Remember also, there is a difference between a basic flat screen that's a few centimetres deep and a large command enclosure such as Rolec's multiPANEL or profiPANEL, which measures up to 800 by 800 by 300mm.

Arms for light and medium loads tend to be manufactured from

aluminium to help reduce weight. Bases, joints and couplings are diecast; profiles are extruded. For greater strength and weight capacity, specify arms with steel profiles and heavy duty parts manufactured from spheroidal graphite.

3. Think about leverage

When specifying the length of the arm, don't just consider the dead weight of the payload—factor in the leverage as well. The longer the arm, the less weight it will be able to support. Keep arm lengths below one metre if you can. Go beyond this point and your arm's payload capacity will diminish rapidly.

How you configure your arm will also affect its weight capacity. Deduct 25 per cent if you are using a base, and 40 per cent for an intermediate joint. Keeping it simple with a straight arm is often the best option.

4. How much cable capacity is required?

In applications that require a large amount of HDMI, DVI or network cabling, an arm with greater internal

capacity is your best option, even if the display is quite light. Choosing an arm with a wider and deeper profile also gives you the option of upgrading the display to a larger, heavier model at a later stage. For long term reliability, look for an arm that offers integrated cable protectors in all rotating elements as standard.

5. Can you future-proof your selection?

Opt for a modular suspension arm so you can specify the precise combination of joints, couplings, bases and profiles you need. The wider the range, the easier it is to select a model that covers all your floor, wall and ceiling mounting requirements.

Purchasers would also be wise to specify an arm that offers plenty of standard options such as adaptors that enable components from one size or model in the range to fit those from another, as this gives much more choice.

6. What is the working environment like?

If you are sourcing for a modern, streamlined smart

factory, a modular support arm such as profiPLUS will match futuristic aesthetics. In a traditional factory environment, however, where equipment must withstand a more punishing regime, purchasers might score Rolec's Quadro arms more highly.

7. How easy is it to customise?

It seems odd to discuss customising a modular product: you can configure your preferred arm from standard components, so isn't every arm bespoke by definition?

Yes and no—a specialist manufacturer will offer purchasers the option to configure their suspension arm and generate a 3D CAD file or pdf, providing samples to assess component quality and suitability. They may also provide CNC machining, and a variety of finishing options, including anodising, powder coating, wet painting, printing, engraving/laser engraving, and EMC shielding.

Opt for a modular suspension arm so you can specify the precise combination of joints, couplings, bases and profiles you need

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A cool approach to sourcing enclosures

Rittal UK's product manager for climate control, Karl Lycett, explains how to protect your assets by specifying enclosures and climate control equipment that work in harmony

In times of uncertainty, the best thing businesses can do is protect existing assets, ensuring that they perform optimally throughout their entire service life. In the industrial space, this means ensuring that any electrical equipment is housed in a protective environment featuring both a high quality enclosure and correctly specified climate control equipment.

Together, these two can safeguard your equipment from conditions that may impact equipment lifespan by increasing the chance of unplanned breakdowns and reducing production output.

To prevent high temperatures within your enclosure, select correctly sized cooling products

such as fans and filters, cooling units or air-to-water heat exchangers. Your choice will depend on both the amount of heat produced by the electrical equipment and the ambient temperature in the surrounding environment.

Remember, low temperatures can also damage equipment, such as when machinery that has been idle is turned on from cold in winter. When oil contained in sealed systems increases in viscosity, it can damage the seals or components, so to prevent this, you should fit a correctly sized enclosure heater.

When connected to a thermostat, the heater will maintain an acceptable minimum

temperature, preventing damage to electrical equipment.

Condensate poses a another safety risk to electrical devices when it forms inside the enclosure in high humidity environments. Combat this by using an enclosure with a minimum of an IP54 seal to prevent humid air from entering the enclosure. Where required, this can be combined with a cooling unit featuring an integrated condensate evaporator to remove excess condensate from the pocket of air within the sealed enclosure.

Dusty or dirty environments also impact electrical equipment performance. In highly contaminated environments use a

cooling product which does not allow dirty air to enter the enclosure, so fans and filters are a no-no. Air-to-air or air-to-water heat exchangers and cooling units are best, but this will depend on the heat load.

To establish whether your current cooling solution is performing optimally, Rittal can conduct a free equipment inspection, regardless of manufacturer, age or condition. It claims implementing the recommended improvements will help optimise your business, reducing costs, while also maximising productivity and efficiency.

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Perfect selection for room sensors

BCL Enclosures has announced availability of its BCS Series sensor enclosures, which are designed to keep air flowing around sensitive electronics including thermostats, sensor probes, and temperature, gas and humidity sensing equipment.

Manufactured from ABS HB, the series is available in several different models. BCS30W is a white sensor case with slots in two sides. It offers PCB mounting points and pre-drilled wall mounting points for ease of installation. The vented fastenings are snap-fit for convenience, with a screw fixing to one side. BCS30B offers the same

specification, but in black, while model BCS30STW is a white solid top version. Dimensions for all three cases are 80 by 80 by 21 mm.

For larger designs, BCS276W measures 84 by 84 by 36mm. This off-white case is manufactured in ABS UL94 V-0. It features internal PCB stand offs and a snap fit top, vented on two sides. Both wall mount and desk mount versions are available. Applications include alarm cases and gas sensors, amongst others.

www.bclenclosures.com



Deeper brush strips now available

Icotek's new KDR-BES-U cabinet floor cable pass-through solution is now available with a brush depth of 50mm to complement the existing 35mm version.

Ideal for individual outbreaks in the control cabinet, IT cabinet or machine wall, both the 50 and 35mm variants can be installed in Rittal VX25 control cabinets with a clamping profile of 2.5 to 3mm. Due to the universal clamping profile, the cable pass-through can be mounted at 90deg angles, even with bevelled metal sheets. The cabinet floor entry is suitable for sheet thickness of 1.5 to 2mm or 2.5 to 3mm.

KDR-BES-U brush strip can be adapted to almost all standard floor plates from various control cabinet manufacturers. Existing floor plates do not need to be replaced, but instead can be used to mount the KDR-BES-U brush strips, which boast simple, fast and tool-free installation. Custom lengths are available up to 1,500mm.

www.icotek.co.uk

Mount any enclosure with DIN rail adapters

OKW has launched two new adapters that enable any small plastic enclosure to be mounted on a DIN rail, saving space and speeding up installations.

Suitable for a range of applications including automation, Industry 4.0, HVAC, timers, sensors, relays and lighting control, the B6811751 DIN rail adapter is designed to fit TH35, TH15 and G32 DIN rails. It can be screwed to the back of the enclosure using two screws and then located on the rail.

The second adapter, which fits TH35 and G32 rails, is available in off-white for the B1300017, or black for the B1300019. It was designed for OKW's IP 66 Robust-Box and Toptec universal plastic enclosures but can be fitted to other OKW housings, notably the new Evotec table-top enclosures.

The fastening element is supplied with screws and is moulded from PA six in off-white and black as standard.

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Rittal has unveiled its new Ri4Power, a streamlined copper busbar designed around the new VX25 enclosure. Said to offer greater efficiency for panel builders and switchgear manufacturers across electrical power distribution in industrial environments, it also boasts higher current ratings and easier monitoring and maintenance. Solutions based on this system have been tested and certified to IEC 61439.

Thanks to a boom in mechanical and plant engineering, and the deployment of more and increasingly powerful drive technologies, switchgear for electrical power distribution and motor control centres must meet ever-higher demands, including higher current ratings and compact dimensions. Rittal's new Ri4Power, based on the VX25 enclosure, meets these challenges.

In contrast to its predecessor, the new copper busbars have a smaller cross-section, which cuts costs. Streamlined dimensions also allow a higher rated current of up to 6,300A, with short-circuit protection up to 100kA for one second. Flat copper bars are used for the various busbar configurations, with a maximum of four bars per phase.

The busbar supports have been redesigned so they suit both 600 and 800mm deep enclosures, and they can be attached either to the left or right side. Installation is further simplified because the support can be fastened to the VX25 enclosure with just three screws.

www.rittal.co.uk

Tough enclosure sourcing solved

Rolec has launched a tough new range of stainless-steel electronic enclosures for challenging industrial environments. The inoBOX range, which is ideal for marine and offshore, petrochemicals, dairy and food manufacturing, is rated IP 66 and NEMA 4X for ingress protection and IK08 EN 62262 for impact resistance.

The enclosures can be wall mounted, either through the base, or with external brackets, which provides added protection against leaks. Spacers in the base accommodate circuit boards, supporting rails or mounting plates with an M5 earthing bolt inside the lid.

There are 14 sizes in the inoBOX

line-up, ranging from 100 by 100 by 90mm to 400 by 300 by 120mm and purchasers can choose from two grades of 1.2mm thick polished stainless steel: 1.4301/A2 and 1.4404/A4.

The A2 enclosures feature single-channel lid and assembly fastening to maximise interior space, while the A4 versions have separate channels. Both guarantee leak-tightness and are fitted with temperature resistant polyurethane gaskets.

Accessories include external mounting brackets, mounting plates, cross rails and supporting rails for series terminals.

www.rolec-enclosures.co.uk



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Buyer's market for semiconductors may be short lived

Semiconductor lead times have shrunk and prices have fallen because of excess capacity and sluggish demand, but the chip market will move towards equilibrium near the end of the year



James Carbone

It will be a buyer's market for semiconductors for the rest of 2019 because of weakened demand, excess supply and falling prices for many chips, especially memory ICs.

The global semiconductor market will decline 12.1 per cent to \$412 billion in 2019 after three years of growth, according to World Semiconductor Trade Statistics (WSTS). All product categories, except discretely, will decline in 2019. Discrete semiconductor revenue will rise 1.4 per cent. However, memory ICs, including DRAM, NAND, NOR and several other types of memory will decline 30 per cent in 2019, according to WSTS. Revenue for analog chips will fall 5 per cent; logic will decline 4 per cent; optoelectronics, 1.5 per cent and sensors, .5 per cent, WSTS said.

However, the decline in the overall semiconductor market is due in large part to the fall of the memory chip segment, which represents about 33 per cent of the overall semiconductor market.

Much of decline is due to falling prices for DRAM and NAND. The average selling price (ASP) for memory IC chips was about \$3.82 in the second quarter of 2018. In the second quarter of 2019, the ASP dropped to \$2.78, according to researcher IC Insights.

The good news for semiconductor manufacturers is that the decline in chip revenue will be short lived. Sales will start to recover in the second half of the year and growth will resume in 2020 when semiconductor sales are forecast to grow 5.4 per cent, according to WSTS.

"The current market downturn is being driven by a broad weakness in demand specifically centered in China and an ingestion of excess inventories in some of the major markets including automotive, mobile phones, and cloud infrastructure," said Mario Morales, program vice president, semiconductors at researcher IDC. "We expect the market to bottom by end of the third quarter this year" as high inventory levels are

worked off, he said.

Recovery is imminent

Some chipmakers were expecting a rebound in their business even before the second half of the year. "Our second quarter outlook is for net revenue to increase about 2.4 per cent, said Jean-Marc Chery, STMicroelectronics president and CEO. "We are planning for strong sequential growth in the second half of the year across the industrial, automotive and personal electronics end markets," he said. For the full year 2019, ST's revenue would be in the range of about \$9.45 to \$9.85 billion, according to Chery.

Dr. Reinhard Ploss, CEO of Infineon, said while the semiconductor industry "boom is over and the momentum in demand has weakened," Infineon would still grow sales about 5 per cent in 2019 to \$9 billion, plus or minus 2 per cent. He said Infineon had "excellent long-term prospects in our key target markets, including electro mobility, autonomous driving,

renewable energy, data centers and mobile communications."

The company was expecting healthy growth from its automotive and industrial power control segments, but its power management segment revenue would grow at a slightly slower pace than the other segments. Revenue for the digital security solutions segment is likely to decrease by a mid-single-digit percentage year-on-year.

While chipmakers are expecting a rebound in business, it will likely remain a buyer's market through the year, according to Brian Matas, vice president of market research for IC Insight. "Buyers are welcoming lower prices, especially for memory and I think that will continue into the third quarter even into the fourth quarter before things stabilise," he said.

Big capacity investment

Prices are lower because excess capacity was added last year and in the beginning of

By the Numbers



\$468.7 billion

The size of the global semiconductor market in 2018. Source: WSTS



12.1%

The percentage that the semiconductor market will decline in 2019. Source: WSTS



\$434.3 billion

The forecast size of the worldwide semiconductor market in 2020. Source: WSTS



12%

The average price decline for integrated circuits in 2019. Source: IC Insights



6.5%

The compound annual growth rate for semiconductors used in consumer electronics from 2018-2023. Source: IDC





2019, especially by memory IC manufacturers. "Over the last two years, Samsung has spent more than, \$20 billion in total semiconductor capital spending each year," said Matas. "Probably two thirds of that for about \$14 billion was for flash and DRAM."

While there are only three major DRAM manufacturers and about six major NAND flash memory manufacturers, those memory IC and manufacturers are concerned about competition from China which is investing in semiconductors, especially memory ICs.

For instance, Yangtze Memory Technologies Co., Ltd. (YMTC), based in Wuhan, began producing 3D NAND chips on 12-inch wafers in 2017.

"Samsung sees the threat from China so they are making sure they have the capacity in place," said Matas. "They are supplying memory for their own products as well as to others. "They've been intent about making sure they stay ahead of the competition," he said.

As a result, memory prices may increase but they won't reach the levels of 2017 and 2018 because of competition among the major DRAM and NAND manufacturers and Chinese memory IC makers.

Matas added supply and demand may reach equilibrium near the end of the year and the chip market will start to recover. "The amplitude of that rebound still remains to be seen. We think the semiconductor industry will grow 15 per cent in the third quarter and 6 per cent in the fourth," he said.

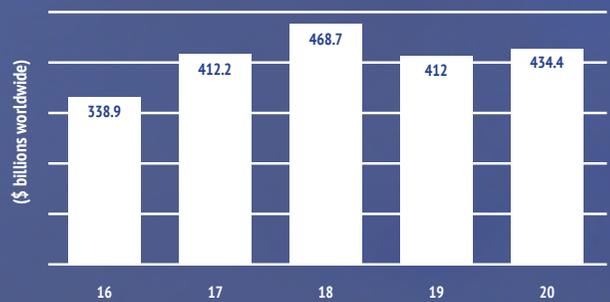
An uncertain future

Such a rebound in revenue "is good but it only gets us to -13 per cent growth this year" because semiconductor sales had slumped so severely in the first half, said Matas. He added what could impede growth in the second half recovery and in 2020 is uncertainly in the market. "Right now, there is a lot of uncertainty in the market," especially with tariffs and trade issues involving China, he said. "Uncertainty is even worse than a down market because when the market is down, you can take steps to adjust," said Matas. However, with uncertainty it's difficult to determine what's the correct course of action. However, despite uncertainty in the market, semiconductor revenue growth will resume in 2020 when the chip market grows from \$412 billion in 2018 to \$434.4 billion in 2020, said WSTS.

Chip demand will rise over the

While semiconductor sales will decline for the first time in three years, the chip market will rebound in 2020 when sales increase 5.4 per cent. Source: WSTS

Worldwide chip market will decline 12.1 per cent in 2019



next several years because of the buildout of 5G networks and continuing strong demand from automakers and their suppliers despite falling to flat automobile sales.

"The automotive market remains one of the strong growth drivers as semiconductor content and design activity for autonomous enabling technologies will continue to drive 3-4 times more growth than the overall market," said Nina Turner, research manager for semiconductors at IDC. (see related story page 18 and 19)

Other segments will also help drive semiconductor demand. For instance, while semiconductor revenue from the computer segment will decline in 2019, it will still post a compound growth rate of 1.3 per cent from 2018 through 2023 because of strong demand from X86 servers and solid-state drives, said IDC.

A positive impact

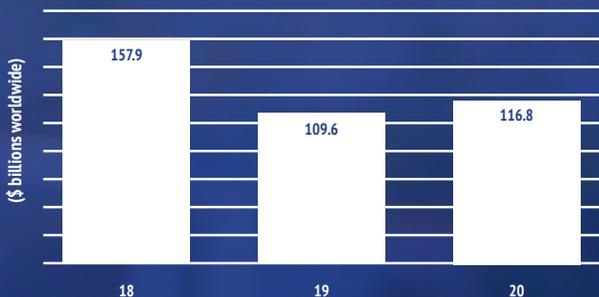
The rollout of 5G networks and 5G handsets will also have a positive impact on semiconductor sales over the next several years. "The full 5G buildout, even though it is still a year or two years away from ramping, shows a lot of potential," said Matas. He noted that more towers will

be needed for 5G to operate efficiently, compared to 4G networks.

As a result, the mobile wireless communications segment will have a CAGR of 4.8 per cent for 2018-2023, according to IDC. Semiconductor revenue for 4G mobile phones will slow, but 5G phones will begin to ramp up in 2020, becoming mainstream by 2025. The RF subsystem in mobile devices will drive most of the revenue growth as the subsystem continues to support more complexity, additional antennas, and the increase in bands on every phone, IDC said.

The consumer semiconductor segment will also post robust growth as sales increase 6.5 per cent per year through 2023. Consumer IoT devices and home automation will gain traction, the researcher said.

Memory IC market drops



Falling prices will result in the memory chip market including DRAM, NAND, declining sharply in 2019. Source: WSTS



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Fibre optics: sourcing patchcords and pigtails

Fibre optic data transmission supports advanced communications technologies and provides the basis for today's increased internet speeds. Here TME explores the practicalities of sourcing fibre optic cable

Fibre optic technology transmits data over a range that is unachievable with an electrical signal sent through traditional copper wire. Using light to transport data in this way underpins many of today's technologies, not least increased internet speeds.

But how does the technology work? In a fibre optic cable, the information carrier is no longer an electric signal, but light generated by a transmitter. Data travels along the fibre thanks to beam reflection and is then picked up by receivers and converted back into an electrical signal.

Using optical fibre as a carrier has several advantages. Not only is the data transfer rate significantly greater than for copper cabling, fibre optic signals can travel over longer distances without generating losses. With their small diameter and flexible nature, fibre optics are also unaffected by kinks or bends, as well as featuring insulation material that protects against mechanical damage and high temperatures.

Which type of cable?

Depending on the material used to make the fibre optic, buyers will find three types of cables, each with different properties: glass fibre core; plastic fibre core; and semiconductor fibre core. The outer cable layer will be made of plastic materials selected to counteract environmental factors.

Purchasers will then be faced with three further options: patchcord cables terminated on both sides with a specific type of connector; fibre optic pigtails in which the connector is mounted only on

one side; or cables featuring a fibre optic core.

How many modes?

The mode structure tells you the number of modes and core thickness. Single-mode fibre, for example, has a core thickness of nine microns and a large signal transmission range of up to 100km. Due to the small thickness of the core, connecting several wires is complicated and requires special tools. The source of the input signal is a laser beam. The diameter of the outer jacket is 125 microns.

Multi-mode fibre has a core thickness of 62.5 or 50 micrometers. It transmits the signal to a maximum distance of 1.5 to 2km and, unlike single-mode components, does not base its functionality on one wave. In this type of optical fibre, the input signal is divided into many rays transmitted at multiple angles, resulting in a lower data transmission rate and a smaller range. The diameter of the outer jacket is 125 microns.

Fibre optic connectors come in two types, which differ in the angle of termination: ultra physical contact connectors or angled physical contact connectors.

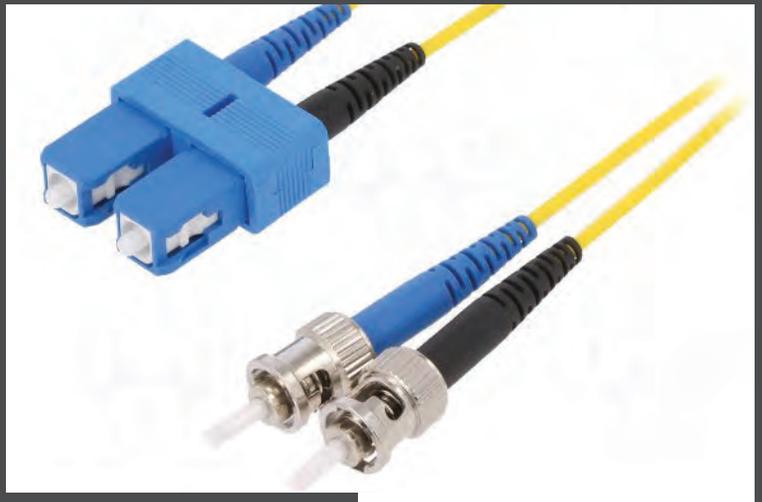
Patchcords and pigtails

TME offers two types of fibre optic connection cables from Lapp Kabel. First, the LAPP-29011902 yellow fibre optic patchcord with a length of two meters and category OS2. These patchcords are terminated on both sides with a blue standard fibre optic connector.

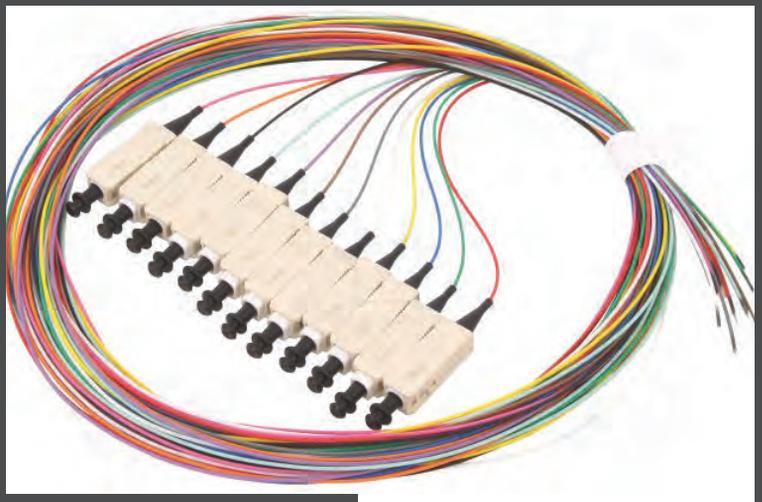
Second, the LAPP-29310902, which consists of a set of twelve two-meter-long fibre

optic pigtails, in various colours. These pigtail cables feature 9/125 micrometer cores, terminated on one side with a standard connector and leaving the other end free for thermal weld or a mechanical connection.

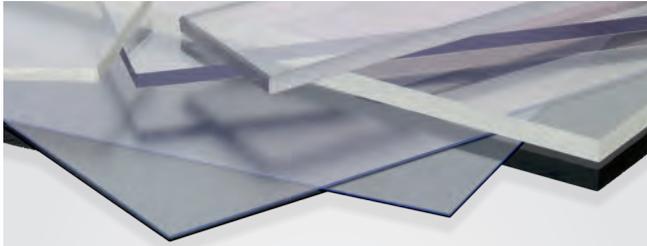
www.tme.eu



Patchcord cables are terminated on both sides with a specific type of connector



Fibre optic pigtails are terminated on one side with a standard connector, leaving the other end free for thermal weld or a mechanical connection

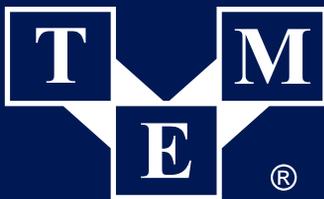


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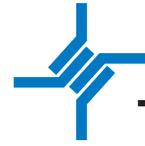
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Power inductors supplied from stock

Coilcraft's new XAL7050 series of high-temperature power inductors is available from stock with inductance values from 22 to 47 μ H and current ratings as high as 5.5A. For lower inductance values, Coilcraft offers a lower-profile companion, the XAL7030, with an identical footprint and inductance range of 0.16 to 10 μ H.

The XAL7050 measures 7.2 by 7.5 by 5.0mm with a composite construction that provides magnetic shielding and minimises audible buzzing. It is qualified to AEC-Q200 grade one standards and exhibits no thermal aging issues, making it ideal for automotive and other harsh-environment applications. Soft saturation characteristics allow the XAL7050 to withstand high current spikes.

Free evaluation samples and technical specifications are available online.

www.coilcraft.com



Resistor values extended

Stackpole's CSRFB0603-HP is a 0.5W rated foil on ceramic current sense chip resistor, now available with an extended resistance value range that includes two milliohm values. The new value range of two to four milliohms has a temperature coefficient of resistance of 100ppm, meaning these low value current sense chips are also accurate over temperature variation. The CSRFB0603-HP is AEC-Q200 compliant and is said to provide exceptional long-term stability and reliability. Pricing varies with resistance value and tolerance.

www.seielect.com



Automotive MLVs can take the heat

AVX has released a multilayer varistor transient voltage suppression device rated for 175°C operation in automotive applications. The new TransGuard VT series provides bidirectional overvoltage protection from -55°C to 175°C, with zero derating across the full operating temperature range. Components are qualified to AEC-Q200 and are currently available in surface-mount 0603 and 0805 cases sizes.

According to the manufacturer, the devices also provide some broadband EMI filtering in their off state, which further extends their utility in automotive circuits by reducing the need for discrete MLCC capacitors. This is especially beneficial considering current MLCC supply shortages. The VT Series MLVs can also be used in other markets, and

additional performance highlights are said to include high current and energy handling capabilities, low leakage current, and multi-strike capabilities per IEC 61000-4-2.

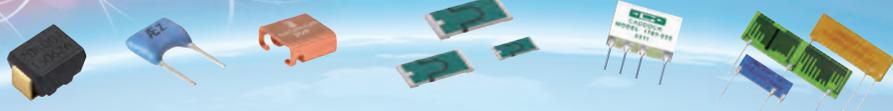
Technical marketing manager for power film capacitors and circuit protection at AVX John Gallipeau, said: "These devices provide automotive and industrial design teams with a compact solution for protecting advanced applications against the transient pulses that are so often encountered in harsh, high-temperature environments."

Standard parts are shipped on tape and reel in quantities of 1,000, 4,000, and 10,000, and lead-time for the series is currently 12 weeks.

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Molex	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	300	N/A	£0	97%	50	1,500+	Y
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OKW Enclosures Ltd	OKW Enclosures	01489 583858	www.okw.co.uk	N	1,955	£40,000	£0	N/A	5	22	Y
Rolec Enclosures	OKW Enclosures	01489 583858	www.rolec-enclosures.co.uk	Y	935	£40,000	£0	N/A	5	22	Y
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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
Polanco	Lane Electronics	01403 790661	www.fclane.com	Y	218	£146,000	£0	100%	6	38	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
INTERCONNECTION (Continued)											
Positronic	Lane Electronics	01403 790661	www.fclane.com	Y	N/A	N/A	N/A	N/A	N/A	N/A	Y
Souriau	Lane Electronics	01403 790661	www.fclane.com	Y	1,929	£806,000	£0	100%	6	38	Y
Switchcraft	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	2,200	N/A	£0	69%	50	1,500+	Y
TE 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.americaii.eu.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
	SeSemi Electronics LTD	01264 731009	www.sesemi.co.uk	Y	2800	N/A	£100		3	12	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



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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
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
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
Freescale Semiconductor	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,000	N/A	£0	66%	50	1,500+	Y
Honeywell	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	15,500	N/A	£0	80%	50	1,500+	Y
Maxim Integrated	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	900	N/A	£0	N/A	50	1,500+	Y
Melexis	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	700	N/A	£0	N/A	50	1,500+	Y
Omron	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	5,700	N/A	£0	N/A	50	1,500+	Y
Sensirion	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	100	N/A	£0	N/A	50	1,500+	Y
TE Connectivity	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,100	N/A	£0	N/A	50	1,500+	Y
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



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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											
ADDA	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	800	N/A	£0	59.00%	50	1,500+	Y
Delta Electronics	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	500	N/A	£0	28%	50	1,500+	Y
ebm-papst	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	2,200	N/A	£0	99%	50	1,500+	Y
Sanyo Denki	EAO Ltd	01444 236000	www.eao.co.uk	Y	300	£150,000	£150	99%	6	22	Y
Sanyo Denki	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk		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
Challenger Solutions Ltd	01245 325252	www.challengersolutions.com	£8m	Essex/SE	95	7	AS9100 Rev D, ISO9001:2015, ISO 140001:2015, UL, CCC, IPC-610-G Class 3	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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Contract Manufacturers Buyers' Guide (continued)

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.etuk.co.uk	£3.5m	SE	55	2	AS9100, ISO9001, ISO14001, IPC610/620 Class 3	Y	Y	Y	Y	Y	Y
Elite Electronic Systems Ltd	028 6652 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
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, IPC7711/7721, 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 449080	www.iconelectronics.co.uk	£6.5m	Hampshire & Yorkshire	70	5	AS9100, ISO9001, BS EN ISO/IEC 80079-34:2018 ATEX, IPC-A-610 Class 3	Y	Y	Y	Y	Y	Y
Industrial Electronic Wiring Ltd.	+44(0)1793 694033	www.view.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
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 including Speedboard	01453 797580 01753 746700	www.note.eu www.speedboard.co.uk	£115m	UK/EU/China	1,050	18	IPC610 to Class 3, ISO9001:2015, 13485, 14001, 18001	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 Class 3	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
Tenkay Electronics Ltd	01903 855455	www.tenkayco.uk	£4.1m	West Sussex	50	1	ISO 9001:2008, ISO 14001:2004, OHSAS 18001:2007	N	Y	N	N	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, Manufacturer &/or Repair)	Location	Approvals	Volume - Small, Medium, Large	Double-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
Photonix Group	01903 231901	www.photonix.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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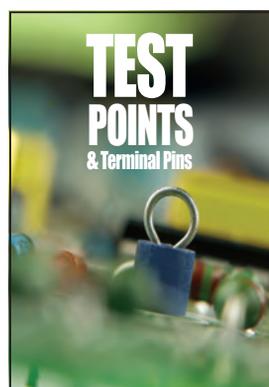
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Advert Index

Alpha 3 Manufacturing Limited	34	Protronix EMS	19
Anglia	BC	Rapid	7
Best Windings	50	Review Display Systems (RDS)	27
Camdenboss	35	Rhopoint Components	42
CML	12	Rittal	36 & 37
Corintech	19	Rutronik	8
Crystal Tech Electronics	28	Schurter	27
DSEI	34	SeSemi Electronics Ltd	19
Digi-Key Electronics	FC, IFC & 24	Simtek EMS Ltd	18
Ecopac Power	9	Solid State Supplies	26
Euroquartz	49	Speedboard	17
FermionX Ltd	20	Stego UK Ltd	33
Fineline	25	Tate Circuits	27
G. English Electronics Ltd	31	Telegartner	41
Interpower	13	Tioga Ltd	22
Mouser Electronics	5, 10, 11, 38, 39, 44, 45, 46, 47, 48 & 49	TME Electronic Components	41
NCAB	43	Trizo Ltd	15
Nemco Ltd	21	Wilson Process Systems	IBC
OKW Enclosures Ltd	29		



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