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Buying parts for tough jobs
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Buyers' Guide

All the facts and figures to help you buy

Editor's Word



Beware purchasing entropy

I like the word entropy. I like its shape on the page, its spoken sound and what I 'think' it means.

As Clint Eastwood's character Harry Callahan said, 'A man's got to know his limitations' and one of my many limitations is truly understanding how entropy works. I've read countless articles on entropy, from pages of thermodynamic formulae to idiots' guides and I've not really understood any of them fully.

Thus, I've made up my own personal meaning which will have scientists the world over spitting their coffee out. Here we go: "It takes effort to keep things organised." I tried my best and if my description is scientific heresy I welcome readers with a better understanding to send me their descriptions.

Basically, over time, left to their own devices, things that started out organised end up disorganised. That is, unless someone puts the effort in to keep them orderly. I'm told entropy can be applied to most systems so I guess purchasing is no exception.

If your company has spent time developing a well organised purchasing process, it won't stay that way unless all those involved are willing the put in the effort to keep it that way. It's not much to ask someone to follow a predefined process or comment on how the process could be improved. Yet I've worked with many people who wilfully avoid processes for their own gain, unaware they are fuelling a gradual decline which forces others in the company to work harder.

Let's all pull together to put a purchasing spanner in entropy's works.

Jon Barrett

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In Search of End-to-End IoT Solutions



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

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

IoT • By Victoria Kickham

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

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

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

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

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

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

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

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

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

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

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

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



Nancy appreciates a calm, uncomplicated purchasing process. That's why she orders from Mouser, the semiconductor and electronic component selection leader with the top brands engineers know and trust. All available in prototype to production quantities and ready to ship same day.

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More sizes, more choice

Enclosures specialist, CamdenBoss, has launched a new range of Takachi flanged communications boxes featuring removable end panels.

The new 94 series comms boxes are available in 24 case sizes offering both low and deep profiles for surface mounting communications equipment such as WiFi routers, access points, measuring equipment and controllers. Moulded in off-white, UL94-V0 flame resistant ABS, the enclosures offer IP40 protection and feature built-in bosses for PCB mounting. Standard units include top cover, flanged base, two detachable panels and four self-tapping screws. Sizes range from 67.3 by 124.3 by 22.5mm up to 240.5 by 270.5 by 60mm.

www.camdenboss.com



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Take a look at touch display

Farnell element14 has introduced an integrated colour display module with touch interface, along with an Android software development kit, for the WaRP7 development platform, which targets internet of things and wearable applications.

The new LCD module incorporates a standard mobile industry processor interface display with serial and I2C interfaces. Designed specifically for use with WaRP7 products, it features a round screen with an active area diameter of 31.9mm with 320 RGB by 320 dots resolution and a power consumption of 226mW. www.element14.com

Tune in for capacitor highlights

Knowles brand, Johanson Manufacturing, has published a capability guide outlining its range of trimmer capacitors and microwave tuning elements. This shortform guide provides an overview of Johanson's variable capacitors for radio frequency and microwave applications.

Of particular interest are the Giga-Trim miniature capacitors, designed for high resolution tuning of RF power circuits in applications such as impedance matching, crystal trimming and filter tuning. Other guide highlights include air capacitors and a selection of ceramic trimmer capacitors, available in surface mount, strip-line and through hole lead styles. www.johansonmfg.com

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Plug into savings

RS Components has extended its RS Pro offering with a range of plug-in and desktop power supplies, including units with medical approvals. These units feature low leakage current of less than 100µA, two means of patient protection input to output isolation and are suitable for body floating applications.

All the new RS Pro power supplies offer universal input voltages and are double insulated, feature short circuit and overload protection, and offer low standby power consumption. Fully compliant with medical IEC60601-1 and ITE IEC90950-1 safety approvals, the single-output supplies are fitted with standard 2.1 by 5.5 by 11mm DC output connectors.

Output voltages of 5, 9, 12 and 24V DC are available, with a range of power ratings. Units are supplied with four interchangeable mains plug-heads for use in UK, Europe, USA, Japan and Australia.

www.rs-online.com

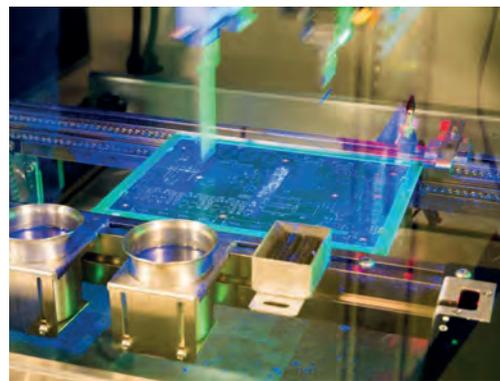
Assembling distributor expands rapid access

PEI-Genesis has expanded its distribution partnership with circular push-pull connector specialist, Lemo. Already a qualified Lemo assembling distributor in North America, PEI-Genesis is now authorised to market and sell Lemo connector solutions across the European Union, Israel and Africa.

Chairman and chief executive officer, PEI-Genesis, Stephen Fisher, said: "This expansion creates added value for our global customers who require a Lemo connector solution. These can now be delivered across Europe with the service, speed and quality for which PEI-Genesis is known."

With assembling facilities in North America, Europe and Asia, PEI partners with customers to develop application-focused connector and cable solutions. Its products support various harsh environments, making it a great match for Switzerland-based Lemo's precision circular push-pull connectors.

peigenesis.com



A quick cure for coating needs

Contract electronics manufacturer, Speedboard Assembly Services, has invested over £100,000 in a new automated conformal coating line set to increase the speed and accuracy of coating. The modular equipment is expected to produce consistent coatings more efficiently, with little or no masking required.

Major benefits of the automated spray line are that it reduces coating time, with polymeric coatings cured in seconds through an integrated UV oven, for resistance against moisture, condensation, external contaminants and corrosion. Deploying an automated spray process also ensures repeatable results that comply to IPC standards.

Operations director, Martin Bullimore, commented: "We will now be able to coat, cure and deliver on the same day, enabling us to satisfy customer requirements and offer reduced lead time for new product introduction."

www.speedboard.co.uk



Power stage is centre stage

Mouser Electronics is now stocking the LMG5200 gallium nitride power stage from Texas Instruments. Said to deliver 25 per cent lower power losses than silicon-based designs, the LMG5200 enables single-stage conversion and provides increased power density in space-constrained, high-frequency industrial, telecom and motor control applications.

This 80V, 10A integrated power stage consists of a high-frequency driver and two 15 milliohm GaN field-effect transistors in a half-bridge configuration. According to Mouser, the device reduces electromagnetic interference while increasing efficiency by minimising packaging parasitic inductances in the critical gate-drive loop. To complete the line-up, Mouser is stocking the LMG5200EVM-02 evaluation module, designed to provide a complete working power stage with an external pulse width modulation signal.

www.mouser.com

Buying into X-ray inspection

Stadium Group's Hartlepool electronics assembly division continues to invest in equipment to boost growth in design-led markets. With its latest acquisition, the company has bolstered product quality with the addition of an x-ray inspection machine.

Following the group's reorganisation last year to establish two manufacturing centres, in the UK and China, Stadium has invested significantly in the upgrade of key kit and machinery. In the past 12 months, the company has invested over \$500,000 in its UK site, focusing mainly on automated assembly equipment, complimented now by the addition of x-ray inspection.

Managing director at the Hartlepool plant, Chris Short, said: "The X-Scope 1800 system will provide insight to improve product and process quality. We have utilised x-ray inspection for some time through an external partner, but by bringing this capability in house, we are able to deliver more rapid and regular utilisation of the technology and ultimately enhance quality inspection for customers."

www.stadiumgroupplc.com



Supporting buyers on the go

TTI's European website is the latest of its sites to be converted to the company's new web content management platform, ultimately providing a more responsive website experience.

Visitors to the new www.ttieurope.com site will find it tailored to their device type, whether they are using a desktop or laptop computer, a tablet or smartphone. PC users will be presented with the familiar point and click interface, while tablet and smartphone users will find an intuitive touch interface and responsive pages that resize to provide an optimal visual experience. TTI has also updated the framework for tools such as its ezBuy, ezReview and order status, to ensure their current and future functionality. www.ttieurope.com



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Sidestep supply shortages

In this article, Rutronik's Reza Armin Maghdounieh, promotes stable, long-term partnerships as the solution to component shortages

2017 was partly defined by extremely high demand for electronic components in the major Asian markets: combined with some heavy increases in purchase prices. It's not uncommon to see prices in Asia reaching values above those in Europe or North America. The strong demand is causing a tense supply situation throughout the rest of the world, forcing not only customers but also distributors to act quickly and decisively.

Those who invested in stable, long-term partnerships will have an enviable competitive advantage

Some manufacturers of passive components have already invoked allocations. Although most semiconductor manufacturers are still reluctant to take this step and have officially declared increased delivery times of 12 to 16-weeks at best, the reality is already dramatically different. Orders placed ahead of time have their shipping dates confirmed weeks and sometimes months later than requested, which has resulted in panic in the affected purchasing divisions.

That said, this shortage of components comes as no surprise. In fact, signs of a shortage became apparent back in the third quarter of 2016 when the first manufacturers of passive

components mentioned a rising book-to-bill ratio and capacity utilisation in the relevant fabs were starting to scrape the 100 per cent mark. This rise not only affects complex, high-technology components, it is also a problem that concerns almost all product segments and technologies.

These recent procurement problems have compelled specialist divisions to commit themselves to ensuring greater security of supply rather than obtaining any possible discount during price negotiations. A sense of proportion is required: can the supplier with the best price really deliver as quickly as my production planning requires the goods? These are questions that should be carefully considered among others before rash decisions are made.

Those who invested in stable, long-term partnerships with their suppliers and resisted the urge to demand every cent of discount will have an enviable competitive advantage. Long-term partnerships strengthen trust on both sides and make it easier for suppliers to build up more generous stocks. Conversely, customers who switch supply channels every year force suppliers to minimise risk. Who wants to sit on stock when a customer keeps switching suppliers?

Strong demand is causing a tense supply situation throughout the rest of the world, forcing not only customers but also distributors to act quickly and decisively

Shortages tend to encourage suppliers, whose goods are from dubious sources, to emerge. Payment in advance and no warranty entitlement are commonplace. By the time a scam is unearthed, the supplier has usually disappeared, resurfacing later with a new address, website and email to resume their business.

During supply shortages buyers should rely on official, certified supply channels. This is the only way customers can be sure they are being provided with original goods. Should a technical issue arise, authorised distributors and their manufacturers will be happy to provide technical know-how and expertise. Rutronik's customers can depend on the company to source its products directly from contracted manufacturers, providing them with the greatest protection from forgeries.

As a broadline distributor, Rutronik was aware of shortage risks early on. While some suppliers spoke about normal market conditions, Rutronik adapted its stocking strategy and built up additional inventory where possible to account for the manufacturers' increased shipping times. Customers throughout the world benefit from this today.

www.rutronik24.com



Reza Armin Maghdounieh, head of purchasing semiconductor, Rutronik Electronic Components



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Shield yourself from sourcing stress

If supply flexibility is a priority for you, it may be wise to evaluate multiple electromagnetic shielding products, but as Kemtron points out, it's not always easy to make comparisons

Engineers designing new products must ensure they meet relevant standards and legislation, including the electromagnetic compatibility directive 2014/30/EU. The buyer's job is then to source components to build these products. It sounds straightforward, but to achieve this successfully, buyers must have confidence that the materials they buy will match the quality and performance of the initial prototype builds that achieved compliance.

The easy route is to lock the supply chain to the original prototype supplier, which is

commonplace in sectors such as defence and aerospace. For other sectors however, it is more important to maintain supply flexibility, to take advantage of lower prices, shorter lead times or better customer service.

Comparing test data

Unfortunately, it can be difficult to compare radio frequency interference or electromagnetic interference shielding performance and quality between potential products. All suppliers publish EMI shielding data, but testing can vary, making it tricky to correlate results.

Some suppliers use transfer impedance test ASTM 1851, Mil-Std 285, to measure the electromagnetic shielding effectiveness of enclosures. This has been superseded by IEEE 299, but tests have to be modified to determine the effectiveness of gaskets and components such as shielded windows and ventilation panels. These test modifications can vary and are not generally published, so comparison is difficult.

The only gasket materials tested to the same standard are certain electrically conductive elastomers. MIL-DTL-83528 has become

the industry standard, covering not only shielding effectiveness, but many other parameters such as volume resistivity, compression set, hardness, specific gravity and more. Suppliers who test to this standard provide complete transparency facilitating a direct comparison to other suppliers.

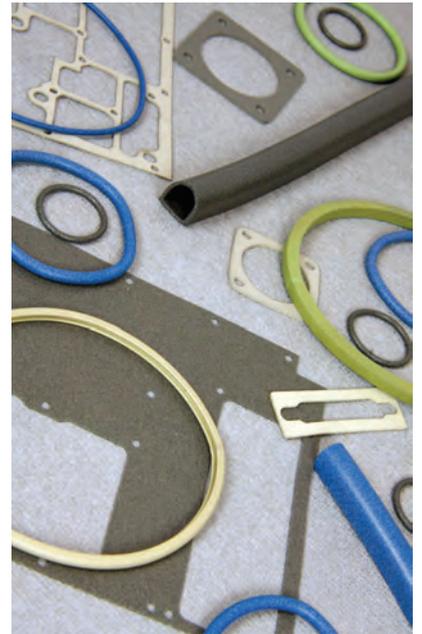
What to look for
Shielding effectiveness is measured in decibels and is therefore logarithmic. Most gaskets and components will achieve an average of 40db shielding across a wide frequency range when fitted correctly. Excellent shielding would be in the region of 90 to 120db, but look at the frequency

range for drop off at higher or lower frequencies.

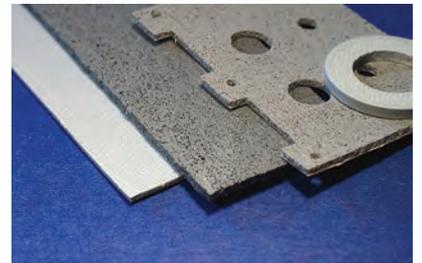
Life expectancy of gaskets is particularly important in shear applications, where abrasion can reduce gasket life. Popular gasket types here are conductive fabric over foam; look for published abrasion resistance or contact resistivity results, which will give a good indication of durability. Compression set is also relevant to life expectancy, particularly in an open/close application, such as a door. The greater the compression set over time, the more the gasket will need to be compressed to achieve a seal and shielding effectiveness will start to degrade. Look for low compression set to avoid this.

RFI and EMI shielding suppliers should be able to provide this kind of information to help buyers make an informed decision.

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The power of distribution

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James Carbone
contributing editor

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

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

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

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

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

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

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

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

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



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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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



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

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



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

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

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

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

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

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

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

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

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

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

Make protection a priority

Commercial director at Texcel Technology, Peter Shawyer, explains how conformal coating can protect electronic assemblies destined for use in harsh environments

Designing and manufacturing products for use in harsh environments requires specialist knowledge. Backed by exactly this expertise, Texcel strongly advocates the use of conformal coatings to protect components and PCBs from moisture, chemical ingress and corrosion.

There are typically four types of conformal coatings: acrylic, urethane, silicone and varnish. While each has its own specific properties, they all offer benefits in the form of insulating components and providing protection against chemical and corrosive attack, as well as minimising stress on the PCB assembly. In addition, these coatings are also 'breathable.' This means

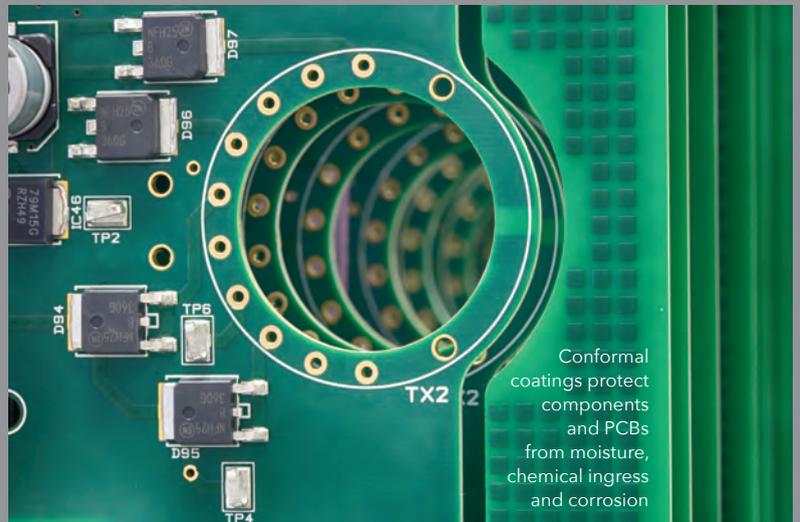
they allow moisture to escape from the PCB, while still providing protection against contaminants.

Coatings can be applied using a variety of different methods including brushing, spraying and dipping. Texcel can advise clients on the most appropriate coating for their finished product, depending on its end-use application, and can also provide assistance and solutions to minimise extreme vibration and shock.

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Commercial director at Texcel Technology, Peter Shawyer



Conformal coatings protect components and PCBs from moisture, chemical ingress and corrosion

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Marketing director at Belden, Gihan Thabrew, explained: "Passengers demand more technology when they travel by bus or coach, so the need for high-speed, reliable data communication is expected. When selecting data cables to use in small spaces, like passenger and engine compartments, it's critical that the cabling is flame resistant to protect passengers.

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Is China still king of PCB production?

Asia dominates the PCB manufacturing industry, but under this broad umbrella there are several different countries and regions, each with its own dynamics. Here NCAB Group explores the strengths, the challenges and the future of each

East Asia almost totally dominates the global PCB industry today. According to figures from Prismark, Europe and the United States together accounted for only 8.5 per cent of world production in 2016. The world's four largest manufacturing countries are China, Taiwan, South Korea and Japan; together they account for 84 per cent.

Among these four, China is the largest, accounting for about 50 per cent of the world's production of PCBs. At the same time, the PCB industry in Southeast Asia is being driven by foreign investment, with operations setting up in Thailand and Malaysia. Together, the countries in Southeast Asia account for six per cent of world production and there is also an increase in the production of printed circuit boards in India.

So, how do the PCB industries in the different Asian regions differ? Where are different types of boards manufactured and for which end products? What are the strengths and challenges in each geographic area, and what are the prospects for the future?

Complex growth

Looking at the way the regions differ in terms of technology or the kind of boards they manufacture, more advanced PCBs are produced in Japan, Taiwan and, to a certain extent, South Korea. It is within this category that the printed circuit board industry in these countries has a future.

NCAB Group's chief operations officer, Chris Nuttall, commented: "For the past 20 years, China has been successful in building an industry that meets the expectations of Western customers. At the same time, it still lacks some knowledge and experience of more complex products. When it comes to the really high-end product categories, we will see Taiwan, South Korea and Japan continuing to compete, by investing in research and development."

Managing director of NCAB Group China, Jack Kei, points out that Chinese manufacturers are producing printed circuit boards for all kinds of products. He explained: "China is where we find the widest range of PCBs, from low-end to high-end. The PCB industry is still growing here, both in terms of manufacturing capacity and quality and there is a strong belief in the future."

Yet the industry is far from dead in the other East Asian countries. A growth forecast for Taiwan in 2017 shows that production there is projected to grow by 2.7 per cent and another for South Korea forecasts 2.8 per cent growth rate. Interestingly, this is not much lower than the forecast for China, which is 3.6 per cent. This trend is also expected to continue in the coming years.

Chris Nuttall added: "China is where you can truly benefit from economies of scale and the country will definitely remain the industry's powerhouse for many years to come. At the same time,



Chief operations officer, NCAB Group, Chris Nuttall

there is also room for growth in Taiwan, Japan and South Korea, albeit in a narrower segment of the industry involving highly complex products and those where short lead times are critical."

China is not uniform

Obviously, the Chinese PCB industry is also focusing on developing more advanced technology. Ten years ago, China was the low-cost, low-tech alternative, but nowadays, more advanced boards are also produced there. Chris Nuttall points out that investment in China is moving in this direction, but China is far from uniform. About 60 per cent of PCB production is in Southern China, centred in Shenzhen, 30 per cent in East China, near Shanghai and 10 per cent inland, in provinces such as Jiangxi, Sichuan, Hunan and Hubei.

Jack Kei elaborated: "It is first and foremost in Southern

Together, the countries in Southeast Asia account for six per cent of world production and there is also an increase in the production of printed circuit boards in India

▶▶ continued on page 22

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and Eastern China that we see investment in more advanced technology. Inland, the focus is on expanding production capacity. This area offers cost advantages, with lower labour, electricity, water and tax costs. The total cost is about 20 per cent lower than in Shenzhen. On the other hand, skilled labour there is in short supply, so manufacturers inland produce mainly low-end PCBs.”

Inland competition

The industry in China’s coastal provinces is looking to develop increasingly advanced products, while at the same time retaining its manufacturing breadth. Inland provinces are, in contrast, competing on the same platform as the emerging industries in Southeast Asia and India. In Southeast Asia, there are currently about 50 factories producing PCBs, mainly lower

end, low-cost boards. But it takes time to build an entire industry from scratch; skilled personnel are hard to come by, the supply chains don’t work as well and local facilities for servicing equipment are often lacking.

Jack Kei said: “In China, it has taken 15 to 20 years for the industry to develop into what it is today. So, although the Southeast Asian countries

and India can compete with, for example, lower costs and less stringent environmental rules, it will take time before they can seriously compete with China.”

For India to become an important player in the world market it will require the right kind of investment in materials, equipment and technology, as well as improved electricity and water supplies.

Jack added: “My guess is that within five to 10 years, inland China will be attracting more investments than South East Asia and other new places when it comes to low-end PCBs. China’s inland offers considerable potential, while support from the public sector is extensive. Investors from Southern China, Taiwan and Japan are already investing heavily here. I think Southeast Asia will eventually develop into a real hotspot, but that won’t happen until the next phase, when China will have reached perhaps 60 per cent of world output and it will be hard to grow the industry further here.”

Setting standards

For a player like NCAB Group to consider investing in manufacturing in Southeast Asia or India, it is vital that certain requirements can be met.

Chris Nuttall explained: “Our mission has been and remains: zero defects, on time, for demanding customers. This calls for a high level of experience and credibility at our factories. For a factory in Southeast Asia or India to be attractive for us,

▶▶ *continued on page 24*

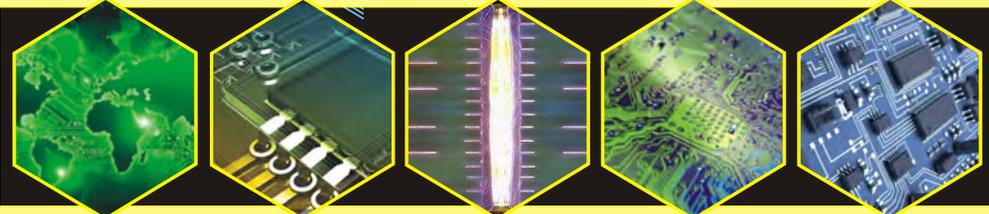


For India to become an important player, it will require investment in materials, equipment and technology, as well as improved electricity and water supplies



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it would have to be stable and able to show long-term growth.”

Chris believes that factories in these countries would need to develop their operations across the board to live up to NCAB’s values in terms of quality and delivery reliability. In its sourcing process, NCAB looks at the whole picture. For example, the type and standard of equipment and materials used, what certifications the factory has and what category of customers it does business with.

He remarked: “One thing you can be sure of, we will not be doing anything just for the sake of it, to say that we are present in multiple places. A factory must be able to deliver something beyond what we already have, enabling us to offer added value to our customers. This applies both to low-cost manufacturing

in new countries and inland China, or for that matter to the manufacture of high-end PCBs, or to production with short lead times in countries such as Taiwan and South Korea. Having said that, we should never allow ourselves to become complacent. We need to keep our eyes open, look at the available options and challenge ourselves.”

Future flexibility

For the foreseeable future, China will most likely maintain its competitiveness, particularly within medium and low-end technology.

Jack Kei explained: “Looking at the total cost, China benefits from a mature supply chain, which includes industrial equipment and all kinds of materials for PCB production. The skilled manpower is there, both when it comes to management and factory personnel. Productivity has increased, quality has

improved and manufacturers are using increasingly advanced technology. Furthermore, we are seeing both domestic and foreign entrepreneurs investing for the future.”

In the case of high-tech boards and boards with short lead times, NCAB is already evaluating the options available in countries such as Taiwan and South Korea. If it turns out that factories there can deliver value to NCAB customers beyond that which the factories in China currently provide, NCAB may well extend its factory management work to these markets also.

Jack qualified these plans, saying: “In the high mix, low volume segment, where we are a particularly important player, experience has shown that making a switch to factories in South Korea and Japan is no easy task. The factories there are traditionally focused on servicing their domestic markets and find it hard to adapt to a more international supply chain in terms of materials selection, equipment, and so on, but this may well change in the future.”

The overall conclusion, according to Chris Nuttall, is that China will, for the foreseeable future remain the most

important player within PCB manufacturing. This does not, however, preclude other regions from also developing positively within their respective niches.

He said: “For our part at NCAB, we are keeping an open mind. What matters to us is that we can deliver in accordance with our values. The bottom line as things stand now, is that we are meeting that objective by keeping the lion’s share of our production in China. As and when factories in other countries show that they can provide customers with new added value, we will be there.”

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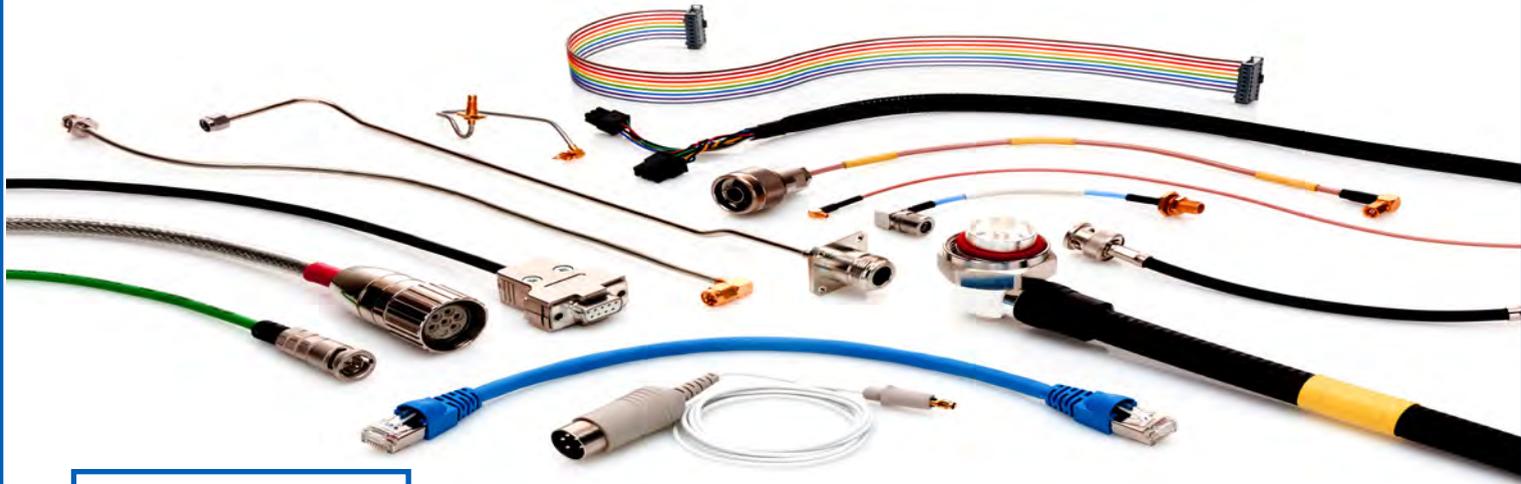
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Southern China is the home of about 60 per cent of the country’s PCB production; this is where NCAB Group China has its head office



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Telegärtner UK is part of the German Telegärtner Group and is engaged in the selling and marketing of high quality electro-mechanical connectivity used in various market sectors including such as marine, rail, industrial and medical.

Alongside promoting Telegärtner RF and Datavoice components, the company represents a number of German manufacturers of connectors, cables and speech communication products, including

Binder, Provertha, FCT, Hummel, Pei tel, Procar, Habia, Hew-Kabel, Kromberg & Schubert, Klasing and Bedea.

Telegärtner UK is also one of the market leaders in the cable assembly field with capabilities across flexible, conformable and semi-rigid coaxial assemblies, multiwire, panel and overmoulded assemblies as well as wiring looms, with purpose-built production facilities in the UK and Slovakia. All production staff work to IPC620B standard and the company is ISO 9001 and ISO 14001 certified.

Additionally, Telegärtner UK offers VMI and supplier management, kitting, subcontract & testing services.

Due to Telegärtner UK's position not only as a manufacturer of cable assemblies, but also as a supplier of wide range of products across connectors, cables and speech communication devices, the company is perfectly positioned to service the demands of various industry sectors, simultaneously offering customers the opportunity for vendor reduction and effective supply chain management.



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Board of growth?

With more than half the world's PCBs now produced in China, and PCB production still growing overall, Electronics Sourcing charts the progress of the humble printed circuit

World printed circuit board production reached an estimated \$58.2 billion in 2016, up 2.2 percent in real terms, according to the IPC's newly published world PCB production report for the year 2016.

Interestingly, the report shows that more than half the world's PCBs based on value are now produced in China. Despite this remarkable figure, Taiwanese companies are listed as the leading PCB producers, fabricating most of their PCBs off-shore. India also provides a key highlight, having the fastest-growing PCB industry in Asia and joining the top 10 PCB-producing countries in the world as of 2016.

Technology shifts

When it comes to printed circuit technology, the world report highlighted an abrupt change in growth trends for rigid PCBs and flexible circuits. Rigid PCB production, which has slowed in recent years, was up slightly in 2016, while the previously growing flex segment decreased. Irrespective of this about-face, the world PCB market overall is expected to continue experiencing modest growth in 2017.

This seems to be the case, with another IPC report highlighting the North American PCB industry, where shrinkage slowed to a rate of just 1.7 percent in 2016. The 2017 annual report on the North American

PCB industry also shows that the military and aerospace markets continue to consume more than one-third of PCBs sold and that this vertical market continues to grow as a percentage of total PCB sales in the region.

To achieve an in-depth understanding of the world's PCB industry, purchasers can access the IPC's world PCB production report in full, to find estimates of the value of PCB production in eight product categories, in each of the world's major PCB-producing countries and regions. There is also a special report on high-speed data communication, which constitutes an interesting driver in the industry.

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The world PCB market overall is expected to continue experiencing modest growth in 2017

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Amazon Business pushes to establish its role in electronics supply chain

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

By James Carbone

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

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

Some electronics buyers are using Amazon Business for production parts, including semiconductors and passives, which is causing some consternation in the electronics supply chain, especially among distributors.

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

Some view Amazon Business as a threat or a potential threat to distributors. Amazon has proven to be a formidable competitor to brick-and-mortar retail chains

often selling merchandise for less than stores resulting in fewer sales and less profit for retailers. As a result, many national retailers have had to close stores as more goods are sold online through Amazon and other online marketplaces. Some electronics distributors are concerned that in the long-term, distributors may face a similar fate if Amazon Business becomes the powerhouse in electronics that it is in retail.

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

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

Growing its product offering
However, Amazon Business is different than other online marketplaces. While it has not been selling electronics

for a long time, it is a well-known brand and is increasing the number of products and suppliers on the site.

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

He said Amazon business has a “broad selection of electronics components, including resistors, capacitors as well as semiconductors such as microprocessors and memory chips in the marketplace. Buyers can purchase a range of quantities on Amazon Business, from single pieces to packs, bundles and reels.

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

Wilson said there are advantages for electronics purchasers to buy parts through Amazon Business. “One unique aspect of Amazon Business is the multi-seller marketplace,” said Wilson. Buyers can view multiple offers on a “single product page for price comparisons, as well as find sellers that consistently meet the performance and service requirements that businesses expect,” he said. Buyers can meet specific

sourcing requirements by refining their search for sellers with specific quality and diversity credentials, such as ISO:9001, SBA, women-owned, or veteran-owned businesses, according to Wilson.

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

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

A cautious approach
Some buyers are purchasing small volumes of non-production items from Amazon Business, but are taking a wait-and-see attitude concerning purchasing components and other production materials.

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

► continued on page 28

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

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

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

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

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

Educating Amazon

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

Distributors do more than just sell parts. “There is the global presence, the technical support,

there are the terms, the quality and compliance,” he said. “There are a lot of elements to distribution of components that are very specific to our industry.”

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

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

He said Future was “looking at

everything as an opportunity. Everything will have risk and the question is how do we make the best out of this online marketplace.”

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

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

Find the upside

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

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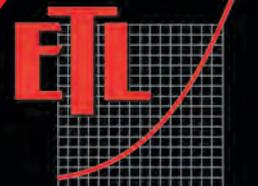
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The opportunity with online marketplaces is with distributors. "If you look at the big aggregator sites such as Octoparts, OEMstrade, FindChips etc. every distributor in the world is engaging with them because they have access to the customers' purchasing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

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

TTI, which sells commodity passives, connectors and semiconductors, does not list parts on Amazon Business. Besides its own website, TTI lists its inventory on ECIAuthorized.com because the site "has a lot of industry traffic and several features that we think are extremely important to the customer and supplier base," said Michael Knight, senior vice president at TTI.

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

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

No impact... so far
Knight said so far, Amazon has not had much of an impact on the electronics industry "but it would be a mistake not to continue to keep our eye on Amazon."

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

He added that one of the hurdles for a web based reseller that is targeting the B2B supply chain business supporting a company's production line is that the "environment is very chaotic and sales support requirements are knowledge and relationship intensive." For instance, factory lead times for components can be very erratic and extreme with little to no warning.

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

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



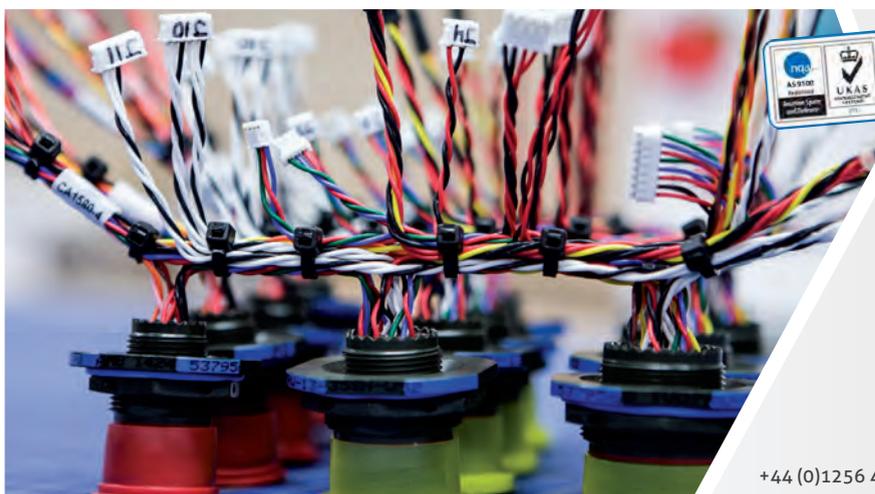
"We have been selling components on Amazon Business for several years, and we are continuing to grow our selection to meet the needs of business customers," said Prentis Wilson, vice president of Amazon Business



"Is Amazon hurting our business or industry? Today they are not," said Karim Yasmine, corporate vice president, strategic supplier development at Future Electronics



"We are monitoring Amazon Business to see what they're doing. They have introduced electronic components into their portfolio, but the sources and the manufacturers are not well defined, said McEuen, vice president of commodity management for Creation Technologies



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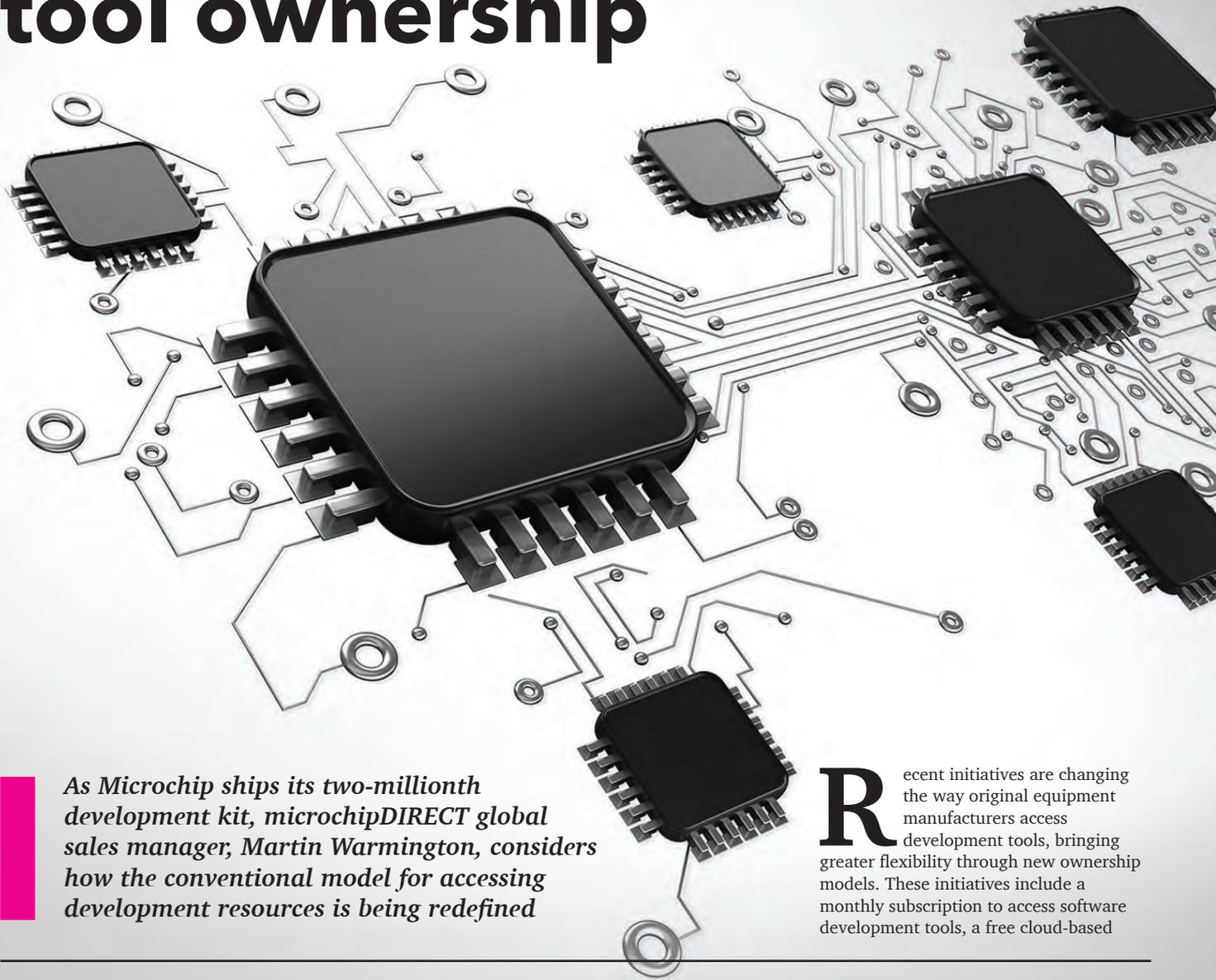
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Redefining development tool ownership



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

Recent initiatives are changing the way original equipment manufacturers access development tools, bringing greater flexibility through new ownership models. These initiatives include a monthly subscription to access software development tools, a free cloud-based

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software development platform and the ability to manage multiple development tool licenses within a single account.

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

Monthly subscriptions

To overcome the need to make a permanent investment in software development tools destined for short-term use, Microchip has introduced a monthly subscription license. This means customers only pay to access the tools while they are actively using them. The renewable monthly subscription for MPLAB XC Pro compilers can be cancelled without penalties at the end of the development phase and reinstated when the next product reaches the software development stage.

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

Managing licenses

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

Cloud-based development

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

The MPLAB Xpress integrated development environment is a cloud-based development platform for PIC microcontrollers. By combining an easy graphical user interface with cloud-

based access, the platform enables people of any technical ability to get started on PIC-based designs without being tied to a PC.

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

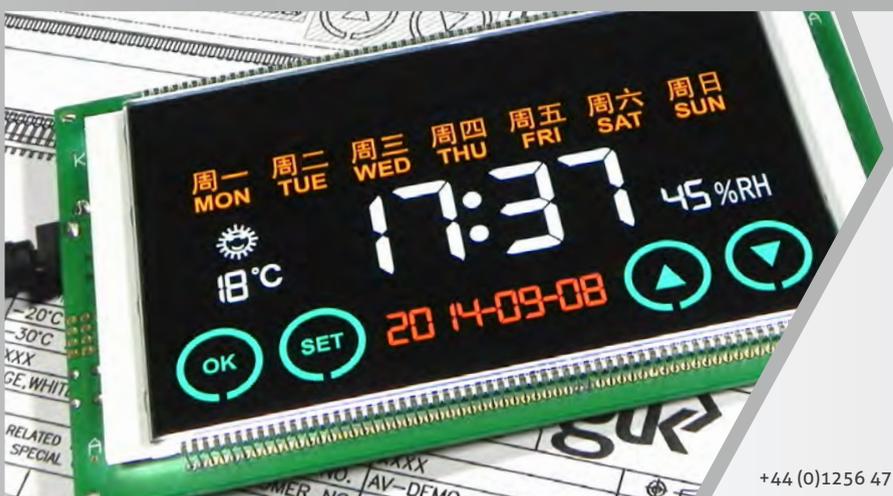
Clearly, the introduction of downloadable subscription-based development tools has gone a long way toward reducing OEM initial outlay on development resources, allowing a lower-cost entry into development. Now it is time for the industry to look at different ways to access these resources, which bring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

www.microchip.com



Global sales manager microchipDIRECT, Microchip Technology, Martin Warmington

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



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LED market growth will rebound despite continued price erosion

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

By James Carbone

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

By The Numbers

Source: IC Insights

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

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

4.3% The expected average price decline for LEDs in 2017

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

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

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

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

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

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

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

More price erosion

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

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

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

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

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



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



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



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

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

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



High voltage supplies deliver up to 400V

Powersolve's latest high voltage AC/DC, single output power supplies provide up to 3,000W, with output voltages from 150 to 400V. There are five models in the PEK3000HV series, all of which feature a 90 to 264V AC input range with active power factor correction and forced current sharing for parallel operation.

All five models offer single outputs programmable between zero and 105 per cent. Output current is also programmable between zero and 105 per cent. A +5V, 0.5A or +9V, 0.3A auxiliary output is also provided.

Other features include constant current limit, LED indicators and an operating temperature range from -25 to 60°C, with derating above 50°C. Units are protected against overload, over voltage, over temperature and fan failure with remote on/off, remote sense and power good signals making system integration simple. PEK3000HV units also feature RS232, RS485 and I²C for remote setting and global control. www.powersolve.co.uk



USB Type-C supply detects required voltage

Stadium Stontronics has added a 60W USB Type-C power supply to its Plug and Go range. USB-C is the new standard for charging and transferring data in laptops, tablets, phones and applications that use Type-C USB connectors, such as Android phones and Apple Macbook.

The new T6560ST power supply auto-senses the voltage required from the device in question, allowing the power supply to be connected to the device without changing any settings. Units feature a reversible USB output connector and provide an output voltage of five to 20V DC to maximum 60W.

At less than 31.5mm in height, the supply is designed to reduce overall packaging size compared to fixed head AC plug-top units. Products are supplied with a choice of AC heads for UK, USA, EU and Australia. www.stontronics.com

Advertorial

Technical expertise has magnetic attraction

Superworld Electronics has appointed Jauch Quartz UK as UK and Ireland distributor for its advanced magnetic components, giving customers in the region access to enhanced technical and logistics expertise

Manufacturer of frequency control products and advanced battery solutions, Jauch Quartz UK, has announced a new, exclusive UK distribution agreement with Superworld Electronics. Effective immediately, Jauch will be Superworld's sole strategic partner for direct supply in the territory and will serve as its technical, demand creation distributor, servicing the UK and Ireland's increasing VOEM engineering base.

Managing director, Jauch Quartz UK, Nicholas Ribton, said: "We have been in a long-term search for a first-class design partner

for Custom Magnetics. With Superworld's innovative products in the areas of wireless charging and LAN magnetics, plus its custom transformer manufacturing capability and wide-ranging coverage in magnetic and EMC components, our search is now over."

"Combine this with Jauch's long established technical and logistics skills, and I'm confident the UK and Ireland customer base will be excited about this partnership. We appreciate the trust Superworld has demonstrated in Jauch with this exclusive agreement and are looking forward

to a long and prosperous collaboration."

Senior sales manager, Asia and Europe, Superworld Electronics, Edwin Chan, added: "Our comprehensive portfolio helps us match the right products and solutions to customer's specific needs. This exclusive agreement enables us to leverage Jauch's formidable field application engineering team in the UK, alongside our prototyping and manufacturing resources, to bring these benefits to many more customers in UK and Ireland."

www.jauch.co.uk



Jauch will be Superworld's sole strategic partner for direct supply in the UK and Ireland



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Half brick converters offer ultra-wide input range

XP Power is targeting its QSB150 series of 150W half brick DC/DC converters at applications where an ultra-wide input range is required. With an input range of nine to 75V DC these units accept all nominal inputs of 12, 24 and 48V DC. By accepting three nominal battery voltages, the QSB150 negates the need for a change in end equipment.

Available in six regulated single output models, covering popular nominal output voltages from 12 to 48V DC, QSB150 series feature a voltage trim function that allows adjustment of ± 10 per cent of stated output to accommodate line losses or non-standard voltage requirements. Input to output isolation is 1,500V DC. Units conform to the industry standard half brick footprint and feature pin out compatibility with existing industry standards. They are also said to be highly efficient, typically up to 92 per cent.
www.xppower.com

Medical supplies provide rugged power

Gresham Power Electronics has introduced a series of low noise AC/DC converters for medical applications. Manufactured by Polytron Devices, the P3/P5/MHIA AC/DC linear power supply series is UL 60601-1 third edition recognised, as well as being 2MOPP compliant. Applications for these encapsulated modules include surgical equipment, patient monitoring, imaging, laboratory and diagnostics equipment.

Capable of providing 4,000V AC reinforced insulation, these single, dual and triple output power supplies are available with either a PC mount or chassis mount footprint with screw terminal connections. Output noise is said to be low at 1.0mV RMS while providing a 2 μ A patient leakage current and a regulation line and load of 0.02 to 0.2 per cent. In addition, models feature short circuit protection, CE certification and optional international input voltages including dual and switchable.

Managing director of Gresham Power, Jake Moir, said: "Encapsulated power supplies offer a safe and rugged solution to medical systems, which operate in many different environments."

www.greshampower.com

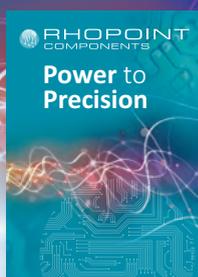


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Advertorial

Intelligent solution to datacenter power

Schurter's new 6600-5 series IEC outlets with integrated light pipes are designed to provide an intelligent, space and cost-saving solution for PDUs used in data centers and other multi-distributed power applications.

Data centers are under constant pressure to improve their efficiency and reliability under growing regulatory requirements to reduce energy use and cost. Meanwhile, demand for reliable transmission with increased speed must keep pace. At the base of this modern day economic demand and supply phenomena is an intelligent, reliable power supply and, at the base of



that, a simple connector. Schurter is pleased to introduce its IEC outlets with integrated light pipes, which bring a simple yet improved solution to intelligent power distribution.

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Thermal advice: not just hot air

When it comes to thermal management, a good supplier can help strike a balance between engineering's quest for efficiency and purchasing's commercial interests, says G English Electronics

An electronic system's ability to perform as designed can depend entirely on the correct cooling solution, since heat dissipated by electrical and electronic equipment can have a detrimental effect on both performance and longevity. Selecting the appropriate cooling solution is not necessarily straightforward however, when variables and limitations such as size, orientation, location, noise, environment and commercial implications are considered.

Furthermore, there is often a misalignment of expectations between engineers, who are trying to develop the most efficient product, and purchasers, who are looking to achieve the best commercial arrangement in the interests of the business. Often a compromise must be met; fortunately, careful vendor selection can make all the difference.

Early interaction

Suppliers will always encourage communication at conceptual stage, as this is the first opportunity to understand project requirements and highlight factors that may not have been considered until this point.

One of the biggest frustrations, for example, can be learning of a planned end of life notification after product qualification has been finalised. A good supplier should act as a trusted partner to your business and when equipped with the project details, should have the foresight to navigate such issues through early dialogue with the engineer.

Fan choice

The size and type of fan are usually dictated by the space available and the air path, but there are other factors to consider. The aim for a system designer should be to incorporate the largest fan possible, in order to achieve the lowest fan speed for the required airflow. This not only reduces noise from the fan, but extends the lifetime through reduced bearing wear. In general blowers tend to produce more noise and on average have a higher price. Consequently, reasonable efforts to reduce system resistance should be taken.

It is worth noting that axial fans in 40, 60, 80 and 120mm frame size are most common, and therefore attract the most competitive pricing and availability. In practice, this means if space is not an issue, then selecting a 40mm frame over a 30mm frame will make more commercial sense.

Consider customisations

Most applications require the fan to be customised in some way, whether it's a simple lead adjustment and the addition of a connector, or something more sophisticated such as a change to the frame. Fans are, however, very sensitive to mishandling and can be easily damaged during any secondary operation. By incorporating any customisations into the manufacturing process, the risk of damages can be mitigated and this is also likely to carry an overall price and lead time advantage.

Environmental conditions should be considered here, as this will determine whether



Sunon thermal management fan

additional coating to provide protection up to IP68 is needed. Attention should also be given to bearing selection.

Dual ball bearing is typically the most robust option and is selected for harsher environments such as high temperatures, long operating cycles and fluid or particle ingress. Sleeve bearing is a viable option where cost is the principle factor, but mounting orientation needs to be carefully considered as well as life expectancy. Other solutions are also available, such as Sunon's patented MagLev bearing, designed to offer superior reliability compared with a traditional sleeve bearing, whilst being priced competitively against an equivalent ball bearing fan.

The term 'custom' is often

It is worth noting that axial fans in 40, 60, 80 and 120mm frame size are most common, and therefore attract the most competitive pricing and availability



Incorporating customisations into the manufacturing process may provide overall price and lead time advantage

communication with the vendor to share information of disruptive changes on the horizon. Benefits such as this are only accessible however, if the purchaser has identified a trusted advisor, not just a vendor.

www.gelec.co.uk

met with some resistance, as it implies that a part will be subject to long lead times and a price premium. Both of these concerns can be counterbalanced by communicating with your supplier to understand which parts are being used in high volumes elsewhere, in order to benefit from consolidated global demand.

Supply arrangements

Forward planning and stock commitment can be challenging when a market is volatile.

Harmonisation of parts across multiple products is encouraged, but unforeseen spikes in demand can still be a problem when faced with lead times. It is therefore worth considering stock agreements with your supplier, taking advantage of optimum price breaks and inventory held locally to your production facility, available at short notice.

Specifying a fan to meet system requirements is obviously critical, however, selecting the right partner to bridge the gap between the client and the manufacturer may be even more important. This can ensure smooth and seamless supply based on bilateral



The size and type of fan are usually dictated by the space available and the air path

Specifying a fan to meet system requirements is obviously critical, however, selecting the right partner to bridge the gap between the client and the manufacturer may be even more important

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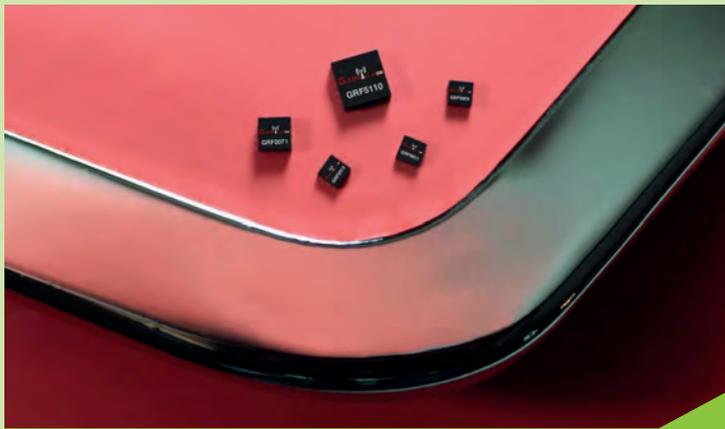
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Extending wireless coverage

Aspen Electronics has introduced a range of RF and microwave IC products from Guerrilla RF designed to enable new levels of range and coverage in wireless systems.

First up is a new failsafe single pole double throw switch for cellular boosters, cellular infrastructure and L-band satellite communications. The GRF6011 is a linear, ultra-low loss switch designed with failsafe characteristics when all voltage inputs are removed. In switching mode, the device delivers IP1dB levels greater than one watt along with greater than 49dBm IIP3 levels for both RF paths.

Other developments include the GRF2013, a high performance broadband gain block featuring high linearity with low noise for small cell and wireless infrastructure applications. It boasts outstanding broadband NF, linearity and return losses over 0.7 to 3.8GHz with a single match. Optimising the bias inductor and coupling caps for lower frequency operation will yield performance down to 50MHz.

www.aspen-electronics.com



Solid choice in the mid-power range

Plessey is extending its LED portfolio of solid-state lighting products with a variety of mid-power LED packages.

The company's Midion offering, now includes products with efficacies up to 210lm/W, modules with zero flicker and LED components with a colour rendering index of 90. All lumen maintenance is certified to LM-80 and offered in standard colour temperatures for general lighting applications. Throughout the portfolio there are various high CRI, high-voltage, super-efficient and three-step MacAdam ellipse as standard, and single-step MacAdam ellipse reels available.

Products in the Midion range include ultra-small dotLED packages, plus variants of the industry standard 2835, 3014, 3030, 5050 and 5630 PLCC packages. The series spans colour temperatures from 2,700 to 6,500K with nominal flux levels from 20 to 140lm and a typical viewing angle of 120deg.

www.plesseysemiconductors.com

Oscillators target video streaming

Astute Electronics now offers EQHJ series ultra-low phase jitter oscillators from Euroquartz. The oscillators are designed for ultra-low phase noise, high-speed, serial communications and video streaming applications within defence, aerospace and demanding industrial environments.

Typically achieving 50fs, the oscillators deliver frequency stability from ± 25 ppm over the industrial frequency range -40 to 85°C. They provide LVCMOS output from a supply voltage of 1.8, 2.5 or 3.3V.

With three industry standard packages available, current consumption ranges from 3mA typical, 5mA maximum for the smallest package to 7mA typical, 10mA maximum for the largest devices. All package sizes are available over the frequency range 5.0 to 50MHz.

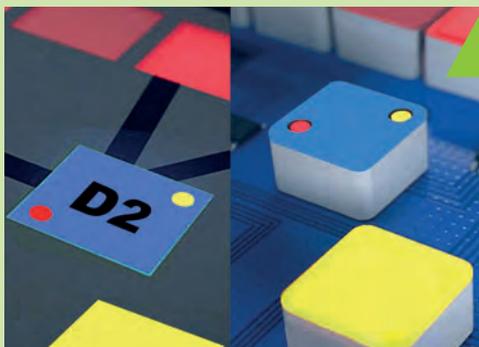
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Housings offer easy-to-install protection

Phoenix Contact is expanding its range of easy-to-install field housing. The electronics housings from the DCS series accommodate LC displays in sizes of 5.7, 7.0, and 15in as well as reliably protecting the integrated electronics against mechanical stress. The housings are suitable for stationary and mobile display units in laboratory and analysis technology, as well as for applications in healthcare and building automation.

www.phoenixcontact.co.uk



Bright ideas for even illumination

Multitron has announced ex-stock availability of four full-face, evenly-illuminated switch keycap ranges, utilising Mentor's light guide expertise. The face of each switch cap features a precision-designed area light guide, said to provide homogeneous illumination with no hot-spots, despite using just two surface mount LEDs. The majority are available ex-stock with low minimum order quantities.

For optimum flexibility, the keycaps incorporate a three-part SMD switch design. The illuminated cap is available separately from the switch and LEDs, enabling users to mix and match switch cap types to produce complex panels. RGB LEDs also allow an infinite choice of switchable colours from a single illuminated switch.

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CABLE ASSEMBLY & HARNESSING											
FTDI	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	100	N/A	£0	N/A	50	1,500+	Y
Molex	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	300	N/A	£0	97%	50	1,500+	Y
CIRCUIT PROTECTION											
Bourns	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	5000	N/A	£0	58%	50	1,500+	Y
EPCOS/TDK	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	5000	N/A	£0	58%	50	1,500+	Y
Littelfuse	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	35000	N/A	£0	67%	50	1,500+	Y
DISPLAYS & LEDs											
NLT Technologies Ltd	Review Display System Ltd	01959 563345	www.review-displays.co.uk	Y	All	N/A	£0	N/A	6	25	Y
ELECTROMECHANICAL											
CUI CORPORATION	Digi-Key	0800 587 0991	digkey.co.uk	Y	15,168	N/A	£0	91.34%	150	3,400	Y
MURATA CORPORATION	Digi-Key	0800 587 0991	digkey.co.uk	Y	61,903	N/A	£0	99.72%	150	3,400	Y
OMRON CORPORATION	Digi-Key	0800 587 0991	digkey.co.uk	Y	70,119	N/A	£0	95.28%	150	3,400	Y
PANASONIC CORPORATION	Digi-Key	0800 587 0991	digkey.co.uk	Y	156,533	N/A	£0	93.83%	150	3,400	Y
TDK CORPORATION	Digi-Key	0800 587 0991	digkey.co.uk	Y	64,978	N/A	£0	99.30%	150	3,400	Y
TE CONNECTIVITY CORPORATION	Digi-Key	0800 587 0991	digkey.co.uk	Y	437,107	N/A	£0	75.47%	150	3,400	Y
ENCLOSURES											
Bud	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	2,500	N/A	£0	80%	50	1,500+	Y
Hammond	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	12,500	N/A	£0	100%	50	1,500+	Y
Metcase Enclosures	OKW Enclosures	01489 583858	www.metcase.co.uk	N	288	£40,000	£0	N/A	5	22	Y
OKW Enclosures Ltd	OKW Enclosures	01489 583858	www.okw.co.uk	N	1,955	£40,000	£0	N/A	5	22	Y
Rolec Enclosures	OKW Enclosures	01489 583858	www.rolec-enclosures.co.uk	Y	935	£40,000	£0	N/A	5	22	Y
Teko Enclosures	OKW Enclosures	01489 583858	www.teko.co.uk	Y	1,860	£40,000	£0	N/A	5	22	Y
FREQUENCY MANAGEMENT											
ABRACON	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,000	N/A	£0	91%	50	1,500+	Y
AEL Crystals Ltd	AEL Crystals Ltd	01293 789200	www.aelcrystals.co.uk	N	N/A	£200,000	£50	100%	3	15	Y
ECS	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	500	N/A	£0	99%	50	1,500+	Y
Epson	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	500	N/A	£0	59%	50	1,500+	Y
Golledge Electronics Ltd	Golledge Electronics Ltd	01460 256 100	www.golledge.com	N	N/A	£800,000	£0	100%	3	24	Y
Jauch Quartz		01276 605900	www.jauch.co.uk			£3M		100%	15	130	Y
HEATSINKS											
Aavid	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	700	N/A	£0	67%	50	1,500+	Y
ICs & SEMICONDUCTORS (continued on next page)											
ALLEGRO MICROSYSTEMS, LLC	Digi-Key	0800 587 0991	digkey.co.uk	Y	2,867	N/A	£0	86.22%	150	3,400	Y
ALTERA	Digi-Key	0800 587 0991	digkey.co.uk	Y	10,502	N/A	£0	80.39%	150	3,400	Y
Altera	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,600	N/A	£0	60.00%	50	1,500+	Y
ANALOG DEVICES	Digi-Key	0800 587 0991	digkey.co.uk	Y	50,633	N/A	£0	73.33%	150	3,400	Y
Analog Devices Inc.	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	9,500	N/A	£0	83.00%	50	1,500+	Y
Atmel	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,700	N/A	£0	58.00%	50	1,500+	Y
Avago Technologies	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	400	N/A	£0	84.00%	50	1,500+	Y
Broadcom	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	100	N/A	£0	69%	50	1,500+	Y



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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
BROADCOM LIMITED (AVAGO)	Digi-Key	0800 587 0991	digkey.co.uk	Y	2,237	N/A	£0	99.96%	150	3,400	Y
Cirrus Logic	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	300	N/A	£0	80.00%	50	1,500+	Y
CREE INC	Digi-Key	0800 587 0991	digkey.co.uk	Y	26,398	N/A	£0	100.00%	150	3,400	Y
CYPRESS SEMICONDUCTOR	Digi-Key	0800 587 0991	digkey.co.uk	Y	26,030	N/A	£0	89.02%	150	3,400	Y
Cypress Semiconductor	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,400	N/A	£0	63.00%	50	1,500+	Y
DIODES INC	Digi-Key	0800 587 0991	digkey.co.uk	Y	32,186	N/A	£0	89.01%	150	3,400	Y
Diodes Incorporated	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,600	N/A	£0	98%	50	1,500+	Y
Exar	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,100	N/A	£0	95.00%	50	1,500+	Y
FAIRCHILD	Digi-Key	0800 587 0991	digkey.co.uk	Y	39,380	N/A	£0	97.62%	150	3,400	Y
Fairchild Semiconductor	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	2,500	N/A	£0	90.00%	50	1,500+	Y
Freescale Semiconductor	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	2,500	N/A	£0	42.00%	50	1,500+	Y
FTDI	Digi-Key	0800 587 0991	digkey.co.uk	Y	486	N/A	£0	100.00%	150	3,400	Y
FTDI	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	100	N/A	£0	97%	50	1,500+	Y
IDT (Integrated Device Technology)	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	2,100	N/A	£0	97%	50	1,500+	Y
Infineon	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	800	N/A	£0	66.00%	50	1,500+	Y
INFINEON TECHNOLOGIES CORPORATION	Digi-Key	0800 587 0991	digkey.co.uk	Y	24,610	N/A	£0	85.64%	150	3,400	Y
Intel	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	500	N/A	£0	78%	50	1,500+	Y
International Rectifier	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	600	N/A	£0	87.00%	50	1,500+	Y
Intersil	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,900	N/A	£0	50.00%	50	1,500+	Y
INTERSIL CORPORATION	Digi-Key	0800 587 0991	digkey.co.uk	Y	24,063	N/A	£0	74.18%	150	3,400	Y
ISSI	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	700	N/A	£0	98.00%	50	1,500+	Y
IXYS CORPORATION	Digi-Key	0800 587 0991	digkey.co.uk	Y	7,268	N/A	£0	99.55%	150	3,400	Y
Lattice	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	700	N/A	£0	69%	50	1,500+	Y
LINEAR TECHNOLOGY CORPORATION	Digi-Key	0800 587 0991	digkey.co.uk	Y	36,207	N/A	£0	76.91%	150	3,400	Y
MAXIM CORPORATION	Digi-Key	0800 587 0991	digkey.co.uk	Y	65,795	N/A	£0	77.63%	150	3,400	Y
Maxim Integrated	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	11,200	N/A	£0	67.00%	50	1,500+	Y
Microchip	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	12,600	N/A	£0	91.00%	50	1,500+	Y
MICROCHIP CORPORATION	Digi-Key	0800 587 0991	digkey.co.uk	Y	58,558	N/A	£0	90.13%	150	3,400	Y
Microsemi	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	400	N/A	£0	90%	50	1,500+	Y
Monolithic Power Systems (MPS)	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	600	N/A	£0	40%	50	1,500+	Y
NXP	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	3,900	N/A	£0	91%	50	1,500+	Y
NXP SEMICONDUCTOR CORPORATION	Digi-Key	0800 587 0991	digkey.co.uk	Y	38,701	N/A	£0	99.27%	150	3,400	Y
ON Semiconductor	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	5,100	N/A	£0	87%	50	1,500+	Y
ON SEMICONDUCTOR CORPORATION	Digi-Key	0800 587 0991	digkey.co.uk	Y	57,566	N/A	£0	79.85%	150	3,400	Y
Power Integrations	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	600	N/A	£0	59%	50	1,500+	Y
Qorvo	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	300	N/A	£0	90.00%	50	1,500+	Y
ROHM Semiconductor	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,400	N/A	£0	55.00%	50	1,500+	Y
SEMTECH CORPORATION	Digi-Key	0800 587 0991	digkey.co.uk	Y	3,694	N/A	£0	87.63%	150	3,400	Y
Silicon Laboratories	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,500	N/A	£0	96%	50	1,500+	Y
SILICON LABORATORIES CORPORATION	Digi-Key	0800 587 0991	digkey.co.uk	Y	17,747	N/A	£0	96.09%	150	3,400	Y
Skyworks	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	300	N/A	£0	91%	50	1,500+	Y
Spansion Inc.	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	600	N/A	£0	93.00%	50	1,500+	Y
STMicroelectronics	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	4,500	N/A	£0	99%	50	1,500+	Y
STMICROELECTRONICS CORPORATION	Digi-Key	0800 587 0991	digkey.co.uk	Y	43,448	N/A	£0	97.47%	150	3,400	Y
Texas Instruments	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	36,900	N/A	£0	41%	50	1,500+	Y
TEXAS INSTRUMENTS CORPORATION	Digi-Key	0800 587 0991	digkey.co.uk	Y	210,905	N/A	£0	89.60%	150	3,400	Y
Toshiba	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	500	N/A	£0	100.00%	50	1,500+	Y
XILINX INC	Digi-Key	0800 587 0991	digkey.co.uk	Y	7,354	N/A	£0	51.78%	150	3,400	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
INDUSTRIAL GRADE MEMORY MODULES											
InnoDisk	Simms	01622 852 848	www.simms.co.uk	N	300+	N/A	N/A	N/A	3	N/A	Y
INTERCONNECTION											
3M	Digi-Key	0800 587 0991	digkey.co.uk	Y	54,086	N/A	£0	93.83%	150	3,400	Y
3M	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	3,100	N/A	£0	16%	50	1,500+	Y
AMPHENOL	Digi-Key	0800 587 0991	digkey.co.uk	Y	426,945	N/A	£0	82.42%	150	3,400	Y
Amphenol	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	25,600	N/A	£0	53%	50	1,500+	Y
Anderson Power Products	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	800	N/A	£0	50%	50	1,500+	Y
Cinch Connectivity Solutions	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,900	N/A	£0	82%	50	1,500+	Y
Delphi Connection Systems	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	3,300	N/A	£0	67.00%	50	1,500+	Y
EDAC	EDAC	01933 427300	www.edacnet	N/A	N/A	N/A	£100	100%	34	500+	Y
FCI	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	4,300	N/A	£0	94%	50	1,500+	Y
Glenair	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,900	N/A	£0	76.00%	50	1,500+	Y
HARTING	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	4,700	N/A	£0	31%	50	1,500+	Y
Harwin	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	2,200	N/A	£0	79%	50	1,500+	Y
Hellermann Tyton	Lane Electronics	01403 790661	www.fclane.com	Y	N/A	N/A	N/A	N/A	N/A	N/A	Y
Hirose Electric	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	6,100	N/A	£0	99%	50	1,500+	Y
HIROSE ELECTRIC CO LTD	Digi-Key	0800 587 0991	digkey.co.uk	Y	39,499	N/A	£0	91.53%	150	3,400	Y
Huber+Suhner	Lane Electronics	01403 790661	www.fclane.com	Y	766	£116,000	£0	100%	6	38	Y
ITW McMurdo	Lane Electronics	01403 790661	www.fclane.com	Y	866	£219,000	£0	100.00%	6	38	Y
JAE Electronics	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,200	N/A	£0	32%	50	1,500+	Y
JST SALES AMERICA INC	Digi-Key	0800 587 0991	digkey.co.uk	Y	4,320	N/A	£0	81.46%	150	3,400	Y
Kycon	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	700	N/A	£0	99%	50	1,500+	Y
LEMO	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	2,900	N/A	£0	65%	50	1,500+	Y
Molex	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	16,900	N/A	£0	75%	50	1,500+	Y
MOLEX CORPORATION	Digi-Key	0800 587 0991	digkey.co.uk	Y	123,772	N/A	£0	95.41%	150	3,400	Y
Neutrik	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,000	N/A	£0	86%	50	1,500+	Y
Phoenix Contact	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	12,000	N/A	£0	99.00%	50	1,500+	Y
Polamco	Lane Electronics	01403 790661	www.fclane.com	Y	218	£146,000	£0	100%	6	38	Y
Positronic	Lane Electronics	01403 790661	www.fclane.com	Y	N/A	N/A	N/A	N/A	N/A	N/A	Y
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.americaieurope.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
OPTO ELECTRONICS (continued on next page)											
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



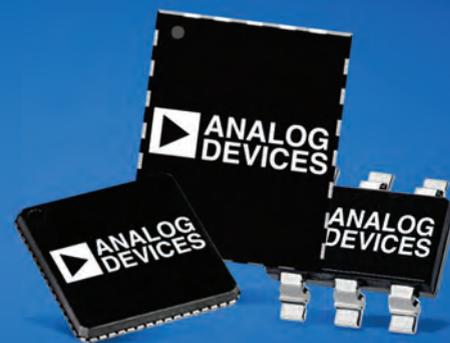
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Buyers' Guide

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
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											
ABRACON CORPORATION	Digi-Key	0800 587 0991	digkey.co.uk	Y	28,548	N/A	£0	98.89%	150	3,400	Y
AVX	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	70,700	N/A	£0	58.00%	50	1,500+	Y
BEL FUSE	Digi-Key	0800 587 0991	digkey.co.uk	Y	4,207	N/A	£0	83.53%	150	3,400	Y
BOURNS	Digi-Key	0800 587 0991	digkey.co.uk	Y	59,314	N/A	£0	82.47%	150	3,400	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
EATON CORPORATION	Digi-Key	0800 587 0991	digkey.co.uk	Y	28,434	N/A	£0	86.49%	150	3,400	Y
EPCCS / TDK	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	31,000	N/A	£0	74.00%	50	1,500+	Y
Fair-Rite	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,000	N/A	£0	94.00%	50	1,500+	Y
HONEYWELL CORPORATION	Digi-Key	0800 587 0991	digkey.co.uk	Y	26,319	N/A	£0	86.01%	150	3,400	Y
Kemet	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	135,800	N/A	£0	93%	50	1,500+	Y
KEMET CORPORATION	Digi-Key	0800 587 0991	digkey.co.uk	Y	48,025	N/A	£0	90.12%	150	3,400	Y
KOA Speer	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	107,900	N/A	£0	82%	50	1,500+	Y
KYOCERA ELECTRONICS CORPORATION (AVX)	Digi-Key	0800 587 0991	digkey.co.uk	Y	65,718	N/A	£0	83.48%	150	3,400	Y
LAIRD CORPORATION	Digi-Key	0800 587 0991	digkey.co.uk	Y	14,568	N/A	£0	97.21%	150	3,400	Y
Laird Technologies	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,800	N/A	£0	50.00%	50	1,500+	Y
LITTELFUSE CORPORATION	Digi-Key	0800 587 0991	digkey.co.uk	Y	86,652	N/A	£0	82.87%	150	3,400	Y
Murata	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	67,300	N/A	£0	99%	50	1,500+	Y
NICHICON	Digi-Key	0800 587 0991	digkey.co.uk	Y	35,421	N/A	£0	96.50%	150	3,400	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
PULSE CORPORATION	Digi-Key	0800 587 0991	digkey.co.uk	Y	11,098	N/A	£0	93.56%	150	3,400	Y
ROHM SEMICONDUCTOR CORPORATION	Digi-Key	0800 587 0991	digkey.co.uk	Y	63,003	N/A	£0	99.85%	150	3,400	Y
Samsung Electro-Mechanics	Digi-Key	0800 587 0991	digkey.co.uk	Y	21,522	N/A	£0	100.00%	150	3,400	Y
TAIYO YUDEN	Digi-Key	0800 587 0991	digkey.co.uk	Y	16,677	N/A	£0	99.96%	150	3,400	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
VISHAY CORPORATION	Digi-Key	0800 587 0991	digkey.co.uk	Y	275,942	N/A	£0	88.52%	150	3,400	Y
WURTH CORPORATION	Digi-Key	0800 587 0991	digkey.co.uk	Y	22,245	N/A	£0	100.00%	150	3,400	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
YAGEO CORPORATION	Digi-Key	0800 587 0991	digkey.co.uk	Y	141,986	N/A	£0	83.67%	150	3,400	Y
POWER & BATTERIES (continued on next page)											
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
FRIVO Gerätebau GmbH	Haredata Electronics	01423 796240	www.haredata.co.uk	Y	250 - 500	€1M	£250	100%	7	14	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
POWER & BATTERIES (continued from previous page)											
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
Carlisle Technologies	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	300	N/A	£0	87%	50	1,500+	Y
CHERRY	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	200	N/A	£0	77%	50	1,500+	Y
EAO Ltd	EAO Ltd	01444 236000	www.eao.co.uk	N	5,000	£500,000	£150	100%	6	22	Y
E-Switch	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	700	N/A	£0	94%	50	1,500+	Y
Grayhill	EAO Ltd	01444 236000	www.eao.co.uk	Y	2,300	£150,000	£150	99%	6	22	Y
Grayhill	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	400	N/A	£0	84.00%	50	1,500+	Y
Honeywell	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	700	N/A	£0	98%	50	1,500+	Y
NKK Switches	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	1,100	N/A	£0	94%	50	1,500+	Y
Omron	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	900	N/A	£0	68%	50	1,500+	Y
TE Connectivity	Mouser Electronics	0044 (0)1494-467490	www.mouser.co.uk	Y	400	N/A	£0	98%	50	1,500+	Y
TERMINAL BLOCKS											
Marathon Special Products	Global Supply Services	01904 436 488	www.global-supply-services.com	Y	8,000	£800,000	£100	100%	3	11	Y
THERMAL MANAGEMENT (continued on next page)											
3m / Laird / Henkel / Brightview / Luminit / Universal Science	Materials direct 247	01908 222211	www.materialsdirect247.com	Y	N/A	N/A	N/A	N/A	N/A	N/A	Y
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



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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
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	Thermaco Ltd	01684 566163	www.thermaco.co.uk	Y	3,500	£230,000	£100	100%	6	12	Y
Sunon	G.English Electronics Ltd	0208 855 0991	www.gelec.co.uk	Y	3,500	£1,000,000+	£0	100%	10	28	Y

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Best Windings	Best Windings	0044 (0)1394 448424	www.bestwindings.co.uk	N	300	N/A	£100	N/A	2	14	Y
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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

PCB Buyers' Guide

Manufacturer	Telephone	Website	Service Provided (ie. Broker, Manufacture &/or Repair)	Location	Approvals	Volume - Small, Medium, Large	Double-sided	Multi-layer 4-10/10-20/20-30	Metal PCBs	Flex / Flex-Rigid	Obsolescence Solutions	Modifications	Prototyping
Cambridge Circuit Company Ltd	01223 423100	www.cambridge-circuit.co.uk	M	SE	ISO9001:2008, UL	SML	Y	4-16	Y	Y	Y	Y	Y
Cleveland Circuits Ltd	01287 651991	www.pcb.co.uk	M	NE	ISO9001:2008 UL	SML	Y	4-30	Y	N	Y	Y	Y
CS Electronics (UK) Ltd	0116 242 4058	www.ccs-electronic-pcb.co.uk	B	M	UL, ISO 9001, TS16949	SML	Y	4-32	Y	Y	Y	Y	Y
Daleba Electronics Ltd	+44(0)1592 510000	www.daleba.co.uk	B/M	SE	ISO9001:2008, TS, UL	SML	Y	4-30	Y	Y	Y	Y	Y
GSPK Circuits Ltd	+44(0)1423 321100	www.gspkcircuits.ltd.uk	M/R	UK, Europe, Asia	BSEN, ISO9001:2008, TS16949:2009, UL, CECC release, Queens Award	SML	Y	4-16	Y	Y	Y	Y	Y
LEF Circuits	0116 2891122	www.lefcircuits.co.uk	M/R	M	ISO 9001:2008, UL	SML	Y	4-30	Y	F/R	Y	Y	Y
Photonix Group	01903 231901	www.photonix.co.uk	B	SE	ISO9001:2008, ISO14001:2004, AS9100-B, NADCAP, TS16949:2002	SML	Y	4-58	Y	F, F/R	Y	Y	Y
Prestwick Circuits GPS Ltd	01294 224631	www.prestwickgps.com	B	UK, Portugal, China	ISO 9001, ISO-TS16949, AS9100, IPC610 Class II/III, UL	SML	Y	4-48	Y	Y	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

Contract Manufacturers Buyers' Guide (continued on next page)

Manufacturer	Telephone	Website	Turnover	Location	Employees	Number of Surface Mount Lines	Approvals	BGA Capacity	Lead Free Manufacturer	Prototyping	Design Capability	Full Turnkey	Cables and Harnessing
AWS Electronics Group	01782 753200	www.awselectronicsgroup.com	£40m	UK & Slovakia	430	11	AS9100, ISO9001, 13485, 14001, TS16949, IPC-A-610 Class 3, NADCAP	Y	Y	Y	Y	Y	Y
Axiom Manuf. Services	01495 242130	www.axiom-ms.com	£40m	SW	300	3	ISO9001, AS9100, ISO13485, ISO14001, SC21, IPC610E, BSI Kitemark, NADCAP, ISO27001	Y	Y	Y	Y	Y	Y
Briton EMS Ltd (OSI Electronics)	01234 266300	www.britonems.co.uk	£12m	Bedford & Singapore	100	3	ISO: 9001, 13485, 14001, AS9100, BSI Kitemark, IPC610	Y	Y	Y	Y	Y	Y
Challenger Solutions Ltd	01245 325252	www.challengersolutions.com	£5m	Essex/SE	55	7	ISO 9001, 14001, UL IPC-610, SC21	Y	Y	Y	Y	Y	Y

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Manufacturer	Telephone	Website	Turnover	Location	Employees	Number of Surface Mount Lines	Approvals	BGA Capacity	Lead Free Manufacturer	Prototyping	Design Capability	Full Turnkey	Cables and Harnessing
Cleveland Circuits Ltd	01287 651991	www.pcb.co.uk	£3.7m	NE	60	2	ISO9001:2008 UL	Y	Y	Y	Y	Y	Y
Contract Production Limited	01751 475950	www.contract-production.co.uk	£1.9m	North Yorkshire	20	2	ISO9001:2008, IPC-A-610 Class 3	Y	Y	Y	Y	Y	Y
Corintech Ltd	+44 (0)1425 655655	www.corintech.com	£7.5m	UK	72	3	AS9100, ISO9001, IPC-A-610 Class 3	Y	Y	Y	Y	Y	Y
CSI EMS Ltd	01376 500050	www.csiems.co.uk	£5m	Essex	50	3	ISO 9001, UL, IPC610	Y	Y	Y	Y	Y	Y
CT Production Ltd	01202 687633	www.ctproduction.co.uk	£4.5m	Poole, Dorset	55	3	ISO9001:2015, AS9100, SC21 Bronze Award	Y	Y	Y	Y	Y	Y
Custom Interconnect Ltd	01264 321321	www.cil-uk.co.uk	£14m	Andover (Hampshire)	130	6	ISO 9000, IPC610, ISO 13485	Y	Y	Y	Y	Y	Y
DI Assembly	01904 436 456	www.diassembly.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, UL	Y	Y	Y	Y	Y	Y
Electronic Technicians Ltd	01202 897722	www.etluc.co.uk	£3.5m	SE	55	2	AS9100, ISO9001, ISO14001, IPC610/620 Class 3	Y	Y	Y	Y	Y	Y
Elite Electronic Systems Ltd	028 6632 7172	www.elitees.com	£17m	UK	160	5	ISO9001, ISO13485, UL, IPC610/620	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
Exception-Fabrinet	01249 814081	www.exceptiongroup.com	£21m	UK/Thailand/US	210	5/31/2	AS9100/NADCAP/EN13485/OHSAS18001/14001/9001/TS16949/FDA/ATEX	Y	Y	Y	Y	Y	Y
FermionX Ltd	+44(0)1903 524600	www.fermionx.com	£5m	Worthing, W. Sussex	40	4	ISO9001:2008, ISO14001	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, IPCJ-STD-001, IPC-7711/7721, BS EN 61340-5-1/2 (ESD)	Y	Y	Y	Y	Y	Y
Hallmark Electronics Ltd	01782 562255	www.hallmarkelectronics.com	£2m	M	26	2	ISO9000/UL, IPC610/D	Y	Y	Y	Y	Y	Y
Icon Electronics Limited	01423 798294	www.iconelectronics.co.uk	£6.5m	Hampshire & Yorkshire	70	6	AS9100, ISO9001, BS EN ISO/IEC 80079-34:2011 ATEX, IPC-A-610 Class3	Y	Y	Y	Y	Y	Y
Industrial Electronic Wiring Ltd.	+44(0)1793 694033	www.iwew.co.uk	£4.5 m	Swindon, UK	60	N/A	ISO9001:2008, IPC610, IPC620	N	Y	Y	N	Y	Y
Jaltek	01582578170	jaltek.com	£8m	UK	80	3	AS9100, ISO9001, ISO13485, IPC-A-610 Class 3, Certified IPC Trainer (IPC-A-610, J-STD-001 & J-STD-001 Space Addendum)	Y	Y	Y	Y	Y	Y
JIS Manufacturing	01455 555500	www.jismanufacturing.com	£23m	M/CZ Republic	270	3	ISO9001:2008 and IPC610 to Class 3	Y	Y	Y	Y	Y	Y
Nemco Limited	01438 346600	www.nemco.co.uk	£11.25m	SE	120	6	AS9100, ISO9001:2008, IPC610/620 to Class 3, ISO14001-2004, SC21	Y	Y	Y	Y	Y	Y
NOTE	01453 797580	www.note.eu	£100m	UK/EU/China	1,000	14	ISO9001, 13485, 14001, 18001, IPC-610 Class 3	Y	Y	Y	Y	Y	Y
M-TEK (Assembly) Ltd	01189 455377	www.mtek.co.uk	£2.4m	SE	30	4	ISO9001:2008/IPC-A-610 Class 3/WHMA-620/ISO14001:2004/IPC-7711/7721	Y	Y	Y	Y	Y	Y
Pektron	01332 832424	www.pektron.com	£50m	E-Midlands	350	8	ISO9001, ISO14001, TS16949, BEAB, VCA, TUV, UL	Y	Y	Y	Y	Y	Y
Protronix EMS	01582 418490	www.protronix.co.uk	£2.5m	Luton	10	2	UKAS ISO9001:2008, IPC-A610	Y	Y	Y	Y	Y	Y
Season Electronics Limited	02392 452222	www.seasongroup.com	£5m/£95m	Havant/Global	65/1800	2/18	(AS9100 & ISO9001 in UK) (TS16949 & ISO13485 at sister sites)	Y	Y	Y	Y	Y	Y
Sedgewall	01582 475555	sedgewall.com	£1.2m	Bedfordshire	25	2		Y	Y	Y	Y	Y	Y
Simtek EMS Ltd	01843 233120	www.simtekems.co.uk	£4m	SE	50	3	ISO9001:2008, ISO13485, IPC-A-610 Class 3 & IPC-7711	Y	Y	Y	Y	Y	Y
Speedboard Assembly Services	01753 746700	www.speedboard.co.uk	£12.5m	Windsor, SE	99	4	IPC610 to Class 3, ISO9001:2015	Y	Y	Y	N	Y	Y
Tenkay Electronics Ltd	01903 855455	www.tenkay.co.uk	£4.1m	West Sussex	50	1	ISO 9001:2008, ISO 14001:2004, OHSAS 18001:2007	N	Y	N	N	Y	Y
TEXCEL TECHNOLOGY PLC	+44(0)1322621700	www.texceltechnology.com	£12m	SE	105	7	ISO9001, ISO14001, IPC610 Class 3,	Y	Y	Y	Y	Y	Y
Tioga Limited	01332 360884	www.tioga.co.uk	£15m	Derby	110	6	ISO 9001:2015, ISO 13485:2016, IPC 610, IPC 7711/7721	Y	Y	Y	Y	Y	Y
Trojan Electronics Limited	01792 469020	www.trojanelectronics.co.uk	£2m	South Wales	20	2	BS EN ISO 9001 2008, ISO 14001 2007	Y	Y	Y	Y	Y	Y
Wilson Process Systems	01424 722222	www.wps.co.uk	£12m	SE	100	4	ISO9001:2008, IPC-A-610 Class 3	Y	Y	Y	Y	Y	Y



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