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NOVEMBER 2020

## DON'T GET BOXED-IN SOURCING ENCLOSURES



AN MMG PUBLISHING TITLE


## On the cover – November 2020

Don't get boxed-in sourcing enclosures

## Contents



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ELECTRONICS sourcing MMG PUBLISHING LIMITED

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## Editor's Word

### Think, make or serve

It's been an interesting 55-years. Like many children of the '60s, I was born into a manufacturing economy. As the years ticked by this was subsequently swept away by the knowledge economy, which was looked upon as higher value, cleaner and more environmentally sound. Just as I got to grips with that concept, it too was pushed aside by the service economy, which itself spawned its little brother: the gig economy. Then along comes Covid-19 which destroys the service and gig sectors overnight.

I understand that in a globalised, interconnected world where people, products, services and money can cross back and forth across borders unimpeded, entire countries need to specialise so they can unleash their limited resources in a specific direction to reap the manual and mental economies of scale required to be competitive.

However, there seems to be a fundamental flaw in this idea. What happens if a country willingly abandons one economic direction for another, only to have the latter snatched away before it has had the opportunity to move on? I guess you are left with little or nothing and some important decisions to make.

How about diversifying across primary, secondary and tertiary economies (so we get to simultaneously think, make and serve) while implementing industry 4.0 techniques to remain globally competitive on a micro or medium scale? It's a plan.

Jon Barrett

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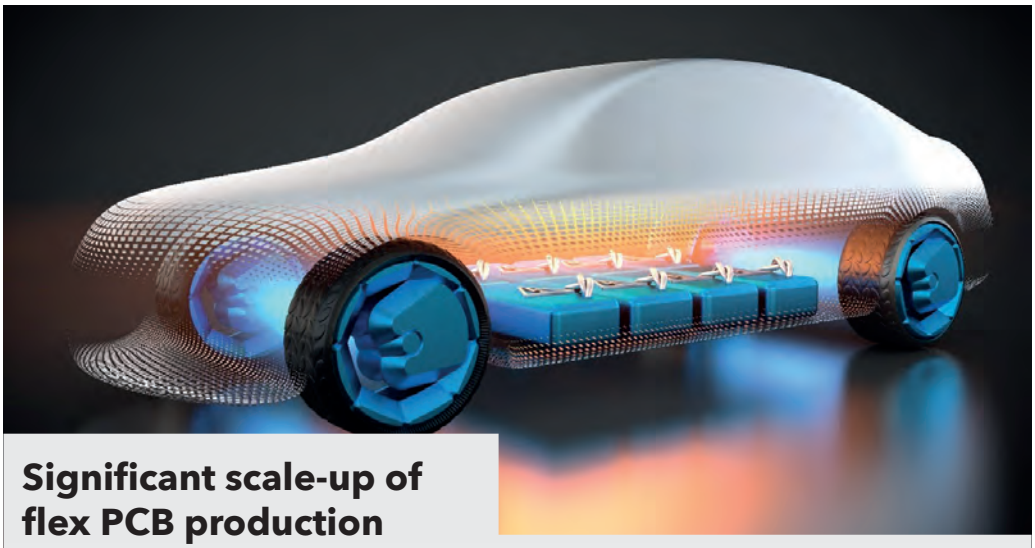
## ES News

### View current editions online

*www.electronics-sourcing.co.uk*



## Significant scale-up of flex PCB production

Trackwise Designs has signed a three-year agreement to manufacture and supply flexible printed circuits to a UK manufacturer of electric vehicles. The agreement is potentially worth up to £38m.

The large quantity and precisely defined cell connections and monitoring locations in battery modules are well-suited to FPCs. Using FPCs in EVs saves part count and assembly time, leading to increased efficiencies during building. They also save space and weight in the final product. FPCs produced using Trackwise' patented Improved Harness Technology can be made to any length.

Trackwise's CEO, Philip Johnston, said: "The UK was the first major economy to set a legally binding target to cut its greenhouse gas emissions to net-zero by 2050. We're delighted to be working with a UK-based EV manufacturer at the forefront of driving the adoption of sustainable technologies and we acknowledge and are grateful to the support of the Faraday Battery Challenge. The selection of Trackwise to help power EVs at scale is a fantastic endorsement of how our technology can help the UK build a robust and reliable domestic supply chain. This in turn will help the government achieve its goal in significantly reducing $CO_2$ emissions.

***www.trackwise.co.uk***

## Growing frequency linecard

Farnell has signed a distribution agreement with ECS, a manufacturer of frequency control and power management products. The products will also be available through Avnet Abacus.

ECS' president of global business development, Kelly Jensen, said: "With Avnet Abacus on board as a distribution partner in EMEA, and the addition of Farnell, the global support that we'll bring to our mutual customers will increase dramatically."

Farnell's, head of product management IP&E, Dave Beck, added: "At Farnell we want to ensure that our customers have access to a broad and relevant range of components for their product development. Adding ECS to our line card enhances our offer in frequency control and power management. ECS's quality products and broad market segment appeal complement our business and we expect to see strong demand from our customer base on these products."

***www.farnell.com***

## E-commerce access to ultra-wideband products

Qorvo's complete line of ultra-wideband products is now available to order on the Mouser website. Products include Impulse Radio UWB technology, which is designed to allow centimetre accuracy distance/location measurement and secure low-power, low-latency data communication in automotive, mobile, industrial and consumer Internet of Things (IoT) applications.

The DW1000 UWB transceiver IC is said to be the world's first single-chip wireless transceiver based on UWB techniques. It lets customers develop cost-effective real-time locating system solutions with precise indoor and outdoor positioning to within 10 cm. Compliant to IEEE802.15.4-2011, the IC supports data transfer at rates up to 6.8 Mbps.

The DWM1000 module integrates the DW1000 IC, an antenna, and power management and clocking components to simplify integration with a variety of microcontrollers. The module supports time-of-flight (ToF) and time-difference-of-arrival (TDoA) location schemes in RTLS and wireless networking applications such as agriculture, building control, factory automation and healthcare.

***eu.mouser.com***


# Differences in North American vs. Japanese Plugs

While the NEMA 5-15 and the Japanese JIS C 8303 cords look alike, there are some critical differences. While the width of the blades appear similar, the Japanese blades are at least 1 mm shorter.

Also, the mains power in America is 125V while in Japan it is 100V. The Alternate Current cycle in North America is 60Hz, and in Japan it is both 50 and 60Hz. If you plug a 50Hz into a 60Hz main and the appliance has a heating element or a motor, that motor could burn out. The difference might also start a fire, or give the end user an electric shock.

Typically Japanese wire sizes range from 0.75 to 2.0 $mm^2$. This translates to AWG sizes 18 to 13 respectively. However, just like North American Hospital-Grade plugs, the Japanese Hospital-Grade plugs also bear a "green dot." Yet unlike NEMA 5-15s, 6-15s, and 6-20s H-G plugs, the C 8303 will not plug into 250V power mains unlike its North American counterparts.

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# N
## ES News

## In Brief

**Expanding transformer production**
SIGA is expanding its Sandy, Bedfordshire factory to handle much higher capacity transformers, formerly manufactured and supplied by Stabilised Transformers in Wolverhampton. Designs for the new transformers include open/enclosed dry transformers/inductors, double/auto wound components and toroidal instrument transformers.
*www.sigatransformers.co.uk*

**£11.5m investment in power manufacturing**
TDK has announced an £11.5m investment to redevelop its TDK-Lambda manufacturing facility in Ilfracombe. Staged over three and a half years, the investment will increase production capacity by 50 per cent. The redevelopment will increase manufacturing space, expand R&D facilities and overhaul/automate end-to-end material flow.
*www.emea.lambda.tdk.com*

**Extended EMEA power network**
Flex Power Modules has announced a new franchise agreement with Richardson RFPD to strengthen the supply and sales support services for its board-mounted DC/DC conversion products for the telecom, data processing, industrial and railway markets. Richardson offers expertise in RF, wireless and IoT applications. Richardson's technical sales team will provide support from prototype to production.
*www.flexpowermodules.com*

**Supporting start-ups**
Arrow Electronics is working with Microsoft for Startups to extend innovative technology to emerging companies in the start-up community. Microsoft for Startups is a program designed to deliver the technology, go-to-market and community benefits needed to catalyse start-up success. The program helps B2B start-ups from more than 140 countries sell their solutions to Microsoft's enterprise customers.
*www.arrow.com*

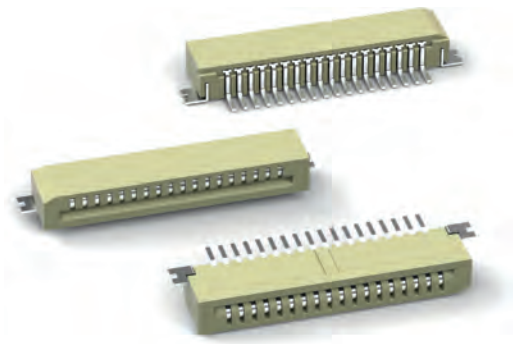
## Memory demand drives semiconductor growth

Building on Q1's bullish growth in weak market conditions, the world's top-10 semiconductor suppliers managed to continue their revenue growth at a rate of 2.4 per cent in Q2 2020. PC and server sales continue to grow driven by Covid lockdown restrictions as working and learning from home are becoming the new norm. Additional revenue growth has been enabled by aggressive inventory strategies by OEMs in anticipation of second half holiday sales.

The total semiconductor market grew by 1.1 per cent sequentially, while, the top-10 chipmakers collectively generated revenue of $65.2billion in the second quarter of 2020.

Senior research analyst at Omdia, Ron Ellwanger, said: "The top-10 semiconductor companies continue to control more of the semiconductor market. They have gained nearly three percentage points share of the total market versus the same time last year. Even more impressive is the six-month growth rate of the top-10 versus the same period last year, up by 12.6 per cent compared to only three per cent for the non top-10."

***omdia.com***



## Secure cable connection

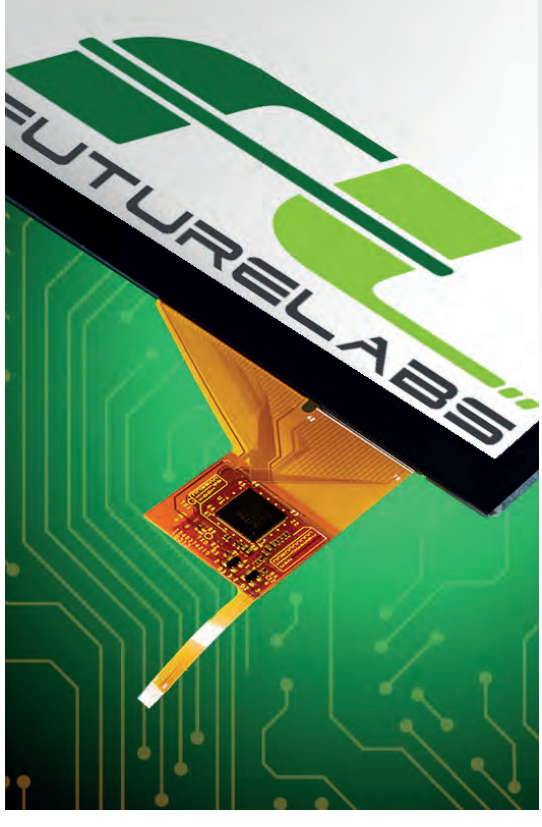
RS Components is now stocking a new range of surface mounted technology, low insertion force connectors from Würth Elektronik. Offering a low profile, lightweight, secure and removable connection, they suit applications such as wearable displays.

The SMT LIF connectors are a wire-to-board solution. Designed for flat flexible cables, they are said to deliver excellent cable retention in small sizes. Their nickel underplating is designed to prevent tin-whiskers. Manufactured from temperature resistant polymer, the connectors are lead-free reflow compatible.

Other features include metal tabs for secure product positioning and phosphor bronze contacts offering good contact resistance, elasticity and low wear.

Specifications include 1mm pitch, 125VAC working voltage and 30mohm contact resistance.

***uk.rs-online.com***




## Tough displays offer many options

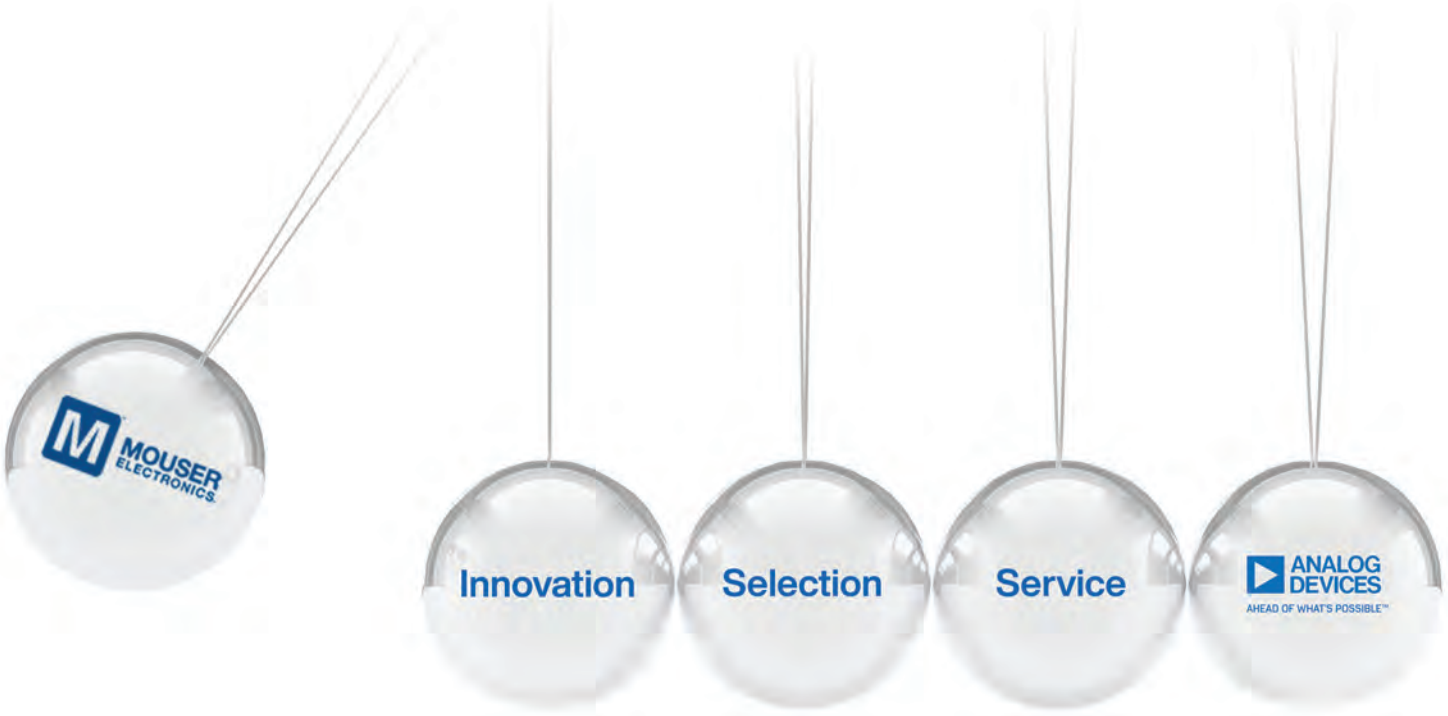
Relec Electronics has announced a range of Futurelabs TFT displays designed for harsh environments. Sized from 3.5 to 17in, the displays can be equipped with PCAP touchscreens and offer an extended operating temperature ranging from -40 to 85°C. In-plane switching technology supports wide viewing angles in a range of lighting conditions indoors and outdoors.

All Futurelabs displays are available with Rocktouch Rugged line PCAP touch panels for noise and water resistance. They are also available with a range of input options including glove touch, operation with water and firmware tuning. Resolution ranges from 640 by 480 RGB pixels to 1280 by 800 RGB pixels. Brightness levels are from 400 to 1000 cd/m².

Displays can be customised with touchscreens, mounting frames, cover lenses, optical bonding, surface treatments and enhancement films.

Applications include factory automation, transportation or public information systems.

***www.relec.co.uk***




# Innovation, selection and service in perfect harmony

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## Real-time connector pricing and inventory

Quoting and supply chain software provider CalcuQuote has partnered with connector and cable supplier PEI-Genesis to provide QuoteCQ users with real-time pricing and inventory information.

In QuoteCQ, PEI-Genesis data will be accessed through an online integration, significantly saving time and simplifying the quoting process.

VP of North American sales and engineered solutions, John Hufnagle, said: "Our strategy of available component inventory and the ability to deliver rapidly is a nice fit for the CalcuQuote model and customer base. This partnership gives our collective customers in the wire harness, cable assembly and EMS business visibility and access to the deepest connector component inventory in the industry."

Digital supply chain integrations in EMS continue to become more critical and a competitive advantage for companies on the front-end of adoption. Not only do these integrations improve speed and efficiency, they also enable organisations to focus resources on more strategic decision-making.

CalcuQuote's VP of operations, Kaitlyn Dotson, added: "Our new integration with PEI-Genesis expands our network of forward-thinking EMS suppliers and further enhances our ability to serve cable and wire harness manufacturers. We're excited to work with PEI-Genesis and bring our mutual customers data faster than ever before."

***www.calcuquote.com***

# Box clever

*Mouser's vice president, EMEA marketing, Graham Maggs explains how state-of-the-art automation is driving efficiency improvements in its warehouses and distribution centre*

**Vice president**, EMEA marketing, **Graham Maggs**

Adoption of start-of-the-art automation boosts efficiency and lowers costs. It also drives more sustainable operations and improved customer satisfaction. Mouser's commitment to investing in new technology in its warehousing and distribution facilities can be seen by the adoption of the I-Pack system. This automated packing/boxing machine can process up to 14 orders a minute, allowing it to deal with incoming orders for electronic components in a faster and more flexible way.

The I-Pack process starts with building the order fulfilment boxes in four standard sizes. The boxes are designed to be exactly the right size, eliminating the shipping of 'air', which saves valuable space on trucks and aeroplanes. Once the operator has chosen the correct box size, the machine performs automatic folding and gluing. Bubble wrap is automatically inserted and the product placed inside. An automatic void measurement and folding process ensures that the products are optimally secured in the box. The machine automatically places the lid and closes the pack, ready for dispatch.

I-Pack delivers several operational advantages. Firstly, it automatically forms cardboard trays quicker than by hand. The automatic void measurement process, which correctly positions components inside the right size box, eliminates the need for hand stuffing packing material, saving more time and reducing 'air' waste. Automated sealing and gluing further streamlines the process.

Regarding sustainability, the process reduces bubble wrap usage by more than 1.5 million square feet each year.

Alongside I-Pack, there are other ways new technology is making a difference. Mouser's 1Mft$^2$ global headquarters and distribution centre in Texas, USA houses the largest installation of Vertical Lift Modules (VLMs) in North America.

VLMs are essentially giant vertical filing cabinets, complete with shelves and an automated elevator, which store tens of thousands of electronic components. VLMs deliver parts directly to the workstation, increasing efficiency and floor space. The machines have been shown to reduce an employee's walking time by 45 per cent or higher. A total of 55 VLMs are installed at the Texas facility, housing up to 120,000 parts. Mouser's 24-hour global distribution centre handles tens of thousands of orders per day, processing and shipping (same day in most cases) to over 630,000 customers in more than 220 countries/territories.

*www.mouser.co.uk*

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# Industry 4.0: manufacturing's supernova

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

*John Denslinger argues Industry 4.0 is a manufacturing supernova on Earth, both for industry and the people enabling its transformation*

Industry 4.0 • By John Denslinger

The fourth industrial revolution was underway long before the pandemic touched every corner of the world. Covid might have limited adoption by those companies at implementation phase, but not among those with ongoing buildouts. Interestingly, had this revolution started earlier, robust digitalisation might have negated much of the Covid impact on manufacturing and their supply chains.

If you're not familiar with the term Industry 4.0 and its competitive implications, perhaps a history lesson is in order. Industry 1.0 applied to the era of initial mechanisation and application of steam power. Industry 2.0 saw the advent of mass production, assembly lines and electrification on a broad scale. Industry 3.0 gave rise to automation, use of computers and electronics replacing mechanics. Then we come to Industry 4.0. It is characterised by a collision of four remarkable technological advances: (1) unabridged connectivity with massive data mining supported by enormous computational power; (2) analytics and artificial intelligence; (3) human-machine interaction; and (4) ascension of concept-to-reality rapid engineering. According to a recently published McKinsey & Company assessment, Industry 4.0 'transforms operations in everything from production efficiency to product customisation with improvements in speed to market, service effectiveness, and new business creation'.

By any measure, this is a manufacturing supernova on Earth. Every aspect of production, procurement and design can be enhanced, if not optimised via digitalisation. That means supplier management, production, resource planning, product design, prototyping, order management, asset utilisation, quality control, employee safety, warehousing, delivery and more. But operations is just one piece. End-to-end also includes markets, customers, suppliers, raw materials, advanced technologies, financials, communication networks, energy management, environmental stewardship and real time feedback loops coupling it all.

Given the sheer size and scope of 4.0 adoption, the financial burden on companies is substantial. Then again, not investing is a likely path to non-competitiveness. There is hope and help though. One only has to look at global, national, state and even large metropolitan frenzies enticing 21st century high-tech companies to their jurisdictions. Governments everywhere are offering generous incentives recognising the significance of a digitally connected world. The accounting firm KPMG identified 17 countries pursuing advanced manufacturing facilities and cited more will follow. Each promotes an array of direct and indirect tax incentives. But study and plan carefully. There is a lot to consider. Just keep in mind, a 4.0 company is extremely attractive and has extraordinary negotiating power.

Finally, 4.0 has another significant player: the US Government. It too is throwing its mighty weight behind the 4.0 movement announcing $1B investment creating 12 hubs dedicated to researching Industry 4.0 technologies. Of specific interest is AI, quantum information systems, and 5G. The idea is to create national R&D centers for these critical industries of the future, as well as stimulate regional economic growth and prepare a next-generation workforce. It appears another $2B is earmarked by 2022 as a steadfast commitment to US future leadership.

When one thinks about the coming age of 4.0 manufacturing, productivity and efficiency improvements seem endless. It truly is manufacturing's supernova not only for our industry but for the many people enabling its transformation.

# Sourcing enclosures for medical electronics

*Medical devices must face punishing working conditions without showing signs of wear. OKW explains how to get the enclosure sourcing right*

Patients don't want to be treated with medical equipment that looks past its prime. They expect it to look spotless all day, every day, no matter how old it is. The enclosures housing these devices must be exemplary: smart, modern, robust and tamperproof. They should also be resilient so they continue to look new for as long as possible.

Unlike 'nine-to-five' office equipment, medical electronics must: withstand the hard knocks of frontline clinical care; be used 24/7/365 by a wide range of clinicians; and be transported from ward to ward. Likewise, it must survive repeated deep cleaning to help medics wage war on infections.

The wide array of different healthcare applications creates a range of challenges for manufacturers.
For electronic enclosures specialist OKW, that means regularly adding new models to its range. Every model is designed to offer a degree of specialism, while being versatile enough to adapt to each OEM's requirements.

Housing can be customised to help manufacturers maintain differentiation.

OKW's marketing director, Robert Cox, said: "Standard enclosures no longer look 'standard'. They all look as if they've been purpose-designed. And that's in their off-the-shelf state, before we've customised them.

"Customising a standard enclosure is a great way for medical device OEMs to help keep costs down and lead times short."

Simple design touches can make a big difference. For example, OKW's new Easytec sensor enclosures feature a concave recess and smart lugs at each end, making it quick and easy to cable-tie them to hospital bed rails or screw them to walls.

Easytec shares the same soft contours as OKW's Evotec tabletop (and wall mounted/DIN rail) enclosures. Evotec offers options including flat/sloping top, recessed/un-recessed and five plan sizes after the addition of size 80.

Continuing with the desktop/wall enclosure theme, the company's new Protec enclosure is available in three versions, offering a recessed interface area, covered recess or extra deep cover.

Modern ergonomic contours also feature in Connect enclosures for wired remote controls or lines of USB connectors. Accessories include a bed rail holding clamp and robust cable glands with kink protection and integrated strain relief.

Comfort is never more important than for wearable electronics. Not just in terms of shape but also material choice. Body-Case watch-style enclosures are moulded from high-gloss, easy-to-clean ASA for a smooth feel, smart aesthetics and UV stability. Body-Case's two case sections are separated by a soft-touch matt TPV sealing ring that adds IP65 ingress protection and a dash of colour.

Sealing rings helped OKW win an iF Product Design Award for its Minitec personal electronic enclosures. Different rings enable Minitec to be fitted to belts, straps, lanyards, key rings or carried loose. Add the choice of shapes, sizes, colours and recess options and the number of standard permutations is huge.

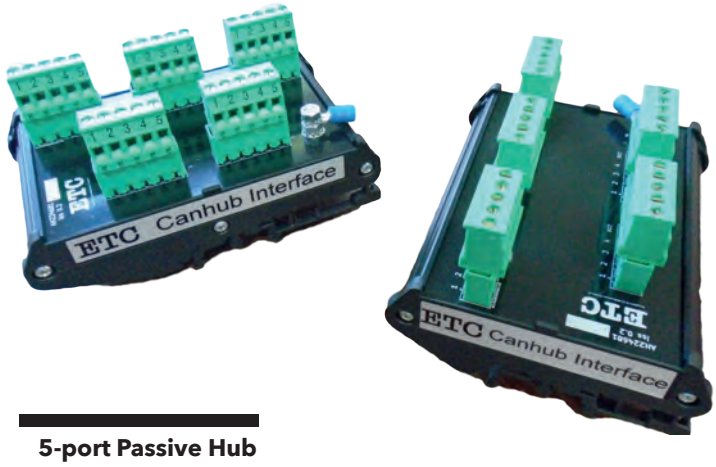
Handheld enclosures become even more specialised with the eccentric, double award-winning Blob range. These unique housings are designed to intuitively guide users' hands to the controls: perfect for patients with restricted grip or learning difficulties.

Regarding larger portable instrumentation, Carrytec provides a tough attaché style case. It can be stored on a docking station for charging/data transfer or clipped to a hospital bed rail.

*www.okw.co.uk*

Easytec sensor enclosures can be mounted using cable ties or screw


Connect enclosures suit wired pendant-type medical devices




5-port Passive Hub

# Making manufacturers more efficient

*Hitaltech explains how a chance meeting helped a customer reduce hassle, labour, storage and costs*

In 2016, Energy Technology and Control's manufacturing and supply chain manager, Julian Newton-Turner, met Hitaltech at Southern Manufacturing. Julian was looking for pad printed connectors for the company's burner safety controls.

Julian explained: "We were buying in connectors, sorting them and sending them to a local pad print company, 1,000 a time per different type. On their return we held them in stock but minimum runs went to 5,000 total pieces. We use 23 different connectors. For a business that runs lean, that was an awful lot of stock to be carrying."

Switching was not simple as ETC's CE and UL approved controls required approved connectors.

Julian continued: "Hitaltech explained they had approved connectors and could pad print. They keep them in stock and can restock us quickly, which makes us more responsive. I was paying £2 per connector and 25p for printing. Now I get the printed connector at less than the previous cost of the connector alone. When you get through a couple of thousand a year for most lines, and have 20-plus lines, that soon adds up."

Julian estimated the switch saved ETC up to £10k per year in pad printing alone, but the switch to Hitaltech did more than cut costs.

Julian concluded: "Our partnership with Hitaltech fits the way we work and enables us to run lean, meet our supply chain commitments and avoid the hassle and inefficiency of carrying large stocks. When the connectors arrive, we just use them. I don't need to think about anything else or pay a premium for short order parts."

ETC's relationship with Hitaltech also includes enclosures, with the supplier involved in the development of a new product, including the customisation and printing of the enclosure.

*hitaltech.co.uk*

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## SMART SENSOR CSS 014.

STEGOs new Smart Sensor is a plug-in solution for Condition Monitoring. The CSS 014 detects ambient temperature and humidity in switch panels. Thus lifting climatisation in enclosures to the next level: Predictive maintenance and remote monitoring allow for immediate response to unwanted and harmful changes in your application. See for yourself.

Also available with IO-Link interface

**NEW:** SMART SENSOR CSS 014

WWW.STEGO.CO.UK

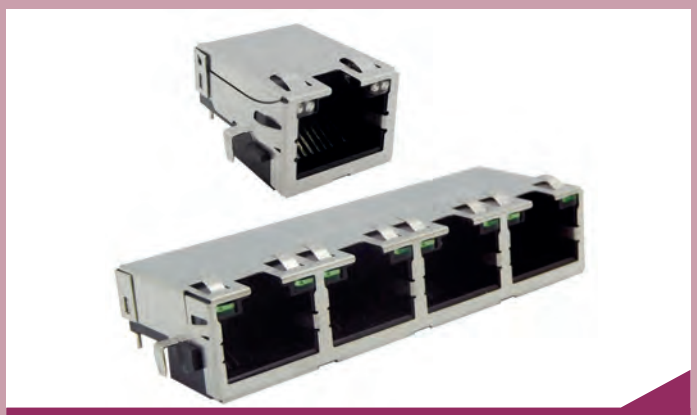
## Cable assemblies support mixed technology connectors

Harwin is expanding its services for Gecko-MT high-reliability connectors. A new on-demand cable assembly service helps customers avoid in-house tooling costs and training/inspection overheads. Via this service, Harwin can assist with prototyping, pre-production runs and full volume production.

Options include male and female or loose cut ends, with both standard and reverse-fix screw-lok fixings supported. Hundreds of possibilities are covered via 24 different termination combinations, two signal wire sizes and cable lengths up to 10m. Back-potting also provides supplementary strain-relief.

In addition to the full cable assemblies, customers can order pre-wired Gecko-MT contacts. This means customers can undertake assembly after the crimping has been done for them. For power, single-ended and double-ended male, plus female and male-to-female contact formats are available. Cable lengths of 150mm and 450mm (white) are stocked directly, while 300mm and other lengths, including red cable options, can be supplied on short lead times. Pre-wired signal contacts are also available.

***www.harwin.com***



## Straddling connectors save space

Stewart Connector has introduced a new series of low-profile mid-plane RJ45 connectors. The design lets the connector straddle the board edge and utilise space above and below the PCB compared to traditional RJ45 connectors that are only designed to mount above the board.

Equipment designers will gain space in applications where the RJ45 would typically be the tallest component on their PCB, reducing their product's height by up to 25 per cent. The connectors suit applications including servers/switches, video games and portable storage devices.

The connectors support 1/2.5G data rates and 100MHz transmission frequencies. They are available in 1 by 1 and 1 by 4 configurations. Other features include Yellow / Green and bi-colour LEDs, 0.085 and 0.125in tail lengths and EMI shielding.

***belfuse.com/stewart-connector***

## Introducing a discrete wire system

RS Components' Samtec's Tiger Eye discrete wire system with a 1.27mm pitch suits rugged applications requiring reliability and mating cycles.

Tiger Eye is a multi-finger, heat-treated, beryllium copper contact designed for rugged environments. The mating surface is on the flat, smooth side of each finger, providing lower contact resistance and longer plating life. In addition, the spring properties of BeCu make it ideal for high mating cycle applications. The 1.27mm system passes the 10-year (mixed flowing gas) MFG test for up to 1,000 mating cycles.

The system is available as components or assemblies with a choice of PVC or Teflon cable, in 28 and 30 AWG. The TFM and SFM series are mated socket and terminal sets available in vertical, right-angle and horizontal orientations in a variety of stack heights with through-hole or SMT terminations. To avoid mismatch the connectors are polarised single and double row and keyed. The shrouded body aids blind mating. Screw down, locking clip, friction latching and weld tab ruggedising options are also available.

***uk.rs-online.com***

## High-power pin and socket portfolio suits high current data comms

TE Connectivity has unveiled a new high-power pin and socket product portfolio, addressing high current rating demands from high-speed board-to-board and board-to-busbar data communication applications. The new portfolio currently includes Iccon Block and Iccon Insert connectors. These products suit applications up to 350A.

To ease installation, an optional floating feature allows +/- 1mm radial misalignment when mating two PCBs or busbars. Standard pin sizes support 30A to 350A. Customisable stack height are offered via different power pin lengths.

Product manager at TE's Data and Devices business unit, Lily Zhang, said: "Products with robust design and high-power capacity are commonly needed for high-speed data communication applications, such as servers, switches and storage. These applications' board-to-board and board-to-busbar connection normally cannot be fully realised through other solutions like cable assemblies due to limited space and high-power density request."

***www.te.com***

## Expanding board-to-board battery connector offering

AVX has extended its board-to-board battery connectors. The 9155-250 Series connectors feature: 3.6mm high halogen-free, high-temperature, UL94 V-0 nylon insulators; 4.5mm nominal working heights; two to five gold-plated beryllium copper contacts rated 3A each on a 2.5mm pitch; pure-tin-over-nickel PCB tails; and large SMT mounting areas for positive mechanical attachment.

They are end-to-end stackable for broad configuration and application suitability and packaged on tape and reel for automated processing. Applications include handheld and portable devices that require docking or cradle charging, such as medical monitoring equipment, disposable cartridges and industrial programming modules.

AVX product marketing manager, Ara Zadoorian, said: "Our new 9155-250 Series reduced-height and pitch battery connectors further expand the characteristics and capabilities of our 9155 Series, enabling even broader application suitability and, like the rest of the family can also be customised to suit unique, application-specific requirements."

The connectors are rated for 3A per contact, 125VAC, 5,000-cycle durability in operating temperatures extending from -40 to 125°C. Standard lead-time is nine weeks.

***www.avx.com***

## Simple assembly thanks to tool-free assembly

Harting has launched the latest generation RJ Industrial field termination RJ45 connectors. The MultiFeature series is designed to meet the needs of customers seeking even easier field installation. The connectors are characterised by easy tool-free assembly and a robust metal housing. The highlight of the design are integrated blades which shorten the individual strands to the correct length when closing the connector: a built-in side cutter. This eliminates this time-consuming step, making assembly over 25 per cent faster.

While the classic RJ45 was a telecommunications development, the RJ Industrial MultiFeature is designed to cope with the requirements and challenges of a hard-operating environment. Specifications include Cat 6A performance, IP20 and IP65/67 housing and PoE IEEE802.3af/at/bt.

The design suits flexible and solid wires from AWG 26 to 22, while robust cable fastening and angled connectors with variable cable outlet direction are further features.

***www.harting.com***

# A connector for everyone

*PEI-Genesis' European operations manager, Mark Bailie, walks readers through its Southampton facility, exploring automation's role along the way*

Connectors make up the ends of everything from HDMI and USB cables to advanced medical, aerospace and military-spec cables, such as the standard 38999 system developed in the '70s.

A typical cylindrical connector assembly comprises four elements: shell, insert, contacts and accessories. The shell forms the outer cover that adds strength and houses the other components. Inside this sits the insert, an inner neoprene rubber core that holds the contacts.

This complexity means assembly isn't easy to automate. Walking through our factory it's easy to forget that, in recent years, this process would have been manually intensive, with operators carefully assembling components by hand.

Before automation, operators would sit at fixed stations and carry out the various assembly processes including gluing, pressing, visual inspection, loading contacts, applying identification marking, oven curing, final assembly and packaging. Today, connectors are assembled using a highly automated Kanban process, starting with the manufacturing resource planning (MRP) system. Components are vertically stored in zones, with the most frequently ordered components situated in a zone closest to the assembly line. The picking team then places the latest orders at the start of the assembly process.

From here, the product travels through the different assembly stages where the contacts, inserts, video marking and curing all make use of automated machines to speed up the process while maintaining high levels of accuracy and efficiency.

Beyond this, the finished connector undergoes quality checking, accessories and protective fittings are added, and the product is bagged and packaged before dispatch.

Some $90m of global inventory including top global brands in the connector industry such as Amphenol, ITT Cannon, CINCH, SOURIAU, and TE Connectivity brands DEUTSCH, Raychem and Polamco, is held in component form. So, rather than hold finished products that may become obsolete, we can build millions of combinations of connectors using these parts.

*www.peigenesis.com*

> **Walking through our factory it's easy to forget that, in recent years, this process would have been manually intensive**

**PEI-Genesis'** European operations manager, **Mark Bailie**

## High current in tough environments

To meet demand for high current handling and reliability in high shock and vibration environments, NYKCS has launched the Zeus range of power connectors which feature IEH hyperboloid contact technology and the MIL-DTL-38999 Series III architecture. Filtered power contacts are available.

For applications where standard Zeus power connectors are not sufficient, inserts can be designed to suit customer specifications with current handling up to 260ADC.

NYKCS can provide a complete interconnect solution including the connector, backshell and accessories such as protective caps and lanyards. The company also offers high power cabling solutions provided by partner Habia.

***www.nykcs.com***

## Knurled nut improves cabling safety

M23 Hybrid series device connectors from Phoenix Contact are now also available with a knurled nut. This enables devices such as servo drives to be connected using either coupler or cable connectors. Inputs and outputs can therefore be clearly distinguished, visually and mechanically. This increases cabling safety, especially in daisy chain applications.

The hybrid connectors with pin or socket contacts enable the transmission of signals, data, and power in a single connector. A CAT5 data interface or four additional signal contacts are available. The connectors suit currents up to 30A and voltages up to 630VAC or 850VDC.

***www.phoenixcontact.co.uk***

## M12 connectors suit AC and DC applications

Binder's new S and T-coded power connectors suit power transmission. The two types are designed per DIN EN 610276-2-111 for applications such as motors and drives and supplying power to AC and DC consumers.

S-coded connectors in Binder's 814 series were developed for AC supplies up to 630VAC. They have a PE lead and can transmit, in the two or three-phase version, power of up to 7.5kW. 814 series connectors suit AC motors and drives, motor load switches and frequency converters.

T-coded connectors in Binder's 813 series are intended for DC voltages up to 63VDC at 12A. They suit fieldbus or Ethernet applications such as Profinet. These connectors can supply DC motors and drives or other power-hungry components with up to 750W.

Series 813 connectors have four gold-plated contacts, while the series 814 plugs have two and three gold-plated contacts and one pre-mating PE contact.

***www.binder-connector.co.uk***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**www.harting.com/UK/en-gb/single-pair-ethernet**

# Component carriers reduce costs

*Harting explains how its component carrier technology simplifies manufacturing processes and reduces costs*

By employing Harting's new component carrier technology, components can be fitted directly onto the carrier, replacing flexible circuit boards. The carrier acts as a connection between the PCB and components such as LEDs, ICs, photodiodes and sensors.

Component carriers are constructed using laser direct structuring (LDS), which applies conductor paths directly onto plastic parts. The body is injection moulded and additives in the material are activated by the laser, making the material an electrical conductor. It can then be assembled using standard surface mount processes.

Electronic assemblies can be made in flexible, complex geometric designs. Products such as smart phones, hearing aids and smart watches can become smaller and more powerful. LDS also enables 3D-MID (mechatronic integrated devices) assemblies, meaning components can be mounted onto a three-dimensional base body without a circuit board or cable.

Carriers can be equipped with several sensors to take measurements in three axes, with parts fitted on two parallel surfaces and the end face. As a stable, reliable process, it is established in quality-critical sectors such as medical and for safety-relevant automotive components.

Another recent application for LDS is security covers for payment terminals. The 3D-MID covers protect internal components from unauthorised mechanical and electronic access, increasing the security of transactions and preventing theft.

In addition to flexibility and simplified installation, component carriers can also cut costs by two-thirds. The automated production process eliminates many of the complex handling processes associated with flexible printed circuit boards such as populating, gluing and assembling. Benefits even apply in small volumes, as the carrier can be used for different applications without adaptation, eliminating the costs of a new injection mould. Compared with flexible printed circuit boards, the process achieves more precise component positioning, greater repeatability and better quality.

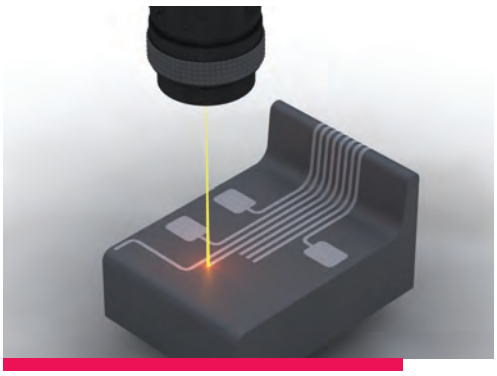
Populated carriers are delivered in tape and reel. Two different sizes are currently available, accommodating components of SOIC-8 and smaller. Carriers can be manufactured to customer-specific sizes.

Timeframes for delivering finished components is reduced because the customer only needs to supply specifications for placement of the components. Harting takes these specifications and creates a production-optimised layout proposal. Once the customer has approved the product, and components are received, initial production samples can be dispatched within two to three-weeks.

Harting is offering a complete value chain for 3D-MID technologies from a single source, including development of customer-specific products, injection moulding, laser direct structuring, metallisation, assembly/connection technology and final inspection.

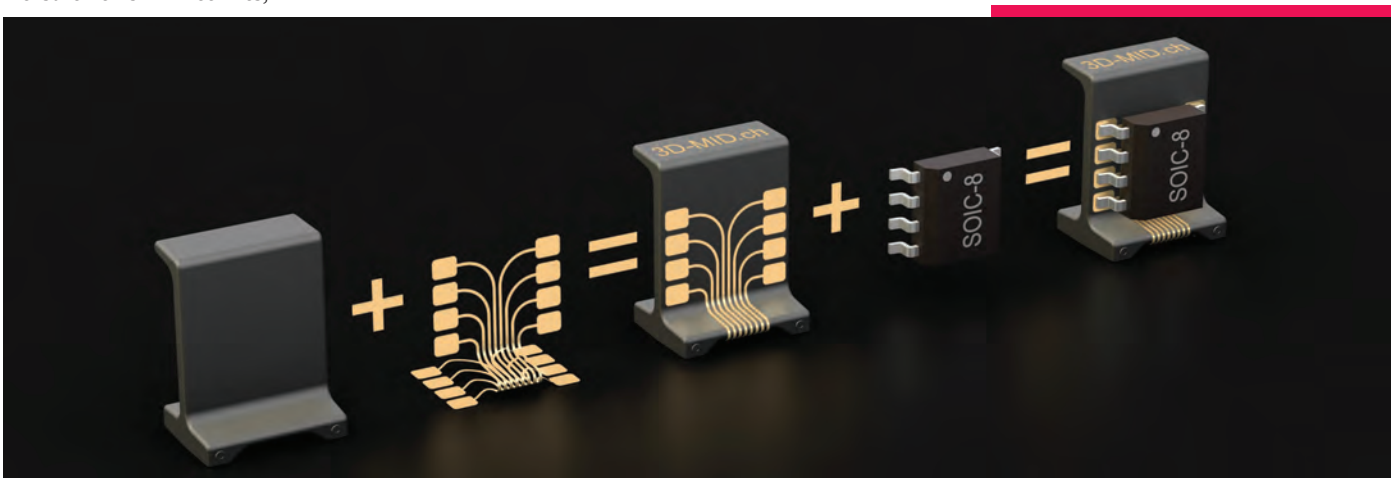
*www.harting.com*

**The carrier acts as a connection between the PCB and components**



Laser Direct Structuring (LDS) applies electronic conductor paths directly onto plastic parts

Electronic components are mounted directly onto the new component carrier



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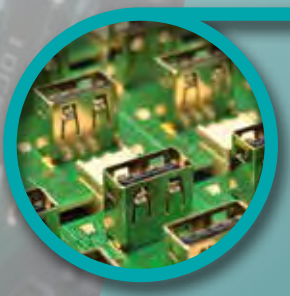

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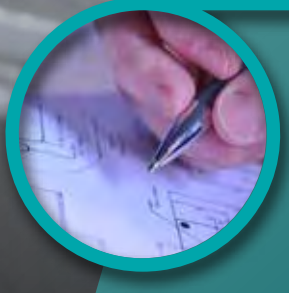

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# Quality comes from training

*Advanced Rework Technology believes there is no better way for a manufacturer to prove its dedication to quality than with industry recognised training*

The IPC exists to help the electronics industry create better quality products, enhance knowledge and boost skills, while reducing costs and waste. The organisation collaborates with industry leaders to develop standards that improve quality, reliability and supply chain communication. Standards are associated with nearly every stage of the product development cycle from design through to end product acceptance. Advanced Rework Technology is proud that many of its trainers work on Standards Development Committees. This ensures they have regular input and are up to date with requirements and changes that effect training programmes and the industry.

A recent IPC case study found that poor quality was an expensive habit for a high reliability product manufacturer as its scrap level was costly. This company turned to IPC training programmes to help control its processes.

*Certified Interconnect Design and Enhanced Design.* This programme provides objective evaluation of core competencies in PCB design, based on industry standards. Courses enhance and assess technical knowledge: how to transform an electrical circuit description into a PCB design which can be manufactured, assembled and tested. The enhanced modules cover key goals beyond the CID level.

*IPC 6012 Qualification & Performance Requirements for the Fabrication of Rigid Boards.* This standard established and defines the requirements of the rigid board providing companies all the information they need to increase skills and performance. Updated to revision E.

*IPC-A-600 Acceptability of (Bare) Printed Boards.* This is an industry consensus standard providing information, photographs and illustrations for acceptable and nonconforming conditions that are either internally or externally observable on the bare printed circuit board. Updated to revision K.

*IPC-A-610 Acceptability of Electronics Assemblies.* This is the most widely used standard published by IPC covering industry accepted criteria reflecting accept/defect conditions of the completed assembly. Revision H soon to be published.

*IPC-A-620 Requirements & Acceptance for Cable & Wire Harness Assemblies.* This standard shows acceptable and defect conditions aided by colour visuals and illustrations. An associated certified hands-on module focusses on process tooling and inspection by following drawing and data sheets to build a finished assembly. For the aerospace industry the *620 Space Application Addendum* ensures the product meets vibration and thermal cyclic environments. Updated to revision D.

*IPC 7711/7721 Rework, Modification and Repair of Electronic Assemblies.* This programme teaches industry developed techniques on through hole, SMD rework and land, conductor and laminate rework and repair. Updated to revision C.

IPC J-STD-001 Requirements for Soldered Electrical and Electronic Assemblies. This programme covers materials, processes and manufacturing of assemblies which is hands-on in nature to increase skills and performance. *Space and Military Addendum* available. Revision H soon to be published.

*rework.co.uk*

# In a time of crises, flexibility is key

*Incap Electronics shares guidance on facing Covid-19 challenges and the lessons learned*

The Covid19 crisis has emphasised the importance of production planning, client communication and maintaining team spirit. Managing director of Incap Electronics UK and Slovakia, Jamie Maughan, suggests that while some people can work from home, people cannot take a production line or test machine with them. So, what is the solution?

While the crisis brought more sick-leave, materials delays and customers scheduling orders, Incap's team created a plan with the emphasis on production flexibility.

Maughan explained: "Our main goal as an agile, flexible and efficient company, has always been providing a fast service depending on changes in the market. Therefore, we see a strength in adjusting our production capacities as necessary, according to varying quantities and varying product mixture.

"We did a thorough mapping of our business and production and definitely suggest this to all other businesses as well: even without the crisis. This has allowed us to first solve urgent problems related to our stakeholders or technology while also concentrating on necessary precautions in production and offices, and keeping our stakeholders informed about our activities and plans.

"This emphasises the importance of always planning the next steps and scenarios, regarding how to restore the company's operations to the same extent as before the crisis while also preparing the company for 'new normality'. Make sure not to forget your team. The real value and best ideas for necessary flexibility comes from planning with the team."

*www.incapcorp.com*

**Jamie Maughan**, managing director, **Incap Electronics UK and Slovakia**

# Customer service: communicate, action, deliver

*DVR's sales director, Tony O'Brien explores contract electronics manufacturing partnerships based on quality, delivery and cost*

For most CEMs it's not how products are made, it's ensuring products fulfil the customer's expectations in many ways. Quality and delivery are key. Indeed, most customers often choose a new supplier for quality, delivery and cost. After sales is often the poor relation as the focus is on production: supplying the customer.

Things can go wrong and it is how we respond to customers and how they perceive we care that is critical. Providing the right tools and customer service puts any organisation in the spotlight. Business is won or lost based on how much a company values its customers.

Firstly, the returns process. If a customer highlights a problem, be proactive and have the product returned with as little fuss as possible. Offering to collect and provide a returns material authorisation (RMA) is essential. The customer is confident their products will be attended to professionally and carefully: indispensable for future business. The returns policy should be detailed and measured via key performance indicators (KPIs). Set a target, typically five-days, to have the products returned to the customer. Inform and communicate. Do not leave a void where expectation is not realised.

Delivery and handling are crucial. It is important to have a packing process that guarantees the hard work is not wasted or delivery compromised due

**DVR's** sales director, **Tony O'Brien**

to unnecessary damage of goods. Ask the customer how they want their goods supplied. Make it a key part of the manufacturing process, document it, implement it, do not leave it to chance.

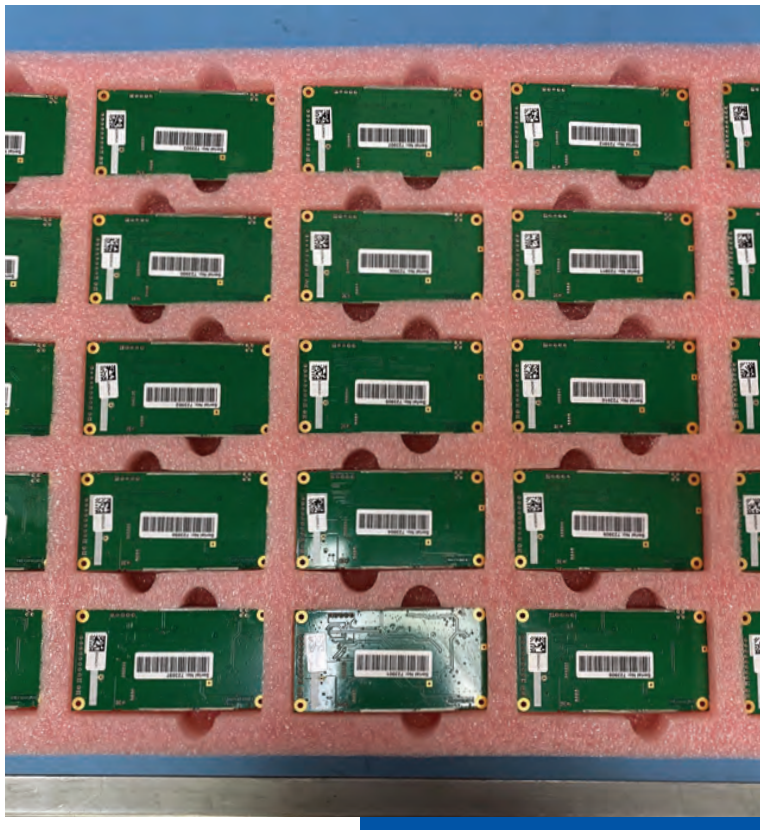
Where possible offer returnable packaging agreed between the customer and manufacturer. This may initially appear expensive but the payback is considerable. Consider key elements of the product at this stage and design the packing to accommodate possible vulnerable areas of the assembly. This alleviates potential for damage during transit or handling. Consider containers that align with Kanban production. There is no point supplying more than can be handled through production or stored.

Kanban is a great tool for managing supplied stock where, from the outset, a quantity of product is agreed and supplied. This can be bar coded by the supplier, delivered to the customer's premisses and recorded on delivery. The supplier can then monitor usage at the customer's site and provide continued supply to keep stock at an agreed level. Many customers find this system invaluable and is something that should be considered essential for long running projects.

Where possible provide your own transport service. This helps reduce the likelihood of damage and deliveries going astray.

Good customer service is key: communicate, action and deliver.

*www.dvr-ltd.co.uk*



Example of bespoke packaging

# X-ray underpins production and trouble shooting

*Buyers looking for a quality focused CEM will note Axiom Manufacturing Services' investment in x-ray inspection and allied training*

X-ray inspection machines offer benefits to CEMs and OEMs in quality control and troubleshooting applications. However, the most powerful machines are complex, advanced-technology devices, so users need training and support to optimise day-to-day performance.

This aspect is well-recognised by Newport-based CEM Axiom Manufacturing Services, which emphasises the 'human factor'. The company's people-based approach to its workforce, customers and suppliers has facilitated growth reaching £50.1m in 2019.

Axiom works with suppliers who share its ideals, as this lets them absorb and obtain competitive advantages from advanced-technology machines like x-ray inspection equipment.

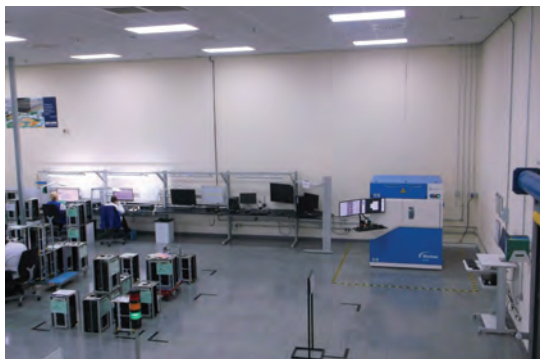
The company recently demonstrated this strategy while upgrading its x-ray inspection facility. Cupio, a supplier of inspection, production and test solutions, was invited to discuss an x-ray inspection upgrade. Firstly, Cupio reviewed Axiom's existing machine, providing insight into its full potential. Accordingly, it remains in service, with improved benefits for Axiom.

Cupio then showed how the Nordson Dage Quadra 7 X-ray inspection and failure analysis machine's advanced technology would enhance both its production and troubleshooting activities.

Along with the Quadra 7's 100nm resolution and 4k image quality, it suits higher-volume production because of its throughput. Programmable with automated routines, it accepts up to five boards simultaneously. This parallel processing is valuable where 50,000 boards/month throughput is typical, with batch sampling rates of 20 to 30 boards.

Axiom regards Cupio's ongoing training as crucial to its x-ray inspection success. The programme has covered SMT inspection, BGA, QFN and voiding measurements for customers, and through-hole fill measuring. It will also include Quadra 7's X-Plane CT functionality and $\mu$CT, encompassing 3D plus 2D imaging.

*www.cupio.co.uk*



# Digital intelligence: a gamechanger

*Rebound Electronics' Raj Keshvara, introduces a digital intelligence partnership designed to help its customers meet key challenges*

The pandemic has added to the challenges faced by Original Equipment Manufacturers and Electronics Manufacturing Service providers.

Many are experiencing a change to service levels, price increases, lead time fluctuations and stock volatility. Rebound have, and will continue to support our customers, regardless of their journey through these unprecedented times. Our focus remains to continue to utilise our global footprint and our expertise in order to provide a competitive, robust service to our customers.

We have a strategy in place to monitor ever changing worldwide manufacturer behaviours, and where relevant, feed this back to our customers.

Technology advances present new demands and in turn, new product ranges. This can result in the obsolescence of legacy products. In addition we witness manufacturer acquisitions, which contributes greatly to an increase in obsolescence.

For the reasons already detailed, life-cycle management plays an important role in managing the demands of a business without turbulence. Life-cycle management starts with design, moves through NPI and volume production and concludes with end-of-life management.

OEMs and EMS companies, by their nature, have different business models. OEMs design and manufacture multiple products for their company, therefore component usage tends to be narrower. Having both product development and design ownership means OEMs have greater visibility of their products therefore more control of their BoM.

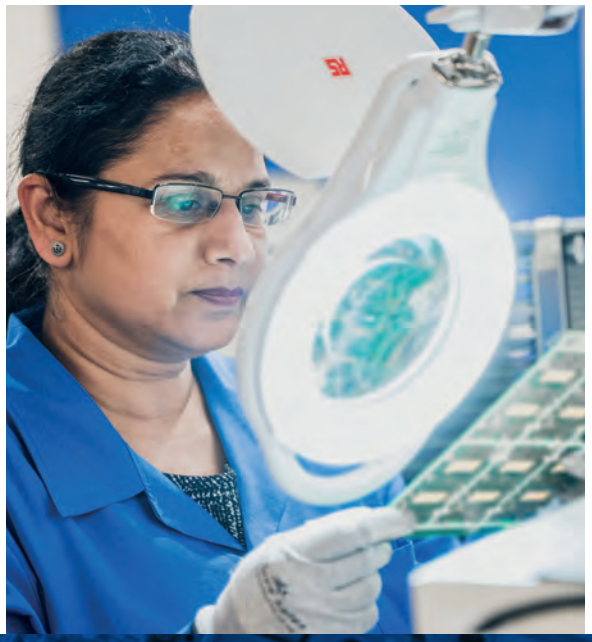
By contrast, EMS companies are focused on manufacturing. Some also offer design capability and services such as outbound logistics, spares and repairs. The emphasis on manufacturing on behalf of many customers, results in a more varied component reach. Not owning product development and design can result in less visibility and control over the BoM.

As a world class sourcing company, Rebound Electronics have developed IT systems, databases, tools, processes and other capabilities to address these critical areas of the supply chain. This has been done while recognising the different business models of OEMs and EMS companies, ultimately creating bespoke solutions to best match individual needs.

Rebound's recent announcement of a strategic partnership with IHS Markit is an example of this collaboration. Rebound and IHS Markit are bringing together their different core competencies to create new solutions that will benefit customers. This can include greater visibility with information and insights into the components they are using or plan to use. Increasing digital intelligence will become a game changer for OEMs and EMS companies.

*www.reboundeu.com*

**Rebound Electronics'** Sales Director of the Americas, Nordic Baltic & UK, **Raj Keshvara**



# Driving production costs out of your manufacturing

*In this article, M-TEK's Frederick Kayrouz discusses the cost saving opportunities of outsourcing to a CEM partner compared with tooling-up for a manufacturing project inhouse*

Product manufacturing can be divided into three phases: front-end, manufacturing and back-end services. Pre-manufacturing front-end services encompass design, product development, new product introduction and supply chain management activities. Actual manufacturing services include assembly and fabrication, plus test, quality assurance and documentation. Post-manufacturing services encompass failure analysis, repairs and logistics. It is common for larger CEMs to include front/back-end services which carry better margins compared to manufacturing only. They also offer an essential link between design, manufacturing and support, thus contributing their expertise and knowledge to design activity to ensure high first batch yield and cost-effective tooling at the prototyping stage, while addressing product support challenges.

By engaging a CEM to support front and back-end services, an OEM can benefit from their partner's manufacturing expertise and its physical manufacturing capabilities. This helps meet critical customer requirements (CCRs) through the proper deployment of investment, tools and activities to close any infrastructure, knowledge and information gaps.

This highlights the value of using a CEM and the potential savings to an OEM resulting from offsetting the direct and indirect manufacturing costs involved with the true baseline cost of the manufacturing quality programmes required to meet the OEM CCR's.

*Continue on p38 »*

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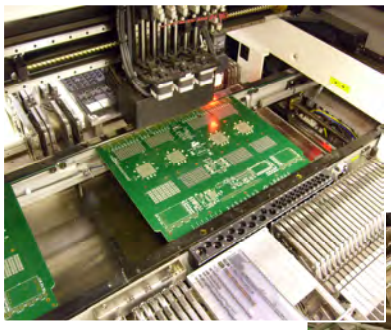


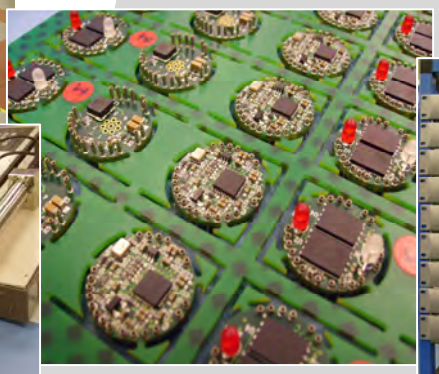

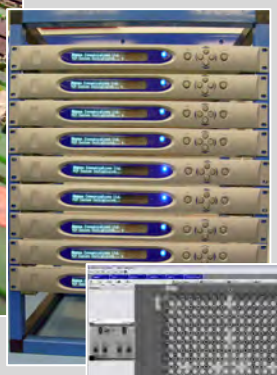

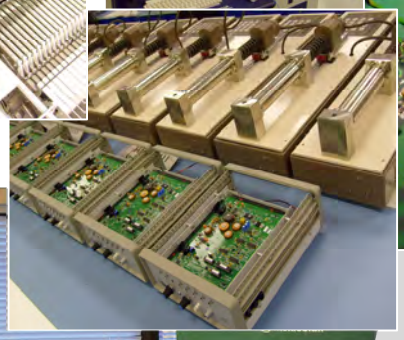


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» Direct and indirect manufacturing cost is offset to the partner CEM who will assess the number of resources required and apportion them appropriately as in-house variables whilst the OEM will benefit from the CEM fixed cost.

A fixed cost is the favoured strategy of traditional accounting principles. However, there is a legitimate argument for challenging the quoted 'fixed cost' as it includes the actual cost to service the OEM, plus the internal costs incurred by the CEM, plus a mark-up. This can be overcome by including the partner CEM early in a manufacturing project and involving them through the design, layout, procurement and manufacturing stages.

Whether the OEM wants to meet its critical requirements regarding manufacturing expertise and capabilities or understand how a quote is formulated, it is essential to understand the costs incumbent to the partner CEM are usually broken down by true production costs, plus those of meeting the programme critical requirements such as the cost of prevention, appraisal and warranty.

Although it may be arguable for an OEM to be in direct control of these costs and risks via the various facilitating leasing options some production equipment manufacturers are willing to offer, it is essential for an OEM not to discount the true costs of such an implementation by looking into the various costs of new equipment selection including: its introduction to the factory; requirement for additional factory space; siting the equipment and ensuring services are available; operating the equipment and associated maintenance costs; environmental conditions monitoring to maintain constant manufacturing environmental conditions; acquiring and maintaining new certifications; and training existing and new staff.

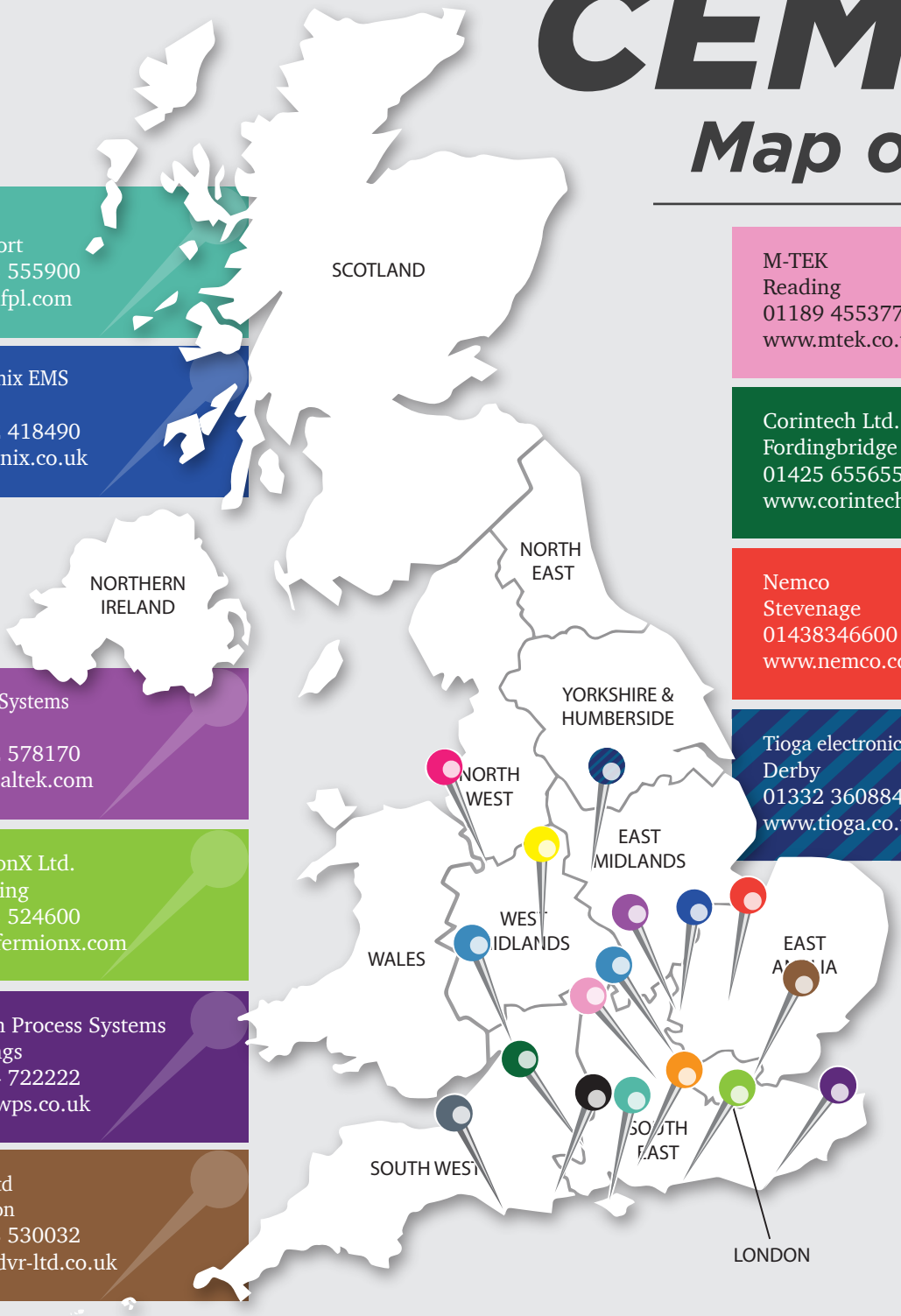
There have been cases where OEMs have invested in their own production lines in the eventuality of niche products where tooling cost might have been prohibitive for business start-up and future sustainability and expansion. However, others have followed in similar footsteps with more generic products and failed to realise that embarking on an outsource strategy to a partner CEM would have allowed them to focus on growth while retaining agility and flexibility allowing them to get the right product to market at the right price and on time.

Even OEMs with specific products outsource the more generic module assemblies as they realise they can benefit from what a partner CEM can offer in addition to its technical manufacturing capabilities and expertise, removing internal constraints or stress and strain on other areas of the business. Additional value inherited from a partner CEM includes: competitive global procurement capabilities with open book policy; stocked components and buffer stock strategies to meet rapid ramp-up demands; and a trialled and tested logistics capabilities which can add as an extension to the OEM's capabilities when necessary.

*www.mtek.co.uk*

**There is a legitimate argument for challenging the quoted 'fixed cost' as it includes the actual cost to service the OEM, plus the internal costs incurred by the CEM, plus a mark-up**

# CEM
## Map of UK

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01753 746700
www.speedboard.co.uk

Ultra CEMS
Weymouth
01305 767100
07584 315992
ultra.group/cems

Phoenix Systems
Fareham
08456 586111
www.phoenixsystemsuk.com

Electronic Technicians Ltd
Wimborne
01202897722
etluk.co.uk

Tate Circuit Industries
Lichfield
01543 622435
www.tatecircuits.com

# Lithium-ion batteries to engulf market

*Transparency Market Research suggests bills-of-materials will increasingly be including cloud-based battery management systems as lithium-ion captures the renewables market*

Cloud-based monitoring of battery management systems lets users monitor battery data and present information on state-of-charge and state-of-health. They also identify potential battery failures at various stages of operation, plus long-term tracking of cell aging. The growing popularity of such systems is driving transformational changes in the battery landscape.

For instance, in July 2019, Bosch announced cloud-based swarm intelligence services to extend the service life of electric vehicle batteries by supplementing individual vehicles' battery management systems. Smart software functions in the cloud continually analyse battery status and take appropriate actions to prevent or slow down cell aging.

With the onset of electric-powered drivetrains, the future of e-mobility is inclining towards substantial demand for lithium-ion batteries. Battery management systems have become an integral part of lithium-ion batteries, accounting for 40 per cent revenue share of the battery management system market. The sales potential of lithium-ion battery management systems will remain instrumental in shaping the energy storage revolution.

Renesas Electronics has announced its fourth-generation lithium-ion battery management integrated circuit, designed to maximise cell life and driving range for hybrid and electric vehicles. This sets a benchmark for data acquisition, temperature control and safety performance requirements.

Public transport is also undergoing transformations. In a 200m euro deal, battery systems manufacturer BMZ Germany announced an agreement to deliver over 1,000 lithium-ion battery systems to Berlin-based bus maker Eurabus.

One obstacle that battery management systems face is the high final product cost in specific industries. For example, in the automotive sector, heavy-duty vehicles face the burden of additional manufacturing costs according to the vehicle type, design and type of cooling required for the smooth functioning of components.

Cost sensitive end users may shy away from paying the additional amount, which discourages manufacturers to take risks to fulfil the demands in terms of technological innovations and capital investments. This is anticipated to hamper the battery management system market in the coming years. However, overall, the industry is seeing a fall in battery prices, thanks to rigorous R&D carried out by key manufacturers to overcome technological obstacles, which will ultimately benefit manufacturers and product producers.

*www.transparencymarketresearch.com*

E-mobility is inclining towards substantial demand for lithium-ion batteries

**The future of e-mobility is inclining towards substantial demand for lithium-ion batteries**

# EMS buyers deal with supply chain uncertainty and risk

*Component shortages, logistics delays, and overall supply chain uncertainty have been some of the challenges that EMS buyers had to deal with during the global pandemic*

If there is one word that describes the challenges buyers in the electronics manufacturing services industry face because of the coronavirus pandemic it is uncertainty.

When the pandemic hit China, it shut down electronics production in the country and there was uncertainty in the electronics supply chain on how long production would be stopped and uncertainty of where buyers could get the parts needed for production. Uncertainty continued as the pandemic spread through southeast Asia, Europe and the Americas as it shut down or slowed electronics production in those regions. There was uncertainty about supply, demand and logistics.

Fortunately, supply disruptions were staggered. When component manufacturing shut down in Europe, it began to come back in China and Asia. When production stopped in the Americas, it started to come back in Europe.

EMS providers say the key to managing the pandemic was getting accurate information not only from suppliers, but from OEM customers about how their production plans may have changed because of COVID-19.

EMS provider Flex set up a "war room" to help manage the impact of the pandemic on the supply chain and to collect pertinent data on the operations of their suppliers and OEM customers. "It was a dynamic situation because demand was changing and supply was changing," said David Gessler, vice president of commodity management, mechanical for Flex.

"COVID-19 hit in the middle of Chinese New Year so there was already some buffer inventory in the system," said Gessler. Many companies close for several weeks during Chinese New Year and build up inventories before they shut down.

Flex had daily war room calls. When the pandemic first impacted Wuhan, China in January, "we tried to figure out what the impact was going to be on supply coming out of China and what the demand was going to be," he said.

He said Flex contacted every supplier and we confirmed every order. That was no easy task. "There were suppliers that could not even get back to their factories" so it was difficult to determine the status of an order.

## Validating demand

Flex also wanted customers to validate their demand. "There was a point in time where we considered bringing in extra inventory for certain parts because

**There was a point in time where we considered bringing in extra inventory for certain parts because we were uncertain about what the future was going to hold**

**David Gessler**, vice president commodity management, mechanicals for **Flex**

we were uncertain about what the future was going to hold" in terms of demand. Flex weighed whether it was worth the risk to take on extra inventory.

"We made the decision not to increase inventory and I am glad we did because component demand shifted," said Gessler. The extra inventory was not needed.

However, one EMS provider that took a different approach to inventory was SMTC Corp., based in Toronto. It increased inventory for some parts, although some of the inventory buildup originated from component shortages of several years ago when multilayer ceramic capacitors (MLCCs), and metal oxide semiconductor field transistors (MOSFETs) were in short supply.

"We systematically started increasing lead times for certain parts and making the decision to carry more inventory on these and other commodities to protect ourselves and our customers from a supply perspective," said Phil Wehrli, senior vice president global supply chain for SMTC. "If a part had a 16-week lead time, we added eight weeks of lead time so we were buying and holding eight weeks more than we did historically," he said. "That really helped us and our customers out." So when COVID-19 hit and disrupted production in China and Asia, SMTC already had strategic inventory in place," said Phil Wehrli, senior vice president global supply chain for SMTC. The only challenges SMTC had was on specialty single sourced parts that were customer directed, but we did not have any supply constraints that impacted any of our customer demand.

Some supply constraints were not caused by a lack of production capacity, but because of unforeseen demand from one or two customer segments. For instance, in the first and second quarters there was strong demand for medical equipment such as ventilators and other breathing apparatus to treat coronavirus patients. Demand for some medical products that Flex builds for medical OEMs increased 200 to 300 per cent, which caused shortages of some semiconductors and other parts used in the equipment.

Flex was able to work with suppliers to get parts it needed for production. "We did not come through unscathed but we never shut down" production of customer's product," he said.

## Uneven demand

Through much of the first half of the year there was uneven demand from some customer segments. "It was not an issue of lack of supply," said Vincent Cellard, vice president commodity management, electrical for Flex. "It was more due to changes in demand. We saw the automotive business dropping to almost zero, then jump up again," he said. Demand from the medical segment was high earlier in the year but demand has since weakened.

"So, we've seen a change of mix over the last few months," said Cellard. "As a result, we have more shortages now that we would've had a year ago because our business has been so dynamic on the demand side.

## Planning for disaster

Whether shortages are short-term problems caused by unexpected demand from a particular customer segment or longer term because of a lack of investment in production capacity by suppliers, component shortages are usually one of the problems that EMS buyers plan for in risk mitigation strategies. Many electronics OEMs and EMS providers beefed up their supply chain risk management strategies after the 2011 earthquake and tsunami in Japan and flooding in Thailand disrupted the supply. The companies hope to minimise the impact of any future disasters or other events that could affect supply.

Many companies have risk mitigation plans and "playbooks" that are supposed to provide guidance on how to deal with disruptions to the supply chain. However, the coronavirus pandemic seemed to catch many companies by surprise.

Flex has risk mitigation plans. "A lot of those plans are good and I think they help you to the extent that you have the organisational framework and IT framework," said Gessler. However, disasters and other catastrophic events don't always go to plan and often cannot be forecasted.

"I seriously doubt if anyone was ready for a pandemic," said Gessler. "No one could've predicted COVID 12 months ago."

Cellard said that the pandemic was different from the natural disasters that shut down production and disrupted the supply chain in 2011.

"Those disruptions were big but they were at a country or region level," he said. The number of suppliers impacted by the tsunami in Japan and flooding in Thailand was limited. With the pandemic, supply disruption was global and many suppliers were affected.

"Very few suppliers can say they had zero impact at all," said Cellard. With the pandemic, "we got a reminder about how complicated the supply-chain model is in the electronics industry. There are so many tiers, so many subcontractors, so many touch points," said Cellard.

For instance, a micro controller may go to multiple sites in the supply chain before being available as a

> **When we had big supply constraints of MLCCs, a lot of the parts came from Asia and we decided to do risk mitigation**

**Phil Wehrli**, senior vice president global supply chain for **SMTC**

finished product, he said. Raw materials suppliers are needed in order for the chip to be made. The part may be purchased from a supplier in China, but the reality is some of the assembly of the chip may be done in the Philippines, some testing is done in Singapore. Then there are logistics issues involved when the part is sent to multiple locations, said Cellard.

Logistics was severely impacted by the pandemic and component manufacturers and EMS providers had to scramble to find ways to ship products. Logistics continue to be an issue as of early October.

Most passenger flights have been canceled which reduced cargo capacity for electronics shipments. "We've seen bottlenecks in some of the harbors in Asia. We've seen an increase in the amount of freight that is going by rail, he said.

## Returning to normal

Cellard said the good news is that the supply-chain is returning to normal, although it's not there yet. "The first phase of the impact is definitely behind us," he said. So, issues such as lockdowns and partial labor availability, which impacted production, are over. Disruption of the supply chain peaked at the end of May or beginning of June. Supply conditions improved since then and are almost back to normal.

He noted there are still long lead times with "some high-end semiconductors and network products. There's definitely some shortages of raw material and shortages of die in some cases," he said.

EMS providers are hopeful that business will improve and the supply chain issues they faced this year will not return in 2021. However, longer lead times are likely for some components and logistics issues may continue to be felt for a while. In fact, Gessler said the impact of COVID-19 in the supply chain may be felt for the next 6 to 12 months.

"The number of passenger airline flights are down which impacts freight, which impacts logistics," he said. In addition, suppliers are being careful about going back to full capacity because "they still don't know if there's going to be a global recession so they are controlling what they put back into their factories," he said. A lack of investment in new capacity could mean more shortages if business spikes up next year.

Another issue is the impact that COVID-19 may have had on the financial viability of suppliers, especially smaller ones. "They were definitely financially challenged during the last six to nine months," said Gessler. "There's a risk of going out of business," he said. Flex is looking at the financial positions of its suppliers closely.

## More allocations?

There are other non-COVID-19 issues that could impact EMS business in the near future. "We tend to forget what's happened in the past with allocations of MOSFETs and MLCCs and other parts," said Cellard. "We could quickly go back into the mode of allocations on some technologies. That's what keeps me awake at night," he said.

He noted there are some industries where lifecycles are short and we "need products to ramp up really, really fast. We've seen it on the medical side. Demand for components for cloud computing and infrastructure applications also creates a lot of stress in the supply-chain," said Cellard.

While the coronavirus pandemic has created stress on the electronics supply chain, EMS buyers may have learned some lessons that may be useful in mitigating supply chain risk in the future. For instance, with COVID-19, production of end equipment and components did not come to a halt in all regions of the world at all once. Rather, supply disruption happened one region at a time which meant that was available in multiple regions at any one time, which is a likely really reason that there were not widespread component shortages.

"The virus spread across the globe, starting in Asia. It went to Europe, hit the US and then Mexico," said Wehrli. "Asia was the first to come back with reduced capacity at first and it was the same thing with Europe, US and Mexico" he said. The pattern repeated in other regions as well.

**"With the pandemic, we got a reminder about how complicated the supply-chain model is in the electronics industry. There are so many tiers, so many subcontractors, so many touch points**

**Vincent Cellard**, vice president commodity management electrical for **Flex**

# Buyers' guide to enclosure choice

***In this article, TME emphasises the benefits of choosing quality enclosures regarding aesthetics, safety, environmental protection and performance***

In many cases, electronic products are designed to be housed in a standard enclosure produced by an external supplier. This facilitates the production process. What's more, by choosing a branded enclosure comprising precision prefabricated components, the manufacturer also improves the quality of the end product.

An electronic circuit housed in a sealed enclosure manufactured from durable materials will function properly for a longer time. It will also resist harsh environments and be more pleasant to the eye. It is crucial that electronic devices are produced to standards requiring good insulation of the circuits for safety.

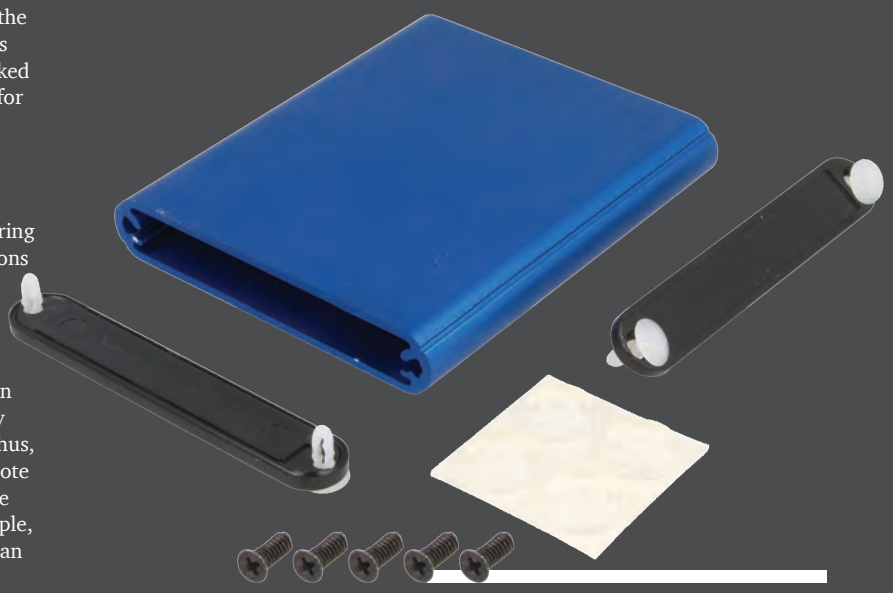
Keeping all the benefits of high-quality enclosures in mind, we recommend clients explore Hammond products. This American company has over 100-years' experience manufacturing quality accessories for electric and electronic devices, primarily specialist enclosures designed for professional applications, from remote controls to multi-bay control cabinets.

TME offers numerous Hammond products in nearly every enclosure category. Read on to learn about two series which illustrate the quality and carefully thought-out design of this manufacturer. Clients seeking the right enclosure for their products are invited to browse TME's catalogue, where they can acquaint themselves with the Hammond brand. Products on TME's website are stocked in our warehouses, ready for dispatch within 24-hours.

The HM-1552 series is designed as an ergonomic component for manufacturing remote controls. Applications range from small-sized machine circuit breakers to more complicated devices such as hospital bed controllers. Products in this series include not only buttons, but also a PCB. Thus, a signal sent from the remote control does not have to be binary. It can be, for example, transmitted wirelessly via an IR diode or by wire, using a protocol operated by the target device. The enclosures are manufactured from ABS and are IP54 rated, making them resistant to dust and splash-proof. Thanks to their plastic structure and removable panels, they can be customised for various applications. HM-1552 series enclosures are designed to fit in the hand but can also be used for desktop devices.

TME offers accessories for HM-1552 series enclosures. For example, strain reliefs can be inserted into the front or rear enclosure panel. Also, as a part of the set, users receive a set of mounting screws and a cable block. Other popular accessories are wall brackets which offer the best way to store a ready-to-use device: always easily available and protected from mechanical damage.

Moving to the HM-1557 series, these square-based enclosures are available



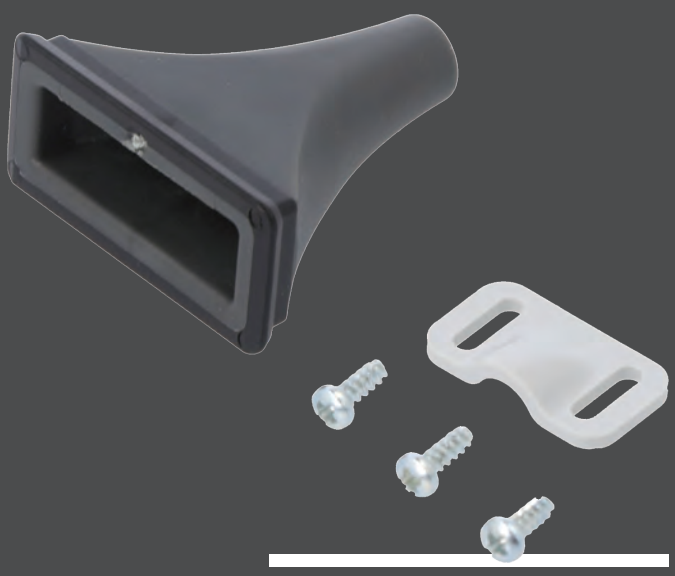
Aluminium enclosure

Enclosure from HM-1552 series

with side lengths from 80 to 200mm. They are designed to protect PCBs in an IP66 (ABS) or IP68 (polycarbonate) rated closure. The latter two can be used outside buildings, as they resist UV radiation and meet the UL94-5VA flammability rating. Curved edges contribute to their modern, light look, so they can be used to produce neat looking consumer devices. The enclosure's cover is mounted with screws made from acid resistant steel, while silicon gaskets are provided. Spaces between the elements have been grooved to provide maximum protection from dust, oil, water and other harmful contaminants.

Accessories include brackets for wall mounting without making holes in the enclosure.

*www.tme.eu*



Slide-on strain relief

Polycarbonate Enclosure from HM-1557 series

| Manufacturer | Distributor | Telephone | Website | Franchised Distributor | No. of Lines for Principal | Stock Value for Principal | Minimum Order Value | % Lead Free for Principal Range | No. of Technical Support Staff | Total No. of Staff | Buffer Stock Facility |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **CABLE ASSEMBLY & HARNESSING** | | | | | | | | | | | |
| FTDI | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 100 | N/A | 0 € | N/A | 50 | 1,500+ | Y |
| Molex | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 300 | N/A | 0 € | 97% | 50 | 1,500+ | Y |
| **CIRCUIT PROTECTION** | | | | | | | | | | | |
| Bourns | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 5,000 | N/A | 0 € | 58% | 50 | 1,500+ | Y |
| EPCOS/TDK | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 5,000 | N/A | 0 € | 58% | 50 | 1,500+ | Y |
| Littelfuse | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 35,000 | N/A | 0 € | 67% | 50 | 1,500+ | Y |
| **ENCLOSURES** | | | | | | | | | | | |
| Bud | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 2,500 | N/A | 0 € | 80% | 50 | 1,500+ | Y |
| Hammond | Switch Electronics | 01482 862255 | switchelectronics.co.uk | Y | 500 | N/A | £0 | 70% | 2 | 6 | Y |
| Hammond | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | 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** | | | | | | | | | | | |
| AEL Crystals Ltd | AEL Crystals Ltd | 01293 789200 | www.aelcrystals.co.uk | N | N/A | £200,000 | £50 | 100% | 3 | 15 | Y |
| ABRACON | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 1,000 | N/A | 0 € | 91% | 50 | 1,500+ | Y |
| ECS | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 500 | N/A | 0 € | 99% | 50 | 1,500+ | Y |
| Epson | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 500 | N/A | 0 € | 59% | 50 | 1,500+ | Y |
| Geyer Quartz Technology | Geyer Electronic UK Ltd | 01794 329341 | www.geyer-electronic.com | N | N/A | N/A | £0 | 100% | 6 | 50+ | Y |
| Golledge Electronics Ltd | Golledge Electronics Ltd | 01460 256 100 | www.golledge.com | N | N/A | £800,000 | £0 | 100% | 3 | 24 | Y |
| Jauch Quartz | Digi-Key Electronics | 0800 587 0991 | www.digikey.co.uk | Y | 500 | £250,000 | 0 | 100% | 15 | 130 | Y |
| **HEATSINKS** | | | | | | | | | | | |
| Aavid | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 700 | N/A | 0 € | 67% | 50 | 1,500+ | Y |

## Services Sourcing

### CEM



### DEVICE PROGRAMMING



### TAPE REELING

| Manufacturer | Distributor | Telephone | Website | Franchised Distributor | No. of Lines for Principal | Stock Value for Principal | Minimum Order Value | % Lead Free for Principal Range | No. of Technical Support Staff | Total No. of Staff | Buffer Stock Facility |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **ICs & SEMICONDUCTORS** | | | | | | | | | | | |
| Altera | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 1,600 | N/A | 0 € | 60% | 50 | 1,500+ | Y |
| Analog Devices Inc. | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 9,500 | N/A | 0 € | 83% | 50 | 1,500+ | Y |
| Atmel | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 1,700 | N/A | 0 € | 58% | 50 | 1,500+ | Y |
| Avago Technologies | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 400 | N/A | 0 € | 84% | 50 | 1,500+ | Y |
| Broadcom | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 100 | N/A | 0 € | 69% | 50 | 1,500+ | Y |
| Cirrus Logic | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 300 | N/A | 0 € | 80% | 50 | 1,500+ | Y |
| Cypress Semiconductor | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 1,400 | N/A | 0 € | 63% | 50 | 1,500+ | Y |
| Diodes Incorporated | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 1,600 | N/A | 0 € | 98% | 50 | 1,500+ | Y |
| Exar | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 1,100 | N/A | 0 € | 95% | 50 | 1,500+ | Y |
| Fairchild Semiconductor | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 2,500 | N/A | 0 € | 90% | 50 | 1,500+ | Y |
| Freescale Semiconductor | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 2,500 | N/A | 0 € | 42% | 50 | 1,500+ | Y |
| FTDI | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 100 | N/A | 0 € | 97% | 50 | 1,500+ | Y |
| IDT (Integrated Device Technology) | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 2,100 | N/A | 0 € | 97% | 50 | 1,500+ | Y |
| Infineon | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 800 | N/A | 0 € | 66% | 50 | 1,500+ | Y |
| Intel | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 500 | N/A | 0 € | 78% | 50 | 1,500+ | Y |
| International Rectifier | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 600 | N/A | 0 € | 87% | 50 | 1,500+ | Y |
| Intersil | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 1,900 | N/A | 0 € | 50% | 50 | 1,500+ | Y |
| ISSI | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 700 | N/A | 0 € | 98% | 50 | 1,500+ | Y |
| Lattice | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 700 | N/A | 0 € | 69% | 50 | 1,500+ | Y |
| Maxim Integrated | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 11,200 | N/A | 0 € | 67% | 50 | 1,500+ | Y |
| Microchip | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 12,600 | N/A | 0 € | 91% | 50 | 1,500+ | Y |
| Microsemi | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 400 | N/A | 0 € | 90% | 50 | 1,500+ | Y |
| Monolithic Power Systems (MPS) | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 600 | N/A | 0 € | 40% | 50 | 1,500+ | Y |
| NXP | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 3,900 | N/A | 0 € | 91% | 50 | 1,500+ | Y |
| ON Semiconductor | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 5,100 | N/A | 0 € | 87% | 50 | 1,500+ | Y |
| Power Integrations | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 600 | N/A | 0 € | 59% | 50 | 1,500+ | Y |
| Qorvo | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 300 | N/A | 0 € | 90% | 50 | 1,500+ | Y |
| ROHM Semiconductor | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 1,400 | N/A | 0 € | 55% | 50 | 1,500+ | Y |
| Silicon Laboratories | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 1,500 | N/A | 0 € | 96% | 50 | 1,500+ | Y |
| Skyworks | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 300 | N/A | 0 € | 91% | 50 | 1,500+ | Y |
| Spansion Inc. | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 600 | N/A | 0 € | 93% | 50 | 1,500+ | Y |
| STMicroelectronics | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 4,500 | N/A | 0 € | 99% | 50 | 1,500+ | Y |
| Texas Instruments | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 36,900 | N/A | 0 € | 41% | 50 | 1,500+ | Y |
| Toshiba | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 500 | N/A | 0 € | 100% | 50 | 1,500+ | Y |
| **INDUSTRIAL GRADE MEMORY MODULES** | | | | | | | | | | | |
| ATP, Innodisk, APRO Kingston | Simms International Plc | 01622 852 848 | www.simms.co.uk | N | 1000+ | N/A | N/A | N/A | 3 | N/A | Y |
| **INTERCONNECTION** | | | | | | | | | | | |
| 3M | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 3,100 | N/A | 0 € | 16% | 50 | 1,500+ | Y |
| Amphenol | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 25,600 | N/A | 0 € | 53% | 50 | 1,500+ | Y |
| Anderson Power Products | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 800 | N/A | 0 € | 50% | 50 | 1,500+ | Y |
| Cinch Connectivity Solutions | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 1,900 | N/A | 0 € | 82% | 50 | 1,500+ | Y |
| Delphi Connection Systems | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 3,300 | N/A | 0 € | 67% | 50 | 1,500+ | Y |
| FCI | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 4,300 | N/A | 0 € | 94% | 50 | 1,500+ | Y |
| Glenair | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 1,900 | N/A | 0 € | 76% | 50 | 1,500+ | Y |
| HARTING | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 4,700 | N/A | 0 € | 31% | 50 | 1,500+ | Y |
| Harwin | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | 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 | 0049 (0)89 520 462 110 | www.mouser.com | Y | 6,100 | N/A | 0 € | 99% | 50 | 1,500+ | Y |
| Huber+Suhner | Lane Electronics | 01403 790661 | www.fclane.com | Y | 766 | £116,000 | £0 | 100% | 6 | 38 | Y |
| ITW McMurdo | Lane Electronics | 01403 790661 | www.fclane.com | Y | 866 | £219,000 | £0 | 100% | 6 | 38 | Y |
| JAE Electronics | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 1,200 | N/A | 0 € | 32% | 50 | 1,500+ | Y |
| Kycon | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 700 | N/A | 0 € | 99% | 50 | 1,500+ | Y |
| LEMO | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 2,900 | N/A | 0 € | 65% | 50 | 1,500+ | Y |
| Molex | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 16,900 | N/A | 0 € | 75% | 50 | 1,500+ | Y |
| Neutrik | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 1,000 | N/A | 0 € | 86% | 50 | 1,500+ | |
| Phoenix Contact | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 12,000 | N/A | 0 € | 99% | 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 | 0049 (0)89 520 462 110 | www.mouser.com | Y | 2,200 | N/A | 0 € | 69% | 50 | 1,500+ | Y |
| TE Connectivity | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 30,900 | N/A | 0 € | 40% | 50 | 1,500+ | Y |

| Manufacturer | Distributor | Telephone | Website | Franchised Distributor | No. of Lines for Principal | Stock Value for Principal | Minimum Order Value | % Lead Free for Principal Range | No. of Technical Support Staff | Total No. of Staff | Buffer Stock Facility |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **OBSOLESCENCE / HARD TO FIND** | | | | | | | | | | | |
| | Cyclops Electronics | 01904 415 415 | www.cyclops-electronics.com | N/A | 177,232 | £5M | £100 | 75% | 3 | 78 | Y |
| Rochester Electronics | Rochester Electronics | +44.1480.408400 | www.rocelec.com | Y | 299 | N/A | $250 | N/A | 10 | 400+ | Y |
| | SeSemi Electronics LTD | 01264 731009 | www.sesemi.co.uk | Y | 2800 | N/A | £100 | N/A | 3 | 12 | Y |
| **OPTO ELECTRONICS** | | | | | | | | | | | |
| Avago Technologies | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 8,200 | N/A | 0 € | 89% | 50 | 1,500+ | Y |
| Cree, Inc. | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 22,500 | N/A | 0 € | 74% | 50 | 1,500+ | Y |
| Dialight | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 9,800 | N/A | 0 € | 99% | 50 | 1,500+ | Y |
| Kingbright | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 3,100 | N/A | 0 € | 100% | 50 | 1,500+ | Y |
| Lumileds | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 1,100 | N/A | 0 € | 99% | 50 | 1,500+ | Y |
| Newhaven Display | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 700 | N/A | 0 € | 65% | 50 | 1,500+ | Y |
| Osram Opto Semiconductor | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 2,800 | N/A | 0 € | 99% | 50 | 1,500+ | Y |
| VCC | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 5,000 | N/A | 0 € | 92% | 50 | 1,500+ | Y |
| Vishay | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 3,100 | N/A | 0 € | 99% | 50 | 1,500+ | Y |
| **PASSIVES** | | | | | | | | | | | |
| AVX | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 70,700 | N/A | 0 € | 58% | 50 | 1,500+ | Y |
| Bourns | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 49,500 | N/A | 0 € | 98% | 50 | 1,500+ | Y |
| Coilcraft | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 10,400 | N/A | 0 € | 98% | 50 | 1,500+ | Y |
| Cornell Dubilier | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 33,000 | N/A | 0 € | 65% | 50 | 1,500+ | Y |
| EPCOS / TDK | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 31,000 | N/A | 0 € | 74% | 50 | 1,500+ | Y |
| Fair-Rite | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 1,000 | N/A | 0 € | 94% | 50 | 1,500+ | Y |
| Kemet | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 135,800 | N/A | 0 € | 93% | 50 | 1,500+ | Y |
| KOA Speer | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 107,900 | N/A | 0 € | 82% | 50 | 1,500+ | Y |
| Laird Technologies | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 1,800 | N/A | 0 € | 50% | 50 | 1,500+ | Y |
| Murata | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 67,300 | N/A | 0 € | 99% | 50 | 1,500+ | Y |
| Nichicon | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 21,600 | N/A | 0 € | 47% | 50 | 1,500+ | Y |
| Ohmite | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 17,300 | N/A | 0 € | 99% | 50 | 1,500+ | Y |
| Panasonic | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 67,900 | N/A | 0 € | 69% | 50 | 1,500+ | Y |
| Taiyo Yuden | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 6,400 | N/A | 0 € | 82% | 50 | 1,500+ | Y |
| TDK | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 25,300 | N/A | 0 € | 85% | 50 | 1,500+ | Y |
| TT Electronics | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 32,800 | N/A | 0 € | 55% | 50 | 1,500+ | Y |
| United Chemi-Con (UCC) | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 13,900 | N/A | 0 € | 99% | 50 | 1,500+ | Y |
| Vishay | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 119,800 | N/A | 0 € | 76% | 50 | 1,500+ | Y |
| Wurth Electronics | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 4,500 | N/A | 0 € | 63% | 50 | 1,500+ | Y |
| Yageo | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 45,300 | N/A | 0 € | 99% | 50 | 1,500+ | Y |
| **POWER & BATTERIES** | | | | | | | | | | | |
| FRIWO Gerätebau GmbH | Haredata Electronics | 01423 796240 | www.haredata.co.uk | Y | 250 - 500 | €1M | £250 | 100% | 7 | 14 | Y |
| Jauch Quartz | | 01276 605900 | www.jauch.com | | | £500,000 | 0 | 95 | 15 | 130 | Y |
| Mean Well | Ecopac (UK) Power Ltd | 01844 204420 | www.ecopacpower.co.uk | Y | 6,000 | £2M | £0 | 100% | 8 | 30 | Y |
| Bel Power Solutions | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 1,400 | N/A | 0 € | 94% | 50 | 1,500+ | Y |
| Cincon | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 5,500 | N/A | 0 € | 60% | 50 | 1,500+ | Y |
| Cosel | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 11,800 | N/A | 0 € | 99% | 50 | 1,500+ | Y |
| CUI Inc. | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 3,900 | N/A | 0 € | 100% | 50 | 1,500+ | Y |
| Mean Well | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 4,500 | N/A | 0 € | 75% | 50 | 1,500+ | Y |
| Murata | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 5,200 | N/A | 0 € | 93% | 50 | 1,500+ | Y |
| RECOM | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 23,300 | N/A | 0 € | 92% | 50 | 1,500+ | Y |
| Schaffner | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 900 | N/A | 0 € | 98% | 50 | 1,500+ | Y |
| SL Power | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 2,100 | N/A | 0 € | 87% | 50 | 1,500+ | Y |
| TDK-Lambda | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 4,600 | N/A | 0 € | 99% | 50 | 1,500+ | Y |
| TRACO Power | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 3,400 | N/A | 0 € | 95% | 50 | 1,500+ | Y |
| **SENSORS** | | | | | | | | | | | |
| All Sensors | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 2,300 | N/A | 0 € | 70% | 50 | 1,500+ | Y |
| ams | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 400 | N/A | 0 € | 77% | 50 | 1,500+ | Y |
| Analog Devices Inc. | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 500 | N/A | 0 € | 78% | 50 | 1,500+ | Y |
| Bosch | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 100 | N/A | 0 € | 94% | 50 | 1,500+ | Y |
| Freescale Semiconductor | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 1,000 | N/A | 0 € | 66% | 50 | 1,500+ | Y |
| Honeywell | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 15,500 | N/A | 0 € | 80% | 50 | 1,500+ | Y |
| Maxim Integrated | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 900 | N/A | 0 € | N/A | 50 | 1,500+ | Y |
| Melexis | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 700 | N/A | 0 € | N/A | 50 | 1,500+ | Y |
| Omron | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 5,700 | N/A | 0 € | N/A | 50 | 1,500+ | Y |
| Sensirion | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 100 | N/A | 0 € | N/A | 50 | 1,500+ | Y |
| TE Connectivity | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 1,100 | N/A | 0 € | N/A | 50 | 1,500+ | Y |

| Manufacturer | Distributor | Telephone | Website | Franchised Distributor | No. of Lines for Principal | Stock Value for Principal | Minimum Order Value | % Lead Free for Principal Range | No. of Technical Support Staff | Total No. of Staff | Buffer Stock Facility |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **SWITCHES & KEYBOARDS** | | | | | | | | | | | |
| ALPS | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 400 | N/A | 0 € | 70% | 50 | 1,500+ | Y |
| Apem | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 700 | N/A | 0 € | 96% | 50 | 1,500+ | Y |
| C&K Components | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 1,500 | N/A | 0 € | 84% | 50 | 1,500+ | Y |
| Carling Technologies | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 300 | N/A | 0 € | 87% | 50 | 1,500+ | Y |
| CHERRY | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 200 | N/A | 0 € | 77% | 50 | 1,500+ | Y |
| E-Switch | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 700 | N/A | 0 € | 94% | 50 | 1,500+ | Y |
| EAO Ltd | EAO Ltd | 01444 236000 | www.eao.co.uk | N | 5,000 | £500,000 | £150 | 100% | 6 | 22 | Y |
| Grayhill | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 400 | N/A | 0 € | 84% | 50 | 1,500+ | Y |
| Honeywell | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 700 | N/A | 0 € | 98% | 50 | 1,500+ | Y |
| NKK Switches | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 1,100 | N/A | 0 € | 94% | 50 | 1,500+ | Y |
| Omron | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 900 | N/A | 0 € | 68% | 50 | 1,500+ | Y |
| TE Connectivity | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 400 | N/A | 0 € | 98% | 50 | 1,500+ | Y |
| **TERMINAL BLOCKS** | | | | | | | | | | | |
| Marathon Special Products | Global Supply Services | 01904 436 488 | www.global-supply-services.com | Y | 8,000 | £800,000 | £100 | 100% | 3 | 11 | Y |
| **THERMAL MANAGEMENT** | | | | | | | | | | | |
| ADDA | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 800 | N/A | 0 € | 59% | 50 | 1,500+ | Y |
| Delta Electronics | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 500 | N/A | 0 € | 28% | 50 | 1,500+ | Y |
| ebm-papst | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 2,200 | N/A | 0 € | 99% | 50 | 1,500+ | Y |
| Sanyo Denki | EAO Ltd | 01444 236000 | www.eao.co.uk | Y | 4,300 | £150,000 | £150 | 99% | 6 | 22 | Y |
| Sanyo Denki | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 2,900 | N/A | 0 € | | 50 | 1,500+ | Y |
| Sunon | G.English Electronics Ltd | 0208 855 0991 | www.gelec.co.uk | Y | 3,500 | £1,000,000+ | £0 | 100% | 10 | 28 | Y |
| Sunon | Thermaco Ltd | 01684 566163 | www.thermaco.co.uk | Y | 3,500 | £230,000 | £100 | 100% | 6 | 12 | Y |
| **TRANSFORMERS & INDUCTORS** | | | | | | | | | | | |
| Best Windings | Best Windings | 0044 (0)1394 448424 | www.bestwindings.co.uk | N | 300 | N/A | £100 | N/A | 2 | 24 | Y |
| **WIRELESS SOLUTIONS** | | | | | | | | | | | |
| Anaren | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 100 | N/A | 0 € | 86% | 50 | 1,500+ | Y |
| B&B Electronics | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 100 | N/A | 0 € | 87% | 50 | 1,500+ | Y |
| Bluegiga Technologies | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 100 | N/A | 0 € | 93% | 50 | 1,500+ | Y |
| Digi International | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 200 | N/A | 0 € | 92% | 50 | 1,500+ | Y |
| Laird Technologies | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 100 | N/A | 0 € | 76% | 50 | 1,500+ | Y |
| Linx Technologies | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 100 | N/A | 0 € | 99% | 50 | 1,500+ | Y |
| Microchip | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 100 | N/A | 0 € | 85% | 50 | 1,500+ | Y |
| Murata | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 100 | N/A | 0 € | 100% | 50 | 1,500+ | Y |
| Panasonic | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 100 | N/A | 0 € | 91% | 50 | 1,500+ | Y |
| Redpine Signals | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 100 | N/A | 0 € | 94% | 50 | 1,500+ | Y |
| RF Digital | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 100 | N/A | 0 € | 100% | 50 | 1,500+ | Y |
| Texas Instruments | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 100 | N/A | 0 € | 75% | 50 | 1,500+ | Y |
| Wi2Wi | Mouser Electronics | 0049 (0)89 520 462 110 | www.mouser.com | Y | 100 | N/A | 0 € | 36% | 50 | 1,500+ | Y |

## Contract Manufacturers Buyers' Guide

| Manufacturer | Telephone | Website | Turnover | Location | Employees | Number of Surface Mount Lines | Approvals | BGA Capacity | Lead Free Manufacturer | Prototyping | Design Capability | Full Turnkey | Cables and Harnessing |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Challenger Solutions Ltd | 01245 325252 | www.challengersolutions.com | £10m | Essex/SE | 100 | 7 | AS9100 Rev D, ISO9001:2015, ISO 140001:2015, UL , CCC, IPC-610-G Class 3 | Y | Y | Y | Y | Y | Y |
| CML Innovative Technologies (uk) Ltd | 01284 714700 | www.cml-it.com | £12M | UK/EU/China | 65 | | ISO9001, TS16949, UL ISO9001 2015, IATF 16949 2016 | N | Y | Y | Y | Y | Y |
| Corintech Ltd | +44 (0)1425 655655 | www.corintech.com | £11m | UK & Far East | 72 | 3 | AS9100, ISO9001, IPC-A-610 Class 3, J-STD-001 | Y | Y | Y | Y | Y | Y |
| Custom Interconnect Ltd | 01264 321321 | www.cil-uk.co.uk | £18.6m | Andover (Hampshire) | 130 | 6 | AS9100 ISO13485 ISO9001 IPC-A-610 Class 3 | Y | Y | Y | Y | Y | Y |
| Electrica Limited | 0161 343 7575 | www.electrica.co.uk | £2.4m | Cheshire | 26 | 3 | BSI ISO 9001:2015, IPC-A-610 to Class 3, IPC-J-STD-001, Cert IPC Trainer, UL | Y | Y | Y | Y | Y | Y |
| Electronic Technicians Ltd | 01202 897722 | www.etluk.co.uk | £3.7m | SE | 50 | 2 | AS9100, ISO9001, ISO14001, IPC610/620 Class 3 | Y | Y | Y | Y | Y | Y |
| Esprit Electronics Ltd | 02380 455411 | www.espritelectronics.com | £11m | Hampshire | 80 | 4 | ISO9001:2008, IPC610 to Class 3 | Y | Y | Y | Y | Y | Y |
| FermionX Ltd | +44(0)1903 524600 | www.fermionx.com | £5m | Worthing, W. Sussex | 40 | 4 | ISO9001:2015, ISO14001:2015, IPC 610 A Class 2 & 3 | Y | Y | Y | Y | Y | Y |
| G&B Electronic Designs Ltd | 01420 474188 | www.gandbelectronics.co.uk | £4.6m | Hampshire | 60 | 2 | ISO9001, ISO13485, IPC-A-610, IPC J-STD-001, IPC 7711/7721 | Y | Y | Y | Y | Y | Y |
| Hallmark Electronics Ltd | 01782 562255 | www.hallmarkelectronics.com | £2m | M | 26 | 2 | ISO9000/UL, IPC610/D | Y | Y | Y | Y | Y | Y |
| Icon Electronics Limited | 01423 449080 | www.iconelectronics.co.uk | £6.5m | Hampshire & Yorkshire | 70 | 5 | AS9100, ISO9001, BS EN ISO/IEC 80079-34:2018 ATEX, IPC-A-610 Class 3 | Y | Y | Y | Y | Y | Y |
| Incap Electronics UK Limited | 01782 753200 | www.incapcorp.com | €113m+ | UK, Slovakia, Estonia & India | 1,300 | 20 | ISO9100, ISO14001, ISO13485, AS9100D, ISO45001 & IATF16949 | Y | Y | Y | Y | Y | Y |
| Industrial Electonic Wiring Ltd. | +44(0)1793 694033 | www.iew.co.uk | £5.5m | Swindon, UK | 60 | N/A | ISO9001:2015, IPC610, IPC620 | N | Y | Y | N | Y | Y |
| Jaltek | 01582578170 | jaltek.com | £10m | UK | 90 | 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 |
| KEY-TECH ELECTRONIC SYSTEMS | 01592 597711 | www.key-tech.co.uk | £5 Million | UK | 65 | 2 | ISO9001:2015, J-STD-001, IPC-610/620 CLASS 3, IPC-7711, BS EN ISO13485:2016 | Y | Y | Y | N | Y | Y |
| Nemco Limited | 01438 346600 | www.nemco.co.uk | £15.9m | SE | 120 | 6 | AS9100, ISO9001:2008, IPC610/620 to Class 3, ISO14001-2004, SC21 | Y | Y | Y | Y | Y | Y |
| Speedboard part of NOTE | 01753 746700 | www.speedboard.co.uk | £115m | UK/EU/China | 1,050 | 18 | IPC610 to Class 3, ISO9001:2015, 13485, 14001, 18001 | Y | Y | Y | Y | Y | Y |
| M-TEK (Assembly) Ltd | 01189 455377 | www.mtek.co.uk | £2.4m | SE | 30 | 4 | IS9001,ISO14001, IPC-A-610 Class 3, IPC-7711/7721, WHMA-3620, Certified IPC Trainer | Y | Y | Y | Y | Y | Y |
| Pektron | 01332 832424 | www.pektron.com | £50m | E-Midlands | 350 | 8 | ISO9001, ISO14001, TS16949, BEAB, VCA, TUV, UL | Y | Y | Y | Y | Y | Y |
| Protronix EMS | 01582 418490 | www.protronix.co.uk | £2.5m | Luton | 10 | 2 | ISO9001:2015, IPC-A610 Class 3 | Y | Y | Y | Y | Y | Y |
| Season Electronics Limited | 02392 452222 | www.seasongroup.com | £5m/£100m | Havant, UK/USA/Mexico/China/Malaysia | 65/1800 | 2/18 | (AS9100 & ISO9001 in UK) (TS16949 & ISO13485 at sister sites) | Y | Y | Y | Y | Y | Y |
| Simtek EMS Ltd | 01843 233120 | www.simtekems.co.uk | £8.2m | SE | 77 | 3 | ISO9001:2008, ISO13485, IPC-A-610 Class 3 & IPC-7711 | Y | Y | Y | Y | Y | Y |
| TEXCEL TECHNOLOGY PLC | +44(0)1322621700 | www.texceltechnology.com | £15.5m | SE | 131 | 7 | ISO9001, ISO14001, IPC610 Class 3, | Y | Y | Y | Y | Y | Y |
| Tioga Limited | 01332 360884 | www.tioga.co.uk | £16m | Derby | 130 | 6 | ISO 9001, ISO 13485, ISO14001, IPC 610, 620, 7711/7721 | Y | Y | Y | Y | Y | Y |
| Wilson Process Systems | 01424 722222 | www.wps.co.uk | £12m | SE | 100 | 5 | ISO9001:2015, IPC-A-610 Class 3 | Y | Y | Y | Y | Y | Y |
| **C-CLASS COMPONENTS** | | | | | | | | | | | | | |
| Essentra Components | 0845 758 5070 | www.essentracomponents.co.uk | £283.3m | UK | 2500 | | UL / CE / IATF | N | Y | Y | Y | N | Y |

## PCB Buyers' Guide

| Manufacturer | Telephone | Website | Service Provided (i.e Broker, Manufacture &/or Repair) | Location | Approvals | Volume - Small, Medium, Large | Double-sided | Multi-layer 4-10/10-20-20-30 | Metal PCBs | Flexi / Flexi-Rigid | Obsolescence Solutions | Modifications | Prototyping |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABL Circuits Ltd | 01462 894312 | www.ablcircuits.co.uk | M | SE | ISO9000: 2015 | SML | Y | 4-10 | Y | Y | Y | Y | Y |
| Cambridge Circuit Company Ltd | 01223 423100 | www.cambridge-circuit.co.uk | M | SE | ISO9001:2015, UL, ISO 14001:2015 | SML | Y | 4-16 | Y | Y | Y | Y | Y |
| DK-Daleba Printed Circuits | 01992 510000 | www.dk-daleba.co.uk | B/M/R | UK, Europe, Asia, USA | UL, ISO9001:2008, TS16949:2009 | SML | Y | 4-30 | Y | Y | Y | Y | Y |
| Fineline VAR Ltd | +44 (0)1249 815 815 | www.fineline-global.com | B | UK / Global | ISO9001:2015 / UL/ TS16949 / Nadcap/ AS9100/ISO14001 | SML | Y | 4-60 | Y | Y | y | y | y |
| GSPK Circuits Ltd | +44(0)1423 321100 | www.gspkcircuits.ltd.uk | M/R | UK, Europe, Asia | IS 9001:2015, IATF 16949:2016, EN (AS) 9100 | SML | Y | 4-34 | Y | Y | Y | Y | Y |
| LEF Circuits | 0116 2891122 | www.lefcircuits.co.uk | M/R | M | ISO 9001:2015, IPC-A-610 | SML | Y | 4-30 | Y | F/R | Y | Y | Y |
| Stevenage Circuits Ltd | 01438 761811 | www.stevenagecircuits.co.uk | M/B | UK/China | ISO 9001:2008, ISO 14001, EN9100:2009, UL, JOSCAR | SML | Y | 4-44+ | Y | F, F/R | Y | Y | Y |
| Tate Circuit Industries Ltd | 01889 583627 | www.tatecircuits.com | B | UK/China | ISO 9001:2015, UL | SML | Y | 4-20 | Y | Y | Y | Y | Y |

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