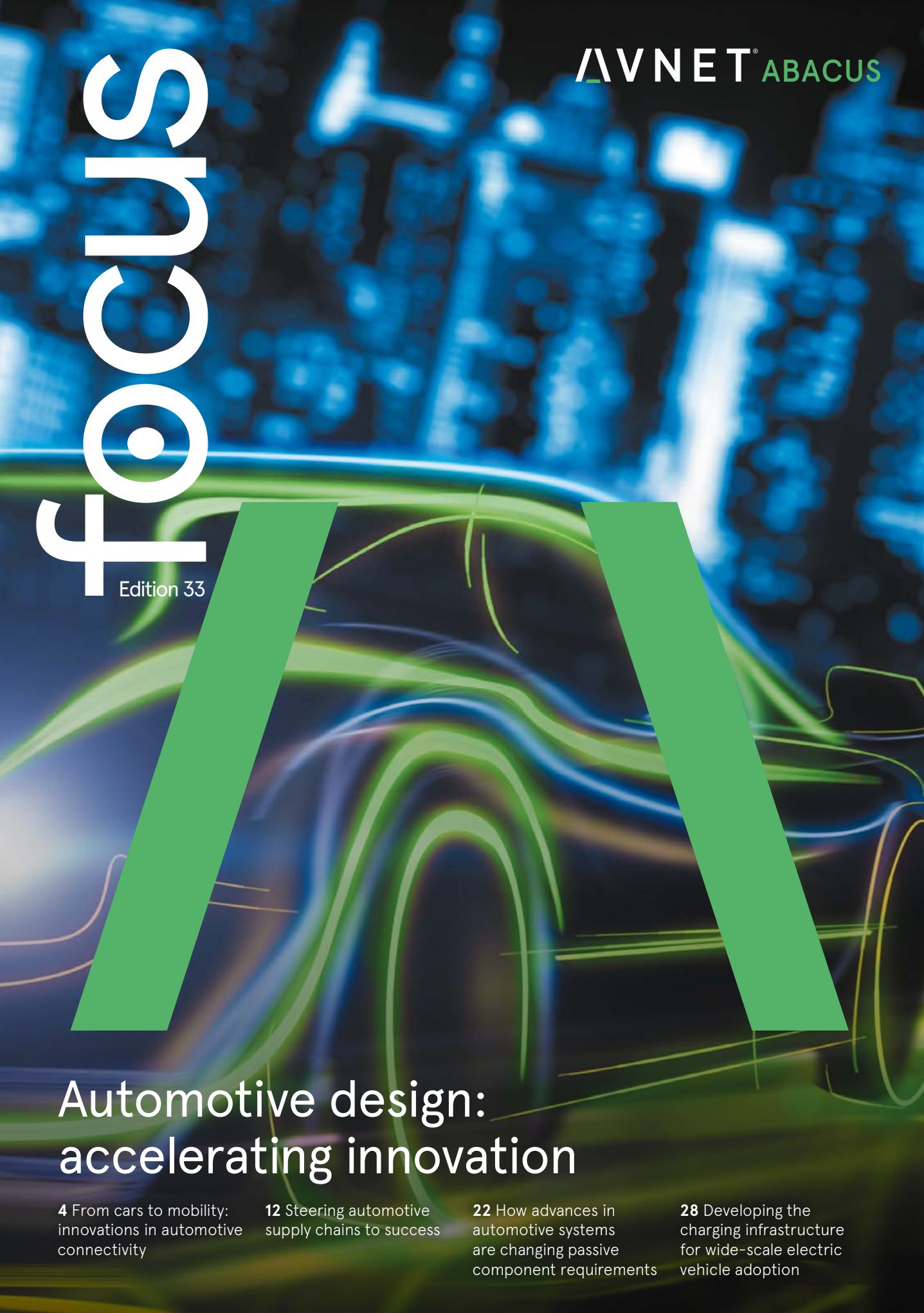


AVNET ABACUS

# focus

Edition 33

# Automotive design: accelerating innovation

focus

Focus is the quarterly magazine from Avnet Abacus, featuring in-depth trend and technology reviews, new product spotlights, Avnet community news and interviews with market leaders.

Avnet Abacus is a pan-European distributor committed to supporting customers from design to fulfilment. Our exceptional linecard features globally recognised manufacturers and an extensive product range that includes interconnect, passive, electromechanical, power supply, energy storage, wireless & sensor products and solutions.

## Features



## Interview



## News



## Supplier technologies

### Connectors



### Electromechanical



### Passive



If you have any comments or questions on the technologies featured in this edition, or wish to speak to one of our technical specialists, you can get in touch at avnet-abacus.eu/ask-an-expert


**Editor** Elinor Gorvett
**Design** TMA The Ideas People
**Print** Image Evolution


Keep up to date with the latest news, product information and technical insights via our social media channels.

**The automotive sector is experiencing unprecedented demand for electronic solutions in passenger vehicles. In addition to being one of the most exciting growth sectors, the industry presents unique challenges for engineers, purchasers, component manufacturers and distributors. This edition of Focus magazine addresses these challenges from each perspective.**

Martin Keenan examines the innovations in automotive connectivity in the first of our feature articles. A discussion on current and future trends in on-board, vehicle-to-vehicle and vehicle-to-infrastructure connectivity, this article highlights the innovations from manufacturers enabling this shift towards increased connectivity.

We interview Stephan Smit, Director Strategic Automotive Accounts on how Avnet Abacus works with suppliers and customers to navigate the intricacies of the automotive supply chain.

In our second feature article, Alan Jermyn reviews and discusses the applications triggering increased demand for passive components. This covers not only the design trends driving innovation from manufacturers but also the standards and specifications pushing the decision-making process in the selection of passive devices for automotive engineers.

Lastly, the development of fast, safe and efficient charging stations is part of the evolutionary growth of the automotive industry. Design considerations, the role of technologies and the charging environment are some of the factors in the future of EV charging infrastructure considered by Alessandro Mastellari.

It is an exhilarating time for the automotive sector and we are thrilled to be part of this revolution.

Rudy Van Parijs
President, Avnet Abacus

To find out more about how Avnet Abacus can support your automotive designs visit: avnet-abacus.eu/automotive

# focus

AVNET ABACUS

# From cars to mobility: innovations in automotive connectivity


**'Established players such as BMW, Jaguar, Toyota and Volkswagen, among others, have been steadily introducing hybrid and fully electric vehicles to their ranges.'**

We are currently experiencing a phase of rapid change in the automotive industry that may profoundly alter the way we travel. Consultancy McKinsey has called it 'the Second Great Inflection', to draw a parallel with that period in the early 1900s when the introduction of the Model T finally made it possible for individuals to travel at will over relatively long distances. The 'horses to cars' transition of the First Great Inflection will be matched by a 'cars to mobility' transition in the Second, McKinsey argues, in which we rethink what freedom to travel means to us, and how we achieve it. One of the key enablers of this change will be a vast increase in the amount of data flowing through cars, and between cars and their environments, made possible by new forms of connectivity.

**Tracking trends**

There are a number of key trends in the automotive industry that are helping to pave the way to the Second

Martin Keenan

Technical Director, Avnet Abacus

Great Inflection. As usual with such trends, some of them are more advanced than public perception would have it, while others lag behind the hype.

One of the most obvious trends is vehicle electrification. While the public profile of electric vehicles has been strongly driven by Tesla, established players such as BMW, Jaguar, Toyota and Volkswagen, among others, have been steadily introducing hybrid and fully electric vehicles to their ranges. Even internal combustion engine cars are seeing greater electrification, as manufacturers choose to reduce the load on the engine by driving subsystems such as power steering and air conditioning electrically. These innovations have been directed in part by improving battery technology, a shift from 12V to 48V power buses, and regulation that has pressured car makers to reduce emissions, both per vehicle and per fleet. Tesla has also been instrumental in addressing the 'chicken and egg' problem of vehicle range by investing heavily in its charging network while also improving its battery technology.

The second high-profile trend in the automotive industry is the shift to greater vehicle autonomy. Again, Tesla has led the hype, at one point promising that its vehicles could drive from coast to coast in the US without their owners having to touch the steering wheel. The reality has turned out differently, with autonomy being limited to what appears to be a combination of lane-keeping and advanced cruise-control strategies on well-lit, well-marked highways. Nonetheless, car makers are paving the way for greater vehicle autonomy by installing various Advanced Driver Assistance Systems (ADAS) in their vehicles.

# From cars to mobility: innovations in automotive connectivity

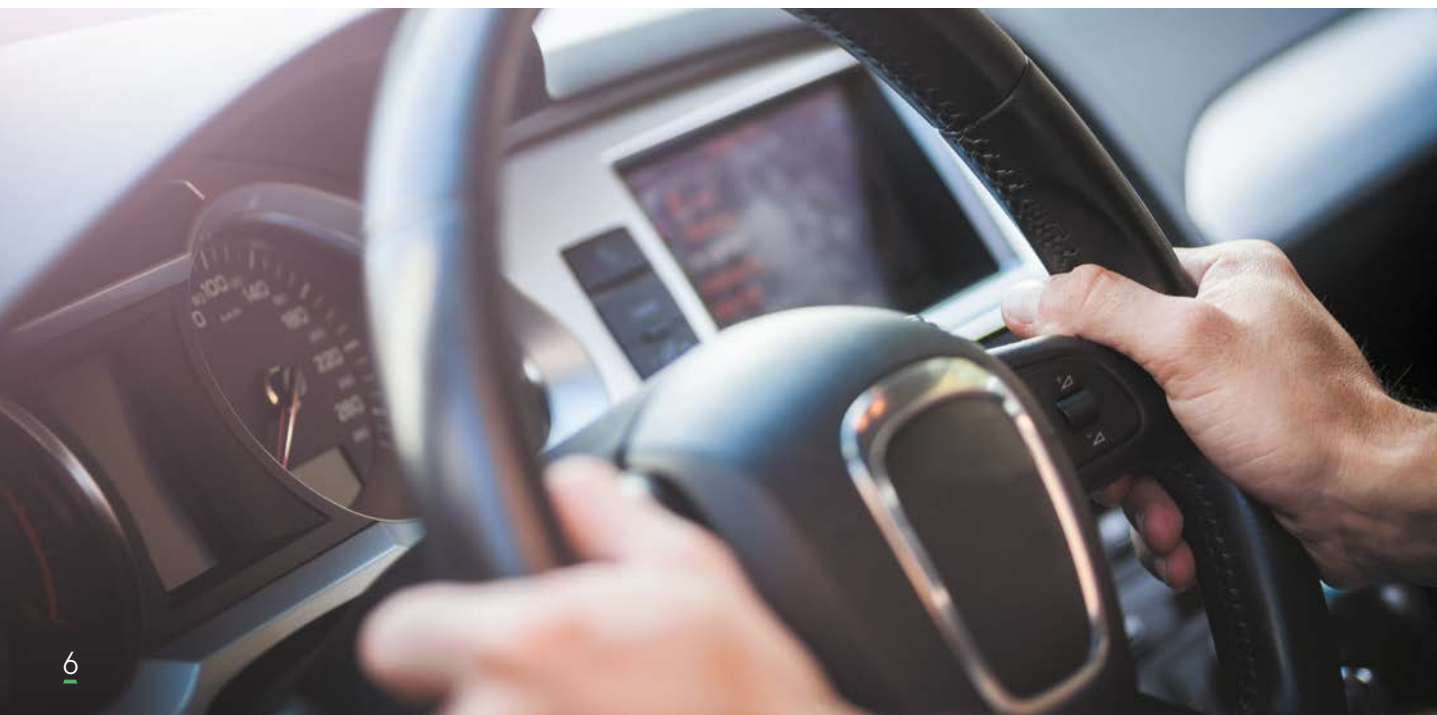
This has demanded the introduction of multiple cameras, sonar, radar and even LIDAR sensors, connected over deterministic networks to sophisticated sensor fusion, analysis and interpretation systems, as well as engine, body and drivetrain controllers.

A third major trend goes to the heart of the automotive industry's purpose: does it sell cars, or help people get from A to B in the way that is most convenient to them? Daimler is already exploring this question by developing facilities such as Moovel, an app combining multiple types of mobility service; car2go, an app-enabled car sharing service; mytaxi, for ride hailing; and other services such as CleverShuttle and FlixBus. More strikingly, BMW and Daimler are pooling their efforts to create a global player in urban mobility services such as multimodal travel, vehicle charging, taxi ride hailing, parking and car sharing. It doesn't take much imagination to recognise that, the taxi version of a Mercedes has very different features to the consumer variant of the same body shape, the shift to these sorts of mobility services will profoundly influence the design of future vehicles.

BMW and Daimler are jointly investing in integrated mobility services. Perhaps the most important enabling trend for all this change is the move to much richer connectivity, within vehicles, between vehicles, and between vehicles and their environments. Some of this is purely consumer driven – people expect their car dashboards now to provide a mix of information and entertainment that is closely equivalent to what they experience on their mobiles and tablets. Some of the shift to richer connectivity is driven by the challenge of managing the flow of vast amounts of safety-critical real-time sensor data to ADAS, and later autonomous driving controllers.

Connectivity is also going to be vital between the car and its environment. Consumers will need reliable internet connectivity to access their preferred online services, as well as to support access to concierge services such as GM's OnStar network. Regulation is increasingly demanding that vehicles can sense when they have been in an accident and use cellular connectivity to report their positions to emergency service centres.

Multiple camera autopilot systems will generate large amounts of time-critical data.



**'Connectivity is also going to be vital between the car and its environment. Consumers will need reliable internet connectivity to access their preferred online services, as well as to support access to concierge services such as GM's OnStar network.'**

And then there is V2X, a whole new layer of emerging connectivity;

- between vehicles and pedestrians (V2P) to alert drivers
- between vehicles and other vehicles (V2V) to exchange information about their speed and location to avoid collisions
- between vehicles and infrastructure (V2I) to exchange information with traffic-management and other forms of infrastructure, to ensure safety at busy intersections and in places with poor visibility.

North America and Europe already have plans to implement V2X communications strategies, using the IEEE 802.11p variant of the familiar WiFi standard starting in 2019. Companies such as Murata are taking advantage of this opportunity by developing V2X wireless communication modules, software and support that use the standard.

**Updating wired automotive interfaces**

Vehicles have been managing a lot of decentralised sensors, actuators and control units for decades now, and there has been a steady evolution in the enabling bus infrastructures.

One of the best-known is LINbus (for Local Interconnected Network), which has a data rate of 20Kbit/s, can be implemented on a single wire with a single master, and is used to create small subnets of sensors and actuators in vehicle networks.

CANbus, otherwise known as the Controller Area Network or ISO 1189, was introduced to enable large numbers of engine control units to be networked. The standard supports data rates of up to 1Mbit/s, is implemented on two wires with support for multiple masters and is deemed suitable for 'soft real-time' applications, where timing is important but not safety-critical.

FlexRay was introduced to support hard real-time (in other words, safety-critical) applications, at data rates of 10Mbit/s. It supports multiple masters, can be implemented on two wires or optical fibre, enables deterministic responses and is designed to be redundant.

MOST, the Media Oriented System Transport, was introduced to make it easier to integrate infotainment services into cars. It supports data rates of up to 24Mbit/s, multiple masters, and is optimised for streaming multimedia data.

The ubiquitous Ethernet is now also making an appearance in vehicle bus architectures, to support much higher data rates and the levels of management and control that are necessary to handle the flow of large amounts of safety-critical data. Interestingly, current work on improving the determinism of the bus architecture builds on work to improve its ability to handle streaming media. The Audio Video Bridging extensions to the standard are now being used as a basis for work on time-sensitive networking, which will add facilities to ensure that time-critical data can pre-empt other data flows on the bus to ensure it arrives within the specified latency.

# From cars to mobility: innovations in automotive connectivity

Rugged Ethernet jacks from Bel Magnetics/TRP may be adapted for automotive use.

**'Vehicles have been managing a lot of decentralised sensors, actuators and control units for decades now, and there has been a steady evolution in the enabling bus infrastructures.'**

Although Ethernet is very widely adopted, frequently using the familiar RJ45 connector, as yet there isn't a standardised connector for automotive Ethernet implementations. Industry bodies are, however, pushing to define and standardise an interoperable connector and cabling system. Prior experience with Ethernet suggests that this approach will cut production and installation costs, increase reliability, and reduce testing and compliance issues.

**Updating wireless automotive interfaces**

Although many vehicles now have 3G and 4G connectivity, to enable access to concierge and emergency services and to support in-vehicle WiFi, V2X strategies will demand a lower latency, more deterministic form of wireless connectivity in the shape of the emerging 5G networking standard. As with previous generations, it will take many years for the new standard to be deployed with enough density to fulfil its promise of delivering 100 times more bandwidth than 4G, at 50 times lower latency, and with 100 times more density.

It is these last two figures that matter for V2X communications, especially latency, given that when two vehicles approach each other at a closing speed of 200km/h, they are getting half a metre closer to each other every ten milliseconds. If V2V systems are to be effective for traffic management they will need the lower latency that 5G offers. Given that 5G will run over microwave frequencies with short path lengths, successful V2V and V2I strategies for traffic management will demand the installation of many more basestations in cities to provide the necessary reach, capacity and redundancy.

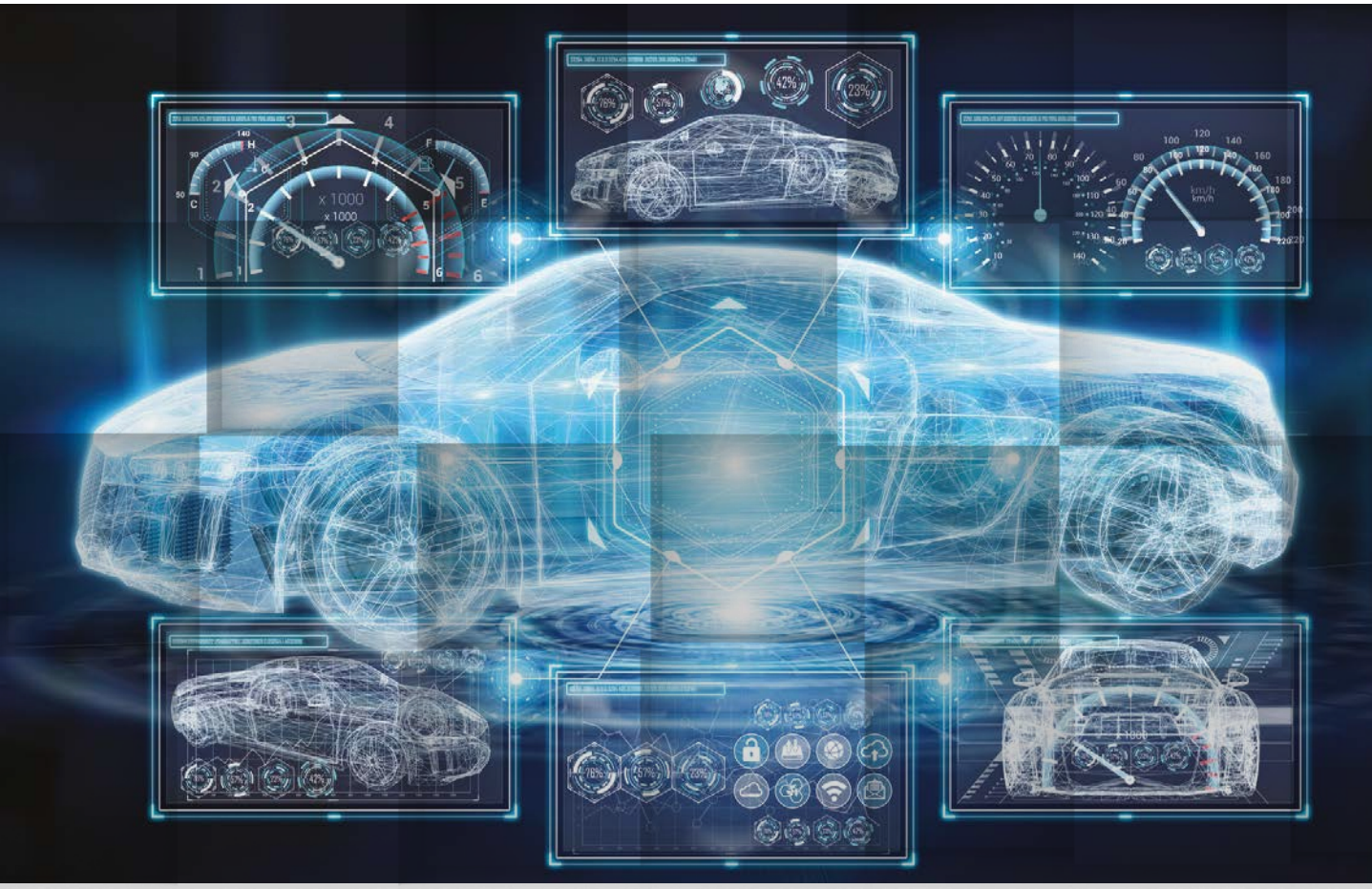
Vehicle makers will have to integrate complex 5G antenna systems into their vehicles, to provide the connectivity necessary to participate fully in V2X strategies. This will mean managing complex RF interactions between the vehicle and the antenna, as well as making robust connections between the antennas and the signal processing that will shape and interpret the transmitted and received signals. These RF subsystems will, in turn, be injecting substantial amounts of data onto the onboard buses to enable analysis and decision making in centralised controllers.

**Connectivity is king**

McKinsey's prediction of a Second Great Inflection in the way in which we travel may or may not come to pass. What we can be sure of, though, is that future vehicles will rely on much greater levels of communication, both among their internal systems and with elements of their environment. Well-proven protocols, reliable cabling systems and robust connectors will be vital to ensuring that this communication continues uninterrupted.

molex

# Redefining the road ahead ›



**The future of connected vehicles is closer than ever, with growing demand for innovations in applications such as driver assistance, safety, comfort, infotainment and connectivity.**

Molex products and solutions continually evolve to meet the ever-increasing demands of the connected vehicle environment, supporting the development of the next generation of intelligent vehicles.

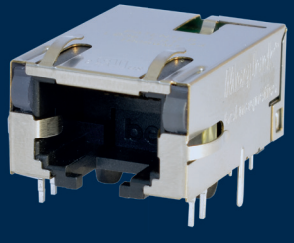
**For more information visit avnet-abacus.eu/molex-automotive**

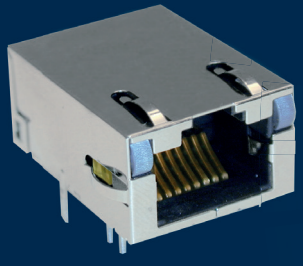
# MagJack® ICMs
# Driving Automotive-Ethernet Innovation


**Bel Magnetic Solutions is the world's largest provider of Integrated Connector Modules with an extensive range covering every Ethernet application on the market today.**

**Our market leading Automotive-Ethernet MagJack® ICMs are SAE/USCAR2-6 compatible - delivering operating temperatures up to 100°C and withstanding vibration and sealing requirements. They are compatible with automotive-grade transceivers and meet all IEEE 802.3 1GBase-T electrical requirements.**

**Visit avnet-abacus.eu/belfuse**





bel MAGNETIC SOLUTIONS
a bel group

**A COMPACT, ROBUST AND VERSATILE CONNECTOR SYSTEM**

The Minitek MicroSpace™ crimp-to-wire connector platform's unique design meets LV214 -2 specifications and is available in 1.8, 1.5 and 1.27mm pitch versions. Minitek MicroSpace™ connectors are available in single and double row versions, with top and side latch configurations. Designed for simple and secure mating, the system features keying to prevent visual mismatching, Terminal Position Assurance (TPA), primary and secondary contact retention, and Connector Position Assurance (CPA).

## FEATURES

- Design based on existing and proven design controls
- Existing crimp section and automated crimp tooling up to 22AWG
- 4N normal force for vibration and >65N connector locking strength
- Human error-preventing polarisation
- Current rating up to 4A per contact

## BENEFITS

- Suitable for harsh environments
- No specific industrial tools required
- High vibration and locking resistance
- Visual mismatching prevention system
- Meets higher power performance requirements

## APPLICATIONS

- Cameras/sensors
- Cluster navigation
- HVAC
- Lighting
- Power steering
- Audio visual equipment

For more information visit:
avnet-abacus.eu/amphenol-icc-automotive

**Amphenol ICC**

**Aptiv (formerly Delphi) is a global technology company that develops safer, greener and more connected solutions enabling the future of mobility.**

Headquartered in Dublin, Aptiv has approximately 150,000 employees and operates in 14 technical centres, as well as manufacturing sites and customer support centres in 45 countries.

Aptiv has 12 dedicated product lines including their high voltage product portfolio covering HV Interconnects, HV Inlets and HV Charging Cables.

With a focus on auxiliary devices, power conversion, 48V, charging applications, Aptiv offers a wide range of solutions to meet the needs of today and tomorrow's growing demand for electrification.


**For more information visit:**
**avnet-abacus.eu/aptiv-automotive**

APTIV

# Steering automotive supply chains to success

We talked to Stephan Smit, Director Strategic Automotive Accounts EMEA at Avnet Electronics Marketing, to find out how Avnet works with automotive customers to keep their production lines running smoothly.

Stephan began his career as a technology marketer, before moving on to various roles, including sales engineer and corporate accounts manager at Avnet Electronics Marketing.

## Interview: Stephan Smit, Director Strategic Automotive Accounts EMEA at Avnet Electronics Marketing

As director of strategic automotive accounts for the EMEA region, he is responsible for the strategic Tier One automotive customers and their supplier partners/manufacturers that sell directly to car makers.

Avnet takes the categorisation a stage further, defining strategic Tier One automotive customers as those who provide core technologies, such as engine control units, to the car makers. Smit, in his role serving these suppliers, has deep insights into the evolving needs of car makers and how the supply chains that service them must adapt to support them.

"Car makers see themselves as at the centre of a triangle, with original component manufacturers at one point, the Tier One automotive customers at a second, and distributors such as Avnet, which help the other two match supply and demand, at the third."

Fulfilling that role means that Avnet has to understand and react to a host of rapidly evolving trends in the car industry.

**Macroeconomic trends**

The global nature of the car industry is nothing new, but it does mean that local supply chains can be disrupted by geopolitical events half a world away.

Smit highlights a number of recent trends that are having an impact here in Europe. For example, China has a strong appetite for European luxury brands, which is good news for manufacturers such as Audi, BMW and Mercedes-Benz. Trade tensions between the US and China, however, are affecting these vendors because they make many of their luxury models for the Chinese market in the US.

**'Car makers see themselves as at the centre of a triangle, with original component manufacturers at one point, the Tier One automotive customers at a second, and distributors such as Avnet, which help the other two match supply and demand, at the third.'**

European sales are also affected by the growing strength of Asian vendors in the global market. And uncertainty over Brexit is pushing the whole supply chain to plan for operating in a new legal regime, whose form will not be settled until the UK exits the European Union, and possibly not even then, when it comes to the most detailed provisions for future trade.

The global scandal over diesel emissions has also prompted new regulations about emissions from internal combustion engines, which has caused a wave of re-engineering and re-qualification for processes and vehicles.

**Technological trends**

One of the most obvious trends in the car industry is the rapid increase in the value and sophistication of the electronics used in vehicles.

"What began as a car radio ten years ago soon added satellite navigation and later became a full-blown infotainment system. Now it is more like a digital cockpit," says Smit. "It's completely changed, and those changes have come at a price. The car makers used to focus on their engines, but now the key selling points for a vehicle are choice and quality of interfaces to smart phones and tablets."

This is driving up the average value of the electronics content of a car, from around 35% now to over 50% by 2030. "With annual car sales hitting around 100 million units, that's a lot of components and subsystems to be made and supplied."

These trends are only likely to accelerate when major technological shifts, such as the rise of vehicle autonomy, increased connectivity, and a move to hybrid and eventually entirely electric drivetrains, take hold.



# Steering automotive supply chains to success

**Vendor trends**

These macro-electronic and technological trends are driving changes at both the car makers and their suppliers.

The rapid pace of consumer electronics development is forcing car makers to shrink their model lifecycles. Otherwise, as Smit says, "when you get into a five-year-old car you can immediately feel that it is old."

The car makers are responding by investing in research, development and engineering resources, as well as forecasting, so that they can take more of the key technology decisions in house. The Tier One automotive customers are responding in similar fashion, focusing on R&D and sales and marketing support. And so the relationships among the four players in the industry triangle described above have evolved.

Car makers now consult with the component manufacturers on technology, with the Tier One automotive customers on a business basis, and then rely on distributors such as Avnet to understand and deliver what they need in terms of the quality of supply processes, global consistency, and the right information, material and financial flows.

A lot of the outsourcing that has taken place as car makers and their Tier One automotive customers focus on their differentiating value has been enabled by the availability of standards. But in rapidly developing areas such as vehicle autonomy there are, as yet, no standards. For example, there is no standard dashboard symbology for engaging cruise control, and so Avnet has to understand and work with the pre-standardisation approaches of multiple car makers.

**Distributor trends**

Distributors are finding themselves at the sharp end of other major market trends. One of these is the industry's gradual shift from making cars to providing mobility. It's not at all clear whether in the future cars will be bought by individuals, by car-sharing companies, or even a new breed of mobility-provision platforms.

A second trend is the possibility of new market entrants from non-traditional sources. The most obvious sign of this is in the rise of entirely new vehicle brands, especially in the electric vehicle market in China. Less obviously, companies such as Uber, Google and Apple may use their strengths in connectivity and software to enter the car market, treating the vehicle itself as a sub-assembly to be contracted out to trusted partners.

A third trend is the increasing complexity of supply chains. Existing component manufacturers continue to diversify the geographical base of their operations, making it more challenging to align supply logistics and quality globally. At the same time, as the Tier One automotive customers continue to strengthen their focus on R&D, marketing and sales, new players, such as the electronic manufacturing services companies, are stepping in to take the burden of manufacturing off their shoulders.

Outsourcing is not a riskless strategy, though – your supplier can always mess up – so car makers are looking for multiple forms of redundancy, using multiple Tier One automotive customers to produce key modules, which have been designed to allow some level of component substitution.

"Obviously, we need to build supply chains for these players," says Smit.

**'The rapid pace of consumer electronics development is forcing car makers to shrink their model lifecycles. Otherwise, as Smit says, "when you get into a five-year-old car you can immediately feel that it is old".'**

**Building the right supply chain**

A robust supply chain that can cope with all these issues doesn't just happen. Avnet has a 25-strong team that is dedicated to designing them, and since minimising risk is the most important task in automotive engineering, it also monitors the resultant supply chains continuously to ensure they keep providing what their customers need.

Avnet's role in the supply chain is to make life simpler and more predictable for both the component manufacturers and the Tier One automotive customers. For example, if a component manufacturer wants to deliver once a month, but a Tier One automotive customer wants to draw off stock on a weekly or even just-in-time basis, Avnet can buffer that mismatch.

Component manufacturers get other help from Avnet, such as centralised demand planning, based on deep insights into customers' production facilities worldwide, and bespoke reporting at a global, multisite level for inventory, forecasts and defined KPIs. Avnet can also manage deliveries centrally, decoupling component manufacturers from the complexities of the global supply chains of Tier One automotive customers, and can even re-label components to meet the custom requirements of individual Tier One automotive customers.

"We play on a horizontal level to help ensure some consistency in the supply chain," says Smit. "A lot of this is enabled by the existence of standards, either global or national standards ratified by an independent body, or standards set by an individual manufacturer."

To ensure a solid basis from which to try and ensure global consistency of the components that it sources for its Tier One automotive customers, Avnet has teams that are dedicated to understanding both international open standards and manufacturer-specific standards, working across 12 time zones and with 250 production facilities.

Risk mitigation also drives a focus on good component traceability, with both date-code labels and lot numbers on incoming supplies. While this may seem excessive for suppliers of simple passives, Smit points out that more sophisticated components such as memories and microcontrollers are likely to go through multiple revisions, including die shrinks, during their production lifetime. Knowing exactly which version of a chip has been used in a subsystem or module may one day be critical to customer safety.

**Transparency and insight**

A distributor such as Avnet obviously works in commercial confidence with both its component-manufacturer partners and its Tier One automotive customers, but nonetheless can find itself acting as a crossroads for rich information flows about what is going on in the car industry.

Non-Disclosure Agreements (NDAs) usually limit information sharing, but three-way NDAs can help improve transparency between willing partners. And then there's the tacit knowledge that the Avnet account teams build up through their experience of serving the automotive industry.

"At the end of the day, we're trying to help the component manufacturer and the Tier One automotive customer to understand each other's capabilities and needs," says Smit.

Often the Tier One automotive customers are looking for a strategic supply chain partner enhancing the transparency between themselves and their EMS/ODM partners. All these processes are conducted though the highest compliance standards subject to but not limited to confidentiality.

Editorial

# C&K: switched on to modern automobile requirements

Cars are increasingly becoming a platform for integrated electronics and software, with this element often comprising more than 30 percent of the vehicle's cost. In this competitive environment, meeting new test and reliability standards while delivering the experience that drivers demand requires a holistic approach, and that is just as true for switches as for any other component.

**Delivering reliable electronics**

The growth of electronics in modern automobiles has meant a vast increase in the computing power required, and that trend will only hasten with the advent of the autonomous vehicle. The engine, power train, chassis, body systems, comfort systems, active safety and driver's assistance systems all rely on electronics.

However, this complexity is causing problems when it comes to designing and testing these electronic systems – which is why most automakers are building their vehicles around the ISO 26262 standard. This standard is the industry's attempt at establishing best practices for designing reliable and safe automotive electronics systems. The standard requires that car makers perform an evaluation of the vehicle design to create an "automotive safety integrity level" (ASIL) rating that describes the failure impact based on exposure, controllability and severity. Car makers use this evaluation to design a vehicle's electronic system architecture. The architecture's requirements will be shared along the supply chain – and may have an impact on component definition.

Although switches are not the most expensive component within automotive electronics, they are critical to the success of any project because of their role within electronic units. The functional requirements depending on ASIL level for each function or system have a direct impact on the switch design and its properties.

Based on these new requirements, C&K can support electronic unit design by offering flexible, high-quality solutions. We have a wide range of switch contacting technology that enables designers and engineers to create the vehicle they intended without compromises, based on three major properties: redundancy, self-failure detection and extended life.

Our high-quality switches extend the life expectancy of applications, including the double-throw and double-pole switches that are so important in creating an ISO 26262-compliant automobile. We develop and manufacture our own products and solutions, so we are able to provide our customers with a product assessment within real actuating conditions. This way, our customers can be confident that the switch works within their design before it is shipped. C&K also offers application engineering services to support customers within the design phase.

**Haptics is the watchword for next-generation automotive switches**

While ensuring that automotive switches perform their function, reliability is of paramount importance, just as crucial as their look and feel. In modern vehicles manufacturers are enhancing the driver's experience as an important way to differentiate their brands, and the look and feel of the interior plays a significant role here.

This is where haptics comes to the fore. It is defined as the science and physiology of the human sense of touch, and acoustics is now also at the centre of automotive designers' thought processes. The look, feel and sound form an important part of the brand identity of the vehicle, and switches are key to this. Haptics and acoustics not only differentiate one manufacturer from another, but can also be used to define the position of a model within a range of automobiles from the same manufacturer.

In the past, dashboards were predicated on robust pushbutton or toggle switches with relatively long


travel. But in this age of smartphones, and with the proliferation of electronic gadgets, consumer tastes have evolved. They now demand smaller, more responsive tactile switches that still supply the same haptic experience they have been accustomed to.

Nowadays, automotive manufacturers, and the companies producing subsystems such as switch panels for them, often produce detailed specifications for the haptic and acoustic performance of the switches they select to ensure that they conform to the brand identity as well as delivering consistency over time.

There are several factors that define the sound made by a tactile switch, such as dome material and composition, structure and design of the switch body, and how the switch fits into the larger system. Characterising the acoustics of any switch usually involves measuring the audible spectral components of the sound made, using an accurate sound meter in a carefully controlled environment. To achieve this, C&K has invested in a state-of-the-art acoustic chamber with accurate sound evaluation that enables evaluation of individual switches and customer sub-assemblies.

Some integrators are attempting to build tactile switches themselves, fitting domes and membranes to a PCB to optimise the cost compared to a discrete switch. But this approach is fraught with problems. It needs many switches in an array to be cost-effective, specific PCB plating is required, and dust management is another challenge. An off-the-shelf tactile switch is guaranteed to perform to specification (including haptics and acoustics) by the manufacturer, and reliability is assured, as is the sealing of the assembly.

**Delivering performance through a holistic approach**

Having ensured that the switch selected for the automobile is reliable, meets the ISO 26262 standard and delivers the desired haptic experience for the customer, it is vital to ensure that it meets these requirements time after time.

While it is essential that any solution reflects the features and requirements that have been defined or highlighted, it must also meet the cost constraints in order to be commercially viable, as well as meeting the needs of the customer. In this context, "cost" refers to more than just the cost of the component; it also has to include everything needed to integrate the solution, for example connection costs and assembly costs – the so-called "total cost of ownership".

However, this approach to design is only valid if the final design is well controlled in manufacturing so that every single product meets the customer's needs. In many ways, the manufacturing process is at least as important as the product itself. As designers and manufacturers, we can adapt our processes and optimise our tools and machines to meet the needs of all customers and designs.

In summary, delivering custom solutions is much more than just meeting a specification. To be truly successful you must combine expertise with design excellence, innovative manufacturing engineering, attention to customer expectations and cost control.

In short, a holistic approach to custom switch design is the key to success.

For more information visit:
avnet-abacus.eu/ck-automotive

C&K®


# Hirose FX18 series, high speed board-to-board connectors with multi-functional contacts

Hirose

Hirose Electric Co. Ltd. has introduced the FX18 series to meet application requirements for connectors capable of speeds greater than 10 Gbps.

The innovative structure of the connector features advanced multi-functional ground, power supply, and three-step sequential contacts. As well, as providing superior ground properties, the ground contacts are strategically positioned next to the differential pair contacts to reduce crosstalk.

The power supply contacts offer up to 3A (amps) per pin meaning signal contacts are no longer needed for power, resulting in the saving of valuable space. A total of 12A can be used.

Within the housing, the three-step sequential contacts are set back in different positions so that the ground contacts connect first, followed by the signal contacts, then the contacts for the detection of the mating connectors.

Six through hole pins are provided to allow strong resistance to wrenching forces.

Large mating guides on the header mean a smoother, secure, user friendly mating operation.

Incorrect insertion is prevented by keyed guides with integral chamfers. Visible solder joints, space for rework and the option of Pin In Hole Intrusive Reflow (PIHR) all allow a reduction in manual soldering.

The FX18 series is part of the FunctionMAX product family. FunctionMAX consists of board-to-board connectors designed to meet the requirements of the industrial market with maximum functionality.

## FEATURES

- Contact positions: 40, 60, 80, 100, 120, 140
- Pitch: 0.8mm
- Current rating: 0.5A (signal contact) /3A (multi-functional contact)
- Voltage rating: 100V
- High speed transmission: 10+ Gbps
- Versions: right angle, vertical and coplanar

## APPLICATIONS

- Medical devices
- Base transmission stations
- LCD TV, LCD displays
- Industrial controllers

For more information visit: avnet-abacus.eu/hirose

HIROSE ELECTRIC EUROPE B.V.

# ECQUA and ECWFG series automotive film capacitors from Panasonic

Panasonic

Panasonic has capitalised on its burgeoning film dielectric technology, to create new products for on-board charging and powertrain electronics for the electric vehicle market. The new AEC-Q200 qualified ECQUA and ECWFG series (metallised polypropylene film capacitors) from Panasonic Industry Europe offer safety and high reliability. Flame-retardant plastic case and non-combustible resin further reduce the risk of flammability.

An innovative in-house patterned metallisation process provides a very stable capacitance level and acts as a fuse mechanism preventing catastrophic short mode failure.

### ECQUA

- **Rated voltage:** 275V.AC (extendable to 305V.AC for short period)
- **Function:** interference suppression (safety class X2) for filtering
- UL60384-14, CAN/CSA E60384-14, EN60384-14, IEC60384-14 certified

### ECWFG

- **Rated voltage:** 630V.DC
- **Function:** power factor correction/smoothing/ filtering/snubber

## FEATURES

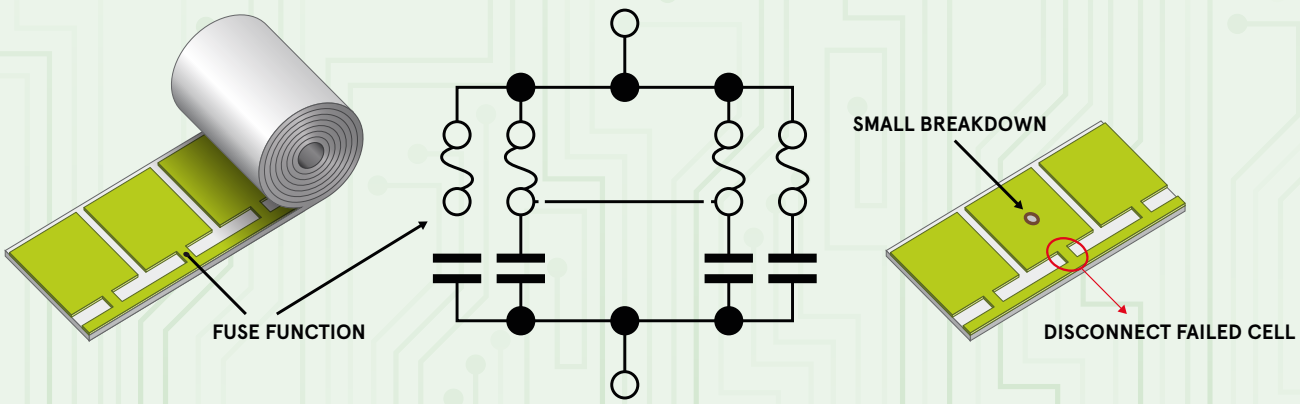
- **Capacitance:** 0.1µF to 4.7µF
- **Operating temperature:** -40°C to 110°C
- High humidity resistance (85°C, 85% RH, 1000 hours)
- High thermal shock resistance (1000 cycles)
- RoHs and REACH compliant

## APPLICATIONS

- On-board charger
- DC-DC converters
- Charging station
- Traction inverter for electric motor
- Electric compressor for AC system

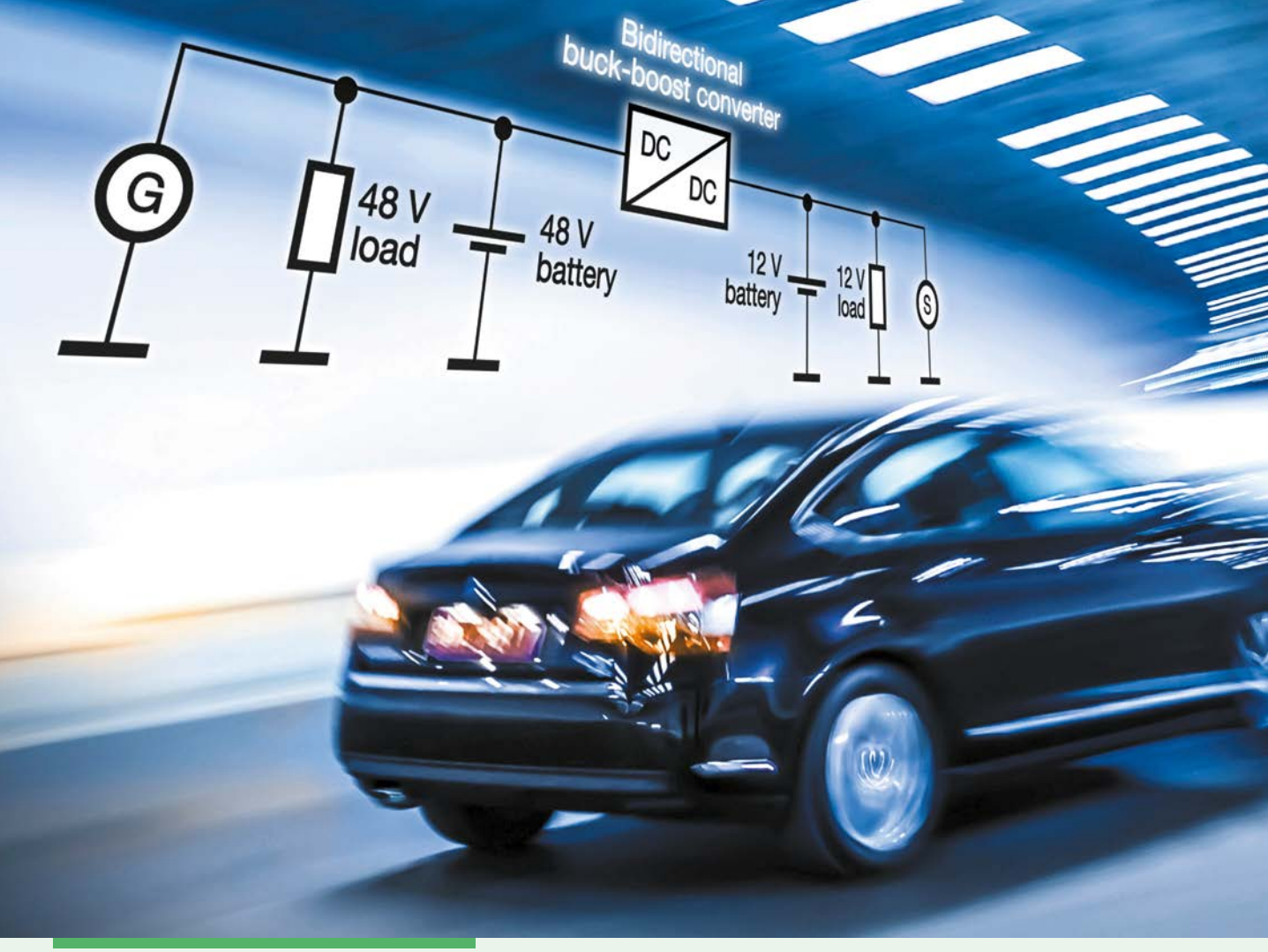

ECQUA series ECWFG series

## PATTERNED METALLISATION WITH FUSE FUNCTION




For more information visit: avnet-abacus.eu/panasonic

Panasonic




## TDK: well equipped for 48V

Some attractive advantages are offered by 48V technology for vehicles: It helps to reduce overall fuel consumption, reduces the environmental impact and can even improve the engine performance. The central component for this is a powerful buck-boost converter. With its power inductors and aluminium electrolytic capacitors, TDK offers key passive components for this purpose.

In view of the growing demands to reduce fuel consumption and $CO_2$ emissions, 48V technology offers attractive advantages. They are not a replacement for existing 12V architectures, but rather represent more of an extension to the 12V systems for handling powerful loads and is coupled to these systems by means of a buck-boost converter.

**Efficient coupling by means of buck-boost converter**

The most important component of a combined 12/48V system is the buck-boost converter which permits the bidirectional flow of energy between the two voltage levels. Figure 1 (right) shows the circuit diagram of such a converter.

TDK has developed two new series of EPCOS power inductors for the storage and smoothing chokes in the converters. The ERU 27 series of inductors, for example, are SMD components. They are characterised by their high current capabilities and very compact footprint of just 30mm x 27.8mm (Figure 2, right). Their insertion height is 15.5mm or 20.3mm, depending on their inductance value. This compact design is made possible by the use of a flat winding that offers a high volume fill factor. The inductors are available in six versions covering an inductance range of 3.5µH to 15µH. Their saturation current varies between 19A and 49A.

As an alternative to the SMD types, the EPCOS ERU 33 types with their PTH terminations can also be used

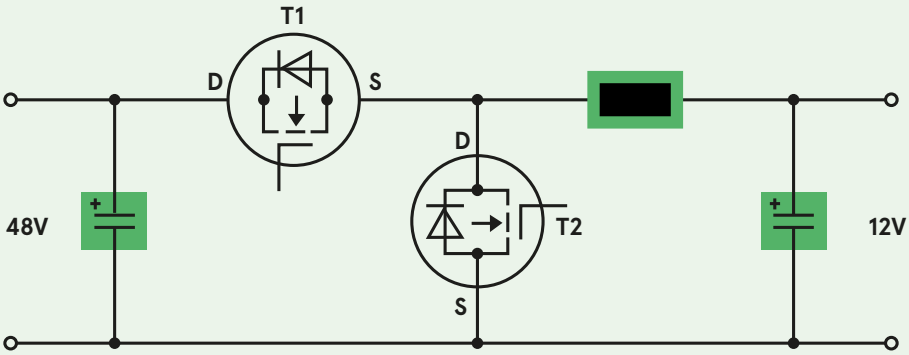



**Figure 1.** Circuit diagram of a buck-boost converter. Apart from the switching transistors, EPCOS power inductors and storage capacitors are the key components.

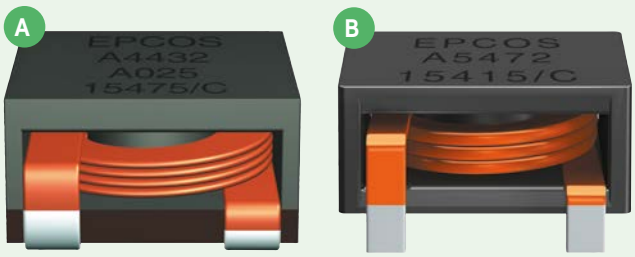



**Figure 2.** The compact EPCOS power inductors for buck-boost converters are available with current capabilities of up to 75A.


**Figure 3.** EPCOS aluminium electrolytic capacitors for automotive electronics are characterised by their extremely high vibration strength of up to 60g and maximum operating temperatures of up to 150°C.

(Figure 2, above). This series offers a rated inductance of 3.2µH to 10µH and – depending on type – they are even designed for a saturation current of 79A at an ohmic resistance of 0.85mΩ. The dimensions of these power chokes are 33mm x 33mm x 15mm. All the above types are suitable for operating temperatures ranging from -40°C to +150°C. They are also RoHS-compatible and qualified to AEC-Q200. In addition to the standard ERU 27 and ERU 33 types, customer-specific types with other inductance values can also be offered.

**Extremely vibration-resistant capacitors with high ripple current capability**

Apart from the inductors, the key components in buck-boost converters are robust aluminium electrolytic capacitors for storage and smoothing. The EPCOS B41689 and B41789 series (Figure 3, above) are specially designed for the stringent demands of automotive electronics. They are characterised by their extremely high vibration strength of up to 60g. The soldering star design and the version with cathode plate contacts on both ends of the capacitor enable optimised mounting with low ESL values.

Thanks to their multiple internal contacts, these capacitors also feature low ESR values, which results in a higher ripple current capability and lower losses. Depending on type, the continuous ripple current capability of these capacitors at a case temperature of 125°C reaches values of up to 29.5A. The automotive series are designed for rated voltages of 25V, 40V (for 12V) and 63V (for 48V). With these voltages they can be used in the new on-board power systems at both voltage levels. The capacitance range extends from 360µF to 4500µF.

For more information visit:
avnet-abacus.eu/tdk-automotive

# How advances in automotive systems are changing passive components requirements

The automotive industry is entering a period of rapid change. Car makers will have to adapt to multiple, concurrent challenges such as new market entrants, tougher emissions standards, vehicle electrification and the shift to mobility platforms, as well as customer demands for greater safety, autonomy and connectivity.

The good news for passive component makers is that addressing many of these issues will demand additional and more sophisticated vehicle electronics in which their parts will play a wide variety of key roles.

According to a recent McKinsey report, car makers face four key challenges, which will, in turn, set the context for automotive component makers until at least 2025.

The first is to cope with the increasing complexity and cost pressures caused by tightening safety and environmental standards, the trend to create more derivatives from each vehicle platform to service niche markets, and the need to keep developing alternative powertrain options to serve as-yet undefined future demand.

The second big challenge, according to McKinsey, is to move car manufacture and its associated supply chains closer to fast-growing emerging markets, whose share of the global car market is expected to grow to 60 per cent by 2020. This will also create demand for new models to match local preferences, such as for smaller vehicles.

The third big challenge is driven by the digital revolution, which is driving customers' expectations of vehicle cabin environments. Where once an SUV was sold, in part, on its deployment of cupholders, today the right choice of hook-ups for mobile phones, tablets and internet connectivity has become equally important.

The fourth major challenge is the shifting car industry landscape, in which component makers will supply more of the value-added content of a vehicle, production will move closer to growing markets, the European market will be restructured, and new entrants, be they Chinese e-vehicle makers or Apple, Google, and Uber, will challenge the incumbents.

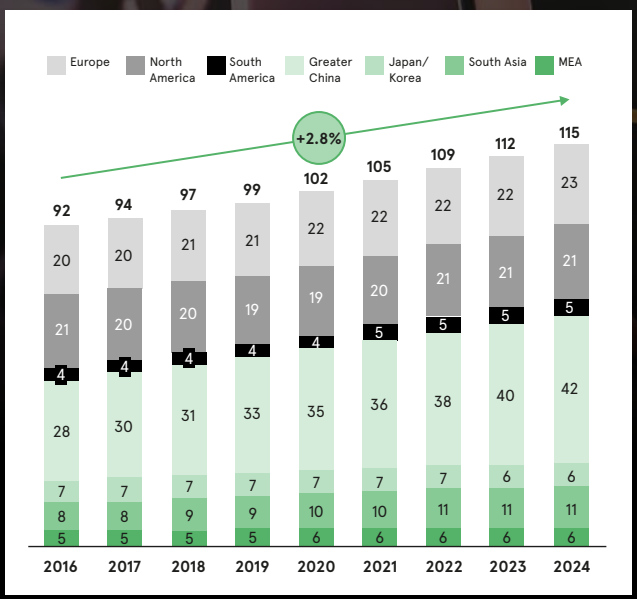
**Drivers for increased use of passives**

What do these macro-economic and industry-wide trends mean for the makers and buyers of passive components? Many market intelligence companies, of varying credibility, offer trend analysis reports, market forecasts and expert insights. Taken together, they paint a picture of a car industry that is increasing the electronics content of every vehicle it makes, and applying electronics to a growing variety of tasks, not just up-and-coming features such as vehicle autonomy.

For example, customer and regulatory pressure to improve driver, passenger and pedestrian safety, is driving a wave of safety innovation that, in turn, demands greater use of passive components.

Alan Jermyn

Vice President
European Marketing,
Avnet Abacus




Global car sales are expected to top 100 million units by 2020. (Source: AlixPartners)

Efforts to improve driving safety are boosting demand for a wide variety of sensors for use in safety-related applications such as braking systems, adaptive cruise control, blind-spot detection, lane-departure warning and even driver alertness. All these sensors need a clean source of power and some signal conditioning to extract the most information from their raw outputs. Once the signal has been conditioned and captured, it needs to be digitised, analysed and transmitted over vehicle buses.

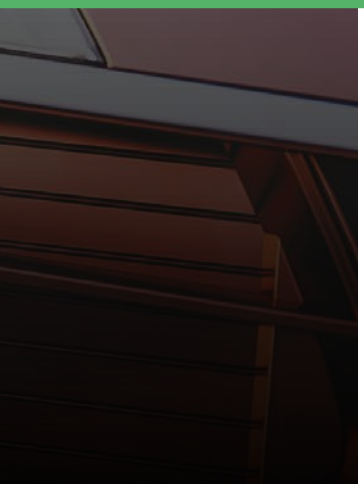
In the longer term, the shift from Advanced Driver Assistance Systems (ADAS), such as lane-keeping and adaptive cruise control, to increased levels of vehicle autonomy, is also creating demand for passives. Increasingly sophisticated ADAS systems are setting the scene for vehicle autonomy by introducing radar systems for cruise control and collision warning, multiple camera systems for interpreting the surrounding environment, ultrasonics for proximity

## How advances in automotive systems are changing passive components requirements

sensing and, eventually, LIDAR to provide another view of the driving environment with which to correlate other inputs.

Again, each of these devices needs onboard passives to condition the sensor for best operation, as well as to stabilise the power supply and ensure the sensor's data is transmitted successfully to whichever centralised system will interpret its signals and act upon them. Analysts ResearchandMarkets.com forecast that the global market for ADAS and autonomous driving related components will grow at a robust 22.31% a year, each year from 2018 to 2028.

**'Efforts to improve driving safety are boosting demand for a wide variety of sensors for use in safety-related applications such as braking systems, adaptive cruise control, blind-spot detection, lane-departure warning and even driver alertness.'**



Infotainment systems are also demanding more passives. What used to be a car dashboard has evolved into a powerful combined information and entertainment centre whose facilities are expected to match, or at least not lag too far behind, the leading edge of consumer smartphone and tablet design. Car buyers expect sophisticated navigation systems, extensive vehicle monitoring, onboard multimedia playback as well as personal device integration (Android Auto and Apple CarPlay), and increasingly, connectivity both for passenger internet access and vehicle services such as the OnStar safety and security system. Analysts Data Intelligence suggest that the global market for automotive infotainment systems will grow in value from $1.45bn in 2018 to $4.2bn in 2022, creating further demand for passives.

The increasing complexity of infotainment systems is matched, if not outstripped, by the growing complexity of behind-the-scenes systems such as Engine Controller Units (ECUs), body controllers and the myriad subsystems that handle everything from keyless entry to vehicle security. Together they form a complex distributed network of sensing, computing and control that has to be tied together by sophisticated bus structures, over which signals are sent and received by transceivers. Analysts Global Market Insights reckon that global shipments of automotive transceivers will rise to 7 billion units a year by 2024. Many of these transceivers will be used to enable increasingly sophisticated control of Internal Combustion Engine (ICE) powertrains, to achieve better emissions control and greater economy.

The transition to hybrid and eventually fully electronic powertrains will also increase demand for passive components. Hybrid vehicles need sophisticated ECUs to manage the transition between electric and ICE driving, as well as regenerative-braking and battery-charging strategies. Fully electric vehicles exchange the complexity of managing a hybrid powertrain for the challenge of trying to ensure predictable range, fast charging and good performance from still-evolving battery technology. All this demands rich sensing, robust communications, and extensive use of power-electronics devices, and their supporting circuitry, to manage the flow of very large amounts of electrical energy. Component maker Murata, for example, reckons that the number of multilayer ceramic capacitors used in each vehicle could rise from between 1000 to 3000 parts today to 8000 when powertrains go electric.

### Components for automotive applications

Automotive passives have to work hard.

They must offer very high reliability so that they work correctly for a vehicle's multiyear lifetime, across extreme temperature ranges, from polar winters to desert summers. And they have to do all this while surviving mechanical shocks and complex vibrations; frequent thermal cycling; electrical, electrostatic and electromagnetic interference; constant exposure to moisture, humidity and solvents; and possible mechanical stresses due to flexing PCBs.

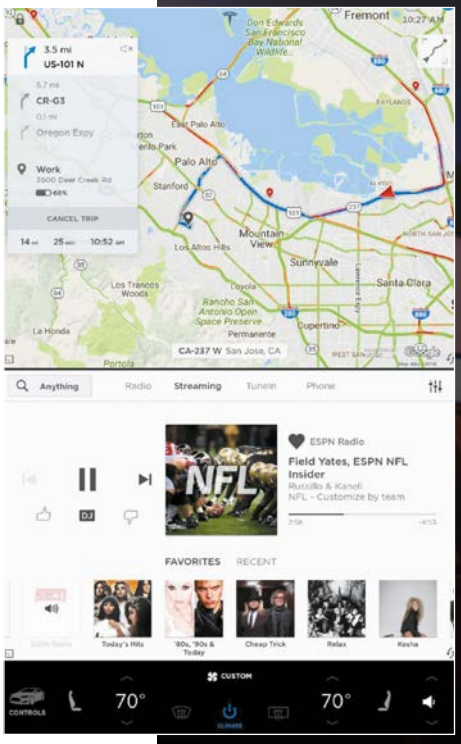
The automotive electronics industry has responded to this laundry list of challenges by defining a component stress-test standard for passive components known as AEC-Q200. The standard covers all the issues mentioned above, as well as production issues such as solder-ability and resistance to soldering heat. Although AEC-Q200 appears comprehensive, some manufacturers apply further statistical tests to their manufacturing lots in order to be able to claim greater levels of component reliability.

For example, Panasonic has developed the EEH-ZE series hybrid aluminium electrolytic capacitors for use in filtering the inputs and outputs of power converters and voltage regulators, and for power and battery decoupling. The AEC-Q200 compliant parts are designed to operate from −55 to 145°C, have a thermal endurance of 2,000 hours at 145°C, can sustain high ripple currents, and have low equivalent series resistances. Nichicon offers UBY aluminium electrolytic capacitors for use in electric power steering and direct-injection engine drive systems. The parts offer higher capacitances and withstand much higher ripple currents than other electrolytic capacitors. The UBY parts are available with capacitances from 160 to 12,000µF, at operating voltages from 25 to 100V, and with a rated temperature range from −40 to +135°C.

The reliability challenge is likely to become bigger once vehicle makers move from 12V DC to 48V DC power systems, so they can offload engines by powering subsystems such as the steering, brakes, water pumps, radiator cooling, and air conditioning electrically. When this happens, automotive electronics designers will have to spec and source passives that can sustain relatively high voltages, high currents, and high operating temperatures, reliably over the long term. This may have profound consequences for their manufacturing processes if, for example, it requires a shift from the use of surface-mounted to radial-leaded components that have to be wave soldered.

This challenge will continue as the automotive industry shifts to e-mobility. Passives manufacturer TDK has responded by creating a range of CeraLink capacitors in low-profile packages, which can act as ripple-current suppressors, DC link capacitors, and snubbers. The parts have been designed for use in fast-switching automotive power supplies and inverters, made possible by the availability of new IGBTs and MOSFETs, where low equivalent series resistances and inductances are important.

These are just some examples of the ways in which the passive component industry is adapting to the multiple challenges that its automotive customers are facing as their industry evolves. Automotive electronics designers can be reassured that, despite cars becoming more complex, their suppliers are working hard to ensure that they have the parts they need to succeed in this increasingly challenging design environment.




Dashboards have become infotainment systems, like this one used in a Tesla. (Source: Tesla)

# PRG series PTC thermistor resettable fuse from Murata

Murata

Murata has developed the PRG series PTC thermistors for overcurrent protection for use in a variety of applications such as automotive and LED lighting. The innovative use of ceramic materials has resulted in quicker protection after a short circuit and higher reliability. Equipment therefore is safer and requires less maintenance.

If you compare the PRG series to PTC elements and chip resistors that have the same characteristics, the PRG series has higher reliability with less characteristic changes after mounting on the PCB. Additionally the PRG series has a longer life cycle.

## FEATURES

- Compact design
- Low profile
- High reliability
- Stable performance during operation
- RoHS compliant
- Halogen free
- UL : E137188 VDE, TUV etc. recognised
- Wide range of operating temperature (-20°C to 85°C)
- Fastest time to trip
- Current 10mA to 75mA
- Voltage up to 32V

## APPLICATIONS

- Automotive
- LED lamp/navigation/ motor/electrical component
- Factory automation equipment: motor drive, sensor controller
- Charger
- USB port protection
- Mobile phone battery and port protection
- Note PC, tablet PC

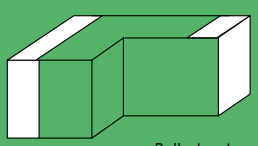
## FEATURES OF MURATA'S CERAMIC PTC

Multi-layer structure enables high voltage and power capacity.

Ceramic materials allow for quick protection, low maintenance and increased safety.

**LEGACY TECHNOLOGY**

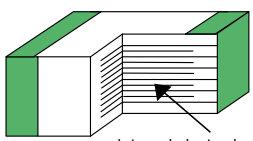
- Lower voltage
- Lower hold current (up to 20mA with 30V)



Bulk structure

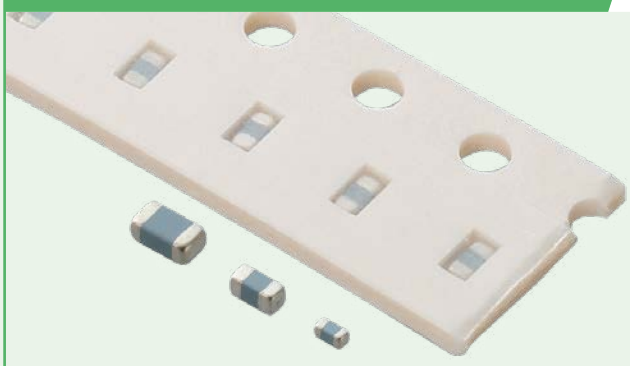
**MURATA TECHNOLOGY**

- Multi-layer structure
- Over 30V max.
- Higher hold current (260mA)



Internal electrode

**Multi-layer technology drastically reduces resistance.**



Thermistors POSISTOR PRG

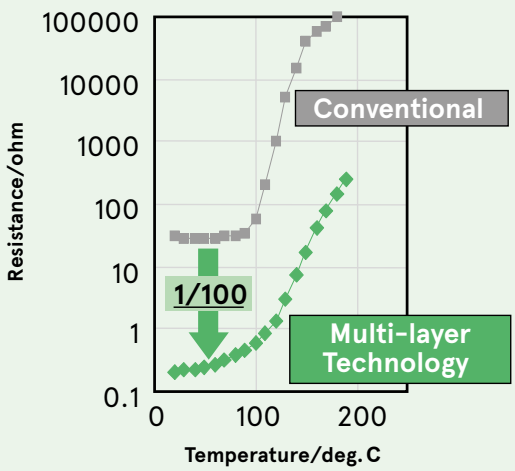



**Figure 1.** Comparing traditional technology and the key benefits of the Murata solution.

muRata
INNOVATOR IN ELECTRONICS

For more information visit:
avnet-abacus.eu/murata-automotive

## X8R automotive MLCC from Yageo

YAGEO

Yageo's X8R dielectric MLCC has a capacitance stability of ±15% between -55°C to +150°C, and is designed for target markets such as automotive and other segments requiring extreme temperature applications.

The X8R series features improved thermal and mechanical robustness with a 150°C maximum operating temperature. In applications where reliability is the primary concern, the X8R is highly recommended.

In addition to automotive, other applications such as oil well exploration, high temperature camera modules, and military and aerospace industries are suitable for the X8R.

Production part approval process (PPAP) documents are ready for all the X8R series items.

### FEATURES

- AEC-Q200 qualified
- Higher working temperature up to 150°C
- 100% performed by automatic optical inspection prior to taping
- Soldering J-STD-020D compliant modules
- RoHS compliant
- Compact footprint

### APPLICATIONS

- Power systems
- Automotive
- Military and aerospace
- Industrial equipment

For more information visit:
avnet-abacus.eu/yageo-automotive

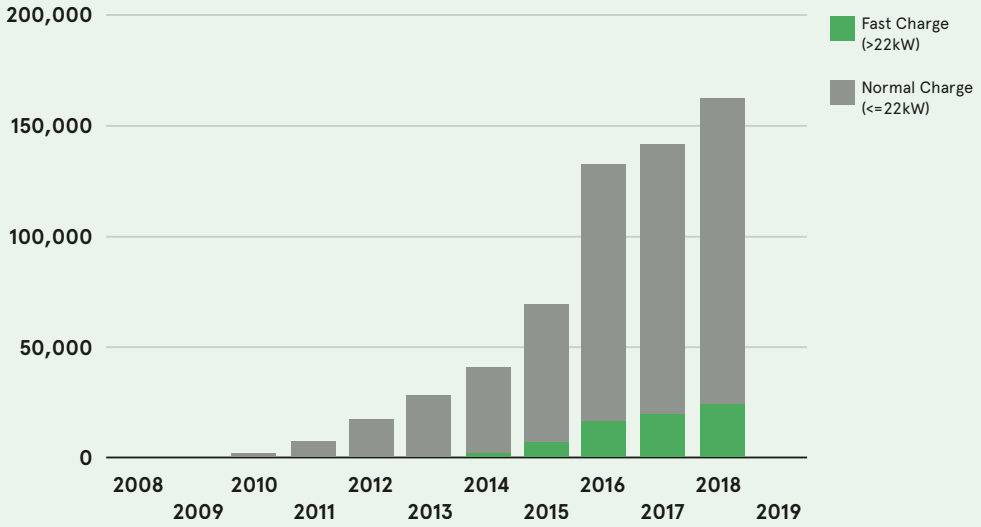

YAGEO

# Developing the charging infrastructure for wide-scale electric vehicle adoption

Alessandro Mastellari

Technical Specialist,
Avnet Abacus

Concerns about carbon emissions and urban pollution are encouraging the automotive industry to introduce hybrid and fully electric powertrains. Their work is being aided by steadily improving battery and motor technology, but is held back by the 'chicken and egg' problem of charging the resultant vehicles. To ensure that electric vehicles (EVs) have the same freedom to roam as today's fossil-fuel cars, a few challenges need to be addressed. Charging has to become faster, the world's network of petrol stations needs to be upgraded with electric-charging facilities, and standalone charging stations need to be introduced to compensate for EV's relatively limited range.

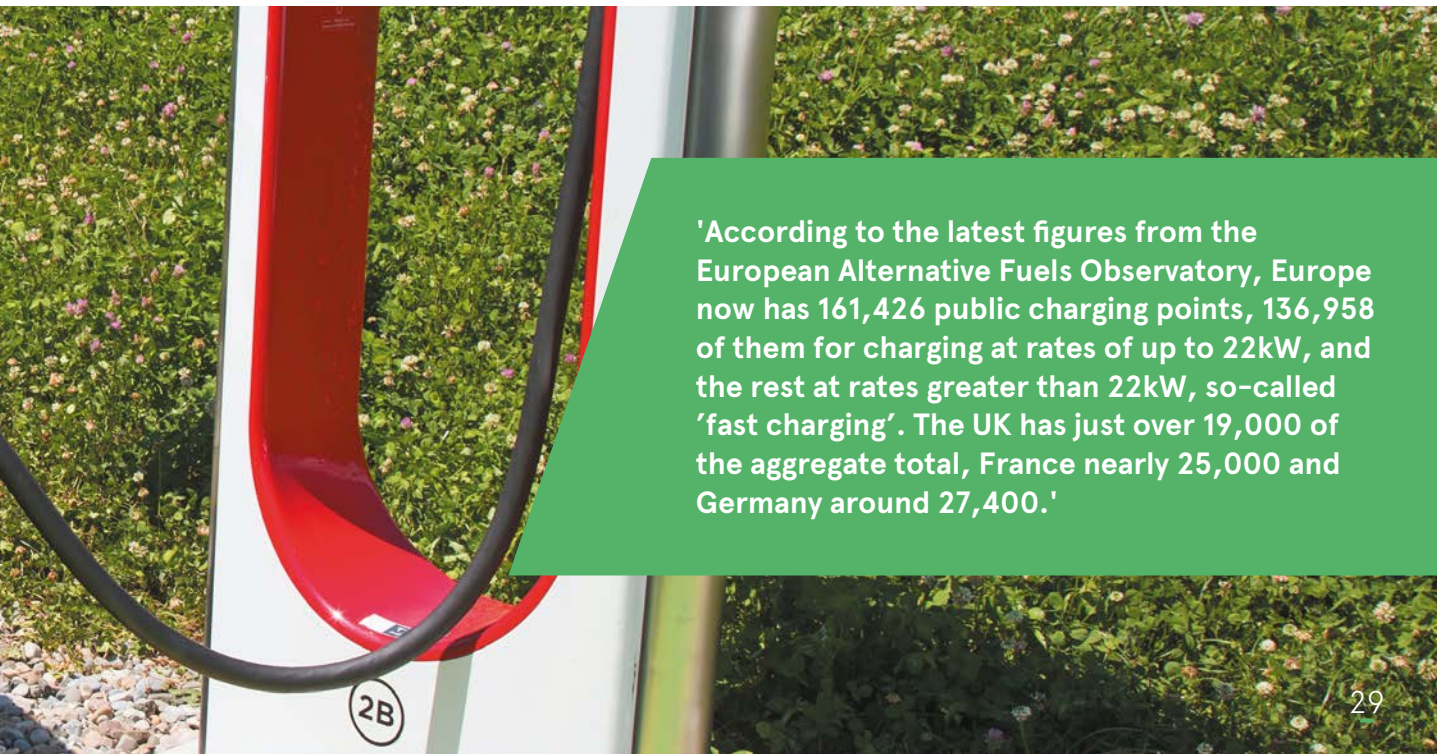



Europe's EV charging infrastructure is growing rapidly (Source: EAFO).

Why is this? A back-of-the-envelope calculation suggests that filling your tank with petrol is like connecting your car to a 5MW energy source. By contrast, Tesla announced in March 2019 that its V3 Superchargers will deliver energy at rates of up to 250kW, although it will take a liquid-cooled charging cable to make this possible. Despite EVs using their stored energy more efficiently than fossil-fuel cars, electric charging has a way to go before it can match petrol's ability to enable useful work in a vehicle. It will take a combination of high voltages, high currents and sophisticated power conversion, filtering and charge-management systems to close the gap. This, in turn, will demand the deployment of some pretty sophisticated connectors, cables, relays, conversion electronics, and passives, to ensure the same kind of fast, safe energy top-up offered by today's petrol stations.

**Charging network growth**

So how close are we getting to a ubiquitous charging network that drivers can rely upon to be there whenever they need it, rather than having to plan their journeys between chargers? Starting with the highest profile player, Tesla said during its V3 announcement that it now has more than 12,000 Superchargers across North America, Europe, and Asia, covering more than 99% of the US population now, and expects to achieve similar coverage in Europe by the end of this year. Tesla also said that it has recently passed 90% coverage of China's population.




**'According to the latest figures from the European Alternative Fuels Observatory, Europe now has 161,426 public charging points, 136,958 of them for charging at rates of up to 22kW, and the rest at rates greater than 22kW, so-called 'fast charging'. The UK has just over 19,000 of the aggregate total, France nearly 25,000 and Germany around 27,400.'**

## Developing the charging infrastructure for wide-scale electric vehicle adoption

In Europe, the number of EV charging points is increasing rapidly, thanks to public subsidies for buying EVs, new regulations, and the willingness of some fuel companies to install chargers in their petrol stations. According to the latest figures from the European Alternative Fuels Observatory, Europe now has 161,426 public charging points, 136,958 of them for charging at rates of up to 22kW, and the rest at rates greater than 22kW, so-called 'fast charging'. The UK has just over 19,000 of the aggregate total, France nearly 25,000 and Germany around 27,400 (please refer to graph).

Building charging networks also looks like it will be big business, if a report from market analysts Markets and Markets is to be believed. It forecasts that the market for EV charging stations will grow from $3.22bn in 2017 to $30.41bn by 2023, or 41.8% a year, every year, from 2018 to 2023. The report offers a number of justifications for its forecast, including subsidy programmes for purchasing EVs in various countries, and a US government initiative to develop 48 charging networks that will together cover about 25,000 miles of US highways across 35 states. This initiative led 28 states, utilities, charging firms, and electric vehicle companies, including GM, BMW and Nissan, to start working together.

**AC or DC charging**

These raw numbers appear encouraging for potential EV drivers but mask the fact that there is still a lot of variety in charging methods, the infrastructure available to support them, and therefore their usability to the average user.

Perhaps the biggest issue is whether an EV is charged using Direct Current (DC) or Alternating Current (AC). Batteries have to be charged with DC, and so the real difference between the two charging strategies is where the necessary rectification is done. Grid power is delivered as AC, and so some vehicles take AC onboard, in either single- or three-phase form, and rectify it to the appropriate DC charging voltage. Others expect rectification to happen in the charging stations, so that they can be charged with DC delivered over the cable.

DC charging can usually deliver more power, because charging stations can use larger, more efficient and better-cooled rectification circuitry than would be possible in a vehicle. Along with charging rate, the choice of AC or DC charging is also driven by decisions about who covers the capital cost of rectification: the operators of DC charging networks, or each owner of an AC-charged EV. Some charging standards also allow bidirectional energy flow, so that a distributed network of charging vehicles can act as both energy sinks and sources to stabilise the energy grid – which, in turn, can attain them regulatory support in some regions.

As you would expect in this phase of a rapidly developing technology, there is a tension between vendors trying to control their customer base by installing proprietary chargers and connectors, and the benefits of adhering to standards that expand the charging network for all. As has been seen multiple times in other technology evolutions, the perceived benefits of lock-in are slowly giving way to standardisation efforts, as EV customers begin to demand ubiquitous charging facilities and weigh their availability more highly in their buying decisions. This is leading to a shake-out in the market for EV charging.

Tesla has its proprietary supercharger strategy, while Japanese companies including Nissan and Mitsubishi have backed CHAdeMO (for Charge de Move), which allows bidirectional charging. China, the world's largest EV market, is establishing GB/T as its charging standard. In Europe, meanwhile, BMW, Mercedes-Benz maker Daimler, Ford and the Volkswagen group, which includes Audi and Porsche, are all backing the Combined Charging System (CCS), an effort to establish a multivendor, multi-technology standard.

CCS is being developed through the Charging Interface Initiative (CharIN), which is busy producing technical specifications and position papers for its vision of the future of charging. Its efforts include defining which protocols should control the charging process, suggesting what sort of signage, dashboard and user information should be provided at charging stations, and taking a view on the requirements for a possible future interoperable wireless-charging standard.

One of the most striking of CharIN's definitions, at least from a circuit designer's point of view, is the classification of DC charging levels. Its 'DC20' specification defines DC voltages of between 200 and 500V, currents of between 1 and 40A at 500V, for a relatively modest charging power of up to 20kW. At the top end of the classification schema, though, HPC350 (or High Power Charging) defines DC voltages of 200 to 920V, charging currents ranging from 5 to 380A at 920V, and a charging power of up to 350kW.

**The connector conundrum**

With such a large amount of power crossing what is effectively a consumer-managed interface, connector design is critical.

**'A third-party industry has sprung up marketing converters and adaptors to allow drivers to charge their cars from any charging station, although the charging rates achieved over such adapted connections may not be as high as when using the native connector.'**

The Type 1 connector, mainly used in Asia, is a single-phase AC charging plug that supports charging powers of up to 7.4kW. Type 2 plugs support three-phase AC charging, at up to 22kW in private settings such as a home garage, and up to 43kW at public charging stations. CCS plugs add two more contacts to a Type 2 plug for fast charging, enabling AC and DC charging powers of up to 170kW. The CHAdeMO connector allows for charging powers up to 50kW, while Tesla uses a modified version of the Type 2 Mennekes plug to enable its proprietary fast-charging approach. Interestingly, given the importance of the Chinese market, Tesla and others are starting to fit a GB/T fast-charging socket alongside their standard sockets.

As you might expect, a third-party industry has sprung up marketing converters and adaptors to allow drivers to charge their cars from any charging station, although the charging rates achieved over such adapted connections may not be as high as when using the native connector.

**The component opportunity**

The automotive industry is vast, producing close to 100 million vehicles year, and the transition to EVs offers huge opportunities to reshape it, for example through the emergence of new market entrants in China, a possible shift away from vehicle ownership to mobility as a service, and the potential for integrating vehicles into the power grid.

All this change creates huge scope for component makers to sell their existing parts and to innovate to enable new opportunities. For example, simply making the power devices used for in-vehicle rectification more efficient will have an immediate effect on the utility of an EV by enabling faster AC charging. More effective filtering will be needed to damp down high-power spurious signals. Connector design, as previously discussed, will become a key gating factor on charging rates and hence people's perceptions of the practical range of an EV.

All these innovations will have to meet rapidly evolving national and international standards, and be expressed in components that are delivered globally, in volume, to strict automotive safety and quality specifications. And as EVs take over from fossil-fuel vehicles, and our transport moves inexorably closer to consumer-electronics market perceptions and timescales, that means that component development and qualification will have to accelerate to match. It's going to be a hard-fought race to EV market dominance.

## ELECTRIC CAR PLUG TYPES

**TYPE 1 PLUG**
Single-phase plug used in car models from the Asian region.

**GB/T PLUG**
Similar to the Type 2 plug but with additional male connectors.

**CHADEMO PLUGS**
Quick charging system developed in Japan.

**TYPE 2 PLUG**
Triple-phase plug considered to be the standard model in Europe.

**CCS PLUGS**
Enhanced version of the Type 2 plug, with additional power contacts for quick charging.

**TESLA SC PLUG**
Modified version of the Type 2 Mennekes plug.

Car makers have come up with different standards for the type of plug used to recharge their electric cars. (Source: The Mobility House)

# TE Connectivity

## TE Connectivity DiBO+ Type 1 EV charging cable assemblies

TE Connectivity's (TE) Type 1 EV charging cable assemblies have a new and improved housing design with an ergonomically designed handle. It is capable of meeting high mating cycle requirements, with testing completed to 10,000 cycles. The product meets the SAE J1772 specifications and is UL 2251 recognised. Additionally, the cables meet UL62 cold impact requirements and are RoHS compliant.

**With over 50 years of experience, you can depend on TE to be safe and reliable in your application.**

Contact assemblies are sealed with liquid silicon rubber to protect against corrosion and moisture inside the connector body. Designed with the end user in mind, materials provide a crush-resistant connector body, meet outdoor classification F1 (UL) and are resistant to common automotive fluids. With over 50 years of experience, you can depend on TE to be safe and reliable in your application. Our core competencies in connectivity and cable assembly manufacturing provides customers with market-leading EV charging solutions.

### FEATURES

- High flexibility, UL62 cold impact approved cable
- Separate housing seal for each contact providing higher safety level than heat shrink
- Custom configurations for customer specific installations available (minimum volume required)
- Up to 32A and 240V
- TPA contact retention
- 3 colour options
- Contacts: brass (500Mpa stress)
- Silver over nickel plated brass
- Housing: UL94 V-0 rated thermoplastic
- Materials are rated UV exposure performance
- SAE J1772 approved
- Superior performance:
  - high flex cable provides superior flex life
  - maximum reliability and functionality for every movement
- Simple to use: ergonomically smaller handle to make it easier to fit security enclosures
- Safer: prevents moisture inside the connector body and corrosion of the crimping zone

### APPLICATIONS

- Type 1 electric vehicle charging
- EV charging stations

AUTHORIZED DISTRIBUTOR

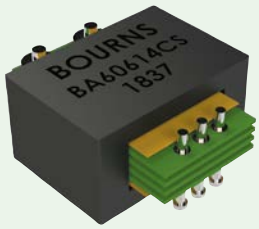
For more information visit:
avnet-abacus.eu/te-connectivity

## Bourns® magnetics for charging station applications

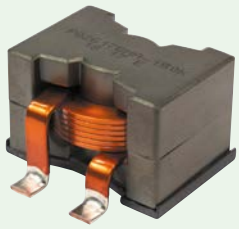
BOURNS

Bourns provides a wide portfolio of magnetic components and power transformers to meet your power supply application requirements.

The range includes transformers, choke coils, PFCs and PVCs as well as common mode chokes developed with improved core materials offering enhanced efficiency to IEC Standards.




Transformers

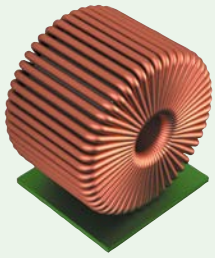


Choke Coils


CMCs

### CMC APPLICATIONS

- Automotive electronics AC and DC line filters



PFCs

### PFC APPLICATIONS

- Standard and custom design
- Customised assemblies

For more information visit: avnet-abacus.eu/bourns

BOURNS®

Panasonic
Electric Works

The HE-S relay from Panasonic Electric Works meets the requirements of the charging station market in one switching solution.

The printed relay is specially designed to meet the requirements of the IEC 61851-1, the international standard for electric vehicle conductive charging systems. This makes the HE-S suitable for every charging station following this standard and provides up to 22KW (3-phase system), with usual current up to 32A per phase.

The HE-S relay is available in a variety of DC coil voltages and is UL and VDE certified.

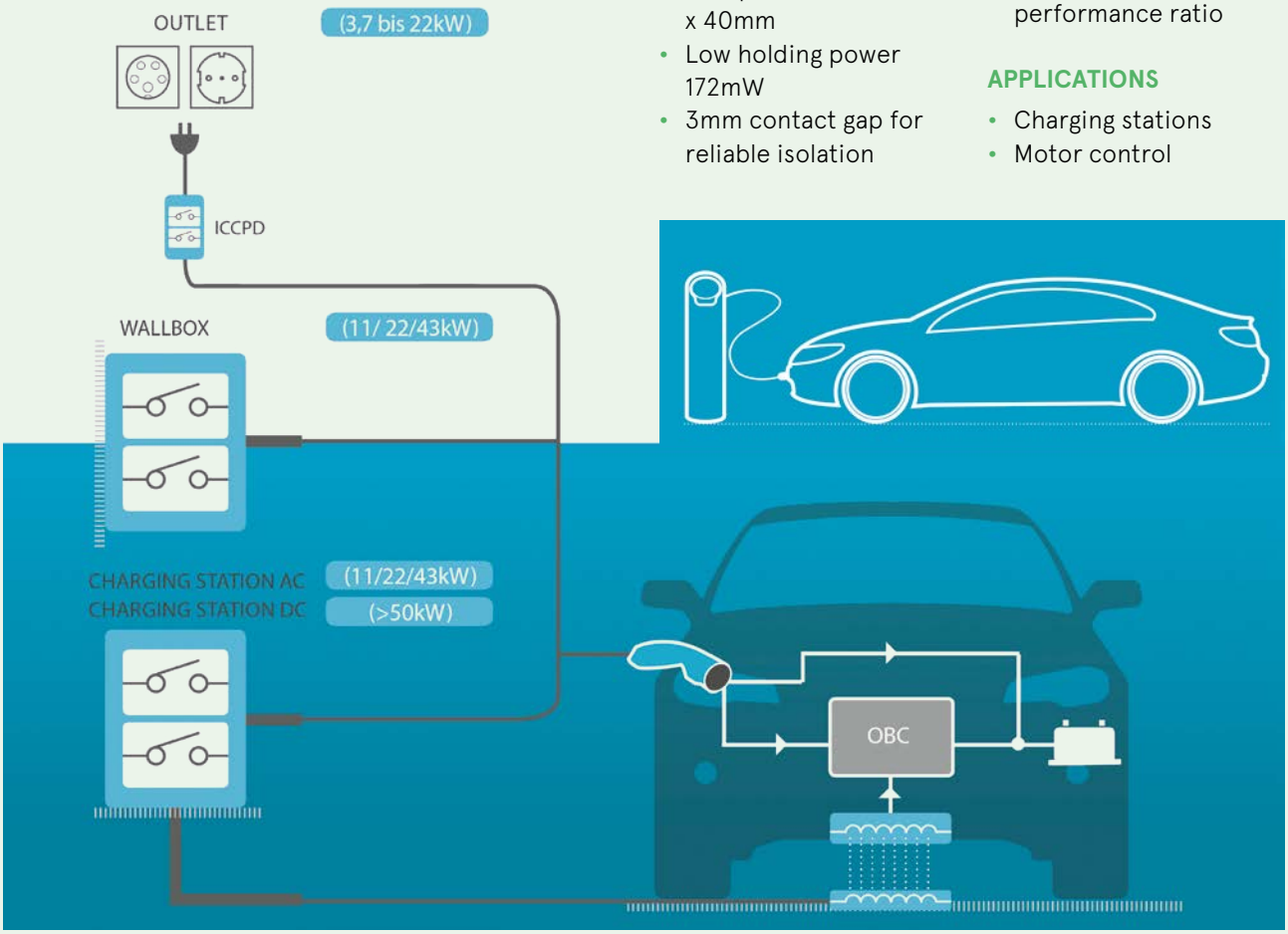
HE-S Relay 35A high power switching

## FEATURES

- Two NO contacts
- Power levels up to 35A/277VAC
- Compact size 36 x 30 x 40mm
- Low holding power 172mW
- 3mm contact gap for reliable isolation
- Mechanical life of 5 million operations
- Low contact resistance (a few mΩ)
- Optimal price/ performance ratio

## APPLICATIONS

- Charging stations
- Motor control




Panasonic

For more information visit:
avnet-abacus.eu/panasonic-electric-works

# Avnet Abacus receives two major distribution awards from TE Connectivity

For the first of the two awards, TE Connectivity has named Avnet Abacus as its '**Distributor of the Year**' for the EMEA region. This is based on Avnet Abacus' overall performance with special attention to key criteria including growth in sales and the development of new designs and projects, as well as delivering training based around the leading-edge products and technologies offered by TE Connectivity.

The second award, for '**Competitive Conversion**', has been given in recognition of Avnet Abacus' strong success in winning new business for TE products in competition with distributors offering solutions from alternative manufacturers.

"To win these two awards from the number one connectivity company in the world is a significant recognition of our capabilities and knowhow, and the contribution made across the entire Avnet Abacus team – from our engineering expertise to our skills in sales," said Alan Jermyn, VP European Marketing at Avnet Abacus.

"Not only have we expanded TE's business in the EMEA region, but very importantly we have also delivered on our strategy to develop new opportunities in exciting and fast-growing applications in a broad range of thriving industries."

"These awards are a clear acknowledgement of Avnet Abacus' company-wide commitment to our products and technologies," said Rabih Nehme, Senior Director EMEA Channel Sales at TE Connectivity.


Berlin, Germany 2019

"They have put in the necessary time and resources to fully understand our products and what is required to unlock the potential offered by our advanced technologies, especially with customers working at the leading edge in a number of areas including IoT and Industry 4.0 applications."

**'This is based on Avnet Abacus' overall performance with special attention to key criteria including growth in sales and the development of new designs and projects, as well as delivering training based around the leading-edge products and technologies offered by TE Connectivity.'**

# Engineers' Insight: the Avnet Abacus blog

## Solving design challenges

Avnet Abacus' technical blog, Engineers' Insight, is designed to help you solve key challenges across the breadth of markets and technologies we serve.

From electronics phenomena such as equivalent series resistance in electrolytic capacitors, to discussions on the best approaches to new wireless technologies, to in-depth design guides for power solutions, this is a blog written for engineers, by engineers.

**Where to read?**
**avnet-abacus.eu/engineers-insight**

AVNET ABACUS