VEHICLE electronics

The monthly magazine for automotive electronics engineers

Volvo, Hella and Jaguar invest in start-up Apex AI

A Silicon Valley start-up developing an operating system for production autonomous vehicles is attracting interest from some of the big players, with Volvo, Hella and Jaguar Land Rover all among the latest investors.



Jan Becker (left) and Dejan Pangercic

Called Apex AI, the company helps automotive developers implement complex artificial intelligence (AI) software. It was founded in 2017 in Palo Alto to build robust, reliable, safe, secure and certified software for autonomous mobility systems.

Its Apex Os runtime software environment is built on ROS (Robot Operating System) 2 and provides a production-grade safety-certified real-time framework for developing safe and secure applications.

Apex Autonomy provides functional building blocks for autonomous vehicles on top of Apex Os. These include libraries for 3D perception, localisation and planning.

"We are excited to invest in a company that enables easier development of safety-certified systems," said Anna Westerberg, acting CEO of Volvo Group Venture Capital.

Apex Os is being certified according to ISO 26262 as a safety element out of context (SEooC) up to Asil D.

The company was founded by engineers Jan Becker and Dejan Pangercic and raised $15.5m in a series A round late in 2018.

"The investment comes at a time of massive change for the mobility industry," said Becker. "As the development of autonomous systems advances, companies need software that is safe and reliable to run, a critical element as the industry moves from research to commercialisation."

Marco Marinucci, partner at Hella Ventures, added: "We believe that Apex AI is uniquely positioned in the autonomous vehicle space."

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January 2020

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Hyundai picks QNX for adas

Hyundai Autron has selected Blackberry QNX to power its next-generation adas and autonomous driving software platform.

Hyundai Autron, a subsidiary of South Korea's largest automobile manufacturer Hyundai Motor, is a research and development company specialising in electronic control software and automotive semiconductors.

Hyundai will use the QNX OS for Safety, software that provides the foundation for building automotive and mission-critical systems in a cost-effective and safe manner. QNX OS, pre-certified to ISO 26262 Asil D and high Sil levels under IEC 61508, is a secure embedded operating system developed for use in safety and mission-critical applications.

"We are excited to work with Hyundai Autron to provide next-generation automobiles with a secured adas and autonomous driving software platform," said John Chen, CEO of Blackberry. "Functional safety and security are top priorities in connected and autonomous vehicles."

QNX software is embedded in more than 150 million cars on the road.

"Hyundai Autron develops the Hyundai Motor standard software platform based on the international Autosar standard," said Dae-Heung Moon, CEO at Hyundai Autron. "Powered by BlackBerry QNX technology, together we will deliver adas and autonomous driving software that will set a new standard for the automotive industry."

• Tier-one Marelli's electronics business unit in China is integrating the QNX Platform for Digital Cockpits into its e-cockpit and digital cluster product.

Samsung shows smart dashboard



This smart dashboard is in Samsung's new retail space at Coal Drops Yard near King's Cross station in London and has been built to demonstrate the company's connected car technology that could be in on-road vehicles some time next year.

Powered by Samsung SmartThings, the driving experience is connected to the driver's smart home. Visitors to the demonstration area can explore how to turn on the lights, check inside the fridge or answer the door all from the driving seat. Similarly, they can check the fuel level or set the temperature in the vehicle before leaving home. These can be done by voice using Samsung's Bixby intelligence assistant.

"And you don't need a key," said Samsung's Benedict Adu Omiri (pictured). "You just look at it, it recognises your face and adjusts the car to your saved preferences such as what is shown on which cluster displays."

Other features include screens from the six cameras around the car to replace mirrors and monitoring technology to check if the driver is paying attention or falling asleep.

"It will then suggest somewhere near to stop for coffee and navigate you there," said Omiri.

BMW, Continental and NXP partner on UWB vehicle access

NXP, BMW and Continental are work on automotive ultra-wideband (UWB) use cases and standards through the Car Connectivity Consortium (CCC).

The work includes a chip developed by NXP that can turn smartphones into car keys.

UWB provides precise, secure, real-time localisation capabilities designed to give spatial awareness to UWB-equipped cars, mobiles and other smart devices, to enable cars to know exactly where the users are.

This means smartphone-based car access can provide the same level of convenience as the latest key fobs. Users can open and start cars, while leaving their phones in their pockets or bags, and enjoy secure remote parking via smartphone.

Furthermore, the UWB IC protects against car theft through relay attacks.

The three companies and others are jointly working on UWB implementations through the CCC and IEEE to improve the customer experiences at the intersection of the vehicle, mobile and consumer devices. These efforts aim to enable a global standard for hands-free smart access and other automotive localisation use cases based on UWB.



Chip turns smartphone into car key

"Today, the smartphone plays a central role in the digital lifestyle," said Olaf Müller, head of development at BMW. "We are convinced that the smartphone-based comfort access is just the beginning of a series of innovative vehicle-related UWB use cases."

The NXP NCJ29D5 is the first of a generation of UWB ICs designed for the global automotive industry.

"The opportunities that exist in the web of mobility and automotive are vast," said Markus Staeblein, vice president at NXP. "We have the ambition to tap these and bring more seamless and secure mobility experiences to users."

Other automotive UWB applications include short-range radar for life-sign detection and easy boot access, smartphone valet parking, autonomous positioning on electric vehicle chargers, drive through payment, localisation for secure on-the-go payment, and car-as-a-key to access garage doors and parking.

Denso and Toyota name joint venture

Denso and Toyota have named the joint venture they announced last summer (VE, August 2019).

Due to be established in April, Mirise Technologies will conduct research and development of in-vehicle semiconductors.

Mirise is an acronym for Mobility Innovative Research Institute for SEmiconductors. It also conveys "mirai", a Japanese word for "future", and "rise".

Yoshifumi Kato has been appointed president and representative director of the new company.

The goal for 2024 is to accelerate the development of in-vehicle semiconductors that play a key role in technology innovation for electric vehicles and automated driving vehicles from aspects of both vehicles and components by combining Toyota's knowledge on mobility with Denso's expertise in in-vehicle components.

Mirise will work on three technology development fields: power electronics, sensing and SoCs.

In power electronics, the company will work on R&D mainly for in-house production including contract manufacturing by leveraging semiconductor material technologies as well as manufacturing knowhow in electrification technologies, mainly in hybrid vehicles.

In the sensing field, the company will develop in-house production and cooperate with joint development partners.

For SoCs, the venture will strengthen its ability to determine the specifications of optimal SoCs for mobility.

Mirise plans to cooperate with universities, research institutes, start-ups and semiconductor-related companies.

Gartner forecasts 740,000 autonomous-ready vehicles by 2023

Within four years – by 2023 – there will be more than 740,000 autonomous-ready vehicles added to the global market, according to Gartner.

This is up from 137,129 units in 2018 and 332,932 in 2019. This growth will predominantly come from North America, China and Western Europe, as countries in these regions become the first to introduce regulations around autonomous driving technology.

"There are no advanced autonomous vehicles outside of the research and development stage operating on the world's roads now," said Jonathan Davenport, research analyst at Gartner. "There are vehicles with limited autonomous capabilities, yet they still rely on the supervision of a human driver. However, many of these vehicles have hardware, including cameras, radar and, in some cases, lidar sensors that could support full autonomy. With an over-the-air software update, these vehicles could begin to operate at higher levels of autonomy, which is why we classify them as autonomous-ready."

While the growth forecast for autonomous-driving-capable vehicles is fast, net additions of autonomous commercial vehicles remain low when compared with consumer autonomous vehicle sales. The number of vehicles equipped with hardware that could enable autonomous driving without human supervision in the consumer segment is expected to reach 325,682 in 2020, while the commercial segment will see just 10,590.

There are no countries with regulations that allow production-ready autonomous vehicles to operate legally, which is a major roadblock to their development and use.

"Companies won't deploy autonomous vehicles until it is clear they can operate legally without human supervision, as the automakers are liable for the vehicle's actions during autonomous operation," said Davenport. "As we see more standard regulations around the use of autonomous vehicles, production and deployment will rapidly increase, although it may be a number of years before that occurs."



VW digitises Golf cockpit

The latest Golf will shortly come to market with a cockpit that is said to be clearer, neater, completely digitalised and connected online, and that will make operating this Volkswagen car more intuitive than ever.



Digital cockpit on VW Golf

The digital cockpit, which comes as standard, includes the instrument cluster, an infotainment system and a multifunction steering wheel. Together, these form the first functional level, in which virtually all the displays and controls are digital.

Touch sliders enable intuitive access to temperature and volume controls, while a touch island under the infotainment system also provides direct access to additional air conditioning functions, the assistance systems, and – depending on the equipment included – driving modes and parking assistants.

In a second touch island, the light and vision functions have been repositioned and brought together: the light, along with the windscreen and rear window heating, is now operated using a digital panel arranged higher on the dashboard to the left of the instruments.

It's possible to enhance the digital driver's workplace further; in combination with the 25cm Discover Pro navigation system, the innovation cockpit has a larger range of functions.

On request, a windscreen head-up display will be added, with information such as speed and navigation information being projected into the driver's field of vision.

This functionality is also evident in the centre console, with the inclusion of the shift-by-wire gear knob for the automatic dual clutch gearbox. The theme continues to flow across the roof console, where operation has also been digitalised. Tilting and sliding panoramic sunroof example (optional): just swipe a finger back or forward over a slider to open and close the transparent roof.

Intuitive operation in the Golf can be supported by natural voice control on request.

The system is activated by saying "Hello Volkswagen" or pressing the voice button on the steering wheel.

The Golf reacts to intuitive voice commands such as "Take me home" (navigation) or "I'm cold" (automatic air conditioner). The digital microphones can locate the person who is speaking (driver or front passenger) and respond accordingly, for example by identifying which interior zone's temperature needs adjusting.

Customised settings can be saved in the vehicle and in the cloud, so they are still available even with a change of driver or vehicle.

These settings include the displays, seat position, settings for exterior mirrors and air conditioning, practically stepless control of the ambient lighting up to 30 colours, and the coming and leaving home functions.

Connectivity via the cloud is enabled by an online connectivity unit with an integrated eSIM, to which all infotainment systems in the Golf are coupled as standard. The unit is also the interface with online-based functions and services from We Connect.



Outsight and Faurecia team on adas

Outsight and Faurecia are working together to bring 3D situation awareness to adas.

The collaboration has been initiated to help manage and improve the increasingly complex situations that drivers and cars face on the road. Acceleration of complex situations requires new ways to process real-time 3D data.

Last year, Faurecia acquired the Japanese company Clarion and launched its fourth business group Faurecia Clarion Electronics. With 9000 people including 1650 engineers, the business group is expected to generate over €2bn in sales by 2022.

"Succeeding in the automotive market requires collaboration with the best companies and teams around the world," said Raul Bravo, co-founder of Outsight. "We are confident in our new partnership with Faurecia. We are excited they have selected us to jointly build a new generation of smarter and safer vehicles."

The collaboration was initiated following the launch of Outsight's 3D semantic camera in September at AutoSens and Outsight receiving the CES 2020 best of innovation award.

The two companies will combine industry know-how from Faurecia Clarion with Outsight's sensor technology to target the adas and autonomous driving market.

"Faurecia is pleased to be collaborating with Outsight on advanced 3D perception for next-generation adas," said Frantz Lohier, CTO of Faurecia Clarion Electronics. "Outsight's unique expertise in sensing and processing technologies with point-cloud classification is notably complementing Faurecia Clarion Electronics leadership in park assist."

Mobica opens Munich office

UK software services company Mobica has opened its first office in Germany, as it looks to strengthen its relationships with the country's automotive OEMs and suppliers.

The Munich office will predominantly focus on its growing automotive customer base and complements the existing offices in the UK, USA and Poland.

This Munich office, and the recruitment of an in-country senior team with experience in the automotive sector, gives Mobica a foothold in one of the world's most innovative automotive markets.

The team, who will work with OEMs and tier-one suppliers across Mobica's existing customer base and look for new customers, includes chief operations officer Stefan Marxreiter, and Wolfram Ries, vice president, both previously from Luxoft. Several additional hires are due to be announced in the coming months.



Agendis Center, home of Mobica in Munich

"The automotive landscape is constantly evolving, particularly with the emergence of technologies such as IoT, AI and 5G which are changing how businesses and consumers view their vehicles," said Marxreiter. "It's such an exciting time for the sector and it's crucial that we're positioned at the heart of Germany's automotive industry. Having a permanent base in Munich will enable us to provide close support to our German customers, collaborate with other players in the sector and deliver more groundbreaking automotive technologies to enable the modern car."

The office is in the Agendis Business Center in the Schwabing quarter of Munich.

"Germany is globally recognised for its automotive industry, and is where a significant amount of our growth strategy is focused," said Simon Wilkinson, chief executive officer of Mobica. "We have a number of partners and customers in the country already and we hope to announce more in the near future."



McLaren uses BF1systems components

BGF invests in BF1systems

BGF has invested £2.4m in BF1systems, a provider of electronic and electrical technology for the motorsport and automotive industries.

Founded in 1994, BF1systems designs, manufactures and distributes high-precision components, including steering wheels, tyre pressure and temperature monitoring systems, as well as force measurement components and wiring harness assemblies.

Based in the UK, its components are used in every major motorsport series around the world, including Formula 1, GT racing and Formula E, as well as by performance road cars, with a client list that includes Bugatti, Ferrari, Porsche, Aston Martin and McLaren.

The business employs more than 100 people at its factory in Norfolk. It also has a facility in Romania, which was established in 2017 to support and expand its wiring harness production.

The minority investment from BGF should support BF1systems' long-term growth strategy, including the expansion of its product offering and development of partnerships.

"Having BGF's funding and support for the next stage of our growth journey is fantastic, with a team that understands our ambition and shares our vision for the business," said Graham Peel, managing director of BF1-systems."

Adam Robson, chair of BGF-backed composites manufacturer Prodrive Composites, will join the board as non-executive chair. And Hugh Costello, an investor at BGF, will also join the board.

"A long-standing and well-respected member of the motorsport community, BF1systems has built an excellent reputation and fantastic track record," said Costello.

X-Fab foundry starts volume production of AutoChips TPMS

X-Fab Silicon Foundries has started volume production of a tyre pressure monitoring system (TPMS) chipset from Chinese chip design company AutoChips.

The automotive-grade AC5111 chipset has been designed in-house by AutoChips and is being manufactured at X-Fab's mems facility in Erfurt, Germany. Orders for the mems-based chipset, equating to tens of thousands of pieces, have already been received.

It is said to be China's first self-designed, full-feature, single-chip TPMS to reach mass production.

"High quality, high reliability and comprehensive functions are regarded as the core aspects of competitiveness for AutoChips, and these are enabling us to become China's new force in automotive semiconductor products," said Wan Tiejun, general manager of AutoChips. "As the only domestic TPMS chipset to integrate six core technologies, test results have shown that the AC5111 can match competitors' products in terms of performance and power consumption, and having access to X-Fab's mems expertise has been absolutely pivotal here."

Studies have shown that 70% of highway traffic accidents in China are caused by tyre punctures. When the air pressure of the tyre is 10% lower than the normal value, its lifespan is reduced by 15% to 20%, and vehicle fuel consumption per kWh increases by 260ml.

Based on these figures, China's standardisation administration has made it mandatory for all vehicles built from January 2020 onwards to incorporate TPMS technology.

The AutoChips device is an integrated AEC-Q100-compliant chipset with six functional elements, including a low-power consumption microcontroller, pressure sensor, temperature sensor and accelerometer, as well as RF and LF functions.

"We are very pleased to be helping AutoChips to gain further traction in the constantly-growing Chinese domestic automotive market," said X-Fab's CEO Rudi De Winter. "We hope that this cooperation will open new opportunities for both companies in the future."

Rimac opts for ADI to manage batteries on C Two hypercar



Rimac C Two fully electric hypercar

Croatian car maker Rimac Automobili is planning to incorporate Analog Devices ICs into its precision battery management system (BMS). The technology has the ability to increase the capacity of its batteries by calculating reliable state of charge and other parameters.

"Our application of BMS is among the most demanding in the world, requiring the highest accuracy, massive current and voltage draws over very short time scales, and rapid dynamic adjustment within the battery management control system," said Rimac CEO Mate Rimac. "We have decided to adopt the Analog Devices portfolio of battery management ICs across our complete product line of battery management systems."

The Rimac C Two is a fully electric hypercar capable of speeds of up to 415km/hr. It accelerates from 0 to 100km/hr in 1.85s and 0 to 300km/hr in 11.8s.

BMS technology acts as the brains behind battery packs by managing the output, charging and discharging as well as providing precision measurements during vehicle operation. A BMS also provides safeguards to protect the battery from damage.

A battery pack consists of groups of individual cells that work together to increase power output. If the cells go out of balance, they can get stressed leading to premature charge termination and a reduction in the battery's overall lifetime. Analog Devices' battery management ICs deliver accurate measurements, resulting in safer vehicle operation and increasing vehicle range per charge.

"High performance electric vehicles require high precision electronics," said Patrick Morgan, vice president of Analog Devices. "Precision accuracy directly translates to maximising battery capacity and range with fast charging time. We are pleased to support Rimac with our precision battery management ICs for its leading-edge electric vehicle systems with the goal of achieving some of the best performance in the world."

STM and Tieto partner on central control units

Tieto and ST Microelectronics are developing CCU central control unit software to run on the Telemaco 3P platform.

Electrification and connectivity requirements of vehicles are pushing for more processing power and better cyber security. In turn, car makers' demands for CCUs meeting connectivity, data privacy, security and over-the-air updates have led STM to develop the Telemaco multi-processor SoCs and its associated Telemaco 3P modular telematics platform.

This provides an open development environment for prototyping smart driving applications. The secure and safe SoC embeds an isolated hardware security module for security. The module provides safety measures for the implementation of Asil B-qualified systems.

Tieto's software R&D services division and STM are developing vehicle CCU software and telematics based on the 3P platform. Tieto aids its customers with system integration as well as design and development of secure smart driving applications. These will support high-throughput wireless connectivity, over-the-air firmware upgrades and car-to-car communications.

"With STM, we'll be able to help automotive OEMs and tier-one vendors get the very most out of STM's powerful and secure Telemaco 3P platform," said Viet-Anh Pitaval, head of automotive business development at Tieto. "Together, we intend to accelerate the development of vehicle central control-unit software as well as enable tremendous new types of value-adding automotive services."

Tieto and STM will demonstrate a smart V2X pedestrian crossing alert application during January's CES in Las Vegas.

Integrity delivers V2X certificates for Ohio

Green Hills subsidiary Integrity Security Services (ISS) has delivered V2X certificates for the entire state of Ohio via the ISS Certificate Management Service (CMS). The Drive Ohio CMS should provide the security underpinning needed to deploy V2X technology along roadways and in vehicles throughout the state.

"Confidence in the security of connected vehicles is key to their successful introduction onto our roads," said Luke Stedke, managing director of Drive Ohio. "The creation of a world-class V2X ecosystem in Ohio, led by Drive Ohio, creates vital protection for vehicle communications now and into the future."

This CMS system is tied to the ISS Root CA that was created under the WebTrust for Certification Authorities auditing framework, the same framework used to assure the secure and safe operations of the underlying security of internet ecommerce activity.

This Root CA together with the ISS CMS, collectively known as the Security Credential Management System (SCMS), should serve the needs of Drive Ohio's connected vehicle and traffic management systems.

"Drive Ohio has now taken a leadership role in the deployment of secure V2X technologies and ISS looks forward to supporting Ohio's rollout of this life saving technology," said David Sequino, president of ISS. "Ohio's experiences and learnings can help inform the use of secure V2X systems across the USA and around the world, as well as help guide global technical and operational standards. This will help ensure that the needs of Ohio are covered in IEEE 1609.2 standards that are followed by automobile manufacturers."

ISS CMS provides a scalable system for issuing security credentials to C-ITS components, including on-board and roadside units, as well as tools used by traffic management authorities.

"ISS is pleased to work with Ohio to assure that its V2X system provides its citizens with a secure, reliable and scalable V2X ecosystem while providing the necessary privacy protections," said Bill Lattin, chief security officer of ISS.

ISS CMS has been used to create two national-level credential management systems. In 2017, ISS delivered the Root CA and CMS, which actively serve North American connected vehicle projects. This Root CA has attained and maintained the WebTrust for Certification Authorities trust services seal.

And, in 2019, ISS delivered Queensland's C-ITS SCMS.

Didi picks Airgain for robo-taxi pilot

Didi Chuxing has selected antenna technology from Airgain to deliver C-V2X connectivity for an autonomous vehicle pilot in Shanghai.

Airgain's Multimax FV ITS three-in-one antenna provides two high gain directional antenna arrays operating in the ITS 5.9GHz frequency band, as is used for DSRC and C-V2X, and one-by-one multi-constellation GNSS (GPS and Beidou) for navigation.

"The Airgain C-V2X was chosen based on the high gain and efficiency results, and the ability to perform at an advanced level when working on set routes," said John Pan, general manager at Airgain. "We're thrilled to have been chosen by Didi and we value our relationship with this leading-edge company. We are looking forward to further technological collaborations in support of the advancement of autonomous driving technologies."

The roof-mount antenna was customised for Didi's robo-taxi project, having been deployed, tested and optimised throughout several key testing stages on its autonomous vehicles on public roads in the Jiading district of Shanghai.

"Working with our auto-industry partners, Didi has the potential to become the first business to realise a large-scale robo-taxi service in China," said Zhang Bo, CTO at DiDi.

C-V2X approval

Autotalks' second generation chipsets have been FIPS certified for secure C-V2X or DSRC deployment in the USA.

The chipsets achieved FIPS 140-2 security level-three certification from the US National Institute of Standards & Technology.

The firm's Craton 2 and Secton embedded hardware security modules are said to be the first to achieve this certification.

FIPS 140-2 is a US government computer security standard.

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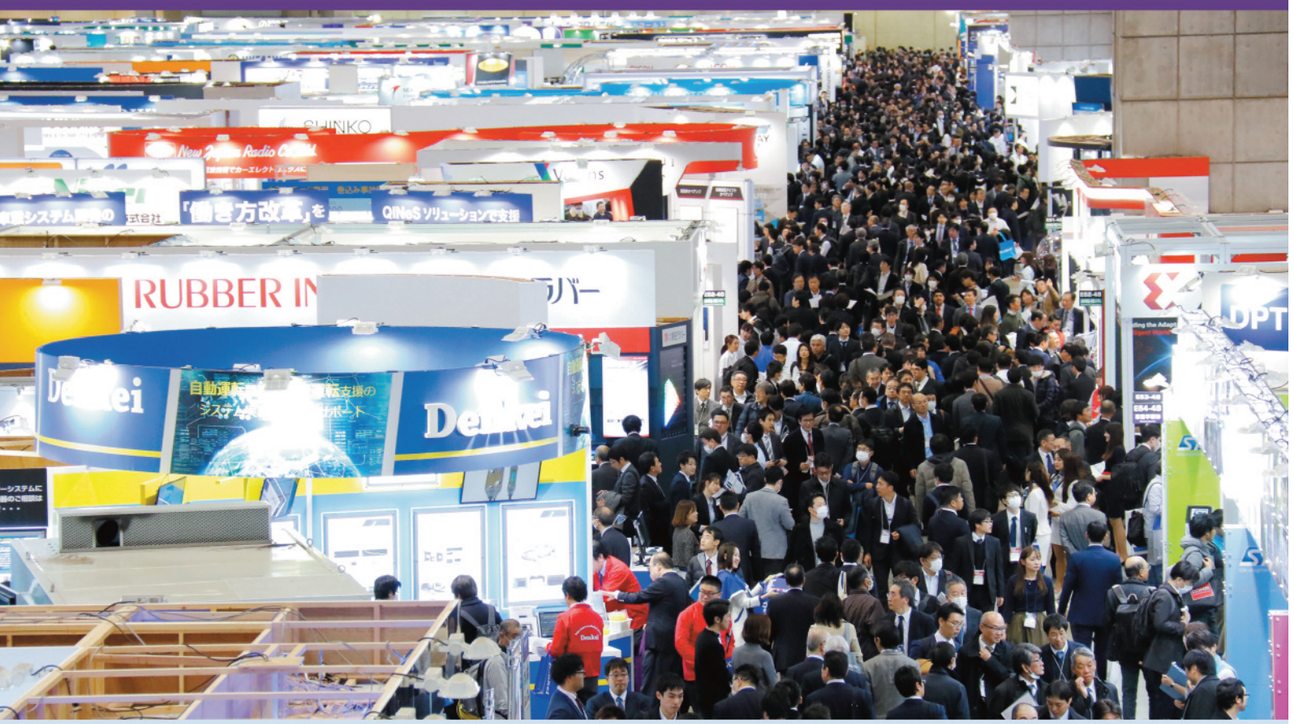
*"Largest" in reference to the exhibitor number and the net exhibit space of trade shows with the same concept.

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AWS helps F1 simulate 2021 re-design



Formula One cars are to get a makeover for 2021 (Picture: Red Bull)

Amazon Web Services and Formula One Group have completed a computational fluid dynamics (CFD) project to simulate the aerodynamics of cars while racing, with detailed simulations that led to the car design for the 2021 racing season.

The CFD project used over 1150 compute cores to run detailed simulations comprising more than 550 million data points that model the impact of one car's aerodynamic wake on another. Using the scalability of AWS, Formula One was able to reduce the average time to run simulations by 70 per cent, from 60 hours down to 18.

The project ran for six months using Amazon Elastic Compute Cloud and delivered performance equivalent to that of a supercomputer, for a fraction of the cost.

Increasing excitement for fans, by enabling closer, wheel-to-wheel racing, was at the core of the project. For Formula One cars, the downforce generated by their aerodynamics is the single largest performance differentiator, helping a car travel faster through corners. The current generation of cars suffer a loss of downforce when they are running close to one another, reducing a drivers' ability to sustain close racing and increasing the difficulty of overtaking.

"This project with AWS was one of the most revolutionary in the history of Formula One aerodynamics," said Pat Symonds, chief technical officer of Formula One. "We were looking at how cars perform in the wake of another, as opposed to running in clean air. We have been able to use AWS technologies to understand the incredible aerodynamic complexities associated with multi-car simulations, and are pleased the results indicate we have made excellent progress towards our aims of closer racing."

Currently, a car running one car length behind another loses up to half of its downforce. To reduce this, F1 used AWS to look closely at how the aerodynamics of cars interact when racing closely. These simulations looked at cars in common situations and the results led to changes to the proposed 2021 car design.

With insights gained from these simulations, Formula One has designed a car with only 15% downforce loss at the same, one car distance. The resulting car will have a new bodywork design and front wing shape, simplified suspension, new rear end layout, underfloor tunnels and wheel wake control devices, and will run on 45.7cm wheels with low profile tyres.

CFD simulates the impact of a liquid or gas on an object and requires extensive compute capacity to perform this kind of simulation, requiring high performance computing (HPC) clusters to do the job. However, running HPC clusters on-premises requires considerable upfront capital expenditure, lengthy procurement cycles, and regular hardware refreshes to avoid obsolescence.

AWS provides an elastic and scalable cloud infrastructure to run HPC applications. With virtually unlimited capacity, engineers and researchers can innovate beyond the limitations of on-premises infrastructure.

There are plans to expand the application, up to 2300 cores, and to introduce AWS machine-learning tools, such as SageMaker, to help with the design and optimise the car's performance.

ELECTRIC VEHICLES

CHARGE!



Joseph Notaro looks at on-board charging systems for EVs supporting electric powertrain adoption

Electric vehicles in their various guises – full electric (BEVs), plug-in hybrid electric vehicles (PHEVs) and mild hybrids – are gaining real traction with the buying public around the world. Onboard charging (OBC) is a vital aspect to make them as practical to use as possible and reduce the leap of faith for consumers previously wedded to combustion-engine modes of transport.

For OBCs to be viable, they need to meet various design challenges including reducing their size and weight and increasing their efficiency.

There are many benefits to these electrical-based vehicles, not least their reduced impact on the environment and lower running costs. Despite early adoption being relatively slow – the landmark of one million vehicles shipped annually only being surpassed in 2017 – numbers doubled over the course of 2018 with momentum fuelled by an abundance of new models from a wider array of manufacturers.

Adoption rates are now really moving at pace with a marked shift towards pure electric vehicles that now represent around two-thirds of the total, and plug-in hybrids accounting for one-third. Nevertheless, and to put the situation into perspective, electric vehicle sales presently represent less than two per cent of all new vehicle sales.

While xEV market penetration is increasing, several challenges still need to be addressed to increase their market deployment. Range anxiety and charging times among consumers have been significant contributors to lower-than-hoped-for sales, as has the typically high purchase price, although it is expected that the new models that will offer ranges in excess of 320km per charge and lower price points will, to some extent, address concerns.

In the future, the rate of deployment of an adequate charging infrastructure could well become the main bottleneck to slow down EV adoption. Estimates suggest there will be around 120 million EVs on the roads in the major markets (Europe, USA and China) by 2030, leading to a 14-fold increase in the required energy for EV charging to around 280 billion kilowatt-hours.

The challenges of delivering the necessary infrastructure are multi-faceted and the plans will need to include very high-power DC chargers in public areas such as beside highways for rapid in-journey top-ups. Most users are expected to prefer to charge at home overnight as this has little impact on their ability to use the vehicle and they can take advantage of low-price electricity during off-peak hours. However, the challenge of delivering adequate charging points in major urban areas where parking spaces may not be close to a dwelling will be very different to suburban areas where many houses have a driveway or garage.

On-board charging

There are two primary types of charging, one based around chargers that supply DC to the vehicle, and a second that uses AC mains voltages. DC types convert the AC from the power grid to DC before it enters the vehicle, allowing the battery to be charged without any further on-board conversion. This is generally restricted to public chargers that can supply power from a relatively modest level up to several hundred kilowatts. With these chargers, vehicle batteries can be significantly replenished in under an hour.

AC chargers are commonly used at home and allow the vehicle to be charged directly from the mains. As the mains is AC, it must be rectified before the battery can be charged. This is done via on-board conversion where the power level is restricted by the amount of power that can be delivered by a typical wall outlet – in most cases, 20kW or less.

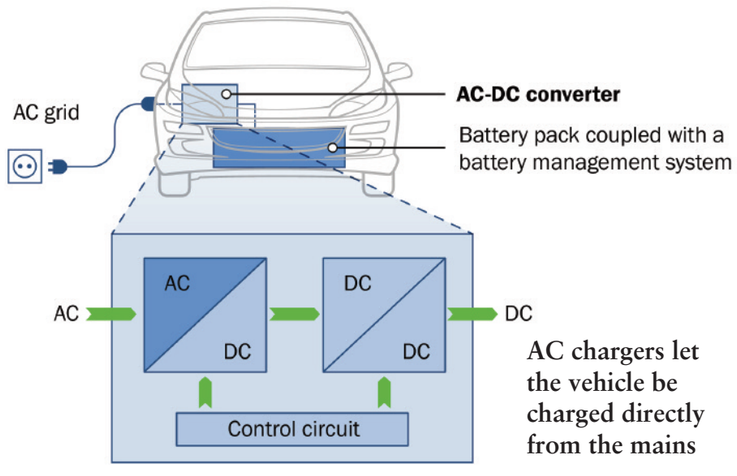
As an aside, wireless charging of vehicles is also being investigated. This works in much the same way as wireless charging of a mobile phone, but of course on a much larger scale. The vehicle is parked over a charging pad and electromagnetic waves are used to charge the vehicle slowly. Efficiency, charge rates and other technical challenges have to date slowed the pursuit of this approach.

AC charging is slower than DC as the power is limited, meaning the charging will take longer. However, it is highly suited to home charging where a vehicle can be parked overnight and charged to be ready for the morning commute. It also allows the use of lower priced electricity during off-peak hours and a high degree of flexibility as any available outlet can be used with a long cable if necessary.

There are two versions of on-board AC charging. Level one is primarily used in the USA and is based upon a single-phase 120V AC electrical outlet with a current capability of 15A resulting in most batteries being fully recharged overnight.

Level two offers more power based upon 220 and 208V residential and commercial outlets with up to 40A available. In single-phase format this can deliver up to 7.6kW, with three-phase increasing the capability to 22kW.

The main challenge associated with on-board charging is common to almost every application on a vehicle – the need to reduce size and weight and increase efficiency. The technological focus to help achieve this is at component level, and in particular on specialist suppliers of semiconductors for automotive use. Unlike the public DC chargers, which sit beside the vehicle, on-board chargers are always carried by the vehicle meaning they occupy space and consume energy in proportion to their weight.



AC chargers let the vehicle be charged directly from the mains

Key elements

A level-two on-board charger comprises two main power stages, an AC-DC conversion stage on the primary side of the power transformer and a DC-DC conversion stage to deliver the final battery charging voltage, located on the secondary side of the transformer. There are five primary sections within a typical on-board charger.

First is the power factor correction (PFC) stage, which maintains the power factor as close to unity power factor as possible as well as boosting the voltage to the working level of the DC bus.

Secondly, the main DC-DC converter provides galvanic isolation via a power transformer that separates the primary and secondary sections. It also regulates the output voltage and current levels as requested by the battery management system. Several topologies are available, with an LLC resonant topology being popular as it enables high levels of efficiency with good EMI performance.

Within the DC-DC converter, the rectification stage is on the secondary side. This may use diodes, although synchronous rectification based on mosfets is often preferred due to the better efficiency, albeit at the expense of slightly more complexity.

The latest designs are increasingly using wide-bandgap devices to enhance efficiency even further. The technology in this area is maturing into practical products. The choices available to automotive designers now frequently comprise integrated modules that capture a range of functionality, reduce footprints and enhance reliability, as well as regular standalone semiconductor devices.



Public charging station

There will be an auxiliary power stage that provides a clean and stable low-voltage supply for the charger control system including gate drivers, switch mode controllers, monitoring circuits, fan and MCU. The auxiliary supply is normally based on a flyback topology, with LDOs providing supplementary rails if needed.

The remaining circuitry within the on-board charger includes a high-voltage gate driver, voltage sensing and current sensing as well as communications and a MCU to control the fans that cool the charger.

Summary

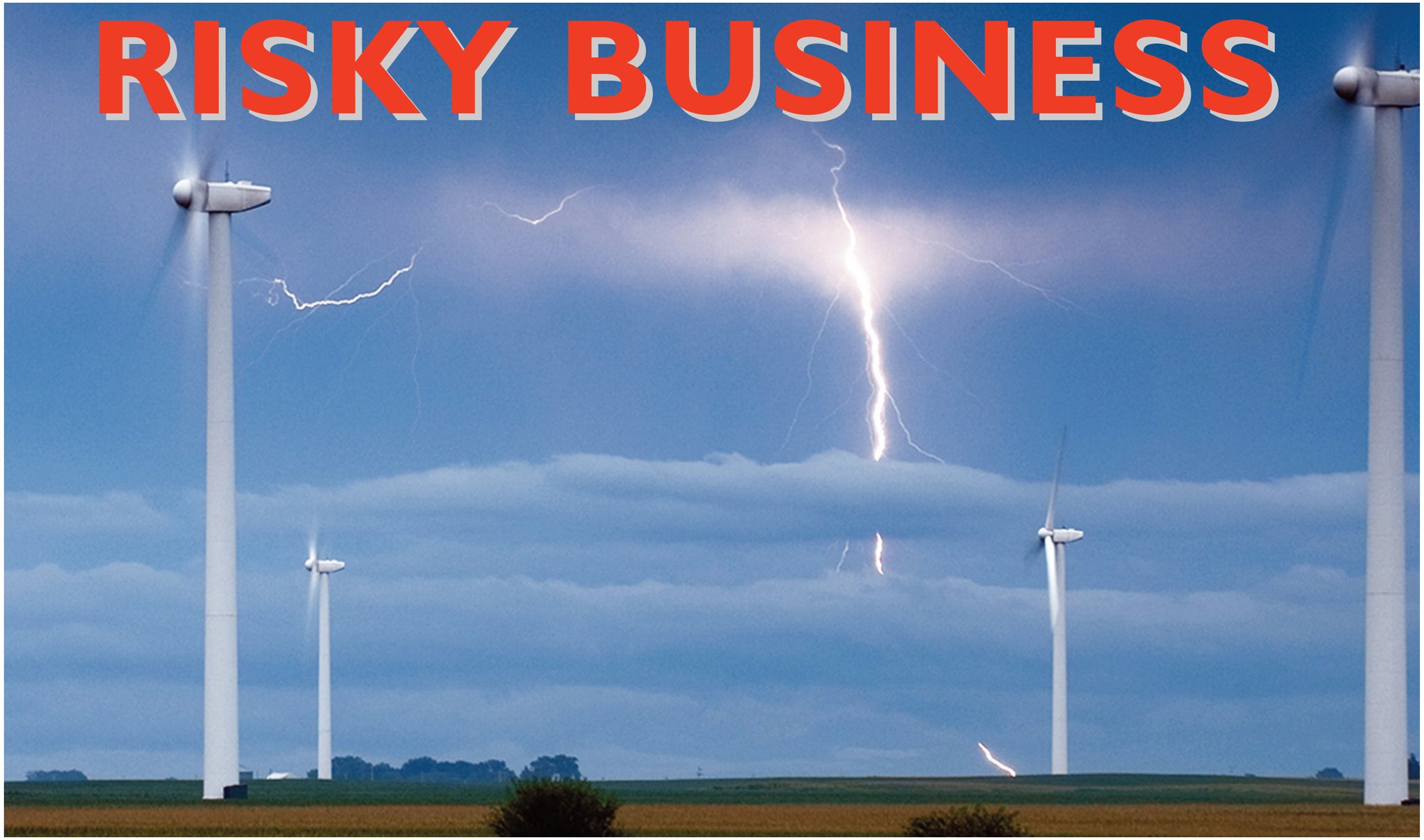
While the fastest charging systems will remain the public DC-based charging, many of which have capability in excess of 300kW, on-board charging will increasingly perform an important role in providing flexible charging. Due to the ability to charge a vehicle battery from any AC mains, consumers will be able to charge their vehicles at home and at the office, maintaining the range without the need to visit a public charging station.

Design work at car makers and tier ones, which is going on now and supported by innovative new semiconductors, will lead to enhancements of electric vehicle offerings. This will include the introduction of capabilities such as bidirectional charging whereby cars will help reduce utility costs and smooth supply and demand issues by using vehicle batteries to store energy, then release it back to the grid at times of peak demand.



Joseph Notaro is a vice president at On Semiconductor

RISKY BUSINESS



David Carr explains how to avoid the hidden costs of isolation design and manage project risk

There's an undeniable trend towards smaller and lighter electrical systems, with automotive electrification as a prime example. Professional services firm PwC estimates that hybrid and full-electric vehicles will comprise 40% of global sales by 2024.

With this increase in vehicle electrification comes the growing need for isolation among the electrical components and systems. For example, electric vehicles with 400V DC battery stacks are becoming more common, with obvious safety implications.

Electrical content

Providing isolation is bringing an increase in the number and variety of challenges. These systems, especially with respect to isolation, involve complex architectures and processes that limit agility and flexibility, while creating barriers to change. The accelerated pace of competition and globalisation has forced companies to put more focus on time to market and return on investment (RoI). This means development teams have to execute flawlessly to a compressed schedule.

With design and development resourcing increasingly scrutinised and stretched, there is not a deep bench of experience in all critical disciplines. Iterations need to be kept low to hit the target RoI but, at the same time, pressure from competitors can quickly and relentlessly push performance targets to differentiate products further.

There are also new regulatory bodies and stricter regulations that add an additional layer of application testing and certification. The demands are steep and the risks are high.

Design

Isolation is an essential part of the design. From determining the required level of isolation, to providing isolated power to complement the isolated data path, to making it fit the available space, many design trade-offs need to be evaluated. Yet each new project comes with its own set of design goals and design requirements.

Multiple factors, including technical difficulty, similarity to previous designs, scheduling and resourcing combine to dictate how much reuse can be employed versus greenfield design options. Reusing previous designs or architectural approaches with few changes will typically result in lower risk and faster execution.

However, added features or increased levels of performance often dictate the investigation of new approaches. It can also be a matter of spending scarce development resources to evaluate new and improved technologies to

provide value-added portions of the design.

Limitations

The advent of integrated isolated DC-DC converters made many of these problems more easily solvable by providing a compact, easy to use method with documented safety certifications. Consider the scenario of a new project being approved, in which a previous design will be upgraded to higher performance metrics with additional features.

The team members are immediately energised and ready to dive into the work. But the technical project leader has to worry about all the different things that might go wrong and manage the increasing complexity under tighter budgetary and schedule constraints.

Among those project management challenges is meeting increasingly demanding electromagnetic-compatibility (EMC) requirements. More and more emerging applications and markets require compliance with numerous EMC specifications, and the bar continues to rise with increasingly strenuous performance limits.

Existing discrete products, such as isolated flyback converters, have some benefits, including a low bill of material, but there are drawbacks.

A typical flyback design (Fig. 1) contains a controller driving an isolation transformer, with rectification and filtering on the secondary, and an optically isolated feedback network. The error amplifier requires engineering effort to develop a compensation network to stabilise the voltage loop, and is dependent on optocoupler performance variability.

Often seen as an inexpensive isolator for use in a power supply, an optocoupler has a variation in current transfer ratio (CTR) that will limit the voltage feedback performance and the effective operating temperature range. The CTR parameter is defined as the ratio of output transistor current to input LED current and is nonlinear, with high unit-to-unit variability.

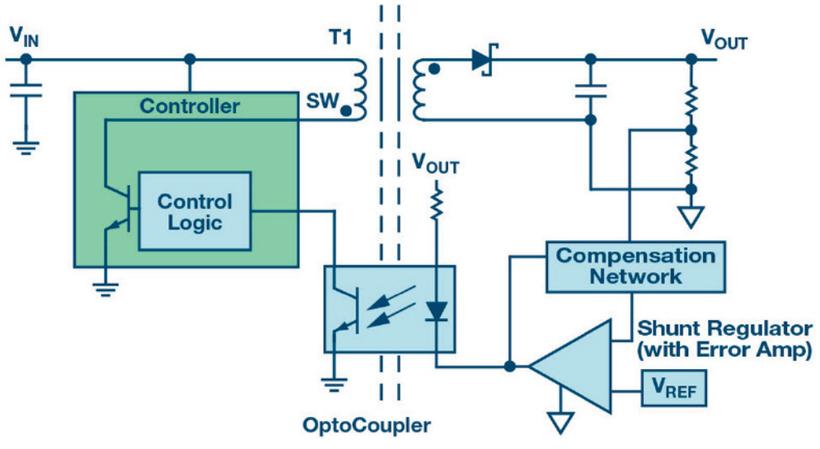


Fig. 1: Typical isolated flyback DC-DC converter

Optocouplers typically have a 2:1 uncertainty in initial CTR, which can degrade up to 50% after years of use in high temperature environments, such as those found in high power and high density power supplies. For a project manager, the discrete flyback approach seems better from a cost point of view, but there's a trade-off in engineering effort and technical risk.

Another concern with the discrete approach lies with meeting safety standards. Safety agencies scrutinise discrete designs more closely, so achieving the necessary certifications for a discrete system design can often lead to multiple design iterations.

Isolation in the system also adds complexity to the power design. A typical non-isolated design has the usual constraints, such as input and output voltage ranges, maximum load current, noise and ripple, transient performance, start-up characteristics and so on. By its very nature, the isolation barrier removes the ability to monitor easily input and output conditions simultaneously, making it more difficult to achieve the performance metrics. The separate ground domains also form a dipole antenna, and any common mode current that traverses the barrier will excite the dipole and lead to unwanted radiated energy.

Passing the tests

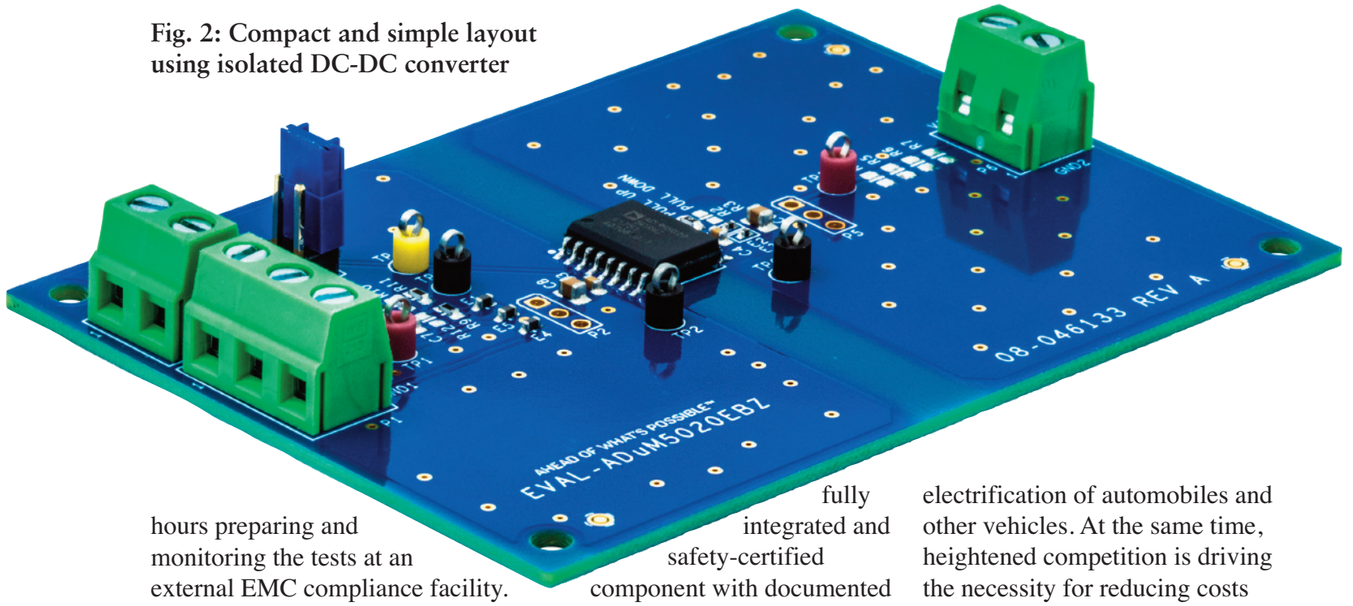
Getting a discrete power design to pass EMC certification can take a few iterations to get right. EMC tests are lengthy and expensive, requiring teams to spend many hours preparing and monitoring the tests at an external EMC compliance facility. When problems do occur, it's back to the lab to troubleshoot and make changes. Then the design must be completely recharacterised to ensure the standard performance metrics weren't compromised by the modifications. Then it's back to the EMC facility for retesting.

The final stage is getting the necessary safety certifications. This is another lengthy and expensive process, carried out by an external safety agency. Many documents must be prepared by the design team and carefully examined by the agency. Anything new is given extra scrutiny, making reuse of previously certified circuits very desirable. A discrete isolated power design might need to be changed if the agency decides it won't meet the safety requirements. Once modified, the design would again need to be recharacterised and put through EMC testing.

Another option

The answer to these problems is a fully integrated and safety-certified component with documented EMC performance. An example would be a low emission isolated DC-DC converter. This can provide up to 0.5W of isolated power from a 5V DC supply and operate from -40 to +125˚C. Such products have been certified to multiple systems and component safety specifications by UL, CSA and VDE. And they meet Cispr 22 and EN 55022 class-B radiated emissions requirements under full-load conditions on a simple two-layer PCB, see Fig. 2.

Fig. 2: Compact and simple layout using isolated DC-DC converter



The small packaging (16- and eight-lead wide body soic) consumes little PCB area, and no safety capacitance is required to meet the emissions targets. This makes the isolated power circuit smaller and less expensive than a discrete approach, such as an embedded stitching capacitor that requires four or more layers with customised spacing to produce the correct capacitance.

Complexity

The need for isolation is increasing with the growing electrification of automobiles and other vehicles. At the same time, heightened competition is driving the necessity for reducing costs and time to market.

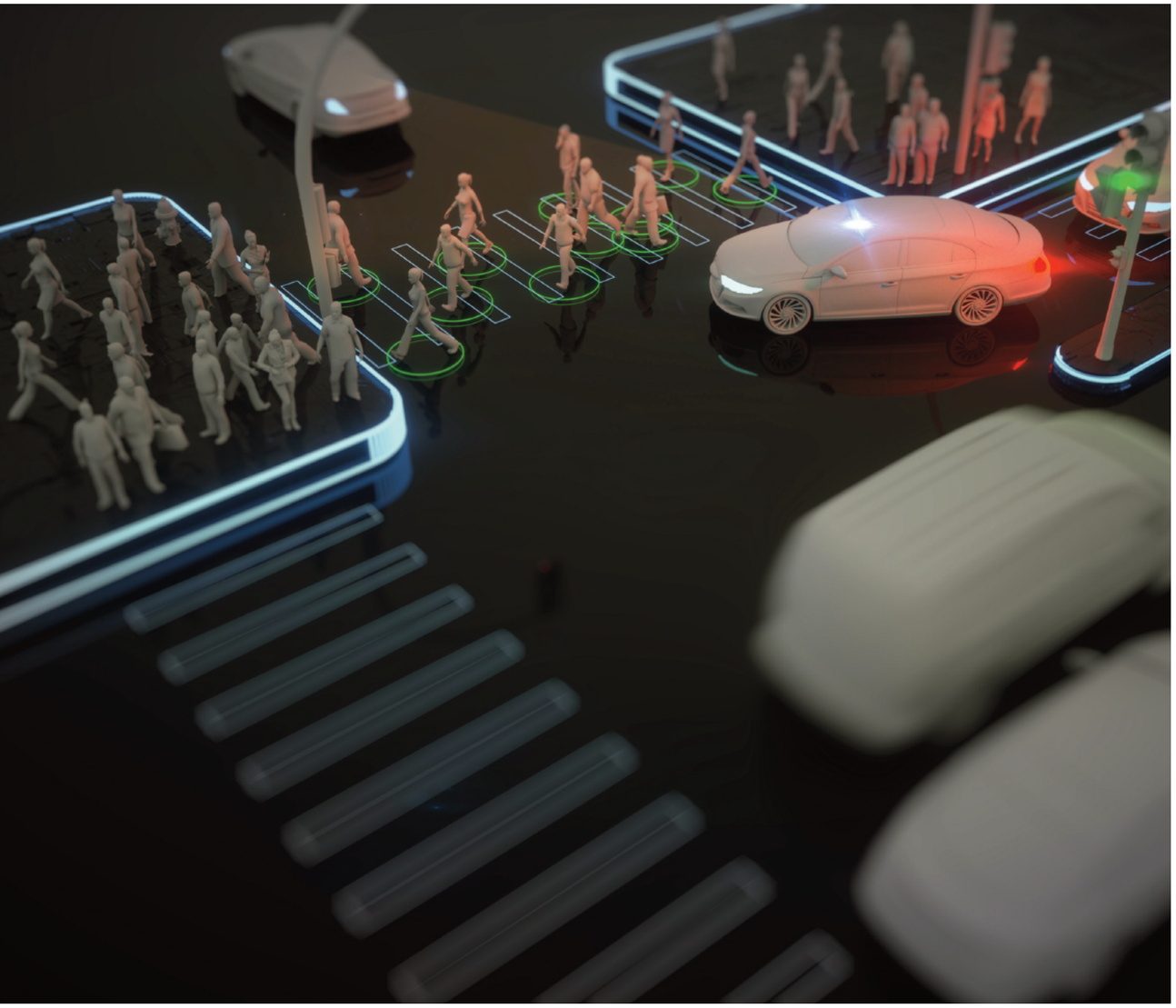
Coupled with these factors are more stringent regulatory requirements and the inherent complexity of isolation design.

This confluence of market demands and challenges cannot be met successfully with conventional approaches to isolation.

Fully integrated and safety-certified isolated DC-DC converters with documented EMC performance offer systems designers a better option. They can dramatically reduce design complexity and ensure better EMC testing and compliance. With less time devoted to redesign, recharacterisation and retesting, designers can reduce board space, lessen risk, lower costs and improve time to market.



David Carr is applications engineering manager at Analog Devices



At the crossroads

Jeff Phillips discusses the changing landscape of automotive test

The use of electronic devices in cars is increasing in both number and complexity with every successive design. Not just for in-vehicle infotainment systems, security and comfort, but for more significant safety features, such as adas.

These systems work by combining the information from multiple sensors – camera, lidar, radar and GPS – to create a more accurate sense of what's around the car. Such sensor fusion, coupled with high power parallel processing and software, enables the system to make adaptive, intelligent, autonomous safety decisions on behalf of the driver.

Adas requires compute-intensive ICs, capable of processing masses of data as well as well written software. The automotive industry is looking to vendors such as Nvidia, Qualcomm, Intel and Arm, manufacturers more synonymous with the computer industry, to provide these chips, more so than its traditional electronic suppliers.

It makes sense to use products from these industries, particularly considering the harsh environment of the mobile phone and the years of R&D in which such manufacturers have invested. The space industry has long since enjoyed such collaboration.

Manufacturers found that the traditional Can controller area network bus did not possess the reliability or redundancy to deal with such systems. Automotive networking protocols such as Ethernet and Flexray came into being as an answer to such requirements.

This electrification requires the automotive and tech industries to collaborate closely. However, the increased use of sensor fused systems and software user interfaces in automobiles poses challenges for both. Automotive testing procedures, traditionally of a serial nature, are not necessarily up to the mark when it comes to testing such systems.

The interaction and synchronisation between sensors and software are highly significant when considering adas and other sensor fused safety decision making systems. Exhaustive testing is essential before release into the public domain, particularly considering the stakes involved.

When it comes to meeting stringent European safety and performance standards, there can be no doubt that car makers have a wealth of test experience. Tech companies, however, have experience in the virtual environment, where invented scenarios can be used to test such systems thoroughly.

In the case of the software-defined car, the embedded software may need manipulation or update to enhance the driver experience, or to add future features. These processes can add delays to the launch of a new model and increase manufacturing costs.

The challenge for the automotive industry moving forward is to integrate these two worlds seamlessly. These systems can't be consumer tested when lives are possibly at stake.

Active safety systems require millions of kilometres of road tests to experience all eventualities, and there would be no safe way to inject errors into safety-critical systems while driving on the road.

There is a need to work in a virtual test environment to analyse the interaction and synchronisation between sensors in sensor fused systems. This involves companies collaborating to create a comprehensive test system that can combine the inputs of all car sensors.

The mission would be to combine their knowledge and skills to provide future-proof and scaleable adas test systems. This would not only be able to test embedded software, but also determine that physical hardware meets the design requirements. Public confidence in the automotive industry can benefit from robust collaborative innovation in the testing domain.



Jeff Phillips is head of automotive marketing at National Instruments



There is a need to work in a virtual test environment

ON THE ROAD

JUKE BOXES CLEVER

A look at the technology in the latest Nissan Juke

Offering the same sense of style and fun with a suite of technologies, the latest Juke is said to be the most connected Nissan so far. The first Juke was unveiled a decade ago, and went on to sell 1.5 million around the world, carving a niche for compact crossover SUVs that have been widely copied since.

The powertrain has a downsized turbo petrol engine that is compact, lightweight, responsive and economical. For the first time, the Juke can also be specified with a seven-speed dual-clutch transmission with paddle shifters or a full auto mode. Together with a new chassis, the car is said to be fun to drive, refined and efficient with exceptional safety.

"The Nissan Juke has never followed the crowd," said Marco Fioravanti, vice president at Nissan Europe. "Instead it leads

Vehicle Electronics

the way, with its big personality and agile driving. The new model builds on the strong athletic design people love about Juke and adds on a unique on-the-road experience thanks to ProPilot and a large choice of intelligent technologies."

The latest Juke is built on the CMF-B platform and will be produced at Nissan's manufacturing plant in Sunderland, UK, with first deliveries having recently started.

Design

The Juke has grown up, but still maintains its sense of fun with a contemporary interior and exterior look. It combines sporty style with a crossover stance. This offers a best-of-all-worlds cross for the city and beyond.

Despite being all new, the car retains iconic design features, including the signature circular headlamps instantly recognisable as Juke. To give it a twist and bring the design up to date, these lights now feature a Y-shaped LED signature that complements Nissan's trademark V-Motion grille.

Stylish wheels give an imposing and athletic stance, while a floating roof design and sharply creased side panel details add a level of prestige.



Floating 20cm infotainment display provides access to Nissan Connect Services

A range of 11 body colours with three roof contrasted colours ensure the car stands out, with matching or contrasting colour combinations for body, roof and interior.

On the inside, there is more style, space, upscale quality and technology. It is roomier for passengers and their belongings, with rear-seat knee room increased by 5.8cm, rear headroom by 1.1cm, and 20% more luggage capacity to 422 litres.

The reimagined interior design has been finished with upmarket materials and ambient lighting, offering more style and comfort. Soft-touch materials on the dashboard, door trim and foot-wells give a premium feel. Monoform seats with a single-piece backrest add a sporty look and can be trimmed in Alcantara and leather.

Besides looking good and offering comfort, the front seats also incorporate, on selected grades, the Bose Personal Plus audio system, which delivers a high-quality and immersive sound. This can be controlled via a floating 20cm infotainment display providing access to the Nissan Connect Services.

Personalisation

For owners wanting to add their own twist and stamp their individual style, the Tekna+ grade joins the familiar Visia, Acenta, N-Connecta and Tekna models in the Juke line up and offers a personalisation package.

For a bespoke interior, owners will be able to choose between three personalisation packs to finish the seats, dashboard, door



Drivers and passengers can enjoy the mix of technologies

panel and armrest, all giving the car a premium feel:

Light Grey offers a modern high contrast and fresh look with black fabric and light grey syntech leather.

Enigma Black provides a refined and stylish interior with black Alcantara and leather.

Energy Orange proposes an eye-catching energetic cockpit with black leather and orange details.

For the exterior, two-tone paint comes as standard, as well as front bumper, rear bumper and side skirt inserts matching the colour of the roof.

Exclusive to Tekna+, the imposing 48cm diamond-cut Akari alloy wheels complete the exterior for an athletic and dynamic look.

Energising

The car has been conceived to delight new and existing users.

"From the ground-up, we designed and built the new Juke with agility at the forefront of our minds," said David Moss, senior vice president at Nissan Europe. "Drivers will feel the benefits as soon as they grab the steering wheel."

Under the sculpted bonnet is a three-cylinder petrol engine that is both efficient and responsive. The turbo-charged 1.0-litre unit is compact and lightweight, delivering fun-to-drive performance. It produces 117PS and 180Nm of torque, 200Nm with over torque function. A six-speed manual transmission is standard, while a seven-speed dual-clutch automatic with paddle shifts is also available for the first time.

Fuel economy has improved, achieving 16.1 to 16.9kmpl for manual transmission versions and 15.6 to 16.4kmpl for DCT models. CO_2 emissions are also reduced, starting from 112g/km for manual versions and 110g/km for the DCT.

A D-Mode allows drivers to switch effortlessly between three modes – Standard, Eco and Sport – to adjust the response of the car depending on the road or the driver's mood.

"The new Juke engine delivers the optimum balance between performance, fuel economy and refinement with truly impressive levels of power and torque," said Moss. "It's a great demonstration of what a downsized powertrain can deliver for the driver in terms of fun and lower running costs."

Technology

The vehicle is equipped with a host of adas technologies and

infotainment options to make each journey safer, simpler and more enjoyable.

The safety features include intelligent emergency braking with pedestrian and cyclist recognition, intelligent speed assist, traffic sign recognition, intelligent lane intervention, rear cross traffic alert, and blind spot intervention.

Blind spot intervention is a premiere on a Nissan model. The system warns drivers when there is a vehicle hidden from view alongside them, and guides the car back into the lane to prevent a collision.

Drivers can also benefit from Nissan's ProPilot technology on automatic versions.

Helping to ease the stress of long commutes and heavy traffic during highway driving, the system controls steering, acceleration and braking to maintain the car's position in lane and a constant, safe distance from other vehicles, even in slow-moving queues.

To improve vision in a safety-critical area, the A-pillars between the windscreen and door frames have been made thinner, yet retain their rigidity due to the strategic use of lighter high-strength steel. At night, standard-fit LED headlamps improve the field of visibility by 10m in width and 5m in length.

Connected

Nissan knows the type of customer who chooses a Juke will expect their car to fit in with their connected life. As a result, it has what is claimed to be the most advanced infotainment system ever fitted to a Nissan. It includes effortless integration of smartphones, an app to control and monitor the Juke, and in-car wifi available early 2020 for data-hungry passengers.

The latest version of the Nissan Connect infotainment system includes Apple CarPlay or Android Auto to mirror favourite smartphone apps on the integrated 20cm touch screen display.

If not using the phone's navigation, drivers can access TomTom Maps and Live Traffic. The Juke's Google Assistant compatibility offers a range of commands, including the ability for drivers to send destinations to the car's navigation system by talking to their smart device.

Occupants can also enjoy the Bose Personal Plus sound system on selected grades. With eight speakers – including two sets of Bose UltraNearfield speakers integrated into both front seat headrests – listeners can enjoy immersive music with clear definition.



There is a choice of Apple CarPlay or Android Auto



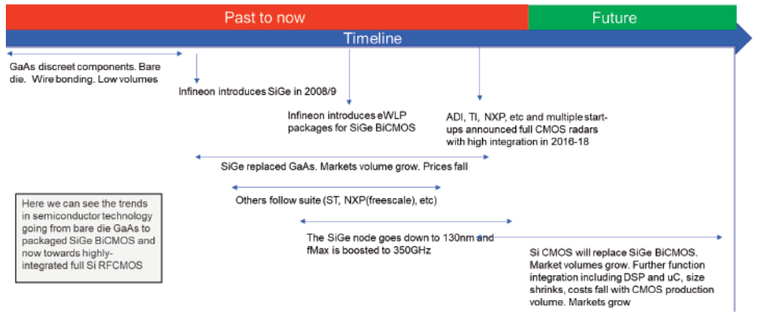
Image: Rohde & Schwarz

Khasha Ghaffarzadeh discusses technology trends in the automotive radar market

Radars are a key element of the sensor suite in adas and autonomous mobility. The technology is already commercially used, particularly on various adas functions, and its use is set to increase in the short and long terms.

In the short term, legislation as well as voluntary safety commitments will push the adoption of radar further. In the long term, the emergence of higher levels of autonomy will increase the radar content per vehicle, thus having a multiplier effect on the market.

These are exciting times for radar technology. Many changes are taking place. Radar performance is improving, in particular with respect to higher azimuth and elevation resolution. There are developments on the signal processing side. The point cloud of radars is becoming denser and methods are emerging to allow radars to detect, classify and track many objects in 3D



The transition towards silicon-based technologies together with the advent of smaller lithographic nodes will mean more capability can be on chip integrated, paving the way towards single-chip devices able to support mimo antennas

space across all weather and light conditions.

These efforts are at an early stage and can be expected to improve dramatically as larger manually or semi-automatically labelled training datasets become available and the fusion techniques evolve.

Trends

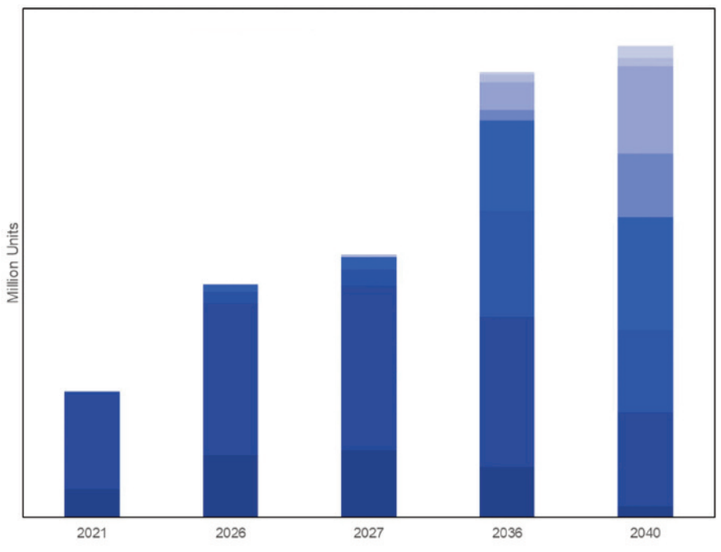
The semiconductor choice in automotive radars is evolving. First generation products deployed GaAs. They were at first used as bare dies mounted directly on boards and wire-bond connected. The next generation was on SiGe. This allowed higher on-chip integration of functions. The carrier mobility was high to allow high-frequency radars even at large lithographic nodes, such as 130nm. Advanced packages were also developed, evolving the technology from CoB to FOWLP (fan-out-wafer-level-packaging) or similar.

Many are now developing Si cmos and SoI technology. Many use the 40nm technology node, but some are pushing it down to 28nm or lower. The shorter channels support a high frequency even with a low carrier mobility.

The small node, together with cmos technology, allows higher integration of functions within the chip. Currently, the latest generation integrates not only the transceiver and the chirp generation, but also a microcontroller and digital signal processing (DSP) unit within the chip itself. This points the way towards single chip radar. The switch to silicon technology will also better sustain a cost reduction path, especially as volumes expand.

The packaging and board technology have also evolved. First generation devices were composed of multiple dies mounted directly on the board (CoB) and connected by wire bonding. These radar modules also had two separate boards, one for the RF and the other for digital functions.

The packaging has evolved, and now various forms of wafer-level packing are employed. The board also evolved to be hybrid with the top RF layer composed of a special low insertion loss material such as ceramic-filled PTFE or similar. In cases where a small antenna array will suffice, antenna-in-package (AiP) designs are already viable and some have been qualified for short-range automotive applications.



Unit number market forecasts segmented by the adas level and autonomous mobility level

The choice of low insertion loss materials is critical and interesting. These materials will need to offer low loss tangent. Crucially, the dielectric constant and the loss tangent will need to remain stable against variations in temperature and frequency.

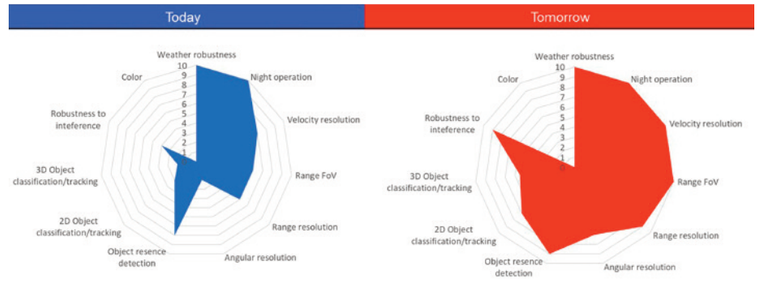
Furthermore, moisture uptake will need to be low and the material will need to be easily – or with well-known modifications – processable, for example on how to make the Cu stick.

4D imaging

The capability of radar technology will rapidly expand. First, the antenna arrays are becoming larger. Some start-ups have designed and demonstrated radar chips able to support 6500 virtual channels. Such radar may reach 1˚ azimuth and 2˚ elevation resolution. This trend would enable rich 4D data points per frame to be obtained giving precise information on velocity, range, azimuth and elevation.

Therefore, such radars would encroach into territory currently occupied by lidar, although the latter will likely retain angular resolution and potentially object classification superiority. Higher data rates will pose interesting questions as to how much pre-processing will be required prior to sending the data out of the radar modules. It may, depending on the second fusion architecture, demand ultra-high speed links within the vehicle.

Furthermore, this and similar arrangements will enable the densification of the point cloud. This is key, because the sparse point cloud of data hinders advanced signal processing and will make data fusion techniques complex. These limitations have kept radars limited to detection of object presence as well as object velocity. They also make it difficult, at times, to distinguish between stationary and slow-moving objects.



Radar charts compare the status of today's radar with that which is emerging

The dense and high-resolution point clouds will enable the developments of object detection, classification and tracking based on radar data. To achieve this, deep learning techniques are being developed. A major challenge though is the lack of extensive labelled training radar data.

The manual labelling process requires expert input, and is thus expensive and time consuming. Now though companies are launching fleets for the capture of radar data in synch with camera, lidar and other data, and are developing semi-automated labelling techniques that rely on late-stage fusion of data between camera, lidar and radar.

Such efforts and techniques will accelerate the development of training datasets.

Currently, such techniques are not as accurate as other means, but this is a fast-evolving space to watch closely.

Overall, this is one of the hottest trends. In the future, as radar technology shifts to smaller nodes, highly integrated packaged single devices will emerge. The antenna array size will expand, thus enabling better azimuth and elevation resolution, and thereby densifying the point cloud.

The deep learning-based algorithms will also evolve in parallel, enabling radars to do object detection, classification and tracking in 3D. In such cases, radars will begin to blur the boundaries with some lidar technologies while retaining the weather and light-level independence.

Automotive radars can become a $12bn market by 2030 in a moderate price erosion scenario. Note that the market will be, within that time frame, mainly pushed by adas. In the longer term (2030 to 2040), autonomous mobility levels three, four and five will drive the market.



Khasha Ghaffarzadeh is research director at IDTechEx

PCIe 2.0 packet switches suit adas

The PI7C9X2G-304EVQ and 404EVQ PCIe 2.0 packet switches from Diodes have three ports and four lanes or four ports and four lanes, respectively.

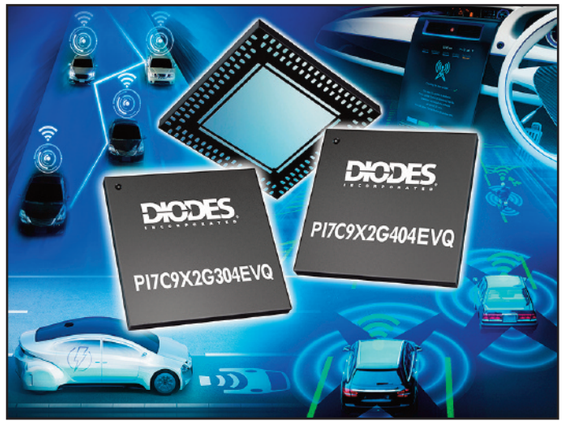
The packet switches are automotive-compliant for use in telematics, adas, navigation systems, in-vehicle wireless routers, and emerging applications such as V2V and V2X communications.

The parts are designed to help increase the fan-out of PCIe ports on SoCs, ASSPs, MPUs and FPGAs, supporting features in the automotive industry.

They are qualified to AEC-Q100 grade two, have an operating range of -40 to +105˚C, are PPAP capable, and are manufactured in IATF 16949 certified facilities.

Interoperability at the system level is guaranteed through compliance with the PCI-Sig PCIe Rev 2.1 standard. At the component level, pin-compatibility with existing grade three products from Diodes provides a migration path to higher performance for existing designs.

Features include an integrated clock buffer and support for peer-to-peer traffic. The low-power operation is complemented by link power management, including active-state power management L0 and L1, device-state power management D0, D3Hot and D3Cold.



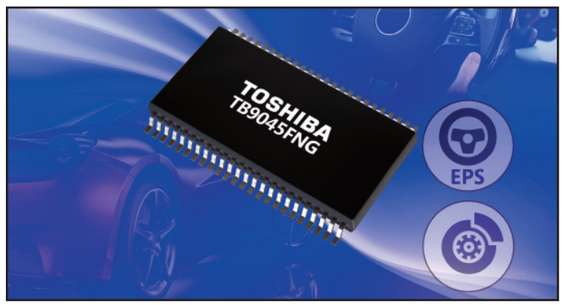
Power dissipation in L0 is 300mW typical, dropping to 35mW in PCI-PM L1.1 D3Hot PM sub-state mode.

Latency for a packet running through the switch without blocking is 150ns, and latency tolerance reporting improves platform power management. While the default mode is cut-through, store and forward modes are also supported. Peer-to-peer traffic is enabled through access control service support.

ICs support multiple outputs

General-purpose power ICs from Toshiba have multiple outputs and support functional safety according to ISO 26262 for safety-critical automotive applications including electric power steering and braking where Asil D is required.

Four devices have output voltages generated by a buck converter – 1.1V (TB9045-FNG-110), 1.2V (FNG-120), 1.25V (FNG-125) and 1.5V (FNG-150). The four output voltages from each device can power the core of an MCU, as well as being used for sensors and other interfaces.



A buck-boost converter generates 6V from the battery and can operate with input voltages as low as 2.7V to ensure constant voltage, even during cranking operations when the battery voltage drops significantly.

The devices are suited to input voltages as high as 18V and can operate from -40 to +125˚C. They are housed in a HTSSOP 48-P-300-0.50 package, measuring 6.1 by 12.5 by 1.0mm, making them suitable for modern densely packed automotive applications.

Fault detection features provide functional safety. These include over voltage for the DC-DC converter and under voltage lockout for the battery power supply as well as thermal shutdown and a circuit to monitor the oscillator frequency.

A watchdog timer detects errors on the external MCU and has the ability to detect latent faults that could indicate a potential failure.

Image sensors mitigate LED flicker

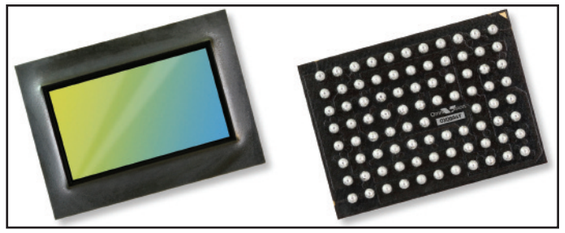
Omnivision Technologies has announced the first two members of its automotive image sensor platform – the 8MP, front-view OX08A and OX08B.

The OX08A is claimed to have the automotive industry's best HDR, while the pinout-compatible OX08B adds a benchmark in LED flicker mitigation (LFM), enabled by the sensor's on-chip Hale HDR and LFM engine combination algorithm.

The clarity and range offered by this platform, in combination with integrated Asil C features, suit front-view automotive applications, such as adas and level-three and above autonomous vehicles, where the ability to detect people and objects from far away in all lighting conditions is needed.

Cases where the scene has very dark and very bright areas, such as when exiting a tunnel with the sun low on the horizon, was the inspiration behind these sensors. In addition, LEDs are becoming omnipresent on the road, including illumination, traffic lights, road signs and bus displays. Having a sensor with LFM is a must for automotive applications to extract the necessary information in front of a vehicle.

The dual conversion gain (DCG) technology can achieve 82dB dynamic range on the first exposure. The 3D stacking technology enabled the integration of the Hale algorithm into the OX08B. The result is this sensor platform provides 140dB HDR, along with LFM and 8MP resolution.



With its four-cell technology, the company can offer LFM with low-light performance in a format that has a 2.1 micron pixel pitch. PureCel Plus-S stacked architecture lets each pixel perform optimally via higher full-well capacity for improved HDR.

This platform also enables sensor fusion, where the same camera signal is used for adas and autonomous machine vision while simultaneously feeding into dash cam front-view recording and display systems. Additionally, these sensors have region-of-interest functionality for clearer images of moving objects within fixed areas in the camera's field of view.

To ensure the safety of images being used for machine vision applications, low power cyber security is also integrated using standard encryption techniques and consuming less than 10% of the sensor's total power.

Both sensors have four-capture, 3840 x 2160 resolution at 36fps and a 16:9 display aspect ratio. They will be available in different colour-filter patterns to match machine vision applications. For instance, an RCCB colour filter will be offered to allow in more light and improve performance in dark environments.

The sensors are both planned to be AEC-Q100 grade-two certified.

Test tool streamlines coding standards

The 10.4.3 release of the Parasoft C/C++ test tool for enterprise and embedded applications focuses on streamlining safety-critical and security coding standards compliance and reporting, with complete coverage for Autosar C++14 and updated rule sets for detecting security weaknesses in the latest editions of CWE, including both the top 25 and on-the-cusp lists that were updated for 2019.

This is said to be the only tool supporting 100% of the required and automated guidelines. This should let organisations confidently adopt the Autosar C++14 standard according to their needs without compromising the quality of their compliance process.

The tool includes static analysis checkers that detect the weaknesses from the CWE top 25 and on-the-cusp enumerations, helping organisations find and eliminate the most frequent and severe security issues.

Automotive and security compliance packs provide these rules in ready-to-use test configurations.

This is along with dedicated compliance reporting that automatically generates the required documentation to reduce the manual overhead of compliance activities.

DSP IP optimises sensor fusion

DesignWare Arc VPX5 DSP and VPX5FS DSP processor IP from Synopsys is based on an extended Arc v2 DSP instruction set and optimised for signal processing applications, such as radar, lidar, sensor fusion and baseband communications processing.

The VPX5 DSP processors implement a configurable, energy-efficient very long instruction word (VLIW), single instruction-multiple data (SIMD) architecture that combines scalar and vector execution units to enable parallel processing.

The VPX5FS provides safety monitors, lockstep capabilities and other hardware safety features that help designers achieve functional safety and fault coverage without significant impact on power or performance.

They support single-, dual- and quad-core configurations. Each VPX core contains a scalar execution unit and multiple vector computation units that support 8, 16 and 32bit SIMD computations within a 512bit vector word.

The DSP processors are configurable, allowing developers to optimise for power and area by selecting only the hardware features and vector resources needed. Neural network algorithms used in machine learning and artificial intelligence can be processed by the processors using the 8bit data type, as well as 16 and 32bit floating point data types.

To address the growing use of floating-point calculations in complex DSP algorithms, up to three vector floating point pipelines are available in each core. They support half-, single- and double-precision floating point data types.

Each core also provides dedicated hardware acceleration for linear algebra and maths instructions, delivering performance for equation-based computations.

They can deliver 512flops and 32 maths operations per cycle.

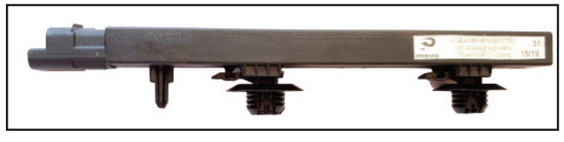
Antenna suits PKE and PEPS

For PKE (passive keyless entry) and PEPS (passive entry, passive start) in automotive are the Premo KGEA-MRHPM mid-range LF magnetic field antennas.

They have been designed to reduce the number of antennas rather than having a larger number of short antennas. They have mechanical robustness and IP69K or better waterproof protection.

The antennas can handle high mechanical loads such as inflection, torsion and drop tests.

Each antenna is fully covered with thermoplastic high-pressure moulding, using a patented technique where there is no point of union between different plastics – bobbin and final over-moulding – making it completely waterproof.



A built-in connector integrated into the over-moulding process reduces cost and eases assembly.

Size is 168mm long by 16mm wide and 11.65mm high. Magnetic field strength is 140.5dBμV/m at 2A p-p at 3m.

The core is protected against magnetostriction using low coefficient thermal expansion materials.

The antenna meets AEC-Q200.



Power relay extends life

A 150A power relay from Fujitsu has a minimum mechanical life of 300,000 operations and an electric life of 30,000 operations for make 150A, 450V DC and break 5A, 450V DC.

The FTR-E3 is a 1 Form X relay that can safely cut off high DC voltages. It is for use in automotive, alternative energy and industrial applications that require power generation, energy storage, inverter control and DC load controls.

The sealed relay has an arc extinguishing plate for arc suppression that eliminates the use of hydrogen gas and the need for polarity in the main contact circuit. This design reduces potential safety hazards while shrinking the relay's overall size to 45.0 by 69.0 by 63.3mm typical.

It is available in 12 and 24V DC models with 2500 dielectric strength, 1000MΩ minimum insulation resistance and an operating range of -40 to +85°C.

Framework bridges ecosystems

An integrated framework to bridge automotive ecosystems including DDS, ROS 2, Autosar Classic and Autosar Adaptive is available from Real-Time Innovations.

Connext Drive provides automotive manufacturers with the software and tools to build autonomous vehicles and fleets. It bridges research and production technologies, thus supporting development from prototype to end use.

The framework includes a native software development kit for developing and integrating vehicle applications. Because it is built to the open Data Distribution Service (DDS) standard, it implements data-centric connectivity that provides a virtual distributed shared memory. This lets algorithms get all the data they need while reducing in-vehicle wiring.

DDS is specified by automotive ecosystems, including ROS 2, Autosar and several commercial designs. This helps OEMs work with the standard or standards that best meets their needs at different points in the cycle.

The framework can directly enforce data integrity through the underlying protocol, and authenticates participants to ensure applications talk only to trusted remote applications. It encrypts flows to protect the privacy of data.

Designers can optimise performance and security by choosing which parts of the system, and even which individual dataflows, must be protected.

Distributed systems evolve, as they often need to incorporate many components that change over time. As they change, component interfaces and data structures evolve and differ. Connext Drive can match these slightly different data structures. This lets systems add capabilities over time. Thus, autonomous vehicle systems in development will maintain relevancy as the market advances over the next decade.

Vehicles must operate non-stop. Even a short downtime threatens safety and reliability. To address this, it supports full redundancy. Any sensor, data source, algorithm, compute platform or even network can be duplicated to improve reliability. The data-centric design allows the system to resolve this redundancy naturally.

Future updates will include reference architectures and data models, development and integration guides and optional ISO 26262 Asil D safety-certified libraries. These will reduce the risk of deploying autonomous vehicles in safety-critical applications.

Tools and services include the ability to collect data to control the vehicle remotely, record data for debugging and simulation, build larger systems including V2X and troubleshoot technical issues.



Radar SoC meets Asil B standard

Calterah Semiconductor's automotive radar SoC has entered mass production using Synopsys DesignWare Arc processor IP.

The ISO 26262 Asil compliant IP helps accelerate safety certification for mm-wave radar chips.

The cmos series includes four transmitter channels at most, four receiver channels, configurable waveform generator and integrated A-D converter with sampling up to 50MS/s.

The chip meets Asil B requirements.

Functional safety-related monitoring and detection took place on more than 190 blocks in the design, analysing over 1000 failure modes, leading to the development of dozens of chip-level safety mechanisms.

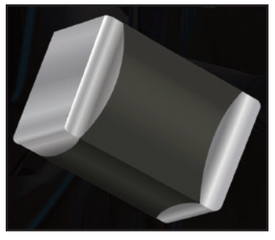
In addition to the conventional embedded wafer-level ball grid array package, the chip includes an antenna-in-package design that integrates the antenna onto the packaging layer.

The IP meets AEC-Q100 and supports quality management for adas, connected vehicle, infotainment and MCU designs. The processor integrates hardware safety features and safety monitors to detect errors.

Varistors work under bonnet

High-temperature, glass-encapsulated multilayer varistors from AVX are qualified to AEC-Q200, rated for operating temperatures up to +150˚C, and are for use in high-energy, harsh-environment automotive under-bonnet applications.

They comprise zinc oxide based ceramic semiconductor devices with nonlinear, bidirectional voltage-current characteristics similar to those of back-to-back Zener diodes, but with more current and energy handling capabilities and the addition of EMI and RFI attenuation.



The TransGuard VGAH varistors combine bi-directional overvoltage circuit protection and EMI and RFI filtering functions in a single SMT device. The series also exhibits high current- and energy-handling capabilities, less than 1ns response times to ESD strikes, multiple-strike capabilities, high-energy absorption and load dump, low leakage, and solderability.

Additional benefits include glass encapsulation for impermeable protection against harsh environments and processes, including acids, salt and chlorine flux, and no de-rating requirements for energy and current from -55 to +150˚C.

Available in five chip sizes (1206, 1210, 1812, 2220 and 3220) with 16 to 31V DC working voltages, 40 to 57V clamping voltages, 0.6 to 13J energy ratings, 1.5 to 50J load dump energy, 200 to 1800A peak current ratings, and 700 to 15,000pF capacitance, the varistors can be used in high-temperature, harsh-environment DC motor, pencil coil, Lin bus, ECU, turbocharger, sensor and relay applications in commercial, hybrid electric, plug-in hybrid electric and internal combustion engine vehicles.

They have RoHS-compliant nickel-barrier-over-pure-tin terminations, are compliant with the ESD performance requirements defined in AEC-Q200, IEC 61000-4-2 and ISO 10605, and are supplied on tape and reel for automated placement.

Multi-radio in-vehicle module

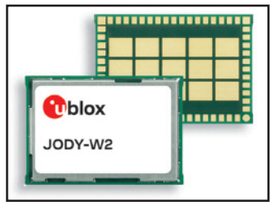
For in-vehicle communications, the Jody-W2 multi-radio module from U-Blox has a 13.8 by 19.8mm footprint.

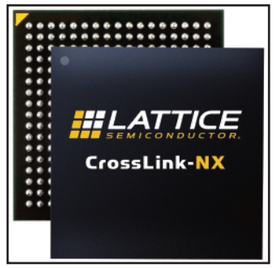
Operating temperature is -40 to +105˚C, and it uses AEC-Q100 qualified wireless system-on-chip (SoC) technology.

It has dual-band Wifi 5 (802.11ac), covering 2.4 and 5GHz channels, as well as built-in WPA3-compliant security mechanisms. Alongside this, it offers Bluetooth 5, with both Bluetooth Classic and Bluetooth Low Energy. There are separate antennas for Bluetooth and wifi.

Optimised for modern infotainment and telematics, it can act as an access point for connection with up to eight devices, offering enough bandwidth for video streaming via several devices at once.

It has the capacity to support parallel transportation of wifi and Bluetooth signals, and can simultaneously act as an access point and as a station, or conduct peer-to-peer communications.





Vision FPGA

The first FPGA developed on Lattice's Nexus platform, the CrossLink-NX is said to provide the low power, small form factor, reliability and performance for embedded vision and AI systems in various applications including automotive.

The Nexus platform combines a 28nm FD-SoI manufacturing process with an FPGA fabric architecture.

The initial device is designed to support rugged environments.

It supports multiple fast IOs, including Mipi, PCIe and DDR3 memory, and IO configuration takes 3ms and total device configuration less than 15ms.

There are 170bit of memory for every logic cell. The device comes in a 6 by 6mm form factor.

In addition to its Radiant 2.0 design software, the company has a library of IP cores including interfaces such as Mipi D-Phy, PCIe, SGMII and Open LDI and demos for embedded visions applications such as 4:1 image sensor aggregation.

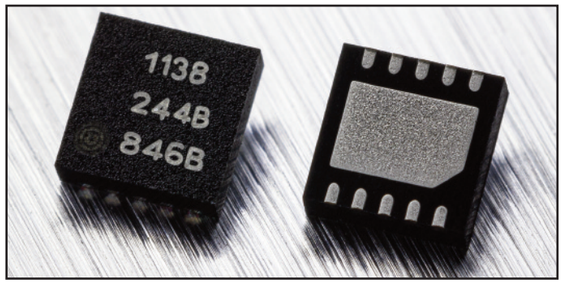
Lin LED controller for ambient lighting

A Lin LED controller from Melexis supports RGB LED based automotive ambient lighting.

The MLX81113 IC has more on-chip memory, higher output current and increased EMC robustness than its predecessor, the MLX81108. It also provides ISO 26262 functional-safety compliance to support its use in Asil A systems.

System-on-chip capabilities include the MLX16 FX 16bit risc microcontroller with 2kbyte of ram and 32kbyte of application usable flash, together with system rom for application use.

The on-chip eeprom is increased to 576byte for storing user data, such as LED calibration coefficients to ensure uniform brightness and colour.



The four output current sources are software programmable and can deliver up to 60mA, allowing the use of a wide range of RGB LEDs from different suppliers.

Independent PWM control, configurable up to 16bit resolution, provides the capability to adjust any colour point and brightness level of the connected RGB LED. Built-in temperature monitoring ensures stable colour from -40 to +125˚C, and permits temperature compensation for all colour channels.

Any temperature drift of red colour as well as green and blue can be fully compensated. To support fast application development, a complete toolchain is available, including an evaluation PCB as well as in-circuit emulator and C-compiler package.

To simplify software development, all essential software parts such as Lin driver, colour mixing and maths library as well as IC initialisation routines are also available.

The IC contains a complete Lin system, including transceiver and protocol handler for connecting RGB ambient modules to the vehicle's existing Lin.

The on-chip system complies with Lin 2.x and SAE J2602.

Made using silicon-on-insulator technology, the device has high-voltage IOs and can operate from a supply voltage down to 4V, delivering performance even if the vehicle supply voltage fluctuates, such as during stop-start operation.

Safety features include 28V jump start, and battery over-voltage and under-voltage detection.

It is in production and can be supplied with PPAP in accordance with AEC-Q100.

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Published by: Vehicle Electronics Magazine,
72 Westwood Road, Nottingham NG2 4FS, UK

Web site: vehicle-electronics.biz
Twitter: @velectronicsmag

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ISSN 2055-1177

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