VEHICLE electronics

The monthly magazine for automotive electronics engineers

LISTEN TO ENGINEERS

Delegates at Move conference attack COP26 summit

The automotive industry has accused the COP26 climate change conference of ignoring engineers in favour of political slogans.

Delegates at November's Move conference in London lined up to heap criticism on the Glasgow event.

"COP26 is not looking at micromobility, it is not looking at public transport," said Carlton Reid, a senior consultant at Forbes, in Move's opening keynote. "The people here at Move are a better judge of future transport trends than those that set the agenda at COP26."

And Andy Palmer, CEO of Switch Mobility, said: "Those in Glasgow think they are setting the carbon zero agenda, but the policy makers should leave it to the engineers to decide how it should be done. The automotive industry has been leading the change to a sustainable future."

Switch makes electric buses and commercial vehicles and Palmer said buses were a democratic, cheap and accessible option for most people to get from A to B.

"The automotive industry is pioneering the move to net zero," he said. "COP26 has proven net-zero is a phrase interpreted in different ways depending on who you are talking to. If you are serious about tackling climate change, it will need a truly global effort."

Thomas Ingenlath, CEO of Swedish electric car company Polestar, added: "We can't afford to wait for the politicians. The clue in COP26 is the number 26. Not much has changed since 1995, but climate change is worse. This cannot be left to the politicians."

Transport, he said, was one of the biggest polluting industries, but the industry had the answers.

"Much has been done," he said. "We are not avoiding the tough questions."

He said that car design needed to be more political.

"Every car should be seen as a campaign for change," he said. "Its manifesto should be to tackle climate change. Any car that doesn't combat climate change has failed in its design."

• **Read more about the Move conference on pages 13 to 16.**



Carlton Reid



Andy Palmer



Thomas Ingenlath

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Tata and Green Hills work on driver monitoring

Tata Elxsi is combining its software and Autosar Adaptive offering with the Integrity real-time operating system (rtos) from Green Hills Software to create a driver monitoring system (DMS) that runs on the latest automotive-grade microprocessors.

The first release of the combined DMS is available to early-access users today and runs on the Renesas R-Car. It is portable to other automotive processors such as those from NXP, Texas Instruments and Qualcomm.

This flexible and standards-based DMS platform helps OEMs and tier-one suppliers reduce the time, cost and complexity of developing and deploying DMS-compliant adas while meeting global safety and security requirements.

A DMS can address the growing safety risks caused by distracted and drowsy drivers and provides the assurance that a driver is ready to assume control from an autonomous driving system.

Euro NCap already requires DMS for five-star safety ratings, while the European General Safety Regulation has mandated DMS for all new cars, vans, lorries and buses starting in 2024.

The National Highway Traffic Safety Administration recommends the use of DMS for driver engagement in level-two vehicles, and the US Congress is pushing for DMS in all new cars within six years.

"Most OEMs and tier-ones are now looking at Autosar Adaptive platforms for domain controllers that are safe, secure and scalable," said Shaju S, vice president at Tata Elxsi.

The integration is said to deliver intelligent determination of a driver's readiness and state of attentiveness and runs on the Integrity-based platform used in millions of vehicles today.

Tata's DMS software detects distracted and drowsy drivers using its hybrid vision pipeline architecture that combines vehicle data such as direction and speed with the driver's eye gaze direction, head orientation and facial expression.

Ericsson tests 5G self-driving bus



Ericsson and partners are testing safety features on a 5G self-driving bus. The Ericsson-backed 5G Ride project has moved closer to full operations following a trial of remote digital monitoring and on-board digital safety services near Ericsson's headquarters in Kista, Stockholm, Sweden.

The project has tested safety features that explore how 5G and remote monitoring of vehicles via control towers could help facilitate the introduction of self-driving electric buses in urban environments safely.

A collaboration between Ericsson, Urban ICT Arena, Intel, Keolis, T-Engineering and Telia, the project debuted in September 2020 with a temporary bus route on the island of Djurgården, Stockholm.

Throughout 2021, the project partners continued to develop the connected control tower concept, using a 5G connection and a combination of digital safety features to monitor and manage fleets of self-driving vehicles on public roads, as well as enhance the safety and security of passengers.

As part of the project the partners recently conducted tests using the self-driving 5G Ride electric minibus in Kista, Stockholm.

Rohm and Zhenghai form SiC joint venture

Zhenghai and Rohm are forming a joint venture in the SiC power module business.

Called Haimosic, it will be established in China in December 2021 and owned 80% by Zhenghai and 20% by Rohm.

The company will develop, design, manufacture and sell power modules using silicon carbide (SiC) power devices, with the aim of developing a power module business for traction inverters and other uses in new energy vehicles.

It aims to develop efficient power modules by combining the inverter technology of Zhenghai, the module technology of both companies, and Rohm's SiC chips.

The modules to be developed are scheduled to be used in electric vehicles, and mass production will start next year.

"The establishment of a joint venture between Rohm and Zhenghai to develop the SiC power module business will surely bring new changes to the power module market," said Bi Bohai, chairman of Zhenghai Group.

Through more than 30 years of development, Zhenghai has accumulated industrialisation experience in many industries such as rare earth permanent magnet, regenerative medicine, automobile interior and electronic information.

"Zhenghai has determined to make the power module business a strategic business for the group, giving it the greatest support in terms of capital and human resources," said Bohai. "Combining Rohm's advanced power device technology with Zhenghai's industrialisation capabilities, we believe the joint venture will contribute to the development of China's power module industry."



Bi Bohai (right) with Wang Qingkai, executive director of Zhenghai

Isao Matsumoto, CEO of Rohm, added: "We are very pleased to establish a joint venture with Zhenghai, which has a wide range of businesses in China. As a leading company in SiC power devices, Rohm has been developing the world's most advanced devices together with peripheral components. The development of power modules in the new company will encourage the use of SiC power devices in new energy vehicles, which are gaining momentum in China, as well as play an important role in other application research."

Tuxera and Telechips partner on infotainment

Data storage management software and networking technologies company Tuxera is working with infotainment SoC supplier Telechips to address the growing global demand for in-vehicle infotainment (IVI) and cockpit technology.

The partnership allows for technical information sharing to empower development. Finland-based Tuxera's quality-assured embedded file systems should optimise the performance and reliability of Telechips' automotive chipsets.

Telechips produces Arm-based chipsets for automotive. The Korean company has a roughly 10% global market share in the industry for integrated cockpits, head-unit displays, IVI, microcontrollers and SoCs.

Telechips and Tuxera both have experience in cooperating with global tier-one suppliers in Korea and have engaged in multiple joint projects for more than five years. They develop and implement products not only in IVI, but also in automotive microcontrollers (MCUs) and neural processing units (NPUs).

This reinforced cooperation should enable Telechips' cockpit and audio processors on Linux, Android or QNX to be more reliable and responsive through Tuxera's file systems, such as GravityCS and the Reliance family.

"We are really happy with this partnership," said Rey-Yue Chien, key account manager at Tuxera. "By working closely with Telechips, we are helping to meet the performance and reliability needs of advanced automotive systems worldwide."

Oxford Instruments and Itri cooperate

Oxford Instruments has signed a memorandum of understanding (MoU) with Taiwan's Industrial Technology Research Institute (Itri) to improve measurements for in-vehicle electronics and the latest semiconductors.

Semiconductor manufacturers moving into the 2nm process face difficulties in accurately measuring the dimensions of key components, such as transistor structure, size and film thickness.

The MoU aims to set up a joint laboratory of metrology and inspection technology used in semiconductor measurements. The signatories intend to integrate the joint R&D capabilities of Itri and Oxford Instruments to improve semiconductor measurement capacities.

Itri has inspection capabilities in down to 2 to 3nm wafer manufacturing. Itri and Oxford started cooperating in 2017 on semiconductor optoelectronics.

"This time we will work on cutting-edge measurement technology for advanced manufacturing processes and key tools in monitoring yields in mass production," said Itri EVP Alex YM Peng. "We hope that the cooperation between Taiwan and the UK will accelerate the technological progress of both sides and open new horizons for the semiconductor industry."

Christian Lang, Oxford Instruments' product director, said it was vital to have insight into development opportunities. The development of semiconductor technology is focused on miniaturisation, high performance and low power consumption. In particular, 3D chip stacking design has been a profound breakthrough.

By relying on the established inspection capabilities of Itri, Oxford Instruments, said Lang, would continue to develop technology for the semiconductor materials.

Besides the signing of the MoU, Oxford Instruments will also move its atomic force microscope (AFM) to the joint laboratory at Itri for more applications. The AFM can speed up key dimension inspections of semiconductor wafer structures by up to ten times and can be applied to the measurement of semiconductor 3D structures.



Nvidia architecture paves way to autonomous vehicles

At its online GTC event in November, Nvidia CEO Jensen Huang announced a computer architecture and sensor set for full self-driving systems.

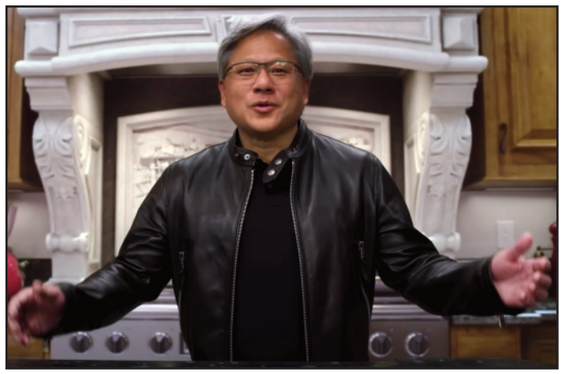
Drive Hyperion 8 is designed for functional safety and cyber security, and is supported by sensors from suppliers including Continental, Hella, Luminar, Sony and Valeo. It is available today for 2024 vehicle models.

The production platform is designed to be open and modular, so designers can use what they need from core compute and middleware up to NCap level-three driving, level-four parking and AI cockpit capabilities.

During the GTC keynote, Huang showed a Drive Hyperion 8 vehicle drive autonomously from the Nvidia headquarters in Santa Clara, California, to Rivermark Plaza in San Jose.

The platform is scalable, with the current standard Drive Orin platform upgradeable with Drive Atlan and DriveWorks APIs compatible across generations.

With a functionally safe AI compute platform at its core, Hyperion can provide a secure base for autonomous vehicle development.



Jensen Huang at Nvidia GTC event

Orin systems-on-chip provide redundancy and fail-over safety, as well as ample compute for level-four self-driving and intelligent cockpit capabilities.

The Hyperion 8 developer kit also includes Nvidia Ampere architecture GPUs, which deliver headroom for developers to test and validate software capabilities.

The DriveWorks sensor abstraction layer streamlines sensor setup with easy-to-use plugins, while Drive AV software contains the deep neural networks for perception, mapping, planning and control.

By including a complete sensor setup on top of centralised compute and AI software, Hyperion provides everything needed to validate an intelligent vehicle's hardware on the road.

Its sensor suite encompasses 12 cameras, nine radars, 12 ultrasonics and one front-facing lidar sensor. And with the adoption of sensor suppliers coupled with sensor abstraction tools, autonomous vehicle manufacturers can customise the platform to their individual self-driving offerings.

This open, flexible ecosystem ensures developers can test and validate their technology on the exact hardware that will be on the vehicle.

The long-range Luminar Iris sensor will perform front-facing lidar capabilities, using a custom architecture to meet stringent performance, safety and automotive-grade requirements.

"Nvidia has led the modern compute revolution, and the industry sees them as doing the same with autonomous driving," said Austin Russell, CEO of Luminar. "The common thread between our two companies is that our technologies are becoming de facto for major automakers to enable next-generation safety and autonomy. By taking advantage of our respective strengths, automakers have access to the most advanced autonomous vehicle development platform."

The radar suite includes Hella short-range and Continental long-range and imaging radars for redundant sensing. Sony and Valeo cameras provide visual sensing, in addition to ultrasonic sensors from Valeo for measuring object distance.

"Nvidia Drive Hyperion is a complete platform for developing autonomous vehicles, which is why Sony has integrated its sensors to give our customers the most effective transition from prototype to production vehicles," said Marius Evensen, head of automotive marketing at Sony.



Continental software calculates manoeuvres in fast-moving traffic

Continental has developed intelligent software that enables complex driving manoeuvres autonomously. It is already close to series production and may be used as early as 2024.

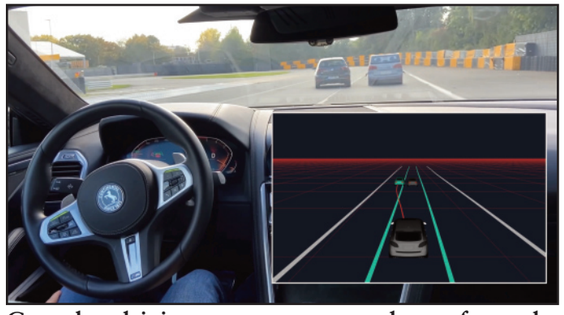
The driving planner is software that enables highly automated driving from level three. This means vehicles can master certain driving tasks independently and without driver intervention, said to represent a significant leap forward in driving intelligence.

The planner calculates precise decision-making variants from a range of sensor data to master complex driving manoeuvres automatically on the highway. To do this, the software can calculate traffic situations several seconds in advance and derive the optimum response from the vehicle.

What is special is it calculates the combination of longitudinal and lateral movements in a harmonious, intelligent and closely timed interaction. Individual systems available today – adaptive cruise control, lane change assistant – plan longitudinal and lateral movements independently of each other, for example, longitudinal movement with adaptive cruise control and lateral movement with lane change assistant.

Driving Planner calculates the longitudinal and lateral movement together over a time horizon of several seconds. This enables the technology to master complex highly automated driving manoeuvres.

A typical example is entering a highway via the acceleration lane. The planner calculates this manoeuvre from radar sensor and camera data and makes a decision. Further software modules take over the actual implementation of the calculated manoeuvre. The vehicle accelerates forward, merges into the ongoing traffic to the side and then picks up speed according to the traffic flow and other road users.



Complex driving manoeuvres can be performed automatically even at higher speeds

Another example is the vehicle traveling in the middle of a three-lane highway, there is a traffic jam on the right, and the speed is high on the left. Suddenly, a car swerves from the right into the middle lane. Within fractions of a second, the planner calculates the safest manoeuvre from possible alternatives – braking in the lane, accelerating and merging to the left, braking and merging behind another vehicle in the left lane.

Driving Planner is capable of calculating driving manoeuvres up to a speed of 130km/h. The development phase of the software system has been completed, and the technology is expected to be launched in 2024.

"With our intensively tested technologies for automated driving conforming to everyday requirements, we are significantly promoting road safety," said Frank Petznick, head of Continental's adas business unit. "Automated driving can already offer a big plus in safety and comfort if we support drivers in typical, often stressful driving situations with intelligent technology."

Qorvo acquires United SiC

RF company Qorvo has acquired New Jersey-based United Silicon Carbide (United SiC), a manufacturer of SiC power semiconductors.

The acquisition expands Qorvo's reach into fast-growing markets for electric vehicles (EVs), industrial power, circuit protection, renewables and data centre power.

United SiC will become part of Qorvo's infrastructure and defence products (IDP) business and this will be led by Chris Dries, who was formerly the CEO of United SiC.

"Our team is thrilled to expand our SiC portfolio as part of Qorvo and continue to build the business with speed and scale, working to accelerate SiC adoption with the industry's highest performance devices," said Dries.



Renesas SoCs drive Toyota Lexus multimedia system

Toyota adopts Renesas SoCs in Lexus multimedia

Toyota has adopted Renesas R-Car H3 and M3 systems-on-chip (SoCs) for its multimedia infotainment system that delivers images, audio and information from in-vehicle and external sources to the driver in a safe and convenient manner.

The multimedia system makes its first appearance in the recently released Lexus NX and is planned for other Lexus and Toyota vehicles.

The multimedia system incorporates a large-format, high-resolution, maximum 35.5cm wide touch display. The display area can be flexibly divided into sections and zoomed in and out, combining functionality and convenience. Voice recognition allows quick start-up in response to voice commands, and there is an automotive sound system and an over-the-air (OTA) software update function.

The R-Car SoCs can import map information, images and video from users' preferred devices, including smartphones, and connected applications to the large display. They also enable functions such as display touch controls, voice recognition via the microphone and audio output to multiple speakers.

In addition, the SoCs' built-in security functions enable secure OTA updates and provide connected services.

"Two of our biggest challenges in realising the leading-edge system was the efficient development while securing the necessary performance and making complex automotive software," said Masato Kobayashi, director at Toyota. "Renesas' R-Car SoCs are designed specifically for automotive applications, providing excellent performance and reliability, backed by a robust ecosystem, a combination that enabled us to create innovative multimedia systems."

As multimedia system functions vary based on the vehicle model, Toyota has implemented the R-Car H3 in systems for high-end models equipped with full functionality, and the mid-range M3 in other vehicle models.

The R-Car family provides software compatibility across the range, contributing to more efficient development when extending to a wide range of vehicle models.

"I am delighted that Renesas' R-Car SoCs are part of Toyota's next-generation multimedia system, and that Lexus vehicles equipped with this functionality are coming to the market," said Takeshi Kataoka, senior VP at Renesas.

Littelfuse makes Carling takeover

Littelfuse has acquired Carling Technologies for $315m to gain access to its commercial vehicle technology.

Founded in 1920, Carling specialises in switching and circuit protection technologies with a strong global presence in commercial vehicle, marine, and datacoms and telecoms infrastructure markets. The business is headquartered in Connecticut, with offices and facilities around the world, and has annual sales of about $170m.

"We are excited to welcome Carling employees to the Littelfuse team," said Dave Lesperance, VP at Littelfuse. "With its strong brand name and a long history of innovation, quality and reliability, Carling enhances our presence and growth in commercial vehicles and communications infrastructure. Our complementary engineering capabilities, application expertise and product portfolios will drive deeper engagement with a broader base of customers and distribution partners, serving as a platform for future growth."

The transaction is subject to customary closing conditions and regulatory approvals, and is expected to close before the end of this year.



Dynamis PRC student racing team

Vicor solves power problems for student racers

Italy's Dynamis PRC student racing team has teamed up with Vicor to solve power and weight problems as it switches from a combustion engine to an electric car protype.

DC-DC converters are helping reduce race car weight while sourcing power from the main battery to meet 12V needs.

Dynamis PRC is the Formula Student team of Politecnico di Milano. More than 100 students in the team design and make a racing car prototype every year, for racing in the international Formula SAE championship.

After 15 years in the combustion category, Dynamis PRC has reached fourth position, and first in Italy, in the Formula Student Combustion world ranking.

The team is now changing from a combustion engine to electric power, allowing it to make many improvements to the car's design and performance. Chief among these was weight reduction, going from over 20kg for the original engine, to four 3.5kg electric motors, one mounted on each wheel. Each motor is independently controlled to optimise traction and braking performance.

One of the major new components was the accumulator, which comprised 660 Sony VTC6 cells to deliver up to around 550V.

To supply the vehicle's 12V low voltage power, a LiFePO4 battery was also included in the electrical system. However, this had very low autonomy. To solve this problem, Dynamis decided to use the existing 12V circuit, powered by the low-voltage battery, to supply the on-board PCBs, sensors and telemetry equipment.

Dynamis would then step down the voltage from the high-voltage accumulator and extract 12V, using two DC-DC converter modules. This meets the more demanding part of the low-voltage load, sourcing 600W, 50A at 12V to supply the cooling fans and cooling water pump.

The DC-DC converter system had to be reliable, as a fault would cause the cooling system to stop, leading to an uncontrolled rise in motor and inverter temperatures. Weight and size were also concerns.

Dynamis opted for Vicor's DCM4623 module, as it satisfied all system requirements. The module can operate in array mode, accommodating an input supply from the accumulator that ranged from 550V down to 330V as the batteries discharged during a race.

The DCM modules were well-documented and easy to use, but the team also found Vicor's help invaluable.

"As important as the product specification, we found in Vicor a partner that was willing to support our project by supplying us with their modules, and also assisting us in the design process," said Marta Bragotto, the team's electronics and powertrain logistics manager. "They made their engineers available to us, along with excellent whitepapers and technical documentation."

Plans include a dual low-voltage system, with 48V for the cooling equipment and 12V for all the onboard electronics. This will use Vicor modules to convert the accumulator's high voltage down to 48V, with further modules to convert from 48 to 12V.

ZF and KPit develop mobility middleware

ZF and KPit Technologies are jointly developing middleware for the mobility ecosystem.

Built with the software expertise of KPit paired with ZF's understanding of vehicle systems, the modular middleware can be deployed across OEMs.

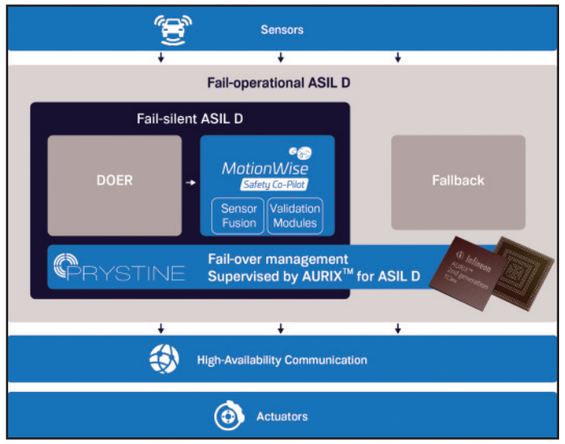
This cooperation will also bring onboard technology from other companies, including semiconductor specialists, software firms, cloud services and start-ups.

"The next generation of vehicles that come into the market will feature electric drives, a high degree of automated functions as well as connectivity, and they will be software-defined," said Dirk Walliser, senior vice president at ZF. "Using what we develop jointly with KPit, we can offer our automotive customers even more comprehensive software that fits seamlessly together with our system portfolio for the software-defined vehicle: high-performance computing, software, intelligent sensors and smart actuators."

In January 2021, ZF established a centre for developing software for future architectures on a group-wide level. One core product is automotive middleware that serves as a mediator between a vehicle computer's operating system and its software applications. Its development is closely connected to the development of application software for mobility domains such as automated driving, integrated safety, vehicle motion control and electric mobility.



Dirk Walliser (left) and Kishor Patil



Failover management mechanism developed under the Prystine project

Infineon and TTTech design architecture for L3 and L4

TTTech Auto and Infineon have developed components for a fail-operational electronic architecture for automated driving at SAE levels three and four.

This enables the safe and reliable processing of, for example, radar or lidar camera sensor data and is targeting car and technology makers. The fail-operational architectural concept and its key components ensure the safe operation of highway pilot functions, valet parking and autonomous lorry driving in case individual functions fail.

The joint research contributed to the completion of the European Prystine programmable systems for intelligence in automobiles project. With a budget of about €50m, Prystine aimed to realise safe automated driving by fail-operational urban surround perception. For three years, about 60 partners worked together in sensor-fusion, electronic architectures and AI coordinated by Infineon.

The mixed critical approach allows the use of computer hardware and software that run applications of different Asils. A failover mechanism consisting of a primary and a fallback ECU ensures the necessary fail-operationality for vehicles.

"With a fail-operational system design, car manufacturers lift the safety of their highly automated vehicle to aviation standard in a cost-efficient manner," said Stefan Poledna, CTO of TTTech Auto. "Based on a centralised computer architecture, it forms the foundation for the future software-based car."

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Bosch to invest €400m in fabs in 2022

Bosch plans to invest more than €400m in its semiconductor fabs in 2022 due the global automotive chip shortage.

Just a few weeks after opening a wafer fab in Dresden, the company has announced another nine-figure investment in its chip manufacturing facilities.

The money will be used to expand its wafer fabs in Dresden and Reutlingen, Germany, and its semiconductor operations in Penang, Malaysia.

"Demand for chips is continuing to grow at breakneck speed," said Volkmar Denner, chairman of Robert Bosch. "In light of current developments, we are systematically expanding our semiconductor production so we can provide our customers with the best possible support."

Most of the capital expenditure is earmarked for Bosch's 300mm wafer fab in Dresden, where manufacturing capacity is to be expanded in 2022.

Around €50m of the planned sum will be spent on the wafer fab in Reutlingen near Stuttgart in the coming year. Bosch will invest a total of €150m in additional clean-room space here from 2021 to 2023.

In Penang, Bosch is building a test centre for semiconductors from scratch. Starting in 2023, the centre will test finished semiconductor chips and sensors.


Bosch cleanroom in Dresden

"Our aim is to ramp up production of chips in Dresden earlier than planned and at the same time expand clean-room capacity in Reutlingen," said board member Harald Kroeger. "Every additional chip we produce will help in the current situation."

In two stages, more than 4000m^2 will be added to the current 35,000m^2 of clean-room space in Reutlingen. The first stage, adding 1000m^2 of production area for 200mm wafers to bring the total to 11,500m^2, has already been completed and has been producing wafers since September.

"We've already expanded our manufacturing capacity for 200mm wafers by some 10%," Kroeger said.

In making this move, the company is responding in particular to increased demand for mems sensors and SiC power semiconductors.

The second stage of the expansion will create a further 3000m^2 of clean-room space by the end of 2023. Bosch is also creating 150 jobs in semiconductor development at Reutlingen.

In Penang, the automated and connected factory is set to perform testing of semiconductor chips and sensors starting in 2023. In total, Bosch has more than 100,000m^2 of land available on Penang's mainland strip, which will be developed in stages.

Initially, the test centre will cover an area of around 14,000m^2, including clean rooms, office space, research and development, and training facilities for up to 400 associates.

Work on the buildings began in May 2021.

The company has been producing semiconductor components in Reutlingen since 1970. They are used in consumer electronics and automotive applications.

"Bosch can draw on its specific semiconductor and automotive expertise to develop superior electronic systems," Kroeger said. "This benefits our customers and the countless people who want to continue to enjoy safe and efficient mobility in the future."

Production in the 300mm wafer fab in Dresden started in July this year, six months earlier than planned. The chips made in the new plant are initially being installed in Bosch power tools. For automotive, chip production started in September, three months earlier than planned.

Steve Rogerson reports from November's Move conference in London

ON THE MOVE

MOVE
MODELS • TECHNOLOGY • SUSTAINABILITY

There was a feeling of inevitability at November's Move conference in London. Yes, for a long time now it has been accepted by those in the industry and some outside that autonomous vehicles are coming and, in many cases, are already here.

What was different at Move was that for the most part these were not the engineers or representatives from the major car makers, but the people who will have to make an autonomous reality work in practice. They are the ones who are making their towns and cities smarter and are looking at how autonomous vehicles can help. There is no "if" in that sentence.

A good example was Claire Ruskin, executive director at Cambridge Network, a member organisation working to transform the UK university city. Even though it only has a population of around 120,000, Cambridge sees something like 100,000 people commuting in and out from a large travel-to-work area each day, leading to serious traffic congestion.

The city is looking towards mixed traffic mobility to solve this problem, including doubling the amount of public transport within the next decade. Ruskin realises that autonomous vehicles will have a role to play in this, but not private vehicles.

"If you make private vehicles autonomous, it does not reduce congestion," she said. "But if you get people onto public transport, then it does reduce congestion."

But she realises that public transportation has to be attractive as forcing people onto buses and trains is not the answer.

"It will cost £20m a year to get the public transport we want in Cambridge," she said.

One way to raise money is through congestion charging, but for that to work they have to accept that a certain number of cars will come into the centre. Low emission zones are also an idea but she said you could not expect low-income people to buy new cars. The answer, at least for the short term, is a mixed traffic model.

Michael Fernandez-Ferri, vice president at Goggo Network, said examples could now be found around the world of companies



Claire Ruskin: "Forcing people onto public transport is hard."



Michael Fernandez-Ferri: "Things are moving fast."



Peter Vincent: "We need coverage and decent latency at a reasonable cost."

and cities running trials of autonomous vehicles.

"Things are moving fast," he said.

For example, Waymo in the USA is about to launch in New York. California is issuing licences. China is running projects in Beijing and Shanghai, with Chinese companies also launching in the USA.

"China has put a lot of investment into this," said Fernandez-Ferri.

He also pointed to tests across Europe, notably in France, Germany and the UK.

This technology can also be used in rural areas such as found in the town of Kelheim in Germany where the challenge is to provide public transport for 123,000 people spread out over lots of villages, and forty per cent of whom are older than fifty.

"It is a nice place to visit," said Stefan Grüttner, the Bavarian district's mobility manager. "But we have a lot of rain, and snow in winter. The weather conditions change the reality of the service. We can't run a stable service, but that is what people want. So we are looking to provide a shuttle service in all kinds of weather."

The plan for the KelRide Project, that started earlier this year and will run till the end of 2023, is to have autonomous ride-sharing shuttles that can take people to, say, the train station to catch a train all paid for and booked through one app.

"We want to integrate ride sharing with public transport," said Grüttner about the €10.9m government-funded project.

A technology that looks set to provide a shot in the arm for the whole connected vehicle industry is 5G, and one company actively exploring this is Scania. It has been running some form of connectivity as options in its vehicles since 2011 and Peter Vincent, head of the company's connected systems, sees 5G and V2X as complementary to what it is already doing.

"Connectivity can help make robotic vehicles work better," said Vincent. "It provides a true gateway to a solid business case for autonomous commercial vehicles."

What 5G brings is bandwidth, coverage and reduced latency, what Vincent described as "prerequisites" for autonomous vehicles.

Scania is carrying out level-four self-driving trials and looking at how this can be combined with an integrated transport system.

"The industry is working on cellular-assisted V2X where the base stations are part of the network, but there is a problem with network capacity and bandwidth," he said. "The telecoms industry is fighting to



Stefan Grüttner: "People want a stable service."

get a big part of this but there is a problem with the capacity of the base stations. We need coverage and decent latency at a reasonable cost."

However, an autonomous truck does not need massive bandwidth most of the time; it just sends small packages.

However, when there is a problem it then needs more bandwidth and low latency, and it needs them fast.

How Vincent sees this panning out is that they operate on low bandwidth but then switch



Paul Newman: "We want to change the way people move."



From the past to the future, visitors exploring technology at Move

instantly to paying for the highest coverage and bandwidth during those important moments.

"I think 5G can handle this," he said. "I think 5G provides a perfect way of doing this and we are rolling this out in our trucks. We have 5G connectivity as an option now and in a couple of years we will roll it out fully."

One obvious problem a lot are dealing with is safety. The challenge is moving from carefully conducted trials and tests, monitored with safety drivers, to a place where these vehicles really do it all by themselves, all day, every day.

"The real innovation is in validation and verification," said Paul Newman, CTO of Oxbotica. "We want autonomous vehicles to change the way people move. So how do we give users the confidence that the software has been tested and is safe, especially with all the start-ups in the industry?"

And this is important because if the people do not ride, then for whom is all this being done.

"There is tremendous pressure to find innovations," said David Storer, director of research innovation at Clepa, the European automotive suppliers' association. "There is a huge opportunity for the industry but the real benefit will be for the consumers. It will bring down prices and make it more inclusive."

Surveys are showing that there is a lot of wariness among ordinary people about the benefits and safety of autonomous vehicles. But the picture is changing as we are no longer talking about individuals having autonomous cars. As Ruskin from Cambridge pointed out, that doesn't reduce congestion, just replaces one form of congestion with another.

The way this will really be implemented will be as a form of public transport, integrated with all the other forms of public transport such as e-scooters and Uber-style taxis, where fixed bus routes are replaced by autonomous shuttles that respond to demand. All of this was on show at Move, an event at London's Excel where many visitors arrived on the driverless trains that run on the Docklands Light Railway, proof if there ever was that people will accept travelling without a driver.



David Storer: "The real benefit will be for the consumers."

TEST & MEASUREMENT

CHAMBER AIDS

Alois Ascher and Andreas von Lösecke

describe a radar test system for future vehicle safety

Increasing autonomy and ever more sophisticated safety functions are leading to a rising number of sensors installed in vehicles. But the right instruments can make testing of onboard radars a routine exercise.

Many drivers like the convenience of adaptive cruise control and appreciate the benefits of collision warning systems. These adas get their environmental data from radar sensors, which are being installed in ever-increasing numbers all over vehicles, see Fig. 1.

As security-related components, they must function flawlessly at all times and fully conform to specified performance data. Up to now this has not been easy to prove, despite the availability of

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radar echo generators that can be used to simulate simple sample scenarios. The development is heading towards autonomous driving, and the situations that must be handled reliably by onboard electronics are becoming more and more demanding.

Ultimately, the technology must fully replicate the cognitive abilities of a human driver.

However, vehicle AI can only make trustworthy decisions if the underlying sensor data reflect the actual environment with the complexity and precision required for vehicle operation. This means objects of different sizes, located at different distances and moving at different speeds, as typically found in urban situations – such as at pedestrian crossings or intersections – must be captured with sufficient reliability.

The required quality assurance of automotive radars includes acceptance measurement of each sensor on manufacturer production lines as well as type testing of the vehicles ready for series production in which the sensors are integrated. Testing is also required earlier in the development process for sensors, adas and vehicles, where test setup flexibility is particularly needed.

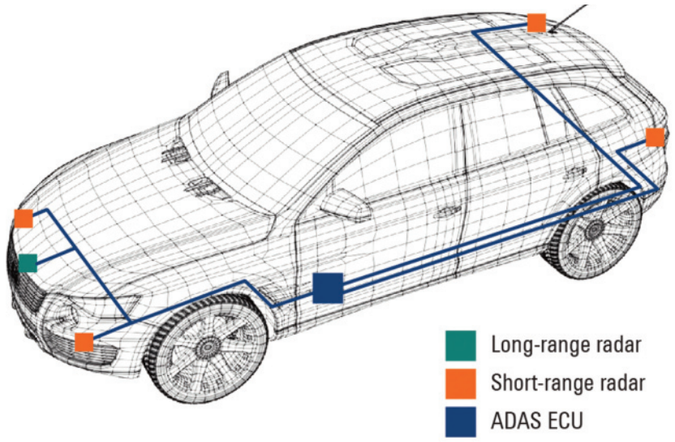


Fig. 1: Short-range and long-range radars provide environment data for various driver assistance systems

Testing of individual sensors is best performed in shielded test chambers because test conditions can be accurately reproduced and uncontrolled external influences can be eliminated.

Entire vehicles must be measured on a chassis dynamometer under semi-realistic operating conditions. Up to now, only the vehicle could be tested under realistic conditions, and realistic scenarios for radar tests were only rudimentarily implemented. In particular, simulation of tangential motion was only possible with mechanically moved antennas or antenna configurations with large gaps, yielding unsatisfactory results. Now a system for testing automotive radars can bring the diversity of real street scenarios into the test environment.



Fig. 2: Radar echo generator and its RF frontend, the antenna array (right), along with millimetre-wave remote front ends (small modules); virtually any type of radar test system can be setup with these three components

The key to the radar test system, consisting of a radar echo generator and an antenna array, see Fig. 2, is purely electronic operation. The generator simulates the targets with the desired size (radar cross section), distance and speed, while the antenna array first receives the radar pulses and feeds them to the echo generator, and then returns the echoes at the desired angle or causes them to move in small steps over an angular range corresponding to the tangential speed of the simulated objects.

Both instruments can be cascaded to create test situations of virtually any desired complexity. It is even possible to achieve 360-degree azimuth coverage and height profiles.

Modularity

The system can be configured precisely for specific test requirements. The instruments themselves can be equipped with options for different scenarios. In the minimal configuration with one baseband module, the radar echo generator simulates a single dynamic target. Four modules can be fitted to simulate up to eight targets when the generator is operated with the array as a front end.

Because of the signal processing time, digital echo generators have a certain latency that takes the form of a blind zone or minimum target distance. In this case, the distance is nearly 17m. For short-range scenarios, such as testing emergency braking assistance systems, graduated analogue delay lines for distances to below 4m can be added. The radar does

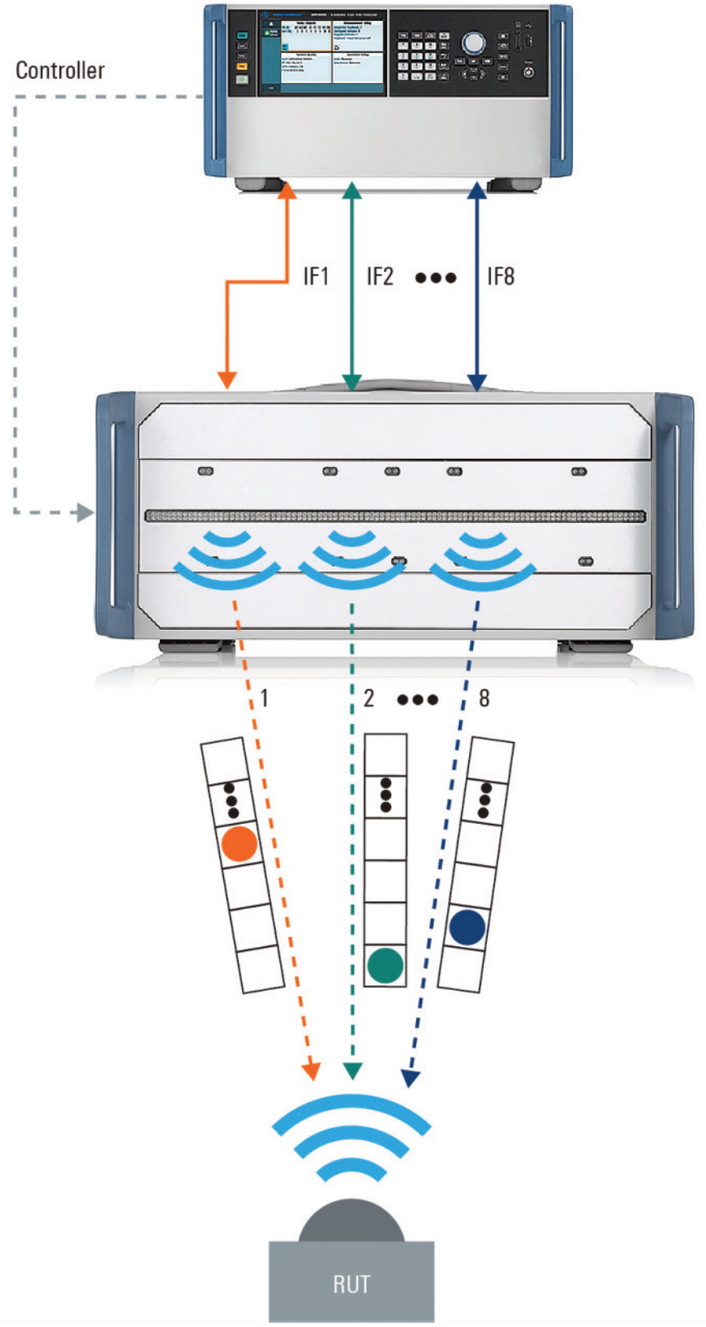


Fig. 3: In combination with the antenna array, the generator can simultaneously simulate eight targets using freely definable 4D data (direction, distance, size, speed) within the system limits and send their echoes back to the radar; with suitable configuration, a target can be moved in fine steps over the entire angle range of an antenna row

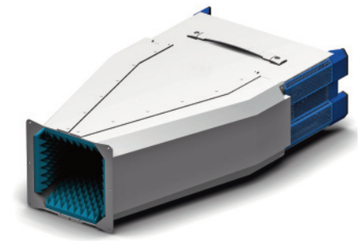


Fig. 4: The shielding system allows the antenna array to be used in a normal lab environment; the radar sensor is mounted at the opposite end

not notice the transition from digital to analogue delay.

Azimuth

The antenna array is an RF front end for the generator. It processes radar with up to 4GHz bandwidth in frequencies from 76 to 81GHz. In the base configuration, an instrument contains 96 transmit antennas arranged in a row with a spacing of 3.7mm, internally divided into four arrays.

The generator can feed a separate echo to each array, see Fig. 3. For a target without a tangential motion component, the echo is emitted by a single, arbitrarily selectable antenna, but for a target moving tangentially the echo travels along the row.

The four antenna arrays of a row can also be coupled to use the full width of the instrument for broad target motions. The previously described configuration can optionally be doubled, giving a total of 192 transmit antennas in two rows with eight arrays for simultaneous simulation of up to eight targets.

Conventional

For tests that do not require this flexibility, such as scenarios without tangential motion or measurements in a test chamber, up to four millimetre-wave remote front ends can be used instead of the antenna array, Fig. 2. Each of these front ends can emit up to eight echoes in a fixed direction in response to a radar signal.

This can be necessary to simulate a set of targets at different distances, such as pedestrians or cyclists in front of a lorry. Up to 32 targets in total can be simulated with this setup.

Live scenarios

For testing individual radar sensors in development or production, compact shielded chambers can be used such as the mini shielded chamber for the lab bench shown in Fig. 4.

Testing the radar functionality of an entire vehicle is naturally a lot more complicated. For this, a large RF shielded test chamber with a chassis dynamometer is needed, see Fig. 5.

Complete system tests, however, were previously only possible to a limited extent due to the lack of suitable over-the-air test

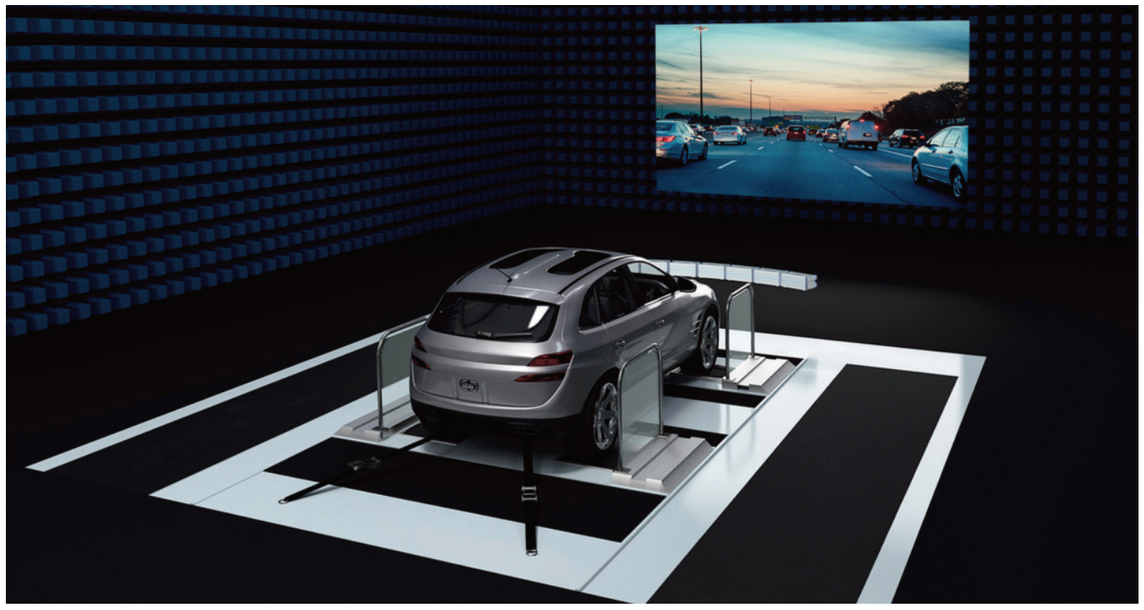


Fig. 5: The radar echo generator and antenna array enable realistic radar tests on a chassis dynamometer using virtual scenarios of almost any complexity

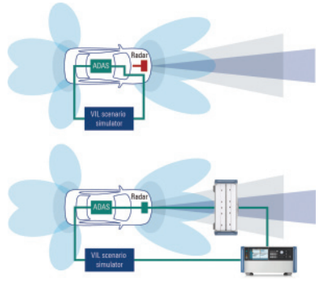


Fig. 6: In the past, radar based adas were mainly tested in vehicle-in-the-loop setups using simulated scenarios with the radar sensors out of the loop (top) – the target data were provided by a scenario simulator; the radar echo generator and antenna array allow the radar sensors to be included in the test loop, known as radar in the loop

equipment. Instead, the adas control unit was usually fed with simulated sensor data (Fig. 6, top). This required accurate acquisition of the environment by the sensors. The test system described here includes the radar sensors in the test (radar in the loop, Fig. 6, bottom), allowing real data to be used.

An arc-shaped radar-reflecting wall of cascaded antenna arrays is set up in front of the chassis dynamometer. The number of units depends on the desired angular coverage and angular resolution.

The number of echo generator digital back ends required depends on the complexity of the scenarios to be simulated. A fully equipped generator simulates up to eight targets that can be distributed to up to eight antenna array units. Individual targets can be transmitted over the entire antenna array chain, that is across a broad azimuth range. For very dense scenarios, each array uses a generator of its own, see Fig. 7.

Sometimes it is necessary to simulate situations in which a target moves not only in a plane, but also in height. An overpass approach road is a typical scenario. For such cases, the arrays can be tipped 90 degrees and operated lying on their sides.

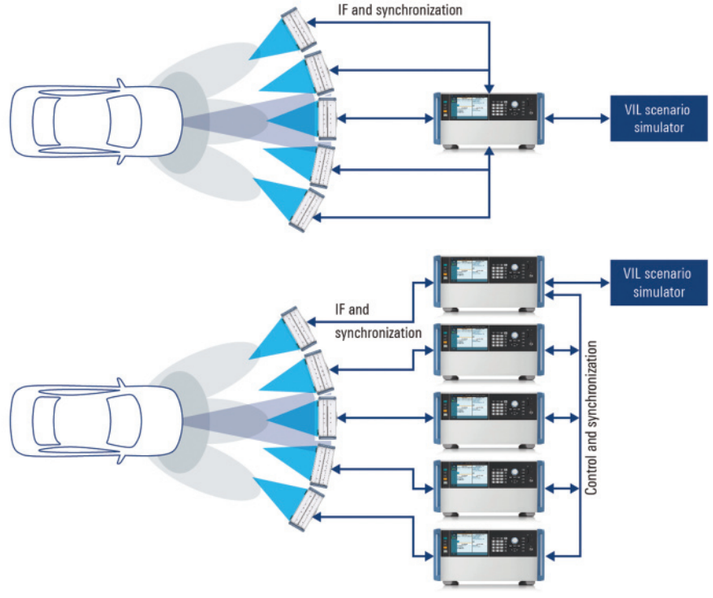


Fig. 7: The number of necessary radar echo generators and antenna arrays depends on the number of targets and their spatial density, as well as the angular range to be covered

Summary

Many driver assistance systems, and in particular growing vehicle autonomy, depend on the reliable operation of more and more installed radar sensors. Previously, only rudimentary testing of these sensors was possible.

The radar test system described here, consisting of a radar echo generator and an antenna array, remedies this. Radar test environments with virtually any desired complexity can be set up with this modular system. It can be used along the entire development and validation path of sensors and radar based adas, including vehicle-in-the-loop (VIL) tests of complete vehicles on a chassis dynamometer. As a result, the system makes an important contribution to the safety of future vehicles.





Alois Ascher (right) is product manager for signal generators and Andreas von Lösecke is product manager for microwave imaging, both at Rohde & Schwarz

IN-CABIN MONITORING

Andreas Pellkofer and Gopal Karnam explore emerging automotive in-cabin sensing for safety and comfort



Child presence detection will be mandatory in some regions

Automotive cabin sensing is a rapidly evolving area with applications using a combination of sensors and intelligent algorithms. Today there are two key aspects driving the development of in-cabin sensing technologies.

First, regulations to improve occupant safety are being realised. Both Euro NCap standards and European Commission (EC) regulations mandate the use of driver monitoring systems (DMS) by 2022, and the US National Transportation Safety Board (NTSB) recommends DMS in semi-autonomous cars.

A hands on-off detection (HOD) system is already required in 2021 to meet UN legislation for lane keeping assist systems (LKAS). Also, child presence detection systems will become mandatory in the USA by 2022.

With this forthcoming legislation, DMS and occupant sensing capabilities will become a standard feature of L2+ and above driving assist platforms.

The second key aspect is comfort enhancement for passengers, for example, through emotional sensing. OEMs have detected this is a differentiation factor and will use innovative technologies to address it.

Fatalities

The European Transport Safety Council (ETSC) has calculated that 51 people per million inhabitants in the EU were killed in road accidents in 2019, with 95% of the cases caused by a human factor: driver error, distraction, drowsiness, stress or fatigue. And the EC has announced a package of transport safety initiatives with the target of a 50 per cent cut in road deaths and serious injuries by 2030, with Vision Zero the aim by 2050.

DMS today already support other adas. As an example, an LKAS is usually combined with an HOD system to detect the hands of the driver on the steering wheel. The system informs the driver to take back control when required. In addition, DMS offer new features to detect the driver's health and ensure adequate attention levels.

The introduction of vital sign monitoring (VSM) technology, such as electrocardiography (ECG) or electrodermal activity (EDA, or skin impedance), offers the ability to sense the driver's health and stress level to avoid potential issues before they even arise. For example, if the VSM system detects the driver is unable to control the car due to drowsiness or fatigue, adas can bring the car to a safe state – slow down, steer to an emergency lane or stop the car.

Comfort

Ensuring an excellent driver and passenger experience is more



Fig. 1: Cabin sensor application examples

critical than ever. It offers the opportunity to innovate increasing brand recognition and ensure customer loyalty.

The ever-increasing expectations of customers is putting an onus on OEMs to add features that offer this enhanced experience. Personalisation and advanced human machine interface (HMI) concepts (intuitive vehicles) are becoming key components of the user experience.

OEMs can strengthen their brands by implementing unique comfort features. These could be automatic climate control or ambient light adjustment based on the driver's mood and mental condition. Touch-free HMI systems allow driver interaction without requiring drivers to move their hands from the steering wheel. Along with voice-operated systems, more precise DMS using eye-tracking technologies continue to close the gap with traditional touch-based interfaces. Differentiation and customer loyalty drive a need for an enhanced user experience.

Applications

A wide range of applications are covered by in-cabin sensing. Figs. 1 and 2 show application examples.

Driver monitoring addresses the legislation requirements, with features such as HOD systems, and is becoming mandatory to be deployed as a standard in future cars.

Vital sign monitoring is also an emerging feature addressing not only health-conscious drivers but also the aging population trends by monitoring the driver's health, stress level, well-being and fitness to operate the vehicle.

Biometric authentication not only provides support for that personalised experience, such as seat and steering wheel position and preferred infotainment setup, but also provides security with the ability to authenticate the driver of the vehicle.

Another vital safety application is occupant sensing. This ensures that should a passenger be accidentally locked inside the vehicle, the driver will be immediately notified with the ability to detect the number and age of the passengers. Emergency responders can be provided with additional information before their arrival to an accident when these data are combined with the emergency call (ecall) system.



Fig. 2: HMI with gesture control

A special use case of occupant sensing is child presence detection, which will become – dependent on the region – a mandatory requirement.

Advanced HMI and gesture control provide enhanced user experience, see Fig. 2. Instead of searching for and pushing a button on the main control area, a gesture can perform simple functions such as skipping an audio track.

Sensor fusion

Looking at these applications, be it from their physical location (see Fig. 3), the comfort versus safety aspect, or what is needed, it becomes evident that a single sensing option cannot address them all.

Sensor fusion with different sensing modalities is required.

The combination of safety and comfort applications needs to be addressed. Several technologies must be combined and work together to reach the goals of the increasing safety and comfort requirements.

Time of flight

A time of flight (ToF) camera is one of the key technologies that can address several of the previously described applications, providing both image and depth data.

A ToF camera in the dashboard or roof can be used for DMS such as eye tracking. ToF is already in production at premium OEMs for advanced HMI and gesture control, with the optimum location being in the roof console. ToF can be excellent not just for detecting the presence of a child but also their body position. There is the need for a different location of the sensor to enable line of sight to the rear seat, as shown in purple in Fig. 3.



Fig. 3: In-cabin sensor locations

With the advances in image sensing technology, ToF is the depth sensing method of choice for its smaller form factor, wide dynamic range of sensing and ability to operate in direct sunlight. The combination of high-resolution distance measurement and medium resolution intensity image – ambient light insensitive 2D active brightness image – is unique to ToF. ToF sensor resolution can be up to 1Mpixel, which enables wider field-of-view cameras.

Although many vision applications can be realised using 2D cameras, the 3D (depth) information offers an additional level of robustness.

For comfort applications this translates to better user experience, and for safety applications it is the key differentiator.

Since there will be multiple cameras in the cabin to support different use cases, it is necessary that cameras support interference cancellation to reduce errors in depth measurement. Such problems must be solved at the system level, and engineers are pursuing this area with a smart mix of hardware and software.

For biometric authentication ToF can be very secure, making it difficult to fool the system, as has been proven possible with other implementations.

Conclusion

The automotive industry is adopting in-cabin sensing applications to increase driver and passenger safety.

Consumers demand continuous innovation in user experience and personalised comfort.

Sensor fusion is required for accurate and robust L2+ and L3 driver assist.



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Gopal Karnam is system architect, both with Analog Devices

VEHICLE electronics

The monthly magazine for automotive electronics engineers

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CLEAN-UP TIME

Simone Bruckner investigates the problem of non-exhaust emissions

Road transportation is widely recognised as a large contributor to carbon emissions, responsible for 24 per cent of the global total. However, carbon isn't the only thing the world's vehicle fleet emits; non-exhaust emissions also have a detrimental impact on the health of the population and the planet.

The electrification of the automotive market is in full swing and, with the ban on new fossil-fuelled cars set for 2030, there is light at the end of the tunnel when it comes to reducing vehicle emissions.

Electric vehicles (EVs) are often referred to as zero emission, but this is not entirely true since non-exhaust emissions are produced by all vehicles, irrespective of their fuel source.

In fact, the EV rollout is not expected to have any impact on non-exhaust emissions.

Not just CO_2

Non-exhaust emissions are particles released from brake, tyre and road surface wear, resulting in the production of particulate matter, which refers to all of the chemical compounds and materials in the air that are not gas.

Particulate matter is classified depending on the diameter of the particles. PM10 and PM2.5 refer to particles less than 10 and

2.5μm in diameter. Although particulate matter has steadily decreased in some countries since 1990, such as the UK, USA and China, in others, such as India and Saudi Arabia, exposure has actually increased.

However, road transport remains a significant source of particulate matter — in the UK it contributes twelve per cent. Stricter emission targets have significantly reduced carbon emissions from vehicle exhausts, but the positive impact of these efforts has been offset by an increase in particulate matter from non-exhaust emissions due to increased traffic. Therefore, it is essential to take further steps to reduce the impact of these other automotive emissions.

Particulate matter

Particulate matter from non-exhaust emissions originates from surface wear, which leads to abrasion and the release of small particles that become airborne. Friction between brake pads and the rotating disc and between the tyre and the road both lead to abrasion, component wear and the release of particles from the surfaces into the atmosphere.

The minute size of these particles means some of the toxins they include are small enough to enter the human body through the bloodstream, where they can cause serious damage to the heart, brain and respiratory systems.

According to the World Health Organisation (WHO), nine out of ten people worldwide breathe polluted air, and seven million people die a year because of the health effects of air pollution.

In addition to the detrimental effects on human health, particulate matter can seriously damage the environment. Once airborne, it can be carried large distances and settle on the ground or in water where toxins can lead to catastrophic ecosystem disruption, altering the nutrients of water and soil and contributing to increased acidity and agricultural destruction.

With so many issues, it comes as a surprise that several nations currently lack a policy regulating non-exhaust emissions. The current legal limit for PM2.5 is 25μg/m^3 in the UK, 20μg/m^3 in the EU and 25μg/m^3 in Australia, all of which exceed the WHO's recommended limit of 15μg/m^3.

However, it looks like legislation may start getting tighter, with the UK pledging to set stricter targets by October 2022. What's more, several countries in the world breach their limits, and over 92 per cent of the world's air exceeds the WHO's recommended air pollution level. Therefore, it's essential for vehicle manufacturers to consider how they can reduce non-exhaust emission through design.

Sustainable by design

When considering how to reduce particulate matter emission, it's important for transport manufacturers to consider the factors that determine the production of non-exhaust emissions. Reducing brake wear is the key area where transport manufacturers can concentrate their efforts to reduce emissions



Further steps are needed to reduce automotive emissions



Road transport is a major contributor to carbon emissions

thanks to regenerative braking technology.

In regenerative braking, upon deceleration, the vehicle's kinetic energy is recovered and stored in the vehicle's battery. This is particularly useful for EVs as the battery powers the vehicle, and so recharging the battery while driving increases range and improves energy consumption.

However, it's important these systems have a safety mechanism in place for when the vehicle's battery is in a high state of charge. If the battery is full or there is a failure, it will be unable to store additional energy from the braking system. Therefore, the energy must have an alternative pathway to keep the vehicle's power system functional.

A dynamic braking resistor is an essential component of a regenerative braking system, safeguarding the power system by removing excess energy and dissipating it as heat. This energy can be used to warm the vehicle's cabin or preheat and keep the battery to maintain the correct working temperature and increase efficiency.

Most of the time, the electric brakes will be sufficient to slow the vehicle, meaning the mechanical system will only be used at very low speeds when the motor cannot generate sufficient braking force to stop the vehicle quickly.

Less reliance on the brakes leads to reduced brake wear, resulting in a reduction in particulate matter and non-exhaust emissions.

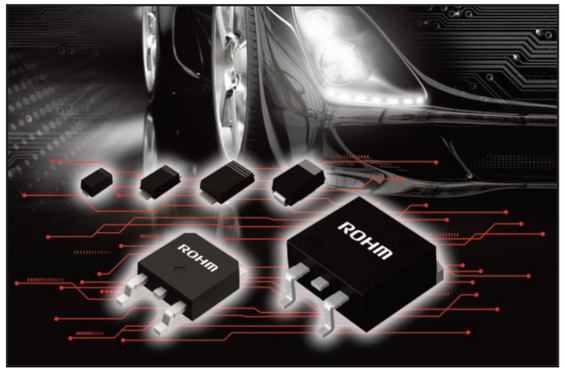
Bans on petrol and diesel vehicles all over the world being put in place from as early as 2025 – just four years' time – will ignite the elimination of exhaust emissions, but the idea that this will result in a zero-emission fleet is incorrect.

Although some of the contributing factors to non-exhaust emissions may be out of our control, it's important to reduce those that we can, such as vehicle mass and brake wear, to reduce risks for the population and the planet.



Simone Bruckner is managing director of Cressall Resistors

Schottky diodes balance size and performance



Rohm has expanded its portfolio of Schottky barrier diodes (SBDs) in the RBR and RBQ series with 178 devices for protection and rectification circuits in automotive, industrial equipment and consumer applications.

As lower power consumption is required, the adoption of SBDs – which are more efficient than other diodes – is on the rise. However, if VF is lowered to improve efficiency, IR which is inversely related to VF will become higher. This increases the risk of thermal runaway, so it is important to balance VF and IR when selecting SBDs for circuit design.

These SBDs balance small size with low VF and IR characteristics for the automotive sector. The market-proven RBR and RBQ series have been expanded to include high current, high voltage products that enable rectification and protection in a wider range of applications.

Introducing a new process has let Rohm improve the chip performance of both series by 25% – VF of RBR series in particular – over its conventional products. Furthermore, the RBR series has low VF characteristics.

Twelve of the products have a PMDE package measuring 2.5 by 1.3mm that reduces mounting area by 42% compared with a PMDU package and SOD-123.

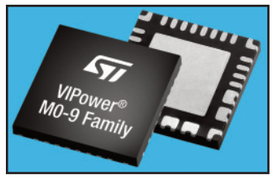
The RBQ series has low IR characteristics that enable stable operation in high temperatures, reducing the risk of thermal runaway. As such they suit automotive powertrain applications and power supplies for industrial equipment that operate in high temperatures.

Twelve 100V products have been added to meet the need for higher voltages. And both series are qualified under AEC-Q101.

Intelligent switches include digital current sensing

Automotive intelligent switches from ST Microelectronics include digital current sensing among the fully digital on-chip diagnostic features.

For high-side connection in applications powered from a 12V battery, the VN9D30Q100F and VN9D5D20FN drivers can simplify the hardware and software design of ECUs and enhance system reliability.



The devices leverage the firm's VIPower M0-9 technology to combine a 40V trench vertical mosfet with 3.3V digital logic and precision analogue circuitry in a 6 by 6mm QFN package. This can save up to 40% of PCB area compared with comparable driver ICs.

The VN9D30Q100F has two 33mW and two 90mW channels. The VN9D5D20FN has two 7.6mW and two 20mW channels.

Each has up to six output channels and a four-wire SPI interface, which reduces the number of microcontroller IO pins to interact with the device. They also have an integrated PWM generator with resolution of 0.1% that provides a control signal at each output to handle functions such as lamp dimming.

The diagnostic circuitry has a continuously running analogue-to-digital converter (ADC) with 10bit resolution and 5% precision to provide digital readings of the load current and case temperature, which eliminates reliance on an ADC in the host microcontroller.

The ADC task manager is synchronised with the driver's PWM engine, ensuring diagnostics for each output channel are automatically performed in the appropriate time frame without microcontroller intervention.

They can simplify Autosar compliance by providing a complex driver operating independently from the application.

Packages simplify functional safety

Functional-safety packages from Microchip can simplify the design of Asil B and C safety applications using the DSPic-33C digital signal controllers, and Pic 18 and AVR microcontrollers.

The ecosystem for DSPic33Cs includes AEC Q100 grade 0-qualified functional safety ready controllers with dedicated hardware safety features.

There are TÜV Rheinland-certified functional safety diagnostic libraries for designs targeting up to Asil C.

A functional safety reference application shows the steps required to develop compliant designs, and the collateral that must be generated for Asil B or C compliance.

The functional safety ecosystem for Pic 18 and AVR MCUs includes AEC Q100 grade one-qualified functional safety ready Pic 18-Q84 MCUs with Can-FD and AVR DA MCUs with Lin interfaces, both with hardware support for capacitive touch sensors.

Both have an SGS TÜV Saar-certified Asil B ready failure modes, effects and diagnostic analysis (FMEDA) report and functional safety manual.

Various functional safety analysis reports and certification reports can ease compliance and certification.

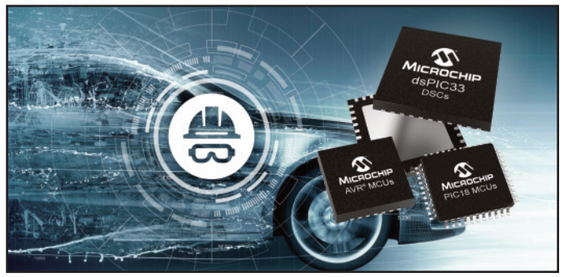
There are three ISO 26262 functional safety packages. The basic package has resources such as the FMEDA report and safety manual so designers can get started with evaluating target functional safety levels and the design of safety-critical automotive applications.

The starter package also includes a reference application and Asil C compliant diagnostic libraries that help designers understand the ISO 26262-compliant development process and the reports that must be generated for compliance.

The full package also includes certified diagnostic libraries with source code and the associated safety analysis reports for designs targeting up to Asil C.

On top of these, there is a TÜV SÜD-certified design tool package for the firm's MPLab development tools ecosystem to ease tools qualification. This includes a TÜV SÜD-certified MPLab XC functional safety compiler with the TÜV SÜD certificate, a functional safety manual for the compiler along with safety plans and complete tools classification and qualification reports for the compiler, MPLab X IDE, MPLab code coverage, and all MPLab development ecosystem programmes.

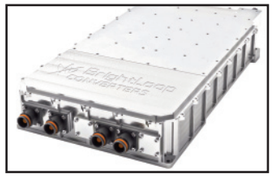
The company also provides functional safety ready Can-FD and Lin transceivers and other companion devices, including voltage supervisor devices, which can be used with the functional safety ready DSCs and MCUs in a wide range of automotive applications.



DC-DC converter targets fuel-cell vehicles

With its DCHV320 DC-DC converter, Bright-Loop is providing off-the-shelf DC-DC conversion for fuel-cell vehicles.

Fuel cells produce electricity to power the high-voltage batteries needed to run the electric motor. However, they do not provide a constant voltage; it varies according to the type and number of cells and their conditions of use.



To accelerate the adoption of hydrogen in electric mobility, it is essential to adapt fuel cells to existing electric architectures, without redeveloping an entire dedicated powertrain, and this requires a DC-DC converter.

The converter interfaces with fuel cells of all levels of power. It is fully reversible, operates in buck or boost mode, and multiple converters can be paralleled to meet the needs of higher power fuel cells.

Voltage range is 50 to 900V DC, maximum current 320A, maximum power 200kW that can be paralleled for increased power, auxiliary power supply 9 to 56V, efficiency 99% for step ratio of 1:2, and weight less than 10kg.

MCUs integrate multiple applications

The RH850/U2B MCUs from Renesas can integrate multiple applications into one chip, realising a unified ECU for evolving electrical-electronic architectures.

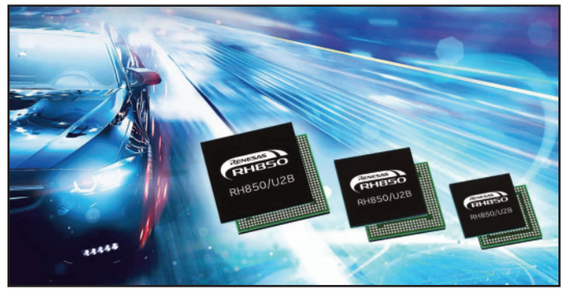
They are built for workloads required by vehicle motion in hybrid ICE and xEV traction inverters, high-end zone control, connected gateways and domain control.

They can be combined with R-Car S4 systems-on-chip for automotive central gateway systems.

For zone and domain applications, the 28nm MCUs build on functions from the RH850/E2x series for powertrain and RH850/C1M-Ax for HEV and EV motor control, while adding accelerator IP, higher performance levels and increased security.

The integrated hypervisor hardware-based virtualisation assist function allows multiple software systems with up to ISO 26262 Asil D functional safety to operate independently, without interference, and reduces virtualisation overhead to maintain real-time execution.

A latency monitor and regulation function help bus masters ensure minimum bandwidth is always available.



They support safe and rapid full no-wait OTA software updates with dual-bank embedded flash that allows the ECU to update and save images while the MCUs are in active mode and enables the ECU to operate from the original code if a failure occurs.

Integrated motor control accelerator IP works with multiple dedicated motor control timer structures such as GTM v4.1 and TSG3 to reduce CPU processing loads while achieving high-speed rotation.

Dedicated data flow processor accelerator IP lets the CPU offload compute-heavy operations for complex control.

Up to eight 400MHz performance cores with four of them in lockstep architecture have built-in flash targeting Asil D and B applications.

Integrated security functions support the Evita Full standard, including elliptic curve cryptography, for protection against cyber attacks.

Dedicated resolver and digital converter accelerator IP processes analogue signals from a motor rotational angle sensor or an inductive position sensor.

A Risc-V-based parallel co-processor IP with vector extension (DFP), licensed from NSITEXE, supports the fast execution of complex mathematical algorithms.

Communication interfaces include Gigabit Ethernet TSN with switch support. There are multiple instances of AES128 lock-step modules for conflict-free, deterministic safe and secure communication.

Samples will be available starting April 2022.

BLDC motor driver supports functional safety

A three-phase automotive brushless DC (BLDC) motor driver IC from Toshiba Electronics supports functional safety.

The TB9083FTG will be used with BLDC motors for automotive applications such as electric power steering (EPS) and electric brakes.

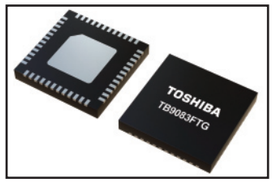
It is a three-phase gate driver for external n-channel power mosfets that are used to drive a three-phase BLDC motor. The device complies with ISO 26262 second edition and supports up to Asil D.

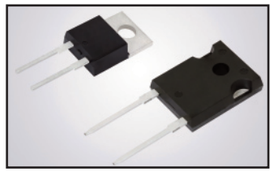
Functional safety standards such as ISO 26262 seek to reduce risk from system failures meaning the device can be used in safety critical automotive systems including steering and braking.

To support this, it includes ABIST and LBIST self-diagnosis and is supplied with an Asil safety manual and safety reports.

Capable of operating with PWM signals up to 20kHz, the driver includes three pre-driver channels for safety relays and a built-in amplifier for motor current detection, with six options for the gain setup.

Communications are via a CRC-enabled SPI bus.





Ten rectifiers

Vishay has introduced ten AEC-Q101 Fred Pt gen-five 600V hyperfast and ultrafast rectifiers for automotive applications.

Offering a claimed best reverse recovery performance for devices in their class, the 15, 30, 60 and 75A rectifiers are designed to increase the efficiency of AC-DC and DC-DC converters and of hard- and soft-switched or resonant designs.

They are said to have 30% lower reverse recovery losses than the closest competing rectifiers and 48% lower than previous Fred Pt parts while maintaining low conduction and switching losses.

The result is improved light- and full-load efficiency in high-speed LLC output rectification stages for EV and HEV on-board chargers.

They are available in TO-247AD and TO-220AC packages and in X-type hyperfast and H-type ultrafast speed classes. X-type devices have lower QRR, while H-type rectifiers have lower forward voltage.

RoHS-compliant and halogen-free, the components offer high temperature operation to +175˚C.

Plug-in boost for agile development

A plug-in brings the capabilities of the LDRA tool suite into the Jenkins automation server for continuous integration for agile software development in automotive and aerospace applications.

Jenkins automates and manages the build process and connects build and version control systems with quality management and automated testing processes for large-scale system-level software projects.

LDRA has long linked to Jenkins to enable developers to analyse, track test and verification fulfilment, and measure code quality. Now, developers can view LDRA results directly in Jenkins, saving time and reducing development costs associated with building systems that meet standards such as ISO 26262.

Managing large-scale safety-critical systems, which often require a global array of components and technology providers, is difficult and costly, especially when development teams span continents, languages and time zones.

This LDRA-Jenkins option offers developers the ability to track productivity and build process efficiency while easing certification and improving software quality. Defects are identified earlier in the software development life cycle, saving time and costs of identifying errors later.

By verifying standards conformance, the tool suite helps companies demonstrate their systems meet certification standards, such as DO-178C and ISO 26262. Specifically, the tool suite provides static and dynamic analysis, requirements traceability, verification, testing, and automated documentation.

In addition to tracking static analysis activities and code quality, the reporting features of Jenkins pulls essential information, such as how many test cases have passed and failed, from LDRA's documentation into the Jenkins dashboard to provide a concise summary.

When test cases fail, developers can be informed via email or a web-based interface so they can take prompt corrective action.

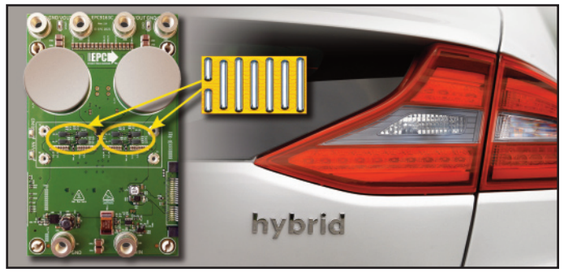
To maintain development efficiency, Jenkins continues to gather information as the baseline changes so test regression can be performed independently of normal developer activities.

Board demonstrates bidirectional converter for mild hybrids

A 2kW, two-phase 48 to 12V bidirectional converter from EPC for mild-hybrid cars operates with 96.5% efficiency.

The design of the EPC9163 demonstration board is scalable in that two converters can be paralleled to achieve 4kW or three converters paralleled to achieve 6kW. The board has eight EPC2218 100V eGaN fets and is controlled by a module that includes Microchip's DSPic 33CK256MP503 16bit digital controller.

The fast switching speed and low losses of the fets allow the converter to operate at 500kHz. The high switching frequency capability allows the use of the small IHTH-1125KZ-5A Vishay inductor.



Three-phase driver keeps batteries cool

An automotive-qualified gate driver IC from Allegro Microsystems is for battery cooling fans and hvac systems in electric and hybrid vehicles.

Part of the QuietMotion line, the three-phase A89307 achieves low noise and vibration by using a field-oriented control algorithm to drive continuous sinusoidal current to the load, helping car makers reduce noise and improve battery life, offering more kilometres per charge and lowering vehicle carbon footprints.

It includes a hardware-based algorithm that requires no external sensors or software development; the user simply selects parameters using a gui and loads them into the IC's on-chip eeprom.

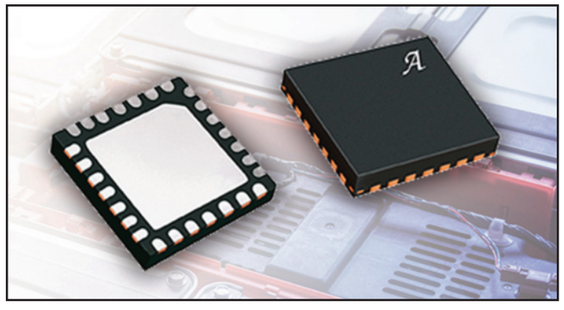
With five external components, it can help designers lower material costs by reducing components and facilitating small system footprints for in-motor PCBs. Its integrated algorithm can even eliminate the need for a separate microprocessor.

Modes of operation include open-loop PWM or fully programmable closed-loop speed control. In closed-loop mode, the user can programme the PWM-to-speed relationship to match the PWM commands provided by an external ECU.

Field weakening is included to improve performance at high speed. Low-speed operation and windmilling start-up are included.

While designed for xEV battery cooling fans, the part can also be used in hvac blowers as well as liquid pumps in traction inverter cooling systems. The external gate drive allows the device to be flexible enough to drive a wide range of motor powers up to 500W.

It is available in a 28L wettable flank QFN package.





Wireless charging design gets WPC Qi 1.3 approval

An automotive wireless charging reference design from NXP has become the first to be certified by the Wireless Power Consortium (WPC) for its Qi 1.3 standard.

The reference design consists of a Qi-certified board with NXP wireless charging MWCT family MCUs, as well as optional NFC, secure element and Can and Lin transceiver. A software package includes NXP's wireless charging Qi 1.3 software library and a suite of customisable software that helps make it easier for developers to bring a Qi-certified wireless charger to market.

The WPC's Qi standard is used by most major smartphone manufacturers, including Apple, Samsung and Xiaomi. Qi 1.3 includes secure authentication features that verify if a smartphone or other wireless power device is Qi certified and can reduce the wireless power transfer to lower levels if an uncertified device is detected to ensure user safety and protect equipment from damage.

This requires the addition of secure storage to the wireless power transmitter, addressed by NXP's automotive-grade products.

The automotive 15W wireless charging transmitter reference design includes NXP's complete wireless charging software library, which users can customise based on the type of wireless charging application targeted, including scaling from 5 to 15W and above with proprietary protocols to support readiness, single or multi-coil chargers, and across vehicles fleets.

Transformer module cuts power size

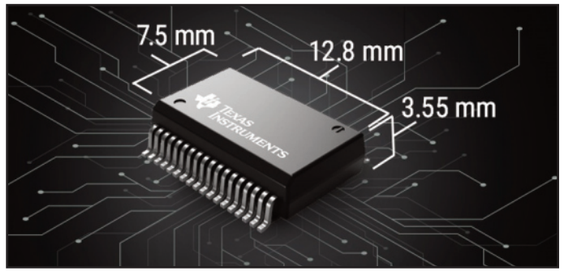
A 1.5W isolated DC-DC bias-supply module from Texas Instruments uses proprietary integrated transformer technology so designers can cut their power stage size in half in high-voltage environments such as electric vehicles (EVs), hybrid EVs, motor-drive systems and grid-tied inverters.

Automotive design engineers want to improve efficiency and reliability while reducing the weight of EV powertrains. Thus, they are moving to a distributed power architecture where every isolated gate driver has a dedicated bias supply. This improves how the system reacts to single-point failures. For example, if one bias supply fails, the other bias supplies remain operational, as do their paired gate drivers.

Integrated power products such as the UCC14240-Q1 help engineers take advantage of distributed architecture by providing size and efficiency advantages that increase power density and efficiency, which can allow vehicles to drive further between charges.

The 3.55mm height and small footprint let designers reduce the power volume by as much as 50%. The height reduction also gives engineers the flexibility to place the module on either side of the PCB.

This dual-output module has 60% efficiency. By delivering over 1.5W at ambient temperatures of +105°C, it lets engineers drive IGBTs, and SiC and GaN switches at high frequencies.



By leveraging integrated transformer technology with a 3.5pF primary-to-secondary capacitance, it can mitigate EMI caused by high-speed switching and achieve common-mode transient immunity performance above 150V/ns.

With soft switching, spread-spectrum modulation, shielding and low parasitics, the device helps meet Cispr 25 and 32 electromagnetic compatibility standards.

Integrated closed-loop control enables ±1.0% accuracy from -40 to +150°C. The device's tight tolerance enables the use of smaller power switches while also improving overcurrent protection.

Fault monitoring, overcurrent protection, overpower protection and overtemperature protection are integrated. There is third-party-certified 3kV RMS isolation.

The device is available in pre-production quantities in a 36-pin, 12.8 by 10.3 by 3.55mm shrink small-outline package.

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