VEHICLE electronics

The monthly magazine for automotive electronics engineers

OnSemi opens EV test lab in Slovakia

OnSemi has opened an application test lab in Piestany, Slovakia, focused on battery and plug-in hybrid electric vehicles and energy infrastructure conversion.

The lab provides specialised equipment to develop and test silicon (Si) and silicon carbide (SiC) semiconductors in collaboration with automotive OEMs, tier-ones and infrastructure providers.

Modern semiconductor devices are essential for efficient power conversion in EV powertrains and charging. The lab will play a central role in ensuring the development of future power products results in differentiated, value-add devices tailored to requirements.

The facility consists of two high-voltage power labs that focus on systems and device level development as well as evaluation of SiC and Si traction inverters and AC-DC and DC-DC power converters.



Part of the OnSemi lab in Slovakia

Laser welding facilities, mechanical clean rooms and workshops should enable fast prototyping and testing.

Evaluation capabilities include round-the-clock testing.

Internally developed and patented software and hardware support high-voltage power cycling via space vector modulation and sinusoidal pulse width modulation.

High-accuracy logging devices are for assessing SiC and Si health and reliability.

To simulate the harsh conditions faced by inverters during operation, liquid-cooled devices can be tested at temperatures from -50 to +220°C.

A wider range of industry-recognised software allows for the programming of FPGAs and Arm microcontrollers on site, as well as qualification testing, data analysis and 3D modelling.

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TÜV SÜD approves DSpace tool chain

With TÜV SÜD's ISO 26262 certification of its entire ASM automotive simulation models tool suite, Aurelion sensor-realistic 3D environment and ModelDesk user interface, DSpace claims to be the world's first provider of a fully certified tool chain for validating safety-relevant automotive functions.

TÜV SÜD had previously certified both the Veos integration platform and the Simphera validation framework.

As a result, DSpace now supports users in the homologation of functions for driver assistance systems, autonomous driving and electromobility applications.

Users can drive their development and approval projects for in-vehicle safety-related functions in a fully ISO 26262-certified environment for all Asils.

The tool chain covers applications from the creation of complex traffic scenarios using interactive editors and various automotive real-time and physics-based sensor models, to integration tasks with virtual ECUs, and complete verification and validation tasks.

"Our goal is to provide our customers with the best possible and most comprehensive support for the approval of safety-relevant vehicle functions," said Michael Peperhowe, lead product manager at DSpace. "The end-to-end ISO 26262 compliance of our tools relieves function managers of a great deal of work."

The certification of ASM, Aurelion and ModelDesk allows users to concentrate on the development of vehicle functions and efficiently drive a sotif-compliant validation process.

Continental CES parking award



Continental's radar vision parking has won an innovation award for next year's Consumer Electronics Show (CES) in Las Vegas.

By combining high-resolution surround radars with high-resolution cameras, it enables parking use cases that require precise and close-range measurement around the vehicle. Early parking slot detection, for example, lets users park in a single stroke without driving past the spot.

As radars are compact, they can be mounted behind all painted bumpers. Together with cameras, they provide a redundant, seamless 360° view around the vehicle.

The ready-to-use software and hardware precisely manages and processes the increasing information in vehicles.

"We are thrilled to have been named among the best-of-the-best with this prestigious award," said Ismail Dagli, head of Continental's autonomous mobility business.

Radar vision parking provides enhanced object height detection and can determine object over-rideability, such as low kerbstones, or under-rideability, such as a hanging bicycle in a garage.

Continental has now been selected for a CES innovation award for eight consecutive years.

CES runs from 9 to 12 January 2024.

R&S targets EVs with oscilloscope

A year after launching its MXO 4 oscilloscope, Rohde & Schwarz has brought out the eight-channel MXO 5 targeting electric vehicle markets.

"Electric vehicles want fast charging, long range and better performance," said Ernst Flemming, R&S's oscilloscope director. "This oscilloscope is for everything connected to power, so EVs and renewable energy. These are being driven by higher power density and faster switching."

The MXO 5 is the company's first eight-channel oscilloscope, and is also available as a four-channel unit.

It can show more of a signal's activity in the time and frequency domains.

"It is the fastest in the world at 4.5 million acquisitions per second," said CS Wong, oscilloscope product manager.

It can also handle 18 million waveforms per second across multiple channels.

This means engineers can capture intricate signal details and infrequent events with precision.

"You can see more infrequent events," said Wong. "We capture 99% of the real-time waveform."

There is digital triggering on all eight channels to isolate small signal anomalies. The digital trigger has a sensitivity of 0.0001 div to isolate small physical layer anomalies, even when large signals are present.

The capability of 45,000 FFTs per second provides engineers with better spectrum signal viewing, particularly for EMI and harmonic tests.

Standard simultaneous acquisition memory is 500Mpoints across all eight channels. A memory extension option can double the recording length to 1Gpoints.



Ernst Flemming (front) and CS Wong demonstrate the MXO 5

It has a 40cm full-HD capacitive touchscreen and the eight-channel model starts at €19,500. The four-channel version starts at €17,000.

VicOne and Block Harbor secure software-defined vehicles

Automotive cyber-security firm VicOne and Block Harbor have developed a way to help automotive OEMs and tier-one suppliers secure software-defined vehicle design and maintenance.

This is the first joint announcement since VicOne invested in Block Harbor earlier this year.

The integrated workflow-based system provides actionable intelligence to cyber-security design teams, vehicle security operations centre and product security incident response teams.

Designed to help automakers generate revenue from the increased volume and velocity of software-enabled feature releases and maintenance, this changes the current time-consuming manual and siloed process to support more software updates in the vehicle and manage the increasing threat perception.

"With the combined expertise of Block Harbor in cyber-security design and operating production systems, and more than 30 years of VicOne's threat intelligence and market-leading vulnerability disclosures, we are able to continuously monitor threats and consistently improve the accuracy of cyber-security posture over time," said Max Cheng, CEO of VicOne. "This collaboration effectively bridges the gap between design and maintenance teams, ensuring a faster and more efficient design that is learning from cyber-security posture during the vehicle deployment and maintenance lifecycle."

The integrated modular system helps manage cyber-security design and fixes in software-defined vehicles at scale. When a new threat or vulnerability is discovered, it immediately helps automakers realise how they are impacted and the severity of the risk.

Stanley adopts Questa for mems verification

Stanley Electric has adopted the Siemens Questa verification platform as the IC functional design environment for its mems devices.

Stanley designs ICs for 2D-mems mirror devices that control automotive and industrial applications requiring performance, integration, low power consumption and low cost.

The target applications are laser-scan headlamps with 2D-mems mirrors to improve night visibility for drivers.

For its latest controller IC design, the company looked to enhance reliability and quality by using Questa to achieve efficient and accurate functional verification cycles, which in turn can help meet quality goals.

"We began by identifying the ideal design verification option for our newest IC for 2D-mems mirror devices, which must deliver extremely high quality, accuracy and performance to meet the stringent functional safety requirements of the automotive market," said Makoto Sakurai, team manager at Stanley Electric. "We determined that Questa provided the best option to help us achieve our ongoing mission of boosting the quality and reliability of each new mems device."

Questa is built on a consistent foundation with a common debug and user interface, enabling designs that are correct-by-construction.

The platform can be used to meet the designer's intent and the project's quality requirements, and for protecting the design throughout its development.

Siemens' lint tool, which is part of the Questa product line, provides syntax checking and debugging capabilities.

Combining the lint tool with the Questa platform's autocheck functionality establishes an integration that allows users to analyse code at the design stage and detect bugs early, which can be used to improve efficiency, enhance development predictability and ease pressure on schedules.



Hyundai innovation centre in Singapore

Hyundai has opened an innovation centre in Singapore that will use cell-based production and digital-twin technology to boost integration between humans, robotics and artificial intelligence (AI).

The Hyundai Motor Group Innovation Center Singapore (HMGICS) should allow flexible vehicle customisation.

The smart urban mobility hub aims for shared growth with Singapore's local businesses and academics, creating an open innovation ecosystem.

The facility has a smart urban mobility hub concept, which includes an automated flexible production system and provides different ways for electric vehicle (EV) buyers to interact with their vehicles and Hyundai.

Delivering a human-centric manufacturing approach, HMGICS elevates collaboration between people, robotics and AI to new levels of synchronisation. Digital-twin meta-factory technology should ensure rapid responses to changing demands and production requirements.

Integrated into the Jurong Innovation District urban landscape and the broader Singapore smart-city ecosystem, the seven-story, 86,900m^2 facility has the capability to manufacture up to 30,000 EVs per year.

It already produces the fully autonomous Ioniq 5 robotaxis and will add Ioniq 6 to its portfolio of models built on-site next year. The facility will serve as a testbed for developing future mobility technology, including purpose-built vehicles.

"HMGICS is an open and connected urban innovation hub that encourages and embraces creativity and collaboration," said Euisun Chung, Hyundai executive chair.



Euisun Chung opens Hyundai innovation centre



Theming Engine provides in-car customisation

Elektrobit lets users customise interface

Continental's Elektrobit subsidiary has developed software that can customise a vehicle's user interface at any point during its life without a software engineer.

The Theming Engine lets OEMs, fleet managers, rental car operators and shared mobility service providers personalise the look and feel of a vehicle on the fly, providing opportunities for revenue generation, improved customer satisfaction and enhanced brand loyalty beyond a vehicle or fleet's point of purchase.

The engine provides easy-to-use design templates and configurations, based on the Android platform, that enable cockpit design teams to produce and apply bespoke interfaces rapidly. It decouples UI design from software development so creative designers can modify the look and feel of an interface at any point within the life of a vehicle.

This makes it easy for them to create and deploy themes including brand- or model-specific imagery, text types and colour schemes; updates for seasons, holidays, time of day and anniversaries; and geographic positioning such as current location or destination location.

Designers can also provide end users with the opportunity to express their own individuality by customising their cockpit with their own themes.

"Once upon a time, aftermarket customisation meant shiny wheels, loud decals and in-vehicle accessories like gearshift sleeves," said Siegfried Dirr, vice president at Elektrobit. "Digitally-aware consumers want a car that meets their ever-changing needs, including advanced interior features such as curved glass displays, voice controls and user-specific interfaces with distinct theming."

RanLos and Anritsu engineer 5G testing

RanLos, Toyo, AeroGT Labs and Anritsu have developed a 5G antenna over-the-air (OTA) measurement system enabling advancements in 5G connected vehicles.

It is engineered with RanLos' OTA tester and Anritsu's MT8000A 5G radio communication test station.

To enable the seamless flow of dynamic, real-time data communication, reliable antenna performance is key to ensure the safety of autonomous and connected vehicles and enable advanced infotainment.

This requirement is addressed by optimising and validating antenna design and installation on a vehicle. However, to accomplish this, design engineers need a consistent, reliable and controllable test environment that can emulate the real world.

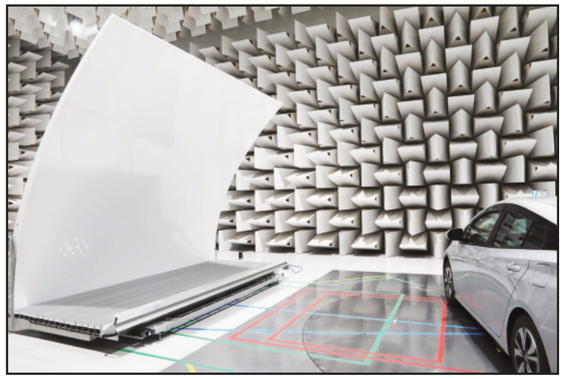
RanLos and Anritsu collaborated on this by integrating a portable antenna test system with a wide dynamic range base station simulation. The combination supports the measurement of throughput and antenna radiation patterns under static conditions and the evaluation of throughput degradation in vehicles operating on a dynamometer.

It suits assessing the performance of antennas on cars, vans, minibuses and autonomous transport systems.

What sets it apart is its capability to be seamlessly integrated into pre-existing EMC chambers, providing manufacturers with an opportunity to establish an essential testing environment while keeping down the initial investment.

"It's a major step to have 5G capabilities integrated into our offering," said Louice Rosdahl, CEO of RanLos. "5G is 100 times faster than 4G at peak speed and will be an enabler for safer connected cars."

As measurement providers, Toyo and its affiliated company AeroGT Labs, specialising in OTA measurements, view this as an optimal choice for those requiring 5G OTA mobility measurement.



Portable antenna test system integrated with wide dynamic range base station simulation

"Integrating Anritsu and RanLos products offers a simple and intelligent way to evaluate the 5G on-vehicle wireless communications and minimise initial investment," said Yoshimichi Imaizumi, senior VP at Toyo.

Steve Wong, chief marketing officer at AeroGT Labs, added: "As transportation vehicles advance further towards an all-interconnected future, holistically evaluating and gauging 5G antenna performance in connected vehicles becomes more than a benchmarking and testing effort."



Renesas roadmap for SoCs and MCUs

Renesas has laid out plans for its SoCs and MCUs as the automotive industry moves to a more centralised architecture.

The company has provided advance information about its fifth-generation R-Car SoC for high-performance applications with in-package chiplet integration technology, which will provide automotive engineers flexibility to customise designs.

For example, if more AI performance is required in adas, engineers will have the capability to integrate AI accelerators into a single chip.

Renesas has also shared plans for two forthcoming MCUs in the R-Car family. One is a crossover MCU designed to deliver the performance required for domain and zone ECUs in EE architectures in automobiles.

These MCUs are expected to close the performance gap between traditional MCUs and the R-Car SoCs.

Secondly, the company announced plans to introduce a separate MCU platform tailored for the vehicle control market.

Both these MCUs will be powered by Arm architectures and are set to become an integral part of the R-Car family.

As part of its roadmap, Renesas plans to offer a virtual software development environment that aligns with the auto industry's move towards a shift-left approach. These software tools will help users design and test software earlier in the development process.

"This roadmap comes after years of collaboration and discussions with tier-one and OEM customers," said Vivek Bhan, senior vice president at Renesas.

Until the fourth generation, the R-Car SoCs were designed for specific use cases, such as adas and autonomous driving that require high AI performance, and gateways with enhanced communications.

The fifth-generation SoC will incorporate chiplet technology to create a flexible platform that can be customised to meet various requirements for each use case. The platform will offer multiple processor sets from entry-level to higher-end models, and can integrate a variety of IP such as AI accelerators and IP into a single package. This will give users the option to customise designs.

As EE architecture in vehicles evolves, it becomes increasingly important for domain and zone control units to handle high computing performance and real-time processing.

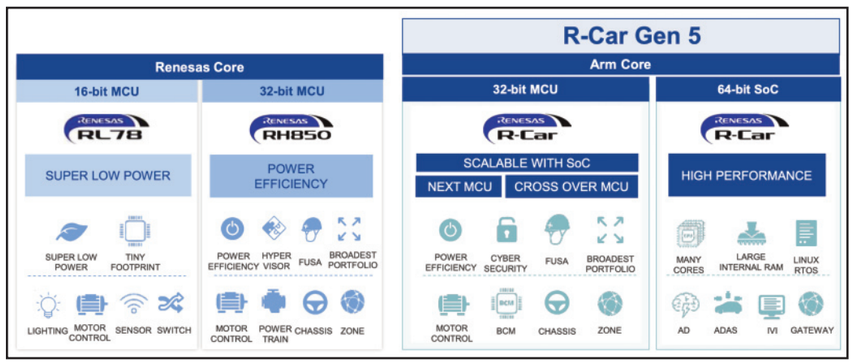
Renesas plans to address this by developing an Arm-based 32bit crossover R-Car MCU with built-in non-volatile memory that can deliver higher performance than traditional MCUs currently offer.

Moreover, to build on the success achieved by the RH850 MCUs, Renesas is extending its vehicle control portfolio with an R-Car MCU, which will be also powered by Arm.

This means, for the first time, automotive system developers will be able to take advantage of the software and ecosystem of Arm by using these MCUs to build powertrain, body control, chassis and instrument cluster systems.

This expansion will allow Renesas to standardise IP between MCUs and SoCs, thus increasing software usability and preserving engineering investments.

Renesas plans to release products from 2024 onwards, following this roadmap.



Renesas reveals plans for fifth-generation R-Car



LG puts YouTube into Hyundai cars

Passengers in Hyundai's latest Genesis models will be able to watch YouTube thanks to the WebOs for Automotive in-vehicle infotainment system from LG Electronics.

WebOS for Automotive lets passengers in the front and back seats watch high-definition content they typically enjoy on their smartphone or TV in compliance with driving and safety regulations.

Infotainment displays can stream content with the car's immersive sound quality.

Leveraging the popularity of WebOS, which has reached cumulative sales of 200 million in the smart TV market, the firm has developed a version for vehicles so drivers and passengers can enjoy an array of services, including YouTube, in an optimised cabin setting.

LG, Hyundai and YouTube collaborated to bring YouTube's native TV app to WebOS for Automotive. In addition, the YouTube app uses the newly developed native touch options on WebOS for Automotive.

Rightware creates Toyota in-vehicle experiences

Toyota is using Rightware's Kanzi One HMI software to create in-car experiences for Toyota and Lexus models.

As shown by the current generation of Toyota vehicles, the combination of Kanzi One and the automotive experience of the Kanzi services team gives Toyota the flexibility and design capabilities to enhance its brands.

With Kanzi One, Rightware says Toyota had the best possible graphics performance on cost-effective hardware. Further, Toyota could build and maintain distinct UI modules, mixing and matching them to create instrument clusters for vehicle variants and models across diverse markets.

"Toyota is one of the world's most iconic brands, and it is a tremendous honour for us to be part of that," said Freddie Geier, CEO of Rightware. "Together, Rightware and Toyota deliver brilliant cockpit experiences for millions of drivers. The powerful combination of Kanzi One and the Kanzi services team delivers competitive advantages to Toyota, taming the growing complexity of automotive design and development."



FPT invests in Landing AI for computer vision

Vietnamese firm FPT is working with US company Landing AI to develop computer vision for automotive applications.

FPT will become one of Landing AI's major investors and a partner in Asia Pacific. This partnership is expected to mark advancement in AI collaboration between Vietnam and the USA.

The two will explore the potential of a dedicated engineering centre in Vietnam to develop AI.

Andrew Ng, Landing AI CEO, will collaborate with FPT Education – FPT's private, industry targeted education system – as an advisor in AI development to create an AI curriculum for students.

"FPT not only demonstrates its expertise but highlights Vietnam's potential as a growing digital hub," said Ng. "There is tremendous optimism about what we could achieve together for the future generations driven by AI innovations."

FPT chairman Truong Gia Binh added: "This collaboration will open up a new era for AI development in Vietnam and bring new opportunities for our country's future generations to excel in high-tech fields."

Automotive semiconductors to see 7.5% CAGR

The global automotive semiconductor market is set for strong growth, reaching $95bn by 2030, according to Persistence Market Research.

This is up from $57.3bn this year, representing a CAGR of 7.5 per cent.

The market is driven by the increasing demand for technologies such as autonomous driving, electric vehicles, adas and connected cars.

One of the primary drivers is the rapid shift towards EVs. As the world addresses environmental concerns and the need to reduce carbon emissions, manufacturers are increasingly adopting electrified powertrains.

The pursuit of vehicle autonomy, driven by the potential for improved safety and efficiency, has led to a growing demand for semiconductor components that enable sensors and computing capacity.

Lidar, radar and cameras require high-performance semiconductors for data processing and analysis.

Autonomous driving will need to process data from a wider range of sensors and make complex decisions in real time.

Silicon carbide (SiC) and gallium nitride (GaN) are more efficient than traditional silicon semiconductors. They can help improve the fuel efficiency of EVs and reduce power consumption of adas features.

Processors are expected to hold the largest market share, driven by their increasing applications in adas, connectivity and autonomous driving. Sensors, such as lidar, radar and cameras, are witnessing rapid growth due to the rise of autonomous vehicles and adas.

Passenger cars are anticipated to dominate the market. Light commercial vehicles are expected to grow rapidly due to the expansion of ecommerce and urbanisation.

UVeye inspects Amazon vehicles



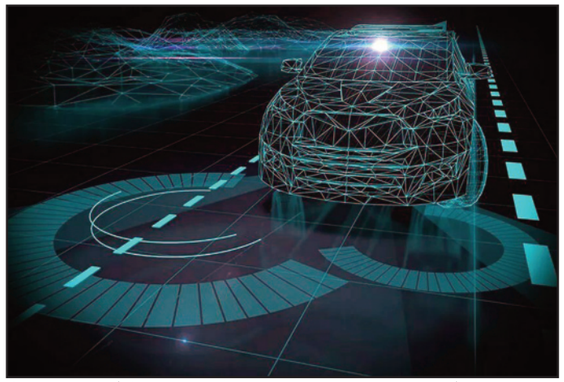
Amazon has deployed automated vehicle inspection (AVI) AI-powered systems in its delivery stations in the USA, Canada, Germany and UK that automate most of the daily inspection process of delivery vehicles.

The technology comes from UVeye, a pioneer in the development of automated vehicle inspection.

AVI scans for and detects automotive issues, improving fleet maintenance and reducing downtime, as well as improving safety for drivers.

The system scans a vehicle in seconds as it drives through a tunnel of cameras and sensors. It has been piloted at select Amazon delivery stations in the USA. A study of the data shows AVI finds more defects in hard-to-inspect places, such as damage to the vehicle undercarriage, or nails in the tyre thread (35% of all issues stem from tyres) than when that part of the inspection process was done manually.

By automating part of the vehicle inspection process using computer vision and machine learning, AVI makes inspections faster, more accurate, systematic and objective. The data analysis also revealed that within weeks, the number of vehicle groundings dropped with improved maintenance of vehicles.



Ansys and Sony to improve sensor simulation

Ansys and Sony collaborate on sensor simulation

Ansys and Sony worked together to enhance high-fidelity image sensor simulation and camera-based features in automotive, including autonomous vehicles and adas.

Ansys Speos can now seamlessly integrate with Sony's sensor models to streamline development and validation with more precise modelling.

Automotive image sensors must continuously evolve to deliver safer, higher functioning adas capabilities. To meet this demand, Ansys developed a software interface compatible with Sony's sensor models, which are based on the internal architecture of image sensors used in camera systems.

The interface enables high-fidelity virtual camera testing in various scenarios, reducing the need for ad-hoc physical camera testing and accelerating verification times.

The users of Sony's image sensors will now have access to end-to-end automotive-grade simulation fidelity for spectral effects, high dynamic range (HDR) and LED light flicker mitigation. Users can also reproduce image sensor phenomena, such as motion blur and rolling shutter.

"The collaboration between Ansys and Sony will provide an automotive-grade, end-to-end spectral simulation pipeline from lens models to sensor models for the adas perception system developers," said Kenji Onishi, deputy senior general manager at Sony Semiconductor. "Sony has prepared a sensor model based on the internal architecture of the image sensors used in camera systems to achieve automotive-grade fidelity."

Physical prototyping and validation are time consuming and costly, and do not offer the bandwidth that simulation and virtual testing provides. Pairing Ansys simulation with Sony's sensor models alleviates these difficulties through virtual testing.

"The Ansys and Sony technology collaboration facilitates rapid development and verification of camera features for AV and adas applications," said John Lee, vice president at Ansys. "As a result, the joint workflow yields more robust simulations, greater predictive accuracy, higher-fidelity images and, ultimately, more reliable AV and adas applications."

Hesai supplies long-range lidar to Neta Auto

Hesai Technology will supply its AT128 high-resolution long-range lidar for Neta Auto's upcoming electric vehicle that is expected to launch in the first half of 2025.

The vehicle will also showcase its latest R&D achievements in intelligent driving.

Neta Auto has the highest monthly registrations for EVs in Thailand in 2023, and has began construction on its first factory in the country. It has offices in China, Europe, Thailand and Indonesia and plans to establish an international headquarters in Hong Kong.

"This collaboration featuring Hesai's AT128 will effectively upgrade the new series production vehicle by enhancing Neta Pilot's advanced intelligent driving system," said Zhang Yong, CEO of Neta Auto."

As of the second half of 2023, Hesai has delivered more than 190,000 lidar units.

The AT128 is an automotive-grade long-range lidar that has an overall resolution of 1200 x 128. It can output real-time 3D data at 1.53 million points per second. Detection range is up to 200m at 10% reflectivity.

The cumulative deliveries for AT128 have surpassed 130,000 units.

"Our joint efforts will provide Neta Auto's consumers with a safer, more comfortable and highly efficient driving experience," said David Li, CEO of Hesai.

Hesai's Maxwell Center in Shanghai is approaching its completion and expected to commence operation by the end of this year.

Alchip rolls out automotive asic platform

Alchip Technologies rolled out an automotive asic platform at November's Design Solutions Forum in Japan.

The platform streamlines the asic design needs of global automotive IC module and component manufacturers, as well as automotive companies themselves.

Taiwanese firm Alchip said it saw significant pre-announcement interest from companies across Europe, Japan, USA and Asia.

The platform consists of six modules: autonomous driving (AD) and adas; safety; test; reliability; automotive chip sign-off; and automotive chip manufacturing service.

The AD and adas module is the platform's starting point. It integrates a CPU and neural processing unit (NPU) into a small die size, while meeting performance and power consumption requirements for automotive applications.

The safety module follows the ISO 26262 prescribed flow that includes required isolated TMR and lock-step design methods. The module has an experienced safety manager and includes the mandated Development Interface Agreement (DIA) that defines the relationship between the manufacturer and the supplier throughout the entire automotive safety lifecycle and activities.

The reliability module includes enhanced electromigration as part of silicon lifecycle management. It also covers AEC-Q grade IP sourcing and implementation.

The automotive chip manufacturing service works with IATF16949 approved manufacturing suppliers. Services include tri-temp testing by target AEC-Q grade, automotive wafer, automotive substrate, assembly and burn-in.

Design for test capabilities support in-system test and MBist and LBist design, critical and redundancy logic for yield harvest, automotive-level ATPG coverage, and physical-aware ATPG.

The final sign-off module covers an aging library based on a customer mission profile, OD, UD, AVS and DVFS library support, and the final design for manufacturing sign-off.

WeRide given commercial go-ahead for driverless robotaxis

WeRide has received approval to launch commercial operations of fully driverless robotaxis in Beijing.

Following driverless road tests in the pilot zone that started in October 2022, WeRide has gradually got the permits to carry out unmanned remote stage demonstration application, high-speed road testing to and back from the airport, and now commercial operations.

This means WeRide can provide a charging service of fully driverless robotaxis to the public in the Yizhuang area of Beijing.



WeRide to operate commercial robotaxis

Passengers can hail a WeRide robotaxi within a designated area via the WeRide Go app and check the estimated cost. The robotaxi will arrive at the pick-up point, and passengers need to verify their identity by scanning a QR code.

The service scope covers popular destinations such as subway stations, residential areas, offices and industrial parks, with a total of 242 pick-up and drop-off stops. A robotaxi can carry one to three passengers at a time, operating from 9am to 5pm.

In November 2018, WeRide launched China's first robotaxi. Next year, WeRide will launch the nation's first commercial robotaxi service in Guangzhou.

To date, WeRide has completed more than 1400 days of commercial robotaxi operation without any proactive accidents.

In November 2021, WeRide and its UAE partner Bayanat launched robotaxi services on Yas and Saadiyat islands in Abu Dhabi. So far, they have completed nearly 20,000 customer orders.

In July this year, the UAE issued WeRide with the country's first autonomous driving test licence.



Autonomous vehicle simulation hosted on Azure

Nvidia speeds automotive digitalisation on Azure

Nvidia hopes to accelerate automotive digitalisation with virtual factory and autonomous vehicle simulation engines hosted on Microsoft Azure.

The goal is to provide a fast track to design, build and operate cars.

Automotive companies are transforming every phase of their product lifecycle by evolving their primarily physical, manual processes into software-driven, AI-enhanced digital systems.

To help them save costs and reduce lead times, Nvidia has announced two simulation engines on Omniverse Cloud: virtual factory and autonomous vehicle (AV) simulation engines.

Omniverse Cloud is a platform-as-a-service for developing and deploying applications for industrial digitalisation It is hosted on Azure. This one-stop shop lets automakers worldwide unify digitalisation across their core products and processes.

For design, engineering and manufacturing teams, digitalisation streamlines their work, converting once primarily manual industrial processes into efficient systems for concept and styling; AV development, testing and validation; and factory planning.

The AV simulation engine is a service that delivers physically based sensor simulation, helping AV and robotics developers run autonomous systems in a closed-loop virtual environment.

The next AV architectures will be built on large, unified AI models that combine layers of the vehicle stack, including perception, planning and control. Such architectures call for an integrated approach to development.

With previous architectures, developers could train and test these layers independently, as they were governed by different models. For example, simulation could be used to develop a vehicle's planning and control system, which only needs basic information about objects in a scene – such as the speed and distance of surrounding vehicles – while perception networks could be trained and tested on recorded sensor data.

However, using simulation to develop a unified AV architecture requires sensor data as the input. For a simulator to be effective, it must simulate vehicle sensors, such as cameras, radars and lidars, with high fidelity.

To address this, Nvidia is bringing sensor simulation pipelines used in Drive Sim and Isaac Sim to Omniverse Cloud on Microsoft Azure.

Omniverse Cloud sensor simulation provides AV and robotics workflows with high-fidelity, physically based simulation for cameras, radars, lidars and other types of sensors. It can be connected to existing simulation applications, whether developed in-house or provided by a third party, via Omniverse Cloud application programming interfaces for integration into workflows.

The virtual factory simulation engine comprises customisable developer applications and services that let factory planners connect large-scale datasets while collaborating, navigating and reviewing them in real time.

WIRELESS

losing WEIGHT

David Tanner answers the dream of automotive engineers wanting to reduce weight by replacing heavy wiring looms with RF technology

One of the heaviest sub-systems in most vehicles, wiring harnesses can weigh in at around 70kg, creating a major headache for designers. Given a shift to wireless control could reduce vehicle weight significantly, then it is little wonder that wireless system management is at the top of the agenda for every major OEM.

Indeed, the move to electric vehicles (EVs) and the understandable obsession with weight reduction, has given the drive to wireless vehicle management event greater urgency in recent years.

If the benefits of ditching copper wire are so great, why is it still in cars rolling off the production line? The truth is, achieving stable RF communications in vehicles is not just a question of plug and play; things are a lot more complex once the bonnet is lifted.

While an interrupted signal is not the end of the world for mobile phone users, when it comes to critical vehicle systems, such as braking or acceleration, there is simply no room for error. Even non-mission critical functions such as headlights or wipers require a reliable signal to ensure consistent functionality. In discussions with OEMs, this fundamental issue is still considered the central go or no-go litmus test for wireless technology adoption.

No compromises

For automotive engineers, this involves a simple thought process: getting rid of heavy wiring is great in principle, but if it compromises safety by one iota in practice, then no.

One of the biggest hurdles facing wireless communications in vehicles is the engine bay. Within this metal tank, which is more than a metre across, resides a wealth of electrical noise caused by spark plugs in the case of ICE engines or electric motors and switchgears where EVs are concerned. For wireless signals, this is a hugely aggressive and constantly changing environment that presents a set of challenges to antenna designers.

Secondly, the issue of network management poses some real puzzles for electrical engineers. Work with OEMs demonstrates that separation of wireless signals for differing levels of control is a key element.

This hierarchy, whereby safety critical operations such as braking and acceleration would take precedence over less crucial functions such as interior lights or electric windows, requires a form of central control while keeping certain wireless signals distinct.



Tesla is looking to use power over Ethernet



Human beings can interfere with wireless signals

Surprisingly, feasibility work has also highlighted the problems that humans create in cars when it comes to consistent wireless transmission. At times there might be a single driver in the vehicle made up of around 70% water, while at others, the car could be full of passengers, all moving within the cabin, creating further potential interference or blocking for signals.

These are just a handful of the key issues considered during work with vehicle manufacturers. There are no simple answers to these questions, however there is a constructive way ahead in the dynamic area of wireless design.

Meshing

A potential answer to the wireless conundrum is meshing technologies, or hopping as it is known in internet parlance. This uses nodes around the vehicle to shorten the path and make signals less prone to interference. It is quite complex and not cheap to install but has potential.

Frequency allocation is another consideration that is actively being explored. In principle, lowering the frequency of signals makes penetration much easier throughout the vehicle. However, the sub-gigabyte frequency is a very congested spectrum.

EV pack leader Tesla is looking to integrate power and data cables, in an approach known as power over Ethernet. One big advantage here is this system is less interference prone. However, where EVs are concerned the amount of power required is considerable and differences in power requirements could be problematic.

An area of real promise lies in high performance antenna design using beam steering technology, which effectively points radio waves into specific directions. This approach used to be expensive but is now becoming much more affordable due to design innovation and the adoption of novel materials.

Beam steering of RF signals has the potential to solve many of the problems cited here. Work in this specialist area proves that stable gain can be achieved in a single direction far more cost effectively than was previously possible.

It may not be the single, silver bullet where wireless communications are concerned in vehicles, but it is one of a number of emerging options designed to take weight out of vehicles.



David Tanner is business development director at Novocomms

POWER TECHNOLOGIES

EXTENDED RANGE



Greg Zimmer explains how to manage the technology behind EV batteries

Unlike a single energy storage element such as a fuel tank, an electric vehicle (EV) battery pack consists of hundreds of individual lithium-ion (Li-ion) battery cells in a long series. When not operated within a carefully controlled range, the capacity and lifetime of these battery cells diminish and diverge over time and operating conditions.

A battery management system (BMS) is responsible for extracting the maximum capacity and lifetime from these cells while ensuring safety and reliability.

At the heart of this system are battery cell monitors that provide the cell measurements used to determine every cell's state of charge (SoC) and state of health (SoH), the key parameters for evaluating a cell's status.

For decades, the automotive industry has slowly consolidated, while technology and brand differentiation has decreased. The powertrain, the system that transfers energy into motion, is arguably the auto manufacturer's most prized intellectual property, with more than a century of refinements behind it. In this context, the emergence of entirely new automotive companies is nothing less than remarkable since the powertrain technology is the one that is being challenged.

A typical internal combustion engine (ICE) vehicle has a 56-litre fuel tank, which is equivalent to nearly 500kWhr of electrical energy: 56 litres of petrol translates to a range of 600km in an ICE; 500kWhr of electrical energy translates to a range of 2300km in an EV.

This enormous efficiency advantage is why EVs will eventually triumph, but the last leg of this journey is yet to be mapped out. The biggest problem facing today's generation of EVs is that they cannot carry enough battery capacity to match the range of an ICE vehicle.

Challenge

The battery pack of an EV consists of hundreds of individual battery cells, operating in series to create voltages from 400 to 800V. Overcharging and over-discharging can damage or prematurely age a cell, which can

reduce capacity or lifetime, and eventually cause cell failure.

The primary function of the BMS is to determine and control the SoC and SoH for every cell in the long series that make up a pack.

Charging any Li-ion cell to 100% of its SoC or discharging to 0% SoC will degrade its capacity. Determining SoC requires measuring cell voltage and temperature, and the accuracy of these measurements directly determines how well SoC can be managed.

In sum, the BMS electronics are the linchpin for increasing operating range, lifetime, reliability and safety of an EV's battery system.

It is no simple feat to measure accurately and continuously all battery cells connected in a long, high-voltage string in a tightly coordinated way. Measurements need to be immune from the corruption of high electrical noise created by inverters, actuators, switches, relays and so on.

The electronics themselves need to be electrically isolated due to the high voltages of the pack. And, finally, the electronics need to operate for years through wear and tear, weather, and the age and mileage of a vehicle.

Heart

Battery management products focus on a few key areas – individual cell measurements (cell monitors), overall pack measurements (pack monitors), communication networks to interconnect devices via wires or via a wireless network, and software to control these devices.

The goal for these electronics is to allow all battery cells to be safely charged to the highest possible capacity, ensuring the complete pack obtains the largest storable energy to maximise the vehicle range.

Arguably, the most critical device is the high-voltage cell monitor IC. Cell monitor ICs measure the cell voltages and temperatures of series-connected battery cells, typically 12 cells per monitor. Cell voltage and temperature are the key parameters; measurement accuracy and synchronicity are the key characteristics.

Combined, this information enables the BMS to operate the cells at the full extent of their safe operating range without stressing them. So, the performance of these cell monitors is critical for a BMS to maximise a vehicle's range, cost, weight and reliability. Since measurement error translates to less effective battery management, BMS products have to offer accurate measurement capabilities.

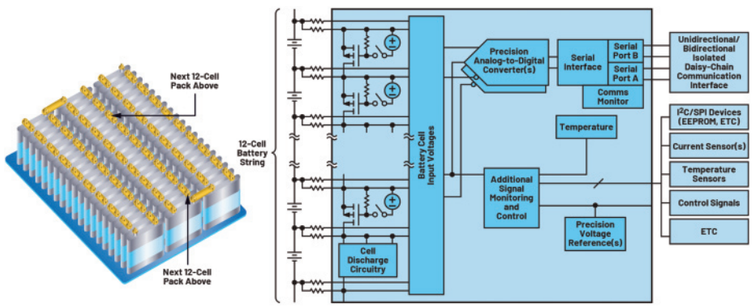


Fig. 1: Simplified description of multicell battery monitor

Communications

Cell monitors can be designed for daisy-chain interconnection using a two-wire communication interface. This should form a robust, EMI-insensitive and electrically isolated network that allows BMS devices to be operated, polled and controlled synchronously from the BMS microcontroller.

This enables all cells in the pack to be measured synchronously with pack current and pack voltage using a pack monitor device.

This daisy chain can be operated with one path to each device, or with dual paths in a loop configuration. The loop allows for access to all of the cell monitor data in the event that a wire or connector fails.

An alternative is to support operation in a wireless BMS (wBMS), where the wired daisy chain is replaced with a 2.4GHz wireless BMS node at the cell monitors.

Safety

Among all the goals of a BMS, ensuring the battery pack is safe is the most important. Recognising and remedying potential failures within an IC requires built-in self-test capability and redundancy.

These functions include redundant measurement paths, improved synchronisation between input signals, self-test capability and many more.

Parts should thus be designed to support the ISO 26262 Asil-D standard.

ISO 26262 is a universally adopted automotive functional safety standard, designed to ensure safety throughout the lifecycle of automotive electrical equipment and systems.

Asil D is a risk classification within this standard that represents the highest level of automotive safety in a system.

By meeting the ISO 26262 standard, designers can generally address other functional safety standards such as IEC 61508 to meet the standards for nonautomotive applications as well.

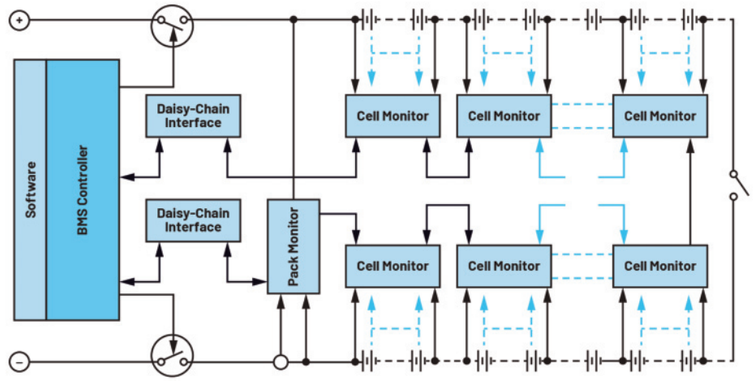


Fig. 2: Outline of a wired BMS

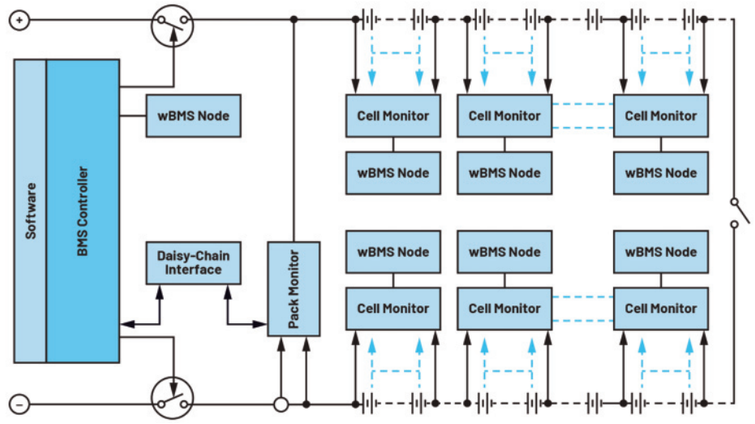


Fig. 3: A wireless BMS replaces the comms wires with a radio

Cell monitoring

In addition to ensuring a stable, predictable and reliable source of energy to power the vehicle, the BMS must ensure the cells themselves are always safe. While it is a rare occurrence, a battery cell defect can cause a cell to short over time and lead to thermal runaway with catastrophic results.

For this reason, the BMS monitors for conditions that could indicate any potential problem.

Battery cells are not inert just because they are not in use. As electrochemical devices, they change over time even when at rest. In other words, the progression of a failing cell can continue even while a vehicle is not operated.

To provide continuous monitoring of the cells within a battery pack, even while a vehicle is in a key-off state, low power cell monitoring (LPCM) is a feature that periodically and autonomously checks key parameters of the battery cells.

With LPCM, the cell monitors alert the BMS to wake up and run appropriate checks if they detect any potential concerns. The BMS is also alerted if the cell monitors fail to provide a periodic positive confirmation.

Conclusion

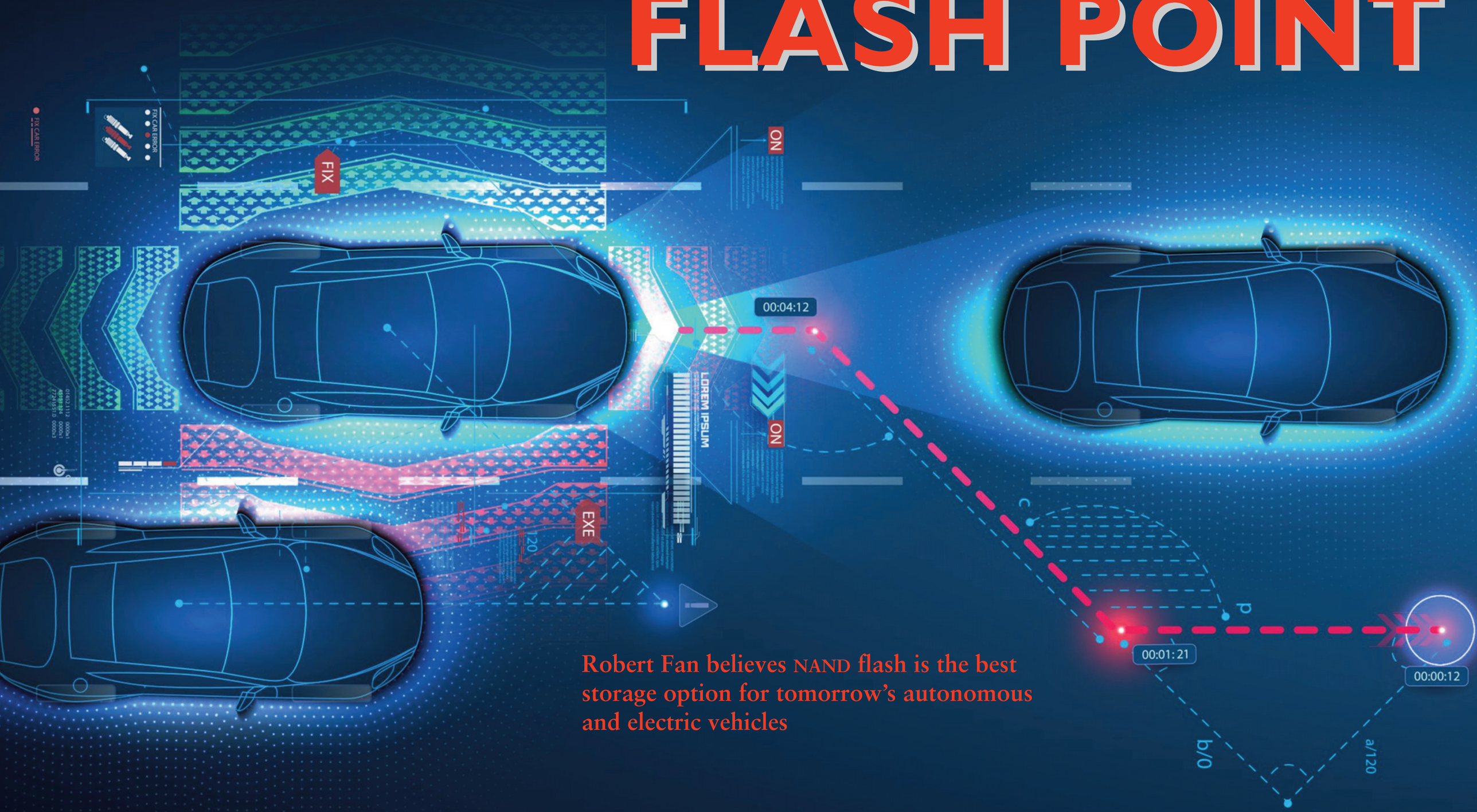
Within the next 30 years, the world will transition from ICE to electric passenger vehicles. The enormously inefficient use of petrol, a product derived from a limited resource, will ensure this happens. Geopolitical and environmental concerns will only accelerate the trend. Electric cars are the future and BMS technology is a key enabler.

Leading-edge BMS products are enabling the future. These certified Asil-D compliant ICs can offer battery cell voltage and temperature measurement accuracy. Continued, they can efficiently address the evolving and challenging requirements for EV fleets and large energy storage systems.



Greg Zimmer is marketing manager for battery management at Analog Devices

FLASH POINT



Robert Fan believes NAND flash is the best storage option for tomorrow's autonomous and electric vehicles

MEMORY

Today's modern vehicles are full of compute, sensors, memory and storage that not only enhance the driving experience but will help usher in the era of autonomous and electric vehicles.

Regardless of its level of autonomy and electric vehicle design, the average car on the road is becoming its own data centre. The need for data storage has grown exponentially, and so has the role of NAND flash storage in automotive applications to support mission-critical functions and entertainment features.

These devices must be able to ensure the level of performance, reliability and longevity required by the automakers.

In addition to meeting automotive grade qualifications, storage devices are expected to last for as long as the vehicle is on the road. NAND flash storage such as embedded multimedia card (eMMC), universal flash storage (UFS) and solid-state drives (SSDs) have experienced proven successes in smartphone, consumer and enterprise storage applications. Now, they are readily being adopted by automakers, tier-one systems designers and other key stakeholders in the automotive supply chain for performance, reliability, longevity and security considerations.

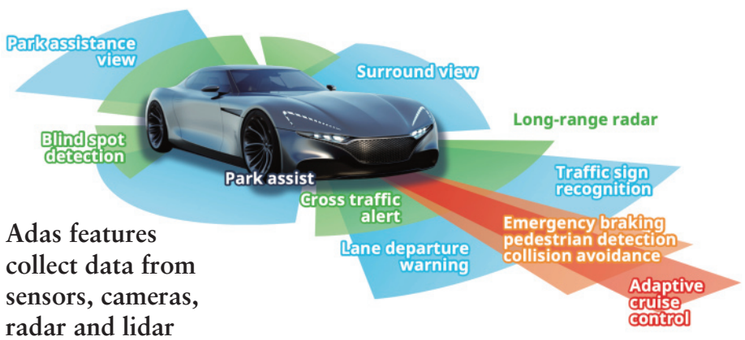
Evolution

Electronic components in motor vehicles have a long history that have put cars on a course to become more data-centric.

According to current research, roughly 90 million cars will be collecting data from sensors and making it available online by 2025. Today's vehicle brings many advanced infotainment features together in a single cockpit dashboard — screens that entertain and provide critical information to the driver to ensure safety and even help them drive.

Screens are getting bigger; some stream music, video and even gaming for passengers, and the GPS is built right into the vehicle along with other adas features. Many adas features collect data from sensors, cameras, radar and lidar. Although the amount of data for each feature can be small, it adds up.

Autonomy, even if only partial, adds a great deal of data to the mix. Adas features such as lane keeping, automatic braking and adaptive cruise control are data-dependent features, and fully autonomous driving that requires no human intervention at all will require data for the automatic decision-making to happen.



Adas features collect data from sensors, cameras, radar and lidar



Connectivity is driving up data storage requirements

Connectivity is also driving up data storage requirements on vehicles. Whether it is wifi or 5G, connectivity makes it easier to upgrade onboard software. When software becomes easier to upgrade, it is more likely to be added to a vehicle in the form of new features, bug fixes and security patches.

The modern vehicle is also equipped with a great deal of diagnostics capabilities that could become remote accessible. Like a commercial aircraft, cars have their own black boxes to record what happens during an accident and the moments leading up to it.

Storage is needed to capture data such as steering input, G-forces on the car, speed, telemetry, and even video and audio. Storage requirements become more specific because a large, sudden burst of data must be written to the device quickly. That storage device must be durable enough to survive a serious impact, and even fire or water damage.

A key design trend in the architecture of intelligent vehicles is the consolidation of many computing capabilities so the storage can serve a variety of applications in the functions of vehicles, while being smart enough to know what takes priority. For example, autonomous functions and entertainment applications might share the same storage pool.

Because of the ever-growing quantities of digital data that must be processed and stored, automotive system designers now prefer NAND flash devices over rotational media for mass storage because of their reliability and tolerance for wide temperature ranges as well as large capacities in small form factors. Any NAND flash storage device must keep pace with capacity requirements, low latency and performance by delivering fast read and write

speeds and high data throughput.

Despite this consolidation, there will be various different NAND storage types to support the required data storage demands in autonomous and electric vehicles.

Modern designs

When NAND flash was still quite expensive and had not attained the densities and cost structures seen today, hard drives using rotational media were considered the best for storing data in cars. Automotive-grade hard drives were designed to handle temperature extremes and vibration as well as withstand shock loads as high as 200 times the force of gravity and more.

They were also inexpensive given the amount of data they could store in a small space. However, hard drives have relatively slow access times and are subject to shock and vibrational failures.

But as NAND flash costs came down and solid-state storage designs matured, they began to make more sense and replace rotational media. A clear advantage for NAND storage over hard drives is the lack of moving parts, which makes them less likely to fail due to shock and vibration. NAND storage is also much faster than a hard drive and can handle the extreme temperatures ranges of automotive applications.

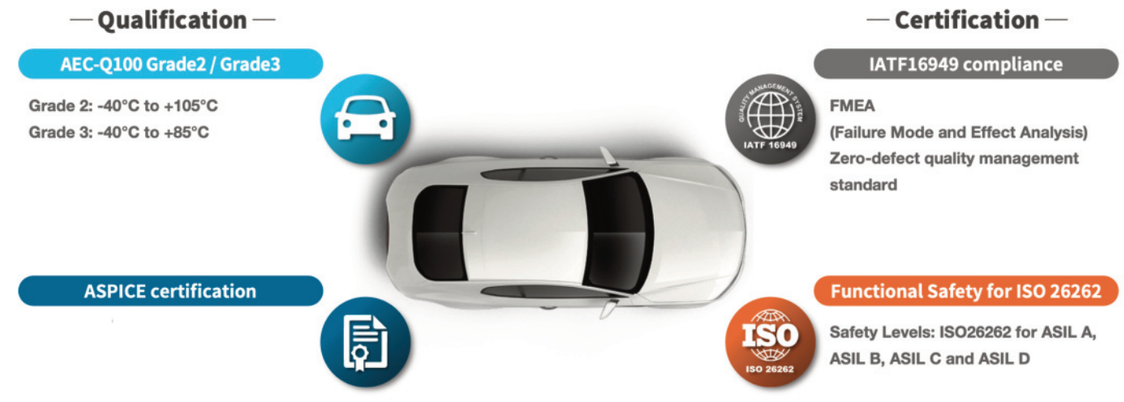
NAND flash finds its way into the modern vehicle in so many ways to support so many applications; the types of NAND flash storage in the vehicle are dependent on application performance and capacity requirements.

CompactFlash and secure digital (SD) cards remain flexible options for automotive applications such as digital maps and dash cameras. These removable storage types enable the flexibility of aftermarket content upgrade and retrieval.

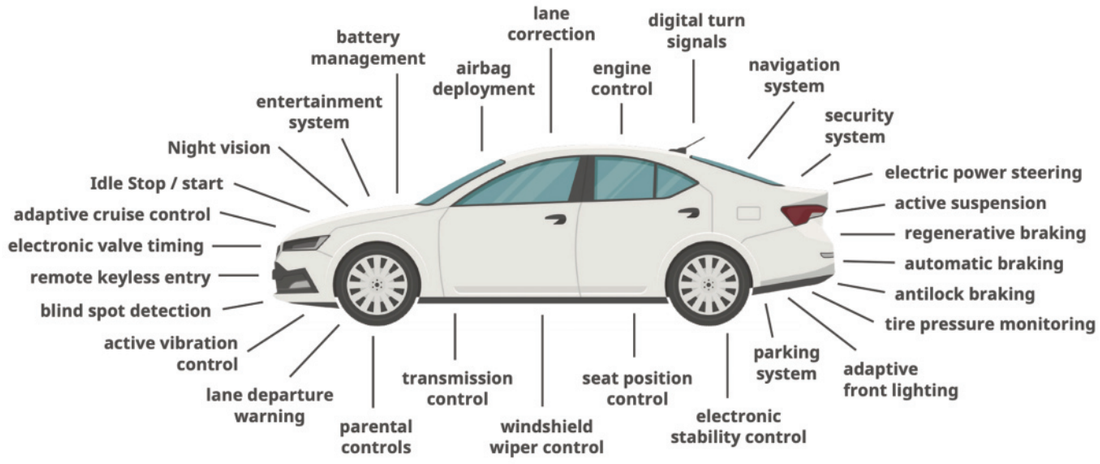
NAND storage in the form of eMMC was the first type of solid-state storage to be widely adopted in automotive applications. Widely deployed in mobile phones, this non-removable memory card is soldered onto a circuit board, making it secure against constant vibrations. EMMC continues to be a viable choice for storing data related to many navigation and infotainment applications, including satellite radio, 3D maps, traffic monitoring and weather information.

The emergence of the UFS interface has seen it usurp eMMC for newer automotive designs, as it was specifically developed to be a high-performance replacement to eMMC. It offers a faster interface, higher density, better power efficiency and higher performance for reads and writes compared with eMMC. UFS also offers fast boot times, allowing for systems to start up as fast as it takes for the driver to turn the key in the ignition.

The computational needs of an automotive design have pushed data storage requirements even further in terms of performance and storage capacity. This has led to the adoption of higher capacity NAND flash storage in the form of full-blown SSDs that are automotive grade, which means they're designed to handle



Automotive-grade flash products must meet various standards and qualifications



Modern cars have increasing demands on storage technology

enterprise equivalent performance and capabilities while supporting extreme temperature ranges. The larger capacities also allow for the consolidation of storage within the automotive system to reduce the overall number of storage devices required.

Automotive-grade SSDs are moving from Sata to the PCIe NVMe interface as more vehicles with advanced autonomous driving capabilities are sold. They require as much as 1Tbyte of flash storage for 3D maps, 4K infotainment content, sensor data and black box recording, all of which increase demands for more bandwidth, latency and capacity.

Controllers

NAND flash storage devices for automotive applications should be tailored for the functions found in the modern vehicle, and this is mainly enabled by the NAND controller technology designed with automotive applications in mind.

The NAND controller is essentially the brains of a storage device, as it plays a key role in optimising the various NAND flash storage for automotive applications by ensuring the performance, reliability and security as well as supporting the various 3D NAND flash technologies.

EMMC, UFS and SSD controllers share many same capabilities as those controllers for other applications. The controllers used for automotive, however, are usually manufactured on an automotive process by the semiconductor foundries, support extended temperature, exhibit low defected parts per million (DPPM), and are designed with ASpice standard compliance in mind.

Whether it's just a controller or full-blown storage device, any automotive-grade flash products must demonstrate they have undergone rigorous testing to meet the qualifications expected by automakers, including AEC-Q100 compliance and ISO 9000 and 9001, and ISO 26262 certification.

Conclusion

Automotive designs are evolving for modern autonomous and EV vehicles and so are the respective storage systems. Because NAND flash finds its way into the modern vehicle in so many ways to support so many applications, automotive manufacturers expect their chosen NAND storage device to have the required performance and reliability with data retention to match the life of the vehicle.

They should turn to a vendor with a robust portfolio of tailored flash storage and controllers optimised to support infotainment, navigation, adas and self-driving applications, as well as being future-proofed to support the evolution of the data centre on wheels.



Robert Fan is president of Silicon Motion

CONNECTED CARS

WHY WIFI?

Fredrik Lonegard and Peter Karlsson explore the use of wifi at the heart of the connected car

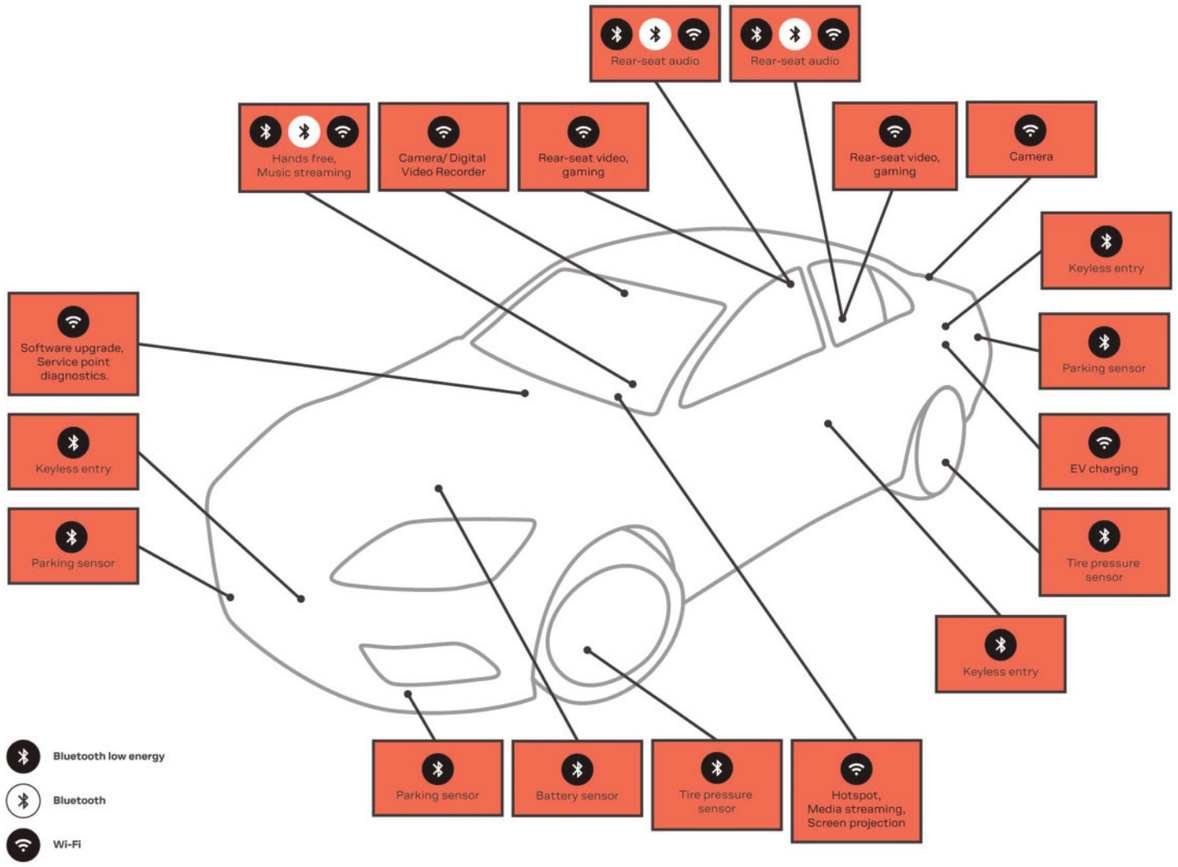


Fig. 1: On board applications demand wireless bandwidth

Modern automobiles increasingly resemble mobile IoT devices, using an array of sensors to improve driver safety and convenience by collecting and acting on internal and external data.

Wireless communications are a fundamental enabler of this evolution in automotive technology, and the rapidly growing volumes of data generated by applications such as adas and in-vehicle infotainment, (IVI) are driving innovation in wireless technologies such as Bluetooth, wifi and cellular.

Wifi is well established in the automotive sector and has responded to the demands of the connected car with a focused set of releases, moving the technology from Wifi 5 through Wifi 6 and 6E, with Wifi 7 in the pipeline, each offering enhancements in bandwidth, throughput and efficiency.

Sophisticated electronic devices are transforming the modern automobile, enhancing the safety, convenience and experience of the driver and passengers, while enabling the creation of a rich support ecosystem around the vehicle. IVI systems are increasingly sophisticated, supporting audio and video-streaming functionality, and adas interpret data from a plethora of sensors within the vehicle.

Wireless communications are at the heart of this transformation, enabling not only the transport of data within the vehicle, but also the concept of the internet of vehicles (IoV), or the connected car.

Connected cars are increasingly sharing data with their external environment, including other road users, intelligent roadside infrastructure and pedestrians. By some estimates, autonomous vehicles will generate up 80Gbyte of data per driven hour, with a significant proportion transferred outside the car, supporting remote diagnostics and predictive maintenance use cases.

This rapidly expanding number of connected automotive applications and use cases, see Fig. 1, is driving an increased demand for wireless bandwidth and throughput.

IVI applications are data hungry, with Spotify alone using up to 150Mbyte per hour, while some estimations suggest high-spec adas can gather as much as 1.4Tbyte every hour. At the same time, OEMs are shifting from traditional, transactional approaches to focus on monetising their installed bases through services such as OTA software and feature updates, and in-vehicle commerce applications.

With the global connected car fleet projected to almost quadruple in size from 236 million units in 2021 to 863 million in 2035, the dependence on wireless data will only grow.

Connected automotive applications are heavily dependent upon Bluetooth and wifi, but both technologies must evolve to avoid the risks of signal fading and degraded performance. The expanding mix of in-car applications, each with its own set of characteristics and system requirements, is putting higher demands on how the wifi system handles its resources and the 2.4GHz band, shared by Bluetooth and wifi, is becoming over-crowded.

Although the availability of the 5GHz band has eased the situation, further measures, such as introducing the 6GHz band as part of Wifi 6E, are required to ease congestion and increase throughput.

Connected

Bluetooth and wifi are well-established within the connected vehicle architecture, with cellular technologies including LTE and, increasingly, 5G supporting external connectivity. Although 5G promises significant enhancements in bandwidth, throughput and latencies, analysts predict that over 70% of future 5G traffic will be off-loaded to wifi, to reduce costs.

In practice, multi-mode options will enable applications to switch between 5G and wifi, depending on the attractiveness – coverage, speed, cost and so on – of the respective network. In busy cities, for example, with many cars and high demand for data, 5G and wifi could run concurrently whereas in situations such as charging stations or parking lots, wifi alone will be able to support the required data rates.

Automotive applications have access to significant ongoing and planned evolutions of the wifi standard, which are set to bring increased levels of efficiency along with more wireless spectrum and throughput.

These evolutions, coupled with the cost-effectiveness of unlicensed spectrum, will consolidate wifi's central position in automotive architecture, and shipments of automotive wifi units are forecast to continue to grow, see Fig. 2.

Demands

Since it first appeared in 2011, wifi has become a common feature in modern automobiles. While most come equipped with Wifi 5 (802.11ac), automakers and OEMs are increasingly taking advantage of the enhanced features and capabilities of Wifi 6

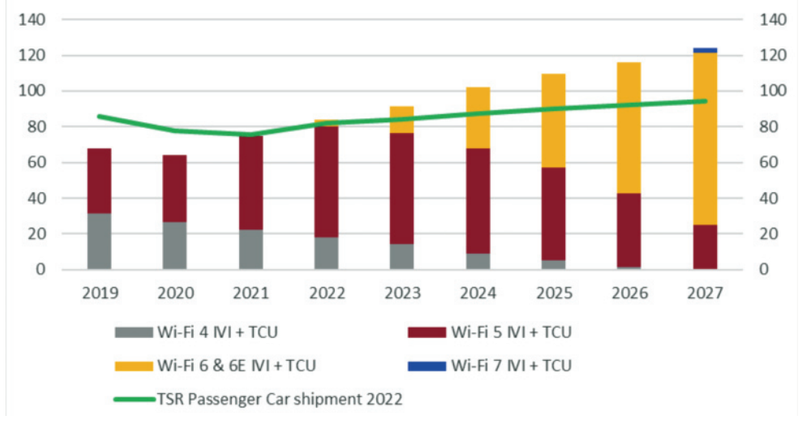


Fig. 2: Forecast shipments of automotive wifi units from TSR's 2022 wireless connectivity market report

and 6E, see Fig. 3, in their devices to future-proof their vehicles.

According to analyst ABI Research, 70% of the wifi chipsets shipped into automotive applications will be Wifi 6 by 2024 with Wifi 6E device shipments also growing rapidly and Wifi 7 devices set to appear in 2027.

Released in 2014, Wifi 5 addressed the issue of congestion in the 2.4GHz band by operating at the less congested 5GHz frequency. Wifi 5 introduced other techniques such as multi-user multiple input, multiple output (mu-mimo) and orthogonal frequency division multiplexing (OFDM) modulation to improve spectral use and throughput.

Although most connected cars use Wifi 5 technology, further releases bring significant enhancements, particularly to bandwidth and throughput-hungry applications operating in difficult congested environments.

Wifi 6 (802.11ax), released in 2019, uses several techniques to reduce congestion, support higher data rates and improve user experience, and offers up to four times higher spectral efficiency than Wifi 5.

Fundamental to this improved performance is orthogonal frequency-division multiple access, (OFDMA), a high-order digital modulation scheme, which lets more users communicate simultaneously.

Unlike OFDM, used in Wifi 5, which transmitted fixed bandwidth data packets sequentially, OFDMA transmits variable sized data packets simultaneously using 256 subcarriers instead of 64.

As illustrated in Fig. 4, OFDM dedicates one packet in a single stream for one device, whereas with OFDMA channel sharing, a packet can include information to multiple clients in multiple streams simultaneously.

OFDMA consequently improves device capacity in dense environments and reduces the impact of multi-path fading of the higher frequency carrier signals, increasing the robustness of Wifi 6 in outdoor environments. Other key features of Wifi 6 include:

- 1024-QAM modulation increases throughput by 25%, over the 256-QAM modulation scheme used by Wifi 5, by enabling each symbol to carry 10bit instead of 8bit.
- Mu-mimo is deployed in the uplink and downlink in Wifi 6, increasing throughput and capacity in both directions.
- Target wake time (TWT) reduces power consumption by allowing devices to negotiate when and how often they will wake up to send or receive data. TWT is valuable for applications that must run when the car is not in use, reducing the drain on battery charge.
- Single user extended range increases the time a symbol stays in the air from one microsecond to ten. Although this longer symbol transmission time reduces data rate, both the quality and reliability of the data transmission are improved, enhancing transmission over longer distances.

	Wi-Fi 5 IEEE 802.11ac	Wi-Fi 6 IEEE 802.11ax	Wi-Fi 6E IEEE 802.11ax	Wi-Fi 7 IEEE 802.11be
Bands	5 GHz 256 QAM	2.4 GHz, 5 GHz 1024 QAM	2.4 GHz, 5 GHz, 6 GHz 1024 QAM	2.4 GHz, 5 GHz, 6 GHz 4096 QAM
Channel bandwidth	20, 40, 80, 160 MHz	20, 40, 80, 160 MHz	20, 40, 80, 160 MHz	20, 40, 80, 160, 320 MHz
Key innovations	• Beamforming	• OFDMA access technology • 1024 QAM • Target Wake Time (TWT) • New PHY headers	• 6 GHz spectrum added	• 4096 QAM • 320 MHz channels • Multi-Link Operation (MLO) • Restricted Service Periods • Triggered Peer-To-Peer Transmission
Benefits	• Better signal-to-noise ratio (SNR)	• Improved device capacity in dense environment • Higher peak data throughput • Reduced power consumption • Longer range	• Improved system capacity	• Increased data throughput • Reduced latency • Deterministic latency in Managed Networks • Enhanced Station (STA) to station direct communication
	2014	**2019**	**2020**	**2023**

Fig. 3: Successive wifi releases introduce additional features and capabilities

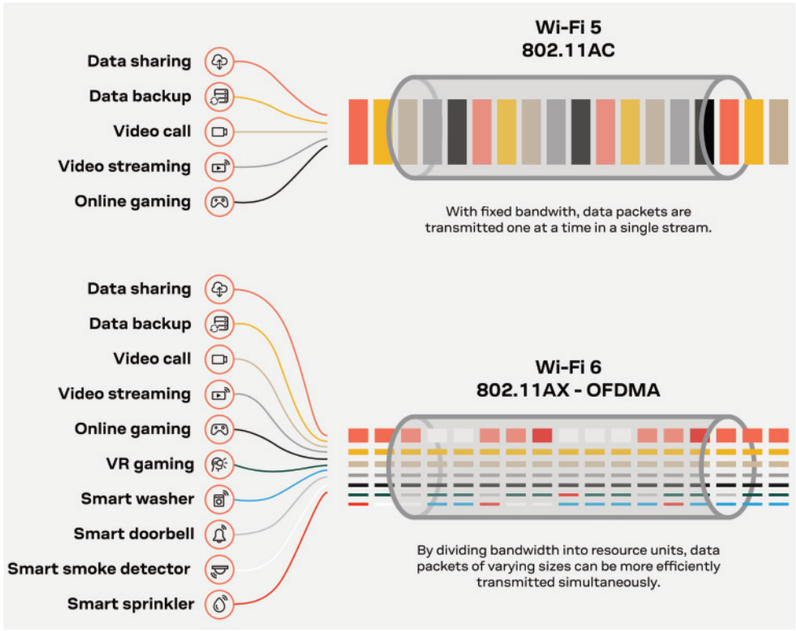


Fig. 4: Wifi 6 uses OFDMA to enhance spectral efficiency

Following on from Wifi 6, Wifi 6E has rapidly been adopted by many countries since the FCC's decision in 2020 to open the 6GHz band.

By using the 6GHz band, Wifi 6E gives applications access to an additional up to 1200MHz, depending on the country, of spectrum, allowing the migration of data traffic to higher frequencies, reducing pressure on the 2.4GHz band.

Wifi 6E offers an up-to-fourfold increase in bandwidth capacity, with devices able to operate in 14 additional 80MHz channels or seven additional 160MHz channels.

The next evolution of the wifi standard will be IEEE 802.11be, or Wifi 7, which is scheduled to be released in 2024. Wifi 7 will operate across the 2.4, 5 and 6GHz bands and will deliver extremely high throughput. This latest wifi standard will include the following functionality:

- A doubling of channel width over Wifi 6, from 160 to 320MHz
- 4096-QAM modulation, enabling each symbol to carry 12bit
- More efficient use of channel spectrum by enabling multiple resource units to be assigned to a single user
- Multi-link operation, enabling devices to send and receive data simultaneously across different frequency bands and channels, thereby increasing throughput, reducing latency and improving reliability

Wifi technology is already well established in the automotive industry and the series of focused releases described here gives developers of automotive applications such as IVI, adas and telematics control units an upgrade path as modern automobiles generate increasing amounts of data.

In this fast-moving environment, OEMs and tier-ones must choose the development path that will give the fastest time to market while optimising cost.

Conclusion

As automobile manufacturers use technology to differentiate their vehicles, the connected car will continue to demand high performing wireless communications. Already well-established in the automotive sector, wifi offers a well-defined upgrade path to OEMs and tier-ones and pre-certified modules help developer stay ahead of the market.

Fredrik Lonegard (right) is product marketing and business development manager



and Peter Karlsson is head of technology for short range radio, both at U-Blox



IC accommodates complex security

A TrustAnchor Security IC from Microchip can accommodate complex automotive and embedded security use cases.

The TA101 supports large key sizes up to ECC P521, SHA512, RSA-4K and AES256 with greater security strength, exceeding current standards and allowing room for future adjustments while maintaining backwards compatibility for smaller keys.

It is offered as an industrial-grade CryptoAuthentication and CryptoAutomotive security IC supporting AEC-Q100 grade one qualified devices for automotive security, data centre and industrial applications.



The cryptographic companion device works alongside a microcontroller (MCU) or microprocessor (MPU) to handle cryptographic functions including public key infrastructure, certificate management and secure key storage.

Features include easy patch updates, message authentication, transport layer security (TLS), secure boot, high-bandwidth digital content protection (HDCP), firmware updates, security upgrades, transfer of ownership, key management and WPC Qi 1.3 authentication.

By introducing key sizes associated with 256bit of security strength, it suits current and future applications.

As an alternative architecture to on-die multicore MCU and MPU management of in-vehicle networking, it offers an off-chip component to handle secure boot and message authentication. The device is compatible with a wide range of MCUs or MPUs, enabling flexibility that can help lower costs and reduce time to market.

On one IC are the Commercial National Security Algorithm (CNSA) required 1.0 suite of algorithms and the ed25519 curve.

Reducing the risk associated with secure code development and implementation, it comes pre-programmed and pre-provisioned in Microchip Common Criteria ALC_DVS.2 certified facilities.

The device is supported by the CryptoAuth Trust platform development kit and several TA101 socket boards that feature a MikroBus connector.

These socket boards can also be used with the MikroBus Xplained Pro extension board, which connects to Xplained Pro boards for developing designs with Sam MCUs.

Material absorbs EM radiation

A microwave absorber material from Parker Hannifin comprises a silicone elastomer matrix with a carbon filler to offer RF absorption performance at a high frequency range.

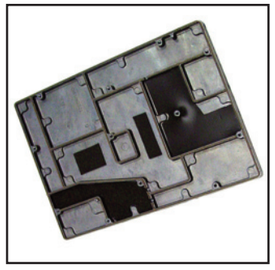
The Cho-Mute 9009 can achieve 50dB/cm of absorption at 77GHz, a standard frequency used in the automotive industry for adas applications.

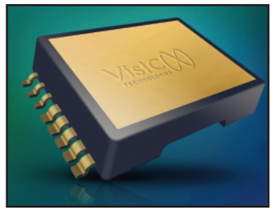
It not only provides a user-friendly approach to the reduction of undesirable electromagnetic radiation from electronic equipment, it also reduces cavity-to-cavity cross coupling and microwave cavity resonances.

By reducing unwanted electromagnetic radiation through the absorption of signals and reduction of reflections from metallic surfaces, it is suitable for use in close quarters with electronic circuitry.

The material offers electrical properties that include: a surface resistance above 1MΩ/square (CEPS-002 test method); bulk volume resistivity of more than 1MΩ-cm (CEPS-002); 1.05 magnetic permeability (ASTM D2520); 0.001 magnetic loss tangent (ASTM D2520); electric permittivity of 10 (ASTM D2520); and 0.08 dielectric loss tangent (ASTM D2520).

The material is available as sheet stock at a selection of standard thicknesses with or without electrically conductive pressure-sensitive adhesive.





GaN power

A GaN power device from Visic Technologies is housed in a gull wing leaded top-side cooled isolated package.

The V22TG D3GaN for electric vehicles brings together an array of features to improve power density and efficiency.

Footprint is 19.7 by 13.6mm including leads.

For automotive AEC-Q101 applications, its design helps thermal management, ensuring performance and reliability in demanding automotive environments.

The isolated package enhances the ease of assembly due to no additional isolation needed.

Applications include OBC, fuel cell and hybrid electric vehicles. With a capability of 650V, it comes in an SMD power package. On-resistance is 22mΩ.

It can support various system configurations, including paralleling of devices, full-bridge and half-bridge topologies, and power factor correction (PFC) circuits.

Samples will be available in the first quarter of 2024.

MCU graphics engine uses smart rendering

Automotive microcontrollers (MCUs) from Infineon have a graphic engine that uses smart rendering technology.

The Traveo T2G Cluster MCUs can simplify OEM integration and reduce costs, making them suitable for smart mobility instrument clusters and heads-up displays in automobiles, motorcycles and off-highway mobility as well as for industrial and medical applications.

Line-based processing, based on an Infineon patent, enables line buffer savings by a factor of ten, resulting in lower power consumption, less memory needs and lower cost.

The devices can be combined with processors in intelligent cockpits to provide a fast startup. The graphics engine reduces the memory required for graphics processing by a factor of three to five, resulting in lower power consumption and lower costs.

With the 2.5D graphics engine, the MCUs support full virtual instrument clusters with resolution up to 1920 x 1080.

Engineering samples are available of a T2G-C series MCU. It features an LPDDR4 interface and can display complex 3D scenes, giving designers more freedom in designing modern HMIs.

Based on up to two Arm Cortex-M7 cores at up to 320MHz, the family enables Asil-B safety performance.

There is up to 6Mbyte flash and 4Mbyte internal vram or 1Gbyte LPPDR4 vram.

An Evita high-level HSM provides security with hardware encryption accelerators and hardware protection with a dedicated Cortex-M0+. As such, it takes into account the latest safety and security requirements.

Package options span from from 500-pin BGA via 216-pin TEQFP to 144-pin LQFP.

Can-FD, Lin, Gigabit Ethernet and CXPI are available as embedded peripherals.

A JPeg decoder, video input and output and two serial SPI or xSPI memory interfaces round off the portfolio.



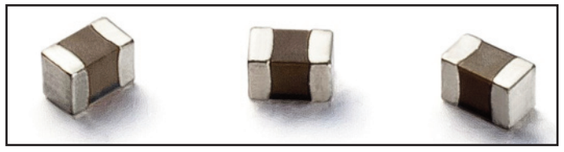
MLCC underpins vehicle safety

A multi-layer ceramic capacitor (MLCC) from Samsung, the CL31B-106KBK6PJ# ,measures 3.2 by 1.6mm and offers 10μF at a 50V rating.

MLCCs underpin vehicle safety and reliability, supporting the stability of on-board circuits.

Using proprietary ceramic and electrode material atomisation, alongside precise lamination, the MLCC maintains its characteristics in the hostile environments that come with driving on the road.

The device carries an X7R TCC (temperature co-efficient of capacitance), thus offering a ±15% deviation tolerance over a temperature range of -55 to +125°C.



Thin-film filters fit tight spaces

Miniature high-pass thin-film filters from Kyocera AVX are engineered to provide high-frequency performance in space constrained microwave and RF applications in automotive and other markets.

The HP filters are based on multilayer integrated thin-film technology that enables the quick adjustment of RF parameters and development of custom filters.

They exhibit reliable and repeatable high-frequency performance and low insertion losses, sharp roll-off values, and steep attenuation.



They are rated for operating frequencies from 1.0 to 5.15GHz and operating temperatures from -40 to +85˚C, and have a characteristic impedance of 50Ω.

Applications include vehicle location systems.

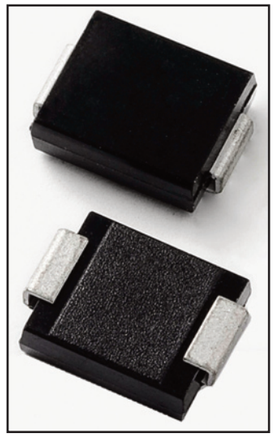
The HP0805 filters come in five part numbers for 2.7, 2.8, 2.9, 3.0 and 5.15GHz performance to enable broad compatibility with high-frequency wireless systems, including 5G and ultra-wideband applications and the high-power remote radio units in base stations.

Their cases measure 2.03 by 1.55 by 0.8mm, ±0.1mm, and they have a 3W continuous power rating.

The HP2816 filters measure 7.0±0.3 by 4.0±0.2 by 1.2mm maximum. They are rated at 15W and are also suitable for military applications.

They are made in an ISO 9001 approved facility and have RoHS-compliant lead-free and solder-coated nickel terminations compatible with reflow, wave, vapour phase and manual automatic soldering.

Finished parts are 100% tested for electrical parameters and visual and mechanical characteristics, and parts are packaged on tape and reel. Lead-time is 14 weeks.



Protection thyristor

An automotive-grade thyristor from Littelfuse provides high surge current protection for equipment operating in harsh environments.

The Pxxx0S3N-A 3kA Sidactor protection thyristor comes in a DO-214AB SMC package.

It can withstand surge currents up to 3kA for 8/20μs and voltages up to 6kV with low clamping voltage.

Developed for battery and plug-in hybrid electric vehicles, the device delivers transient surge protection for on-board chargers.

It is also suitable for exposed applications such as charging piles, EV wall chargers and energy storage systems.

The device complies with AEC-Q101.

The series is available in tape-and-reel quantities of 3000.

SiC modules enhance design flexibility

Silicon carbide (SiC) power modules from ST Microelectronics come in a 32-pin, dual-inline, moulded, through-hole package for automotive applications.

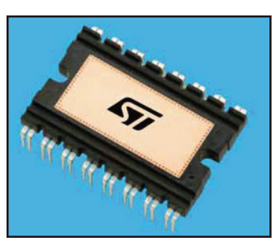
Targeted at on-board chargers (OBC), DC-DC converters, fluid pumps and air conditioning, the Acepack DMT-32 has high power density, compact design and simplified assembly.

They can enhance flexibility for designers with a choice of four-pack, six-pack and totem-pole configurations.

The modules contain 1.2kV SiC power switches that leverage SiC mosfet technology ensuring low $R_{DS(on)}$ values. The devices deliver efficient switching performance with little dependence on temperature to ensure high efficiency and reliability at converter level.

The modules can reduce overall development costs while ensuring reliability. The package technology features an aluminium nitride insulated substrate for thermal performance. There is also an integrated NTC sensor that provides temperature monitoring for thermal protection.

The first in the series, introduced with ramp-up to volume production from late this year, is the M1F45M12W2-1LA.



Motor controller brings comfort to cabins

The S32M2 purpose-built motor controller from NXP increases software re-use across the S32 vehicle compute platform and supports the transition to software-defined electric vehicles.

The integrated device can simplify and optimise motor control of body and comfort applications, reducing in-cabin noise and enhancing occupant comfort,

The purpose-built motor controller is optimised for efficiency improvement across vehicle applications such as pumps, fans, sunroof and seat position, seat belt pretensioners, and trunk openers.

Building on the S12 MagniV portfolio, the system-in-package adds power and analogue functions as well as software libraries for motor control to S32K microcontrollers.

Brushless direct current (BLDC) and permanent magnet synchronous (PMSM) motors are known for their endurance and robustness, small size, low weight and efficiency, which contribute to energy savings and range extension for EVs.

The S32M2 enables simplified and robust motor control functions that can run efficiently while maintaining performance headroom to integrate more functions and capabilities while optimising costs.

OEMs can perform motor diagnostic tests, transmit data to the zonal controller and optimise for performance to improve efficiency and lower audible noise in the final application, which improves occupant comfort.

Based on the system-in-package approach, the S32M2 combines compute with mosfet gate drivers, physical layer interfaces for Can-FD and Lin communications, and a built-in voltage regulator directly from the vehicle's 12V battery, addressing various motor control applications.

Integrating either an Arm Cortex-M4 or Cortex-M7 core, it covers memory options from 128kbyte to 1Mbyte.

These devices use the 64-pin LQFP package, which gives the flexibility to select across different memory sizes while having pin-to-pin compatibility all within the same family.

It also leverages the S32K's development processes certified to ISO 26262 Asil B, the S32's CSEc and HSE security subsystems, and the S32K's tools and software ecosystem.



Gate driver IC speeds GaN switching

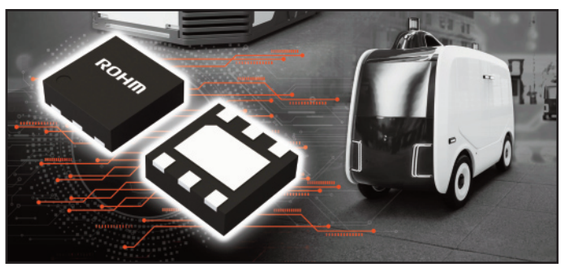
A gate driver IC from Rohm suits high-speed GaN switching.

The BD2311NVX-LB has a minimum gate input pulse width of 1.25ns.

As GaN devices are sensitive towards gate input overvoltage, the company has developed a method to suppress the gate voltage overshoots and implemented it in this driver.

On top, the optimum GaN device can be selected by adjusting the gate resistance based on application requirements.

The firm also has a line of GaN devices under the EcoGaN name. When used with the IC, they can simplify design and enhance reliability.



In power switching applications such as DC-DC and AC-DC converters, and in lidar applications, the performance of GaN devices can contribute to smaller, more energy-efficient and higher performance applications.

The reduced rise time of this driver IC should help reduce switching losses, which is an advantage of GaN.

Diodes protect data interfaces

Low-capacitance ESD protection diodes from Nexperia can protect data interfaces such as USB, HDMI, high-speed video links and Ethernet in automotive infotainment applications.

The PESD 18, 24, 30 and 32V F1BLS-Qs in DFN1006BD-2 packages enable optical inspection in automotive production lines using side wettable flanks.

In addition, the PESD 18, 24 and 30V F1BBL-Qs are available in the DFN1006-2 package.

All variants are in leadless packages to improve electrical performance and signal integrity while enabling miniaturisation in automotive designs.

ESD diodes protect electronic systems and subsystems by dissipating the energy of electrostatic discharges. This protects SoCs and other components from being damaged in an ESD event.

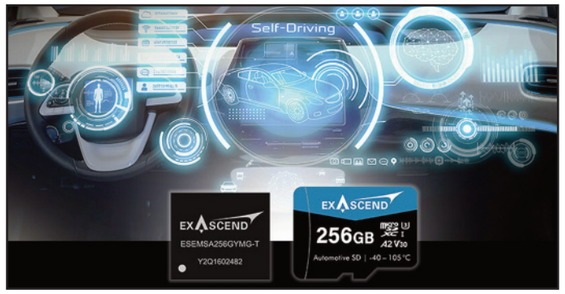
Adding components to a high-speed data line can deteriorate the signal integrity of the transferred data. Therefore, choosing the right components that protect the system but do not hamper the signal transmission is vital to modern high-speed automotive systems.

Signal integrity performance enabled by the low device capacitance down to typically 0.28pF combined with the standoff voltage of 18 to 32V allows placement closer to the connector.

For design flexibility, these diodes are offered with and without side wettable flanks, with the side wettable flanks enabling automated optical inspection.

These AEC-Q101-qualified devices exhibit deep snapback behaviour combined with a dynamic resistance of 0.8Ω for improved system-level robustness and clamping performance in high-speed data interfaces.





Storage meets increase in data requirements

Memory cards and eMMC storage from Exascend are designed to meet rising data storage demands of connected and autonomous vehicles.

The EM500 eMMC and Micro SD500 memory cards are equipped with 3D TLC NAND flash technology and can withstand temperatures up to +105°C.

They cater to automotive applications, including adas, in-vehicle infotainment, navigation and high-definition mapping.

The EM500 has capacities from 4 to 256Gbyte and delivers sequential read-write speeds up to 295Mbyte/s and 210Mbyte/s in HS400 data transfer mode.

It comes in a 153-ball FBGA package compliant with Jedec eMMC v5.1.

Features include LDPC ECC, power loss protection, wear levelling, IOPS optimisation, read disturb prevention, secure erase, write protection and field firmware update (FFU).

Exascend provides customisable firmware and long-term support to meet user requirements.

For removable storage, the Micro SD500 comes in capacities from 8 to 256Gbyte with speed classes V30, U3 and C10, and performance class A2. Its rugged and IP67-rated design meets shock, vibration, temperature and humidity criteria.

It incorporates technologies including LDPC ECC, wear levelling and pseudo SLC for 8 and 16Gbyte cards to deliver sustained performance, low storage latency and endurance.

Manufactured in an IATF 16949 certified facility, both undergo rigorous quality control testing, including wide-temperature burn-in tests from -40 to +105°C, ensuring performance even in harsh conditions.

Both series are undergoing AEC-Q100 grade-two qualification.

Samples are available now.

Simulation software update adds scenario standards

Release eight of Vector Informatik's Dyna4 simulation software for virtual test driving focuses on the scenario engine.

This now natively supports the Asam standard Open Scenario 1.2 as an input format for the description of complex test drive scenarios.

Thus, Dyna4 offers scenario testing of control functions with seamless integration of Asam standards Open Scenario, Open Drive and OSI.

Modelled scenario catalogues are thus consistently reused throughout the entire ECU development process and across various simulation execution environments.

Open Scenario defines a description format for modelling the dynamic part of virtual test drives, for example road users such as vehicles, pedestrians and cyclists.

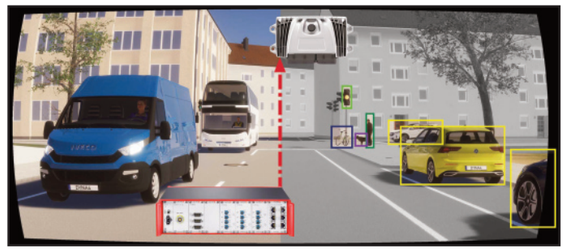
The static part, such as the road network, is modelled based on the Open Drive standard.

During the scenario execution, it allows flexible access to simulated model signals, for reading values to trigger conditions, or for writing values to perform signal manipulations, for example for a targeted fault injection.

This offers a consistent use of modelled scenarios throughout the ECU development process.

The physical models of Dyna4 or its scenario engine module can be integrated into other tool chains with Asam standards. Interface problems when transmitting generated ground truth data or simulated sensor data are avoided by supporting the OSI format.

Another added feature is the direct injection of simulated camera images into an adas ECU. The virtual cameras provide different distortion models for regular or fisheye lenses with a range of applicable image effects and configurable Bayer filter pattern, according to the cmos used.



For direct injection to an ECU, images generated via real-time simulation are sent via Ethernet to the Vector VX1161 multi base module. The module outputs them as serialised image streams via FPD-Link III or GMSL using the VX1161.51 streaming interface cards.

The adas function code on the ECU processes the injected virtual camera images to perform its detection, fusion, tracking and planning tasks.

When the ECU outputs are received with the Vector VN network interfaces or the VT system cards, they can be fed back into the virtual Dyna4 vehicle model. This creates a hardware-in-the-loop test system for adas ECUs.

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