VEHICLE electronics

The monthly magazine for automotive electronics engineers

Aumovio gets rid of 4000 R&D jobs

Aumovio, formerly Continental's automotive division, plans to shed 4000 R&D jobs this year.

The company is headquartered in Frankfurt, and has over 86,000 employees in more than 100 locations worldwide.

The job losses will primarily be implemented at locations in India, Singapore, Romania, Serbia, Germany and Mexico. For sites in Germany, the company sees the need to reduce positions in a range reaching into the high triple digits.

By focusing R&D expenditures on value-creating technologies, intensifying development partnerships, and implementing additional efficiency measures, it hopes to reduce its R&D expense ratio to below 10% by 2027; it was 11.9%in the third quarter of 2025.

Aumovio is talking with employee representatives with the aim of developing alternatives to increase efficiency and reduce the need for job reductions in Germany.

The company plans to launch a voluntary programme at the affected locations in Germany as early as this month.

"In a challenging environment, we are now taking additional measures to consistently enhance our efficiency," said Philipp von Hirschheydt, CEO of Aumovio. "We are focusing on value-creating technologies, investing in future-oriented fields, and leveraging both new and proven partnerships."

So it can work with fewer employees, Aumovio plans to focus its technology portfolio, align activities with market developments, and consolidate operations more strongly. Together with the ongoing measures for standardisation, automation and improved organisational alignment, this should lead to a reduced need for positions within the company's development areas.

The firm says it will continue to invest significantly in R&D activities, as well as in expanding its technology partnerships in future fields such as software-defined vehicles, autonomous mobility, displays and electronic braking.



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Voice-calls-over-satellite demo planned for MWC

Viasat, Cubic³, Qualcomm and Fraunhofer IIS are demonstrating satellite-enabled voice calls over a 3GPP-compliant non-terrestrial satellite network for connected vehicles.

The demo at this month's Mobile World Congress in Barcelona will show a voice call conducted over satellite, letting vehicles maintain voice connectivity when cellular networks are patchy or unavailable.

This milestone aims to show that voice communications can operate reliably beyond the reach of terrestrial networks.

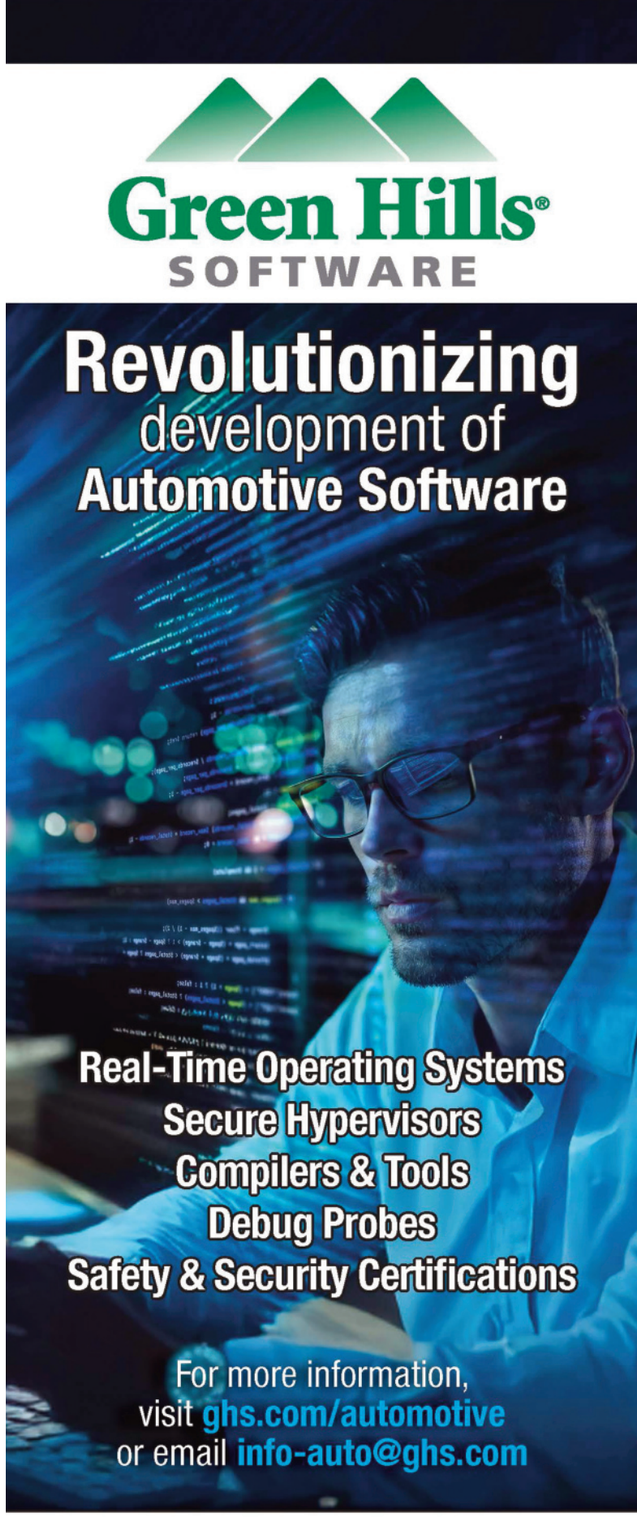
The demo brings together several technologies to show how always-on connectivity can be integrated into modern software-defined vehicles (SDVs). This includes Viasat's satellite network, Cubic³'s global connectivity management platform and hybrid eSIM, Qualcomm' Snapdragon Auto 5G modem-RF platform, and the NESC voice codec from Fraunhofer IIS, with additional technical support from Amarisoft.

By extending voice services beyond cellular coverage, automakers can ensure drivers remain connected for emergency assistance and critical safety applications, regardless of location. The demonstration also lays the foundation for future NTN-enabled vehicles as consumer expectations on data services increase and technology evolves to meet growing demand.

It builds on the partnership announced by Viasat and Cubic³ in June 2025, which combined satellite and terrestrial connectivity to support global vehicle communications. Cubic³ also intends to work with Viasat to bring future 5G-NR satellite services, such as video streaming and seamless voice calls, to the automotive market.

These applications would leverage Equatys, a jointly held entity founded by Viasat and Space42. Equatys is designed to enable seamless 5G connectivity across satellite and terrestrial networks, extending services to billions of people and devices globally.

"As vehicles become increasingly software-defined, connectivity must be intelligent and truly global," said André Schlufter, director at Cubic³. "This demonstration shows how satellite connectivity can extend the reliability automakers already expect from cellular networks."



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Mercedes-Benz and Nvidia lead robotaxi support



S-Class forms base for robotaxi collaborations

Mercedes-Benz is collaborating with partners to create a robotaxi ecosystem built on the technology architecture of the latest S-Class.

It is working with Nvidia, Momenta, and mobility providers such as Uber and Lumo on robotaxi services.

The S-Class enables fail-safe operation. It integrates redundancies for steering, braking, compute and power supply and, with the MB.Os proprietary operating system, it can be a launchpad for a driverless shuttle service in America, Asia, Europe and the Middle East.

Mercedes-Benz is pushing SAE level-four development in various projects around the world with partners, leveraging the potential of MB.Os.

"Mercedes-Benz is the pioneer in safe autonomous driving," said Jörg Burzer, Mercedes-Benz chief technology officer. "The next step on our roadmap is to enable a robotaxi experience based on the new S-Class. To accomplish our goal, we have strong industry-leading partners at our side. For us, these partnerships mark the beginning of our entry into the robotaxi market with the S-Class and MB.Os as the ultimate platform."

Mercedes-Benz and Nvidia are collaborating to create a robotaxi ecosystem together with Uber based on the S-Class. Nvidia will implement its Drive Hyperion architecture and full-stack Drive AV L4 software. It will further be enhanced by Alpamayo open AI models, simulation tools and datasets to bring reasoning-based, safety-first autonomy to the platform.

Nvidia's expertise in AI-based software development includes being used for Mercedes' latest adas.

At the end of last year, the car maker announced another L4 project with Momenta to develop a robotaxi experience based on the S-Class.

Mobility provider Lumo – a subsidiary of technology company K2 – plans to operate the shuttles initially in Abu Dhabi with the option for more locations later.

The first S-Class robotaxi test vehicles will be deployed on Abu Dhabi roads later this year.

SK Keyfoundry launches 200V 0.18μm BCD process

SK Keyfoundry has launched its fourth-generation 200V 0.18μm BCD process to accelerate expansion into automotive and AI power semiconductor markets

The South Korean foundry plans to begin full-scale product development with domestic and global customers, targeting mass production within the year.

Automotive architectures are transitioning from 12 to 48V systems, while AI servers and data centres are raising operating voltages from 380V to as high as 800V DC to increase power efficiency and density.

Against this backdrop, the importance of process technologies capable of reliably withstanding high voltages above 100V while enabling efficient power control has never been greater.

The fourth-generation BCD process has more than a 20% improvement in on-resistance and breakdown voltage, reflecting enhanced power efficiency and high-temperature robustness.

In addition, the process offers low on-resistance devices optimised for each operating voltage, reducing chip area and power loss.

Notably, the process provides a thick IMD option that enables the safe transmission of digital signals while blocking unwanted high voltage and noise between PMICs using BCD and HV mosfet technologies.

It also supports embedded memory options, including sram, rom, MTP and OTP, as well as Hall sensors for precision motor control, expanding design flexibility for high-voltage ICs.

The process meets AEC-Q100 Grade 0, enabling immediate adoption in automotive electronic components that require reliability under extreme conditions.

Vesa updates DisplayPort automotive extension

Standards body Vesa has released version 1.1 of its DisplayPort automotive extension (DP AE) specification for functional safety and security in automotive displays.

DP AE v1.1 incorporates a fully executable, normative software emulator that enables silicon manufacturers, system integrators and automotive OEMs to design and validate DisplayPort- and embedded DisplayPort (eDP)-based devices to meet ISO 26262 Asil-D and UN R155 and ISO 21434 for security.

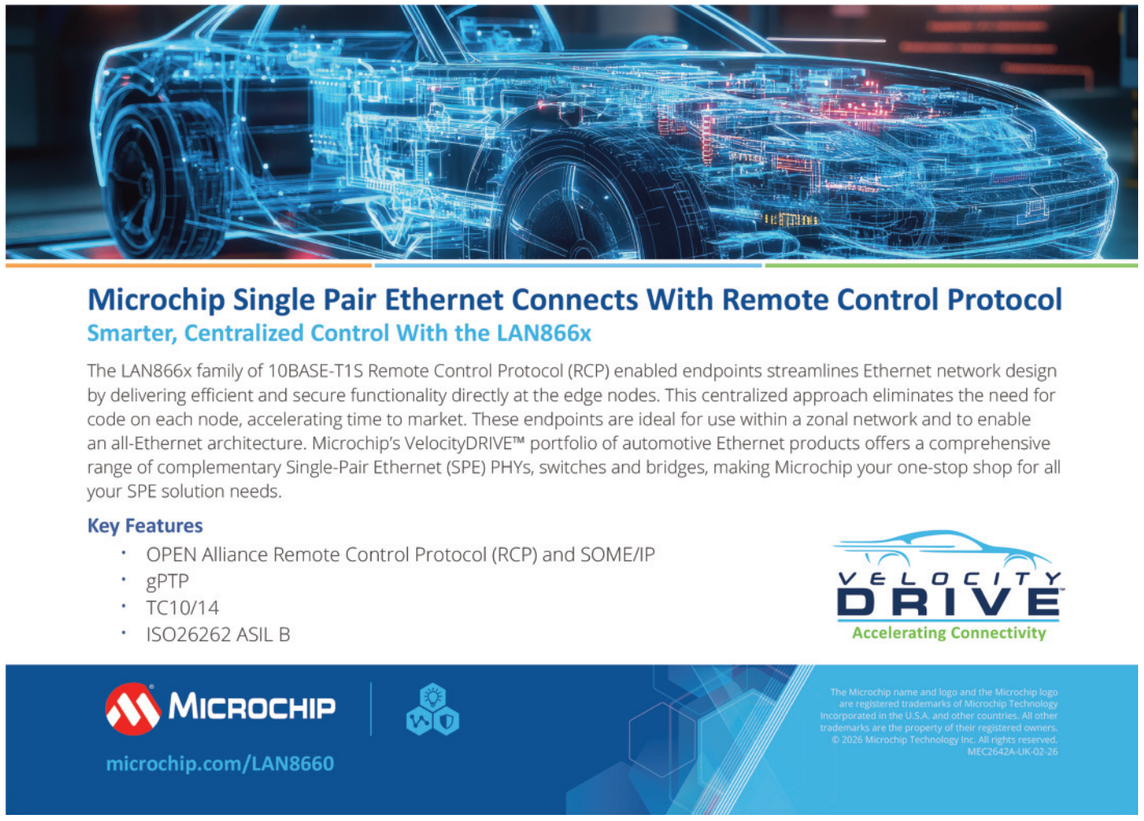
The centrepiece of the update is a white-box C-model software emulator that implements all four normative safety and security profiles defined in the DP AE specification. These profiles add layered protection for main video data paths, auxiliary channels and overall system integrity, enabling stakeholders to verify frame-level fidelity, detect tampering and enforce cryptographic authentication in automotive display pipelines.

Most automotive displays use DisplayPort or eDP to carry video data from the central vehicle computer or ECU to the displays. In addition to its high video bandwidth capability, DisplayPort features MST, which enables multiple displays to be connected to a single DP source port.

However, until the introduction of DP AE standard, there was no standard way to verify the data transmitted from the ECU were received by the display in the same way they were sent, ensuring they were free of noise injection errors and have not been the target of malicious tampering.

The C-model emulator is available as a Linux application and can be integrated into software testing environments. A Windows-based graphical interface is under development to support automotive technicians in manufacturing and validation roles.

Vesa is developing a compliance test specification (CTS) and logo programme for DP AE, which will enable formal product validation and certification.



NXP picks Ceva AI for SDVs

NXP has integrated Ceva's AI DSP into its S32Z2 and S32E2 processors to power real-time domain and zonal control modules in software-defined vehicles.

The processors provide the compute efficiency for high performance, deterministic, safety-critical control with AI inference in a multi-application environment.

They leverage Ceva's SensPro AI DSP technology to deliver real-time decision-making and intelligent perception so vehicles can interpret their environment and respond with precision. Applications such as predictive analytics for extended battery lifespan, predictive maintenance, driver monitoring and in-cabin voice-controlled interfaces can all be enabled through the DSP.

"The S32Z2 and S32E2 meet the stringent performance, safety and scalability requirements of next-generation vehicles," said Robert Moran, vice president at NXP. "By integrating Ceva's AI DSP, we deliver the machine learning and AI capabilities our customers need to accelerate innovation in real-time compute applications for SDVs."



Infineon and BMW shape SDV future

Infineon and BMW have joined forces to shape the future of software-defined vehicles (SDVs).

Infineon is providing components for central computing, high-speed connectivity, power management and distribution for BMW's Neue Klasse vehicle.

Centralised computing is delivering faster processing and lower latency, allowing smoother handling, extended range and improved updateability. The zonal design reduces wiring by 600m and improves efficiency by approximately 20 per cent via smart power distribution.

By delivering an integrated, flexible and future-ready EE architecture, the Neue Klasse lays a foundation for safer, smarter and more sustainable mobility.

"We are proud to collaborate with BMW to shape the future of mobility," said Jochen Hanebeck, CEO of Infineon. "BMW's Neue Klasse marks a significant step in introducing software-defined vehicles to the market and elevates individual mobility to the next level in terms of decarbonisation and digitalisation."

The Neue Klasse EE architecture is designed for scalability and long-term adaptability of vehicle functions. It leverages Infineon's Aurix and Traveo microcontrollers, Brightlane Ethernet connectivity, Optireg power management ICs as well as Profet smart power switches and e-fuses for SDVs.

By decoupling software from hardware, the architecture enables over-the-air features and software updates without any hardware changes, so BMW can quickly adapt to evolving consumer demands and regulations.

Four high-performance central computing units are at the core of this architecture. One is called Heart of Joy and governs driving dynamics such as acceleration, braking and steering in a single high-speed computer. It enables faster processing than previous systems and reduces latency. As a result, the driver benefits from smoother handling and a more dynamic and responsive driving experience.

Optimised recuperation increases the range of the vehicle significantly.

The other three so-called superbrains manage automated driving, infotainment and base vehicle operations.

All four are supported by three separate zone control units that optimise data flow and power distribution, while end-point ECUs handle critical applications such as traction inverters, battery management and on-board charging.

Smart efuses such as Infineon's Profet Wire Guard family replace up to 150 conventional fuses per vehicle, allowing BMW to implement intelligent and efficient power distribution across the EE architecture.

The efuses support software-controlled power management, letting the vehicle adjust energy distribution dynamically.

DSpace and MathWorks streamline traffic simulation

DSpace and MathWorks have expanded their partnership to streamline traffic simulation using open standards.

Developers of autonomous driving applications can now use road models created in RoadRunner directly in ASM OpenX, the latest generation of DSpace traffic models, improving efficiency and reducing development time.

"By combining the ASM OpenX with RoadRunner as a powerful road editor, we let our customers simulate traffic scenarios more efficiently and cost-effectively on a wide variety of road models and thus in a broad range of operational design domains," said Thorsten Püschl, product manager at DSpace.

ASM OpenX is the latest DSpace traffic model and is natively based on the OpenScenario XML and OpenDrive open standards. In contrast to previous ASM traffic models, the native use of standards eliminates the error-prone and time-consuming conversion of scenes and road models.

The requirement for manual rework is significantly reduced, making the use of OpenX in the DSpace simulation tool chain much simpler, more robust and more efficient.

RoadRunner is an interactive editor with programmatic APIs for designing detailed road models and 3D scenes as well as scenarios, supporting OpenDrive and OpenScenario. It enables efficient customisation and has proven in a comprehensive evaluation to complement ASM OpenX, especially for the provision of road models in OpenDrive.

Hexagon readies Red Bull for lights out



Measurement technologies from Hexagon have helped the Red Bull Formula One racing team prepare for the start of the 2026 season with regulations that have forced a complete redesign of the cars.

Red Bull Ford Powertrains used Hexagon's high accuracy coordinate measuring machines, 3D laser scanners and software to achieve the sub-micron tolerances necessary for the manufacture, testing and assembly of its entirely new 1.6 litre V6 turbo hybrid powertrain.

While the new rules increase reliance on electrical energy, altered aerodynamics and changes to wings will produce less downforce, placing performance demands on the car's power unit. The front wings are simplified, while the undersides of cars have lost Venturi tunnels that generated a huge amount of grip.

To meet these rules, Red Bull took the decision to build its own powertrain from scratch at its technology campus in Milton Keynes, with Ford Racing on board as technical partner.

Hexagon's metrology technologies have proved integral to achieving the thousandth-of-a-millimetre tolerances required to deliver the race-ready power unit on time. They have accelerated testing and inspection along the entire R&D phase right through to prototyping, test-rig testing and production.



Wayve and Uber to launch service in London this year

AI driving start-up Wayve raises $1.5bn

Microsoft, Nvidia and Uber have invested in autonomous driving AI start-up Wayve as part of a $1.5bn series D round, alongside car makers Mercedes-Benz, Nissan and Stellantis.

The money will be used to accelerates the company's shift from AI research to scaled commercial deployment.

Wayve plans to launch commercial robotaxi trials this year and deploy supervised autonomy software in consumer vehicles from 2027.

Wayve pioneered the application of end-to-end AI to autonomous driving in 2017 and has since industrialised its safety-by-design architecture into a production-ready autonomy platform.

From this year, consumers will experience Wayve-powered robotaxis through commercial trials with Uber. From 2027, they will be able to buy passenger vehicles equipped with Wayve's AI Driver, starting with L2+ hands-off capability that allows the vehicle to steer, navigate and respond to traffic under driver supervision.

Wayve licenses its AI Driver directly to automakers, providing tools to customise driving models for specific vehicles and brands. The system runs entirely on onboard vehicle compute and embedded sensors, and doesn't rely on high-definition maps or location-specific engineering.

By partnering with car makers and mobility platforms, Wayve enables autonomy to scale globally with lower capital.

In the past year, Wayve became the first and only AV developer to drive zero-shot in more than 500 cities across Europe, North America and Japan, meaning without city-specific fine-tuning before deployment. That performance is enabled by a foundation model trained on globally diverse data spanning over 70 countries and a range of vehicle platforms.

Uber has committed additional capital to support multi-year deployments of Wayve-powered robotaxis on the Uber network, with plans to scale to more than ten markets globally. The companies plan to launch their first service in London this year, with broader international rollout to follow.

Technica platform simplifies SDV development

Technica Engineering has announced the first open-source release of Flync, a platform designed to simplify software-defined vehicle (SDV) development by managing complex network configurations across teams, tools and suppliers.

By treating configuration data like code, Flync helps teams reduce manual effort and duplication across architecture, development and testing.

It can improve consistency and traceability throughout the vehicle lifecycle, and accelerate collaboration between internal teams and external suppliers.

Time to market can be shortened by reducing rework and configuration mismatches.

Arm foundation powers Tensor robocar

Arm and Tensor have announced a multi-year collaboration to deliver the foundational compute architecture behind Tensor's agentic AI personal robocar.

Tensor is leveraging the Arm compute platform, which unifies hardware, software and ecosystem enablement, to power physical AI workloads spanning the entire vehicle. Tensor has integrated more than 400 Arm-based cores in each vehicle, the highest concentration of Arm technology in a consumer vehicle today.

As Tensor scales its personal robocar fleet for global commercialisation in 2026, the companies plan to work together to enable level-four autonomous capabilities.

Tensor's robocar is powered by a vertically integrated level-four autonomy stack, and a sensor suite of 37 cameras, five lidars, 11 radars, 22 microphones, ten ultrasonic sensors, three IMUs, GNSS, 16 collision detectors, eight water-level detectors, four tyre-pressure sensors, a smoke detector, and triple-channel 5G connectivity.

To make this possible, Tensor is using the Arm compute platform to distribute safety-capable intelligence across the vehicle from the onboard supercomputer to the smallest sensors, allowing the car to perceive and navigate safely its environment.

Each robocar incorporates 433 Arm-based cores, including Neoverse AE for high-throughput AI processing, Cortex-X for agentic AI cabin and peak performance system control, Cortex-A for drive-by-wire, lidars, redundancy and general compute, Cortex-R for real-time safety-critical systems, and Cortex-M for low-power subsystem management.

The Arm compute platform enables Tensor to deploy AI workloads across diverse compute domains while meeting automotive safety, thermal and power requirements, operating with Nvidia-accelerated AI processing to support Tensor's proprietary autonomy stack.

"Autonomous vehicles are a leading example of how AI is shifting to the physical world, requiring world-class, high-performance, safe and power-efficient compute foundations to transform the future of mobility in meaningful and tangible ways," said Drew Henry, executive vice president at Arm.

Jewel Li, Tensor COO, added: "Delivering personal autonomous vehicles at scale requires more than breakthrough AI and autonomy, it demands advanced engineering for safety, redundancy, reliability and power efficiency."

The AI-native vehicle architecture used in each Tensor robocar is enabled by a growing network of partners spanning AI compute, manufacturing, safety systems and critical vehicle technologies. Tensor has also selected suppliers, semiconductor firms and cloud partners including, Autoliv, ZF, Continental, Nvidia, AMD, Qualcomm, Samsung and Oracle.

The Tensor robocar will be offered in the USA, EU and Middle East later this year.

Neusoft cockpit MoU with Cerence

Neusoft and Cerence AI have signed a memorandum of understanding (MoU) to collaborate on an AI-powered automotive cockpit platform.

Through joint innovation and ecosystem integration, the two will work together to deliver pre-integrated, scenario-driven, intelligent interactions for automotive partners.

As automotive technology continues to evolve, drivers and passengers seek more than basic voice responses; they want a companion that understands natural language, communicates smoothly and resonates emotionally.

The partnership between Neusoft and Cerence AI is designed to meet this, establishing humanlike interactions.

Neusoft will leverage its intelligent cockpit software as the core foundation, integrating Cerence AI's expertise in conversational and generative AI and large language models.



Tensor robocars powered by Arm

Anritsu and Valeo plan SDV digital-twin demo at MWC

Anritsu and Valeo are collaborating to pioneer virtual digital-twin validation capabilities for the evolution of software-defined vehicles (SDVs).

This partnership aims to transform software development for vehicle domains such as the telematics unit, enabling a more cost-efficient and future-ready process.

Valeo and Anritsu will unveil a live demonstration at this month's Mobile World Congress in Barcelona.

Cellular connectivity is playing a growing importance in the move towards in-vehicle software-defined architectures by connecting the vehicle to cloud infrastructures to deliver continuous values for users. This shift requires a wide range of test parameters.

Traditional workflows rely on hardware-based validation and manual parameter extraction, forcing design engineers to develop complex test bench setups to cover various operating conditions. Given the accelerating demands of the continuous integration and continuous deployment cycle, there is an urgent need for quicker, scalable and automated modelling.

Anritsu addresses this by integrating a virtual engine that reproduces field events into its software-based in-the-loop simulator. This makes it possible to build a realistic digital twin of multi-network environments and vehicle-to-vehicle communications that simulates multiple vehicles.

Anritsu has a one-stop toolchain that comprehends everything from field driving tests to simulations in the lab. The integration with Valeo's software development lets car makes carry out end-to-end verification, from in-vehicle systems to the backend in a fully virtualised environment.

• Anritsu's hybrid ecall evaluation, featuring the MX703330E ecall tester, has obtained EN 18052: 2025 certification following testing by Cetecom Advanced. This confirms end-to-end validation of hybrid ecall operating across 2G and 3G circuit-switched and 4G packet-switched networks.

Microchip and Hyundai collaborate on connectivity

Microchip and Hyundai are collaborating to explore 10baseT1S single-pair Ethernet for future automotive connectivity.

The collaboration aims to evaluate and promote the adoption of in-vehicle network technologies leveraging each company's strengths.

Single-pair Ethernet serves as a foundational technology for modern automotive architectures, enabling seamless connectivity across systems.

By reducing the need for bridging between multiple standard and proprietary communication buses, it can simplify wiring, lower system costs and streamline network integration.



Hyundai to integrate Microchip technology

Hyundai is working to integrate Microchip's 10baseT1S products into its future vehicle platforms, particularly in high-growth areas such as electric vehicles, autonomous driving and smart mobility.

The collaboration also includes access to Microchip's technical support and early product samples to accelerate time to market and optimise performance.

"As the automotive industry transitions to software-defined vehicles, the need for high-performance and scalable in-vehicle networks has never been greater," said Matthias Kaestner, corporate vice president at Microchip. "Our portfolio of single-pair Ethernet hardware and software enables customers to reduce cost, risk and time to market. Our collaboration with Hyundai will support the development of next-generation in-vehicle networks that address the mobility needs of tomorrow."

The 10baseT1S technology supports multi-drop Ethernet communication over a single twisted pair, extending in-vehicle networking to the edge, hopefully connecting devices, actuators and sensors efficiently and cost-effectively.



Volvo's EX60 fully electric SUV

QNX software-defined audio for Volvo EX60

QNX has expanded collaboration with Haleytek to enable a fully centralised software-defined audio (SDA) architecture for Volvo's upcoming EX60 fully electric SUV.

This supports Volvo's progress in its Superset tech stack strategy, which seeks to unify hardware and software into a scalable, future-ready platform.

The EX60 will debut with Volvo's SPA3 infotainment platform, featuring branded sound system options from multiple audio providers.

Unlike traditional approaches that rely on dedicated DSPs within amplifiers, SDA centralises audio processing on a SoC, providing automakers with flexibility, faster deployment of new features and a foundation for continuous software innovation.

"Our Superset tech stack strategy is about building a foundation that is optimised for continuous improvement," said Martin Kristensson, head of SDVs at Volvo. "This approach ensures we can evolve capabilities over time, providing customers with a premium experience that keeps getting better long after they drive off the lot."

The EX60 will implement a fully centralised SDA architecture using QNX Sound. This was achieved through collaboration between QNX and Haleytek, Volvo's software subsidiary, leveraging QNX Sound and the Oasis VirtIO Sound open standard.

QNX Sound is a digital audio platform for SDVs that decouples audio and acoustics software from hardware, unifying all vehicle audio functionalities, including voice treatment, media playback, alerts and noise control into one system, helping streamline development, reduce hardware needs and speed time to market for automakers.

"This implementation demonstrates how QNX Sound enables automakers to migrate more vehicle functions to software," said Grant Courville, senior vice president at QNX.

Munro & Associates, an engineering and manufacturing consultancy, recently confirmed that migrating from a legacy hardware-based approach using DSP-enabled smart amplifiers to SDA on a centralised SoC can potentially save automakers $22 to $98 per vehicle, depending on complexity and trim level.

Tata to make Qualcomm modules in India

Tata Electronics is to make Qualcomm automotive modules at its upcoming semiconductor assembly and test facility in Jagiroad, Assam, India.

The collaboration aims to enable local production of automotive technologies for digital cockpits, infotainment, connectivity and intelligent vehicle systems for Indian and global automakers.

The facility will integrate the Snapdragon Digital Chassis SoCs and components into production-ready modules.

By simplifying design and accelerating development timelines, the modules should enable scalable, turnkey architectures that support the industry's transition to software-defined vehicles.

The greenfield, high-volume semiconductor assembly and test facility is being built with an investment of $3bn.

Renesas presents SoC and memory at ISSCC

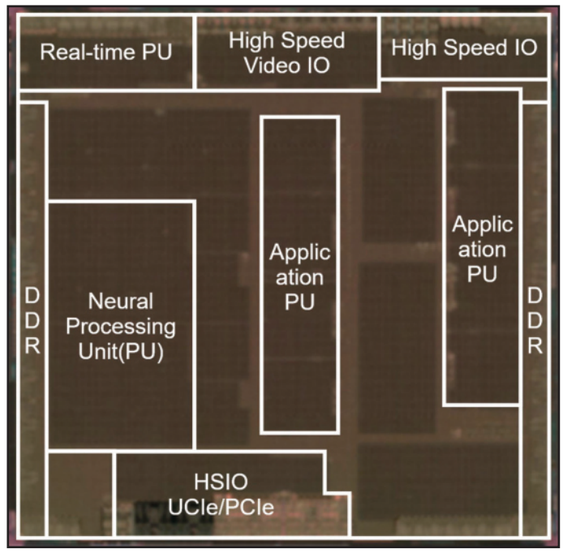
At February's International Solid-State Circuits Conference (ISSCC) in San Francisco, Renesas presented three systems-on-chip (SoCs) for automotive multi-domain ECUs and announced a configurable ternary content-addressable memory (tcam) built on a 3nm finfet process.

The SoCs feature AI processing capabilities and chiplet functions, serving as the core technology platform for automotive EE architectures.

The tcam simultaneously delivers higher density, lower power and strengthened functional safety, making it suitable for automotive use.

To meet the functional safety requirements of automotive SoCs, Renesas has developed a proprietary architecture that supports Asil D even in a chiplet configuration. By combining the standard die-to-die UCIe interface with a proprietary RegionID mechanism, the architecture prevents interference with hardware resources, even when numerous applications run simultaneously, thereby achieving freedom from interference.

Renesas has also created a 3nm SoC design that improves the performance of neural processing units for AI processing, while maintaining automotive-grade quality.



Automotive SoC technology presented at ISSCC

To achieve the high level of performance required for automotive SoCs with improved power efficiency and safety, Renesas has developed power gating technology that uses over 90 power domains. It enables precise power control, from several milliwatts to several tens of watts, depending on operating conditions.

To meet Asil-D functional safety standards, the dual core lock step configuration controls the master and checker cores with independent power switches and controllers. With this design, even if one side fails, the failure can be detected through lockstep operation.

These technologies are being used in Renesas' R-Car X5H SoC for multi-domain ECUs.

With the rapid expansion of 5G and cloud-edge computing, network traffic continues to surge, driving demand for large and diverse tcam configurations such as 256bit by 4096 entries. Conventional scaling that relies solely on hard macros increases peripheral area due to more banks and repeaters and makes timing closure more difficult, while also raising search power.

Automotive applications further require higher safety coverage to meet standards such as ISO 26262.

The newly developed tcam hard macros are supported by a memory compiler in fine granularities with search key widths of 8 to 64bit and entry depths of 32 to 128.

Larger configurations are realised by combining these hard macros with tool-driven soft-macro auto-generation to provide a configurable single macro that covers a wide range of use cases on one chip. This achieves a memory density of 5.27Mbit/mm^2.

Each hard macro integrates an all-mismatch detection circuit and executes a two-stage pipelined search. Based on the first-stage result, the second stage can be continued or halted to avoid unnecessary energy consumption.

Because tcam bitcells for the same address are physically adjacent, a double-bit error caused by soft errors cannot be corrected by conventional SECDED ECC.

Renesas mitigates this with techniques that improve safety coverage in automotive contexts.

Arrow hub helps design EE architectures

Arrow Electronics has launched a research hub to support future vehicle electrical and electronic (EE) architectures.

To help engineers and procurement specialists, the dedicated research hub is an online resource providing technical insights, whitepapers and design tools for EE architecture development.

The resource aims to provide automotive manufacturers and tier-one suppliers with the engineering expertise and supply chain stability to navigate the industry's shift towards software-defined vehicles.

This initiative builds on the company's 2024 acquisitions of software firms iQmine and Avelabs, engineering services providers for the automotive and transportation industry. These additions have bolstered Arrow's software development centres and its automotive centre of excellence.

"The EE architecture is the cornerstone of the modern automotive revolution, enabling the transition from hardware-centric machines to intelligent, software-defined mobility," said Murdoch Fitzgerald, chief growth officer for Arrow. "By combining our global engineering reach with a broad range of components and specialised software expertise, we are well positioned to help our customers navigate this complexity, reducing their time to market and helping ensure their platforms are built to adapt as the industry evolves."



Arrow can help with EE architecture design

This shift moves away from hundreds of individual components towards a more centralised system where computing hubs manage multiple functions. This transition can streamline and harmonise systems and operation while reducing the internal wiring of a car by up to 20 per cent, leading to vehicles that are lighter, more energy-efficient and easier to update via software throughout the vehicle's lifecycle.

Arrow aims to bridge the gap between individual components and integrated systems. Its design engineering services include a dedicated team of automotive experts who provide cross-technology support in semiconductor and interconnect, passive and electromechanical components.

This technical depth is matched by global inventory and supply chain services that help ensure confidence through multi-sourced, traceable component strategies and proactive obsolescence planning so automakers have the right components in hand when they need them.

In addition to hardware, Arrow has expanded its transportation software footprint in recent years to include expertise in Autosar, functional safety standards and automotive cyber security.

Mobileye picks Elektrobit for L4 system

Elektrobit's EB Corbos Linux for Safety Applications has been integrated into Mobileye Drive, a scalable end-to-end level-four self-driving system.

As the foundation for global OEM offerings and robotaxi vendors, the platform will use Elektrobit's safety-compliant product, delivering automotive grade features and field updates.

EB Corbos Linux for Safety Applications is an open-source operating system compliant with automotive functional safety standards. It has been assessed for Asil B and Sil 2 by TÜV Nord for the safety element out of context (SEooC) based on ISO 26262 and IEC 61508.

The operating system lets automotive manufacturers and suppliers use Linux in safety-related high-performance computing functional domains such as applications for adas and autonomous vehicles.

Open source sets itself apart from proprietary software through its transparency, flexibility, speed of innovation and security.

Drive is a scalable self-driving system to help automakers and transport operators make robotaxis, ride-pooling, public transport and goods delivery fully autonomous.

DRIVER ASSISTANCE

POWERING ADAS

Kirk Ulery explains the role of 48V in adas

Adas is becoming increasingly sophisticated. The systems integrate a growing array of sensors, not only greater in number but with higher resolutions and broader functionalities. Compute platforms are more powerful, and control systems more complex.

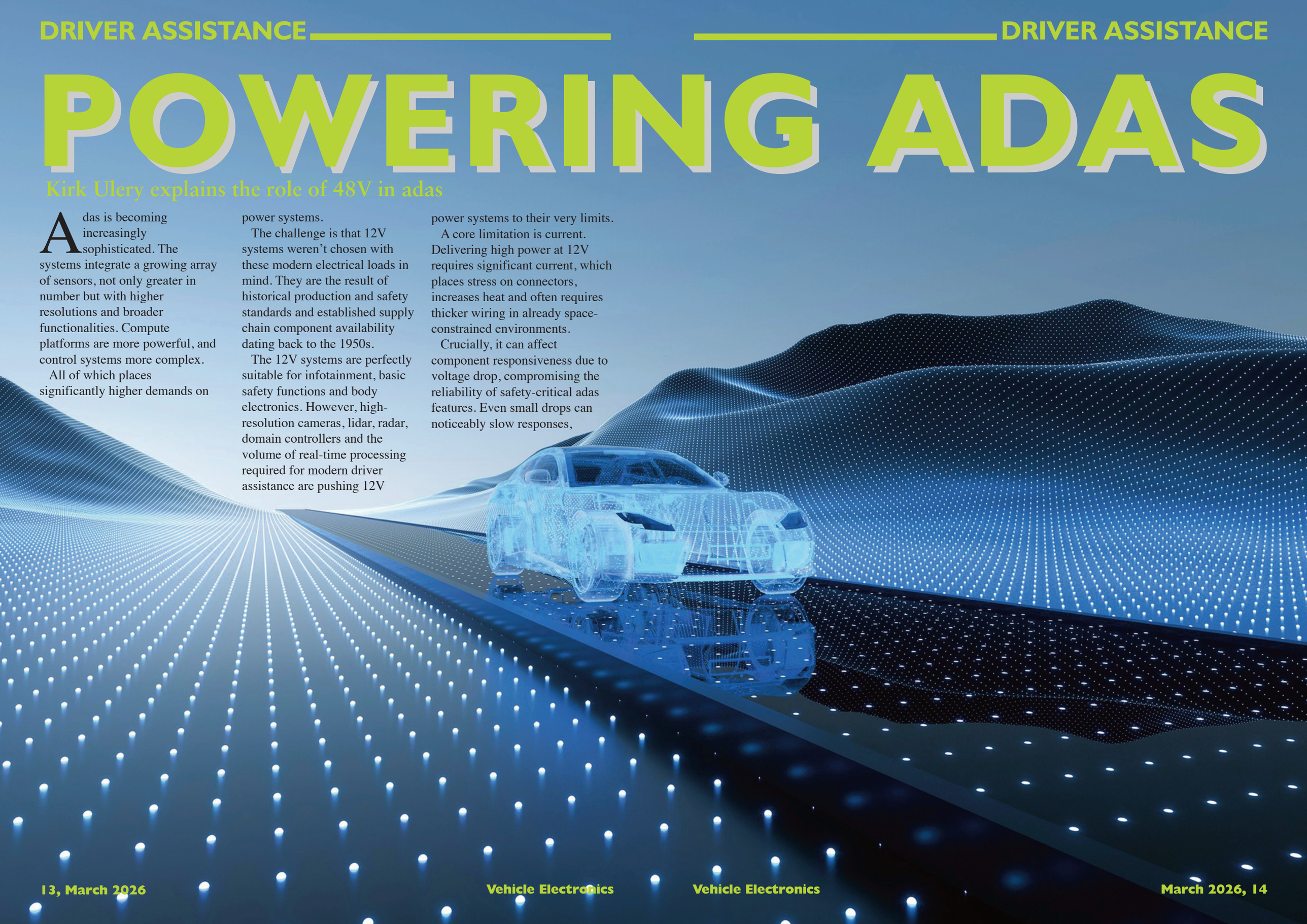
All of which places significantly higher demands on power systems.

The challenge is that 12V systems weren't chosen with these modern electrical loads in mind. They are the result of historical production and safety standards and established supply chain component availability dating back to the 1950s.

The 12V systems are perfectly suitable for infotainment, basic safety functions and body electronics. However, high-resolution cameras, lidar, radar, domain controllers and the volume of real-time processing required for modern driver assistance are pushing 12V power systems to their very limits.

A core limitation is current. Delivering high power at 12V requires significant current, which places stress on connectors, increases heat and often requires thicker wiring in already space-constrained environments.

Crucially, it can affect component responsiveness due to voltage drop, compromising the reliability of safety-critical adas features. Even small drops can noticeably slow responses,





Adas will benefit from added power capacity and stability offered by 48V

effectively undermining adas.

Transitioning to a 48V electrical architecture enhances adas performance and reliability.

The 48V systems require far less current to achieve the same levels of power delivery. Because lower current results in lower resistive losses, command power reaches motors, actuators and processors more quickly and reliably.

As a result, there are improvements in response times, ramp-up speeds and reaction speeds, all of which are vital for safety and control systems such as adaptive cruise control, emergency braking and lane-keeping or changing.

It is also important to consider that many adas events often occur under worst-case electrical conditions. Any emergency course correction, for example, using braking, steering and torque change, requires a huge number of sensor inputs, real-time processing and system controls to all operate at peak load simultaneously. A 48V system creates electrical headroom, useful for scalable sensor platforms and additional safety systems.

Understandably, dual 12 and 48V setups are rapidly becoming the universal standard for power delivery in next-generation vehicles, delivering higher performance, greater efficiency, and improved reliability.

The adas features that stand to benefit the most from the added power capacity and stability offered by 48V are primarily, those that combine high sensor density and data processing with real-time control.

Lane departure warning, for example, benefits from improved sensor precision and camera performance. Automatic emergency braking is faster and more accurate.

While 48V systems don't directly power the brakes themselves, the sensor networks and processing are all supported. Likewise, both adaptive cruise control and blind spot monitoring depend on consistent radar, lidar and camera performance. Even non-critical assistance systems, such as automated parking, stand to benefit as they depend on multiple components and real-time processing for precise manoeuvring.

Components

The 48V lithium-ion battery is central to new dual-voltage systems. It works alongside the traditional 12V system, storing energy from regenerative braking or coasting to power both propulsion and energy-intensive auxiliary systems. An electric motor or generator captures the kinetic energy, recharging the 48V battery, improving fuel efficiency and supporting acceleration.

A bi-directional DC-DC boost converter links the 12 and 48V domains. It manages energy flow between these two systems, stepping up voltage from 12 to 48V when more power is needed. Conversely, when excess energy is available, the converter will reverse direction, stepping 48V down to 12V. This real-time balancing ensures consistent power delivery and improves system performance.

And unifying all these systems are the connectors. High-performance connectors built to handle 48V systems are vital. Their durability, thermal and EMI insulation preserve power and signal integrity, while supporting safety standards.

Challenges

There are though technical challenges automakers must address when integrating 48V systems, particularly in terms of safety, thermal management and design complexity.

The 48V systems can help with thermal management by lowering current draw in particular circuits. However, the higher voltages increase the risk of electrical arcing, overheating and connector failure. To mitigate these risks, appropriate insulation, material selection and clearance distances must be used.

There are also environmental factors to consider. Just as 12V systems must withstand temperature extremes, vibration, moisture and contaminants without degradation, so too must 48V. Given that they support critical safety systems, performance reliability must be exceptionally high. Locking mechanisms and strain relief on connectors help prevent disconnections, while protective features such as seals and coatings deliver long-term performance.

Managing space availability for components can also be problematic. Compact, lightweight connectors are an essential measure, enabling more versatile system configurations. Similarly, it can become increasingly difficult to maintain signal integrity as component and cabling counts rise without the appropriate shielding, grounding and routing.

Future

Looking ahead, the adoption of 48V electrical architectures will influence the future development of adas and broader vehicle electrification.

The move to 48V is fundamentally reshaping power distribution and delivery within modern vehicles. It is effectively an innovation platform. With it, adas can continue to improve, incorporating ever more powerful and precise sensors combined with AI-driven capabilities to make vehicles safer.

The industry is also shifting towards zonal vehicle architectures, both for localised adas design and beyond. The shift to 48V will provide the high-capacity, low-current power backbone these designs need, with reliable power delivery, reduced wiring weight and losses. Zonal controllers can then step power down if and where necessary, be that 12V or otherwise, making 48V a fit for these modular designs.

And looking beyond adas, 48V will continue to underpin the increasing electrification of propulsion systems, creating a bridge between conventional internal combustion vehicles and full high-voltage electrification.



Kirk Ulery is distribution business development manager at Molex

SOFTWARE-DEFINED VEHICLES

WHAT IS THE WEAKEST LINK?

Bernd Niedermeier explains how cyber security should evolve for software-defined vehicles



As software-defined vehicles (SDVs) become the norm, cyber-security strategies must evolve beyond traditional perimeter defences. The automotive industry has made significant strides in protecting vehicles through secure networks, encrypted over-the-air (OTA) updates and strong authentication protocols.

However, embedded data stored locally in SDVs remain a key vulnerability that could undermine the security of next-generation vehicles.

Modern vehicles are closer to connected computers on wheels than traditional mechanical systems. Each SDV hosts gigabytes of sensitive data, from diagnostic logs and firmware images to vehicle identity, user credentials and sensor inputs. These data are frequently stored locally on flash memory within embedded systems.

As attack surfaces evolve, cyber attackers are increasingly turning their attention to these internal data systems.

Interestingly, while the industry is focusing on securing communication layers and perimeter access, data stored inside the vehicle often go unprotected or managed using legacy systems that cannot protect against today's complex and sophisticated security threats.

Cyber chain

While encryption and secure communications protect data being transferred between various nodes, data stored inside a vehicle are often inadequately secured. Insecure or poorly designed file systems can expose mission-critical assets even in vehicles that appear compliant with ISO/SAE 21434 or UN R155 on paper.

Examples of the cost of neglecting storage-level security include data corruption, service costs and multi-million-pound recalls caused by failed OTA updates or flash memory failures.

Embedded systems in SDVs are now expected to handle increasingly demanding tasks from real-time logging, AI workloads, continuous OTA updates and more. All this results in more data being written, more frequently, to the same flash storage. Without proper management, this shortens the lifespan of storage systems and increases the risk of corruption or complete failure.

Cyber attackers are also getting smarter. They know that if they gain access to a vehicle's embedded storage, whether physically or remotely, they can extract or tamper with critical files such as logs that track vehicle behaviour, certificates for secure communication or even update images that could be modified to deliver malicious payloads.

Design

Addressing modern SDV cyber-security risks requires protecting the data stored within the vehicle. Without data integrity, cyber-security systems cannot be trusted to detect tampering, log attacks or even confirm the state of the vehicle.

This is why security must be embedded directly into the file system layer. Unlike open-source file systems that often lack determinism and fail-safety, automotive-grade options must be resilient, certifiable and built from the ground up with data integrity and security in mind.

When a file system fails to mount correctly or cannot withstand power loss, it can leave the system in an unpredictable state, which can result in a security risk. Attackers can exploit these inconsistencies, introduce malware during incomplete write cycles, or manipulate stored logs and configurations that lack integrity validation.

Therefore, a fail-safe architecture is essential. It must be capable of reliably recovering after power interruptions without risking data corruption. Vehicles routinely experience abrupt power-down events, from ignition-off cycles to sudden battery disconnects, and storage systems must maintain operational consistency.

Equally important is transactional integrity. Every write must ensure that incomplete updates don't leave logs, credential stores or OTA payloads in a compromised state as this

SOFTWARE-DEFINED VEHICLES



Engineers assess battery placement within a simulated EV platform

could lead the system to become vulnerable to security threats.

Mount times are also important. In safety-critical systems, every millisecond counts. File systems for storage should remount quickly and reliably, enabling ECUs to resume normal operation and restart diagnostics immediately after a reboot.

Another core requirement is built-in encryption with secure key management. Security is about preventing unauthorised data modification as much as it is about controlling who can access the data. Encryption helps ensure that even if data are accessed, they cannot be read or altered without proper credentials.

Secure erase is another often-overlooked requirement. Due to block management inside the flash, critical data may remain on flash memory even after a standard delete. Ensuring that deleted data are truly unrecoverable is essential for safeguarding embedded systems.

File systems used in safety-related ECUs should provide deterministic timing behaviour, robust data integrity mechanisms and well-defined failure modes. They should be developed with appropriate safety processes and deliver the artefacts required to support ISO 26262 qualification and system-level safety cases.

Importantly, real-world testing has shown that it is possible to maintain 100% data integrity even after more than 15,000 power-off cycles in automotive-grade environments.

Ultimately, cyber security and data integrity go hand in hand. Without assured, traceable and tamper-resistant records, it is impossible to know whether a system has been attacked, let alone to respond or recover effectively. As SDVs evolve, the ability to trust the data stored inside the vehicle will be critical for the success of the entire security architecture.

Imperative

Global regulations are raising the bar for cyber security. For example, UN R155 effectively mandates continuous lifecycle cyber-security management and appropriate protection of software and vehicle data. These frameworks make clear that security should be front and centre when it comes to embedded systems and stored data.

OEMs are under growing pressure to demonstrate end-to-end security. However, many still rely on open-source or legacy file systems that were never built for the requirements of SDVs. Without changes at the software stack's foundation, compliance will be difficult to prove and even harder to sustain over time.

It is important to recognise that demonstrating compliance requires evidence of secure-by-design thinking, especially when it comes to protecting stored data. Data integrity should be a central focus, as compromised or inconsistent data can erode system trust. Storage options that don't offer strong integrity guarantees may expose OEMs to future technical or legal risks.

Flash

OEMs who adopt secure, flash-optimised storage can extend device lifetimes, reduce service calls and lower the risk of recalls. This also affects the bottom line as avoiding flash overprovisioning and using flash-optimised file systems could significantly reduce hardware costs.

Beyond the per-unit savings, the choice of embedded storage has broader financial implications. For large-scale programmes, optimising how data are stored and managed can translate into multi-million-pound savings.

Crucially, choosing the right embedded storage software partner also plays a key role in supporting evolving compliance needs. Regulatory requirements increasingly mandate not just security, but traceable, verifiable integrity of data over time.

Even when open-source systems are supported by commercial vendors, the task of modifying the code often falls to development teams that lack deep expertise in file systems and embedded storage. This makes it difficult to implement changes that are secure and efficient, especially in safety-critical environments. As a result, outdated or unsupported architectures struggle to meet the increasingly rigorous demands of cyber security and compliance.

The industry is also seeing growing awareness, particularly when it comes to safety-critical domains such as EVs and adas, about the importance of data resilience and system integrity.

The old days of good-enough storage are over. Storage needs to support the needs of the vehicles of today and tomorrow.

Future

As vehicles become more autonomous, interconnected and software-reliant, the risks to embedded data will continue to grow. Security must be addressed holistically, starting from the storage layer.

File systems are no longer just about performance or compatibility. They are the foundation upon which security, compliance and long-term vehicle reliability are based. Undoubtedly, the SDV transition has created opportunities for faster innovation and better vehicle experiences. But it also requires rethinking some of the basics. Embedded storage is one of the most critical.

In short, a critical question for today's SDV engineering teams is whether current approaches adequately protect the data stored within the vehicle. Because, if embedded data are not secure, the cyber-attack door is wide open.



Bernd Niedermeier is head of automotive market development at Tuxera

SOFTWARE TOOLS



FIGHTING THE MULTI-THREADED DRAGON

Colin Rullkotter explains how a requirements-based test suite for <threads.h> helps develop multi-threaded code

Multi-threading breaks strict sequential execution into a more parallel and dynamically scheduled order that is non-deterministic. It improves efficiency and responsiveness significantly in modern automotive software, especially for automotive applications that need to handle a variety of domains simultaneously.

These include sensor input such as from cameras or radar, control algorithms, communications, diagnostics and HMI.

However, multi-threaded code can easily become a multi-headed dragon if not approached methodically and prudently. Each head (parallel execution, mutual exclusion and waiting for data from another thread) must be carefully tamed to prevent data races and unpredictable behaviour.

For automotive developers working with a real-time operating system (rtos) under tight timing constraints, the stakes could not be higher. The <threads.h> library provides the shields and swords needed to keep these data dependencies in check, and its implementation must be carefully verified because both it and its specification are decidedly non-trivial.

Testing

Testing thread library functions in isolation presents several challenges. Many of these functions must be used in pairs; examples include lock-unlock, wait-signal and wait-broadcast. This makes their correct usage inherently dependent on sequencing and coordination.

Their interfaces are often simple, typically producing binary outcomes, but their success or failure are expressed through the synchronisation of data between threads, rather than by computing some direct value.

This means the functions' intended behaviour only becomes clear within a wider context, one that is further subject to the C standard's guarantees and restrictions regarding the avoidance of race conditions. Their use imposes constraints on the developer; constraints not enforced by the compiler but that, if violated, leave the programme in an unpredictable state.

As a result, intra-thread testing must be performed strictly within the boundaries of these constraints, since any violation of them produces undefined results.

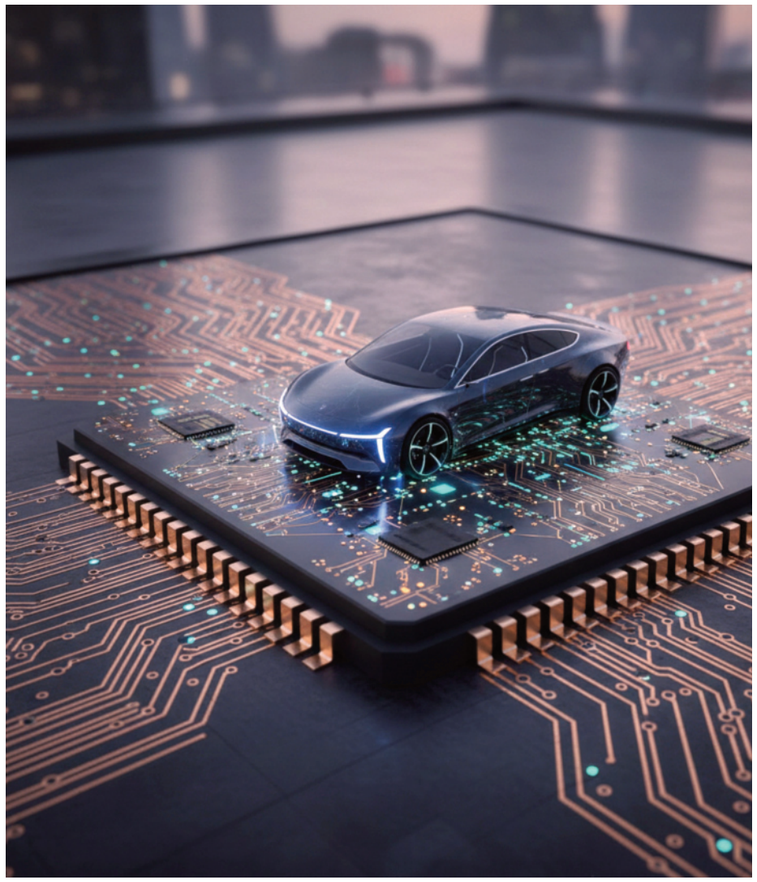
Weaving

Tests used to demonstrate compliance with functional safety standards, such as the automotive ISO 26262, have specific difficulties that must be overcome. First, the test suite must be requirements-based, necessitating traceability, unit testing, code coverage and robust diagnostics. It can be difficult to prove that isolated thread function tests meet these safety goals.

Secondly, automotive toolchains often use custom compilers, rtoses and non-standard thread APIs, which require tests that are robust and portable. And, thirdly, automotive ECUs have limited CPU, memory and power, which constrains stress testing.

Tests for thread functions must demonstrate real-world, multi-threaded scenarios.

Within this context, the test framework initialises mutexes and condition variables, creates multiple threads, and manages



SOFTWARE TOOLS

their execution, so tested threads can use shared variables and contribute to a common result. These variables verify that each thread executes exactly once, respects protected data and synchronises correctly.

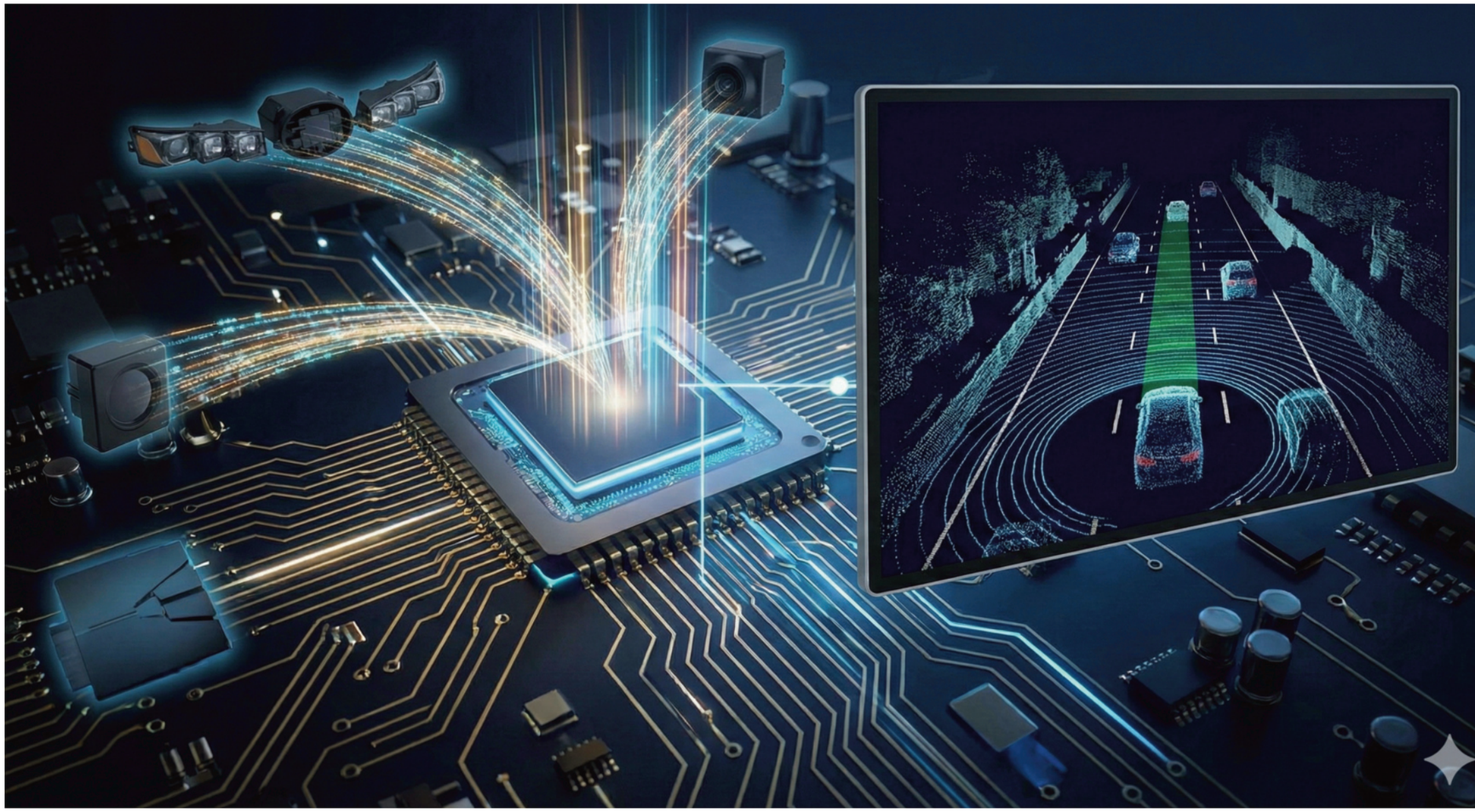
Three faces

To implement real-world complexity, the test framework uses different thread interaction scenarios, each representing a different face of the dragon: first, a strictly serialised model, where each thread accesses one item of mutex-protected shared data. Secondly, a data parallel model, where threads independently operate on separate resources without mutexes. And, thirdly, a concurrent model where threads share a limited number of resources protected by resource mutexes, creating realistic concurrency and interaction scenarios.

Scaling these models up and down – changing the number of threads N and shared resources R – helps evaluate performance and reliability under varying stress conditions. The dragon can behave unpredictably under pressure; thread functions that appear correct in simple cases may fail under heavy load or non-deterministic scheduling. Robust testing must therefore consider both functional correctness and resilience.

Toolkit

Unlike conventional tests, multi-threaded testing introduces non-determinism; the order of operations can change from run to run. Reliability and repeatability are central design goals tests in functional safety, and these require additional effort when multi-threading is involved.





Dragon slaying

Thread testing is unlike traditional C conformance testing. Its outcomes are influenced by timing, scheduling and system load, all of which can change dynamically.

Failures may only appear under extreme conditions, making non-deterministic behaviour an inherent risk. This is why reliability in scaling (the ability to reproduce results across load conditions) should be a major design principle of a thread testing approach.

By exploring different combinations of threads and resources, developers can expose implementation weaknesses before they appear in deployed software.

Does the code terminate cleanly under heavy load? Are mutexes and condition variables handled correctly across compilers and platforms? Does the implementation match the requirements of the C11 standard? The correct toolkit can help answer these questions systematically.

Conclusion

The multi-threaded dragon is powerful but unpredictable. Left unchecked, the implementation of the <threads.h> library can introduce race conditions, timing faults and subtle synchronisation errors that are notoriously hard to detect. But when properly trained and tested, it becomes an invaluable ally, enabling modern automotive systems to handle concurrent tasks with speed and precision.

Through <threads.h> support, the correct toolkit should combine rigorous, scalable testing with automotive safety and certification needs. It can ensure that every head of the multi-threaded dragon is kept firmly under control, so developers can confidently build the next generation of safe, intelligent vehicles.



Colin Rullkotter is a software engineer at Solid Sands

TEST & MEASUREMENT

REACHING THE PINNACLE



Gabriel Sikorjak discusses an alternative to conventional test pins for improving productivity

In testing high-end electronics during the production process, conventional test pins are reaching the end of the road: electronic designers require more in specifications, while manufacturers serving the automotive industry, among others, seek greater productivity.

Among the disruptive forces that are reshaping the automotive industry, electrification is entrenched and unrelenting. Market demands as well as safety and environmental legislation are calling for all cars – from entry-level to premium models – to become smarter, more assistive, more connected and sustainability conscious.

To deliver these values, car makers are adding more sensors, computing power and communication capabilities and electrifying more subsystems, from water pumps and power steering to the entire drivetrain.

It's a trend that presents opportunities for electronic component manufacturers and assembly builders in the automotive supply chain. Among the challenges, the industry's high-quality expectations and unit-volume demands call for test capabilities that are fast and extremely accurate, able to identify correctly good units and any that have defects. This needs to be accomplished with few errors or time-consuming rechecking to rectify false-negative results.

Improvements

Contact test methods for advanced equipment, using probes, could prevent suppliers from meeting their objectives, as test contact points are becoming smaller, more closely spaced and more difficult to reach with conventional sprung test probes, see Fig. 1.

Furthermore, connecting with the DUT (device under test) at a single point creates unreliability. All types of electronic devices are affected, from semiconductor wafers to ECU modules, as component geometries are being reduced and PCB assemblies are more densely populated. Also, intricately designed vibration-proof connectors used within the automotive industry present difficulties for probes to achieve contact when placed on the test fixture, see Fig. 2.

Problems with sprung test probes, or pogo pins, are already common. The pins often fail to make proper contact with the test point. Based on actual research, only 80% of occasions when tests are performed using standard pogo pins result in the DUT being correctly classified. Such errors result in high false-negative rates that require investigation and re-testing.

In addition, the typical lifetime of a pogo pin can be about 100,000 cycles. At automotive mass-production volumes, this

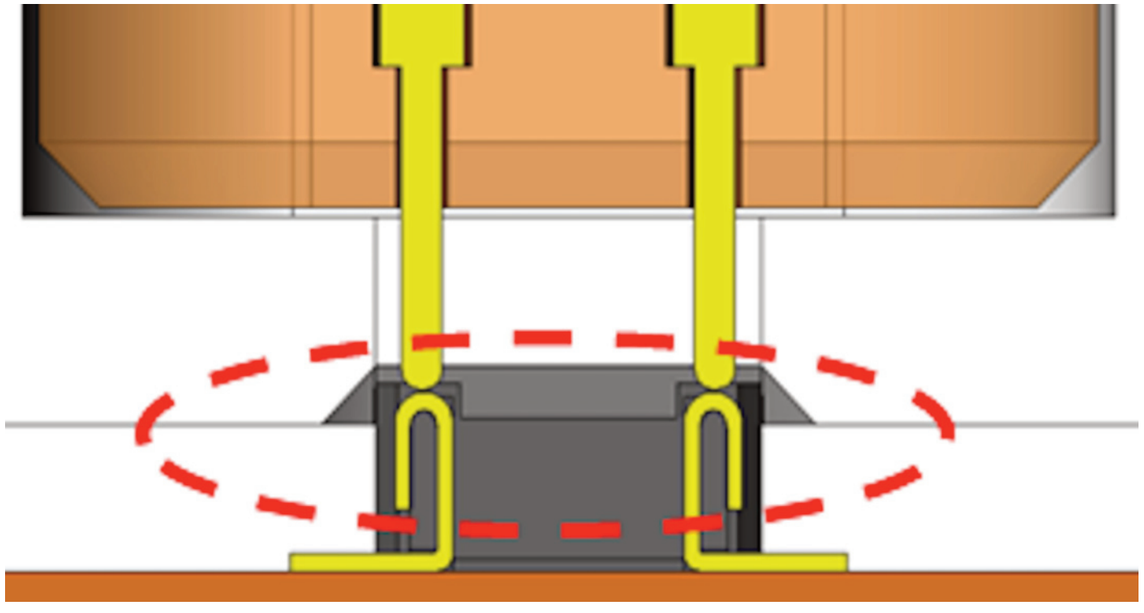


Fig. 1: Pogo pins allow only limited tolerance to ensure pins connect with contact points

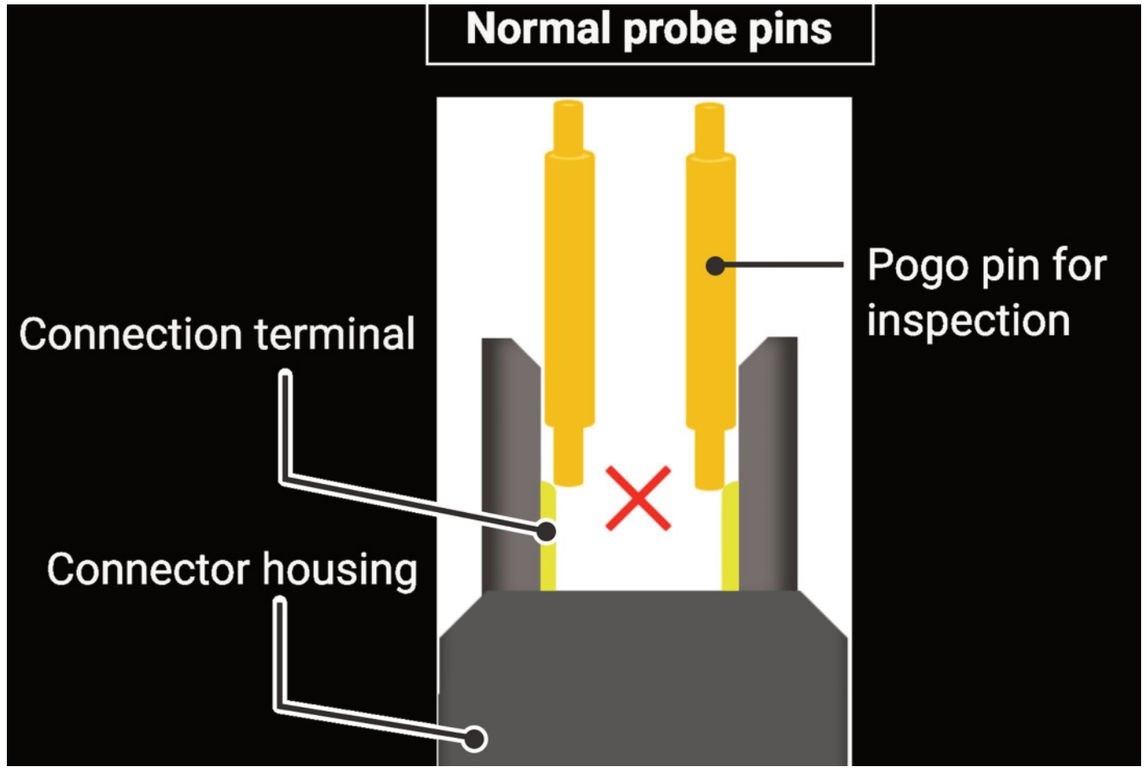


Fig. 2: Connectors designed with vibration resistance are challenging for inspection

can demand frequent stoppages for replacement. Inaccurate results and frequent stoppages both impair productivity and cause delivery delays.

Also, the contact resistance due to conventional pogo pin structure can be inconsistent and is not usually less than 70mΩ, which can prevent testing assemblies where contact resistance needs to be low.

A generally accepted practicable minimum diameter for conventional sprung pins is about 0.35mm. Reducing the size can prevent reliable contact with test points as the probes can become fragile leading to more frequent malfunctions and breakages. And yet, smaller test pins are required to meet future demands. An alternative is needed to ensure efficient, fast and accurate contact testing.

Limitations

Conventional pogo pins are carefully designed to possess compliance that allows tolerance for a small amount of positioning error, as well as spring force to press against the DUT test point and ensure a robust electrical connection with low ohmic resistance.

However, the mechanism adds complexity to the design and seizing or other malfunctions are possible as the DUT is placed on the test fixture. The pin can break or the spring may fail if positioning error or force is excessive. Further reducing the mechanism size, to permit closer positioning needed to test densely populated boards, results in the pin being more fragile and more easily broken.

Creating an alternative that overcomes these limitations while also supporting the drive towards smaller geometries is not easy or trivial. A suitable pin must provide adequate compliance to let it find its place against the test point as well as ensuring adequate and consistent contact force.

At the same time, durability needs to be improved to reduce stoppages to replace broken pins and prevent false-negative results from poor electrical contact and inconsistent contact resistance.

A new type of test pin made with a specially developed

TEST & MEASUREMENT



Fig. 3: Pin shape and material can be optimised to ensure high endurance for testing high-frequency signals or to handle high-current testing

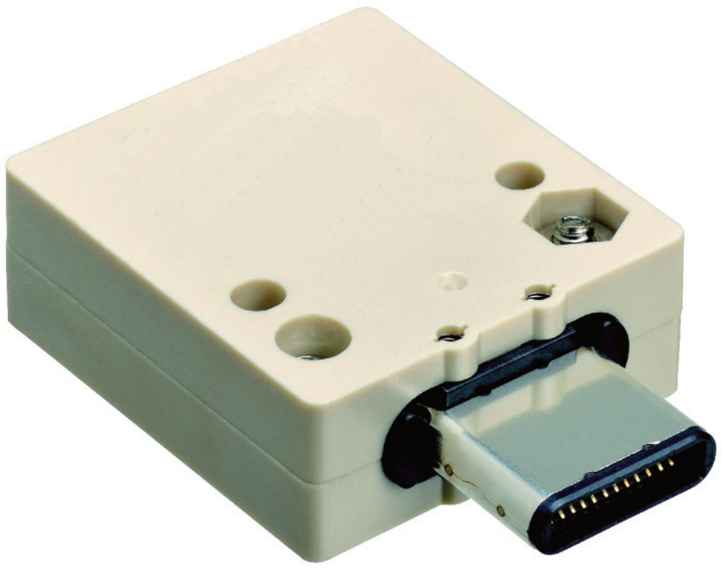


Fig. 4: Socket's floating head mechanism prevents mis-insertion

electroformed components (EFC) metal alloy and fabrication process now presents a solution to these problems. The custom material provides mechanical properties comparable with 304-grade stainless steel and meantime electrical properties achieving great conductivity at copper level.

The combination of alloy properties and dedicated pin design (Fig. 3) allow one-piece pins that eliminate the size restrictions and potential for seizing associated with the conventional spring mechanism.

Parameters

The pins let test engineers create high-reliability test fixtures with a pitch down to 0.175mm. Because the pins have been shown to make proper contact with the test point on over 99.8% of test operations, the risk of false-negative results from poor pin contact is greatly reduced.

Also, with a lifetime easily reaching 500,000 cycles depending on application and design, their longevity improves efficiency and reduces stoppage time. The one-piece design ensures consistent electrical parameters and extremely low contact resistance, typically about 30mΩ, which is suitable for testing products such as OLED panels.

Moreover, flexibility to optimise all aspects of the pin size, shape and tip design mean the pin properties can be adapted for a wide variety of applications.

EFC pins are suitable to pin blocks and complete custom sockets for board-level testing and are also used in optimised fixtures for IC and other component testing, or even device test. They have been designed for testing high-end modules with high transmission speeds, as well as high-power electronics at levels much above 2A per pin for unique bundle structure, meantime reaching highest testing durability.

There are also off-the-shelf products. The test socket for USB type-C connections combines EFC pins with resin pin tips and a floating head mechanism that allows one degree of tolerance in x-y positioning, see Fig. 4. The floating head ensures fast and faultless insertion to avoid stoppages when used in test equipment while the internal pin structure extends the endurance of testing sockets compared with existing means.

Conclusion

Pogo pins have a long and distinguished record in the history of electronics testing and can continue delivering great performance in many applications. At the cutting edge, however, the geometries of the latest components and assemblies are becoming too small for conventional pins.

Creating something suitable has demanded innovation both in materials science and electroforming production processes.

One-piece EFC pins allow test-point spacing as small as 0.175mm, with lower contact resistance than pogo pins, and enhance positional accuracy, resilience and reliability. Using custom shapes and tip profiles, these pins can reach difficult areas such as inside complex connectors, and can meet applications such as high-frequency or high-current testing.

Product manufacturers can experience fewer false-negative calls and fixture repairs, raising efficiency, productivity and delivery performance.



Gabriel Sikorjak is marketing manager at Omron Electronic Components

MANUFACTURING

GAINING INSIGHTS



Bodo Philipp says migrating to enterprise resource planning (ERP) software can bring essential automotive insights

Vehicle Electronics

MANUFACTURING

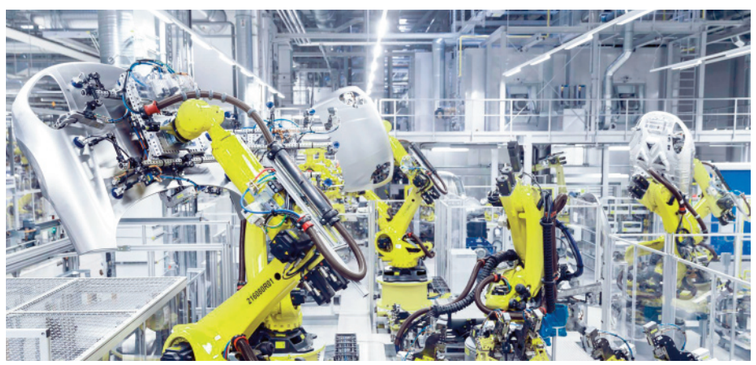
Automotive manufacturers have long been lauded for highly efficient manufacturing and logistics processes. But in a fast-changing market, agility is now a priority. New market entrants, a changing sales model and fundamental technology changes combine to create a new customer driven paradigm that demands faster, dynamic reaction.

Successful adoption of ERP systems such as Sap S/4 Hana and digital transformation will not only enable automotive companies to respond to today's challenges by improving efficiency and productivity but also provide the data required to understand how to build a successful future.

While the priority for many organisations' Sap S/4 Hana migration strategy has been adding efficiency to manufacturing and logistics processes, the adoption of modern cloud-based ERP also provides the opportunity to drive additional value from customer data.

Automotive is not alone is facing pressure on market share, changing customer perception, even core values, alongside agile and innovative new market entrants. Industries globally face changing customer demands and, in response, tailored customer experience is scaling new heights, from AI led engagement to real-time customised offers and the creation of new routes to market.

For successful brands, this level of personalisation and customer recognition must become part of the automotive buying and, critically, owning process. Customers expect car brands to reflect their needs, whether that is AI driven air conditioning that automatically adjusts to each driver's preferences, or seamless integration with social media accounts to enhance the entire journey experience.



Productivity improvements underpin business case

Informing change

One of the most pressing issues to address is how to counter the rise in intended vehicle brand defection, up to 56% in the UK in 2025. In addition to understanding and responding to customers' continually evolving attitudes towards ICE versus electric vehicles versus hybrid, the industry must also address changing perceptions of vehicle ownership.

While attitudes vary globally, there is a marked shift towards mobility-as-a-service (MaaS) over vehicle ownership among younger consumers.



Adding efficiency to manufacturing and logistics

The migration from legacy ERP to cloud-based Sap S4 Hana provides the foundation for automotive companies to respond to changing customer behaviour. With a single source of all operational data, automotive manufacturers can leverage powerful analytics to understand customer expectations and experiences.

This insight can inform the transformation of customer engagement throughout the changing sales model. It can flag opportunities to use AI safely, both within vehicles and throughout the ownership experience.

Critically, it can surface information to support complex decisions about future business models and brand direction, such as carving a niche in the luxury car market or being at the forefront of the self-driving market.

Conclusion

In an industry that is enduring change from every direction, future success will require a different approach at every level, from the way brands interact with and engage customers throughout a vehicle's lifespan to the pace of innovation and the evolution of vehicle sales and finance models.

The migration to Sap S/4 Hana is now pressing, given the deadline, but with the right approach, the shift to cloud-based ERP presents an essential opportunity to redefine the automotive industry.

It will enable automotive manufacturers to gain enormous value from highly accurate predictions and forecasts; it will transform agility and offer the chance to drive rather than just respond to customer perceptions. It will introduce opportunities to leverage AI both to support faster product iteration and improve customer engagement.

Improvements in efficiency and productivity will underpin the business case for migration, but it is the information held within an integrated, end-to-end ERP system that will play a vital role in creating the foundation for future automotive success.



Bodo Philipp is CEO at MHP Consulting

Touchscreen controllers for large and small displays

Touchscreen controllers from Microchip now cover free-form widescreen format automotive displays up to 107cm and down to compact screens in the 5 to 13cm range.

Part of the MaxTouch M1 family, the ATMXT 3072M1-HC and 288M1 are designed to work with a wide variety of display sizes, while supporting emerging technologies such as OLEDs and microLEDs.

The controllers use the proprietary Smart Mutual touch acquisition scheme and algorithms to boost the touch signal-to-noise ratio by up to 15dB compared with previous generations.

Smart Mutual technology is engineered to deliver reliable touch detection even on integrated touch sensors exposed to high capacitive loads and significant display noise coupling. This capability is particularly critical for large, thin displays such as on-cell OLEDs, where embedded touch electrodes are subjected to higher capacitive loads and increased noise coupling, raising the risk of false or missed touch detections.



The 3072M1-HC is for large, continuous touch sensor designs that cover both the cluster and centre information display, addressing the needs of left-hand and right-hand drive vehicles with a single hardware design. This can help eliminate the need for dedicated hardware designs by the OEM and simplify global automotive market support.

The continuous touch sensor design maintains uniform optical properties regardless of the ambient lighting environment.

The host-client 3072-M1-HC appears as a single MaxTouch device to the host MCU, streamlining system design by removing the need for an external MCU to merge touch coordinates; client interaction is managed by the host device.

For small screens, the 288M1 meets the increasing demand for compact automotive displays, such as traditional analogue clocks and AI driver assistants, where physical space constraints are critical.

A TFBGA60 package delivers a 20% reduction in PCB area compared with the previous smallest automotive-qualified MaxTouch product.

Both controllers are supported by the MaxTouch ecosystem including the MaxTouch Studio IDE for development and Analyzer for production line testing.

Host software driver support is available for rtos platforms including Linux, Android, Windows, Alios, Automotive QNX and Zephyr.

Controller combines touch and force sensing

Expanding its Axiom portfolio, TouchNetix has introduced the AX24A touch and force sensing controller for automotive and other applications.

It supports button features, as well as force sensing behind conductive surfaces.

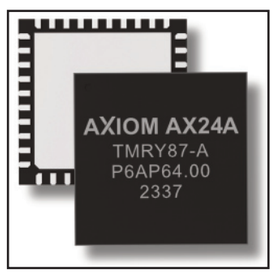
Available in a 40-pin QFN package, it enables up to 22 touch and force buttons, and haptic and LED feedback via macro-driven I²C or GPIO sequences. It can be used for touch buttons requiring force activation and force-only buttons behind metal panels.

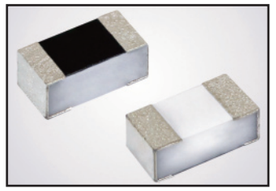
Control logic allows individual buttons to be configured or they can be linked logically for functions such as channels or one-hot groups.

Force sensing lowers the chance of accidental activation, removes the need for mechanical buttons and reduces wear.

Force-only buttons can be implemented behind conductive materials such as metal and are unaffected by water or fluids.

The device can detect micron-level changes in applied force from 20g to 20kg with a linear response profile.





Thick-film resistors

AEC-Q200 qualified thick-film chip resistors from Vishay come in the 0201 case size measuring 0.6 by 0.3 by 0.23mm.

The CRCW0201-AT e3 devices suit automotive, industrial and telecoms applications.

Compared with devices in the larger 0402 size, the resistors can reduce PCB requirements by half. This supports downsizing while maintaining stable electrical performance and reliability.

Power rating is 0.05W at +70°C and operating voltage is 30V. Operating temperature range is -55 to +155°C and they are available with resistance values from 10Ω to 1MΩ (0Ω jumper), with tolerances of ±1% and ±5% and TCR of ±200ppm/K.

RoHS-compliant and halogen-free, the resistors have a coating for electrical, mechanical and climatic protection.

Suitable for automatic soldering using reflow or vapour phase, the devices' pure matte tin plating is compatible with lead (Pb)-free and lead-containing soldering.

Shunt reference ICs maintain output accuracy

Automotive shunt reference ICs from Ablic achieve an output voltage accuracy of ±0.1% and output voltage temperature coefficient of ±20ppm/°C.

The S-19760/1 series can be used as a reference voltage for A-D converters. They enable the output of a highly precise reference voltage even in severe temperature environments, contributing to improved sensor readout accuracy.

Furthermore, with its integrated filter circuit, the product has an output noise of 28μV RMS. This reduces measurement errors in ADCs during the conversion of sensor signals into digital values.

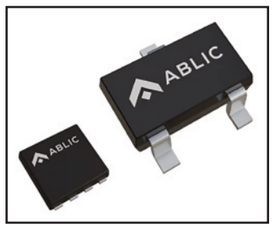
Maximum shunt current is 30mA, allowing one shunt reference IC to be used as the reference voltage for multiple circuits, reducing the number of components, saving space and contributing to cost reduction.

In addition to the standard sot23-3 2.8 by 2.9 by t1.3mm package, the line also includes the HSNT-8(1616)B 1.6 by 1.6 by t0.41mm package, enabling space-saving mounting.

Vehicles are equipped with various sensors that precisely monitor the constantly changing vehicle conditions. For example, in EV and HEV inverters, sensors monitor current, voltage and motor angle to enable precise motor control. When these sensor signals are processed by an A-D converter, a precise reference voltage is essential to ensure precise digital conversion.

By using this series, users can ensure precision inverter monitoring and control even in harsh environments.

AEC-Q100 qualification is in process with PPAP compliance forthcoming.



Fast-charging DC connector

With the KW21A series, Rutronik is expanding its JAE automotive portfolio, complementing the MX81 series with a component for the charging infrastructure market.

The CCS2-compatible charging connectors meet demand for fast-charging in EVs. They support rated charging currents of 40 or 100A at voltages up to 1kV DC and enable bidirectional vehicle-to-grid charging.

A robust plastic housing with double insulation ensures weather resistance and safety.

The connectors meet the requirements of CE certification according to applicable safety standards. They offer a service life of up to 10,000 mating cycles, operate in temperatures from -35 to +50°C, and have a dielectric strength of 3kV AC per minute.



For precise temperature monitoring, the connectors have an integrated Pt1000 temperature sensor according to Din EN 60751, ensuring reliable performance even under demanding conditions.

Analysis tool update adds Can-XL support



With the PCan-Explorer 7, Peak is delivering an update that adds support for Can-XL, multiple symbol files per connection, Python scripting and flexible licensing including floating licences.

Existing users will see familiar usability to analyse, monitor and simulate Can, Can-FD and Can-XL networks.

Adding full Can-XL support brings bit rates up to 20Mbit/s and payload of 2048byte.

Users can assign multiple description data bases per connection such as symbol files or Candb files, which makes it easier to work with several data bases in parallel avoiding manual merging effort.

The addition of Python scripting brings a modern automation environment to the platform.

The licensing system based on CodeMeter means users can choose between single user or floating licences. In addition, USB licence dongles are available to make single user licences portable.

For those who want to test the software, trial licences are available.

These options make the Explorer software more flexible for individuals and teams.

Fine-grade trace playback lets users step through trace files message by message, pause automatically on defined breakpoints, and create controlled test and replay scenarios.

Support for J1939 FD enables engineers who work with heavy-duty and off-highway applications to analyse and simulate protocol variants.

Highlighting data changes in the receive list makes it easier to spot dynamic values, detect anomalies and follow changing signals in real time.

The core functionality of this Windows software tool is built around simultaneous access to multiple Can channels, which allows users to observe, analyse and log communication in complex network environments.

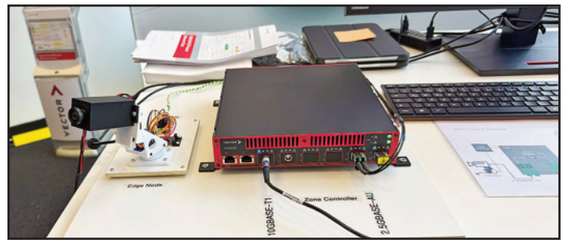
A central element is the symbolic representation of messages, which transforms raw Can data into readable and meaningful signal information using symbol files.

In everyday use, it enables manual and periodic transmission of messages, making it suitable for testing, network trouble shooting and system development.

Interface includes optical testing compliance

Vector has expanded the capabilities of its VN5650 Ethernet interface to include multi-gigabit optical Ethernet testing in compliance with IEEE 802.3cz-2023.

By integrating KD's KD7251 optical transceivers, the interface can establish, monitor and analyse in-vehicle optical Ethernet links within existing Vector workflows.



This is a step towards mainstream adoption of optical Ethernet in automotive validation, leveraging tools and software already used by OEMs and tier-one suppliers.

With KD7251 devices installed, the interface maintains its characteristic robustness and modularity supporting up to 12 Automotive Ethernet ports via VNmodule60 slots, while adding nGbaseAU optical connectivity for link speeds up to 10Gbit/s, with 2.5, 5 and 10Gbit/s supported.

Features such as synchronous monitoring and fault-load generation extend to optical links.

It integrates with Canoe option Ethernet, letting engineers script, simulate and verify Ethernet behaviour at scale while assessing conformance to 802.3cz.

High-side driver protects against severe transients

With 4V minimum operating voltage, ST Microelectronics' VNQ-9050LAJ four-channel automotive high-side driver powers through disturbances including extreme cold cranking operation down to 2.7V, boosting vehicle reliability and improving user experiences.

This resilience when exposed to severe transients meets the latest version of LV124, the automotive industry's quality standard for electrical and electronic components.

Designed to power 12V ground-connected loads, the driver is compatible with 3 and 5V logic signals. Built with the firm's VIPower-M09 technology, the driver has typical on-resistance as low as 50Ω to help boost efficiency and save energy.

As an intelligent power switch, it brings innovations to protect resistive, capacitive and inductive loads. These include high-precision load-current sensing by implementing an on-chip current-mirror circuit with a sense-fet that closely tracks the main power-fet parameters.

The current mirror is connected to an external pin that permits connecting a resistor to convert the sensed current into a voltage for continuous load monitoring and detection of abnormal conditions.

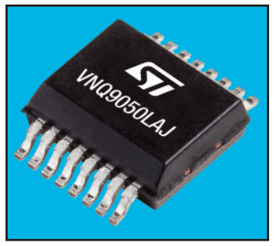
The current mirror's accuracy permits rich current-sense diagnostic functions, including analogue feedback of load current, overload and short-to-ground or power-limitation alerts, thermal-shutdown indication, output short-to-V_{CC} detection, and off-state open-load detection.

A sense-enable pin lets similar devices share the external sense resistor to reduce costs.

The device has an overvoltage clamp, thermal-transient limiting and a configurable latch-off on overtemperature or power limitation with dedicated fault reset pin.

There is also electrostatic discharge protection, loss of ground and loss of V_{CC} protection, and reverse-battery protection.

The device is in production and available in a thermally enhanced power-SSO16 package.

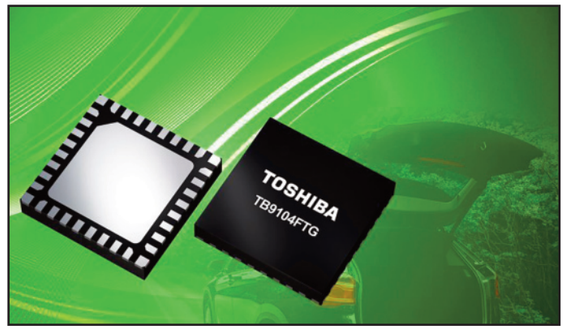


Gate driver IC controls brushed DC motors

A gate driver IC from Toshiba can control high-current brushed DC motors for applications such as powered tailgates, sliding doors and seat adjusters.

In addition to the optionally available standard PWM input pins, the TB9104FTG has an intelligent SPI for controlling the motor operation itself.

Several motors can be controlled using just the SPI bus. Thus the IC streamlines system architecture, reducing wiring harness and the MCU processing load with its built-in PWM clock-generation circuits.



By using the SPI, the host MCU can have fewer pins and initiate motor drive with one SPI rotation command, reducing MCU processing load and preventing communication bus congestion.

These capabilities are housed in a VQFN32 package typically measuring 5.0 by 5.0mm.

An exposed thermal pad ensures effective heat dissipation when paired with external H-bridge mosfets.

A dual half-bridge mode is also supported for operating two DC motors simultaneously.

To address safety in high-current applications, the driver integrates a precision current-sense amplifier that provides feedback to the MCU, enabling precise drive-stop control during abnormal current events.

The device also includes detection functions for low voltage, charge-pump overvoltage, overheating, external mosfet monitoring and SPI errors.

Scheduled for AEC-Q100 grade one qualification, it operates from -40 to +125°C.

Shipment of engineering samples has started.

Development platform speeds safety and security

The latest release of HighTec's Rust and C/C++ Arm development platform broadens its device support, integrates LLVM 19 to boost performance, supports memory-safe Rust for hybrid development with legacy C/C++, and comes with qualification kits to speed safety and security certification.

The toolchain for Rust and C/C++ Arm development is qualified according to ISO 26262 Asil D and the ISO 21434 cybersecurity standard.

Version 10.0.0 can help embedded software developers meet the needs of automotive applications while accelerating innovation cycles and time to market.

Open-source LLVM 19 lets software designers generate faster and more efficient code. With the v10.0.0 comes a unified toolchain for hybrid development with Rust and C/C++ on Arm devices.

Developers can build on their legacy C/C++ code base and integrate modern Rust code. Even existing automotive software such as MCal and Autosar can be reused without modification, and Rust software components can be deployed on application level.

Safety qualification kits provided with the tool suite facilitate the development and certification of safety-critical applications, which helps automotive software developers speed up their certification process.

With the latest version, the list of supported devices has been extended.

Embedded software engineers can use the platform for the latest architectures, including 32bit Arm Cortex-A, Cortex-R and Cortex-M. This support ensures compatibility and flexibility for developers working on single and multicore automotive applications.





Redriver optimises signal integrity

A 1.8V, 2.5Gbit/s redriver from Diodes has four differential data lanes and one clock lane and is designed for the Mipi D-Phy 1.2 protocol.

The automotive-compliant PI2MEQX2505Q regenerates D-Phy signalling in channels that involve PCB traces, connectors and cables, providing optimal electrical performance from a CSI-2/DSI source to sink by compensating for frequency loss.

It supports data rates up to 2.5Gbit/s across its configuration, letting it support the higher pixel count requirements of automotive camera monitoring systems and adas.

The redriver provides programmable receiver equalisation, adjustable output voltage swing and selectable transceiver pre-emphasis levels. This lets engineers extend PCB trace lengths while reducing signal latency, cost and power consumption.

For instance, the receiver equalisation can be set to three standard levels – 3, 6 or 9dB at 1250MHz – and to select the pre-emphasis levels at 0, 1 or 3dB, while the output voltage swing can be adjusted up to 275mV. These settings can be configured through the local I^2C interface or by using pin-strap control.

The device operates from a supply voltage of 1.8V. It reduces power consumption by supporting low-power states. Activity-detection circuitry integrated into the D-Phy link interface facilitates its transition into a lower power mode.

Power consumption metrics include up to 200mW in active mode, 6mW in low-power mode and 0.2mW in standby.

The device is supplied in the W-QFN3555-28/SWP 3.5 by 5.5mm package.

LDO regulators achieve stable operation

LDO regulators from Rohm have 500mA output current to achieve stable operation even with small capacitors to expand design flexibility for high-current applications.

The BD9xxN5 regulator ICs use Nano Cap proprietary stable control technology.

There are 18 products in the series designed for 12 and 24V primary power supply applications in automotive, industrial and communication equipment.

They build on the success of the 150mA BD9xxN1 launched in 2022 by increasing the output current to 500mA, broadening their suitability for applications requiring higher power.

In addition, low output voltage ripple of approximately 250mV with load current variation of 1 to 500mA within 1μs is achieved with an output capacitance of 470nF typical. Beyond standard small MLCCs in the range of several μF and large-capacity electrolytic capacitors, it also supports small MLCCs, such as the 0603M size (0.6 by 0.3mm), with capacities below 1μF, where stability was previously difficult to achieve.

High-precision Spice models are provided.

Automotive applications include powertrain power supplies for fuel injection and tyre pressure monitoring systems, power supplies for body control modules, and infotainment power supplies for clusters and head-up displays.

Nano Cap refers to a stable control technology achieved by combining analogue expertise covering circuit design, processes and layout using a vertically integrated production system.

Stable control eliminates the problem of unstable operation related to capacitors in analogue circuits, contributing to a reduction in design resources for applications in automotive, industrial, consumer and other fields.



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