VEHICLE electronics

The monthly magazine for automotive electronics engineers

Continental brings Google generative AI to cockpits

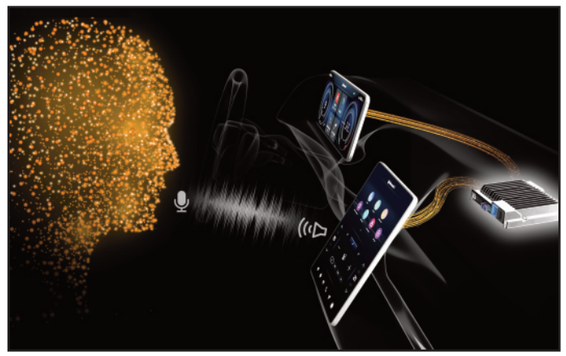
Google Cloud and Continental are working together to equip cars with generative AI.

The partnership will combine Continental's expertise in automotive technology with Google's data and AI technologies to create user-focused automotive products. Furthermore, the two parties expect to expand their partnership into other fields to build more in-car connectivity and consumer experiences.

Continental is integrating Google Cloud's conversational AI technologies directly into its smart-cockpit high-performance computer (HPC) running on Android Automotive OS to help redefine automotive voice assistants.

The companies expect this to be ready for production after 18 months of development time.

Announced during September's IAA Mobility conference in Munich, this should open up ways for passengers to communicate with their cars using natural language, facilitated by generative AI.



Continental and Google enable intuition

The smart cockpit HPC enables an adapted system performance for a pre-integrated function set and offers fast response times and an intuitive user interface.

Pre-integrated functions for cluster, infotainment and visual driver assistance can further reduce costs and help automakers bring new vehicles and experiences to the market more quickly.

"By working with Google Cloud, we can accelerate our innovation for the software-defined vehicle," said Philipp von Hirschheydt, Continental board member.

The partnership should help automotive OEMs lower costs by reducing complexity and development times and bringing products to market faster.

"Our partnership with Continental has great potential and we're very much looking forward to the collaboration," said Behshad Behzadi, vice president of engineering at Google Cloud.

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Synopsys puts automotive IP on TSMC N5A

Synopsys has announced what it claims is the industry's broadest portfolio of automotive-grade interface and foundation IP for TSMC's N5A process.

Together, Synopsys and TSMC are helping power software-defined vehicles by enabling long-term reliability and high-performance compute requirements of automotive systems-on-chip (SoCs).

"TSMC has worked closely with our design ecosystem partners to provide the automotive semiconductor industry with IP, EDA and manufacturing technologies," said Dan Kochpatcharin from TSMC. "Synopsys' portfolio of automotive-grade IP for TSMC's N5A process enables automotive chip innovators to accelerate the design of their safety-critical SoCs while taking advantage of N5A's significant performance, power efficiency and logic density boost."

Synopsys IP on the TSMC N5A process is designed and tested to the AEC-Q100 reliability and automotive grade-two temperature standards for ambient -40 to +105°C, helping ensure reliability of adas, highly automated driving and zonal SoCs.

"New generations of automotive SoC designs will need to support massive amounts of safety-critical data processed at extreme speeds and with high reliability," said John Koeter, senior vice president at Synopsys. "Synopsys' high-quality, automotive-grade interface and foundation IP on TSMC's N5A process enables automotive OEMs, tier-ones and semiconductor companies to minimise IP integration risk and help meet the required functional safety, performance and reliability levels for their SoCs."

Multi-city shuttle test



Aurrigo's auto-shuttle is being tested working on public transport routes in Prague (pictured), Brno and Milton Keynes as part of the EU-funded Living Lab for Autonomous Public Transport (Living LAPT) project.

A goal is to replace on-board safety drivers with remote supervisors who monitor a number of vehicles. This would move autonomous public transport to the next level.

The project aims to build trust in autonomous driving, through a robust transnational safety framework as well as promoting user acceptance and trust in close collaboration with citizens, cities, operators, academia, industry and policy makers.

By working with multiple cities in more than one country, the participants are gaining experience from different types of street layouts, road conditions and public attitudes to autonomy. This phase will also examine integration with trip planning applications used in those cities.

"The mediaeval, cobbled streets of Prague built before cars or buses were dreamt of are in stark contrast to the modern roads of Milton Keynes, which shows the importance of testing in multiple cities," said Aurrigo CEO David Keene.

The technology s brings together lidar and cameras with Aurrigo's in-house developed software to give a constant, 3D, all-weather picture of its surroundings.

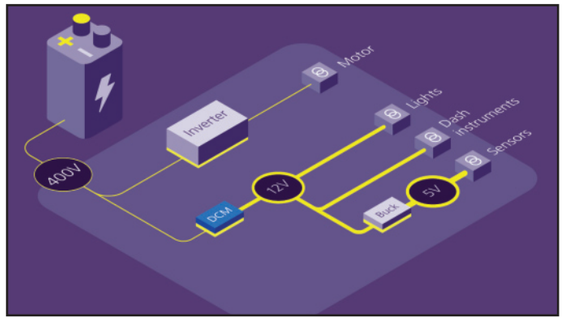
Lighting Motorcycles adopts Vicor DC-DC converters for 12V

Lightning Motorcycles has adopted the Vicor DCM4623 DC-DC converter in all its products, to power the 12V control electronics, lighting system, dash instrumentation and sensors.

As Lightning's motorbikes have become more sophisticated, the electronics on board demanded more power, but not weight.

The Vicor modules were chosen because of their reliability, low noise, power density and thermal management. Lightning's top bikes now range more than 270km and can recharge to 80 per cent in ten minutes.

Lightning holds the land speed record for electric motorcycles, exceeding 350kmph. The California company was founded in 2007.



Vicor DC-DC converter powers Lightning

"After the first ride I was convinced that electric motorcycles should be a business," said Richard Hatfield, founder and CEO of Lightning Motorcycles. "The bike gives you a feeling of limitless torque, with no vibration, no noise and no heat; there is almost a magical feeling to it."

Having cut his teeth on EVs in the late 1990s on the development of an electric Porsche, Hatfield, a lifelong motorcyclist, set his sights on creating a bike that leveraged the same technology.

After developing early prototypes with his original EV motorcycle design, Hatfield equipped his next bike with a Tesla motor and Lightning was born.

"We took it to the Bonneville Salt Flats and broke a speed record that had stood for 35 years," Hatfield said.

Managing electrical noise in a compact and lightweight vehicle is always difficult.

Lightning adopted the Vicor DC-DC converter in all of its products to power the 12V control electronics, lighting system, dash instrumentation and sensors.

Hyundai and Autotalks collaborate on V2X

Hyundai Mobis and Autotalks are working together to implement V2X for connected cars.

They are set to unveil their latest joint effort in the form of multi-functional telematics control unit (MTCU) connectivity modules.

Hyundai's first module supported day-one V2X services in all geographies. Powered by an Autotalks V2X chipset, it alerts drivers in dangerous, non-line-of-sight situations, for example to avert a possible collision with a vehicle or bicycle at an intersection.

Additional applications include alerts about road hazards.

Hyundai selected Autotalks' third-generation chipset to power its next connectivity module expected to be available in 2024 and that will let car manufacturers offer safety applications based on V2X communication.

This enables use-cases from basic day-one to advanced day-two V2X applications. This is achieved through its support for global V2X standards, dual-channel operation, and the integration of functional safety-grade implementation, enabling car actuation based on V2X data.

TÜV rates Macronix non-volatile memory at Asil D

Macronix's Octaflash non-volatile memory has received ISO 26262 Asil-D certification from SGS TÜV Saar.

"This certification reflects how Macronix is building on our success both in Octaflash's evolution as powerful flash storage for the automotive market and in playing a key role in maximising the functional safety of vehicles," said Macronix VP FL Ni. "Now, our customers have an even greater level of confidence to meet the industry's highest safety standards when selecting Octaflash for the automotive electronic systems they manufacture."

The memory offers a high data-transfer-rate-operation frequency up to 200MHz and throughput of 400Mbyte/s, meeting the instant-on demand performance for real-time system responsiveness in automotive applications.

Green Hills supports NXP application processors

Green Hills Software is supporting NXP's i.MX 9 applications processors by creating an integrated platform based on its safe and secure foundational software.

This includes safety-certified rtos, virtualisation services and safety-qualified C/C++ development tools.

The platform helps developers create and deploy safe and secure software across applications in automotive, industrial and IoT.

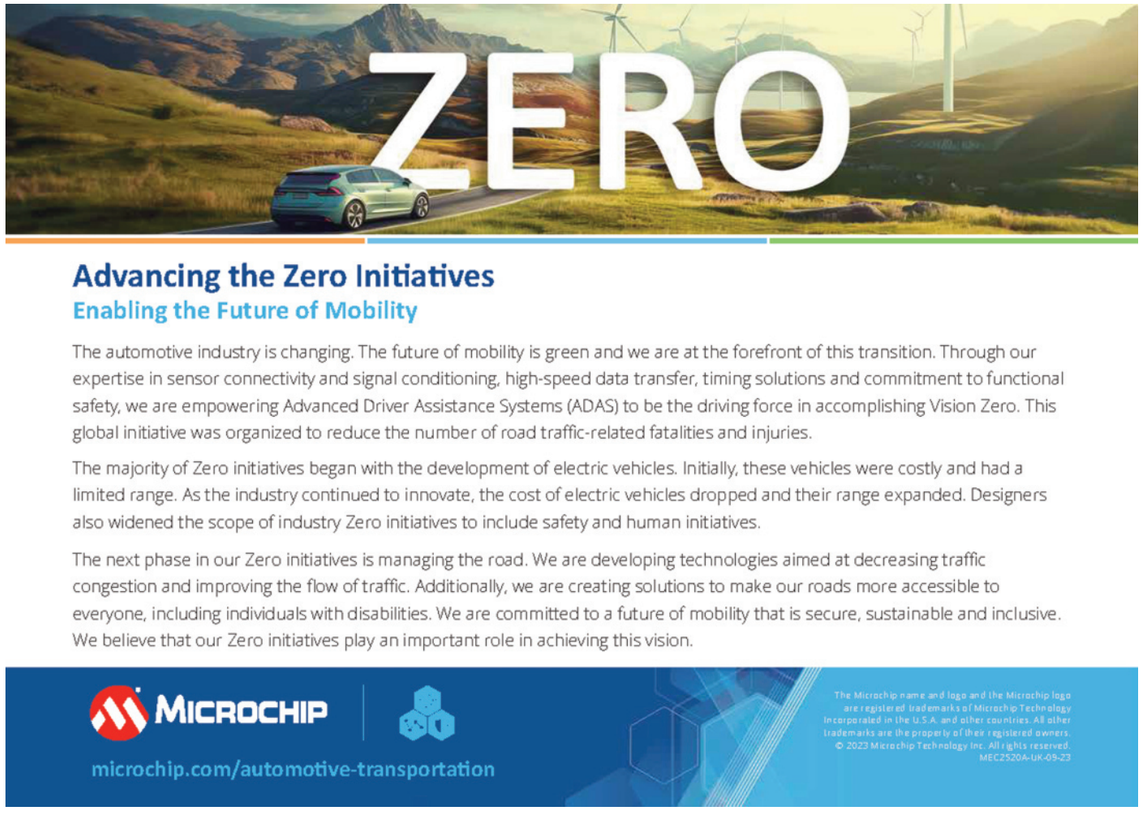
A critical requirement for the next wave of edge applications is higher processing and machine-learning capabilities, combined with high-speed connectivity, to analyse the environment and make intelligent decisions locally. Additionally, the latest designs require high performing, safe and secure hardware and operating systems, developed in compliance with automotive Asil B and industrial Sil 2 functional safety standards.

Finally, intuitive development tools are needed by development teams to tame the complexity of the growing amount of software and to meet production deadlines.

"By leveraging the combination of i.MX 9 series' safety, AI and performance features with the Green Hills Integrity rtos's proven separation architecture, car makers and tier-ones can realise multiple competitive advantages on their production vehicle programmes," said Dan Loop, vice president at NXP. "We're enabling lead customers on the i.MX 93 family and we look forward to extending our combined support to future devices in the i.MX 95 family as well."

Integrity and the μ-Velosity rtos from Green Hills target ISO 26262 for automotive, featuring Arm Cortex-A55 processor cores and real-time and safety domain, featuring Cortex-M microcontroller cores, and part of the EnergyFlex heterogeneous architecture of the i.MX 95 and i.MX 93.

Integrity multivisor virtualisation can also safely and securely run Linux and Android alongside critical real-time tasks.



Renesas and Inventec develop EV gateways

Renesas and Inventec have agreed to design automotive-grade gateways for electric vehicles (EVs).

Targeting tier-one automotive suppliers and OEMs, the companies will develop a proof of concept (PoC) for connected gateways based on the Renesas R-Car system-on-chip (SoC).

Renesas will provide Inventec its R-Car SoCs, analogue and power products, along with engineering support to help Inventec develop a PoC for in-vehicle connected gateways.

The two companies will regularly share product development roadmaps, market insights and specifications.

The first PoC will integrate cyber-security and over-the-air (OTA) features for connected gateway applications and is expected to be available by Inventec in Q2 2024.

"We are delighted to have Inventec as a partner to build a faster and more secure gateway for EVs," said Takeshi Fuse from Renesas. "As tier-ones and car manufacturers increasingly invest in automotive electrification, we are uniquely positioned to build a working design that addresses the complex demands of today's automotive industry."



Danny Chan (left) from Renesas with Sam Yeh

The development of the PoC for automotive gateways reflects a shift towards new EE architectures in the automotive industry. Automotive developers need to integrate complex networks of ECUs into their vehicles and enable software to receive OTA updates securely.

The PoC aims to drive innovation in vehicle development and create possibilities for emerging vehicle manufacturers worldwide to take part in the rapidly expanding EV market.

"We have years of experience serving the PC, server and mobile phone markets and meeting the performance and reliability requirements of our customers," said Sam Yeh, chairman of Inventec. "The integration of our technology with Renesas' field-proven R-Car SoC platform will enable us to reach a new base of EV customers in search of advanced intelligent automotive options around the world."

The R-Car scalable compute platform addresses a range of automotive applications, such as automated driving, adas, connected gateways, in-vehicle infotainment systems, cockpits and dashboards.

In the future, the two companies plan to collaborate not only in connected gateways, but also in in-vehicle applications such as vehicle computers and battery management systems.

Vishay makes inductors in Mexico

Vishay has opened a manufacturing facility in Gómez Palacio, Durango, Mexico, to mass produce power inductors for automotive electronics, handheld devices, computers and other applications.

The La Laguna 18,000m² Leed v4-certified facility will add to Vishay's power inductor capacity, which includes production lines in the USA, Israel and China.

At La Laguna, the company has equipment and production lines set up and is conducting internal and international standards qualifications to make commercial product by the end of this year.

Production of automotive grade power inductors will follow next year.

"Our La Laguna facility serves a number of strategic and logistical goals for Vishay and our power inductor customers in the USA and Europe, many of whom have established manufacturing facilities of their own in Mexico," said Mike Husman, SVP at Vishay. "La Laguna will give us plenty of room to grow and to help us achieve our plan to double our global inductor capacity."

Does Your Test Strategy Require Simulating Sensors?
Including pressure, temperature, altitude, strain gauges & displacement
Validate ECU Operation & Software using Hardware-in-the-Loop Simulation
Simulation & fault insertion are essential in mission-critical HIL applications, and companies turn to open architecture PXI-based systems for size, cost, flexibility and choice.
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pickering

AWS helps Qualcomm with software-defined vehicles

Qualcomm and Amazon Web Services. (AWS) announced at September's IAA Mobility in Munich their commitment to long-term co-innovation efforts on software-defined vehicles (SDVs).

AWS and Qualcomm will combine their expertise to provide development infrastructure and tools to accelerate autonomous driving and SDV transformation.

"The Qualcomm Cloud AI 100 and Snapdragon Ride platforms power automotive innovation for leading automakers," said Nakul Duggal, senior vice president at Qualcomm. "AWS's breadth of services and capabilities help unlock new possibilities for transformation in the industry. Through our technology collaboration with AWS, we'll share best practices and deliver on our joint vision of collaborative automotive innovation."

To help democratise vehicle software development for the industry, AWS and Qualcomm are making strides to help automakers experiment and integrate cloud technologies into their development processes.

For instance, with Qualcomm's software stack, which powers a vehicle's computer vision system for safety functions such as automatic braking and lane assist, developers can use the benefits of the cloud to simulate, test, validate and verify their features and functions before moving to more traditional testing on hardware. This helps expedite the development process and aids software engineers in arriving at a viable product faster.



Nakul Duggal: "We'll share best practices and deliver on our joint vision."

Premium luxury car makers, including BMW, have worked with Qualcomm to co-develop automated driving systems based on the open, scalable and modular Snapdragon Ride platform, which has an integrated Ride Vision software stack to enable 360-degree perception for the vehicle.

With AWS and Qualcomm, BMW engineers can leverage the benefits of hardware, vision software and cloud capabilities in a cohesive, integrated, end-to-end automated driving development platform.

AWS brings its experience in artificial intelligence, machine learning, data processing and analysis, and high-performance computing.

The two companies expect to experiment and integrate insights into future automotive products that will change how vehicles are designed, marketed and driven on the road.

"Software-defined development in automotive is increasingly prevalent, requiring automakers, tier-ones and automotive developers to ramp up efforts and find novel ways of accelerating the vehicle design process," said Wendy Bauer, general manager of automotive at AWS. "Learning from one another, while helping joint customers like BMW deliver on their visions, we're confident the industry will benefit for years to come.

"We are energised to continue uncovering these insights with our customers and co-innovators and turning them into actions that will shape the future of mobility."

Hitachi picks AMD for forward cameras

Mobility supplier Hitachi Astemo has selected AMD adaptive computing technology to power its stereo-format, forward-looking camera for adaptive cruise control and autonomous emergency braking.

This can improve the vision capabilities and helps increase the safety of vehicles.

The AMD Automotive XA Zynq UltraScale+ multi-processor system-on-a-chip (MPSoC) provides stereo and monocular image processing in the camera, enabling it to detect objects over 120° – a three times wider angle than its previous cameras – to enhance overall safety.

"The MPSoC is incredibly versatile and allows us to add multiple safety-critical features in our forward camera system," said Makoto Kudo, deputy head of ECUs at Hitachi. "AMD high-performance, scalable, programmable silicon offers distinct benefits for the extremely complex image signal processing requirements of our forward camera system."

Cameras are a critical part of autonomous driving and adas in vehicles. Forward cameras help vehicles reliably detect objects and people.

The Hitachi Astemo system combines stereo camera image-processing algorithms with artificial intelligence to provide object detection that will also enable video-based driver-assistance systems.

"Hitachi Astemo has clearly demonstrated its technological leadership with the development of this stereo forward camera that utilises AMD adaptive computing technology," said Yousef Khalilollahi, corporate vice president at AMD. "Increased safety and accident avoidance are key tenets to automotive technologies, and AMD is proud to offer the foundational technology in these camera systems."



AMD XA Zynq UltraScale+ multi-processor SoC

Solid Sands extends C++

Solid Sands unveiled an extended C++ subset of its SuperGuard product at September's IAA Mobility event in Munich.

This subset is a requirements-based test suite for standard C++ library qualification and meets functional safety standards, such as ISO 26262.

This addresses the underestimated problem of standard C++ library qualification. The size of the standard C++ library is significantly larger than its C counterpart.

The nature of the standard C++ library core headers, relying heavily on templates executed by the compiler, presents complexities in achieving statement coverage and modified condition and decision coverage.

Solid Sands has combined in-house analysis and tools to improve coverage percentages for third-party C++ libraries.

NEC invests in Sonatus SDV software company

NEC is investing in Sonatus, a Silicon Valley automotive software company accelerating the transition to software-defined vehicles (SDVs).

Following its expansion into Japan in April, Sonatus says this investment strengthens its ties with Japanese electronics firms and vehicle manufacturing ecosystem.

The products comprising the Sonatus platform serve as building blocks that allow automotive companies and their ecosystem to improve costs, capabilities, reliability and user experience over the vehicle lifespan.

Sonatus' software is in mass production vehicles from Hyundai, Kia and Genesis today and could grow to millions of cars next year.

Mitsubishi climbs Blackberry Ivy inside vehicles

Mitsubishi has selected Blackberry to power its latest in-vehicle system.

Mitsubishi's FlexConnect automotive in-cabin system will be powered by Blackberry Ivy, an edge-to-cloud vehicle data platform.

The collaboration should help advance road safety by leveraging an array of sensor data to anticipate safety risks, reduce driver distractions, highlight driving hazards and enable more consumer experiences.

"The collaboration between Mitsubishi and Blackberry to advance our in-cabin system takes the driving experience to the next level," said Mark Rakoski, vice president at Mitsubishi. "With its advanced safety features, intuitive interface and enhanced sensory feedback, FlexConnect establishes a new cabin experience standard, revolutionising the way we interact with vehicles. With Ivy, we're able to bring innovations like this to market faster, and in full confidence that the security and privacy of user data is protected."

The FlexConnect core is its driver and occupant monitoring systems. Ivy allows the platform to extract and analyse data from internal and external sensors and leverages machine learning to process all data collected at the vehicle edge compute node.

"By leveraging Ivy as a key component of its FlexConnect platform, Mitsubishi raises the bar for in-cabin experiences and helps improve road safety," said Vito Giallorenzo, senior vice president at Blackberry.

Safety features include determining driver distraction and concentration levels.

Lucid hits Samsung's Wall



Lucid Motors has installed Samsung's The Wall at its design studio to enhance the collaborative design process for its future electric vehicles.

Using MicroLED technology, The Wall provides Lucid with tools to meet the surging demand for sustainable electric vehicles.

The authentic image rendition allows for increased collaboration between engineering and design teams, resulting in accelerated decision-making processes that can save the company time and money.

"While designing the Lucid Air Sapphire, from concept sketches all the way to final adjustments, Samsung enabled us to visualise the future of our vehicles in high resolution at all stages of development," said Jenny Ha, exterior design manager at Lucid Motors.

The Wall's flexible-yet-compact design also saves studio floor space at Lucid's headquarters. This allows multidisciplinary teams to use the space for collaborative design workshops to refine details of the vehicles.

The 650cm display lets designers view and review their designs in true-to-life colour at a 1:1 scale.

"The Wall has revolutionised the way our design and engineering teams work together," said Ha.

Otobrite aims camera modules at lorries



Otobrite camera modules are for heavy vehicles

Otobrite is targeting its automotive-grade 5 and 8MP camera modules at autonomous heavy commercial vehicles.

Because the heavier the vehicle, the longer it takes to stop, these modules can improve the visibility and perception capabilities of adas and automated driving systems, and have been adopted in North America.

The company offers a flexible business model and vision-AI technology stack, enabling it to provide systems, camera modules or AI IP licensing to cater to diverse requirements.

Its automotive-grade camera modules have already garnered the trust of clients and entered the supply chain of car OEMs such as Luxgen, Sony, Toyota and XPeng, with over a million automotive-grade camera modules deployed.

The 5 and 8MP camera modules use high-sensitivity cmos sensors. The 5MP camera module is equipped with a Sony IMX490 sensor and has 30°, 60°, 90° and 120° viewing angles. The 8MP module uses the Sony IMX728 sensors and also offers various viewing angles.

Both are equipped with GMSL2 interfaces and tested with waterproof and dustproof standards of IP67/69K. They can operate from -40 to +85°C.

Otobrite has a 1K class clean room factory certified to IATF16949 and endorsed by several car OEMs. The in-house developed five- and six-axis active alignment machine for high-end camera modules exhibits the capability to manufacture over 60 SKU variants of camera modules.

Autoliv and GWM collaborate on zero-gravity seat

Autoliv and Chinese car maker Great Wall Motor (GWM) plan to work together to address opportunities in the global automotive market, including a zero-gravity seat.

GWM produces and sells vehicles under its own branding, such as Great Wall, Haval, Wey, Tank and Poer. It also produces dedicated electric vehicles under the brand name Ora.

Autoliv has worked with GWM since 2003, when it developed and began supplying seat belts for Haval SUVs.

The cooperation aims to drive innovation through collaboration around technologies with a focus on quality. It is expected to result in advancements that will redefine the driving experience, such as an overhead passenger airbag that deploys from the ceiling of the car, freeing up space in its interior.

The collaboration also includes an integrated safety system – the zero-gravity seat – for autonomous vehicles. The seat features airbags and an integrated seatbelt for safety.

As the seat reclines, the safety system adjusts to the needs of different drivers and passengers, adapting to their weight, height and gender.

With a shared commitment to sustainability, Autoliv and GWM are dedicated to creating low-carbon options. The collaboration includes the development of several products with sustainable materials, such as using bio-PET as the basic fabric for airbag cushions, and bio-leather wrapping on steering wheels.

"This strategic collaboration marks an important milestone in Autoliv's and GWM's joint goal of redefining how people experience transportation," said Mikael Bratt, CEO of Autoliv. "We also share a commitment to safety with an emphasis on quality, innovation and sustainability. Autoliv China will work closely with the GWM team, pooling Autoliv's knowledge and strengths into our cooperation, enhancing both the safety and overall driving experience for global users."

Toyota adopts Kanzi One HMI

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

Combining Kanzi One and the automotive experience of the Kanzi services team should give Toyota the flexibility and design capabilities to enhance its brands.

With Kanzi One, Toyota can achieve better graphics performance on cost-effective hardware platforms. Further, Toyota can create and maintain distinct UI modules, mixing and matching them to create instrument clusters for vehicle variants and models across diverse markets.

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

Webasto integrates Hesai lidar in roof module

Hesai is to provide automotive lidar sensors to Webasto for its roof sensor module for passenger cars with adas.

Hesai's AT128 long-range lidar has been integrated in Webasto's roof sensor module, which has several cameras and lidars. Webasto's system includes an entire sensor set, with other antennas, concealed under a full-surface polycarbonate cover that blends with the vehicle's silhouette.

The AT128 generates high-resolution point clouds and perceives objects 200m away, whether vehicles, pedestrians, tyres or traffic cones. It captures objects in detail for accurate decision-making to avoid risks.

This automotive-grade lidar is being used by 11 OEMs and over 130,000 units have been shipped.

Hesai's latest ET25 long-range lidar is 25mm thick, which makes it suitable for rooftop and behind-the-windshield installation. ET25's range can reach 225m even behind the windshield, with angular resolution reaching 0.05 by 0.05°.

The sensor uses 12W to avoid overheating, and it stays extremely quiet. At lower than 25dB, its noise level is less than that of a quiet library.

"Autonomous driving has seen impressive technological progress, and we are now looking to create something that combines functionality with visual appeal for the mass market," said Thomas Schütt, vice president at Webasto.

Bob in den Bosch, senior vice president at Hesai Technology, added: "We want to see our cutting-edge lidar technology adopted by leading automotive OEMs and become a mainstream component in series-production vehicles. That means reliably delivering at the highest quality with the best price points. We hope to push boundaries once more in this new collaboration."



Webasto's roof sensor module prototype



Horiba Mira opens driving simulator centre in UK

Automotive engineering, test and development consultancy Horiba Mira has opened a driving simulator centre at its UK head office in Warwickshire.

It features driver-in-the-loop simulator technology, supported by Mira's engineering service and consultancy.

Over £4m has been invested in the facility so established automotive OEMs, start-up vehicle manufacturers and tier-one suppliers can develop vehicles that reflect marque brand characteristics. By using virtual tools, the capability can deliver vehicle attributes that conform to brand DNA faster, more sustainably and at a reduced development cost.

"Through the newly launched driving simulator centre, the speed, cost and complexity of refining driven vehicle attributes to meet today's changing customer expectations is significantly reduced," said Declan Allen, managing director of Horiba Mira.

At the heart of the centre is a VI-Grade DiM250 dynamic motion driving simulator. Use of the simulator reduces the need for physical vehicle testing and prototypes.

Those using the centre will also get access to its VI-Grade Compact simulator, acquired in 2021, located within the same facility.

Guido Bairati, managing director at VI-Grade, said: "With a long and respected automotive engineering history, we're excited that both VI-Grade's DiM250 dynamic simulator and Compact simulator will be supporting global automotive manufacturers and suppliers as they look ahead to future vehicle programmes and engineering challenges."

The centre, with Horiba Mira's subjective led attribute methodology, puts the human-in-the-loop at the start of the virtual engineering series. Attribute development engineers can make accurate and unlimited comparisons quickly and at lower cost, often at the flick of a switch.

This is especially important when working to balance conflicting attributes to achieve an optimised vehicle. This results in more informed subjective-led decisions made throughout the entire development cycle rather than waiting for a physical prototype, and in many cases can significantly reduce the number of prototypes required.

Automotive companies can conduct virtual development across many applications. Predominantly this is focused on driven attributes such as vehicle dynamics, noise, vibration and harshness (NVH), and drivability, but also includes holistic engineering across capabilities growing in complexity and importance, such as adas, HMI and x-in-the-loop (XiL) applications.

"This facility enhances Horiba Mira's capabilities and is an enabler of its attribute-led development methodology, while also being a critical tool supporting complex engineering developments across adas, HMI and XiL," said Allen.

The centre is a key enabler of net zero ambitions by reducing the industry's reliance on carbon-intensive physical prototypes.

Alongside the centre, Horiba Mira has made investments in its propulsion and electromobility capabilities, as well as developing the Mira Technology Park in Nuneaton, which is now home to more than 40 companies working on emerging technologies for the automotive industry.

LIDAR

STOPPING THE SUN

Noe Quintero explains how to cancel ambient light for lidar receivers

One of the more difficult challenges of time-of-flight (ToF) lidar is the high sensitivity required for the receive signal chain, and the difficulty in mitigating the effects of ambient light for lidar receiver chains.

Typically, a collimated (parallel rays of light) laser pulse is sent out to a spot. The advantage of a collimated laser source is it limits light lost from divergence and keeps the spot size constant over distance.

However, once the light hits an object, this light will bounce back in many directions; this is called scattering.

The amount of reflected light back to the source is proportional to 1/R2, also called the inverse square law. At short distances, detecting an object is not as difficult. However, to detect objects at more than 100m, high gains are needed to detect the small amount of reflected light due to the inverse square law loss.

One of the consequences of using high gains in the receiver is the effects on the signal chain from the ambient light. The Sun is a light source with a broad spectrum of wavelengths. Lidar systems typically choose wavelengths of 900 and 1550nm due to natural nulls of light from the Sun in these spectrums.

Unfortunately, to detect faraway

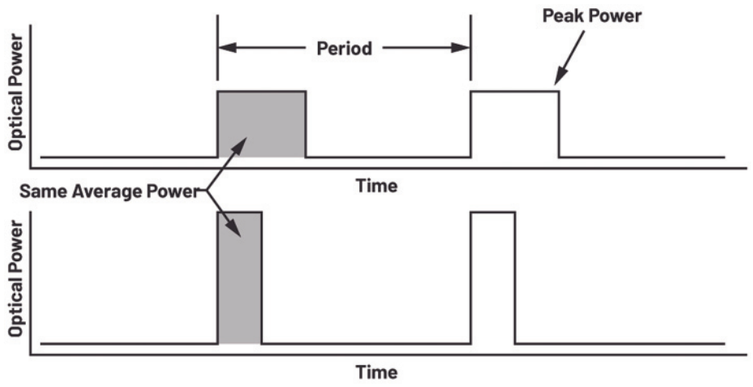


Fig. 1: Example of different laser outputs

objects, significant gains are needed in the receiver, and the Sun's ambient light can saturate the receiver even with these natural nulls in the spectrum. This effectively blinds the system and renders it useless.

Basics

Taking a step back, a laser is used to send out a narrow pulse of light; this laser pulse hits a target, and the light reflects off the object. A detector is used to measure the time this reflection took to return. By knowing the speed of light and round-trip time of the laser pulse, the distance can be calculated.

Generally, the higher the amplitude of the pulsed laser, the larger the return signal will be. For long-range lidar, eye safety from the power of the laser limits the range of modern systems. The area under the curve dictates the energy of the pulse, as shown in Fig. 1.

By going to higher peak power, the width of this pulse must be reduced to keep the area under the curve below the eye safety limits.

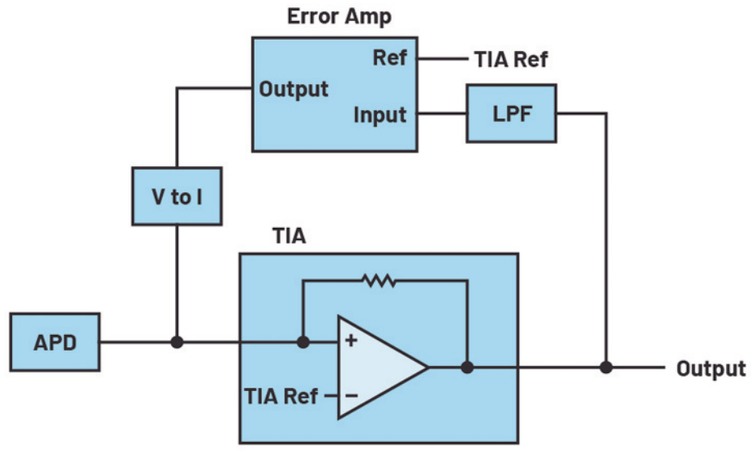


Fig. 2: DC cancel block diagram

Thus, the goal is to provide a high amplitude laser pulse with a relatively narrow width.

In current lidar systems, the pulse widths are on the order of 5ns and are moving to shorter pulse widths.

Another aspect to consider for lidar is scattering. Typically, an avalanche photodiode (APD) detector is implemented to provide optical gain to combat the inverse square law problem. APDs are beneficial for the signal chain, since the transimpedance amplifier (TIA) is the limiting factor for noise in the signal chain. By applying gain in the detector, the system's input referred noise is reduced.

Keep in mind there are limitations in the APD, where too much gain will produce worse noise performance as it reaches breakdown.

Challenges

As with any other engineering problems, there are trade-offs. The receive signal chain needs to have high enough bandwidth to detect the edges of about 5ns wide laser pulses, and the capacitance of the detector needs to be small to not limit the TIA bandwidth.

The smaller capacitance also helps the shot noise of the APD since they are proportional to one another. Sensitivity, bandwidth and power must be balanced for real-world applications.

Another challenge of having higher gains in the receive signal chain is the large dynamic range that comes with it. Modern APDs are reverse biased close to 300V to achieve these larger gains.

The problem becomes apparent when a highly reflective object is very close to the detector. This large signal compounded with the relatively large gain of the APD can cause hundreds of mA to flow through the TIA. Most communications TIAs are not designed to survive this event, let alone recover within a reasonable time for the next cycle of the pulse.

Fortunately, lidar-specific TIAs have built-in clamps to shunt the current and recover in under 100ns. Power is addressed by duty cycling and shutting down the unused channels.

With these in mind, the last big problem is the DC photocurrents from the ambient light, and solving this is not trivial.

AC versus DC

At first glance, a simple answer would be to AC couple the inputs to the TIA to block the DC current. Unfortunately, there are many pitfalls with this approach.

The saturation recovery time will be compromised, blinding the system. In the event of a large pulse from a close object, the AC capacitor will be charged. The TIA can only inject a small amount of current into the AC cap because the feedback resistors, which are on the order of 10 to 100kΩ, limit the current.

Depending on the value of the capacitor, the RC time constant is very large and can take hundreds of μs to recover. This is unacceptable, since typically 2μs of time is allocated for 100m detections, and will miss the signal from the farther objects. Another pitfall of AC coupling the TIA is the repetition rate of the laser source. When the incoming

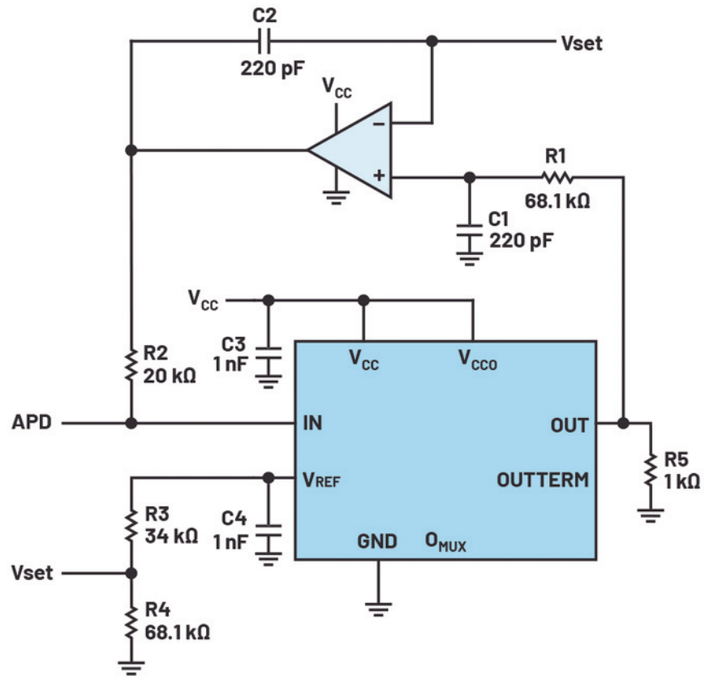


Fig. 3: DC cancel circuit for single-channel transimpedance amplifier

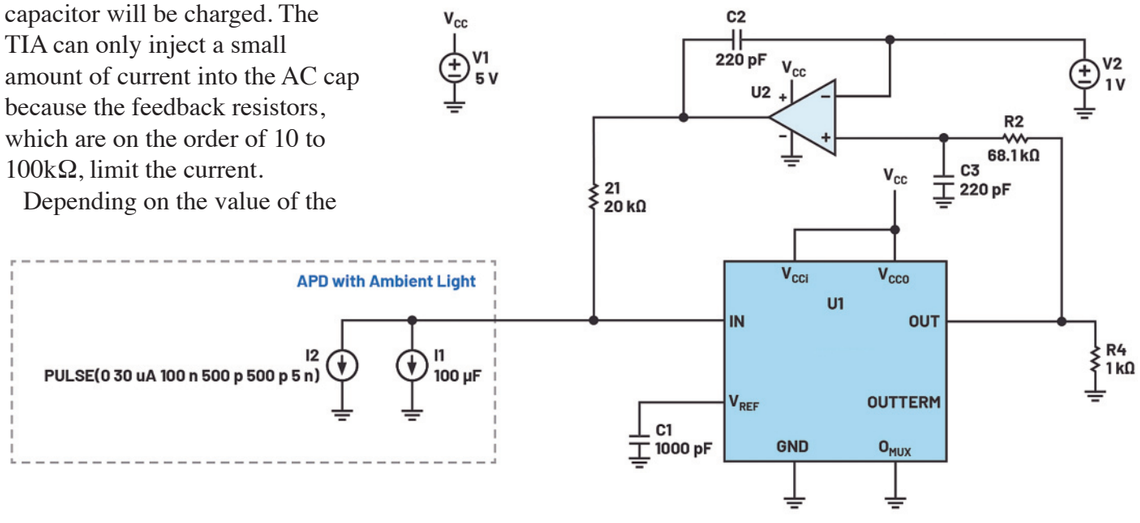


Fig. 4: Simulation schematic

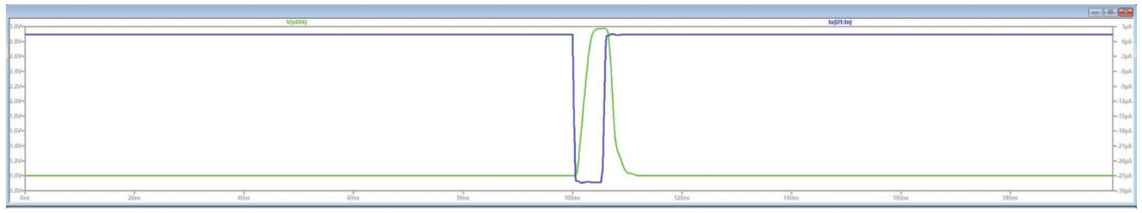


Fig. 5: Input and output waveform of the DC cancel simulation

pulses is AC coupled, the pulses will be averaged on the AC cap. The detector's signal is unipolar and will slowly charge the AC capacitor. There will be a DC offset produced on this capacitor.

This systematically reduces the linear range of the TIA, and the DC offset will change based on repetition rate and amplitude of return signal.

Fortunately, a DC-coupled input avoids all these nuances and secondary effects, but at a cost of added complexity. An effective method for cancelling this current is by incorporating a closed-loop circuit to inject opposite current into the input of the TIA.

Cancel circuit

Fig. 2 shows the block diagram of how to implement an analogue closed loop to cancel the DC input currents. The job of the error amp is to look at the output of the TIA and to inject an opposite current into the input of the TIA. It compares and servos the output to match the TIA's reference.

It is best to use the TIA's reference to derive the error amp's reference for two reasons: to match the output's reference, and to ensure the PSRR is conserved for the TIA. To save on power and cost, a lower bandwidth amplifier should be used for the error amplifier's circuit. A low-pass filter is recommended for the error amplifier's input since the fast pulses should not be coupled back into the input.

Fig. 3 shows the DC cancel circuit for a single-channel transimpedance amplifier. Nominally the output of the amp sits at about 1V DC when there is no input current into the TIA. Therefore, a resistor divider is needed from the reference to match this voltage, dividing down the reference nominal 1.5V to match the output 1V.

R1 and C1 create a low pass of about 10.6kHz; this helps reduce the amount of noise injected into the device from the error amplifier. This low pass will be the dominant pole for this loop and can be adjusted for different bandwidth requirements.

A simple integrating error amplifier circuit is used to servo the output to 1V; keep in mind 1V is the nominal output voltage when there is no current on the device.

R2, a 20kΩ resistor, is a simple implementation to convert the output of the op amp to a current. The value of this resistor and the maximum swing of the op amp will set the maximum current

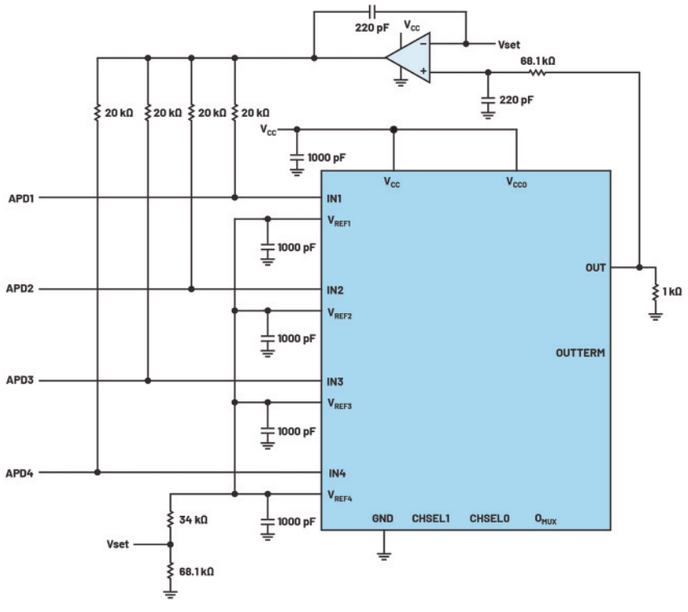


Fig. 6: Three op amps can be saved by using four output resistors to inject the current into each channel

based on the output swing. Since this is not a rail-to-rail op amp, the maximum DC current cancel will be limited to be the difference between the maximum swing of the op amp and the input self-bias voltage of the single-channel transimpedance amplifier, which is nominally 1.5V. This works out be about 3V and will give a maximum DC cancel current of 150μA.

Figs. 4 and 5 show a simulation of the DC cancel circuit. Notice V2 is used in the simulation to set the reference of the integrating error amp. This is used to help the circuit simulate and establish a deterministic starting voltage.

Three op amps can be saved by using four output resistors to inject the current into each channel, as shown in Fig. 6.

One thing to note is this can create a path that can couple the channels. However, 40kΩ of resistance has little impact on the channel-to-channel isolation.

Lastly, the channels should be very similar in DC input currents since the error amp cannot change drastically between channels. This circuit will benefit a system where all the optical channels are close to one another.

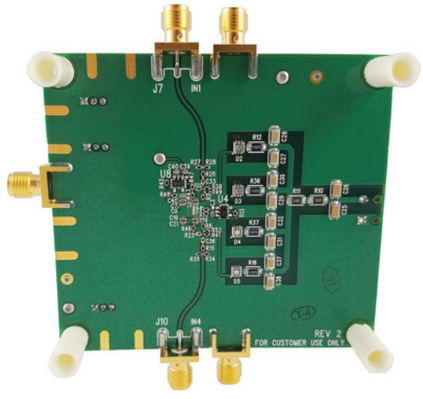


Fig. 7: DC cancel circuit lab board

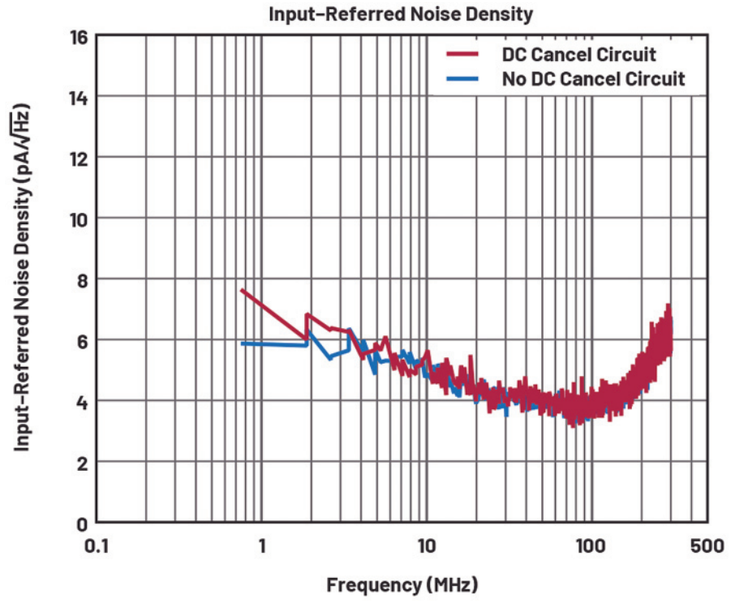


Fig. 8: Input referred noise density

Results

A proof-of-concept board was made to verify performance. This is shown in Fig. 7.

As expected, the DC cancel circuit is dominated by the parasitic elements of the board routing and components. The circuit increases the integrated noise from 64nA rms for the non-DC cancel circuit to 66nA rms for the DC cancel circuit integrated from 100kHz to 200MHz.

Fig. 8 shows the measured input referred noise densities with and without the DC cancel circuit. The APDs were removed to find the noise floor without the capacitive loading to the TIA. This produced an integrated noise of 59nA rms for the non-DC cancel circuit and 60nA rms for the DC cancel circuit. However, the circuit is intended to be used with a detector and should include the capacitance into the performance of the circuit.

Conclusion

AC coupling the inputs of the single-channel transimpedance amplifier may pose some difficulties. Ultimately, there are limited cases where AC coupling can be implemented with minimal impacts to the circuit's performance.

In modern lidar systems, to increase system performance, the proposed DC cancel circuit can provide maximum recovery time performance without impacting circuit noise. The trade-offs for this performance are complexity with the layout and increased power consumption of the integrating error amplifier.



Noe Quintero is an analogue design engineer at Analog Devices

SOFTWARE TOOLS

EXHAUSTING

Benoît Jubin explores the advantages of exhaustive static analysis



Traditionally, automotive software developers have harboured doubts about achieving 100% verification, validation and compliance activity coverage. This scepticism has been driven by the escalating intricacies of vehicle systems, marked by distributed architectures, connectivity demands, virtualisation and other imperatives that strain testing capabilities and adherence to standards such as ISO 26262 and ISO 21434.

Yet, recent advances in academic research and computational potency have shattered these preconceptions by clearly demonstrating that 100% code and input coverage is achievable, offering unprecedented advantages to teams engaged in safety- and security-critical development within the realm of electronic vehicle development and manufacturing.

Static and dynamic testing methods have helped automotive manufacturers take on the task of testing and certification, but using formal methods to drive test results to even higher levels of accuracy and detail helps guarantee safety, security and reliability for automotive software.

Innovation

With vehicle electronics, exhaustive static analysis tools stand as a beacon of innovation, meticulously engineered to incorporate the capabilities of formal methods seamlessly into the well-established testing and compliance procedures of automotive testing teams. These tools bring with them a host of compelling advantages, effectively eclipsing conventional testing and static analysis methods.

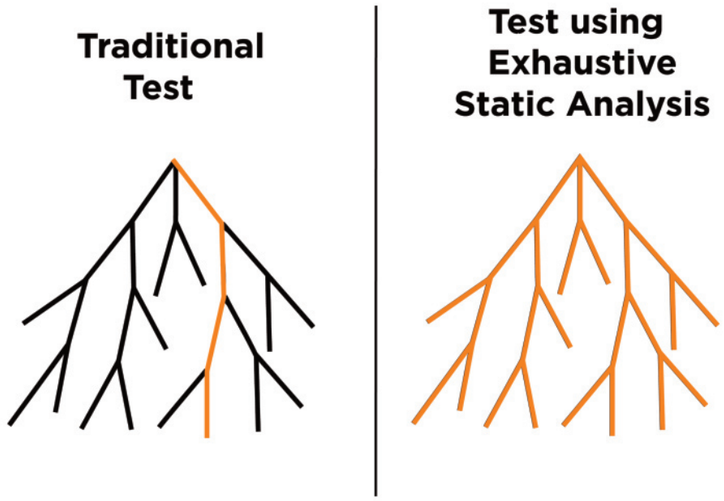
For example, they deliver application coverage of up to 100%, including all potential functions, statements, paths, decisions and conditions. There is also an unmatched level of input coverage of up to 100%, encompassing all conceivable values within a defined testing scope.

The gift of mathematical certainty ensures code is devoid of errors or vulnerabilities, resulting in an issue-free deployment. The elimination of false negatives ensures all vulnerabilities have been found by the tool.

The mitigation of false positives preserves developers' time by steering them clear of non-issues.

And there is support for ISO 26262 and ISO 21434 certification.

Exhaustive static analysis, an innovation in automotive testing techniques, redefines the boundaries of test coverage. While traditional best-effort test designed tools are often constrained to executing a solitary code branch per run, this approach concurrently explores all branches, achieving 100% code and input coverage while reducing testing time.



Exhaustive static analysis allows developers to run tests for all possible inputs

Awareness

Exhaustive static analysis tools that take the existing vehicle computing hardware into account can improve the accuracy and efficiency of software testing. Differences in compiler implementations, hardware architectures and memory alignment between platforms can lead to drastically different code behaviour. For example, on 64bit targets, long is typically 64bit and int is typically 32bit. On 32bit targets, both long and int are typically 32bit.

These implementation characteristics influence test design, as shown in this code sample:

```
long double_that(int i) {
  return (long)i * 2;
}

double_that(0x7FFFFFF0);
```

Tests or static analysis methods that are unaware of the underlying implementation would not know whether the last statement causes an integer overflow (32bit target) or is safe behaviour (64bit target). This code would decrease the efficiency of test designs that assume a 64bit data range when the target is actually 32bit, which would negatively impact accuracy when assuming a 64bit target and potentially miss the integer overflow when it is actually 32bit.

Hardware-aware exhaustive static analysis balances between 100% coverage and the minimum number of test cases necessary to achieve it. It also means tests can be run without requiring a physical target to be connected to the host. Target tests can be run before the physical hardware is available.

And test capacity can increase and costs decrease as physical hardware is not required for every developer.



Results

In the pursuit of satisfactory validation for adas and autonomous vehicles, encompassing all potential test cases and scenarios can be extremely difficult. Certain situations pose inherent dangers when executed in real-world settings and simulations alone fail to identify safety and security vulnerabilities comprehensively.

Certain adas providers are now taking an unconventional approach, transcending established testing procedures and methodologies to guarantee the safety, dependability and security of their autonomous driving software platform using exhaustive static analysis.

One possible challenge lies in validating that an adas software platform's response to vehicle positioning and its surroundings, including all objects (referred to as living beings), will not trigger any undefined behaviour that could jeopardise user safety or security.

By leveraging formal methods, it becomes possible to generalise test inputs and comprehensively identify all instances of undefined behaviour, ranging from buffer overflows to accessing uninitialised variables and division-by-zero scenarios.

It is imperative that automotive software developers not be tethered to outdated testing methodologies. This means embracing technologies that assure the discovery of every single defect and functional safety concern within their codebase.

Conclusion

Automotive software development cycles that use exhaustive static analysis can benefit from a qualified tool that offers a far more thorough and efficient road to what had been a traditionally strenuous certification process.

The workload can be shortened significantly thanks to the reduction in testing iterations provided by target emulation and the tool's efficiency in providing zero false negatives and up to zero false positives.

Being proactive with exhaustive static analysis now significantly reduces the likelihood of software bugs and vulnerabilities in the field, further improving the overall reliability and security of automotive software systems. Automotive standards can be more efficiently met and iterations reduced with virtual target emulation and bug detection earlier in the development cycle.



Benoît Jubin is product owner at TrustInSoft

MY TURN TO DRIVE



Andrew Cole shows how 5G can enable automated valet parking

Vehicle Electronics

V2X

Autonomous vehicles have inbuilt systems to facilitate local sensing and decision making, using data sensed about nearby objects. This is limited by sensor range, obstacles, poor weather or the unknown intentions of other drivers.

Integrating cellular vehicle-to-everything (V2X) or 5G enables the offloading of sensing, processing and decision making to external systems that can offer higher capability and capacity. This brings possibilities for autonomous driving by sidestepping the limitations of local sensing and computing.

The 5G and V2X use cases are varied and, for their deployment, many technical, economical, psychological and regulatory hurdles need to be overcome. Some use cases, such as local hazard information and sharing, teleoperated driving or automated valet parking (AVP) may have a lower barrier to deployment.

AVP is a use case where the vehicle is parked automatically, so the user does not have to perform this tedious activity. AVP will be deployed in a controlled environment of parking facilities, where many risk factors associated with autonomous vehicles are not present.

There are two types of AVP that differ in where the intelligence and sensor are placed.

With AVP type one, the intelligence and sensors are in the vehicle. The vehicle is parking itself, using its own sensors and decision making. The disadvantage of this is the variability in autonomous vehicles capabilities and the potential complexity stemming from that. It, however, does not require specialised parking facilities or communication infrastructure.

AVP type two is different in that the vehicles do not need to be autonomous, as the parking facility is the smart component. The vehicles only need to be able to be remotely driven and communicate over 5G, which is crucial for an AVP type two setup and needs to function reliably.

For the rest of this article, AVP will refer to AVP type two.

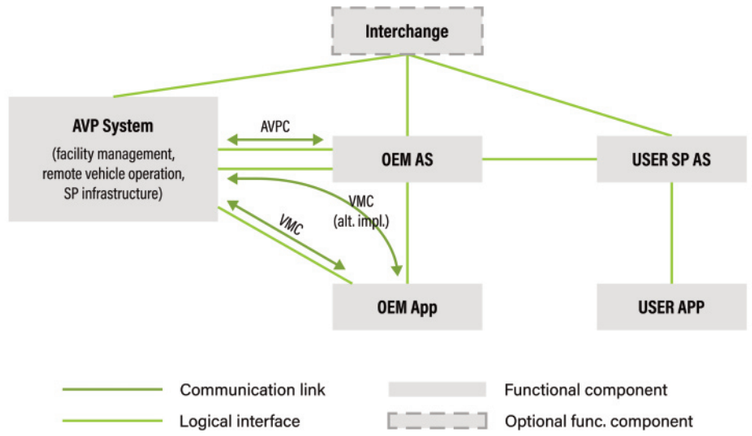


Fig.1: Simplified AVP application-level system architecture

Advantages:
The technical complexity is at the side of the AVP service provider, so it is easier and cheaper to deploy and maintain. Powerful sensors can be easily and economically installed, with a local server or multi-access edge computing handling the sensor inputs processing and trajectory calculations.

The environment in an AVP facility can be controlled, thus there are fewer variables.

The requirements for AVP certified vehicles are lower, with no sensors or adas necessary.

The business case is clear, as the capital investment and operational expenses are mainly on the side of the AVP facility operator, with the revenue stream being the parking fees paid by the users.

Architecture

The AVP architecture comprises components handling the parking facility, vehicle remote control, user interaction and so on. A simplified AVP application-level system architecture is in Fig. 1.

The AVP system takes care of the infrastructure, such as the parking facility gates and sensors. It manages the parking facility availability, checks the compatibility between the vehicle and parking facility, dispatches the vehicle into driverless operation, and hands over authority with the user.

It receives and process the sensor inputs to calculate the vehicle manoeuvre trajectory. It then provides instructions to the OEM app in the vehicle using the VMC logical interface.

The OEM application server (AS) offers services to the vehicles and its drivers and passengers by communicating with the OEM app. The user AS offers services for end users by communicating with the user app that can be on a smart phone.

The OEM app integrates services offered by the OEM AS into vehicles. For the AVP service, it performs the on-board vehicle operation following manoeuvre instructions received via the VMC logical interface.

The user app provides the services offered by the user AS to the end user.

An interchange is needed to automate the discovery of AVP service providers and scale up communications between AVP ASs and OEM ASs, to avoid full mesh connectivity.

Logical interfaces include AVP control (AVPC) for management and control communications among AVP services, for example authentication, service discovery or reservations. Vehicle motion control (VMC) is used for communicating information such as driving commands and instructions.

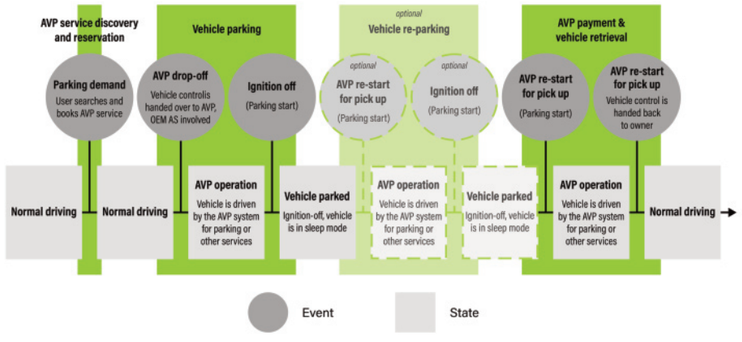


Fig. 2: AVP operation sequence

Operation

AVP operation can be looked at from two angles. From the user's perspective, it brings a simple to use service that improves comfort with these phases: AVP service discovery, where the user checks the availability of a parking spot and reserves it; driving to the AVP facility and stopping in the drop off zone; and the user steps out of the vehicle and hands over authority to the AVP.

When returning to the AVP facility, the user requests for the vehicle to be returned to the pickup zone. The user receives back the authority, gets into the vehicle and drives off.

From the point of view of the AVP system, it proceses the parking request enquiry and reservation, and then takes authority of the vehicle and drives it from the drop-off area to the parking spot.

Re-parking can take place, whether for space optimisation or to get the vehicle ready for pickup. It finally drives the vehicle to the pickup area and hands authority back to the user.

All these phases are combined in Fig. 2, which shows the whole procedure for all involved parties.

Testing

The AVP test setup mirrors the system architecture, with special focus on the communication path between the AVP system and the OEM application, enabling end-to-end testing.

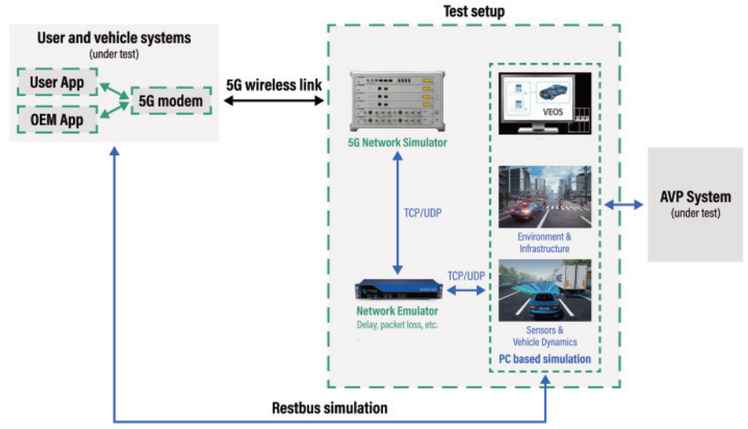


Fig. 3: AVP test setup

The test setup can be used for: interoperability tests of early implementation of both end-points; development and integration testing of the user and vehicle system, or the AVP system; and understanding the different ways of setting up a parking facility, for example by observing the link QoS resulting from different 5G network deployment strategies, or by evaluating the effect of the sensor density and quality on the remote driving performance.

Test setup

The test setup offers a scalable test environment that can expand to cover the volume of testing required for AVP evaluation. The test setup components are shown in Fig. 3.

The PC based simulated environment simulates both the parking facility and the vehicle as digital twins. It generates the sensor signals, which can be fed into the AVP system for processing, and reflects any status changing feedback from the AVP system or the vehicle. It controls both the 5G network simulator and the network impairment simulator, providing a unified interface for scenario automation.

The 5G network simulator enables testing under different phy, mac and RLC layer configurations, mobility scenarios, including corner cases, and unusual scenarios.

The network impairment simulator represents the transport network between the parking facility and AVP system, if they are not co-located. It can simulate negative effects, such as packet losses, jitter and latency.

Endpoints

There are endpoints, which are either under test or serve as the communication partner for the system that is being tested.

The AVP system handles the user app communications. It then receives the sensor data from the simulation environment and evaluates them to calculate the vehicle's trajectory and generate VMC commands that will be sent to the OEM application via the 5G link. The user application handles the discovery and reservation of the parking spot via the 5G Uu interface.

The OEM application receives the VMC commands and translates these into steering instructions. It can then send feedback into the simulated environment via Restbus.

Throughput, latency or retransmissions can be evaluated under different phy, mac or RLC layer configurations. A software defined architecture means it can be expanded to accommodate future technologies, and automated easily, enabling smooth integration with other components.

Conclusion

AVP type two is a use case, where the vehicle is automatically parked using remote control in a specially furnished parking facility. The deployment in such a controlled environment reduces many risk factors and lowers the barriers for successful mass adoption. Before this can happen, extensive end-to-end testing is still necessary. The presented test setup contains all the necessary components, including a 5G network simulator, that enable realistic testing of all subsystems.



Andrew Cole is an application engineer at Anritsu

MARKET ANALYSIS

FULL CHARGE

Ta Tran Minh examines the outlook for the automotive industry



Vehicle Electronics October 2023, 28

MARKET ANALYSIS



From global disruptions that have caused supply chain shortages to heightened inflation and successive interest rate rises, the automotive sector is transitioning through one of its most challenging and uncertain periods in history.

According to TrendForce analysis, global car sales remained almost unchanged in 2022, with a year-on-year decline of 0.1% to 81.05 million vehicles.

The USA experienced an 8.1% decline with 13.7 million vehicle units, Western Europe witnessed a 4.6% decline with 11.8 million vehicle units, and Eastern Europe recorded a significant YoY drop of 27.3%.

However, China proved the outlier, bucking the trend with 26.9 million vehicle units sold in 2022, a YoY growth of 3.7%.

Recovery

Difficult times sometimes call for creative measures and the automotive industry has proven itself to be adept at finding innovative solutions to problems in the past. And this will be needed to navigate safely the supply chain bottlenecks caused by the global challenges over the past few years.

There will be a notable shift from the just-in-time process to inventory management to boost supplies through the tracking and organising of goods from suppliers, through the manufacturing process and into the end product, despite the additional inventory costs.

To insulate further against disruptions, automotive manufacturers will adopt vertically-integrated business models, specifically in areas such as the battery value chain. EU legislation is placing added pressure on manufacturers to source local components if they are to avoid penalising tariffs; many have publicly stated they are facing difficulties in sourcing localised battery manufacturing.

ABI Research expects a modest return to growth for new consumer and commercial vehicle sales over the next two years with global vehicle sales growth hitting 5.1% in 2023 and 3.3% in 2024. Sales are expected to return to the 90 million plus highwater mark in 2025. Despite the headwinds, experts remain cautiously optimistic of a market rebound defined by a number of key trends.

Clean mobility

EVs have been on a charge and are expected to dominate the sustainable mobility drive. In 2023, battery electric cars (BEVs) and plug-in hybrid electric vehicles (PHEVs) are projected to account for 19% of new passenger car registrations, up from 14% in 2022, with China and Europe as the most significant markets.

Software-defined vehicles

As every industry embarks on its digital transformation, the era of software-defined vehicles has marked its arrival with innovative software and breakthrough technology. EVs are brimming with the newest tech, able to provide smartphone-like features and functionality for connectivity and infotainment systems.

Automakers have been leveraging artificial intelligence (AI), machine learning (ML), computer vision, natural language processing and robotic automation to expand the horizon of possibilities for the industry.

AI and ML algorithms will analyse data from various sources to detect potential hazards and predict accidents in real time, improving overall safety on roads.

While plans for fully autonomous vehicles have been delayed by technical and regulatory complexities, AI and ML will play a part in optimising manufacturing, supply chains and vehicle performance.

AI-powered chatbots, virtual assistants and personalised recommendations will provide superior customer experiences, from personalised in-car entertainment options to vehicle maintenance.

In addition, automakers will leverage the power of over-the-air (OTA) updates, connectivity and in-vehicle gaming to create a more immersive and enjoyable driving experience.

Software-defined vehicles are redefining the future of the automotive industry, harnessing advanced digital technologies to enhance vehicle performance, safety and efficiency.

The software approach gives automakers the freedom to standardise across different vehicle models and brands. At the same time, drivers will experience new levels of convenience, comfort and connectivity.

Gartner estimates the total market value for connected vehicle data, including aggregated anonymised data and consumer-authorised services, will hit $10.8bn by 2030. With automakers, transportation companies, telematics providers and other fleet owners gathering petabytes of data from vehicles, engineers will understand more about how vehicles are performing to predict either problems before they occur or create new services for drivers.

The industry is undergoing a major transformation and finding the right partner with the experience, expertise and proven track-record to help on that journey will be the differentiator in a competitive market.

Closer collaboration is necessary between automotive and technology companies as connected vehicles branch out into the broader ecosystem. And by working together, firms can tap into skilled software engineers specialising in automotive technology with the vertical industry know-how to drive innovation and success in the industry.



Ta Tran Minh is vice president at FPT Software

MOTOR SPORT

RED IN THE CLOUDS

Oracle is using its cloud technology to help Red Bull design Formula One engines from 2026 onwards





Cloud technology has had a monumental impact on Red Bull's journey

Red Bull may be running away with this year's Formula One world championship, but history shows no team dominates for ever. And with regulation changes coming from the FIA regularly, it is a battle just to stand still.

For the Milton Keynes-based team, the situation is set for a major change in the 2026 season when, along with its junior team Scuderia Alpha Tauri, the company will by building its own hybrid power units under its subsidiary Red Bull Ford Powertrains (RBFPT).

In 2021, Red Bull announced its intent to become an independent power unit (PU) manufacturer for Formula One, and Red Bull Powertrains was born. This has now evolved into two distinct businesses – Red Bull Powertrains, which focuses on running the Honda-built PU specification for 2023 to 2025, and RBFPT, which has set an ambitious goal of developing 2026-specification PUs from scratch for Red Bull Racing and Scuderia Alpha Tauri. RBFPT will be one of only six manufacturers supplying engines for the F1 series in 2026.

The future supplier of hybrid power units is building its 100 per cent sustainable fuel engine with help from its main sponsor Oracle.

By running its most complex simulations on Oracle Cloud Infrastructure (OCI), the engineering team is taking advantage of cloud technologies to help overcome the difficulties of building a new business from the ground up.

OCI supplies massive processing power that allows RBFPT engineers to use digital simulations to evaluate concepts and refine designs before building a physical prototype. Using OCI, including bare metal compute and cluster networking, eliminated the expense and time required to implement large scale on-premises high performance computing (HPC).

This approach allowed the engineering team to get started on designing and delivering the high-performance and sustainable engine quickly and to scale-up resources as needed.

"Our powertrains team is operating at an incredibly high speed to debut competitive power units that use 100 per cent sustainable fuels by 2026," said Christian Horner, Oracle Red Bull Racing team principal. "Oracle gives us the best infrastructure and the expertise to integrate it with our processes, so we can accelerate our powertrain development and meet the substantial challenge ahead."

To ensure it had the highest levels of performance and data security, and could adjust the amount of processing power used almost instantly, RBFPT selected OCI to run the complicated calculations required to simulate the inner workings of a competitive race engine.

One of the biggest challenges facing the team in creating its 2026 PU was its design work started from scratch. Like most start-ups, RBFPT's design began with a blank sheet of paper that lacked the benefit of historical product data. Because the team is competing against established PU manufacturers, RBFPT needed to increase every technical advantage possible as it began the design process.

The newly formed team at RBFPT has been solely reliant on digital simulations to find the optimal shapes and configurations for the initial PU designs. Flexible infrastructure from OCI not only gave them the platform to achieve this, but also expanded to meet the needs of the growing team as it on-boarded a large number of engineers in just a few months.

Standard high performance OCI shapes are suitable for demanding tasks such as simulations needed to optimise the power unit for increased output while meeting F1's exacting requirements. OCI's high-performance shapes can network multiple servers together for HPC workloads such as computational fluid dynamics (CFD), which the team uses to model new engine combustion chambers rapidly and efficiently.

To support the engineering of its internal combustion engine, RBFPT runs specialised, mission-critical simulation tools including Convergent Science's Converge CFD software and a Siemens CFD platform on OCI. With its array of specialised tools, RBFPT can quickly predict the performance of various engine designs and set up simulations to help its engineering team more rapidly evaluate and refine options.

"Cloud technology has had a monumental impact on the Red Bull team's journey, from the fan experience to the engine design and beyond," said Karan Batta, vice president at OCI. "OCI has given Red Bull Ford Powertrains massive compute capacity to run and increase the scale of its workloads to deliver its next-generation hybrid engine by 2026. Oracle Red Bull Racing's continued success on and off the track is a testament to the versatility and performance of our cloud."

On the racetrack, Oracle continues to power the team's billions of race simulations that help improve race strategy and sharpen driver decision making. In addition, Red Bull uses OCI to benefit its Sim Racing team and is using Oracle Fusion Cloud CX to power fan engagement opportunities during 2023.



Christian Horner: "Our powertrains team is operating at an incredibly high speed."

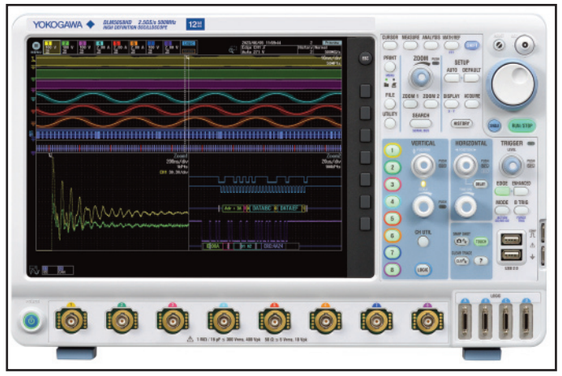
Oscilloscope tackles SiC needs

Power devices using silicon carbide (SiC) could benefit from Yokogawa's DLM5000HD oscilloscope.

It expands the firm's line with 500 and 350MHz frequency bandwidth models that deliver resolution for more accurate waveform analysis.

This scope is designed to meet needs resulting from the growing emphasis on measures to help decarbonise society with power devices using SiC technology.

There are two eight-channel and two four-channel models.



The series offers 12bit vertical resolution that is 16 times higher than that of the existing DLM5000 series, for more accuracy in waveform observation.

This is particularly beneficial for developers of inverters, enabling the accurate observation of minute changes in high-speed signals. This allows the detection of phenomena that can cause unexpected anomalies.

The serial bus analysis auto-setup function sets the optimal bit rate and threshold level. It can now be used with previously captured waveforms, such as low-frequency signals, improving the efficiency of in-vehicle bus development and evaluation.

It can store up to a billion points of acquired data, twice that of the DLM5000 series. This allows users to store history data on up to 200,000 captured waveforms as history waveforms.

This means a device can measure the behaviour of braking systems and other apparatuses that needs to be captured at a high sampling rate for several milliseconds, improving the efficiency of evaluation and analysis.

Measurements can be captured with up to 16 analogue channels and 64bit of logic (eight 8bit logic channels) by using the dual-unit synchronous measurement function to operate two eight-channel units.

This allows the simultaneous measurement of both analogue and logic signals to, for example, analyse numerous power-on sequences while debugging an ECU.

Target markets include car electronics in applications such as simultaneous measurement of analogue signals and bus signals based on Can, Can-FD and other in-vehicle standards.

Mosfets suit high-power ECUs

Automotive 60 and 120V mosfets from Infineon are available in TOLx packages for 24 to 72V supplied high-power ECUs.

In addition to passenger cars, two- and three-wheelers as well as light vehicles are being electrified.

Therefore, the automotive market for ECUs powered by 24 to 72V is expected to keep growing in the coming years.

To address this, Infineon is complementing its OptiMos 5 portfolio of automotive mosfets in the 60 and 120V range with products in the high-power TOLL, TOLG and TOLT packages.

They have a compact form factor with good thermal performance and switching behaviour.

The six additions offer a narrowed gate threshold voltage ($V_{GS(th)}$) enabling designs with parallel mosfets for increased output power capability.

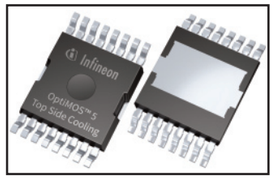
The IAUTN06S5N-008, 008G and 008T are 60V mosfets, and the IAUTN12S5N-017, 018G and 018T are 120V mosfets.

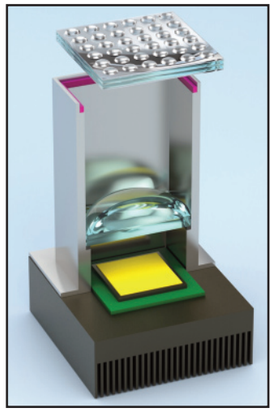
The on resistance ($R_{DS(on)}$) ranges from 1.7 to 1.8mΩ for the 120V mosfets and 0.8mΩ for the 60V units.

This makes the 60V devices suitable for high-power 24V supplied CAV applications or for HV-LV DC-DC converters in xEVs.

The 120V mosfets are for 48 to 72V supplied traction inverters for two- or three-wheelers and light electric vehicles.

Samples can be ordered now.





Microlens adhesive resists yellowing

An adhesive from Delo for automotive lighting applications is resistant to yellowing and, with its high aspect ratio, is particularly suitable for bonding microlens arrays, such as those found in headlights and projection systems.

Microlens arrays project LED light, which sits behind a very short focal length, providing sharp images and individual geometries. These systems are increasingly being used as optics in headlights and projection systems due to low required installation depth.

For increased efficiency, such microlenses are often made of optically pure polymers, in other words, adhesives. The microlens arrays are then fixed to a housing.

With a viscosity of 75,000mPa·s, Photobond OB4189 enables a high enough aspect ratio for the bonding process. The adhesive thus retains its shape after dispensing and does not flow, which is important for bonding microlens arrays.

It also resists yellowing, as shown by life cycle simulations of 500 hours at +140°C. This is essential for such optically demanding applications.

The modified acrylate is solvent-free and developed for a temperature of -40 to +120°C. Compressive shear strength is 30MPa on polycarbonate and 25MPa on PMMA.

It can be cured with UV (365nm) and visible light (400nm). The typical exposure time at 400nm with a layer thickness of 100μm is 5s.

Board suits motor control development

With the RDK4, Rutronik has expanded its portfolio of base and adapter boards.

It supports the development of motor control units by combining a microcontroller, a system base chip, and Can-FD and Lin automotive interfaces.

As a result, development departments of automotive OEMs or tier-ones do not need to design suitable hardware themselves but can test and implement applications for motor control units directly.

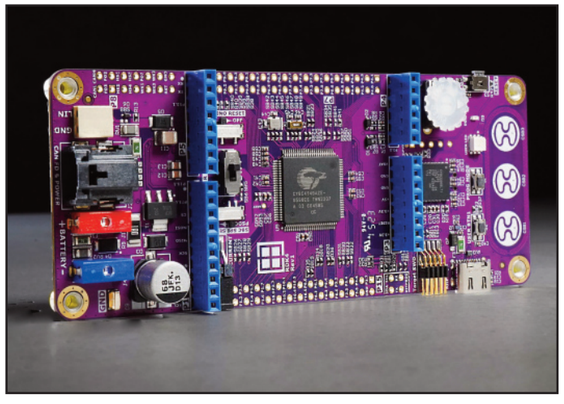
For this purpose, the RDK4 is integrated into Infineon's ModusToolbox development environment, where software examples are available.

A compact base board contains many relevant components for developing motor control units, so most applications can be tested in detail in the pre-development phase and reach market maturity more quickly.

Infineon's PSoC 4100S Max with an Arm Cortex-M0+ microcontroller is at the heart of the base board.

A system base chip is integrated into the base board in addition to the microcontroller. The built-in Optireg Mid-Range+ system base chip from Infineon provides integration, performance and scalability.

Interfaces Can-FD from Amphenol and Lin from Kyocera AVX are integrated into the board.



With the help of jumpers, it is also possible to measure selectively the power consumption of the microcontroller, for example, during different power modes.

Software examples are available in ModusToolbox and ensure efficiency gains in the development of applications for motor control units.

Developers benefit from the easy combination with other boards such as the HMS Anybus, text-to-speech, Rab1 and Rab2 thanks to the Arduino interface.

Boost and sepic controller enables PWM dimming

A boost single-ended primary inductance converter (sepic) controller from Diodes is for automotive LED applications.

The AL8853AQ is an automotive-compliant and integrated boost sepic controller for LED applications including exterior lights, headlamps, head-up displays (HUDs) and backlight displays.

Automotive headlamp manufacturers can use sepic topology to enable high or low beam LED array drivers that operate directly from a vehicle's battery, instead of using the conventional two-stage topology of a boost followed by a buck converter or a full-bridge buck-boost topology.

The sepic functionality supports buck-boost-like topology, which is suitable for HUDs.

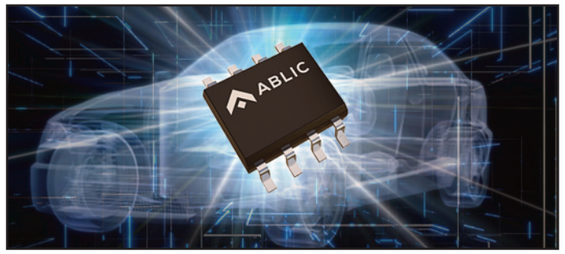
The input from 6 to 40V supports a typical 12V vehicle battery voltage input. Its 200mV feedback reference voltage has ±3% tolerance to maintain brightness control while improving efficiency.

The fixed 400kHz switching frequency supports low EMI by using a fundamental frequency outside the medium-wave band. In addition, this controller's 50kHz pulse width modulation (PWM) to analogue dimming mode (100% down to 1%) prevents visible low or high-frequency flickering usually associated with PWM dimming.

Protection features guard against unexpected overvoltage, overcurrent, overtemperature, and diode and inductor short-circuit events.

It is qualified to AEC-Q100 Grade One, manufactured in IATF 16949 certified facilities, is PPAP capable, and comes in an SO-8 package.





LDO combines high PSRR and fast response

An automotive high-withstand voltage LDO linear regulator IC from Ablic combines high power supply rejection ratio (PSRR) with fast transient response.

The S-19222 has a PSRR of 75dB at 1kHz which makes it capable of removing overlapping ripple noise in the input power supply to provide stable output voltage.

The fast transient response means it can provide stable voltage even in the event of major fluctuations in input voltage caused by cranking.

These features ensure stable operation even with smaller input and output capacitors, making it possible to use smaller components at lower costs.

It does not require the trade-off of higher current consumption normally required for high PSRR and fast transient response, but achieves a 22μA current consumption, contributing to lower standby current in ECUs.

It boasts 36V operation with a current consumption of 30μA or less as an LDO linear regulator IC.

The high PSRR helps it reduce overlapping ripple noise in the input power supply to contribute to more stable system operation. In addition, the IC input and output require fewer capacitors for connection, which contributes to lower costs.

Installing a buffer circuit in the error amplifier output makes it possible to reduce overshoot and undershoot events caused by transient fluctuations in the power supply voltage to 1/60th that of conventional models, achieving the fast transient response.

There are five package options including SOT-23-5 and a high-heat dissipating TO-252-5S(A). They will comply with AEC-Q100 Grade 0 reliability and PPAP.

Input voltage is 3.0 to 36.0V and internally set output voltage 1.8, 2.5, 3.0, 3.3, 5.0, 5.5 and 6.0V. Output voltage externally set is 1.8 to 30V.

BMS chipset handles 25 in-series cells

A battery monitoring chipset from Nuvoton measures the voltage and temperature of automotive battery cells and the current of a battery pack.

One IC can manage up to 25 in-series battery cells.

A redundancy measurement system and daisy-chain communication make it easier to develop and design a battery management system (BMS) in accordance with ISO 26262 Asil-D.

The stand-alone chipset detects abnormalities during car-parking or while the system sleeps, and starts a host microcontroller.

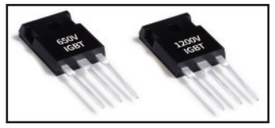
It can provide accurate estimation of a battery's state of charge (SoC) and state of health (SoH), ensured by synchronised current and voltage measurements within 10μs.

The chipset consists of a battery monitoring IC that measures the voltage and temperature of battery cells, a line of pack monitoring ICs that measures a battery pack's current and monitors its internal control, and a communication IC that serves as an interface with the ICs and a microcontroller.

The daisy-chain communication among chipset ICs adopts bi-directional ring communication to ensure continuous communication in case abnormalities are detected. This redundancy realises higher robustness, which suppresses communications disruption in case of failures.

A low power consumption mode regularly permits stand-alone monitoring of battery status while the microcontroller is in sleep state. In case abnormalities are detected in the temperature or voltage of the battery cells, the chipset wakes up the microcontroller using the daisy-chain communication to start the BMS.





PTC IGBTs

Magnachip has launched 1200 and 650V IGBTs for the positive temperature coefficient (PTC) heaters of electric vehicles.

Built on its field stop trench technology, the AMBQ40T-120RFRTH (1200V) and -65PHRTH (650V) provide a minimum short-circuit withstand time of 10μs. This level of ruggedness enables PTC heaters to be protected from a permanent failure in the event of overcurrent conditions.

The thick heat sink of the TO-247 package improves heat dissipation.

Upgrade simplifies fuzzing process

An upgrade to Autocrypt's automotive fuzzing software enables a wider testing range and more automation.

Version 2.0 of its Security Fuzzer allows automotive OEMs to benefit from a more simplified and efficient fuzzing process for UN R155 (WP.29) compliance.

The software was first released in December 2021 for the vehicular environment. Its fuzzing algorithms were built based on the structures of UDS, the communication protocol used in ECUs.

Version 2.0 expands the testing range beyond ECUs to include other protocols such as Can, wifi, Bluetooth Low Energy and Ethernet, which is a crucial component of software-defined vehicles.

The v2.0 platform also allows protocols to be added through software updates.

Offered through an intuitive UI, v2.0 improves the user experience, yet its biggest differentiation point is its smart fuzzing capabilities.

It accurately identifies the functions and technical specifications of each test target and generates test cases based on these characteristics, ensuring only relevant test cases are input into the programme.

Moreover, testing can be assigned at a project level, allowing for continuous testing for multiple ECUs. Even if an unexpected interruption occurs, the fuzzing process will continue based on its automation algorithms.

It offers diagnostics services and NRC support features based on ISO 14229, and provides support for all ISO-TP specifications as defined in ISO 15765.

Security Fuzzer is a component of the firm's in-vehicle systems (IVS) security offering providing end-to-end automotive cyber security that secures all stages of the vehicle lifecycle.

Options boost radar testing



Options have been added to a radar test system from Rohde & Schwarz that simulates driving scenarios for radar-based adas and radar sensors used in automated driving entirely over the air.

The options are for the AREG800A automotive radar echo generator and QAT100 antenna array. The system can generate extremely short distances for the artificial objects, and therefore enables realistic autonomous braking tests in a small distance.

It suits radar object simulation, from single sensor tests to 360° environments, covering 76 to 81GHz for automotive radar sensors. Its scalability and adaptability allow many adas traffic scenarios to be electronically generated along the whole testing lifecycle.

It can be used in benchtop development, hardware-in-the-loop and vehicle-in-the-loop.

From the automotive radar perspective, a higher instantaneous bandwidth improves the distance resolution. With the mm-wave remote frontends, the instantaneous bandwidth will be extended from 4GHz to 5GHz so users can measure automotive radars using a higher bandwidth.

Laterally, highly accurate moving objects can be simulated. A feature for near object range allows minimum distance of one or more artificial objects to be reduced down to the airgap value of the radar under test.

For the QAT100 is the option for enhanced flatness that contains a detailed characterisation of each antenna of the QAT frontends. With this option, the accuracy of the amplitude flatness of all antennas is improved.

Tests performed in real-world test drives can be relocated to the lab, enabling errors to be detected at an early stage and saving costs.

240GHz radar

A commercial fully integrated 240GHz radar front-end (RFE) silicon transceiver complements Indie Semiconductor's 76 to 81GHz radar for long range vehicle sensing.

The higher frequency-enabled precision of 240GHz radar is being used for emerging vehicle dynamics and monitoring applications, including assessment and control of air spring-based suspension settings, real-time road surface quality and hazards to adapt ride quality dynamically, and even implement fine grade monitoring of petrol tank levels.

The TRA240091 is a cascadable RFE with an operating bandwidth up to 45GHz at 240GHz. These enable high resolution for applications within the licence-free 244 to 246GHz ISM band and beyond.



Power module uses transfer moulding

Vitesco is developing a power module that will be made using a transfer moulding process.

During this process the power electronics are sealed under a dielectric material that protects the components. The result is a robust, cost effective and reliable.

The module consists of three overmoulded half-bridges and forms the core of an inverter system, which controls both the drive energy and the energy recovery (recuperation) in high-voltage electric vehicles.

The modules will be delivered to a large global car maker from mid-2025 onwards.

The firm has been adapting and using transfer moulding technology since 2020, first applying it to compact transmission control units for integration inside a gear box.

The overmould power modules now combine silicon carbide (SiC) with overmoulding to facilitate a robust product with increased power density and reduced weight.

Cmos image sensor tops pixel count

A cmos image sensor from Sony for automotive cameras is said to have the industry's highest pixel count, at 17.42 effective megapixels.

The IMX735 supports the development of automotive camera systems capable of sophisticated sensing and recognition performance. It enables high-definition capture of far-off objects.

Automotive cameras using this sensor more easily synchronise with mechanical scanning lidar, since their laser beams also scan horizontally.

This better synchronisation can improve the sensing and recognition capabilities of the automated driving system as a whole.

The sensor's improved saturation illuminance, made possible by a proprietary pixel structure and exposure method, yield a dynamic range of 106dB even when simultaneously employing high dynamic range (HDR) imaging and LED flicker mitigation.

The dynamic range is higher, at 130dB, when using dynamic range priority mode. This helps suppress highlight blow-outs even in backlit conditions, enabling more precise object capture in road environments with marked differences in brightness, such as tunnel entrances and exits.

The product is qualified to AEC-Q100 Grade 2. The development process complies with ISO 26262 at Asil B(D).

It supports cyber-security features such as camera authentication via a public-key algorithm to confirm cmos image sensor authenticity, image authentication to detect any tampering with acquired images, and communication authentication to detect any tampering with control communications.



The 236-pin BGA plastic package measures 14.54 by 17.34mm.

Editor and Publisher:
Steve Rogerson
editor@vehicle-electronics.biz

Advertising Manager:
Diane Trotman
diane@vehicle-electronics.biz

Web Site Manager:
Martin Wilson
admin@vehicle-electronics.biz

Published by: Vehicle Electronics Magazine,
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