VEHICLE electronics

The monthly magazine for automotive electronics engineers

Renesas fire worsens chip supply problems

A fire at a Renesas factory in Japan is worsening the already bad situation for automotive chip supplies.

The fire took place on 19 March halting the 300mm line in the N3 building of the Naka factory in Hitachinaka, Ibaraki prefecture.

Though the fire was extinguished the same day, production has stopped as the clean room will need major repairs and damaged equipment will need replacing. The aim is to resume production within a month.

There were no reported casualties.

Although approximately two-thirds of the products manufactured within the N3 building can be alternatively produced in-house or in foundries, due to the recent increase in demand for semiconductors, the situation does not allow for all of these products to be immediately produced elsewhere.

The halted production will cost Renesas around ¥17bn per month.

"We would like to give our sincerest apologies to neighbouring residents, customers, partner companies, relevant authorities and all those involved for the trouble the fire caused," said Hidetoshi Shibata, president and CEO of Renesas. "In addition, we would like to express our gratitude for the fire department and those who partook in the extinguishing of the fire."

The casing of the equipment and the plating tank have relatively low resistance to heat, and the equipment ignited due to overcurrent. However, the cause of the overcurrent and the reason for the ignition is being investigated.

The fire follows an earthquake in February that shut down production for three days.



Fire damage at Renesas factory in Japan

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Blackberry and Desay link on dual-screen control

Blackberry has teamed up with Desay SV Automotive to launch a dual-screen virtual smart cabin domain controller to enable safer driving.

Leveraging the QNX hypervisor and real-time operating system, the technology is available in Chinese car maker Chery's Tiggo 8 Plus and Jetour X90 models.

Developed and built on the Chery T1X platform, the Tiggo 8 Plus is Chery's flagship SUV, while the Jetour X90 is the brand's first Jetour vehicle equipped with the L2 intelligent automated driving system, providing drivers and passengers with a cinematic experience while on the road.

Both models have Desay's smart cabin domain controller, built on the QNX hypervisor, which provides the reliability and performance of the Neutrino rtos, while allowing multiple operating systems to co-exist safely on the same SoC.

With the hypervisor, developers can partition and isolate safety-critical and infotainment systems, ensuring the continued function of critical systems even if other components fail.

"Thanks to its advanced technology and rapid application abilities, Desay SV Automotive is well positioned to provide a smart cabin with a multi-sensory immersive experience," said John Wall, senior vice president at Blackberry. "Augmented with secure and reliable BlackBerry QNX technology, together we can address the diverse needs of an auto industry that is undergoing rapid transformation."

Based on virtual instrument software architecture, Desay has achieved multi-ECU integration, combining the integrated processing technology of multiple displays and creating a smart cabin.

Marelli SiC module for motorsports



Marelli has developed a SiC power module for electric and hybrid traction applications in motorsports. The technology is said to enable conversion efficiencies of up to 99.5%, with smaller size and weight.

Developed in the company's Corbetta facility in Italy, it uses direct cooling and could be a core building block for more efficient, compact and lighter inverters.

The module, called EDI for enhanced direct-cooling inverter, was developed by Marelli Motorsport with the Fraunhofer Institute for Reliability & Microintegration IZM and features an innovative structural design that reduces the thermal resistance between the SiC components themselves and the liquid coolant, thanks to a baseplate-less design. The result is a compact power stage that can exploit the efficiency advantage of silicon carbide.

Bosch turns to GF for mm-wave radar

Semiconductor manufacturer GlobalFoundries (GF) and Bosch have partnered to develop and manufacture automotive radar technology.

Bosch's aim is to develop a mm-wave automotive radar system-on-chip (SoC) for adas, manufactured using GF's 22FDX RF process.

"We are proud to partner with Bosch to develop a new generation of automotive radar, and to help make vehicles smarter and roads even safer than they are today," said Mike Hogan, senior vice president at GF.

GF's 22FDX chips are manufactured at its Fab One facility in Dresden, Germany.

"Dependable radar and adas are of paramount importance to drivers and automakers around the world," said Oliver Wolst, senior vice president at Bosch. "We chose to partner with GlobalFoundries for their proven leadership in RF and mm-wave technology, which is reinforced by their deep expertise in the automotive market. We carefully scrutinised the universe of available semiconductors, and GF's 22FDX RF proved to be today's most attractive and most appropriate platform for our next generation of highly efficient and safe automotive radars."

As part of the partnership, Bosch will use GF's automotive turnkey system for mm-wave testing and packaging development, which will assist in increasing design efficiency and speeding time to market. These post-fab and turnkey services will take place in Dresden and at GF's mm-wave testing lab at Fab Nine near Burlington, Vermont.



Cleanroom at GF's Fab One facility in Dresden

The first 22FDX-based radar SoCs for further testing of Bosch's automotive radars are targeted for delivery in the second half of 2021.

To date, GF's 22FDX has realised $4.5bn in design wins, with more than 350 million chips shipped around the world.

Cognizant acquires ESG Mobility

Cognizant is acquiring German firm ESG Mobility, a digital automotive engineering R&D provider for connected, autonomous and electric vehicles.

ESG Mobility is a subsidiary of ESG Elektroniksystem & Logistik, a privately-held technology consultancy for the design, integration and operation of complex, security-related electronic and IT systems.

Upon the close of the acquisition, around 1000 engineering R&D specialists will join Cognizant in the automotive innovation hubs of Germany, USA and China.

The acquisition will expand Cognizant's automotive engineering expertise, particularly in connected vehicles.

"The automotive industry is undergoing a fundamental shift, embracing new mobility concepts that rely heavily on software, connectivity and artificial intelligence," said Malcolm Frank, technology president at Cognizant. "Our priority is providing clients with the capabilities they need to compete as modern digital businesses, and ESG is a natural complement to our existing connected mobility offerings and global delivery model."

Together, Cognizant and ESG will provide engineering services to eight of the world's top ten automotive OEMs.

ESG Mobility provides services across the automotive software stack with strengths in electrical and electronic systems and connected vehicle applications, as well as emerging capabilities for autonomous and electric vehicles.

"We have built a world-class team of engineering R&D and technology consultants who deeply understand our automotive clients in Germany and around the world," said Jörg Ohlsen, CEO of ESG Mobility. "By joining Cognizant, we can provide a higher quality of service, build more innovative products and support a broader range of digital initiatives for our current and future customers."

LDRA and PTC aid critical software development

LDRA has partnered with PTC to reduce the cost of compliance for critical embedded software developers who must adhere to functional safety and security standards.

The integration between the LDRA tool suite and PTC's Windchill RV&S provides the capability to perform bidirectional traceability, standards compliance, and automated software quality analysis and verification throughout the development lifecycle, saving time and money for those who need to demonstrate compliance.

"Customers in automotive, medical, aerospace and defence are leveraging PTC's Windchill RV&S to achieve higher levels of requirements, source code, and test case management and traceability," said Ian Hennell, LDRA operations director. "Through this partnership, enterprises can quickly link the Windchill RV&S artefacts into the software quality and verification workflow. By enabling customers to determine quickly the impact of requirements changes and verify the implementation to those changes, we help customers to see tangible results and save time and money."

The integration is enabled by the LDRA TBmanager integration pack for PTC. From a workflow perspective, Windchill RV&S can gather, author, approve and manage requirements, test cases and code.

The LDRA tool suite links those requirements to the software analysis and verification process, enabling the tool suite to help identify and eliminate software flaws and vulnerabilities. Developers can use both in-depth static and dynamic code analysis to verify the code, including checking for coding standards compliance such as Misra and Cert compliance, as well as structural coverage analysis.

They can also perform automated test case generation and execution on the code within the LDRA tool suite and feed the results of those tests into Windchill RV&S to achieve bidirectional linkage and traceability.



Nexperia works with UAES on developing GaN devices

Nexperia is working with China's United Automotive Electronic Systems (UAES) to develop gallium nitride (GaN) power semiconductor devices.

The programme will focus on power systems for electric vehicles, with the aim to develop automotive applications using GaN technology.

UAES has started using Nexperia GaN fets in its research and collaborative projects including vehicle-mounted chargers and high-voltage DC-DC converters for electric cars. The technology has good figures of merit and reverse recovery charge metrics that support high switching frequencies and efficient power conversion.

Nexperia produces GaN based on mature and reliable mass production techniques, largely in its own global production facilities, to manufacture products according to AEC-Q101 standards.

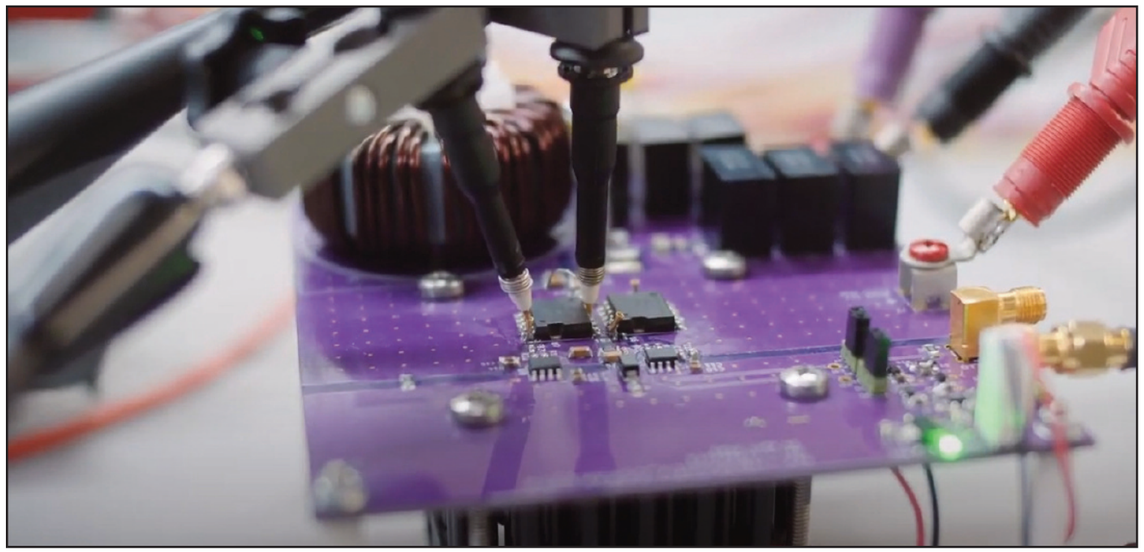
"The power density and efficiency of silicon-based GaN field-effect transistors will play key roles in the electrification of cars," said Paul Zhang, senior vice president for Nexperia in China. "We recognise the broad offering, industry position and customer basis that UAES has in the automotive industry and we believe that our intensified collaboration in GaN will help both companies to deliver more advanced and efficient EV power systems to our customers."

Earlier this month, Nexperia announced an increase in global production and R&D investment to support product development. It intends to expand its investments and jointly create a laboratory to develop automotive GaN technology applications.

UAES provides car manufacturers with powertrain and body control systems. It specialises in the development, production and sales of petrol engine management systems, transmission control systems, vehicle body electronics, and hybrid and electric drive controls.

Its five technology centres in China have laboratories for entire vehicles, engines, automatic transmissions and electric drive performance development. The equipment provides engineering services including system development, component development and calibration for various Chinese car makers.

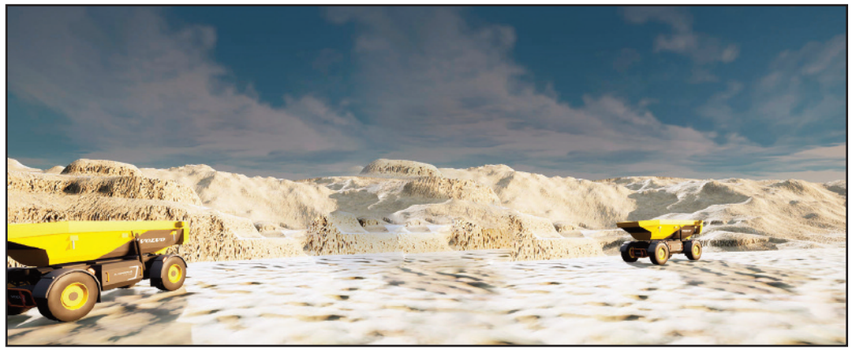
"We are pleased to work with Nexperia on the development of innovative EV vehicle power systems based on GaN technology," said a UAES spokesperson. "Nexperia is a leading semiconductor supplier for automotive applications. This partnership will help us to reduce the number of devices used, reduce costs, increase power density, and increase the reliability and effectiveness of the entire system."



Nexperia GaN demonstration board

Volvo and Foretellix partner on autonomous driving verification

Volvo has agreed with verification firm Foretellix to address large-scale verification of autonomous driving on highways and in confined areas such as mines.



Verification is for highways and confined areas such as mines and quarries

The two companies are creating coverage driven verification for autonomous driving that will enable massive scale testing of millions of different scenarios, which will validate autonomous vehicles and machines dealing with anything they might encounter within their specified operational design domain.

The partnership will focus on providing safety and productivity for vehicles and machines. The ability to orchestrate large-scale simulation and conduct the big data analysis required should reduce costs and time to market.

Foretellix has developed a verification platform that uses intelligent automation and big data analytics tools that coordinate and monitor millions of driving scenarios to expose bugs and edge cases, including the most extreme cases.

Volvo will adapt this for highways and confined area applications, such as mines and quarries.

It will use the M-SDL open measurable scenario description language created by Foretellix.

This can simplify the capture, reuse and sharing of scenarios, and can specify any mix of scenarios and operating conditions to identify previously unknown hazards.

"This partnership is a significant milestone for the industry as it is the first time that large scale coverage driven verification will be used for verification of autonomous driving in confined areas," said Ziv Binyamini, CEO of Foretellix. "Our partnership will combine the expertise of the two companies and set a new standard in the verification of automated driving systems, boosting both safety and productivity."

In 2020 both companies conducted a successful pre-study that evaluated the Foretellix portfolio and its potential value in confined areas.

Rohm and Sanden Huayu set up joint lab

Rohm and automotive air-conditioning maker Sanden Huayu have established a joint laboratory at Sanden Huayu's headquarters in Shanghai.

Since 2018, the two firms have exchanged technology and collaborated on developing applications with power devices, such as IGBTs.

Electric compressors using Rohm IGBTs and peripheral components have been in mass production since October.

This laboratory contains equipment for evaluating devices and automotive applications, primarily air conditioning. Going forward, the firms plan to strengthen their relationship to accelerate development by evaluating power devices and intelligent power modules that combine driver ICs with peripheral components.

"After over two years of technical exchanges, we have been able to develop and mass produce IGBT-equipped automotive applications this year," said Yao Yi, Sanden Huayu assistant manager.

Kazuhide Ino, corporate officer at Rohm, added: "Rohm has been developing power devices in fields from silicon IGBTs and mosfets to SiC power devices, and boasts a track record of combining peripheral components such as driver ICs."

Etas and LHP provide Autosar training

Etas and LHP Engineering are collaborating to deliver Autosar training courses for the automotive industry.

Receiving hands-on experience using software tools is one way to help skill up and repurpose engineering teams, which also aids in retention.

With increasing demand for training, LHP and Etas are collaborating to become a driving force for providing Autosar courses that ramp up automotive engineers.

Through discussions and hands-on practice, skillsets can be developed for building Autosar applications, identifying and integrating complex drivers, and developing a deeper awareness of the impact Autosar has on organisations.

Each engineer is provided with a temporary Etas Isolar A/B software licence for the duration of the training course.

"With a premier software provider like Etas collaborating with a premier integrator like LHP, embedded engineers are provided a hands-on opportunity to practice using the Isolar toolset, taught by instructors who implement Autosar strategies on a daily basis," said Pamela Tartt, director at LHP.

As product innovation in the automotive space has been steadily moving from hardware design to software development, exponential growth in software has driven corresponding growth in software complexity.

Companies such as Etas and LHP hope to bridge the skills gap through training and development to meet the demand for a strong technical workforce in automotive.

"There are more than two billion electronic control units with our Autosar-based software in vehicles today," said Eric Cesa, general manager at Etas. "Pairing our expertise in Autosar Classic and Adaptive architectures with LHP's extensive knowledge of integrating Autosar results in a powerhouse source of training and education for industry engineers."

Natural dialogue in BMW iDrive



BMW has updated its iDrive. What began 20 years ago as a rotary dial and a digital display is now an all-encompassing, intelligent, multi-sensory experience tailored to the user at hand.

The big shift is to using natural dialogue between the user and their vehicle; this is said to be more intuitive, personal and inspiring, and also engaging on an emotional level.

The latest version of BMW's operating system lets the vehicle actively engage in its relationship with those on board and, in so doing, serves as a digital, intelligent and proactive partner. Natural dialogue is created with the aim of precisely tailoring all the functions controlled via iDrive to the driver's needs and preferences as the situation demands.

Underpinning the BMW Operating System 8 are displays, controls and software, as well as connectivity and data processing.

The iDrive will be rolled out gradually across all vehicle classes, making its debut later this year in the BMW iX before also featuring in the i4.



Hesai's lidars suit Kodiak's mirror pods

Kodiak integrates Hesai lidar into mirror pods

Kodiak Robotics is integrating 360˚ scanning lidars from Hesai Technology into its patent-pending mirror pods.

Hesai develops lidar technology to handle real-world autonomous vehicle deployment. With their long-range capabilities, the lidars can enhance the side- and rear-view capability and redundancy of Kodiak Vision, a principles-based perception system that increases the value of lidar, cameras and radar.

Kodiak has built its technology for deployment as a level-four autonomous trucking product, not as a proof-of-concept. Hesai's lidars can feed Kodiak Vision with actionable data under a wide range of conditions, including the tough environments Kodiak sees on Texas highways.

"Kodiak's partnership with Hesai will be critical to making autonomous trucking a reality in the very near future," said Don Burnette, Kodiak's CEO. "Hesai's lidars have the reliability and performance we need to deploy the Kodiak Driver in the harsh conditions common in long-haul trucking."

David Li, Hesai's CEO, added: "Kodiak is an industry leader in thoughtfully integrating sensor technology into self-driving stacks, and has built a principles-based perception system designed to get the most out of every sensing modality. Together, we can build one of the industry's most capable and reliable self-driving solutions."

Innoviz starts shipping lidar perception platform

Innoviz Technologies has started shipping its automotive perception platform to BMW and other car makers, helping them accelerate consumer autonomous vehicle programmes globally.

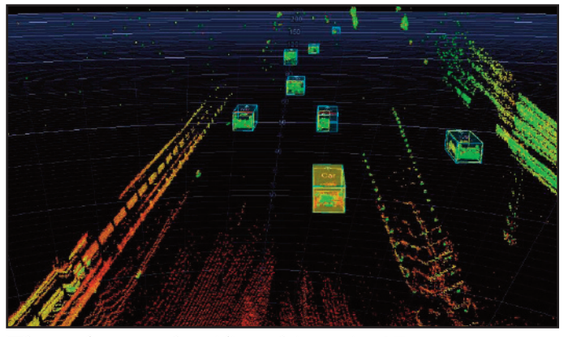
The provider of solid-state lidar sensors and perception software has released the InnovizApp, which includes automotive-grade hardware and software that help autonomous vehicles identify and classify objects.

The platform is based on the firm's perception software, which leverages data from lidar sensors coupled with proprietary AI algorithms to analyse the point cloud and estimate an object's speed with precision.

The software can detect and classify objects in any 3D driving scene up to 250m away, including cars, lorries, motorcycles and pedestrians. It also executes perception algorithms in real time, detecting and classifying pixels as collision or non-collision relevant.

The hardware provides a reference design based on low-cost automotive-grade components. It connects to existing vehicle systems and enables real-time perception in a plug-and-play manner, so automakers can test and learn how to build their own autonomous driving systems.

"InnovizApp is a true technology breakthrough, offering an adaptable automotive-grade chip and platform that can be incorporated into existing vehicles," said Omer Keilaf, CEO of Innoviz. "We developed it in response to requests from major automakers, and our customers in Asia, Europe and North America are already optimising their AV programmes with this platform, which is rapidly becoming the gold standard for customer validation."



The software classifies objects in 3D scenes



Time-of-flight ghosting correction

Melexis licenses Chronoptics time-of-flight IP

Melexis has entered a licence agreement with Chronoptics, a New Zealand-based specialist in the design and integration of time-of-flight 3D cameras.

The agreement gives Melexis exclusive use of Chronoptics' multipath and linearity error correction technologies in automotive applications. This includes adas for autonomous vehicles, and interior monitoring and safety systems. The companies will also work together to improve and deploy the technology in the automotive market.

Multipath interference in time-of-flight cameras can sometimes lead to inaccurate depth measurements, such as when a wide field-of-view (FoV) is used, or when the scene contains highly reflective objects.

It is typically caused by stray light and scattering due to bright reflections in the scene.

Chronoptics' patented multipath correction technology recovers the correct depth values to produce accurate and robust point clouds even in challenging scenarios. Future vehicle applications are set to demand an even wider FoV.

"These new IPs will be available for evaluation in our time-of-flight reference design," said Damien Macq, vice president at Melexis. "Our third-generation ToF sensors are a breakthrough in terms of sensor performance, and this innovative technology along with other Melexis IP will further enhance system level performance."

Richard Conroy, CEO of Chronoptics, added: "We are experts in tailoring fit-for-purpose 3D cameras that leverage our patented depth pipeline technologies and know-how to deliver clean and accurate 3D data for any application."

LG and Luxoft set up automotive electronics joint venture

LG Electronics and Luxoft have set up a joint venture called Alluto aimed at bringing digital, consumer-grade technology to automotive.

Headquartered in Santa Clara, California, Alluto will drive the commercialisation of production-ready digital cockpit, in-vehicle infotainment, passenger-seat entertainment and ride-hailing systems based on the WebOs Auto platform.



Adam Woolway

WebOs Auto 2.0 offers access to a growing number of in-vehicle and connected services and brings control and convenience through head unit functionality.

In-vehicle features and functionality incorporate essential components such as multimedia processing, multi-display control, connectivity and security to improve comfort and convenience to passengers and drivers.

"With Alluto, car makers can now tap into the vibrant WebOS ecosystem from the edge to cloud and have a new, powerful alternative to innovate and differentiate future mobility experiences," said IP Park, president and CTO of LG Electronics.

As a customisable and scalable platform, WebOS Auto lets OEMs create their own user experience.

"WebOS Auto is not only an attractive platform but also a blueprint for the complete digital vehicle," said Dmitry Loschinin, Luxoft. CEO

Adam Woolway will be CEO of Alluto. He was CEO and co-founder of Plugsurfing.

"Combining WebOS with the industry leading technology of Luxoft represents an unprecedented offering and resource for the automotive market," said Woolway.

Here and Unity collaborate on in-vehicle 3D experience

Unity, a platform for creating and operating real-time 3D content, is working with location data company Here Technologies to develop embedded automotive HMIs with 3D rendering.

The collaboration will extend to work on location technology for autonomous driving, simulations, city planning and digital twins.

To showcase the combined capabilities, the partners developed a proof-of-concept embedded in-vehicle-infotainment system.

Created on Unity's platform and featuring Here 3D city data, it shows a futuristic, wide-screen navigation experience of a 3D map of San Francisco and demonstrates what can be achieved with HMI workflow design improvements.

Here has mapped in 3D more than 70 major cities in the USA, Europe and Asia with plans eventually to offer global 3D map coverage.

"Car buyers now care more about interactivity with their vehicle than horsepower or fuel-efficiency," said Julien Faure, vice president at Unity. "Unity's work with Here opens up the ability to meet consumer demand, providing a continuous user experience across all displays powered by Unity and our ecosystem. By working with industry leaders like Here, we feel that Unity has the potential to power dynamic infotainment, immersive augmentation, and geospatial and media experiences all integrated into a seamless user experience."

While several dedicated HMIs exist, this collaboration will combine elements of automotive-grade map data and services with a real-time 3D engine that brings dynamic, high-end design capabilities to the user experience for maps, infotainment and more.

"The goal of our collaboration with Unity is to meet our customers' desire for an in-car navigation experience that's an engaging representation of reality," said Jorgen Behrens, chief product officer at Here. "Unity's robust 3D rendering engine makes Here 3D city data, route guidance and navigation look impressive, providing a rich and immersive in-dash experience to the driver."

The proof-of-concept application runs on Qualcomm Snapdragon and, last year, Unity announced collaborations with multiple companies across the HMI ecosystem, including Elektrobit and NXP.

Here is owned by Mercedes-Benz, BMW, Audi, Mitsubishi, NTT, Intel, Bosch, Continental and Pioneer.



Here and Unity proof-of-concept embedded in-vehicle-infotainment

Socionext licenses Inova display technology

Socionext has licensed Apix 3 technology from Inova Semiconductors for its smart display controllers.

The display controllers will be used in vehicles from 2025 or 2026 and the first samples will be available by 2Q 2022.

Features include a repeater function where several graphic controllers can be cascaded. This enables architectures such as panoramic displays in the dashboard where there is a trend towards larger or multi-display applications.

Local dimming and warping-on-the-fly will be implemented.

Apix (automotive pixel link) is 12Gbit/s serdes technology for automotive video applications. It is available from Inova as proprietary chips and as IP for licensing.

Apix 3 offers operating modes of 1.5, 3, 6 and up to 12Gbit/s bandwidth.

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Vayyar radar spots children left in cars

Vayyar, a specialist in 4D imaging radar, has developed a single radar-on-chip (RoC) that covers the entire cabin of any passenger vehicle.

The production-ready in-car sensor is designed to cover up to three rows. It can also accommodate cars with sunroofs, thanks to uniform rear ceiling installation, and can monitor every seat, all footwells and open boot area.

Around 200 children die each year from vehicular heatstroke after being left unattended in cars. These can occur in minutes since on days as cool as 22˚C, the inside of a car, especially one equipped with a sunroof, can quickly reach 47˚C.

Vayyar offers OEMs and tier-one suppliers a child presence detection (CPD) and seat-belt reminder (SBR) combo to meet Euro NCap's 2023 and 2025 safety scoring protocols. The platform detects occupants, classifying children and adults, and detects posture and position.

"With SUVs making up over 40% of vehicle sales in many countries, complete cabin coverage is crucial," said Ian Podkamien, head of automotive at Vayyar. "Three-row CPD for all vehicles, including those with sunroofs, will help prevent hot-car incidents, while enhanced SBR will save thousands more lives by ensuring that all passengers wear seat belts. And with just one affordable sensor for both functions, high-end safety is now available to all vehicles."

The full-cabin sensor is operational in all lighting and weather conditions and maintains privacy since no cameras are involved. The wide field of view and resolution are provided by the 48 transceivers in each sensor.

Vehicles with sunroofs have presented difficulties for in-cabin sensor positioning. With no option of fitting a sensor in the centre of the ceiling, manufacturers had to make do with sub-optimal installations. Now OEMs can install one sensor in the rear ceiling area, covering the entire interior of any passenger vehicle, with or without a sunroof.



Vayyar radar-on-chip covers entire cabin

The platform is AEC-Q100 qualified and Asil-B compliant and supports over-the-air software updates.

A 4D point cloud API lets users independently develop and deploy additional safety features over the point cloud layer. These include occupant status, optimised airbag deployment and dynamic disabling, seat belt pretensioning, ecall, gesture recognition, out-of-position detection, and intruder detection.

TÜV SÜD certifies IAR build tools for functional safety

Build tools from IAR supporting deployment in Linux-based frameworks have been certified by TÜV SÜD for functional safety development.

The certification covers build tools for Linux for Arm, and has been performed according to the requirements of IEC 61508, the international umbrella standard for functional safety, as well as ISO 26262 for automotive safety-related systems, and others.

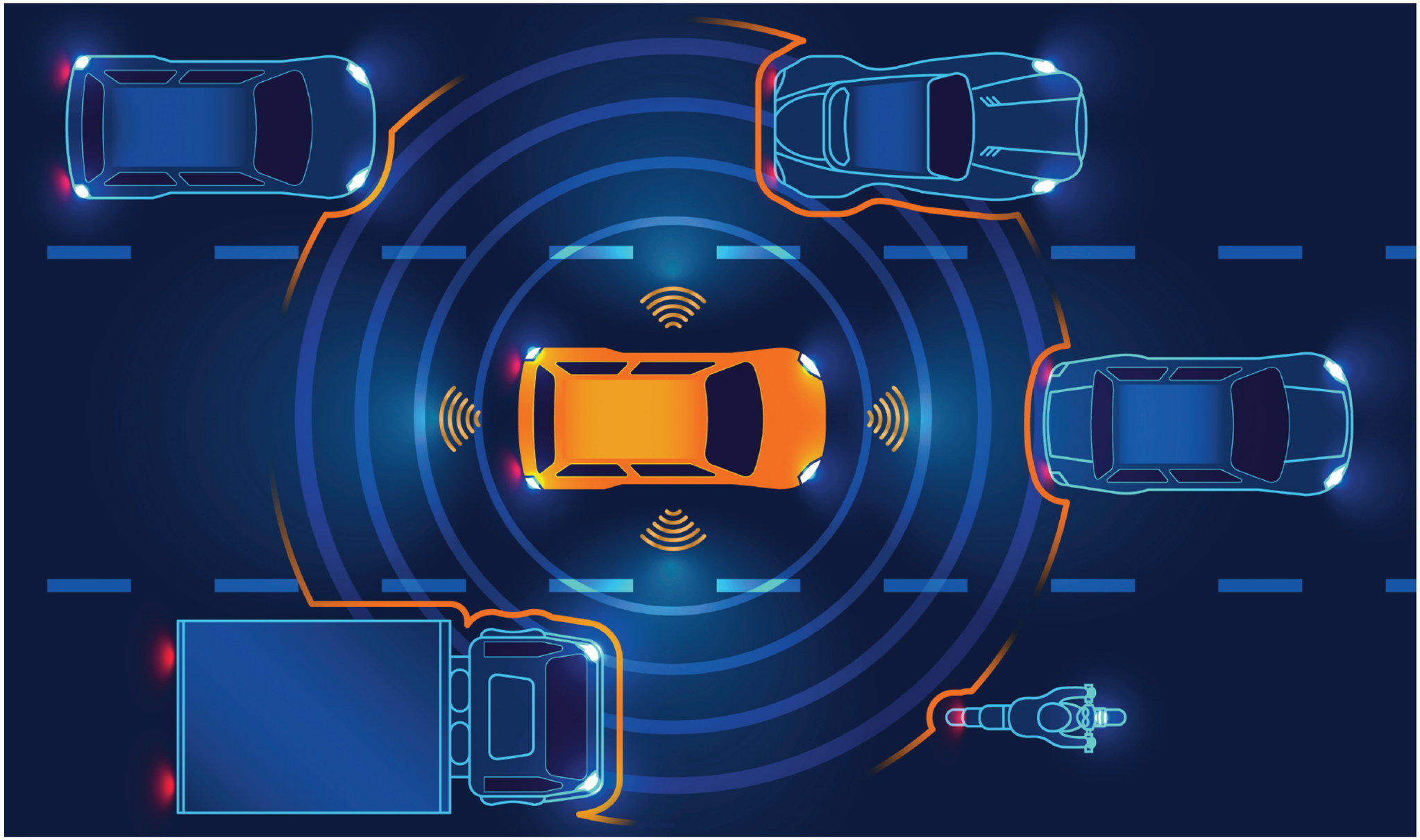
The tools can be integrated into different build systems, such as CMake and Ninja, and the command line build utility IARBuild streamlines building for integration with continuous integration engines such as Jenkins and Bamboo, or with docker containers.

With the integrated static analysis tool C-Stat, developers can ensure code quality throughout development and testing. C-Stat proves code alignment with standards such as Misra C: 2004 and 2012, and Misra C++: 2008, and detects defects, bugs and security vulnerabilities as defined by Cert C and the Common Weakness Enumeration.

The functional safety edition includes a functional safety certificate, a safety report from TÜV SÜD and a safety manual.

With the certified tools, IAR provides a functional safety support and update agreement with guaranteed support for the sold version for the longevity of the contract. Along with prioritised technical support, the agreement includes access to validated service packs and regular reports of known deviations and problems.

SOFTWARE TOOLS



FIRST STEP TO AUTONOMY

Stan Schneider looks at the role of the Data Distribution Service (DDS) standard in autonomous vehicles

Autonomous vehicles that can do everything drivers can do are probably still decades away. While it's new to our roads, the technology behind autonomy has been developing for years in flying drones, robotics, underwater vehicles and military systems.

These systems do not try to operate without humans, they leverage humans through remote human assistance, or teleoperation. The automotive industry can also use these techniques to put highly autonomous vehicles on the roads much sooner.

Autonomous vehicle (AV) safety is not perfect, but it will soon be better than human drivers. Humans overall are by far the weakest safety system in the car, responsible for 94% of collisions. AVs will certainly make mistakes that humans would not, but AVs are improving rapidly. Safe operation will not likely be the main business blocker.

But safety is not enough. Compelling economics require driving without a human in the car. The big wins are eliminating parking, automating delivery and enabling shared robotaxis. To do any of these, AVs must be able to handle corner cases. We can't have AVs stuck and blocking traffic whenever there's construction or an accident scene they don't know how to navigate around, see Fig. 1.

High-speed connections could allow a remote operator to drive the vehicle, also known as live teleoperation. This requires live video communications to the operator and low-latency control signals back to the AV. This requires a very fast, reliable, delay-free, pervasive network. Widespread 5G is years away, so live teleoperation should be thought of as a future nice to have as opposed to current enabling infrastructure.

There is a more near-term answer. Successful autonomous systems in other industries also run into corner cases they cannot handle. They use humans to assist operation via remote control. The most proven way to do this is strategic teleoperation. These

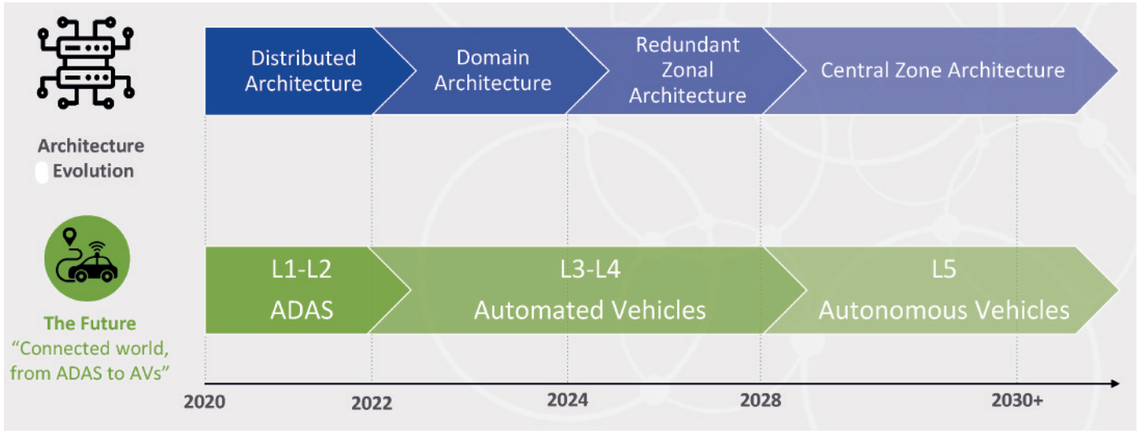


Fig. 1: Future of mobility: Software architecture

systems work by providing a look at the scene to a remote human operator, who indicates a path to follow. This works with low bandwidth and high latency. This for instance, lets Nasa drive robots on Mars despite tiny bandwidth and 20-minute latencies. This help-from-a distance strategy can work for AVs with even minimal network connectivity.

Architecture in the car

Autonomy should be seen as an evolution. Systems become more autonomous as they can handle increased time and increased complexity without human intervention. The challenge today is to build an architecture that can track this evolution. Changing architectures is extraordinarily painful.

The first practical AVs will combine both in-vehicle control and remote oversight. Today, most developers and system architects do not consider the implications of intimately connecting these systems. But they should not be designed independently. AVs need one consistent architecture for the vehicle, control centre, wide-area connectivity and cloud.

Inside the vehicle, AVs work by connecting sensors to high-performance processors running control algorithms, see Fig. 2.

Vehicle software needs real-time delivery for many different types and flow of data. Some sensors such as video and lidar produce copious data. Others such as steering and braking control produce less data, but need fast, repeated feedback loops. The intelligent algorithms need to find and access easily data of many types, sizes and speeds. All these systems run in a complex environment with many different types of processors and networks.

Autonomy may be just around the corner, but it's clear it cannot be done with the traditional automotive architecture. Today's designs are far too rigid, far too dependent on hardware implementation, and unproven in intelligent systems.

Cloud

The role of the cloud in autonomy is often overstated. Relying on a cloud connection for teleoperations control or safety functions would require sending all sensor information to the cloud, processing it and getting it back to the vehicle fast enough to react to external events. This requires latency guarantees and reserved compute bandwidth well beyond likely capabilities. The cloud's strengths of central location, elastic general computing and storage simply aren't valuable in an AV.

Nonetheless, the cloud plays important roles. For instance, AI algorithms learn by processing training sets, which are snippets of time where there is some interesting action, such as an accident. Deep learning works (roughly) by taking those training sets, having a human or other system determine what to do in that case and then using that to teach the AI.

Thus, AI cars do not learn themselves; they get the trained AI results from a central source. Every AV learns from the experiences of the other AVs. The entire fleet then learns from each event and improves over time.

Since the cloud also has access to all vehicles and the control centre, it's the right place to run fleet management software, collect and disseminate road status, and dispatch field personnel to the vehicles. The cloud is a critical part of an AV system, but it's only a part.

Control centre

Teleoperation, of course, requires more than in-vehicle and cloud software; it needs someone to teleoperate the vehicle. A control centre for an AV fleet may need to employ hundreds of operators and monitor many thousands of vehicles.

When an AV needs attention, it will be assigned to an operator. The operator may request live sensor feeds, historical information, and vehicle status and routing. Thus, each station needs access to most any data from across the system, without the ability to predict what particular information is needed ahead of time. Other stations will monitor overall system status and fleet deployment.

While the AV fleet case will have unique challenges, these types of control centre demands are typical of many systems.

Architecture

So how can this come together into a future proof architecture? The real challenge is to start from today's technology and evolve to the highly capable autonomy of the future without changing the core architecture.

Inside the vehicle, the industry is migrating to a common connectivity standard called the Data Distribution Service (DDS). DDS is an end-to-end system-wide architecture based on a standard. It offers flexibility, performance and reliability in thousands of real-world systems and smart machines.

In particular, it's already used by hundreds of autonomous vehicle designs. DDS evolved specifically for autonomous systems, first in high-end flight systems, now increasingly in ground, space and underwater vehicles.

The two most popular in-vehicle stack ecosystems, research-oriented ROS2 and production-oriented Autosar Adaptive, also use DDS. The industry consolidation around DDS means that it's the least-risk choice for new designs.

Interestingly, DDS is also a well-proven architecture for many operational control centres. Examples include the combat management operations centres for navy surface ships, most drone ground-control systems, Nasa KSC's launch control firing room, and power monitoring control rooms for hydropower plants.

In transportation, DDS monitors and controls train systems, metro rail, air traffic control and airport ground systems. Because it's already proven in both AVs and control centres, DDS is well positioned to take on the teleoperation use case for autonomous vehicles.

Data centric

Although it transports information, DDS is more than a connectivity technology. It's best to think of DDS as a data-centric architecture. It implements a simple concept: a shared global

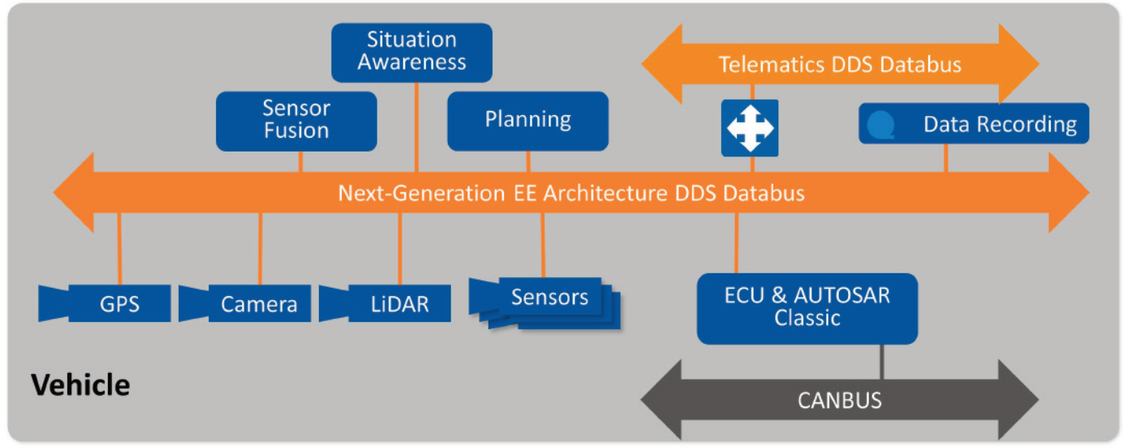
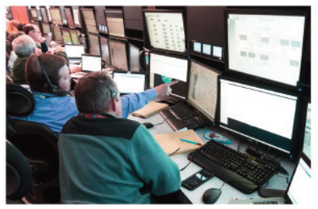
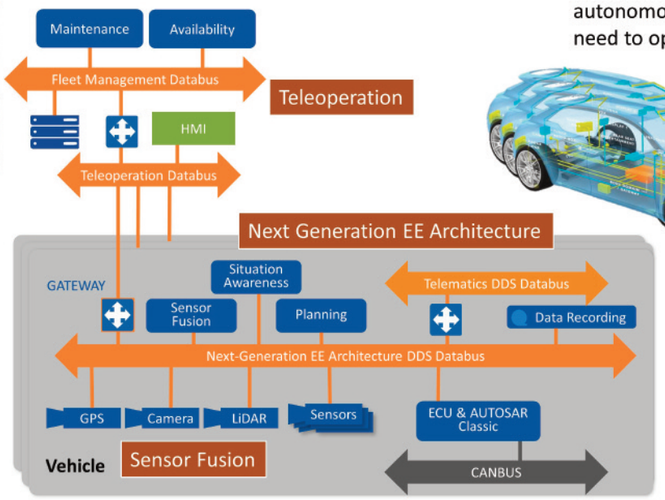


Fig. 2: The system must fuse sensing, awareness and planning to determine actions; it then controls the vehicle through a hardware interface platform



DDS operates control rooms for teleoperation



DDS delivers the data autonomous vehicles need to operate

Fig. 3: DDS is well-proven for both on-vehicle and control-room use cases and provides a consistent data model throughout the system; data routing between levels helps build reliable, large-scale infrastructure

data space. This means all data appear to be inside every device and algorithm in local virtual memory. Applications don't talk directly to each other; they exchange data by reading and writing this virtual shared memory. This is a very new design for vehicle systems.

In the vehicle, the emphasis is on high-speed connection, reliability and AI integration. DDS does these with quality of service (QoS) guarantees.

For instance, when an algorithm requests a data flow, it specifies more than just what data it wants. It can also set when and how data flow. For instance, there are QoS guarantees for flow rate, sensor liveliness, reliability and more. Because the data appear to be in local memory, mobility does not complicate the flow. Applications get the data needed, when needed, no matter where they are, even as the vehicle changes networks.

Control centres need a consistent data model and dynamic access to many types of data. Importantly, when an operator accesses a new vehicle, control centre operators need a dynamic, reliable, secure connection to the vehicle. DDS makes this easier by automatically discovering vehicles and data, by securing individual flows with clear permissions and by implementing reliability and security-certificate exchange independently of the transport network, see Fig. 3.

Finally, cloud algorithms need massive data access that scales across an entire fleet. Because each algorithm in a data-centric design sees only what appears as its own local memory, adding scale does not drive complexity.

DDS can also work with direct peer-to-peer networking, requiring no central servers. This eliminates the difficult choice of where to put a server, ends worry about overloading servers and obviates server failover schemes. From the system point of view, all algorithms and devices simply send and receive exactly what they need, when they need it.

Most importantly, by using the same abstraction, data centricity lets systems evolve as a whole. As long the underlying connectivity can satisfy the QoS demands, entire functions can move from vehicle devices, to in-car domain servers, or to the cloud transparently.

The DDS standard originated in autonomous systems. Today, it's the clear leader for both in-vehicle frameworks, for emerging ecosystems, and for control centres. In the future, it can combine these for automotive systems as it has in other industries. The consistent system-wide data model is truly a new architecture. It enables an evolving distributed system that can grow with the future of autonomy.



Stan Schneider is CEO at Real-Time Innovations (RTI)



How Hongjing Drive built an L1 to L4 full-stack autonomous driving system

For autonomous vehicles to meet strict requirements for safety, power consumption and cost, the domain controller, which acts as the car's brain, must perform to higher technical standards. Apart from industry giants such as Tesla, few players have a commercial system in this segment.

Hongjing Drive, founded in 2018, however, is one of the pioneers in the area of autonomous driving domain controllers.

Hongjing is a full-stack autonomous driving system provider committed to developing the computation platform required for autonomous driving. With experience in hardware and software, as well as autonomous driving system integration, the company is enabling the complete lifecycle of L1 to L4+ intelligent driving innovation.

Hongjing has received nearly RMB100m in pre-A round funding. It is headquartered in Hangzhou, China, with R&D facilities in Shanghai, Hefei and Detroit.

Hongjing was looking to enter the autonomous driving market with an automotive domain-controller (ADCU) that supported L3 or higher autonomous driving systems. Compared with traditional distributed control systems such as L0 to L2 adas, L3 and higher level autonomous driving systems are a great leap forward.

With less intervention by the driver, the system must follow more-stringent requirements for vehicle safety, and therefore it demands a significantly higher level of functionality and complexity.

Though technically very strong, Hongjing knew that by entering the autonomous driving market that it would face many new problems.

Compute power

As machine learning algorithms become more complex, there is an increase in the type and number of sensors used and stronger computational power is needed to support information processing and decision-making on the domain controller. Traditional MCUs running at several hundred megahertz or even CPUs are unable to address such massive demands. Another compute-related challenge is how to deploy intelligent AI processing engines on the domain controller to enable intelligent driving.

Scalability

An important consideration is how to provide scalability with continuously optimised algorithms, without compromising performance and cost.

Hongjing believes only those autonomous driving systems that can be specifically customised for different users and application scenarios will be truly accepted by consumers and commercialised.

Safety

Automotive electronics require more strict compliance to safety standards than other markets.

Most L3 and more advanced autonomous driving systems are based on industrial controllers that cannot meet automotive-grade mass production requirements. In addition, the domain controller for L3 and higher-level autonomous driving must meet more-stringent ISO 26262 Asil-D functional safety requirements.

Power

Power consumption is also a challenge for domain controllers.

Compared with standard in-car ECUs, autonomous driving domain controllers may consume much more power. Most industrial controllers available on the market consume between 500 and 1000W and are unable to meet even the basic requirements of mass production.

Design tools

Developing excellent products requires excellent tools and finding the right combination of integrated hardware and easy-to-use software can be quite difficult. A perfect autonomous driving system is the result of the collaboration of hardware and software engineers.

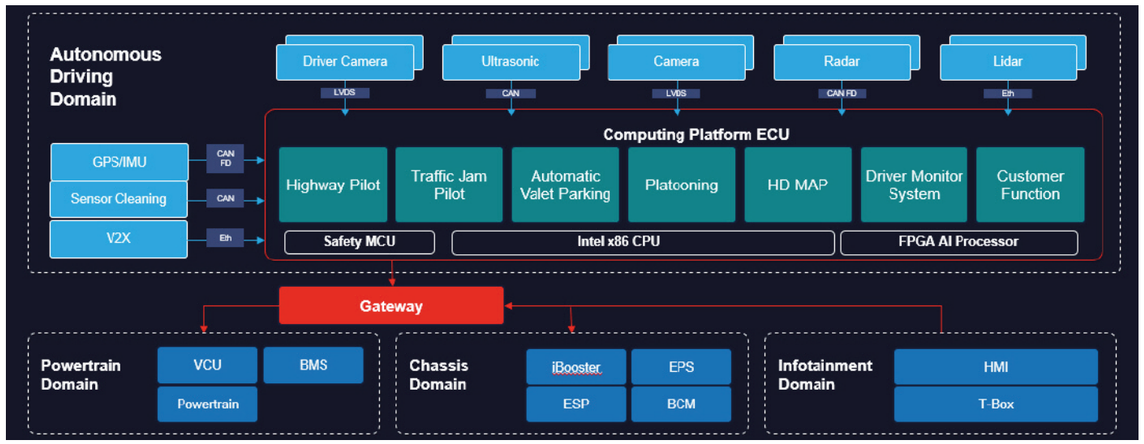
Platform

To address these challenges, Hongjing tapped Xilinx's flexible, automotive-grade XA Zynq UltraScale+ MPSoC and Vitis software development platform to build its line of Gemini ADCUs. The result was a high-performance platform that is being used in L3 and L4 vehicles, and in a variety of applications including intelligent lorries, robotaxis and unmanned mining vehicles.



Gemini hardware-software integrated ADCU

Featuring adaptability and high-performance computing, the automotive-grade XA Zynq UltraScale+ MPSoC platform addresses many of these issues, including safety, power consumption and performance.



Hongjing Drive's autonomous driving computation platform

Gemini delivers an autonomous driving computation platform with high performance, power efficiency, safety, reliability and versatility.

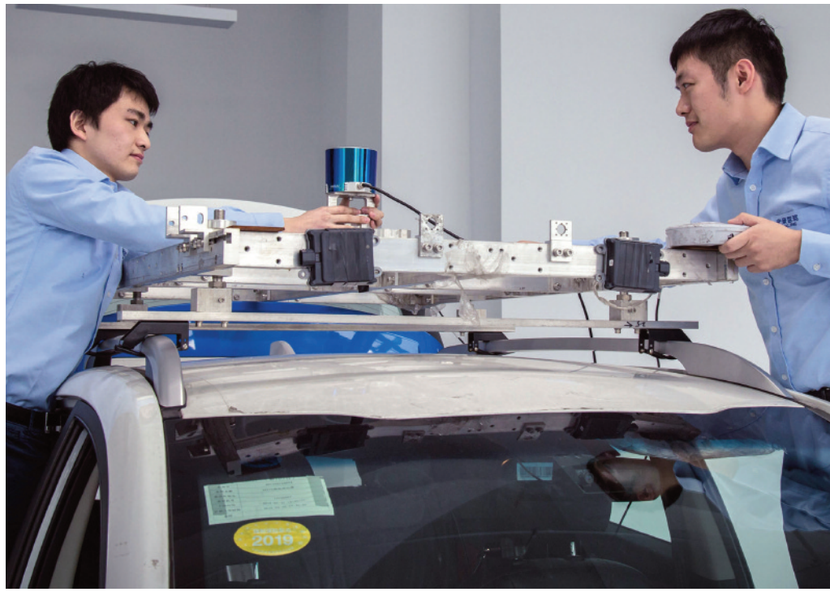
It is a rare, versatile domain controller in China that supports advanced autonomous driving development.

Feilong Liu, CEO of Hongjing Drive, said: "While defining the ADCU's product design, we holistically compared a range of silicon and ultimately we chose Xilinx' automotive XA Zynq UltraScale+ MPSoC for its high performance, low latency, low power consumption and hardware configurability."

The ISO 26262 Asil-C certified 16nm Zynq UltraScale+ MPSoC is a heterogeneous multi-core adaptive SoC platform designed for L2+ to L4 adas and autonomous driving applications. This platform features chip integration, programmability, computing performance and a set of IO ports that met Hongjing's requirement for automotive compliance, safety, quality, reliability, customisability and scalability.

Benefiting from the support of Xilinx's adaptive SoCs and Vitis AI software development platform, Hongjing's ADCU is said to offer powerful hardware and software performance.

Hongjing's full-stack autonomous driving system provides five advantages:



Hongjing Drive has entered the autonomous driving market

- Heterogeneous architectures with multi-cores;
- Power efficiency with a total consumption less than 70W;
- Asil-D functional safety;
- Reliability that supports automotive-grade mass production; and
- Versatility with a modular software architecture that covers L1 to L4 applications.

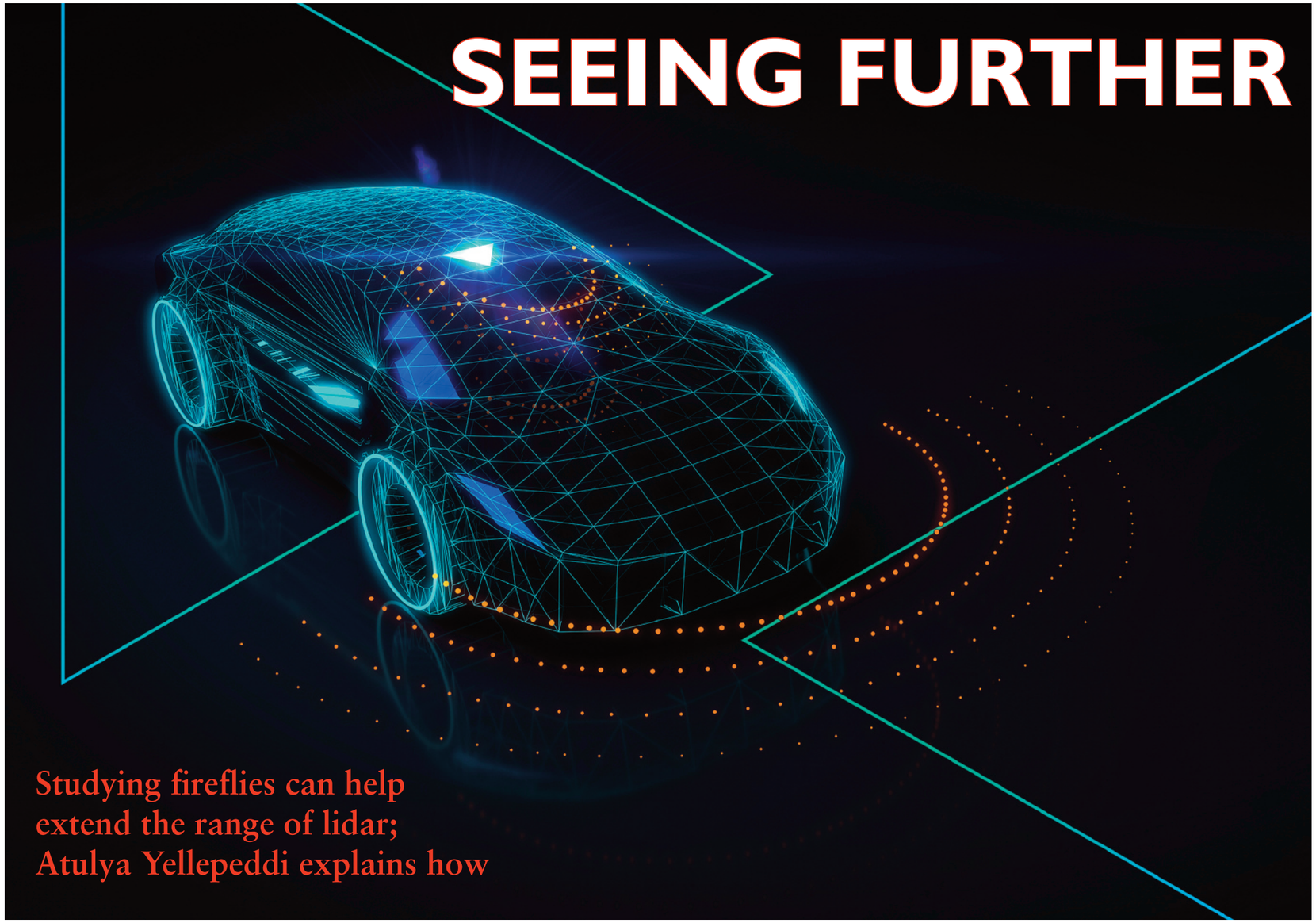
This supports up to 12-channel cameras, six-channel lidar systems and multi-channel, millimetre-wave radar processing that enables real-time multi-channel and multi-object AI sensing and processing. It also supports Asil-D grade functional safety modular software architectures tailored for L1 to L4 multiple applications.

In addition, Hongjing has adopted the Vitis AI platform, a complete, software-based AI development environment that provides AI acceleration processors, AI optimiser, AI quantiser, AI compiler tools and reference designs for deep-learning neural networks. This tool has been helpful to Hongjing for deep-learning model deployment and optimisation, and to meet the requirement of higher AI performance-per-watt in its autonomous driving computation platform.

With Xilinx's support, Hongjing was able to launch its Gemini platform prototype in July 2019 and released the production version in January 2020. Gemini has now been successfully deployed in some L3 and L4 vehicles.

Hongjing has also received sampling orders from several OEMs in China. Moreover, the company has realised the successful use of this platform in various applications including intelligent driving trucks, urban autonomous driving taxis and unmanned mining vehicles in controlled environments.

LIDAR



Studying fireflies can help extend the range of lidar; Atulya Yellepeddi explains how

Technology has always been a tool to free people from their most boring tasks. For many in the modern world, few things are more tiresome than being stuck in traffic on a morning commute, or dealing with highway hypnosis and long weekend traffic for hours on end.

While this has fuelled much excitement over autonomous vehicles (AVs), the prospect of two-ton pieces of metal zooming around unattended has also led to a renewed focus on technology to enable their safe operation.

To achieve superhuman safety, a detailed 3D map of various dynamic objects such as other cars, pedestrians and bicycles is generally considered essential to an AV. Lidar sensors are often considered among the most useful to have on board, as they are capable of forming such detailed maps. An example of such a map is shown in Fig. 1.

The further away a self-driving car can reliably detect the presence of an object on the road, the easier an evasive manoeuvre becomes. Researchers have investigated extending the detection range of lidar and developed a way of using physical constraints on the movement of objects to extend range. To understand this, it is important explain the principle of operation of lidar.

How it works

Lidar systems fire a laser pulse at an object and measure the time it takes for the light to reflect off the object and return to the sensor, as shown in Fig. 2. By scanning the laser along the horizontal and vertical directions, a lidar system forms a complete 3D map of the scene in front of it. Every such map is called a frame. Modern lidar systems typically have frame rates between 10 and 30frame/s.

Once the laser has fired in a particular direction, a sensor records the light coming from that direction, converts it into an electrical signal, and searches that signal for the location of the laser pulse shape, using a technique called a matched filter. The output of the matched filter is compared with a threshold, and if the signal crosses the threshold, a detection is declared.

Detection limits

Of course, nothing in the real world is ideal. The detection process in lidar introduces noise, both electrical noise from the various components of the receiver and optical noise from the detector itself. Thus, an object is detectable only so long as enough light is received from it that the matched filter is able to distinguish that signal from noise.

Physics shows that the intensity of light falls off as the square of the distance it has travelled from its source. Practically, that means that the amount of reflected laser light received by the lidar from an object 200m away is only a quarter of the light that would have been received had the same object been 100m away.

It follows that a matched filter will have a harder time seeing objects further away, and, in the extreme, when an object gets far enough away, it will become invisible to the lidar.

Fig. 3 demonstrates this; the return signal amplitude from the car being imaged falls off precipitously with the distance, and at 220m away the signal is essentially indistinguishable from noise and is missed by the detection threshold set.

One way to get around this problem is by setting a really low threshold of detection, so the car at 220m in Fig. 3 is visible. Obviously, given the SNR level, it would also detect a lot of noise.

Now, a full 3D frame of data has a number of flashes in it, some of which correspond to an object, and some of which are just noise. As an example, Fig. 4 shows all the detections (post-thresholding) in just one vertical slice – that is, at a fixed vertical angle – of a lidar frame. Most of the detections are just noise, but some do correspond to a real object. How to know which is which? While this is difficult to do with just one frame, it becomes more feasible after a few frames of data are seen.

Firefly process

To understand why, the flashes can be modelled like this: suppose there's a firefly buzzing around a box, and a flash from the firefly is seen at regular intervals. Unfortunately, random flashes from the environment are also seen, and those could occur anywhere. To make matters worse, flashes from the firefly are sometimes missed, and the position measured for the firefly is usually not quite perfect.

The fundamental question is: "Given a sequence of flashes,

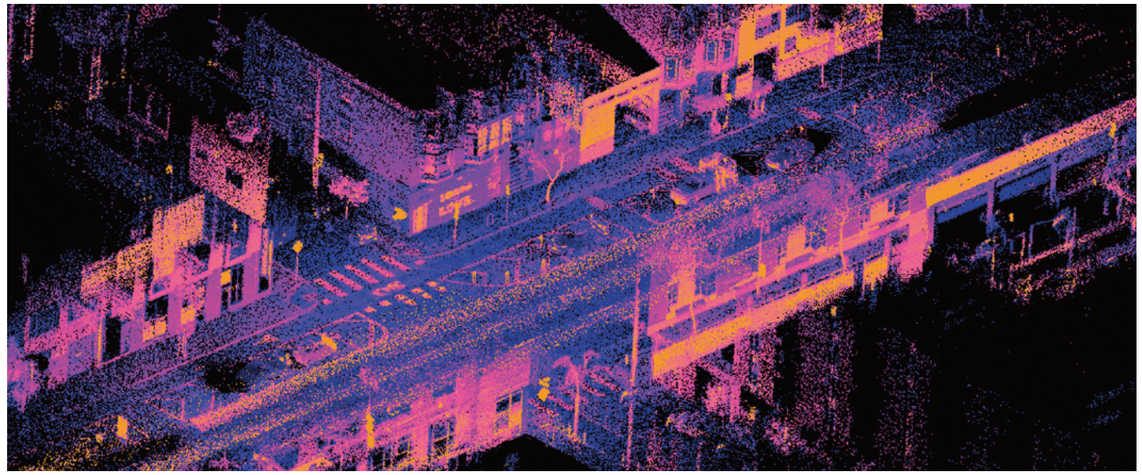


Fig. 1: Lidar map

where each one is a flash from a single frame, is it possible to tell whether the entire sequence came from a firefly or not?"

The technical term given to such questions is hypothesis testing. The information available to make a decision is that the frames arrive ten times per second for a rate of 10frame/s, and a firefly can only move in a physically reasonable way in that time.

For instance, a firefly cannot travel the length of the box in a frame, as that would be a physically unrealistic velocity; and it cannot reverse direction in two frames, as that would be a physically unrealistic acceleration.

Put a different way, the information that can be used is that the track followed by a firefly must be a track that a physical object could, indeed, have taken. Applying these track-based constraints lets those be distinguished from tracks made by noise. The language of hypothesis testing lets the mathematical form of the constraints be determined and applied given tracks of any length.

Given flashes from two and three consecutive frames, the constraints are simply limits on the velocity and acceleration of the track. For longer tracks, the constraints do not have quite so simple an interpretation but turn out to be quite simple to apply.

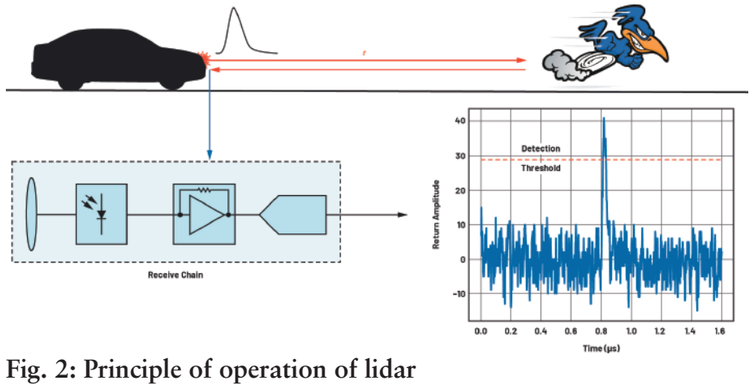


Fig. 2: Principle of operation of lidar

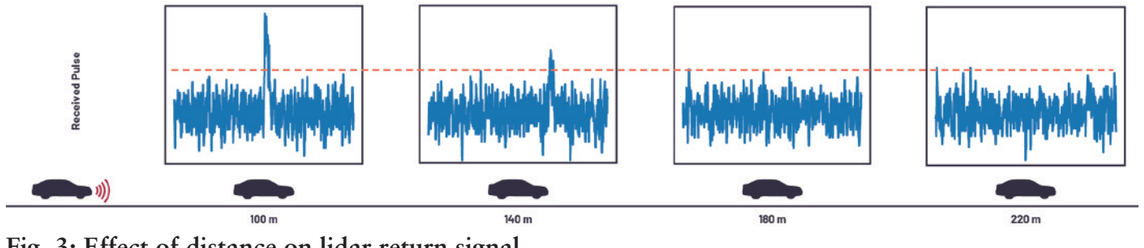


Fig. 3: Effect of distance on lidar return signal

Results

Fig. 5 demonstrates the effectiveness of the technique on two simple scenes. The image on the left is the true map of what's in the frame, with objects such as the road stripped out for simplicity. The image in the middle shows what can be got from conventional processing with a reasonable threshold, and on the right, what can be obtained after the firefly processing. The firefly process detects objects nearly 300m away. State-of-the-art lidar systems have ranges of about 150m.

Table 1 shows the detection (%) and number of false positives per frame obtained from the firefly process and the conventional processing; MF stands for matched filter.

The detection threshold is set so that there is 99.9% confidence based on pre-collected statistics that a particular peak corresponds to an object. However, the detection rate is very low. Using the track constraints helps quite a bit.

Conclusion

The firefly process describes a boundary on how objects can move – that is, it details the constraints, not on the detector or signal chain, but on the object they are measuring. Its power to improve the detection rate holds an important lesson: conventional detection and signal chain problems can often be greatly improved by using constraints and ideas that come from outside of the system being designed.

The aim is to continue to leverage such insights in designing smarter and more sophisticated signal chains, and continue to gain advantages from exploiting unconventional constraints.

Atulya Yellepeddi is a research scientist at Analog Devices. Jennifer Tang, Sefa Demirtas, Christopher Barber and Miles Bennett also contributed to the article.



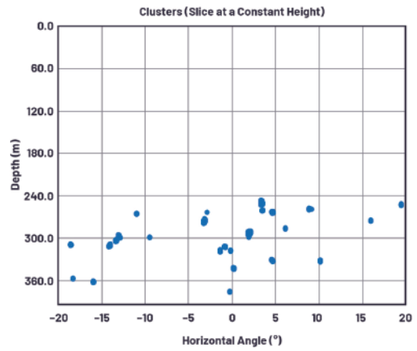


Fig. 4: Single vertical slice of lidar frame

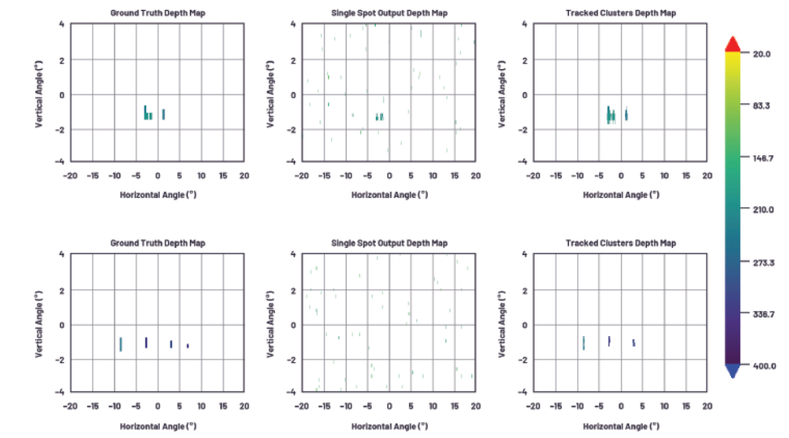


Fig. 5: Examples of detecting by tracking using the firefly process

Table 1: Numerical results

	Cluster Size	Length	Detect %	False pos
Firefly		3	67.7	3.14
		4	65.6	0.12
		5	61.5	0.04
		6	58.8	0.02
		7	55.1	0.03
		8	51.6	0.02
		9	46.9	0.00
		10	40.6	0.00
MF	1		19.1	52.00
Peak	10		18.0	14.34
99.9%	20		13.1	0.00
	50		6.7	0.00

PRODUCTION

STAY CLEAN

Emily Peck explains how to stop contamination impacting conformal coating

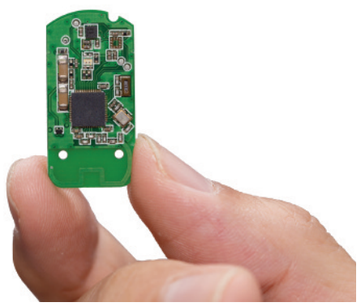
The use of electronics within the automotive sector is rapidly increasing and evolving. What was once centred on mechanical machines is shifting to electronics. These systems are now the heart of modern vehicles and will continue to be as the industry pushes ahead with autonomous and intelligent transport systems.

As electronics play a bigger role, the importance of ensuring these systems work reliably becomes even more important. Modern vehicles are packed full of complex circuitry and miniaturised PCBs, which will increase as technology and applications advance within the automotive industry. This brings with it, consistency concerns.

These PCBs have to work, and work well. They must perform without fault and have long-term reliability. Not only is this assurance important to stay competitive in a fierce marketplace, but it is essential for safety. It can, however, be extremely challenging to achieve because of the small size and difficult geometries of the PCBs and assemblies used to operate these systems.

Let's not forget there is also the added challenge of having to withstand extremely harsh conditions over long periods of time. Every day, vehicles face excessive temperatures, high humidity, salt-spray, fuel vapour and constant vibration.

Conformal coatings can be critical to protect PCBs from these environments and ensure long-term reliability. They protect the delicate circuitry and electrically insulate the components from environmental stresses. What is key to remember is that cleaning before conformal coating is critical to its successful application and to the reliability of the PCB.



Modern vehicles are packed full of complex circuitry and miniaturised PCBs

Clean first

One of the main causes for PCB failure is contamination, therefore cleaning is advised whether it is conformal coated or not as the process will increase reliability. Any contaminant can negatively affect the PCB's dependability and can lead to a number of problems from electrochemical migration and delamination, to parasitic leakage, dendrite growth and shorting. Contaminated boards can also severely affect conformal coating effectiveness and in turn PCB reliability.



Contaminant can include simple dirt, dust or oil from a fingerprint, to ionic contamination such as flux residue, or white residue left behind after soldering the PCB. Ionic contamination normally consists of inorganic salts or acids and contains molecules that are conductive when in a solution. If conformal coating is not effectively applied to form a moisture barrier, the ionic residue can split into negatively or positively charged ions increasing the overall conductivity of the solution. Any small voids in the PCB conformal coating can expose the PCB and gradually degrade its components.

Any particulate left on the board can also inhibit bonding of the conformal coating to the PCB substrates. If PCBs are not effectively cleaned before applying the conformal coating layer, defects may occur. These can include uneven coverage, pinholes, bubbles and craters. It is also important to be aware that flux residue on the PCB can absorb and trap moisture, which is released during the coating curing operation. The coating can then separate from the board, allowing corrosive materials, dust or water from the end-use environment to enter the PCB assembly.

This can cause board corrosion, dendrite growth, parasitic leakage, signal loss or complete PCB malfunction. To prevent performance problems, residue-free cleaning prior to conformal coating is critical.

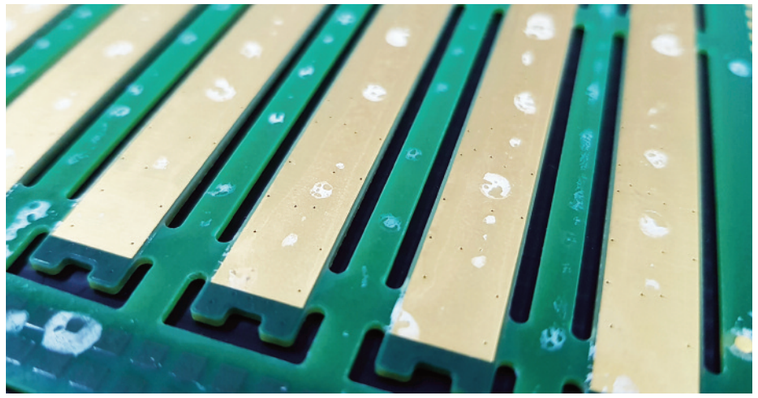
Effective process

Cleaning prior to applying conformal coatings will go a long way in eliminating reliability issues. But the question is: What is the most efficient and effective method to clean a PCB? It must

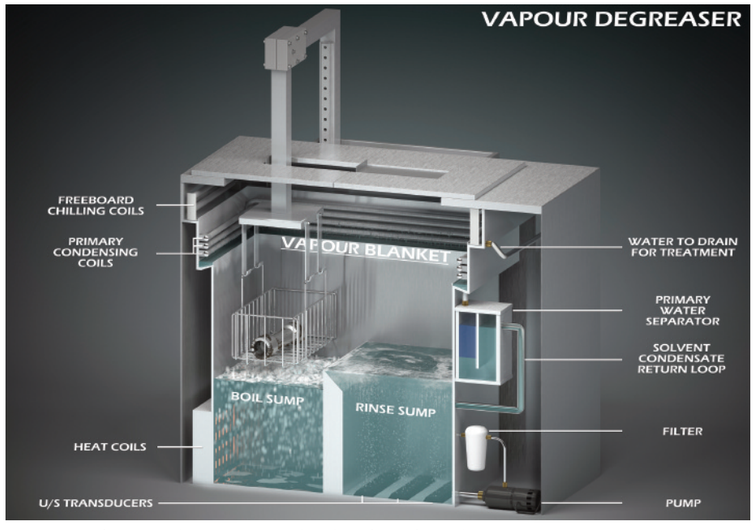
be a sustainable, efficient, cost-effective and consistent method. It must also be able to clean effectively multifunctional and complex low standoff electronic components such as flip chip, micro BGA, mosfets and QFN packages all tightly packed on to miniaturised boards. If every millimetre of the PCB is not cleaned well, reliability is at risk.

Vapour degreasing can assist in the cleaning problems faced by vehicle manufacturers. As a tried and tested application, vapour degreasing has many benefits. It uses solvent immersion, combined with vapour rinsing and drying to remove all types of oil, flux and particulate.

A vapour degreaser is a cleaning process that encompasses a closed-loop system. Basic systems contain a top-loading container composed of two chambers or sumps, both filled with cleaning fluid. In one chamber, the fluid is heated to a boil, which then generates a vapour layer that rises to meet two sets of cooling coils. These cooling coils cause the vapours to condense and return to their liquid state. This liquid is then channelled back into the vapour degreaser for reuse.



Contaminant includes white residue left behind after soldering



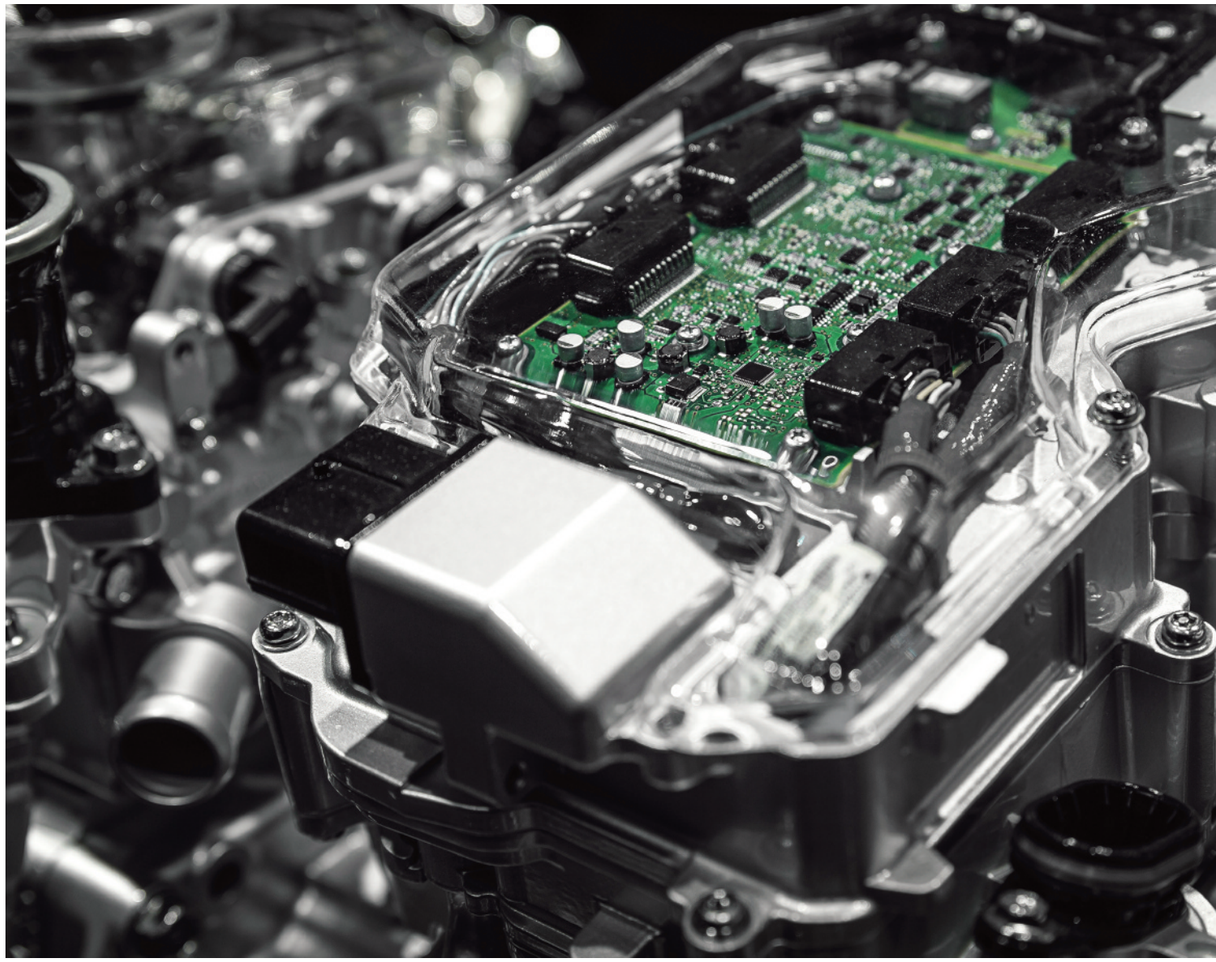
Vapour degreasing can assist in the cleaning challenge faced by vehicle manufacturers

A hoist lowers a basket containing the contaminated components through the vapours and into the boil sump first. The basket is then lowered into the rinse sump containing the clean solvent that has been condensed from the vapours. This process is easily programmable and allows for excellent process control and repeatability. The parts come out clean, dry and immediately ready for further processing such as the application of a conformal coating layer.

The cleaning fluid used within a vapour degreaser also has a significant effect on PCB cleanliness. The low-boiling cleaning fluids have multiple properties that are advantageous to critical cleaning. For example, they have a low surface tension and a very low viscosity, therefore they easily penetrate and clean even the tightest of spaces and under zero clearance components.

They not only penetrate these areas, but they also completely flow out and away from the components, taking any contaminant and residue with them.

Most vapour degreasing fluids also are very heavy and dense, typically 20 to 40% heavier than water, which aids in dislodging particulate from the components. Because the cleaning fluid is engineered for specific applications, delicate parts are easily cleaned and dried making it an ideal cleaning process to use



A main cause of PCB failure is contamination

before conformal coating.

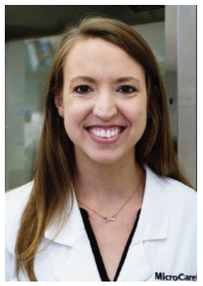
Vapour degreasing systems can be extremely cost-effective because the cleaning fluid is re-used many hundreds of times. As an additional and important benefit, modern cleaning fluid is a non-flammable, non-toxic, environmentally acceptable cleaning option that is completely ozone-safe and meets strict regulatory conditions.

Future

When properly designed, equipped and configured, vapour degreasers out-perform the cleaning efficiency of any other cleaning technology, making them the most adaptable option when it comes to guaranteeing precision cleaning processes. PCBs used within vehicle electronics must be reliable, therefore they must be cleaned effectively to ensure contamination does not interfere with important applications such as conformal coating.

The optimal PCB cleaning process needs to dissolve or displace common contaminants in a quick and effective manner.

Vapour degreasing with modern, sustainable cleaning fluids delivers the highest quality of cleaning in the most cost-effective and time-efficient way. To ensure PCB reliability and safeguard long-term functionality, always clean effectively.



Emily Peck is a senior chemist at MicroCare

DISPLAYS



FINGER ON THE PULSE

Sebastian Masi looks at the features of interactive displays that will find their way into the passenger cell of the future

Smartphones, tablets, televisions: touch displays are ubiquitous and are increasingly being used in modern vehicles, whether for buttonless operation of the air conditioning or infotainment system. In contrast to consumer electronics, these functions face special challenges in vehicles such as strong vibrations, changing temperatures and electromagnetic fields.

To ensure drivers can enjoy the benefits of touch displays not only at home but also in their cars, the technology must therefore be adapted to the requirements of the automotive industry. This is achieved, for example, by integrating technologies with TDDI (touch and display driver integration) or OLED (organic light-emitting diode) components, but also by means of a testing and validation process with regard to resistance and function. In this way, it can be ensured that the driving experience is actually enhanced and not diminished by touch displays.

Capacitive sensors are used for touch displays due to their higher reliability and wider range of functions. While panels in household electronics are becoming thinner and lighter, this poses a greater problem for vehicles. There, the sensitive sensor technology is subject to stricter requirements in terms of service life and environmental influences, which is why more robust displays have been developed, but at the expense of lightweight construction.

Nevertheless, precise sensor technology is still necessary in vehicles to transport the accustomed comfort into the vehicle of tomorrow. While high rigidity of components is also important, touch displays should still be flexible enough in an accident to reduce the risk of injury in a collision. It is therefore important to protect the sensors and the driver on the one hand, but also to bring familiar features into the passenger cell on the other.

Evolution

This is achieved by integrating the individual components into the display. When the electronics are applied to the outer layers (outcell technology), they are more exposed to temperature fluctuations, vibrations and electromagnetic fields.

As a result, the sensor and the microcontroller were built deeper and deeper into the panel (oncell technology). The advantage of such a design is the basic structure of a touch component. The heart of every touch LCD is the so-called cell, which essentially consists of a protective TFT glass layer on which TFT circuits are mounted. Above this is a layer of liquid crystals, which is closed at the top by a colour filter and the corresponding glass layer. This entire element is enclosed by the polarisation filter.

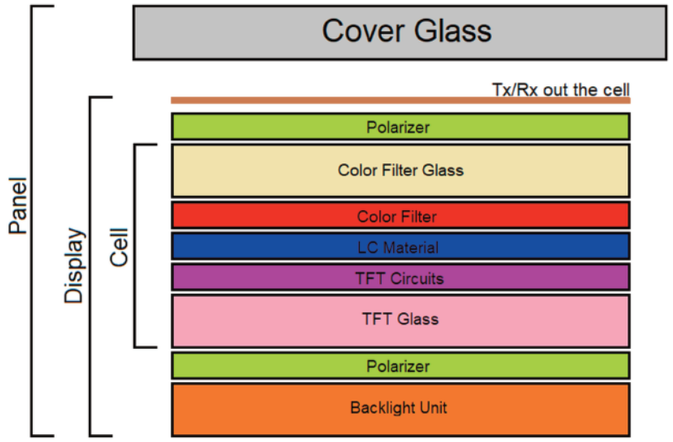
From below, the display is supplemented by a backlight and protected at the top by a cover glass. The deeper the sensor technology is built into the cell, the more the surrounding components offer protection; a slimmer, thinner design becomes possible. Limiting the number of layers in the optical stack results in lower reflection and improved solar radiation without increasing the brightness of the backlight.

Initially, the so-called outcell design was common for the development of touch displays. Here, the display was connected to the sensor by a bonding process. The biggest advantage of this design is that any display technology preferred for the application can be used. For example, any commercially available touch sensor that meets the requirements can be combined with the display. However, this means the sensor technology rests externally on the polarisation filter, which makes the entire component thicker than is desired in consumer electronics.

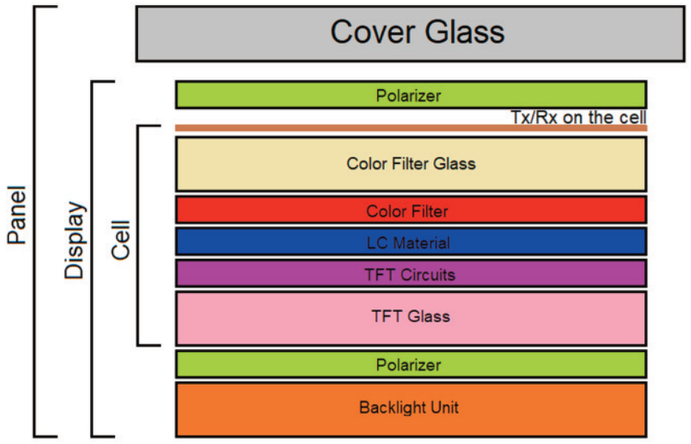
To counteract this disadvantage of the outcell design, the oncell design was established as the next step. Here, the sensors within the display are mounted directly on the cell, which already leads to a thinner construction due to the integration.

This trend towards thinner displays is reinforced in the automotive industry today with the complete integration thanks to the incell variant in combination with TDDI technology. This allows sensors and even controllers to be moved right into the centre of the display, and thus optimally protected.

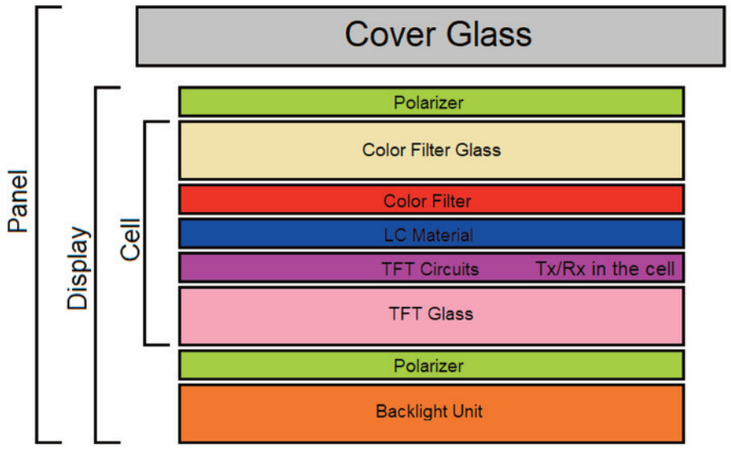
The advantages of this design



In the outcell design, the display was connected to the sensor using a bonding process; the advantage of this design is that any LCD preferred for the application can be used



In the oncell design, the sensors within the display are mounted directly on the cell, which already leads to thinner construction due to the integration



Today, the automotive industry typically uses the incell design with TDDI technology as it allows sensors and even controllers to be moved to the centre of the display

are a thinner module and improved optical quality. The production process itself is also accelerated by this design, since fewer production steps and suppliers are required for an incell display.

Requirements

However, with the complete incell integration of sensor technology and controller, not all challenges for touch displays in vehicles have yet been mastered. This is because many automobile manufacturers have high demands and special requirements.

One of the most common demands is for a waterproof design, for example in which touching by raindrops or condensation is recognised and ignored by an algorithm in the touch software. Thanks to this technology, the system can be operated even in moist conditions without unexpected behaviour.

Another often requested feature is a display that allows touch gestures even when passengers are wearing gloves. The details for such features vary from manufacturer to manufacturer and must therefore be tested and developed for the respective performance requirements.

To ensure smooth series production, reliable tests that meet the standards of objectivity, reliability and validity are already required during prototype construction. To this end, the respective test procedures should provide the same conditions for each component.

Automated endurance and stress tests can be used to check certain points in rapid succession to detect possible deviations on the entire touch surface and eliminate sources of error at an early stage. In addition, the use of standardised gloves with different materials makes it possible to test functions for different applications.

Conclusion

To increase the driving pleasure, other trends for touch displays are also finding their way from household electronics into the car. For example, OLEDs are increasingly being used in vehicles, in which each individual pixel represents a light source in its own right.

In conjunction with TDDI technology, it is thus possible to develop curved yet thin touch displays, enabling numerous new designs.

Developments such as quality-of-life features for haptic feedback are also being integrated into modern vehicle displays. Using different types of actuators, different parts of the display can be moved in the micrometre range. This gives the driver the feeling of actually pushing or turning a physical button.

If this is supplemented with force sensing, different functions can be activated depending on the force of the fingers applied to the display.

As much as the automotive industry can learn from the use of touch displays in the entertainment industry, the reverse would also be possible. After all, the increased requirements with regard to heat, vibration and electromagnetic compatibility in vehicles also open up possibilities for consumer electronics. A smartphone, for example, could benefit greatly from greater resistance despite thin and flexible components.

This means consumer electronics can benefit from the latest developments in the field of touch displays in vehicles.

Sebastian Masi is a senior engineer at Arrk Engineering





Touch displays are increasingly used in modern vehicles

Sensors for touch technologies

In the past, very different sensors were used for the displays in vehicles. Three technologies were the most common: resistive, optical and capacitive.

The basis for resistive sensors are two electrically conductive layers. As soon as they are connected by pressure, the position of the pressure point can be found out via the electrical resistance and forwarded to the display.

For optical infra-red technology, light beams are sent from a transmitter to a receiver, line by line and column by column. As soon as a fingertip interrupts this connection, the display can thus locate the location and passes on this information.

In contrast, a display with capacitive sensors uses two electrodes to determine the input. As soon as a finger comes close to these electrodes, the touch coordinates can be recognised based on the changed electrically measurable capacity.

Vision and security stacks receive multiple updates

The latest version of Lattice Semiconductor's mVision 2.0 stack for low power embedded vision systems features multiple updates that accelerate the design of embedded vision applications for industrial, automotive, medical and smart consumer systems.



As the next step in its mission to deliver secure, cyber-resilient system control, the company has also announced the latest version of its stack for secure system control.

Sentry 2.0 enables hardware root-of-trust compliant with Nist SP-800-193 and supporting 384bit encryption.

MVision 2.0 includes support for popular new image sensors used in automotive and an image signal processing IP core and reference design to help developers design smart vision applications at the edge.

The stack also includes support for the Lattice Propel design environment to simplify development of vision systems with an embedded Risc-V processor.

This version of Sentry addresses the rapidly evolving security requirements of current and emerging server platforms by providing developers with an efficient and secure way to implement enhanced system and cryptographic applications. The stack supports firmware security for the communications, computing, industrial, automotive and smart consumer markets.

Updates to the mVision stack include expanded support for automotive embedded vision applications with two additional development boards.

Features for Sentry 2.0 include heightened security with support for the Lattice Mach-NX secure control FPGA and a secure enclave IP block that enable 384bit cryptography to secure Sentry-protected firmware against unauthorised access.

Sentry 2.0 supports faster ECDSA (40ms), SHA (up to 70Mbit/s) and QSPI performance (64MHz).

These let it deliver faster boot times that help reduce down time and exposure to attempted attacks on firmware during the boot process.

The Sentry stack is capable of real-time monitoring of up to five mainboard components in a system at boot and during operation.

FPGAs go into volume production

Automotive qualified and military-grade PolarFire FPGAs from Microchip are available in volume production.

They are bring shipped in both AEC-Q100 T2 and military grade for -40 to +125˚C TJ.

On-chip security features enable secure communication, an encrypted bit stream and a cryptographically secured supply chain.

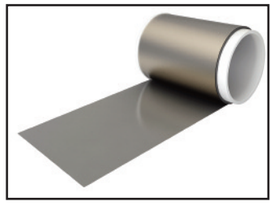
Unlike sram-based FPGAs, these devices can operate without fans and in some cases without heatsinks, simplifying thermal design and creating opportunities for smaller, lighter designs. This is important in automotive for blind spot detection, lane change warning and back up cameras.

The family of devices pan from 100k to 500k logic elements and feature 12.7G transceivers.

The Libero SoC design suite now supports both AEC-Q100 and military-temperature-grade FPGAs.

They are supported by development boards, VectorBlox accelerator software development kit and IP, plus the firm's HLS high-level synthesis tool for edge compute.





Noise reduction

A thin, flexible noise suppression sheet from Kemet is designed to reduce electromagnetic interference and other noise disturbances.

The EFG3 and Flex Suppressor series operate in a broader frequency range up to 40GHz band, advancing capabilities in 5G-connected devices and electronics for commercial, telecommunications and automotive applications.

Made from proprietary EMI-absorbent material, the sheets help prevent noise-induced impairments, malfunctions and total system failure. The flexible polymer material houses micron-sized magnetic metal flakes that absorb unwanted radiated noise and convert it into heat.

It also prevents quasi-microwave range interference, electrostatic discharge and de-sense in digital TV, 5G, wifi and Bluetooth devices.

Applications include car infotainment systems.

The flexible sheet can be cut into custom shapes for any design. Additionally, it is available in a flexible tape style.

Data acquisition IC meets Asil D

A data acquisition system from Maxim Integrated achieves Asil-D compliance for voltage, current, temperature and communication in a battery management system.

The Max 17852 battery monitor IC has an integrated current sense amplifier. The 14-channel, high-voltage device is for integration within electric vehicles, hybrid electric vehicles and other transportation systems. It is suitable for smart junction box, 48V and other automotive battery systems that can see voltages up to 400V and beyond.



OEMs and electric vehicle manufacturers require that all battery systems meet ISO 26262 guidelines. Through diagnostics and a safety-driven architecture, the device lets users design their systems to meet Asil-D standards for voltage, current, temperature and communication.

The IC is said to have the highest accuracy for delivering voltage, current and temperature data with tight time synchronisation.

It allows a typical cell voltage measurement of ±0.45mV at room temperature and a maximum of ±2mV error in a temperature range of +5 to +40˚C.

With a current sense amplifier capability of ±300mV, and a gain setting up to 256 times and 0.3% current sense gain error, it provides accurate data for calculating power management, state of health and state of charge.

Current information is acquired at the same time as cell voltage and temperature. Hall effect sensors and shunt resistors can be used as sensing components.

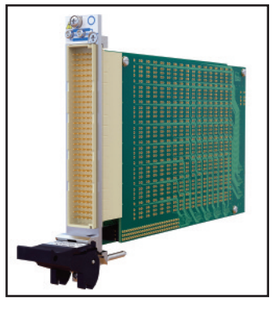
Module lets engineers check open status

A PXI multiplexer from Pickering lets test engineers monitor the open status of any channel.

The 40-619 performs the same as a typical single-pole, 2A 60W multiplexer but uses secondary relays to determine the multiplexer channel status. Every multiplexer channel is provided with an additional monitor switch that allows the user, via an external measurement device, to verify that multiplexer channels are open before applying test signals.

This feature is essential in applications where the incorrect or unintended application of signals may damage the device-under-test.

It comes in nine switching configurations from 16:1 to 128:1, providing flexibility in test system design. It uses electro-mechanical signal relays suitable for switching up to 2A at 250V AC and DC. The single-slot footprint permits the implementation of a monitoring function while reducing chassis slot space.

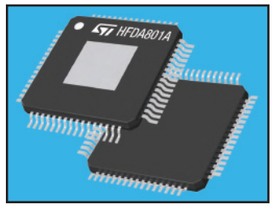


Audio amp adds safety diagnostics

A high-resolution audio amplifier from ST Microelectronics is for compact automotive applications.

The HFDA801A is a 2MHz switching pulse-width modulation class-D amplifier with a quad-bridge configuration.

An integrated digital-to-analogue converter ensures hifi quality sound under any load condition, with noiseless turn on and off and without creating any output artefacts.



By integrating in-play diagnostics as well as a digital impedance meter and real-time load-current monitor, the device can be used in safety-related audio applications that must demonstrate Asil compliance, such as acoustic vehicle alerting systems.

Signal-to-noise ratio is 121dB, dynamic range 120dB and output noise 10μV.

The feedback configuration with integrated L-C low-pass filter provides a wide flat frequency response up to 80kHz and reduces dependence on external components. The wide bandwidth allows use in high-definition audio applications, letting designers rely on linearity and low distortion that are independent of the inductor and capacitor quality.

The architecture derives all required voltages internally, enabling it to draw its supply from the vehicle battery without the need for additional power converters. The amplifier has load capabilities, ensuring stable performance even while driving high power on low-impedance loads of 2Ω on all four channels.

The device is sampling now and will be in production in the second half of 2021.

Tester debugs Ethernet chipsets

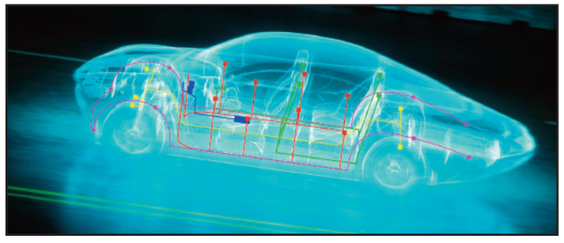
A multi-gigabit Automotive Ethernet compliance tester from Tektronix allows for accurate and reliable validation and debugging of multi-gigabit Ethernet chipsets and ECUs to meet physical media attachment (PMA) transmitter measurement requirements up to 10Gbit/s.

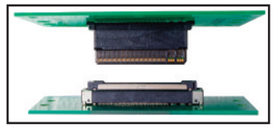
The TekExpress automated compliance tester fits the current version of the IEEE 802.3ch Multi-GbaseT1 specification.

Multi-gigabit Ethernet uses PAM4 modulation to achieve high data rates and reliability, pushing the boundaries of signal integrity and requiring better measurements for compliance, debugging and validation. Debug tools such as DPOJet and PAM4 Analysis allow for quick identification of the root cause of a failure, saving time and effort.

The product works seamlessly with the firm's oscilloscopes. Because the application uses the TekExpress automation framework, engineers do not have to learn a new software interface.

This application enhances the company's existing in-vehicle network offering of 10baseT1S, 100baseT1 and 1000-baseT1 compliance testing applications for Automotive Ethernet.





Floating connector

The floating board-to-board connector of Yamaichi's HF301 series is suitable for connecting two PCBs.

The floating mechanism allows for the smooth functioning even during shock and vibration, making it suitable for difficult environmental conditions.

The series has a contact construction that combines the floating function in the x, y and z directions and thus achieves mechanical stability under all vibration and shock conditions.

The electromechanical system has a maximum data transfer rate of 8Gbit/s. Additional power pins are integrated.

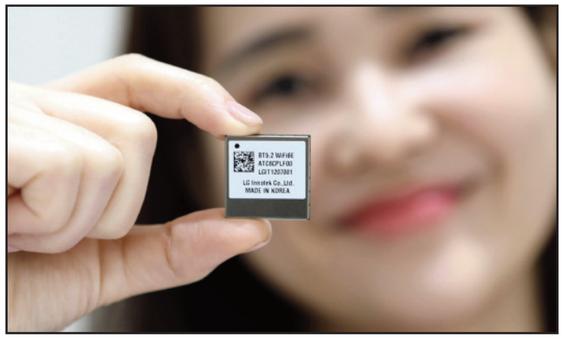
It has been developed and tested based on automotive specifications but is suitable for other applications with similar requirements such as in industrial environments.

The connectors are made in IATF16949-certified factories.

The board-to-board connector consists of a plug and a socket with 102 signal contacts each and four power contacts for up to 5A.

Wifi 6E module connects in-vehicle infotainment

LG Innotek has developed an automotive Wifi 6E module, a near-field wireless communication component connecting in-vehicle infotainment systems controlling driving information and multimedia content to internal smart devices and external routers.



Using 6GHz bandwidth, the module has data transmission speeds approximately three times faster than the existing Wifi 5.

This module combines a communications chipset, RF circuit and other components, and it can be mounted on multiple components of a vehicle, including the audio-video navigation system and smart antenna.

A passenger can enjoy movies, games and more on the in-vehicle display or audio system by wirelessly connecting it to a smartphone. The module also allows software updates.

Data transmission speed is 1.2Gbit/s. It takes 2ms to connect to the network, so there is no buffering for high-resolution videos.

The module also enables seamless internet use with multiple connections. The RF and antenna technologies prevent interference even in such a compact space as a vehicle.

It can withstand temperature changes between -40 and +85°C, and is not easily deformed by low temperatures in winter and can endure the heat generated by data transmission.

The module is made to tolerate repeated shrinking and swelling by using a larger synapse surface design.

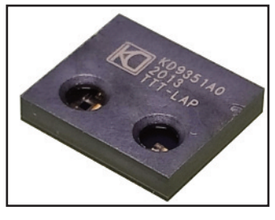
There are more than 200 components in the module including communications chipset and RF circuit in the one-sixth of a credit card size.

Fibre-optic transceiver

An integrated fibre-optic transceiver (FOT) from KDPOF can reduce costs for in-vehicle networks compared with STP.

Incorporating transmit and receive optoelectronics in one component, the KD9351 is a transceiver for 100Mbit/s to 1Gbit/s.

Applications, with EMC critical or galvanic isolated links, include safe Ethernet backbones and sensor links for adas.



The FOT lowers costs by combining the transimpedance amplifier, photodiode, LED driver and LED as one device.

It reuses low-cost MEMs encapsulation and allows SMD reflow assembly with 8 by 7mm LGA components. It is shielded against electromagnetic radiation.

Temperature range is -40 to +105°C. It can withstand motor conditions with a vibration class of V2 and endures water without sealing.

Detecting door opening and closing

The SPVQ8H switch from Alps Alpine is for detecting the opening and closing of vehicle doors.

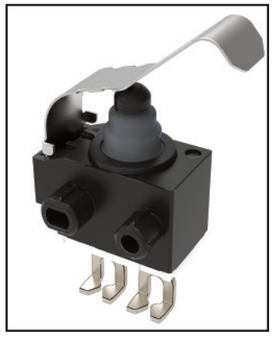
Door latches require smaller detectors in the trend towards thinner, more compact structures.

Because of a growing need for long-stroke switches to elevate design freedom and enable diverse latch cam operation, the firm is bolstering its existing SPVQ8 detector switches with actuator-included varieties.

Latch cam is a structure for pressing down the switch part of the latch.

Actuator switches can widen limits of detection vertically and sideways and enhance consistency. They also extend life by cushioning impact.

The casings enhance robustness and improve mounting compatibility.



NTC thermistor stands +185˚C

An AEC-Q200 qualified NTC thermistor from Vishay Intertechnology comes with Peek-insulated, nickel-iron (NiFe) leads and a low thermal gradient.

Designed to withstand temperatures up to +185˚C, the BC Components NTCLE350E4 can deliver fast and accurate temperature measurement and sensing in automotive applications.

The NiFe alloy of the conductor wire is said to have the lowest thermal conductivity on the market. As a result, the device offers a thermal gradient of less than 0.01K/K, or 1%, dissipating almost no heat to the surrounding environment and allowing for accurate temperature measurement.

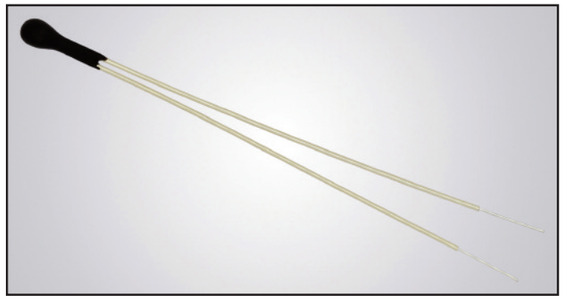
To improve reliability in high humidity conditions, the sensor has high adhesive strength between its Peek-insulated lead wires and encapsulating epoxy lacquer. A maximum bead size diameter of 2.4mm results in a response time of 6s in air.

It is suitable for engine coolant, fuel and manifold air pressure sensors in combustion engines, in addition to hvac applications.

In electric traction motors, the device can be processed by potting or moulding into sensors for protecting high current connectors.

The device can also be used in oil temperature sensors in transmission systems and liquid-cool starter generator systems, in addition to exhaust gas recirculation applications.

The RoHS-compliant sensor has a resistance at +25˚C from 2.1 to 30kΩ, with tolerance down to 1%, and beta from 3435 to 3984K, with tolerance down to ±0.5%. Maximum power dissipation is 100mW and it is resistance to noxious gases and acid.





BLDC motor driver suits 48V systems

A brushless DC (BLDC) motor driver from Texas Instruments is for 48V motor control systems such as traction inverters and starter generators in mild hybrid electric vehicles.

The DRV3255-Q1 can help designers shrink their motor system size by as much as 30%, while providing high gate-drive current for increased protection and output power.

It was designed according to the firm's TÜV SÜD-certified functional safety development process for up to Asil D.

The device can supply as much as 30kW of motor power to improve the response time of a 48V motor-drive in heavy vehicles.

The three-phase driver integrates high- and low-side active short-circuit logic, which eliminates external transistors and control logic.

The active short-circuit logic feature gives designers the flexibility to arrange mosfet connections based on needs, and helps prevent catastrophic failures due to overvoltage.

The dynamic fault response automatically switches the motor driver to active short-circuit mode in overvoltage conditions, which protects the vehicle's motor and electrical components from overvoltage stress.

For motors requiring currents up to 600A, it can directly drive up to 1000nC gate-charge mosfets.

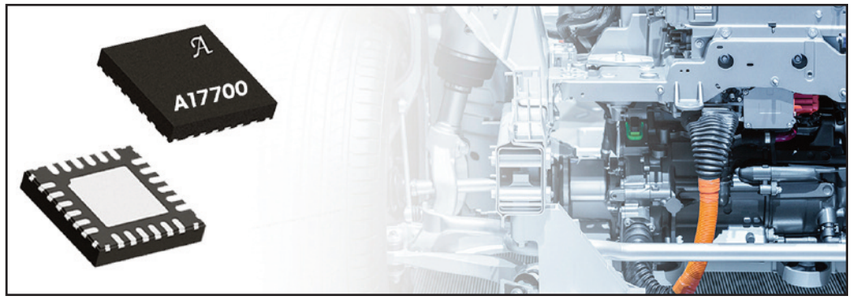
The AEC-Q100 grade 0 driver protects 48V powertrain systems from switching transients as high as 95V and load-dump conditions at a temperature range of -40 to +150˚C, eliminating the need for protection circuitry.

The digital input and output pins withstand up to 75V maximum to protect the device against an external 12V power-supply overvoltage.

It is available in a 64-pin quad flat package.

Sensor interface IC provides flexibility

A sensor interface IC from Allegro Microsystems provides accuracy and output flexibility for resistive bridge pressure sensors with signal conditioning algorithms for automotive and industrial pressure sensing.



The A17700's compensation algorithms increase accuracy during temperature and sensing bridge variation.

Precise pressure information is delivered in low delay analogue, PWM or Sent outputs.

It has AEC-Q100 grade 0 qualification and EMC robustness with few external components, and includes integrated system diagnostics.

The device is configurable for resistive bridge pressure sensors in critical vehicle applications from high-pressure dynamic brakes in turbo and hybrid EVs or petrol direct injection to medium and low-pressure systems such as brake boosters, hvac applications for EVs and automatic transmission oil management.

With its integrated polynomial algorithm, the sensor provides accuracy over pressure and temperature through two-stage processing of a pressure signal. This compensation improves accuracy in resistive membranes requiring either high- or low-point characterisation during assembly.

EMC performance is up to 4kV HBM.

Designers can select the algorithm and IO options that best fit their requirements, balancing accuracy and end-of-line test times.

With parallel processing paths for input and temperature, it can achieve the claimed smallest chip delay on the market. With an input-to-output processing delay of 100μs, systems can compensate for vibration effects on the membrane with no output resolution loss, increasing fidelity.

Environmental conditions, such as a change in supply voltage level, temperature, input bridge signal and connection, can cause temporary faults in pressure sensing. The IC captures these changes and signals them in the output protocol, enabling fault filtering at the system level for more accurate safety notifications.

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