VEHICLE electronics

The monthly magazine for automotive electronics engineers

Intel banks on 5G for autonomous driving

The 5G era is about a fantastic, flexible network that will connect everything to everything, and everybody to everything. It will enable the next great technology transformations, from drone deliveries to self-driving cars.

That is the view of Aicha Evans, senior VP and general manager of Intel's communications and devices group.

Speaking last month ahead of Mobile World Congress in Barcelona, she said: "The big difference with 5G is that when you start to talk about autonomy and factories, cars and hospitals thinking for themselves, they will rely on split-second connectivity to do so, with no room for error."

She described 5G as "one of the most impactful technology transformations we are likely to see in our lifetimes".

Aicha Evans

At the show, Intel announced the third generation of its mobile trial platform for integrating and testing 5G devices and wireless access points and the XMM 7560 modem to deliver gigabit LTE speeds in one unit with global coverage.

However, the chip giant's main focus was on building partners to form an ecosystem to deliver 5G technology.

"We will continue to seek out partners across the industry to define, prototype and deliver early 5G products and use cases that will shape the market," said Evans.

Examples, she said, included recent partnerships with AT&T, Ericsson, Nokia and Telefónica, as well as in 5G interoperability tests.

"Interoperability is critical for setting standards and guiding the development of technologies that work with other products or systems, present or future," she said. "It's a major implementation hurdle. In the spirit of helping lead the industry and drive the innovation agenda, Intel has collaborated with key industry players to test and deploy interoperability, which is critical to scale 5G trials."

At MWC, Intel and Ericsson demonstrated live over-the-air interoperability between the 5G Intel mobile trial platform and the Ericsson 5G radio prototype.

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March 2017

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LG and Qualcomm collaborate on cellular V2X

Qualcomm and LG Electronics are coordinating efforts to facilitate testing and adoption of 5G and cellular-V2X (C-V2X) communications in vehicles. The companies expect to test these next-generation wireless technologies during the first half of 2018.

On the path to 5G, LG is developing automotive connectivity technology based on Qualcomm's connected car platform, which supports Gigabit LTE speeds using the Snapdragon X16 LTE modem, and is complemented by QCA65x4 wifi 802.11ac. The connected car platform also supports 802.11p, DSRC and C-V2X, based on 3GPP Release 14 specifications.

"The advanced wireless capabilities of 5G and C-V2X will usher in new use cases necessary to fulfil our vision for increasingly connected and autonomous vehicles," said Kim Jin-yong, executive vice president at LG Electronics.

C-V2X complements other adas sensors, such as cameras, radar and lidar, to provide information about the vehicle's surroundings, even in non-line-of-sight scenarios. It is also designed for enhanced situational awareness by detecting and exchanging information using direct communications in the 5.9GHz ITS band with other vehicles, infrastructure and pedestrians' devices, as well as network-based communications to cloud services using commercial cellular bands.

"Wireless communications provide the vehicle with data that truly complement what other sensors deliver," said Patrick Little, senior vice president at Qualcomm Technologies. "For instance, C-V2X and its evolution to 5G can help the car discover what is around corners, detecting a pedestrian's smartphone or a car approaching an intersection even when the object is obstructed by buildings or other large vehicles."

That will be all, Jeeves

The Design Museum in London welcomed a new exhibit this month – the Range Rover Velar, with its own digital butler. The car's suite of consumer technologies work together to create an in-built technology butler. At its heart is an infotainment system called Touch Pro Duo.

Velar is the first vehicle to be launched and displayed at the new Design Museum, which opened to the public in November 2016 after moving from its original Shad Thames location.

"The connected infotainment system learns from you and anticipates your needs, serving you what you want, when you want it, but never intrudes letting you enjoy the drive, while it takes the stress out of daily life, like any good butler or digital personal assistant should," said Peter Virk, Jaguar Land Rover director.

The name Velar is derived from the Latin *velare* meaning to veil or cover. The exhibit ran from 1 to 5 March.

MTA develops display for Volvo XC90 SUV

Italian electromechanical and electronic product design company MTA collaborated with Volvo on a display for the four-seater Excellence variant of the XC90 SUV. This is the first car from the SPA (scalable product architecture) common development platform.

The display has a capacitive sensor and an 11cm touchscreen, and was developed in house through the use of OS Autosar R4.x, a process standard used in software development, and Automotive Spice Level 3, a process model for software lifecycle, both tailored to automotive needs.

The display developed by MTA is pulled-down in the central console and can handle functions such as displaying and adjusting the different seating positions, operating heating and lumbar massage. It can also turn on the food warmer and the refrigerator.

MTA display in Volvo XC90 SUV

The touchscreen display for Volvo was developed from the ground up and put into production in just one year, allowing the company to comply with the timing of the OEM's assembly lines.

The display is the first MTA has created for Volvo, and the company will offer derivatives of it in the future for other Volvo cars.

Alps and Commsignia partner

Commsignia has formed an alliance with Alps Electric, a supplier of wireless modules, to accelerate V2X deployment.

Commsignia aims to deliver automotive-grade software to support all current and future generations of Alps hardware modules with complete V2X software stack, security and adas safety applications. This should give Alps the ability to improve time to market.

"It is always hard to evaluate something you cannot see," said Jozsef Kovacs, Commsignia CEO. "V2X technology will be at the heart of all cars and will be the cornerstone of cooperative decisions made by drivers and driverless cars all around the world."

Spirent and Technica in Ethernet pact

Spirent Communications and Technica Engineering are collaborating on Automotive Ethernet testing and validation.

Technica is helping Spirent implement the advanced physical layer chipsets into Spirent's Automotive Ethernet products for protocol conformance testing with Broad R-Reach (100-baseT1) network interface cards.

"With Technica's expertise to design development environments that simulate Automotive Ethernet networks, we are also able to demonstrate how Spirent Automotive Ethernet solutions are testing the quality and performance of in-vehicle components," said Stephan Pietsch, director of products and engineering at Spirent.

Erick Parra, business developer at Technica, added: "The cooperation with Spirent enables us to test and validate our Automotive Ethernet network devices for performance features such as bandwidth, synchronisation, timing and so on. These tests ensure reliable Automotive Ethernet products that meet the challenging requirements of today's in-vehicle networks.

"Combining our companies' expertise helps both Spirent and Technica adapt competencies and determine the future of safe and autonomous driving."

AWS gains TS16949 approval for Slovakia factory

Electronics manufacturing services company AWS Electronics has achieved full TS16949 certification, the standard for automotive quality management, for its facility in Slovakia.

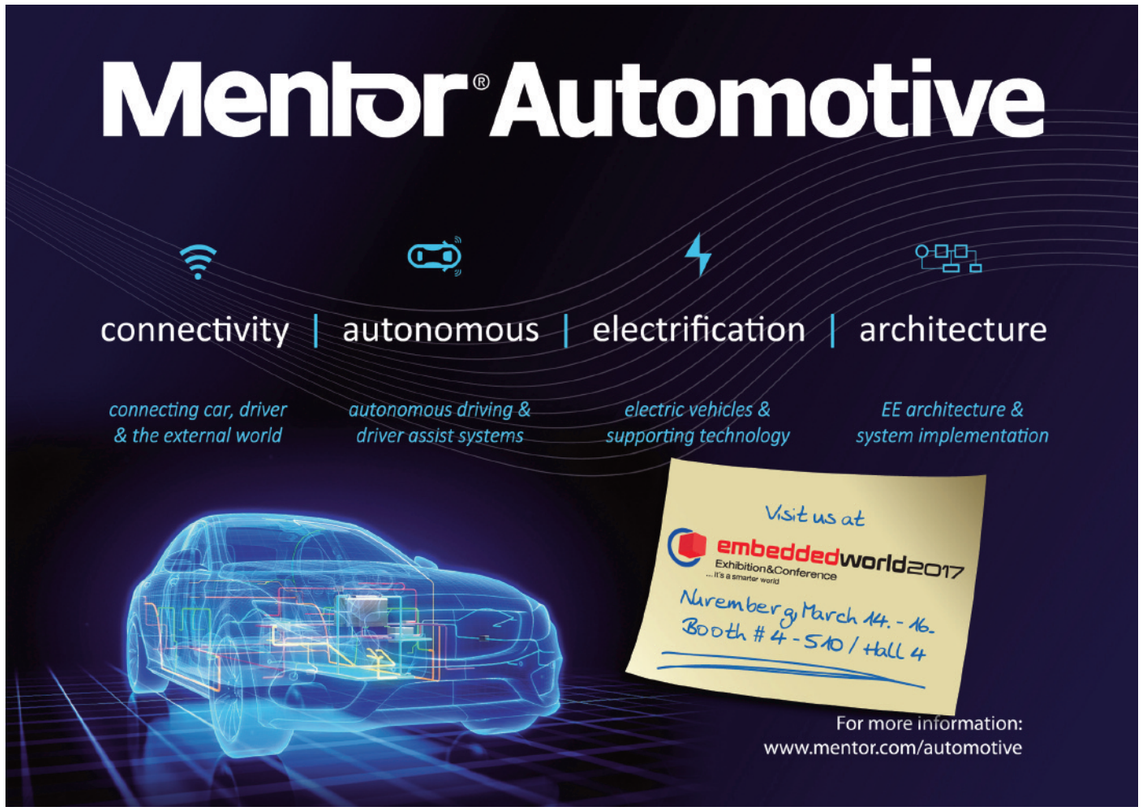
AWS has invested significantly in its Slovakia facility since its inception nine years ago. The company moved from its original location onto a green field site in 2010. Since then, the facility has seen two further expansions in manufacturing space, taking the total factory to 35000m². The original dedicated high volume automotive hall has also recently been expanded with the addition of a second automotive line.

The Námestovo site now employs more than 250 people and has seen revenue growth of 25 per cent year on year over the past four years. Achieving TS16949 approval has been critical to cementing its position as an EMS provider to the automotive market, demonstrating a dedicated and thorough understanding of how to provide quality and process control as well as world-class manufacturing in a low-cost environment.

AWS facility in Slovakia gains full TS16949

"We embarked on our first automotive project just over two years ago, working for one of the world's largest tier-one suppliers," said Paul Deehan, AWS CEO.

The Slovakia facility also carries ISO 9001, ISO 14001 and ISO 13485 approvals, and complements a mirror-image facility in the UK.



Infineon and VW plan joint developments

Infineon Technologies and Volkswagen are working together to define the requirements for future semiconductors and pursue joint development approaches.

Advances made with electronics, along with shorter innovation cycles, have created a situation in which all participants in the development process need to cooperate to implement technically mature and reliable systems.

Peter Schiefer (left) and Volkmar Tanneberger

"Future joint development tools, such as virtual prototyping systems, will make it possible to further reduce development times, despite the continual increase in system complexity," said Volkmar Tanneberger, head of electronic development at Volkswagen.

Volkswagen has launched a programme to ensure these requirements can be met, and is cooperating directly with chip manufacturers, the first of which is Infineon. The goal is to develop technology for future vehicles. A key aspect involves the precise definition of requirements.

"Microelectronics from Infineon make driving cleaner, safer and more convenient," said Peter Schiefer, president of Infineon's automotive division. "We as a partner look forward to cooperating even more closely with Volkswagen. High-performance semiconductors are key to the future car. With our products, vehicles of every class will soon be fully automated and purely electric."

BMW first to Here open location platform

BMW has become the first car maker to use the Here open location platform for developing and launching its digital driving services.

Using the platform, BMW can create differentiated location services from the data generated by connected cars and the Here data ecosystem. For example, it will be able to combine car sensor data with other data streams available through the platform, such as from cities and the broader IoT, and build services using a framework for geodata processing.

In the first wave, this will help vehicles better detect, process and validate fleet sensor data related to hazards on the road, speed signage location and values, and physical road dividers.

"The raw data crowd-sourced from car sensors become more valuable when you have contextual information for those data," said Peter Kürpick, chief platform officer at Here. "Our analytical tools provide that rich location context giving BMW and other automakers the ability to turn their data into differentiating services that elevate the driving experience."

The platform also provides secured environments, letting participants work with their data either in isolation from others or with selected parties with whom they have agreed to share data and create collaborative services. For example, BMW is one of three car makers submitting car data for use in real-time sensor-based services created by Here and launching in 2017.

Here envisages a marketplace where organisations from any industry can access an ecosystem of different data streams, ranging from road geometry and real-time traffic conditions to weather, live public transit information and other non-automotive data sources.

"We are already shaping the industry ecosystem," said Stefan Butz, BMW vice president.

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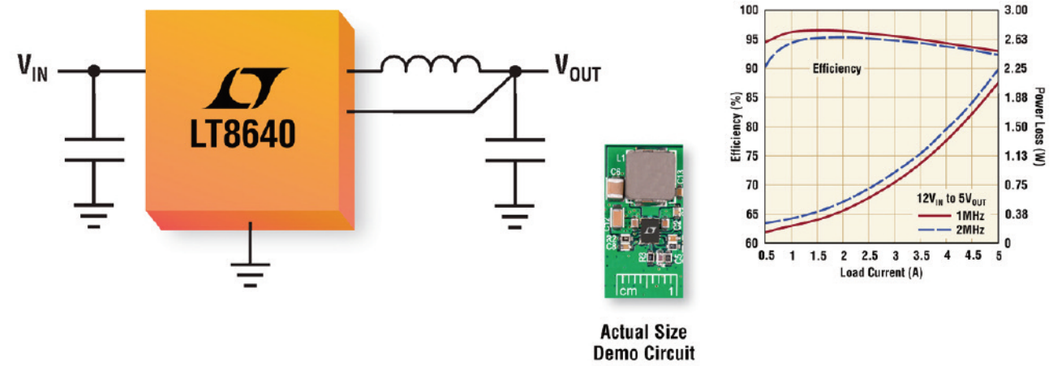

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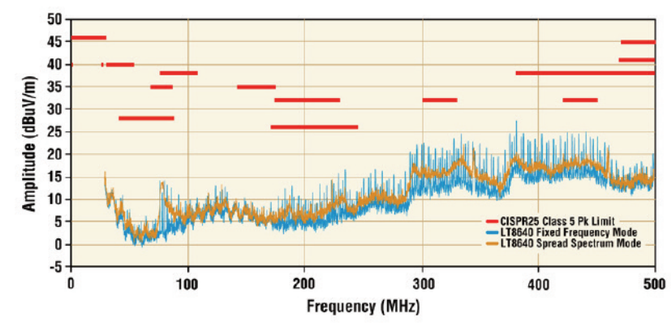

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STM and Airbiquity demonstrate over-the-air updates at MWC

Airbiquity demonstrated the integration of its software update management service into ST Microelectronics' Telemaco telematics and connectivity processors at Mobile World Congress in Barcelona.

The demonstration featured Airbiquity's over-the-air (OTA) software and data management offering integrated into the Telemaco 3 evaluation board (EVB).

"We see tremendous potential for this technology combination to help OEMs realise the significant benefits of deploying OTA software management across their vehicle portfolios," said John Tuttle, vice president of engineering at Airbiquity.

Presenting how the technology protects consumers, their automotive investment and manufacturers, the demo highlighted the interoperability between the Airbiquity cloud-based service and the on-board EVB platform in various software-update campaign scenarios and typical OEM OTA use cases.

"The Telemaco family of telematics and connectivity processors has been architected to support and secure feature-rich connected-car applications, with dramatically improved processing performance and a hardened hardware security module," said Antonio Radaelli, director of infotainment for STM.

The Telemaco devices provide 1Gbit/s Ethernet bandwidth connectivity and processing capability to handle wireless data management typically required for automotive telematics. They can handle the control of the in-vehicle Can bus through an independent and isolated Arm Cortex-M subsystem running a dedicated real-time operating system.

With flexible memory and CPU cores configurations, the processors allow implementing scalable systems throughout the various car connectivity applications requiring rich Linux and other Posix operating systems.

Airbiquity's offering is designed to orchestrate and automate highly targeted, scalable and secure multi-ECU software updates and data collection for connected vehicles. The back-end management capability enables refined campaign targeting, configuration and approvals, and is scalable to accommodate the geographic, volume and IT hosting requirements of the automotive industry.

Denso picks Cinemo

Denso has selected Cinemo's multimedia platform for integration into its latest automotive head unit project.

This work is for a major Japanese car OEM and includes Cinemo's file, stream and disc playback, media management, and UPnP based content sharing features.

"With technology convergence upon us, expectations are becoming very high in today's in-vehicle infotainment system design, so delivering performance remains a constant challenge," said Jim Corbett of Cinemo. "Cinemo's multimedia solutions have already become a critical element in infotainment systems, so we are very happy to be working with Denso once more to move the benchmark further in IVI development."

Genivi and OSF partner

The Genivi Alliance and Open Connectivity Foundation (OCF) have agreed to co-develop open standards for vehicle connectivity and data exchange, including a unified model for secure discovery and exchange of information between smart homes, connected cars and other IoT devices.

The joint effort will also address end-to-end security and will be the basis for a growing number of V2X products, enabling opportunities across multiple verticals.

They will also closely collaborate with the W3C Automotive Working Group, which develops an open web platform API specification, to expose vehicle data to web application developers.

At CES in Las Vegas in January, the two organisations demonstrated a smart home gateway that featured vehicle-to-smart-home connectivity using Genivi remote vehicle interaction and vehicle signal specifications and OCF's LoTivity technologies. The demonstration displayed approaches on how connected vehicles could interact with IoT and the smart home.

Mentor helps with ISO 26262 qualification

Mentor Graphics has launched an ISO 26262 qualification programme.

Called Mentor Safe, the programme includes the Nucleus SafetyCert real-time operating system, the Volcano VStar Autosar operating system and BSW stack, and a growing array of ISO 26262 certified documentation and qualification reports for Mentor tools supporting design and verification of system-on-chip, system, mechanical and thermal applications.

The programme should let users integrate Mentor tools and software into their safety-critical designs and verification flows at all criticality levels up to and including Asil D.

The latest design automation products certified under the programme are from the company's Tessent silicon test and yield analysis tools.

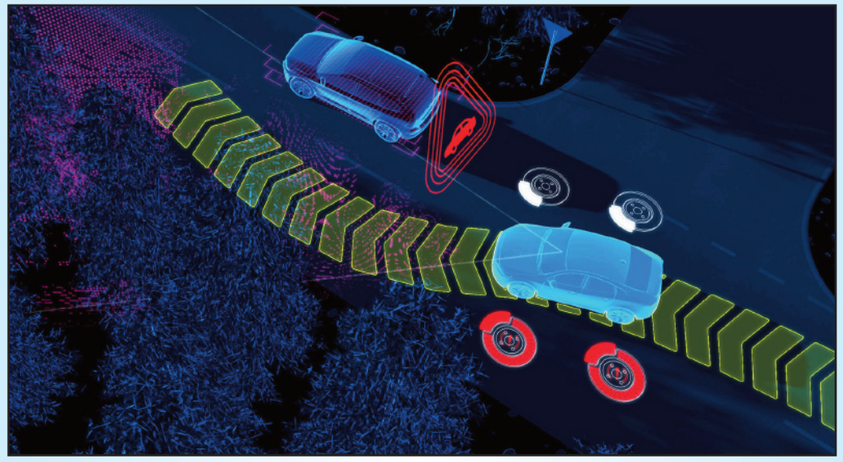
Independent compliance firm SGS-TUV Saar recently certified the Software Tool Qualification Reports for nine Tessent tools for any tool confidence level.

"As vehicles grow increasingly sophisticated, functional safety has become an essential market requirement for electronics software and hardware design technologies," said Brian Derrick, vice president at Mentor Graphics. "We established the Mentor Safe programme to help our customers rapidly navigate the increasingly complex process of functional safety certification with confidence, allowing them to spend more time creating value-add that helps differentiate and win in highly competitive markets."

Mentor Safe products will ship with enablement collateral providing descriptions and best practices information in the use of programme-qualified products.

Also included in Mentor Safe is ReqTracer, an industry-standard line of software tools for requirements management and tracking in automotive and other safety critcial applications. Achieving the highest possible confidence level as a standalone tool, ReqTracer is qualified for ISO 26262 designs and verification flows at all criticality levels including Asil D.

Volvo steers clear in Geneva



Volvo's XC60 SUV revealed at this month's Geneva Motor Show features three advanced driver assistance features aimed at keeping the driver out of trouble. They are designed to provide the driver with automatic steering assistance or support to avoid potential collisions.

"We have been working with collision avoidance systems for many years and we can see how effective they are," said Malin Ekholm, senior director at Volvo's safety centre. "With the XC60 we are determined to take the next step in reducing avoidable collisions with the addition of steering support and assistance."

Steering support engages when automatic braking alone would not help avoid a collision. Oncoming lane mitigation alerts a driver who has wandered out of a driving lane by providing automatic steering assistance, guiding them back into their own lane.

The optional blind spot information system has been updated to include steer assist that helps avoid potential collisions with vehicles in a blind spot by steering the car away from danger.

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Kaspersky research finds flaws in connected car app security

Kaspersky Lab researchers have examined the security of applications for the remote control of cars from several well-known car manufacturers and found that all contained security issues that could allow criminals to cause significant damage for connected car owners.

Mobile applications make it possible to obtain the location coordinates of a vehicle as well as its route, and to open doors, start the engine and control additional in-car devices. These are extremely useful but manufacturers need to secure these apps from the risk of cyber attacks.

The researchers tested seven remote car control applications developed by major car makers which, according to Google Play statistics, have been downloaded tens of thousands and, in some cases, up to five million times. The research discovered that each of the examined apps contained several security issues.

For example, the list included no defence against application reverse engineering. This means malicious users can work out how the app works and find a vulnerability that would allow them to obtain access to server-side infrastructure or to the car's multimedia system.

Some had no code integrity check, which is important because it lets criminals incorporate their own code in the app and replace the original programme with a fake one. Others had no rooting detection techniques. Root rights provide trojans with almost endless capabilities and leave the app defenceless

There was also a lack of protection against app overlaying techniques. This helps malicious apps show phishing windows and steal users' credentials. And some stored logins and passwords in plain text. Using this weakness, a criminal can steal users' data relatively easily.

"The main conclusion of our research is that, in their current state, applications for connected cars are not ready to withstand malware attacks," said Victor Chebyshev, security expert at Kaspersky Lab. "The attack surface is really vast here."

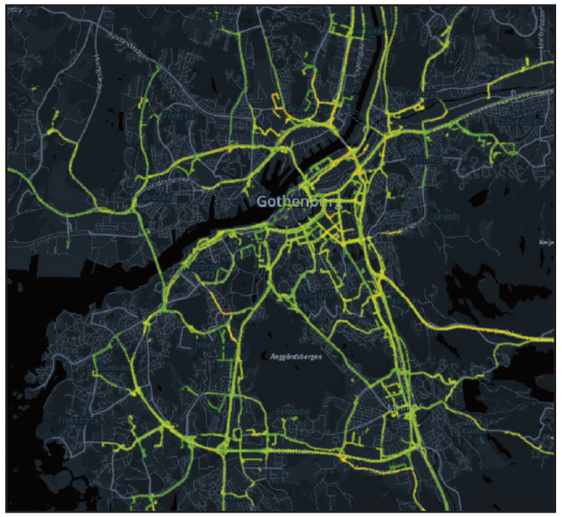
Swedish roll out for road surface monitors

Nira Dynamics is rolling out in Sweden a system that continuously monitors road friction in real time. By combing this information from numerous cars to a central server, warnings can be sent to other cars approaching a dangerous area.

During this winter, Nira provided the Swedish Transport Administration and Klimator with software for a large number of cars to monitor the road conditions continuously. The gathered information is sent to Nira's servers, where it is aggregated to provide real-time insights about the road conditions.

This provides drivers with slip warnings. Self-driving cars also need to be aware of the traction and braking distance at any time.

As a positive side-effect, the software also facilitates more efficient and environmentally-friendly winter road maintenance, resulting in cost savings.



Tyre grip indicator data around Gothenburg

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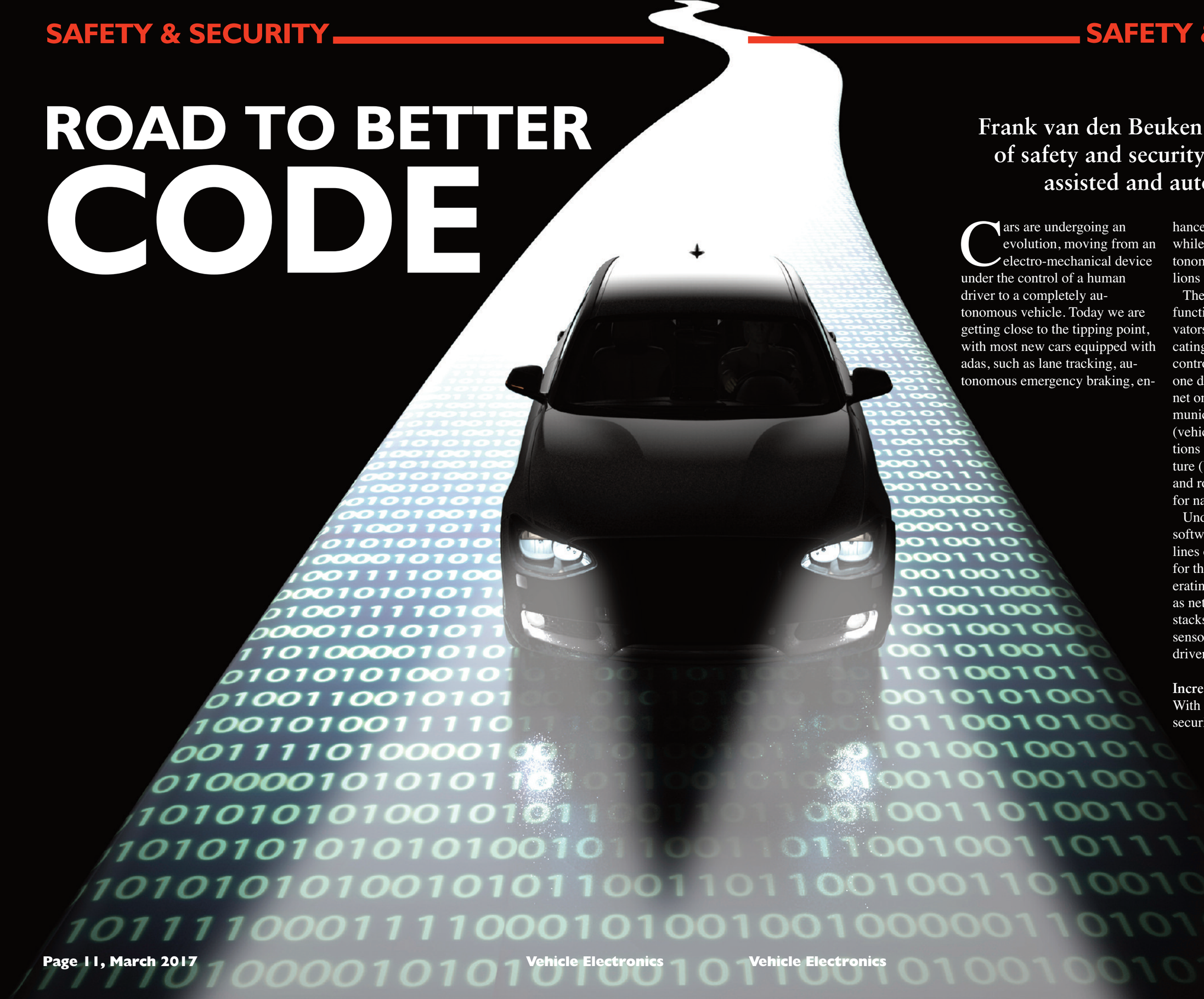
ROAD TO BETTER CODE



Frank van den Beuken looks at the role of safety and security in the future for assisted and autonomous driving

Cars are undergoing an evolution, moving from an electro-mechanical device under the control of a human driver to a completely autonomous vehicle. Today we are getting close to the tipping point, with most new cars equipped with adas, such as lane tracking, autonomous emergency braking, enhanced vision systems and more, while experimental fully autonomous cars are racking up millions of kilometres of test driving.

The systems to provide these functions are built of sensors, activators, radar and lidar, communicating through networks, and controlled by microcontroller, so one definition of a car is an internet on wheels. Cars are also communicating with other cars (vehicle to vehicle communications or V2V), to the infrastructure (V2I) such as traffic lights and road signs, and to satellites for navigation and reporting.

Underneath all this is, of course, software – more than 100 million lines of code. As well as the code for the applications, there are operating systems, middleware such as network communications stacks and interfaces to the sensors, actuators and to the driver's display.

Increased vulnerability

With this increased complexity, security and safety have become

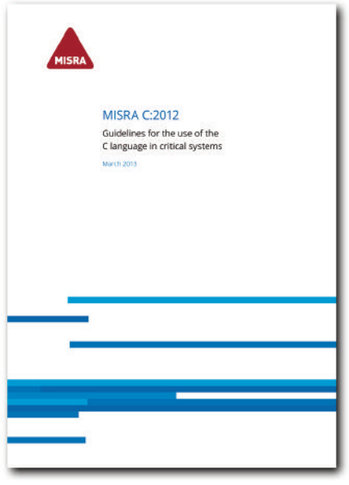
SAFETY & SECURITY

an increasing concern. With the growth of V2X communications, cars become open to outside attack: already a third party has taken control of a Jeep, overriding the driver. A further vulnerability can be added by the car user.

Car manufacturers all use on-board diagnostics (OBD) to monitor various engine parameters, for fault finding and for diagnostics at servicing. The connector interface, OBD II, is publicly available and there is a mass of Bluetooth OBD connectors to let a driver monitor engine health from a mobile phone.

This could also open the engine control system to an unfriendly person. A recent paper from the University of Michigan has described using a direct laptop connection to the OBD to override driver instructions on a large lorry and on a school bus.

With such large quantities of code, safety is also critical. The Toyota unintended acceleration court case demonstrated that much legacy code is not of a high standard. New code must be developed to a much higher standard.



Misra C: 2012 guidelines

Standardisation

It was only five years ago that a specific safety standard for cars was issued. ISO 26262 is an adaptation of the IEC 61508 functional safety standard that focuses on the needs of electrical and electronic systems installed in series-production passenger cars, and applies to all activities within the safety lifecycle of these safety-related systems. This includes requirements on the quality of software.

The standard uses automotive safety integrity levels (Asils) to provide a measure of the risk associated with a subsystem. They range from A to D, where A is the lowest safety integrity level and D the highest, that is the strictest with most requirements. In addition to these Asils, the class QM (quality management) denotes no requirement to comply with ISO 26262, which means it is the discretion of the development organisation to warrant quality. The parameters of severity of risk, probability of exposure and controllability determine the Asil.

The controllability parameter requires special attention. It is assumed the driver is in an appropriate condition to drive, has the appropriate driver training (a driver's licence) and is complying with all applicable legal regulations, including due care requirements to avoid risks to other traffic participants: the driver has to comply with traffic laws.

Laws will need adapting so when an automated driving system is in operation the driver will not have to pay attention unless the system asks for driver intervention. Correct operation of driver notification and fall-back to human control is crucial. If the notification fails, the human driver may not be paying attention and won't be able to avoid harm, as may have happened with the recent Tesla accident. If the fall-back fails, the system may stay in control instead of allowing the driver to intervene and avoid harm. Such situations must always be assigned the highest controllability class (C3), meaning less than ninety per cent of all drivers or other traffic participants are usually able, or barely able, to avoid harm.

Last year, a driver was killed when his Tesla Model S crashed while in self-driving mode

Part 6 of ISO 26262 is devoted to the software development process to produce code that is reliable enough when running in a system to meet the Asil level needed.

The SAE J3016 standard breaks driving automation into six classes, from no automation to fully automatic. Automated driving systems, defined as SAE level three or higher, rely on software to gather the data from sensors, to create a model of the environment and then, based on the goal, deciding on how to assist the driver, or control the vehicle. It also has other critical tasks, such as determining whether sensors are functioning correctly, when to alert the driver and when to trigger fall-back to human control.

It is vital this software behaves reliably. Other software tasks, such as modelling the sensor data,

may be less critical, but even for these risk analysis will be needed.

Legislation

Traffic laws will need to change to accommodate automated driving systems, particularly in the area of liability and privacy. Each country has its own traffic laws and there are legislative initiatives in many jurisdictions.

In the USA nationally, the National Highway Traffic Safety Administration has proposed a formal classification system that defines five levels ranging from when the driver completely controls the vehicle at all times up to the vehicle performing all safety critical functions for the entire trip, with the driver not expected to control the vehicle at any time.

Individual states vary in their approach: Nevada was the first state to authorise the operation of autonomous vehicles, to test autonomous driving technology on public roads, in 2011, followed by California, Florida, Michigan, North Dakota, Tennessee and Washington DC.

A European research project named Automated Driving Applications & Technologies for Intelligent Vehicles began in 2014 and develops various automated driving functions for daily traffic by dynamically adapting the level of automation to situation and driver status. The project also addresses legal issues that might impact successful market introduction.

Vehicle & Road Automation (VRA) is a support action funded by the European Union to create a collaboration network of experts and stakeholders working on deployment of automated vehicles and its related infrastructure.

VRA partners with some OEMs and suppliers, but most partners are research institutes and universities. VRA has identified a list of legal and regulatory issues in the EU.

Volkswagen has appealed for collective European legal actions, including progressive amendment of ECE Regulation 79 (also a UN rule) on steering equipment.

This demands that the driver can, at any time, over-ride the function and remain in primary control at all times.

The hack of a Jeep Cherokee has focused the industry on security

The Japanese government plans to develop laws to govern use of driverless cars. The government also created a classification of automated driving into four classes, including one for completely autonomous driving.

In China, Baidu (often called China's Google) is also working on a self-driving car with BMW. China's legislation is quite flexible so the government has more power to put the required changes in place. However, they will have to deal with the same complex issues as other countries.

India is also thinking about autonomous driving, but there are major challenges, one of them being the slow-moving legislation and the difficulty in imposing the expected rules because of different infrastructure.

Development approaches

In this context, how do you create code that is both safe and secure? As mentioned, ISO 26262 puts forward a process for software development, which includes use of coding standards and code checking tools.

System security starts with designing in features that will contribute to a secure result, such as:

- application separation, particularly segregating with firewalls, safety critical applications such as steering and brakes from those less critical, particularly those that communicate with the outside world, such as infotainment;
- limiting communications; and
- checking and validating data that are communicated.

As most software in this area is written in C a good starting point for safe and secure code is Misra C: 2012 (Misra 3). This provides a set of guidelines for writing C programmes, which, as well as avoiding undefined behaviour, includes rules that improve maintainability, testability, portability and readability of the source code. There is also a large overlap between Misra rules and ISO 26262-6 compliance tables, making Misra a compelling choice when ISO 26262 compliance is required.

Recently, Misra published amendment one to Misra 3. This has 14 new rules to extend still further Misra's coverage of the development of secure systems.

Tools are an important part of developing in accordance with ISO 26262. Static code analysis tools are an important part of managing code quality, providing both a quality control on the code and measuring its adherence to coding standards such as Misra. Test tools provide further confidence in the software, while verification tools measure how well the software is doing what the designer intended.

It is possible to develop safe and secure systems for vehicles, and organisations that have remodelled their development processes to conform with ISO 26262 have discovered that, after the initial introduction and learning phase, they are also reaping gains in productivity.

SAE level	Name	Narrative Definition	Execution of Steering and Acceleration/ Deceleration	Monitoring of Driving Environment	Fallback Performance of Dynamic Driving Task	System Capability (Driving Modes)
***Human driver* monitors the driving environment**						
0	No Automation	the full-time performance by the *human driver* of all aspects of the *dynamic driving task*, even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	Driver Assistance	the *driving mode*-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	Human driver and system	Human driver	Human driver	Some driving modes
2	Partial Automation	the *driving mode*-specific execution by one or more driver assistance systems of both steering and acceleration/ deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	**System**	Human driver	Human driver	Some driving modes
***Automated driving system* ("system") monitors the driving environment**						
3	Conditional Automation	the *driving mode*-specific performance by an *automated driving system* of all aspects of the dynamic driving task with the expectation that the *human driver* will respond appropriately to a *request to intervene*	System	**System**	Human driver	Some driving modes
4	High Automation	the *driving mode*-specific performance by an automated driving system of all aspects of the *dynamic driving task*, even if a *human driver* does not respond appropriately to a *request to intervene*	System	System	**System**	Some driving modes
5	Full Automation	the full-time performance by an *automated driving system* of all aspects of the *dynamic driving task* under all roadway and environmental conditions that can be managed by a *human driver*	System	System	System	**All driving modes**

SAE J3016 levels

Frank van den Beuken works for PRQA

POWER TECHNOLOGIES

Heavy going

Bruce Haug looks at an alternative to anti-surge devices in lorries and heavy-equipment environments

Lorry, automotive and heavy equipment environments are very demanding for any type of power conversion devices. Wide operating voltage ranges, coupled with large transients and wide temperature excursions, combine to make reliable and robust electronic system design challenging.

Further, some applications require installation of power conversion devices under the bonnet, so +150˚C operating capability is needed. At the same time, the number of electronic components is increasing, space requirements are shrinking, making high efficiency and high input surge voltage ride-through even more critical.

Whether it's a load dump, cold crank or high temperature under the bonnet, automotive on-board power supplies need to be designed to operate reliably under all these conditions.

Under normal steady-state conditions, a 12V battery system only varies from about 9 to 18V and a 24V system about 21 to 36V. However, during a load dump transient, voltages in excess of 120V can be generated for hundreds of milliseconds.

A load-dump occurs when the alternator is charging the vehicle's battery and an electrical open-circuit causes a momentary disconnection of the battery from the alternator – a very common phenomena. Until the voltage regulator can respond, the full alternator charging current is applied directly to the automotive power bus, raising its voltage to potentially dangerous levels. Such a transient could be caused through a physical disconnection and

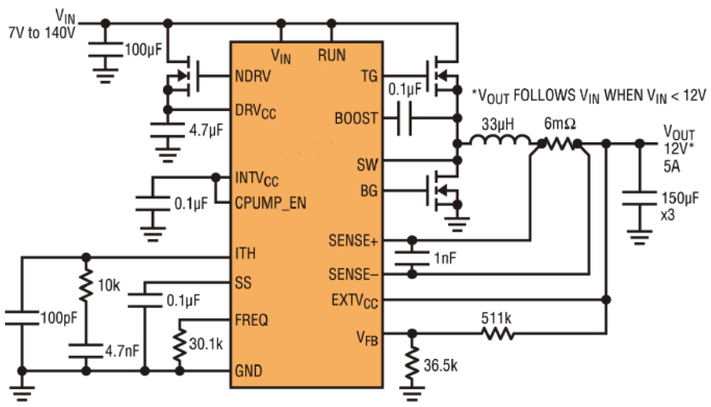


Fig. 1: Schematic showing IC producing a 12V output from a 7 to 140V input

could also result from a faulty connection in the battery cable or corrosion at the battery terminals.

Other physical factors in vehicular design are also a concern. In particular there are long power supply lines that feed from the power distribution box in the engine compartment to the distant corners of the vehicle. The average automobile has approximately 1.6km of copper wire, compared with just 45m in 1948. Because of the inductive characteristics of long leads, there are even higher transient levels than those that occur during a load dump. The governing specification for tail light electronics is that they must be able to withstand transients of +100V. This can be a challenge for IC-based electronics such as LED tail light regulators.

Moreover, there are several electronic systems that require continuous power even when the vehicle's motor is not running, such as remote keyless entry, GPS and security systems. It is essential for these types of always-on systems to have a DC-DC converter with low quiescent current to increase the battery run time when in sleep mode.

Under such circumstances, the regulator runs in normal continuous switching mode until the output current drops below a predetermined threshold of around 30 to 50mA. Below this level, the switching regulator must go into lower quiescent current operation to reduce the current draw, thereby reducing the power drawn from the battery, which in turn extends its run time.

Critical systems must survive, and must also function seamlessly through such transients without interruption. Until now, most vehicles have used a passive protection network consisting of a low-pass LC filter and a transient voltage suppression array to clamp the peak voltage excursions of the power bus. However, a high input voltage DC-DC step-down controller can operate through these high voltage surges and protect downstream components without the need of additional surge suppression devices.

Such a device is shown in Fig. 1. This is a non-isolated synchronous step-down switching regulator controller that drives all n-channel mosfet power stages. Its 4 to 140V (150V absolute maximum) input voltage range is designed to operate from a high input voltage source or from an input that has high voltage surges, eliminating the need for external surge suppression devices. It continues to operate at up to 100 per cent duty cycle during input voltage dips down to 4V, making it well suited to automotive, lorry and heavy equipment applications.

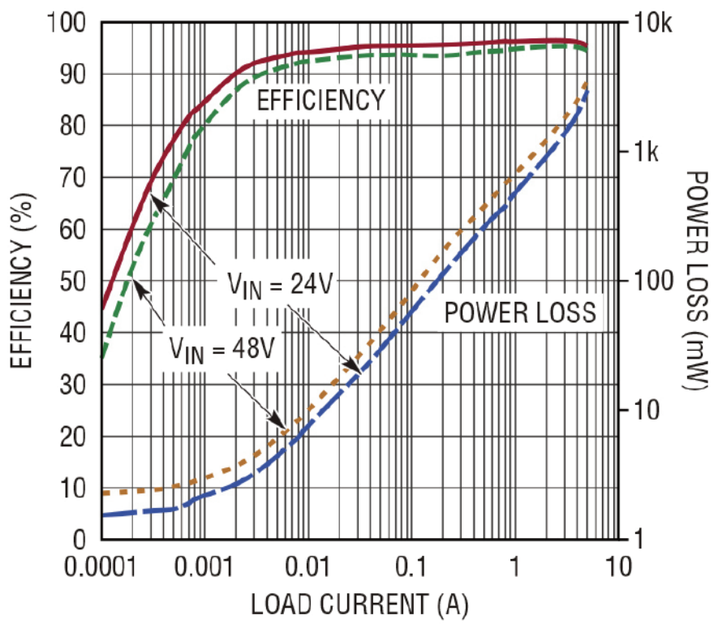


Fig. 2: Efficiency curves for a 12V output from a 24 or 48V input

The schematic in Fig. 1 produces a 12V output from a 7 to 140V input voltage range. When the input voltage is below 12V, the output voltage will follow the input voltage since it would be running at 100 per cent duty cycle with the top mosfet on continuously. This feature is possible due to an on-board charge pump.

Burst mode

A device such as this can be enabled to enter high efficiency burst mode operation, constant frequency pulse skipping, or forced continuous conduction mode at low load currents. When configured for burst mode operation and during a light load condition, the converter will burst out a few pulses to maintain the charge voltage on the output capacitor. It then turns off the converter and goes into sleep mode with most of its internal circuits shut down.

The output capacitor supplies the load current and, when the voltage across the output capacitor drops to a programmed level, the converter starts back up, delivering more current to replenish the charge voltage. The action of shutting down and turning off most of its internal circuits significantly reduces quiescent current, thereby helping to extend the battery run-time in always-on systems when in standby mode.

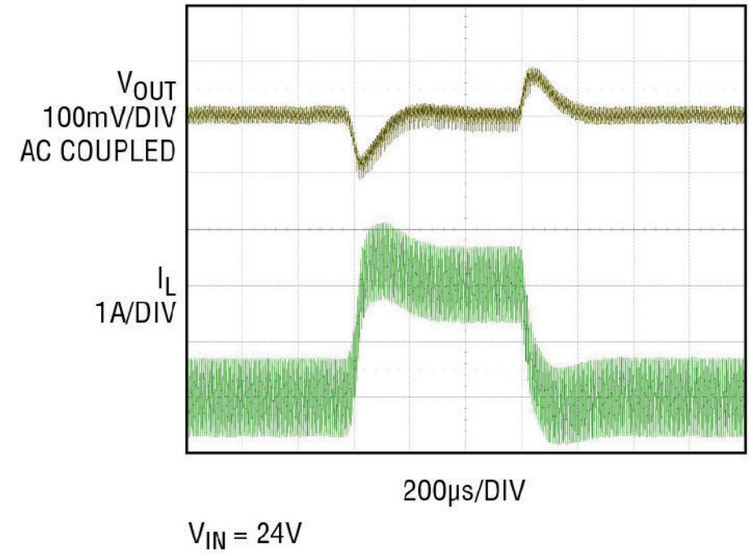


Fig. 3: Transient response for a 2A step-load for a 12V output

Efficiency

The efficiency curves in Fig. 2 are representative of the Fig. 1 schematic with a 24 or 48V input voltage. As shown, the 8.5V output produces very high efficiency at up to 98 per cent. The 3.3V is also over 90 per cent efficient. In addition, this design is still over 75 per cent efficient for each output with a 1mA load, due to its burst mode operation.

Fast transient response

The device uses a fast 25MHz bandwidth op amp for output voltage feedback. The high bandwidth of the amplifier, along with high switching frequencies and low value inductor, allow for a very high gain crossover frequency. This enables optimisation of the compensation network for a very fast load transient response.

Fig. 3 illustrates the transient response of a 2A step load on a 12V output with a less than 100mV deviation from nominal and a 200μs recovery time.

Conclusion

A new level of performance for safe and efficient operation can be brought to demanding high-voltage transient environments such as those commonly found in automotive DC-DC converters. This choice suits lorry, heavy equipment, rail and automotive applications, where high voltage transients are commonplace.

Bruce Haug is senior product marketing engineer with Linear Technology

DRIVER ASSISTANCE

Put a SoC in it

Aaron Behman and Adam Taylor discuss considerations for adas and the advantages of programmable SoCs

Increases in processing capability and the development of cmos image sensors and other sensor technologies have helped vehicle manufacturers introduce advanced driver assistance systems (adas). Adas enhances drivers' awareness of the environment around them reducing the chances of collision. Some systems can also monitor drivers and alert them should they become sleepy, for instance.

Increasingly adas also takes control or provides information to autonomous driving systems, providing assistance to the driver with capabilities such as parking assist, lane assist and adaptive cruise control.

It is therefore no surprise that the adas market is predicted to be worth $4bn a year by 2021 and is experiencing a ten per cent compounded annual growth rate.

Adas use a wide spectrum of sensors encompassing embedded vision, radar and lidar. Often, to extract the information required they use a sensor fusion approach combining information from several sensors. Within the embedded vision sphere, adas can be split further into two categories: external monitoring addresses aspects such as lane departure, object detection, blind spot detection and traffic sign recognition; while internal systems monitor aspects such as driver drowsiness and eye detection. Both internal and external adas applications bring with them challenges to address in implementing the image processing algorithms.

These challenges range from the ability to implement the algorithms required for the application, to complying with the correct automotive standards.

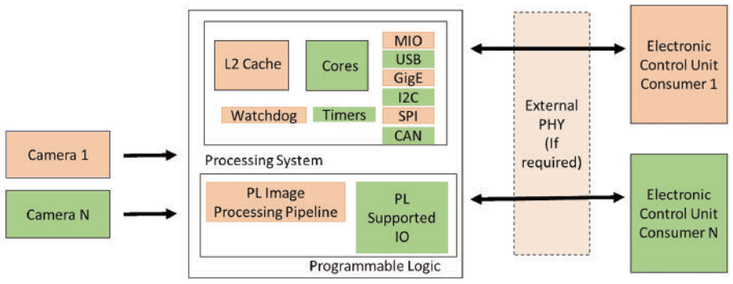
Many adas applications also require sensor fusion to combine the inputs from several sensors, significantly increasing the required processing power.

Sensor fusion can be homogeneous where the multiple sensors of the same type are used, or heterogeneous where different sensor types are used to extract the information required.

Many applications use an all-programmable SoC or FPGA to implement the system due to the flexibility provided, both to implement the required algorithms but also due to the ability to interface with different sensor types and networks.

Along with performance, adas applications also come with several difficulties that may not be obvious at first. Vehicle manufacturers have stringent pollution standards to achieve and therefore the weight and power consumption of the overall system is important.

The cost is also critical due to the many tens or hundreds of thousands of vehicles being produced. While security and safety of the system are very critical and governed by standards, using a



Support for any-to-any interfacing with sensors and consumers

SoC or FPGA can help us address a number of these.

System architecture

The development of embedded vision that monitors both external and internal cameras can be seen to be one of the more difficult adas implementations. This needs to interface to several cameras around the vehicle, process the images and provide the information to the occupants.

Many camera systems use point-to-point LVDS wiring to transfer the data, however this brings with it additional cost and weight in the cabling required. There are though alternative approaches that are increasingly gaining ground, pushing some functionality into the camera itself. If the image output by the camera is compressed and not the raw image, then network based architectures are possible. These networks could be based around commonly used automotive buses such as:

- Most (Media Oriented Systems Transport): A high speed network that can be implemented in optical or electrical physical layers;
- IDB-1394: High speed network implemented over an electrical physical layer and implemented in a daisy chained topology; and
- Ethernet AVB (audio visual bridging): This provides the ability to route image data and other data around the vehicle as needed.

When using a network, the system architect must ensure the necessary bandwidth is available to transfer the image data between the camera and adas core with the required latency for its application.

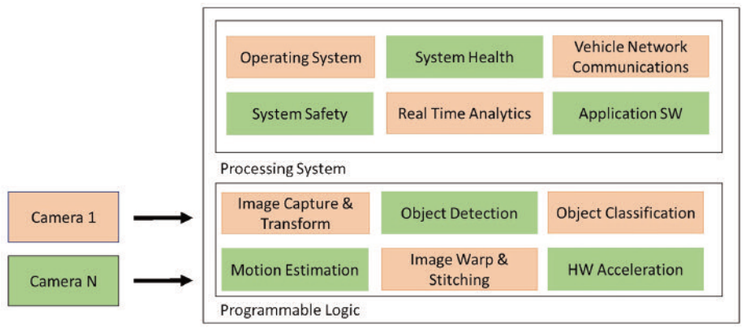
The data generated by the adas may need to be shared with other systems within the car, for instance adaptive cruise control or parking assist. Therefore, the adas must be able to interface to other commonly used automotive interfaces such as Can or Flexray.

At the architectural level, the use of an all-programmable SoC approach provides several advantages. If point-to-point wiring is used to interface to the cameras, the camera receivers can be implemented in the programmable logic prior to the image processing chain. If a programmable SoC were to be used, the flexibility of the processor system side would allow for the easy inclusion of a Can, Ethernet and other protocols such as Flexray when combined with logic in the programmable logic and an external phy if necessary. The combination of dual-core processors and programmable logic allows for a very low power per pixel, as the system is very tightly integrated.

SoC architecture

Where the SoC comes into its own is the use of programmable logic to implement camera interface and image processing chain, while the processing system of the SoC provides the communications, control and additional algorithmic processing as required. The image processing pipeline can be generated using IP libraries and more specialist IP cores.

To develop additional algorithms, high-level synthesis tools can accelerate the development. Rather than developing the IP using a traditional hardware description language, a higher level language such as C or C++ can reduce the time to market.



Architectural blocks for multiple camera system

Further acceleration of the algorithm can be achieved using open source frameworks. Algorithms developed in this way can be mapped into a high-level synthesis video library. This eases the transition from proof of concept and demonstration to the algorithms running in the target hardware for characterisation and qualification.

Many implemented architectures will use the processor DDR memory as a frame buffer; this enables the processor to access the images as necessary for further onwards transmission if using an Ethernet based system or PCIe, for example. The processor can perform additional image processing algorithms on the images stored within the DDR before reinsertion into the image processing chain.

This provides a very interesting capability that the SoC itself can form its own prototype and demonstration platform. Using common embedded vision development frameworks running on the cores within the processor, this provides for a down to size prototype system. This system can then be optimised for performance using the programmable logic side of the SoC.

Safety and security

The very nature of adas is that it contributes to automotive safety, and as such systems must be developed in line with a standard as with many other high reliability systems.

For adas, the applicable standard is ISO 26262. This defines a number of automotive safety integrity levels (Asils) that define the time to failure in hours. There are four Asils with D being the highest and most difficult to achieve and A the lowest.

Adas head up application displaying navigation and situational awareness information

Achieving these requirements requires an integrated engineering delivery lifecycle to ensure not only the target Asil is achieved, but the data pack generated also demonstrates this by containing the necessary evidence.

Automotive applications are subject to harsh environments, and as such the developers need to ensure they use automotive grade components, for instance one certified to AEC-Q100, which has been manufactured and qualified to a higher standard than commercial components.

They must also consider the security of the system that is preventing unauthorised people from making modifications to the system, as this could potentially lead to catastrophic results.

Using a programmable SoC provides the ability to use its secure boot capability to prevent unauthorised programmes and bit streams from being configured into the system.

Conclusion

At both the system and device level, the use of a programmable SoC offers a number of benefits providing for greater levels of integration, allowing for a more weight and power efficient system. Modern high-level synthesis tools enable the rapid development of image processing functions that can be used within many open-source commonly used frameworks.

Aaron Behman is director of strategic marketing at Xilinx

and Adam Taylor is an embedded systems consultant

Colour guide

Theju Bernard discusses colour brightness matching in automobile LCD panels

Today, more and more vehicle models include displays in the instrument cluster, centre console, rear-view mirror, and in the rear seats to keep the kids entertained. Manufacturers go to great lengths to create styling and branding for each model and the styling extends from the exterior vehicle body to the interior passenger cabin.

Increasingly, it is important that each display has the desired look and matches the other adjacent or nearby displays.

And as displays become critical in relaying important safety information to the driver, such as the backup camera image, ensuring the displays are highly reliable and present this information accurately is a must.

The need for gamma correction originated with the invention of CRT TV displays. The CRT uses an electron beam raster to illuminate the phosphor coating behind the display front panel. The applied grid control voltage proportionately controls the luminous intensity and it follows the power law:

Luminous intensity = Control voltage to the power gamma

This is inherently non-linear. The nominal gamma for the CRT is about 2.5. The human eye on the other hand has an inverse response and is relatively sensitive to changes in the darker portion of the greyscale. Therefore, to make the final image display the greyscale true-depth variation to the human eye, gamma correction must be implemented on the red, green and blue signals prior to transmission. This is done at the system where the video originates, such as a TV broadcast camera.

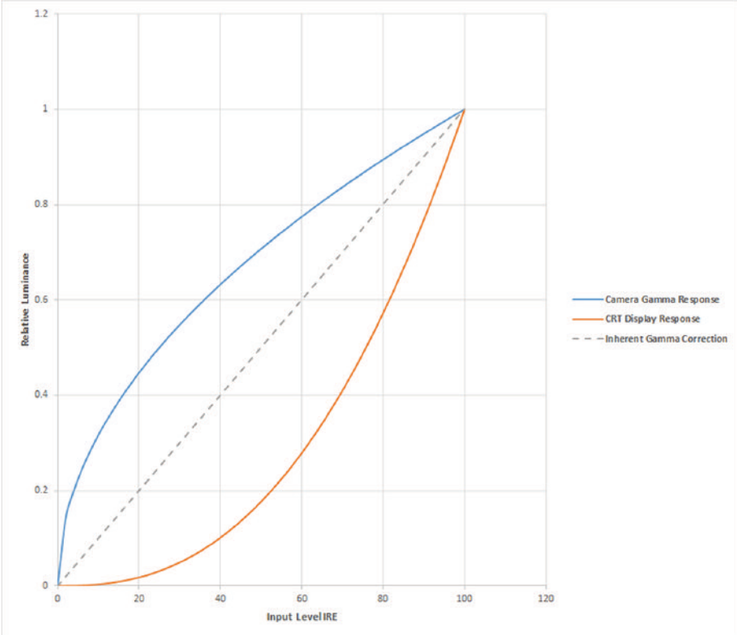


Fig. 1: Gamma for legacy CRT systems

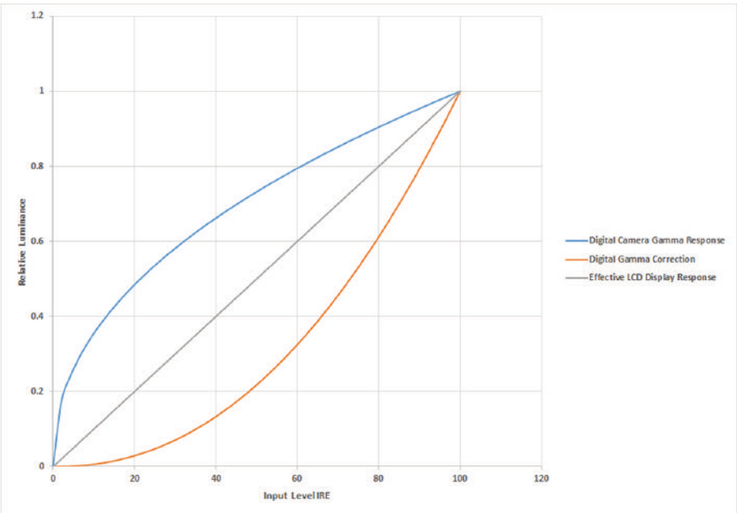


Fig. 2: Gamma for LCD systems

Gamma correction, also known as gamma calibration, can ensure consistent brightness and colour matching of TFT-LCD panels used in automobiles.

Cameras are designed to output a voltage that is proportional to luminous intensity raised to power 1/2.5 or luminous intensity raised to power 0.4. Since a gamma slightly greater than 1.0 is preferred, the broadcast standard typically uses a gamma of 0.5, which leads to a system gamma of 1.25. Fig. 1 shows that the camera's built-in gamma response is the inverse of the CRT response and therefore no additional system gamma correction is required. However, the TFT-LCD's signal must be adjusted to compensate for the camera's gamma adjustment, which was originally set for the CRT display.

Gamma calibrating

TFT-LCD panels are increasingly used in an automobile's instrument cluster, infotainment and navigation head unit, and advanced driver assistance system (adas) smart mirrors. They do not have an electron gun and phosphors to generate luminous intensity, but instead apply a voltage to a liquid crystal pixel, which controls the transmittance of "backlight" through the pixel. A cold cathode fluorescent lamp or LED array is used to provide the backlight. The voltage applied to a liquid crystal pixel controls the amount of backlight allowed to pass to the front to recreate the transmitted image and this defines the transmission curve for the TFT-LCD.

The gamma of the TFT-LCD differs from the CRT; however, it does have a slight gamma response. Legacy broadcast systems have gamma correction built into the transmission to compensate for CRT gamma response, and this combines with the inverse response as perceived by the human eye. Therefore, gamma correction must be done to the signal before applying it to the TFT-LCD pixels.

It is necessary that TFT-LCD gamma correction follows that of a CRT display. The incoming video signals are digital and the gamma correction code is applied to the digital-to-analogue converter (DAC), which generates the voltage that is then applied to the pixels.

These gamma correction codes help panel display manufacturers determine applicable codes that enable the required visual performance. Often the system can store multiple gamma correction settings for varying ambient light conditions. Fig. 2 shows the normalised gamma correction for use with TFT-LCD panels to achieve a system gamma of 1.0.

Digital video data, typically low-voltage differential signalling (LVDS), must be converted using a DAC to generate an analogue voltage for the pixel. Gamma is corrected – intentionally made non-linear – by the use of piecewise non-linear DACs in the panel's source and column drivers. The source driver DACs determine how many different voltage steps can be applied to the pixels. For example, an 8bit DAC yields 28 or 256 steps of possible greyscale. Fig. 3 shows the perception of changes in greyscale intensity caused by each voltage step is relative to the panel's gamma response – voltage-transmission or V-T curve – and the response of the eye.

The non-linear nature of gamma correction results in compressed image data that reside at the low luminance level, with little or no compression at the high luminance level. The low-level compression makes the image data in the dark-to-not-so-dark region stand out and be more discerning to the human eye. This improves

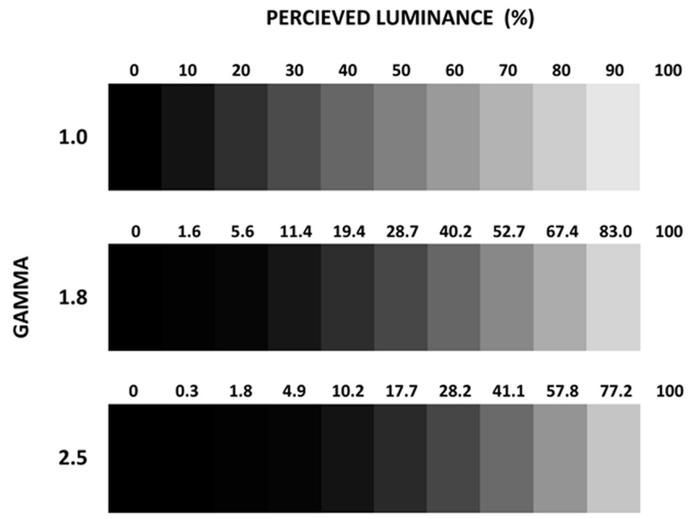


Fig. 3: Changes in relative intensity compared with gamma response

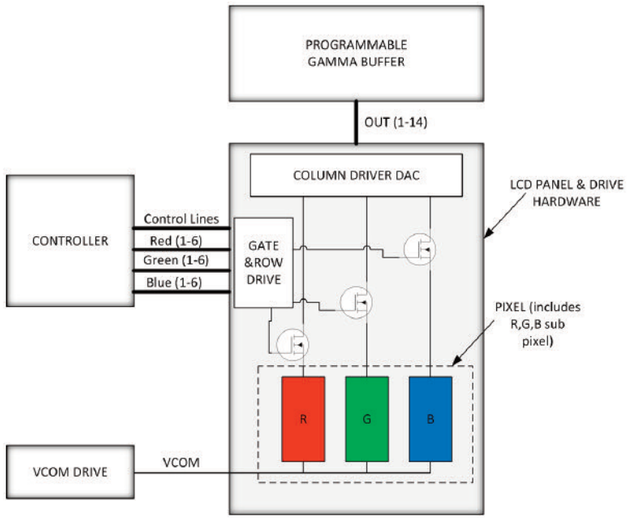


Fig. 4: Simplified TFT-LCD panel

the image depth.

And as an added bonus, the compression and non-linearity results in a lower number of bits used for luminance coding, for example 8bit for non-linear versus 12 or 14bit if it were linear. The compression also helps reduce video signal noise, if any exists.

Programmable gamma buffer

To change the LCD panel's gamma response to a desired V-T transfer function, the panel's source (column) driver DACs may use various reference voltages applied at multiple tap points. These voltages force each DAC to have a certain desired non-linear operation. The reference voltages are often supplied by gamma buffer ICs, which are generally buffer amplifiers that drive the analogue voltages to the DAC taps.

The gamma buffer ICs can be static or programmable.

Fig. 4 shows a simplified system block diagram of a TFT-LCD panel.

With the capability to control the DAC taps, automotive LCD panel makers can fine-tune the voltages to adjust or calibrate further the panel's non-linear gamma response, also called gamma calibration.

It allows an automotive LCD panel maker to ensure that all its LCD panels of a certain model exhibit the same gamma response from panel to panel.

This means any potential visual performance variations, caused by things such as variances in LCD fabrication and manufacturing, are reduced and thus the automotive LCD panel maker has a more consistent and visually appealing product. Consumers can be assured that the vehicle they purchase will include displays that visually perform like the ones they saw during their test drive at the dealership.

Panel makers ultimately decide how they want to calibrate the gamma response – for example gamma = 2.2, 2.0, 1.8, or a combination of gammas based on the intended brightness – so their display has a certain look. It's noteworthy that gamma characteristics tend to shift with wide viewing angles and different ambient lighting conditions. When shopping for a car at the dealership, it would be a good idea to compare the display under bright light and low light conditions to determine whether the image presented is visually appealing.

Different gamma

Fig. 5 compares the same image, but with different overall gamma. The differences are easily discernable. The middle image, is the nominal (original) gamma (for example gamma = 2.2), while the top image is more than nominal and the bottom image is less than nominal.

The bottom image loses contrast as the darks disappear, and becomes more washed out. The top image gets more contrast, but overall has more darkened area.

Display settings

Automotive LCD panels have black-to-white endpoint levels that are fixed by the capability of the source driver. However, digital adjustments can be made to the signal during video data processing. Brightness can also vary by simply adjusting the LCD panel's backlight intensity, which adds another dimension to system performance. Often the display controls can be adjusted for brightness and contrast, and for day and night settings.

The programmable gamma buffer simplifies the task of evaluating and setting the display transfer function by moving it into the manufacturing cycle of the auto display maker. These gamma settings are programmed into the eeprom and are transferred to the DAC on power up.

Some have multiple banks to hold more than one display profile for various ambient light conditions, and a custom setting that could be user programmable with the facility to save and store it.

The manufacturer set gamma profile is generally adequate for most automotive applications. This programming is done during the initial setup, after which the profile is never changed, unless fine-tuning is required to improve the display's visual performance.

Conclusion

Automotive LCD panel manufacturers strive to make their display panels visually desirable to car makers and consumers. Doing so requires a stable gamma buffer reference that ensures the video colour images displayed on their LCD panels are matched with the exact same contrast, brightness and colour across all displays. This can be accomplished by using a high accuracy programmable gamma buffer.

Theju Bernard is a principal applications engineer at Intersil

Fig. 5: From top to bottom, examples of high, nominal and low gamma for a given picture

ON THE ROAD

CONNECTED CATS

Jaguar's F-Type sports car continues to evolve, with a fresh look, state-of-the-art infotainment system and ReRun app that combines vehicle data with GoPro video to enhance the driving experience

Since launch in 2012, Jaguar's all-aluminium two-seater has firmly established itself as the best-selling sports car in its segment in its home market and has won nearly 160 awards worldwide. The balance of design, performance and dynamics has always made the F-Type unique, in a range that has evolved to include coupé bodystyles, manual transmissions and intelligent all-wheel drive.

The latest F-Type range offers more driver-focused technology and a broader model range, comprising 22 derivatives from the purist appeal of the rear-wheel drive, 340PS to the 320km/hr, all-wheel drive SVR – Jaguar's all-weather supercar.

Every F-Type now features Touch Pro infotainment. Its fast responses, intuitive tablet-style operation, intelligent navigation functions such as Share ETA and online services such as real-time traffic and live weather reports put information at the driver's fingertips.

True enthusiasts will be able to capture and share their driving experiences using the ReRun app developed in collaboration with GoPro. ReRun combines real-time video from the driver's GoPro with key vehicle performance data including speed, throttle position, gear selection, braking force and g force. The high quality video – including highlights sections – can be downloaded to the driver's smartphone and shared on social media.

Full LED headlights boost visual appeal further and help improve driver safety and comfort.

"Great sports car design is about proportion and purity," said Ian Callum, director of design at Jaguar. "The most challenging element of the process for designers is to focus on and maintain an exciting silhouette that promises performance. For the 2018 model year F-Type, we looked at how we could fine-tune key details to deliver even more clarity of purpose in the overall design – for the driver, the passenger and onlookers."

Joining the F-Type's suite of driver-focused assistance systems is a semi-automated park-assist function designed to make parallel parking in even the tightest of spaces quicker and easier. When passing a potential space, the car's ultrasonic parking sensors measure its length. If suitable, the system takes care of the steering; all the driver has to do is press a button, engage reverse and control the throttle and brakes. The system will also guide the vehicle out of the space when it's time to leave.

Jaguar has updated LED lighting

LEDs

At the front end, LED headlights add a technological edge. Inside, lightweight slimline seats deliver more style, more room and greater comfort. A harmonious selection of interior finishes and materials give a more exotic feel.

The full LED headlights help signal clarity in the F-Type's design language. Jaguar's distinctive J-Blade daytime running lights are retained, and these now double as the direction indicators, with the lamp's eyelid indexing with the bonnet's cutline to accentuate the lights' multi-layered graphics.

The improved aesthetics are matched by performance and functionality: light from the LEDs has a colour temperature of 5500 to 6000K, making it similar to natural daylight. Putting higher-quality light on the road improves visibility, helps alleviate fatigue on long drives and makes it easier for drivers to spot hazards earlier.

The adaptive front lighting makes the LED headlights more effective. Networking them to the vehicle's suite of sensors enables them to switch intelligently between the four main driving modes of city, country, motorway and bad weather.

Enthusiasts will be able to capture and share their driving experiences using the ReRun app

In normal conditions at up to 48km/hr, city mode provides a wide-angle low beam setting that helps the driver see pedestrians and side roads more easily in built-up areas. To aid progress in heavy rain, bad weather mode activates at speeds of up to 64km/hr.

When the F-Type accelerates above 48km/hr, country mode activates, providing a narrower, longer beam to improve distance visibility. At speeds beyond 90km/hr, motorway mode sets its focus further down the road.

The LED rear light clusters have been updated. The characteristic light graphic of a horizontal line intersecting a roundel – a feature inherited from the iconic Jaguar E-type – is now accentuated by darker lenses to give the car a more purposeful appearance.

Infotainment

The Touch Pro comes to the F-Type for the first time, bringing levels of in-car technology from navigation that can tell the driver's friends when he or she will arrive to a Spotify app that can recommend playlists, to the ReRun app developed in collaboration with GoPro

ReRun enables real-time video from the GoPro camera to be overlaid with key performance data from the F-Type, including speed, throttle position, gear selection, braking force, g-force and steering wheel angle.

The data are displayed using animated gauges.

With the smartphone connected wirelessly to the GoPro and to the infotainment system via USB, drivers are ready to start recording. Performance data are taken directly from the vehicle's electronic control networks to the ReRun app, allowing it to be overlaid in real time with the footage from the GoPro. A feature analyses the data to capture highlights such as peak cornering and braking forces.

"The ReRun app combines several unique features from our developer toolkits to help F-Type drivers create premium quality, easy-to-share videos of their driving experiences," said Adam Silver, senior director of GoPro. "Thanks to the close collaboration between Jaguar Land Rover's In-Control Apps team and our developer programme team, ReRun offers outstanding functionality and is intuitive to use. We're looking forward to the launch and see-

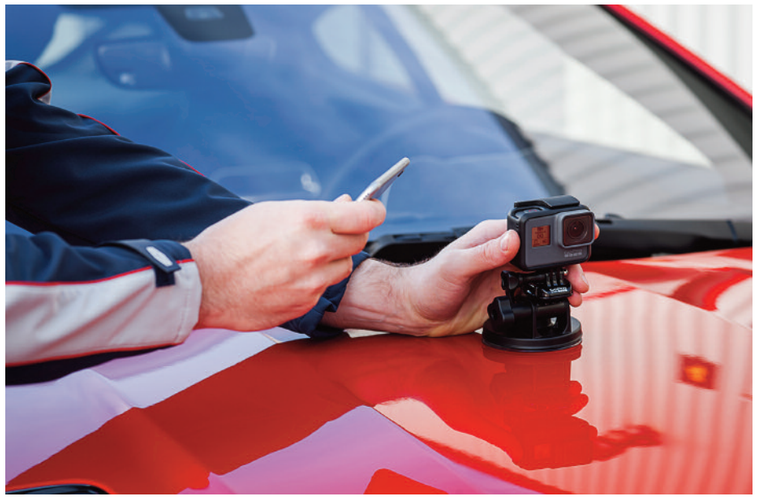
ing the first customer videos online."

The app lets drivers download either the entire video with highlights included, or just the highlights – and there's also an editing function. The videos are easy to share via social media platforms, making it possible for the driver to post their driving experiences across the internet.

ReRun is compatible with all F-Type models equipped with InControl Apps, and with iOS devices and GoPro cameras. ReRun is available in English, French, German, Italian, Portuguese and Spanish.

Touch Pro is the most advanced infotainment system offered by Jaguar and is now standard equipment across the entire F-Type range. It was designed and developed around a quad-core processor, high-speed 60Gbyte solid-state drive (SSD) and fast Ethernet network.

The system's 20.5cm capacitive touchscreen features quality graphics and the home screen can be customised and widgets added to provide shortcuts to specific features and functions. More customised home screens can be added if desired.



ReRun lets real-time video from the GoPro camera be overlaid with key performance data

Data stored on the SSD can be accessed more quickly than with conventional hard drive technology, making the graphics more responsive. Zooming in and out of maps can be done with pinch-and-pan gestures as on a smartphone or tablet.

A 4G data connection enables access to a suite of smart, location-based features. For example, enter a destination and Fuel Finder will check if there's enough fuel in the tank to get there. If not, this will be flagged and filling stations on the route that are within range are displayed on the map: tapping on one of them is all it takes to add it as a waypoint. Fuel prices can also be shown.

Commute Mode learns daily drives so it can offer alternative routes to avoid congestion using historical and real-time traffic information. But if the car does get caught in a jam, Share ETA can send destination, current location and estimated time of arrival to selected contacts via email or text message. If the ETA slips, the system can automatically follow up with an update.

Touch Pro's smart navigation features can help even as the journey is coming to an end: Arrival Mode adds a 360˚ interactive view of the destination alongside the map display when the car is 200m distant – it can even show where the nearest available parking spaces are and provide directions.

A companion app for iOS and Android smartphones enables door-to-door route planning and guidance and can help drivers complete the final stage of their journey on foot. The app also enables synching of routes and destinations between devices and the Touch Pro system so routes can be set in advance and uploaded automatically once in the car.

InControl Touch Pro provides better audio performance, and offers a choice of two systems developed for the F-Type with experts from Meridian. The standard-fit system has ten speakers, while the optional Surround Sound system has 12 speakers and delivers clear, crisp sound optimised for driver and passenger.

The experience is enriched with Gracenote album art stored on the SSD drive – 10Gbyte is dedicated to user media storage. Touch Pro also has smart functions such as "Play more like this", which automatically compiles playlists, or Music Queue, which makes it easy to search for and add songs, albums or artists to a music queue while the current track is playing.

Jaguar Land Rover is on a mission to transform the way customers listen to music in cars, which is why an app was developed with Spotify for streaming music. Accessed using InControl apps, the app mirrors the Spotify interface that users will recognise from their smartphones – intuitive swipe and touch gestures are used to navigate content, helping reduce distraction.

Tapping into Spotify's deep learning, which recognises listening habits, users can access Just for You playlists containing recommended tracks, saving time when scrolling through music on the move. Drivers in low-signal areas don't need to worry, as Spotify's offline mode will display downloaded content even if there is a poor internet connection.

Exotic feel: Inside the F-Type

Tool generates Autosar Dext files

With version 8.5 SP2 of Candela Studio, Vector presents a way to create Autosar-compliant configurations of the diagnostic basic software for vehicle ECUs.

It lets development teams at vehicle and ECU manufacturers generate Autosar Diagnostic Extract (Dext) files at the press of a button.

Dext is an extension of the Autosar system description. It is used to describe the unified diagnostic services supported by Autosar ECUs.

Beginning with service pack two of version 8.5, the Candela Studio diagnostic specification tool has an export function for generating the Dext. The exported files correspond to the Dext template standard introduced with Autosar 4.2.

Diagnostic development teams at vehicle and ECU manufacturers should thereby be able to configure the diagnostics-related components of the Autosar basic software faster and more easily.

Diagnostic users can create diagnostic descriptions with the user interface. These descriptions can then be consumed in further process steps, say data supply for testers or validation.

Another advantage of the tool is the simple migration of already existing and common diagnostic formats, such as ODX, into the Dext format.

DaVinci Configurator Pro from Vector can read the generated Dext files and use them for the automatic configuration of the diagnostics-related Autosar components in the basic software.

Rugged router realises resilient radio

A rugged router featuring the Cisco 5921 embedded services router (ESR) is available from Eurotech to provide resilient radio connectivity in vehicles.

Designed for harsh environments, the Boltmar 20-28 is certified for the transportation sector including rolling stock (EN50155) and fire and smoke (EN45545) and is pre-certified for some cellular carriers.

It guarantees protection by using rugged circular connectors and a fanless IP66 design, enabling operation from -40 to +70˚C. The class S2 power supply supports voltage inputs from 9 to 137.5V DC and copes with 10ms power outages; isolation of serial and digital IO ports adds extra protection.

The unit supports up to two UMTS, HSPA or LTE cellular modems with dual sim for improved roaming coverage.

Connectivity includes dual Gigabit Ethernet, Can bus, wifi 802.11 a/b/g/n, Bluetooth Low Energy and GPS with dead reckoning.

Hardware features suit Cisco ESR requirements, including commercial, industrial, homeland security, emergency response and mobile IoT.

The embedded ESR's network optimisation capabilities enable self-forming and self-healing networks that support traditional and IoT services, such as remote sensor management, vehicle-to-vehicle communications, passenger high-speed networks, and on-board and track-side crew communications.

For edge and fog computing, it includes the Everyware Software Framework, a commercial enterprise-ready edition of Eclipse Kura, the open source Java/OSGi middleware for IoT gateways.

Programmable Hall sensor reduces error

The A1377 from Allegro Microsystems is a programmable linear Hall-effect sensor IC for applications that require high accuracy and high resolution without compromising bandwidth.

The device uses segmented, linearly interpolated temperature compensation technology to reduce the total error of the device across the whole temperature range. As a result, it is suited to linear and rotary position sensing in automotive applications such as actuators and valves.

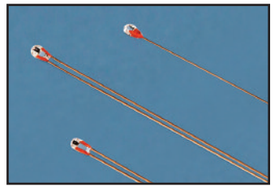
Available in a through-hole, small form factor, single in-line package (SIP), it has a broad range of sensitivities and offset operating bandwidths. The accuracy and flexibility is enhanced with user programmability, via the supply voltage and output pins.

This ratiometric Hall-effect sensor IC provides a voltage output that is proportional to the applied magnetic field. The quiescent voltage output is user-adjustable from approximately five to 95 per cent of the supply voltage. Sensitivity is adjustable from 1 to 14mV/G.

Each bicmos monolithic circuit integrates a Hall element, temperature-compensating circuitry to reduce the intrinsic sensitivity drift of the Hall element, small-signal high-gain amplifier, clamped low-impedance output stage and proprietary dynamic offset cancellation technique. Operating temperature is -40 to +150˚C.

The sensor is provided in a three-pin single in-line package with integrated bypass capacitors. It is lead (Pb) free, with 100 per cent matt-tin lead-frame plating.

Thermistors provide stability



Glass-encapsulated thermistors can provide long-term stability and reliability for high-accuracy temperature sensing in automotive applications.

Hermetically sealed, the Ametherm DG devices can eliminate errors in resistance readings due to moisture penetration and are 1.5mm diameter.

Operating temperature is -55 to +200˚C. They can be encapsulated in housings such as ring lugs and hex nuts.

There are four resistance values at +25˚C – 10, 40, 50 and 100kΩ – with tolerances down to ±2%, dissipation constant of 3.0mW/˚C and thermal time constant of 6s.

The devices provide TCRs of -3.9, -4.4 and -4.75%/˚C; beta values of 3500, 3950 and 4200K; and 32 AWG dumet wire leads.

Module manipulates Can FD

A stress and trigger module from Göpel Electronic can manipulate Can and Can FD communications enabling accurate protocol tests.

The functionality is available as an extended option for the Series 61 communications controllers.

The Basic Can6153 STM interferes with Can and Can FD messages resulting in the generation of error frames. In addition, external resources can be controlled via trigger output to specific frames or triggered via a trigger input.

The Can-IP has been extended by corresponding disturbance functions.

The parameterisation is carried out using the company's API allowing the module to be integrated into user-specific products.

The disturbance function supports Can FD as well as the standard Can protocol on one of four configurable ports. Ethernet is the host interface; alternatively PXI, PCI and USB are available.

Telematics devices suit connected vehicle use

Two high-end telematics devices for connected vehicle applications have been introduced by Calamp.

They address growing demand in Europe and Latin America for more connected vehicle technology and enable applications such as fleet management, usage-based insurance, crash notification, stolen vehicle recovery, vehicle finance and auto rental.

For fleet management applications, the LMU-2640 incorporates the flexibility of GSM and GPRS wireless communications along with sensitive GPS, a processing engine and a triple-axis accelerometer that detects and communicates driver behaviour.

It supports the company's ICN instant crash notification services suite, delivered via email, SMS or through an API.

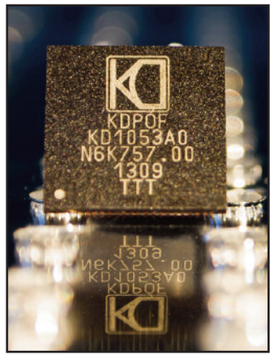
For track-and-trace applications, the LMU-200 provides connectivity through GPRS. It has sensitive GPS, motion detection, remote starter disable and built-in antennas that lower deployment costs and simplify installation.

Built on scalable hardware and a device management platform suite, each uses the company's Peg on-board alert engine and processing environment as well as the Puls over-the-air device management and maintenance application.

POF transceiver implements physical layer

KDPOF plans to sample in August an automotive Gigabit Ethernet plastic optical fibre (POF) transceiver that implements the physical layer of Gigabit Ethernet over POF.

Optimised for low power and small footprint, it transmits data at 1000/100Mbit/s on standard SI-POF, MC-POF or PCS, according to 1000baseRH (IEEE 802.3bv).



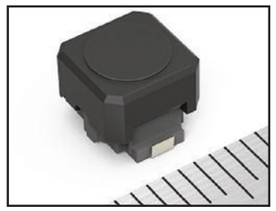
The KD1053 is for use with automotive qualified photonics, including 650nm RCLED, LED and Si PIN PD that are used in existing automotive products, with updated analogue optoelectronics interfaces.

The transceiver supports different standards – RGMII, RMII, MII, SGMII, 1000baseX and 100baseX – for the host digital interface. This simplifies the system and board level designs. Also, it provides a serial management interface (SMI).

Manufacture is based on a 65nm cmos process.

Applications include communications backbone, smart antenna link, infotainment, battery management systems and adas.

Its built-in analogue interface simplifies connectivity to fibre optic transceivers. Products able to incorporate POF ports based on the device ASSP include ECUs, switches, cameras and infotainment nodes.



Soft touch switch with high force

Mass production has started of the Alps Electric SKPS Tact switch with soft operating feel, combining a high operating force with a long operating life for in-vehicle controls.

Typical applications include air conditioning controls in the centre console, audio-visual system controls on the steering wheel, and switches enabling hands-free calls.

The model has dimensions of 5.9 by 6.0 by 5.0mm and operating forces of 3.0 or 3.6N. Life is 300,000 cycles.

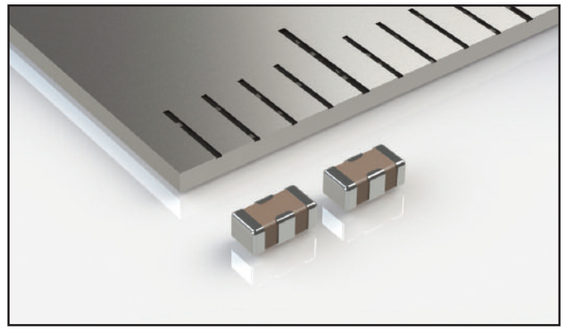
The travel is shorter than earlier products, reduced from 1.3 to 1.05mm. Changes were also made to the sliding structure of the main stem and rubber dome. A structure preventing ingress by dust or dirt was adopted to curb contact issues while achieving the same quiet operation as earlier products.

Maximum rating is 50mA, 16V DC, and initial contact resistance is 100mΩ maximum.

Three-terminal capacitors see reduced board area

Three-terminal capacitors from Murata are said to meet high-speed processor needs in automobile safety systems.

The NFM18HC series of three-terminal ceramic multilayer capacitors are for high reliability automobile applications such as preventive safety systems and adas.



The use of a three-terminal capacitor as opposed to a conventional two-terminal helps reduce board area. The power circuit of a processor requires many decoupling capacitors to reduce that impedance, thereby suppressing fluctuation of the power voltage, and increasing stability.

As the processing speed – operating frequency – of the processor increases, the control of impedance across a wide frequency band is important and one problem is that dozens or hundreds of decoupling capacitors are needed and these occupy a lot of space.

The three-terminal ceramic capacitor has a smaller equivalent series inductance than conventional two-terminal components, thus reducing the overall impedance. This lowers the number of capacitors that need to be used for higher frequency bands, freeing up board space for other components and making it possible to reduce the PCB area required.

This has resulted in its wide adoption for smartphones and other devices where compactness and high density are needed for mounted high-speed processors. The use in the automotive market has surged recently due to the demand for high performance processors and smaller electronics.

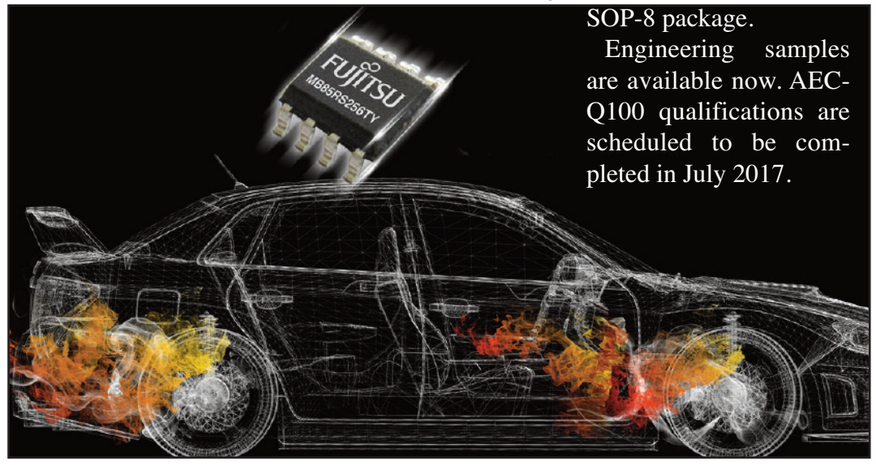
This has driven the increase in high-functioning multitasking onboard equipment such as adas, preventive safety systems and in-vehicle infotainment. The capacitors come in a 1.6 by 0.8mm package and conform to AEC-Q200.

Fram hits AEC-Q100

Fujitsu Electronics has launched a fram as the first component of a product group designed for an operating temperature up to +125°°C and qualified to AEC-Q100.

The MB85RS256TY is said to provide high-speed random access and high write endurance allowing instant and continuous data storage in applications such as airbag data storage, event data recorders, battery management systems, adas, navigation and infotainment systems.

The 256kbit device has an SPI and an operating voltage of 1.8 to 3.6V. Operating temperature is -40 to +125˚C. Write endurance is 1013 and it is housed in a standard SOP-8 package.



Engineering samples are available now. AEC-Q100 qualifications are scheduled to be completed in July 2017.

Reference platform aids imaging development

A modular automotive reference system from On Semiconductor gives system and software developers a ready-to-use camera for research and development activities.

The Mars platform lets users reconfigure cameras with different lenses, image sensors, image signal processors and communications options for rapid prototyping and experimentation.

The system can be used for the full spectrum of automotive camera applications including adas, surround and rear viewing systems, in-cabin cameras for gesture recognition, driver eye monitoring or light level inspection purposes, and autonomous driving.

Due to the different boards available, engineers have access to image sensors and co-processors, plus various automotive communications protocols from third party suppliers.

This modular approach means time-consuming activities such as creating custom boards, testing high-speed interface standards or writing code for drivers are not necessary.

Mars is supported by an ecosystem, encompassing software development tools, schematics, gerbers, bill-of-materials and more. A user guide is also included.

The support of commonly used communications standards such as GMSL, FPD-Link, LVDS, Mipi and Ethernet enables direct interfacing with existing vehicle ECUs. Modules are already prequalified with third party products.

Emulator acts as development environment

An on-chip debugging emulator is intended as a development environment for the latest devices in the Renesas RH850, RX and RL78 families of microcontrollers and for automotive SoCs.

The E2 emulator supports the extended debugging functionality of the RH850 and contributes to shortening the time required for Can communications and the current consumption debugging.

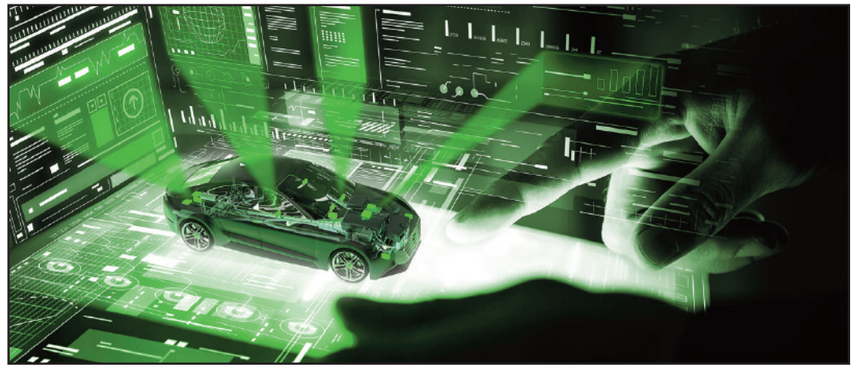
Additional debugging features required for software development have been integrated into the device. Specifically, it reduces the time required to determine the cause of an error during Can communications by providing a connection to the bus that allows message timing to be matched with executing code; it also makes it easier to determine the cause of current consumption peak by monitoring the current draw of the device and correlating that with the code.

The emulator can stop the programme when it detects that the interrupt response time has exceeded a specified limit, and record and display trace data relating to Can communications reception and interrupt response processing simultaneously.

The method for measuring Can communications response time can allow trace analysis of Can communications and programme operation to be performed by the emulator alone, and reduce the time to determine the cause of an error.

The emulator can display the programme operation and current consumption together, making it easier to identify areas where current reduction should be targeted.

Tool simplifies software projects



A customisable and extensible development tool that simplifies the verification of automotive system behaviour in a run-time environment has been released by Elektrobit. Platform-agnostic, EB Solys helps car makers and suppliers save time and costs during software development and bug fixing and ensures the final product performs without error.

Advanced automotive systems that enable connectivity and highly automated driving features must overcome complex technical problems. To do so, projects often require extensive collaboration among numerous software suppliers with different development methods.

This tool visualises how software components interact with each other and allows developers to monitor and verify actual runtime behaviour against the software architecture in real time. Through graphical and programmatic analysis, compliance issues and other conflicts can be pinpointed and resolved, saving time and resources.

Previously known as EB Race, the tool now has more features including continuous integration support with EB Solys Auto for permanent key performance indicator measurements during the entire project lifecycle. The built-in script engine has an application programming interface for data post-processing, facilitating efficient and formal data analysis.

The company has also been granted Asil-D certification for EB Tresos Safety RTE. The run-time environment plays a role in Autosar architecture by providing the main interface and ensuring the safe communications between application software components.

Certification agency Exida has confirmed that all EB Tresos Safety products ensure safe and efficient communications between ECU software applications, according to ISO 26262.

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