VEHICLE electronics

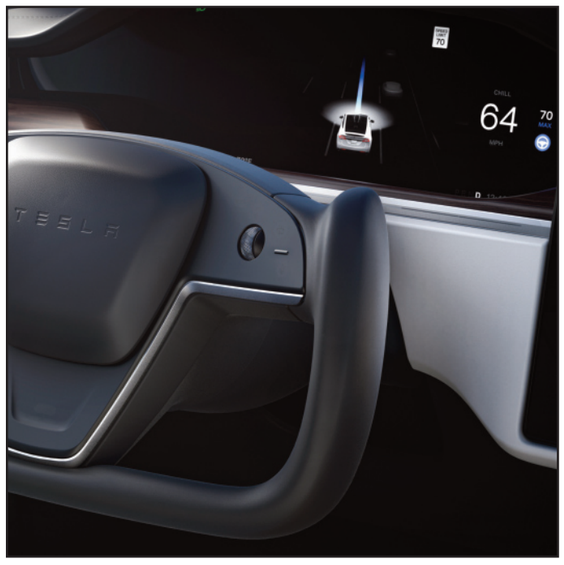
The monthly magazine for automotive electronics engineers

USA investigates Tesla after autopilot crashes

US authorities are investigating Tesla after eleven crashes where the autopilot or traffic aware cruise control became confused by flashing lights of first responder vehicles.

The National Highway Traffic Safety Administration (NHTSA) said most incidents took place after dark and the crash scenes encountered included measures such as first responder vehicle lights, flares, an illuminated arrow board and road cones.

Since January 2018, the Office of Defects Investigation (ODI) has identified eleven crashes in which Tesla models of various configurations have encountered first responder scenes and subsequently struck one or more vehicles involved with those scenes.



Tesla's autopilot is under investigation

Autopilot is an adas in which the vehicle maintains its speed and lane centring. With the adas active, the driver still holds primary responsibility for detecting and responding to objects.

ODI has opened a preliminary evaluation of the level-two adas autopilot in the 2014 to 2021 models Y, X, S and 3. The investigation will assess the technologies and methods used to monitor, assist and enforce the driver's engagement with dynamic driving tasks during autopilot operation.

The investigation will also assess the detection and response by vehicles in autopilot mode.

And the investigation will include examination of the contributing circumstances for the confirmed crashes and other similar crashes.

Tesla has been asked for its response,

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Foxconn buys Macronix SiC fab in EV push

Foxconn has bought fellow Taiwanese company Macronix's six-inch wafer fab and equipment in the Hsinchu Science Park for NT$2.52bn.

Macronix is a device designer and manufacturer of non-volatile memory products.

The transaction, believed to signify a deeper commercial collaboration between Macronix and Foxconn on SiC technology for electric vehicles, is expected to close by the end of this year.

The agreement was signed by Chih-Yuan Lu, president of Macronix, and Bob Wei-Ming Chen, president of Foxconn's semiconductor business group.

"The acquisition of the six-inch wafer fab in Hsinchu Science Park officially signals Foxconn's entry into the manufacture and development of wide band gap semiconductors, especially SiC, paving the way for a long-term commitment to semiconductor development," said Young Liu, CEO of Foxconn. "SiC mosfet is an important device for EV, while EV occupies the number-one position in Foxconn's strategy."

Miin Wu, CEO of Macronix, added: "To enhance advanced technology and global competitiveness, Macronix will focus on 12-inch wafer business, especially R&D and manufacturing of the advanced 3D NAND and NOR flash products after capacity expansion. Macronix is pleased to see the six-inch wafer fab continue to make its contribution to Taiwan as Foxconn commits to have the fab be used as an important base to reinforce its semiconductor development plan and to meet the demand of electric vehicles."

He said that considering Macronix wanted to take the lead in the global automotive electronics market, a closer collaboration between Macronix and Foxconn in the near future could be anticipated.

In addition to SiC mosfets, Foxconn confirmed it would also make silicon wafer products such as mems to achieve its goals in the electric vehicle and digital health markets.

App connects drivers and garages



A Dutch mobile phone app that brings car owners and their maintenance suppliers closer is about to take off in the UK after success in the Netherlands.

The iGarage app was developed by software company Autoconnect. For car owners, it is a free downloadable app that provides everything they need to manage their vehicles easily and cost-effectively.

Thousands of Dutch drivers use it to access information on everything from buying a car or products including insurance, or even parking or toll charges, to accessing model-specific technical information.

The app also provides preventative maintenance updates and gives an easy portal through which to contact garages to book a service or inspection.

For maintenance companies, it provides a direct, live link to the customer through which messages and push notifications can be sent. And the system's intelligence means these can be targeted accurately.

Vicor prepares assault on EV power conversion

US firm Vicor is preparing a serious assault on the automotive power market with a range of modules that can replace tens or even hundreds of discrete components.

The company started its automotive initiative back in October 2018 and a year later signed collaboration agreements with a Japanese OEM and a European customer.

A year ago, it started supplying its first samples to provide proofs-of-concept, and signed a collaboration agreement with a North American OEM, which is still ongoing.

This year should see the work come to fruition as it is expecting IATF 16949 certification by the end of the year with design validation for its core products completed early next year.

"We are aiming for a production ramp at the end of 2022 and early 2023 with model year 2024 vehicles in mind," said vice president Patrick Wadden.

He said the company had no real competitors in the power module market as the others were just providing discrete components rather than modules that could fit in the palm of a hand, replacing around 200 components.

He said though he hoped to be taking market share away from the likes of Texas Instruments, Renesas, Infineon and Analog Devices.

"Our automotive business is ramping up quickly," said Wadden. "We are adding new people every month."

Automotive OEMs are competing to build affordable, feature-rich electric vehicles (EVs) that deliver extended range. However, increasing electrification requires more space and increased weight, which limits range and space for new features.

Vicor's goal, he said, was to work with the OEMs to design power delivery networks based on power modules.

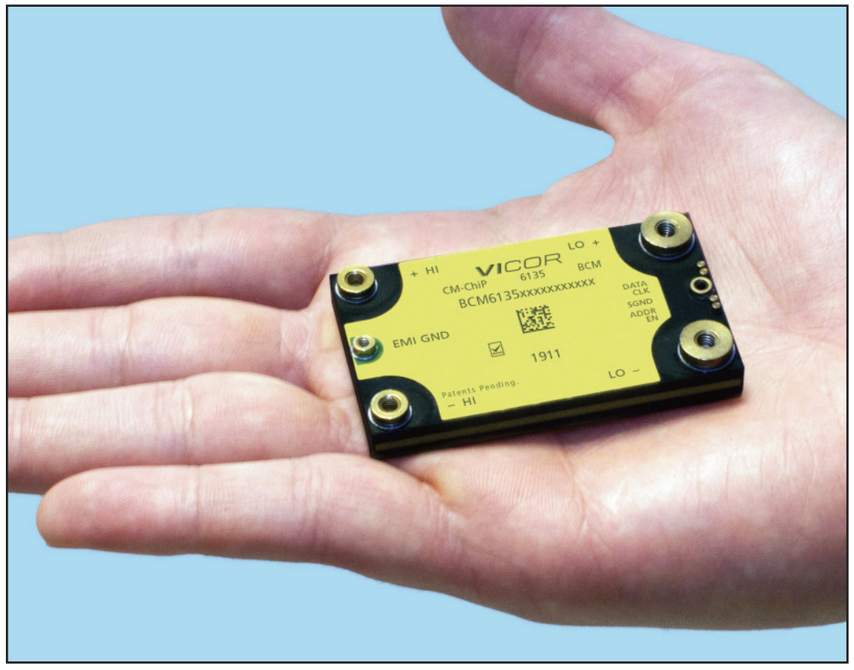
"We wanted to create demand with the OEMs," said Wadden. "The products we make are considered game changers, and will have a significant effect on the weight and size of the vehicle. When we started, a lot of OEMs said they couldn't get what they wanted from their suppliers."

Vicor is focusing on three-way partnerships between the company, OEMs and tier-one suppliers.

The modules are for converting battery voltages down to voltages that can be used by the systems in a vehicle. By having complete modules, the idea is they can be used in different vehicles in a range without going through new qualification processes.

"When you take a car in with a broken radio, they won't fix the radio, they will replace it," said Wadden. "That is happening all over the car with systems becoming modular."

He said he believed Vicor was five years ahead of competitors who were doing this using discrete components.



Vicor's power modules can fit in the palm of a hand

AT&T brings 5G connectivity to GM vehicles

AT&T will bring 5G cellular connectivity to millions of General Motors vehicles coming off the assembly line over the next decade in the USA.

GM and AT&T are working together to set the benchmark for automotive connectivity with a 5G cellular network architecture to meet the needs of an all-electric and autonomous future.

This should enable faster music and video downloads with higher quality, faster, more reliable and secure over-the-air software updates, and faster navigation, mapping and voice services.

The 5G connectivity will first be available in select model year 2024 vehicles. Additionally current 4G LTE-equipped model year 2019 and newer vehicles will experience faster connectivity speeds and many of the same benefits of 5G-equipped vehicles.

Chevrolet, Buick, GMC and Cadillac owners in the USA with 4G LTE-capable model year 2019 and newer vehicles will be able to migrate to the new network infrastructure once available.

This rollout is part of GM and AT&T's strategy to launch the world's largest fleet of 5G-enabled vehicles and the culmination of a two-year collaboration, including test-driving connected vehicles in GM's 5G proving grounds in Milford, Michigan.

AT&T's 5G network covers more than 250 million people across the USA. From 2016 to 2020, AT&T invested more than $110bn in its wireless and wireline networks, including capital investments and acquisitions of wireless spectrum and operations.

GM offers OnStar and connected services to more than 16 million customers in the USA and Canada. Since the launch of 4G LTE in 2014, GM owners have used more than 171 million gigabytes of data across its brands, which is equivalent to nearly 5.7 billion hours of music streamed or more than 716 million hours of streaming video.

AT&T is also linking its 5G network with Microsoft's cloud services.



Chip shortage could last longer than Covid

The global semiconductor shortage will have a greater impact on the automotive industry than the Covid pandemic, according to software provider VNC Automotive.

"In conversations with clients and suppliers, it's become clear that the effects of the semiconductor shortage will long outlast the pandemic, and will potentially have a far more serious impact on sales and future development," said Tom Blackie, CEO of VNC Automotive. "Some of our suppliers are seeing prices for chips that are more than 30 times higher than before and, at that level, their use is no longer sustainable."

He said he was even seeing vehicle buyers and fleet operators having to consider purchasing models that were not on their preferred lists because that was all that was available.



Tom Blackie: "Restrictions are frustrating."

"At a time when the industry is asking people to consider making the switch to EVs, supply restrictions are leaving them frustrated," said Blackie.

On its most recent earnings call, Tesla's CEO Elon Musk covered the issue of substituting alternative chips into production vehicles, having to write the new firmware in a "matter of weeks" and the "intense effort" this approach required.

ESI Automotive is advising automotive OEMs to take a systems-level look at their supply chains and take immediate action to reduce the risk of over-reliance, as the chip shortage continues to cripple global production schedules.

"Automotive OEMs are facing a perfect storm of material supply, with semiconductor materials already behind production schedules, and a shortage of rubber and metal all fueling further chaos," said Chris Klok, director of vehicle electrification at ESI Automotive. "The past 18 months have demonstrated vulnerabilities in traditional vehicle supply chains and triggered the need for review."

He said by viewing future vehicle manufacture at a systems level, it was possible to understand in greater detail where these vulnerabilities existed and make subtle changes that not only aided vehicle performance but reduced over-reliance on materials to spread supply chain risk.

"For example, we are working with one OEM to understand their process for EV powertrain design," said Klok. "They had always used an inverter type that was soldered. Therefore, they required semiconductor devices to solder to the substrate – more than 90 individual devices. We worked with them to instead use silver sintering technology, which enabled them to reduce semiconductor content by 75%."

Blackie said suppliers and OEMs may be forced to simplify their designs to use fewer complex components that were still available.

"We're concerned this will lead to a reduction in functionality at a time when consumer expectations have never been higher," he said.

Companies such as Bosch are looking at establishing their own manufacturing plants to create a guaranteed chain of supply.

ESol licenses Segger EmCompress

ESol has licensed Segger's EmCompress compression software to enable faster firmware updates in ECUs for automotive users.

Designed for embedded systems, EmCompress can compress and decompress data even on the smallest microcontrollers.

In automotive, slow bus systems such as Can are common. To address the speed limitations imposed by the bus, the best option is to reduce the amount of data to be transferred. As the information in a firmware update needs to stay complete, compression is a logical choice.

EmCompress supports the Lempel-Ziv-Markov chain algorithm (LZMA) to perform lossless data compression.

Typical compression rates for firmware images range from two to four.



Hella project to explore lighting for autonomous vehicle communications

Hella has started a research project to look at how lights on the outside of an autonomous vehicle can be used to communicate with other road users.

The Karlsruhe Institute of Technology, Fraunhofer Institute, Würzburg Institute of Traffic Sciences, Saarland University, Electric-Special Photronic Systeme and Version1 are also involved in the Initiative project.

The research will last three years and is funded by Germany's Federal Ministry for Economic Affairs & Energy.

"Without communication, mobility is no longer conceivable these days," said Michael Kleinkes from Hella. "Wherever cars, vehicles or pedestrians meet, road users have to communicate, for example when crossing roads or in unclear right-of-way situations. But if, in the future, cars are able to move around completely independently, at least in certain situations, and the driver is able to turn his attention to other activities, it must still be ensured that self-driving vehicles are able to communicate with other road users and lighting technology will play a prominent role in this."



External lights communicate with pedestrians

The researchers are investigating how an autonomous vehicle can use light-based systems to signal that it has detected a pedestrian or cyclist and it is safe for them to cross the road.

The use of LED-based status indicators or displays on the vehicle body is conceivable, for example.

"The difficulty is essentially that the form of communication must be visible at all times of the day and night," said Kleinkes. "It also must be easily and quickly understood by every road user. Such a uniform communication methodology does not exist yet, but it is a basic prerequisite for automated driving to become a reality."

The Initiative project builds on the InterAct project that was completed in the middle of last year. Different communication methods are now being tested under real conditions in the connected, urban infrastructure of a test site in Oldenburg; sensor data from the automated vehicle and the traffic infrastructure are also being used.

In addition, the project will investigate how the intentions of the individuals involved can be recorded both inside the vehicle and in traffic, with the aid of camera-based artificial intelligence and how they can be taken into account in communications.

Blaize closes $71m funding round

AI edge and automotive computing firm Blaize has closed a $71m series D funding round.

The funding will support acceleration of its roadmap to meet growing demand for higher performance, lower power, lower cost AI hardware and transformational AI software in automotive, smart retail, smart city and industrial markets.

New investor Franklin Templeton and existing investor Temasek led the round, with participation from Denso and others.

Tony Cannestra, director at Denso, said: "With substantial power advantages making EVs more efficient and economical, Blaize SoCs offer best in class performance with lower power across in-cabin, out of vehicle and autonomous operations, enabling a streamlined architectural evolution to centralise compute."

Blaize is delivering a fusion of AI hardware and AI Studio end-to-end software for high-value knowledge-driven edge computing.

"We are well positioned to accelerate our next-generation products and sustain our lead in delivering integrated hardware and software offerings that enable true value creation for our customers," said Dinakar Munagala, CEO of Blaize.

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AutoX turns to OnSemi for image and lidar sensing

On Semiconductor's image sensing and lidar technologies are powering key functions of AutoX's latest self-driving platform.

Revealed at the recent World Artificial Intelligence Conference in China, the fifth-generation autonomous vehicle technology enables a driverless robotaxi.

"In our quest to bring our level-four autonomous robotaxi to the market, On Semiconductor is the obvious partner for all of our sensing needs," said Jianxiong Xiao, CEO of AutoX.

The AR0820AT 8MP image sensor enables high-resolution camera fusion with other sensors. This can be crucial in dense urban scenarios, where a wide field of view is needed to capture objects on pavements or cross traffic, while extending the practical sensing distance to beyond 300m to enable autonomy at motorway speeds, where objects or signs must be recognised farther away from the vehicle to enable sufficient reaction time.



AutoX robotaxi powered by OnSemi

OnSemi has provided 28 high-resolution AR-0820AT image sensors and four SiPM arrays for lidar sensors, providing a full surround view with no blind spots.

"Performance and deep integration are both key for truly driverless applications," said Ross Jatou, senior vice president at On Semiconductor. "We are thrilled with the continued engagement with AutoX, as we continue to advance active safety and enable fully autonomous driving."

AutoX's hardware and software stack for level-four autonomous driving can handle dense and dynamic traffic conditions, demonstrated by its recognition as the first company to receive a licence to operate fully autonomous robotaxis in China.

AutoX has deployed hundreds of robotaxis in Shanghai, Shenzhen, Wuhan and other major Chinese cities. The company also launched robotaxi and robo-delivery pilot services in California last year.



Spoke C-V2X device protects cyclists

Qualcomm helps Spoke use C-V2X to protect bicyclists

Qualcomm is working with mobility platform Spoke to improve road safety for cyclists, e-scooters and pedestrians by applying cellular vehicle to everything (C-V2X) technology to vulnerable road users.

This will see communications shared between devices up to around 1km apart. These messages convey safety information to drivers such as upcoming hazards, or the presence of vulnerable users on the road.

With Qualcomm, Spoke has developed a smartphone-sized C-V2X device that can be paired with a bike computer and which will improve a driver's situational awareness of hazards and vulnerable road users.

The device can also receive messages from C-V2X-equipped vehicles to alert riders to hazards around them, messages that can be displayed on smartphones or compatible bike computers.

This provides critical augmentation to other adas sensors, such as cameras, radar and lidar.

"This is game-changing connectivity for both safety and for the mobility experience overall," said Jarrett Wendt, Spoke CEO. "For the first time, Spoke will provide dedicated hardware and software, what we refer to as vulnerable road user-to-everything (VRU2X), to unlock V2X communication to the most vulnerable users. VRU2X unlocks location accuracy through direct digital communication that connects all users anonymously to each other and to the infrastructure."

C-V2X offers low-latency direct communications between VRUs, vehicles and infrastructure in the 5.9GHz ITS spectrum without relying on cellular networks.

China to lead C-V2X growth, says Berg

There were about 0.7 million cars with V2X capabilities on the roads at the end of 2020, according to analyst firm Berg Insight.

This is expected to grow to 35.1 million by 2025.

One of the main challenges using V2X communications is the lack of industry spanning standards.

Two key sets of V2X direct communications exist: 802.11p-based technologies such as dedicated short-range communications (DSRC) and cellular V2X (C-V2X).

The first V2X use cases deployed globally are related to traffic efficiency and basic safety. These include, for example, local hazard warnings and traffic information as well as emergency electronic brake light warnings and left turn assist.

"V2X implementation is starting to gain momentum in key regions after many years of development," said Martin Svegander, senior analyst at Berg Insight.

DSRC-based V2X has been deployed in Europe and Japan, backed by Volkswagen and Toyota. C-V2X is gaining momentum in other regions and is backed by Ford, BMW, Audi and the telecommunications industry.

The market heavily depends on regulatory mandates and spectrum allocation.

"Policymakers in China favour C-V2X, whereas the USA and EU have been in a regulatory uncertainty," said Svegander.

In 2020, the FCC reassigned a portion (30MHz) of the 5.9GHz band used for ITS to C-V2X.

Berg believes C-V2X will account for about 78 per cent of all V2X enabled vehicles in 2025, mainly represented by China.

About half of all new cars sold in China will feature C-V2X as standard in 2025, it predicts.

"Examples of automotive OEMs that have launched C-V2X in China include BYD, GAC, FAW, GM/SAIC, Ford, BAIC BJEV, Weltmeister, Great Wall, Human Horizons and NIO," said Svegander.



Renesas AHL enables HD video over low-cost cables

Renesas hopes its Automotive HD Link (AHL) technology will help car makers deliver high-definition video over low-cost cables and connectors that currently support standard-definition video.

HD video is increasingly important in car safety for object recognition. AHL can be paired with other Renesas products, such as the R-Car automotive SoCs, RH850 MCUs, automotive PMICs and analogue components to implement safety features.

The RAA279971 AHL encoder and RAA279972 decoder use a modulated analogue signal to transmit the video, enabling transmission rates ten times less than required to transmit HD signals digitally.



Renesas AHL technology improves in-car video

The lower transmission rate means traditional twisted pair cables and standard connectors can be used, as can existing analogue video cables and connectors.

On the other hand, digital links such as serdes require heavily shielded cables and high-end connectors that cost more than those for AHL may require replacement after five to seven years and are difficult to route due to bending radius limitations.

AHL is robust against noise and has a bi-directional control channel that operates independent of the video data and can initialise, programme and monitor the camera module.

A key AHL performance and cost reducing feature is the ability to control the camera simultaneously over the same pair of UTP wires during video transmission. Another safety benefit is performance compared with a digital link.

In a rear-view camera application, a digital link will degrade due to a failure in the cable harness or connector assembly, as weak signals can cause macroblocks to appear, hiding large portions of the viewing area.

Using the same cable under the same conditions for comparison, the AHL link will present a slight change in video colour or contrast, but all pixels will appear on the screen, and the image will precisely identify an object or person behind the vehicle.

"Advanced safety systems are no longer only available in luxury vehicles," said Niall Lyne, vice president at Renesas. "The AHL enables our automotive customers to deliver these features in all new vehicles, including economy models."

AHL supports resolutions from VGA up to 720p/60 or 1080p/30 to implement non-standard vertical resolutions, not just the TV video standard 16:9 resolutions.

Mipi-CSI2, BT656 and DVP inputs and outputs provide flexible interfaces to support old and new image sensors. It requires only a 27MHz crystal clock, with internal PLLs able to generate the necessary clock frequencies for higher resolutions.

The encoder and decoder are available today.

Hyundai picks Qt for HMI development

Qt has become the HMI technology partner for all Hyundai, Kia and Genesis brand vehicles.

The software technology will enable the development of Hyundai's CCOS connected car operating system across the in-vehicle infotainment system, instrument cluster and rear seat entertainment systems.

The first Hyundai vehicle using Qt for its HMI technology was the Genesis GV80 launched in late 2019 and followed by the G80 and GV70.

The CCOS controls and operates the key aspects of connected car infrastructure – in-vehicle framework, infotainment framework and connectivity framework – to ensure connected cars can adapt to innovations in safety, comfort, convenience and security.

Hyundai will use Qt Design Studio, a UI designer and development tool, to accelerate its HMI development from prototyping to deployment.

Continental buys stake in Kopernikus

Continental has bought a minority stake in Leipzig-based start-up Kopernikus Automotive for an undisclosed fee.

As a specialist in autonomous driving, Kopernikus develops technology for infrastructure-based manoeuvring of vehicles. The technology is based on sensors permanently installed in the infrastructure and artificial intelligence-based algorithms that centrally move the vehicles.

The first two use cases of this technology are automated valet parking and autonomous manoeuvring at vehicle manufacturers or in logistics areas.

The first vehicles are already being steered through vehicle factories without a driver.

With automated valet parking, drivers get out, for example at an airport terminal, hand the vehicle over to the infrastructure via an app, and the car parks autonomously. Cameras are used as sensors here.

At the heart of the system are AI-based algorithms that ensure safe and optimal orchestration and guidance of all vehicles.

Vehicle components required for this are an automatic transmission, an electric parking brake, electric steering assistance and an intelligent communication unit.

"In the future, cars in factories, logistics centres and parking garages will be moved autonomously," said Ralph Lauxmann from Continental. "Kopernikus and Continental are working together."

At IAA Mobility in Munich from 6 to 12 September, Continental and Kopernikus's offering will be on show.

SiLabs sale

Silicon Labs has completed the divestiture of its infrastructure and automotive business to Skyworks for $2.75bn in an all-cash asset transaction.

"To my former infrastructure and automotive colleagues, you have not only been a cornerstone of Silicon Labs' success but also a personal source of pride," said Silicon Labs CEO Tyson Tuttle. "We wish you continued successes at Skyworks."

The closure leaves Silicon Labs to focus on secure, intelligent wireless connectivity for the IoT market.



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Bosch sets up R&D centre in Ireland

Bosch is setting up an automotive R&D centre in Limerick, Ireland, creating 30 jobs over the next two years. Activities will focus on semiconductor products and automotive electronics.

Initial development at the facility will include ICs for 77GHz radar sensors, which have applications for adas such as automatic emergency braking, collision avoidance and adaptive cruise control as well as radar technologies for automated driving.

"We're very excited about the possibilities that this new facility will provide to us," said Oliver Wolst, senior vice president at Bosch. "This new facility in Ireland demonstrates our commitment to working with the best engineering talent to develop the most advanced technology for our customers."

Mary Buckley, executive director of Ireland's Industrial Development Agency, added: "The decision by Bosch to establish its automotive R&D centre in Limerick further enhances the region's reputation as an emerging hub for software and automotive systems. It is also a strong endorsement of the talent available in the mid-west region, particularly in the areas of engineering and design."

Over the next two years, Bosch will be hiring IC design and layout, radio frequency measurement and evaluation, software and firmware engineers.

"This is a great opportunity for the team whose background in integrated circuits, married with Bosch's deep system level knowledge in automotive, can develop truly innovative and performance-optimised products to meet the needs of tomorrow's cars," said Mike Keaveney, who is manager of the R&D centre in Limerick. "Working with the talented engineers here, and the teams across Europe that we are now part of, is particularly rewarding. Our next focus is on growing the local team. There's a lot of talent in and around the region and we're looking to hire more engineers with the skillsets needed to develop state-of-the-art integrated circuit products."



Bosch is looking to recruit electronics engineers

IAR and Nsitexe speed Risc-V functional safety

IAR Systems is collaborating with Denso subsidiary Nsitexe to accelerate functional safety development for its Risc-V-based IP cores.

The partnership focuses on bringing development tools with ensured functional safety and support to Risc-V applications.

Functional safety is a growing requirement for embedded systems in automotive applications, industrial automation and medical devices.

IAR launched the first edition of its functional safety certified products in 2013. With the rise of Risc-V technology and its rapid evolution into many different embedded systems, functional safety for Risc-V is also becoming more important.

In 2020, IAR presented its functional safety products for Risc-V.

Nsitexe was established in 2017 as a wholly-owned subsidiary of Denso. Recently announced, the NS31A is a general-purpose CPU with a single-issue core with a four-stage in-order pipeline that uses a 32bit Risc-V ISA. It supports the ISO 26262 Asil D functional safety mechanism required for automotive applications, and supports a privileged mode that is required by Autosar.

"At Nsitexe, development efforts have been focused on three pillars – versatility, efficiency and functional safety – with massive future trends in mind," said Hideki Sugimoto, CTO of Nsitexe. "The NS31A implements these as a Risc-V 32bit general-purpose CPU with high functional safety for users who want to control embedded systems easily, reasonably and safely."

Stefan Skarin, CEO of IAR Systems, added: "Together with Nsitexe, we are now enabling companies to speed up the path of using Risc-V in applications where ensured safety is critical for success."

SAFETY & SECURITY



IN A FLASH

Adrian Cosoroaba discusses the hidden security risks of automotive electronics

The IoT is driving new capabilities that are transforming how people live, work and play. However, as lives become more connected, the risk from hackers and other security breaches increases with every new IoT device.

While most people are pretty well versed in why they need to keep their most trusted devices secure – such as mobile phones and laptops – they often don't think about the connected intelligence that is now powering cars.

The truth is, these systems are ripe for security breaches. Just look at the Telsa Model 3, which is one of the most intelligent cars on the market. Back in 2019, hackers targeted this car's infotainment system and, by using a JIT bug in the renderer, they were able to take control of the system.

Granted, this was part of a hacking event so it posed no risks to the owner, but it did expose a gaping hole in the security of automotive electronic systems. If cars are going to continue to become more intelligent and connected to the world's growing IoT infrastructure, this weakness must be addressed and solved.

Flash

Automobile electronic systems are steadily becoming more

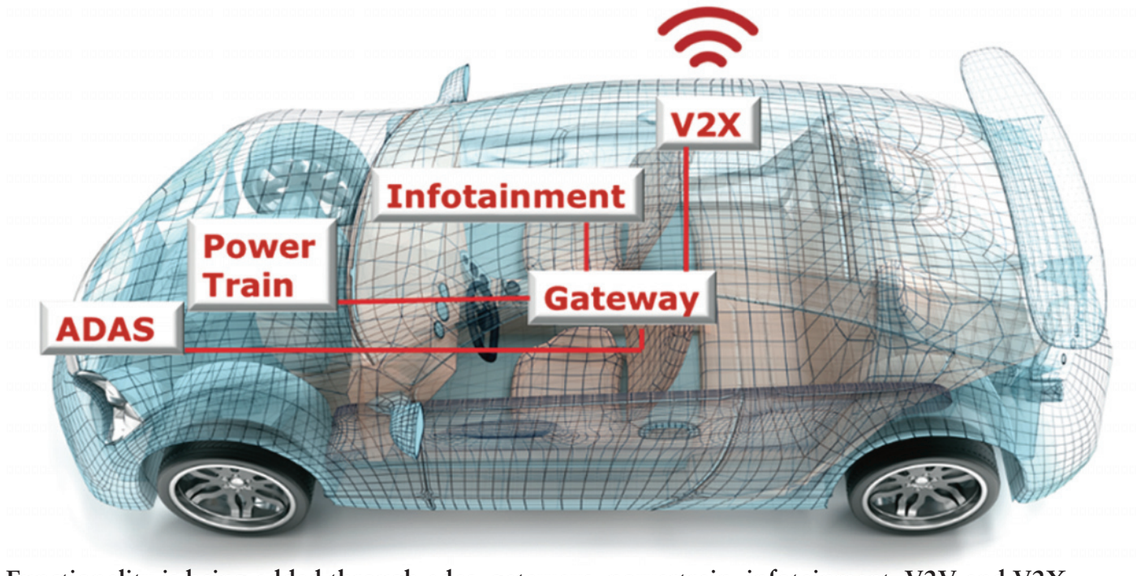
intelligent. Advanced electronic functionality is being added throughout the vehicle such as adas, gateways, powertrain, infotainment, V2V and V2X. These new capabilities are driving the need for increased security and safety, particularly around the flash memory that has become a key component of these systems.

Flash memory has been around for decades and it has evolved now to serve the automotive market. The problem, however, is that current embedded flash poses significant security risks because it is based on legacy technology and architectures that don't have the proper certification to guarantee both security and safety.

In automotive systems, safety and security are fundamental to guarantee a tolerable level of risk, as defined by the ISO 26262 standard. These risks are managed by car manufacturers and subsystem providers but, with an increasing complexity of vehicle electronics, the functional safety is now also the responsibility of IC manufacturers including the flash memory that stores critical code and data.

Security in automobiles is all about hiding the information and encrypting everything to prevent leakages via sophisticated mechanisms such as side channel. Data stored in flash array must be mixed and encrypted and the communication channel must be strongly encrypted.

Likewise, safety in automobile systems is about 100% observability, error detection and maximum disclosure of information. Data should be validated and testing should guarantee very high quality level at around 0 DPPM. In addition, defect analysis should allow quality improvement and fault root-cause detection.



Functionality is being added through adas, gateways, powertrain, infotainment, V2V and V2X

Questions

It is imperative that automobile manufacturers and makers of vehicle electronic systems ask the tough questions now – and not after a security breach has occurred in real life.

Auto manufacturers have a choice in the type of flash technology they adopt and that decision will play a key role in protecting or exposing the vehicle once it is on the road and in the hands of consumers. Thus, before deciding which flash product to trust for security and safety, ask these following key questions:



The Tesla Model 3 was the subject of a famous hack

- **Is the flash technology CC EAL5+ certified and at what level?**

A secure system is not really secured and trusted without certification. Having CC EAL5+ certification means the flash memory meets the highest security requirements for any automotive application including V2V and V2X.

With this type of security, the architecture can detect even the smallest unauthorised change in data and immediately reports this to the host. The stored data are protected from any unauthorised modification, either intentional or due to fault.

Any such modification is immediately reported to the host and the reporting mechanism cannot be blocked.

The flash array should also be protected by an extra layer of CRC based detection code. The flash logic incorporates sophisticated logic for detection of any wrong state. The SPI interface protocol adds a layer of both encryption and error detection making it both secure and safe from errors.

- **Is the fab that manufacturers the flash ISO 26262 certified for safety?**

ISO 26262, the functional safety standard released in 2011, is a certification indicator to verify whether the automotive electronic suppliers meet Asil (automotive safety integrity level) requirements. ISO 26262 includes management of functional safety, concept phase, system-level, hardware-level and software-level designs and verifications, manufacturing, operation, maintenance and decommissioning services for the entire product life cycle.

Asil-D of ISO 26262 represents the highest level of risk management so components or systems that are developed for Asil-D are made to the most stringent safety requirements. Flash devices storing the code for critical car's functions should meet high safety requirements and reduce safety risks by providing highly reliable code storage.

- **Is security implementation upgradeable and programmable? What is the root of trust (RoT) implementation? Is there platform resiliency?**

It is imperative for secure systems to have a level of platform resiliency so they can evolve and adapt over time to protect the system from breaches. With traditional rom or embedded flash



Memories help keep vehicles safe and connected

approaches that use MCUs and SoCs, a software implementation is used whereby the RoT code is stored in rom.

These systems lack upgradability and have no resiliency for future attacks.

In contrast, the more modern approaches are based on MCU, SoC and programmable secured flash. These use an implementation based on software and hardened hardware which allows them to be programmable and upgradeable. This type of programmable hardware-based RoT can be continuously updated to contend with an ever-increasing range of threats and provide platform resiliency.

Approach

Clearly, a more modern approach to flash memory is needed in automobile systems for all the reasons highlighted, and more. Unlike some of the older flash technology on the market, new technology is needed that can enable code and data to be transferred between a secured area and the SoC or MCU over a cryptographically secured standard SPI bus.

In the future, it is likely that these more secure flash options will become a requirement for meeting security guidelines and standards, particularly since cyber attacks are becoming more pervasive and sophisticated. Regulations are likely also to become more stringent, which will further elevate the importance of security and functional safety in automotive applications.

Future

Electronics play a vital role in almost every part of the vehicle today, from the body to the powertrain to the infotainment system.

As consumers demand more innovation in advanced safety, security, infotainment, comfort and convenience features and federal fuel economy standards keep increasing, modern vehicles will have an even greater number of electronic components. This will make it increasingly important that the core technology such as the flash memory meets the highest level of security and safety standards.

Threats from hackers have become increasingly sophisticated and this is going to require semiconductor manufacturers to develop more modern approaches that can thwart these attacks quickly and effectively.

When it comes to automobiles, safety and security are definitely not something that should be skimped on.



Adrian Cosoroaba is technical marketing manager for Winbond

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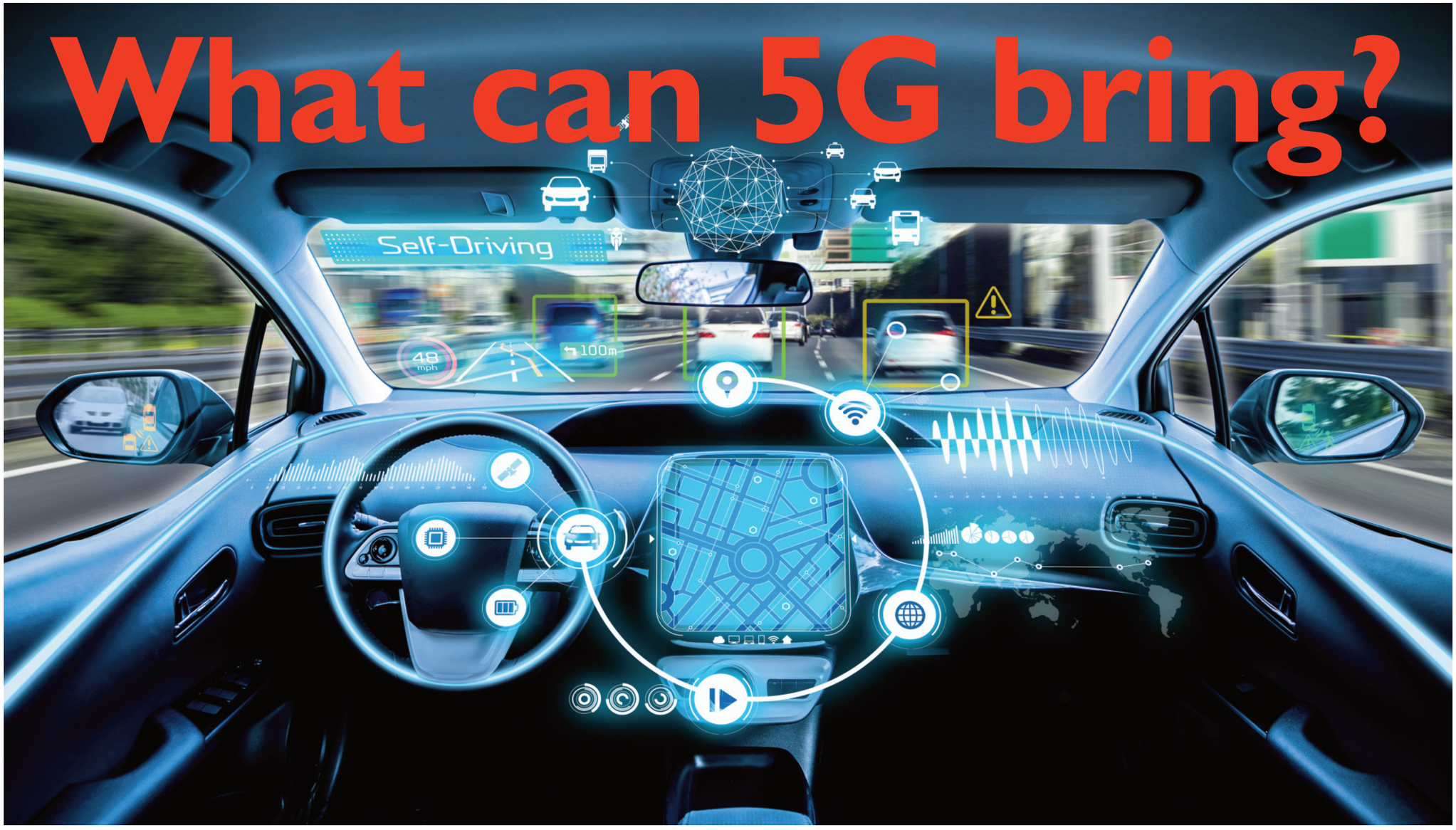
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V2X

What can 5G bring?



Tatsiana Tsiukhai asks what new horizons 5G brings for connected vehicles and V2X communications

Today's connected cars can communicate with infrastructure, the cloud and each other thanks to vehicle-to-everything (V2X) technology. High-speed communications, ongoing network connectivity and fast responses pave the way for smart cars.

The V2X ecosystem in tandem with 5G can improve the driver experience and bring new heights for automotive companies.

Today's smart vehicles can communicate with navigation systems, traffic lights, parking facilities and other vehicles. Cars read their surroundings through multiple recognition sensors such as cameras, radars and ultrasonics. Connected cars generate a lot of data, which include travel routes, speed and tracking components' wear and tear.

The connectivity in the automotive industry is based on various communication technologies, including DSRC, wifi, GPS and cellular.

V2X technology involves communication between vehicles (V2V), vehicles and infrastructure (V2I) and vehicles and other road users. Most often, these include pedestrians and cyclists (V2P). It, in particular, allows cars to establish various connections outside the vehicle:

- **Vehicle to navigation:** The information from the map, GPS and other cars' sensors helps calculate arrival time, monitor traffic, determine the current speed limit, locate any accidents, and more.
- **Vehicle to traffic infrastructure:** These include signs, traffic signals, toll booths, work zones and school zones.
- **Vehicle to public transport:** This informs about public transportation and traffic conditions and helps suggest alternate routes and options for rescheduling trips.

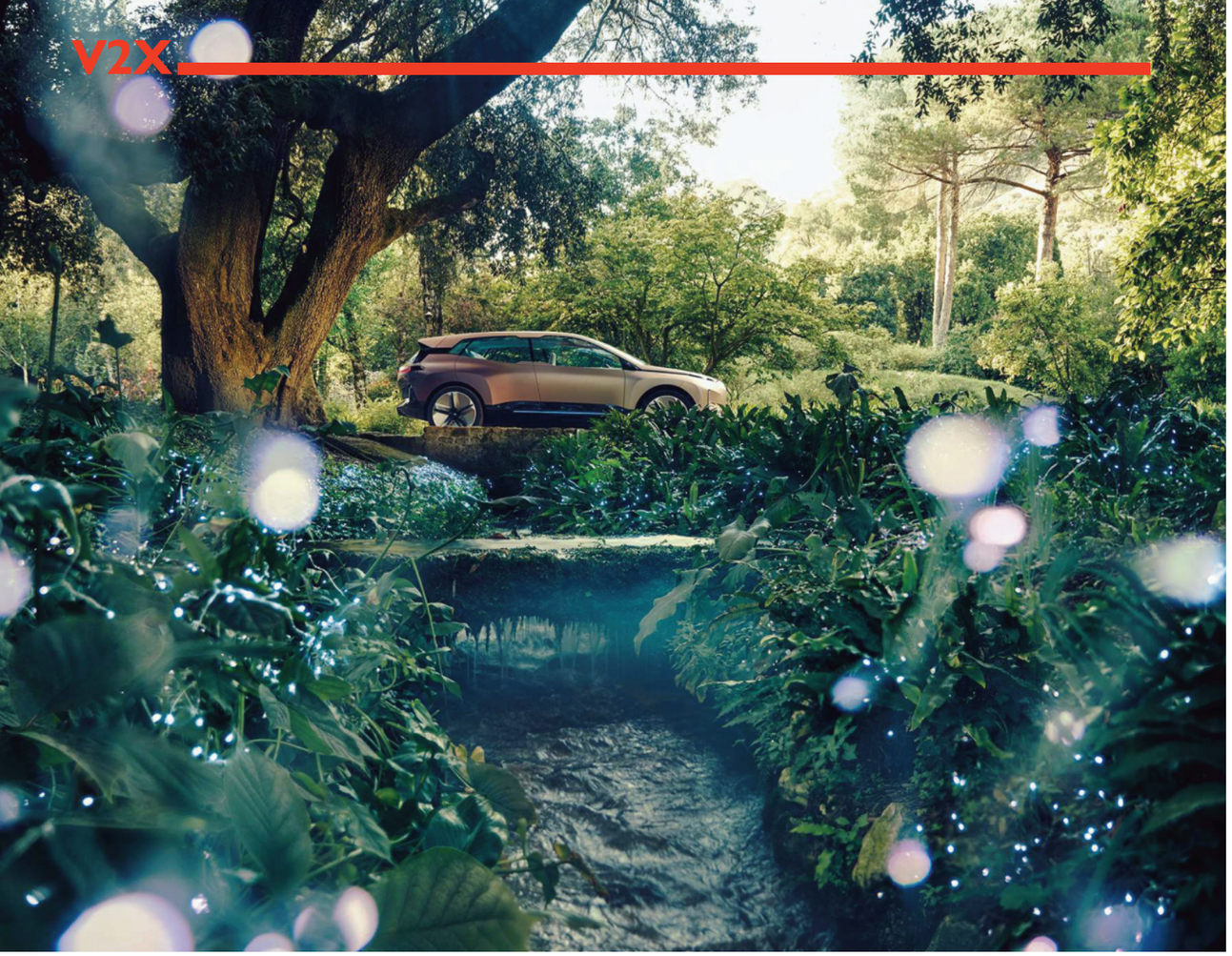
5G network

5G is the fifth-generation standard for broadband cellular networks. Since its first launch in 2019, 5G has faced many challenges including economic uncertainty caused by the lasting pandemic. But 5G expansion is only a matter of time. According to forecasts, by 2025 the spread of 5G will account for one-fifth of connections worldwide.

The use of 5G in V2X connectivity is possible thanks to a shift to cellular V2X (C-V2X), the most recent industry standard for vehicle communications. Leading car makers such as Audi, BMW and Tesla deploy C-V2X in their vehicles. C-V2X products are installed in more than 500 US cities, counties and school districts, enabling cellular connectivity to traffic signals, school zone beacons and emergency vehicles. And some automotive companies have already started using 5G.

For example, Ericsson and Telefónica in Germany collaborated to use 5G in car production at a Mercedes-Benz factory. Samsung and Harman joined BMW to launch the BMW iNext equipped with a 5G telematics control unit (TCU).

Compared with 4G, 5G



BMW announced the iNext equipped with a 5G telematics control unit

connectivity is up to 100 times faster, with a theoretical top speed of around 20Gbit/s. It is capable of handling up to a million devices per square kilometre. 5G operates at a broader range of frequencies than 4G, adding more capacity. It can also process data at a shortened response time, delivering 4ms in typical conditions and 1ms at maximum speed. As of the end of 2020, 5G was available in 100 US cities, and expansion is only a matter of time.

Use cases

C-V2X connectivity adds efficiency to traffic infrastructure and improves road safety. It provides automotive companies new areas for development and has a variety of possible uses.

V2X relies not only on sensors but also on data from nearby cars, which introduces a set of advancements for cooperative driving, avoiding collisions and safety warnings. Let's take a closer look at some of potential uses of V2X enhanced with 5G.

Platooning allows users to drive vehicles operating in close proximity. Such a convoy can accelerate and brake simultaneously, increasing the capacity of roads and saving fuel. With 5G, high-density platooning is possible when more than three vehicles can communicate with each other. Platooning brings its greatest efficiency and safety benefits to long-distance lorry driving. For example, if one driver falls asleep, their truck automatically follows the platoon leader.

OEMs such as Volvo and Scania have already deployed on-road prototypes, and several US states have allowed automated following.

Cooperative driving is a connected vehicle option that allows cars to adapt to surrounding traffic. Nearby cars share sensor data to coordinate their trajectories and manoeuvres. One possible scenario is that when a vehicle passes, the other slows down automatically. Acting cooperatively, cars can eliminate disruptions caused by lane changes, sudden braking or other unexpected movements. In practice, cooperative driving is impossible without 5G.

Collision avoidence systems aim to alert drivers of any potential collision risk. This includes correcting steering or even forcing the car to brake. To anticipate collisions, each vehicle broadcasts its position, speed and direction to match other nearby vehicles. It is also possible to avoid pedestrians and cyclists by detecting their smartphones. 5G, in turn, could support the vast ocean of connections between all vehicles and determine the accurate positioning of each car and other road users.

Self-driving cars require quicker data transmission than other vehicles. Fast response time is necessary to make effective decisions in real-time road conditions. Pinpointing an upcoming pedestrian's accurate position or predicting the next green light are just a few examples of how this technology works.

With 5G speeds, automation control systems can instantly respond in emergency situations, where quick decision-making is crucial.

Connected vehicles can also process data in the cloud and allow cloud-based AI to make self-guided decisions immediately.

Using data from smart cars, machine-learning techniques can produce accurate models of the car's surroundings, forcing cars to slow down or change lanes. Moreover, the smart combo of 5G and edge computing helps decipher data even faster.

Takeaways

5G is driving the automotive industry to new heights, enhancing wireless connectivity and introducing innovations. It can support many connections in a small area and detect precise positioning more quickly.

5G-based V2X connectivity brings ultra-low latency and ultra-high reliability, the benefits of which include smooth connection, quick data transfer with little loss of speed, revealed traffic patterns, improved road safety and enhanced predictive maintenance.



Tatsiana Tsiukhai is a copywriter with Softeq



Scania has taken part in platooning projects

CONNECTORS

ON TRACK



John Skinner looks at what makes reverse bayonet connectors so reliable in harsh environments

Reverse bayonet connectors are one of the most reliable connectors on the market for harsh environments and can make all the difference in applications where failure is costly.

As Forrest Gump said, "life is like a box of chocolates, you never know what you're gonna get". This is true, life is full of surprises. But, in mission-critical applications, surprises aren't often welcome, and engineers need to be sure operational outcomes will be successful. In Forrest's words, they have to know what they're "gonna get".

Reverse bayonet connectors are typically used in military, commercial transportation, industrial and aviation applications because of their reliability and robustness. These industries need reliable connectors that can withstand intense vibration and shock, extreme temperatures, and contact with fluids.

So, what is it about reverse bayonets that make them one of the most dependable options for these industries?

Positive coupling

Reverse bayonet connectors need a 120˚ turn to mate, which enables fast and effortless mating and unmating. Their design also allows the user to confirm mating in three different ways: tactile, audible and visual. The user feels the connector lock into position when mated. A loud click is heard as the three studs snap into place when the coupling nut is fully engaged.



Reverse bayonet connectors

Additionally, a coloured triangle on the receptacle aligns with a dot on the coupling nut when the connector is properly mated. These simple steps ensure the user can be confident the connector is mated, and significantly reduces the risk of accidental decoupling due to user error or vibration.

Reverse bayonet connectors come with either an O-ring and/or a wave spring and washer. The purpose of these components is to provide the resistance when the user connects the plug to the receptacle and twists the coupling nut. The resistance gives a positive mating and prevents vibrations from making the connector loose. O-rings also ensures IP67 protection when connectors are mated.

A standard reverse bayonet connector has a mating cycle of 500 times without any decrease in performance, however some ranges feature a wear pin on the receptacle, which increases the mating cycle to 2000 times, making the connector even more durable and increasing value for money.

Resilience

Reverse bayonet connectors generally use insulators and grommets made from chloroprene. Using this material enables reverse bayonets to operate over a temperature range of -50 to +125˚C and to offer IP67 when mated. This is important in commercial transportation, military, industrial and aviation industries where extreme temperatures and exposure to environmental contaminates are common.

Reverse bayonet connectors have earned their reputation for being durable and reliable over the years, and it's clear to see why.

All that's left is to choose a reliable supplier to meet demands.

So, while life may be like a box of chocolates, using reverse bayonet connectors for an application is not. Users know exactly what they are going to get – a reliable, robust and durable connector that will help operations run smoothly.

John Skinner is European product manager at PEI-Genesis

POWER TECHNOLOGIES

IN YOUR HAND

David Megaw explains how to protect and power automotive electronics systems with no switching noise and high efficiency

Electrical and mechanical systems that interface with a vehicle's battery can cause wild voltage excursions in the nominal 12V supply.

In reality, 12V can vary from -14 to +35V for extended periods and see voltage spikes with extremes from +150 to -220V. Some surges and transients arise from everyday use, others from fault conditions or human error.

Regardless of cause, the damage they can produce in a vehicle's electronics system can be difficult to diagnose and expensive to fix.

The experience of automakers over the last century has led to a catalogue of electrical conditions and transients that are known to disrupt operation and cause damage. These are compiled in the ISO16750-2 and ISO7637-2 specifications for road vehicles.

At a minimum, the power supply for an automotive ECU should survive these conditions without damage. For critical systems, functionality and tolerances must be maintained. This requires that the power supply regulates the output voltage through the transient to preserve ECU operation.

Ideally, a complete power system avoids the need for fuses, reduces power dissipation, and features low quiescent current to support always-on systems without draining the battery.

Conditions

In its latest iteration, the ISO7637-2 electromagnetic compatibility specification focuses on more than 100V, 150ns to 2ms transients from 2 to 50Ω impedance sources. These voltage spikes can often be mitigated with passive components.

Fig. 1 shows ISO7637-2 pulse one as defined and with an added 330μF bypass capacitor. The capacitance reduces the spike's amplitude from -150 to -16V, well within the range of reverse battery protection circuitry. ISO7637-2 pulses 2a, 3a and 3b have significantly lower energy than pulse one and require less capacitance to suppress.

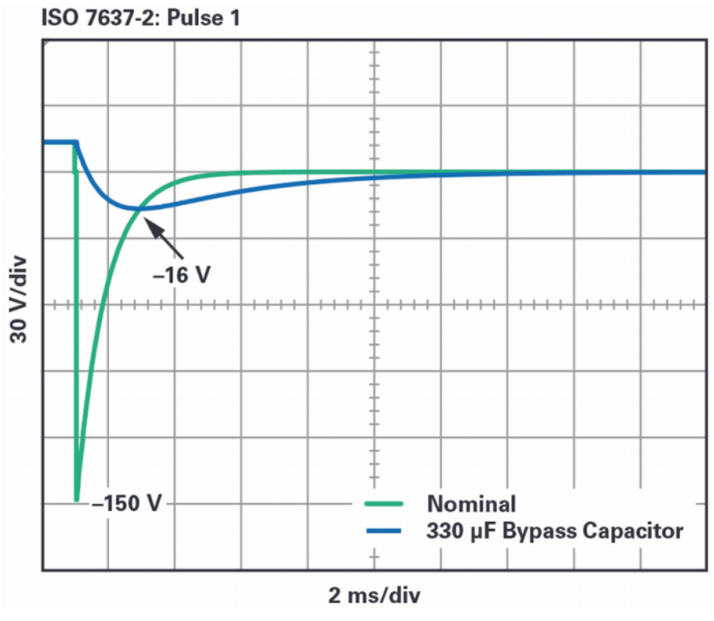


Fig. 1: ISO7637-2 pulse one with and without a 330µF bypass capacitor

ISO16750-2 focuses on longer duration pulses from low impedance sources. These transients cannot easily be filtered and frequently require active, regulator-based technology. Some of the more challenging tests include the load dump (test 4.6.4), the reverse battery condition (test 4.7), the superimposed alternating voltage test (test 4.4), and the engine starting profile (test 4.6.3).

Fig. 2 gives a visual overview of these test pulses. The variety of conditions presented in ISO16750-2, along with the voltage and current requirements of the ECU, frequently require a combination of approaches to satisfy them all.

Load dump

A load dump (ISO16750-2: test 4.6.4) is a severe overvoltage transient that models a battery disconnect while the alternator is sourcing substantial current.

The peak voltage during a load dump is classified as either suppressed or unsuppressed, depending on whether avalanche diodes are used on the outputs of the three-phase alternator. A suppressed load dump pulse is limited to 35V, whereas an unsuppressed pulse peak ranges from 79 to 101V. In either case, it can take up to 400ms to recover due to the large amount of magnetic energy stored in the alternator's stator windings.

While most automakers use avalanche diodes, increasing reliability demands are driving some manufacturers to require that ECUs satisfy peak load dump voltages approaching that of the unsuppressed case.

One answer for facing load dumps is adding a transient voltage suppressor (TVS) diode to clamp the ECU supply locally. A more compact and tighter tolerance approach is to use an active surge stopper, which linearly controls a series n-channel mosfet to clamp the maximum output voltage to a user programmed level, for example 27V.

Surge stoppers add the ability to disconnect the output, allowing programmable current limit and undervoltage lockout, and often provide reverse battery protection when back-to-back n-fets are used.

The concern with any linearly regulated power device such as a surge stopper is the potential for significant power dissipation in the n-channel mosfets when limiting the output voltage during a load dump, or when limiting current with a shorted output.

The safe operating area (SOA) constraints of the power mosfet ultimately limit the maximum current possible with a surge stopper. It also puts a time limit – typically set with a programmable timer pin – on how long regulation can be maintained before the n-channel mosfet must be shut off to avoid damage.

These SOA-imposed limitations become more acute at higher operating voltages, making surge stopper use trickier for 24 and 48V systems.

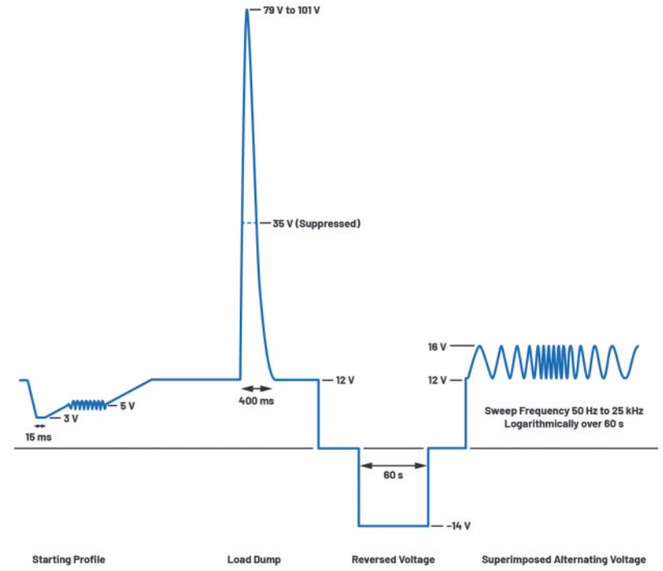


Fig. 2: Overview of some of the tougher ISO16750-2 tests

A more scalable approach is to use a buck regulator capable of operating with a 42V input. A switching regulator doesn't have the mosfet SOA limitations of a linear regulator, but it is more complex.

The efficiency of a buck regulator allows for very high current operation, and its top switch permits output disconnect and current limiting. Concerns about buck regulator quiescent current have been put to rest with the latest generation of parts that draw only a few microamps while in regulation under no load conditions. Switching noise has also improved substantially with silent switcher technology and spread spectrum frequency modulation techniques.

Additionally, some buck regulators can operate at 100% duty cycle such that the top switch is on continuously, passing the input voltage to the output through the inductor. Switching operation is triggered during overvoltage or overcurrent conditions to limit output voltage or current, respectively. These buck regulators act as switching surge stoppers, achieving low noise, low loss operation while still retaining the robustness of a switch-mode power supply.

Reverse voltage

A reverse voltage condition – also known as a reverse battery condition – occurs when battery terminals or jumper cables are connected backwards due to operator error. The relevant ISO16750-2 pulse (test 4.7) applies -14V to the DUT for 60s durations, repeatedly.

Some manufacturers add their own dynamic versions of this test where the part is initially powered – for example V_{in} = 10.8V – before a reverse bias (-4V) is abruptly applied.

A quick survey of data sheets

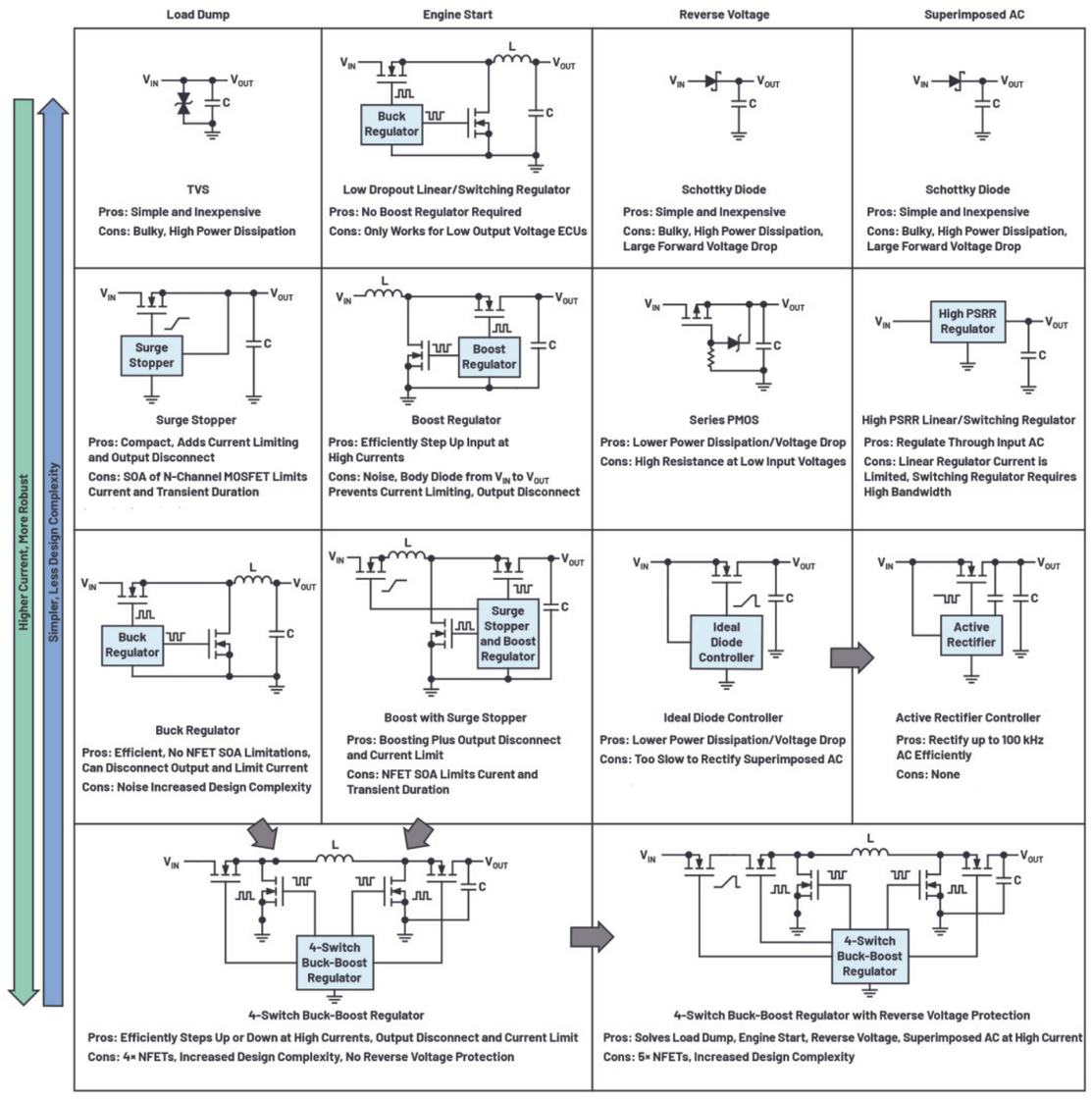


Fig. 3: Different approaches to solving difficult ISO16750-2 problems

shows that few ICs are designed to tolerate negative biases, with IC absolute minimum pin voltages typically limited to -0.3V. Voltages more than a diode below ground can cause excessive current flow through internal junctions such as ESD protection devices as well as body diodes of power mosfets. Polarised bypass capacitors such as aluminium electrolytics may also be damaged during the reverse battery condition.

A Schottky diode can prevent reverse currents, but this leads to significant power loss at higher forward currents in normal operation. A simple protection scheme based on the series p-channel mosfet shown in Fig. 3 reduces this loss, but may not work well at low input voltages, for example, engine start due to the device threshold voltage.

A more efficient approach is to use an ideal diode controller that drives a series n-channel mosfet that cuts off input voltages below ground. In normal operation, such a controller regulates the source to drain the voltage of the n-channel mosfet to 30mV or less, reducing forward voltage drop and power dissipation by more than an order of magnitude compared with a Schottky diode.

Alternating voltage

The ISO16750-2 test 4.4 superimposed alternating voltage test models the impact of the AC output of the vehicle's alternator.

As the name implies, a sinusoidal signal is superimposed on the battery rail with peak-to-peak amplitude of 1, 2 or 4V, depending on severity level classification.

For all severity levels, the maximum input voltage is 16V. The frequency of the sinusoid is swept logarithmically from 50Hz to 25kHz and then back to 50Hz over 120s and repeated five times.

This test causes large amplitude current and voltage swings in any connected filter network with a resonance below 25kHz. It can also cause problems for switching regulators where loop bandwidth limitations make it a struggle to regulate through high frequency input signals.

One answer is an intermediate rectifying element such as a power Schottky diode but, as with reverse voltage protection, this is a poor way to solve the problem.

An ideal diode controller will not work here as it did for reverse voltage protection because it cannot switch the n-channel mosfet sufficiently fast to keep up with the input. The limiting factor is the gate pull-up strength, which is typically limited to 20μA or so by an internal charge pump. While the ideal diode controller can quickly turn the mosfet off, turn on is painfully slow, unsuitable for rectification of anything beyond very low frequencies.

A more elegant approach is to use an active rectifier controller that can toggle an n-channel mosfet fast enough to rectify the input voltage at frequencies up to 100kHz. An active rectifier controller is an ideal diode controller with two important additions: a large reservoir of charge boosted up from the input voltage and a powerful gate driver to toggle the n-channel mosfet both on and off quickly.

This method can reduce power loss by more than 90% compared with a Schottky. It also protects downstream circuitry from a reverse battery condition just as an ideal diode controller would.

Starting profile

The engine starting profile (ISO 16750-2: test 4.6.3) is an extreme undervoltage transient, sometimes referred to as the cold crank pulse because the worst-case battery droop occurs at lower temperatures. Specifically, when the starter turns over, the 12V battery voltage can momentarily drop to 8, 6, 4.5 or 3V, depending on severity level classification (I, IV, II and III, respectively).

In some systems, a low dropout (LDO) linear regulator or switching buck regulator is sufficient to allow power rails to ride through this transient, provided that ECU voltages are less than the lowest input voltage. For example, if the highest ECU output voltage is 5V, and it must satisfy severity level IV (minimum input voltage of 6V), then a regulator with a dropout voltage less than 1V is enough.

The lowest voltage segment of an engine starting profile lasts for only 15 to 20ms, so a rectifying element – Schottky diode, ideal diode controller, active rectifier controller – followed by a large bypass capacitor may ride through this portion of the pulse if the voltage headroom briefly dips below the regulator dropout.

If, however, the ECU must support voltages higher than the

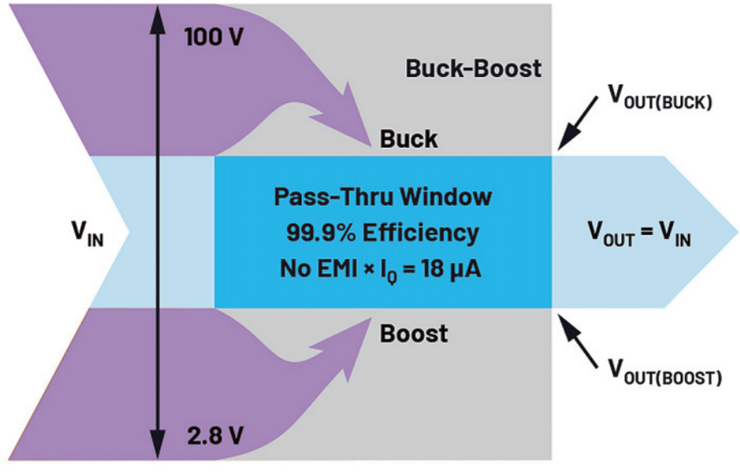


Fig. 4: Buck-boost controller with pass-through mode solves many of the problems imposed by automotive standards tests

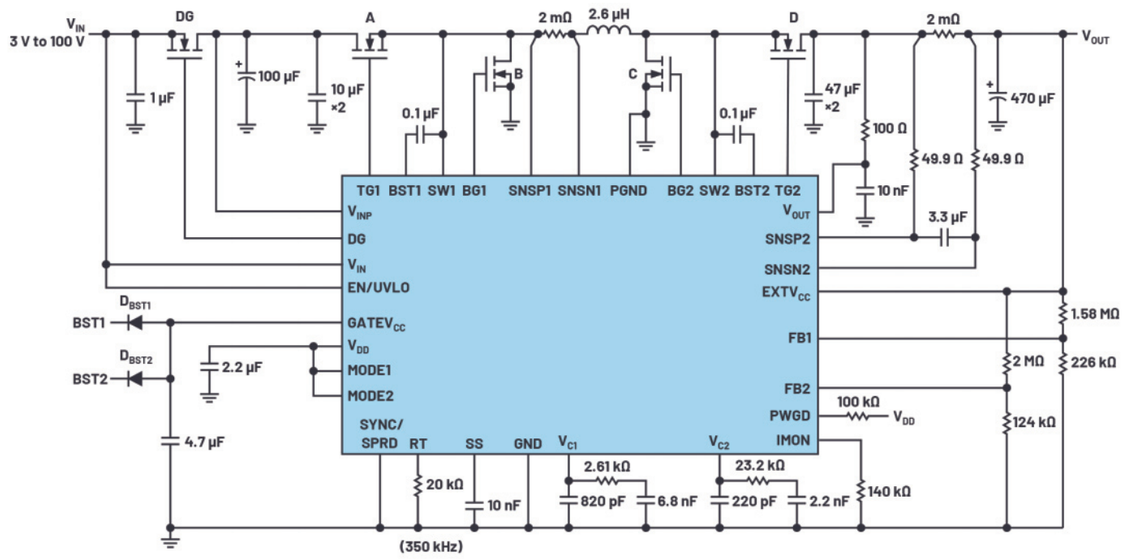


Fig. 5: This 3 to 100V input buck-boost controller operates with 8 to 17V pass-through outputs

lowest input voltage, then a boost regulator is required. Boost regulators can efficiently maintain a 12V output voltage from inputs less than 3V at high current levels.

There is one problem with a boost regulator, though: the diode path from input to output prevents disconnect, so current is not naturally limited at start-up or due to a short.

To prevent current runaway, specialised boost regulators incorporate a surge-stopper front end to allow output disconnect and current limiting, as well as provide reverse voltage protection when back-to-back n-channel mosfets are used. This can address the load dump, engine start and reverse battery conditions with a single integrated circuit, but available current is limited by the SOA of the surge-stopper mosfet.

A four-switch buck-boost regulator lifts this constraint by combining a synchronous buck regulator and a synchronous boost regulator through a shared inductor. This can satisfy both the load dump and engine starting profile tests without mosfet SOA limitations on current level or pulse duration, while retaining the ability to disconnect the output and limit current.

The switching operation of a buck-boost regulator depends on the relationship between the input and output voltages.

If the input is significantly higher than the output, the boost top switch turns on continuously while the buck power stage steps down the input. Similarly, when the input is significantly lower than the output, the buck top switch turns on continuously while the boost power stage steps up the output.

When the input and output are roughly equal, within 10 to 25%, the buck and boost power stages switch simultaneously in an interleaved fashion.

In this way, efficiency is increased in the various switching regions – buck, buck-boost, boost – by limiting switching to only the mosfets required for regulation for input voltages above, roughly equal to or below the output, respectively.

ISO16750-2 summary

Fig. 3 summarises the various ways to address the load dump, reverse input voltage, superimposed alternating voltage and engine starting profile tests along with the pros and cons of each approach. Several key takeaways begin to emerge.

A series n-channel mosfet with its drain facing the input can be used to limit current and disconnect the output whether it is used as a switch – such as in a buck power stage – or linearly controlled, as in a surge stopper.

In the case of reverse input protection and superimposed alternating voltage, using an n-channel mosfet as the rectifying element (source facing the input) significantly reduces power loss and voltage drop compared with a Schottky diode.

A switch-mode power supply is preferable to a linear regulator because it alleviates the reliability concerns and output current restrictions that come with operating within the SOA of the power device. It can regulate at input voltage extremes indefinitely, whereas linear regulator and passive products have inherent time limitations that complicate design.

A boost regulator may or may not be necessary depending on the severity classification of the starting profile and the details of the ECU (what's the highest voltage it must provide?).

If boost regulation is called for, then a four-switch buck-boost regulator combines these desirable traits into a single part. It can efficiently regulate through severe undervoltage and overvoltage transients at high current levels for extended periods.

This makes it the most robust and straightforward approach from an application's standpoint, despite the increased design complexity. Nevertheless, a typical four-switch buck-boost regulator has some drawbacks. For one, reverse battery protection is not naturally provided and must be addressed with additional circuitry.

The primary shortcoming of the four-switch buck-boost regulator is it spends much of its operational life in the lower efficiency, noisier buck-boost switching region.

When the input voltage is nearly equal to the output, all four n-channel mosfets are actively switching to maintain regulation. Efficiency drops as a result of increased switching losses and application of maximum gate drive current.

Radiated and conducted EMI performance suffer in this region as both the buck and boost power-stage hot loops are active and the regulator input and output currents are discontinuous.

A four-switch buck-boost regulator can regulate through occasional large amplitude undervoltage and overvoltage transients, but at the price of operating with high quiescent current, lower efficiency and increased noise in the far more common, nominal conversion region.

Operating mode

A four-switch buck-boost DC-DC controller can operate conventionally with a fixed output voltage and feature a pass-through operating mode (Fig. 4), which eliminates the switching losses and EMI through a programmable input voltage window.

This can operate from 2.8 to 100V, allowing it to regulate through the most severe battery drop during engine start to the peak amplitude of an unsuppressed load dump. This can come with built-in reverse battery protection to -40V, which is implemented by adding a single n-channel mosfet (DG in Fig. 5).

In pass-through mode, the output voltage is regulated to the edges of a voltage window when the input voltage is outside the window. The top of the window and the bottom are programmed via the FB2 and FB1 resistor dividers. When the input voltage is within this window, the top switches (A and D) turn on continuously, passing the input voltage directly to the output.

In this non-switching state, the total quiescent current drops to tens of microamps. The absence of switching means no EMI and no switching losses, enabling efficiencies of greater than 99.9%.

Conclusion

When designing a power supply for an automotive electronic system, a four-switch buck-boost DC-DC controller is superior with its 2.8 to 100V input operating range, built-in reverse battery protection and pass-through operating mode. Pass-through mode improves upon buck-boost operation, achieving no switching noise, no switching losses and low quiescent current while regulating the output to a user-programmed window rather than a fixed voltage.

The output voltage minimum and maximum values are bounded during large amplitude transients such as load dump and cold crank without mosfet SOA concerns, or the current or timing limitations that come from linear products.

The control scheme results in clean and fast transitions between the different switching regions (boost, buck-boost, buck and non-switching) allowing it to regulate through large signal, high frequency AC voltage on the input.



David Megaw is a senior design engineer with Analog Devices

FROM ROAD TO SKY



Micromotors, says Stewart Goulding, are aiding the decarbonisation of the transport sector

Transitioning to more environmentally friendly modes of transport and improving fuel economy will be crucial in reducing greenhouse gas emissions from transport.

Micromotors are supporting the switch to electric vehicles (EVs) and improving the efficiency of commercial aircraft.

Global transport emissions increased by less than 0.5 per cent in 2019, compared with 1.9 per cent annually since 2000, owing to efficiency improvements, electrification and greater use of biofuels. Nevertheless, transportation is still responsible for 24 per cent of direct carbon emissions, according to the International Energy Agency.

Because of this, the decarbonisation of transport has become a crucial part of governments' climate crisis strategy.

Last year, for example, the UK government released a report on what must be done to reduce transport emissions to reach net zero by 2050. Efficiency improvements in aircraft and switching to EVs are two strategies in the document, and innovative motor technology can catalyse progress in these areas.

Charging ahead

As part of its decarbonisation strategy, the government has banned the sale of new internal combustion engine (ICE) cars and vans from 2030, enforcing a shift to EVs.

Despite EVs producing around 50 per cent less greenhouse gas emissions than ICE vehicles, increasing EV adoption has been challenging. Many drivers are reluctant to switch as they believe EVs cannot preform as well as ICE vehicles, or have concerns over the inconvenience of charging.

Micromotors are helping combat these apprehensions, as they're being used in applications that can make EV charging quicker and simpler. For example, micromotors can be incorporated into an EV charging port to allow electronic opening of the flap, providing easy access for the driver. This design feature also allows the port to be secured at the touch of a button, thus preventing physical damage and tampering of the internal components.

In the confined spaces of a charging port, a bespoke drive system is often the best option to achieve the maximum performance in the given space. Standardised parts are designed to operate in various applications, and therefore only partially suit most products.

Shifting gear

Micromotors also play a vital role in EV gear shifts. ICEs require multi-speed transmissions, as they can only operate within a narrow RPM window at each gear before stalling. On the other hand, the electric motors in EVs have a much larger operating window, so a single speed transmission can work for both high and low acceleration.

While EVs don't need a multi gear system, that doesn't mean they can't benefit from it. A single-speed transmission will work for a wide range of acceleration, but there is a degree of trade off that can impact torque and efficiency. For heavy vehicles such as buses and lorries especially, a multi-speed transmission can improve the EV's efficiency and performance, helping it travel up hills and accelerate to highway speeds.

However, multi-speed transmissions are larger than single-speed, which can be problematic in commercial vehicles that require increased space to carry goods or passengers. Fortunately, automotive engineers can make the transmission system more compact by using small and power-dense micromotors in the integrated actuation system.

Every gram counts

While there are fewer travelling commercial aircraft than road vehicles at any given time, planes have a higher fuel consumption rate and should also be prioritised in the transport decarbonisation strategy. For example, a Boeing 747 jumbo jet can burn around four litres of fuel every second.

Shedding weight will help bring down the high fuel consumption of planes. For instance, when United Airlines switched its in-flight magazine to lighter paper, it saved over 170,000 gallons of fuel a year.

A crucial area where airlines can reduce plane weight and improve fuel economy is in motorised systems. Motors are found in a range of cabin equipment to add comfort and a touch of luxury, such as in reclining seats, motorised television screens and electric window blinds.

They're also found on board in safety-critical applications, playing a key role in locking cabin door mechanisms, emergency exits and the pilot's seat, which must remain in a fixed position during take off and landing. Motors are also used to adjust the valves that regulate the plane's air-conditioning.

With a number of motorised systems on board, aerospace engineers can shave grams off aircraft by switching to more compact alternatives.

Materials can help, such as titanium, known for its incredibly low weight and high strength in customised mechatronics, improving performance.

The transport sector can capitalise on advancements in motor technology to reduce greenhouse gas emissions. Micromotors can help accelerate EV adoption and improve the fuel economy of aircraft, assisting the transition to greener travel.



Stewart Goulding is managing director of drive system supplier EMS



Shedding weight brings down fuel consumption in planes

Cmos op amps boost immunity



Rail-to-rail IO high-speed cmos op amps from Rohm have an improved EMI immunity for automotive and industrial equipment applications requiring high-speed sensing in harsh environments, such as vehicle engine control units and anomaly detection systems for factory automation equipment.

In recent years, advancements in electrification and mounting density have increased the amount of environmental noise in electric vehicles and cars equipped with adas. Generally, it is hard to carry out noise evaluation on individual boards and systems during automotive development, so it has to be performed after assembly.

Moreover, some results require improvements such as large-scale EMI countermeasures to lower noise.

The op amps are part of the firm's Emarmour series, first introduced in 2017 with noise immunity that reduced design resources by combining a vertically integrated production system with proprietary analogue design technology.

The products can prevent malfunctions due to noise without taking special application measures.

The latest BD8758xY series has demonstrated performance under four international noise evaluation tests. For example, in ISO 11452-2 radio wave emission testing conducted by vehicle manufacturers, the output voltage of standard products fluctuates by more than ±300mV in all frequency bands, while the BD8758xY series achieves ±10mV or less.

At the same time, the cmos element structure enables accurate, high-speed signal amplification without being affected by external noise when installed in the targeted sensor applications.

This improves reliability while reducing design production-hours in a wide range of applications, including anomaly detection systems.

In addition, the Rohm Real Spice model matches the electrical and temperature characteristics of the actual IC and simulation values to prevent rework after prototyping.

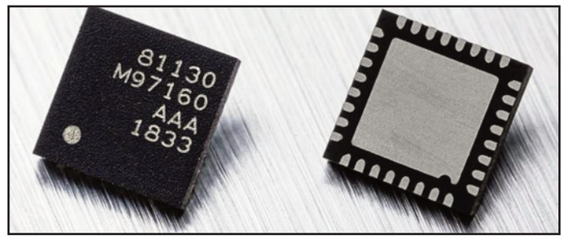
Applications include EV and HEV inverters, engine control units, ecall, car navigation and air conditioning systems.

Controller handles LEDs and OLEDs

An intelligent OLED controller from Melexis integrates all the active components needed to realise combined point (LED) and area (OLED) lighting inside and outside a vehicle.

Each MLX81130 can drive 25 LEDs and OLEDs and supports the firm's MeLiBu light bus interface.

It allows simpler static and animated lighting system development, and is suitable for rear combination lamps or small OLED displays.



The controller lets LEDs and OLEDs be driven by a single device. Designed to support Asil B system integration, it comes in a QFN 5x5 package with 25 programmable constant current sources and has been designed to operate in single-master, multiple-slave configurations.

The total number of LEDs and OLEDs that can be controlled by one master is almost unlimited.

Each constant current output is controlled through the integrated 16bit MLX16 FX pipelined microcontroller, supported by a 32bit maths co-processor and 32kbyte of flash. Two watchdog timers with independent clocks and a 10bit ADC are provided.

Outputs can be controlled via PWM. These output currents are programmable in steps of 1mA between 0 and 15mA, then 2mA steps up to 30mA per output. For more output current, multiple outputs can be bridged.

Samples are available now.

Positioning modules operate up to 105˚C

Automotive-grade positioning modules from U-Blox are operational up to +105˚C.

The Neo-M9L modules and the M9140-KA-DR chip are built on the M9 GNSS platform and use dead reckoning to provide accurate position data when satellite signals are compromised or unavailable.

The M9L-20A and M9L-01A modules are designed for first-mount automotive use. The modules and the chip are all automotive grade, with the M9L-01A offering an operational temperature range up to +105˚C, making it suitable for integration on the roof, behind the windscreen or inside hot ECUs.

Applications include integrated navigation systems such as in-vehicle infotainment and head units, integrated telematics control units, and V2X.

They include six-axis inertial measurement units (IMUs) that deliver low-latency 100Hz raw data output. The modules have a low-latency 50Hz position update rate for real-time applications.

The automotive dead reckoning output combines the GNSS fix with IMU data to improve positioning accuracy.

Additional GNSS-only output enables seamless integration into third-party applications. The receiver also supports wake-on-motion, which enables features such as theft protection and power-efficient designs.

Sensor-based spoofing detection provides security and robustness. It offers protection against possible GNSS signal spoofing, which can cause navigation systems to report faulty position data or time.

All variants comply with AEC-Q104. Engineering samples and an evaluation kit will be available by the end of September.



Secure flash receives approvals

Winbond Electronics' TrustMe W77Q secure flash has obtained Common Criteria EAL2 and ISO 26262 Asil-C ready certifications from SGS Brightsight and SGS-TÜV Saar, respectively.

The flash comes in densities of 16 and 32Mbit now, with 64 and 128Mbit available before the end of the year. Operation is at a frequency of 66MHz in double transfer rate mode and 133MHz in single transfer rate mode.

Features include standard single, dual, quad and QPI serial peripheral interface (SPI), as well as standard packages and pin-outs to facilitate their uses as a drop-in replacement for non-secure SPI NOR flash devices.

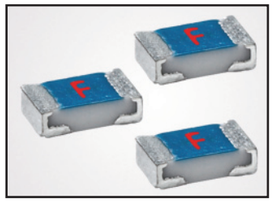
The memory can retain data for over 20 years and perform 100,000 programme-erase cycles with an operating temperature of -40 to +105˚C.

The flash provides secure boot code storage and authentication, secure firmware update, remote attestation for building platform root of trust, and firmware resiliency.

Chip fuse protects battery management

A fast-acting thin-film chip fuse from Vishay, the Beyschlag MFU 0603 AT, is AEC-Q200 qualified and has current ratings from 0.5 to 5.0A.

The device is for used in electric and hybrid electric vehicles, where it will protect voltage sensing circuits in battery management systems, in addition to circuit protection for small loads. For these applications, the fuse's controlled thin-film manufacturing process guarantees stability of fusing characteristics.

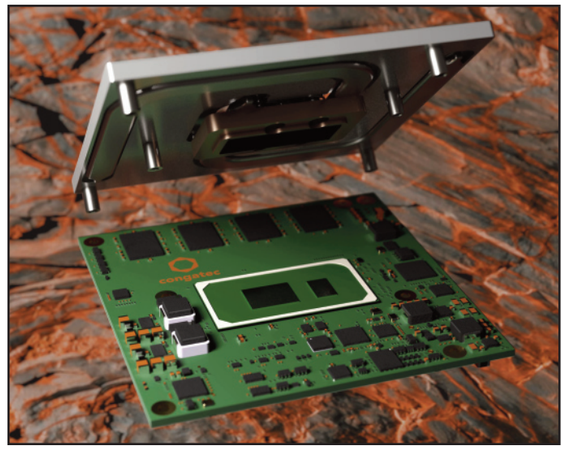


It consists of a homogeneous metal alloy film deposited on a ceramic substrate, with fuse elements covered by a coating designed for electrical, mechanical and climatic protection.

The device offers sulphur resistance in accordance with ASTM B 809, and withstands +85˚C, 85% RH for 1000 hours biased humidity testing and testing for thermal shock.

Offered in the 0603 case size, the fuse has a rated voltage of up to 63V, breakdown capacity of 50A and operating temperature of -55 to +125˚C. It is RoHS-compliant, halogen-free and Vishay Green.

CoMs use 11th-generation Core, and resist vibrations



For transportation and mobility applications, Congatec has introduced 11th-generation Intel Core processor based computers-on-module (CoMs) with soldered ram for shock and vibration resistance.

The Com Express type-six CoMs can withstand temperatures of -40 to +85°C. For more price sensitive applications, there is an Intel Celeron based shock and vibration resistant variant for use from 0 to +60°C.

Typical users for the CoMs based on the Tiger Lake microarchitecture are OEMs of trains, commercial vehicles, construction machines, agricultural vehicles, self-driving robots and other mobile applications in outdoor and off-road environments.

These applications can benefit from fast LPDDR4X ram with up to 4266MT/s and in-band error-correcting code for single failure tolerance and high data transmission quality in EMI critical environments.

The package includes rugged mounting options for the CoM and carrier bundle, active and passive cooling options, optional conformal coating for protection against corrosion due to moisture or condensation, a list of recommended carrier board schematics, and shock and vibration resistant components for the extended temperature range.

The service offering includes shock and vibration tests for custom designs, temperature screening and high-speed signal compliance testing, along with design-in services and training.

The modules have nearly three times higher GPU performance than their predecessors, along with PCIe gen-four support. Graphics and compute workloads benefit from up to four cores, eight threads and 96 graphics execution units for massive parallel processing.

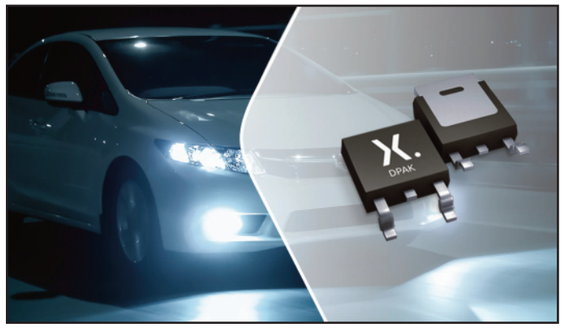
The integrated graphics supports 8k displays or four 4k, and can be used as a parallel processing unit for convolutional neural networks or as an AI and deep learning accelerator.

Using the Intel Open Vino software toolkit, which includes optimised calls for Open CV, Open CL kernels, and other tools and libraries, workloads can be extended across CPU, GPU and FPGA compute units to accelerate AI workloads, including computer vision, audio, speech and language recognition.

Nine transistors in DPak

Nine power bipolar transistors extend Nexperia's portfolio of products in the thermally and electrically advantageous DPak package to cover applications from 2 to 8A and from 45 to 100V.

The MJD series parts are pin-to-pin compatible with other MJD devices in DPak package.



Available as AEC-Q101 automotive-qualified devices and industrial grade parts, the transistors are rated at 2A 50V (MJD2873/-Q), 3A 100V (MJD31CH-Q), 4A 45V (MJD148/-Q), and 6A 100V (MJD41C /-Q and MJD42C /-Q).

The MJD31CH-Q is a high gain version.

Applications include LED automotive lighting, backlight dimming in LCDs, linear voltage regulators, relay replacement, motor drives and mosfet drivers.

Image sensor mitigates flicker

An automotive image sensor from Samsung has a 120dB high dynamic range (HDR) and LED flicker mitigation (LFM) for surround-view monitors or rear-view cameras in 1280 x 960 resolution.

This is the firm's first imaging product optimised for automotive applications.

The Isocell Auto 4AC combines image sensors with CornerPixel technology for HDR and LFM capabilities.

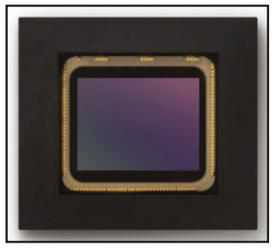
The company plans to expand its automotive sensor line to areas such as camera monitor systems, autonomous driving and in-cabin monitoring.

CornerPixel technology uses a pixel structure that mitigates LED light over 90Hz. Within a single pixel area, it embeds two photodiodes, one 3.0μm pixel for viewing low light images, and a 1.0μm pixel at the corner of the big pixel for brighter environments.

With two photodiodes capturing images in different exposures simultaneously, the sensor offers up to 120dB HDR with little motion blur, allowing smoother transitions between dark and bright areas while preserving more details of the road ahead.

To reduce LED flickering, the smaller photodiode's exposure time can be extended, preventing pulsing LED light from being displayed as flickering on the camera screen.

This delivers a more pleasant viewing experience for the driver and more accurate image data on LED-embedded objects for the automotive system to recognise.



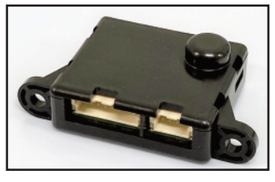
It comes in a 1/3.7in optical format with 1.2 million 3.0μm pixels and, for streamlined client system installations, an image signal processor is embedded within the sensor.

The sensor meets AEC-Q100 grade-two qualifications, including a -40 to +125°C operating temperature.

ECU detects grip on steering wheel

An ECU from Alps Alpine supports autonomous driving systems by distinguishing between variations in a driver's grip on the steering wheel.

Vehicles may need to detect and assess a driver's driving status to allow safe and smooth switching between automated and manual driving. One aspect is hands-off detection, a function for determining the status of the driver's grip on the steering wheel.



The ECU uses data obtained via a capacitive sensor wrapped around the steering wheel to determine if the driver is touching it and conveys the assessment to an adas.

Whereas existing hands-off detection systems are mono-zone setups, with a single electrode, Alps has developed a multi-zone configuration with four electrodes. Dividing the steering wheel and grip patterns into smaller sections enables efficient system switching and enhanced touch assessment reliability.

Resilience to physical stress is a necessary consideration when employing capacitive control, as is the need to maintain resistance to environmental factors such as temperature, humidity and electromagnetic noise, and the feel of the sensor itself.

Alps has developed an original capacitive control asic with improved durability and versatility for conformance to strict automotive standards.

Deliveries to steering wheel manufacturers have started. The product conforms to ISO 26262.

Rectifying diode

Infineon and Bosch are launching a low-loss active rectifying diode for light vehicle generators.

It enables an increase in generator efficiency of up to eight per cent compared with conventional power conversion methods and helps generators qualify as eco-innovations as defined by the European Union.

Deploying the diode can reduce the CO_2 emissions of a car by up to 1.8g/km. Since it can replace standard devices one-to-one, the diode can easily be applied even to generators and cars that are already in series production.

DC-DC converters deliver up to 40A

Automotive grade, step down DC-DC buck converters from Dialog Semiconductor deliver current levels up to 40A.

The DA914X-A family integrates power fets and control logic into a monolithic device. Few external components are required for operation, enabling system footprints below 170mm^2.

They are suitable for powering graphics or AI embedded processors in machine-learning and vision applications for autonomous vehicles.

There are two devices. The DA9141-A operates as a single-channel, quad-phase buck converter, delivering up to, 40A output current. The DA9142-A operates as a single-channel, dual-phase buck converter, delivering up to 20A.

Both have an input voltage of 2.8 to 5.5V and an output voltage of 0.3 to 1.3V.

Multi-phase operation is said to deliver better transient performance, lower losses, better efficiency, optimised thermal dissipation and reduced ripple current and voltages compared with a single-phase architecture.

Inductors and capacitors can be placed close to the point of load.

Remote sensing improves accuracy and supports multiple PCB routing scenarios without loss of performance.

Fully programmable soft start limits the inrush current from the input to give a slope-controlled output voltage.

Dynamic voltage control (DVC) enables adaptive adjustment of the supply voltage dependent on the load. This increases efficiency when the downstream circuitry enters low power or idle mode, resulting in power savings.

Configurable GPIOs support features including I^{2}C, DVC and power-good indicator.

The devices are AEC-Q100 grade-one qualified and are available in a 4.5 by 7.0mm, 0.6mm pitch 60-pin FC-BGA package.





SoCs enable quality graphics rendering

The Gen3e range series of Renesas R-Car systems-on-chip (SoCs) has six members offering a scalable line for entry- to mid-range automotive uses that need high-quality graphics rendering.

These include integrated cockpit domain controllers, in-vehicle infotainment, digital instrument clusters, driver monitoring systems and LED matrix lights.

The devices extend the Gen3 SoC products with CPU performance up to 50k DMips and 2GHz speeds to help car makers navigate demands for continuous user experience, security and safety improvements.

Users can combine the devices with the firm's timing ICs and power management products.

An on-chip real-time Arm Cortex R7 CPU combined with a PMIC eliminates the need for an external vehicle controller.

Development times can be reduced with references for fast boot, HMI and functional safety. Board support packages have been updated with the latest versions of the Linux and Android operating systems.

Pre-integrated software enables higher application integration, for example for 2D and 3D cluster HMI, welcome animation, rear-view camera, and surround view applications.

VirtIO technology allows developers to add the references to existing applications without changing the existing Linux or Android application.

They support Asil-B safety requirements for applications such as telltale monitoring and camera freeze detection, as well as for hardware separation in non-hypervisor cockpits.

The SoCs are available now in samples.

Buck converters for use up to 5W

For isolated buck regulator designs, the ST Microelectronics A6986I and L6986I DC-DC converter ICs are for energy-efficient operation in automotive and industrial applications up to 5W.

The isolated buck topology lowers cost in uses that require a regulated non-isolated primary voltage and one or more isolated secondary voltages. The secondary voltage is governed by the transformer turns ratio and no optocoupler is needed for regulation.

Common uses include powering gate drivers for SiC mosfets and IGBTs that require asymmetrical isolated power rails and powering isolated interfaces such as RS232, I^{2}C and SPI.

Applications for the AEC-Q100 grade-one A6986I converters include automotive on-board chargers and hybrid and electric vehicle traction drives. The 100% duty-cycle capability and input voltage from 4 to 38V meet the cold-crank and load-dump specifications for automotive.

The industrial-grade L6986I is for motor drives, solar power-conditioning systems, uninterruptible power supplies and welders.

The converters operate in forced-PWM mode with peak-current-mode control to regulate the primary output voltage. An extended negative current limit on the primary side gives flexibility to ensure suitable secondary current using a typical transformer coil ratio.



Programmable soft-start enhances reliability and pulse-by-pulse current sensing provides constant-current protection in the primary side. A pre-set current-sense blanking time of 300ns filters oscillations generated by the transformer leakage inductance and improves stability during high-side switching.

Over-voltage and thermal shutdown protection are built in and there are external pins for synchronisation and setting the switching frequency.

Two evaluation boards are available to help accelerate development of single- and dual-output automotive converters. The Steval-A6986IV1 comes with +18 and -4.5V isolated outputs. The Steval-A6986IV2 has a single 5V isolated output. Users can adjust these voltages with external components.

Both devices are in production and available in a thermally enhanced HT ssop-16 package.

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