VEHICLE electronics

The monthly magazine for automotive electronics engineers

Hyundai invests $50m in Canada AI company

Hyundai has invested $50m in Tenstorrent, an artificial intelligence (AI) semiconductor company based in Toronto, Canada.

This will let the group integrate AI into future Hyundai, Kia and Genesis vehicles, and other future mobilities, including robotics and air mobility.

Hyundai and Kia will invest $30m and $20m, respectively, making the group the lead investor in this latest $100m funding round. The money will be used to accelerate Tenstorrent's design and development of AI chiplets and its machine learning (ML) software.

Hyundai expects to leverage Tenstorrent's technologies to develop semiconductors for CPUs and neural processing units (NPUs).

"Tenstorrent's high growth potential and high-performance AI semiconductors will help the group secure competitive technologies for future mobilities," said Heung-soo Kim, executive vice president at Hyundai. "With this investment, the group expects to develop optimised but differentiated semiconductor technology that will aid future mobilities."

Jim Keller, CEO of Tenstorrent, added: "It has been impressive watching Hyundai become the third largest automaker in the world through its aggressive adoption of technology."

Keller is a renowned figure in the semiconductor industry.

Hyundai established a group this year dedicated to customised semiconductor development for its mobility products through collaborations with external partners.

Founded in 2016, Tenstorrent focuses on designing and developing processors to accelerate AI and ML workloads.



Jim Keller (left) and Kim Huang-soo

Issue 117
September 2023

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BMW and Innoviz increase lidar development

Innoviz and BMW are starting a B-sample lidar development phase based on the InnovizTwo lidar sensor.

After two years working together on an existing programme that will include the first deployment of lidar-enabled highly automated technology on the BMW 7 Series later this year, BMW and Innoviz are beginning to focus on the next generation of the technology by starting this B-sample phase.

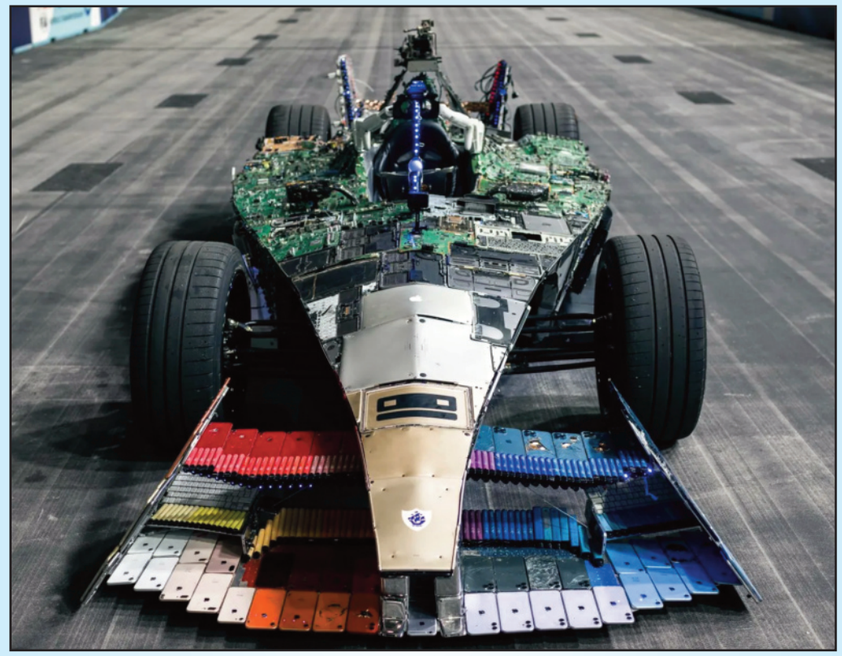
The result of this phase will help BMW decide on a serial development agreement with Innoviz focusing on bringing automated capabilities to a broader range of the BMW line.

"Lidar is one of the critical technologies underpinning level-three or even higher automated functions," said Nicolai Martin, senior vice president at BMW. "Optimising lidar technologies and costs are the major challenges to bring level-three highly automated driving into the mainstream."

BMW and Innoviz have also started this first phase to develop an expected first-ever lidar-based minimal risk manoeuvre (MRM) system. The MRM acts as a secondary safety driving decision platform that will leverage the InnovizTwo to manage real-time driving decisions.

The MRM system is part of a growing software suite from Innoviz that will also include perception software. With roughly half of its research and development investment focused on software development, Innoviz has made advances in deploying artificial intelligence (AI) and machine learning to accelerate development and upgrade cycles of its software suite and to expand its core software capabilities.

Racing car built from e-waste



Formula E team Envision Racing has built a full-size, drivable Formula E car made entirely out of electronic waste including disposable vapes, mobile phones, laptops, MP3 players, plugs and batteries.

Envision Racing partnered with British artist and designer Liam Hopkins to design and build the car entirely from donated electronic products by the UK tech business, Music Magpie and school children.

"Unfortunately, today we choose to discard and replace electronics instead of repairing and recycling them leading to a global e-waste crisis," said Hopkins. "Through design and creativity, we want to show the issue of e-waste and its potential to accelerate the creation of a circular economy."

The car was unveiled at London's Excel, on the eve of the London e-prix, the final race of the 2022-23 Formula E season.

"We are on a mission to tackle e-waste and ensure the precious metals, minerals and materials in old laptops, phones and other electrical devices are extracted and reused," said Sylvain Filippi, Envision Racing's CTO.

Elektrobit adds software to NXP processors

Elektrobit and NXP are collaborating on software enablement for S32G3 processors in software-defined vehicles.

Elektrobit's software for developing automotive ECUs based on the latest Autosar standards, as well as its Linux offering, now support the S32G3 vehicle network processor from NXP.

S32G3 processors more than double the processing, memory and networking capabilities, while maintaining package pinout and software compatibility with the S32G2 processors.

As car makers migrate to consolidated domain and zonal architectures for software-defined vehicles, the combination of S32G3 hardware and Elektrobit's Tresos and Corbos software can reduce time and development costs.



Elektrobit and NXP collaborate on SDVs

"We're pleased to continue our long-standing collaboration with Elektrobit to support our S32G3 safe and secure high-performance vehicle network processors," said Brian Carlson, marketing director at NXP.

The S32G3 vehicle network processors are designed for central vehicle compute applications in zonal-based, software-defined vehicles. They also provide Asil-D safety processing for autonomous driving and adas applications, with the same scalability and pinout as previous generation processors.

"The new NXP S32G3 is ideal for next-generation architectures, and we are happy to extend its capabilities with our broad line of Autosar-compliant software, as well as our new EB Corbos Linux, built on Ubuntu," said Michael Robertson, vice president at Elektrobit. "Together, we're making it easier for car makers and suppliers to develop the complex systems required by software-defined vehicles."

Synopsys completes PikeTec acquisition

Synopsys has completed the acquisition of PikeTec, a specialist in testing and verification of automotive software for control unit systems.

"As the automotive industry evolves towards software-defined vehicles, so does the need for more efficient and effective software testing methods," said Jens Lüdemann, PikeTec CEO. "Joining Synopsys reflects our commitment to enable automotive OEMs with the most comprehensive virtualisation and testing that help them scale to deliver high quality software."

PikeTec's test automation tools enable intuitive and flexible testing across all phases of development and simulation from model-in-the-loop (MiL) to vehicle-in-the-loop (ViL). As the volume and complexity of software increases, it is pushing testing of automotive software to earlier in development with models, software and processors in virtual environments.

The combination of Synopsys' software-in-the-loop (SiL) and virtual hardware with PikeTec's test automation tools and services offers automotive companies a way to bring software-defined vehicles to market faster, safer and more securely.

"Many automotive OEMs have adopted PikeTec's software testing and verification to address the rapidly increasing software content and complexity as they move towards software-defined vehicles," said Ravi Subramanian, general manager at Synopsys. "Combining the expertise of Synopsys and PikeTec will enable us to bring to market innovative virtualisation and testing that directly address our customers' challenges as they shift left in software development and verification."

- Intel and Synopsys have agreed to expand their IP and EDA partnership by developing a portfolio of IP on Intel 3 and Intel 18A for Intel's foundry customers.

Nvidia integrates Hesai lidar technology

Hesai Technology's lidar sensors have been integrated into the Nvidia Drive and Omniverse ecosystems.

Combining Hesai's expertise in lidar with Nvidia's AI, simulation and software development platforms could unlock possibilities for autonomous driving.

Nvidia DriveWorks is a foundation for autonomous vehicle software development. Developers building on DriveWorks will be able to integrate Hesai's lidar sensors into their vehicles, leading to more efficient and reliable autonomous driving.

Simulation is critical to sensor integration. Built on Omniverse, Nvidia Drive Sim is a simulation platform that lets developers test and validate autonomous driving in a physically based virtual environment.

With the ability to access Hesai lidar sensor models in Drive Sim, developers can use capabilities for simulating real-world lidar data, enabling more robust and accurate testing of autonomous vehicle algorithms.

Hesai's AT128 is an automotive-grade, high-resolution long-range lidar. With 128 independent VCSEL laser transmitters, it can achieve 1.53 million data points per second and a detection range of 200m.

"By combining our expertise in lidar technology with Nvidia's world-class simulation and software development platforms, we can provide developers with invaluable insights and resources for unlocking the full potential of lidar in autonomous driving applications," said Bob in den Bosch, Hesai SVP.

Hesai is collaborating with 11 OEMs on multi-year adas contracts, including China's largest new energy vehicle manufacturer and leading auto companies. Six of the OEMs plan to start mass production and delivery before the end of 2023.

"This collaboration will provide autonomous vehicle developers with seamless tools and flexibility along the AV pipeline," said Glenn Schuster, senior director at Nvidia.



Mipi and ASA enter serdes agreement

The Mipi Alliance and the Automotive Serdes Alliance (ASA) have entered a liaison agreement.

The Mipi Alliance develops interface specifications. The ASA is a non-profit alliance of automotive technology providers standardising asymmetric serdes tech.

The agreement creates a pathway so implementers can use Mipi Camera Serial Interface 2 (CSI-2) – widely considered the preferred camera and image sensor interface – directly, or natively, with the ASA Motion Link (ASA-ML) physical layer (phy) interface.

Supporting specifications would also be made available through this pathway, such as Mipi Camera Service Extensions (CSE), which provides protocol-layer security and additional functional safety support.

Mipi and ASA each have standardised asymmetric serdes phy interfaces (A-Phy and ASA-ML, respectively) for automotive applications such as adas, autonomous driving and in-vehicle infotainment that rely on cameras, sensors and displays.

Mipi members can implement CSI-2 directly only with a Mipi phy or approved non-Mipi phy. Products incorporating other phys may use CSI-2 with a bridge device following a Mipi-approved phy. Upon completion of the process defined under this liaison, ASA-ML will be approved for native integration with CSI-2.

ASA will develop an application stream encapsulation protocol (ASEP) to enable native CSI-2 transport over the ASA Motion Link phy. Once the CSI-2 ASEP is approved by Mipi, ASA will include the CSI-2 ASEP in its next specification release as the only recommended camera protocol interface.

Implementation of CSI-2 over ASA Motion Link will require memberships of Mipi and ASA to benefit from their intellectual property licensing terms.

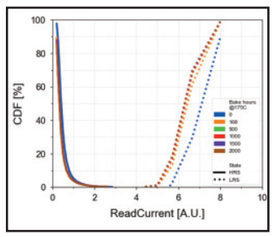
"This agreement supports the continued coalescence around CSI-2 in automotive applications," said Sanjiv Desai, chair of the Mipi Alliance.

The agreement also provides for dialogue between the organisations on the use of Mipi Display Serial Interface 2 (DSI-2) and security-related specifications.

Weebit qualifies resistive ram up to 125˚C

Weebit Nano has qualified its resistive ram (reram) module up to +125˚C, the temperature specified for automotive grade-one non-volatile memories (NVMs).

This demonstrates the suitability of Weebit reram for microcontrollers and other automotive components, as well as high-temperature industrial and IoT uses.



Weebit reram retention at +125˚C

The qualification, using Weebit's demo chips manufactured by its R&D partner CEA-Leti, was performed based on Jedec standards for NVMs. These standards impose rigorous testing of many silicon dies blindly selected from three independent wafer lots.

All the Weebit dies passed the entire set of qualification tests at +125˚C for ten years retention.

"This achievement is part of an ongoing process through which we are extending the qualification of our reram technology to even higher temperatures, longer retention and higher endurance levels," said Coby Hanoch, Weebit CEO. "In our discussions with tier-one foundries and semiconductor companies, we're seeing increased interest in our reram for automotive and industrial applications."

Simone Bertolazzi, technology analyst at Yole Intelligence, added: "Embedded reram is a promising candidate for automotive applications, demonstrating better performance metrics than flash, such as programming time, endurance and power consumption. Thanks to the involvement of major foundries and leading automotive MCU suppliers, the volume of embedded reram wafers is expected to rise at a CAGR above 80% between 2022 and 2028."

The reram demo chip comprises a full subsystem for embedded applications, including the reram module, a Risc-V microcontroller, interfaces, memories and peripherals. The module includes a 128kbit 1T1R reram array, control logic, decoders, IOs and error correcting code.

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Battery Cell Simulator — Simulate batteries in a stacked architecture
Fault Simulator — Simulate cell shorts and broken wires
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Foxconn picks Blackberry as platform foundation

Foxconn's Mobility in Harmony (MIH) consortium has selected Blackberry to provide the foundation for its next platform.

The consortium seeks to create an open ecosystem to transform and accelerate innovation within the electric vehicle industry.

MIH will use Blackberry software and services as the safe and secure software foundation for its open and agnostic electric vehicle platform with a modular design approach.

Project X, one of the MIH EV projects, will be a single-row three-seater geared towards Asian consumers, and is set to be unveiled in Japan later this year. MIH will also release six-seater and nine-seater vehicle platforms in the coming years to provide more vehicle segment choices, and to enable greater innovation.



MIH electric vehicle platform

MIH will use the safety-certified Blackberry QNX portfolio and Ivy cloud-connected, automotive AI platform, including QNX SDP 7.1 licences, QNX middleware technologies, and engineering professional services for system-level integration, performance optimisation and validation.

"MIH is committed to driving an open and agnostic ecosystem, with a focus that goes beyond just electric vehicles," said Jack Cheng, CEO at MIH. "Our ambition lies in crafting intelligent user experiences that enhance smart living and redefine the future of mobility and green logistics. We anticipate deeper collaboration to realise our shared vision to revolutionise the electric vehicle industry."

Mattias Eriksson, president of Blackberry IoT, added: "The Foxconn-led MIH consortium has articulated an ambitious and compelling vision focused on accelerating innovation in the EV ecosystem. As the leading foundational software for the intelligent edge, QNX helps our customers and partners turbocharge their software development efforts."

He said companies all over the world deployed Blackberry's foundational software to allow their own internal resources to focus on layers higher up the software stack.

"They trust us for the plumbing, so they can confidently dedicate their work to software directly impacting their customers' experiences," he said. "This accelerates development, improves safety and security, while reducing overall costs. We are excited to join the MIH consortium and look forward to helping them execute on their vision of transforming the overall EV industry."

Samsung to make Inova ISELED products

Inova plans to produce its ISELED smart LED controller products at Samsung's foundry in South Korea as well as at its existing foundry.

The start of long-term mass production is scheduled for Q4 2024.

Inova's ISELED technology – also called digital LED – is already used on a large scale by car manufacturers in Europe, but mostly in Asia.

Thanks to the simplicity of use – there is no need for binning or user calibration – and the trend to central and domain-based architectures, ISELED is penetrating the market quickly. Supported by the ISELED Alliance, a consortium of more than 50 lighting companies from around the globe, Inova believes one billion ISELED chips per year will be produced by 2026.

"With the high acceptance of ISELED especially in Asia and the enormous growth which far exceeds even optimistic expectations, we simply have to ensure we can always reliably supply our global automotive customers," said Robert Kraus, CEO of Inova. "We are happy we soon can strengthen our supply chain through Samsung as an additional source."

Gibong Jeong, executive vice president at Samsung, added: "Automotive semiconductors are a field that requires technological stability and reliability based on research and development experience."

TSMC plans €10bn wafer fab in Dresden

Taiwanese semiconductor manufacturer TSMC plans to spend €10bn constructing a production facility in Dresden.

The plant for 300mm wafers will be in the heart of the electronics hub known as Silicon Saxony. The German government and the EU will offer financial support for the project, pending EU approval.

The planned factory will have a monthly capacity of 40,000 wafers. Construction is scheduled to start in the second half of 2024, with the facility to go operational by the end of 2027.

The planned joint venture will be 70% owned by TSMC, with Bosch, Infineon and NXP each holding a 10% stake, subject to regulatory and other approvals.

"We are excited at this opportunity to deepen our long-standing partnership with Bosch, Infineon and NXP," said CC Wei, CEO of TSMC.

The plant's products will be aimed primarily at the European and German automotive and industrial sectors, said TSMC.

"Europe is a highly promising place for semiconductor innovation, particularly in the automotive and industrial fields, and we look forward to bringing those innovations to life on our advanced silicon technology with the talent in Europe," said Wei.

Stefan Hartung, chairman of Bosch, added: "Apart from continuously expanding our own manufacturing facilities, we further secure our supply chains as an automotive supplier through close cooperation with our partners. With TSMC, we are pleased to gain a global innovation leader to strengthen the semiconductor ecosystem in the direct vicinity of our semiconductor plant in Dresden."

Infineon CEO Jochen Hanebeck said Dresden was strengthening its position as "one of the world's most important semiconductor hubs that is already home to Infineon's largest front-end site".

And NXP CEO Kurt Sievers said: "The construction of this new and significant semiconductor foundry will add much needed innovation and capacity for the range of silicon required to supply the sharply increasing digitalisation and electrification of the automotive and industrial sectors."

The project follows similar expansions by German chip maker Infineon in Dresden and US giant Intel in Magdeburg, also in eastern Germany.

Tier IV and Axell develop SoC for robo-taxis

Tier IV worked with Axell, a Japan-based computer hardware company, on a collaborative research project to create an application-specific system-on-chip (SoC) and software platform for robo-taxis.

The SoC has been optimised to integrate with Autoware open-source software for autonomous driving championed by Tier IV.

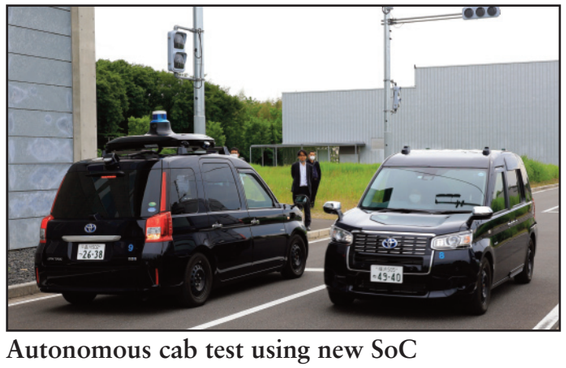
The project culminated in a demonstration showing the power and performance advantages of Autoware accelerators. These hardware accelerators are custom-designed for the Autoware architecture.

Designed to execute a diverse range of autonomous driving (AD) algorithms with efficiency, the SoC sets the stage for the development of a complete robo-taxi system with an estimated power consumption of less than 150W.

Additionally, the system uses hardware accelerators that manage high-load sensor data processing, achieving close to a tenfold reduction in power consumption compared with existing environments.

To ensure seamless execution of control system processing, a dedicated real-time operating system is seamlessly integrated with many-core processors, effectively mitigating fluctuations in execution time.

With its focus on AI edge computing, the SoC aims to provide more efficient AD functions.



Autonomous cab test using new SoC

AWS cloud helps Continental speed software development

Continental has expanded its tool box for automotive software development with the vECU Creator virtual ECU software.

This will let developers at vehicle manufacturers, suppliers and third parties configure and run virtual cloud-based ECUs in their development environments to help develop code for microcontroller and processor hardware that does not yet exist.

The vECU Creator is part of the firm's CAEdge automotive edge framework, which runs on Amazon Web Services (AWS).

By using cloud-based vECUs, applications or software features for software-defined vehicles (SDVs) can be built by OEMs faster, more efficiently and in a more agile way. That allows developments to be tested and debugged continuously by engineers within the cloud, at the same time as hardware development and production cycles.

The vECU Creator brings together Continental's high-performance computers and ECUs with Elektrobit's software for Autosar Classic and Adaptive.

"A great vehicle relies on both quality hardware and software," said Gilles Mabire, CTO at Continental Automotive. "Our vECU Creator will make it easy for our software experts to work in parallel, enabling us to create applications for the software-defined vehicle that enhance the driver's safety and experience."

As car makers look to bring models much faster to market and want to provide software updates, traditional hardware-in-the-loop (HiL) development and testing of automotive software is slow and limited in scale. Most functional, safety and security issues can only be addressed when the physical ECUs are available.

Until now, there were no comprehensive tools for developers at automotive manufacturers and system suppliers to simulate in the cloud the performance of digital features and confirm compatibility across existing or new car lines prior to general hardware availability, leading to increased risk prior to launch.

Bringing together Continental's record in design and manufacturing of complex automotive systems at scale and Elektrobit's mass market ready automotive base software and middleware, the vECU Creator lets automotive software developers decouple hardware and software decisions, simulate digital feature performance on the digital twin of hardware subsystems and continuously release applications that customise and enhance the driver experience.

CAEdge users can configure their vECU choosing from a range of virtualised hardware and software for base tooling and simulation, covering typical microcontroller-based ECUs, zone controllers or high-performance computers.



AWS is Continental's preferred cloud provider

After selecting the target chipset and middleware, a vECU is automatically set up in the user's development environment based on CAEdge preferences, letting developers begin coding immediately.

Elektrobit's Autosar Classic and Adaptive product lines are pre-integrated in the vECU Creator and help enable an automated approach to integrate software, upgrade components, and test and validate new builds without the target hardware.

Scaling vECUs for verification and validation is easy and on-demand, and time for test runs can be reduced.

AWS is Continental's preferred cloud provider for vECU Creator and its services help support CAEdge, a modular hardware and software framework that connects the vehicle to the cloud and features a virtual workbench offering options to help automakers develop, supply and maintain software-intensive functions.

This means drivers can integrate the functions they want going forward during the entire service life of their vehicle by downloading software updates.

Dongfeng opts for ECar X smart cockpits

A joint venture between Dongfeng and Stellantis is buying intelligent cockpits from mobility technology provider ECar X and internet of vehicles (IoV) company China Unicom Smart Connection (CUSC).



Peugeot's flagship 508L long-wheelbase sedan

Dongfeng Peugeot-Citroën Automobile (DPCA) is buying the Intelligent Cockpit 2.0 products that are based on the ECar X E02 intelligent cockpit computing module.

DPCA will use them for three major vehicles launches this year.

These products have been integrated into DPCA's Citroën Tianyi, Peugeot 4008 compact SUV and Peugeot's flagship 508L long-wheelbase sedan models, which were launched for mass production in the first half of August.

As of July 2023, more than one million units of the E02 intelligent cockpit computing module have been installed in 32 vehicle models.

E02 is an integrated core computing module designed for the infotainment systems of intelligent cockpits. It has integrated multiple electronic components, including energy-efficient systems-on-chip (SoCs) with 4G communication module and power management chips.

In terms of functionality, E02 supports the development of common and practical functions including data and information encryption, augmented reality navigation, facial recognition, telematics box, quick start, intelligent voice assistant, multi-screen interaction, surround view monitor and digital video recorder.

The independent display can have up to four screens.

E02 has passed AEC-Q104 qualification, representing the capability to maintain stable performance in demanding external environments while fulfilling safety requirements.

It uses the recently upgraded C-Connect 3.0 interactive smart connectivity system and intelligent technology functions.

It helps CUSC increase the development efficiency for its intelligent cockpit products and create a series of differentiated units.

LG picks Valens chipset for camera

LG has selected Valens' VA7000 Mipi A-Phy chipset family for its next camera system project.

Automotive OEMs are expected to benefit from this starting in 2026.

Valens chipsets will form the underlying connectivity between multiple camera sensors and LG's camera system. This will enable the seamless display of multifunctional information to augment driver decision-making and enhance passenger safety.

Chipset benefits include EMC performance.

Leapmotor architecture combines SoC and MCU

Chinese car maker Leapmotor has developed a four-leaf clover automotive architecture that combines a single system-on-chip (SoC) and MCU to create a central supercomputing unit.

The central integrated electronic and electrical architecture integrates the cockpit system, intelligent driving system, power domain and body domain, using high computing power, fast communication, and low latency to enable efficient collaboration among the key components of electric vehicles.

Zhu Jiangming, CEO of Leapmotor, said it was through years of self-development that Leapmotor gained the capability to explore core technologies deeply.

The architecture achieves a generalisation rate of over 90% and offers three configuration options – standard, mid-range and high-end – catering to the RMB-100,000 to RMB300,000 price range vehicles.

All three use an NXP S32G MCU. The standard configuration has a Qualcomm Snapdragon 8155 SoC, the mid-range adopts a Snapdragon 8295 SoC and the high-end a 8295 SoC plus an Orin-X chipset. The system supports L2++ level intelligent driving assistance functions.

"All Leapmotor C-series vehicles are equipped with the Snapdragon 8155 chipset," said Xian Lei, senior vice president at Qualcomm. "Soon to be unveiled, Leapmotor's new model will also be among the first to feature the Snapdragon 8295 chipset. We are looking forward to utilising the latest from the Snapdragon digital chassis to provide users with a top-notch immersive driving experience."



Zhu Jiangming, CEO of Leapmotor

It systematically integrates the cockpit system, intelligent driving system, power domain and body domain, concentrating computing power and enabling centralised information decision-making through the central controller.

Analogous to the human brain's left and right hemispheres, the SoC is responsible for data processing, while the MCU handles logical calculations, achieving the convergence of the four domains.

The architecture applies regional control technology to restructure the allocation of vehicle sensors and actuators, establishing standard interface communication. As a result, the entire length of vehicle wiring harness is shortened to 1.5km.

"Leapmotor has been an early adopter of NXP's S32K, and has grown together with the S32K series MCU," said Liu Fang, general manager of NXP's China automotive electronics division. "We hope that the collaboration will lead to exploring the next generation of electronic architecture and unlock more potential for intelligent automobiles."

The four-leaf clover architecture adopts a central supercomputing platform and enables vehicle over-the-air (OTA) updates, allowing for entire vehicle-level evolution by upgrading just central supercomputing software. As a result, the architecture can achieve seamless OTA upgrades for the entire vehicle without causing disruption.

Arasan Can integration

Arasan Chip Systems is offering its Can XL IP combined with the Cansec acceleration IP, delivering hardware acceleration for secure Can bus transactions.

This addition completes its Can IP portfolio, alongside Can-FD, Can 2.0 and TT-Can.

Can XL IP adheres to the CiA 613-2 specifications and maintains backwards compatibility with Can-FD, Can 2.0 and TT-Can. The integrated Cansec IP enhances security and complies with the current draft version.

Can XL IP with Cansec is ISO 26262 Asil-B ready, with support for Asil C and higher. Can XL fills the gap between Can-FD and Ethernet.



Inside Bosch's test centre in Penang

Bosch opens chip test centre in Malaysia

Bosch has opened a test centre for automotive chips and sensors in Penang, Malaysia, at a cost of €65m.

It plans to invest a further €285m in the site by the middle of the next decade.

"With our new semiconductor test centre in Penang, we are creating additional capacity within our worldwide manufacturing network to meet the continued high demand for chips and sensors," said Stefan Hartung, chairman of Bosch. "Semiconductors are a decisive success factor for all Bosch business areas, and the expansion of this business is strategically very important."

Bosch has 100,000m^2 of land available on Penang's mainland strip. The test centre covers more than 18,000m^2 and includes clean rooms, office space and laboratories for quality assurance and manufacturing.

By the middle of the next decade, up to 400 people will be working there. With the new factory and a total of 4200 associates, Penang is now Bosch's biggest location in south-east Asia.

Semiconductor manufacturing can basically be divided into two sections: frontend and backend manufacturing. For the latter, Malaysia is an important hub in the global semiconductor supply chain. The country is estimated to cover around 13 per cent of global backend manufacturing.

According to official figures, in recent years the state of Penang has generated more than five per cent of worldwide semiconductor revenue.

"The new test centre in Penang brings our manufacturing network closer to the companies that serve the further value chain of semiconductor manufacturing as well as to customers in this important Asian market," said Markus Heyn, chairman of Bosch's mobility business sector. "That shortens delivery times and routes, and improves our competitiveness."

The frontend is where the circuits are attached and patterned on the wafers. At Bosch, for example, this work is performed in the clean rooms of the wafer fabs in Reutlingen and Dresden. The backend is where individual chips are then separated from the wafers, assembled and tested.

Bosch carries out most of the final testing of its semiconductors in Reutlingen, Germany; Suzhou, China; and Hatvan, Hungary. Those locations will now be joined by the centre in Penang.

At the site, Bosch will immediately begin testing semiconductors the company manufactures at its frontend in Dresden, among other locations.

"Our new test centre in Penang completes our internal process chain, especially for semiconductors from Dresden," Heyn said.

Over the next three years, Bosch plans to invest €3bn in Dresden and Reutlingen.

Following its expected acquisition of part of the business of TSI Semiconductors, based in Roseville, California, which is due before the end of the year, Bosch plans to invest roughly an additional €1.4bn in retooling the fab to support the latest manufacturing processes for silicon carbide semiconductors.

SIMULATION & MODELLING



pAIn relief

Seth DeLand explains how AI is improving automotive simulation

The automotive industry has consistently been an area of rich innovation, as the growing complexity and demanding production schedules require the adoption of tools and techniques to build differentiated products. Automotive engineers are faced with challenges as they incorporate AI into vehicle systems and R&D workflows.

Artificial intelligence (AI) cannot be viewed as a standalone component but must be integrated with consideration for the impact on adjacent systems. This means AI algorithms need to be simulated alongside other components to understand their impact and function before they can be deployed to the vehicle.

There are three key issues facing the automotive industry in terms of AI and simulation.

The first is the challenge of insufficient data, where simulation models can be used to synthesise data that might be difficult or expensive to collect. The second is the use of AI models as approximations for complex high-fidelity simulations that are computationally expensive, also referred to as reduced-order modelling.

The third is the use of AI models in embedded systems for applications such as controls, signal processing and embedded vision, where simulation has

SIMULATION & MODELLING

become a key part of the design process.

As automotive engineers are finding new ways to develop more effective AI models, how can simulation and AI combine to solve problems of time, model reliability and data quality?

Training and validating

Collecting and ordering real-world data are time consuming and labour-intensive. While AI can be assistive, engineers must be mindful that AI models not only operate based on fixed parameters but also continually learn and may be exposed to new data that were not captured in the initial training set.

Projects are more likely to fail without robust data to help train a model, making data preparation a crucial step in the AI workflow. Bad data can leave an automotive engineer spending hours trying to determine why the model is not working, without the promise of insightful results.

Simulation can help automotive engineers overcome these difficulties. In recent years, data-centric AI has brought the AI community's focus to the importance of training data.

Rather than spending all a project's time tweaking the AI model's architecture and parameters, it has been shown that time spent improving the training data can often yield larger improvements in accuracy. The use of simulation to augment existing training data has multiple benefits:



Big data and AI drive innovation and efficiency in the automotive industry

- Computational simulation is in general much less costly than physical on-vehicle experiments.
- The automotive engineer has full control over the environment and can simulate scenarios that are difficult or too dangerous to create in the real world, such as emergency braking on icy roads.
- The simulation gives access to internal states that might not be measured in an experimental setup, which can be useful when assessing why an AI model doesn't perform well in certain situations, including testing nonlinear values such as NOx emissions.

Using industry tools means automotive engineers can generate simulated data that mirror real-world scenarios. The combination of modelling and simulation tools with programming language and numeric computing environments enables engineers to simulate their data in the same environment they build their AI models, meaning they can automate more of the process and not have to worry about switching toolchains.

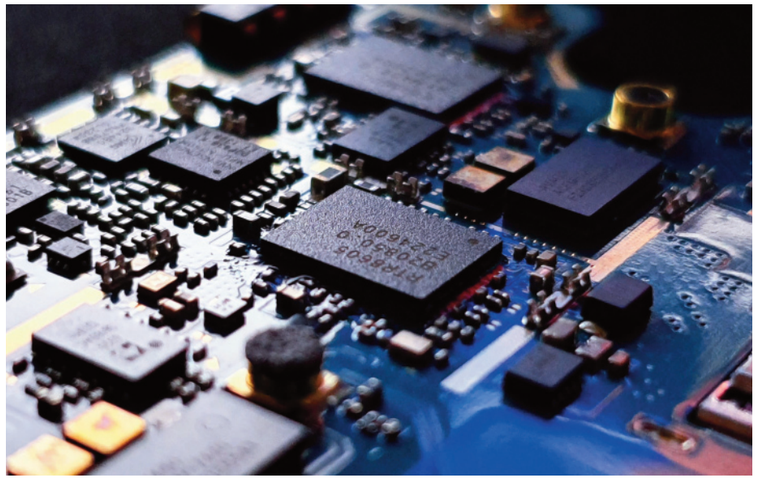
Complex

Using simulation-based models is key when designing algorithms that interact with physical systems. Simulations can enable rapid design iterations for algorithms that interact with manual systems, such as code that is designed to control a hydraulic valve.

In the controls field, this is called the plant model; in the wireless vehicle communications area it is called channel model. In the reinforcement learning field, it's called the environment model.

Whatever it is called, the idea is the same: create a simulation-based model that gives the necessary accuracy to recreate the physical system with which the algorithms interact.

The problem with this approach is that to achieve the necessary accuracy, automotive engineers have historically built high-fidelity models from first principles, which for complex systems can take a long time both to build and simulate. Long-



AI techniques are streamlining design processes

running simulations mean less design iteration will be possible, meaning there may not be enough time to evaluate potentially better design alternatives.

AI comes into the picture here in that automotive engineers can take that high-fidelity model of the physical system they've built and approximate it with an AI model – a reduced-order model. In other situations, they might just train the AI model from experimental data, completely bypassing the creation of a physics-based model.

The benefit is that the reduced-order model is much less computationally expensive than the first-principles model, meaning the automotive engineer can perform more exploration of the design space. And, if a physics-based model of the system does exist, the engineer can always use that model later in the process to validate the design determined using the AI model.

It doesn't need to be the entire system that is approximated; the user can decide and prioritise which parts of the system are best-suitable for AI approximation by assessing the speed and accuracy trade-off.

Another benefit of using AI-based approaches for reduced-order modelling comes from reducing the number of software tools that need to be combined to simulate a system. For example, when trying to add detailed controls to a system or when assembling subsystems into larger models, reduced-order modelling can help reduce other software dependencies, FMU and FMI integration, and hurdles associated with co-simulating various automotive engineering tools.



AI-based reduced-order modelling is accelerating design iterations

Algorithms

Simulations are becoming indispensable for automotive engineers who design algorithms for control systems. In many cases, these automotive engineers are developing virtual sensors that attempt to calculate a value that isn't directly measured from the available sensors.

Various approaches are used including linear models and Kalman filters.

But the ability of these methods to capture the nonlinear behaviour present in many real-world systems is limited, so automotive engineers are turning to AI-based approaches that have the flexibility to model the complexities.

They use data – either measured or simulated – to train an AI model that can predict the unobserved state from the observed states, and then integrate that AI model with the system.

At the forefront of research in this area, reinforcement learning takes this approach a step further. Rather than learning just the estimator, reinforcement learning learns the entire control strategy.

This has shown to be a powerful technique in some difficult applications such as robotics and autonomous systems, but building such a model requires an accurate model of the environment, which may not be readily available, as well as the computational power to run a large number of simulations.

In addition to virtual sensors and reinforcement learning, AI algorithms are increasingly used in embedded vision, audio and signal processing, and wireless applications.

For example, in a car with automated driving capabilities, an AI algorithm can detect lane markings on the road to help keep the car centred. In vehicle voice assistants, AI algorithms can help enhance speech and supress noise. In all these applications, AI algorithms are part of the larger system. Simulation is used for integration testing to ensure the overall design meets requirements.

Conclusion

As models in the automotive industry grow in intricacy and scale to serve increasingly complex applications, AI and simulation will become increasingly essential tools in the automotive engineer's toolbox. Industry tools have empowered engineers to optimise their workflows and cut their development time by incorporating techniques such as synthetic data generation, reduced-order modelling and embedded AI algorithms.

With the capacity to test, develop and validate models in precise and cost-effective ways, before hardware is introduced, these methodologies will only continue to grow in use.



Data-centric AI is revolutionising automotive engineering



Seth DeLand is data analytics product marketing manager at MathWorks

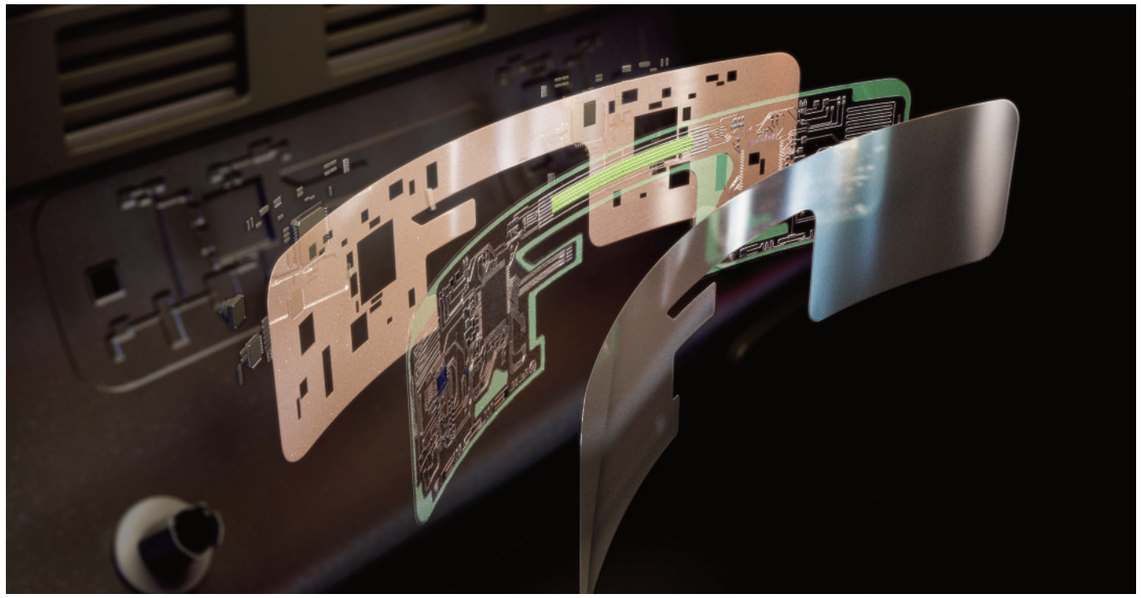
SIMULATION & MODELLING

INTEGRATION

AGENTS OF SHIELDS

Neil Armstrong looks at the rise of integrated electronics for front shields

Vehicle Electronics



Multi-layer flexi-hybrid circuit assembly sealed and bonded to inner form of moulded shield

The traditional automotive vehicle grille has served a fundamental purpose for the past hundred years; a means to ventilate the front of the vehicle and provide cooling air to the engine. As brand identity became a strong part of the buying experience the use of the grille as an imposing or subtle part of that aesthetic became increasingly important.

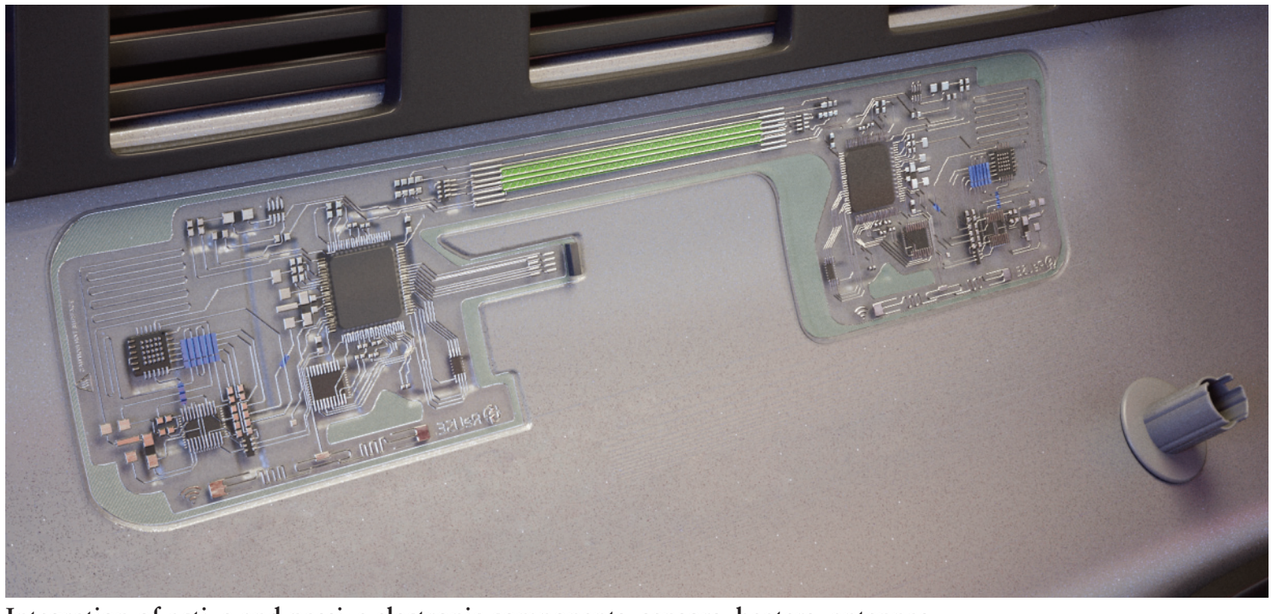
Then in the shift away from the internal combustion engine in meeting the challenges of environmentally sustainability, via the development of electrification, the conventional grille has a reduced functional requirement for venting and is finding alternative uses.

Even the naming of the part is changing. The description of 'shield' acknowledges the change in both opportunity and use.

The clear movement in the industry is to house sensors, electronics and lighting systems in the shield, thereby providing alternative packaging, effective positioning and aesthetic differentiators in a way not previously viable.

Mercedes is integrating adas sensors into the front three-pointed star emblem and Hyundai is integrating significant and innovative LED illumination in its lighting grille. The Polestar 3 has marketed the smart surface front shield, heralding the homogenous integration of radar, camera and heating systems to the part.

The front shield market is developing at a pace. It is estimated that the compound annual growth rate is upwards of 7%, with the current market valued at over $15bn a year. The integration of electronics is set to increase this value significantly.



Integration of active and passive electronic components, sensors, heaters, antennas and communication harnesses on one bonded foil

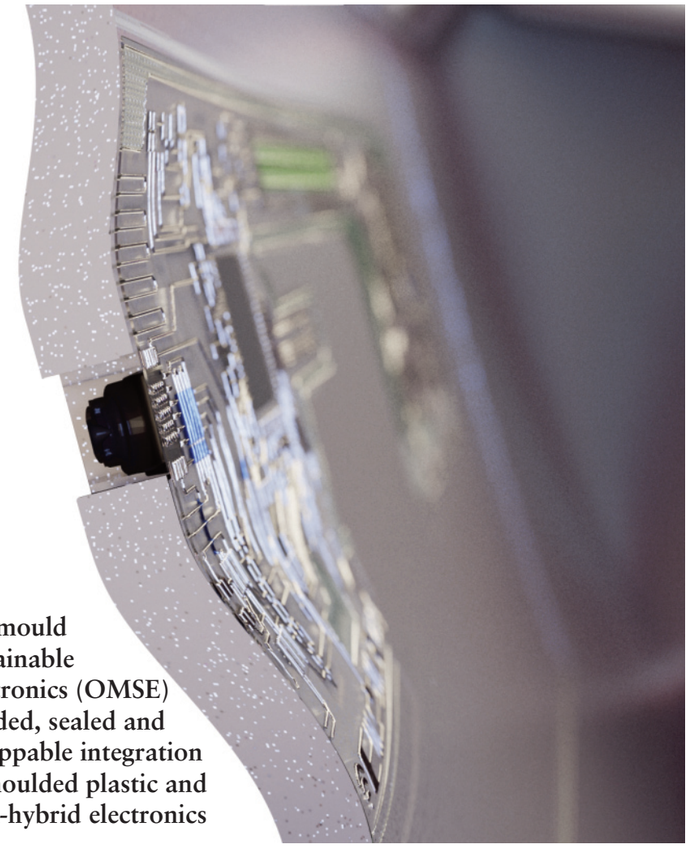
Integration

Packaging electronic printed circuit assemblies (PCAs) means the current options wire harness multiple circuit boards together. These units need to be individually sealed to protect them against the elements encountered at the front of a vehicle; doing so takes up space, added to which is the requirement for the mechanical inclusion of individual modules throughout the shield.

All these requirements make the system complex and to some extent unwieldy in production, as well as increasing the risk of reliability issues with a considerable number of interconnects and units to seal.

Adas sensors require an unimpeded view. The sensing system needs to be as close to the front of the shield as possible, which is conflicted with the production methods of injection moulding.

A more growing need in the automotive industry is for reduced CO_{2e} impact and increased circularity at the end of life.



On-mould sustainable electronics (OMSE) bonded, sealed and unzippable integration of moulded plastic and flexi-hybrid electronics

The market has an ever-increasing driving force to increase sustainability to meet government rules and customer expectations. However, the developing integration of electronics in vehicles is at odds with the lack of scalable sustainability for the electronic PCA.

The commercially unviable recycling of printed circuit boards and assemblies means a sizeable portion of these are essentially shredded and then buried. This is a complete paradox to the global focus of delivering highly sustainable technologies, which the automotive industry is starting to understand.

Answers

Today, the conventional go-to method is a very predictable mix of separate electronic units and sensors that are connected via a wiring harness. All these components are produced separately, shipped individually to the OEM, and installed on dedicated mechanical mounting systems.

The connection system is a standard harness with connectors per individual or group of electronics, heaters or sensors. Packaging is a realisable issue, plus the time and cost to produce are significant.

There is a growing trend in the industry towards IME (in mould electronics) to deliver the end goal.

The technology essentially injection moulds a three-dimensional shape around a printed electronic foil, embedding the conductors and in some circumstances electronic components into the unit. The aim is to produce a single part that reduces the total component count in a highly protected environment.

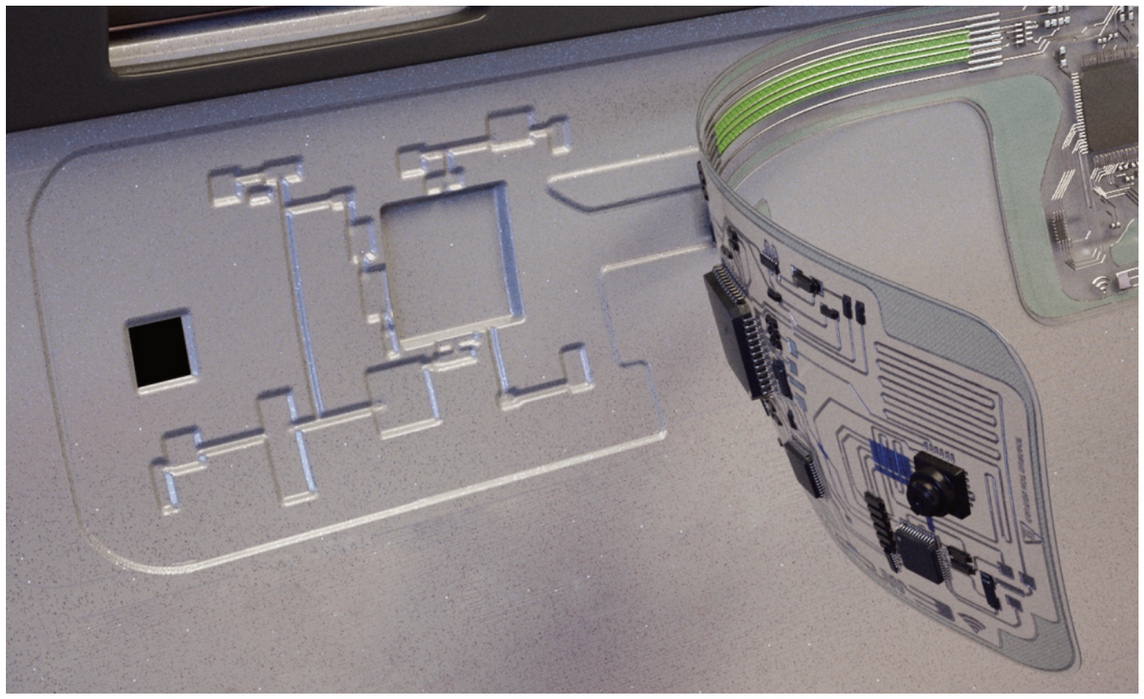
The gains are significant. A lifecycle assessment (LCA) shows a demonstrable reduction in transport costs of individual items and materials, as well as energy to produce a full shield.

At first, this seems the panacea to the integrated shield design. However, the technology does not lend itself effectively to the integration of multiple electronic components, as they are subjected to high temperatures and pressures of the moulding process.

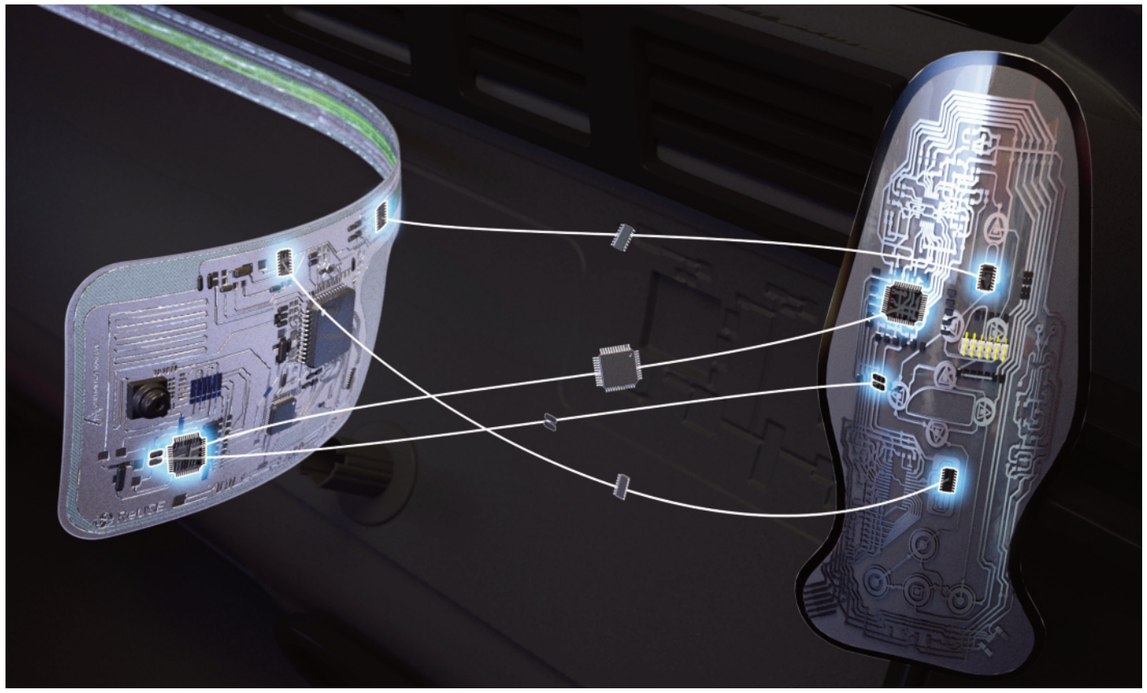
More significant is the lack of end-of-life recyclability; as the unit becomes a thermo-set synergy of parts, it is rendered nearly useless for second-life. The level of recyclability is even less than the current technology of separate fibreglass resin-printed circuit boards, wiring and connectors.

In some LCA calculations, the offset is significant towards the apparent lower part count and reduced logistics in production, but the inability to reuse at the end of life or recycle in a significantly effective way is not taken into account particularly well.

So, as the industry moves from LCA comparators to full circularity assessments, this will be an Achilles heel to IME and its equivalents.



Circuit built into car showing components and receptive moulded cavities



Flexi-hybrid circuit assembly showing components in first-life application within automotive shield, and transition into second-life applications

Recyclable

Technology exists to provide the foundations for a fully recyclable integrated electronics front shield. This can deliver fully unzippable bonded conductive traces, printed sensors, and electronic and mechanical components onto a sustainable substrate, such as PET, bioplastics or nano-polymers.

These systems are referred to as flexi-hybrid electronic (FHE) technologies.

The flexible circuit board can be formed and laminated using bonding materials to a pre-vac formed or injection moulded one-piece front shield. The rear of the front shield moulding incorporates cavities to house the components of the flexi-hybrid sub-assembly, therefore fully protecting the electronic components and sensors, while critically allowing full end-of-life disassembly and recyclability.

The harness or connecting system is also created using an additive process to the FHE substrate, creating a seamless and fully integrated interconnection system, thereby significantly reducing connectors.

On-mould sustainable electronics (OMSE) gains all the benefits of in-mould electronics, while delivering the ability to disassemble completely the unit into its constituent parts at its end of life.

The unzipping process, delivered at extremely low energy levels, using just hot water, allows the electronic components to be unstressed in separation, therefore providing for full second-life use.

Conclusion

The more electronics are integrated into the exterior and interior of vehicles, the more the need to think about the impact of end-of-life recyclability. E-waste is the fastest-growing waste stream globally. Over 58 million tonnes of electronics are shredded and buried annually.

The premise that recycling electronics is a good thing, the way it is done today, does not hold true. There is a need to understand methods for full circularity, to reuse at the end of life the parts that make up the virgin unit. The world's finite resources must be preserved, and the automotive market has an obligation with its ever-increasing appetite to use electronics to move the game on.



Neil Armstrong is group managing director of In2tec

URBAN MOBILITY

Roger Brereton examines some of the key predictions for urban mobility in 2050



LOOK TO THE FUTURE

URBAN MOBILITY

History is awash with examples of predictions about technology that went spectacularly wrong. Yet, design engineers must carry out their work with one eye on the future, however uncertain it might be.

Perhaps the most famous prediction in the history of transport owes its notoriety to the fact that it was so emphatically wrong. At the outset of the last century, the president of the Michigan Savings Bank advised Henry Ford's lawyer not to invest in Ford Motor. "The horse is here to stay, but the automobile is only a novelty – a fad," Horace Rackham was warned.

Although this story might discourage people from betting against new technologies, they should be equally cautious when making bold projections of technological progress. SpaceX and Tesla founder Elon Musk is recognised as one of the greatest geniuses of our era, but he also has a reputation for making technology predictions that can turn out to be spectacularly wrong. In 2010, he was quoted as saying: "I'm going to go out on a limb and say that by 2020 there will be serious plans to go to Mars with people."

According to a 2018 United Nations report, the number of people living in the world's urban areas is expected to grow by 2.5 billion by 2050. At that stage, two out of every three people will be living in a city or urban area. But what will urban mobility look like in 2050? Should people believe those like Musk who predict fully driverless vehicles and subterranean structures everywhere? Or should they be better casting caution on the idea that things will be radically different?



Companies such as Tesla are making the shift to EVs a reality



More buses on the roads would make sense

All electric?

The ascent of electric vehicles is not a future revolution; it's already happening.

The shift to EVs is seen as a necessity in virtue of the environmental benefits, and companies such as Tesla are making this a reality. New regulatory targets in the EU and the USA aim for an EV share of at least 50 per cent by the middle of the next decade, so by 2050 electric vehicles can be expected to have almost entirely displaced the internal combustion engine for passenger vehicles.

For others types of vehicle, the future is not quite so certain. There are two reasons for this. First, it is much more difficult to electrify heavy vehicles such as buses and trucks. With the automotive sector shifting to EVs, the first step for commercial vehicles will be last-kilometre delivery vans.

This is already underway, and there is likely to be increasing demand for this in urban areas, thanks to the decline of the high street and shifting consumer preferences.

However, it is far from certain that every vehicle type will convert to electric. Even in the automotive sector, many companies are continuing to invest heavily in hydrogen. For larger vehicles, the jury's is still out on whether electric is the most viable option.

So, while shoppers might receive their groceries from an electric last-kilometre delivery van, they will just as likely ride a hydrogen bus as an electric one.

Driverless vehicles

Perhaps the area most prone to premature predictions about the future of transportation is the area of driverless vehicles. The history of driverless technology in the last decade or so has not followed the path its early advocates would have anticipated. The initial focus was on robo-taxis, but has more recently shifted to long-haul trucking.

Heavy-goods vehicles travel on long straight roads, whereas urban mobility requires navigating a far more complex environment. Developing artificial intelligence capable of responding to this level of complexity and unpredictability is therefore more challenging than many assumed.

It seems likely that by 2050 the technology will be there, but the world is currently a lot further

from this reality than many people realise.

Furthermore, too many people have focused on technological feasibility and ignored the importance of other factors such as regulatory frameworks and moral dilemmas.

It's arguably impossible to programme an artificial intelligence programme to respond to a situation such as the trolley dilemma, as it involves making a moral judgement.

Also not known is if a driverless vehicle were to be involved in accident, what the insurance implications would be. There might be a point where our cities are full of fully driverless vehicles, but there are many hurdles to overcome along the way.

Public transport

More buses on the roads would make sense both from an environmental point of view, but also for reducing traffic. In the UK, there has been a steep decline in their use since 1950.

Several factors suggest there could be an increase in public transportation, whether that be trains, buses or something else. Growing urbanisation, other factors being equal, should imply a growing demand.

Government policies that discourage the use of cars could also help underpin the return of the bus or tram. This can be seen in many cities.

In Paris, for example, the authorities are aiming to ban private cars from its historic centre by as early as 2024. Technologies that provide more information to the public to allow them to make better use of public transport are also being introduced.

However, there are other factors that are pulling in the opposite direction. The same technologies that will give the public better access to information about trains and buses will also give them more information about things such as ride pooling options. Whether or not an increase in ride pooling will cannibalise public transport's passengers and revenues is open to debate, but it is a factor in the equation.



The focus of autonomous vehicles has shifted to long-haul trucking



Government policies can encourage the use of buses and trams

At the same time, if more members of the population continue to work from home, it could reduce demand for public transport despite increases in population.

Engineering

For parts suppliers, it is easier when a customer comes and puts a specification on the table. It is more difficult to design something that is generic. A good example is a collapsible steering column for last-kilometre delivery vans.

Rather than responding to a specific set of customer requirements, it can be better to develop a generic column. Doing this involves looking to the future and anticipating the types of components expected to be in higher demand in future.

The column that was developed is therefore compact and lightweight, designed for last-kilometre delivery vehicles and electric vans. This means when a customer comes with an enquiry in future, there is already something available as a starting point.

However, there is always the risk of designing something in anticipation of future demand, without knowing whether that demand will materialise, or what the exact requirements will be. Companies therefore have to keep scanning the horizon of the future, assessing which ideas will make the leap from science fiction to reality and what role engineering can play in that.



Roger Brereton is head of sales at Pailton Engineering

ON THE ROAD

MAXIMISING MINI

BMW uses technology to enhance user experiences on future Mini models



Experience modes connect drivers and vehicle

German car maker BMW is taking history-rich British brand Mini into the digital age with its latest model family. At the heart of the action is the iconic central instrument – the Mini interaction unit.

The round OLED display, with its 240mm diameter and rich colours, is positioned within the cabin so it can be used comfortably by the driver and front passenger.

"We are taking a massive leap into the digital world with the new Mini family and, in so doing, underscoring the charismatic heritage of the brand," said Stefanie Wurst, head of the Mini brand. "The iconic central display in the new Mini family is round and will be filled with round content for the first time. I am convinced that the digital power of the new models will delight Mini customers around the world."

Frank Weber, BMW board member, added: "We are presenting our all-new Mini family with a unique technology package. It is based on the latest tech stack from BMW and brings a very specific Mini flavour to signature brand-defining functions such as the experience modes and the voice assistant. The result is a display of cutting-edge digital fireworks with a sharp eye for detail."

The Mini Operating System 9 has a Mini-specific, emotionally engaging design optimised for touch control. It is an in-house development by BMW and is based for the first time on an Android open-source project software stack.

Up to eight experience modes provide an immersive driving experience through the orchestrated use of light, user interface designs, drive settings and sound. An optional light projector on the back of the interaction unit bathes the dashboard in colours and patterns to match the experience mode selected. The presentation of content in the optional head-up display is also adapted accordingly.

The acoustic repertoire comprises new driving sounds in the interior, a distinctive Mini brand sound to mark the identity of the car from the outside, jingles for the experience modes and 30 new sound signals with information and warning functions.

The intelligent personal assistant is activated by saying "Hey Mini" and can be used with the Mini or Spike visualisations. The personal assistant lets users control important functions by voice, enables travel-related requests or wishes, and recognises whether it is the driver or front passenger speaking.

The cloud-based navigation system provides fast and precise route calculation. The latest map data are always streamed live into the vehicle. And charging-optimised route planning means drivers of fully electric Minis can take longer journeys with peace of mind.

The augmented view option offers drivers a live video stream in the interaction unit, with extra information added for orientation for navigating. Users can choose from various map designs and activate a visualisation option featuring 3D buildings.

A connected store provides optional access to a wide and evolving range of practical and entertaining apps, such as AirConsole gaming, music and video streaming.

The optional Digital Key Plus offers the driver flexible access to the vehicle, without having to take their smartphone out of their pocket. The key can be passed on to other people digitally using the sharing function.

Mini vehicles now receive regular free improvements via over-the-air software updates. Depending on the country, vehicle model, equipment and vehicle condition, users may even receive additional functions or improvements free of charge.

The design language is reflected in the aesthetic of the user interface, which brings together functional and emotional elements. The reduced design uses graphics to create a modern look. Static and dynamic elements blend naturally into the circular form of the OLED display. Micro-animations enhance the intuitive interaction between the driver and central instrument.

At the centre of the screen is the start menu, where personalised content can be selected and launched by swiping to the side. In the lower section of the screen is the fixed status bar containing the menu items navigation, media, telephony, all apps and, depending on the situation, home, which can be selected directly. Swiping up from the lower edge of the screen reveals a tool belt, a process similar to many consumer electronics devices.

Favourite functions can be stored here and called up again rapidly, such as navigation destinations and radio stations. The tool belt can also be activated via the star button on the multifunction steering wheel.

The upper screen area is reserved for driving-relevant content such as the vehicle speed and information on vehicle status. The optional head-up display shows the most important information for the driver in their field of view.

The temperature for the driver and front passenger is permanently displayed on the left- and right-hand edge of the screen. The climate control settings are integrated into the interaction unit and can be adjusted on the top layer by touch or voice command.

Depending on the experience mode, a tap on the speed display transforms the entire interaction unit into a Mini-typical speedometer.

Modes

The emotional connection between the Minis and their drivers steps up intensity with the experience modes. Standard specification includes the Core, Green and Go-Kart modes, each of which has its own user interface design.

The experience modes can optionally be taken to the next level by the coordinated use of light and sound. Drivers can immerse themselves in up to eight different worlds in the interior thanks to the modes, with a distinctive jingle for each mode indicating it has been activated.

The interaction unit displays different designs and content according to the mode selected.

An optional projector on the back of the OLED display bathes



Experience modes add coordinated use of light and sound

the dashboard in coordinated colour worlds and patterns. The interplay of the projection, ambient lighting and interaction unit creates an immersive experience that extends into the door trim.

A particular highlight is personal mode, which breaks ground in terms of personalisation and adjustability. It allows users to turn their own pictures from their smartphone gallery into the background for the interaction unit using the Mini app. The ambient lighting is set automatically in a colour that matches the picture selected.

The colour design in the optional head-up display likewise adapts to the experience mode selected.

In the foreground when core mode is selected is the main menu with the Mini widgets.

Sound

The brand-typical soundscapes of the family are also part of the digital user experience. The spread of options includes all-new driving sounds in the interior, an unmistakable Mini brand sound to confirm the car's identity from the outside, jingles for the experience modes and 30 new sound signals with information and warning functions.

The sounds bring extra emotional appeal to the interior. They provide the cars with a distinctive, Mini-typical identifying feature on an acoustic level. The first users to experience the sounds will be drivers of the new Mini Cooper Electric.

The experience modes provide the stage on which the soundscapes are performed. Familiar Mini sounds conveying information while also sparking emotions are generated using analogue instruments, digital technology and artificial intelligence. These modes deliver immersive driving experiences.

Assistant

This is the first time a full-capability voice assistant will be included in models from the Mini brand. The intelligent personal assistant can be activated using the greeting "Hey Mini" or by pressing the push-to-talk button on the steering wheel.

The voice-controlled interaction on the circular OLED display takes place in the form of an animation made up of graphical elements, typography and an avatar. For the visualisation, users can choose between Mini – a stylised representation of a Mini – and, optionally, Spike, a familiar figure to many Mini fans.



Personal assistant is activated by saying "Hey Mini"

Functions such as navigation, telephony, radio and temperature can be controlled by voice command. The driver can make travel-related requests or wishes, such as "What's the weather in...?" and "Show me charging stations along the route".

If someone says "I'm hungry" or "I'd like a coffee", relevant options in the vicinity are displayed and route guidance to the destination can be started directly. Two microphones in the front detect automatically whether it is the driver or front passenger speaking.

The brand-typical character of the personal assistant can be experienced through chit-chat, which will bring up Mini-specific answers, jokes and stories.

In the UK, the assistant will be based on the Alexa technology stack at market launch, allowing it to engage in natural dialogue with the driver with a brand-defining voice. In other markets, the voice and other features also enabled by using Alexa will be introduced at a later stage over the air.

Navigation

The cloud-based navigation system provides intuitive destination entry. It enables fast and dynamic route calculation based on real-time traffic data transmitted at short intervals, which is then combined with forecasting models.

When the navigation app is selected, the map takes up the entirety of the circular display. The colour scheme for the map graphics changes to match the selected experience mode, while buildings can be shown in 3D.

In all-electric models, as soon as the destination has been entered, a charging-optimised route will be calculated if the vehicle's range is not enough to reach the destination. Both the calculation algorithm and the speed of calculation for charging-optimised routes are subject to a process of constant improvement.

Information for the charging stops is displayed in the route overview, such as the estimated state of charge upon arrival, recommended charging time and target state of charge for the onward journey.

Live data are processed during the journey, allowing charging stations to be automatically added to the itinerary if any of the stations originally planned for charging stops no longer have availability. The driver is also offered alternative charging-optimised routes, where available.

The optional augmented view improves navigational guidance. It provides a complement to the navigation system's instructions in crucial situations. For this, a live video stream from the driver's perspective is shown on the interaction unit and augmented by supplementary information that matches the context.

At confusing junctions, for instance, an animated directional arrow is integrated into the video image to help the driver take the best turn-off for the planned route. Information on applicable local parking regulations also appears in the live video stream in augmented reality form.



Engineers test all-new driving sounds

Further navigation functions such as precise visualisations of lane guidance are part of the optional connected package.

Entertainment

Following its introduction in BMW models, a form of in-car gaming unique in the automotive sector now also awaits users of the Mini. For example, the driver and passengers can play casual games in the AirConsole app when the vehicle is stationary as a way of passing time while waiting for the high-voltage battery to recharge.

All players need is their smartphone, which acts as the controller, and the interaction unit. Once the app has been launched in the vehicle, the smartphone and car can be connected by scanning a QR code on the OLED display. Players can then get straight down to the action.

The technology enables games to be made instantly available over the air and controlled using smartphones. This set-up means multiple players – including passengers in the rear – can get involved in the in-car gaming during breaks in the journey.

The games offered are casual games, so called because they are easy to pick up with intuitive control of gameplay. A range of racing, sport, general-knowledge quiz and music quiz games are available, along with simulation, strategy, jump-and-run and puzzle games, with titles including Go-Kart Go, Golazo, Music Guess and Overcooked.

Music streaming apps such as Spotify have been adapted so they integrate into the circular interaction unit. The user's Spotify account can be connected by scanning a QR code.

Apple CarPlay and Android Auto are included as part of the operating system for connecting smartphones wirelessly.

High-side switches enable modern EE architectures

Low ohmic high-side switches from Infineon target modern EE vehicle architectures where partial or complete electrification of the primary and secondary power distribution must be taken into account.

The Power Profet +12V switches come in a TO-leadless package allowing for different mounting locations and enclosure options, enabling decentralised power architectures with high efficiency.

Two variants are available: the BTS50005-1LUA has an on-resistance ($R_{DS(ON)}$) of 0.6mΩ; and the BTS50010-1LUA an $R_{DS(ON)}$ of 1.0mΩ.

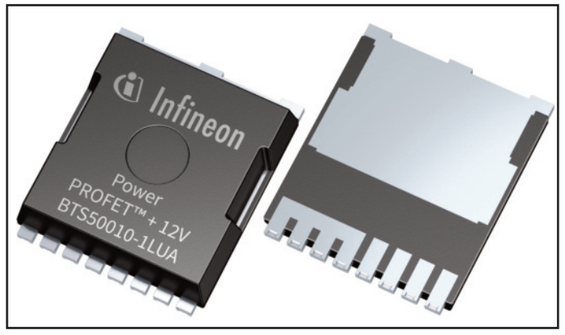
They can control high inrush current applications in hot cabin and engine compartment environments such as in heaters, pumps and fans. They provide more than a million switching cycles compared with, for example, an average 200,000 switching cycles of a relay.

The switches can replace electromechanical relays, fuses and discrete circuits in power distribution boxes and other applications up to 65A in a 12V electrical system.

Built-in protection and diagnostic functions include short-circuit, over-current and over-temperature protection. They provide a fault signal via the diagnosis enable pin to a connected microcontroller for diagnosis in power distribution modules. They can prevent failure modes in the power board net.

An eight-pin TO leadless package, reduces the footprint by 23 per cent compared with D2Pak while providing similar thermal performance.

The accuracy of the load current sense has been improved down to five per cent and can be evaluated by reading an analogue voltage on the IS pin.



In addition, the family is Pro-SIL ISO 26262-ready and comes with a safety application note supporting the evaluation of hardware elements.

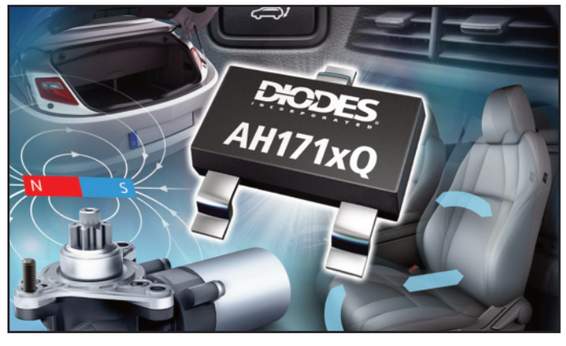
To enable an easy design-in process, they are integrated into the firm's smart power switches intrinsic fuse and kilis tools.

The fuse tool helps calculate the intrinsic fusing characteristic based on the embedded over-temperature protection of the selected product under certain boundary conditions. The kilis tool is used for calculating and visualising the range of the sense current for specific load currents on the selected product, taking the kilis rate, sense resistor and ADC tolerances into account.

Hall latches allow sensitive sensing

Low-voltage Hall latches from Diodes enable high-sensitivity sensing in automotive motor control.

The AH171xQ devices are for brushless DC motor commutation speed measurement, angular or linear encoders, and position sensors.



Device options provide three high-sensitivity BOP and BRP settings of ±7, ±18 and ±50Gauss with tight operating windows to provide accurate, reliable switching points.

These latches have a 30kHz sensing bandwidth to support higher rotational speed-sensing. They offer protection against ESD, 8kV human body model and 2kV charge device model.

AEC-Q100 grade 0 qualified, they have a chopper-stabilised architecture and an internal regulator with temperature compensation. They operate across the 2.4 to 5.5V supply range and the -40 to +150˚C temperature range.

BLE modules monitor tyre pressure

Bluetooth LE modules from RF-Star are based on TI's CC2340 MCUs for automotive as well as smart home, medical device and industrial sensor applications.

The CC2340 family includes CC2340R5 and CC2340R2 versions, providing integrated wireless connectivity with support for Bluetooth 5.3 Low Energy, Zigbee and proprietary 2.4GHz protocols.

The CC2340R2 MCU provides 256kbyte flash, 28kbyte sram and 12 IO pads, while the CC2340R5 has 512kbyte in-system programmable flash, 36kbyte low-leakage sram and up to 26 IO pads.

Both share the same MCU architecture to support OTA and a selection of peripherals communication interfaces such as uart, SPI, I²C, timer, temperature sensor, battery monitor, analogue comparator and analogue-to-digital converter.

The modules have a standby current of less than 710nA. Up to ten years of service life on a coin cell battery can be achieved in wireless applications such as tyre pressure monitoring systems (TPMS).

Output power is up to +8dBm and receiving sensitivity is -102dBm.

The different RF output modes, such as half-hole Ant RF pin and Ipex connector, enable different applications with a choice of antenna.

An integrated RF balun enables a simpler design with fewer external components.

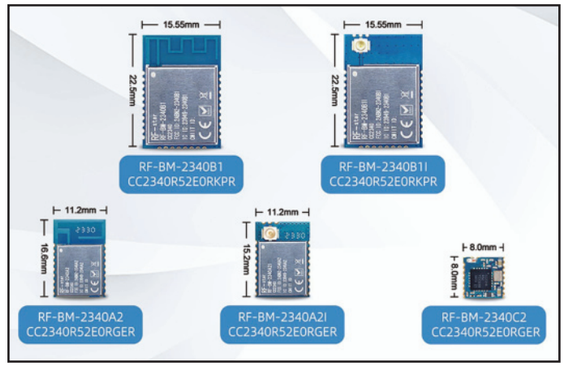
They can operate from -40 to +85˚C, and meet AEC-Q100.

The RF-BM-2340Ax BLE5.3 module based on the CC2340R5 is available in a 16.6 or 15.2 by 11.2mm stamp half-hole package, and the RF-BM-2340Cx module based on CC2340R2 uses an 8 by 8mm stamp half-hole package.

In automotive, they can be used for TPMS or passive entry and passive start (peps) systems.

Wake-up methods include timer and external GPIO.

They are compatible with mobile phone Bluetooth, providing compatibility test reports and related test tools accordingly.

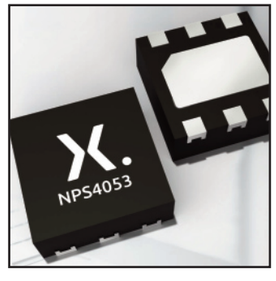


Load switch improves safety

A high-density load switch IC from Nexperia is for automotive infotainment systems, notebook computers, desktops and docking stations.

The NPS4053 can help increase system reliability and ensure safety.

Load switches are essential in the operation of a wide array of modern electronic systems. They play a crucial role in managing current and voltage in a controlled manner from source to the load.



In a typical power chain, the load switch is usually positioned closest to the load for power sequencing and inrush-current control, and shutting off power islands to conserve power, making it useful in battery-operated equipment.

This monolithic device simplifies circuit design and has an 85% smaller PCB footprint than a comparable network of discrete components.

Input voltage is 2.5 to 5.5V and it contains a 55mΩ self-protected mosfet, which manages the flow of power to the load.

Programmable current-limiting circuitry allows precise control of the load current over a range of 110mA to 2.5A with an accuracy of +6%. The device also supports true reverse current blocking, providing end-to-end system protection.

To enhance system monitoring, a fault indicator pin alerts the host controller of a fault event.

The device is UL 62368 recognised and an automotive AEC-Q100 qualified version is available.

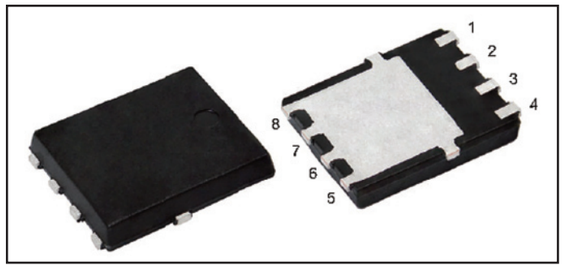
It comes in leaded and leadless (HWSON 6) packages.

Rectifier and TVS in one package

A combined standard rectifier and transient voltage suppressor (TVS) from Vishay comes in a surface-mount package for automotive applications.

Featuring an oxide planar chip junction design and a common cathode circuit configuration, the R3T2FPHM3 combines a 3A, 600V standard rectifier with a 200W Transzorb TVS in a FlatPak 5x6 package.

With a temperature range from -55 to +175˚C, the device is suitable for high reliability automotive applications, including secondary protection for sensor units, distributed airbag modules, and low power DC-DC converters in power distribution systems.



By combining two technologies in a single package, the dual-chip device saves PCB space, simplifies layouts and lowers overall costs. When paired in series with a standard TVS, it offers designers a complete >24V option with a low clamping ratio.

The two-in-one device's rectifier has a forward voltage drop of 0.86V to reduce power losses and improve efficiency, while its TVS offers a breakdown voltage of 27V.

It provides ESD capability in compliance with IEC 61000-4-2, air discharge and contact mode; offers a MSL moisture sensitivity level of one, per J020, LF maximum peak of +260˚C; and its moulding compound features a UL94 V-0 flammability rating.

RoHS-compliant and halogen-free, the device is available as an AEC-Q101 qualified version.

SM diodes

Automotive-grade 400W TVS diodes from Littelfuse come in surface-mount packages.

The SZSMF4L protect sensitive systems with fast response time, low Zener impedance, high surge handling, and clamping capabilities. Its low leakage current is suitable for protecting sensors.

Applications include EV powertrains, on board charging, battery management systems, EV invertors, power distribution units, domain controllers, zone controllers, body control modules, and low leakage current for sensor protection.



They come in a SOD-123FL TVS diode package with both uni- and bi-directional protection. The package is compatible with automated PCB assembly processes.

Working peak reverse voltage range is unidirectional 5 to 78V and bi-directional 10 to 78V. Operating temperature is up to +175˚C.

The diodes are available in tape and reel packages of 1500 and 5000.

Non-volatile memory with I²C

Evaluation samples are available of Fujitsu's MB85RC512LY automotive-grade I²C-interface 512kbit Fe-ram

The non-volatile memory has 512kbit memory density and operates at a power supply voltage from 1.7 to 1.95V. Maximum operating current is 0.4mA at 3.4MHz.

This product guarantees ten trillion read-write cycle at +125˚C.

It is optimal for industrial robots and automotive applications such as adas.

Those using an I²C interface for their platform do not need major design modifications in developing an end-product by using the memory parts.

The automotive-grade family has variations of 3.3 and 1.8V operation for I²C and SPI interface versions.

Seven AEC-Q100 compliant products have been added in the last year. In addition, four 1Mbit products are under development.

Fujitsu believes that the required memory density needs to be varied because applications are diverse.





TVS diode

Rutronik has added the Yageo TVS diode series 5.0SMDJ to its portfolio of qualitative surge protection components.

They use a DO-214AB package, which with the power handling capacity of the diodes ensures higher protection.

They have a short response time, and absorb high voltage peaks to prevent failures or system malfunctions. The series includes uni- or bidirectional variants and certified automotive versions.

With built-in strain relief and passivated glass junction, the 5kW diode is in a low-profile plastic housing. The operating voltage of the TVS ranges from 5 to 600V, or higher.

Typical IR is less than 2μA. The terminals tolerate high-temperature soldering at +260˚C for 10s.

The diodes meet MSL 1 according to J020, enable compliance with IEC 61000-4-2 ESD protection of up to 30kV air and contact discharge, and are available in automotive grade with AEC-Q101 qualification.

Interfaces support 10baseT1S

Vector is supporting the 10baseT1S standard in its VN5650 and VN5240 Automotive Ethernet interfaces.

Existing Vector Ethernet interfaces can also be upgraded to 10baseT1S capability via a physical layer module. This provides the user with support for simulation, analysis and testing of 10baseT1S and 100 or 1000baseT1 networks.

For the user, 10baseT1S support in the Automotive Ethernet environment is provided by modularising the VN5650 and VN5240 with the VNmodule60 physical layer module. This enables 10baseT1S and 100/1000baseT1 in parallel.

For remaining bus simulations with Canoe Ethernet, messages from several simulated ECUs are sent to the bus via multi-drop line with cycle accuracy via a 10baseT1S port on the VN5650.

For analysis with Canoe, exact receive and transmit time stamps, error states and statistics are displayed as usual.

In addition, direct access to the 10baseT1S multi-drop line is available for testing.

The 10baseT1S ports can be combined with other Ethernet standards via the switches and taps available on the device. This allows easy media conversion from standard Ethernet to 10baseT1S.

In addition, physical layer modules for 2.5G, 5G and 10GbaseT1 will soon be available that can be flexibly combined with the physical layer standards 10baseT1S, 100baseT1 and 1000-baseT1.



MCU meets AEC-Q100 grade two

Artery has launched its first automotive grade MCU.

The AT32A403A is for automotive body control, adas, car audio and video, and battery management system (BMS) applications. It is certified to AEC-Q100 grade two, and operates from -40 to +105˚C.

Powered by a 32bit Arm Cortex-M4 core, it embeds a single precision floating-point unit (FPU) and uses a 55nm process to achieve 200MHz speed. Memory design supports up to 1Mbyte flash and 224kbyte sram, with one external memory controller and an SPIM interface for up to 16Mbyte of external SPI flash.

There are up to three I²Cs, four SPIs, two SDIOs, eight usarts or uarts, one USBFS and two Cans.

It also has three 12bit 2MS/s ADCs and two 12bit DACs for data acquisition and transmission, and up to eight 16bit general-purpose timers, two 32bit general-purpose timers and two 16bit timers for automotive motor control.

The three low-power modes are sleep, deep sleep and standby, with a 2.6 to 3.6V power supply.

During SPI NOR flash programming, programmes and data to be programmed are encrypted by MCU internal hardware.

Interface material suits thin bond lines

A thermal interface material from Parker Hannifin is for use in very thin bond lines.

Therm-A-Gap Gel 50TBL is a dispensable thermal gel that offers 5W/m-K bulk thermal conductivity.

At a minimum bond line thickness of 0.05mm, the apparent thermal conductivity exceeds 10W/m-K.

With a TBL suffix that stands for thin bond line, the thermal gel needs no mixing or secondary curing, supporting simple application and the potential to undertake rework.

The product has a flow rate of 25g/min using a 30cc syringe with 2.5mm orifice at 621kPa.

It requires low compressive force to conform under assembly pressure, ensuring components, solder joints and leads encounter few stresses.



The formulation is said to accommodate today's high-performance and high-reliability electronic demands, while being suited to automated dispensing machines and field repair situations.

The gel offers low thermal impedance and avoids any pump-out effect with temperature changes.

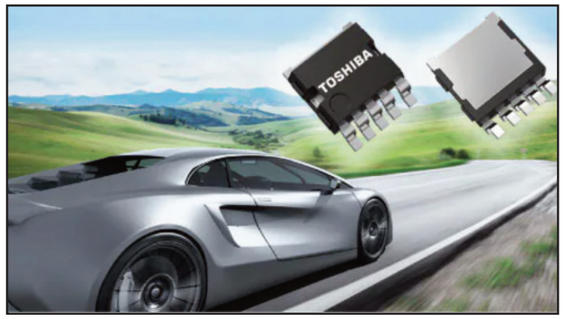
Applications include automotive ECUs, as well as telecommunications base stations, consumer electronics, power supplies, semiconductors, LEDs, microprocessors and graphics processors.

The material is primarily for thin bond lines and is not typically intended for use as a filler in gaps larger than 0.50mm.

Electrical properties include: 200V AC per millimetre dielectric strength; 1014Ωcm volume resistivity; 7.0 dielectric constant at 1000kHz; and 0.002 dissipation factor at 1000kHz.

RoHS-compliant, the material can operate at temperatures from -55 to +200˚C.

The gel is available in syringe, cartridge and pail containers, offering standard fill volumes from 10 to 2500cc.



Package boosts heat dissipation

Two automotive 40V n-channel power mosfets use Toshiba's S-TOGL (small transistor outline gull-wing leads) package with U-Mos IX-H process chips.

The XPJR6604PB and XPJ1R004PB use the 7.0 by 8.44mm package, which has a post-less structure unifying the source connective part and outer leads. A multi-pin structure for the source leads decreases package resistance.

Combining package and process achieves an on-resistance reduction of 11% against the firm's TO-220SM(W) package, which has the same thermal resistance characteristics. The package also cuts the mounting area by approximately 55%.

On top of this, the 200A drain current rating is higher than the similarly sized DPak+ package at 6.5 by 9.5mm, enabling high current flow.

Overall, the S-TOGL package realises high-density and compact layouts, reduces the size of automotive equipment, and contributes to high heat dissipation.

Since vehicle equipment is used in extreme temperatures, the reliability of surface mounting solder joints is critical. The package uses gull-wing leads that reduce mounting stress, improving the reliability of the solder joint.

Assuming multiple devices will be connected in parallel for applications requiring higher-current operation, it supports grouping shipment for the products, in which the gate threshold voltage is used for grouping. This allows designs using product groups with small characteristic variation.

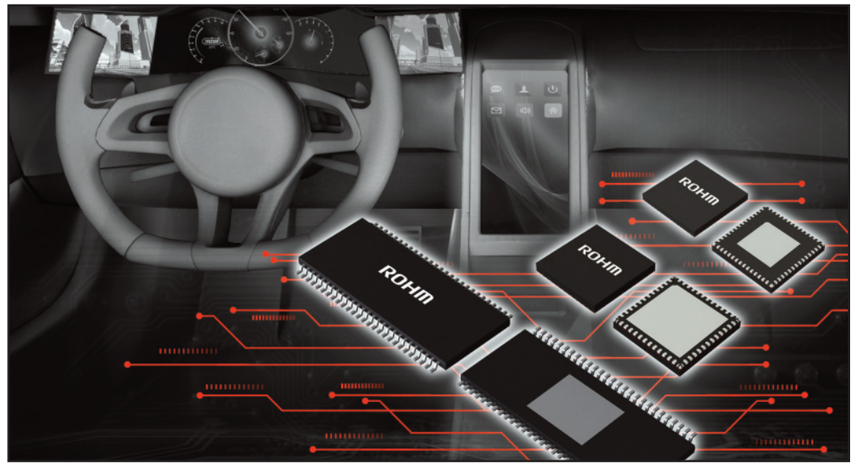
Applications include inverters, semiconductor relays, load switches and motor drives.

Driver ICs suit LCD backlights

LED driver ICs from Rohm suit automotive LCD backlights.

The BD94130 MUF-ME2 and EFV-ME2 support large displays increasingly being used in car infotainment and instrument clusters.

These products can control more zones than conventional ICs, making it possible to reduce the mounting area by reducing the number of LED drivers required.



The matrix LED drivers combine an eight-line switch controller with 24-channel current driver, allowing control (dimming) of up to 192 zones for backlighting with a single IC. The mini-LEDs in each zone can be independently adjusted by using a local dimming function, contributing to larger contrast ratio, lower power consumption displays.

For example, with mainstream 25.4cm infotainment displays with around 600 zones, they enable operation with one-fourth the number of LED drivers than existing 48-zone products, decreasing LED driver mounting area by 84%.

This advantage will only increase as screens become larger and the number of zones rises.

The drivers combine a 24-channel current driver with a switch controller that can be divided into up to eight lines. The number of switch controller lines can be selected from three patterns – four, six or eight – via register settings, supporting various specifications based on the number of zones and LED current consumption.

A built-in feedback control function maintains a constant feedback voltage independent of LED temperature characteristics, reducing thermal design hours along with loss ratio.

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

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

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

Published by: Vehicle Electronics Magazine, 72 Westwood Road, Nottingham NG2 4FS, UK

Web site: vehicle-electronics.biz
Twitter: @velectronicsmag

© 2023 Vehicle Electronics
ISSN 2055-1177

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