VEHICLE electronics

The monthly magazine for automotive electronics engineers

Peugeot and FCA merger targets autonomous mobility

The proposed merger of Peugeot and Fiat Chrysler aims to create a global group with the scale to tackle connected, electrified, shared and autonomous mobility.

The group will be owned 50% each by Groupe PSA and FCA shareholders. It aims to leverage its R&D footprint and ecosystem to foster innovation.

The combination would create the fourth largest global OEM in terms of annual unit sales at 8.7m vehicles, combined revenues of nearly €170bn and recurring operating profit of over €11bn.

The merged entity would bring together the companies' capabilities in the technologies shaping sustainable mobility, including electrified powertrain, autonomous driving and digital connectivity

No plant closures are planned resulting from the transaction.

The board will be composed of 11 members. Five board members will be nominated by FCA, including John Elkann as chairman, and five would be nominated by Groupe PSA, including the senior independent director and the vice chairman.

Chief executive officer will be Carlos Tavares for an initial term of five years and he will also be a member of the board.

"This convergence brings significant value to all the stakeholders and opens a bright future for the combined entity," said Tavares.

Gero Decker, CEO and co-founder of business transformation provider Signavio, added: "We've all seen the disruption and decline of automotive manufacturing in some countries. The big players in the automotive sector know they have to move fast in order to survive. The winners will be the ones who can recalibrate and remain competitive in an age where process automation and innovation will be the key drivers of growth."



PSA is to merge with FCA

Issue 71
November 2019

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VW sets up autonomous driving subsidiary

Volkswagen has established a subsidiary to act as a centre of excellence for autonomous driving.

Called Volkswagen Autonomy (VWAT), it will be under the direction of Alexander Hitzinger, senior vice president for autonomous driving in the Volkswagen Group.

VWAT will bundle group activities for developing self-driving systems from level four.

VWAT will have headquarters in Munich and Wolfsburg. Another subsidiary in Silicon Valley will follow in 2020 and a further subsidiary is planned for China in 2021.

The plan is to build up know-how within the group and bring a self-driving system to market maturity.

"We want to establish Volkswagen Autonomy as a global technology company where we bundle expertise from the automotive and technology industries, combining the agility and creativity of a high-performance culture with process orientation and scalability," said Hitzinger. "We will continue to use synergies across all group brands to reduce the cost of self-driving vehicles, high-performance computers and sensors. We plan to start commercialising autonomous driving at a large scale around the middle of the next decade."

The first applications are planned in the commercial sector such as robotaxis and robo vans.

More than half the staff will be employed in Munich and Wolfsburg. Munich was chosen as the group's Autonomous Intelligent Driving is already headquartered there. The site will also become the European headquarters of Argo AI. Silicon Valley was selected due to its proximity to Argo AI. Plus, California legislation offers favourable conditions for self-driving systems.

Rohm sponsors Formula Student



Rohm will be active in Formula Student Electric & Driverless as the company has signed a sponsoring contract with Team Starcraft of the Technical University Ilmenau in Germany. As part of the cooperation, Rohm will provide students with products from its portfolio for the development of their vehicles. The team will also receive financial support.

In Formula Student, university teams compete in an international design and racing competition that is not just about speed. The goal of every team is to achieve the optimal overall package of construction, performance, and financial and sales planning.

Formula Student is divided into three classes. In addition to classic combustion vehicles and modern electric vehicles, there has been a class for autonomous vehicles since 2017.

With this cooperation, Rohm wants to prove the application possibilities and advantages of its products in the automotive sector.

"It's nice to see how much heart and soul the students put into their work," said Toshimitsu Suzuki, president of Rohm Semiconductor in Europe. "Rohm is proud to support the next generation of top engineers and contribute to the mobility of tomorrow."

Hyundai pilots autonomous vehicle service in California



Hyundai autonomous vehicle in California pilot

Hyundai, in collaboration with Pony.ai and Via, has unveiled BotRide, a shared, on-demand, autonomous vehicle service operating on public roads in California.

Starting this month, a fleet of self-driving Hyundai Kona Electric SUVs will provide a free ride-sharing service to the local community in Irvine, California.

"The pilot introduces BotRide to several hundred Irvine residents, including college students," said Christopher Chang, head of business development at Hyundai Motor. "The goal is to study consumer behaviour in an autonomous ride-sharing environment. We are going to learn about ecosystems, where the vehicles travel and optimise the customer experience."

Hyundai partnered with Pony.ai to build the self-driving system and with Via to create the BotRide on-demand ridesharing technology and application. Using the BotRide app on iOS or Android, riders can hail an autonomous Kona Electric SUV directly from their smartphone.

Via's algorithms let multiple riders share the same vehicle, outfitted with Pony.ai autonomous vehicle technology. The app directs passengers to nearby stops for pick up and drop off.

Integrated Hyundai and Pony.ai technologies enable the vehicles to navigate complex road scenarios safely. These vehicles are equipped with Pony.ai's sensor hardware and proprietary software to identify the precise position of surrounding vehicles, handle pedestrian traffic in urban areas, monitor its surroundings, predict the behaviour of other road users, and precisely plan actions accordingly.

The car launches with multiple popular destinations where a passenger may hail a ride using the app. The service area covers several residential, commercial and institutional points of interest. The technology prioritises passenger-to-system interactions such as automated onboard passenger verification, giving riders the chance to familiarise themselves with technologies expected to become commonplace in the future.

"Through BotRide, Hyundai is leveraging cutting-edge autonomous vehicle and mobility technologies to introduce a new, safe and convenient form of transportation to the public," said Daniel Han, manager at Hyundai Motor. "The BotRide pilot represents an important step in the deployment and eventual commercialisation of a growing mobility business. In addition to the technology partners powering BotRide, the broader city and community ecosystem have also played an important role in making BotRide possible. The pilot can serve as an example of how cities and companies can come together to truly enable smart cities and smart transportation systems of the future."

The pilot will run till the end of January.

Synopsys and Samsung Asil work

Synopsys is collaborating with Samsung Foundry to deliver automotive chip designs that meet target safety integrity levels (Asils) for autonomous driving and adas.

Samsung Foundry and Synopsys have enabled Samsung's automotive reference flow to meet target Asils for safety-critical designs. Developed based on its 8LPP process, Samsung 's automotive reference flow has been tuned to deliver benefits on various process technologies.

Synopsys' designs deliver complex functional safety analysis, implementation and verification capabilities. Differentiated offerings for automotive design, such as unified functional safety verification and native automotive options, help designers prove at the planning and implementation phases that their chip safety architecture can achieve target Asils.

Audi and STM collaborate on exterior OLEDs

ST Microelectronics is collaborating with Audi to conceive, design, industrialise, manufacture and deliver automotive exterior OLED lighting.

The first demonstration of this was the showing of digital OLED technology by Audi at the recent International Symposium on Automotive Lighting (ISAL) in Germany.

The parties plan to release this technology in future Audi cars.

STM joined Audi's semiconductor programme in 2012, with the relationship initially focusing on reducing CO_2 emissions, safety, security, infotainment and comfort.

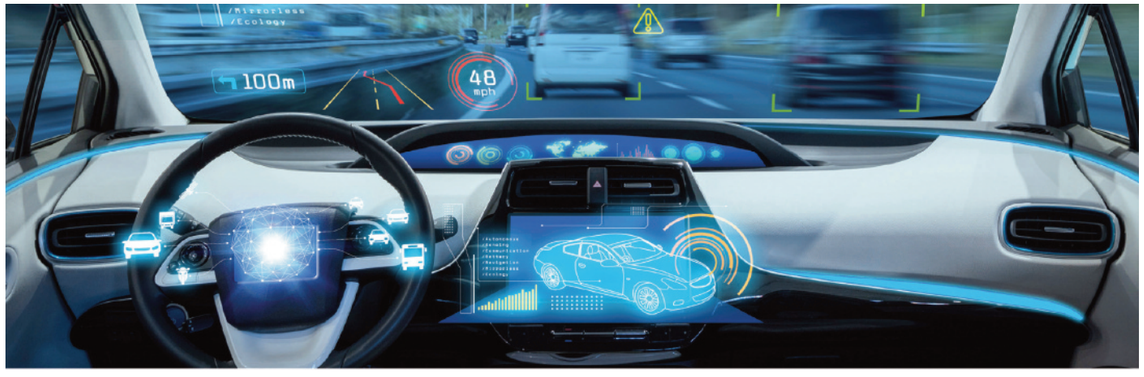
The current cooperation builds on Audi's creativity in automotive lighting and STM's expertise in automotive semiconductors, specifically controllers and drivers for automotive lighting.

The next lighting design should enable more customised and animated lighting patterns, by controlling and diagnosing hundreds of individual OLEDs. In addition to the flexibility to give design styling to Audi cars, the animated patterns will provide additional value in safety to customers.

"With Audi's long history of innovation and success in the premium automotive market, it was important to work with a semiconductor company who could bring their expertise in converting our ideas into robust, reliable chips that would meet our customers' demanding expectations," said Klaus Büttner, EVP of Audi.

In the ISAL demonstration, STM contributed a complete plug-and-play system to control and continuously adjust the brightness of individually energised OLED pixels by a high-speed automotive communication layer, adapted by STM for lighting architecture and embedded in the actuator IC.

"Having worked closely with Audi for many years, STM has had the opportunity to lend our expertise, customer focus and manufacturing reliability to many products in their outstanding vehicles," said Marco Monti, president of STM's automotive and discrete group.



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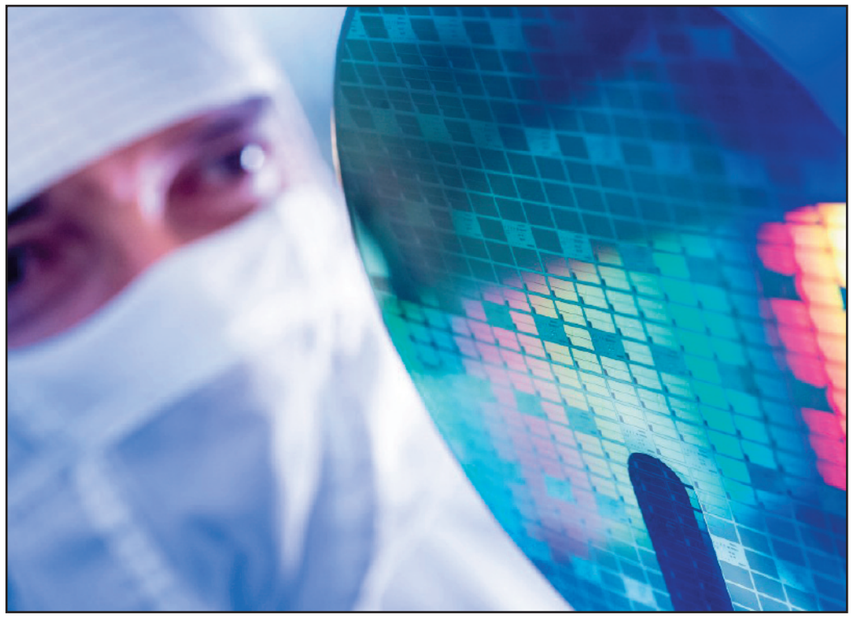
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Bosch develops SiC for EVs

Bosch has developed silicon carbide (SiC) semiconductors as it aims to make electric cars more efficient.

The company says the microchips it has developed have better electrical conductivity than the silicon it has used to date. This should enable higher switching frequencies while also ensuring that much less energy is dissipated in the form of heat.



SiC wafer from Bosch

"Silicon carbide semiconductors bring more power to electric motors," said Harald Kröger, member of the Bosch board of management. "For motorists, this means a six per cent increase in range."

Bosch is making the chips at its Reutlingen plant, 40km south of Stuttgart.

The company said this would address one of the stumbling blocks for potential buyers of electric cars: 42 per cent decide against buying an electric vehicle because they are afraid the battery will run out while they are on the road. In Germany, this anxiety is even more prevalent, affecting 69 per cent of consumers.

Alternatively, SiC lets car manufacturers make the battery smaller for a given range. This reduces the cost of an electric car's most expensive component, which in turn reduces the vehicle's price.

"Silicon carbide semiconductors will transform e-mobility," said Kröger.

The technology also offers further potential savings down the line: the lower heat losses of the chips, combined with their ability to work at much higher operating temperatures, mean manufacturers can cut back on the expensive cooling of the powertrain components. That has a positive impact on electric vehicles' weight and cost.

With this SiC technology, Bosch says it is systematically expanding its semiconductor know-how. The company will be using the SiC semiconductors in its own power electronics in the future.

Bosch says it is the only automotive supplier that also manufactures semiconductors.

"Thanks to our deep understanding of systems in e-mobility, the benefits of silicon carbide technology flow directly into the development of components and systems," Kröger said. "Our semiconductor know-how helps us not only to develop new automotive functions and IoT applications but also to continuously improve the chips themselves."

Turning the SiC wafers into semiconductor chips involves a manufacturing process that can last up to 14 weeks. In several chemical and physical processes, the wafers acquire ultra-fine structures that will subsequently make up the tiny chips, each of which measures just a few millimetres.

"Semiconductors are a core component of all electrical systems," said Kröger. "They are also turning data into a coveted raw material of the future. As they become increasingly important in our fields of activity, we want to continuously expand our manufacturing operations."



Self-driving technology start-up raises $50m

Chinese and American self-driving technology start-up DeepRoute has raised $50m in its pre-series A funding.

The money will help the company accelerate the research and development of autonomous technologies for passenger vehicles.

"Our on-going research and development of industry technologies will continue to prioritise the safety and security of the public as we strive to bring full vehicle autonomy worldwide," said Shuang Gao, chief operating officer of DeepRoute.

With research centres in Shenzhen, Beijing and Silicon Valley, DeepRoute specialises in level-four autonomous driving. The start-up is designing self-driving technologies including sensors, high-definition mapping and positioning, and machine learning, in addition to products such as hardware systems, infrastructure and simulators that perform with precision accuracy.

It is working alongside OEMs to provide a full-stack self-driving system to offer a self-driving operation fleet. It will support vehicle platooning technology and could provide a self-driving robo-taxi service during an international sporting event.



DeepRoute full-stack self-driving demo

The company's core technology team includes experts from universities such as Carnegie Mellon University, Cambridge University and Columbia University and firms such as Google, Microsoft, Ford, Intel, General Motors, Cruise, Baidu, Huawei and Tencent.

The financing round was led by Fosun RZ Capital, the Beijing-based venture capital arm of Chinese conglomerate Fosun. Shanghai-based GoldenSand Capital, Yunqi Partners and Ventech China, as well as Shenzhen-based Green Pine Capital Partners, also contributed.

Start-up Hi Auto solves voice control problem

Israeli start-up Hi Auto is emerging out of stealth to demonstrate its audio-visual commercial technology for speaker separation and speech enhancement in vehicles, aimed at solving the reliability problem of voice-based vehicle control in noisy environments.

The company has completed a $4.5m seed round led by Israeli car importer Delek Motors and Hi Auto's active chairman Zohar Zisapel. Other investors were Allied Holdings, Singapore-based Goldbell Group and Plug & Play.



Hi Auto's Eyal Shapira (left) and Roy Baharv

Hi Auto is planning to use the funds to complete the development of its first product, launch sales and expand its team. The company has already established contacts with automotive players, which are expected to examine its technology in early 2020.

Speech recognition platforms suffer from poor recognition rates in a noisy environment such as kids in the back seat of cars, ambulance passing by or heavy rain. Hi Auto's audio-visual approach, which combines a microphone and a camera that tracks the speaker's lips, can eliminate all noise and make speech recognition in cars work reliably under noise conditions.

The company was founded in February by CEO Roy Baharav, CTO Eyal Shapira and Zisapel.

Nidec completes Omron takeover

Nidec has completed the acquisition of Omron Automotive Electronics.

Nidec positions its automotive motor business as one of the company's key strategic businesses, and expects it to grow rapidly in the coming years. It particularly focuses on module products composed of electric power steering motors, electric brake motors and ECUs, eyeing further electrification and autonomous driving in the automotive industry, as well as EV traction motor systems, for which it expects significant market growth.

The company anticipates that the electrification trend will accelerate further in response to environmental and energy related problems globally, and will step up research and development activities with Nidec Elesys, an ECU manufacturer that joined the Nidec group in 2014, to create more electrification products going forward.

Omron Automotive Electronics (AE) engages in research and development, manufacturing, and sales of automotive electronics products as a subsidiary of Omron Group, which has strengths in control equipment, systems and electronic components based on its sensing and control technologies.

In particular, Omron AE has produced many control products for body control system, ECUs for motor control systems, power control systems, and other areas to address the market's electrification needs.

Through the transaction, the company hopes to create module and systems products by combining Nidec group's motors, pumps and gears with Omron ECUs and other electronics products.

Furthermore, Nidec Elesys and Omron AE have a complementary relationship in the area of adas. In particular, Nidec Elesys has strengths in wave radar and camera-related products, while Omron has strengths in lidar and driver monitoring systems, which will allow the two companies to provide a spectrum of sensors for autonomous driving in the future.



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SmartSens suppresses LED flicker for cmos sensors

SmartSens has developed LED flicker suppression (LFS) technology so cmos image sensors can effectively mitigate the dangers that often accompany LED flicker, making AI-enabled adas and autonomous vehicles safer.

LED has gradually replaced traditional lighting options in various automotive applications, such as traffic lights, car headlamps and turn signals.

However, since LED drivers often use pulse width modulation (PWM) signals, LED lights flicker at frequencies imperceptible to the unaided eye.

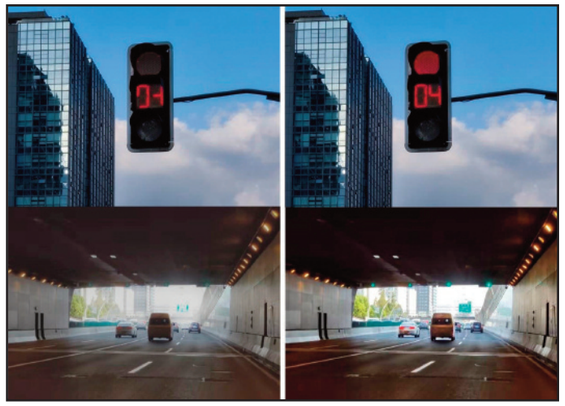
For cmos image sensors that have faster shutter speeds, mismatch between exposure time and LED pulse could lead to sensors picking up inaccurate visual signals.

Autonomous vehicles may rely on cmos image sensors making accurate readings to assess road conditions, a necessary prerequisite for AI systems to compute optimal next steps.

This means automotive cmos image sensors must adapt to modern traffic signal systems by being able to distinguish between the on and off states of LEDs.

SmartSens has opted for using its proprietary QCell technology to mitigate LED flickering. This has the benefit of increasing a sensor's sensitivity and dynamic range, making it suitable for dim or fluctuating lighting situations, such as the openings of carports and tunnels.

"LED flicker suppression is a feature that all automotive cmos sensors should possess, but is in fact not so easy to achieve," said SmartSens CMO Chris Yiu. "In the future, cmos sensors that SmartSens produces for the automotive electronics market will all come equipped with LFS technology, upgrading our clients' systems to be much more adaptable and safer."



Images taken without (left) and with LED flicker suppression

The technology has garnered the interest of multiple suppliers of automotive electronic systems.

Yuan Peng Zhang, CEO of Bovo Technology Group, said: "As a supplier of automotive parts and systems, Bovo has always paid close attention to the development of cmos image sensors. We look forward to the LFS-equipped cmos sensors that SmartSens will be releasing, and we believe that these sensors are instrumental in making vehicles, especially autonomous ones, safer and smarter than ever before."

Touch display market stalls but future looks rosy

While the global market for automotive display touch modules is stalling in 2019, the longer-term outlook is revving up, with shipments expected to rise in the coming years due to improving economic conditions and rising demand from autonomous vehicles, according to IHS Markit.

Worldwide shipments of automotive touch modules are expected to increase by 1.1 per cent in 2019 to reach 64 million units. Growth will remain tepid for the next two years, with increases of 1.4 and 2.4 per cent in 2020 and 2021.

Stronger growth will resume in 2022, with a 7.2 per cent annual expansion. The market's rise will continue in 2023, with shipments increasing by a healthy 7.8 per cent to reach 77 million units.

"The major factors behind the automotive touch module market's near-term weakness are the global economic downturn, slowing demand and the USA-China trade dispute," said Kimi Lin, senior analyst at IHS Markit.

Autotalks demonstrates C-V2X conformance

Autotalks has demonstrated its chipset's conformance to the Chinese C-V2X standard and the Chinese OSCCA security standard in a large-scale interoperability demonstration of multi-brand C-V2X communications.

This demonstration brought together more than 20 automotive companies that formed about 50 demonstration teams including car makers, chip makers, and terminal and security providers working together in a real-world setting.

The demonstration was part of the China SAE Congress and Exhibition last month in Shanghai.

Autotalks' chipset was used by five car makers – Renault-Nissan, Brilliance Auto, FAW, Great Wall and another European OEM.

They conducted demonstration rides for hundreds of visitors, exhibiting conformance and interoperability at chipset, system, software and security levels.

The demonstration included V2V and V2I applications with security enabled according to the Chinese OSCCA standard for the first time. Protection of the V2X system against cyber-security attacks through roadside units was evident throughout the demonstration rides.

Autotalks has been working with its tier-one and ecosystem partners to ensure end-to-end conformance and interoperability. Leading up to the event, Autotalks completed interoperability testing with all other C-V2X chipset vendors.

Recently, Autotalks and Neusoft signed a cooperation agreement aimed at forming a partnership for creating secure global V2X. The two companies launched and demonstrated this joint product with four car makers at the event.



Group photo at the Chinese C-V2X event



The latest Volkswagen Golf uses NXP RoadLink V2X communications

NXP supplies V2X for latest VW Golf

NXP has rolled out its RoadLink V2X communications in the latest VW Golf. The recently released Golf is the first volume European car equipped with V2X.

The technology can prevent accidents by having cars communicate with each other, independent of car brands and without the support of cellular infrastructure.

"Road safety forms the core of VW's commitment to its customers," said Johannes Neft, head of vehicle body development for Volkswagen. "As a high-volume manufacturer we aim to be a pioneer in this space."

He said the introduction of V2X, together with traffic infrastructure providers and other vehicle manufacturers, was a major milestone in this direction.

"Volkswagen includes this technology, which doesn't involve any user fees, as a standard feature to accelerate V2X penetration in Europe," he said.

NXP and Volkswagen have collaborated for reliability and performance, as well as for standardising V2X communication that addresses cyber security and privacy protection.

"Volkswagen has taken a bold step to seize the road safety initiative through the implementation of V2X," said Torsten Lehman, senior vice president at NXP. "After proving our technology in more than one million test days globally, we are pleased that our RoadLink technology, developed in cooperation with Cohda Wireless, was chosen to enable new levels of safety in Europe's most popular car model, the new Golf."

NXP says it offers the only 5.9GHz V2X system in volume production.

LG and Unity partner on simulation

Engineers at the LG Electronics R&D centre in Silicon Valley are working with machine learning experts at Unity Technologies to develop simulation software to accelerate autonomous vehicle development.

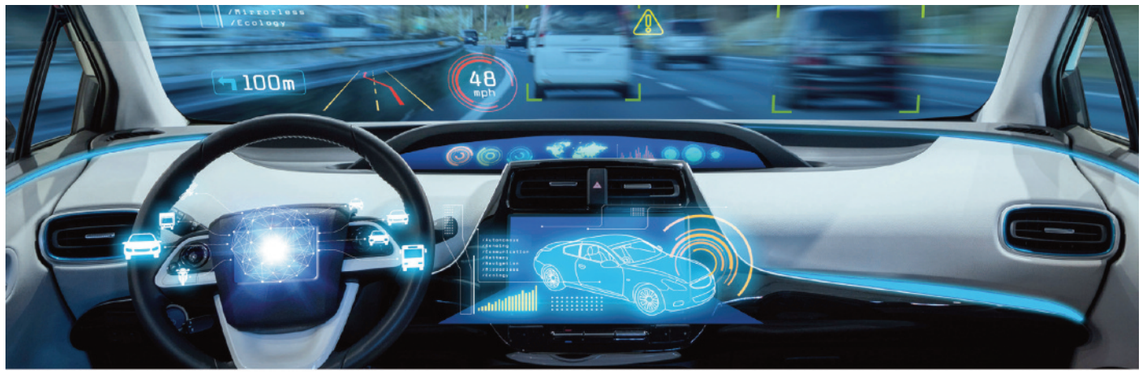
The collaboration of LGSVL Simulator on Unity Simulation leverages LG's AI expertise combined with skills of Unity Technologies, creator of a real-time 3D development platform.

Unity Simulation enables the running of multiple instances of a Unity product at scale, lowering the barrier to train, test or validate products and services in a high-fidelity 3D environment. Computer-vision-oriented applications for the automotive industry are particularly compelling, according to Danny Lange, Unity Technologies vice president of AI and machine learning.

"Unity's confidence in the LGSVL Simulator for the development of safe and robust autonomous driving is a clear indicator that this is a win-win partnership from the start," said Seonman Kim, vice president of engineering for LG in Silicon Valley. "We look forward to exploring opportunities to bring our respective technologies to the automotive market."

He said the collaboration was expected to benefit the automotive industry as it moved towards a self-driving future. Autonomous vehicle developers running the LGSVL Simulator on Unity Simulation will be able to accelerate the training of their systems by running multiple scenarios in parallel. The simulator can use digital twins of real-world environments with sensor models to train autonomous vehicles across multiple scenarios.

Training and validating an autonomous vehicle is a prime example of how a virtual environment can reduce the risk for both the car and those around it, allowing businesses to stress-test systems before they are put on the road.



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COMPANY PROFILE

STILL SMILING



Steve Rogerson visits Analog Devices' operations in Limerick to hear the company's automotive plans

To say that everyone will like autonomous driving is a bold statement but one that Martin Cotter, a senior vice president at Analog Devices, was confident to make as he laid out the company's plans in the automotive industry.

"As we go from level two to three, we are very much a part of that," he said. The future is levels four and five, and we plan to be part of that too. Everyone will like autonomous driving, especially if you want to get through traffic jams and want safety. It is all about zero deaths."

He said that whereas individual technologies such as radar and lidar can show roughly where things are, it was the technologies that fused these together that gave a position that was much more certain.

"We have radar technology that is good enough to distinguish a child's leg from a thin post," he said. "This is pretty exciting technology."

Analog Devices has grown from its beginnings in 1965 to a global company with around15,000 employees and a presence in more that twenty countries. Around a third of its revenue comes from the USA, a quarter from Europe, a fifth from China, 12 per cent from Japan and a tenth from the rest of Asia, with automotive accounting for 16 per cent of its $6.2bn annual revenue; $1.2bn a year is spent on R&D. It has manufacturing facilities in the USA, Ireland and the Philippines.

The company has been in Ireland since 1976 where it now has more than 1200 employees, well over half of which are engineers and technicians.

The R&D centre in Limerick has had €50m investment in the past four years, with another €40m on expanding its cleanroom.

The company believes having a European base is key partly due to the importance the continent has in the automotive field with the top two tier ones worldwide – Bosch and Continental – having their homes on the continent.

"Looking at automotive, Europe is a key driver," said Mike Britchfield, European vice president for sales. "The EU dominates the automotive tier-one market."

He said Europe also led in the semiconductor technology being used for high-end vehicles and for future autonomous driving.

"Automotive is a very significant business for us," added Cotter.

Electric vehicles

One area of automotive that is a big focus for the company as the world moves towards more electric vehicles is battery management systems, and it has an interest from vehicle batteries throughout their life in the vehicle and beyond.

"Our technology starts with the

signal processing in the production of the batteries to improve their quality," said chief technology officer Dan Leibholz. "Once in the car, we have battery management that relates to vehicle performance, kilometres per charge, lifetime and so on. And there is the second life market where the battery can be used for energy storage after it can no longer be used in the vehicle."

The next five to seven years should see a massive shift from internal combustion engines to electric vehicles, according to Patrick Morgan, vice president of automotive electrification.

"We are seeing a change from kilometres per litre to kilometres per millivolt," he said. "China invested early in this and their OEMs make up about half of all the world's electric vehicle shipments. But the likes of Volkswagen and Toyota are also seeing massive shifts towards electric vehicles."



Mike Britchfield: "The EU dominates the automotive tier-one market."

He said in Europe a lot of this was being driven by environmental legislation.

About a third of the cost of the electric vehicle is the battery and it needs to be managed carefully.

"There are algorithms that look at the state of charge and health of the battery as it goes towards the end of its life, and then into other areas where the battery can be used," said Morgan. "Our technology maximises the usable energy in the battery pack, and it does that by creating very accurate instruments so we can very accurately discharge and charge the battery, increasing the usable energy by ten to fifteen per cent."

Battery packs have moved from single board designs to more modular systems that can be more easily built to suit the size of the vehicle. Monitoring these modules is done today using wires but Morgan says in the future this will be done wirelessly. This will save weight and increase flexibility.

Autonomous driving

The other big area, of course, is autonomous driving, something that was not even talked about seriously just a few years ago.

"Just five to ten years ago, autonomous driving was still in the realms of science fiction," said Chris Jacobs, vice president for autonomous transportation. "What drives us at Analog Devices all comes down to the safety of these systems. Our vision zero is to have zero fatalities or serious injuries in or by a vehicle."

Leibholz added: "We are working with tier ones and OEMs in the vision zero project to achieve zero fatalities in automotive."



Martin Cotter: "Automotive is a significant business for us."



Dan Leibholz: "We are working with tier ones and OEMs."



Chris Jacobs: "What drives us is saving lives."

The interactions of the driver and the car have moved, said Morgan, from the driver seeing the road to the car seeing the road and now to the car seeing the driver as part of the path towards self-driving vehicles.

"The car can look inside and see what the passengers and driver are doing," he said. "The handover from car to driver will be one of the most critical parts of autonomous driving."

This, he said, could lead to cars not letting the driver take control even if that was what the driver wanted.

"Say you are in an emergency situation and the driver may panic and grab the steering wheel," he said. "The car may decide it knows best and, to protect the driver, it retains control."

Jacobs said already advanced technologies were leading to a dramatic decrease in vehicle related fatalities.

"Our sensors save about eight lives a day," he said. "What drives us is saving lives. We are making these technologies rugged so they can be in every vehicle on the planet."

The goal now is predictive safety where the sensors can see all round the car and predict what will happen. This, he said, was generally not in the remit of today's cars but would be in the future.

"The vehicle needs to see the world around it and activate itself," he said.

A good example today was automatic emergency braking, and this will be standard in all new cars from 2022.



Inside Analog Devices' R&D laboratory in Limerick

"Analog Devices radar technology is a fundamental piece of that," he said.

Alongside this is automatic emergency steering, where the car will steer itself to avoid a collision.

"You need an implementation of sensor fusion to achieve this," said Jacobs. "This is a fusion of radar and inertial measurement units."

The company has a test vehicle near Munich that is equipped with various sensor technologies to see how they handle complex use cases.

"We can detect a bicycle chained to railings under a bridge for example," he said. "We have to move beyond places like Phoenix where the weather is good and the roads are straight where these are being developed

now and look for more challenging and complex environments."

He said people drove differently in different countries and they learn when to break the rules. Cars will have to learn these experiences.



Patrick Morgan: "The car may decide it knows best."

Instrumentation

For all these technologies to work and be developed, they themselves need measuring and checking, and that means high-quality instrumentation.

"If you want to measure something, it has to be better than what you are trying to measure," said Leo McHugh, vice president for instrumentation. "So you have to have leading edge technology."

For example, vehicle radar at 77 to 79GHz needs to be tested if it is to achieve the required performance level. Electrification involves grading the batteries with the best going into electric vehicles and the worst into power tools, said McHugh.

"You need confidence in the results," he said. "You have to use the technology to measure the next technology, and there are a lot of techniques we have developed for this."

Then the measurements have to move from the laboratory to the field.

"You need to make measurements in remote locations," he said. "So you need robust instruments that need to be reliable to give you the confidence in their measurements."

He also said intelligence was needed at the edge to look for abnormalities. Diagnostics needed to be embedded and insights provided with machine learning.



Leo McHugh: "You need confidence in the results."

Conclusion

Analog Devices recognises the importance of the European market in the automotive world, which explains its continuing investment in its facilities in Limerick with the R&D centre and the expansion of its cleanroom facilities.

The company has spent €1.5bn on capital infrastructure in the country and it is the single largest holder of US patents in Ireland with more than 500. A quarter of the company's worldwide business is based in Europe and the Limerick R&D centre is responsible for more than 100 new products every year.

VEHICLE electronics

The monthly magazine for automotive electronics engineers

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Going soft

Software was the dominant theme at last month's Eliv conference in Bonn, as Steve Rogerson reports

Is the automotive industry becoming more pessimistic? One could be forgiven for thinking so during the opening ceremony at last month's Eliv electronics in vehicles conference in Bonn where the audience was surveyed as to when they thought level three autonomous vehicles would arrive.

While the most popular answer of 2030 may not seen too bad, it was five years later than the audience voted when asked the same question at the previous Eliv in 2017.

The conclusion is most likely that as the engineers seriously grapple with the problems of achieving autonomous driving, the reality of how difficult they are becomes more of a reality.

What was clear was that the attention today is firmly in the software domain, and specifically applying artificial intelligence (AI) to the vast amounts of data that vehicles will collect.

"When vehicles and the drivers connect with other vehicles and the infrastructure, software, software, software is needed," said Siegmar Haasis, CIO for R&D at Mercedes-Benz Cars, during his keynote speech. "We are in the middle of a transformation. We are living in a world where software plays the dominant role. Software in the name of the game."

He described data as the new oil and said that achieving a high quality of data was a major problem.

"This is a mind set and it has to do with discipline," Haasis said. "It is like brushing your teeth. It is a discipline you need to do every day. Data quality is the foundation."

Quality data are needed to power AI, and when that happened, he said, it would revolutionise products and change the way people worked.

"AI can be a game changer," he said.

Also on an oil theme, Christoph Grote, senior vice president for electronics at BMW, said it was software that was the new oil, but added: "It is like a gold rush."



Siegmar Haasis: "Data quality is the foundation."



Christoph Grote: "It is like a gold rush."

However, he described the software industry as very unprofessional and unstructured, adding: "It is important that we have good data. We need more and more data to test the product. Full physical testing is not possible."

Data refining

Whether data are or software is the new oil, that oil is no good in its raw form.

"It is crude oil," said Joachim Langenwalter, NVidia's director of automotive software, "and AI is how to refine it."

This was useful, he said, both for autonomous driving and the smart cockpit where the vehicle monitors what the driver and passengers are doing.

"AI is used for perception," he said, "looking at the images coming in from the sensors and interpreting them. The AI process starts from collecting lots of data. You need to label these data and you don't want to label everything. You then train it to interpret the information, and then test and validate what you have.

You go through this loop many times."

This, he said, was summed up as data in, which are refined and an autonomous driving function comes out.

Raphael Pfeffer, product manager at IPG Automotive, said all the major trends in automotive were linked to AI, whether autonomous or automated driving, safety, electric mobility or mobility as a service.

"We thus need algorithms for decision making, trajectory planning, image processing and so on," he said. "A conventional algorithm takes an input and uses a function to produce an output. With AI, you have the inputs and outputs but the function is a neural network. You need a lot of training data before the neural network works."

An important aspect of training neural networks was simulation.

"If you want the car to learn how to react to, say, a deer crossing a road, it would take a long time to wait for an actual deer to cross the road to train the network," Langenwalter said. "So you need to simulate this. You can build this in simulation."

Pfeffer agreed that collecting and labelling the data took a lot of effort and was time consuming but said that simulation alone did not produce accurate enough results. However, he said that combing just a small amount of real data with simulated data produced results that were almost as accurate as real data but could be processed in a fraction of the time.

Pfeffer uses a process known as semantic segmentation, which on its own he said had "pretty bad" accuracy.

"But if you mix semantic segmentation with real data, the accuracy improves," he said. "If I take just five per cent of real data and mix that with 95 per cent of segmented data, I get very good results. This can be used to train neural networks."

Extending data usage



Harnessing the power of data is Luxembourg company Motion S that is using data science to provide information on driver behaviour to move just beyond setting insurance premiums to understanding when it is a suitable time to move to an electric vehicle and even predicting when to change tyres. One project is also helping infrastructure developers plan where to put charging stations.

"We take the GPS data and put them into context," said Isabell Scherer (pictured), marketing manager at Motion S. "We enrich the data. We match accident statistics with location. We create mobility profiles of specific users."

The score this produces can be used by various companies including a tyre maker to help it suggest when to switch tyres.

"It is pretty accurate," said Scherer. "The tyre maker was really impressed at the accuracy based only on GPS and mobility profiles and not data from the actual car."

The company is running an e-mobility project to help people pick when to switch to an electric vehicle based on where charging stations are and the user's driver profile.



Reiner Friedrich: "We need partnerships."

Level three

BMW vice president Reiner Friedrich said there were already 43 level-two assisted driver features on the road and, despite the survey results, the car maker was targeting 2021 for level three.

"We know that was not popular in the survey but that is what BMW is focussed on with our Personal CoPilot," he said. "For level three, we need a lot of sensors, we need a lot of investment, we need partnerships."

He also said new, flexible ways of working were needed to develop the necessary software quickly enough. And movement was needed on regulations and standards.

"Even if the technology works well, it doesn't serve us if it is not approved," he said. "Long decision-making processes are necessary to get approval. It will be a long time before we get robust regulations. We need at least some guidelines to be able to act on in the meantime."

Helping overcome these difficulties and to provide evidence for the law makers is an EU research project dealing with level three automated driving in Europe. There are 36 bodies involved, one of which is engineering company FEV. Its



Joachim Langenwalter: "The AI process starts from collecting lots of data."

Bluetooth LE is key



Dialog Semiconductor is using Bluetooth Low Energy technology to measure distance and direction for keyless remote entry applications. The idea is for the car only to unlock when it is sure the holder of key – stored in a mobile phone – is close to the vehicle.

"The car and the phone only exchange the secret key when the person is near the vehicle and not at any other time," said Erik Peters (pictured), product marketing manager at Dialog Semiconductor. "So a key in a house or restaurant will not relay the information so this cannot be picked up by a thief."

The system uses triangulation from two devices on the vehicle to work out the direction to the key. It also uses phase-based ranging from sensors to calculate distance.

"We sample over different frequencies," said Peters. "This means there are two different wavelengths and by comparing the signals you can calculate the distance."

The product will use an automotive version of the company's DA14691 microcontroller that will be released early next year.

project engineer Markus Kremer said the aim was to have 100 vehicles in ten countries.

"All the major European OEMs are supporting us," he said. "This lets the OEMs test automated driving. We also get feedback from the test drivers. Data are collected by the vehicles."

He said the amount of data was between 4 and 40Tbyte per eight-hour day per vehicle.

"We need a plan of what to do with those data," he said.

Security

Having good, high quality data is not enough. The data need to be secure.

"Data security is important," said Haasis. "We are living in a world where we are setting up big firewalls, but they might not be in the right place. You have to check where are your crown jewels and look at how to protect them in the correct way."

Johannes Heinrich, consultant at the Institut für Qualitäts & Zuverlässig, said the increase into the amount of software had to be evaluated in terms of safety, and the ease at which it could be updated was a bonus.

"We can install a live repair in the system without the driver noticing," he said. "You can use software anywhere in the vehicle, not just the control unit for which it was developed."

AI, he said, was a special case.

"We are still in our infancy as to knowing what happens in the neural network," he said. "But in the future we will need to categorise these in terms of functional safety to see if it can meet Asil D."

Conclusion

The date may be moving backwards for when level three automated driving will become a regular sight, but that is only because the brains in the industry are working together to make sure when this happens it does so in a way that will be accepted by the public. The focus is more and more on processing the data using AI. The software engineers are coming into their own.

Fusion improves positioning



Munich company Anavs was showing a multi-sensor RTK module with the company's sensor fusion framework.

"We are doing sensor fusion of different types of lidar, computer vision, GNSS, local positioning systems, inertial sensors, vehicle data and so on," said Nicole Nedela (pictured), the company's marketing manager. "We do this to give advanced navigation for autonomous driving. We have centimetre-level accuracy using up-to-date data and up-to-date maps."

UAV company Aeroxess is already using the technology on its drones and Anavs is working with Stihl on robot lawn mowers and vacuum cleaners.

"We have some cooperation with car makers," said Nedela. "We are just starting so it is in the beginning."



Johannes Heinrich: "We can install a live repair."

Maxim checks batteries and verifies components



Maxim Integrated did a double launch at the show – a battery monitor IC and an automotive-grade secure authenticator for verifying genuine components.

The Max 17853 single-chip battery monitor helps designers achieve Asil D compliance and targets mid to large cell count configurations.

"One of the challenges is inadequate levels of safety in battery management systems," said Tamer Kira (pictured left), Maxim' executive director of business management. "This device is Asil D compliant and permits the use of the same board for different pack sizes. To get life and range out of the battery, you need to monitor them closely. Our technology monitors voltage across all the cells and if any falls out of range, it brings them back up to range. The one board handles from eight to 14 cells."

The DS28C40 DeepCover authenticator IC meets AEC-Q100 grade one and can help reduce the design complexity and software vulnerability while ensuring that only genuine components are used in a vehicle's electronic systems.

"Unauthorised components can compromise safety critical systems," said Michael Haight (pictured right), direct of business management. "The part we are introducing can help. This is our first foray into automotive security but we have been doing it for over thirty years for other sectors."

It can replace microcontroller-based approaches and reduces system design complexity and associated code development efforts.

The authenticator deters theft of high-value components such as front-light modules. It also offers public-private key asymmetric ECDSA (ECC-P256 curve) and other key authentication algorithms built into the IC, allowing OEMs to skip development of proprietary device-level code. This and other algorithms in the authenticator IC defend against unauthorised components that could compromise performance, safety and data integrity.

"We do not believe in developing our own algorithm," said Haight. "That is a dangerous thing. We use open algorithms that have been proven. But we have a key in it that makes it difficult to extract data to the outside world."

The device comes in a 4 by 3mm TDFN package and operates over the -40 to +125°C temperature range.

Haight said the company was in advanced talks with an OEM for batteries and was also taking about using it to authenticate a cable harness. For adas cameras that need specific calibration, the device will show if a new camera has been plugged in that has not been calibrated properly.

"It can also detect if a device has lost some of its memory," said Haight.

Saving lives on the road



Christian Hof explains why rapid emergency response for automotive demands robust testing

When drivers of a vehicle have accidents, they need help – fast. In urban areas, it's relatively easy to alert the emergency services and send help within minutes. In rural areas, however, where around 57% of road traffic accidents take place, the speed of emergency assistance is more uncertain.

There's less remote traffic monitoring, fewer people on hand to make an emergency call and greater distances to the nearest hospital. The upshot is that it's more difficult to report accidents in rural areas and, once they have been reported, it takes some time for help to arrive. In the case of a serious accident, every minute counts.

The commodification of mobile communications systems such as GSM, and of global navigation satellite systems (GNSS) such as America's GPS, the European Galileo and Russia's Glonass, has created the infrastructure to address this issue.

In April 2015 the European Parliament voted in favour of the e-call regulation that required all new cars be equipped with e-call technology from April 2018. In the event of a serious accident, e-call automatically dials 112 – Europe's single emergency number.

It communicates the vehicle's exact location to emergency services, the time of incident and the direction of travel – an important factor on motorways – even if the driver is unconscious or unable to make a phone call.

To date, e-call implementations are based on Etsi and CEN standards using an in-band modem to transmit acoustically (using tones similar to a fax machine) the e-call minimum set of data (MSD) over a GSM or UMTS voice channel.

The Russian Federation has a similar emergency roadside assistance system, known as ERA-Glonass, to cut accident response times. It is harmonised with Europe's e-call system, using the same protocols and principles, but adds features such as exploiting SMS as a redundant communications channel.

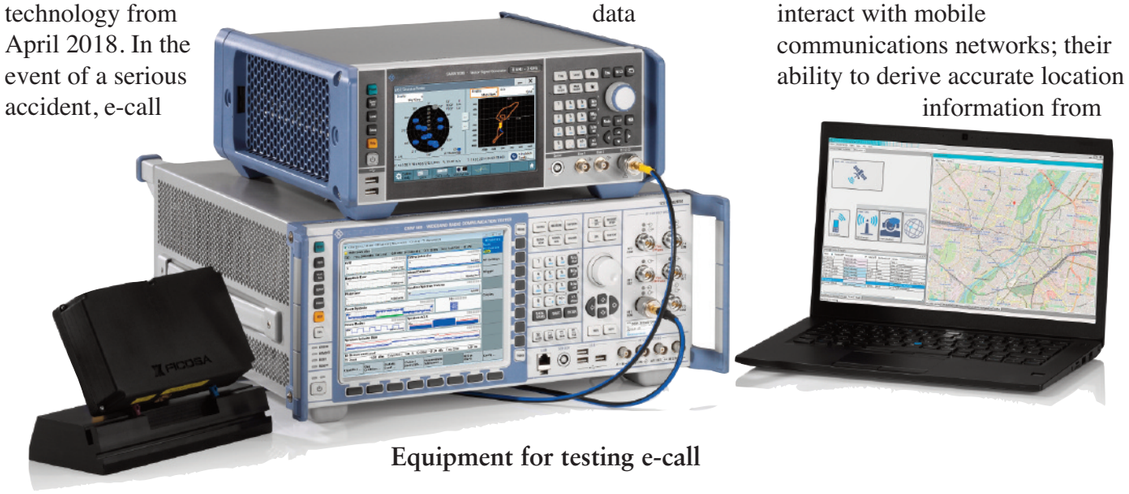
The ambition is laudable, but do these systems work? In the Russian Federation, the ERA-Glonass system has already been activated in more than 37.000 accidents. The average time for data transmission to the emergency response services was approximately 19s, a dramatic reduction over previous response times.

Clearly these systems have value, so long as they work reliably. If they don't, their introduction could reduce road safety, by creating a false sense of security that leads emergency service providers to cut back on the other ways in which they serve rural areas.

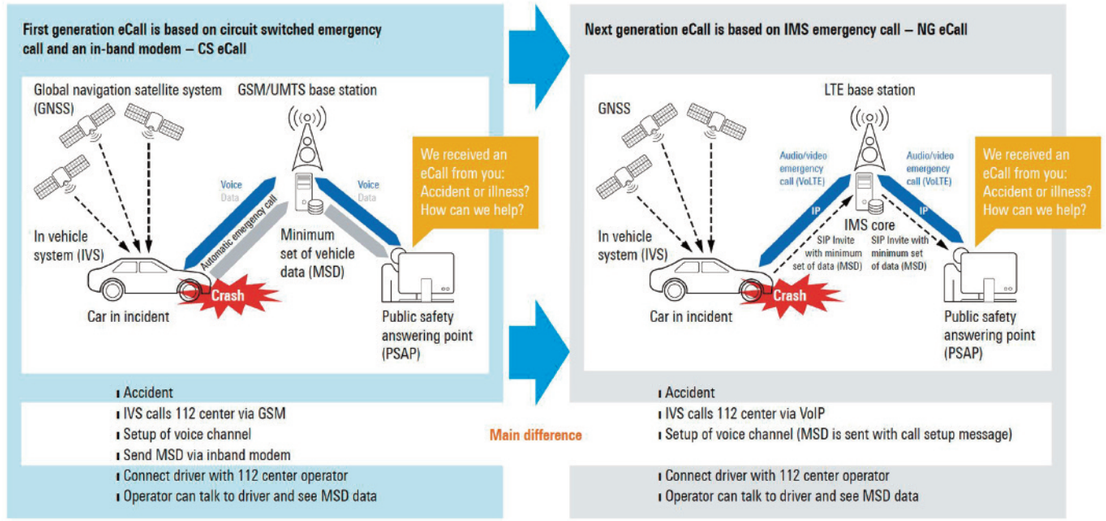
As a safety system, the in-band modems must be highly reliable and correctly transmit MSD. This is particularly critical in cellular networks optimised for voice transmissions such as GSM or UMTS.

The ability to test implementations of these systems for both conformance to the relevant standards and performance has become a vital part of the type-approval process for new vehicles.

This kind of testing can be complex; developers need to check IVS implementations for their conformance to the e-call requirements; their ability to interact with mobile communications networks; their ability to derive accurate location information from



Equipment for testing e-call



Difference between standard and NG e-call

the GNSS constellations available overhead; and for their ability to integrate this information and coordinate these services reliably enough to constitute an emergency service.

These tests need to be carried out at various levels. Any custom devices and boards designed to form part of an IVS module will need testing during R&D, verification, production and maintenance. Devices also need to be tested to ensure they can coexist with other systems, and during conformance and acceptance testing. At the system level, developers need to test IVS radiated performance, how it interacts with the vehicle body, its ability to coexist with other systems, the ways in which it can become desensitised, and its overall indoor and outdoor performance.

Much of this testing is best done using simulation, so complex real-world variables such as radio-frequency interference, and the impact of cellular network management strategies, can be taken out of the equation.

There are a number of tools that can be brought together to configure an end-to-end testing system for both e-call and ERA-Glonass implementations.

Next generation

With network operators planning to phase out GSM technology over the next decade, next generation (NG) e-call was defined to make e-call ready for the future. It uses the capabilities of 4G-LTE and IP-based networks and, in the future, maybe 5G infrastructure as well. This simultaneously adds functionality that was previously not possible.

NG e-call goes further enabling faster and more reliable calls, the transfer of MSD via IP without interrupting the voice call, and the ability to transfer more than 140byte of data, the current limit for e-call. It uses the latest infrastructure such as LTE for the connectivity and the IP multimedia subsystem (IMS) acts as a service enabler for NG e-call, which in LTE is known as the service enabler for voice over LTE (VoLTE).

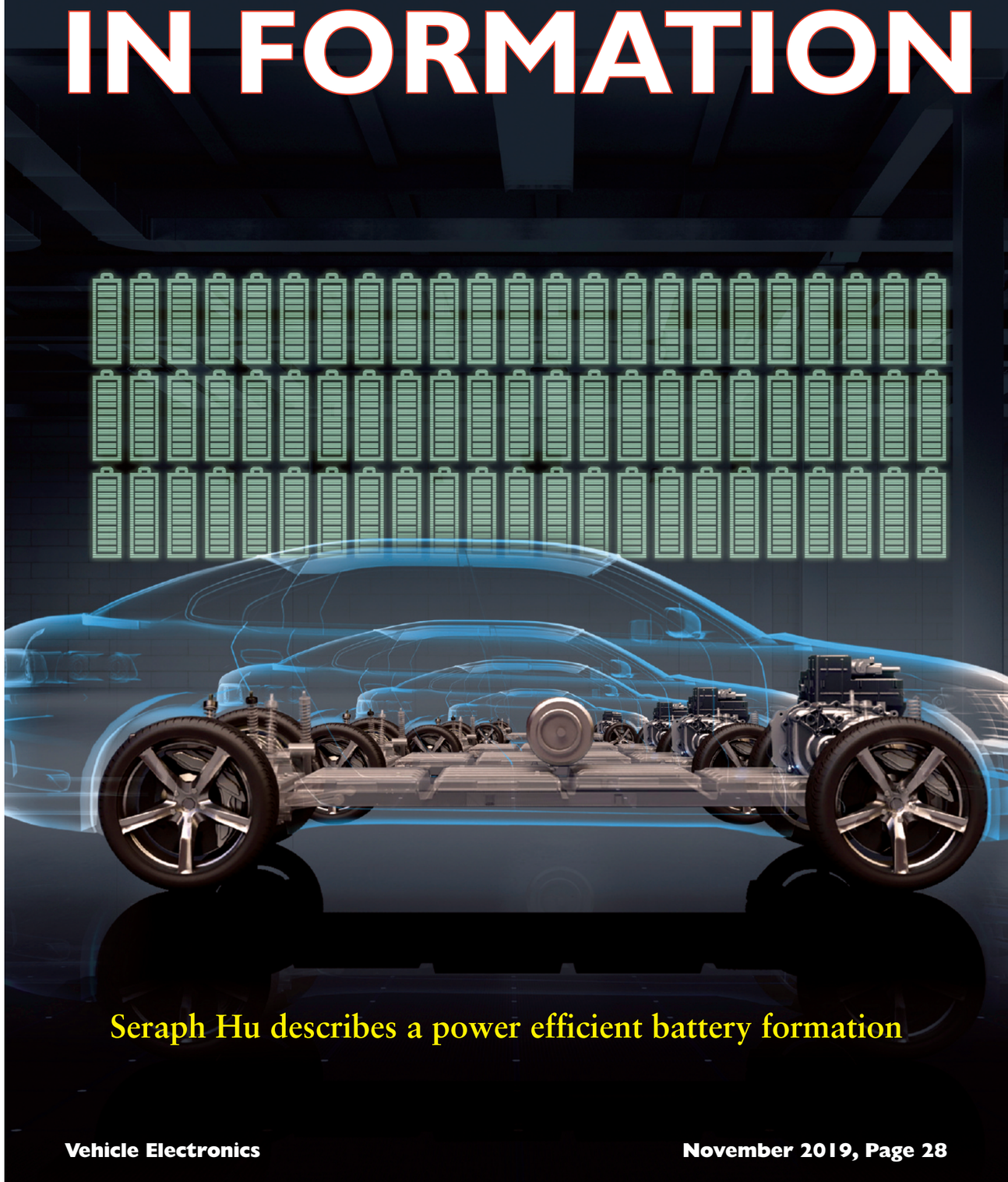
Conclusion

Effective emergency services demand high levels of coordination. Systems such as e-call, ERA-Glonass and NG e-call, which are meant to improve the effectiveness of emergency services, rely on the coordination of complex infrastructure such as cellular networks and GNSS. Ensuring these deliver on their promise demands effective coordination of complex tests, as made possible by suitable test hardware and supporting software.



Christian Hof is a senior product manager at Rohde & Schwarz

IN FORMATION



Seraph Hu describes a power efficient battery formation

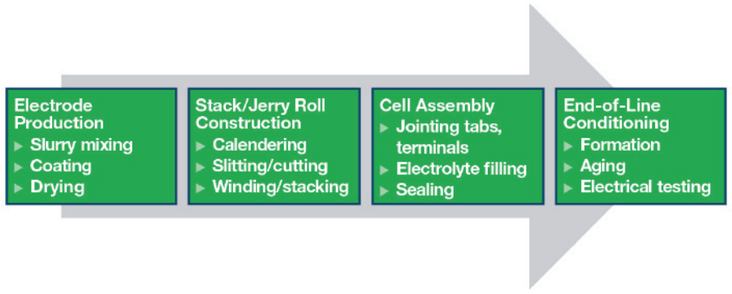


Fig. 1: Li-Ion battery manufacturing process

Lithium ion (Li-ion) manufacturing is a long process. The first three stages prepare the essential materials – electrodes, electrolyte, separator and so on – and assemble them into a battery cell form. The final stage will activate the cell and enable the cell to perform its electrical functionality.

The activation process is called battery formation. The grading process ensures battery cell consistency. Li-ion batteries with low storage capacity of less than 5A are widely used in portable equipment such as laptop computers and mobile phones. For them, concern over manufacturing efficiency has taken a back seat to manufacturing cost.

Meanwhile, batteries used in vehicles have a much higher total capacity, typically in the hundreds of amps. This is achieved with thousands of small cells or a few high capacity batteries. For this type of application, battery cell consistency is more important, and therefore the grading process to improve the cell's consistency is critical.

At the same time, power efficiency becomes especially important as a part of the battery formation cost within the manufacturing process. It would be ironic for these environmentally friendly vehicles to use batteries manufactured in a way that wastes high amounts of energy.

There is a better quality, more efficient battery formation and grading process using a single silicon chip incorporating a precision analogue front end and a buck-boost PWM controller. This offers an accuracy of better than 0.02% and power efficiency higher than 90%.

In addition, during battery formation and grading, energy discharged can be recycled in the process for other batteries. In many existing systems, their batteries are discharged into resistive loads. Some use this energy for building heat or simply to vent hot air to the outside.

Although discharging batteries into resistive loads is the simplest method of battery discharging, the costs quickly add up when large numbers of batteries must be put through charge-discharge cycles.

Our proposed system has high single-channel efficiency, but its real value is in its ability to recycle energy from the discharging batteries with low additional complexity. This architecture could result in an energy savings of over 40%.

In a word, the single-chip has the following features for the battery formation and grading process:

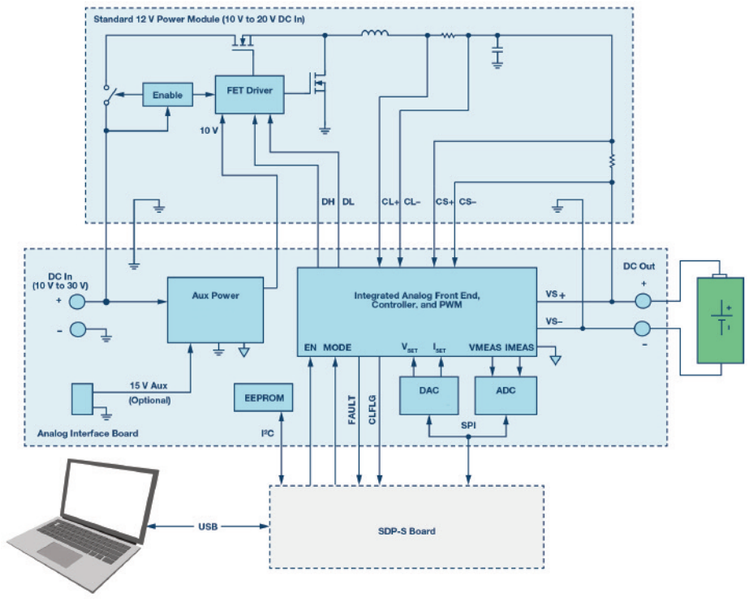


Fig. 2: Single-channel system built around integrated analogue front end, controller and PWM

- Lower battery cost;
- Energy recycling;
- High power efficiency; and
- High testing accuracy.

Manufacturing

Fig. 1 shows an overview of the Li-ion battery making process. Battery formation and testing at the end-of-line conditioning step are the process bottlenecks, and have the greatest impact on battery life, quality and cost.

Battery formation is the process of performing the initial charge-discharge operation on the battery cell. During this stage, special electrochemical solid electrolyte interphase (SEI) will be formed at the electrode, mainly on an anode.

This layer is sensitive to many different factors and has major impacts on battery performance during its life time.

Battery formation can take many days depending on the battery chemistry. Using a 0.1C (C is the cell capacity) current during formation is very typical, taking up to 20 hours for a full charge and discharge cycle, making up 20 to 30% of the total battery cost.

Electrical testing can use currents of 1C for charge and 0.5C for discharge, but each cycle still requires about three hours. A typical test sequence requires several cycles.

Battery formation and grading and other electrical testing could have tight accuracy specifications with the current and voltage controlled to better than ±0.02% in the specified temperature range. The grading process will make the battery's electrochemical property settle down.

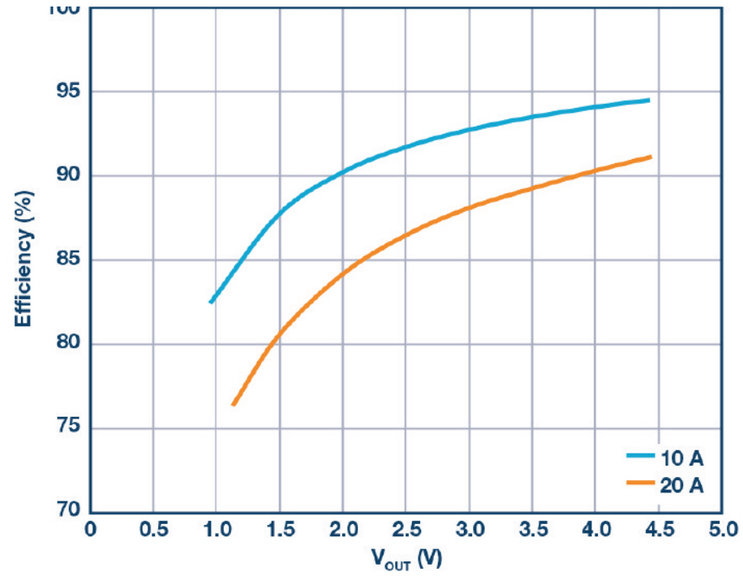


Fig. 3: Results of system power efficiency tests

According to the data recorded during this stage, the cells with similar electrochemical behaviour will be grouped together as a module and/or pack. In this way, the consistency of the power system of an electrical vehicle could be increased.

The measurement and control accuracy will determine the quality of the data records and therefore have non-negligible influence on the whole battery power system performance.

The other challenge for vehicle battery manufacturing is power efficiency. Efficiency must also be kept high during charging and, if possible, the energy should be recycled during discharging. This will not only help comply with environmentally friendly policies, but also save costs for large-scale battery manufacturing, which is increasingly common nowadays due to the rise in electrical vehicle applications.

A single silicon chip can integrate precision analogue front end and a buck-boost PWM controller in one package to tackle these problems. Internal thin film matching resistors can help ensure accurate and reliable current signal sensing.

The analogue control loop would work with the PWM controlling circuit to enable higher quality charging and discharging.

Topologies

Design engineers often use linear regulators to meet the accuracy requirements of formation and testing of batteries used in portable equipment, while compromising on efficiency. On larger batteries, this results in challenges with heat management and decreased efficiency due to temperature drift.

The high number of cells used in electric and hybrid vehicles, all

of which have to be well matched, imposes even more stringent accuracy requirements, making switching topologies a very attractive option. Table 1 shows a comparison of different cell categories in terms of power capacity and end function.

Fig. 2 shows a single-channel system built with the integrated chip. This allows the system to be easily configured with different power stages. The analogue front-end measures and conditions the voltage and current signals in the loops. It also has a built-in PWM generator configurable for buck or boost mode operation.

The interface between the analogue controller and the PWM generator consists of low impedance analogue signals that don't suffer from the jitter causing problems in the digital loop. The output of the constant current (CC) and constant voltage (CV) loops determine the duty cycle of the PWM generator, which drives the mosfet power stage through the fet driver.

When the mode changes from charge to discharge, the polarity of the in-amp inside the device that measures the battery current reverses. Switches inside the CC and CV amplifiers select the correct compensation network, and the device changes its PWM output to boost mode.

This entire function is controlled via a single pin and standard digital logic.

In this implementation, a high resolution ADC monitors the system, but it is not part of the control loop. The scan rate is unrelated to control loop performance, so a single ADC can measure current and voltage on many channels in multichannel systems. This is true for the DAC as well, so a low cost DAC can control multiple channels.

In addition, a single processor only needs to set the CV and CC set points, mode of operation, and housekeeping functions, so it can interface with many channels without becoming the bottleneck in control loop performance.

A system configured with a 4V battery and 20A maximum current results in better than 90% efficiency and typical accuracy over 25˚C ±10˚C of 90ppm for current loops and 51ppm for voltage loops.

The CC to CV transition is glitch-free and occurs within 500μs. Current ramping from 1 to 20A needs less than 150ms. This number could be much faster depending on configurations.

Users will need to make some trade-offs, for example, between ramping time and low current performance to decide how fast they like the ramping to be. These specifications are ideal for vehicle battery manufacturing and testing.

Fig. 3 shows the efficiency in CC discharge mode at 10 and 20A as an example.

Table 1: Comparison of linear and switching systems

Battery Size	Small	Medium	Large
Capacity (Ah)	<5	10 to 15	30 to >100
Applications	Portable devices such as mobile phones and camcorders	Laptop computer	HEV, EV, scooter
Number of channels per system	~512	~768	16 to 64
Technical requirements	Low drift over temperature and time	Higher accuracy over temperature and time	Highest accuracy over temperature and time; current sharing
System topology	Linear or switching; trend towards switching		Switching; higher efficiency; energy recycling preferred

Battery cost

The challenge of reducing battery cost requires addressing the whole manufacturing process. The system described here enables lower cost battery formation and test systems without sacrificing performance. The improved accuracy allows shorter and fewer calibration cycles, resulting in longer uptime.

In addition, simpler design and smaller power electronics components as a result of the higher switching frequencies also contribute to lower cost. Channels can also be combined to output higher currents with low effort.

This approach also reduces software development costs by performing all the control in the analogue domain, eliminating the need for complicated algorithms. Finally, energy recycling, coupled with high system efficiency, significantly reduces on-going operation costs.

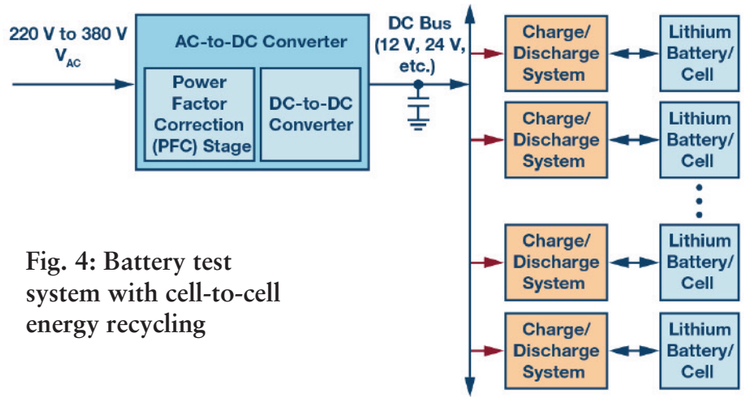


Fig. 4: Battery test system with cell-to-cell energy recycling

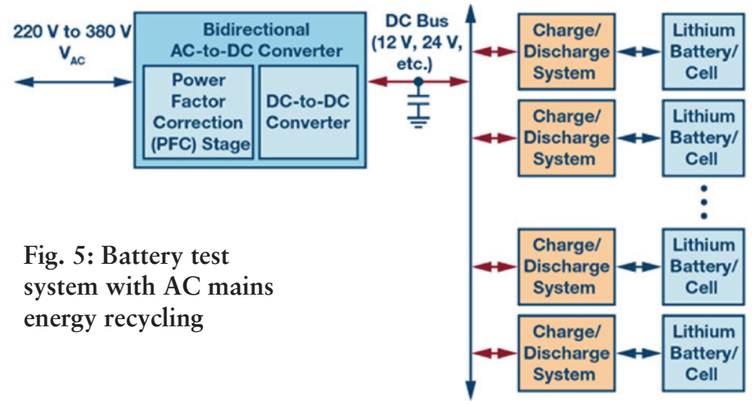


Fig. 5: Battery test system with AC mains energy recycling

Energy recycling

Compared with the architecture discharging batteries into resistive loads, this can control the battery voltage and current while pushing energy back into a common bus, where other banks of batteries can use it for their charge cycles.

Each battery channel can be in charge mode, drawing energy from the DC bus, or in discharge mode, pushing energy back into the DC bus. The simplest systems include a unidirectional AC-to-DC power supply, which can only source current from the AC mains into the DC bus, such as the system in Fig. 4.

This means the system must be carefully balanced to ensure the net current from the AC-to-DC power supply is always positive. Pushing more energy into the DC bus than what is being consumed by the charging channels would result in an increase in bus voltage, possibly damaging some components.

A bidirectional AC-to-DC converter addresses this by pushing energy back into the AC grid, as shown in Fig. 5. In this case, all the channels can be set first to charge mode, followed by discharge mode, returning the current back to the grid. This requires a more complex AC-to-DC converter but provides additional flexibility for system configuration and there is no need to balance the charge and discharge currents carefully to ensure a net positive current from the power supply.

Conclusion

A switching power supply provides a performance, cost-effective method for modern rechargeable battery manufacturing. The device described here simplifies the system design with better than 0.02% system accuracy, higher than 90% power efficiency and energy recycling capability to save over 40% energy compared with those systems wasting the discharged energy instead of reusing them to charge other batteries.

It helps to solve the rechargeable battery manufacturing bottleneck problem and makes hybrid and electric vehicles environmentally friendly starting with their manufacturing process.



Seraph Hu is marketing engineer with Analog Devices

AFTERMARKET

COUNTDOWN



Luca Govean counts down five challenges facing the European aftermarket to help workshops prepare for the future

Few industries operate at such a rapid pace as the European aftermarket. From servicing new vehicles with increasing use of electrical systems, to the struggle to attract top talent and compete with main dealers, independent workshops across Europe are consistently upskilling and adapting their business models to remain competitive.

However, as the industry continues to seek new forms of mobility, adapts to changing political landscapes and moves ahead designing the car of the future, independent workshops must embrace further change and evolve their businesses to keep up. The five key challenges facing the European aftermarket are in reverse order:

5. Adas

What was once a new innovation has quickly become commonplace in new vehicle design and, while workshops may not have overwhelming demand for adas-related work now, they will in the future.

The European Commission recently announced that adas will become mandatory on all new cars from 2021, as they become an integral part of autonomous and electric vehicle design. An understanding of how these systems work and how they are affected by more standardised repair and servicing work is key if workshops are going to take advantage of the new vehicle parc.

An increase in adas-related work means workshops need to pay serious consideration to their floor space and equipment. Unlike when the industry transitioned into computer-controlled engine management systems and some repairers chose to become undercar specialists, there will be no avoiding adas technology.

Even a job as straightforward as a windscreen repair will become a specialist job, since the way that adas equipment is tied into the windscreen means cameras and sensors will inevitably be disrupted, rendering safety systems inefficient.

Not only are specialist calibration and diagnostics tools required to service adas successfully, but the right training is also essential for technicians. Workshops may also need to ensure their business liability is up to date, following factory procedures and document work at every step.

4. Electric and hybrid vehicles

It's hard to believe the electric Nissan Leaf has been available for more than five years and yet many still consider electric and hybrid vehicles a relatively new innovation. In addition to the safety precautions that must be taken to work on an electric vehicle, hybrid vehicles – which many experts expect to become the norm – have further requirements.

Lower viscosity oils required by hybrid vehicles will lead to shorter oil change intervals; however, while some forms of service will become more important, when you remove a traditional combustion engine from a vehicle, you also remove most of the components that are subject to wear, meaning many workshops will have to diversify into other, new service areas.

The crash repair industry will need to undergo significant upskilling to counter the dangers associated with electric vehicles.

Simply removing the battery takes time and specialist care since they are typically protected within an integrated, secure casing to shield against vibration and impact. Even with hybrid vehicles, it's rarely enough to simply turn the petrol or diesel off as this does not necessarily disengage the battery.

The repainting and recoating process must also be reconsidered, as vehicle electrical systems will

not respond well to the high levels of heat generated by drying booths.

Lithium-ion batteries typically used in electric vehicle applications need to be treated with huge respect and must be kept within a specific voltage and temperature range to reduce the risk of explosion in the workshop. There will also be new stipulation pertaining to how these components are disposed of to ensure safe handling at all times.

While electric vehicle development is still in its early stages, many early iterations of electric car, such as the Nissan Leaf, are now finding their way into the aftermarket and technicians need to be ready to convert these opportunities into regular custom.

3. Digitalisation

These days, nearly every vehicle has built-in telematics capability, with digital connectivity set to transform vehicle maintenance and repair. Digitalisation has already changed the way repairers order parts and the next few years will see the focus shift to servicing. New technologies will allow repairers to move even closer to customers, with the proliferation of new channels and interfaces disrupting the norm and opening up business opportunities. Services, such as remote diagnostics, are among the high-margin opportunities that car-generated data creates.

According to the auditing and consulting company, PwC, there will be more than 470 million connected vehicles on the roads by 2025. Besides intelligent connectivity of diagnostic systems, future vehicles will provide more data-driven insights, which enable repairers to predict future servicing and repair requirements more accurately, making for more accurate business forecasts and more effective work scheduling.

A recent McKinsey report suggests that digital-driven products and services will account for a growing share of overall value within the aftermarket. It predicts that their share of aftermarket revenue will increase by a factor of three with growth achieved through hardware, such as telematics devices, sensors and displays.



It's not just parts and servicing where digitalisation promises to disrupt the aftermarket but in the customer journey as well. As the world continues to adopt remote devices, motorists are turning towards the convenience of the internet to purchase products and services.

The nine-to-five of the service world is being forgotten; we're now used to ordering groceries at whatever time we feel like and receiving rapid delivery at a time we choose. The same will be true of vehicle repairs, as motorists expect new service levels and a round-the-clock garage experience. Independent workshops can capitalise on this trend by offering an around-the-clock service, such as any-time secure vehicle drop-offs or remote servicing.

2. Mobility-as-a-service

With a new type of vehicle comes a new ownership model and, as forecasters predict a trend towards autonomous driving, the model of traditional car ownership as we know it is deteriorating. Instead, the roll out of autonomous vehicles as mobility-as-a-service (MaaS) is most likely to be controlled by fleets. While this will create a steadier income stream for independent workshops, fleets typically demand lower cost servicing and the highest quality parts, forcing independent workshops to adapt their existing business models.

With this new form of mobility comes a critical mass of big data, which independent workshops can use to their advantage. By regularly analysing the data collected from customer vehicles,



they can begin to understand in depth the behaviour, preferences and needs of their customers and use this information to tailor marketing campaigns and service offerings.

It's not just in customer relationships that data such as these can prove valuable but in a workshop's own purchasing habits as well. Many large motor factors are already analysing vast data pools to upsell products based on previous activity and help workshops get the very best price for parts. This, in turn, helps make parts ordering more cost-effective for repairers and more profitable when sold on to customers at a higher rate.

1. Access to the customer

The convergence of technologies in the future of the aftermarket is exciting but perhaps the biggest challenge to independent workshops is the same one that has been faced for decades: access to the customer.

With more franchised main dealers attempting to lock customers into servicing agreements to protect warranties and an increase in the number of work provider web sites that act as middle-men between a garage and its customers, it's becoming increasingly difficult to offer the personal service that independent workshops have built their reputation upon. The answer lies in effective marketing and the ability to offer a service that far outweighs that delivered by competitors. The right equipment, parts, staff and location will all play a part.

During an age when consumer choice has never been greater, the biggest threat facing an independent repairer is in not being able to access the customer directly to build mutual long-term relationships. It is for this reason that the independent sector needs to embrace new technologies and trends more than ever.

Independent repairers can no longer afford to turn down work because they've not kept up with changes in the automotive industry. Investment in skills, people and equipment is a must. By working closely with major parts manufacturers and staying abreast of new products entering the market, technicians can stay one step ahead of their customer's future servicing and repair needs. By harnessing technology and embracing digitalisation, the independent sector can deliver more personalised services, predictive maintenance and support throughout the lifecycle of a vehicle.

Conclusion

While several trends may seem light years away from the type of work technicians receive at their workshop today, the industry travels at such a pace that we never truly know what tomorrow might bring. By remaining agile, responsive and alert, Europe's independent sector can continue to thrive no matter what the future has in store.



Luca Govean is Denso's director of independent aftermarket sales

Sensor checks pressure in evap units

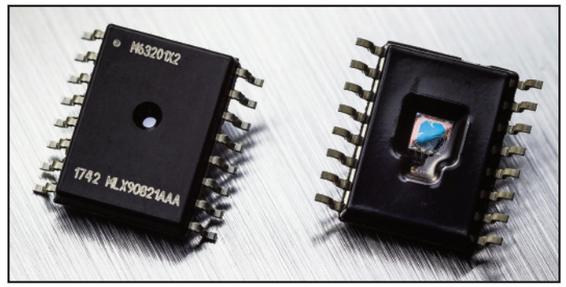
A relative pressure sensor IC from Melexis can measure very low pressures in automotive applications.

Using mems technology integrated with an analogue signal chain and digital signal processing, the MLX90821 is a system-in-package IC for the reliable measurement of fuel vapour pressure as low as 50mbar and up to 700mbar. This makes it suitable for evap systems designed for internal combustion engines or hybrid vehicles.

Implementing fuel pressure vapour detection using evap (evaporation) systems is increasingly important for automotive manufacturers, as more regions introduce legislation prohibiting the venting of fuel vapour to the atmosphere.

As vapour builds up inside fuel tanks and crank cases, the evap systems are designed to capture, store and responsibly dispose of the vapour, preventing it from escaping into the air.

Pressure sensors such as this that can operate at very low pressures are a crucial part of these systems, as they can detect even the smallest leaks that can appear at any point in the evap system.



Its easy-to-seal packaging is certified to operate between -40 and +150˚C and comes with PPAP support.

While being small enough to be used in any size module, the integration provided through the system-in-package approach is said to make designing with the IC easier, providing what is essentially a plug-and-play approach.

While both analogue and sent outputs are provided, the DSP offers the ability to make full use of the sent interface's fast and slow channels, add diagnostic messaging and apply custom calibration.

The device has automotive diagnostic features such as clamping levels, broken track diagnostics and multiple internal fault diagnostics.

The system-in-package approach uses a mems sensor manufactured through back-side etching. This allows the sensing element to be exposed to the vapour or other media while providing protection against contaminants present in harsh environments such as fuel vapour systems.

The cmos part of the system has been developed to deliver design flexibility, while the entire sensor provides EMC protection and immunity.

Each sensor IC is calibrated during the final steps of manufacture, with the pressure transfer curve and clamping levels stored in the internal eeprom. The measurement is provided through the ratiometric analogue output or as a sent output, which may also contain temperature measurements.

An optional NTC temperature compensation feature makes use of an external NTC, which may be required when the application also needs to record an accurate temperature measurement of the media being monitored. Further configuration is possible using software tools provided.

Bipolar transistors

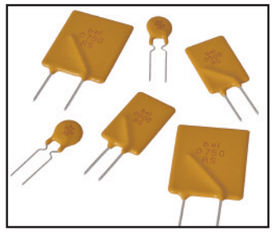
Automotive AEC-Q101-qualified and consumer and industrial-qualified MJD 3 and 8A power bipolar transistors are available from Nexperia.

The product family includes eight parts housed in the DPak (TO-252 and SOT428C) package and offered in 80 and 100V npn and pnp versions.

These devices in industry-standard footprint complement the firm's portfolio of bipolar power transistors in the LFPak 56 package and expand the company's total power bipolar discrete offering.

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





Resettable fuses

Resettable PPTC fuses for automotive use are available from Bel Fuse-Circuit Protection.

The 0ZRS radial fuses are AEC-Q compliant and have an operating range of 500mA to 10A, a maximum current of 100A and continuous use at voltages up to 32V DC, with an operating temperature of -40 to +125˚C.

With low resistance and high hold current, the devices are designed for applications such as motor and motor circuit protection (power door locks, mirrors, seats, sunroofs and windows), ECU IO protection, HVAC motor and IO protection, infotainment and navigation systems, LCDs, power and cigarette lighter outlets, plugs and adapter-chargers, and stall detection in express window and sunroof circuits.

They are RoHS 2 compliant, halogen free and meet AEC-Q200. Approvals include TÜV (EN/IEC 60738-1-1 and 60730-1) and UL1434.

Packaging varies from 1000 to 3000 pieces. Bulk is available for all and tape and reel for most.

Chipset enables PCIe connectivity

A chipset from Valens is said to provide the high-speed bandwidth and resilience required for applications in connected and autonomous cars, guaranteeing a flexible and future-proof architecture.

The VA608A chipset delivers data transmission speeds of up to 16Gbit/s and lets car makers extend native PCIe as a long-distance in-vehicle connectivity technology up to 15m. It enables 2.5Gb Ethernet over a single unshielded twisted pair (UTP) wire with near-zero latency.

This should let OEMs and tier-ones use an array of existing components without requiring a complete redesign of the vehicle's architecture. This leads to reduced costs and wiring complexity, and the ability to use more powerful technologies with increased speed and functionality.

The PCIe extension technology is designed for many use cases in the vehicle including telematics, multi-modem smart antennas (5G, wifi, WiGig, BT and so on), ECU-to-ECU connectivity, and shared storage and black box storage. It also simplifies high-speed, low latency, power-efficient backbone architecture.

It is scalable technology designed to handle harsh EMI and environmental interference in the vehicle landscape. The chipset is an asic prototype and is available.

LED driver targets rear lights

A 12-channel LED driver from ST Microelectronics targets automotive rear combination lamps and interior lighting, bringing features to support complex and innovative visual effects.

Independent 7bit PWM dimming on all channels of the ALED1262ZT allows flexible control of tail, stop and indicator lights, with dynamic effects.

Each channel delivers constant output current at 19V for controlling multi-LED series strings. Adjustment from 6mA to 60mA ensures a wide dimming range with high maximum brightness.

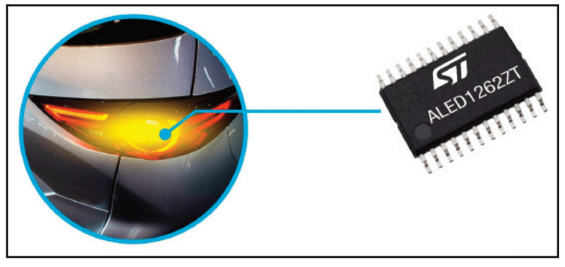
The driver responds to I²C commands from a host microcontroller and provides two pre-programmed configurations that allow standalone operation for flexibility.

With diagnostic features including open-LED detection and over-temperature warning with thermal shutdown, the device is said to ensure long-lasting robustness and stability.

The input-voltage from 5.5 to 38V allows use in direct battery-connected systems. In addition, it is for low-noise operation, with slow turn-on-off time per channel and spread-spectrum clock operation to simplify integration with other in-vehicle electronics.

The device is in production now in a 6.4 by 7.8mm thermally efficient HTSSOP24 exposed-pad package.

An evaluation board, the STEVAL-LLL002V1, is available.



Software boost for cyber security

To increase cyber security in vehicles, vHSM from Vector Informatik is a software stack for hardware security modules that contains various cryptographic functions.

The stack not only supports current issues such as SecOC secure onboard communications and secure boot, it also addresses future requirements such as IPsec and TLS transport layer security.

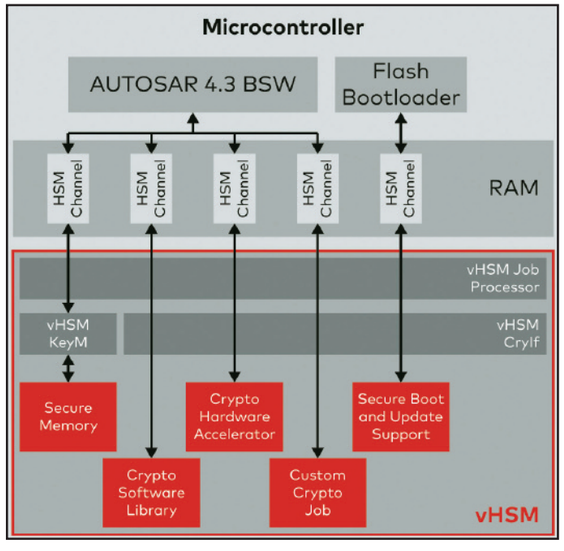
It has been designed as modular and configurable software, and can be seamlessly integrated into an ECU with any Autosar Basic software.

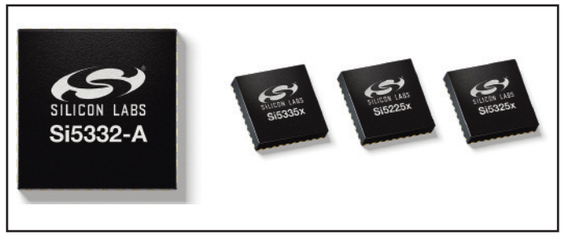
Configuration and expansion options make it possible to customise the software stack to the desired use case. It can shorten the development times of ECU projects by avoiding extensive iteration loops.

The crypto driver supplied was developed to ISO 26262 Asil D, and it offers a standard interface to Autosar Basic software.

It is available for hardware security modules integrated in microcontrollers and that have become established as hardware trust anchors.

The software offers an abstraction of the hardware and provides the user with an Autosar-conformant interface for different hardware platforms. In addition, it supports various hardware accelerators that permit efficient execution of complex algorithms.





Timing chips meet AEC-Q100

Automotive grade timing products from Silicon Labs can meet the clocking needs of in-vehicle systems.

The devices include the Si5332 any-frequency programmable clock generators, Si5225x PCIe Gen1/2/3/4/5 clocks, Si5325x PCIe buffers and Si5335x fanout clock buffers.

These devices can help automotive OEMs and tier-one suppliers simplify clock tree design, reduce system points of failure, increase system reliability and optimise the performance of high-speed serial data transfer.

The devices target automotive applications such as camera sub-systems, radar and lidar sensors, adas, autonomous driving control units, driver monitoring cameras, infotainment systems, Ethernet switches, and GPS and 5G connectivity.

Operating temperature is -40 to +105˚C.

Consolidating multiple reference clocks into one clock generator IC reduces the number of quartz crystals and oscillators in a design, so there are fewer potential points of failure.

The Si5332 clock leverages the firm's MultiSynth technology to provide any-frequency, any-output clock synthesis with lower jitter.

Supporting up to eight clock outputs, selectable signal formats per output clock (LVDS, LVPECL, HCSL, LV cmos) and independent 1.8 to 3.3V VDDO, the Si5332 clock interfaces to various FPGAs, asics, Ethernet switches, phys, processors, GPUs, SoCs and PCIe Gen1/2/3/4/5 and NV Link serdes.

Clock synthesis, clock distribution and format and level translation are consolidated on-chip, enabling a single-IC clock tree.

The clock generators and clock buffers are configurable and customisable using the firm's ClockBuilder Pro software.

Samples and production quantities are available in 32-QFN and 40-QFN packages. Evaluation boards are available.

GNSS module offers metre-level positioning

Metre-level positioning technology from U-Blox provides GNSS performance for automotive and high-end telematics applications.

The M9 technology platform uses the UBX-M9140 GNSS chip. The Neo-M9N module can receive signals from up to four GNSS constellations (GPS, Glonass, Beidou, and Galileo) concurrently, to achieve positional accuracy even in difficult conditions such as deep urban canyons.

Position update rate is up to 25Hz, enabling dynamic applications such as helping UAVs receive position information with low latency.

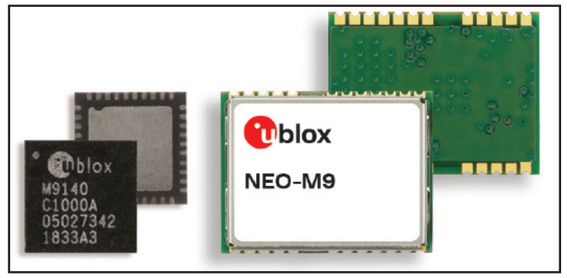
Features include filtering against RF interference and jamming, spoofing detection, and detection algorithms that enable it to report fraudulent attacks quickly so that users' systems can react to them in a timely fashion.

A saw filter with an LNA in the RF path is integrated in the module. This setup guarantees normal operations even under strong RF interferences, for example when a cellular modem is co-located with the module.

The Explorer Kit M9 development board lets designers assess the technology.

The plug-and-play device is supplied with U-Start software, which includes pre-set scenarios so users can explore the performance of the device.

It complies with ISO/TS 16949, ISO 16750 and AEC-Q100 standards.



Flexible level shifters work at 125˚C

Two flexible automotive-compliant voltage translators from Diodes are for use in environments with ambient temperatures up to +125˚C.

The PI4ULS5V108Q and PI4ULS5V202Q are for adas, infotainment and telematics use.

Both are compatible with either push-pull or open-drain connections, delivering the convenience of a single part number to address multiple applications. In addition, bidirectional flexibility with automatic direction sensing can simplify level shifting between bus interfaces, such as SM Bus, PM Bus or I²C devices, by eliminating the need for a direction-control signal.

The eight-channel PI4ULS5V108Q performs up-translation at up to 100MHz and down-translation at over 100MHz, delivering responsive performance for use in high data-rate interfaces.

Designers can ensure fast exchanges across SPI or other interfaces, with no limitation due to level shifting. This enables data transfers between system-on-chip and peripheral components to be executed efficiently.

The PI4ULS5V202Q is a two-channel translator with internal 10kΩ pull-up resistors, allowing direct connection to interfaces with open-drain topology, such as I²C ports.

The maximum voltage-translation range of 1.2 to 5.5V provides flexibility to work with various I²C chips and circuit designs. It has fast rise and fall times, due to high-speed one-shot detectors at the IC inputs and can support data rates of up to 20Mbit/s.

Both devices are AEC-Q100 grade one qualified, PPAP capable and in production at IATF 16949 certified sites.



SiC mosfets charge EVs

Six trench gate structure SiC mosfets from Rohm are suitable for electric vehicle charging stations.

The SCT3xxx xR devices use a four-pin TO-247-4L package that increases switching performance, making it possible to reduce switching loss by up to 35% over conventional three-pin packages.

With three-pin packages, the effective gate voltage at the chip reduces due to the voltage dropped across the parasitic inductance of the source terminal. This causes the switching speed to reduce.



Adopting the four-pin package separates the driver and power source pins, reducing the effects of the parasitic inductance component. This makes it possible to increase the switching speed.

Six models are offered, three each with a breakdown voltage of 650 and 1200V.

An evaluation board is equipped with the company's gate driver ICs optimised for driving SiC devices along with multiple power supply ICs and additional discrete components that facilitate application evaluation and development.

The board can be used for double pulse testing as well as the evaluation of components in boost circuits, two-level inverters and synchronous rectification buck circuits.

Interior LEDs present colourful combinations

Lighting products from Everlight Electronics suit automotive interior applications. The EL Smart LED series can present colourful combinations.

The package technology is said to achieve improved uniformity of light, and an embedded intelligent IC driver can manage colours and adjust brightness via a controller.

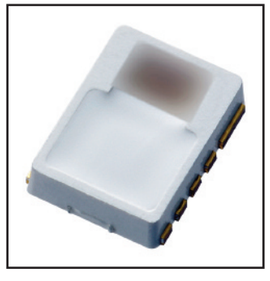
Targeting OEMs, the integrated driver IC allows control of thermal runaway by temperature sensing of the red LED.

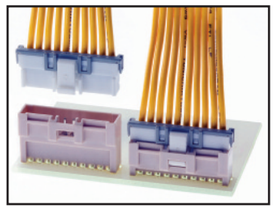
Up to 4000 LEDs can be ganged in series via the Lin interface with a transmission speed of 2Mbit/s.

They have been developed to meet AEC-Q102.

Applications include interior light, roof reading lighting and dashboard display.

The dimension of the SMD package is 3.0 by 4.1mm.





Wire-to-board and wire-to-wire connector

A 2mm wire-to-board and wire-to-wire connector system from Molex provides electrical and mechanical reliability in a high-temperature designs in consumer and automotive markets.

The Micro TPA has a current rating up to 2.5A for use within constrained spaces.

It has the advantage of two to 15 circuits in a wire-to-wire connector system, acceptance of a range of wire sizes, crimp terminals that are already popular in the market, TPA retainers, positive lock structure, RoHS compliance and high-temperature capabilities, vertical through-hole headers, and a 2.00mm pitch.

A raised bottom and ledge on the connector allows potting material to cover the entire PCB, preventing water from entering the connector and eliminating otherwise typical conductivity issues.

Temperature range is -40 to +105˚C and cable 0.85 to 1.50mm.

Functional safety extended to 8bit MCU

IAR Systems has extended its safety-related software with a certified version of its development tools for ST Microelectronics' 8bit STM8 MCUs, used for automotive and industrial applications.



The functional safety edition of IAR Embedded Workbench for STM8 is certified by TÜV SÜD according to IEC 61508, the umbrella standard for functional safety, as well as ISO 26262.

The certification also covers IEC 62304, which specifies life cycle requirements for the development of medical software and software within medical devices, and the European railway standards EN 50128 and EN 50657.

This is a functional safety edition of the complete C/C++ compiler and debugger toolchain. The quality assurance measures and the included safety manual allow the use of Embedded Workbench in safety-related software development without further tool qualification.

The certification has been proceeded by a thorough assessment of how IAR develops, tests and supports its software, and validates the quality of the entire development process, as well as the delivered software.

The edition includes a functional safety certificate and a safety report from TÜV SÜD. The certified tools provide a functional safety support and update agreement with support for the sold version for the longevity of the contract. Along with prioritised technical support, the agreement includes access to validated service packs and regular reports of known deviations and problems.

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