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+

ALSO ON PAGE 12: HOW SMART SWITCHES IMPACT AUTOMOTIVE APPLICATIONS

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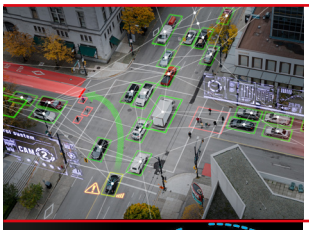
CONTENTS



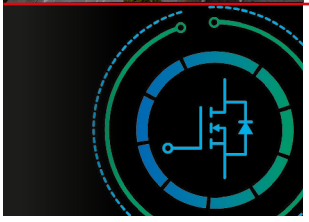
10 WI-FI HALOW
Designing remote wireless systems for the edge



12 SMART SWITCHES
How smart switches impact automotive applications



16 AUTOMOTIVE
The silent backbone of connected mobility



20 POWER
Full lineup of Events for APEC 2026

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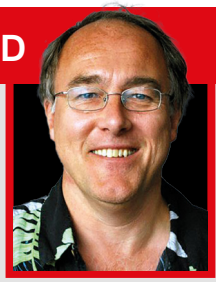
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EDITOR'S WORD



Power takes center stage

In my younger days, power often felt like an afterthought. Today, power has emerged as one of the most fascinating—and consequential—domains in electronics. It's a space where physics, materials science, sustainability, and clever engineering intersect in endlessly inventive ways.

Consider energy harvesting, where designers coax useful power from ambient sources such as light, heat differentials, vibration, or stray RF signals. These technologies are enabling classes of devices that can operate autonomously for years, sometimes decades, without human intervention.

Meanwhile, battery innovation is accelerating rapidly. Iron-air systems promise low-cost grid storage, silicon-carbon chemistries push energy density ever higher, graphene enhances performance and durability, and solid-state batteries hint at safer, lighter, and longer-lasting energy storage across countless applications.

And then there's the other end of the spectrum entirely. From companies developing small modular reactors (SMRs) to ongoing efforts to finally bring fusion power online, the scale of ambition is extraordinary.

Power, once taken for granted, now sits squarely at the heart of modern design challenges and opportunities. Whatever direction these technologies take, you can be sure that the team here at DENA will be right there, keeping you informed about the latest and greatest developments.

Max Maxfield

CLIVE 'MAX' MAXFIELD
Editor, DENA



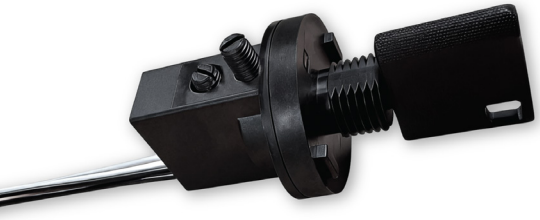
TOP STORY
Touchscreen controllers

Microchip Technology has expanded its maXTouch M1 family of touchscreen controllers to bring reliable, secure touch detection to an even broader range of automotive displays, now covering free-form widescreen displays up to 42 inches and down to small, compact screens in the 2-to-5-inch range. The ATMXT3072M1-HC and ATMXT288M1 products are designed to work with a wide variety of display sizes, while supporting emerging technologies such as Organic Light Emitting Diodes (OLEDs) and microLEDs.

The M1 controllers utilize Microchip's proprietary Smart Mutual touch acquisition scheme and advanced algorithms to boost the touch Signal-to-Noise Ratio (SNR) by up to 15 dB compared to previous generations. Smart Mutual technology is engineered to deliver reliable touch detection even on integrated touch sensors exposed to high capacitive loads and significant display noise coupling. This capability is particularly critical for large, thin displays such as on-cell OLEDs, where embedded touch electrodes are subjected to higher capacitive loads and increased noise coupling, raising the risk of false or missed touch detections with other capacitive solutions.

The ATMXT3072M1-HC is designed for large, continuous touch sensors that cover both the cluster and center information display (CID), addressing the needs of left- and right-hand-drive vehicles with a single hardware design. For small screens, the ATMXT288M1 is designed to meet the growing demand for compact automotive display solutions, such as traditional analog clocks and AI driver assistants, where physical space is limited.

www.microchip.com



Magnetic key switches

Standex Electronics has announced the launch of the KS01 Reed Technology Key Switch for secure On/Off control for industrial and commercial applications. Engineered for environments where reliability is non-negotiable, the KS01 delivers exceptional durability, long service life, and peace of mind for OEMs and end-users alike.

Traditional mechanical key switches often fail under exposure to moisture, chemicals, and dust, leading to costly downtime and maintenance. The KS01 solves these challenges with magnetic non-contact switching and hermetically sealed reed technology, eliminating corrosion and mechanical wear. This design ensures millions of fault-free operations, even in the harshest conditions.

www.standexelectronics.com

Standardized FPGA modules

The Standardization Group for Embedded Technologies (SGET) has announced the official release of the Open Harmonized FPGA Module (oHFM) specification. As the world's first open and vendor-independent FPGA module standard, oHFM brings the proven success of Computer-on-Module (COM) principles to the FPGA ecosystem, offering a new level of flexibility for developers and silicon partners alike.

Traditionally, FPGA-based designs required highly specialized carrier board layouts, often tailored to a specific silicon architecture. The oHFM standard introduces a harmonized pinout and interface philosophy that complements the offerings of leading silicon vendors. This allows developers to more easily scale their designs across different performance classes and manufacturers, reducing design complexity and accelerating time-to-market.

www.sget.org/standards/ohfm



Tough plastic enclosures

OKW's ROBUST-BOX (IP 66) plastic enclosures for industrial electronics are now available in tough polycarbonate (PC) as standard, complementing the existing ABS version. ROBUST-BOX is ideal for a wide range of wall-mount and desktop electronic and electrical applications, including HVAC, machine building, construction, push-button controllers, sensors, measuring equipment, and gateways.

PC (UL 94 HB) ROBUST-BOX offers high heat resistance for use in harsh environments. Its ABS (UL 94 HB) counterpart is approved for terminal mounting. Both case shells are equipped with pre-molded threads, enabling designers to choose either the flat or the high part as the base. Each shell has a recessed operating area to protect a membrane keypad or product label.

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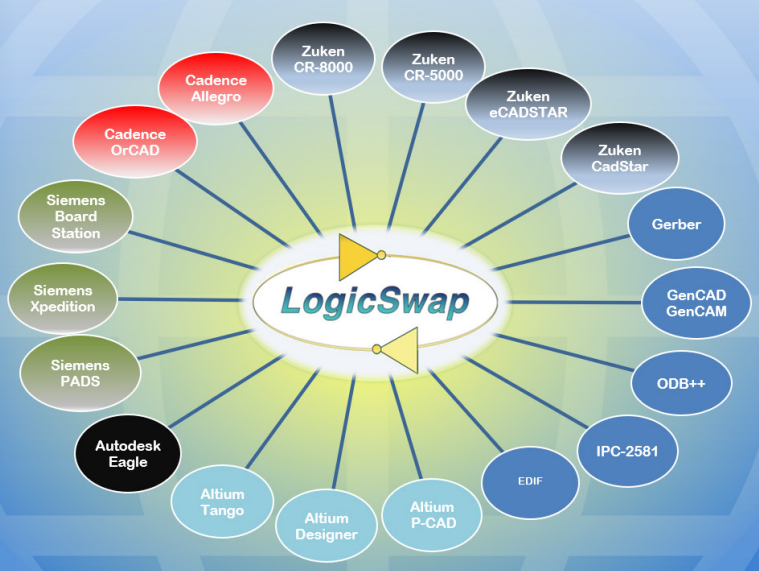
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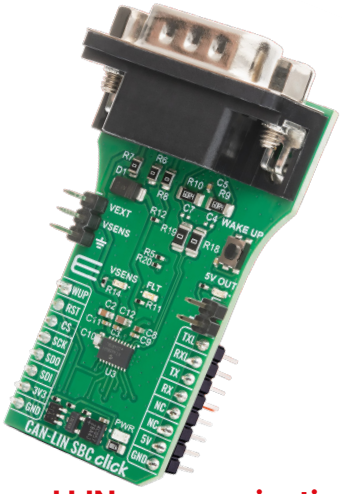
Design migration

Zuken and LogicSwap Solutions have created a free migration module that enables users of Cadence OrCAD to migrate existing PCB designs, schematics, and libraries to Zuken's modern, internet-connected PCB design platform, eCADSTAR.

This software provides a direct and automated path for converting legacy OrCAD data into eCADSTAR-compatible formats, minimizing the effort and risk typically associated with tool migration. The LogicSwap solution represents an important step for customers seeking to modernize their EDA environments and consolidate legacy design data within eCADSTAR. The module is available free to licensed eCADSTAR users and can be downloaded from LogicSwap's website.

www.zuken.com
www.logicswap.com



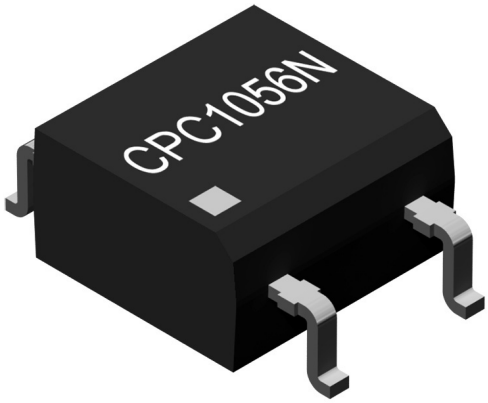


CAN and LIN communication

MIKROE has introduced a new communication interface, the CAN-LIN SBC Click. The compact Click add-on boards enable developers to rapidly provide proof-of-concept, then prototype and code new embedded projects. CAN-LIN SBC Click provides high-speed communication over both Controller Area Network (CAN) and Local Interconnect Network (LIN) interfaces, ensuring robust, dual-protocol connectivity between automotive and industrial subsystems.

This new Click board is ideal for automotive body electronics, industrial automation, and other embedded systems that require simultaneous dual-protocol CAN and LIN communication with advanced power management and fault protection. It supports partial networking, low-power operation with local and remote wake-up, bus biasing, diagnostic and protection features, and robust EMC/ESD performance for reliable operation in harsh environments.

www.mikroe.com



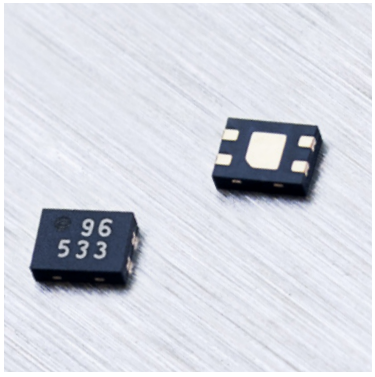
Solid-state relays

Littelfuse has introduced the CPC1056N, a compact, high-performance 60V, 75mA 1-Form-A solid-state relay (SSR) designed to meet the growing demand for fast, efficient, and space-saving switching solutions in next-generation electronics systems.

Featuring a solid-state design with no moving parts, the CPC1056N delivers silent, maintenance-free operation and avoids EMI/RFI interference. It offers high input-to-output isolation (1500 VRMS) and fast 3ms switching speeds. It operates with an ultra-low LED trigger current of 0.5mA, enabling direct drive from low-power TTL or CMOS logic without additional circuitry.

Housed in a compact 4-pin SOP package, the CPC1056N meets EN50130-4, UL 1577, and EN 62368-1 standards, making it ideal for security, medical, industrial automation, smart meters, and EV charging infrastructure applications.

www.littelfuse.com



Micropower linear Hall-effect sensors

Melexis has unveiled the MLX90296, a new micropower linear Hall-effect sensor that draws less than 5µA at 100Hz and integrates digital filters for enhanced performance. Its flexible architecture is available in multiple pre-configured variants under different part numbers, enabling short lead times and supporting a wide range of battery-powered applications, including keyboards, game controllers, smart IoT interfaces, industrial automation systems, and more.

Traditional mechanical potentiometers suffer from wear and limited configurability, while legacy Hall-effect and linear sensors often fall short of current requirements for power efficiency, miniaturization, and precision. The MLX90296 addresses these challenges with a micropower design, compact DFN-4L footprint, and fully digital signal path.

www.melexis.com

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Advanced aluminum enclosures for power applications

As power densities rise, enclosure engineering becomes a first-order concern

By **Sean Bailey**, President of **OKW Enclosures, Inc**.

As power conversion and management equipment becomes more compact yet more capable, the role of precision-engineered rack-mount and desktop enclosures has never been more important.

The global transition toward electrification, renewable energy, and distributed power systems is accelerating. Specifying robust, easily customizable enclosures is vital in ensuring the reliability and longevity of today's modern power devices.

Aluminum enclosures balance strength, weight, and thermal performance, making them ideal for applications ranging from data center infrastructure to energy storage and building power systems. Aluminum's ability to be anodized or powder-coated in various finishes enhances both appearance and durability, while also providing corrosion resistance.

Large 19" rack systems dominate major installations where multiple power modules or subsystems must coexist within a confined footprint. These include uninterruptible power supplies (UPS), DC power distribution units, rectifier systems, energy storage converters, and battery management interfaces for modular storage systems.

In renewable energy applications, rack-based converters and controllers serve as the interface between battery banks, solar inverters, and the utility grid. In industrial or commercial building settings, rack systems often host load-balancing equipment and monitoring electronics that ensure the stable operation of distributed power systems.

Rack cases intended for these applications need good structural integrity. Heavy components such as transformers, inductors, and heat sinks call for enclosures that maintain rigidity without excessive weight. Aluminum's high strength-to-weight ratio allows for a lightweight chassis that resists deformation.

Thermal management is equally vital. High-power electronics generate substantial heat, and aluminum's natural thermal conductivity helps to dissipate it efficiently. Designers frequently integrate heatsinks into the chassis, leveraging the metal's ability to evenly distribute heat. Airflow management must be carefully modelled to ensure safe operating temperatures under continuous load.

Electromagnetic compatibility (EMC) and grounding also shape enclosure design. Aluminum enclosures can provide excellent EMI/RFI shielding when properly grounded, preventing interference in a dense rack environment. Precision-machined mating surfaces and conductive finishes help to maintain electrical continuity across panels.

Accessibility and serviceability round out the design priorities. Downtime is costly in power-critical environments, so enclosures must offer easy access. Bezels allow the front panel to be removed while the case is still in the rack. However, this design can limit the availability of custom heights, and it's usually more expensive.

For these reasons, flat-fronted models such as METCASE's COMBIMET 19" are highly popular. COMBIMET enclosures can be quickly pulled from a rack, with removable top, base, and rear panels providing easy access. Smart design also makes COMBIMET simple to customize. Many custom COMBIMET designs have since become standard, including superdeep (24"), open-top, and smooth-top versions.

Desktop enclosures typically serve smaller, more specialized power systems, such as laboratory equipment, small UPS units, or controllers for distributed energy storage and microgrid management. Though small, these devices still demand careful consideration of mechanical strength, safety, and thermal control.

For desktop enclosures, the user interface becomes central to the design. Operators interact directly with these devices, so the enclosure must balance form and function, providing clean, modern aesthetics while maintaining ergonomic access to displays and controls. Models such as UNIMET-PLUS speed up installation by allowing PCBs to slide in and out on guide rails.

PCB guide rails are also available as accessories for premium TECHNOMET enclosures, which offer a modern, cohesive design with no visible fixing screws. Diecast front and rear bezels fit flush with the case body for a smooth appearance, and unlike many rival designs, TECHNOMET can be specified in bespoke heights, widths, and depths.

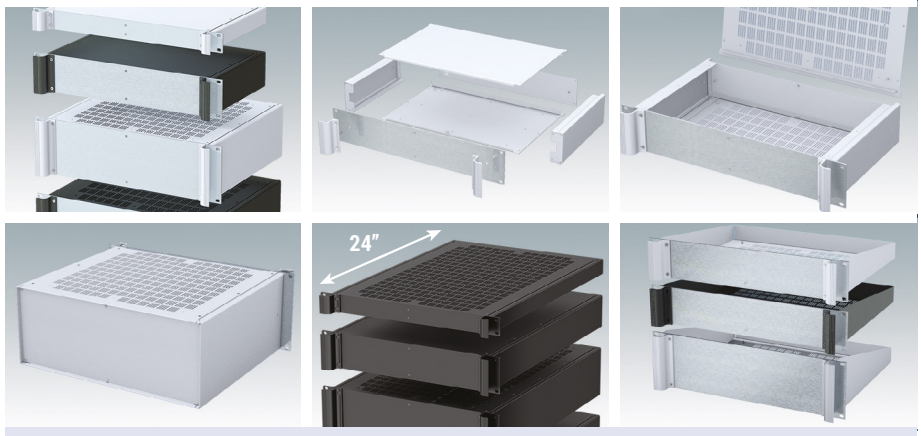
As OKW Enclosures, Inc. Sales Manager Rob Macek says: "Every enclosure will require customization of some form, usually machined and printed front and rear panels. New technology has made customization more cost-effective, even in low volumes. It pays to partner with a specialist enclosures manufacturer that carries out all the customization work in-house, ensuring quality and accountability throughout the entire process."

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Designing remote wireless systems for **the edge**

Why Wi-Fi HaLow changes the equation

By **Andy McFarlane**, Vice President of Marketing at **Morse Micro**

Designers working on remote and distributed systems have, for over a decade, faced a familiar challenge: connectivity is a limiting factor that restricts the breadth of their thinking and the impact of the solutions they develop. Whether in industrial automation, smart infrastructure, agriculture, or large commercial buildings, modern systems increasingly rely on devices deployed far from traditional network access points. For engineers designing products that must operate reliably across large sites or in difficult environments, the wireless link itself has been the primary constraint for far too long.

The requirements are clear. These systems must be secure, scalable, power-efficient, and simple to deploy and maintain. Yet many traditional connectivity options force compromise. Wired solutions offer reliability but add cost, complexity, and rigidity. Cellular or satellite networks provide wide-area coverage but introduce recurring fees, higher power consumption, and operational overhead. Short-range wireless technologies, including conventional Wi-Fi, struggle with range, penetration, and device density as deployments move beyond controlled indoor spaces.

As a result, designers often combine multiple technologies, gateways, proprietary radios, and mesh networks to make systems work. This increases cost and complexity while reducing long-term flexibility.

Where traditional approaches fall short

Conventional Wi-Fi operating at 2.4GHz and 5GHz was designed for high throughput over short distances. Performance degrades quickly in environments with walls, metal structures, or outdoor deployments, requiring dense access-point layouts and careful planning. Scaling beyond hundreds of devices often means more hardware, more maintenance, and higher cost.

Low-power wide-area technologies address range and energy efficiency but sacrifice throughput and native IP connectivity. This limits their usefulness for applications that require firmware updates, diagnostics, or data-rich sensing, and often forces designers to rely on proprietary protocols and translation layers.

What engineers increasingly need is a single wireless technology that delivers long-range coverage, low power operation, high device density, and native IP networking, without adding architectural complexity.

A different wireless foundation

Wi-Fi HaLow, based on the IEEE 802.11ah standard, was created specifically to address these challenges. Operating in the sub-GHz spectrum, Wi-Fi HaLow provides significantly greater range and penetration than traditional Wi-Fi while retaining the simplicity of IP-based networking.

From a design perspective, the benefits are practical and measurable. Sub-GHz signals travel farther and penetrate walls, floors, and industrial materials more effectively, enabling reliable coverage across large facilities, campuses, farms, and industrial sites with far fewer access points. A single Wi-Fi HaLow access point can support thousands of devices, dramatically simplifying network design.

Power efficiency is equally important. Wi-Fi HaLow was engineered for battery-powered devices, making it suitable for sensors, meters, locks, cameras, and controllers that must operate for months or years without maintenance. At the same time, data rates are sufficient to support firmware updates, diagnostics, and edge intelligence—capabilities that were previously impractical over long-range wireless links.

Designing for scale, security, and longevity

Because Wi-Fi HaLow is part of the Wi-Fi ecosystem, it supports standard IP networking and WPA3 security. This simplifies integration with existing IT infrastructure, cloud platforms, and edge computing systems, while avoiding proprietary security models.

From a lifecycle standpoint, this matters. Systems designed today must adapt over time as requirements evolve. Wi-Fi HaLow supports over-the-air updates, evolving security standards, and the addition of new device types without requiring wholesale network redesigns.

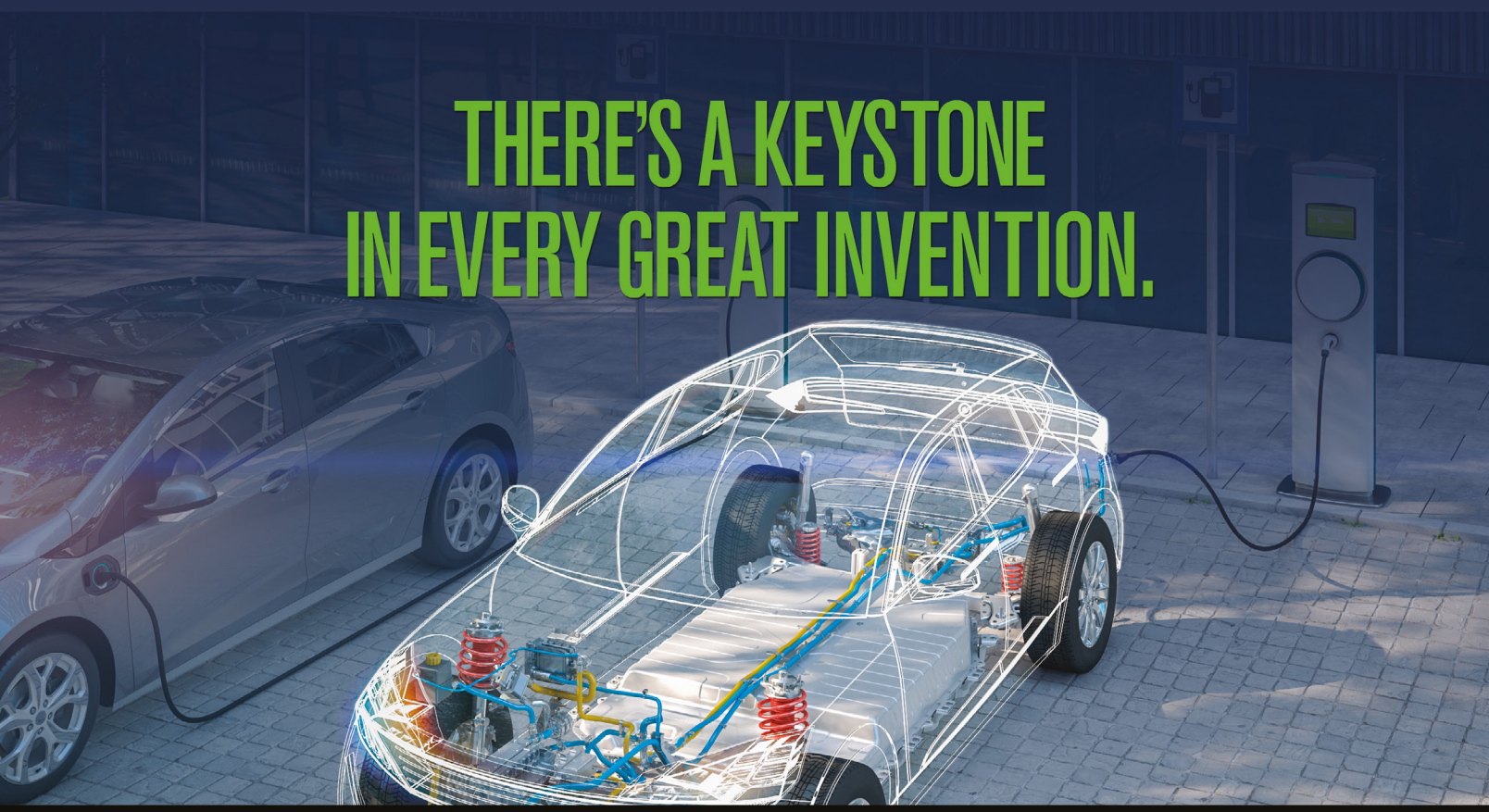
A practical path forward

As remote wireless becomes central to modern system design, long-held assumptions about Wi-Fi's limits are being re-examined. Wi-Fi HaLow offers designers a practical alternative to complex, fragmented connectivity architectures.

By combining long-range, low-power operation, high device density, and native IP connectivity, Wi-Fi HaLow enables simpler, more resilient designs, providing a wireless foundation that finally aligns with real-world requirements for remote and distributed systems.

www.morsemicro.com

THERE'S A KEYSTONE IN EVERY GREAT INVENTION.

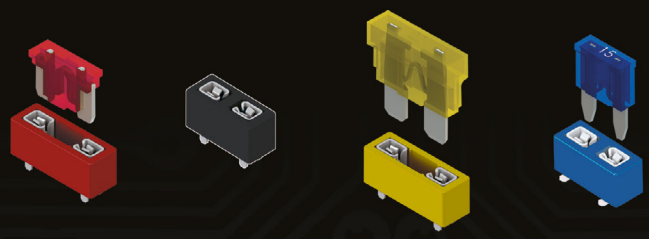


ELECTRIC VEHICLES (EV) & THEIR ELECTRONICS

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The Electric Vehicle (EV) began its commercial life in 1997 with the Toyota Prius, the world's first mass-produced hybrid. The EV has gradually gained mainstream acceptance, and up until recently, the Driverless Vehicle or Autonomous Vehicle (AV) seemed a product of science fiction. AV looks to be the next milestone in automotive evolution.

EVs and AVs will continue to develop new electronic devices and equipment, both under the hood and inside the compartment, to make these vehicles more in line with gas powered cars. Doing so will be necessary for long term commercial success.



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How smart switches impact **automotive** applications



Next-generation switching for demanding automotive environments

By **Daniel West**, Lead Technical Applications Engineer, **KYOCERA AVX**

Turning something on with a switch is one of the most intuitive ideas in electronics. From a young age, we learn that flipping a wall switch creates light, and we carry this simple cause-and-effect model forward as we interact with toys, appliances, smartphones, and countless other devices.

However, the idea that current is simply flowing or not flowing oversimplifies what actually happens in complex electronic systems. In reality, current magnitude and frequency matter, revealing that even "simple" switching often requires significant engineering. Poorly designed switches can become an overlooked cause of faulty operation or a safety hazard.

As electronics have advanced, switch technology has evolved alongside them to meet increasingly demanding power requirements. Unsurprisingly, some of the most advanced switching solutions have emerged from automotive applications, where switching power on and off must survive particularly harsh conditions.

Relays have traditionally been used to electrically isolate control circuitry from high-power loads. Mechanical relays, however, are relatively slow and subject to wear mechanisms that can be difficult to diagnose and repair. Contacts can pit over time, leading to arcing that injects noise into the system or causes unintended switching states. Coils can also degrade, altering the switching characteristics assumed by the control circuit.

Solid-state relays (SSRs) eliminate many of these mechanical issues, offering consistent switching behavior and longer lifetimes. Their drawbacks include a tendency to fail short-circuit and the need for additional protection components. In high-power DC applications, rapidly interrupting current with SSRs remains especially challenging. The typical solution is a pyrotechnic fuse, which is effective but loud, destructive, and not resettable.

Recent advances in switching technology combine the reliability of SSRs with ultra-fast overcurrent protection that outperforms pyro fuses and is remotely resettable. The Kyocera AVX Smart Switch exemplifies this approach. It is a silicon carbide (SiC)-based SSR with integrated current sensing and control electronics that can be pre-programmed or reconfigured after installation, hence the term "smart." SiC devices inherently support extremely fast switching at high power levels, with current modules rated up to 930VDC, 800A continuous, and 2.4kA for short pulses.

What truly distinguishes the smart switch is its ability to detect and interrupt overcurrent events at unprecedented speed, delivering a significant safety advantage. Testing shows that the switch detects overcurrent conditions in approximately 2µs. In a comparative test using a 2000A trigger threshold, a battery management system (BMS) relying on CAN communication required nearly 3ms to detect the same event. By the time the pyro fuse began interrupting the current, it had reached almost 20kA. In contrast, the smart switch detected the event within 2µs, keeping the current well below 3000A when interruption began.

The smart switch's electronic fuse is also resettable and silent, eliminating both fuse replacement and the explosive discharge associated with pyro fuses. Durability testing showed virtually no degradation after two million fuse cycles.

Supporting this combination of speed and power density requires packaging with low inductance and excellent thermal performance, while still meeting size and weight constraints. Accurate modeling and simulation aligned with manufacturing capabilities enable scalable designs optimized for size, weight, and power. The integrated controller remains accessible for customization of $RDS_{(on)}$ and fuse thresholds, and IGBT-based smart switch variants are also available.

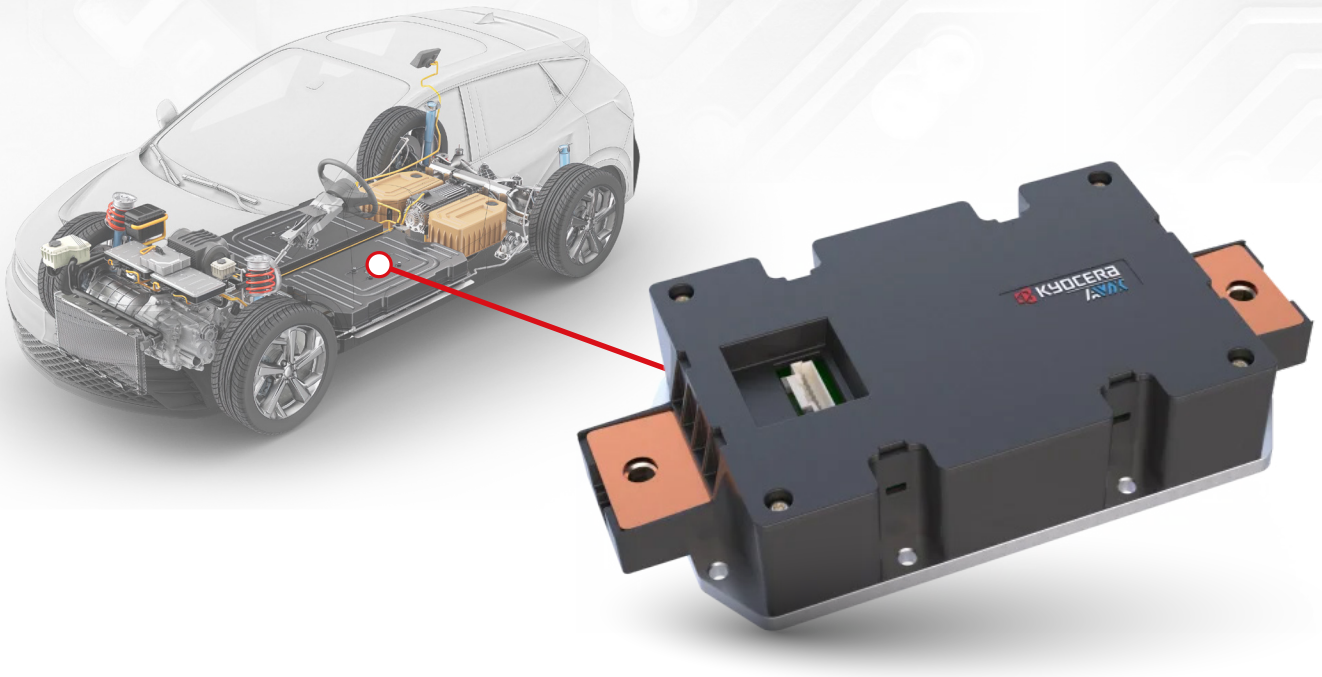
While improved overcurrent response is clearly valuable for electric vehicles, automotive technologies often migrate into broader markets as volumes rise and costs fall. Thanks to its scalability and cost-conscious design options, the EV smart switch is already well suited to a wide range of high-voltage battery-powered applications beyond automotive.

www.kyocera-avx.com



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As electric vehicles continue to evolve, so do the demands placed on their power management systems. The **KYOCERA AVX Electric Smart Switch** is designed to meet these demands, providing precise and reliable control in high-voltage EV applications.

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Avnet Insights: **Engineers get behind AI**

The results are in from the 2026 Avnet Insights engineering survey

By **Alex Iuorio**, Senior Vice President, Global Supplier Development at **Avnet**

For the fifth consecutive year, Avnet, Inc. has released its Avnet Insights survey, which has been tracking how engineers are responding to market dynamics since 2021. This year's survey provides new insight into how engineers are embracing artificial intelligence (AI) and machine learning (ML), and the continued promise and challenges this latest technological evolution presents for product design.

Preliminary insights include the following:

More products are shipping with AI built in. Globally, over half of engineers (56%) said that they have incorporated AI into the designed products and solutions they are shipping to customers. This is a 33% increase from last year, when only 42% said they were shipping products with AI incorporated into designs.

Process automation continues to be key. Among current embedded AI deployments with the highest adoption rates, engineers say the top applications are process automation (42%), predictive maintenance (28%), and fault/anomaly detection (28%). These were also the top applications predicted to have the highest adoption rates last year.

Multi-modal AI adoption is accelerating, with engineers increasingly combining Edge AI and ML models to deliver greater functionality and value in their products. Over half of all respondents (57%) said they are prioritizing the incorporation of Edge AI and ML equally, underscoring the importance of both technologies. Multi-modal describes using more than one type of artificial intelligence in a product or using a type of AI that can perform more than one type of inference. For example, a large language model (LLM) that can process both text and image data.

AI incorporation is not without challenges. Engineers pointed to several design and operational challenges they expect when integrating AI into their products. Almost half of engineers globally (46%) listed data quality issues as one of their top design challenges. In terms of operational challenges, 54% of respondents stated that continuous learning and maintenance is the top challenge.

Engineers are turning to LLMs for technical questions. 16% of global engineers said they would prefer to use a publicly available LLM to answer technical questions, but almost half (47%) would prefer to use an LLM trained by engineers outside of their organization. However, they are turning to tools such as ChatGPT (69%), Google Gemini (57%), and Microsoft Copilot (50%) to help answer these questions, demonstrating the need for more appropriately trained tools for engineers to use.

"Early results from our latest Avnet Insights survey show that worldwide, significantly more products are being shipped with AI incorporated than last year," said Alex Iuorio, Senior Vice President, Global Supplier Development, Avnet. "AI adoption is growing quickly, and engineers are using it—but they're still learning. There are challenges ahead, and it's too soon to know which skills will matter most. Still, as engineers keep applying AI, the potential for growth remains strong."

Avnet Insights is an annual survey of engineers. The 2026 survey was conducted online and fielded to 1,200 global respondents from October 21 through November 5, 2025. Regionally, respondents were based in the Americas, EMEA, Asia, and Japan.

The full 2026 Avnet Insights survey was released in January 2026.

www.avnet.com

Accelerating power density and reliability



Diotec's role in upcoming super-efficient power conversion

By **Andrew Dixon**, Sales & Marketing Manager at **Diotec Semiconductor Americas**

The global shift towards high-performance digital infrastructure, the electrification of mobility, and the use of renewable energy are driving power electronics into a new era of efficiency, power density, and reliability.

Diotec Semiconductor AG has positioned itself as a focused specialist in exactly this domain. With a strong portfolio of low-loss silicon rectifiers and power MOSFETs, ultra-fast recovery diodes, high-temperature Schottky devices, ESD protection, and rapidly expanding silicon carbide (SiC) offerings, the company helps customers optimize conduction losses, reverse recovery behavior, and thermal margins across a wide range of topologies.

In high-power PFC stages, traction inverters, and DC/DC converters, Diotec's SiC Schottky diodes enable significantly reduced switching losses and virtually zero reverse recovery charge, allowing designers to increase switching frequency, shrink magnetic components, and simplify cooling concepts. In parallel, ruggedized TVS and protection devices with high surge capability and controlled clamping behavior safeguard sensitive power stages against load dump, lightning transients, and repetitive industrial surges—critical for automotive, energy storage, and grid-connected systems.

Several customers have already translated these device-level advantages into tangible system benefits: higher inverter efficiency in the megawatt class, compact, fast-charging modules with improved thermal headroom, and power supplies for data centers that achieve higher power density with reduced total cost of ownership. These successes are the result of close cooperation between component supplier and system designer.

At APEC 2026, Diotec will demonstrate how advanced silicon and SiC technologies, combined with application-driven engineering and a clear long-term roadmap, are helping customers push the limits of efficiency, power density, and reliability—powering the next generation of energy conversion systems.

www.diotec.com





Shifting automotive electronics design into top gear

Open platforms reshape automotive electronics development

By **David Sandys**, Senior Director of Technical Enablement and Engagement at **DigiKey**

The evolution of electronics design in the automotive industry has accelerated over the last few years. While trends like electrification, vehicle-to-vehicle (V2V) and vehicle-to-everything (V2X) communications, and zonal-controlled architecture have often taken center stage, two of the most critical innovation enablers include software-defined vehicles (SDVs) and open-source hardware ecosystems, which now support faster innovation, broader knowledge sharing, and more rapid prototyping than ever before.

Software-defined vehicles have recently advanced significantly. The ability to share a common codebase across vehicle platforms, with parameter changes that enable feature inclusion or remote upgrades, delivers compelling value and simplifies development, testing, deployment, and support. An industry-wide challenge is how to scale learning and prototyping in a production-level environment that academia can use to onboard the next generation of automotive electronics design engineers while, at the same time, enabling professional engineers at both OEMs and aftermarket companies to rapidly develop the SDVs of the future.

Enter the world of digital.auto

Digital.auto is described as “An open community of car manufacturers, suppliers, start-ups and end-users working together to create the next generation of software-defined vehicle experiences.” The community’s goal is to build an open, use-case-driven SDV ecosystem validated by partners and community end users. Partners include AWS, Bosch, ETAS, Arduino, DigiKey, and many other vendors and manufacturers. One key tool created for this initiative is the digital.auto playground. The playground is a web-based prototyping environment that enables rapid, cloud-based prototyping, fast and efficient validation of new vehicle features, simple and advanced testing, an open project library, and support for multiple industry standards.

The digital.auto initiative helps drive innovation forward by early functional validation, which helps avoid typical integration challenges. This is an important complement to the traditional “cycle accurate” virtual testing, which is focused on load and performance. It also introduces a clear vehicle application programming interface (API) layer that helps shift non-safety software components into faster-moving, more easily manageable QM runtime environments.

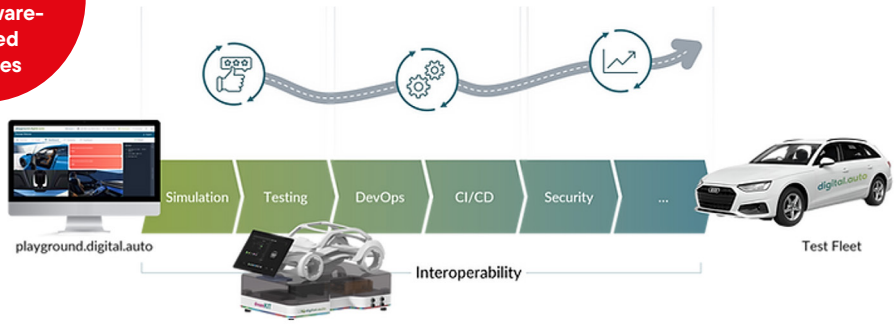
The visual approach of digital.auto’s environment fosters effective communication between technical and non-technical stakeholders. Its prototyping approach is designed to support pragmatic test solutions that can combine simulation, virtual ECUs, and target hardware—an important fit for the agile, dynamic environments of expedited vehicle development.

An SDV E/E starter kit for everyone

The system’s hardware and software interoperability is key. Since high-end production environments can be costly, the team at digital.auto wanted a low-cost test setup environment. Leveraging ETAS, a leader in SDV development and design, Bosch and Arduino have partnered to create the E/E Starter Kit.

The E/E Starter Kit is a modular, scalable solution that features a central Arduino Portenta X8 compute unit and two Arduino H7 distributed zone controllers. It has a high-speed real-time interconnect for synchronized control and a preconfigured networking stack for SDV middleware integration. Because the hardware and software were developed with interoperability in mind, engineers can focus on application-level software rather than

The aim of an open tool chain for software-defined vehicles



worry about lower-level design or SDV middleware integration. In fact, the kit comes with a fully integrated SDV middleware stack that enables vehicle data abstraction, hardware abstraction for rapid prototyping and development, and seamless interoperability with other SDV ecosystem components.

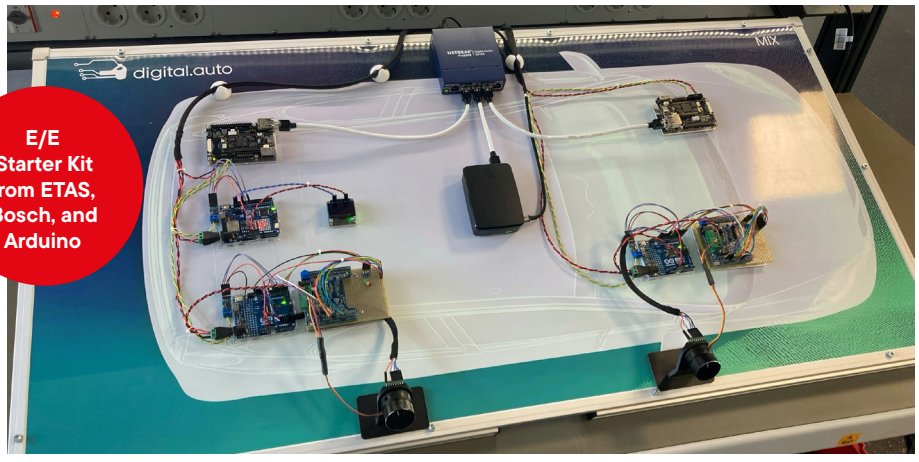
The kit also comes with a sample SDV application that demonstrates millisecond-accurate real-time control between the two zones. The E/E Starter Kit is compatible with the digital.auto playground. It supports an SDV101 training module, which provides an ideal tool for both learning and rapid prototyping.

Arduino in automotive? Yes please!

What Raspberry Pi has done to embedded system ideation, Arduino now enables in automotive electronic design. Automotive reference designs are costly, complicated, and challenging to integrate. All these obstacles are overcome when leveraging an open-source low-cost hardware ecosystem like Arduino Pro.

Arduino's open-source hardware/software foundation allows seamless integration with non-Arduino systems and vehicle-grade peripherals, which are critical when interfacing with sensors, actuators, and CAN-bus/IBUS or emerging automotive interfaces. Accessible tools lower risk and cost during experimentation, thereby ensuring more ideas survive early evaluation, expanding the innovation funnel, and speeding cross-domain collaboration (important in areas like AGVs, fleet robotics, and HMI experimentation). The availability of open-source automotive-related libraries (e.g., IBUS communication libraries for BMW infotainment systems) demonstrates how Arduino naturally becomes a bridge between OEM and ecosystem innovation.

Contrary to its "hobbyist" reputation, modern Arduino supports professional development workflows: PlatformIO, VS Code, CI/CD pipelines, JTAG/SWD debugging, register-level control, and performance profiling. These align directly with embedded engineering practices inside automotive suppliers and OEMs. This means Arduino can serve as both a learning platform and a serious R&D accelerator, enabling automotive teams to validate software-defined vehicle concepts using the same debugging paradigms used in production environments.



E/E Starter Kit from ETAS, Bosch, and Arduino

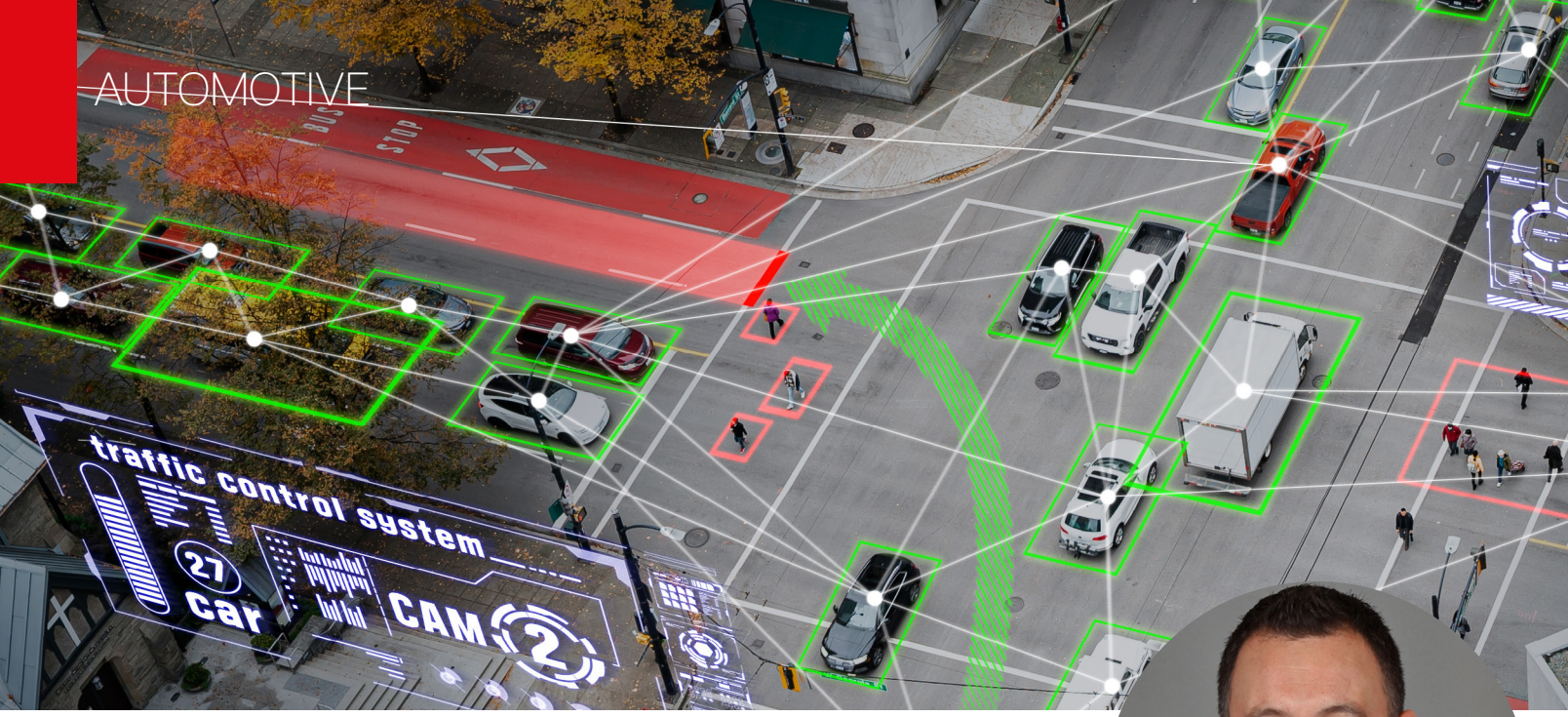
Case in point: BMW Group and Arduino Pro

Let's look at BMW Group's decision to standardize on the Arduino Pro platform for future innovation. From a technical standpoint, leveraging Arduino has given BMW Group a highly flexible and efficient prototyping foundation that enables rapid translation of abstract, forward-looking concepts into functional systems.

Arduino's open-source, modular ecosystem enables engineers at BMW to quickly integrate sensors, actuators, and processing units, supporting early design-technology convergence across both interior and exterior vehicle concepts. The affordability and ease of use of platforms such as compact microcontrollers and modular hardware families enable fast iteration without heavy upfront investment, while seamless interoperability with non-Arduino hardware reduces integration challenges. This rapid iteration is essential for advanced concept exploration where future architectures and features (10+ years out) must be validated before dedicated ECUs or components exist.

Collectively, this technical flexibility shortens early-stage innovation cycles from weeks to hours, supports rapid testing, and enables precise, working prototypes that keep pace with the long-term, exploratory R&D demands of next-generation automotive development.

www.digikey.com



The silent backbone of **connected mobility**



RF and microwave in automotive electronics

By **Gabe Osorio**, Director, TBU Marketing at **TTI**

Modern automobiles are now sophisticated electronic ecosystems. From advanced driver assistance systems (ADAS) to vehicle-to-everything (V2X) communication, connectivity is shaping the future of mobility. At the core of this transformation is RF and microwave engineering—often overlooked, yet essential.

Why RF matters in automotive

As vehicles become more connected, reliable data transmission is mission-critical. Radar systems at millimeter-wave frequencies enable features like collision avoidance and adaptive cruise control. V2X communication enables vehicles to "talk" to the infrastructure and to each other, reducing accidents and improving traffic flow. These capabilities depend on RF and microwave components that must perform precisely under tough conditions.

Designing for high-frequency reliability

Designing at frequencies like 77GHz brings unique challenges. PCB layout requires precision—every trace, via, and connector can affect signal integrity. Engineers must control impedance, minimize parasitic effects, and manage thermal loads to prevent performance degradation. Simulation tools are essential for predicting design behavior before building prototypes.

Material selection is also critical. Substrates with low dielectric loss help maintain signal quality, while advanced shielding reduces electromagnetic interference in crowded electronic environments. These factors directly impact the reliability of safety-critical systems.

Component selection: Navigating the RF landscape

Choosing the right RF components is key to robust automotive designs. Engineers must assess antennas, filters, amplifiers, and transceivers for performance under automotive conditions, which include wide temperature ranges, vibration, and electromagnetic interference.

Automotive-grade parts must meet strict reliability standards, often requiring AEC-Q100 or AEC-Q200 qualification. For millimeter-wave radar, phased-array antennas and low-noise amplifiers are vital for detection range and accuracy. Even connectors and cables affect insertion loss and system performance, so supplier collaboration and thorough testing are essential.

Testing beyond the lab

Validation doesn't stop at design. RF systems must work flawlessly in real-world conditions where heat, vibration, and electrical noise are constant challenges. Engineers use vector network analyzers and spectrum analyzers to check performance and ensure compliance with automotive standards and safety requirements. Testing now includes dynamic driving scenarios to confirm radar and communication systems stay robust under stress.

Standards and compliance: Meeting the bar

Industry standards are non-negotiable for automotive RF systems. ISO 26262 governs functional safety, demanding rigorous analysis and validation of safety-critical electronics. For V2X, IEEE 802.11p and 3GPP Release 16 (for C-V2X) define interoperability and security. EMC compliance is required by CISPR 25

and ISO 11452, ensuring RF systems don't interfere with other vehicle electronics. Integrating compliance testing early in the design cycle helps avoid costly redesigns and certification delays.

The road ahead: Emerging trends in automotive RF

In the future, RF and microwave technology will play an even bigger role in automotive innovation. As autonomous driving advances, vehicles will need higher bandwidth and lower latency for sensor fusion and real-time decisions. Millimeter-wave radar will expand beyond ADAS into full autonomy, while V2X will integrate with 5G networks for seamless communication. Software-defined radios and AI-driven RF optimization are enabling adaptive systems that respond to changing environments and threats. The integration of radar and lidar is driving the development of new sensor-fusion architectures, requiring even greater expertise in high-frequency design.

For engineers, mastering high-frequency design and the tools that ensure reliability from concept to deployment is essential. The future of mobility depends on those who understand the silent backbone of RF and microwave technology.

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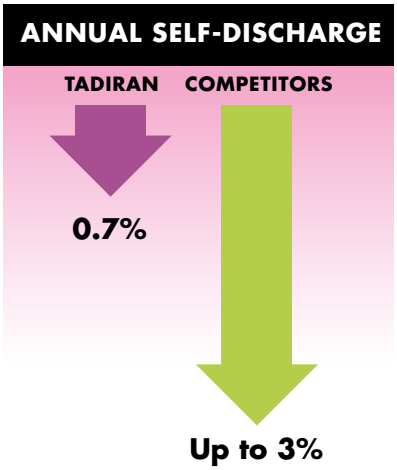
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Building the future of model-based engineering



SysML v2 is the most significant advancement in systems modeling since the language's creation

By **David Allen Blubaugh**, Systems & MBSE Researcher at the **University of Dayton**

Systems engineering is undergoing a major digital shift as organizations move from document-centric methods to model-based systems engineering (MBSE) approaches that span the full system lifecycle, from systems of systems to individual components. This transition enables automation, stronger configuration management across the digital thread, and the systematic reuse of model patterns, reducing risk while accelerating development and change.

At its core, MBSE replaces static documents with dynamic, analyzable models that act as authoritative sources of system intent and support continuous reasoning about architecture, behavior, requirements, and verification, allowing teams to better manage complexity, uncertainty, and evolving stakeholder needs.

Since its adoption in 2006, the Systems Modeling Language (SysML) has been central to this shift. SysML v1.x, most recently v1.7, released in 2022, significantly expanded MBSE adoption across industry and government, but years of practical use exposed structural limitations, such as uneven semantics, inconsistent terminology, and a heavy reliance on Unified Modeling Language (UML) constructs originally designed for software modeling. SysML v2 addresses these challenges by introducing a next-generation systems modeling language purpose-built for modern digital engineering.

Current SysML V2 status

At the Object Management Group (OMG) meeting in Orlando in June 2023, SysML v2 co-leads Sanford Friedenthal and Ed Seidewitz presented the language's status and development path. By the end of 2023, SysML v2 had advanced from early alpha submissions through task-force review to released beta specifications, with final specifications targeted for 21 July 2025.

A key milestone has been the continuous use of an open-source pilot implementation during specification development, supporting SysML v2's textual syntax and execution semantics, while early graphical views have been produced using prototype visualization tools based on PlantUML and draw.io, with an architecture designed to support future commercial-grade tools offering higher-fidelity visualization and user experience.

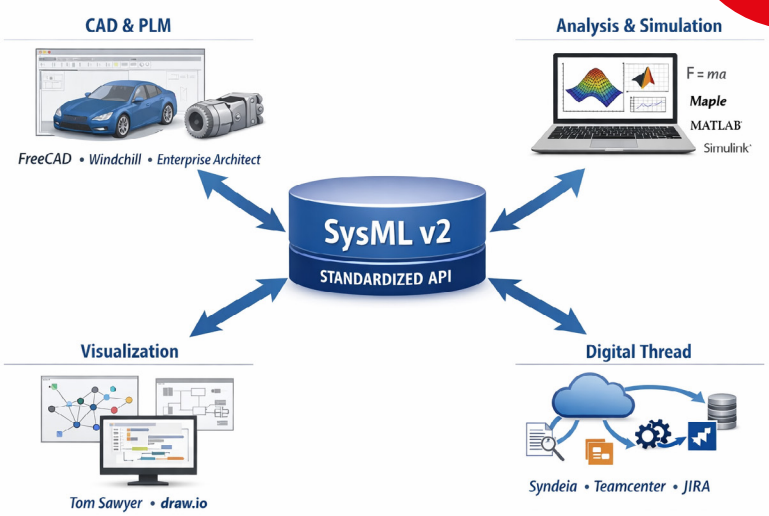
Is SysML V2 unique?

SysML v2 represents a fundamental shift rather than an incremental enhancement, establishing a new foundation for systems modeling defined by three key characteristics.

First, it introduces a metamodel no longer constrained by UML, retaining much of UML's expressive power while grounding the language in formal semantics designed specifically for systems engineering rather than software-centric abstractions.

Second, SysML v2 treats graphical, tabular, and textual representations as first-class notations, with each view mapping to the same underlying model and supported by a comprehensive expression language that ensures consistent interpretation across tools.

Third, SysML v2 includes a standardized systems modeling API that provides direct programmatic



SysML v2 connected through its standardized API to CAD, analysis, visualization, and other tools

access to models and enables integration with computer-aided design tools, analysis solvers, configuration-management platforms, and digital-thread infrastructure, allowing SysML v2 to function as an integration backbone rather than a standalone diagramming language.

Definition and usage: The core design shift

A major shift in SysML v2 is the standardization of definition and usage across the entire language, replacing the informal and inconsistent patterns of SysML v1 that relied on elements such as blocks and part properties.

In SysML v2, every major construct—including parts, attributes, ports, actions, states, constraints, and requirements—follows a consistent structure, enabling efficient reuse of model elements across contexts, simplifying learning by reducing conceptual variation, and supporting tool-level automation based on predictable semantics. As a result, decomposition and specialization behave uniformly across structural, behavioral, and verification models.

Requirements as executable constraints

SysML v2 fundamentally reframes how requirements are represented. Building on the property-based approach introduced in SysML v1, each SysML v2 requirement is defined as an explicit constraint. A requirement may include an identifier, a natural-language "shall" statement, a formal constraint expression, and assumptions governing applicability.

Consistent definition and usage across parts, actions, states, and requirements enables reuse and automation

Because these elements are machine-readable, solvers can execute them to determine pass/fail compliance, integrating requirements engineering directly into automated verification workflows rather than treating it as a manual review activity.

Individuals, snapshots, and time

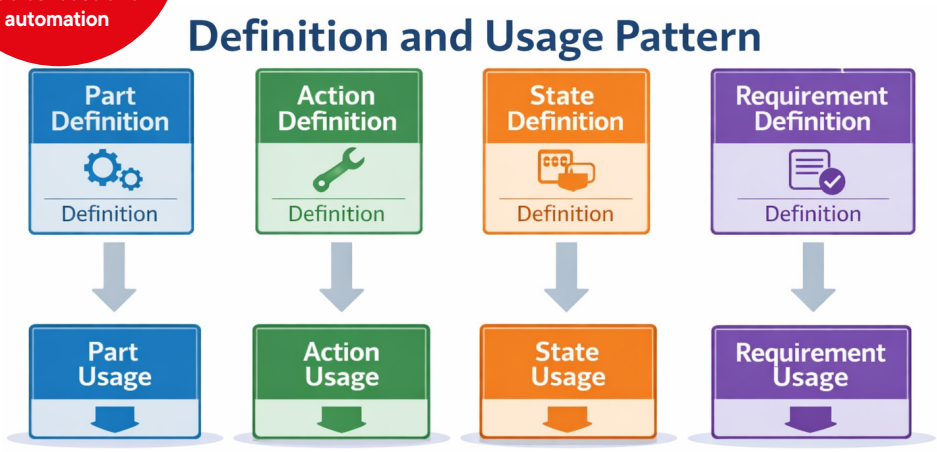
Another important conceptual advance in SysML v2 is the distinction between individuals and snapshots. The language explicitly separates an entity from its state at a specific moment in time, enabling clearer reasoning about lifecycle behavior, operational modes, and time-sliced analysis.

This capability supports advanced use cases such as mission-phase trade studies and model-based fault analysis. Because SysML v2 is textual and version-controllable, model evolution can be efficiently tracked using standard tools such as GitHub, strengthening traceability and supporting collaborative development across teams.

Extensibility and interoperability by design

Extending SysML v1 typically required applying stereotypes to UML profiles, which often resulted in fragmented semantics and limited tool support. SysML v2 replaces this approach with a library-based extension mechanism that unifies specialization and profiling while preserving the integrity of the core language.

Interoperability is central to the design of SysML v2. Through its standardized API, SysML v2 models integrate with CAD environments, graph visualization tools, analysis solvers, and digital-thread configuration management platforms.



This positions SysML v2 not merely as a modeling notation, but as a true systems engineering backbone.

Transitioning from V1 to V2

For organizations committed to MBSE, transitioning to SysML v2 is both a major opportunity and a significant responsibility, requiring deliberate planning aligned with existing digital-engineering initiatives and supported by practical pilot projects to assess real-world impact.

Early actions include launching Jupyter-based pilot projects to evaluate workflows, engaging tool vendors to understand product roadmaps, developing phased transition plans for training, metrics, and infrastructure, and establishing strong model-quality standards, validation frameworks, and review processes from the outset. The importance of this effort is underscored by the U.S. Department of Defense's Office of Digital Engineering, which has already begun developing formal transition guidance. This highlights the strategic importance of SysML v2 for defense and aerospace programs.

Conclusion: MBSE's future foundation

SysML v2 is the most significant advancement in systems modeling since the language's creation, replacing UML-bound frameworks with a purpose-built foundation, introducing executable semantics for requirements and analysis, and establishing a standardized API that connects MBSE to the broader digital-engineering ecosystem.

With the integration of generative and agentic artificial intelligence, SysML v2 evolves beyond a modeling language to become the intelligence layer of digital engineering, enabling machine-assisted design, autonomous verification, and continuously evolving system models.

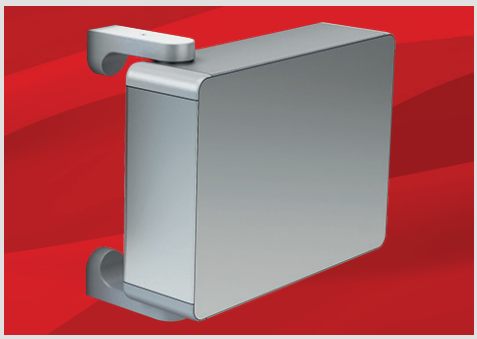
For organizations, the message is clear: begin transition planning now, not merely to adopt a new language, but to elevate model quality, rigor, and automation across the enterprise, because SysML v2 is the foundation for the next decade of AI-driven, model-based systems engineering.

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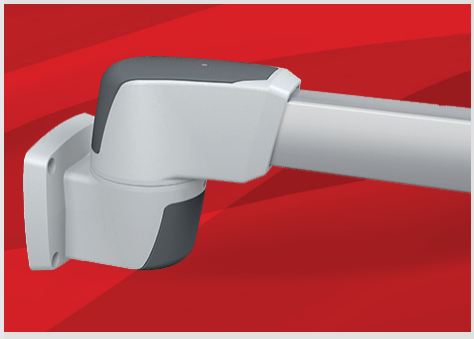
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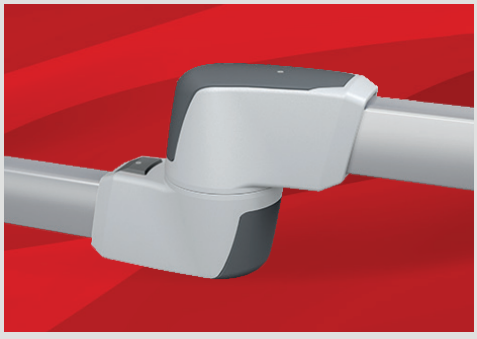














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The Sensors Converge 2026 conference program delivers 50+ expert-led sessions and in-depth workshops, organized around today's most critical system-level challenges. Tracks include Sensors + AI, MCU & Sensor Architectures for AI/ML, Connectivity & System-Level Design, Power Management & Efficiency, Automotive & Transportation Sensing, and Medical & Healthcare Sensing—designed for engineers seeking practical insight they can apply immediately.

Keynote insights from industry leaders

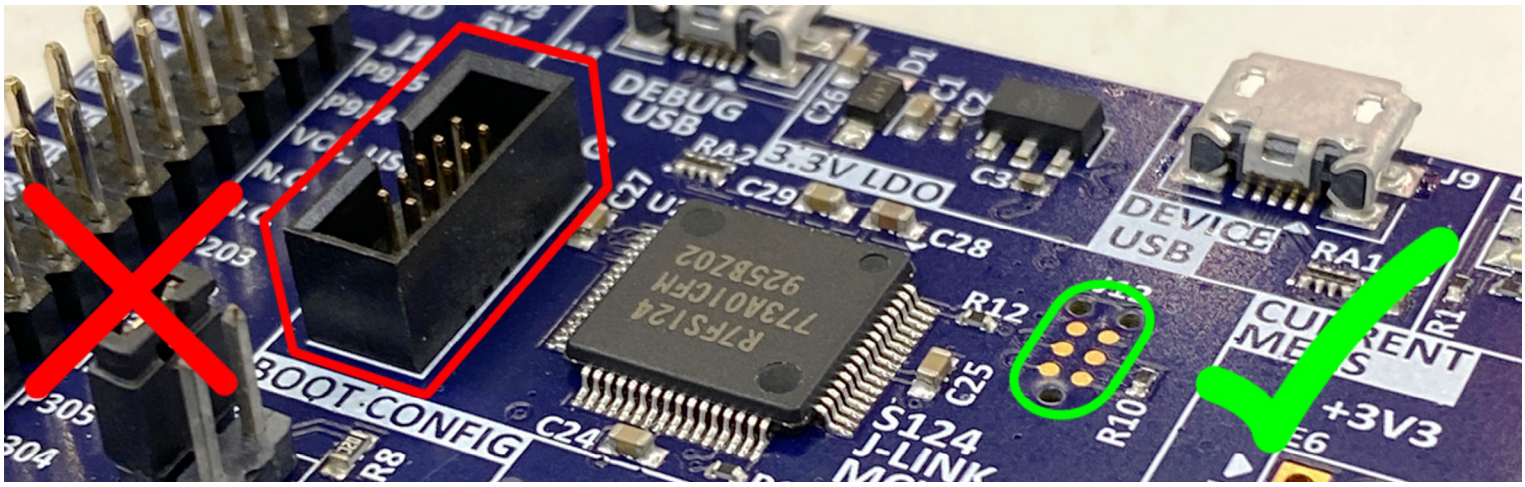
The keynote lineup features leaders at the forefront of intelligent system design, including Pankaj Kedia (2468 Ventures), Ganesh Kondapuram (Intel), and Omar Abed (InvenSense, a TDK Group company)—bringing strategic and technical perspectives on edge AI, sensor fusion, and next-generation human-machine interfaces. All keynotes are included with every pass.

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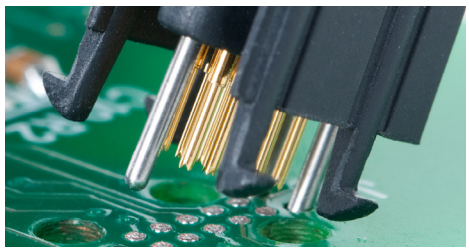


Tag-Connect

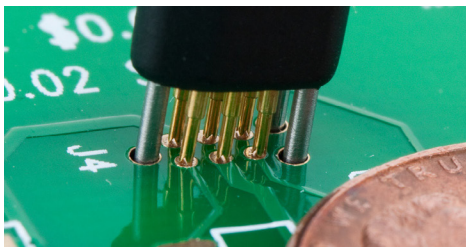


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