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www.lthd.com

MIKROE celebrates 2000th Click board with NXP RTC targeting ultra-low-power timekeeping with alarms, watchdog, and timestamps

Joins wide range of compact add-on boards that save embedded designers significant development time and money

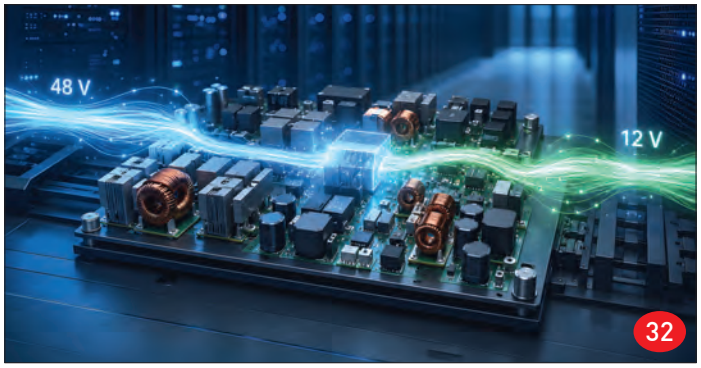
MIKROE launched its 2000th Click board™, the RTC 27 Click, designed for low-power real-time clock and calendar functionality, time tracking, alarm event generation, watchdog timing, and time-stamp capture.

The Click board concept centres around the mikroBUS™ socket and standard, and was pioneered 15 years ago when Neb Matic, MIKROE CEO & Founder of MIKROE asked himself a question: 'What is the minimum number of pins that can cover the greatest number of peripherals?' The answer, he determined, was 16, in two rows of 8. This is the fewest number of pins that can account for most chips, modules, and components that designers could ever want to place on an add-on board. From this, MIKROE has developed the Click board product range such that the company now launches one new Click nearly every day.

RTC Click is the latest addition to the Click board family of compact add-on boards that enables developers to rapidly provide proof-of-concept, then prototype and code the new embedded projects. It is based on the PCF8525, a nano-power CMOS real-time clock and calendar with an I2C interface from NXP. It provides year, month, day, weekday, hours, minutes, seconds, and 1/100-second data, selectable crystal temperature compensation with aging offset support for improved timekeeping accuracy, programmable alarm and watchdog timer functions, timestamp capture, battery backup with automatic switch-over circuitry, and two configurable interrupt outputs with selectable routing through onboard jumpers. Its ultra-low-power operation, requiring only 64 nA typical current consumption in timekeeping mode at 3.3 VDD, makes it especially suitable for battery-powered and always-on designs.

RTC 27 Click is suitable for portable instruments, wearable devices, industrial systems, and IoT applications requiring reliable, low-power, and accurate timekeeping. The board also features the ClickID function which enables automatic identification by the host system, simplifying use. Devices can be used on any host system supporting the mikroBUS™ standard, and come with the mikroSDK open-source libraries, offering excellent flexibility for evaluation and customization.

■ **MIKROE**
www.mikroe.com



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Editorial Director - **Gabriel Neagu**
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Web design - **Petre Cristescu**

Contributing editors
Cornel Pazara
PhD. **Paul Svasta**
PhD. **Norocel Codreanu**
PhD. **Marian Blejan**
PhD. **Bogdan Grămescu**

EURO STANDARD PRESS 2000 srl
VAT: RO3998003 | Tel.: +40 (0) 744 488818
office@electronica-azi.ro | https://international.electronica-azi.ro

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Low-Cost High Safety Microcontroller: AVR® SD

ASIL C and SIL 2 Compliant

Achieving high safety integrity levels (SIL) for safety-critical functions in automotive and industrial applications is complex and requires expertise and rigorous processes. Functional safety engineers face pressure to reduce design costs to stay competitive. Selecting the right microcontroller is crucial to meet international functional safety standards and optimize costs without compromising safety. To address this, we announced the AVR® SD family, compliant with ISO 26262 (ASIL C) and IEC 61508 (SIL 2). It is ideal for safety functions like monitoring temperature, current, or voltage spikes and simplifies designs by offloading safety-critical functions from a central processor. With built-in hardware safety features (dual cores in lockstep, ECC on memory, a dedicated error controller), it detects faults within 1millisecond and includes a complete development ecosystem with compliant software, safety documentation, and a certified compiler.

Key Features

- **Dual-Core Lockstep CPU:** Ensures high diagnostic coverage of faults by running two identical processing cores in parallel and catching any discrepancies almost instantaneously (1 clock cycle).
- **Error Correcting Code (ECC) on All Memories:** Detects and corrects errors, maintaining data integrity.
- **Dedicated Error Controller Module:** Continuously monitors for errors and takes corrective actions, maintaining system integrity and safety.
- **Voltage and Clock Monitors:** Ensures the microcontroller operates within safe voltage and clock parameters, preventing system failures due to power or timing issues.
- **Fault Detection Time Intervals:** Suitable for applications with high safety demands and fault detection time interval targets down to 1 millisecond.

Join the Future of Safety-Critical Design With AVR32SD32.

MICROCHIP

microchip.com/avr-sd

Infineon introduces RIC70115 radiation-hardened GaN HEMT driver for satellite and high-reliability space applications

Infineon Technologies introduces the RIC70115, a radiation-hardened (rad hard) gallium nitride (GaN) high-electron mobility transistor (HEMT) driver designed for satellite and high-reliability space applications where power conversion performance and long-term operational integrity are critical requirements. The RIC70115 supports both silicon (Si) and GaN MOSFET designs in low-side and high-side configurations, giving power system designers greater flexibility to adopt GaN-based power architectures in space platforms without compromising safe operation across varying bias voltage conditions. As the New Space economy continues to scale and satellite constellations grow in complexity and number, demand for rad hard power components that support the transition from silicon to GaN is increasing.

Integrated protection and noise immunity

The RIC70115 integrates an independent Miller Clamp function that prevents parasitic-induced turn-on while maintaining the desired switching speed, reducing switching losses and improving overall efficiency. A Truly Differential Input (TDI) logic stage delivers high noise immunity by rejecting common-mode noise and mitigating the effects of electromagnetic interference and radio frequency interference, both particularly relevant in the electrically demanding environment of a satellite power bus. An integrated low dropout regulator (LDO) generates a tightly regulated 4.8 V drive voltage from a 5 V or 12 V source, reducing the need for external regulation components and supporting a power input range of 4.75 V to 15 V. Together, these integrated functions reduce external component count, simplify circuit design, and improve system reliability in high-cycle space power applications.

Radiation performance for space environments

The RIC70115 meets the requirements of MIL-PRF-38535 across an extended operating temperature range of -55°C to 125°C. It is radiation hardened to a Total Ionizing Dose (TID) rating of up to 100 krad (Si) and has been characterized for Single Event Effects (SEE) up to a Linear Energy Transfer (LET) of 81.9 MeV·cm^2/mg, providing the radiation performance margins required for low-earth orbit and beyond.

■ **Infineon Technologies** | www.infineon.com

Microchip Advances Neural Network Implementation with VectorBlox™ 3.0 Accelerator SDK

Deploying AI inference in power-constrained and mission-critical environments such as aerospace and defense systems requires solutions that balance performance, efficiency, reliability and ease of development. To better manage these challenges, Microchip Technology has released the VectorBlox™ 3.0 Accelerator Software Development Kit (SDK) to help simplify FPGA-based AI implementation and speed time-to-market. Offered to developers free of charge, VectorBlox 3.0 SDK and associated CoreVectorBlox IP is designed as an integrated toolchain that streamlines optimization, compilation and deployment of convolutional neural network (CNN) models on PolarFire® FPGA and SoC-based platforms. Because the accelerator scales efficiently across model sizes and supports multiple AI workloads on a single device, customers can consolidate various vision or sensor-based AI functions on a single low power FPGA.

Sparse neural networks improve Edge AI efficiency

With support for sparse neural networks, VectorBlox 3.0 helps enable efficient execution of vision-based CNN models by skipping zero-valued operations. This capability helps developers accelerate inference performance while reducing power consumption, an important advantage for always-on edge AI applications that must balance responsiveness with energy efficiency. Enabling sparsity-based model compression is designed to reduce compute and memory demands, while preserving accuracy.

Latest release leverages sparse neural networks to improve performance and enable more efficient edge AI on PolarFire® FPGAs and SoCs

AI-enabled autonomy for space applications

Additionally, Spacecraft Pose Network v2 (SPNv2), a neural network designed to estimate position and orientation using vision data, enables autonomous navigation and proximity operations in space for applications such as autonomous rendezvous and docking, space debris removal, satellite inspection and formation flying. Built on mid-range, power-efficient, single-event-upset (SEU) immune PolarFire FPGAs and SoCs, the solution delivers secure boot, anti-tamper protection and high reliability for harsh environments. These features are necessary for mission-critical defense, aerospace and industrial deployments where long operational life, data protection and system resilience are essential.

VectorBlox SDK v3.0 is supported by Microchip's Libero® SoC Design Suite and integrates with CoreVectorBlox IP. Visit the website to learn more about the company's full portfolio of FPGAs and design resources.

Comments

"As AI models continue to grow in complexity, compression is becoming essential for deploying intelligence at the edge," ***said Shakeel Peera, corporate vice president and GM of Microchip's FPGA business unit****. "With VectorBlox 3.0, we're leveraging sparsity-based model compression from our Neuronix acquisition to reduce compute demands while preserving accuracy."*

"Leveraging VectorBlox acceleration on Microchip's PolarFire SoC enabled us to efficiently deploy advanced onboard AI pipelines for low-latency payload operations in orbit," ***said Vito Fortunato, SPACEDGE™ services line manager at Planetek Italia****. "The platform allowed us to validate real-time Earth Observation processing capabilities including object detection, semantic scene analysis and edge-generated actionable information products on top of the AI-eXpress-1 satellite, deployed in 2025, while providing the radiation resilience and operational reliability required for continuous Low Earth Orbit operations."*

■ **Microchip Technology** | www.microchip.com

Emerson Launches Modular Testing Architecture for Automotive Display and Camera Interfaces

Emerson introduced a new modular test architecture designed to address increasing complexity in software-defined vehicles. Built on NI-based technology, the automotive vision device combines a high-performance FPGA core with interchangeable serializer/deserializer (SerDes) interface devices, enabling engineers to configure test systems for evolving automotive display and camera requirements.

Flexible testing on the NI PXI platform

With this launch, Emerson continues to advance the NI PXI platform as an open, modular foundation for evolving test requirements – extending its capabilities for high-performance automotive test applications. It includes the NI PXIe-1480 FlexRIO multiprotocol vision carrier module, which hosts interchangeable interface devices for automotive display and camera testing. The first available interface devices support FPD-Link IV, a high-speed automotive video interface commonly used in advanced driver assistance systems (ADAS) and in-vehicle display applications.

As vehicle architectures shift toward centralized electronic control units (ECUs), engineers must validate multiple high-speed interfaces on increasingly complex systems. Conventional display test methods, often relying on cameras or visual inspection, limit scalability and introduce variability. By providing a direct interface to ECU and display SerDes Input/Output (I/O), the modular PXI-based approach improves test coverage through automated, deterministic testing. The result is a single, flexible platform that streamlines validation and improves test repeatability.

Support for display, camera and ADAS validation

The NI PXIe-1480 carrier module serves as the foundation for this architecture, supporting interchangeable interface devices tailored to specific testing requirements. At launch, the available interface devices are focused on display testing. Emerson plans to extend the platform later this year with additional interface devices supporting a broader range of camera and display protocols.

■ **Emerson** | www.emerson.com/global

Mouser Now Shipping Infineon Technologies KITPSE84AITOBO1 PSOC Edge E84 AI Evaluation Kit for AI and ML Applications

Mouser Electronics is now shipping the new KITPSE84AITOBO1 PSOC™ Edge E84 AI evaluation kit from Infineon Technologies. The KITPSE84AITOBO1 kit is a hardware platform designed for rapid prototyping of wearables, smart home devices, human machine interfaces (HMI), and artificial intelligence (AI) applications.

Hardware-accelerated machine learning

The Infineon Technologies KITPSE84AITOBO1 evaluation kit, available from Mouser, enables rapid prototyping, development, and evaluation of Infineon's ML platform, DEEPCRAFT™ Studio, and the deployment of embedded systems, ML models, and other software products, leveraging the versatile PSOC Edge E84 microcontroller (MCU).

The PSOC MCU is designed for responsive computing and control tasks, with hardware-accelerated machine learning that delivers refined end-user interaction and application awareness, suitable for "always-on" applications in IoT and industrial sectors. The PSOC Edge E84 microcontroller features 512Mbit QSPI Flash, 128Mbit octal RAM, and a SIP-based wireless interface based on an Infineon Technologies AIROC™ CYW55513 Wi-Fi® and Bluetooth® combo. The Infineon Technologies AIROC CYW55513 is a low-power device that supports 1×1 single-stream, tri-band Wi-Fi 6/6E, is IEEE 802.11ax-compliant, and supports Bluetooth 5.4.

Integrated sensing and development ecosystem

The PSOC™ Edge E84 AI evaluation kit also features an onboard programmer/debugger (KitProg3), SWD debug header, a MIPI-DSI connector, speaker interface, USB host and device interfaces, IO expansion headers, an IMU sensor, a magnetometer, a barometric pressure sensor, two analogue microphones (PDM interface), an image sensor, and an Infineon Technologies BGT60LTR11x XENSIV™ radar MMIC. The BGT60LTR11x is a fully integrated microwave motion sensor optimised for size, including Antennas in Package (AIP) and built-in motion and direction-of-motion detectors.

■ **Mouser Electronics** | www.mouser.com

Mouser Accelerates Innovation with Online Resource Centre on Transportation for Next-Generation Mobility

Mouser Electronics is empowering engineers with its comprehensive transportation resource centre focused on the technologies reshaping mobility. As systems evolve, engineers must address complex requirements around power management, functional safety, real-time decision-making, and infrastructure integration. The hub provides technical insights and resources to help designers navigate these evolving challenges and accelerate the development of future transportation solutions.

As mobility evolves toward cleaner, more autonomous systems, engineers are navigating modern infrastructure, safety, and performance challenges. Emerging urban air mobility (UAM) platforms require designs that support reliable electric propulsion and charging infrastructure, while hydrogen fuel cell systems need advanced power management solutions to maximise efficiency. At the same time, robotaxis and autonomous transportation are driving demand for robust sensing, AI-powered decision-making, and functional safety. Mouser's transportation resource centre helps engineers navigate these evolving design requirements with expert technical content, practical insights, and the latest products needed to bring next-generation mobility solutions from concept to deployment.

Curated by Mouser's technical team and trusted manufacturing partners, the content centre features a comprehensive collection of articles, blogs, eBooks, and new products from leading manufacturers.

The featured technical content explores how engineers can move the industry toward intelligent and autonomous e-mobility systems with new infrastructure, advanced power management, and proven real-world deployment strategies. For the newest products, Mouser stocks the industry's widest selection of semiconductors and electronic components, including the newest solutions for transportation applications. Here are a few examples:

- The **FRDM-A-S32K312** evaluation board from NXP Semiconductors is a flexible development platform designed for automotive, industrial, and IoT applications. Featuring Arduino UNO compatibility, OpenSDA debugging, USB Type-C® connectivity, and expansion support for motor control and communications, the board offers engineers a streamlined platform for rapid prototyping and system development.
- The **PIC32CM SG** 32-bit Arm® Cortex®-M23 microcontrollers (MCUs) by Microchip Technology combine low-power performance with advanced security, safety, and connectivity. Running at up to 72 MHz, the devices support CAN-FD, USB, and Arm TrustZone® integrated hardware security capabilities for secure embedded designs in industrial and automotive applications.
- The **AMPSEAL** robust headers from TE Connectivity provide secure, high-reliability PCB connectivity for transportation, industrial, and harsh environment applications. With support for high-current applications and multiple configuration options, AMPSEAL Robust Headers help engineers build durable, scalable systems for electric vehicles, factory automation, robotics, and smart infrastructure.
- The **Sine Systems AHD Series**™ connectors by Amphenol provide a cost-effective, reliable solution for diagnostic connectivity. Intermateable with industry-standard 6- and 9-pin connectors, the series is available in both non-sealed and environmentally sealed threaded configurations to support a range of operating conditions. With J1939 Type 1 and Type 2 options, the AHD Series Connectors deliver flexible, rugged connectivity for systems in transportation and industrial applications.

■ **Mouser Electronics** | www.mouser.com

Toshiba expands lineup of AEC Q101 compliant 40V N-channel MOSFETs in small, thermally enhanced S-TOGL package

Toshiba has launched the XPJ1R504PB, an automotive-compliant 40V, 120A N-channel power MOSFET housed in the S-TOGL™ package, expanding its lineup for 12V systems. Target applications include inverters, semiconductor relays, load switches, and motor drives. By adding this 40V MOSFET to its existing lineup in the S-TOGL™ package, which includes the XPJR6604PB and XPJ1R004PB, Toshiba has expanded its product options to meet a range of applications and performance requirements.

In recent years, with the advancement of electrification in automotive equipment, the adoption of inverters and motor drives has been expanding, driving higher output and efficiency. To address these trends, MOSFETs must deliver both low power loss and high heat dissipation. The XPJ1R504PB, featuring the S-TOGL package, enables compact, high-density mounting and excellent thermal performance, thereby reducing the size of automotive equipment and improving efficiency.

Improved mechanical and thermal performance

As these types of automotive equipment operate in a wide range of temperature conditions, the reliability of the solder joints is critical. The S-TOGL package employs gull-wing leads that help relieve mounting stress, thereby improving the mechanical reliability of the soldered connections. In addition, the package features a post-less structure that integrates the chip's source-electrode connection and outer leads, thereby reducing parasitic resistance and achieving an on-resistance (RDS(ON)) of 1.54mΩ (max.) at a gate-source voltage (VGS) of 10V.

The use of a thick copper frame in the S-TOGL package lowers the transient thermal impedance between the channel and the case (Zth(ch-c)) to 0.76°C/W, reducing conduction loss and suppressing heat generation, thereby improving overall system efficiency. Furthermore, a multi-pin structure for the source leads enhances current distribution, enabling high current capability.

Toshiba will continue to develop automotive MOSFET products suited to various applications and system requirements, thereby contributing to higher efficiency.

■ **Toshiba** | https://toshiba.semicon-storage.com

Navitas and Magnachip Announce Strategic Partnership to Accelerate High-Voltage and Ultra-High-Voltage Silicon Carbide Adoption

Navitas, an industry leader in next-generation GaNFast™ gallium nitride (GaN) and GeneSiC™ silicon carbide (SiC) power semiconductors, and Magnachip Semiconductor, a designer and manufacturer of analog and mixed-signal power semiconductor platform solutions, announced a strategic partnership to accelerate adoption of SiC technologies in high-voltage (HV) and ultra-high-voltage (UHV) power markets.

Under the terms of the agreement, Magnachip will license Navitas' GeneSiC™ Trench-Assisted Planar™ (TAP) technology to enter the HV and UHV SiC markets. The license covers 1200V, 2300 V, 3300 V and higher voltage GeneSiC technologies, enabling Magnachip to build on Navitas' proven SiC device platforms for next-generation power conversion applications. Magnachip will also gain access to Navitas' SiC supply chain and materials ecosystem, supporting faster market entry. At the same time, the technology is planned to be ported, qualified, and internalized at Magnachip's fab in South Korea. The companies expect this approach to help accelerate Magnachip's entry into SiC while maintaining continuity with Navitas' established technology and materials base. The licensed technologies are expected to support next-generation applications including energy and grid infrastructure, energy storage, industrial electrification, automotive and other high-power systems.

"This strategic partnership with Magnachip reflects our long-term vision to broaden GeneSiC adoption across high-voltage and ultra-high-voltage power markets," ***said Chris Allexandre, President and CEO of Navitas.*** *"By licensing our proven GeneSiC technologies and supporting Magnachip through our supply-chain and materials ecosystem, we are creating a path to scale advanced SiC solutions more rapidly while enabling a deeper, long-term collaboration between our companies."*

"This agreement opens an important new market opportunity for Magnachip in high-voltage and ultra-high-voltage SiC," ***said Chae Lee, Chief Executive Officer of Magnachip.*** *"The addition of GeneSiC technology complements our existing MOSFET and power semiconductor portfolio and positions Magnachip to serve customers that require higher efficiency, higher voltage capability and more reliable power conversion solutions."*

■ **Navitas Semiconductor** | www.navitassemi.com

From marine plastic to mobility: igus presents an e-bike made of recycled plastic for the first time

igus continues to drive forward the vision of sustainable urban mobility. At the Eurobike trade show, the company is presenting an electric version of its igus:bike for the first time, responding to the growing demand for low-maintenance e-mobility in cities. The previous model has already proven its robustness on a 1.5-year world tour in wind and weather. The tried-and-tested plastic bicycle has been continuously enhanced and forms the basis for the new electric bicycle. Like the igus:bike, it consists of 50 per cent recycled fishing nets and offers people the opportunity to combine environmental protection with low-maintenance urban mobility. And all this at a reasonable price of €2,500.

Congested roads and bad air: more and more people in cities want to switch from cars to bicycles to get from A to B faster and reduce CO_2 emissions. Around every second newly purchased bicycle in Germany is now an e-bike, according to a market analysis by the management consultancy EY.

"We are convinced that we are launching an e-bike that is not only particularly durable, but also fits in with the idea of circular economy. With the electric version of our igus:bike, we are responding to the increasing demand," ***says Jens Boldt, Head of the igus:bike Business Unit at igus.***

Boldt and his team are inspired by the igus:bike world tour, which took the bike across 25 countries. The plastic bike has covered almost 6,000 km and proven its durability in various climate zones in wind and weather. The new e-bike is made of 50 per cent plastic, from the bicycle frame to the wheels and the seat post to the handlebars. Metal is only used whenever it is still technically necessary, e.g. for the suspension fork, brake discs and brake cables. The igus e-bike is designed for urban traffic: the single-speed e-bike weighs around 20kg and works with a 60 Nm rear-wheel motor and a toothed belt made of carbon fibres and plastic. The battery allows a range of up to 120 km. Series production will start in the third quarter of 2026. The igus e-bike will be available for around €2,500. igus is also planning a non-electrified variant with an eight-speed gear hub.

Protecting the seas while cycling

According to the environmental organisation WWF, around a third of the world's plastic waste in the seas consists of fishing gear such as nets and ropes. To reduce this amount of waste, igus works with a Belgian partner to produce the igus:bike. They collect nets that fishing boats have lost near the coast, clean them and process them into plastic powder. *"Our materials scientists have managed to ensure that 50 per cent of the plastic for bicycle frames can be made of this recycled material,"* ***says Boldt***.

For production, igus relies on a special process that was already used in the predecessor and can produce seamless and robust hollow bodies. "However, we have refined the process to such an extent that the frame now shows a higher stiffness. This allowed us to reduce the wall thicknesses and make the frame design much slimmer." A characteristic feature is the new design with seat and chain stays on both sides, which gives the orange and black bike a distinctive look. igus manufactures other components such as seat posts and handlebars via injection moulding.

■ **igus** | https://press.igus.eu

Farnell Partners with Hailo to Accelerate Edge AI Innovation Globally

Farnell has announced a new global partnership with Hailo, a pioneering edge artificial intelligence (AI) chip-maker, to expand access to high-performance AI solutions for customers worldwide.

Through the collaboration, Farnell will offer Hailo's AI products via their global distribution network, e-commerce platforms, and engineering community, enabling engineers, developers, and enterprises to integrate advanced edge AI capabilities into their edge designs more efficiently and at scale.

Hailo's AI processors deliver data centre-class performance for edge devices with exceptional power efficiency. The partnership will support customers in developing next-generation AI applications across industries, including physical AI, smart cities, industrial automation, logistics, automotive, and intelligent retail — helping meet the growing demand for intelligent, connected, and sustainable solutions.

Customers will have access to Hailo's AI accelerators, modules, and development kits, supported by design resources, technical expertise, and reliable supply chain services. The collaboration reflects Farnell's ongoing commitment to supporting engineers and businesses with innovative technologies that accelerate product development and time-to-market.

Comments

"Partnering with Hailo further strengthens Farnell's commitment to delivering leading-edge technologies that help our customers accelerate innovation," ***said Jose Lok, Global Product Category Director – Onboard Components & SBC at Farnell****. "Hailo's high-performance AI solutions bring powerful edge AI capabilities to a wide range of applications, and we are excited to make these technologies more accessible to customers globally."*

"We're excited to join forces with Farnell to bring our advanced edge AI solutions to more customers globally," ***said Jan-Friso Blacquiere, VP Sales EMEA, Hailo Technologies****. "With Farnell's strong global presence and online channels, this partnership will empower innovators to realise new levels of AI performance at the edge."*

Hailo AI solutions are now available at Farnell in EMEA, Newark in North America, and element14 in APAC.

■ **Farnell** | https://uk.farnell.com

DigiKey

AI and Industrial Automation Accelerate a New Growth Cycle in the Electronics Industry

Mike Slater, *Vice President, Global Business Development at* ***DigiKey****, kindly answered questions from Electronica Azi, offering a global perspective on the electronic components market, the technology trends with the greatest potential, and how DigiKey supports engineers, designers and companies developing new solutions.*

Electronica Azi International

DigiKey has a global view of the electronics industry. How would you describe the current state of the market, especially after the supply chain disruptions, inventory corrections and changes seen over the past few years?

Mike Slater

The industry is continuing its record expansion cycle, which we expect to sustain for some time, provided there's not an increase in external volatility. We anticipate continued growth this year across all industries, particularly in industrial automation, AI infrastructure, edge AI, robotics and humanoids, EVs, autonomous systems, the maker space, advanced driver assist systems (ADAS), flexible electronics and aerospace and defense.

DigiKey began the year with explosive growth, with year-over-year revenue growth in Q1 2026 of nearly 48%, plus, we saw double-digit growth across Europe. In fact, Europe was our fastest-growing region last year, in terms of both revenue growth and customer acquisition.

We're seeing a great deal of innovation in the industrial space right now.

With labor costs being high, the need for automation and robotics is proving greater than ever.

I'm really optimistic about this in the longer term.

In today's international context, supply chain resilience has become a key concern for many companies. How does DigiKey help customers manage uncertainty, component availability and delivery reliability, especially in Europe and in markets such as Romania?

The speed of innovation has triggered massive demand for new products and solutions. By partnering with franchised suppliers, DigiKey ensures it offers the most cutting-edge, sought-after products available on shelves to support new designs and product introductions. We also continuously source and invest in new supplier engagements to fulfill the needs of market segments in Romania and Europe. Utilizing AI and leveraging digital connectivity solutions are also part of our corporate strategies to ensure continuous enhancement of our services, capabilities, and productivity for our global customer base.

Further, DigiKey is actively engaged in discussions with our suppliers and industry tariff experts to understand how we can mitigate the impact tariffs have on our customers. We continue to monitor and adapt to evolving changes, which will best position DigiKey to continue providing high-quality products at cost-effective pricing. Additionally, suppliers can partner with DigiKey's Foreign Trade Zone (FTZ) program, which allows DigiKey to become the Importer of Record (IOR), handling paperwork, declarations, and tariff management, resulting in lower costs and more competitive prices.

Finally, DigiKey has invested in our regional Marketplace options to leverage a customer's location to avoid tariffs and other geopolitical issues that may cause higher costs or delays, and we continue to explore additional options to provide customers with more choices in their regions.

Many electronics companies are moving from "just-in-time" to more resilient sourcing strategies. What changes are you seeing in the way engineers, buyers and OEMs approach component sourcing today?

Customers today expect more than just availability; they want predictability, transparency and speed. We're seeing a shift toward localized sourcing strategies and diversified supply chains to mitigate risk.

At DigiKey, we've responded by enhancing our logistics capabilities and investing in tools that provide us with better visibility into inventory and lead times to inform our stocking level decisions. Technical support is also evolving. Customers continue to seek information, not just a storefront selling parts. Examples of the information being sought include requirements for datasheets, part images, symbols, footprints and cross-references. Other elements being added to that list are country of origin, tariff flags, carbon footprint and more.

The automotive industry in Europe is going through a difficult transition, while at the same time vehicles are becoming increasingly dependent on electronics, power devices, sensors, connectivity and embedded systems. How does DigiKey see this market evolving, and what role can distribution play in supporting automotive-related innovation?

The amount of electronic content in cars is increasing all the time, even as the number of units shipped by automotive brands remains relatively flat. We see automotive as one of the fastest-growing segments, and it's our goal to show up with the resources and products needed to fuel that growth.

Power electronics is one of the key technology areas today, driven by electrification, energy efficiency, renewable energy, data centers and industrial applications. Which trends in power electronics are currently generating the strongest demand from DigiKey's customers?

Europe has been leading the world in efficiency, sustainability and the push for renewable energy. The innovations emerging from Europe support not only the electrification of vehicles but also extend to other areas such as battery management systems (BMS) for battery stacks, home appliances and much more.
On a smaller scale, we are seeing engineers finding ways to conserve energy in places like data centers and other commercial buildings that were not always constructed with high efficiency in mind. Opportunities to save energy through HVAC systems are being explored, including a shift toward electrification where possible, as well as increased search for alternative avenues of enhanced efficiency.

While these efforts may only reduce a few watts here and there, they add up and can make a substantial impact over time.

All of this means the demand for small, reliable electronic products is growing. Today, GaN and SiC semiconductors are playing a larger role in the evolution of power and are at the leading edge of advancements in power switching technology.

Artificial intelligence is changing not only software, but also hardware design, embedded systems, edge computing and industrial applications. How is DigiKey supporting engineers who are developing AI-enabled products or integrating AI at the edge?

AI is transforming the distributor-customer relationship from a transactional to a collaborative one. Engineers use AI-powered design tools to simulate and validate components before purchase, while procurement teams leverage intelligent platforms to assess risk, compare alternatives and automate routine tasks.

At DigiKey, we're building capabilities that allow customers to interact with us more intuitively, whether through chatbots, smart search or embedded design support. We are still in the early stages, with hype exceeding reality, but given the pace of innovation in this space, the ROI crossover is within sight.

Engineers increasingly need more than access to components; they also need design resources, development tools, reference designs, technical content and faster ways to evaluate solutions. What new online tools, platforms or services has DigiKey developed to support engineers during the design process?

DigiKey supports customers in several ways. First, through our industry-leading website, which offers several different buying experiences, like APIs, EDI, our punchout catalog, our parts list management tool, myLists, and more.

We also offer digital tools like our SchemeIt, CAD models, various forms of content and TechForum, where customers can ask questions of our community of technicians, engineers, and, in some cases, the manufacturer.

DIGIKEY: AI AND INDUSTRIAL AUTOMATION ACCELERATE A NEW GROWTH CYCLE IN THE ELECTRONICS INDUSTRY

DigiKey works with a very broad ecosystem of suppliers and technologies. How do you decide which new suppliers, products and technology areas to add to your portfolio, and how important is fast access to new product introductions for design engineers?

Our goal is simple – we want the widest selection of products available for our customers. We grow that selection in three key ways:

- New product introductions (NPI): We want our customers to have immediate access to the latest technology to drive innovation and solve problems. DigiKey distributes more NPIs than any electronics distributor. Last year, 25% of our customers purchased parts released in the last 24 months, showing strong interest in NPIs and innovation.
- Part conversions: We list many parts we don't stock initially. We also analyze many data points, vertical markets and industry trends to spot rising demand. Based on that, we move high-potential parts from "non-stocking" to "stocking" status.
- Marketplace growth: Our DigiKey Marketplace platform lets us offer parts that may not fit traditional models to keep in stock – whether due to size, complexity, or niche demand – while still giving customers DigiKey's service guarantees. We're always looking for new ways to expand selection and meet customer needs, and we're confident that our approach will continue to deliver results.

In a highly competitive distribution market, what differentiates DigiKey from other major global electronic component distributors, particularly from the perspective of design engineers and small or medium-sized companies?

The DigiKey difference is evident in our inventory pipeline, in-stock product availability, competitive pricing, localization, and top-notch quality service to enhance the customer experience. Our industry-leading product range gives customers unparalleled visibility and access to the latest technologies across semiconductors, power, connectivity, automation and more.

As a result, designers can quickly evaluate options, compare specifications and make informed choices without being locked into a single vendor or constrained by limited local availability.

Our key differentiators as a high-service distributor include:

- The breadth and depth of our product portfolio
- Ease of doing business with us
- High-quality and robust technical and educational content for both customers and suppliers
- Leading export compliance services
- Tariff mitigation
- Localization, including expanded local shipping capabilities

Looking at the short and medium term, what are the main opportunities and challenges you see for the electronics industry, and which technology areas do you believe will create the strongest momentum in the coming years?

We anticipate significant expansion in industrial automation, data centers, AI, robotics, humanoids, EVs, autonomous systems, the maker space, and aerospace and defense.

We expect revenue growth across all business units, led by industrial automation. We believe the industry will be stronger in all regions in 2026, with DigiKey outperforming the broader market.

The most significant shift we're seeing in the industry this year is the continued rise of AI driven, intelligence led operations across the entire value chain.

Customers still expect high service, speed, and accuracy, but they are no longer willing to absorb the cost of manual inefficiencies.

In response, distributors are embedding AI into core workflows to improve demand forecasting, inventory optimization, pricing decisions, and customer engagement.

At DigiKey, this isn't about isolated projects; it's about building a connected intelligence network that spans the organization.

By integrating AI to augment our team members' expertise, we're able to make better, faster, and more informed decisions that serve both customers and suppliers more effectively, redefining what true high distribution value looks like in 2026.

Romania has a growing community of electronics engineers, embedded developers, industrial automation specialists and technology companies. How can DigiKey support engineers and companies in smaller but technically active markets such as Romania?

DigiKey is a global company that can support engineers anywhere, regardless of location or size.

Our partnership with nearly 3,000 global suppliers and portfolio of more than 18 million components gives Romanian customers unparalleled visibility and access to the latest technologies across semiconductors, power, connectivity and automation.
It also helps designers quickly evaluate options, compare specifications and make informed choices without being locked into a single vendor or constrained by limited local availability.

DigiKey provides a high level of operational resilience through fast fulfillment, small-lot availability, transparent lead times and a wide breadth of products.

Being a global partner means we help customers reduce friction throughout their entire product lifecycle – from concept, design and deployment to maintenance, repair and ideation for the next generation.

Traditional distributors tend to focus on availability and transactional fulfillment, but at DigiKey, we take pride in our support role, which helps enable designs throughout the lifecycle.

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Powerful, ultra small MCU's

ENABLE COMPACT SMART SENSORS

In this article we will look in more detail at the WLCSP package and how Renesas have used this package for the RA4L1 Low Power Microcontroller

Author:
Graeme Clark, Principal Engineer
Renesas Electronics

Today's microcontrollers are used in a wide variety of different applications, one of the strongest areas of growth is the demand for intelligent sensors, where the requirement for distributed intelligence is driving the need to integrate microcontrollers into each sensor. Distributing intelligence in this way to each sensor, can have many benefits, such as reducing the processing demand on the central processor, reducing network traffic and reduce wiring costs in the network This requirement covers many diverse applications, from industrial to medical applications, and many of these applications have common requirements, with a strong focus on size and weight as well as power consumption and cost.

The latest generation of microcontrollers is now starting to take advantage of the latest packaging technologies to address these requirements, with many new devices utilising the latest BGA (Ball Grid Array) and WLCSP (Wafer Level Chip Scale Packaging) technologies. These provide a much better solution compared to that of the traditional LQFP and QFN packages. WLCSP packages are also alternatively known as WLBGA packages (Wafer Level Ball Grid Array) or just generically CSP. Win this article we will call the package WLCSP.

WLCSP packages been available since the 1990's and provide the most compact packaging solution, providing engineers with the ability to develop extremely thin and compact applications.

These packages are ideal for a wide variety of applications such as industrial sensors and wearable electronics.

These packages are becoming very attractive use in many MCU applications, as they not only offer the most compact option for MCU packaging, but they also bring several other advantages such as improved electrical performance and a higher I/O density.

Chip Scale Packages typically allow us to offer devices that are typically close in size to the original die, by definition (see the (IPC/JEDEC J-STD-012 standard) less than 1.2 times the die size, has an extremely low profile and is very light compared to more traditional semiconductor packages.

This allows us to provide users with the most compact size possible; this means that CSPs can offer up to a large size reduction compared to the traditional packages used for MCU's such as QFN or QFP packages.

A CSP package will typically support a very small ball or pad pitch, normally around 0.5mm or less. CSP packages often use an interposer to bridge between the die and the balls, or pads may also be printed directly onto the wafer.

There are several different types of Chip Scale Packages including, Customized lead-frame-based CSP (LFCSP), Flexible substrate-based CSP, Flip-chip CSP (FCCSP) and Wafer-level redistribution CSP (WLCSP).

Each of these types of CSP package bring specific advantages, however in this article we will focus on the WLCSP as this is the type most commonly used in MCU designs today and this is the package type chosen for Renesas's RA4L1 low power microcontroller.

In the WLCSP package, the bare die is placed on a redistribution layer (RDL) or interposer, which is used to rearrange the bond pads on the die so they are large enough and have enough spacing between them to be placed on a PCB, allowing the WLCSP to be handled during the manufacturing process just like a ball grid array (BGA) package.

The interposer is often constructed out of a polyamide material with copper plated on its surface.

You can see a simplified diagram of the internal structure of such a WLCSP package in Figure 1.

In Figure 1, you can see the internal structure of the WLCSP package, the microcontroller die is typically ground to reduce its thickness, and a protective passivation layer is deposited on top.

This is then mounted onto the interposer (Redistribution Layer) which is used to modify the arrangement of the pads so that the lead-free solder balls can be deposited onto the interposer in a pattern which can easily be mounted on the PCB. An additional passivation layer provides both a mechanical contact (SMT assembly pick and place) and UV light protection to the backside of the die.

WLCSP packages bring many advantages in a typical application:

1. The biggest advantage of the WLCSP package is as already discussed, its compact size, the WLCSP is extremely thin and has a small PCB footprint and so is suitable for any applications that are size or height constrained.

2. Due to the minimal use of packaging materials, the WLCSP package is not only smaller but also lighter than other package types.

3. WLCSP offers a higher I/O density for a specific package size.

4. WLCSP packages provide superior electrical performance with lower parasitic inductance and resistance compared to more traditional package types. The compact WLCSP package shortens the length of internal and external connections, improving signal integrity and reducing noise.

5. WLCSP packages offer lower thermal resistance compared to other traditional package types, providing a more efficient heat path, via the solder balls to the PCB. This enables heat generated by the device to dissipate more efficiently, improving the reliability of the device.

6. Compared to using bare die, the WLCSP offers almost the same compact size, but are much easier to handle and test, so saving manufacturing and test costs.

Figure 1 *Simplified Internal structure of the WLCSP package.*

You can see a summary of the comparison between WLCSP packaging and other common MCU package types in Table 1.

Feature	LQFP	BGA	WLCSP
Size	Large	Medium	Small
Pitch	Medium	Medium–Small	Small
Electrical Characteristics	OK	Good	Excellent
Thermal Characteristics	OK	Good	Excellent
Cost	Low	High	Medium

Table 1
Package Specification Comparison

As the WLCSP package is essentially the same size as the microcontroller die itself, the wafer level chip scale package option provides the smallest available package option available for a device.

The WLCSP is also typically very thin, so it can be useful in applications where height is a key concern, and they often use a very fine pitch to maximise the number of balls, and the number of available I/O pins in the package.
The WLCSP device with its ultra fine pitch typically requires stricter PCB design rules than some other packages, both in terms of the PCB layout and PCB material.

There are also stricter requirements for the manufacturing equipment required to create products using this type of package, so some care must be taken during the design to make sure all the required design parameters are achieved.

Taking everything into consideration, the use of WLCSP packaging often provides an ideal solution when an application is space constrained and lighter packaging is of benefit. Sensor applications in the industrial and medical markets as well as wearable devices are typical applications where the use of WLCSP devices is growing fast.

Renesas is now releasing the powerful RA4L1 low power microcontroller in a compact 72 ball, WLCSP package with a 3.64 mm × 4.28 mm footprint with a package thickness of 0.5 mm. You can see an image of this package in Figure2.

The use of the WLCSP package with the RA4L1 allows us to provide a solution for applications that have space constraints but need a powerful, low power, high performance microcontroller.

The RA4L1 combines a powerful 80 MHz ARM Cortex® M33 CPU with 512 Kbytes of dual-bank Flash memory and peripherals designed specifically to support sensor and wearable applications such as on-chip SPI, I²C and I³C interfaces applications as well as low power analogue functions and multiple low power UARTs and a USB FS interface. The block diagram of the RA4L1 is shown below. The RA4L1 is just one of the RA4 microcontrollers available in a WLCSP package, other devices from the RA family including members of the small pin count RA2 family are also available with space saving WLCSP package options.

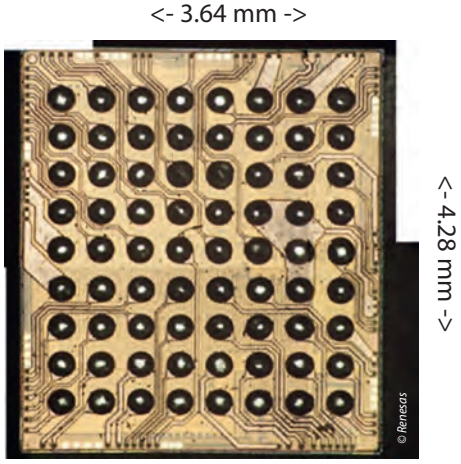

Figure 2 *RA4L1 WLCSP package.*

When designing with CSP packages, care should be taken to make sure we can obtain optimal electrical performance and reliable solder joints.

The solder joint dimensions on the chip and the PCB side should be well-balanced and ideally within 5% tolerance of each other.

The PCB pads can be of either Solder Mask Defined (SMD) type or Non-Solder Mask Defined (NSMD) type. Figure 4 shows a top view of the two different pad types.

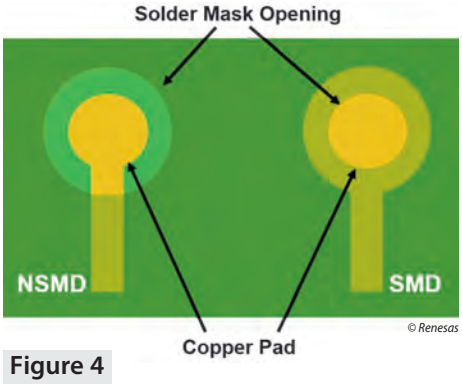

Figure 4
SMD vs NSMD Copper Pad.

SMD pads are defined by the solder mask opening on the board. For SMD pads, the opening of the solder mask is smaller than the underlying copper pad for soldering to the associated bump. NSMD pads have solder mask opening larger than the copper pad. There are many factors influencing whether the PCB designer should use SMD or NSMD pads.

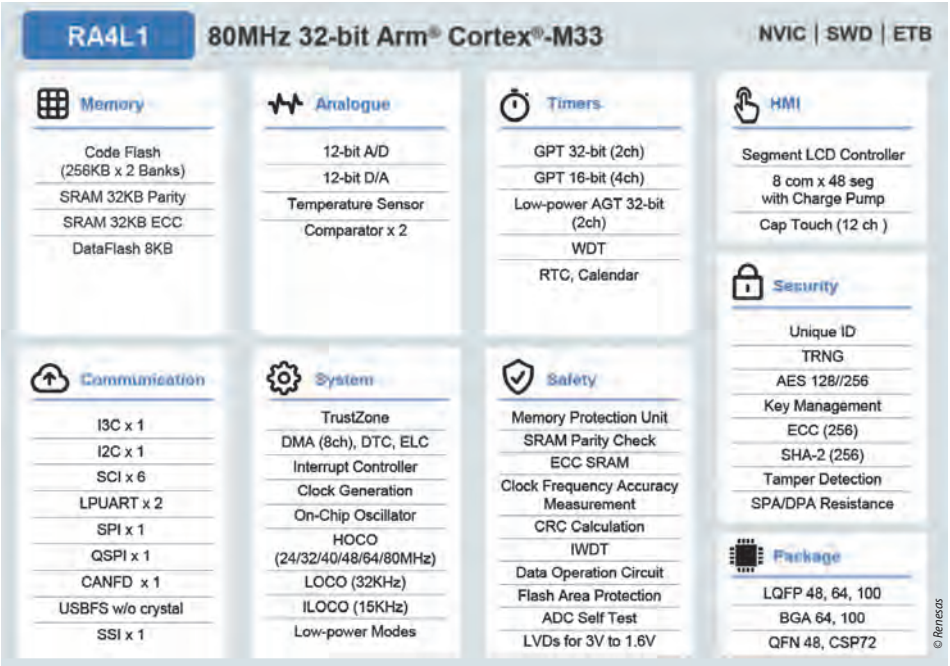

Figure 3 *Block diagram of the RA4L1.*

Either type can successfully be used with WLCSP packages. For WLCSP, Renesas recommends using NSMD pads where possible.

Renesas' s WLCSP can be assembled on standard epoxy glass substrates, however high temperature FR-4 which has smaller CTE (coefficient of thermal expansion) is preferable because it enhances package reliability as compared to standard FR-4. The actual CTE of PCB board is also affected by numerous factors such as number of metal layers in the PCB, trace density, laminate material and operating environment etc. Ideally, the glass transition temperature of the substrate should be above the operating temperature range of the intended application.

Thinner boards are more flexible and result in greater reliability during thermal cycling. They also provide improved thermal fatigue life in comparison to thicker boards. Typical board thickness currently used in the industry ranges from 0.4 mm to 3.2mm. The thickness is selected depending on the required robustness of the assembly and the need for improved heat dissipation in power hungry applications.

WLCSP packages are also often used mounted on flexible PCB material, typically used in consumer or wearable applications where the need for a very thin solution is required, and often flexibility is also required, these materials will typically be 0.1mm - 0.3 mm thick, meaning the total thickness of the application can be less than 1mm.

Due to the relatively fine pitch and small terminal geometry used on a WLCSP, optimizing the paste printing process is critical to ensure the reliability of solder joints. In-process inspection for paste height, percent pad coverage, and registration accuracy to solderable land pattern is highly recommended. The availability of the RA4L1 low power microcontroller in the compact WLCSP enables designers to create powerful solutions for space constrained applications in the consumer and industrial markets. These devices provide an idea solution for applications such as audio applications, digital cameras, hearables, optical modules, smart sensors and wearables as well as many others.

For more information on the RA4L1 Microcontroller and it's WLCSP package options, please visit our website at www.renesas.com/RA4L1, you can also find more information about the use of the WLCSP package in the Renesas Semiconductor Package Mount Manual which is also available for download from our website.

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Switching regulators as replacements for LDOs

ENERGY-EFFICIENT POWER SUPPLY FOR COMPACT ELECTRONICS

Linear voltage regulators are still used billions of times over, but they waste a significant amount of energy as heat. Modern switching regulators minimize these losses, eliminate the need for heat sinks, reduce material and production costs and thereby support decarbonization.

Author:
Ralf Kern, Line Manager
Rutronik

The impacts of global warming are unmistakable: Heat waves in spring, snowfall in typically warm regions, prolonged rainfall and storms that devastate entire forests. Many people wonder how they can help reduce CO_2 emissions without feeling that their individual impact is insignificant. A comparison may be helpful here: A single sandbag cannot stop a flood, but a million sandbags can protect an entire community against flooding.
Technical improvements follow the same principle: Even if the savings for a single component seem minor, the sum of millions or billions of units has a substantial impact. This is exactly the case for linear voltage regulators (LDOs, Figure 1), which are used billions of times worldwide. However, their low efficiency leads to significant energy losses, creating substantial potential savings. Modern switching regulators can minimize these losses and thus enhance both energy efficiency and sustainability.

The low efficiency of linear regulators can be clearly demonstrated using a simple example (see Information box).

Even under small loads, many times the required power is dissipated as heat. Switching regulators, on the other hand, convert the same energy with far lower losses.

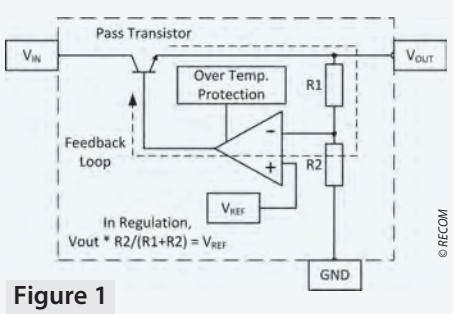

Figure 1

A linear regulator is basically just a transistor operating as a variable power resistor in its linear mode. The difference between input power and output power is dissipated as heat.

Drop-in alternative with switching regulators

Switching regulators (Figure 2) are regarded as a more energy-efficient alternative to linear regulators. They regulate the output voltage by rapidly switching the power transistor on and off. This reduces the power loss. Heat is only generated during the brief switching operations; in the on and off states, however, there is hardly any heat generation. As a result, switching regulators do not require heat sinks, even at ambient temperatures of 90 °C. Additionally, their standby current (without load) is much lower than that of linear regulators, as the internal control loops switch off when not in use.

A linear regulator typically requires about 8 mA of standby current to supply the internal comparator. This current is independent of the load current. The R-78-K-0.5 series switching regulators feature a typical standby current of just 1 mA.

The R-78 series from RECOM is pin-compatible with the conventional 78xx regulators. The new R-78K series (see Table 2) continues this tradition and offers higher efficiency, a wider input voltage range and lower weight. In the same scenario as above, the switching regulator dissipates only 0.2 W and does not require a heat sink.

Besides efficiency under load, standby current plays a crucial role, especially for devices that are permanently switched on but rarely become active. A design with a linear regulator consumes around 2 W in standby mode at an input voltage of 24 V, which is equivalent to roughly 1.75 kWh per year. A switching regulator, in contrast, only needs about one-eighth of that. Since switching regulators are available in TO-220 format (Figure 2), they can be used as direct replacements and retrofitted into existing designs.

Technical comparison between linear and switching regulators

Scenario: 24 V → 3.3 V, load 300 mA

Linear regulator (e.g., 78xx)

- Output power: P_{out} = 3.3 V × 0.3 A ≈ 1.0 W
- Input power (without standby current): P_{in} = 24 V × 0.3 A = 7.2 W
- Power loss: P_{loss} ≈ 6.2 W
- Efficiency: η ≈ 1.0/7.2 *100% ≈ 13.7%

  ➞ High heat loss, heat sink usually required

Switching regulator (e.g., R-78K3.3-0.5)

- Output power: 1.0 W
- Input power (measurement/data sheet example): 24 V × 0.05 A = 1.2 W
- Power loss: 0.2 W
- Efficiency: η ≈ 1 /1.2*100% ≈ 83%

  ➞ Significantly less heat, no heat sink required (up to ~90 °C ambient temperature)

Standby current comparison (24 V):

- Linear regulator typ. ~8 mA ➞ P≈0.192 W ➞ ~1.68 kWh/ year
- R-78K-0.5 typ. ~1 mA ➞ P≈0.024 W ➞ ~0.21 kWh/ year

A linear regulator thus wastes over seven times the energy that the load actually consumes. With such low efficiency, even a low load of only 1 W requires a heat sink to dissipate the heat loss.

Despite the higher unit price, the total costs are reduced, as heat sinks, thermal paste, mounting materials and installation are unnecessary.

In summary, this offers the following advantages:

- **No heat sink required**: Savings on material, installation effort and production costs.
- **Low standby current**: Typically 1 mA instead of approx. 8 mA with LDOs
- **High ambient temperatures**, up to 90°C without additional cooling
- **Compact design and low weight**, suitable for space-critical designs
- **Manufactured in Asia**, thus enabling competitive pricing

The potential savings become especially evident when the losses of a single controller are extrapolated. In typical applications (28 V → 5 V, 0.5 A), a linear regulator generates around 11.5 W of heat loss, while an efficient switching regulator produces only around 0.55 W. With annual sales of one billion linear regulators, this translates to a global potential savings of roughly 11 GW – equivalent to the output of nine medium-sized nuclear power plants. Even minor efficiency improvements in standard components can therefore make a significant contribution to global energy savings.

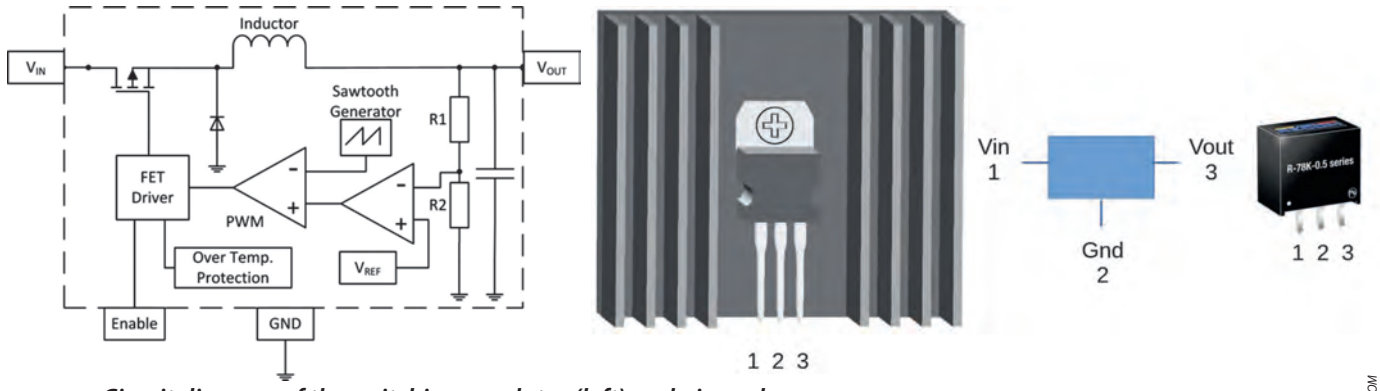

Figure 2 *Circuit diagram of the switching regulator (left) and pin and function-compatible switching regulators of the 78xx and R-78k series (right).*

Characteristics	R-78-K-0.5	R-78-K-1.0	R-78-K-2.0
Input voltage	4.5 - 36 VDC (depending on model)	4.5 - 36 VDC (depending on model)	4.5 - 36 VDC (depending on model)
Efficiency	Up to 93%, without heat sink	Up to 95%, without heat sink	Up to 96%, without heat sink
Operating temperature	-40°C to +90°C without derating	-40°C to +90°C without derating	-40°C to +90°C without derating
Protective function	Undervoltage and short-circuit protection	Undervoltage and short-circuit protection	Undervoltage and short-circuit protection

Table 1: **Comparison of the models in the R-78K series of non-isolated switching regulators.**

Door opening system in an IP67 package

When calculating total cost of ownership, other factors must also be considered. A supplier planned a stand-alone door opening system featuring a fingerprint reader, a microcontroller in an IP67 package, a door release solenoid and a 12 V battery with charger, also in an IP67 package.

The basic requirements were:

- Secure access control through a fingerprint recognition system in the outdoor area
- Ambient temperatures up to 50 °C and package temperatures up to 65 °C
- 24-hour emergency operation via battery in the event of a power failure
- Minimal costs with high reliability

Below, two solutions are compared: One using linear regulators and the other using switching regulators.

The customer's solution (Figure 3, top) used linear regulators for the 5 V supply. However, at high temperatures, the components overheated, leading to voltage instability. To split the current, two regulators were operated in parallel – a practice that is not recommended. Although a small heat sink was used, the temperature in the sealed IP67 package continued to rise until the regulators entered thermal shutdown. This made the system unreliable.

Figure 3, bottom shows an alternative solution using switching regulators, as proposed by RECOM. Despite the higher acquisition costs, the input power was reduced by more than half in this case. A smaller battery and charger (5 Ah instead of 12 Ah) could therefore be used. This not only reduced the overall costs but also the weight and volume of the components. Packaging and transportation also became simpler, and the carbon footprint was minimized.

Operational reliability was a decisive factor, too: Even at high temperatures, the power supply remained stable, posing no risk to the fingerprint reader and the microcontroller. A comparison demonstrates that, despite the higher unit price of the switching regulator, the overall solution is cheaper, more reliable and more sustainable.

Technical progress and sustainability in harmony

These examples demonstrate that technical progress and sustainability can go hand in hand. Switching regulators minimize losses, reduce material and production costs and enhance reliability. In doing so, they contribute measurably to CO_2 reduction without raising overall costs. With billions of linear regulators used every year, adopting this technology presents significant decarbonization potential.

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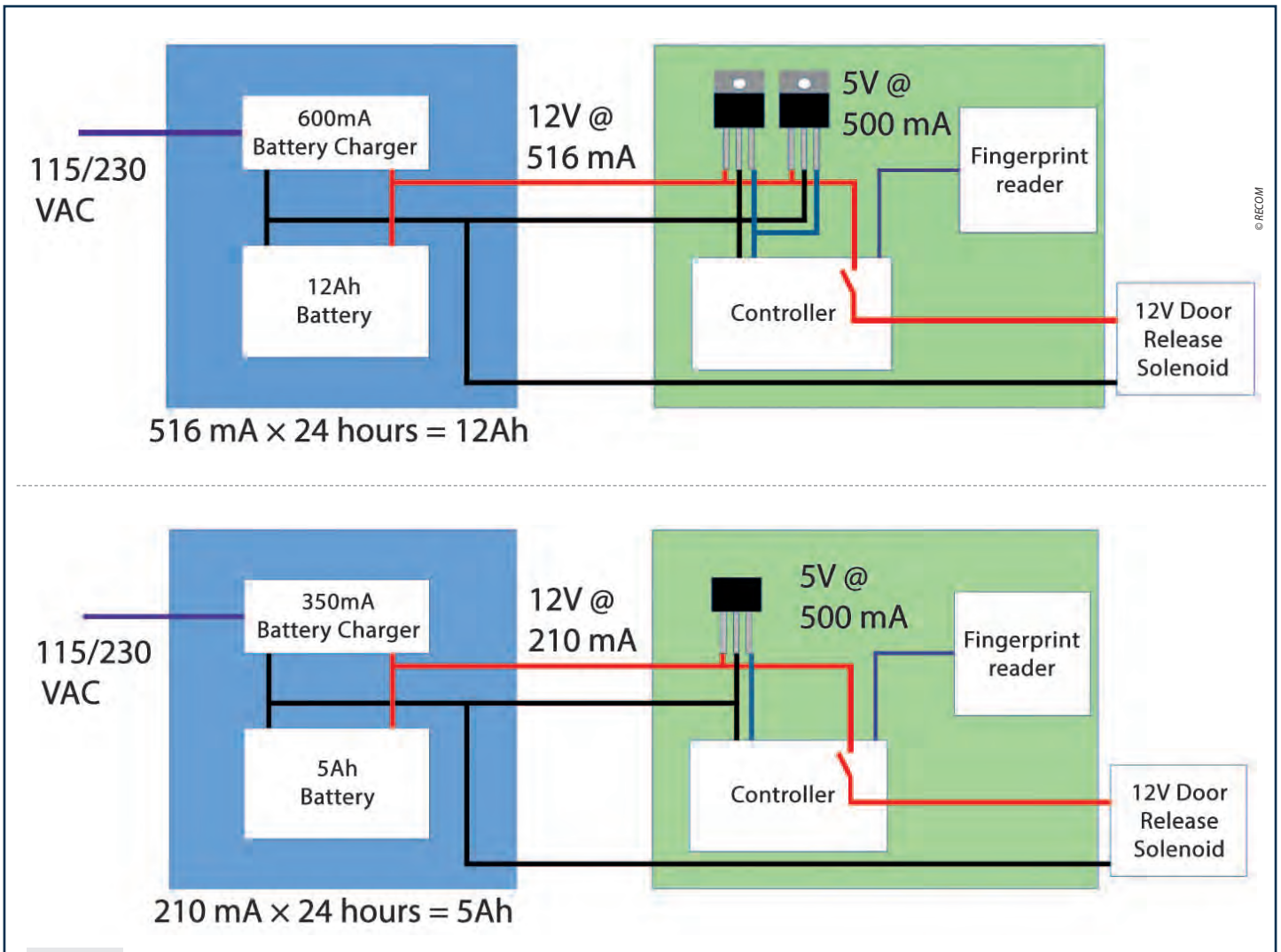


Figure 3 *Comparison between door access systems with linear (top) or switching regulator (bottom).*

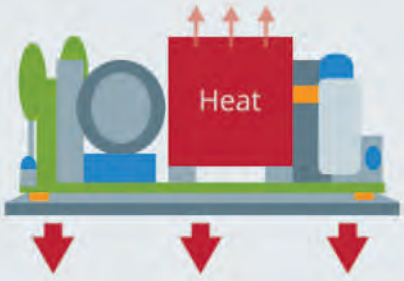
LFM Series

Power in a Compact Space

New to the product line-up is CINCON's unique 1" low profile LFM series.
The product uses a unique thermal architecture referred to as a semi-potted design based on 100% conduction cooling.

Traditional AC/DC open-frame power supplies are meant to be installed on the system chassis using four pillars in each corner.

A heatsink would cover the top of PSU for heat dissipation of transformer, MOSFET and inductor components. By channelling an airflow through the system and over the heatsink, the overall power density of the PSU could be effectively increased.



Heat dissipation in a power supply and the need for thermal management of the internal components.

Fan-based cooling systems, however raise concerns regarding long-term reliability (system MTBF) and the potentially loud noise generated during operation. The option of eliminating fans from the system emerges but this necessitates finding an alternative solution for heat dissipation.

Hence, the inclusion of pure conduction cooling (integrated heatsinks) power supply concepts in the design methodology has been introduced to enhance power ratings under natural convection conditions. However, challenges persist in terms of overheating specific components like magnetic components.

Principle of conduction cooling: Heat is transferred from the power supply to the baseplate or the system's metal enclosure.

Maximizing thermal performance with an enhanced conduction cooling design, utilizing potting material and the low-profile advantage to conduct heat from the unit to its baseplate, removes the need for an external fan. Additionally, semi-potting reinforces the mechanical structure to withstand shocks and vibrations.

The LFM series is available in three standard footprints: 3×2" for at a total power of 200W, 4×2" for 300W and finally 3×5" for 420W and 550W.

CINCON's 1" midget offers both, industrial and medical approvals including 2xMOPP and "body floating" (BF) rating, which includes EMC Class II.

The medical version also features the household standard IEC/EN60335-1. It meets Over Voltage Category (OVC) III up to 2000m altitude and OVC II up to 5000m.

The LFM series from CINCON is the perfect fit for a versatile range of applications like medical equipment, industrial automation or in telecom infrastructure projects.

Samples and comprehensive product documentation are available from CODICO.

For more information, please contact Irina Groiss, CODICO Sales Manager for Romania and Moldova.
Irina.Groiss@codico.com

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About CODICO
CODICO provides high-quality distribution services for electronic components. Its extensive product portfolio includes active and passive electronic components, as well as interconnect technology products. The company operates from its headquarters in Perchtoldsdorf, on the southern outskirts of Vienna. CODICO is an independent, privately owned company, with sales offices in Germany, Denmark, Italy, France, the Czech Republic, Slovenia, Sweden and the United Kingdom, as well as a number of partner companies in Central and Eastern Europe. CODICO focuses on Design-In activities and relies on a team with a high level of technical expertise. What sets the company apart is the technical support it provides throughout the entire process, from the development phase to the final product, as well as the exclusive marketing and sale of selected high-quality products.

Use an Advanced MOSFET Process for Greater Power Density and Reliability

*This article provides a brief overview of the design requirements for power supplies used in relevant applications. It then introduces an advanced MOSFET process technology from **Toshiba** and shows how devices based on this technology can be used to meet these requirements.*

Author: **Rolf Horn,** Applications Engineer, **DigiKey**

Designers of power supplies for applications such as DC/DC converters, motor controls, load switching, data centers, and communications equipment are continually challenged to reduce the footprint of their designs to increase power density. However, higher power density requires devices with minimal heat dissipation to keep the operating temperature within bounds and support reliability. Achieving this requires active switching devices that are not only smaller but also have lower losses, allowing them to operate at higher efficiencies.

When selecting suitable switching devices, designers must carefully consider characteristics such as size, on-state resistance, breakdown voltage, switching speed, and reverse recovery charge.

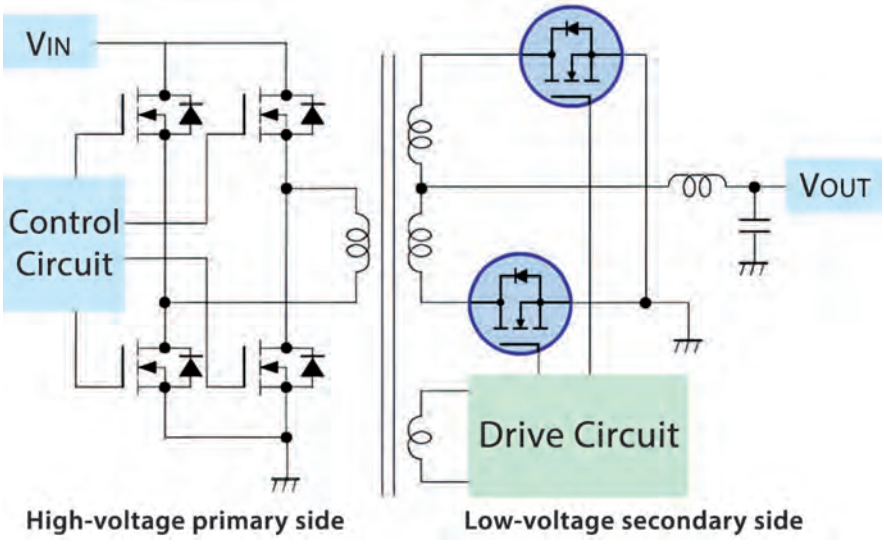
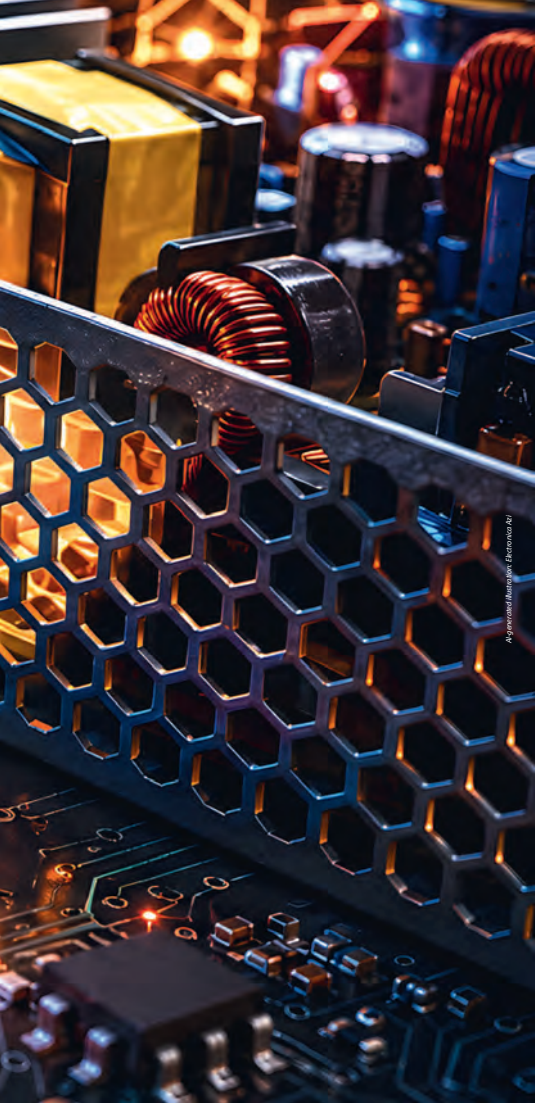


Figure 1 *Shown is an SMPS using low-voltage MOSFETs as a synchronous rectifier in the secondary side circuit; high-voltage MOSFETs form a full-bridge switch stage on the primary side.*



How design requirements for power supplies are evolving

Electronic devices are becoming smaller across various applications, including communications, automotive, the Internet of Things (IoT), the Industrial IoT (IIoT), and wearables. Designers of these systems require switched-mode power supplies (SMPSs) in smaller sizes with higher power density.

Achieving this higher power density requires components that are smaller and more efficient, allowing for a lower internal operating temperature and supporting high design reliability.

The most common active components in an SMPS are MOSFET switches, which are found in both the primary or high-voltage side, and the low-voltage secondary circuits (Figure 1).

The primary side of the SMPS typically operates at a high voltage. For example, in supplies operating off the power line, the primary MOSFETs rectify the line voltage. The secondary side typically operates at a lower voltage; this is the intended application area for low-voltage MOSFETs.

High efficiency and low losses

High efficiency in a power supply is achieved by minimizing power losses.

Losses associated with active semiconductor devices include conduction, switching, and body diode losses. These losses occur at various times within the device's operating cycle (Figure 2).

MOSFETs in an SMPS operate in either of two states, ON or OFF. The device state changes depending on the gate-to-source voltage (V_{GS}).

When the device is on, the drain-to-source voltage (V_{DS}) is at a low level.

In the ON state, the drain-to-source current (I_{DS}) through the device is determined by the load impedance and the ON-state drain-to-source resistance ($R_{DS(ON)}$). For an inductive load, the current increases linearly while it charges the magnetic field of the inductor.

During the ON time, the current through the channel resistance generates conduction losses that are proportional to the square of I_{DS} and $R_{DS(ON)}$.

When the device is off, the V_{DS} is high, and the I_{DS} represents the device's leakage current, which determines the OFF-state conduction losses.

During the transitions between states, both voltage and current are simultaneously non-zero, and power is dissipated in the device in proportion to voltage, current, and switching frequency. These are the switching losses.

The recovery losses are caused by the reverse recovery of the MOSFET's body diode when it is switched from a conducting to a nonconducting state.

The remnant charge in the PN junction must be removed during this time, resulting in a reverse recovery current spike and its associated power loss.

The loss is proportional to the device's reverse recovery charge (Qrr), which determines the reverse recovery time.

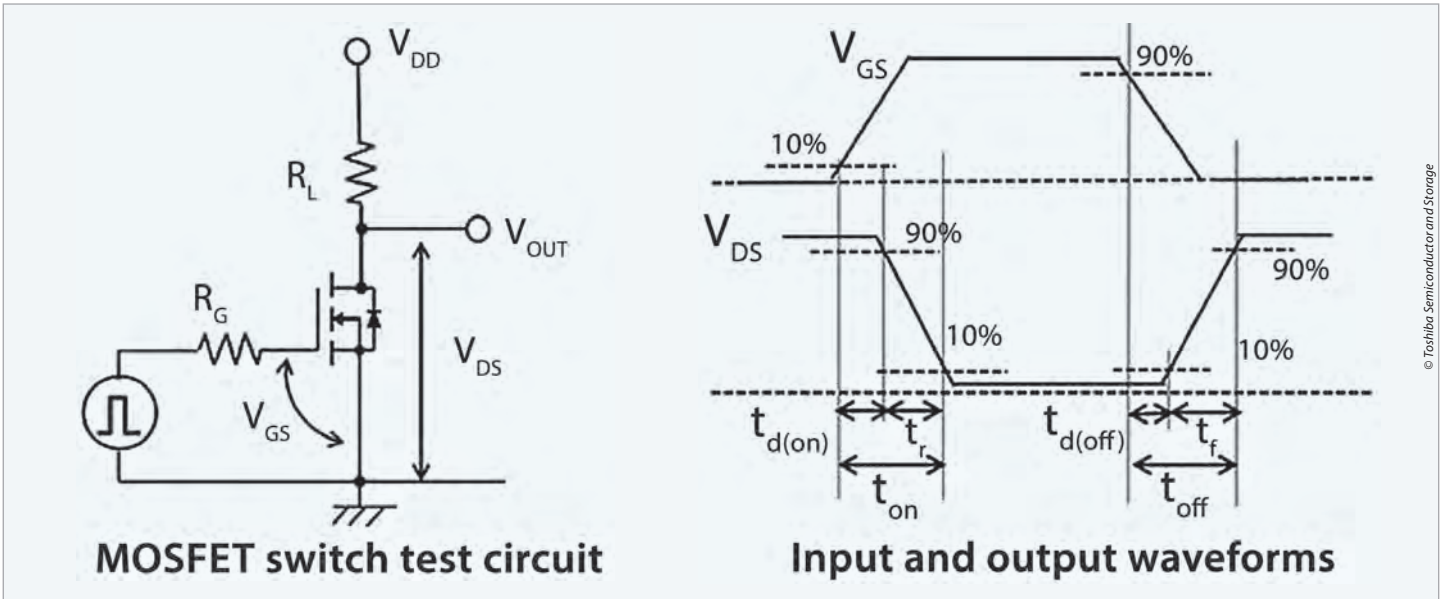


Figure 2 *The operating cycle of a MOSFET switch (left) includes the ON, OFF, and transition intervals (right), each with its own associated source of power loss.*

The device's total power loss is the sum of all these components.

How a trench structure enables more compact devices

The physical structure of a MOSFET affects the device's size and dimensions. The trench MOSFET structure (Figure 3) is the most compact construction, offering the highest channel density while reducing $R_{DS(ON)}$.

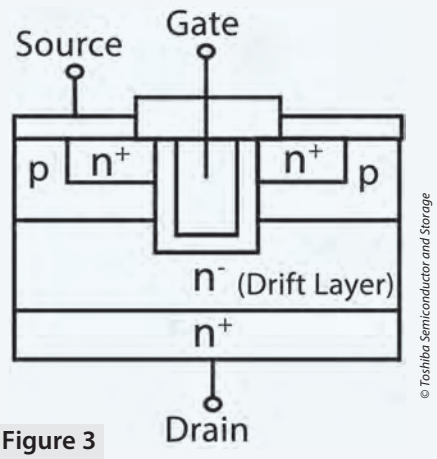


Figure 3

The trench MOSFET structure has a vertical current flow, resulting in a smaller footprint.

Conventional planar MOSFETs use horizontal current flow; the trench-gate process forms a vertical gate channel in the shape of a **U**.

This vertical flow reduces the device footprint, allowing more devices to be created on each wafer. The structure also decreases the $R_{DS(ON)}$. Additionally, the higher layout density allows parallel connection of multiple devices, further reducing the ON-state resistance.

The smaller size also decreases interelectrode capacitance, enabling faster switching and higher-frequency operation.

Switching losses are also a function of the duration of the transition region. The duration is governed by the parasitic capacitances of the device, which require a transfer of charge before the state of the MOSFET can be changed.

The total gate charge (Qg) is the amount of charge necessary to change the gate potential to its designated voltage. Lowering the switching losses requires shortening the switching time by decreasing Qg.

The product of $R_{DS(ON)}$ and Qg is a common figure of merit for a MOSFET, indicating a device's efficiency by combining conduction losses, which are proportional to $R_{DS(ON)}$, and switching losses, which are inversely proportional to Qg.
Better performance is indicated by a lower value for the $R_{DS(ON)} \times Qg$ product.

Since switching losses include a term for the reverse recovery loss of the body diode, the product of $R_{DS(ON)}$ and Qrr contributes to understanding the individual impact of conduction and switching losses.

Although the product of $R_{DS(ON)}$ and Qrr are not a customary figure of merit, it provides another window into a MOSFET's total power loss.

Toshiba's U-MOS 11-H MOSFETS

The Toshiba **U-MOS11-H** process, based on an improved trench structure, delivers MOSFET products with lower $R_{DS(ON)}$ for reduced conduction losses and improved overall switching characteristics due to lower Qg and Qrr, making it a solid fit for low-voltage and high-efficiency applications, such as SMPSs, motor drives, and server power supplies.

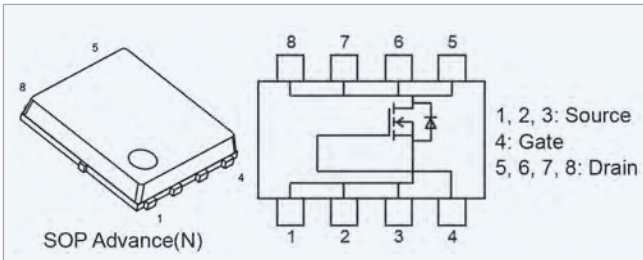


Figure 4

Shown are a view of the SOP Advance(N) package (left) and the internal circuit connections for the TPH2R70AR5-LQ (right).

The Toshiba **TPH2R70AR5-LQ** MOSFET is rated at 100 V and exemplifies the improvements in the U-MOS11-H process. Compared to an equivalent device from an earlier process, the TPH2R70AR5 offers an $R_{DS(ON)}$ that is approximately 8% lower and a Qg that is 37% lower. The resulting $R_{DS(ON)} \times Qg$ figure of merit is 42% lower.

The reverse recovery losses are minimized by using lifetime control technology, which introduces ion-beam-induced defects in the semiconductor to increase switching speed and reduce Qrr. Qrr is enhanced by 38%, and the resulting $R_{DS(ON)} \times Qrr$ product is reduced by 43%. These lower figures of merit indicate lower power loss, higher efficiency, and higher power density.

The TPH2R70AR5-LQ can handle a maximum drain-to-source voltage of 100 V, and drain currents up to 22 A in an ambient environment and up to 190 A with cooling (a case temperature of +25°C).

The $R_{DS(ON)}$ is 2.7 mΩ, worst case, for a drain current of 50 A and a gate drive of 10 V; the $R_{DS(ON)}$ is 3.6 mΩ, worst case, for an 8 V gate drive signal. Qg is typically 52 nC with a gate drive of 10 V, and the typical Qrr is 55 nC.

The TPH2R70AR5-LQ comes in a 5.15 mm × 6.1 mm × 1 mm surface-mount SOP Advance(N) package (Figure 4), providing excellent mounting compatibility with industry standards.

This package size is matched to the MOSFET's 100 V maximum VDS ratings. Lower-voltage devices have smaller package dimensions due to the decreased spacing requirements.

Toshiba's support for this product includes a fast **G0 SPICE** grade model to aid designers in quickly verifying circuit function. They also make available a more precise G2 SPICE grade model that includes transient analysis.

Conclusion

The Toshiba TPH2R70AR5-LQ low-voltage MOSFET is specifically designed for use on the secondary side of an SMPS.

It uses a novel cell structure that reduces power losses and improves the switching characteristics of the transistor, enabling the design of power devices with high power density and reliability for modern applications.

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Battery reference design for connected sensor IoT battery packs

NB-IoT is a key wireless technology for providing long distance and reliable communication links to all kinds of smart connected sensors. The challenges of placing these sensors in a variety of location types, while providing reliable data links for longer periods of time, have led to the selection of larger and more expensive non-rechargeable battery packs to power these NB-IoT systems.

Author:
Furqan Noor, Application Engineer
Microchip Technology

This has led to higher costs for both the system and for replacing the battery packs, along with a bigger overall system solution which is not suited for trending compact space constrained applications. These systems often rely on non-rechargeable Lithium Thionyl chloride battery packs. These packs need to last as long as possible in remote locations without being serviced or replaced for a reliable and sustained IoT network solution. This happens as a larger battery pack is needed to meet the peak current requirement for the transmission phase of the NB-IoT wireless link.

The higher current pulse requires a battery pack and supercapacitor (supercap) system to provide the peak current for the wireless transmission. The selected capacitance value of this supercap is also often over-specified because of the intrinsic leakage current losses associated with supercap construction and its performance variations under varying operating temperatures.

In short, both the battery pack and the supercap are over-specified, which leads to a larger, more expensive and less efficient solution.

The NB-IoT specification operates in the licensed spectrum over long distances by tapping into the 4G LTE cellular network. However, there are two different operating models and many different power levels that impact the design of the power system and the specification of the battery pack.

The original NB1 variant of the protocol provides data of 26 kbit/s for the downlink or 66 kbit/s for the uplink on a narrow 180 kHz radio band and would typically upload data from the sensor once a day. This leaves the modem in sleep mode 99.9% of the time.

The latest NB2 boosts this to 127 kbit/s for the downlink and 159 kbit/s for the uplink and adds a new power class with a 14 dBm transmission power for longer range smart sensor connections.

This translates to a current consumption of 155 mA in the latest NB-IoT modules, where the peak current is typically 275 mA.

An optimized power scheme reference design from Microchip creates a reliable, efficient and affordable power solution for NB-IoT systems such as industrial sensors, smart farms and smart meters. This design dramatically reduces the size of the supercap, thereby reducing the required number of battery packs for any NB-IoT power solution. This reduces the power consumption and the size of the overall NB-IoT solution, e.g. smart home or smart meter applications.

This reference design reduces the size of the supercap for both these transmission modes by a factor of 20, allowing a smaller battery pack with a longer lifetime before replacement and higher reliability. This is also valuable for other long-distance applications that use NB-IoT such as asset tracking or smart farming.

The key to the reference design is the separate high-power and low-power paths, coupled with a programmable load switch.

This is controlled by a 16-bit microcontroller that can switch from the low-power sleep mode to the high-power mode for transmission.

In deep sleep or listening modes, the high-power path is disabled and a low IQ power circuit, based on a Low Dropout (LDO) regulator and high-side power switch, is activated. This helps to extend the life of the battery pack and the overall efficiency of the system.

To provide required peak current during high-power mode this design uses a low-cost accurate linear current source MIC2039 to precharge the supercap right before the requirement of high-power transmission phase. This eliminates the need for special tooling for the precharge process of the supercap for more efficient manufacturing processes and saves costs for related housekeeping.

Using this accurate current source to charge the 470 mF supercap results in a deterministic charge time or charge recovery time that converges faster to the battery pack voltage than a Resistor-Capacitor (RC) design. MIC2039 has an adjustable output current limit that is resistor programmable from 0.2A to 2.5A as well as a kickstart feature that allows momentary high-current surges up to the secondary current limit during start-up or while operating in steady state. This is useful for charging loads with high inrush currents, such as capacitors for the transmission phase of the NB-IoT link and helps optimise the size of the supercap.

In this novel power scheme, the high-power path employs a battery pack to charge the supercap to a voltage close to the battery pack voltage (around 3.6 V). The supercap compensates for voltage drops and current source limitation of the battery pack. The supercap powers a synchronous boost converter MIC2875 that operates either in bypass mode or boost mode depending upon the charged voltage of the supercap. The 2 MHz synchronous boost converter regulates output voltage of the high-power path with a 4.8A switch, and has a bidirectional load disconnect function which prevents any leakage current between the input and output when the device is disabled.

This DC-DC boost makes 100% of the battery's capacity usable, which further extends the lifetime of the battery pack or allows for a smaller pack. The boost feature enables the design to work even when the battery is discharged below its nominal voltage. This also prevents overstressing the battery pack while ensuring the fastest and most accurate charging.

A load switch disconnects the supercap from the battery pack to reduce leakage current when high power is not required.

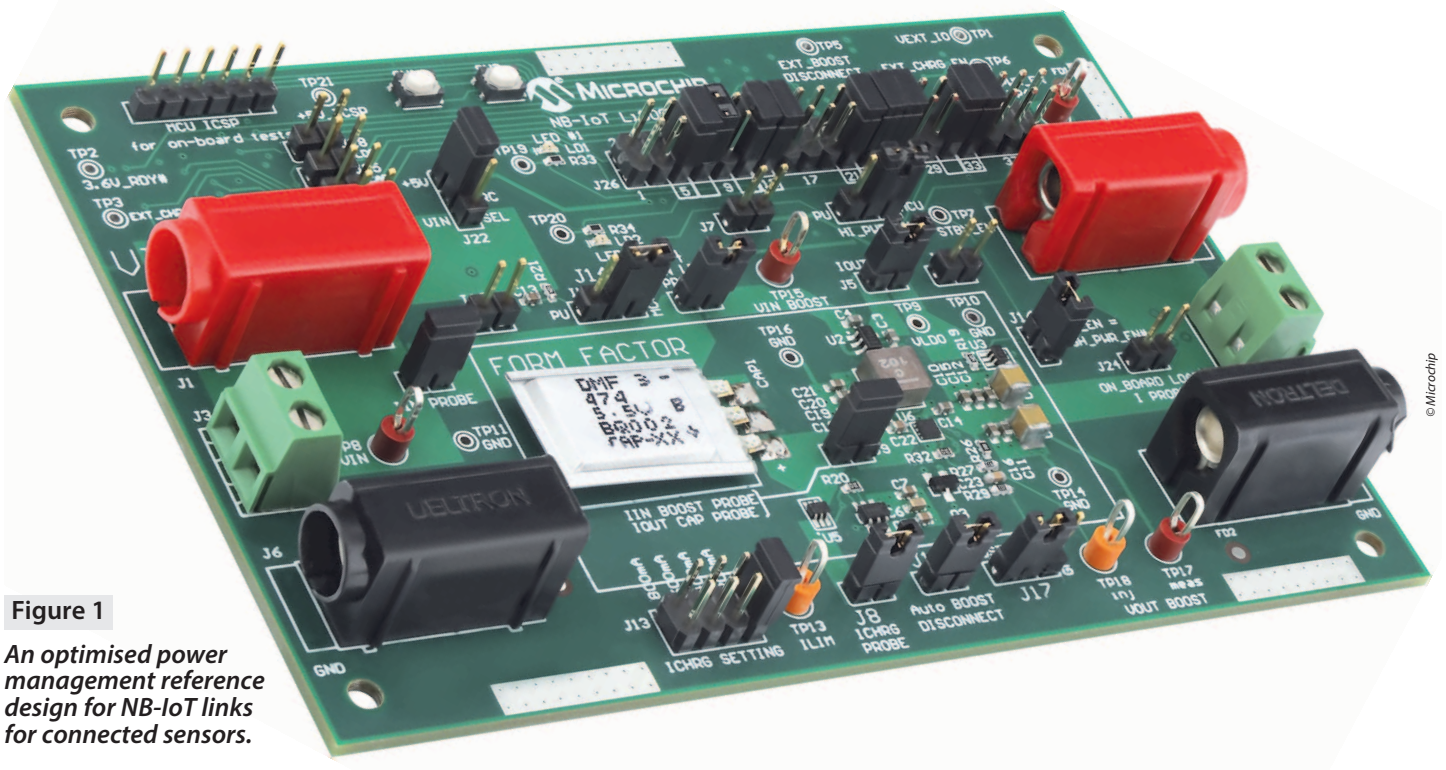

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Figure 1

An optimised power management reference design for NB-IoT links for connected sensors.

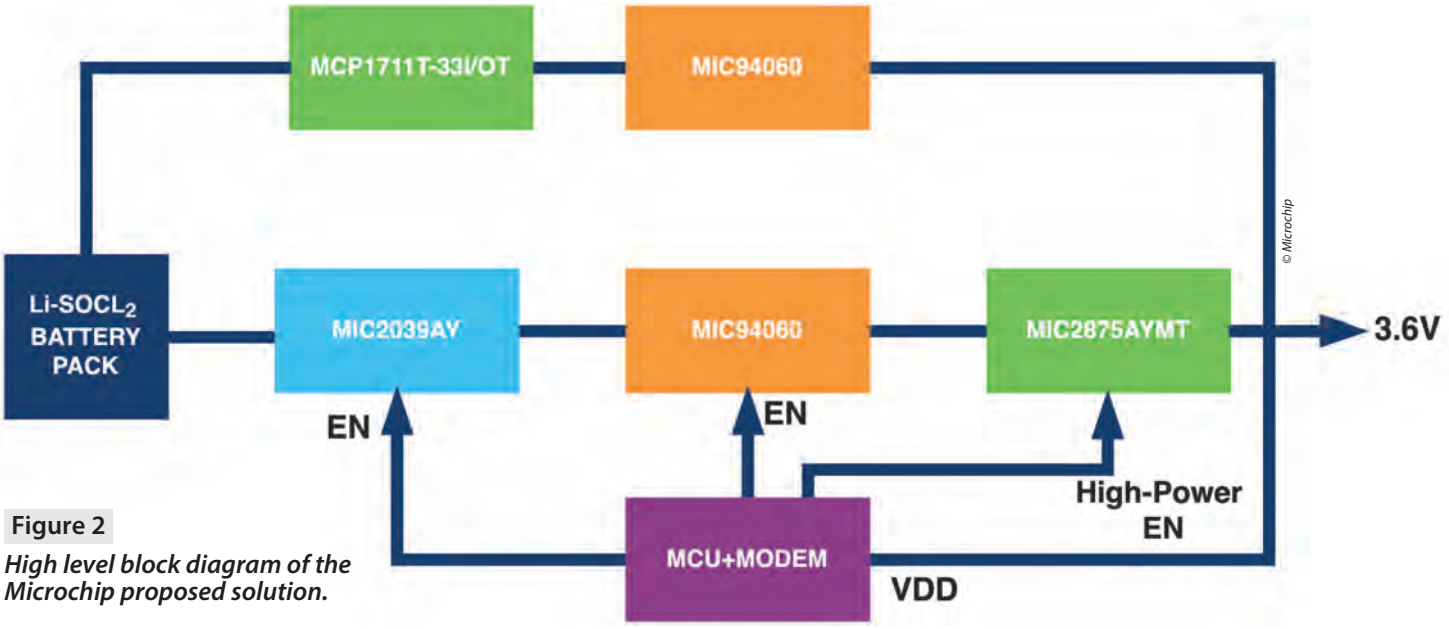

Figure 2
High level block diagram of the Microchip proposed solution.

The choice of chemistry of the battery pack is also important. The design uses LiSOCl2 (Lithium Thionyl chloride) primary cells as these offer the best compromise between cost, size and required performance, especially with ultra-low self-discharge current.

These are easily available in AA and AAA form factors depending on the lifetime requirements of the design. The voltage across the supercap can vary from 2.5V up to 3.65V to support the power needs of different tasks and the supercap can be disconnected from the application by disabling the load switch.

The boost converter operates in bypass mode automatically when the input voltage is greater than the target output voltage. At light loads, the boost converter goes to the PFM mode to improve the efficiency.

The DC-DC converter also features an integrated anti-ringing switch to minimize EMI which is important for meter designs with wireless links.

The validated non-rechargeable battery pack power scheme reference design developed by Microchip combines a low cost 16-bit microcontroller with a high-power path for charging a supercap for transmission and a low-power path for the sleep and listening modes.

A programmable switch controls the transition between the two paths.

This enables the supercap to be 20 times smaller than in other designs and allows the use of a relatively smaller battery pack.

Using lithium thionyl chloride primary cells also offers the best compromise between cost, size and performance.

This combination of battery, supercap and power management improves the reliability of smart sensor networks and extends the time required to replace the battery packs, cutting cost for equipment suppliers and operators.

https://www.microchip.com/en-us/tools-resources/reference-designs/narrowband-iot-reference-design

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Part Number	Product Type	Description
PIC16F1769	16-bit PIC® Microcontroller	14/20-pin, Up to 14KB, Up to 1K RAM, Op amps, ZCD
MIC2039	Programmable 0.2A - 2.5A High Accuracy High-Side Current Limit Power Switch	ADJ, High-Side, Power Distribution Switch
MIC94060	High-side load switch 2A, 77mΩ	Load switch w/level-shift
MCP1711	150 mA Ultra-Low Iq, Capless LDO Regulator	150 mA Ultra-Low Quiescent Current, Capless LDO Regulator
MIC2875	2MHz 4.8A Isw Synchronous Boost Regulator	Ultrasonic Synchronous Boost Regulator
MCP6444	450 nA, 9 kHz Op Amp	MCP6444 is a 9 kHz Op Amp with typical supply current of 450nA and operates from 1.4V to 6.0V. This quad Op Amp is available in SOIC and TSSOP package
MCP6549	Open-Drain Output Sub-Microamp Comparators	600nA, 4uS, Quad Channel Open-Drain Comparator

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Figure 3 ***Reference Design BOM.***

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INTERMEDIATE BUS CONVERTER PART 2: PERFORMANCE

This article will discuss the performance of a discrete quarter brick power supply and how it meets a higher output power requirement with very high efficiency.

Authors:
Karl Audison Cabas, Applications Development Engineer
Ralph Clarenz Matociños, Associate Applications Development Engineer
Christian Cruz, Staff Applications Engineer
Analog Devices

A quarter brick power supply is a critical component in data center applications with the emergence of 48 V architecture. It must offer high performance in terms of efficiency and transient requirements while maintaining its size within a quarter brick form factor.
The quarter brick power supply shows that both the efficiency and transient requirements can be designed in such strict form factor constraints while delivering industry-leading output power of 2 kW.
The reference design shows 98.59% peak efficiency at 48 V input, and 97.68% efficiency at full load for 54 V input.

Introduction

With the development of stronger processor cores and the increasing usage of artificial intelligence (AI) chips in data centers, the power requirements for next-generation machines are greater than their predecessors. These machines need to maintain their form factor to ensure that the upfront cost for migration is minimized. Therefore, a better-performing power supply of the same dimension is in demand to provide the next generation of chips with the required power. This is why using a standardized quarter brick power supply is advantageous for system design.

Using a quarter brick power supply reduces system design complexity because of its ready-to-use features and compatibility among different vendors.

However, quarter brick power supplies do not have the same topology nor performance, so engineers should choose carefully depending on their requirements. Operating input voltages, output voltage regulation, peak and full load efficiency, transient and thermal performance, and scalability are some of the key parameters that engineers should consider when designing with a quarter brick power supply.

Data and Results

The test findings below comprise of start-up and steady-state performance measurements, functional performance waveforms, and temperature measurements.

The following configurations were tested using the quarter brick reference design and its system board. The system board is equipped with a hot swap circuit.

QB Power Supply Operation Settings

- Input Voltage: 40 V to 60 V
- Output Voltage: 12 V
- Output Load: 0 A to 166.67 A
- Switching Frequency: 150 kHz

Performance Data

EFFICIENCY AND POWER LOSS

Using a 4-phase DC-to-DC converter lowers the current per phase, therefore reducing conduction losses. The quarter brick is tested at 48 V and 54 V input for efficiency and is plotted in Figure 1.

At lower input voltage, peak efficiency is greater due to lower step-down voltage. However, it slowly rolls off at higher output power due to increasing input current. Conversely, lower peak efficiency is seen at 54 V but has better full load efficiency.

Figure 1

ADI's quarter brick 48 V and 54 V, efficiency and power loss graph.

In a quarter brick PCB area, the converter achieves about 98.59% of peak efficiency at 48 V, 800 W, and full load efficiency of 97.33%. For 54 V applications, it can achieve a peak efficiency of 98.45%, 1000 W, and 97.68% at full load.

The synchronous rectification employed mitigates diode conduction losses, further optimizing efficiency.

By utilizing high quality, low equivalent series resistance (ESR) input and output capacitors, along with proper coupled inductor selection, losses across critical components are reduced.

This meticulous component selection and design considerations contribute to overall power loss reduction.

With proper layout design, thermal management, and optimization of control loop parameters, the device enables reliable and efficient power supply solutions.

TRANSIENT RESPONSE:

EXTENDED POWER DELIVERY

The converter is well-suited for dynamic power delivery requirements for intermediate bus applications. Its 4-phase architecture enables efficient load distribution, reducing the effects of unexpected changes in load circumstances.

This design innovation improves with the controller's capacity to adapt to shifting power needs rapidly and effectively, ensuring a constant output voltage during transient occurrences.

The interleaved operation allows for a quick response to sudden load fluctuations. This responsiveness is critical in situations where quick power supply adjustments are required.

It is designed to deliver extended power for a limited amount of time to support sudden load demands while maintaining the regulated output voltage.

This 2 kW rated design was tested for 1.5× extended power delivery for 50 ms as seen in Figure 2, and 1.8× extended power delivery for 500 µs as seen in Figure 3.

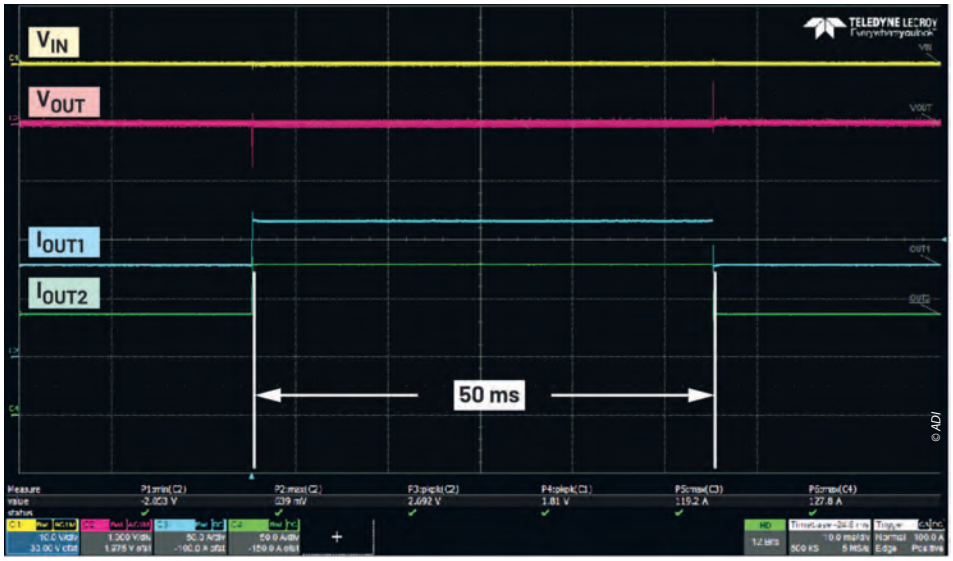

Figure 2 ***2 kW to 3 kW step-load for 50 ms.***

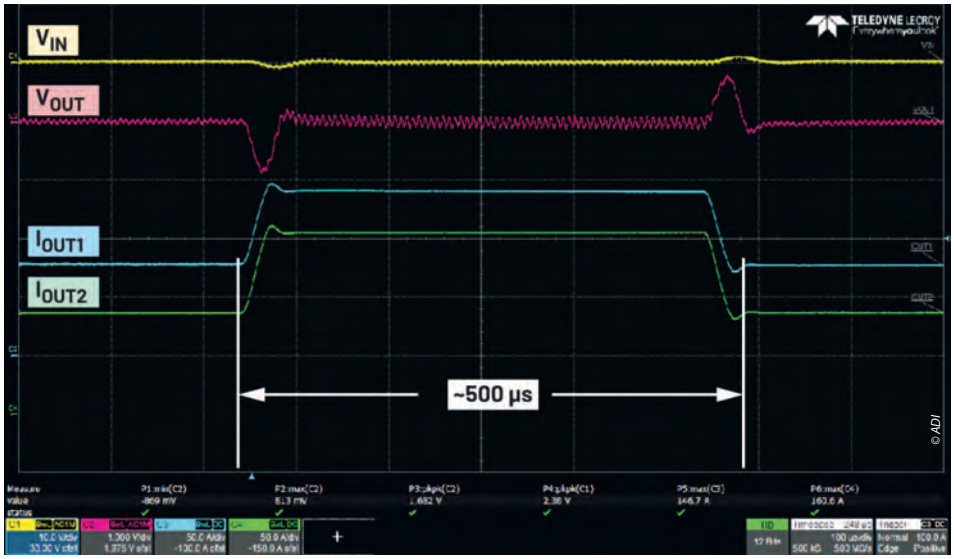

Figure 3 ***2 kW to 3.6 kW step-load for 500 µs.***

The transient response of the converter can be further optimized by tuning its type-2 compensation, enabling precise regulation, and minimizing deviations in the output voltage.

THERMAL PERFORMANCE

The thermal performance of this reference design is a critical factor of its overall functionality. Proper thermal management ensures the reliable operation of the device and prevents overheating, which can degrade performance and shorten the lifespan of electronic components. See Figure 4 for its thermal characteristics without the heatsink and baseplate implemented.

Enhancing the thermal performance of the quarter brick power supply by incorporating effective heatsinking ensures thermal dissipation while maintaining adequate airflow around the device. The data sheet typically provides recommendations for proper heatsink design, including details on thermal resistance and the maximum allowable junction temperature. By implementing these guidelines, designers can prevent the critical devices (controllers, FETs) from exceeding temperature limits, ensuring reliable and continuous operation.

Additionally, the converter includes features such as overtemperature protection, which helps safeguard the device against thermal issues. This protection mechanism can automatically shut down the controller or reduce its output power in the event of excessive temperatures, preventing damage to the device and the surrounding components.

START-UP RESPONSE

Startup allows for low input inrush current from the main power source to charge the bulk capacitors, and a gradual increase in the output voltage during the initial power-up phase.

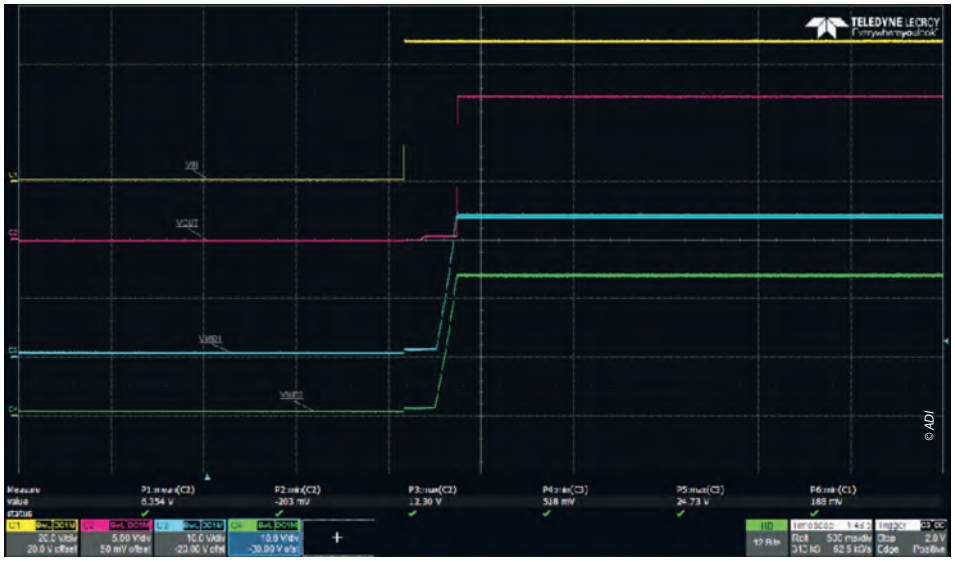

Figure 5 *Hybrid converter startup at no load condition.*

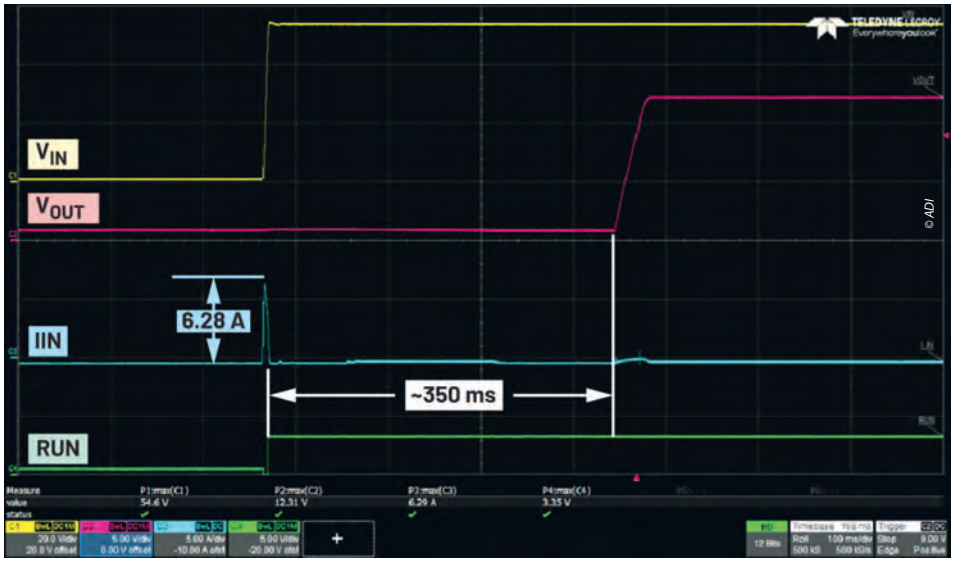

Figure 6 *QBS startup at no load condition.*

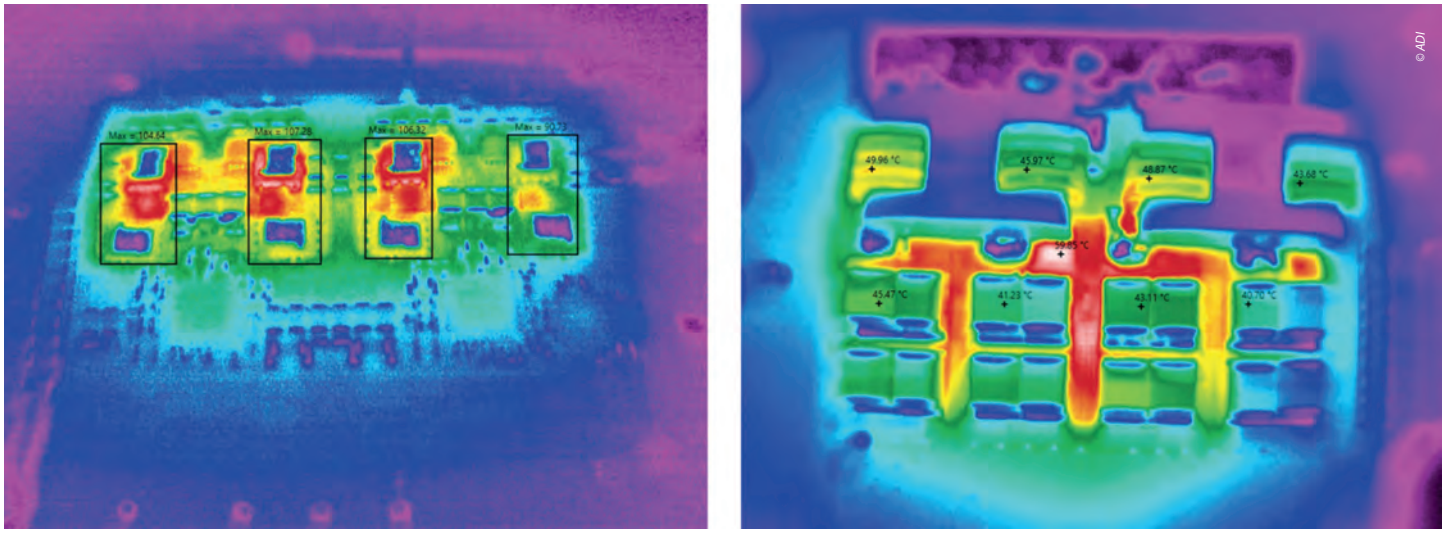

Figure 4 *QBS thermal performance at 48 V_{IN}, full load (P_{OUT} = 2 kW).*

This prevents inrush current and voltage overshoots, enhancing system reliability and protecting downstream components from potential damage. The controller also includes fault monitoring mechanisms to detect abnormal conditions during startup, triggering appropriate responses to prevent potential issues. Figure 5 shows the start-up response before the output voltage ramps up.

During startup, the converter carefully ramps up the output voltage, ensuring a smooth transition to operational mode. This controlled approach is essential in applications where sudden changes in voltage could impact connected components. The controller is designed to handle startup under various conditions, accommodating a wide range of input voltages and load scenarios. For Analog Devices' quarter brick reference design, the hot swap controller **LTC4287** is also incorporated to ensure smooth input voltage ramp.

OUTPUT RIPPLE

Output ripple refers to the fluctuations or variations in the output voltage of the power supply. The converter achieves low output ripple by employing an interleaved phase with coupled inductor, where the switching phases operate slightly out of phase with each other. This phase interleaving effectively reduces output voltage ripple, providing a cleaner and more stable output voltage. See Figure 7.

By using high quality, low ESR capacitors and properly chosen inductors, designers can further minimize output ripple. The data sheet typically provides guidelines and recommendations for selecting appropriate components to optimize output ripple performance. In applications where low output voltage ripple is critical, the multiphase design and features contribute to maintaining a smooth and precisely regulated output. This is particularly beneficial for powering sensitive electronic components or systems where stable voltage levels are essential for proper functionality. Ripple data from both input and output voltage is also dependent on measurement setup so a short probe at the closest ceramic capacitor is recommended to capture the real ripple performance at steady-state.

Conclusion

Quarter brick power supplies provide a streamlined, high performance power solution suitable for diverse applications. Renowned for their compact design, energy efficiency, and robust reliability, these power supplies boast superior power density, accurate voltage regulation, and advanced protective features, making them an essential device across various industries. ADI's latest discrete intermediate bus converter delivers key advantages for powering data centers, offering high efficiency, robust performance, and advanced control features.

Figure 7 ***Input voltage ripple and output voltage ripple.***

The converter with output ripple performance is influenced by various factors, including the quality of input and output capacitors, the inductor selection, and the overall layout design.

Its ability to optimize power delivery, enhance reliability, and reduce operational costs makes it an ideal solution for efficient and dependable data center power management.

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About the Authors:

Karl Audison Cabas is an applications engineer focusing on power applications at Analog Devices since September 2020. He holds a bachelor's degree in electronics engineering from Polytechnic University of the Philippines and a postgraduate diploma in power electronics from Mapua University. He has more than 4 years of experience in DC-to-DC power converters. His previous function involved catering to customer inquiries and design issues related to DC-to-DC converters. He now works as a power system applications engineer for cloud and data center applications.

Ralph Clarenz Matociños graduated with a bachelor's degree in electronics engineering from Pamantasan ng Lungsod ng Maynila (PLM) in Manila, Philippines. He has over one year of engineering experience in power electronics, including battery management system development and DC-to-DC power conversion. He joined ADI in 2022 and currently works as a power systems applications engineer for cloud and data center applications.

Christian Cruz is a staff applications development engineer at Analog Devices, Inc., Philippines. He holds a bachelor's degree in electronics engineering from the University of the East in Manila, Philippines. He has more than 12 years of engineering experience in the field of analog and digital design, firmware design, and power electronics, which includes power management IC development as well as AC-to-DC and DC-to-DC power conversion. He joined ADI in 2020 and is currently supporting power management requirements for cloud-based computing and system communications applications.

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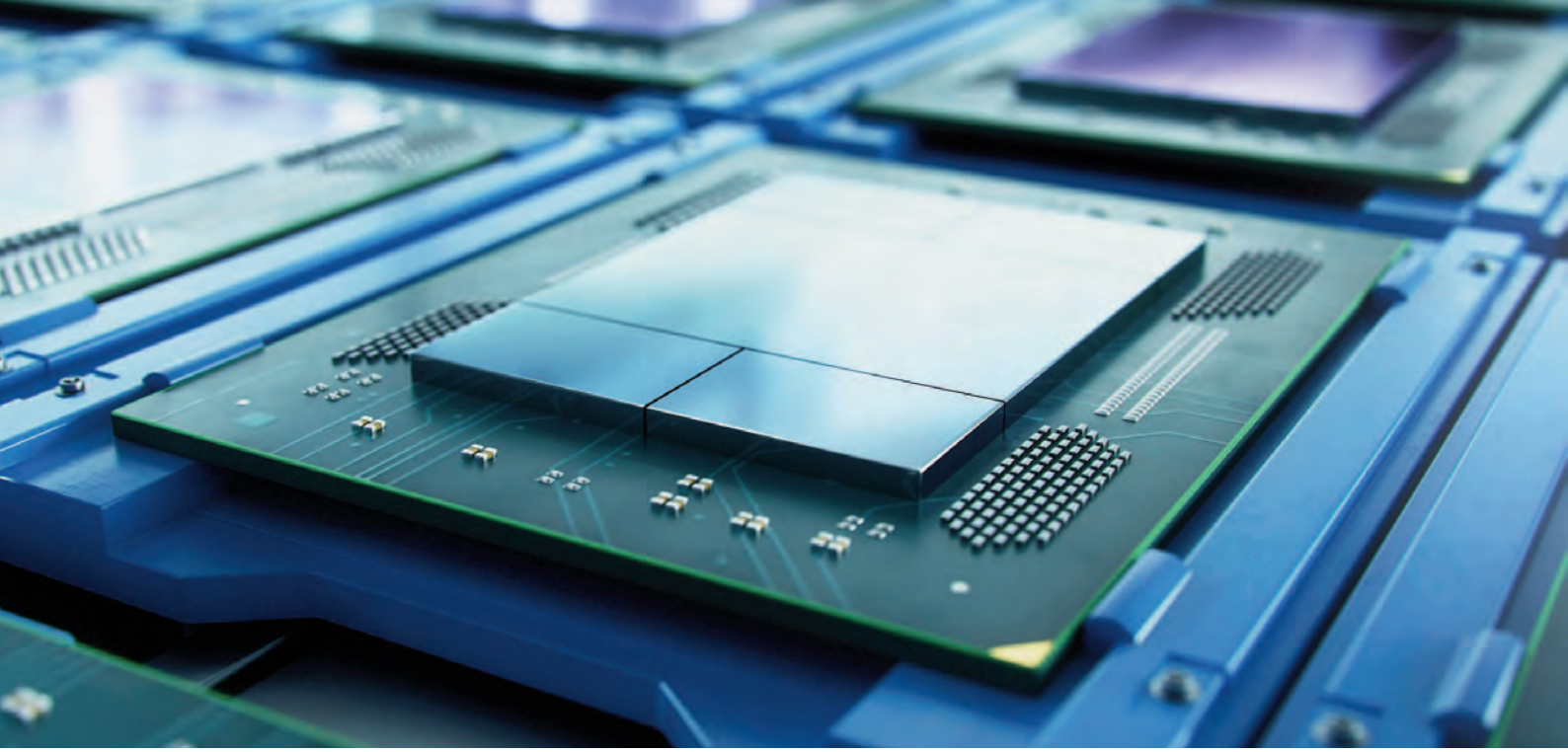

Siemens advances self-verifying agentic AI workflows for semiconductor and PCB design

Siemens announced an expansion of its strategic partnership with NVIDIA to deliver self-verifying agentic AI workflows to EDA, helping semiconductor and printed circuit board (PCB) engineering teams move from autonomous task orchestration toward more trusted, continuously validated engineering outcomes. The new capabilities build on Siemens' recently introduced Fuse™ EDA AI Agent system and add new NVIDIA AI technology to help long-running, domain scoped, AI agents reason, act and continuously validate decisions against deterministic, physics-based EDA engines.

The updates to Siemens' Fuse EDA AI Agent are designed to help the semiconductor and PCB industry move beyond simple automation and deliver trusted and verifiable outcomes that improve result quality, time-to-results, tool-calling reliability and token efficiency across long-running engineering workloads. The Fuse EDA AI Agent system is now integrated into Siemens' recently launched Intelligence Center X, supporting agent creation and orchestration in Siemens' enterprise industrial AI environment. Intelligence Center X delivers AI-driven, coordinated processes across design, manufacturing and supply chain – enhancing the comprehensive Digital Twin to support smarter execution and more trusted outcomes.

The Fuse EDA AI Agent solution now combines Siemens engineering intelligence and trusted verification capabilities with NVIDIA AI infrastructure technologies to execute complex semiconductor design tasks with enhanced speed and precision:

Optimized EDA agents built with NVIDIA NeMo Gym open library for agentic environments improve result quality, speed and token efficiency for semiconductor and PCB design. This empowers customers with EDA design flows that get smarter over time with self-verifying agents which learn from every project to automatically improve execution strategies, optimize workflows and make better use of accumulated context.

The NVIDIA OpenShell secure runtime enables enterprise scale design teams to run autonomous agents across their entire EDA environment with enterprise-grade security, access controls and audit trails within governed runtime environments.
Advanced reasoning with the latest NVIDIA Nemotron models and Switchyard accelerates design with AI agents that understand complex engineering trade-offs at the speed of AI reasoning and supports complex engineering workflows with improved performance and token efficiency.

NVIDIA accelerated computing and CUDA-X libraries helps design teams achieve signoff-quality results in hours instead of days, powering both AI reasoning and EDA engines for dramatic speedups without sacrificing accuracy.
Together, these capabilities enable secure and token-efficient multi-agent coordination, real-time feedback and improved convergence across semiconductor and PCB design and verification flows, helping customers achieve trusted engineering outcomes.

The new offering spans Siemens' EDA technologies across the full semiconductor and electronics lifecycles, from high-level synthesis with Catapult, verification with Questa One and Veloce, and custom IC design and verification with Solido, through to physical implementation with Aprisa, signoff verification with Calibre and design-for-test with Tessent. It also supports advanced 3D IC integration using Innovator3D IC and PCB design with Xpedition.

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Strato Pi Plus Now Shipping: Edge Server with Multiple Isolated Serial Interfaces

Sfera Labs has begun shipping Strato Pi Plus, a hybrid industrial edge server that combines the Raspberry Pi 4B or 5 with a dedicated RP2354 co-processor in a compact 4-module DIN-rail enclosure. The device solves a problem that has long frustrated industrial automation engineers: how to deploy a Linux single-board computer in the field while keeping the reliability guarantees that industrial applications demand.

The RP2354 co-processor runs entirely independently of the Raspberry Pi, managing the hardware watchdog, power cycle logic, RS-485 TX-enable, CAN communication, relay output, fan control, and input power monitoring. If the Raspberry Pi OS becomes unresponsive, the RP2354 detects and recovers the system automatically - with no software running on the Raspberry Pi required. OTA firmware updates to the RP2354 are delivered over Raspberry Pi GPIO, so deployed fleets can be updated in the field without physical access.

Quad RS-485 and CAN FD

Variant A of Strato Pi Plus offers four individually isolated RS-485 interfaces - each built around the Analog Devices ADM2861E transceiver with ESD protection and programmable termination. For engineers managing multi-bus Modbus RTU networks, this eliminates external RS-485 gateways entirely.

Variants A and B supports both CAN 2.0B and CAN FD at up to 8 Mbps data rates, with galvanic isolation and ESD protection - making Strato Pi Plus equally at home in machine networks and vehicle or fleet telemetry applications.

Wide-voltage supply, precision RTC, and hardware security built in

The power supply accepts 10÷50 V DC, covering 12 V, 24 V, and 48 V industrial rails without an external converter. An NXP PCF2131 real-time clock with a temperature-compensated oscillator (±3 ppm) keeps accurate time through power interruptions, while the Microchip ATECC608 secure element provides hardware key storage, and other standard cryptographic functions for device authentication and secure communications.

An optional 3-axis accelerometer enables tamper detection and vibration monitoring. An optional internal fan, controlled by the RP2354, activates on user-configurable temperature thresholds.

Three variants, fully open software, M.2 SSD storage support

Strato Pi Plus is available in Variant A (4× RS-485, CAN FD, relay), Variant B (1× RS-485, CAN FD, relay), and Variant C (1× RS-485). All variants are available with Raspberry Pi 4B or 5, in memory configurations from 1 GB to 16 GB, with optional internal fan and are CE, FCC, IC compliant. Linux drivers expose all RP2354-managed parameters via the sysfs file system, enabling integration from any language or framework.

Raspberry Pi 5 models will add optional M.2 SSD storage support in late 2026 - making Strato Pi Plus one of the very few industrial DIN-rail Raspberry Pi platforms to offer this capability, alongside Sfera Labs' own Strato Pi Max. For deployments that require fast local storage, data logging at scale, or local AI model inference, onboard SSD support removes a significant constraint that has historically pushed engineers towards more expensive or proprietary solutions.

For more information on the Strato Pi Plus, visit: https://sferalabs.cc/product/strato-pi-plus/

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New Mouser and onsemi eBook Examines the Power and Sensing Technologies Enabling the Next Generation of AI Systems

Mouser Electronics, Inc., the industry's leading New Product Introduction (NPI) distributor with the widest selection of semiconductors and electronic components™, has released a new eBook in collaboration with onsemi, Powering and Sensing AI: From Cloud Infrastructure to Physical Autonomy.

Artificial intelligence is often viewed through the lens of software, algorithms and large language models. However, as AI expands from cloud data centres into industrial automation, robotics, autonomous machines, and edge systems, the physical realities of power delivery, sensing, and system efficiency are becoming critical determinants of performance, scalability, and reliability.

The new eBook brings together insights from experts across the AI ecosystem, including specialists from onsemi, Amazon, Google, Meta and Tesla, to explore how advances in power semiconductors, sensing technologies and hardware architectures are supporting AI applications from hyperscale data centres to robots, through to real-world autonomous systems.

Power efficiency for growing AI workloads

As AI workloads continue to grow, the industry faces mounting challenges in delivering the power required to support increasingly dense computing environments. The eBook examines how the move towards higher-voltage architectures and the adoption of wide-bandgap semiconductor technologies such as silicon carbide (SiC) and gallium nitride (GaN) are helping data centre operators improve efficiency, reduce thermal management demands and lower overall energy consumption.

Sensing technologies for physical AI

The eBook also highlights the growing importance of sensing in physical AI applications. While vision remains a key element of autonomous systems, intelligent machines increasingly rely on a combination of image, force, torque, position and proximity sensing to interact safely and effectively with the physical world. The eBook explains how improvements in sensing quality can reduce processing overhead, lower power consumption, improve response times and enable more reliable AI decision-making at the edge.

Topics covered in the eBook include:

- How growing AI workloads are reshaping power requirements in data centres, edge infrastructure and industrial systems
- The role of silicon carbide (SiC) and gallium nitride (GaN) technologies in improving power efficiency, reducing thermal challenges and supporting higher power densities
- Why sensing quality directly affects AI accuracy, latency, power consumption and overall system performance
- The benefits of intelligent edge sensing, local data processing and sensor fusion in autonomous and AI-enabled systems
- Strategies for reducing latency and improving safety in robotics, industrial automation and collaborative machines
- System-level approaches to integrating sensing, power delivery and AI processing to enable physical autonomy

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Highlights

- Gap filling, heat spreading and hybrid solutions
- Customized components for optimal fit
- Advisory services from technical experts