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In this issue...

The theme for the first issue of 2018 is Power. Everything relies on it and there is a lot of development in this field. We present articles exploring GaN Power Devices: their potential, benefits, and keys to successful use; the necessity of digital power; and how online resources are narrowing the PSU Make-or-Buy Decision. Our industry news section details the Mont-Blanc 2020 project which is to create the next generation of industrial processor, takes a peek at Europe's nanoelectronics roadmap and discusses STMicro's proposed acquisition of software developer Atollic.

Plus, of course, regulars: Dev Kit Pick, Video Wall and the latest, most innovative NPIs now in stock at Mouser. Now read on...

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Fab4Lib consortium to develop German Li-ion cell production

A group of 17 companies and research institutes have formed the Fab4Lib consortium, for the express purpose of developing large-scale battery cell production in Germany. Advanced battery technology is at the core of many products and market sectors, and the ability to manufacture advanced batteries in a large volume is key to success in those spaces. The German government will fund the initiative initially with 12.1 million euros.

Prof. Schuh (PEM RWTH Aachen), Prof. Kampker (StreetScooter), State Secretary Rachel (BMBF)

Among the members of the Fab4Lib consortium are TerraE, StreetScooter, BMZ, Umicore, Custom Cells, Litarion, Manz, Siemens, ThyssenKrupp, RWTH Aachen, and ZSW in addition to many others. The goal is to eventually develop an annual capacity of 6 GWh of modular capability, so manufacture can be set up where and when needed.

TerraE Holding (www.terrae.com) is the project lead, and the 18-month project will first see a series of demonstrators that the company plans to put into practice though in its own facilities. The plans are to create German Gigafactory along the lines of Tesla's where they intend to produce up to 34 GWh of capacity by 2028.

VR Website creation platform to support next-generation Cloud development

It isn't easy to create next-generation virtual reality (VR) systems, when there is so little content and so few services catering to the VR space (pun intended).

To address this, Double XVR (doublx.com) unveiled their DoublX Beta online platform, enabling VR technology developers to create VR-Websites without a single line of code.

Using a drag-and-drop interface, the software allows users to insert images, flat and 360-degree, as well as video and audio effects so creators, designers, and VR camera owners can easily add an array of advanced functions to create custom VR-websites.

Based on proprietary RENDERER software, the solution operates on regular web browser such as Chrome or Safari. DoublX features are built into the platform and don't require code to implement.

It also provides the ability to use its databases to manage content and clients, to reduce the need for outside developer help that can cost several thousands of dollars.

EU to review and update their batteries directive

One major barrier to development in Europe is antiquated policy based on legacy technologies favoured because of earlier market dominance. With that in mind, the European Commission (EC) opened public consultation into the EU's Batteries Directive, part of an across-the-board review of laws regarding batteries in the EU.

Current legislation from 2006 uses data and market information from the turn of the millennium, and the EU must consider advances in battery technologies and the topical issues currently facing the electronics industry.

The 2006 Directive overly focuses on lead-acid technology, which dominated the market in the years 2000 to 2005, the years the directive used as a reference, and must be updated and made flexible enough to take account of new and developing battery chemistries.

The new initiative will tackle the current contradictions existing between the Batteries Directive, the End of Life Vehicles Directive, and the REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) Directive. Existing EU laws class batteries by usage type, but new use cases have emerged as well as a new generation of wireless Cloud-based products in mobility, communications, energy, medical care, and industrial applications.

STMicro to buy software developer Atollic

STMicroelectronics (www.st.com) announced its acquisition of software-development tools specialist Atollic, supplier of TrueSTUDIO, an Integrated Development Environment (IDE) focusing on Arm Cortex -M microcontrollers. The software already supports the STM32 family of Cortex-M based MCUs from ST, and the acquisition will allow the company to guide the future evolution of TrueSTUDIO to serve the STM32 ecosystem and others from ST.

The STM32 MCU portfolio and its development ecosystem has positioned ST as a leader in embedded systems, and Atollic's TrueSTUDIO will give STM32 developers a competitive advantage with the availability of the STM32 TrueSTUDIO IDE in a combined package. ST has acquired Atollic for a cash payment of $7 million, and a deferred earn-out contingent on certain conditions, which ST currently estimates will be about $1 million.

atollic

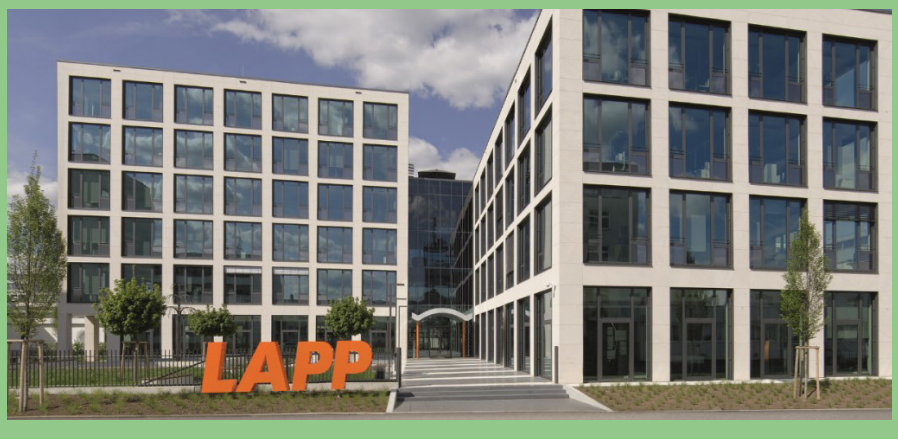
Lapp Group acquires SKS Automaatio and SKS Connecto

The Lapp Group (www.lappgroup.com) stated that they will purchase SKS Automaatio and SKS Connecto in Finland and Poland to strengthen Lapp's leadership in cable harnessing in North-Eastern Europe. Cable and cable-harness manufacturer SKS Connecto Oy in Hyvinkää, Finland, is also known for their circuit boards and distributor rails. SKS Connecto Polska in Gdansk, Poland, is another site that specializes in cable harnesses, wire set manufacturing, and electrical assemblies.

SKS Automaatio Oy is a leader in automation and electrical components in Vantaa, Finland. Among its offerings, the company makes tailored solutions, fitting in with Lapp`s future strategy.

Both companies combined are worth roughly €40 million Euro, with around 280 employees employed. Originally made up of 8 companies, SKS Group was a family-run engineering company founded in 1924.

The contract with the Finnish SKS Group was signed on December 15, 2017, although the Lapp Group and SKS have been partners for over 50 years, and share a similar corporate culture and management philosophy. The takeover is yet subject to approval by the relevant regulatory authorities.



Mont-Blanc 2020 to create the next generation of industrial processor

After the three previous Mont-Blanc projects, the three core partners Arm, Barcelona Supercomputing Center, and the Atos Group will partner again for the development of a next-generation industrial processor for Big Data and High Performance Computing.

Consortium members also include the CEA, Forschungszentrum Jülich, Kalray, and SemiDynamics. With a budget of 10.1 million Euros from the European Commission under the Horizon2020 program, the first Mont-Blanc project was launched in 2011 at the Atos site in Les Clayes, France.

The Mont-Blanc 2020 project plans to develop a future low-power European processor technology for Exascale, but to improve the economic viability, the project also includes analyzing the requirements of other markets.

The project's effort is based on a modular packaging strategy that would make it possible to create a family of SoCs conformable to different markets, such as autonomous driving or server farms.

The project's objectives are to define a low-power System-on-Chip architecture, implement new critical IP building blocks, deliver initial proof-of-concept demonstrations, and the exploration of the reuse of these building blocks to serve other markets.

ElringKlinger and Chengfei Integration Technology to partner on battery development

ElringKlinger reached an agreement with Sichuan Chengfei Integration Technology on the companies' collaboration on Li-ion battery development. Signed on November 24, 2017, the agreement initially runs for a period of ten years up to December 31, 2027, and establishes a joint venture entity for the development, production, and distribution of lithium-ion battery modules for the global automotive market.

The effort brings together complementary capabilities, as CITC is responsible, via its subsidiary China Aviation Lithium Battery (CALB), for the electrochemical constituents of the cell, while ElringKlinger will be contributing the remaining components, such as contact systems and cell housings.

CALB will contribute the electrochemical constituents of the battery cell to the joint venture. In addition, ElringKlinger will oversee battery module design and production. The collaborative approach will aid business activities targeting sustained improvement and deeper market penetration.

Active in battery technology as early as 2009, ElringKlinger not only produces various components and cell contact systems for lithium-ion batteries, the company develops and manufactures complete battery modules and systems as well as aggregate energy storage units. CITC is a subsidiary of the state-owned Aviation Industry Corporation of China, with a stake in CALB, which produces batteries and power supply systems for various applications.

Solid Power and BMW to cooperate on next-gen EV batteries

With all of the noise over Lithium Ion, there is a lot of activity going on the find its next-generation replacement. Efforts from advanced anodes to better electrolytes to completely new topologies and core technologies are being explored to address Li-ion's issues with safety and toxicity.

U.S. EV battery company Solid Power (www.solidpowerbattery.com) announced it had partnered with Germany's BMW to develop next-generation solid-state battery technology for use in electric vehicles (EVs).

BMW is helping Solid Power develop its technology to achieve the performance levels required for high-performance EVs. Financial terms were not disclosed. Promising to improve on current lithium-ion batteries, solid-state battery technology replaces the liquid or gel electrolyte now used with a solid, conductive material that offers more capacity and better safety. Established in 2012, Solid Power claims that solid-state rechargeable batteries can lower costs by eliminating many of the costly safety features associated with lithium-ion systems.

NEREID presents European nanoelectronics roadmap

The NEREID project ("NanoElectronics Roadmap for Europe: Identification and Dissemination") presented a roadmap on the future of European nanoelectronics at EFECS 2017 in Brussels, to foment public discussion and to identify possible improvements in the roadmap itself on their website (www.nereid-h2020.eu).

The project intends to bring together technology and market experts to jointly define a development roadmap based on application needs, with a series of workshops involving more than 100 international research and application experts from various institutions in eleven countries. This new nanoelectronics roadmap will focus on the requirements of European semiconductor and application industries. NEREID intends to address the societal challenges created by advanced concepts and technologies to identify promising and novel technologies all along the innovation chain. The final result will be a roadmap for European micro- and nanoelectronics, with a clear identification of objectives from medium to long term.

The NEREID roadmap for nanoelectronics also aims to coordinate efforts to address challenges in nanoelectronics and put the EU at the forefront of future technological developments, taking into account the European industrial and academic landscape for better coordination between academic and industrial research in equipment, semiconductors and application developments.

The NEREID roadmap is divided into several main technology sectors: Advanced Logic (including Nanoscale FETs and Memories) and Connectivity, Functional Diversification (Smart Sensors, Smart Energy, Energy for Autonomous Systems), Beyond-CMOS (Emerging Devices and Computing Paradigms), Heterogeneous Integration and System Design, Equipment, Materials and Manufacturing Science, and it also includes cross-functional enabling domains. Highlights of the NEREID project include three general workshops, gathering the needs of the main application sectors and the different technology domains, with a broad involvement of leading experts from industry and academia. The project consortia of NEREID is distributed all over Europe and consists of AENEAS, CEA-LETI, IUNET, EPFL, edacentrum, Fraunhofer IISB, ICN2, Grenoble INP, SINANO, imec, PoliTo, VTT and Tyndall.

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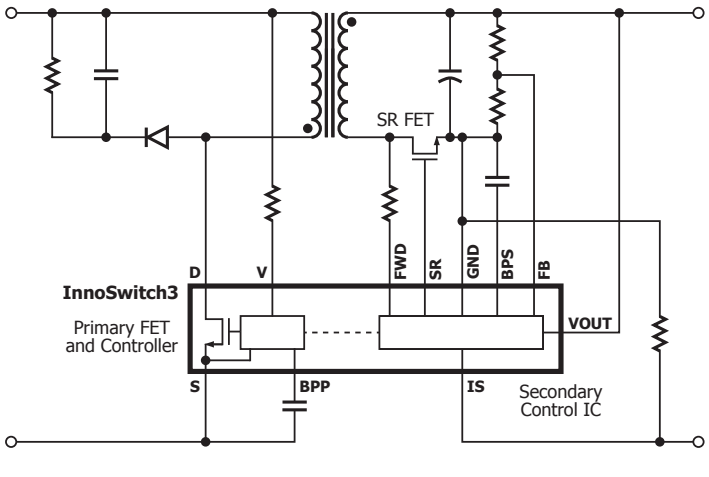

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Mouser Electronics named Distributor of the Year at 2017 Elektra Awards

Last month, Mouser Electronics was named Distributor of the Year at the 2017 Elektra Awards. Organized by Electronics Weekly, the Elektra Awards showcase the best innovations, people and companies as judged by an independent panel of leading experts and are widely regarded as among the very top accolades in the electronics industry. This is the second time for Mouser to receive this top Elektra award.

Mark Burr-Lonnon, Mouser's Senior Vice President of Global Service & EMEA and APAC Business, was presented with the award at a glittering ceremony held December 6 in London's Grosvenor House Hotel. After the ceremony, Burr-Lonnon commented, "I am delighted that Mouser has been named Distributor of the Year, especially given the prestigious companies we found ourselves sharing the shortlist with.

In 2017, we continued our mission of providing the very best and latest new product introductions from leading global manufacturers to design engineers, and expanded the services, tools and resources available on Mouser.com for the global design community."

A key reason behind Mouser's continued success in Europe has been the company's nine customer support locations, strategically placed across the region to provide personalized service to design engineers and buyers in local languages, currencies, and time zones.

Burr-Lonnon continued, "We were fortunate enough to exceed our own growth forecasts in the EMEA region over the four consecutive trimesters covered. We also maintained excellent partnerships with our existing franchise partners and added many new ones.

This award demonstrates the commitment to teamwork shown by all our staff members in Europe and their ability to deliver best-in-class customer service."

Mouser, TTI, Molex to sponsor Formula E all-electric racing team

Mouser Electronics will again sponsor the Dragon Racing team throughout the current FIA Formula E racing season. The 2017–2018 season marks the fourth edition of Formula E racing and the fourth-straight year that Mouser Electronics will be a team sponsor.

Formula E features cars powered solely by electric power and represents a vision for the future of the motor sports industry, serving as a framework for research and development around zero-emission motoring.

Mouser will sponsor Dragon Racing team throughout the 14-race season in collaboration with TTI, Inc. and valued supplier Molex. "Formula E cars require the latest sustainable and — most importantly — high-performance components to gain the competitive edge.

By teaming up with TTI and Molex to sponsor Dragon Racing, Mouser shows its commitment to keeping engineers up to date with these innovative technologies," said Todd McAtee, Vice President, Americas Business Development for Mouser Electronics. "The Dragon team finished strong last year, and we look forward to another great season ahead."

Founded by Jay Penske, Dragon Racing earned second place in team points in the inaugural 2014–2015 season, after clinching first and third finishes at the Berlin ePrix and another double-podium at London.

This season's drivers — Jerome D'Ambrosio, who won the 2015 Berlin ePrix and who had several strong outings with Dragon Racing last year, and Neel Jani, winner of the 2016 24 Hours of Le Mans and 2016 FIA WEC Drivers' Championship — look to rack up more points with new Formula E races in Zurich and Rome.

Following the season opener in Hong Kong, the series heads to Marrakesh, Morocco on January 13; Santiago, Chile, February 3; Mexico City, March 3; São Paulo, March 17; Rome, April 14; Paris, April 28; Berlin, May 19; Zurich, June 10; and New York City, July 14 and 15 before ending the season with two races in Montreal on July 28 and 29.

www.mouser.com/formula-e

Win at Bahrain secures Team and Drivers' trophies for Vaillante Rebellion

The Mouser-sponsored Vaillante Rebellion racing team ended the 2017 FIA World Endurance Championship season with a double-podium win at the 6 Hours of Bahrain, securing the LMP2 team and drivers' trophies. The Vaillante Rebellion No. 31 car, driven by Bruno Senna, Julien Canal and Nicolas Prost, fought back from a 40-second shortfall to edge past Jackie Chan DC Racing and clinch the 2017 FIA Endurance Trophy for LMP2 Teams.The victory also gave Senna and Canal the points necessary to win the FIA Endurance Trophy for LMP2 Drivers.

The Rebellion No. 13 car, piloted by Mathias Beche, Nelson Piquet Jr. and David Heinemeier Hansson, rounded out the podium with an impressive third-place finish. It was the second consecutive double-podium win for the Vaillante Rebellion team, which enjoyed a mirror finish Nov. 5 in Shanghai. Overall it was the team's eighth podium finish in nine races this season."All of us at Mouser are ecstatic to celebrate this win with Vaillante Rebellion," said Todd McAtee, Mouser's Vice President of Americas Business Development. "The team ran away with the crown in the LMP1 Privateer Class in 2016, and it's been fantastic watching them climb the ranks to win the tougher LMP2 trophy."

www.mouser.com/rebellion-racing

Mouser RushUp to distribute accelerator boards for IoT

A new distribution agreement with RushUp, creator of innovative product accelerator boards for makers, developers, and high-mix/low-volume companies that want to quickly incorporate Internet of Things (IoT) technologies into their products will allow customers of Mouser to access the former's KITRA and JAM board solutions.

The RushUp portfolio is comprised of two product families: the KITRA, based on Samsung ARTIK IoT modules, and the JAM, based on STM32 Open Development Environment (ODE) function packs from ST Microelectronics (ST). The KITRA boards facilitate easy integration into small devices without the extra time and cost associated with R&D and engineering validation. The family of KITRA product accelerators includes the KITRA 520, a super-integrated, 40×40 mm general-purpose IoT platform with dual computational functionality, sensors, USB, LEDs and more.

RushUp JAM family of boards includes Cloud-JAM and Cloud-JAM L4, which allow engineers to develop with STM32 ODE and STM32 Nucleo boards in the prototype phase and go to production with JAM boards without requiring industrialization, validation, and firmware or software development. These product accelerators incorporate a series of STM32 Nucleo development boards into a single module to form production-grade versions of the P-NUCLEO-CLD1 and FP-CLD-AZURE STM32 ODE function packs.

The Cloud-JAM board is based on the STM3F401RE microcontroller, while the Cloud-JAM L4 is based on the STM32L476RG microcontroller. Both boards enable engineers to connect motion and environmental sensors to the cloud, interfacing via a Wi-Fi network using SSID, password and web authentication stored in the dynamic NFC.

NEWMANUFACTURER

RUSHUP

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Mouser signs global T&M agreement with Keysight

Mouser has signed a global agreement with Keysight Technologies that covers oscilloscopes, benchtop power supplies, waveform generators, and digital multimeters.

From high performance to extreme value and bandwidths ranging from 50 MHz to 200 MHz, Keysight offers oscilloscope solutions to meet evolving needs. Keysight Technologies InfiniiVision 1000/2000 X-Series oscilloscopes are engineered to provide industry-proven technology at low prices. These oscilloscopes feature professional-level functionality for measurements with industry-leading software analysis and accessible expertise.

Keysight benchtop DC power supplies enable engineers to prove designs, understand issues, and ensure product quality. Keysight offers a broad selection of bench-friendly instruments with a wealth of available capabilities to meet a variety of challenges. These power supplies allow engineers to test confidently with clean and precise DC power that is fully specified and guaranteed.

Keysight waveform generators offer capability, fidelity and flexibility. The devices' low harmonic distortion offers clean, spurious-free signals that don't introduce noise or artifacts. Reduced jitter provides very low phase noise for the most accurate representation of signals, and variable bandwidth noise enables engineers to control the frequency content of the signal.

Keysight digital multimeters (DMMs) help engineers visualize their measurement data in multiple ways, obtain useable information faster, and document results more easily. The company's Truevolt DMMs feature advanced graphical capabilities, such as trend and histogram charts, that help engineers achieve greater insights faster. Many Keysight products are supported by Keysight BenchVue PC software. BenchVue software makes it simple to connect, control instruments, and automate test sequences, which helps engineers quickly move past the test development phase and access results.

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GaN Power Devices:

Potential, Benefits, and Keys to Successful Use

By Bill Schweber for Mouser Electronics

For well over a decade, industry experts and analysts have been predicting that viable power-switching devices based on gallium nitride (GaN) technology were "just around the corner." These GaN-based switches would offer greater efficiency, power handling, and other performance attributes compared to the well-established, widely available silicon MOSFET power devices—all factors that are critical to meeting the high-power, high-density needs of today's systems, servers, and computers. The good news is that the predicted corner has been reached and turned, and there's no turning back.

Today, a wide array of GaN devices are in volume production from over a dozen manufacturers. Furthering their acceptance and credibility, these GaN devices are now in use and in the field, working inside power supplies and motor controls for industrial, commercial, and even extremely stringent automotive applications.

(Note that GaN-based RF power amplifiers, or PAs, also have achieved major design-in success, but that is a very different application and beyond the scope of this article.) This article explores the potential for GaN devices, compares GaN and MOSFET devices, discusses GaN drivers as key to success, and includes techniques for minimizing noise coupling from power supply to the gate-drive loop.

Why go GaN?

Silicon-based MOSFET devices have been extremely successful and represent the present standard for power switches in power applications—AC/DC supplies, DC/DC supplies, and motor controls—ranging from just tens of watts up to hundreds and even thousands of watts. They have seen continual improvements in key parameters such as on-resistance RDS(ON), voltage ratings, switching speed, packaging, and other attributes. However, the rate of improvements in these MOSFETs has leveled off, as their performance is now close to the theoretical limit as determined by the underlying fundamental physics of these materials and processes.

That's why power devices based on gallium nitride are attractive. GaN is a high electron mobility transistor (HEMT), as shown in Figure 1, with a higher critical electric field strength than silicon. This high electron mobility means that GaN has a higher electric-field strength than silicon does, and also means that a GaN device will have a smaller size for a given on-resistance and breakdown voltage than a silicon semiconductor. GaN also offers extremely fast switching speed and excellent reverse-recovery performance, critical for low-loss, high-efficiency performance. GaN transistors with 600/650V ratings are now widely available and are a good fit for a very large proportion of applications, adding to the 100V ratings of the first-generation of GaN devices.

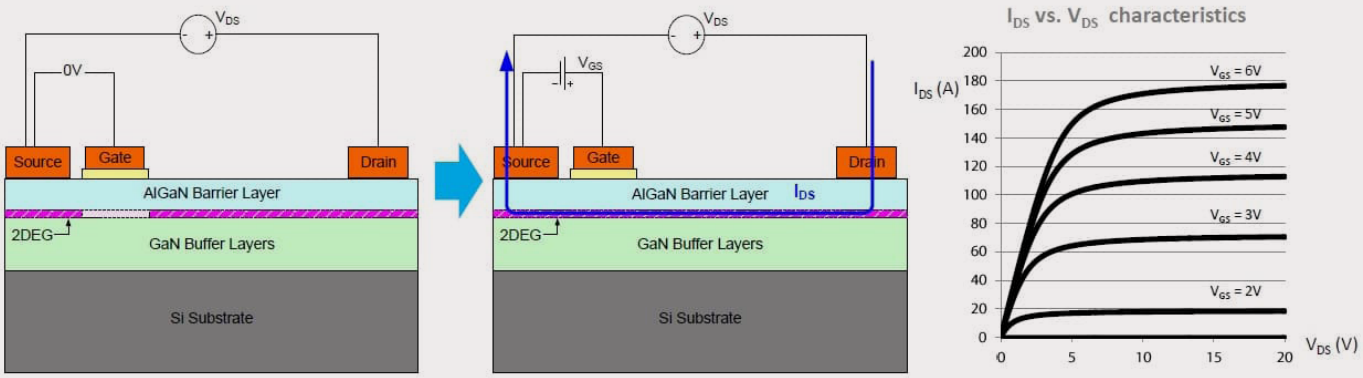


Figure 1: A GaN switch is built on a silicon substrate, with a lateral two-dimensional electron gas (2DEG) channel formed on a AlGaN/GaN hetero-epitaxy structure that provides very high charge density and mobility; the enhancement-mode GaN device does not conduct when the gate drive is at zero (left image) but does conduct when the gate drive exceeds the threshold (center and right images). (Source: GaN Systems)

There are two broad types of GaN devices:

- **Those operating in depletion mode:** The depletion-mode GaN transistor is normally on; to turn it off, a negative voltage relative to the drain and source electrodes is needed.

- **Those operating in enhancement mode (called e-mode):** The enhancement-mode transistor is the opposite, as it is normally off and is turned on by positive voltage applied to the gate.

The difference is more than just a matter of their complementary operating modes. For the depletion-mode device, there are start-up issues to contend with when power is applied; a negative bias must first be applied to the power devices to turn it off and so avoid a start-up short circuit. In contrast, enhancement-mode devices are off and do not conduct current when there is zero bias on the gate, which is the desired start-up state. To work around this apparent shortcoming of depletion mode GaN devices and have them in a normally off configuration, they are often packaged in a cascade configuration with a low-voltage silicon MOSFET that reverses this situation.

GaN versus MOSFETs

While there are differences between MOSFETs and GaN devices, let's look at areas of commonality first. The good news is that although the parameter values of GaN devices differ from those of MOSFETs (after all, that's why they are attractive); the terminology and top-tier parameters are the same. Like a MOSFET, a GaN transistor has a source, drain and gate, and the key figures of merit are on-resistance and breakdown voltage.

The similarities go beyond these surface issues. Both MOSFETs and enhancement-mode GaN devices are normally off and are voltage-driven devices (not current-driven) with an input capacitance that must be properly charged/discharged by their driver.

"A GaN device can switch hundreds of volts in nanoseconds"

The slew rate and shape of this charge/discharge drive waveform is an important factor in performance.

However, there are important differences, in addition to the obvious semiconductor material and process differences. First, GaN's top-tier specification of on-resistance RDS(ON) is very low, thus reducing a major source of static losses and inefficiency when in the on state. Also, the structure of the GaN FET results in a device with very low input capacitance, which enables faster on/off switching. A GaN device can switch hundreds of volts in nanoseconds, supporting the design of supplies that can switch large currents at rates of several megahertz (some latest-generation devices can operate in the hundreds of MHz); again, this potentially means higher efficiency and allows use of smaller magnetics and passive components.

A representative GaN device is the GaN Systems GS66516B, a 650V, enhancement-mode, GaN-on-silicon power transistor that combines high current, high voltage breakdown, and high switching frequency (Figure 2). This six-contact bottom-side-cooled transistor, Figure 3, measures just 11 × 9mm and also offers very low junction-to-case thermal resistance.

On-resistance is 25mΩ, and maximum drain-source current is 10A, while switching frequency can be as high as 10MHz and even higher. Design-in is simplified by the 0-to-6V gate-drive requirement that is enhanced by transient-tolerant gate drive of -20 to +10V.

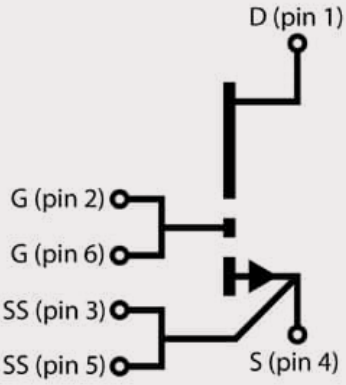


Figure 2: The GaN Systems GS66516B 650V enhancement-mode GaN-on-silicon power transistor has six contacts, doubled up to increase current capacity and reduce stray inductance. (Source: GaN Systems)

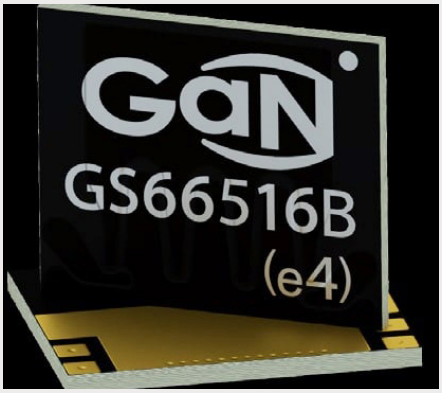


Figure 3: The 11x9mm package of the GaN Systems GS66516B incorporates a bottom-side thermal path to maximize cooling options. (Source: GaN Systems)

Driver is Critical to GaN Success

It takes a properly matched and configured driver to ensure that the switching device—either GaN or MOSFET—operates to its full specifications and does not have unintended issues. In simplest terms, the role of the driver is to be the electrical interface between the lower-voltage digital output of the microprocessor-based controller or similar circuitry and the higher-voltage, high-current, slew-rate demands of the power-switching device.

"The total Miller charge is much lower for a GaN device than it is for a MOSFET"

Of course, there's much more to the driver's role than that. The driver must supply the needed current at a high enough rate to quickly charge the input capacitance at the gate of the device and to turn it on, yet without inducing ringing or overshoot; in turn-off mode, it must quickly and crisply pull that charge from the gate input, again without ringing or overshoot. It must also do so consistently, with proper skew-time control to avoid "shoot-through" short-circuits in bridge configurations.

Three factors define the top-tier concerns of driving GaN devices: The maximum allowable gate voltage, the gate threshold voltage, and the body diode voltage drop. The gate-source voltage for an enhanced GaN device is 6V, roughly half that of a MOSFET, and this simplifies the challenge of generating the needed turn-on/turn-off voltages and currents.

The gate voltage is also lower than it is for most power MOSFETs and also has a lower negative temperature coefficient, which also simplifies driver-compensation issues. The forward-voltage drop of the body diode, which is an inherent part of the device structure, has a forward drop about a volt higher than comparable silicon MOSFETs.

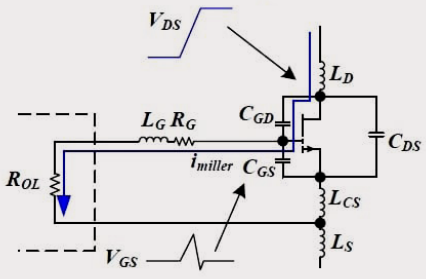
A few numbers can make the dynamic GaN versus MOSFET situation clear. GaN can switch faster than silicon-based MOSFETs, with dV/dt slew rates in excess of 100 V/nsec. Overall GaN turn-on times are about four times faster than MOSFETs with the same RDS(ON) rating, while turn-off time is about twice as fast. While faster is better, it brings new levels of concern in the dynamic issues of the driver and associated circuitry.

There are also issues with the Miller charge that limits turn-on/turn-off speed (do you recall the Miller effect from that class on solid-state device physics?) and has an effect on waveform shape. The total Miller charge is much lower for a GaN device than it is for a MOSFET with comparable RDS(ON), so the GaN device can be turned on/off much faster, which is an advantage.

However, a high-speed dV/dt slew time can affect efficiency adversely by creating a shoot-through condition between paired devices in a bridge during the switching transition. Therefore, it is necessary to control gate-drive pull-up resistance to minimize transition time but not induce other unwanted loss mechanisms, all while also providing a way to avoid overshoot and ringing. This is needed to avoid false turn-on/turn-off glitches which are a major potential concern, as well as minimize EMI generation.

While the analysis gets fairly complicated (Figure 4 and Figure 5), the simplest solution for GaN devices where the threshold voltage is low is to split the gate pull-up and pull-down connections in the driver and allow the insertion of a discrete resistor as needed (Figure 6).

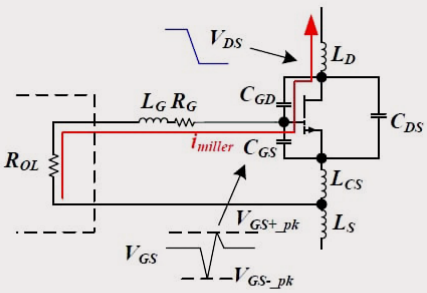
Positive dv/dt



- Prevent false turn-on
- Strong pull-down (low R_G/R_{OL})
- Low L_G to avoid ringing
- Use negative gate bias, -2 to -3V is recommended

Figure 4: A detailed model of the GaN device turn-on scenario is needed to analyze the turn-on issues and solutions. (Source: GaN Systems)

Negative dv/dt



- Occurs at turn-on of the complementary switch in half bridge
- Keep V_{GS-_pk} within -10V
- Strong pull-down (low R_G/R_{OL}) and low L_G for lower ringing
- V_{GS} may bounce back >0V (LC ringing): ensure $V_{GS+\_pk} < V_{G(TH)}$ to avoid false turn-on or gate oscillation

Figure 5: A complementary model of the GaN device turn-off situation is also needed. (Source: GaN Systems)

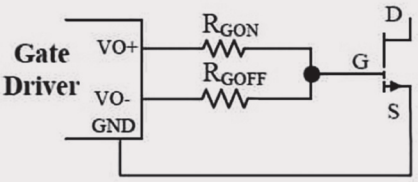


Figure 6: By using independent gate-drive resistors for turn-on and turn-off modes, each stage can be optimized for desired performance with respect to ringing, overshoot and other undesirable characteristics. (Source: GaN Systems)

In short, a humble, passive component—the gate resistor (or resistor pair)—is a crucial element in successful drive, balancing the many related parameters. The optimum gate turn-on/off resistor ratio results in tuned performance and drive stability, so independent gate resistors for turn-on and off are recommended.

This resistor ratio is generally in range of between five and 10Ω for controlling the Miller effect. If the turn-on gate resistor is too large (typically, it is between 10 and 20Ω), the turn-on dV/dt slew rate is reduced, so switching is slowed down and losses increase.

Conversely, if the slew rate is too low, there are switching losses, but this time they are due to Miller-effect turn-on as well as potential gate oscillation. For turn-off, the gate needs to be "held down" as strongly as possible with minimum impedance, so the turn-on gate resistor is typically between 1 and 2Ω for strong and fast pull-down.

Gate-driver ICs, available from many vendors, are valuable to handle many of the subtleties while still allowing the user to tailor the design specifics to the selected GaN device, the design switching speed and other factors. Among the available drivers is the LMG1205 from Texas Instruments (Figure 7), which is a gate driver for enhancement-mode GaN FETs.

This IC can drive both the high-side and the low-side devices in a synchronous buck, boost, or half-bridge configuration. It has independent inputs for the high-side and low-side outputs for maximum control flexibility; peak source-current capability is 1.2A, while peak sink current is 5A to prevent unwanted turn-on during transitions. The split-gate outputs provide flexibility to independently adjust the turn-on source and turn-off sink currents.

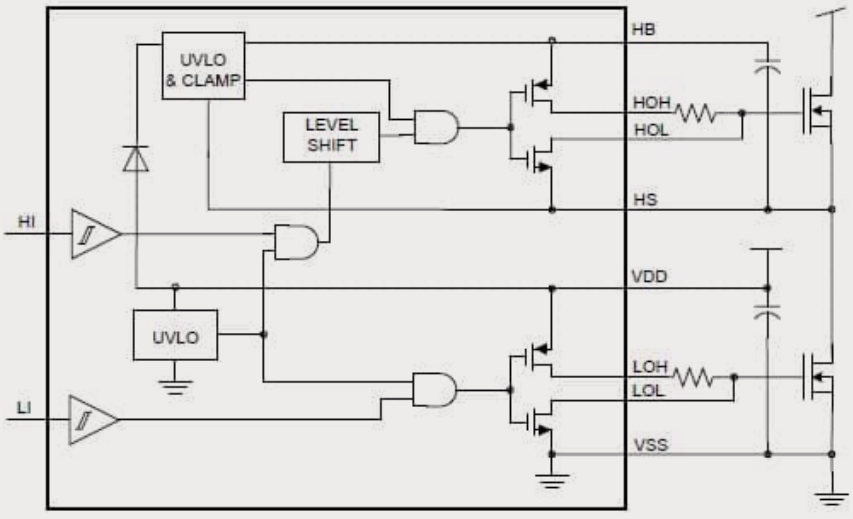


Figure 7: The Texas Instruments LMG1205 gate driver embodies many features and specifications that make it well-suited for GaN-device management. (Source: Texas Instruments)

The inputs are TTL-logic compatible, yet can tolerate input voltages up to 14V regardless of the VDD rail voltage.

Also, in combined high-side/low-side applications such as these, both low propagation delay and channel-to-channel skew (matching) are critical for efficiency and to avoid shoot through, so the LMG1205 features 35ns typical propagation delay and 1.5nsec propagation-delay matching.

Other available GaN drivers include the Silicon Labs Si827x series, the ADuM4223A/B family from Analog Devices, the Maxim MAX5048C and the Texas Instruments LM5113. In addition, there are existing, already widely-used MOSFET drivers that have the flexibility, specifications, and features to also handle GaN devices as long as the GaN device is used at lower frequencies.

Success Takes More Than a Schematic

Every designer with any experience in high-speed circuits knows that the schematic and optimized selection of components and their values are only part of a successful and reliable system.

In the case of GaN devices and circuits, it is critical to control and minimize noise coupling from power supply to the gate-drive loop.

The high dV/dt and di/dt transitions, combined with low input capacitances and gate thresholds, mean that noise-induced spikes on the gate, as well as the Miller effect, may result in gate ringing or sustained oscillation.

The consequences are false turn-on/off, system malfunction or even device failure.

Among their many possible causes, gate ringing and oscillation are often initiated and sustained by stray inductance in a feedback path from power supply to gate loop, as well as coupling via Miller-effect capacitance between gate and drain. Multiple, multilayered approaches are often needed to solve these problems.

The techniques include making layout changes to reduce stray inductance; minimizing external gate-to-drain coupling by locating the driver as close to the GaN device gate as possible; using low-inductance, wide PC board traces; using a Kelvin-source connection to minimize common-source inductance; and even extend to employing galvanically-isolated power supply rails. Other steps include adjusting the value of the gate-drive resistor to fine tune the turn-on slew rate; using a negative bias (-3V) for the turn off; adding ferrite beads in series with the gate to reduce high-frequency LC-ringing and overshoot; and possibly adding an RC "snubber" across the gate-source path.

Conclusion

GaN-based switching components have truly matured and now have an ecosystem of versatile devices, modeling and simulation tools, requisite drivers, applications support, field experience and more from long-established sources, less-well known vendors and even innovative start-ups. These GaN devices take power-switching into performance regions beyond what existing and even foreseeable MOSFET-based designs are able to offer.

However, the speed and capabilities of these GaN devices means that even more attention and sophistication is needed to properly manage their turn-on/off characteristics with respect to gate drive, voltage and current slew rate, current levels, noise sources and coupling, layout considerations and many other factors.

Digital Power Quickly Goes from *"Nice Idea"* to *"Absolutely Necessary"* Architecture

By Bill Schweber for Mouser Electronics

Just a few years ago, "digital power" was mostly a concept with some prototypes under long-term evaluation, but few actual installations. Fast-forward to today, and you will see these supplies are now standard and essential in power-intensive applications such as data centers. Without the attributes and virtues they offer, it would be very hard to provide the hundreds of amps at a variety of DC rails given the space available, the efficiency mandates and thermal constraints, and the sophisticated supply demands of these installations.

The reasons for the widespread adoption of digital power supplies in these power-intensive applications include:

- Their high efficiency yields lower operating cost; there is less heat to dissipate; and they make it easier to meet environmental-related regulatory requirements.
- They can implement the challenging and sophisticated technical requirements of powering processors and FPGAs.
- Their flexibility supports dynamic changes in strategies during operation, and they can handle complicated power-up and power-down sequencing scenarios.

Power-supply designers (and many users) are generally a cautious group, as they must be when dealing with high current, voltage and power levels, and the consequences to equipment and people of supply malfunction or failure. It is a cautious user base that prefers products with a track record and long, viable product life spanning a decade, two decades, or more, and that does not want to subscribe to a trend just for sake of being leading edge.

For these and other reasons, there was some early reluctance to embrace the firmware-based approach, but the situation has changed. However, due to the positive track record of high-end digital power confirmed by solid data, other application areas, such as industrial systems, are seeing "trickle down" availability at lower levels. The gains include improved efficiency from low load to full load, which saves energy, reduces thermal stress on components, simplifies cooling challenges and increases MTBF (mean time between failures).

What is "Digital Power?"

The objective of a power supply or converter is simple to state: provide a stable, regulated DC output at the desired voltage value despite changes in input voltage or load conditions. This requires some form of closed-loop control within the DC/DC converter, based on measurement of the actual output voltage, comparison with the setpoint value, and implementing feedback-based corrections to force the output back to the setpoint and keep it there.

This regulation has traditionally been implemented using a closed-loop negative-feedback with analog circuitry in a switching regulator, Figure 1. (The alternative, a low-dropout regulator, or LDO, is also an option, but only viable at fairly low power levels.) There are many standard architectures for these switchers, with a long list of additional enhancements to increase efficiency across the entire load range, boost performance and ensure consistent operation. These enhancements can become quite complicated and clever, and have impressive names such as SEPIC (single-ended primary-inductor converter).

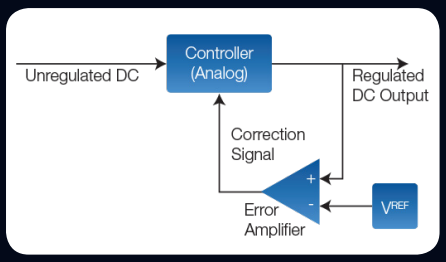


Figure 1: The standard analog power converter uses the well-known closed-loop topology to maintain a regulated DC output despite changes in input and load.

These variations can become fairly complicated and sophisticated, but all have one drawback: they lack flexibility for real-time setting of operational parameters. For example, the Intel/Xilinx VR13 standard requires the ability to direct the supply to change its nominal output voltage from 1.2 to 0.9 V and back "on the fly," which an all-analog supply cannot do. This adaptive voltage scaling (AVS) adjusts the supply output voltage to the minimum required by the processor, depending on its clock speed and workload, and also compensates automatically for process and temperature variations within the processor.

To do all this requires a fully programmable, sophisticated, firmware-controlled converter.

It is possible to implement some of the desired changes via an I/O port on the supply coupled with digital parameter-setting circuitry. This results in a hybrid supply that has an inner analog-control loop but overall digital supervision and some reporting of supply status, Figure 2.

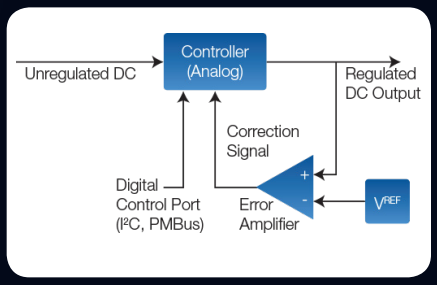


Figure 2: The enhanced analog controller design retains the fundamental closed-loop design, but allows for digital setting of some parameters under external control via a digital port such as PMBus, I2C, SPI or other.

The all-digital supply uses a very different internal architecture. Rather than implement the control loop using analog circuitry, even with some digital oversight, the digital supply uses analog/digital (A/D) converters to digitize critical internal voltages and currents. The converted values are used by a dedicated, embedded processor (DSP, FPGA) that executes code for closed-loop algorithms. Finally, the algorithms' outcomes are converted back to analog signals via a digital/analog (D/A) converter, adjusting the voltages and currents as needed, Figure 3.

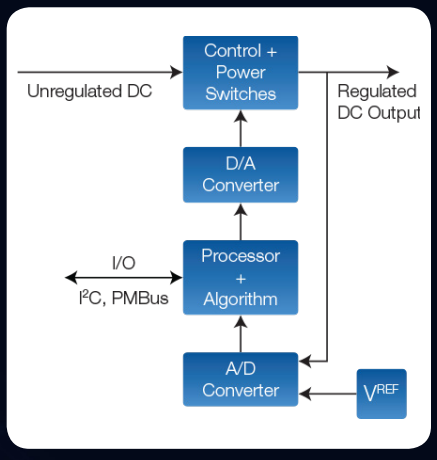


Figure 3: The all-digital control approach immediately digitizes key voltages and currents, then uses a firmware-driven processor and algorithms to initiate control action, and so can implement complicated control strategies as well as dynamically adjust those as circumstances demand.

"The algorithms' outcomes are converted back to analog signals"

The control algorithm is firmware-based rather than built as a hardwired analog circuit, so the control strategy can be fairly complicated and sophisticated. Even better, a single processor (if powerful enough) can control two or more independent output rails, and coordinate these rails to manage factors such as output levels, ramp rates and relative power on/off timing between these rails. It can also provide detailed reports and historical data on the supply's status, conditions and changes, so likely failures can be anticipated rather than just reported after they occur.

Two examples will show how digital supplies are now able to serve applications at lower current and power needs than those of data center racks. The NDM2Z-50 from CUI, Inc. (Figure 4) is an all-digital DC/DC point-of-load (PoL) converter for a 4.5- to 14-V input range and 0.6- to 3.3-V programmable output, providing up to 50 A (165 W maximum).

It includes an SMBus interface and is PMBus™ compatible. Despite its small package (30.85 x 20.0 x 8.2mm for the horizontal-mount version), it provides features such as voltage tracking, voltage margining, active current sharing, parametric capture, voltage/current/temperature monitoring, and programmable soft start and soft stop.

Its data sheet (Reference 1) includes dozen of graphs showing all aspects of static and dynamic performance.

Figure 4: This all-digital DC/DC PoL converter from CUI delivers up to 50A and is part of a family of both larger and smaller efficient, flexible, compatible and feature-rich DC/DC converters for larger application needs. (Image: CUI Inc.)

Summary

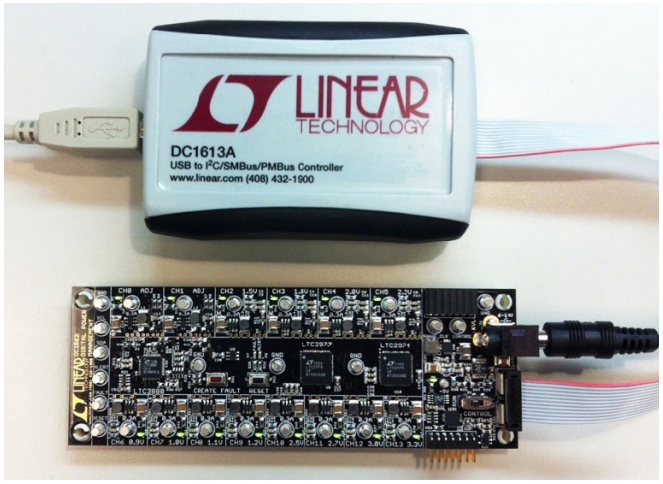
The power needs of many of today's electronic systems can no longer be satisfied by even leading-edge analog supplies, but instead require a new form of power-supply architecture for control. The fully digital power-supply implementation has significant and tangible benefits with its flexibility, performance and adaptability. While it is radically different in concept and execution from the traditional analog-based supply, the digital design is mature and is rapidly expanding to other applications.

The power tools you need

Top 5 development tools

Mouser offers one of the widest ranges of development kits immediately available off-the-shelf to help designers get started. To coincide with our January Power theme, Mouser's Technical Marketing Manager, EMEA, Mark Patrick, presents his 'Top 5 Pick' of recently-released power kits.

www.mouser.com/Development-Tools-Center



Power system control

DC1962C-KIT starter kit from Linear Technology/Analog Devices

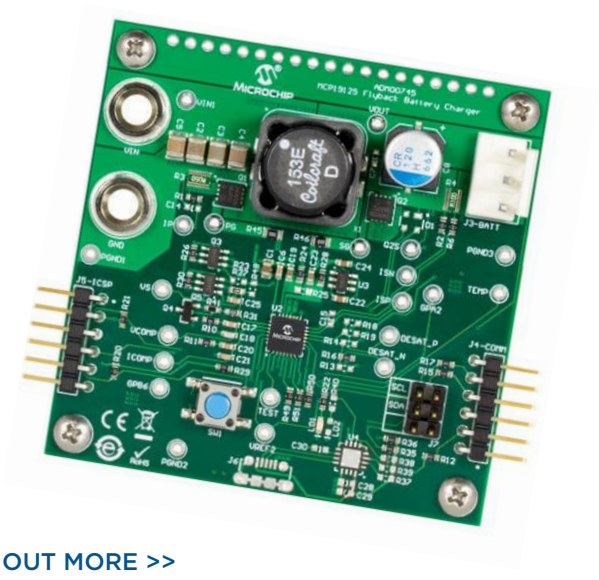
Linear Technology/Analog Devices DC1962C-KIT Starter Kit supports the LTC3880, LTC2974, and LTC2977 devices. The LTC2974 and LTC2977 are I2C/ SMBus/PMBus power system managers with EEPROM. The LTC3880 is a dual output PolyPhase® step-down DC/DC controller with digital power system management. The kit demonstrates these devices' ability to sequence, trim, margin, supervise, monitor, and log faults for fourteen power supplies. Each power supply channel's output voltage is monitored and each device monitors its own internal die temperature. Six channels have current and external temperature sensing.

FIND OUT MORE >>

Highly integrated PWM controller

Microchip's MCP1912x flyback battery charger evaluation board

Microchip's MCP1912x is a highly-integrated, mixed-signal low-side synchronous PWM controller. This evaluation board features individual analogue PWM control loops for both current regulation or voltage regulation. The MCP1912x evaluation board also features an integrated microcontroller core, making it an ideal device for battery charging applications, LED lighting systems, and any other low-side switch PWM. MCP1912x PWM controllers are highly integrated, mixed-signal low-side synchronous devices that operate from 4.5V to 42V.



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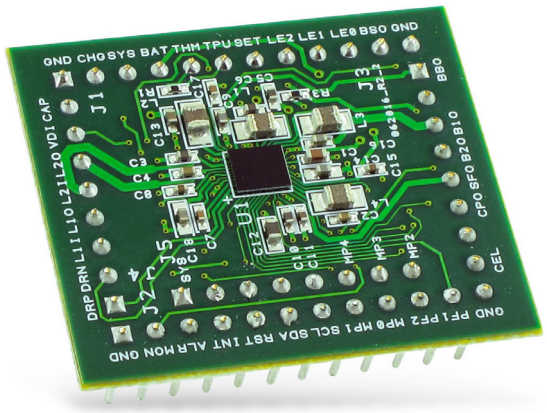
Wearable power management

MAX20303 evaluation kit from Maxim Integrated

This kit is a fully assembled and tested circuit for evaluating the MAX20303 programmable power solution which targets ultralow-power wearable applications. The kit's default settings differ from other versions of the IC to allow for flexible evaluation and it has an I2C serial interface. The MAX20303 has a minimal footprint to reduce design size. A flexible set of power-optimized voltage regulators provides a high level of integration for a fully optimized power architecture. The quiescent current of each regulator is specifically suited for 1µA (typ) to extend battery life in always-on applications.



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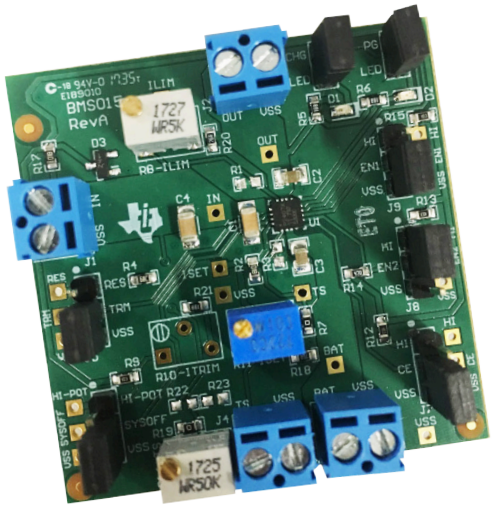


Charge management and system power

BQ2407x 1.5A USB-Friendly Li-Ion Battery Chargers

Texas Instruments BQ24076EVM/BQ24078EVM evaluation modules provide a convenient method for evaluating the performance of a charge management and system power solution for portable applications using the BQ24076 or BQ24078 products. Each of these chargers is designed to deliver up to 1.5A of continuous current to the system or charger for one-cell Li-ion or Li-polymer applications using a dc power supply. The charger is programmed from the factory to deliver 0.9A of charging current. Each of these evaluation modules was designed as a stand-alone evaluation module, but they can also be interfaced with the system and host via the connectors and headers.

FIND OUT MORE >>

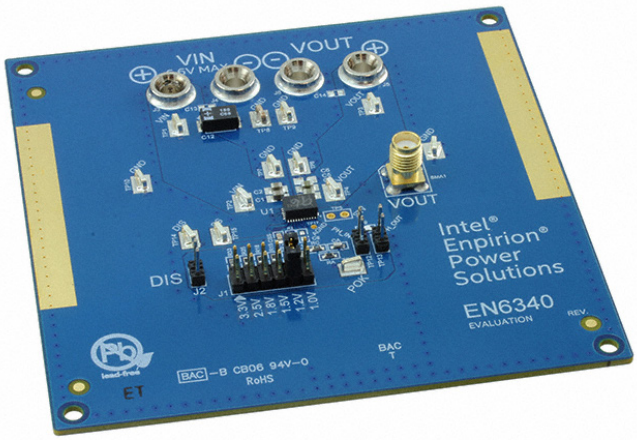
High power density and conversion efficiency

EN6340QI PowerSoC DC-DC Step-Down Converter

Intel EN6340QI Converter Evaluation Board is designed to evaluate the EN6340QI PowerSoC DC-DC step-down converter. The input voltage range of this evaluation board is 2.7V to 6.6V and the output voltage range is 0.75V to 6.12V. The EN6340QI evaluation board has an output current of 4A.

Intel High-Efficiency PowerSoC DC-DC Step-Down Converter delivers an outstanding combination of power density and conversion efficiency. This converter integrates power switches, inductor, gate drive, controller, and compensation in a small 4 x 6mm QFN package. The EN6340QI converter provides a low-risk solution with excellent FIT rates because of its high level of integration.

FIND OUT MORE >>



Excellent Resources Narrow the Make-or-Buy Decision for Power Supplies

By Landa Culbertson, Contributing Author, Mouser Electronics

In today's energy conscious, high tech environment, the performance of the power supply - historically disregarded as just a basic necessity - has arguably taken center stage. Consider for example, the U.S. Department of Energy's $37.7 Million USD investment in an ARPA-E program that seeks to increase energy efficiency of power conversion systems and enable high efficiency, high power density power electronics across all applications from consumer, mobile, and computing to wireless infrastructure, lighting, industrial, and automotive. The effort is driven by the department's assessment that by 2030, 80% of the country's electricity could flow through power converters, as compared to just 30% in 2005.

In the not too distant past, it was generally an automatic decision to choose to purchase a ready-made power supply over designing one at the component level when given the choice. However, as the importance of the power supply has risen in recent years, amazing tools and resources from semiconductor suppliers have become available to support component-level power supply designers seeking to differentiate their end product based on power technology. These same assets can aid the designer tasked with unique requirements that would not be met by off-the-shelf products.

It is now more worthwhile than ever to spend the time to carefully evaluate the make versus buy decision for power supplies.

Why Buy?

Purchased power supplies provide the following great advantages:

Lower cost: The component bill of materials (BOM) of a power supply is high compared with buying a complete off-the-shelf product due to volume manufacturing. For example, the BOM of a 30-amp 5-volt power supply is about 5 times the cost of purchasing a commercial power supply.

Time to market: You can get to market faster by saving development time and applying resources to your core competencies instead.

Safety and regulatory compliance certifications: Off-the-shelf power supplies remove the expense, time, and challenge associated with seeking agency approvals. Regulations are also subject to change, and a purchased power supply is guaranteed to meet standards at the time of purchase. Some approvals to consider are:

- *Worldwide Electrical Safety Standards*
- *Worldwide EMC/EMI Standards*
- *Global Power Consumption and Efficiency Regulations for External Power Supplies and Battery Chargers*
- *Application-Specific Certifications such as Medical and ITE Certification*

Quality and Reliability: Commercial power supplies have been rigorously tested over line, load, temperature, shock, and vibration specifications. Some products are even backed by extended warranties.

Second sourcing: By choosing products offered in industry-standard form factors such as quarter-brick, half-brick, and full-brick, you can realize the benefits of having alternate sources.

Commercial power supplies are readily available. TDK-Lambda, with 36 years of experience, is one notable provider.

The company takes pride in offering an extensive collection of highly reliable products, including the ZWS-BP Series of 150W – 240W compact, lightweight, high efficiency, open frame, AC-DC power supplies.

Offering 200% peak power capability (280W – 480W), this series meets global safety standards for a universal input (85-265VAC) and less than 0.5mA earth leakage current, meets EMC/EMI standards including power factor correction requirements, and comes with a 5 year warranty.

The TDK-Lambda portfolio also includes the MWS65 Series of 55-67W AC-DC power supplies with Medical and ITE certifications including BF (Body Floating) rating for applications where the equipment may come in direct contact with the patient, such as blood pressure monitors and ultrasound equipment. For DC-DC applications, TDK-Lambda recently introduced the PH-A280 Series of converters for 50W, 75W, 100W, and 150W output power levels from a 200 to 425VDC input. These devices come in industry standard quarter-brick modules and are ideal for liquid, air cooled, and conduction cooled systems given their wide temperature range of -40 to 100°C. The series is also backed by a 5 year warranty.

For DC-DC, make sure to also take a look at Murata Power Solutions, currently the world's largest supplier of DC-DC converter modules. The NCM6 Series of isolated 6W single and dual output DC-DC converters, the SPM15 Series of isolated 15W DC-DC converters, and the SPM25 Series of isolated 25W DC-DC converters are amongst the company's latest introductions. All of these products feature small footprints for board mounting.

NCM6 is encapsulated for superior thermal performance, and SPM15/25 are potted in a metal can for low electromagnetic interference emission, protection from harsh environments such as high humidity, and resistance to mechanical stresses such as vibration and shock.

Making Your Own Power Supply is Easier than Ever Before

Here are some of the latest design tools and resources available to assist both expert and new power supply designers:

Texas Instruments

PowerLab™ Reference Design Library: Use the online PowerLab™ Power Reference Designs Selection Tool to input your design criteria including AC or DC input, isolated or non-isolated, input and output voltage ranges, and output current, as well as other advanced search criteria such as application or topology to search TI's database of over 1200 reference designs. These are designs that have actually been built and tested by TI, and have downloadable documentation including circuit schematic, printed circuit board (PCB) layout, BOM, test report, and gerber files.

Power Stage Designer™ 2.1: This online tool helps you to design the power stage of the most commonly used switchmode power supplies. Choose the topology (buck, boost, flyback, etc) and input your design criteria, and the tool will show you the recommended values for the inductor/ and or transformer as well as provide helpful insight on the duty cycle, input power, losses on the diodes, current ripple, and more.

WEBENCH® Power Designer: End-to-end power supply design is really just a matter of clicks using this online design and simulation tool. Simply input your design requirements, select your optimization preference from high efficiency, small footprint, to low BOM cost, and the tool will return your design options for module, integrated, and controller-based solutions. From there, select one or more designs to electrically and thermally simulate, as well as optimize components. Finally, export your schematic and layout to popular CAD formats for hardware prototyping.

Fairchild Semiconductor

Power Supply WebDesigner: Topologies supported by Fairchild's online power supply design tool include primary-side regulated flyback converters, secondary-side regulated flyback converters, switch-mode power supplies, AC-DC off-line power supplies, isolated buck-boost converters, forward isolated buck converters, and DC-DC isolated converters. Just enter basic design requirements or use the tool to optimize parameters. The tool enables you to analyze and simulate the design and then automatically generates a schematic and BOM.

International Rectifier

SupIRBuck® Design Tool: IR's online DC-DC design tool takes basic parameters and any special requirements entered by the user and generates solution recommendations from which the user chooses the best fit for the application. The tool produces a detailed schematic and BOM, with the ability to fine tune. Features include a full AC analysis, modeling of key voltage and current waveforms, transient performance modeling, re-arranging of component layout, a detailed thermal analysis, and power dissipation analysis.

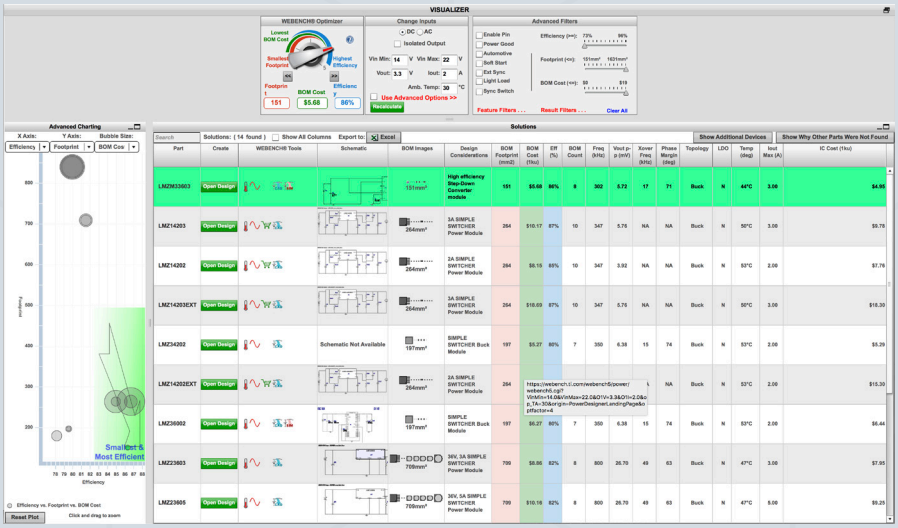
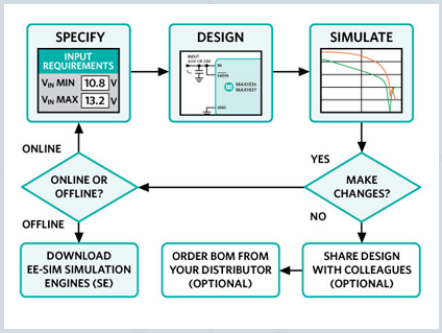


Figure 1: Screenshot of TI's WEBENCH Power Designer Tool



Maxim's EE-Sim Design Generation and Simulation Tool

Maxim Integrated

EE-Sim Design Generation and Simulation Tool: Maxim's online tool allows you to input your design requirements, change from default to preferred components, and simulate your design. Use the checkout feature to see the availability of components and pricing at your favorite distributor, including Mouser. Save or print your schematic and BOM.

ON Semiconductor

GreenPoint® Design Tool: The GreenPoint online design simulation tool from On is currently dedicated to LED Lighting drivers in AC-DC, DC-DC, or linear applications.

Power Integrations

PI Expert Online is a web-based program that takes your specifications and automatically generates a power conversion solution. It provides everything necessary to build and test a working prototype.

- Comprehensive Transformer Construction Report – a "ready-to-build" solution
- Electrical and Mechanical Diagrams
- Winding Instructions
- Bill of materials (BOM)
- Board layout recommendations

Though power supply design should always be undertaken with care and is still considered an art by many seasoned designers, given the new tools and resources available now, making your own supply is easier to achieve than ever before.

Whether you ultimately decide to make or buy, Mouser is here to help. Mouser carries products from over 600 suppliers to enable you during the evaluation and development process.

Videos

Engineering Benchtop: Discovery kit for IoT

STMicroelectronics' B-L475E-IOT01A Discovery Kit for IoT Node enables a wide diversity of applications by exploiting low-power communication, multiway sensing, and ARM® Cortex® -M4 core-based STM32L4 Series features.

MCUs balance power and performance

Silicon Labs Pearl Gecko 32-bit microcontroller family provides a powerful 32-bit ARM® Cortex®-M4 and a range of peripherals. Devices feature ultra-low-power consumption and fast wake up time for battery-powered IoT applications.

Ease IoT Development

ON Semiconductor's IoT Development Kit (IDK) offers a modular, easy to use, and compact platform that provides developers with access to all of the hardware and software building blocks needed to rapidly design, evaluate, and implement medical, home, and industrial IoT applications.

Fully qualified BLE modules

Cypress EZ-BLE PRoC Extended Range (XR) BT 4.2 modules are fully qualified/certified to FCC, CE, MIC, KC, IC. They support Bluetooth Low Energy (BLE) wireless communication with long range connectivity capabilities of 400m line-of-sight.

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Secure ultra-low-power authentication

NXP Semiconductors' A1006 Secure Authenticator embedded security solution offers best-in-class, tamper-resistant authentication through an asymmetric public/private authentication protocol to help manufacturers prove the authenticity of genuine products and prevent damage from counterfeits.

The A1006 device is the industry's smallest, lowest-power secure authenticator, with an active power consumption of just 500 µA in packages as small as 1 mm × 1 mm.

Available from Mouser Electronics, the A1006 Secure Authenticator provides an outstanding level of security, while overcoming the challenges of performance, power consumption and solution footprint. The device's digitally signed certificates employ 224-bit ECDSA and SHA-224 digest hash, and authentication is performed in under 50 milliseconds.

The A1006 authenticator provides a strong and effective option for device manufacturers, offering simple system integration and a flexible architecture communication, with the choice of single-wire or I2C interface. Built in NXP's secure manufacturing facilities, this robust authentication IC delivers protection against a wide range of invasive and non-invasive attacks; the device's industry-leading security features include TRNG, security sensors, and active shielding.

The A1006 Secure Authenticator IC is a sturdy security platform suitable for a broad range of hardware and software, including smartphones, chargers, printer cartridges, medical devices, electric vehicle chargers, and embedded systems that require a strong security infrastructure.

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Multi-protocol SoC supports BLE and 2.4GHz stacks for IoT and connected health wearables

The RSL10 multi-protocol system-on-chip (SoC) from ON Semiconductor delivers ultra-low-power wireless connectivity for a broad range of applications; the versatile Bluetooth® 5-certified SoC supports Bluetooth low energy technology as well as 2.4 GHz proprietary or custom protocol stacks.

The ON Semiconductor RSL10 SoC, available from Mouser Electronics, features a 48 MHz Arm® Cortex®-M3 processor bolstered by a 32-bit dual-Harvard DSP core that supports the audio codecs necessary for wireless audio communication. Including both flash and RAM, the device's diverse memory architecture enables storage of the Bluetooth stack, as well as other applications.

The highly integrated RSL10 SoC includes a DMA controller, oscillators, and ultra-efficient power management units. The SoC is designed for use in applications with 1.2V and 1.5V batteries and supports a supply voltage range of 1.1 to 3.6 V without the need for an external DC/DC converter.

The SoC is supported by the RSL10 Evaluation Board, which provides access to all input and output connections through standard 0.1-inch headers. Additionally, the evaluation board offers an onboard communication interface circuit and a J-Link solution to enable users to debug the board through a USB/PC connection.

ON Semiconductor's RSL10 SoC supports a wide range of medical applications including fitness trackers, hearing aids, heart rate monitors, glucose monitors and pulse oximeters.

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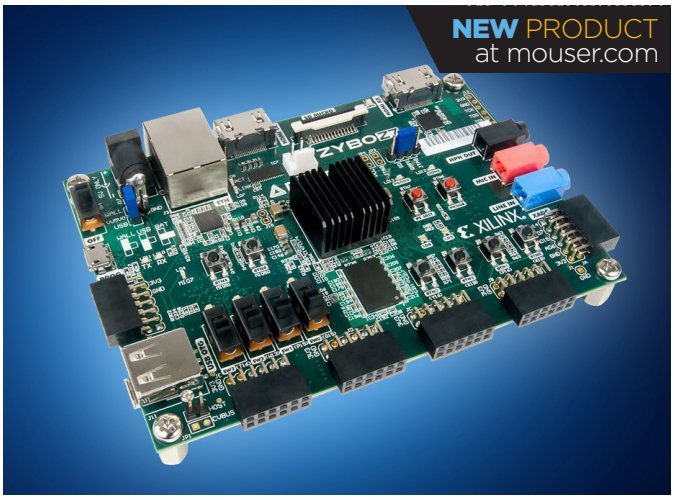
Entry-level platform for ARM/FPGA development

Zybo Z7 development boards from Digilent, the latest addition to the popular Zybo platform of Arm®/FPGA system-on-chips (SoCs), include feature-rich, ready-to-use, entry-level embedded software to deliver a digital circuit development platform for a wide range of applications, including robotics, embedded architecture, medical equipment, server-backhaul products, advanced driver assistance systems, and embedded vision.

The Zybo Z7 development boards, available from Mouser Electronics, are based on the Xilinx Z-7010 (Zybo Z7-10 board) and Z-7020 (Zybo Z7-20) All-Programmable SoCs (AP SoCs) architecture, which integrates a dual-core Arm Cortex®-A9 processor with Xilinx 7-series FPGA logic. When coupled with its rich set of multimedia and connectivity peripherals, the Zybo Z7 development boards offer designers a flexible, cost-effective alternative so they can leverage the massive processing power and extensibility of the Zynq AP SoC architecture.

The Zybo Z7-20 has an internal FPGA that is three times larger than the Z7-10's, which translates into additional features due to the extra FPGA pins. The Zybo Z7-20 also includes a heat sink for the additional FPGA resources. Both boards include a voucher for the SDSoC toolset, which provides a familiar embedded C/C++ application development experience.



Both the Zybo Z7-10 and Z7-20 also come equipped with a rich set of multimedia and connectivity peripherals to create an impressive single-board computer that is perfect for embedded circuit development. The video-capable feature set includes a MIPI CSI-2 compatible Pcam connector, HDMI input, HDMI output and high DDR3L bandwidth. In addition, six Digilent Pmod™ connectors on the boards enable access to Digilent's catalogue of Pmod peripheral modules, which include motor controllers, displays, and sensors.

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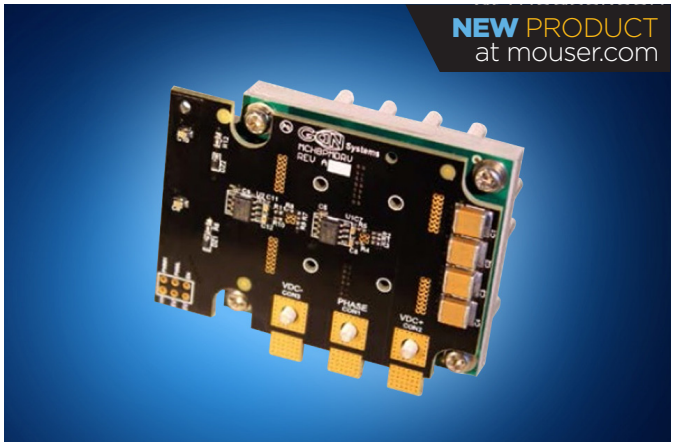

Develop high-efficiency power systems with new eval platform

The GSP65RxxHB-EVB insulated metal substrate (IMS)-based evaluation platform from GaN Systems demonstrates an inexpensive way to improve heat transfer, increase power density, and reduce system cost of power systems in automotive, consumer, industrial, and server or data center applications.

Available from Mouser Electronics, the platform consists of the GSP65MB-EVB motherboard and two IMS evaluation modules that each includes a high-power, bottom-side-cooled GaN Systems GS66516B enhancement mode high electron mobility transistor (E-HEMT).

The 650 V IMS evaluation modules are configured as a half bridge and are available in 13 milliohm, 2–4 kW and 25 milliohm, 4–7 kW variants. Together, the motherboard and IMS evaluation modules enable 10 different configurations, with two additional configurations when using a second motherboard. Designers can also use the IMS evaluation modules independently as a high-power gallium nitride (GaN) intelligent power module (IPM) with their own boards for in-system prototyping.

The evaluation modules offer very low inductance and feature an optimized driver board that minimizes both the power and gate driver loops. Typical applications include onboard chargers, DC/DC converters and three-phase inverters for electric and hybrid vehicles, industrial photovoltaic inverters and motor drives, switch mode power supplies for server/data centers and residential energy storage systems.

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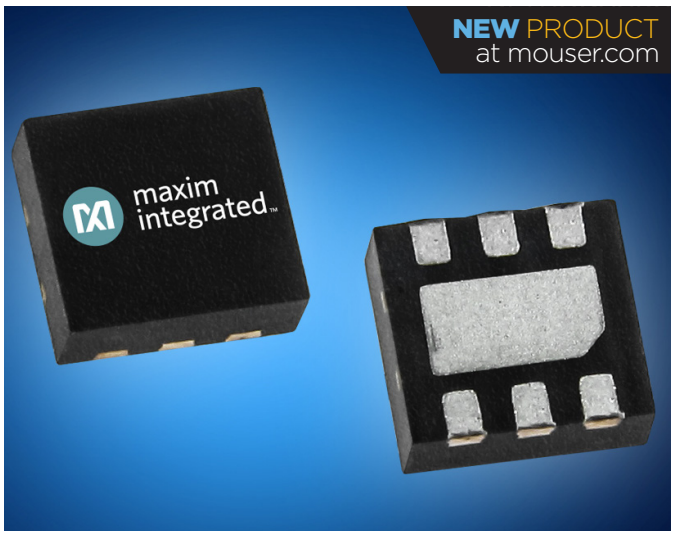
DeepCover ECDSA Authenticator for flexible, asymmetric security

Maxim Integrated's DS28E38 DeepCover® secure ECDSA (Elliptic Curve Digital Signature Algorithm) authenticator is designed to protect devices against security attacks.

It incorporates Maxim's patented ChipDNA™ physically unclonable function (PUF) technology.

The Maxim DS28E38 DeepCover secure ECDSA authenticator, available from Mouser Electronics, is the first secure authenticator to integrate the Maxim ChipDNA capability to protect all device stored data from invasive discovery. ChipDNA technology involves a PUF that enables the DS28E38 to deliver cost-effective protection against invasive physical attacks. Attempts to probe or observe ChipDNA operation modifies the underlying circuit characteristics, preventing discovery of the unique value used by the chip cryptographic functions.

With ChipDNA capability, the device provides a core set of cryptographic tools derived from integrated blocks including an asymmetric hardware engine, a FIPS/NIST-compliant true random number generator, 2 Kbits of secured EEPROM, and a decrement-only counter. The device also offers a unique 64-bit ROM identification number, which is used as a fundamental input parameter for cryptographic operations and serves as an electronic serial number within the application.



The DS28E38 communicates over the single-contact 1-Wire® bus at both standard and overdrive speeds. The communication follows the 1-Wire protocol with the ROM ID acting as node address in the case of a multidevice 1-Wire network. The DS28E38 is supported by the DS28E38 Evaluation System, which demonstrates the features of five DS28E38 authenticators and five DS2476 DeepCover secure coprocessors.

The DS28E38 secure ECDSA authenticator enables engineers to add an extra layer of protection to applications such as Internet of Things (IoT) nodes, device management, secure peripherals, and medical sensors.

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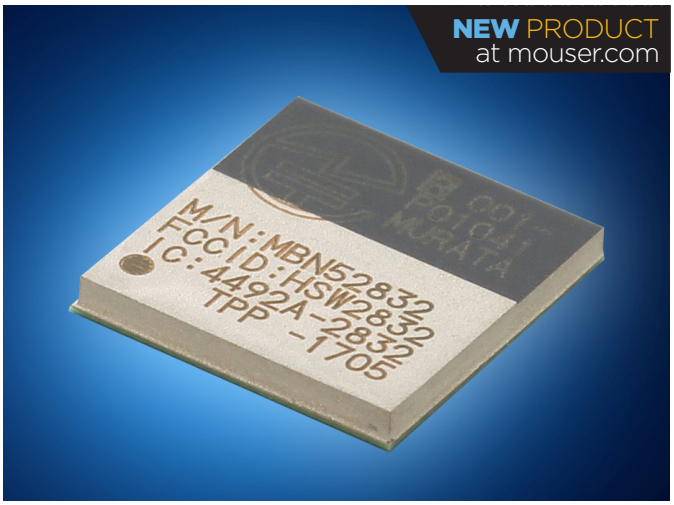
Ultra-low-power Bluetooth 5 functionality in a small package

Based on a Nordic nRF52832 system-on-chip (SoC), the WSM-BL241 Bluetooth® low energy module from Murata offers ultra-low-power Bluetooth 5 functionality in a small package, ideal for Internet of Things (IoT), asset-tracking, beacon, and medical applications.

Available from Mouser Electronics, the WSM-BL241 leverages the powerful Nordic nRF52832 SoC to provide high-performance Bluetooth low energy connectivity between smartphones, tablets, and other devices.

The low-power nRF52832 SoC combines a built-in Arm® Cortex®-M4 core, 512 Kbytes of flash, and 64 Kbytes of RAM with a 2.4GHz multiprotocol radio. The WSM-BL241 module includes a 32 MHz crystal, on-board antenna, and two pins for an NFC antenna and external omnidirectional antenna—all in a form factor of just 7.4 × 7.0 × 1.0 mm.

The module is supported by the MBN52832 development kit, also available from Mouser.



The MBN52832 development kit facilitates application development using the Nordic nRF52 software development kit (SDK). The kit consists of two separable modules: an interface module with J-Link USB-SWD and USB-UART interfaces, and a breakaway module with the onboard WSM-BL241 module with NFC antenna to support evaluation of Bluetooth- and NFC-based networking products.

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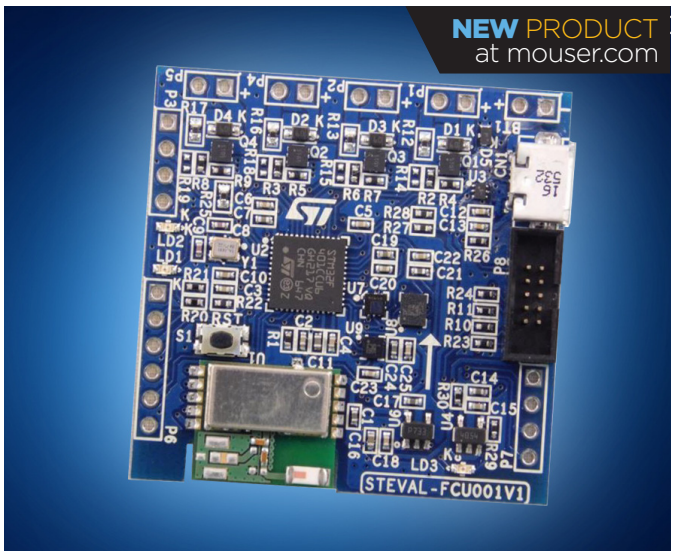
Build drone flight-control designs

The STMicroelectronics STEVAL-FCU001V1 evaluation board, a compact flight-controller unit (FCU) suitable for small- and medium-sized quadcopter drone designs is scalable and efficient with sample firmware to accelerate development.

It helps quadcopter designers evaluate the performance of inertial measurement unit sensors during real flight conditions.

The ST STEVAL-FCU001V1 evaluation board, available from Mouser Electronics, incorporates an STM32F401 32-bit microcontroller with Arm® Cortex®-M4 core, an SPBTLE-RF0 module with Bluetooth® low energy 4.1 connectivity, and an STC4054 800mA lithium-ion/lithium polymer battery-charger chip. Designers can use a smartphone or tablet to control the board through the Bluetooth connection or can connect a radio frequency (RF) receiver to the board's PWM inputs to interface with a standard RF remote controller.

The board also includes ST's LSM6DSL iNEMO inertial module with low-power digital accelerometer and gyroscope, its LIS2MDL high-performance magnetometer, and its LPS22HD MEMS pressure sensor to support 3D navigation applications.



Designers can drive four brushed DC motors through the onboard STL6N3LLH6 STripFET H6 Power MOSFETs or brushless DC (BLDC) motors through an electronic speed-control unit. In addition, the board offers SWD, I2C and USART interfaces that allow for firmware development and debugging as well as support for additional external sensors or RF modules.

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TE's LUMAWISE outdoor lighting solutions give long-term reliability

The LUMAWISE photo control base assembly, sleeve and cover products from TE Connectivity help ensure long-term reliability for outdoor lighting applications by combining a power and signal interface to the dimming receptacle.

Available from Mouser Electronics, LUMAWISE products maximize the effectiveness of light-sensing devices through the use of optional clear covers; coloured covers are also available to designate specific voltage ratings. The base assembly features power twist lock terminals, spring leaf signal terminals and a separately packaged foam gasket, and meets the ANSI 136.41 standard for roadway and area lighting equipment.

The fully assembled LUMAWISE photo control operates over a temperature range of -40 to +105 degC and achieves an IP66 rating, providing robust protection against dust and heavy jet spray in exposed weather conditions. Additionally, the cover meets the highest UL 94 flammability rating, 5VA. LUMAWISE base assemblies are available in diameters of 76 mm and 81 mm with covers of different heights to allow designers to choose the right option for their applications.

LUMAWISE photo control products are suitable for a variety of lighting applications, such as outdoor roadway, street, and area lighting fixtures, including those in harsh weather conditions.

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