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25-i
Energy Innovation

700 V buck converter with fast start-up is ideal for industrial controls and home appliances

The AL17052 from Diodes Incorporated steps a mains voltage input down to a fixed 5 V output, providing a well regulated supply to devices which require low power consumption in standby mode.

DIODES INCORPORATED

FEATURES

- Auto-restart after over-current and overload faults
- Excellent load and line regulation
- Fast transient response
- Constant voltage control

APPLICATIONS

- Home appliances
- IoT devices
- Industrial controls

FREE DEV BOARD

Board demonstrates fast start-up of AL17052 mains-voltage buck converter.

Orderable Part Number
AL17052EV1

APPLY HERE NOW

The AL17052 from Diodes Incorporated is a non-isolated buck converter with an integrated 700 V MOSFET which produces a maximum output current of 50 mA at 5 V from a universal mains input-voltage range of 85 V to 300 V ac.

Suitable for the power supply of industrial control systems, IoT devices and home appliances, the converter offers fast start-up in less than 8 ms to give better system response time.

The AL17052 provides outstanding dynamic performance and load regulation without the use of an optocoupler. Low standby power consumption of 10 mW means that the AL17052 can be used in IoT devices which need to maintain always-on connectivity, even when not in active use.

Conversion efficiency is 60% when stepping down a rectified mains voltage to 5 V with the output at 50 mA. Efficiency is 50% with a 10 mA light load.

With an on-chip 700 V MOSFET, the AL17052 enables the development of integrated power supplies with a streamlined bill-of-materials and a small board footprint. The MOSFET operates with a small 330 µH inductor.

Built-in protection features include:

- Over-temperature protection
- Under-voltage lockout
- Over-current protection
- Overload protection

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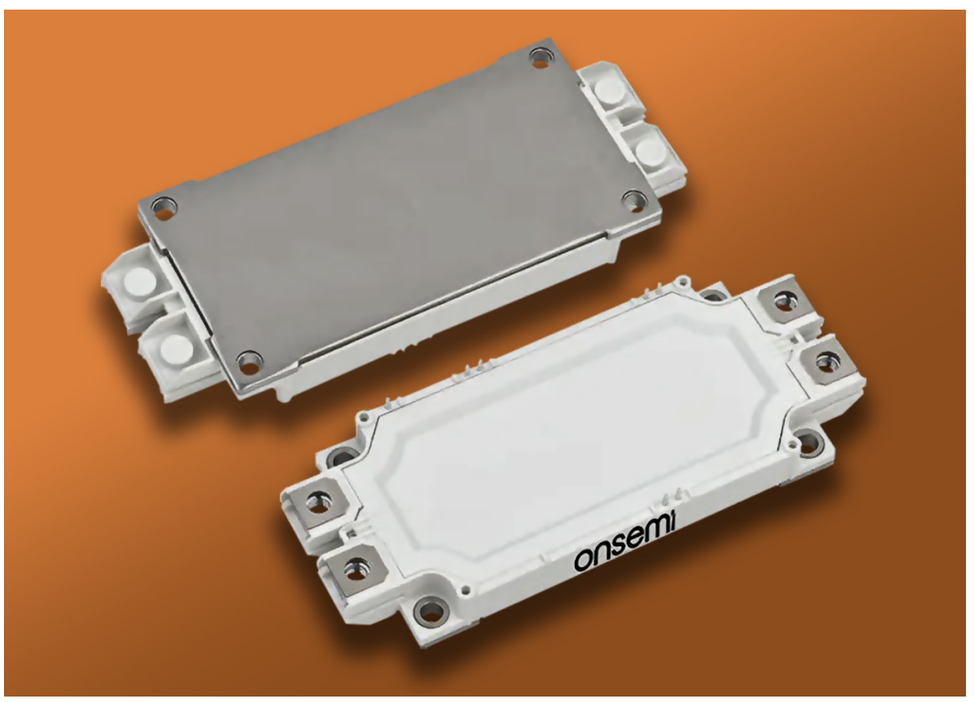
800 A IGBT module offers high efficiency in high-power conversion systems

The NXH800H120L7QDSG power module from onsemi features new field stop trench technology which results in lower losses. Extensive testing assures the reliability of the module in harsh and demanding operating conditions.



onsemi

FEATURES

- NTC thermistor
- Low-induction layout
- 5.5 V threshold voltage
- 5.6 µC gate charge
- Operating-temperature range: -40°C to 175°C

APPLICATIONS

- Motor drives
- Servo drives
- Solar inverters
- Uninterruptible power supplies
- Energy storage systems
- Commercial and agricultural vehicles

The onsemi NXH800H120L7QDSG is a 1200 V, 800 A-rated half-bridge QDual3 IGBT power module which provides an output rated for a maximum of 1,200 V and 800 A. Featuring field stop trench 7 (FS7) IGBTs and seventh-generation diodes, the NXH800H120L7QDSG produces lower conduction losses and switching losses than previous IGBT modules, enabling designers to achieve higher efficiency and superior reliability.

The FS7 technology used for the switches in the QDual3 module has a substantial impact on performance and efficiency in high-power applications such as solar inverters and energy storage systems. In particular, the important parameter of saturation voltage has been improved by 0.4 V compared to the previous generation of onsemi IGBTs.

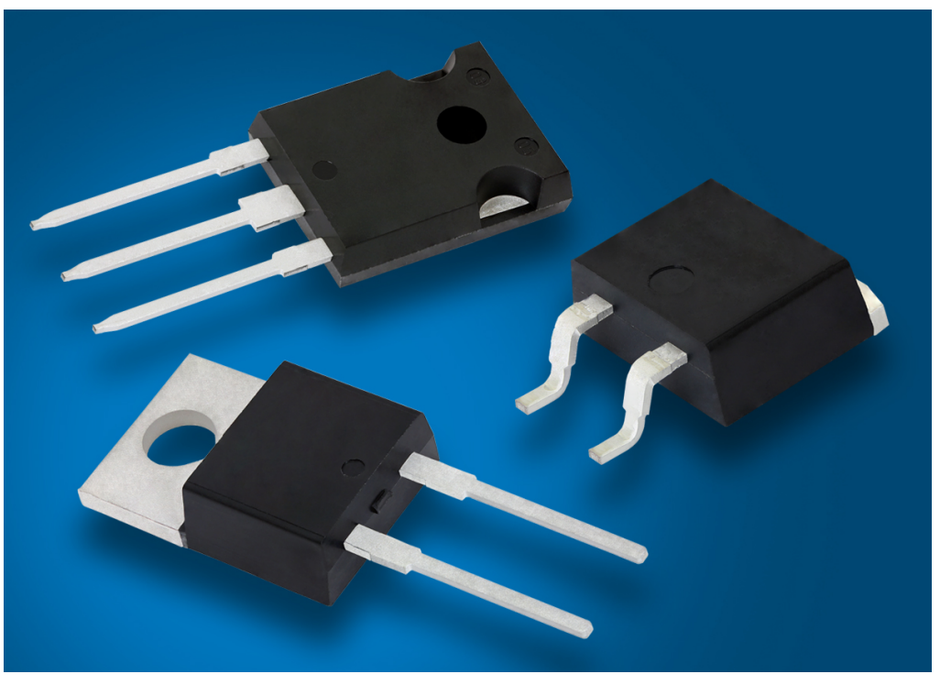
FS7 technology also shrinks the chip size by around 30% compared to its predecessor, enabling onsemi to increase power density in this QDual3 module.

Every module incorporates an isolated baseplate for mounting and thermal management. Direct PCB mounting is possible using solderable pins which are configured in an industry-standard layout pattern. This allows for multi-sourcing, as well as giving the ability to retrofit the NXH800H120L7QDSG to existing designs.

All QDual3 modules are subject to stringent reliability tests. Humidity testing is performed with a 960 V bias voltage for 2,000 hours, more demanding than the 80 V for 1,000 hours normally applied to this class of power module. Vibration testing is performed at 10Grms for 22 hours to meet the requirements of the AQG324 standard, much more than the 5G/1 hour test used elsewhere.

650 V SiC Schottky diodes boost efficiency and reliability in switching power converters

The third-generation VS-3C 650 V silicon carbide (SiC) Schottky diodes from Vishay offer low forward voltage drop, capacitive charge, and reverse leakage current in devices with current ratings ranging from 4 A to 40 A.



VISHAY
The DNA of tech.

FEATURES

- Forward voltage drop as low as 1.46 V
- Capacitive charge as low as 12 nC
- Reverse leakage current as low as 1.3 µA
- 175°C maximum junction temperature.

APPLICATIONS

- Mobile network infrastructure
- Fixed network infrastructure
- Home appliances
- Server power supplies
- Notebook and desktop PC power supplies
- Energy generation and exploration systems
- Energy distribution and management
- Energy storage systems
- Industrial equipment
  - Motor drives
  - Power tools

Vishay has introduced its third-generation family of surface-mount and through-hole SiC Schottky diodes with a breakdown-voltage rating of 650 V. Single-chip versions of the VS 3C Schottky diodes are available with current ratings from 4 A to 20 A, and from 16 A to 40 A for dual-chip diodes in a common-cathode configuration.

SiC-based Schottky diodes are intended for use in high-performance ac-dc and dc-dc converter circuits, suitable applications include power factor correction (PFC) and output rectification in ultra high-frequency dc-dc converters.

SiC diodes offer better reverse-recovery behavior and higher peak repetitive reverse-voltage capability than silicon-based diodes. SiC diodes from Vishay also benefit from an attractive product of capacitive charge and forward voltage, which helps to reduce turn-on stress and hence switching losses in the active switch. This characteristic enables increases in switching frequency and thus in power density.

The Vishay SiC Schottky diodes feature a special structure, the backside is thinned by laser annealing, which reduces the forward voltage drop. The diodes have low typical reverse leakage current which reduces conduction losses, ensuring high system efficiency when supplying light loads.

Unlike ultrafast diodes, the third-generation SiC Schottky diodes have almost no recovery tail, which further improves efficiency. The reverse recovery times are nearly temperature-independent, enabling operation at higher temperatures up to 175 °C without shifts in power efficiency caused by switching losses.

The VS-3C 650 V diodes are notable for high reliability, illustrated by the stringent testing performed by Vishay: higher-temperature reverse bias testing lasting 2,000 hours, and temperature cycling testing for 2,000 cycles.

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New low-cost, low-power 32-bit MCU streamlines BoM in display-based applications

The STM32U083 line microcontrollers from STMicroelectronics integrate multiple functions alongside an Arm® Cortex®-M0+ 32-bit RISC core, including an LCD controller, generous memory capacity, and a broad range of analog peripherals.

The latest in the STM32U0 series from STMicroelectronics, the STM32U083 line, is an energy-saving and cost-effective microcontroller which consumes up to 50% less power than previous generations of MCUs.

ST has achieved this breakthrough in power efficiency in the STM32U083 MCU through a combination of state-of-the-art design techniques and an advanced manufacturing process. These include extremely low static power consumption in standby mode, and superior wake-up performance, enabling the MCU to spend more time in power-saving sleep modes to minimize average energy demand.

The STM32U083 line is based on an Arm Cortex-M0+ 32-bit RISC core operating at a frequency of up to 56 MHz, backed by generous memory capacity: 256 kbytes of Flash memory, and a 40 kbyte SRAM with hardware parity check.

Integration is a strong feature of the STM32U083 line. The MCU includes up to 21 capacitive sensing channels, plus an integrated LCD controller which can drive 8 x 48 or 4 x 52 segment displays via an internal step-up converter. Applications with an LCD, such as meters, thermostats, smart retail labels, access control panels, and factory automation equipment, can take advantage of this to streamline the bill-of-materials (BoM).

The integration continues with the provision of analogue and communications peripherals. The STM32U083 MCU includes a 12-bit ADC, a 12-bit DAC, two embedded rail-to-rail analogue comparators, one operational amplifier, and a low-power real-time clock. The on-board timers include one general-purpose 32-bit timer, one 16-bit PWM timer dedicated to motor control, three general-purpose 16-bit timers, and three 16-bit low-power timers.

FEATURES

- On-chip system oscillator
- Security functions:
  - 128-/256-bit key AES encryption hardware acceleration
  - True random number generator
  - Secure boot
  - Password-based regression
  - Five passive anti-tamper pins
- 20 communications interfaces including USB 2.0
- Eight package options

APPLICATIONS

- Industrial equipment:
  - Smart door locks
  - Thermostats
  - Heat cost allocators
  - Smoke detectors
  - Security cameras
- Medical equipment:
  - Insulin pumps
  - Glucose meters
- Smart meters
- Consumer devices:
  - Activity trackers
  - Headphones

FREE DEV BOARD

Discovery kit provides reference hardware platform for Cortex-M0+-based STM32U083 MCU.

Orderable Part Number
STM32U083C-DK

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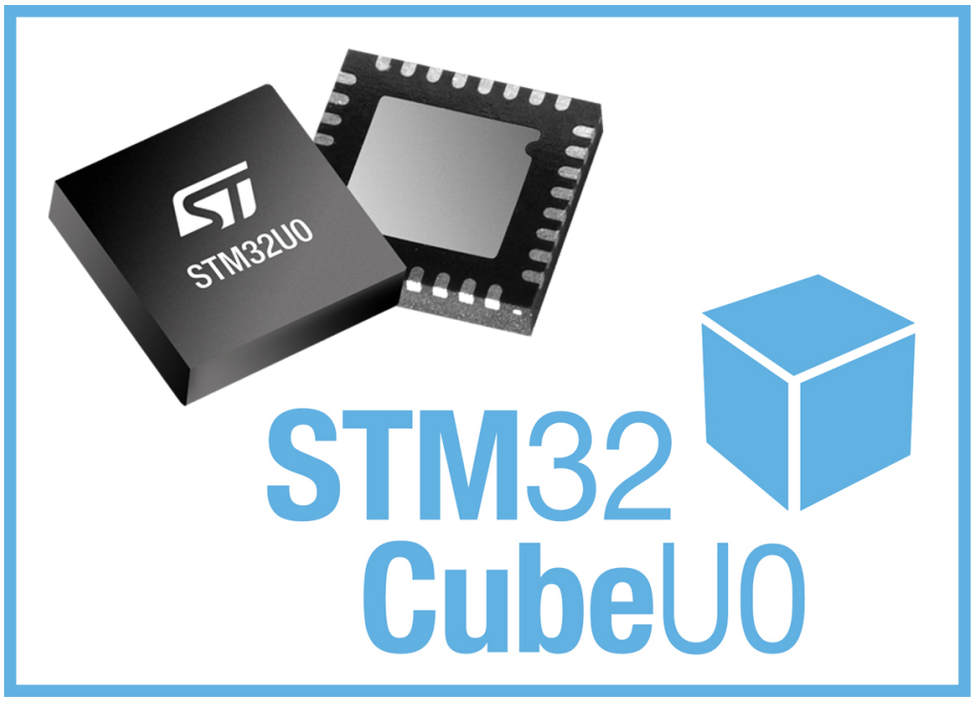
Embedded software accelerates development of small, low-power devices

The STM32CubeU0 embedded software package from STMicroelectronics includes low-level utilities and interfaces, middleware, and an operating system to enable the developer to start working with STM32U0 series MCUs quickly and easily.



The STM32CubeU0 from STMicroelectronics is a single package which combines all the generic embedded software components required to develop an application on STM32U0 series microcontrollers.

The package includes the STM32Cube hardware abstraction layer (HAL) and low-layer application programming interfaces (APIs), a consistent set of middleware components such as the Azure® real-time operating system (RTOS), USB, and STM32 touch-sensing library. All embedded software utilities are supplied with examples running on STM32 boards.

The STM32Cube HAL ensures the greatest possible portability across MCUs in the STM32 portfolio, while the low-layer APIs make up a fast, lightweight resource which is useful for embedded experts, as it is closer to the hardware than the HAL is. HAL and low-layer APIs can be used simultaneously, with a few restrictions.

The STM32CubeU0 package is part of the STM32Cube software set, which provides code to support the whole STM32 32-bit MCU portfolio. STM32Cube includes STM32CubeMX, a graphical software configuration tool which enables developers to generate C initialization code using graphical wizards.

The package is available on free, user-friendly license terms. ST supplies a framework for updating the STM32CubeU0, and provides notifications to users when a new release is available.

FEATURES

- More than 280 code and application examples
- Developed in compliance with MISRA C:2012 guidelines
- Mbed-crypto security functionality
- CMSIS files
- Supports Nucleo development boards

APPLICATIONS

- Industrial equipment:
  - Smart door locks
  - Thermostats
  - Heat cost allocators
  - Smoke detectors
  - Security cameras
- Medical equipment:
  - Insulin pumps
  - Glucose meters
- Smart meters
- Consumer devices:
  - Activity trackers
  - Headphones

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Discovery kit provides reference hardware platform for Cortex-M0+-based STM32U083 MCU.

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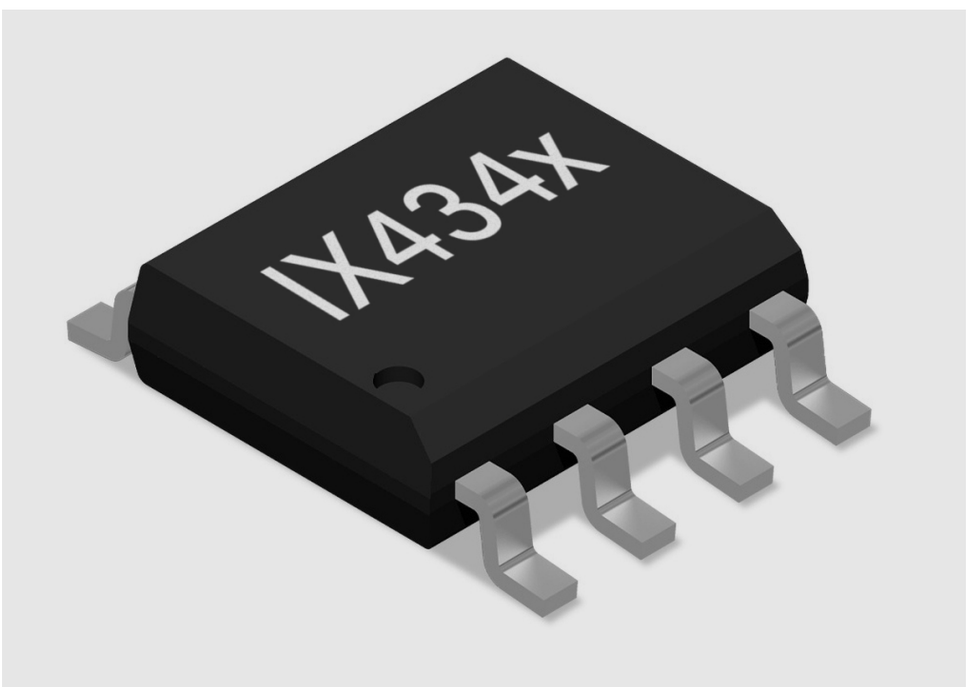
Dual 5 A low-side MOSFET gate drivers ideal for high-frequency power converters

The IX4341 and IX4342 from Littelfuse feature short propagation delays and fast rise and fall times. With a choice of industry-standard package styles, these gate drivers are easy to integrate into power-system designs.



Littelfuse

FEATURES

- 1.5 Ω source output resistance
- 1.1 Ω sink output resistance
- 3.8 V maximum under-voltage lockout threshold

APPLICATIONS

- Industrial equipment
- General electrical equipment
- Appliances
- Building control systems
- Data centers
- Energy storage systems
- Renewable energy equipment

Littelfuse has launched the IX4341 and IX4342, dual 5 A low-side MOSFET gate drivers which support high-speed operation for use in high-frequency switch-mode power supplies, dc-dc converters, motor controllers and power converters. The IX4341 and IX4342 drivers' propagation delay time is just 16 ns, while rise and fall times are 7 ns.

With the addition of these new IX434x gate drivers, this Littelfuse series now consists of dual non-inverting, dual inverting, and non-inverting and inverting input versions, providing OEMs with a comprehensive range of input logic options.

For designs requiring a drive current higher than 5 A, the two channels of the IX4340 and IX4341 devices can be paralleled to form a single 10 A driver.

A notable feature of the IX434x drivers is their compatibility with TTL and CMOS logic inputs, enabling direct interfacing with most controllers. Each output has an independent enable function and under-voltage lockout circuitry to ensure reliable and safe operation.

When the supply voltage falls below the required value, the gate driver output is maintained low, turning the external power component off.

The IX434x MOSFET gate drivers are available in a standard 8-pin SOIC, a thermally enhanced 8-pin SOIC, or a 3 mm x 3 mm MSOP package.

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New 400 V SiC MOSFETs increase power density and efficiency in AI server power supplies

New silicon carbide (SiC) MOSFETs from Infineon are based on its second-generation CoolSiC™ technology. These 400 V-rated MOSFETs offer higher efficiency than 650 V SiC MOSFETs in the power circuit supplying AI processors.

Infineon has launched its new 400 V family of CoolSiC SiC MOSFETs, taking advantage of the second-generation (G2) CoolSiC technology introduced in 2024. This new SiC MOSFET voltage range was specially developed for use in the ac-dc converter stage of artificial intelligence (AI) servers.

The new family offers lower conduction and switching losses than 650 V SiC and silicon MOSFETs. When the 400 V CoolSiC MOSFETs G2 are used in a multi-level PFC circuit, the ac-dc converter stage of an AI server's power supply unit can achieve power density of higher than 100 W/in^3, and efficiency of up to 99.5%. This is 0.3 percentage points higher than solutions based on 650 V SiC MOSFETs.

The new portfolio consists of 10 400 V MOSFETs with on-resistance ranging from 11 mΩ to 45 mΩ. The MOSFETs are housed in Kelvin-source TOLL and D^{2}PAK-7 packages with .XT package interconnect technology, and withstand harsh switching conditions, and are 100% avalanche tested.

The 400 V SiC MOSFETs are particularly well able to cope with the power peaks and transients caused by sudden changes in the power drawn by the processor in an AI server. Both the .XT interconnect technology and a low and positive on-resistance/temperature coefficient enable excellent performance in applications operating at a high junction temperature.

Infineon

FEATURES

- 4.5 V gate threshold voltage
- Supports unipolar driving
- Switching speed is highly controllable
- Low overshoot in presence of transient voltages
- Best-in-class thermal performance
- Supports innovative topologies such as 3L PFC and ANPC

APPLICATIONS

- Solar inverters
- Energy storage systems
- EV chargers
- Motor drives
- Industrial and auxiliary power supplies
- Solid-state circuit breakers

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1,200 V SiC Schottky diode performs ultra-efficient switching

The STMicroelectronics STPSC20H12G2-TR uses a silicon carbide substrate to provide superior electrical and thermal characteristics, and can handle high voltage surges to give robust performance across a range of applications.

FEATURES

- 120 µA maximum reverse leakage current at a junction temperature of 25°C
- Switching behavior stable over operating-temperature range
- 129 nC total capacitive charge at a reverse voltage of 800 V
- 175°C maximum junction temperature

APPLICATIONS

- EV charging stations
- Switch-mode power supplies
- Dc-dc converters

The STMicroelectronics STPSC20H12G2-TR is a 20 A, 1,200 V Schottky power diode fabricated on a silicon carbide (SiC) substrate which supports very fast and efficient switching. It is ideal for use in power-conversion functions such as:

- Power factor correction
- Dc-dc power converters

The wide-bandgap SiC material permits the design of a Schottky diode structure which combines a low forward voltage, for reduced power loss and higher efficiency, with the robustness to handle a 1,200 V repetitive peak reverse voltage. The forward voltage drop is typically 1.5 V at a forward current of 20 A and a junction temperature of 25°C.

Because of the Schottky construction, the diode draws little or no reverse-recovery current at turn-off, and ringing patterns are negligible. The negligible turn-off capacitance characteristic is stable across the operating-temperature range.

The STPSC20H12G2-TR helps to boost performance in hard-switching applications. Its high forward surge capability ensures robust operation when exposed to transient voltages.

The STPSC20H12G2-TR is supplied in a 10.0 mm x 15.3 mm D^2PAK HV package.

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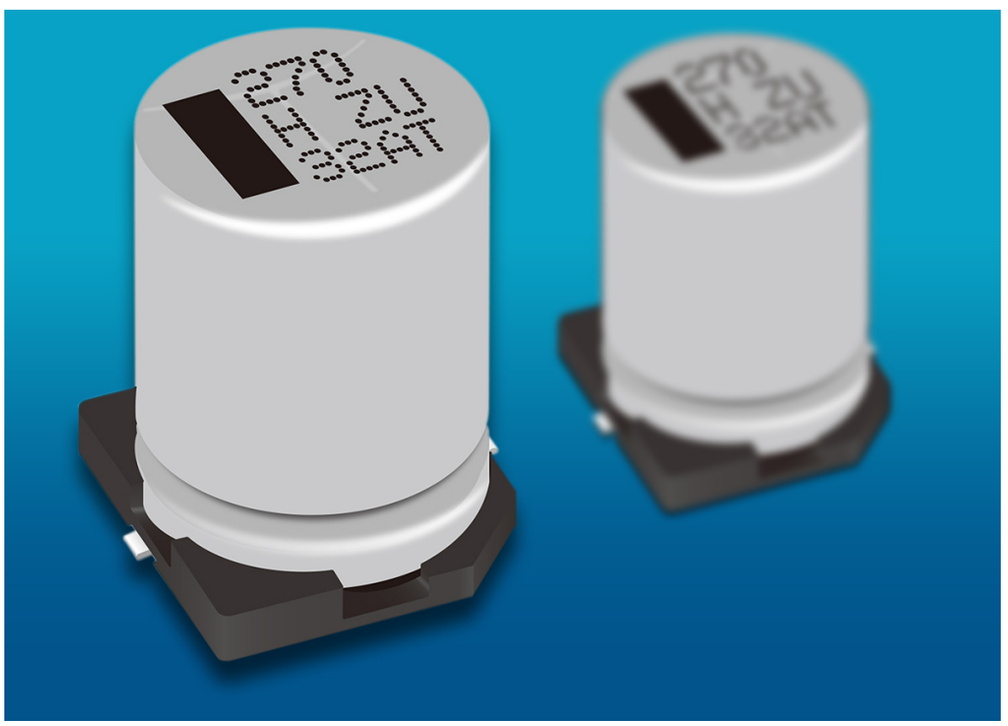
Automotive capacitors provide long lifetime at high temperature

The new ZUU conductive polymer hybrid aluminum capacitors from Panasonic Industry feature high ripple-current handling capability combined with high capacitance and low ESR values.



Panasonic INDUSTRY

FEATURES

- 10 mm diameter
- Two length options: 12.8 mm or 16.8 mm
- Voltage rating options: 25 V, 50 V, 63 V
- Operating-temperature range: -55°C to 135°C
- Vibration-proof variants available

APPLICATIONS

- Automotive systems
- Telecoms equipment
- Base stations
- Industrial equipment
- Robotics
- Power supplies

The new ZUU series of conductive polymer hybrid aluminum electrolytic capacitors from Panasonic Industry offer highly attractive specifications for automotive applications operating in demanding conditions.

The AEC-Q200-qualified ZUU series features high maximum ripple-current handling capability of 6.1 Arms, a 60% increase over the previous best Panasonic offering in its ZS series, at 125°C and 135°C. Capacitance values up to 1,000 µF mark an 80% increase over the Panasonic ZU series offering, while ESR is just 8 mΩ. The ZUU also provides high reliability, with endurance rated at 4,000 hours at both 125°C and 135°C.

These technical improvements make the surface-mount ZUU series polymer hybrid capacitors ideal for use in under-the-hood automotive applications such as pumps, electric power steering, cooling fans, high-current dc-dc converters, and advanced driver assistance systems. More widely, the ZUU capacitors are suitable for the inverter power supply in industrial applications, and on the dc side of both inverter and rectifier circuits in general power supplies.

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Entry-level MCUs offer best-in-class power consumption

The Renesas RA0 series of microcontrollers provides an entry point into 32-bit processing, with essential functions and very low power, cost and size.

The Renesas RA0 series microcontrollers are based on a 32 MHz Arm® Cortex®-M23 CPU, providing the lowest overall power consumption in the general-purpose 32-bit MCU market.

The RA0 MCUs consume 84.3 µA/MHz of current in active mode, and just 0.82 mA in sleep mode. In addition, Renesas offers a software standby mode in these MCUs which reduces power consumption by a further 99% to a minuscule 0.2 µA. This is coupled with a high-speed on-chip oscillator (HOCO) for fast wake-up to active mode.

The first group of MCUs in the RA0 Series are the RA0E1. These MCUs have a feature set which is optimized for cost-sensitive applications. The RA0E1 MCUs offer a wide operating-voltage range of 1.6 V to 5.5 V, saving designers the need to add a level shifter or regulator in 5 V systems. These MCUs also integrate timers, serial communications, analogue capability, safety functions and human-machine interface features. This high level of integration helps OEMs to reduce component count and cut bill-of-materials cost.

The RA0E1 MCUs include important diagnostic safety functions, as well as an IEC 60730 self-test library. Security features include a true random number generator, and AES libraries with encryption functions for IoT applications. In addition, the HOCO maintains high frequency stability of ±1.0% across a temperature range from -40°C to 105°C. This wide temperature range enables designers to avoid costly and time-consuming trimming, even after the reflow process.

The RA0E1 MCUs are supplied in a wide range of package options, including a tiny 3 mm x 3 mm, 16-lead QFN.

As with all RA family MCUs, the RA0E1 Group MCUs are supported by the Renesas Flexible Software Package (FSP). The FSP enables faster application development by providing all the infrastructure software needed, including multiple real-time operating systems (RTOS), a board support package, peripheral drivers, middleware, connectivity, networking, and security stacks as well as reference software to build complex AI, motor control and cloud solutions. The FSP allows designers to integrate legacy code and the choice of RTOS, thus providing full flexibility in application development. The FSP also eases migration of designs from the RA0E1 to larger RA family MCUs.

RENESAS

FEATURES

- Memory:
  - Up to 64 kbytes integrated code Flash
  - 12 kbytes of SRAM
- Analogue peripherals:
  - 12-bit ADC
  - Temperature sensor
  - Internal reference voltage
- Serial interface options:
  - UART, SPI and I2C

APPLICATIONS

- IoT devices
- Industrial automation and sensors
- Consumer products
- Home appliances
- Building automation
- Medical and healthcare devices
- Wearable devices

FREE DEV BOARD

Fast prototyping board for entry-level RA0E1 MCUs.

Orderable Part Number
RTK7FPA0E1S00001BJ

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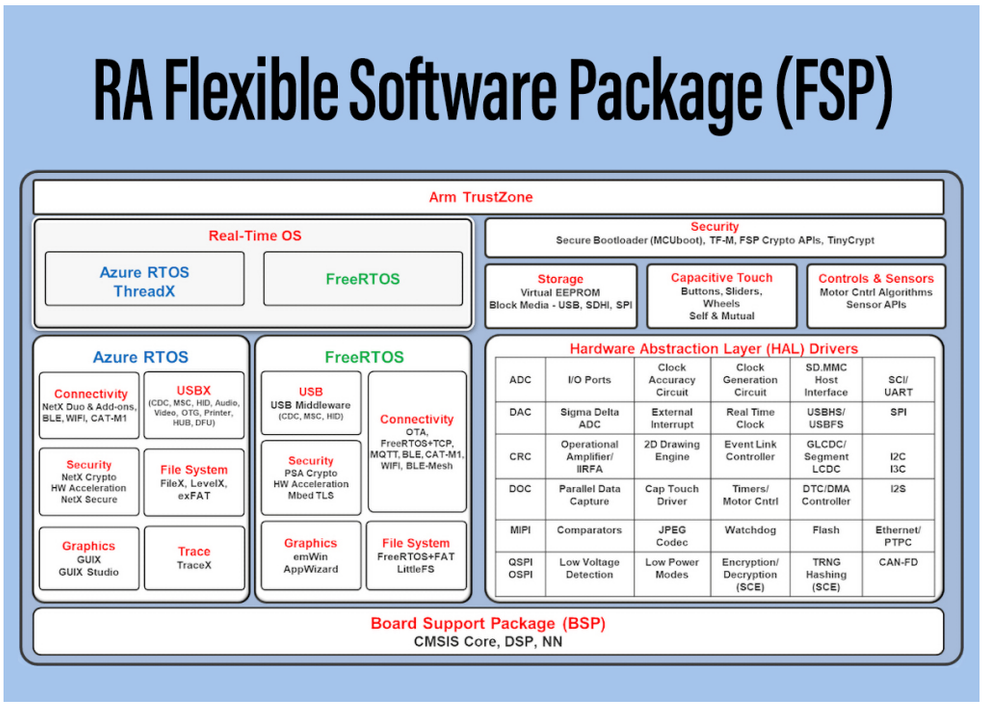
Embedded software package provides security and connectivity for IoT devices

The Flexible Software Package for Renesas RA Family microcontrollers provides a comprehensive set of firmware and middleware components, to give designers a head start in developing MCU-based products.



The Renesas Flexible Software Package (FSP) provides developers working with the Renesas RA Family of microcontrollers with user-friendly, scalable software for embedded system designs. Use of the FSP ensures software compatibility across all devices in the RA Family, from the RA0 series based on a 32 MHz Arm® Cortex®-M23 core to the RA8 series with a 480 MHz Cortex-M85 core.

Features of the FSP make it suitable for use in the development of connected IoT devices. These include support for the Arm TrustZone® secure partitioning technology and many other advanced security features, as well as protocol stacks for wireless connectivity via Cat-M1, Wi-Fi®, and Bluetooth® Low Energy technologies.

The FSP accelerates the establishment of secure operating frameworks for RA Family microcontrollers thanks to its provision of production-ready drivers, the Azure and FreeRTOS™ real-time operating systems (RTOS), and other middleware stacks. The FSP also includes best-in-class hardware abstraction layer (HAL) drivers which offer high performance and a small memory footprint.

Alongside the middleware, Renesas supplies the e² studio integrated development environment, which provides intuitive configurators and intelligent code generation to make programming and debugging easier and faster.

The FSP and e² studio can be used free of charge on any Renesas device.

RENESAS

FEATURES

- Static and dynamic analysis using industry-standard tools
- TCP/IP and MQTT connectivity protocol stacks
- USB middleware support for CDC, HID, and MSC modes
- File system support:
  - FreeRTOS+FAT
  - LittleFS
- Storage support for SDMMC, SPI, and USB
- Virtual EEPROM on Flash
- Capacitive touch middleware
- Motor control algorithms
- Secure bootloader through MCUboot
- Sensor module APIs

APPLICATIONS

- IoT devices
- Industrial automation and sensors
- Consumer products
- Home appliances
- Building automation
- Medical and healthcare devices
- Wearable devices

FREE DEV BOARD

Fast prototyping board for entry-level RA0E1 MCUs.

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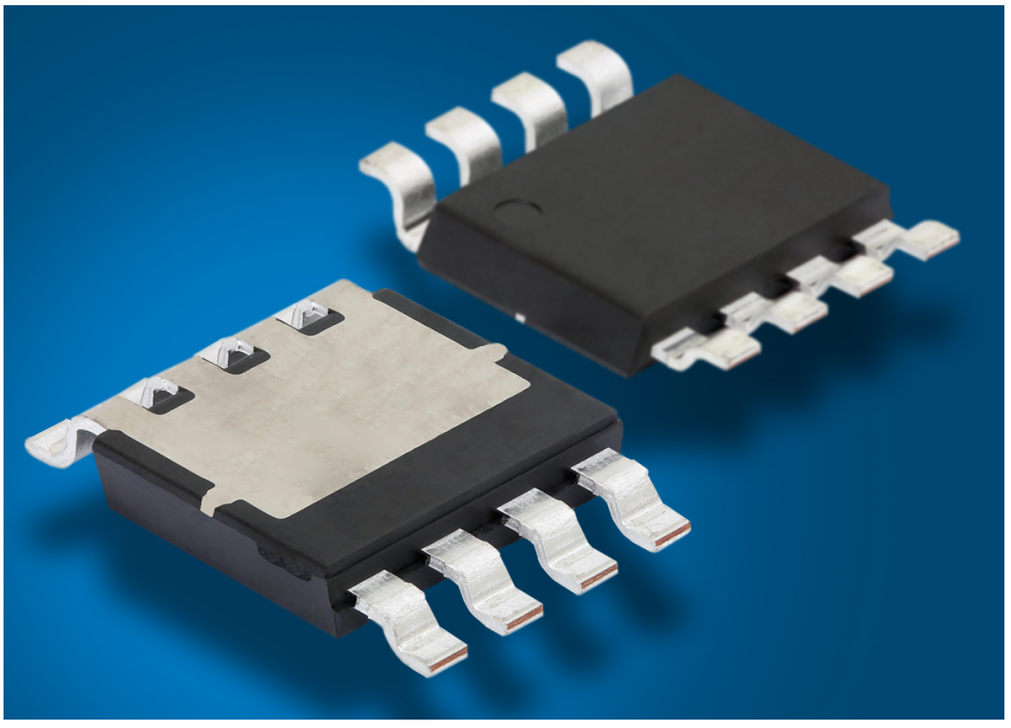
600 V MOSFET in top-cooled package saves space in 3 kW power supplies

The innovative package of the Vishay SiHR080N60E superjunction MOSFET is lower than a standard D2PAK and offers better thermal performance, giving higher power density in power supply circuits.



VISHAY
The DNA of tech.

FEATURES

- Low effective capacitance
- 5.0 V maximum gate-source threshold voltage
- Operating-temperature range: -55°C to 150°C
- 441 ns reverse-recovery time

APPLICATIONS

- Solar inverters
- Motor drives
- Server power supplies
- Telecoms equipment
- Uninterruptible power supplies
- Gaming PC power supply units
- Lighting power supplies
- Industrial power supplies:
  - Welding equipment
  - Induction heating
  - Battery chargers

Vishay has introduced a MOSFET in the E series of superjunction MOSFETs which has a new, thermally efficient top-side cooled PowerPAK 8 x 8LR package.

The SiHR080N60E MOSFET, intended for use in power supplies rated for up to 3 kW, provides a space-saving alternative to 600 V MOSFETs housed in a standard D2PAK package. The SiHR080N60E package is just 36% of the height of the D2PAK, and it provides an overall space saving of 52%.

At the same time, the high current rating, with a maximum continuous drain current of 32 A at a case temperature of 100°C, means that power-system developers can realize designs with much higher power density than in circuits based on a D2PAK MOSFET.

The PowerPAK 8 x 8LR package, which includes a Kelvin source connection, also offers outstanding thermal performance. Maximum junction-to-case thermal resistance is just 0.25°C/W.

The MOSFET is notable for its efficient conversion performance, thanks to low on-resistance of 84 mΩ and gate charge of 42 nC.

10110 DATASHEET

SAMPLES

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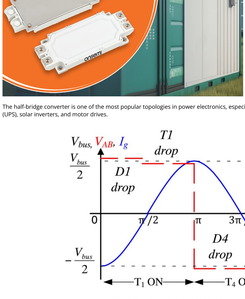
New power converter topologies extend the efficiency and reliability of IGBTs

Power-system designers have long used IGBTs in a half-bridge topology in applications such as solar inverters and motor drives. Recent experience shows that I- and T-type topologies can offer important advantages over the half-bridge.



The half-bridge converter is one of the most popular topologies in power electronics, especially in uninterruptible power supplies (UPS), solar inverters, and motor drives.

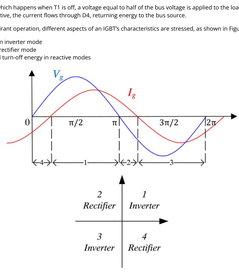


Fig. 1: The operating modes of a half-bridge circuit

The half-bridge output voltage depends on the switching state and current polarity, shown in Figure 1. If an inductive load draws positive current, Ig>0, it will flow through T1 and supply energy to the load, Vg. On the contrary, if the load current, Ig, is negative, the current flows back through D1 and returns energy to the dc source.

Similarly, if T4 is on, which happens when T1 is off, a voltage equal to half of the bus voltage is applied to the load, and the current decreases. If Ig is positive, the current flows through D4, returning energy to the bus source.

In so-called four-quadrant operation, different aspects of an IGBT's characteristics are stressed, as shown in Figure 2:

- Saturation voltage in inverter mode
- Forward voltage in rectifier mode
- Turn-on energy and turn-off energy in reactive modes

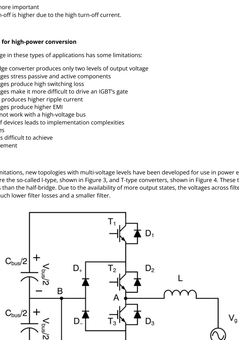


Fig. 2: A half-bridge circuit's four-quadrant operation

Power at the time intervals 4 and 2 is negative. This negative power is called reactive power. Reactive power is common in motor drives and other applications, and it increases the apparent power of a converter. A converter must be able to accommodate this element of total power to properly drive a reactive load.

Power line networks in most countries have not been upgraded to support the increased number of solar inverters. As a consequence, during peak daylight time, while solar generators feed the line, there is likely to be an over-voltage at sub-nodes. Hence all new solar inverters have to be able to absorb the over-voltage through the generation of reactive power.

Factors affecting IGBTs in motor drives and solar inverters

The main characteristics of a motor drive application using a half-bridge topology are:

- No current ripple is observed at high inductive loads
- Turn-on energy is generally higher than turn-off energy due to high reverse-recovery current
- Low switching frequency ends with high conduction loss
- Always hard switching

By contrast, the main characteristics of inverters suitable for solar and UPS applications are:

- Current ripple is up to 30% higher than in drive applications
- IGBT turn-on and forward diode turn-off occur at a lower current than for the same IGBT at turn-off and the forward diode at turn-on
- Turn-off energy is more important
- Over-voltage at turn-off is higher due to the high turn-off current.

Emerging topologies for high-power conversion

The classical half-bridge in these types of applications has some limitations:

- A standard half-bridge converter produces only two levels of output voltage
- High transient voltages stress passive and active components
- High transient voltages produce high switching loss
- High transient voltages make it more difficult to drive an IGBT's gate
- The voltage pattern produces higher ripple current
- High transient voltages produce higher EMI
- The half-bridge cannot work with a high-voltage bus
- Series connection of devices leads to implementation complexities
- High switching losses
- Thermal balancing is difficult to achieve
- High filtering requirement

To overcome these limitations, new topologies with multi-voltage levels have been developed for use in power electronics. The most common structures are the so-called I-type, shown in Figure 3, and T-type converters, shown in Figure 4. These topologies can operate at higher bus voltages than the half-bridge. Due to the availability of more output states, the voltages across filter components are lower, and result in much lower filter losses and a smaller filter.

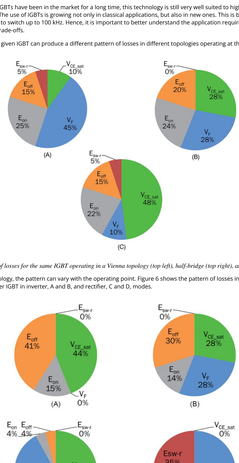


Fig. 3: I-type converter

Even switching losses fall significantly, while conduction losses go up slightly, a benefit in higher-frequency applications. These topologies implement unipolar switching by connecting to the neutral point during the off cycles.

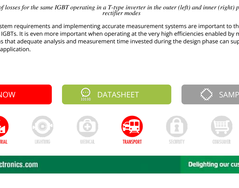


Fig. 4: T-type converter

It is worth mentioning that alongside the numerous advantages, these multi-level topologies present some difficulties, such as:

- Capacitor voltage balancing, addressed by active control
- Loss distribution imbalance under certain operating conditions
- Dependence on modulation index/duty ratio
- More complicated to control
- Better optimization techniques are needed

Advances in semiconductors and control technologies are enabling the use of these converter types in mid- to low-power applications consuming less than 10 kW. In fact, each of the I- and T-type topologies has its own advantages and disadvantages depending on operating conditions: the T-type shines at lower frequencies, and has lower switching losses than the half-bridge. The I-type offers better performance at high frequencies.

Semiconductor improvements might shift the balance of benefits and drawbacks between the I- and T-type topologies. In general, it is true that three-level inverters help to improve efficiency and increase operating frequency. In rectifier mode, the T-type is better for mid-frequencies while the I-type offers better high-frequency operation and better thermal balance.

One of the main disadvantages of both lies in the more complex control circuitry and the need for more semiconductor components, though not necessarily a larger silicon area.

Conclusion

Despite the fact that IGBTs have been in the market for a long time, this technology is still very well suited to high-voltage and high-current applications. The use of IGBTs is growing not only in classical applications, but also in new ones. This is because new technologies are able to switch up to 100 kHz. Hence, it is important to better understand the application requirements and choose the right set of IGBT trade-offs.

Figure 5 shows how a given IGBT can produce a different pattern of losses in different topologies operating at the same frequency.

Fig. 5: Distribution of losses for the same IGBT operating in a Vienna topology (top left), half-bridge (top right), and full-bridge (bottom)

Even in the same topology, the pattern can vary with the operating point. Figure 6 shows the pattern of losses in a T-type topology for the outer and the inner IGBT in inverter, A and B, and rectifier, C and D, modes.

Fig. 6: Distribution of losses for the same IGBT operating in a T-type inverter in the outer (left) and inner (right) position in inverter and rectifier modes

Understanding the system requirements and implementing accurate measurement systems are important to the development of reliable designs using IGBTs. It is even more important when operating at the very high efficiencies enabled by modern IGBTs and topologies. This means that adequate analysis and measurement time invested during the design phase can support the selection of the right IGBT for the application.

Compact power module provides isolated gate bias voltage to power switches

Part of a broad portfolio of gate-drive modules, the RECOM R9C1T18/R isolated dc-dc converter module's programmable output is compatible with all types of power switch, including the latest wide bandgap semiconductor devices.

RECOM

FEATURES

- 5 kV ac/1 min reinforced isolation
- 1.4 kV dc working voltage
- High dV/dt immunity
- Operating-temperature range: -40°C to 120°C
- Three-year warranty

APPLICATIONS

- Industrial and factory automation equipment
- Building and home automation
- Energy equipment
- Telecoms and network equipment
- Transport infrastructure

RECOM supplies a broad range of dc-dc converters for providing an isolated gate bias voltage to IGBTs, silicon MOSFETs, silicon carbide (SiC) MOSFETs and gallium nitride (GaN) power transistors.

This RECOM portfolio includes the 1.5 W R9C1T18/R power module in a 36-pin SSOP surface-mount package which has a footprint of 7.5 mm x 12.83 mm. The module operates over an input-voltage range of 8.5 V to 18 V dc. The asymmetrical output voltages are programmable in a range from ±2.5 V to ±15.5 V.

The module offers superior reliability, even when operating in harsh, high-power and high-frequency switching environments. The ultra-low isolation capacitance of less than 3.5 pF ensures minimal noise propagation across the isolation barrier.

While the R9C1T18/R's +15.5 V/-2.5 V capability is particularly well suited to driving the gate of SiC MOSFETs, the broad RECOM portfolio also includes other power modules with a +7 V/-3 V output capability for GaN transistors.

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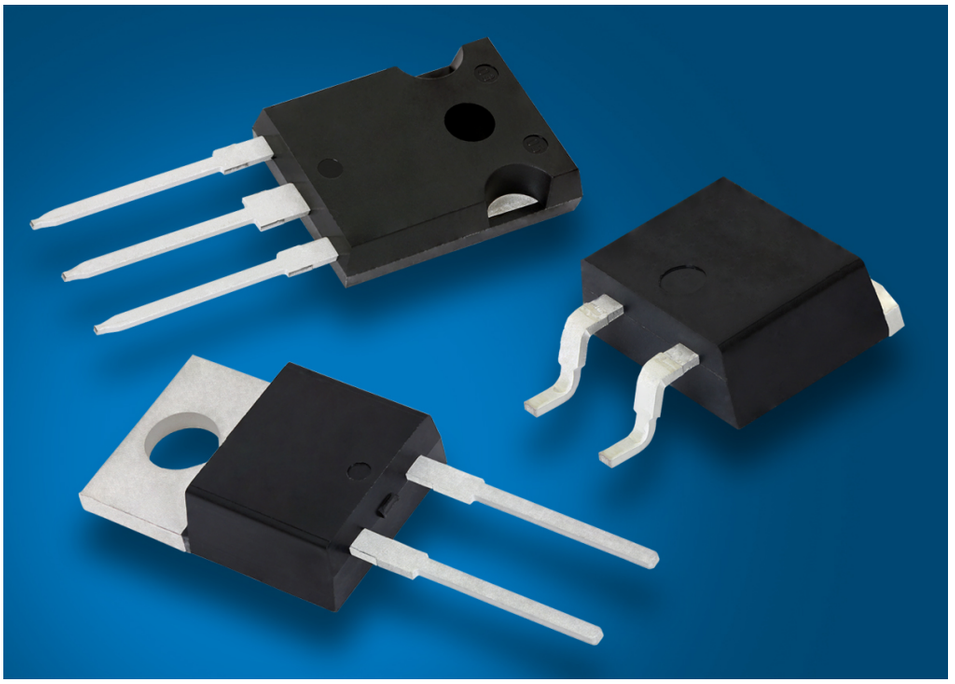
1,200 V SiC Schottky diodes boost efficiency and reliability in switching power converters

The third-generation VS-3C 1,200 V silicon carbide (SiC) Schottky diodes from Vishay offer low forward voltage drop, capacitive charge, and reverse leakage current in diodes with current ratings ranging from 5 A to 40 A.



VISHAY
The DNA of tech.™

FEATURES

- Forward voltage drop as low as 1.35 V
- Reverse leakage current as low as 2.5 µA at 25°C
- Forward surge ratings up to 260 A
- 175°C maximum junction temperature.

APPLICATIONS

- Mobile network infrastructure
- Server power supplies
- Energy generation and exploration systems
- Energy distribution and management
- Energy storage systems
- Industrial equipment
  - Motor drives
  - Power tools

Vishay has introduced its third-generation family of surface-mount and through-hole SiC Schottky diodes with a breakdown-voltage rating of 1,200 V. Single-chip versions of the VS-3C Schottky diodes are available with current ratings from 5 A to 30 A, and from 10 A to 40 A for dual-chip diodes in a common-cathode configuration.

SiC-based Schottky diodes are intended for use in high-performance ac-dc and dc-dc converter circuits, suitable applications include power factor correction (PFC) and output rectification in ultra high-frequency dc-dc converters.

SiC diodes offer better reverse-recovery behavior and higher peak repetitive reverse-voltage capability than silicon-based diodes. SiC diodes from Vishay also benefit from an attractive product of capacitive charge and forward voltage, which helps to reduce turn-on stress and hence switching losses in the active switch. This characteristic enables increases in switching frequency and thus in power density.

The Vishay SiC Schottky diodes feature a special structure, the backside is thinned by laser annealing, which reduces the forward voltage drop. The diodes have low typical reverse leakage current which reduces conduction losses, ensuring high system efficiency when supplying light loads. Unlike ultrafast diodes, the third-generation SiC Schottky diodes have almost no recovery tail, which further improves efficiency.

The high surge capability of the Vishay SiC diodes improves reliability, and aids in the implementation of SiC diodes in bridgeless PFC and other circuits that are directly connected to the grid.

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Launch of scalable mainstream solution for integrated three-phase motor control

STMicroelectronics has launched the STSPIN32G0 series of integrated motor controller/drivers for brushless dc and permanent magnet synchronous motors. Combining a three-phase driver and microcontroller, the STSPIN32G0 saves space and simplifies motor designs.

The new STSPIN32G0 series from STMicroelectronics are highly integrated motor controller systems-in-package (SiPs) for driving three-phase motors.

The STSPIN32G0 SIPs integrate a gate driver rated for 250 V or 600 V and a STM32G0 microcontroller based on a 64 MHz Arm® Cortex®-M0+ core. The built-in MCU has sufficient computing power to handle popular motor algorithms such as six-step and field-oriented control (FOC).

These compact motor controllers enable motor system designers to realize designs with a substantially smaller board footprint than comparable designs based on discrete motor drivers and controllers, without compromising performance or robustness.

The four motor controllers in the STSPIN32G0 series are

STSPIN32G0251: a 250 V three-phase driver with STM32 controller. Maximum output voltage of 250 V, and gate current of 0.35 A.

STSPIN32G0252: a 250 V three-phase driver with STM32 controller. Maximum output voltage of 250 V, and gate current of 0.85 A.

STSPIN32G0601: a 600 V three-phase driver with STM32 controller. Maximum output voltage of 600 V, and gate current of 0.35 A.

STSPIN32G0602: a 600 V three-phase driver with STM32 controller. Maximum output voltage of 600 V, and gate current of 0.85 A.

All members of the STSPIN32G0 series are supported by a rich set of hardware and software resources, including the **X-CUBE-MCSDK** motor control software development kit (SDK). The latest version 6.3 of the SDK includes a new Workbench tool, featuring a modern user interface with a fully reworked use flow. This new UI guides the designer through every phase of the motor configuration process.

FEATURES

- Gate driver supply-voltage range: 9 V to 20 V
- Protection functions:
  - Thermal shutdown
  - Short-circuit protection
  - Overload protection
  - Under-voltage lockout
- Smart shutdown
- Integrated bootstrap diodes
- Standby mode for reduced power consumption

APPLICATIONS

- Compressors
- Home appliances
- Fans and pumps
- Power tools

FREE DEV BOARD

Evaluation board for new integrated motor controller/driver SiP.

Orderable Part Number
EVSPIN32G06Q1S1

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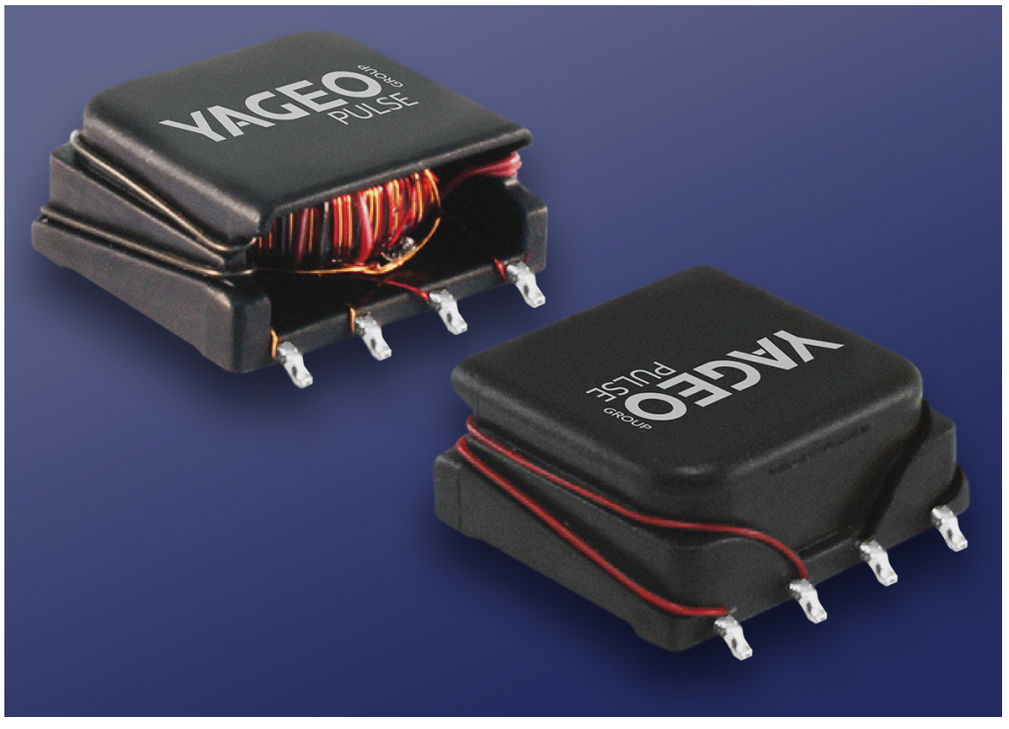
Isolation transformer saves space in industrial and automotive power circuits

The PGG6457NL transformers from YAGEO, which provide high isolation in low-voltage applications, are available with various options for the winding ratio. YAGEO also supplies the PMG6457NL transformers for automotive applications.



YAGEO GROUP PULSE

FEATURES

- Turns ratio options: 1:1, 1:2, 3:4, 5:7
- Leakage inductance up to 1.2 µH
- 30 pF maximum capacitance

APPLICATIONS

- Industrial electronics
- Automotive systems

The Pulse Electronics division of YAGEO has introduced the PGG6457NL series of space-saving isolation transformers for low-voltage power conversion circuits. The new family also includes the PMG6457NL transformers for automotive applications, which have ITAF approval.

The surface-mount transformer's compact dimensions, just 15.6 mm x 16.5 mm x 7.2 mm, are attributable to the Pulse innovative sidecar packaging design. Despite its small size, this transformer provides 13 mm of creepage between pins. The isolation rating between the windings is 4.2 kVrms, and it also provides reinforced safety insulation.

The PGG6457NL and PMG6457NL are intended for operation in a fixed duty-cycle push-pull topology, as part of a low-cost solution for supplying up to 2.5 W from a low-voltage source. A typical application is an isolated RS-485 driver circuit. The transformer is compatible with a very wide range of power controllers, giving the designer flexibility in component selection.

For a fixed 50% duty cycle mode of operation, the output voltage is simply determined by the input voltage and turns ratio. The transformers are available with various turns ratios to support a variety of output voltages.

FUTURE ELECTRONICS
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Compact tuning fork crystal offers stable and predictable performance

The ECX-12R crystal from ECS Inc, which produces a frequency output of 32.768 kHz, is rated for operation over a broad industrial temperature range. Low drive power makes it suitable for use in wearable devices.

ECS INC INTERNATIONAL

FEATURES

- 70 kΩ ESR
- 1 µW drive power
- 1.3 pF shunt capacitance

APPLICATIONS

- Metering
- Automotive systems
- Industrial equipment
- IoT devices
- Wearable devices

The ECS Inc ECX-12R 32.768 kHz tuning fork crystal is an ideal timing device for automotive, industrial, IoT and wearable applications thanks to its stable frequency output over an operating-temperature range of -40°C to 85°C. Frequency tolerance options are ±20 ppm or ±10 ppm.

Supplied in a 2.0 mm x 1.2 mm x 0.6 mm package, the ECX-12R features a load capacitance of up to 12.5 pF. The temperature coefficient is -0.033 ppm/°C^2 over the operating temperature range, and first year aging at 25°C is specified at ±3 ppm. This means that designers can rely on the crystal's accuracy throughout the standard operating lifetime of the design.

Automotive-grade 1,200 V SiC MOSFET saves space in EV chargers and motors

The SCT025W120G3-4AG MOSFET from STMicroelectronics, one of the world's largest manufacturers of SiC devices, enables faster switching, lowers losses and improves thermal management in automotive and industrial applications.

FEATURES

- AEC-Q101 qualified
- Very fast and robust intrinsic body diode
- 27 mΩ on-resistance
- 56 A maximum continuous drain current
- Source sensing pin for increased efficiency
- 200°C maximum junction temperature

APPLICATIONS

- Electric vehicles:
  - Main traction inverters
  - On-board chargers
  - Dc-dc converters

The SCT025W120G3-4AG, part of the third generation of silicon carbide (SiC) MOSFETs from STMicroelectronics, combines very low on-resistance over the entire temperature range with low capacitances and high switching performance. Use of the SCT025W120G3-4AG enables power-system designers to increase the application's operating frequency, raise energy efficiency, and reduce system size and weight compared to systems based on conventional silicon MOSFETs.

SiC MOSFETs also have a higher voltage rating relative to their die size compared to silicon alternatives, making the technology an excellent choice for electric vehicles (EVs) and EV rapid chargers.

The high-frequency switching capability of the SCT025W120G3-4AG enables the use of smaller passive components, producing more compact and lightweight designs for the electrical equipment in vehicles.

The packages in which ST supplies its third-generation SiC MOSFETs offer innovative design features, such as specially placed cooling tabs that simplify connection to base-plates and heat spreaders in EV applications.

Transformer modules with reinforced insulation ideal for energy storage applications

The new HXE20xxHL series from YAGEO is available with support for a range of working voltages up to 1.5 kV, for use in high-voltage battery and energy storage systems and emergency back-up power supplies.

YAGEO GROUP PULSE

FEATURES

- Excellent electrical performance up to 4 MHz
  - <1 dB insertion loss
  - >20 dB return loss
- Auto-wound ferrite core
- Supports automated assembly processes

APPLICATIONS

- Grid-level energy storage systems
- Remote energy generation back-up supplies
- Emergency battery stacks
- Residential energy storage systems
- Wall- or floor-mount battery packs
- Marine and aviation battery management systems

The new HXE20xxHL series from the Pulse Electronics division of YAGEO are surface-mount, reinforced-insulation transformer modules.

The transformer modules provide safety isolation and protection on communication links which control and monitor renewable energy storage systems exposed to hazardous high working voltages. The new modules feature a 1:1 tapped transformer and integral choke which give excellent signal conditioning and EMI performance.

The transformers' reinforced insulation complies with the requirements of the EC/EN/UL 62368-1 standard at four working voltages: 500 V, 800 V, 1,000 V, and 1,500 V dc. The HXE20xxHL modules also provide three levels of input-output isolation:

- 4,300 V dc
- 5,000 V dc
- 6,000 V dc

Insulation resistance is 400 MΩ over the operating-temperature range of -40°C to 125°C.

The high isolation and insulation ratings make these transformer modules ideal for use in demanding outdoor applications for battery stacks which provide energy storage or a back-up energy supply in remote or residential locations.

The surface-mount modules have a compact footprint, but provide high creepage distance of more than 15 mm. The modules are matched to popular chipsets that perform cell monitoring and control, and battery monitoring control. This means that the HXE20xxHL can be used to isolate the daisy-chain communication links between battery monitoring controllers and cell monitoring controllers.

As well as supporting energy storage applications, these transformers can also be used in marine and aviation applications in which communication links for battery management need digital separation from the high-voltage battery stacks and circuits.

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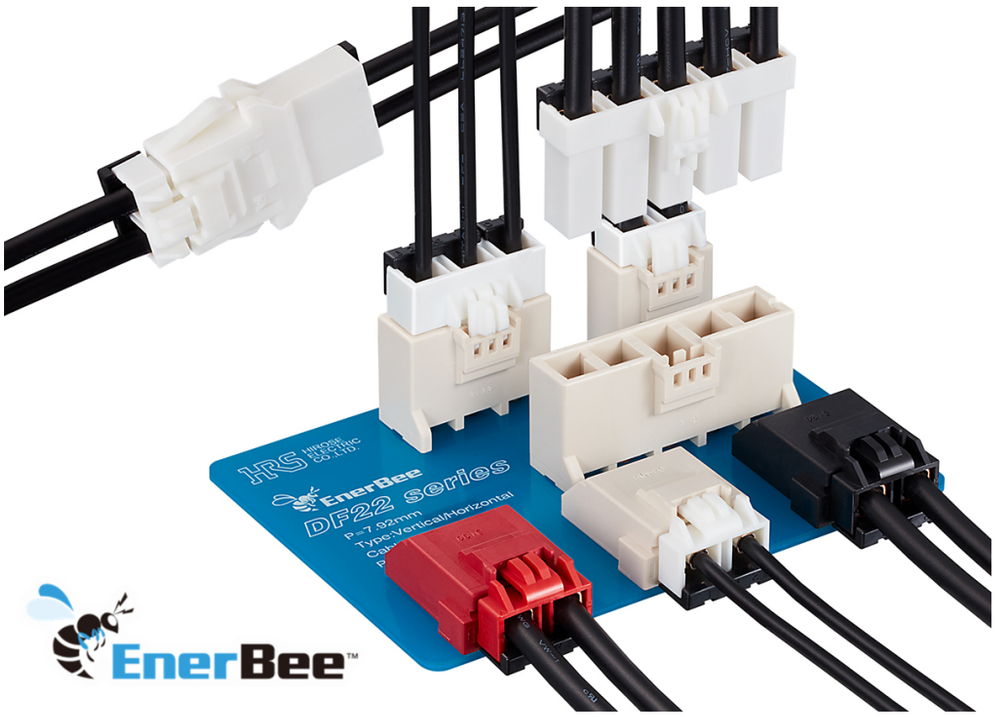
Wire-to-board connector offers high current capability in industrial applications

Hirose supplies the DF22 series of connectors to provide a reliable, high-power connector for robots, smart meters and other industrial devices. The DF22 center lock termination saves space and eases assembly.



HRS HIROSE ELECTRIC EUROPE B.V.

FEATURES

- 7.92 mm contact pitch
- Number of contacts: 1 to 5
- Rated-current range: 15 A to 30 A
- 1,000 V ac/dc rated voltage
- 30 mating cycles
- Terminations compatible with AWG 10 to 16 wire
- Operating-temperature range: -55°C to 85°C

APPLICATIONS

- Industrial equipment
- Robots
- Medical devices
- Smart meters
- Servers
- LED lighting

Hirose has introduced the DF22 series of high-power wire-to-board connectors, which offer the reliability required by industrial equipment. In a single-position configuration with an AWG 10 crimp contact and cable, the DF22 connectors can handle current of up to 30 A.

The DF22 series consists of cable-mounted facing crimp sockets and board-mounted vertical and right-angle male headers. Panel-mounted in-line versions are also available for cable-to-cable connections. A robust internal walled structure protects the header contacts, preventing short circuits between adjacent contacts. In addition, the connector can withstand a high voltage of 2.5 kV for one minute.

The robust lock provides a tactile sensation and an audible click when mated. This confirms that the connector is fully engaged, guaranteeing complete electrical and mechanical connection. The lock is on the center of the housing to avoid uneven locking and cable entanglement, a common problem in side-lock systems. The center lock also means that multiple connectors can be mounted close together side-by-side.

Keying options prevent incorrect insertion of the mating connector when multiple connectors are used. Built-in guide posts ensure accurate connector positioning and orientation on the board.

The DF22 series is part of the EnerBee product family.

Sealed high-current connectors withstand high temperatures and harsh conditions

TE Connectivity (TE) provides the AMPSEAL cable-to-board connector family to provide heavy-duty connections for applications including off-highway vehicles and construction equipment.

TE connectivity
AUTHORIZED DISTRIBUTOR

FEATURES

- Compatible with wire sizes from 16 AWG to 24 AWG
- Current ratings:
  - 17 A with gold contacts
  - 8 A with tin contacts
- Operating-temperature ranges:
  - -40°C to 125°C with gold contacts
  - -40°C to 105°C with tin contacts
- 250 V ac voltage rating
- Tool-less backshells for reduced wire strain and easy assembly

APPLICATIONS

- Commercial vehicles
- Off-highway vehicles
- Energy generation and storage equipment
- Marine equipment
- Construction equipment
- Forklift trucks

The AMPSEAL connectors from TE Connectivity provide cable-to-board connections in harsh environments.

Environmentally sealed up to IP69K for protection from dust, water and spray, these connectors are available in cable plugs and PCB headers which withstand extreme temperatures and moisture. The connectors are suitable for high-temperature under-the-hood applications.

The pre-assembled receptacle housing connector features built-in contact sealing to eliminate the need for individual wire-sealing grommets, while an integral interfacial seal protects mated connectors.

The AMPSEAL connectors enable manufacturers to minimize mismating and misidentification by providing various connector colors and mechanical polarized keyings.

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New wireless MCU eases development of smaller, more efficient smart Bluetooth devices

The STMicroelectronics STM32WB09 line Bluetooth® wireless microcontrollers support the latest Bluetooth Low Energy 5.4 specification, enabling designers to implement advanced features such as real-time location finding and indoor positioning.

The STM32WB09 line from STMicroelectronics are Bluetooth wireless microcontrollers which enable the next generation of better, smaller short-range wireless connectivity devices to extend battery run-time.

Complying with the latest Bluetooth v5.4 specification, the STM32WB09 opens up the opportunity for designers to make smarter products such as wireless beacons and devices which can calculate their location indoors with centimeter accuracy. The chip supports advanced Bluetooth capabilities including direction finding for accurate position detection, thereby enabling applications such as real-time location, indoor positioning, item finding, and asset tracking.

This new MCU puts all the processing power and Bluetooth radio-frequency technology needed in a single chip. The STM32WB09 line is supplied with a Bluetooth v5.4 protocol stack, as well as free PC-based design tools, essential software and sample code to accelerate application development. The chip is based on an Arm® Cortex®-M0+ MCU core – backed by 512 kbytes of Flash memory and 64 kbytes of RAM, which hosts the application, while the ST state-of-the-art radio manages the Bluetooth wireless connection.

While providing generous on-chip memory, ST has prioritized features that make the biggest difference in the target applications. These include support for power-control options in the Bluetooth radio, and the ability to fine-tune the RF output power in 1 dBm steps. This tuning optimizes battery life and system reliability, and ensures coexistence with other nearby wireless devices.

FEATURES

- RF performance:
  - Up to -104 dBm sensitivity
  - +8 dBm output power
  - 4.9 mA peak Transmit current
  - 3.6 mA peak Receive current
- Integrated balun and crystal
- Works with 2-layer PCB

APPLICATIONS

- Industrial equipment
- Smart home
- IoT devices
- Remote controls
- Wearable devices
- Wireless sensors
- Warehouse inventory management systems
- Smart meters
- Disposable medical sensors
- Access control equipment

FREE DEV BOARD

Bluetooth Low Energy evaluation board demonstrates low-power operation of STM32WB09 line.

Orderable Part Number
NUCLEO-WB09KE

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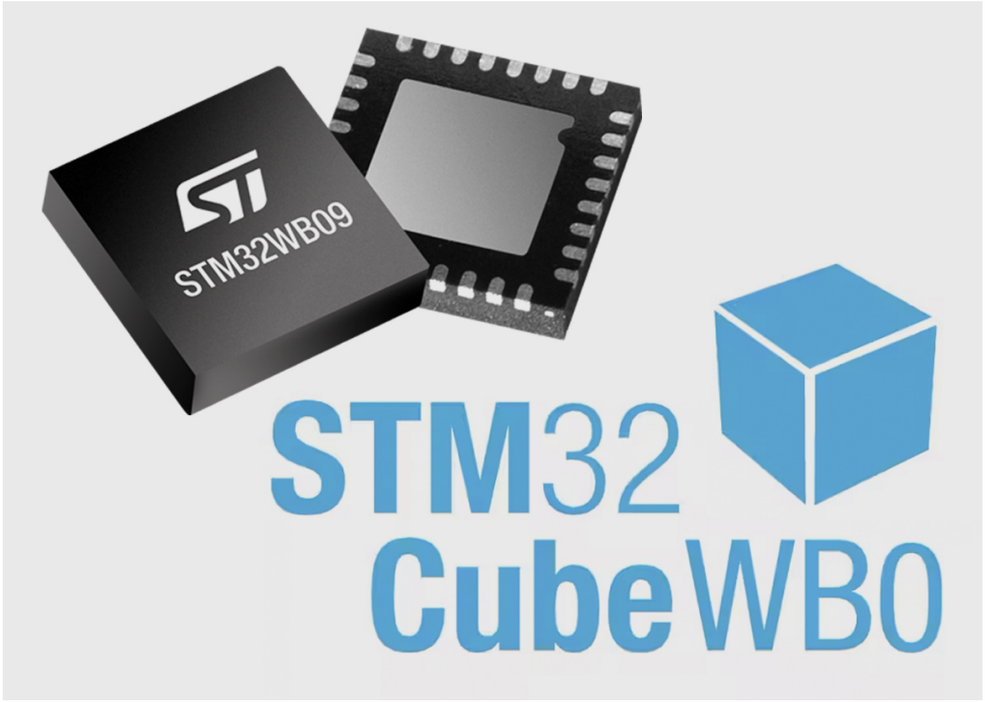
Embedded software accelerates development of Bluetooth Low Energy applications

The STM32CubeWB0 embedded software package from STMicroelectronics includes low-level utilities and interfaces, middleware, a protocol stack and operating system to enable the developer to start working with ST wireless MCUs quickly and easily.



The STM32CubeWB0 from STMicroelectronics is a single package which combines all the generic embedded software components required to develop an application on STM32WB0 series Bluetooth® wireless microcontrollers.

The package includes the STM32Cube hardware abstraction layer (HAL) and low-layer application programming interfaces, a consistent set of middleware components such as a certified Bluetooth Low Energy v5.4 protocol stack, a FreeRTOS™ operating system kernel, and FatFS generic file system module.

On top of this, the STM32CubeWB0 includes demonstrations of the MCU's 2.4 GHz radio, showing how advanced features such as low-power manager integration and over-the-air firmware upgrades operate.

The STM32CubeWB0 package is part of the STM32Cube software set, which provides code to support the whole of the STM32 32-bit MCU portfolio. STM32Cube includes STM32CubeMX, a graphical software configuration tool which enables developers to generate C initialization code using graphical wizards.

The package is available on free, user-friendly license terms. ST supplies a framework for updating the STM32CubeWB0, and provides notifications to users when a new release is available.

FEATURES

- Bluetooth Low Energy application code
- 2.4 GHz radio driver
- CMSIS files
- Supports Nucleo development boards

APPLICATIONS

- Industrial equipment
- Smart home
- IoT devices
- Remote controls
- Wearable devices
- Wireless sensors
- Warehouse inventory management systems
- Smart meters
- Disposable medical sensors
- Access control equipment

FREE DEV BOARD

Bluetooth Low Energy evaluation board demonstrates low-power operation of STM32WB09 line.

Orderable Part Number
NUCLEO-WB09KE

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Complete energy harvesting PMIC for battery-free system designs

Nexperia has expanded its energy harvesting portfolio with the release of the NEH7100BU, a PMIC which provides new power management features including battery protection, an LDO regulator and USB charging.

nexperia

FEATURES

- Compatible with various types of storage elements
- Configurable through I2C interface

APPLICATIONS

- Wearable devices
- Remote controls
- Wireless PC devices
- Industrial sensors
- Asset tracking
- Environment monitoring
- Electronic shelf labels
- Consumer electronics

Nexperia has introduced the NEH7100BU, a high-performance power management IC (PMIC) which charges a storage element using energy harvested from a wide range of ambient sources including light, a temperature gradient, or kinetic energy.

The NEH7100BU enables designers to rethink the operation of traditionally battery-powered systems, by extending the life of the battery or by achieving full energy autonomy. The PMIC makes battery-less designs possible because of its cold-start feature, which allows a storage element such as a capacitor to collect small amounts of energy, so that the system can power up from very low energy levels.

By removing or limiting the need for battery replacement, this new Nexperia energy harvesting solution enables the creation of sustainable and cost-effective devices.

The NEH7100BU requires no external inductor. The PMIC includes power management features such as over-voltage protection, low-voltage detection and over-current protection to protect the storage element. In addition, the NEH7100BU includes an LDO voltage regulator, an I2C interface, and a USB charging circuit, helping designers to create more integrated systems with a reduced bill-of-materials cost and a simpler board layout.

Handling a wide input-power range of 15 µW to 100 mW, the NEH7100BU can convert energy at an efficiency of up to 95%. The PMIC includes an on-chip maximum power point tracking (MPPT) algorithm for optimizing energy transfer as the harvested power and voltage input fluctuate. This high-performance algorithm adapts to the external environment every 0.5 seconds.

The NEH7100BU is supplied in a 28-lead, 4 mm x 4 mm QFN package.

10110 DATASHEET

SAMPLES

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Integrated high-voltage power stage produces smaller, more robust motor drives

In the new PWD5T60, STMicroelectronics has integrated gate drivers, power MOSFETs, bootstrap diodes, and high-speed protection functions in a single package, reducing the board space occupied by motor drive circuits.

STMicroelectronics has launched the PWD5T60, a three-phase motor driver which integrates gate drivers and six 500 V power MOSFETs with on-resistance of 1.38 Ω for superior application efficiency.

Ideal for applications operating at up to 500 V, the PWD5T60 also includes zero-drop bootstrap diodes, minimizing the need for external components, and occupying 30% less board space than comparable discrete drivers. Tightly matched propagation delays at both high- and low-side MOSFETs eliminate cycle distortion, giving the designer flexibility to set operating frequencies to optimize response time and power efficiency.

The PWD5T60 is backed by a dedicated evaluation board, the EVLPWD-FAN-PUMP, which enables engineers to quickly evaluate the performance of the PWD5T60 in applications consuming up to 100 W. The board features the PWD5T60 and an STM32G0 microcontroller, enabling field-oriented control or six-step control of permanent magnet synchronous motors (PMSM) and brushless dc (BLDC) motors.

High-voltage motor applications benefit from the PWD5T60 array of protection functions. Smart shutdown uses a comparator to provide fast over-current protection. When a fault is detected, the output is immediately turned off, and the subsequent output disable time can be set by connecting a capacitor and an optional pull-up resistor to a dedicated pin. The turn-off response is not affected by these components, so product developers can set the optimal disable time to ensure that the fault is resolved quickly while still implementing immediate turn-off.

The PWD5T60 handles a wide supply-voltage range of 9 V to 20 V, while CMOS/TTL-compatible logic inputs down to 3.3 V simplify interfacing with a host MCU.

FEATURES

- Low- and high-side under-voltage lockout
- Interlocking and dead time functions
- Dedicated Enable pin
- Supports compact and simple board layout

APPLICATIONS

- Fans and pumps
- Home appliances
- Industrial appliances
- Refrigerator compressors

FREE DEV BOARD

Small circular evaluation board helps shorten development time for fans and pumps.

Orderable Part Number
EVLPWD-FAN-PUMP

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Standard rectifiers offer space savings with new thermally-efficient package

The SE20x, SE30x, and SE40x rectifiers from Vishay offer higher current ratings than competing rectifiers in conventional packages that have a bigger footprint. Excellent electrical characteristics help to increase system efficiency.

VISHAY
The DNA of tech.™

FEATURES

- 0.88 mm package height
- Oxide planar chip junction
- Low forward voltage drop
- Less than 0.1 µA reverse current
- Operating-temperature range: -55°C to 175°C

APPLICATIONS

- Consumer electronics:
  - Entertainment equipment
  - Home appliances
  - Health and care equipment
  - Mobile phones
- Computer power supplies
  - Energy distribution and management
  - Energy generation and exploration
- Energy storage systems
- Mobile network infrastructure
- Fixed network infrastructure
- Industrial equipment
- Home and building automation
- Automotive systems
- Agricultural equipment

Vishay supplies the industry's first 600 V-rated standard rectifiers to be housed in a low-profile DFN3820A package with wettable flanks.

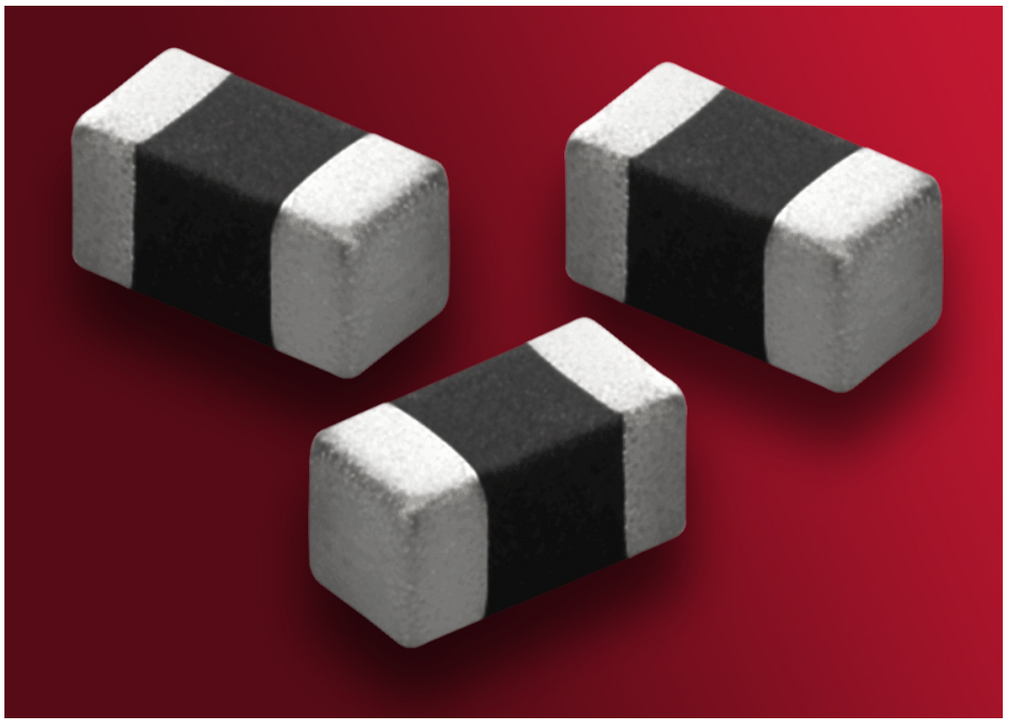
The 2 A SE20x, 3 A SE30x and 4 A SE40x rectifiers combine high current density and high efficiency in a small and very low-profile Power DFN package. The rectifiers can be used for power-line polarity protection and rail-to-rail protection in consumer, industrial, and automotive applications. Each of the SE20x, SE30x and SE40x series is available in versions with a peak repetitive reverse-voltage rating of 200 V, 400 V, and 600 V.

The optimized copper mass design and advanced die placement technology allow for superior thermal performance which enables operation at higher current ratings than commonly used packages that have a larger footprint and higher profile, such as the conventional SMB (DO-214AA) and SMC (DO-214AB) packages.

The rectifiers are available in versions qualified according to AEC-Q101 for use in automotive applications.

New NTC thermistors offer precise measurements at high temperatures

The latest NCU and NCP thermistors from Murata offer good temperature measurement performance at low cost over a broad temperature range. Automotive-grade versions of the NCU product handle a wide temperature range.



muRata
INNOVATOR IN ELECTRONICS

FEATURES

- Up to 100 kΩ resistance at 25°C
- Operating-temperature range options:
  - Automotive: -55°C to 150°C
  - Non-automotive: -40°C to 125°C or -55°C to 125°C
- UL/cUL recognized
- Excellent solderability
- Stable performance across the temperature range

APPLICATIONS

- Consumer devices
- Industrial equipment
- Medical devices
- Automotive systems
  - Powertrain
  - Safety equipment

Murata has launched two families of affordable, surface-mount NTC thermistors which perform precise temperature measurement at high temperatures.

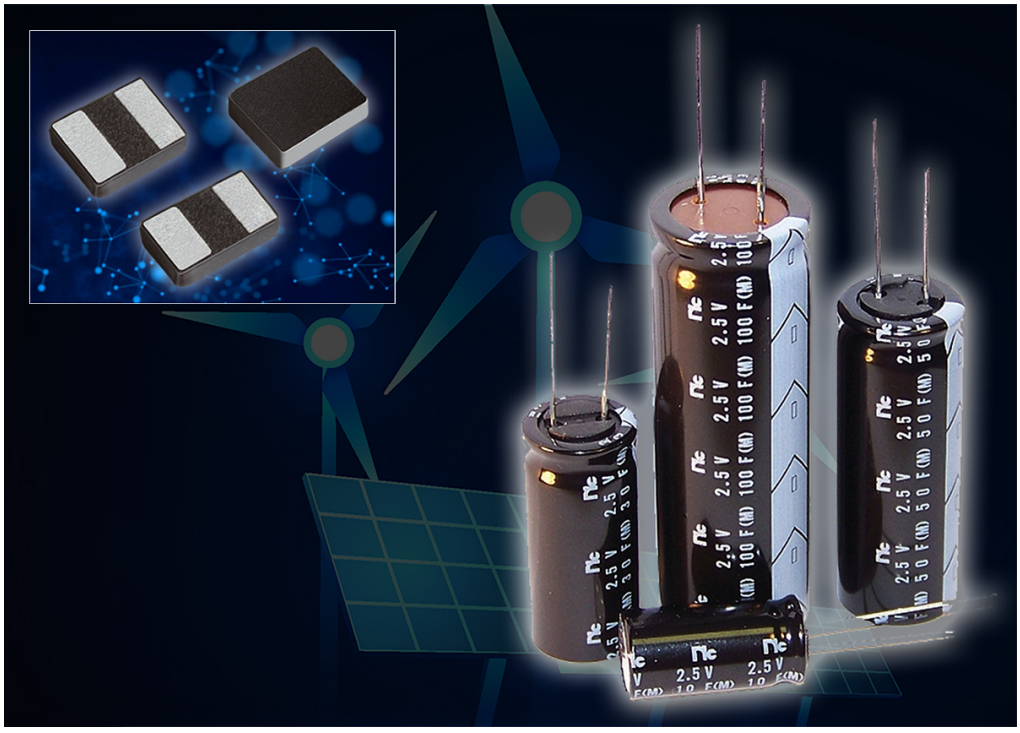
Thermal design is becoming a more important function in electronic systems, as more functions are added to increasingly sophisticated consumer, mobile, and computing devices and to vehicles, increasing the load on components such as microprocessors and electronic control units (ECUs). Precise measurement at high temperatures is now required to maintain high performance even when operating at high temperatures.

To meet this requirement, Murata has developed its latest NCU and NCP thermistors, which offer substantial improvements in measurement error compared to competing devices.

Automotive AEC-Q200-qualified versions of the new NCU thermistors are available in 1005 and 1608 case sizes. New NCP thermistors for use in non-automotive applications are available in 0402 and 0603 case sizes. NCU thermistors for use in non-automotive applications are available in 1005 and 1608 case sizes.

Supercapacitors provide large energy storage capacity for energy harvesting systems

The latest NIC Components NDRW supercapacitors, offering capacitance up to 70 F, are also ideal for use as back-up power supplies and to provide a peak power boost in battery-powered systems.



NIC COMPONENTS CORP.

FEATURES

- Long cycle life
- Operating temperature range: -40°C to 65°C extendable to 85°C with voltage derating

APPLICATIONS

- Energy harvesting
- Back-up power
- Peak-power assistance
- Renewable energy systems
- Industrial equipment

NIC Components supplies the NDRW series of supercapacitors for energy storage applications that require high capacitance and low ESR.

Offering a range of capacitance values from 0.1 F to 70 F, and a rated voltage of 2.7 V, the NDRW supercapacitors provide long life and reliable performance in the latest generation of energy harvesting systems operating on power generated by photovoltaic cells, thermoelectric generators or kinetic energy generators. The NDRW are also suitable for use as a back-up power source, or to provide peak power assistance.

NIC has also introduced the NPMS and NPMT series of power inductors for energy-related applications, as well as the NTX series of LAN transformers for high-speed networking and telecommunication applications.

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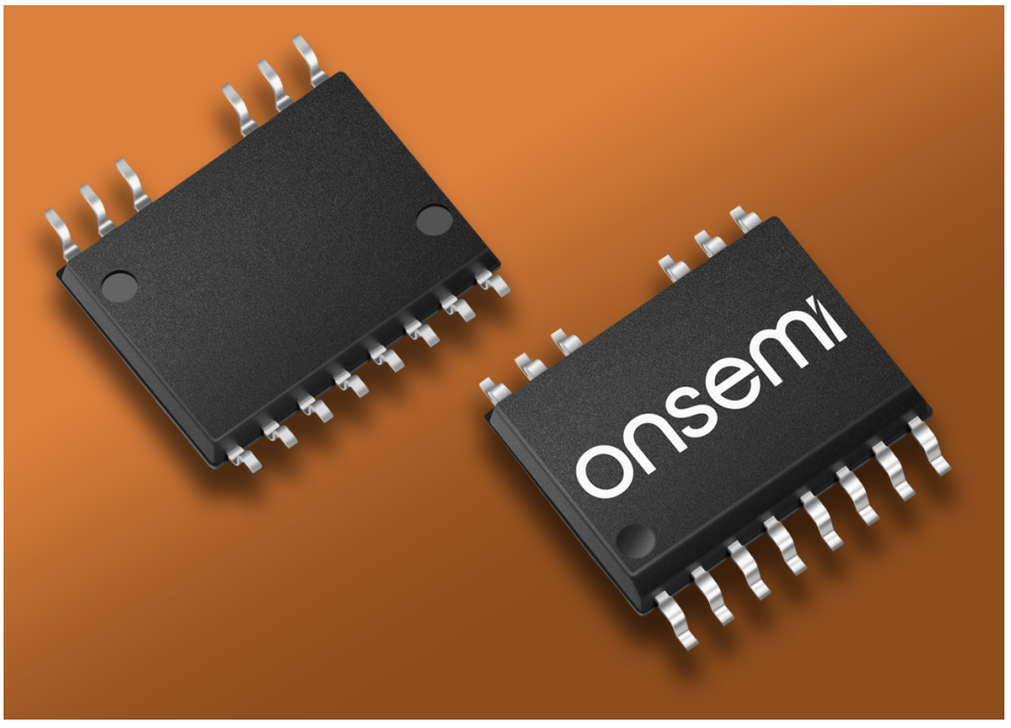
Dual IGBT gate driver provides high galvanic isolation

The NCD57252 from onsemi offers flexible configurations for use in industrial power supplies and solar energy systems. The NCV57252 variant is AEC-Q100 qualified and PPAP capable for use in automotive applications.



onsemi

FEATURES

- High peak output current
- 1.5 kVrms differential voltage between output channels
- Short propagation delays with accurate matching
- Programmable overlap or dead-time control
- Gate clamping during short circuits

APPLICATIONS

- Automotive power systems
- Industrial power supplies
- Electric vehicle chargers
- Uninterruptible power supplies
- Solar inverters

The NCD57252 from onsemi is a high-current, dual-channel isolated IGBT gate driver which offers internal galvanic isolation from the input to each output, and functional isolation between the two output channels.

The gate driver is supplied in two package variants: the galvanic isolation it offers is either 2.5 kV or 5 kVrms depending on the package. The peak output current also depends on the chosen package: either ±6.5 A or ±3.5 A.

Accepting signals and a bias voltage in a range from 3.3 V to 20 V on the input side, the NCD57252 supplies up to a 32 V bias voltage on the output side. The driver handles complementary inputs, and provides separate pins for disable and dead-time control, for easier system design.

The NCD57252 supports various configurations and can be used as a dual low-side, a dual high-side, or a half-bridge driver.

Other gate drivers in the same family, the NCD57253 for silicon carbide MOSFETs, and the NCD57255 for IGBTs, share similar electrical characteristics to the NCD57252.

FREE DEV BOARD

Isolated gate driver board provides two output channels.

Orderable Part Number
NCD57252GEVB

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Versatile 110 A power relay ideal for solar inverters

Compact new HE-A power relay from Panasonic offers 110 A carrying and 90 A switching capability, and provides an affordable switching solution for high-power energy management applications.

Panasonic INDUSTRY

FEATURES

- 1.92 W operating power
- 310 mW maximum holding power
- 800 V maximum switching voltage
- Operating-temperature range: -40°C to 85°C
- UL/C-UL and VDE approvals

APPLICATIONS

- Solar inverters
- EV charging systems
- Industrial automation equipment

Panasonic Industry has launched a versatile new power relay, the HE-A, which provides highly reliable performance in solar inverters and other heavy-duty energy-management applications.

Part of the Panasonic HE family of high-power, PCB-mount relays, the compact HE-A power relay measures just 33 mm x 38 mm x 38.8 mm, and features a 3.6 mm contact gap between the normally open contacts. The power relay is rated for a maximum switching current of 90 A, and a maximum carrying current of 110 A. Electrical life of 1,000 operations is guaranteed at 90 A and 277 V ac, and the relay can withstand a short-circuit current of up to 5,000 Arms.

The relay offers a welding detection function with a mirror contact mechanism which complies with the EN 60947-4-1 standard.

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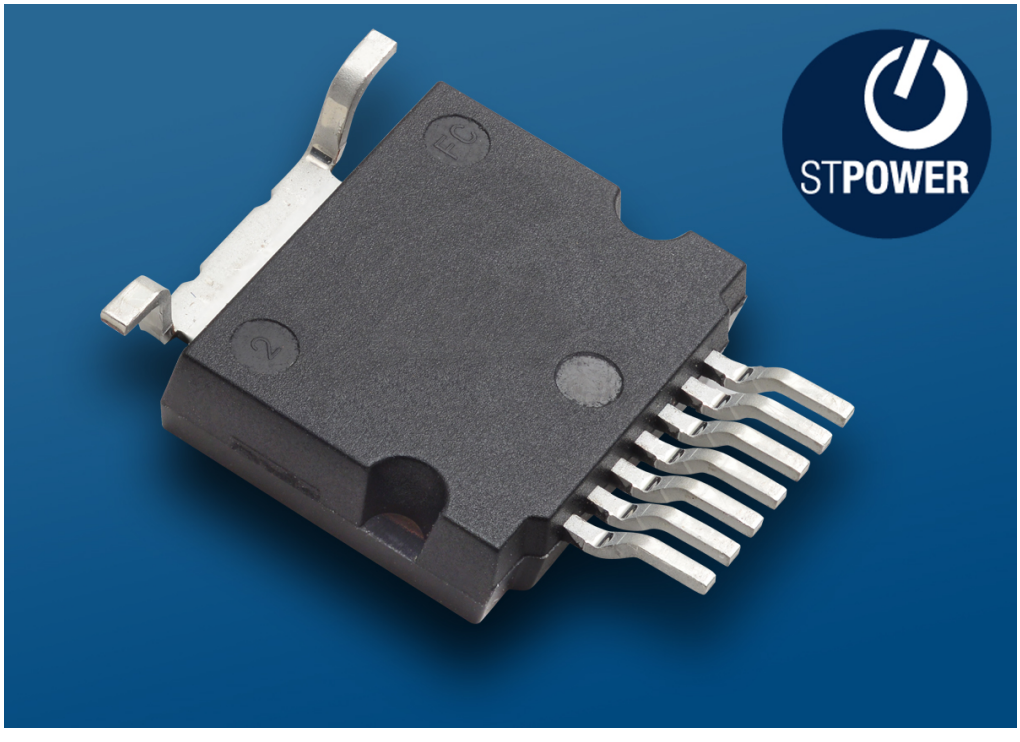
Automotive high-voltage rectifier gives high performance in bridge applications

The STMicroelectronics STBR3012L2Y-TR rectifier features ultra-low conduction losses and a low forward voltage drop, to give high efficiency in power-converter circuits.



FEATURES

- Ultra-low reverse losses
- 175°C maximum junction temperature
- 30 A maximum average forward current
- 10 µA reverse leakage current
- PPAP capable

APPLICATIONS

- Automotive power systems
- Electric vehicle on-board chargers

The STBR3012L2Y-TR rectifier from STMicroelectronics offers consistently reproducible characteristics and is intrinsically rugged, making it ideal for heavy-duty applications which call for long-term reliability, including automotive power systems.

Thanks to the ultra-low conduction losses, the AEC-Q101-qualified STBR3012L2Y-TR is especially well suited to use as an input bridge diode in battery chargers. Forward voltage drop is 0.95 V at a forward current of 30 A and a junction temperature of 150°C.

The rectifier's maximum repetitive peak reverse-voltage value of 1,200 V is guaranteed across an operating-temperature range of -40°C to 175°C.

New solid-state relays offer high reliability in industrial applications

The new SRP1 family of solid-state relays from Littelfuse provides a long-lived alternative to traditional electro-mechanical relays, thanks to the absence of moving parts. Suitable for high-current circuits up to 50 A.

Littelfuse

FEATURES

- Zero-voltage and instantaneous (random) turn-on options
- IP20 finger-safe protection
- Over-voltage protection

APPLICATIONS

- Industrial automation
- HVAC units
- Food and beverage equipment:
  - Industrial ovens
  - Coffee machines
  - Warming trays
  - Warming displays

Littelfuse has announced the release of the SRP1 family of solid-state relays (SSRs), which provide a reliable and durable isolated switching function in industrial and commercial machinery applications.

The SRP1 SSRs are available in five configurations:

- SRP1-CR: All-in-one SSRs with touch-safe and over-voltage protection
- SRP1-CB: Basic SSRs for design flexibility
- SRP1-CB...F: Quick-connect terminals for fast installation
- SRP1-CE: Basic SSRs for simple heating applications
- SRP1-CC: Ideal for dc voltage load applications

At the heart of the SRP1 SSRs is a proprietary, enhanced power component designed by Littelfuse. This tailor-made component provides optimal performance even under harsh conditions, ensuring higher reliability and a longer lifespan. Highly resistant to heat degradation, the Littelfuse power component substantially reduces the risk of failure, minimizing downtime and improving productivity in machinery and applications. The SRP1 relays are rated for up to 750,000 life stress cycles, three times more than competing devices.

Across the SRP1 family, current ratings range from 10 A to 50 A at low or high voltage. Relays are available with either ac or dc control. Compliance with international standards ensures that the SSRs have undergone rigorous testing, assuring OEMs of the safety and quality.

Video link
Introduction to the SRP1 relay family

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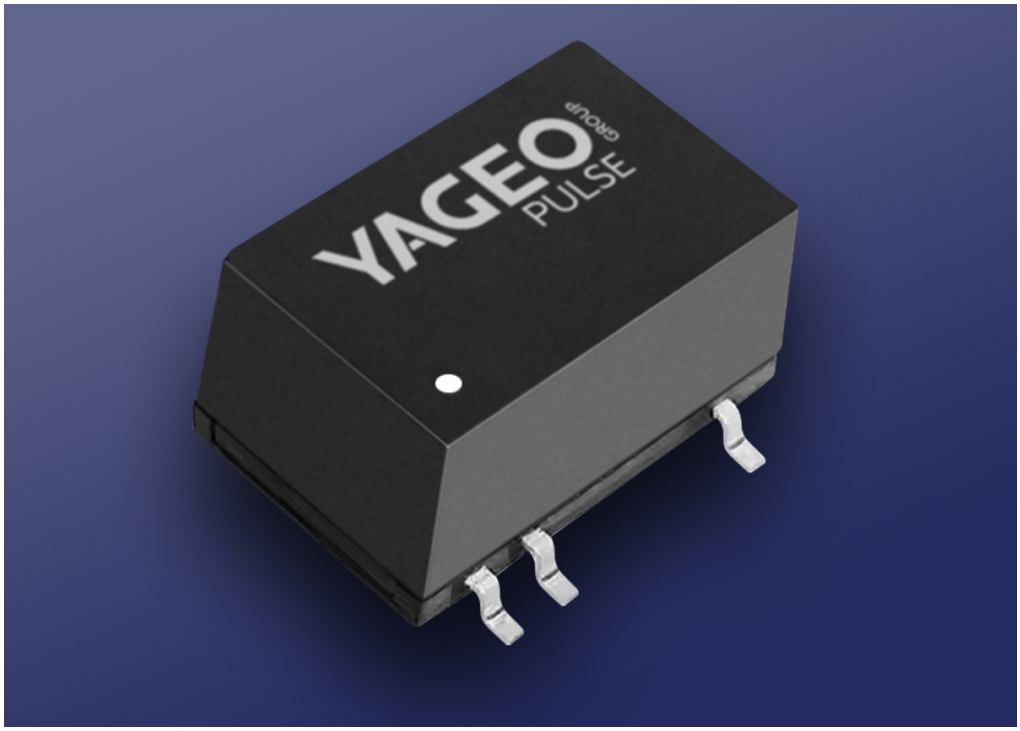
1 W dc-dc converter modules provide up to 3 kV of isolation

The SA1 series of surface-mount power modules from YAGEO provides a wide range of options for both input and output voltage.



YAGEO GROUP PULSE

FEATURES

- IEC/EN 62368-1 approved
- Low ripple and noise
- Thermal shutdown protection

APPLICATIONS

- Industrial equipment

YAGEO supplies a broad range of SA1 dc-dc converter modules with a 1 W maximum power output which provide 1 kV or 3 kV dc of isolation.

Across 28 parts in the SA1 series, YAGEO provides options for the input-voltage rating of 3.3 V, 5 V, 12 V, 15 V, and 24 V. Fixed single output-voltage options are 3.3 V, 5 V, 9 V, 12 V, 15 V, and 24 V. Dual output-voltage options are ±3.3 V, ±5 V, ±9 V, ±12 V, and ±15 V.

Operating over a temperature range of -40°C to 85°C with no heat-sink required, the surface-mount SA1 modules achieve conversion efficiency of up to 83%.

DATASHEET

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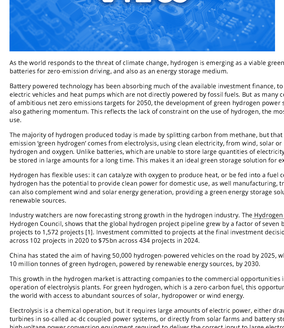
Making green energy a reality: How new electronic component technology supports the growth of the global hydrogen industry

By Steve Albuquerque
Asia Region Business Development Manager for EnerTy Innovation, Future Electronics

Read this to find out about:

- The forecast rate of growth in the hydrogen fuel market, and the trends driving growth in demand for electrolysis equipment
- The features of the main power topologies used in ac-dc coupled and dc-dc coupled electrolyzers
- New products and technologies from power component manufacturers which are enabling substantial improvements in the efficiency and cost of new electrolyzer plants



FUTURE ELECTRONICS
A WT Microelectronics Company

As the world responds to the threat of climate change, hydrogen is emerging as a viable green energy source, both to complement batteries for zero-emission driving, and also as an energy storage medium.

Battery powered technology has been absorbing much of the available investment finance, to enable a shift to products such as electric vehicles and heat pumps which are not directly powered by fossil fuels. But as many countries work towards the achievement of ambitious net zero emissions targets for 2050, the development of green hydrogen power systems and hydrogen fuel supplies is also gathering momentum. This reflects the lack of constraint on the use of hydrogen, the most abundant element available for human use.

The majority of hydrogen produced today is made by splitting carbon from methane, but that produces carbon emissions. Zero-emission 'green hydrogen' comes from electrolysis, using clean electricity, from wind, solar or hydro sources, to split water into hydrogen and oxygen. Unlike batteries, which are unable to store large quantities of electricity for an extended period, hydrogen can be stored in large amounts for a long time. This makes it an ideal green storage solution for excess renewable energy.

Hydrogen has flexible uses: it can catalyze with oxygen to produce heat, or be fed into a fuel cell to make electricity. In a fuel cell, hydrogen has the potential to provide clean power for domestic use, as well manufacturing, transportation, and more. Hydrogen fuel can also complement wind and solar energy generation, providing a green energy storage solution to balance the intermittency of the renewable sources.

Industry watchers are now forecasting strong growth in the hydrogen industry. The Hydrogen Insights 2024 report, published by the Hydrogen Council, shows that the global hydrogen project pipeline grew by a factor of seven between 2020 and May 2024, from 228 projects to 1,572 projects [1]. Investment committed to projects at the final-investment decision stage also grew from around $10bn across 102 projects in 2020 to $75bn across 434 projects in 2024.

China has stated the aim of having 50,000 hydrogen powered vehicles on the road by 2025, while the European Union aims to produce 10 million tonnes of green hydrogen, powered by renewable energy sources, by 2030.

This growth in the hydrogen market is attracting companies to the commercial opportunities in the manufacturing, installation and operation of electrolysis plants. For green hydrogen, which is a zero carbon fuel, this opportunity is particularly appealing in parts of the world with access to abundant sources of solar, hydropower or wind energy.

Electrolysis is a chemical operation, but it requires large amounts of electric power, either drawn from the grid or directly from wind turbines in so-called ac-dc coupled power systems, or directly from solar farms and battery storage in dc-dc coupled systems. The high voltage power conversion equipment required to deliver the correct input to large electrolysis plants consuming megawatts of power has traditionally been the domain of a few global giant manufacturers such as ABB, Siemens and Schneider Electric. The growth in demand for electrolysis plants is opening up opportunities not only for these incumbents but also for smaller companies which have expertise in high-voltage power equipment manufacturing.

In the high voltage equipment market, established and new suppliers will be judged by customers, the hydrolysis plant operators, on four crucial criteria:

- Power quality
- Efficiency
- Reliability
- Cost

This creates an opening for electronic component manufacturers to advance their position by providing products which help equipment manufacturers to improve products on any one or more of these criteria. This is leading to a new wave of innovation at component level.

Drive to improve efficiency and lower cost of hydrolysis

The basic process of hydrolysis is the same, whether it is implemented in a small-scale local production facility, such as a roadside hydrogen refueling station consuming less than 500 kW, or a bulk hydrogen manufacturing plant potentially consuming 20 MW or more. A single electrolysis cell, which separates water into hydrogen and oxygen, operates at a forward voltage of around 1.8 V to 1.9 V, depending on the temperature and the chemical additives used to enhance the electrolyte.

Current densities in the electrolyte range up to 0.5 A/cm^2. A direct current of 1,000 A can drive a cell with an area of 2,000 cm^2, generating roughly 1 kg of gaseous hydrogen per day [2].

Given that this basic chemical process has been well understood for many years, where is the scope to achieve future cost reductions and efficiency improvements? Currently, the cost of hydrogen produced via electrolysis ranges from $4 to $7 per kilogram, depending on the electricity price and electrolyzer efficiency. The US Department of Energy (DoE) has set a goal for this cost to fall to $2 per kilogram by 2025, and $1 per kilogram by 2030.

Achieving these cost reduction targets will require substantial improvements in electrolyzer efficiency as well as improved economies of scale resulting from the large-scale deployment of electrolysis plants.

Some of the efficiency gains for electrolysis plants will have to come from more efficient power conversion systems. And this is sharpening the industry's focus on the improved component offerings from the main suppliers to high-voltage equipment manufacturers, such as Infineon and Littelfuse.

Ac-dc coupled systems: battle between thyristors and IGBT switches

For instance, in ac-dc coupled power systems, electrolysis plants adopt a range of configurations of the power conversion system, shown in Figure 1), typically based on either a diode/thyristor rectifier topology, or an IGBT based active front end (AFE) topology. AFE rectifiers can be operated at unity power factor, and produce total harmonic distortion (THD) of less than 5%.

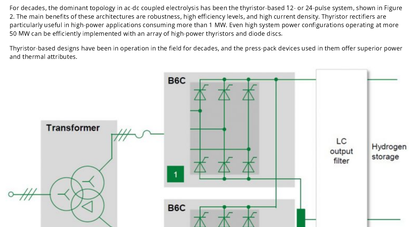


Fig. 1: Typical hydrolyser plant configurations in ac-dc coupled settings. (Image credit: Infineon)

For decades, the dominant topology in ac-dc coupled electrolysis has been the thyristor-based 12- or 24-pulse system, shown in Figure 2. The main benefits of these architectures are robustness, high efficiency levels, and high current density. Thyristor rectifiers are particularly useful in high power applications consuming more than 1 MW. Even high system power configurations operating at more 50 MW can be efficiently implemented with an array of high-power thyristors and diode discs.

Thyristor-based designs have been in operation in the field for decades, and the press-pack devices used in them offer superior power and thermal attributes.

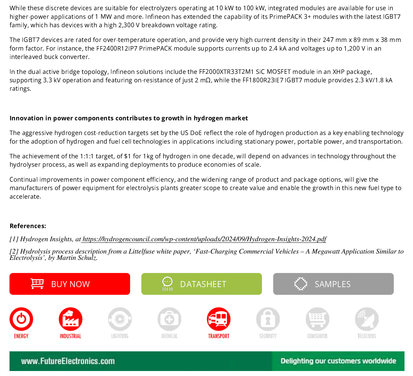


Fig. 2: A thyristor-controlled B12C rectifier driven by a dedicated transformer. (Image credit: Littelfuse)

In some industrial electrolyzers, the current flowing through the rectifier can be in a range between 1.5 kA and 2.0 kA. For such high-power systems, both Littelfuse and Infineon offer integrated power solutions called power stacks, power blocks and power discs. Littelfuse offers the N1781NC200 phase-controlled thyristor capsule for up to 2.0 kA applications.

For high-voltage electrolyzers, Infineon supplies a component choice for any choice of topology. This includes AFE rectifiers, which can use its TRENCHSTOP™ 7 IGBT technology and/or CoolSiC™ silicon carbide (SiC) MOSFETs at lower power levels up to 100 kW, and IGBT-based PrimePACK™ modules at up to 5 MW.

Thyristor vs IGBT: the pros and cons

Efficiency: IGBT systems offer higher energy efficiency than thyristor rectifiers. In green hydrogen electrolysis, in which it is important to maximize efficiency, IGBTs can minimize energy loss during power conversion.

Current and voltage handling: thyristor rectifiers are more suitable for large-scale hydrogen electrolysis plants as they can handle higher currents and voltages. Although IGBTs are efficient, thyristors excel at managing high power levels, making them ideal for extensive hydrogen production systems.

Control and precision: IGBTs provide more power control and precision than thyristors. IGBT systems also provide greater flexibility in the control of voltage and current, ensuring the smooth and efficient operation of hydrogen electrolysis equipment.

Installation and maintenance: IGBT systems are typically smaller and easier to install than thyristor rectifiers. However, thyristors offer excellent durability and require less maintenance, making them a cost-effective option for large-scale industrial hydrogen production plants.

Both IGBT-based and thyristor rectifier-based topologies play a role in optimizing the efficiency and performance of green hydrogen electrolysis systems. Understanding the advantages of each technology can help the manufacturer to choose the correct option for hydrogen production requirements.

Dc-dc coupled systems: wide bandgap innovation

In dc dc coupled systems powered by solar energy and/or batteries, typical topologies used for power conversion in hydrolysers are:

- Interleaved buck
- Dual active bridge, shown in Figure 3

Fig. 3: Topologies for conversion in hydrolyser dc-dc coupled conversion systems. (Image credit: Infineon)

Here too, component innovation is helping to power equipment manufacturers to meet the market need for higher efficiency and reliability at lower system cost. For instance, Infineon is enabling manufacturers to take advantage of the superior electrical and thermal attributes of SiC MOSFETs with a new CoolSiC FET series which offers a breakdown voltage rating of up to 2,000 V.

Supplied in an HCC package with 14 mm creepage and 5.5 mm clearance distances, the IMYH200Rxxx M1H MOSFETs are available with on-resistance as low as 12 mΩ. Use of these MOSFETs in electrolysis gives benefits including:

- Low conduction and switching losses
- Low reverse-recovery loss
- Excellent thermal performance
- Robust body diode for hard commutation

While these discrete devices are suitable for electrolyzers operating at 10 kW to 100 kW, integrated modules are available for use in higher power applications of 1 MW and more. Infineon has extended the capability of its PrimePACK 3+ modules with the latest IGBT7 family, which has devices with a high 2,300 V breakdown voltage rating.

The IGBT7 devices are rated for over-temperature operation, and provide very high current density in their 247 mm x 89 mm x 38 mm form factor. For instance, the FF2400R12IP7 PrimePACK module supports currents up to 2.4 kA and voltages up to 1,200 V in an interleaved buck converter.

In the dual active bridge topology, Infineon solutions include the FF2000XTR33T2M1 SiC MOSFET module in an XHP package, supporting 3.3 kV operation and featuring on-resistance of just 2 mΩ, while the FF1800R23IE7 IGBT7 module provides 2.3 kV/1.8 kA ratings.

Innovation in power components contributes to growth in hydrogen market

The aggressive hydrogen cost reduction targets set by the US DoE reflect the role of hydrogen production as a key enabling technology for the adoption of hydrogen and fuel cell technologies in applications including stationary power, portable power, and transportation.

The achievement of the 1:1:1 target, of $1 for 1kg of hydrogen in one decade, will depend on advances in technology throughout the hydrolyser process, as well as expanding deployments to produce economies of scale.

Continual improvements in power component efficiency, and the widening range of product and package options, will give the manufacturers of power equipment for electrolysis plants greater scope to create value and enable the growth in this new fuel type to accelerate.

References:

[1] Hydrogen Insights, at https://hydrogencouncil.com/wp-content/uploads/2024/09/Hydrogen-Insights-2024.pdf

[2] Hydrolysis process description from a Littelfuse white paper, 'Fast-Charging Commercial Vehicles – A Megawatt Application Similar to Electrolysis', by Martin Schulz.