

**NPIs, DESIGN
AND TECHNOLOGY NEWS**

23-iv Motor Control



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Three-phase 600 V driver with embedded controller offers ready-made solution for BLDC motors

STSPIN32F0601 from STMicroelectronics combines an MCU for running popular motor-control algorithms with three-phase gate-drive circuit in a single package, helping simplify board designs and accelerate BLDC motor development.



life.augmented

FEATURES

- Low-power standby mode
- Matched propagation delay for all channels
- Integrated bootstrap diodes
- On-chip debug support
- Operating-temperature range: -40°C to 125°C

APPLICATIONS

- Corded power tools
- Motor drives
- Pumps
- Fans
- Compressors

The STSPIN32F0601 from STMicroelectronics is a 600 V-rated motor drive solution for brushless dc (BLDC) motors operating from a 250 V ac mains power supply. The device combines three-phase gate drivers and an STM32F0 Arm® Cortex®-M0 microcontroller in a single 10 mm x 10 mm TQFP package.

Providing a simple and highly integrated solution for the implementation of high-voltage BLDC motor-drive designs, the STSPIN32F0601 is supplied with popular control algorithms and application examples. This embedded software includes single- and three-shunt field-oriented control (FOC) schemes, as well as traditional sensed single-shunt and six-step sensorless control.

The gate drivers integrate zero-drop bootstrap diodes and protection circuitry, including cross-conduction prevention and dead-time insertion. In addition, under-voltage lock-out protection on both the low- and high-side driving sections prevents the power switches from operating in low-efficiency or dangerous conditions. There is also a patented fast-acting smart shutdown function for overload and over-current protection.

The integrated 48 MHz STM32F0 MCU gives designers the freedom to use the rich STM32 development ecosystem when building applications. The MCU features 4 kbytes of SRAM, and 32 kbytes of Flash memory for data and code storage. The STSPIN32F0601 analog and digital peripherals include a 12-bit ADC with up to ten channels, six general-purpose timers, 21 general-purpose I/O pins, and I2C, UART and SPI ports.

An integrated bootloader provides for flexible device lifecycle management, allowing firmware updates to be applied in the field.

The STSPIN32F0601 is pin-compatible with the ST 250 V-rated STSPIN32F0251 and STSPIN32F0252, allowing hardware and firmware to be re-used in products for operation on either 110 V or 250 V ac mains supplies.

FREE DEV BOARD

Evaluation board for integrated BLDC motor driver.

Orderable Part Number
EVSPIN32F0601S3

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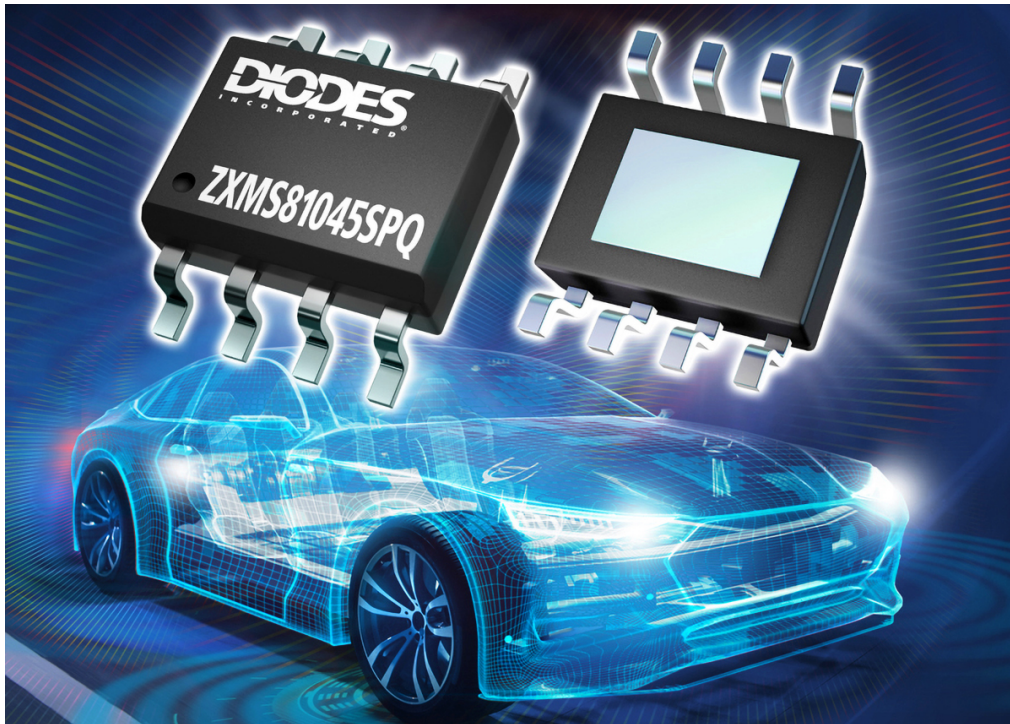
CONSUMER



TELECOMS

Intelligent high-side 41 V power switch enhances automotive system reliability

The ZXMS81045SPQ from Diodes Incorporated is suitable for driving automotive 12 V loads while providing a range of protection functions, offering a reliable and smaller alternative to relays, fuses and discrete circuits.



DIODES
INCORPORATED

FEATURES

- 45 mΩ maximum on-resistance at 25°C
- AEC-Q100 qualified
- PPAP capable
- Manufactured in IATF 16949-certified facilities
- Compact SO-8EP package

APPLICATIONS

- Automotive systems:
 - LED lighting
 - Bulbs
 - Actuators
 - Motors

Diodes Incorporated has introduced the DIODES™ ZXMS81045SPQ, a high-side IntelliFET™ power switch that can drive 12 V automotive loads while providing a range of protection and diagnostic capabilities.

Integrating protection into the power switch, the ZXMS81045SPQ provides an efficient, reliable, and smaller alternative to relays, fuses, and discrete circuits in automotive body control and lighting applications.

The ZXMS81045SPQ combines a 41 V-rated N-channel FET with circuitry that provides protection against short circuits, manages inrush currents, and safeguards against over-voltage conditions including load dumps. In addition, this intelligent switch features over-temperature protection with auto-restart, plus protection against ESD strikes. Protection against loss of ground and reverse polarity can also be implemented with the aid of a few external components.

A dedicated Current Sense pin provides precision analog current monitoring of the output and produces a fault indication in the event of a short to battery, short to ground or open load.

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TELECOMS

Three-phase mains filters give excellent attenuation of EMI noise

Space-saving FMBC EP and FMBD EP double-stage filters from SCHURTER feature new safety design for compliance with the IEC 60204-1 safety standard applied to electronics equipment.



SCHURTER
ELECTRONIC COMPONENTS

FEATURES

- IP20 protection rating
- Operating-temperature range: -40°C to 100°C
- More than 200,000 hours mean time before failure according to MIL-HB-217 F
- Screw terminal for safe termination of wiring

APPLICATIONS

- Industrial automation
- Stepper motor drives
- Industrial machines
- Frequency inverters
- Uninterruptible power supplies
- Electric vehicle charging stations
- Energy storage systems

SCHURTER has expanded its successful FMBC EP and FMBD EP families of three-phase filters, introducing new variants for machine applications. The new filters meet the requirements of the machine safety specifications set by the IEC 60204-1 harmonizing standard. They are suitable for three-phase or three-phase-with-neutral conductor applications at rated currents from 16 A to 230 A.

The FMBC EP and FMBD EP dual-stage block filters have a small footprint, and offer excellent noise attenuation in industrial and energy applications such as electric vehicle fast-charging stations and energy storage systems. The filters feature high-quality components including large film capacitors, and chokes with highly permeable cores, making them suitable for industrial applications that generate high EMI emissions.

To meet the requirements of IEC 60204-1, the filters contain capacitors that have a short discharge time: residual voltage is less than 60 V within a maximum of 2 seconds after disconnection. The use of larger resistors has increased the insulation value between phases and ground to at least 1 MΩ.

All family members have ENEC and cURus approvals and are recommended for applications up to 760 V ac. The standard variants are designed for industrial applications with leakage currents of less than 10 mA. Special variants with leakage current of less than 3 mA are also available.

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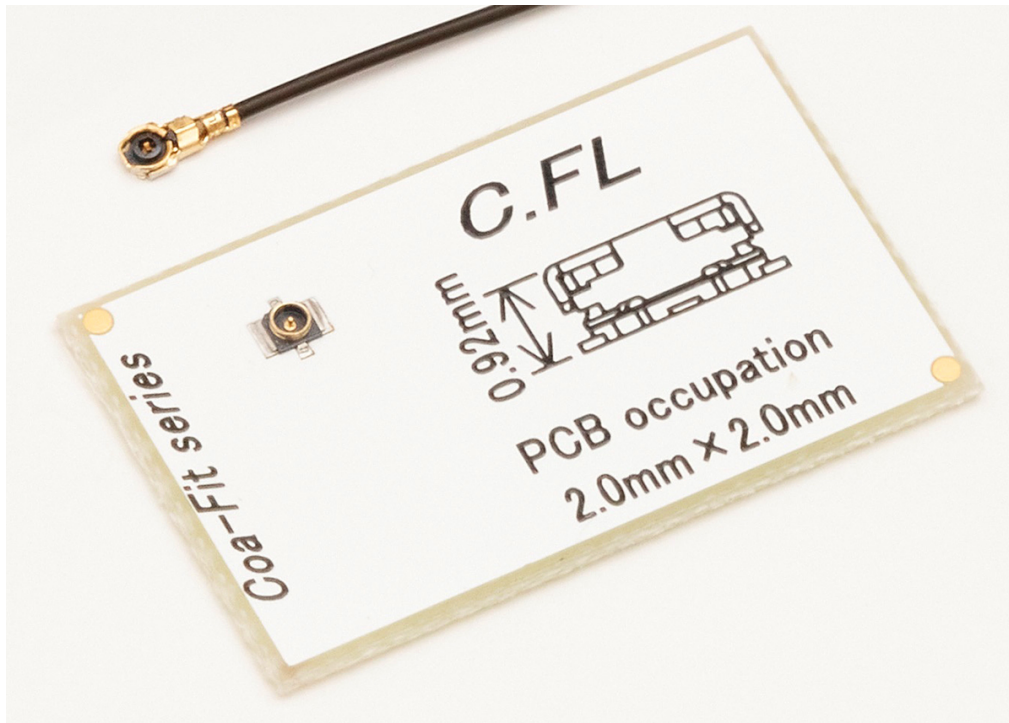
CONSUMER



TELECOMS

Coaxial connector saves space in 5G mobile applications

C.FL series connectors from Hirose, which support signal transmission at frequencies up to 30 GHz, have a mated height of less than 1 mm and a board footprint of 4mm².



Hirose has introduced the C.FL series of miniature connectors that support 30 GHz signal transmission, suitable for 5G mobile telephone equipment.

While typical 3G and 4G connectors offer limited frequency bandwidth, the Hirose C.FL connectors meet all the requirements of 5G networks, including for millimeter wave signals. They offer low reflection loss and insertion loss, and provide the capabilities required for future mobile networking applications.

The C.FL series connectors are ideal for space-constrained applications: board mounting area is 2 mm x 2 mm, and the connector has a mated height of 0.92 mm. The frequency characteristics of the connector have been enhanced by reducing the dimension of the male receptacle contact, and optimizing the internal design of the plug.

The connector's flexible cable, which has a diameter of 0.64 mm, is easy to route inside devices. The C.FL connectors are available in embossed packaging, which enables the plug and receptacles to be mounted automatically.

HRS HIROSE
ELECTRIC
EUROPE B.V.

FEATURES

- 50 Ω characteristic impedance
- Voltage standing-wave ratios:
 - 1.4 or less from dc to 15 GHz
 - 1.5 or less from 15 GHz to 20 GHz
 - 1.6 or less from 20 GHz to 30 GHz
- Operating-temperature range: -40°C to 90°C
- 20 mating cycles

APPLICATIONS

- Smartphones
- Notebook PCs
- Tablets
- Gaming PCs
- Wearable devices
- AI speakers
- Drones
- Robots
- AGVs
- Routers
- Wi-Fi® access points
- Customer premises equipment

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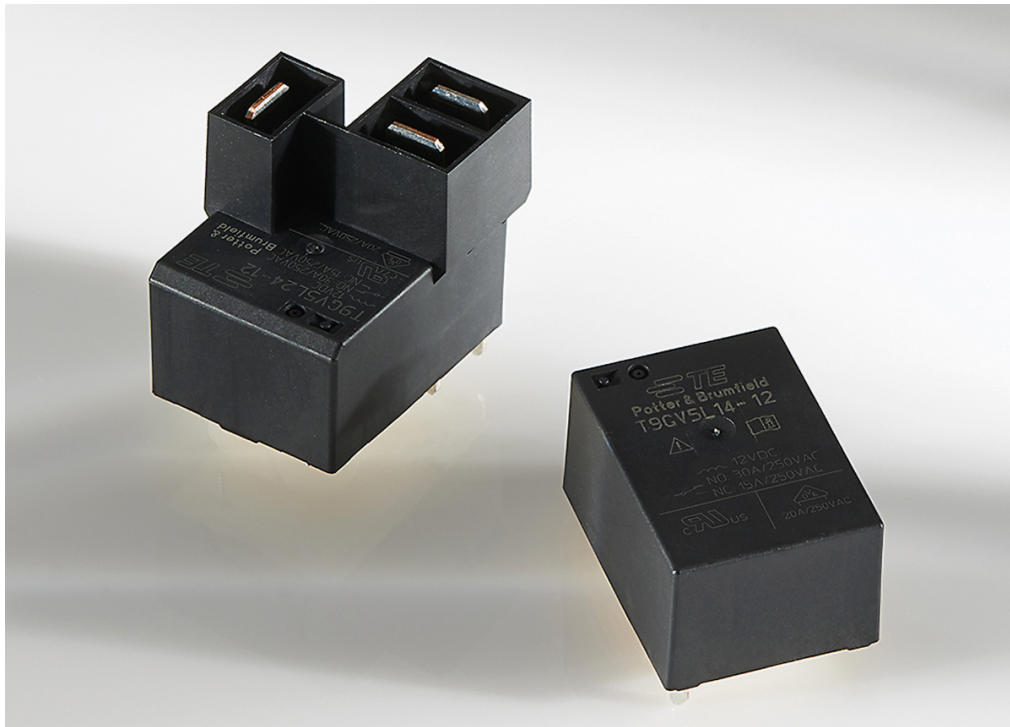
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TELECOMS

30 A PCB relay saves space in industrial equipment

The T9G series from TE Connectivity has a standard footprint, and features innovative design that maintains distance between coil and contacts in a small enclosure.



FEATURES

- Coil power-rating range: 800 mW to 1,000 mW
- Coil insulation Class F
- Coil voltage ratings: 5 V, 9 V, 12 V, 15 V, 18 V, 22 V, 24 V, 48 V, 110 V dc
- UL recognized
- VDE certified

APPLICATIONS

- Heating, ventilation and air-conditioning units
- Appliances
- Industrial control
- Energy management systems

The Potter and Brumfield T9G series products from TE Connectivity (TE), the smallest 30 A PCB relays in their class, enable industrial equipment manufacturers to fit more components on a board without compromising relay performance. The T9G relays are 30% smaller than the T9A series, and occupy 13% less board area. Despite these space savings, the T9G relays have a standard footprint.

The monostable T9G relays comply with the specifications of the IEC 61810-1 standard for reinforced insulation thanks to an innovative design that increases the distance between coil and contacts within a small package. This helps to prevent flash-over from the control circuit to the load, resulting in a safer application.

Quick-connect terminations make the relay user-friendly and easy to install.

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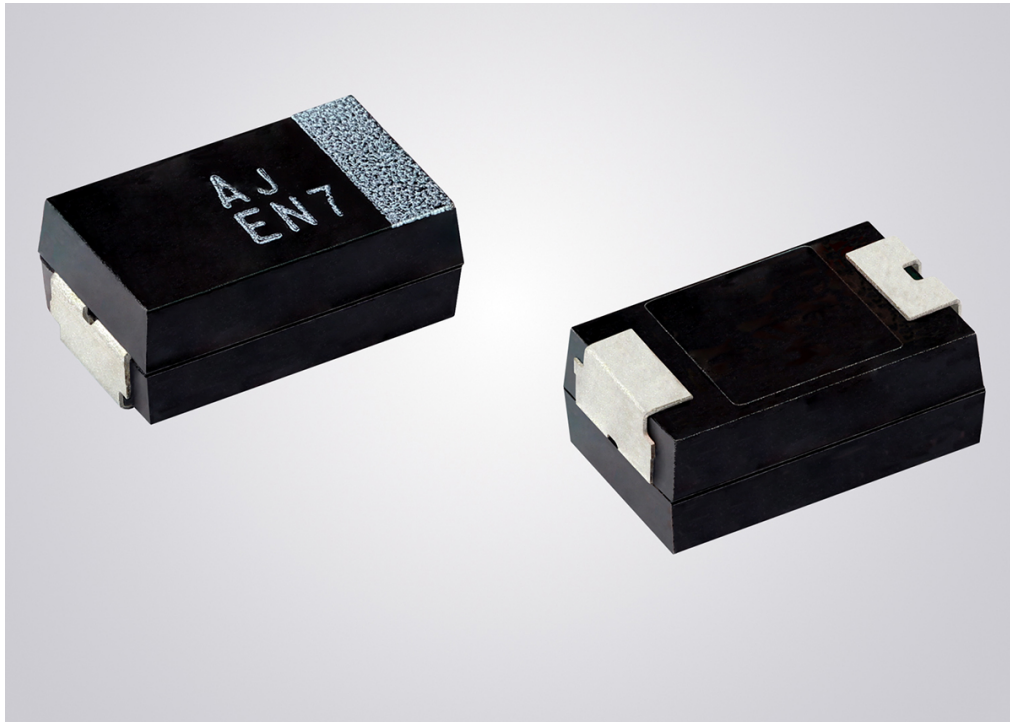
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TELECOMS

Space-saving automotive polymer tantalum chip capacitors offer low ESR

Vishay T51 series capacitors in compact D and V case sizes operate at temperatures up to 125°C, and provide a space-saving alternative to traditional tantalum and aluminum capacitors and MLCCs.



FEATURES

- AEC-Q200 qualified
- Ripple current up to 2.37 A

APPLICATIONS

- Automotive systems:
 - ADAS
 - Infotainment
 - Other in-vehicle electronic systems
- Networking equipment
- Industrial equipment

Vishay has introduced a new series of automotive-grade vPolyTan™ surface-mount polymer tantalum chip capacitors which offer improved performance at high temperatures and in high humidity.

The Vishay T51 series offers lower ESR and lower voltage derating than traditional tantalum capacitors, while offering higher capacitance values as a function of package size. These features also make the T51 series more attractive than multi-layer ceramic chip capacitors or aluminum capacitors of a similar capacitance. The T51 capacitors are ideal for decoupling, smoothing, and filtering functions in automotive switch-mode and point-of-load power supplies.

The T51 capacitors are supplied in the compact D (EIA 7343-31) and V (EIA 7343-20) case sizes, with capacitance values ranging from 6.8 µF to 330 µF over voltage ratings ranging from 2.5 V up to 35 V. Capacitance tolerance is 20%.

Featuring a highly conductive polymer cathode system, the capacitors provide low ESR of as little as 40 mΩ at 25°C.

Tolerant of harsh environments, the T51 capacitors can operate at temperatures up to 125°C, with voltage derating above 105°C. The devices are rated for a high-temperature load time of 2,000 hours.

Vishay supplies a wide range of other vPolyTan surface-mount polymer tantalum chip capacitors. These include the T55 products, which are notable for their low ESR, resulting in a lower voltage drop and better frequency response.

The T59 capacitors are available with capacitance ranging from 15 µF to 470 µF. These capacitors offer a high ripple-current capability, and stable capacitance over operating temperature, voltage, and frequency range.

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How to select power MOSFETs for battery-powered BLDC motor drives

Nexperia supplies a wide range of MOSFETs in space-saving package options. This Design Note examines the key product specifications that affect a MOSFET's performance in a low-voltage BLDC motor drive.



nexperia

Brushless dc (BLDC) motor technology is gaining adoption at a rapid pace. The power tool segment is a prime example of a market that has seen a shift from the use of small petrol engines, for chainsaws and garden equipment for instance, to efficient mains- or battery-powered BLDC motors. The convenience of portable battery-powered systems in particular has led to substantial growth in this market.

The requirements of the motor drive circuit in these battery-powered tools are very similar to those in other segments such as automation, industry 4.0 and consumer products. These applications typically use dc motors with voltage ratings in the range 4 V to 48 V, and board space is limited.

The brushless motor has grown in popularity because of its superior speed, reliability, and power compared to the traditional brushed motor. The main disadvantage of the brushless motor type is the added complexity of an electronic control module: this module requires many power MOSFETs to control a multi-phase winding, as shown Figure 1.

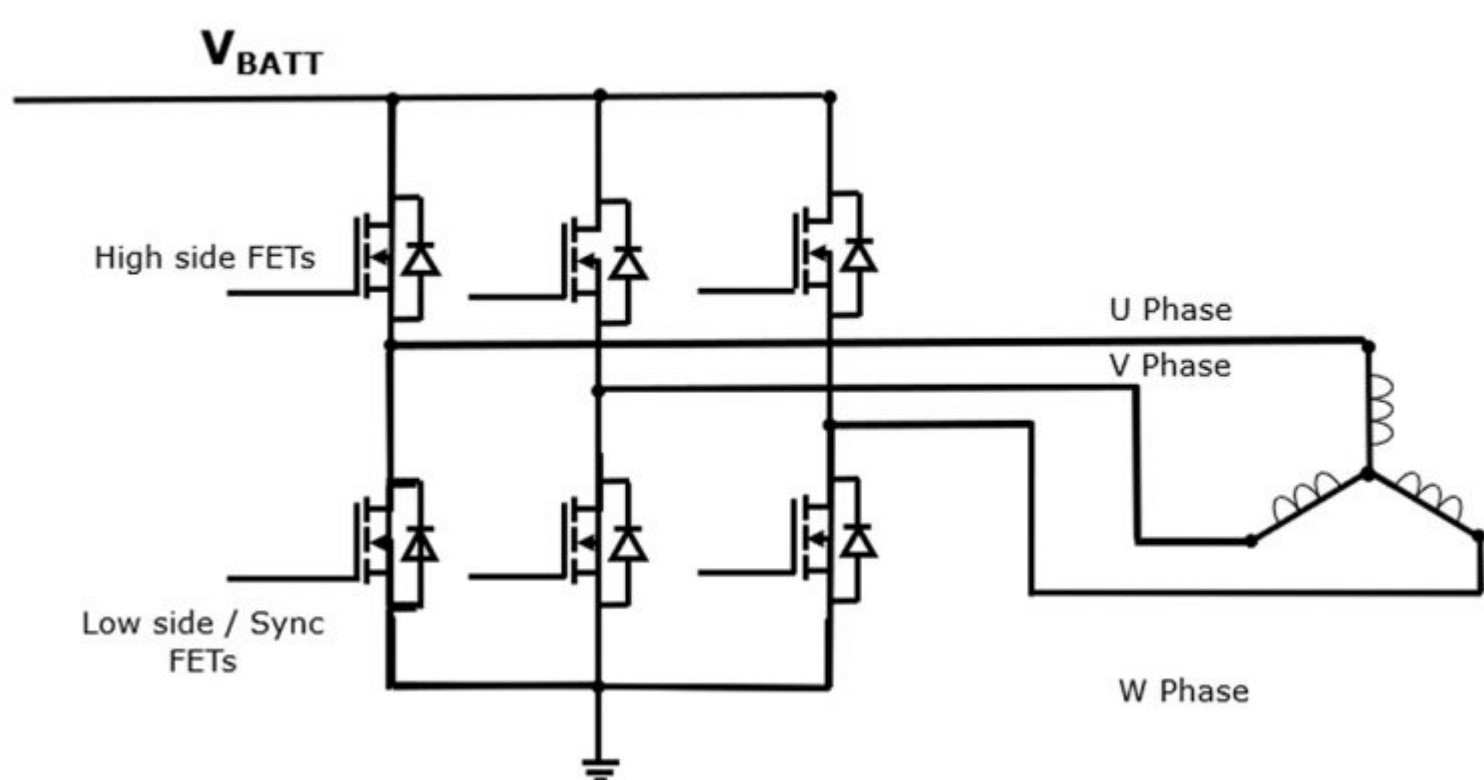


Fig. 1: Typical BLDC motor drive topology

In many of these applications, power dissipation is relatively low. This means that component selection has to consider a wide range of parameters, rather than choosing the device with the lowest on-resistance.

The most important factors affecting MOSFET performance in low-voltage BLDC motors are:

- Drain-source voltage rating
- Product of on-resistance and gate charge, which affects conduction and switching losses
- Power density, which helps to reduce circuit size in space-constrained applications such as handheld drills or cordless vacuum cleaner brush heads
- Dc current rating and pulse-current ratings, so that the MOSFET can handle peak overload and fault currents caused by events such as a locked rotor
- Low drain-source leakage current, which reduces the rate of battery discharge during long periods of inactivity
- Package and board-level reliability, which affect an application's ability to handle harsh operating conditions, such as extreme temperatures or vibration

Other factors that designers consider when evaluating options for a motor-drive MOSFET include:

- Avalanche rating: high avalanche energy can be dissipated in the MOSFET when exposed to fault currents and long wires
- Safe operating area (SOA): in fault conditions, or when trying to turn off the motor during an overload, the MOSFETs will often be pushed briefly into their linear mode, when resistance rises substantially. A MOSFET with a large SOA can withstand these conditions
- Low gate leakage: to avoid unwanted turn-off events in linear mode

Nexperia has released a range of dual-MOSFET devices housed in an LPAK56 package which save board space and give improved power density while ensuring that the performance of the MOSFET is not compromised.

For example, the Nexperia PSMN6R8-40HS in an LPAK56D, clip-bonded package features two MOSFETs, each with a maximum on-resistance of 6.8 mΩ and gate charge of 28.9 nC at a gate-source voltage of 10 V. Each MOSFET has a maximum drain current rating of 40 A, while offering good SOA current capability of 5 A at 24 V for a 1 ms pulse, shown in Figure 2.

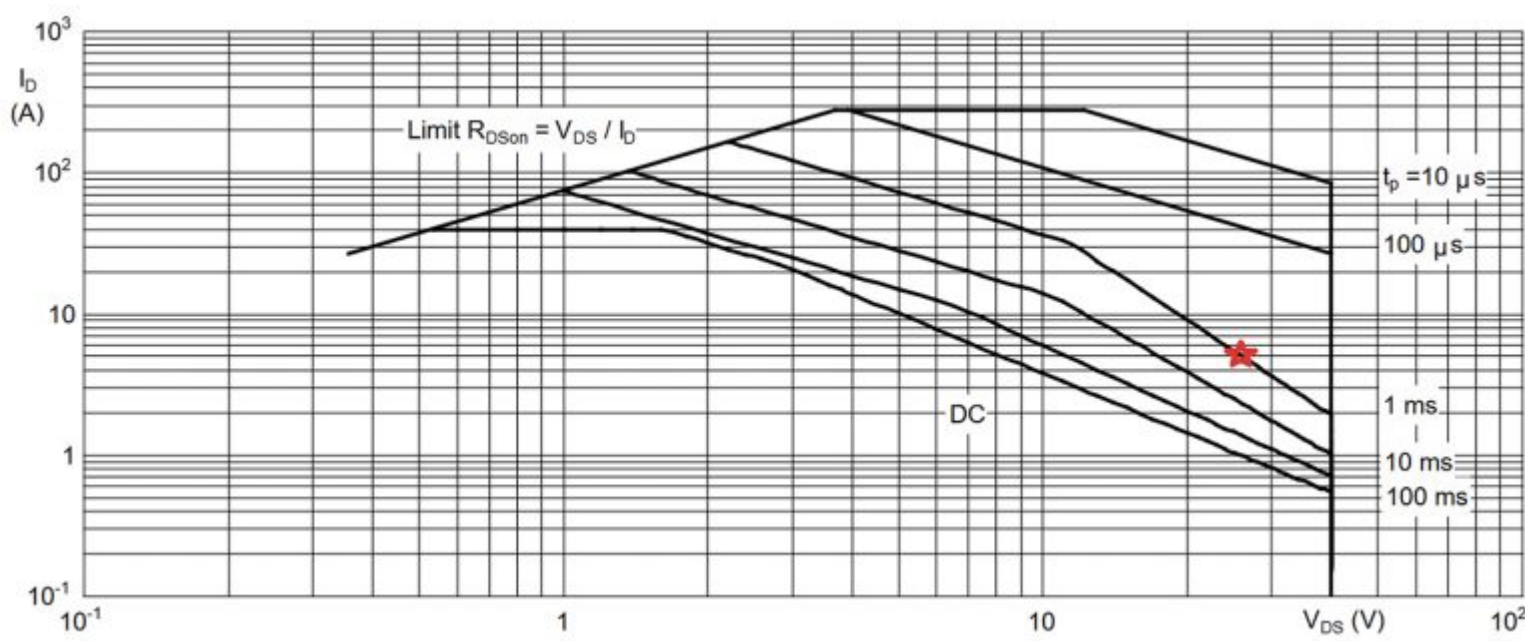


Fig. 2: 24 V/1 ms SOA plot for the PSMN6R8-40HS MOSFET

This device is repetitive avalanche-rated, and offers high performance in the other key parameters for BLDC motors. Nexperia has demonstrated the MOSFETs' reliable performance by subjecting them to high-temperature reverse-bias life testing at 175°C.

Wide range of MOSFET product options

The Nexperia MOSFETs suitable for BLDC motors are supplied in a 100% clip-bonded LPAK56D package. This package is robust, offering high board-level reliability and providing excellent thermal performance.

A selection of the parts in this portfolio is shown in Table 1.

Voltage Rating	Part Number	On-resistance at 10 V	Gate Charge at 10 V	Maximum Drain Current	Avalanche Energy	SOA Current, 1ms
40 V	PSMN6R8-40HS	6.8 mΩ	28.9 nC	40 A	130 mJ at 40 A	5 A at 24 V
60 V	PSMN9R3-60HS	9.3 mΩ	34.2 nC	40 A	103 mJ at 40 A	2.5 A at 40 V
60 V	PSMN011-60HL	11.5 mΩ	24.5 nC	35 A	118 mJ at 35 A	2.1 A at 40 V
100 V	PSMN025-100HS	24.5 mΩ	38.1 nC	29.5 A	83 mJ at 29.5 A	1.1 A at 50 V
100 V	PSMN038-100HS	37.6 mΩ	25.9 nC	21.4 A	46 mJ at 21.4A	1.1 A at 50 V

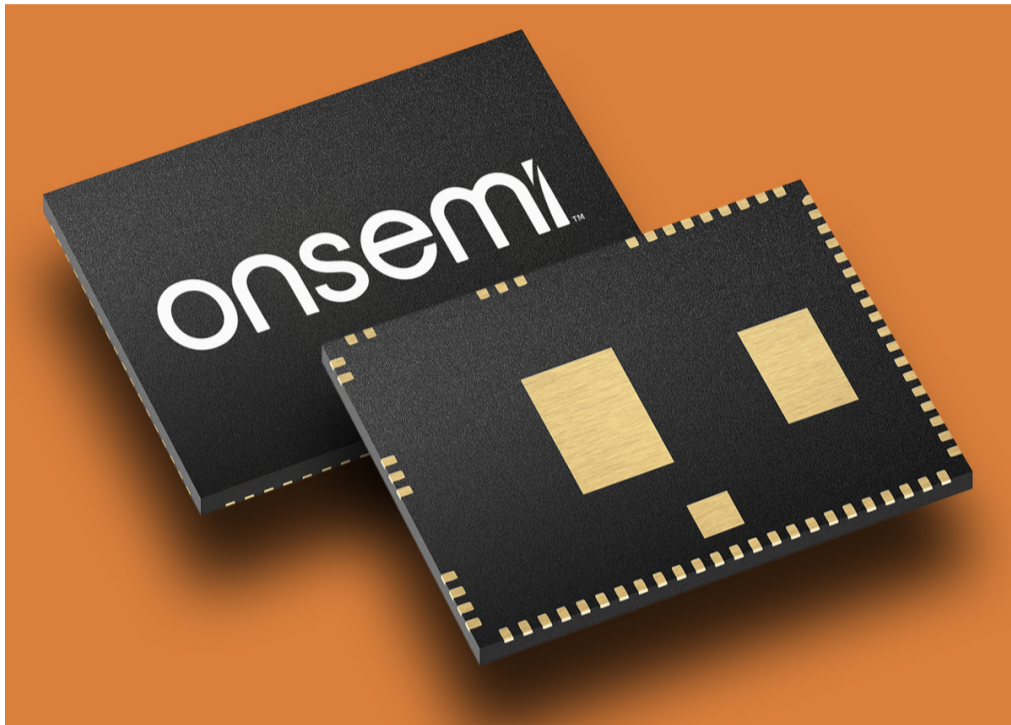
Table 1: MOSFETs in an LPAK56 package suitable for use in demanding BLDC motor applications

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Compact 600 V motor controller simplifies design of efficient BLDC systems

The onsemi ECS640A integrates three-phase gate drive circuit, feedback circuitry and a microcontroller core capable of running various motor control algorithms in a single compact package.



The ECS640A from onsemi, a 600 V motor controller, provides a single-chip system for driving and controlling three-phase brushless dc (BLDC) motors.

The first part in a new ecoSpin™ family of motor controller products, the integrated ECS640A combines an Arm® Cortex®-M0+ microcontroller core with high-performance gate drivers and feedback circuitry in a single package which has a footprint of just 10 mm x 13 mm. The device simplifies the design of embedded motor control systems, improves system reliability, and enables designers to achieve faster time-to-market.

The ECS640A system-in-package (SiP) forms the basis for scalable BLDC motor designs. Its Arm core can support various traditional motor control techniques such as trapezoidal and vector control. In addition, the ECS640A can drive a more complex direct torque and flux control (DTFC) algorithm which supports high-voltage and high-power operation via a scalable three-phase half-bridge topology with integrated protection circuits.

The ECS640A's embedded 600 V gate driver and dedicated motor control engine are able to provide the required PWM modulation signals in DTFC mode to external discrete power FETs or IGBTs, and to capture measurements of the motor's corresponding three-phase currents through an external shunt-current feedback. These three motor-current signals can be conditioned internally using the embedded operational amplifier structure, which is optimally paired to the MCU core to reduce losses.

The ECS640A motor controller provides multiple communication interfaces, including serial peripheral, UART and I2C, and GPIOs. The device offers great scope to apply complex proprietary protocols. Sensorless and sensed operation are both supported.

Use of the integrated ecoSpin ECS640A reduces time-to-market by eliminating the need to separately select and design in a microcontroller, gate driver, bootstrap diode and op amp. The motor controller also makes it simpler to reuse design IP when scaling to higher or lower BLDC motor power levels.

As a single SiP, the ECS640A offers higher reliability than a circuit based on multiple discrete devices, while also reducing PCB routing area.

onsemi

FEATURES

- Arm Cortex-M0+ core:
 - 40 MHz clock frequency
 - 8 kbytes of RAM
 - 64 kbytes of Flash memory
- FAN73896 600 V gate driver
 - 350 mA source/650 mA sink driving capability
- Four NCS20034 sense amplifiers for current sensing
- Integrated bootstrap diodes

APPLICATIONS

- Heating, ventilation and air-conditioning equipment
- Robotics
- Home appliances:
 - Refrigerators
 - Washing machines
 - Tumble dryers
 - Dishwashers
- Pumps

FREE DEV BOARD

600V BLDC Motor Control Development Kit.

Orderable Part Number
STR-ECS640A-GEVK

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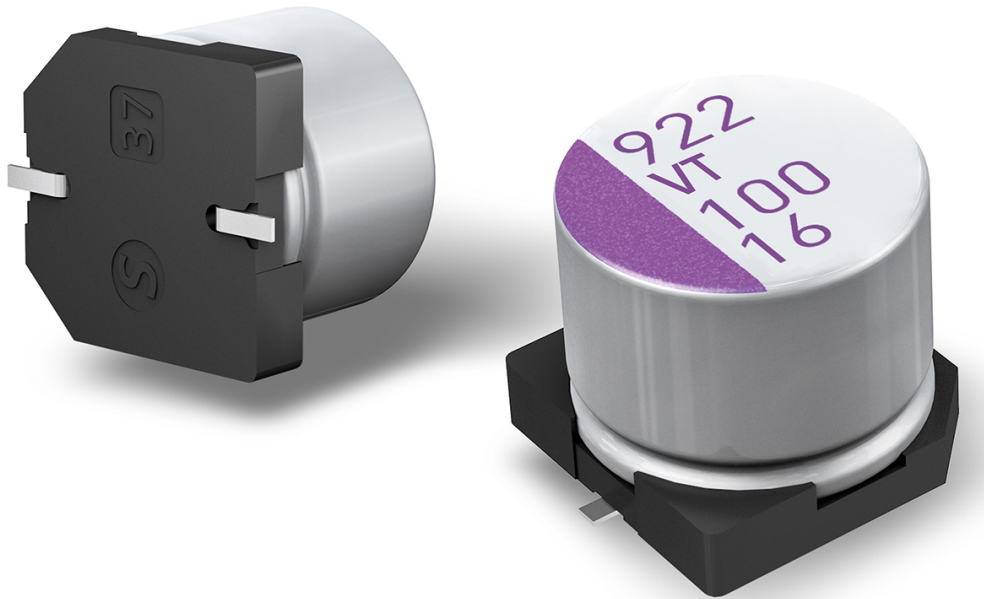
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Surface-mount capacitors offer low ESR and excellent noise reduction up to 125°C

The SVT series, part of the Panasonic OS-CON family of surface-mount conductive polymer aluminum capacitors, tolerates high-temperature operation and gives reliable operation over a long lifetime.



Panasonic INDUSTRY

FEATURES

- $\pm 20\%$ tolerance of capacitance
- 1,000 hours' damp heat endurance

APPLICATIONS

- Dc-dc converters
- Power supplies
- Servers
- Industrial PCs
- Base stations
- Motor controls
- Embedded systems

The SVT series of OS-CON™ surface-mount conductive polymer aluminum solid capacitors from Panasonic is suitable for applications such as power supplies or base stations in which low equivalent series resistance (ESR) and noise reduction are critical. The SVT series capacitors offer low ESR even at low temperatures, as well as excellent frequency characteristics.

A wide operating-temperature rating of -50°C to 125°C for up to 2,000 hours shows the robustness and long lifespan of these new capacitors, and ensures that they can be used in applications requiring high reliability.

Depending on the model, the new SVT capacitors feature a rated voltage range of 2.5 V to 16 V or 2.5 V to 50 V, and ESR ratings of 12 m Ω to 35 m Ω . Capacitance values of the SVT products range from 18 μ F up to 2,700 μ F.

OS-CON capacitors offer a combination of the lowest ESR and the highest ripple current in their class, providing a reliable, high-quality capacitor for industrial applications.



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TELECOMS

Automotive-qualified 100 V half-bridge gate driver features on-chip bootstrap diode

The MPQ1923-AEC1 from Monolithic Power Systems, a 100 V automotive-grade half-bridge gate driver for N-channel MOSFETs, features short rise and fall times to support high-frequency switching.




FEATURES

- AEC-Q100 Grade 1 qualified
- 120 V bootstrap voltage rating
- 20 ns propagation delay
- 8 A sink current and 7 A source current at 12 V
- Less than 300 μ A quiescent current

APPLICATIONS

- Motor drivers
- Telecoms power supplies
- Avionics power supplies

The MPQ1923-AEC1 from Monolithic Power Systems is a high-frequency half-bridge gate driver that provides a protected solution for driving motors, power supplies, two-switch forward converters, and active-clamp forward converters.

Featuring an integrated bootstrap diode, the MPQ1923-AEC1 reduces the external component count. The gate driver drives a 1 nF load with a rise time of 7.2 ns and a fall time of 5.5 ns at 12 V, making it suitable for use in high-frequency switching converters.

The low- and high-side N-channel MOSFET driver channels are controlled independently, and are matched with a time delay of less than 5 ns. In the event of an insufficient power supply, the under-voltage lockout protection function forces the outputs to the low- and high-side MOSFETs to low.

The MPQ1923-AEC1 is supplied in two QFN package options with ten or eight leads, both with a footprint of 4 mm x 4 mm.

FREE DEV BOARD

High-frequency half-bridge gate driver evaluation board.

Orderable Part Number

EVQ1923-RE-00A

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TELECOMS

Ultra-low power three-axis accelerometer for industrial and battery-powered applications

The STMicroelectronics IIS2DLPC offers four low-power modes which can be selected on-the-fly to adapt the accelerometer's operation to the requirements of the application.



The STMicroelectronics IIS2DLPC is a three-axis linear accelerometer which offers ultra-low power consumption in both quiescent and active operation.

The sensor has selectable full scales of $\pm 2\text{ g}/\pm 4\text{ g}/\pm 8\text{ g}/\pm 16\text{ g}$, and measures acceleration in three axes at output data rates from 1.6 Hz to 1.6 kHz. This makes it suitable for applications requiring functions such as vibration monitoring, tilt or inclination measurement, smart power saving or motion activation, or impact detection and logging.

Low power consumption means that the IIS2DLPC can be deployed in battery-powered devices such as portable medical equipment or hearing aids. Operating from a supply-voltage range of 1.62 V to 3.6 V, the sensor draws just 50 nA in power-down mode, less than 1 μA in active low-power mode, and 120 μA in high-performance mode. These modes can be changed on-the-fly, enabling the sensor to adapt to the requirements of the application.

Intelligent features of the IIS2DLPC reduce the application's requirement to call on the host processor. An internal engine processes motion and acceleration data to provide a range of built-in functions including free-fall and wake-up detection, highly configurable single-/double-tap recognition, activity/inactivity detection, stationary/motion detection, portrait/landscape detection and 6D/4D orientation.

An embedded self-test capability allows the designer to check the functioning of the sensor in the final application.



FEATURES

- Digital I2C/SPI output interface
- Up to 800 Hz bandwidth
- Minimum 90 $\mu\text{g}/\sqrt{\text{Hz}}$ noise
- 32-level FIFO buffer and two independent programmable interrupts
- Embedded temperature sensor
- Withstands 10,000 g shock

APPLICATIONS

- Industrial IoT and connected devices
- Anti-tampering devices
- Appliances
- Robots
- Industrial tools
- Factory equipment
- Portable healthcare devices
- Hearing aids

FREE DEV BOARD

IIS2DLPC adapter board for a standard DIL 24 socket.

Orderable Part Number
STEVAL-MKI191V1

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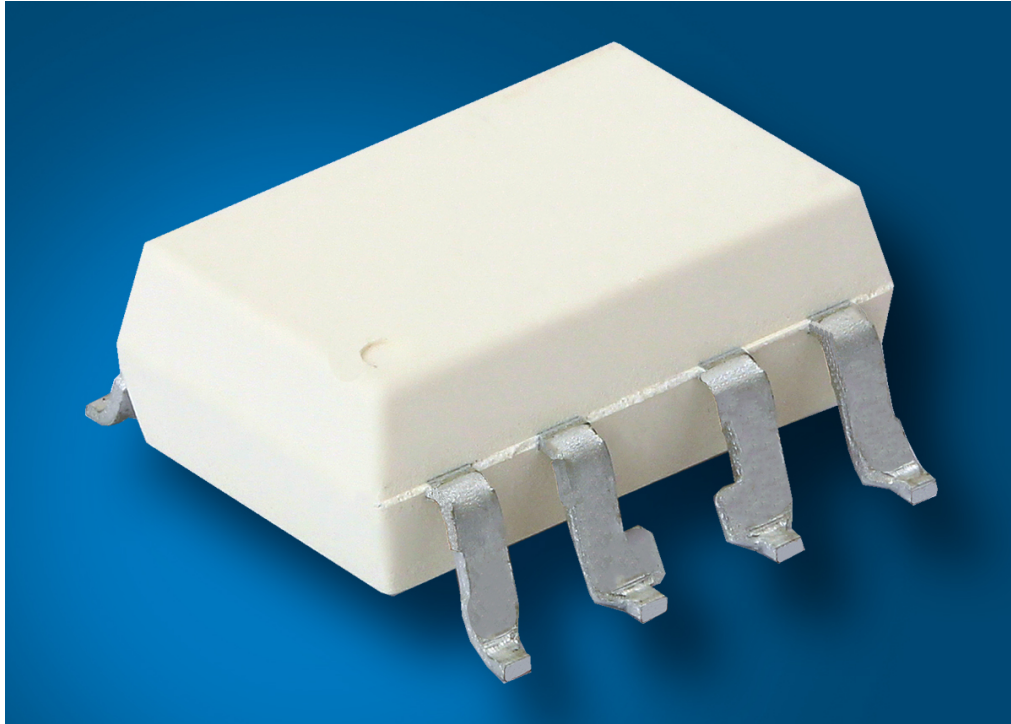
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TELECOMS

Automotive linear optocoupler offers fast response and high isolation voltage

The Vishay VOA300 ensures fast data transfer and stable gain over temperature, to provide for reliable and timely detection of power faults in electric vehicle battery systems.



FEATURES

- Reliable data transfers at a rate of 1.4 MHz
- 1 pF input-output capacitance
- 0.25% gain linearity
- 50 ppm/°C gain drift
- Less than 15 mW power consumption
- Operating-temperature range: -40°C to 125°C

APPLICATIONS

- Electric vehicles
 - On-board chargers
 - Traction inverters
 - Dc-dc converters

Vishay has introduced the industry's first AEC-Q102 qualified linear optocoupler, providing a high-performance option for galvanically isolated current and voltage measurement in electric vehicles.

Offering an industry-high isolation voltage of 5,300 Vrms, the VOA300 provides a response time five times faster than competing devices. At the same time, the optocoupler offers high transfer gain stability of 0.005%/°C, and a single-ended output for design flexibility. This output can be directly connected to an amplifier stage or an ADC.

The fast response time enables quick detection of voltage and current ripples to trigger battery cut-off mechanisms, or eFuses, which protect passengers and vehicles.

The VOA300's feedback photodiode captures a portion of the LED's flux and generates a control signal that is used to servo the LED drive current, while the photodiode produces an output signal that has a linear relation to the servo optical flux generated by the LED.

The time and temperature stability of the input-output coupler is ensured by using matched PIN photodiodes that accurately track the output flux of the LED.

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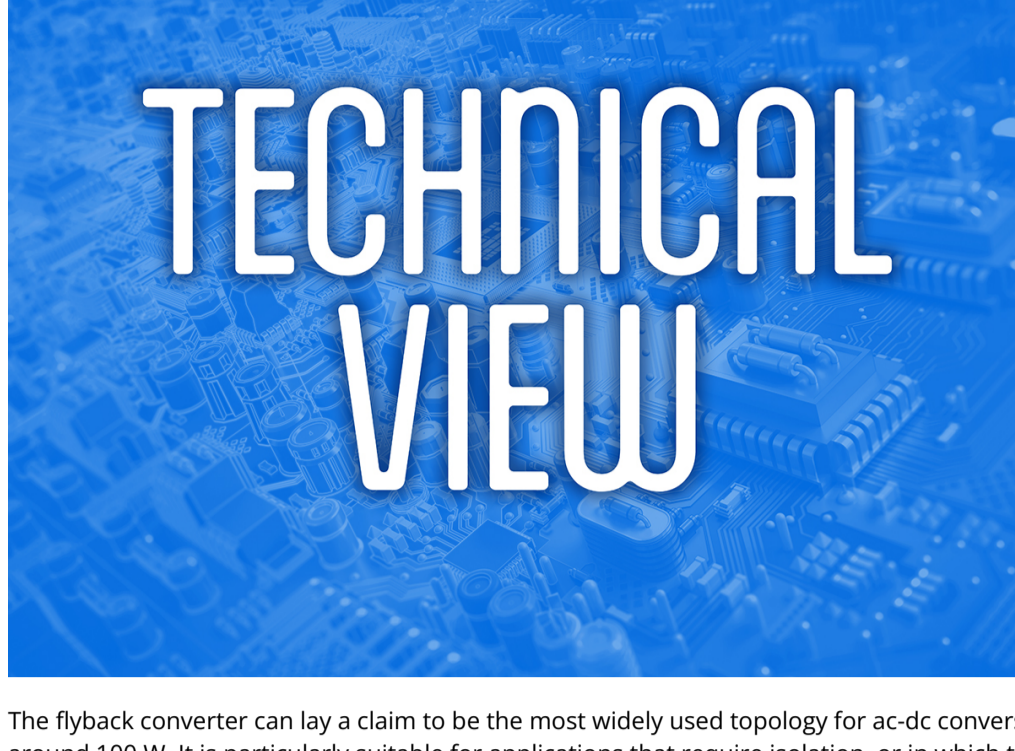
TELECOMS

Simplicity and efficiency: 1,700 V integrated flyback controllers based on SiC MOSFET technology set a new trend

By Akif Hakki Polat
Eastern Europe Analog and Power Specialist Field Application Engineer, Future Electronics

Read this to find out about:

- The drawbacks of a discrete approach to high-voltage flyback converter design
- The case for using an integrated SiC flyback controller with internal 1,700 V MOSFET
- A comparison of 1,700 V-rated integrated flyback controllers from Power Integrations and ROHM Semiconductor



The flyback converter can lay a claim to be the most widely used topology for ac-dc conversion in systems supplying a load of up to around 100 W. It is particularly suitable for applications that require isolation, or in which the input-to-output voltage ratio is high.

The flyback converter is most often used in mains-powered systems, which are covered by a universal input-voltage range of around 85 V to 265 V ac. But it is also suitable for industrial applications in which the input-voltage range can extend from 40 V to 440 V ac. The flyback converter can also be used for dc-dc conversion over a wide input-output voltage spread: in some industrial and automotive applications, the dc input voltage might be as high as 1,000 V dc. And of course the input voltage in the application affects the specification of the breakdown voltage of the power switches used in the converter.

In the past, this has limited the ability of power-system developers to take full advantage of an integrated flyback converter controller, which is simpler to design into a board layout, occupies less space and requires fewer components than a comparable discrete circuit. At lower voltages, the integrated flyback controller has often been the preferred option, but for a long time the highest breakdown-voltage ratings for the silicon MOSFET embedded in integrated controllers were in the range 800 V to 1,000 V, insufficient on its own for many very high-voltage applications.

Now the maturing of the market for MOSFETs based on the wide bandgap silicon carbide (SiC) material has made it possible to dramatically extend the voltage capability of integrated flyback controllers up to 1,700 V.

This article helps the reader to evaluate products from the two pioneering manufacturers that have led the way in the market for SiC MOSFET-enabled integrated flyback controllers.

The drawbacks of a discrete approach to high-voltage flyback converter design

In an integrated flyback controller, the control circuitry, gate driver and power switch are all housed in a single package. This streamlines the selection of components as well as simplifying the board design. The reduced board footprint compared to a discrete system is particularly helpful in designs that are subject to space constraints.

But in systems that require the power switch to provide a voltage rating above 1,000 V, designers have been forced to work around the limited breakdown-voltage capability of integrated flyback controllers.

One option is to relinquish the benefits of integration, and to use a stand-alone flyback controller with a discrete high-voltage silicon MOSFET. The other approach is to continue to use an integrated flyback controller with a voltage rating limited to the range 800 V to 1,000 V, but to reinforce its internal MOSFET with a cascode-connected external MOSFET.

The problem with the first approach is the maximum breakdown voltage of a conventional silicon MOSFET: the application for the design is limited to systems that are guaranteed to operate at lower than 1,200 V.

The second approach is not hamstrung in the same way, because the withstand voltages of the integrated and the external switch are additive. But this comes at the cost of a more complex power-system design. Figure 1 shows the schematic of a typical circuit in a cascode MOSFET configuration, based on a 60 W isolated StackFET™ flyback power supply which uses a Power Integrations InnoSwitch™ 3-EP flyback converter, part number INN3679C-H606, with a MinE-CAP™ MIN1072M bulk capacitor miniaturization and Inrush management IC.

When using the cascode configuration, proper functioning of the converter requires the designer to take great care over the board layout and component selection. What is more, the use of conventional silicon MOSFETs in such very high-voltage applications entails higher switching losses than in a circuit using a single SiC MOSFET. This is in part because of the inherent high efficiency of a SiC MOSFET. But in addition, in the cascode configuration losses are higher because the two MOSFETs in series both conduct during on-time.

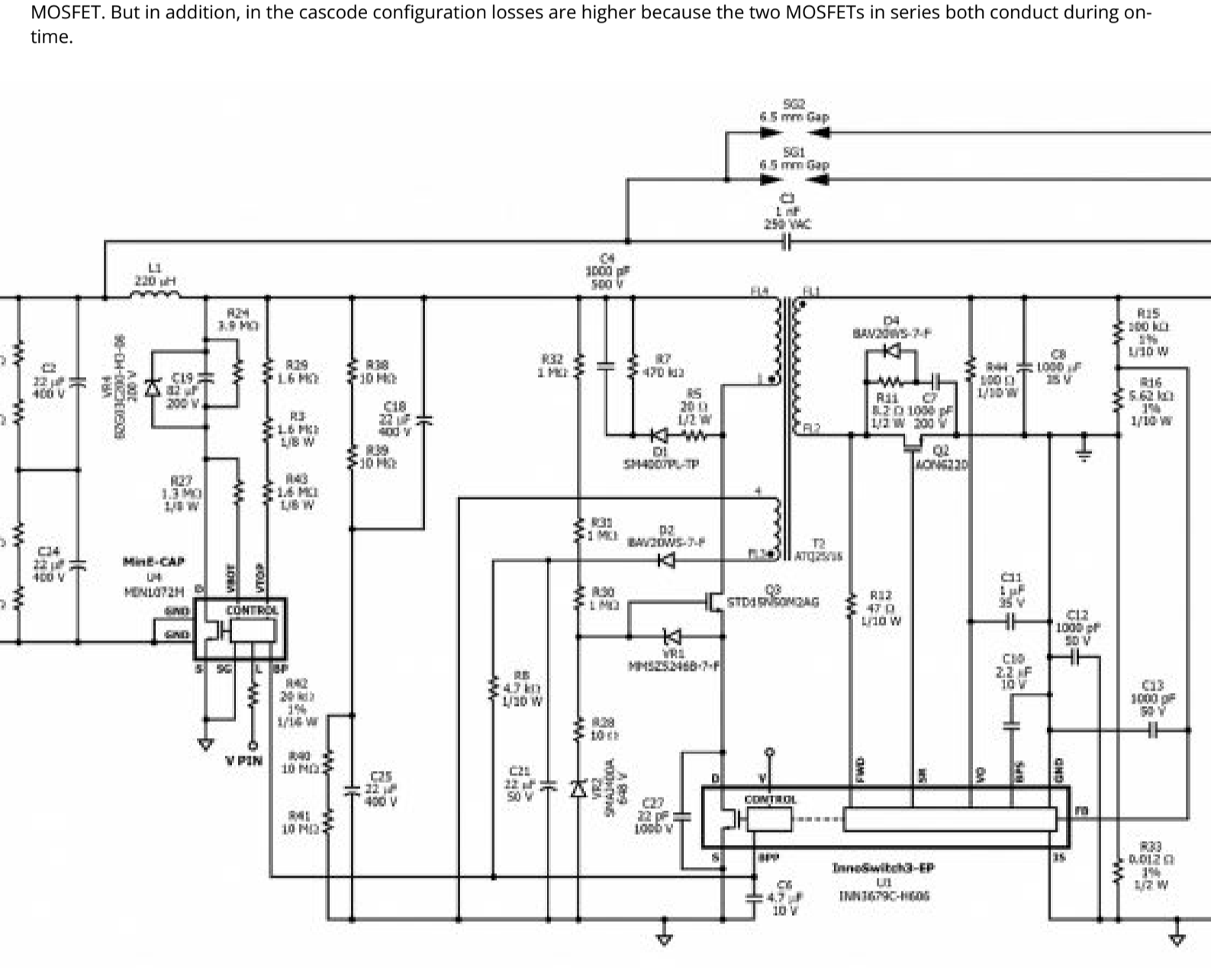


Fig. 1: Schematic of a flyback converter circuit which includes an external cascode-connected MOSFET. (Image credit: Power Integrations, from Design Example Report 712.)

Integrated options for very high-voltage flyback converters

So the two options for developing flyback converters with a power-switch voltage rating above 1,200 V both have their drawbacks. The availability of SiC MOSFET-based integrated flyback controllers that have a breakdown voltage rating of 1,700 V now means that these drawbacks can be avoided.

Devices from Power Integrations and ROHM Semiconductor provide an integrated solution for applications that operate from a very high-voltage ac or dc input without the need to use external power switches. They also let power-system designers benefit from the much lower on-resistance of SiC MOSFETs by comparison with the silicon equivalent, resulting in higher conversion efficiency, less waste heat and higher power density.

The Power Integrations SiC MOSFET flyback controllers are available in two series:

- InnoSwitch3-EP series – the INN3647C, which has a maximum output power of 50 W, and the 70 W INN3649C
- InnoSwitch3-AQ series of automotive-qualified controllers is comprised of the 50 W-rated INN3947CQ and the 70 W INN3949CQ

ROHM also supplies its SiC flyback controller, an industrial-grade device, in two versions, but here the difference between the two is in their packaging: the BM25C12xFP2-LBZ is a surface-mount device with a higher creepage distance, and the BM25CQ12xT-LBZ is in a through-hole package.

A typical application circuit for the Power Integrations controller is shown in Figure 2.

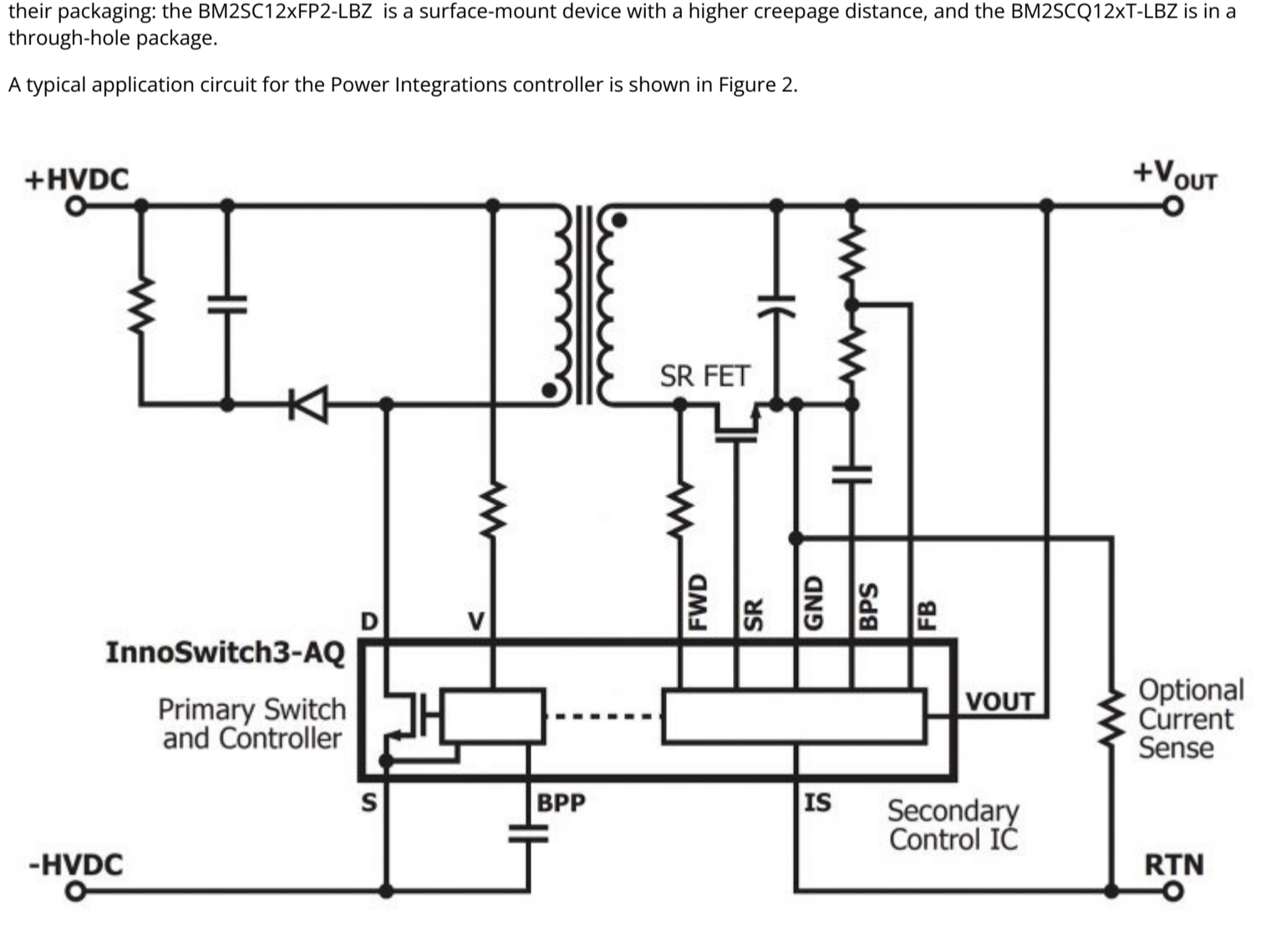


Fig. 2: Simplified typical application circuit for the Power Integrations InnoSwitch3-AQ flyback controller. (Image credit: Power Integrations, from InnoSwitch3-AQ datasheet.)

Figure 2 provides a striking illustration of the benefits of integration: this circuit contains few external components. In particular, it includes no external current-sense resistor on the primary side. Instead, two current-limit levels can be set by changing the value of the capacitor connected to the BPP pin, which selects one of two current limit levels.

On the secondary side, a standard diode can be used instead of a synchronous rectification (SR) MOSFET. The SR pin must be tied to ground to disable the synchronous rectification function. Quasi-resonant operation is controlled via the FWD pin on the secondary side.

A similar simplicity can be achieved in industrial applications by using a ROHM integrated flyback controller, as shown by the application circuit in Figure 3.

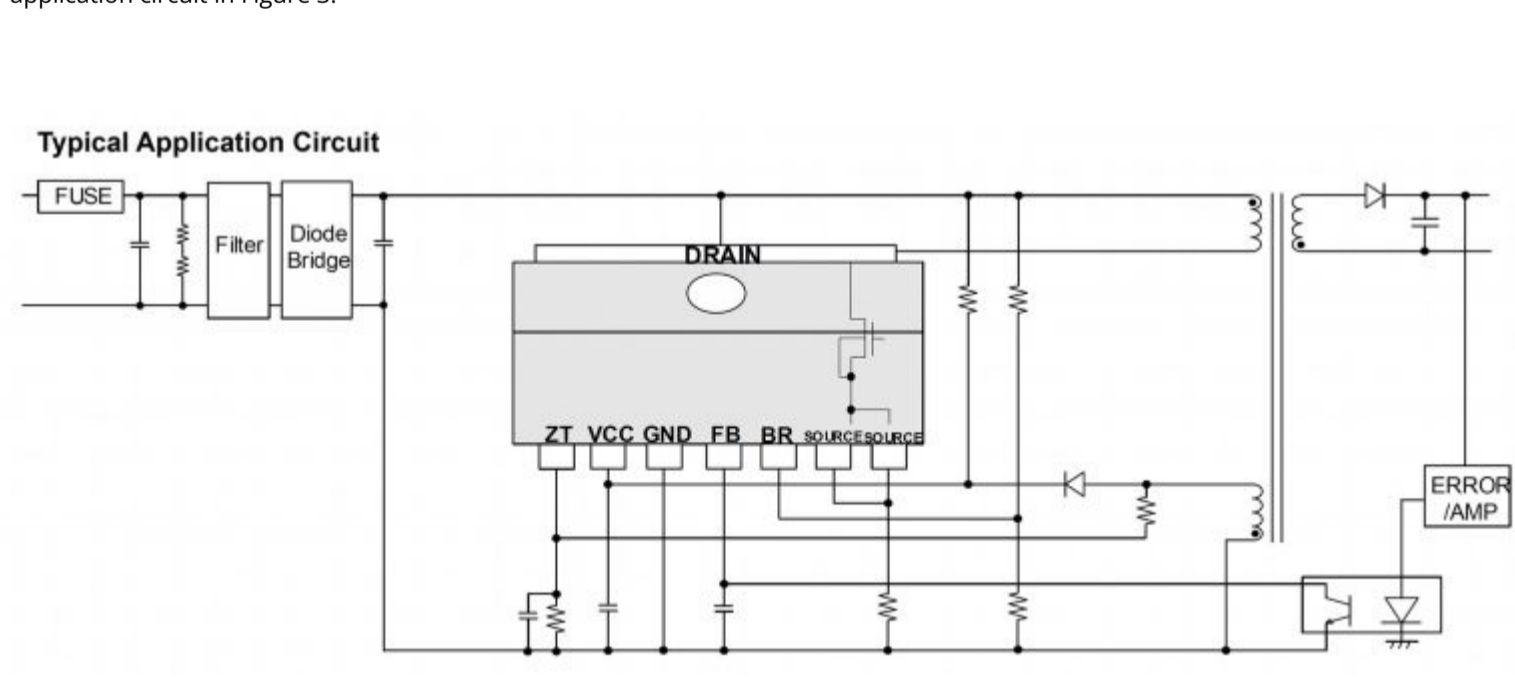


Fig. 3: Simplified typical application circuit for the ROHM BM25C12xFP2-LBZ flyback controller. (Image credit: ROHM Semiconductor, from BM25C12xFP2-LBZ series datasheet.)

In contrast to the Power Integrations controller, the ROHM controller's current-sensing scheme needs an external sensing resistor connected between the Source pin of the internal MOSFET and ground. This external resistor gives the designer the freedom to set different current-limit values by selecting the value of the current-sense resistor.

Quasi-resonant operation is controlled by sensing the bias winding voltage via divider resistors on the primary side.

Comparing the two integrated controllers

There are many more similarities between the Power Integrations and the ROHM parts than there are differences. The most important features are common to both:

- A high level of integration, which simplifies the circuit design, and reduces component count and system size
- High conversion efficiency and low power loss, a result of the very low switching losses in the internal SiC MOSFET. For instance, ROHM states that the BM25C12xFP2-LBZ can be used in circuits supplying up to a 48 W load with no requirement for a heat-sink thanks to the small amount of waste heat generated by this efficient device.

The clearest difference between the two parts is in the range of applications which they support. The ROHM controllers and the Power Integrations InnoSwitch3-EP are for use in industrial applications, typical examples include the auxiliary power supply for high-voltage rectifiers, inverters, motor drivers, solar inverters, and high-voltage metering devices.

But Power Integrations also supplies an automotive-qualified series, the InnoSwitch3-AQ, which is suitable for applications such as the inverter of an electric vehicle's traction motor or its on-board charger.

The other important difference is in the ROHM controller's requirement for an external current-sense resistor, which the Power Integrations controllers do not need. Designers using the Power Integrations controllers can therefore benefit from a lower component count and avoid the bill-of-materials cost of the resistor. But on the other hand, the ROHM controller pre-sets the designer the freedom to set any current limit, whereas the Power Integrations controller only provides a choice of two pre-set current limit values.

In this context, it is also worth pointing out that the Power Integrations controllers include integrated FluxLink isolated feedback signaling, whereas the ROHM parts require an external optocoupler or other isolated feedback link.

First to a growing market?

Both Power Integrations and ROHM have stolen a march on the rest of the industry, pioneering the development of devices which combine high integration with a 1,700 V rating for use in very high-voltage systems. Here at Future Electronics, we expect the benefits of integration and efficiency in these integrated flyback controllers to be popular with industrial OEMs and, in the case of the INN3947CQ and INN3949CQ, with automotive OEMs.

Of course time will tell, but other manufacturers have excellent SiC MOSFET manufacturing capabilities, and we can expect to see more new integrated flyback controllers with an embedded SiC power switch reach the market in the coming months and years.

New MPU with on-chip EtherCAT communication enables accurate, real-time industrial control

Products such as robots, ac servo drives and inverters can benefit from the reliable, deterministic processing of the RZ/T2L microprocessor from Renesas, which features an 800 MHz CPU and 576 kbytes of RAM.



RENESAS

FEATURES

- Functional safety-ready
- Security capabilities:
 - Secure boot
 - Secure firmware update
 - JTAG authentication
 - Unique ID
 - Cryptographic accelerator
- Supported by the Renesas product longevity program

APPLICATIONS

- Industrial equipment
- Robots
- Factory automation
- Medical equipment
- Building automation

Renesas has introduced a new industrial microprocessor that includes an on-chip EtherCAT communication module to enable high-speed, accurate real-time control of industrial systems.

The Renesas RZ/T2L MPU shares the same hardware architecture as the RZ/T2M, a higher-end product, giving it the capacity to meet the high-speed processing requirements of products such as ac servo drives, inverters, industrial robots, collaborative robots (cobots) and other applications in which EtherCAT communication is required. At the same time, designers can achieve board space savings because the RZ/T2L's chip size is as much as 50% smaller than that of the RZ/T2M.

The RZ/T2L is equipped with an Arm[®] Cortex[®]-R52 CPU that has a maximum operating frequency of 800 MHz alongside a proven EtherCAT slave controller for reliable Ethernet communication. A large 576 kbyte memory directly connected to the CPU reduces the unpredictability in execution time that can be caused by cache memory, and enables reliable, deterministic processing. All internal RAM is backed by error correction code to minimize data bit errors.

The RZ/T2L also offers peripheral functions that are particularly useful in industrial control systems, such as multi-protocol encoder interfaces for angle sensors, sigma-delta interfaces, and ADCs. These are arranged on a dedicated low-latency peripheral port bus directly connected to the CPU for fast and accurate responses.

The Renesas flexible software package and software development environment familiar from earlier RZ Family MPUs and RA Family microcontrollers allow engineers to make use of software assets across multiple product variants.

FREE DEV BOARD

Evaluation kit for the RZ/T2L Family microprocessor.

Orderable Part Number
RTK9RZT2L0S00000BJ

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Dual op amp features 200 mA output per channel

The STMicroelectronics TSB582 offers high gain-bandwidth product and rail-to-rail output, while robust protection features are valuable in industrial and automotive applications.



life.augmented

FEATURES

- Rail-to-rail output
- Low rail input
- 3.1 MHz gain-bandwidth product
- Operating-temperature range: -40°C to 125°C
- 10 years' longevity commitment

APPLICATIONS

- Servo drivers
- Valve drivers
- Power supplies
- Portable instrumentation
- Motor control

The STMicroelectronics TSB582 dual operational amplifier handles high supply voltages and provides a high output-current capability while maintaining protection through internal current limiting and thermal shutdown. The unity-gain stable TSB582 is suitable for both industrial and automotive applications.

The TSB582 offers enhanced ESD and RF noise immunity. It provides a typical output of up to 200 mA per channel to drive low-resistance inductive loads such as angle resolvers, lineout cables and piezo actuators. The op amp operates from a wide supply-voltage range of 4 V to 36 V.

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TELECOMS

Precision thin-film chip resistors offer high moisture and sulfur resistance

New RP series products from YAGEO provide the precise and stable resistance required in power systems operating in harsh automotive, industrial or medical environments.



YAGEO

FEATURES

- Low electrical noise
- Operating-temperature range: -55°C to 155°C
- Maximum working voltage:
 - 0402 case: 50 V
 - 0603 case: 75 V
 - 0805 case: 150 V
 - 1206 case: 200 V

APPLICATIONS

- Automotive systems
- Telecoms equipment
- Industrial equipment
- Medical equipment
- Test and measurement equipment
- Power systems

YAGEO has launched a series of automotive-grade thin-film chip resistors which maintain precise resistance values in harsh conditions exposed to moisture and atmospheric sulfur.

The new AEC-Q200-qualified RP series resistors feature a special passivation coating which forms a water-resistant interface between the resistive layer and the environment. This protection enables the RP series to maintain highly stable resistance in harsh environments.

The RP series resistors are supplied in case sizes ranging from 0402 to 1206, and with resistance values ranging from 10 Ω to 1.5 MΩ. Resistance tolerance options are ±0.1%, ±0.25%, ±0.5%, and ±1%.

The resistors are available in four options for temperature coefficient of resistance: ±10 ppm/°C, ±15 ppm/°C, ±25 ppm/°C or ±50 ppm/°C.

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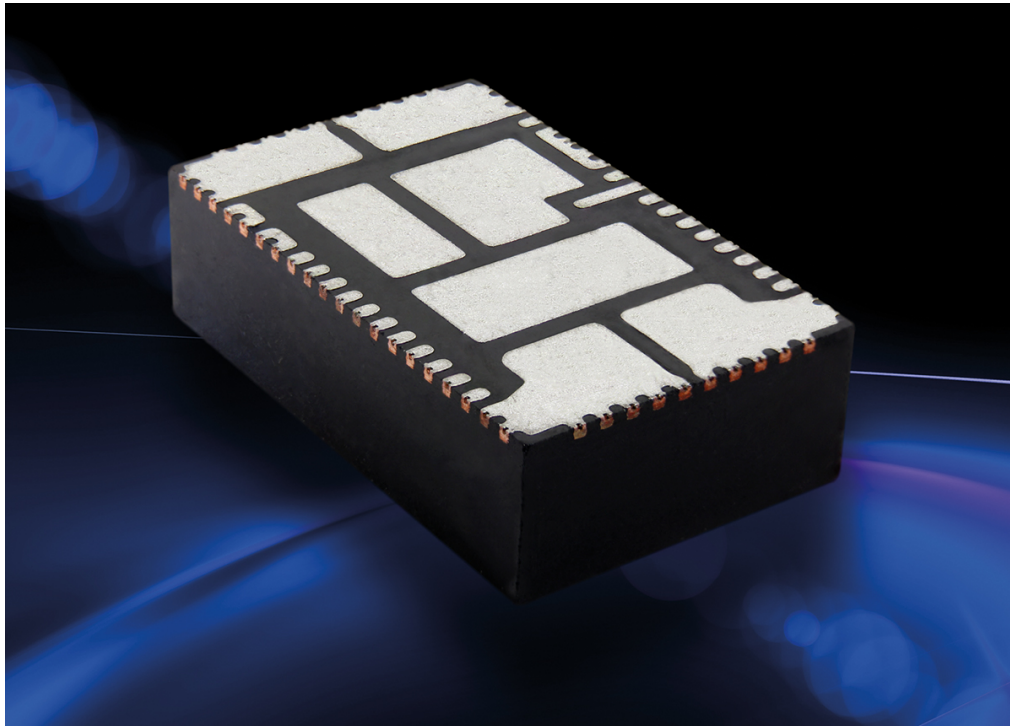
CONSUMER



TELECOMS

20 A dc-dc regulator module in new space-saving package design

The SiC931 dc-dc regulator module from Vishay provides a complete power-conversion system for stepping a 4.5 V to 18 V input down to an adjustable output voltage ranging between 0.6 V and 5.5 V.



FEATURES

- Output-voltage tracking and sequencing with pre-bias start-up
- $\pm 1\%$ output-voltage accuracy from -40°C to 125°C
- Package dimensions: 10.6 mm x 6.5 mm x 3.0 mm
- Output over-voltage protection
- Output under-voltage and short-circuit protection
- Power Good flag
- Over-temperature protection

APPLICATIONS

- FPGA power supplies
- Point-of-load power supplies
- Industrial equipment
- Automation

The SiC931 from Vishay, a synchronous buck regulator module which is capable of supplying a continuous 20 A output, features an innovative microBRICK™ package design which is less than one-third of the volume of equivalent competing modules. Its board footprint is also less than half the size of competitors'.

Intended as a power supply for microprocessors, DSPs, FPGAs, or ASICs, the SiC931 is a complete power system including power MOSFETs and inductor. The power stage supplies a maximum continuous current of 20 A at a switching frequency of up to 2 MHz. Requiring few peripheral components, the SiC931 is easy to design into an end product's power system.

The SiC931 module produces an adjustable output voltage between 0.6 V and 5.5 V from a 4.5 V to 18 V input range. The architecture supports an ultra-fast transient response with minimal output capacitance and tight ripple regulation. The regulator is internally compensated, and no external ESR network is required to maintain loop stability.

The SiC931 gives the designer a choice of four programmable switching frequencies: 600 kHz, 1 MHz, 1.5 MHz and 2 MHz. The mode of operation is also programmable, between continuous-conduction and power-saving modes.

The module implements an adjustable soft-start process, and applies an adjustable cycle-by-cycle current limit. It also incorporates a power-saving scheme which increases light-load efficiency.

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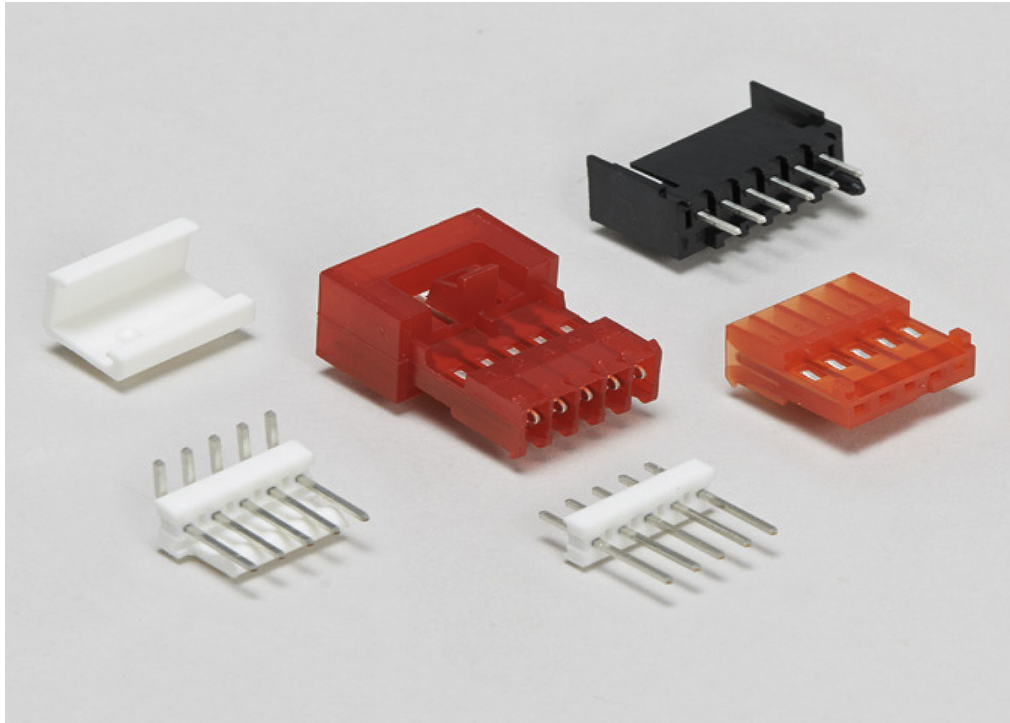
CONSUMER



TELECOMS

Connectors reduce applied cost of assembling cable harnesses

The MTA 100 and MTA 156 series from TE Connectivity support mass termination assembly to reduce the labor required to connect multiple cables.



FEATURES

- Audible latch for connection feedback on posted housings
- Wire feed-through for daisy-chaining
- Tin or gold plating
- Wire sizes:
 - MTA100 – 28 AWG to 22 AWG
 - MTA156 – 26 AWG to 18 AWG
- UL recognized
- Conforms to UL1410

APPLICATIONS

- Home appliances
- Industrial machinery and controls
- Personal healthcare devices

TE Connectivity (TE) provides families of wire-to-board and wire-to-wire connectors for low-power and signal applications that greatly reduce the cost of terminating cable or harness assemblies.

The MTA 100 and MTA 156 connectors feature insulation displacement contact (IDC) technology to support mass termination assembly processes. By enabling the mass termination of wires, they reduce the manual labor required to assemble harnesses, and so lower the applied cost.

The MTA 100 connectors offer 0.10" (2.54 mm) centerline spacing while still allowing for up to 28 positions. The maximum current rating is 5 A. The MTA 156 connectors offer 0.156" (3.96 mm) centerline spacing and from two to 24 positions. The maximum current rating is 7 A.

Housings feature styles that include both closed-end and feed-through connectors with locking ramps, both with and without polarizing tabs. For higher quality and easier handling, MTA 100 and MTA 156 connectors offer one-step assembly, and require no wire stripping. Use of these connectors eliminates the risk of contact damage, and results in fewer wiring errors, simpler tooling, and simple maintenance and repair.

The connectors offer numerous options including colored housings and various types of plated contacts.

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TELECOMS

1,500 V battery protection fuse provides fast response to fault currents

The ESR fuse from Littelfuse protects large battery installations in applications such as energy storage systems, battery racks, and hybrid solar power/energy storage systems.



Expertise Applied | Answers Delivered

FEATURES

- Class aBat partial-range fuse
- Low leakage power
- Conforms to IEC 60269-7 battery standard
- Compact NH 1XL case

APPLICATIONS

- Battery energy storage systems
- Battery protection units
- Battery racks
- Power-conversion systems
- Dc common bus systems
- Hybrid solar/energy storage system inverters

The Littelfuse Energy Storage Rack (ESR) 1,500 V battery protection fuse responds quickly to a range of fault currents, to safeguard battery modules or other devices.

The ESR is a high-speed, square-body fuse which offers superior short-circuit protection and a low minimum breaking capacity from three times the fuse's rated current up to 175 kA, and 250 kA when self-certified. This means that it protects against a range of over-current events that traditional high-speed partial-range fuses do not. The low minimum breaking current also reduces the size and rating of a battery system's dc contactors to save space and cost.

The ESR fuse affords the ability to scale up systems without the need to redesign existing circuit protection, saving time and costs.

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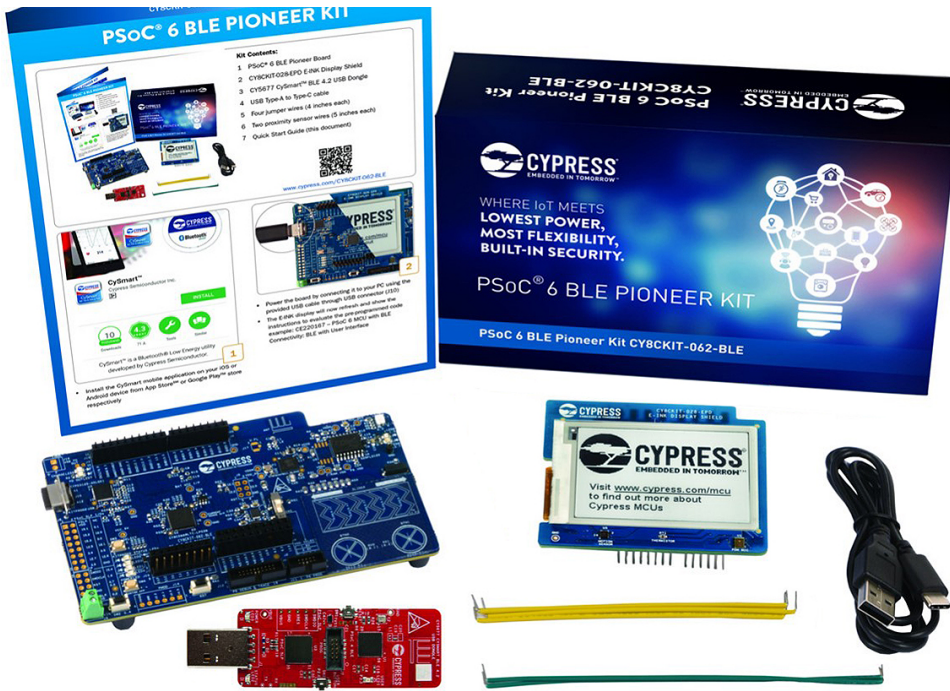
CONSUMER



TELECOMS

Module based on Bluetooth LE MCU provides fast way to implement connected motor-control designs

The AIROC CYBLE-416045-02 wireless module from Infineon is based on the PSoC 63, a dual-core 32-bit microcontroller with integrated Bluetooth® Low Energy radio.



FEATURES

- Programmable Transmit power up to 4 dBm
- -92 dBm Receive sensitivity
- Integrated CAPSENSE™ touch-sensing capability
- 1 Mbyte of Flash
- 128 kbytes of ROM
- 36 GPIOs
- Five serial communication blocks
- 2 Mb/s maximum data rate

APPLICATIONS

- Home automation
- Power tools
- Wireless sensors
- IoT devices

To address a growing need for connectivity in motor control designs, Infineon provides the AIROC™ CYBLE-416045-02, a fully certified Bluetooth Low Energy (LE) module based on the PSoC™ 63 MCU with AIROC Bluetooth LE wireless microcontroller.

This embedded module includes a royalty-free Bluetooth stack compatible with the Bluetooth 5.0 specifications. It is supplied in a 14 mm x 18.5 mm x 2.0 mm surface-mount package, and is certified compliant with the FCC, ISED, MIC, and CE regulations. The CYBLE-416045-02 module is tested, certified and qualified for use out of the box, making it a fast, efficient route to production.

Based on a dual-core architecture – an industry-leading 150 MHz Arm® Cortex®-M4 core paired with a 100 MHz Cortex-M0+ – the PSoC 63 MCU with AIROC Bluetooth LE MCU is capable of running complex applications alongside the Bluetooth LE protocol and 2.4 GHz radio functionality. This makes it ideal for cost-sensitive applications that implement basic motor control, such as smart door locks or power tools, and that also require wireless connectivity.

The need for connectivity in motor drives is growing, as it enables manufacturers to gather information about the status of equipment, anticipate the need for maintenance, and implement configuration changes over-the-air.

The AIROC CYBLE-416045-02 module provides a ready-made solution for building a PSoC 63 MCU with AIROC Bluetooth LE MCU into designs: fully integrated, it includes a crystal oscillator, passive components, Flash memory, and a trace antenna alongside the PSoC 63 MCU. This means that OEMs can develop connected device designs more effectively and get to market faster.

FREE DEV BOARD

PSoC™ 6-BLE Pioneer Kit.

Orderable Part Number
CY8CKIT-062-BLE

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TELECOMS

Integrated motor driver chip ideal for three-phase applications

The STDRIVE101 single-chip motor driver from STMicroelectronics enables designers of motors or inverters to reduce component count and simplify their system board design.



life.augmented

FEATURES

- Matched propagation delay for all channels
- 40 ns propagation delay
- 12 V, 50 mA LDO
- Embedded drain-source voltage monitor for each external MOSFET
- Over-current comparator
- Under-voltage lockout protection
- Thermal shutdown protection

APPLICATIONS

- E-bikes
- E-scooters
- Three-phase brushless dc motors
- Fans
- Pumps
- Servo drives

The STMicroelectronics STDRIVE101 is a single chip containing three half-bridge gate drivers for N-channel power MOSFETs, and providing a comprehensive system for driving three-phase brushless motors. The IC integrates a low-dropout linear regulator which generates the supply voltage for both the low- and high-side gate drivers through a bootstrap circuit.

This means that replacing a circuit based on the use of discrete single or dual gate drivers with the STDRIVE101 reduces component count and simplifies the design.

Each of the STDRIVE101's half-bridge drivers has a current capability of 600 mA sink/source. The operating-voltage range is 5.5 V to 75 V. Under-voltage lockout protection on both the low- and high-side sections prevents the power switches from operating in low-efficiency or dangerous conditions. Interlocking and dead-time functions prevent cross-conduction.

The logic inputs are CMOS/TTL-compatible at levels down to 3.3 V, to provide for easy interfacing with control devices.

FREE DEV BOARD

Demonstration motor driver board for three-phase brushless motors.

Orderable Part Number
EVALSTDRIVE101

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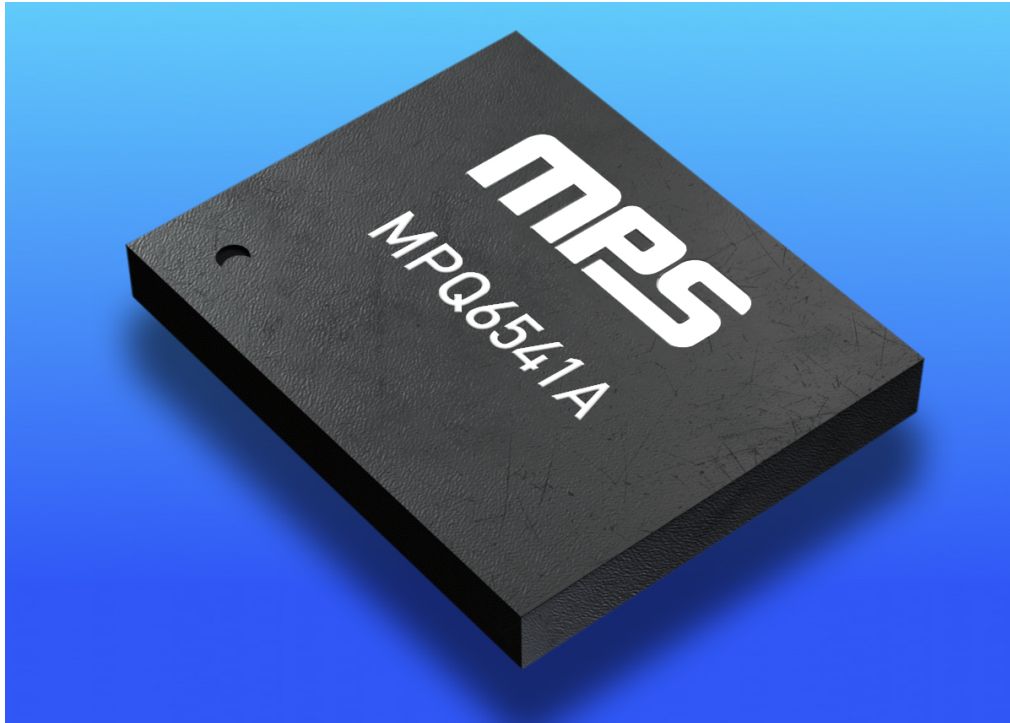
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Integrated motor driver IC provides complete power solution for BLDC motors

The Monolithic Power Systems MPQ6541 supplies a continuous current to the motor of up to 8 A. Reliable operation is assured by a comprehensive array of protection functions.



MPS

FEATURES

- Supply-voltage range: 4.75 V to 40 V
- 15 mΩ on-resistance per MOSFET
- Automatic synchronous rectification
- Protection functions:
 - Under-voltage lockout
 - Over-voltage
 - Thermal shutdown
 - Over-current

APPLICATIONS

- BLDC motor drives
- Permanent magnet synchronous motor drives

The Monolithic Power Systems MPQ6541 and MPQ6541A provide an integrated driver solution for three-phase brushless dc (BLDC) motors.

The products each consist of three integrated half-bridges implemented with six N-channel power MOSFETs, alongside six pre-drivers, two gate-driver power supplies, and three current-sense amplifiers.

The MPQ6541 has Enable and PWM inputs for each half-bridge; the MPQ6541A has separate high- and low-side inputs. Otherwise, these parts are identical.

These motor drivers can supply up to 12 A of peak current for 1 second, or 8 A of continuous current, depending on the thermal and board-level conditions. An internal charge pump generates the gate-driver supply for the high-side MOSFETs, and a trickle-charge circuit maintains a sufficient gate-driver voltage to operate at 100% duty cycle.

The MPQ6541 and MPQ6541A are supplied in a 6 mm x 6 mm TQFN-26 package. They are available with AEC-Q100 Grade 1 qualification.



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TELECOMS

Ultra low-power digital temperature sensor offers $\pm 0.5^{\circ}\text{C}$ accuracy

Housed in a 4mm^2 package, the STTS22H from STMicroelectronics is factory-calibrated, and accuracy up to 125°C is verified with traceable equipment.



life.augmented

FEATURES

- Supply-voltage range: 1.5 V to 3.6 V
- Programmable thresholds with Interrupt pin
- 1.75 μA operating current in power-saving one-shot mode
- 16-bit temperature data output

APPLICATIONS

- Wearable devices
- Smart home automation
- Asset and goods tracking
- Smartphones
- HVAC units
- Refrigerators
- Air humidifiers
- Portable consumer devices
- White goods
- Thermostats

The STTS22H from STMicroelectronics is an ultra low-power digital temperature sensor which offers high performance over the entire operating-temperature range of -40°C to 125°C . Accuracy is a maximum $\pm 0.5^{\circ}\text{C}$ over a temperature range of -10°C to 60°C .

The STTS22H is a band-gap temperature sensor coupled with an ADC, signal processing logic, and an I2C/SMBus 3.0 interface in a single chip. The sensor is housed in a small $2\text{ mm} \times 2\text{ mm} \times 0.5\text{ mm}$ 6-lead UDFN package with exposed pad down, giving a better temperature match with the surrounding environment.

The digital temperature sensor is factory-calibrated and requires no additional calibration on assembly into the application. STTS22H units are all tested on a production set-up which is traceable to National Institute of Standards and Technology (NIST) standards, and verified with equipment which is calibrated in accordance with the automotive IATF 16949:2016 standard.

FREE DEV BOARD

Temperature probe kit based on STTS22H.

Orderable Part Number
STEVAL-MKI200V1K

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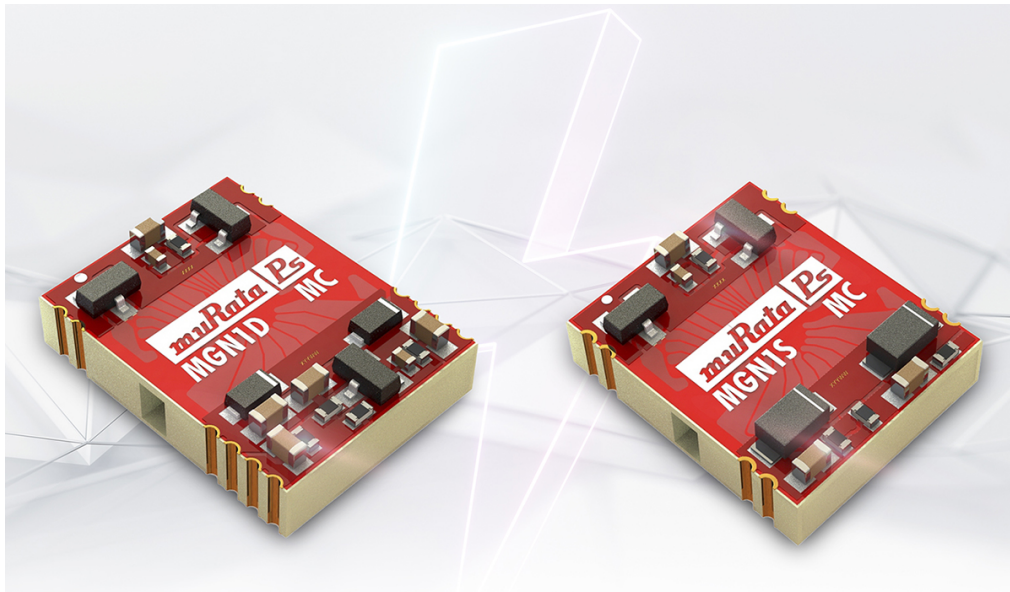
CONSUMER



TELECOMS

New dc-dc converters meet fast-switching requirements of GaN-based systems

The MGN1 series of converter modules from Murata provides the ideal isolated power supply solution for the gate drivers required by GaN power switches. Compact dimensions ensure they can be accommodated in tightly-packed board layouts.



muRata
INNOVATOR IN ELECTRONICS

FEATURES

- 6.5 mm creepage and clearance
- 3 kV ac isolation voltage
- Operating-temperature range: -40°C to 105°C
- Reverse-polarity protection
- Short-circuit protection
- 68.5% efficiency
- 1% load regulation

APPLICATIONS

- EV fast charging stations
- Battery energy storage systems
- Smart grid equipment
- Solar inverters
- Computing equipment
- Data centers
- Wind turbines
- Motor drives

Murata has introduced compact new 1 W dc-dc converters, the MGN1 series, which supply the voltages needed by the gate drivers of wide bandgap gallium nitride (GaN) power switches. The regulated output-voltage options are +8 V, +12 V, and +6/-3 V from a 12 V nominal input voltage.

Lightweight, and measuring 12.0 mm x 16.0 mm x 4.25 mm, these surface-mount modules can easily be integrated into space-constrained designs.

One of the key attributes of the MGN1 series converters is their ultra-low isolation capacitance of 2.5 pF. This minimizes the coupling of transients across the isolation barrier, preventing signal distortion, and alleviating system EMI problems.

Common-mode transient immunity of more than 200 kV/ μ s makes the MGN1 modules ideal for GaN-based systems that switch at high frequency. Thanks to their partial discharge performance, reliable operation is maintained in high-voltage conditions.

The dc-dc converters in Murata's MGN1 series support a continuous isolation barrier withstand voltage of 1.1 kV. UL 62368 conformance is pending for 650 V dc basic insulation and 240 V ac reinforced insulation.



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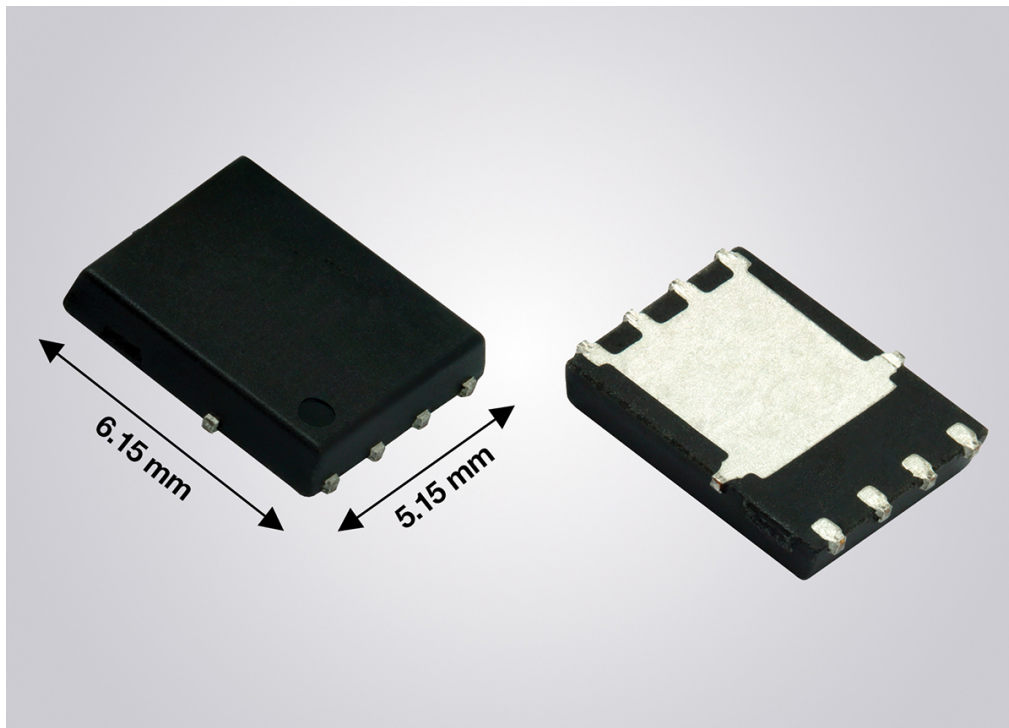
CONSUMER



TELECOMS

45 V MOSFET provides more efficient alternative to 60 V devices in low-voltage applications

The SiR608DP from Vishay features low on-resistance, gate charge and output capacitance, while offering higher breakdown capability than a 40 V MOSFET.



Vishay provides an advanced 45 V N-channel MOSFET that is intended for use in high-efficiency dc-dc power-conversion circuits.

The SiR608DP is ideal as a replacement for a 40 V MOSFET in circuits that are at risk of transient voltage events for which the 40 V breakdown voltage rating provides an insufficient safety margin.

In these conditions, the 45 V SiR608DP provides better efficiency than a 60 V MOSFET, the typical alternative to a 40 V MOSFET in power circuits. This is because of the outstanding operating characteristics of the SiR608DP: its low on-resistance is complemented by very low gate charge and output capacitance.

The SiR608DP is supplied in a PowerPAK[®] SO-8 package which has a standard 6 mm x 5 mm footprint, and which contributes negligible additional resistance to the circuit.



FEATURES

- 1 mΩ maximum on-resistance at a gate-source voltage of 10 V
- 50.5 nC gate charge
- 166 A maximum continuous drain current at a case temperature of 70°C
- 2.3 V maximum gate-source threshold voltage

APPLICATIONS

- Battery management systems
- Computing devices
- Motor control
- Power supplies
- Power tools
- Servers
- Telecoms equipment

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TELECOMS

Fully programmable motor controller combines MCU with gate driver IC in a single package

The IMD700A motor controller from Infineon enables designers to implement compact BLDC motor or PMSM control systems with fewer components, and supporting operation from a battery power supply.



FEATURES

- Three shunt amplifiers for current sensing
- Protection functions:
 - Over-current protection
 - Under-voltage lockout
 - Over-temperature protection
 - Locked rotor detection

APPLICATIONS

- Professional cordless power tools
- Drones
- Power tools for gardening
- E-bikes
- Automated guided vehicles
- Portable oxygen concentrators
- Fans

The MOTIX™ IMD700A from Infineon is a fully programmable motor controller which combines an XMC1404 32-bit microcontroller and a 6EDL7141 three-phase, half-bridge gate driver and supporting components into a single, compact package. The integration of control, MOSFET driving, current-sensing, protection and power-supply functions into one package enables designers to implement designs that are smaller, with fewer components and a simpler board layout than systems based on multiple discrete components.

The IMD700A is ideal for compact, battery-powered motor-control systems that use a brushless dc (BLDC) motor or permanent magnet synchronous motor (PMSM).

The XMC1404 MCU, based on an Arm® Cortex®-M0 processor core, provides dedicated features for motor control. A hardware math co-processor operating at 96 MHz accelerates calculations that are commonly used in the field-oriented control of a PMSM, such as arctan and other division and trigonometric functions. Useful peripherals include PWM timers, a POSIF position-sensor interface, and serial communication modules supporting protocols including CAN.

The motor controller's 6EDL7141 MOSFET gate driver features sink and source currents that are configurable up to 1.5 A for driving a wide range of MOSFETs efficiently. It offers adjustable gate driver supply-voltage settings of 7 V, 10 V, 12 V or 15 V which are available even when the battery power supply is at a low voltage, thanks to built-in high- and low-side charge pumps.

The 6EDL7141 also has adjustable gate driver parameters to enable control of the slew rate, for minimizing system EMI. All of the 6EDL7141's settings can be quickly changed with an easy-to-use PC-based GUI supplied by Infineon.

FREE DEV BOARD

Fully integrated BLDC motor drive solution based on the MOTIX™ IMD701A.

Orderable Part Number
EVAL_IMD700A_FOC_3SH

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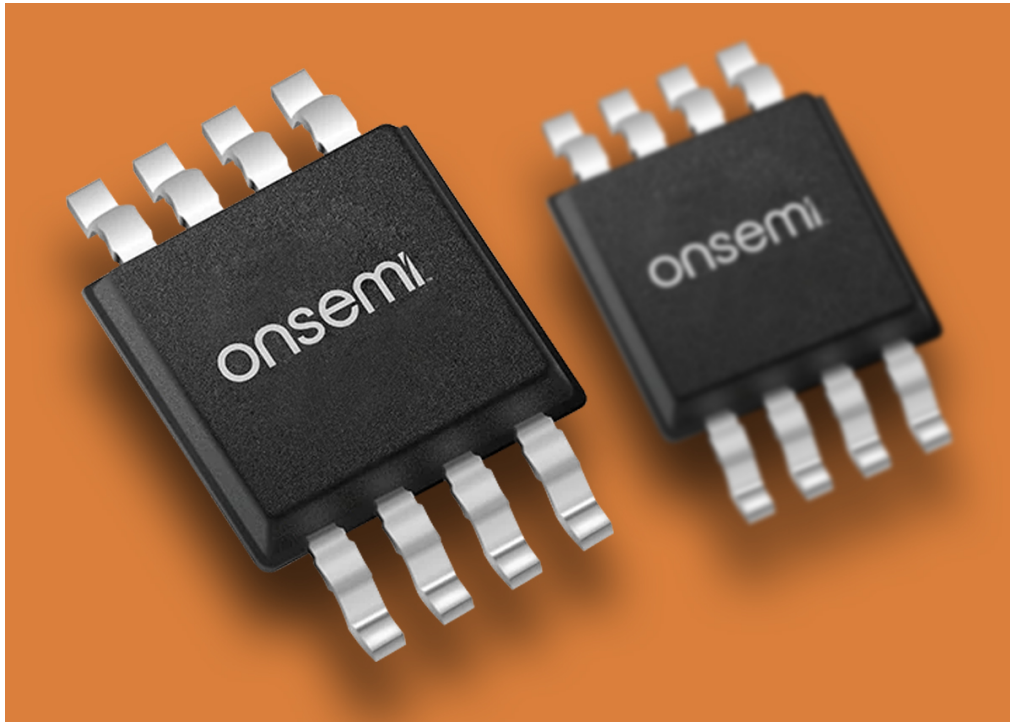
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Ultra-low noise LDO operates over wide input-voltage range up to 38 V

The NCP731 from onsemi, an LDO with a maximum output current of 150 mA, provides the tightly regulated and stable power supply required by precision analog circuitry.



onsemi

FEATURES

- Capacitor-programmed soft start
- 290 mV dropout voltage at 150 mA/3.3 V output
- 70 dB power-supply rejection ratio at 10 kHz
- Stable with ≥ 1 μ F ceramic capacitor

APPLICATIONS

- Power supplies
- Factory automation equipment
- Test and measurement equipment
- Audio equipment
- Telecoms equipment

The NCP731 LDO voltage regulator from onsemi combines very low noise and fast transient response with wide input- and output-voltage ranges, to give designers flexibility in the design of power supplies for noise-sensitive components.

The NCP731 handles inputs across a voltage ranging from 2.7 V to 38 V, supplying an output current of up to 150 mA. It offers fixed output-voltage options of 3.3 V and 5.0 V, or an adjustable output voltage up to 35 V. Other fixed output voltages are available on request. The wide input-voltage range gives designers extra headroom for specifying the power rail, and also enables the use of a single stock-keeping unit to serve multiple product designs using power rails at various voltages.

Ultra-low noise of 8 μ V_{rms} makes the device ideal for applications in which clean voltage rails are important for system performance, such as the operational amplifiers, ADCs, DACs and other precision analog circuitry in test and measurement or audio equipment. High output-voltage accuracy of $\pm 0.6\%$ gives improved output-voltage sensing.

The LDO implements a power good circuit which indicates that the output voltage is in regulation. This signal could be used for power sequencing with a delay function, or as a microcontroller reset. This means that the NCP731 allows the implementation of complex power-supply designs with sequencing and improved brown-out protection using fewer components.

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TELECOMS

Precision thin- and thick-film chip resistors offer narrow tolerance of resistance

The RE thick-film, and AT and RT series thin-film resistors from YAGEO provide high temperature stability and a range of resistance values and case size options.



YAGEO

FEATURES

- High resistance to humidity
- Long lifetime
- Excellent heat dissipation

APPLICATIONS

- Power converters
- Printers
- Servers
- Telecoms equipment
- Consumer devices
- Industrial control
- Automotive systems
- Metering

YAGEO provides a broad portfolio of precision chip resistors fabricated using both thick- and thin-film processes.

Using advanced sputtering technology, YAGEO thin-film chip resistors provide high precision, high stability, a narrow tolerance of $\pm 0.1\%$ and a low temperature coefficient of resistance of $\pm 25\text{ppm}/^\circ\text{C}$.

YAGEO thick-film precision chip resistors are optimized with a highly reliable electrode construction. Like the thin-film series, the thick-film resistors feature a narrow tolerance of $\pm 0.1\%$. The TCR is $\pm 50\text{ppm}/^\circ\text{C}$.

The thick-film resistors are the **RE series**, which are compatible with all soldering processes, and are suitable for automatic placement in surface-mount applications. The RE series resistors are supplied in case sizes ranging from 0201 to 1206, and with resistance values ranging from $10\ \Omega$ to $1\ \text{M}\Omega$.

Thin-film resistors in the YAGEO portfolio include the **automotive-grade AT series**. These AEC-Q200 qualified resistors offer high resistance to environmental sulfur. They are notable for their high precision and stability, and low electrical noise. The AT series resistors are supplied in case sizes ranging from 0201 to 1206, and with resistance values ranging from $10\ \Omega$ to $1\ \text{M}\Omega$.

The **RT series precision resistors** feature a metal resistive layer which provides robust moisture resistance. Design engineers value these resistors for their long-term stability, low current noise, and high stability.

The RT series resistors are supplied in case sizes ranging from 0201 to 2512, and with resistance values ranging from $1\ \Omega$ to $1\ \text{M}\Omega$.



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TELECOMS

Motor protection relay provides Bluetooth link for remote monitoring

The Littelfuse MP8000 relay features a comprehensive set of protection functions for safe and reliable operation of motors and pumps drawing current of up to 1,000 A.



Expertise Applied | Answers Delivered

FEATURES

- Protection functions:
 - Overload/over-power
 - Underload/under-power
 - Over-current
 - Under-current
 - Current unbalance/phase loss
 - Phase reversal
 - Over-voltage
 - Under-voltage
 - Voltage unbalance
 - Rapid cycling/jog
 - Contactor failure
 - Zero-sequence ground fault
 - PTC motor over-temperature
- Three selectable restart options
- Four programmable delay timers

APPLICATIONS

- Motors
- Pumps

The feature-rich MP8000 series relay from Littelfuse, which protects three- or single-phase motors operating at voltages between 90 V and 690 V ac, provides a Bluetooth® wireless connection to enable remote monitoring and programming of important relay functions via the Littelfuse smartphone and tablet app. The relay also features an Ethernet communications port that can be used to form an Ethernet Modbus TCP/IP or Ethernet/IP network for remote monitoring.

The MP8000 protects any motor or pump drawing a full load of between 0.5 A and 1,000 A. External current transformers are required for protection above 100 A. Protection functions provided by the MP8000 include locked rotor, overload, over-temperature, and unbalance protection.

The intuitive Bluetooth and Ethernet functions increase arc-flash safety, because the app allows settings to be modified and real-time operational information to be viewed. The user is not required to open the control panel to view information or monitor faults displayed in the app.

The relay can also be remotely monitored and controlled from a PC or SCADA system. Data logging is supported via a PC with the optional MP8000 software, or other software program that uses the MP8000 memory map.

The MP8000 relay operates as a fail-safe device. This means that when the voltage is within the programmed limits, the relay will energize and the normally open contact will close. When the unit loses power or senses a fault condition, the relay will de-energize and contacts will return to their original state.

Use of external potential transformers can extend the relay's upper voltage range above 690 V ac.



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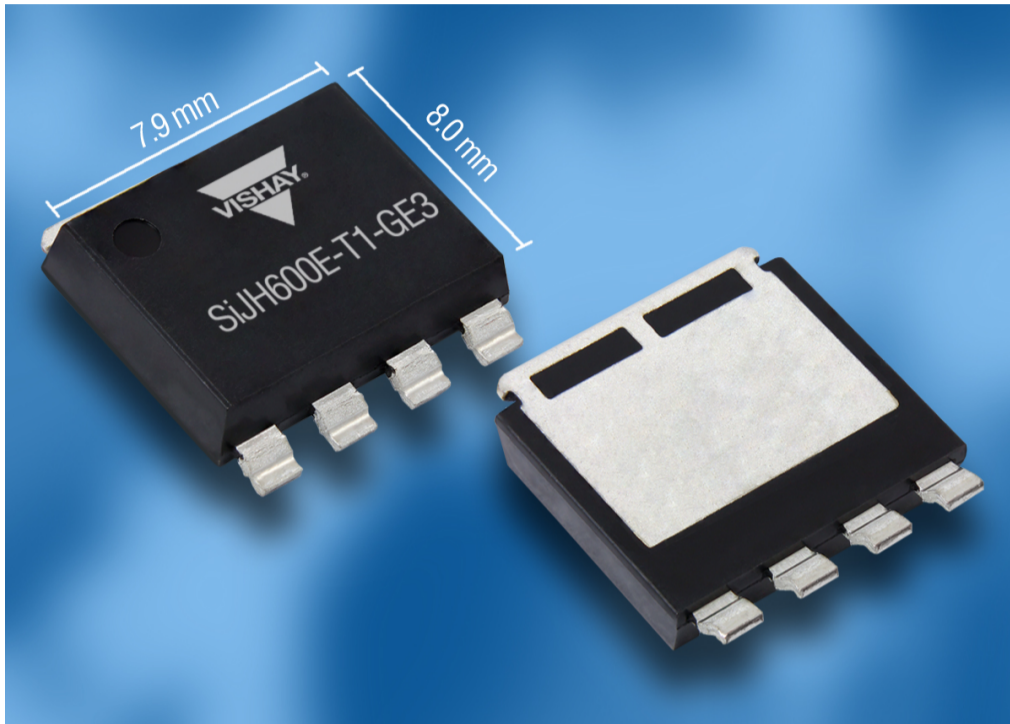
CONSUMER



TELECOMS

Power MOSFETs in space-saving package run at up to 175°C

The SiJH series MOSFETs from Vishay are housed in a thermally efficient PowerPAK package which is 57% thinner than the familiar D2PAK package commonly used for MOSFETs, and occupies a 60% smaller board footprint.



FEATURES

- Optimized gate charge
 - Low switching losses
- Robust UIS capability
- 100% UIS tested

APPLICATIONS

- Dc-dc converters
- Power supplies
- Battery management systems
- Motor drives

Vishay has extended its range of low-voltage N-channel power MOSFETs that benefit from the high thermal performance and space-saving properties of the PowerPAK 8 x 8L package.

Like the other TrenchFET MOSFETs in the series, the new 60 V SiJH600E and 80 V SiJH800E and SiJH5800E offer low on-resistance and withstand operating temperatures up to 175°C.

The PowerPAK package has gullwing leads and solder jointing for reliable operation over a long lifetime. The package characteristics include low thermal resistance for good heat dissipation. The PowerPAK 8 x 8L also has a 50% smaller footprint than a TO-263/D²PAK package, allowing for use in tightly populated board layouts, and resulting in high power density.

The SiJH MOSFETs are intended for use in functions including ORing and synchronous rectification.

Part Number	Maximum Drain-source Voltage	On-resistance at 10 V	Gate Charge at 10 V	Maximum Continuous Drain Current
SiJH440E	40 V	0.96 mΩ	279 nC	200 A
SiJH600E	60 V	0.92 mΩ	141 nC	373 A
SiJH800E	80 V	1.55 mΩ	140 nC	299 A
SiJH5800E	80 V	1.35 mΩ	103 nC	302 A
SiJH112E	100 V	2.8 mΩ	106 nC	225 A
SiJH5700E	150 V	4.1 mΩ	93 nC	174 A

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TELECOMS

New low- and high-side bidirectional current sense amplifiers feature very low drift

TSC21x series from STMicroelectronics provides a wide range of gain options to enable designers to find the right fit for their industrial or automotive application.



life.augmented

FEATURES

- Maximum offset voltage:
 - TSC210 , TSC211, TSC212 – $\pm 35 \mu\text{V}$
 - TSC214, TSC215 – $\pm 60 \mu\text{V}$
 - TSC213 – $\pm 100 \mu\text{V}$
- $\pm 1\%$ maximum gain error
- $0.1 \mu\text{V}/^\circ\text{C}$ maximum offset drift
- $20 \text{ ppm}/^\circ\text{C}$ maximum gain drift
- $100 \mu\text{A}$ quiescent current

APPLICATIONS

- Industrial equipment
- Automotive systems
- Telecoms equipment
- Battery chargers
- Notebook computers
- Server power supplies

The TSC21x series from STMicroelectronics are bidirectional current sense amplifiers for use with a shunt resistor to measure current with a high degree of precision and accuracy. Based on a zero-drift architecture, the amplifiers' performance is very stable over the operating-temperature range of -40°C to 125°C .

The TSC21x current sense amplifiers operate over a wide supply-voltage range of 2.7 V to 26 V and offer high tolerance of ESD, making them ideal for industrial and automotive applications.

The amplifiers can perform high- or low-side current sensing, and are also suitable for other functions such as over-current protection, current monitoring and feedback loops.

There are six amplifiers in the TSC21x series. The amplifier gain of the TSC210 is 200 V/V , for the TSC211 the gain is 500 V/V , $1,000 \text{ V/V}$ for the TSC212, 50 V/V for the TSC213, 100 V/V for the TSC214, and 75 V/V for the TSC215.

The TSC21x amplifiers are supplied in either a QFN10 package measuring $1.8 \text{ mm} \times 1.4 \text{ mm}$, or an SC70-6 package.

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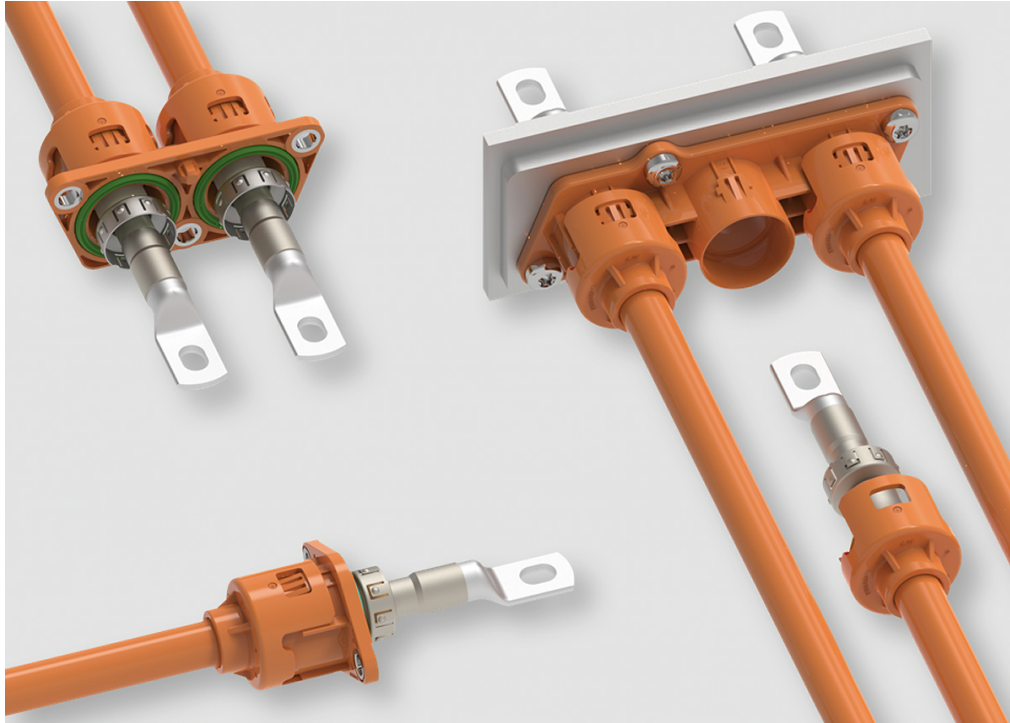
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TELECOMS

High-voltage connectors withstand strong vibrations in EVs and HEVs

Robust IPT-HD high-voltage power bolt connectors from TE Connectivity handle extreme temperatures, and offer various IP rating options for use in harsh automotive environments.



FEATURES

- One, two, or three positions
- Operating-temperature range: -40°C to 125°C
- 1,000 V voltage rating
- Current-ratings range: 250 A to 400 A at 85°C
- Vibration standards compliance: ISO 16750-3, LV214-S4, USCAR V3
- IP rating options: IP67, IP68, IP6K9K

APPLICATIONS

- Buses
- Trucks
- Agricultural vehicles
- Construction vehicles
- Passenger vehicles

Featuring a new shielding design, easy mounting holes, and flexible assembly connectivity, TE Connectivity's (TE) new IPT-HD high-voltage power bolt connectors meet the need for highly vibration-resistant connections in hybrid-electric (HEVs) and electric vehicles (EVs).

The 360° shielded TE IPT-HD connectors maintain low contact resistance, even after vibration, and can be used in environments exposed to extreme temperatures.

Offering flexible assembly options for a wide range of applications, the IPT-HD power bolt connector supports three options for the conductor cross-section: 50 mm², 70 mm² or 95 mm².

In addition to the traditional integral wiring harness assembly and an easy machining process for mounting holes, the IPT-HD connector provides a separate, single wiring harness for increased assembly flexibility.

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