Component Focus: Pages 3-6
STMicroelectronics’ low-voltage TS985 single-channel comparator draws just 14µA

Design Notes: Pages 7-9
CUI explains the latest EU CoC Tier 2 efficiency standards, plus SiC MOSFETs from Microsemi

Application Spotlight: Pages 10-25
Compact 6W-rated DC-DC converter modules from RECOM fit in space-constrained designs

Technical View: Pages 26-27
ROHM Semiconductor: Reduce the size and cost of an auxiliary power supply with SiC technology

Application Spotlight on:

Power

In association with my-boardclub.com: the designers’ site for FREE development boards
New Murata supercap just 0.4mm high
Murata has introduced the world’s thinnest supercapacitor, which features a profile of just 0.4mm. The DMH414P0VS3E3MAT0 supercapacitor is intended for use in peak power-assist applications in wearable devices, smart cards, e-paper devices and other highly space-constrained products. The 4.5V device has a capacity of 3.5F.

Families of ARM core-based MCUs optimised for motor- and power-control applications

The Kinetics® V series of MCUs from NXP Semiconductors, based on the ARM Cortex-M0+, Cortex-M4 and Cortex-M7 cores, are intended for use in a wide range of motor-control and digital power-power-conversion applications.

Drawing on NXP’s extensive expertise in motor and power control, the Kinetics V series MCUs enable developers to realise secure, connected, high-efficiency designs. All the V series families are supported by a full enablement suite of software from NXP and third-party sources, including reference designs, software libraries and motor-configuration tools. These enablement resources include:

- Kinetics motor suite: supports three-phase Brushless DC (BLDC) and Permanent-Magnet Synchronous Motors (PMSM), providing a Fast-Directed Control (FDC) algorithm which is suitable for both sensorless and sensor-controlled motor implementations.
- Embedded software libraries: algorithms for mathematical, motor control and power conversion functions and for filters.
- Reference designs for PMSM, BLDC and AC induction motors.
- FreeMASTER GUI-based debug monitor and data visualisation tool.
- Kinetics software development kit, a software framework for application development.
- MGX™ real-time operating system.
- Processor Expert® Eclipse plug-in tool.

The 170201 for samples or pricing e-mail info@my-ftm.com
High-current connectors comply with flammability standards

The TE Connectivity’s (TE) power key connectors are rated for a continuous current of up to 7.5A. In the economy power II series, this maximum current value rises to 11A. Terminal Position Assurance (TPA) devices are available in the economy power II series. TPA helps to ensure that the contacts are fully seated in the housing. This helps to avoid downtime and costly service calls to repair equipment failures that are due to a back-out contact. In addition, a latch helps to prevent unintended disconnection. The two connector families offer a variety of housing and header styles and configurations in Glow Wire-compatible material.

10A power key connectors provide for easy assembly

The TE Connectivity (TE) power key connectors are wire-to-board connectors with a 5.0mm centreline for power circuits with a maximum current up to 10A. The connector system, which uses housing lances to prevent tangling of wired contacts, consists of plug housings for wires, and compact PCB header assemblies.

Inertia-locking connectors include features to help prevent half-mated connections

The GRACE INERTIA series of wire-to-board and wire-to-wire power connectors from TE Connectivity (TE) helps manufacturers and assemblers to avoid the risk of defects attributable to half-mated connections and other errors in assembly.

Make first, break last connector offers superior grounding performance

The TE Connectivity (TE) has added a product with Make First, Break Last (MFBL) functionality as part of its POWER TRIPLE LOCK line of connectors.

APPLICATIONS
• Household appliances
• Gas appliances
• Powercord applications
• Control boards

FEATURES
• 300V AC voltage rating
• Maximum current rating: 10A with AWG 16 wire and two contacts
• Operating-temperature range: -30°C to 105°C
• Wire sizes: AWG 24 to AWG 16
• UL recognised
• Some models comply with Glow Wire Test and UL 94 V-0 flammability standard

The three-position, wire-to-panel or wire-to-wire MFBL connector is based on a 6.0mm pitch. Like other POWER TRIPLE LOCK connectors, it is rated for 600V AC or DC, although the MFBL connector is limited to a 12A maximum current, as its contacts accept wire no larger than AWG 16.

APPLICATIONS
• Home appliances
• Commercial building equipment

FEATURES
• Low insertion force
• Optional terminal position assurance device
• Tin-plated copper alloy contacts
• Compliant with glow-wire test requirements
• Operating-temperature range: -55°C to 105°C

In the MFLB, the MFBL connector offers unique features. Using TE’s proven POWER TRIPLE LOCK connector design, the MFBL connector can achieve easier assembly and more secure connections than other pin-and-socket connector solutions.
High power-density PN rectifier offers a 400V rating

The PNS40010ER, which benefits from high-efficiency planar technology, is notable for its high power density. It carries a maximum continuous forward current of 1.4A and withstands a maximum reverse voltage of 400V. Its average forward current rating is 1A at a switching frequency of 20kHz and an ambient temperature of up to 115°C. These superior power ratings are provided by a device which is packaged in a small, SOD123W surface-mount housing with flat leads. The device is able to withstand junction temperatures up to 175°C. Thermal resistance from junction to solder point is 15K/W.

APPLICATIONS
- General rectification applications
- Reverse polarity protection

FEATURES
- Standard switching time
- Low forward voltage
- Low reverse current
- Low-inductance package
- Package height typically 1mm
- AEC-Q101 qualified

NEXperia

Tiny low-voltage comparator for space-constrained applications

The TS985 from STMicroelectronics is a single-channel, low-voltage comparator which combines battery-friendly performance with enhanced dynamic range and high-speed operation. Housed in a six-bump chip-scale package with a footprint of less than 1mm², it is ideal for use in portable products in which board space is severely limited.

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- Low forward voltage
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STMicroelectronics

Design consideration in the use of SiC MOSFETs: on-resistance and the gate-drive circuit

Silicon Carbide (SiC) MOSFETs are being used more commonly in certain power-switching applications at voltages higher than 500V, especially in those that benefit from the higher switching speeds that SiC devices can support when compared to an equivalent Silicon (Si) MOSFET. In fact, there are many similarities between SiC MOSFETs and Si MOSFETs: both are enhancement-mode devices with body diodes, and they are much faster than IGBTs. In addition, the on-resistance of a SiC MOSFET increases with temperature just as the on-resistance of an Si MOSFET does, but not by as much.

And in both types of device, the switching speed is governed mostly by the speed at which the gate charge is removed or added. The speed limit is determined by the output capacitance and the ability of the device to source high currents. There are, therefore, important differences between SiC and Si MOSFETs:

- SiC MOSFETs have a lower on-resistance than Si MOSFETs. They are normally driven at a higher gate voltage, in the range -5V to +20V, to keep on-resistance to a minimum and increase switching speed.
- The body diode of a SiC MOSFET has a high voltage drop of around 4V, but a low minority carrier lifetime. They have a significantly faster reverse recovery time and a lower recovery charge than those of silicon MOSFETs.
- The output switching current, di/dt, is considerably higher in SiC MOSFETs than in Si MOSFETs. This affects DC bus ringing, EMI, and output-stage losses.
- The slew rate at the output of a SiC half-bridge can be much higher than when using a Si MOSFET. SiC power stages can easily switch at a di/dt of 10-20A/µs. This should be considered in the design of the gate driver's signal isolation, gate power isolation, and EMI mitigation.
- SiC MOSFETs, then, offer considerable benefits in the operation of high-voltage and high-speed power-conversion circuits. Two particular aspects of a SiC MOSFET-based circuit's operation are discussed in this Design Note.

The effect of temperature on on-resistance

Figures 1-3 show the different effects of temperature on on-resistance in SiC and Si MOSFETs. The behaviour of electron mobility in Si MOSFETs is dominated by thermal scattering. Figure 1 shows that, from 25°C to 150°C, on-resistance increases by around 2.7 times. Figure 2 is typical of a Microsemi 1,200V SiC MOSFET. There are two scattering mechanisms affecting electron mobility, with the resulting benefit that from 25°C to 175°C, on-resistance only varies typically from about 1.5 to 1.8.

A Microsemi 700V SiC MOSFET's behaviour is slightly different, as shown in Figure 3.

Gate drive considerations

The design of a SiC MOSFET gate driver is much like the design of a standard IGBT or Si MOSFET driver. Most of the features and practices are the same:

- Asymmetrical high gate drive current keeps switching losses to a minimum
- Secondary-side power monitoring and short-circuit protection might both be useful

Due to the higher speed of SiC MOSFETs, the capacitance of the gate-drive interface should be kept to a minimum. At 50V/ns, 5pf of interface capacitance results in 250mA current pulses. On the control side, these current pulses should be directed away from cables or control electronics by bypassing to a chassis or other filtering structure.

The power supply that supplies the gate-drive power should be rated for at least 50V/ns. Most are not, but a good option is RECOM's Rex2000 Series of DC-DC power supplies, which are intended for use with SiC MOSFETs. The gate driver itself should support bipolar operation, and should also support >50V/ns speeds.

More detail on this, and on other aspects of the use of SiC MOSFETs, may be found in Microsemi's Full Application Note 1826, available at www.microsemi.com from February 2017.
Understanding the latest changes to the laws governing external power supplies

People today are familiar with the challenges associated with our use of energy, and in particular the need to control greenhouse gas emissions, legislators have been constantly increasing pressure on equipment suppliers to deliver products which use less and less power and which operate more and more efficiently. In February 2016, the US Department of Energy (DoE) enacted legislation requiring external power adapters marketed in the US to comply with international Level VI eco-design specifications. The dust has barely settled, and yet the European Union is now tightening the screw by publishing its new Code of Conduct (CoC) Tier 2 efficiency standards.

There is some history behind this leapfrog-style progress in environmental legislation. About two years ahead of the US move to Level VI, the EU in 2014 introduced CoC Tier 1 as a voluntary standard. CoC Tier 1 specifies efficiency and power limits that are only slightly less stringent than Level VI, but also requires an extra efficiency measurement to be taken at 10% of full load. This presents a tough challenge to designers, as power supplies are known to exhibit their poorest efficiency at such low loads. CoC Tier 1 is intended to encourage a design review by the suppliers, with the expectation that it will become mandatory during 2017. In 2018 CoC Tier 2 is expected to come into force, further tightening the no-load power, average efficiency and 10% load specifications, and effectively setting the bar higher than Level VI.

Efficiency standards: a brief history

For the full story of the regulations governing external power supplies, it is necessary to go back to the 1960s when the US Environmental Protection Agency first implemented voluntary standards. In the early 1990s and the US ENERGY STAR initiative, ENERGY STAR began as a voluntary labelling programme for products such as computer peripherals and white goods. A short while later a University of California Berkeley Laboratory study found that by operating of domestic appliances accounted for 5% of the nation’s residential electricity consumption.

At the time, the external power supply was considered a prime culprit, and it was estimated that it was more than one billion external power supplies active in the US alone. The operating efficiency of the linear technology used then was often as low as 50%. Worse still, power continued to be drawn even when the end equipment was turned off or disconnected. Researchers feared that the growth in use of such external power supplies could lead to wasteful power use account for as much as 30% of all electrical energy consumption, if nothing was done to reduce the losses. Legislation was considered necessary to require equipment manufacturers to respond adequately. Accordingly, in 2004, the California Energy Commission became the first to implement mandatory energy efficiency standards.

Since that time, various authorities around the world have introduced a succession of standards, some voluntary and others mandatory, which imposes tighter and tighter requirements on the efficiency of external power supplies. Figure 1 illustrates the sequence of events. It not only brings us to the present but also shows what OEMs should be expecting in 2017 and 2018.

Challenges faced by OEMs

While these standards might benefit the consumer and the environment, they present a considerable challenge to both the manufacturer of the external power supply and the OEM which pair it with its end-product. For the power-supply manufacturer, the technical challenge of meeting the efficiency specifications becomes ever more complex with each successive regulation. For the OEM, the compliance of the countries where the power supply is used involves a number of logistical and supply-chain challenges. These difficulties are amplified because, despite attempts to harmonise standards across the globe, their development and adoption has in reality proved to be a game of leapfrog as countries or regions seek to catch up with and then surpass their neighbours.

In practice this means that OEMs which want to avoid the complexity of maintaining different product configurations for different geographic markets need to ensure their external power supplies meet the latest and most stringent standards worldwide. EPS manufacturers, for their part, must employ leading-edge design techniques to comply with evolving standards and keep their product lines ahead of the wave of changes.

CoC Tier 2 regulations

The CoC Tier 2 standard significantly lowers the already tight limits set by the DoE’s Level VI standards. A supply with a nameplate rating between 48W and 250W, which has a maximum no-load power of 210mW under Level VI and 250mW under CoC Tier 1, will have to consume less than 150mW to satisfy the requirements of CoC Tier 2. Figures 2 and 3 present a comprehensive list of the Tier 2 specifications. Here, average efficiency is the mean of active efficiency measured at 25%, 50% and 75% of full load; load efficiency is measured at 10% of full load.

Changes to be expected in future

Globally, it is expected that other nations will soon follow the lead set by the DoE Level VI standard. It should also be expected that countries with existing efficiency regulations previously in line with the US, such as Canada, will move to harmonise with the newer US and European standards.

The US Environmental Protection Agency estimates that external power-supply efficiency regulations implemented over the past decade have reduced energy consumption by 32 billion kWh, saving $2.5bn annually and reducing CO2 emissions by more than 24 million tonnes per year.

Further, some OEMs are now starting to demand greener power supplies as a way to differentiate their end-products, pushing efficiencies continually higher.

OEMs therefore need to future proof their external power supplies to ensure that they meet these new CoC Tier 2 standards. CUI has already done everything needed to adapt its circuit topologies to meet efficiency requirements at all load levels, using advanced devices, high-efficiency topologies and reduced switching frequencies under light and no-load conditions.

The company has further qualified the majority of its Level VI line to also conform with the more stringent CoC Tier 2 standards. In the future, CUI will continue to implement the latest energy-saving technologies into its external power supplies in order to comply with current and future standards as the regulatory landscape continues to evolve.

CUI INC

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Power controller for LED lighting offers high power factor, efficiency and reliability

STMICROELECTRONICS

Operating directly from the rectified mains, STMicroelectronics’ HVLED001A quasi-resonant controller for LED lighting integrates both high- and low-voltage circuitry on the same chip, eliminating the cost of external high-voltage components.

Offering a high power factor greater than 0.9, low total harmonic distortion of less than 10%, and high conversion efficiency of more than 90%, the HVLED001A helps lighting equipment manufacturers to comply with stringent standards governing lighting fixtures.

ST’s HVLED001A is an enhanced peak-current-mode controller capable of controlling flyback or buck-boost topologies in LED drivers that have an output power of up to 150W. Other topologies, such as buck, boost and SEPIC, can also be implemented.

ST’s innovative high-voltage silicon technology allows for direct connection of the

HVLED001A to the input voltage to start-up the device and to monitor the input voltage, without the need for external components. The device embeds advanced features to control either the output voltage or the output current precisely and reliably using few, mainly passive components. It also controls operation of the power circuit under abnormal conditions such as an open circuit, output short-circuit, input over-voltage or under-voltage, open loop or over-current.

The devices in the TO-252 (DPAK) package.

600V and 650V MOSFETs feature low-inductance package

VISHAY

Vishay Intertechnology has extended its offering of 600V and 650V E series power MOSFETs with three N-channel devices in the compact, surface-mount PowerPAK SO-8L package. The devices benefit from reduced package inductance.

Measuring just 5mm x 6mm, the SHJN60E, SHJN65E, and SHJN76E MOSFETs provide a space-saving and reliable alternative to MOSFETs in the TO-252 (DPAK) package. The devices occupy only half as much board space as TO-252 devices, and are half as high. Also, the gating leads of the PowerPAK SO-8L package result in better board-level reliability than MOSFETs in leadless DFN packages.

This allows Vishay’s energy-efficient E series superjunction technology, the SHJN60E, SHJN65E, and SHJN76E feature a low product of gate charge and on-resistance, a key figure of merit for MOSFETs used in power-conversion applications. The MOSFETs produce extremely low conduction and switching losses, helping designers to reduce power consumption in PFC, flyback and two-switch forward converters, and in hard-switched topologies for High-Intensity Discharge (HID) and LED lighting.

IGBT gate driver integrates multiple protection features

ON SEMICONDUCTOR

The NCD5700 is a high-current, stand-alone IGBT gate driver for high-power applications which helps designers to realise a cost-effective system by eliminating the need for many external components.

It integrates multiple protection features including an accurate under-voltage lock-out function, an Enable input and an Active Low fault output. The NCD5700’s active Miller clamp prevents spurious gate turn-on events. In addition, its desaturation protection includes a programmable delay.

The device features an accurate 5.0V output. Separate high and low driver outputs ease system design. A high current output of 44+/6A at IGBT Miller Plateau voltages reduces switching losses and keeps switching times short.

The driver is designed to accommodate a wide range of bias voltages including unipolar and bipolar inputs.

40V, 0.5A Schottky barrier rectifier has a low forward voltage

NEXPERIA

The PMEG4005CEA from Nexperia, the discrete power components business recently spun-off from NXP Semiconductors, is a planar Schottky barrier rectifier with a low forward voltage. This makes it suitable for low-voltage rectification and for applications in which power-conversion losses must be kept to a minimum.

The PMEG4005CEA is housed in a SOD323 (SC-74) surface-mount package which has a footprint of just 1.9mm x 1.35mm. It features an integrated guard ring for stress protection.

The rectifier is rated for a maximum reverse voltage of 40V, and an average forward current of up to 0.5A at a switching frequency of 20kHz and a temperature of up to 135°C. Typical forward voltage is just 500μA, measured at a pulsed forward current of 500mA and a junction temperature of 25°C.
High-performance buck regulators aimed at high-voltage applications

Semtech has announced an extension to its high-voltage power-management platform with the introduction of the TS3004x family of integrated switching buck regulators. The new product family is aimed at high-performance applications that operate from an input voltage of up to 40V, in markets such as industrial, telecoms and consumer equipment.

The TS3004x product family is comprised of the TS30040 and the TS30042 DC-DC synchronous switching regulators. The TS30040 has a maximum continuous output current rating of 1A, and the TS30042 is rated for 2A. The devices are available with a range of fixed output-voltage choices: 1.0V, 1.8V, 2.5V, 3.3V and 9V, with ±2% output tolerance.

There is also an adjustable version which provides an output voltage ranging from 0.9V up to 1V lower than the input voltage. All the TS3004x products, which implement current-mode PWM control, have integrated power switches and robust fault-protection features. They run in pulse-width-modulation mode for improved efficiency at light loads.

The TS3004x regulators help designers to realise compact power-management designs, as they are housed in a small 16-pin QFN package with a 3mm x 3mm footprint.

Boost LED driver features programmable dimming function

Brightness control is implemented by the AL3050 via either PWM or single-wide digital dimming, giving accurate LED current control from one pin.

The AL3050 offers under-voltage lock-out, over-voltage, over-current and thermal protection functions.

SL Power Electronics has introduced the new TB1110 series of internal power supplies, part of its comprehensive range of power solutions for noise-sensitive test and measurement equipment.

The new TB1110 series models offer up to 90% efficiency, and are available in a small 2.0” x 4.2” x 1.4” form factor, ideal for use in 1U chassis applications. They comply with the most stringent requirements of the EN61000-4-1 standard, to enable designers to readily implement power systems that comply with EMC regulations. They meet the Class B requirements for conducted EMI with a dB6 margin, and for radiated EMI with a dB3 margin. The products also offer 4kV surge immunity. Long life and reliability are achieved with notable features of the TB1110 series. Mean time before failure at a temperature of 50°C is calculated to be longer than 1 million hours. In addition, capacitor life is rated at longer than 15 years at an ambient temperature of 40°C. Operating from an input voltage range of 90V-264V AC, the TB1110 products supply up to 110W of output power with airflow, and 80W when convection-cooled.
60V N-channel logic-level MOSFET has low leakage current

**APPLICATION SPOTLIGHT – POWER**

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**APPLICATIONS**
- Point-of-load power supplies in telecoms servers
- Industrial products
- Industrial computing equipment
- Consumer electronics devices

**FEATURES**
- Switching frequency selectable in a range from 100kHz to 1MHz
- 95% peak efficiency
- <10µA shut-down current
- <250µA operating current when enabled but not switching
- User-programmable soft start
- Cycle-by-cycle current limit

**ON SEMICONDUCTOR**

The FCH023N65S3L4 from ON Semiconductor is a SuperFET® III 650V MOSFET which uses advanced superjunction technology to achieve extremely low on-resistance and low gate charge.

- **Applications**
  - Telecoms equipment
  - Server power supplies
  - Industrial power supplies
  - Uninterruptible power supplies
  - Solar energy-generation equipment

- **Features**
  - 1.98nF effective output capacitance
  - 100% avalanche tested
  - 2.025J maximum single pulsed avalanche energy
  - Operating temperature range: -55°C to 150°C
  - 0.21°C/W junction-to-case thermal resistance

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**VISAY**

The SiC462 from Vishay is a synchronous buck regulator with integrated high-side and low-side power MOSFETs. Its power stage is capable of supplying a continuous current of 6A at a switching frequency of up to 1MHz.

The regulator produces an adjustable output voltage as low as 0.8V from a wide input-voltage range of 4.5V-60V. The SiC462’s architecture provides for ultra-fast response to voltage transients with a small requirement for output capacitance. Tight ripple regulation is maintained at very light loads.

- **Applications**
  - Point-of-load power supplies in telecoms servers
  - Industrial products
  - Industrial computing equipment
  - Consumer electronics devices

- **Features**
  - Optimised for 4.5V gate-drive applications
  - 150°C maximum junction temperature
  - Exposed leads can be wave soldered
  - Low parasitic inductance and resistance

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**NEXPERIA**

The PSMN1R0-40YLD from Nexperia, the discrete power components business recently spun-off from NXP Semiconductors, is a 40V logic-level MOSFET which is notable for its soft switching and low leakage current.

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**VICOR**

The FCH023N65S3L4 from ON Semiconductor is a SuperFET® III 650V MOSFET which uses advanced superjunction technology to achieve extremely low on-resistance and low gate charge.

- **Applications**
  - Telecoms equipment
  - Server power supplies
  - Industrial power supplies
  - Uninterruptible power supplies
  - Solar energy-generation equipment

- **Features**
  - 1.98nF effective output capacitance
  - 100% avalanche tested
  - 2.025J maximum single pulsed avalanche energy
  - Operating temperature range: -55°C to 150°C
  - 0.21°C/W junction-to-case thermal resistance

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**EASY RELIABLE PREDICTABLE**

- Integrated power modules from 25 W to over 1,000 W
- Input operating voltages from 8 V to over 420 V (per module)
- DC-DC Converter Modules
  - Isolated, Regulated
  - Non-Isolated, Fixed Ratio
  - Isolated AC-DC Converters with PFC

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**170222** For samples or pricing e-mail info@my-ftm.com

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**APPLICATIONS**
- Telecoms equipment
- Server power supplies
- Industrial power supplies
- Uninterruptible power supplies
- Solar energy-generation equipment

**FEATURES**
- Optimised for 4.5V gate-drive applications
- 150°C maximum junction temperature
- Exposed leads can be wave soldered
- Low parasitic inductance and resistance
New digital controller for wireless battery-charger transmitters

The STWDBC-WA from STMicroelectronics, a digital controller IC for wireless battery-charger transmitters, has been optimised for use in wearable devices.

The STWDBC-WA, which has a rated input-voltage range of 3.5V-5.5V, is ideally suited for operation from the 5V USB power supply which is available device chargers use. It is suitable for charging applications using less than 3W.

The power transmitter unit is responsible for controlling the transmitting coil and generating the correct amount of power requested by the receiver unit. This ensures the highest possible level of end-to-end efficiency, keeping power losses to a minimum. It also helps the charging system to maintain a low operating temperature.

The digital wireless battery transmitter can adapt to the amount of energy transferred by the coil by modulating the frequency, duty cycles or coil input voltage.

ROHM SEMICONDUCTOR

ROHM Semiconductor has announced a new 1.7kW silicon carbide (SiC) MOSFET intended for industrial applications, including manufacturing equipment and high-voltage inverters.

ROHM is expecting particularly high demand for the SCT2H12NZ in auxiliary power-supply designs in industrial equipment such as motor drives and the inverters in photovoltaic (PV) energy generators. By combining the SCT2H12NZ with ROHM's BD7682FJ-LB power controller, as featured on page 21, designers can realise an auxiliary supply unit which offers robust performance and which improves efficiency by up to 6% compared to systems based on silicon MOSFET power switches.

The SCT2H12NZ combines a high breakdown voltage with low on-resistance of 1.15Ω. The device's TO-3PFM package allows for a 36-75V input-voltage range and a maximum junction temperature of 175°C, which was recently spun-off from NXP Semiconductors, is an N-channel logic-level MOSFET housed in a compact LFPAK33 (Power33) package.

SiC MOSFET offers size and efficiency benefits in auxiliary power supplies

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New switching regulator supplies digital components from 4-20mA loop

RECOM

RECOM has launched the R420-1.8/PL switching regulator, which is intended to be used to supply microprocessors and microcontrollers from a 4-20mA loop.

The benefits of the flat module include its very low stand-by power consumption, and its high conversion efficiency in normal operation. The analogue 4-20mA loop is commonly used in process and control technology, because of its simple two-wire topology, which is reliable and easy to install. The unused portion of the loop current may be used to supply digital components. This calls for regulation to step the input from the 4-20mA loop down to the level required by a digital component.

Conventional switching regulators, which offer high efficiency at full load, are unsuitable as their poor conversion efficiency at low loads means that they are incapable of meeting the output-power requirements from a 4mA input. Linear regulators are also unsuitable: their poor efficiency decreases the power available from the 4-20mA supply by a factor of around three compared to switching regulators.

To solve this problem, RECOM developed the R420-1.8/PL switching regulator, which draws a stand-by current of just 100µA while maintaining the rated output voltage. For example, from a 24V DC input sourcing less than 3.5mA, the R420 can provide a 10mA output at 3.3V. This is enough to supply a sensor alongside an MCU and HART modem without affecting the loop’s functionality or the accuracy of the measurement instrument connected to it.

50A power relays switch high lighting and motor loads

DJ-H relays from Panasonic are flux-resistant 39mm x 30mm x 15mm package

The DJ-H series from Panasonic are latching power relays which are suitable for lighting and motor loads.

The relays are able to handle high in-rush currents, such as TV-20 class tungsten lighting loads, and NEMA410 standard electronic ballast loads. They are also suitable for use with capacitive loads which comply with the IEC 60669-1 standard.

The DJ-H relays are housed in a flux-resistant package measuring 39mm x 30mm x 15mm. They are supplied in single-coil and double-coil versions, and in Standard and Manual Switch types with voltage ratings of 5V, 12V or 24V DC.

The single-coil versions have a power rating of 1W and the double-coil versions have a power rating of 2W.

Digital multiphase power solutions for 10A to 450A applications

Easy-to-use digital multiphase controllers coupled with our smart power stage technology provide scalable solutions from 10A to 450A.

- Full telemetry data, monitoring and control with PMBus™ 1.3 and AVB®* support for smart, energy-efficient systems
- Patented synthetic current control tracks phases with zero latency to respond to any load with precise current and voltage positioning, requiring 30% less capacitance than competitive devices
- PowerNavigator™ GUI software tool allows you to quickly optimize your configuration and easily store it in non-volatile memory
New technology lowers on-resistance to 1.35mΩ in low-voltage MOSFETs

VISHAY

Vis shy's TrenchFET® Gen IV series of low-voltage MOSFETs features advanced transistor technology which produces very attractive energy-saving characteristics for designers striving to increase the efficiency of power-conversion applications.

The TrenchFET Gen IV MOSFETs are particularly notable for their low on-resistance. In the SRA00DP 30V N-channel MOSFET, for instance, on-resistance is rated at a maximum 1.30mΩ at a gate-source voltage of 4.5V, when sinking a current of 15A. When the gate-source voltage rises to 10V and the current to 20A, this on-resistance value falls even further, to 1.00mΩ.

The devices in the TrenchFET Gen IV series also offer very low gate charge values: in the SRA00DP, total gate charge is just 66nC at a gate-source voltage of 4.5V and a drain current of 20A. In addition, the ratio of gate-source charge to gate-drain charge is as low as 0.3 in TrenchFET Gen IV MOSFETs. This low ratio can help to prevent shoot-through by lowering gate-induced voltages. The PowerPAK® packages in which TrenchFET Gen IV devices are housed offer excellent thermal characteristics, and allows for the design of systems with high power density.

Power MOSFET features low on-resistance and gate charge

ON SEMICONDUCTOR

ON Semiconductor’s NTMFSH600NL is a 60V N-channel power MOSFET which is capable of supplying a continuous drain current of 250A at a case temperature of 25°C.

The NTMFSH600NL’s low on-resistance of 1.3mΩ helps to keep conduction losses to a minimum in the power-conversion applications for which it is intended, such as point-of-load modules, high-performance DC-DC converters and secondary non-synchronous rectification circuits.

In addition, low total gate charge of 40nC at a gate-source voltage of 4.5V and a drain current of 50A reduces losses in the MOSFET driver circuit. The device is housed in a compact five-terminal dual flat no-lead package with a 5mm x 6mm SD-8 footprint.

1,200V SiC MOSFET provides stable, efficient performance at up to 200°C

STMICROELECTRONICS

The SCT50N120 Silicon Carbide (SiC) power MOSFET family extends the STMicroelectronics family of robust and efficient SiC power semiconductors. It features a maximum breakdown voltage of 1,200V and a maximum continuous-current capability of 65A at a case temperature of 25°C, and 50A at 100°C.

The high efficiency of the SCT50N120 is due in large part to its low on-resistance, which is rated at 5.5mΩ at a junction temperature of 150°C when sinking 40A. Switching performance is also consistent, benefiting from highly stable turn-off energy and gate charge over the full temperature range up to the maximum junction temperature of 200°C. The resulting low conduction and switching losses, combined with ultra-low leakage current, simplify thermal management and improve the reliability of the circuit.

Quasi-resonant power controller enables soft switching at high frequency

ROHM SEMICONDUCTOR

ROHM Semiconductor’s BD768xFJ is a series of DC-DC controllers which operate in quasi-resonant mode to provide for soft switching and low EMI.

When incorporated into power converter designs with an external MOSFET power switch and current-sense resistor, a BD768xFJ device offers the user a great deal of flexibility to match the performance of the circuit to the requirements of the application. The BD768xFJ controllers can switch an external MOSFET at frequencies up to 120kHz, and go into burst-mode operation at light loads in order to enhance efficiency and conserve power. In addition, the controller itself draws just 1.9µA in standby mode.

The BD768xFJ series has been specifically designed to drive Silicon Carbide (SiC) MOSFETs, which are becoming an increasingly popular choice for the power-switch function in power converters with a high AC or DC input voltage. The ROHM controller includes a gate-clamp circuit for optimal driving of SiC MOSFETs, and a valley-detection function to keep switching losses and electro-magnetic emissions to a minimum.

A built-in brown-out function monitors the input voltage level. The BD768xFJ is featured in the Technical View on page 26.
Isolated DC-DC converters in a rugged package operate at high efficiency

CUI INC

CUI Inc has added to its line of isolated DC-DC converters with the introduction of three new encapsulated models with power outputs ranging from 10W to 30W.

The 10W PDQ10-D, 15W PDQ15-D and 30W PDQ30-D are supplied in an industry-standard 1” x 1” encapsulated package, enabling users to save space in end product designs by replacing equivalent 1” x 2” modules. The converters’ low-profile, rugged DIP package has a five-sided, shielded metal case. The PDQ modules are available in versions which provide a single regulated output voltage of 3.3V, 5V, 12V or 15V DC or dual regulated output voltages of ±5V, ±12V or ±15V DC, and with an input-voltage range of either 9V-36V DC or 18V-75V DC. Typical conversion efficiency is as high as 90%.

Featuring a broad operating-temperature range of -40°C to 105°C, the PDQ-D series is suitable for convection-cooled equipment and may be used in harsh environments. All PDQ-D models offer input-to-output isolation of 1,500V DC, while the single-output models also offer output-voltage trimming which allows for a ±10% adjustment of the nominal output.

Miniature rechargeable NiMH button cells suited to battery back-up applications

VARTA MICROBATTERY

VARTA Microbattery offers four series of rechargeable Nickel Metal Hydride (NiMH) button cells, giving designers a choice of energy-storage devices optimised for robustness, high-temperature operation at up to 85°C, or high power output.

The smaller NiMH cells are particularly well suited for use as a battery back-up for the Real-Time Clock (RTC) devices found in many types of electronic systems. For instance, the small V6 HR cell is highly reliable, offers a nominal capacity of 6mAH, and has a 2.15mm high, easily fits on space-constrained circuit boards alongside low-profile surface-mount semiconductor components. Tolerant of a 0.18mA continuous over-charge current, the V6 HR enables the designer to implement a simple charging circuit which continuously trickle-charges the cell.

All VARTA NiMH button cells include a built-in pressure vent to guarantee safe operation in the event of mis-treatment. The cells also have a low rate of self-discharge, which means that they are ready for use without charging or special handling procedures even after an extended period of storage.

It is an inherent property of batteries that their capacity declines with use: the VARTA NiMH button cells have an extended product lifetime of more than 1,000 cycles.

The four series of NiMH button cells are:

• V.H. series – robust cells with a discharge capability of up to 2CA.
• V.HF series – robust cells with high-temperature capability. Discharge capability of up to 2CA.
• V.HR series – high-rate button cell with a discharge capability of up to 5CA.
• V.HRT series – high-rate, high-temperature button cell with a discharge capability of up to 5CA.

All cells are UL recognised.

Regulated 6W DC-DC converters offer high power density

RECOM

RECOM’s new RS6 series of 6W-rated DC-DC converter modules is intended for use in space-constrained applications which require high power density.

The modules feature power density of 2.7W/cm², and will operate at full load across a wide temperature range from -40°C to 70°C. Output accuracy is rated at ±1%. The new RS6 DC-DC converters have a 2:1 input-voltage range at nominal voltages of 5V, 12V and 48V DC. Housed in a 21.8mm x 9.2mm x 11.1mm package, they are pin-compatible with the RS6, RS and RS3 models, providing for easy upgrading without the need to change the PCB design.

The RS6 module is available in versions with a single 3.3V, 5V or 12V DC output. Dual-output versions rated at ±5V, ±12V and ±15V DC are also available. A Trim pin allows for accurate matching of the output voltage to the load requirement.

The RS6 series devices offer high efficiency at both full and low loads. At full load, conversion efficiency is up to 88%. Even at 30% load, efficiency can be as high as 80%.

Features:

• Low-voltage rectification
• Automotive LED lighting
• DC-DC converters
• Switch-mode power supplies
• Reverse-polarity protection
• Low-power applications

Applications:

• Industrial equipment
• Test and measurement equipment
• Battery-powered products

Applications: 2000VA, 1500W

For samples or pricing e-mail info@my-ftm.com
Rugged DC-DC converter modules suitable for military applications

NetPower offers various series of rugged DC-DC converter modules which are intended for use in harsh environments.

The rugged converters offer input/output conversion ratios of 8:1, 4:1 and 2:1, and provide power outputs up to 1kW. The modules are available in sizes ranging from a thirty-second brick to full brick.

One of the NetPower series of DC-DC converters is the EYRS1, a one-eighth brick which offers an input-voltage range of 9V-36V. Four variants of the product are available offering an output voltage of 5V, 12V, 15V or 28V.

Heat distribution inside the encapsulated package is carefully managed to ensure even and sufficient heat dissipation. The standard operating-temperature range is -40°C to 100°C, but an extended temperature range is also available, providing for operation at temperatures as low as -50°C.

The NetPower converter modules all offer built-in protection against input under-voltage, output over-voltage, over-current and short-circuit conditions, and over-temperature.

20V N-channel trench MOSFET supports very fast switching

It is capable of supporting very fast switching operations. Turn-on delay time is rated at 8ns, and rise time at 35ns. The turn-off delay time is 500ns and the fall time is 14ns.

The PMV28UNEA from Nexperia, the discrete power components business recently spun-off from NXP Semiconductors, is an N-channel trench MOSFET in a small SOT23 (TO-236AB) surface-mount plastic package measuring 3.0mm x 1.4mm.

AEC-Q101 qualified, the PMV28UNEA is intended for use in automotive applications. It is rated for operation at junction and ambient temperatures ranging from -55°C to 150°C, and can handle a drain current of up to 4.7A at an ambient temperature of 25°C. On-state resistance under these conditions is 24mΩ, and total gate charge is 6.2nC.

Motor-control development board supports sensed and sensorless designs

The FRDM-KV102 from NXP Semiconductors is a development platform for users of the Kinetics® VX1 series of microcontrollers. The KV102 MCU is based on the ARM® Cortex®-M0+ processor core, have the features and performance required to implement sensed or sensorless control of a Brushless DC (BLDC) motor or a Permanent Magnet Synchronous Motor (PMSM).

The FRDM-KV102 kit is supplied with a KV102 MCU-based development board, a quick reference card and a USB A-to-MicroB cable. Alongside the FRDM-KV102 kit, developers can use NXP’s FRDM-MC-1BLDC, a three-phase BLDC motor kit for the Freedom platform. The board includes an output and a Linear 42V/24V-40 motor with wiring for the three motor phases and Hall-effect sensor signals.

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AC-DC converter IC helps users comply with tough light-load power regulations

STMicroelectronics

The VIPer01 from STMicroelectronics is a high-voltage converter which includes a logic-level 800V avalanche-rugged power MOSFET and a PWM control circuit for a current-mode controller.

The logic-level power MOSFET technology enables the VIPer01 to operate from a supply of just 4.5V and enables the design of ultra-efficient power supplies with a 5V output. Moreover the 800V technology allows the device to handle a very high AC input voltage.

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In pulse-frequency consumption and operates as it has very low power consumption standards, which have to comply for use in end-products.

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How to use a SiC MOSFET operating in quasi-resonant mode to cut the size and cost of auxiliary power supplies

A power converter used in an industrial system such as a photovoltaic (PV) inverter, Uninterruptible Power Supply (UPS) or industrial motor drive will normally include an auxiliary supply unit which supplies power to system peripherals such as a microprocessor, LCD display, sensors and fans, as well as to the gate drivers inside the main power circuit.

Auxiliary supply units commonly support loads of up to 40W, and provide an output at a low DC voltage. The standard topology used in these circuits is flyback, and in three-phase systems they will typically operate from an input voltage of up to 480V AC or 900V DC.

Such a system places considerable demands on the auxiliary supply unit’s power switch. Taking into account the reflected voltage in the primary side, which is added during the blocking state, a power switch with a breakdown voltage of more than 1,500V is normally required. The use of standard silicon MOSFETs for this application entails considerable problems. The designer is faced with one of two undesirable options: either to connect several lower-voltage devices in series, which increases the system’s complexity, size and component count; or to use a 1.5kV silicon MOSFET, a device type which suffers from high power losses which require a bulky and expensive heat-sink.

The adoption of a high-voltage Silicon Carbide (SiC) MOSFET in place of a single silicon MOSFET eliminates these drawbacks. SiC MOSFETs with a 1.7kV rating are available now from ROHM Semiconductor in surface-mount (TO-268-2L) and fully moulded, isolated (TO-3PFM) packages, as shown in Figure 1. The devices feature an extended creepage distance of 5mm and 5.45mm respectively.

ROHM Semiconductor

To show the superior characteristics of an auxiliary supply unit based on a SiC MOSFET, ROHM has developed an evaluation board which may be used to supply peripheral devices in a power converter, and which supports loads up to 40W at an output voltage of 12V. Based on the flyback topology, this AUX Evaluation Board includes the SCT2H12NZ, a 1,700V SiC MOSFET, as the main switch, and the BD7682FJ-LB, a quasi-resonant flyback controller. This controller’s operation helps to keep the dynamic losses in the SiC MOSFET to a minimum, thus reducing its operating temperature.

The board operates from both AC and DC inputs, drawing power either directly from the mains or from the DC portion of the power supply, such as after the PFC stage. For mains-supplied designs, the input-voltage range is wider: from 210V to 690V AC. This is useful in UPS and industrial drives, which commonly supply the auxiliary power unit from the mains.

For DC-fed systems, the input range is 300V-900V DC. In PV inverters, this enables the auxiliary supply unit to draw power directly from the solar panels, or after the boost-conversion stage. The BD7682FJ-LB quasi-resonant controller used in the AUX Evaluation Board is a compact and effective solution intended to meet the requirements of a SiC MOSFET. It operates at a variable frequency of up to 120kHz; the frequency is adjusted in response to the load conditions.

The turn-on time is dynamically modified to ensure that the switch turns on in an oscillation valley. This minimises the switching losses in the SiC MOSFET, reducing its operating temperature and increasing system efficiency. When there is no load, the controller goes into burst mode to keep energy losses low.

Simple to use and housed in a compact SOP8-LJ8 package, the BD7682FJ-LB offers many functions and protection features:

- Current sense, implemented via a shunt resistor in series with the SiC MOSFET
- Overload protection configured by the current-sensing resistor
- Mask function: avoids erroneous sensing of the output voltage over the auxiliary winding
- Quasi-resonant control for low-dynamic losses and EMI
- Frequency-reduction mode to increase efficiency at light loads
- Burst operation in no-load conditions for low-current standby operation
- Output over-voltage protection
- Soft start
- Input brown-out protection
- Integrated SiC MOSFET driver

Measured system performance

Figure 5 shows the performance of the AUX Evaluation Board when operating at three DC input voltages: 300V, 600V and 900V. In each case, efficiency was measured across an output-power range from zero to the system’s maximum rated power of 40W. At the lowest 300V input voltage, overload protection was activated above 30W. At an input voltage of 300V, efficiency peaks at 87%. At higher input voltages, dissipation across the resistor dividers used in the circuit increases. This means that efficiency declines slightly as the input voltage increases. Nonetheless, efficiency remains above 80% across nearly all load conditions.

Over the entire load range at all three input-voltage values, the measured system efficiency is always above 80%.

The board consumes 170243 samples or pricing e-mail info@my-ftm.com (170243) Fast-track board request code: FTM72A

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There is a new name in Discretes, Logic and MOSFETs.

Nexperia is a dedicated global leader in Discretes, Logic and MOSFETs devices. Originally part of Philips and more recently NXP, we became independent at the beginning of 2017.

Focused on efficiency, Nexperia produces consistently reliable semiconductor components at high volume: 85 billion annually. Our extensive portfolio meets the stringent standards set by the Automotive industry. And industry-leading small packages, produced in our own manufacturing facilities, combine power and thermal efficiency with best-in-class quality levels. Built on over half a century of expertise, Nexperia has 11,000 employees across Asia, Europe and the U.S. supporting customers globally.

Introducing: Nexperia, the Efficiency Company.

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