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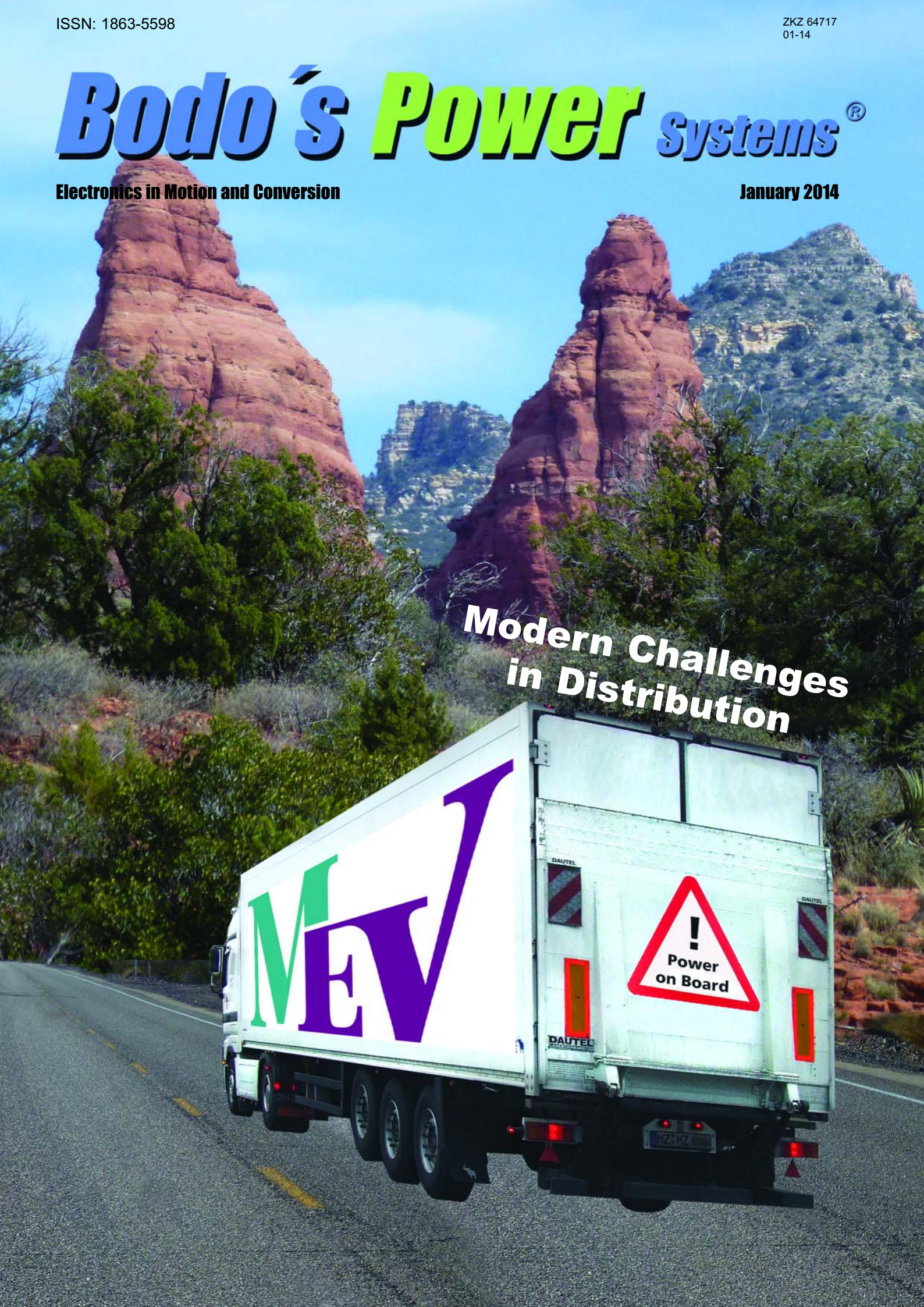
Bodo´s Power Systems®

Electronics in Motion and Conversion

January 2014

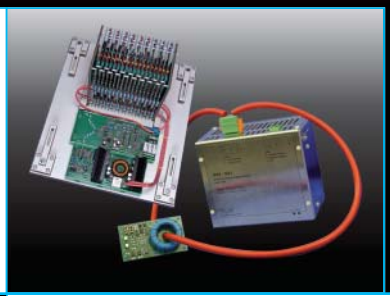
Modern Challenges in Distribution



High voltage?
RELAX!

Medium voltage components for power electronics

Does this sound familiar? Voltage increases, whenever it is least expected. Good for thrillers. Not so good for power electronic installations. That is why we developed our “ready-to-use switch components” based on IGBT and Thyristor technology, specifically for use in MV applications. They are even available with or without control or current loop feed power supply. So sit back, relax and look forward to an exciting conversation with your House of Competence. It's worth it.



- **MV IGBT DC switches**
- **MV Thyristor AC switches**
- **MV IGBT / Thyristor control**
- **MV current loop feed power supply**

engineered by

GvA Power Electronics

Welcome to the House of Competence.

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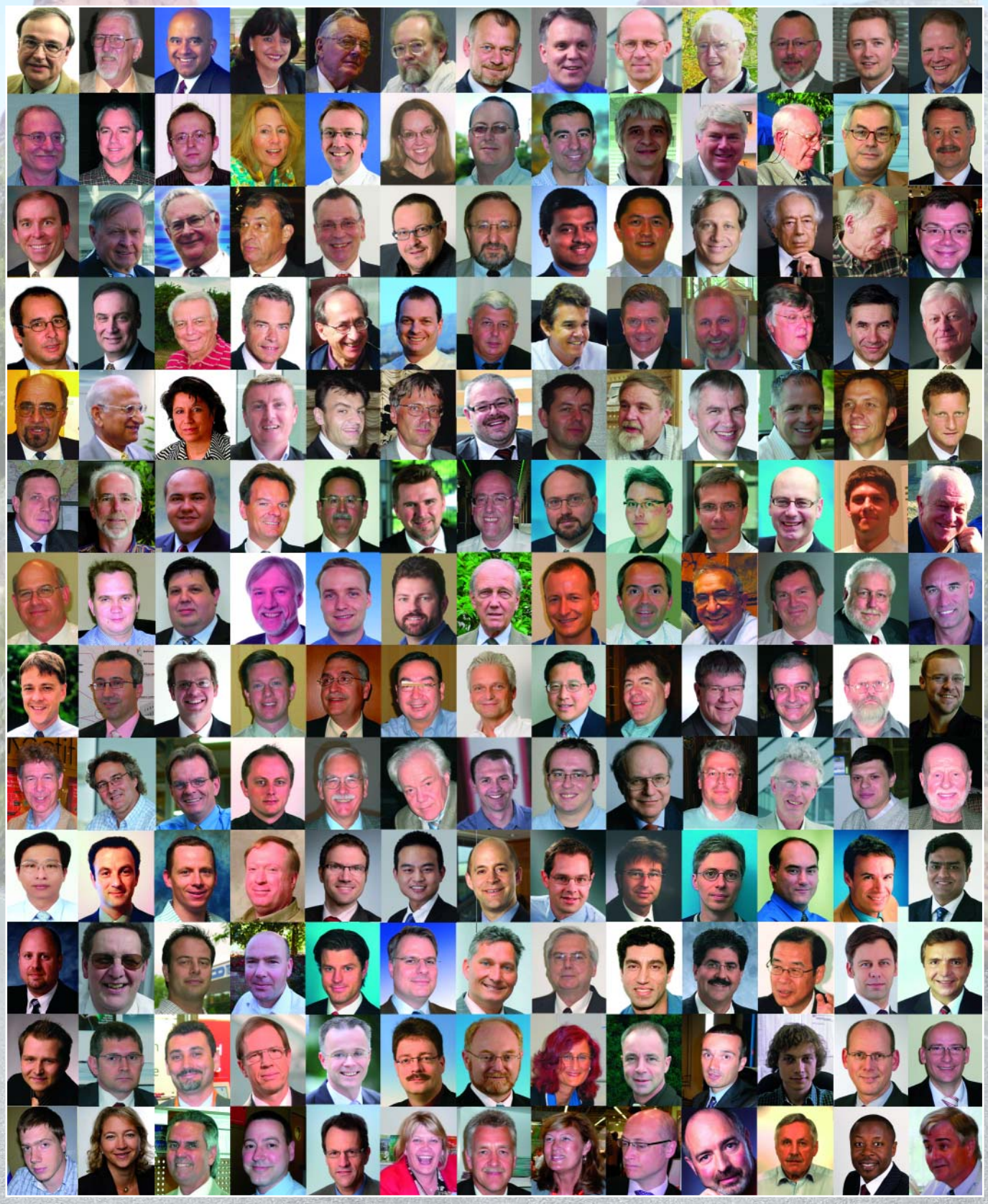
Phone +49 (0) 621/7 89 92-0 | www.gva-leistungselektronik.de | info@gva-leistungselektronik.de

Read online and search for key subjects from all articles in Bodo's Power Systems by going to Powerguru:

powerguru.org

The Gallery



One Source Solutions for your Power Modules

Cu-AlN & Al-AlN Substrates

Cu-AlN Substrates with superior bending strength > 650MPa
Al-AlN Substrates with excellent reliability (> 3.000 heat cycles from -40/+125 °C)

Power Sintering Paste

With high reliability (> 1.000 heat shock cycles from -55/+150 °C) for low pressure (< 8MPa) and pressureless Ag sintering

GaN HEMT Epiwafers on Si

With high breakdown voltage (1.000V) and low leakage current (1E-6A)

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Events

Cips 2014,
Nuremberg, Germany, February 25-27
www.cips-conference.de

Embedded World 2014,
Nuremberg, Germany, February 25-27
www.embedded-world.de

EMC 2014,
Duesseldorf, Germany, March 11-13
www.mesago.de/en/EMV/home.htm

APEC 2014, Fort Worth, Texas,
March 16-20 www.apec-conf.org/

APEX 2014,
Las Vegas, Nevada, March 25-27
www.ipcapexexpo.org/html/main/default.htm

battery university,
Aschaffenburg, Germany, March 25-27
www.batteryuniversity.eu

AMPER 2014, Brno Czeck,
March 18-21 www.ampr.cz

New Energy Husum 1014,
Husum, Germany, March 20-23
www.new-energy.de

Progress in SiC and GaN - Good Things for the New Year

Both of these semiconductor materials have been around for a while, but we are now seeing significant progress from several sources towards volume production.

The Rohm SiC Customer Forum drew a good picture of practical designs, the status of SiC wafer production, improving yields, and the move to larger wafer diameters. Wafer production, which has been seen as a bottleneck, has overcome its historical limits. SiCrystal gave an impressive description of its work in developing 150mm wafers at great yields. A lot of achievements in process technology have been made. All these have cost advantages and pave the way to large scale applications.

SiC devices show significantly lower switching losses leading to more efficient systems for many designs. As such, solar and wind power benefit from SiC inverters. Aviation and electro-mobility applications benefit from the reduced size and weight of these new systems. SiC MOSFET's and Diodes have been introduced in highly efficient pre-engineered modules and these reduce the development cycle-time for the system designer.

GaN is moving up to higher voltages, once seen as SiC territory. Transphorm has made significant progress with 600 Volt products serving line-voltage applications. At Delta Electronics' exclusive Power Design Engineering event in Shanghai, Transphorm presented their JEDEC-qualified, GaN (Gallium Nitride) on Silicon HEMT (high electron mobility transistor) products and applications based on its proprietary EZ-GaN™ technology. Transphorm's participation was the only external supplier invited to this event, where Delta shared technology insights across a variety of areas at its Hangzhou and Shanghai Design Centers. Recently, Fujitsu Semiconductor and

Transphorm announced that they have reached an agreement whereby the two companies will integrate their GaN power devices for power supply applications. This activity will improve the market acceptance of GaN devices.

Communication is the only way to progress. We delivered twelve issues last year, each month, on time, every time. In this January issue we've published 12 technical articles amongst 52 pages. As a media partner, Bodo's Power Systems serves readers across the globe. If you speak the language, or just want to have a look, don't miss our Chinese version: www.bodospowerchina.com.

My Green Power Tip for January:
Relax and plan extra time for car trips. Avoid rushing and speeding up too much. Driving at a constant speed, without accelerating and breaking, saves significantly on fuel.

See you soon at APEC in Texas, and around the world.

Best Regards

Future precision.
Future performance.
Now available.

CAS-CASR-CKSR

The transducers of tomorrow. LEM creates them today. Unbeatable in size, they are also adaptable and adjustable. Not to mention extremely precise. After all, they have been created to achieve great performance not only today – but as far into the future as you can imagine.

- Several current ranges from 6 to 50 A_{RMS}
- PCB mounted
- Up to 30% smaller size (height)
- Up to 8.2 mm Clearance / Creepage distances +CTI 600 for high insulation
- Multi-Range configuration
- +5 V Single Supply
- Low offset and gain drift
- High Accuracy @ +85° C
- Access to Voltage Reference
- Analog Voltage output

www.lem.com

At the heart of power electronics.

LEM®

600V GaN Power Conversion Adopted by Delta Electronics

Transphorm Inc. announced that it has been invited to present at Delta Electronics' exclusive Power Design Engineering event in Shanghai, to be held in November 2013. Transphorm has presented its JEDEC-qualified GaN (Gallium Nitride) on Silicon HEMT (high electron mobility transistor) products and applications based on its proprietary EZ- GaN™ technology. Transphorm's participation as the only invited external supplier at this internal event, where Delta shares technology insights across a variety of areas at its Hangzhou Design Center (HDC) and Shanghai Design Center (SDC), will allow Delta's engineering force to proliferate the adoption of 600V GaN products in applications ranging from power supplies to various other inverters/converters.

Transphorm has established the industry's first qualified 600V GaN device platform with its TPH3006PS GaN HEMT. The GaN transistor combines low switching and conduction losses, offering reduced energy loss of 50 percent compared to conventional silicon-based power conversion designs. The TO-220-packaged device features $R_{DS(on)}$ of 150 mΩ, Q_{rr} of 56 nC and high-frequency switching capability that enables compact lower cost systems.

www.transphormusa.com

APEC 2014 Returns to Fort Worth with Enhanced Attendee Features

The Applied Power Electronics Conference, which will convene March 16-20, 2014 at the Fort Worth Convention Center, continues the longstanding tradition of addressing issues of immediate and long-term interest to the practicing power electronics engineer. APEC 2014 will provide:

- The best power electronics exposition.
- Professional development courses taught by world-class experts.
- Presentations of peer-reviewed technical papers covering a wide range of topics.

Time to network and enjoy the company of fellow power electronics professionals in a beautiful setting.

Attendees at APEC 2014 will find several technical features that will enhance their APEC experience. Following on the successful introduction of a mobile app at APEC 2013, attendees with smart phones will be able to download an App that will provide them with information about conference sessions and speakers, schedules of all events and exhibitor directory. The App will enable attendees to put together their schedule to make optimum use of their time at the conference.

Other technical enhancements include:

- Hosted Cyber Cafes in the exhibit hall
- Digital signage outside session rooms to allow for updates and additional information about the sessions.

In addition to a world-class program offering attendees over 400 high-quality technical papers, APEC will again offer a slate of Professional Education Seminars on Sunday and Monday. In addition, there will also be a series of 12 Industry Sessions where important and timely industry developments will be introduced. The ever-popular Micro-Mouse Contest will be held on Monday night after the opening evening exhibit. On Tuesday evening, after the exhibits close, everyone is invited to sit in on one of the engaging Rap Sessions that always generate a lot of dialog. The Wednesday evening Gala is always popular and this year will be no exception.

APEC 2014 promises to be the largest APEC event ever - exceeding last year's record-breaking attendance. This year we are planning on 3,500 attendees and around 200 exhibitors.

If you haven't already made plans to attend, don't wait any longer. Come to Ft. Worth and be part of this exceptional event - truly The Premier Event in Applied Power Electronics™.

www.apec-conf.org/

Power Electronics China Launched in Xi'an China

China's role as the fastest developing market for power electronics technology was again established by the latest PEC - Power Electronics China conference and exhibition in Xian, China. Organized by the i2i Group, co-organized by Bodo's Power China magazine, the event attracted 293 delegates for two days of concentrated conference sessions, workshops and panel discussions. This event was preceded by PEC Suzhou, held in October. Combined these two events attracted 571 delegates, the largest Power Electronics educational and networking seminar program in China in 2013.

"Power electronics technology is developing in an intelligent and ingenious way." commented General Secretary He Xiaoning from the Shaanxi Semiconductor Association while addressing PEC Xi'an.

General Secretary Xiao Xiangfeng from the Power Electronics Society of China Electrical Equipment Industry Association also addresses the delegates with an inspiring speech about China's power electronics market developments, with a special focus on the prominence of the growing SiC device market.

PEC Xi'an covered leading industry and technology themes, including: rail transit energy efficiency, new energy and LED lighting, as well as SiC and GaN. The event focused on application uses of the technology with a specific highlight on how industry and business operators can benefit from these products.

PEC Xi'an is part of a series of annual conferences and exhibitions for power electronics manufacturers and application users. PEC attracts leading power electronics companies such as: Infineon, Mitsubishi, Fuji, CNR, Amantys, Semikron, Fairchild, as well as national universities - Xi'an Jiaotong University, Xi'an University of Technology and the Chinese Academy of Science.

www.pe-china.asia

Vincotech
The Power to Move Ahead

Speed and Flexibility

Vincotech, a 100% independent company within **Mitsubishi Electric Corporation**, is a market leader in power modules. With over 40 years of experience Vincotech develops and manufactures high-quality electronic power components for Motion Control, Renewable Energy, and Power Supply applications.

What Vincotech offers:

- Power modules with various topologies ranging from 4 A to 800 A and from 600 V to 2400 V
- Designed with low stray inductance (Rectifier, Sixpack, PIM (CIB), IPM, Boost, NPC, H-Bridge, Half-Bridge, PFC, etc.)
- 21 different standard housings

The Vincotech difference:

- A large variety of standard products for qualified, reliable solutions
- Building blocks to design your product – flexible designs to meet your specific requirements
- Ultra-low inductance designs
- Phase-change material – no more thermal grease

Best choice for highly efficient central solar inverters

2x*flow*NPC 4w

- 2400 V NPC topology – 1200 V semiconductors
- For 1500 V DC-link
- 800 A nominal module current
- Extreme low commutation inductance
- High current screw interface

More details: www.vincotech.com/2xflowNPC_4w

If you can imagine it – we can build it

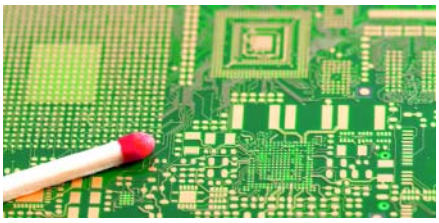
www.vincotech.com

Industrial Drives | Solar Inverters | UPS | Embedded Drives | Welding | Power Supplies

HDI Microvia PCBs now available online at WEdirekt

The HDI specialist Würth Elektronik has set new standards in the PCB industry. Recently, HDI microvia PCBs are available on the online shop, WEdirekt. Within just a few clicks, your HDI PCB is calculated and the price is shown immediately online. Ordering prototypes is thus considerably simplified and faster.

Normally, the following statement applies: low quantity required plus a complicated production process results in high costs. This is not so at Würth Elektronik. Due to its mass of experience, the PCB manufacturer is a specialist in the field HDI and has now



expanded its online shop with this technology. HDI Microvia PCBs can be ordered at competitive prices starting with no minimum order quantity. "It's an interesting development, especially for designers and developers because they can order HDI microvia prototypes without driving up costs," explains Carina Harnisch, the WEdirekt team leader.

Firstly, there are two versions of these boards to purchase at WEdirekt: PCBs with four or six layers using a layer structure of 1-2-1 or 1-4-1 respectively. Thickness from 0.8 to 1.55 mm are available. For more complex HDI microvia printed circuit boards, the specialists from Würth Elektronik can provide further assistance.

www.we-online.de

CIPS 2014, February, 25 - 27, Nuremberg

8th International Conference on Integrated Power Electronics Systems

Program: http://conference.vde.com/cips/2014/Pages/Program.aspx

Prof. Leo Lorenz, General Chair (center), Eckhard Wolfgang, ECPE (left) and Hans-Dieter Silber, University of Bremen, Technical Program Chairs.

Higher power efficiency, density, reliability, and lower volume and cost: How to reach this goals and what solutions are feasible will be discussed again at the 8th CIPS by power electronics experts coming from all over the world.

The conference is organized by VDE ETG and ECPE and technically co-sponsored by the IEEE PELS and ZVEI.

The conference papers did undergo a peer review process which allows their storage in the IEEE Xplore digital data base. The Technical Program Committee has selected 81 papers to be presented: 52 of them will be oral and 29 will be poster presentations. The best poster as well as the best young engineer's presentation will be awarded.

As usual for CIPS there is a frame of 3 Keynotes and 9 Invited Papers given by worldwide leading experts.

Keynote Papers:

- What are the big challenges in power electronics? Johann W. Kolar, ETH Zurich, Switzerland
- Simulation and test vibration - nonlinear effects in durability of electronic systems, Abhijit Das Gupta, University of Maryland, USA
- Present and future of GaN Power Devices, Daisuke Ueda, Advanced Technology Research Laboratories, Panasonic, Japan

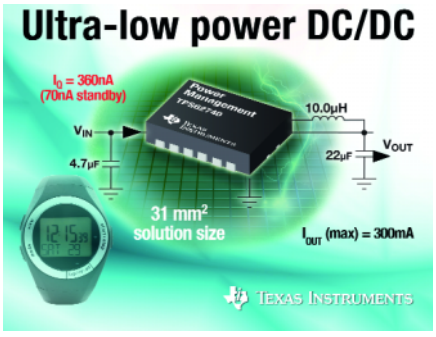
Invited papers:

- Power module reliability, Josef Lutz, University of Chemnitz, Germany
- Transient hygro-thermal-response of power modules in inverters - mission profiling for climate and power loading, Reinhold Bayerer, Warstein, Germany
- Power Supply With Integrated PassivEs-POWERSWIPE, Cian Ó Mathúna, Tyndall National Institute, Ireland
- Practical Aspects and Uses of Thermal Interface Material Testing Methods - David Saums (DS&A LLC, USA)
- EMI and Integration, Dushan Boroyevich, Virginia Tech, USA
- Power Electronics - Key Technology for Renewable Energy Systems - Status and Future, Frede Blaabjerg, Aalborg University, Denmark
- New applications in power electronics for integrated high-speed magneto-resistive current sensors, Simon Scherner, Sensitec GmbH, Germany
- Packaging very fast switching power semiconductors, Eckart Hoene, FhG IZM, Germany
- SiC Power Electronics, Hans-Peter Nee, KTH Royal Institute of Technology, Sweden

www.cips-conference.de

Ultra-Low Power Circuits for Energy Harvesting

Texas Instruments introduced five new next-generation power management integrated circuits that efficiently acquire and manage microwatts (uW) to milliwatts (mW) of power harvested from light, heat or mechanical energy sources. The bq25570, bq25505, TPS62740, TPS62737 and TPS62736 maintain the industry's lowest levels of active quiescent current and enable battery-free operation to wireless sensor networks, monitoring systems, wearable medical devices,



mobile accessories and other applications with limited access to power.

www.ti.com

Eckart Seitter appointed as Managing Director

Vincotech announced that Eckart Seitter has been appointed the Managing Director of Vincotech GmbH. He started on this position on November 1, 2013, to reinforce the current Management Board of Joachim Fietz (CEO) and Ralf Meinardus (CFO).
He has held several leading positions in marketing and sales after joining Vincotech more than 14 years ago. Eckart Seitter is a seasoned executive with an impressive track record. His performance and vision have been influential for the company and are an integral part of Vincotech's success. Mr. Seitter will also remain Senior Vice President Global Sales & Marketing.
"We are excited to have Eckart Seitter join the Management Board," said Joachim Fietz, CEO of Vincotech. "With his tremendous business and leadership skills, his strategic insight and customer-focused mentality, he will help to further advance Vincotech's profitability and success in the market. "
Speaking about his new role, Mr. Seitter stated "I am happy to be joining and look forward to working with my colleagues on the Management Board. We aim to set the course for further global growth, drive the development of Vincotech, a strong brand within the Mitsubishi Electric Corporation, and live up to our commitment of fulfilling customer requirements quickly and flexibly."
Eckart Seitter holds a bachelor's degree in engineering from Esslingen University of Applied Sciences and a master's degree in international marketing from Reutlingen University.

www.vincotech.com

Transphorm and Fujitsu to Integrate GaN Power Device Businesses

Bringing together technologies to accelerate market establishment and volume production of high-reliability, high-performance Gallium Nitride devices
Fujitsu Limited, Fujitsu Semiconductor Limited, and Transphorm, Inc., a leader in GaN power devices for power supplies, announced that they have reached an agreement whereby Fujitsu Semiconductor and Transphorm will integrate their gallium-nitride (GaN) power devices for power supplies businesses. This integration will dramatically improve the market competitiveness of Transphorm's GaN power device business. The three companies have also agreed that both Fujitsu Limited and Fujitsu Semiconductor will take a minority equity position in Transphorm.
Device manufacturers around the world are competing to commercialize GaN power devices. While Transphorm has already released the first qualified high voltage commercial GaN devices, the company continues to make significant improvements in performance, quality and productivity. Given this, Fujitsu Limited, Fujitsu Semiconductor and Transphorm will bring together their complementary strengths in technology and manufacturing to enable superior GaN power device solutions to be delivered quickly to the market with both scale and affordability.

www.fujitsu.com

http://jp.fujitsu.com/fsl/en/

www.transphormusa.com

ECPE Calendar of Events 2014

Date	Location	Event	Topic
5 - 6 Feb. 2014	La Rochelle, France	Conference	9th European Advanced Technology Workshop on Thermal Management
25 - 27 Feb. 2014	Nuremberg, Germany	Conference & ECPE Annual Event	CIPS 2014 - Int. Conf. on Integrated Power Electronics Systems in conjunction with the ECPE Annual Event
March 2014	TBD	ECPE Tutorial	Power Semiconductor Devices & Technologies Chairman: Prof. D. Silber (Univ. of Bremen)
26 - 27 March 2014	Munich, Germany	ECPE Double Workshop	**Quality Inspection in Power Electronics Manufacturing** Chairmen: A. Schletz (Fraunhofer IISB), T. Harder (ECPE) **Electrical Testing of Power Electronic Systems** Chairmen: Prof. N. Grass (TH Nuremberg), J. Koszescha (ECPE)
31 March - 1 April 2014	Berlin, Germany	ECPE Lab Course	EMC Optimised Design (Parasitics in Power Electronics) Course Instructor: Dr. E. Hoene (Fraunhofer IZM)
20 - 22 May 2014	Nuremberg, Germany	Conference & Exhibition	PCIM Europe 2014 Conference and Exhibition with ECPE Students Day
26 - 30 May 2014	Gaeta, Italy	Recruitment Event	15th European PhD School on ´Power Electronics for Electrical Machine and Energy Control´
3 - 4 June 2014	Barcelona, Spain	ECPE Tutorial	EMC in Power Electronics; Chairmen: Dr. E. Hoene (Fraunhofer IZM), Prof. J.-L. Schanen (G2ELab)
June 2014 (CW 26)	Toulouse, France	ECPE Workshop	Advanced Multilevel Power Converter; Chairmen: T. Meynard (Univ. of Toulouse), R. Marquardt (Univ. BW Munich)

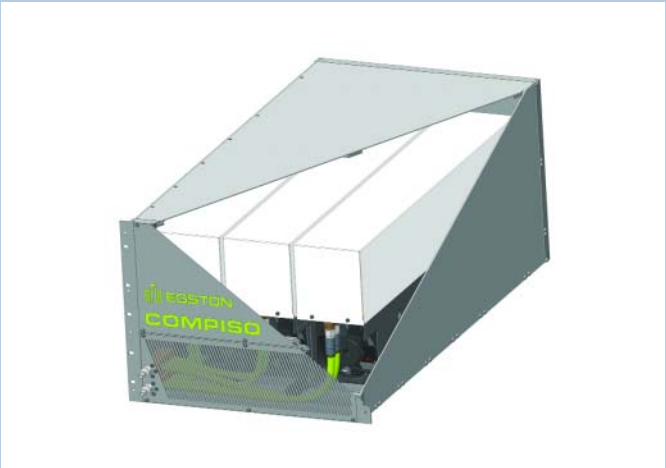
www.ecpe.org

Compact Converter Series COMPISO

The Austrian manufacturer of electronic components Egston provides a compact Converter series with high bandwidth output signals. The modular series is optimally suited for building up DC-DC, DC-AC as well as AC-AC converter systems in the power range of 120kW up to 1 MW.

Introduction

Egston has developed a series of compact Converters with minimum ripple and high bandwidth output signals. The modules with bidirectional energy flow are interconnected via fast optical links and can be configured as single-phase or three-phase inverters. The base module is in the power range of 120kVA /kW with a nominal voltage of 800V (max. 1000V). By cascading power ratings up to 1 MW can be achieved both for high current DC-DC converters as well as for DC-AC inverters. Typical applications are: low harmonic grid-tie inverters, clean grid applications (harmonic compensation up to 10kHz), DC and AC power sources as well as motor inverters when a sinusoidal voltage supply is required.



Topology

The topology is based on six-fold interleaved legs interconnected via coupled inductors. Interleaving allows reducing the output current ripple and increasing the apparent switching frequency seen at the output. In the standard version the single legs are operated at 20 kHz resulting in an apparent frequency at the output of 120 kHz. Higher dynamic versions with 360 kHz apparent frequency are optionally available with slight power derating. The high single-leg switching frequencies (up to 60 kHz) are possible due to the IGBT/SiC-diode pair and the low inductance commutation circuit in combination with new anti-ferroelectric capacitors (TDK / EPCOS Cera-link™). The transient voltage overshoot is kept below 1% which allows operating the inverter at voltages up to 1000V. The thermal management is based on water cooling.

Signal quality and dynamics

The mutual cancellation due to interleaving and the 4th order output filter are suppressing ripples to the per mill range with THD values below 0,12%. In order to achieve this extremely high signal quality EGSTON has made strong research efforts on the optimization of the coupled inductors.

The step response for a voltage transition from 0 to 800V is kept clearly below 100µs.

In the standard dynamic version the bandwidth (-3dB) of the closed loop voltage control is 16 kHz. The full-span amplitude can operated up to 5 kHz (thermal limit of the output-filter). With linear degrading of the amplitude sinusoidal signals can be provided up to 20 kHz.

Efficiency

Due to the IGBT/SiC diode combination and the optimized output filter efficiencies up to 99,5 % are reached in DC-DC mode (at relatively high output voltages). In a DC-AC operation at full output voltage amplitude the efficiency is kept above 99% over a wide load range (measured with Yokogawa Precision Power Analyzer WT 1800). In an application for example as a photovoltaic inverter this is even slightly better as best-in class products.

Available Configurations

DC - DC Converter with integrated function generator (360 kW / Rack)
DC - 3~ AC Converter (120 kVA / Rack)
Multipurpose System: DC-DC Converter and DC to 3~ AC Converter in one Rack

World Premieres

USA: APEC 2014 - Ft. Worth - TX
Europe: PCIM 2014 - Nürnberg - Germany

www.egston.com

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electrical engineering software

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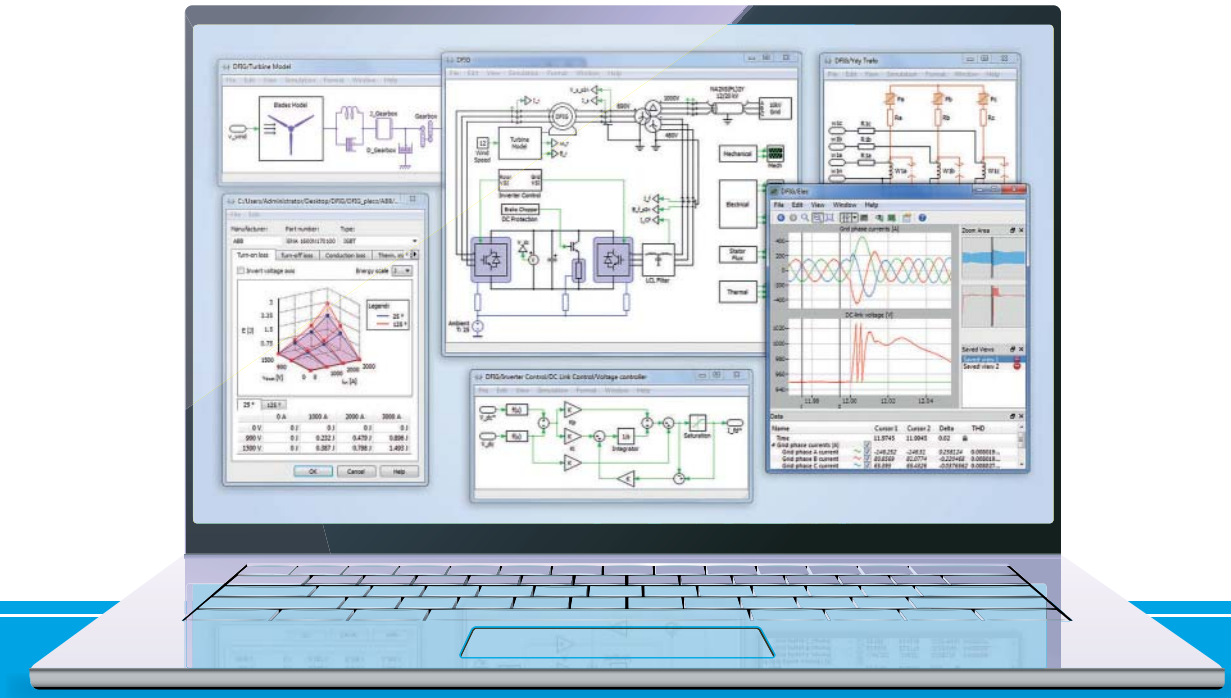
THE SIMULATION SOFTWARE PREFERRED BY POWER ELECTRONICS ENGINEERS



MODELING DOMAINS

- Electrical
- Control
- Thermal
- Magnetic
- Mechanical

KEY FEATURES

- Fast simulation of complex systems
- Code generation
- Frequency analysis
- Available as standalone program or Simulink blockset

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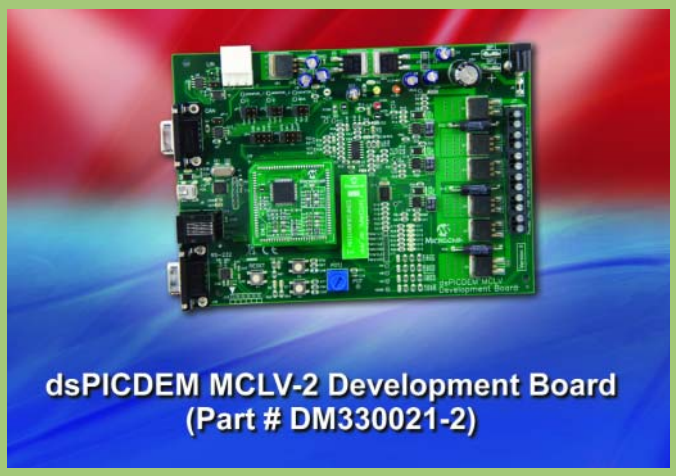
GREEN PRODUCT OF THE MONTH

Win a dsPICDEM™ MCLV-2 Development Board

Bodo's Power is offering you the chance to win a dsPICDEM™ MCLV-2 Development Board from Microchip (#DM330021-2). This board provides a cost-effective method of evaluating and developing sensored or sensorless Brushless DC (BLDC) and permanent magnet synchronous motor control applications. The board supports Microchip's 28-pin SOIC and 100-pin Plug-In-Modules with dsPIC33E or dsPIC33F Digital Signal Controllers. The board supports the use of the internal, on chip OpAmps found on certain dsPIC devices or the external OpAmps found on the MCLV-2 board. A dsPIC33EP256MC506 Internal OpAmp PIM (MA330031) is included. The board is capable of controlling motors rated up to 48V and 15 Amps, with multiple communication channels such as USB, CAN, LIN and RS-232.



The dsPICDEM MCLV-2 Development Board is targeted to control a Brushless DC (BLDC) motor or Permanent Magnet Synchronous Motor (PMSM) in sensor or sensorless operation. This flexible and cost-effective board can be configured in different ways for use with Microchip's specialized motor control digital signal controllers. The dsPICDEM MCLV-2 Development Board supports the dsPIC33E or dsPIC33F motor control device family. It offers a mounting option to connect either a 28-pin SOIC device or a generic 100-pin Plug-In Module (PIM).

For the chance to win a dsPICDEM™ MCLV-2 Development Board, please visit the following site and enter your details in the entry form:

www.microchip-comps.com/bodo-mclv

Looking to speed your analog development time?

PIC® MCUs with Intelligent Analog make designs easier

With a powerful combination of rich analog integration and low power consumption, the PIC24FJ128GC010 family enables a significant cost reduction over a multi-chip design as well as enabling lower noise, faster throughput, smaller PCB size and a faster time to market.

In addition to Microchip's first 16-bit ADC and a 10 Msps 12-bit ADC, the PIC24FJ128GC010 integrates a DAC and dual op amps to simplify precision analog design. The on-chip LCD driver provides the ability to drive displays with up to 472 segments for information-rich user displays; whilst mTouch™ capacitive touch sensing adds advanced touch capabilities.

The PIC24FJ128GC010 family helps to reduce noise to deliver more consistent analog performance in a very small form factor. Simply add sensors to the low-cost starter kit for easy prototyping.

GET STARTED IN 3 EASY STEPS:

1. Begin with the low-cost PIC24F Starter Kit for Intelligent Analog (DM240015)
2. Add custom sensors to the clean analog header to create a prototype
3. Re-use and modify the demo code to speed development

PIC24F Starter Kit for Intelligent Analog (DM240015)

For more information, go to: www.microchip.com/get/euGC010

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The Changing World of Power

By Parviz Ghaffaripour, Senior VP and General Manager, Exar

Given the recent changes in the Power IC industry, it is interesting to examine the challenges and trends that have kept all of us on our toes.

A major trend in the industry that shook up the participants and helped forge a new direction for our industry was the emergence of many new players in Asia and specifically in China. Our industry benefited greatly by having a larger group of diversified IC vendors playing in the field. The new players dominated the low end of the market providing substantially lower prices in their local markets. The resultant falling prices drove established companies to revert or convert to the most important criteria that originally made our industry strong, providing innovation and value-added products. The natural selection process took over and the companies that could innovate, as a result of this process, are emerging better companies with better products.

Another trend that changed the industry is the emergence of energy management. With the processing power increasing in computing and mobility markets, the need for a specialized power management system became apparent. The major CPU providers had to define a sophisticated power chip-set, either integrated as part of the CPUs or as companion chips, making PMICs or PMUs common names in our industry. This became the start of a transition from power conversion to power (or energy) management and a proliferation of lower voltage rails for our industry. In the past, system designers viewed power system requirements as a black box and relied heavily on IC vendors to address their needs through discrete components. These components, for the most part, were designed for a general market and hence did not fully address the specific needs of the customer. With PMICs and PMUs, the IC designers started thinking creatively how to increase system efficiency and provide a flexible power management solution rather than increasing components' efficiency and thus energy management. By now, almost every system requires complex power management at the system level and the system designers prefer to have ICs that are flexible in order to address the changing requirements.

As a result of the above challenges and trends many diverse solutions surfaced in the marketplace. Digital Power Management, Power Modules, Complicated PMICs that integrate every conceivable functionality, and specialized components such as PoL (Point of Loads) DrMOS come to mind among others, addressing high-voltage, high-power or low-voltage, high-power markets. These solutions require expertise beyond IC Design that includes package design, wafer process design and of course system know-how. As usual, due to diverse offerings in each of these areas, confusion and frustration took over for the customer and differentiation among the solutions became a major fruitless research project. Taking digital power as an example, there are offerings that range from integration of simple supervisory functions with PWM switching regulators to integrating a full-fledged DSP and drivers.

The challenge going forward for companies is to distinguish themselves among the diversity of products. How is this achieved? Adopting customer needs as an overriding criteria for new product develop-

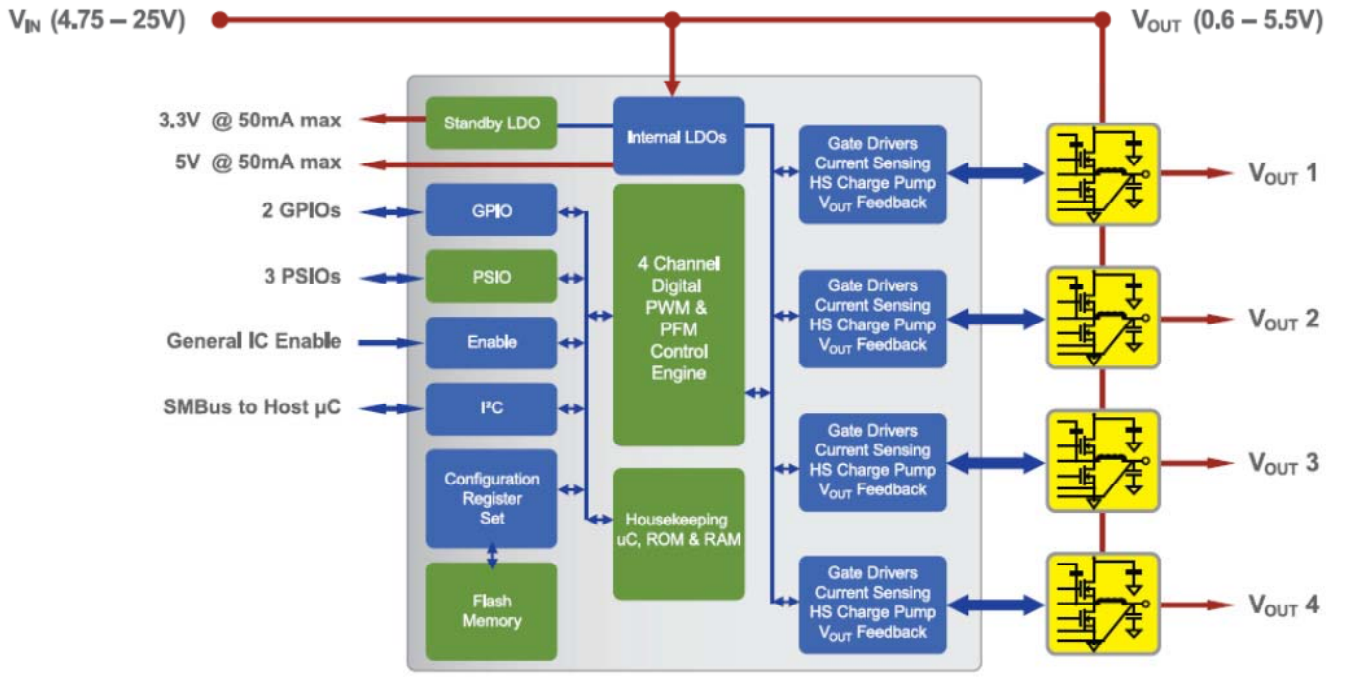

Figure 1: XRP7724, the power management block is a constant element in all designs and yet is programmable to meet a wide variety of applications

ment, allows clarity and simplicity to take over. There is no single solution that meets the requirements for everybody. There will be different solutions but all have to meet these criteria: address specific application needs, longevity beyond present generation, simple to use, and finally proper price-value point. At Exar, we have taken this to heart and have been working hard to provide solutions that add value to our customers' systems. About two years ago, Exar decided to focus its power management activities to address the three major trends: proliferation of low voltage rails, energy management, and the need for system solutions.

Exar's unique approach to energy management is summarized in our Universal PMIC, also known as Programmable Power family of products. These multi-output power system products offer a fully customizable solution through hardware and software configurations enabling local and remote monitoring and configurability, security anti-tampering, field serviceability, small board space, and upgradeability. Incorporating a proprietary control loop technology and digital interface, these products require little to no loop compensation filters and few external components as depicted in Figure 1.

Given the complex system designs and multiple issues the system designers face, many of them cannot afford to spend the necessary time on the power management design portion of the system. These designers prefer a simple-to-use solution that is confined, yet flexible to work in different versions of the system in design. The best approach for such customers is miniature modules that have the look and feel of an IC but which integrate the full PCB and external components. This is where package technology, system know-how and power management design expertise are needed to provide a value-added solution, benefiting the customers. The newly released XRP9711 is an example of such a solution. Housed in a tiny 12x12x2.8mm LGA package, this system product has integrated MOSFETs, inductors, capacitors and resistors offering 0.6V-5.5V programmable output voltages for 2x 6A step-down outputs in addition to two additional external PWM outputs. The XRP9711 allows ultimate ease of use for designers with the flexibility and control of a universal PMIC.

On the other extreme, it is interesting that there is always a need for simple-to-use Linear Low Drop Out Regulators (LDO) in every system. No matter how many outputs we jam into PMICs, there is always a reason why we need one or more LDOs in every system due to low noise, size, or fewer external components. When ultra low input voltage, high current LDOs offer high efficiencies matching or exceeding those of switching regulators, then LDOs become much more interesting and a required item for system designers. Exar's XRP6275 offers 75mV at 2A output current, operating at ultra low voltages ranging from 1.045V to 2.5V, and is a leading product in its class and a problem solver for system designers.

As stated earlier, competition is great for the power industry. It facilitates a natural business selection process through which stronger companies surface and more advanced innovations enrich our industry. In the end, system designers will benefit by employing these innovations to offer end market solutions to better our lives.

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Electronics Industry Digest

By Aubrey Dunford, Europartners

The worldwide installed base of smart meters will grow from 313 million in 2013 to nearly 1.1 billion in 2022, so Navigant Research. Growth in the smart electric meter market has cooled during the last year. But deployments in North America will begin to recover after 2014, although the pace of new shipments is unlikely to match the levels witnessed in the recent past. In 2012, penetration rates reached nearly 39 percent in North America.

SEMICONDUCTORS

Worldwide sales of semiconductors reached $ 80.92 billion during the third quarter of 2013, the industry's highest-ever quarterly total and an increase of 8.4 percent over the second quarter, so the WSTS. Global sales for the month of September 2013 reached $ 26.97 billion, the highest monthly total ever, an increase of 8.7 percent compared to September 2012, and 3.3 percent compared to August 2013. September sales topped sales from the same month last year in the Americas (24.3 percent), Asia Pacific (9.9 percent), and Europe (6.4 percent), but decreased in Japan (-12.9 percent), in large part because of the devaluation of the Japanese yen.

The top 20 semiconductor companies' sales are forecast to increase by 7 percent in 2013 as compared to 2012, which would be two points better than the 5 percent forecast for the total worldwide semiconductor market this year, so IC Insights. It is expected to take total semiconductor sales of over $ 3.7 billion to make the top-20 ranking in 2013. There are numerous changes expected within the top-20 semiconductor ranking in 2013 as compared to 2012.

Dialog Semiconductor, a German provider of highly integrated power management, audio, AC/DC, solid state lighting and short-range wireless technologies, announced its partnership with Richtek Technology, a provider of power management, analog and mixed-signal products. Founded in 1998, Richtek is headquartered in Taiwan with additional offices in Asia, the USA and Europe. With this collaboration, the two companies will develop and commercialise differentiated power management system solutions for the high-volume, high-growth consumer market in China, including ICs for smartphones and tablets.

Total silicon wafer area shipments were 2,341 million square inches during the most recent quarter, a 2.0 percent decrease from the 2,390 million square inches shipped during the previous quarter, so SEMI. New quarterly total area shipments are 2.0 percent lower than third quarter 2012 shipments. In spite of this recent decline, year-to-date silicon shipment volumes remain essentially flat when compared to the first nine months of 2012.

Due to a reevaluation of its business situation in permanent bonding and the ongoing losses in this product line, SÜSS MicroTec, a supplier of equipment and process solutions for the semiconductor industry, has decided to cease production of cluster systems for permanent bonding applications. The development and production of the manual permanent bonding systems are not affected by this strategic action. In this context one-off expenses of approximately € 8.3 M can be expected in the fourth quarter 2013. SÜSS MicroTec also announces a revision of the full year guidance 2013. The sales expectation of formerly € 150 M is revised to a bandwidth of € 125 - € 135 M. An EBIT in the range of minus € 22 to minus € 27 M can be expected. The EBIT for 2013 includes approximately € 14.3 M charges for the restructuring of the product line permanent bonding.

OPTOELECTRONICS

Following Samsung's introduction of the first flexible OLED products this year, demand for these elastic displays is expected to grow by more than a factor of four next year, with sales reaching $ 94.8 M in 2014, up from $ 21.9 M in 2013, so IHS. Samsung's initial product is likely to be a first-generation flexible display, employing a nonglass substrate that yields superior thinness and unbreakable ruggedness. However, such displays are flat and cannot be bent or rolled. Flexible displays are expected to eventually evolve into rollable and foldable OLED screens that are likely to be introduced after 2016.

OTHER COMPONENTS

CTEK Group announced the acquisition of the Inelco Group's battery charging business. CTEK develops, markets and sells lead acid and lithium ion battery chargers. The acquisition of the battery charging business from Inelco will strengthen CTEK Group's business and increase its competitiveness mainly within the professional and industrial segments. Inelco Group consists of the Danish company Inelco and the Polish company Inelco Polska. The company has 30 employees.

Teradyne, a supplier of automatic test equipment used to test semiconductors, wireless products, data storage and complex electronic systems, named Mark E. Jagiela to succeed Michael A. Bradley as CEO effective January 31, 2014. Mr. Jagiela is currently the company's President and a 31-year veteran of Teradyne. Mr. Bradley, who will retire as the company's CEO effective January 31, 2014, will continue as a Director of the company. In 2012, Teradyne had sales of $ 1.66 billion and currently employs approximately 3,700 people worldwide.

DISTRIBUTION

European distribution bookings in Q313 declined by 6.8 percent compared to Q213 and increased by 8.9 percent when compared to Q312, so the IDEA (International Distribution of Electronics Association). Sector specific bookings changes in Q313 compared to the same period in 2012 were: semiconductors increased by 11.3 percent; passives increased by 6.4 percent; and electro-mechs and other components increased by 3.6 percent. European distribution billings in Q313 declined by 2.8 percent, when compared to the previous quarter and increased by 4.6 percent compared to Q312. Sector specific billings changes in Q313 compared to Q312 were: semiconductors increased by 5.3 percent; passives increased by 5.2 percent; electro-mechs and other components increased by 1.8 percent. At 0.99, the Q313 overall book-to-bill ratio was down compared to 1.03 in Q213.

This is the comprehensive power related extract from the "Electronics Industry Digest", the successor of The Lennox Report. For a full subscription of the report contact: eid@europartners.eu.com or by fax 44/1494 563503.

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Digital Power Continuing to Evolve and Growing in Importance

By Richard Ruiz, Analyst, Darnell Group

The adoption of digital power technology is considered to be one of the most important factors in reducing power consumption and managing the growing power complexity in modern electronic systems. Applications range from information and communications technology (ICT) to cost-sensitive portable applications and applications where efficiency maximization is critical. Darnell's next report on dc-dc converter modules to be released later this month will include an extensive quantitative analysis of the growing use of digital power across a growing range of applications.

Digital power management and control provide real-time intelligence enabling system developers to put together power systems that automatically adapt to their environment and optimize efficiency. The use of intelligent digital power ICs also means automatic compensation for changes in load and system temperature, enabling energy savings with adaptive dead-time control, dynamic voltage scaling, frequency shifting, phase dropping, discontinuous switching modes, and so on.

The European power electronics community has taken a leadership position in driving both the development of and adoption of digital power. Two examples of that leadership can be seen in Ericsson Power Modules and Powervation. Introduced just last month, the BMR463-25A from Ericsson is a third-generation digital point-of-load (POL) regulator that offers a power density of 28.44W/cm3 (465W/in3), delivering 25 percent more output current in the same footprint as second-generation 20A module and the new POL includes Dynamic Loop Compensation which improves stability and shortens time-to-market. With a footprint that is fully compatible with the second-generation BMR463-20A the new POL features a full set of PMBus commands enabling systems architects to fully monitor and dynamically control the energy delivered to strategic components, such as processors, FPGAs, ASICs and others, down to a very low and highly economical level.

Embedding the latest technology in terms of Dynamic Loop Compensation, the BMR463-25A runs the DLC algorithm as default each time the output is enabled. However, three more settings are also available via the PMBus for systems architects to choose the most appropriate method for their application with the DLC algorithm run every second or every minute or simply disabled. In addition to standard methods, designers can also use the Loop Compensation Tool featured in the latest Ericsson Power Designer software to set their own loop compensation profile to match specific application requirements. In addition, developed with high efficiency in mind, the BMR463-25A powertrain is composed of the latest MOSFET technology to deliver up to 95.2 percent efficiency at 3.3V output and up to 89.4% at 1.0V when the output load is at 50 percent.

Also last month, Powervation Ltd. made the latest in a series of announcements about the adoption of its digital power control technology when Bellnix Co., Ltd revealed that it has adopted the PV3012 digital controller for use in a new low-profile, 60A dc-dc (D2D) module. The BDP12-0.6S60R0 digital power module is a PMBus-compliant, non-isolated step-down converter that is designed for today's communications and computing applications, and addresses the needs for small form-factor designs while providing high levels of reliability and performance.

Bellnix's 60 A BDP is the first in a series of Bellnix Digital Power modules based on Powervation's digital controller architecture that provides a total power solution in a low-profile, 10mm, form-factor. The 60 A BDP uses Powervation's PV3012 digital two-phase controller, and parallel BDP module operation is supported via Powervation's DSS® current sharing bus. This PMBus-compliant module features precision measurement and telemetry reporting, a full-line of programmable power supply protection features, power good, and optional tracking function, all in a compact 32.8 mm x 23.0 mm ROHS compliant SMD package design.

As is evident from the two preceding developments, digital power management and control are no longer considered "emerging" technologies. They have entered the mainstream and are now widely considered to be commercial products and are now used in a variety of applications ranging from IT and communications infrastructure to portable electronics and lighting. In addition to the traditional areas, digital power also impacts a broad range of non-traditional applications such as hybrid electric vehicles, and alternative energy sources including solar and wind. The growing range of applications means that the factors driving adoption of digital power control are changing.

The value of digital power has always been the functions it can provide, and that functionality has become more defined and focused over the past several years as users demand a number of specific features and operations such as auto-compensation, PMBus capabilities, loop control, etc. The continued growth of digital power use is also evident in the continuing investment the industry is making in the PMBus standard. Shortly, a major revision to PMBus will be finalized.

PMBus V1.3, which is in the final stages of the approval process, will include: higher speed communication to reduce latencies; a dedicated Adaptive Voltage Scaling (AVS) bus to statically and dynamically control processor voltages; and general enhancements and cleanup from Version 1.2. This presentation added details to that initial announcement, including a 1-MHz Clock, Mandatory Clock Stretching Support and Backwards Compatibility using the same open-drain signaling as the previous PMBus specification. These changes are expected to result in a 2.5-times faster throughput.

PMBus+ supports IEEE 754 industry standard floating point, half-precision, 16-bit numbers; a uniform number system with negative numbers, NaN and +/-Inf and easy conversion to C types. It also supports global process calls, an extension of the SMBus ARA specification and enables intelligent global queries. In the area of applications, it supports device discovery, prioritized fault management and faster bulk reads. In the area of setting relative output voltage thresholds PMBus+ supports margin levels, warn limits, fault limits and power good limits. Values are specified as a percentage of output voltage and changing the VOUT_COMMAND moves all thresholds.

As previously announced, the addition of AVSBus for Adaptive Voltage Scaling is a major change in PMBus 1.3. The AVSBus is behaviorally and electrically similar to SPI bus without chip select lines. In this case, the AVS_MData and AVS_SData are equivalent to MOSI and MISO and the AVS_Clock is equivalent to CLK of the SPI bus. The new specification supports a 50MHz maximum bus speed.

The use of digital power techniques such as PMBus gives system developers greater flexibility in design. For instance, an increasingly complex power distribution system may require a large number of voltage rails, which are needed to sequence or track other rails to properly bias microprocessors, ASICs, FPGAs, microcontrollers, and any other digital logic ICs present in the system and likely to require different voltages for operation. As a product design moves through various phases, changes in the design may occur including the addition of another power rail, more current on a rail, or the requirement for a tighter transient response. This would require the redesign of the power distribution, whereas a digital power solution is flexible and can adapt with changing requirements.

A new voltage rail can be added to the power-management system using the industry-standard SMBus. The digital power ICs communicate with each other via the SMBus using the Power Management Bus (PMBus) protocol, the standard protocol for communicating with power conversion systems using a digital communications bus. The use of PMBus and PMBus-enabled devices for power conversion provides flexibility and control that is not possible with traditional analog power systems. Adding a new rail is integrated into the monitoring, sequencing, margining and fault detection schemes.

The digital power IC for the new rail is provided with its own SMBus address and is added to the system and there is no need to reprogram or add more stand-alone power-management ICs because of the additional voltage rail. In addition, for system monitoring, a digital power solution provides multiple methods of reacting to a fault. Over-current and under-current, over-voltage and under-voltage, and over-temperature faults and warning thresholds can also be configured and adjusted throughout the entire lifecycle of the product. As stated earlier, a digital power solution can reduce cost-the lower component count makes a more reliable and longer-lived system.

A big advantage is that digital power enables designers to use the same device for each voltage rail and make changes to the operation of the device without having to make costly hardware changes. Digital power solutions can be more efficient by meeting increasing thermal demands, an increasingly common challenge as boards become denser and generate more heat

Today, digital solutions are being driven by the need for specific functions in emerging applications that are driving new power architectures. As a result, this is leading to new system configurations that require new power supply designs. Standards for energy efficiency and power management continue to evolve, as well, and some of the new ones are combining to create new opportunities in existing applications. One of the major features of digital power is that for any given system application, the end user will typically select only a subset of the available digital power solutions. This decision will be based on factors such as cost, complexity and system availability and maintenance requirements. Darnell's soon-to-be-released analysis of the market for dc-dc converter modules will include a highly detailed and quantitative analysis of the continued evolution and development of digital power as one of the major themes.

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Modern Challenges in Distribution

Distributors in the electronics industry have been known for about 50 years. Today, there are several types of distributors. Some companies have become very big and carry over a hundred or more different product lines in their portfolio. Due to their large and global customer base, every electronic device manufacturer, who wants to do business worldwide, has to deal with them.

By Jens Egbers and Christopher Rocneanu,
Field application Engineers MEV Elektronik Service GmbH, Germany

Another type is the catalog distributor. One of its key tasks is to have all devices in stock. All big manufacturers use one or more catalog distributors to enable fast sampling and on-time availability.

MEV Elektronik Service GmbH is a medium sized distributor and has been on the market for over 20 years. The main focus is the concentration on niche markets with niche products. MEV's strengths are its customer-orientation and its offer of detailed technical support. The system selling approach completes the strategy and is adapting the customer's feedback while thinking ahead what technology the market and customer could use in the future. To see recent products and newest innovations of technologies are today's challenges for the Application team of MEV Elektronik Service GmbH.

Challenges of future technologies in Power Devices

Everybody is talking about wide band gap power electronic devices like SiC and GaN at the moment. MEV started to go with the SiC technology a long time ago and even went successfully through the maturing times of new technologies. While it is a difficult decision to anticipate which technology will last or which technology the customer will adapt to, it is important for MEV to be ahead.

Over the last few years, SiC power devices were considered expensive, but suitable for high performance applications. In fact, SiC diodes are used in PFC inverters and many more applications. Through the last years, the price dropped to approx. US$ 0.50/ Ampere and will continue to fall. CREE for example, is ready to run 6 inch wafers in production when demand increases. There is only one work step remaining for the customer to save money with a SiC diode: You have to take a detailed look at the diode's operating point (required current at your estimated operating temperature in your application) when comparing devices from different manufacturers and wanting to choose the best device in terms of performance and price. Of course MEV will help customers to choose the right device.

Second approach with SiC devices

With SiC transistors it is a different story. The first approach with SiC was to get the best efficiency out of applications. Meanwhile, in some applications you can omit the SiC Diode when you use the body diode of the MOSFET as a freewheeling diode. Furthermore you can significantly decrease system size and weight as well as inductance when you increase the switching frequency. Dieter Liesabeths, Sales Manager CREE, EMEA, says, "It is possible to reap many of the benefits of 3level topologies while staying with the simpler 2level topology by taking advantage of the low switching losses and high blocking voltages of SiC MOSFETs."

Helpful tools for the customer to evaluate SiC are Reference Designs and Demo Boards. With CREE's gate driver board CRD-001, the customer can quickly start driving the MOSFET or the module. Additionally, CREE's 60W Demo Aux Power Supply (CRD-060DD12P) is available at MEV. Without the time- consuming development of an evaluation board, the aux power supply offers a platform for, fast comparisons between CREE's 1700V 1Ohm MOSFET (C2M1000170D) and Si High Voltage devices. Target Application is auxiliary power supply for Inverters, UPS, E-meter or motor drives.

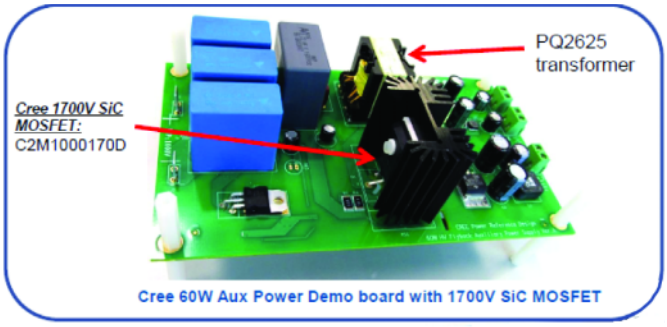

Figure 1: CREE Reference Design: 60W Aux Power Supply. Vin=200-1000 VDC, POUT=12VDC/4.5A; 5V/0.5A;-12VDC/0.25A; Operating frequency: 75kHz; Topology: Single-end Flyback

Solution out of one hand

It is not only important to rely on the right technology. Moreover, you have to offer a full solution. Additionally, the benefit of a design-in distributor like MEV for customers is on-time technical support in power electronics.

The technical support of the application engineers at MEV Elektronik Service GmbH mostly starts with a customer visit. Talking with the design engineers face to face is a very good starting point to find out the requirements or the needs of the customer. For power electronics, the good thing is that every application needs a power supply like AC/DC or DC/DC solutions. So, every customer is interested in the latest power electronics, new topologies or new regulators to develop the power part of their application.

To have a dedicated portfolio of different power products is mandatory for a distribution company like MEV Elektronik Service GmbH. With a portfolio starting with AC/DC switching regulators, DC/DC linear and switching regulators and a lot of discrete parts like diodes and bridge rectifiers, MEV is well prepared to find the right solution for almost any application. To complete the power management product portfolio, also ready "plug and play" AC/DC power supplies,

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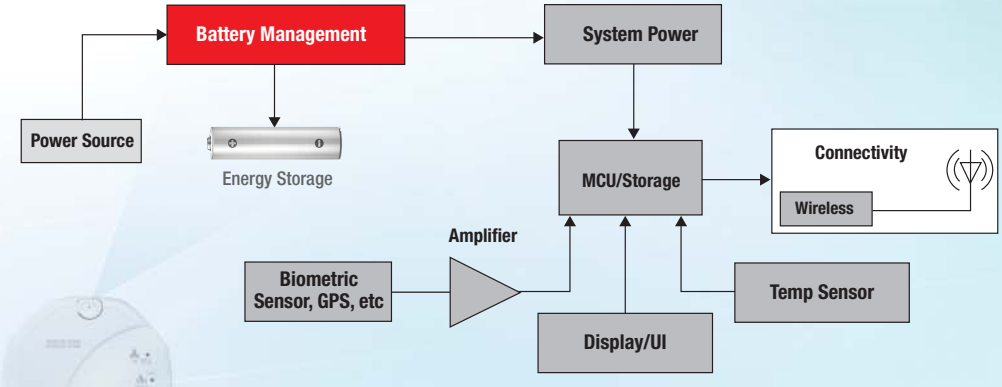

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TEXAS INSTRUMENTS

DC/DC converters or point of loads are part of the MEV portfolio. This is important to serve also customers with smaller volumes or where the development time is critical. Figure 2 shows a typical block diagram for a power supply and where MEV and its partners can offer solutions.

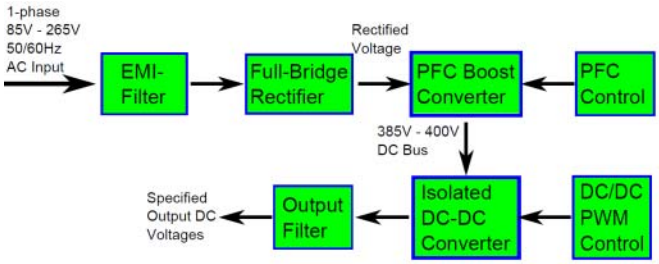


Figure 2: A short pull-out from manufacturers who offer suitable devices in above AC/DC power supply block diagram: CREE, Power Integration, Micrel, Itacoil, MS Schmelzer

After the customer visit and the discussed possible power management solutions, the next step begins for the application engineers at MEV. Especially for developments of discrete AC/DC power supplies, the distributor can help in different design stages, e.g. starting by defining the right regulations IC and sometimes ending with a complete prototype which will be developed in the MEV laboratory.

For most design engineers, it is very important to see the complete solution of their power supply from the beginning. This means for example that not only a switching regulator is interesting, but also the corresponding parts which are required are important to calculate the complete bill of materials and to see the complete solution. For this reason, the engineers at MEV provide the complete diagram, bill of materials and the transformer design for a discrete AC/DC solution. Figure 3 shows a typical 12W AC/DC solution based on a switching regulator from MEV's partner company Power Integrations.

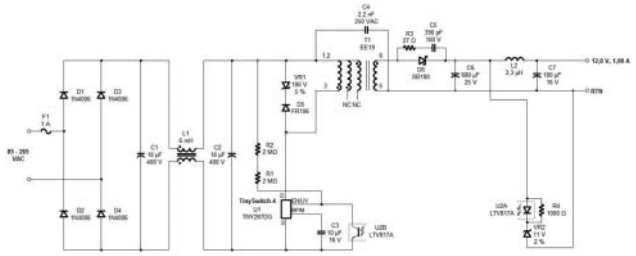


Figure 3: A 12W power supply based on a flyback topology

All important parts are included in the published diagram. It starts with the AC 85-265V input, continuing with the primary rectification and the EMI components, followed by the galvanic isolation of the transformer and the secondary regulation with the feedback network/output stage. Having a schematic BOM and the transformer design at the beginning of the development is a big benefit for the customer. After that, he may use this diagram or he may fine-tune it to fit his requirements.

Transformers, EMI and other technical requirements

In addition to the diagram, the transformer design plays a big role in the AC/DC power supply. A proper transformer design helps the customer to save a lot of money. For example the efficiency, safety, output regulation and the EMI behavior depend on the transformer design. This means that with a properly designed transformer, the customer can save further components and thus money. Especially for safety reasons, the transformer has to be designed to fulfill the required creepage and clearance distance.

The MEV application engineers also make suggestions and simulations here to support their customers. Figure 4 shows a simulation to define the transformer in terms of windings, size, cores and bobbins.

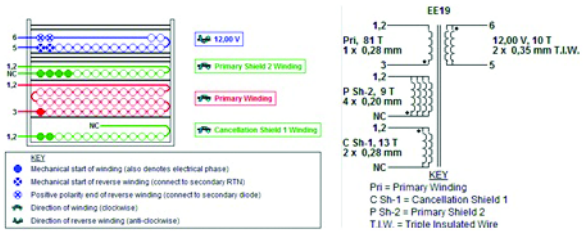


Figure 4: Simulation for a flyback transformer

The customer can take these simulations and go to his magnetic supplier and ask for samples according to the simulated results.

For a customer who wants to start quickly with an evaluation kit, Power Integrations offers for example a wide range of reference design kits for almost any switching regulator family. The kit consists of a complete ready AC/DC power supply with all components, a raw PCB board to assemble and test own discrete parts, several regulator samples and documentation. Figure 5 shows a PCB board of a Power Integrations reference design kit.

Figure 5: AC/DC evaluation board for first testing

When the design is finished at the customer, MEV is also there to double-check the design or to help when problems arise. For power supplies measurements like primary and secondary currents/voltages, EMI or temperatures are mandatory. With an own laboratory, the application engineers will also help here to find problems or check if everything is functioning properly with the power supply. Figure 6 shows for example the improvement with a primary common mode choke (highlighted in green in the diagram) at an input stage of an AC/DC power supply.

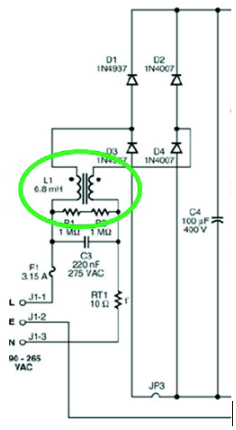


Figure 6: Input stage of a typical power supply

The left side of Image 7 shows the AC/DC power supply without a common mode choke at the primary side which failed the EMI test. And on the right, the passed test after improvement of the primary side with a common mode choke is illustrated.

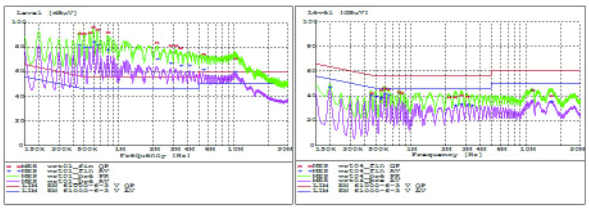


Figure 7: EMI Results without and with a common mode choke at the primary side

The key EMI sources are:

" High di/dt current waveforms in the primary and secondary loops
" High dv/dt voltage waveforms from switching transistors
" Charging and discharging of parasitic capacitances in the transformer windings
" Noise generated from diodes
" Coupling between transistor and heat sink

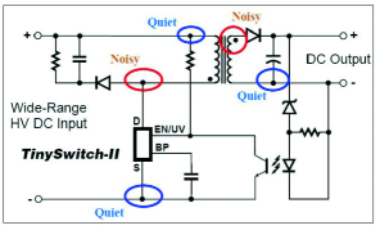


Figure 8: Nodes in a flyback topology

Image 8 shows what "noisy" and "quiet" nodes in a flyback topology are. Noisy nodes are those nodes which see high voltage switching signals. Potential on these nodes is changing over a switching period. Quiet nodes are low impedance nodes which see little switching activity. Potential on these nodes is constant over the switching period.

Apart from the technical support, the big benefit is that MEV can deliver the most important parts like regulation ICs and transformers from one source.

Summary

Challenges in distribution are not only relying on the right technology but being able to offer a complete solution to the customer. Moreover, for a medium-sized company like MEV, application support is the key feature for success. With its internal laboratory and a steady growing team of field application engineers, MEV is well prepared for another 20 years of distribution.

www.mevpower.com

Pin-Compatible Switcher Replacement for TO220-Style Linear Regulators

Linear regulators are still widely used in all kind of applications. If the current needs are in the lower range and efficiency is not important, they are still first choice. Also from a cost perspective, linear regulators can be a good choice, if the total solution cost including a heat sink can compete against a switcher solution. But if, for example, the power demands of an existing board increases, even a large linear regulator in a TO220 package can come to its limit. The widely used uA78xx and LM317 for example, are rated up to 1.5A output current. But this current rating is more of a theoretical value, as we struggle due to the power dissipation even for this kind of package, what we will see later on.

By Matthias Ulmann, Texas Instruments

This article shows, how a synchronous buck converter with the same size as a TO220 package as well as the same pinning can solve the problem, if the power dissipation of a linear regulator solution causes trouble or if the power demands rise and no redesign of the PCB is possible or wanted.

Limits of a linear regulator based solution

In a typical small industrial application, a uA7805 generates 5.0V from a 12.0V or 24.0V input. It supplies a microcontroller, some signal LEDs, digital and analog interfaces. The current demand is mostly in the range of a few tenths up to some hundred milliampere. With this specification, the power losses on the linear regulator for a maximum output current of 200mA can be calculated easily:

$P_{Losses} = (U_{In}-U_{Out}) \cdot I_{Out} = (12V-5V) \cdot 0.2A = 1.4W$

Figure 1 shows the linear regulator without being mounted to a heat sink on the left side.

The losses of 1.4W cause a heating up to more than 100ºC at 21ºC ambient temperature. Although the output power of 1 W is quite low, the linear regulator in its TO-220 package needs to be attached to a heat sink to dissipate the significant losses. On the right side, a LM25017 based buck converter with the same size like a TO-220 package shows only a maximum temperature of around 44ºC under the same test conditions.

For the next comparison, the linear regulator was mounted properly on a type of standard heat sink for this kind of application (Aavid Thermalloy, 531102B02500G, 38.1x34.9x12.7mm) with a thermal resistance of 10.4k/W with natural convection.

At 400mA load which equals an output power of 2W and power losses of 4.9W, the maximum temperature using a proper heat sink with natural convection is around 60ºC. This is an acceptable value but care has to be taken, that the large amount of heat can be dissipated. Using this solution inside a small closed housing will not work in most cases, since the 4.9W of power losses will heating-up the interior significant.

Due to the high efficiency of around 83% at this operation point, only 410mW need to be dissipated by the LM25017 buck-based solution shown on the right side of Figure 2. With the same size like a TO-220 package, the maximum temperature is also around 60 ºC.

So using a linear regulator in a large package like TO-220 is mostly not done due to high output current demands, but rather to allow dissipation of the losses.

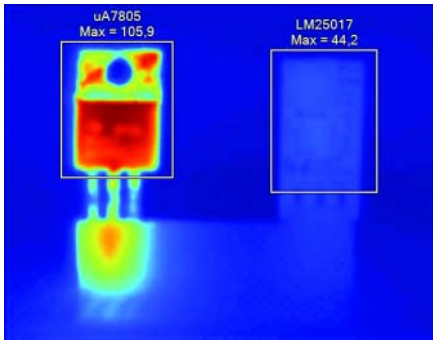


Figure 1: 12V to 5V @ 200mA load

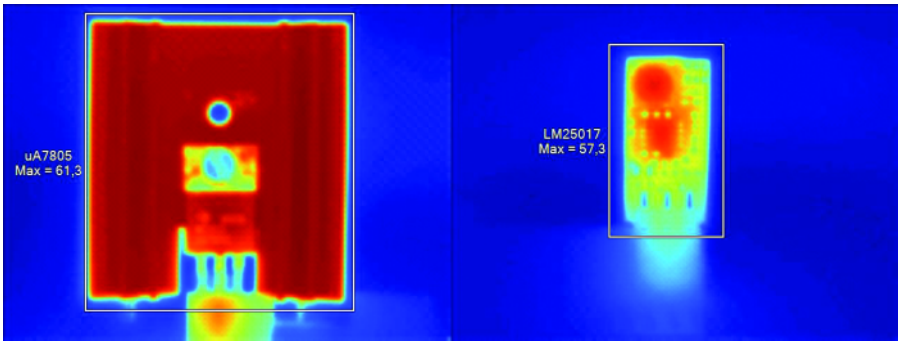
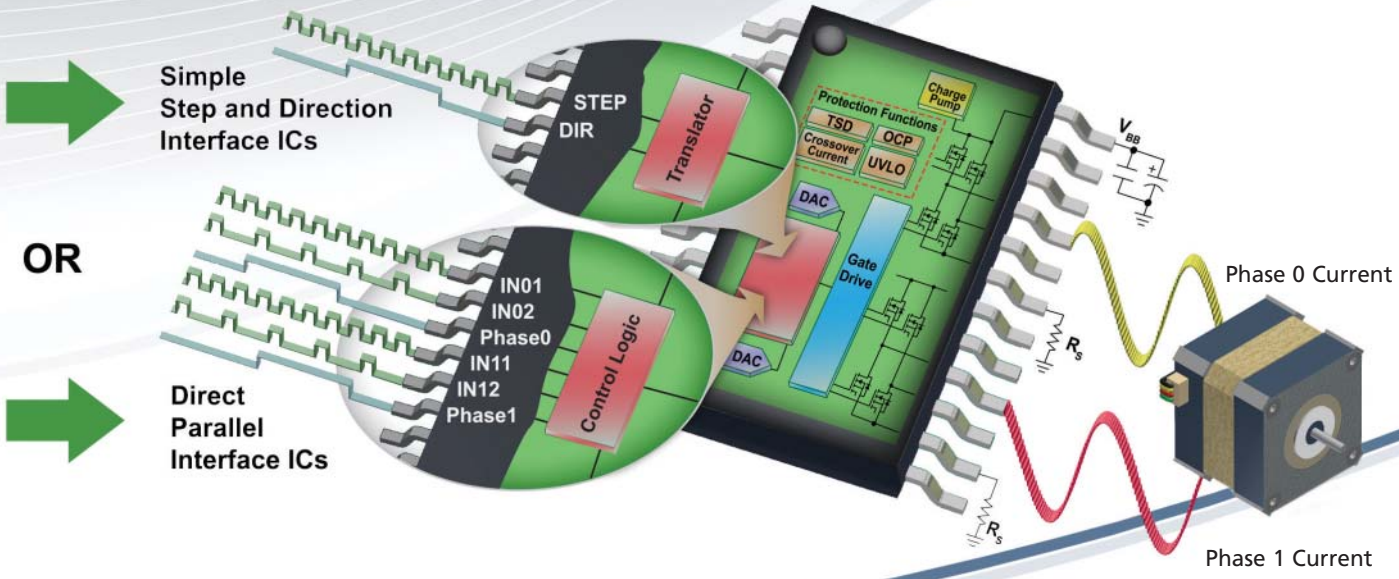


Figure 2: 12V to 5V @ 400mA load

Allegro Stepper Motor Driver ICs



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Integrated Driver ICs	A3988	8 to 36	1.2	Phase I0/I1	4
	A4986	8 to 35	2	Phase I0/I1	2
	A4987	8 to 35	1	Phase I0/I1	2
	A3977	8 to 35	2.5	Step/Dir	2
	A3979	8 to 35	2.5	Step/Dir	2
	A4982	8 to 35	2	Step/Dir	2
	A4984	8 to 35	2	Step/Dir	2
	A4985	8 to 35	1	Step/Dir	2
	A4988	8 to 35	2	Step/Dir	2
	A4990*	7 to 50	1.4	IN_{1-4}/INH	2
	A4979	7 to 50	1.5	Step/Dir or Serial	2
	A3981*	7 to 50	1.4	Step/Dir or Serial	2
	A4992*	7 to 50	1	Step/Dir or Serial	2

* AEC Q100 qualified

Allegro MicroSystems offers a full line of stepper motor driver and pre-driver ICs. These devices feature easy to use two wire step and direction translator interfaces as well as industry standard parallel or serial control. Microstepping positioning is available with resolutions from full step to 16 microsteps per step. Safety features include thermal shutdown, undervoltage lockout and over current protection.

Two package options are available, a TSSOP (with leads), and a QFN (without leads) which has the smallest PCB footprint. Both packages have an exposed pad for enhanced thermal performance.

Applications

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Printers	Sewing machines	Throttle control
Scanners	Closed circuit television	Transmission
Copiers	CNC milling machines	Headlamp leveling
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Switcher replacement in TO-220 size

For a direct replacement of this kind of linear regulators, three main prerequisites need to be fulfilled:

- Same size and pin out
- Regulation independent of additional input and output capacitors
- Wide input voltage range

The available space is 10x15mm, if the components are mounted only single sided. This needs a switching frequency in the higher range at the expense of higher switching losses, to keep the inductor small. For a pin-to-pin compatible replacement it is necessary, that the control scheme is not influenced by additional capacitance on the output. Buck converters based on voltage or current mode change their transient response, if the output capacitance is increased or decreased. Therefore a control scheme which is not influenced by additional output capacitance like Constant On-Time is most suitable for this application. The LM25017 with its large input voltage range up to 48V fulfills perfectly all these requirements.

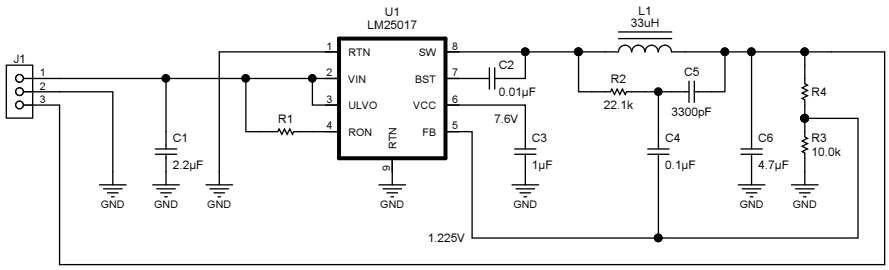

Figure 3: LM25017 buck converter

The circuit is small and needs only a few external components, which is important to get the solution on the required small size. For regulation of the output voltage, the converter needs a voltage ripple of at least 25mV on the feedback. This can be generated either by using an output capacitor with high ESR or by generating a triangular ramp using the switching node and an R-C combination (R2, C5). With the second solution, the output ripple is much lower, as a ceramic output capacitor can be used.

Resistor R1 sets the switching frequency, which is not constant due to the regulation scheme and changes between 500 and 800 kHz dependent on the input and output voltage. For 5.0V output voltage, R1 needs to be set to 80.6kΩ and R4 to 30.1kΩ. The same circuit can also be used for lower output voltages by changing only these two resistors. For an output voltage of 3.3V for example, R1 needs to be 52.3Ωk and R4 16.9kΩ.

The synchronous buck converter is designed for an input voltage range of 10 to 30V DC and for an output voltage of 5.0V or 3.3V at 600mA load. 600mA is the peak output current; the continuous output current is around 400mA if the board temperature should stay at a decent value as shown in Figure 2.

The efficiency curve (Figure 4) shows good results for this circuit. At higher input voltage, the efficiency drops due to the increasing switching losses.

As already mentioned, the Constant On-Time control scheme needs a voltage ripple on the feedback. This voltage ripple is derived from the current ripple of the inductor and therefore dependent on the ratio of the input and output voltage. This causes an influence on the load regulation as it can be seen in Figure 5. Anyhow, the output voltage is at all operation points

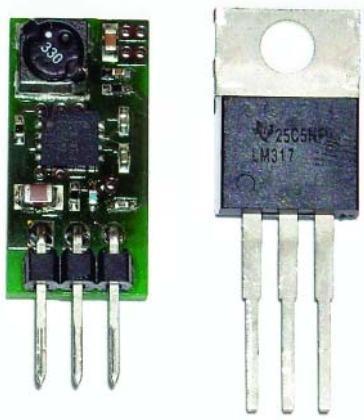

Figure 6: Comparison of devices

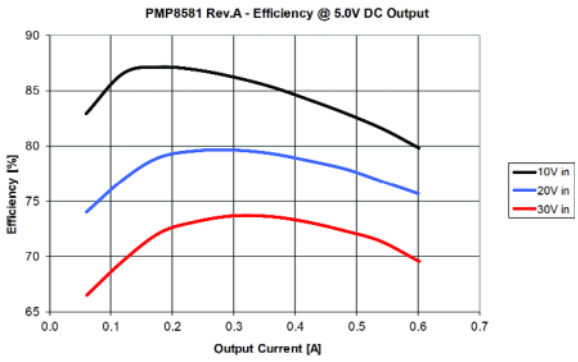

Figure 4: Efficiency

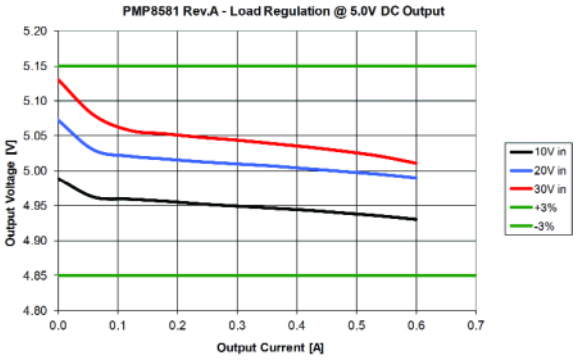

Figure 5: Load regulation

within a tolerance band of ±3% of the nominal output voltage of 5.0V.

Measurements of the output voltage ripple showed a maximum of 40mV (0.8%) and also the output voltage variation on a load step from 200mA to 400mA and vice versa is remarkable low with maximum 90mV (1.8%).

Conclusion

This article showed the practical limits of linear regulators in a TO-220 package a how they can be replaced by a pin-to-pin compatible synchronous buck converter based on a LM25017 with the same size. It offers a wide input voltage range from 10V up to 30V and is ideal for industrial applications, where supply voltages of 5.0V and 3.3V with a few hundred milliampere are needed. All information for this reference design (schematic, layout, bill of material) is available on ti.com under the keyword "PMP8581".

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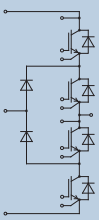
The degree of efficiency for the two 3-level topologies, NPC1 and NPC2, has to be evaluated depending on the switching frequency.

- EconoPACK™ 4 NPC2 topology for low and medium switching frequencies (approx. $f_{sw} < 12$ kHz)
- EconoPACK™ 4 NPC1 topology for high switching frequencies (approx. $f_{sw} \geq 12$ kHz)

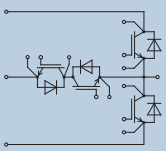
NPC1 topology

- 650V IGBT4
- Optimized for $f_{sw} \geq 12$ kHz
- Portfolio
  - F3L200R07PE4
  - F3L300R07PE4



NPC2 topology

- 650V/650V IGBT4
- 650V/1200V IGBT4
- Optimized for $f_{sw} < 12$ kHz
- Portfolio
  - F3L400R07PE4_B26
  - F3L300R12PT4_B26
  - F3L400R12PT4_B26



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5. eCarTec 2013 Munich: Connecting Mobility Markets

The fifth international trade fair for electric and hybrid mobility eCarTec 2013 which took place from 15th to 17th October, 2013 in Munich, showed that the the electric mobility industry has almost crossed the valley of tears. Despite a difficult start at the beginning of 2013, the organizers of the trade show are satisfied with the exhibitor and visitor figures of this year's show. Mottoed "Connecting Mobility Markets!", it seems that the trade show is about to become the industry's international venue for electric mobility.

By Marisa Robles Consée, Corresponding Editor; Bodo's Power Systems

Covering 22,000 m² including the parallel trade show for Lightweight Design "Materialica", the scale of the event made it possible to show the complete spectrum of the electric mobility industry. 479 companies presented their products in the fields of electric vehicles, electronics, energy storage technology, energy and infrastructure as well as lightweight design and smart materials to more than 12,000 visitors. "The most significant outcome of eCarTec 2013 was the high quality of specialist visitors. We are very proud that most of visitors are professionals, in other words engineers, designers, design engineers, decision-makers from communities and local authorities and fleet managers", says Robert Metzger, CEO of MunichExpo Veranstaltungs GmbH and organiser of Materialica and eCarTec Munich, eCarTec Paris and eCarTec Beijing. "In the past five years, eCarTec has become the most important and largest platform for electric mobility. Industry experts value eCarTec mainly because it enables them to establish business relationships with decision makers and to keep themselves updated on the latest trends and innovations", explains Robert Metzger.

Figure 1: The Mercedes SLS AMG Coupé Electric Drive was one of the eye catcher of this year's eCarTec. The EV has four electrical motors and uses Li-Ion batteries. (Picture: Marisa Robles Consée)

A special highlight at eCarTec Munich 2013 and Materialica 2013 were the presentations for the 'Materialica Design + Technology Awards 2013' and the 'eCarTec Awards 2013' as a Bavarian State Prize for electric mobility. Both sets of awards are traditionally presented on the first day of the trade fair as the highpoint of a festive award ceremony. Altogether, eight companies received the eCarTec Awards 2013 in the categories Electric Car (Volkswagen with e-up!), Electric Utility Vehicle (Brusa Elektronik with E-Force), Drive Technology/System Electrics/Testing Systems (Webasto Thermo & Comfort SE with HVH), Storage Technology/System Integration (RWTH Aachen), Energy/Infrastructure/Connection Technology (Brusa Elektronik with ICS), Product Concept/Vision (Rinspeed with microMAX), and a special category for Sustainable Mobility Concept (Conductix-Wampfler with IPT-Charge).

Batteries in fast progress

Charging and recharging has to be possible without complications and hazards. Well-known battery systems are currently being feverishly improved and entirely new systems developed. Alterations are being made to the materials used for the surfaces and matrices of electrodes, the electrolytes, the separators and their production processes. This applies to tried and tested lead batteries, nickel-cadmium (NiCd) systems, nickel-zinc (NiZn) and nickel-metal hydride (NiMH) as well as the "Zebra" battery and a broad range of lithium-ion (Li-Ion) batteries, among them recent developments such as lithium-titanate, lithium-iron phosphate and lithium-polymer batteries as well as newer developments such as the lithium-air battery.

"From a physical-chemical point of view, lithium systems offer unbeatable advantages. There is no way around them", affirms Dr. Dr. Reinhard Löser from the Advisory Council Bundesverband eMobilität e.V.. Li-ion systems stand for the highest energy densities (up to more than 160 Wh/kg), very high efficiencies, very high specific energy (1,800 W/kg), low self-discharge and with the appropriate cell management they are highly reliable. Their stability under load already exceeds 10,000 cycles. They are, of course, still comparatively expensive. If high power densities are needed (1,400 kW/kg), lithium-iron phosphate systems are the preferred choice (120 Wh/kg). "They boast rapid charging to 90% capacity in five minutes." When the lithium-metal oxide, the other electrodes and the electrolyte/separator are produced as sheets on polymer matrices, we speak of lithium-polymer systems which are easily formable and quite inexpensive.

Their specific energy is 3,000 W/kg, their energy density per volume reaches peak values (300 Wh/l), but measured by mass they are only mediocre (130 to 200 Wh/kg). Metal-air systems will determine

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future developments. Since one electrode is omitted (replaced by oxygen from the air), more weight can be cut out. The zinc-air battery already achieves energy densities three times greater than conventional lithium-ion batteries. These inexpensive and high-performance batteries are expected to hit the market in the next three to five years. But the lithium-air battery seems to be the most attractive. It achieves the highest energy density (more than 450 Wh/kg) and power density. That's why Reinhard Löser predicts: "The efficiencies achieved up to now of more than 80% give reason to hope that a market launch of the system, with the best performance although not the cheapest, will be successful in the next five to ten years. The price will drop further." In 2010, the price for lithium-ion batteries fell by two thirds to 300€/kWh. There will be more price reductions in the competition for the best solutions; new recycling processes will play their part, Löser is convinced: "But different types of batteries will always be deployed, depending on which factor is most important: energy content, energy density, power density, number of cycles, charging speed, environmental compatibility or safety - or price, in the same way as petrol, diesel and natural gas engines are in use today."

Winner: Compact Inductive Charging System

As mentioned before, Brusa ICS was the winner in the category Energy, Infrastructure, Connection Technology. Its compact inductive charging system (ICS) with integrated power electronics made the made it to the top. Brusa is renowned for its conductive chargers and has now developed an inductive charging system. It differs from familiar systems thanks in particular to its compact construction and will set new benchmarks in the area of induction charging.

Figure 2: The Compact Inductive Charging System (ICS) from Brusa with integrated power electronics. (Picture: Brrusa)

The new system only comprises of a floor and vehicle plate - the required power electronics are already integrated. Current inductive charging systems encompass two current coils: a primary coil located on the floor or, for instance, embedded in the road, and a secondary coil on the underside of the vehicle. The primary side also includes a wall box containing the power electronics and which supplies the primary coil. On top of this, other functions are required such as for foreign object and living object detection. On the vehicle side, besides the secondary coil an additional module is also required containing a power control unit, AC/DC converter and other communication components.

Brusa has managed to integrate all the modules and functions into the coil housings which mean the ICS only comprises of two components: Besides space and cost savings, this brings additional benefits such as a vast improvement in electromagnetic compatibility (EMC) as there is no longer any need for metres of HF cabling between the wall box and primary coil. This also makes it really easy to install the floor plate in the end customer's garage as it can simply be connected to the home's fused power supply (230 V/16 A). What's more, as the entire floor plate weighs less than 20kg the end customer can also handle it with ease. Carmakers also benefit from much shorter production and vehicle-integration times as the OEM only has to install one component into the vehicle: the fully-integrated secondary unit.

The ICS has been developed for everyday use and incorporates various safety features such as foreign-object detection and living-object detection. The charging system activates automatically as soon as the vehicle is in the correct position, with the vehicle and floor plate communicating over the wireless LAN standard 802.11p. The floor plate also offers advanced connectivity via a PLC. The overall system is also impressive with a high efficiency level of approx. 92% making it just as efficient as conductive charging systems.

Figure 3: The electrical 18-tonne truck E-Force uses two Brusa el ectric motors, controllers and chargers as well as a DC converter. (Picture:Brusa)

E-Force, an electric 18-tonne truck for regional and city goods distribution was the winner in the category Electric Vehicle: Commercial Vehicle. With the assistance of Lithiumstorage and Designwerk, the recently founded company E-Force One AG builds the electric truck and was able to acquire customers such as the brewery Feldschlösschen and the food retailer Coop which already have the first E-Force trucks in their fleets or will start soon. While the etruck may be about twice as expensive as a conventional truck, it pays for itself very quickly thanks to its extremely low running costs. Each new E-Force truck uses two Brusa electric motors, controllers and chargers as well as a DC converter.

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LED professional Symposium +Expo 2013

The Lighting Hub

Over 1,100 visitors from 34 countries attended the LED professional Symposium +Expo 2013 in Bregenz, Austria, from September 24th to 26th. Research institutes, lighting organizations and the lighting industry presented their insights on the latest trends in LED and OLED lighting technologies in multiple sessions, workshops and throughout the 2,000 m2 exhibition area. Keynote speaker, Dietmar Zembrot, President of LightingEurope said, "I think this is one of the most important lighting events in the world".

By Marisa Robles Consée, Corresponding Editor; Bodo's Power Systems

Luger Research e.U., the organizer of LpS 2013, announced a new attendance record with increased international visitor and exhibitor figures. Almost 60% of all visitors were from manufacturing companies, over 10% were from distributors, about 8% came from engineering and design services and around 5% from universities. The largest percentile of visitors was made up of executive and corporate managers (20%), followed by research and development engineers (17%), then distributors and sales people (14%) and finally application engineers (4%).

The visitors had the choice of 46 lectures, six workshops, two tech-panels, an international exhibition and networking opportunities. "This makes it a "must go" event for professional audience in the lighting industry", Siegfried Luger, LpS event director and publisher of LED professional, is convinced. The lighting industry is in a fundamental process of change. "Predictions for the next five to seven years are that we'll see more LED/OLED performance increases along with continuous price declines. Therefore, profitability is the key to success", he says. The challenges of phasing out old technologies and ramping up new technologies are huge. Siegfried Luger also says that "merging" lighting with the fast and innovative semiconductor industry requires new processes, structures, partners, alliances and a new understanding of the lighting sector itself.

New and enhanced technologies are the major innovation drivers in semiconductor lighting. Technologies are increasingly being merged on a sub-system level while various industries are intensifying collaborations. But the key question remains: "What will the winning approaches be in the years to come?" In order to be able to make future-oriented decisions, it is important that the different technological developments are understood. “The LpS is designed to give the attendees an overview of relevant background information that will help them find answers and solutions to their questions and problems”, says Luger. At the same time, leading global companies and research organizations will be presenting their newest products, services, components, modules, systems and production techniques.

New in 2013

The markedly extended program offered an even deeper and broader spectrum of information, knowledge and topics for discussion this year. A total of 46 lectures on the topics of LEDs, OLEDs, optics, electronics, equipment, materials, reliability, standards, measurement, design and applications cover the most important subjects and trends in the SSL field. The workshop program has also been extended noticeably. This year, six workshops were offered in two parallel tracks on specific LED technology topics. The subjects of Reliability and Thermal Testing, Standardization, 3-Dimensional System Designs and Optics, Printoptical Technology, Computer Supported Design of LED and OLED Systems as well as Qualification and Reliability were discussed and explained in an interactive environment. Due to the increasing number of exhibitors, the exhibition area was increased by 20% or almost 2,000 m². Besides the many interesting new developments presented by about 80 international exhibitors, the LpS was also a good place for product launches in Europe.

Figure 1: The Keynote speakers discussed the actual lighting trends (from left): Siegfried Luger (Luger Research), Dietmar Zembrot (Lighting Europe), Menno Treffers (Zhaga) and Alfred Felder (Tridronic). (Picture: Marisa Robles Consée)

This year the Tech Panels were open to the public for the first time. Dietmar Zembrot (President of LightingEurope and CEO of Trilux), Klaus Vamberszky (Executive Vice President of Technology at Zumtobel), Christian May (Head of Business Unit Lighting and Flexible Integration at Fraunhofer), Nicola Trivellin (Researcher at the University of Padova) and Henk Veldhuis (Chair of the Technical Advisory Working Group of the Connected Lighting Alliance) discussed "LED & OLED Lighting Innovations - How to Break Through".

Two tracks were dedicated to drivers and controls; one of the core topics this year. Stefan Zudrell-Koch, the director of strategic marketing and business development at Dialog Semiconductor was giving a talk on this subject titled "Digital Processing Techniques in Retrofit Lamp Driver ICs". Today, off-line AC/DC LED drivers are dominantly operated and controlled by mixed signal control ICs; the first generation of digital power management ICs. IC technologies with a substantially higher scale of integration are available at low cost today. They allow for large-scale integration and substantially more complex logic structures to be implemented compared to today's solutions. Digital systems offer free configurability. These new systems are enabled with unprecedented performance, flexibility and ease of use. Zudrell-Koch demonstrated how such technologies help master challenges in retrofit lamp design, drive cost reduction, and make LED lamps future proof.

Trends and Innovations

About 80 exhibitors from all over the globe showed their latest innovations, products, equipment and services. Underwriter Laboratories, Gold Sponsor of the event, presented its testing and approval services. Silver sponsor Tridonic and Lanyard sponsor Harvard Engineering showcased their competence in the field of electronic drivers while Pen sponsor Osram Opto Semiconductors highlighted its latest LED technologies.

Trend 1: Transition to the Super system

Single devices are increasingly being combined into poly-systems. Cree for example, launched their new CXA LED Arrays. These are the industry's first High-Density (HD) LED Arrays. According to Cree, this technology doubles the system intensity of spotlights compared to previous arrays. The LEDs placed on ceramic based PCBs are packed more densely and are supposed to enable lighting manufacturers to design products that deliver the same light intensity and quality at up to 50% lower power. Another example is Itswell from South Korea who presented its LED Array L5256 Series for the general lighting market. The next integration step into standardized modules was demonstrated by the Italian company LightCube, a spin-off from the University of Padua, with its all-in-one modules. The market is seeing an increased number of modularization and especially standardized modules (e.g. Zhaga). Multiple companies deliver Zhaga compliant system components for modules. The distributor, MSC from Germany showed fully integrated lighting solutions with Zhaga compatible modules and snap-in reflectors.

Trend 2: Increasing Degree of Trimming, Optimization of Flow

Due to the cost pressure on LED lighting systems, this trend will become a key driver for new developments. COB technology with its elimination of LED packages was presented by a number of companies. The trimming trend can be obtained in the field of LED drivers as well. AC LEDs (shown by Neumüller/SSC) and also single-stage topologies driver concepts (Recom, ON Semiconductor) offer systems solutions with less or no converter stages to reduce costs and losses. CeramTec, manufacturer of ceramic materials and products, eliminates heat barrier for the thermal management design. They have improved their materials and found enhanced heat conduction solutions, enabling high power applications. marulaLED from South Africa showed their innovative Cool Tube Technology, which is an active cooling system that allows the pro-

duction of modules with high luminous power and compact designs for high and low bay lighting. Amphenol LTW presented a connector system to eliminate wiring and soldering for LED boards.

Figure 3: The LpS 2013 was a good place for product launches in Europe. (Picture: Luger Research)

Trend 3: Increasing Controllability, Degree of Completeness and Elimination of Human Involvement

Symposium lectures as well as technologies shown at the exhibition are following the trend of digitalization. Dietmar Zembrot states: "LEDs and OLEDs together with sensors and innovative lighting controls will enable the industry to build intelligent lighting systems with a higher customer benefit. Even beyond energy efficiency cost and usability will be a key success factor." Semiconductor light will finally be driven and controlled from "fully-digital" environments. Companies such as ams from Austria, Harvard Engineering from the United Kingdom, Tridonic from Austria, TCI from Italy and Recom from Germany offer sensors and drivers for these purposes. Self-controlled and self-adjustment systems are in preparation and will be part of next generation products.

Trend 4: Increasing Coordination

Tridonic launched their LED Control Gear portfolio at the LpS event. The analogue/PWM controlled drivers, to increase controllability and coordinating signals, are available in 20W, 35W and 65W. TCI presented custom specific LED drivers for non-standardized lighting solutions. Recom enlarged their driver portfolio in regard to power range and presented housings with smaller form factors. They displayed their driver competence with their new phase cutting dimmer for standard housing installations and a solar driven street lighting concept.

Trend 5: Optical properties

Bayer Material Science and Evonik, both from Germany, showed diffuser foils and optical materials for lenses. Bayer Material Science adapted their encapsulating materials to fit the needs of LEDs, available in transparent, coloured or opaque. The material shows good optical qualities, is particularly weather-resistant, robust and yet flexible and is therefore widely applicable.

Figure 2: More than 1,100 visitors from 34 countries attended the LED professional Symposium +Expo 2013 in Bregenz, Austria. (Picture: Marisa Robles Consée)

Socializing

Light Art Project: On the first evening of the event, Zumtobel invited exhibitors and visitors to view their light installation at the newly renovated Vorarlberg Museum. This installation intended to build a bridge between technology and application. Outside, the artist Peter Kogler used the museum's façade for a fascinating light show. The 200 attendants received detailed information about the lighting requirements given by the museum and the lighting system created and implemented by Zumtobel.

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InDUR Power Inductors with Minimum Size and Weight for DC and AC Filter Applications

Improving power density is a permanent challenge of R&D in power electronics. A survey of modern power electronic circuits shows that further optimization has to be based on the passives and particularly on the inductive components.

By Alexander Stadler and Christof Gulden, STS Spezial-Transformatoren Stockach GmbH & Co. KG, Am Krottenbühl 1, 78333 Stockach, Germany

State-of-the-art inductors (e.g. in LC, LCL and filters) contribute a lot to space, weight, losses and cost as well. In this paper, a new generation of power inductors is presented. The thermal management of these components has been optimized using FEM and extensive thermal measurements. Thus, much higher electrical current densities have become possible at the same hot-spot temperature, which is finally equivalent to higher energy density and smaller component size.

Figure 1: Power inductors optimized for 3m/s forced air cooling (a) and cold plate mounting (b)

In recent work (e.g. [1] [2]), the general influence of the power electronics topology on the filter and especially on the inductor size has been investigated. The next step that usually reduces the size of these components is the electromagnetic optimization [3]. Assuming an optimal construction of coil and core, there are only two options left for further downsizing: Firstly, a core material with higher saturation flux density can be used. Secondly, the electrical current density of the winding can be increased.

Figure 2: Flat wire helical winding

Due to the fact that there's no theoretical potential for a new (high frequency) core material with considerably higher saturation limit, the choice of higher current densities promises the highest gain in package density. However, higher current densities lead to higher losses and the main limitation then is given by the maximum hot-spot temperature of the component to avoid accelerated aging and insulation breakdowns. Consequently, the main optimization potential is to minimize the thermal resistance of the inductors and to optimize its internal thermal management.

A survey of today's constructions shows, that approximately 50% of the temperature drop between hot-spot and cooling medium occur inside the housing, which is quite far from optimum. The main goal of the optimized construction shown in Figure 1 is that the temperature drop between hot-spot and housing has been minimized. Thereby, the flat wire helical winding technology (Figure 2) is one of the key components to achieve much higher cooling efficiency. Below, the thermal management is investigated using finite element method (FEM) and data drawn from extensive thermal measurements.

Simulation and Measurement of the Hot-Spot Temperature

Investigation of the Forced-Cooled Heat Sink

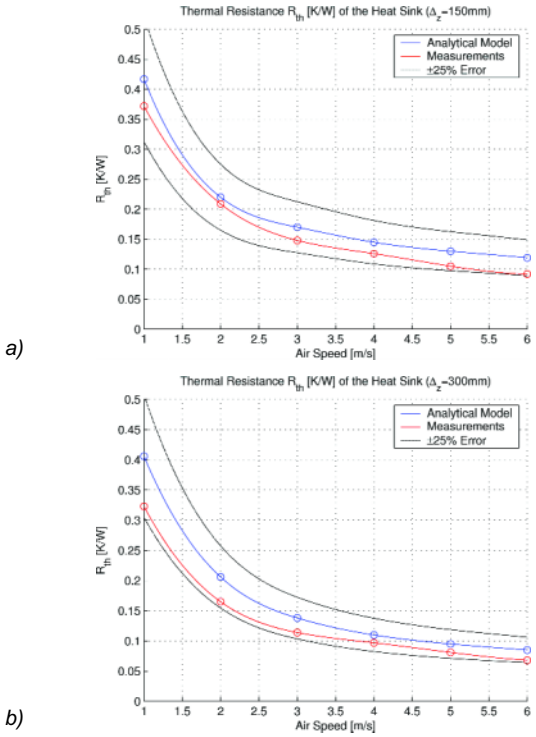
To begin with, an analytical model is conducted to optimize the forced cooled heat sink [4] [9] and to predict its thermal resistance. Figure 3 shows a comparison between calculated and measured results. It is found that the thermal resistance $R_{th}\,[\mathrm{K/W}]$ can be predicted with adequate accuracy ($\leq \pm$ 25%). With the cooler area A, the heat transfer coefficient $\alpha\,[\mathrm{W/(m^2K)}]$ can be calculated:

$$\alpha = \frac{1}{R_{th} A} \quad . \qquad (1)$$

Equation (1) can directly brought into FEM to describe the cooler boundary condition.

Simulation of the Hot-Spot Temperature

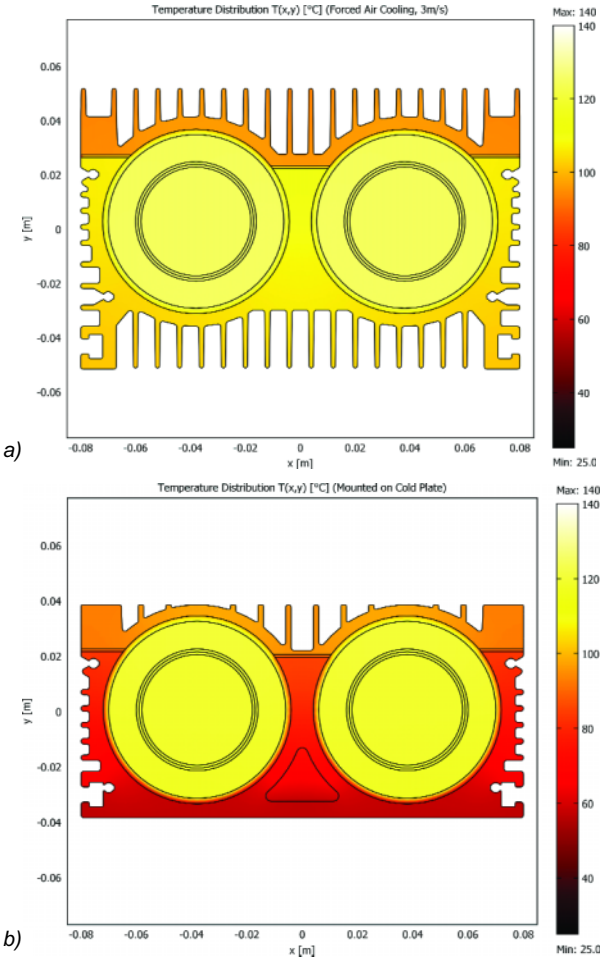
Figure 4 depicts the simulated temperature distribution inside the inductor. In Figure 4a the forced-cooled version is shown. It can be seen that the temperature distribution is nearly homogeneous quite close to the optimum. If the inductor is mounted on a cold plate (Figure 4b), the insulation material between coil and aluminum housing remains as the main thermal barrier. However, a considerably high heat flux can be detected due to the inhomogeneous temperature distribution inside the continuous casted aluminum parts.



a)

b)

Figure 3: Thermal resistance of the forced-cooled heat sink: Length Δ_z=150mm (a) and Δ_z=300mm (b)



a)

b)

Figure 4: Temperature distribution for 120°C hot-spot temperature: 3m/s forced air cooling (a) and cold plate mounted version (b)

Conclusion

Figure 5 shows the wind tunnel and the cold plate used for verification and for performance measurements. The performance data of the new components are listed in Table 1. For the forced-cooled inductors it is found that the current density can be increased from 3.7A/mm² to 5.6A/mm² (in other words this corresponds with a size reduction by a factor of 1.5). If the inductors are mounted on a cold plate, even a current density of 8.0A/mm² becomes possible - a value that only has been reached in direct water cooled conductors until now.

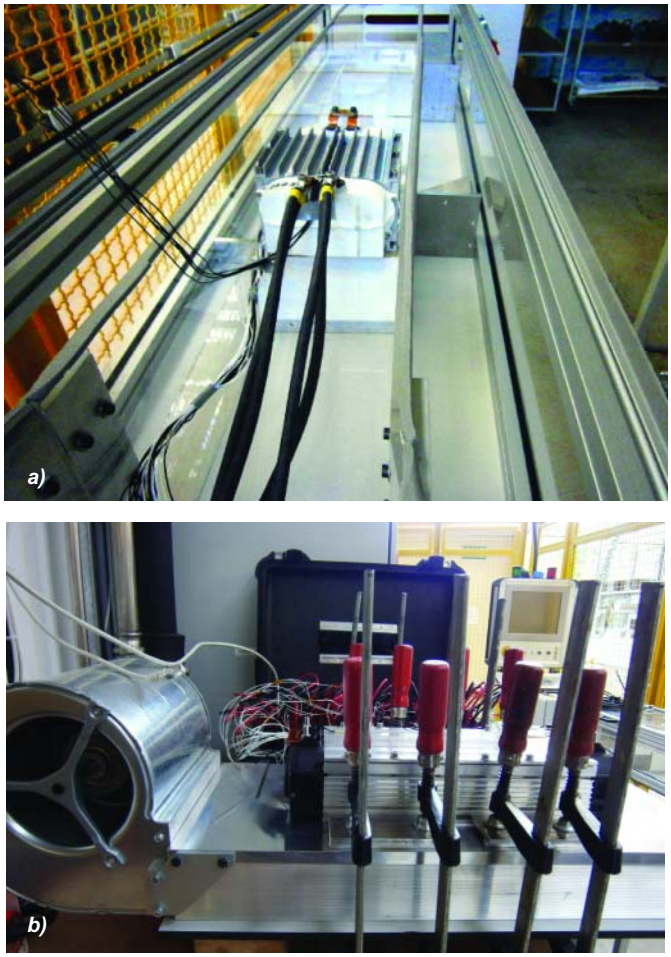


Figure 5: Wind tunnel (a) and cold plate (b) for verification and performance measurements

The performance data in Table 1 were extracted from the thermal measurements using DC winding current only. However, for high permeability core material and (one-layer) flat wire helical windings (Figure 2), the practical inductor energy density can still be estimated. In all cases N=438 turns of flat wire 10x1mm were used. The legs were built from circular ferrite disks with radius R=20mm and height h=7.5mm to realize a distributed air gap. According to the maximum allowed flux density (e.g. B_s=400mT for ferrite material), the necessary air gap length l_g can be calculated to avoid saturation:

$$l_g \geq \mu_0 \frac{N \cdot I}{B_s} \quad . \qquad (2)$$

Consequently, for the maximum currents 37 A, 56 A and 80 A given in Table 1, 51 mm, 78 mm and 111 mm total air gap length are required. The inductor energy density w_m is finally given by the relation between stored magnetic energy (primarily within the air gap volume $A_g \cdot l_g$) and inductor box volume V_{bus} :

$$w_m = \frac{\frac{1}{2}LI^2}{V_{Box}} \approx \frac{\frac{1}{2}N^2\mu_0\frac{A_g}{l_g}I^2}{V_{Box}} = \frac{\frac{1}{2}N^2\mu_0\frac{\pi R^2}{l_g}I^2}{V_{Box}} \quad . \qquad (3)$$

As depicted in Table 1, we obtain 847 Ws/m³, 1269 Ws/m³ and 2599 Ws/m³, which demonstrates, that the inductor energy density is approximately proportional to the winding current density.

Inductor Type	*Conventional Inductor with*	*Optimized Inductor for 3m/s Forced Air*	*Optimized Inductor for Cold Plate Mounting*
Injected Power Loss	250 W	571 W	**1120 W**
DC Current	**37** A	**56** A	**80** A
Current Density	**3.7** A/mm²	**5.6** A/mm²	**8.0** A/mm²
Inductor Energy	847 Ws/m³	1269 Ws/m³	2599 Ws/m³
Hot-Spot Temperature	**126°C**	**125°C**	**120°C**
Air/Water Temperature	**25°C**	**26°C**	**57°C**
Thermal Resistance (Hot-Spot – Air/Water)	**0.404 K/W**	**0.173 K/W**	**0.056 K/W**
Heat Flux Threw Winding Surface	**2.48 kW/m²**	**5.66 kW/m²**	**11.11 kW/m²**
Cooling Fins	**Yes**	**Yes**	**No**
Inductor Size	**160x100x300 mm**	**160x100x300 mm**	**160x70x300 mm**

Table 1: Performance data of the example inductors in comparison to a conventional inductor

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60W-90W PoE Systems-Integration Opens Door to Energy Savings

Advanced PoE products requiring up to three times the power of previous-generation devices can be implemented with intelligent power management ICs

By Faisal Ahmed, Vice President, Marketing, Akros Silicon

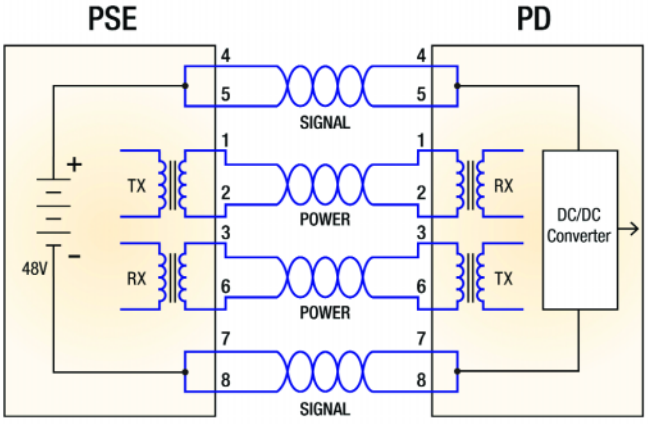
Evolving PoE Standards

In 2011 Cisco introduced a new 60W implementation it calls UPOE while the IEEE is working on a new standard called PoE++ that specifies 60W - with potential increases to 90W - of power that can be delivered over the standard Ethernet Cat6 cable / RJ-45 connector scheme. This evolution in PoE represents significant increases from Cisco's original 7W "Inline Power" standard introduced in 2000, or even the latest 2009 PoE+ (IEEE 802.3at-2009) that allows for up to 25.5W of power delivery.

PoE++ will make it possible to power an exceptionally wide range of products, such as thin clients, IPTVs, IP turrets, remotely controlled video cameras, point of sale (POS) terminals, as well other devices that currently require a separate power source. But perhaps the most important benefit of 60-90W PoE is the ability to intelligently manage energy consumption over the enterprise through careful system integration. By utilizing energy-management ICs in each Powered Device (PD), the Power Sourcing Equipment (PSE) can modulate the power delivered on a node-by-node basis, therefore enabling a far more efficient use of the PSE power supply. And as more and higher power devices are added to the PoE network, intelligent energy management will become more important.

Managing Higher-Power PoE

The typical implementation of 15W PoE (IEEE 802.3af) and 30W PoE+ (IEE 802.3at) delivers power from the power sourcing equipment to the powered devices using two of the four twisted pairs in a standard Cat 5e or Cat 6 cable. Two variations of this scheme are possible. In the most common implementation scheme, power is superimposed on the signal pairs (Figure 1a); in the other, the spare pairs are used to deliver power (Figure 1b). In either case, the PSE provides nominal 48V of DC common-mode power of either polarity to the PD. Each PD extracts the power using a diode bridge to deliver the power to the power conversion circuitry.



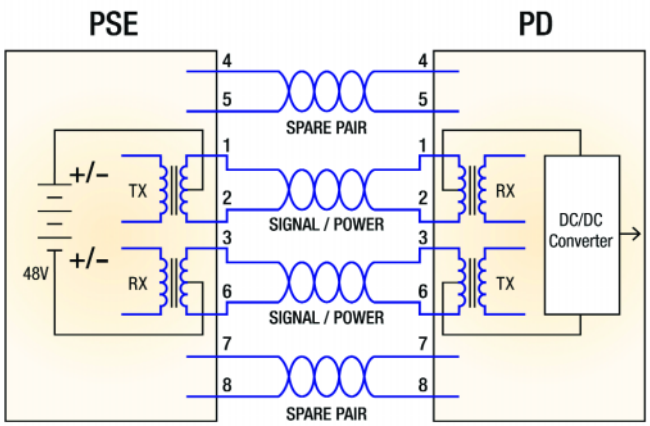


Figure: 1a / 1b. Standard configurations for PoE and PoE+

The higher-power (60W-90W) PoE utilizes all four pairs in the cable to provide power. The PSE has two separate power supplies, each capable of delivering 30W-45W of power to any PD node. The two parallel power sources are then applied through two diode bridges as input sources to the PD power management (Figure 1c).

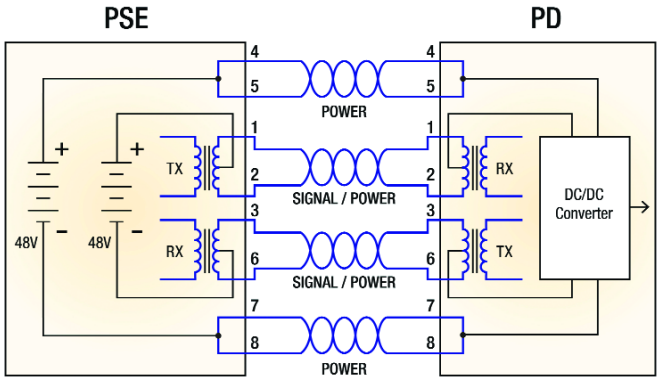


Figure 1c. Dual power source delivery for 60-90W PoE requires use of all four pairs of wires in Ethernet cable

This power delivery system greatly expands the range of devices that can be added to the network. The PSE will now have devices that require only a few Watts of power (e.g., IP phones, access control nodes,) and medium-power devices (e.g., IP security cameras, wireless access points), as well as higher-power devices like IPs TVs, POS terminals and thin client computers. With this broad range of power requirements, it now becomes all the more important for designers to manage the PSE power output delivered to each node. Questions they need to consider include:

- What is the maximum power required at each node in the network?
- What are the power losses in the cable to each node?
- Is the PD operating on a continuous basis or can it be on standby at times?

If the PSE is required to supply the maximum power to each port on a continuous basis, the size of the PSE power supply would have to be considerably larger than needed under most operating conditions. The capability of delivering power to each PD at the level required, and only when required, has the dual benefit of reducing the size of the PSE power supply and allow the supply to operate at levels closer to peak efficiency.

60W/90W PoE Systems

The implementation of advanced 60-90W PoE systems will require the availability of power sourcing equipment that is capable of delivering 60W or even 90W of power, as well as an effective technology solution for power device product manufacturers to incorporate into their new designs.

In order to achieve the requirements listed above for PoE implementation of PDs at these higher power levels, a total energy management approach is needed that not only provides high-efficiency power conversion ICs, but also focuses on total system efficiency. The objective is to dynamically control the power by monitoring the environment resulting in truly efficient system designs - not just of power sub-conversion. Additionally, a total energy management approach minimizes emissions, systematically, at the source.

60W/90W PoE implementation at the PD needs to take into consideration a number of important factors:

- Multi-rail power conversion configurable to voltages required for device sub-systems including LED backlighting.
- Real-time energy monitoring - such as input power measurements, power system health monitoring on a continuous basis.
- High-efficiency conversion - including light load management, ultra-low standby power and sleep-mode power.
- Fast system dynamic response and sequencing control - including the ability to rapidly change operating mode of the device from continuous to discontinuous modes and to rapidly go in and out of standby and sleep modes; flexible sequencing control to optimize multiple-rail output power start-up.
- Digital power control - such as voltage margining to manage power consumption under differing performance requirements, managing standby and sleep requirements.
- High-efficiency EMI control and mitigation that minimizes radiative and conductive emission noise from the power supplies.

As this list suggests, intelligent energy management takes advantage of the ability of the PSE and PDs to communicate with each other to operate the network at optimum efficiency. This requires the integration of a large number of functions including power conversion, isolation, communications and control. Integrated system-on-a-chip (SoC) solutions are becoming available handle all or most of these requirements; and without an SoC solution higher-power (60W and above) PoE PDs would require multiple components, such as two or three power management ICs, several optocouplers and custom transformers. In addition to adding component cost, consuming board space and increasing design complexity, these approaches are vulnerable to shoot-through issues and losses due to rectifier diode and reverse recovery.

An example of total power management approach that accommodates 60W-and-above PoE applications has been developed by Akros Silicon. This SoC solution uses just two components: one AS1860 SoC and one external FET. Moreover, by integrating the company's GreenEdge digital isolation technology, the AS1860 enables the implementation of many advanced diagnostic and high-voltage telemetry features that allow operators to remotely manage power, which in turn enhances reliability and energy efficiency.

Interoperability of PSEs and PDs

The IEEE has instituted a working group to establish a new PoE standard for the rapidly approaching higher-wattage implementation. In the meantime, it will be important for designers to be assured of interoperability between PSE and PD implementation. Recognizing this, Akros has entered into an interoperability collaboration with Broadcom, a leading producer of PoE PSE power controllers. Broadcom's model BCM59111 and Akros Silicon's AS1860 (Figure 2) interoperability was demonstrated at electronica 2012 in November, 2012.

Interoperability is a key factor in achieving intelligent energy management. Communications between the PSE power management controller and each PD provides information, including instantaneous load requirements, cable losses, system status and other operational data. The AS1860 SoC includes I/O functions, integral A-to-D converter and on-board digital isolation that combine to provide seamless data communications with the PSE.

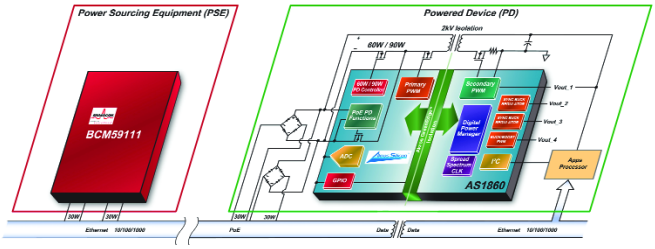


Figure 2. Interoperability of Broadcom's PoE PSE controller (BCM59111) and Akros' SoC IC (AS860)

Summary

As Ethernet bandwidths continue to increase, the nature of the devices that will require PoE will also increase. With bandwidths supporting IPTVs, POS terminals and other such devices, the need to manage system power will become even more important. The power requirement for power sourcing equipment will be managed by having the ability to adjust the power delivered to the powered devices under widely varying operating conditions. The PDs will be required to provide this information in real time and respond to PSE control inputs. A total energy management approach can provide a flexible, cost-effective means of responding to the evolving - and increasing - demands of PoE systems.

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Design Tips for Even Better Class-D Amplifier Performance

Examination of some of the finer points of class D amplifiers, and how engineers can optimize audio performance and keep improving their designs.

By Jun Honda, Director of Audio Systems Engineering at International Rectifier

The efficiency and size advantages of class-D amplifiers, which enable improvements in system form factor, styling and battery life, are generally understood. However, class D operation also provides inherently low distortion and more stable dynamic response than class AB. Whereas class AB forces designers to trade power efficiency for audio fidelity, efficiency and fidelity theoretically improve together in class D; as semiconductor advances boost efficiency, audio performance also increases.

Recap on Class D Operation

As figure 1 illustrates, the class-D amplifier converts the input audio signal into a series of pulses which have instantaneous average value proportional to the input signal. This binary signal switches the power MOSFET, creating an amplified version of the PWM. A passive low-pass filter attached to the PWM switching stage removes high-frequency components to recover the amplified audio signal.

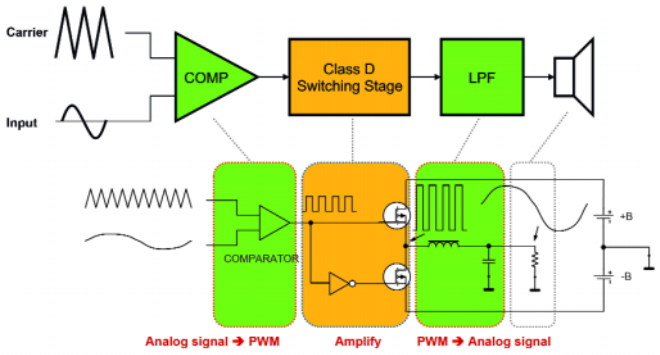


Figure 1: Overview of class-D amplifier and principles

Class D Under the Skin

The inherently high efficiency of a class-D amplifier allows parts such as heatsinks and cables to be downsized enabling audio equipment to be far smaller than has historically been possible. This not only helps improve aspects such as styling and portability, but also contributes to improved audio performance. Every current loop inside an amplifier forms magnetic couplings with other current loops, effectively creating many small transformers that can interfere with nearby circuits and components. When the amplifier is physically smaller, the magnetic flux due to these current loops is reduced. The susceptibility to flux is also lower. In practice, the impact of magnetic flux is inversely proportional to the square of size.

Compared to class AB, class D exhibits inherently superior response to changes in power demand, resulting in highly dynamic sound characteristics. This superiority comes from the completely different manner in which the class-D amplifier controls its output power. Even when the amplifier is idling, the output MOSFETs are turned fully ON or OFF alternately every 1.2µs. Hence the timing of the switching controls the power flow; to change from zero output power at idle to a half rated power output takes only 0.6µs until the next switching event is triggered. Hence the switching timing regulates output power, with no additional energy needed to commence the event. In other words the output power is controlled independently of the current or voltage demanded by the speaker, and is simply determined by when the PWM signal switches from one state to another. This ensures robust control of the power output to the speakers, and reduces distortion caused by the speakers' back EMF.

In addition, there is no temperature-sensitive operating bias point in a class-D power stage. This enables the amplifier to maintain stable operation under dynamic power changes. The gain of the class-D stage is simply a function of supply voltage and a ratio of the ON time between the output MOSFETs, and is not related to temperature. One big challenge in class AB design used to be how to maintain the stability of the bias current under dynamic loading conditions, since the transistor gain when used in the linear region is strongly dependent on bias current, which in turn is highly sensitive to temperature. Class D eliminates this interdependency.

Key Semiconductor Components

Although class D allows a theoretically perfect amplifier, with 0% distortion and 100% efficiency, the actual performance is dependent on the quality of the components used. In particular, the output power MOSFETs and the controller IC each have a major influence.

MOSFET

A perfect MOSFET would allow the amplifier to have 100% efficiency resulting in zero heat generation. Today's state-of-the-art MOSFETs allow a practical Class D to achieve above 90% power efficiency. Examining the On resistance (RDS(ON)) x gate charge (Qg) figure of merit (FOM) illustrates how closely the performance of today's MOSFETs now approaches that of an ideal power switching device.

Consider the evolution of 200V rated MOSFETs over the last couple of decades. To achieve the highest efficiency in a Class-D amplifier, the conduction loss from RDS(ON) and switching loss dictated by gate charge Qg should both be as low as possible. The IRF640 from the 1980s, which has a planar structure, has RDS(ON) of 180m? with Qg of 70nC. The latest trench structure MOSFET IRFB4227 has RDS(ON) of 20m? with the same 70nC Qg. The FOMs has been reduced from 12,600 to 1400; a nine-fold improvement.

Control IC

As far as the controller IC is concerned, effective noise isolation is a key requirement. IR has paid special attention to this aspect in the design of its class-D amplifier controllers, and uses proprietary tech-

niques to prevent switching noise being coupled into noise-sensitive error-compensation circuitry. This has enabled the built-in noise-sensitive analogue error amplifier in the IRS2092 controller, for example, to provide a clean low-noise output despite the fact that the other side of the silicon chip just 1mm away is switching between -60V and +60V at very fast transition speed. This error amplifier is also well isolated from the switching of the external output power MOSFET.

To achieve low distortion, precise timing control of the PWM gate-drive signal is as crucial as ensuring precision analogue signal processing in the error amplifier section. A stable dead-time control and jitter-less level shifting is also needed to control the gate signals to the output MOSFETs. IR has developed special circuits that attain very low jitter in the signal path.

The IRS2092 combines these noise-isolation and timing-control features with robust protection circuitry to create a class-D amplifier that surpasses the audio performance possible with a conventional class AB approach in many aspects.

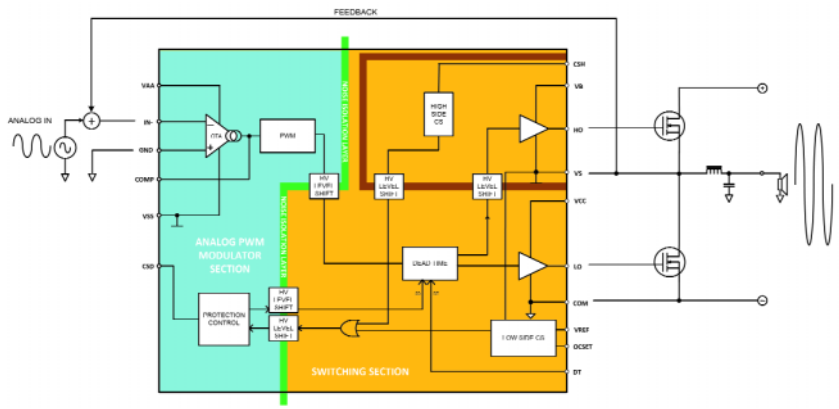


Figure 2: Internal structure of IRS2092

Integrated Class-D amplifier

Building on the same MOSFET and controller IC construction, IR's PowIRaudio™ IR43xx ICs combine both components in a small surface-mount package.

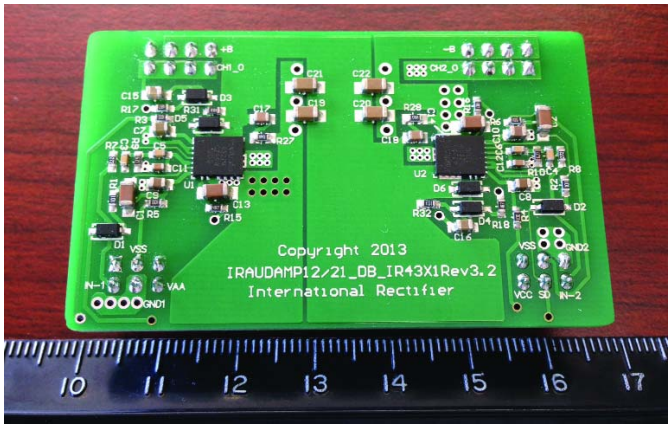


Figure 3: 2x135W (2Ω) design example with PowIRaudio™ IR4321

Instead of integrating the controller and output power MOSFETs on a single piece of silicon, the IR43xx family features separate controller IC and MOSFET chips. This approach takes full advantage of the wide operating voltage range and strong noise immunity of the IRS2092, as well as the latest-generation application-optimised MOSFETs, to deliver the high efficiency and high audio quality achievable with class D within an even smaller footprint. Evolution is set to continue further, for example using new semiconductor materials such as Gallium Nitride (GaN) which can potentially bring a ten-fold performance increase.

The PowIRaudio family comprises the IR4301M, IR4311M, IR4321, IR4302M, IR4312M and IR4322, supporting full-bridge and half-bridge topologies from 20W to 320W per channel.

Summary

Class D is redefining the tradeoffs in audio power amplifier design, simultaneously delivering smaller size and higher power density with better sound. The roadmap for IR's latest IR43xx PowIRaudio™ ICs show how smaller solution size for the same output power enables new generations of products delivering higher energy efficiency and better audio performance. Smaller really is better with class D.

The power stage is the key factor governing the performance of a class-D amplifier. Component selection holds the key to achieving great power and sound, taking advantage of the exceptionally high linearity and energy efficiency inherent in the class-D operating principle. Newer device technology moves these amplifiers closer towards the ideal by increasing efficiency and improving distortion. The evolution of class D never stops.

www.irf.com

3-Phase Non-Contact, True Rms, Current Transducer

The RCTrms 3-ph current transducer from Power Electronic Measurements (PEM) delivers a convenient, safe and accurate solution for measuring current in three phases. It features a thin, clip-around, flexible sensor coil and provides accurate true rms measurement with 4-20mA or 0-5V output, enabling simple installation with PLC's, SCADA systems or automation equipment.

The compact, DIN-rail or panel mountable RCTrms-3ph extends the design of PEM's proven RCTrms single-phase transducer, connecting to three Rogowski coils to capture measurements from three current phases simultaneously. This significantly reduces cost per channel, while enabling safe and fast installation.

With 18 current ratings options from 100A to 50,000A, and a choice of 300mm, 500mm, 700mm or custom coil lengths, the RCTrms-3ph can be used in many applications and connected to a wide variety of SCADA systems, PLCs, data loggers, protection equipment or motor controllers. The clip-around coil design allows fast and easy positioning, and provides accurate results without needing to be centralised around the conductor. An isolated BNC-BNC cable-split option is available, to ease installation such as when threading through existing conduit.

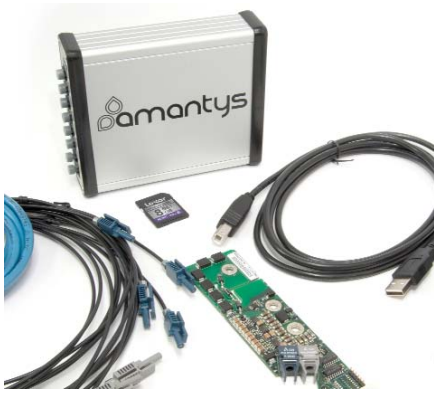
RCTrms-3ph operates from a 12V-24V supply, and generates an accurate, true-RMS output as an industry-standard 4-20mA or 0-5V signal. The transducer provides a galvanically isolated measurement. Each unit is supplied with a traceable calibration certificate.

The RCTrms-3ph uses non-magnetic materials, which ensures excellent linearity and prevents damage from over currents. Typical accuracy is better than 1% of reading from 10 to 100% full scale. The units are safe, with 2kVdc power-supply isolation and 2kVpeak coil rating, and are CE marked and compliant with EMC EN 61326-1 2006 and IEC61010-1:2001.

www.pemuk.com

Monitoring Existing High Power IGBT Module Systems

Amantys announced the Amantys Power Insight Adapter, a fully engineered solution to add Insight data monitoring and observability to an IGBT Module-based power assembly. The Adapter is designed for use during the development and commissioning of new systems, allowing engineers to observe and analyse critical parameters such as temperature and voltage and to use this information to improve overall switching performance, drastically reducing the design cycle time. Also, where an existing system is suffering failure events, with the addition of an Amantys drive and adapter, fault and failure events can be observed and diagnosed to identify a solution to the problem much more quickly. The Adapter sits between the host control system and the IGBT Module, interfacing with the IGBT gate driver to export key switching performance parameters from the heart of the power system. Combined with an Amantys Power Drive to control IGBT Modules, this will significantly shorten design times and reduce the need for costly re-engineering.



The Adapter receives Insight signals from the IGBT Gate Driver over the PWM isolation interface, allowing the host system to observe power switching performance in real-time and respond to changes in operation, environment, or to monitor faults that may occur.

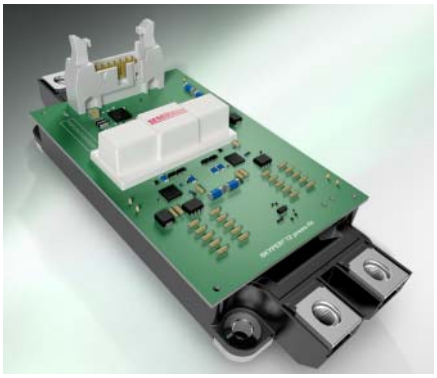
www.amantys.com

First IGBT Driver for Direct Press-Fit Mounting

Easy assembly, electrical robustness and a long service life: The SKYPER 12 press-fit half-bridge driver was developed with these aspects in mind. It is pressed directly onto the IGBT module, which means that there are no costs for an adapter board, cable splices, and associated assembly and soldering processes.

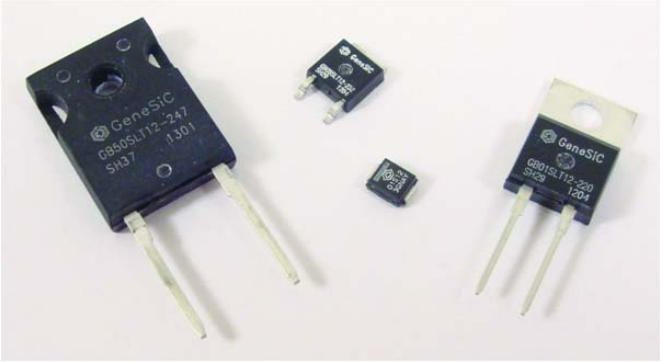
With 30% fewer components than available plug&play solutions, the driver reduces the failure rate of the individual components and achieves an MTBF (mean time between failures as per SN 29500) rate of over 5 million hours at full load. This means that safe IGBT control is ensured even for the long working lives of industrial drives.

A generation of mixed-signal ASICs achieves a high level of integration. The ASIC chip set contains the power supply and protection and control functions, and the external components ensure optimum thermal spreading. The costs are reduced and the lower risk of failure increases reliability. Thanks to short pulse suppression and an interface ground concept, the usual good EMC stability of the SKYPER family is achieved. With square-wave signal transmission, the SKYPER 12 even switches without errors at a high dU/dt. The mixed-signal ASICs work in a stable manner over the entire temperature range with no transit time differences.



www.semikron.com

SiC Schottky Diodes Offer Smallest Footprints



GeneSiC Semiconductor announced the availability of a family of Industry-standard SMB (JEDEC DO-214AA) packaged SiC Rectifiers in the 650 - 3300 V range. Incorporating these high voltage, reverse recovery-free, high frequency and high-temperature capable SiC Diodes will increase conversion efficiency and reduce the size/weight/volume of multi-kV assemblies. These products are targeted towards Micro-solar inverters as well as voltage multiplier circuits used in a wide range of X-Ray, Laser and particle generator power supplies.

Contemporary Micro-solar inverters and voltage multiplier circuits may suffer from low circuit efficiencies and large sizes because the reverse recovery currents from Silicon rectifiers. At higher rectifier junction temperatures, this situation becomes worse because the reverse recovery current in Silicon rectifiers increases with temperature. With thermally constraints high voltage assemblies, junction temperatures rise quite easily even when modest currents are passed. High Voltage SiC rectifiers offer unique characteristics that promises to revolutionize the micro-solar inverters and high voltage assemblies. GeneSiC's 650 V/1 A; 1200 V/2 A and 3300 V/0.3 A Schottky rectifiers feature zero reverse recovery current that does not change with temperature. The 3300 V-rated devices offer relatively high voltage in a single device allows a reduction in voltage multiplication stages required in typical high voltage generator circuits, through use of higher AC input voltages. The near-ideal switching characteristics allow the elimination/dramatic reduction of voltage balancing networks and snubber circuits. The SMB (DO-214AA) overmolded package features industry-standard form factor for surface mount assemblies.

www.genesicsemi.com/index.php/sic-products/schottky

High Voltage DC Power Supplies up to 10 kV at 2 kW to 8 kW in 2U

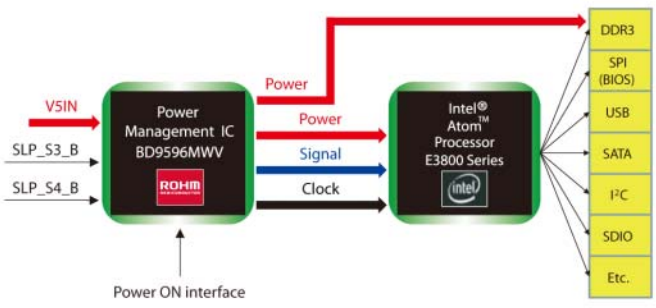
Magna-Power Electronics announced the immediate expansion of the XR Series product line, now offering models at 2 kV, 4 kV, 6 kV, 8 kV and 10 kV at 2 kW, 4 kW, 6 kW and 8 kW in an industry leading 2U rack-mount package. The XR Series, validated at customer sites worldwide as an advanced reliable programmable DC supply since its initial release in 2009, enters its fourth generation coinciding with the new high voltage models release. The product line delivers ± 0.075% programming accuracy and the high voltage models offer ? 0.15% RMS output voltage ripple, making it among the most accurate lowest ripple high voltage power supplies available in the market. The units are offered with either the positive or negative output terminal grounded, specified by the customer at time order.

Building upon the established product line, the new high voltage models allow Magna-Power Electronics robust current-fed power processing to address new markets. The new models address requirements in: ion beam deposition, photovoltaic manufacturing, ion implantation, capacitor charging, ATE systems, powering specialized lasers and insulator testing, among a wide variety of OEM and laboratory applications. The new models use the same high frequency IGBT-based switch-mode topology as the other XR Series models. All Magna-Power Electronics power supplies models come standard with front panel control, 37-pin isolated analog-digital I/O for comprehensive remote capability, and a RS232 computer programming interface. For computer communications, Remote Interface Software is provided, along with Magna-Power Electronics IVI Driver, enabling programming from a variety of environments, including LabVIEW and Visual Studio. In addition, an included SCPI command set greatly simplifies the product's advanced programming capabilities. Communication options include LXI TCP/IP Ethernet Interface (+LXI), IEEE-488 GPIB Interface (+GPIB), and USB Edgeport (+USB). All XR Series units are available with 3-phase input, with options ranging from 208 Vac up to 480 Vac, while a 1-phase 208/240 input option is available for 2 kW models.

www.magna-power.com

Power Management ICs for Intel Bay Trail I Platforms

ROHM Semiconductor is announcing the general availability of Power Management ICs (PMICs) based on the Intel® AtomTM processor E3800 family. The Intel® AtomTM processor E3800 product family is a system-on-chip designed for intelligent systems, delivering outstanding compute, ECC, HD graphics processing, and media performance while operating in an extended range of thermal conditions. Based on the Silvermont microarchitecture, these devices are fabricated on Intel's industry-leading 22nm process with 3-D Tri-Gate transistors, which deliver significant improvements in performance and energy efficiency. The family members offer low power consumption levels that range from 6 to 10 Watts.



Used in combination with ROHM's optimized power management solutions, which feature industry-leading power conversion efficiency, results in systems that also deliver very low power consumption, with a minimal PCB footprint, and few external parts.

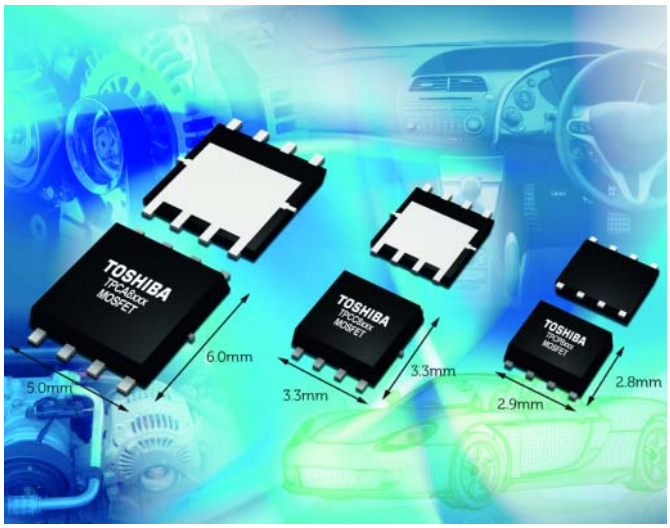
www.rohm.com/eu

Automotive MOSFET Miniature Packages

Toshiba Electronics Europe (TEE) has expanded its family of power MOSFETs for automotive applications with three new miniature package formats that will help designers make significant PCB space savings without compromising performance.

The TPCA8xxx, TPCC8xxx and TPCP8xxx series of MOSFETs offer N-channel and P-channel variants and are provided in SOP Advance, TSON Advance and PS-8 package formats respectively. Respective dimensions are 5mm x 6mm x 0.95mm; 3.3mm x 3.3mm x 0.85mm and 2.8mm x 2.9mm x 0.8mm. All of the new devices are 175°C rated and feature low on resistance and low input capacitance leading to low conduction and switching power loss. SOP Advance and TSON Advance packages have bottom-side metal heat slugs to conduct heat better than conventional miniature packages, such as SOP-8.

Toshiba's SOP-Advance devices are ideal for mid-power applications where DPAK devices are conventionally used. TSON advance and PS-8 devices can replace SOP-8 devices and save board space.



www.toshiba-components.com

Reworkable Gap Pads are Stronger, Stickier, Softer for Low-Stress Applications

Gap Pad® 1450 has joined the Gap Pad family of thermally conductive gap filling Thermal Interface Materials from the Bergquist Company, featuring a permanent polyester (PEN) liner that allows reworking and enhances mechanical compliance in low-stress applications.

Offering high thermal conductivity of 1.3W/m-K, Gap Pad 1450 is available in six thicknesses from 0.508mm to 3.175mm. The standard sheet size is 8 inches by 16 inches. Custom, die-cut parts are also available to special order.

With its clear PEN liner, Gap Pad 1450 is also puncture and tear resistant thereby helping protect components and preserve electrical isolation. The un-lined side maintains a conformable, yet elastic nature that provides excellent interfacing and wet-out characteristics, even to surfaces with high roughness or uneven topography. In addition, the material has greater natural tack than similar ultra-soft materials, which saves applying adhesive and hence helps maximise the thermal performance of assemblies.

Gap Pad 1450 is ideal for applications such as solid-state lighting and other LED assemblies, computer and telecommunication equipment, and generally between heat-generating semiconductors and heatsinks, particularly where strain on fragile component leads must be minimised.

www.bergquistcompany.com

Step-Down Buck DC/DC Converter

Advanced Power Electronics Corp. (USA), a leading Taiwanese manufacturer of MOS power semiconductors for DC-DC power conversion applications, has introduced the APE1723-HF-3, a 200kHz 1A PWM buck DC/DC convertor with an adjustable output voltage range from 0.745V to 24V. The APE1723-HF-3 can drive a 1A load without an external transistor, saving considerable board real estate. Additionally, the APE1723-HF-3 operates at a fixed switching frequency of 200 kHz, enabling simpler filter components to be used in a design.

The external shutdown function of the APE1723-HF-3 is controlled with logic level signals, putting the device into its low-power standby mode. A further feature is internal compensation which provides feedback control for excellent line and load regulation, again without the need for additional external components. The device features thermal shutdown for protection against damage in the event of over-temperature operation and has current limit protection and short circuit protection to safeguard the output switch. Output voltage tolerance is guaranteed at ±3% under specified input voltage and output load conditions.

The APE1723-HF-3 is RoHS-compliant and completely BFR/halogen-free to meet current REACH environmental requirements. It is available in either an SO-8 or a 5-lead SOT-23 package.

http://www.a-powerusa.com/docs/APE1723-3.pdf

Compact Ambient and Infrared Sensor Sets New Standard for Displays

Intersil Corporation introduced the ISL29035, an innovative and highly compact ambient and infrared sensor. The ISL29035 is the industry's smallest 6-lead digital light sensor and addresses the latest requirements for angular response and sensitivity to various light sources in handheld, PC, TV and industrial display applications.

The ISL29035 enables the automatic adjustment of display brightness based on the ambient light conditions to improve the user experience and extend battery life. The ISL29035 sensor offers market-leading angular response of a minimum of +/- 35% field of view at 50% light intensity. The wide dynamic range of 0.01 lux to 64,000 lux enhances users' visual experience while using minimal power. A lux range select feature allows users to program display brightness to suit various ambient light conditions, such as dark, normal and bright light.

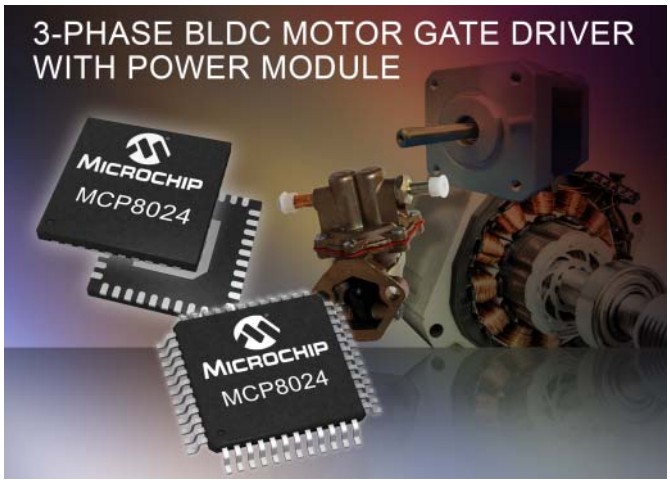
The ambient light sensor's advanced self-calibrated photodiode arrays emulate human eye response, providing excellent infrared (IR) light rejection. An on-chip charge-balancing 16-bit ADC rejects 50Hz and 60Hz flicker caused by artificial light sources.

www.intersil.com

Three-phase brushless DC Companion Device Offer Robust Motor Systems

Microchip announced a three-phase BLDC motor gate driver with power module: the MCP8024. This new device includes functions that power dsPIC® Digital Signal Controllers (DSCs) and PIC® microcontrollers (MCUs) with capabilities to drive six N-channel MOSFETs. Customers can implement improved performance and high robustness providing increased efficiency and lowering system cost while reducing time to market.

The MCP8024 operates across a wide voltage range of 6V to 28V and can withstand transient voltage up to 48V. The device provides high-integration analogue, such as three current-sensing operational amplifiers; an over-current comparator; MOSFET drivers and a bidirectional communication interface for a complete motor system design. The configurable driver dead-time management; driver blanking-time control; and Over-Current Limit (OCL) for external MOSFETs, offer a significant increase in flexibility. The adjustable step-down DC-to-DC converter powers a broad range of microcontrollers with the efficiency benefits of a switch-mode power supply.



www.microchip.com/get/RTAS

New Distribution Channel for Fuji Electric in Germany

With GvA Leistungselektronik GmbH based in Mannheim Fuji Electric Europe GmbH, Offenbach, relies in the future on a well-known partner for the sales of its portfolio of power semiconductors in Germany.

GvA as a distributor, developer and manufacturer of custom specific power electronics sees in this new product line the perfect complement of its existing program and can thus offer its customers highly innovative IGBT modules in high diversity. The product range of Fuji Electric scores with a large product range of IGBT modules in the voltage classes 600V, 1200V, 1700V and 3300V, and rated current of 8A to 3600A:

Fred Eschrich, General Manager of Fuji Electric Europe, is very pleased with the new partnership: "With GvA we can not only gain

a competent distribution partner for Germany. The know-how of GvA as a developer and producer in almost every field of power electronics gives us the assurance that our customers receive the best possible advice also from a practical point of view."

GvA Managing Director Werner Bresch added: "We are delighted to have with Fuji a very reputable manufacturer of semiconductors as a partner. In our new modular inverter system MODIS for example, we use the PrimePACKTM modules of FUJI together with the intelligent IGBT drivers of Amantys with very good test results. We believe that our broad range of experience also benefits our customers. With the wide product range of Fuji we can also reach customers in Germany, we could not address so far."

www.gva-leistungselektronik.de

Dual Output SupIRBuck® Voltage Regulators for Space-Constrained Applications

International Rectifier has introduced the IR3891 and IR3892 SupIRBuck® integrated dual output voltage regulators designed for space-constrained netcom, server and storage applications.

The dual output devices are optimized for single rail operation from 5V to 12V inputs or 1V to 21V input with external 5V bias. Available in a compact 5x6mm PQFN package, the IR3891 and IR3892 offer an ultra-compact solution for applications requiring up to 4A per channel and up to 6A per channel respectively in as little as 165 mm2.

The IR3891 and IR3892 feature a proprietary modulator scheme that enables jitter-free and noise-free operation to allow higher frequency/higher bandwidth operation for better transient response and fewer output capacitors to reduce overall system size.

Other key features include interleaved phases to reduce input capacitance, powertrain isolation to eliminate crosstalk and sequencing capability on channel two.

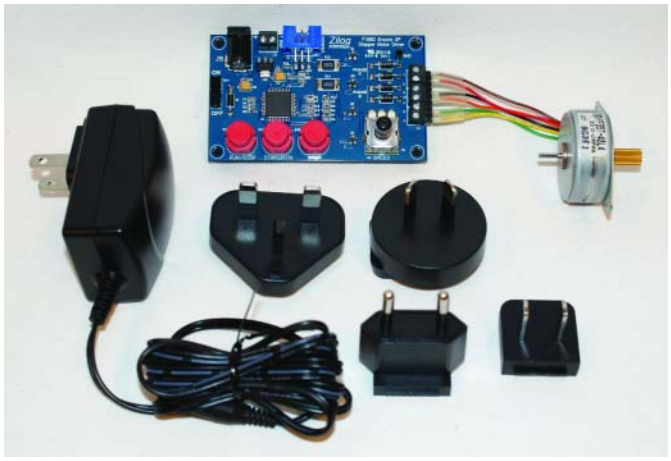
The IR3892 single-sided PCB designs are 46% smaller when compared with traditional designs that utilize two 6A single output converters. The IR3892 also works comfortably with dual- sided designs, further reducing PCB board size to less than 30% of the space required in traditional designs.

Offering SupIRBuck standard features, the IR3891 and IR3892 have switching frequency up to 1.5MHz and 1.0Mhz respectively, pre-biased start-up, input voltage aware enable, over voltage protection, power good, optional true output voltage sensing for open line feedback and adjustable OVP, internal soft-start and minimum input voltage of 1.0V (with ext. bias) and operating junction temperatures of -40oC to 125oC. This device and the entire SupIRBuck family are industrial qualified ensuring robust designs for durable systems.

www.irf.com

Microstepper Motor Control Reference Design Featuring the Z8F1680 MCU

Zilog, Inc., a wholly-owned subsidiary of IXYS Corporation and a pioneer supplier of microcontrollers (MCUs) providing solutions for the industrial, telecommunication, automotive and consumer markets, introduces its new Microstepper Motor Control Reference Design to expand its portfolio of reference designs that target motor control applications and provide accelerated time-to-market solutions.

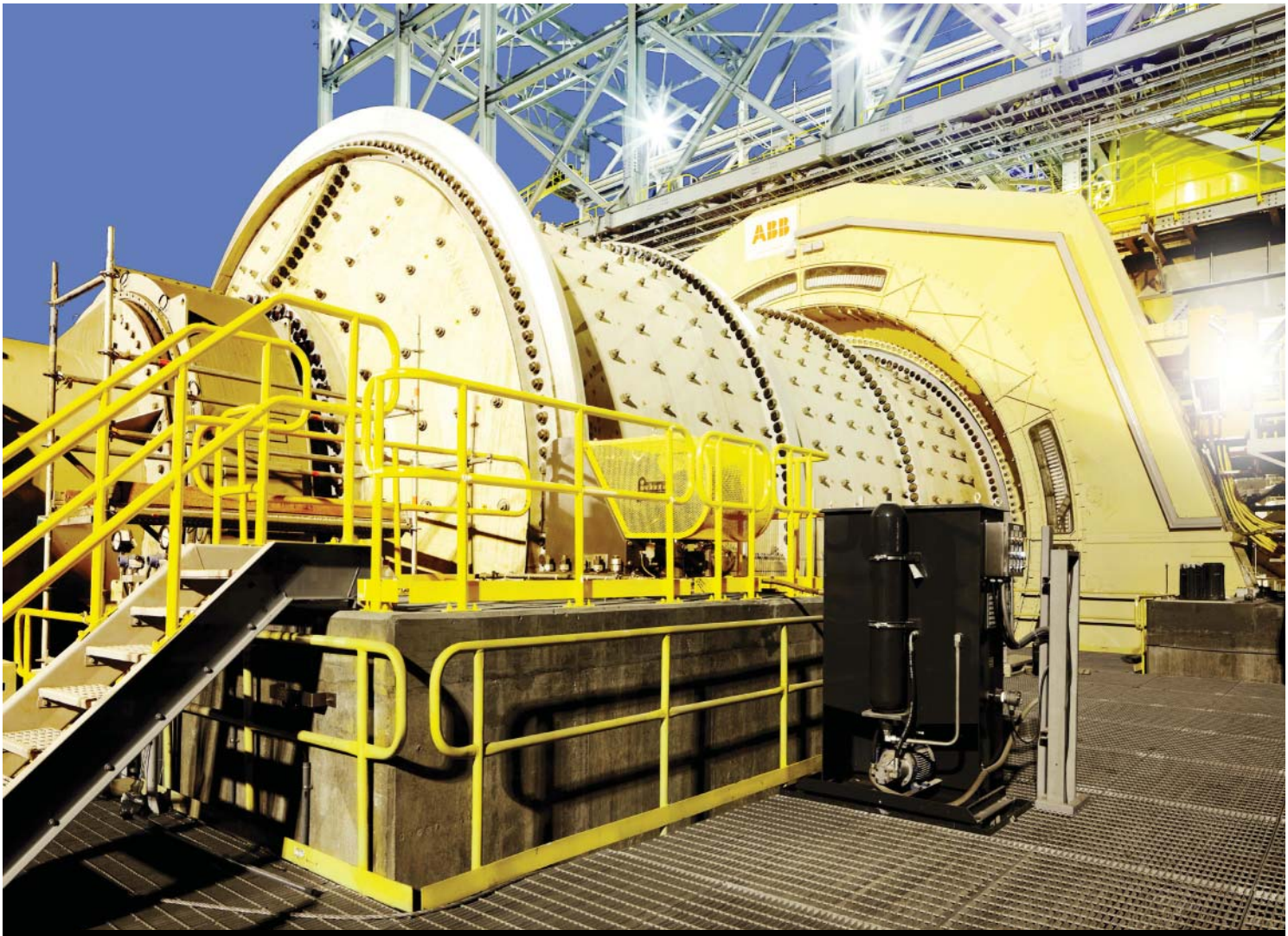


Zilog's Z8F1680 MCU-based Microstepper Motor Reference Design is a complete and easy-to-use platform that demonstrates the feature set of the Z8F1680 microcontroller, which is optimized for microstepper motor control. This Microstepper Motor Reference Design drives a unipolar stepper motor using the Z8F1680 MCU's onboard analog comparators for one-shot feedback current limiting. It also uses the Z8F1680 MCU's multichannel timer as a microstepper sine/cosine current generator. The Microstepper Motor Reference Design is designed to be operated either by battery or an external power supply of 5V DC to 12V DC.

Other key features of the Microstepper Motor Reference Design include speed and directional control of the motor, one-step advancing of the motor, and a current generator for each coil. Examples of applications that are well suited for this reference design include precision surgical tools, motorized position cameras, motorized solar panel tracking, automation and robotics, HVAC coolant control, valve control for a fluid control system, motorized curtains or window cover controls, laser or optical precision positioning equipment, linear actuators and stages, motorized mirror mounts, flatbed/image scanners, computer printers and plotters.

www.zilog.com

ADVERTISING INDEX



Thyristors enabling energy savings of 30%?

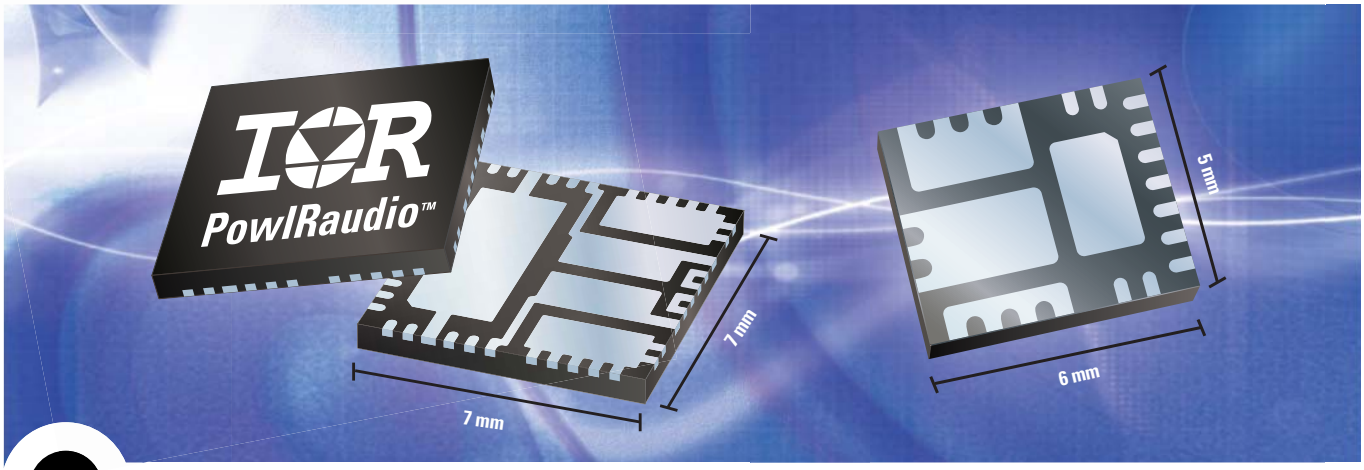
Definitely.

ABB Semiconductors' Phase Control Thyristor (PCT) has been a key component in the high power electronics industry since its introduction almost 50 years ago. Common PCT applications range from kilowatt DC-drives to gigawatt converters for high-voltage direct current transmission (HVDC). The use of PCT powered converters enables significant energy savings. ABB's thyristor portfolio includes both PCT and bi-directionally controlled thyristor (BCT) press-pack devices with ratings of 1,600 to 8,500 volts and 350 to 6,100 amperes.
For more information please visit our website: www.abb.com/semiconductors

ABB Switzerland Ltd. / ABB s.r.o.
www.abb.com/semiconductors
m.abb.com
abbsem@ch.abb.com

Power and productivity
for a better world™

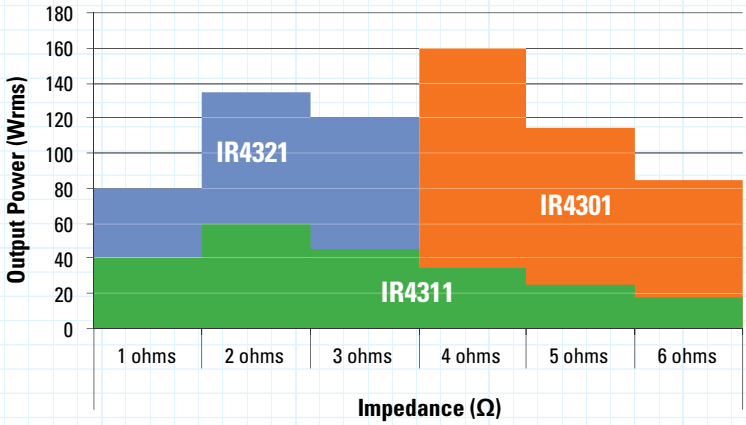
ABB



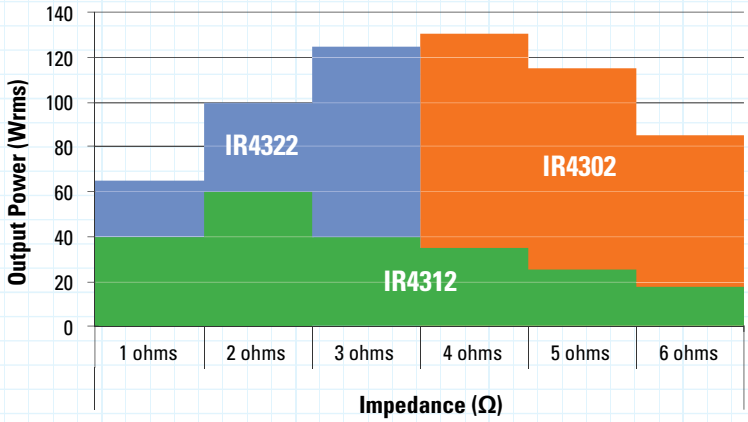
Compact, Efficient, Class D Audio Solutions

IR's Integrated **PowIRaudio™** Class D Amplifier

Single-Channel **PowIRaudio™** Modules



Dual-Channel **PowIRaudio™** Modules



PowIRaudio™ Advantage:

- No heatsink required
- Best-in-class power efficiency and audio performance
- Reduce component count, simplify design
- Compatible with single supply or split rail configuration

Reference Designs Available:

- 20W to 130W per channel
- Single supply or dual supply
- Single channel or dual channel modules

PowIRaudio™

International
IOR Rectifier
THE POWER MANAGEMENT LEADER

For more information call +49 (0) 6102 884 311
or visit us at www.irf.com