ISSN: 1863-5598
ZKZ 64717
01-13

Bodo´s Power Systems®

Electronics in Motion and Conversion

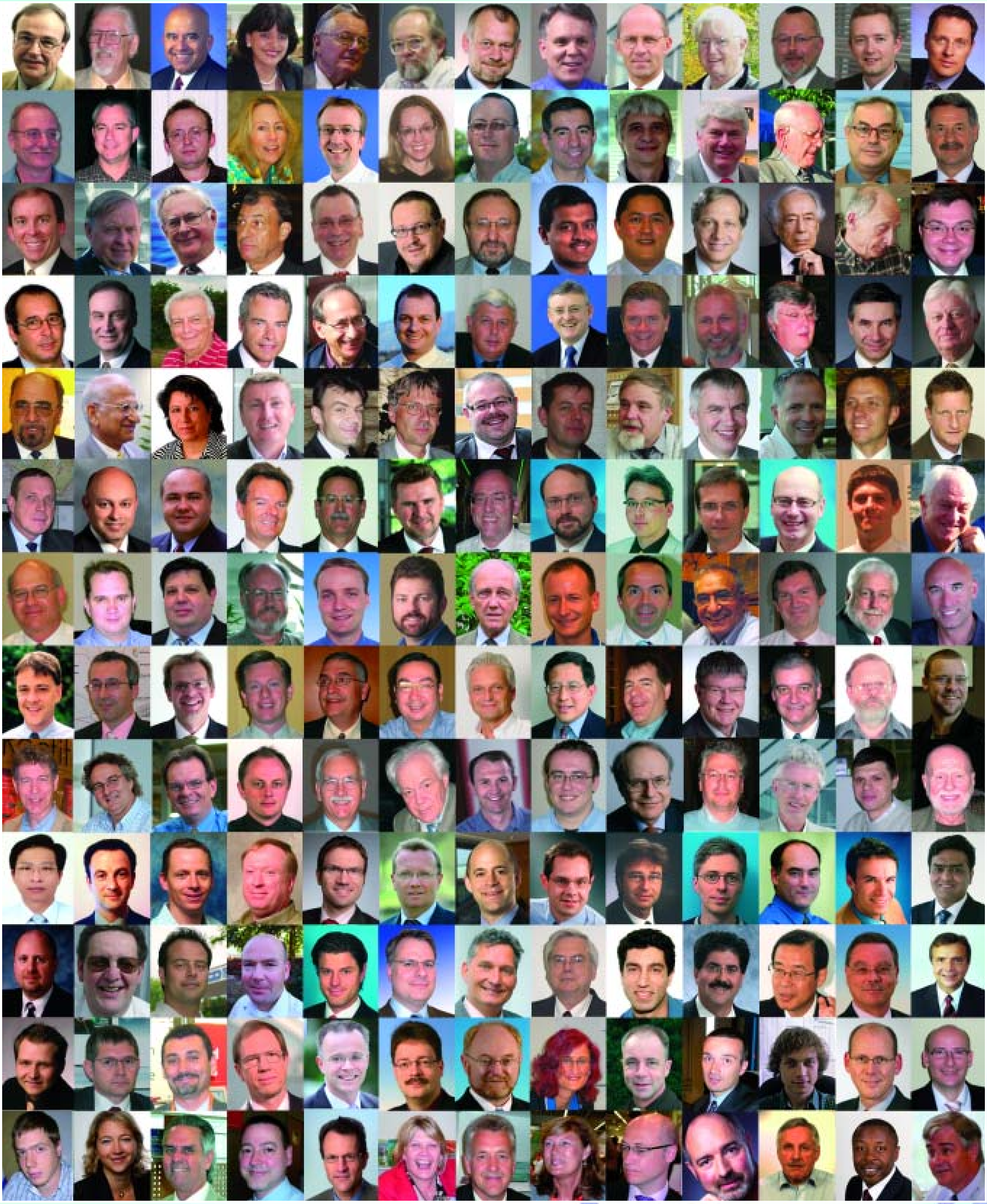
January 2013

CONTENT

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

powerguru.org

The Gallery



Bodo´s Power Systems®

A Media
Katzbek 17a
D-24235 Laboe, Germany
Phone: +49 4343 42 17 90
Fax: +49 4343 42 17 89
editor@bodospower.com
www.bodospower.com

Publishing Editor
Bodo Arlt, *Dipl.-Ing.*
editor@bodospower.com

Corresponding Editor
Marisa Robles Consée,
Marisa@bodospower.com

Creative Direction & Production
Repro Studio Peschke
Repro.Peschke@t-online.de

Free Subscription to qualified readers

Bodo´s Power Systems
is available for the following
subscription charges:
Annual charge (12 issues) is 150 €
world wide
Single issue is 18 €
subscription@bodospower.com

circulation print run 20 000

Printing by:
Central-Druck Trost GmbH & Co
Heusenstamm, Germany

Events

Smart Grids Summit,
Berlin 2013, J
anuary 28th-30th
www.thesmartgridsummit.com

Embedded World 2013,
Nuremberg, Germany,
February 26th - 28th
www.embedded-world.eu

New Energy 2013,
Husum Germany, March 21st-24th
www.new-energy.de

EMC 2013,
Stuttgart, Germany
March.5th – 7th
www.mesago.de/de/EMV

APEC 2013
Long Beach CA USA,
March 17th - 21st
www.apec-conf.org/

Looking Forward to More Innovations!

We face the requirement for more efficiency in our applications. Wasting energy must be avoided. Energy not needed for the function is the best energy to save. Regeneration from electric motors using the system inertia can provide significant returns – true for many motor applications: elevators, high speed trains, hybrid vehicles, and many other variable speed motor applications.

Electric power from renewable resources - water, wind and solar – is increasing. The grid and its control must be smart enough to take from these diverse and variable sources and serve the varying demands of its users. It is obvious that energy storage has become a more important subject. Well known from my childhood are the pumped storage lakes - using available excess power to pump water up, and then have electricity generated when needed with the pumps as turbine generators. It is a simple easy method, working well for decades. Modern technology makes batteries and super capacitors attractive for storing energy, and although these solutions are more focused to serve the needs of data and communication power levels, some new installations of large battery/inverter systems are emerging. It is still not the preferred way for heating houses!

Did you celebrate the 30th anniversary of the invention of the IGBT in December 2012?
For most applications at line voltage and higher, IGBT's are the switch - thanks to the invention of Hans Becke and Frank Wheatley. The IGBT has changed the world for the better – more economic use of electronics, efficient and practical designs of variable speed drives, better gas mileage, to name a few examples.

Innovation continues - we see a strong move to adapt GaN in a wide area of applications. Also the early thought that GaN will be in the lower voltage region must be reviewed. Products capable of line voltages are available.

Communication is the way to progress. We delivered twelve issues last year and will continue each month, on time, every time. Last year approached 900 pages and 132 technical articles, a continuous improvement since I started my publication. As a media partner, Bodo's Power Systems is internationally positioned. If you speak the language, or just want to take to look, don't miss our Chinese version: www.bodospowerchina.com.

My Green Power Tip for January:
If you are cold this winter, use the onion system - wear an extra shirt and an extra pullover to protect from the cold. More layers keep you warm. Have you ever heard an onion complain of the cold?

Your happiness in the New Year, and Best Regards,

LED Practice Developer Forum was a Full Success

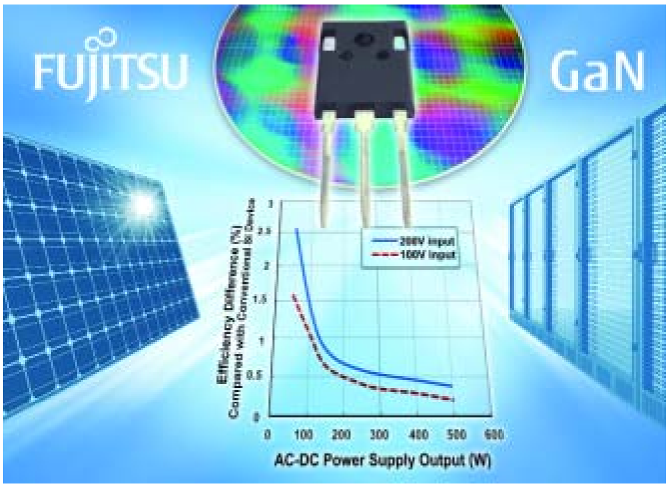
There is much to be learnt when converting conventional lighting to LEDs. The participants in the annual LED Practice Developer Forum in Würzburg gained useful practical experience of the advantages and pitfalls when implementing LED lighting systems. In addition to informative lectures and educational seminars, the attendees had the chance to talk directly with the manufacturers as part of a tabletop exhibition.

The undisputed highlight of the Forum was the unique practical workshop arranged by RECOM in collaboration with Cree and Arrow electronics – the first time such an opportunity has been offered in Europe. The aim of the workshop was to convert a conventional desk lamp to the latest LED technology which the attendees could then take home. Accompanied by technical presentations covering the necessary know-how, the participants was taught how to select the right LED, how to handle the thermal management and the correct choice of the appropriate optics. Then this theoretical knowledge was put into practice as the attendees built their own LED lamps. Any further questions could be answered immediately by the many expert mentors present. The participants worked enthusiastically and learnt first-hand how important it is to have a competent manufacturing partner for implementation of LED lighting solutions.

www.recom-lighting.com

GaN Power Devices for High-Efficiency Power Supply Units in 2013

Fujitsu Semiconductor has achieved high output power of 2.5kW in server power-supply units equipped with gallium-nitride (GaN) power devices built on a silicon substrate. Using GaN technology in power supply applications enhances power efficiency and helps reduce the



carbon footprint. Compared with conventional silicon-based power devices, GaN-based power devices feature lower on-resistance and the ability to perform high-frequency operations. Since these characteristics improve the conversion efficiency of power supply units and make them more compact, this technology is ideal for a broad range of applications including servers, solar inverters, battery chargers or electric vehicles.

Fujitsu Semiconductor collaborated closely with Fujitsu Laboratories to achieve this technological progress, including the development of the process technology for growing high-quality GaN crystals on a silicon substrate, optimizing the design of electrodes to control the rise of on-resistance during switching, and devising a circuit layout for power supply units that can support high-speed switching of GaN-based devices.

Fujitsu plans to commercialise GaN power devices on a silicon substrate, increasing the diameters of the silicon wafers and enabling low-cost production. Fujitsu has established a mass-production line for 6-inch wafers at its Aizu-Wakamatsu plant and will begin full-scale production of GaN power devices in the second half of 2013.

www.de.fujitsu.com

Analog Design Contest First Prize to KU Leuven Students

Belgian team catches judges' eye with wireless data acquisition system, designed to improve patient comfort.

A crowd gathered to witness the award of top recognition and cash prizes to four student teams, who were finalists in the third annual Texas Instruments (TI) Analog Design Contest in Europe. The students received their awards at TI's Engibous Prize Giving Ceremony at electronica 2012 in Munich, Germany. The 2012 Engibous Prize recognized four top teams from among 20 first-round contest winners in the EMEA region. The Katholieke Universiteit Leuven (KU Leuven) team, consisting of Hans De Clercq, Piet Callemeyn, and Jereon Lecoutere, won first prize and an award of US$10,000 for their project: A baby's pajama suit made of fabric with integrated sensors for comfortable data acquisition of key vital signs to monitor the baby's health remotely, such as monitoring for risks like Sudden Infant Death Syndrome (SIDS). Their project also included a wireless charging system under the bed's mattress to keep the pajama sensor system powered continuously.

"We were very impressed with the project target goal, solid analysis of the problem and safety of the application from the KU Leuven team. They were the complete package," said Prof. Yves Leduc of Polytech University Nice-Sophia and one of the three independent TI Analog Design Contest judges. "A strong favorite for me as well was the team from Politecnico di Milano because their project was totally analog. All in all, it was a very tough decision to make because the level of professionalism in these projects is outstanding. It seems they become more innovative each year."

http://www.ti.com/ww/eu/university/winners.html

www.ti.com

Tamura's New Flux-Gate Current Sensors – The Ideal Solution

The time has come to consider Tamura's flux-gate current sensors as the "ideal solution" for your current application and next generation designs. Here's why:

- **Tamura's highest accuracy sensor series**
- **Industry-standard mounting configurations for drop-in replacement for all major brands**
- **Optimized design for PV inverter & array monitoring applications**
- **Improved electromagnetic immunity**
- **Small footprint, low profile**

As Tamura's global channel partner, Richardson RFPD provides the engineering support to identify the best solution for your application. Contact Richardson RFPD today for samples of Tamura's new Flux-Gate Current Sensor series.

TAMURA

"the ideal solution..."

New Flux-Gate Current Sensors Available!

Download Tamura's Current Sensor Selector Guide at: www.richardsonrfpd.com/Tamura

Series	Primary DC Current	Power	Mounting Supply	Primary	Output Connection	UL 508
F01P***S05	±6A, ±15A, ±25A, ±50A	+5VDC	PCB	Integrated Primary	2.5V±0.625V	Yes
F02P***S05	±6A, ±15A, ±25A, ±50A	+5VDC	PCB	Integrated Primary	2.5V±.625V & VREF IN/OUT	Yes
F03P***S05	±6A, ±15A, ±25A, ±50A	+5VDC	PCB	Integrated Primary	2.5V±.625V & VREF IN/OUT	Yes

Your Global Source for RF, Wireless & Energy Technologies

RichardsonRFPD
An Arrow Company

www.richardsonrfpd.com

Maxim Integrated and RadioPulse target ZigBee Solutions for the Smart Grid

Maxim Integrated Products is partnering with RadioPulse to provide ZigBee communication for smart grid solutions. Both companies will collaboratively market and develop ZigBee software, highly integrated systems on chips (SoCs), and smart transceivers to expand Maxim's current smart grid solutions as well as Zeus, its recently announced smart-meter SoC. The partnership is already providing more highly integrated smart grid solutions. The synergy between the RadioPulse wireless ZigBee software and Maxim's IC solutions saves time, board space, and implementation costs for customers, says Anders Reisch, Executive Director EMEA Marketing of Maxim Integrated Products: "The advantages of this partnership are immediately apparent when compared to existing nonintegrated solutions."

According to a report from IMS Research there have been almost 60 million smart meters deployed in the past three years. Almost 20 million including a 'HAN gateway' (home area network – typically ZigBee) to enable connectivity between the backhaul Advanced Metering Infrastructure (typically powerline or RF mesh) and in-home devices, such as in-home displays (IHDs). The future of smart metering seems to look bright: The analysts forecast that more than 100 million smart meters with integrated HAN gateways will be deployed in the next five years, driving the market for home energy management systems past 9 Billion US$.

www.maximintegrated.com

www.radiopulse.co.kr

International Trade Fair Leaves Industry Feeling Confident

- More than 72,000 visitors from 78 countries
- Automotive electronics the main attraction in all halls
- CEO Round Table a popular attraction

The 25th electronica, the International Trade Fair for Electronic Components, Systems and Applications, came to a close today with more than 72,000 visitors. A total of 2,669 exhibitors from 49 countries presented the future of electronics and showcased application-oriented solutions during the four-day fair, which revolved around intelligent and energy efficient solutions in the sectors for energy storage, LEDs and smart grids. Smart grids were also the focus of this year's CEO Round Table, one of the highlights in the related-events program.

www.messe-muenchen.de

Modern High-Voltage Thyristor & Diode Modules

Proton-Electrotex, a manufacturer of power thyristors and diodes in stud, disk and module design, and the heat sinks for them, offers a new range of power semiconductor modules with diode/diode (MDx), thyristor/diode (MT/Dx) and thyristor/thyristor (MTx) structure in a voltage range of 4400V to 6500V and a current range of 240A up to 470A.

The above mentioned modules can be applied in electrical drives, soft starters and power supplies, rectifiers and traction control. These devices have improved long-term stability of blocking characteristics and high power cycling capability

The pressure contact design gives the modules high resistivity to the cyclic loads. These modules have electrically isolated baseplates, which make it possible to assemble any number of the modules on one heatsink.

New products combine the benefits of modern modules:

- low on-state voltage;
- low leakage current;
- low turn-on and turn-off power dissipation;
- long-term stability of leakage currents, blocking voltages;
- high power cycling capability.

www.proton-electrotex.com

Powervation Closes USD7M Funding Round – Adds Strategic Investor

Series C Funding Round Fuels Business Growth for Intelligent Digital Power™ IC Platform in Cloud and Communications Infrastructure - Semtech Corporation Joins as Strategic Investor

Powervation Ltd (www.powervation.com), the pioneer in digital power IC solutions that deliver intelligent adaptive performance, increased system efficiency, and breakthrough design simplicity, announced it has recently raised a USD7M Series C funding round to fuel business growth and accelerate market adoption of its Intelligent Digital Power™ platform at cloud and communications infrastructure OEMs. New investor Semtech Corporation (Nasdaq: SMTC), a leading supplier of mixed signal semiconductors, has made a strategic investment in the company, joining the round participation of the existing investor group - Intel Capital, SEP, VentureTech Alliance and Braemar Energy Ventures. The funding will enable Powervation to accelerate business growth, expand sales channels and strengthen applications engineering including establishing a new facility in Taiwan to support its Asian business growth.

Enterprise Ireland joined the funding round with an R&D investment which will enable Powervation to further strengthen its design team in Cork to accelerate new product development.

www.powervation.com

Best-in-Class Audio and Car Control in Audi's Next-Generation

Texas Instruments Incorporated confirmed that Audi's MIB High system, the next-generation infotainment platform for Audi vehicles, is the first automotive system to incorporate TI's "Jacinto 5" automotive infotainment processor. Jacinto 5 plays an important role in the new architecture of Audi's high infotainment systems, which consist of a multimedia applications unit ("MMX") and a highly integrated radio and car control unit ("RCC"). Among other features, the processor enables feature-rich vehicle interfaces, and vivid digital radio and audio within the RCC unit in Audi's MIB High system, which debuted in the 2012 Audi A3.

TI's Jacinto 5 automotive infotainment processor is an automotive-qualified, heterogeneous multicore processor providing power, flexibility and real-time signal processing. The Jacinto 5 includes an integrated ARM® Cortex™-A8 core that manages middleware, drivers and applications stacks, along with a digital signal processor (DSP) that powers audio, radio and automotive low-level tasks. The processor also integrates a rich collection of automotive peripherals and connectivity options. This highly integrated system-on-chip enables a cost-effective design for mid- to high-level infotainment systems and can scale to add the functionality of an external applications processor.

TI collaborated with Audi and other industry leaders to support Audi's goal of providing best-in-class infotainment features to customers, while ensuring a long lifecycle for the vehicle interfaces. This long span, made possible by the MIB High system's unique modular approach, allows developers to retain the stable vehicle processor within the RCC unit, and provides the flexibility to incorporate future consumer-demanded features to the MMX unit.

www.ti.com

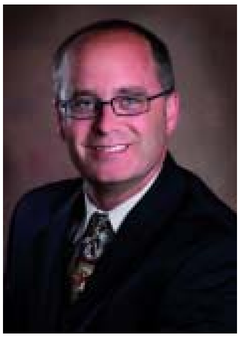
Earning ISO 9001:2008 Certification

Premier Magnetics announces that its Quality Management System has been awarded ISO 9001:2008 accreditation. Issued by the International Organization for Standardization (ISO),the highly regarded standard certifies that the company's' quality management systems demonstrate consistent customer satisfaction and compliance with statutory and regulatory requirements. Upon completing an intensive audit, Premier Magnetics was issued certification on November 18, 2012, under the Scope of Registration for "design, sales and distribution of electromagnetic components used by a large range of industries."

"Premier Magnetics' ISO 9001:2008 certification is a testament to the commitment of our dedicated manufacturing, management and technology teams in providing world-class products and services," said Jim Earley, President of Premier Magnetics. "This achievement also signals to Premier's customers that we put a premium on achieving the highest-possible standards for quality."

www.premiermag.com

Mouser and Marquardt Enter Global Distribution Agreement



Mouser Electronics, Inc. announced a global agreement to partner with Marquardt, a world innovator in switching solutions. The Marquardt product line-up includes switches, sensors, and control devices.

The Marquardt name represents a rich history in product pioneering. Some of Marquardt's innovations include the first German-made snap-action switch, the first electronic systems for power tools, and the first specialty rocker and snap-action switches for the automotive market. Further globalization has allowed more expansion into high-technology markets. Recent Marquardt product developments include complex switching systems such as driver authorization, control panel, and keyless entry systems for automobiles.

"We are excited to partner with Marquardt to deliver the newest in innovative switch designs," states Keith Privett, Mouser Vice President of Electromechanical, Power & Test. "Marquardt is committed to be on the leading edge of technology and to provide high quality switching solutions. Their vision is to anticipate the newest innovations in high-technology markets and to make interaction with new technologies more efficient, more comfortable, and more reliable. That fits perfectly with the Mouser model to deliver What's Next in newest products and advanced technologies."

www.mouser.com

DC/DC Converters Fully Certified for Use on Rolling Stock

Railway technology sets high technical and quality standards for all of the components in their systems. Extreme conditions such as vibration, shock, extreme heat and cold are all part of the daily routine. With over 30 years experience in design and manufacture of DC/DC converters, AC/DC modules and LED drivers, RECOM offers the railway industry a broad range of low power supply products, which have a proven history of working reliably for many years under the harshest railway conditions.

To ensure that the products used in railway applications meet the specific requirements and demanding quality standards, the railway-specific RPR-series are fully certified to EN50155: Railway Applications – Electronic Equipment used on Rolling Stock including EN50121: Railway Applications – Electromagnetic Compatibility.

Some manufacturers state that their products are "compliant" with the requirements of the railway standards, but don't include test results for all aspects of the standard. RECOM's RPR series have detailed test results for electrical performance, EMC, and environmental compliance available, and that's why renowned producers of railway, tram and subway systems around the world trust RECOM quality products.

www.recom-electronic.com/railway

Fraunhofer ISIT Itzehoe Gets a Second Cleanroom

The raw building had been completed. It is a milestone for future investment in Schleswig-Holstein into semiconductor development. 1000 m² clean room and 500 m² labs will be the final result. Finishing the building and infrastructure within 2013 and have the labs and fab running in 2014. The help from the local Government in founding of 27,45 million Euro strength the region. This investment is a mile stone for industry partners working with the Fraunhofer ISIT. The progress and success since 20 years is a great thing for the region. There are 350 Industry customers working with the ISIT. 50 of them are regional from Schleswig-Holstein. So 300 of them are international positioned.

www.isit.fraunhofer.de

IEEE Standards for Wireless Data Networking designed for Smart Grids

Four new updates to IEEE 802® family of standards can be used to implement advanced metering infrastructure and ensure communications network reliability.

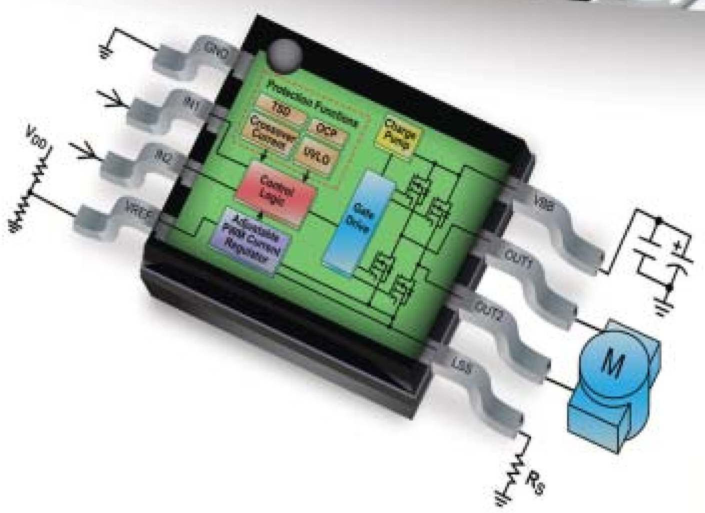
IEEE, the world's largest professional organization advancing technology for humanity, announced updates to four wireless communications technologies in the IEEE 802® family of standards, as well as a new IEEE 802 standards-development project. The new standards support the global utility industry's needs for smart grid data communications infrastructure and build on the IEEE Standards Association (IEEE-SA) portfolio of more than 100 active IEEE standards or standards in development pertaining to the smart grid.

The new IEEE 802 standards include the following:

- IEEE 802.15.4gT-2012 - IEEE Standard for Local and Metropolitan Area Networks - Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs) Amendment 3: Physical Layer (PHY) Specifications for Low-Data-Rate, Wireless, Smart Metering Utility Networks - is a global standard that provides carrier-grade wireless communications connectivity for very large-scale smart metering applications and advanced metering infrastructure used in smart grids
- IEEE 802.16T-2012 - IEEE Standard for Air Interface for Broadband Wireless Access Systems. The standard supports worldwide deployment of innovative, cost-effective, interoperable and multi-vendor broadband wireless access (BWA) products, with Ethernet as well as IP interfaces, that utilities can use for machine-to-machine smart grid applications.
- IEEE 802.16.1T-2012 - IEEE Standard for WirelessMAN-Advanced Air Interface for Broadband Wireless Access Systems. The standard provides an enhanced air interface and improved capacity for metropolitan-area networks that utilities can use for smart grid machine-to-machine communications, as well as mobile voice-based applications, with support for Ethernet as well as IP interfaces

http://standards.ieee.org

Allegro Motion Control



Brush DC Motor Driver IC Solutions

Allegro MicroSystems, Inc. offers a complete lineup of DC motor driver ICs for all markets, including office automation, automotive and industrial. Depending on the needs of a given application, Allegro IC solutions can include features such as:

- Low standby current for energy efficiency
- Internal DMOS outputs or gate controllers to drive external MOSFETs
- Parallel interfaces with forward, reverse, coast, and brake modes
- Commercial grade and fully automotive qualified drivers
- Small footprint and reduced external components
- Strong protection and diagnostic features

Featured Allegro Brush DC Motor Driver ICs

	Part Number	Output Voltage Range (V)	Output Current Range	Number of Bridges
Internal MOSFET	A4950*	8 to 40	3.5 A	Single full
	A4952	8 to 40	2 A	Single full
	A4953	8 to 40	2 A	Single full
	A4954	8 to 40	2 A	Dual full
MOSFET Gate Drivers	A3946*	7 to 60	>5 A Typical	Half bridge
	A3921/41*	7 to 50	>5 A Typical	Single full
	A4940*	5.5 to 50	>5 A Typical	Single full
	A4957	4.5 to 50	>5 A Typical	Full bridge

* Automotive Grade Available

Applications include:

Office Automation
- Inkjet / laser printers
- Copiers
- Office equipment peripherals

Industrial
- Power tools
- Factory automation
- Gaming electronics
- Scanners
- Vending machines

Automotive
- HVAC systems
- Hydraulic pumps
- Actuators
- Electronic Power Steering (EPS)

Representatives

ALLREM
94616 Rungis Cedex, FRANCE
Tel: +33 (0) 1 56 70 03 80
E-mail: info@allrem.com

SSG Semiconductor Systems GmbH
D79856 Hinterzarten, GERMANY
Tel: +49 (0) 7652-91060
Website: www.ssg-de.com
E-mail: mail@ssg-de.com

Consystem S.r.l.
I-20144 Milano, ITALY
Tel: +39 02 4241471
Website: www.consystem.it
E-mail: support@consystem.it

MSM Ltd.
Weybridge Surrey, KT13 0RZ
United Kingdom
Tel: +44 (0) 1932 341106
E-mail: msm@intonet.co.uk

Allegro® MicroSystems Europe Ltd

High-Performance Semiconductors

www.allegromicro.com/camp1136

Industry's First 30A Fully-Encapsulated Power Module

DC/DC Power Module Delivers 100W from a 17mm Square PCB Footprint

Intersil Corporation, a world leader in the design and manufacture of high-performance analog, mixed signal and power semiconductors, today announced the ISL8225M, the industry's first 30A fully-encapsulated power module. The ISL8225M features the industry's highest power density and dramatically simplifies the design of high-performance board-mounted power solutions.

The ISL8225M can deliver up to 100W output power from a small 17mm square PCB footprint. The two 15A outputs may be used independently or combined to deliver a single 30A output. Current sharing and phase interleaving allow up to six modules to be paralleled for 180A output capability. Excellent efficiency and low thermal resistance permit full power operation without heat sinks or fans.

Designing a high-performance board-mounted power supply has never been simpler -- only a few external components are needed to create a very dense and reliable power solution. And the QFN package with external leads permits easy probing and visual solder inspection.

Features and Benefits:
* Dual 15A or single 30A output from a 17mm square PCB footprint
* 4.5V to 20V input voltage range
* 0.6V to 6V output voltage range
* Up to six modules may be paralleled to support 180A output current
* Full power operation without heat sinks or fans
* Exposed QFN package leads permit easy probing and visual solder inspection

Pricing and Availability:
The ISL8225M is currently available in a 17mm x 17mm QFN package with prices starting at $48.85 each in 500-unit quantities.

More Information
Video:
http://www.intersil.com/ISL8225MThermal

Datasheet:
http://www.intersil.com/content/dam/Intersil/documents/fn78/fn7822.pdf

Appnotes:
http://www.intersil.com/content/dam/Intersil/documents/an17/an1789.pdf http://www.intersil.com/content/dam/Intersil/documents/an17/an1790.pdf
http://www.intersil.com/content/dam/Intersil/documents/an17/an1793.pdf

Join the Conversation
Twitter
Facebook
LinkedIn
Google+
Pinterest

About Intersil
Intersil Corporation is a leader in the design and manufacture of high-performance analog, mixed-signal and power management semiconductors. The company's products address some of the fastest growing markets within the industrial and infrastructure, personal computing and high-end consumer markets. For more information about Intersil or to find out how to become a member of our winning team, visit our website and career page at

www.intersil.com

New 8-bit Microcontrollers with integrated configurable logic in 6- to 20-pin packages

Microchip's new PIC10F/LF32X and PIC12/16F/LF150X 8-bit microcontrollers (MCUs) let you add functionality, reduce size, and cut the cost and power consumption in your designs for low-cost or disposable products, with on-board Configurable Logic Cells (CLCs), Complementary Waveform Generator (CWG) and Numerically Controlled Oscillator (NCO).

The Configurable Logic Cells (CLCs) give you software control of combinational and sequential logic, to let you add functionality, cut your external component count and save code space. Then the Complementary Waveform Generator (CWG) helps you to improve switching efficiencies across multiple peripherals; whilst the Numerically Controlled Oscillator (NCO) provides linear frequency control and higher resolution for applications like tone generators and ballast control.

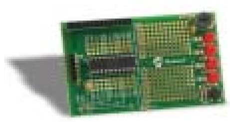
PIC10F/LF32X and PIC12/16F/LF150X MCUs combine low current consumption, with an on-board 16 MHz internal oscillator, ADC, temperature-indicator module, and up to four PWM peripherals. All packed into compact 6- to 20-pin packages.

Go to www.microchip.com/get/eunew8bit to find out more about low pin-count PIC® MCUs with next-generation peripherals

FAST-START DEVELOPMENT TOOLS

PICDEM ™ Lab Development Kit - DM163045

PIC16F193X 'F1' Evaluation Platform - DM164130-1



PICkit™ Low Pin Count Demo Board - DM164120-1

Free CLC Configuration Tool:
www.microchip.com/get/euclctool

MICROCHIP

Microcontrollers • Digital Signal Controllers • Analog • Memory • Wireless

Microcontrollers Tailored by Software Meet Industrial Application Requirements

By Dr. Stephan Zizala, Senior Director, Industrial and Multimarket Microcontrollers, Infineon Technologies

Several large trends influence microcontroller selection. Energy efficiency is the long-term and well-discussed trend in industrial applications, such as drives, factory automation and building automation. A parallel trend to achieve efficiency affordably is that individual electronic systems must be integrated in communication networks. Also, legislation, especially in Europe, has accelerated the need for safety features in industrial systems.

How do these trends influence the choice of the microcontroller? Computing performance requirements grow to allow adoption of powerful algorithms. Requirements for application specific peripherals grow to enable highest performance of the power and analog components. Communication stacks, operating systems and more elaborated control software drive the need for a high-level programming support to manage software complexity. And safety applications in addition to certain microcontroller features also require the right quality level under all operating conditions and typical product lifetimes beyond 10 years.

Industrial microcontroller suppliers can help in three major ways to address those trends:

1) with a microcontroller architecture that can be tailored to the specific application, e.g. combining several timer units by hardware signals to build a 3-level inverter
2) with reliable, long-term availability of specific components and
3) with a more efficient approach to cope with the growing software complexity.

Faster control loops and more advanced algorithms require a core architecture with DSP functionality and a fast Flash memory even in worst case conditions. Optimized peripherals enable faster and more accurate measurement of analog signals and faster and more adapted PWM (Pulse Width Modulation) generation. Building on these characteristics, the combination of standard microcontroller peripherals in an FPGA (Field Programmable Gate Array)-like approach allows the system developer to tailor the microcontroller hardware to the application. The XMC4000 microcontroller family of Infineon is unique in the way it enables flexibility to combine different hardware peripherals. A central connection matrix allows connection of internal and external input and output trigger signals of different hardware modules by software. Thus, software tailors hardware functionality in a very flexible way.

Higher connectivity is the next logical step in industrial systems. Its benefits are improved system interoperation, easier system integration, and streamlined management and maintenance. There are two aspects to this: Connectivity within the real-time critical domain and connectivity to the "outside" world. Within the real-time critical domain CAN, simple standards like UART, SPI, IO-Link or proprietary protocols are widespread, cost-efficient and reliable. For connectivity to the outside world there are two main use cases. For a manual update or download, high-speed interfaces like USB or SD/MMC are required. For remote process management, monitoring or maintenance, Ethernet is seen as the main trend.

Several industry studies confirm that software complexity is one of the major problems for embedded system development. This is true especially for small and medium-sized companies with comparatively small development teams of some ten engineers. Key challenges include communications stacks, operating system integration and re-use of optimized algorithms.

To gain control of software complexity, the selected microcontroller hardware should be flexible enough to support a wide variety of applications and enabling platform solutions. It also requires a higher abstraction of software development. Infineon offers DAVE™ 3, a free Eclipse-based integrated development environment (IDE) that includes a tool chain and an extendable autocode generator. Using DAVE 3, software components known as "DAVE Apps" can be combined and connected in a graphical environment. DAVE 3 handles the task of mapping the components to the available resources (memory, peripherals, pins, etc.) of the microcontroller and then generates the C code. In contrast to programming with libraries and code examples, it allows higher software abstraction, easier integration and maintenance. And as DAVE 3 is an open platform it allows extensions and adaptations by users and smooth interoperation with third party compilers and debuggers.

www.infineon.com/XMC

www.infineon.com/dave

Dr. Stephan Zizala is the head of Infineon's Industrial and Multimarket Microcontroller business segment. Before he took over his current position in 2009, he held several management positions in microcontroller product marketing, application and concept engineering. He holds Dr.-Ing. and Dipl.-Ing. degrees in Electrical Engineering from Technische Universität München (Technical University, Munich, Germany). Contact: stephan.zizala@infineon.com

POWER MODULES

SIMPLIFY POWER

100W DC/DC POWER SUPPLY IN 17mm sq. FOOTPRINT

- **Simple:** One ISL8225M plus a few components and you're done
- **Flexible:** 5V – 20V input; dual 15A or single 30A output
- **Scalable:** Parallel up to 6 modules for 180A output
- **Reliable:** Full power operation without fans or heat sinks

▶ GET STARTED NOW

- Download Datasheet
- Read App Note
- Order Evaluation Board
- Watch Video: Improving Thermal Performance

INTERSIL.COM/ISL8225M

intersil™

SIMPLY SMARTER™

Smart Grids: No energy efficiency without semiconductors

To successfully implement the necessary transition to renewable energy sources, distribution grids must not only be expanded, but better controlled and monitored. The semiconductor industry is confronting these challenges with intelligent technical solutions.

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

The speakers at this year's CEO Round Table during the trade show electronica 2012 all agree on one thing: Smart grid will be one of the electronics industry's key topics now and in the future. The four CEOs from STMicroelectronics, NXP Semiconductors, Freescale Semiconductor and Infineon Technologies see smart grid not only as "a great opportunity" for the semiconductor industry but also for the world, to make the grids smarter, more efficient and of less carbon footprint. Furthermore, the "smart world" of smart grid, smart homes, smart metering will boost its revenue expectations over the next years as well.

This year's CEO Round Table speakers Carlo Bozotti from STMicroelectronics, Rick Clemmer from NXP Semiconductors, Gregg A. Lowe from Freescale Semiconductor and Dr. Reinhard Ploss from Infineon Technologies are convinced that nothing but semiconductors can realize a reliable and affordable renewable energy infrastructure. Gregg Lowe from Freescale explains: "In less than 10 % of the time just 20 % of the network capacity is used today. There must be a better way to be more efficient." Modernizing the network infrastructure is essential to ensure network stability and, with it, the supply of energy in the future.

But this is not enough. There are intelligent networks needed and the semiconductors could have a large part in order to expand smart grids that not only transport and distribute electricity efficiently but also are able to use electricity on a more efficient manner. Certainly the semiconductor industry will have a great future, Carlo Bozotti is convinced. On his view, these technologies devour semiconductors at all and he informs about the latest developments in Italy: "In Italy we have about 33 million intelligent smart meters installed. This means an investment of 2 billion Dollars but these efforts save expenses of 500 million Dollars every year."

Why this model couldn't be transferred to other European regions hasn't been explained at the CEO Round Table. But one thing is clear for Dr. Reinhard Ploss from Infineon Technologies: The acceptance of smart grid depends strongly on ease of use and reliability: "Otherwise, people will not accept this new technology." In fact, the same way semiconductors are evolving according to Moore's Law they are getting cheaper. At the same time the reliability improves as well. This allows using them with remote control, he says: "Lots of devices could be managed automatically in the background without the user's awareness. This is very comfortable for the user as he doesn't need to know all specific details or technical specifications which guarantee an ease of use." On the same way, manufacturer and support-organizations could provide their maintenance remotely, adds Gregg Lowe from Freescale. "Home appliances with an IP address could be easily controlled via smartphone with internet connection", he explains viewing the next step ahead: "This leads us to the next step where the communication from Human-to-Machine will change to Machine-to-Machine-Interface. Due to a tracking system the smartphone will know that it is for example on the way home and will switch on heating, lights or AirCon automatically to comfort the user."

The speakers at this year's CEO Round Table during the trade show electronica 2012 (from left): Gregg A. Lowe from Freescale, Carlo Bozotti from STMicroelectronics, Rick Clemmer from NXP and Dr. Reinhard Ploss from Infineon.
Picture: Messe München/Alex Schelbert

But this will not boost the acceptance alone, Rick Clemmer from NXP is convinced. NXP sees itself as a leading company of security ICs offering a range of ICs for smart cards, tags, labels and readers, featuring many coprocessor, security, memory and interface options. Therefore Rick Clemmer states: "For the acceptance there is one essential criterion and this is data security. In the future the Internet of Things will play a major role even more within the energy environment." It is expected, that the number of things connected with the internet will exceed the number of people soon. By 2020 there will be 50 million things connected. "The message is clear. Without security no acceptance, this cannot be repeated enough."

Nothing goes without high-power semiconductors

The industry still faces a few challenges. Electricity must be fed, transported and controlled, and several components are needed to do so. The interaction and reliability of these components are essential to avoid ultimately ending up in the dark due to a failing device. “The smart grid is not a single challenge”, as Dr. Reinhard Ploss from Infineon pointed out focusing on the final device which uses the power: “Smart grid combines the power efficiency of all the devices. High-power semiconductors are needed which are able to switch devices on and off and re-direct power.”

On the transmission network level the high-voltage direct current (HVDC) technology can transport power more efficient over large distances as today’s AC power lines can do. And in existing transmission routes, an intelligent idle power management could drive to more efficiency. “Power semiconductor are playing a key role on both matters”, states Dr. Reinhard Ploss. In future the importance of distribution networks will improve as smart meters will manage the data. Therefore, parallel to the power distribution a communication network is needed. On this way, a better matching between supply and demand would allow accurate load shifts and load management. This is required to smooth the peak times and off-peak times of fluctuate renewable energy. Microcontrollers and sensors are needed, being able to control the flow of electrical energy. Although, the distribution grid is able to manage the power from many of these decentralized suppliers which it’s often changing load direction. The customer will adopt an important role within the smart grids while providing data for an efficient load management over their smart meters or home gateways. This finally conducts to an intelligent “smarter” home. Carlo Bozotti from STMicroelectronics drives the attention again to the installed smart meters, pointing out that his company has produced over 40 million components dedicated for smart grids. “The technique exists, no doubt! There is just a need to orchestrate it accordingly.”

“Smart metering, smart lighting, smart home – these markets will growth about 20 % by 2020”, Rick Clemmer dares to forecast. In China alone there will be more than 300 million smart meters installed by 2016, he says. The “smart world” will accelerate in China much faster than in other regions of the world based on the specific goals that are established in the five-year-plan of the Chinese government.

Indeed, all hopes of the semiconductor industry are once again pinned on China, especially for the revenue of next year. Their revenue for 2013 will strongly depend on the growth in China. Rick Clemmer expects for the upcoming year 2013 a low single-digit percent range of the world market, and all other CEOs agree on these expectations.

www.freescale.com

www.infineon.com

www.nxp.com

www.st.com

Electronics Industry Digest

By Aubrey Dunford, Europartners

Following “industry-average” electronic system sales growth of 6 percent in 2011, electronic system sales are expected to grow 3 percent in 2012—half the long-term average, but the improving outlook for global GDP is forecast to help boost electronic systems growth 5 percent in 2013, so IC Insights. The communications category is the only major electronic system segment expected to register better than 6 percent growth in 2012.

SEMICONDUCTORS

Utilization rates at Taiwan's top-3 IC foundries will average 84.8 percent in the fourth quarter of 2012, down from 94.8 percent in the prior quarter and 95.5 percent in the second quarter, so Digitimes Research. Weaker-than expected end-market demand has resulted in rising inventory levels among their fabless and IDM customers, which already led to a sequential decrease in their average utilization rates in the third quarter. Inventory among the global major IC suppliers climbed to a record $ 16.51 billion in the third quarter, reflecting a weak 2012 peak season.

Two research projects with a combined budget approaching € 70 M achieved significant advances in semiconductor manufacturing efficiency and have been recognized with the 2012 ENIAC JU Innovation Award at the European Nanoelectronics Forum. The IMPROVE project partners developed computational models for equipment behaviour and history enabling virtual metrology, predictive maintenance and adaptive control plans to improve throughput, stability and reproducibility, and the overall wafer fab efficiency. In LENS, 12 partners advanced design, masks, metrology, exposure tool, materials and process integration using double exposure for systems on chip and spacer based pitch doubling for phase change memories to extend the applicability of the immersion lithography technology. IMPROVE and LENS have been selected in the open and competitive call for proposals from 2008, and came to completion this year. Between 2008 and 2011, the ENIAC JU programme launched 40 projects with combined budgets exceeding € 1 billion.

OPTOELECTRONICS

Global large-size (9-inch and above) TFT LCD panel shipments will reach 722 million units in 2013, decreasing 3.5 percent from 2012, as a result of weakening demand from the PC sector, Digitimes Research estimates. Shipments for notebook and monitor applications will both decrease, contributing to the rare annual decrease for the LCD panel industry. But TV applications will see a significant increase in average panel area in 2013 amid of growing demand for bigger screens.

PASSIVE COMPONENTS

Bel Fuse, a supplier of magnetics, modules, circuit protection and interconnect devices, has signed a definitive agreement to acquire the Transpower magnetics business of TE Connectivity. Bel will pay approximately $ 22.4 M in cash to acquire the business, which had trailing twelve month revenue of approximately $ 75 M.

TT electronics announced the expansion of its North American operations in Mexicali, Mexico with a new stateof-the-art production facility for the company’s portfolio of variable and passive components serving the defense, aerospace, medical, transportation, energy and industrial electronics markets. TT electronics has also entered into an agreement to sell Ottomotores to a subsidiary of Generac Holdings. Ottomotores, based in Mexico and Brazil, provides secure power solutions.

OTHER COMPONENTS

Cookson Group proposed to demerge its Performance Materials division to form a new London-listed specialty chemicals company, called Alent. The demerger is expected to become effective December 19, 2012. Alent will outline its position as a global supplier of electronics assembly materials and advanced surface treatment plating chemicals, serving primarily the electronics production industry, and also the automotive and other industrial markets. The net sales value for the division, being revenue less the value of tin and precious metals included in revenue, was £ 418 M (2010: £ 410 M).

DISTRIBUTION

European distribution bookings in Q312 declined by 4.7 percent compared to the previous quarter and by 4.1 percent when compared to the same period in the previous year, so the IDEA (International Distribution of Electronics Association). Sector specific bookings changes in Q312 compared to the same period in 2011 were: semiconductors declined by 5.8 percent; passives increased by 2 percent; and electro-mechs and other components declined by 3 percent. European distribution billings in Q312 declined by 4.3 percent, when compared to the previous quarter and by 10.6 percent compared to Q311.

Rohm Semiconductor has awarded Silica, an Avnet company, for its support in driving demand creation for the Silicon Carbide (SiC) power devices across Europe. SiC is widely expected to be used for the next generation of power devices due to its superior electrical characteristics, resulting in power devices with lower power loss. Rohm Semiconductor has already started mass production on SiC SBD, MOSFETS, and Modules.

Enpirion, a supplier of integrated power IC solutions, and Future Electronics announce the availability of products based on the world’s first wafer level magnetics (WLM) technology. In partnering with Future Electronics, Enpirion has made available these devices worldwide, which are the lowest cost PowerSoC DC-DC converters in the world enabled by bringing the economics of silicon wafers in place of traditional discrete bulk magnetics.

Mouser Electronics was awarded the European 2012 Bourns Distributor of the Year POS Growth Award. Mouser also received the Teledyne LeCroy Emerging Distributor of the Year Award for 2012. Mouser has also expanded its automotive application site with four new block diagrams. The newly enhanced site helps speed design engineers in finding the latest automotive advancements, sourcing product information via block diagram navigation.

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.

www.europartners.eu.com

Advanced Materials to Drive Power Conversion in 2013

By Jeff Shepard, President, Darnell Group

Silicon-carbide (SiC) and gallium-nitride (GaN) will be challenged by new contenders in the coming year. That's not to say that SiC and GaN power devices will not gain increasing market adoption, they will. But other semiconductor materials such as aluminum-nitride (AlN) (and others), advanced thin-film magnetic materials, and more, will emerge as the 'next big things' in 2013. The emergence of more new materials will be accompanied by the emergence of 'new' companies such as HexaTech, Inc., Ferric Semiconductor, and others.

Last month, HexaTech, received a $2.2 million award from the U.S. Department of Energy Advanced Research Projects Agency – Energy (ARPA-E) that will enable the development of a new power semiconductor technology for the modernization of the electrical power grid. HexaTech's aluminum-nitride (AlN) technology was identified by the Department of Energy as having the potential to be a transformational, breakthrough technology with significant technical promise, potentially 10X better performance than comparable silicon-carbide devices.

Using very low-dislocation-density single-crystal AlN substrates, HexaTech will develop novel doping schemes and contact metals for AlN/AlGaN with high Al content. For power systems and grid-scale power conversion applications, high-efficiency AlN-based power devices are expected to offer a significant reduction in size, weight, and cooling.

Dr. Baxter Moody, Director of Engineering, said, "This contract marks the beginning of a technological leap in device performance and efficiency for power semiconductors. The development will enable a significant step toward producing 20 kV AlN-based Schottky diodes (SBD, JBSD) and transistors (JFET, MOSFET). The ARPA-E contract has opened the door for the material development and research to demonstrate AlN high-voltage, high-efficiency power conversion capability."

Power semiconductor devices at this level are not currently available on the market. Experimental devices based on silicon carbide (SiC) technology are currently being developed. Compared to SiC technology, it is expected that Aluminum Nitride will enable power electronics with a 10X improvement in performance. Based on the wide bandgap material properties of AlN, the critical field is 6X larger, the on resistance will be lower, and the resulting power device area will be smaller for a comparable power level. This is expected to be a transformational technology that will revolutionize the power distribution grid.

HexaTech manufacturers single crystal Aluminum Nitride (AlN) substrates. This substrate material will enable long life UV-C light emitting diodes (LEDs) for disinfection applications, deep UV lasers for biological threat detection, and high voltage power semiconductors for smart grid and efficient power conversion.

The company's current product lines include single crystal and polycrystalline AlN substrates. Long life UV-C LEDs and high voltage power devices based on AlN substrates are also in development. Founded in 2001 with a team of industry experts in III-nitride semiconductors, the company has successfully solved complex material science and engineering challenges to commercialize high quality bulk AlN for volume production.

While HexaTech is chasing the emerging market for high-voltage devices to be used in tomorrow's smart grid applications, Ferric Semiconductor was founded by a team of engineers and materials scientists out of Columbia University, with the goal to develop integrated inductors in CMOS technology for use in advanced on-chip voltage regulators. The company's objective is to commercialize power converters utilizing inductors with precisely engineered laminations of high-permeability magnetic material.

This is expected to enable a significant improvement in power converter current density and subsequently enable power supplies for microprocessors and systems on chip (SoCs) to be down converted in the same package, or even on the same die. This new class of integrated voltage regulators (IVRs) will provide as much as 20% reduction in total power consumption for digital ICs by reducing resistive losses and enabling improved power management techniques.

Voltage regulators utilizing integrated magnetic thin-film inductors are expected to have cost and performance advantages over the other voltage regulator products that are commercially available. Therefore this technology is expected to have a sizeable impact on the $10 billion worldwide voltage regulator market. Furthermore, the integration of magnetic materials with CMOS will facilitate advances in other magnetic based systems, such as magnetic filters, sensors and imagers. Likewise, the experience gained from commercializing a magnetic material process module with CMOS technology will lower the technological barriers for other forms of heterogeneous integration.

Enpirion, Inc. has also developed a new magnetic alloy, which enables the miniaturization of passive magnetic components and their assimilation with integrated circuits at wafer level. So-called wafer level magnetics (WLM) present a leap in traditional technology, which will take magnetic components from their 3-dimensional discrete shape to a planar 2-dimensional thin-film form that can be deposited with standard wafer processes on top of CMOS wafers.

Enpirion developed a turnkey process module, which features low cost of ownership plating equipment to deposit FCA on 6 inch or 8 inch wafers. The technology has been successfully transferred and embedded in a volume wafer production facility earlier this year, where Enpirion is producing the world's lowest cost, noise sensitive, low power POL dc-dc converters, the 1 Amp EL711 and the 1,5 Amp EL712, the industry's first Power System-on-Chips based on electroplated wafer level magnetics.

Enpirion's WLM technology is fully qualified for full-scale mass production in a high volume foundry and enables the industry's first ever Power System-on-Chips based on electroplated wafer level magnetics. Developed with a view to achieving monolithic Power System-on-Chips, the WLM technology can be easily transferred to other micro-magnetic applications, for example micro-transformers for signal isolation, micro-electromagnets for life sciences, integrated magnetic sensors for navigation and PMICs for portable consumer applications.

"Increasing the switching frequency allows the use of smaller inductors utilizing electroplated WLM materials that can be post-CMOS processed. We developed an amorphous Fe-Co based alloy called FCA, which is capable of operating at frequencies higher than 20MHz with minimal attenuation of magnetic properties," explains Dr. Trifon Liakopoulos, Director of MEMS technology and Enpirion's co-founder. "With wafer electroplating methods, it is possible to cost-effectively deposit photo-lithographically defined FCA magnetic cores on silicon wafers."

FCA has high resistivity, low coercivity and maintains high effective permeability at frequencies higher than 20MHz. FCA's high magnetic saturation makes it suitable for use as single or multiple layers in power circuits, where it is compatible with flip-chip, wire-bonding and solder re-flow packaging methods.

Renesas Electronics has developed the RAA20770X Series of mini-POL converters for ASICs and other large-scale logic circuits in a wide variety of application fields, including personal computers, servers, industrial, office automation and networking equipment. The RAA20770X Series devices achieve the industry's highest level of miniaturization and power density. Renesas has released six products with different current supply ratings and functionality.

In the RAA20770X products, Renesas adopted a wafer-level chip size package to achieve POL devices that can supply large amounts of current in a miniature form factor making it possible to reduce the IC's internal wiring resistance and package wiring resistance to an absolute minimum. For example, in the RAA207701GBM, which has a maximum rated current of 10 A, the package size is an extremely small 2.7 x 3.4 mm, which corresponds to a roughly 75 percent reduction in package size compared to earlier Renesas SiP POL products. Furthermore the thermal resistance from the package surface to the chip junction area is an extremely low 1Ù/W, allowing a high thermal dissipation design when used with a heat sink and air flow.

Recently, there have been two changes in power supplies market. The first is the requirement for reduced power consumption to achieve an energy-saving society, and the second is the increasing diversity in supply voltages required by increasingly highly functional semiconductor products such as microcontrollers (MCUs) and SoC devices.

To satisfy the first requirement, the new RAA20770X devices perform high-efficiency power conversion during normal load and - typically 90 percent of the time - also execute the frequent transitions to low-power mode quickly. As a result, they reduce overall system power consumption and help enable an energy-efficient society.

To satisfy the second requirement, although mounting area is spreading according to electric source increasing, the RAA20770X devices achieve a size reduction of about 75 percent compared to earlier Renesas products, featuring an ultra-miniature wafer-level chip size package that is essentially the same size as the chip itself. Furthermore, since no wired connections are required within the package, resistance in the wiring is reduced, which contributes to more efficient voltage conversion. The RAA20770X Series represents the first devices with this level of integration in this small a package size.

These and other advanced power conversion materials, devices and technologies will be discussed at the first-annual Darnell Energy Summit (DES '13) to be hosted September 9-13 in Dallas, Texas. DES '13 will be a combined event featuring the Tenth Darnell Power Forum (DPF '13) plus the Fifth Green Building Power Forum (GBPF '13) plus the Fourth Smart Grid Electronics Forum (SGEF '13). With a single registration, delegates can attend any sessions of interest during these simultaneous leading-edge events.

http://energysummit.darnell.com

Magnetic Induction or Magnetic Resonance for Wireless Charging?

Recent activities in wireless power technologies have created questions about the adoption direction of the ideal solutions. Magnetic Induction (MI) or Magnetic Resonant (MR) can both be considered for use in the consumer market. Regardless of which direction the consumer market takes, it is a given that the adoption of wireless charging will happen.

By Siamak Bastami, Technical Marketing Director, Analog and Power Division, Integrated Device Technology

Within next couple years we will see penetration starting around the cellular market ECO system mainly driven by cellular providers. The Computing environment with its strong ECO system will follow and generate the next phase of growth in the use of wireless charging technology. From there it is likely that wireless power will expand into infrastructures supporting cellular and computing solutions. These uses will represent just the beginning of how wireless power technologies will be utilized in tomorrow's architectures and solutions.

There have been many reports and market studies about adoption rates and the potential total available market (TAM) associated with wireless power technologies. It is challenging to provide accurate market information since adoption rates and the choice of technologies are the key parameters in these forecasts. For MI technology there are two main prevailing standards: Wireless Power Consortium (WPC) and Power Matters Alliance (PMA). Both standards are fairly mature with many products already in use in the consumer market. Alliance for Wireless Power (A4WP) is the first standard based on Magnetic Resonance. It should be noted that Intel's Wireless Charging Technology, which is also based on Magnetic Resonance, is targeted at ultrabook and its own ECO system. Others such as Power by Proxy and WiTricity, which have already established their place in industrial and military applications, are now penetrating the consumer market too. All these standards and solutions have created questions of which direction wireless power technology will go and which solutions are the ideal to adopt. Before we can address this question, it is important to try to understand the fundamental differences between MI and MR technologies. Based on these understandings and application/system requirements one can choose the right solution for a given application.

Mobile Device Solutions

Mobile solutions are adopting wireless power solutions first in the consumer market. With LTE technology, communication speed and bandwidth they will not have any limitations for at least the next few years. Convenience is one of the key factors driving mobile solutions in the consumer market. Different mobile solutions such as cell phones, tablets, media players and mobile TVs require different adaptors with different interface connectors. One needs to carry many connectors and adaptors to serve the same purpose of transferring charge into a mobile device. A universal wireless adaptor with a powerful supporting infrastructure and ECO system could address the needs. Having the solution available in cars, coffee shops, libraries, restaurants, trains, airplanes, offices and conference rooms will create the needed convenience.

Every couple year's mobile solutions are upgraded to enhance their cosmetic appearance, performance and features. These upgrades force changes in power requirements, connectors and interfaces, and as a result new adaptors are usually required. These changes and upgrades force the wasteful obsoleting and disposal of existing adaptors. Eliminating various adaptors and connections and using standard wireless charging will help to reduce e-waste and improve the 'green credentials' of mobile devices.

Another important factor is technology upgrades in mobile solutions with the adoption of display technologies such as 1080P and 3D providing a good example. Mobile solutions will increasingly use high resolution display technology supported by high performance graphics controllers with multi-core CPUs to enhance required performance. Integration of 3D GPS solutions, high performance video and audio technology, NFC technologies, portable TV and high-performance gaming are some of the examples and features that will be adopted in increasing numbers of mobile solutions. Most of these features and requirements will generate a greater demand for power from the device's battery.

The source of energy in mobile solutions is typically Li+/Polymer battery packs whose energy density has been at saturation for several years already. Technology enhancements and the migration to different metallization in Li+ based battery packs to increase the capacity and longevity has not been able to keep up with increased energy

EconoDUAL™ 3 – Best in class

Highest Power Density with 600 A modules with 650 V / 1200 V / 1700 V IGBT4

The **'Best in class' EconoDUAL™ 3** portfolio with **new PressFIT** auxiliary terminals :

- FF600R07ME4_B11
- FF600R12ME4_B11
- FF600R17ME4_B11

The **EconoDUAL™ 3** modules key applications:

- Construction, commercial and agriculture vehicles
- High performance drives
- Wind applications

The **EconoDUAL™ 3** with optimized features:

- Improved switching characteristics
- Minimized thermal and electrical resistance
- Enhanced mechanical robustness
- PressFIT pins minimizes assembling costs and improves FIT rates

www.infineon.com/highpower

demand placed upon them. Battery packs must also have small physical dimensions in order to meet the application requirements of mobile solutions. Since battery capacity per unit volume is at its limits, solutions will either require larger battery capacity or more frequent charging. While mobile solutions are getting smaller, fitting a larger capacity battery will impact the size and the cost of the overall solution. It should also be noted that larger battery capacities will require faster charging that may cause a change in the chemistry while maintaining battery life cycle and required longevity. It seems a more obvious solution to the situation is to enable more frequent charging.

It is feasible that every application surrounding us that uses electricity is a potential candidate for adopting wireless power technologies. In order to answer which wireless technologies - MI or MR - is best for a given application, we need to review the fundamentals of each.

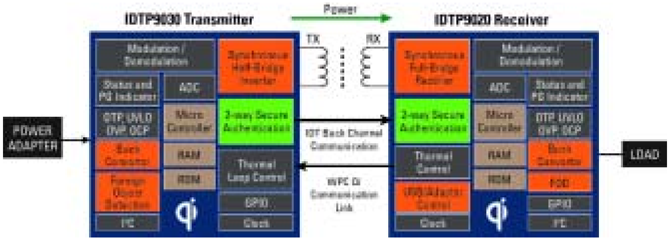


Figure 1: Wireless Charger System: Transmitter and Receiver Block Diagrams

Magnetics

There are many similarities in the architecture of MI and MR technologies. For example, both use a magnetic field as a bridge to transfer power.

In both technologies current is induced into a resonant circuit, creating a magnetic field to transfer the power. Magnetics specification has a big impact on how the electromagnetic field is shaped. The magnetic flux can be contained and / or directed using electromagnetic shields and / or shaping the physical dimensions of the magnetic core. The flux density and containment is improved by improving the permeability of the electromagnetic shield. Cost and thickness are key drivers for selecting the appropriate electromagnetic shield. The alignment of the receive and transmit coils in the flux field and the distance between them will determine how efficiently energy is transferred; greater separation between transmit and receive coils results in less efficient power transfer. Resonant frequency, the ratio of transmit to receive coil dimensions, coupling factor, coil impedance, skin effect, AC and DC elements and the parasitic of the coil are other factors that have a large impact on how efficiently energy is transferred.

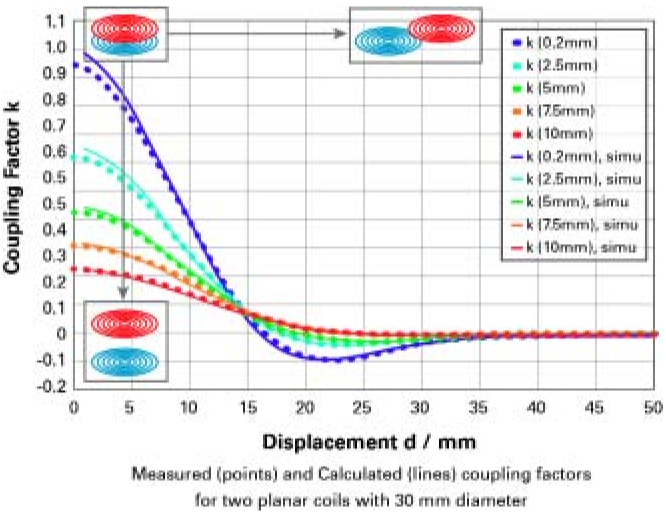


Figure 2: Coupling Displacement

It is given that as the x, y and z separation and the proportional angle between transmit and receive coils increases, the losses and efficiency will be greatly impacted.

In the WPC specification, there are specific requirements for the positioning of the receiver coil on the transmitter to address efficiency. This requires alignment by the user to maximize the coupling factor between the two coils. In the case of MR technology, freedom of positioning and the ability to place single or multiple devices in the flux field creates more convenience for the user. However, one needs to understand the impact on transferred efficiency as the separation distance between coupled devices increases.

Depending on the requirement, including cost and size considerations, a single or multiple coil solution can be utilized in all technologies.

In WPC and PMA based MI technologies, power can be transferred over a wide range of frequencies. The resonant frequency at which the power is transferred is selected based on the load impedance. Due to this variation, the Q factor is relatively low compared to MR solutions. Optimum efficiency can only be achieved at selected frequency and load impedances.

In the case of MR technologies, since the power is transferred only at a certain resonant frequency, Q factor is larger and requires very close resonant impedance network matching in the receiver and transmitter.

In both MR and MI technologies, the variation in matching network parameters needs to be tightly controlled since it directly impacts the transferred power.

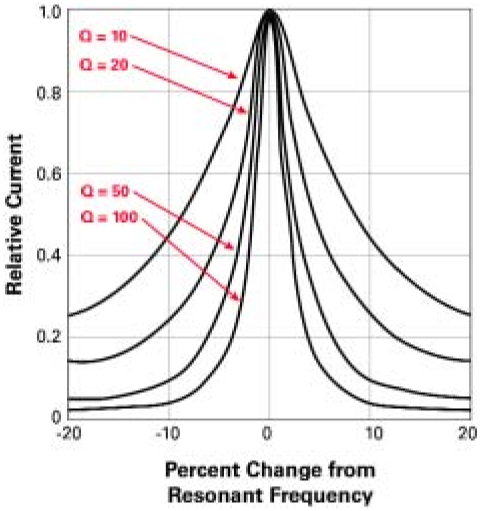


Figure 3: Q-factor percentage

In WPC 1.1, the resonant frequency can be selected over a wide range from 100 KHz to 205 KHz. The situation is similar in PMA, but the frequency range changes to 277 KHz to 357Khz. Typical Q factors for these solutions are in the region of 30 to 50. In A4WP based solutions, the resonant frequency and impedance networks between receiver and transmitter need to be reasonably closely matched since the frequency is fixed. Typically MR solutions require higher Q Factors (50 to 100) compared to MI solutions.

Power Management

Development of high performance power management architectures has a big impact in the implementation of successful MR and MI

solutions. On the transmitter side, in order to induce current into the resonant circuit, a DC to AC conversion takes place. In MI technology, a half-bridge or full-bridge inverter is utilized for this conversion whereas in MR technology current is induced through a power amplifier. The power amplifier architecture and classification can vary based on the frequency, standby current, efficiency, size, cost, and integration requirement of the application. During these conversions, careful consideration needs to be given to reducing losses in gate drivers, switching, conduction, biasing, body diode losses and parasitics such as equivalent series resistance (ESR) and equivalent series inductance (ESL) of external components. These are some of the key challenges for developing high performance integrated solutions.

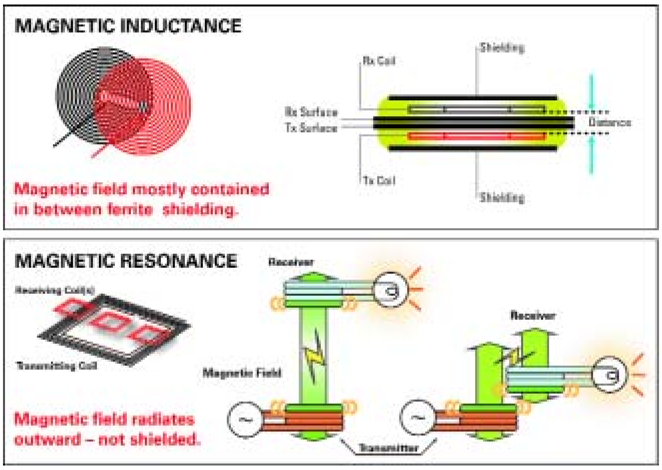


Figure 4: Magnetic fields

Depending on the input voltage requirement and design architecture, process selection has a big impact on optimizing integrated solutions. There are multiple control loops in the system upon which the stability of the complete control loop has a big impact on the overall success of a high performance solution. In both MI and MR technologies, similar performance and efficiencies can be achieved through effective power management.

Communications

In order that power transfer is achieved successfully, the transmitter needs to recognize the correct coupled receiver. In WPC and PMA solutions, the transmitter 'pings' periodically to search for the receiver. As the receiver is recognized, the power transfer takes place. These solutions use fixed frequency modulations to communicate. Some other methods of communication are amplitude, power, current, and pulse width modulation (PWM). All of these options can be utilized if the matching network between transmit and receive can tolerate wider frequency variations.

Because in an A4WP magnetic resonant solution the matching networks in transmit and receive are tightly matched, frequency modulation cannot be used. However, if the load is fixed, then it is possible to use amplitude modulation. Power and current modulation can be utilized if the receiver performance is not affected. Because in mobile applications the load varies based on functionality requirements, it would be challenging and probably not size and cost effective to develop a solution based on the above mentioned modulation schemes. A4WP selected either Bluetooth or ZigBee as a standard method for their communications. These methods are convenient since they already exist in mobile solutions. It is also convenient for the transmitter to transfer power to multiple devices by identifying different receivers. Other similar methods are available to achieve the same objectives.

Communication is also utilized to inform the status of power transfer such as foreign object detection (FOD), status of coupling, and maybe even alignment guidance information (AGI). Foreign objects such metals in the electromagnetic field can potentially cause a temperature rise based on the conductivity of the materials. This is a potential problem regardless of the technology.

Accurately monitoring voltage and current on both transmit and receive sides is necessary in order to maximize efficiency in magnetic induction technologies. Other functions such as the effect of load reflection, current induction and the timing of modulation and demodulation and impact of them in the closed loop systems are critical to help maintain the stability of the system and ensure successful communication. Other challenges including meeting regulations such as California Environmental Association (CEA) and Federal Communication Commission (FCC) part 15 and 18 may also impact the overall efficiency of the system.

It is reasonable to conclude that the best potential solution for a specific application will be based on the required features and performance. If free positioning or multi-device charging capability in X, Y and Z directions is required then magnetic resonance could be the preferred solution. If high efficiency performance with strong standards compliance is required, then WPC compliant solutions may represent the optimum choice. However, there is no question that a multi-mode solution able to seamlessly recognize the coupled magnetic Induction or Resonant based device and transfer power effectively and efficiently will be the ideal solution to serve such applications.

IDT has been developing solutions in both MI and MR technologies. The company's highly integrated MI solution is architected to meet and exceed WPC (Qi) requirements. These solutions use highly advanced process technologies to integrate power devices and intelligence to effectively communicate and control the closed loop function between receiver and transmitter. IDT's IDTP9020, IDTP9030, IDTP9035 and IDTP9036 all meet WPC requirements. These integrated solutions require a minimal number of external components helping reduce BOM cost and total required PCB real estate.

Integrated Device Technology and Qualcomm have collaborated to support IDT's development of an integrated circuit for consumer electronics devices based on Qualcomm's WiPower Technology. This IC is being designed to meet the requirements of Qualcomm's new near-field magnetic resonance wireless power charging solution. They are designed to provide spatial freedom for charging consumer electronics, such as mobile phones and other battery-powered / low-power direct-charge devices.

IDT's magnetic resonant solution portfolio is expanding by developing receiver and transmitter solutions based on Intel's technology for ultrabook ECO system. Intel and IDT also team up for Wireless Charging Technology Chips. Intel Corp. has selected IDT to develop an integrated transmitter and receiver chipset for its wireless charging technology based on resonance technology. Intel along with IDT aims to deliver validated reference designs that are targeted for deployment in ultrabooks, all-in-one (AiO) PCs, smart phones, and standalone chargers.

www.idt.com

Maximizing Precision in Thermal Interface Layers

Simply "Good" is not good enough for TIM as a functional layer

The thermal interface as a crucial building block in power electronics deserves special attention

Today, modern semiconductors are driven at the edge of their capabilities due to cost pressure in a volatile market. Increased power ratings in given designs are supported using upgraded generations of power modules which lead to increased thermal stress. This in turn shifted the focus in design towards advanced thermal management which became a dominant factor in power electronic devices.

By Dr.-Ing. Martin Schulz, Infineon Technologies

Still the combination of power module, heat sink and adequate thermal solution, along with the qualification effort to be done, often leads to second best solutions. As a consequence, 20% of performance respectively lifetime can easily be lost.

Material Science

Searching for a proper material to act as a thermal interface in power electronics is a time consuming work. Minimum requirements were defined and tests conducted to determine the thermal properties and the long-term stability of a given material. The conclusion drawn from a four year project was, that a new, dedicated material had to be developed to really suit the needs of power electronic modules. Figure 1 hints out four steps of the material development conducted to cope with all the requirements.

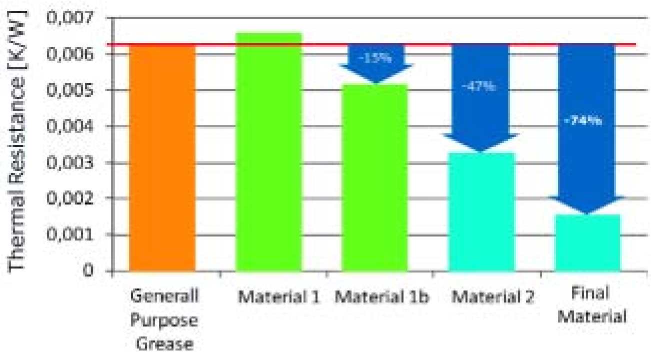


Figure 1: Four steps in developing a new kind of thermal interface compound and the major advancement achieved with the final material. Measurements done acc. to ASTM D-5470

Compared to the general purpose thermal grease widely used in power electronic applications, the first development turned out to fail this benchmark. Changing filler components, blending various filler materials and varying the level and ratios of different fillers used were steps taken during the optimization. Finally, after almost three years of iterative improvements, a material was generated that reduced the thermal resistance, compared to the well established general purpose grease, by 74%. The material, IFX-TIM is customized and exclusively available to Infineon.

Precise local application

Building the perfect thermal interface layer immediately brings up the questions, how much material has to be applied and what kind of distribution to chose. The historic approach of applying a homogenous layer using roller or squeegee cannot be considered the best solution as in general too much material is applied. Additionally, a homogenous layer would prevent the forming of the metal-to-metal contact that is desired.

Applying material using an inhomogeneous pattern is the preferred solution. However a detailed knowledge about the power module geometry is mandatory to determine the area in which to apply the TIM and the volume to be applied. Stencil printing allows controlling both parameters precisely. The distribution can be aligned using the pattern's shape while the volume can be varied by properly adapting the stencil's thickness. The drawing in Figure 2 depicts a stencil geometry dedicated to one particular module family.

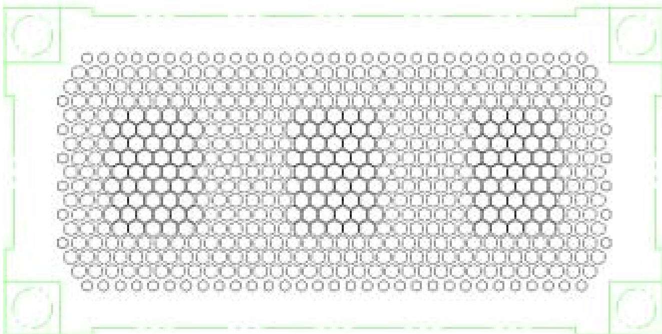


Figure 2: Stencil pattern to define the TIM-distribution on an EconoDUAL3, FF450R12ME4

To apply the material in a reproducible way in mass production, fully automated equipment is unavoidable. A dedicated manufacturing line was build consisting of automated handling systems, inline screen printing and visual inspection machinery. As the Infineon solution consists of a phase changing material, a drying step is necessary. This step is done in an inline oven. Afterwards, controlled cool-down processes ensure that the modules have reached a suitable temperature level for packaging.

Regarding the volume applied, there is a small but reasonable range between too much material applied and too little amount used. In copious examinations, this range was evaluated closely to ensure excellent results, taking slight variations in module geometry and more severe deviations in heat sink qualities into considerations.
From the diagram in Figure 3 it can be seen, that a change in stencil thickness from 60µm to 120µm does not lead to noteworthy detrimental effect.

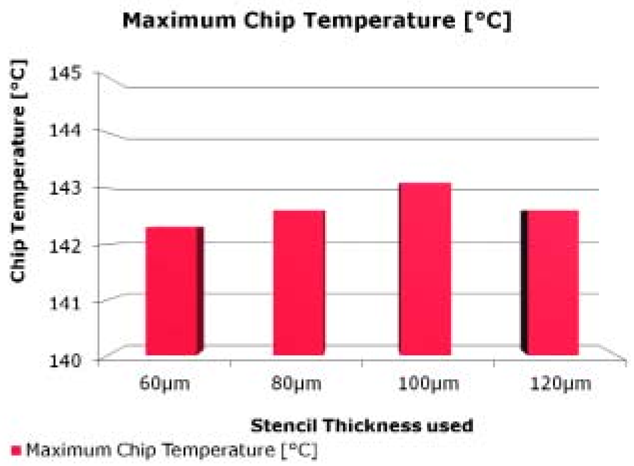


Figure 3: Thermal results from various screen thicknesses. DUT: FS450R17OE4P

Of utmost interest is the hottest spot inside the module. As a consequence of the unique TIM-properties, the influence of the screen thickness is very small in the range targeted. The tiny variations are all within the +/- 1K resolution accuracy of the equipment in use.
A stencil thickness was finally chosen that takes a worst case scenarios of combining borderline materials in both, heat sink and module geometry under considerations.

Accurately controlling the process
If 100µm is targeted but 60µm could be a risky limit, meticulous monitoring of the process is mandatory. The deviation allowed is less than 40µm, about half the thickness of a human hair.

To prevent getting close to the limit, a very accurate measurement strategy for verification is implemented.
This extraordinary level of precision can only be achieved using fully automated, cutting edge optical inspection systems. The system accurately checks the alignment of the printed pattern in respect to the module regarding translational and rotational deviation. Every single dot is measured in position, size and height allowing the calculation of the volume applied dot by dot.
High-speed 3D pattern recognition is the key to perform this 100%-test in a timely manner.
As a result, even tiniest deviations are recognized as for example bridges forming between two honeycombs as shown in Figure 4. For comparison, the screenshot in Figure 5 displays a pad with the demanded high quality printing result.

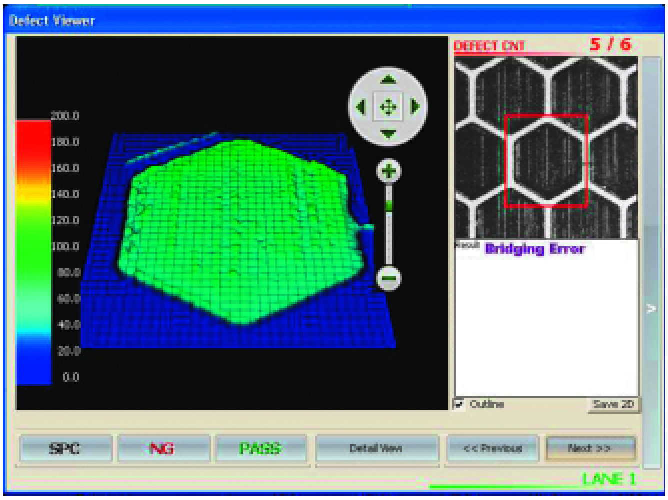


Figure 4: 3D-Pattern of pad 146 out of 3078 revealing an unwanted bridge

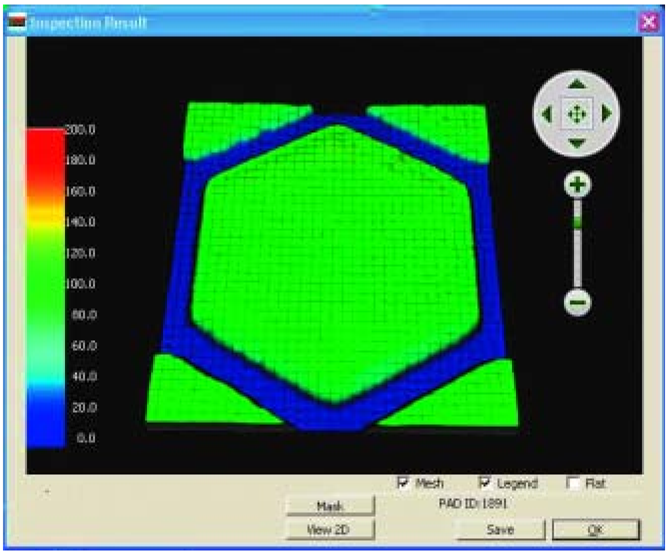


Figure 5: 3D-Pattern of pad 1891 out of 3078 showing the desired printing result

For traceability reasons and quality management, a proper set of data of all modules considered ok is stored.

Customer Benefit
Screen printing is a common process in industrial applications, though it is rarely controlled down to the µm scale and taking place in clean-room environment. Having the thermal interface material applied to the module releases the customer's assembly line from this often unwanted process and reduces assembly times. It also eases work in case of maintenance. This however is of minor importance. The major benefit for the customer is the change in paradigm and the committed improvement regarding the thermal quality of a power semiconductor.

Charakteristische Werte / Characteristic Values

FS450R17OE4P			min.	typ.	max.	
Wärmewiderstand, Gehäuse bis Kühlkörper Thermal resistance, case to heatsink	pro IGBT / per IGBT valid with IFX pre-applied thermal interface material	R_{thCH}			0,037	K/W

Figure 6: Committed to excellence. The datasheet clearly states the superior performance of modules equipped with Infineon's new thermal solution

Comparing the datasheet of a FS450R17OE4, a module without IFX-TIM applied, and the TIMed version FS450R17OE4P, the change in thermal qualities can easily be found within the thermal resistance Case-To-Heat-Sink Rthch. The excerpt taken from the according datasheets is given in Figure 6 revealing two changes.

The thermal resistance is no longer listed as a typical value but qualifies as a maximum value. Designers of power electronic equipment now can rely on this parameter to be a guaranteed value that remains correct throughout the lifetime of the design. The effort of qualification in respect to “how typical is my design” is eliminated.

Figure 7: Module families that will be available with TIM in 2013, including 62mm, PrimePACK, EconoPACK4 and EconoDUAL3

Compared to the 41K/kW for the typical value stated for the standard module, the value for the module with TIM applied additionally is reduced by about 20% down to 37K/kW.

With this, it remains customer’s choice to either increase the output power staying at a given temperature level or keep the output power and benefit from decreased temperature levels. This in turn will extend the design’s lifetime.

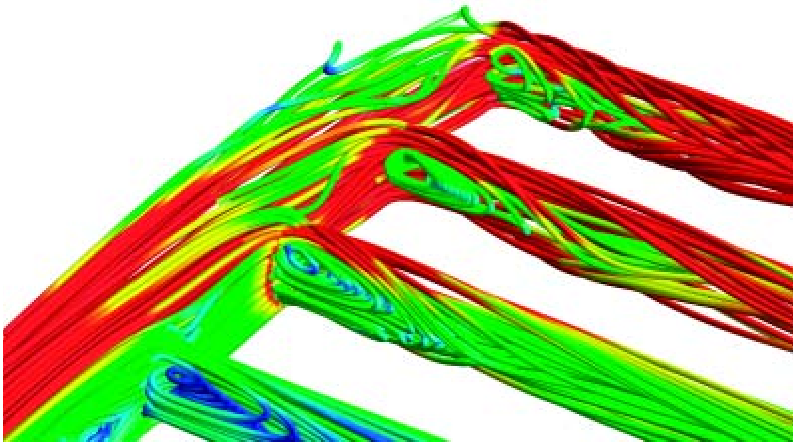
EconoPACK+ in the new D-Series design is the first module available with TIM applied. Mass production has started in November 2012. Several projects are currently ongoing to serve the market with further module families featuring Infineon TIM. Figure 7 shows the portfolio that will be available in the near future.

Conclusions

With the ongoing developments in IGBT module technology, power electronics and the increased power densities today, thermal interface materials become a more crucial aspect in the field of thermal management. To achieve outstanding results, in-depth knowledge of the power module is necessary and a dedicated material is the most wanted solution. After several years of testing, refining and qualifying, Infineon Technologies now offers modules with TIM applied. In doing so customers are supported in building a high performance, reliable, long-term stable thermal interface to cope with the demanding conditions seen in power electronics.

www.infineon.com/tim

Simulation and Infrared Technology Track Down Flows



Turbulence in the Cooler Plate

Modern high-end cooling modules place great requirements in quick and even heat dissipation. Liquid-operated coolers usually have several channels through which the liquid needs to flow evenly. The following article shows that this is not a trivial task...

By Stefan Schuler and Konstantin Lickey

Even the old Egyptians were facing a similar problem: irrigating several fields out of one main ditch by using one branch each. The trick was to provide the same quantity of water to each field, even at different water levels in the reservoir. Different water levels will impact the flow speed and the volume flow ratio in the branches.

For liquid-powered cooling units, this means an evenly distributed volume flow that should be independent from the cooling medium's pressure and viscosity. The key to a good distribution is the feeder port mounted in the face side flanged to the actual cooler plate. This flange is the subject of the flow simulations presented now. Afterwards, the optimal design derived from the simulations will be analyzed for suitability in a sophisticated practical test.

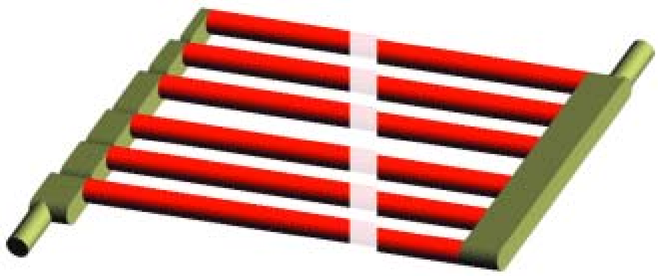


Figure 1: Geometry of the coolant ducts (section). Left: optimized flange; right: non-optimized flange.

An analogy – and the problem

Figure 1 shows a cooler plate's basic design with two attached flanges for the feeder and the return line. The flanges connect to the main lines on opposite sides and they distribute the liquid flow in this example to 6 parallel coolant pipes.

The important and interesting thing is the question for the flow's quantitative distribution to each separate flow. A familiar analogy for this solution approach is the pattern of parallel-circuit electric resistances used in the network theory. This presumed analogy intuitively provides an equivalent distribution of electric current for identical resistances.

The most common conclusion from this observation is that the fluid's volume flow is also equivalent. However, this is not quite correct because water molecules, as opposed to electrons, possess a mass.

The molecules' inertia resulting from this fact makes changing the velocity vector within a given time frame defined by the water flowing past the ducts more difficult. This window is defined by the coolant duct's expansion, the flow velocity in front of it, and the forces acting upon any given water molecule. At high flow velocities, the window is too small for the majority of the molecules – they will mostly be dragged along by the main flow.

Each additional branch will reduce the volume per time unit, and thus also the flow velocity at a constant cross-section. The windows become more and more favorable, so more and more molecules will change direction.

In order to minimize the branches' relative impact upon the feeder line's flow velocity, its cross-section should be as large as possible. This is true; however, it's practicable to restrict the feeder line's cross-section to approximately twice the total cross-section of all branches. For reasons of space, and other reasons, this is not always feasible. This is the point to focus on/demand a favorable design of the flange.

Just a matter of approximation?

A simple formula-based calculation of the volume flow distribution is hardly ever possible because the formation of vortices and dead flow areas (areas that are not included in the flow and that often produce undesirable turbulences) make the situation infinitely complex. Under circumstances, the flow's direction may even invert, forming large vortices between the front and rear coolant ducts. In this scenario, the amount of each volume flow could even be approximately identical, but evenly distributed cooling will no longer be provided at all.

These considerations led to the decision to simulate the flow by means of the finite element method (FEM).

Simulation only?

FEM simulations are a numerical method for solving partial differential equations. As the name suggests, the spatial problem is divided up into a finite number of elements. In this process, each element is assigned specific properties, besides shape and size, such as density, viscosity, surface tension and heat capacity. Increased precision, i.e. smaller elements, entails increasing computing power . Therefore, an appropriate compromise needs to be found.

The flow scenarios for different flange geometries were simulated with the fluid dynamics (ANSYS) software suite. The initial or reference design was a flange with lateral inflow and a constant cross-section (not optimized). This simple component makes optimizations visible particularly well (figure 1, right side).

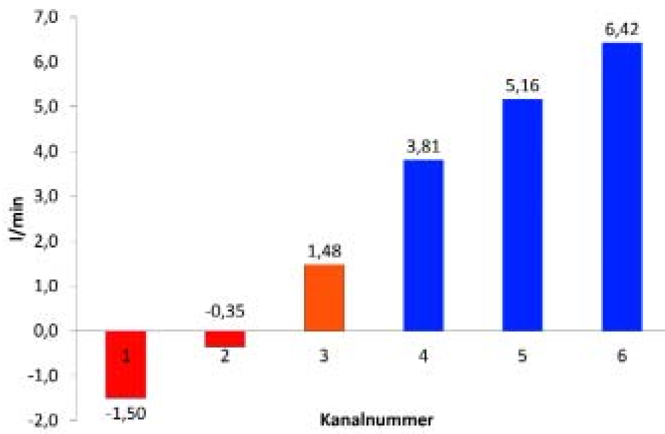


Figure 2: Simulation results for the non-optimized flange. The volume flow in the front ducts (red) shows clearly lower velocity and is inverted.

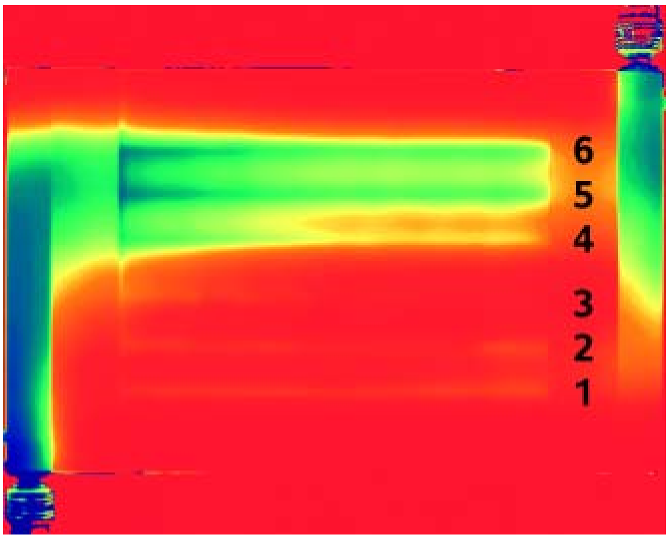


Figure 3: Heat image 5 seconds after the cooling starts (non-optimized flange). There is a clear preference for the rear ducts (5 and 6).

The first step was to use a section of the separate optimization of the feed and return lines in the middle of the cooling plate, transverse to the cooling ducts. This "golden" cut, considered a neutral level, would then receive the same amount of water per time unit from each coolant duct. However, this approach clearly restricted the degrees of freedom because it excludes the option of mutual compensation between feeder and return line. In addition, the return line's geometry impacts the flow distribution significantly less than the feeder line's geometry. Therefore, individual sections were not analyzed, but whole design was considered.

In the following steps, the primary objective was to homogenize the flow velocity upstream and downstream of each branch. The easiest way to achieve this was to adjust the cross-sections while taking into account these could actually be physically produced. The result was a design that showed a very even distribution without any backwater. Time to subject the simulations to a realistic measurement…

From simulation to measurement

The familiar restrictions of FEM may lead to partially incorrect calculations and/or imprecisions which may turn very large after a number of iterations. Therefore, a test under realistic conditions is advisable for validating simulation results. Using the existing CAD data made it easy to produce flanges milled out of a solid blank – that was the easy part. This changed when it came to selecting the measuring technology. Starting from three available methods:

Flow metering, Measuring the pressure drop and Z_{th} measurement, we initially opted for method two because it promised to have the least impact on the flow scenario in the test setup. The fixed correlation of pressure difference, temperature, cross-section and flow rate makes this method preferable which can then be used to calculate the flow rate (neglecting any temperature changes).

Unfortunately, this turned out to be far from trivial: Vibrations in the differential pressure measurement made measuring the low pressure drop precisely impossible. Flow metering was still not an option due to the presumed impact (the return flange would have to be replaced by one flow sensor for each coolant duct). Therefore, a different measurement method had to be found.

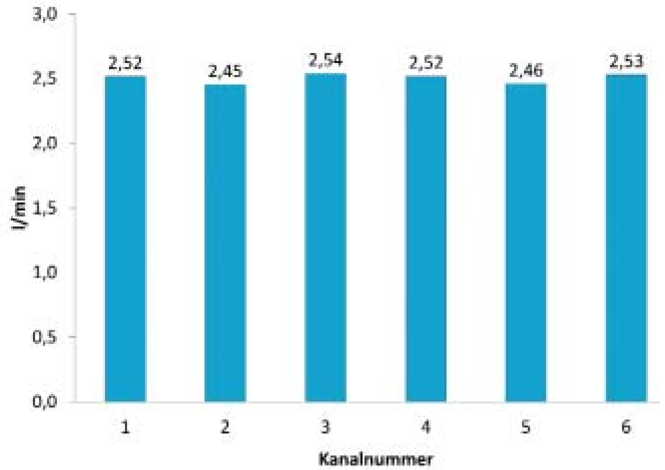


Figure 4: Volume flow in the optimized flange (in simulation). Almost identical throughput in all ducts.

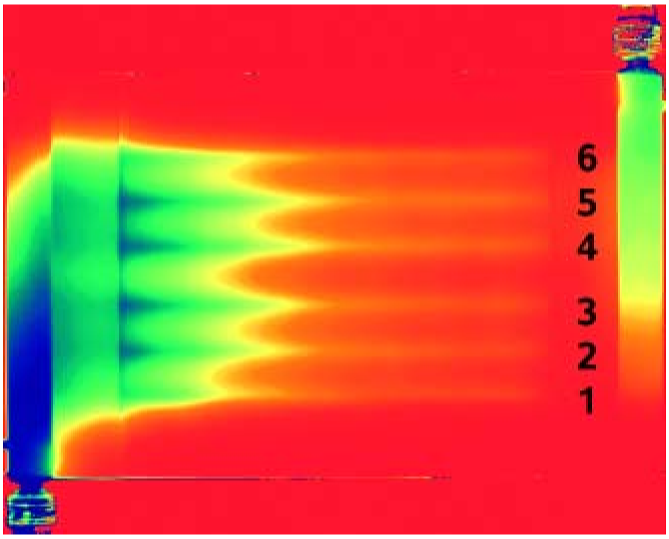


Figure 5: Heat image 5 seconds after the cooling starts (optimized flange). Symmetrical front can be seen spreading.

Sophisticated heat imaging

In practice, the differential pressure measurement was little encouraging. This was the right time to look for an alternative measurement method. This possibility came along in the form of a brand new high speed thermal imaging camera. The device possesses an indium-antimonite detector which is cooled down to 77K (Sterling cooler), a 20mK thermal resolution (at 1ms integration time) and 640x512 pixels at 14bit depth resolution. In full-screen mode, it's possible to record approximately 100 images/s. Perfect reasons to thoroughly test the camera and to film a horizontal cooler plate heated up to 95° while suddenly sending cold water through it (25°C).

The result was stunning due to its great detail, and it confirmed the previous simulations. Figure 3 shows an infrared image five seconds after the coolant started flowing. A strong asymmetry prefers the two rear ducts (5 and 6) while at the same time neglecting the front channels. The evaluation of the 30-second clip shows a backflow in front channels 1 and 2. This was of course to be expected due to the Venturi effect, yet we were surprised by its rather great severity (figure 2). In practice, this circulation will lead to absolutely insufficient cooling of the first ducts in particular (1 and 2) since these ducts only receive already warm backwash.

Figures 4 and 5 provide the answer to the resulting, and exciting, question of the optimized version's effectiveness: an even front of coolant spreads throughout all channels from the left to the right. The film's analysis shows no circulation (neither did the simulation). The stationary shot shows a very homogenous temperature distribution throughout the cooler plate.

Comparing both snapshots (5 seconds after start each), one might recognize a presumably better coolant throughput in the non-optimized flange. This misconception results from the lower effective flow resistance of ducts 5 and 6 in relation to the entire design. Comparing the totals of both versions, there is no difference in throughput.

Conclusion

The flow-optimized flange in the feeder line provides a significantly more even dissipation of heat in the cooler plate. This can be impressively demonstrated by using a high-speed precision infrared camera. The improved heat dissipation will lead to a lower temperature gradient within the modules, thus increasing total life expectancy.

Compensatory measures, such as increased heat spread, e.g. by a thicker metal layer on top of the coolant ducts, of extremely conductive materials, such as copper, lose a good portion of their purpose due to the optimization.

Stefan Schuler is a developing engineer at SEMIKRON
stefan.schuler@semikron.com

Konstantin Lickey is a graduate student at SEMIKRON
konstantin.lickey@semikron.com

www.semikron.com

Fuji Electric Europe GmbH
Goethering 58 · 63067 Offenbach am Main · Germany
Fon +49(0)69-66 90 29 0 ▸semi-info@fujielectric.de
Fax +49(0)69-66 90 29 56 ▸www.fujielectric.de
Products Overview ▸www.fujielectric-europe.de/info/overview.pdf

Usage of Computer Modeling in Production of Power Semiconductor Devices

By A. A. Pisarev (Proton-Electrotex JSC)
and S. I. Matyukhin (State University – Educational R&D Complex)

Relevance of adaptation of computer modeling in production of power semiconductor devices.
Production of power semiconductor devices (PSD) nowadays is one of the most developing directions in world electronics. During production of PSD lot of strict and certain requirements should be taken into consideration.
Production of PSD is not global as for example production of microelectronics, though nomenclature is quite wide. Most of devices are produced in small lots with special customer requirements.
To ensure these requirements development of flexible production system is required, i.e. production adapted for fast delivery of special orders in big and small lots. Such flexible production system is successfully implemented in Proton-Electrotex JSC Company (in more details – in article by Alexander Stavtsev “Modern Production of Power Semiconductor Devices – Flexible Production”, Bodos Power Systems, February-2012.

In this regard the following questions occur:
- provision of production with necessary materials;
- achievement of PSD characteristics in accordance with special requirements of customer.

If production is flexible and adapted to a certain customer this doesn’t mean that procurement of materials and production start right after order, because this will lead to apparent increase of complete production cycle. To optimize production time Proton-Electrotex JSC studies the market for devices planning special types of silicon, normalizes silicon rated values, develops sales forecast. All of these enable to have all necessary materials on stock and intermediate goods on production site, and complete orders in short terms. Moreover, ERP-system of recordkeeping and production forecast is successfully implemented into production process (in more details – in article by Peter Semenov “Practical Experience of ERP-System Implementation in Power Semiconductor Manufacturing”, Bodos Power Systems, July-2011).

However, question of securing necessary electrical, thermal, mechanical and reliable characteristics of PSD is still open. Technical specialists from Proton-Electrotex and other institutes, who deal with problems of power semiconductor electronics, have a lot of theoretical knowledge, analytic dependences, characteristic peculiarities acquired during production of PSD. Nonetheless, at present it’s quite obvious that all these data is not enough to quickly follow and react to constantly growing demands of real production.
All too often there are no evaluation methods of characteristics dependences of complete devices on technological peculiarities of their production and deviations of conventional technological process, or they do not have the required result, which could correspond to reality.
Due to that it’s necessary to rely on analytical dependencies or produce sample lots while designing devices according to special requirements of the customers. However production of samples leads to substantial increase of lead time, and in some cases it’s even impossible to do. Usage of analytical dependencies while solving this question can lead to unexpected results. Developing flexible production adapted to certain requirements of the customers, these factors should be totally excluded.

That is why on a certain development stage of production of power semiconductor electronics necessity in additional tool occurred, which made possible:
Quickly and efficiently analyze dependences of characteristics of devices on technological features of their production, departure from technological process and operating modes;
Get an idea of physical processes happening in semiconductor element and changes of main physical values in time.
At the moment such tool is computer instrumentally technological modeling, which became available due to rapid development of computers.

Review of types of numerical schemes of power semiconductor devices in computer modeling.
Using computer modeling numerical schemes should comply with the following conditions:
- Display with required accuracy characteristics of PSD in wide range of voltage, current and temperature;
- Correctly display connection between characteristics and physical processes (or characteristics of technological modes);
- Consider static scattering of physical parameters over the surface of the element and uneven effects for PSD with big surface.

Models of PSD can be divided into technological, physic topological, and electrical.

For technological model diffusion characteristics and their modes are initial (temperature and diffusion time, diffusant concentration and so on). Moreover, characteristics values received after certain diffusion processes can be used (surface resistance, breakdown voltage of p-n-junction).
Output parameters of technological model are physical parameters of semiconductor element such as junction depth, surface concentration, holes and electrons lifetime after diffusion processes. Technological models are used to optimize technological process and to achieve initial data required to create physic topological model of PSD.
Physic topological model is the basis for automated projecting of PSD, because it describes direct dependency of physical parameters of semiconductor element on technological features of its production. The initial here are the geometrical dimensions of PSD, physical

specifications of p-n-junctions and layers (concentration of dopants and its profile, carrier lifetime, charge carrier mobility and so on). Geometrical dimensions are defined by mask layout, bevel profile of semiconductor element, thickness of wafer and p-n junction depth. Output characteristics are electrical, such as break-down voltage of p-n junctions, leakage currents, volt-amps diagram, current capacity in conductive state and others.

Electrical model is used for automated projection of converter schemes. The initial characteristics of this model are output characteristics of physical and topological model. Electrical models are built on basis of more simple physical representations comparing to physical and topological models.
Based on that we can say that in production of PSD technological or physical and topological models can be used.
However, since on a definite production of PSD there are certain peculiarities connected with production culture, equipment, microclimate, then the target output characteristics of technological model can mismatch the tested output characteristics. That is why usage of technological model is limited.
Physical and topological model as output characteristics can use not the tested physical parameters, but experimental values of production, which have certain technological conditions.

Usage of physical and topological model is the most reasonable for applying in PSD production.
Physical and topological model of thyristor is used for analysis and synthesis of semiconductor element.
Analysis is calculation of electrical characteristics. These are break-down voltage of p-n junction, switching voltage, volt-amps diagram, turn-on and turn-off times and other characteristics. Calculation of overheating temperature in different modes, which enable to define tolerable power losses, surge current and di/dt durability are very significant.
Synthesis of semiconductor element comes to calculation and optimization by target technical requirements of basic structural parameters (dimensions and physical characteristics of silicon wafer, structure of gate electrode). These results are used to get topological drawings or photographic masks.
At present there are no instrumental technological computer modeling software, which can satisfy the requirements of PSD synthesis.

Types of physical and topological models of power thyristors.
There are the following types of physical and topological models of PSD:
1. Two-dimension physical and topological model. To produce it two-dimensional scaled-down model is being prepared, and the electrophysical results of this model are multiplied by dimension factor.
2. Quasi 3D physical and topological model. To produce it cross-section view of full size or scaled-down model are being prepared, and then it is being transmitted about the symmetry axis.
3. Physical and topological model, which consist of one or several emitter shorts.

Two-dimension physical and topological model distorts topology of metalized electrodes, prevents considering technological diversion. Such model for computer modeling of thyristors is not acceptable, because it doesn't allow precisely simulating the turn-on processes,

receiving volt-amps diagrams in on- and off-states, turn-off dynamics and other effects connected with distribution of turn-on state and discharge of reverse recovery charge.
Quasi 3D physical and topological model with following transmission about the symmetry axis allows setting correct geometry of metalized electrodes in cases, when gate electrode and regenerating area of power thyristor are cyclic. However, within the range of this model tracking the technological diversion is impossible as well. This prevents studying temperature stability of switching voltage in off-state during direct turn-on, dv/dt stability, influence of different technological characteristics on turn-off time.

This problem can be partially solved by physical and topological model, which consists of cylindrical area with r0 radius including one emitter short. Radius r0 approximately equals half the distance between the centers of the adjoining emitter shorts. This emitter short influences only the specified area of semiconductor element, and other similar areas are influenced by other emitter shorts. The specified area of semiconductor element can be considered as independent p-n-p-n structure with one emitter short. Behavior of this area under different influences is the same as in all other areas, and consequently, same with the whole structure.

In this case emitter short of such semiconductor structure is local gate electrode, through which it is possible to switch the thyristor. This allows to analyze volt-amps diagram during reverse turn-on, volt-amps diagram during direct turn-on in off- and on-states, study the processes of turn-on and turn-off within the range of this local structure. However due to absence of main gate electrode and regenerating area in this model, study of influence of geometry of these electrodes on dynamic characteristics is impossible. And this question is very significant for modern production of power thyristors. Also due to the fact that all local areas with one emitter short are equal, it is impossible to study the influence of dimensional effects on characteristics of power thyristors, and this is a very significant question due to constantly growing diameter of semiconductor elements. As a resolution to this question, 3D physical and topological models of PSD can be used.

Instrumental technological computer modeling software Sentaurus TCAD.
Instrumental technological computer modeling software Sentaurus TCAD allows to design 3D physical and topological models of PSD on the basis of which electrical, thermal, mechanical characteristics can be calculated, as well as analyze the processes, which occur in semiconductor structure during operation in different modes and circuits.

Main advantages of 3D physical and topological models designed with help of Sentaurus TCAD:
- model is designed with help of language script Scheme, which allows to smoothly change technological peculiarities of production;
- in unaltered model topology of technological diversion and metalized electrodes, which allows to study their influence on dynamic characteristics;
- model allows to achieve distribution of physical quantities in semiconductor element, which gives an opportunity to study processes, which go inside during operation, and also study influence of dimensional effects.

In Sentaurus TCAD software there is a submicroscopic approach to modeling of PSD. This approach is based on numerical calculation of fundamental equations - Poisson's equations (formula 1), continuity equation (formula 2), which describe the processes and behavior of carriers in different (local) areas of device.

$$\Delta\psi = -\frac{q}{\varepsilon}\cdot(p - n + N) \qquad (1),$$

where ψ – electrostatic potential, V;
q – elementary charge, C;
p – hole concentration, cm^{-3};
n – electron concentration, cm^{-3};
N – charge associated with ionized donors, C.

$$\nabla\cdot J_n = qR_{SRH}; \qquad \nabla\cdot J_p = -qR_{SRH} \qquad (2),$$

where J_N – electron current densities, A/m^3;
J_P – charge density, A/m^3.

Alternating considers Shockley-Read-Holl recombination, which is the main recombination process, which uses traps in forbidden zone of semiconductor.

$$R_{SRH} = \frac{np - n_i^2}{\tau_p(n + n_1) + \tau_n(p + p_1)} \qquad (3),$$

where n_i – charge carriers intrinsic density, cm^{-3};
τ_P – hole lifetime, s;
τ_n – electron lifetime, s;
n_1, p_1 – carrier density depending on energy levels of traps, cm^{-3}.

Electron current densities (formula 4), and holes charge density (formula 5) can be expressed in the following way:

$$J_n = -qn\mu_n\nabla\psi + qD_n\nabla n \qquad (4),$$

where μ_n – electron mobility, $m^2/(V\bullet s)$;
J_p– electron diffusion constant.

$$J_p = -qn\mu_p\nabla\psi - qD_p\nabla p \qquad (5),$$

where μ_P – hole mobility, m2/(V•s);
D_P – hole diffusion constant.

Sentaurus TCAD allows working with virtual production. On the basis of virtual production it is possible to analyze the influence of distribution of technological characteristics on instrumental and sheet-oriented characteristics, choose the best solutions from the point of view of yield ratio, and as a result work on boost of production effectiveness of devices.

On the competitive market between manufacturers of PSD, delivery terms and cost of new devices development stage, optimization of the produced devices with peculiar requirements of end customers and technology play a certain role, which is why every modern company cannot do without implementation of instrumental technological modeling.

www.proton-electrotex.com

Enhancement Mode GaN Making Wireless Power Transmission More Efficient

In this article we show that enhancement mode GaN transistors enable significant efficiency improvements in resonant topologies and demonstrate a practical example of a wireless power transmission system operating in the 6.78 MHz range.

By Alex Lidow PhD, CEO; Michael deRooij PhD, Executive Director of Application Engineering; David Reusch PhD, Director of Application Engineering, Efficient Power Conversion Corporation

Resonant Converters

To achieve improved efficiency at higher switching frequencies, resonant topologies may be considered. Resonant topologies are particularly beneficial in DC/DC transformer applications due to the removal of the regulation requirements, allowing the converter to always operate at the resonant frequency. To demonstrate the opportunities enabled by converting from silicon-based power MOSFETs to enhancement mode GaN transistors, we chose the topology as shown in Figure 1 that employed a resonant technique utilizing the transformer's magnetizing inductance (L_M) and resonance of the leakage inductance (L_K), together with a small output capacitance (C_O), to achieve zero voltage switching (ZVS), limit turn-off current, and eliminate body diode conduction [1].

To obtain a direct comparison in performance between GaN transistors and Si MOSFETs in a high-frequency resonant bus converter application, devices with similar on-resistance were selected, the same circuit topology was used, and a similar layout was maintained for both designs. The Figures of Merit (FOMs) of importance in this work are Q_G x $R_{DS(ON)}$ and Q_{OSS} x $R_{DS(ON)}$ due to the soft switching topology that reduces the switching related losses, thereby rendering the FET gate drive and conduction being the major loss contributors. The device output charge has a direct impact on the energy required to achieve ZVS. A reduction in energy required to achieve ZVS can result in reduced dead time, providing a larger power delivery period and lower RMS currents in a high-frequency resonant converter. eGaN® FETs [2] show significant improvements when compared to Si MOSFETs, with the gate drive FOM (Q_G x $R_{DS(ON)}$) having been improved by a factor of approximately 4 and 3 for the 100 V [3] and 40 V [4] devices respectively, while the output charge FOM (Q_{OSS} x $R_{DS(ON)}$) is improved around a factor of 1.6 and 2 for the primary and secondary devices respectively. The eGaN FETs also provide performance improvements in the form of reduced Miller charge that reduces the turn-off switching losses in the primary devices. As a further advantage, the LGA packaging of the eGaN FET has low parasitic package inductance as compared to the traditional Si MOSFET package (SuperSO8). When putting all these benefits together, multi-MHz switching frequencies can be obtained through the use of advanced topologies combined with low-loss eGaN FETs [5].

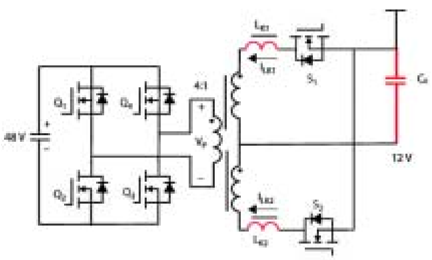


Figure 1: High frequency bus converter schematic.

The experimental switching waveforms for the designs at 1.2 MHz are shown in Figure 2. Both designs have the same magnetizing inductance, built into the transformer via an air gap, to achieve zero-voltage switching during the device off state. Due to almost a factor of 2 decrease in output charge (Q_{OSS}) provided by the primary and secondary eGaN FETs, the ZVS transition is achieved in a proportionally shorter period, increasing the effective duty cycle and improving the overall converter performance. For the Si MOSFET design, the dead time required for ZVS was measured to be 87 ns and the effective duty cycle for each device was limited to 34%. With the faster switching eGaN FETs, the dead time was reduced to 42 ns resulting in a 42% duty cycle for each device while allowing for an extended power delivery period. From the switching waveforms, it can also be seen that the gate drive speed for the eGaN FET is significantly faster than the Si MOSFET counterpart even when driven with a lower gate drive voltage, providing both faster switching speed and reduced gate losses.

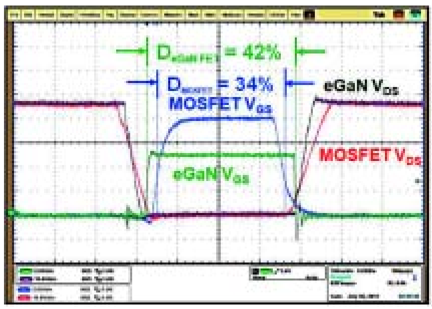


Figure 2: Switching waveforms showing effective duty cycle for primary side eGaN FET and Si MOSFET designs at F_S = 1.2MHz, V_{IN} = 48 V, and I_{OUT} = 26 A.

The comparison in efficiency and power loss between the two designs operating at 1.2MHz is shown in Figure 3. The eGaN FET-based converter offers a one-percentage point improvement in peak efficiency over its Si MOSFET counterpart, resulting in about 25% less power loss. Since products based on this type of design are thermally limited, the reduction in power loss translates directly into higher output power handling capability. In this case, the eGaN FET converter can increase the output power capability by up to 65 W (14W maximum power loss) while maintaining the same total converter loss when compared to the benchmark SiMOSFET design. Assuming an approximate 12 W maximum power loss for both designs, the output power of the eGaN FET-based converter can be increased from 270W to 325W.

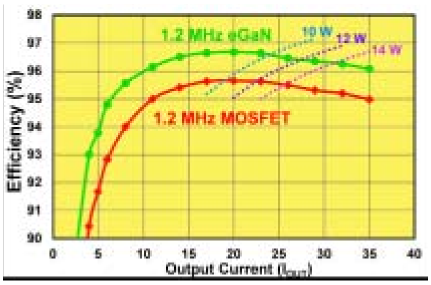


Figure 3: Experimental comparison between eGaN FET and Si MOSFET based V_{IN} *= 48 V,* V_{OUT} *= 12 V,* F_S *= 1.2 MHz resonant bus converters.*

Wireless Power

Wireless power applications are gaining popularity in many commodity products such as mobile phones chargers. Most of the wireless power solutions have focused on tight coupling with induction coil solutions at operating frequencies around 200 kHz, and Class E [6], F and S amplifier converter topologies. Recently, however, there has been a push for operation in the restricted and unlicensed lower ISM band at 6.78 MHz where traditional MOSFET technology is approaching its capability limit. Enhancement mode gallium nitride transistors offer an alternative to MOSFETs as they can switch fast enough to be ideal for wireless power applications. To illustrate the opportunity to improve efficiency, an experimental evaluation was performed for an induction coil wireless energy system using eGaN FETs in a half-bridge topology operating at 6.78 MHz designed to be suitable for multiple 5 W USB-based charging loads. The experimental system was compared to a similar unit based on equivalent MOSFETs in the power converter stage.

The amplifier selected was a Class D converter operating at a fixed frequency. The converter is operated above resonance to take advantage of zero voltage switching (ZVS) and therefore obtain maximum power amplifier efficiency. The smallest 40 V eGaN FET, EPC2014 [7], was chosen because it has a low on-state resistance and low C_{oss} which are factors that will ensure minimum losses. Figure 4 shows a block diagram of the wireless system.

To show what benefits eGaN FETs can bring to wireless energy, it is necessary to compare the performance of the circuit when fitted with

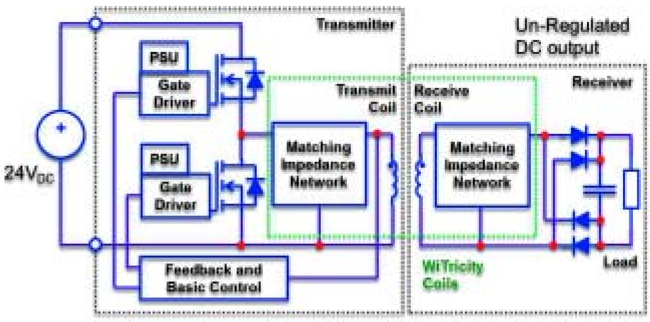


Figure 4: Schematic block diagram of the proposed wireless energy system.

an equivalent MOSFET. The MOSFET selected is a BSZ130N03LS_G [8] and is available in a PG-TSDSON-8 (3 mm x 3 mm) package. It has a very similar RDS(ON) compared to EPC2014 but is only rated to 30 V where the eGaN FET is rated to 40 V.

A demonstration unit was designed and built to evaluate the performance of both the eGaN FET and the MOSFET [10]. The efficiency as a function of output power for both the eGaN FET solution and the MOSFET solution are shown in Figure 5. This graph shows that using eGaN FETs in the power amplifier yields a 4% amplifier efficiency improvement over the MOSFET version (a 24% reduction of power losses) [10].

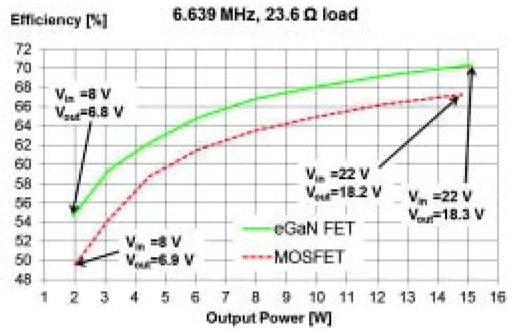


Figure 5: DC in to DC out efficiency (including gate driver power consumption) comparison between eGaN FET and MOSFET wireless boards as a function of output power for a fixed load resistance.

Summary

It has been previously shown that gallium nitride transistors have a distinct advantage over silicon MOSFETS in hard-switched applications [11], but little has been demonstrated about the impact in soft switching converters. In this article, it is shown that eGaN FETs can also provide significant efficiency improvements over power MOSFETs in soft switching resonant converters such as being used in intermediate bus DC-DC converters and wireless power transmission.

References:

[1] Y. Ren, M. Xu, J. Sun, and F. C. Lee, "A Family Of High Power Density Unregulated Bus Converters," IEEE Transactions, Power Electron, Vol. 20, no. 5, pp. 1045–1054, Sep. 2005.

[2] Efficient Power Conversion Corporation, www.epc-co.com

[3] EPC2001 datasheet, EPC, http://epc-co.com/epc/Products/eGaNFETs/EPC2001.aspx

[4] EPC2015 datasheet, EPC, http://epc-co.com/epc/Products/eGaNFETs/EPC2015.aspx

[5] David Reusch and Johan Strydom, "The eGaN® FET-Silicon Power Shoot-Out Vol. 10: High Frequency Resonant Converters", Power Electronics Technology, Vol.38, No.9, September, 2012

[6] W. Chen, R. A. Chinga, S. Yoshida, J. Lin, C. Chen, and W. Lo, "A 25.6 W 13.56 MHz Wireless Power Transfer System with a 94% Efficiency GaN Class-E Power Amplifier" Microwave Symposium Digest (MTT), 2012 IEEE MTT-S International.

[7] EPC2014 datasheet, EPC, http://epc-co.com/epc/Products/eGaNFETs/EPC2014.aspx

[8] BSZ130N03LS_G datasheet, Infineon, www.infineon.com

[9] Witricty Corp. supplied the coils with matching networks. The coil set part numbers are 190-000037-01 and 190-000038-01, www.witricity.com

[10] Michael de Rooij and Johan Strydom, "eGaN® FET – Silicon Shoot-out Vol. 9: Wireless Power Converters", Power Electronics Technology, Vol. 38, No. 7, July 2012

[11] Lidow, Strydom, deRooij, and Ma, "GaN Transistors for Efficient Power Conversion" Power Conversion Publications, 2012, http://www.amazon.com/GaN-Transistors-Efficient-Power-Conversion/dp/0615569250/ref=sr_1_1?ie=UTF8&qid=1328124172&sr=8-1

Low-Cost GaN e-mode Transistors and Diodes

Manufactured on an Integrated CMOS-Compatible 8-Inch Platform

Within the power electronics industry, GaN technology is slowly growing out of its niche. The first GaN transistors are winning a small but growing share of the power electronics market. Underpinning this development, a value-chain is developing between R&D cen-ters, substrate providers, device designers and system integrators.

By Steve Stoffels, Denis Marcon and Stefaan Decoutere, Imec

<Today the market for power devices is still largely dominated by silicon-based designs. But the industry has reached the limits of what it can do with silicon in terms of efficiency and operating frequency. To further improve silicon-based power devices, quite complex 3D architectures are needed.

So the R&D centers and the industry have been looking at alternative materials with better suited properties, such as Silicon Carbide (SiC) or Gallium nitride (GaN) technology. SiC for one, is available only as small diameter and expensive wafers. GaN also is an expen-sive material, but it is possible to grow thin layers of it on inexpensive silicon substrates. And an added advantage is that these wafers may be processed in high-productivity CMOS fabs.

Fabricating suitable large-area substrates, developing a CMOS-compatible flow, and designing superior devices are all considerable challenges. But the outlook is positive, and the growing need for these devices makes for an attractive investment case.

200mm wafers are optimal, but can we make them?
Today, the bulk of the GaN development and fabrication is still done on 6-inch or 4-inch wafers. Considerations of cost efficiency compel us to look at larger wafer sizes, in the first place 8-inch (200mm). But adding to that, the manufacturing platform on 8-inch is much more advanced than on 6-inch or 4-inch. 8-inch equipment is very well supported and innovations developed on 12-inch (300 mm) are in a number of cases even retro-fitted to the 8-inch lines. That means that 8-inch fabrication offers higher productivity, better process control and consequently also a higher yield than smaller wafer sizes.

Imec is one of the R&D centers that has been involved from the start in developing GaN technology. We are one of Europe's premier R&D centers in microelectronics and have actively participated in developing CMOS technology as it is today. We have cleanrooms and state-of-the-art tools for the various wafer formats. So moving GaN from the smaller wafer sizes to 8-inch wafers was a natural step, for which we had the expertise and the tools readily available.

In parallel to our device work on 6-inch wafers, we developed the necessary epitaxy pro-cesses on 8-inch silicon substrates, perfecting the buffer and device layers. The main challenges were growing high-quality, uniform layers, mitigating the stress that develops during the growing processes and controlling the wafer bow. The end result has to be a wafer with extremely uniform device layers that is within the bow specifications that can be handled in the silicon fab.

The stresses that develop are due to the large lattice mismatch between the III-N films (GaN and AlGaN) and the silicon substrate. This has required us to add carefully selected buffer layers between the substrate and the final film, resulting in a wafer bow below ±50µm.

Designing and fabricating devices through collaborative research
With 8-inch wafers ready for 200 fabs added to GaN's superior material properties, it is possible to start designing devices with superior breakdown voltages and lower resistances at a lower price.

To speed up the learning curve and gather all the necessary expertise, imec set up a col-laborative research program. We invited top companies involved in power electronics to do R&D together in imec's world-class 200mm facilities. Today, this partnership includes more than 10 companies setting the specifications and developing this technology. These companies are a mix of device manufacturers, foundries, as well as substrate manufacturers and equipment suppliers.

Our GaN development platform runs on a fully-automated 8 inch pilot line, allowing for fast learning cycles to improve the technology and explore a wide variety of concepts.

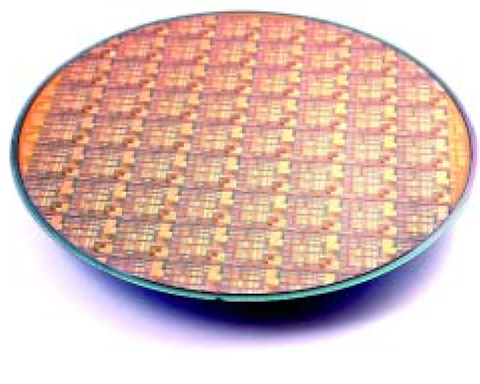


Figure 1: Fully processed 8-inch GaN-on-Si MISHEMT device wafer

We are concentrating on 600V devices, which we think will be a lead driver spec for tech-nology development in power devices. On our test platform we have designed several flavors of devices, which can be tuned towards lower or higher voltages. Some of the companies in our program have a special interest in devices with lower voltage ranges, while a few are looking at voltages going up to 1000 V.

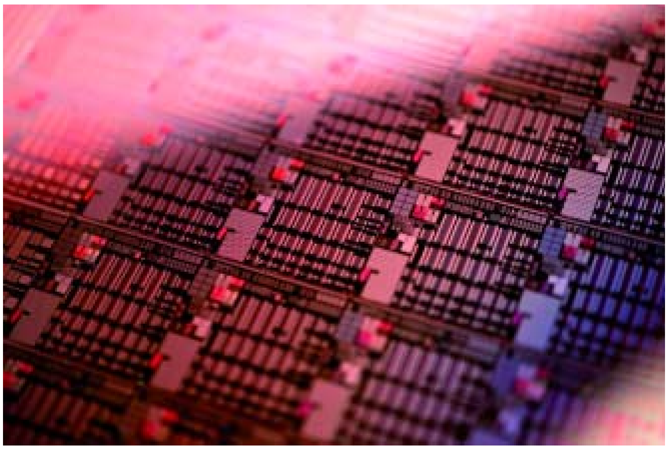


Figure 2: Detail of fully processed MISHEMT device wafer

CMOS compatible processing – access to high-productivity fabs
Our objective is to develop technology that is completely compatible with high-productivity CMOS infrastructure. However, typical GaN device processing requires lift-off metallization schemes using gold (Ni/Au or Mo/Au) to define ohmic and gate contacts. To be compatible, these should be replaced by gold-free metallization schemes, using dry etch patterning instead of lift-off.

However, fabricating gold-free ohmic contacts with a contact resistance below 1.0 ??mm is not straightforward. We have demonstrated a technique that uses AlGaN barrier recess in the ohmic areas, resulting in a contact resistance distribution of 1.25 ± 0.15??mm when leaving ~5 nm AlGaN barrier. We are now investigating how we can further reduce the contact resistance, which is fundamentally important for power devices.

Another concern for CMOS-compatibility is gallium contamination, since gallium is a p-type dopant for silicon. During initial processing test loops on a restricted set of tools, we have observed that the gallium contamination spread from the GaN-on-Si wafers to the transport systems and process chambers of the tools, in most cases exceeding the tolerance limits for gallium contamination. To mitigate this processing contamination, we have developed a cleaning procedure to be applied to the backside of GaN-on-Si wafers. With this procedure, the contamination level is reduced to close to the detection limit.

As a result of these measures and techniques, we can now process GaN-on-Si wafers in between batches of other CMOS development runs, using exactly the same equipment set, without having to make changes. Where we still have to look for further improvements is in the quality of the wafers, in terms of defectivity and uniformity, and also in the throughput of the toolsets. The equipment suppliers in our program are using these development runs as a learning cycle to optimize their hardware for higher throughput and reproducibility.

Making e-mode devices – investigating several approaches
On our platform, we develop both depletion mode and enhancement mode devices. As by nature, GaN power devices are normally-on devices, the challenge is definitely to make enhancement mode, normally-off devices. Our partners in the program have given us the challenge to explore different e-mode architectures side-by-side. That way, they want to identify the one with the highest chance of success that they can transition to manufacturing.

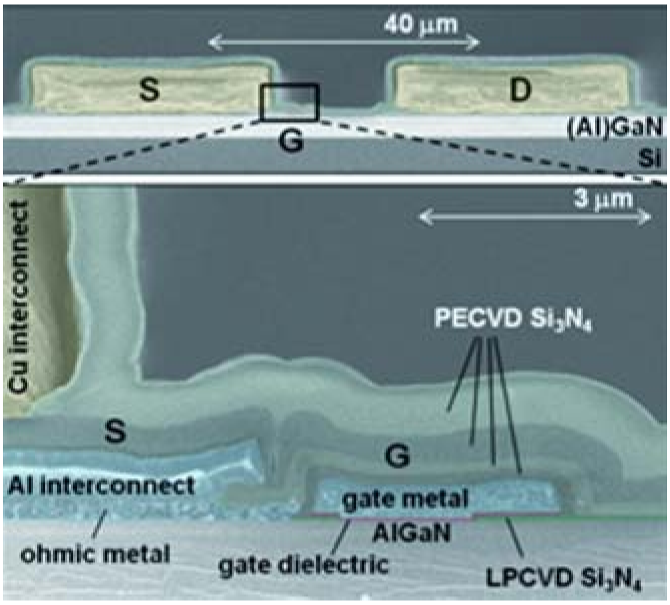


Figure 3: Cross-section SEM pictures of the power device. The top figure shows the source-gate-drain finger configuration, with the 8 µm thick source and drain Cu intercon-nects encapsulated by Si3N4. The bottom picture details the source-gate area: the T-shaped metal gate electrode with the field plate, the gate dielectric, and the metallization stack in the ohmic source area.

Recently, we were able to demonstrate first working e-mode transistors on our 8-inch platform. For these devices, we used a MISHEMT (Metal Insulator Semiconductor High Electron Mobility Transistor) architecture with an isolated gate, to create ultralow leakage GaN transistors. In this architecture, we inserted a gate dielectric between the metal gate electrode and the AlGaN barrier to avoid the creation of a Schottky gate contact, which limits the maximum gate overdrive and reverse leakage current. The maximum output current of these devices is 6 A at VGS = 8 V and VDS = 10 V, which demonstrates the fea-sibility of high current AlGaN/GaN MISHEMT powerbars on 8-inch silicon substrates.

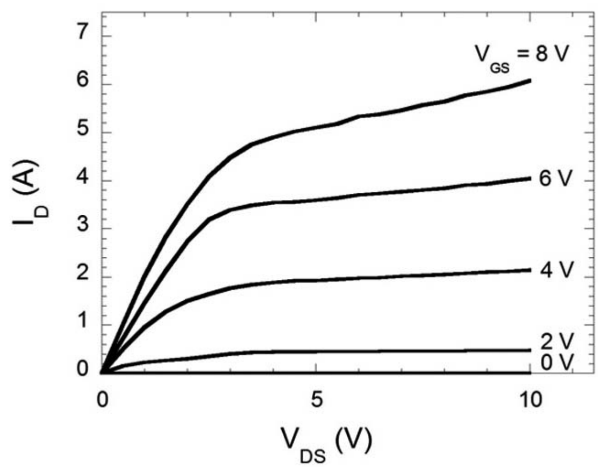


Figure 4: Pulsed ID-VDS output characteristics of an e-mode power device (pulse-width 1 ms), fabricated in our 8-inch technology.

Future plan for diodes and exploration of other concepts

Our current work involves improving the key parameters of the devices we have devel-oped on 8-inch technology. Previously, we have processed devices on 6-inch with a max-imum output current of 8 A, a breakdown voltage of 750 V, a specific on-resistance of 2.9 m??cm2 and an off-state drain leakage at 600 V of 7 µA. There are no obvious barriers to obtaining these specs also with 8-inch pro-cessing.

Moreover, we are further investigating the varying concepts to reach e-mode operation. Each of these concepts will be analyzed to deter-mine which has the best overall perfor-mance for reliable, high volt-age, high current e-mode operation in a cost effective industrial plat-form.

In addition, we also look to monolithically integrate diodes together with transistors in the same process flow. This will allow the creation of a full monolithic GaN solution for inte-grated half bridges on a sin-gle die, further reducing the costs for high efficiency GaN DC-DC convertors.

www.imec.be

Efficiency Improvements in 3-Phase, PWM, Voltage-Source Inverters

New circuit techniques will allow major increases in PWM frequency and power for three-phase inverters and enhanced power quality.

By Donald Partridge, 1MT LLC, Apple Valley California

This article introduces the following three significant improvements in 3-phase PWM voltage-source inverters (VSIs) allowing low-cost increases in efficiency, power or PWM frequency.

1) 90% reduction in switching losses(“LHS”)
2) 150% increase in output power with just control logic changes to an existing standard 3-phase PWM system (“OPWM”).
3) very low cost single-IGBT 3-phase PFC circuit with less than 0.5% THD that can be run isolated with little added cost. The circuit can also be used as a Solid State Circuit Breaker when there is a fault from which the inverter would otherwise not recover.

The improvements are described in the following three sections.

First Improvement – Low-loss Hard Switching [1]
Low-loss Hard Switching (LHS) is an economic circuit technique for reducing inverter switching losses to about 10% of conventional hard-switched losses. This is achieved by briefly reducing the DC-link voltage to 10% of nominal value during the inverter commutation phases by a three-terminal insertion network shown in Fig. 1. It should be noted, that the operation of LHS does not transfer losses to the Black Box but reduces them by 90% and is compatible with 4-quadrant operation. The three-terminal network requires a low-cost, co-axial air-core autotransformer and standard semiconductors [2].

The network serves as a dynamic inductive potential divider to reduce inverter voltage during commutations, reducing switching losses by 90%. This can lead to a ten-fold increase in carrier frequency for a given power or a doubling of inverter power for a given frequency, depending on the device technology: with a 300Hz carrier, 4.5kV IGBTs can run at 1.6 times higher power while IGCTs can run at 2.5 times the power of the original inverter. At 2100Hz, power increases by nearly 4 times for IGBTs and over 5 times for IGCTs.

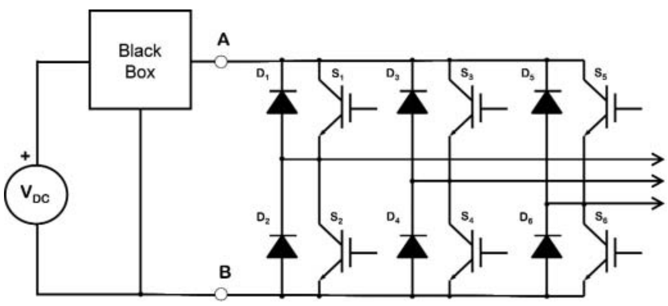


Figure 1: Black Box representation of the insertion network for LHS

The cost of the loss-reduction circuit at 2800 volt 1MW is approximately USD2500 for increased power at constant frequency. In a 600 volt 1MW system the cost is USD500.

Description
The Black Box of Figure 1 is so designed as to modulate the input voltage to the inverter (the voltage across Terminals A and B) per Figure 2.

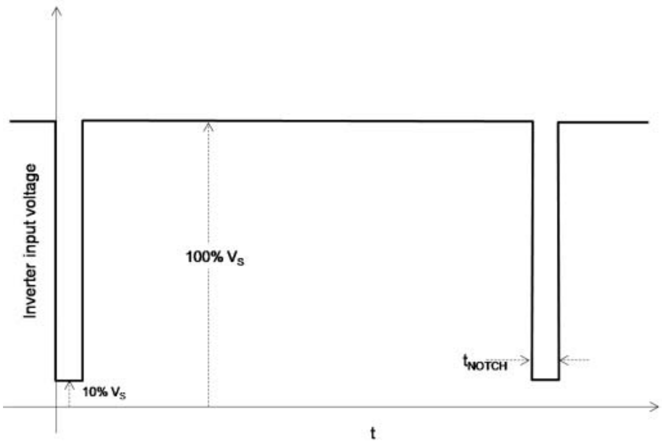


Figure 2: Input voltage to the inverter (across Terminals A - B) with LHS operation

The DC voltage is cyclically reduced to 10% of its nominal value during each inverter commutation. During these low voltage "notches" or "blanks", each inverter commutation is effected, be it ON or OFF, for all square-wave or PMW modes.

Single-shot investigative measurements on a 2.5kV/1200A IGBT [3]
The development of LHS was predicated on the observation of the switching loss dependence on voltage on the above-referenced device tested at 10% of its normal DC voltage (i.e. at 120V). The choice of 10% was not arbitrary but was found to provide an optimal value for reasons beyond the scope of this article.

For a switching voltage of 120V during commutation, the following results were obtained:

1) turn-on losses of the inverter switches reduced by ≈ 93%
2) turn-off losses of the inverter switches reduced by ≈ 70%
2) turn-off losses of the inverter diodes reduced by≈ 99%.

In a recent publication, a low voltage inverter was shown by calorimetry to have 80% lower switching losses [4].

Principle of Operation

The black box of Figure 1 has many variants of which only two are shown here. In all cases, the operating principle is that of potential division and the variants use different techniques to either recover the stored inductive energy (preferred for increased PWM frequencies) or to dissipate it (optional for increased o/p power).

Figure 3 shows a very simple variant for increasing power at low frequency. When the auxiliary LHS switch is on, the inverter DC voltage falls to one tenth of VDC determined by the 9:1 turns-ratio of the choke. When the switch is turned off, current stored in the 9-turn section free-wheels through D1 and R1 which dissipates the trapped magnetising energy prior to the next commutation.

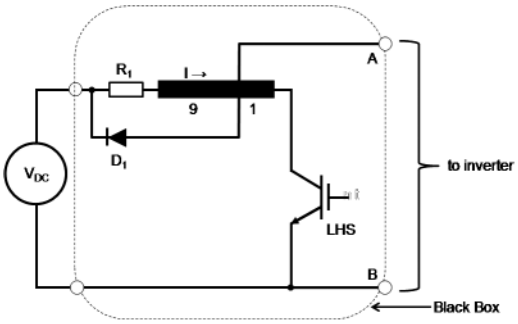


Figure 3: One of many "Black Boxes"

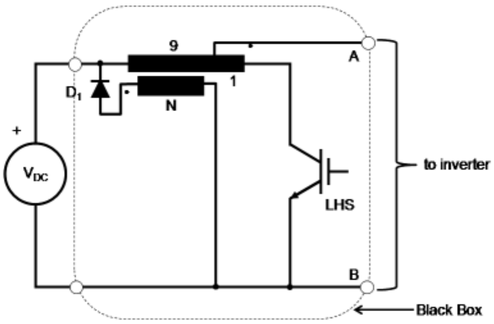


Figure 4: Black Box version allowing trapped energy to be returned to the source at no-load and forwarded to the load at full-load

Figure 4 shows a more sophisticated arrangement whereby the trapped magnetising energy is returned to the VDC source, as would be preferred in an HF application. With this circuit there is an overvoltage of about 20% (for N= 45) during diode conduction which restores the full average DC voltage as seen by the inverter. The circuit of Figure 3 is best suited for lower carrier frequencies.

The basic operation of Figure 3 is described below.

When the LHS switch is on, the voltage across the 1-turn of the autotransformer is 1/10 of the input voltage; this is the voltage across the 3-phase inverter at which commutations occur.

At no-load to full-load, with the LHS switch on, current flows in the series circuit comprising the DC source, the 9-plus-1 turns of the autotransformer and the LHS switch. When the LHS switch turns off, current flows in the 9-turns of the autotransformer and diode D1 and R1. The current in the 9-turn section, after turn-off of the LHS switch, will be 1.11 times the previous current in the LHS switch.

The LHS switch operates at 3 times the carrier frequency with a fixed pulse-width. On starting, the current in the 9-turns of the autotransformer is zero but rises with each successive pulse until the positive volt-seconds on this winding with LHS switch on, is equal to the negative volt-seconds across it due to the current flowing through diodes D1 and R1, with the LHS switch off.

The notch time is chosen as a function of the stray inductance in the inverter and the switching times of the inverter semiconductors when commutated at 10% of the DC bus voltage. The power loss in R1 is a function of carrier frequency and notch time for a given magnetizing inductance and DC link voltage:

DC volts	Carrier frequency	Notch time	Power loss in R1
1000V	1500Hz	2us	0.88%
2800V	750Hz	4us	0.88%
2800V	1500Hz	4us	1.76%

Second Improvement - Optimised PWM

The second improvement results in a 33% increase in output voltage with only control logic changes to an existing standard 3-phase PWM system ("OPWM"). There are three parts to this improvement. Firstly, a 3-phase PWM method is developed whereby the inverter switch with the most current in it is not turned off at the end of the carrier cycle and only the two other inverter legs are switched [1], [2]. This not only significantly reduces the switching losses of the inverter (both with and without LHS) but also allows the peak of the fundamental component to attain 100% of VDC for unity modulation index (m = 1) as opposed to only 86.6% of VDC for conventional PWM thus producing a 15% increase in output power without "over-modulation" (OPWM1). The inverter output waveforms and the IGBT current waveforms are shown in Figure 5 and Figure 6 for conventional and "low-loss" PWM respectively, from which it can be seen that the output waveforms are identical despite the fewer commutations of Figure 6.

Secondly, the addition of a third harmonic in the reference signal raises the fundamental line-line voltage by a further 15% whilst not appearing in this voltage but only in the line-neutral voltage (OPWM2).

The combination of the two techniques (OPWM) increases the output voltage and hence power of the inverter by 33% for the same DC link and current [1], [2].

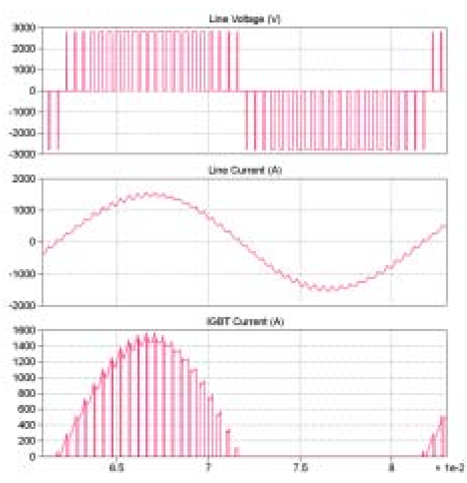


Figure 5: PLECS simulations [5]

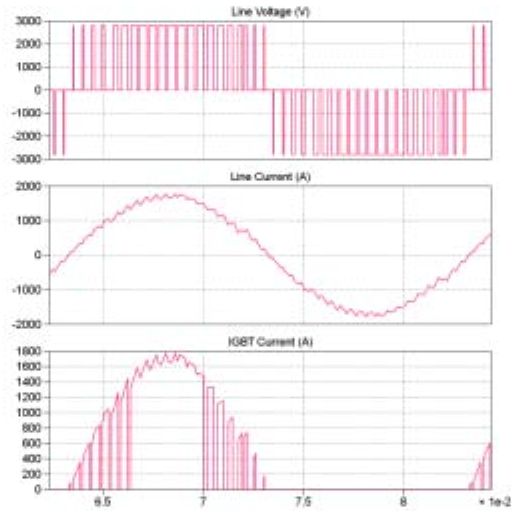


Figure 6: Simulations

Thirdly, the absence of commutations (from 60° to 120°) apparent in Figure 6, reduces the switching losses by 50%. Thus, assuming that static and dynamic losses are roughly proportional to current, in a system which formerly operated at 50/50 static and dynamic losses, the o/p power could now be increased by 33% so that the combined power increase would be 1.33 x 1.33 = 1.77 or 77%.

Combined LHS and OPWM

LHS has been calculated to allow an overall 90% switching loss reduction in MV inverters [2] and measured to allow an 80% switching loss reduction in LV inverters [4].

This affects system efficiency but the maximum power which can be obtained from a given inverter is usually determined by the active switch (IGBT or IGCT).

In an MV IGBT inverter, again with a 50/50 static/dynamic loss ratio, combining LHS with OPWM can result in an increase in power by a factor 2.5 and much more where the dynamic losses are greater than the conduction losses.

Example of 1 MW LHS Design (Figure 3)

The following is a 1 MW, 2-level, 3-phase inverter design with a peak inverter output current of 1000 amps and a 1000 volt DC link using the circuit of Figure 3. This design holds the losses in R1 to 0.88% of the load power. The notch time is set to 2µs, the modulation index is 1 and the carrier frequency is set to 1.5 kHz (LHS frequency with OPWM = 3 x 1500 = 4500 Hz).

Ordinarily, using a standard 3-phase triangle/sine-wave modulation approach, the maximal inverter power would be 750 kW but using OPWM, we obtain 33.3% more output voltage than with the standard 3-phase triangle/sine-wave modulation approach and thus obtain a 1 MW output for the aforementioned 1000 A peak current.

The basic design criteria here is to have the current in the 9-turn section of the autotransformer (Figure 3) greater than 1000 amps (the maximum peak current of the inverter) whenever the LHS switch is off. Under these conditions the LHS insertion network looks like a 1.5 volt source in series with the DC link and has no effect on the load dynamics.

The physical size of the 9/1 co-axial air-cored autotransformer is the same as a 9 turn 7?h air-cored inductor rated for 1000ADC [2]. The leakage inductance of the autotransformer is only about 7µH because of the coaxial construction so that the overshoot voltage on the LHS switch at turn-off is primarily a function of the connection inductance of the DC source, the autotransformer and the LHS switch.

The trapped energy at each LHS commutation is a function of the autotransformer inductance (7µH), carrier frequency and the notch-time resulting in a steady dissipation in R1 of Figure 3 of about 8.8 kW which is constant and independent of load.

There are several ways of fully recovering this power, of which Figure 4 is just one of many variants [2].

Summary of LHS and OPWM

These techniques allow a greatly increased SOA of the inverter devices: commutations occur at the attenuated voltage during normal operation and during all fault conditions with fault current limitation for the inverter (very slow rise of fault current) allowing active turn-off of devices during the fault since it occurs at only 10% of the DC voltage.

The benefits of LHS and OPWM are summarised in Figure 7 for 4.5kV devices in 2-level inverters based on simulations with manufacturer's datasheets.

The LHS topology is a means of separating the switching from the conducting functions of semiconductors which are usually designed to achieve a compromise between acceptable dynamic and static losses. The LHS switch is chosen as a low EOFF device which may have a very high on-state (silicon carbide?) and the main devices are then chosen to have very low on-states which further increase's the power from existing inverters.

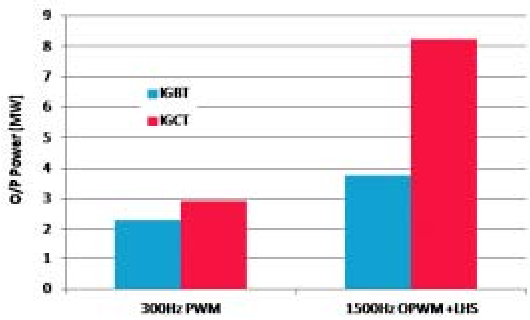


Figure 7:Comparison of 2-level inverters based on 4.5kV IGBTs/IGCTs with 2.8kV DC-link [2]
(PLECS [5] thermal simulations with ABB devices 5SNA 1000G450300 and 5SHY 55L4500)

Because the inverter devices switch at low voltage, there are no significant overvoltage transients to contend with, allowing full and cost-effective use of the device (static) voltage ratings.

With the growing demand for power conditioning at transmission and distribution levels, the need for HV devices (e.g. 10kV) will increase. The switching difficulties with HV devices (SOA, losses, diode snap-off) disappear with LHS because commutations occur at low voltage, even under fault conditions.

With LHS, the bulk of the remaining switching losses are the tail losses of the active switch which could only be eliminated using dual-gate devices. This becomes attractive where both very high frequency and voltage are required as it would lead to almost 99% switching loss reduction allowing a ten-fold increase in carrier frequency or a significant increase in power.

Third Improvement - Low–cost, Low THD 3-Phase PFC Circuit
In this development, the basic circuit has 1 IGBT and 9 or 11 diodes (including the 3-phase bridge), depending on the version used. The switching frequency of the circuit is of the order of 35 kHz. None of the diodes have any current in them when commutated off. The basic circuit also has 3 capacitors and 3 small inductors. No other parts are required. The circuit can be run isolated or non-isolated with little difference in costs. The new topology has less than 0.5% THD.

The single-phase version of this concept contains 1 IGBT and 5 diodes.

Important Advantages of Regulated PFC Circuits
A very important advantage of a regulated PFC circuit is the increase of 30-50% of inverter output power due to the regulated (constant) output voltage i.e. it is not necessary to design for full power at low input line voltage as the output voltage of the PFC circuit is set to the maximum voltage for which the inverter is designed.

In combination with LHS (i.e. – switching at 10% voltage normally and under all fault conditions) the DC bus voltage can be raised to the value determined by the acceptable cosmic ray failure rate because there are no longer any SOA or switching voltage-transient limitations.

Another significant advantage of this PFC circuit is the much lower cost of 35 kHz transformers over line-frequency transformers where isolation is required.

The last significant advantage is that this PFC circuit can be used as a Solid State Circuit Breaker (SSCB) when there is an inverter fault.

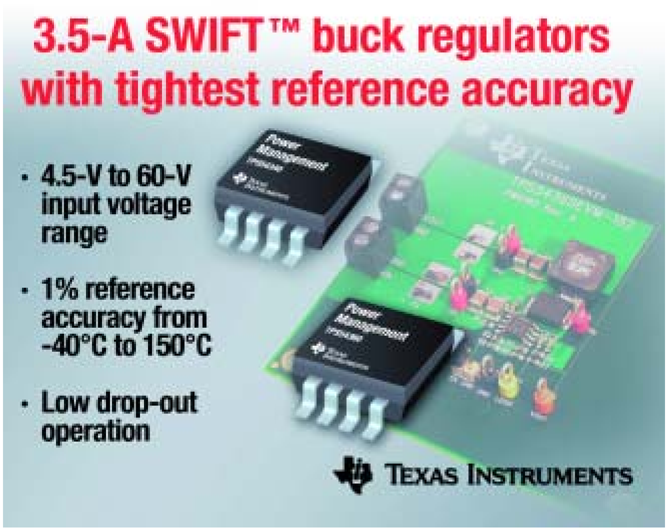
Summary
Three loss-reduction circuits have been presented, all of which are available for purchase from the author. Additionally, using other switching loss-reduction techniques, a very low-cost resonant Induction Heating that runs from 1kHz to 1MHz using a single IGBT, is also available [6], [7]. Combined with the aforementioned PFC circuit, low cost DC-side isolation is additionally achieved.

Further explanations and copies of references [2], [4] and [6] can be obtained from the author at: dPart5837@aol.com.

References:

[1] US patent 7,417,409 B2
[2] LHS White Paper
[3] ABB IGBT type 5SNA 1200E250100, Datasheet Doc. No. 5SYA 1557-02 July 04
[4] Method for reduction of switching losses in an IGBT Inverter, S.Geissmann, D.Partridge, E.Carroll, M.Rahimo, U.Schlapbach, R.Schnell, F.Jenni, PCIM Nuremberg, 8 – 10 May 2012
[5] Piecewise Linear Electrical Circuit Simulation, www.plexim.com
[6] Universal Induction Heating Power Supply White Paper
[7] US Patent # 7,733,067 B2

DC/DC Converters Integrate 60-V Power MOSFET



Texas Instruments Incorporated introduced two 3.5-A step-down DC/DC converters with an integrated MOSFET and industry-leading reference accuracy of one percent. The SWIFT™ 60-V TPS54360 and 42-V TPS54340 buck regulators operate over a wide input voltage range and the industry's widest temperature range for high-performance industrial, consumer, computing, communication and automotive applications. Using these new products together with TI's WEBENCH® online design tool can simplify and speed the design process. For more information and samples, visit www.ti.com/pmp-tps54360-pr-eu. Watch a video demonstration at www.ti.com/pmp-tps54360-prv-en.

The TPS54360 and TPS54340 join TI's family of Eco-Mode™ SWIFT DC/DC converters that operate over a wide input range with low operating and shutdown quiescent current. The family also includes the 0.5-A, 42-V TPS54040A and 1.5A, 60-V TPS54160A that feature precision enable threshold for adjustable under voltage lockout. For more information on all of TI's SWIFT converters, visit

www.ti.com/swift-pr

RAD-Hard Ultra-Low Dropout DC-DC Voltage Regulators for Space Applications

International Rectifier has introduced a series of high current, ultra-low dropout (ULDO) RAD-Hard hybrid linear voltage regulators avail-

able in Standard Microcircuit Drawings (SMD) for space applications including satellites and launch vehicles.

The new Defense Logistics Agency (DLA), Land and Maritime certified voltage regulators are also included in IR's Radiation Hardness Assurance (RHA) program certified by DLA Land and Maritime division (formerly DSCC) that guarantees the devices' radiation performance down to the component level.

The space level screened devices, designed for point-of-load and post DC-DC power conversion, offer a low dropout voltage of only 0.4 V at full 3 A load. They are available in two industry standard package styles, a 5-pins MO-078AA and an 8-pins flat pack, each with multiple lead bend options. The new regulators feature a Silicon On Insulator (SOI) CMOS Regulator IC, latch-up and SEU immunity with LET of 84 MeV.cm2/mg, as well as outstanding TID rating of 300 Krad(Si) and ELDRS testing in excess of 100 Krad(Si) with negligible effect on regulation tolerance. In addition, the devices provide fast transient response, timed latch-off over-current protection and internal thermal protection, and on/off control via shutdown pin.

www.irf.com

High-Temperature N-Channel MOSFET Transistor 80V / 1A

CISSOID, the leader in high-temperature semiconductor solutions, introduces the CHT-NMOS8001, the latest member of its EARTH family of general purpose transistors.

The CHT-NMOS8001 is an N-channel MOSFET guaranteed for operation from -55°C up to +225°C. It is available in a tiny thin dual flat pack (TDFP) hermetically-sealed Ceramic SMD package, as small as 5x5.5mm (PCB footprint).

This transistor is capable of switching a current up to 1A (continuous) or blocking a voltage up to 80V with a drain cut-off current as low as 10uA at 225°C. In repetitive pulse conditions, it is able to handle peak currents up to 3.3A at 225°C.

The NMOS8001 is a logic-level device, i.e. it can be directly driven by a 0-5V logic signal.

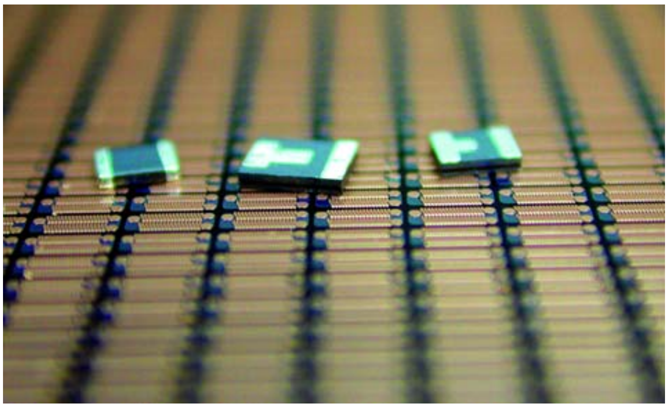
The gate is protected by anti-series diodes, with ESD rating up to 2KV HBM, allowing a negative gate-to-source bias which gives more flexibility to circuit designers.

With a static on-state resistance (RDS-ON) of 0.76? at 25°C (1.56? at 225°C) and a total switching energy of 413nJ (at 40V/1A), the CHT-NMOS8001 offers a perfect trade-off between conduction and switching losses for current switching in the range between 100mA and 500mA, e.g. in low-power low-voltage Flyback DC-DC converters.

www.cissoid.com

Thin-Film Magnetic Cores with Wafer Level Magnetics Technology

Enpirion, the leader of integrated power IC solutions, announced the successful commercialization of a new magnetic alloy, which enables the miniaturization of passive magnetic components and their assimilation with integrated circuits at wafer level. So-called wafer level magnetics (WLM) present a leap in traditional technology, which will take magnetic components from their 3-dimensional discrete shape to a planar 2-dimensional thin-film form that can be deposited with standard wafer processes on top of CMOS wafers. Enpirion's WLM technology is fully qualified for full-scale mass production in a high volume foundry and enables the industry's first ever Power System-on-Chips based on electroplated wafer level magnetics. Developed with a view to achieving monolithic Power System-on-Chips, the WLM technology can be easily transferred to other micro-magnetic applications, for example micro-transformers for signal isolation, micro-electromagnets for life sciences, integrated magnetic sensors for navigation and PMICs for portable consumer applications.



www.enpirion.com

Low-cost 50 A Current Transducers Improve on Shunt Measurement Techniques

LEM introduces its new HLSR series of current transducers, that provide a cost-effective and technically superior alternative to resistive shunt/optocoupler configurations for insulated current measurements up to 50 Amps. The five new HLSR transducers will satisfy application requirements in, for example, industrial inverters and motor drives; switch-mode and uninterruptible power supplies; specialist power supplies such as welding units; air conditioning; home appliances; but also in renewable-energy systems, for example, in solar combiner boxes and in solar inverters to track the maximum-power-point (MPPT).

LEM's HLSR series uses open-loop Hall-effect current sensing technology, to measure AC, DC or pulsed currents with nominal values of 10, 20, 32, 40 or 50 ARMS. LEM's proven expertise in open-loop Hall-effect technology allows these new devices to achieve a response time of only 2.5 µsec, with very low gain and offset drift over their operating temperature range of -40 to +105 °C.

www.lem.com

6th Generation 600V IGBTs Improve Hard Switching Efficiency

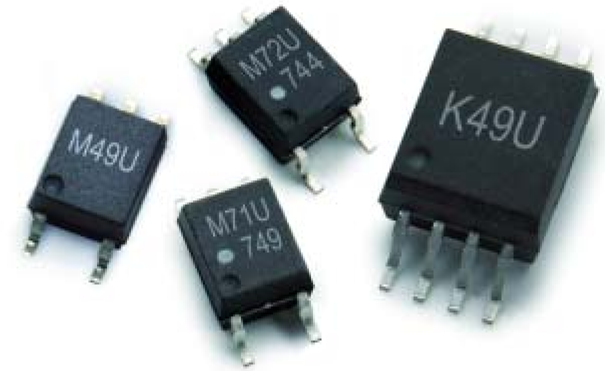
Toshiba Electronics Europe (TEE) has announced a sixth generation IGBT technology that offers improved switching loss/conduction loss trade off for increased efficiency and improved performance. The new technology is the basis for a new family of compact 600V devices that will suit a variety of hard switching applications including motor drives, solar inverters and uninterruptible power supplies (UPS).

Toshiba's sixth generation IGBT technology combines a finer pattern design and a thinner 'punch through' wafer process than the previous generation, as well as a highly optimised vertical design. As a result, devices based around the new process are able to provide lower VCE(sat) conduction losses and reduced Eon and Eoff switching losses.

New products featuring the sixth generation technology offer current ratings of 15A (GT15J341), 20A (GT20J341), 30A (GT30J341) and 50A (GT50J342). Each of the parts integrates both the IGBT and a fast reverse recovery diode connected between emitter and collector, in a single, compact package. All feature a typical VCE(sat) of 1.5V at the nominal current. The 15A and 20A parts are supplied in a isolated TO-220SIS package, while the 30A and 50A devices are available in an non-isolated TO-3P(N) (TO-247 equivalent) package.

www.toshiba-components.com

Extended Operating Temperature Digital Optocouplers



Avago Technologies announced its ACPL-M49U/K49U/M71U/M72U digital optocouplers, which are additions to its R2CouplerTM family. These optocouplers provide a wider offering of extended temperaturerange digital optocouplers to the exisiting family and are designed to meetcustomer needs for low power, low leakage, higher isolation voltage and higher common-mode rejection (CMR).

Avago Technologies' extended operating temperature digital optocouplers are increasingly used in a wide variety of isolation applications ranging from power supply, computing, factory automation, data communications and digital logic interface circuits.

These digital optocouplers, ACPL-M49U/K49U/M71U/M72U ensure the AC and DC performances over the extended temperature range of –40°C to +125°C.

www.avagotech.com/optocouplers

IGBT Drive Unit SKYPER 42 LJ for Inverters up to 400kW

To increase the efficiency of inverters up to 400kW, circuit topologies are developed that are optimized for specific applications. However, interleaved, multilevel and parallel circuits that improve IGBT efficiency also place higher requirements on signal performance. The new drive unit SKYPER 42 LJ by SEMIKRON combines the benefits of digital signal consistency while maintaining full functionality.

The SKYPER 42 LJ is a dual-channel IGBT driver unit for 600V, 1,200V and 1,700V IGBT modules. It reliably controls IGBT modules up to 1,000 Amperes with an output current of 80 mA with a maximum switching frequency of 100 kHz. The highly integrated SEMIKRON ASICs and an optimum power supply concept guarantee extreme signal precision with a maximum jitter of just +/- 1.5ns across the entire temperature range. In combination with the low tolerances of the SEMIKRON ASICs the SKYPER 42 LJ achieves runtime differences below 20 nanoseconds. Due to the adjustable short impulse suppression and stabilized gate voltages empower an uncompromising parallel IGBT control.

Despite its high performance, the SKYPER 42 LJ offers maximum security. SoftOff and overvoltage recognition securely switch off any current. The separate transfer of switching and error signals allows for rapid error feedback, even in 3-level applications. Thanks to the adjustable error management, both the integrated protection circuit and the paramount controller are able to quickly respond to system errors.

www.semikron.com

High-Voltage MOSFETs Provide Industry-Leading Robust Body Diode Performance

High-end, AC-DC switch-mode power supply (SMPS) applications such as servers, telecom, computing, and industrial power applications require high power density, and to be successful, designers need cost-effective solutions that take up less board space and improve reliability. Fairchild Semiconductor (NYSE: FCS) helps designers with these challenges by introducing the 600V N-channel SuperFET® II MOSFET series.

Offered in two product families, the SuperFET II and SuperFET II Easy Drive, these MOSFETS offer a smaller stored energy in output capacitance (Eoss) for higher efficiency in light-load conditions and best-in-class robust body diode for increased system reliability in resonant converters.

Utilizing an advanced charge balance technology, these MOSFETs provide a significantly low on-resistance and a lower gate charge (Qg) performance for a lower figure of merit (FOM). The devices are comprised of several integrated features to assist in a simplified design that reduces component count for a more efficient, cost-effective design including a gate resistor (Rg) that greatly reduces gate oscillation and improves overall system performance.

www.fairchildsemi.com

Programmable Hall-Effect Switch with Advanced Programming Algorithm

New from Allegro MicroSystems Europe, the A1128 is a field-programmable, unipolar Hall-effect switch designed for use in high-temperature automotive and industrial applications, particularly those involving proximity sensing with ferromagnetic targets.

The device uses a chopper-stabilisation technique to eliminate the offset inherent in single-element devices, and incorporates an advanced programming algorithm to simplify the customer's end-of-line process. It also has a high programming resolution for tighter magnetic switch points.

External programming is used to set the magnetic operating point while the hysteresis remains fixed. This advanced feature allows optimisation of the sensor IC switch point, and can drastically reduce the effects of mechanical placement tolerances found in end-user production environments. Other programmable parameters include output polarity and output fall time for reduced EMI in automotive applications.

The proprietary dynamic offset cancellation technique, with an internal high-frequency clock, reduces the residual offset voltage, which is normally caused by device overmoulding, temperature dependencies, and thermal stress. Having the Hall element and amplifier on a single chip minimises many problems normally associated with low-level analogue signals.

www.allegromicro.com

GaAs Hybrid Amplifiers from ANADIGICS

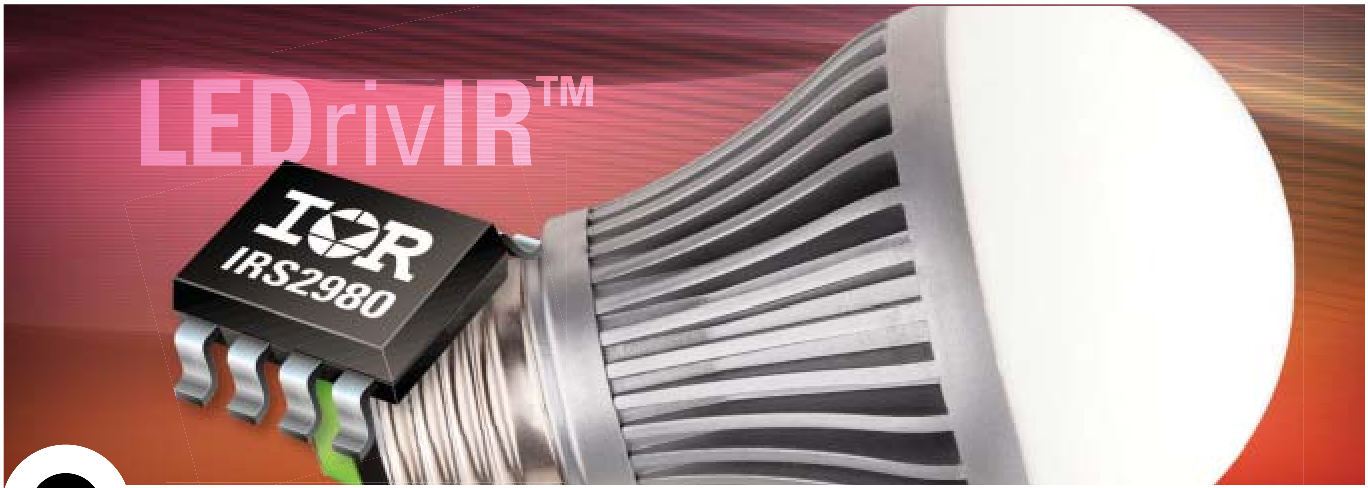
Richardson RFPD, Inc. announced immediate availability and full design support capabilities for two new GaAs hybrid amplifiers from ANADIGICS.

The ACA2786 and ACA2788 each consist of two pairs of parallel amplifiers that are optimized for exceptionally low distortion and noise figure with input and output transient voltage protection. These rugged devices include an integrated ring wave surge protection, as well as superior ESD protection of >7kV, and are offered in standard SOT-115J packages. They are designed for distribution nodes, system amplifiers, and line extenders in CATV HFC distribution systems.

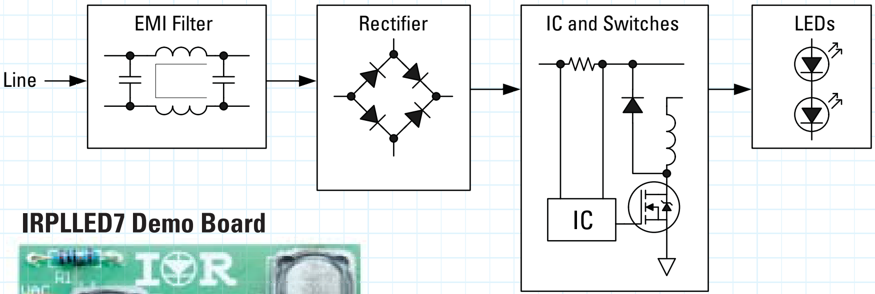
The devices are in stock and available for immediate delivery. To find more information, or to purchase these products today on the Richardson RFPD website, please visit the ANADIGICS GaAs Hybrid Amplifiers webpage. The devices are also available by calling 1-800-737-6937 (within North America); or please find your local sales engineer (worldwide) at Local Sales Support. To learn more about additional products from ANADIGICS, please visit the ANADIGICS storefront webpage.

www.richardsonrfpd.com

ADVERTISING INDEX



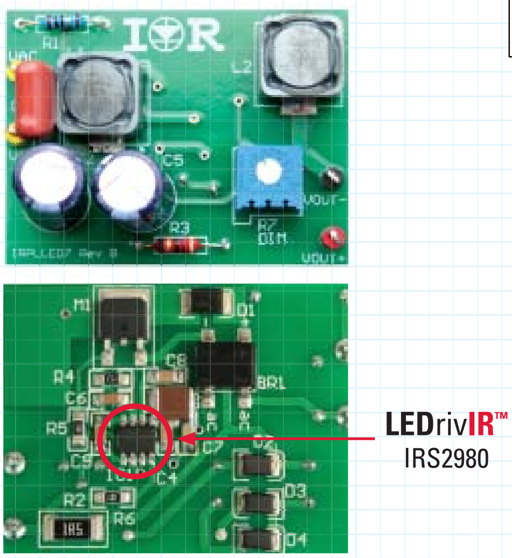
High-Voltage Buck Control ICs for Constant LED Current Regulation



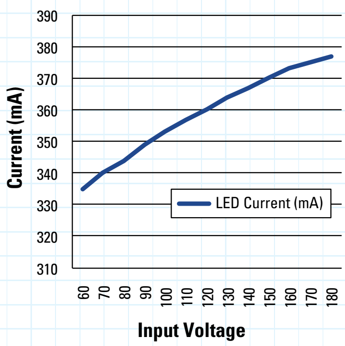
IRS2980 Features

- Internal high voltage regulator
- Hysteretic current control
- High side current sensing
- PWM dimming with analog or PWM control input
- Free running frequency with maximum limiting (150kHz)

IRPLLED7 Demo Board



IRPLLED7 Demo Board LED Current vs Input Voltage



IRS2980 Benefits

- Low component count
- Off-line operation
- Very simple design
- Inherent stability
- Inherent short circuit protection

Demo Board Specifications

- Input Voltage 70V to 250V (AC)
- Output Voltage 0V to 50V (DC)
- Regulated Output Current: 350mA
- Power Factor > 0.9
- Low component count
- Dimmable 0 to 100%
- Non-isolated Buck regulator

Part Number	Package	Voltage	Gate Drive Current	Startup Current	Frequency
IRS2980S	SO-8	450V	+180 / -260 mA	<250 µA	<150 kHz
IRS25401S	SO-8	200V	+500 / -700 mA	<500 µA	<500 kHz
IRS25411S	SO-8	600V	+500 / -700 mA	<500 µA	<500 kHz

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

International IOR Rectifier
THE POWER MANAGEMENT LEADER