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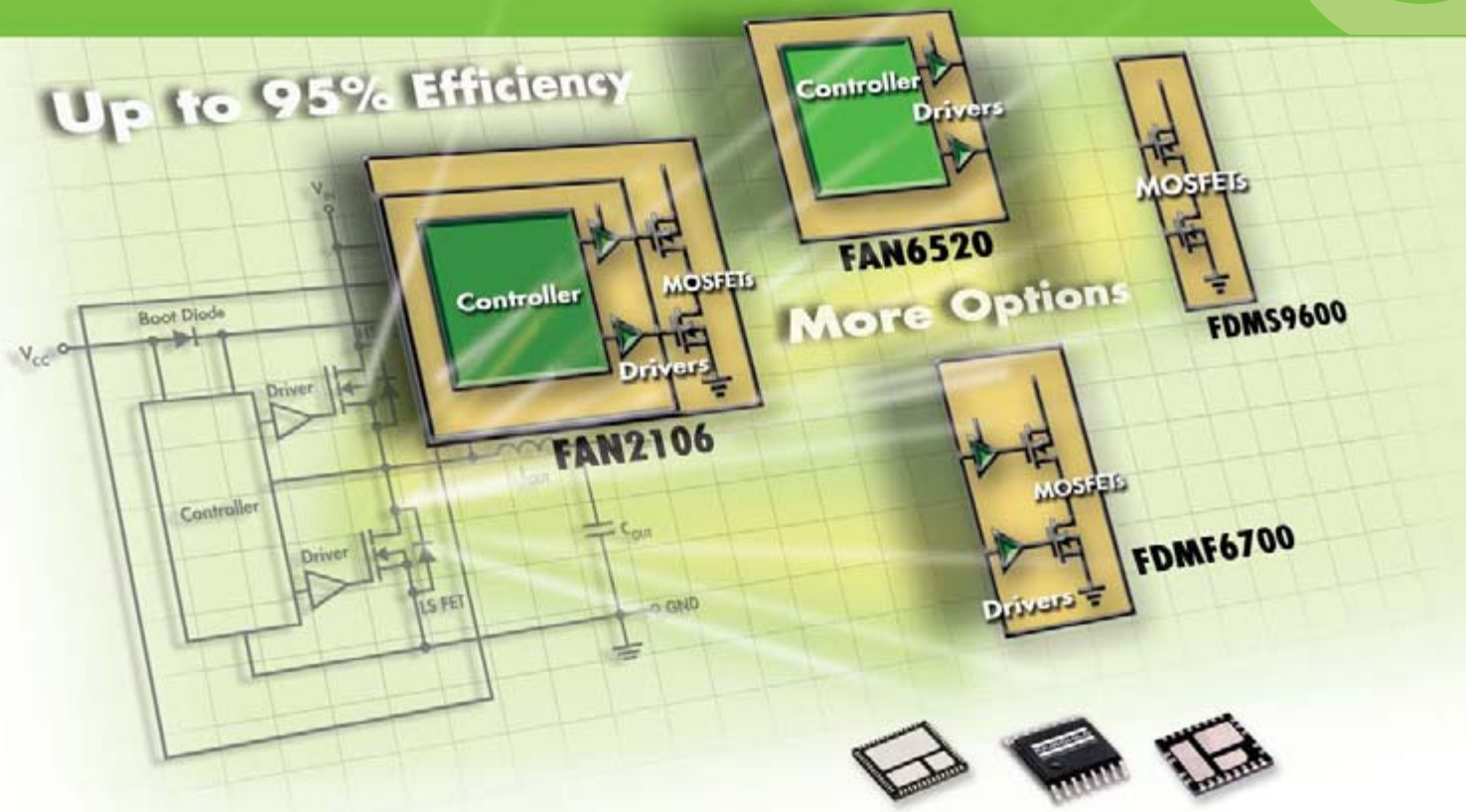
Bodo´s Power™ Systems

Systems Design Motion and Conversion

November 2007

FAIRCHILD
SEMICONDUCTOR®

Maximize energy efficiency in every DC-DC design.



Here is a selection of our integrated DC-DC solutions:

Product	Part Numbers*	Features
Integrated Switching Regulators (Controller + Drivers + MOSFETs)	FAN2106 FAN5350	• Up to 95% efficiency • Small, ultra-thin package (MLP and CSP)
Power Controllers (Controller + Drivers)	FAN6520	• Drives N-Channel MOSFETs in a synchronous buck topology • Output voltage range as low as 0.8V to V_{IN}
Power Drivers (FET plus Driver Multi-Chip Module)	FDMF8704 FDMF6700	• >85% efficiency • Optimal synchronous buck power stage DrMOS solutions • Unique MLP 6×6 package
Integrated MOSFETs (multiple MOSFETs in one package)	FDMS9600 FDMS9620	• 50% board space savings versus discrete solution • Ease of layout in PCB design • Optimized matching and sizing of MOSFETs (>92% efficiency) • MLP 5×6 package

*These products represent a small sampling of Fairchild's DC-DC portfolio.

Choose your DC-DC functions, performance, size and energy savings

No one offers more efficient DC-DC options than Fairchild. We combine perfectly matched power analog and discrete components with advanced packaging and power expertise for the industry's leading energy-saving portfolio. You can choose the optimum combination of controller, drivers and MOSFETs in a wide range of performance and size specifications.

Whatever your system performance and time-to-market needs may be, Fairchild has your ideal DC-DC solutions.

Learn more about all of our DC-DC solutions—including PWM controllers, voltage regulators and MOSFETs—at www.fairchildsemi.com/dcdc.

FAIRCHILD SEMICONDUCTOR CELEBRATING 50 10 YEARS

www.fairchildsemi.com

the power® franchise

Bodo's Power Systems

The Gallery

Efficient POWER for your applications

SPS/IPC DRIVES/
Electric Automation
Systems and Components
Exhibition & Conference
27 – 29 Nov. 2007
Nuremberg

Halle 1
Booth 531

INFINEON TECHNOLOGIES offers a broad range of leading-edge power semiconductors for standardized and application-specific industrial applications such as industrial drives, renewable energies, transportation, power supplies and medical instruments. Our proven chip expertise combined with many years' package know-how enable our customers to select the right solutions for their applications.

www.infineon.com/highpower

Never stop thinking

Bodo´s Power Systems

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Events

Ansoft Design Seminars
www.ansoft.com/firstpass

Microchip MASTERs Conference,
Munich Nov. 6- 8,http://microchip.com

Fairchild Power Seminars
www.fairchildsemi.com/powerseminar07

TI Portable Power Design Seminars
www.ti.com/portable-power-e-pr

Digital Power Europe, Nov. 13-15, Munich,
http://www.dpfeurope.darnell.com

Productronica, Nov. 13-16, Munich,
http://www.productronica.com

SPS/IPC/DRIVES, Nov. 27-29, Nuremberg,
http://www.mesago.com

It is Show Time

Indian summer says: “Thanksgiving is not far away”. Electronic shows will have their peak - then we relax for Christmas. Like the changing color of the leaves and new seasons coming – I enjoy the wonders of Mother Nature.

My last cover was an innovative approach to show that power electronics is not something in just one direction – one side “Power”, the other side “Control”. Defining high and low power in electronics - it all depends on your perspective! Power is multifaceted, so the best approach to keeping losses to a minimum requires a broad outlook.

Power components are not the only major element of drives and power supplies to increase volume, weight, and inefficiency. Power management starts with controller IC’s: putting functions to sleep when not needed and slowing down clock cycles. Digital Power becomes more and more important on the control side.

Modern controllers using C-MOS digital logic run at extremely low voltages. You need to consider the correct voltage at the proper peak current of the load and provide the best distributed power conversion at the board and system level. MOSFETS are the semiconductor elements that serve that purpose today.

“What is low power and what is high power?”; a frequent question. It depends upon the application. Individuals working on automotive controllers may define 42 volts as being high voltage for high power. Conversely, those in industrial and commercial electronics, 240 volts or 420 volts RMS in Europe, consider a voltage below these values to be low voltage. Here IGBTs with 600 to 1200 volt capability come into play. Above these values, applications include power distribution and traction and preferred solid-state devices are the IGBT and IGCT.

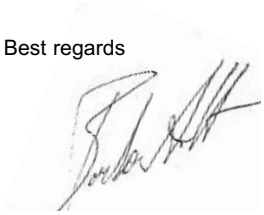
So which is more important – a million applications saving a Watt, or a Megawatt less loss in a traction system ? Guessing what is low voltage, or low power - it depends upon your perspective!

My magazine covers the entire gamut of applications to supply the power designer with up to date information. Articles in the magazine cover varied subjects to alert readers to all the aspects of power electronics. Web-links are provided for follow up with more details - data sheets, applications notes, etc. Your comments on content will be appreciated.

I look forward to seeing you at the Digital Power Forum, at Productronica, or at SPS/IPC/DRIVES.

A Green Power tip this month - park in the shade to avoid a lot of air-conditioning afterwards.

Best regards



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To help your innovation we make ourselves small.

Minisens, FHS Current transducer

Minisens is taking miniaturization to the next level as it is a fully fledged current transducer for isolated current measurement including magnetic concentrators in an IC SO8 size. This allows you to include all the functionalities you are looking for into the space that you have available.

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- Isolation provider
- Attractive price
- Flexible design allows a wide range of current measurement from 2-70 A_{RMS}
- +5V power supply
- Access to voltage reference
- Ratiometric or fixed gain and offset
- Standby mode pin
- Dedicated additional fast output for short circuit detection
- High performance gain and offset thermal drifts

www.lem.com

At the heart of power electronics.

LEM®

Design and Manufacturing Partnership

C-MAC MicroTechnology and Danfoss Silicon Power announced a strategic partnership to co-develop and manufacture intelligent, compact power modules targeted at the rapidly growing Automotive sector. C-MAC MicroTechnology is a world leader in high-reliability electronic systems, modules and components for the Automotive, Aerospace and Defence Electronics markets. Danfoss Silicon Power, a business unit of the Danfoss Group, is a leading global supplier of standard and customized power modules for the Industrial and Automotive markets.

Claus Petersen, President of Danfoss Silicon Power said "We are absolutely delighted to be working with C-MAC, their expertise in supplying high-reliability electronics into applications where size, weight and power density are often a constraint, will enable Danfoss Silicon Power to take our existing designs on to a new level of cost/performance, opening up new applications for us."
Indro Mukerjee, CEO of C-MAC commented "The opportunity to work closely with a company with the pedigree that Danfoss has in the supply of power modules, is extremely exciting. I am confident that the combined expertise of both our companies will result in truly exceptional products, which will further enhance the strong growth we are currently enjoying in our Automotive businesses."

http://www.danfoss.com

http://www.cmac.com

Promotion of Alessandro Leopardi to Managing Director (CEO)

ROAL Electronics is pleased to announce the promotion of Mr. Alessandro Leopardi to the key position of Managing Director (CEO). This announcement was followed closely by the confirmation of his appointment as a member of the Board of Directors.

Mr. Leopardi started his career at ROAL Electronics in 1990 as Export Sales Manager. Prior to becoming CEO, Mr. Leopardi served as General Manager and Sales Director for ROAL Electronics from September 2000 to the present.

Upon acceptance Mr. Leopardi stated that, "I am very honoured to accept this new challenge. My entire career has been dedicated to ROAL, but what is particularly exciting is that I'm going to be a part of a different and renewed ROAL, one with a strengthened vision and purpose of revitalizing how mankind thinks of energy. We are focusing our strategies to provide more technologically advanced solutions within the power conversion field. Our intent is to serve our customers not just with products, but with products that demonstrate our respect for a higher quality of life, and our renewed appreciation for the world we live in."

http://www.roallivingenergy.com

Semikron and LS Industrial Systems team up

Two global players combine their strengths to offer state of the art power electronics solutions for industrial drives and consumer appliances worldwide.

Semikron International, the world leader in diode/thyristor power modules and expert in power module packaging, and LS Industrial Systems Korea, former LG Industrial Systems, a leading manufacturer of factory automation products are teaming up to develop and deliver power electronic solutions for the industrial drives and consumer market. The two companies have signed a memorandum of understanding combining their expertise to offer LSIS integrated power modules based on Semikron's MiniSKiiP IGBT-platform.

The cooperation creates new opportunities for both companies. LSIS will be adapting the Semikron integrated power modules with pressure contact technology to be promoted to the industrial and appliance market. The MiniSKiiP power module platform will allow for faster development and the lower production costs. Semikron will be adapting the control technologies of LSIS to develop application specific systems. The new MiniSKiiP modules from LSIS and Semikron are set to address the rapidly growing demand for more integrated high-power platforms in a wide range of applications, including LCD and Plasma Display Panel.

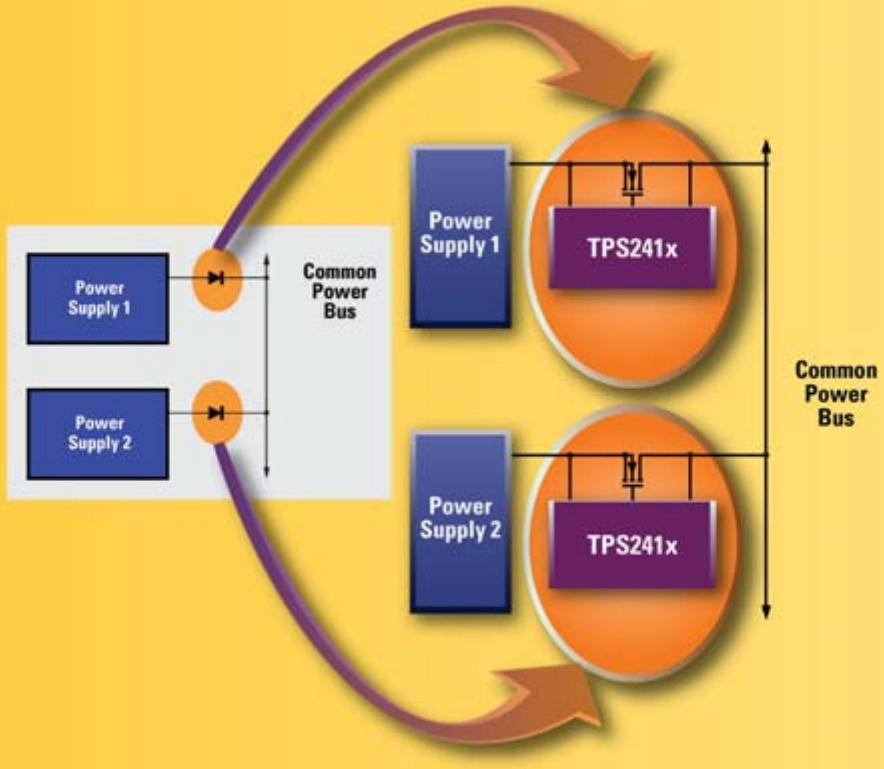
"Making these integrated modules enables us to compete in the power electronics market and thereby establishing our position in the consumer industry," said Chung-Man Kim, Vice Chairman and CEO at LS Industrial Systems. "We believe combining our knowledge in power electronic modules and controller technologies will strengthen both companies' positions in world power electronics market in the future," says Peter Frey, General Manager at Semikron International." "This will be the start of a long-term relationship," he concluded.

www.semikron.com

www.lsis.biz

ORing FET Controllers Save Power

Protect Redundant Power Supply Systems



Applications

– Blade servers
– N+1 redundant systems
– Telecom line cards
– RAID
– Merchant power

Features

– Ultra-fast, adjustable gate turn-off
– Internal charge pump
– Wide voltage operation range
– Adjustable turn-off threshold
– Complements TI's TPS2490 hot swap controller

HIGH-PERFORMANCE ANALOG >> YOUR WAY™

The new **TPS241x** family of ORing controllers from Texas Instruments provides a high-efficiency replacement for ORing diodes. Also, they offer intelligent monitoring and control of power supplies to prevent bus transient events from causing board-damaging faults or voltage spikes during operation. These ICs provide 130ns ultra-fast gate turnoff and a wide voltage operation range from 16.5V down to 0.8V.

Device	Linear Gate Control	On/Off Gate Control	Fast Comparator Filtering	Voltage Monitoring	MOSFET Fault Monitoring	Enable Control	Status Pin	Package
TPS2410	X		X	X	X	X	X	14-Pin TSSOP
TPS2411		X	X	X	X	X	X	14-Pin TSSOP
TPS2412	X							8-Pin TSSOP
TPS2413		X						8-Pin TSSOP

For samples,
evaluation modules
and datasheets, visit >>
www.ti.com/tps2410-e
or call toll free:
00800-ASKTEXAS (00800 275 839 27)
or international: +49 (0) 8161 80 2121

Technology for Innovators™

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Joint Company for High-Power Semiconductors

Siemens Power Transmission and Distribution (PTD) and Infineon Technologies AG signed a contract at the end of September for the establishment of a joint venture for the development and production of bipolar high-power semiconductors. The main emphasis will be in the area of high-voltage direct current transmission (HVDC). Infineon has integrated its production lines for bipolar high-power semiconductors in Warstein (Germany) and Cegléd (Hungary) into the joint venture and holds a majority stake of 60 percent of the shares of the newly formed company, which will trade as a GmbH & Co. KG. Siemens PTD is already an important customer for high-power thyristors which Infineon manufactures on its bipolar production lines in Warstein and Cegléd. They are used chiefly in projects for high-voltage direct current transmission (HVDC), for example in China for the transmission of power from inland dam projects to cities on the coastline. Reinhard Ploss, member of the Board of Directors of Infineon and Head of Operations, stated: “I’m absolutely certain that this joint venture is the right way to achieve success with our bipolar products in the long term. Together with Siemens PTD, we will succeed in consolidating and expanding our position on the HVDC market. The joint venture will also safeguard jobs and gives us the necessary technology lead.”

The Siemens Power Transmission and Distribution Group (PTD), headquartered in Erlangen, Germany, is one of the leading global players in its market sector. As a product supplier, system integrator, solution designer and service provider, Siemens PTD ensures - for utilities and industry alike - the efficient and reliable transmission of electrical energy from the power plant to the consumer. With a worldwide workforce of about 27,500 and operations in more than 100 countries, PTD had sales of 6.5 billion euros according to U.S. GAAP in fiscal 2006.

www.siemens.com/ptd

www.infineon.com

Licence Agreement for DirectFET® Packaging Technology

International Rectifier and Infineon Technologies announced that Infineon will licence from International Rectifier its patented advanced power management packaging technology, DirectFET®.
Designed for use in AC-DC and DC-DC power conversion applications in computers, notebooks, telecommunications and consumer electronics devices, the DirectFET power package is an industry-first surface-mount power MOSFET packaging technology for efficient topside cooling in an SO-8 footprint or smaller. Compared to standard plastic discrete packages, DirectFET’s metal can construction enables dual-sided cooling to effectively double the current handling capacity of high frequency DC-DC buck converters.
Infineon will deploy the DirectFET power package technology with its OptiMOS® 2 and OptiMOS 3 chip technology and expects to sample the OptiMOS 2 in DirectFET packages starting early 2008.

http://www.irf.com

http://www.infineon.com

Digital Power Developments in Europe

November 13th to 15th Munich
You will learn about the latest advances made in Digital Power technologies by European engineers and researchers at Darnell’s Digital Power Europe in Munich, November 13-15. You’ll hear what’s happening at ROAL Electronics, Ericsson Power Modules, CamSemi, Powervation, European Commission Joint Research Centre, University of Padova, and others.

You’ll also hear from digital power leaders in North America including: Analog Devices, Microchip, National Semiconductor, Power-One, Primarion, Texas Instruments and Zilker Labs. Bodo's Power is being a Supporting Sponsor of DPE.

http://dpfeurope.darnell.com/registration.php

Todd Hendrix Head of Marketing and Sales

SynQor strengthens its senior management team with the addition of electronics industry veteran Todd Hendrix as the new head of marketing and sales. Mr. Hendrix will focus on the further expansion of SynQor's telecom business while accelerating growth into new markets areas.

Mr. Hendrix brings with him more than 20 years of experience in marketing, sales and business management. He has proven success in high level management positions in the global electronics marketplace including Lite-ON, Philips and ON Semiconductor. Most recently Mr. Hendrix spent 4 years as VP of Worldwide Marketing and Business Development with Artesyn Technologies, which was acquired by Emerson’s Network Power group.

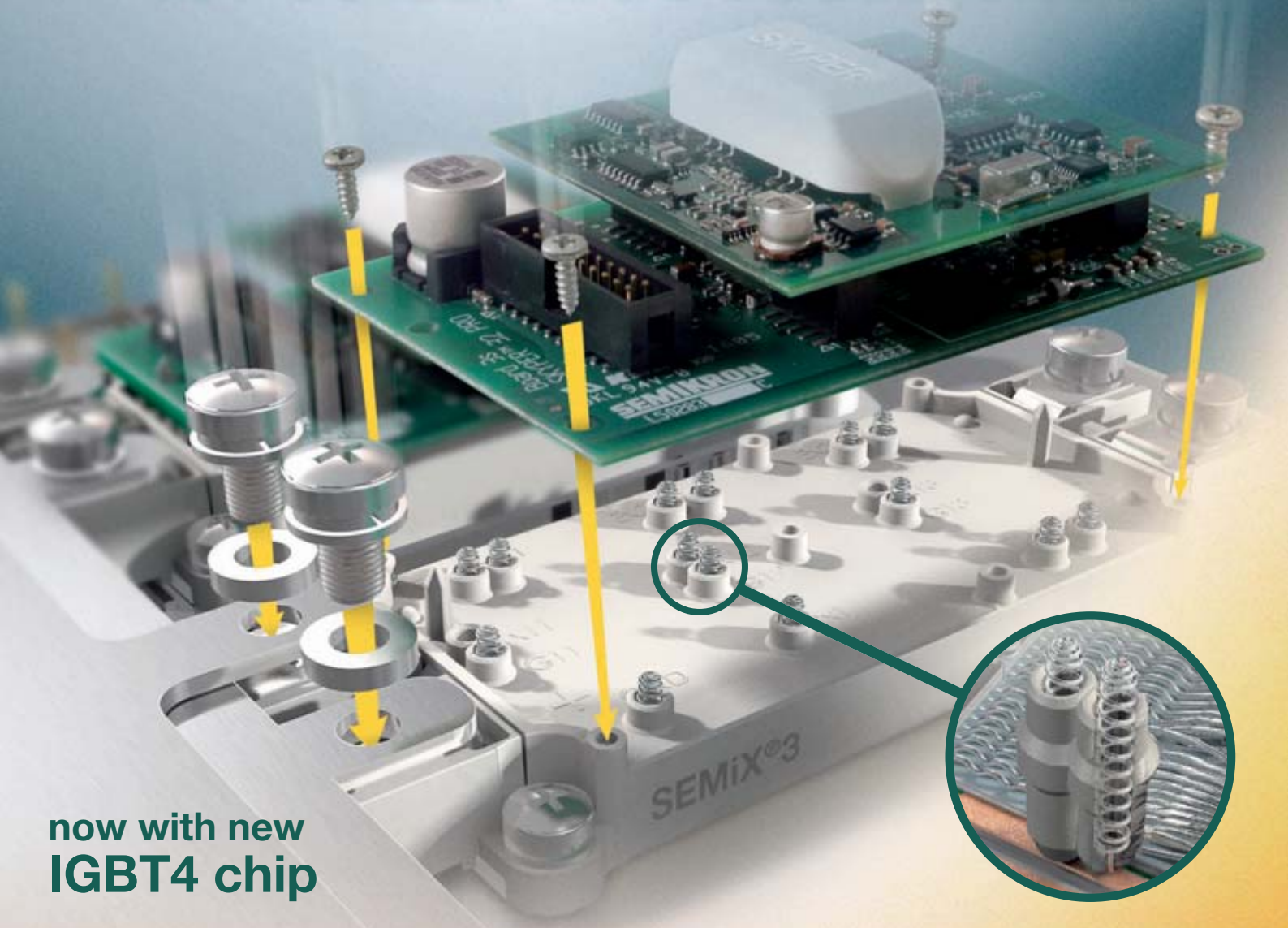
"I am delighted to be joining SynQor. The company's success to date is most impressive given the power industry’s continuous restructuring and consolidation. SynQor’s stability, operational excellence and commitment to superior service are much appreciated assets to the telecom equipment OEMs. Customers in the industrial, medical and Hi-Rel markets would like to be extended the same benefits, and I look forward to leading the charge." said Mr. Hendrix.

http://www.synqor.com

SEMIKRON
innovation+service

SEMiX®

for solder-free assemblies



now with new IGBT4 chip

- Fast assembly from the top, in one direction
- Reliable spring contacts used as electrical contact to control unit
- Solder-free connection to control unit in one production step
- Separation between AC, DC and control unit
- Identical cases and height (17mm) of IGBT and rectifier modules guarantee a flat and compact inverter design

IGBT (125 A - 900 A)

Rectifier (75 A – 340 A)

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sales.skd@semikron.com **www.semikron.com**

First Standard Current Sense Ignition IGBT for Automotive Applications

Fairchild Semiconductor's FGB3040CS is the industry's first standard current sense ignition IGBT. This IGBT lowers power dissipation by 30 percent and reduces heat in automotive applications by eliminating the need for a high current sense resistor. With the ability to sense current, the FGB3040CS replaces the high power sense resistor with a smaller, low current sense resistor, simplifying system component requirements and total cost. The FGB3040CS is designed with EcoSPARK® technology, offering the highest energy density for ignition IGBTs in the industry. This technology enables a die size that is small enough to fit into a D-Pak without giving up performance.

Key advantages of the FGB3040CS include:

- Thirty percent lower system power dissipation compared to existing solutions.
- EcoSPARK technology that provides the industry's highest energy density.
- Elimination of the high current sense resistor.
- A Kelvin ground to improve current sense accuracy.
- Elimination of the gate-to-emitter input resistor to simplify the IGBT gate control.

Fairchild has further expanded its IGBT portfolio with two new products, the FGD2N40L and the ISL9V2540S3S. The FGD2N40L is an ignition IGBT for small engine applications, such as lawn mowers and snow blowers. These IGBT devices offer tremendous advantages in applications that traditionally have not used these products in their designs. Traditional bi-polar technologies need base current to activate the spark, which requires a higher engine RPM for the ignition system to start. Since the gate of Fairchild's IGBT has extremely high impedance, it requires less energy to control the spark, allowing operation at lower engine RPMs. The ISL9V2540S3S is an ignition IGBT for designs requiring 250mj of SCIS capability. It reduces overall system cost compared to higher-rated ignition IGBTs.

Fairchild's unique capabilities in advanced process and packaging technologies, as well as its ability to integrate power analog, power discrete and optoelectronic functionality into innovative packaging, enable Fairchild to develop energy efficient solutions for the automotive electronics market. Fairchild offers the industry's most comprehensive portfolio of products, from 1W to >1200W, to maximize energy efficiency in today's automotive electronic applications such as power management, body control, motor control, ignition and engine management, and electric and hybrid electric vehicle systems.

Fairchild's New IGBT Ignition Portfolio:

Product Part	Clamping Voltage Typ (V)	I_C@1000°C amps	$V_{CE(SAT)}$ TYP (V)		SCIS Energy @25°C Min (mJ)	Package	Price (each) US$ 1K pcs
			TYP (V)	Test Condition			
FGD2N40L	400	7*	1.6	2.5A, 2.4V	NA	TO-252 (D-PAK)	$0.36
ISL9V2540S3S	420	15.3	1.37	6A, 4/5V	250	TO-252 (D-PAK)	$0.75
FGB3040CS	400	17	1.6	6A, 4V	300	TO-263 (D^2PAK)	$1.03

*Note: * is 25°C rating*

The FGD2N40L, FGB3040CS and ISL9V2540S3S utilize lead-free (Pb-free) terminals and have been characterized for moisture sensitivity in accordance with the Pb-free reflow requirements of the joint IPC/JEDEC standard J-STD-020. All of Fairchild's products are designed to meet the requirements of the European Union's Directive on the restriction of the use of certain substances (RoHS).

For datasheets in PDF format, please go to:

http://www.fairchildsemi.com/ds/FG/FGB3040CS.pdf,
http://www.fairchildsemi.com/ds/FG/FGD2N40L.pdf,
http://www.fairchildsemi.com/ds/IS/ISL9V2540S3S.pdf

In 2007, Fairchild celebrates its "50/10" anniversary, commemorating 10 years as a new company and 50 years in the industry. Known as the "Father of Silicon Valley," Fairchild developed the planar transistor in 1958 – and with it a new industry.

www.fairchildsemi.com

The Best-Selling 2-Channel IGBT Driver Core

The 2SD315AI is a 2-channel driver for IGBTs up to 1700V (optionally up to 3300V). Its gate current capability of ±15A is optimized for IGBTs from 200A to 1200A.

The 2SD315AI has been established on the market as an industrial standard for the last four years. The driver has been tried and tested within hundreds of thousands of industrial and traction applications. The calculated MTBF to MIL Hdbk 217F is 10 million hours at 40°C. According to field data, the actual reliability is even higher. The operating temperature is -40°C...+85°C.

The driver is equipped with the award-winning CONCEPT SCALE driver chipset, consisting of the gate driver ASIC IGD001 and the logic-to-driver interface ASIC LDI001.

Chipset Features

- Short-circuit protection
- Supply undervoltage lockout
- Direct or half-bridge mode
- Dead-time generation
- High dv/dt immunity up to 100kV/us
- Transformer interface
- Isolated status feedback
- 5V...15V logic signals
- Schmitt-trigger inputs
- Switching frequency DC to >100kHz
- Duty cycle 0...100%
- Delay time typ. 325ns

Driver stage for a gate current up to ±15A per channel, stabilized by large ceramic capacitors

Specially designed transformers for creepage distances of 21mm between inputs and outputs or between the two channels. Insulating materials to UL V-0. Partial discharge test according IEC270.

Isolated DC/DC power supply with 3W per channel

More information: www.IGBT-Driver.com/go/2SD315AI

CT-Concept Technology Ltd. is the technology leader in the domain of intelligent driver components for MOS-gated power semiconductor devices and can look back on more than 15 years of experience.

Key product families include plug-and-play drivers and universal driver cores for medium- and high-voltage IGBTs, application-specific driver boards and integrated driver circuits (ASICs).

By providing leading-edge solutions and expert professional services, CONCEPT is an essential partner to companies that design systems for power conversion and motion. From custom-specific integrated circuit expertise to the design of megawatt-converters, CONCEPT provides solutions to the toughest challenges confronting engineers who are pushing power to the limits.

As an ideas factory, we set new standards with respect to gate driving powers up to 15W per channel, short transit times of less than 100ns, plug-and play functionality and unmatched field-proven reliability.
In recent years we have developed a series of customized products which are unbeatable in terms of today's technological feasibility.

Our success is based on years of experience, our outstanding know-how as well as the will and motivation of our employees to attain optimum levels of performance and quality. For genuine innovations, CONCEPT has won numerous technology competitions and awards, e.g. the "Swiss Technology Award" for exceptional achievements in the sector of research and technology, and the special prize from ABB Switzerland for the best project in power electronics. This underscores the company's leadership in the sector of power electronics.

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Let experts drive your power devices

Digital Control of Power – Starting to Cross the Chasm?

By Arnold N. Alderman, Anagenesis, Inc.

At the APEC 2003 rap session, digital control of power supplies was but a vision. Since then, the technology has grown, and is now starting to enter mainstream portfolios. Driven more by hope than substance, both users and providers have had an intuitive feeling that digital control of power supply could provide much more than the present analog controlled supplies do. However the evolution has been long and slow. Gus Mehas and Zaid Salman of Intersil pointed out recently that "One esteemed IC vendor predicted in March 2006 that digital power supplies would be a $3 billion market by 2008, and $8 billion by 2010. We're not even close to that today!" As many business development leaders will tell you, crossing the chasm (Crossing the Chasm by Geoffrey A. Moore, Harper Collins, 1991) can be a monumental task. So, are digitally controlled power supplies about to become mainstream items? Some would tell you it is already mainstream. However, Mr. Mehas and Mr. Salman care to differ.

Early designs sought only to replace the analog functions in the power supply. This limited application of digital control minimized the real value that this technology could provide the user. Thoroughly impressed and excited about the technology, early marketing attempted to "sell" digital. Most found that it did not have much affect on the customer. They were trying to sell digital to those who know it better than the power specialists.

Revolution or Evolution?

The transition from analog to digital has been not so much a revolution as an evolution. Digital elements starting invading the power supply almost a decade ago with the appearance of the housekeeping micro-controllers. Slowly, since that time, more and more digital components have shown up in designs, which now include either application-specific integrated circuits (ASICs) or digital signal processors (DSPs), making the transition complete.

What is emerging?

At Digital Power Forum 2007 (DPF07) in San Francisco last month, it was clear that engineers and marketers are starting to listen to the customer, and are moving to identify and develop those new features that one could never consider in the analog realm. Some players are still talking the old theme of "complexity is still being a problem" when you make digital look like analog. Most were showing off new features and performances. These included:

Advanced algorithms (i.e. adaptive behavior, filtering, etc) for system optimization
Simpler closed loop adjustments
Minimizing ripple
Remote programmability
Factory calibration and test
The advantage of "soft" component values – compensating for component variation and component aging
Immediate fault diagnostics (Ericsson)
Even adjustments for new topologies are possible
Advanced multi-phase management for better efficiency and minimum ripple
Data reporting (formerly provided with micro-controllers)
In-field testing
Tracking failures, predicting failures, tracking system problems
Soft re-configuration
This is a significant list with much more to come.

Software Novices

The players that are new to the software world are still working on functions and "how to do it." Audience comments during DPR07 pointed out that some offerings have given little thought given to the critical issues of software bulk optimization, validation, and certification. With the tradeoff between usability and software bulk, there is plenty of room to improved software accuracy and resolution.

Riding the Efficiency Wave

Several players are stating that digitally controlled power supplies are more efficient. They tout features that optimize operation for maximum efficiency such as:

Optimal dead time delay
Adjustable frequency for maximum efficiency
Output voltage scaling, to further increase the efficiency improvement potential
Improved efficiency by automatically adjusting the zero voltage transition (ZVT) switchers at the system level – Intelligent Energy Management

Is this a desperate attempt to ride the efficiency band wagon or is there a real foundation to the argument? The point that Laszlo Balogh of Fairchild made was that perhaps one can optimize topological efficiency with digital control; however, the basic efficiency improvements will be implemented in the power train topology.

ASIC vs. DSP

The controversy regarding who will win out, ASIC or DSP, is not determined yet. Both the ASIC digital solution and the general purpose DSP solution are well received by users. DSP success in the Embedded Systems may make that solution attractive for those designers involved with embedded system design, and even perhaps some motherboard voltage regulator-down (VRD) designs, the ASIC may be more attractive to the power supply designers with their easy graphic user interface (GUI). At present, both are attractive solutions and it may remain that way. However, if we look at what happened in motor drive designs, the DSP became dominant within a few years; but the fact that the power supply has many more topological configurations than the motor drive may prevent either solution becoming dominant.

Getting the message to the user

Conjectures are fine, but the industry is waiting for presentation of some hard facts regarding the comparative benefits of digitally controlled power supplies. Brian Zahnstecher of Hewlett Packard pleaded with the DPF07 presenters to "please tell the users what digital control does for them." Is the absence of this message to the users just an oversight? I think not. The basic problem is the focus; presenters focused on their perceived customer, the power supply designers. There needs be a forum where the digital control suppliers can focus on and present to the user. In reality, user conversations are going on privately between power supply manufacturers and their customers. However, if digital control is to achieve wide general acceptance, then we need to state the message to the user in open forum.

Once the benefits of new features become evident, there will never be a return to analog. Analog will not disappear completely; digital will simply start to dominate the high-end and intermediate applications with analog relegated to the "simple" and knock-off power supplies. Eventually even those power supplies will start to see the application of digital chips. Just as the bipolar transistor did not go away when the MOSFET entered the scene and started dominating the market, so it will be the same with analog control of power supplies.

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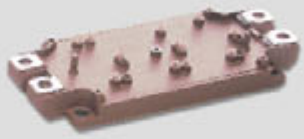

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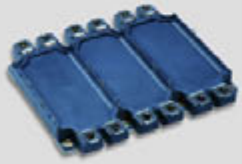
600V: 50A - 600A
1200V: 50A - 450A
1700V: 150A - 400A

1-Pack IGBT
600V: 600A
1200V: 200A - 800A



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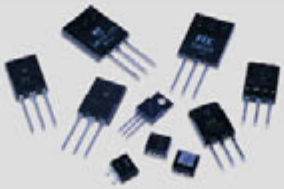

Discrete IGBT
600V: 5A - 75A
1200V: 3A - 25A

IPM-IGBT
600V: 15A - 300A
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Electronics Industry Digest

By Aubrey Dunford, Europartners

GENERAL

After double digit growth in 2005, electronics output in the Central and Eastern European (CEE) is set to increase further by 8.1% and 8.5% in 2006 and 2007 respectively, so Reed. That works out to a projected figure of $ 42 billion for 2007. Backed by strong foreign investment, CEE countries now account for approximately 13% of the total European electronics production. In fact just three CEE countries account for 73% of electronics output, and around 50% of the CEE market. With 38%, Hungary is the biggest player, with output in excess of the combined figures for the Czech Republic and Poland combined (at 21% and 14% respectively). Russia accounts for just 7%. The lower cost CEE countries such as Bulgaria, Romania and Slovakia, will attract more investments in the future.

SEMICONDUCTORS

Worldwide sales of semiconductors rose sharply in August, growing to $21.6 billion, an increase of 4.5% over August 2006, and an increase of 4.9% from July of this year, so SIA. The increase over July was in line with seasonal trends, and growth accelerated in all regions except Americas. Monthly unit sales reached a new record, with for the first time more than 50 billion units shipped worldwide.

European Semiconductor sales in August 2007 amounted to $ 3.379 billion, up 2.9% versus the previous month, and up 5.3% from August 2006, so WSTS. On a YTD basis semiconductor sales increased by 4.4% versus the same period in the year 2006.

Avago Technologies, a supplier of analog interface components for communications, industrial and consumer applications, announced that as part of its manufacturing outsourcing program it will reduce its workforce, primarily in Asia, by approximately 400 employees.

North American-based manufacturers of semiconductor equipment posted $1.39 billion in orders in August 2007 and a book-to-bill ratio of 0.83, so **SEMI**. Orders for Japanese semiconductor equipment totalled $ 1.2 billion in August, and the book-to-bill ratio stood at 0.81, so SEAJ.

Applied Materials paid approximately U$483 M in cash to acquire HCT Shaping Systems SA (HCT), a Swiss supplier of precision wafering systems for manufacturing crystalline silicon (c-Si) substrates for the solar industry.

OPTOELECTRONICS

Cree and Nichia have entered into an agreement that expands their cross license arrangements announced in 2002 and 2005 to include additional patents relating to white LED technology and certain Cree patents relating to nitride lasers. Cree and Nichia also agreed to resolve any future patent disputes.

PASSIVE COMPONENTS

Industry personnel in the connector industry believe connector prices will increase during the next six months, so **Bishop & Associates**. The majority of responses shows an increase by 0% to 4%. Industry respondents also put lead times at 5.3 weeks, and they predict lead times will be at 5.6 weeks six months from now.

AVX has completed the acquisition of American Technical Ceramics (ATC), a US-based manufacturer of capacitors and thin film circuits for a broad range of commercial and military applications, for pproximately $231 million.

OTHER COMPONENTS

TDK will spend $135 million to buy all shares it does not own in affiliate Densei-Lambda to expand into power switches for cars and digital products. TDK also concluded an agreement with Alps Electric regarding the transfer of Alps' equipment and intellectual property rights such as patents and know-how concerning its HDD head business.

Dover has realigned its operations into four business segments. In the electronic technologies group (Ceramic Products Group, DEK, Everett Charles Technologies, Knowles Electronics, Microwave Products Group, OK International, Vectron), sales were $1.4 billion last year.

Cascade Microtech, a US-based supplier of probe cards and test sockets for test of ICs has opened a wholly owned subsidiary in Munich, Germany, to support its growing European business. The company continues to operate an office in the UK and works with distribution.

Continental plans to acquire Zhangjiagang Fugang Heli Electronics, a Chinese manufacturer of cooling fan modules and window lift motors (250 employees).

DISTRIBUTION

In the first half of 2007, distribution sales in the five major European countries declined by 3.3% to € 3252 M, compared with the same period of 2006, so IDEA. The Nordic countries showed the best performance with +1.9%, at € 331.7 M. Sales were flat in Germany (-0.6%, at € 1237.4 M) and in UK (+0%, at € 702.4 M), while France and Italy were reporting a significant decline: respectively –9.9% (at € 439.1 M) and –10.2% (at € 541.1). Globally, distribution sales for the five major countries were down 3.7% in semiconductor (at € 2178.5 M), -1.1% in passive components (at € 444.1 M) and – 3.3% in electromechanical (at € 629.3 M).

Avnet has entered into an agreement to acquire Betronik. The Berlin, Germany-based passive components distributor and its French subsidiary DEL S.A. will be combined with the Avnet Time organization in Germany and France, respectively. Betronik reported calendar year 2006 revenues of approximately $40 Million.

This is the comprehensive power related extract from the « Electronics IndustryDigest », the successor of The Lennox Report. For a full subscription of the report contact:
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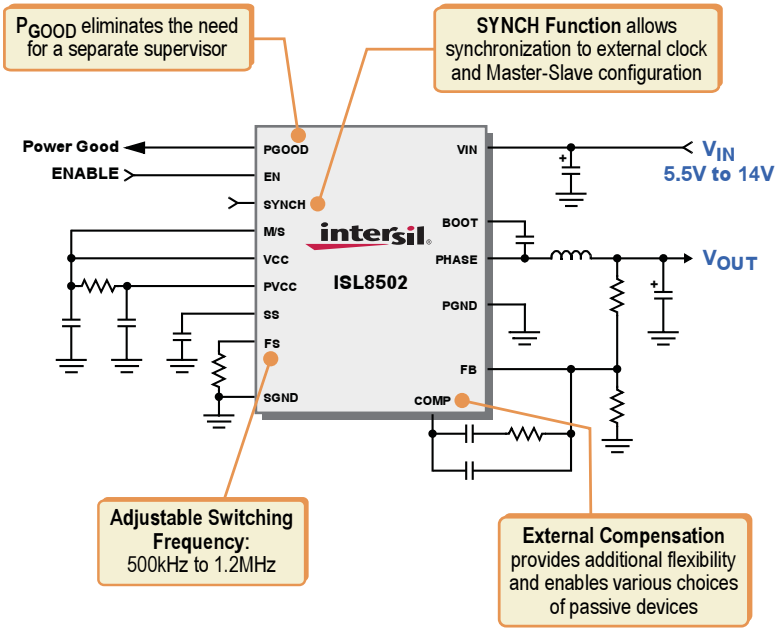

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- Short-circuit protection, OVP, OTP, UVLO
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HIGH PERFORMANCE ANALOG

Solar Power in the Spotlight

By Douglas Bess, Editor, PowerPulse.net

Rising costs for fossil fuels are driving the adoption of green technologies, including solar power systems, throughout Europe.

Solar power continues to be in the spotlight as oil and gas-based electricity generation costs spiral relentlessly upward. Energy efficiency is a critical concern in solar power systems. In the development of solar power technologies, a large part of the investment has been focused on improving the efficiency of the photovoltaic (PV) cells.

But an equally important aspect of solar power systems is the design of highly efficient inverters for converting the raw dc power from the PV cells into refined ac power useable for transmission through the electric power grid. Advanced PV inverters rely on digital power technologies to provide maximum efficiencies.

Digitally-controlled PV inverters will be one of the topics at the up-coming Digital Power Europe forum (in Munich on 13 – 15 November). Olivier Monnier with Texas Instruments will discuss how “Digital Signal Controllers Improve Efficiency for Solar Power Inverters.” According to Mr. Monnier, “By creating higher efficiencies in the conversion of the dc input, users will realize lower costs and higher quality ac output. This is especially true in regions of the world that have intermittent sunlight. The algorithms that help convert fluctuating sunlight rely on ever faster processors to deliver high quality ac current – these same processors must also keep bill of materials costs low.”

During his talk, Mr. Monnier will present key elements of a digital control system and how they can be implemented in inverters. He will present an architectural overview of digital signal controllers optimized specifically for power converter applications and he will outline software development strategies for successfully developing high-efficiency PV inverters. While Digital Power Europe will provide state-of-the-art developments in digital power and PV inverters, considerable work is also being done in PV cells in Europe.

Germany and Spain are both recognized as large and growing markets for PV systems. But recent announcements show that Belgium, Italy and France are also increasing their use of advanced PV technologies. Trina Solar Ltd. recently entered into an agreement with the Italian company EniPower. The contract is the result of a letter of intent signed in April 2007. Both parties agreed then to establish a long-term business relationship where, among others, Trina Solar would supply EniPower with PV modules. A 1MW contract has been already signed with an option of an additional 5MW for the rest of the contract period.

"Trina Solar is pleased to have entered into this important agreement with EniPower and to continue expanding the brand in the Italian market," remarked Arturo Herrero, Vice-President of Sales & Marketing of Trina Solar. "The solid background of EniPower as a pioneer in the power industry together with Trina Solar’s high quality modules and experience in the PV sector will contribute to the development of the Italian PV industry.”

This agreement is described by Trina Solar as an important milestone as it continues to strengthen its brand in Italy’s growing PV market. It is claimed that recent regulations to promote solar PV installations in Italy make the nation one of the most attractive markets in the solar PV industry today.

United Solar Ovonic LLC, recently expanded it presence in both Belgium and France. In Belgium, the company has signed a multi-year supply agreement with Enfinity Management BVBA for 21.15MW of UNI-SOLAR® thin-film photovoltaic (PV) laminates. Under the agreement, United Solar will supply Enfinity 1.15MW in calendar year 2007 and 10MW in each of the calendar years 2008 and 2009. Enfinity intends to use the UNI-SOLAR® products for roof-top installations in Europe.

"The UNI-SOLAR product is uniquely suited for roof-top applications because it is lightweight, provides superior electricity generation and integrates directly into the roof structure. These advantages, combined with the ease of installation, provide a cost-effective solution that we can offer to our customers," said Gino Van Neer, Chief Executive Officer of Enfinity.

Enfinity, headquartered in Ghent, Belgium, has raised private equity funds for PV projects in Europe. It has already financed PV projects with a total capacity of more than 30MW and is planning to finance several hundred megawatts through 2010.

"We are pleased to have established this multi-year supply relationship with Enfinity, a leading investor in PV projects. Investors like Enfinity see the unique value proposition offered by our UNI-SOLAR products, particularly for roof-top systems where our product features provide a cost-effective PV solution. We look forward to working closely with Enfinity and its customers on the success of these roof-top projects," said Subhendu Guha, the President and Chief Operating Officer of United Solar Ovonic.

United Solar has also signed an 18-month agreement with EDF Energies Nouvelles (EDF EN) for the supply of 12MW, with an option to buy an additional 18MW, of UNI-SOLAR® thin-film photovoltaic (PV) laminates to be used for large-scale installations on industrial and commercial buildings. Headquartered in Paris, France, EDF EN will use UNI-SOLAR® laminates to develop its photovoltaic business especially in the building-integrated segment.

"This is another important illustration of the potential of UNI-SOLAR products in large-scale commercial installations," said Guha. "These installations benefit our customers, and they benefit the environment. We are pleased to help lead the growing movement toward the increased use of renewable sources of energy."

"This new agreement demonstrates the acceptance of our product in the European market. With the feed-in tariff recently approved in France, there is a preference for building-integrated photovoltaic installations. Our agreement with EDF EN follows our overall strategic plan to expand our presence in emerging markets like France," said Salama Naguib, Vice President of Global Sales & Marketing at United Solar Ovonic.

According to United Solar, unlike traditional crystalline technology, which typically uses heavy glass panels, UNI-SOLAR products are flexible, durable, lightweight, and easy to install. Because of these characteristics, UNI-SOLAR triple-junction products offer a suitable solution for both grid-connected and off-grid solar electric systems. According to the company, independent studies in Europe and elsewhere have shown that triple-junction products deliver more energy per rated power than the conventional crystalline products.

Energy Efficiency in Telecom Equipment

By Linnea Brush, Senior Analyst, Darnell Group

Energy efficiency is a major feature driving power supply sales in all regions of the world. Telecommunications carriers are looking to lower their utility bills, just like data center operators. In Europe, regulatory actions could have an impact on rectifier design, particularly for broadband applications.

The European Commission (EC) has been working since 1997 on power supply efficiency, and more recently on uninterruptible power supplies and data centers. Some of these topics will be addressed in the Digital Power Europe forum in Munich on 13 – 15 November.

In 2006, the EC issued the Code of Conduct (CoC) on Energy Consumption of Broadband Equipment. Tier 1 entered into force in January, 2007, and Tier 2 will start in January, 2008 and be valid for one year. The CoC is a voluntary base initiative with the aim of targeting "reduced energy consumption of broadband communication equipment without hampering the fast technological developments and the service provided."

One of the aims for both network and customer equipment is to require power reduction and adoption of power management (low power modes L2/L3) for new ADSL2+/VDSL2 systems. The requirements on power reduction push for specific study and development of energy efficient equipment, while the implementation of power management would allow benefits from time periods when data traffic is limited or absent.

Telecom Italia Group is actively involved in this initiative, and in a presentation at Intelec, 2007, they indicated that the power targets are challenging. The 2008 goals will imply "a complete redesign of xDSL chips and systems, and the development of power management mechanisms will require analysis and proposals in conjunction with standardization bodies (ITU-T/ETSI)." In fact, a proposal to start standardization activities on power consumption reduction of DSL equipment has been presented with wide support from operators and accepted (ETSI TM6 and ITU-T SG15).

Network equipment covered under the CoC includes DSL ports, combined ports, ISDN terminators at customer premises, WiMAX base stations, PLC and cable service provider equipment and optical network terminals. Tier 1 and Tier 2 refer to the maximum power consumption targets (power measured on the 230Vac input).

Optimizing a base station's power efficiency is a key consideration for companies in the telecommunications industry. Significant efforts are being made to reduce the overall energy consumption of base stations to lessen their impact on the environment. The principal day-to-day running cost in a base station is electrical energy. As rectifiers are replaced, the replacements tend to be more energy efficient than the previous models. The priority for rectifier replacement is usually reliability, but energy efficiency has become a close second.

For example, the power amplifier (PA) can consume more than one-half of the required power for a base station, so optimizing its power efficiency improves operational performance and provides environmental and financial benefits. In the latest-generation (2.5G and 3G) base stations, design strategies include methods for achieving high linearity while also minimizing power consumption. By monitoring and controlling the performance of the base station's PA, it is possible to maximize the PA's output power while achieving optimum linearity and efficiency.

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State-of-the-Art High Frequency Optimized IGBT Modules

NFH and NFM – Series

The introduction of NF Series in the year 2003, which is followed by NFH- and recently developed NFM-Series for medium frequency switching applications considering the application requirements, proved the successful development track record.

By Pragad Bhalero and Robert Wiatr ; Mitsubishi

In recent years, power semiconductor modules achieved the highest gains, driven by unusually high levels of growth in the UPS market, medical equipments, induction heating, welding and also in the renewable energy field. Considering this growth, the standard NF-Series was introduced by Mitsubishi Electric in the year 2003 with dual IGBT modules with a rated current of 100A to 1000A, employing the CSTBT™ - IGBT technology and package compatibility with Mitsubishi old H-Series. By new standard CSTBT™ chip technology a reduction of static and switching losses is achieved compared to previous planar H-Series. The NF- Series enables the user to replace the old H-Series without changing the layout of the system. At the same time NFH-Series is developed and launched as a special product series for high switching frequency applications. The IGBT chip of NFH-Series is optimized for the switching frequency 50 kHz.

To meet the specific requirements in applications such as welding, medical X-ray, where the medium switching frequency of 15 to 30 kHz is necessary, NFM-Series is the best choice.

		Rated Current (A)					
Vce (V)		100	150	200	300	400	600
NFH-SERIES							
600	Dual	CM100DUS-12F	CM150DUS-12F	CM200DU-12NFH	CM300DU-12NFH	CM400DU-12NFH	
1200	Dual	CM100DU-24NFH	CM150DU-24NFH	CM200DU-24NFH	CM300DU-24NFH	CM400DU-24NFM	CM600DU-24NFM
NFM-SERIES							
1200	Single					CM400HC-24NFM	CM600HC-24NFM
	Dual	CM100DC-24NFM	CM150DC-24NFM	CM200DC-24NFM	CM300DC-24NFM	CM400DC-24NFM	

Table 1: NFH- and NFM- Series Line-up

Standard Series with CSTBT™ chip technology made possible to achieve about 30% VCE(Sat) reduction compared to planar H-Series IGBT at the same current density. Furthermore, increased carriers in n- layer by carrier-stored layer fasten the turn-on switching capability. Thus, it has been proved that new CSTBT™ chip structure reduces the total losses - static losses, switching losses by 80% at comparable conditions as compared to planar gate structure. In addition the improved solder and Al-wire bonding in NF-Series enhances the performance and reliability. Table 1 shows the entire available product line up for NFH- and NFM-Series by Mitsubishi.

NFH - NFM-Series

NF-Series is optimized for hard switched PWM inverters with carrier frequency less than 15 kHz (where low $V_{CE(sat)}$ is a main consideration) making them difficult to use in applications such as welding and power supply for medical equipments, where operation at high frequency (from 30 kHz to 60 kHz) is necessary. NFH- and NFM-Series offer a solution to these applications. The typical Half Bridge Inverter circuit and Full Bridge Inverter circuit for such applications have been shown in Figure 1a and 1b respectively. These high frequency inverters (between 30 to 60 kHz) involve soft turn-on and hard turn-off switching. NFH-Series has been marketed, taking an advantage of broad latitude in adjusting the carrier density spread in the CSTBT™ chip structure to increase the turn-off speed of the elements.

Generally for better high-frequency switching response in IGBTs, the minority carrier lifetimes in n- layer can be reduced excessively, but that causes an increase of the on-state voltage and reduces the energy loss Esw(off). The trade-off between Eoff and VCE(sat) is achieved by optimized chip design shown in Figure 2. It can been seen from the trade-off curve ($V_{CE(sat)}$ vs. E_{off}) of 1200V high speed NFH-Series, the turn-off losses are reduced by one fifth to the standard 1200V IGBT module.

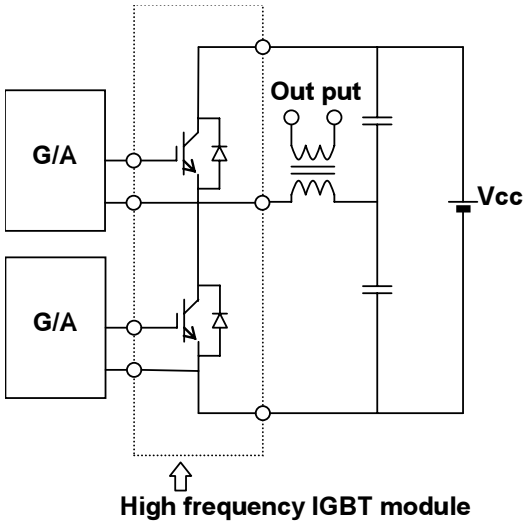

Figure 1a: Typical Half Bridge Inverter circuit configuration for the power supply using high frequency IGBTs

Another advantage of high switching frequency in these applications is that it enables to reduce the bulky size of the output transformer making it easy to handle in production, increase ultimate device reliability.

Furthermore applications such as X-Ray and welding, where medium switching frequency is required (between 15 to 30 kHz), 1200V NFM-Series shows better electrical performance with low $V_{CE(SAT)}$ and also is compatible to European standard package.

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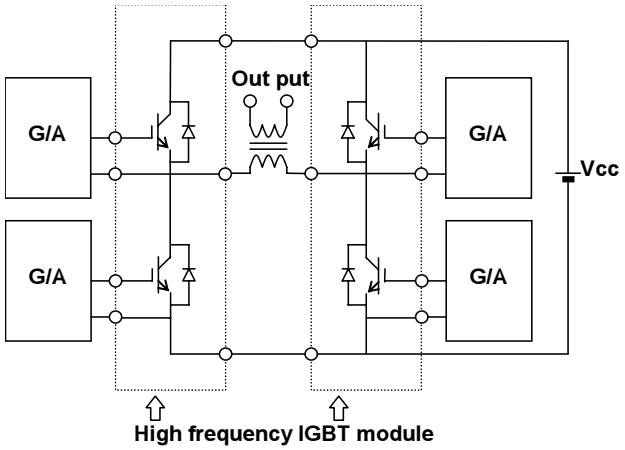


Figure 1b: Typical Full Bridge Inverter circuit configuration for the power supply using high frequency IGBTs

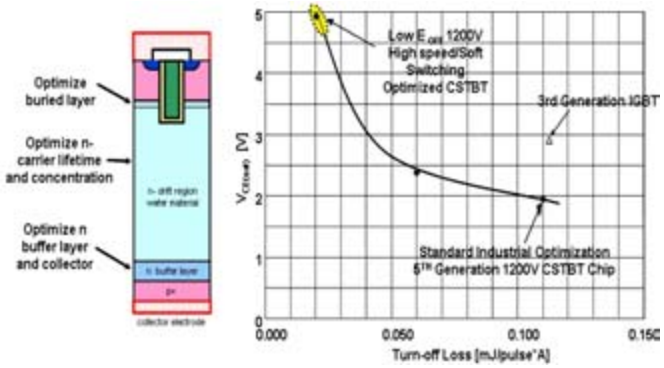


Figure 2: 1200V NFH-Series - VCE(sat) vs. Turn-off loss Esw(off)

Table 2 shows the data comparison for 1200V, 200 A Dual NF, NFH and NFM-Series.

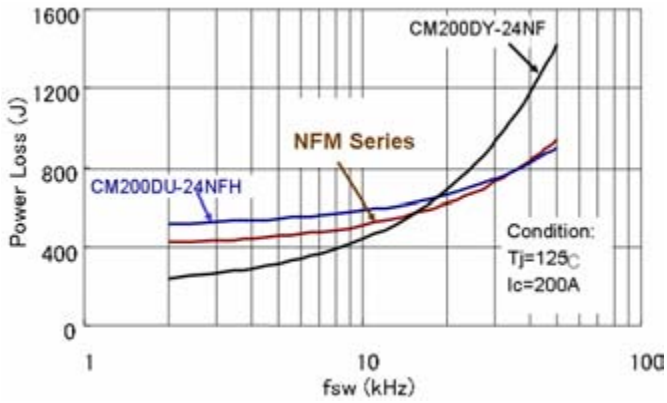


Figure 4: Comparison of NF-, NFH- and NFM-Series for power loss and switching frequency

Figure 4 shows the trade-off (Eoff vs. Vce(sat)) curves comparison for 1200V, 200A dual NF-, NFH- and NFM-Series at comparable operating conditions. The trade off between Eoff and Vce(sat) is achieved in NFH- and NFM-Series for high switching frequency operation. The turn-off performance in NFH- and NFM- is improved by reducing IGBT tail current as compared to NF-Series (shown in Figure 5).

Figure 3 shows the comparison of NF-, NFH- and NFM-Series on the basis of power loss vs. switching frequency. It depicts switching range of 15 kHz to 30 kHz NFM-Series has lower power loss while about 30 kHz NFH-Series is advantageous.

1200V/200A Device @125˚C (typ.)		
$V_{CE(sat)}$ (V)	5.0	3.0
Eon (mJ/p)	15.0	15.0
Eoff (mJ/p)	9.0	13.0
Esw (mJ/p)	24.0	28.0
Applicable Freq.(kHz)	30 - 60	15 - 30
Application	IH,MRI	Welder, X-ray

Table 2: Comparison of electrical parameters of NF, NFH and NFM-Series (Operating conditions: Vcc = 600V, VGE = ±15V, Rg=1.6 Ù)

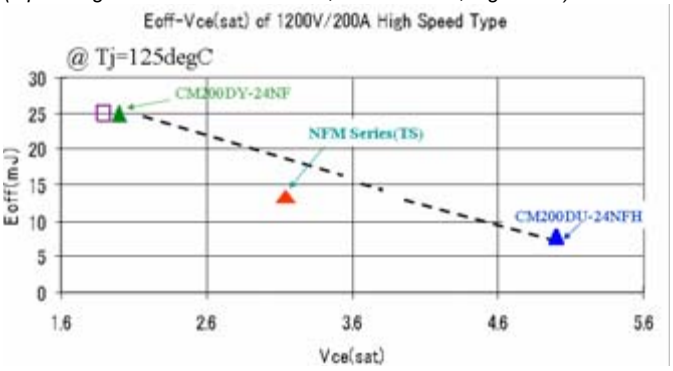


Figure 3: Trade-off curve comparison of NF-, NFH- and NFM-Series

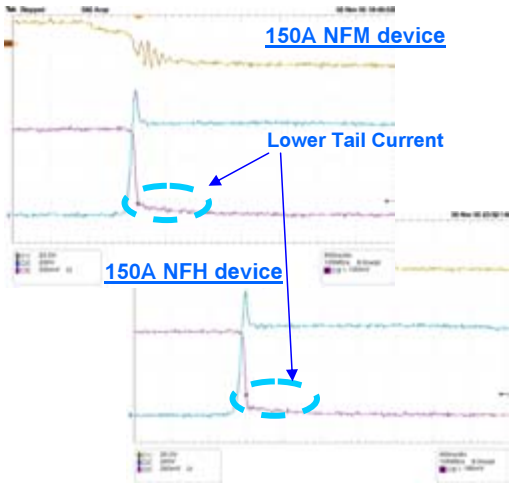


Figure 5: Turn-off waveform of 1200V/150A NFM- and NFH- Series @ Tj = 125°C

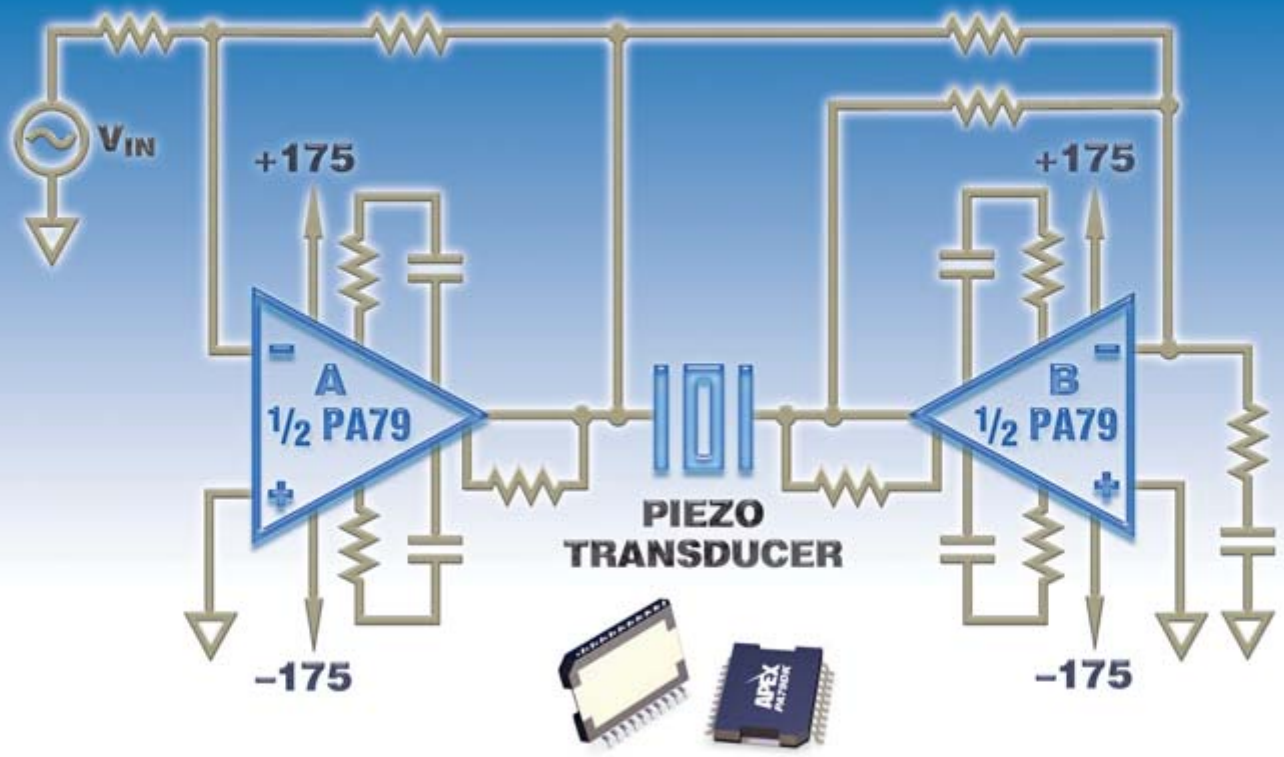
The main difference in the NFH- and NFM-design is the diode chip. NFH-Series uses the diffusion type diode while NFM employs an epitaxial diode. The use of epitaxial diode in NFM-Series reduces the diode reverse recovery tail current and the reverse recovery losses. Due to these features NFM-Series has enhanced performance especially in resonant operations.

Conclusion:

In high frequency applications, Mitsubishi's NFH-, NFM series proves a high performance, high reliable, robust, & compact solution. Mitsubishi Electric as a leader in the development of power semiconductor technology is constantly following the demand on the market for delivering high performance, high reliability and compatible modules.

POWER, PERFORMANCE, VALUE

Precision ICs



Dual High Voltage Power Amplifier In Bridge Mode Delivers 2X Speed To Drive Piezos

Model	Supply Voltage V	Output Current mA	Slew Rate V/µs	Power Bandwidth kHz	Production Volume Pricing 10k pcs USD
PA79 Dual	±175	150 X2*	350	200	$23.90
PA78EU	±175	150	350	200	$24.85
PA86EU	±125	150	350	200	$18.15
PA69EU	±100	75	350	200	$11.35

* The DUAL PA79DK is capable of 150mA per amplifier. Circuit design and packaging can limit output current. MAX power dissipation is 14W per channel. PA78EU, PA86EU, PA69EU power dissipation is 23W MAX.

Dual power amplifier features two high voltage, high speed amplifiers in a single surface mount package to deliver twice the 350V/µs slew rate

Piezo drives thrive on combinations of high voltage and high speed. The dual PA79 doubles up on output voltage swing and slew rate when used in a bridge connection circuit while being well suited to applications with low supply voltages, or those operating near maximum voltage ratings. It can also serve as both a modulation and charge amplifier in applications utilizing multiple drivers such as inkjet printing. To save on board space, the PA79 houses two amplifiers in a 20-Pin PSOP surface mount package.

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Unique Pressure Indicating Sensor Film Aids Circuit Breaker Production

Sensor Products Inc. presents Pressurex®, a tactile pressure indicating sensor film that quickly and accurately maps and measures pressure distribution and magnitude between any mating or contacting surfaces.
Recently a major manufacturer of circuit breakers searched for a mechanical method of checking contact alignment and surface pressure of a series of moving contacts that mated to a stationary contact bar.

They used Pressurex® to see whether each contact was making at

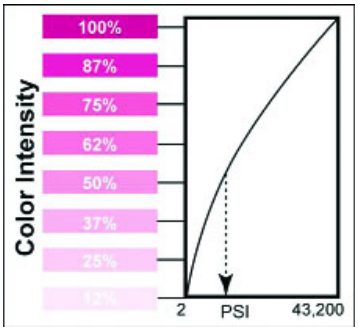

Figure 2: Color Intensity Reveals Pressure Distribution of Pressurex® Film

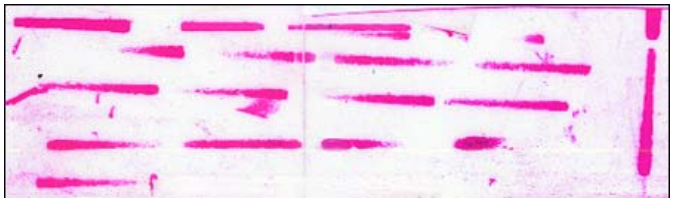

Figure 1:Aligning Contacts in a Circuit Breaker Using Pressurex® Film

least a 70% mating of contact surfaces. If it was found to be less than 70%, the manufacturer made a series of adjustments to correct the alignment, each time verifying the markings the contacts made on the Pressurex® film. The manufacturer said they knew of no other product that could let them see markings of the individual pressure distribution of the contacts so that they could manually assemble the circuits. Pressurex® is now being used as part of their quality control protocol.
Pressurex® film measures pressure from 2 - 43,200 PSI (0.14 - 3,000 kg/cm²). When placed between two contacting or mating surfaces, it instantaneously and permanently changes color. This color change is directly proportional to the actual pressure applied. Precise pressure magnitude is easily determined by comparing the resultant color intensity to a color correlation chart (conceptually similar to interpreting Litmus paper). No training or instrumentation is required.

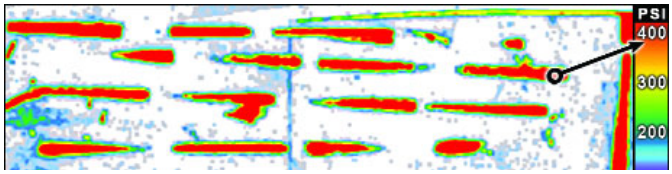

Figure 3:Topaq® Image Analysis provided by Sensor Products further revealed the precise magnitude and distribution of the surface pressure

Bottom row shows just one contact in a set of four made a mark on the Pressurex®. On further adjustments, 2nd row from bottom shows fair markings, possibly 60 – 70% contact area. 3rd row from bottom shows even more contact markings, 70% +. The 4th and 5th rows from bottom show further adjustments made significant changes in area of contact marking. The top or 5th row could be considered 70%, even though the right hand mark was slight. After a series of test operations, the markings would look like the 3rd row.

Pressurex® is also a useful tool for analyzing contact uniformity in the design and production of printed circuit boards (PCB) assemblies. In wafer fabrication, Pressurex® is often used to verify flatness, revealing lamination press problems caused by inconsistent bonding pressures. It can successfully predict and evaluate load distribution, revealing problems such as the overloading of connector contacts, standoffs, and component solder joints.

Pressurex® is ideal for dozens of electronic and industrial applications, such as assessing contact inconsistencies in heat sinks, gaskets, clamps, connector, bolted joints, heat sealing elements, nip rolls and welding heads. New uses for Pressurex® are discovered daily.
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Sensor Products is headquartered in New Jersey, USA and established in 1990, Sensor Products Inc. is a world leader in the manufacture and distribution of tactile pressure sensing solutions. Their customized and off-the-shelf products are installed within all of the Fortune 500 industrial companies as well as thousands of smaller manufacturing firms. Their sensors are used in applications as diverse as tire testing to semiconductor manufacturing and from R&D labs to space missions. Additionally, Sensor Products provides in-house and on-site stress and pressure mapping analysis, as well as a variety of regional technical seminars.

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New Applications for Optical Sensors

Triangulation sensor instead of camera

Infrared sensors that work using the triangulation principle also measure accurately on reflective surfaces and are not affected by either light scatter or high temperatures. When used with a pyroelectric resistor, the wide-angle versions can even distinguish between people and objects. They can therefore be used in applications for which only image processing has previously been possible.

By Andreas Biß; Product Marketing Optoelectronics; Sharp Microelectronics Europe

Up to now optical sensors have mainly been used in printing and copying systems. Depending on the model and design, however, detectors of this type can also be used in other applications in which it is necessary to recognise objects. They could be used in industrial plants, vending machines and cash dispensers, in sanitary applications or in vehicle interiors. Infrared (IR) sensors can trigger predefined switching processes and can be used with wide-angle sensors to control robots. Previously, only cameras were able to record objects and environments in three dimensions. What is more, the efficiency of camera technology is undisputed and image resolution is high even over a distance of several hundred meters. The optical imaging method has disadvantages, however. For example, maintenance costs are high as the appliances are sensitive to contamination. In addition, processing image data takes up computer capacity and cameras are more expensive than IR sensors. They are therefore not suitable for price-sensitive applications. Many applications also do not need high-resolutions sensors, for example if they only need to detect objects and estimate their distance.

Angle measurement increases accuracy

Many object detection applications can make do with a simple IR distance meter. Sharp offers a wide range of such meters with analogue and digital distance-measuring sensors (DMS). Depending on the model, they have a range of between 4 mm and 500 cm. Unlike traditional IR sensors, which use the intensity of the reflected IR beam to determine the distances, Sharp sensors use trigonometry. This means that they determine the distance to the object using the angle at which the reflected light reaches the detector. This new generation of sensors is based on the "Position Sensitive Device" (PSD) developed by Sharp, which records the reflected beam at different points on the PSD surface. The electrical currents I1 and I2 (Figure 1) that are generated are directly proportional to distances d1 and d2 between the point of impact of the beam and the outside edge of the PSD. This means that the distance can be clearly assigned to an output voltage. In analogue sensors, an internal circuit converts the PSD signal into an equivalent voltage between 0.4 and 2.4 V. In digital sensors, the logic state of the initial output pin changes as soon as a predefined distance threshold is reached (Figure 2). Compared with traditional distance sensors this mode of operation offers very accurate measurements and long lifetime. Furthermore, measurements are not affected by light scatter or temperature fluctuations or distorted by colours or reflective surfaces. Even rapidly-moving objects cause little or no distortion, depending on the application and type of sensor. Such distinctions are easy for the human eye, but this is an outstanding performance for an optical sensor, especially since it only operates with the monochrome infrared light of an LED.

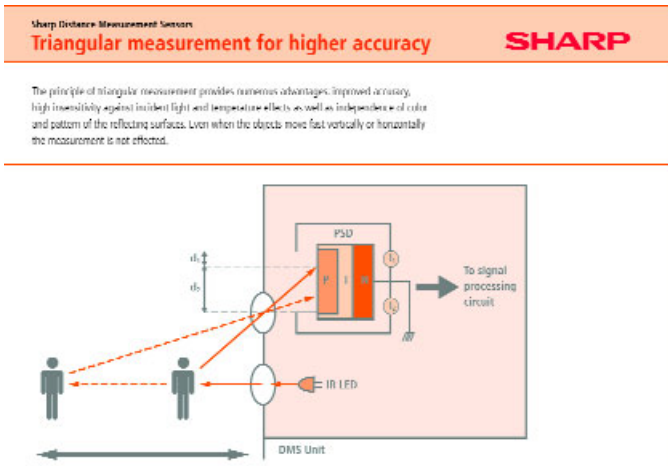

Figure 1: Position Sensitive Device

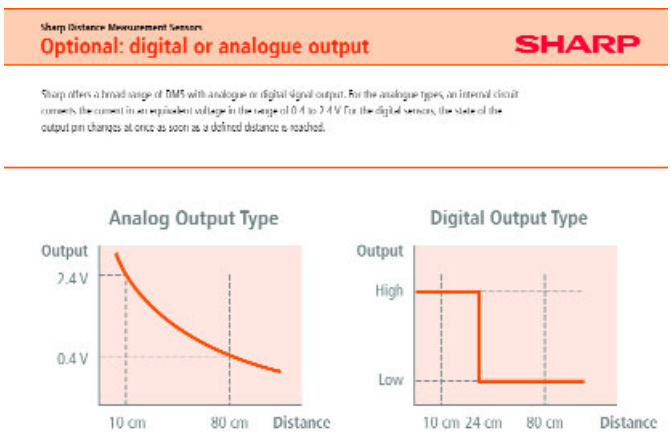

Figure2: Digital sensors changes as soon as a predefined distance threshold is reached

Short reaction time, wide temperature range

A distance-measuring sensor tolerates different surfaces and movements. This has advantages for many measurements. DMS are used to check the filling level of containers in filling systems, for example. As many different products are processed in modern plants, each product has to be monitored reliably. It is important to avoid overfilling with apple juice, for example, and bottles of cherry juice should not leave the factory half-full. The filling system needs to be reset for each change of product if gravimetric methods are used. However, this is not the case with IR sensors, as the system does not need to be reset even if the products to be checked have different densities. As long as the bottle shape remains the same, there is no change to the filling level for a predefined volume. On the other hand, the originally weighed in quantity may be different for each product. Another important factor is that the filling level is the same for the 100,000th bottle or the first bottle.

Measuring, counting and switching

In addition to an operating temperature of – 40 to + 130 °C, the short reaction time of only 8 m/s is also an advantage for distance sensors. This enables them to achieve a switching cycle of at least of 32 ms and record up to 30 parts per second. This is sufficient for many industrial production processes. This means that as well as measuring filling levels in filling systems and drink vending machines, the distance meters are also suitable as counters on conveyor belts or as sensors for controlling industrial robots. As a result of the wide operating temperature range Sharp DMS can be used even in situations where there a great amount of process heat is generated. In addition, DMS can be used as proximity switches to activate a vending machine or information terminal as soon as it is approached by a user. When the user moves away, the machine switches back to electricity-saving standby mode. DMS are therefore a simple and cost-effective way of saving electricity, particularly for machines that are only used sporadically. In vehicles, distance sensors could be used as dimmers for interior lighting or for selectively controlling ventilation and air-conditioning. The system could automatically detect which seats in a car are actually occupied and direct the cooling flow of air only towards the occupied seats. Optimising the use of the air-conditioning system in this way will reduce petrol consumption, especially if the driver is the only occupant of the vehicle. Sharp now also offers a battery-operated DMS for sanitary applications. They are suitable for use where there is no power supply available or where electricity cannot be supplied for safety reasons - in rooms where water is present, for example. They are already used in automatic toilet flush systems, taps, hand-driers and paper dispensers.

Infrared eyes instead of a camera

Wide-angle sensors (WAS) are a further technical development of distance meters. Wide-angle sensors contain five DMS units, which are arranged horizontally with an aperture of 25°. This means that a WAS is not only able to detect the fact that an object is approaching, but also the direction from which it is approaching. If a number of DMS units are used, the aperture can be widened to up to 90°. Distances of 4 to 30 cm, 20 to 150 cm or 40 to 300 cm can be determined, depending on the type of sensor. The sensor that is suitable for long distances measures 53 x 20 x 21 mm3. Shorter-range models measure 41 x 20 x 21 mm3. If a WAS is also equipped with a pyroelectric sensor, it can distinguish between people and objects based on the differing levels of thermal radiation. The heat radiation is detected using pyroelectric crystals, which respond to changes in temperature with a change of status. Intelligent wide-angle sensors are therefore suitable as a cost-effective alternative to camera systems, for controlling self-propelled robots, for example. Sharp is currently supporting a development project, in which autonomous robots are used to measure buildings. This shows how useful it is for a WAS to be able to distinguish between people and objects and not to be sensitive to different surfaces and movements. If a robot encounters obstacles such as walls or items in a room during measurement, it will avoid them. If a person approaches, the robot will detect that it is a person on the basis of thermal radiation and wait until the person has moved out of the reception range before continuing its work. This means we are that much closer to the concept of robots not just measuring but also cleaning buildings as if by magic.

Figure 3: Wide-angle sensors (WAS)

Figure 4: Distance-measuring sensors (DMS)

Summary: you don't always have to go for the expensive solution

The high-resolution recognition of objects and people is not needed in many areas of automation technology. For this reason, distance-measuring sensors and wide-angle sensors are often a perfectly adequate and, above all, cost-effective alternative to camera systems. By combining them with pyroelectric sensors to distinguish between people and objects, the DMS or WAS can also function as sensors for self-propelled robots.

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Multiphase Buck Converters

Phase management optimize efficiency

New microprocessors, DSPs and ASICs demand more and more current while supply voltages decrease. At the same time load transients in the 500A/us range are not unusual. Even during these transients the voltage to the processors has to stay within a narrow window, often +/-3%. In order to fulfill these requirements special power supply architectures such as multiphase converters are deployed.

By Marcus Zimnik, Texas Instruments

This article highlights the benefits of multiphase buck converters and important aspects that need to be considered. Also enhancements to the multiphase concept such as single cycle phase balancing and phase shedding are discussed. A design example concludes this article.

Differences between a single phase and a multiphase converter

A multiphase converter consists of paralleled power stages, which drive a common load. By phase shifting the PWM signals to the converter power stages, or "channels", several advantages over a single power stage including lower current ripple on the input and output capacitors, faster transient response to load steps, improved power handling capabilities, and higher system efficiency are obtained. These benefits are discussed in more detail in the next sections.

Figure 1 shows the block diagram of a 2-phase interleaved buck converter and its appropriate waveforms.

Benefits gained by interleaving power stages

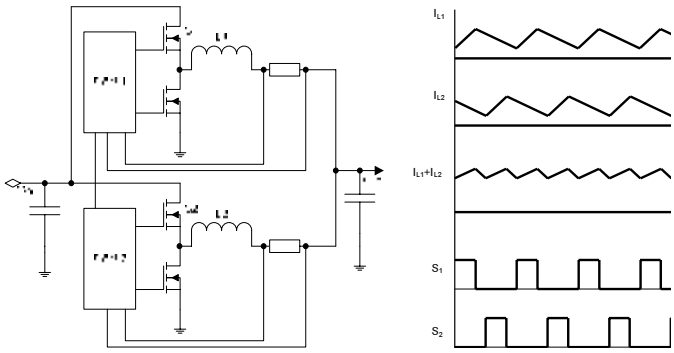

Figure 1: A 2-phase buck converter and waveforms

Output ripple current reduction

One of the main benefits of interleaved buck converters is output ripple current reduction. By phase shifting the PWM control signals to each other, the inductor ripple currents of the power stages tend to cancel each other out. The amount of ripple current cancellation depends on the operating duty cycle, thus the Vout/Vin ratio. Figure 1 shows this for a dual phase buck converter. The sum of the inductor currents is smaller than the individual inductor currents. In case of a 50% duty cycle operation, the inductor currents of a dual phase buck converter cancel out completely – provided both channels share the exact same amount of ripple current amplitudes.

The cancellation factor for an n-phase converter is defined as:

$$K_i = \frac{\Delta I_L}{\Delta I_{LCH}} = \frac{N \cdot (D - \frac{m}{N}) \cdot (\frac{m+1}{N} - D)}{D \cdot (1 - D)}$$

where D=Duty Cycle, N=Number of phases and m = floor(N*D) is the maximum integer that does not exceed N*D.

Figure 2 shows the output ripple current cancellation over duty cycle for different amount of phases.

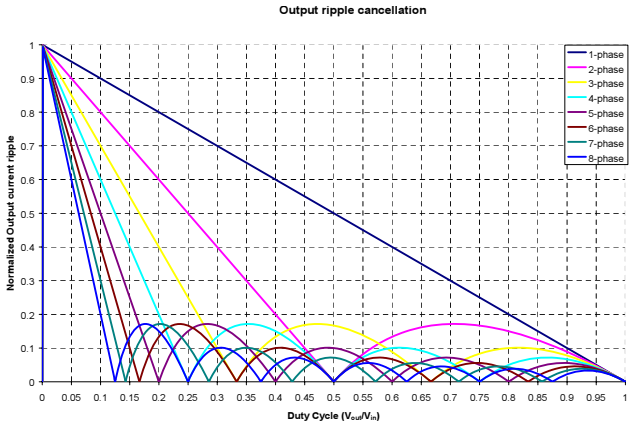

Figure 2: Normalized output ripple current vs. duty cycle, $\Delta I_{ripple} = \frac{V_{out}}{L_{eff} \cdot F_s}$

Output ripple voltage reduction and relaxed output capacitor requirements

The cancellation of inductor ripple currents result in a smaller ripple current flowing into the output filter capacitors. This means that higher ESR capacitors can be used to fulfill the same output ripple voltage requirements. At the same time the output ripple current frequency is multiplied by the number of phases, e.g. the output ripple current frequency of a 4 phase interleaved buck converter exhibits 4 times the individual channel switching frequency. Therefore, the capacitance value of the output capacitors can be reduced. As a result of that, a change in capacitor technology can be considered, e.g. from tantalum or polymer organic capacitors to low ESR ceramic capacitors [3]. Even though the multiphase buck converter approach supports actually higher ESR capacitors, load transient voltage requirements usually demand low ESR capacitors to minimize voltage over- and undershoot. Modern multilayer ceramic capacitors with very low ESR values and moderate capacitance levels fulfill both requirements perfectly.

Input ripple current reduction and relaxed input capacitor requirements

Buck converters have discontinuous input currents since the control switch is placed between the DC input source and the inductor. A capacitor at the input supplies the pulsating current to the buck converter. Interleaved buck converters spread the on-times of the high switches over the switching period and the current flowing through the input capacitor is reduced significantly. Figure 3 shows the normalized effect of input ripple current reduction over duty cycle for different phase configurations. Note that the input ripple current reduction due to interleaving never reaches zero because the inductor ripple current is always present. This is graphically explained in figure 4. The switching frequency seen by the input capacitor is the channel switching frequency times the number of channels. A more detailed analysis of the input capacitor current is performed in [3-4]. The effect of input current reduction relaxes the requirements for the input filter capacitors in terms of capacitance and ESR. In real world applications, however, the input capacitor should be placed as close as possible to the input power stage to minimize parasitic inductance. This means that each channel will have its own input capacitor, but with the advantage that the actual current ripple is almost reduced by the number of channels.

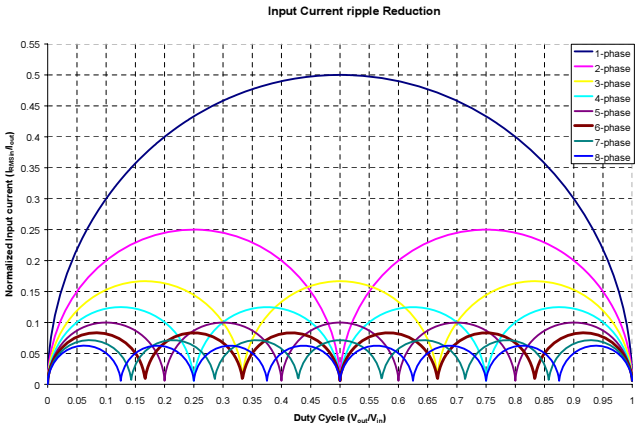

Figure 3: Normalized RMS input ripple current vs. duty cycle

Improved load transient response

Interleaving buck regulators has an improved effect on transient response. From the large signal point of view it is the ripple current cancellation at the output of the interleaved buck converter. Each phase is allowed to increase the magnitude of ripple current by reducing the channel inductance. A smaller inductor allows for higher di/dt rates giving the greatest benefit in transient response recovery. When a load drop is being viewed, there is a large amount of energy in the inductor transferred into the output capacitors. When more phases are added, there is less energy to "ring" the output voltage higher because the energy storage decreases as the square of the current through it. By increasing the number of phases, the current per phase drops by 1/n.

During a load step increase, the single-phase converter has a response time quite a bit slower than multiphase converters because the output inductance is the highest.

From the small signal point of view it is the increase in the output ripple frequency by the number of channels, which allows the control loop to have a greater bandwidth, resulting in faster transient response.

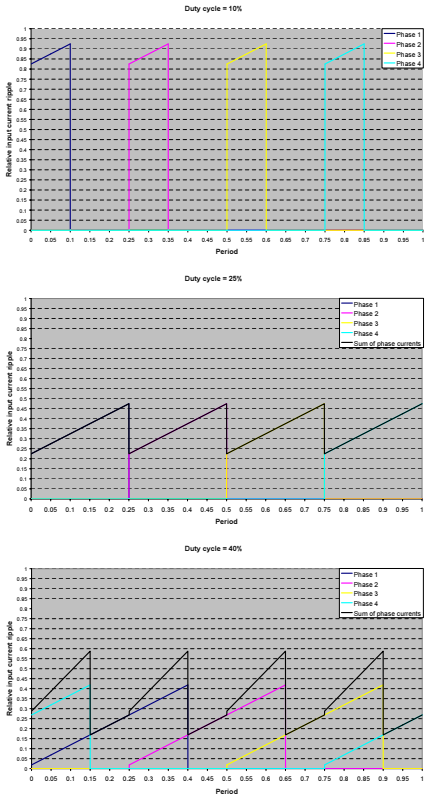

Figure 4a -c: Input currents for a 4-phase interleaved buck converter operating at different duty cycles (not to scale)

Other benefits

The multiphase buck converter topology has more packaging advantages. Each channel converts power at a fraction of the single phase buck converter, which reduces the size of the inductors and power MOSFETs used in the design. Along with the reduction in the number of input and output capacitors this allows for lower profile designs and better heat distribution. Smaller power MOSFETs reduce dynamic losses due to smaller parasitic capacitances. Together with lower losses in the capacitors due to the ripple current cancellation, higher efficiencies can be achieved. Now, a trade off between higher efficiency and smaller size by increased switching frequency can be made.

Important considerations for optimum multiphase converter performance

Optimum phase number for minimizing the ripple currents

It can be seen from Figure 2 and 3 that several local minimums exist for each phase number. The best ripple current cancellation is reached whenever the ratio Vout/Vin (or the duty cycle) is near to a local minimum for a selected phase number. The optimum number of phases is derived by calculating the duty cycle and finding the phase number which has their local minimum close to the given duty cycle.

An example: Vin = 12V, Vout = 1.5V thus the duty cycle is 12.5%. An 8-phase converter has its first local minimum at 1/8 = 12.5%. In the case of similar Vin = 12V but Vout = 3V the duty cycle becomes 25%. Now a 4-phase converter (1/4 = 25%) and an 8-phase converter (2*1/8) will be a good match. Whether the 4-phase or 8-phase converter is chosen depends on the input voltage range. For a narrow input voltage range the 4-phase converter is most likely sufficient. If the input voltage varies over a wide range, then the 8-phase convereter might be considered instead.

Phase current sensing and current balancing

One challenge in designing a multiphase converter is ensuring that current is properly shared between phases. A significantly disproportionate amount of current in one phase will stress components and degrade their lifetime.

Per-phase current sensing can be achieved by monitoring the current through the MOSFETs, or by sensing the current through a shunt resistor placed in each phase. The MOSFET method is inexpensive, but it is inaccurate because MOSFET resistances vary significantly over process and temperature. The current shunt method is quite accurate, but adds cost and decreases power-supply conversion efficiency.

Another popular method for extracting per-phase current information is to use the DC resistance (DCR) of the inductor as the current-sense element. This approach does not add cost because it makes use of an existing circuit element and provides good accuracy depending on the DCR tolerance. This method is employed in all Texas Instruments multiphase buck controllers.

Especially heavy varying loads such as processors challenge the current balancing mechanism of multiphase buck controllers. Ideally current imbalances are regulated within a clock cycle. Texas Instruments multiphase controllers such as the TPS40131 / TPS40090/1 and TPS40140 feature high accuracy (<5%) cycle by cycle current sharing in output phases over the entire load range [5]. This allows for minimal over-sizing of output MOSFETs and prevents catastrophic failures due to imbalanced load distribution. Single cycle current balance forces the current in each phase to be balanced within a switching cycle.

Phase Management

Phase management performs phase shedding to optimize efficiency over the load range. It turns on or off phases of the power supply so that only the phases required to power the load are enabled. At the same time, loop response is tailored to achieve acceptable transient response over the load range. With phase management efficiency improvements up to 30% can be achieved. This feature is implemented in Texas Instruments Digital Power Point of Load System Controller UCD9240 [6-7].

Remote output voltage sensing

Another important aspect is the voltage regulation at the point of load. New processors only allow +/-3% voltage tolerance for proper operation. Since multiphase buck converters usually supply high current demanding loads, voltage drops across PCB traces between the output of the power converter and the load are more likely. These voltage drops are compensated by the power converter via remote output voltage sensing. Differential remote output voltage sensing is the most accurate and robust method because it rejects ground shifts. All Texas Instruments multiphase buck controllers have differential remote output voltage sensing capability.

Design example

Three buck power supplies according to the specs listed in table 1 have been calculated to show the positive effects of interleaving buck power stages. The design has been calculated for a single phase, a dual phase and a quad phase converter. The results are listed in table 2 for comparison.

The design example shows the positive effect interleaving has on ripple current cancellation and on efficiency. The 4-phase converter operates close to a local minimum (see figure 2 + 3) and requires the least amount of capacitance and also allows for the highest ESR in the capacitors to fulfill the ripple voltage requirements.

Input Voltage:	5V
Output Voltage:	1.2V
Minimum Output Current:	4A
Maximum Output Current:	40A
Output Ripple Voltage:	12mV
Input Ripple Voltage:	50mV
Load step:	27A
Maximum Voltage deviation during load step:	30mV
Feedback loop crossover frequency:	1/10 of combined ripple current frequencies

Table 1: Specification for design examples

	Single Phase	Dual Phase	Quad Phase
Switching Frequency/phase [kHz]	500	500	500
Inductor Ripple current/phase [A]	8	8	8
Min. L/phase [nH]	228	228	228
Selected Inductor	PA0513.261NLT	PA0515.221NLT	PA0515.221NLT
Lsel [nH]	260	225	225
DCRLsel, typ [mOhm]	0.32	0.63	0.63
Selected Inductor Ripple current/phase [A]	7.015	8.107	8.107
RMS current in selected Inductor/phase [A]	40.051	20.063	10.27
Inductor Power Loss/phase [W]	0.513	0.255	0.066
All Phases loss [W]	0.513	0.51	0.264
Input ripple voltage [mV]	50	50	50
RMS current in input cap [A]	17.112	10.123	3.016
Required min Cin Capacitance [uF]	451	231	115
Required max. Cin ESR [mOhm]	2.9	4.94	17
Power Loss for min. required input cap [W]	0.856	0.506	0.155
Output ripple voltage [mV]	12	12	12
Ripple Current in Output Cap	9.231	7.298	0.561
Required min Cout Capacitance [uF]	192	152	12
Required max. Cout ESR [mOhm]	1.3	1.644	21
Power Loss for min. output required cap [W]	0.111	0.0876	0.0066
Minimum Capacitance for load step [uF]	886	443	221
High Side FET Loss			
Number of High Side FETs/phase	2	1	1
Selected High Side FET	IRF6636	IRF6620	IRF6636
Conduction Loss/FET [W]	0.62	0.381	0.163
Switching Loss/FET [W]	0.44	0.431	0.14
Qoss losses/FET [W]	0.013	0.02	0.013
Qrr losses from Bottom FET Diode/FET [W]	0.113	0.113	0.033
All High Side FET loss (over all phases) [W]	2.372	1.89	1.396
Low Side FET Loss			
Number of Low Side FETs/phase	2	1	1
Selected Low Side FET	IRF6727	IRF6727	IRF6620
Conduction Loss/FET [W]	0.785	0.794	0.314
Body Diode Loss/FET [W]	0.385	0.385	0.2
Qoss losses/FET [W]	0.035	0.035	0.02
All Low Side FET loss (over all phases) [W]	2.41	2.428	2.136
Total Gate Driver losses (High+Low Side FETs) [W]	0.36	0.435	0.56
Controller loss [W]	0.05	0.05	0.05
Total Converter Loss [W]	6.67	5.91	4.57
Total Efficiency	**87.80%**	**89.04%**	**91.31%**

Table 2: Comparison of the calculated results for single, dual and quad phase converters

The capacitance for the load step has been calculated by taking into account the loop crossover frequency. The loop crossover frequency was chosen 1/10 of the effective output ripple frequency, thus 50kHz for the single phase converter and 200kHz for the quad phase converter.

The ripple current was kept equal at about 8A per phase. In a real world design this might be chosen higher for the dual and quad phase converter in order to minimize the inductor and further enhance large signal transient response. The inductors and MOSFETs for each configuration have been selected solely for highest efficiency achievements.

Summary

Multiphase buck converters are an interesting alternative for high current applications due to their advantages in terms of dynamic response, output ripple cancellation, thermal management and optimized design.

They minimize the amount of capacitance for input and output capacitors while relaxing ESR requirements due to ripple current cancellation. At the same time they offer better response to load steps while enhancing efficiency and heat distribution. Digital controller solutions further enhance efficiency by phase management. Single cycle current balancing reduces component stress and further minimizes component size.

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Nd-Fe-B Magnets are Going Offshore in Wind Mill Generators

Wind Energy in Europe: Status, Hints and Potentials

Using permanent magnets in wind mill generators may be of advantage regarding total weight and in special designs even the possibility to incorporate reliable easy gearboxes to reduce maintenance, effort and costs.

By Dr. Denis Rollik and Bernd Schleede
Vacuumschmelze GmbH & Co. KG, Hanau, Germany

The use of Wind Energy has a long history. Besides the possibilities of driving mechanical gears, such as grain mills or water pumps, the combination with a generator to produce electrical energy has been in focus from the very beginning. With today's electronic possibilities, it's no problem at all to run a wind mill generator in such a way, that the power is directly fed into the power-line network. Based on today's technology the selection of the location to erect the wind mill is more or less independent from the location of the energy consumer. Therefore the general trend is to increase the size and power of the individual wind mill, select an near- or off-shore location to erect the tower / mast and focus on extremely reliable and maintenance free operation. Especially when operating off-shore the maintenance issue becomes an overruling factor, since maintenance or even replacement of major components such as gears or generators are virtually impossible. In Europe the possible locations of erection is decreasing, due to the fact that the regions, where the wind is sufficient to operate a wind mill effectively, are limited. One of the key arguments against wind mills are the noise emission and optical appearance which mutilate the landscape. At least these arguments are of minor impact for off-shore installations.

In general the average size of a wind mill is continuously growing to sizes of up to 5 MW or even 7 MW as recently announced by GE. For all sizes these generators may be of asynchronous or synchronous type. In case of a synchronous generator the excitation is either electrical or with NdFeB permanent magnets.

The total capacity of installed wind mills in Europe is predicted to increase dramatically within the next 15 years:

2003 installed	28 GW	On-shore	+ 1	GW Off-shore
2010 predicted	65 GW	On-shore	+ 10	GW Off-shore
2020 predicted	70 GW	On-shore	+ 70	GW Off-shore

EWEA figures (set in 2003)

Assuming almost all off shore installations to be in the range of 1 MW to 5 MW of power and considering per today only 1 GW of off shore installation is in place, EWEA expects almost the full load of 70 GW off shore to be erected within the next 15 years. By adding only 30 GW of the on shore potential, we end up with about 100 GW of power all in all. Assuming an average power level of 3.5 MW per wind mill we are looking forward to about 30,000 installations of high power wind mills (> 1 MW) during the upcoming 15 years in Europe. Not counting a possible demand in South East Asia and the USA, no doubt this industry may be one of the fast growing industry world wide.

A share between the different generator types is still uncertain. Even only with an estimate of 15% of installations using NdFeB permanent magnets a total market in Europe may be foreseeable of about 30 mil € / year for the next 15 years.

In some cases permanent magnets have been mounted on rotors to build a synchronous generator.

While the asynchronous high power generator (up to 5 MW type) wind mill needs a very heavy gear box with the weakness that at "high load @ high speed" failure may occur, a synchronous type may only use a simple lighter reliable gear. Thus in the case of off-shore erection the risk of additional maintenance can not be neglected.

Comparison of technologies for 4 -5 MW wind mill generators

Direct drive

Currently there is only one manufacturer on the market with a direct driven 4.5 MW windmill:
ENERCON ® E 112 with a 114 m diameter of the blades and a height of 124 m of the rotor axis. The big diameter ring is directly attached to the hub and has a typical speed of 6 to 15 rpm. The unique design of the ring generator has a diameter of about 8 m and is electrically driven. In principle this electric excitation could be directly replaced by NdFeB permanent magnets. Such a design change could save up to 70 tons of weight (copper and steel).
The application of permanent NdFeB magnets of such design has been proven in several prototypes e.g. VENSYS ® of 1.5 MW without any problems.
For off-shore application the additional weight is a major handicap for this type of design. The high weight of the nacelle calls for a more stable / stiff and heavier tower especially with high gust of wind, which is typical for off-shore application. This may cause severe problems apart from leading to higher costs in construction and maintenance.

Standard gears 1 :100 to 1:200
The traditional construction of big wind mills is using a gearbox to increase the speed of rotation level by a factor 100 to 200 from typical 12 rpm to 2000 rpm. The asynchronous standard generator – even for 5 MW – is rather small at such a high level of rotational speed. The majority of today's wind mills are equipped with such combinations of gearboxes and generators. The maintenance of the gearbox contributes to the majority of the maintenance-costs. High gust of wind may be a risk especially when operated off-shore.

With planetary gear 1 : 10
As a "hybrid" between the two a.m. concepts a solution has popped up recently based on a single and reliable one stage planetary gear and thus a generator running at 50 to 200 rpm. This so called "MULTIBRID" concept has the lowest weight of all three solutions and has been successfully tested in installations of 1 MW, 3 MW and 5 MW. All three sizes of generators are produced by using NdFeB permanent magnets (typically VACODYM® 655) sub-assemblies. A solution with electric excitation is not being considered.

Outlook
All three principle designs are competing against each other in the market. In all three cases, solutions with or without permanent magnets are feasible. Considering the total costs per device of appr. 4 mil € and the typical costs of NdFeB permanent magnets assemblies being a share of appr. 0.1 mill €, the decision in favour or against NdFeB permanent magnets can only be :
Do the future applications of wind mills call for weight reduction and reduction of maintenance, which in off-shore application may be the only reasonable solution?
In this case with the latest high end NdFeB permanent magnets such as VACODYM® 655 or VACODYM® 863 grades including latest coating VACCOAT® 10047 or VACCOAT® 20011 and assembly technology there is a very good chance for VACUUMSCHMELZE GmbH & Co. KG, Hanau , Germany, to participate in the upcoming market.

Reqirement profile for NdFeB magnets and assemblies
There are several requirements for permanent magnets and sub-assemblies which are mandatory to be fulfilled especially as soon as the devices are placed off-shore: Humidity; Salty Atmosphere and High gust winds, vibration.

Material grade
As mentioned before, the total weight is an important criteria for such machines, thus the remanence level Br should be as high as possible at a specific temperature and magnetic load line (typically VACODYM® 655 or VACODYM® 863).
Material grades to fulfil all requirements are available with most of the established and especially licensed NdFeB magnet manufacturer.

Corrosion stability
Because of the harsh environment the generator producers are calling for a corrosion resistant NdFeB grade and an appropriate coating. A typical test requirement is:
240h @ 130°C and 95% relative humidity to withstand and to prove a mass reduction of max. 2 mg / cm² for an uncoated magnet after 10 days of exposition.
In addition a salt spray resistance according to ASTM B 117 or DIN 50021 of the coating VACCOAT® 10047 or VACCOAT® 20011 is mandatory.These requirements are well known and have been proven to both VACODYM 6xx and VACODYM 8xx series with our Al-Spray coating.

Typical values for VACODYM® 6xx with VACCOAT® 10047 according to ASTM B 17 or DIN 50021 standards are:

> 96 h	coating thickness	> 5 µm
> 240h	coating thickness	> 15 µm
> 500h	coating thickness	> 20 µm
> 1000h	coating thickness	> 30 µm

Bonding procedure
As most magnets are mounted to sub-assemblies the handling and the gluing of big magnet blocks need to be performed in an absolute reliable condition.

A pure Nickel coating of the magnet may not always be the best solution, since the glue and its adhesion on a steel back-iron deteriorates due to the lack of surface roughness of Nickel.

One further item needs to be considered very carefully, the fact, that the mismatch of thermal expansion coefficient of NdFeB magnets and steel can be up to 10 x 10-6 / K, thus causing internal mechanical stresses within the glue.

Therefore we may in some case suggest to coat only 5 sides of a magnet block leaving one side uncoated to be glued directly onto the steel iron back-joke.

All this includes the selection of preferred glues, correct preparation of the surfaces, controlled curing of the glue and meaningful testing procedures for the bonding strength. The harsh environment together with the temperature shifts and all forces during assembly and operation is a challenging task for appropriate glue selection.

Mounting to Rotors and Bandaging
The last step a magnet manufacturer is typically involved in is the mounting of sub-assemblies to the rotor. This usually requires a lot of experience and a very special and unique tooling to handle high magnetic forces.

A bandage of carbon fibres / glass fibres or stainless steel hood may be applied to the individual modules prior to mounting. Alternatively the fully assembled rotor may be bandaged with a carbon or glass fibre-wrapping. In this case the mounting of the rotor into the stator is a very tricky and impressive procedure as extreme magnetic forces are to be kept under control.

Summary
The current tendency to bigger wind mills offers – at least in Europe -- a rather big market potential for high-end NdFeB magnets. On top of the pure magnet material, special know-how regarding coating, gluing, bandaging and mounting of sub-assemblies of very heavy devices is required.

Using permanent magnets in wind mill generators may be of advantage regarding total weight and in special designs even the possibility to incorporate reliable easy gearboxes to reduce maintenance, effort and costs. Especially in off-shore applications these factors will draw more attention to, as foundation costs erection time are directly linked to the overall weight of a wind mill. High gust winds need to be considered and maintenance cost need to be minimised by using high end technology.

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Digital Measurement of Inverter Efficiency

Measurements on over-modulation PWM

An inverter is a type of electric power converter which converts DC into AC. When the DC signal is converted into AC, the output is a pseudo-AC signal which is made by changing the pulse width using a switching circuit. The modulation method used to change the pulse width is called PWM (pulse-width modulation), and is illustrated by the waveforms shown in Figure1.

By Terry Marrinan, Yokogawa Europe – Test & Measurement

Bandwidth considerations

The main application of this type of inverter is motor control. Any motor presents a load in which resistance and inductance are connected in series, as shown in Figure 2. In this example, the frequency characteristic of the resistive/inductive load impedance is as shown in Figure 3. If the PWM frequency is 30 Hz and the carrier frequency is 10 kHz, the spectrum of the PWM voltage signal components and the average power components are as shown in Figure 4.

Note that the high-frequency current components are very low because of the R-L load frequency characteristic, even if the PWM voltage that has the high-frequency component is taken into the R-L load. For power measurements, the measuring instrument can look at either the voltage or the current characteristic of the frequency bandwidth. A high-frequency bandwidth is unnecessary because high-frequency components are not included in the current signal - even if high-frequency harmonics are present in the voltage PWM signal. The example of Figure 4 indicates that the measurement bandwidth need only be up to several times the carrier frequency for highly accurate power measurement. This result shows that the measuring accuracy of the fundamental frequency is more important than bandwidth for measuring the active power of the inverter drive motor.

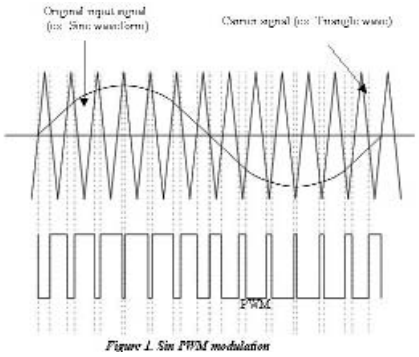

Figure 1. Sine-wave PWM modulation

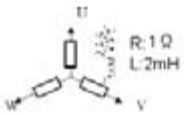

Figure 2. Equivalent circuit of motor

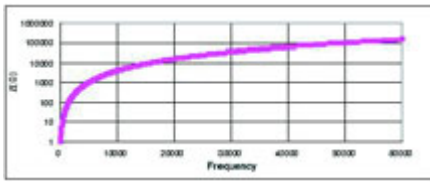

Figure 3. Simulation result: frequency characteristic of the R-L load; the impedance (Z) increases as the frequency rises

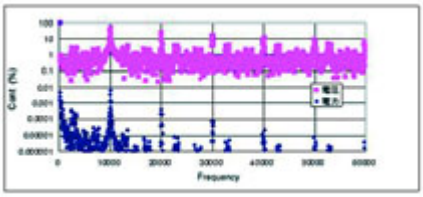

Figure 4. Simulation result of PWM operation: demodulated sine waveform at 30 Hz; carrier at 10 kHz; amplitude ratio 9 (peak of original signal) or 10 (peak of carrier signal). The vertical axis is shown in percentage of voltage and power; the fundamental frequency components are referenced to 100%. The graph shows how much percentage each frequency contributes, compared to the fundamental frequency component for both voltage and power. The harmonics components of the power signal are very small compared with the fundamental frequency component

Voltage measurement of sine-wave PWM

The fundamental frequency component of the inverter output voltage determines the drive characteristic of the motor when used with a sine-wave PWM inverter, in which the fundamental frequency component has an effect of the torque in the motor. Practical experience shows that the fundamental frequency component value of the sine-wave PWM is almost the same as the average rectified value of the original input sine wave. Hence measuring the average rectified value of the original input value is a good indication of the voltage output measurement of the inverter.

Inverter modulation and voltage measurement

In order to improve the energy efficiency of inverters, the over-modulation method of PWM is becoming popular (Figure .5). With this technique, measurements of the average rectified value (voltage mean) are likely to show that it is quite different from the fundamental frequency component value in the modulated signal. It is therefore important for measurements on over-modulation PWM to use a power meter which can measure both fundamental component and all bandwidth components.

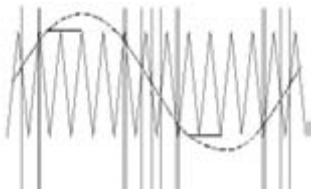

Figure 5. Example of an over-modulated PWM waveform with a modulation ratio of 2:1. The modulation ratio is the peak of the original input waveform divided by the peak of the carrier waveform

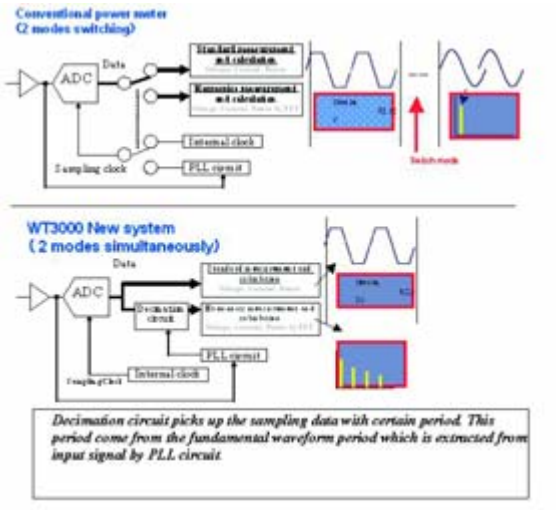

Figure 6. Simultaneous measurement of normal and harmonics parameters. The decimation circuit picks up the sampled data over a certain period, derived from the fundamental waveform period which, in turn, is extracted from the input signal via the phase-lock-loop circuit

Measuring multiple parameters

In conventional power meters, it is generally necessary to switch between the normal power measurement mode and the harmonic measurement mode in order to make multiple measurements. With the latest digital power meters, however, it is possible to measure voltage, current, power and harmonic parameters simultaneously (Figure 6). This not only eases the measurement task, but also makes it possible to correlate the various parameters over a period of time. For example, because heat generation, which changes with time, greatly influences the characteristics of the inverter drive circuitry, it is important to be able to monitor the various parameters together. Moreover, with a digital power meter that can monitor four elements simultaneously, it is possible to measure both the input DC and the output 3-phase PWM signals simultaneously. The power meter's display then allows the various parameters to be measured and displayed alongside one another.

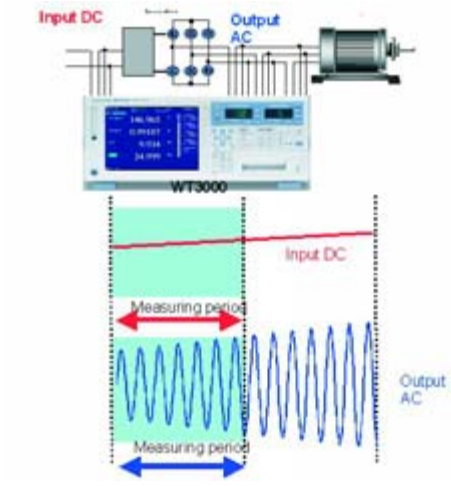

Figure 7. Simultaneous measurement of input and output

Efficiency measurement and basic power accuracy

The inverter efficiency is calculated from measurements at the input and output. To minimise error margins, the power measurements must be highly accurate. For a modern digital meter with a basic power accuracy of 0.02% of reading, even the smallest efficiency variations to be identified.

Conclusion

Inverter efficiency measurements benefit from using a modern digital power meter with high accuracy. Motor efficiency and total efficiency measurements are also aided by the availability of powerful motor/inverter evaluation functions with torque and speed input terminals. The ability to measure normal and harmonics measurement data simultaneously greatly enhances harmonics measurement, while multiple input elements mean that all input DC and output 3-phase PWM signals can be measured using a single instrument.

PIQC – Process Integrated Quality Control

Multidimensional szstem for bond qualitz control without production

An increasing number of products are focusing on zero failure targets. This implies consideration of every wire bond connection. Apart from the technical challenges for such quality targets, the increasing costs for more sophisticated and/or additional quality measurements have to be considered.

By Dipl.-Ing. H. Stürmann, Hesse & Knipps

Several different methods of monitoring bond quality have been suggested over the past 20 years. The only methods being used in industrial production at present are non-destructive pull test methods, optical inspection methods and monitoring of transducer current and wire deformation.

Deformation measurements however are only partially suitable for quality monitoring or active control systems.

A significant influence is seen in the transducer current and the movement at the tip of the wedge tool. Deviations in the movement of the tip of the wedge tool can be proven when bonding on a surface contaminated with inorganic material.

Non-Destructive Integrated Pull- and Shear Test

Mechanical non-destructive pull tests can be integrated into wire bonders and are available from several machine suppliers. With respect to increasing the certainty of bond quality, these integrated pull tests raise questions about the right choice of force to apply while pulling. Which amount of force is necessary to judge bond quality and how high is the risk of weakening a bond by the act of pulling? It also needs to be considered that the integrated pull test can only detect selected failure modes. The time necessary for this test reduces the throughput, therefore this mechanical test is often only applied under statistical considerations. The loss of throughput can reach 20 to 30% .

In addition to the pull test a bondhead integrated shear test has been available since 2007. This new bondhead (HBK 06) by Hesse & Knipps GmbH leads to a significantly enhanced transparency in considering possible failure modes.

In contrast to pull testing, the shear test measures especially the quality of the intermetallic connection. The original looping geometry remains untouched and the wire is not stressed in any location. The impact on process time falls into the same magnitude as with integrated pull testing.

Both of these integrated test methods can still not detect all of the possible failure modes.

Both methods add, beside the time for testing, some additional uncertainties which are to be eliminated by a new process integrated test method.

Process Integrated Quality Control

The goal of process integrated quality control is to monitor the most applicable and significant measures for judging bond quality.

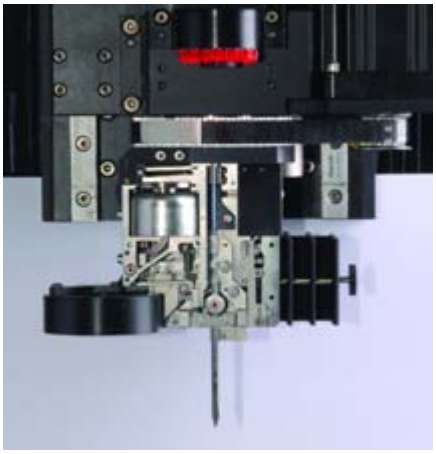

Figure 1 : Bondhead HBK06 with integrated pull- and shear test

These measures can include mechanical vibration, transducer current, wire deformation, resonance frequency and the scrub behavior during the welding process. An additional goal is to acquire this data in parallel to the bond process to avoid impact on machine throughput. This will allow a throughput neutral 100% quality control. The resulting quality control system does not rely on any statistical assumptions.

The PIQC Concept

A multidimensional control system for bond quality was designed based on patent EP 1 023 139 or US 6, 308, 881 B1. An additional sensor was added to the transducer in order to provide all relevant feedback data for calculating a bond quality value. This assures real-time feedback of the conditions at the tip of the wedge tool – especially wedge tool movement. The real-time feedback of these sensor signals through an additional interface in the DDS ultrasonic generator is realized by a new developed FPGA based circuitry.

The multidimensional control system for bond quality includes the decision relevant oscillations at the tip of the wedge tool, the transducer current, the resonance frequency, the friction and to complete the assessment also the wire deformation.

All real-time acquired feedback signals are statistically analyzed in the PIQC box based on a newly developed mathematical decision model. The control algorithms are implemented in VHDL. The new quality control system can only be applied by using the new digital ultrasonic generator developed especially for PIQC. The PIQC box allows derivation of extensive quality statements.

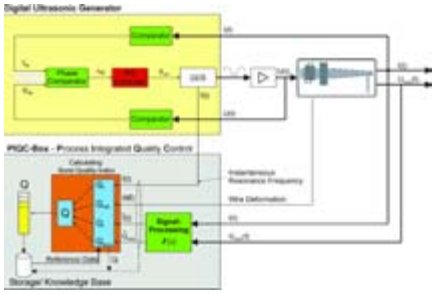

Figure 2 : The PIQC Concept

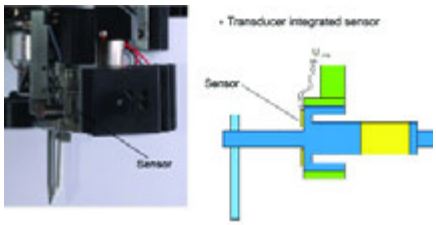

Figure 3 : PIQC Oscillation Sensor

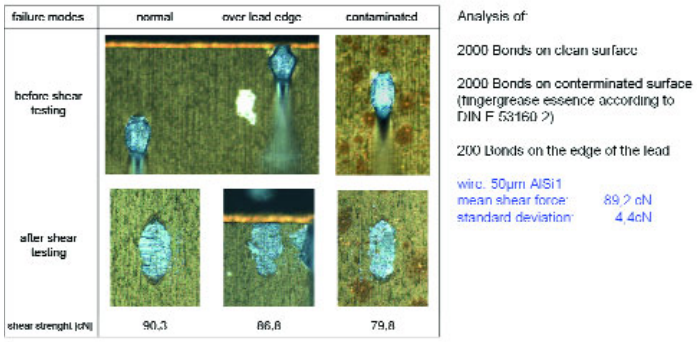

Figure 4 : Extract from test results

Quality Statements by PIQC

The signal feedback and processing allows detailed analysis of the welding process and translation into a quasi optimized reference process. The PIQC box calculates a quality index for each bond based on the actual feedback data and the reference data. Raw data and quality index can be displayed graphically at any time.

After the learning phase, the PIQC box can recognize any deviations in real-time. These can be classified and interpreted by the user. It is possible to directly link certain signal deviations to a certain failure mode.

The user is presented with a maximum amount of information. No other quality control system on the market offers such a potential in the bandwidth of acquired measurement signals as well as in the evaluation of these measurements. The most outstanding evolution lies in the real-time signal feedback of the wedge tip oscillation which is dampened by the friction during bonding.

Selected Results by PIQC

Under laboratory conditions 6000 bonds were analyzed in an experiment on contaminated and non-contaminated bond surfaces. The PIQC box was able to detect completely the pre-defined area with “good” and “bad” bonds.

Figure 5 shows exemplarily that the gained signals allow significant statements by analyzing the deviations. During the first 5 milliseconds of the welding process the signals don’t stay within the 3ó tolerance boundaries and can be easily recognized.

This shows, that the sensitivity of the integrated sensor allows to generate sufficient differentiation to separate good bonds from critical results especially bonds on contaminated surface.

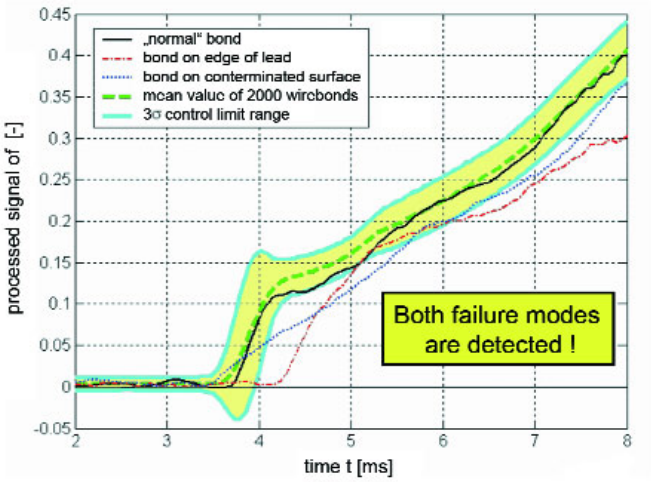

Figure 5 : Processed signals of integrated sensor

In contrast to the explained results the deformation signals or the transducer current signals couldn’t be used to identify the bonding quality differences.

The PIQC box is being tested intensively in a field test since January 2007. The production release will occur before the end of this year. The collected data not only shows process variations from changes in the surface conditions, clamping conditions of the substrate and the wedge tool can also be detected.

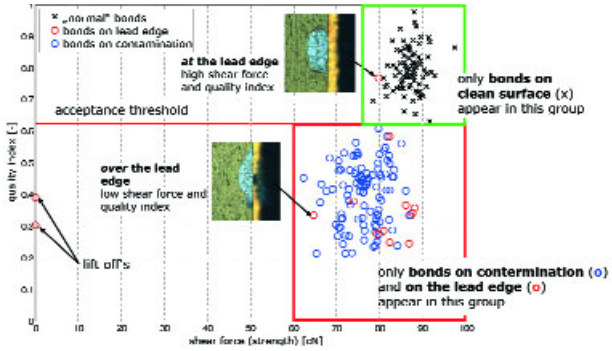

Figure 6 : Except “good / bad” bonds

Critical Assessment

The process integrated quality control system PIQC is a thorough multidimensional control system for bond quality. For the first time all physically relevant measures are evaluated in real-time with an individual quality index for result.

This method allows a new definition of possibilities in quality control especially for companies with high and fast increasing quality demands.

It certainly becomes clear that this PIQC method is introducing a change in paradigm of ultrasonic bonding quality control. For the transition phase the bondhead HBK 06 allows the use of an additional mechanical non-destructive test depending on the detected failure mode. This test will confirm a direct correlation to the detected failure mode. Mid- or long-term, the mechanical pull- and shear tests will become obsolete.

www.hesse-knipps.com

Productronica, München, 13.-16. November, Hall A5, Stand 165

Increasing Efficiency in Secondary-Side Rectification

Replacing Schottky diodes with MOSFETs

Electronic products within a broad range of applications have evolved over recent years, taking advantage of advancing signal- and data-processing silicon technologies to achieve greater functional densities. Significant developments in both IC design and IC fabrication have accelerated this trend.

By Mario Battello, Marketing Manager, iPOWIR Product Line, International Rectifier

An important consequence of these activities is that power supplies now must provide greater currents and, often, in more space-constrained environments than has historically been the case. With growing pressure on power density, supply architecture has become a greater concern in product design.
Some of the greatest power-supply challenges occur in consumer products such as game consoles, PDP and LCD TVs, LCD monitors, laptop computers, home-theatre equipment, and "headless" mini-PCs, which sell under severe price competition and enjoy short model lifetimes. These market constraints combine to severely limit the OEM's design-cycle time while increasing the need for power-supply optimization. As a result, designers must tune their supply designs more tightly or risk a competitor gaining an edge for having done so.

Finally, energy conservation has been growing in importance as a matter of public policy. Legislation such as the EU's EuP (energy-using products) directive 2005/32/EC, specifications such as those from the US EPA EnergyStar program, and the IEA's (International Energy Agency's) 1W-standby initiative serve to highlight the path our industry is on globally.

Synchronous rectification provides greater efficiency and density
Designers turn to synchronous rectification to improve the efficiency of their power-subsystems' secondary-side circuitry. This conceptually-simple modification of a classic topology, such as a flyback converter, can significantly reduce secondary-side dissipation by replacing Schottky diodes with MOSFETs at little or no system-cost penalty. The power level at which such a modification is practical has been decreasing with every new generation of power MOSFETs, so synchronous rectification is applicable to an ever-growing range of products.

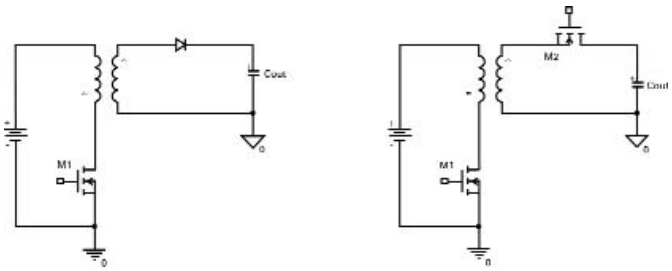

Figure 1: Typical flyback converter and Synchronous Rectifier

For example, a typical flyback converter dissipates between 600 and 720 mW/A in the Schottky diode (Figure 1A). The dissipation follows this linear relation, the slope of which is a function of the device's operating temperature:

$$P_D = V_F(T) I_{DRMS}$$

where P_D is the diode's power dissipation, V_F is the diode's forward voltage at temperature T, and I_D is the diode's forward current. Replacing the diode with a synchronous rectifier (Figure 1) trades the diode's dissipation behaviour for that of the MOSFET. The FET's conduction losses are proportional to the square of the current, but are scaled by the device's channel resistance, which for modern devices is quite small:

$$P_M = R_{DS(on)}(T) I_D^2$$

where P_M is the power dissipation due to the MOSFET's conduction losses, $R_{DS(on)}$ is the MOSFET's channel resistance at temperature T, and I_D is the MOSFET's on-time current. Neglecting, for the moment, additional losses due to the diode's reverse recovery or the MOSFET's switching and body-diode losses, the example of an 18 milliohm MOSFET substantially reduces the secondary-side dissipation (Figure 2).

The MOSFET's smaller dissipation allows designers to take advantage of smaller components with less heat sinking—increasing power density while lowering both BOM and assembly costs, product size, and shipping weight.

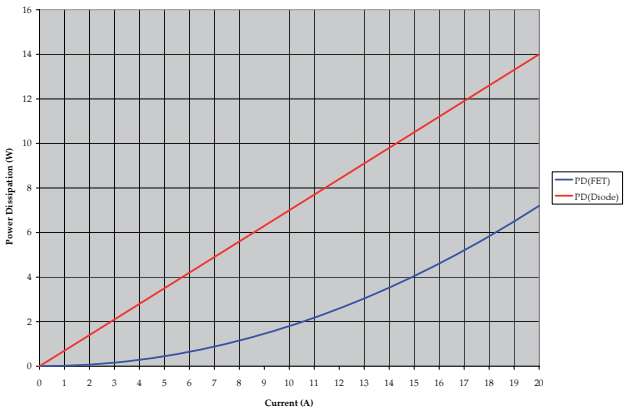

Figure 2: Comparison of MOSFET to Diode Losses

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FET-control methods

The challenge to implementing synchronous rectifiers lies in deriving a gate-drive signal with sufficiently precise timing. Imprecise timing quickly degrades the power supply's efficiency by allowing the output-filter components to discharge through the secondary circuit during a fraction of each cycle.

One method of implementing a synchronous rectifier derives the timing from the primary-side waveform. This approach, however, suffers from a number of difficulties. In isolated converters, the timing signal from the primary side to the secondary requires a path across the isolation barrier, which affects significantly, not only the system cost, but also timing synchronization between the two sides of the converter. Timing skew accrues from the differential delay between the power and timing paths. Due to the different mechanisms that implement the two paths, the differential delay is also a function of operating temperature.

The smallest isolation link for a timing signal originating from the primary side is an optocoupler. Though attractive for its size, optocouplers are slow and limit the converter's top operating frequency. This speed limitation affects the size of filter components and impairs the converter's ability to respond quickly to load-current transients.

Circuits that derive their timing from the primary also often perform poorly under light-load conditions. This limitation increases the challenge that energy-conservation programs, such as the 1W-standby initiative, pose.

Of the synchronous-rectifier control methods that derive their timing from the transformer secondary, the best known uses a current transformer to sense the polarity of secondary current (Figure 3). The operation of this circuit is fairly straightforward.

At the beginning of the secondary's conduction phase, the MOSFET is off. When the secondary voltage rises to more than about 0.7V

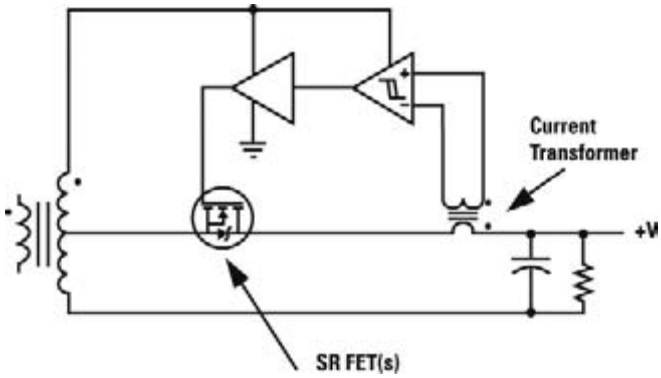

Figure 3: Current transformer to sense the polarity of secondary current

above the filter-capacitor voltage, current begins to conduct through the MOSFET's body diode. A comparator that monitors the secondary through a current transformer detects this positive current flow and changes state, which causes the driver to turn on the FET.

At the end of the conduction phase, the secondary voltage begins to collapse. When the secondary voltage falls below the filter-capacitor voltage, reverse current flows from the capacitor through the MOSFET and the secondary winding to ground. Again, the comparator detects secondary current by way of the current transformer and, owing to the current's polarity reversal, the comparator turns off the gate driver and, by extension, the MOSFET.

This scheme is much more efficient than the Schottky-diode based topology: A typical example of this design for a 120W laptop-computer adapter provided an operating efficiency of 87.75% under low-line conditions at 45 degrees C.

But the current-transformer-based design still has its drawbacks. The comparator triggers the MOSFET's off interval after the reverse current has developed to a sufficient amplitude to overcome the polarity-detector circuit's hysteresis. This turn-off delay allows a small percentage of energy stored in the output filter to discharge. The resultant circulating current does nothing but reduce the overall supply efficiency, which adds to the design's thermal load and increases the output ripple for a given charge-storage capacity.

The current-transformer sensing method also tends to require many components: The aforementioned 120W laptop-computer adaptor using this approach requires 20 components on the secondary side for the full implementation plus the extra winding on the power transformer.

A smarter rectifier

An alternative method works by directly monitoring the synchronous-rectifier FET. This approach results in faster and more precise timing, requires few parts, and occupies little board space. Indeed, one IC implementation of the method, referred to as the SmartRectifier, reduces the 120W laptop-adapter example to six parts that fit into an area less than 160 mm^2.

At the heart of the technique is a provision for switching the synchronous-rectifier FET very near the secondary current's zero crossing (Figure 4).

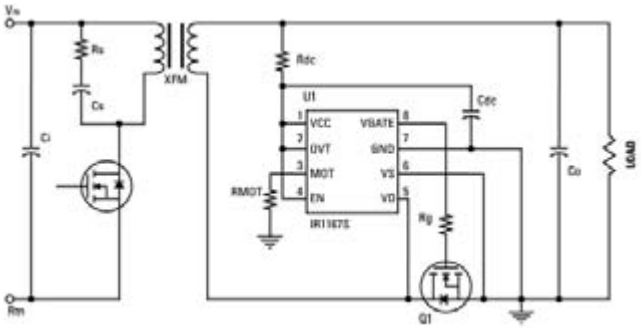

Figure 4: Directly monitoring the synchronous-rectifier FET

To precisely execute the necessary switch timing, a pair of integrated high-speed 200-V comparators sense the FET's drain-source voltage. The comparators operate on three voltage thresholds– V_{TH1}, V_{TH2}, and V_{TH3} – to determine the correct turn-on and turn-off times for the synchronous-rectifier switch (Figure 5).

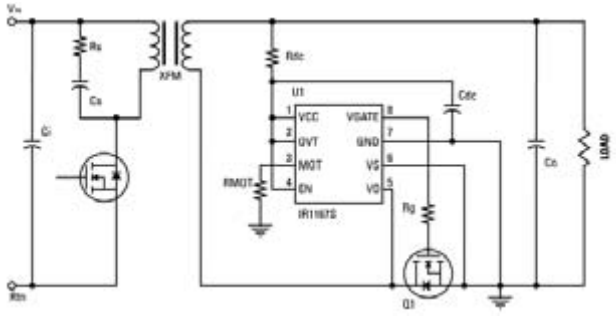

Figure 5: Correct turn-on and turn-off times for the synchronous-rectifier switch

At the start of the secondary's conduction phase, the FET is off and V_{DS} is reversing from positive to negative, presenting a forward bias to the FET's body diode. Current through the body diode forces V_{DS} to exceed V_{TH2}, and the control IC turns on the FET. As the FET turns on, V_{DS} falls to $I_{SEC}R_{DS(on)}$.

For a flyback converter in DCM (discontinuous-conduction mode) or CrCM (critical-conduction mode), the rectified current decreases after the switch turns on. The absolute value of V_{DS} follows the current, decreasing until it reaches V_{TH1} at which point the controller turns off the FET again.

The behaviour under CCM (continuous conduction mode) is slightly different: During the conduction phase the current decays and the drain-source voltage decreases. When the primary-side switch turns back on, the current through the secondary FET rapidly decreases. This forces the drain-source voltage through the V_{TH1} threshold at which point the controller turns off the FET, turning off the FET.

Beyond this basic algorithm, the method requires two additional functions to prevent spurious behaviour. The transient event that accompanies the FET's turn on can excite resonances in the secondary circuit, which can briefly drive V_{DS} below V_{TH1}. To prevent the controller from misinterpreting this threshold crossing as a normal end of cycle, implementations of this method impose a minimum on time. This feature imposes a minimum duty cycle on the secondary circuit and a corresponding maximum duty cycle on the primary-side switch.

A similar precaution in necessary at the end of the conduction phase: When the FET turns off a small residual secondary current continues to flow through the FET's body diode, causing V_{DS} to snap past V_{TH2} on the gate drive's falling edge. To prevent the controller from misinterpreting this event as the start of a conduction cycle, a blanking period begins with the gate drive's falling edge. During this interval, the controller does not respond to the V_{TH2} threshold crossing. The blanking period ends when V_{DS} crosses V_{TH3} at which point the device resumes its basic operation.

This synchronous-rectifier-control method reduces switching losses by briefly allowing current flow through the body diode before turning on the switch, imposing conditions on the FET very similar to ZVS (zero-voltage switching). The effect is to reduce the gate-charge that the gate driver must supply to the FET.

In addition to producing converter's losses on the order of 8% less than the current-transformer method, this alternative also reduces the converter's parts count by 75% and, as a consequence, reduces PCB area, BOM and assembly costs.

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Analysis Tool Covering Wide Application Range

Portunus supports transient thermal simulations

Nowadays simulation tasks go beyond the investigation of individual component behaviour. Despite electrical engineers naturally preferring different software tools to their colleagues developing mechanical components, virtual tests have to consider more than electrical values. This article lists the requirements for system simulation software and how they are met by the software package Portunus.

By Dr.-Ing. Thomas Barucki, Adapted Solutions GmbH

Simulator Functions

Simulation tasks can be roughly divided into component and system analysis. While component design tools are quite often largely dedicated to special needs, system simulation packages follow a more general approach. Modern packages should (but do not always) fulfil the following requirements

- Easy-to-use graphical user interface following a clear software philosophy,
- Flexibility regarding the model implementation,
- Fast and stable solver algorithms,
- Support of different analysis types,
- Powerful visualisation and debugging features,
- Data exchange with other software packages / automation options.

With the simulation package Portunus a new product has come to market. Due to fortunate circumstances its developers could combine long-term experiences in software development and the freedom of creating a product without compatibility issues.

Portunus supports the simulation of systems from different physical domains. Analyses can be performed in the time domain (with the option of a preceding initialisation run), frequency domain, quiescent domain and for the operating point. Models can be built-up by means of networks (electrical, mechanical, thermal etc.), block diagrams, state machines, macro components and C-code.

Portunus facilitates debugging in several ways. Results can be displayed during the simulation run in diagrams or tables. A number of models offer animation features, i.e. their appearance changes during the simulation run depending on model values like state, voltage, current or temperature. To reduce calculation time this feature can be de-activated. Display and animation functions are completed by a so-called 'Replay' mode, in which the results of the last simulation run are displayed stepwise (Figure 1).

The graphical user interface allows the definition of virtual experiments by means of automated parameter variations and user interactions. The results can be displayed simultaneously in a single diagram or table.
User interactions may require artificial slowing of the simulator performance in order to give the user sufficient time to adjust the settings. For this purpose the so-called 'Time Scaling' function allows a defined ratio of run time and simulation progress providing the simulator can solve the equations fast enough.

Software Philosophy

One of the most critical points of software development is the clear definition of software structure and internal and public interfaces. Obeying the rules of lean programming has a major impact on the functionalities and capabilities of the product.

Portunus uses a single kernel to solve the algebra-differential equation system derived from networks and block diagrams. This guarantees numerical stability by avoiding signal delays. The solver algorithms must happen sequentially but the interrelations are managed by a step-size control.

In Portunus the core object is the schematic which does not only hold information about models, parameters, connections, outputs and variable definitions but also keeps the settings for experiments, user interaction and 'time scaling'. The graphical user interface is one application with the option to display or hide docking windows for the features listed above.

To integrate Portunus into design flows an automation interface is available allowing the use of tools like Excel or Matlab for pre- and post-processor purposes. The available commands let the user load and save schematics, modify parameters and control simulation runs. To shorten calculation time

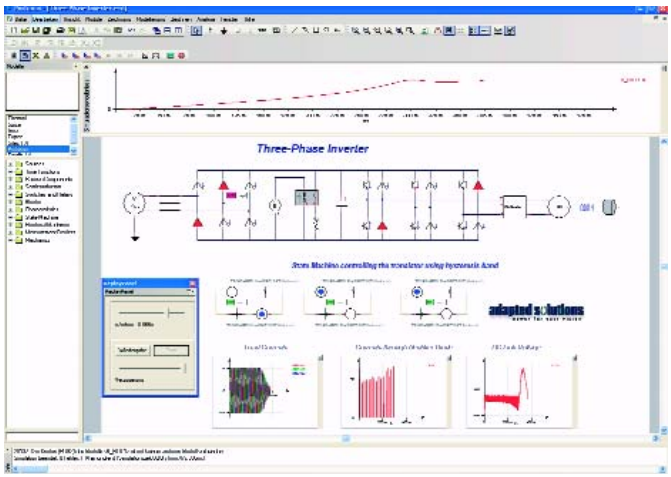

Figure 1: Electric Drive Model: Symbol Animation, Result Display, Replay Mode

Portunus may be run in a 'hidden' mode.
Beside the automation interface Portunus allows the data import from leading CAE tools like SPEED (SPEED laboratory, UK) for electric motors, InCa (Cedrat SA., France) for bus bars and Motor-CAD (Motor Design Ltd., UK) for thermal networks. Simulation results can be exported directly into Excel, Matlab and Origin without writing an intermediate file. Additionally a file export using the csv-format is possible.
Portunus comes with a comprehensive set of model libraries that can be expanded by the user. The standard version already includes electrical and mechanical models, time functions, blocks, state machine components as well as measurement and analysis devices. Two types of semiconductor models are available: 'Switch models' can be used for fast system analysis without consideration of semiconductor transients. For more physics-based simulations the SPICE (3F5) model set has been incorporated. To analyse thermal networks, a "Thermal Library" has been created in co-operation with Motor Design Ltd. (UK). It contains models for all heat transfer mechanisms, i.e. conduction, convection, radiation, heat storage, power and temperature sources as well as measurement devices.

Applications
Due to the flexible modelling options provided by Portunus, the potential application range is comprehensive and exceeds merely power electronics and drives. In the following we present three examples.
The combination of control components, electrical and thermal networks at the example of a M3.2 rectifier is shown in Figure 2. The variation of the junction temperature due to the periodic current flow can be clearly seen.

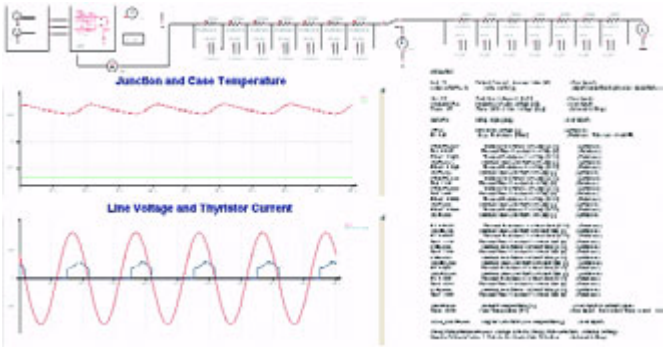

Figure 2: Model of a controlled rectifier including the thermal network for the calculation of junction temperature

Figure 3 shows how time functions, electrical networks and block diagrams are used for the design of a net feeding inverter (full bridge). The inverter, which is coupled to the net via a LC filter, is modelled by a controlled voltage or current sources. This is possible as the filter has a huge damping effect at the pulse frequency of the full bridge. Different control strategies such as current and power control have been investigated thereby taking advantage of the possibility to run both transient and AC analyses for the same schematic. AC simulations have been run to determine frequency responses and optimum parameters according to Ziegler/Nichols and Nyquist criteria. Transient simulations with the line voltage made up of the fundamental component and harmonics verify the design.

Within a joint project by Cummins Generator Technologies, Motor Design and the University of Edinburgh the "Thermal Library" has been used to further develop models for Cummins STAMFORD range of synchronous generators. Based on an existing spreadsheet application thermal models have been created for stator, rotor and

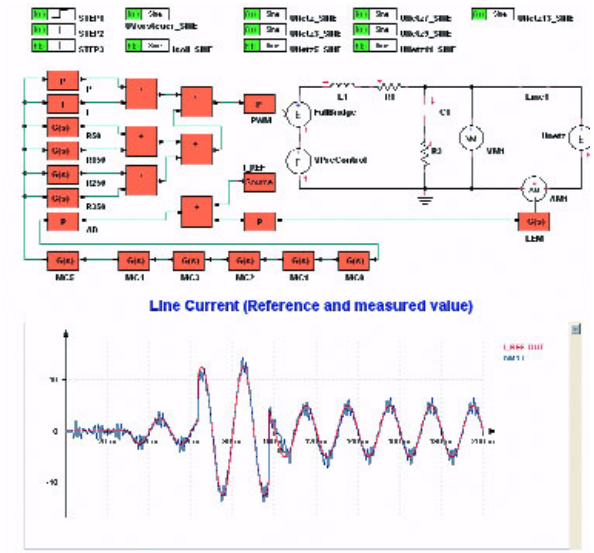

Figure 3: Net Feeding Inverter – Current Control

the heat transfer between them (see Figure 4). With the help of Portunus sub-sheets each part of the generator can be divided into as many subsections (layers) as possible. The parameters are calculated by the spreadsheets and exported to Portunus using the ActiveX interface. Due to the scalability of the topology, models can be used for the whole STAMFORD range of low-volts generators from 7.5 kVA to 2.5 MVA. By using Portunus a number of limitations of the spreadsheets could be overcome: As Portunus supports transient thermal simulations, analysis is no longer restricted to steady-state behaviour. Displaying the thermal network diagram increases clarity and allows for easy extension of the model. The next steps are to include the calculation of temperature-dependent losses. The aim is for a multi-physics solution, in this case linked electromagnetic and thermal simulations in order to provide improved accuracy in loss prediction. This is important when solving for transient state, both electro magnetically and thermally.

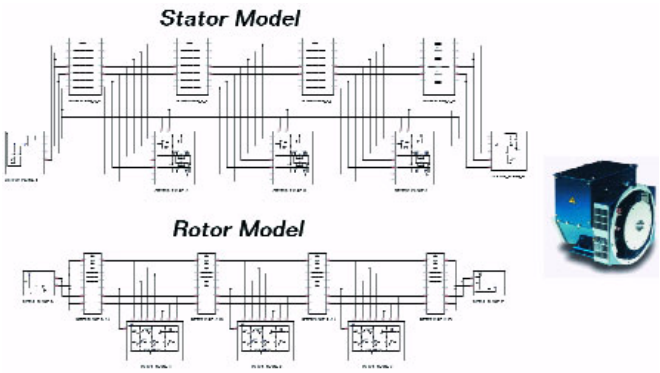

Figure 4: Parts of the Cummins Generator Model

Acknowledgements
Many thanks for helpful contributions go to the University of Edinburgh, especially to Carlos Mejuto, Chemnitz University of Technology, Chair for Power Electronics and Electromagnetic Compatibility, Cummins Generator Technology and Motor Design Ltd.
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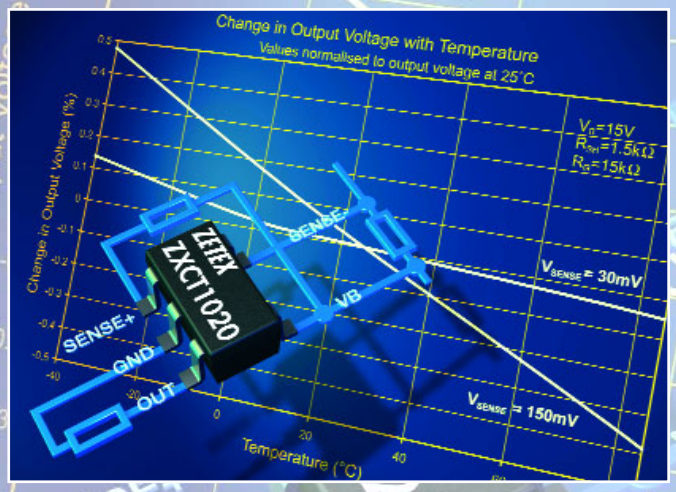

Dedicated Current Monitors Boost System Performance

To improve power dissipation, efficiency and reliability, electronic systems are increasingly depending on some form of continuous current measurement. Compared to alternative discrete and integrated solutions, dedicated current monitor ICs provide a simple and yet very accurate means of current measurement for a broad range of applications.

By Simon Ramsdale, Standard ICs Marketing Manager, Zetex Semiconductors

In all of the applications reviewed by this article standard current monitors provide a simple and cost effective solution to current measurement. The currents are measured by the addition of a small value resistor in series with the load which causes minimal voltage drop and power dissipation. In most applications they provide an increase in performance with a reduction in overall footprint.

LED driving

To maximize the lifetime of high power LEDs accurate regulation of the LED current is required.

Most regulators however are voltage regulators and use a 2.5V or 1.25V reference to maintain high performance regulation.

Unfortunately when programmable voltage regulators are used as current regulators the voltage drop across the current sensing resistors produces too large a power loss – as the voltage drop across the resistor is equal to the reference voltage.

So for a 3W LED an additional 2.5W would be dissipated in the current sensing resistor – be it a linear regulator or a switching regulator. This creates large levels of self heating and reduces efficiency to be at best of the order of 50% - having a major negative impact on any dc-dc converter solution.

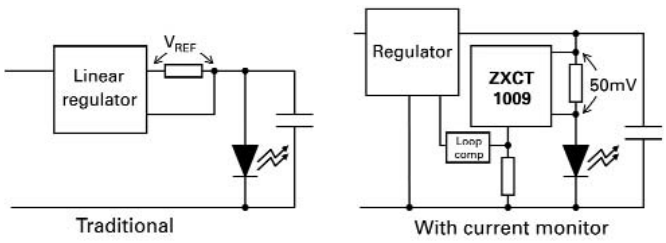

Figure 1: LED current regulation

Figure 1 shows a simple and cost effective solution to the problem; by using a current monitor to measure the LED current and amplify it to match the reference voltage, the voltage drop across the current sensing resistor is reduced, typically less than 100mV. This provides great power savings.

When used with switching regulators the overall performance and versatility can be improved by using a current monitor on the high side of the LED to measure the LED's current. Since sensing is no longer ground referred, noise susceptibility is reduced. Another benefit of high-side current measurement using current monitors is that it can be used in buck, boost and boost as buck configurations.

Power supply over-current measurement

For increased reliability many power supplies incorporate some form of over-current protection/sensing of supply rails.

For single outputs the current can be measured on the ground side but this has the disadvantage of disturbing the ground plane. This can be overcome by measuring the current on the rail itself and allows multiple rails to be measured. While there are numerous op amps capable of measuring the current referred to ground, most cost effective op amps are either not capable of measuring a signal referred to their supplies or their power supply range is not great enough to allow them to be used in these applications.

Figure 2 compares the traditional circuit configuration to that using a current monitor. Current monitors have specifically targeted the measurement of high side referred currents and derive their bias from the rails being monitored.

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This means that they do not require a separate supply pin and require only 2 resistors. This allows them to substantially reduce PCB area and component count and improve performance over general purpose op amps.

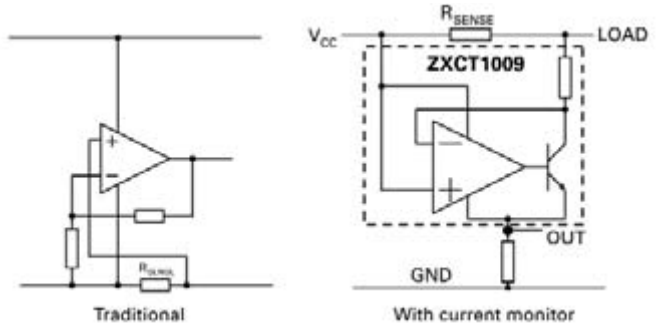

Figure 2: Overcurrent sensing

The more recent current monitoring devices have integrated a reference and comparator providing an integrated over-current protection solution. As shown in figure 3 this integration brings the amplifiers, references and transistor into one device, so saving PCB area and avoiding disruption of the ground plane.

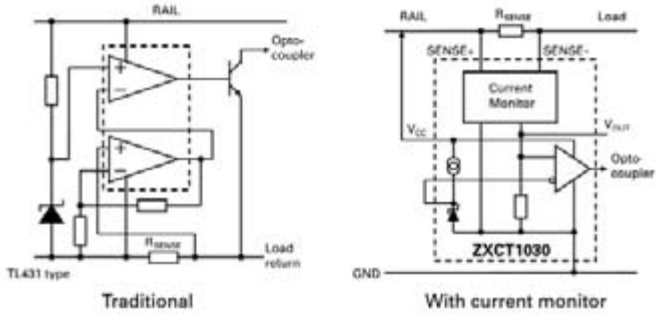

Figure 3: Overcurrent protection

Portable equipment battery life estimation

A growing number of portable applications are demanding cost effective improvements in battery life estimation ('gas gauging') and an increase in battery lifetime through advanced system power management.

Traditional battery capacity measurement has largely relied on the measurement of battery voltage to give a simple estimation of battery life - since a decline in battery charge results in a decline in battery voltage. However, this is proving to be inadequate in many applications due to the cell voltage continually changing during the discharge of the cell and is very dependent on the temperature of the cell, the discharge rate and the temperature at which the cell was charged.

Using battery voltage alone as the measure for battery capacity can be made worse by false low battery readings being caused by large increases in load current causing extra voltage to be dropped across the effective battery impedance. For example, a mobile phone with IrDA, Bluetooth connectivity and a camera flash all active at the same time could confuse the battery monitoring circuitry into giving a low battery warning. This can cause the system to switch off certain functions to increase battery life. Potentially the function that was demanding the increase in current from the battery!

For very high discharge rates (1200mA from a 600mAHr cell) the battery life can be 20% lower than nominal but has a much softer discharge knee than that occurring at very light discharge rates. This phenomenon greatly limits the accuracy of the measurement of the battery life remaining and means that using the same voltage for the low battery flag, for all temperature and discharge rates, can produce very large errors.

The performance and accuracy of battery capacity can be increased by measuring the discharge current. This enables an estimation of remaining charge to be calculated which can be used to display remaining battery capacity; as well as enabling the system to switch off parts of the system not being used in order to improve battery life.

A further advantage of measuring discharge current is that it can be used to protect the battery from too large a discharge current which could shorten battery life or even damage the battery.

Notebook computer batteries have used dedicated gas gauge ICs to measure battery life but in many smaller cost sensitive applications these ICs have proven to be too expensive and consume too much power.

A simple solution for smaller portable equipment such as mobile phones is to use a micro-power op amp or current monitor to measure the discharge current via a small series resistor.

They will normally be used in conjunction with the existing power management system that measures battery voltage and temperature; thereby removing the need for additional expensive components and an increase in PCB area.

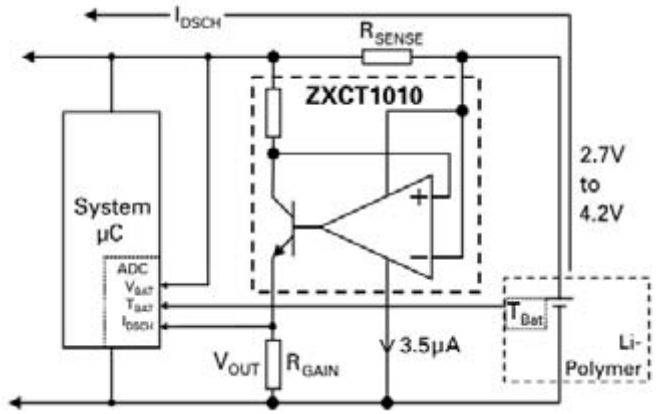

Figure 4: Cost effective micro-power gas gauge

Micro-power current monitors are well suited to these applications as they have the ability to work with one or multiple Li-Ion/polymer cells and do not interfere with the ground connections and will derive their power from the battery rail being monitored. A current output current monitor uses one external resistor to set its gain, providing a simple means by which one component can be used in multiple systems to match the dynamic range required. In figure 4 the only additional components required are the current monitor, a low value series current sensing resistor and a gain setting resistor.

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Today, as much as 43% of all wind generators feature SEMIKRON technology. The total wind power capacity installed since 1993 worldwide is 72,6 Gigawatt. (Source: EurObserver, Systems Solaires No177, Wind Energy Barometer, 02/2007) According to the European Renewable Energy Council, renewable energies will cover more than 35% of energy needs worldwide by the year 2030. Against the backdrop of a dynamically growing market, these intelligent integrated subsystems are ideal for use in wind generators and reduce production times and, consequently, the time to market.

Founded in 1951, German-based Semikron is a family enterprise that employs 2,700 people worldwide. Semikron comprises of a global network of 35 companies that guarantees a fast and competent on-site customer care. According to a study carried out by IMS, a leading Market Research Institute, Semikron is the market leader in the field of Diode/Thyristor modules, enjoying a 30% share of the worldwide market.

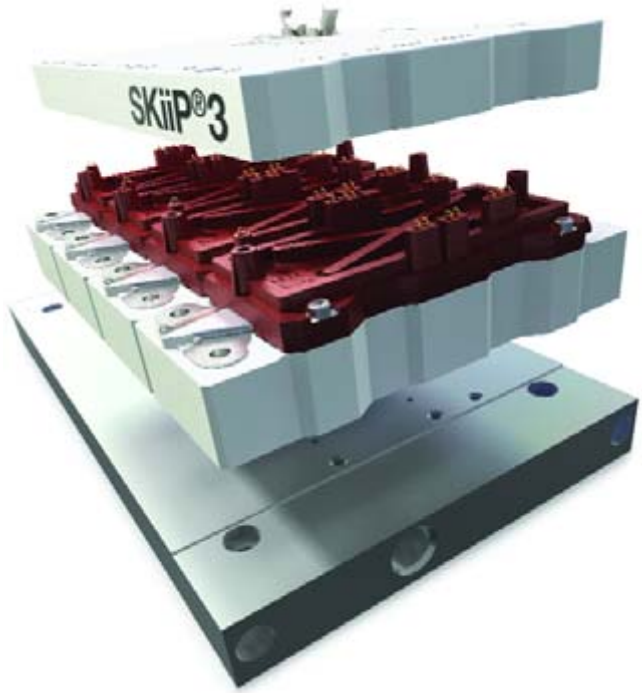

Figure 1. SKiiP intelligent power module, with perfectly matched cooling, gate driver, current sensors and protective functions already integrated optimised for wind applications

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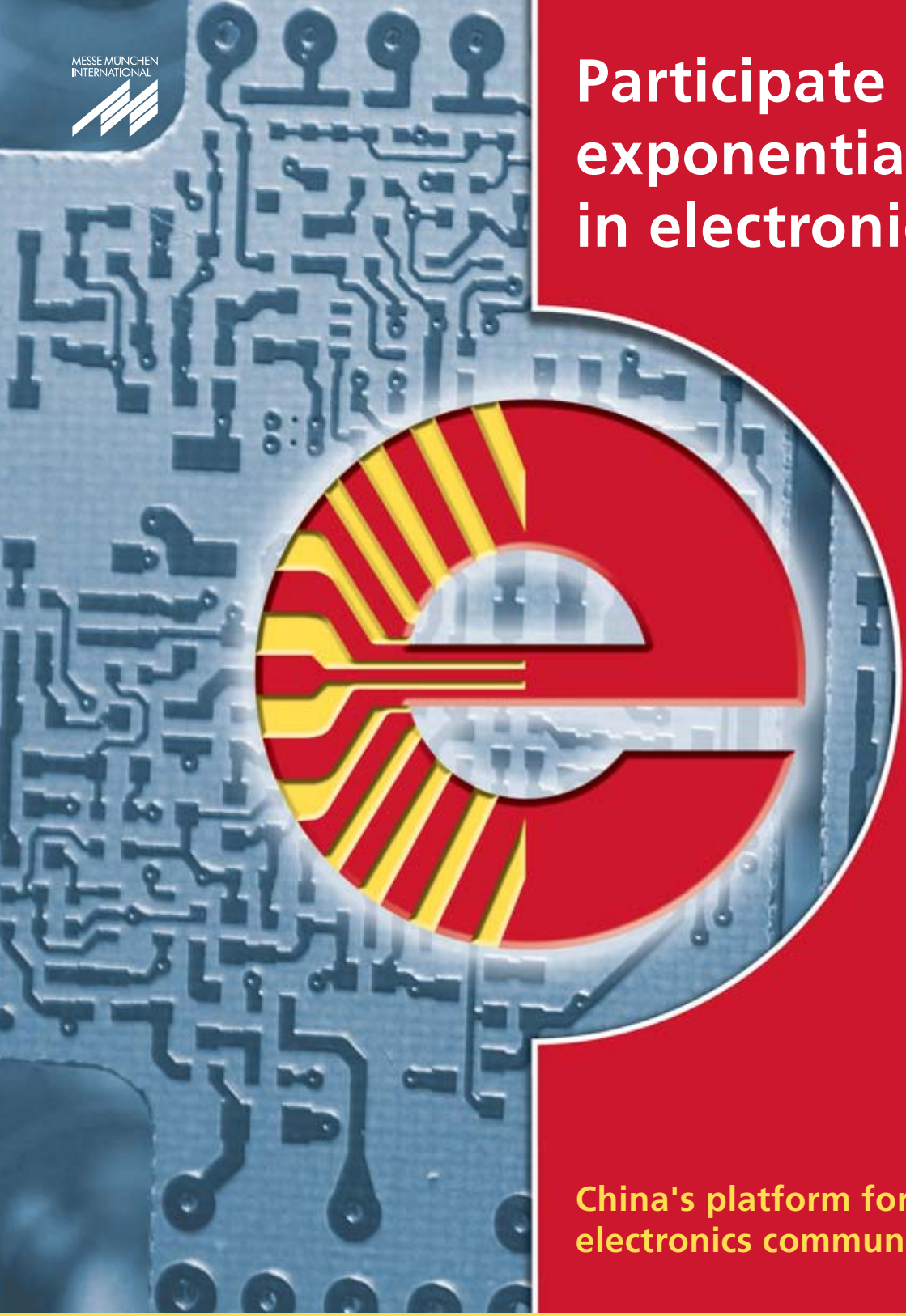

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A new approach to simulating power electronic circuits together with their controllers

System simulators allow the simple creation of controllers but the power electronics they control must then be described by circuit equations. On the other hand, circuit simulators allow simple circuit creation but the interface to the controller is generally more complex. PLECS however allows the intuitive creation of the circuit on screen, couples it to its controller and achieves fast and stable simulations of the complete system.

By Orhan Toker, PLEXIM GmbH and Eric Carroll, EIC Consultancy

The Status Quo in Simulation

Power Electronics (PE) is today so ubiquitous that practically every industry has its own design centers to exploit it: the automobile, aeronautics, medical, domestic-appliance, energy management, renewable energy industries etc., which has led to the need to develop and evaluate new circuits quickly and efficiently. This, in turn, generalizes the need for PE simulation to the point at which it becomes a "desktop" application as common as Excel or Word – ideally with the same ease of use.

Traditionally this has not been the case. A PE circuit, apart from its potential complexity (for example, a snubbered 3-level inverter has over 20 branches, see Fig. 1) includes events with a wide span of time-constants ranging from that of microseconds for semiconductor switching events to that of seconds for motor responses to that of minutes for thermal stabilization. This has invariably led to compromises between small integration steps (for good stability and convergence) and short computation time (for analysis and iteration). In general, the complexity of such simulations resulted in the establishment of simulation specialists with design engineers bringing them their problems to process – akin to taking one's report to the typing pool.

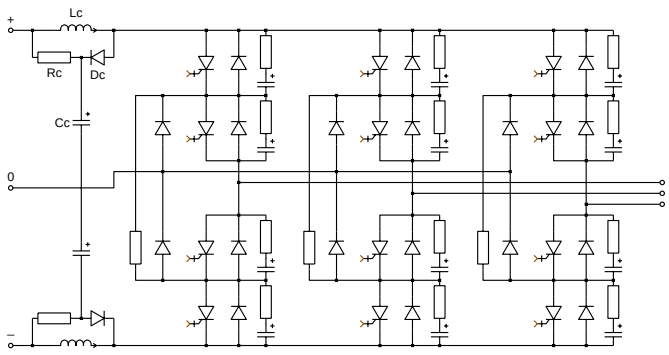

Fig. 1 – Complete snubbered 3-level inverter with clamp circuit; the lettered entities are significant for a single switching event; the complete inverter system can be simulated using ideal switches

A New Approach

In order to develop a software tool, which can be used to simulate PE problems ranging from simple circuits to the complex systems of Fig.1, the problem of the disparate time constants must be solved. In PE, the principle cause of short time constants is the fast switching of semiconductor devices such as thyristors, which occurs in the sub-microsecond range. In PLECS, this problem is eliminated by considering all semiconductor switches as ideal – a concept which anyone familiar with power semiconductors will, at first, find strange!

This is made possible by considering a new set of circuit equations at each switching event, whereby a switching event is deemed "ideal" and hence instantaneous (obviating the need to know how quickly it happens). To achieve this, PLECS creates a "switch manager" from the circuit directly entered by the user and this function oversees the boundary conditions (e.g. "is the diode current negative?") invoking the computation of the next set of equations resulting from the new circuit configuration.

It is clear that in the circuit of Fig. 1, the precise behavior of the semiconductor switch has little impact on the overall system performance though it may, for instance, determine whether the semiconductor survives the event or fails due to over-voltage. This detailed analysis is best carried out in a separate, open-loop simulation on a single switching cell such as that of Fig. 2. Indeed, an important part of the inverter design is to evaluate the interaction of the semiconductor's dynamic characteristics with parasitic parameters such as buss-bar inductances.

The PLECS Environment

PLECS (standing for Piece-wise Linear Electrical Circuit Simulation) operates within Simulink®. Simulink® is an environment for multi-domain simulation and Model-Based Design providing an interactive graphical environment and a set of block libraries that allows the simulation of a variety of time-varying systems, including communications, controls, signal processing, etc. Simulink® can also compute electrical circuit responses, provided that the circuits are described by their mathematical equations – a time consuming exercise which requires specialized knowledge. PLECS however, allows the arbitrary composition of circuits from a library of components, voltage and

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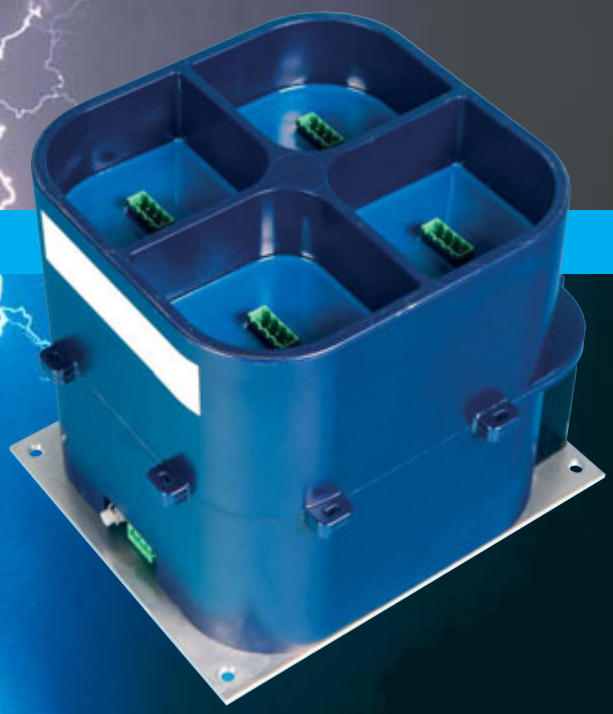

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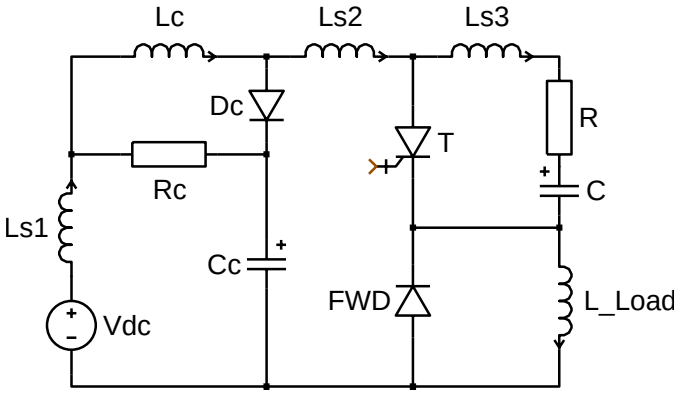


Fig. 2 – Detail of switching cell of Fig. 1 in which the unknown stray inductances L_{S1-3}, resulting from buss-bar layout, can be simulated in "open-loop" using generic behavioral models for switch T and iterated for different assumed values of L and switching speeds

current sources, switches, meters, motors etc. Simulink® provides the controller inputs, displays the output waveforms from the "meters" and receives whatever feedback signals are required from the PLECS-based circuit.

Simulating Semiconductors

Needless to say, semiconductor switches, which are at the heart of any PE system, are far from ideal and thus designers frequently clamor for a "model" for their prospective semiconductors in the hope of foreseeing all the circuit constraints which will arise from a particular choice of device. It must first of all be recognized that the true simulation of a semiconductor can only be based on physical models requiring not only sophisticated software but also knowledge of device structures and doping profiles – which the device manufacturers are not about to divulge. Therefore, only "behavioral" or "empirical" models should be expected, which will mimic the devices or, at least, part of their data-sheets. It must be remembered, that all device parameters are subject to process distributions. A manufacturer will therefore, either specify the minimal and maximal values of each parameter, or simply specify the "worst" value (e.g. the highest switching loss). In many cases, a datasheet parameter may only be ascribed a "typical" value with no indication of how "good" or "bad" that parameter might be in practice. Semiconductors require many parameter specifications: an IGBT, for instance, is described by some 20 parameters, most of which have voltage, current and temperature dependencies. For this reason, many semiconductor manufacturers are reluctant to offer models for fear that they might not describe the devices in quite the same way as their datasheets do, thus leading to greater, rather than less, frustration on the part of the users. To cap all this, the worst value of one parameter (say turn-off loss) will correspond to the "best" value of another parameter (e.g. longest fall-time) resulting in an optimistically low switching over-voltage.

Since most simulation programs require finite transition speeds for their switches, the demand for potentially misleading models, is understandable and the semiconductor suppliers generally try to oblige. A further reason for wanting a model is that the thermal constraints on the semiconductor can simultaneously be determined during simulation and hence the cooling requirements, calculated. PLECS however, requires no dynamic model for stable operation and does not waste computing time using inaccurate models to calculate losses. The computed currents and voltages of the ideal switches are used to read data from a one, two or three dimensional look-up table containing the datasheet losses of the considered device as illustrated by Fig. 3.

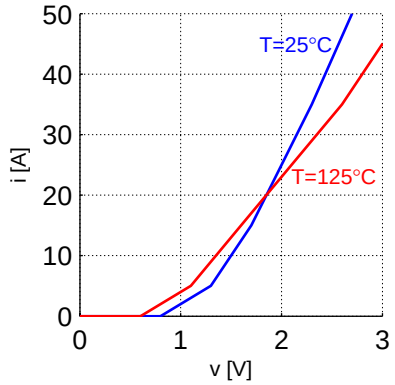


Fig. 3a – 2-D Look-up Table taken directly from a semiconductor's datasheet conduction loss curves

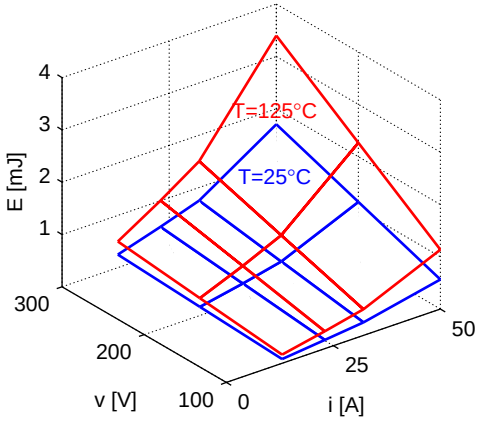


Fig. 3b – 3-D Look-up table derived from a semiconductor's datasheet switching losses using switching loss curves at 125°C and 25°C data from developed curves based on a single-point loss ratio of 25/125°C

Returning to the circuit of Fig. 2, the open-loop simulation of the switching event does, nevertheless, require a behavioral model and the wise user will exploit it knowingly. First of all, the parasitic components (L_{S1-3}) are, at the design stage, just as unknown (but just as important) as the semiconductor's switching speeds. Thus, the model will be used only to ascertain the interaction of the unknowns and to fix allowable limits for them, which can then be used as a basis for selecting or specifying the devices and optimizing the mechanical construction. PLECS recognizes this requirement and currently offers generic semiconductor models for diode and thyristor reverse recovery as well as MOSFET and IGBT turn-on.

Graphical User Interface

The PLECS graphical user interface allows the designer to compose his circuit intuitively by "drag-and-drop" of circuit components, sources, "ammeters" and "voltmeters", selected from a library. A typical PLECS circuit "window" can be seen in Fig. 4 (yellow background). The switches and meters are then interfaced to signal generators and oscilloscopes respectively, within Simulink® and the resultant waveforms observed. The controls are simulated under Simulink®, which then treats the graphically composed converter circuit under PLECS, as a separate Simulink® subsystem seen as the yellow block in the white Simulink® window.

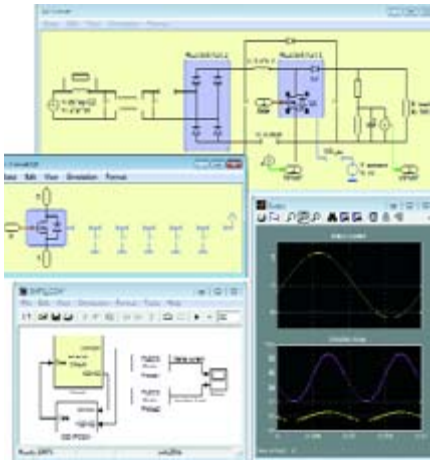


Fig. 4 – The PLECS graphically composed circuit window and circuit block (yellow backgrounds) and the Simulink® controller and waveform windows (white and black backgrounds respectively)

Fig. 4 illustrates the main parts of a PLECS simulation: the power converter PLECS Graphic User Interface and the Simulink®control blocks and output "oscillograms". Meters are added to observe voltages and currents (shown in green) and connected to "Outports" which export the signal for Simulink®to display. A controller is selected from the Simulink®library and connected via an "Inport" to a switch gate (shown in brown).

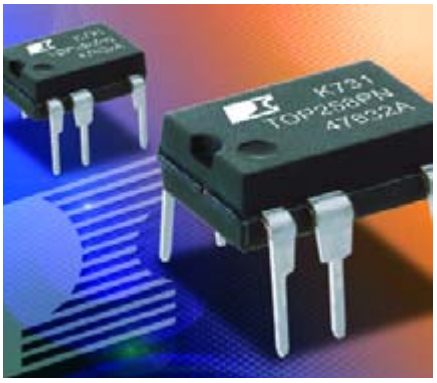
Profile

PLECS is developed by PLEXIM; a Zurich based company founded in 2002 with the mission to develop and market fast and user-friendly simulation software for the power electronics industry. PLECS is used in over 30 countries around the world both in Industry and in Academia for its speed, stability and ease of use resulting in efficient prototyping and shortened time-to-market. PLECS licenses are available as single, concurrent or classroom versions.

www.plexim.com

TOPSwitch-HX Offers Best-in-Class Efficiency

Power Integrations announced the TOPSwitch®-HX family of AC-DC power conversion ICs. Power Integrations introduced its original TOPSwitch product in 1994, combining a 700 V switching power MOSFET with controller and supervisory functions into a single monolithic IC. The TOPSwitch-HX family of ICs utilizes Power Integrations' EcoSmart® energy-efficiency technology and combines great standby power performance with constant, high efficiency under all load conditions, enabling best-in-class efficiency over the entire load range.



TOPSwitch-HX enables power supply designs that easily meet proposed and existing energy standards such as CEC and ENERGY STAR, while delivering up to 48 W without the need for heat-sinking (and up to 150 W with a heat sink). A new multi-mode control scheme provides highly efficient operation across the entire load range, eliminating the need for a separate standby power supply in some applications.

http://www.powerint.com

Ultra High Accuracy LDO

ON Semiconductor introduced the NCP590 family of an very high precision, dual-output CMOS Low Dropout Regulators (LDO). Offered in a ultra-small, low profile package, these devices are ideal for battery powered consumer and microprocessor-controlled portable applications such as cell phones, PDAs, GPS and Portable Media Players. The NCP590 family of LDOs is capable of delivering up to 300 milliamps (mA) per output. A special combination of process and architecture is employed to offer fast customer response and outstanding flexibility.

Voltages from 0.8 volts (V) to 5 V are available to accommodate the varied needs of customers. The NCP590 is stable with any type of capacitor and under no-load conditions. The set point output voltage of the NCP590 is accurate to within +/-0.9% with an operating voltage input up to 5.5 V meeting very tight overall error budget requirements of high-performance applications.

http://www.onsemi.com

LEM at SPS/IPC/DRIVES

LEM will be highlighting a range of products at the show, including the AT and TT families of split-core current transducers. Both products use a new type of ferrite for the core material which enables improved magnetic permeability and allows current transformer technology to reach new levels of performance. Being split-core they are easy to install and put into operation, which means they can be retro-fitted into existing installations without shutting down operation. This ease of mounting, coupled with the transducers' high reliability, will reduce installation and maintenance costs.

As with all other LEM products both families of transducers benefit from the company's proven high-quality approach to manufacturing and are backed by a five-year warranty.

LEM is a leading manufacturer of current and voltage transducers used in a broad range of industrial applications, including variable speed drives for motors and power supplies, AC/DC converters, UPS systems for computers as well as in new innovative energy applications, such as micro-turbines, wind and solar power generation. LEM's products are used in a variety of rail transport applications, and in the automotive market for battery management and electrical motor controls for steering & braking systems.

SPS/IPC/Drives 2007 – Nürnberg, Hall 4, Stand 280

www.lem.com

Integrated and Protected Class D Audio Chipset

International Rectifier has introduced a chipset featuring the new IRS2092 integrated audio driver IC with protected PWM switching and IR's full complement of digital audio MOSFETs. The chipset targets medium power, high performance Class D audio amplifiers from 50W to 500W in home theatre, home stereo, active speaker, musical instrument, and professional audio applications.

The new chipset forms a Class D audio solution that is much smaller than a comparable Class AB design. In a 100W application, for example, the IRS2092 IC and IRF6645 DirectFET® MOSFETs reduce board size by 60% and eliminate 20% of the parts from the typical bill of materials.

Based upon a half bridge topology, the new

audio driver IC integrates four essential functions for Class D design implementation including error amplifier, PWM comparator, gate driver, and robust protection circuitry. As a result, this compact 16-pin IC offers high noise immunity and reduced start and stop click noise, while greatly reducing some of the most complicated and costly design tasks such as overload protection.

Key IRS2092 features include an analog PWM modulator with frequency up to 800 kHz, programmable bidirectional over-current protection (OCP) with self-reset control, under-voltage lockout protection (UVLO), and programmable preset deadtime for a scalable power design.

The IC may be paired with an extensive range of digital audio MOSFETs addressing output power from 50W to 500W. These MOSFETs, part of IR's IRFI4x, IRFB422x, and DirectFET families, have been optimized around parameters critical to audio performance such as efficiency, THD, and EMI.

http://www.irf.com

Power Management Predicts Battery Life in Handhelds

How much battery life do I really have left? Texas Instruments answers the question by introducing its system-side fuel gauge integrated circuit (IC) with Impedance Track™ technology for smart phones and other handhelds. The 2.5 mm x 4 mm gauge predicts battery life with 99-percent accuracy to extend run-time, protect data and provide a better user experience for mobile handheld users. See: www.ti.com/bq27500-pr.

The bq27500 system-side battery fuel gauge with TI's patented Impedance Track technol-

ogy accurately measures data from a device's single-cell Li-Ion battery to predict remaining battery capacity under all conditions, even as a battery ages. The tiny IC analyzes precise state-of-charge by correlating between a battery's voltage and cell impedance, or resistance, and its current integration to adjust remaining state-of-charge up or down the predicted discharge curve.

http://www.ti.com/battman

Innovative Packaging for High Capacitance Polypropylene Film Capacitor Series

Electronic Concepts announced the introduction of state-of-the-art packaging for the UP30 film capacitor series, an innovation that further enhances the existing UL30 product offering. The end product is a combination of the company's widely accepted UNLYTIC film technology, and cost effective, unique packaging for higher storage capacity and greater voltage creepage protection.

Design breakthroughs include a solid plastic top that adds more than a one inch gap between the case and terminal connections; compact packaging that measures approximately 3.5" in diameter with 4", 5" and 6" heights; isolation of the capacitor from the outer case; simple package and connection mounting; and configuration as a standard UP33 with a bolt mount case.

UP30 film capacitors are well suited for bulk DC storage and especially useful in DC link converter/inverter applications.

http://www.ecicaps.com

AlSiC Metal Matrix Composite Base Plates

CPS Corporation offers AlSiC (Aluminum Silicon Carbide), a metal matrix composite ideally suited for base plates material for insulated gate bipolar transistor (IGBT) used in high-power traction, power control, Hybrid Electric Vehicle power systems, and fly-by-wire applications. AlSiC has been tested and meets the requirements of the Restriction of Hazardous Substances Directive (RoHS compliant) of the European Parliament.

The low isotropic coefficient of thermal expansion (CTE) value of AlSiC-9 (8 ppm/°C: 30 – 100°C) is compatible with the thermal expansion value of the die or substrate used in IGBT applications. The AlSiC CTE match reduces the mechanical stresses on IGBT die and substrates that is induced by thermal power cycling which improved reliability of substrate attachment and reduces die cracking failures.

http://www.alsic.com

High-Side Power Switch Family That Enhance Battery Life

Micrel launched the MIC94070/1/2/3, a series of high-side load switches that extend Micrel's industry-leading family of high-side load switch products. The new devices are aimed at a wide variety of cost effective, mass-market handheld, battery-powered consumer devices, including cell phones, digital cameras and personal entertainment consoles. The MIC94070/1/2/3 series is currently available in volume.

The MIC94070/1/2/3 family compliments Micrel's industry-leading MIC94060/1/2/3 high side load switch products. The original family addresses high-end consumer devices such as high performance smart phones. The new ICs now provide mass market consumer device manufacturers with a cost-effective alternative that still features Micrel's high quality.

The MIC94070/1/2/3 all feature a typical R DSON of 120milliOhm. The devices operate with inputs ranging from 1.7V to 5.5V. Each IC can be driven by a mere 1.5V of logic, which is accomplished by incorporating a novel built-in level shift circuitry that allows low voltage logic to control higher voltage supplies. Battery time is greatly extended in portable applications due to the low operating current of 2µA and shutdown current of less than 1µA.

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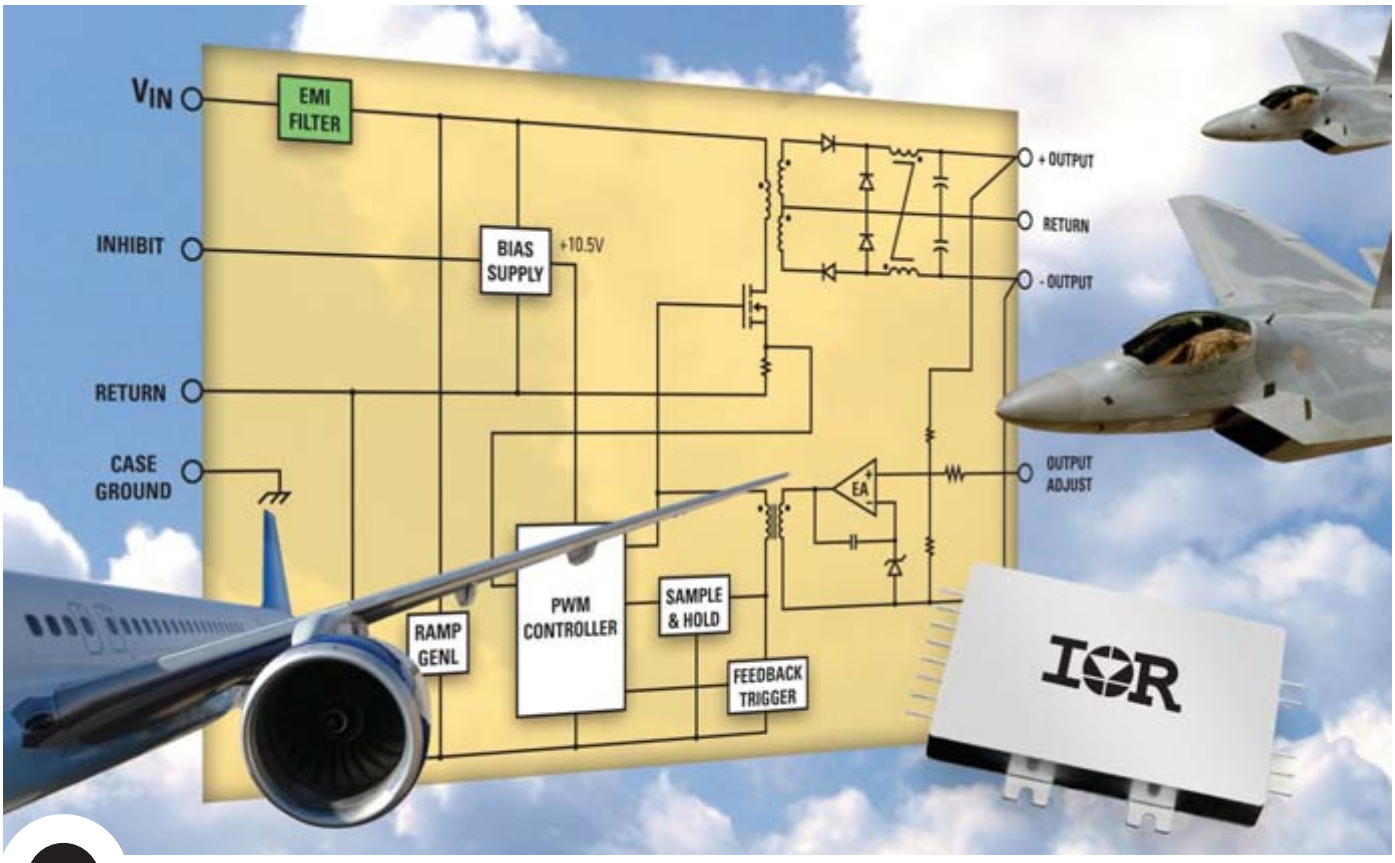

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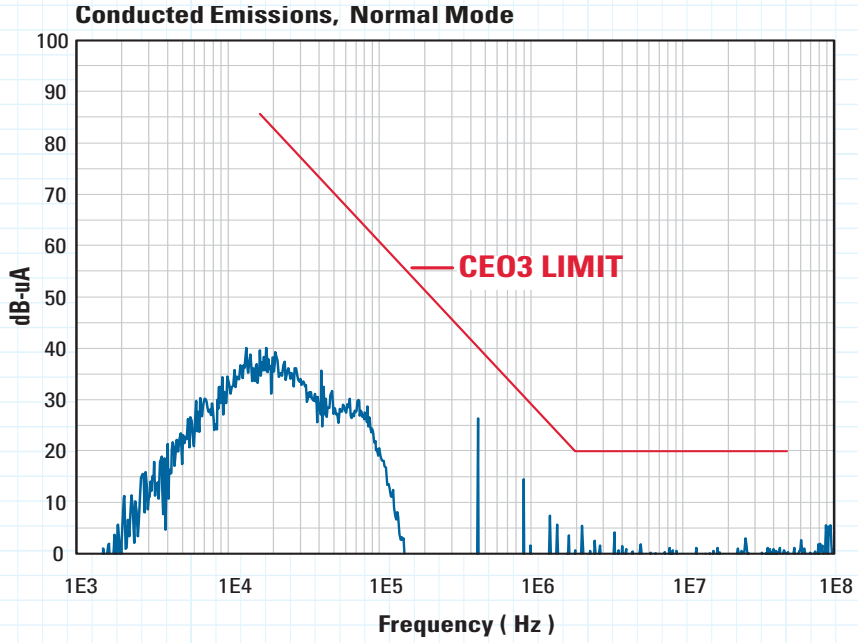

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