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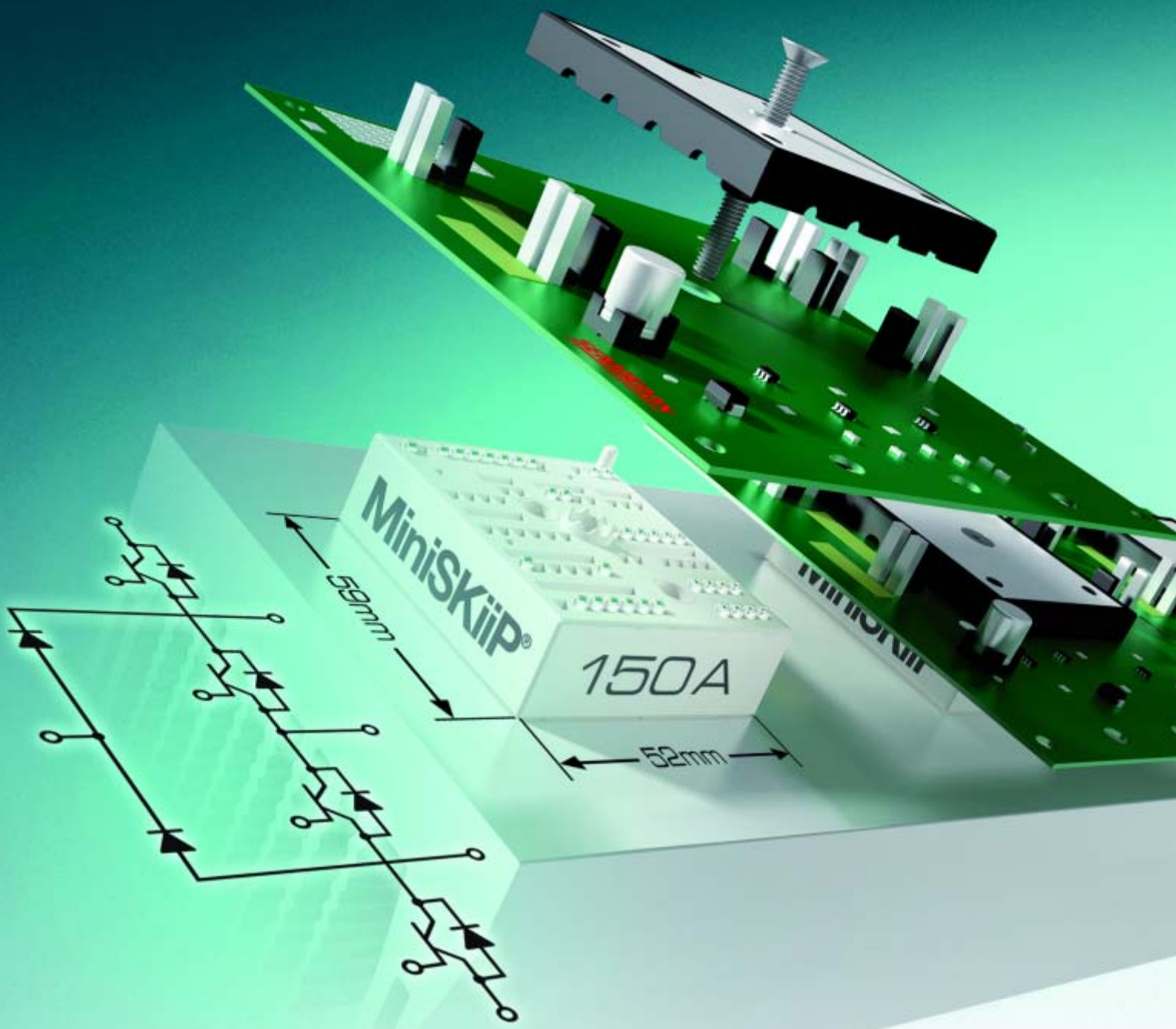
Bodo´s Power Systems®

Electronics in Motion and Conversion

September 2011



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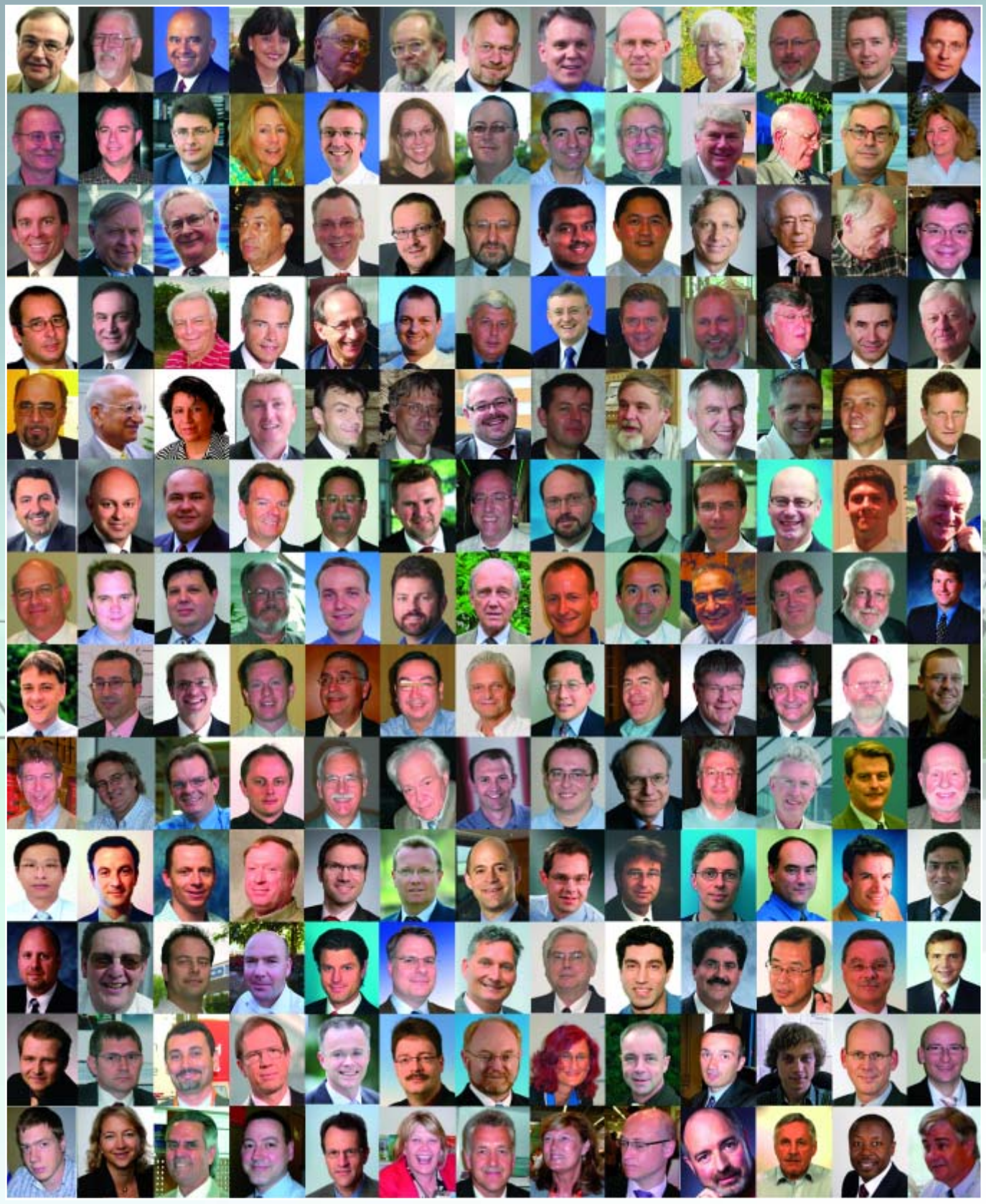
Bodo's Power Systems®

The Gallery



Fairchild's Board of Directors announces:

Foundation of Technology Development Centre for High-Voltage Semiconductors in Munich

The mission of this team is to advance Fairchild's Technology and product portfolio for High Voltage applications for Industrial, Automotive and Consumer markets to take over the leading edge position.

This newly formed R&D centre, located in Munich, provides opportunities to their members to closely work with existing global Fairchild Technologists in US, Sweden and Korea, as well as to work in partnerships with Research institutes and hand selected partnership programs with competitors.

The scope of this team includes

- Device and process simulation
- Design and layout experts
- Characterization and testing lab
- Experts for process integration, device architecture, novel materials and module development

For the initial phase, we have opened positions for:

Device Simulation Experts

Job description:

You are responsible to develop and optimize device architecture for Fairchilds next generation IGBT generations, optimize static and dynamic device performance and work with local and Korean process experts to create prototypes.

Job requirement:

We are looking for highly innovative and self-motivated individuals, Master or PhD degree in Electrical engineering, Physics or similar, fluency in English required.
At least 4 years experience in High Voltage Discrete device development, using state of the art simulation software, preferably Synopsis TCAD process and device simulators. Solid knowledge of state-of-the art IGBT device architecture required. 3D simulation, device layout experience and packaging know-how is of advantage but not mandatory.

Device Modelling Experts

Job description:

You will be spearheading a team for device parameter extraction and modelling including behavioural and (semi)-mathematical models for High Voltage devices. Near term emphasis is put on Trench IGBT and Superjunction MOSFET developments.

Job requirement:

We are looking for highly innovative and self-motivated individuals with Master or PhD degree in Electrical engineering, Physics or similar; fluency in English required.
At least 3 years experience in High Voltage device test keys drawings, parameter extraction and device modelling. PSPICE - equivalent circuit and knowledge of electro-thermal behaviour for Power devices is required. Device layout experience would be beneficial.

IGBT Technologist

Job description:

You will be shaping a global team with the distinct focus in IGBT development, focussing on device architecture, new process modules and innovative package solutions for automotive and industrial applications.

Job requirement:

We are looking for a senior technology expert with Master or PhD degree in Electrical engineering, Physics or similar with profound semiconductor background in the field of high-voltage technology.
You need to have at least 10 years experience in IGBT development, wide knowledge of process, device and package topics. Experience with HV-MOSFETS, Superjunction, GTO's or IGCT's as well as experience on specific automotive and industrial applications will be preferred.

We offer:

- Start-up spirit in highly inspirational and expanding team in Muenchen
- Space for fundamental and scientific research
- Very competitive, performance oriented compensation schemes
- High strategic impact and visibility within a global company

Contact:

Dr. Thomas Neyer
Vice President and Fellow of Fairchild Semiconductor
Head of the Fairchild Technology Center in Munich

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Events

EPE, Birmingham,
August 30th –Sept.1st
www.epe2011.com

26th EU PVSEC,
Hamburg, Germany, Sep. 5th –9th
www.photovoltaic-conference.com

Advanced Energy Solutions Conference
San Diego CA, Sep. 12th-15th
http://aes.fullpowerinc.com

ECCE2011,
Phoenix, AZ, Sept. 17th -22nd
www.ecce2011.org

Battery Power,
Nashville, TN, Sept.20th – 21st
www.batterypoweronline.com

Thermal Management,
Nashville, TN, Sept.20th – 21st
www.thermalnews.com

Darnell's Power Forum,
Silicon Valley, CA Sept. 26th -28th
http://DPF.Darnell.com

LED Symposium+Expo,
Bregenz, Austria, Sep. 27th -29th
www.lps2011.com

Electric Drives Production Conference
Nuremberg, Sept. 28th-29th
http://edpc.eu

Speakers and Trains

Today a child's understanding of technology has come to the point that we must take it seriously. My grand nephews, 8 and 12 years old, started discussing taking energy from the clouds in a thunderstorm. What a great mind set - little boys thinking of new and complex power sources. Today there is no means of harvesting this tremendous amount of energy. We are happy to at least have protection elements which deliver the lightening stroke to ground – just short it and generate heat. Is anyone in the world (besides my nephews) thinking of routing it into a capacitor for storage and contribution to the grid?

Progress in technology for high voltage elements and modern semiconductor switches may be good enough to someday harvest energy on these levels.

My goal is to support these young boys and help them on their way to being successful in whatever paths they choose for their future. It would be especially nice to see them studying for a professional technical career.

Seeds have to be in the ground to grow. Winter will soon come and the little boxes of Marklin Size 1 Trains are ready to be unpacked by the little engineers. The enjoyment of playing can develop talents for a job and enjoyment for a lifetime. This was how I became an engineer and I have been happy since my early days. A lot of growth comes from trying to understand ones errors. My first error was to put banana jacks from the extra speaker into the mains outlet (still possible in Europe). I loved listening to music, but I'd managed to shut down all the power in the house, it was evening and we were sitting in the dark. I hid under the table, a safe retreat for a three year old boy. But my parents were happy to find me there and I learned that making music needs the right connections. Maybe that was my first challenge in understanding technology.

Great shows and conferences that we should not miss this September: EPE takes place in Birmingham; the Photovoltaic Conference is in Hamburg and LED Professional in Bregenz. In the US, there is Battery Power in Nashville, Tennessee (along with Country Music) and Thermal Management and the Darnell Power Forum will take place in Silicon Valley. It is a busy time all over the globe. Just look at the events list in the magazine, on my website, or in my e-newsletter – all ways to access information my publication provides. Communication is the only way to progress. Bodo's Power Electronics magazine provides information to all, including those for whom travel to relevant trade shows is not possible. We have now delivered nine issues this year, with 592 pages of information - on time, every time. As a media partner, Bodo's Power Systems is internationally positioned and represented at more than two dozen shows and conferences worldwide.

My Green Power Tip for September:
Start the cool weather season with heating the house to just a little below what is comfortable. Wearing a sweater is a great way to save energy.

Looking forward to seeing you at one of the next shows!

Best Regards

Solar energy committed to a lifetime of safety and performance

CTSR

LEM commits to renewable energy sources of the future by enabling control and ensuring safety of today's solar power solutions. CTSR transducers combine safety and performance, accurately measuring small AC and DC leakage currents. Easy installation for single or three phase residual current measurement: CTSR is today's choice for the energy of tomorrow.

- Two nominal current ranges: 0.3 and 0.6 A_{RMS}
- Printed circuit mounting
- Large 20.1 mm diameter aperture
- Available with primary inserted conductor
- +5 V single supply
- Up to 11 mm creepage and clearance distances + CTI 600 for high insulation
- Low offset drift
- –40 to +105° C operation
- Reference Voltage access and control
- Self-test and degauss
- High overload capability: 3300 A

www.lem.com

At the heart of power electronics.

LEM®

Events

ESREF,
Bordeaux, France, October 3rd -7th
www.esref.org

Distribution Automation Europe,
London UK, October 10th-11th
www.smi-online.co.uk
/distributionautomation38.asp

Semicon Europa,
Dresden, Germany October 11th -13th
www.semiconeuropa.org/

eCarTec,
Munich, Germany, October 19th -20th
www.ecartec.de

Smart Grid Electronics Forum,
San Jose, CA Oct. 24th -26th
http://SmartGrid.Darnell.com

Productronica,
Munich, Nov. 15th -18th
http://www.productronica.com

SPS/IPC/Drives,
Nuremberg, Nov. 22nd -24th
wwwmesago.de

Power electronics Moscow,
Nov. 29th –Dec. 1st
www.powerelectronics.ru

Maxim Acquires SensorDynamics

Maxim Integrated Products announced it has acquired SensorDynamics, a privately held semiconductor company that develops proprietary sensor and micro-electromechanical (MEMS) solutions. SensorDynamics is based in Lebring, near Graz, Austria. SensorDynamics holds numerous original patents for MEMS sensor technology. It has devoted over 800 man-years of research and development to the high-growth fields of MEMS sensors and associated low power interface and wireless connectivity solutions. Consequently, this acquisition enables Maxim to accelerate expansion in markets where it already has a strong presence including automotive and high-end consumer.

"Maxim is a recognized leader in analog integration, and this acquisition extends Maxim's integration strategy by enabling us to fuse many types of sensors with our analog technology. The strategic integration of sensors, analog functions and low power wireless connectivity will allow us to deliver end-to-end mixed-signal solutions that provide our customers with better performance, smaller form factors and lower system costs," said Tunc Doluca, Maxim's President and Chief Executive Officer. "The result will be a unique combination of technologies that will eventually enable a whole new generation of intelligent machines. We're thrilled that SensorDynamics is joining us."

In the near term, this acquisition enables SensorDynamics to focus on its strength in engineering for sensors and MEMS, while utilizing Maxim's considerable manufacturing, distribution and sales infrastructure. This will quickly make the combined company a leading competitor in the inertial sensor, wireless connectivity and sensor interface markets.

www.Maxim-ic.com

Stephan Greiner Named Vice President, Cree Europe

Cree has appointed Stephan Greiner to Vice President of its EMEA region. Stephan Greiner leads the team from the German regional head quarter. In his role, he is responsible for the sales of Cree's complete portfolio, ranging from LED chips and components to RF and Power devices. Stephan Greiner brings more than 16 years of experience in the semiconductor sales market to his position at Cree. He worked as Vice President of Global Sales at the optoelectronics supplier Everlight Electronics in Taiwan. Before, he worked at the Osram Opto Semiconductors GmbH as Senior Director of Sales where he was in charge of the regions Europe, Latin America and Middle East.

"Cree has an enormous growth potential in the EMEA region" said Stephan Greiner. "It's my goal to expand our market presence and to further promote the LED lighting technology by promoting the benefits that Cree's portfolio brings to customers in the region."

www.cree.com

Enhanced Low Dose Rate Sensitivity Testing Facility

Intersil Corporation announced its continued commitment to the global space community by introducing its new Palm Bay, Florida ELDRS testing facility. The facility will perform low dose rate total ionizing dose (TID) acceptance testing for all Intersil radiation hardened products – regardless of process technology – on a wafer by wafer basis. These tests will be conducted in accordance with government performance specifications MIL-PRF-38535 (QML) and MIL-STD-883, and will provide Intersil customers with assured low dose rate performance.

Intersil products that are acceptance tested at low dose rate will be designated with an EH suffix. Intersil's current high dose rate only products carrying the RH suffix will remain unchanged. All EH certified products will carry Intersil certificates of compliance for both high dose rate testing and low dose rate testing.

"We are very excited to announce the opening of this new facility. The expansion of our in-house radiation testing capabilities reinforces our leadership in this market and is an example of our commitment to providing best possible products to the global space community," said Michael Althar, Vice President and General Manager of Intersil's Specialty Products Group. "Our aerospace customers will now know that any product purchased from Intersil with an EH designation has been acceptance tested at both high and low dose rates. We're not only providing them with an extra level of confidence in our products, but we're simplifying their design procedures at the same time."

The first low dose rate acceptance product to receive DLA Land and Maritime (formerly DSCC) approval is the popular HS1840A analog multiplexer (HS1840AEH / SMD P/N 5962F9563004). Intersil has completed production low dose rate acceptance testing of another 10 products to date, including the ISL70001SRH 6A synchronous buck regulator, and will submit these products for approval shortly. Additional parts are currently undergoing testing.

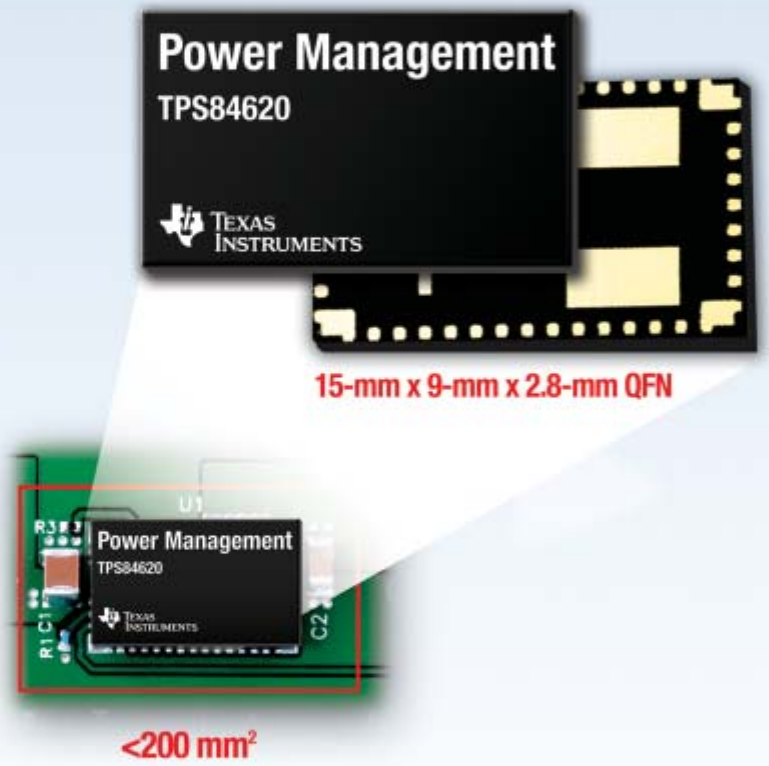
For additional information on Intersil's Space, Defense and Hi-Reliability solutions or on its low dose rate radiation testing facility visit.

www.intersil.com/space/

6-A, 14.5-V Integrated Power Solution

Ultra-Dense Power – TPS84620

The TPS84620 is a highly integrated step-down point-of-load solution with high density and efficiency and 30% better thermal dissipation compared to competitor solutions. The QFN package combines the inductor and passives onto one device and requires only three external components—making design layout extremely simple.



Key Features

- Integrated inductor and passives
- Easy-to-mount 15-mm x 9-mm x 2.8-mm QFN delivers 800W/in^3 solution
- 95% peak efficiency and 13°C/W $\theta_{j/a}$
- Adjustable frequency, soft start and UVLO and PG pins

Key Benefits

- As few as 3 external components
- 40% smaller package than competitive 12-V, 6-A integrated inductor solutions
- Low thermal resistance delivers full 6-A rate current without airflow
- Provides the design flexibility of a discrete solution

> Learn more
> Order free samples
> Order evaluation module

www.ti.com/tps84620

Texas Instruments

Call for Papers CIPS 2012, 6 - 8 March 2012 in Nuremberg

The 7th International Conference on Integrated Power Electronics Systems (CIPS 2012) will take place on 6 - 8 March 2012 in Nuremberg / Germany in conjunction with the ECPE Annual Event 2012.
The CIPS 2012 will focus on following main topics: Mechatronic Integration; Hybrid System and Ultra High Power Density Integration and Systems and Components Reliability.
We would like to invite you to participate in the conference by submitting your paper until 5 September 2011. Please create a pdf formatted abstract in English, 2 pages, including figures, tables & references showing summary, motivation and results. The paper should be headed by: Title, Author's names, Affiliations.
www.cips-conference.de > "Call for Papers"
Another way to present your interesting developments is the Table Top Exhibition.
www.cips-conference.de > "Table Top Exhibition"
If you are interested in the CIPS 2010 papers, please look at IEEE Xplore.
Prof. Eckhard Wolfgang, Technical Chair CIPS 2012 is looking forward to receiving your submissions.

www.ecpe.org

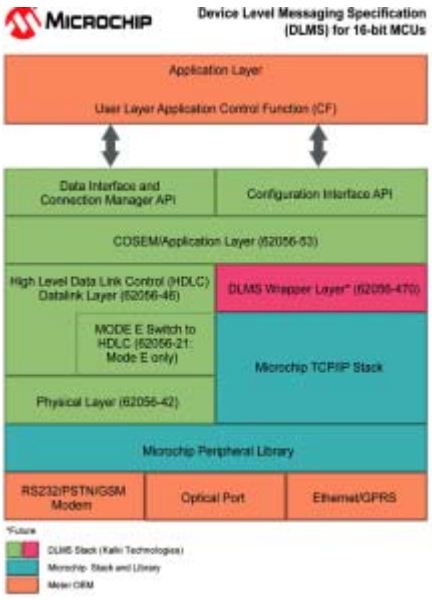
PowerStackTM Packaging Technology in Volume Production

Texas Instruments has shipped more than 30 million units of its PowerStackTM packaging technology, which significantly boosts performance, lowers power and improves chip densities in power management devices.
PowerStack technology's benefits are achieved through an innovative packaging approach where TI's NexFETTM power MOSFETs are stacked on a grounded lead frame, using two copper clips to connect the input and output voltage pins. This unique combination of stacking and clip bonding results in a more integrated quad flat no-lead (QFN) solution.
By stacking the MOSFETs in the PowerStack approach, the clear benefit is a package reduction by as much as 50 percent over alternative solutions that position MOSFETs side-by-side. In addition to reducing board space, PowerStack packaging technology provides excellent thermal performance, higher current capability and higher efficiency for power management devices.

ti.com/powerstack

Global Smart Meter Interoperability with Certified Stack for PIC® Microcontrollers

Microchip announces that it has partnered with Kalki Communication Technologies Ltd. (Kalkitech) to provide a Device Language Message Specification (DLMS) protocol stack that is optimised for 16-bit PIC® microcontrollers (MCUs). The DLMS protocol has become the worldwide standard among smart meter designers for interoperability among metering systems for different types of energy such as electricity, gas, heat and water; in residential, transmission and distribution applications; and over a wide range of communication methods such as RS232, RS485, PSTN, GSM, GPRS, IPv4, PPP and PLC; as well as for secure data access via AES 128 encryption.
To make the DLMS certification process faster and easier, the software stack has been tested and verified by the DLMS User Association and is customised to operate on all of Microchip's 16-bit PIC® microcontrollers and dsPIC® Digital Signal Controllers (DSCs). Additionally, the stack has been developed to ensure seamless integration with Microchip's communication protocol stacks, including TCP/IP, ZigBee® and PLC, to cover a broad spectrum of smart energy applications. The small memory footprint enables the use of the most compact and cost-effective MCUs. For European applications, the stack provides support for the IEC 62056-21 Mode E implementation.
The Explorer 16 Development Board can be used to develop DLMS solutions using Microchip's vast portfolio of industry-leading 16-bit MCUs and DSCs. This DLMS stack is available today, in four versions: The free DLMS Evaluation Library for 16-bit MCUs; the DLMS-lite Stack for 16-bit MCUs (SW500160); the DLMS Stack for 16-bit MCUs (SW500162); and the DLMS Explorer (SW500164) Windows® based DLMS/COSEM client application.



http://www.microchip.com/get/93G2

Microelectronic Relay Designers Manual

International Rectifier has released a CD-based Microelectronic Relay (MER) Designers Manual featuring a selection guide, application notes, datasheets and design tips on the company's extensive portfolio of MER products.
The MOSFET-based devices are ideal solid-state relays for switching AC and DC loads and sensory signals from a few milliamps to several hundred watts in industrial controls, instrumentation, peripheral telecom devices, computer peripherals and office equipment.
The IGBT-based photovoltaic relay is ideal for switching industrial loads up to 400W or 280VA. Available in a DIP14 package, the device is designed as a drop-in replacement for Mercury-wetted reed relays.
The Photovoltaic Isolators offer single- and dual-channel, optically isolated outputs that can be used for directly driving the gates of discrete power MOSFETs and IGBTs, allowing designers the flexibility of creating their own, custom-made solid-state relays capable of controlling loads over 1,000 volts and 100 amps.

www.irf.com

Digitally powered.

Energy control advances in PFC make going digital simply brilliant.

Cirrus Logic High-Efficiency Digital Power Factor Correction ICs

The CS1501/1601 are high-performance active digital power factor correction (PFC) controllers that feature Cirrus Logic's EXL Core® technology, intellegently solving complex power management challenges. With an industry standard pin out, these ICs offer best-in-class THD, power factor and effenciency across all load conditions, while also reducing the size and number of required external components.

A variable on-time/variable frequency algorithm is used in achieving close to unity power factor and spreading the EMI frequency spectrum, which reduces the conducted EMI filtering requirements. The feedback loop is closed through an integrated compensation network within the IC, eliminating the need for additional external components. Protection features, such as overvoltage, overcurrent, overpower, open and short circuit protection, over temperature and brownout, help protect the device during abnormal transient conditions.

CS1501/1601/1601H Features/Benefits:

- Enables a reduction in the boost inductor value (L_B)
- Reduces the size of the EMI filter stage
- Reduces need for external passive components

Powerful stuff? To learn more, visit cirrus.com/bpspfc and order a free sample.

CIRRUS LOGIC®

2012 Frankfurt, 27th European Photovoltaic Conference

WIP, organiser of the EU PVSEC – European Photovoltaic Solar Energy Conference and Exhibition, announces that in 2012 the 27th EU PVSEC will take place in Frankfurt, Germany. This is the first time that Frankfurt will be the focal point for the global photovoltaic solar sector: From 24 to 28 September 2012, this event will gather experts from research and from industry on the Messe Frankfurt fairground. The EU PVSEC is considered as leading photovoltaic event and takes place annually at changing European locations. The conference delegates and exhibitors come from all domains of PV research and industry. The spectrum of exhibitors includes manufacturers of PV production equipment, manufacturers of photovoltaic solar cells and modules, systems suppliers, companies and organizations specialized in project development, finance and consultancy as well as research institutes.

This year, the 26th European Photovoltaic Solar Energy Conference and Exhibition will be held from 5 to 9 September in Hamburg, Germany. 950 exhibitors from around the globe will be showcasing their products and services along the entire photovoltaic value chain. Production equipment manufacturers for PV components represent the largest industry segment at this show, closely followed by manufacturers of PV solar cells and modules. 40,000 PV professionals are expected to attend the EU PVSEC industry show. At the same time, over 4,000 representatives from science and research present and discuss the latest trends and developments at the world's largest PV conference. A total of 1,500 plenary, oral and visual presentations will be held, focusing greatly on the close interaction between science and industry.

www.photovoltaic-exhibition.com

www.photovoltaic-conference.com

Power Electronics 2011 Moscow

Power Electronics 2011, the 8th International Exhibition for Power Electronics, Energy & Energy Saving, will be held on 29 November to 1 December 2011in Moscow. Leading industry experts will gather in the modern Crocus Expo exhibition centre to discuss current industry issues, see the latest technologies and developments, and establish direct business contacts.

Power Electronics is a rapidly developing area of science and technology, and covers almost every sphere of human activity: industry, mining, transport and communications.

The exhibition is officially supported by federal ministries (Ministry of Industry and Trade, Ministry of Education and Science, and Ministry of Environment), the State Duma Committee for Science and High Technology, Federal Foundation for the Development of Electronic Technology, and government and public organizations.

The central business event of the exhibition is the international cconference entitled "Power Electronics: A Key Technology for Russian industry in the 21st Century", which provides an opportunity to obtain the latest innovative achievements from market experts, and to learn about the practical application of the latest developments. The conference will include specialised sections devoted to topical industry areas: automated electric drives and power sources for LED lighting.

According to the results for 2010, the exhibition and conference were attended by 2700 trade visitors from 45 Russian regions and 31 countries. Visitors 96% were industry specialists, and 90% were responsible for or had a say in purchasing decisions. 99% of the exhibitors rated the quality of the visitors as high.

Every year, the organisers follow the latest industry trends: in 2010 the exhibition included a roundtable entitled "Energy Conservation and Energy Efficiency - the Government's Economic Strategy: Legislation, Solutions and Prospects", which provided a unique opportunity to attract additional attention to energy conservation and renewable energy sources from the business community, industry associations, non-profit partnerships, and legislative and executive authorities. In 2011, the exhibition will feature a new section devoted to hybrid technologies.

Hybrid technologies – a new energy of Power Electronics

Hybrid technologies are used in combined equipment with internal-combustion engines in transport engineering. According to experts, they are the most effective way of achieving high performance on fuel economy and emissions reduction in vehicles. Power electronic components are also used to create hybrid engines.

www.powerelectronica.ru

SEMICON Europa 2011 is Platform for European Companies

Micro- and nanoelectronics, industrial biotechnology, photonics, innovative materials and manufacturing systems form a key part of future European industrial policy. Therefore, the development in these industries will be one of the main topics at the SEMICON Europa 2011 in Dresden.

Trade associations, business representatives and a high-ranking expert group initiated by the European Commission agree that Europe must be and continue to be an attractive location for what is known as "Key Enabling Technologies" (KETs). The main target is to ensure a high-tech sector in Europe which is stable, innovative and yields profit. Currently, joint strategies are being devised to make sure that Europe stays competitive in general.

Since all industries rely on semiconductor technology, it is all the more important to maintain and concentrate development of this indispensable expertise in Europe. This is where European production forms a vital component and provides the basis for a competitive semiconductor industry. Starting with research laboratories and universities, equipment and material manufacturers right up to the finished chip, this technology must always be state of the art, with unrestricted availability and accessibility for high-tech companies in Europe. Production locations, jobs and, finally, also competitiveness throughout Europe may be at risk in the case of delivery bottlenecks when depending on suppliers from Asia or North America.

Heinz Kundert, President of SEMI Europe: "The Key Enabling Technology Initiative of the European Commission provides the incredibly valuable possibility of increasing Europe's competitive power. The SEMICON Europa 2011 is the right place to gather information about the latest technological trends and market development and to obtain important impetus for the companies' strategic alignment."

www.semiconeuropa.org

RELY Research Project, New Ways of Chip Design Methodology

Germany's foreign trade success is determined to an ever-increasing degree by the quality and reliability of high-tech products. Seven partners from the German business and research communities are teaming up in the three-year "RELY" project to explore ways of enhancing the quality, reliability and resilience of modern microelectronic systems. The focus will be on applications in transportation, in particular electro mobility, in medical technology and automation.

Microelectronics will play a far more prominent role in these sectors in the coming years. While vehicles today incorporate semiconductor components to the value of some 300 US dollars, this figure is set to rise to about 900 US dollars in hybrid and electric vehicles. We will see electronic systems for enhanced safety and comfort making greater inroads into the automotive sector, and some of them call for enormous computing capacity: they will enable recognition of speed limits and persons in the dark, and allow automatic parking systems, radar-based driver assistance systems and emergency call systems, for instance. To fulfill all these tasks, the respective semiconductors have to provide an ever-growing number of functions, while meeting stringent quality and safety standards approximating those in the aerospace industry.

The RELY research project, which sets out to design new development processes for tomorrow's microelectronic systems and to integrate new reliability and safety criteria, is supported by the German Federal Ministry of Education and Research (BMBF) with Euro 7.4 million under the "Information and Communications Technology 2020" program. The team members alongside project leader Infineon Technologies AG are EADS Deutschland GmbH, the Fraunhofer-Gesellschaft, MunEDA GmbH, X-FAB Semiconductor Foundries AG, the Technische Universität München (Technical University of Munich) and the Universität Bremen (University of Bremen).

RELY targets a chip design methodology leveled at reliability.

The RELY research project lays the foundations for establishing reliability as a new target parameter throughout the chip development process. So far, optimization has been leveled primarily at area, performance and energy consumption. In the course of the research, the partners seek to develop novel chip architectures that will allow a chip to automatically determine its operating status, react to it and even enter into interaction with the electronic system. In future, such a self-test function of the chip could permit a timely alert of possible signs of wear in electronic systems. This is important particularly in applications that have to operate reliably for many years, such as production plants, trains or cars, or medical implants such as insulin pumps.

In order to be able to implement the self-test function of chips, the research will initially focus on various preparatory activities. The project partners will work on extending the modeling of manufacturing technologies, formulating new chip design specifications, defining new characteristics also in higher design levels, and in enabling system simulation and chip verification with respect to reliability.

The German RELY research project (BMBF funding reference number 01M3091) is part of the European CATRENE project of the same name – also coordinated by Infineon.

www.infineon.com

Multi-Source Digital POL Platform

CUI Inc has reached a statement of cooperation with Ericsson, the world's leading provider of technology and services to telecom operators, under which it will develop and market multi-source, digital Point-of-Load (POL) power solutions that are based on the Ericsson footprints and designs.
The agreement concerns Ericsson's current BMR46X platform and plans for its expansion. CUI will initially develop and bring to market a solution that is pin and function compatible with the BMR46X platform under CUI's Novum Advanced Power product line. Novum digital non-isolated POL modules allow power design engineers to realize better energy efficiencies, more compact designs, and improved time-to-market compared to traditional analog technology.
The initial efforts by CUI will be followed by CUI and Ericsson cooperating to provide solutions outside of the 12A to 40A range.
"Given the diversity and complementary strengths of our respective experience and know-how in digital power, we look forward to cooperating with Ericsson to further the advancement of our Novum power products," stated Mark Adams, VP of Advanced Power Marketing for CUI Inc. "Together, we expect to bring the digital power revolution to a whole new level."

www.cui.com

www.cuiglobal.com

Energy Conversion Innovation for a Clean Energy Future

An Interactive Discussion on Latest Advances in Energy Conversion
A distinguished panel of speakers will address the IEEE Energy Conversion Congress and Expo (September 17-22) in the Plenary Session on September 19 at the Hyatt Regency Phoenix in Phoenix, AZ.
Dr. Alex Lidow, co-founder and CEO of Efficient Power Conversion Corporation (EPC) will speak on "Gallium Nitride as a Displacement Technology for Silicon in Power Management"
Dr. Ryne P. Raffaelle, Vice President for Research and Associate Provost at Rochester Institute of Technology, and former Director of National Center for Photovoltaics in the U.S. DOE National Renewable Energy Laboratory (NREL) will discuss "The Past, Present, and Future Photovoltaics"
Dr. David Parekh, Vice President, Research, and Director of United Technologies Research Center (UTRC) will speak on "A Joule in Hand is Worth Ten in the Ground".
ECCE 2011 will also feature three exciting Rap Sessions on technological trends and visions for Renewable Energy, Vehicle Electrification, and Vehicle-Grid interactions by renowned researchers and industry experts on the evening of September 20. Each session will feature presentations by a panel of experts followed by a 30-minute Q&A, allowing for an audience and expert interaction to entertain technical possibilities beyond the known boundaries. The three Rap Sessions are:

"Mission Impossible? A 100% Renewable Energy Society" moderated by Dr. Dan M. Ionel, Chief Scientist, Vestas Technology Americas R&D

"Vehicle Electrification Technologies, Today and Tomorrow" moderated by Dr. Chris Mi, Associate Professor, University of Michigan – Dearborn

"Plug-in Electric Vehicles and the Electric Power Grid: Colliding Industries" moderated by Dr. Jin Wang, Professor, Ohio State University

The IEEE Energy Conversion Congress and Exposition (ECCE) will be held in Phoenix, Arizona, USA from September 17-22, 2011 at the Phoenix Convention Center and the Hyatt Regency Phoenix.
ECCE is a major global event sponsored by the IEEE Power Electronics Society (PELS) and the IEEE Industry Application Society (IAS). It provides an opportunity for authors to present and attend high quality technical presentations and tutorials on all aspects of energy conversion, as well as industry seminars and over 50 exhibits to showcase state-of-art energy conversion systems and apparatus.
Supporters of ECCE also include Opal-RT Technologies Inc., United Technologies Research, Power-One and General Atomics.
An annual event, ECCE receives more than 1200 abstract submissions, and, through rigorous peer review, only 600 of the best are chosen to be presented in oral presentation and poster session formats, forming an exciting and extensive Technical Program.
For more information about ECCE and to register, please contact ecce@courtesyassoc.com or call 202-973-8744.

www.ecce2011.org

Indium Corporation Technology Expert Presenting at EMPC

Indium Corporation's Technical Manager Karthik Vijay will present his technical findings at the European Microelectronics and Packaging Conference (EMPC), September 12-15, 2011, in Brighton, UK.
Karthik will present Miniaturization - Solder Paste Attributes for Maximizing the Print & Reflow Manufacturing Process Window. This paper describes the development of a flux technology platform to realize print consistency, eliminate head-in-pillow, obtain complete solder coalescence and prevent clumpy solder joints, and achieve very low voiding.
Karthik will also present Power Electronics - Solder TIMs (Thermal Interface Materials) for Improved Thermal Management, which discusses the work done on solder TIMs that have been developed for high-power applications and how they compare to thermal grease.
These papers will be available online at www.indium.com/techlibrary/whitepapers/ after publication at EMPC.

Karthik joined Indium Corporation in 2003. He earned his master's degree in Industrial Engineering with a specialization in Electronics Packaging & Manufacturing from the State University of New York at Binghamton. He is an SMTA-certified engineer and earned his Six-Sigma Green Belt certification from Dartmouth College's Thayer School of Engineering.
Indium Corporation will also participate in the exhibition September 13-15. For more information about EMPC 2011, visit www.empc2011.com.

www.indium.com

LED professional Symposium and Exhibition 2011

The LED professional Symposium and Exhibition (abbreviated: LpS 2011) takes place from the 27th to the 29th of September, 2011 in western Austria. It is being organized by LUGER RESEARCH, and the venue is the „Festspielhaus“ (Festival House) in Bregenz.

The technology of Light Emitting Diodes (LED) is not new, but its application in lighting technologies is. With the development of high-efficiency and high-performance LEDs it has become possible to use LEDs in lighting and illumination. This kind of lighting technology has shown a very fast and interesting development. It is very flexible and consumes much less energy than conventional lighting systems do. A building's carbon footprint from lighting can be reduced by 85 percent by exchanging all incandescent bulbs with new LED lighting.

This meeting of experts from all over the world is planned to become an annual event because LED lighting technology has a big influence on the development of new lighting solutions and is applied in all areas of lighting. It aims to be Europe's foremost LED lighting technology meeting point for lighting experts operating in industry and research.

The Symposium

At the LED professional Symposium and Exhibition 2011, up to date information about the newest technologies and developments will be presented. Visitors will see the latest, as yet, unpublished technology presentations on the subject of LED-technologies and their applications put forward by experts from all over the world. These experts will also be available for detailed technical discussions during the whole event. It is the ideal platform for dialogues between people from the fields of research, industry, product development and application. The symposium covers LED lighting technologies for illuminants, lamps and modules focusing on new system approaches, new components and the most up-to-date design techniques.

A comprehensive program regarding this topic is offered. The LED professional Symposium and Exhibition mainly targets interest groups who are eager for new information about LED lighting technology and its application in light modules and lighting elements.

The Exhibition

Running concurrently with the symposium is an exhibition of products and LED-technology services. This will be the ideal opportunity to make new contacts with a vast amount of people in the lighting industry, to help you expand your networks, find solutions and see products demonstrated. The exhibitors are a diverse mix of companies which include manufacturers, distributors, laboratories, institutes of the lighting industry that deal with LED-technology and government organizations.

Topics covered at the LpS 2011:

- Evolution of LED lighting systems
- Technologies for increased efficiencies of white light LED systems
- Technologies for mixing LED light
- Reliability of LED lighting systems
- Standardization & measurement of LED lighting systems
- Design approaches & tools of LED lighting systems
- Cost & production process improvements for LED lighting systems

System areas covered at LpS 2011:

- Light generation
- Primary & secondary optics
- Driver ICs
- Lighting driver modules
- Cooling devices
- Substrate, packaging & connection devices & materials
- Lighting control modules
- Lighting design tools & configurators covering optics, electronics & thermal components
- Measurement & calibration equipment
- Production methodologies & manufacturing tools

www.lugerresearch.com

www.lps2011.com

Development Board for Fast Development of Power Conversion Circuits and Systems Using Enhancement Mode Gallium Nitride (eGaN®) FETs

EPC9004 facilitates rapid design of high frequency switching power conversion systems based on the 200 V EPC2012 with a ready-made, easy to connect development board and well-documented engineering support materials.

Efficient Power Conversion Corporation (EPC) announced the introduction of the EPC9004 development board to make it easier for users to start designing with EPC's 200 V enhancement-mode gallium nitride (eGaN) field effect transistor (FET) in applications such as solar microinverters, class D audio amplifiers, Power over Ethernet (PoE), and synchronous rectification.

The EPC2012 FET is a 1.6 mm^2 200 V_{DS} device with a maximum $R_{DS(ON)}$ of 100 milliohms with 5 V applied to the gate. This eGaN FET provides significant performance advantages over the first-generation EPC1012 eGaN device. The EPC2012 has an increased pulsed current rating of 15 A (compared with 12 A for the EPC1012), is fully enhanced at a lower gate voltage, and has superior dv/dt immunity due to an improved ratio of Q_{GD}/Q_{GS}.

Compared to a state-of-the-art silicon power MOSFET with similar on-resistance, the EPC2012 is much smaller and has many times superior switching performance. Applications that benefit from eGaN FET performance include high-speed DC-DC power supplies, point-of-load converters, class D audio amplifiers, hard-switched and high frequency circuits.

"With the expansion of our family of eGaN FETs, we continue to raise the bar for the performance of gallium nitride FETs. In addition, this new generation of eGaN products are the industry's first gallium nitride FETs to be offered as lead-free and RoHS-compliant," said Alex Lidow, co-founder and CEO.

The EPC9004 development board is a 200 V maximum input voltage, 2 A maximum output current, half bridge with on board gate drives, featuring the EPC2012 200 V eGaN FET. The purpose of this development board is to simplify the evaluation process of the EPC2012 eGaN FET by including all the critical components on a single board that can be easily connected into an existing converter.

The EPC9004 development board is 2" x 1.5" and contains not only two EPC2012 GaN FETs in a half bridge configuration with gate drivers, but also an on board gate drive supply and bypass capacitors. There are also various probe points to facilitate simple waveform measurement and efficiency calculation. A Quick Start Guide, http://epc-co.com/epc/documents/guides/EPC9004_qsg.pdf, is included with the EPC9004 development board for reference and ease of use.

EPC9004 development boards are priced at $95.00 each. EPC9004, like all EPC products, are available for immediate delivery from Digi-Key at http://digikey.com/Suppliers/us/Efficient-Power-Conversion.page?lang=en

Design Information and Support for eGaN FETs:
Download EPC2012 and all EPC eGaN datasheets at
http://epc-co.com/epc/Products/eGaNFETs.aspx
Development boards and other design support available at
http://epc-co.com/epc/Products/DemoBoards.aspx
View eGaN product training support materials at
http://epc-co.com/epc/DesignSupport/eGaNFETBasics.aspx
Application notes for eGaN FETs can be found at
http://epc-co.com/epc/Applications/ApplicationBasics.aspx

About EPC
EPC is the leader in enhancement mode Gallium Nitride based power management devices. EPC was the first to introduce enhancement-mode Gallium-Nitride-on-Silicon (eGaN) FETs as power MOSFET replacements in applications such as servers, netbooks, notebooks, LED lighting, cell phones, base stations, flat-panel displays, and class-D audio amplifiers with device performance many times greater than the best silicon power MOSFETs.

eGaN is a registered trademark of Efficient Power Conversion Corporation, Inc. Visit our web site:

www.epc-co.com

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Introducing the ZL9101M, the Industry's First Fully-Encapsulated Digital Power Module

Simplify your design and replace up to 80 external components with one compact "pick and place" module. The ZL9101M's digital architecture supports feature selection and system monitoring via the industry standard PMBus interface. Configuration is as simple as "point and click" with the PowerNavigator™ graphical user interface.

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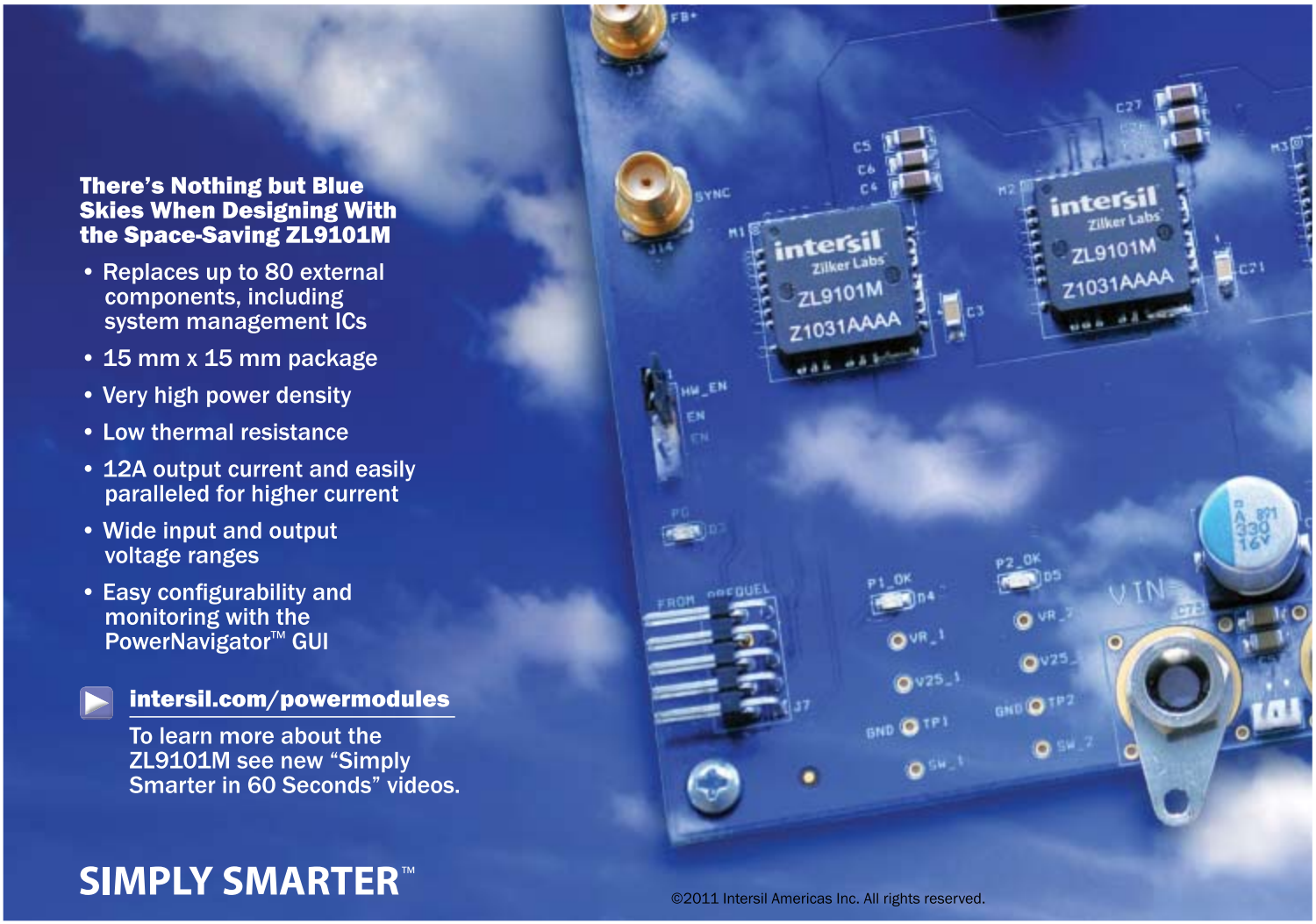

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250 kW Module MT Series V Programmable DC Power Supply

Magna-Power Electronics, a leader in high-power programmable DC power supplies, released their MT Series V power supply with a new, high power 250 kW module. This new fifth generation product now includes 65 models spread across independent 100 kW, 150 kW, and 250 kW modules, scalable into the megawatts through paralleling, with voltages from 16 Vdc to 4000 Vdc and currents from 24 Adc to 24000 Adc. The MT Series V features Magna-Power Electronics' signature current-fed power processing, delivering additional power processing stages for increased system protection under abusive loads.

The newest 250 kW module integrates Magna-Power Electronics' harmonic neutralizer, which suppresses families of AC harmonics by increasing the number of power phases—an important consideration for switch-mode power supplies in the hundreds of kilowatts. The harmonic neutralizer creates a 12-pulse AC waveform, minimizing harmonic distortion. The harmonic neutralizer eliminates families of harmonic components by multiplying the number of input phases with specially wound autotransformers, providing a cost effective solution to maintaining power quality at acceptable levels.

By designing a 250 kW module and integrating the harmonic neutralizer, the overall 250 kW system size was reduced by over 33%. In addition, the integrated harmonic neutralizer greatly reduces installation requirements, easing multi-module scalability.

The new MT Series V features identical controls and features as Magna-Power Electronics line of programmable DC power supplies. All the products come standard with RS-232 interface, programmable SCPI command set, isolated 37-pin I/O for PLC integration, and rotary front panel control, metering, and calibration. Furthermore, programming options such as LXI TCP/IP Ethernet (+LXI) and IEEE 488.2 GPIB (+GPIB) as well as performance options such as photovoltaic power profile emulation (+PPPE) and the recently released high slew rate output (+HS). Units are capable of master/slave parallel and series operation through the plug-and-play UID46 device.

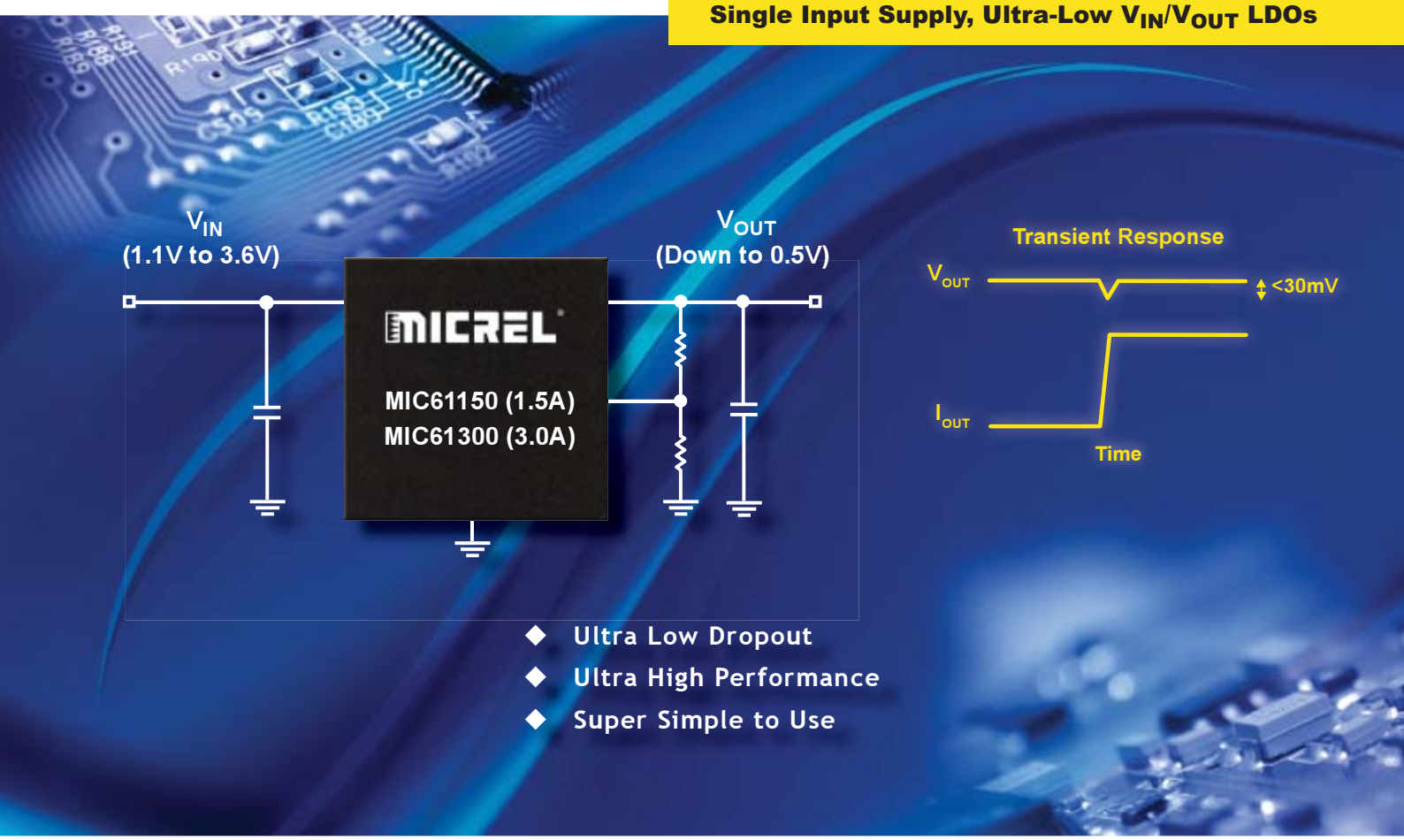
The new MT Series V products are now shipping worldwide. For a full list of specifications and models, please refer to the MT Series V product datasheet.

Magna-Power Electronics designs, and manufactures robust current-fed power supplies in the USA that set industry standards for quality, size, and control. Its products can be found around the world feeding power to national laboratories, universities, and a wide range of industrial sites. The company's experience in power electronics is reflected in its 2 kW to 1 MW+ product line, quality service, and reputation for excellence.

www.magna-power.com

Simple, High-Current LDOs for Powering Next Generation FPGAs, DSPs and ASICs

Single Input Supply, Ultra-Low V_{IN}/V_{OUT} LDOs



- Ultra Low Dropout
- Ultra High Performance
- Super Simple to Use

Powering today's FPGAs, ASICs and DSPs involves the challenge of supplying high currents in very low input-output voltage conditions. This is where Micrel's new family of ultra-low V_{IN}/V_{OUT} LDOs excels. These new Micrel LDOs offer the convenience of adjustable output voltages as low as 0.5V with input voltages as low as 1.1V, while supplying up to 3A of output current.

To further enhance flexibility and reduce overall cost for the power supply designer, Micrel has eliminated the additional bias supply! Unlike other solutions, the MIC61150 and MIC61300 do not require an additional bias supply and hence offer clean and simple single input supply operation.

For more information, contact your local Micrel sales representative or visit Micrel at: www.micrel.com/ad/mic61xxx.

Key Applications

- FPGA/DSP Power Supplies
- ASIC/Microprocessor Power Supplies
- Telecom/Networking Cards
- Point-of-load Applications

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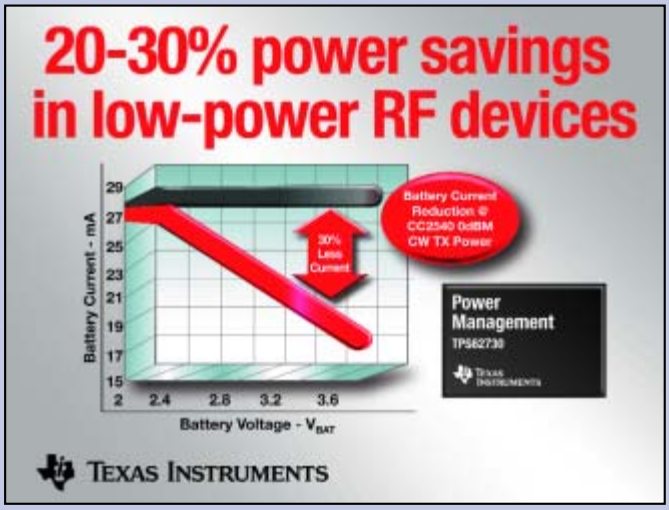
20-Percent Run-Time Added for Ultra-Low Power Wireless Applications with 3-MHz, 100-mA Step-Down DC/DC Converter

High-performance voltage regulator with integrated bypass switch and DCS-Control™ technology extends battery life. Texas Instruments Incorporated introduced a 3-MHz, 100-mA synchronous step-down DC/DC converter, which integrates a bypass switch and a unique DCS-Control™ technology. The new device extends battery run-time by 20 percent in low-power wireless and MSP430™ MCU-based applications, when compared to competing solutions. The high-performance device has an operating current of only 25 uA and supports many low-power applications, such as Bluetooth® low-energy systems, metering and building technologies, mobile phones, consumer electronics, medical and human interface devices.



The TPS62730 achieves 95-percent conversion efficiency and reduces current consumption drawn from the battery in transmit and receive modes. In bypass mode the device´s ultra-low consumption is only 30nA of current for sleep and low power modes. The TPS62730 converter also generates less than 15 mVpp typical output voltage ripple, providing low noise to low-power RF applications, such as those powered by TI's 2.4-GHz CC2540 and CC430 system-on-chip (SOC) solutions. To order samples and an evaluation module or to download the datasheet and SwitcherPro™ design tool and PSpice® and TINA-TI™ models of the TPS62730, visit: www.ti.com/tps62730-preu.

DCS-Control™ technology

DCS-Control™ technology is an advanced regulation topology that combines the advantages of hysteretic current mode and voltage mode control within a single device, enabling excellent line and load regulation. The feature provides a seamless transition between high-load and light-load (power save) operation. An additional voltage feedback loop also ensures DC accuracy. DCS-Control™ technology alleviates the need to research external filtering components, thus reducing associated space and cost.

Key features and benefits

- Excellent low-output voltage ripple (<15 mVpp typical) over the entire load range, which benefits RF applications.
- Small solution size of 12 mm^2: 3-MHz frequency and fixed output voltage options require only three external components.
- Input-voltage range of 1.9 V to 3.9 V supports Li-primary battery chemistries such as Li-$SOCl_2$, $LiSo_2$ and Li-MnO_2, and also two alkaline batteries.
- Ultra-low-power shutdown/bypass-mode current of 30 nA, typical, supports the sleep and low-power modes of modern RF transceivers.

Tools and support

TI offers a variety of tools and support to speed the implementation of the TPS62730:

- TPS62730EVM-726 step-down DC/DC converter evaluation module (EVM): www.ti.com/TPS62730EVM-pr
- SwitcherPro(TM) switching power supply design tool: www.ti.com/tps62730spstool-pr.
- PSPICE model: www.ti.com/tps62730pspice-pr.
- TINA-TI transient SPICE model: www.ti.com/tps62730tinati-pr.
- TINA-TI reference design: www.ti.com/tps62730refdesign-pr.

Availability and pricing

The TPS62730 is available now from TI and its authorized network of distributors in a small, 6-pin, 1- mm x 1.5-mm x 0.6-mm SON package, priced at $0.85 in quantities of 1,000. Additional devices with fixed voltages include TPS62731, TPS62372, TPS62374 and TPS62735.

Find out more about TI's low-power RF and power management solutions:

- Download TI's Wireless Connectivity Solutions Guide: www.ti.com/tps62730wcguide-pr.
- Ask questions, help solve problems in the Power forum in the TI E2E™ Community: www.ti.com/tps62730powerforum-pr.
- Download the new Power Management Guide: www.ti.com/power-guide-pr.

Texas Instruments semiconductor innovations help 80,000 customers unlock the possibilities of the world as it could be – smarter, safer, greener, healthier and more fun. Our commitment to building a better future is ingrained in everything we do – from the responsible manufacturing of our semiconductors, to caring for our employees, to giving back inside our communities. This is just the beginning of our story.

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When Wide Bandgap?

By Dan Kinzer, Chief Technology Officer and Senior Vice President, Fairchild Semiconductor

The promise of wide bandgap material is a tremendous gain in efficiency, size, and weight at similar or even reduced cost for power electronic systems. Roughly speaking, wide bandgap devices can have 10 times better conduction and switching properties. That gain is critical for pervasive adoption of wind and solar energy, hybrid electric and electric vehicles, and microgrids with distributed energy generation and storage. The cost of the power electronics is an increasing fraction of the cost of such systems, even as the absolute costs come down; the cost of solar panels is dropping faster than the balance of system, for example. Intelligent system control is a must to conserve every watt possible, but just as importantly the power devices need to deliver every watt as efficiently as possible. What needs to happen to further the adoption of wide bandgap devices? What is the future for silicon power devices?

First, consider silicon carbide. Research on SiC power devices has been ongoing for more than 20 years. The first commercial power devices emerged 10 years ago as 600V Schottky diodes, which then progressed to junction barrier and merged PiN Schottky diodes. The great thing about silicon carbide devices is the robustness that can be achieved due to the material. The thermal conductivity is more than 3X better than silicon, and the homogeneous substrate and epitaxy layers allow for vertical power devices that can spread heat generation uniformly across the die, with high current surge and high transient voltage and power capability.

Just now, SiC transistor switches are making their first commercial appearance. Early MOSFET offerings have relatively high on-state resistance, and still have limitations due to surface channel mobility and gate dielectric stresses. New MOSFET devices are in development and partially address these limitations. Bipolar and JFET devices avoid these issues, and as a result have lower resistance that can approach theoretical limits. Bipolar devices are normally off, which is a must for most applications. New BJTs have no storage time, 20ns switching, high current gain above 100, no gain rolloff at high current, negative gain and Vcesat temperature coefficient for stability, and no secondary breakdown. JFETs can be fabricated to pinch off at zero gate bias, but this increases the on-state voltage, and limits the gate voltage swing to less than 3 volts. Normally on JFETs have conduction losses almost equal to bipolars, but usually require a cascode device in series, or at least a negative drive if the normally on operation is tolerable.

What about Gallium Nitride? Lower voltage parts ranging from 30V to 200V have already been introduced. Below 100V, the devices actually have higher specific on-resistance than the silicon alternatives. A small advantage in gate charge is the only edge these devices have, while driving the device without gate rupture can be challenging. Commercial 600V devices are about to emerge. Some of these are built on silicon carbide substrates, but for cost reasons most companies are focusing on GaN epitaxy on silicon substrate approaches. This is an incredibly tough process challenge due to the large crystal mismatch; MOCVD processes are in development that can deliver several micron thick layers, enough to handle the 600V requirement, without excessive warping or cracking of the layers. The inevitable dislocations that arise due to the mismatch, usually in the range of $10^9/cm^2$, need to be suppressed to avoid leakage to the conductive silicon substrate. It is important to incorporate special impurities in the films to control the leakage as well as bulk charge trapping. Surface and bulk charge trapping can lead to on-state voltage increases and blocking voltage instability. Fortunately, a lot of progress has been recently reported on addressing these instabilities.

In theory, a vertical device in GaN could have better conductivity than SiC. This is often shown on specific Rdson vs rated BV graphs. The problem is the lack of a homogeneous GaN substrate at a reasonable cost and diameter. Consequently, almost all efforts are on lateral high electron mobility transistors (HEMTs), which do not follow the model for vertical devices. The performance of these devices depends on reducing feature sizes, 2DEG contact resistance, and the drain drift length. This means high surface electric fields are unavoidable to achieve low resistance and these devices are not able to withstand significant avalanche current. The devices must be overdesigned to ensure no voltage transient ever reaches the actual device breakdown voltage. HEMTs are normally on devices with a leaky Schottky gate, so for high voltage an insulated gate structure and an innovation in normally off device design is essential.

The key to success in silicon carbide is to accelerate the cost and material defectivity learnings, expand substrate and epitaxial capacity, and to transition to 150mm diameter to access widely available wafer fabrication. Expect to see this happen in the next 2-3 years commercially for 600V to 1700V devices, with much higher voltages possible as well. The key to success in gallium nitride is improved high volume and lower cost MOCVD processes on silicon in the 150mm to 200mm range, with device and material designs that can withstand the high operating voltage and surface electric field stresses. This has begun to happen in development for 100V to 600V devices, so expect to see these devices ramp in 2-3 years as well.

Will silicon devices withstand the onslaught? Absolutely! With decades of proven reliability and field use, and a highly mature and cost effective manufacturing infrastructure, IGBTs, SuperFET® mosfets, and STEALTH™ rectifiers will serve the 600V to 1200V market well for years to come. Shielded gate PowerTrench® silicon devices are still the device of choice for 25V to 150V applications. As system designers learn to use the high frequency capability of the wide bandgap devices, the system performance, size, and cost advantages will emerge and drive a gradual shift in the industry through the rest of this decade and into the next.

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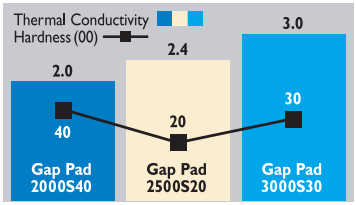

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Electronics Industry Digest

By Aubrey Dunford, Europartners

GENERAL

A key expert group set up by the Commission set out guidelines on giving European industry a competitive edge in deploying the industrial technologies of the future (Key Enabling Technologies). The main conclusions call on decision-makers to adopt radical policy objectives to retain critical capability and capacity in Europe through a single and comprehensive approach to KETs. In particular, the group recommends that the vital importance of KETs should be reflected in the structure and funding balance in the upcoming framework for research and innovation and in the priorities of the EU's future regional policy.

European Commission Vice-President Antonio Tajani warned that Europe's industry "would suffer losses in competitiveness", if it fails to successfully exploit the six following important KETs (micro- and nanoelectronics, advanced materials, industrial biotechnology, photonics, nanotechnology and advanced manufacturing systems). The European Semiconductor Association (ESIA) applauds the final report and urges for its swift implementation.

SEMICONDUCTORS

The ENIAC Joint Undertaking has launched its new Call for proposals, boosted by the strong participation of the funding authorities who committed in 2011 grants up to € 175 M, an increase of 100 percent over the previous year. The ENIAC Joint Undertaking generated R&D activities in value of more than € 1 billion since its inception in 2008, taking now a big step towards fulfilling its objective to approach € 3 billion by 2013.
The ENIAC Joint Undertaking is a public-private partnership focusing on nanoelectronics that brings together the ENIAC member States, the European Union, and AENEAS (an association representing European R&D actors in this field).
The Q111 capacity utilization of semiconductor manufacturing plants worldwide was 93.7 percent from 92.9 percent in Q410, so SICAS.
The world's first automated high volume production site for thermoelectric chip devices has been officially opened by Micropelt at their new location in Halle/Saale, near Leipzig. The fab produces thermoelectric thin films on 6" silicon wafers, which are processed further into tiny micro coolers, sensors and thermo generators. Around € 15 M are being invested by the company. Production starts in summer 2011. Volume ramp-up is targeted for 2012.
Micropelt has planned its first fab for 100 wafer starts per week, good for up to 10 million devices per year.
TowerJazz, an Israeli specialty foundry supplier, has agreed to sell its holdings in Hua Hong Semiconductor, one of Mainland China's leaders in the field of IC foundry service, in an HHSL buyback transaction, for $ 32 M in cash.
Siltronic and the Belgian nano-electronics research institute imec have concluded an agreement to collaborate on the development of silicon wafers with a gallium nitride layer as partner of imec's GaN-on-Si industrial affiliation program (IIAP). The endeavour aims to enable production of solid-state lighting (LEDs) and power semiconductors of the next generation on 200 mm silicon wafers.

OPTOELECTRONICS

AU Optronics announced the inauguration of AU Optronics Slovakia in Trencin, Slovak Republic. As one of the two AUO production bases in Europe, AUO Slovakia will play a key role in the manufacturing, assembly, and selling of large-sized LCD modules for TV set makers. The decision to establish a LCD module plant in Trencin was made in December 2009. The 200,000-square-meter construction project was completed in April 2011, with mass production took place in May and first shipment delivered in the same month. The plant will be able to reach a capacity of 240k per month by the end of 2011. When fully online in 2012, AUO Slovakia is expected to generate as many as 3,000 job offers.
There is no obvious increase in LED production in 2011, so LEDinside. Although 2H11 is traditionally the peak season for the LED industry, doubt about oversupply spreads on weak market demand. LEDinside estimates that LED chip supply volume in 2011 is about 100 billion units and demand volume is around 89 billion units – an oversupply ratio of 12 percent. In addition, after LED chip makers' capacity expansion comes online in 2012, it is estimated that oversupply ratio will then rise to 21 percent.

OTHER COMPONENTS

OM Group has signed a definitive agreement to purchase Vacuumschmelze of Hanau, a German supplier in advanced materials and specialty magnetics, forapproximately € 700 M. In the 12-month period ending March 31, 2011, VAC recorded revenues of approximately € 389 M and operating profit of € 54 M.

DISTRIBUTION

Arrow Electronics has signed a definitive agreement to acquire the distribution business of Seed International. Seed is a value-added distributor of embedded products with 14 offices across China. The company is primarily focused on Texas Instruments products, and is well known in China as a strong technical service provider with DSP specialization. Seed is headquartered in Beijing, China, and has approximately 200 employees. The company's sales for the latest fiscal year were approximately $ 90 M. Arrow Electronics will also distribute Dawin Electronics in the EMEA region. Semiconductor manufacturer Dawin, based in Incheon, Korea, produces diode, IGBT, MOSFET, thyristor and rectifier modules, as well as discrete components.
Richardson RFPD, an Arrow Electronics company, has received for the second consecutive year the "Top Distributor of the Year" award from TriQuint Semiconductor, a RF solutions supplier.
Avnet announced that Rick Hamada has succeeded Roy Vallee as the company's Chief Executive Officer (CEO). The transition was previously announced on Feb. 14, 2011, and became effective with the beginning of Avnet's fiscal year 2012. Vallee will continue to serve as Avnet's Executive Chairman of the company's Board of Directors.

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

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Power Supply on Chip Getting Powered Up

By Linnea Brush, Senior Research Analyst, Darnell

Of all the new technologies changing the power electronics landscape, none is causing quite as much excitement as Power Supply on Chip (PwrSoC). Conferences like PwrSoC '08 and '10 are promoting it; companies like Enpirion have introduced commercial products; and organizations like PSMA are releasing roadmaps. Darnell Group is now pulling together these preliminary trends and clarifying the market through two resources: Darnell's Power Forum '11, being held in San Jose, California, in September; and the first detailed forecast report for PwrSoC, being released by Darnell at the end of the month.

In the early stages of an emerging technology, definitions are very important. At this point, a common, accepted definitions of PwrSoC and Power Supply in Package (PSiP – a related package style) are not yet available. In fact, "system" is often used instead of "supply." The Power Sources Manufacturers Association (PSMA) has defined an encapsulated power supply with an integrated discrete inductor within the package as a PSiP. With PwrSoCs, the power passives are integrated on semi-substrate. In addition, a group working with PSMA has proposed the following definition for existing PwrSoC and PSiP products: (1) less than 1"x1"x1"; (2) module to chip-scale package; (3) contain all silicon components; and (4) contain at least one power passive.

A simpler way of defining these products has been given as: "the use of a module to encapsulate the power semiconductors and ICs in unpackaged dice, along with passive devices, including the inductor, in the same form factor as an IC." PSiP, on the other hand, is a highly integrated "micro-module," usually based on multi-chip co-packaging technology. Enpirion is the only company to have introduced a PwrSoC product by that name and definition, so the concept is often discussed with PSiP, where one can argue that more commercial products fit the description.

It is also important to distinguish these products from systems-on-chip (SoCs), where the silicon inductor is either discrete or integral to the IC. To avoid confusion, Darnell Group has proposed the following definitions that revolve around packaging distinctions:

Power Supply on Chip: A complete switch-mode dc-dc converter solution integrated onto a single piece of silicon.

Power Supply in Package: A highly integrated "micro-module," usually based on multichip co-packaging technology.

The distinguishing characteristic between these two is that PwrSoC is technically a "single package" solution, whereas PSiP may be a "package within a package." Either way, these definitions will probably evolve over time.

Darnell's Power Forum '11 (DPF '11) is one of the venues that is looking at "the state of PwrSoC," and how it fits among other technologies. DPF '11 is a solutions-oriented event, with a strong emphasis on practical advances in power electronics and a focus on today's "best practices." The conference looks forward to next-generation solutions and advances, including digital power conversion, energy harvesting and storage, GaN and power supply on chip. All of these are in various stages of commercial development and adoption, and they all point to significant changes going on in the power electronics industry.

For example, power delivery has become a key element for mobile platforms to improve battery life and meet energy efficiency regulations. With high-performance servers, multi-core microprocessor power delivery has becoming increasingly dense and complex. Due to the increase in the number of cores per die and the need to selectively operate the processor cores in different modes, it has become necessary to segment the power delivery to each core or functional unit block. Moreover, because of the need to reduce power significantly, the power delivery system must deliver power more efficiently and more quickly to the load, which means the power conversion must be as close to the load as possible, bypassing losses due to parasitic interconnect circuit elements.

Addressing some of these issues is the PwrSoC session at DPF, with papers from Cymbet, Intel and Tyndall National Institute. Intel sees "the start of a revolution in power delivery and power management for SoCs and high performance applications." Part of this is "combining" power delivery and power management in applications ranging from performance servers to small consumer electronic devices. The trend in platform power needs to shrink, become more efficient, and be more cost-effective.

Intel's proposed architecture is an integrated voltage regulated technology that supports a flat efficiency curve. "Fine grain" power management allows for multiple voltage rails. The company has proposed a "common cell" architecture consisting of twenty 2.8mm2 "power cells" with active voltage positioning for current sharing and balance. Each power cell would function like a "mini voltage regulator," with 16 phases per power cell and 320 phases per chip, under the control of a "master controller block." Intel is working on integrated on-chip inductors using thin-film on-die magnetics.

Cymbet has a unique packaging solution that will further enable PwrSoC solutions. The company has developed an embedded solid-state battery technology that can be used for system-on-chip power. The company's EnerChip™ rechargeable solid-state energy storage devices are created using semiconductor processing techniques on silicon wafers. EnerChip devices are compatible with other semiconductor integrated circuits and passive devices and can be co-packaged together. They are as small as 1mm x 1mm and can be coupled with other ICs to create unique innovative products.

The Micropower team at Tyndall National Institute in Cork, Ireland, has focused their
research into micro-magnetics on silicon for PwrSoC applications. The Tyndall micro-inductor structure consists of a racetrack of electroplated copper windings encased in a thin film, electroplated, closed, nickel-iron soft magnetic core. Recent prototype devices have demonstrated efficiency data for micro-inductors of more than 90%, operating at 20MHz and delivering 0.5 Amps, within a footprint of 5.5mm.

Advanced materials will be the "building block" of many of these emerging power technologies. Efficient Power Conversion (EPC) has a featured plenary presentation at DPF on its second-generation

enhanced performance eGaNfield effect transistor (FET). The EPC2010 has the ability to switch quickly and without a lot of power loss, so users can go to much lower pulse widths in power conversion circuits. Applications that could benefit from eGaN FET performance include high-speed dc-dc power supplies, point-of-load converters, class D audio amplifiers, hard-switched and high frequency circuits.

EPC believes that, "the greatest opportunity for GaN to impact the performance of power conversion systems comes from the intrinsic ability to integrate both power-level and signal-level devices on the same substrate. GaN on silicon, much like SOI, has no significant parasitic interaction between components, allowing designers to easily develop monolithic power systems on a single chip."

In many ways, the power electronics industry is undergoing changes unprecedented in its history. Although more of an evolution than revolution on an individual basis, the synergy among these emerging technologies is creating a "pseudo-revolution." In other words, these solutions are working together and addressing similar markets, and the net effect will be significant and game-changing.

Darnell's Power Forum

http://dpf.darnell.com/index.php

DC-DC Converter ICs Reports

http://www.darnell.com/dcdc

Taking Power Density to a New Level

Efficient inverter assembly now in even more applications

The well established, 15-year-old MiniSKiiP family now has two new additions: MiniSKiiP 3-level modules and the MiniSKiiP IPM. MiniSKiiP modules have proven to be very successful thanks to their power density, reliability and easy and fast one-screw mounting. The 3-level MiniSKiiPs deliver the highest rated current per module area among any competitor products and can help bring about an increase in efficiency in solar and UPS inverters thanks to the reduced switching losses. The IPM solution means short development times for the customer thanks to the removal of the driver development stage. Developments such as these will help the MiniSKiiP family establish itself as a standard platform in inverter technology.

By Alexander Langenbucher, Product Manager, Semikron

More than 15 million MiniSKiiP modules can be found in drives and frequency converters across the globe. European inverter manufacturers, in particular, use these modules for low-power applications of up to 30 kW. Three quarters of these applications are standard drives for pumps, robotic arms, printing presses or compressors. This figure is expected to increase by a further three million MiniSKiiP modules this year. Besides the established European market, the MiniSKiiP family is gaining ground on Asian markets, too. This product is also available from two other suppliers, a fact that ensures that customer demand for improved supply reliability is met. Thanks to the lower losses, the new 3-level topology boosts the efficiency of IGBT semiconductor modules and, consequently, the overall efficiency of power inverters. That is why 3-level MiniSKiiP modules are set to become standard in the coming years, especially in solar inverters and uninterruptable power supply systems.

In air conditioning systems and industrial drives, the MiniSKiiP IPM will continue to gain ground. These modules feature an integrated driver and the corresponding driver circuits, and boast optimized switching properties. This means that any application where the driver properties don't have to be specifically adapted can be covered, which is true in around 80 per cent of applications. The result is the gate driver no longer has to be adapted to the power modules and the time-to-market for products featuring MiniSKiiP IPMs is far shorter.

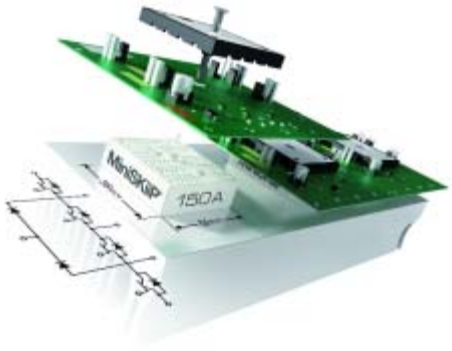

Figure 1: The 3-level MiniSKiiP module allows for the design of compact 3-level inverters thanks to the highest current density in the market and no space consuming busbars needed.

Greater efficiency, lower costs

An increase in energy costs of around 40 per cent over the past ten years has made the use of an inverter for drive control increasingly appealing. Besides high efficiency, energy cost savings can be made, inverter losses reduced and the resulting overall inverter costs cut. The high level of efficiency is of great importance, particularly in the markets for UPS systems and solar inverters. It is these very markets that will now profit from the 3-level topology in terms of efficiency gains and line quality improvements.

The first 3-level topology was in fact proposed almost 30 years ago. Technological progress on the inverter market, however, did not move quickly enough in this direction. To begin with, for efficiency reasons, this configuration was used in high-voltage applications. Today, in addition to UPS systems and solar inverters, this topology can also be found in applications where high switching frequencies are needed. Thanks to the far lower losses in comparison to a conventional 2-level solution, 3-level topology enables savings of up to 40 per cent in the overall losses – and even more for higher switching frequencies.

3-level topology reduces harmonics

A reduction in switching losses is the first, fundamental difference between 2-level and 3-level topology and results from switching only half of the voltage level. Modules in 3-level topology may need more power semiconductors – ten per phase leg in a 3-level module (four IGBTs in series) and four in a 2-level module; this, however, is compensated for somewhat by the higher current densities of the 600V semiconductors in comparison to 1200V semiconductors. Another difference which brings about several advantages at the same time is the improved spectral performance. To keep the harmonics as low as

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

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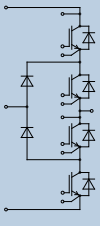
- EconoPACK™ 4 in NPC1 topology for high switching frequencies (approx. $f_{sw} \geq 12kHz$)

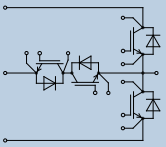
NPC1 topology

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



NPC2 topology

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



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possible, a 2-level module needs large filters, while 3-level modules have an intermediate stage for the output voltage. In this way, the output signal can be met far better, i.e. it becomes more harmonic, and the filter size – and hence the filter costs – can be reduced.

The better quality of the output voltage signal, or of the lower distortion factor for the same switching frequency, is of great importance in electric energy supply networks. Since inverters do not cause sinusoidal current in the energy supply network and these harmonics – put simply – distort the line voltage, a low THD (Total Harmonic Distortion) in the line voltage equals good voltage quality in the line. Owing to the low distortion factors of the output current, applications which need a high switching frequency do not require, for example, expensive line filters. It is also possible to optimize such an application to suppress inverter noise in work environments such as offices or factories.

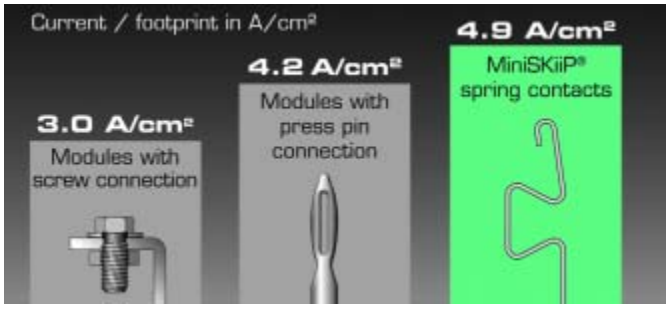

Figure 2: Comparison: power density of 3-level MiniSKiiP with competitor modules

One-step assembly

The layout of the 3-level MiniSKiiP modules has been optimized: the four different commutation paths cover a minimum area and their terminals are as close together as possible. In this way, module inductance and the resultant overvoltages are kept to a minimum. And there is more: thanks to the use of spring contacts, the power density of 3-level MiniSKiiP modules is as high as 4.9 A/cm², 0.7 A/cm² more than in modules with press pins and 1.9 A/cm² more than modules with screw connections. In the MiniSKiiP family, the rated current per module area is almost twice as much as in other 3-level modules, and no solid bus bars are needed between the three phases. This fact, coupled with the smaller filter size as mentioned above, makes it possible to develop much smaller inverters.

The assembly of MiniSKiiP modules is very simple: the module is connected to the heat sink and driver board with a single screw, creating the electric and thermal connection at 150 A rated module current. Time-consuming solder processes are not needed and the PCB can be easily replaced, if necessary, thanks to the use of spring contact technology. In other words, single-step assembly – another merit that will help make the MiniSKiiP become an industrial standard – which can bring about savings of up to five US dollars per inverter assembly, irrespective of the case size.

Integrated driver for easier inverter development

All these advantages regarding assembly also apply to MiniSKiiP IPMs. For a case volume of 49 cm3, however, these deliver not only 50% more current density than IPMs with comparable topology, but also offer additional functions, because the driver is already integrated. The HVIC (High-Voltage-Integrated-Circuit) driver in SOI (Silicon-On-Insulator) technology contains an innovative level converter to control the high-side or low-side IGBTs in order to improve electromagnetic immunity and switching behaviour. In addition to the drivers, the gate resistors used enable the IPMs to cover 80 percent of all applications. This is particularly attractive for SMEs which, on the one hand, do not have to worry about driver integration and, on the other hand, do not need the relevant driver development capacities either. Only the controller has to be programmed and connected.

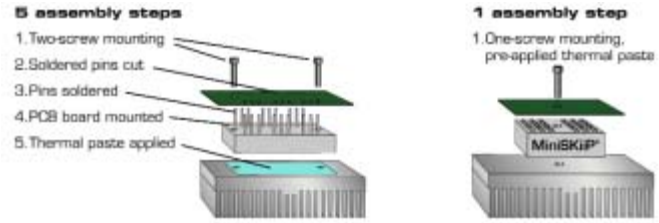

Figure 3: Comparison of the assembly of a competitor solder module (left) and MiniSKiiP (right). Thanks to the fast and easy one-screw mounting of MiniSKiiP modules the production costs of inverters can be reduced significantly. The number of production steps and the time-consuming solder processes are not needed thanks to the use of spring contact technology.

In order to give the user sufficient configuration possibilities, the MiniSKiiP IPM has both an ITRIP input for current monitoring and an additional multi-purpose error input with a higher switching threshold. These inputs give additional freedom of adaptation in an application. Every MiniSKiiP module comes with a suitable integrated temperature sensor.

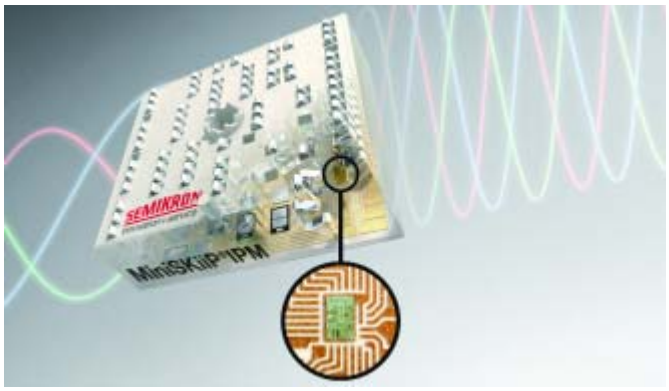

Figure 4: The MiniSKiiP IPM with integrated driver was developed for frequency inverters for industrial drives and UPS applications with a voltage range of 600V and 1200V with up to 15kW output power and is based on the MiniSKiiP spring contact technology.

Conclusion

MiniSKiiP is an established name in the world of power electronics. These modules are prized for their excellent power density, but also their fast and easy assembly. In fact, to connect the MiniSKiiP module, PCB and heat sink, just one single screw is needed. Instead of solder contacts, all of the power, gate and auxiliary connections to the PCB are made using pressure contacts. Thanks to the spring contact system - a unique selling point of this system over competitor IGBT modules – the electrical contacts boast longer service life and greater reliability, and the vibration resistance of the entire system is improved. With the new additions to the MiniSKiiP range – the efficient 3-level MiniSKiiP with its low distortion factor and the MiniSKiiP IPM featuring integrated driver – these modules now enable cost-effective, efficient inverter use in many new areas of application.

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		1200A	●	●	
		1600A	●	●	
	 140 x 190 mm	1200A			●
		1500A			●
		2400A	●	●	
		3600A	●	●	
2-Pack	 130 x 140 mm	600A	●	●	
		800A	●	●	
		1200A	●	●	
	 89 x 172 mm	600A	●		
		650A		●	
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		1400A	●	●	

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High Efficient Power Converter for Low Voltage Traction Applications with Power Multiplication

A combined optimization of MOSFET parameters, electro-thermal concept and gate drive control is the key

In low voltage battery fed drives, such as in lift trucks and electrical passenger cars, power MOSFETs with high current ratings up to approx. 100 - 200 ampere and the converter design play a significant role with respect to the performance and efficiency of the converter drive. Due to the limited installation space in automotive applications, packaging and efficiency are major points of interest in the development of power converters. In this article a three phase 24 V / 5 - 15 kVA dc/ac inverter concept based on two paralleled, special molded power MOSFET modules is presented, which has been developed by the Competence Centre of Power Electronics Schleswig-Holstein, Germany.

By Ole Mühlfeld, Björn Wittig and Friedrich W. Fuchs, Christian-Albrechts-University of Kiel and Jacek Rudzki Danfoss Silicon Power GmbH

Typical applications of low voltage power MOSFETs are dc/ac inverters and dc/dc converters, e.g. for feeding a three phase ac motor or for the use in battery backup systems. Due to the high power demands and low dc-link voltages of e.g. 24 V or 48 V, high currents result. Thus there is an intensive demand for low voltage power MOSFETs with a low drain-source on-state resistance $R_{DS(on)}$ on the market to achieve lower conduction losses at several hundreds of amperes of load current. This request in mind, a 24 V / 5 kVA dc/ac inverter concept based on molded power MOSFET modules and without active cooling is developed. Additionally a power multiplication, where up to three discrete 5 kVA inverters are connected in parallel, has to be possible to achieve an output power of e.g. 15 kVA.

Thus a power MOSFET with a very low drain-source on-state resistance $R_{DS(on)}$ of typical 0.72 mΩ @ T_J=25°C was developed by Fraunhofer Institute for Silicon Technology which fulfills these requirements. Besides the gate to source threshold voltage $V_{GS,th}$ is about 4.4 V to achieve higher robustness against parasitic turn-on. These power MOSFETs are included in the power module, depicted in Figure 1.

To accomplish a passive cooling of the dc/ac power system two MOSFET devices have to be connected in parallel for each bridge to handle load currents up to 250 Arms. Besides the characteristic and performance of the semiconductors one focus has to be on the power module design. A small and flat molded power module is essential for compact inverter dimensions but also a low thermal contact resistance is desirable, which has been accomplished with the molded module, depicted in Figure 1, by a thermal resistance of

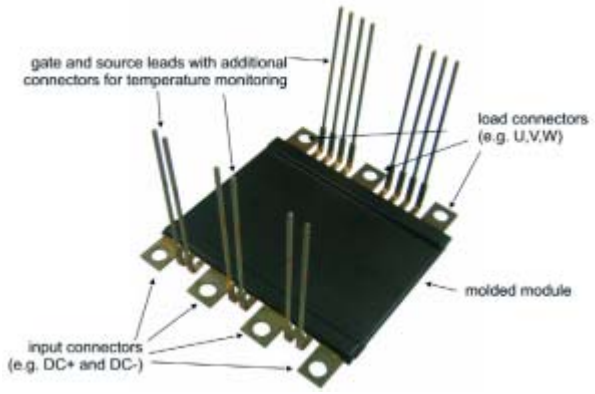

Figure 1: Power MOSFET module with integrated three phase full bridge inverter topology

$R_{th,JC}$ = 0,107 K/W. The final module measures 61 mm x 49 mm x 5 mm (without connectors).

In terms of reducing the size of the module and increasing the reliability, two new technologies are applied: molding and sintering. Commonly power electronic modules are filled with silicone gel to assure a resistant layer against outer environment influences like humidity and provide electrical insulation.
Replacing silicone gel with mold compound provides a reduced volume of the power module and additionally allows increasing the temperature operating range.

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One of the main challenges in the power electronic packaging is to substitute the solder by other more reliable materials. Silver powder can be applied instead of solder layer between die and substrate to increase the melting point up to 960°C. This assures more reliable joining layer even for elevated operating temperature. Additionally the better thermal property of the silver layer allows decreasing the junction temperature T_J of the die, thus enhancing the life time of the power modules.

Due to the demand for high efficiency and low EMI emissions the optimization of the stray inductance of the commutation path in the two paralleled power modules is of high interest. According to the well known formula $U_{ind}=L_\sigma \cdot dI/dt$ the reduction of the switching loop inductance allows to use shorter switching times, while the amount of induced overvoltage stays constant. This has two advantages regarding the losses: The switching losses decrease with faster current transitions and the on state losses of the power semiconductor decrease when lower breakdown voltages are sufficient. Hence, the direct result of the lower stray inductance is a higher efficiency of the overall system.

An analysis and optimization of the parasitic inductances of the power modules and the busbars has been performed aided by simulations using the PEEC method. In this work, 10 different DCB layouts have been investigated and compared regarding their stray inductance. Based on the results an optimization of the best suited DCB layout was performed and fabricated in a small sample series afterwards (Figure 1).

One newly designed feature of the presented inverter is the combined use of two independent busbar systems (Figure 2). The common planar busbar system allows easy connection of power cables. A desirable multiplication of the output power (e.g. 10 kVA or 15 kVA) can simply be done by paralleling the inverters via the screwable copper plating, which is illustrated in Figure 3. Because of the low maximum pwm signal propagation delay time variations of the gate driver below 68 ns and the low device variation of the $R_{DS(on)}$, there is no essential measurable splitting of the load current between two paralleled power MOSFETs or power modules during switching or on-state.

A second vertical busbar system ensures the electric connection between the power module and the dc link capacitors as well as the gate drive circuit. The cross-section of the busbars was chosen to ensure acceptable low conduction losses and to ensure low stray inductance.

This approach allows to exclude the planar busbar from the commutation path, which is formed by the vertical busbars between the power modules and the dc link capacitors. The chosen arrangement of the phases in the power modules leads to an antiparallel current flow in the vertical leads. Thereby the magnetic mutual coupling in the vertical busbar is increased leading to a reduction of the overall stray inductance. Compared to single leads without coupling effects, the inductance of the single commutation path could be reduced from 38 nH to 25 nH. Through the parallel operation of two modules this value is reduced to the half (13 nH) during conventional operation.

In Figure 2 the construction scheme of the presented 24 V / 5 kVA dc/ac inverter is shown. Here the power modules are mounted on a heat spreader. The power ports are connected via a busbar on top of the modules. Above this planar busbar the gate drive circuit board including the dc link is arranged and is being electrical connected via signal and power leads.

The use of these additional vertical leads has been necessary because thermal simulations have shown that the heat transfer from the power modules to the driving circuit and the dc link capacitors has to be reduced in order to guarantee reliable operation of the inverter and to increase lifetime of the capacitors.

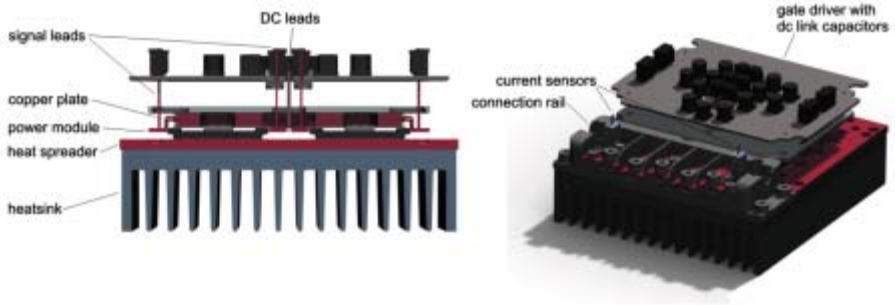

Figure 2: Construction scheme of the passive cooled three phase 24 V / 5 kVA dc/ac inverter

Figure 3: Three paralleled 5kVA inverters for output power multiplication up to 15 kVA

Additionally, the dc link capacitors are effectively cooled by a second heat sink on the top of the inverter (not shown in Figure 2).

Due to the unavoidable stray inductances in the switching loop path and the high load currents there has to be paid special attention to the design of the gate drive circuit. At turn-on during the current rise time the induced voltages at the stray inductances lead to an enormous lower drain to source voltage stress at the power MOSFETs and therefore to lower switching losses. In contrast to that at turn-off these induced voltages generate an overvoltage at the device during the whole current fall time. Therefore

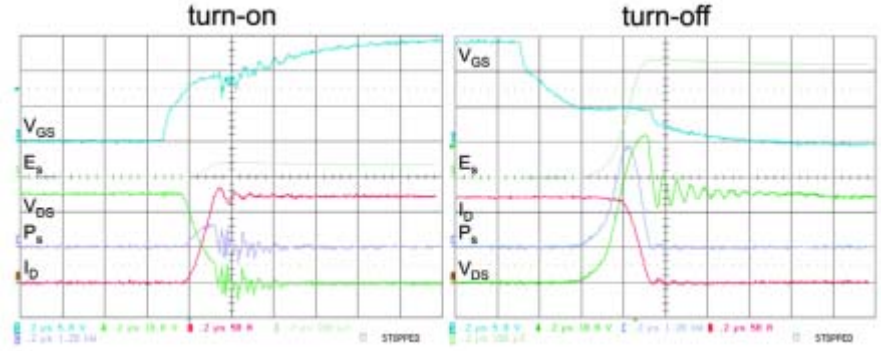

Figure 4: The compromise between switching the device as fast as possible to reduce switching energies and delay times and to keep the device in its safe operating area

turn-off energies of low voltage power MOSFETs are several times higher than the turn-on energies at high load currents. Designing the gate drive circuit, there has to be found a compromise between switching the device as fast as possible to reduce switching energies and delay times and to keep the device in its safe operating area below a limit of permitted overvoltage. For this reason a du/dt-control has been implemented on the gate driver which leads to about 25 % lower switching losses and more than 50 % lower turn-on and turn-off delay times compared to a conventional gate drive circuit with just a gate resistance at the same induced overvoltage.

The inverter was fabricated in a small sample series after the phase of design and tested in the laboratory afterwards. A type test has shown the capability of delivering the rated output power, keeping the temperatures within the limits given by the specifications. The efficiency is 97.4 % at nominal operation of 2.9 kVA. Besides, a long-term test was started and is ongoing at the moment.

This project was accomplished by the

'Competence Centre of Power Electronics Schleswig-Holstein, Germany'

Members of the project:
Jungheinrich Norderstedt AG
ESW GmbH
Danfoss Silicon Power GmbH
Fraunhofer Institute
for Silicon Technology
Westcoast University of Applied Sciences, Germany
University of Applied Sciences Kiel,
Germany
Christian-Albrechts-University of Kiel, Germany

Conclusion

Within a combined project between universities, a research institution and industrial partners a 24 V / 5-15 kVA inverter concept and prototype was developed. Among the special features are the compact size, high efficiency the sufficiency of passive cooling and the possibility for parallel operation of multiple inverters.

These features where obtained by usage of a newly developed components like a new power semiconductor, an adapted power module, an optimized power section design and a state-of the art driving circuit which are briefly presented in this article.

The test of the fabricated prototypes shows accordance to the design targets defined at the beginning of the project. Investigations on the lifetime estimation and reliability are ongoing.

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IGBTs at Higher Operation Temperature

Impact on inverter design

The development of IGBT power modules has always been characterized by the continuous increase of the power density for cost reduction and design optimization of the complete frequency converter system [1]. The requirement of higher power density is directly associated with increased current per chip area and therefore an increase of the junction temperature during the operation is expected.

By Klaus Vogel, Alexander Ciliox and Andreas Schmal,
Infineon Technologies AG, Warstein, Germany

The cooling conditions related to applications like hybrid vehicle drive trains are further important drivers for the need of an increase of the junction temperature [2]. The reason for this is that for cost improvement the cooling of the IGBT module is combined with the combustion engine's cooling system, which reaches temperatures in the range of 120°C.

The most important questions for the application of power modules with increased junction temperature focus on:

- How much more inverter output current can be achieved per chip area?
- How much can the cooling effort be reduced?
- How does the temperature rise influence further inverter components and what are the consequences?
- How is the influence to IGBT module's lifetime expectation?

Relation between output current and IGBT temperature

As already mentioned above, one of the benefits of increased junction temperature is a higher power density of the frequency converter system. To find out how much more output current can be achieved, a calculation of the junction temperature at different output currents was performed with IPOSIM [3] and, based on this data, a metrological investigation was carried out.

Figure 1: Power converter with forced air cooling and components covered with black paint

A power converter configured as H-bridge was used for the practical validation as is shown in Figure 1. The FF450R12ME4 modules from Infineon's EconoDUAL™ family were mounted on an air cooled heat sink. The complete setup was covered with black paint as preparation for the temperature measurement utilizing an infrared camera.

The module 1 was equipped with Infineon's adapter board MA200E12 to observe the thermal behavior of the PCB components under real field conditions. Module 2 was mounted without lid and gel to measure the chip temperature and thus to crosscheck the results of the calculation. The air flow direction is given by the blue arrow. The IGBTs were driven by Infineon's 2ED300C17-S driver. The result of the measurement is hinted out in Figure 2.

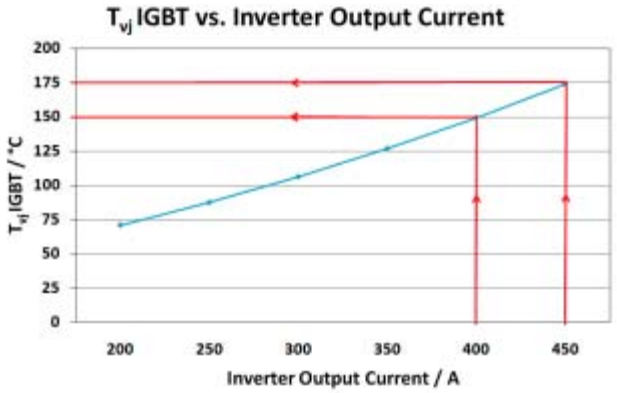

Figure 2: IGBT junction temperature as a function of the inverter output current

The operation of the IGBT at a junction temperature of 175°C allows an increased output current, respectively output power, of 12,5% in comparison to an operation of the IGBT at 150°C.

Relation between inverter cooling and IGBT temperature

Another advantage for applications using modules with higher junction temperature is the possibility to increase the heat sink's thermal resistance to ambient R_{thha}. This leads to lower cost for the heat sink with lower performance respectively or in the case of hybrid vehicles higher liquid cooling temperatures can be accepted. The same measurement setup as displayed in Figure 1 was used to find out how much the heat sink performance can be decreased. The air flow through the heat sink was reduced by about 10%. This was done by

reducing of the supply voltage of the fan. Due to this change, the R_{thha} was increased by approximately 23%.

The diagram of the IGBT's junction temperature as a function of the measured inverter output current for the two different cooling conditions is depicted in Figure 3.

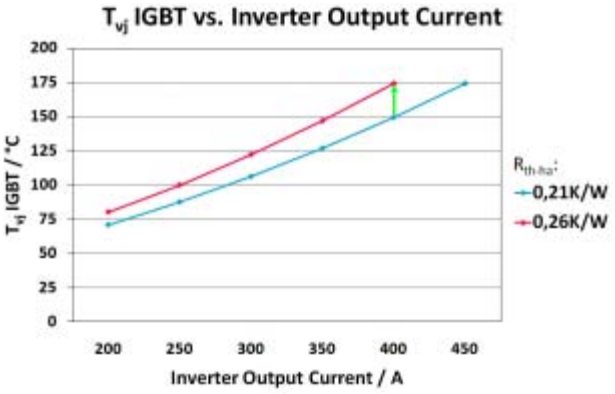

Figure 3: IGBT junction temperature as a function of inverter output current with different cooling conditions

The green arrow shows that for an inverter output current of 400A it will be possible to increase the R_{thha} from 0.21K/W to 0.26K/W if an increase of the IGBT's junction temperature from 150°C to 175°C is tolerable.

Influence of the IGBT temperature on the inverter components
The aim in this part of the investigation was to find out the temperature rise and distribution on surrounding inverter components as a function of the inverter output current and of the dies' junction temperature.

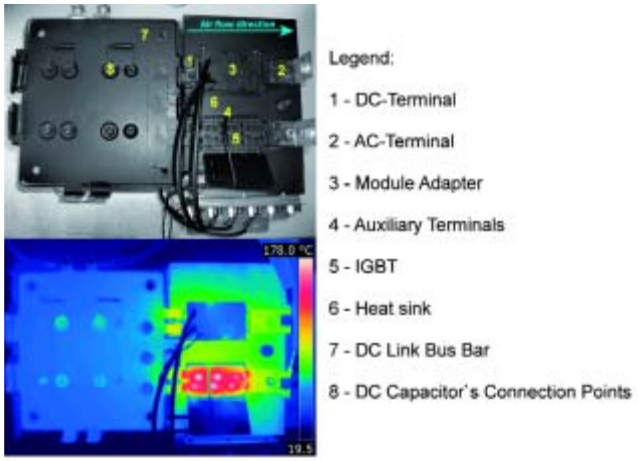

Figure 4: Measurement setup with evaluated temperature points and corresponding infrared image

The setup depicted in Figure 1 together with the infrared image of the power converter under load conditions and at 175°C junction temperature can be seen in Figure 4. The legend on the right side of the picture lists the selected points that were evaluated concerning the maximum temperatures.

The temperatures in the frequency converter as a function of the inverter output current are indicated in the diagram in Figure 5.

The values of the IGBT's virtual junction temperature T_{vj}, the case temperature T_c and the heat sink temperature below the chips T_h were calculated with IPOSIM. The NTC temperature results from the NTC's resistance measured during the experiment. All other temperatures were evaluated with the infrared picture of the measurement setup.

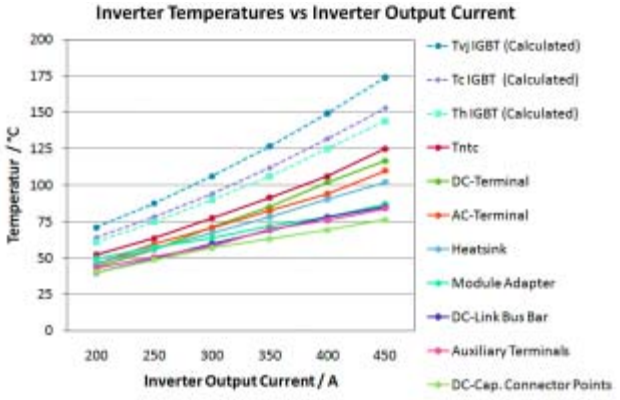

Figure 5: Frequency converter temperature as a function of the inverter output current

At T_{vj}=175°C the base plate temperature of 153°C and the heat sink temperature of 144°C represent a challenge for the thermal interface material. The usually used materials today are not necessarily suitable for such high temperatures and further investigations concerning this topic are necessary.

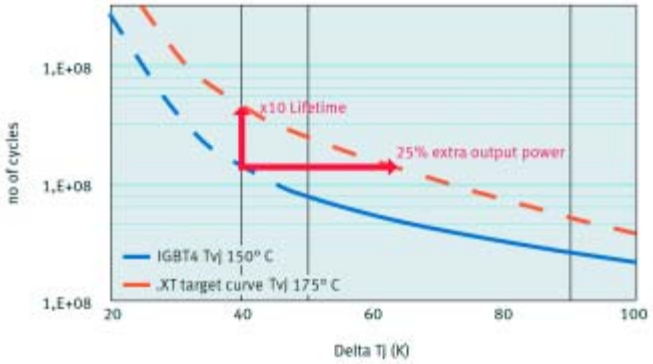

Figure 6: Increased Power Cycling Capability for modules with Infineon's new .XT Technology

Due to the fact that the lifetime of capacitors is strongly temperature dependent, it is important to take care of the maximum temperature achieved in its vicinity and on the connectors to the DC-link. In the setup used, the DC-Terminals of the module heated up by 15K through the step of 400A to 450A output current.

The maximum temperature achieved on the adapter board of 87°C and on the auxiliary terminals of 84°C is not critical taking into account the maximum recommended temperature of FR4 material of 105°C to 140°C. On a printed circuit board (PCB) that conducted the load current, an elevated temperature is expected. A temperature rise on the PCB also increases the mechanical stress on its solder joints, causing an accelerated degradation of these interconnections [4].

The increased temperature of the components surrounding the module demands an adjusted design of the converter to enable all components to work without reduction of the lifetime. The more compact the inverters, the more attention to the temperature rise of the passives devices has to be paid and the thermal management becomes more important.

How is the IGBT module's lifetime expectation?

To define the lifetime expectation of an IGBT module, the power cycling capability of this device has to be used as basis. The higher the maximum junction temperature T_{vjmax}, the higher is the stress to the device which results in a reduced number of cycles [5]. Therefore, the expected lifetime of the module decreases with the increase of the junction temperature. The lifetime is limited mainly by the packaging technologies, such as wire bonding and soft soldering. Infineon introduced a new integrated set of interconnection technologies which overcomes today's limitations for wire bonding as well as chip and substrate soldering. The so called .XT technology increases the lifetime of IGBT modules by a factor of 10 compared to existing technologies. Alternatively the output power can be increased by 25% [6][7], visible in Figure 6. The realization of an application with higher junction temperature is only reasonable with such kind of technology.

Conclusion

With an increasing IGBT operating temperature the user will have the choice to raise the output current or to decrease the cooling costs. The investigations have proven that an IGBT module can handle 12.5% more output power if the maximum junction temperature rises from 150°C to 175°C. Alternatively, lower cost cooling systems can be considered to benefit from the high temperature capabilities. Beside this, care must be taken regarding the temperature raise seen at other system components to guarantee that the frequency inverter's lifetime does not suffer from an elevated temperature. A good thermal management also considering the surrounding area of the module becomes mandatory. At module level the frequency inverter will work at T_{vj} = 175°C without additional lifetime restrictions compared to state-of-the-art designs if devices utilizing Infineon's new .XT technology were used.

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CAPACITOR SOLUTIONS FOR POWER ELECTRONICS

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High-Voltage Power Thyristors with Built-In Protective Elements in the Semiconductor Structure in Case of Emergency Mode

Nowadays converter equipment based on fully controlled semiconductors switches (IGBT, GTO, IGCT) have developed dramatically in many fields of application, especially in high power and high voltage power electronics but in fact the implementation of "conventional" power thyristors are still technically justified and in demand.

By P.G. Dermenzhi, Y.M. Loktaev, A.M. Surma, A.A. Chernikov

The main developing trends towards this type of power semiconductor devices can be characterized in the following manner:

The increase in maximum power, switched by a separate device. Adopted range of blocking voltages is up to 8000V, with the real prospect of its extension up to 12000V Adopted range is up to 3000A at the average current of thyristor which corresponds to the diameter (100-150 mm) of a separate silicon thyristor element
Stable market niche of high voltage and current devices for the implementation with mains frequency
The growing demands on reliability and resource. The leading companies commence to compare safe life of power thyristors with safe life of electric locomotives, transformers, electric arc furnace and other objects where the thyristors are applied. The thermodynamic stability of case is becoming a key requirement for devices.

The important trend towards improving the design of power thyristor, which allows to increase their reliability, is employment of self-protective elements. They are integrated into the silicone structure of thyristor semiconductor [1] what eliminates breakdown in case of unauthorized operating mode.

These modes such as particularly turn- on of power thyristors in so-called "dynistor mode" (without external control signal) work beyond the scope of safe operating and thus unacceptable in the operation of conventional thyristors, and exactly by means of application in forward direction:

Overvoltage (peak voltage rising below the critical rate)
Peak voltage increasing at a rate above the critical speed/ rising above the critical rate
Peak forward voltage till the end of process of recovery non-trigger characteristics (delay time of peak forward voltage after the end of peak of anode current less turn-off time t< tq)

Generally thyristor is switched in abovementioned modes within local region of small area. In addition if the extension of turned -on area is going rather slowly, pulse current with amplitude even much lower than the average current of thyristor can degrade semiconductor structure irreversibly.

In the first and second modes, indicated above, protection can be carried out by means of external elements as part of gate structure (drivers). As for the third mode the problem of protection is quite difficult because real turn-off time of thyristor depends on many factors which change during the operating process of thyristor within devices (temperature of semiconductor structure, amplitudes of anode current, voltage and change rate of these values under turning off). At the same time the most dangerous thing for thyristor is usually narrow time interval of delay time of peak forward voltage when this delay time is close to the actual value of delay time, but less than it. During this "dangerous" interval initial turn -on of thyristor in abnormal mode occurs within the limits of local region with small area in consequence of which breakdown is likely to happen in case of increasing "emergency" anode current.

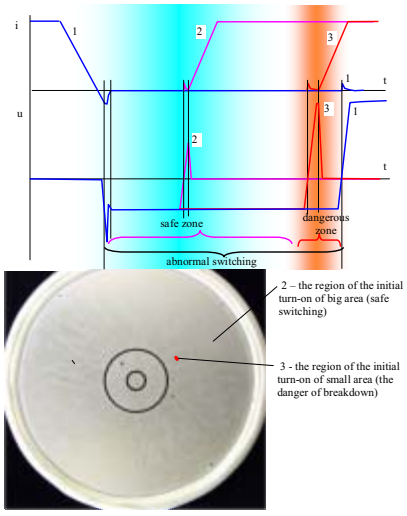

Figure 1: Dependence of anode current and voltage on time in the operation of abnormal switching with application of peak forward voltage till the end of process of recovery non-trigger characteristics. 1 – "normal" process of switching off (t> tq), emergency switching doesn't occur; 2 – emergency switching in "safe" zone, the region of the initial turn - on has a large area and perimeter 3 – emergency switching in "dangerous" zone, the region of the initial turn-on has a small area and perimeter.

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Although remote possibility that negative development of emergency situation can take place, the problem concerning protection of power thyristor from puncture in described mode is quite urgent. Analysis has been performed in order to detect failure of thyristors during their employment in high-voltage converter equipment at Vyborg HVDC scheme, where 6000 thyristors T273-1250 of 42nd voltage grade are operating. It appeared that more than half of failures can be explained as a consequence of developing emergency cases with application of “abnormal” peak forward voltage to the thyristor till the end of process of its recovery non-gate characteristics. Similar results were obtained analyzing the failure of thyristors T453-500 with voltage grade 40 and TFI853-800 with voltage grade 22 in the process of optimization and operation of converter of electric multiple unit “ÝÒ2À” with induction motor.

In order to produce thyristor with protection from breakdown in indicated mode sufficient perimeter of region of initial turn-on is required in any modes of abnormal switching.

If we assume that condition changes in the anode current at the leading edge in emergency switching don’t exceed tolerable limits for normal switching with appliance of peak gate current, than the perimeter of region of initial turn-on in case of abnormal switching must be not less than the perimeter of control gate (CG) of thyristor (or the sum of perimeters of control gate of auxiliary and main thyristors, provided that auxiliary thyristor structure is applied). Different design technological activities have been employed in order to guarantee controlled configuration of region of initial turn-on in abnormal mode.

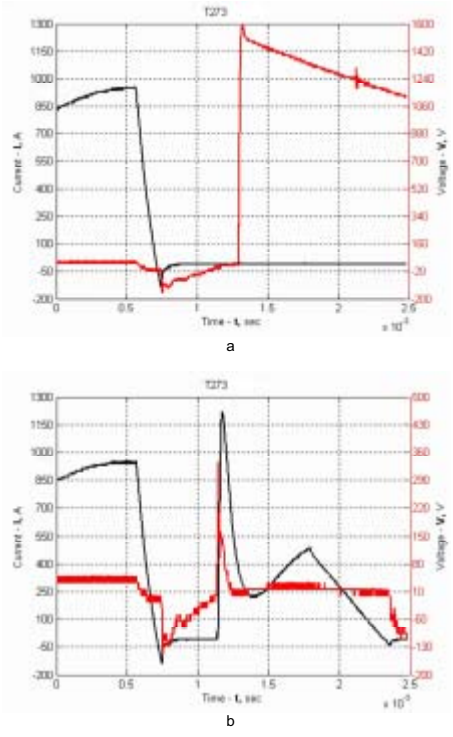

Figure 2: Typical oscillograms of voltage and current switching thyristor, which is resistant to emergency switching in case of the incomplete recovery of the non-gate ability, in the process of testing: a. - Thyristor is not switched (time delay of peak forward voltage is more than turn-off time b. - Switching thyristor in the "danger" zone (time delay of peak forward voltage is close to turn-off time tq, but less of it).

A set of technological measures which aimed at obtaining homogeneous thyristor semiconductor structure in area extent of initial distribution of such variables as life time of charge carrier in base and emitter layers, sheet resistance of P-base and etc. These measures allow eliminating emergence of “uncontrolled” local region of initial turn-on in abnormal mode.

Creation of local region (or the group of regions) with a controlled configuration

Within this controlled configuration turn-off time is more than in other regions of thyristor structure and in abnormal switching this region (or the group of regions) are guaranteed to be the first to switch and provide the necessary perimeter of region of initial turn-on. In order to obtain such regions different methods can be used such as the creation of local region in area extent of reduced recombination in the N-base layer or local regions with a reduced efficiency of the distributed cathode shunt and etc.

a set of measures which helps to obtain configuration of area of initial turn-on in any case corresponding to projected. Today to provide the required perimeter of region of initial turn-on different methods are applied to produce regions with a “gradient” distribution of “local” turn-off time (in this regard area of region of initial turn-on can change but its perimeter changes slightly) as well as a variety of design and technological methods like the “transference” of turn-on to region near control gate.

Application of the abovementioned design and technological activities has allowed developing and employing technology of manufacturing thyristors in mass production, which are resistant to unauthorized switching in mode in case of peak forward voltage till the end of process of recovery non-gate characteristics [3].

Parameters and unit of measurement	symbols	Serial- No. (new device)		
		T453C-800	T273C-1250	T173C-1600
Repetitive peak off-state and reverse voltage, V	U_{DRM} U_{RRM}	2400-3200	4200-4400	3600-4000
Average on- state current, A	$I_{T(AV)}$	800(85°C)	1250(85°C)	1600(85°C)
Peak repetitive on-state current, A (under t≤t_q)	$I_{TM(tq)}$	800	1250	1600
peak non-repetitive surge current, kA	I_{TSM}	15	33	36
Critical rate of rise of off-state current, A/max	$(di_T/dt)_{crit}$	630	250	250
Junction temperature , °C -the maximum allowable -the minimum allowable	 T_{jm} T_{jmin}	 +125 -60	 +125 -60	 +125 -60
Peak on-stage voltage, V, no more than	U_{TM}	2,3	2,1(3925A)	2,05
Repetitive peak reverse and off-state current , mA, no more than	I_{DRM} I_{RRM}	100	150	150
Gate trigger direct voltage,V, no less than	U_{GT}	5,0	3,0	3,0
Gate trigger direct current , A, no more than	I_{GT}	0,40	0,3	0,30
Safe life , years		15	15	15
Turn –off time , max, no more than	t_q	160-250	250-500	250-500
Turn- off time under U_R=0, max, no more than	t_{q0}	$1,2t_q$	$1,2t_q$	$1,2t_q$
Critical rate of rise of off-state voltage, V/max, no less than	$(dU_D/dt)_{crit}$	1600	1000-1600	1000-1600
Thermal resistance junction to case, °C/Вт, no more than	R_{thjc}	0,02	0,01	0,01
Dimensional specifications of case -height, mm -diameter , mm		 26 75	 26 107	 26 107
Mass, kg	M	0,5	1,2	1,2

Table 1: Main features of the new devices

Today JSC "Proton-Electrotex" produces a series of thyristors which are resistant to emergency switching of the incomplete recovery non-gate capacity, intended for a set of devices in electric power and transportation industries. These devices are able to switch in this mode safely and commutate fault current pulses ITM(tq) with amplitude for no less than a certified value of the passport. Typical oscillograms of current and voltage switching of the thyristor in the process of testing are shown in Figure 2. The main features of the new devices are shown in Table 1.

We continue for the future with the next article that will be covering the protective elements of thyristors against surges.

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- 388 exhibitors from 25 countries in 2010 (expected exhibitors in 2011: about 600)
- eCarTec Award 2011 endowed with € 52.500
- 2-days eCarTec Conference
- Big electric car test area

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NTC Thermistors as Lifesavers for Power Semiconductors

Integrated temperature protection

NTC thermistors with a wafer-based manufacturing process can be integrated very simply in power semiconductors. This allows a reliable temperature monitoring function to be implemented that protects electronic systems from expensive failures or destruction.

BY David Connett, Director IC Reference Design, EPCOS

Conventional ceramic-based NTC (negative temperature coefficient) thermistors are ideal and simultaneously cost-effective components for temperature measurement. These products have been manufactured for many years by EPCOS in leaded versions or as SMT components in the most common EIA case sizes such as 0402, 0603, 0805 etc.

NTC thermistors are used in a wide range of applications, in automotive and industrial electronics as well as in domestic appliances – for example in refrigerators, washing machines, dishwashers and cookers.

Compact SMT versions of these NTC thermistors are increasingly being integrated directly into power semiconductors such as IGBT modules for overtemperature protection. However, conventional versions give rise to certain difficulties in process management. These include:

- The terminals must be designed as pads on the semiconductor substrate for the solder or bonding process.
- Increased thermal resistances can occur between substrate and NTC thermistor if the component is not in a completely flat position.
- Differing temperature coefficients of substrate and NTC thermistor can lead to fracturing.
- The thermal and mechanical stresses occurring in the injection molding process used for the semiconductor can also lead to the thermistor fracturing.

These problems can be partially solved using complex and thus costly process technology. However, the risk of fracture formation during the operation of the semiconductor cannot be completely excluded. To solve these problems TDK-EPC developed a wafer-based manufacturing process for EPCOS chip NTC thermistors (Figure 1).

Figure 1: Wafer for NTC thermistors before separation. Complete NTC wafer with carrier. The contact areas are top and bottom of the chip and not on the sides as is usually the case for SMD components.

For NTC thermistors, which are manufactured from wafers (Figure 2), the configuration of the electrical terminals is crucial: unlike conventional SMD components, they are not located on the sides of the component, but on its upper and lower surfaces. This allows a direct and very level contact to the semiconductor substrate via the lower terminal. The upper terminal is contacted via conventional bonding. The contact surfaces are optionally available in gold- or silver-plated for optimal bonding results.

The horizontal arrangement of the terminals on the substrate significantly reduces the risk of fracture. It also makes soldering unnecessary.

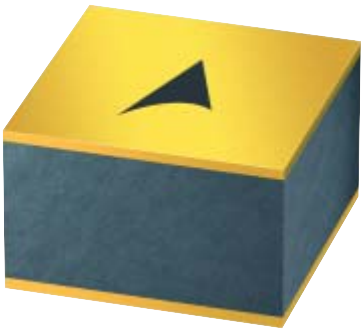

Figure 2: Chip NTC thermistor. The arrangement of the terminals on the top and bottom of the component significantly reduces the risk of fracture.

Wafer process permits narrower tolerances

The very narrow electrical and thermal tolerances of these NTC chip thermistors are another advantage. This precision is achieved by a special process technology: before separating the components, the total resistance of the wafer is determined with respect to a rated temperature of 100 °C. The size of the thermistors to be separated is then calculated from this. This ensures that the tolerance field of the

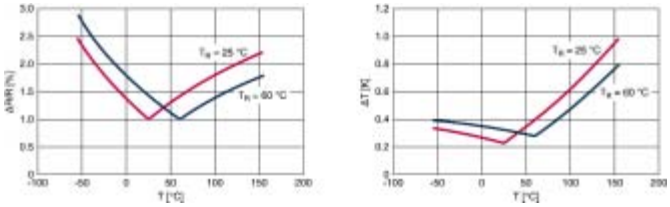

Figure 3: Resistance and temperature tolerance. The resistance (left) and temperature (right) tolerances of the NTC chip thermistors referred to rated temperatures of 25 and 60 °C are shown.

individual components is very narrowly dimensioned. Figure 3 shows the Δ-values of resistance and temperature referred to the rated temperatures of 25 and 60 °C.

The narrow tolerances and the associated high accuracy more than satisfy the requirements of the semiconductor manufacturers. This is because they allow the IGBT modules to be operated at temperatures that are very close to the maximum permissible values.

The B value of an NTC thermistor and its tolerances are important for its accuracy. In general, the B value specifies the slope of the R/T curve. The narrower the tolerances of the B value, the greater is the accuracy of the measurement. This relationship is clarified in Figure 4. It shows how the resistance and temperature change as a function of various B-value tolerances.

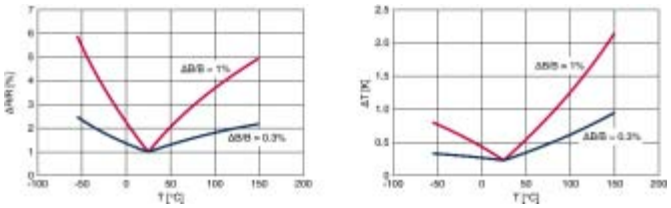

Figure 4: Resistance and temperature tolerances as a function of the B value. The narrower the B-value tolerances, the more accurate the measurement. The graphs show the resistance (left) and temperature (right) tolerances at ΔB/B values of 0.3% and 1%.

The effects of the B value on the accuracy of the measurement are shown in Figure 5. It compares a conventional SMD NTC thermistor of case size 0603 with a rated temperature of 25 °C (3% B-value tolerance; 5% tolerance at $R_{25/25}$) and a chip NTC thermistor with a rated temperature of 100 °C (1% B-value tolerance; 3.5% tolerance at $R_{25/100}$). It is evident that the chip NTC thermistor offers a significantly narrower and thus better tolerance.

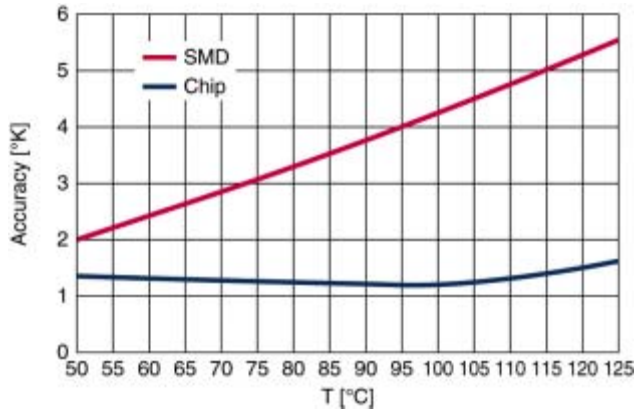

Figure 5: Comparison of chip NTC and conventional SMD NTC thermistors. In the temperature range around 120 °C, which is critical for semiconductors, the chip NTC thermistor has a high measurement accuracy of ±1.5 K. In contrast, the SMD variant has a distribution of ±5 K.

In practice, this means that an IGBT module equipped with an SMD NTC thermistor must be derated at a measured temperature of 120°C at the latest, as the actual temperature may already have reached the 125°C value that is critical for the depletion layer in view of its tolerance of ±5 K. On the other hand, the temperature may only be 115°C and nevertheless make a switch-off necessary. It must also be considered that most SMD NTC thermistors are subject to a resistance drift of up to ±3% due to the solder process, which reduces the measurement accuracy still further.

The scenario is completely different for the chip NTC thermistor: thanks to its narrow tolerance of only ±1.5 K at 120°C, no switch-off is needed until the temperature reaches 123°C. This example shows clearly that the chip NTC thermistors allow IGBT modules to be used right up to their performance limits and thus be better utilized. Currently available chip NTC thermistors can be operated at temperatures of up to 155°C. The maximum operating temperature can even be extended to 175°C. At the same time, their B-value tolerances can be narrowed down to 0.5%. This also makes chip NTC thermistors ideal for the latest generations of semiconductors such as those based on silicon carbide (SiC).

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Remote Sensing Utilising Alternative Energy

Harvest energy from the surroundings

Applications that require remote sensing often utilise alternative energy sources for power. This can be found in systems that monitor vibrations in bridges, the growth of trees in forests and seismic buoys. These energy sources usually are limited in the amount of power available so the design of these systems must be extremely frugal with power. In this article we will examine several methods for designing lower power sensor systems that take advantage of every microwatt yet provide outstanding analogue performance.

By Richard F. Zarr – MTS Technologist, National Semiconductor

Our civilised world is only possible through a vast and amazingly complex infrastructure that grows larger everyday. As it ages, weaknesses can appear that could lead to catastrophic events such as a bridge collapse or a wide scale power failure. Engineers are often tasked with devising ways to keep tabs on this network of roads and other crucial systems. One solution that is being deployed utilises active sensors with various telemetry relays via satellite uplinks, terrestrial radio relays or cellular systems to report the status of key elements in the network. By monitoring these elements, it is possible to know the condition of the system and provide required maintenance to prevent failure.

Active Systems Require Power

Active sensing systems provide a great advantage over passive monitoring. For example, passive sensors utilising RFID tags and strain gauges can be mixed with concrete and poured directly into structures - however someone with a RFID reader must excite these tags with near proximity RF fields in order to acquire the data. That means someone must drive to a remote location to monitor the condition of the structure. Active systems however can be retrofitted to older structures and report vibration and stresses via remote control.

The major drawback to active systems is that they require power to run the sensors, microcontrollers and uplink. Batteries can be employed (and often are as backup) however they will deplete with time and require replacement. An alternative is to harvest energy from the surroundings. For instance, a sensor deployed on a bridge that is well travelled can harvest energy from the vibration of passing traffic. This works in all weather and allows longer periods between monitor system maintenance (e.g. battery replacement).

Two things are very important for designers to keep in mind when designing these systems. First and foremost, power is everything. Without it, the system will fail, so efficiency of power conversion and storage is highly important. The second item on the list is the amount of power required to run the system. If the electronics draw more power than is available, the system also fails. So harvesting the most available energy, converting it in the most efficient way and utilising it very frugally is the challenge.

Lowering the Energy Footprint

Power supplies now routinely run at very high efficiencies utilising hysteretic conversion and sleep modes. These designs can provide 90% - 95% efficiency across a very wide range of load. This is important since to operate over long periods, remote sensors sleep a great deal of the time. The power supply however is still busy charging batteries or providing stand-by power to real-time clocks to periodically wake up the system and make a reading.

This method has been utilised for decades to extend the running time of equipment on batteries and still applies today. Figure 1 shows how a typical remote sensor power system might operate. Since reaching a satellite in low earth orbit may take several watts of RF power, the transmission time must be very short. If the power storage is depleted before the communications are complete, the information may be lost. The crucial calculation here is to make sure the power consumed during the sleep phase is low enough to make sure that enough energy is stored (worse case) for the active phase or the system will crash.

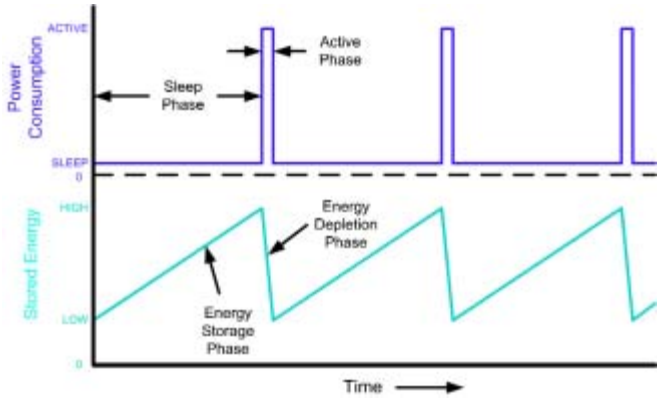

Figure 1 – PWM Cycle of Power Consumption

The calculations are fairly simple. The total power is:

$$P_T = P_A DC + P_S(1 - DC)$$

Where $\mathbf{P_T}$ is the total power, $\mathbf{P_A}$ is the active power, $\mathbf{P_S}$ is the sleep power and **DC** is the system duty cycle (between 0 and 1). The har-

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vested energy required during the storage phase must be larger than the product of P_T and the period (seconds). Even though energy is being used during the depletion phase, the system can still be acquiring energy unless this mode is disabled during active operation. So:

$$E_C \cdot e > P_T \cdot T$$

Where E_C is the energy harvested in joules during the charging phase, e is the storage efficiency (between 0 and 1), P_T is the total power in watts, and T is the cycle period in seconds.

The Problem of Continuous Monitoring

The basic idea shown above is to store more energy than the system needs between the times it consumes it the most. In remote sensing the radio's power amplifier will most likely be the largest consumer of power during the uplink or connection phase. However, there is a problem with putting the system to sleep in between these updates.

If the system merely needs to read the air temperature and humidity every 15 minutes and report this information, the entire device can sleep with only a real time clock (RTC) running. An RTC uses extremely low power and often has an interrupt pin which is programmable with an interval. This function can bring a system out of sleep (low power mode) to make the measurements, turn on the radio, uplink the data and return to sleep mode.

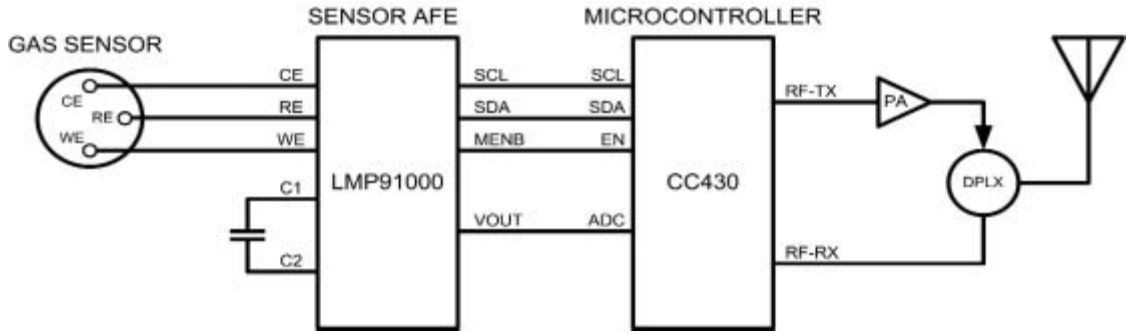

Figure 2 – Typical Remote Gas Sensing Application

However, if a system needs to continuously monitor something such as detecting poison gas or transient overload conditions or even accumulating averages then this method does not work. Instead, the system needs to be continuously operating with the lowest power possible. For most microcontrollers this is not an issue, however for the analogue front ends that need to connect to sensors, this can be extremely challenging.

Typically, noise is the enemy. Systems that require a great deal of gain require low noise amplifiers. The challenge here is that low power op-amps typically have higher noise – this is due to the lower tail currents in the first stage of the amplifier. It is a delicate balance between power consumption and lower noise, so the selection of amplifiers that are used continuously must be done with care.

If the system contains an analogue to digital converter (ADC), depending on the frequency of interest, a filter is required to prevent aliasing (or signal mirroring) caused by the sampling. This phenomenon is caused when signals are present at the input of the data converter that are higher in frequency than the half the sampling rate. In sampling theory, this is called the Nyquist Rate which states that to accurately reproduce an analogue signal the rate of sampling must be twice the highest frequency component (or system bandwidth). Anything higher will appear or "alias" as a lower frequency component causing errors in the signal processing. The filter will also require power and if it is a continuous time filter (op-amp based), it will draw power even between the sampling cycles of ADC.

Yet another issue is the offset adjust and other sensor calibration requirements. Some calibration can be done in the microcontroller, but often requires an offset that supplies a stimulus to the sensor or bridge circuit. Gas sensors used to detect toxins can be particularly complex depending on the type of gas being detected. Often sensor manufacturers will provide example circuits depending on the user's design requirements such as cost, accuracy and end application.

Integration and Tools

Since a large part of the complexity of these monitoring systems resides in the analogue front end, semiconductor manufacturers have begun to integrate much of the functionality into a single device. This has several advantages – one being the control of the signal path from the sensor all the way through the analogue to digital converter. Another advantage is the ability to control power more closely which is a key factor to remote sensing applications.

An example is the LMP91000 AFE Potentiostat which is designed specifically for low-power chemical sensing applications. This device uses a clever architecture that helps designers overcome many of the issues stated above. It contains all the required circuitry to connect directly to either 2 or 3 lead electrochemical cells and provide a calibrated output voltage. Due to the complexity of the many sensors available the LMP91000 is supported by National Semiconductor's Webench tool called "Sensor AFE Designer". This tool provides a designer the ability to select an end application such as ammonia sensing, the sensor manufacturer and type and then calculate all the required external components (where there are only a few) and the programming required.

Combine LMP91000 with an ultra-low power microcontroller such as Texas Instrument's CC430 which includes the analogue to digital converter and most of the radio electronics and a complete remote gas sensing platform can be created (see figure 2).

Conclusions

Remote sensing where the power to run the system is harvested locally can be an amazingly complex design challenge. The energy source can be intermittent and limited, power conversion and storage must be extremely efficient and the circuitry must be ultra-low power. Much of this heavy lifting has been accomplished by semiconductor manufacturers to aid designers in both quickly getting to market as well as meeting all the design challenges found in these sensor systems.

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High Frequency Carrying Gate Drive

A small simply circuitry makes it possible

For the "Synchronous bridge rectifier with microcontroller on the mains" was developed a special "high side carrying gate drive circuitry". The developer and author decided to make it simple, fast and reliable at the same time.

By Milan Marjanovic, Texas Instruments

High side gate drive

High side gate drive is always needed if the driven switch is not referred to the ground. In this case the switching element must be connected to the bus rail, 'on the high side'. This means, the reference point (normally emitter or source) is not any more on the quiet potential – gnd. It is now jumping, changing own potential from zero to the bus voltage. Because of these issues there are several possibilities to drive high side switch:

Description	Remarks
High side gate drive with bootstrap capacitor	Very cheap solution + Very fast + 100% duty cycle is not possible – Up to 1200V available silicon -
High side gate drive with isolation barrier	Need isolated power supply – Very fast + 100% duty cycle is possible + Very expensive -
Carrying gate drive	Very cheap solution + Very slow – 100% duty cycle is possible +

Table 1: Gate driver overview

What is carrying gate drive?

Normally, if we generate or transform energy, we try to control this energy by power, voltage, current, etc. over some feedback loop. In some cases there is no need to control these values so precisely; it can be related to the load conditions and some fixed parameters which are defined in the system. This is the way every open loop system works. However, in our case, for the gate drive we need two stable conditions:

1. No excitation => zero gate voltage (or close to zero) without possibility for self excitation
2. Excitation => Defined gate voltage, transients and voltage slope have to be done as fast as possible

When we build a galvanic isolated gate drive, the simple way is to do this with a transformer. But if this has to be done for a low frequency (<1kHz), the transformer is going to be too bulky and too expensive.

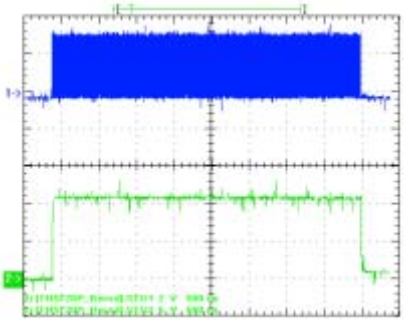
In our example we can modulate high frequency signal with a low frequency source - in this case as control signal. On this way the energy transfer can be realized down to 0Hz, using again small low cost high frequency transformer. This type of gate drive is called "high frequency carrying gate drive", because this high frequency signal is carrying the energy for the gate excitation.

	Gate voltage high	Gate voltage low	Up going slope	Down going slope	Minimum pulse with
Min.	10	0	0	0	100us
Max.	12	1	20us	20us	10ms

Table 2: Main Requirements

Main requirements

This system will work as an open loop system, and as we mentioned, some parameters have to be defined by the system. To ensure that the gate voltage will stay in defined range, the supply voltage has to stay also in the same range.



Picture 1: Main Requirements

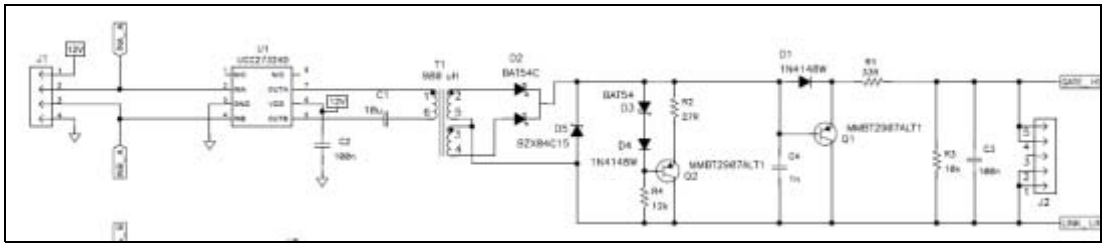


Figure 2: built and tested schematic

How is it working?

The picture 2 shows the built and tested schematic.

INA_A & INB_A are push-pull control signals, coming from MSP430. The switching frequency is 200kHz.

UCC27324 (double gate driver) is well suited to make an additional current gain and voltage shifting.

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C1 is preventing saturation of transformer T1 during eventually DC offset on driver's output.
Transformer T1 provides the galvanic isolation and AC power flow.
D2 & D5 is respectively performing the rectification and eventually voltage clamping.

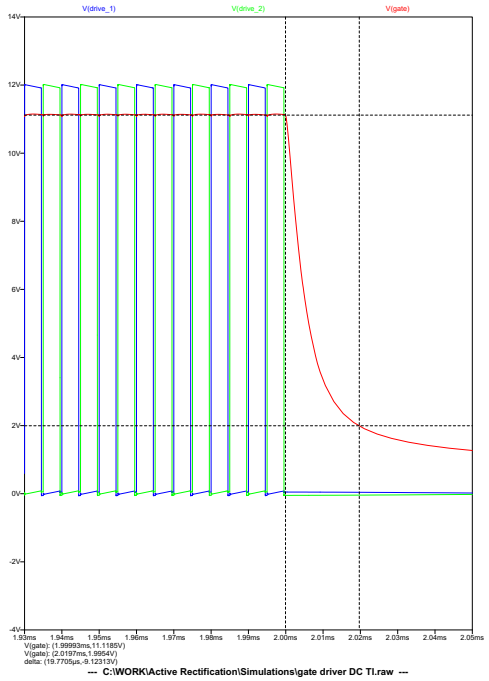

Figure 3: Simulation result: rising edge drive_1 & drive_2: transformer primary side. Gate: Gate source voltage of the power MOSFET

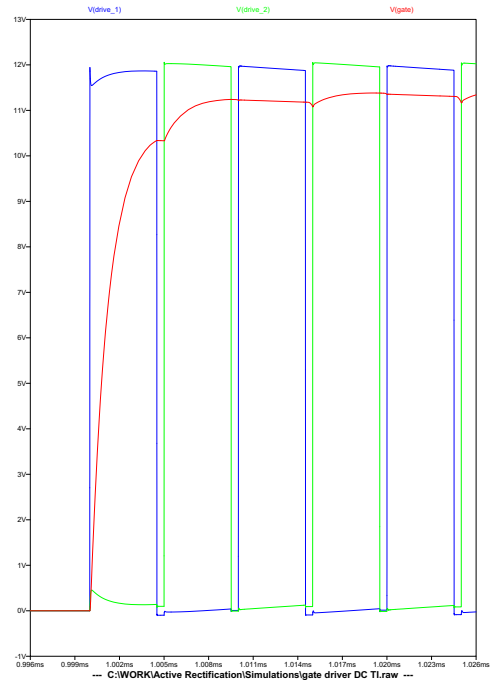

Figure 4: Simulation result: falling edge drive_1 & drive_2: transformer primary side. Gate: Gate source voltage of the power MOSFET

Block circuitry D3, D4, R4, Q2, R2 are building a constant current drain of 10mA. This current will bias the base of Q1 if the voltage on gate is going to be higher then excitation voltage (in this case voltage across C4). This way the gate voltage is going to be discharged by a constant sink current of minimum 300mA. This current value is enough to discharge even high gate charge in very short time.

C3 is filtering the high frequency excitation voltage and protecting MOSFET re-igniting against high Miller currents. This can happen if the high dv/dt would be applied on drain. This high speed voltage change can produce very high capacitive current (Miller current) flowing into the gate, causing gate voltage increasing to threshold voltage. Due to this fact, the MOSFET can get uncontrolled conducting, which can cause an error.

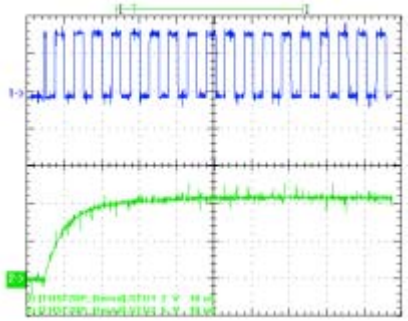

Figure 5: Measurements result rising edge 10us/div.
The blue one: INA_A
The green one: Gate source voltage of the power MOSFET

R3 should discharge the rest of charge which is below voltage threshold of 1V (two times base-emitter voltage threshold, Q1&Q2). See the test results on the picture 3 and 4.

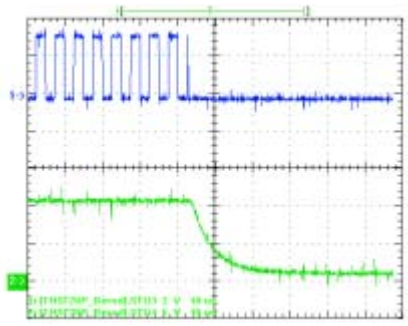

Figure 6: Measurements result falling edge 10us/div.
The blue one: INA_A
The green one: Gate source voltage of the power MOSFET

Conclusion

With a small simply circuitry is possible to realize fast isolated carrying gate drive. The circuitry is very efficient and reliable. It was possible to do very precise calculations, simulations and measurements on the real hardware. Simulation and real measurement matched very well, according to the test results.

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Triac Dimmers for LED Lamps

The basic triac dimmer circuit is so simple that no DC supply is needed

Dimming LED lamps with triac based dimmers has been widely discussed and various techniques have been proposed to enable smooth and flicker free dimming. Unfortunately these all add complexity and cost to the LED driver and at the same time reduce efficiency. Engineers in the industry are currently developing solutions to best meet the tradeoff between these factors and the required dimming performance.

By Peter B. Green, Manager LED Systems and Applications, International Rectifier

A better solution to the problem might be to re-design the dimmer itself to enable smooth and flicker free dimming with simple and efficient LED driver circuits.

However, at present marketing factors rather than technical justifications dictate that LED lamps need to be compatible with established dimmer technology that has been in use for several decades.

The ubiquitous triac based phase cut dimmer was originally designed to operate with resistive incandescent lamps that draw current in the range 100mA to 1A. The triac is fired by means of a simple time delayed trigger circuit and continues to conduct until the current falls below the holding current, which will happen close to the end of the AC line cycle. Adjusting the firing angle controls the RMS current supplied to the lamp and the light output. This is known as leading edge dimming.

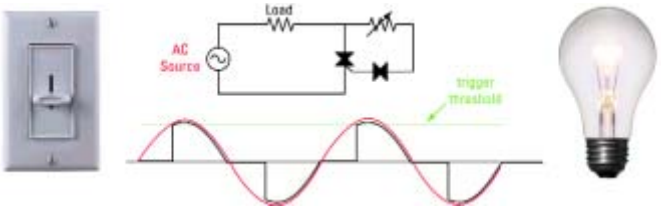

Figure 1: Triac dimming waveform

When CFL light bulb replacements were introduced in the 1980s they were expensive as LED based equivalents are now. One of the major disadvantages was that they could not be dimmed and to attempt to do so would very probably damage the CFL or the dimmer.

Despite numerous attempts to produce dimmable CFL designs only limited performance could be achieved with the inevitable cost and efficiency penalties. Although LEDs are easier to dim than gas discharge lamps they consume even less current than CFLs to produce the required light output, which often does not provide sufficient load for a dimmer. Without sufficient current dimmers fire erratically sometimes several times during a single cycle resulting in severe flickering because the current drops below the triac holding current prematurely. To avoid this there is no alternative but to consume additional current by means of a “bleed” circuit to maintain stable dimmer operation. This must necessarily result in wasted power. Smart techniques are being developed to minimize this however the problem can never be totally eliminated. Bleed circuit losses are greater in 220VAC systems than in 120VAC systems meaning that dissipative stabilization techniques may not even be practical in many parts of the world restricting LED lamp use to certain dimmers with low holding currents only.

It is very possible that new dimmers will gradually replace existing triac based products on the market since government legislation is set to phase out incandescent lamps in the next few years. This initiative is motivated by the desire for energy efficiency and clearly wasteful bleed circuits go against this goal. It has been suggested that since a lot of power savings have already been made by converting to LED and a single LED light may only consume 10W, the small amount of power wasted in each lamp could be tolerated.

This may be the case today, however such justifications fall apart when considering lighting as a load consisting of millions of lamps rather than considering only one individual lamp. The bottom line is that Lumens per Watt (luminous efficacy) must be maximized for the total lighting load connected to the power grid. For this reason replacing outdated triac dimming technology can potentially eliminate a significant quantity of wasted power.

At first glance the design of a replacement dimmer might seem quite straightforward. However there are several challenges in producing a low cost circuit that meets the performance requirements. One major problem in designing a replacement dimmer is that the triac dimmer generally requires only a two wire in and out connection like a switch with no neutral connection. The triac based circuit when operating with a resistive incandescent lamp is well suited to operate in this way, however this is not ideal when designing alternatives. The neutral connection is a problem since the existing light switch wiring in most homes does not provide a neutral cable only a hot, load and ground.

Any dimmer design requires a bi-directional switch. At present most

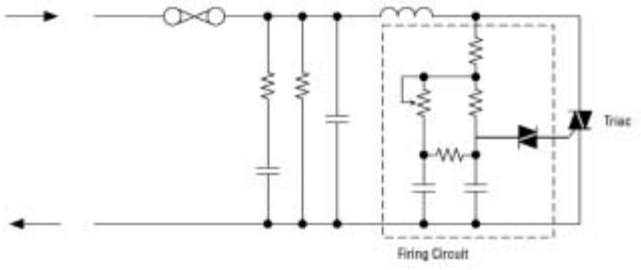

Figure 2: A triac dimmer circuit

dimmers are rated for operation up to several Amps, however this is only necessary because of the relatively high current required for incandescent lamps. A dimmer for LED lighting could be rated to a lower current which would enable two high voltage MOSFET devices or one MOSFET and a diode bridge to form the switching element without requiring large expensive devices and maintaining lower power loss. A co-packaged dual MOSFET may be a cheaper alternative. Perhaps new Silicon or GaN bi-directional switches may be developed specifically for this application considering the huge potential volumes required.

Dimmer designs exist that get around the neutral connection issue by using the ground connection in place of the neutral, however this is bad practice and risks tripping GFIs connected in the circuit. The solution therefore should be to devise a more innovative 2 wire dimming solution perhaps with improved power semiconductor devices.

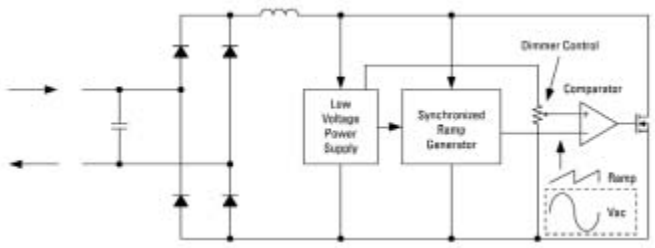

Figure 3: A dimmer without a triac

The erratic firing of the triac based dimmer when connected to a reactive load such as an LED driver or CFL can be solved by using power switches where both switch on and switch off are controlled such as MOSFETs. High performance dimmers are already on the market that use this method but most of them require an additional neutral connection in order to provide a source for the low voltage DC supply needed to run the control circuitry. The basic triac dimmer circuit is so simple that no DC supply is needed because the triac switch off is not controllable. Without a neutral connection it is a challenge to obtain a DC supply over the full dimming range while keeping the cost low and the efficiency high. These factors will mean that new LED friendly dimmers are likely to cost more than existing triac products at least in the short term probably creating a barrier to adoption for consumers that don't consider long term benefits.

Unlike incandescent dimmers, dimmers for LED lights need not dim all the way to full voltage. That is not to say that the light output does not need to be adjustable over the full range but instead that maximum light output could occur at close to full output voltage. This would mean that under all dimming conditions the dimmer switching element would be open for some period during the AC line cycle. It may be possible to derive a low voltage DC supply from the open switch voltage. In theory this would enable a design to be made without needing a neutral connection. The dimmer control circuit should require only a small current in the milli-Amp range which should be possible to supply without significant losses.

In conclusion the best solution to the LED dimming would be to change over to a different dimmer design that allows controlled switching for stable phase cut control. This would be more efficient and cost effective than making LED lights compatible with old technology. LED friendly dimming is best achieved by having an additional neutral connection to the dimmer which may require wiring modifications in many locations. A two wire dimmer with no neutral could be designed to get around this but there are significant design and cost factors to overcome.

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Efficient Power Solutions for LED Lighting Installations

A review of best practice in developing efficient power supply solutions for solid state lighting

The LED lighting market looks set to explode, with some sources predicting that in five years time 50% of the global lighting market will be fulfilled by solid state solutions. Whether street or office illumination, refrigeration or architectural lighting, every solid state light needs power – and the power supply is often the weakest link.

By Cor van Dam, Marketing Director – Power, Avnet Abacus

Whilst the LEDs themselves are highly efficient, the benefits of this can be lost if energy efficiency is not optimised in the power supply. Correctly installed, the lifetime of an LED light can be 35 years or more, but even a well-designed power supply working within its operating parameters will last only 10-12 years. A poorly designed, lower efficiency power supply unit running at high-temperature will not even last half as long.

Designing a power supply unit to achieve maximum operating efficiencies for LED lighting applications can be a daunting task. Designers have to consider a wide range of issues when conceiving power solutions to navigate the regulations for LED installations and ensure a power supply with maximum service life.

Regulations

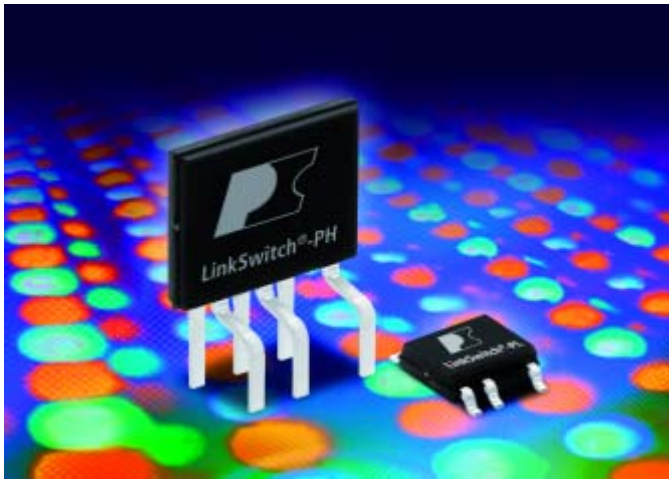
Due to specific operating voltages and the configuration in which the LEDs are arranged, a standard power supply cannot be used with LED lighting. LED power supplies are governed by specific legislation covering safety (EN61347-1/ -2-13, UL8750, UL1310 Class 2), EMC (EN55015) and harmonics (EN61000-3-2 Class C), but not all these specs are relevant to lighting applications. In addition, the EU Ecodesign Directive 2009/125/EC sets out rules for reducing the environmental impact of Energy-using Products (EuP) and other Energy related Products (ErP) at all stages from design concept to manufacturing. Street, office and domestic lighting all fall within this directive, along with their respective power supplies.

This legislation can sometimes be complicated to interpret for lighting designers and LED engineers entering the market, so discussing specific requirements with a specialist distributor such as Avnet Abacus with its comprehensive power portfolio and consultative approach can be valuable at the design stage to ensure compliance from the start. In addition, a good distributor will work with its suppliers to keep up with future regulations and participate in regular training.

Operating Efficiencies

The illumination output of solid state systems depends on how the LED array is driven. For example, using a constant current power supply produces the lowest cost and highest efficiency solution, but unbalanced current for each parallel branch of LEDs can lead to uneven brightness and shortened life. On the other hand, using a constant voltage power supply with an LED driver IC will accurately control the current through the LEDs, delivering a more uniform light output and long life, but at a reduced efficiency and a higher cost.

Designers will need to consider what application they are designing for and if a return on investment could be achieved by using a more expensive, but more uniform driver solution to give extended life, instead of a low cost, reduced life option.



For example, for small and medium power LED Lighting systems, sophisticated semiconductor solutions from Power Integrations (PI) could be specified. PI leads on technology solutions to design customised LED power supplies with the minimum of component with their perfect working software tools. This could be a low cost option for large volume applications, and one benefit is that the circuit can be trimmed for the highest efficiency. However, this is not always the option with the fastest turnaround time, given the approval process required for some regulations.

The alternative is a ready to use, high quality, high efficient off the shelf solution resulting in a faster time to market. Typically we have over 500 different models available with constant current (CC) output power 3W up to 350W, and a growing number with dimming options for use in applications such as architectural lighting. In addition, a wide range of LED power supplies with constant voltage (CV) output are available, ranging from 10W to thousands of Watts, suitable for low to high power LED lighting systems and screens.

Maximising Service Life

Much has been written about the longevity of LEDs, but it is important to be aware that they are not indestructible; a simple voltage

glitch has the capacity to damage the LED. Aside from that, the main area affecting service life of both the power supply and LED lighting is that of excess heat.

Although the LED devices run at low power, the build up of heat in the array as well as in the power supply needs to be minimised by using heat sinks on mountings for example. Not only will the lighting unit run more efficiently at a lower temperature but the risk of damage to the housing holding the LEDs will be significantly reduced. Designers should be integrating heat dissipation solutions into the power supply design from the outset in order to maximise service life. Consideration should also be given to where and how the lighting units will be mounted to aid the cooling process.

Another issue to weigh up is minimising weak points within the power supply assembly itself. Components such as electrolytic capacitors and opto couplers are known to impact on service life and reliability. Increasingly, designers are specifying power supply solutions without these items. In addition, care should be taken to ensure that high quality construction methods are used to prevent against the potential degradation caused by heat, aggressive moisture ingress and UV light. A dry solder joint from poor quality construction methods could prove critical once the power supply is in the field.

Selecting a power supply for LED lighting applications is not straight forward, and not everyone will have the in-depth knowledge of the rules and regulations that must be complied with in each specific market. In order to achieve the longest life cycle possible with LED lighting, it is crucial to get the right advice and specify and select the correct power supply from the many solutions available and install it correctly. Only when all these things have been taken into consideration can you expect to achieve the most efficient solution possible.

Learn How to Achieve Efficient Power Solutions with Avnet Abacus

As one of Europe's leading power, interconnect, passive, and electro-mechanical distributors, Avnet Abacus is teaming up with some of the world's leading manufacturers of power components to deliver a series of free technical seminars in five locations across Europe focused on the difficult challenges that face power system design engineers.

In the one-day sessions, Avnet Abacus and its franchises Aimtec, Cymbet, Emerson, Enpiron, Excelsys, Murata Power Solutions, Power Integrations, and Schaffner will provide an overview of environmental and energy efficient directives impacting power supply design. Explains Cor van Dam, Avnet Abacus' European Marketing Director: "Efficient use of power is a challenge that affects everyone. There are many issues: new mandatory regulations will require standby (no-load) energy consumption to approach Zero watts; consumers demands that battery-powered devices have a long life between recharging; and LED lighting systems must be powered correctly or the benefits are wasted. Our seminar series will address these topics and many more, and we encourage design engineers to raise their own specific areas of interest during the extensive Q&A sessions with technical representatives from the participating companies."

There will also be tabletop presentations from leading manufacturers of associated power products including Molex, Pulse and TE Connectivity.

The seminars are scheduled for Europe:

Paris	– 4th October,	Novotel Charenton
Milan	– 12th October,	Avnet Abacus office
Stuttgart	– 20th October,	Avnet Abacus office
Munich	– 25th October,	Avnet Abacus office
Newbury	– 3rd November,	Avnet Abacus office

Design engineers are invited to register for the free seminars by visiting www.avnet.abacus.eu/power or call +44-1628 512940.

www.avnet.abacus.eu/power

Dielectric Performance of Ceramic Capacitors

The resultant effects on the performance of a filter

Syfer Technology has considerable experience in the manufacture of MLC capacitors and low pass filters, both panel mount and surface mount, together with ceramic filtering elements such as discoidal capacitors & planar arrays supplied to the low pass filter industry.

By Steve Hopwood, Senior Applications Engineer, Syfer

Everybody ages, some faster than others, and some of us remain stable, but others were unstable to start with! Capacitors can be viewed in exactly the same light.

A recent letter to the EMC Journal issue 90, September 2010, highlighted how capacitor ageing resulted in 3 year old lighting ballasts failing EMC testing despite having been tested and passed when new. Investigations showed that the problem was paper film X2 capacitors ageing at 10% per decade.

Over the last few months, Syfer Technology has seen a significant increase in the number of enquiries relating to how ceramic capacitors change depending on the temperature and voltage in their application.

This has highlighted a general lack of understanding about the way capacitors age, the effects that operating conditions can have on component performance and the importance of the dielectric material and design used to make the capacitor in the first place.

Dielectric Codes, TC & VC characteristics

Most people are familiar with the ceramic dielectric designations C0G/NP0, X7R & Z5U – and some will also recognise other designations such as X5R & X8R – but this is only the tip of a whole range of dielectric types.

Each designation identifies the manner in which the dielectric changes with time, temperature and occasionally voltage. As a general rule, the higher the dielectric constant of a given material the more capacitance you can achieve per unit volume, but it becomes more unstable with temperature, voltage and over time.

Each designation indicates the performance of the dielectric over the operating temperature range.

	C0G/NP0	X7R	Z5U	Y5V	X7W
EIA dielectric classification	Ultra stable	Stable	General purpose		
Rated temperature range	-55°C to +125°C	-55°C to +125°C	-10°C to +85°C	-30°C to +85°C	-55°C to +125°C
Maximum capacitance change over temperature range (No voltage applied)	0 ±30 ppm/°C	±15%	+22-56%	+22-56%	±40-80%
Ageing characteristic	Zero	1% per time decade	6% per time decade	5% per time decade	5% per time decade

Figure 1: Summary of ceramic characteristics

It can be seen that for the most stable performance a C0G / NP0 dielectric should be specified, and that some dielectrics can lose as much as 90% of the quoted capacitance just by operating them within the limits of their temperature range.

However, this is only part of the story. The EIA codes shown in Fig. 1 only characterise a dielectric with respect to change due to temperature – the TC characteristic. Most dielectrics also change due to the application of voltage - the VC characteristic.

To include this it is necessary to look beyond the commonly recognised EIA codes to the CECC or MIL codes, which include VC characteristics.

Spec.	Classification	Temperature range °C	Maximum capacitance change @ rated DC volts	Syfer dielectric code
CECC	1B/CG	-55 +125	0 ± 30ppm/°C	C
EIA	C0G/NP0	-55 +125	0 ± 30ppm/°C	C
MIL	CG (BP)	-55 +125	0 ± 30ppm/°C	C

Figure 2a: C0G/NPO – Ultra stable Class I ceramic (EIA Class I)

Spec.	Classification	Temperature range °C	Maximum capacitance change % over temperature range		Syfer dielectric code
			No DC volt applied	Rated DC Volt	
CECC	2C1	-55 +125	±20	+20 -30	R
	2R1	-55 +125	±15	- -	X
	2X1	-55 +125	±15	+15 -25	R
EIA	X8R	-55 +150	±15	- -	N
	X7R	-55 +125	±15	- -	X
	X5R	-55 +85	±15	- -	P
MIL	BX	-55 +125	±15	+15 -25	B
	BZ	-55 +125	±20	+20 -30	R

Figure 2b: X8R, X7R & X5R – Stable class II ceramic (EIA Class II)

So C0G/NP0 is stable and exhibits minimal change through temperature or voltage, but a standard X7R or 2R1 capacitor has no required voltage characteristic and it is not unusual for standard X7R to lose as much as 75% of the quoted capacitance when full rated voltage is applied. Codes such as 2C1 & 2X1 allow the change through applied voltage to be taken into account, but reduce the capacitance range that can be achieved. It's possible that physically larger capacitors may be required to achieve the required performance. Less stable codes such as Z5U, Y5V etc generally have no equivalent codes taking voltage into account.

Of course, one option is to increase the voltage rating of the capacitor or filter so it is operated at a lower voltage than its rating – thus inferring an inherent voltage characteristic. For example, at Syfer, we

have standardised our filter range at a 500V rating wherever possible to improve performance figures, compared to the 100V (typical max) industry standard.

Actual Performance

We have seen that the dielectric codes define variation with temperature and sometimes voltage. Now let's make things more complex!

A dielectric code, for example X7R/2C1 (BZ) defines the performance characteristics, but only for that family. Think of it as, say, defining a small family car – it must have 5 doors, seat 4 and have a minimum engine size of 1.6ltrs, but it doesn't define that it must be petrol or diesel, manual or automatic transmission, with or without air conditioning. These additional factors come from the actual make & model selection – in our case from the actual dielectric material type. Many different dielectric powders, when used in conjunction with defined design rules, will meet the requirements of the X7R 2C1 (BZ) coding, but they may all have different actual performance characteristics, just as a Ford will differ from a VW.

If we look at the typical standard X7R family of capacitors, most manufacturers will sell a range of parts but within that range there will be a number of actual dielectric powder formulations. Each will meet the X7R specification but will be optimised for different characteristics (for example a high voltage dielectric is likely to differ from a low voltage one) and are likely to have different actual performance curves.

All 3 dielectrics comfortably meet the X7R requirements of ±15% over the temperature range, but exhibit three different performance curves.

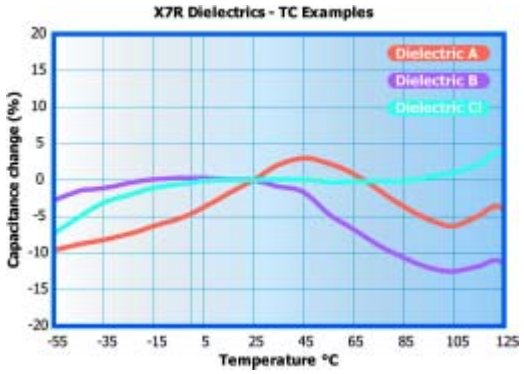


Figure 3: X7R Dielectrics – TC examples

Ageing

We have shown that the quoted nominal capacitance may not be actually what is being achieved, but there is still more to take into account.

Ceramic dielectric ages at a known linear rate, and of course C0G/NP0 is the best having negligible ageing whereas X7R ages at <2% per decade and Z5U/Y5V at typically 6% per decade, but it's important to understand how this works in practice:
C0G does not age – so the value will remain constant.

X7R ages at <2% per decade – in practice typically 1% per decade. This means that the capacitance value will decrease logarithmically after it is cooled through its curie point (about 135°C) by approximately:

a) 1% between 1 and 10 hours
b) An additional 1% between the following 10 and 100 hours
c) An additional 1% between the following 100 and 1000 hours
d) An additional 1% between the following 1,000 and 10,000 hours etc
The ageing rate continues in this manner throughout the capacitor's life, although '1,000hrs to 10,000hrs' equates to '6 weeks to 59 weeks' and '10,000hrs to 100,000hrs' equates to '59 weeks to 11 years' so ageing is considered flat beyond 1000hrs for most practical purposes.

The less stable dielectric categories, such as Z5U / Y5V etc, age in a similar manner to X7R, but at a faster rate – typically 6% per decade.

It has been standard practice in the ceramic capacitor industry to quote capacitance based on the 1000hr value for many years. This allows the user to have some confidence that the capacitance will not vary much from the quoted value.

However, this has not universally been transferred to the filter industry where either a nominal value or GMV (Guaranteed Minimum Value) is quoted. Again, be careful with this – GMV does not usually take ageing into account and relates to the value as supplied, not a guarantee of what the capacitance will age to and certainly not what it will be under normal working conditions.

If in doubt, ask the supplier exactly what value they are quoting or supplying and remember to take the tolerance into account. The filter industry is lagging somewhat behind the capacitor industry in still quoting very wide tolerances. If a part is quoted with a tolerance of -20% +80%, then the value targeted in manufacture will probably be +20% with respect to nominal.

Whilst discussing GMV it is also worth noting that this can be an excuse for supplying whatever parts the supplier has in stock at that time. For example a 10nF GMV part could have 15nF or 100nF nominal capacitance and vary batch to batch, not very useful for knowing how the circuit will perform over time.

Effect on value and performance
It has been demonstrated that the capacitance of a part can actually vary considerably compared to the quoted nominal value. Consider now the typical performance of a 5,000pF filter capacitor, offered in standard dielectric classifications, operating at a voltage of 100Vdc at 85°C and at an age of 10,000 hours. The final capacitance value can fall within a range of values taking into account the ageing process, and the effects of temperature and voltage.

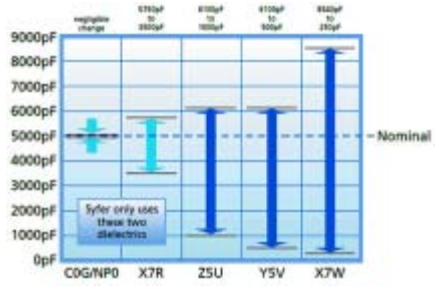


Figure 4: The final capacitance value can fall within a range of values taking into account the ageing process

It's not easy to test at the extremes of voltage, temperature and ageing, but we can get an approximation of relative performance by testing capacitors of nominal values to match the extremes. In the above example we have a nominal 5,000pF capacitor which could have an actual value of 250pF. But let's assume it's not quite as bad as that and compare the attenuation curves of a 5000pF MLCC feedthrough chip and a 330pF MLCC feedthrough chip, as these are readily available standard values.

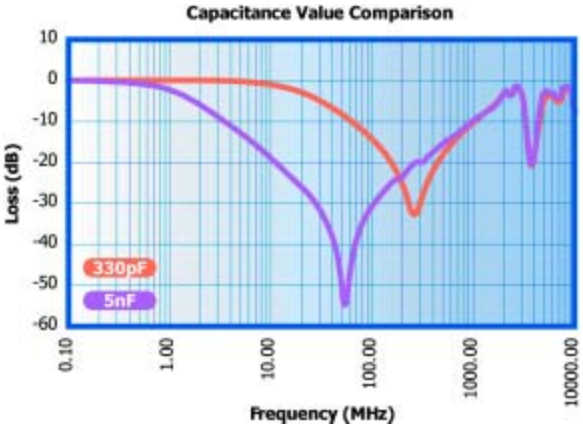


Figure 5: Capacitance value - performance comparison

And similarly, a comparison of panel mount 'C' filters with capacitance values of 10nF and 100nF can also show how problems can occur, with up to 20dB degradation in the filtering performance due to the change.

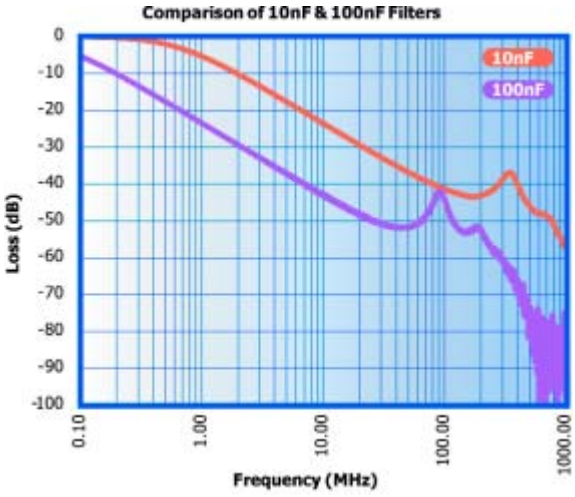


Figure 6: Comparison of 10nF and 100nF Filters

Potentially a problem we would suggest.

Conclusion
Dielectrics other than C0G/NP0, or the stable X5R/X7R/X8R, should not be used to make ceramic chip capacitors. Whereas, the less stable Z5U/Y5V/X7W dielectrics are still commonly found in the manufacture of feedthrough filters where high capacitance values are required from older technologies (e.g. single layer capacitors). It is certainly worth carefully checking the dielectric characteristics when specifying these components, especially if you should you try to make your own filter.

But most of all don't rush in when specifying capacitors, and don't assume the value is what it says on the packet. Ask as many questions as you need – a reputable manufacturer like Syfer will always be willing to help, that's what we're here for!

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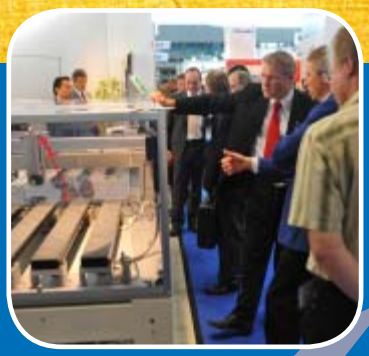

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Industrial Testers

Testers for power semiconductors

Two exemplary testers for diode and thyristor parameters measurement are described. The testers have been designed due to the inspiration from the semiconductor elements producers.

By Adam Sitnik, Dacpol

U_{RRM}/U_{DRM}; U_{TM}/U_{FM}; du/dt Tester

During the diodes and thyristors production process some structure and finished element parameters are measured. Industrial testers are used for those parameter measurements. They are equipped with the external presses which provide proper compress force for tested elements.

This tester is designed for the final inspection of the diode and thyristor parameters before packing and sending them to the client.

Tester verifies the following parameters:

1. Voltage class – Half wave of the sine voltage: amplitude range 200÷8000V.
2. Forward voltage – Extortion with the sine half wave (amplitude up to 5000 A).
3. Thyristor resistance for the du/dt effect – linear voltage rise (500V/µs ÷ 4000V/µs)

Figure 1: U_{RRM}/U_{DRM}; U_{TM}/U_{FM}; du/dt Tester

Test current and voltage waveforms are set up within a 1% tolerance. All of the measurements are made by a computer equipped with the measuring boards which cooperate with the non inductive shunts, voltage and current Hall transducers and the high voltage capacitance probe for the du/dt measurement.

Tested element is placed in the external press which is connected to the tester. Tester automatically sets up test conditions based on:

- Parameters received from the master computer of the measurement line
- Bar code read by a reader
- Test parameters manually entered by an operator.

Tester is operated with a touch screen, keyboard, mouse, control buttons and signal lamps. During tests the only thing that an operator needs to do is to exchange tested elements in the press. Results are automatically assessed by the tester on the basis of criteria recorded in the computer memory. Tests results are displayed on the computer screen in digital form as well as a parameter diagram. Final test results are given by the TEST PASS and TEST FAILURE signal lamps.

Computer software also covers assistance in maintenance (diagnostics and separate control of tester components.)

Figure 2: Q_{rr} measurement tester

Tester for the reverse recovery charge (Q_{rr})measurement

This tester allows for measurement of reverse recovery charge Qrr of both: structures and finished power diodes and thyristors. Tested structure or finished element is placed in the external press which is connected to the tester.

Tester generates trapezoid-shape current test impulse with the independent regulation of its rise di/dt rate, maximum value and its duration and fall di/dt rate. Reverse recovery charge is calculated by a computer on the basis of the reverse current waveform of the tested element with three methods.

Tester allows for a Qrr measurement with a current impulse up to 5000A and 2000 µs duration. Maximum measured value of the reverse current I_r is 1000A and the measurement time is limited to 100 µs.

Tests are performed automatically after entering parameters to the computer. Those parameters can be obtained automatically from the external computer or manually entered by an operator.

Tester operation is controlled by a computer equipped with measuring and control boards. Measuring board registers current and voltage waveforms and the computer makes an assessment based on the criteria specified in the test recipe.

Tests results are displayed on the computer screen in digital form as well as a parameter diagram.

Computer software allows realization of the test cycle, detects and localizes failures, allows for separate control of every component and validates tester operation after the maintenance.

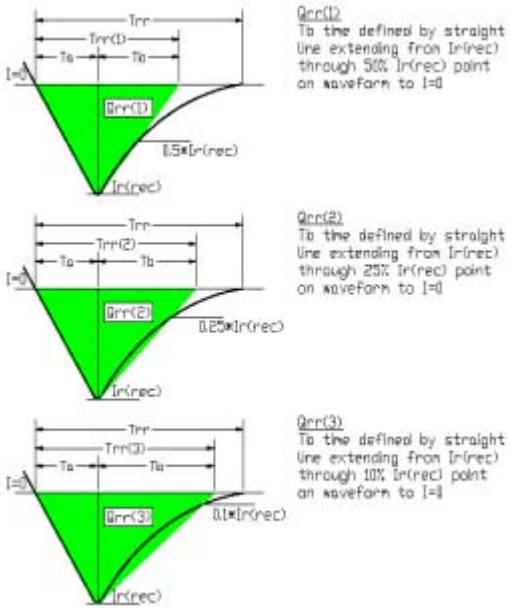


Figure 3: Q_{rr} Measurement methods

Dacpol Service is the tester producer mainly for the electrotechnical industry. During the last 10 years it has developed more then 20 unique tester constructions for parameter measurement of the following components:

- Power semiconductors ;
- Power contactors and switches;
- Varistors;
- Fuses.

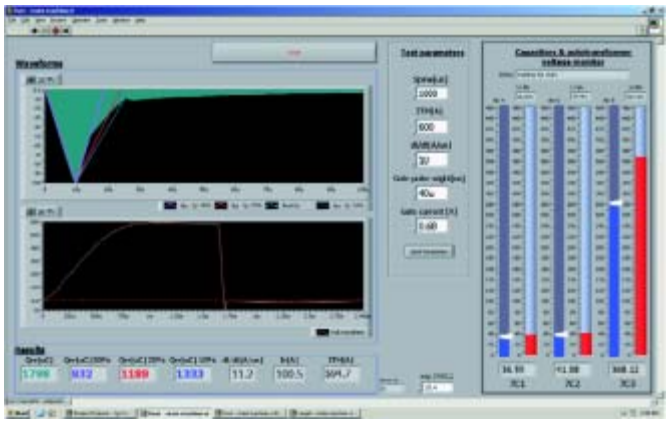


Figure 4: Screen display

Producers of components listed above are main recipients of those type of testers. All testers are designed according to the individual customer requirements.

www.dacpol.com

Mid-Mount Connector Offering

CUI Inc announced an addition to their Components line that now includes mid-mount pc board 3.5 mm audio jacks and 2.5 mm center pin dc power jacks. These mid-mount connectors are ideally suited for low profile design requirements in consumer electronics applications.
Switch options for the audio jacks include ring switch, tip switch, and two or three switch configurations. The dc power jacks are fully shielded for EMI suppression with a rating of 16 Vdc @ 5 A. All connectors are RoHS compliant.

www.cui.com

Flexible SMD Offline Transformer

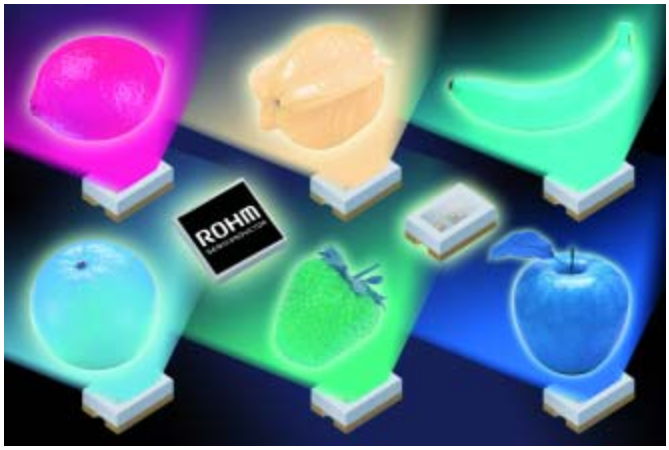
Wurth Electronics Midcom announces a series of surface mount transformers, created specifically for LED lighting and offline power supply markets. This marks the series as one of the only SMD transformers for reinforced insulation, offline power supplies on the market today.

The 12-pin SMD transformers are designed to comply with IEC60950-1, for reinforced 400VDC. This is made possible by an offset bobbin rail to distance the triple insulated wire solder joints from the other coils and core.
The SMD transformers come in multiple voltage options with flexible secondaries, ranging from 5V to 41V. It also has auxiliary voltage taps at 6V and 14V or 20V, for maximum flexibility.
The SMD transformers provide 3kVAC isolation and have an operating temperature of -40°C to 125°C. The parts' dimensions are 13.8mm x 17.8mm x 26.1mm. The eight-part series has three options for US input voltage, three options for European input voltage and two offline power options for Universal input voltage.
Custom designs are available to optimize turns ratio and maximize efficiency.

www.we-online.com/midcom

LED Line-up Features a Wide Range of Custom Colours

ROHM Semiconductor presents its new EXCELED™ LED family(1) which is based on original device and advanced phosphor technology, combined with refined wavelength rank sorting as well as 4-element chips and wafer processing. As a result, the devices facilitate wavelength customization and are able to emit custom colours, including white and pastels. In addition to the eight standard colours dark red, red, orange, yellow, yellow-green, green, blue, and white, six optional colours (pink, blue-green, blue lagoon, saphire blue ,ice blue, incandescent bulb colour) can be offered for a wide range of applications such as automotive, consumer, gaming, industrial and more.



For greater compatibility, designers can choose from a big variety of package types, from an ultra-thin packaging of 1.6 x 0.8 x 0.36 mm (0603) up to a package size of 3.0 x 2.0 x 1.3 mm (1206). ROHM's overall chip LED line-up consists of standard type, top-view type, side-view and reverse-mount types providing maximum design and soldering flexibility.

The products are available on a made-to-order basis.

www.rohm.com/eu

Guide for Optical Isolation Selection

Toshiba Electronics Europe (TEE) has announced the availability of a free guide for engineers looking to build galvanic isolation and noise protection into their designs using photocoupler-based technology.

The 80-page Photocouplers and Photorelays Product Guide will speed the identification, comparison and selection of photocouplers.

As well as technical data for each product, the guide incorporates a 'product tree' that allows engineers to quickly narrow down their choice to a few key components. A new product section introduces the latest additions to the range, while information on topics ranging from packaging to board assembly considerations helps to further simplify design and implementation.

Products in Toshiba's photocoupler portfolio are based on the optical coupling of either GaAs or GaAlAs infrared LEDs with a silicon photodetector. The range, which includes ultra-compact and high-temperature options, covers photocouplers for logic signal transmission, products for driving gates of MOSFETs and IGBTs, and Photorelays that can replace conventional mechanical relays.

www.toshiba-components.com

Surface-Mount 2410 Fuses Provide High I²t Characteristics

TE Circuit Protection announces the 2410SFV family of 20 new AC/DC fuses featuring current ratings from 0.5A to 20.0A.

The 2410 fuses help provide secondary-side circuit protection, conserve board space and reduce design costs in a broad array of high-voltage, high-current designs. Typical applications include home appliances (LCD TV LED backlighting, LCD TV CCFL backlighting) and LED lighting, as well as office automation, industrial and medical equipment.

Available in an ultra-thin (6.1x2.5mm) SMD package, 2410SFV fuses offer I2t characteristics as high as any similar SMD device on the market. They also offer a nominal cold resistance (DCR) from 0.0034? to 0.231? and a high-interrupt current from 50A to 300A. Rated for operation at temperatures ranging from -55°C up to 125°C, the fuses' high-inrush current withstand capability minimizes nuisance tripping during transient overload conditions.

As wire-in-air (WIA) fuses, the 2410SFV products feature a straight wire configuration. As surface-mount devices they provide a rugged, single-piece package that speeds assembly time and is compatible with standard pick-and-place SMD processes. Additionally, the 2410SFV fuses' structure minimizes the risk of the end cap of the device becoming dislodged, a feature not offered by most competitive devices. In accordance with industry standards and trends for "green" products, the fuses are 100% lead- and halogen-free and are RoHS-compliant and UL listed.

www.te.com

LED Driver IC Design Support Tool

Renesas Electronics announced the availability of the R2A20134EVB design support tool for the R2A20134. It comes mounted with the R2A20134, a high-efficiency LED driver IC for applications such as LED lamps, and is intended to simplify the design of complex LED control circuits. Six product versions are available to match a variety of circuit configurations used by customers. Renesas Electronics plans to increase production of the R2A20134 LED driver IC to 10 million units per month in 2014, backed by the system design support provided by the new R2A20134EVB design support tool.

The use of LED lighting is becoming more widespread due to increasing awareness of the need to conserve electricity and preserve the environment by, for example, improving power efficiency and reducing emissions of carbon dioxide. The market for LED lighting is expected to grow substantially moving forward, with the replacement of incandescent light bulbs playing a central role.

The features of the R2A20134 LED driver IC, which is mounted on the design support tool, are reduced system cost and LED driver MOSFETs typically have a voltage tolerance of 700 V, but the R2A20134 enables use of MOSFETs with tolerances in the 500 V to 300 V range.

This contributes to lower system cost overall.

www.renesas.eu

Solid State Relay for Electromechanical Relay Users

Crydom's LifePlus ED series of AC and DC output pluggable Solid State Relays offer Electromechanical Relay users the opportunity to directly replace traditional 12 x 29 mm EMRs with Crydom's proven Solid State Relay Technology. Solid State Relays offer substantial performance advantages over traditional EMR switching solutions in many applications including significantly greater life expectancy (>100 million operations), contactless

high speed switching eliminating contact bounce and resulting electrical noise, precise logic compatible control inputs, acoustically silent operation and high vibration resistance, among many others. Available in a SPST N.O. configuration, the "LifePlus ED series" offers output ratings of either 3 or 5 amps rms at 24 to 280 VAC, or 5 amps dc at 1 to 48 or 1 to 80 VDC, all at 40 °C ambient temperature. AC outputs incorporate Crydom's proven Back-to-Back SCR technology while DC outputs utilize high efficiency FETs, both technologies resulting in the lowest possible on-state power dissipation and high surge current ratings which make the "Crydom LifePlus" an excellent choice for applications such as small Motors, Solenoids, Heaters and Lamps. Optically isolated control inputs available include 3 to 15 VDC, 18 to 32 VDC, 48 to 72 VDC, 18 to 36 VAC and 90 to 140 VAC.

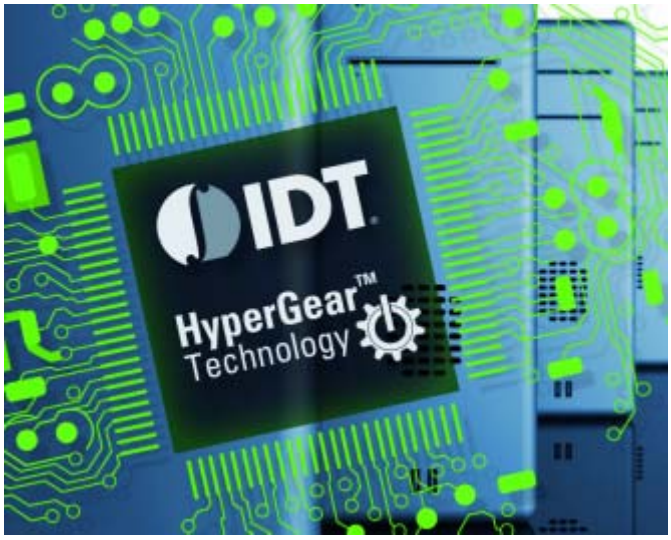
www.crydom.com

HyperGear™ Technology Reduces Motherboard Power Consumption

Integrated Device Technology, Inc. announced that it has developed a power savings and performance enhancement architecture for high frequency voltage regulator designs targeted at computing applications. The patent pending “HyperGear” technology dynamically adjusts the CPU voltage, peripheral bias voltage, and CPU clocking frequency based on the CPU usage demand and can provide more than 10% efficiency improvement while simultaneously boosting CPU performance. This technology saves significant power and cooling costs in cloud-based datacenter environments and extends battery life in portable applications.

An innovative HyperGear algorithm included in IDT’s power management ICs recognizes the need for higher CPU speed when running data-intensive programs such as games and videos, or during heavy internet traffic on cloud-based enterprise servers. Under these demanding conditions, HyperGear automatically and safely overclocks the CPU to improve performance and concurrently shorten the duration required for processing. During rest periods, HyperGear scales down the clock frequency for improved efficiency. In sum, these dynamic frequency and voltage controls allow computers to run faster while reducing net energy consumption under typical operating conditions.

HyperGear uses a proprietary two-wire serial interface bus to link IDT CPU power management chips to the IDT clock console. Using Voltage ID (VID) information and monitoring the output load, HyperGear will dynamically adjust the CPU’s core voltage and clock frequency, without the need for additional external components or complex circuit design. IDT has started utilizing the technology on all current and future power management solutions that comply with industry standard specifications, such as VR12, making it easy to realize the benefits of a HyperGear solution on new and existing platforms.



www.IDT.com

Prototype Exceeds DOE's 21st Century Lamp L PrizeSM Requirements

Demonstrating the future of lighting, Cree, Inc. unveiled a concept LED light bulb from its lighting research and development team. Redefining what is possible with high-performance LED lighting, the lamp delivers more than 1,300 lumens at 152 lumens per watt (LPW) using Cree TrueWhite® Technology. Cree's prototype LED light bulb exceeds the performance goals set by the U.S. Department of Energy (DOE) for the 21st Century Lamp, the third category in its L PrizeSM competition.

LED lighting at this level of performance is only made possible by advancements across all elements of the LED lighting system – lighting-class LEDs, optical elements, drivers and power supplies. Optimizing each element was critical in achieving the performance reached by Cree's prototype LED lamp. As an efficiency comparison, a traditional 75 watt incandescent light bulb produces 1,100 lumens at only 14.6 lumens per watt.

Third-party testing by independent lab OnSpeX confirmed that Cree's lamp delivered more than 1,330 lumens and consumes only 8.7 watts. The lamp uses Cree TrueWhite Technology to deliver a high-quality, energy-efficient light with a CRI of 91 at a warm white color of 2800 K. This project benefits from technology developed under DOE-funded contracts, which are part of Cree's ongoing collaboration with DOE to advance the successful adoption of energy-saving solid-state lighting.

www.CreeLEDLighting.com

2011 Advanced Energy Solutions Conference

FullPower, Incorporated announced that it will host the annual Advanced Energy Solutions Conference Sep.12th-15th at The Catamaran Hotel & Resort in San Diego, CA.

AES 2011 will feature industry leaders that will discuss new and emerging energy developments. The high level of participation by users of energy storage technologies has driven an expanded, solution oriented approach. At AES 2011, participants will be exposed to critical material and component suppliers. Energy industry leadership, including utilities, automotive, and government, will discuss the issues and requirements associated with the deployment of efficient energy systems and power transmission

http://aes.fullpowerinc.com

Class-G and Class-D Amplifiers Balance Power Versus Battery Life

To meet this challenge, Fairchild Semiconductor developed the FAB1200 stereo Class-G ground-referenced headphone amplifier with integrated buck converter, as well as the FAB2200 audio subsystem with stereo Class-G headphone amplifier and 1.2W Class-D mono speaker amplifier.

The FAB1200 features a charge pump which generates a negative supply voltage that allows the headphone output to be ground-centered and capacitor-free, eliminating up to two external capacitors. An integrated inductive buck regulator provides direct battery connection and adjusts the supply voltage between two different levels based on the output signal level resulting in reduced power consumption. The result of these features is reduced systems cost and extended battery runtime, while maintaining a high level of audio quality.

The device, available in a 16-bump, 0.4mm pitch, 1.56mm x 1.56mm WLCSP package, offers excellent audio performance for better sounding audio headsets and is ideal for

mobile handsets, tablets/MIDs, MP3 and portable media players.

The FAB2200 is an audio subsystem that combines a capacitor-free stereo Class-G headphone amplifier with a Class-D speaker amplifier. A proprietary integrated charge pump generates multiple supply rails for a ground-centered Class-G headphone output significantly reducing power dissipation when compared to Class-AB design implementations, while offering high power supply rejection ratio.

The filterless Class-D amplifier can be connected directly to a speaker without the need for two external filter networks, reducing the overall solution systems cost. The device also features Automatic Gain Control which limits the maximum speaker output levels to protect speakers without introducing distortion. It can also dynamically limit clipping as the battery voltage falls.

The FAB1200 and FAB2200 mobile audio ICs make handsets, tablets/MIDs, and other portable audio applications sound louder and better while reducing overall systems cost and minimizing the impact on battery runtime.

The FAB2200, available in a 25-bump, 0.4mm pitch, WLCSP package, is ideal for cellular handsets, notebook computers and tablets.

www.fairchildsemi.com

Innovative RO-LINX Power Circuit Busbars

Rogers Corporation's Power Distribution Systems Division has announced an innovative new solution for emerging power electronics applications: RO-LINX® PowerCircuit™ busbars. The PowerCircuit solution was developed to meet the growing power distribution demands in electric vehicle (EV) drives, hybrid electric vehicle (HEV) drives and related charging systems. Other significant applications include solar power inverters, uninterruptable power supplies (UPS) and industrial motor drives. RO-LINX PowerCircuit busbars fill the gap between printed circuit board (PCB) power distribution solutions and higher power laminated busbar systems, such as Rogers' highly regarded RO-LINX laminated busbar products.

RO-LINX PowerCircuit busbars combine the performance features of power PCBs and laminated busbars. RO-LINX PowerCircuit busbars are highly engineered solutions for multilayer power distribution delivering optimal thermal management. Unlike two dimensional (2D) power PCBs, PowerCircuit busbars can be made in three dimensions (3D) to reduce weight and footprint and to conform to specific engineering designs to maximize efficiency. In addition, PowerCircuits eliminate assembly steps at the end user reducing complexity and sources of error.

Traditional power PCBs can handle up to 100 A current due to limited conductor layer thickness. Laminated busbars serve much higher power applications, generally at current levels from 500 A to more than 1000 A. RO-LINX PowerCircuit busbars fill the gap in designs for low to medium voltages and current levels. They are subsequently ideal for applications at current levels from 100 to 500 A, such as industrial variable frequency drives and HEV or EV motor drives. Furthermore RO-LINX PowerCircuit busbars can perfectly be combined with industrial mounting of functional components such as capacitors, sensors, and IGBTs.

www.rogerscorp.com

35 Amp Current Sensor for Automotive

Inverters and DC/DC battery chargers for Electric and Hybrid Vehicles require minimum space (Premo's Automotive Current Sensor use just 2.4mm3), and maximum power handling per cubic cm (This sensor handles 14.6A/cm3). A proper switching management require digital controls more than conventional PWM and a real time high frequency (The sensor is designed for 200kHz) sampling of the currents flowing through the primary is a must for high speed anticipative control systems.

The CS-100-AU current sensor is designed with low losses and high temperature stability toroidal ferrite core which allows working frequencies higher than 200 kHz at operat-

ing temperatures from -40ºC up to 155ºC.

The converters for hybrid and electric vehicles works at high voltage (400V) in the input site, which makes a must to isolate primary winding of the current sensor, directly connected to the high voltage circuit, from the secondary site, connected to the control circuit. Premo current sensor guarantees 3kV isolation and a creepage distance > 6.5mm.

A precise (Premo sensor precision 2%) sensing of primary currents let the system manage line and specially load regulation being able to set the workload and optimum working point either to maximize power or to minimize power consumption or dissipation (Sensor dissipation less than 1W). Above all, a low DCR current sensor (Premo's typical DCR is 0.5mOHM), is an efficient tool for ZVT and ZVS full bridge topologies to minimize stress in High frequency switching MOFET's.

www.grupopremo.com

720 W Isolated Dc-Dc Quarter Brick

CUI Inc introduced the engineering release and initial customer sampling of the NQB Series isolated dc-dc quarter brick based on their patented Solus Power TopologyTM. As part of CUI's Novum Advanced PowerTM portfolio, the 720 W intermediate bus converter will initially support an input range of 36-60 V with an output of 12 V and will provide an efficiency greater than 96%. The NQB product will eventually support a wider input range as well as an output of 9.6 V. Additional features include options for DOSA 1st generation or 2nd generation footprint compatibility, remote on/off, and load share capability. The NQB Series aims to address the trend of rising power requirements and efficiency demands in telecom systems and data centers, supplying an industry leading power density of 445 W/in3 across the full 36-60 V input range.

CUI's Solus Topology integrates a conventional buck converter into a SEPIC converter to form a totally new SEPIC-fed buck converter; a patented single stage topology with one magnetic element, one control switch

and two commutation switches that are optimally controlled by pulse-width modulation (PWM). With lower voltage and current stresses in the topology coupled with an inherent GCE (gate charge extraction) process, Solus is able to reduce switching turn-on losses by 75% and switching turn-off losses by 99% on the control FET when compared to a conventional buck converter. The Solus Topology further increases total efficiency by distributing the energy delivery into multiple paths, reducing circuit conduction losses by nearly 50%. With these advantages, CUI is now in a position to develop a wide range of ac-dc and dc-dc power conversion platforms with greatly improved energy efficiency, faster transient response and increased power density versus the leading designs currently on the market.

"This is the first product of many that will be based on the Solus Topology. The flexibility of the Solus Topology will allow us to not only incorporate it into an isolated dc-dc solution, but will also move to our non-isolated dc-dc and ac-dc product roadmaps," said Mark Adams, CUI's VP of Advanced Power Marketing.

"In today's green world where efficiency and density is king, we believe our Solus Topology will be a difference maker in the market for years to come," concluded Adams.

CUI has been sampling the NQB product to select customers and will continue to provide engineering samples to select customers until full production release in Q1 2012.

www.cui.com

Redesigned and Upgraded Thyristors

JSC “Proton-Electrotex” has recently upgraded the product family of high voltage thyristors for 320, 800 and 1250 amps. The following devices have been improved:

T473-1250-65; T673-1250-65; T653-800-65; T953-800-65; T643-320-65 and T743-320-65

These power semiconductors can be implemented in high-voltage converters, soft-starters and reactive power compensators.

The redesigned and upgraded devices have the following advantages:

Implementation of central gate electrode provides stable operation of thyristors in the low anode current mode. Due to improving the thyristor topology, static loses have been decreased. Low dispersion of reverse-recovery charge for series connection became possible thanks to improved irradiation technology.

For more information please contact sales department: Phone: +7 (4862) 44 -06-42

E-mail: sales@proton-electrotex.com

www.proton-electrotex.com

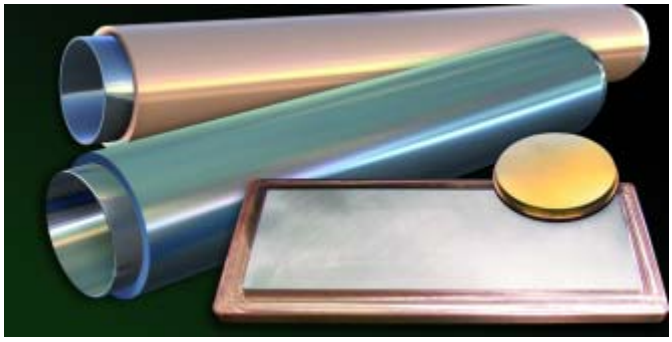
Highest Power Density Planar Transformer

Payton has introduced the highest Power Density Planar Transformer available for use in SMPS. The power density is +2,500 Watts/cubic inch .The transformer is designed to accept a wide range of input from 200 to 700 Vdc and have an output of 150 to 300Vdc. The total output power is 8000 Watts provided the transformer is mounted on a 600C cool plate. Switching frequency is 200Khz and the topology is Half Bridge ZVT. The weight is 170grams with the maximum dimensions of 2.2"x2.2"x0.67"

www.paytongroup.com

Copper-Gallium and Rotary Sputtering Target

Indium Corporation is featuring its newly developed copper-gallium and indium rotary sputtering targets at the 26th European Photovoltaic Solar Energy Conference and Exhibition (EU PVSEC), September 5-8, 2011 in Hamburg, Germany.



The targets are made by Indium Corporation's vertically integrated proprietary process utilizing aerospace powder metallurgy technology. The production process output produces a consistently homogeneous alloy with low PPM contaminate levels and consistent density throughout the target, resulting in very consistent sputtering film properties.

The Cu/Ga targets can be produced in chemistry ranges from 50% to 80% Cu atomic weight. The In targets are typically 4/9-5 plus grade. They are both produced as a monolithic material, bonded onto the backing tube during Indium Corporation's unique hybrid consolidation process.

Visit us at EU PVSEC at stand #A4/B19.

www.indium.com/solar

Single-Chip Battery Management Device for Power Tools and e-Bike Applications

Texas Instruments introduced the industry's first fully integrated battery protection and cell-balancing solution for Li-Ion and lithium iron phosphate battery packs. The bq77910 battery management and protection device can manage 4- to 10-cell battery packs, and two devices can be stacked to protect 11- to 20-cell packs. The device simplifies battery pack designs for e-bikes, e-scooters, portable gardening tools, power tools and uninterruptible power supplies (UPS) and can also be used when replacing lead acid batteries. For samples and evaluation modules, visit www.ti.com/bq77910-preu.

The bq77910 protects the battery pack by monitoring individual cell voltages and drives two N-channel power MOSFETs to interrupt current flow during fault conditions. Fault detection and recovery criteria for the device are fully programmable in non-volatile memory to suit all types of lithium battery systems.

www.ti.com

Six-Channel Analogue Front-End for Three-Phase Energy Metering

Microchip announced its first high-accuracy, stand-alone six-channel analogue front-end (AFE) for three-phase energy metering. The MCP3903 AFE includes six 16-/24-bit Delta-Sigma analogue-to-digital converters (ADCs) and offers industry-leading accuracy, with a typical signal-to-noise and distortion (SINAD) of 89 dB and typical total harmonic distortion (THD) of -99 dB. Additional integrated features include programmable gain amplifiers (PGAs), a low-drift voltage reference and phase-delay compensation resulting in a reduced external component count which increases design flexibility and lowers costs. The MCP3903 AFE is ideal for the utility and industrial markets, such as in utility meters, power-monitoring equipment and instrumentation.

Government regulations and trends in smart metering, together with the Advanced Metering Infrastructure, have dramatically increased the need for products that offer precise measurements in multi-phase metering, while simplifying designs and reducing costs. The MCP3903 delivers this functionality by providing a highly accurate solution with integrated features that enhance design flexibility. The MCP3903's six 16-/24-bit Delta-Sigma ADCs enable the simultaneous sampling of six inputs, making it ideal for three-phase power monitoring and metering, while its industry-leading accuracy allows for higher-accuracy products.

The MCP3903 is available in a 28-pin SSOP package and samples are available today.

www.microchip.com/get/1NKJ

Miniaturized Series of Gate-Drive Transformers

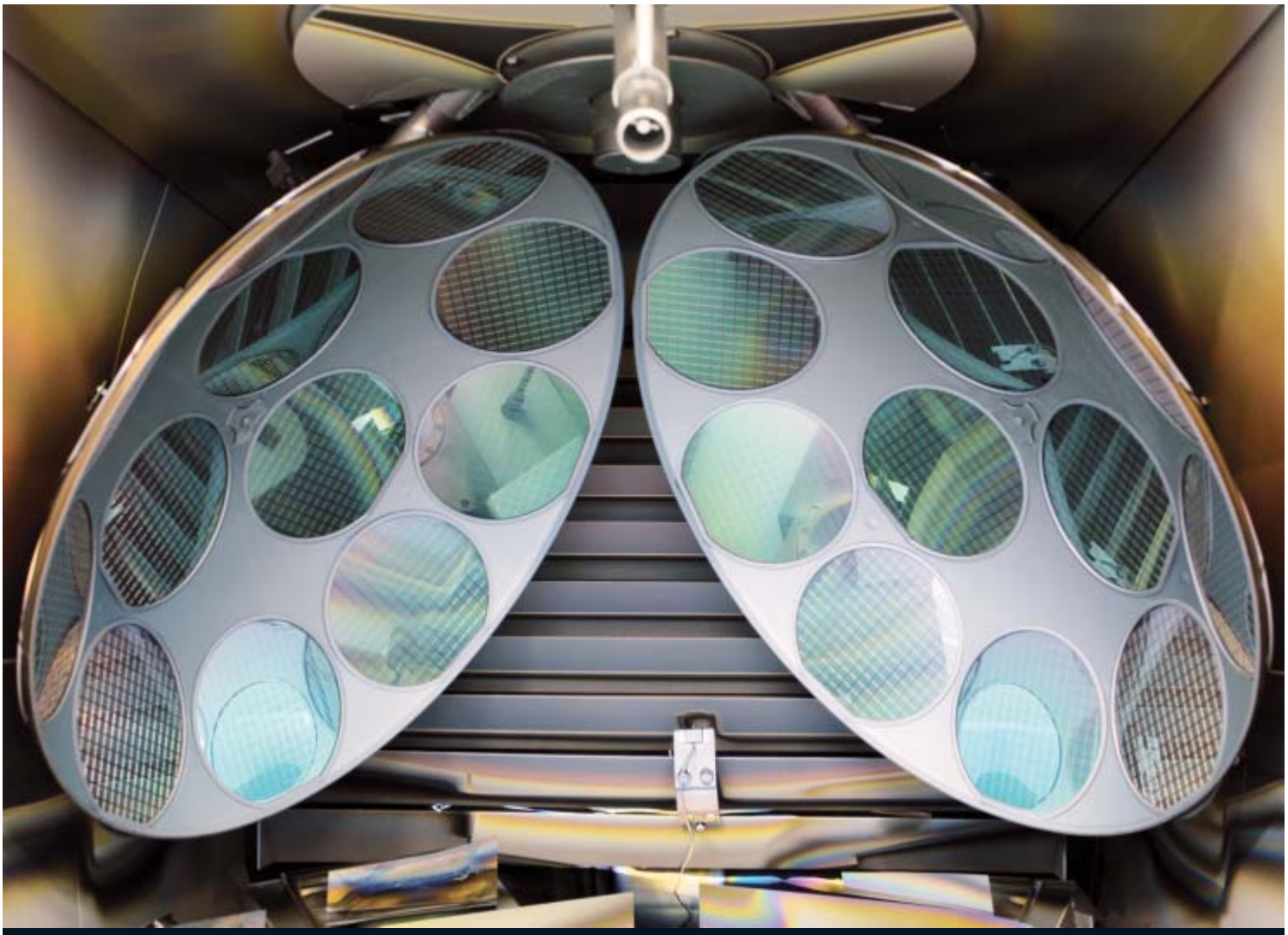
TDK-EPC, a group company of TDK Corporation, has developed a new series of EPCOS EP5 SMT pulse transformers. They are used to couple gate-drive circuits to MOSFETs and IGBTs operating at switching frequencies within a range of 150 kHz to several MHz. These transformers are available with a wide range of turns ratios, polarities and outputs.

Thanks to the use of miniaturized EP5 cores, these transformers have dimensions of only 8.1 x 6.7 x 5.4 mm³. As several transformers are usually used in a circuit, the size reduction of the transformers results in significant space savings on the circuit board. Thanks to a special winding technology, parasitic capacitances between windings are only 25 to 95 pF, depending on the type. Stray inductances are likewise low. They range between 0.9 and 2.5 µH. Short-term dielectric strength is tested to 1500 V DC for all types of the B82804A* series. These components are designed for ambient temperatures of up to 85 °C and operating temperatures of up to 125 °C. Their terminal configuration and pin assignment correspond to the industry standard.

The main applications of these new transformers are half- and full-bridge converters as well as in frequency converters or inverters.

www.epcos.com/smt_gdt

ADVERTISING INDEX



High Power Semiconductors. Layer by layer towards best-in-class performance.

Hundreds of process steps are required to manufacture ABB's high power semiconductor chips. Implantation, Diffusion, Photolithography, Etching and Metallisation are only some of them. Precision in manufacturing is a must to exceed the quality requirements. Statistic Process Control is the key to guarantee quality in each of these steps. For more information please visit our webpage:
www.abb.com/semiconductors

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Power and productivity
for a better world™

Delivering Real Power

Compact, Powerful CCM PFC from 75W to 4kW+

PFC Control ICs	
Part Number	**Description**
IR1152	Fixed 66KHz switching frequency with brownout protection and dual OVP protection
IR1153	Fixed 22KHz switching frequency with brownout protection and programmable OVP protection
IR1155	Programmable switching frequency and programmable OVP protection

600 V PFC IGBTs for High Power Systems				
Part Number	**Circuit**	**I_c @ 100C (A)**	**$V_{CE(on)}$ (max) (V)**	**Package**
IRGB20B60PD1	Co-Pack	22	2.35	TO-220AB
IRGP20B60PD		22	2.35	TO-247AC
IRGP35B60PD		35	2.15	TO-247AC
IRGP50B60PD1		45	2.35	TO-247AC
IRG4(B/IB)C20W	Discrete	6.5	2.6	TO-220AB; TO-220 FullPak
IRG4(B/IB/P)C30W		12	2.7	TO-220AB; TO-220 FullPak; TO-247AC
IRG4(B/P)C40W		20	2.5	TO-262; TO-220AB; TO-247AC
IRG4PC50W		27	2.3	TO-247AC
IRGP4069		35	1.85	TO-247AC
IRGP4063		48	2.14	TO-247AC
IRGP4066		90	2.1	TO-247AC

The µPFC family of controller ICs radically alters traditional thinking about PFC solutions. The IR115x uses a "One-Cycle Control integrator with reset" technique to deliver the high performance of Continuous Conduction Mode (CCM) PFC with the simplicity and low component count of Discontinuous Current Mode (DCM).

Features

- Small, easy, powerful solution
- Fast time to market
- Enables compliance with energy standards (1W, Blue Angel, Energy Star)
- No AC line voltage sense required
- 0.999 power factor
- Switching frequency of 22kHz, 66kHz or programmable value available
- Average current mode control
- Cycle by cycle peak current limit system protection

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

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