ISSN: 1863-5598

ZKZ 64717
12-16

Bodo's Power Systems®

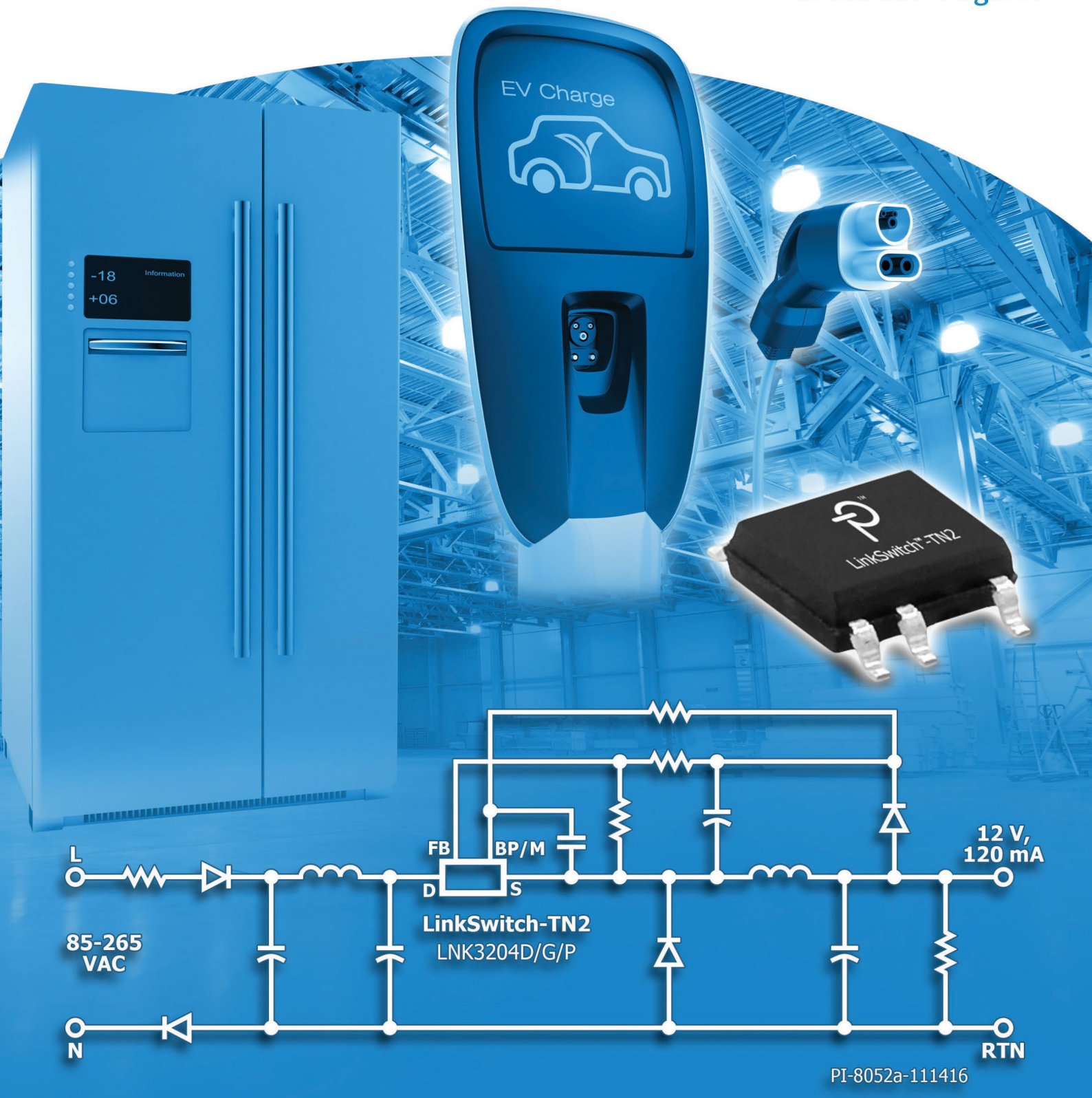
Electronics in Motion and Conversion

December 2016

power integrations™

LinkSwitch™-TN2

Accurate Offline Switcher IC for Non-Isolated Applications up to 360 mA - **Page 24**



WELCOME TO THE HOUSE OF COMPETENCE

ENGINEERING | PRODUCTION | **GvA SOLUTIONS** | DISTRIBUTION

FLEXIBLE POWER

IS IN THE NATURE OF VARIS™!

VARIS™ – THE MODULAR CONVERTER SYSTEM

- Tested and ready-to-connect converters
- Cross-industry system solutions
- Scalable power through parallel connection
- Customizable
- Cooling method freely selectable
- Economic and sustainable through the use of standard components

GvA Leistungselektronik GmbH
Boehringer Straße 10 - 12
D-68307 Mannheim
Phone +49 (0) 621/7 89 92-0
VARIS@gva-leistungselektronik.de
www.gva-leistungselektronik.de

GvA Power Electronics

Viewpoint **4**
Merry Christmas

Events **4**

News **6-10**

Blue Product of the Month **12**
Win a TimeFlash Oscillator Programming Kit with 2 Socket Cards!
By Microchip

Guest Editorial **14**
GaN in Progress
By Girvan Patterson, GaN Systems

Technology **16-18**
IEEE Energy Conversion Congress and Expo—ECCE 2016
By Gary M. Dolny, Bodo's Power Systems

Market **20**
Awards for Energy and Automotive Innovations
By Roland R. Ackermann,
Bodo's Power Systems correspondent editor

Market **22**
CEOs Discuss Security and Safety Issues at Electronica
By Roland R. Ackermann,
correspondent editor Bodo's Power Systems

Cover Story **24-29**
Efficient, Reliable Power Solutions for Industrial and Consumer Applications
By Silvestro Fimiani, senior product marketing manager, Power Integrations

IGBT Modules **30-31**
The Rugged 62Pak IGBT Module Range Employing the Next Generation 1700V SPT++ Chip Set for 175°C Operation
By Sven Matthias & Vasileios Kappatos,
ABB Switzerland Ltd. - Semiconductors

Automotive Power **32-34**
Well Equipped for 48 Volts; *By Christoph Jehle, Epcos*

IGBT Modules **36-37**
Line-up Expansion of X-Series High Voltage IGBT Modules in the 3300 V Class
By Eugen Wiesner and Eugen Stumpf Mitsubishi Electric Europe B.V. and H. Uemura Mitsubishi Electric Corporation

Measurement **38-41**
Measuring Systems with High Accuracy and Work Speed
By Paul Semenov, Head of Automation Lab, R&D Center, Proton-Electrotex

New Products **42-48**

The Gallery

WÜRTH ELEKTRONIK

4power!

#redCUBE

WE speed up the future

embedded world Hall 3 Booth 359

REDCUBE terminals are the most reliable high-power contacts on the PCB level. Low contact resistance guarantees minimum self-heating. Four different designs cover all leading processing technologies and offer a wide range of applications.

www.we-online.com/redcube

- Flexibility in processing and connection technologies
- Highest current ratings up to 500 A
- Board-to-Board and Wire-to-Board solutions
- Extremely low self-heating
- Robust mechanical connection

REDCUBE PRESS-FIT

REDCUBE PLUG

REDCUBE SMD

REDCUBE THR

Bodo's Power Systems®

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

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

Junior Editor
Holger Moscheik
Phone + 49 4343 428 5017
holger@bodospower.com

Senior Editor
Donald E. Burke, BSEE, Dr. Sc(hc)
don@bodospower.com

UK Support
June Hulme
Phone: +44(0) 1270 872315
junehulme@geminimarketing.co.uk

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

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

circulation ASC audit since 09/2006 print run 24 000

Printing by:
Brühlsche Universitätsdruckerei GmbH
& Co KG; 35396 Gießen, Germany

Events

Smartsystemsintegration,
Cork Ireland, March 8-9
http://www.smartsystemsintegration.com

Embedded World 2017,
Nuremberg, Germany, March 14-16
http://www.embedded-world.de

EMC 2017,
Stuttgart, Germany, March 28-30
http://www.mesago.de/en/EMV/home.htm

APEC 2017, Tampa FL , March 26-30
http://www.apec-conf.org/

ExpoElectronica 2017,
Moscow Russia, April 25-27,
http://expoelectronica.primexpo.ru/en/

Merry Christmas,

At electronica in Munich I saw that our industry is very busy, and technology is continually improving. The development of WBG semiconductors, both SiC and GaN, has been the big new thing in recent years, and now it has reached the fine-tuning stage of getting a portfolio of products out to users. More and more designs are using these devices, as cost-of-ownership analyses show that cost is no longer a point of discussion.

I have been visiting the electronica for decades; first as a design engineer in the 70s, later in application marketing at the old Messe in the center of Munich, and now as a publisher and editor at the beautiful new location where the Munich Riem airport was once located. In the early years there were benches and chairs available at all hallway cross-overs and crossing points on the upper level. Now they are gone and it is a challenge for seniors to get through the day

without a rest. This year's electronica meant thirteen halls to and many kilometers to cover when one's interests are wide-ranging. Not only the seniors would say thank you for a place to sit and rest, but so would the young people sitting on radiators and on the floor.

How about having industry-sponsored benches, spread about at the intersections? That's my wish for Christmas - I do hope Santa is listening! My other wishes include peace and freedom in our world. Nature provides enough challenging disasters; we need not add man-made ones. Hopefully, the wisdom to respect people will be delivered to political leaders. And journalists must be free to report the truth. History has clearly shown that if a government is arresting editors, it is engaged in illegal activities that must be stopped by the people. The press must be free and independent.

I look forward to seeing you next year in March at the APEC in Tampa. Bodo's Power Systems reaches readers across the globe. If you are using any kind of tablet or smart phone, you will now find all of our content on the new website www.eepower.com. If you speak the language, or just want to have a look, don't miss our Chinese version: www.bodospowerchina.com

My Green Power Tip for December:
Use motion sensors if you illuminate your house for Christmas. When people come to visit, all the lights will turn on to full brightness and offer a welcome surprise! It will also save a lot of energy and help limit global warming.

Best Regards

ENERGY UNDER CONTROL

HO - A Range of Choices

A breakthrough in the tradeoff between performance, cost, size & mounting versatility. Whatever current you need to measure, mounting constraints or performance required, the HO current transducer range offers you the perfect solution.
6 families cover nominal currents from 2.67A to 250A, PCB-through-hole, surface-mount or multiple panel mounting versions, and offer an aperture or integrated primary conductor.
LEM ASIC technology brings Open Loop transducer performance closer to Closed Loop transducers, providing you with better control and increasing the efficiency of your system, but at a significantly lower price.

- Single +5V or +3.3V power supply
- Up to 8mm creepage and clearance + CTI 600 for high insulation
- Half the offset and gain drifts of previous generation
- Overcurrent detection on a dedicated connection
- Fast response time from 2.5 to 3.5µs
- Over-drivable reference voltage
- Fault reporting function
- Versatile panel mounting version (3 ways)
- -40 to +105°C operation

www.lem.com

At the heart of power electronics.

LEM®

Patent for Innovative SiC Module Switching Technique

AgileSwitch, LLC, innovator of intelligent IGBT and SiC MOSFET gate drivers, announces that it has “allowed patent claims” related to its proprietary ATOFF™ (Augmented Turn-Off)) switching technique. The firm expects the formal patent to be awarded within the next 60 to 90 days.

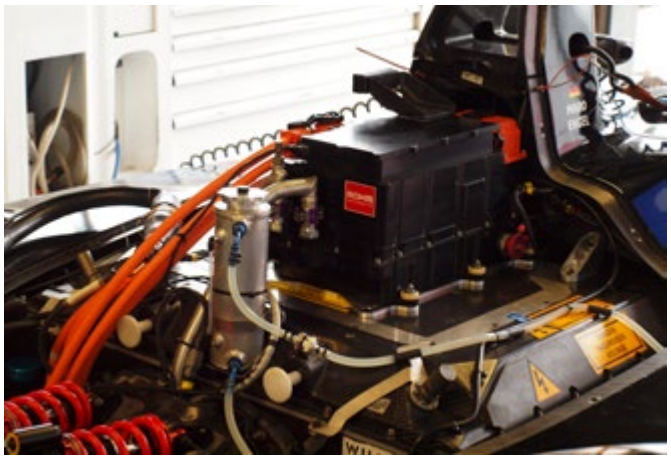
AgileSwitch’s Augmented Turn-Off technology addresses two significant impediments to the successful implementation of Silicon Carbide modules in high-power applications. By reducing turn-off spikes and ringing both under normal operation as well as short-circuit (DSAT) conditions, SiC MOSFET modules can be operated in the higher frequencies that enable dramatic increases in power conversion density. (A whitepaper describing the performance improvements attained using ATOff is available for download.)

The ATOff technology has been incorporated into AgileSwitch’s first SiC gate drive assembly. The software configurable EconoDual Electrical Master 3 (EDEM3) is optimized for driving SiC MOSFETs, currently offered by ROHM, up to 1200V. The EDEM3 provides up to 15 Amps of peak current at an operating frequency up to 100 kHz. The driver includes isolated HI and LO Side DC/DC converters and monitors seven fault conditions that are reported as a combination of the three fault lines via the 20 pin control header.

www.agileswitch.com

Introduces SiC Technology into Formula E

ROHM Semiconductor presented its cutting-edge silicon carbide (SiC) technology at the first race of the new 2016/2017 Formula E season in Hong Kong. At the start of season three, the leading Japanese semiconductor manufacturer started sponsoring and officially partnering with the Venturi Formula E team. The exciting collaboration between ROHM and Venturi in Formula E highlights the key to success in the all-electric racing series – power management. The challenge of Formula E is to find the most efficient way of using the energy provided by the battery and applying it on the road. To do this, ROHM developed new power device technology using silicon carbide. This material can withstand much higher electric fields than conventional silicon, which results in extremely low losses of power and higher temperature resistance. Thus, ROHM and Venturi hope to gain an edge over the competition while also pushing forward the development of new technical solutions to increase power conversion efficiency.



The inverter for season three features embedded SiC Schottky diodes, making it 2 kg lighter than the inverter for season two. Electric efficiency has been increased by 1.7%, while the volume of heat extraction components has been reduced by 30%. But this is just a start. In season four, the SiC MOSFET integrated inverter will demonstrate drastic changes once again.

http://rohm.com/fe/

Agreement Supplying SiC Cascode Devices into 10kW Battery Chargers

The Micropower Group, a global supplier of battery chargers for automotive, material handling, and floor cleaning equipment, has finalized an agreement with United Silicon Carbide Inc (USCi), an innovative leader in Silicon Carbide (SiC) components, to begin receiving production shipments of USCi’s breakthrough Silicon Carbide Cascode devices.

Micropower uses USCi’s innovative SiC Cascodes for industrial battery chargers, enabling higher efficiency, smaller system size and cost reduction without having to change the gate drive requirements. Through this agreement, USCi will supply Micropower Group’s production facility located in Växjö, Sweden with SiC Cascode devices. These devices will be used in a family of new 10kW battery chargers that are capable of charging both traditional Lead-Acid and state of the art Lithium batteries. “We selected USCi SiC Cascodes because we could gain up to 1.5% higher efficiency, are able to get 30% more power from a given system size and its standard gate drive capability was crucial to be able to drop in replace from a conventional Si device and its gate driver requirement” says Magnus Pihl who is R&D Project Manager at Micropower AB,” further the cascode has been proven to be very robust in our field test”.

“With the industry’s lowest RDS,ON per area and an integrated body-diode with an unmatched, close to SiC Diode performance our cascode technology has significant advantages in performance and increasing efficiency”, explains Christopher Rocneanu, Director Sales EMEA at USCi. ”As one only drives a low voltage Si MOSFET, our devices enable designers to save cost using standard gate drivers with no penalty in performance. At the same time we have the only device in the world which supplies cutting edge SiC performance while being dual source capable to both Si and SiC devices.”

www.micropower-group.com

www.UnitedSiC.com

Architects of Modern Power Releases Standard for High Power Bus DC-DC Converter

The Architects of Modern Power® (AMP Group®) consortium announced a standard aimed to keep designers of high-performance datacom and telecom equipment one step ahead as cloud computing and IoT continue to drive power density and power requirements higher. Initially supporting 1 kW of output power, the 'HPABCqbAMP™' standard establishes common mechanical and electrical specifications for high power advanced bus dc-dc converters in distributed power systems.

The new 'HPABCqbAMP' standard builds upon the previously released "ABCebAMP™' and 'ABCqbAMP™' that defined standards for eighth brick and quarter brick advanced bus modules ranging from 264 to 300 W and 420 to 468 W, respectively. Measuring 58.42 x 36.83 mm, the 'HPABCqbAMP' standard occupies the same board space as a standard quarter brick converter. The new specification defines the mechanical and electrical specifications for analog and digital versions, as well as compatible software configuration files for the digital version. The first products to meet with this new 'HPABCqbAMP' standard will be announced by AMP Group members early next year.

The AMP Group is an alliance formed in 2014 between CUI, Ericsson Power Modules and Murata to define a true multi-sourced, high performance power ecosystem for distributed power architectures. AMP Group members have set out to agree upon common mechanical and electrical specifications for their products, including standardization of monitoring, control and communications functions, as well as common configuration files for plug-and-play interoperability between modules from each firm.

www.cui.com

www.murata.com

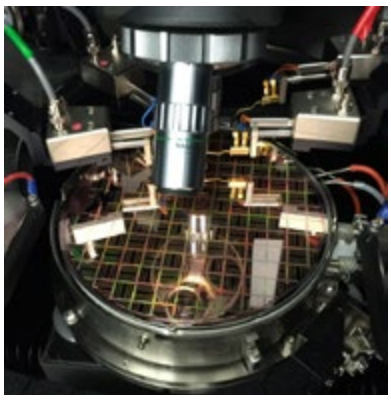
NXP has agreed to be acquired by Qualcomm

The combining of NXP into Qualcomm is based on compelling strategic logic that brings together two highly successful and complementary businesses to create a premier semiconductor industry leader. With unique leadership positions in Wireless technologies, Security and Processing, the union is ideally positioned to address the emerging trends of ADAS and Autonomous Vehicles, the Internet of Things (IoT) and the 5G revolution.

The combined company is expected to have annual revenues of more than $30 billion, serviceable addressable markets of $138 billion in 2020 and leadership positions across mobile, automotive, IOT, security and networking segments.

http://investors.nxp.com/

Fabrication of First Double-Sided B-TRAN™ Power Semiconductor Devices



Ideal Power Inc., announced that its semiconductor foundry partner has successfully completed the fabrication of prototypes of Ideal Power's Bi-Directional Bi-Polar Junction TRANsistor (B-TRAN™). Ideal Power holds over 20 patents on the B-TRAN™ including patents on the unique double handle wafer process that was used to produce the initial devices.

Due to its anticipated low conduction and switching losses, Ideal Power believes that the B-TRAN™ has the capability to improve the efficiency of a range of power control and conversion equipment, such as variable frequency drives, solar PV inverters, bi-directional energy storage and microgrid power conversion systems, electric vehicle drivetrains, solid-state DC and AC contactors, and other power conversion products. IHS Technology projects that the power semiconductor market will be over $20 billion by 2019. Ideal Power expects the performance advantages of B-TRAN™ to enable it to address a significant portion of the power semiconductor market that currently relies on power semiconductor devices such as Integrated-Gate Bipolar Transistors (IGBTs).

www.IdealPower.com

Combining Power and Simplicity in Intelligent

Motion-Control Device for Smart Industry and High-End Consumer Electronics

STMicroelectronics, a global semiconductor leader serving customers across the spectrum of electronics applications, is accelerating smart industry, also known as smart manufacturing or Industry 4.0, with a powerful single-package device for intelligent motor control.

ST's new STSPIN32F0 motor-control system-in-package combines the power and flexibility of a microcontroller-based drive with ease of use and space efficiency. Target applications include smart-manufacturing equipment, power tools and cooling fans, as well as emerging high-tech product categories such as drones, small robots, and home appliances containing high-efficiency motors, such as high-performance portable vacuum cleaners or air purifiers.

"Designers of Industry 4.0 and high-end consumer electronics systems need freedom to optimize their motor-control strategy, as well as high processing performance to enable autonomous operation with minimal intervention from a central controller," explained Domenico Arrigo, General Manager, Industrial and Power Conversion Division, STMicroelectronics. "The STSPIN32F0 makes these qualities accessible in a convenient and space-efficient system-in-package, taking advantage of the power-control libraries and algorithms available from our uniquely rich STM32 ecosystem to streamline and simplify the development of intelligent and highly-featured precision motion controls."

www.st.com/stspin

Alpha Launches New tensoRED™ Master Tensioning Frame

Alpha Assembly Solutions, the world leader in the production of electronic soldering and bonding materials, is pleased to announce the launch of its new tensoRED™ Master Tensioning Frame, the latest development in Alpha's range of state-of-the-art printing stencils. ALPHA® tensoRED™ Master Tensioning Frame has been specially designed to enable a higher and more even tension compared to ALPHA® tensoRED™. Due to its innovative design, no air pressure on the frame is needed, resulting in significantly reduced maintenance costs and improved reliability.

"This new Master Tensioning Frame delivers a more even tension," said Donald Corlett, General Manager for the Stencils division of Alpha Assembly Solutions, part of the MacDermid Performance Solutions group of businesses, "Which results in less paste smearing, as well as reduced variation and improved positional alignment on volume deposits, compared to ALPHA® Tetra Master Frame."

ALPHA® tensoRED™ requires a minimum of 1 loading station per customer and is available in common printer sizes and additional adaptors that configure smaller frame sizes to fit into full 29" printer openings. ALPHA® tensoRED™ can be used with a number of ALPHA® stencil products, including ALPHA® Precision Milled Stencils, ALPHA® Cut, ALPHA® Nickel-Cut and ALPHA® Form.

http://alphaassembly.com/Products/Stencils

Gene Sheridan Presented CEO Keynote at Prestigious IEEE Event

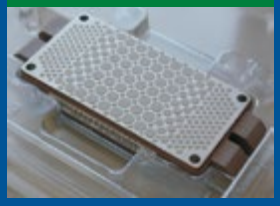
Navitas CEO presented Navitas AllGaN™ Power IC key advantages of high-frequency, high-density and energy savings at the 4th IEEE workshop on Wide Bandgap Power Devices and Applications (WiPDA 2016) of the world's first Gallium Nitride (GaN) Power ICs, using its proprietary AllGaN™ technology, at the IEEE Power Electronics Society 4th IEEE Workshop on Wide Bandgap Power Devices and Applications (WiPDA).

The conference was held from November 7–9, 2016, at The Chancellor Hotel, Fayetteville, Arkansas, USA. Navitas presented a keynote entitled 'Speed Drives Performance' at 9AM Wednesday, November 9, 2016. A Navitas technical paper "650V AllGaN™ Power IC for Power Supply Applications" (1068) was presented later the same day by the company's Vice-President of IC Design, Marco Giandalia. WiPDA provides a forum for device scientists, circuit designers, and application engineers from the Power Electronics and Electron Devices Societies to share technology updates, research findings, development experience and potential applications.

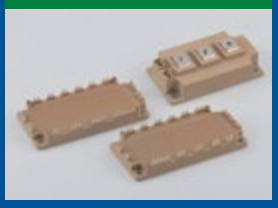
http://navitassemi.com

Season's Greetings

Pre-applied Thermal Interface Material (TIM)



Hybrid IGBT-Modules with SiC Schottky FWD



All- SiC Modules 2 in 1 with SiC MOS-FET & SiC Schottky FWD

New

IGBT-Modules for 3-Level inverters

PIM with Solder-pins and PressFit contacts

6-Pack IGBT-Modules, Solder-pins and PressFit contacts

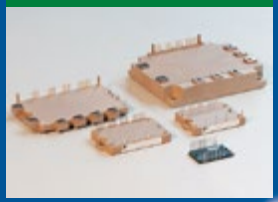
2-Pack IGBT-Modules, with Spring- , Solder- & PressFit contacts

Standard 1- & 2-Pack IGBT-Modules

High Power Modules 1200V, 1700V & 3300V

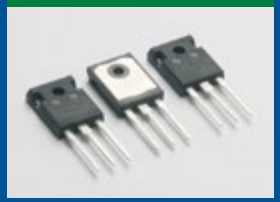
High Power Modules 2-Pack & Chopper

I P M Intelligent Power Modules

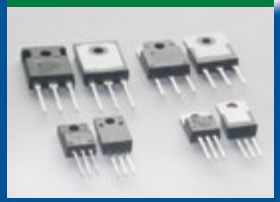


Chopper Modules & High Speed IGBTs

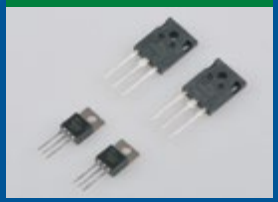
Discrete IGBTs, standard and Reverse Blocking IGBT



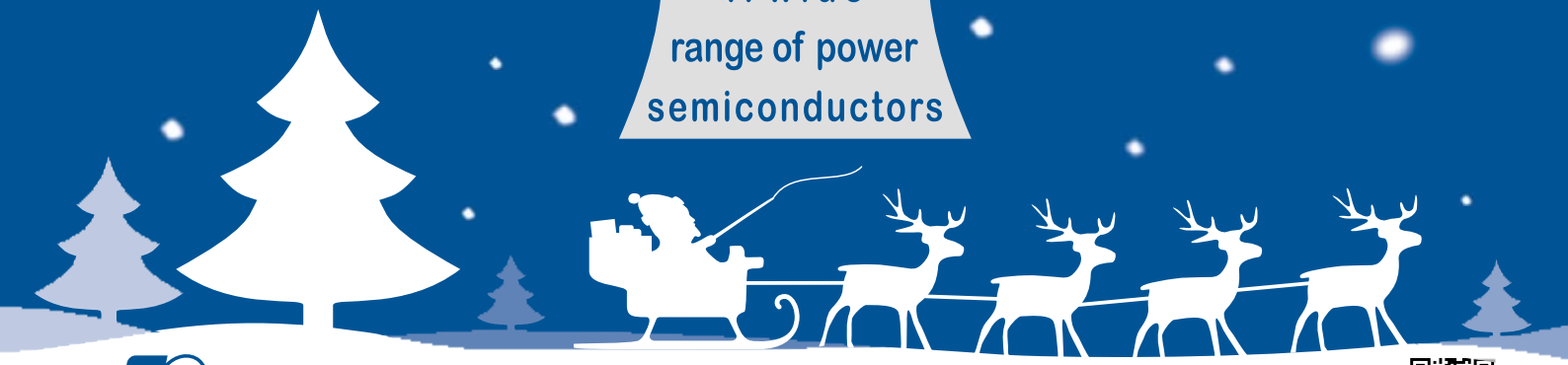
Super Junction MOSFETs with & without FRED



SiC Schottky Barrier Diodes



A wide range of power semiconductors



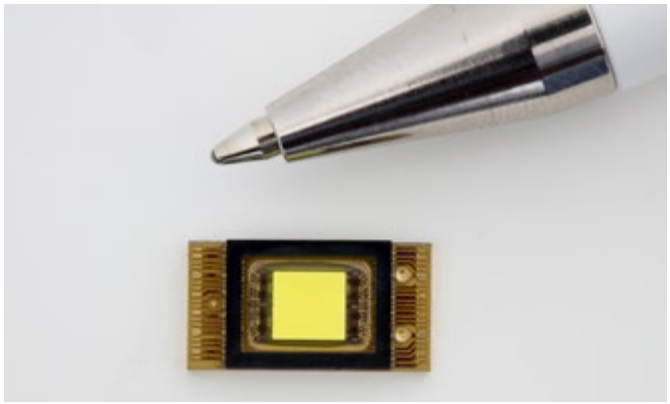
Fuji Electric
Innovating Energy Technology

Fuji Electric Europe GmbH
Goethering 58
63067 Offenbach/Main-Germany

Fon +49(0)69-66 90 29 0
info.semi@fujielectric-europe.com
www.fujielectric-europe.com

Automotive Lighting Revolutionizes Road Safety

A German research alliance with well-known members from industry and research has developed the basis for smart, high resolution LED headlights, which takes adaptive forward lighting to a new dimension.



The demonstration model was developed by overall project manager Osram in collaboration with the project partners Daimler, Fraunhofer, Hella and Infineon. Both headlights contain three LED light sources, each with 1,024 individually controllable light points (pixels). This means that the headlight can be adapted very precisely to suit the respective traffic situation to ensure optimum light conditions at all times without dazzling other drivers. The light can be adapted to take account of every conceivable bend in the road so that there are no dark peripheral areas. In addition, with the aid of sensors in the vehicle, the surroundings can be analyzed in order to illuminate oncoming traffic. This allows the driver to see these vehicles more clearly. At the same time, the beam of light does not shine on the heads of oncoming drivers, which means they're not dazzled. As a result, such shifting headlights no longer have to be dimmed on country roads.

www.osram.de

Focus on Product Design for the Accelerating Wireless Charging Market

JJPlus Corporation and Efficient Power Conversion Corporation (EPC) announce their design collaboration for innovative wireless charging designs. In an effort to address the recently announced Taiwan wireless power standards organization's announcement of adopting AirFuel™ Alliance's resonant wireless charging standard, JJPlus Corporation and Efficient Power Conversion Corporation announce their collaboration to design GaN-based wireless power solutions. In addition to the Taiwan initiative, these designs will have application for wireless charging systems worldwide.

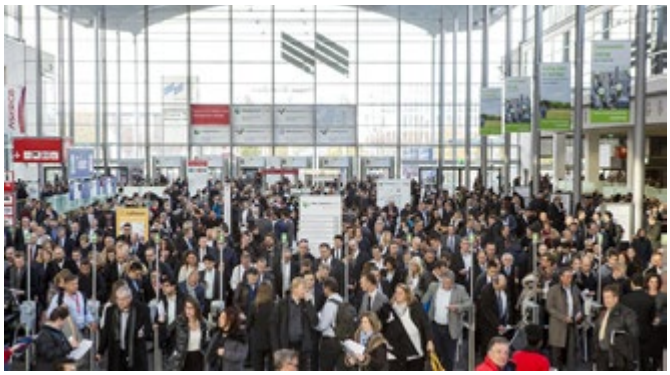
The AirFuel™ Alliance, a global consortium of industry leaders focused on enabling and accelerating the adoption of wireless power technology, recently signed a Letter of Intent with the Taiwan Association of Information and Communication Standards (TAICS), to establish a wireless charging ecosystem in Taiwan through the introduction of AirFuel's resonant technology standard. Jeff Shu, General Manager of JJPlus Corporation said, "We are excited to partner with EPC in the design and implementation of innovative wireless power solutions.

www.epc-co.com

www.epc-co.com.tw

Internet of Things Revolutionizing the Electronics Industry

In keeping with the motto "Connected Worlds—Safe and Secure," electronica, the largest electronics trade fair in the world, took place in Munich from November 8–11. A total of 2,913 companies from more than 50 countries presented their solutions for this sector. They used the industry gathering to network with approximately 73,000 visitors and dialog with professionals from around the world.



According to Falk Senger, Managing Director at Messe München: "This year's electronica did an impressive job of demonstrating how the various aspects of our lives will network with one another in the future and redefine our everyday lives. What we have seen is revolutionary." Kurt Sievers, Chairman of electronica's Technical Advisory Board, European Vice President and General Manager Automotive, NXP Semiconductors, adds: "Smart technologies and applications make it vital for new security solutions to keep up with this development. Security by design is an important guiding principle for the industry." "It will play a key role in the future," explains Christoph Stoppok, Managing Director of the Electronic Components and Systems Division and the PCB and Electronic Systems Division of the ZVEI (German Electrical and Electronic Manufacturers' Association).

The next electronica takes place in Munich from November 13–16, 2018.

http://electronica.de/

Win a TimeFlash Oscillator Programming Kit with 2 Socket Cards!

Win the Microchip TimeFlash Oscillator Programming Kit with 2 Socket Cards (DSC-TIMEFLASH-KIT2) from EPE!

The TimeFlash programmer allows users to rapidly program Microchip's field programmable MEMS oscillator to a custom frequency in seconds, minimizing design time by enabling fast prototyping and testing. Microchip's MEMS oscillators are available in industry standard packages that are drop-in replacements to standard crystal oscillators.

Includes socket cards in 2 different sizes: 3.2 x 2.5 mm and 2.5 x 2.0 mm. Some of the features include: custom frequencies in seconds with immediate design verification, support for all Microchip MEMS oscillator package sizes, support for CMOS, LVPECL, LVDS, and HCSL output types and easy to use interface with auto software update.

The TimeFlash kit supports Microchip's new DSC6000 family of MEMS oscillators which are the industry's smallest MEMS MHz oscillators with the lowest power consumption over full frequency range of 2 KHz to 100MHz.

The single-output DSC6000 MEMS oscillators are excellent choices for use as clock references in small, battery-powered devices such as wearables and Internet of Things (IoT) devices in which small size, low power consumption, and long-term reliability are paramount. The TimeFlash field programming kit provides instant frequency generation by fusing the One-Time Programmable (OTP) memory in a blank DSC6000.

For your chance to win a Microchip TimeFlash Oscillator Programming Kit with 2 Socket Cards, visit the website and enter your details in the online entry form:

www.microchip-comps.com/bodo-dsc6000

NEWS FLASH

USCi
United Silicon Carbide, inc.

+

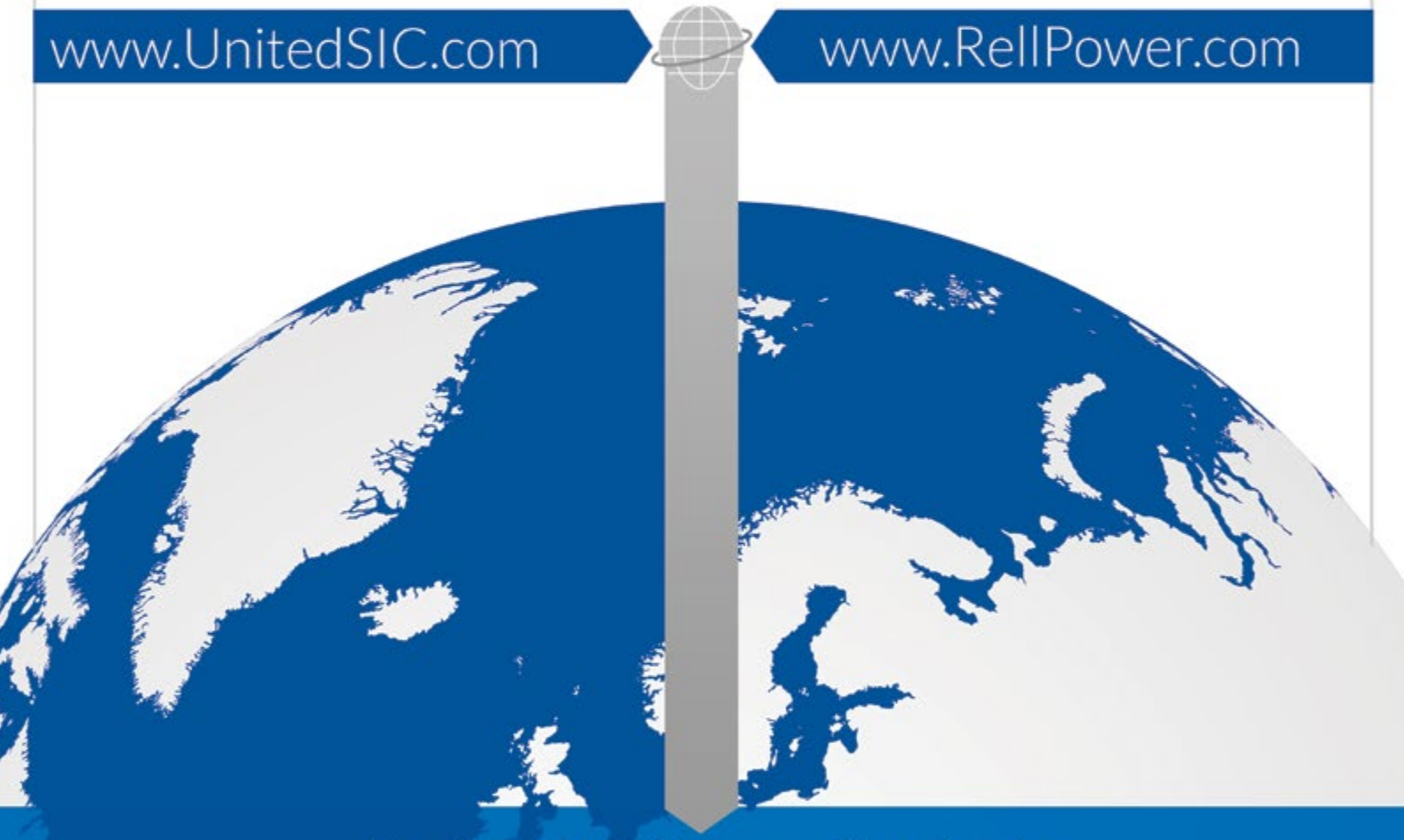
Richardson Electronics
POWER & MICROWAVE TECHNOLOGIES

Amazing Silicon Carbide Products

Global Provider of Engineered Solutions

www.UnitedSIC.com

www.RellPower.com



United Silicon Carbide
The Power to Do More ...
With Less

Now Available **EVERYWHERE**

Find out more at www.UnitedSIC.com | sales@unitedsic.com

Looking Back and Forward on 10 Years with GaN Systems

By Girvan Patterson, GaN Systems

Back in the dark days after the internet bubble burst, Nortel had demised, and high tech in Canada's Silicon Valley North was in the doldrums. The idea of starting a semiconductor company based on an unknown technology probably seemed an insane idea. But that's exactly what my partner John Roberts and I did. John was a fifty year veteran of the semiconductor business; I a serial entrepreneur with some half-dozen start-ups and IPOs to my credit. Recognizing those were our strengths and we weren't about to learn new ones at this stage in our careers, we created GaN Systems. That was nearly ten years ago, and this September John and I announced our retirement from the company that has become the leader in gallium nitride power transistors.

What an amazing journey – not only building the company, but watching an entirely new technology evolve and become an established part of the power electronics world. Our timing was right. The world was awakening to the need for more efficient power management – the cleantech revolution was underway. The need for new core-enabling technologies – batteries, storage systems, more efficient electronics was evident. We saw the potential for wide bandgap technology to move from LEDs and RF applications to power switching devices – if only the design challenges could be overcome. And what challenges they turned out to be! Only a career overcoming the hurdles of high tech development (and funding!) gave us the vital element of perseverance to keep pursuing the goals.

I'm often asked how a small unfunded semiconductor start-up in Canada could rise to the position of the pre-eminent supplier of a new technology in a field dominated by giants. I believe there are three main reasons. First, we approached the problem with a clean sheet of paper. We had no CMOS design heritage to adapt, no foundry to keep busy – just a lifetime of semiconductor knowledge to bring to bear. We quickly realized traditional layouts simply couldn't handle the currents and switching speeds that gallium nitride portended. The result was our Island Technology, which solved all the problems of electromigration, inductance, scalability and yield. Later on we overcame the inductive limitations of traditional packaging by introducing our innovative embedded packaging, GaNPX – a bold move for a young start-up.

Second, we had access to a wide bandgap foundry - a rarity in those days. Operated by our local National Research Council labs and acquired from the ashes of Nortel, it offered a small, three inch GaN-on-SiC capability accompanied by a wealth of cooperative expertise. And third, the people. Out of chaos comes opportunity - high tech had collapsed in the area – but had left behind a wealth of technologists only too happy to be involved in something new and exciting. We were joined by material scientists, semiconductor process engineers, R&D directors and product managers of a caliber and experience a start-up could only dream of attracting. My role as CEO was easy – simply to provide the happy corporate environment to allow these great people to deliver their best – and they did!

Of course with any new technology there were naysayers, convinced that all we were attempting was impossible – defects would kill the devices, lateral devices couldn't handle high currents, etc. Fortunately imagination and perseverance exists to defeat such views. A lot of time in the early years was on missionary work – explaining to anyone who would listen about the potential of gallium nitride. It was during this time that I came to meet my peers and fellow industry evangelists – Alex at EPC, Umesh and Primit at Transphorm, AJ and Dan at RFMD, – never really competitors, more collegial advocates of GaN's future. I met visionary editors too, especially Bodo, who believed in GaN as a future technology and creatively aided the awareness process. It's been a great and rewarding experience working alongside these folks – people with a lifetime of experience in power semiconductors – which I didn't have - a spirit I've not encountered in my previous technologies.

As well as good device design, we had to build the supply chain to deliver the goods. Here too, the missionary work continued, persuading suppliers they needed to be on board when GaN arrived. Our early devices were normally-on GaN-on-SiC, followed by cascode development. But it was our partnership with TSMC, initiated some four years ago, that brought us to the point in 2014 where we launched into distribution the industry's first family of normally-off, high-current GaN-on-Si devices.

Since that launch, the rate of increases in GaN applications has been amazing to watch. By 2016 we were seeing commercial systems where GaN has enabled reductions of 4-10x in power system size, weight and power loss. The really exciting part has been the emergence of undreamed of applications enabled by GaN. We knew all along that as well as the obvious applications, GaN would trigger the imagination of bright application engineers and produce innovative new topologies and end-products undreamed of when we started. Today, we see this occurring in industrial, datacenter, consumer and particularly in automotive markets. This is one of the most rewarding aspects of what we have achieved. Our accomplishments were epitomized in the memorable day spent at the Google Little Box Challenge finals – eventually won by CE+T's Red Electrical Devils team who used our devices to design the tour de force inverter which produced a power density of 143 W/cubic inch in a mere 14 cubic inches.

With the launch of our product family in 2014 it was time to transition the company to a full-scale semiconductor manufacturer, and again, with the backing of our unstintingly supportive VCs, we brought in the world-class team that would head this up. The company is in great hands for the future.

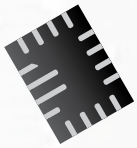
It has been an amazing journey, watching an entire new technology come from concept to full realization. John and I leave it with a mélange of emotions that range from the satisfaction of what has been achieved, to the excitement as we watch future applications unfold and see that we really did contribute to global conservation.

www.gansystems.com

Low Iq? Longer Life!

36V, 3.5A, Low Quiescent Current Synchronous Step-Down Converter

MPQ4430-AEC1



3mmx4mm
QFN-16

Key Highlights

- Wide 3.3V to 36V Input Range
- 10μA Sleep Mode Quiescent Current
- High Efficiency 2.2MHz Synchronous Operation: >93 at 1A (12V Vin, 5V Vout)
- 350kHz to 2.5MHz Programmable Switching Frequency
- Also Available in 1A, 2.2A and 3A pin-equivalent Versions
- Compact 3mmx4mm QFN-16, Optional Wettable Flank
- AEC-Q100

Applications

- Automotive Infotainment / Head Unit
- Automotive Telematics
- Industrial Power Systems

MonolithicPower.com

Follow us:

MPS®
Simple, Easy Solutions™

IEEE Energy Conversion Congress and Expo—ECCE 2016

ECCE, the foremost IEEE conference in the field of electrical and electromechanical energy conversion provided an international audience the opportunity for exchange of technical knowledge, networking, and exposure to the latest technology trends.

By Gary M. Dolny, Bodo's Power Systems, gary.dolny.us@ieee.org

The 2016 IEEE Energy Conversion Congress and Expo, ECCE, took place from September 18-22 at the Milwaukee Convention Center, Milwaukee, WI, USA, in the heartland of North America's electric drive and electrical equipment industry. ECCE is co-sponsored by the IEEE Power Electronics Society (PELS) and the IEEE Industry Applications Society (IAS) and is considered the world's leading conference and technical exposition in the field of energy conversion. The ECCE presented its usual perspective of the industry with emphasis on integrated systems and topics on contemporary energy conversion as well as discussion of innovations from the more fundamental components. The topics were wide-ranging, and included power converters, motors and motor drives, renewable energy, smart-grid, lighting and power semiconductor devices.

General Chairman John Shen, opens the 8th annual ECCE

The 8th annual ECCE continued its tremendous growth both in the number of attendees and in the number of technical papers submitted for review. A record high of 1650 attendees participated in this year's conference while the 1717 digests submitted exhibited a 10% increase over the previous mark set in 2015. From these, the conference committee selected a total of over 925 papers for presentation which were organized into 16 parallel tracks of oral sessions each day and 3 poster sessions. This represented a competitive acceptance rate of 53.9% and ensured a program full of high-quality submissions.

The conference had strong international participation with over 42 countries from around the world represented; 49% of the attendees were from North America, 30% from Asia, 17% from Europe and 4% from other areas of the world.

In addition to the peer-reviewed technical sessions the conference featured interactive Town Hall Forums, Student Demonstrations and Special Panel Sessions consisting of invited presentations. There was also a full day of tutorials offering in-depth discussion of state-of-the-art topics presented by world-class experts in the field on the Sunday prior to the conference opening.

The Town Hall Forums were described by conference organizers as a public forum to discuss topics that are state-of-the-art, forward looking, controversial and motivate creative and innovative thinking. This year's forum topics focused on the internet of things and the new frontier of the grid.

The Special Session Topics emphasized Simulation and Modeling of Power Electronics, Cyber Security of the Grid, SiC Power Devices, Advanced Electric Machines and the Water Energy Nexus.

To complement the rich technical program, ECCE offered numerous opportunities for professional networking. The Sunday night opening reception was held at Milwaukee Art Museum with its landmark architecture and great view of Lake Michigan. Wednesday evening featured an Oktoberfest themed banquet to celebrate Milwaukee's German Heritage and beer brewing history.

Wide-bandgap (WBG) semiconductor devices were a major topic at this year's ECCE. Both SiC and GaN devices and applications were featured in many conference sessions, as well as a special session devoted to the use of SiC MOSFETS for industrial applications. Conference General Chairman, Professor John Shen of Illinois Institute of Technology noted that historically the wide-bandgap themed sessions are some of the most highly attended at ECCE.

High-voltage SiC MOSFETS, IGBTs and modules at 10-15kV for grid-connected inverters received considerable attention. Because of the lack of commercially available devices at these voltages most of the research efforts focused on series connected lower voltage devices, typically 1.7-3.3kV. The key to these designs is to develop dynamic voltage sharing techniques to minimize the effects of mismatches in the device characteristics and gate signals. Various approaches were discussed including simple RC snubber networks [1-2] and a Supercascode structure [3].

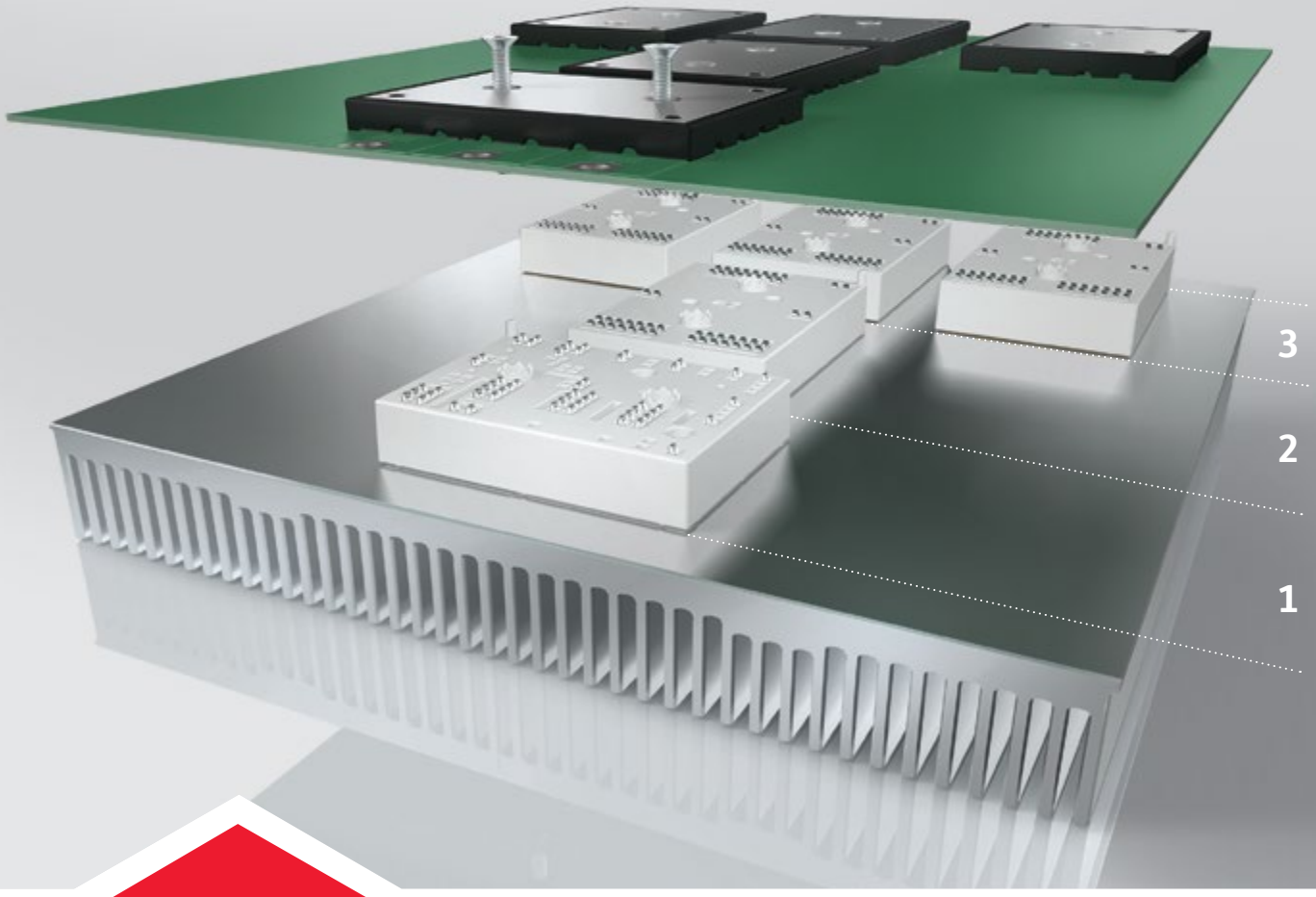
As SiC becomes more mature, and moves into more mainstream applications, reliability and robustness become a greater concern. This was reflected in a number of presentations addressing reliability issues from basic material through devices to full systems. At the basic materials level, the University of Warwick presented a study of the impact of triangular defects on the performance of SiC PiN diodes [4]. The defects were attributed to both substrate issues as well as epitaxial growth conditions. They showed that the presence of these defects could raise leakage currents by up to 6 orders of magnitude and result in soft-breakdown characteristics. A collaboration between

SEMIKRON
innovation + service

MiniSKiiP®

One Concept – Scalable without Compromise

Solutions from 2kW to 90kW



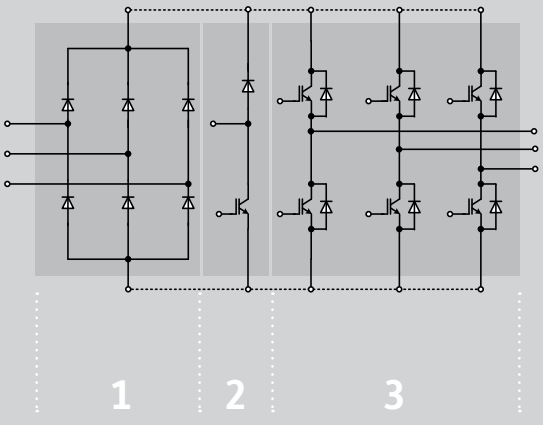
Scalable without compromise, from input to output

Major system cost savings with less material used compared to standard baseplate solutions

Compact inverter design replacing copper bus bars with high power PCBs

Full drive solution from rectifier to inverter output, including brake chopper

One PCB concept, scalable from 2kW to 90kW



www.semikron.com

shop.semikron.com

Aalborg University, Aalborg Denmark and ABB Corporate Research, Västerås, Sweden studied the reliability of SiC MOSFETS from a user perspective [5]. They studied both the electrical characteristics of the die and also the package properties of the modules under a variety of standard reliability tests including high-temperature reverse bias, high-temperature gate bias, thermal cycling and high temperature, humidity, reverse bias. Although the sample sizes were small, they concluded that most devices tested showed adequate tolerance to the stress conditions, although there was some significant variation observed between their samples.

Robustness of wide-bandgap devices against short circuit stresses was addressed in a number of presentations. The University of Berlin, Berlin, Germany benchmarked 600V GaN HEMTS against Si and SiC Power MOSFETs for robustness in short-circuit mode [6]. Their measurements showed that the Si and SiC MOSFETs were capable of withstanding short-circuit times up to 13µs at 400V and 150°C, while the normally-off and cascode GaN devices demonstrated considerably less withstand capability. The University of Aalborg, Aalbog Denmark studied the short circuit safe operating area (SCSOA) of SiC power MOSFET modules and concluded that two separate failure mechanisms contribute to device degradation under short circuit conditions [7]. The first mechanism results in excess drain-to-source leakage and is attributed to a local fusion of the surface metal as a result of the high energy dissipated during the event. The second mechanism occurs at the gate terminal and is attributed to degradation of the gate oxide due to high gate leakage currents exacerbated by the high-temperatures that occur during the short circuit stress.

ECCE attendees enjoy the exhibit hall reception.

A number of presentations were devoted to the growing field of electric vehicle (EV) applications. The University of Hannover, Hannover Germany, designed, tested and implemented a 60kW SiC traction inverter for electric vehicle systems combined with a boost DC-DC converter [8]. The system was switched at >40kHz. A number of innovative solutions were discussed to enable plug-in hybrid EV applications in which the coolant temperatures can be as high as 105oC. In addition, the total chip size was reduced by a factor of four compared to a silicon solution with comparable power rating. The University of North Carolina, Raleigh NC USA presented a high-efficiency charger for plug-in EV applications using off-the shelf SiC components [9]. Their system showed a 9 times reduction in volume and a 6 times reduction in weight compared to the current state-of-the-art. A collaboration between Nanjing University and Southeast University, Nanjing, China presented a prototype 1MHz/2kW 330V/12V DC-DC converter based on GaN transistors for EV applications [10]. A two-staged converter consisting of buck and multi-phase interleaved LLC-SRC was chosen as the main topology. Arizona State University, Tempe, AZ, USA and Texas Instruments, Phoenix, AZ, USA demonstrated a GaN based active clamp 2.2 MHz buck converter for automotive point-of-load applications [11]. The converter implements zero-voltage switching for both the main and auxiliary switches to achieve both low EMI and high-efficiency operation. Peak efficiencies of 91.8% to 93.2% were obtained at 12V input, 5V output and 2.2 MHz switching frequency.

Several presentations were concerned with a comparison between GaN, SiC and Silicon for various circuit topologies and applications. Texas A&M University, College Station, Texas, USA presented a comparison between GaN and SiC Quasi-Z--Source multiphase inverter for photovoltaic applications [12]. Their results showed that the front end isolated converter has a higher efficiency when using the GaN devices. Stanford University, Stanford, CA, USA did a comparison of GaN vs SiC devices in a 6.78MHz, 2.2 kW resonant inverter for wireless power applications [13]. A single-ended 2-phase inverter with 1200V SiC MOSFETs had a 93% efficiency with 400V input while a push-pull inverter with two 650V GaN FETs showed 96% efficiency at 200V input.

The 2017 ECCE will be held from October 1-5, 2017 at the Duke Energy Convention Center in Cincinnati, OH, USA. According to the conference website ECCE 2017 will be the co-location of ECCE with the IEEE IAS Annual meeting. Attendees will be able to choose to register for ECCE alone, or to jointly register for ECCE and the IAS Annual Meeting at a reduced combination rate. Additional information can be found on the ECCE 2017 conference website:

http://www.ieee-ecce.org/2017/

References

[1] K. Vechalapu, S. Bhattachrya, “Performance comparison of 10 kV-15 kV high-voltage SiC modules and high voltage switch using series connected 1.7 kV LV SiC MOSFET Devices”, Proceedings of ECCE 2016, paper EC-1703

[2] K. Vechalapu, A. Negi, S. Bhattachrya, “Performance evaluation of series connected 15 kV SiC IGBT devices for MV power conversion systems”, Proceedings of ECCE 2016, paper EC-1163

[3] X. Song, A. Q. Huang, L. Zhang, P. Liu, X. Ni, “15kV/40A FREEDM supercascode: A Cost Effective SiC High Voltage and High Frequency Power Switch”, Proceedings of ECCE 2016, paper EC-0834.

[4] Y. Bonyadi, P. Gammon, R, Bonyadi, O. Alatise, J. Hu, S. Hindmarsh, P. Mawby, “The impact of triangular defects on electrical characteristics and switching performance of 3.3kV 4H-SiC PiN diode”, Proceedings of ECCE 2016, paper EC-0903.

[5] V. D. Karaventzas, M. Nawaz, F. Iannuzzo, “Reliability assessment of SiC power MOSFETs From the end user’s perspective”, Proceedings of ECCE 2016, paper EC-0091.

[6] N. Badawi, A. E. Awwad, S. Dieckerhoff, “Robustness in short-circuit mode: Benchmarking of 600V GaN HEMTs with power Si and SiC MOSFETs”, Proceedings of ECCE 2016 paper EC-0791

[7] P. D. Reigosa, H. Luo, F. Iannuzzo, F. Blaabjerg, “Investigation on the short circuit safe operation area of SiC MOSFET power modules”, Proceedings of ECCE 2016, paper EC-0554

[8] A. Merkert, J. Müller and A. Mertens, “Component design and implementation of a 60 kW full SiC traction inverter with boost converter”, Proceedings of ECCE 2016 paper EC-0668

[9] S. Srdic, X. Liang, C. Zhang, Wensong Yu, S. Lukic, “A SiC-based high-performance medium-voltage fast charger for plug-in electric vehicles”, Proceedings of ECCE 2016 paper EC-0711

[10] Z. Pang, X. Ren, J. Xiang, Q. Chen, X. Ruan, W. Chen, “High-frequency DC-DC converter in electric vehicle based on GaN transistors”, Proceedings of ECCE 2016, paper EC-1348

[11] C. Nan, R. Ayyanar, Y. Xi, “A GaN based 2.2 MHz active-clamp buck converter for automotive applications” Proceedings of ECCE 2016, paper EC-1114

[12] Y. Liu, B. Ge, H. Abu-Rub, H. Zhang, R. S. Balog, “Comparison of SiC and GaN devices for front-end isolation of quasi-Z-source cascaded multilevel photovoltaic inverter”, Proceedings of ECCE 2016, EC-1065

[13] J. Choi, D. Tsukiyama, J. Rivas, “Comparison of SiC and eGaN devices in a 6.78 MHz 2.2 kW resonant inverter for wireless power transfer” Proceedings of ECCE 2016, paper EC-0807

STSPIN32F0: 32-bit MCU-based BLDC motor driver

A three-phase, half-bridge gate driver and a 32-bit MCU integrated in a 7x7 mm QFN package

KEY FEATURES AND BENEFITS

- High integration with embedded 32-bit STM32F0 MCU with ARM® Cortex®-M0 core
  - 48 MHz, 4-Kbyte SRAM and 32-Kbyte Flash memory,12-bit ADC
  - 1- to 3-shunt FOC supported
  - Communication interfaces: I²C, UART, and SPI
  - Complete development ecosystem available
- High performance three-phase gate driver
  - Wide application range: 600 mA current capability to drive a wide range of MOSFETs in applications up to 45 V
  - Robust: real-time programmable over-current, cross-conduction, under-voltage and temperature protection
  - Integrated bootstrap diodes reduce BOM costs
- Design flexibility with operational amplifiers and comparator
  - Cost-effective sensorless systems or accurate control with Hall-effect sensor feedback
- High efficiency, with on-chip generated supplies for MCU, driver and external circuitry
- Compact design with a 7x7 mm QFN package

Find out more: **www.st.com/stspin**

Awards for Energy and Automotive Innovations

Three Trade Fairs on Mobility to be Combined

Mid October, the eMove360° Europe 2016 – International Trade Fair for Mobility 4.0 –, the succession event of the former exhibitions sMove360 and Materialica, took place in Munich in parallel with the eCarTec – the world´s largest trade fair for electric mobility, presenting the complete range of sustainable mobility, battery systems and charging infrastructure, drivetrains and electric vehicles of all kinds as well as modern sharing schemes and mobility concepts.

By Roland R. Ackermann, correspondent editor Bodo's Power Systems

Starting next year, these events will all be combined and covered by eMove 360° Europe 2017. MunichExpo, the organizer, will then present all sectors of electro mobility, interconnected and autonomous driving, mobility services as well as urban and mobile design under one roof on the Munich fairgrounds.This year, the B2B trade fair eMove 360° 2016 was attended by 356 exhibitors from 28 countries, and together both events showed their innovations and solutions for the mobility of the future on a space of 22,000 m², addressing more visitors than last year.

Around 300 experts participated in the successful 2. World Mobility Summit, that also took place in parallel. And many renowned companies and institutions contended for the exhibition-related awards on the topics electro mobility, materials & design and interconnected & autonomous driving, comprising renowned companies like BMW, Audi, Continental, Schaeffler, ebm-papst or Bosch Software, but also many SMEs and prestigious research facilities. "With some 70 submissions we have set a new record for our award. We are delighted about this because it proves that electric mobility is no longer a niche product, but on the way to become a mass market. I cordially congratulate all winners and finalists! They have outrivaled numerous very competitive applications – in terms of quantity as well as quality", said Robert Metzger, Managing Director of MunichExpo.
This international award was presented in the categories Sustainable Product & Mobility Concepts, Energy Infrastructure & Storage, Powertrain & Electronics and Electric Vehicle. Among the winners the project "aCar Mobility" of Technical University (TU) Munich, because it brings mobility to disadvantaged rural areas. It provides better access to healthcare, education and information in remote areas. The derived vehicle concept is to be used as energy source, communication tool or educational device and should build a center of community live. By using simple, robust and cheap biomedical sensors even basic medical examinations will be feasible. In addition to the award trophy they could take home a price money of 15,000 Euro each.

The Huber+Suhner Cooled Cable System, winner in the category Energy Infrastructure & Storage, is designed to reduce charging times by transferring large volumes of electricity. The cables are also designed to be light thanks to their minimal weight and small dimensions, and are easy to use because of their ergonomic design. The realised solution allows the conductor cross section to be reduced from 95 mm² or 120 mm², as is required for uncooled cables, to as little as 10 mm², thereby lowering the weight from 2,800 g/m to as little as 800 g/m and the diameter from 37 mm to 22 mm.

The BMW 225xe car has won the award in the category Powertrain &

Electronics. Its installed electric machine is a permanent-magnet-electric-machine, providing a low weight of 31.5 kg, a robust overall design and extreme high 100kW-power. The low weight and high power characteristics of the electric machine were achieved by an innovative combined cooling of rotor and housing. The patent pending housing of the machine and the unique lost-foam-production-technology for the e-machine housing delivers a highly robust design.

Winner in the category Electric Vehicle was StreetScooter GmbH, a spin-off from RWTH Aachen University and combining leading university know-how with industrial experience. The company designs, develops and produces e-vehicles for short distance travelling and/or transportation. The current range of models covers e-bikes as well as light electric commercial vehicles. Currently the focus Is on e-vehicles for last mile logistics operations. Based on its unique development and production approach, StreetScooter was able to present a new generation of e-vehicles, the Compact model, within less than 18 months in 2011. Series production of this model has commenced mid-2015.

http://nfm-ecartec.de/

life.augmented

Your SMPS design deserves a Plus

ST's VIPerPlus offline high-voltage converters combine an 800 V avalanche-rugged power section with a leading-edge PWM controller

- **A plus in efficiency**
  High efficiency over a wide load range and best-in-class in standby with less than 4 mW at 230 VAC
- **A plus in reliability**
  800 V avalanche-rugged power MOSFET, thermal shutdown, soft start, short-circuit protection and auto-restart features
- **A plus in integration**
  Direct feedback, jittered switching frequency for low EMC, embedded HV start-up, embedded SenseFET MOSFET, and clamp-less design
- **A plus in versatility**
  Power scalability from a few watts up to 15 W, with optional auxiliary winding, and available in through-hole or SMD packages, supporting all SMPS topologies

Zero-power mode	**VIPerPlus series 0P**			VIPER0P		
Low voltage/minimal BoM	**VIPerPlus series 1**	VIPER01				
Quasi resonant	**VIPerPlus series 5**				VIPER25	VIPER35
Minimal BoM	**VIPerPlus series 6**	VIPER06	VIPER16		VIPER26	
Brown-out	**VIPerPlus series 7**		VIPER17		VIPER27	VIPER37
Peak power	**VIPerPlus series 8**				VIPER28	VIPER38

Fly-back converter 85-265 VAC	4 W	6 W	7 W	12 W	15 W
Buck converter	150 mA	200 mA		350 mA	

For further information and full design support, visit us at
www.st.com/viperplus

CEOs Discuss Security and Safety Issues at Electronica

By Roland R. Ackermann, correspondent editor Bodo's Power Systems

Security, safety and the protection of data and systems are gaining in importance. This is evident in many massive threats companies have to deal with; numerous attacks demonstrate the vulnerability of entire branches of the economy. Thus the development of strategies and protection mechanisms against all these threats is of paramount importance.

Consequently, especially with 5G and the autonomous car coming up, the traditional CEO roundtable discussion during the opening day of electronica 2016 had a strong focus on the topics safety and security this year. Kilian Reichert, the moderator, placed the initial questions: Who are our enemies? What are the problems, and which chances do we have to overcome the threats?

Rick Clemmer, President and CEO of NXP, opened the discussion, stating that "it´s the development of future autonomous cars, that will ensure an ever increasing level of security. Accordingly the applications, not the components or the technology play the important role in this context, plus the steady demand for more convenience – they altogether are doubling the complexity plus the need for more security of data transmission. These are the most important trends, even more than the ubiquitous digitalisation. And, don´t forget: Safety and security are a part of the total solution, not hardware or software alone."

Carlo Bozotti, CEO of STMicroelectronics, added: It is also conversion. The objectives are the same all over the world, be it Industry 4.0 or China 2025, the IoT or Industrial Automation – security and safety are prerequisite for the implementation and the merging of all this programs. Distributed islands of solutions and their cooperation will be central for the future architectures, no longer the network, to increase productivity, reliability, efficiency and flexibility of the industrial landscape.

"Connection density increases ten times, as well as the proliferation of connected devices – and each one can be a door for attackers. So we must protect the overall applications. "

"Yes, smart solutions will be crucial to guarantee security", confirms Stefan Auerbach, Member of the Management Board and Group Executive Mobile Security of Munich-based Gieseke + Devrient. And in his opinion software will be more decisive than hardware.

Replying to the statement "The more connected we are, the higher the risk", Professor Frank H. P. Fitzek, Deutsche Telekom Chair of Communication Networks of Technical University Dresden and 5G expert, commented: "The networks are not the risk, but the solution. End-to-end security and centralistic approaches are obsolete. We are not fast enough inside the networks. We must take the holistic approach including e.g. connectivity, too, not just the single device."

Dr. Reinhard Ploss, CEO Infineon Technologies, confirmed: "We can react. Firstly hardware devices have to behave as we expect. The architecture of the hardware must be sure – how can we manage in the overall system? For instance in the car there is an increasing need that each group has to provide the required level of high security – so the solution goes in horizontal as well as in vertical direction. It has to be hardware, starting on the chip level, and the software in all aspects." He continues: "IT security must be split in two ways, a.) we must harden the car or the systems and shield them against any attack, and b.) we must ensure zero defects and cannot allow any failures."

As we are confronted with all kinds of attacks, complements Prof. Fitzek, from school kids hacking computers up to even states aggressing companies and networks (he revoked on Stuxnet), we have to make sure, that every part, components, computers, networks, work 100 per cent sure. So it´s the technology itself. "We need monitoring all over, and more investment in the global market." Carlo Bozotti proposes three levels: silicon, devices/systems and the internet. Where he sees the system level as the most dangerous one, which stands for "attacking from above". Rick Clemmer recognises even cultural differences: In Europe engineers are securing information, in the US they are protecting the systems from being hacked, and in China the government decides what is to be protected.

We must not forget, notes Stefan Auerbach, that a lot of secure hardware is already available and in use. SIM cards, which his company offers, are very safe. "We deliver 5 billion cards every year, increasingly embedded. They themselves are not hacked, only – if at all – the system around them. And now it´s our task to bring these components into the IoT arena. Also for 5G we don´t have to reinvent the wheel. We have learnt a lot about cryptology and can apply it accordingly."

Prof. Fitzek duns an intelligent approach: Not designing and then checking if everything is protected; safety and security, or e.g. latency as aimed at, must be in the design from the beginning. Dr. Ploss agrees: We need safety by design. Even the politicians can help, funding projects like Industry 4.0. But what happens with already existing installations like 4G, products and software, or machines of different providers exchanging data, and bringing all the technologies together? One approach are decentralized networks, says Fitzek. Labelling was not seen as expedient by the discussants, as the users will not understand or accept it. But branding: The companies will take every effort to take responsibility, protect their brands and increase trust and awareness.

BOOST EFFICIENCY AND SLASH COSTS

Vincotech

SOLAR

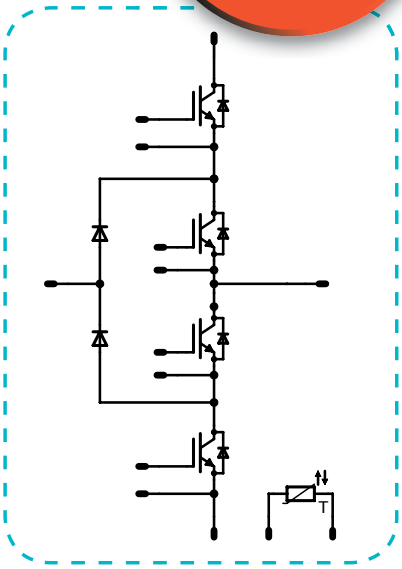
UPS

*flow*NPC 0 & 1 with IGBT Trenchstop™ 5

650 V / 75 A & 150 A

Higher performance, lower spend: You can have it both ways with the new *flow*NPC 0 and *flow*NPC 1 lines. Featuring the latest-generation **IGBT Trenchstop™ 5 chipset**, they outperform standard products with double the switching frequency, equal or **greater efficiency,** and **bring down** your component **costs.**

SAMPLE
www.vincotech.com/NPC-S5-sample



Main benefits

- Latest IGBT S5 & L5 chipsets
- Highest efficiency at lowest price
- Available with pre-applied phase change material and Press-fit pins
- Low inductive layouts and packages
- Switching frequencies up to 50 kHz without SiC
- Optimized for solar and UPS output stages

www.vincotech.com/NPC-S5

EMPOWERING **YOUR IDEAS**

Efficient, Reliable Power Solutions for Industrial and Consumer Applications

Over a decade ago, Power Integrations launched its LinkSwitch™-TN IC product family which has proved highly successful. Now the company has introduced LinkSwitch-TN2, a new generation of the family which offers improved efficiency, voltage regulation and additional safety features, extending the range of applications where a non-isolated supply can be used.

By Silvestro Fimiani, senior product marketing manager, Power Integrations

The LinkSwitch-TN has been an extraordinary successful AC-DC switching regulator. Designers have benefited from the controller's reliability, efficiency, design flexibility, small size, and reduced bill of materials requirement. However, modern microcontrollers and displays demand even more accurate supply voltage regulation, plus there has been a considerable shift in industrial and consumer product legislation which requires very low standby power to improve overall efficiency. Power Integrations took a long look at the new and emerging market requirements and the result is the LinkSwitch-TN2 family of AC-DC switching regulators. These feature a wide input voltage range, 85 VAC – 265 VAC, four output current level options 80 mA, 170 mA, 270 mA and 360 mA, output voltage regulation of +/- 3 %, class leading efficiency of over 80 % across a wide current range and an array of safety features including line (input) overvoltage protection, output overvoltage protection, thermal shutdown and short-circuit protection.

Technical features

The LinkSwitch-TN2 is fabricated using a proprietary BCDMOS process that combines a high voltage power MOSFET switch with a low power switching controller capable of supporting a number of topologies including high-side and low-side buck, buck-boost and flyback. The MOSFET is rated at 725 V to withstand input voltage surges reducing the requirement for external protection circuitry. Figure 1 shows a functional block diagram of the LinkSwitch-TN2. We can use this to illustrate the key features of the part and its operating modes.

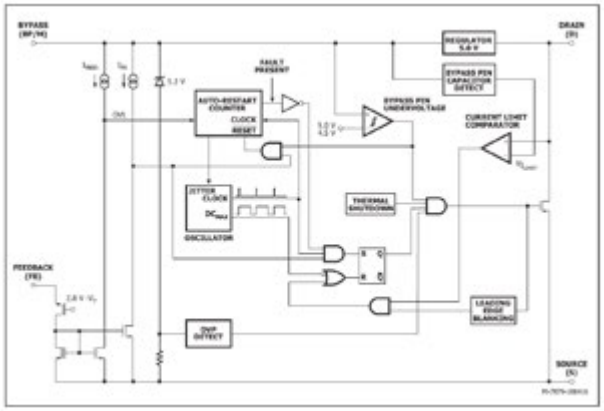


Figure 1: LinkSwitch-TN2 Block Diagram

In addition to the power MOSFET the device consists of an oscillator, feedback (sense and logic) circuits, 5.0 V regulator, BYPASS (BP/M) Pin undervoltage circuit, over-temperature protection, line and output overvoltage protection, frequency jittering, current limit circuit, leading edge blanking and additional circuitry for auto-restart. Central to the operation of the device is the 66 kHz (nominal frequency) oscillator chosen to allow the use of standard low cost inductors. This generates two internal signals, the maximum duty cycle signal and a timing clock used to indicate the beginning of each cycle. Frequency jitter is applied to the clock, typically 4 kHz peak-to-peak to minimize EMI emissions allowing the use of low cost double sided printed circuit boards. The modulation rate for the frequency jitter is 1 kHz.

During normal operation the switching of the MOSFET is controlled by the FEEDBACK (FB) Pin. Switching is terminated when a current greater than 49 µA is delivered into this pin causing the internal feedback node to go low. This signal is sampled at the beginning of each cycle on the rising edge of the clock signal. If it is high, the power MOSFET is turned on (enabled) for that cycle, otherwise the power MOSFET remains off (disabled). Sampling is done only at the beginning of each cycle and changes to the FEEDBACK pin current during the remainder of that cycle does not impact the state of the MOSFET during that cycle. If a current greater than 670 µA is delivered into this pin for two consecutive switching cycles, a fault situation is detected and the part will stop switching and enter into an Auto-Restart time out. This feature can be used to monitor the line (input) voltage when the device is used in a Flyback configuration and provide overvoltage protection on the line voltage. Figure 2 below illustrates one possible circuit implementation.

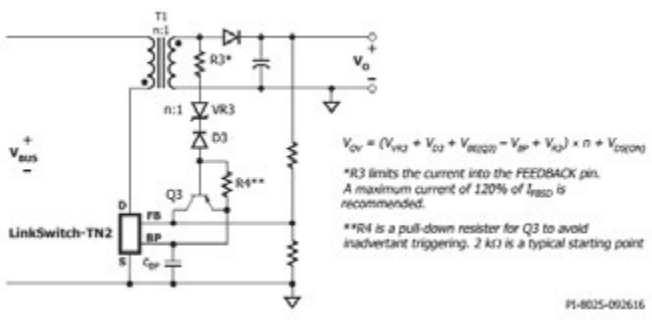


Figure 2: Line Overvoltage Sensing using FEEDBACK Pin

SEMIKRON
innovation + service

Power Electronic Stacks

When Time to Market Counts

You want to...

- **reduce time to market**
- **limit your financial investment**
- **control your cost of development**
- **save costs on manufacturing of stack assemblies**

We are the global market leader in power electronic stacks with over 200,000 assemblies in the field. Five global stack centers provide optimized, pre-qualified and field-tested stack assemblies. Our stacks feature short lead times while still easy to customize for your needs. Our global stack centers provide worldwide coordination, engineering, manufacturing and test to localize manufacturing of your stack assemblies.

Further information: www.semikron.com/power-stacks
Contact us: power-stack@semikron.com

In addition to the FEEDBACK pin fault detection, Auto-Restart is initiated when a variety of fault conditions are detected such as, output overvoltage, output overload, output short or an open loop condition. During Auto-Restart an internal counter, clocked by the oscillator, gets reset every time the FEEDBACK pin is pulled high. If the feedback pin is not pulled high for 50 mS the power MOSFET switching is disabled for a time equal to the auto-restart off time. The first time a fault is asserted the off time is 150 mS. If the fault condition persists the off time is increased to 1500 mS. The Auto-Restart alternately enables and disables the switching of the power MOSFET until the fault condition is removed.

Output Overvoltage Protection (OVP) is triggered by delivering a current in excess of 6 mA into the BYPASS pin. The BYPASS pin capacitor forms a low pass filter providing noise immunity from inadvertent triggering. During a fault condition resulting from loss of feedback, the output voltage will rapidly rise above the nominal voltage. A voltage at the output that exceeds the sum of the voltage rating of the Zener diode connected from the output to the BYPASS pin and bypass voltage, will cause a current in excess of 6 mA to be injected into the BYPASS pin, which will trigger the auto-restart and protect the power supply from overvoltage. Figure 3 illustrates a typical non isolated buck convertor circuit configuration. Output voltage set via the feedback resistor potential divider R1 and R2 and output overvoltage detection provided by D4 and R3.

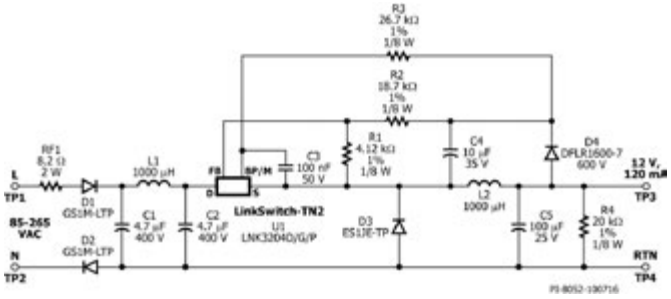


Figure 3: Non Isolated 12V, 120mA Continuous Output Buck Convertor

Current through the power MOSFET is internally sensed by the device. When this current exceeds the internal threshold Ilimit (dependant on the chosen device) the power MOSFET is turned off for the remainder of the cycle. The leading edge blanking circuit inhibits the current limit comparator for a short time after the power MOSFET is turned on so that the current spike caused by the capacitance and ultra fast rectifier diode reverse recovery time will not cause premature termination of the switching cycle. Capacitor C3 connected between the SOURCE (S) pin and the BYPASS pin is used to set the upper and lower current limits for the chosen device. (0.1uF for normal current limit and 1uf for reduced current limit).

Die temperature is sensed internally and thermal shutdown is initiated when the die temperature rises above the threshold 142 °C typical. The power MOSFET is disabled and a 75 °C hysteresis is applied to the control logic so that switching will not be re-enabled until the die temperature has fallen below 67 °C typical.

LinkSwitch-TN2 ICs use a simple ON/OFF control method to regulate the output voltage. The decision to switch or not switch is made on a cycle by cycle basis resulting in excellent transient response and removes the requirement for external control loop compensation networks. At the beginning of each cycle the FEEDBACK Pin is sampled, if Ifb is less than 49 µA the next cycle is initiated. If Ifb is greater than 49 µA the next cycle is skipped. Thus, as the output load is reduced, more cycles will be skipped and if the load increases, fewer cycles are skipped. To provide overload protection if no cycles are skipped during a 50 ms period, LinkSwitch-TN2 will enter auto-restart, limiting the average output power to approximately 3 % of the maximum overload power. Due to tracking errors between the output voltage and the voltage across C3 at light load or no-load, a small pre-load may be required (R4). Table 1 below illustrates the cycle by cycle control method during normal operation and auto restart mode.

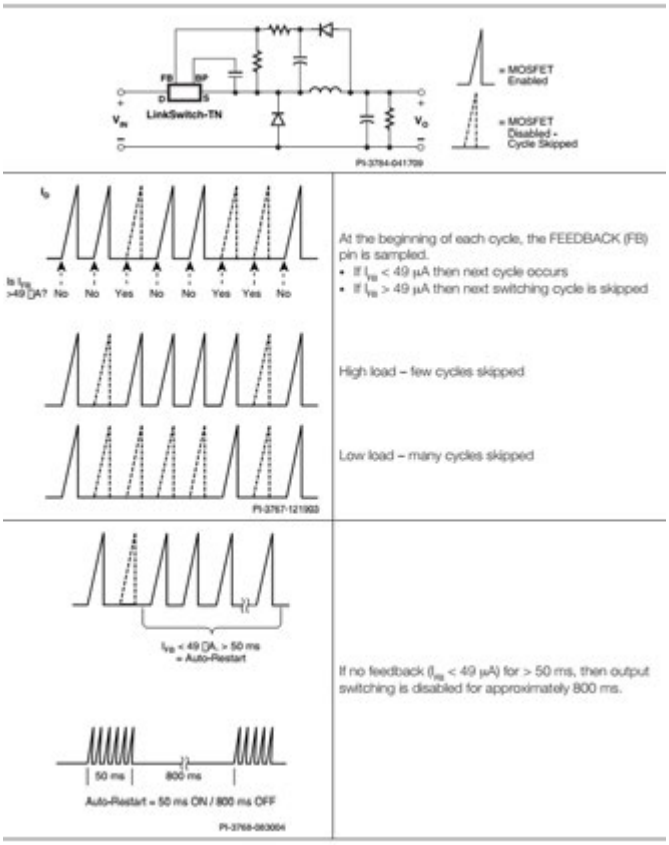


Table 1: LinkSwitch TN2 ON/OFF control scheme

For maximum efficiency it is better to operate the LinkSwitch-TN2 in Mostly Discontinuous Conduction Mode (MDCM) as opposed to Continuous Conduction Mode (CCM). Table 2 below explains the difference between the two modes of operation and the design trade-offs associated with each operating mode.

Comparison of CCM and MDCM Operating Modes

Operating Mode	MDCM	CCM
Operating Description	Inductor current falls to zero during t_{OFF}; borderline between MDCM and CCM when t_{OFF} = 0.	Current flows continuously in the inductor for the entire duration of a switching cycle.
Inductor	**Lower Cost** Lower value, smaller size.	**Higher Cost** Higher value, larger size.
Freewheeling Diode	**Lower Cost** 75 ns ultrafast reverse recovery type (≤35 ns for ambient >70 °C).	**Higher Cost** 35 ns ultrafast recovery type required.
LinkSwitch-TN	**Potentially Higher Cost** May require larger device to deliver required output current=depends on required output current.	**Potentially Lowest Cost** May allow smaller device to deliver required output current=depends on required output current.
Efficiency	**Higher Efficiency** Lower switching losses.	**Lower Efficiency** Higher switching losses.
Overall		**Typically Higher Cost**

Table 2: Comparison of CCM and MDCM Operating Modes

The phrase “mostly discontinuous” is used since a few switching cycles may exhibit continuous inductor current, however the majority of the switching cycles will be in the discontinuous conduction mode. A design can be made fully discontinuous but that will limit the available output current, making the design less cost effective. Additional differences between CCM and MDCM include better transient response for DCM and lower output ripple (for same capacitor ESR) for CCM. However, these differences, at the low output current levels the LinkSwitch-TN2 is designed for are normally not significant. MDCM is generally preferred as it provides maximum efficiency and gives the lowest overall solution cost but CCM can be used where maximum output current is the prime concern.

LinkSwitch-TN2 can be used in all common topologies, with or without an optocoupler and reference to improve output voltage tolerance and regulation. Table 3 below provides a summary of these configurations and key features. For more information, see the Application Note – LinkSwitch-TN2 Design Guide.

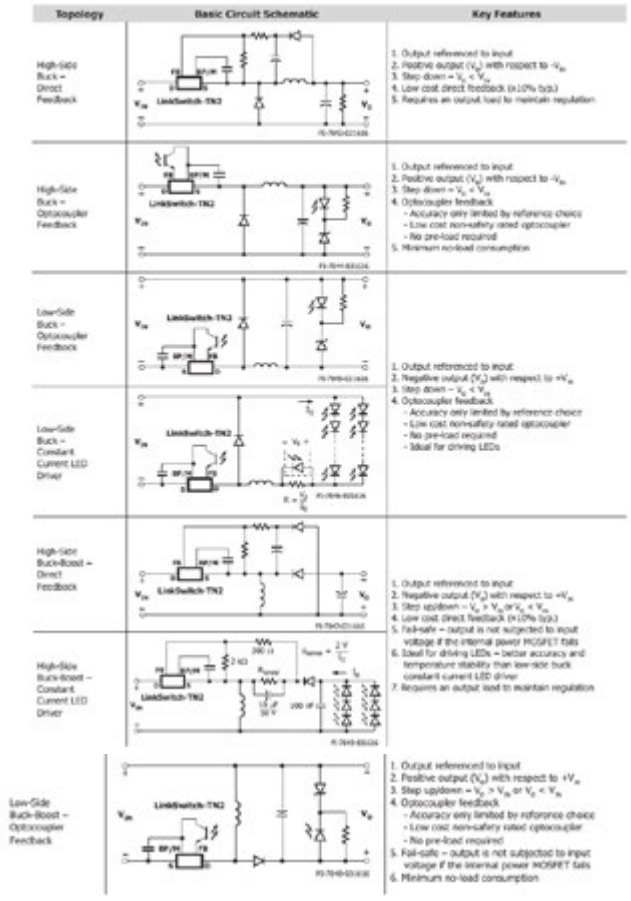


Table 3: Common Circuit Topologies using LinkSwitch-TN2

Design analysis

Using the circuit in Figure 3, we can analyse the prime design considerations used this LinkSwitch-TN2 Buck Convertor power supply. The device is self-starting from the DRAIN (D) pin with local supply decoupling provided by a small 100 nF capacitor C3 connected to the BYPASS (BP/M) pin when AC is first applied. During normal operation the device is powered from output via a current limiting resistor R3. Here, the device LNK3204D is used in a buck converter configuration. The supply is designed for MDCM operation with the peak L1 inductor current set by the LNK3204D internal current limit. The on-time for each switching cycle is set by the inductance value of L3, LinkSwitch-TN2 current limit and the high voltage DC input bus across C2. Output regulation is accomplished by skipping switching cycles in response to an ON/OFF feedback signal applied to the FEEDBACK (FB) pin. This differs significantly from traditional PWM schemes that control the on time (duty cycle) of the switching cycle. During the ON time current ramps in L2 and is simultaneously delivered to the load. During the OFF time the inductor current ramps down via free-wheeling diode D3 into C5 and is delivered to the load. Diode D3 should be selected as an ultrafast diode (tRR of 35 ns or better is recommended. Capacitor C5 should be selected to have an adequate ripple current rating (low ESR type)). Efficiency of this design is in excess of 80 % across the majority of the converters load range. See Figure 4

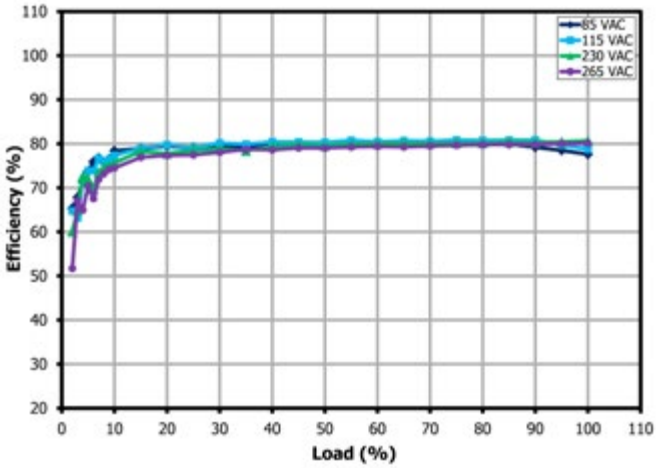


Figure 4: Efficiency vs. Output Load (Room Temperature)

The voltage across L2 is rectified and smoothed by D4 and C4 during the off-time of U1. To a first order, the forward voltage drops of D3 and D4 are identical and therefore, the voltage across C3 tracks the output voltage. To provide a feedback signal, the voltage developed across C3 is divided by R1 and R2 and connected to U1’s FB pin. The values of R1 and R2 are selected such that at the nominal output voltage, the voltage on the FB pin is 2 V. This allows this simple feedback to meet the required overall output tolerance of ±3 % at rated output current. Figure 5 illustrates output voltage against load.

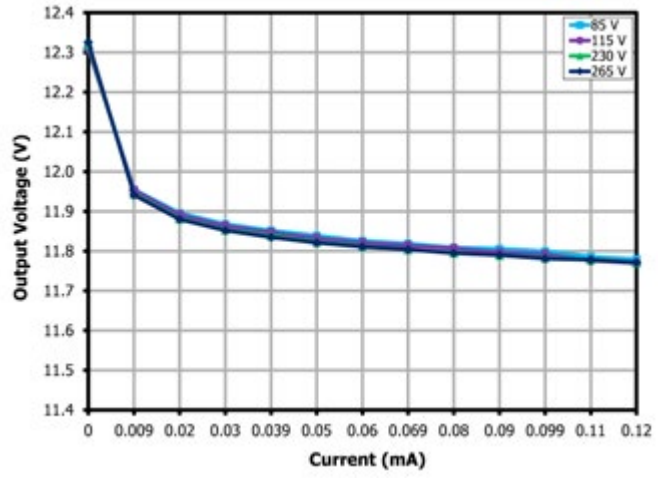


Figure 5: Output Voltage vs Output Current (room temperature)

To improve manufacturability, the LinkSwitch-TN2 family are available in a range of package options, 8 Pin DIP, 8 Pin SMD and 8 Pin SO, the SO being the smallest of the packages with a MSL rating of 1 (can be exposed to ambient room conditions 30 °C / 85 % RH indefinitely).

Conclusion

LinkSwitch-TN2 ICs address the requirements of global energy efficiency regulations with a no-load consumption of <30 mW in high-side buck converter topology and <10 mW in flyback topology with external bias. Applications include metering, home and office building automation, industrial controls, consumer appliances and LED lighting, where a LinkSwitch-TN2 IC-based design can replace simple, low efficiency, unreliable cap dropper supplies as a reliable highly efficient alternative, which - because of its inherent tight voltage regulation - requires no post regulation. Designs using the LinkSwitch-TN2 device benefit from improved reliability, improved performance, higher efficiency and lower cost, even when compared against cap droppers which require large and expensive X-capacitors.

Manufacturers of all types want to improve the reliability of their products and reduce the total cost of ownership. Power supplies are an area where significant improvements can be made by taking advantage of the latest technology. With Power Integrations' long history in high-voltage power semiconductor design and production provide a range of AC-DC converters with reliability designed in. The company subjects 100% of its LinkSwitch-TN2 parts to a high-voltage stress test to ensure maximum quality and reliability.

https://www.power.com/

The Rugged 62Pak IGBT Module Range Employing the Next Generation 1700V SPT^{++} Chip Set for 175°C Operation

Throughout the past years the efforts in power semiconductor development were targeted to increase the power density for a given application. This performance target has been achieved by reducing losses, increasing the safe operating area and maximizing the allowable junction temperature during operation.

By Sven Matthias & Vasileios Kappatos, ABB Switzerland Ltd. - Semiconductors

The third generation of 1700V SPT^{++} IGBTs is capable of operating up to a maximum temperature of T_{vj}=175°C. The new IGBT design exploits the full potential of the optimized enhancement layer in combination with a novel termination technology and aggressive silicon design. Therefore offering outstanding performance for low to medium inductance applications as demanded in industry and traction. Figure 1 shows the table with the losses for the three current ratings and the 62Pak itself.

Rating	300A		200A	150A	unit
T	125°C	*175°C*	125°C	125°C	°C
I_{ces}	1.5	*30*	1	0.75	mA
V_{CEsat}	2.55	*2.75*	2.55	2.55	V
V_F	1.75	*1.7*	1.75	1.75	V
E_{on}	95	*115*	60	57	mJ
E_{off}	75	*95*	50	37	mJ
E_{rec}	75	*110*	55	40	mJ

Figure 1: The 62Pak (standard footprint of 62mm x 106.4mm) module using the third generation ABB SPT^{++} chipset for high temperature module operation (nominal conditions: V_{DC}=900V, I_C=300A or I_C=200A, V_{GE} = ±15 V, L_s =60 nH and R_{Gon} = R_{Goff} = 2.2 W or RGon = R_{Goff}= 2.7 W for I_C=150A version, respectively).

The IGBT reflects the latest generation of our enhanced planar MOS-cell concept. This well-established concept features an n-type enhancement layer surrounding the p-well in the IGBT MOS cell. This n-type layer increases the carrier concentration at the cathode side of the IGBT and thus lowering the on-state voltage drop without significantly increasing the turn-off losses. This layer was increased in its doping concentration and limited in its diffused depth to allow for a 10% n-base reduction compared to the previous SPT^{+} generation. This results in minimized conduction and switching losses.

A reliable operation at high junction temperatures was enabled by the development of a new junction termination design based on the floating guard ring concept. The termination consists of a number of diffused p-type rings contacted by metal plugs and interconnected by a semi-insulating layer. Such a termination design has been proven to be immune to inter-ring distance variations and interface states while offering very low leakage current levels. The achieved reduction of the leakage current by a factor of four compared to the previous generation allow us to expand the operating temperature to 175°C.

The newly developed Field Shielded Anode (FSA) design is characterized by a modified doping profile at the anode. Its depth is maintained at the previous generation by introducing a deep profile having a reduced concentration and resembling a low p-doped buffer, preventing the electric field from reaching the zone of radiation defects during blocking. In addition, a shallow highly doped p-layer ensures good contact and good anode injection in the high-current regime to enable a good surge current capability. This FSA design has the inherent advantage of separating the radiation defects from the space charge region evolving during blocking, which results in a significantly reduced high temperature leakage current and allows the FSA diode to be operated safely at T_{jmax}=175°C.

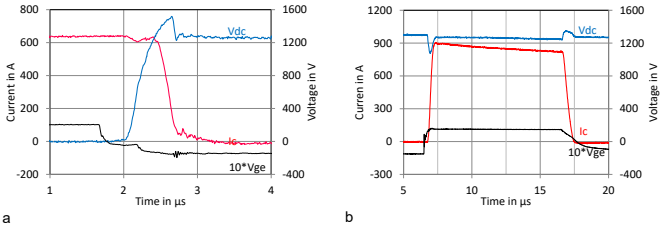


Figure 2: a) IGBT turn-off at elevated safe-operating area conditions: T_{case}=175°C, V_{DC}=1300V, I_C=650A, V_{GE}=20V / -15V, L_s=60 nH and R_{Gon} = R_{Goff} = 2.2 W. b) IGBT short circuit failure mode condition: T_{case}=175°C, V_{DC}=1300V, V_{GE}=±15V, L_s=60 nH and R_{Gon} =2.2W, R_{Goff} =20W.

Figure 2a shows the IGBT chip turn-off capability of two parallel chips in the 62Pak measured at T_{case}=175°C without an active clamp. The chip withstands a phase of dynamic avalanche regime, turning off a current exceeding twice the nominal value, safely and reliably. The excellent short circuit capability of the new 1700V SPT^{++} IGBT is shown in Figure 2b where the short circuit waveforms at T_{case}=175°C and a DC-link voltage of 1300V can be seen. No thermal runaway after the test has been observed for pulse times exceeding 10µs by a few microseconds. The SPT buffer and anode design employed in the SPT^{++} IGBT have been optimized to obtain a high short-circuit SOA capability, even at gate voltages exceeding the standard gate drive voltage of 15V over the whole junction temperature range from -40°C to 175°C. This is completed by homogeneous soldering interface

between the chips and the substrate resulting in an optimized heat transfer during operation.

Figure 3a shows the reverse recovery safe operating area for the diode at T_{case}=175°C. The diode turns off the double nominal current at elevated dc-link voltage safely without any oscillations. The surge current testing reveals no degradation after repetitive cycles up 1500A at T_{case}=175°C and a high destruction limit beyond 2400A.

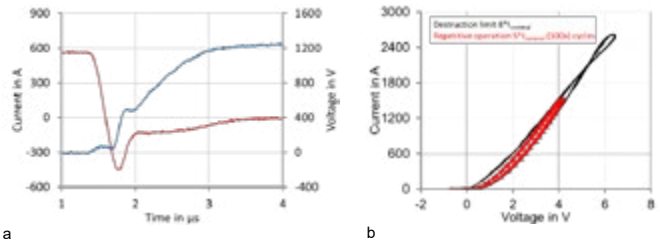


Figure 3: a) Diode turn-off at elevated safe-operating area conditions: T_{case}=175°C, V_{DC}=1300V, I_C=600A, L_s=60 nH. b) Surge current test: T_{case}=175°C, repetitive 100x cycles up to I=1500A and destruction limit > I=2400A.

Efficiency analysis using the SEMIS tool

To demonstrate the efficient operation of the 62Pak for common industrial applications the example of two-level voltage-source-converter was used, operated at inverter mode. Low voltage motor drives as well as UPS converters are examples of applications for such topology. The converter operation at steady state was simulated using the SEMIS tool found at the ABB SEMICONDUCTORS website [1]. The following converter parameters were chosen: AC line voltage V_{L-L}=400V, AC side frequency F_{out}=50 Hz, load real power P=120kW, load power factor PF=0.88, D_C link voltage V_{DC}=900V, switching frequency f_{sw}=2.5kHZ, cooler with thermal resistance R_{th} heatsink to ambient=0.1 K/W (per phase leg switch), voltage modulation index ma=0.73. The ABB 62Pak module chosen was the 300A rating (5SNG 0300Q170300). The results coming from the online simulation tool SEMIS demonstrate the favorable impact on converter losses and junction temperature rise on semiconductors positioning the ABB 62Pak module among the most efficient in the market at its product class. Considering the 175°C rating as well as its robust dynamic behavior, the 62Pak allows for fairly good design margin in case of transient overload conditions.

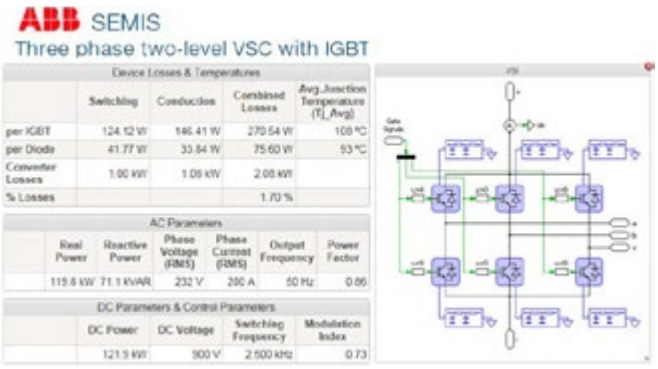
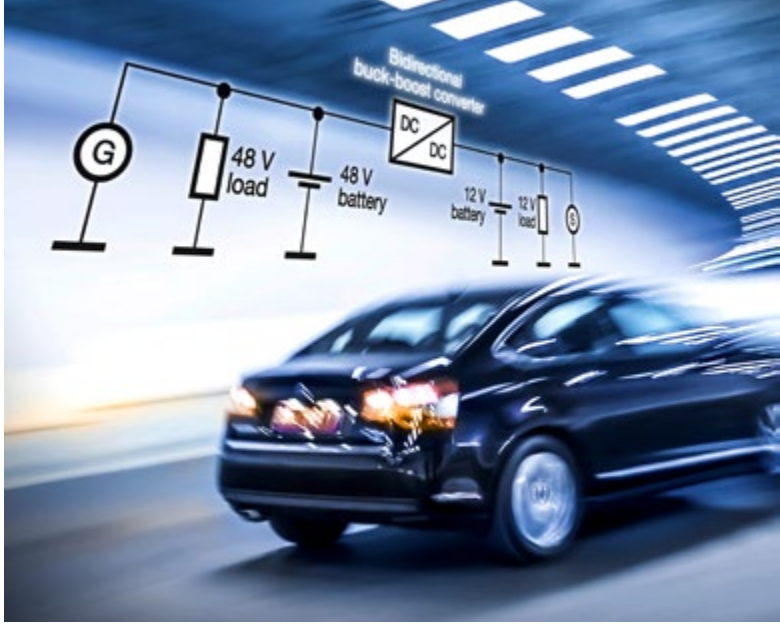


Figure 4: Simulation results of 5SNG 0300Q170300 from SEMIS

Outstanding SOA turn-off and short circuit capability as well as considerable IGBT conduction losses reductions have been achieved whilst keeping the ultra-low switching losses by exploiting the full potential of the enhanced planar technology. A careful optimization of the IGBT termination design and process has enabled stable and reliable operation at T_{jmax}=175°C. By using the Field Shielded Anode concept, a soft and low losses recovery diode has been developed which can be operated at the same high temperature with a high recovery ruggedness. The presented 62Pak passes the full platform electrical and reliability qualification.

http://new.abb.com/semiconductors/semis

Well Equipped for 48 Volts



Some attractive advantages are offered by 48-volt technology for vehicles: It helps to reduce overall fuel consumption, reduces the environmental impact and can even improve the engine performance. The central component for this is a powerful buck-boost converter. With its power inductors and aluminum electrolytic capacitors, TDK offers key passive components for this purpose.

By Christoph Jehle, Manager Technology & Product Communications; EPCOS AG

The number of electrical loads in vehicles is continuously rising: complex drivetrain management, convenience features such as auxiliary electrical heating systems, and safety-related systems such as ABS, ESP and many others are emerging as really high consumers of energy. The levels of power to be provided by alternators these days are rising in line with this demand. In the early 1980s, even luxury vehicles managed with alternator outputs of about 0.7 kW. The power output required today, however, has already reached 3.5 kW – a seven-fold increase. The snag here is that if a 14-V alternator is generating this power, it means a current of 250 A is flowing. At this voltage-current ratio, however, a maximum efficiency of just 70 percent can be achieved. This necessitates a generator input power of 5 kW that must be supplied by the engine. A further drawback of the high total of currents is that large conductor cross-sections required, which add significantly to the weight of the vehicle and thus the overall costs.

Greater efficiency thanks to 48-volt systems

In view of the growing demands to reduce fuel consumption and CO2 emissions, a solution to this dilemma must urgently be found. This is where 48-volt technology offers attractive advantages, because it enables a number of fuel-saving features to be implemented that are not feasible with systems that only operate on 12 volts. These include:

- High-performance energy recuperation at >5 kW
- Extended start-stop functions, such as sailing or coasting
- Electrification of units such as turbocharger and electric power steering
- Support of micro-hybrid and mild hybrid solutions

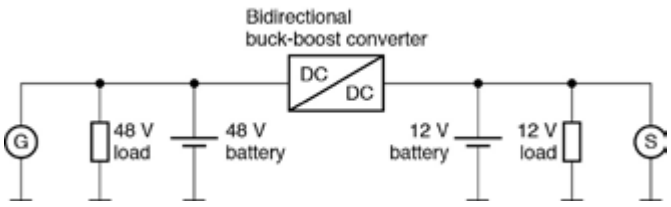


Figure 1: Principle of the combined 12/48-volt on-board power supply architecture. Most developments set the generator to the 48-volt level, enabling higher outputs and efficiency levels to be achieved. The two voltage levels are connected by means of a bidirectional buck-boost converter

The 48-volt systems are not a replacement for existing 12-volt architectures. Instead, this approach represents more of an extension to the 12-volt systems for handling powerful loads and is coupled to these systems by means of a buck-boost converter. Figure 1 illustrates the principle of this architecture. A conventional lead-acid or lead-gel battery is used for the 12-volt level, while a lithium-ion battery is used for the 48-volt level. Double-layer capacitors can also be connected in parallel here for improved storage of electrical energy during recuperation.

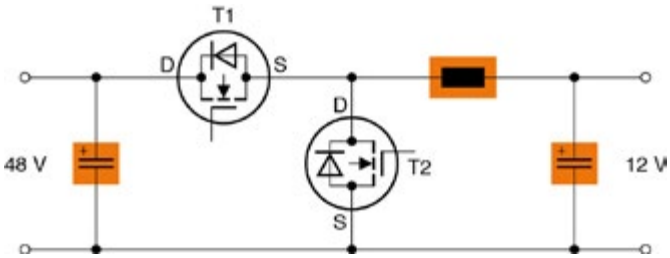


Figure 2: Circuit diagram of a buck-boost converter. Apart from the switching transistors, EPCOS power inductors and storage capacitors are the key components.

Efficient coupling by means of buck-boost converter

The most important component of a combined 12/48-volt system is the buck-boost converter which permits the bidirectional flow of energy between the two voltage levels and is designed for outputs of between 2 and 5 kW. Figure 2 shows the circuit diagram of such a converter. In the normal mode, the converter operates as a buck converter in order to output the power generated on the 48-volt level to the 12-volt system. In this operating mode T2 is continuously blocked and T1 operates as a switching regulator. The boost mode is necessary if an output is required at the 48-volt level. In this case, T1 is continuously connected and T2 operates in pulse mode. In order to keep ripple current and voltage to a minimum, systems with 6 or 8 phases, which can be serially connected, are used in practice.

TDK has developed two new series of EPCOS power inductors for the storage and smoothing chokes in the converters. The ERU 27 series of inductors, for example, are SMD components. They are characterized by their high current capabilities and very compact footprint of just 30 mm x 27.8 mm (Figure 3, left). Their insertion height is 15.5 mm or 20.3 mm, depending on their inductance value. This compact

APEC®

2017

THE PREMIER GLOBAL EVENT IN APPLIED POWER ELECTRONICS™

Visit the APEC 2017 website
for the latest information:
www.apec-conf.org

IAS IEEE INDUSTRY APPLICATIONS SOCIETY Linking Research to Practice

IEEE Advancing Technology for Humanity

pels IEEE POWER ELECTRONICS SOCIETY Powering a Sustainable Future

PSMA Power Sources Manufacturers Association

MARCH 26-30, 2017 | TAMPA, FLORIDA

design is made possible by the use of a flat winding that offers a high volume fill factor. The inductors are available in six versions covering an inductance range of 3.5 µH to 15 µH. Their saturation current varies between 19 A and 49 A. In order to increase the mechanical stability of the components on the PCB, the power chokes feature a third soldering pad in addition to the two solder pads for the winding.

Figure 3: The compact EPCOS power inductors for buck-boost converters are available with current capabilities of up to 75 A.

As an alternative to the SMD types, the EPCOS ERU 33 types with their PTH terminations can also be used (Figure 3, right). This series offers a rated inductance of 3.2 µH to 10 µH and – depending on type – they are even designed for a saturation current of 79 A at an ohmic resistance of 0.85 mΩ. The dimensions of these power chokes are 33 mm x 33 mm x 15 mm. All the above types are suitable for operating temperatures ranging from -40°C to +150°C. They are also RoHS-compatible and qualified to AEC-Q200. In addition to the standard ERU 27 and ERU 33 types, customer-specific types with other inductance values can also be offered.

Figure 4: EPCOS aluminum electrolytic capacitors for automotive electronics are characterized by their extremely high vibration strength of up to 60 g and maximum operating temperatures of up to 150°C.

Extremely vibration-resistant capacitors with high ripple current capability

Apart from the inductors, the key components in buck-boost converters are robust aluminum electrolytic capacitors for storage and smoothing. The EPCOS B41689 and B41789 series (Figure 4) are specially designed for the stringent demands of automotive electronics. They are characterized by their extremely high vibration strength of up to 60 g. The soldering star design and the version with cathode plate contacts on both ends of the capacitor enable optimized mounting with low ESL values.

Thanks to their multiple internal contacts, these capacitors also feature low ESR values, which results in a higher ripple current capability and lower losses. Depending on type, the continuous ripple current capability of these capacitors at a case temperature of 125 °C reaches values of up to 29.5 A. The automotive series are designed for rated voltages of 25 V, 40 V (for 12 V) and 63 V (for 48 V). With these voltages they can be used in the new on-board power systems at both voltage levels. The capacitance range extends from 360 µF to 4500 µF.

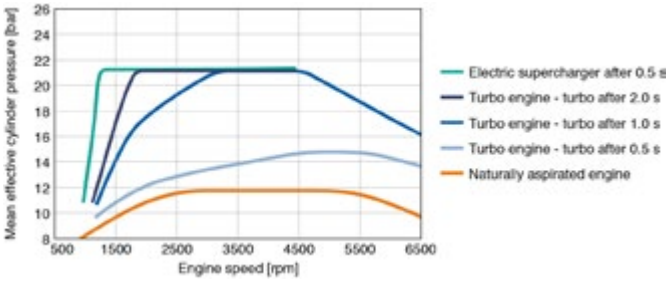


Figure 5: Engine with different chargers

In addition to the power inductors and aluminum electrolytic capacitors as key components, a series of additional TDK components is necessary for the implementation of buck-boost converters. These include MLCCs, current sense transformers and varistors.

Greater engine efficiency thanks to electric turbochargers

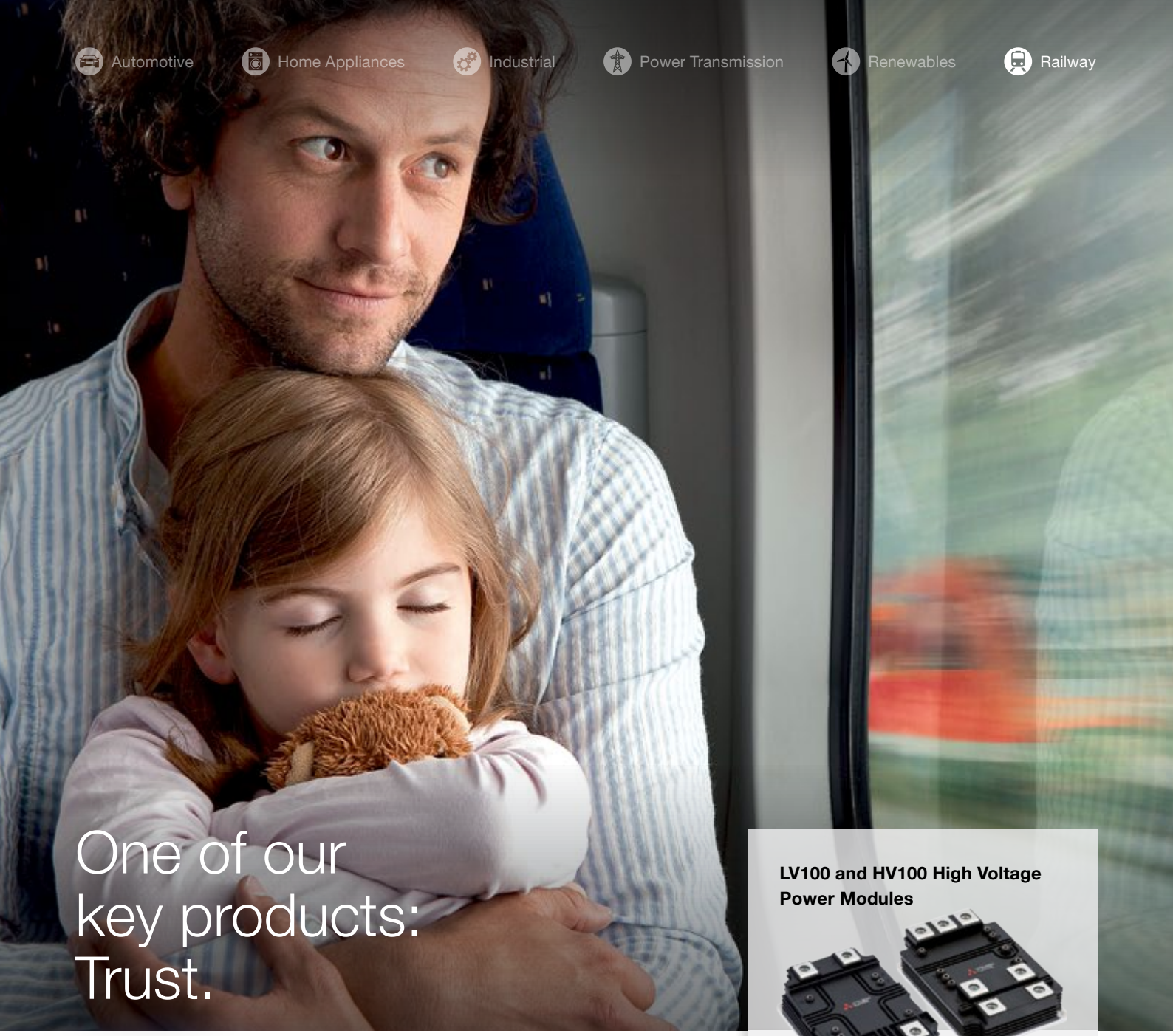
Apart from the electrification of conventional units such as pumps, 48-volt technology also makes it possible to run the engine more efficiently by using an e-turbocharger. Conventional turbochargers are driven by exhaust gases and their performance is very closely related to engine speed. In addition, they operate with a slight delay – also known as turbo lag.

This shortcoming is eliminated by electrically operated chargers, as they respond instantly and also at lower engine speeds, e.g. in urban traffic conditions, thereby offering better engine efficiency (see Figure 5). One more advantage: the e-turbocharger can be combined with a conventional turbocharger, either to further increase charging pressure, or so that the electrical charger can be switched off at high engine speeds.

www.epcos.com/eru_chokes

www.epcos.com/alu_axial

Automotive | Home Appliances | Industrial | Power Transmission | Renewables | Railway



One of our key products: Trust.

Power Devices from Mitsubishi Electric.

LV100 and HV100: The new high voltage power modules of Mitsubishi Electric for a safe and greener tomorrow. The newly developed dual module structure is reducing the thermal stress applied to Si- and SiC-power chips, enabling a low internal package inductance and allowing good scalability for flexible power electronics solutions. Latest proved technologies are applied to satisfy reliable operation and long life time requirements in demanding applications as Railway, Wind generators and MV-drives.

LV100 and HV100 High Voltage Power Modules

- IGBT chips with latest generation CSTBT™ technology and RFC diodes
- Robust main terminals suitable for doubling the rated module current in case of using SiC-chips
- Eliminating of substrate solder by new MCB (Metal Casting direct Bonding) technology
- High robustness/resistance against environmental influences due to the newly developed SCC (Surface Charge Control) process
- Module case material suitable for high pollution degree and fire inhibition according to EN45545

eco Changes **for a greener tomorrow**

More Information:
semis.info@meg.mee.com
www.mitsubishichips.eu

Scan and learn more about this product series on YouTube.

MITSUBISHI ELECTRIC
Changes for the Better

Line-up Expansion of X-Series High Voltage IGBT Modules in the 3300 V Class

The 3300 V X-Series continues the success story of the R- and the H-Series power modules of Mitsubishi Electric by improving the overall performance of the device.

By Eugen Wiesner and Eugen Stumpf Mitsubishi Electric Europe B. V. and H. Uemura Mitsubishi Electric Corporation

Introduction

Major applications using 3300 V IGBT modules like traction, medium voltage drives or power transmission & distribution require an absolute minimization of the number of field failures. Taking into consideration all possible worst case application conditions, it must be ensured that the device must be operated safely inside the technical specification. But in reality, it is sometimes impossible to predict all the worst case conditions which might occur during an actual field operation. That is the reason behind the requirement which states that IGBT modules must have reasonable margin between the parameters representing the module specifications and the critical operation of the module. The 3300 V X-Series was developed to improve the device durability, reliability and to further minimize the failure probability during an actual operation in the field. This article describes the basic points of the X-Series design including the improvements contributing to a safe operation of the device to ensure an overall good performance.

Seventh Generation 3300 V IGBT chip

The first 3300 V modules (H-Series) were released by Mitsubishi Electric in 1997. The IGBT chip performance has been continuously improved over time since the release of the first generation. The first H-Series power devices have a planer gate IGBT chip structure. The subsequent R-Series devices utilize an improved planar gate structure thereby allowing a wide operation temperature range from -50 °C to 150 °C. Furthermore a reduction of power losses and an increase in the module power density was achieved.

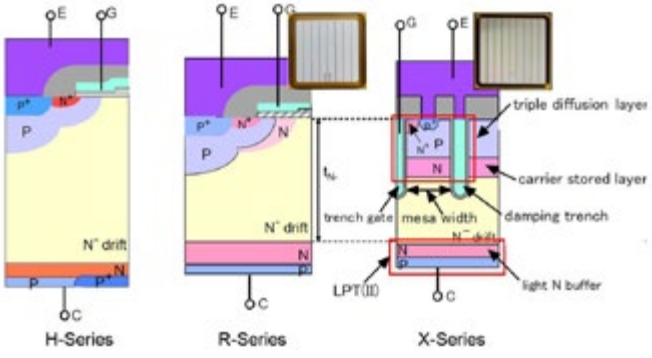


Figure 1: 3300V IGBT chip evolution

The development sequence of the 3300 V IGBT chips has been represented in Figure 1. The X-Series 3300 V IGBT chips contribute to a further increase in the module power density and an additional improvement in the IGBT power module characteristics. The CM1800HC-66X will be the first device out of this new 3,3 kV X-Series that will be available in Q2/2017. It has the current rating of 1800A, it is a standard package with a foot print of 190 mm x 140 mm possessing an isolation voltage of 6 kV(AC).

Trade-off for Optimizing the IGBT Performance

The Figure 2 shows the fundamental triangular trade-off relationship of the IGBT power device. Three main parameters – the IGBT forward voltage (VCE(sat)), the turn off energy (EOFF) and the safe operating area (SOA) are strongly related to each other [1]. Additionally, the Short Circuit Safe Operating Area (SCSOA) is an important parameter which affects the optimization potential of other parameters. The consequent improvement of one parameter - like the reduction of the IGBT forward voltage may cause the increase of the short circuit current. The short circuit time tSC representing the SCSOA will thus be reduced.

Figure 2: Fundamental trade-off for IGBT characteristics

The X-Series 3300 V IGBT chip was designed to provide an optimized and a balanced performance between IGBT forward voltage VCE(sat), turn-off switching energy EOFF and safe operating area. The design target was to maintain the 10 µs short circuit time (which is an existing market standard) along with a reasonable safety margin. The VCE(sat) versus EOFF trade-off curve of the X-Series is shown in Figure 3. The forward voltage was reduced by about 30% compared to the previous planar R-Series devices. The turn-off energy was maintained on the same level. This improvement was possible by adopting the trench gate structure CSTBT(III)TM and increasing the active chip area. The increase of the active chip area was possible by using an advanced guard-ring structure [2].

Even with such an improvement in the forward voltage, the short circuit current is relatively low thereby permitting the utilization of a short circuit time duration of 10 µs.

To design a power module with adequate safety and reliability, it is also important to know the real limitation of the module. In this regard, the module will be tested to ascertain the point of failure and the device under test therefore will be subjected to extended short circuit time duration. Figure 4 shows the typical short circuit measurement result with CM1800HC-66X module at maximum operation conditions of T_J=150 °C and V_{CC}=2500 V with a time duration of 15 µs. Apart from the short circuit energy, the short circuit time is also a parameter which indicates the short circuit device capability. With respect to the test result mentioned in Figure 4, the short circuit energy dissipated was more than 250 J. The 15µs time duration is 50% higher compared to the standard value of 10 µs, although the device could withstand 15 µs without failure.

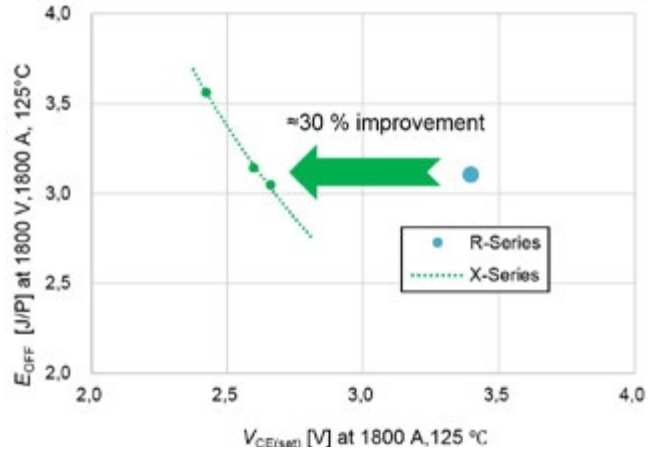


Figure 3: trade off $V_{CE(sat)}$ vs. E_{OFF} at T_J =125°C

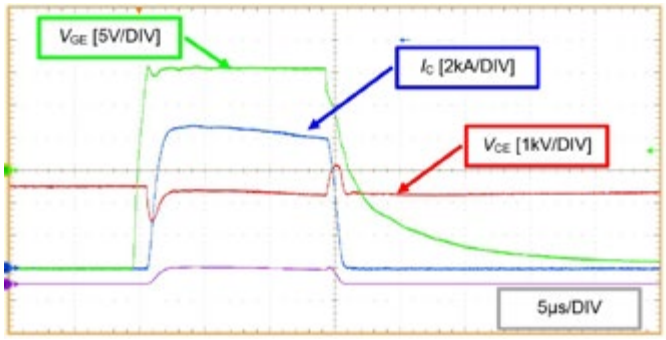


Figure 4: typical short circuit evaluation waveforms at T_J=150 °C, V_{CC}=2500 V

The durability of the 7th Gen. IGBT chip to endure short circuit types II and III was already demonstrated with the X-Series first runner 6500 V power module - CM1000HG-130XA [3].

Furthermore, the contribution of the guard-ring size reduction is the improvement of the thermal resistance between junction and case. Compared to the R-Series, the thermal resistance (junction to case) was improved by about 11% for the IGBT and by about 8% for the diode. This also contributes to enhancement of the module power density.

Case Study for Inverter Operation

The overall electrical and thermal performance characteristics improvement can be represented by simulation result in the three phase inverter operation. The diagram in Fig. 5 shows the simulation result of the normalized RMS output current versus switching frequency under the conditions: VCC=1800 V, m=1, cos(φ)=0,9, TJ=150 °C and the junction to case temperature increase of 10 K. At the switching frequency of 300 Hz, the RMS output current of CM1800HC-66X power module can be increase by about 20% compared to CM1500HC-66R device.

The CM1800HC-66X was designed not only to deliver good electrical performance, but also to withstand harsh environmental conditions like high humidity. The part of the module that is most sensitive to humidity is the chip guard ring area. With the newly adopted Surface Charge Control (SCC) technology, it is possible to control the surface charge in the guard ring area to achieve significant humidity withstand capability even when the guard ring width is reduced [4].

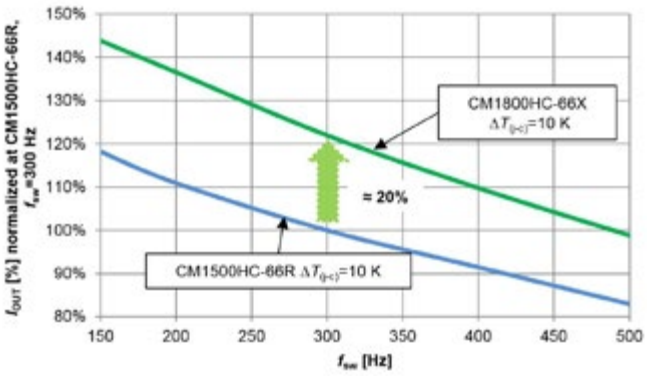


Figure 5: Inverter output current versus switching frequency at V_{CC}=1800 V, cos(φ)=0,9, m=1, T_J=150 °C.

Conclusion

The new CM1800HC-66X power module allows an improvement in the converter design by reducing the power losses or increasing the converter power density. Furthermore it continues MITSUBISHI's tradition of delivering high reliability and enabling a durable design in the 3300 V class IGBT power modules.

References

[1] T. Minato and H. Takahashi, "New Power-Element Technology", Mitsubishi Electric ADVANCE, pp. 24-27, 2004.
[2] Ze Chen, et al, "A balanced High Voltage IGBT Design with Ultra Dynamic Ruggedness and Area-efficient Edge Termination," Proc. ISPSD 2013, p 37, Kanazawa, Japan.
[3] N. Tanaka, "Durable Design of the new HVIGBT Module", PCIM 2015.
[4] Sh. Honda, "High Voltage Device Edge Termination for Wide Temperature plus Humidity with Surface Charge Control Technology", ISPSD 2016.

Measuring Systems with High Accuracy and Work Speed

Nowadays the spheres of power semiconductors usage are enhancing. Along with the production development and new types of power supplying the requirements for load capacity of power semiconductors are rising.

By Paul Semenov, Head of Automation Lab, R&D Center, Proton-Electrotex

Introduction

The goal of meeting the requirements demands the joint power semiconductor usage in high loaded electric circuit, which in its turn defines special requirements for major characteristics measurement accuracy, as well as reliability and capacity of measuring equipment. For the purposes mentioned engineers of Proton-Electrotex automation laboratory have developed the line of measuring systems, which comply with the most demanding accuracy and work speed requirements, providing the high level of flexibility and work convenience for all users from operators and maintenance services to technicians and quality engineers.

Equipment description

Measuring equipment represent module systems. According to the necessities it is possible to configure the system as both manual and automated measuring post. The basic features of module principle are represented below:

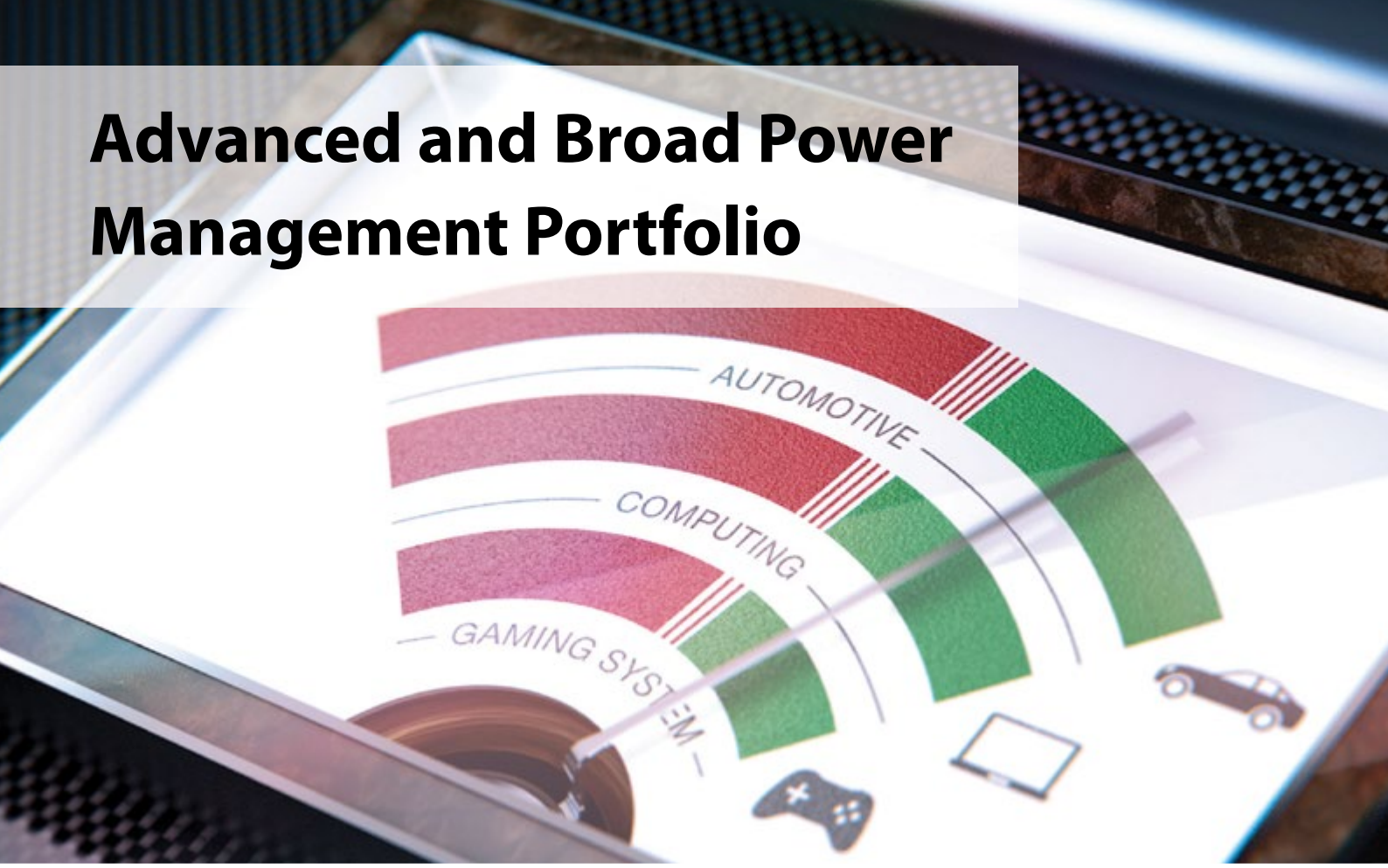
- Module design allows to configure the equipment for purposes of a certain task, combining the necessary units into one measuring system. Such approach allows to reduce organization measuring process costs, as there is no need in purchasing the broadband laboratory measuring device, and additionally the opportunity to use the perfectly matching equipment.
- Simplicity and economic efficiency of building-up. Power capacity as well as the spectrum of measurements might be increased as a consequence of using module design and applying new units. Hereby the equipment might be easily configured according to the altering demands of the measuring process. Let us admit the necessity of adding new and enhancing the range of existing parameters. The reason for such a necessity might be in the launch of a new product or equipment. Modular measuring equipment allows to connect new measuring units to already existing systems. Consequently, the cost reduction connected with equipment modernization exists.
- The third critical feature is the maintenance simplicity. This feature is particularly relevant when organizing automatic flow measurements, as the process stoppage may lead to enormous losses. Module structure allows to reduce the repair simply up to scale of whole serviceable unit replacement. The time of unproductive time loss will be substantially reduced. For instance, there is time for carrying out the maintenance of some units. The sequence of maintenance actions would be: stopping the production line, dismantle the required unit, connect the temporary unit and proceed to the production process. The system possesses the opportunity to remain functioning with disconnected units. Due to this feature the launch of the equipment is possible within 1 or 2 hours upon condition the stock units have been installed. The replaced units are subject to diagnostics.

Currently the following set of measuring units has been designed and implemented in order to meet the requirements for available acceptance tests measurements:

1. Static losses measurement unit. Measuring current up to 12.6кА
2. Blocking characteristics measurement unit. Current up to 8000V, current creepage up to 500mA (power semiconductor up to 65 class)
3. Drive gate characteristics measurement unit.
4. Isolation resistance, cathode-anode resistance, isolation dielectric strength measurement unit for 6 kV AC/10kV DC at current 10 mA.
5. Critical rate of rise of direct voltage measurement unit. Up to 2500V / μs, up to 4500V (power semiconductors up to 65 class)
6. Reverse recovery charge measuring unit
7. Surge reverse power dissipation measuring unit
8. The measuring system is equipped with additional measuring units which provides more simplicity and convenience:
9. Interface unit. The unit is equipped with a 17 inch sensor unit which provides the convenient computer interface with the opportunity to adjust the measuring and analysis process.
10. Commutation unit allows to conduct all measurements at once – as high voltage measurements as high current.
11. Stable circuit voltage unit. Allows to level down the circuit power supply noise impact on the measurement process.
12. The special equipment has been developed for design tests for surge current up to 120kA.
13. Measuring units for IGBT measurements for both static and dynamic parameters at the stage of industrial tests.

The manual measuring workplace consists of the measuring equipment with connected clamping device. A huge variety of clamping devices applicable to various types of measured components allows

Advanced and Broad Power Management Portfolio



Microchip Technology has an expansive offering of power management solutions to fit virtually every type of design criteria. From the smallest form factor needed for mobile devices to complex industrial power management designs to automotive standards, you are sure to find a highly integrated solution to meet your needs. If you are looking for greater flexibility in your design, Microchip's digitally enhanced power analog devices integrate a microcontroller (MCU) or digital signal controller (DSC) for a fully programmable and flexible solution.

Applications:

- LDO and switching regulators
- Charge pump DC/DC converters
- Power MOSFET drivers
- Digitally enhanced and PWM controllers
- System supervisors
- Voltage detectors
- Voltage references
- Li-Ion/Li-Polymer battery chargers
- Power MOSFETs

microchip DIRECT
www.microchipdirect.com

MICROCHIP

www.microchip.com/powermanagement

to choose the optimum option for particular customers demand. The most technically complicated devices are the clamping devices with electro-mechanical drive, which allow to generate force up to 150kN and heating up to 200° C. The measuring system and clamping device are mounted in the 19" racks . The work place of the operator is the clamping device and measuring system equipped with heating and cooling systems. Human-machine interface unit and special table console provide the ergonomics of operator's workplace of the highest level.

In case of automated line the clamping devices are set up in a row in front of three-degree-of-freedom manipulator which moves the devices measured between the measuring stations. The automated parameter control system (code name ATSM) for module devices is currently put into operation. This system allows to conduct the measurements at the room temperature as well as at maximum junction temperature. Both measurements are carried out sequentially in different clamping devices which allows to get all range of characteristics for one run through the measurement system. Besides, the insulation resistance measurement are carried out. The main benchmark feature of ATSM is the automated valid devices marking. As a result the devices are identified unambiguously as a result of the measurements at ATSM, and the probability of faulty devices being dispatched to the customer is reduced to zero. The operator's task is to load a lot of devices into ATSM and unload measured and marked devices.

The infrastructure of information measurement system.
The infrastructure of information measurement system represents the distributed network solution. Every measuring system is connected to the corporate network with the host server. Measuring systems cooperate within the network and pass the data to the hosting server and receive configuration and measurements profiles.

In order to obtain a complete understanding of a system it is recommended to begin with the description of the operator's work in conditions of manual measurement activation. The operator receives devices which is required to measure. Using the bar code scanner the operator enter the measured devices type. Measuring system requests the measurement parameters of measurement profile for the type entered at the host server.

Then the operator enters the unique code for the measured device with the help of sensor display or scanner, loads the device into the clamping device and presses the "start" button. All measurements are carried out complying with the measurement conditions in a completely automated mode. The results are saved and then are transferred to the host server for storing in the central database of the information measurement system. The operator's only duty left is to unload the measured device and then to put next one inside the clamping device.

At first sight the whole procedure looks pretty simple. Though if the question of how the work of operator has become so simple and how the possible mistake was led down to zero, then the question of measurement profiles arises. These profiles have to be designed for all possible types of devices and their modifications in accordance with technical conditions and special additional requirements. Measurement profiles should be maintained properly to stay valid. Let us imagine that the enterprise puts not one or two MME but five or ten of them into operation. The issue of maintenance and adjustment becomes then the significant challenge. However this could be solved by the information system infrastructure easily and effectively. The maintenance service engineers at their workplace which could be any PC connected to the corporate network launches the managing software and carry out the centralized adjustment and changes the measurement profiles. Such software provides the opportunity to change existing profiles, creating new profiles, searching for available profiles. For instance there is no need in having access to profiles for stud devices at the MME for disk devices. More than that, in such a software the security policies might be set up for regulating the access of different operators to different systems. The sufficient opportunity for integration between the host server and various information systems like ERP systems, which could provide the data for measurement profile compilation.

We have observed the technical aspect of measurement tests process concerning minimum level of human error.

However that is not the first priority goal for such information system of measurements structure, as the main goal is to obtain and analyze the measurements' results. As it has already been referred to higher the measurement results are saved automatically in the central database. Upon completion of measurements the operator has an opportunity to print the test measurement protocol for a particular lot on demand. Additionally to that, the special software could be used for the demands of technological and engineering departments. All measurement test results will constitute interest for technologists in order to analyze these data through the time range. Such analytical software might be launched using any PC connected to the corporate network. This software gives an opportunity to draw various reports, slicers on different options: time ranges, lots, types of devices. Using these reports and slicers it becomes more effective to monitor the stability of production process. These data might a source of SPC or other intellectual data analitics using the neural networks and fuzzy logic. The data might be exported into the third party software. Among other features software allows to prepare and print any types of test protocols, required by customers or producers. The opportunity for integration of the centralized database with the corporate website is substantial for convenience of clients, as they would be able to obtain true and precise parameters of a semiconductor device using its serial number. This feature is also applicable for those customers who are designing the devices using semiconductors as components.

The automated measuring systems are much easier to be operated as the operator only has to load the batch of devices into the automated system and unload the measured and marked devices. All other processes are conducted fully automated yet likewise in manual mode.

Conclusion
To summarize it all mentioned above, the equipment designed and produced by Proton-Electrotex automation laboratory satisfies the demands of a wide segment of customers. Modularity of equipment allows to match and configure the measurement system satisfying the most modest demands. Usually companies which are servicing and conduct maintenance of the semiconductor containing equipment demand for such systems. Infrastructure of information system of measurements allows to match and configure huge and automated systems, applicable for medium and large semiconductor manufacturers.
Additionally to the above we need to claim that Proton-Electrotex has initiated the process of mobile low- power measurement systems development for field use and in 2017 the first market samples will be available.

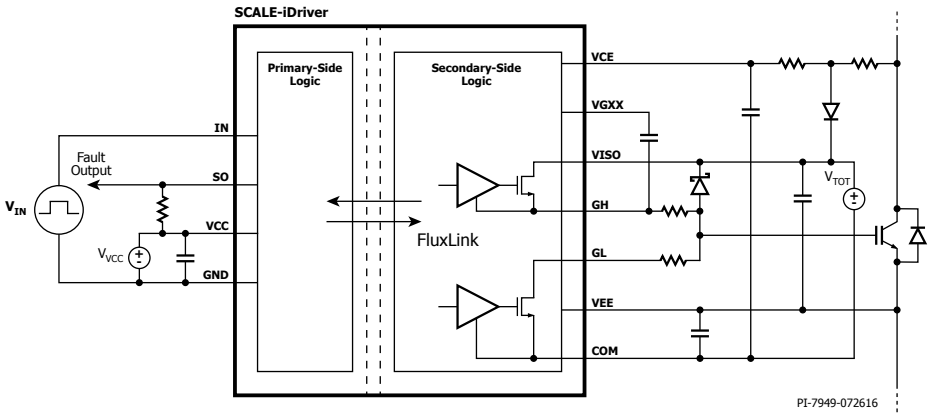
paul.semenov@proton-electrotex.com

www.proton-electrotex.com

power integrations™

SCALE-iDriver™ Family

Single-Channel Gate Driver ICs with Reinforced Isolation



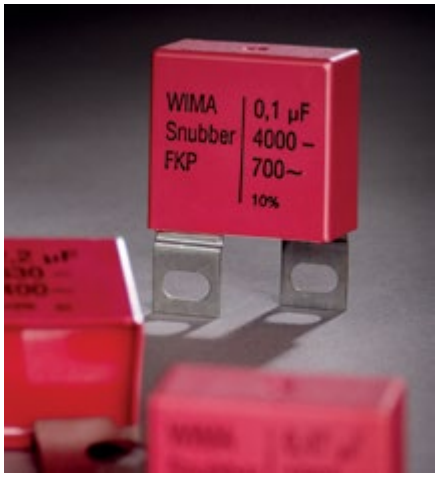
- 2.5 A, 5 A, 8 A output current devices
- Drives 1200 V IGBTs and MOSFETs up to 110 kW
- Revolutionary FluxLink™ communication technology
- Low profile with 9.5 mm creepage and reinforced isolation

www.power.com

ac-dc converters

led drivers

igbt drivers



Reformation of Snubber Capacitors

WIMA has reworked and extended its Snubber Capacitor Ranges. The standard lug versions were submitted to thorough verification and - if necessary - adjusted to the requirements of modern IGBTs.

The WIMA Snubber MKP range with double-sided metallization and internal series connection was extended by three additional voltage ranges 850 VDC, 1250 VDC and 2500 VDC. The capacitance range now comprises values from 0.047 µF up to 8 µF and voltage ranges of 700 VDC up to 3000 VDC.

As for the especially pulse resistant WIMA Snubber FKP range numerous values were added and case sizes changed. Moreover, a new 1250 VDC range was added. The range now shows capacitance values of 0.01 µF up to 3.3 µF and rated voltages of 630 VDC to 4000 VDC.

WIMA Snubber capacitors are manufactured under mass production conditions, but are also available in lower quantities as individually designable components.

http://www.wima.com

Flat Aluminum Electrolytic Capacitors offer 5,000 Hour Life at 125 °C

Cornell Dubilier Electronics, Inc. (CDE) has introduced the latest in its series of Flatpack ruggedized flat aluminum electrolytic capacitor, the MLSG. This series targets compact power supply applications in military and aerospace, as well as other critical systems. Design enhancements and a new electrolyte push the MLSG to nearly double the operating life of its predecessor, at no added cost. Two principal package profiles are offered in this technology, the MLSG Flatpack which measures just 0.5” thick and 1.75” wide and the MLSG Slimpack measuring 0.5” thick by 1.00” wide, both offered in length increments of, 1.5”, 2.0”, 2.5” or 3.0”.

MLSG Flatpack capacitors can be made to withstand up to 50g vibrations (10g standard) and altitudes greater than 80,000 feet. With stainless steel cases and near hermetic welded seals, they are built for extended duty in very harsh conditions. Especially noteworthy is that a high level of performance is maintained over the full operating temperature range. Capacitance retention at -55 °C is very strong, with excellent high temperature performance up to +125 °C. The new electrolyte system is fully REACH compliant, allowing application of the components in a broad range of applications where space efficiency and extraordinarily long life are required.

www.cde.com/MLSG/MLSGFlatpack.htm

Efficient 360-500W Baseplate-Cooled Half-Brick DC-DC Converter

Murata is announcing a new development effort for industrial class DC-DC half brick converter modules from Murata Power Solutions. The ICH series of industrial grade, isolated DC-DC converters provide highly efficient, baseplate-cooled power from 360 Watts up to 500 Watts from an industry-standard half-brick package measuring 2.40 x 2.50 x 0.52 inches (61.0 x 64.0 x 13.2 mm). The ICH series was designed for rough service or industrial applications and incorporates features such as a wide 4:1 input voltage range, from 9 to 36 VDC, and a specially designed package/baseplate that allows conduction cooling for improved thermal performance including closed-box applications. These highly efficient converters, typically up to 95.7% for the 500 Watt unit, are available in three single-output models providing regulated 12, 24, or 28 VDC. The electrical and mechanical design allows the ICH series to deliver the full power rating with a baseplate temperature of -40°C to +105°C without derating. In addition, the ICH is designed to meet the environmental stress limits for shock & vibration specified in MIL–STD810G throughout its service life.

muRata
INNOVATOR IN ELECTRONICS

The ICH series achieves its high performance by incorporating proprietary circuit architectures, advanced packaging, and thermal design advances. The outputs are fully isolated from the input supply, allowing flexibility for various grounding requirements or for creating positive or negative outputs. Galvanic input to output isolation rated at 2250 VDC, incorporating a Basic insulation system, are standard across all models. The ICH series has been designed to meet EN60950, UL/CSA safety requirements for imbedded power modules.

www.murata.com

High-Speed DC Load Solves Point-of-Load Converter Test Challenges

Intepro Systems announces the EL 2000 HS (high-speed) electronic DC load as the latest addition to its growing family of power system automatic test equipment (ATE). The EL 2000 HS Series is a stand-alone 40W load module providing point-of-load (POL) connections and point-of-use (POU) for fast slew rate DC loading. Ever-higher switching speeds and lower operating voltages present unique challenges in testing POL/POU power conversion systems. In response, the EL 2000 HS load offers a smart on-board load head that minimizes inductance, resistive losses and noise, which pose serious problems with loads using wires to connect the load to the device-under-test (DUT). In addition, the EL 2000 HS is designed for sub-1V testing to meet the demands of low-voltage devices.

The EL 2000 HS's standalone modular POU design, along with its smart on-board load head, allows for positioning the load to DUT without the need for customization. The standard load offers four programmable modes of operation: constant current, constant resistance, constant power and constant voltage. All have a 50MHz measurement bandwidth with a 150MS/s, 14-bit digitizer. Measurements include voltage, current, power, noise,

settling time and overshoot/undershoot for both V and I. The standard 20V/20A/40W module can sink 20A with only 0.3V applied to the load head. In constant-current mode the module achieves 40A/μs rise time with a 20A load for high-speed pulse loading when conducting real load simulation of high-bandwidth devices. Ethernet control allows for easy operation by utilizing either Intepro's PowerStar software package or third-party software.

www.inteproATE.com

DC/DC Converter B05xxLD-1WR2 & B05xxLS-1WR2 Series Specialized for BMS

BMS system generally adopts LTC680X chip to monitor each lithium battery block. Based on it, MORNSUN developed a new 50VDC and 60VDC DC/DC converter B05xxLD-1WR2 and B05xxLS-1WR2 series specialized for BMS. They aim to reduce energy consumption of lithium battery pack and extend the battery mileage.

The series offer stable 50VDC or 60VDC output ensuring the accuracy of monitored chip, meet requirements of EMI CISPR25 CLASS 3 standard and electrostatic discharge of ISO 10605±8KV and have high reliability.

Features:

- Meet requirements of EMI CISPR25 CLASS 3 standard
- Operating temperature: -40°C to +85°C
- Efficiency up to 79%
- High power density
- Isolation: 1500VDC
- International standard pin-out

www.mornsun-power.com

ICD-A: Automotive Measuring Technology System

The latest product development in measurement technology from Isabellenhütte is a compact current measuring module. The shunt-based ICD-A system has a sealed six-pole MCON connector, which is commonly used in the automotive industry. It protects the signal and power transmission from external influences. With transmission rates of up to 1 Mbit/s, the connection provides digitised data in CAN bus 2.0 format, and ensures a high level of measurement precision for its users. The microcontroller used for digitisation includes, among other features, an AC/DC converter, temperature measurement and voltage regulation. This solution also stands out from the crowd thanks to its ultra-low energy consumption, which the sensor can also measure and supply independently – an advantage that is particularly important in the area of e-mobility. The ICD-A is available in three variations with different current levels: 100 A, 300 A and 500 A. All models have the same dimensions.

www.isabellenhuette.de

OptiMOS™ 5 150 V Delivers a Breakthrough Reduction in On-State Resistance

Infineon Technologies AG introduces the OptiMOS™ 5 150 V portfolio. This product family further expands the industry leading OptiMOS 5 generation of power MOSFETs. The new 150 V product family is especially optimized for high performance applications which require low charges, high power density and yet high ruggedness. It is an important contributor to Infineon's system solutions for low voltage drives, synchronous rectification in telecom rectifiers and brick converters as well as solar power optimizers.

Greener technologies: Infineon is constantly developing products which help to reduce the global CO 2 emissions by enabling high efficiency designs. OptiMOS 5 150 V contributes to this goal by decreasing the power consumption of telecommunication equipment or increasing the power and range of electric vehicles. Compared to the next best alternative, OptiMOS 5 150 V offers a breakthrough reduction in on-state resistance R DS(on) of 25 percent in a SuperSO8 package and the FOM g is improved by up to 29 percent over the previous generation. Increased commutation ruggedness is provided by the ultra-low Q rr, which is 72 percent lower than the next best alternative in SuperSO8. An additional outstanding feature of this product family is an improved EMI behaviour.

http://www.infineon.com/optimos5-150V

Sixpack Topology, Extended Power Range in a MiniSKiiP® Module

Vincotech, a supplier of module-based solutions for power electronics, today announced that the company has released a new MiniSKiiP® product line. Featuring sixpack topology and able to handle up to 200 A, these MiniSKiiP® PACK 2 and MiniSKiiP® PACK 3 modules are available with the new Mitsubishi Electric›s latest gen 7 chips.

Vincotech's 1200 V MiniSKiiP® PACK 2 & 3 modules reduce static losses by 20 %. Designed for industrial and embedded drive applications, these sixpack modules provide superior EMI behavior and cut overall system costs. With the benefit of this extended power range of up to 200 A in the MiniSKiiP® PACK 3 module, it is far more easy for engineers to turn up flexible, scalable inverter designs.

www.vincotech.com/PACK-M7

http://www.vincotech.com/products/by-topologies.html

Second Generation Portfolio with Lower On-Resistance

Transphorm Inc. announced its latest portfolio addition: the TPH3212PS. Available in a TO-220 package, the device has an on-resistance of 72 mOhms (mΩ) and targets AC to DC and DC to AC power supplies. When used inside the former, the TPH3212PS—along with its family members—makes implementing bridgeless totem-pole power factor correction (PFC) designs possible.

To date, Transphorm's product portfolio consists of 600V and 650V discrete FETs spanning TO-220, TO-247, and PQFN88 packages for power levels up to 4.5 kilowatts. The TPH3212PS fills a power level gap in the company's second generation product line, specifically between the 52mΩ and 110mΩ FETs. As a result, battery charger, PV inverter, server and servo motor manufacturers gain more design flexibility with Transphorm's newest high-quality, high-reliability discrete device.

Release of the TPH3212PS remains in step with Transphorm's mission to enable design engineers to effectively implement GaN technology into designs. The company develops its GaN in well-understood TO-XXX and PQFN88 packages. Further, Transphorm uses the high-reliability cascode configuration, which eliminates the need for custom drivers and—most importantly—considerably increases the GaN FET's gate safety margin.

http://www.transphormusa.com/

Microsize DC / DC High Voltage Power Supplies

Dean Technology, Inc., announced the introduction of its PMT series of high voltage, microsize, DC / DC power supplies. The series offers standard parts with input voltages of 12, 15, and 24 volts, and outputs up to 1,500 volts and 1 watt. All parts in the series are UL Recognized Components and have CE certification.

This series of power supplies are ideal for countless applications, including photomultipliers, ionizers, and various electrostatic solutions. They have an analog controlled adjustable output, and an industry leading low ripple for uses that require very stable output. As UL Recognized Components and with CE certification, they are ready for integration in complex systems.

Standard versions of the PMT series are offered with both positive and negative adjustable outputs up to 600 volts through 1,500 volts. Custom versions are also available, with minimum design times, and production costs similar to the standard parts. Full product details can be found on the company's website, and the parts are in stock and immediately available directly from Dean Technology or through any approved sales channel.

www.deantechnology.com

Line of USB 2.0 and 3.0 Connectors Expands Interconnect Portfolio

CUI's Components Group announced an expansion to its existing portfolio of power, audio and signal connectors with the addition of a USB product line. The new connector family incorporates USB 2.0 and 3.0 connectors available in Type A, Type B, Micro AB, Micro B, Mini AB and Mini B USB versions. Able to support data rates up to 5 Gbps in USB 3.0 models, the product family is ideal for a variety of I/O applications in consumer and portable electronic devices, including mobile computing equipment, digital audio devices and high volume storage products.

Offered in jack or plug connector types with horizontal or vertical orientations depending on the model, the new USB line boasts a number of mounting styles including surface mount, cable mount, mid mount SMT and through hole, allowing them to plug into virtually any design. All models feature a voltage rating of 30 Vac, current ratings of 1 or 1.8 A and reliability as high as 10,000 mating cycles for specific models. Color insulator options of black, blue and white are also offered. The USB connectors also feature an operating temperature range of 25 to 85°C and RoHS compliance.

http://www.cui.com/contact

3"x2" 40W-100W AC-PSU for Medical-Grade Applications

RECOM's RACM series of medical-grade AC/DC power supplies offer full performance at elevated ambient temperature levels, for example in enclosures where forced cooling is not possible because of hygiene, safety, contamination or acoustic noise.

The 40W, 65W and 100W modules offer continuous output power with free air convection cooling. All power supplies are CE marked and 3rd Edition UL/IEC/EN60601-1 medical certified with 2MOPP/ 250VAC, ultra-low leakage (75µA) and BF-rated, trimmable 5V to 48VDC output voltages.

The RACM series offers an efficiency of up to 93%, low power dissipation and tight regulation over a wide range of output load and input voltage variations. No load power consumption is below 0.3W, ensuring that they conform to the ErP Ecodesign Directive.

The space-saving models are only 3"x2" and are available in open-frame and metal-enclosed designs (100W only available in metal enclosure). The metal-enclosed design is shielded for conducted cooling and operator protection. All models operate from -40°C up to +85°C. These Class II power supplies have 4kVAC reinforced isolation between input and output and 1.5kVAC between input/output and EMC ground. All modules comply with EN60601-1-2 Medical EMC, FCC18 and EN55011 Class B EMC standards without external filtering and come with a 5-year warranty.

www.recom-power.com

CPC1010N Expands Offering of Small Outline Package SSRs

IXYS Integrated Circuits Division announced the immediate availability of the CPC1010N, 250V, single-pole, normally open (1-Form-A) Solid State Relay (SSR) with a 170mA load current rating. The CPC1010N is specially designed to provide the best combination of performance, size and price.

Packaged in a 4-pin SOP, the CPC1010N employs optically coupled MOSFET technology to provide 1500Vrms of input to output isolation. The efficient MOSFET switches and isolated driver IC use IXYS ICD's patented OptoMOS architecture and technology.

IXYS ICD's advanced molded vertical construction makes the CPC1010N one of the world's smallest relays and offers board space savings over the competitor's larger 4-pin SOP relay. Additional features include low drive power requirements, high reliability, arc-free with no snubbing circuits, and no EMI/RFI generation. The CPC1010N is designed to replace, and offers superior reliability over, electromechanical relays. The 250 volt load voltage rating, 170mA load current rating and 11.5 ohms of on-resistance makes this device suitable for industrial applications, instrumentation, multiplexers, data acquisition, and electronic switching.

Approvals include: UL Recognized Component: File E76270, CSA Certified Component: Certificate 1172007, EN/IEC 60950-1 Certified Component: TUV Certificate B 13 12 82667 003.

www.ixysic.com

www.ixys.com

TRAFIM LEVEL 8 DC-Link Capacitors

TPC (AVX Group) started the next level of TRAFIM Evolution ! The well known TRAFIM High Power Capacitor family with "controlled self healing" belongs to the most compact and safe Powercapacitors, available in the market.

The actual improvement, compared to the classic TRAFIM, is the increase of the maximum Hot Spot Temperature to 95° C instead of 85° C with the former style. Also the Life-Time improve, offering now 100.000 hours at 80° C Hot-Spot instead of only 70° C Hot-Spot temperature, compared to common Power Capacitors in the market. Rapseed Oil impregnation is offering highest safety (because of very low gasemission during selfhealing process) with low FIT Rates.

The TRAFIM Technology offers a high energy density - reduced shape - following the demand for traction application or new motor-drives. TRAFIM is able to meet EN45545-02/-05 and other regular Standards for power capacitors. The Voltage Range of TRAFIM Level 8 Capacitors starts at 1850Vdc climbing up in steps of 250Vdc/500Vdc up to 6000Vdc.

Contact Partner in D-A-CH Region is MUECAP Bauelemente GmbH in Munich

www.muecap.de

Compact 12A POL DC-DC Converters have a wide 0.7V to 8.5V output range

TDK Corporation announces the introduction of the iCH series of 12A Point of Load (POL) non-isolated DC-DC converters, featuring a wide 0.7V to 8.5V output adjustment range. Operating from a 4.5Vdc to 14Vdc, the products can operate from either a 5V and 12Vdc bus voltage, avoiding the need to stock multiple part numbers.

Measuring just 12.2 x 12.2 x 8.5mm and weighing just 2.5g, these compact converters are ideally suited for a wide range of applications, including communications, broadcast, industrial and test and measurement equipment.

Up to 97% efficiency minimises internal heating, allowing the full 12A operation in natural convection and low airflow environments with ambient temperatures of up to 70ºC. The iCH converters have excellent transient response characteristics, without the need for externally mounted loop tuning circuitry. Standard features include a trim pin for output voltage adjustment, positive remote sense, remote on-off (positive or negative logic), input under-voltage, over-current and over-temperature protection. A DC Good (low on fail) signal provides indication that the output is outside of the +/-12% set point tolerance. Safety certification includes IEC/EN 60950-1, UL/CSA 60950-1 with CE marking for the Low Voltage and RoHS2 Directives.

www.de.tdk-lambda.com/ich

Automotive-Grade Constant-Current PWM Dimmable Buck Regulator LED Driver

Allegro MicroSystems Europe has introduced an automotive, AEC-Q100 qualified single IC switching regulator that provides constant-current output to drive high-power LEDs.

Allegro's A6217 integrates a high-side N-channel DMOS switch for DC-to-DC step-down (buck) conversion. A true average current is output using a cycle-by-cycle, controlled on-time method. This LED driver is targeted at the automotive lighting market and includes the following key applications: daytime running lights, front and rear fog lights, turn/stop lights, map lights, and dimmable interior lights.

Output current is user-selectable by an external current sense resistor. Output voltage is automatically adjusted to drive various numbers of LEDs in a single string, ensuring optimal system efficiency. LED dimming can be accomplished by logic-level or "chopped battery" PWM, as well as analogue dimming capability. The A6217 also features switching frequency dithering for reduced EMI signature.

www.allegromicro.com

125°C- rated GFET3 and HFET1 Integrated Power Switches

Silego Technology made this announcement of five new products include a suite of system-level protection features. In space-constrained applications, elevated operating temperatures place additional performance burdens on system protection devices. In many cases, system designers are forced to select less robust products or implement discrete, pcb-space-consuming alternatives when in-circuit ambient temperatures exceed 85°C or 105°C.

For supply-voltage applications up to 5 V, Silego announced the 8.4 mΩ/4 A SLG-59M1657V, the 17 mΩ/2.5 A SLG59M1658V, and the 13 mΩ/3.5 A SLG59M1707V. In addition, the SLG59M1707V's analog current monitor output feature offers substantial system BOM cost/pcb savings by eliminating the need for an external current shunt resistor, a difference/level-shifting amplifier, and associated passive components to measure directly FET current. Depending upon the application's maximum operating current, pcb footprints range from 1.6 mm^2 to 4 mm^2.
For supply-voltage applications up to 24 V, Silego announced the 13.3 mΩ/4 A SL-G59H1013V and the 13.1 mΩ/3.5 A SLG59H1016V, in 4.8 mm2 package sizes.

http://www.silego.com/

Advertising Index

ABB Semiconductor	C3+47	Microchip	39
APEC	33	Mitsubishi	35
CDE	11	Mornsun	43
Danfoss	27	MPS	15
Dr.-Ing. Seibt	31	PCIM 2017	45
electronic concepts	1	Power Integration	41
Fuji Electric Europe	9	Proton	29
GvA	C2	Semikron	17+25
Hioki	48	STM	19+21
Hivolt	37	TDK Epcos	7
Infineon	C4	USCi	13
ITPR	44	Vincotech	23
LEM	5	VMI	29
Malico	1+12	Würth	3

Let’s write the future
with high-quality products for industrial applications.

ABB is regarded as one of the world’s leading suppliers of high-power semiconductors, setting standards for quality and performance. Our unique knowledge in the field now expands to industry standard medium-power IGBT, as we launch the 62Pak phase leg IGBT modules, featuring 1700 V voltage class and choice of 150 A, 200 A, and 300 A current ratings, all in standard 62 mm packages. The 62Paks are designed for low-loss performance and the highest operating temperatures in demanding medium-power applications, such as variable speed drives, power supplies, and renewables.
abb.com/semiconductors

Smooth and powerful

Infineon® Power Start modules for soft-start applications up to 300 kW

Application specific product design offers:

- 70 % faster time-to-market
- 20 % higher power density
- 100 % cost savings in stack production

www.ifbip-shop.com | www.infineon.com/powerstart

Infineon Technologies Bipolar