

pcim
EUROPE

International Exhibition and Conference
for Power Electronics, Intelligent Motion,
Renewable Energy and Energy Management

Conference Program

Nuremberg, 10 – 12 May 2016

Power for Efficiency
pcim-europe.com

7 Seminars on 8 May 2016
10 Tutorials on 9 May 2016
Conference from 10 – 12 May 2016

mesago
Messe Frankfurt Group

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Welcome Address

Dear PCIM Europe participants,

It is my pleasure to welcome you to the PCIM Europe 2016 Conference in Nuremberg. This important event serves as a technical and scientific platform for engineers and researchers engaged in all fields related to power components, power converter technologies and future development of power electronics.

The technical program for this year's conference highlights advanced technologies for power semiconductor devices and passive components control. Additionally it highlights drive strategies for high efficient power converters, drive systems for e-vehicles and renewable energy technologies. New material for semiconductor devices, reliability issues on power modules and on system levels as well as designs to manage ultrafast switching devices in the circuit set up, form the backbone of the PCIM Europe Conference.

The keynote papers cover the development trend for power semiconductor devices, including packaging technologies, developments in solid state transformers as well as trends on solar systems. The highlights of the conference include the special sessions on challenges in smart lighting, passive components and traction drivers for e-cars as well as a panel discussion on »The Smart Future of Power Electronics«.

With its high level technical program and discussion platform, this year's PCIM Europe Conference will provide you with an overview of the key technology development trends in power electronics and inspire you to pursue new business opportunities.

I wish you an enjoyable and successful conference, packed with new ideas for your future business.



Leo Lorenz,
General Conference Director, Germany

Boards

Board of Directors



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Ionel Dan Jitaru, Rompower, USA

Nando Kaminski, University of Bremen, Germany

Ulrich Kirchenberger, STMicroelectronics, Germany

Philip C. Kjaer, Vestas Wind Systems, Denmark

Christopher Kocon, Texas Instruments, USA

Jacques Laeuffer, Dtalents, France

Stéphane Lefebvre, SATIE, France

Romeo Letor, STMicroelectronics, Italy

Andreas Lindemann, Otto-von-Guericke-University Magdeburg, Germany

Stefan Linder, Alpiq, Switzerland

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Martin März, FhG – IISB, Germany

Gourab Majumdar, Mitsubishi Electric, Japan

Klaus Marahrens, SEW-Eurodrive, Germany

Elison Matioli, POWERlab, EPFL, Switzerland

Mike Meinhardt, SMA Solar Technology, Germany

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Geraldo Nojima, Eaton Corporation, USA

Yasuhiro Okuma, Fuji Electric, Japan

Nejila Parspour, University of Stuttgart, Germany

Robert J. Pasterczyk, Schneider Electric, France

Volker Pickert, University of Newcastle, United Kingdom

Bernhard Piepenbreier, University of Erlangen, Germany

Munaf Rahimo, ABB Switzerland, Switzerland

Kaushik (Raja) Rajashekara, University of Dallas at Texas, USA

Chris Rexer, ON Semiconductor, USA

Katsuaki Saito, Hitachi Europe, Great Britain

Franck Sarrus, Mersen France, France

Andrew Sawle, International Rectifier, Great Britain

Achim Scharf, Techmedia International, Germany

Hubert Schierling, Siemens, Germany

Manfred Schlenk, Infineon Technologies, Germany

Manfred Schrödl, Vienna University of Technology, Austria

Walter Schumacher, Braunschweig University of Technology, Germany

Yasukazu Seki, Fuji Electric, Japan

Toshihisa Shimizu, Tokyo Metropolitan University, Japan

Christopher A. Soule, Thermshield, USA

Elmar Stachorra, KoCoS Power Grid Services, Germany

Peter Steimer, ABB Switzerland, Switzerland

Bernhard Strzalkowski, Analog Devices, Germany

Wolfram Teppan, LEM SA, Switzerland

Giuseppe Tomasso, University of Cassino and South Lazio, Italy

Joël Turchi, On Semiconductor, France

Yoshiyuki Uchida, Japan Fine Ceramics, Japan

Alfredo Vagati, Politecnico di Torino, Italy

Peter Wallmeier, Delta Energy Systems, Germany

Dehong Xu, Zhejiang University, China

Peter Zacharias, University of Kassel, Germany

Conference Program at a Glance

Sunday, 8 May 2016

14:00 – 17:30 **Hotel Arvena Park** Görlitzer Str. 51, D-90473 Nuremberg
Seminars

Monday, 9 May 2016

09:00 – 17:00 **Hotel Arvena Park** Görlitzer Str. 51, D-90473 Nuremberg
Tutorials

Tuesday, 10 May 2016

09:00 **Brüssel**
Conference Opening and Award Ceremony

09:45 **Brüssel**
KEYNOTE »Welcome to the Post-Silicon World: Wide Band Gap Powers Ahead«

10:30 Coffee Break

11:00	Brüssel SiC Devices	München 1 Module Materials	Athen Magnetics & Inductors	Mailand DC/AC and AC/DC Converters	München 2 SPECIAL SESSION »Passive Components«
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13:00 Lunch Break

14:00	Brüssel SiC Reliability	München 1 DC/DC Converters I	Athen Control Converters	Mailand Control Techniques in Intelligent Motion Systems I	München 2 DC/AC Converters
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15:30 **Foyer Entrance NCC Mitte**
Poster/Dialogue Session

17:15 **NCC Ost Level 1**
Exhibition Party

Wednesday, 11 May 2016

08:45 **Brüssel**
KEYNOTE »Smart Transformers – Concepts-Challenges-Applications«

09:30 Coffee Break

10:00	Brüssel GaN Converters	München 1 Module Design	Athen Power Electronics in Transmission Systems in Smart Grids	Mailand SPECIAL SESSION »E-Mobility«	München 2 High Power Semiconductor
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12:00 Lunch Break

14:00	Brüssel Multi Level Converters	München 1 DC/DC Converters II	Athen Lamp Ballasts Lighting Systems	Mailand Sensorless Motor Control	München 2 Software Tools and Applications
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15:30 **Foyer Entrance NCC Mitte**
Poster/Dialogue Session

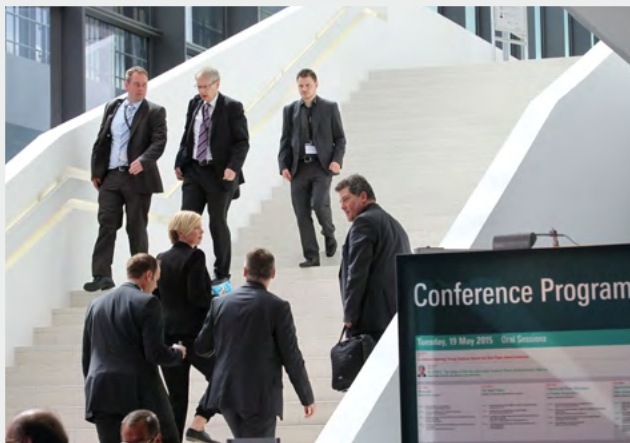
16:30 **Brüssel**
PANEL DISCUSSION »The Smart Future of Power Electronics«

Benefit from early-bird rates until
7 April 2016 and save up to 100 Euro!
pcim-europe.com/registration

Thursday, 12 May 2016

08:45	Brüssel KEYNOTE »Trends of Solar Systems and their Integration in Electricity Networks«			
09:30	Coffee Break			
10:00	Brüssel Cosmic Ray & Ruggedness	München 1 SPECIAL SESSION »Smart Lighting«	Athen New and Renewable Energy Systems	Mailand Power Electronics in Automotive
12:00	Lunch Break			
14:00	Brüssel Module Technology	München 1 Drive Strategies in Power Converters	Athen Energy Storage	Mailand Control Techniques in Intelligent Motion Systems II

as of March 2016/subject to change without notice



Seminars Sunday, 8 May 2016, 14:00 – 17:30

Venue: Arvena Park Hotel Nuremberg, Görlitzer Str. 51, 90473 Nuremberg

Seminar 1

Basics of Electromagnetic Compatibility (EMC) of Power Systems

Jacques Laeuffer, Dtalents, France



About the instructor

Jacques Laeuffer has 30 years' experience of R&D in Power Electronics, inside international companies, with powers from 10 W up to 10 MW, including design of 80 KW high frequency resonant converters and high voltage transformers for medical imaging, design of 50 Nm electric machines and 20 KW triphase inverters for powertrains of hybrid cars, EMC design of 12 MW drives for compressors... He is inventor of 27 patents. Affiliated professor at Ensta-ParisTech, he is a teacher at CentraleSupélec (Paris-

Orsay University), Aemc and Eurosae, about EMC, power electronics, electric machines, control, mechatronics, hybrid cars and history of physics, for both initial and continuing education.

Contents

Seminar Benefits

- Avoid noisy oscillations in power systems
- Calculate, optimize and design Differential Mode (DM) and Common Mode (CM) filters
- Comply with EMC Standards, avoiding expensive shielding, and improving reliability
- »Case method« shows orders of magnitude of perturbations, and examples of calculations

Seminar Topics

- Introduction
- Issues take source in power transistors and diodes sudden commutations.
- Control electronics and power electronics are both considered.
- Differential Mode interferences occurs when perturbation flows through active circuits.
- Common Mode occurs through parasitic capacitors, cases, grounds, etc.

→ Differential Mode (DM) management and filtering

- Within control: resistive, inductive and capacitive coupling. Reduction by ground planes.

- Switching power supply operating sequence as EMI source.
- Disturbances calculations from transistors and diodes. Spectrum analysis.
- Line diodes recovery. Line inductance effect.
- Disturbances measurement by L.I.S.N. and spectrum analyzer, according to standards.
- DM filter calculation, including damping. Design of L, C, R components.
- Some MHz perturbations evaluations. Reduction means.
- Wiring strategies evolution from »star connection« to »net connection«.

→ Common Mode (CM) management and filtering

- Within control: implementation and interconnection between PCBs and cabinets.
- CM parasitic coupling calculation and reduction.
- Signal transmission by optics.
- Switching power supply operating sequence as EMI source.
- CM capacitances of heatsinks, transformers, screens, electric machines stators.
- Disturbances calculations. Measurement according to standards.
- CM filter calculation. CM leakage current constraint. CM coupled inductance design.

→ EMC Commutation Control of Power Semiconductors

- Tuning commutation times as a trade-off between switching losses and EMC.
- Calculation of di/dt and dv/dt front edges of semiconductors according to gate drive.
- Gate drive circuit designs for MOS and IGBTs.

Who should attend?

This course is targeted towards engineers and project managers, who design, specify, simulate, tune integrate high frequency power electronics, including power supplies, converters, inverters, fast control electronics boards, EMC differential and common mode filters according to EMC Standards, for high efficiency conversion, low global cost and reliability.

Seminar 2

Design Approaches to SMPS Ripple Reduction

Bruce Carsten, Bruce Carsten Associates, USA

**About the instructor**

Bruce Carsten has 46 years of design and development experience in switchmode power converters at frequencies from 20 kHz to 1 MHz and power levels to 10 kW. His seminars target the practicing design engineer, and emphasize an intuitive understanding of phenomena involved.

Contents

This seminar presents and discusses the many different ways to reduce ripple in switchmode power converters, including passive and active filtering, and a few design tricks. Topics include:

→ **Passive filtering:**

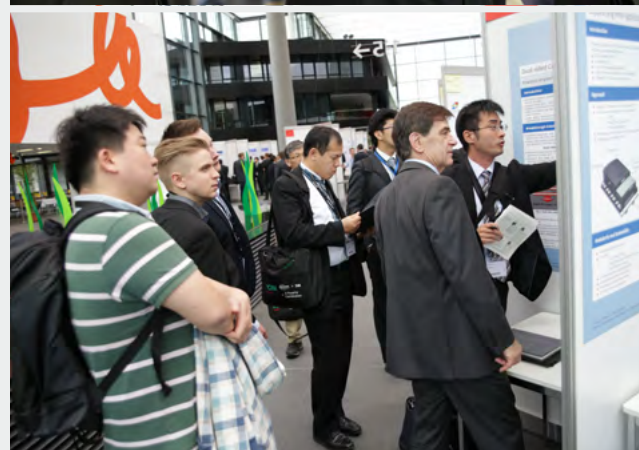
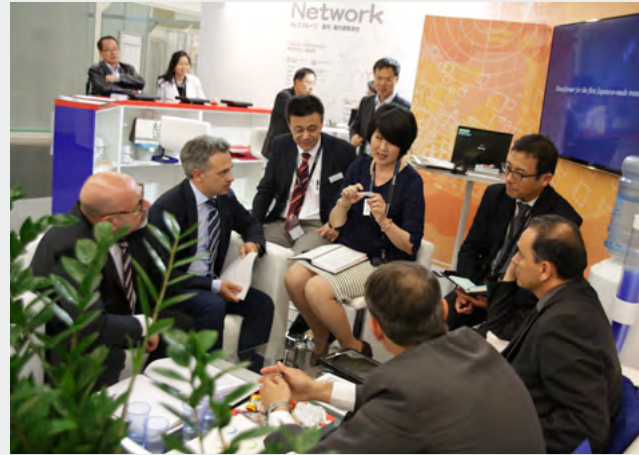
- Classical single stage filters; ideal vs. real
- Classical multi-stage filters
- »Dominant L« multi-stage filters
- Practical multi-stage filters with electrolytic capacitors
- Adding wave traps for selected frequencies
- Broadband ripple rejection techniques
- Ripple steering in two winding inductors
- Resonance damping in multi-stage filters
- Closing the feedback loop around multi-stage filters

→ **Active filtering:**

- Poly-phase, or interleaved power conversion
- »1-D« ripple cancellation
- Active feedback filtering, and practical limitations
- Active feedforward filtering
- Switchmode/linear hybrids

Who should attend?

This course is directed towards design engineers who would like to expand their knowledge of design approaches and design alternatives to reducing ripple in switchmode converters.



Seminars Sunday, 8 May 2016, 14:00–17:30

Venue: Arvena Park Hotel Nuremberg, Görliitzer Str. 51, 90473 Nuremberg

Seminar 3

High-performance Control Techniques for DC-DC Converters

Richard Redl, Redl Consulting, Switzerland



About the instructor

Dr. Redl is a power-electronics consultant in Switzerland, specializing in power supplies, UPSs, inverters, electronic ballasts, battery chargers and battery management systems, and integrated circuits for power management. He holds twenty-two patents, has written over hundred technical papers and three book chapters, and co-authored a book on the dynamic analysis of power converters.

Contents

Dc-dc converters are essential building blocks of most electronic equipment. They are used for voltage/current regulation, scaling, and modulation, and sometimes isolation of the power source from the load. The dc-dc converter is expected to be robust, to have fast response to rapid changes in the input voltage or load current, and to maintain high efficiency from light load to full load. This seminar presents an overview and evaluation of the high-performance control techniques that provide robustness, fast response, and high efficiency over a wide range of load currents. The outline is as follows.

→ Classification of control techniques

→ Single-loop control

- Duty ratio modulation (constant-frequency, variable-frequency, speeding up the response of the modulator)
- Basic ripple-based control (types, characteristics, reducing sensitivity from the parameters of the output capacitor)

→ Two-loop control

- V2 control (concept, variations, RPM control)
- Current-mode control (types, characteristics, current-sense issues, emulated current control)

→ Feedforward control

- Input-voltage feedforward (small-signal, large signal, feedforward pulse-width modulators)
- Load-current feedforward, including capacitive current control
- Combined input-voltage and load-current feedforward
- Special cases (feedforward in isolated converters, feedforward without access to the pulse-width modulator)

→ Control for high efficiency

- PFM control
- Phase shedding in multiphase converters
- Valley-mode control
- Optimizing efficiency of two-stage architectures
- Converter architectures and control techniques for zero-voltage switching

→ Protection against overload or overvoltage

- Pulse-by-pulse and average current limit
- Input and output overvoltage protection

Who should attend?

The target audience of this seminar is power-supply design engineers, power-management IC designers, system designers, project managers, engineering students, and all other professionals interested in high-performance control of dc-dc converters.

Seminar 4

Modern Soft Switching Technologies – Do GaNs need Soft Switching?

Ionel Dan Jitaru, Rompower, USA



About the instructor

Ionel »Dan« Jitaru is the founder of Rompower Inc. an internationally recognized engineering firm in the field of power conversion, later in 2001 Ascom-Rompower Inc. and in 2003 Delta Energy Systems (Arizona) Inc. Presently, he is the president of Rompower Energy Systems Inc. He has published 51 papers and held 44 professional seminars professional at different International Conferences in the power conversion field, wherein several of them have received the best paper award. Mr. Jitaru is one of the pioneers in

several trends in power conversion technologies such as »Soft Switching«, »Full Integrated Multilayer PCB Packaging Concept«, »Synchronized Rectification« and »Intelligent Power Processing«. Mr. Jitaru has 61 patents wherein 25 granted patents and 36 pending patents that have covered some of these technologies.

Contents

Soft switching topologies have been around for many years and most of the power conversion engineers have embraced them. The goal of this seminar is to define the basic methodologies of obtaining soft switching and the need for soft switching in Power Factor Correction and DC-DC Converters. The development of new semiconductor devices such as SiC and GaN has created the idea that soft switching may not be necessary. The argument in favor of hard switching using »ideal« components is fueled by the need of simplicity. Many of soft switching topologies added too much complexity and additional costs. The seminar will describe initially the basic methodologies to obtain soft switching and show several example of deriving such topologies. The seminar will present a brief history of the evolution is soft switching topologies with special focus on the latest technologies. New types of soft switching technologies which are derived by using intelligent power processing will be presented. The seminar will look into the advantages and the limitations associated with the new semiconductor technologies such as GaNs in hard switching and soft switching. The presentation will be highlighted with many design examples and experimental results using GaNs and silicon MOSFETs.

Seminar 5

Fundamentals of Power in the Data Center

Brian Zahnstecher, PowerRox, USA

**About the instructor**

Brian Zahnstecher is the principal of PowerRox, where he focuses on power design, integration, system applications, and OEM market penetration for power electronics. He has successfully handled assignments in system design/architecting, AC/DC front-end power, embedded solutions, processor power, and digital power solutions for a variety of clients. He previously held positions in power electronics with industry leaders Emerson Network Power, Cisco, and Hewlett-Packard, where he advised on best practices,

oversaw product development, managed international teams, created/enhanced optimal workflows and test procedures, and designed and optimized voltage regulators. He has been a regular contributor to the industry as an invited speaker, author, workshop participant, session host, roundtable moderator, and volunteer. He has over 12 years of industry experience and holds Master of Engineering and Bachelor of Science degrees from Worcester Polytechnic Institute.

Contents

Power electronics in data center hardware can make or break the ability to enable an implementation for success or not. A common industry practice is to use simplified assumptions for loading and power conversion efficiency to provide approximate calculations of power utilization. Unfortunately, implementers find huge errors and variability between predicted and actual power consumption, which yield very costly (in CAPEX, OPEX, and time) headaches for many stakeholders. This is due to oversimplification of the highly convoluted and transient nature of power loading in the data center. This entry- to intermediate-level seminar will provide an in-depth investigation into what drives power requirements in data center equipment. The first part will focus on key attributes of data center hardware system power budgets including major loads and their power profiles, correlation between such attributes and how they impact overall power demand (i.e. – how redundancy impacts budget), and specific examples (i.e. – blade server, white-box, high-end network switch). The second part will focus on rolling-up what was learned about power budgets at the system-level into the rack, aisle, and complete data center levels to provide the full picture of the data center power solution all the way from the load to the building inputs. There will also be a brief focus going beyond the data center to explore the impact of a massive power footprint at the utility level and how intelligent power management (mostly software tools) can help to maximize utilization and optimize fluctuating power market rates. This will include many application-specific examples (i.e. – virtualization, dynamic power allocation, etc.) representative of solutions for today and tomorrow (i.e. – IoT, Cloud Computing, etc.).

Who should attend?

Engineers involved in enterprise power solutions, program managers, data center managers, enterprise/networking system designers, SW/FW engineers, mechanical engineers, technical sales & marketing personnel.

Seminar 6

Get the Most out of GaN – Design Strategies for Highly Dense and Efficient Power Supplies

Eric Persson, Infineon Technologies, USA

**About the instructor**

Eric Persson is the head of GaN Applications at Infineon Technologies (formerly IR where he was for the past 15 years). For 20 years before that, he was a hands-on power electronic design engineer developing many different converters, motor drives and inverters ranging in size from implantable medical devices to 75 kW power supplies. Eric has presented more than 70 tutorials and papers at various international conferences. He is a regular lecturer, presenting short courses and tutorials at UW Madison, the University of

Minnesota (his alma mater) and Purdue University. He is also Chairman, Board of Directors of the Power Source Manufacturers Association (PSMA). Mr. Persson holds 13 patents, and is a recipient of the IEEE Third Millennium Medal.

Contents

This seminar takes a look at power supply design in the 300 to 3,000 W range, focusing on commonly-used topologies and control strategies. In particular, it covers the differences between superjunction FETs and GaN HEMTs, and how those differences impact the selection of topology and control strategy. The design direction for optimization depends on whether the goal is to maximize density, or focus on highest efficiency possible. The seminar is divided into two major sections, first looking at the PFC front-end of a power supply followed by the DC-DC back-end. Practical considerations are covered at the end along with a summary and Q&A session.

Seminar Outline:→ **Introduction, overview**→ **Power Factor Correction Circuits**

- Classic boost PFC topology
- Dual boost PFC topology
- Totem-pole PFC topology
- Hard vs. soft-switching (CCM vs. CrCM)
- Achieving ZVS by adding Triangular Current Modulation
- GaN HEMT characteristics compared to superjunction
- High-frequency operation of totem-pole PFC using GaN HEMTs
- Practical considerations
- Design examples

→ **DC-DC Power Supply Back-End**

- Phase-shifted full-bridge topology (GaN and Si)
- LLC topology (GaN and Si)
- Effects of superjunction nonlinear Qoss
- Secondary-side SR recovery reflected back to the primary
- Applying GaN to high-frequency LLC
- Design examples

→ **A Detailed Look at GaN Characteristics**

- Saturation current
- Conducting current in the forward and reverse direction
- GaN gate drive
- Temperature effects

→ **Summary – Q&As**

Seminars Sunday, 8 May 2016, 14:00 – 17:30

Venue: Arvena Park Hotel Nuremberg, Görlitzer Str. 51, 90473 Nuremberg

Seminar 7

Design of Magnetic Components for High Power Converters

Tomás Pagá, Enerdrive, Switzerland



About the instructor

Tomás Pagá born in Venezuela in 1969, he received his B.S and M.S. degrees from Simón Bolívar University in Caracas, Venezuela in 1994 and 1999 respectively. He was university professor and researcher until 2000. From 2001, during the last 15 years, has been power electronics converter designer for industry, railway and renewable energy applications. Currently he works as consultant in high power electronics for Enerdrive GmbH in Zurich, mainly for wind energy multi-megawatt power converters manufacturers. His

research interests include high power electronics converters design, magnetic components modeling and design, modeling of power electronics components, thermal management and high frequency converters.

Contents

Filter chokes and transformers for high power converters, ranging from hundreds to thousands of kW, are commonly one of the most costly and difficult components to design. Desired electrical performance and tight restrictions in weight, volume and cooling represent a challenging compromise for the designer. In this seminar we address topics from how to specify the components for outsourcing to how to get deep inside the detailed design itself. References, test results and failure examples from real cases are presented.

The seminar will be based on a design case, where the main design problems for each step will be addressed. Analytic, finite element method and circuit simulation tools will be used during the design. Losses calculation and measuring are treated in detail. Losses produced by the switching high frequency components are often miscalculated resulting in poor thermal performance. High frequency losses curves of laminated magnetic steel are commonly not available from the suppliers, so the designer faces with the need of high frequency losses measuring methods. Losses measurement error sources, like low power factor and angle errors, are explained in detail and methods to overcome those issues will be discussed. Additional sources of losses due to winding resistance, skin/proximity effect and fringe flux on the air-gaps will also be addressed. Finally, cooling methods and mechanical design considerations for robustness and acoustic noise reduction are discussed.

Fields of application:

- **Grid Connected Converters**
 - Solar Inverters
 - Wind Generators
 - UPS systems
- **Electrical Drives**
 - Traction Drives
 - Wind Generators
- **Isolated Grid Supplies**
 - Railway Auxiliary Converters
 - UPS systems

Program:

- **Field of application**
- **Magnetic design basic concepts**
- **Design case**
 - Analytical calculation
 - Finite Element modeling
 - Interaction with the PE converter
 - High frequency losses estimation
 - Additional losses
 - Simulation and measurement methods for validation
- **Cooling and mechanical design topics**

Who should attend?

Engineers and project managers involved on the design, specification and integration of transformers and inductors for high power electronics converters. High power electronics converters designers. Magnetic components, inductors and transformers, designers and manufacturers.



Tutorials Monday, 9 May 2016, 09:00 – 17:00

Venue: Arvena Park Hotel Nuremberg, Görliitzer Str. 51, 90473 Nuremberg

Tutorial 1

Exceeding 99% Efficiency for PFC and Isolated DC-DC Converters. GANs Versus Silicon

Ionel Dan Jitaru, Rompower, USA

About the instructor



Ionel »Dan« Jitaru is the founder of Rompower Inc. an internationally recognized engineering firm in the field of power conversion, later in 2001 Ascom-Rompower Inc. and in 2003 Delta Energy Systems (Arizona) Inc. Presently, he is the president of Rompower Energy Systems Inc. He has published 51 papers and held 44 professional seminars professional at different International Conferences in the power conversion field, wherein several of them have received the best paper award. Mr. Jitaru is one of the pioneers in several trends in power conversion technologies such as »Soft Switching«, »Full Integrated Multilayer PCB Packaging Concept«, »Synchronized Rectification« and »Intelligent Power Processing«. Mr. Jitaru has 61 patents wherein 25 granted patents and 36 pending patents that have covered some of these technologies.

Contents

The new developments in semiconductor technology such as GaN and SiC may enable us to exceed the 99% efficiency power conversion for PFC and isolated DC-DC Converters. To reach that goal we have to start by reevaluating of the most suitable topologies in power conversion. Soft switching topologies have become popular in many applications in the last thirty years. Though we have more than 30 years tradition in soft switching topologies some of these topologies, have added too much complexity and their practical use becomes questionable with the availability of more ideal components. A portion of the tutorial describes the latest soft switching topologies which are addressing the soft switching both in primary and the secondary side. Well known topologies are presented in the light of latest improvements, as well as new topologies which were recently derived. A detailed power dissipation analysis in several applications will highlight the need for magnetic optimization. In spite of the significant progress in the semiconductor industry, the magnetics lags behind. The tutorial will describe the impact of the parasitic elements in the magnetics in optimizing the performance of the power converters. In the quest for 99% efficiency the magnetics and the packaging become key factors in efficiency optimization. The tutorial will present the impact of intelligent power processing in optimizing the efficiency and even in converting a traditional hard switching topology

into a soft switching topology. The presentation will be highlighted with many design examples and experimental results such as 99%+ efficiency PFC with power densities above 450W/in³, and 99% efficiency isolated DC-DC Converter.

→ Loss Mechanisms in Power Converters

- Switching Losses
- Reverse Recovery Losses in rectifier means
- Conduction losses in different topologies
- Losses in the magnetics

→ Soft Switching on the primary and secondary switchers

- ZVS through Current Shaping through Resonant Tank
- ZVS through Current Shaping through Clamp Inductor
- ZVS through Current Shaping of Magnetizing Current
- ZVS through Current Shaping by Current Injection
- ZVS through Current Shaping by Magnetizing Current and Current Injection

→ Magnetic Structures for high Efficiency

- Controlling the leakage Inductance
- Magnetic Integration
- Termination effects
- Magnetic for Very High Frequency

→ Intelligent Power Processing

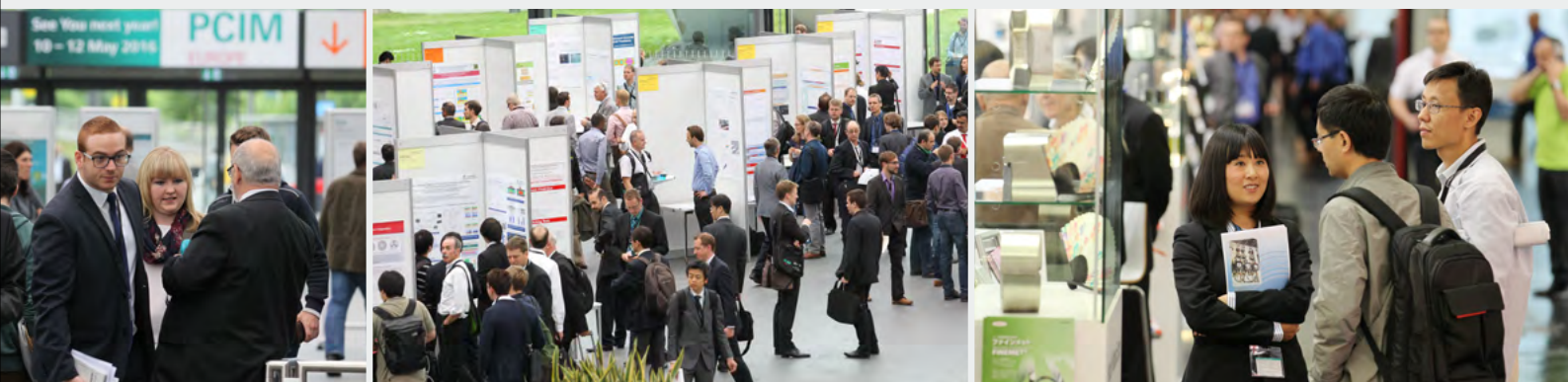
- »Intelligent control« in converting a classical topology in a soft switching topology
- Optimizing the power train operation by »intelligent control«

→ Design examples for efficiency optimization

- 99% Efficiency PFC with power density above 450W/in³
- 99% 1000W Isolated DC-DC Converter Converter

→ Conclusion

- Future trends in Power Conversion



Tutorials

Monday, 9 May 2016, 09:00 – 17:00

Venue: Arvena Park Hotel Nuremberg, Görliitzer Str. 51, 90473 Nuremberg

Tutorial 2

New Developments in Power-Factor Correction

Richard Redl, Redl Consulting, Switzerland



About the instructor

Dr. Redl is a power-electronics consultant in Switzerland, specializing in power supplies, UPSs, inverters, electronic ballasts, battery chargers and battery management systems, and integrated circuits for power management. He holds twenty-two patents, has written over hundred technical papers and three book chapters, and co-authored a book on the dynamic analysis of power converters.

Contents

The European norms EN61000-3-2 and EN61000-3-12 require that the current harmonics of all line-connected equipment stay below prescribed limits. Compliance with those norms is usually achieved by adding a harmonic-reduction/power-factor correction (PFC) circuit to the rectifier front-end of the equipment. This tutorial presents the causes of, and motivations for, PFC (nonlinear loads, line-current distortion and its effects on power transmission and power quality, harmonic regulations), discusses the energy storage considerations, introduces the basic passive and active solutions for single-phase and three-phase PFC, and reviews and evaluates the most interesting new developments. The following topics will be covered.

→ Introduction

- Power factor definitions
- Causes and effects of line-current harmonics
- Overview of the harmonic regulations

→ Single-phase PFC

- Passive solutions (choke, LC and LLC waveshaping, valley-fill rectifier)
- Active solutions:
 - Energy storage considerations
 - Power-circuit topologies
 - Boost PFC and its derivatives (voltage-doubler, interleaved, multilevel, ZVS)
 - Other nonisolated converters (buck, two-switch buck-boost, SEPIC, Cuk)
 - Isolated converters (flyback without or with high-efficiency post-regulation, isolated boost, transformer-coupled higher-order converters, bridgeless isolated converters, nonisolated PFC and isolated downstream converter combination, isolated single-stage converters with energy storage on the input side, charge-pump PFC)

- PFC system architectures
- Control techniques
 - Standard average-current control
 - Boundary conduction control
 - Nonlinear carrier control
 - Inductor current control with modulated ramp
 - Voltage-follower control with distortion reduction
 - Controlling the two-switch buck-boost PFC
 - Control for fast transient response, high efficiency, reduced component stress, low distortion
- Practical issues (inrush current limit, generating bias power, protection, EMI reduction with filtering and with frequency dithering)

→ Three-phase PFC

- Passive solutions
 - Rectifier bridge with dc-side or ac-side inductors
 - Harmonic filter
 - Multi-pulse rectification
- Active solutions
 - Rectifier bridge and dc-side CCM boost converter combination
 - Boost PFC in DCM
 - Single-switch boost
 - Distortion reduction by harmonic injection
 - Two-switch zero-voltage-switching boost (»Taipei rectifier«)
 - Three-level Taipei rectifier
 - Boost PFC in CCM
 - Two-level Y and Δ converters
 - Two-level bidirectional PFC
 - Three-level PFC
 - Low-frequency (»slow-switching«) version
 - High-frequency version (»Vienna rectifier«)
 - Topologies
 - Control
- Buck PFC
- Four-switch buck-boost
- Modular architectures

Who should attend?

This tutorial is offered to power-supply design engineers, system designers, managers, engineering students, PFC IC designers, and other professionals interested in power-factor correction and lineharmonics reduction.

Tutorial 3

Electromagnetic Design of High Frequency Converters and Drives

Jacques Laeuffer, Dtalents, France

**About the instructor**

Jacques Laeuffer has 30 years' experience of R&D in Power Electronics, inside international companies, with powers from 10 W up to 10 MW, including design of 80 KW high frequency resonant converters and high voltage transformers for medical imaging, design of 50 Nm electric machines and 20 KW triphase inverters for powertrains of hybrid cars, EMC design of 12 MW drives for compressors... He is inventor of 27 patents. Affiliated professor at Ensta-ParisTech, he is a teacher at CentraleSupélec (Paris-

Orsay University), Aemc and Eurosae, about EMC, power electronics, electric machines, control, mechatronics, hybrid cars and history of physics, for both initial and continuing education.

Contents**Tutorial Benefits**

- Design HF lines, layouts, windings to avoid noisy resonances, over voltages, extra losses.
- Choose and design E.M.C. optimized power converters (from 100 W up to 10 MW).
- Design E.M.C. drive systems made of inverters, cables and electric machines together.
- Avoid expensive shielding. Improve reliability.
- »Case method« shows orders of magnitude of perturbations, and examples of calculations.
- Learn electromagnetism with deep physical understanding, but only simple calculations.

Tutorial Topics→ **Introduction**

- Examples of issues. Noisy ringing inside converters and magnetics. Damping. Expected and non-expected actions of electromagnetic fields. Conduction and radiation. Differential mode (DM) and common mode (CM). Magnetic dominant and electric dominant fields.

→ **Lines Design**

- Propagation on lines. Poynting theorem. Electric and magnetic energy storage.
- Electromagnetic power flow. Four impedances and speed. Reflection on load.
- Calculation of conditions for a line to propagate power, or filter, or oscillate.
- Design bifilar, coaxial, and strip lines accordingly. Practical examples of applications.

→ **Winded Components Design**

- Initial sizing calculation of foil, planar and multi-layers HF transformers.
- Power flow through transformers, inductances, and electric machines stators.
- Equivalent schematics and simulation. Propagation delays calculation. Examples.
- Conditions to avoid ringing. Design workflow for low EMI and low HF losses. Examples.
- Proximity effect and optimization. Sizing of inductances.

→ **Converters Design**

- Power propagation in converters. Semiconductors connection. SiC and GaN devices.
- Design of flyback, forward, bridge, ZVS and ZCS converters according to EMC.
- Matching components and layout HF impedances.

→ **Drives Design**

- System made of inverter, cable, shielding, ground and electric machine, as DM and CM.
- Equivalent schematics for evaluation of conditions to avoid HF oscillations.
- Simulation algorithms of the system, and design workflow for low EMI.
- Protection of electric machines against breakdown by HF overvoltage.

→ **Radiations Reduction**

- Examples of emissions of electric and magnetic fields. Fields measurements.
- Reduction of influence of fields, in control and power systems.

Who should attend?

This course is targeted towards engineers and project managers, who design, specify, simulate, tune, integrate high frequency power electronics, including power supplies, converters, inverters, EMC filters, electric machines, drives assembling inverter, power cable and electric machine, for high efficiency conversion, low global cost and reliability. Neighbor and far field identification. Examples. Wiring, grounding, shielding, packaging.

Tutorials Monday, 9 May 2016, 09:00 – 17:00

Venue: Arvena Park Hotel Nuremberg, Görliitzer Str. 51, 90473 Nuremberg

Tutorial 4

High Performance Control of Power Converters

Christian Peter Dick, Jens Onno KraH, Cologne University of Applied Sciences, Germany



About the instructors

Christian P. Dick studied electrical engineering at RWTH Aachen University, Germany, where he also received his PhD degree. Beginning of 2011 he joined SMA Solar Technology AG as director for advance development of solar converters up to 20 kW. Since end of 2011 he is professor for power electronics and electrical drives at Cologne University of Applied Science. Since years, Christian Dick is member of VDE and IEEE. His main research interests are resonant converters and the largescale utilization of renewable energy, including automation and safety aspects.



Prof. Dr. Ing. Jens Onno KraH studied electrical engineering at the University Wuppertal and obtained his PhD in 1993 by Prof. Holtz within electrical drives research. Until February 2004 he worked as technical director for Kollmorgen, formerly Seidel Servo Drives. He was responsible for the development of the Kollmorgen Servo Drives. Since March 2004 Prof. KraH teaches control engineering at the University of Applied Sciences Cologne.

Contents

Utilizing power electronic based converter technology is a key approach to build energy efficient solutions. Due to the innovation cycles of the semiconductor suppliers the size and the cost of the more and more complex inverter systems is not increasing. However, especially the new fast switching wide bandgap devices (SiC & GaN) are challenging the control hardware. The advanced control architectures are covered by discussing algorithms and possible implementations using μC , DSP and FPGA technology. Robust controller designs with well-defined set up procedures or reliable self-tuning algorithms can help to use these innovations utilizing a reasonable set-up time.

1. Converter Design Basics

- IGBT, MOSFET, SiC
- 2-Quadrant Chopper
- Buck, Flyback, resonant LLC
- State machine based dead time generation
- 2-Level/3-Level Inverter – including Energy Efficiency Classes
- Gate driver basics

2. Inverter Modulation Techniques

- Single Phase Modulator

- Pulse Width versus Pulse Frequency Modulation
- 2-Level/3-Level SVM

3. Analog to Digital Conversion

- Sigma-Delta DAC versus R-2R DAC and PWM
- Sigma-Delta Modulation
- Sinc³ decimation filtering
- Efficient FIR implementations, Demonstration, Examples

4. Current Sensing

- Transducer versus shunt
- Synchronous sampling
- Aliasing, EMI suppression
- 2 vs. 3 current probes in 3~ Loads

5. Current Control

- Hysteresis Control
- Sampling Control
- Synchronous Control (FOC): Clarke, Park, decoupling
- Hybrid control
- (single-phase) PLL
- Dead-Time Compensation
- Buck, Flyback, resonant LLC

6. Current Prediction

- Modelling the Plant
- Smith Predictor
- Current Observer

7. Parameter Tuning

- Theoretical background
- Parameter estimation

8. Conclusion and Future Trends

Who should attend?

This tutorial will be especially valuable for engineers and PhD's who address the following control aspects:

- Digital Motion Control
- Mains Control, including PFC
- High-Bandwidth Sensor Circuitry including Robust Signal Transmission
- Modulation Techniques
- Controller Implementation using FPGA
- Controls-Related Novel Converter Aspects like Wide-Bandgap Devices



Tutorial 5

Advanced Design with MOSFET and IGBT Power Modules

Tobias Reimann, ISLE Steuerungstechnik und Leistungselektronik, Germany
Thomas Basler, Infineon Technologies, Germany

**About the instructors**

Tobias Reimann received 1994 his PhD from the Technische Universität Ilmenau in the field of power semiconductor applications for hard and soft switching converters. In 1994, he was one of the founders of the ISLE company which is engaged in system development for power electronics and electrical drives. He is responsible for the operational business of this company. In addition, since July 2009 he is Professor for industrial electronics at Technische Universität Ilmenau. Prof. Reimann is a member of scientific board

of »Thuringian Center of Excellence in Mobility (ThIMo)« at Technische Universität Ilmenau in the field of automotive electronics.



Thomas Basler received his Diploma in Electrical Engineering from Chemnitz University of Technology in 2009. His Diploma thesis was on the robustness of power diodes. Between 2009 and 2013 he was a member of the scientific staff at the Chair of Power Electronics and Electromagnetic Compatibility at Chemnitz University of Technology. At the beginning of 2014 he received his PhD. His thesis is about short-circuit and surge-current ruggedness of IGBTs and was supervised by Prof. Dr. Josef Lutz. 2014 he joined Infineon Technologies AG, Neubiberg, Germany, where he works

on the development of IGBTs and diodes.

Contents→ **Power Devices/Modules/Reliability**

- New Developments in MOSFETs, IGBTs, Freewheeling Diodes
- Module Layouts
- Thermal Mismatch, Thermal Stress
- Power Cycling Capability
- Design for Reliability

→ **Drive and Protection**

- Principles, Technical Realisations
- Failure Modes, Failure Detection
- Current, Voltage, Temperature Protection

→ **Topology-dependent Power Losses**

- DC/DC-Converters
- DC/AC-Converters
- Load Cycles
- Calculation of Heat Sink

→ **Device Induced Electromagnetic Disturbance**

- Parasitics
- Oscillations in Power Modules

→ **Special Aspects of Application**

Consideration of Special Problems of Participants, for example:

- Paralleling and Series Connection, Special Effects in ZVS/ZCS Topologies
- Special Problems Related to New Device Technologies
- Short-Circuit Ruggedness of IGBTs.

Who should attend?

Engineers designing converters with IGBT- and MOSFET power modules having basic knowledge in power devices and power converters.

Tutorial 6

SMPS Topology Selection and Circuit Design Tricks

Bruce Carsten, Bruce Carsten Associates, USA

**About the instructor**

Bruce Carsten has 46 years of design and development experience in switchmode power converters at frequencies from 20 kHz to 1 MHz and power levels to 10 kW. His seminars target the practicing design engineer, and emphasize an intuitive understanding of phenomena involved.

Contents

This tutorial is in two parts. In »Topology Selection« I first present the concept of »Component Load Factors« a dimensionless Volt-Amps/Watt »figure of merit« which can be applied to magnetic elements and high ripple capacitors, as well as the power semiconductors used for illustration. Among other insights, this analysis shows that, contrary to popular wisdom, it is not always more efficient to process power in a single stage. Classical topologies are then further evaluated for suitability as a function of input and/or output voltages, power level, and frequency. A selection of lesser known but »high performance« power circuits are then shown for specialized applications. In »Circuit Design Tricks« I present a wide variety of circuits that I have found useful. In the »early days« the switchmode circuit designer had to design his own control circuits out of discretes and small scale ICs, whereas today it is often mandatory that the designer use off-the-shelf control ICs. However, a new and innovative topology may not have a suitable controller available, or it may be necessary to add »glue logic« to a standard controller to overcome limitations or achieve additional capabilities.

Topics include:

→ **Power Circuit Design:**

- HF current shunts and pulse current transformers
- Damper and clamp circuits to reduce ringing and voltage spikes
 - Optimal input filter damping to prevent oscillation
 - Multi-stage filter damping
 - High energy voltage clamps
- PCB thermal considerations, including current capabilities

→ **Logic and Drive Circuit Design:**

- Useful analog circuits
- Digital logic design tricks
- Logic pulse transformers & circuits, for high speed communication with isolation
- FET gate drive circuits
- FET test circuits

Who should attend?

This course is directed towards design engineers who would like to expand their »bag of tricks« when conventional circuits are not up to the job.

Tutorials

Monday, 9 May 2016, 09:00 – 17:00

Venue: Arvena Park Hotel Nuremberg, Görlicher Str. 51, 90473 Nuremberg

Tutorial 7

Reliability of IGBT Power Modules

Josef Lutz, Chemnitz University of Technology, Germany



About the instructor

Josef Lutz joined Semikron Electronics, Nuremberg, Germany in 1983. First he worked in the development of GTO Thyristors, then in the field of fast recovery diodes. He introduced the Controlled Axial Lifetime (CAL) diode. Since August 2001 he is Professor for power electronics and electromagnetic compatibility at the Chemnitz University of Technology, Germany. His main fields of research are ruggedness and reliability of power devices. He is involved in several national and international research projects regarding power

cycling lifetime of IGBT modules and further reliability aspects. He is one of the authors of the book »Semiconductor Power Devices – Physics, Characteristics, Reliability«, published by Springer 2011.

Contents

- Basic architecture of IGBT power modules
- Substrates in power electronics
- Interconnection technologies in power modules
- Heat transport, thermal resistance, thermal impedance, cooling methods
- Temperature determination
 - Virtual junction temperature: Definition, measurement
 - Thermal simulation
- Fatigue processes in power modules, fatigue detection, related standardized tests
- Power cycling as main method to determine the lifetime expectation
 - Experimental setup, test strategies
 - Standard measurements and failure criteria
 - New methods for online state-of-health analysis
- Empirical models for lifetime prediction
 - LESIT model
 - CIPS 2008 model
 - Limits of available models
 - Special aspects with SiC devices
- Improved technologies and future trends in power module lifetime expectation
 - Diffusion sintering,
 - Diffusion soldering,
 - Cu bond wires,
 - Coated bond wires,
 - Improved substrates.

Who should attend?

Engineers in design of converters with IGBT modules with interest in reliability, beginners as well as experienced engineers are welcome. Focus is not on semiconductors, but on thermal problems.

Tutorial 8

IGBT Gate Drive Technologies

Reinhard Herzer, Arendt Wintrich, Semikron Elektronik, Germany



About the instructors

Reinhard Herzer studied electrical engineering and received 1984 his PhD in the field of microelectronics and 1992 his habilitation in the field of power devices and smart power ICs from the Ilmenau Technical University. He joined Semikron Electronics Nuremberg, Germany in 1995 as head of the MOSFET, IGBT and IC research department. Now he works in the field of new power device applications and is responsible for the development and introduction of new driver- and sensor- IC for power systems. Further he is associated professor at the Ilmenau University of Technology where he teaches and coaches students and PhD students.



Dr. Arendt Wintrich studied electrical engineering with focus on power electronics at the Chemnitz University of Technology. He received his doctorate in electrical engineering with the subject »Modeling of power semiconductors«. He joined SEMIKRON in 1999 as applications manager focusing on customer consulting and system design. Further key activities are circuit simulation, loss and temperature calculation.

Contents

- **Fundamentals**
 - Power control system
 - Inverter principle, frequency inverter
 - Methods of potential separation
 - Different topologies and applications
- **Power devices**
 - Physical basics, parameter and characteristics
 - Parasitics
 - Switching behaviour, switching times and losses
- **Driver fundamentals**
 - Gate driver topologies
 - Influence of different gate driver components on the switching behaviour
 - Transmission principles of control signal and driving energy
 - Galvanic isolation and level shift
 - Variants of power supply: DC/DC converter, bootstrap power supply, charge pump
 - Gate driving technologies and different gate driver circuits
- **Protection techniques**
 - Under voltage protection
 - Short pulse suppression and interlock

- Different kinds of short circuit protection
 - Current and temperature sensing
 - Hard and soft turn-off
- **Calculation and selection of drivers**
- Information and parameters, e.g. gate charge, frequency output voltage and current
 - Dimensioning of output stages
- **Using IGBT drivers**
- Input and output signals, V_{CE} -diode
 - Dimensioning and design of gate resistors
 - Gate- and V_{CE} -Clamping
 - Connection between gate driver and IGBT module, paralleling of modules
 - Some questions of system design: dc-link design (low inductivity), choice of right snubber, design of AC-terminal connection
 - Application circuits
- **New innovative gate driver concept- digital gate driver**
- Concept, solution, interfaces
 - Properties, advantages
- **Gate driver for SiC- and GaN devices (normally-on devices)**
- Different devices, concepts and solutions
- **Overview about available gate drivers**
- Hybrid drivers
 - IPMs
 - Integrated driver ICs, Single Chip Inverter

Who should attend?

Engineers using and designing drivers, converters and power electronic systems with IGBTs and MOSFETs.



Tutorials

Monday, 9 May 2016, 09:00 – 17:00

Venue: Arvena Park Hotel Nuremberg, Görlicher Str. 51, 90473 Nuremberg

Tutorial 9

Design Challenges for High Frequency Magnetic Circuit Design for Power Conversion

William Gerard Hurley, Werner Hugo Wölfle, National University of Ireland, Ireland



About the instructors

William Gerard Hurley received the B.E. degree in electrical engineering from the National University of Ireland, Cork in 1974, the M.S. degree in electrical engineering from the Massachusetts Institute of Technology, Cambridge MA, in 1976 and the PhD degree at the National University of Ireland, Galway in 1988. He worked for Honeywell Controls and Ontario Hydro in Canada from 1977 to 1983. He is currently director of the power electronics research centre at the National University of Ireland, Galway.

He is a fellow of the IEEE. He received the IEEE Power Electronics Society Middlebrook Technical Achievement Award in 2013 and was appointed distinguished lecturer of the IEEE for 2014–2015. He has co-authored a text book on magnetics for power electronics.



Werner Hugo Wölfle was born in Bad Schussenried, Germany. He graduated from the University of Stuttgart in Germany in 1981 as a Diplom-Ingenieur in power electronics. He completed a PhD degree at the National University of Ireland, Galway in 2003. He worked for various companies in the field of power electronics as a development engineer for power converters in space craft, military and high grade industrial applications. Since 1989 he is managing director and head of the R&D department of Traco Power Solutions in Ireland. Traco Power Solutions develops high

reliability power converters and power supplies for industrial applications. Mr. Wölfle is currently an adjunct professor in electrical engineering at the National University of Ireland, Galway. He has co-authored a text book on magnetics for power electronics.

Contents

The key to reducing the size of power supplies is high frequency operation and magnetic components can play a critical role. The tutorial begins with the design rules for inductor design and examples of different types of inductors are given. A special example is the inductor in a flyback converter, since it has more than one coil. This is followed by the general design methodology for transformers and many examples from switched mode power supplies and resonant converters are given. The main focus is placed on modern circuits where non-sinusoidal waveforms are encountered. General rules are established for optimising the design of windings under various excitation and operating conditions. The skin effect and the proximity effect give rise to increased losses in conductors due to the non-uniform distribution of current in the conductors. A new approach to high frequency losses that avoids cumbersome Fourier analysis will be presented to optimise the winding design, for non-sinusoidal waveform encountered in power electronics. Core losses for both sinusoidal and non-sinusoidal flux will be covered.

This tutorial is based on a new textbook authored by the speakers: *Transformers And Inductors For Power Electronics: Theory, Design And Applications*, Wiley, 2013.

Content:

→ Introduction

The introduction covers the fundamental concepts of magnetic components that serve to underpin the later sections.

→ Inductor Design

In Section I, the design rules for inductor design are established and examples of different types of inductors are given. The single coil inductor, be it in air or with a ferromagnetic core or substrate, is the energy storage device for magnetic fields. A special example is the inductor in a flyback converter, since it has more than one coil. Examples include: forward, flyback, push-pull and LLC resonant converters; filter chokes.

→ Transformer Design

Section II deals with the general design methodology for transformers. Particular emphasis is placed on modern circuits where non-sinusoidal waveforms are encountered and power factor calculations for non-sinusoidal waveforms are covered. Examples include: forward, pushpull and resonant converters.

→ High Frequency Design

There is an inverse relationship between the size of a transformer and its frequency of operation. However, losses increase at high frequency. There is skin effect loss and proximity effect loss in the windings due to the non-uniform distribution of the current in the conductors. The core loss increases due to the eddy currents circulating in the magnetic core and due to hysteresis. General rules are established for optimising the design of windings under various excitation and operating conditions. A new approach to high frequency losses that avoid cumbersome Fourier analysis will be presented to optimise the winding design.

→ Measurements

Advances in instrumentation have given new impetus to accurate measurements. Practitioners are well aware of the pitfalls of incorrect measurement techniques when it comes to inductance, because of the non-linear nature of hysteresis. Core loss measurement and the measurement of the effective capacitance of a transformer will also be included.

Who should attend?

This tutorial is of interest to students of electrical engineering and electrical energy systems; graduate students dealing with specialised inductor and transformer design and practising engineers working with power supplies and energy conversion systems.

Tutorial 10

Reliability Engineering in Power Electronics – from Components to Systems

Frede Blaabjerg, Francesco Iannuzzo, Huai Wang, Aalborg University, Denmark



About the instructors

Frede Blaabjerg is currently a professor with the department of energy technology and the director of Center of Reliable Power Electronics (CORPE), Aalborg University, Denmark. He has intensive research work on power electronics and its applications in motor drives, wind turbines, PV systems, harmonics, and the reliability of power electronic systems. He has held more than 300 lectures national and international, most of them in the last decade are invited and as keynotes at conferences, covering various topics

on power electronics, including the reliability. He was a distinguished lecturer for the IEEE Power Electronics Society from 2005 to 2007 and for the IEEE Industry Applications Society from 2010 to 2011. He has contributed more than 300 journal papers, many of which in the last four years are relevant to the reliability of power electronic components, converters and systems. Dr. Blaabjerg received the IEEE William E. Newell Power Electronics Award in 2014, the IEEE PELS Distinguished Service Award in 2009, the Outstanding Young Power Electronics Engineer Award in 1998, and 17 IEEE Prize Paper Awards. He served the editor-in-chief of the IEEE transactions on power electronics from 2006 to 2012.



Francesco Iannuzzo is currently a professor of reliable power electronics at the department of energy technology, Aalborg University, Denmark, where he is also part of CORPE (Center Of Reliable Power Electronics). He earned his M.Sc. degree cum laude in 1997 and his Ph.D. degree in electronics and information engineering from the University of Naples, Italy, in 2001, with a study on the reliability of power MOSFETs during diode operations. He is primarily specialized in the field of power device modeling. His research interests are in the field of reliability of power devices,

including against cosmic rays, power device failure modeling and testing of power modules up to MW-scale under extreme conditions. Prof. Iannuzzo was the Technical Programme Committee Chair in two editions of ESREF, the European Symposium on Reliability and Failure analysis. On top of more than 100 publications in the field, he has given a number of tutorials and invited speeches in the field of robustness of power devices at first conferences like EPE and SEMICON.



Huai Wang is currently an associate professor and a work package leader with the Center of Reliable Power Electronics (CORPE), Aalborg University, Denmark. His current research interests include the reliability of power electronic systems, reliability of capacitors and IGBT modules, and emerging power electronics applications. Dr. Wang is the co-lecturer of a PhD course on reliability of power electronic systems at Aalborg University since 2013, an invited speaker at the European Center for Power Electronics (ECPE) workshops, and a tutorial lecturer at leading power electronics conferences.

He has co-edited a book on reliability of power electronic systems in 2015, filed 4 patents, and contributed about 30 journal papers, including several concept papers on the reliability of capacitors and power electronic systems. Dr. Wang received his PhD degree from the City University of Hong Kong, Hong Kong, China, in 2012, and B. E. Degree from Huazhong University of Science and Technology, China, in 2007. He was a visiting scientist with the ETH Zurich, Switzerland, from August to September, 2014 and with the Massachusetts Institute of Technology (MIT), Cambridge, MA, USA, from September to November, 2013. He was with the ABB Corporate Research Center, Baden, Switzerland, in 2009. He serves the guest editor-in-chief of IEEE JESTPE special issue on power electronics for energy efficient buildings and an associate editor of IEEE transactions on power electronics.

Contents

In many mission-critical applications of energy conversions such as renewables, industry, electric vehicles, and aircrafts, etc, the power electronics should be extremely reliable and robust to avoid high cost of failures. In order to meet this challenging requirement, there is an ongoing paradigm shift in this field from the statistics-based assessment to the physic-of-failures based analysis. In this shift the stress and strength models of the power electronics components need to be accurately built, and both of the factors are closely related to the operating conditions or mission profiles of the whole systems. These mission profiles will involve multi-disciplinary knowledge and new engineering approaches for the design of reliability performances.

In this tutorial the paradigm shifts in reliability research on power electronics as well as some reliability engineering concepts are first introduced. Afterwards some testing examples on the power electronics components for either wear-out and severe/abnormal events are both presented. Based on these results, a series of new modeling and control concepts are given to evaluate/improve the reliability performances of power electronics systems, considering mission profiles with several examples on renewable energy and motor drives. Finally, the tutorial will also present the views of the instructors on the future research opportunities in the area of reliability of power electronics.

Table of Contents

→ Towards Reliable Power Electronics

- Motivations, field experiences and challenges
- Ongoing paradigm shift in reliability research
- Design for reliability concept

→ Basics about reliability Engineering and Metrics

- Weibull distribution, Reliability, Failure rates, and Bx lifetime
- Concepts of FMEA, HALT, CALT, Six sigma design, etc.
- Importance of mission profiles

→ Wear-out Testing of Power Electronic Components

- Power cycling of IGBT modules under real filed mission profiles
- Degradation testing of film capacitors under humidity conditions
- Reliability testing of LED

→ Failure Mechanisms and Testing of IGBT Operated at the Edge of SOA

- Severe and abnormal events on the reliability performances
- Basic of instabilities and phenomenon
- Instabilities during short circuit of IGBTs
- Non-destructive testing technique and setups

→ Advanced Design Tool for Reliability of Power Electronics Systems

- Multi timescales modeling of power electronics system
- New thermal models of IGBT for mission profile translation
- Rain flow counting, accumulated damages and Monte Carlo simulation
- Examples on Wind power, PV power and Motor drive systems

→ Active Thermal Control for Improved Reliability

- Basics ideas and control freedoms
- Thermal measurement and monitoring
- Controls under normal operations of converter
- Control under severe and abnormal conditions

→ Future Research Opportunities in Reliability of Power Electronics

- Interdisciplinary efforts and opportunities ahead

Who should attend?

Engineers or researchers in power electronics design and testing with interest in improving reliability performance. Beginners as well as experienced engineers are both welcome. Focus is more on the reliability engineering including testing and modeling aspects from components to system level.

Awards



Best Paper Award

The Best Paper Award honours the best paper of the conference. The award ceremony and speech will be part of the PCIM Europe Conference opening ceremony.

The nominees are:

New Ultra Fast Short Circuit Detection Method Without Using the Desaturation Process of the Power Semiconductor

Stefan Hain, Mark-M. Bakran, University of Bayreuth, D

High Power, High Frequency Gate Driver for SiC-MOSFET Modules

Gunter Koenigsmann, Reinhard Herzer, Sven Buetow, Matthias Rossberg, Semikron Elektronik, D

A Generic Topology for Electrical Energy Storage Systems

Christoph Marxgut, Helbling Technik, D

Effect of Self Turn-On during Turn-On of HV-IGBTs

Patrick Münster, Hans-Günter Eckel, University of Rostock, D

Cosmic Ray Failure Mechanism and Critical Factors for 3.3kV Hybrid SiC Modules

Tetsuya Nitta, Yoshiaki Inoue, Toshiba, J; Georges Tchouangue, Toshiba Electronics Europe, D

A Large Input Voltage Range 1MHz Full Converter with 95% Peak Efficiency for Aircraft Applications

Nicolas Quentin, SAGEM, F; Remi Perrin, INSA de Lyon, F; Christian Martin, Charles Joubert, Ampere Laboratory, F

This award is sponsored by:



Young Engineer Award

The Young Engineer Award goes to the three best lectures from engineers not older than 35 years and will be also honoured in the PCIM Europe Conference opening ceremony.

The nominees are:

Benefits of Increased Cosmic Radiation Robustness of SiC Semiconductors in large Power-Converters

Christian Felgemacher, Araujo Vasconcelos, Christian Nöding, Peter Zacharias, University of Kassel, D

New Ultra Fast Short Circuit Detection Method Without Using the Desaturation Process of the Power Semiconductor

Stefan Hain, Mark-M. Bakran, University of Bayreuth, D

Non-isolated Three-Port DC/DC-Converter for ± 380 VDC Microgrids

Yunchao Han, Julian Kaiser, Leopold Ott, Matthias Schulz, Fabian Fersterra, Bernd Wunder, Fraunhofer Institute IISB, D

High Efficiency Three-Phase-Inverter with 650 V GaN HEMTs

Jennifer Lautner, Bernhard Piepenbreier, Friedrich-Alexander-University of Erlangen, D

EMI Study in a GaN HEMT Power Module

Xiaoshan Liu, Bertrand Revol, Cyrille Gautier, Francois Costa, ENS Cachan-SATIE, F

DC-DC Converter based on the Asymmetric Multistage Stacked Boost Architecture with Feed-Forward Control for Photovoltaic Plants

Georgios Mademlis, Aristotle University of Thessaloniki, GR; Gina Steinke, Alfred Rufer, EPFL, CH

Generic Topology for Electrical Energy Storage Systems

Christoph Marxgut, Helbling Technik, D

Effect of Self Turn-On during Turn-On of HV-IGBTs

Patrick Münster, Hans-Günter Eckel, University of Rostock, D

A Large Input Voltage Range 1MHz Full Converter with 95% Peak Efficiency for Aircraft Applications

Nicolas Quentin, SAGEM, F; Remi Perrin, INSA de Lyon, F; Christian Martin, Charles Joubert, Ampere Laboratory, F

High Speed Electronic Over Current Breaker for DC-Grids without Additional Sensing

Alexander Würfel, Johannes Adler, Nando Kaminski, University of Bremen, D; Anton Mauder, Infineon Technologies, D

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Keynotes



Speaker: Dan Kinzer,
Navitas Semiconductor,
USA
Chairperson: Leo Lorenz,
ECPE, Germany

Tuesday, 10 May 2016

Welcome to the Post-Silicon World: Wide Band Gap Powers Ahead

In the early 1980's, industry pioneers transformed the silicon bipolar transistor into the mass production MOSFET. The 1990's saw the adoption of IGBT, and the 2000's brought superjunction MOSFET into volume. Now, an even more fundamental transition is underway as Silicon is overtaken by the introduction of SiC and GaN high performance, wide band-gap power products. The breakthrough performance of qualified products, with the subsequent application benefits of size and cost, is now fully appreciated by power system designers. As the ecosystem continues to mature, with new enabling topologies, control ICs and magnetic solutions, the transition will accelerate and transform the power industry. Examples will be taken from applications such as electric vehicles, renewable energy, power supplies, and battery chargers.



Speaker: Johann
Walter Kolar, ETH Zürich,
Switzerland
Chairperson: Jose Mario
Pacas, University of
Siegen, Germany

Wednesday, 11 May 2016

Smart Transformers – Concepts-Challenges-Applications

Smart and/or Solid-State Transformers (SSTs) are formed by power electronics interfaces at the MV input and LV output side, which are linked through a MF transformer. Accordingly, SSTs show a high power density and are offering high controllability. Therefore, SSTs are seen as key elements of future smart microgrids, and are well suited for replacing bulky LF transformers of locomotives. However, the connection to MV, the high overall complexity/realization costs, and the potentially lower efficiency are still major challenges for practical applications.



Speaker: Jens Merten,
National Solar Energy
Institute, France
Chairperson: Philippe
Ladoux, University of
Toulouse, France

Thursday, 12 May 2016

Trends of Solar Systems and their Integration in Electricity Networks

With their constant cost reduction, solar systems have become already today an economically viable alternative in many regions of the world. While the cost for solar modules has been drastically reduced in the last years, the cost reduction potential for the balance of system components, like for example power conditioners, still needs to be exploited. On the other side, the massive penetration of variable solar energy systems challenges the management of the electricity networks. This speech outlines trends for solving these issues.

Conference Tuesday, 10 May 2016, Morning und Afternoon Oral Sessions

Room Brüssel

09:00

Conference Opening/ Best Paper Award/ Young Engineer Award

Prof. Leo Lorenz warmly welcomes you to the PCIM Europe 2016 international exhibition and conference.

In more than 300 oral and poster presentations international experts present their latest technological trends and developments in power electronic components and systems.

This year the conference highlights include, amongst others, three keynote speeches, three special sessions as well as one panel discussion. In the latter, experts from different fields will analyse and discuss current topics such as the importance and challenges of industry 4.0 for power electronics.

More information about the awards on page 22.

Room Brüssel

09:45

KEYNOTE:

Welcome to the Post-Silicon World: Wide Band Gap Powers Ahead

Speaker: Dan Kinzer, Navitas Semiconductor, USA

Chairperson: Leo Lorenz, ECPE, D

More information on page 23.

10:30 Coffee Break

Room Brüssel

SiC Devices



Chairperson: Serge Bontemps,
Microsemi PMP Europe, F

11:00

Ultra-low (1.25m?) On-Resistance 900V SiC 62mm Half-Bridge Power Modules Using New 10mO SiC MOSFETs
Jeffrey Casady, Vipindas Pala, Edward Van Brunt, Brett Hull, Sei-Hyung Ryu, Gang-Yao Wang, Peter Killeen, Brice McPherson, Kraig Olejniczak, Brandon Passmore, David Simco, Wolfspeed, USA

11:30

Evolution of SiC Products for Industrial Application
Naoyuki Kizu, Satoru Nate, Mineo Miura, Noriaki Kawamoto, Kazuhide Ino, Rohm, J

12:00

Advanced Protection for Large Current Full SiC-Modules
Eugen Wiesner, Eckhard Thal, Mitsubishi Electric Europe, D; Andreas Volke, Karsten Fink, Power Integrations, D

12:30

Switching Performance of a 1200V SiC-Trench-MOSFET in a Low-Power Module
Daniel Heer, Daniel Domes, Dethard Peters, Infineon Technologies, D

13:00 **Ground Floor** Lunch Break

Room Brüssel

SiC Reliability



Chairperson: Uwe Scheuermann,
Semikron Elektronik, D

14:00

Breakdown of Gate Oxide of 1.2 kV SiC-MOSFETs Under High Temperature and High Gate Voltage
Menia Beier-Möbius, Josef Lutz, Chemnitz University of Technology, D

14:30

Avalanche Robustness of SiC MPS Diodes
Thomas Basler, Roland Rupp, Rolf Gerlach, Bernd Zippelius, Infineon Technologies, D; Mihai Draghici, Infineon Technologies, AT

15:00

Compact, Low Loss and High Reliable 3.3kV Hybrid Module
Satoshi Kaneko, Eiji Mochizuki, Motohiro Hori, Fuji Electric, J

15:30 Coffee Break

15:30 – 17:30 **Foyer Ground Floor Entrance NCC Mitte** Poster/Dialogue Session (More information on pages 26/27)

17:15 **NCC Ost Level 1** Exhibition Party

Room München 1

Module Materials



Chairperson: Reinhold Bayerer,
Infineon Technologies, D

11:00

Beyond Thermal Grease, Enhancing Thermal Performance and Reliability
Sanjay Misra, The Bergquist Company, USA; Michael Stoll, The Bergquist Company, D

11:30

High Thermal Conductivity Silicon Nitride substrate for Power Semiconductor (or Module) Applications
Dai Kusano, Gen Tanabe, Yoshiyuki Uchida, Japan Fine Ceramics, J

12:00

Thermal Management of Future WBG Devices using Two-Phase Cooling
Shailesh Joshi, Ercan Dede, Toyota Research Institute North America, USA

12:30

Highly Reliable and Lead-Free High Power IGBT Modules Using Novel Copper Sintering Die Attachment
Akitoyo Konno, Yoshihiko Koike, Mutsuhiro Mori, Hitachi, J

Room München 1

DC/DC Converters I



Chairperson: Klaus Marahrens,
SEW-Eurodrive, D

14:00

Isolated Synchronous Forward Controller with Integrated Feedback Loop and Adjustable Deadtime for High Efficiency DC/C Converter
Bernhard Strzalkowski, Analog Devices, D; Subodh Madiwale, Analog Devices, USA

14:30

Extreme High Efficiency Non-Inverting Buck-Boost Converter for Energy Storage Systems
Zhe Yu, Holger Kapels, Fraunhofer Institute ISIT, D; Klaus F. Hoffmann, Helmut Schmidt University, D

15:00

A High-Efficiency Bidirectional GaN-HEMT DC/DC Converter
Michael Ebli, Martin Wattenberg, University of Reutlingen, D; Martin Pfost, University of Innsbruck, AT

Room Athen

Magnetics & Inductors



Chairperson: Eric Favre,
IMI-Precision Engineering, CH

11:00

A New Generation of Nanocrystalline Magnetic Cores with Very Low Magnetic Losses

Bashar Gony, Stephane Camus, Julia Hill, Frederic Pottier, Aperam Alloys Amilly, F

11:30

The Fe-based Glassy Alloy Powder Core Inductor for the Boost Converter by GaN HEMT and SiC SBD 1MHz Operation

Mitsunao Fujimoto, Takao Mizushima, Yutaka Naitoh, ALPS Green Devices, J

12:00

Accurate Calculation of AC Losses of Inductors in Power Electronic Applications

Ranjith Bramanpalli, Würth Elektronik Eisos, D

12:30

Thin-Film Based Microtransformer Suitable for High Switching Frequency Power Applications

Dragan Dinulovic, Mahmoud Shousha, Martin Haug, Alexander Gerfer, Würth Elektronik eiSos, D; Sebastian Beringer, Marc C. Wurz, Leibniz University Hannover, D

Room Mailand

DC/AC and AC/DC Converters



Chairperson: Peter Steimer,
ABB Switzerland, CH

11:00

Design Of High Efficiency High Power Density 10.5kw Three Phase On-Board-Charger for Electric/Hybrid Vehicles

Gang Yang, Valeo, F; Eirik Draugedalen, Torbjorn Sorsdahl, Hui Liu, Roar Lindseth, Valeo Powertrain Energy Conversion, NO

11:30

A Bridgeless, Quasi-Resonant ZVS-Switching, Buck-Boost Power Factor Correction Stage (PFC)

Markus Scherbaum, Manfred Reddig, University of Applied Sciences Augsburg, D; Ralph Kennel, Technical University of Munich, D; Manfred Schlenk, Infineon Technologies, D

12:00

A high efficiency 5.3kW Current Source Inverter (CSI) Prototype using 1.2kV Silicon Carbide (SiC) Bi-Directional Voltage Switches in hard Switching Mode

Jérémy Martin, Anthony Bier, Stéphane Catellani, Luis Gabriel Alves-Rodrigues, Franck Barruel, Commissariat à l'énergie atomique et aux énergies alternatives, F

12:30

Comparison of the EMC and Efficiency Characteristics of Hard and Soft Switching Three-Level Inverters

Manfred W. Gekeler, Stefan Schreitmüller, Gunter Voigt, HTWG Konstanz University of Applied Sciences, D

Room München 2

SPECIAL SESSION
Passive Components

Chairperson: Wolfram Teppan, LEM Switzerland, CH; Petar J. Grbovic, Huawei Technologies, D

11:00

Drive System Loss Reduction by Allpole Sine Filters

Dennis Kampen, BLOCK Transformatoren-Elektronik, D; Michael Burger, SEW Eurodrive, D

11:30

Harmonic Filtering in Variable Speed Drives

Luca Dalessandro, Andrzej Pietkiewicz, Xiaoya Tan, Norbert Naeberle, Schaffner, CH

12:00

A just Comparison of Ferrite and Nanocrystalline Common Mode Chokes

Jörn Schlieve, Christian Paulwitz, Stefan Weber, Epcos, D

12:30

Modeling an Anti-Ferroelectric Ceramic Capacitor for Time- and Frequency-Domain Simulations of Power Systems

Stefan Scheffler, Stefan Weber, Epcos, D; Markus Puff, Epcos, AT

Room Athen

Control Converters



Chairperson: Geraldo Nojima,
Eaton Corporation, USA

14:00

Direct Delta Sigma Signal Processing for Control of Power Electronics

Michael Homann, Axel Klein, Walter Schumacher, Technical University of Braunschweig, D

14:30

Finite Control Set Model Based Predictive Control of a PMSM with Variable Switching Frequency and Torque Ripple Optimization

Fernando David Ramirez Figueroa, Mario Pacas, University of Siegen, D

15:00

Efficiency Improvement by Frequency- and Mode-Adaptive Control of DC-DC Converter

Lukas Keuck, Joachim Böcker, University of Paderborn, D

Room Mailand

Control Techniques in
Intelligent Motion Systems I

Chairperson:
Walter Schumacher, Technical
University of Braunschweig, D

14:00

Load Torque Estimation in Repetitive Mechanical Systems by Using Fourier Interpolation

Van Trang Phung, Mario Pacas, University of Siegen, D

14:30

Fast Current Waveform Calculation Algorithm for a Six Phase Switched Reluctance Machine

Jacek Borecki, Bernd Orlik, University of Bremen, D

15:00

Process Requirements-Based Adaptive PWM for Improved Efficiency of Machine Tool Feed-Drives

Matthias Braband, Florian Frick, Armin Lechler, Alexander Verl, ISW – University of Stuttgart, D

Room München 2

DC/AC Converters



Chairperson: Jean-Paul Beaudet,
Schneider Electric, F

14:00

Comparison of Bidirectional T-Source Inverter and Quasi-Z-Source Inverter for Extra Low Voltage Application

Thomas Baier, Bernhard Piepenbreier, Friedrich-Alexander-University Erlangen, D

14:30

Benchmarking of SiC JFET and SiC MOSFET Modules for the Application in Medium Power Traction Converters

Andreas März, Roman Horff, Teresa Bertelshofer, Mark-M. Bakran, University of Bayreuth, D; Martin Helsen, Siemens, D

15:00

New Bus-bar Topology to Suppress the Current Imbalance of Parallel-connected IGBT Modules for High Power Railway Traction Converter System

Naoki Sakurai, Masaaki Konishide, Yasuhiko Kouno, Hitachi, J

Conference Tuesday, 10 May 2016, Poster Dialogue Session

15:30 – 17:30, Foyer Ground Floor Entrance NCC Mitte

MOSFET, IGBTs, Freewheeling Diodes



Chairperson: Yasuyuki Nishida,
Chiba Institute of Technology, J

- PP001 New LV Wide SOA Power MOSFET Technology for Linear Mode Operation**
Filippo Scrimizzi, Gaetano Bazzano, Daniela Cavallaro, Marco Comola, Giuseppe Consentino, Stefania Fortuna, Giuseppe Longo, Gaetano Pignataro, STMicroelectronics, I
- PP002 Field Stop Trench IGBT Process Parameter Calibration for Advanced Predictive Prototyping**
Mehrdad Baghaie Yazdi, Hermann Fischer, James Victory, Fairchild Semiconductor, D
- PP003 Best-in-class 1200V IGBT for High Frequency Applications**
Ramakrishna Tadikonda, Jorge Cerezo, Chiu Ng, Infineon Technologies Americas, USA
- PP004 Extra Electro-Thermal Performance of 1700V IGBT with the Latest 7th Generation Chipset/ Package Technologies**
Thomas Heinzel, Fuji Electric Europe, D; Mutsumi Sawada, Shinichi Yoshiwatari, Hiroaki Ichikawa, Yuichi Onozawa, Osamu Ikawa, Fuji Electric, J
- PP005 Parameter Extraction for PSpice Models by Means of an Automated Optimization Tool – An IGBT model Study Case**
Francesco Iannuzzo, Carlos Gomez Suarez, Paula Diaz Reigosa, Ionut Trintis, Frede Blaabjerg, Aalborg University, DK
- PP006 800V Super Junction MOSFET (HV-DTMO5 IV) with Better Trade-Off Between Switching Loss and $dVDS/dt$**
Hiroyuki Irihara, Hiroshi Ohta, Kaga Toshiba Electronics Corporation, J; Hiroaki Yamashita, Hideyuki Ura, Kenji Mii, Masato Nashiki, Naotsugu Kako, Toshiba Corporation Semiconductor, J; Georges Tchouangue, Toshiba Electronics Europe, D
- PP007 Highly Robust 1700V Diodes Fabricated on 8" Line Using Optimized Proton Implanted Buffer**
Maolong Ke, Xiaoping Dai, Dynex Semiconductor, GB
- PP008 Loss and Softness Optimized IGBT-Diode System for Fast-Switching Applications**
Christian Müller, Stefan Buschhorn, Infineon Technologies, D

Intelligent Power Modules



Chairperson: Yasuhiro Okuma,
Fuji Electric, J

- PP009 Protection Features of Intelligent Power Module against Transient State**
Taehyun Kim, Minsub Lee, Junbae Lee, Daewoong Chung, Infineon Technologies Power Semitech, ROK
- PP010 New High Level Integrated Intelligent Power Module with Three Phase Inverter and Power Factor Correction Topologies Optimized for Home Appliance**
Hyosang Jang, Byoungcho Choo, Junbae Lee, Minsub Lee, Daewoong Chung, Jaewook Lee, Infineon Technologies Power Semitech, ROK

- PP011 Layout of On-Chip Temperature Sense: Influence of the Temperature Diode Position**
Inpil Yoo, Infineon, D
- PP012 New DIPIPM+TM Series Module with All-in-one Integrated**
Yuancheng Zhang, Xiankui Ma, Mitsubishi Electric & Electronics, CN
- PP013 Improvement of System Level Power Density of 15A/600V Intelligent Power Modules**
Jonathan Harper, ON Semiconductor, D; Toshiyuki Iimura, ON Semiconductor, J
- PP014 Optimization of FREDFET-based μ IPM for very Low Power Motor Drive Applications**
Rajeev Krishna Vytla, Danish Khatri, Brian Sun, Infineon Technologies North America, USA
- PP015 A novel Transfer Molding Intelligent Converter Inverter Brake IGBT Module (DIPIPM+) with Integrated Level Shifting Control ICs**
Marco Honsberg, Mitsubishi Electric Europe, D; Teruaki Nagahara, Mitsubishi Electric Corporation, J; Eric R. Motto, Powerex, USA
- PP016 An Automatic IGBT Collector Current Sensing Technique via the Gate Node**
Jingxuan Chen, Andrew Shorten, Wai Tung Ng, University of Toronto, CA; Masahiro Sasaki, Tetsuya Kawashima, Haruhiko Nishio, Fuji Electric, J

High Voltage Devices



Chairperson: Munaf Rahimo,
ABB Switzerland, CH

- PP017 Design and Characterisation of Optimised Protective Thyristors for VSC Systems**
Michael Spence, Ashley Plumpton, Dynex Semiconductor, GB
- PP018 Cathode Emitter vs. Carrier Lifetime Engineering of Thyristors for Industrial Applications**
Jan Vobecky, Marco Bellini, Karlheinz Stiegler, ABB Switzerland, CH
- PP019 Experimental Results of a Large Area (91mm) 4.5kV »Bi-Mode Gate Commutated Thyristor« (BGCT)**
Thomas Stiasny, Umamaheswara Reddy Vemulapati, Martin Arnold, Munaf Rahimo, Jan Vobecky, ABB Switzerland, CH; Christian Kähr, Norbert Hofmann, University of Applied Sciences Nordwestschweiz, CH
- PP020 Effect of Self Turn-On during Turn-On of HV-IGBTs**
Patrick Münster, Hans-Günter Eckel, University of Rostock, D
- PP021 An Innovative 6500V HVIGBT with High Robustness**
Bo Hu, Gaosheng Song, Mitsubishi Electric & Electronic, CN
- PP022 New High Power 3.3kV/1500A IGBT Module Packaging**
Daohui Li, Wei Zhou, Fang Qi, Matthew Packwood, Yangang Wang, Steve Jones, Xiaoping Dai, Dynex Semiconductor, GB
- PP023 The LinPak High Power Density Design and its Switching Behaviour at 1.7 kV and 3.3 kV**
Samuel Hartmann, Fabian Fischer, Andreas Baschnagel, Harald Beyer, Raffael Schnell, ABB Switzerland, CH
- PP024 Power Converter GTO to IGBT Upgrade – a New Life for Traction Converters**
Augusto Franco, Luis Sequeira, Nomad Tech, PT



Packaging Technologies and Materials



Chairperson: Yoshiyuki Uchida,
Japan Fine Ceramics, J

- PP025 Reliability Improvement Aspects of large Area Sintered Power Semiconductor Devices**
Dmitry Titushkin, Alexey Surma Proton-Electrotex JSC, RUS; Michiel De Monchy, Anna Lifton, Alpha, RUS
- PP026 Analysis of Interface Structure and Composition of Cu/Al2O3 for the High Stability of DBC (Direct Bonded Copper)**
Hyunwoo Kim, Jaehoon Jung, Woogyo Suh, Kisoo Jun, KCC Corporation, ROK
- PP027 Power Stack – Advantages and Reliability of an Aluminum Based Stacked Power Module**
Chris Burns, AB Mikroelektronik, AT
- PP028 Evaluation of Metal-Matrix composites Baseplates with anisotropic thermal Conductivity Inserts**
Fabian Streb, Infineon Technologies, D; Henning Zeidler, Michael Penzel, Andreas Schubert, Thomas Lampe, Technical University of Chemnitz, D
- PP029 Analysis of Packaging Impedance on Performance of SiC MOSFETs**
Andrew Lemmon, The University of Alabama, USA
- PP030 Low-Stress Silicone Encapsulant for Reliable Power Conversion Devices**
Eric Vanlathem, Guy Beaucarne, Dow Corning Europe, D
- PP031 Pumping out Failure Free Package Structure**
Junji Yamada, Yoshitaka Otsubo, Mitsubishi Electric Corporation, J; Satoshi Miyahara, Mitsubishi Electric, D
- PP032 High power IGBT Module with New AlN Insulated Substrate**
Hiroyuki Nogawa, Akira Hirao, Yoshitaka Nishimura, Takashi Saitou, Yuuta Tamai, Fumihiko Momose, Eiji Mochizuki, Yoshikazu Takahashi, Fuji Electric, J
- PP033 Nanosilver Paste for Low Pressure Die Attach: A Turn Key Process**
Francesc Masana, Barcelona Semiconductors, ES
- PP034 New Silicone Gel Enabling High Temperature Stability for next Generation of Power Modules**
Thomas Selldrum, Eric Vanlathem, Vincent Delsuc, Dow Corning, BE; Hiroji Enami, Dow Corning Toray, J
- PP035 A new Ag paste composed of nano and micro-Ag particles prepared simultaneously and its application as die-attachment materials**
Katsuki Saganuma, Jinting Jiu, Hao Zhang, Shunsuke Koga, Shijo Nagao, Osaka University, J

Packaging and Reliability



Chairperson: Joël Turchi,
On Semiconductor, F

- PP036 Reliability of Double Side Silver Sintered Devices with Various Substrate Metallization**
Francois LeHenaff, Alent, D; Gustavo Greca, Alpha/Alent, USA; Olivier Mathieu, Rogers Germany, D; Zoltan Sarkany, HU
- PP037 For Future High Reliable Power Module Assembly**
Steven Josso, Henkel Electronics, BE

- PP038 Encapsulation of Smart Power Electronic Devices – Dielectric Behavior under Thermal Load**
Tina Thomas, Technical University of Berlin, D; Karl-Friedrich Becker, Jörg Bauer, Tanja Braun, Eckart Hoene, Mathias Böttcher, Andre Arens, Klaus-Dieter Lang, Fraunhofer Institute IZM, D
- PP039 Improvement on the Mechanical Properties of Sn-Ag-Sb Lead-Free Solders**
Mohammed Gumaan, Rizk Shalaby, Mustafa Kamal, Mansoura University, AE
- PP040 Health-Monitoring of IGBT Power Modules using repetitive Half-sinusoidal Power Losses**
Marco Denk, Mark-M. Bakran, University of Bayreuth, D
- PP041 Reliability Investigation on SiC BJT Power Modules**
Alexander Otto, Sven Rzepka, Fraunhofer-Institute ENAS, D; Eberhard Kaulfersch, Berliner Nanotest & Design, D; Sophia Frankeser, Technical University of Chemnitz, D
- PP042 Investigation of the Influence of Ageing Processes on Thermal Characteristics of an IGBT Power Module by Means of Transient Thermal Analysis**
Tobias von Essen, Mohamad Abo Ras, Berliner Nanotest & Design, D; Stefan Stegmeier, Gerhard Mitic, Siemens, D
- PP043 Test Setup for Multistress Characterization of Insulation Degradation Mechanisms in Electric Drives**
Davide Barater, Giovanni Franceschini, Università degli Studi di Parma, I; Chris Gerada, Michael Galea, University of Nottingham, GB; Fabio Immovilli, Raw Power, I
- PP044 Integration of a Measurement Circuit to determine Junction Temperatures of IGBTs in a Three-phase Inverter**
Bastian Strauss, Andreas Lindemann, Otto-von-Guericke-University, D
- PP045 A Recuperation Topology for Power Device Testing**
Tomas Krecek, ON semiconductor, CZ
- PP046 Electrolytic Capacitor Age Estimation using PRBS-Based Techniques**
David Hewitt, James Green, Jonathan Davidson, Martin Foster, David Stone, University of Sheffield, GB
- PP047 On-line Monitoring for Diagnosis on Traction Transformer for Rolling Stock Application**
André-Philippe Chamaret, SNCF, F; Toufann Chaudhuri, ABB Sécheron, CH

Cooling



Chairperson: Mark M. Bakran,
University of Bayreuth, D

- PP048 Direct-Water-Cooled Next High Power Density Dual (nHPD2) Considering Inverter Layout**
Keisuke Horiuchi, Yuichiro Konishi, Mitsuhiro Mori, Daisuke Kawase, Hitachi, J; Katsuaki Saito, Hitachi Europe, GB
- PP049 Heat Pipes and Their Applications as Heat Flux Transformers and Remote Heat Rejection**
Devin Pellicone, Jens Weyant, Advanced Cooling Technologies, USA
- PP050 Direct Flexible Cooling of an IGBT**
Jörg Ihrig, Mersen, CH; Alexandre Erokhin, CERN, CH
- PP051 New Class of Graphite TIMs provide Performance and Reliability**
Prasanth Subramanian, Alex Augoustidis, GrafTech International, USA
- PP052 Heat Pipe System Development for Railway Application working with speed Motion Convection**
Thomas Albertin, Atherm, F
- PP053 High Performances Passive Two-Phase Loops for Power Electronics Cooling**
Vincent Dupont, Calyos, BE
- PP054 Thermal Management and Modelling for Integrated High Current Systems**
Marco Schilling, Ulf Schwalbe, Tom Wagner, Technical University of Ilmenau, D
- PP055 Packaging and Characterization of Silicon SiC-based Power Inverter Module with Double Sided Cooling**
Charles-Alix Manier, Hermann Oppermann, Christian Ehrhardt, Fraunhofer-Institute IZM; Bernhard Wunderle, Technical University of Chemnitz, D; Klaus-Dieter Lang, Technical University of Berlin, D

Sensors, Control and Protection



Chairperson: Eric Carroll,
EIC Consultancy, F

- PP056 Digital Adaptive Control Approach to Dynamic Response Improvement for Compact PFC Rectifiers**
Trong Tue Vu, George Young, Eisergy, IE
- PP057 Nonlinear Output Characteristic of DAB Converter caused by ZVS Transition**
Martin Jagau, Michael Patt, Technogienetzwerk Allgäu, D
- PP058 Efficiency Maximization for Half-Bridge LC Converter through Automatic Dead Time Tuning**
Vittorio Crisafulli, ON Semiconductor, D; Gianluca Fazio, On Semiconductor Italy, I; Diego Hernandez Gutiérrez, CH
- PP059 Improved Finite Control Set Model Predictive Control with Fixed Switching Frequency for Three Level NPC Grid Connected Converter with L Filter**
Margarita Norambuena, Hang Yin, Sibylle Dieckerhoff, Technical University of Berlin, D; Jose Rodriguez, University Andres Bello, CL
- PP060 Current Sensorless Totem-pole Bridgeless Power Factor Corrector**
Felipe López, Francisco Azcondo, Paula Lamo, Alberto Pigazo, University of Cantabria, ES
- PP061 DC-DC Converter Model with Predictive Current Control**
Pavol Bauer, Aditya Shekhar, Laurens Mackay, Laura Ramirez-Elizondo, Delft University of Technology, NL
- PP062 Parameter-Independent Battery Voltage Control Based on Virtual Capacitor Emulation**
Andoni Urtausun, Ernesto L. Barrios, Pablo Sanchis, Luis Marroyo, Public University of Navarre, ES
- PP063 FPGA Digital Control for VSI Nonlinearity Effect Compensation**
Mauro Di Monaco, Umberto Abrozini, Ciro Attaianesi, Matilde Arpino, Giuseppe Tomasso, University of Cassino and South Lazio, I
- PP064 Offline Non Isolated Converter Protection**
Cathal Sheehan, Bourns Electronics, IE; Roberto Scibilia, Texas Instruments, D
- PP065 Optimisation of Shunt Resistors for Fast Transients**
Melanie Adelmund, Christian Bödeker, Nando Kaminski, University of Bremen, D
- PP066 Magnetoresistive Current Sensors as an Enabler for Advanced Control Techniques**
Rolf Slatter, Sensitec, D
- PP067 Rotational Speed Measurement Based on Avago ADNS-9800 Laser Mouse Sensor**
Cheng Liu, Yanan Xu, Ji-Gou Liu, Hui Sun, Chenyang Technologies, D; Ralph Kennel, Technical University of Munich, D

Low EMI High Efficiency Converters



Chairperson: Hans Ertl,
Vienna University of Technology, A

- PP068 Practical EMI Control in a Power Component Design Space**
David Bournier, Vicor Corporation, USA
- PP069 Converter Switching Noise Reduction for Enhancing EMC Performance in HEV and EV**
Ho Tae Chun, JinHwan Jung, Hyundai Motors Company, ROK
- PP070 Efficiency and Vibration Observations of a Symmetrical Six-Phase Drive applying Interleaved Space Vector Modulation**
Daniel Glose, Peng Qian, Ralph Kennel, Technical University of Munich, D
- PP071 High Efficiency Three-Phase-Inverter with 650V GaN HEMTs**
Jennifer Lautner, Bernhard Piepenbreier, Friedrich-Alexander-University of Erlangen, D
- PP072 A Large Input Voltage Range 1MHz Full Converter with 95% Peak Efficiency for Aircraft Applications**
Nicolas Quentin, SAGEM, F; Remi Perrin, INSA de Lyon, F; Christian Martin, Charles Joubert, Ampere Laboratory, F; Louis Grimaud, Safran Group, F; Rolando Burgos, Dushan Boroyevich, CPES/Virginia Tech, USA
- PP073 Integrating Depletion-Mode SiC VJFETs into Production Motor Drives**
Michael Mazzola, James Gafford, Mississippi State University, USA
- PP074 Higher Light Efficacy in LED-Lamps by Lower LED-Current**
Reinhard Jaschke, Helmut Schmidt University Hamburg, D
- PP075 Synchronized Switching and Active Clamping of IGBT Switches in a Simple Marx Generator**
Martin Sack, Martin Hochberg, Georg Müller, Karlsruhe Institute of Technology, D
- PP076 High Efficient and Lightweight Auxiliary Power supply with new SiC Power Device**
Ryosuke Nakagawa, Mitsubishi Electric Corporation, J
- PP077 A New Behavioral Model for Accurate Loss Calculations in Power Semiconductors**
Ajay Poonjal Pai, Tomas Reiter, Infineon Technologies, D; Martin März, Fraunhofer Institute IISB, D
- PP078 High Speed Electronic Over Current Breaker for DC-Grids without Additional Sensing**
Alexander Würfel, Johannes Adler, Nando Kaminski, University of Bremen, D; Anton Mauder, Infineon Technologies, D
- PP079 Wireless Power Transmission with High Efficiency for Extensive Applications**
Markus Rehm, IBR Ingenieurbüro Rehm, D

Conference Tuesday, 10 May 2016, Poster Dialogue Session

15:30 – 17:30, Foyer Ground Floor Entrance NCC Mitte

Motors and Motor Drives



Chairperson: Hilmar Darrelmann,
Darrelmann + Partner Ingenieure, D

- PP080 Prevention of Traction Drives Stator Insulation Faults Based on Overvoltage Reduction Utilizing Active Edge Shaping**
Markus Vogelsberger, Bombardier Transportation Austria, AT; Clemens Zöller, Thomas Hausberger, Mathias Blank, Tobias Glück, Hans Ertl, Andreas Kugi, Technical University Vienna, AT
- PP081 Noise & Vibration Levels of modern Electric Motors**
Christoph Stuckmann, Edward Hopper, Maccon, D
- PP082 Development Platform and Techniques for the Rapid Implementation of High Performance Drives**
Christian Balke, Simon Wiedemann, Maccon, D
- PP083 Functional Safety for Integrated Circuits used in Variable Speed Drives**
Tom Meany, Analog Devices ERDC, IE
- PP084 A System Approach To Understanding The Impact of Non-ideal Effects In A Motor Drive Current Loop**
Jens Sorensen, Analog Devices, USA; Dara O'Sullivan, Analog Devices, IE
- PP085 Gate Driver as Part of the Inverter Safety Concept: Optimizing Inverter's Design**
Laurent Beurenaut, Infineon Technologies, D; Peter Sinn, Robert Bosch, D

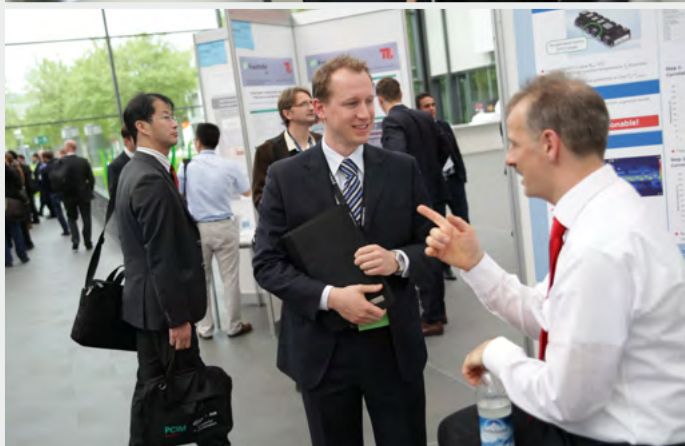
Passive Components



Chairperson: Martin März,
Fraunhofer IISB, Germany

- PP086 Estimation of Ripple and Inductance Roll off when using Powdered Iron Core Inductors**
Gautham Ram Chandra Mouli, Pavol Bauer, Miro Zeman, Delft University of Technology, NL; Jos Schijffelen, Power Research Electronics, NL
- PP087 Optimized DC Link for Next Generation Switch Modules**
Michael Brubaker, Terry Hosking, Edward Sawyer, SBE, USA
- PP088 In-Circuit-Characterization of Ceramic Capacitor with Anti-Ferroelectric Material for Voltage Source Inverters**
Jürgen Kropp, Mark-M. Bakran, University of Bayreuth, D
- PP089 Operability of Metallized Polypropylene Capacitors under High Pressure**
Magnar Hernes, Ole Christian Spro, SINTEF Energy Research, NO; Volker Gleitner, Electronicon Kondensatoren, D
- PP090 Application of High-voltage 750V Aluminum Electrolytic Capacitor in Inverter**
Samuel Qiu, Qiang Deng, Shenzhen Zeasset Electronic Technology, CN

- PP091 Analytic Loss Calculation for E-Core Inductors including the End Windings**
Johannes Heseding, Axel Mertens, Leibniz University Hannover, D
- PP092 The Applicability of Nanocrystalline Stacked and Block Cores for Power Electronics**
Cezary Swieboda, Marian Soinski, Jacek Leszczynski, Marcin Kwiecien, Magneto, PL Vienna, A
- PP093 The Benefit of Formed or Compacted Litz-Wire Coils**
Tobias Appel, STS, D; Hans Rossmann, Friedrich-Alexander-University of Erlangen, D
- PP094 Development of a 100kW, 20 kHz Nanocrystalline Core Transformer for DC/DC Converter Applications**
Kapila Warnakulasuriya, Carroll & Meynell Transformers, GB; Farhad Nabhani, Vahid Askari, Teesside University, GB
- PP095 Simulation of a 3-Phase Common- and Differential Mode Inductor on a Four-Limb Core**
Michael Owzareck, BLOCK Transformatoren-Elektronik, D; Nejila Parspour, University of Stuttgart, D
- PP096 Design Procedure for Pot-Core Integrated Magnetic Component**
Martin Foster, University of Sheffield, GB; Andrew Fairweather, Grant Ashley, VxI Power, GB
- PP097 Investigation of Core Losses under Different Conditions Applying the Cross Power Method**
Boris Hudoffsky, PMK Mess- und Kommunikationstechnik, D; Chihiro Okinori, IWATSU Test Instruments, J
- PP098 A Finite Element Simulation of Nanocrystalline Tape Wound Cores**
Christian Scharwitz, Holger Schwenk, Johannes Beichler, Werner Loges, Vacuumschmelze, D



Conference

Wednesday, 11 May 2016, Morning und Afternoon Oral Sessions

Room Brüssel

08:45

KEYNOTE:

Smart Transformers – Concepts-Challenges-Applications

Speaker: Johann Walter Kolar, ETH Zürich Power Electronic Systems Laboratory, CH

Chairperson: Jose Mario Pacas, University of Siegen, D

More information on page 23.

09:30 Coffee Break

Room Brüssel

GaN Converters



Chairperson:
Stéphane Lefebvre, SATIE, F

10:00



EMI Study in a GaN HEMT Power Module

Xiaoshan Liu, Bertrand Revol, Cyrille Gautier, Francois Costa, ENS Cachan- SATIE, F

10:30

Ultra-High Frequent Switching with GaN-Fets using the Coss-Capacitances as non-dissipative Snubbers

Hubert Berger, Luis Alfonso Fernández-Serantes, Wolfgang Stocksreiter, University of Applied Sciences Joanneum, AT

11:00

eGaN® FET based 6.78 MHz Differential-Mode ZVS Class D A4WP Class 4 Wireless Power Amplifier

Michael de Rooij, Efficient Power Conversion Corporation, USA

11:30

High Frequency, High Temperature DC/DC Converter for GaN Gate Drivers

Yohan Wanderoid, Dominique Bergogne, CEA Leti, F

12:00

Fully-Monolithic GaN-on-Si Half-Bridges with Integrated Reverse-Diodes

Richard Reiner, Patrick Waltereit, Beatrix Weiss, Matthias Wespel, Michael Mikulla, Rüdiger Quay, Oliver Ambacher, Fraunhofer-Institute IAF, D

12:00 **Ground Floor** Lunch Break

Room Brüssel

Multi Level Converters



Chairperson: Philippe Ladoux,
University of Toulouse, F

14:00



DC-DC Converter based on the Asymmetric Multistage Stacked Boost Architecture with Feed-Forward Control for Photovoltaic Plants

Georgios Mademlis, Aristotle University of Thessaloniki, GR; Gina Steinke, Alfred Rufert, EPFL - Ecole polytechnique fédérale de Lausanne, CH

14:30

A Novel Submodule Concept for Modular Multilevel Converters

Benjamin Ruccius, Nicola Burani, Dirk Malipaard, Fraunhofer Institute IISB, D; Marek Galek, Siemens, D

15:00

Electro-Thermal Design of a Modular Multilevel Converter Prototype

Emilien Coulinge, Alexandre Christe, Drazen Dujic, EPFL - Ecole polytechnique fédérale de Lausanne, CH

15:30 Coffee Break

15:30 – 17:30 **Foyer Ground Floor Entrance NCC Mitte** Poster/Dialogue Session (More information on page 31/32/33)

16:30 – 18:30 **Brüssel** PANEL DISCUSSION »The Smart Future of Power Electronics« (More information on page 34)

Room München 1

Module Design



Chairperson:
Stefan Linder, Alpiq, CH

10:00

Resin Encapsulation Combined with Insulated Metal Baseplate for Improving Power Module Reliability

Shinsuke Asada, Satoshi Kondo, Yusuke Kaji, Hiroshi Yoshida, Mitsubishi Electric Corporation, J

10:30

An Experimental Study on the Thermal Performance of Double-Side Direct-Cooling Power Module Structure

Akira Matsushita, Ryuichi Saito, Takeshi Tokuyama, Takashi Kimura, Hitachi Automotive Systems, J; Kinya Nakatsu, Hitachi, J

11:00

New Transfer Mold DIIPM Utilizing Silicon Carbide (SiC) MOSFET

Yazhe Wang, Masataka Shiramizu, Mitsubishi Electric Corporation, J

11:30

A 1700V-IGBT module and IPM with new insulated metal baseplate (IMB) featuring enhanced Isolation Properties and Thermal Conductivity

Takuya Takahashi, Yoshitaka Kimura, Hiroshi Yoshida, Hidetoshi Ishibashi, Yoshitaka Otsubo, Mitsubishi Electric Corporation, J

12:00

NHPD2 (Next High Power Density Dual) with Next Generation Chip Suitable for Low Internal Inductance Package

Daisuke Kawase, Kazuhito Nagashima, Tomohisa Hirayama, Katsunori Azuma, Seiichi Hayakawa, Hitachi Power Semiconductor, J; Katsuaki Saito, Hitachi Europe, GB

Room München 1

DC/DC Converters II



Chairperson: Jacques Laeuffer,
Dtalents, F

14:00



Non-isolated Three-Port DC/DC-Converter for $\pm 380\text{VDC}$ Microgrids

Yunchao Han, Julian Kaiser, Leopold Ott, Matthias Schulz, Fabian Fersterra, Bernd Wunder, Fraunhofer Institute IISB, D

14:30

Wide Voltage Input Range Isolated Current Fed Buck Flyback-Forward for DC/DC Power Conversion in Electric/Hybrid Vehicle

Chelghoum Reda, Luis De Sousa, Larbi Bendani, Valeo, F; Daniel Sadarnac, CentraleSupelec, F

15:00

SiC JFET Cascode Enables Higher Voltage Operation in a Phase Shift Full Bridge DC-DC Converter

Jonathan Dodge, United Silicon Carbide, USA

Room Athen

Power Electronics in Transmission Systems in Smart Grids



Chairperson: Hans-Günter Eckel,
University of Rostock, D

10:00

Energetic analysis of a Hybrid-MMC

Viktor Hofmann, Mark-M. Bakran, University of Bayreuth, D

10:30

Selective HVDC Transmission Line Breaking for Bus Bar Applications under Reduced Expenses

Rene Sander, Michael Suriyah-Jaya, Thomas Leibfried, Karlsruhe Institute of Technology, D

11:00

Decentralized Controller for Modular Multilevel Converter

Seleme Isaac Seleme Jr., Federal University of Minas Gerais - UFMG, BR; Luc-André Grégoire, Marc Cousineau, Philippe Ladoux, University of Toulouse, F

11:30

Power Converters for PV Systems with Energy Storage: Optimal Power Flow Control for EV's Charging Infrastructures

Mauro Di Monaco, Umberto Abronzini, Ciro Attaianese, Matilde Arpino, Giuseppe Tomasso, University of Cassino and South Lazio, I

Room Mailand

SPECIAL SESSION
E-Mobility

Chairperson: Nejila Parspour,
University of Stuttgart, D

10:00

Modular and Comfortable Electromobility

Mihai Dragan, Bernhard Budaker, Jonathan Brix, Fraunhofer Institute IPA, D

10:30

Power Hardware-in-the-Loop Emulation of Permanent Magnet Synchronous Machines with Nonlinear Magnetics – Concept & Verification

Alexander Schmitt, Jan Richter, Michael Braun, Martin Doppelbauer, Karlsruhe Institute of Technology, D

11:00

Multimode Charging of Electric Vehicles – A combined Concept with Multiple Use of Components and Strategies for Decreasing Power Losses, Weight and Volume

Marco Jung, René Marklein, Georgios Lempidis, Jonas Steffen, Axel Seibel, Jörg Kirchof, Oliver Strecker, Mohammad Zaisan Rahen, Miao Wang Fraunhofer Institute IWES, D

11:30

Design of Contactless Energy Transfer System for an Electric Vehicle

Mike Böttigheimer, University of Stuttgart, D

Room München 2

High Power Semiconductor



Chairperson: Gourab Majumdar,
Mitsubishi Electric, J

10:00

3300V HiPak modules with Enhanced Trench IGBTs and Field Charge Extraction Diodes rated up to 1800A

Chiara Corvasce, Maxi Andenna, Liutauras Storasta, Sven Matthias, Arnost Kopta, Munaf Rahimo, Luca De Michielis, Silvan Geissmann, Raffael Schnell, ABB Switzerland, CH

10:30

Durable Design of the New HVIGBT Module

Nobuhiko Tanaka, Kenji Ota, Shuichi Kitamura, Shinichi Lura, Keiichi Nakamura, Mitsubishi Electric Corporation, J; Eugen Wiesner, Eckhard Thal, Mitsubishi Electric Europe, D

11:00

The 62Pak IGBT Module Range Employing the 3rd Generation 1700V SPT++ Chip Set for 175°C Operation

Sven Matthias, Chiara Corvasce, Charalampos Papadopoulos, Arnost Kopta, Silvan Geissmann, Raffael Schnell, Munaf Rahimo, ABB Switzerland, CH

11:30

Extended Power Rating of 1200V IGBT Module with 7G-RC-IGBT Chip Technologies

Daniel Hofmann, Thomas Heinzl Fuji Electric Europe, D; Misaki Takahashi, Souichi Yoshida, Akira Tamenori, Yasuyuki Kobayashi, Osamu Ikawa, Fuji Electric, J;

Room Athen

Lamp Ballasts Lighting Systems



Chairperson: Ulrich Kirchenberger,
STMicroelectronics, D

14:00

Detailed Comparison of One Stage Topologies for LED Lighting Applications

Alexander Pawellek, Thomas Dürbaum, Friedrich-Alexander-University Erlangen, D

14:30

Low Cost High Density AC-DC Converter for LED Lighting Applications

Simon Nigsch, Janosch Marquardt, Kurt Schenk, University of Applied Sciences NTB Buchs, CH

15:00

Design Optimization for a High Power-Density, Wide Output, High Frequency LLC Resonant Converter for Lighting Applications

Janosch Marquardt, Simon Nigsch, Kurt Schenk, University of Applied Sciences NTB Buchs, CH

Room Mailand

Sensorless Motor Control



Chairperson: Jose Mario Pacas,
University of Siegen, D

14:00

Computationally efficient Anisotropy-Identification based on a Square-Shaped Injection Pattern

Peter Landsmann, Dirk Paulus, Sascha Kühl, Ralph Kennel, Technical University of Munich, D

14:30

Estimation of the Excitation Current and the Rotor Resistance of an Externally Excited Synchronous Machine with an Inductively Supplied Excitation Coil

Stefan Köhler, Bernhard Wagner, Technical University Nuremberg Georg Simon Ohm, D; Stefan Endres, Fraunhofer Institute IISB, D

15:00

High Speed Sensorless Control of a Synchronous Motor with Kalman Filter

Philipp Niedermayr, Alpitronic, I; Silverio Bolognani, Luigi Alberti, University of Padova, I; Reiner Abl, BMW, D

Room München 2

Software Tools and Applications



Chairperson: Andreas Lindemann,
Otto-von-Guericke-University
Magdeburg, D

14:00

Physical Modeling and High-Fidelity Simulation of the Transient Behavior of Multiply-Contacted Power Busbars

Vanessa Basler, Wolfgang Hölzl, Gerhard Wachutka, Technical University of Munich, D

14:30

Small-signal Output Impedance Modeling of Intersil R4 Technology

Yi Huang, Chun Cheung, Intersil Corporation, USA

15:00

An Approach of Reinforcement Learning Based Lighting Control for Demand Response

Xinxing Pan, AIT, IE

Conference

Wednesday, 11 May 2016, Poster Dialogue Sessions

15:30 – 17:30, Foyer Ground Floor Entrance NCC Mitte

SiC and GaN



Chairperson: Katsuki Saito,
Hitachi Europe, GB

- PP099 An Insightful Evaluation of a 650V High-Voltage GaN Technology in Cascode and Stand-Alone Transistors**
Jaume Roig, German Gomez, Frederick Declercq, Filip Bauwens, On Semiconductor, BE; Manuel Fernandez, Diego Gonzalez, University of Oviedo, ES
- PP100 Characterisation of Discrete State-of-the-Art SiC Power Transistors**
Michael Meisser, Horst Demattio, Thomas Blank, Karlsruhe Institute of Technology, D
- PP101 Analytical Losses Model for SiC Semiconductors dedicated to Optimization Operations**
Gnimdu Dadanema, Francois Costa, ENS Cachan - SATIE, F; Jean-Luc Schanen, Yvan Avenas, G2ELAB, F; Christian Voltaire, Laboratoire Ampere, F
- PP102 Current Measurement and Gate-Resistance Mismatch in Paralleled Phases of High Power SiC MOSFET Modules**
Roman Horff, Teresa Bertelshofer, Andreas März, Mark-M. Bakran, University of Bayreuth, D
- PP103 Gate Drive Strategies of SiC Cascodes**
Anup Bhalla, Xueqing Li, Shirley Zhang, United Silicon Carbide, USA
- PP104 State-of-the-art of HF Soft Magnetics and HV/UHV Silicon Carbide Semiconductors**
Geraldo Nojima, Eaton Corporation, USA; Paul Ohodnicki, DOE-National Energy Technology Laboratory, USA
- PP105 Comparison of Unipolar Silicon Carbide Power Transistors Used in High Switching Frequency Inverter Topologies**
Sebastian Fahlbusch, Nizar Sahli, Sebastian Klötzer, Ulf Mütter, Björn Schäning, Klaus F. Hoffmann, Helmut Schmidt University Hamburg, D
- PP106 ST SiC MOSFETs in 1MHz DC-DC Converter**
Luigi Abbatelli, Giuseppe Catalisano, STMicroelectronics, I
- PP107 Switching Performance Comparison of Latest SuperJunction and SiC MOSFETs**
Andrew Lemmon, The University of Alabama, USA; James Gafford, Mississippi State University, USA
- PP108 Towards a One Nano-Henry Power Module for SiC and GaN**
Jacques Laeuffer, Dtalents, F
- PP109 Scalable SiC Cascode Power Blocks**
Jonathan Dodge, Matt Grady, Ke Zhu, Anup Bhalla, United Silicon Carbide, USA
- PP110 High Power Density, High Efficiency 380v to 52v LLC Converter Utilizing Emode GaNS**
Moshe Domb, Infineon, USA

Gate Drive Units



Chairperson: Bernhard Strzalkowski,
Analog Device, D

- PP111 High Power Density, High Efficiency 380v to 52v LLC Converter Utilizing Emode GaNS**
Moshe Domb, Infineon, USA
- PP112 Isolated Gate Driver for High Current/High Speed FET-Converters**
Florian Kapaun, Rainer Marquardt, Universität der Bundeswehr Munich, D
- PP113 Simple Gate-boosting Circuit for Reduced Switching Losses in Single IGBT Devices**
Martin Hochberg, Martin Sack, Georg Müller, Karlsruhe Institute of Technology, D
- PP114 Stability and Performance Analysis of a Voltage Controlled Resistor Circuit for Wide Band-gap Device Gate Drivers**
Alessandro Soldati, Giorgio Pietrini, Davide Barater, Carlo Concari, Università degli Studi di Parma, I
- PP115 State of the Art of Gate-Drive Power Supply for Medium and High Voltage Applications**
Layal Ghossein, Piotr Dworakowski, SuperGrid Institute, F; Hervé Morel, Florent Morel, Ampère, F
- PP116 The Optimized Gate Driver Design Techniques for IGBT Properties and Downsizing in Eco-Friendly Vehicle**
KangHo Jeong, SangChul Shin, KiYoung Jang, JinHwan Jung, KiJong Lee, JiWoong Jang, Hyundai Motors, ROK
- PP117 A Revisit to Resonant Gate Driver and a New Driver to Improve EMI vs. Loss Tradeoff for SiC MOSFET**
Chi-Ming Wang, Toyota Motor Engineering & Manufacturing, USA
- PP118 Application and Design Considerations of CoolMOS CFD and EiceDRIVER™ IC in Motor Drive Application**
Wolfgang Frank, Infineon Technologies, D

AC-DC Converters and Power Supplies



Chairperson: Drazen Dujic, Power
Electronics Laboratory, EPFL, CH

- PP119 4D-Interleaving of Isolated ISOP Multi-Cell Converter Systems for Single Phase AC/DC Conversion**
Matthias Kasper, Johann Walter Kolar, ETH Zürich, CH
- PP120 Battery Charger Based on a Triple-LCp Resonant Converter**
Christian Branas, Francisco Azcondo, University of Cantabria, ES; Juan C. Viera, Manuela González, University of Oviedo, ES
- PP121 High Efficient Flyback Converter with SiC-MOSFET**
Johann Austermann, Tim Stuckmann, Holger Borcherding, University of Applied Sciences Ostwestfalen-Lippe, D
- PP122 PCB Integration of a Magnetic Component dedicated to a Power Factor Corrector Converter**
Herault Guillaume, Mercier Adrien, Stéphane Lefebvre, Denis Labrousse, ENS Cachan-SATIE, F

- PP123 Evaluation of TCM and CrCM modulation for Totem Pole PFC**
Haihua Zhou, Wenduo Liu, Eric Persson, Infineon Technologies Americas, USA
- PP124 System Concept and Model-Based Optimization of High-Current Variable-Voltage Chopper-Rectifiers**
Zhiyu Cao, AEG Power Solutions, D; Joachim Böcker, University of Paderborn, D
- PP125 Evaluation of a Unidirectional Three-Phase Rectifier Based on the Third Harmonic Injection Concept in Comparison to a VIENNA Rectifier**
Markus Makoschitz, Hans Ertl, Technical University of Vienna, AT; Michael Hartmann, Schneider Electric Power Drives, AT
- PP126 SiC Improves Switching Losses, Power Density and Volume in UPS**
Christian Schulte-Overbeck, Nikolai Epp, Zhiyu Cao, Michael Lemke, Lothar Heinemann, AEG Power Solutions, D
- PP127 Optimization of 12 Pulse and 18 Pulse Rectifier Systems by the Selection of Optimum Parameters for Magnetics**
Kapila Warnakulasuriya, Carroll & Meynell Transformers, GB; Farhad Nabhani, Teesside University, GB

DC-DC Converters I



Chairperson: Peter Wallmeier,
Delta Energy Systems, D

- PP128 Analysis of the Flyback Converter Utilizing a Transformer with Stepped Air-Gap**
Panagiotis Mantzanas, Daniel Kübrich, Markus Barwig, Thomas Dürbaum, Friedrich-Alexander-University of Erlangen, D
- PP129 Novel Method for the Estimation of Switching Losses in Resonant Converters**
Christian Oeder, Markus Barwig, Thomas Dürbaum, Friedrich-Alexander-University of Erlangen, D
- PP130 Active Dead-Time Optimization for wide Range Flyback Active-Clamp Converter**
Sebastien Larousse, Nacer Abouchi, Remy Cellier, Institut des nanotechnologies de Lyon, F; Hubert Razik, Laboratoire Ampere, F; Philippe Volay, Centralp, F
- PP131 Energetic Macroscopic Representation (EMR) and Control Scheme for the Asymmetric 4-Stage MSBA**
Gina Steinke, Alfred Rufer, EPFL - Ecole Polytechnique Fédérale de Lausanne, CH
- PP132 Adjustable 20 kW full-SiC Electronic Load with Energy Recovery for Medium-frequency Inverter**
Fabian Denk, Karsten Haehre, Julian Koerner, Rainer Kling, Wolfgang Heering, Karlsruhe Institute of Technology, D
- PP133 A New High Frequency Transformer for UPS**
Michael Schmidhuber, Michael Baumann, Markus Schmeller, SUMIDA Components & Modules, D
- PP134 DC/DC-Converter for Modular Coupling of 48 V Battery Packs to a High Voltage DC Bus**
Michael Eberlin, Milad Mohammad Hossein Khani, Fraunhofer Institute ISE, D
- PP135 High Dynamic Current Source for LED Light and Data Transmission Applications**
Karl Edelmoser, Technical University of Vienna, AT; Felix Himmelstoss, Technikum Vienna, AT

- PP136 Design Methods for LLC Converter considering Buck and Boost Mode with limited Frequency Range for Wide Input Voltage Range**
Dustin Funk, Tobias Reimann, Technical University of Ilmenau; Ulf Schwalbe, ISLE Steuerungstechnik und Leistungselektronik, D
- PP137 The Behavior of Electro-Magnetic Radiation of Storage Inductor in DC-DC Converters**
Ranjith Bramanpalli, Würth Elektronik Eisos, D

DC-DC Converters II



Chairperson: Elison Matioli,
POWERlab, EPFL Lausanne, CH

- PP138 A new Ferrite Material for GaN Applications High Frequency Resonant Transformers**
Herbert Jungwirth, Michael Schmidhuber, Michael Baumann, Markus Schmeller, SUMIDA Components & Modules, D
- PP139 Multi-Stage LLC Resonant Converters designed for Wide Output Voltage Ranges**
Chi Wa Tsang, Chris Bingham, University of Lincoln, GB; Martin Foster, Dave Stone, University of Sheffield, GB; John Leach, Castle, GB
- PP140 Application Advantages and Disadvantages of Modern Fast Switching MOSFETs in VRM**
Zhiyang Chen, Ann Starks, ON Semiconductor, USA
- PP141 Medium to Low Voltage DC/DC Resonant Converter with SiC SCRs and Nanocrystalline Magnetic Core Transformer**
Iñigo Martinez de Alegria, Angel Luis Perez, Madaci Madaci, Jon Andreu Larrañaga, University of the Basque Country, ES; Kerdoun Djallel, GLEC Constanine 1, DZ
- PP142 GaN Active-Clamp Flyback Converter with Resonant Operation Over a Wide Input Voltage Range**
Nicolas Quentin, SAGEM, F; Remi Perrin, Cyril Buttay, INSA de Lyon, F; Christian Martin, Charles Joubert, Ampere Laboratory, F; Bertrand Lacombe, Safran Group, F
- PP143 Demonstration of superior SiC MOSFET Module performance within a Buck-Boost Conversion System**
Maximilian Slawinski, Daniel Heer, Infineon Technologies, D
- PP144 High Efficiency and High Power Density Boost / Buck Converter with SiC JFET Modules for Advanced Auxiliary Power Supply in Trolleybuses**
Miroslav Hruska, Skoda Electric, CZ; Martin Jara, West Bohemian University, CZ
- PP145 Development of a 12kW isolated and bidirectional DC-DC Converter dedicated to the More Electrical Aircraft: The Buck Boost Converter Unit (BBCU)**
Pascal Asfaux, Jeremy Bourdon, Airbus Operation, F
- PP146 Reverse Mode Application of Sine Amplitude Converters**
David Bourner, Vicor Corporation, USA

DC-AC Converters



Chairperson: Mike Meinhardt,
SMA Solar Technology, D

- PP147 Influence of the Configuration of the Load Cable on Switching Characteristics of IGBTs**
Lars Middelstaedt, Dennis Richter, Andreas Lindemann, Otto-von-Guericke-University, D; Arendt Wintrich, Semikron, D
- PP148 Improved Power Decoupling Scheme for Single-Phase Grid-Connected Differential Inverter with Realistic Mismatch in Storage Capacitances**
Wenli Yao, Xiaobin Zhang, Northwestern Polytechnical University, CN; Xiongfei Wang, Poh Chiang Loh, Frede Blaabjerg, Aalborg University, DK
- PP149 Technical Approach: Interleaved, Folding, Interpolating Dual-Path Adiabatic Autotransformer Based Power Converter**
John Wood, Ed Shelton, Silicon Contact, GB; Kevin Rathbone, Robotae, GB; Mehdi Baghadadi, Patrick Palmer, University of Cambridge, GB
- PP150 Design and Performance Evaluation of a Three Phase AC Power Source with Virtual Impedance for Validation of Grid Connected Components**
Peter Jonke, Johannes Stöckl, Hans Ertl, AIT – Austrian Institute of Technology, AT
- PP151 Design and Testing of a Modular SiC based Power Block**
Maja Harfman Todorovic, Ljubisa Stevanovic, Brian Rowden, GE Research Center, USA
- PP152 A Novel Method to simulate the Control-to-output Transfer Function of Resonant Converters**
Julian Dobusch, Christian Oeder, Thomas Dürbaum, Friedrich-Alexander-University of Erlangen, D
- PP153 A Study of the Thermal and Parasitic Optimization of a Large Current Density Highly Parallelized Three-Phase Reference Board for Motor Drive Applications**
Mehrdad Baghaie Yazdi, Fairchild Semiconductor, D

AC-AC and Multilevel Converters



Chairperson: Silvio Colombi,
General Electric, CH

- PP154 Trends in Residential and Industrial Induction Cooking: Topologies and Power Devices for High Efficiency**
Vittorio Crisafulli, ON Semiconductor, D
- PP155 Direct Power Control of a Three Phase Z-Source Inverter Connected to the Grid**
Manuel Steinbring, Mario Pacas, University of Siegen, D
- PP156 Interleaved Series Input Parallel Output forward Converter with Simplified Voltage Balancing Control**
Kaspars Kroics, Alvis Sokolovs, Linards Grigans, Ugis Sirmelis, Riga Technical University, LV
- PP157 Fault-Tolerant Behaviour of the Three Level Advanced-Active-Neutral-Point-Clamped Converter**
Sidney Gierschner, David Hammes, Jan Fuhrmann, Hans-Günter Eckel, University of Rostock, D;

Max Beuermann, Siemens, D

- PP158 Cell Voltage Balancing Controller for the Modular Multilevel Converter Arm using Symmetrical Transformation**
Andrey Dudin, Aaron Fischer, Thomas Ellinger, Jürgen Petzold, Technical University of Ilmenau, D
- PP159 Isolated low-power multi-output DC-DC Converters with Heterogeneous Loads for an Efficient Supply of Modular Power Electronics Systems**
Arthur Singer, Thomas Weyh, Florian Helling, Universität der Bundeswehr Munich, D; Arun Jeyaprakash, Technical University of Munich, D; Stefan Götz, Duke University, USA
- PP160 A wire based communication interface for Medium and High-Voltage Converters**
Marek Galek, Manuel Blum, Siemens, D
- PP161 An Auxillary Power Supply with integrated Communication Capability for Medium and High-voltage Applications**
Manuel Blum, Marek Galek, Siemens, D
- PP162 FPGA Based Direct Model Predictive Current Control of PMSM Drives with Three-Level NPC Power Converter**
Zhenbin Zhang, Christoph Hackl, Ralph Kennel, Technical University Munich, D
- PP163 IGBT Power Module in Three-Level Neutral Point Clamped Type 2 (NPC2, T-NPC, Mixed Voltage) Topology in Short Circuit Modes**
Vladan Jerinic, Kevin Lenz, Danfoss Silicon Power, D
- PP164 Efficiency Verification Power Circulation Method of a High Power Low Voltage NPC Converter for Wind Turbines**
Berthold Benkendorff, Friedrich W. Fuchs, Christian-Albrechts-University, D; Toke Franke, Danfoss Silicon Power, D
- PP165 Control of the Actively Balanced Capacitive Voltage Divider for a Five-Level NPC Inverter-Estimation of the Intermediary Levels Currents**
Alfred Rufner, EPFL - Ecole Polytechnique Fédérale de Lausanne, CH

Automotive Applications



Chairperson: Daniel Chatroux,
CEA-LITEN, F

- PP166 Automotive Power Module Technologies for High Speed Switching**
Shinichiro Adachi, Takuma Kouge, Souichi Yoshida, Hiroshi Miyata, Hideto Kobayashi, Akira Nishiura, Fuji Electric, J
- PP167 Power Semiconductors for the Automotive 48V Board Net**
Felix Hüning, University of Applied Sciences Aachen, D
- PP168 Status and Advances in Electric Vehicle's Power Modules Packaging Technologies**
Itxaso Aranzabal, Asier Matallana, Oier Oñederra, Iñigo Martinez de Alegria, David Cabezuelo, University of the Basque Country, ES
- PP169 Highly Integrated Full SiC Six Pack Power Module for Automotive Applications**
Bao Ngoc An, Thomas Blank, Karlsruhe Institute of Technology, D; Johannes Kolb, Schaeffler Technologies, D

Conference

Wednesday, 11 May 2016, Poster Dialogue Sessions

15:30 – 17:30, Foyer Ground Floor Entrance NCC Mitte

- PP170 Automotive-grade P-channel Power MOSFETs for Static, Dynamic and Repetitive Reverse Polarity Protection**
Filippo Scrimizzi, Giusy Gambino, Giuseppe Longo, STMicroelectronics, I
- PP171 Isolated On-Board DC-DC Converter for Power Distribution Systems in Electric Vehicles**
Sven Bolte, Joachim Böcker, University of Paderborn, D
- PP172 Innovative Solution of Static and Dynamic Contactless Charging Station for Electrical Vehicles**
Nikolay Madzharov, Valeri Petkov, Technical University of Gabrovo, BG
- PP173 Combining an External Rotor Motor with Vernier Concept for Drives in Intralogistics**
Matthias Thesseling, Tao Liu, Lenze SE, D; Hans-Joachim Wendt, Lenze Drives, D
- PP174 Dynamic Modeling and Optimal control for Series-parallel Drivetrain based on Lithium-ion battery**
Tedjani Mesbahi, Ecole Centrale de Lille, F; Moudrik Meradji, Gaolin Wang, Dianguo Xu, Harbin Institute of Technology, CN
- PP175 Optimized DC Link Connections for Automotive IGBT Modules**
Michael Brubaker, Terry Hosking, Edward Sawyer, SBE, USA
- PP176 Automotive Voltage Stabilizer with ISO7637 Compliant Reverse Polarity Protection**
Vijay Choudhary, Mathew Jacob, Texas Instruments, USA
- PP176a On-Chip Temperature Measurement: A new Approach for Optimizing Automotive Inverters Compliant Reverse Polarity Protection**
Laurent Beurenaut, Inpil Yoo, Infineon Technologies, D

Renewable Energy Systems



Chairperson: Philip C. Kjaer, Vestas Wind Systems, DK

- PP177 Resonant load Emulator for Distributed Energy Resources to test Anti-islanding Algorithms**
Daniel Heredero-Peris, Daniel Montesinos-Miracle, Fernando Jorge-Ques, Universitat Politècnica de Catalunya, ES; Tomàs Lledó-Ponsati, TeknoCEA, ES
- PP178 Low Voltage Ride Through (LVRT) Capability of an Enhanced DFIG System**
David Velasco, Jesús López, Public University of Navarre, ES
- PP179 Control and Modulation for Loss Minimization for Dc/Dc Converter in Wind Farm**
Catalin Gabriel Dincan, Philip C. Kjaer, Aalborg University, DK

- PP180 A Variable Step Size Perturb and Observe Method Based MPPT for Partially Shaded Photovoltaic Arrays**
Jawad Ahmad, Filippo Spertino, Paolo Di Leo, Politecnico di Torino, I
- PP181 Renewable Electricity Conversion and Storage: Focus on Power to Gas process, EMR Modelling and Simulation**
Ahmed Remaci, Octavian Curea, Christophe Merlo, Amélie Hacala, ESTIA, F; Vincent Guerre, Local Energy Alternative & Fair, F
- PP182 Balancing Current and Efficiency Modelling of Single Switch Active Balancing Systems for Energy Storage Systems**
Iosu Aizpuru, Unai Iraola, Jose Mari Canales, Ander Goikoetxea, Mondragon University, ES
- PP183 A Control Strategy for Multiple Energy Storage Devices for Power Leveling of Renewable Energy Systems**
Koji Kato, Yoichi Ito, Sanken Electric, J
- PP184 Examining Contrasting Excitation Modes within Battery Characterisation using Maximum Length Sequences**
Andrew Fairweather, Vxl Power, GB; David Stone, Martin Foster, University of Sheffield, GB
- PP185 Comparison Between Standard and Innovative Solutions to Exchange Energy in High Energy Storage Systems**
Laurent Garnier, Daniel Chatroux, Sébastien Carcouet, Julien Dauchy, University Grenoble Alpes CEA LITEN, F

EMI, Harmonics, Filters



Chairperson: Francisco Javier Azcondo, University of Cantabria, E

- PP186 Simulation and Experimental Analysis of Non-Linear Loads from Residential and Educational Buildings**
Gabriel Nicolae Popa, Angela Iagar, Corina Maria Dinis, Politehnica University Timisoara, RO
- PP187 A Digital Predictive Constant Frequency Hysteresis Controller for 3-Phase PFC Rectifier**
Marcelo Schupbach, Cree, USA; Binod Agrawal, Navneet Mangal, CREE India Private Limited, IN
- PP188 DC-link Harmonic Content in Double Two-Level Inverter for Permanent Magnet Synchronous Motor Drive Systems**
Toktam Khani, Technogienetzwerk Allgäu, D
- PP189 Hybrid Filter With An Optimized Switching Method of the Compensation Capacitors and Predictive Active Filter Control**
Sven Bosch, Heinrich Steinhart, HTW Aalen, D

- PP190 Active Mains Filters with Combined Feed-Forward and Feed-Back Control**
Felix Himmelstoss, Technikum Vienna, AT; Karl Edelmöser, Technical University of Vienna, AT
- PP191 Influence of the Zero Sequence Voltage on the Design of a Series Active Filter**
Andreas Reinhold, Rolf Grohmann, HTWK Leipzig, D; Uwe Rädcl, Jürgen Petzoldt, Technical University of Ilmenau, D
- PP192 Electromagnetic Emissions in High Density and Fast GaN Switched Halfbridges with Resonance Filter Structures**
Wolfgang Stocksreiter, FH Joanneum, AT

Energy Transmission and Grid



Chairperson: Klaus F. Hoffmann, Helmut-Schmidt-University, D

- PP193 AC or DC Grid for Urban Railway Station?**
Lilia Galai Dol, Efficacy, F; Alexandre De Bernardinis, French Institute of Science and Technology for Transport, Development and Networks, F
- PP194 Solid-State Transformer Modeling for Analyzing its Application in Distribution Grids**
Christoph Hunziker, Nicola Schulz, University of Applied Sciences Northwestern Switzerland, CH
- PP195 Hybrid Reactive Power Compensation System for Grid Code Compliance in Renewable Energy Power Plants**
Gianluca Postiglione, Antonio Raso, Giovanni Borghetti, Francois, Pezet, Nidec ASI, I
- PP196 A New Shunt Connected HVDC Tap based on a High Efficient Resonant Cascade Converter**
Andre Birkel, Mark-M. Bakran, University of Bayreuth, D
- PP197 Analysis of Voltage and Current Unbalance in a Multi-Converter Topology for a DC-Based Offshore Wind Farm**
Thomas Lagier, SuperGrid Institute, F; Philippe Ladoux, University of Toulouse, F
- PP198 Experimental Demonstration of a Solid-State Damping Resistor for HVDC Applications**
Konstantin Vershinin, Ikenna Efika, David Trainer, Colin Davidson, Alstom Grid, GB; Nick Wright, Newcastle University, GB
- PP199 High-Precise Loss Measurement of an HVDC Converter Station**
Helmut Weiß, Technical University of Leoben, AT
- PP200 A Fast Methodology for Solving the Power Flow in Hybrid AC/DC Networks: The European North Sea Supergrid Case Study**
Rodrigo Teixeira Pinto, Monica Aragues-Penalba, Andreas Sumper, CITCEA-UPC, ES; Christian Alejandro Leon-Ramirez, Elmer Sorrentino, University Simon Bolivar, VE

Conference

Wednesday, 11 May 2016, Panel Discussion

16:30 – 18:30, Room Brüssel



The Smart Future of Power Electronics

Chairperson: Mark M. Bakran, University of Bayreuth, D

Industry 4.0 is becoming more and more important and power electronics is a crucial part of this development. Hence, there is a lively discussion in the power electronics community where this path will lead to in the future.

In this panel discussion experts from different fields will analyze and discuss the link between power electronics and »smart technologies«. Various aspects will be taken into consideration. The panel discussion will foster new activities in the integration of power electronics and will draw the attention on smarter not only faster switching.

The panel discussion will deal with the following topics:

The future of power electronics – only faster or also more intelligent

Communication – new communication needs for power electronics in Industry 4.0

Condition monitoring – power electronics as a monitor and power electronics to be monitored

Functionality – new requirements on safety from a power electronics perspective

Safety – challenges for power electronics in a safe converter and safe environment

Flexibility – Intelligent adaption of power electronics to the environment

Big data – how can power electronics profit from more information processing

Participants:

Hans-Günter Eckel, University of Rostock, D

Drive and converter topologies, functional safety

Steffan Hansen, Danfoss, DK

Industrial drives

Franz Heuser, Infineon Technologies, D

Power semiconductors, -modules, control and safety

Christian Keller, General Electrics, D

Windpower

Jochen Koszescha, European Center for Power Electronics, D

Study on smart converters and industry needs

Martin März, Fraunhofer Institute IISB, D

Smart converters for stable and robust LVDC grids

Reiner Nowitzki, Finepower, D

Control schemes for adaptable power electronics

Rainer Sommer, Siemens LD, D

Large drives, Safety structures, condition monitoring

Markus Vogelsberger, Bombardier, AT

Traction drives, condition monitoring of drive



Conference

Thursday, 12 May 2016, Morning und Afternoon Oral Sessions

Room Brüssel

08:45

KEYNOTE:

Trends of Solar Systems and their Integration in Electricity Networks

Speaker: Jens Merten, National Solar Energy Institute, F

Chairperson: Philippe Ladoux, University of Toulouse, F

More information on page 23.

09:30 Coffee Break

Room Brüssel

Cosmic Ray & Ruggedness



Chairperson: Nando Kaminski,
University of Bremen, D

10:00



Cosmic Ray Failure Mechanism and Critical Factors for 3.3kV Hybrid SiC Modules

Tetsuya Nitta, Yoshiaki Inoue, Toshiba, J; Georges Tchouangue, Toshiba Electronics Europe, D

10:30



Benefits of Increased Cosmic Radiation Robustness of SiC Semiconductors in large Power-Converters

Christian Felgemacher, Samuel Araujo Vasconcelos, Christian Nöding, Peter Zacharias, University of Kassel, D

11:00

Passive IGBT Turn-off during Short-circuit Type V

Jan Fuhrmann, Hans-Günter Eckel, University of Rostock, D; Sebastian Klauke, Infineon, D

11:30

High-Current Power Cycling Test-Bench for Short Load Pulse Duration and First Results

Guang Zeng, Christian Herold, Menia Beier-Möbius, Josef Lutz, Technical University of Chemnitz, D; Sascha Kubera, Rodrigo Alvarez, Siemens, D

12:00

Thermal Transient Testing of Advanced Power Semiconductor Devices: Challenges and Opportunities

Gabor Farkas, Mentor Graphics, Marta Rencz, Zoltan Sarkany, HU

→ 12:00 **Ground Floor** Lunch Break

Room Brüssel

Module Technology



Chairperson: Josef Lutz,
Chemnitz University of Technology, D

14:00

Fault-Tolerant B6-B4 Inverter Reconfiguration with Fuses and Ideal Short-On Failure IGBT Modules

Michael Gleißner, Mark-M. Bakran, University of Bayreuth, D

14:30

Statistical Evaluation of Current Imbalance in Parallel Devices

Uwe Scheuermann, Semikron Elektronik, D

15:00

Batch Purity in Semiconductor Power Modules

Christian Aggen, Henning Ströbel-Maier, Matthias Mau, Jürgen Laue, Marco Bäßler, Danfoss Silicon Power, D

15:30

Novel Technique to Reduce Substrate Tilt & Improve Bond-line Control between AlN Substrate & AlSiC Baseplate in a Traction IGBT Module

James Booth, Dynex Semiconductor, GB; Karthik Vijay, Indium Corporation, GB

Room München 1

SPECIAL SESSION

Smart Lighting



Chairperson: Manfred Schlenk,
Infineon Technologies, D

10:00

Smart Lighting - Requirements for Modern Lighting Systems and Expected Trends

Diederik de Stoppelaar, LightingEurope, BE

10:30

Special requirements on a SMPS for LED-Lighting Purposes by an Example of an Individual High-End LED-Driver Solution

Florian Müller, Stefan Raitchel, Vossloh-Schwabe Lighting Solutions, D

11:00

The seven challenges of LED lighting

Claudio Adragna, Francesco Ferrazza, Giovanni Gritti, STMicroelectronics, I

11:30

Highly Flexible Single Stage Flyback Quasi-Resonant Digital Controller for Advanced LED Applications

Marc Fahlenkamp, Infineon Technologies, D

Room München 1

Drive Strategies in Power Converters



Chairperson: Yasukazu Seki,
Fuji Electric, J

14:00

Smart Driver: Communicating Gate Driver for SiC MOSFET

Christophe Bouquet, Nicolas Ginot, Christophe Batard, University of Nantes, F

14:30



New Ultra Fast Short Circuit Detection Method Without Using the Desaturation Process of the Power Semiconductor

Stefan Hain, Mark-M. Bakran, University of Bayreuth, D

15:00



High Power, High Frequency Gate Driver for SiC-MOSFET Modules

Gunter Koenigsmann, Reinhard Herzer, Sven Buetow, Matthias Rossberg, Semikron Elektronik, D

15:30

Integrating a real-time T_{vj} calculation into an IPM

Stefan Schmies, Infineon, D

Room Athen

New and Renewable Energy Systems



Chairperson: Friedrich-Wilhelm Fuchs, Christian-Albrechts-University of Kiel, D

10:00

Carrier- Based Modulation Technique to Reduce Low Frequency Oscillation on DC-Link Partial Voltage for Three-Level/Phase/-Wire NPC Converter Applied to Future Dc Bipolar Micro Grid Networks

Marcelo Heldwein, Joabel Moia, Federal Institute of Santa Catarina – IFSC, BR

10:30

FPGA Based Direct Model Predictive Power and Current Control of 3L NPC Active Front Ends

Zhenbin Zhang, Ralph Kennel, Technical University of Munich, D

11:00

Scalable Insulated DC/DC Converters for Safe and Efficient Coupling of Fuel Cells, Electrolyzers and DC Grids

Bernd Seliger, Stefan Zeltner, Fraunhofer Institute IISB, D

11:30

SiC MW PV Inverter

Maja Harfman Todorovic, Ljubisa Stevanovic, Brian Rowden, GE Research Center, USA; Robert Roesner, GE Research Center, D

Room Mailand

Power Electronics in Automotive



Chairperson: Giuseppe Tomasso, University of Cassino and Southern Lazio, I

10:00

A Performance Comparison of a 650V Si IGBT and SiC MOSFET Inverter under Automotive Conditions

Teresa Bertelshofer, Roman Horff, Andreas März, Mark-M. Bakran, University of Bayreuth, D

10:30



A Generic Topology for Electrical Energy Storage Systems

Christoph Marxgut, Helbling Technik, D

11:00

Pulse Width- and Frequency Modulated DC/DC Converter for Hybrid- and Electrical Vehicles

Magnus Böh, Andreas Lohner, Christoph Engelhard, Technical University of Cologne, D

11:30

New High Power Density Modules for EV/HEV Applications

Seiichiro Inokuchi, Shoji Saito, Arata Izuka, Hata Yuki, Shinji Hatae, Mitsubishi Electric Corporation, J; Khalid Hussein, Mitsubishi Electric Europe, D

Room Athen

Energy Storage



Chairperson: Enrique J. Dede, University of Valencia, ES

14:00

12 Volt Starter Battery using Lithium-ion Cells combined in parallel with Electric Double-layer and Lithium Capacitors for Cold Cranking

Hans-Georg Schweiger, Enrique Machuca, Technical University of Ingolstadt, D; Sergej Vlasov, BFFT, D

14:30

Artificial Neural Networks Based Algorithm to Predict the Behavior of Electric Vehicles Battery State of Charge and State of Health

Sender Rocha, Alex Franca, Thais Sousa, CPqD, BR

15:00

An Efficient Implementation of a Reconfigurable Battery Stack with Optimum Cell Usage

Martin Wattenberg, Reutlingen University, D; Martin Pfof, University of Innsbruck, AT

15:30

Comparative Study and Evaluation of Passive Balancing Against Single Switch Active Balancing Systems for Energy Storage Systems

Iosu Aizpuru, Unai Iraola, Jose Mari Canales, Ander Goikoetxea, Mondragon University, ES

Room Mailand

Control Techniques in Intelligent Motion Systems II



Chairperson: Hubert Schierling, Siemens, D

14:00

Voltage Levels Comparison and System Optimization for Electric Drives in Hybrid Vehicles

Quentin Werner, Daimler, D; Serge Pierfederici, Noureddine Takorabet, University de Lorraine, F

14:30

Real-Time Capable Model Predictive Control of Permanent Magnet Synchronous Motors Using Particle Swarm Optimisation

Oliver Wallscheid, Joachim Böcker, University of Paderborn, D

15:00

A Modular Multilevel Matrix Converter for High Speed Drive Applications

Dennis Bräckle, Felix Kammerer, Mathias Schnarrenberger, Marc Hiller, Michael Braun, Karlsruhe Institute of Technology, D

15:30

Smart Supercapacitor based DC-link Extension for Drives offers UPS Capability and acts as an Energy Efficient Line Regeneration Replacement

Jens Onno Krah, Markus Höltingen, David Langhals, Technical University of Cologne, D; Nico Sieweke, Christoph Klarenbach, Beckhoff Automation, D

Exhibition

At PCIM Europe, leading companies from the field of power electronics present innovative products and system solutions. Thereby it offers its visitors an exceptional platform to inform themselves about the latest trends and developments of the industry.

Besides more than 400 exhibitors, PCIM Europe offers a multifaceted range of programs with numerous highlights, as the special area showing approaches and progresses from the field of efficient vehicle technology or the exhibitor forum and industry forum, where exhibitors have the chance to present their products and concepts to a competent audience.

List of Exhibitors

3M Deutschland, D
A Media Bodo's Power Systems, D
 A.L.M.T., J
 Aalborg University, DK
 Aavid Kunze, D
 Aavid Thermalloy, I
 AB Mikroelektronik, A
 ABB France, F
 ABB Switzerland – Semiconductors, CH
 Acal Bfi Germany, D
 Advanced Cooling Technologies, USA
 Advanced Energy Industries, D
 Advanced Techne – PRIATHERM DIVISION, I
 Advanced Technology & Materials, CN
 Aerovox, USA
 AgileSwitch, USA
 AIC Europe, D
 AIT Austrian Institute of Technology, A
 AixControl, D
 AKER Technology, TW
 AKG Thermotechnik International, D
 ALCON Electronics, IND
 alfatec, D
 Alisha Coils & Transformers, IND
 Allegro MicroSystems Europe, GB
 Allray, CN
 Alpha, GB
 Alpha and Omega Semiconductor, USA
 ALPHA-Numerics, D
 alpitronic, I
 alttec, D
 Alutronic Kühlkörper, D
 Amantys Power Electronics, GB
 AMS Technologies, D
 Analog Devices, D
 Aperam Alloys Amilly, F
 APOJEE, D
 Arcel, F
 Arthur Behrens, D
 AT & S Austria Technologie & Systemtechnik, A
 Atherm, F
 ATV Technologie, D
 austerlitz electronic, D
 AUXEL, F
 Avago Technologies, D
 AVX, GB
 Axson, D
Barcelona Semiconductors, E
 Beijing Sinking Power Electronic Technology, CN
 Biesterfeld Spezialchemie, D
 BLOCK Transformatoren-Elektronik, D
 Bluestar Silicones France, F
 Bourns Sensors, D
 BROXING, CH
CADFEM, D
 Caltest Instruments, D
 CALYOS, B
 Cambridge Microelectronics, GB
 Cascade Microtech, USA
 CEFEM INDUSTRIES, F
 CEJN-Product, D
 Celeem Passive Components, IL
 CeramTec, D
 Chang Sung, ROK
 China Amorphous Technology, CN
 CKE Products by Dean Technology, USA
 Cofan USA, USA
 Columbia-Staver, GB
 Constellium Singen, D
 CONTEX, J
 Cool Tec Electronic, D
 COOLTECH, I
 CoorsTek Advanced Materials ANCeram,
 Zweigniederlassung der CoorsTek, D
 CoorsTek, D
 Cosmo Ferrites, IND
 CPS Technologies, USA
 CTX Thermal Solutions, D
DACO Semiconductor, TW
 Danfoss Silicon Power, D
 Danotherm Electric, DK
 dataTec, D
 DAU, A
 Dean Technology, USA
 Denka Chemicals, D
 DETAKTA Isolier- und Meßtechnik, D
 DEWESoft, D
 DEWETRON Deutschland, D
 Diotec Semiconductor, D
 DODUCO, D
 Dow Corning Europe, B
 DOWA HD Europe, D
 dSPACE, D
 Ducati Energia, I
 DYNETICS, D
 Dynex Semiconductor, GB
EBG Elektronische Bauelemente, A
 ECOMAL Europe, D
 ECPE European Center for Power Electronics, D
 ed-k Dipl.-Ing. Hubert Kreis, D
 EKL, D
 ELECTROHMS, IND
 Electronic Concepts (Europe), IRL
 Electronic Specifier, GB
 ELECTRONICON Kondensatoren, D
 ELEKTRISOLA Dr. Gerd Schildbach, D
 EME, B
 EPA, D
 EPCOS A TDK Group Company, D
 EpiGaN, B
 ET System electronic, D
 ETI DE, D
 Exagan, F
 Exxelia Supply, F
F & K Delvotec Bondtechnik, D
 Fairchild Semiconductor, USA
 Ferrotec Europe, D
 Ferroxcube Deutschland, D
 Feuerherdt, D
 Filcap, D
 Finepower, D
 Foshan City Shunde District ShengYe Electrical, CN
 Franz Steger Transformatorenbau, D
 Fraunhofer Institut für Integrierte Systeme und
 Bauelementetechnologie IISB, D
 Fraunhofer Institut für Solare Energiesysteme ISE, D
 Fraunhofer-Institut für Keramische Technologien und
 Systeme IKTS, D
 Fraunhofer-Institut für Werkstoffmechanik IWM
 CAM, D
 Fraunhofer-Institut für Zuverlässigkeit und
 Mikrointegration IZM, D
 Freicomp, D
 Frizlen, D
 FTCAP, D
 Fujii Electric Europe, D
GaN Systems, CDN
 GE Global Research, USA
 Gemballa Electronics, D
 GeneSiC Semiconductor, USA
 GES Electronic & Service, D
 Global Power Technologies, USA
 GLYN, D
 GraffTech International, USA
 GT elektronik, D
 Guangdong Fengming Electronic Tech, CN
 Gutre, D
 GvA Leistungselektronik, D
HAHN, D
 Haining Ferriwo Electronics, CN
 HALA Contec, D
 Hangzhou Xenbo Electric, CN
 Hauber & Graf Electronics, D
 HE System Electronic, D
 HEBEI GUANTAI ELECTRONIC TECHNOLOGY, CN
 Hefei Shengda Electronics Technology Industry, CN
 HEIDEN power, D
 HEINE Resistors, D
 Henkel, D
 Heraeus Deutschland, D
 Hesse, D
 HF Instruments, D
 High & Low, TW
 High Voltage Power Solutions Products
 by Dean Technology, USA
 Himag Planar Magnetics, GB
 Hitachi Europe, GB
 Hitachi Metals Europe, D
 Hochschule Konstanz Technik, Wirtschaft und
 Gestaltung, D
 Höganas, S
 Hollmén, FIN
 HV Components Associates Products
 by Dean Technology, USA
 HVP High Voltage Products, D
 HVR International, D
 HYDRA Components, D
 HY-LINE Power Components, D
I.C.E., I
 IB-Billmann, D
 ICAR – INDUSTRIA CONDENSATORI, I
 INCOPA, D
 Indium Corporation of Europe, GB
 Inductive Systems Europe, NL
 Ineltron, D
 Infineon Technologies, D
 InPower Systems, D
 Interplex NAS Electronics, D
 InTiCa Systems, D
 Isabellenhütte Heusler, D
 IS-POWER a Division of IS-Line, D
 ITELCOND, I
 IWATSU TEST INSTRUMENTS, J
 IXYS Semiconductor, D
Jentech Precision Industrial, TW

JFE Steel, J
 JGD Semiconductor, CN
 Jianghai Europe Electronic Components, D
 Johann Lasslop Induktive Bauteile, D
 JSC Electrovipryamitel, RUS
 Junior Kühlkörper, D
KKAMAKA Electronic Bauelemente, D
 Kanthal Global Sandvik Heating Technology, USA
 Karlsruher Institut für Technologie (KIT), D
 Kaschke Components, D
 KCC, ROK
 KEMET Electronics, USA
 Kendeil, I
 KERAFOL – Keramische Folien, D
 Keysight Technologies Deutschland, D
 KLEINER Stanztechnik, D
 KOA Europe, D
 Kojin, J
 KRAH Elektronische Bauelemente, D
 KUBARA LAMINA, PL
 Kulicke & Soffa, SGP
 KYOCERA Fineceramics, D
Lean technik Signal- & Leistungsübertrager, D
 Leclanché Capacitors, CH
 LEM Europe, D
 Lin Horn Technology, TW
 Littelfuse Europe, D
 LS Mtron, ROK
MACCON, D
 MacMic Science & Technology, CN
 MagDev, GB
 Magnachip Semiconductor, ROK
 Magna-Power Electronics, D
 Magnetec (Guangzhou) Magnetic Device, CN
 Magnetec Gesellschaft für Magnet-Technologie, D
 Magnetics, USA
 Malico, TW
 MARSCHNER TABUCHI ELECTRIC, D
 MB Electronic, D
 Mecc. AL, I
 Mentor Graphics, GB
 Mersen France, F
 MES Manz Electronic Systeme, D
 MEV Elektronik Service, D
 Michael Koch, D
 Microchip, GB
 Micrometals, USA
 Microsemi, USA
 MinDCet, B
 Mitsubishi Electric Europe Niederlassung Deutschland, D
 MJC Elektrotechnik, D
 MS Power Semiconductor, CN
 MUECAP Bauelemente, D
 Multi Measuring Instruments, J
 Murata Elektronik, D
Nanjing New Conda Magnetic Industrial, CN
 Neumüller Elektronik, D
 NGK Electronics Devices, J
 NIKKI Manufacturing, J
 Ningbo Degson Electrical, CN
 Nucon Energy, RUS
 NWL, USA
OMICRON electronics, A
 ON Semiconductor, GB
PADA Engineering, I
 Panasonic Automotive & Industrial Systems Europe, D
 PARKER OVERSEAS, IND
 Payton Planar Magnetics, IL
 PBF Group, NL
 PFARR STANZTECHNIK, D
 PHOENIX CONTACT Deutschland, D
 PHOENIX MECANO Power Quality, D
 Piciesse Elettronica, I
 PINK Thermosysteme, D
 pk components, D
 PLANSEE, A
 Plathaus, D
 Plexim, CH
 PM Professional Maintenance, D
 PMK Mess- & Kommunikationstechnik, D
 POCO, CN
 Power Electronic Measurements, GB
 Power Integrations, D
 Power Research Electronics, NL
 Power Systems Design, USA
 PowerCon, DK
 POWERSEM, D
 POWERSYS, F
 PRECISION ELECTRONIC COMPONENTS, IND
 PREVENTPCB, D
 Prima Electro, I
 Prodrive Technologies, NL
 Pulse Magnetic & Power Electronics, IND
 PVA TePla Analytical Systems, D
QUICK OHM Küpper, D
R & D Electronics International, HK
 Raytheon Systems, GB
 RECOM Power, A
 Richardson Electronics, D
 Richardson RFPD Germany, D
 RISSE electronic, D
 ROGERS Germany, D
 ROHM Semiconductor, D
 Rubadue Wire, USA
 Rudolf Pack, Pack LitzWire, D
 RUTRONIK Elektronische Bauelemente, D
Samwha Europe, D
 Sarnikon Metal ve Elektronik San. ve Tic. TR
 SAS IDEALEC, F
 SBA-TrafoBau Jena, D
 SBA-TrafoTech, D
 SBE, USA
 Schmidbauer Transformatoren und Gerätebau, D
 Schulz-Electronic, D
 Schunk Hoffmann Carbon Technology, A
 Schunk Sonosystems, D
 schwa-medico Transformatorenbau & Industrieprodukte, D
 Schweizer Electronic, D
 SCL PCB Solutions Group, GB
 SCR, F
 SDS Performance – Systems Development & Solutions, F
 Seifert electronic, D
 Sekels, D
 Semelab, GB
 SEMIKRON International, D
 Semtech, USA
 Sensitec, D
 Serigroup, I
 SERTO, D
 SET Power Systems, D
 Shanghai Eatop Electronic Technology, CN
 Shanghai SK Transformer, CN
 Shenzhen Belta Technology, CN
 Shenzhen Cectn Technology, CN
 Shenzhen Click Technology, CN
 Shenzhen Gaoyu Electronic Technology, CN
 Shindengen UK, GB
 Siba, D
 SIBO Electronic, D
 Siebel Elektronik, D
 Siemens, D
 SIGNALTEC, D
 Silicon Projects, D
 SIR Resistor, I
 SIRECTIFIER ELECTRONICS TECHNOLOGY, CN
 SIRIO ELETTRONICA, I
 Smart Power Solutions, GB
 SMP, D
 Special-Ind Deutschland, D
 Sree Vishnu Magnetics, IND
 StandexMeder Electronics, D
 Starpower Europe, CH
 Stellar Industries, USA
 STGCON Germany, D
 STMicroelectronics International, CH
 STS, D
 SUMIDA Components & Modules, D
 Sunrise Power Transformers, D
 Susumu Deutschland, D
 Sycomp, D
 SYRMA TECHNOLOGY, IND
 System Plus Consulting, F
 Taiwan Chinsan Electronic Industrial, TW
 Taiwan Semiconductor Europe, D
 Tamura-Europe, GB
 TCT Tores Composants Technologies, F
 TDG, CN
 Team Pacific, RP
 Tech Semiconductors, CN
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 Technische Universität Wien Institute of
 Energy Systems and Electrical Drives (ESEA), A

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 Tektronix UK, GB
 TELCON, GB
 Teledyne LeCroy, D
 TH Proton-Electrotex, RUS
 THALES MICROELECTRONICS, F
 The Bergquist Company, D
 Thomas Waidner, D
 THORA Elektronik, D
 Tianjin Century Electronics, CN
 Tigris Elektronik, D
 TOELLNER Electronic Instrumente, D
 Toshiba Electronics Europe, D
 trafomodern, A
 Traftor Europe, F
 TRAMAG Transformatorenfabrik, D
United Silicon Carbide, USA
 Universitat Politècnica de Catalunya CITCEA-UPC, E
 University of Nottingham, GB
VACUUMSCHMELZE, D
 Verein Tera Tu Graz, A
 Vicor Germany, D
 Vincotech, D
 Vishay Europe Sales, D
 Vogel Business Media, D
Wacker Chemie Carl Kurt Walther, D
 Walther-Präzision, D
 Weidmüller Interface, D
 Wijdeven Inductive Solutions, NL
 WIMA, D
 Wolfspeed, A Cree Company, USA
 Wolverine Tube MicroCool Division, USA
 WÜRTH ELEKTRONIK eiSos, D
 Würth Elektronik ICS, D
 WuXi ChenRui New Energy, CN
Xi'an Yongdian Electric, CN
 Xi'an Miqam Microelectronics Materials, CN
 Yangzhou Pairui IMP. & EXP, CN
 Yangzhou Positioning Tech, CN
 Yangzhou Yangjie Electronic Technology, CN
 Yixing Kexing Alloy Materials, CN
 Yokogawa Deutschland Niederlassung Herrsching
 Test- und Messtechnik, D
 Yole Developpement, F
Zeasset Electronic Technology, CN
 ZES ZIMMER Electronic Systems, D
 ZEZ SILKO, CZ
 Zhejiang Zenli Rectifier, CN
 Zhuzhou CRRC Times Electronic, CN

As of March 2016/subject to change without notice



Industry Forum

Hall 6 Booth 248

Tuesday, 10 May 2016

10:30 – 11:15	Sensorlose energieeffiziente elektrische Antriebe – Volles Drehmoment bis Stillstand ohne Drehgeber	Technische Universität Wien, Manfred Schrödl
11:30 – 12:30	Technologies for Efficient Simulation of Complex Power Converters	Plexim, Orhan Toker
12:30 – 13:00	Entwicklung eines effizienten Elektro-Fahrzeugs	Tera TU Graz, Rene Pöschl
13:00 – 13:45	Hybrides Energiespeichersystem aus Batterie und Doppelschichtkondensatoren (EDLC) Systemanalyse, Schaltungstopologien und praktische Umsetzung in einem digital geregelten System für den Niederspannungsbereich	Rutronik, Andreas Mangler
13:45 – 15:15	Vorstellung der Studie »Stromversorgungsmodulare für die Leiterplattenmontage« Anschließend Podiumsdiskussion »Passive Bauelemente für die Leistungselektronik«	WEKA Fachmedien, Andrea Gillhuber, Ralf Higgelke, Engelbert Hopf
15:15 – 16:00	Hexaferritmaterial für die EMV Schirmung im Frequenzbereich größer 1000 MHz	Ferroxcube, Dietmar Holz; IMG Electronic & Power Systems, Frank Gräbner
16:00 – 17:00	The Future of Power Semiconductors: Rugged and High Performing Silicon Carbide Components	Infineon, Peter Friedrichs

Wednesday, 11 May 2016

10:00 – 12:00	Are Power Electronics Ready for High Temperature?	Yole Développement, Pierric Gueguen
12:00 – 13:00	SIC – Volume, Production and Cost	A Media, Bodo's Power Systems, Bodo Arlt
13:00 – 14:00	GaN – Volume, Production and Cost	A Media, Bodo's Power Systems, Bodo Arlt
14:00 – 14:45	Digitally controlled LED-Drivers using a PFC-Flyback Topology	Infineon, Uli vom Bauer
14:45 – 15:30	Robert Bosch Center for Power Electronics – Study and Research what moves you	Reutlingen University – Robert Bosch Center for Power Electronics, Michael Ebli, Martin Wattenberg
15:30 – 16:00	Application Level Testing for Power Integrated Modules	On Semiconductor, Jonathan Harper

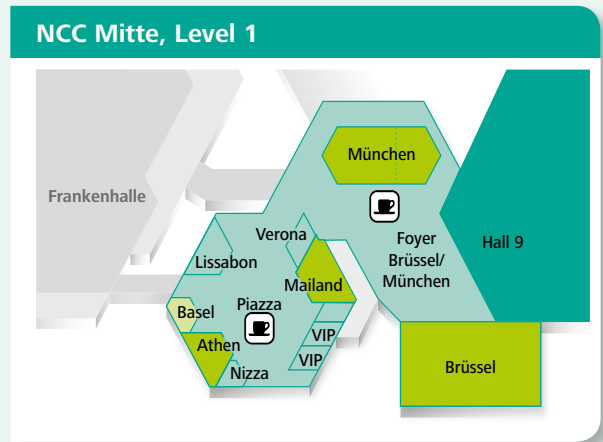
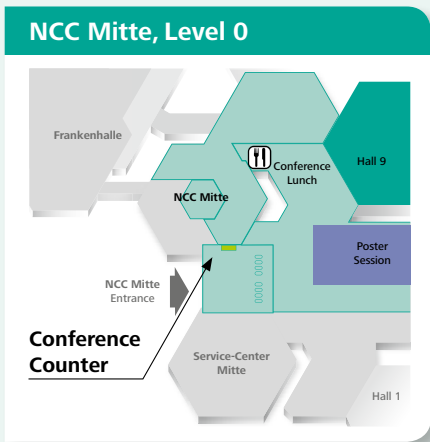
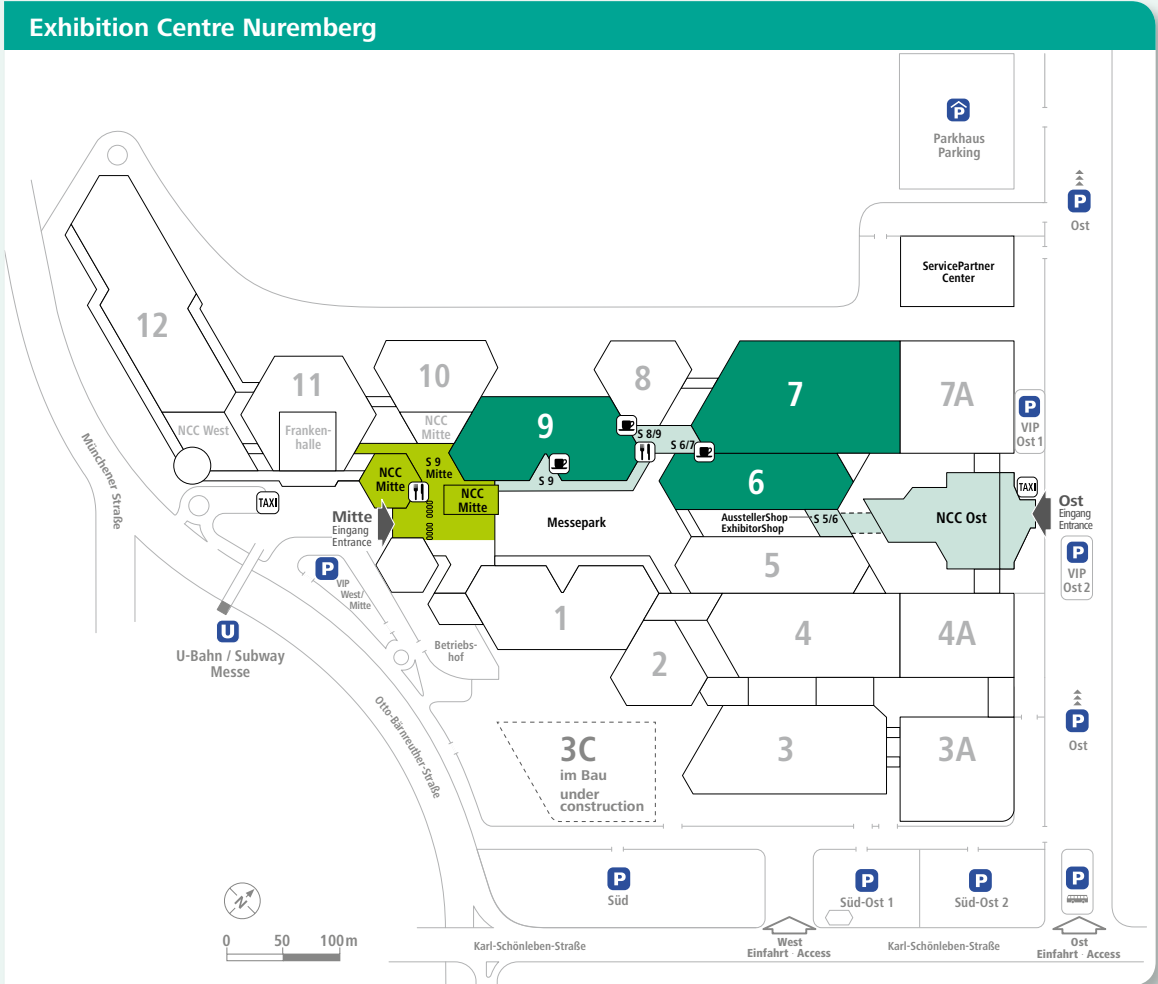
Thursday, 12 May 2016

10:00 – 13:30	ECPE Students' Day	ECPE
13:30 – 14:15	Industry 4.0 – Meaning to a Company in the Field of Electrical Drive Technology	SEW Eurodrive, Hans Krattenmacher
14:15 – 15:15	Thermal Design of Power Modules: Detailed Investigation and Reliability over Lifetime on a Real User Case	Mentor Graphics, Om Lebel, Andreas Simon-Kajda
15:15 – 16:00	A Modular Low Inductance Reference Design Board for Power Modules with accompanying Physically Scalable SPICE Model	Fairchild, Mehrdad Baghaie
16:00 – 16:30	Preisverleihung Messerallye ECPE Students' Day	ECPE

Program as of March 2016



Room Plan



- Exhibition
- Entrances and Services
- Conference
- Advisory Board/ Speaker's Room

Registration Information

Registration Fees

	Until 7 April 2016	From 8 April 2016
These are per named delegate as follows:		
One Conference Day	640 EUR	740 EUR
Two Conference Days	1,040 EUR	1,140 EUR
Three Conference Days	1,240 EUR	1,340 EUR
Tutorial Full Day	690 EUR	790 EUR
Seminar Half Day	345 EUR	395 EUR
University Staff*	920 EUR	920 EUR
Students	40 % Discount	40 % Discount
Exhibitor special rate**	250 EUR	250 EUR

* University staff and students may only register for the full conference at a reduced rate and must enclose a copy of their university ID-card.
A student discount of 40 % is available upon request. This discount cannot be combined with the University Staff fee.
Please contact Ms. Daniela Käser at Daniela.Kaeser@mesago.com for registration.

** A transferable ticket valid for the three keynote presentations including the conference proceedings is only available to PCIM Europe 2016 exhibitors. A special registration is required.

On-site registration: please add 30 EUR per participant.
All fees plus 19 % VAT

To register please go to
pcim-europe.com

Registration Terms

Registration for the PCIM Europe Seminars, Tutorials and the Conference from 8–12 May 2016 is binding and only accepted online at pcim-europe.com. Participation fees are due on registration with payment by credit card (VISA, Master/Euro Card and Amex) via the Saferpay gateway. An invoice for the fees will be issued by mail.

Once the registration process is complete, you will receive an email booking confirmation including an entry voucher to the exhibition, please make sure to bring this along. Your conference documents will be issued on site at the conference counter.

Cancellations will be accepted in writing only. Cancellations received by Mesago by 14 April 2016 will incur a processing fee of 80 EUR. Thereafter if the participant does not attend, the full fee will be due. If a participant is unable to attend, a substitute can be nominated.

Mesago reserves the right to cancel the conference/seminars/tutorials due to poor bookings or other reasons beyond our control. No further claims beyond the reimbursement participation fees already paid will be accepted. The program or speakers are subject to change and no claims may be made in this respect.

The conference language is English.

Payment of fees entitles you to the following services:

→ Conference:

Participation at the conference days as booked, proceedings, free admission to the exhibition (3 day ticket), exhibition catalogue, lunch and entry to the exhibition party on 10 May 2016.

→ Tutorials:

Participation at the tutorial as booked, printed and digital course documentation, free admission to the exhibition (3 day ticket), exhibition catalogue, lunch and entry to the exhibition party on 10 May 2016.

→ Seminars:

Participation at the seminar as booked, printed and digital course documentation, free admission to the exhibition (3 day ticket), exhibition catalogue and entry to the exhibition party on 10 May 2016.

General Information

Venue

The seminars on Sunday 8 May 2016 and the tutorials on Monday 9 May 2016 will take place at **Arvena Park Hotel**, Görlitzer Str. 51, 90473 Nuremberg, phone: +49-911-89220

The conference from Tuesday 10 May until Thursday 12 May 2016 will take place at Conference Center Mitte, NürnbergMesse, Otto-Bärnreuther-Strasse, 90471 Nuremberg

Accommodation

Hotel Information

For hotel booking please contact the hotel directly.

PCIM Europe Head Quarter Hotel

Hotel Arvena Park

Görlitzer Str. 51

D-90473 Nürnberg

Tel: +49 911 89 22 0

Fax: +49 911 89 22 115

eMail: info@arvenapark.de

5 min. by underground U1 to the conference site.

Registration Counter Opening hours

Arvena Park Hotel

Sunday 8 May 2016 from 13.00 until 17.00

Monday 9 May 2016 from 8.00 until 14.00

NCC Mitte, NürnbergMesse

Monday 9 May 2016 from 16.00 until 18.00

10 – 12 May 2016 from 8.00 until 17.00

Questions?

Ms. Daniela Käser

Phone: +49 711 61946-972

daniela.kaeser@mesago.com



Travel



There are several non-stop flights to Nuremberg daily. In addition, Nuremberg's closeness to international airports such as Frankfurt, Munich, Zurich, Amsterdam or Paris ensures optimum connections to the intercontinental flight network. Getting from the airport to the exhibition centre is fast and easy. The airport is close to the city with direct underground and taxi connections to the exhibition centre. The underground takes you in 20 minutes from the airport to the exhibition centre. At Nuremberg Airport, taxis to the exhibition centre are available around the clock. Take the taxi directly to the exhibition centre. Journey time from the airport to the exhibition centre by taxi is approximately 15 minutes and costs about 25 EUR.



You can reach Nuremberg's main train station »Nürnberg Hauptbahnhof« conveniently from every German city with the following trains: ICE, IC or EC. There are also frequent train connections from major European cities such as Paris, Brussels, Zurich, Vienna, Amsterdam or Prague. From »Nürnberg Hauptbahnhof« the underground U1 or U11 (direction: »Langwasser Süd«) will take you directly to the exhibition centre in only 8 minutes. At the main train station in Nuremberg there are several taxis waiting for you. By taxi you reach the exhibition centre within 10 minutes.



Nuremberg is centrally located in the South of Germany. Its excellent connections to the European motorway and direct feeder roads make it easy and convenient to reach the exhibition centre by car. Destination address for your navigation system: NürnbergMesse, Karl-Schönleben-Str., Messeplatz 1, 90471 Nuremberg

For more travel and hotel information please visit pcim-europe.com

PCIM Worldwide



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EUROPE

16–18 May 2017, Nuremberg, Germany
pcim-europe.com



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ASIA

28–30 June 2016, Shanghai, China
pcimasia-expo.com

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70178 Stuttgart

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