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

Nuremberg, 5 – 7 June 2018
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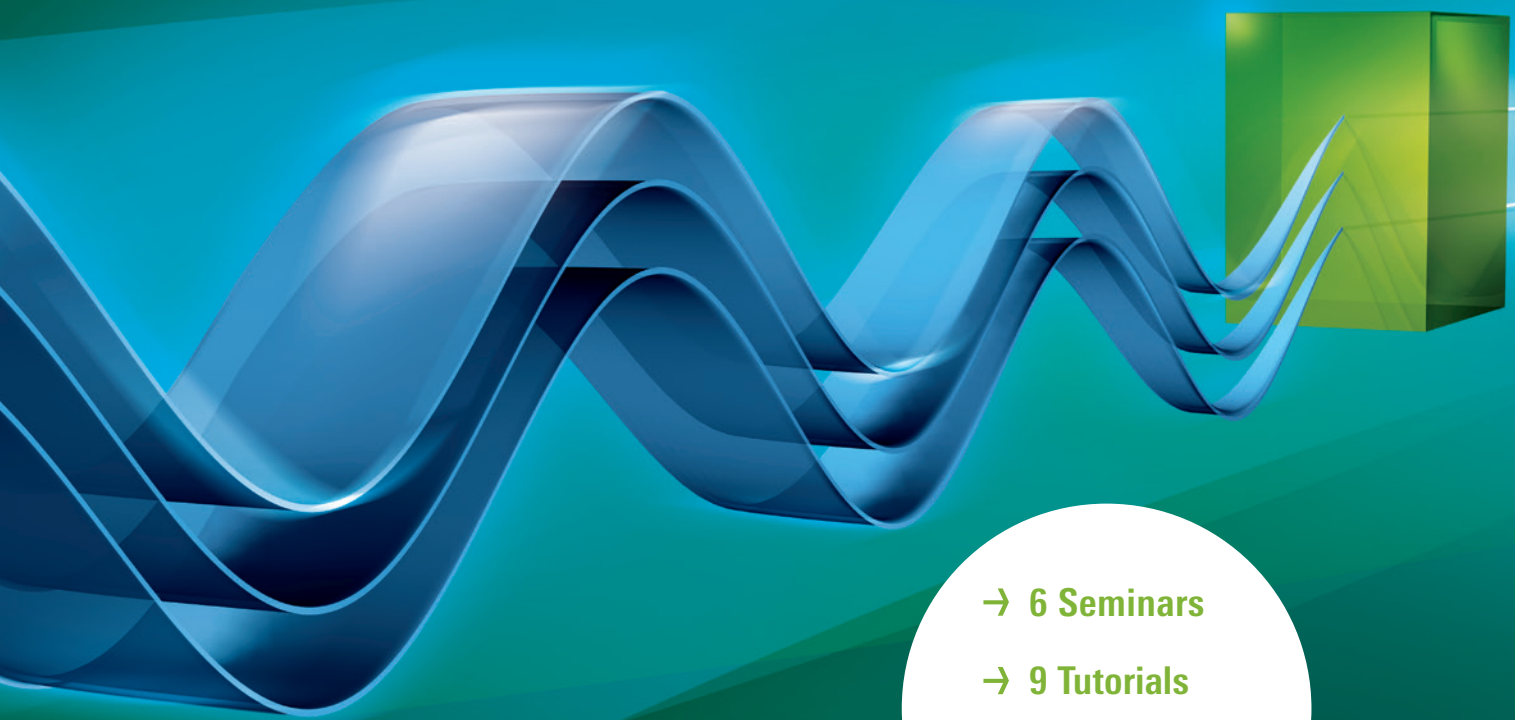
Conference Program



→ 6 Seminars

→ 9 Tutorials

→ Over 300 presentations

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Conference Program at a Glance

All seminar attendees will receive all seminar documentations. The same applies for the tutorial documentations.

Sunday, 3 June 2018

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

Monday, 4 June 2018

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

Tuesday, 5 June 2018

09:00	Brüssel 1 **Conference Opening and Award Ceremony**				
09:45	Brüssel 1 **Keynote »Electric Vehicles Charging – An Ultrafast Overview«**				
10:30	Coffee Break				
11:00	Brüssel 1 **Special Session: Advanced Solutions for Charging of Electric Vehicles**	Brüssel 2 **Special Session: Materials for Packaging and Thermal Management**	München 1 **SiC based Power Module**	München 2 **Traction Inverters**	Mailand **Intelligent Motion**
12:40	Lunch Break				
14:00	Brüssel 1 **SiC Devices I**	Brüssel 2 **Advanced Packaging Technologies I**	München 1 **Power Electronics Topologies**	München 2 **Multi-Level Converters**	Mailand **Energy Storage**
15:15	Foyer Entrance NCC Mitte **Poster/Dialogue Session**				
17:30	**Welcome Party**				

Wednesday, 6 June 2018

08:45	Brüssel 1 **Keynote »New Passive Devices in Power Conversion - Nice to Have or a Must?«**				
09:30	Coffee Break				
10:00	Brüssel 1 **High Power IGBT Devices**	Brüssel 2 **Converter Design and Integration**	München 1 **Control in Power Electronics**	München 2 **Gate Driver**	Mailand **Special Session: Passive Components**
12:00	Lunch Break and impulse-presentation »Fit for Stage«				
14:00	Brüssel 1 **SiC Devices II**	Brüssel 2 **High Power IGBT System Applications**	München 1 **Advanced Packaging Technologies II**	München 2 **HVDC Transmission Systems**	Mailand **Software Tools and Applications**
15:15	Foyer Entrance NCC Mitte **Poster / Dialogue Session**				

Thursday, 7 June 2018

08:45	Brüssel 1 **Keynote »Modular Multilevel Submodules for Converters, from the State of the Art to Future Trends«**			
09:30	Coffee Break			
10:00	Brüssel 1 **Reliability SiC Devices**	München 1 **Power Modules & Smart Driver**	München 2 **Reverse Conducting IGBT's**	Mailand **High Frequency Converters**
12:00	Lunch Break			
14:00	Brüssel 1 **GaN Devices**	München 1 **System Reliability**	München 2 **Power Converters**	Mailand **Advanced Sensors**

As of March 2018 / subject to change without notice.

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Seminars Sunday, 3 June 2018, 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 a 35 years' experience of R&D in Power Electronics, inside international companies, with powers from 10 W up to 10 MW, including HF resonant converters and high voltage transformers, electric machines and inverters for hybrid cars. He is inventor of 27 granted patents and author of over 80 technical papers. As a consultant, his activities extend from one day consulting to several months' projects, including choices & design of conversion topologies, power components & electric machines sizing, EMC, digital control, industrial property, field support. Affiliated Professor at Ensta-ParisTech, he teaches also at CentraleSupelec, France, and for inter and intra companies trainings, on former topics and also on mechatronics, cars powertrains, or »Experience and Innovation«.

Content

Fast semiconductors commutations are required for efficiency of high frequency (HF) power converters and drives, and their wide bandwidth control electronics. These sudden front edges generate perturbations in control circuits, and on public utility power networks. The seminar shows step by step how perturbations propagate, as Differential Mode (DM) and Common Mode (CM), how to reduce noisy oscillations from the beginning, how to design and implement robust control electronics, how to calculate and optimize DM and CM filters for EMC standards compliance, how to avoid expensive shielding and improve reliability. Number of practical designs are analytically calculated, showing orders of magnitudes for a wide range of powers and frequencies.

Introduction: Issues & Standards

DM in Control
- → Resistive, inductive & capacitive coupling reduction.
- → Reduction by ground planes.

DM in Power & Filters Design
- → Switching power supply sequence as EMI source.
- → Calculation of Disturbances from transistors & diodes.
- → Measurement by L.I.S.N. and Spectrum Analyzer.
- → DM Filter calculation, Design of L, C & R components.
- → Some MHz perturbations evaluations. Reduction means.

CM in Control
- → Between PCBs & between Cabinets. Electric & Optics.
- → CM parasitic coupling calculation and reduction.
- → Wiring & Layout evolution form »Star« to »Net«.

CM in Power & Filters Design
- → Calculation of Disturbances from CM capacitances.
- → Heatsinks, transformers, screens, electric machines stators.
- → Measurement. CM Filter calculation.
- → Leakage current constraint. CM coupled inductance design.

EMC Commutation Control of Power Semiconductors
- → Tuning as a trade-off between switching losses & EMC.
- → Control of di/dt and dv/dt front edges by gate drive.
- → Gate drive circuit designs for MOS and IGBTs.

Radiations Reduction
- → Examples of emissions of Electric & Magnetic Fields.
- → Fields measurements and reduction.
- → Neighbor Field & Far Field identification. Examples.
- → Wiring, grounding, shielding, packaging.

Who should attend?

This course is targeted towards engineers, students or project managers, who design, specify, simulate, tune, or integrate high frequency power supplies, converters, EMC filters, electric machines, and intelligent motion, for high efficiency conversion, low global cost and high reliability.

Seminar 2

Diagnosing and Locating Sources of EMI in Switchmode Power Converters

Bruce Carsten, Bruce Carsten Associates, USA

About the instructor

Bruce Carsten has 48 years of design and development experience in switchmode power converters at frequencies from 20 kHz to 1 MHz. In 1982 he designed a 48 Vdc, 200 A, 50 kHz natural convection cooled switchmode telecom rectifier which met the FCC Class A requirements for conducted and radiated emissions. This seminar targets the practicing design or test engineer, and emphasizes an intuitive understanding of the phenomena involved.

Content

The instructor advocates that a power converter be designed for low EMI from the beginning, but he realizes that it can take many years of experience to »get it right the first time«, or even come close. A central problem is that EMI is a very »low energy« phenomena, with only 8 to 80 nW of conducted EMI allowed below 30 MHz at any given frequency (depending on the applicable standards), with similar constraints on radiated EMI above 30 MHz. These limits generally apply regardless of converter power level, so a 10 kW converter has 1.000 times tighter limits than a 10 W converter, with 0.8 to 8 pW per watt output allowed. Consequently, the sources of EMI are easily overlooked as trivial by the less experienced engineer.

Failure to meet EMI standards can be found »the hard way«, by paying for an EMI lab to find out for you (and they will not be able to advise you how to fix it). Alternatively, with a relatively modest investment in equipment, you can first get a reasonable estimate of the conducted and radiated emissions level, and then, with very little more equipment, begin to track down the origins.

Conducted EMI is measured with a LISN (Line Impedance Stabilization Network) on each power input, and with these can be measured yourself with a spectrum analyzer, a tunable voltmeter, or even an oscilloscope with an FFT (fast Fourier transform) capability. However, this measurement is the vector sum of common (longitudinal) and differential (transverse) mode currents, which are generated by completely different phenomena. A transformer circuit will be presented which can simultaneously separate the LISN outputs into mutually isolated common and normal mode currents, allowing their sources to be tracked down individually. Typical sources of both will be described, and methods to minimize each presented.

The instructor has found that radiated noise is almost invariably generated by common mode currents in the input (and/or output) power lines, using these lines as a radiating antenna. »Exceptions« can occur with: common mode currents on other lines, such as control or communication lines; normal mode currents on widely separated input or output power lines; or (rarely) direct radiation form an unenclosed power converter.

The sources of these currents are largely the same as for conducted EMI and, to some extent, can be found from the separated LISN outputs, but HF current transformers are better suited to this task due to the high frequencies which may be involved. Suitable constructions of current transformers for common and normal mode currents will be described.

Who should attend?

This seminar is directed towards the engineer, technologist or technician who needs to locate sources of EMI in a switching power converter so that, once found, they can be remedied.

Seminar 3

Wide Band Gap (WBG) Power Devices, Characterisation, Simulation and Testing

Edward Shelton, Patrick Palmer, University of Cambridge, Great Britain
Geoff Haynes, Inspirit Ventures, Great Britain
Giorgia Longobardi, Kyushu Institute of Technology, Japan
Edgar Ayerbe, Wolfspeed, USA

About the instructors

Ed Shelton graduated from the University of Cambridge in 1997. He has since worked for a number of high-tech businesses, more recently focusing on power systems as Senior Engineer at Amantys Ltd. Since 2015 he has been a Senior Research Associate at the University of Cambridge and freelance consultant.

Dr Patrick Palmer received his PhD from Imperial College London. He has been an academic at the University of Cambridge for over 25 years, teaching power electronics. He was a co-founder of Amantys Ltd. He is a Chartered Engineer and has published more than 150 articles and papers.

Geoff Haynes is a serial entrepreneur: He has a life-time of experience in the semiconductor industry. He was co-founder of GaN Systems Inc., and now works as a freelance consultant. He is also part of an activity commericalising university research in the UK.

Dr Giorgia Longobardi is currently a JSPS Fellow at Kyutech, Japan. From 2010 to 2017 she has been working on modelling, characterization, and simulations of GaN power devices at Cambridge University, where she received the PhD in 2014. She is co-founder of Cambridge GaN Devices Ltd.

Edgar Ayerbe graduated from Rensselaer Polytechnic Institute in 1995 and has since worked for a number of leading businesses in the semiconductor industry. He joined CREE in 2011 and is currently involved in marketing and simulation modelling of their SiC MOSFETs.

Content

The presentation will start with a high-level overview of GaN and SiC transistors; device structures and characteristics; the advantages they offer over conventional Silicon; the applications and markets that can benefit from these power devices; and industry trends and emerging technologies. [Geoff Haynes]

We will then delve into the technical details of GaN power transistors, focusing on the most promising normally-off technologies. We will cover the main engineering challenges that are faced by engineers using GaN devices today, including the effects of circuit parasitics and device packaging. Reliability issues occurring when GaN transistors are subject to high voltage stress will be then discussed and the available device level solutions to such issues will be presented. We will conclude this section by looking at simulation modelling and tools. [Giorgia Longobardi]

Next we will look at the details of SiC power MOSFETs, the various competing structures used for these devices, manufacturing processes, and compare the advantages of each approach from different manufacturers.

We will discuss how this creates devices with some unique properties and switching characteristics. The relevance of these properties to particular applications will also be discussed. The audience will be guided past some of the potential pitfalls that users should be aware of. Test waveforms will be presented and analysed. Simulation models and tools will be discussed and results demonstrated. [Edgar Ayerbe]

Following on from this, we will look at the design of WBG test circuits. The difficulties of taking reliable and meaningful measurement data will be discussed. Circuits that the authors have developed will be presented. The key implementation details of these circuits will be described and test results shown to demonstrate their effectiveness. [Ed Shelton]

Finally, switching test results for various market-leading WBG and Si devices will be examined and compared. Straightforward numerical analysis will be applied to quantify performance and arrive at appropriate test circuit optimisations and solutions. A comparison to simulation results will be made and the accuracy of available simulation models and tools examined. [Patrick Palmer]

Finally, we will wrap up the session with a summary and reminder of what has been covered and what has been learned, as well as a discussion of challenges and opportunities for the future in the WBG industry. This will be followed by a Q & A session, where the audience will have the opportunity to clarify presentation details, and will be invited to explore areas of further interest with the speakers.

The goal of this seminar is to demonstrate how to achieve practical, efficient and reliable operation of WBG devices in high-frequency high-power switching circuits, by:

1. Understanding the fundamental principles of operation, benefits and limitations of WBG devices.
2. Apprising effectiveness of simulation and modelling techniques, and other design tools available.
3. Test circuits and measurement systems that achieve performance required for proper evaluation.
4. Examining test waveforms and analysing circuit behaviour. Comparison between power devices.
5. Designing circuits that achieve an optimum price / performance point.

Who should attend?

The presentation is aimed at all levels of listener, starting with material to engage the novice, through to detailed technical material for the accomplished engineer. The aim is to get listeners of all abilities to the point where they can understand WBG devices and successfully test their own circuits.

Seminars Sunday, 3 June 2018, 14:00 – 17:30

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

Seminar 4

Modern Magnetic Technologies for High Efficiency and High Power Density

Ionel Dan Jitaru, Rompower, USA

About the instructor

Ionel Dan Jitaru is the founder of Rompower Inc., later Ascom Rompower Inc. and Delta Energy Systems (Arizona) Inc., an internationally recognized engineering firm in the field of power conversion. Presently he is the president of Rompower Energy Systems Inc., an advance development company in Power Conversion Field. He has published 54 papers wherein several of them have received the best paper award, and held 46 professional seminars at different International Conferences in the power conversion Mr. Jitaru has pioneered several trends in power conversion technologies such as »PWM Soft switching«, »Full integrated multilayer PCB Magnetic«, »Synchronized rectification« and recently »True Soft Switching technologies« wherein the primary switchers turn on at zero voltage and the secondary switchers turn off at zero current. Some of these technologies have been covered by 62 intellectual properties wherein 29 are granted patents.

Content

This seminar will present a comprehensive overview of the modern magnetic technologies presently used in power conversion and new trends in magnetics aimed to address the new demands in power conversion. In the quest for higher power densities and higher efficiency magnetic technologies were forced to adapt and then new magnetic structures were developed.

The seminar will start by presenting several key characteristics of magnetic transformers such as leakage inductance, stray inductance, inter-winding and intra-winding capacitances and their impact in power conversion performance. Methods of measuring and controlling these parasitic elements are also presented. Furthermore, it will present the most suitable magnetic technology for different topologies designed to enhance the efficiency and power density.

A chapter is dedicated to quasi integrated and integrated magnetics and methods of calculating and simulating such structures. Magnetic structures wherein two independent power trains are placed on the same standard magnetic core without interference will also be presented. Magnetic technologies for specific applications such very high current will be presented together with experimental results.

A chapter is dedicated to models for simulating the magnetics in a circuit using Spice. Another chapter is presenting magnetics for wireless power with very high efficency exeeding 97%. The seminar will also show some present and future trends in magnetics for higher frequency operation.

A chapter will be dedicated to the new trends in magnetic technology for very high efficiency applications. These new magnetic technologies are compatible with the latest technologies in power conversion aimed at very high efficiency and very high power density. The seminar will address different applications ranging from very high density and very high efficiency AC-DC power adapters to the multiple KW DC-DC converters and Power Factor Correction modules. The presentation will be highlighted with design guidance, design example and experimental results, such as 99.6% efficiency transformer for 99% efficiency DC-DC Converters.

Who should attend?

This course is designed for magnetic engineers, power conversion engineers and technical managers who are involved in state-of-art power conversion. The participants will get familiar with the latest advancement in magnetics in power conversion aimed to increase the performance and reduce the total cost.

Seminar 5

Functional Safety - an Introduction for Inverter and Servo Drive Developers

Jens Onno Krah, Cologne University of Applied Sciences, Germany

About the instructor

Prof. Jens Onno Krah studied electrical engineering at the Bergische Universität Wuppertal and received his doctorate in 1993 from Prof. Holtz in the field of electric machine and drive research. Until February 2004 he was Technical Director responsible for the development of Kollmorgen Servo Drives. Since 2004 Prof. Krah has been teaching control technology, motion control, FPGA-based digital signal processing and functional safety at the TH Köln. The research focus is on the development of robust, safety-related and energy-efficient inverter control with programmable hardware.

Content

Functional safety is increasingly requested for drives. Safe Torque Off (STO) is now standard on many frequency inverters and servo drives. Safe motion and safety related field buses are an increasing demand. The technical basics of functional safety are explained in the seminar:

- Explanation of Safety Keywords
  Mean Time To Fail (MTTF), Failure In Time (FIT), Safe Failure Fraction (SFF), Diagnostic Coverage (DC), Fail Safe -Fail Operational, Fault Exclusion Category, Performance Level (PL), Safety Integrity Level (SIL)
- Safe Digital Input
  Testing, calculation of FIT, DC and SFF
- Safe Digital Output
  Testing, calculation of FIT, DC and SFF
- Safe Torque OFF (STO)
  Basic techniques to implement STO
- Safe Brake Control (SBC)
- Safety Related Fieldbus Technology
  Black Channel, Cyclic Redundancy Check
  PROFIsafe, FSoE
- Safety Related Motor Feedback
  2 Feedback devices
  Analog interface: Sin-Cos Encoder, Resolver
  Digital Interface: Single-Turn, Multi-Turn
  EnDAT 2.2, SCS open link, Hiperface DSL
- Safe Motion
  Safe Limited Speed (SLS), Safe Limited Position (SLP), etc.
- Safe Logic, Environment Requirements
  Power Supply
  Clock, Voltage and Temperature Monitoring
- Safe Logic Implementation
  Redundancy, Diversity
  Dual CPU, Lockstep CPU, FPGA
  Watchdog, Build In Self-Test (BIST), Self-Test Library (STL), Error Correction Code (ECC)
  FIT Estimation

Who should attend?

This seminar is intended for designers and engineers involved in frequency inverter and servo drive design. It assumes a working knowledge of electrical engineering basics and a familiarity with inverter design principles. Knowledge of functional safety is not required.

Seminar 6

Design of Magnetic Components for High Power Converters

Tomás Pagá, Enerdrive, Switzerland

About the instructor

Tomás Pagá 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 consultant in the energy and oil industry. From 2001, has been Power Electronics Converter Designer for industry, railway and renewable energy applications. Currently he works as High-Power Electronics consultant at ENERDRIVE GmbH in Zurich, for manufacturers of multi-megawatt, wind energy and industrial drives power converters. His research interests include high power electronics converters, magnetic components modeling and design, power electronics cooling and grid integration.

Content

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. 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. Finite Element modelling of high frequency winding losses will be used for the analysis.

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 and energy storage systems
- Electrical Drives
  - Traction Drives
  - Lifts and cranes
- 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 converter designers.
Magnetic components, inductors and transformers, designers and manufacturers.

Tutorials Monday, 4 June 2018, 09:00–17:00

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

Tutorial 1

Modern Soft Switching Technologies

Ionel Dan Jitaru, Rompower, USA

About the instructor

Ionel Dan Jitaru is the founder of Rompower Inc., later Ascom Rompower Inc. and Delta Energy Systems (Arizona) Inc., an internationally recognized engineering firm in the field of power conversion. Presently he is the president of Rompower Energy Systems Inc., an advance development company in Power Conversion Field. He has published 54 papers wherein several of them have received the best paper award, and held 46 professional seminars at different International Conferences in the power conversion Mr. Jitaru has pioneered several trends in power conversion technologies such as »PWM Soft switching«, »Full integrated multilayer PCB Magnetic«, »Synchronized rectification« and recently »True Soft Switching technologies« wherein the primary switchers turn on at zero voltage and the secondary switchers turn off at zero current. Some of these technologies have been covered by 62 intellectual properties wherein 29 are granted patents.

Content

The goal of this tutorial is to present the modern soft switching technologies as an avenue to increase the efficiency and power density in power convertors. Soft switching topologies have become popular in many applications in the last thirty years. Though we have such a long tradition in soft switching technologies, some of these have added too much complexity and their practical use becomes questionable. In addition, some of the traditional soft switching topologies address just the soft switching on the primary side and not the soft switching in the secondary.

Many of these technologies are novel and never presented before. In many of these novel technologies, zero voltage switching is accomplished by using the energy contained in the parasitic elements which traditionally were dissipated. The modern soft switching technologies which will be presented in the seminar do provide true soft switching. In true soft switching technology, the primary switching devices turn on at zero voltage and the secondary switching devices turn off at zero current. There is no ringing or spikes across any of the switching devices during operation; and this is done without the use of any snubbers. These technologies are a derivation of the classical topologies, such as flyback, boost, two transistors forward, half bridge and full bridge with some minor modification and most of them are using intelligent control to obtain true soft switching.

The goal of the modern soft switching technologies is to have a simple and low-cost hardware and an intelligent control designed to minimize the losses under different operating conditions.

Though the tutorial will be focused on the modern topologies, a section is dedicated to magnetics. In the quest for efficiency above 99%, the magnetic technology plays a very important role. In some applications such as modern soft switching flyback some of the energy for soft switching is extracted from the parasitic elements of the transformer. 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 technology in magnetics lags behind. The tutorial will describe the impact of the parasitic elements in the magnetics in optimizing the performance of the power converters. Presently we are reaching 99% efficiency in PFC and DC-DC converters by using these modern soft switching technologies, optimized magnetics and intelligent control. The developments in semiconductor technology such as GaN and SiC did help us to further improve the efficiency exceeding the 99% in some applications.

The tutorial will present also 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 design examples and experimental results such as 99%+ efficiency PFC with power densities above 1000W/in3, and 99% efficiency isolated DC-DC Converters.

Who should attend?

This course is designed for power conversion engineers, magnetic engineers and technical managers who are involved in state-of-art power conversion. The participants will get familiar with the latest advancement in topologies, control and magnetics in power conversion aimed to increase the performance and reduce the total cost.

Tutorial 2

Design of Multilevel Converter Systems

Marc Hiller, Karlsruhe Institute of Technology, Germany

About the instructor

Prof. Hiller received his diploma in Electrical Engineering from the Technical University Darmstadt in 1998. After one year as R&D engineer for traction converters at the Siemens AG, Erlangen, he joined the University of Federal Armed Forces in Munich, Germany, in 1999. After receiving his PhD degree he worked for 11 years in the R&D department for industrial LV & MV converters at the Siemens AG, Nuremberg, where he was involved in various projects on Multilevel Converters for industrial drives. As project manager and group leader he introduced the first Medium Voltage Modular Multilevel Converter for drive and grid applications to the market. In 2015, he joined the Karlsruhe Institute of Technology where he holds a chair for Power Electronic Systems at the Institute of Electrical Engineering (ETI).

Content

Compared to the most commonly used 2-Level converters, multilevel converters feature several voltage steps at the output. This allows using power semiconductors which do not have to be rated for the full DC link voltage and avoids series connection of switches. Furthermore this enables higher system voltages for AC and DC applications as well as improved efficiency and reduced harmonic distortion at higher resulting switching frequencies.

In recent years, many 3- and 5-Level converter topologies have been introduced for demanding applications like photovoltaic systems, wind converters, uninterruptible power supplies, MV drives and active filters. In addition, split DC link topologies are commonly used in power grids (HVDC, SVC) and MV applications.

All of these applications benefit from one or more of the most important advantages of multilevel converters:

- Improved EMI behavior, less harmonics,
- Improved efficiency,
- Use of cost-efficient power semiconductors at lower voltage ratings,
- Reduction of passive filters (improved power density),
- Improved availability using redundant components,
- Higher bandwidth.

- Despite these benefits multilevel converters still suffer from some drawbacks:
- Higher parts count and higher design complexity,
- Higher costs, which are only partly compensated by the system benefits,
- Increased control effort.

- The tutorial delivers important competencies allowing the professional design, rating and implementation of multilevel converter based systems. The main focus is put on 3- and 5-Level topologies but higher level concepts will also be explained.
- In order to give a system-oriented design overview the following topics will be covered:
- Overview on multilevel topologies
- Introduction to their basic functionality
- 3- and 5-Level converters
- Modular multilevel converters (MMC)
- Design aspects and features of multilevel converters:
  - Component design
  - Semiconductor losses and modulation
  - Voltage balancing
  - Fault management, redundancy, filter design
- Application examples

Who should attend?

The tutorial is designed for R&D engineers, system designers, project managers and (PhD) students interested in power electronic converters and systems, especially for grid and drive applications.

Tutorial 3

Electromagnetic Design of High Frequency Converters and Drives

Jacques Laeuffer, Dtalents, France

About the instructor

Jacques Laeuffer has a 35 years' experience of R&D in Power Electronics, inside international companies, with powers from 10 W up to 10 MW, including HF resonant converters and high voltage transformers, electric machines and inverters for hybrid cars. He is inventor of 27 granted patents and author of over 80 technical papers. As a consultant, his activities extend from one day consulting to several months' projects, including choices & design of conversion topologies, power components & electric machines sizing, EMC, digital control, industrial property, field support. Affiliated Professor at Ensta-ParisTech, he teaches also at CentraleSupelec, France, and for inter and intra companies trainings, on former topics and also on mechatronics, cars powertrains, or »Experience and Innovation«.

Content

Increasing high frequencies (HF), i.e. with very fast Si or SiC & GaN semiconductors, leads to new challenges: i.e. the »wiring inductance« issue is dramatically increased, while windings show »parasitic capacitances«. Electric machines suffer insulation breakdowns by HF ringing over voltages …

As a matter of fact, reduced commutations times become smaller than electromagnetic propagation delays inside power conversion and intelligent motion systems. Thus conventional »electric circuit« equations do not operate anymore as before. This tutorial shows a new appropriate physical analysis to understand what happens, and how to make clean designs without noisy resonances, EMI or extra losses for full benefit from new semiconductors.

For this purpose, the tutorial shows 3D distributions of volumes' energy densities & surfaces' power densities, and focuses on main phenomena to lead to simpler understanding. Number of practical designs are calculated, analytically and/or by simulation, showing first orders of magnitudes for a wide range of powers, frequencies and impedances.

Introduction: Examples of issues.

- Lines & Wiring Design
  - Propagation process on lines: energies, impedance & speed
  - Clean power propagation, or filtering, or oscillatory reflections
  - Design bifilar, coaxial, and strip lines accordingly
  - Examples: busbars, modules, spot welder, radiology, Ethernet
- Capacitors & Windings Design
  - Capacitors sizing, & shape for clean HF propagation
  - Transformers, inductors & electric machines stators sizing
  - HF propagation process in windings, as DM & CM
  - Simulation: Spice; Finite Difference Time Domain (FDTD)
  - Propagation delays calculation. Shapes for clean design
  - HF equivalent schematics. Proximity effect and optimization
- HF Converters Design
  - Topology choice from flyback, forward, bridge, to ZVS & ZCS
  - Examples: photovoltaic, PFC, computer, induction heating, HiFi
  - SMD commutation loop <1nH, including DC capacitor
  - Power module + busbars + DC capacitor: loop <1nH
- Intelligent Motion Drives Design
  - System made of inverter + shielded cable + stator + filters
  - HF equivalent schematics combining above knowledges
  - Differential Mode (DM) & Common Mode (CM) aspects
  - Examples of HF simulations. Clean impedances matching

Who should attend?

This course is targeted towards engineers, students or project managers, who design, specify, simulate, tune, or integrate high frequency power supplies, converters, EMC filters, electric machines, and intelligent motion, for high efficiency conversion, low global cost and high reliability.

Tutorials Monday, 4 June 2018, 09:00–17:00

Venue: Arvena Park Hotel Nuremberg, Görlitzer 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 20kW. He is now professor for power electronics and electrical drives at Cologne University of Applied Sciences. His main research interests are resonant converters with focus on magnetics, and the large-scale utilization of renewable energy.

Prof. Jens Onno Krah studied electrical engineering at the Bergische Universität Wuppertal and received his doctorate in 1993 from Prof. Holtz in the field of electric machine and drive research. Until February 2004 he was Technical Director responsible for the development of Kollmorgen Servo Drives. Since 2004 Prof. Krah has been teaching control technology, motion control, FPGA-based digital signal processing and functional safety at the TH Köln. The research focus is on the development of robust, safety-related and energy-efficient inverter control with programmable hardware.

Content

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
- → 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 vs. 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
- → Special Controls: Flyback, resonant LLC

6. Current Prediction
- → Modeling 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 Issues like Wide-Bandgap Devices

Tutorial 5

Advanced System Design with Ultra-Fast Si/SiC/GaN Power Semiconductor Devices

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 company ISLE GmbH 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 SiC MOSFETs, diodes and Si IGBTs.

Content
- → Fast Power Devices / Modules / Reliability
  - New developments in fast power devices (SiC/Si MOSFETs, IGBTs, GaN devices, freewheeling diodes)
  - Device design, properties and suitable applications
  - Reliability topics of (new) devices, e.g. gate oxide, dynamic Ron, cosmic ray ruggedness
  - Power module layouts and optimal design for low inductivity
  - Thermal mismatch, thermal stress, power cycling capability
- → Drive and Protection
  - Principles, technical realizations
  - Special driver requirements for fast power devices (Si, SiC, GaN)
  - Failure modes, failure detection
- → Topology-dependent Power Losses
  - DC / DC-converter
  - DC / AC-converter
  - Load Cycles
  - Calculation of heat sink
- → Device Induced Electromagnetic Disturbance
  - Parasitics
  - Oscillations in Power Modules
- → Special Topics of Application
  Consideration of special problems and questions of participants, for example:
  - Parallel/series connection of power devices
  - Special effects in ZVS/ZCS topologies
  - Special problems related to new device technologies
  - Short-circuit ruggedness of IGBTs and SiC MOSFETs

Who should attend?
Engineers designing converters equipped with fast power semiconductors like Si/SiC MOSFETs, IGBTs and diodes having basic knowledge in power devices and power converters.

Tutorial 6

Switchmode Printed Circuit Board Design and Layout for Low EMI

Bruce Carsten, Bruce Carsten Associates, USA

About the instructor

Bruce Carsten has 48 years of design and development experience in switchmode power converters at frequencies from 20 kHz to 1 MHz. In 1982 he designed a 48 Vdc, 200 A, 50 kHz natural convection cooled switchmode telecom rectifier which met the FCC Class A requirements for conducted and radiated emissions. His tutorial targets the practicing design engineer, and emphasize an intuitive understanding of phenomena involved.

Content

Although related to previous comprehensive EMI seminar versions by the instructor, the focus of this new tutorial is on the physical design and layout of a PCB to minimize Electromagnetic Interference (EMI). A great deal of switchmode EMI can be produced or avoided in the layout and construction of a Printed Circuit Board (PCB), and EMI from a poor layout is usually very difficult to fix without a redesign. This tutorial contains extracts from the original tutorials, but focuses on the printed circuit board, including the magnetic and electric shielding benefits of ground planes, and the use of »switching cell macros« to assist in a low EMI layout. New material for this tutorial illustrates the significant magnetic field reduction above and behind a PCB with a ground plane.

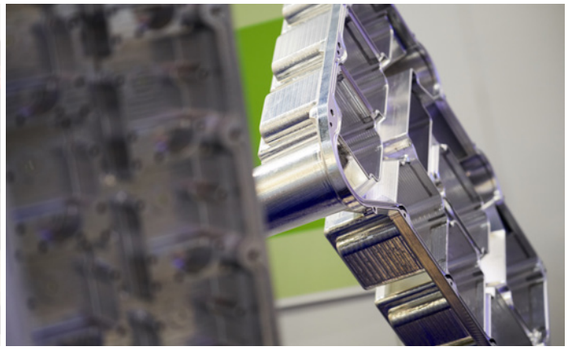
A good PCB layout for low EMI is a technically demanding design task, ideally performed by one versed in the physics and visualization of electric and magnetic fields. Unfortunately, PCB layout is increasingly performed by someone trained only in the use of layout software, where arbitrary component placement and the use of auto-routing of conductor traces can be deadly to EMI performance.

The tutorial will begin with physical demonstrations of energy coupling by changing magnetic and electric fields to aid in the comprehension of EMI generation. A full set of tutorial notes will be provided, but some subjects maybe gone over lightly or even skipped due to the limited time.

Questions and comments from attendees are strongly encouraged.

Topics include:
- → Definition of EMI, and how it is measured
- → How EMI is generated by changing voltages and currents
- → Magnetic field coupling from a current loop to a pickup loop
- → Electric field coupling from one surface to another
- → Illustration of energy coupling through changing electric and magnetic fields
- → Why EMI is so hard to prevent; a »parts per trillion« phenomena
- → »Switching Cells« as the principal source of EMI
- → Conductive shielding of Magnetic Fields
- → Faraday shielding of Electric Fields
- → The many benefits of a Ground Plane (expanded from last year)
- → Layout of switching cells as a »macro« or »component«, which can be moved but not pulled apart
- → Locating sources of EMI with H-field and E-field probes

Who should attend?
This tutorial is directed largely towards the switchmode design engineer who is either directly involved in PCB layout, or needs to direct and assist layout technicians. However, the tutorial will also be of some value to layout software users without an engineering background.



Tutorials Monday, 4 June 2018, 09:00–17:00

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

Tutorial 7

Reliability of Si and SiC Power Devices and Packages

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 reliability of IGBTs and wide bandgap devices. He is one of the authors of the book »Semiconductor Power Devices – Physics, Characteristics, Reliability«, published by Springer 2011.

Content

Focus is on thermal problems and other lifetime-limiting mechanisms in power devices, aspects going from Si to SiC are considered.

1. Basic architecture of Si and SiC power modules and discrete packages
2. Materials, substrates and interconnection technologies
3. Heat transport, thermal resistance, thermal impedance, cooling methods
4. Temperature determination
→ Virtual junction temperature: Definition, measurement
→ Temperature sensitive electrical parameters in Si, SiC, GaN
5. Fatigue processes, fatigue detection, related tests
6. Power cycling as main method to determine package related lifetime expectation
→ Experimental setup, test strategies
→ Test according to the German automotive standard LV 324
→ New methods for state-of-health analysis
7. Empirical models for lifetime prediction
→ LESIT model, CIPS 2008 model
→ Application of available models, limits, work on new models
→ Special aspects with SiC devices
→ Special aspects with discrete packages
→ First results with GaN devices
8. Improved technologies and future trends for increased lifetime expectation
→ Diffusion sintering, Diffusion soldering
→ Improved bond wires
→ Improved substrates
9. Gate oxide reliability in Si and SiC
10. Some aspects on cosmic ray reliability
→ Cosmic ray sources
→ Failure pattern
→ Failure mechanism
→ Comparison SiC devices and Si devices

Who should attend?

Engineers in design of converters with IGBTs and SiC devices with interest in reliability, beginners as well as experienced engineers are welcome.

Tutorial 8

Reliability Engineering in Power Electronics Systems

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

About the instructor

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 has contributed more than 350 journal papers. Among other awards, Dr. Blaabjerg received the IEEE William E. Newell Power Electronics Award in 2014.

Francesco Iannuzzo is currently a Professor of Reliable Power Electronics at the Aalborg University, Denmark, and CORPE (Center of Reliable Power Electronics). His research interests are in the field of reliability of power devices, including against cosmic rays, power device failure modelling and testing of power modules under extreme conditions. He has contributed more than 160 journal and conference papers in the field. Prof. Iannuzzo was the Technical Chair in two editions of ESREF, the European Symposium on Reliability and Failure analysis, and is the ESREF 2018 general chair.

Huai Wang is currently an Associate Professor with the Center of Reliable Power Electronics (CORPE), Aalborg University, Denmark. His research addresses the fundamental challenges in modelling and validation of power electronic component failure mechanisms, and application issues in system-level predictability, circuit architecture, and robustness design, and condition monitoring. Prof. Wang received the IEEE PELS Richard.

Content

In many mission-critical applications of energy conversions such as renewables, industry, electric vehicles, and aircrafts, etc., 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 systems need to be accurately built, and both 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 basics about reliability engineering are presented, followed by a specific section on abnormal condition testing, and another one on condition monitoring and active thermal control. Based on these results, a series of new modelling 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 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

→ Introduction to reliability basics
- Reliability basics, Weibull distribution, Failure rates, Bx lifetime, Reliability block diagrams
- Concepts of FMEA, HALT, CALT, Six sigma design, etc.
- Mission profiles and case studies

→ Reliability prediction of power electronic converters – case studies
- Six-step system-level reliability prediction approach for power electronic converters
- Reliability prediction for model based power electronic converter design
- CORPE Design for Reliability and Robust (DfR2) tool platform for case studies

→ Condition monitoring and active thermal control for improved reliability
- Basics ideas and control freedoms
- Thermal measurement and monitoring
- Control under normal operations of converter
- Control under severe and abnormal conditions

→ Abnormal condition testing basics for power electronic components
- Impact of severe and abnormal events on the reliability performances
- Basic of instabilities and related phenomena
- Instabilities during short circuit of IGBTs
- Non-destructive testing technique and setups

→ 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 modelling aspects from components to system level.

Tutorial 9

Magnetic Components - The Key to Future Power Electronic Circuits

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 has been at the National University of Ireland, Galway since 1991. He is a Life 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 2014-2017. He has co-authored a text book on magnetic component design for power electronics.

Werner Hugo Wölfle 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. Dr. Wölfle has co-authored a text book on magnetics for power electronics.

Content

Developments in power semiconductor devices naturally lead to higher frequency operation in the host circuit and this in turn means smaller magnetic components. The advent of GaN and SiC devices has accelerated the movement to resonant circuits for power conversion. High frequency operation of magnetic components means that additional losses occur: skin effect, proximity effect in windings and fringing effect around air-gaps. This tutorial will address all of these effects offering both analysis and practical solutions to mitigate any losses that arise.Losses for both sinusoidal and non-sinusoidal operation will be covered.

This tutorial is based on a textbook authored by the speakers: TRANSFORMERS AND INDUCTORS FOR POWER ELECTRONICS: Theory, Design and Applications, Wiley, 2013.

Outline of the Tutorial

→ 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, pushpull and LLC resonant converters; filter chokes. Examples with both distributed and discrete gaps will be presented.

→ 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. Optimised design for core and winding losses will be fully covered taking into account the additional losses at high frequency. 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 robust and simplified approach to high frequency losses will be presented to optimise the winding design. Losses that result from fringing effect of the magnetic field around an air-gap will be covered. The use of litz wire for mitigating skin and proximity effects will be treated. The application of interleaving to reduce proximity effects will be explained.

Who should attend?

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

Awards

Best Paper Award

pcim Europe
Best Paper Award
FINALIST

The Best Paper Award honours the best paper of the conference.

The finalists are:

25 kW High Power Resonant Inverter Operating at 2.5 MHz with SiC SMD Phase-Leg Modules
Fabian Denk, Christoph Simon, Santiago Eizaguirre, Michael Heidinger, Rainer Kling, Wolfgang Heering, Karlsruhe Institute of Technology (KIT), D; Karsten Haehre, Porsche Engineering, D

Reducing the dv/dt of Motor Inverters by a Two Leg Resonant Switching Cell
Thomas Fuchslueger, Hans Ertl, Technical University of Vienna, AT; Markus Vogelsberger, Bombardier Transportation, AT

Plasma-induced Diode Short-Circuit in Neutral-Point-Clamped Converters
David Hammes, Jan Fuhrmann, Robin Schrader, Sidney Gierschner, Hans-Günter Eckel, University of Rostock, D; Dietmar Krug, Siemens Industry, D

High Dynamic Stress on SiC Trench MOSFET Body Diodes and their Behaviour
Andreas März, Mark-M. Bakran, University of Bayreuth, D

Diagnostic Technique for Traction Motor Insulation Condition Monitoring by Transient Signal Assessment
Markus Vogelsberger, Bombardier Transportation Austria, AT; Clemens Zöller, Hans Ertl, Thomas M. Wolbank, Technical University of Vienna, AT; Martin Bazant, Bombardier Transportation, CH

Highly Integrated Two-Phase SiC Boost Converter with 3D Printed Fluid Coolers and 3D Printed Inductor Bobbins
Arne Hendrik Wienhausen, Alexander Sewergin, Rik W. de Doncker, RWTH Aachen, D

This award is sponsored by:

POWER ELECTRONICS EUROPE

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Young Engineer Award

pcim Europe
Young Engineer Award
FINALIST

The Young Engineer Award goes to the three best lectures from engineers not older than 35 years.

The finalists are:

25 kW High Power Resonant Inverter Operating at 2.5 MHz with SiC SMD Phase-Leg Modules
Fabian Denk, Christoph Simon, Santiago Eizaguirre, Michael Heidinger, Rainer Kling, Wolfgang Heering, Karlsruhe Institute of Technology (KIT), D; Karsten Haehre, Porsche Engineering, D

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Highly Integrated Two-Phase SiC Boost Converter with 3D Printed Fluid Coolers and 3D Printed Inductor Bobbins
Arne Hendrik Wienhausen, Alexander Sewergin, Rik W. de Doncker, RWTH Aachen, D

Applying the 2D-Short Circuit Detection Method to SiC MOSFETs Including an Advanced Soft Turn Off
Patrick Hofstetter, Stefan Hain, Mark-M. Bakran, University of Bayreuth, D

New 6.5kV 1000A IGBT Module with Side Gate HiGT
Hiroyuki Koguchi, Taiga Arai, Takayuki Kushima, Tatsuya Matsumoto, Hiroki Kawano, Takahiro Saiki, Tetsuo Oda, Hitachi Power Semiconductor Device, J; Masaki Shiraishi, Hitachi, J

High Efficiency Three-Level Simplified Neutral Point Clamped (3L-SNPC) Inverter with GaN-Si Hybrid Structure
Alexander Lange, Jennifer Lautner, Bernhard Piepenbreier, Friedrich-Alexander-University Erlangen, D

Control Scheme for Wide-Bandgap Motor Inverters with an Observer-Based Active Damped Sine Wave Filter
Franz Maislinger, Hans Ertl, Technical University of Vienna, AT; Goran Stojcic, Florian Holzner, Christoph Lagler, Bernecker + Rainer Industrie Elektronik, AT

Common- and Differential-Mode Separators Including the FM Broadcasting Band
Karl Oberdieck, Jérôme Gossmann, Andreas Bubert, Rik W. de Doncker, RWTH Aachen, D

Novel Thyristor-Based Pulsed Current Converter for a Medical Application – a Conceptual Introduction
Stefan Wettengel, Lars Lindenmüller, Steffen Bernet, Technical University of Dresden, D; Florian Kroll, Florian-Emanuel Brack, Helmholtz-Zentrum Dresden - Rossendorf, D; Jörg Pawelke, OncoRay - Nationales Zentrum für Strahlenforschung in der Onkologie, D

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Keynotes

Speaker:
Drazen Dujic, Power Electronics Laboratory, EPFL, CH
Chairperson:
Leo Lorenz, ECPE, D

Tuesday, 05 June 2018

Electric Vehicles Charging - An Ultrafast Overview

Electric vehicles charging infrastructure, its costs, availability and performances represent very important factors that will directly impact smoothness of mobility transition and is wider deployment. There are varieties of the electrical vehicles charging technologies, standards, requirements, different technological approaches and different charging levels (both in power and time). The keynote will cover the broad topic of electric vehicles charging and provide an overview of the past and present developments as well as future trends in this field.

Speaker:
Petar J. Grbovic, Huawei Technologies, D
Chairperson:
Jose Mario Pacas, University of Siegen, D

Wednesday, 06 June 2018

New Passive Devices in Power Conversion - Nice to Have or a MUST?

Power electronics play significant role in industrial applications, power generation, home appliance, transportation, etc., etc. Until today, significant research effort has been made in the field of power semiconductors and control circuitry. However, somehow minor research effort has been made in the field of passive devices. The Key Note will address the need to invest more in Passive Devices: Magnetic material for medium, high and very high frequencies, capacitors for very high current applications, system integration, passive current sensors and PCB integration.

Speaker:
Markus Billmann, Fraunhofer Institute IISB, D
Chairperson:
Philippe Ladoux, University of Toulouse, F

Thursday, 07 June 2018

Modular Multilevel Submodules for Converters, from the State of the Art to Future Trends

Modular Multi Level Converters have become a mature and proven technology. This paper describes the need for a next step which should be standardization for the submodules of an MMC converter. A submodule that will combine recent topology improvements with latest available semiconductors is described. As it is difficult to pick one of the actual global players to set one new standard, an option to solve such political challenges is also identified.

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Conference Tuesday, 5 June 2018

Morning Oral Sessions

09:00 **Room Brüssel 1** Conference Opening and Award Ceremony

09:45 **Room Brüssel 1** **Keynote »Electric Vehicles Charging – An Ultrafast Overview«**
Drazen Dujic, Power Electronics Laboratory, EPFL, Switzerland

10:30 **Coffee Break**

Room Brüssel 1
Special Session: Advanced Solutions for Charging of Electric Vehicles

Chairperson: Alfred Rufer, EPFL, CH

11:00
85kHz Band Wireless Charging System for EV or Electric Bus
Akihisa Matsushita, Toshiba, J

11:25
Advanced Vehicle Charging Solutions Using SiC and GaN Power Devices
Bernd Eckardt, Fraunhofer Institute IISB, D

11:50
System Architectures for Multiple Ports, Bidirectional and Buffered Charging Unit for EV's
Alfred Rufer, EPFL, CH

Room Brüssel 2
Special Session: Materials for Packaging and Thermal Management

Chairperson: Peter Kanschat, Infineon Technologies, D

11:00
Development of High Temperature Gels
Makoto Ohara, Shin-Etsu Silicones Europe, D

11:25
Silicone Gels for Continuous Operation up to 200C in Power Modules
Thomas Seldrum, Dow Chemicals Company, BE

11:50
High Temperature Encapsulation for Smart Power Devices
Karl-Friedrich Becker, Fraunhofer-Institute IZM, D

12:15
Next-Generation PPS Grades for Power Module Applications
Christian Schirmer, Yuki Ota, Toray Resins Europe, D

Room München 1
SiC based Power Module

Chairperson: Manfred Schlenk, Infineon Technologies, D

11:00
New SiC 1200V Power MOSFET & Compact 3.25 m?, 41mm Power Module for Industrial Applications
Jeffrey Casady, Ty McNutt, Brett Hull, John Palmour, Wolfspeed - A Cree Company, USA

11:25
A Wire-bond-less 10 kV SiC MOSFET Power Module with Reduced Common-mode Noise and Electric Field
Christina DiMarino, Dushan Boroyevich, Rolando Burgos, Center for Power Electronics Systems Virginia Tech, USA; Bassem Mouawad, Robert Skuriat, Mark Johnson, University of Nottingham, UK

11:50
Enhanced Breakdown Voltage and High Current of All-SiC Modules with 1st Generation Trench Gate SiC MOSFETs
Motohito Hori, Masayoshi Nakazawa, Fuji Electric, J; Thomas Heinzel, Fuji Electric Europe, D

12:15
Highly Integrated SiC-power Modules for Ultra-Fast Lithium Ion Battery Chargers in LLC-Topology
Thomas Blank, Bao Ngoc An, Dominik Bauer, Matthias Luh, Marc Weber, Karlsruhe Institute of Technology, D; Dai Ishikawa, Hitachi Chemical, J

Room München 2
Traction Inverters

Chairperson: Daniel Chatroux, CEA-LITEN, F

11:00
Effects of a SiC TMOSFET Tractions Inverters on the Electric Vehicle Drivetrain
Alexander Nisch, Daimler, D

11:25
Highly Integrated Traction Inverter for a Modular Drive Concept
Ulf Schümann, Jasper Schnack, Ronald Eisele, Dominik Hilper, University of Applied Sciences Kiel, D; Christian Mertens, Patrick Heumann, Volkswagen, D; Hans-Jürgen Schliwinski, Malte Päsler, Jörn Hinz, Fraunhofer Institute ISIT, D; Mathias Kamprath, Annika Zastrow, Vishay Siliconix Itzehoe, D; Holger Beer, Frank Osterwald, Danfoss Silicon Power, D; Thomas Ebel, Sven Brückner, FTCAP, D; Hagen Reese, Sergej Schikowski, Reese und Thies, D

11:50
Automotive Traction Inverter Utilizing SiC Power Module
Masaharu Nakanishi, Aly Mashaly, Guenter Richard, ROHM Semiconductor, D

12:15
Novel Approach of Integrated Motor-Inverter Power Module for 48V Mild Hybrid Starter and Generator (MHSG)
Jihwan Seong, Sang Won Yoon, Min Ki Kim, Jangmook Lim, Hobeom Han, Hanyang University, ROK; Semin Park, Hyunkyu Choi, Yucheol Park, Pilkyoung Oh, Sang Min Kim, Taesuk Kwon, Hyundai Mobis, ROK

Room Mailand
Intelligent Motion

Chairperson: Manfred Schrödl, Vienna University of Technology, AT

11:00
Decentralized Control of a Twelve-Phase PMSM
Oliver Dieterle, Thomas Greiner, University of Applied Sciences Pforzheim, D

11:25
Computationally Efficient Predictive Direct Torque Control Strategy for PMSGs Without Weighting Factors
Mohamed Abdelrahem, Hisham Eldeeb, Christoph Hackl, Ralph Kennel, Technical University of Munich, D; Jose Rodriguez, University Andres Bello, CL

11:50
Switching Frequency Control for a DS-PWM
Axel Klein, Malte Thielmann, Walter Schumacher, Technical University of Braunschweig, D

12:15
Improvements on a Sensorless Controlled Synchronous Reluctance Machine Down to Standstill
Mario Nikowitz, Manfred Schrödl, Technical University of Vienna, AT

12:40 **Lunch Break**

Conference Tuesday, 5 June 2018

Afternoon Oral Sessions

Room Brüssel 1
SiC Devices I

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

14:00
A 3.3 kV/800 A Ultra-High Power Density SiC Power Module
Takashi Ishigaki, Seiichi Hayakawa, Tatunori Murata, Koyo Kinoshita, Tetsuo Oda, Yuji Takayanagi, Hitachi Power Semiconductor Device, J; Toru Masuda, Hiroshi Miki, Ryusei Fujita, Akio Shima, Hitachi, J

14:25
Mission Profile Analysis of a 1200V Silicon-Carbide Trench-MOSFET Module for Automotive Traction Inverter Applications
Ajay Poonjal Pai, Tomas Reiter, Infineon Technologies, D; Martin März, Fraunhofer Institute IISB, D

14:50
Applying the 2D-Short Circuit Detection Method to SiC MOSFETs Including an Advanced Soft Turn Off
Patrick Hofstetter, Stefan Hain, Mark-M. Bakran, University of Bayreuth, D

pcim Europe
Young Engineer Award
FINALIST

Room Brüssel 2
Advanced Packaging Technologies I

Chairperson: Masahito Otsuki, Fuji Electric, J

14:00
Investigation of Ton Dependency of Al-Clad Cu Bond Wires Under Power Cycling Tests
Nan Jiang, Josef Lutz, Technical University of Chemnitz, D; Benjamin Fabian, Marko Kalajica, Heraeus, D

14:25
System Cost Reduction with Integration of Shunts in Power Modules in the Power Range Above 75 kW
Klaus Vogel, Infineon Technologies, D

14:50
Cost Effective Direct-Substrate Jet Impingement Cooling Concept for Power Application
Bassem Mouawad, Robert Abebe, Robert Skuriat, Jianfeng Li, Liliana De Lilo, Lee Empringham, Mark C. Johnson, University of Nottingham, GB; Andy Roberts, Robert Clarke, RAM Innovation, GB, Geoff Haynes, Inspirit Ventures, GB

Room München 1
Power Electronics Topologies

Chairperson: Francisco Javier Azcondo, University of Cantabria, E

14:00
Protection Schemes in Low-Voltage DC Shipboard Systems
Seongil Kim, Drazen Dujic, EPFL - Ecole polytechnique fédérale de Lausanne, F; Soo-Nam Kim, Hyundai Electric & Energy Systems, ROK

14:25
Power Stage and Control Design of A 60-kV 60-kW Switching-mode Power Supply for Industrial Electrostatic Precipitators
Shengwen Fan, Yiqin Yuan, Zhenyu Shan, Pengyu Jia, Zhengxi Li, Yinghong Li, North China University of Technology, CN

14:50
Design and Characterization of a Full-SiC 80 kW Current Source Inverter for Photovoltaic Applications
Luis Gabriel Alves Rodrigues, Jérémy Martin, Anthony Bier, Stéphane Catellani, Commissariat à l'Énergie Atomique et aux Énergies Alternatives, F; Jean-Paul Ferrieux, University Grenoble Alpes, F

Room München 2
Multi-Level Converters

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

14:00
Modular Multilevel Converters as Active Filters to Mitigate Low Frequency Current Harmonics in Converter Fed Grid Applications
Dennis Bräckle, Stefan Mersche, Mathias Schnarrenberger, Patrick Himmelmann, Marc Hiller, Karlsruhe Institute of Technology (KIT), D

14:25
MMC-Based High Power DC-DC Converter Employing Scott Transformer
Stefan Milovanovic, Drazen Dujic, Power Electronics Laboratory, EPFL, CH

14:50
Experimental Validation of Three-Level Advanced-Active-Neutral-Point-Clamped Converter for Grid Operation
Sidney Gierschner, Felix Kayser, David Hammes, Yves Hein, Hans-Günter Eckel, University of Rostock, D; Diemtar Krug, Siemens Industry, D

Room Mailand
Energy Storage

Chairperson: Silvio Colombi, General Electric, CH

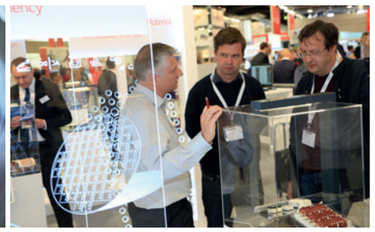
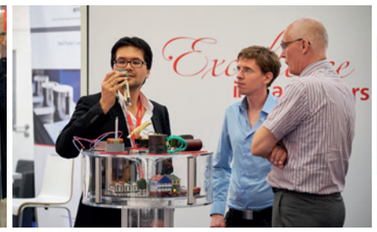
14:00
Megawatt Scale Li-Ion Batteries Mounted in Opposition to Save Power During Test
Younès Jaoui, Philippe Laflaquiere, SAFT, F

14:25
A Battery Cell Emulator for Hardware in the Loop Tests of Reconfigurable Lithium-Ion and Post-Lithium Batteries
Simon Bischof, Cem Kücük, Thomas Blank, Marc Weber, Karlsruhe Institute of Technology (KIT), D

14:50
Combined Sensor Minimal Cell-Monitoring and Active Inductive or Capacitive Cell-Balancing
Constantinos Sourkounis, Philip Dost, Ruhr-University of Bochum, D

15:15 **Coffee break**

15:15 **Foyer Entrance NCC Mitte** Poster / Dialogue Session


Conference Tuesday, 5 June 2018, Poster / Dialogue Session Foyer

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

MOSFET and IGBT

Chairperson: Gourab Majumdar, Mitsubishi Electric, J

A New MOSFET Intelligent Power Module for Low Power Motor Drive Applications
Jaewook Lee, Junbae Lee, Daewoong Chung, Infineon Technologies Power Semitech, ROK

High Voltage Semiconductor Switch on the Base Of RCRSD for Bipolar Power Current Pulse Commutation
Alexey Grishanin, Alexey Khapugin, Valentin A. Martynenko, Viacheslav Muskatinev, Vyacheslav Eliseev, Electrovipryamitel JSC, RU; Sergey Korotkov, Ioffe Physico-Technical Institute, RU; Igor Galakhov, Vladimir Osin, Institute of Laser-Physical Researches, RU

IGCT Switching Behaviour Under Low Current Conditions
Dragan Stamenkovic, Drazen Dujic, EPFL - Ecole Polytechnique Fédérale de Lausanne, CH; Umamaheswara Reddy Vemulapati, Munaf Rahimo, ABB Switzerland, CH

LV100 High Voltage Dual Package in Paralleling Operation
Ryo Tsuda, Nils Soltau, Eugen Wiesner, Eugen Stumpf, Eckhard Thal, Mitsubishi Electric Europe, D; Kenji Hatori, Shinichi Iura, Mitsubishi Electric, J

MOSFET Technologies for Auxiliary DC-DC Converters
Filippo Scrimizzi, Filadelfo Fusillo, STMicroelectronics, I

Evaluation of Miller Capacitance Depending on Drain-Source Voltage when SJ HV Power MOSFETs are in Reverse Mode
Carmelo Parisi, Domenico Murabito, Antonio Gaito, Valeria Cinnera Martino, Yosef Damante, Antonio Giuseppe Grimaldi, STMicroelectronics, I; Giuseppe Consentino, University of Calabria, I

Dynamic Current Sharing and Gate Feedback During Turn-OFF of Paralleled IGBTs
Robin Schrader, Patrick Münster, Hans-Günter Eckel, University of Rostock, D

SuperJunction Power Device Evolution: Characteristics Analysis and Performance Comparison of MDmesh™ M2 and MDmesh™ M6 Technologies
Antonino Gaito, Maurizio Melito, Santina Leo, STMicroelectronics, I

Characterization of Voltage Divergence in Series Connected SiC Trench MOSFETs and Si IGBTs
Zarina Davletzhanova, Olayiwola Alatise, Jose Ortiz Gonzalez, Tianxiang Dai, Roozbeh Bonyadi, University of Warwick, GB

SiC and Silicon MOSFET Solution for High Frequency DCAC Converters
Luigi Abbatelli, Gianluca Stella, Giuseppe Catalisano, STMicroelectronics, I

Short Circuit Robustness Improvement by FEM Simulation on IGBT
Daniela Cavallaro, Rosario Greco, Gaetano Bazzano, STMicroelectronics, I

A New Combined VGE and VCE Based Short-Circuit Detection for High-IC,desat HV-IGBTs and RC-IGBTs
Julian da Cunha, David Hammes, Jan Fuhrmann, Daniel Lexow, Hans-Günter Eckel, University of Rostock, D

SiC Devices

Chairperson: Serge Bontemps, Microsemi PMP, F

Analog Based High Efficiency 2KW Totem Pole PFC Converter Using Surface Mount SIC MOSFET's
Jianwen Shao, Guy Moxey, Cree, USA; Binod Agrawal, Venkata Subash Bathula, Navneet Mangal, Cree, IN; Jianwen Shao, Wolfspeed, USA

Switching Pattern and Performance Characterization for »SiC+Si« Hybrid Switch
Haihong Qin, Nanjing University of Aeronautics and Astronautics, CN

Driver Integrated Fault-Tolerant Reconfiguration after Short-On Failures of a SiC MOSFET ANPC Inverter Phase
Michael Gleißner, Teresa Bertelshofer, Mark-M. Bakran, University of Bayreuth, D

SiC Effect on Surge Voltage Distribution in Large Electrical Machines
Robert Maier, Mark-M. Bakran, University of Bayreuth, D

Junction Temperature Measurement of SiC MOSFETs: Straightforward as it Seems?
Tobias Kestler, Mark-M. Bakran University of Bayreuth, D

In-Depth Study of Short-Circuit Robustness and Protection of 1200V SiC MOSFETs
Xuning Zhang, Gin Sheh, Levi Gant, Sujit Banerjee, Monolith Semiconductor, USA

Avalanche Rugged Low On-Resistance 1200V SiC MOSFETs With Excellent Long-Term Stability
Kwangwon Lee, ON Semiconductor, KR, Martin Domeij, Jimmy Franchi, Benedetto Buono, Fredrik Allerstam, ON Semiconductor, SE; Thomas Neyer, ON Semiconductor, D

High Performance 4H-SiC MOSFETs with Optimum Design of Active Cell and Re-Oxidation Process
Toshikazu Tanioka, Yuji Ebiike, Yasunori Oritsuki, Masayuki Imaizumi, Masayoshi Tarutani, Mitsubishi Electric Corporation, J

Derating of Parallel SiC MOSFETs Considering Switching Imbalances
Teresa Bertelshofer, Andreas März, Mark-M. Bakran, University of Bayreuth, D

Commutation Characteristics During Switching of Hybrid SiC and Si Configurations
Michael Schütt, Hans-Günter Eckel, University of Rostock, D

Current Sharing During Unipolar and Bipolar Operation of SiC JBS Diodes
Thomas Barbieri, Adam Barkley, James Solovey, Edward van Brunt, Edgar Ayerbe, Wolfspeed - a Cree Company, USA

Ruggedness Behavior of SiC JBS Diodes and SiC MOSFET Body Diodes Under Extreme Short Circuit Conditions
Mehrdad Baghaie Yazdi, Thomas Neyer, ON Semiconductor Germany, D; Andrei Konstantinov, Martin Domeij, ON Semiconductor, SE

GaN Devices and Applications

Chairperson: Chris Rexer, ON Semiconductor, USA

Application of GaN-GITs in a Single-Phase T-Type Inverter
Carsten Kuring, Jan Böcker, Sibylle Dieckerhoff, Technical University of Berlin, D

S-Parameters Characterization of GaN HEMT Power Transistors for High Frequency Modeling
Loris PACE, Arnaud Videt, Nadir Idir, University of Lille - L2EP, F; Nicolas Defrance, Jean-Claude Dejaeger, IEMN

650V E-Mode GaN HEMT Switching at 1MHz for Travel Adapter Application
Ann Starks, ON Semiconductor, USA

Power p-GaN HEMT Under Unclamped Inductive Switching Conditions
Juraj Marek, Alexander Šatka, Martin Jagelka, Aleš Chvála, Patrik Príbytný, Martin Donoval, Daniel Donoval, Slovak Technical University in Bratislava, SK

Designing High-Density Power Solutions with GaN
Paul Brohlin, Masoud Beheshti, Texas Instruments, USA

Inverse Thermal Model of Temperature-to-Power Mapping for GaN Systems
Shuangfeng Zhang, Eric Laboure, University of Paris, F; Denis Labrousse, Stéphane Lefebvre, ENS Cachan – SATIE, F

High Performance Thermal Solution for High Power GaN FET Based Power Converters
Michael de Rooij, Yuanzhe Zhang, David Reusch, Efficient Power Conversion (EPC) Corporation, USA; Sriram Chandrasekaran, Raytheon, USA

Wafer Level Embedding Technology for Packaging of Planar GaN Half-Bridge Module in High Power Density Conversion Applications
Charles-Alix Manier, Kirill Klein, Hermann Oppermann, Klaus-Dieter Lang, Fraunhofer-Institute IZM, D; Sophie Andzouana, Radoslava Mitova, Schneider Electric, F

Monolithic GaN Power ICs Enable High Density High Frequency 3.2KW AC-DC Rectifier
Tom Ribarich, Navitas Semiconductor, USA; Ruiyang Yu, Qingyun Huang, University of Texas at Austin, USA

Experimental Study on Gate Driver Influences to the 650V GaN E-HEMT
Zhang Yi, Teng Liu, Yifan Tan, Chai Chen, Yong Kang, Huazhong University of Science and Technology, CN

SiC Power Modules

Chairperson: Romeo Letor, STMicroelectronics, IT

Switching Behavior of SiC-MOSFETs in High Power Modules
Florian Störmer, Hans-Günter Eckel, University of Rostock, D; Franz-Josef Niedernostheide, Frank Pfirsch, Infineon Technologies, D

The Challenges of Using SiC MOSFET-Based Power Modules for Solar Inverters
Matthias Tauer, Vincotech, D

Low Inductive SiC Power Module Design Using Ceramic Multilayer Substrates
Thomas Huber, Alexander Kleimaier, University of Applied Sciences Landshut, D; Sebastian Polster, Olivier Mathieu, Rogers, D

Very Low Stray Inductance, High Frequency 1200V_ 2 mOhms SiC MOSFET Phase Leg Module
Serge Bontemps, Pierre Laurent Doumergue, Microsemi Power Module Products, F

Comparative Study of Full SiC Power Module in 1MHz, 600V, 50A Switching Operation
Kei Hayashi, Tsuyoshi Funaki, Osaka University, J; Hisato Michikoshi, Kenji Fukuda, National Institute of Adavnced Industrial Science and Technology, J

3.3kV SiC Hybrid Module with High Power Next Core (HPnC) Package
Lukas Kleingrothe, Thomas Heinzel, Fuji Electric, D; Yusuke Sekino, Susumu Iwamoto, Akira Iso, Hideaki Kakiki, Yuichi Harada, Osamu Ikawa, Fuji Electric, J

High Reliable 1700V Full SiC Power Module
Kenji Hayashi, Yoshihisa Tsukamoto, ROHM, J

Analysis of 1200 V Si-SiC-Hybrid Switches for Resonant Applications
Michael Meissner, Sebastian Fahlbusch, Daniel Lüthke, Klaus Hoffmann, Helmut-Schmidt-University of the Federal Armed Forces Hamburg, D

Simulation Based Design of SiC MOSFET Power Modules for EV/HEV Traction Inverter Applications with Test Validation
Roy Davis, Yifan Xiao, John Grabowski, Younhee Lee, ON Semiconductor, USA

Sintering Cu Paste Die-Attach for High TJ Power Devices
Shijo Nagao, Yue Gao, Osaka University, J

Advanced Power Modules

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

Influence of Auxiliary Gate and Emitter Connections on Short Circuit Behaviour of Multichip IGBT Modules
Helong Li, Chunlin Zhu, Paul Mumby-Croft, Daohui Li, Yangang Wang, Xiaoping Dai, Dynex Semiconductor, GB

Impact of I2t Capability of RC-IGBT and Leadframe Combined Structure in xEV Active Short Circuit Survival
Hayato Nakano, Akihiro Osawa, Keiichi Higuchi, Kitamura Akio, Fuji Electric, J

New Developed 3.3kV/1500A IGBT Module
Daohui Li, Xiaoping Dai, Yangang Wang, Fang Qi, Matthew Packwood, Paul Mumby-Croft, Wei Zhou, Helong Li, Dynex Semiconductor, GB

Newly Developed 7th Generation 1,700V IGBT Module Product Family for Industrial Application
Takuya Yamamoto, Shinichi Yoshiwatari, Osamu Ikawa, Souichi Okita, Fuji Electric, J; Thomas Heinzel, Fuji Electric, D

Analytical Modelling of Dynamic Power Losses Inside Power Modules for 2-Level Inverters
Arne Bieler, Ole Mühlfeld, Danfoss Silicon Power, D

Failure Protection in Power Modules with Auxiliary-Emitter Bond-Wires
Nick Baker, Francesco Iannuzzo Aalborg University, DK

An Efficient Active Mains Rectifier Bridge Based on Bipolar Technology
Nick Koper, WeEn Semiconductors, NL

Development of New 600V Smart Power Module for Home Appliances Motor Drive Application
Samuell Shin, Bumseung Jin, Kinam Song, Sewoong Oh, Thomas Yim, ON Semiconductor, ROK

DC-DC Converters

Chairperson: Ionel Dan Jitaru, Rompower, USA

Implementation of an Adaptive Dead Time in Resonant Converters
Christian Oeder, Nikolas Foerster, Thomas Dürbaum, Friedrich-Alexander-University of Erlangen, D

Modified Basic DC-DC Converters
Felix Himmelstoss, Karl Edelmoser, Technikum Vienna, AT

GaN Based Multilevel Intermediate Bus Converter for 48 V Server Applications
David Reusch, Efficient Power Conversion (EPC) Corporation, USA

A FPGA-Based Algorithm for Soft Switched DC-DC Converters with a Variable Transmission Path
Lukas Göbel, Ansgar Ackva, Sebastian Raab, University of Applied Sciences Würzburg-Schweinfurt, D

Compact Bidirectional GaN Buck-Boost Converter for Negative Rail Supply in Bipolar DC-Grids
Sebastian Klötzer, Sebastian Fahlbusch, Ulf Müter, Klaus Hoffmann, Helmut Schmidt University of the Federal Armed Forces Hamburg, D

Exact Analytical Solution of the Peak Gain for the LLC Resonant Converter
Markus Barwig, Christian Oeder, Manfred Albach, Friedrich-Alexander-University of Erlangen, D

GaN Buck Converter in CCM with Optimized High Frequency Inductors
Sven Bolte, Joachim Böcker, University of Paderborn, D

Modelling of a Bi-Directional Converter from a Power Supplying System With Application in Radio Communication Systems
Ivan Nedyalkov, University of Telecommunications and Post, BG; Dimitar Arnaudov, Nikolay Hinov, Technical University of Sofia, BG

A Bidirectional Quasi-Z-Source Based DC-DC Converter
Yuba Raj Kafle, Graham Town, Macquarie University, AU

Traction, Ship, Aircraft

Chairperson: Gianmario Pellegrino, Politecnico di Torino, IT

Humidity in Traction Converters
Fabian Quast, Andreas Nagel, Siemens, D

New Traction Converter with Low Inductive High-Voltage Half Bridge IGBT Module
Bernd Laska, Jan Weigel, Siemens, D; Sven S. Buchholz, Waleri Brekel, Matthias Wissen, Infineon Technologies, D; Patrick Münster, Till-Mathis Plötz, Hans-Günter Eckel, University of Rostock, D

Nanocrystalline Cores for Common Mode Current Suppression in Electrical Ship Propulsion System - a Case Study
Wulf Günther, Acal BFi Germany, D

Discrete 1200V SiC MOSFETs - SMD Package Benefits and Impacts of Multiple Device and Circuit Parameters Mismatch in High Power Parallel Applications
Rajagopalan Jagannathan, Hans-Peter Hoenes, Tushar Duggal, Marco Atzeri, ON Semiconductor Germany, D

High-Dynamic High-Power E-Motor Emulator for Power Electronic Testing
Sebastian Liebig, SET Power Systems, D

New Approach of Smart Hybrid Power Module Dedicated to Aircraft Electro-Mechanical Actuators up to 20 kW
Alain Calmels, Julien Richer, Microsemi Power Module Products, F; Shane O'Donnell, Microsemi, IR

pcim Europe Best Paper Award FINALIST

Diagnostic Technique for Traction Motor Insulation Condition Monitoring by Transient Signal Assessment
Markus Vogelsberger, Bombardier Transportation Austria, AT; Clemens Zöller, Hans Ertl, Thomas M. Wolbank, Technical University of Vienna, AT; Martin Bazant, Bombardier Transportation, CH

Conference Tuesday, 5 June 2018, Poster / Dialogue Session Foyer

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

Control, Intelligent Motion

Chairperson: Peter Wallmeier, Delta Energy Systems, D

Modelling of Inverter Nonlinear Effects
Anton Tamas, Simon Wiedemann, MACCON, D; Ralph Kennel, Technical University of Munich, D

Self-Commissioning of the Current Control Loop in AC Drives
Simon Wiedemann, MACCON, D; Ralph Kennel, Technical University of Munich, D

Sensorless Position Estimation for an Externally Excited Synchronous Machine over the Whole Speed Range
Johannes Schuster, Vasken Ketchedjian, Jörg Roth-Stielow, University of Stuttgart, D

VSI with Sinusoidal Voltages for an Enhanced Sensorless Control of the Induction Machine
Harith Al-Badrani, Simon Feuersänger, Mario Pacas, University of Siegen, D

Simplified Wide Speed-Range Sensorless Control Scheme for a PMSM
Van Trang Phung, Mario PacasUniversity of Siegen, D

A Stacked 7-Level Common Mode Voltage Eliminated Inverter Scheme with Single DC-link for Open-End Induction Motor Drive
Apurv Kumar Yadav, Gopakumar Kumarukuttan Nair, Krishna Raj Ramachandran Potti, Umanand Loganathan, Indian Institute of Science, IN; Kouki Matsuse, Hisao Kubota, Meiji University, J

Energy Optimal Motion and Rotor Flux Trajectories for an Induction Motor Drive
Gunar Steinborn, Wilfried Hofmann, Technical University of Dresden, D

Controller Synthesis and Testing in a 48V System Based on Physical Models
Sabin Carpiuc, MathWorks, GB

Modeling and Analyzing the Stability of an Induction Motor Drive System using an Output LC Filter
Pascal Combes, Al Kassem Jebai, Schneider Electric, F

Synchronization of Multi-Axis Motion Control Over Real-Time Networks
Jens Sorensen, Analog Devices, USA; Christian Aaen, Dara O'Sullivan, Analog Devices, IR

Lean and Fast Fieldbus based Safety Functionality for Drives in Automation
Jens Onno Krah, Adin Basic, Technical University of Cologne, D

Renewable Energy and Power Transmission

Chairperson: Philip Kjaer, Vestas Wind Systems, DK

A Sliding-Mode Observer for Encoderless Direct Model Predictive Control of PMSGs
Mohamed Abdelrahem, Philipp Catterfeld, Christoph Hackl, Ralph Kennel, Technical University of Munich, D

Wind Turbine Nacelle Test Bench Using an Optimized Torque Control and an Aerodynamic Real Time Model
Sören Behrens, Johannes Adler, Bernd Orlik, University of Bremen, D; Holger Raffel, Bremen Center of Mechatronics, D; Holger Schlöcker, SIT, D

Wind Turbine for Underground Subway Stations
Lilia Galai Dol, Jose Luis Cardassi, EFFICACITY, F; Alexandre De Bernardinis, IFSTTAR, F

Assisting Passive AI Proposal for VC-VSIs
Cristian Chillón-Antón, Marc Llonch-Masachs, Daniel Heredero-Peris, Marc Pagès-Giménez, Daniel Montesinos-Miracle, Universitat Politécnica de Catalunya CITCEA-UPC, ES

Evaluation of DC-to-DC-Converter Impedance Passivity Using Pseudo-Random Test Signals
Leopold Ott, Fraunhofer Institute IISB, D

Solving Isolation- and Power Supply Problems for Current Monitoring in High Voltage Power Line Application
Bernhard Strzalkowski, Analog Devices, D

Zero Vector Placement Strategies in Space Vector Modulation of Inverters for UPS Applications
Lorenzo Giuntini, GE Consumer & Industrial, CH

Passive Components, Sensors, Diagnostics

Chairperson: Elmar Stachorra, KoCoS Engineering, D

Advanced Solutions in Over-Current Protection of Hvdc Circuit of Battery-Powered Electric Vehicle
Mitja Koprivsek, ETI, SI

Inductive Power Transfer Systems for Rotating Applications
Nikolay Madzharov, Raycho Ilarionov, Valery Petkov, Lyudmil Petkov, Technical University - Gabrovo, BG

Coupled-Inductors Losses Modelling for Size and Weight Optimization Process Avoiding Time-Consuming Co-Simulations
Leyla Arioua, Menouar Ameziani, VEDECOM, F

Enlarging the Standard Permeability Set of Powder E-Cores by Combination of Different Perm Core-Halves
Paul Winkler, Wulf Günther, Acal BFi Germany, D

Guideline for Hysteresis Curve Measurements with Arbitrary Excitation: Pitfalls to Avoid and Practices to Follow
Erika Stenglein, Daniel Kübrich, Manfred Albach, Thomas Dürbaum, Friedrich-Alexander-University of Erlangen, D

Comparing Inductive Components for Different Boost Converter Topologies in a PV System
Michael Schmidhuber, Christian Reichhart, SUMIDA, D; Marco Jung, Fabian Schnabel, Fraunhofer Institute IWES, D

Linear Machine with a Magnetic-Coupled Structure Based on the Transverse Flux Technology
Jannik Ulbrich, Alexander Norbach, Bernd Orlik, University of Bremen, D

Wide Bandwidth Current Sensor Combining a Coreless Current Transformer and TMR Sensors
Nathan Tröster, Johannes Ruthardt, Maximilian Nitzsche, Jörg Roth-Stielow, University of Stuttgart, D

Precise Voltage Measurement for Power Electronics with High Switching Frequencies
Maximilian Nitzsche, Matthias Zehelein, Nathan Tröster, Jörg Roth-Stielow, University of Stuttgart, D

Fault Diagnosis in Frequency Inverter with Space Vector Recognition of Output Voltage
Rudolf Mecke, Harz University of Applied Sciences, D

Characterization Platform for Modular Power Converters
André Andreta, Yves Lembeye, Jean-Christophe Crébier, University Grenoble Alpes - G2Elab, F

Rare-Earth Free EV and HEV Motor Drives: State of the Art
David Cabezuelo, Edorta Ibarra, Jon Andreu, Iñigo Kortabarria, Jose Ignacio Garate, University of the Basque Country (UPV/EHU), ES

Conference Wednesday, 6 June 2018

Morning Oral Sessions

08:45 Room Brüssel 1 **Keynote »New Passive Devices in Power Conversion -Nice to Have or a Must?«**
Petar J. Grbovic, Huawei Technologies, D

09:30 Coffee Break

Room Brüssel 1
High Power IGBT Devices

Chairperson: Katsuaki Saito, Hitachi Power Semiconductor Device, J

10:00
New 6.5kV 1000A IGBT Module with Side Gate HiGT
Hiroyuki Koguchi, Taiga Arai, Takayuki Kushima, Tatsuya Matsumoto, Hiroki Kawano, Takahiro Saiki, Tetsuo Oda, Hitachi Power Semiconductor Device, J; Masaki Shiraishi, Hitachi, J

10:25
Plasma-induced Diode Short-Circuit in Neutral-Point-Clamped Converters
David Hammes, Jan Fuhrmann, Robin Schrader, Sidney Gierschner, Hans-Günter Eckel, University of Rostock, D; Dietmar Krug, Siemens Industry, D

10:50
The third generation 6.5kV HiPak2 module rated at 1000A and 150°C
Charalampos Papadopoulos, Boni Boksteen, Maxi Andenna, Elizabeth Buitrago, Samuel Hartmann, Sven Matthias, Chiara Corvasce, Arnost Kopta, Umamaheswara Reddy Vemulapati, Friedhelm Bauer, Daniel Prindle, Marco Bellini, Munaf Rahimo, ABB Switzerland, CH

11:15
Design and Development of an Integrated Power Module Used in Low Voltage DC/AC Hybrid Circuit Breaker
Kenan Askan, Michael Bartonek, Eaton Industries, AT; Klaus Sobe, Infineon Technologies, AT

11:40
New 1200 V IGBT and Diode Technology with Improved Controllability for Superior Performance in Drives Application
Christian Müller, Alexander Philippou, Christian Jäger, Max Seifert, Infineon Technologies, D; Antonio Vellei, Michael Fugger, Infineon Technologies, AT

Room Brüssel 2
Converter Design and Integration

Chairperson: Stéphane Lefebvre, SATIE, F

10:00
Fully Optimized Discrete Coupled Inductor DC/DC Converter as The TriMagiC Converter
Mitsunao Fujimoto, Yutaka Naitoh, ALPS, J

10:25
Ultra Compact 2kW 12V-48V Converter Using a 4-Phase Coupled Inductor
Patrick Deck, Christian Peter Dick, Institute for Automation Engineering/TH Köln, D

10:50
Thermal Analysis of a Directly Liquid Cooled Silicon Carbide Resonant Inverter for High Voltage Generation
Ulf Müter, Klaus Hoffmann, Helmut Schmidt University of the Federal Armed Forces Hamburg, D; Oliver Woywode, Jens Radvan, Philips Medical Systems, D

11:15
Highly Integrated Two-Phase SiC Boost Converter with 3D Printed Fluid Coolers and 3D Printed Inductor Bobbins
Arne Hendrik Wienhausen, Alexander Sewergin, Rik W. de Doncker, RWTH Aachen, D

11:40
High Step-Up High-Frequency Zero Voltage Switched GaN-Based Single-Stage Isolated DC-DC Converter for PV Integration and Future DC Grids
Armin Jafari, Elison Matioli, POWERlab, EPFL, CH

Room München 1
Control in Power Electronics

Chairperson: Walter Schumacher, Braunschweig University of Technology, D

10:00
Control Scheme for Wide-Band-gap Motor Inverters with an Observer-Based Active Damped Sine Wave Filter
Franz Maislinger, Hans Ertl, Technical University of Vienna, AT; Goran Stojcic, Florian Holzner, Christoph Lagler, Bernecker + Rainer Industrie Elektronik, AT

10:25
Adaptive Frequency Control of DC-DC-Converters for Maximum Efficiency Using Artificial Neural Network
Lukas Keuck, University of Paderborn, D

10:50
Estimation of the Excitation Current of an Externally Excited Synchronous Machine Supplied by a Two-Switch Flyback Converter
Stefan Köhler, Bernhard Wagner, Technical University of Applied Sciences Nuremberg Georg Simon Ohm, D

11:15
Adaptive and Robust Stabilization of Flyback Power Converters with Digital Control
Gaetan Beneux, Louis Grimaud, Safran, F; Pierre Riedinger, Jamal Daafouz, CRAN, F

11:40
Asymmetric Current Control of Grid Connected 3-Phase Cascaded H-Bridge Multilevel Inverter
Taha Lahlou, Technical University of Munich, D

Room München 2
Gate Driver

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

10:00
IGBT Power Stage Delay Calibration is Minimizing Current Imbalance in Large Power Modules with Isolated Multiply Segmented Paralleled Half Bridges
Sven Teuber, Marco Honsberg, Günter Katzenberger, Axel Kubitz, SEMIKRON Elektronik, D

10:25
Performance Comparison Between Voltage Source and Current Source Gate Drive Systems
Wolfgang Frank, Infineon Technologies, D; Ziqing Zheng, Infineon Technologies, CN

10:50
High-Side Driver Supply With Reduced Coupling Capacitance
Jens Friebe, Oliver Prior, SMA Solar Technology, D; Marcin Kacki, SMA Magnetics, PL

11:15
An Isolated Voltage-Source Integrated SiC Gate Driver IC with a Slew Rate Adjusting for Gate-Resistance-Free
Yasufumi Kawai, Shuichi Nagai, Noboru Negoro, Shingo Enomoto, Osamu Tabata, Songbaek Choe, Panasonic, J

11:40
A Gate Driver Approach using Inductive Feedback to Decrease the Turn-on Losses of Power Transistors
Michael Ebli, Martin Pfost, Technical University of Dortmund, D

Room Mailand
Special Session: Passive Components

Chairperson: Wolfram Teppan, LEM Intellectual Property SA, CH

10:00
Design and Optimization Method of PCB-Integrated Inductors for High-Frequency Converters
Ammar Chafi, Nadir Idir, Arnaud Videt, University of Lille - L2EP, F

10:25
Simulating the Parasitic Capacitance of Inductive Components
Stefan Schefler, Jörn Schliewe, Stefan Weber, EPCOS, D

10:50
Future Winding for Next Power Electronic Generation
Dennis Kampen, BLOCK Transformatoren-Elektronik, D

11:15
Rippel Current Determination for Inductors in a DC/DC Converter Both With and Without Magnetic Bias
Tobias Appel, Daniel Benner, STS, D

11:40
Development of Accelerated Testing of Thermal Degradation in Metallized Ceramic Substrates for SiC Power Modules
Hiroyuki Miyazaki, Hideki Hyuga, Hiroshi Sato, Hiroshi Yamaguchi, Kiyoshi Hirao, National Institute of Advanced Industrial Science and Technology (AIST), J; Shoji Iwakiri, Hideki Hirotsuru, Denka, J

12:00 Lunch Break and Supporting Program: Impulse-Presentation »Fit for Stage«, 13:00 – 13:45 Room Mailand

New!*

***Attractive supporting program**
Take advantage of the available time in the lunch break to visit the exhibition or attend the impulse-presentation entitled »Fit for Stage«. Here, Kailey Peng, EXPLAIN Presentation Coach, will introduce the principles of presenting successfully in a new and entertaining light.

Conference Wednesday, 6 June 2018

Afternoon Oral Sessions

Room Brüssel 1
SiC Devices II

Chairperson: Nando Kaminski, University of Bremen, D

14:00
Beyond the Datasheet: Commercialization of 700 V - 1.7 kV SiC Devices with Exceptional Ruggedness for Automotive & Industrial Applications
Avinash Kashyap, Amaury Gendron-Hansen, Dumitru Sdrulla, Bruce Odekirk, Dennis Meyer, William Brower, Changsoo Hong, Microsemi, USA

14:25
6.5 kV Full SiC Power Module with HV100 Package
Junichi Nakashima, Akinori Nishizawa, Tetsu Negishi, Shinichi Iura Mitsubishi Electric, J

14:50
Is an Antiparallel SiC-Schottky Diode Necessary? Calorimetric Analysis of SiC-MOSFETs Switching Behavior
Otto Kreutzer, Markus Billmann, Fraunhofer Institute IISB, D; Martin März, FAU Erlangen-Nuremberg, D

Room Brüssel 2
High Power IGBT System Applications

Chairperson: Klaus Marahrens, SEW-Eurodrive, D

14:00
A Test Bench for Thermal Characterization of IGBT Power Modules Over Mission Profiles
Christoph van der Broeck, Rik W. de Doncker, RWTH Aachen, D

14:25
Floating Gate Method to Protect IGBT Module from Explosion in Traction Converters
Enea Bianda, Vinoth Kumar Sundaramoorthy, Gerold Knapp, Alexander Heinemann, ABB Switzerland, CH

14:50
A Condition Monitoring System for Power Semiconductors in Wind Energy Plants
Wilfried Holzke, Holger Groke, Alexander Brunko, Nando Kaminski, Bernd Orlik, University of Bremen, D

Room München 1
Advanced Packaging Technologies II

Chairperson: Stefan Linder, Alpiq, CH

14:00
Sintering Cu Bonding Paste: Cycle Reliability and Applications
Hideo Nakako, Yoshinori Ejiri, Chie Sugama, Yuki Kawana, Motohiro Negishi, Hitachi Chemical, J

14:25
Selective Silver Sintering of Semiconductor Dies on PCB
Fabian Dresel, Sigrid Zischler, Sebastian Letz, Andreas Schletz, Fraunhofer Institute IISB, D; Michael Novak, Continental,

14:50
Feasibility of Copper-Based Ribbon Bonding as an Assembly Method for Advanced Power Modules
Stefan Behrendt, Ronald Eisele, University of Applied Sciences Kiel, D; Martin Becker, Andre Bastos Abibe, Danfoss Silicon Power, D

Room München 2
HVDC Transmission Systems

Chairperson: Philippe Ladoux, University of Toulouse, F

14:00
Design of a Surge Arrester Based Load Commutation Switch for Hybrid HVDC Breakers and MVDC Breakers
David Weiss, Mathias Duerr, Noemi Drack, Felix Kirchhoff, Philippe Maibach, ABB Switzerland, CH; Arman Hassanoor, ABB, CN

14:25
Fault Discrimination in Bipolar HVDC MTS Equipped with Bus Bar Breakers
Max Görtz, Rene Sander, Simon Wenig, Wolf Schulze, Michael Suriyah, Thomas Leibfried, Karlsruhe Institute of Technology (KIT), D

14:50
An HVDC Current Flow Controller for Multi-Terminal Grids
Viktor Hofmann, Mark-M. Bakran, University of Bayreuth, D

Room Mailand
Software Tools and Applications

Chairperson: Bernhard Strzalkowski, Analog Devices, D

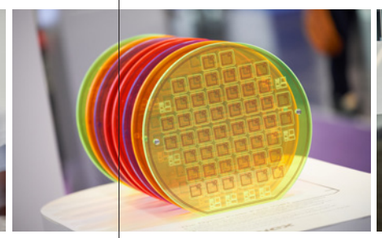
14:00
S-parameter Based Simulation Modeling a Power Module Independent of Measurement Data
Junichi Kashiwagi, Hiroyuki Sakairi, Naotaka Kuroda, Hirotaka Otake, Ken Nakahara, ROHM, J

14:25
Electro-Thermal Simulation for Predicting the Temperature of SiC Dies in the Power Module of a High Frequency Operating Power Converter
Yohei Nakamura, Tristan M. Evans, Hirotaka Otake, Yusuke Nakakohara, Hiroyuki Sakairi, Naotaka Kuroda, Ken Nakahara, ROHM, J

14:50
Comparison of Dynamic Performance of a Lab-Scale Modular Multilevel Converter and its Equivalent Model for Real-Time Simulations
Nikola Stankovic, Opal-RT Europe, F; Jerome Rivest, Tarek Ould-Bachir, Jean Belanger, Opal-RT, CA

15:15 Coffee break

15:15 Foyer Poster / Dialogue Session



Conference Wednesday, 6 June 2018, Poster / Dialogue Session Foyer

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

Thermal Management

Chairperson: Pavol Bauer, Delft University of Technology, NL

Application of Mmc Alsic Thermocompensators in Power Press Pack Diodes and Thyristors
Alexey Grishanin, Valentin A. Martynenko, Vyacheslav Eliseev, Mikhail Malygin, Anton Samoylov, Alexander Plotnikov, Electrovipryamitel JSC, RU; Konstantin Nishchev, Mikhail Novopoltsev, Ogarev Mordovia State University, RU

Reliability of the Power Module Using the Insulated Substrate with Al/C Composite
Kazuhiko Minami, Shoichiro Wakabayashi, Katsumasa Hirose, Ichiro Ota, Showa Denko, J

A Development of Resin Insulating Material for High Reliable Enhanced Power Module
Shinji Amanuma, Hitachi Chemical, J

Experimental Investigation of Gravity-Driven Two-Phase Cooling for Power Electronics Applications
Devin Pellicone, Advanced Cooling Technologies, USA

Integrated Cooling Channels in Direct Bonded Copper Substrate for Silicon Carbide MOSFETs
Alexander Stippich, Maximilian Battefeld, Rik W. De Doncker, RWTH Aachen, D

Thermoelectric Cooling for Bare Dies Power Devices Embedded in PCB Substrates
Shuangfeng Zhang, Eric Laboure, University of Paris, F; Denis Labrousse, Stéphane Lefebvre, ENS Cachan – SATIE, F

Generic Lumped Parameter Thermal Model with Optimized Use of Computational Resources
Joaquim Pinol Bel, Heinrich Steinhart,University of Applied Sciences Aalen, D

Methodology and More Accurate Electrothermal Model for Fast Simulation of Power HEMTs
Aleš Chvála, Juraj Marek, Luboš Černaj, Patrik Príbytný, Alexander Šatka, Daniel Donoval, Slovak Technical University in Bratislava, SK; Steve Stoffels, Niels Posthuma, Stefaan Decoutere, IMEC, BE

A New Transient Thermal Impedance Model for Estimating the Dynamic Junction Temperature of IGBT Modules
Xin Ma, Jia Zhao, Yong Yang, Infineon Integrated Circuit (Beijing), CN

Packaging Technologies

Chairperson: Petar J. Grbovic, Huawei Technologies, D

Effect of Lead Frame Structure and Electrical Characteristic Comparison of IPM Module
Samuell Shin, Bumseung Jin, Kangyoon Lee, Jinkyu Choi, Thomas Yim, ON Semiconductor, ROK

Development of 140X100 Footprint HV IGBT Module
Daohui Li, Xiaoping Dai, Yangang Wang, Fang Qi, Matthew Packwood, Wei Zhou, Dynex Semiconductor, GB

Performance Comparison Between Surface-Mount and Embedded Power Modules
Gerald Weis, AT&S Austria Technologie & Systemtechnik, D

PCB-Embedding of Power Dies Using Pressed Metal Foam
Yoann Pascal, Denis Labrousse, Mickaël Petit, Stéphane Lefebvre, François Costa, SATIE, F

Direct Power Board Bonding Technology for 3D Power Module Package
Hidetoshi Ishibashi, Hiroshi Yoshida, Daisuke Murata, Shota Morisaki, Hodaka Rokubuichi, Nobuhiro Asaji, Mitsubishi Electric Corporation, J

A Surface-Mountable 1.2 cc Compact Molded Package Suitable for 13 kV SiC MOSFET
Hisato Michikoshi, National Institute of Advanced Industrial Science and Technology (AIST), J

Particle Prevention During Ultrasonic Welding Process
David Guillon, Samuel Hartmann, Remi Guillemin, Pauline Morin, Fabian Fischer, Dominik Truessel, ABB Switzerland - Semiconductors, CH

Asymmetrical Flyback Converter in High Density SMPS
Alfredo Medina Garcia, Matthias Joachim Kasper, Manfred Schlenk, Infineon Technologies, D; Gerald Deboy, Infineon Technologies, AT

Reliability Aspects

Chairperson: J.A. Ferreira, Delft University of Technology, NL

Reliability Testing of SiC JBS Diodes for Harsh Environment Operation
Thomas Barbieri, Adam Barkley, Edgar Ayerbe, Wolfspeed, A Cree Company, USA; Zoltán Major, Vincotech, HU; Matthias Tauer, Vincotech, D

Mechanical Properties and Reliability of Pressureless Sintered Silver Materials for Power Devices
Masafumi Takesue, Tomofumi Watanabe, Keisuke Tanaka, Naoya Nakajima, Kenji Shimoyama, Bando Chemical Industries, J

Control of Partial Discharge with High Temperature Insulating Polymer for High Voltage IGBT Module Application
Muhammad Morshed, Ariful Islam, Thomas Roose, Daniel Longney, Yangang Wang, Andy Dai, Daohui Li, Dynex Semiconductor, GB

Thermal Characteristics Evaluation of Wide Band Gap Power Devices
Shijo Nagao, Katsuaki Suganuma, Osaka University, J

From Feasibility to SoP in a 6 Steps Process Described on a SiP Dc-Dc Buck Converter Powermodule
Florian Blum, Würth Elektronik, D

H³TRB Test on 1.2kV SiC MOSFETs
Michael Hanf, Christian Zorn, Nando Kaminski, University of Bremen, D; Martin Domeij, Fredrik Allerstam, Benedetto Buono, Jimmy Franchi, ON Semiconductor, SE; Thomas Neyer, ON Semiconductor, D

Control and Drive Strategies

Chairperson: Hans Ertl, Vienna University of Technology, A

Synchronization and Control of Modular AC- and DC-Sided Parallel-Connected Three-Level NPC Inverters
Jochen Staiger, Swen Bosch, Heinrich Steinhart, University of Applied Sciences Aalen, D

Comparison of Two Model based Temperature Control Sysems Implemented on a Three Level T-Type Inverter
Julian Felix Wölfle, Matthias Pitters, Johannes Ruthardt, Johannes Schuster, Martin Stempfle, Jörg Roth-Stielow, University of Stuttgart, D

Real-Time Development Interface Embedded in a Compact Motion Controller
Josef Reill, Cristina Serrano Gonzales, Volker Senft, DLR- German Aerospace Center, D

Optimized PWM Technique for Overmodulation Region in Vector Controlled High Speed Drives
Peter Stumpf, Sándor Halász, Budapest University of Technology and Economics, HU

Dynamic Space Vector Modulation Control for Asymmetric Neutral Point Clamped Multilevel Inverter
Syed Inam Ul Murtaza Shah, Robert Bosch, D

Short Pulse Transmission for SiC Communicating Gate Driver Under High Dv/Dt
Julien Weckbrodt, Nicolas Ginot, Christophe Batard, University of Nantes / IETR, F; Stéphane Azzopardi, Safran, F

Advanced Functionality of HVIC Technology for Intelligent Power Module
Jinkyu Choi, Wonhi Oh, Kinam Song, Samuell Shin,ON Semiconductor, ROK

Three-Level-Gate-Driver to Run Power Transistors in the Saturation Region for Junction Temperature Control
Johannes Ruthardt, Manuel Fischer, Julian Felix Wölfle, Nathan Tröster, Jörg Roth-Stielow, University of Stuttgart, D

SiC MOSFET Gate Driver for High Switching Frequency and High dv/dt
Christophe Bouguet, Christophe Batard, Nicolas Ginot, University of Nantes -IETR, F

Improved Gate-Drive Unit for RC-IGBT to Overcome Load Current Disturbance in Static MOS-Control
Daniel Lexow, Holger Wiencke, Hans-Günter Eckel, University of Rostock, D

AC Input Current Distortions and Compensation Schemes of PFC Stages Working in Critical Conduction Mode
Markus Schmid, Infineon Technologies, D

Assessment-Based Flux Trajectory Optimization and Pulse Width Modulation for Flux-Oriented Control: A Comparison
Axel Rothstein, Volker Staudt, Ruhr-University of Bochum, D; Carsten Heising, Avasition, D

AC-DC, DC-DC Converters

Chairperson: Yasuyuki Nishida, Chiba Institute of Technology, J

Resonant Inverter Stage in Modular Converter for Electric Vehicle Charging
Dimitar Arnaudov, Stoyan Vuchev, Dimitar Penev, Nikolay Hinov, Technical University of Sofia, BG

Modeling and Investigation of Converter Modules Simultaneous Operation in Electric Vehicle Charging Systems
Stoyan Vuchev, Dimitar Arnaudov, Dimitar Penev, Nikolay Hinov, Technical University of Sofia, BG

SiC-Hybrid Three Level T-Type Rectifier
Hans-Günter Eckel, Florian Störmer, University of Rostock, D

650 V Silicon Carbide MOSFETs in Totem-Pole Bridgeless PFC Design Achieves High Efficiency (80+ Titanium) Without Adding Complexity and Cost
Adil Salman, Edgar Ayerbe, Jianwen Shao, Guy Moxey, Sei-Hyung Ryu, Adam Barkley, Wolfspeed, USA

GaN Power ICs and Off-the-Shelf Controllers Enable 150W, 500kHz AC-DC with 4x Power Density
Tom Ribarich, Stephen Oliver, Navitas Semiconductor, USA

Active Phase Shifting Technique for Inductive Power Transfer (IPT) Systems
Malvika Kamat, Michael Patt, Technology Network Allgäu, D

Analysis of a ZVS Synchronous Sepic/Zeta DC/DC Converter
Burkhard Ulrich, Baden-Wuerttemberg Cooperative State University Stuttgart, D

High Efficiency Shoot-Through Modulation Technique for Quasi-Z-Source DC/DC Converters
Yuba Raj Kafle, Graham Town, Macquarie University, AU

DC-AC Converters

Chairperson: Jacques Laeuffer, Dtalents, F

Reducing the dv/dt of Motor Inverters by a Two Leg Resonant Switching Cell
Thomas Fuchslueger, Hans Ertl, Technical University of Vienna, AT; Markus Vogelsberger, Bombardier Transportation, AT

SiC 2.5 MHz Switching Mode Resonant Halfbridge Inverter
Christoph Simon, Fabian Denk, Santiago Eizaguirre, Michael Heidinger, Rainer Kling, Wolfgang Heering, Karlsruhe Institute of Technology (KIT), D

Analysis and Design of a Multilayer DC Bus With Low Stray Impedance and Homogenous Current Distribution
Asier Matallana, Jon Andreu, Jose Ignacio Garate, Iker Aretxabaleta, Iñigo Kortabarria, University of the Basque Country (UPV/EHU), ES

Replacing Si-IGBTs with SiC-MOSFETs in Low Voltage Grid Converters
Marius Kaufmann-Bühler, Hendrik Just, Sibylle Dieckerhoff, Technical University of Berlin, D

A Polymer Optical Fiber Bus for Power Electronic Applications
Marek Galek, Jacob Ranftl, Siemens, D

High-Inductive Zero-Voltage Commutations within Active-Neutral Point-Clamped Inverters
Felix Kayser, Jan Fuhrmann, David Hammes, Hans-Günter Eckel, University of Rostock, D

A SiC-based 15-Level Power Inverter for the Generation of Variable High Frequency Output Voltages
Sebastian Fahlbusch, Michael Meissner, Sebastian Klötzer, Felix Bröcker, Klaus Hoffmann, Helmut Schmidt University of the Federal Armed Forces Hamburg, D

Loss Optimization for 48 Volt High Current Inverter
Matthias Ippisch, Dieter Gerling, Universityof the Federal Armed Forces Munich, D

Common- and Differential-Mode Separators Including the FM Broadcasting Band
Karl Oberdieck, Jérôme Gossmann, Andreas Bubert, Rik W. De Doncker, RWTH Aachen, D

Accurate Self-Identification of Inverter Nonlinear Effects in AC Drives
Simon Wiedemann, MACCON, D; Ralph Kennel, Technical University of Munich, D

Special Converters

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

Strategy for Reducing Oscillations in Power Electronic Circuits Using Gate Control
Lars Middelstaedt, Andreas Lindemann, Otto-von-Guericke-University, D

The newest ST's Super-Junction Power MOSFET Technology for the Best Efficiency in Air Conditioning System
Carmelo Parisi, Carmelo Mistretta, STMicroelectronics, I

High Efficiency Three-Level Simplified Neutral Point Clamped (3L-SNPC) Inverter with GaN-Si Hybrid Structure
Alexander Lange, Jennifer Lautner, Bernhard Piepenbreier, Friedrich-Alexander-University Erlangen, D

Reducing Astable Relay Power Consumption by the Use of a Constant-Current Buck Converter
Michael Heidinger, Christoph Simon, Fabian Denk, Karlsruhe Institute of Technology (KIT), D

Effect of Spurious Resonant Modes on the Operation of Radial Mode Piezoelectric Transformers
Jack Forrester, Jonathan Davidson, Martin Foster, University of Sheffield, GB

Fuzzy Logic Based Adaptive Controller for AC/DC Boost Converters
Andrea Morici, Infineon Technologies, D; Zain Bin Tariq, Technical University of Munich, D

Power Supply System with Integrated Energy Storage for Supeconducting Magnets
Maria Papamichali, Emilien Coulinge, CERN, CH; Francisco Freijedo, Drazen Dujic, EPFL - Ecole Polytechnique Fédérale de Lausanne, CH

Novel Thyristor-Based Pulsed Current Converter for a Medical Application – a Conceptual Introduction
Stefan Wettengel, Lars Lindenmüller, Steffen Bernet, Technical University of Dresden, D; Florian Kroll, Florian-Emanuel Brack, Helmholtz-Zentrum Dresden – Rossendorf, D; Jörg Pawelke, OncoRay – Nationales Zentrum für Strahlenforschung in der Onkologie, D

Conference Wednesday, 6 June 2018, Poster / Dialogue Session Foyer

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

Power Electronics in Automotive

Chairperson: Thomas Neyer, ON Semiconductor, D

Robust Automotive 40V Power Mosfets for Safer Vehicles
Filippo Scrimizzi, Giuseppe Longo, Giusy Gambino, STMicroelectronics, I

Huge Capacity Power Module Packaging Technology For Automotive Inverter Applications
Yuki Hata, Shoji Saito, Seiichiro Inokuchi, Shinji Hatae, Mitsubishi Electric, J

Analysis of a Multiphase Multi-Star PMSM Drive System with SiC-Based Inverter for an Automotive Application
Stefan Piepenbreier, Fabian Streit, Matthias Kegleleers, Fraunhofer Institute IISB, D; Julian Berlinecke, Robert Plikat, Volkswagen, D; Nicola Burani, Roland Bittner, Semikron Elektronik, D; Serhij Matichyn, EPCOS, D

Supercapacitors-Based Engine Start Battery Support Device with Active Control
Kaspars Kroics, Riga Technical University, LV

A Modular DC/DC Converter to Couple a Double Layer Capacitor to the Automotive High Voltage Grid for Short Time Energy Storage
Bastian Strauß, Andreas Lindemann, Otto-von-Guericke-University, D

Design Optimization of a Three-Phase Bidirectional Dual Active Bridge DC/DC Converter for E-Vehicles Applications
Eduardo Facanha de Oliveira, Peter Zacharias, University of Kassel, D; Felipe Bandeira da Silva, Tobias Rafael Fernandes Neto, Federal University of Ceara, BR

On-Chip Current Sense: A New Approach for Over Current and Short Circuit Detection for Automotive Main Inverter
Rony Karim, Infineon Technologies, D

Evaluation of Infineon HybridPACKTM Drive with Optimized Integrated Capacitor/Bus DC Link for High Performance Inverter Applications
Michael A. Brubaker, Terry Hosking, SBE, USA; Michael Mazzola, Energy Production and Infrastructure Center, USA; Tomas Reiter, Infineon Technologies, D

Multiple Comb Pattern Based Living Object Detection with Enhanced Resolution Design for Wireless Electric Vehicle Chargers
Van Thai, Junhyeong Park, Chuntaek Rim, Gwangju Institute of Science and Technology, ROK; Seogyong Jeong, Korea Advanced Institute of Science and Technology, ROK

Power Modules for Electric Vehicles SRM Converter
David Cabezuelo, Jon Andreu, Iñigo Kortabarria, Edorta Ibarra, Iñigo Martinez de Alegría, University of the Basque Country (UPV/EHU), ES

Power Quality, Power Transmission

Chairperson: Hilmar Darrelmann, Darrelmann + Partner Ingenieure, D

Active Damping for Power Quality Improvement in Grid-Connected Current-Controlled Voltage Source Converters
Lorenzo Giuntini, Andrea Mannuccini GE Consumer & Industrial, CH

Harmonic Current Control in DG-Connected Network Using Proposed Pulse Adaptive VSI
Navid Daniali, Euro Engineering, D

Dynamic Performance Evaluation of a dual UPQC Operating Under Power Quality Disturbances
Sergio Augusto Oliveira da Silva, Leonardo Bruno Garcia Campanhol and Vinícius de Souza, Federal University of Technology Parana, BR

Active Filtering of DC Ripple Currents Between Converter and Low-Resistive DC Load
Sebastian Raab, Ansgar Ackva, University of Applied Sciences Würzburg-Schweinfurt, D

Dynamic Control and Design of a Modular Power Flow Controller for HVDC Networks with Fault Clearing Capabilities
Daniel Dinkel, Claus Hillermeier, Rainer Marquardt, University of the Federal Armed Forces Munich, D

Multi-Terminal HVDC Grid Control Using a Fictitious, Model Based Machine Set
Steffen Menzel, Alexander Ernst, Johannes Adler, Bernd Orlik, University of Bremen, D

Research on Solid State Circuit Breaker Based on SiC MOSFET with Soft Switch off Method
Haihong Qin, Ying Zhang, Shishan Wang, Nanjing University of Aeronautics and Astronautics, CN

Software Tools and Applications

Chairperson: Geraldo Nojima, Eaton Corporation, USA

Virtual Prototyping of Applications for Wide Bandgap Power Devices Using Physically Scalable SPICE Models in Keysight Advances Design System
Mehrdad Baghaie Yazdi, ON Semiconductor Germany, D

Predicting ZVS Behavior of Resonant Converters Using a Fast and Effective Calculation Method
Christian Oeder, Markus Barwig, Thomas Dürbaum, Friedrich-Alexander-University of Erlangen, D

A Novel Combination of Algorithms for Accelerated Convergence to Steady-State
Benedikt Kohlhepp, Jens Göttle, Eva Schmidt, Thomas Dürbaum, Friedrich-Alexander-University of Erlangen-Nuremberg, D

A Novel Detailed Analysis of the Boost Converter Utilizing Nonlinear Inductance and Capacitance
Panagiotis Mantzanas, Erdi Bayrakdar, Thomas Dürbaum, Friedrich-Alexander-University of Erlangen, D

Performance Analysis of IGCT Clamp Circuit and Thermal Loss Modeling of IGCT Based Converters for High Power Applications
Madhan Mohan, Anup Kavimandan, ABB Gispl, IN; Umamaheswara Reddy Vemulapati, Evgeny Tsyplakov, Munaf Rahimo, ABB Switzerland, CH

SMPS Protection Against Lightning Effects
Claudio Mazzurco, STMicroelctronics, I

Power Loss Breakdown in BLDC Drives Applications Using MATLAB
Hrach Amirkhanian, Infineon Technologies, USA

Statistical Modelling Method for Active Power Components Based on Datasheet Information
André Andreta, Yves Lembeye, Jean-Christophe Crébier, University Grenoble Alpes - G2Elab, F; Luiz Lavado Villa, LAAS, F

Fast Solver to Get Steady-State Waveforms for Power Converter Design
Guillaume Fontes, Regis Ruelland, Alvaro Morentin, Guillaume Delamare, Nicolas Videau, Adel Ziani, Power Design Technologies, F; Thierry Meynard, University of Toulouse, F

System Complexity Reduction Approach in the Modelling of a Discrete Power Device
Daniela Cavallaro, Alessandra Cascio, Giuseppe Greco, STMicroelectronics, I

Automated Medium Voltage Virtual Test Bench Using Hardware-in-the-Loop
Emmanuel Frappé, Alain Dutrey, François Malrait, Schneider Electric, F

Conference Thursday, 7 June 2018

Morning Oral Sessions

08:45 **Room Brüssel 1** **Keynote »Modular Multilevel Submodules for Converters, from the State of the Art to Future Trends«**
Markus Billmann, Fraunhofer Institute IISB, D

09:30 **Coffee Break**

Room Brüssel 1
Reliability SiC Devices

Chairperson: Josef Lutz, Chemnitz University of Technology, D

10:00
Practical Aspects and Body Diode Robustness of a 1200V SiC Trench MOSFET
Thomas Basler, Daniel Heer, Dethard Peters, Reinhold Schörner, Infineon Technologies, D; Thomas Aichinger, Infineon Technologies, AT

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pcim Europe Young Engineer Award FINALIST

10:25
High Dynamic Stress on SiC Trench MOSFET Body Diodes and their Behaviour
Andreas März, Mark-M. Bakran, University of Bayreuth, D

10:50
Reliability and Ruggedness of SiC Trench MOSFETs for Long-Term Applications in Humid Environment
Ingo Voss, Thomas Basler, Peter Friedrichs, Roland Rupp, Infineon Technologies , D; Thomas Aichinger, Infineon Technologies, AT

11:15
Investigation on Reliability of SiC MOSFET Under Long-Term Extreme Operating Conditions
Tien Anh Nguyen, Nidhal Boucenna, Denis Labrousse, Gérard Chaplier, Stéphane Lefebvre, SATIE Laboratory, F; Stéphane Azzopardi, Safran, F

11:40
High Humidity, High Temperature and High Voltage Reverse Bias - A Relevant Test for Industrial Applications
Joni Jormanainen, Aleksi Vulli, Jonny Ingman, ABB OY, FI; Elena Mengotti, Thiago Batista Soeiro, Enea Bianda, David Baumann, Thomas Friedli, Alexander Heinemann, ABB Switzerland, CH

Room München 1
Power Modules & Smart Driver

Chairperson: Uwe Scheuermann, Semikron Elektronik, D

10:00
Impact of Load Profiles on Power Module Design - a Detailed Analysis Based on 7th Generation of IGBT and Diode Technology
Stefan Buschhorn, Anastasia Brodt, André Lenze, Alexander Philippou, Christian Jäger, Johannes Laven, Benjamin Sahan, Christian Müller, Infineon Technologies, D

10:25
A Novel Insulation Technology for Gate Drivers
Karsten Fink, Andreas Volke, Power Integrations, D; Matthias Kurth, Power Integrations, CH

10:50
Directly Cooled HybridPACK Power Modules with Ribbon Bonded Cooling Structures
Andre Uhlemann, Infineon Technologies, D

11:15
Enhanced Module Design with DPD Technology
Roberto Bellu, SEMIKRON Elektronik, D

11:40
Direct 2-Way Coupled Electro-Thermal Simulation of Temperature and Current Distribution in Power Devices
Marina Montaine, Uwe Scheuermann, SEMIKRON Elektronik, D; Martin Hanke, CADFEM, D

Room München 2
Reverse Conducting IGBT's

Chairperson: Munaf Rahimo, ABB Switzerland, CH

10:00
Short-Circuit Behavior of 6.5 kV RC-IGBT
Holger Wiencke, Daniel Lexow, Hans-Günter Eckel, University of Rostock, D

10:25
New Transfer Mold SMD Type IPM with Integrated RC-IGBT, Bootstrap Diode and Capacitor
Yazhe Wang, Maki Hasegawa, Mitsubishi Electric Corporation, J

10:50
The Series of 7th-Generation »X Series« RC-IGBT Modules for Industrial Applications
Akio Yamano, Fuji Electric, J

11:15
4.5kV Rupture Resistant Press Pack IEGT
Raita Kotani, Toshiba, J; Georges Tchouangue, Toshiba, D

11:40
New Low Loss Phase Control Thyristors for Medium Current UHVDC Transmission
Sascha Populoh, Chunlei Liu, Marco Bellini, Kenan Tugan, Urban Meier, Jan Vobecky, ABB Switzerland, CH

Room Mailand
High Frequency Converters

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

10:00
Optimisation of an Integrated Bidirectional Interleaved Single-Phase Power Factor Corrector
Johan Le Lesle, Rémy Caillaud, Nicolas Degrenne, Roberto Mrad, Stefan Mollov, Mitsubishi Electric R&D Centre, F; Florent Morel, Cyril Buttay, Christian Vollaire, Laboratoire Ampère, F

10:25
Multi-MHz LED Drivers: Design for Lifetime and Reliability
Riccardo Pittini, Thomas Andersen, Toke M. Andersen, Mickey Madsen, Martin Rødgaard, Jakob Mønster, Nordic Power Converters, DK

10:50
High-Frequency and High-Density Design of all GaN Power Supply Unit
Ruiyang Yu, University of Texas at Austin, USA

11:15
Comparison Between an Interleaved Boost Converter Using Si MOSFETs Versus eGaN FETs
Simon Ravyts, Mauricio Dalla Vecchia, Jeroen Zwysen, Giel van den Broeck, Johan Driesen, KULeuven, BE

11:40
A Novel AC Direct Linear LED Driver with Unity Power Factor, Low Input Current THD, Low Light Flicker and Low Profile
Jie Fu, Gang Wang, Shan Wang, Zhiquan Chen, Liang Shi, Philips Lighting, CN

12:00 **Lunch Break**

Conference Thursday, 7 June 2018

Afternoon Oral Sessions

Room Brüssel 1
GaN Devices

Chairperson: Elison Matioli, POWERlab, EPFL, CH

14:00
High Power Nanosecond Pulse Laser Driver Using an eGaN®FET
John Glaser, Efficient Power Conversion (EPC) Corporation, USA

14:25
Very High Current Wire Bondable and Embeddable GaN E-HEMT Devices for High Power Applications
Larry Spaziani, Di Chen, Lucas Lu, GaN Systems, CA

14:50
6.78 MHz Multi Amplifier and Transmit Coil eGaN® FET based Class-E Wireless Power System Evaluation
Michael de Rooij, Yuanzhe Zhang, Efficient Power Conversion (EPC) Corporation, USA

15:15
Towards Highly-Integrated High-Voltage Multi-MHz GaN-on-Si Power ICs and Modules
Stefan Moench, Richard Reiner, Beatrix Weiss, Patrick Waltereit, Rüdiger Quay, Fraunhofer-Institute IAF, D; Thomas Kaden, Robert Bosch, D; Ingmar Kallfass, University of Stuttgart, D

Room München 1
System Reliability

Chairperson: Hubert Schierling, Siemens, D

14:00
Partial Discharge Measurement in a Motor Winding Fed by a SiC Inverter – How Critical is High dV/dt Really?
Marco Denk, Mark M. Bakran, University of Bayreuth, D

14:25
Evaluation of Sinter-Based Joining Technologies on Lead Frame
Alexander Otto, Tim Schröder, Rainer Dudek, Mario Baum, Ralf Döring, Sven Rzepka, Wei-Shan Wang, Fraunhofer-Institute ENAS, D; Kei Murayama, Kiyoshi Oi, Shinko Electric Industires, J

14:50
On-line Health Monitoring of Wire-Bonded IGBT Power Modules using On-State Voltage at Zero-Temperature-Coefficient
Nicolas Degrenne, Stefan Mollov, Mitsubishi Electric R&D Centre, F

15:15
First Results of Development of a Lifetime Model for Transfer Molded Discrete Power Devices
Guang Zeng, Oliver Wenzel, Josef Lutz, Technical University of Chemnitz, D; Ludger Borucki, Oliver Schilling, Infineon Technologies, D

Room München 2
Power Converters

Chairperson: Ulrich Kirchenberger, STMicroelectronics, D

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pcim Europe Young Engineer Award FINALIST

14:00
25 kW High Power Resonant Inverter Operating at 2.5 MHz with SiC SMD Phase-Leg Modules
Fabian Denk, Christoph Simon, Santiago Eizaguirre, Michael Heidinger, Rainer Kling, Wolfgang Heering, Karlsruhe Institute of Technology (KIT), D; Karsten Haehre, Porsche Engineering, D

14:25
A Trans-Linked 5-kW Inverter Using SiC MOSFETs to Achieve Fan-less Operation
Fatsuya Miyazaki, Hirotaka Otake, Yusuke Nakakohara, Ken Nakahara, ROHM, J; Mamoru Tsuruya, Power Assist Technology, J

14:50
High power Constant Current Class EF2 GaN Power Amplifier for AirFuel Magnetic Resonance Wire-Less Power Transfer Systems
Tiefeng Shi, Paul Wiener, GaN systems, USA

15:15
System Efficiency and Power Density Comparison of Voltage-Source Based DC-Link and Matrix Converters for Highly Integrated Electric Motor Drives
Rüdiger Schwendemann, Marc Hiller, Karlsruher Institute of Technology (KIT), D; Boris Janjic, KSB SE, D

Room Mailand
Advanced Sensors

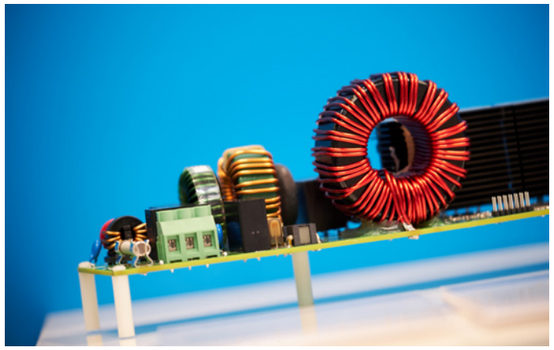
Chairperson: Eric Favre, IMI Precision Engineering, CH

14:00
Closed-Loop Hall Sensors with Near Fluxgate Performance for Residual Current Measurement in Photovoltaic Systems
Stéphan Trombert, LEM International, CH

14:25
Evaluation of Overall Accuracy of New Current Sensing Concepts in Comparison to State-of-the-Art Methods
Frank Lautner, Mark M. Bakran, University of Bayreuth, D

14:50
Design and Implementation of an Integrated Current Sensor for a Gallium Nitride Half-Bridge
Janes Walter, Javier Acuna, Ingmar Kallfass, University of Stuttgart, D

15:15
Utilization of Parasitic Luminescence from Power Semiconductor Devices for Current Sensing
Jonathan Winkler, Jan Homoth, Robert Bosch, D; Ingmar Kallfass, University of Stuttgart, D



Industry Forum

Hall 6 Booth 6-155

Tuesday, 5 June 2018

11:00	**From Niche to Mainstream – SiC Power Devices as Enabler for Revolutionary Designs,** Infineon Technologies
12:00	**Challenges and Opportunities facing Power Supply Manufacturers over the next 5 years,** Power Systems Design
13:00	**SiC and GaN, which Challenges Remain in the Road to Success?,** Yole Développement
13:30	**Digital Control for Off-Line Power Supplies Using Digital Platform DP2,** Fraunhofer EAS-IIS
14:00	**Measurements beyond Standard Tasks – 100kA Peak Current, 100MW Peak Power, etc.,** TU Leoben
14:30	**Thermal Management of High Heat Flux Electronics with Mechanically Pumped Two-Phase Cooling,** ENEA, Energy Technologies Department
15:00	**Langzeitlagerung elektronischer Komponenten als Bestandteil einer vorausschauenden Obsoleszenzstrategie,** HTV Halbleiter-Test & Vertriebs-GmbH

Wednesday, 6 June 2018

10:00	**Automotive Power Modules - Design Changes and Technology Innovations to Come?,** Yole Développement
11:30	**15 Years ECPE Research Network,** ECPE European Center for Power Electronics
12:30	**A Semi-Modular-Based and SiC-Based Smart Transformer,** Christian-Albrechts-University Kiel
13:30	**SIC – Devices for the Future Design,** A Media, Bodo's Power Systems
14:30	**GaN – Devices for the Future Design,** A Media, Bodo's Power Systems
15:30	**Electric Vehicles Charging – An Ultrafast Overview,** Power Electronics Laboratory, EPFL

Thursday, 7 June 2018

10:00	**New Passive Devices in Power Electronics - Nice to Have or a MUST?,** Huawei Technologies
10:30	**Strategies for Increasing Efficiency, Controlling EMI and Reducing Cost in Practical Power Electronics Designs,** Bose Research
11:30	**Einführung Students Day,** ECPE European Center for Power Electronics
12:30	**How will Battery Packs Requirements impact Power Electronics Market?,** Yole Développement
13:00	**Realizing the New Growth Wave for Semiconductors Startups and Innovation in High Voltage and Power Density,** Silicon Catalyst
13:45	**SiC Solutions for Industrial and Automotive Applications,** ROHM Semiconductor
15:30	**Verlosung Students Day,** ECPE European Center for Power Electronics

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E-Mobility Forum

Hall 6 Booth 6-320

Partner

Elektronik automotive
Fachmedium für professionelle Automobilelektronik

Tuesday, 5 June 2018 and Wednesday, 6 June 2018

10:00	**Power Electronics for Future Mobility,** Fraunhofer IISB
10:30	**Electrification and Autonomous Vehicle Systems: The Change of Electrical / Electronic Architecture,** EBV Elektronik
11:00	**Car Electrification: Semiconductor Power Technologies Meet Challenges and New Applications,** On Semiconductor
11:30	**SiC Solutions for E-Mobility,** Rohm Semiconductor
12:00	**Latent Heat Carbon Solutions for E-Mobility,** Schunk
	Break
14:00	**Technical Edge and Future Evolution of Onboard Charger,** Valeo
14:30	**Dynamic Electric Vehicle Charging: an Innovation Story,** Qualcomm
15:00	**Semiconductor Solutions for the Automotive Onboard Charger Applications,** Infineon Technologies
15:30	**Thermal Management of Lithium-Ions Cells in Battery Packs – Key Element of Functional Safety in E-Mobility Applications,** Rutronik

As of March 2018 / subject to change without notice

List of Exhibitors

At PCIM Europe 2018, more than 470 exhibitors from 28 nations showcase products and services as well as the most recent innovations in the fields of power electronics, intelligent motion, renewable energy and energy management.

3M Deutschland, D
A.L.M.T., J
ABB Switzerland, CH
Acal BFi Germany, D
Advanced Cooling Technologies, US
Advanced Techne Priatherm Division, I
Advanced Technology & Materials, CN
Aerovox, US
AgileSwitch, US
AIC Europe, D
AIT Austrian Institute of Technology, AT
AixControl, D
ALCON Electronics, IN
alfatec, D
Alisha Coils & Transformers, IN
Allray, CN
Alpha and Omega Semiconductor, US
Alpha Assembly Solutions, GB
ALPHA-Numerics, D
alpitronic, I
ALPS Electric Europe, D
alttec, D
Alutronic Kühlkörper, D
Amantys Power Electronics, GB
amec, D
Amosense, KR
AMS Technologies, D
Amulaire Thermal Technology, TW
AMX AUTOMATRIX, I
Analog Devices, D
Aperam Alloys Amilly, F
APOJEE, D
Applied Micro Electronics, NL
Arcel, F
ASM Assembly Systems, D
ATE Electronics, I
Atherm, F
ATV Technologie, D
Aurubis Finland, FI
Aurubis Stolberg, D
austerlitz electronic, D
AutomatisierungsTechnik Voigt, D
AUXEL, F
AVX, GB
AVX-TPC, F
Arthur Behrens, D
Beijing Deepcool Industries, CN
Beijing Victory Electric, CN
Beijing Xinchuang Chunshu Rectifier, CN
IB-Billmann, D
BINDER tecsys, D
Blinzinger Elektronik, D
BLOCK Transformatoren-Elektronik, D
Blume Elektronik, D
Bose Research, IN
Bourns Sensors, D
Brightek, GB
Broadcom, D
BROXING, CH
Bs&T, D
Caltest Instruments, D
Capxon Europe, D
Shenzhen Cectn Technology, CN
Cefem Power, F
CEJN-Product, D
Celem Passive Components, IL
CeramTec, D
Chang Sung, KR
China Amorphous Technology, CN
CKE Products by Dean Technology, US
CMC Klebetechnik, D
CME Control Motion Electronics, D
CMP, F
COILCRAFT, GB
Columbia-Staver, GB
Constellium Singen, D
Cool Tec Electronic, D
COOLTECH, I
CoorsTek, D
Cosmo Ferrites Limited, IN
CPS Technologies, US
CRRC Qingdao Sifang Rolling Stock Research Institute, CN
CST-Computer Simulation Technology, D
CTX Thermal Solutions, D
CYG Wayon Circuit Protection, CN
DACO Semiconductor, TW
Danfoss Silicon Power, D
Danotherm Electric, DK
dataTec, D
DAU, AT
Dean Technology, US
Denka Chemicals, D
DEWESoft, D
DEWETRON Deutschland, D
dhs ELMEA Tools, D
Diamond Electric, J
Diotec Semiconductor, D
DK Thermal, GB
DODUCO Solutions, D
Dongwan Speed Electronic, CN
Doublecircle Electronics, CN
DOWA HD Europe, D
dSPACE, D
DSW Elektronik, D
Ducati Energia, I
DYNETICS, D
Dynex Semiconductor, GB
EA Elektro-Automatik, D
Shanghai EAGTOP Electronic Technology, CN
EBG Elektronische Bauelemente, AT
EBV Elektronik, D
ECOMAL Europe, D
ECPE European Center for Power Electronics e.V., D
ed-k Dipl.-Ing. Hubert Kreis, D
Efficient Power Conversion, US
EICHHOFF Kondensatoren, D
EKL, D
EKV, D
Electronic Concepts, IE
Electronic Specifier, GB
ELECTRONICON Kondensatoren, D
Electrovipryamitel JSC, RU
ELEKTRISOLA Dr. Gerd Schildbach, D
Elesa Transformadores, ES
EMB-Elektromaschinenbau, D
EME, BE
Emtron electronic, D
EPFL Lausanne, CH
EpiGaN, BE
Essentra Components, D
ET System electronic, D
ETI Elektroelement, SI
EURAL GNUTTI, I
Exagan, F
Exxelia, F
F & K DELVOTEC Bondtechnik, D
Fachhochschule Kiel Fachbereich IuE Institut Mechatronik, D
Fericor, SI
Ferroxcube Deutschland, D
FERYSTER, PL
Filcap, D
Finepower, D
First Sensor Lewicki, D
Flux, DK
FormFactor, US
Foshan city XinYuan Electronic, CN
Fraunhofer Institut für Integrierte Systeme und Bauelemente-technologie IISB, D
Fraunhofer Institut für Solare Energiesysteme ISE, D
Fraunhofer-Institut für Keramische Technologien und Systeme IKTS, D
Fraunhofer-Institut für Zuverlässigkeit und Mikrointegration IZM, D
Fraunhofer-Institut für Siliziumtechnologie ISIT, D
Frizlen, D
FTCAP, D
Fuji Electric Europe, D
GaN Systems, CA
Gaotune Technologies, CN
Gemballa Electronics, D
GES Electronic & Service, D
GLYN, D
Gruppo Energia, I
GT elektronik, D
Guangdong Fengming Electronic Tech, CN
Guangzhou Kingtachi Electronic, CN
gutre, D
GvA Leistungselektronik, D
HAHN, D
Haining Ferriwo Electronics, CN
Hangzhou Liansheng Insulation, CN
Hangzhou Xenbo Heat transfer Science & Technology, CN
Hangzhou Xifeng Semiconductor, CN
Hauber & Graf Electronics, D
HE System Electronic, D
HEIDEN power, D
Heraeus, D
HERVER-9, ES
Hesse, D
HF Instruments, D
High Voltage Power Solutions Products by Dean Technology, US
Himag Planar Magnetics, GB
Hitachi Chemical Europe, D
Hitachi Europe, GB
Hitachi Metals Europe, D
Höganäs, SE
Hollmén & Co, FI
HolyStone, GB
Honeywell Specialty Chemicals Seelze, D
Hottinger Baldwin Messtechnik, D
Huawei Electronic, TW
Hubei Ruiyuan Electronic, CN
Huizhou Click Electronics, CN
HV Components Associates Products by Dean Technology, US
HVP High Voltage Products, D
HVR International, D
HYDRA Components, D
Bruker Hydrostatic Extrusions, GB
HY-LINE Power Components, D
I.C.E., I
ICAR, I
ICEL, I
IDEALEC, F
IEEE Power Electronics Society, US
imperix, CH
Indium, GB
Ineltron, D
Infineon Technologies, D
Ingenieurbüro Federer, CH
innovatek OS, D
inpotron Schaltnetzteile, D
InPower Systems, D
INTENSA Technische Dienstleistungen, AT
Interplex Precision Technology, SG
InTiCa Systems, D
IQ evolution, D
Isabellenhütte Heusler, D
Ise Magnetics, NL
Italfarad, I
Itech Electronic, CN
ITELCOND, I
IWATSU TEST INSTRUMENTS, J
IXYS Semiconductor, D
J&D Electronics, KR
Japan Resistor, J
Jentech Precision Industrial, TW
JFE Steel, J
Jian Hui Metal and Plastic Parts, CN
Jianghai Europe Electronic Components, D
JGD Semiconductor, CN
Jovil Universal, US
Junior Kühlkörper, D
Kanthal Part of Sandvik Heating Technology, US
Kapteos, F
Karlsruher Institut für Technologie, D
Kaschke Components, D
KCC, KR
KEMET Electronics, US
Kendeil, I
KERAFOL Keramische Folien, D
Keysight Technologies Deutschland, D
KIKUSUI Electronics, J
KLEINER Stanztechnik, D
KOA Europe, D
KRAH Elektronische Bauelemente, D
Johann Lasslop Induktive Bauteile, D
Leclanché Capacitors, CH
Leicht + Müller Stanztechnik, D
LEM Europe, D
Littelfuse Europe, D
LS Mtron, KR
MACCON, D
MacMic Science & Technology, CN
MagDev, GB
Magnachip Semiconductor, KR
Magna-Power Electronics, D
Magnetec, D
Magnetics, US
Malico, TW
Marini Mario, I
MB Electronic, D
Mecc. AL, I
Mentor Graphics, D
Mersen France, F
MEV Elektronik Service, D
Microchip Technology, D
Micrometals, US
Microsemi, US
Miles Platts, GB
MinDCet, BE
Mitsubishi Electric Europe, D
Mitsui Mining & Smelting, J
MJC Elektrotechnik, D
MK Magnetics, US
Momentive Performance Materials, NL
MS Power, D
MUECAP Bauelemente, D
Multi Measuring Instruments, J
Murata Electronics Europe, NL
Myrra Deutschland, D
Naina Semiconductor, IN
Nanjing Chieful Science & Technology, CN
NeoGraf Solutions, US
NGK Europe, D
Nidec Servo, J
Ningbo CRRC Times Transducer Technology, CN
Ningbo Degson Electrical, CN
Ningbo Wanji Electronics Science & Technology, CN
Nippon Pulse Motor, US
Nippon Rika Industries, D
Noratel Germany, D
North Star High Voltage, US
NORWE, D
NORWE, US
Novel Crystal Technology, J
Nucon Energy, RU
NWL Capacitors, US
Su Zhou OCA Microelectronics, CN
OMICRON Lab, AT
ON Semiconductor, GB
Online Engineering, D
OPAL-RT EUROPE, F
Osterrath Verbindungstechnische Präzision, D
Oupiin Enterprise, TW
Rudolf Pack Pack LitzWire, D
PADA Engineering, I
Panasonic Industry Europe, D
PARKER OVERSEAS, IN
Payton Planar Magnetics, II
PETERCEM, F
PHOENIX CONTACT Deutschland, D
Piciesse Elettronica, I
Pikatron, D
PLANSEE, AT
Plexim, CH
PMK Mess- & Kommunikationstechnik, D
POCO Holding, CN
POLFER Podzespoly Indukcyjne, PL
POMCEG ELECTRONICS, ES
Power Coils, I
Power Design Technologies, F
Power Electronic Measurements, GB
Power Integrations, D
Power Research Electronics, NL
Power Sources Manufacturers Association, US
POWERSEM, D
POWERSYS, F
PPM - Pforzheimer Präzisions Mechanik, D
PRECISION ELECTRONIC COMPONENTS, IN
PREMO, ES
Pre-Switch, US
Prima Electro, I
Promet, CH
ProNova, D
Protechnic Electric, CN
ProTek Devices, US
TH Proton-Electrotex, RU
PTR HARTMANN, D
PTS Präzisionsteile, D
Pulse Magnetic & Power Electronics, IN
PVA TePla Analytical Systems, D
R3Tec, D
Rayben Technologies, CN
RECOM Power, AT
RENA Technologies, D
Richardson RFPD Germany, D
RISSE electronic, D
ROGERS Germany, D
Rohde & Schwarz, D
ROHM Semiconductor, D
RSG Electronic Components, D
Rubadue Wire, US
Rudi Göbel, D
Rutronik Elektronische Bauelemente, D
SABIC Innovative Plastics, NL
SAMWHA Electronics, KR
Samwha Europe, D
Sansha Electric, FI
Sarnikon Metal ve Elektronik San. ve Tic, TR
SAXOGY - POWER ELECTRONICS Ingenieurbüro Domes, D
SBA-TrafoTech, D
SBE, US
Manfred Schmelzer, D
Schmidbauer Transformatoren und Gerätebau, D
SCHROEDER + BAUER Werkzeugbau Stanztechnik, D
Schukat electronic, D
Schulz-Electronic, D
Schunk, D
Schunk Sonosystems, D
schwa-medico Transformatorenbau & Industrieprodukte, D
Schweizer Electronic, D
Seifert electronic, D
Sekels, D
SEMIKRON International, D
Sensitec, D
Sentec E&E, TW
Serigroup, I
SERTO, D
SET, D
SET Power Systems, D
Shaanxi Yihong Investment Management, CN
Foshan City Shunde District ShengYe Electrical, CN
Shenzhen Amorphous Technology, CN
Shenzhen Belta Electronics, CN
Shenzhen BYD Microelectronics, CN
Shenzhen ChuangShiDing Electronics, CN
Shenzhen Xiefutai Technology, CN
Siba, D
Siebel Elektronik, D
SIGNALTEC, D
Sika Deutschland, D
SINUS Electronic, D
SIR Resistor, I
SIRECTIFIER ELECTRONICS TECHNOLOGY, CN
SIRIO ELETTRONICA, I
SK Electric Europe, NL
Skeleton Technologies, D
SMA Magnetics, PL
SMP Sintermetalle Prometheus, D
SOCAY Electronics, CN
Special-Ind Deutschland, D
Speedgoat, CH
Spitzenberger & Spies, D
StandexMeder Electronics, D
Stangenes Industries, US
Starpower Europe, CH
Franz Steger Transformatorenbau, D
STMicroelectronics, CH
STS, D
Strohheker Kunststoffteile und Metallwaren, D
Suin Instruments, CN
SUMIDA Components & Modules, D
Sumitomo Electric Industries, J
Beijing Sunking Power Electronic Technology, CN
Susumu Deutschland, D
System Plus Consulting, F
Taiyo-Yuden Europe, D
Tamura, J
Tamura-Europe, GB
TDK Europe, D
Zhuzhou CRRC Times Electronic, CN
Tech Mount, TW
Tech Semiconductors, CN
Technix, F
TECNOAL, I
Tektronix, D
TELCON, GB
Teledyne LeCroy, D
Termoresine, I
tesch-emc, D
tesema Leistungselektronik, D
THALES DMS FRANCE, F
The MathWorks, US
Thercon, RU
THORA Elektronik, D
Tianjin Century Electronics, CN
Tigris Elektronik, D
TOELLNER Electronic Instrumente, D
Toshiba Electronics Europe, D
Toshiba Materials, J
Toyochem, J
TPS Elektronik, D
trafomodern, AT
Traftor Technology (Shenzhen), CN
TRAMAG Transformatorenfabrik, D
TRANSPHORM, US
TY-OHM Electronic Works, TW
United Silicon Carbide, US
VACUUMSCHMELZE, D
Vicor Germany, D
ViMOS Technologies, D
Vinatech, KR
Vincotech, D
Vishay BC Components, NL
Vishay Europe Sales, D
VISIC Technologies, Il
WAGO Kontakttechnik, D
Thomas Waidner, D
Walther-Präzision Carl Kurt Walther, D
WARMES, D
Wayne Kerr Europe, D
WeEn Semiconductors, GB
Weidmüller Interface, D
WEVO-CHEMIE, D
widap electronic components, D
Wieland-Werke, D
WIMA, D
Wolverine Tube MicroCool Division, US
wts // electronic components, D
WÜRTH ELEKTRONIK eiSos, D
Würth Elektronik ICS, D
Wuxi CRE New Energy Technology, CN
Xiamen Hidins Technology, CN
Xiamen SET Electronics, CN
Xi'an MIQAM Microelectronics, CN
Xintlas Electronics Technologies, D
Yangzhou Kaipu Electronics, CN
Yangzhou Pairui, CN
Yokogawa Deutschland Test- und Messtechnik, D
Zeasset Electronic Technology, CN
Zeon, J
ZES ZIMMER Electronic Systems, D
ZEZ SILKO, CZ
ZH Wielain Electronic (Hangzhou), CN
Zhejiang NBTM KEDA Magnetoelectricity, CN
Zurich Instruments, CH

As of March 2018 / subject to change without notice

Gold-Sponsor

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WÜRTH ELEKTRONIK eiSos

Registration Information

Registration Fees

	Until 2 May 2018	From 3 May 2018
These are per named delegate as follows:		
One Conference Day	670 EUR	770 EUR
Two Conference Days	1,120 EUR	1,220 EUR
Three Conference Days	1,330 EUR	1,430 EUR
Tutorial Full Day	690 EUR	790 EUR
Seminar Half Day	345 EUR	395 EUR
University Staff*	940 EUR	940 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. Donata Pfender at Donata.Pfender@mesago.com for registration.
** A transferable ticket valid for the three keynote presentations including the conference proceedings is only available to PCIM Europe 2018 exhibitors. A special registration is required.
On-site registration: additional 30 EUR per participant. Please note that cash payments are not possible. Payment by credit card only.
All fees plus 19% VAT.

Registration and terms and conditions on pcim-europe.com

General Information

Venue
The seminars on Sunday, 3 June 2018 and the tutorials on Monday, 4 June 2018 will take place at Arvena Park Hotel, Görlitzer Str. 51, 90473 Nuremberg, phone: +49-911-89220.

The conference from Tuesday, 5 June 2018 until Thursday, 7 June 2018 will take place at Conference Center Mitte, NürnbergMesse, Otto-Bärnreuther-Strasse, 90471 Nuremberg.

Accommodation
For hotel booking please contact the hotel directly.
PCIM Europe Head Quarter Hotel
Hotel Arvena Park
Görlitzer Str. 51
D-90473 Nürnberg
Phone: +49 911 89 22 0
info@arvenapark.de
5 min. by underground U1 to the conference site.

Registration Counter Opening hours
Arvena Park Hotel
Sunday 3 June 2018 from 13.00 until 17.00
Monday 4 June 2018 from 8.00 until 14.00

NCC Mitte, NürnbergMesse
Monday 4 June 2018 from 16.00 until 18.00
5 – 7 June 2018 from 8.00 until 17.00

Questions?
Ms. Donata Pfender
Phone: +49 711 61946-503
donata.pfender@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 is approximately 15 minutes and costs about 25 EUR.

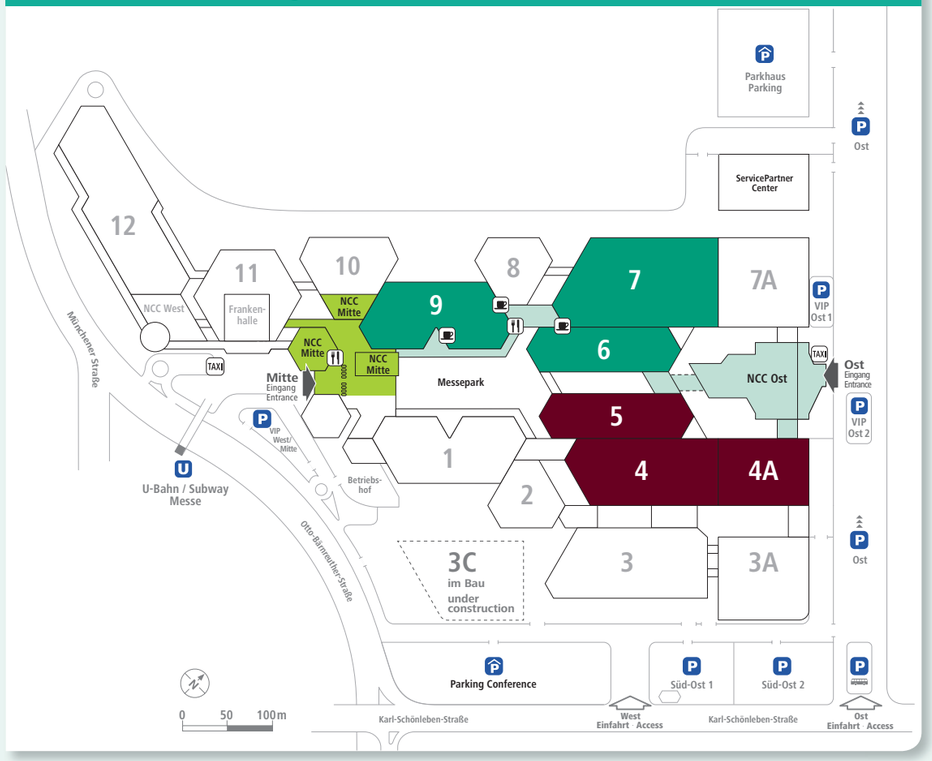
You can reach Nuremberg´s main train station 'Nürnberg Hauptbahnhof' conveniently from every German city with the following trains: ICE, IC or EC. There are also frequent train connections from major European cities such as Paris, Brussels, Zurich, Vienna, Amsterdam or Prague. From 'Nürnberg Hauptbahnhof' 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

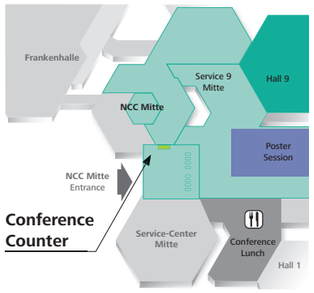
For more travel and hotel information please visit **pcim-europe.com**

Room Plan

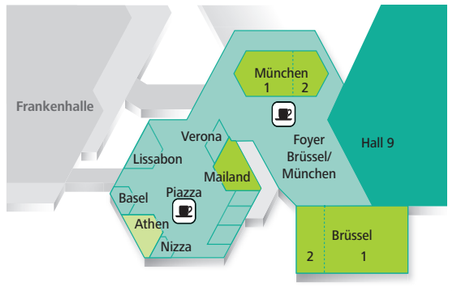
Exhibition Centre Nuremberg



NCC Mitte, Level 0



NCC Mitte, Level 1



PCIM Europe 2018

Entrances and Services

Conference

Advisory Board/
Speaker's Room

SMT Hybrid Packaging 2018

PCIM Worldwide

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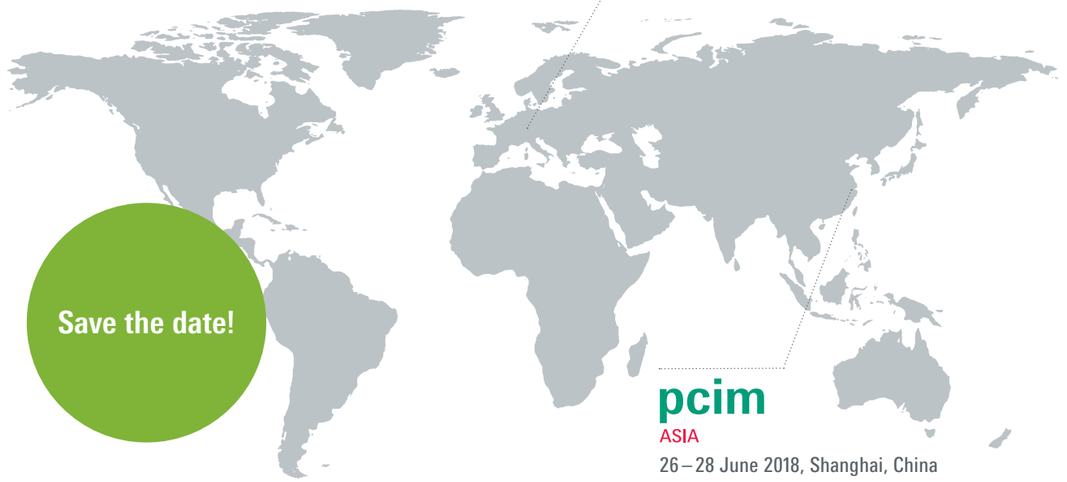
EUROPE
07 – 09 May 2019, Nuremberg, Germany
pcim-europe.com



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Organizer

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Messe Frankfurt Group

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Rotebuehlstr. 83 – 85
70178 Stuttgart

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Offical event hashtag #pcimeurope