

Table of Content PCIM Europe 2016

Keynotes

Keynote: Welcome to the Post-Silicon World: Wide Band Gap Powers Ahead.....	31
Dan Kinzer, Navitas Semiconductor, USA	
Keynote: Smart Transformers – Concepts-Challenges-Applications	32
Johann Walter Kolar, ETH Zürich Power Electronic Systems Laboratory, CH	
Keynote: Trends of Solar Systems and their Integration in Electricity Networks	33
Jens Merten, National Solar Energy Institute, F	

SiC Devices

Ultra-low (1.25 mΩ) On-Resistance 900V SiC 62 mm Half-Bridge Power Modules Using New 10 mΩ SiC MOSFETs.....	34
Jeffrey Casady, Vipindas Pala, Edward Van Brunt, Brett Hull, Sei-Hyung Ryu, Gang-Yao Wang, Jim Richmond, Scott T. Allen, Dave Grider, John W. Palmour, Peter Killeen, Brice McPherson, Kraig Olejniczak, Brandon Passmore, David Simco, Wolfspeed, USA	
Evolution of SiC Products for Industrial Application	42
Naoyuki Kizu, Satoru Nata, Mineo Miura, Noriaki Kawamoto, Kazuhide Ino, Rohm, J; Masaharu Nakanishi, Rohm Semiconductor, D; Nobuhiro Hase, Rohm Semiconductor, USA	
Advanced Protection for Large Current Full SiC-Modules.....	48
Eugen Wiesner, Eckhard Thal, Mitsubishi Electric Europe, D; Andreas Volke, Karsten Fink, Power Integrations, D	
Switching Performance of a 1200 V SiC-Trench-MOSFET in a Low-Power Module	53
Daniel Heer, Daniel Domes, Dethard Peters, Infineon Technologies, D	

Module Materials

Beyond Thermal Grease, Enhancing Thermal Performance and Reliability	60
Sanjay Misra, Henkel, USA	
High Thermal Conductivity Silicon Nitride substrate for Power Semiconductor Applications	64
Dai Kusano, Gen Tanabe, Yoshiyuki Uchida, Japan Fine Ceramics, J	
Thermal Management of Future WBG Devices using Two-Phase Cooling	72
Shailesh Joshi, Ercan Dede, Toyota Research Institute North America, USA	
Highly Reliable and Lead-Free High Power IGBT Modules Using Novel Copper Sintering Die Attachment	78
Akitoyo Konno, Takaaki Miyazaki, Yuusuke Yasuda, Osamu Ikeda, Hiroshi Nakano, Toshiaki Morita, Hiroshi Houzouji, Mutsuhiro Mori, Masato Nakamura, Yoshihiko Koike, Hitachi, J	

Magnetics & Inductors

A New Generation of Nanocrystalline Magnetic Cores with Very Low Magnetic Losses	84
Bashar Gony, Stephane Camus, Julia Hill, Frederic Pottier, Aperam Alloys Amilly, F	
The Fe-based Glassy Alloy Powder Core Inductor for the Boost Converter by GaN HEMT and SiC SBD 1 MHz Operation	91
Mitsunao Fujimoto, Yutaka Naitoh, Takao Mizushima, ALPS Green Devices, J	
Accurate Calculation of AC Losses of Inductors in Power Electronic Applications	99
Ranjith Bramanpalli, Würth Elektronik eisos, D	
Thin-Film Based Microtransformer Suitable for High Switching Frequency Power Applications	107
Dragan Dinulovic, Mahmoud Shousha, Martin Haug, Würth Elektronik eiSos, D; Sebastian Beringer, Marc C. Wurz, Leibniz University Hannover, D	

DC/AC and AC/DC Converters

Design of High Efficiency High Power Density 10.5 kw Three Phase On-Board-Charger for Electric/Hybrid Vehicles	113
Gang Yang, Valeo, F; Eirik Draugedalen, Torbjorn Sorsdahl, Hui Liu, Roar Lindseth, Valeo Powertrain Energy Conversion, NO	
A Bridgeless, Quasi-Resonant ZVS-Switching, Buck-Boost Power Factor Correction Stage (PFC)	120
Markus Scherbaum, Manfred Reddig, University of Applied Sciences Augsburg, D; Ralph Kennel, Technical University of Munich, D; Manfred Schlenk, Infineon Technologies, D	
A high efficiency 5.3 kW Current Source Inverter (CSI) Prototype using 1.2 kV Silicon Carbide (SiC) Bi-Directional Voltage Switches in hard Switching Mode	128
Jérémie Martin, Anthony Bier, Stéphane Catellani, Luis Gabriel Alves-Rodrigues, Franck Barruel, Commissariat à l'énergie atomique et aux énergies alternatives, F	
Comparison of the EMC and Efficiency Characteristics of Hard and Soft Switching Three-Level Inverters	136
Manfred W. Gekeler, Stefan Schreitmüller, Gunter Voigt, HTWG Konstanz University of Applied Sciences, D	

Special Session “Passive Components”

Drive System Loss Reduction by Allpole Sine Filters	144
Dennis Kampen, BLOCK Transformatoren-Elektronik, D; Michael Burger, SEW Eurodrive, D	
Harmonic Filtering in Variable Speed Drives	148
Luca Dalessandro, Xiaoya Tan, Andrzej Pietkiewicz, Martin Wüthrich, Norbert Naeberle, Schaffner, CH	
A just Comparison of Ferrite and Nanocrystalline Common Mode Chokes	156
Jörn Schliewe, Christian Paulwitz, Stefan Weber, Epcos, D	
Modelling an Anti-Ferroelectric Ceramic Capacitor for Time- and Frequency-Domain Simulations of Power Systems	164
Stefan Scheffler, Markus Koini, Stefan Weber, Epcos, D; Markus Puff, Epcos, AT	

SiC Reliability

- Breakdown of Gate Oxide of 1.2 kV SiC-MOSFETs Under High Temperature and High Gate Voltage** 172
 Menia Beier-Möbius, Josef Lutz, Chemnitz University of Technology, D

- Avalanche Robustness of SiC MPS Diodes** 180
 Thomas Basler, Roland Rupp, Rolf Gerlach, Bernd Zippelius, Infineon Technologies, D; Mihai Draghici, Infineon Technologies, AT

- Compact, Low Loss and High Reliable 3.3 kV Hybrid Module** 188
 Satoshi Kaneko, Naoyuki Kanai, Motohiro Hori, Nakazawa Masayoshi, Hideaki Kakiki, Yasushi Abe, Yoshinari Ikeda, Eiji Mochizuki, Fuji Electric, J

DC/DC Converters I

- Isolated Synchronous Forward Controller with Integrated Feedback Loop and Adjustable Dead Time for High Efficiency DC/C Converter** 195
 Bernhard Strzalkowski, Analog Devices, D; Subodh Madiwale, Gabriele Bernardinis, Michael Daly, Analog Devices, USA

- Extreme High Efficiency Non-Inverting Buck-Boost Converter for Energy Storage Systems** 202
 Zhe Yu, Holger Kapels, Fraunhofer Institute ISIT, D; Klaus F. Hoffmann, Helmut Schmidt University, D

- A High-Efficiency Bidirectional GaN-HEMT DC/DC Converter** 210
 Michael Ebli, Martin Wattenberg, Universtiy of Reutlingen, D; Martin Pfost, University of Innsbruck, AT

Control Converters

- Direct Delta Sigma Signal Processing for Control of Power Electronics** 216
 Michael Homann, Axel Klein, Walter Schumacher, Technical University of Braunschweig, D

- Finite Control Set Model Based Predictive Control of a PMSM with Variable Switching Frequency and Torque Ripple Optimization** 224
 Fernando David Ramirez Figueroa, Mario Pacas, University of Siegen, D

- Frequency- and Mode-Adaptive Control of DC-DC Converter for Efficency Improvement** 232
 Lukas Keuck, Farshid Almai, Sven Bolte, Norbert Fröhleke, Joachim Böcker, University of Paderborn, D

Control Techniques in Intelligent Motion Systems I

- Load Torque Estimation in Repetitive Mechanical Systems by Using Fourier Interpolation** 240
 Van Trang Phung, Mario Pacas, University of Siegen, D

- Fast Current Waveform Calculation Algorithm for a Six Phase Switched Reluctance Machine** 248
 Jacek Borecki, Bernd Orlík, University of Bremen, D

- Process Requirements-Based Adaptive PWM for Improved Efficiency of Machine Tool Feed-Drives** 256
 Matthias Braband, Florian Frick, Armin Lechler, Alexander Verl, ISW – University of Stuttgart, D

DC/AC Converters

Comparison of Bidirectional T-Source Inverter and Quasi-Z-Source Inverter for Extra Low Voltage Application	264
Thomas Baier, Bernhard Piepenbreier, Friedrich-Alexander-University Erlangen, D	
Benchmarking of SiC JFET and SiC MOSFET Modules for the Application in Medium Power Traction Converters	272
Andreas März, Roman Horff, Teresa Bertelshofer, Mark-M. Bakran, University of Bayreuth, D; Martin Helsper, Siemens, D	
New Bus-bar Topology to Suppress the Current Imbalance of Parallel-connected IGBT Modules for High Power Railway.....	280
Naoki Sakurai, Masaoki Konishide, Yasuhiko Kohno, Hitachi, J	

GaN Converters

 EMI Investigation in a GaN HEMT Power Module.....	288
Xiaoshan Liu, Francois Costa, Bertrand Revol, Cyrille Gautier, ENS Cachan- SATIE, F	
Ultra-High Frequent Switching with GaN- HEMTs using the Coss-Capacitances as non-dissipative Snubbers	296
Hubert Berger, Luis Alfonso Fernández-Serantes, Wolfgang Stocksreiter, Gerald Weis, University of Applied Sciences Joanneum, AT	
eGaN® FET based 6.78 MHz Differential-Mode ZVS Class D AirFuel™ Class 4 Wireless Power Amplifier	304
Michael de Rooij, Yuanzhe Zhang, Efficient Power Conversion Corporation, USA	
High Frequency, High Temperature designed DC/DC Coreless Converter for GaN Gate Drivers	312
Yohan Wanderloid, Dominique Bergogne, CEA Leti, F; Hubert Razik, University Claude Bernard Lyon, F	
Monolithic GaN-on-Si Half-Bridge Circuit with Integrated Freewheeling Diodes	319
Richard Reiner, Patrick Waltereit, Beatrix Weiss, Matthias Wespel, Michael Mikulla, Rüdiger Quay, Oliver Ambacher, Fraunhofer-Institute IAF, D	

Module Design

Resin Encapsulation Combined with Insulated Metal Baseplate for Improving Power Module Reliability	326
Shinsuke Asada, Satoshi Kondo, Yusuke Kaji, Hiroshi Yoshida, Mitsubishi Electric Corporation, J	
An Experimental Study on the Thermal Performance of Double-Side Direct-Cooling Power Module Structure	331
Akira Matsushita, Ryuichi Saito, Takeshi Tokuyama, Takashi Kimura, Hitachi Automotive Systems, J; Kinya Nakatsu, Hitachi, J	
New Transfer Mold DIPIPM™ Utilizing Silicon Carbide (SiC) MOSFET	336
Yazhe Wang, Kiyoto Watabe, Shinji Sakai, Toshikazu Tanioka, Mitsubishi Electric Corporation, J	
A 1700 V-IGBT module and IPM with new insulated metal baseplate (IMB) featuring enhanced Isolation Properties and Thermal Conductivity	342
Takuya Takahashi, Yoshitaka Kimura, Hiroshi Yoshida, Hidetoshi Ishibashi, Yoshitaka Otsubo, Mitsubishi Electric Corporation, J	

NHPD² (Next High Power Density Dual) with Next Generation Chip Suitable for Low Internal Inductance Package	348
Daisuke Kawase, Kazuhito Nagashima, Tomohisa Hirayama, Katsunori Azuma, Seiichi Hayakawa, Hitachi Power Semiconductor, J; Katsuaki Saito, Hitachi Europe, GB	

Power Electronics in Transmission Systems in Smart Grids

An Optimized Hybrid-MMC for HVDC	355
Viktor Hofmann, Mark-M. Bakran, University of Bayreuth, D	

Selective HVDC Transmission Line Breaking for Bus Bar Applications under Reduced Expenses	363
Rene Sander, Michael Suriyah-Jaya, Thomas Leibfried, Karlsruhe Institute of Technology, D	

Decentralized Controller for Modular Multilevel Converter.....	371
Seleme Isaac Seleme Jr., Federal University of Minas Gerais – UFMG, BR; Luc-André Grégoire, Marc Cousineau, Philippe Ladoux, University of Toulouse, F	

Power Converters for PV Systems with Energy Storage: Optimal Power Flow Control for EV's Charging Infrastructures	379
Mauro Di Monaco, Umberto Abronzini, Ciro Attaianese, Matilde Arpino, Giuseppe Tomasso, University of Cassino and South Lazio, I	

Special Session “E-Mobility”

Modular and Comfortable Electromobility	386
Mihai Dragan, Bernhard Budaker, Jonathan Brix, Fraunhofer Institute IPA, D	

Power Hardware-in-the-Loop Emulation of Permanent Magnet Synchronous Machines with Nonlinear Magnetics – Concept & Verification	393
Alexander Schmitt, Jan Richter, Michael Braun, Martin Doppelbauer, Karlsruhe Institute of Technology, D	

Multimode Charging of Electric Vehicles – A combined Concept with Multiple Use of Components and Strategies for Decreasing Power Losses, Weight and Volume	401
Marco Jung, René Marklein, Georgios Lempidis, Jonas Steffen, Axel Seibel, Jörg Kirchhof, Roland Gaber, Fraunhofer Institute IWES, D	

Design of Contactless Energy Transfer System for an Electric Vehicle	410
Mike Böttigheimer, Nejila Parspour, Marco Zimmer, Anna Lusiewicz, University of Stuttgart, D	

High Power Semiconductor

3300 V HiPak2 modules with Enhanced Trench (TSPT+) IGBTs and Field Charge Extraction Diodes rated up to 1800 A	417
Chiara Corvasce, Maxi Andenna, Liutauras Storasta, Sven Matthias, Arnost Kopta, Munaf Rahimo, Luca De Michielis, Silvan Geissmann, Raffael Schnell, ABB Switzerland, CH	

Durable Design of the New HVIGBT Module	425
Nobuhiko Tanaka, Kenji Ota, Shuichi Kitamura, Shinichi Lura, Keiichi Nakamura, Mitsubishi Electric Corporation, J; Eugen Wiesner, Eckhard Thal, Mitsubishi Electric Europe, D	

The 62Pak IGBT Module Range Employing the 3rd Generation 1700 V SPT++ Chip Set for 175 °C Operation.....	432
Sven Matthias, Chiara Corvasce, Athanasios Mesemanolis, Emilia Gustafsson, Charalampos Papadopoulos, Arnost Kopta, Silvan Geissmann, Martin Bayer, Raffael Schnell, Munaf Rahimo, ABB Switzerland, CH	
Extended Power Rating of 1200 V IGBT Module with 7G-RC-IGBT Chip Technologies	438
Misaki Takahashi, Souichi Yoshida, Akira Tamenori, Yasuyuki Kobayashi, Osamu Ikawa, Fuji Electric, J; Daniel Hofmann, Fuji Electric Europe, D	

Multi Level Converters

 DC-DC Converter based on the Asymmetric Multistage Stacked Boost Architecture with Feed-Forward Control for Photovoltaic Plants	445
Georgios Mademlis, Aristotle University of Thessaloniki, GR; Gina Steinke, Alfred Rufer, EPFL – Ecole polytechnique fédérale de Lausanne, CH	
A Novel Submodule Concept for Modular Multilevel Converters	453
Benjamin Ruccius, Nicola Burani, Dirk Malipaard, Fraunhofer Institute IISB, D; Marek Galek, Siemens, D	
Electro-Thermal Design of a Modular Multilevel Converter Prototype	461
Emilien Coulinge, Alexandre Christe, Drazen Dujic, EPFL – Ecole Polytechnique Fédérale de Lausanne, CH	

DC/DC Converters II

 Non-isolated Three-Port DC/DC-Converter for ±380VDC Microgrids	469
Yunchao Han, Julian Kaiser, Leopold Ott, Matthias Schulz, Fabian Fersterra, Bernd Wunder, Martin März, Fraunhofer Institute IISB, D	
Wide Voltage Input Range Insulated Current Fed Buck Flyback-Forward for HV/LV Power Conversion in Electric/Hybrid Vehicle	477
Reda Chelghoum, Luis De Sousa, Larbi Bendani, Valeo, F; Daniel Sadarnac, CentraleSupélec, F	
SiC JFET Cascode Enables Higher Voltage Operation in a Phase Shift Full Bridge DC-DC Converter	484
Jonathan Dodge, United Silicon Carbide, USA	

Lamp Ballasts Lighting Systems

Detailed Comparison of One Stage Topologies for LED Lighting Applications	492
Alexander Pawellek, Thomas Dürbaum, Friedrich-Alexander-University Erlangen, D	
Low Cost High Density AC-DC Converter for LED Lighting Applications	501
Simon Nigsch, Janosch Marquardt, Kurt Schenk, University of Applied Sciences NTB Buchs, CH	
Design Optimization for a High Power-Density, Wide Output, High Frequency LLC Resonant Converter for Lighting Applications	509
Janosch Marquart, Simon Nigsch, Kurt Schenk, University of Applied Sciences NTB Buchs, CH	

Sensorless Motor Control

Computationally efficient Anisotropy-Identification based on a Square-Shaped Injection Pattern	518
Peter Landsmann, Dirk Paulus, Sascha Kühl, Ralph Kennel, Technical University of Munich, D	

Estimation of the Excitation Current and the Rotor Resistance of an Externally Excited Synchronous Machine with an Inductively Supplied Excitation Coil	526
Stefan Köhler, Bernhard Wagner, Technical University Nuremberg Georg Simon Ohm, D; Stefan Endres, Fraunhofer Institute IISB, D	
High Speed Sensorless Control of a Synchronous Motor with Kalman Filter	534
Philipp Niedermayr, Alpitronic, I; Silverio Bolognani, Luigi Alberti, University of Padova, I; Reiner Abl, BMW, D	

Software Tools and Applications

Physical Modeling and High-Fidelity Simulation of the Transient Behavior of Multiply-Contacted Power Busbars	543
Vanessa Basler, Wolfgang Hözl, Gerhard Wachutka, Technical University of Munich, D	
Small-signal Output Impedance Modeling of Intersil's R4TMTTechnology	550
Yi Huang, Chun Cheung, Intersil Corporation, USA	
An Approach of Reinforcement Learning Based Lighting Control for Demand Response	558
Xinxing Pan, Brian Lee, AIT, IE	

Cosmic Ray & Ruggedness

 Cosmic Ray Failure Mechanism and Critical Factors for 3.3 kV Hybrid SiC Modules	566
Tetsuya Nitta, Yoko Sakiyama, Raita Kotani, Tomoki Inoue, Ryoichi Ohara, Kenya Sano, Masakazu Yamaguchi, Toshiba, J; Georges Tchouangue, Toshiba Electronics Europe, D	
 Benefits of Increased Cosmic Radiation Robustness of SiC Semiconductors in large Power-Converters	573
Christian Felgemacher, Samuel Araujo Vasconcelos, Christian Nöding, Peter Zacharias, University of Kassel, D	
Passive IGBT Turn-off during Short-circuit Type V	581
Jan Fuhrmann, Hans-Günter Eckel, University of Rostock, D; Sebastian Klauke, Infineon, D	
High-Current Power Cycling Test-Bench for Short Load Pulse Duration and First Results	588
Guang Zeng, Christian Herold, Menia Beier-Möbius, Josef Lutz, Technical University of Chemnitz, D; Sascha Kubera, Rodrigo Alvarez, Siemens, D	
Issues in Testing Advanced Power Semiconductor Devices	596
Gabor Farkas, Mentor Graphics, HU; Zoltan Sarkany, Marta Rencz, BME, HU	

Special Session “Smart Lighting”

Smart Lighting – Requirements for Modern Lighting Systems and Expected Trends	604
Diederik de Stoppelaar, LightingEurope, BE	
Special requirements on a SMPS for LED-Lighting Purposes by an Example of an Individual High-End LED-Driver Solution	605
Florian Müller, Stefan Raithel, Vossloh-Schwabe Lighting Solutions, D	
The seven challenges of LED lighting	612
Claudio Adragna, Francesco Ferrazza, Giovanni Gritti, STMicroelectronics, I	

Highly Flexible Single Stage Flyback Quasi-Resonant Digital Controller for Advanced LED Applications	620
Marc Fahlenkamp, Infineon Technologies, D	

New and Renewable Energy Systems

Carrier-Based Modulation Technique to Reduce Low Frequency Ripple at the Partial Dc-Link Voltages of a Three-Level-/Phase-/Wire NPC Converter Applied to Future Dc Bipolar Active Distribution Networks	621
Joabel Moia, Marcelo Heldwein, Federal Institute of Santa Catarina – IFSC, BR	
FPGA Based Direct Model Predictive Power and Current Control of 3L NPC Active Front Ends	629
Zhenbin Zhang, Ralph Kennel, Technical University of Munich, D	
Scalable Insulated DC/DC Converters for Safe and Efficient Coupling of Fuel Cells, Electrolyzers and DC Grids	637
Bernd Seliger, Stefan Matlok, Stefan Zeltner, Fraunhofer Institute IISB, D	
SiC MW PV Inverter	645
Maja Harfman Todorovic, Ljubisa Stevanovic, Gary Mandrusiak, Brian Rowden, Fengfeng Tao, Philip Cioffi, Jeffrey Nasadoski, Rajib Datta, GE Research Center, USA; Fabio Carastro, Tobias Schuetz, Robert Roesner, GE Research Center, D	

Power Electronics in Automotive

A Performance Comparison of a 650 V Si IGBT and SiC MOSFET Inverter under Automotive Conditions	653
Teresa Bertelshofer, Roman Horff, Andreas März, Mark-M. Bakran, University of Bayreuth, D	
  A Generic Topology for Electrical Energy Storage Systems	661
Christoph Marxgut, Helbling Technik, Dli	
Pulse Width- and Frequency Modulated DC/DC Converter for Hybrid- and Electrical Vehicles	669
Magnus Böh, Andreas Lohner, Technical University of Cologne, D; Christoph Engelhard, HELLA KGaA Hueck	
New High Power Density Modules for EV/HEV Applications	677
Seiichiro Inokuchi, Shoji Saito, Arata Izuka, Hata Yuki, Shinji Hatae, Mitsubishi Electric Corporation, J; Khalid Hussein, Mitsubishi Electric Europe, D	

Module Technology

Fault-Tolerant B6-B4 Inverter Reconfiguration with Fuses and Ideal Short-On Failure IGBT Modules	683
Michael Gleißner, Mark-M. Bakran, University of Bayreuth, D	
Statistical Evaluation of Current Imbalance in Parallel Devices	691
Uwe Scheuermann, Semikron Elektronik, D	
Batch Purity in Semiconductor Power Modules	698
Christian Aggen, Henning Ströbel-Maier, Matthias Mau, Jürgen Laue, Marco Bäßler, Danfoss Silicon Power, D	

Novel Technique to Reduce Substrate Tilt & Improve Bondline Control between AlN Substrate & AlSiC Baseplate in IGBT Modules	704
James Booth, Paul Mumby-Croft, Matthew Packwood, Kim Evans, Andy Dai, Dynex Semiconductor, GB; Karthik Vijay, Indium Corporation, GB	

Drive Strategies in Power Converters

Communicating Gate Driver for SiC MOSFET	712
Christophe Bouquet, Nicolas Ginot, Christophe Batard, University of Nantes, F	

  New Ultra Fast Short Circuit Detection Method Without Using the Desaturation Process of the Power Semiconductor	720
Stefan Hain, Mark-M. Bakran, University of Bayreuth, D	

 High Power, High Frequency Gate Driver for SiC-MOSFET Modules	728
Gunter Königsmann, Reinhard Herzer, Sven Buetow, Matthias Rossberg, Semikron Elektronik, D	

Integrating a real-time T_{vj} calculation into an IPM	735
Stefan Schmies, Peter Lahl, Wolfram Kruschel, Matthias Lassmann, Infineon, D	

Energy Storage

12 V Lithium Ion Starter Batteries	742
Hans-Georg Schweiger, Enrique Machuca, Jonas Löchel, Technical University of Ingolstadt, D	

Electric Vehicles Batteries Modeling Analysis Based on a Multiple Layered Perceptron Identification Approach	750
Sender Rocha dos Santos, Thais Tóssoli de Sousa, Alex Pereira França, CPqD, BR	

An Efficient Implementation of a Reconfigurable Battery Stack with Optimum Cell Usage	757
Martin Wattenberg, Reutlingen University, D; Martin Pfost, University of Innsbruck, AT	

Comparative Study and Evaluation of Passive Balancing Against Single Switch Active Balancing Systems for Energy Storage Systems	763
Iosu Aizpuru, Unai Iraola, Jose Mari Canales, Ander Goikoetxea, Mondragon University, ES	

Control Techniques in Intelligent Motion Systems II

Voltage Levels Comparison and System Optimization for Electric Drives in Hybrid Vehicles	772
Quentin Werner, Daimler, D; Serge Pierfederici, Noureddine Takorabet, University de Lorraine, F	

Real-Time Capable Model Predictive Control of Permanent Magnet Synchronous Motors Using Particle Swarm Optimisation	780
Oliver Wallscheid, Joachim Böcker, University of Paderborn, D; Ulrich Ammann, Esslingen University of Applied Sciences, D	

A Modular Multilevel Matrix Converter for High Speed Drive Applications	788
Dennis Bräckle, Felix Kammerer, Mathias Schnarrenberger, Marc Hiller, Michael Braun, Karlsruhe Institute of Technology, D	

Smart Supercapacitor based DC-link Extension for Drives offers UPS Capability and acts as an Energy Efficient Line Regeneration Replacement	796
Jens Onno Krah, Markus Höltgen, David Langhals, Technical University of Cologne, D; Nico Sieweke, Christoph Klarenbach, Beckhoff Automation, D	

MOSFET, IGBTs, Freewheeling Diodes

New LV Wide SOA Power MOSFET Technology for Linear Mode Operation	804
Filippo Scrimizzi, Gaetano Bazzano, Daniela Cavallaro, Marco Comola, Giuseppe Consentino, Stefania Fortuna, Giuseppe Longo, Gaetano Pignataro, STMicroelectronics, I	
Field Stop Trench IGBT Process Parameter Calibration for Advanced Predictive Prototyping	813
Mehrdad Baghaie Yazdi, Hermann Fischer, James Victory, Fairchild Semiconductor, D; Detlef Conrad, Synopsys, D	
Best-in-class 1200 V IGBT for High Frequency Applications	819
Ramakrishna Tadikonda, Jorge Cerezo, Chiu Ng, Infineon Technologies Americas, USA	
Extra Electro-Termal Performance of 1700V IGBT with the Latest 7th Generation Chipset/ Package Technologies	824
Thomas Heinzel, Fuji Electric Europe, D; Mutsumi Sawada, Shinichi Yoshiwatari, Hiroaki Ichikawa, Yuichi Onozawa, Osamu Ikawa, Fuji Electric, J	
Parameter Extraction for PSpice Models by Means of an Automated Optimization Tool – An IGBT model Study Case	831
Carlos Gomez Suarez, Francesco Iannuzzo, Paula Diaz Reigosa, Ionut Trintis, Frede Blaabjerg, Aalborg University, DK	
800 V Super Junction MOSFET (HV-DTMOS IV) with Better Trade-Off Between Switching Loss and dVDS/dt	839
Hiroyuki Irfune, Hiroshi Ohta, Kaga Toshiba Electronics Corporation, J; Hiroaki Yamashita, Hideyuki Ura, Kenji Mii, Masato Nashiki, Naotsugu Kako, Toshiba Corporation Semiconductor, J; Georges Tchouangue, Toshiba Electronics Europe, D	
Highly Robust 1700 V Diodes Fabricated on 8"Line Using Optimized Proton Implanted Buffer	845
Maolong Ke, Haihui Luo, Ian Deviny, Xiaoping Dai, Jianwei Huang, Guoyou Liu, Dynex Semiconductor, GB	
Loss and Softness Optimized IGBT-Diode System for Fast-Switching Applications	850
Christian Müller, Stefan Buschhorn, Infineon Technologies, D	

Intelligent Power Modules

Protection Features of Intelligent Power Module against Transient State	858
Taehyun Kim, Minsub Lee, Junbae Lee, Daewoong Chung, Infineon Technologies Power Semitech, ROK	
New High Level Integrated Intelligent Power Module with Three Phase Inverter and Power Factor Correction Topologies Optimized for Home Appliance	863
Hyosang Jang, Byoungho Choo, Junbae Lee, Minsub Lee, Daewoong Chung, Infineon Technologies Power Semitech, ROK	
New DIPIPM+TM Series Module with All-in-one Integrated	871
Yuancheng Zhang, Xiankui Ma, Hongtao He, Gaosheng Song, Ming Shang, Mitsubishi Electric & Electronics, CN	
Improvement of System Level Power Density of 15 A / 600 V Intelligent Power Modules	877
Jonathan Harper, ON Semiconductor, D	
Optimization of FREDFET-based µIPMTM for very Low Power Motor Drive Applications	882
Rajeev Krishna Vytla, Danish Khatri, Brian Sun, Infineon Technologies North America, USA	

A novel Transfer Molding Intelligent Converter Inverter Brake IGBT Module (DIPIPM+) with Integrated Level Shifting Control ICs	889
Marco Honsberg, Mitsubishi Electric Europe, D; Teruaki Nagahara, Mitsubishi Electric Corporation, J; Eric R. Motto, Powerex, USA	
An Automatic IGBT Collector Current Sensing Technique via the Gate Node	895
Jingxuan Chen, Andrew Shorten, Wai Tung Ng, University of Toronto, CA; Masahiro Sasaki, Tetsuya Kawashima, Haruhiko Nishio, Fuji Electric, J	

High Voltage Devices

Design and Characterisation of Optimised Protective Thyristors for VSC Systems	903
Michael Spence, Ashley Plumpton, Colin Rout, Alan Millington, Richard Keyse, Dynex Semiconductor, GB	

Cathode Emitter vs. Carrier Lifetime Engineering of Thyristors for Industrial Applications	911
Jan Vobecky, Marco Bellini, Karlheinz Stiegler, ABB Switzerland, CH	

Experimental Results of a Large Area (91 mm) 4.5 kV “Bi-Mode Gate Commutated Thyristor” (BGCT)	917
Thomas Stiasny, Umamaheswara Reddy Vemulapati, Martin Arnold, Munaf Rahimo, Jan Vobecky, ABB Switzerland, CH; Christian Kährl, Norbert Hofmann, University of Applied Sciences Nordwestschweiz, CH	

  Effect of Self Turn-On during Turn-On of HV-IGBTs	924
Patrick Münster, Daniel Lexow, Hans-Günter Eckel, University of Rostock, D	

An Innovative 6500 V HVIGBT with High Robustness	932
Bo Hu, Gaosheng Song, Mitsubishi Electric & Electronic, CN	

New High Power 3.3 kV / 1500 A IGBT Module Packaging	938
Daohui Li, Wei Zhou, Fang Qi, Matthew Packwood, Yangang Wang, Steve Jones, Xiaoping Dai, Dynex Semiconductor, GB	

The LinPak High Power Density Design and its Switching Behaviour at 1.7 kV and 3.3 kV	945
Samuel Hartmann, Fabian Fischer, Andreas Baschnagel, Harald Beyer, Raffael Schnell, Christian Treier, ABB Switzerland, CH	

Power Converter GTO to IGBT Upgrade – a New Life for Traction Converters	953
Luis Sequeira, Augusto Franco, Adriano Carvalho, Nuno Freitas, Nomad Tech, PT	

Packaging Technologies and Materials

Aspects of Reliability Improvement for Large Area Power Semiconductor Devices through Sintering	957
Dmitry Titushkin, Alexey Surma Proton-Electrotex JSC, RUS; Michiel De Monchy, Anna Lifton, Alpha, RUS	

Analysis of Interface Structure and Composition of Cu/Al₂O₃ for the High Stability of DBC (Direct Bonded Copper)	961
Hyunwoo Kim, Jaehoon Jung, Hanna Choi, Kisoo Jun, KCC Corporation, ROK	

Power Stack – Advantages and Reliability of an Aluminum Based Stacked Power Module	969
Chris Burns, AB Mikroelektronik, AT	

Evaluation of Metal-Matrix composites Baseplates with anisotropic thermal Conductivity Inserts	976
Fabian Streb, Infineon Technologies, D; Henning Zeidler, Michael Penzel, Andreas Schubert, Thomas Lampke, Technical University of Chemnitz, D	

Analysis of Packaging Impedance on Performance of SiC MOSFETs	984
Andrew Lemmon, Levi Gant, The University of Alabama, USA; Sujit Banerjee, Kevin Matocha, Monolith Semiconductor, USA	
Low-Stress Silicone Encapsulant for Reliable Power Conversion Devices	992
Guy Beaucarne, Eric Vanlathem, Dow Corning Europe, B; Lu Zhou, Dow Corning, CN; Kent Larson, Dow Corning Corporation, USA	
Pumping out Failure Free Package Structure	996
Junji Yamada, Yoshitaka Otsubo, Mitsubishi Electric Corporation, J; Satoshi Miyahara, Mitsubishi Electric, D	
High power IGBT Module with New AlN Insulated Substrate	1001
Hiroyuki Nogawa, Akira Hirao, Yoshitaka Nishimura, Takashi Saitou, Yuuta Tamai, Fumihiko Momose, Eiji Mochizuki, Yoshikazu Takahashi, Fuji Electric, J	
Nanosilver Paste for Low Pressure Die Attach: A Turn Key Process	1009
Francesc Masana, Barcelona Semiconductors, ES	
New Silicone Gel Enabling High Temperature Stability for next Generation of Power Modules	1017
Thomas Seldrum, Eric Vanlathem, Vincent Delsuc, Dow Corning, BE; Hiroji Enami, Dow Corning Toray, J	
A New Ag Paste Composed by Nano and Micro-Ag Particles prepared Simultaneously and Application as Die-attachment Materials	1021
Katsuaki Suganuma, Jinting Jiu, Hao Zhang, Shunsuke Koga, Shijo Nagao, Osaka University, J	

Packaging and Reliability

Reliability of Double Side Silver Sintered Devices with various Substrate Metallization	1027
Francois LeHenaff, Alpha Assembly Solutions, D; Gustavo Greca, Paul Salerno, Oscar Khaselev, Monnir Boureghda, Jeffrey Durham, Anna Lifton, Alpha Assembly Solutions, USA; Olivier Mathieu, Martin Reger, Rogers Germany, D; Zoltan Sarkany, Weikun He, Joe Proulx, John Parry, Mentor Graphics, UK; Jean Claude Harel, Satyavrat Laud, Renesas Electronics America, USA	
New Interconnect Materials: For Future High Reliable Power Module Assembly	1035
Stieven Josso, Henkel Electronics, BE	
Encapsulation of Smart Power Electronic Devices – Thermal Degradation and Dielectric Behavior	1040
Tina Thomas, Technical University of Berlin, D; Karl-Friedrich Becker, Klaus-Dieter Lang, Fraunhofer Institute IZM, D	
Improvement of the Mechanical Properties of Sn-Ag-Sb Lead-Free Solders: Effects of Sb Addition and Rapidly Solidified	1046
Mohammed Gumaan, Rizk Shalaby, Mustafa Kamal, Mansoura University, AE; Esmail A. Ali, University of Science and Technology Yemen, YE	
Health-Monitoring of IGBT Power Modules using repetitive Half-sinusoidal Power Losses	1055
Marco Denk, Mark-M. Bakran, University of Bayreuth, D	
Reliability Investigation on SiC BJT Power Modules	1063
Alexander Otto, Sven Rzepka, Fraunhofer-Institute ENAS, D; Eberhard Kaulfersch, Berliner Nanotest & Design, D; Sophia Frankeser, Technical University of Chemnitz, D; Klas Brinkfeldt, Swerea IVF AB, SE; Olaf Zschieschang, Fairchild Semiconductor, D	

Investigation of the Influence of Ageing Processes on Thermal Characteristics of an IGBT Power Module by Means of Transient Thermal Analysis	1072
Tobias von Essen, Berliner Nanotest & Design, D; Stefan Stegmeier, Gerhard Mitic, Siemens, D	
Test Setup for Multistress Characterization of Insulation Degradation Mechanisms in Electric Drives	1073
Davide Barater, Alessandro Soldati, Giorgio Pietrini, Giovanni Franceschini, Università degli Studi di Parma, I; Chris Gerada, Michael Galea, University of Nottingham, GB; Fabio Immovilli, Raw Power, I	
Integration of a Measurement Circuit to determine Junction Temperatures of IGBTs in a Three-phase Converter	1081
Bastian Strauss, Andreas Lindemann, Otto-von-Guericke-University, D	
A Recuperation Topology for Power Device Testing	1089
Tomas Krecek, ON semiconductor, CZ	
Electrolytic Capacitor Age Estimation using PRBS-Based Techniques	1095
David Hewitt, James Green, Jonathan Davidson, Martin Foster, David Stone, University of Sheffield, GB	
On-line Monitoring for Diagnosis on Traction Transformer for Rolling Stock Application	1103
André-Philippe Chamaret, SNCF, F; Toufann Chaudhuri, ABB Sécheron, CH	
 Cooling	
Direct-Water-Cooled Next High Power Density Dual (nHPD2) Considering Inverter Layout	1110
Keisuke Horiuchi, Yuichiro Konishi, Mutsuhiko Mori, Daisuke Kawase, Hitachi, J; Katsuaki Saito, Hitachi Europe, GB	
Heat Pipes used as Heat Flux Transformers and for Remote Heat Rejection	1118
Devin Pellicone, Jens Weyant, Advanced Cooling Technologies, USA	
Direct Flexible Cooling of an IGBT	1125
Jörg Ihrig, Mersen, CH; Alexandre Erokhin, CERN, CH	
New Class of Graphite TIMs provide Performance and Reliability	1126
Prasanth Subramanian, Alex Augoustidis, GrafTech International, USA	
Heat Pipe System Development for Railway Application working with speed Motion Convection	1132
Thomas Albertin, Atherm, F	
High Performances Passive Two-Phase Loops for Power Electronics Cooling	1139
Vincent Dupont, Cyrille Billet, Thomas Nicolle, Calyos, BE	
Thermal Modelling and Management for increasing the Power Density in High Current Power Electronic Systems	1147
Marco Schilling, Benjamin Köhnlechner, Ulf Schwalbe, Tobias Reimann, Technical University of Ilmenau, D	
Packaging and Characterization of Silicon SiC-based Power Inverter Module with Double Sided Cooling	1155
Charles-Alix Manier, Hermann Oppermann, Lothar Dietrich, Christian Ehrhardt, Fraunhofer-Institute IZM, D; Zoltán Sárkány, Budapest University of Technology and Economics, HU; Bernhard Wunderle, Technical University of Chemnitz, D; Wilhelm Maurer, Infineon Technologies, D; Radoslava Mitova, Klaus-Dieter Lang, Technical University of Berlin, D	

Sensors, Control and Protection

Digital Adaptive Control Approach to Dynamic Response Improvement for Compact PFC Rectifiers	1163
Trong Tue Vu, George Young, Eisergy, IE	
Nonlinear Output Characteristic of DAB Converter caused by ZVS Transition	1171
Martin Jagau, Michael Patt, Technologienetzwerk Allgäu, D	
Efficiency Maximization for Half-Bridge LC Converter through Automatic Dead Time Tuning	1178
Vittorio Crisafulli, ON Semiconductor, D; Gianluca Fazio, On Semiconductor Italy, I; Diego Hernandez Gutiérrez, CH	
Improved Finite Control Set Model Predictive Control with Fixed Switching Frequency for Three Phase NPC Converter	1186
Margarita Norambuena, Hang Yin, Sibylle Dieckerhoff, Technical University of Berlin, D; Jose Rodriguez, University Andres Bello, CL	
Current Sensorless Totem-pole Bridgeless Power Factor Corrector	1194
Felipe López, Francisco Azcondo, Paula Lamo, Alberto Pigazo, University of Cantabria, ES	
State Space Model for n-Parallel Connected DC-DC Converters with Predictive Current Control Strategy	1201
Aditya Shekhar, Pavol Bauer, Laurens Mackay, Laura Ramirez-Elizondo, Delft University of Technology, NL	
Parameter-Independent Battery Voltage Control Based on Virtual Capacitor Emulation	1209
Andoni Urtasun, Ernesto L. Barrios, Pablo Sanchis, Luis Marroyo, Public University of Navarre, ES	
FPGA Digital Control for VSI Nonlinearity Effect Compensation	1217
Mauro Di Monaco, Umberto Abronzini, Ciro Attaianese, Matilde Arpino, Giuseppe Tomasso, University of Cassino and South Lazio, I	
Offline Non Isolated Converter Protection	1224
Cathal Sheehan, Bourns Electronics, IE; Roberto Scibilia, Texas Instruments, D	
Optimisation of Shunt Resistors for Fast Transients	1232
Melanie Adelmund, Christian Bödeker, Nando Kaminski, University of Bremen, D	
High Bandwidth Current Sensors as an Enabler for Advanced Control Techniques	1240
Rolf Slatter, Sensitec, D	
Rotational Speed Measurement Based on Avago ADNS-9800 Laser Mouse Sensor	1248
Cheng Liu, Yanan Xu, Ji-Gou Liu, Hui Sun, Chenyang Technologies, D; Ralph Kennel, Technical University of Munich, D	

Low EMI high efficiency converters

Practical EMI Control in a Power Component Design Space	1253
David Bourner, Vicor Corporation, USA	
Converter Switching Noise Reduction for Enhancing EMC Performance in HEV and EV	1262
Ho Tae Chun, SeungHyun Han, ChangHan Jun, JeongYun Lee, JaeWon Lee, JeeHye Jeong, JeongHong Joo, JinHwan Jung, Hyundai Motors Company, ROK	
Efficiency and Vibration Observations of a Symmetrical Six-Phase Drive applying Interleaved Space Vector Modulation	1270
Daniel Glose, Peng Qian, Ralph Kennel, Technical University of Munich, D	



- High Efficiency Three-Phase-Inverter with 650 V GaN HEMTs** 1278
 Jennifer Lautner, Bernhard Piepenbreier, Friedrich-Alexander-University of Erlangen, D



- A Large Input Voltage Range 1 MHz Full Converter with 95 % Peak Efficiency for Aircraft Applications** 1286
 Nicolas Quentin, SAGEM, F; Remi Perrin, INSA de Lyon, F; Christian Martin, Charles Joubert, Ampere Laboratory, F; Louis Grimaud, Safran Group, F; Rolando Burgos, Dushan Boroyevich, CPES/Virginia Tech, USA

- Integrating Depletion-Mode SiC VJFETs into Production Motor Drives** 1294
 Michael Mazzola, James Gafford, Mississippi State University, USA; Gerald W. Godbold, Hyperion Technology, USA

- Higher Light Efficacy in LED-Lamps by Lower LED-Current** 1300
 Reinhard Jaschke, Klaus F. Hoffmann, Helmut Schmidt University Hamburg, D

- Synchronized Switching and Active Clamping of IGBT Switches in a Simple Marx Generator** 1305
 Martin Sack, Martin Hochberg, Georg Müller, Karlsruhe Institute of Technology, D

- High Efficient and Lightweight Auxiliary Power supply with new SiC Power Device** 1311
 Ryosuke Nakagawa, Mitsubishi Electric Corporation, Japan

- A New Behavioral Model for Accurate Loss Calculations in Power Semiconductors** 1315
 Ajay Poonjal Pai, Tomas Reiter, Infineon Technologies, D; Martin März, Fraunhofer Institute IISB, D



- High Speed Electronic Over Current Breaker for DC-Grids without Additional Sensing** 1324
 Alexander Würfel, Johannes Adler, Nando Kaminski, University of Bremen, D; Anton Mauder, Infineon Technologies, D

- Wireless Power Transmission with High Efficiency for Extensive Applications** 1332
 Markus Rehm, IBR Ingenieurbüro Rehm, D

Motors and Motor Drives

- Prevention of Traction Drives Stator Insulation Faults Based on Overvoltage Reduction Utilizing Active Edge Shaping** 1339
 Clemens Zöller, Thomas Hausberger, Mathias Blank, Tobias Glück, Hans Ertl, Andreas Kugi, Technical University Vienna, AT; Markus Vogelsberger, Bombardier Transportation Austria, AT

- Noise & Vibration Levels of modern Electric Motors** 1345
 Christoph Stuckmann, Maccon, D

- Development Platform and Techniques for the Rapid Implementation of High Performance Drives** 1353
 Christian Balke, Simon Wiedemann, Maccon, D

- Functional Safety for Integrated Circuits used in Variable Speed Drives** 1361
 Tom Meany, Analog Devices ERDC, IE

- A Sytem Approach To Understanding The Impact of Non-ideal Effects In A Motor Drive Current Loop** 1369
 Jens Sorensen, Analog Devices, USA; Dara O'Sullivan, Analog Devices, IE

- Gate Driver as Part of the Inverter Safety Concept: Optimizing Inverter's Design** 1377
 Laurent Beaurenaud, Infineon Technologies, D; Peter Sinn, Robert Bosch, D

Passive Components

Estimation of Ripple and Inductance Roll off when using Powdered Iron Core Inductors	1383
Gautham Ram Chandra Mouli, Pavol Bauer, Miro Zeman, Delft University of Technology, NL; Jos Schijffelen, Power Research Electronics, NL	
Optimized DC Link for Next Generation Power Modules	1391
Michael Brubaker, Terry Hosking, SBE, USA; Tomas Reiter, Infinoen Technologies, D; Laura D. Marlino, Madhu S. Chinthavali, Oak Ridge National Laboratory, USA	
In-Circuit-Characterization of Ceramic Capacitor with Anti-Ferroelectric Material for Voltage Source Inverters	1400
Jürgen Kropp, Mark-M. Bakran, University of Bayreuth, D	
Operability of Metallized Polypropylene Capacitors under High Pressure	1408
Magnar Hernes, Ole Christian Spro, SINTEF Energy Research, NO; Volker Gleitner, Electronicon Kondensatoren, D	
Application of High-Voltage 750 V Aluminum Electrolytic Capacitor in Inverter	1416
Kezhuang Yu, Mingkai Peng, Mianwei Qiu, Shenzhen Zeasset Electronic Technology, CN	
Analytic Loss Calculation for E-Core Inductors including the End Windings	1421
Johannes Heseding, Axel Mertens, Leibniz University Hannover, D	
The Applicability of Nanocrystalline Stacked and Block Cores for Power Electronics	1428
Cezary Swieboda, Marian Soinski, Marcin Kwiecien, Magneto, PL; Wojciech Pluta, Czestochowa University of Technology, PL; Jacek Leszczynski, AGH University of Science and Technology, PL	
The Benefit of Formed or Compacted Litz-Wire Coils	1434
Tobias Appel, STS, D; Hans Rossmanith, Friedrich-Alexander-University of Erlangen, D	
Development of a 100 kW, 20 kHz Nanocrystalline Core Transformer for DC / DC Converter Applications	1439
Kapila Warnakulasuriya, Carroll & Meynell Transformers, GB; Farhad Nabhani, Vahid Askari, Teesside University, GB	
Simulation of a 3-Phase Common- and Differential Mode Inductor on a Four-Limb Core	1447
Michael Owzareck, BLOCK Transformatoren-Elektronik, D; Nejila Parspour, University of Stuttgart, D	
Design Procedure for Pot-Core Integrated Magnetic Component	1455
Martin Foster, University of Sheffield, GB; Andrew Fairweather, Grant Ashley, Vxi Power, GB	
Investigation of Core Losses under Different Conditions Applying the Cross Power Method	1463
Boris Hudoffsky, PMK Mess- und Kommunikationstechnik, D; Chihiro Okinori, IWATSU Test Instruments, J; Jürgen Trüller, HF Instruments, D	
A Finite Element Simulation of Nanocrystalline Tape Wound Cores	1471
Christian Scharwitz, Holger Schwenk, Johannes Beichler, Werner Loges, Vacuumschmelze, D	

SiC and GaN

An Insightful Evaluation of a 650 V High-Voltage GaN Technology in Cascode and Stand-Alone Transistors	1479
Jaume Roig, German Gomez, Frederick Declercq, Filip Bauwens, On Semiconductor, BE; Manuel Fernandez, Diego Gonzalez, University of Oviedo, ES	

Static Characterization of Discrete State-of-the-Art SiC Power Transistors	1487
Michael Meisser, Horst Demattio, Thomas Blank, Karlsruhe Institute of Technology, D	
Analytical Losses Model for SiC Semiconductors dedicated to Optimization Operations	1494
Gnimdu Dadanema, Francois Costa, ENS Cachan - SATIE, F; Jean-Luc Schanen, Yvan Avenas, G2ELAB, F; Christian Vollaire, Laboratoire Ampere, F	
Current Measurement and Gate-Resistance Mismatch in Paralleled Phases of High Power SiC MOSFET Modules	1503
Roman Horff, Teresa Bertelshofer, Andreas März, Mark-M. Bakran, University of Bayreuth, D	
Gate Drive Strategies of SiC Cascodes	1511
Anup Bhalla, Xueqing Li, Shirley Zhang, United Silicon Carbide, USA	
State-of-the-art of HF Soft Magnetics and HV/UHV Silicon Carbide Semiconductors	1518
Geraldo Nojima, Faete Filho, Eaton Corporation, USA; Paul Ohodnicki, DOE-National Energy Technology Laboratory, USA; Alex Leary, Michael E. McHenry, Carnegie Mellon University, USA	
Comparison of Unipolar Silicon Carbide Power Transistors Used in High Switching Frequency Inverter Topologies	1528
Sebastian Fahlbusch, Nizar Sahli, Sebastian Klötzer, Ulf Müter, Björn Schäning, Klaus F. Hoffmann, Helmut Schmidt University Hamburg, D	
ST SiC MOSFETs in 1 MHZ DC-DC Converter	1536
Luigi Abbatelli, Giuseppe Catalisano, STMicroelectronics, I	
Towards a One Nano-Henry Power Module for SiC and GaN	1541
Jacques Laeuffer, Dtalents, F	
Scalable SiC Cascode Power Blocks	1549
Jonathan Dodge, Matt Grady, Ke Zhu, Anup Bhalla, United Silicon Carbide, USA	
High Power Density, High Efficiency 380v to 52v LLC Converter Utilizing Emode GaN Switches	1555
Moshe Domb, Infineon, USA	

Gate Drive Units

A Low Impedance Drive Circuit to Suppress the Spurious Turn On in High Speed Wide Band-Gap Semiconductor Halfbridges	1562
Franz Stubenrauch, Norbert Seliger, Doris Schmitt-Landsiedel, University Rosenheim, D	
Isolated Gate Driver for High Current/ High Speed FET-Converters	1570
Florian Kapaun, Rainer Marquardt, Universität der Bundeswehr Munich, D	
Simple Gate-boosting Circuit for Reduced Switching Losses in Single IGBT Devices	1578
Martin Hochberg, Martin Sack, Georg Müller, Karlsruhe Institute of Technology, D	
Stability and Performance Analysis of a Voltage Controlled Resistor Circuit for Wide Band-gap Device Gate Drivers	1584
Alessandro Soldati, Giorgio Pietrini, Davide Barater, Carlo Concari, Università degli Studi di Parma, I	
State of the Art of Gate-Drive Power Supplies for Medium and High Voltage Applications	1592
Layal Ghossein, Piotr Dworakowski, SuperGrid Institute, F; Hervé Morel, Florent Morel, Ampère, F	

The Optimized Gate Driver Design Techniques for IGBT Properties and Downsizing in Eco-Friendly Vehicle	1600
KangHo Jeong, SangChul Shin, KiYoung Jang, JinHwan Jung, KiJong Lee, JiWoong Jang, Hyundai Motors, ROK	
A Revisit to Resonant Gate Driver and a New Driver to Improve EMI vs. loss Tradeoff for SiC MOSFET	1608
Chi-Ming Wang, Toyota Motor Engineering & Manufacturing, USA	
Application and Design Considerations of CoolMOS™ CFD2 and EiceDRIVER™ IC in Motor Drive Application	1615
Wolfgang Frank, Michael Wendt, Infineon Technologies, D; Sam Abdel-Rahman, Infineon Technologies Americas, USA	
 AC-DC Converters and Power Supplies	
4D-Interleaving of Isolated ISOP Multi-Cell Converter Systems for Single Phase AC/DC Conversion	1622
Matthias Kasper, Michael Antivachis, Dominik Bortis, Johann Walter Kolar, ETH Zürich, CH; Gerald Deboy, Infineon Technologies, AT	
Battery Charger Based on a Triple-LCp Resonant Converter	1631
Christian Branas, Francisco Azcondo, University of Cantabria, ES; Juan C. Viera, Manuela González, University of Oviedo, ES	
High Efficient Flyback Converter with SiC-MOSFET	1639
Johann Austermann, Tim Stuckmann, Holger Borcherding, University of Applied Sciences Ostwestfalen-Lippe, D	
PCB Integration of a Magnetic Component dedicated to a Power Factor Corrector Converter	1647
Herault Guillaume, Mercier Adrien, Stéphane Lefebvre, Denis Labrousse, ENS Cachan-SATIE, F	
Evaluation of TCM and CrCM modulation for Totem Pole PFC	1655
Haihua Zhou, Wenduo Liu, Eric Persson, Infineon Technologies Americas, USA	
System Concept and Model-Based Optimization of High-Current Variable-Voltage Chopper-Rectifiers	1662
Zhiyu Cao, Holger Fahnert, Jürgen Schiele, AEG Power Solutions, D; Jitendra Solanki, Norbert Fröhleke, Joachim Böcker, University of Paderborn, D	
Evaluation of a Unidirectional Three-Phase Rectifier Based on the Third Harmonic Injection Concept in Comparison to a VIENNA Rectifier	1669
Markus Makoschitz, Hans Ertl, Technical University of Vienna, AT; Michael Hartmann, Schneider Electric Power Drives, AT	
SiC Improves Switching Losses, Power Density and Volume in UPS	1677
Nikolai Epp, Christian Schulte-Overbeck, Zhiyu Cao, Michael Lemke, Lothar Heinemann, AEG Power Solutions, D	
Optimization of 12 Pulse and 18 Pulse Rectifier Systems by the Selection of Optimum Parameters for Magnetics	1685
Kapila Warnakulasuriya, Carroll & Meynell Transformers, GB; Farhad Nabhani, Vahid Askari, Teesside University, GB	

DC-DC Converters I

- Analysis of the Flyback Converter Utilizing a Transformer with Stepped Air-Gap 1693**
 Panagiotis Mantzañas, Daniel Kübrich, Markus Barwig, Thomas Dürbaum, Friedrich-Alexander-University of Erlangen, D
- Novel Method for the Estimation of Switching Losses in Resonant Converters 1701**
 Christian Oeder, Markus Barwig, Thomas Dürbaum, Friedrich-Alexander-University of Erlangen, D
- Active Dead-Time Optimization for wide Range Flyback Active-Clamp Converter 1707**
 Sébastien Larousse, Nacer Abouchi, Remy Cellier, Institut des nanotechnologies de Lyon, F;
 Hubert Razik, Laboratoire Ampere, F; Philippe Volay, Centralp, F
- Energetic Macroscopic Representation (EMR) and Control Scheme for the Asymmetric 4-Stage MSBA 1713**
 Gina Steinke, Alfred Rufer, EPFL - Ecole Polytechnique Fédérale Dde Lausanne, CH
- Adjustable 20 kW Full-SiC Electronic Load with Energy Recovery for Medium-frequency Inverter 1721**
 Fabian Denk, Karsten Haehre, Julian Koerner, Rainer Kling, Wolfgang Heering, Karlsruhe Institute of Technology, D
- A New High Frequency Transformer for UPS 1728**
 Michael Schmidhuber, Manfred Wohlstreicher, Michael Baumann, Markus Schmeller, SUMIDA Components & Modules, D
- DC/DC-Converter for Modular Coupling of 48 V Battery Packs to a High Voltage DC Bus 1733**
 Michael Eberlin, Milad Mohammad Hossein Khani, Fraunhofer Institute ISE, D
- High Dynamic Current Source for LED Light and Data Transmission Applications 1741**
 Karl Edelmoser, Technical University of Vienna, AT; Felix Himmelstoss, Technikum Vienna, AT
- Design Methods for LLC Converter considering Buck and Boost Mode with Limited Frequency Range for Wide Input Voltage Range 1749**
 Dustin Funk, Tobias Reimann, Technical University of Ilmenau; Ulf Schwalbe, ISLE Steuerungstechnik und Leistungselektronik, D
- The Behavior of Electro-Magnetic Radiation of Storage Inductor in DC-DC Converters 1757**
 Ranjith Bramanpalli, Würth Elektronik Eisos, D

DC-DC Converters II

- A New High Frequency Ferrite Material for Gan Applications 1764**
 Herbert Jungwirth, Michael Schmidhuber, Michael Baumann, Markus Schmeller, SUMIDA Components & Modules, D
- Multi-Stage LLC Resonant Converters designed for Wide Output Voltage Ranges 1769**
 Chi Wa Tsang, Chris Bingham, University of Lincoln, GB; Martin Foster, Dave Stone, University of Sheffield, GB; John Leach, Castle, GB
- Application Advantages and Disadvantages of Modern Fast Switching MOSFETs in VRM 1777**
 Zhiyang Chen, Ann Starks, ON Semiconductor, USA
- Medium to Low Voltage DC/DC Resonant Converter with SiC SCRs and Nanocrystalyne Magnetic Core Transformer 1785**
 Iñigo Martínez de Alegria, Angel Luis Perez, Madaci Mansour, Jon Andreu Larrañaga, University of the Basque Country, ES; Kerdoun Djallel, GLEC Constanine 1, DZ

GaN Active-Clamp Flyback Converter with Resonant Operation Over a Wide Input Voltage Range	1792
Nicolas Quentin, SAGEM, F; Remi Perrin, Cyril Buttay, INSA de Lyon, F; Christian Martin, Charles Joubert, Ampere Laboratory, F; Bertrand Lacombe, Safran Group, F	
Demonstration of superior SiC MOSFET Module performance within a Buck-Boost Conversion System	1800
Maximilian Slawinski, Tim Villbusch, Daniel Heer, Marc Buschkühle, Infineon Technologies, D	
High Efficiency and High Power Density Boost / Buck Converter with SiC JFET Modules for Advanced Auxiliary Power Supply in Trolleybuses	1808
Miroslav Hruska, Skoda Electric, CZ; Martin Jara, West Bohemian University, CZ	
Development of a 12 kW isolated and bidirectional DC-DC Converter dedicated to the More Electrical Aircraft: The Buck Boost Converter Unit (BBCU)	1814
Pascal Asfaux, Jeremy Bourdon, Airbus Operation, F	
Reverse Mode Application of Sine Amplitude Converters	1822
David Bourner, Vicor Corporation, USA	
 DC-AC Converters	
Influence of the Configuration of the Load Cable on Switching Characteristics of IGBTs	1829
Lars Middelstaedt, Dennis Richter, Andreas Lindemann, Otto-von-Guericke-University, D; Arendt Winrich, Semikron, D	
Improved Power Decoupling Scheme for Single-Phase Grid-Connected Differential Inverter with Realistic Mismatch in Storage Capacitances	1837
Wenli Yao, Xiaobin Zhang, Northwestern Polytechnical University, CN; Xiongfei Wang, Poh Chiang Loh, Frede Blaabjerg, Aalborg University, DK	
Technical Approach: Interleaved, Folding, Interpolating Dual-Path Adiabatic Autotransformer Based Power Converter	1845
John Wood, Ed Shelton, Silicon Contact, GB; Kevin Rathbone, Robotae, GB; Mehdi Baghadadi, Patrick Palmer, University of Cambridge, GB	
Design and Performance Evaluation of a Three Phase AC Power Source with Virtual Impedance for Validation of Grid Connected Components	1846
Peter Jonke, Johannes Stöckl, Hans Ertl, AIT-Austrian Institute of Technology, AT	
Design and Testing of a Modular SiC based Power Block	1853
Maja Harfman Todorovic, Rajib Datta, Ljubisa Stevanovic, Xu She, Philip Cioffi, Gary Mandrusiak, Brian Rowden, Paul Szczesny, Jian Dai, Tony Frangieh, GE Research Center, USA	
A Novel Method to simulate the Control-to-output Transfer Function of Resonant Converters	1857
Julian Dobusch, Christian Oeder, Thomas Dürbaum, Friedrich-Alexander-University of Erlangen, D	
A Study of the Thermal and Parasitic Optimization of a Large Current Density Highly Parallelized Three-Phase Reference Board for Motor Drive Applications	1864
Mehrdad Baghaie Yazdi, Xiaomin Wu, Peter Haaf, Klaus Neumaier, Fairchild Semiconductor, D	

AC-AC and Multilevel Converters

- Trends in Residential and Industrial Induction Cooking: Topologies and Power Devices for High Efficiency** 1865
Vittorio Crisafulli, ON Semiconductor, D
- Direct Power Control for a Grid Connection of a Three Phase Z-Source Inverter** 1873
Manuel Steinbring, Mario Pacas, University of Siegen, D
- Interleaved Series Input Parallel Output forward Converter with Simplified Voltage Balancing Control** 1880
Kaspars Kroics, Alvis Sokolovs, Linards Grigans, Ugis Sirmelis, Riga Technical University, LV
- Fault-Tolerant Behaviour of the Three Level Advanced-Active-Neutral-Point-Clamped Converter ...** 1888
Sidney Gierschner, David Hammes, Jan Fuhrmann, Hans-Günter Eckel, University of Rostock, D;
Max Beuermann, Siemens, D
- Cell Voltage Balancing Controller for the Modular Multilevel Converter Arm using Symmetrical Transformation** 1896
Andrey Dudin, Aaron Fischer, Thomas Ellinger, Jürgen Petzold, Technical University of Ilmenau, D
- Isolated low-power multi-output DC-DC Converters with Heterogeneous Loads for an Efficient Supply of Modular Power Electronics Systems** 1904
Arthur Singer, Thomas Weyh, Florian Helling, Universität der Bundeswehr Munich, D; Arun Jeyaprakash,
Technical University of Munich, D; Stefan Götz, Duke University, USA
- A wire based communication interface for Medium and High-Voltage Converters** 1912
Marek Galek, Manuel Blum, Siemens, D
- An Auxillary Power Supply with integrated Communication Capability for Medium and Highvoltage Applications** 1919
Manuel Blum, Marek Galek, Siemens, D
- FPGA Based Direct Model Predictive Current Control of PMSM Drives with 3L-NPC Power Converter** 1926
Zhenbin Zhang, Christoph Hackl, Ralph Kennel, Technical University Munich, D
- IGBT Power Module in Three-Level Neutral Point Clamped Type 2 (NPC2, T-NPC, Mixed Voltage) Topology in Short Circuit Modes** 1934
Vladan Jerinic, Kevin Lenz, Reiner Hinken, Danfoss Silicon Power, D
- Efficiency Verification Power Circulation Method of a High Power Low Voltage NPC Converter for Wind Turbines** 1942
Berthold Benkendorff, Friedrich W. Fuchs, Christian-Albrechts-University, D; Toke Franke, Danfoss
Silicon Power, D
- Control of the Actively Balanced Capacitive Voltage Divider for a Five-Level NPC Inverter-Estimation of the Intermediary Levels Currents** 1949
Alfred Rufer, Nelson Koch, Nicolas Cherix, EPFL – Ecole Polytechnique Fédérale de Lausanne, CH

Automotive Applications

- Automotive Power Module Technologies for High Speed Switching** 1956
Shinichiro Adachi, Takuma Kouge, Souichi Yoshida, Hiroshi Miyata, Daisuke Inoue, Yoshikazu Takamiya,
Hideto Kobayashi, Akira Nishiura, Fumio Nagaune, Fuji Electric, J; Thomas Heinzel, Fuji Electric Europe, D

Power Semiconductors for the Automotive 48 V Board Net	1963
Felix Hüning, University of Applied Sciences Aachen, D	
Status and Advances in Electric Vehicle's Power Modules Packaging Technologies	1970
Itxaso Aranzabal, Asier Matallana, Oier Oñederra, Iñigo Martinez de Alegria, David Cabezuelo, University of the Basque Country, ES	
A Highly Integrated Full SiC Six Pack Power Module for Automotive Applications	1979
Bao Ngoc An, Viktor Wegelin, Martin Bernd, Benjamin Leyrer, Michael Meisser, Horst Demattio, Thomas Blank, Marc Weber, Karlsruhe Institute of Technology, D; Johannes Kolb, Schaeffler Technologies, D; Jochen Altstadt, Kortec, D	
Automotive-grade P-channel Power MOSFETs for Static, Dynamic and Repetitive Reverse Polarity Protection	1987
Filippo Scrimizzi, Giuseppe Longo, Giusy Gambino, STMicroelectronics, I	
Isolated On-Board DC-DC Converter for Power Distribution Systems in Electric Vehicles	1992
Sven Bolte, Joachim Böcker, Norbert Fröhleke, University of Paderborn, D	
Innovative Solution of Static and Dynamic Contactless Charging Station for Electrical Vehicles	1999
Nikolay Madzharov, Valeri Petkov, Technical University of Gabrovo, BG	
Combining an External Rotor Motor with Vernier Concept for Drives in Intralogistics	2007
Matthias Thesseling, Tao Liu, Lenze SE, D; Hans-Joachim Wendt, Lenze Drives, D	
Dynamic Modeling and Optimal control for Series-parallel Drivetrain based on Lithium-ion battery	2014
Tedjani Mesbahi, Ecole Centrale de Lille, F; Moudrik Meradji, Gaolin Wang, Dianguo Xu, Harbin Institute of Technology, CN	
Smart Diode and 4-Switch Buck-Boost Provide Ultra High Efficiency, Compact Solution for 12-V Automotive Battery Rail	2019
Vijay Choudhary, Mathew Jacob, Texas Instruments, USA	
On-Chip Temperature Measurement: A new Approach for Optimizing Automotive Inverters	2027
Laurent Beaurenaud, Inpil Yoo, Infineon Technologies, D	

Renewable Energy Systems

Resonant load Emulator for Distributed Energy Resources to test Anti-islanding Algorithms	2035
Daniel Heredero-Peris, Fernando Jorge-Ques, Daniel Montesinos-Miracle, Universitat Politècnica de Catalunya, ES; Tomàs Lledó-Ponsati, TeknoCEA, ES	
Low Voltage Ride Through (LVRT) Capability of an Enhanced DFIG System	2043
David Velasco, Jesús López, Public University of Navarre, ES	
Control and Modulation for Loss Minimization for Dc/Dc Converter in Wind Farm	2050
Catalin Gabriel Dincan, Philip C. Kjaer, Aalborg University, DK	
A Variable Step Size Perturb and Observe Method Based MPPT for Partially Shaded Photovoltaic Arrays	2058
Jawad Ahmad, Filippo Spertino, Paolo Di Leo, Alessandro Ciocia, Politecnico di Torino, I	
Renewable Electricity Conversion and Storage: Focus on Power to Gas process, EMR Modelling and Simulation	2066
Ahmed Remaci, Octavian Curea, Christophe Merlo, Amélie Hacala, ESTIA, F; Vincent Guerre, Local Energy Alternative & Fair, F	

Balancing Current and Efficiency Modelling of Single Switch Active Balancing Systems for Energy Storage Systems	2074
Iosu Aizpuru, Unai Iraola, Jose Mari Canales, Ander Goikoetxea, Mondragon University, ES	
A Control Strategy for Multiple Energy Storage Devices for Power Leveling of Renewable Energy Systems	2083
Koji Kato, Yoichi Ito, Sanken Electric, J	
Examining Contrasting Excitation Modes within Battery Characterisation using Maximum Length Sequences	2090
Andrew Fairweather, Vxi Power, GB; David Stone, Martin Foster, University of Sheffield, GB	
Comparison Between Standard and Innovative Solutions to exchange Energy between High Energy Storage Systems	2098
Laurent Garnier, Daniel Chatroux, Sébastien Carcouet, Julien Dauchy, University Grenoble Alpes CEA LITEN, F	

EMI, Harmonics, Filters

Simulation and Experimental Analysis of Non-Linear Loads from Residential and Educational Buildings	2106
Gabriel Nicolae Popa, Angela Iagar, Corina Maria Dinis, Politehnica University Timisoara, RO	
A Digital Predictive Constant Frequency Controller for High Frequency 3-Phase Silicon Carbide PFC Rectifier	2114
Marcelo Schupbach, Cree, USA; Binod Agrawal, Navneet Mangal, CREE India Private Limited, IN	
DC-link Harmonic Content in Double Two-Level Inverter for Permanent Magnet Synchronous Motor Drive Systems – Comparison and Analysis	2122
Toktam Khani, Michael Patt, Technologienetzwerk Allgäu, D	
Hybrid Filter With an Optimized Switching Method of the Compensation Capacitors and Predictive Active Filter Control	2129
Swen Bosch, Heinrich Steinhart, HTW Aalen, D	
Active Mains Filters with Combined Feed-Forward and Feed-Back Control	2137
Felix Himmelstoss, Technikum Vienna, AT; Karl Edelmoser, Technical University of Vienna, AT	
Influence of the Zero Sequence Voltage on the Design of a Series Active Filter	2145
Andreas Reinhold, Rolf Grohmann, HTWK Leipzig, D; Uwe Rädel, Jürgen Petzoldt, Technical University of Ilmenau, D	
Electromagnetic Emissions in High Density and Fast GaN Switched Half Bridges with Resonance Filter Structures	2151
Wolfgang Stocksreiter, Hans List, Hubert Berger, Gerald Weis, Markus Krenn, FH Joanneum, AT; Günter Engel, CeraCap, AT	

Energy Transmission and Grid

AC or DC Grid for Railway Stations?	2159
Lilia Galai Dol, Efficacity, F; Alexandre De Bernardinis, French Institute of Science and Technology for Transport, Development and Networks, F	
Solid-State Transformer Modeling for Analyzing its Application in Distribution Grids	2167
Christoph Hunziker, Nicola Schulz, University of Applied Sciences Northwestern Switzerland, CH	

Hybrid Reactive Power Compensation System for Grid Code Compliance in Renewable Energy Power Plants	2175
Gianluca Postiglione, Antonio Raso, Giovanni Borghetti, Francois Pezet, Nidec ASI, I	
A new shunt connected HVDC Tap Based on a Highly Efficient Resonant Cascade Converter	2181
Andre Birkel, Mark-M. Bakran, University of Bayreuth, D	
Analysis of Voltage and Current Unbalance in a Multi-Converter Topology for a DC-Based Offshore Wind Farm	2189
Thomas Lagier, SuperGrid Institute, F; Philippe Ladoux, University of Toulouse, F	
Experimental Demonstration of a Solid-StateDamping Resistor for HVDC Applications	2197
Konstantin Vershinin, Ikenna Efika, David Trainer, Colin Davidson, Alstom Grid, GB; Nick Wright, Amit Tiwari, Newcastle University, GB	
High Precision Loss Measurement at HVDC Converter	2204
Helmut Weiß, Technical University of Leoben, AT; Bernhard Grasel, Dewesoft, AT	
A Fast Methodology for Solving Power Flows in Hybrid AC/DC Networks: The European North Sea Supergrid Case Study	2211
Rodrigo Teixeira Pinto, Monica Aragues-Penalba, Andreas Sumper, CITCEA-UPC, ES; Christian Alejandro Leon-Ramirez, Elmer Sorrentino, University Simon Bolivar, VE	

Panel Discussion “The smart future of power electronics”

Using Smart Converter to obtain Traction-Machine Insulation Health State Information	2219
Markus Vogelsberger, Bombardier Transportation Austria, AT; Clemens Zöller, Jörg Bellingen, Thomas Wolbank, Technical University of Vienna, AT	

Manuscripts which were handed in late

Investigation of the Influence of Ageing Processes on Thermal Characteristics of an IGBT Power Module by Means of Transient Thermal Analysis	2226
Tobias von Essen, Berliner Nanotest & Design, D; Stefan Stegmeier, Gerhard Mitic, Siemens, D	
A Study of the Thermal and Parasitic Optimization of a Large Current Density Highly Parallelized Three-Phase Reference Board for Motor Drive Applications	2231
Mehrdad Baghaie Yazdi, Xiaomin Wu, Peter Haaf, Klaus Neumaier, Fairchild Semiconductor, D	