

Table of Content

Session 1: Power Electronic Systems

Chairmen: J. D. van Wyck, University of Johannesburg, South Africa; E. Wolfgang, ECPE e. V., Germany

- 1.1 Keynote: Performance, Trends and Limitations of Power Electronics Systems 17**
J. W. Kolar, ETH Zurich, Switzerland
- 1.2 Integrated Gate Driver Solutions (Invited paper) 37**
R. Herzer, Semikron Elektronik GmbH & Co. KG, Nuremberg, Germany

Session 2: System Integration

Chairmen: B. Allard, Ampere-Lab, Villeurbanne, France; J. A. Ferreira, Delft University of Technology, The Netherlands

- 2.1 High Density System Integration for Medium Power Applications (Invited paper) 47**
D. Boroyevich, Z. Chen, F. Luo, K. Ngo, P. Ning, R. Wang, Di Zhang, Center for Power Electronics Systems, Virginia Tech, Blacksburg; F. Wang, University of Tennessee, Knoxville; R. Burgos, ABB U.S. Corporate Research Center, Raleigh; R. Lai, GE Global Research Center, Niskayuna; S. Wang, GE Aviation Systems, Vandalia, United States
- 2.2 A Formal Approach to System Integration 57**
J. M. Gutierrez-Alcaraz, S. W. H. de Haan, J. A. Ferreira, Delft University of Technology, The Netherlands
- 2.3 Design for Fault Tolerance and Predictive Failures 63**
J. Wolmarans, J. A. Ferreira, H. Polinder, I. Josifovic, Delft University of Technology; D. Clarenbach, Aeronamic BV Almelo, The Netherlands
- 2.4 Modular Concept for Power Electronics in Electric Cars 69**
W. Wondrak, A. Dehbi, A. Willikens, Daimler AG, Boeblingen, Germany
- 2.5 Power Module with Solid State Circuit Breakers for Fault-Tolerant Applications 73**
K. Kriegel, A. Melkonyan, M. Galek, Siemens Corporate Technology, Munich; J. Rackles, Munich University of Applied Sciences, Munich, Germany

Session 3: Reliability

Chairmen: G. Coquery, INRETS, Versailles, France; U. Scheuermann, Semikron Elektronik GmbH & Co. KG, Nuremberg, Germany

- 3.1 Railway Traction Reliability (Invited paper) 79**
M. Mermet-Guyennet, M. Piton, ALSTOM Transport, Semeac, France
- 3.2 First Power Cycling Results of Improved Packaging Technologies for Hybrid Electrical Vehicle Applications 85**
A. Hensler, J. Lutz, Chemnitz University of Technology; M. Thoben, K. Guth, Infineon Technologies AG, Warstein, Germany

3.3	How Materials Behaviour Affects Power Electronics Reliability	91
	M. H. Poech, Fraunhofer Institute ISIT, Itzehoe, Germany	
3.4	Interface Degradation of Al Heavy Wire Bonds on Power Semiconductors during Active Power Cycling Measured by the Shear Test	97
	J. Goehre, M. Schneider-Ramelow, K.-D. Lang, Fraunhofer Institute IZM, Berlin; U. Geißler, Berlin University of Technology, Germany	
3.5	Observation of Chip Solder Degradation by Electrical Measurements during Power Cycling	103
	S. Hartmann, M. Bayer, D. Schneider, L. Feller, ABB Switzerland Ltd., Semiconductors, Lenzburg, Switzerland	
3.6	A Novel Built-In Methodology for Screening LDMOS Transistors to Achieve Zero Defects in the Automotive Environment	109
	V. Malandrucolo, M. Ciappa, W. Fichtner, Swiss Federal Institute of Technology (ETH), Zurich, Switzerland; H. Rothleitner, Infineon Technologies AG, Villach, Austria	
3.7	The Future of Wire Bonding is? Wire Bonding!	115
	D. Siepe, R. Bayerer, R. Roth, Infineon Technologies Austria AG, Villach, Austria	

Session 4: Drivers

Chairman: R. Bayerer, Infineon Technologies AG, Warstein, Germany

4.1	SiC BJT Driver Applied to a 2 kW Inverter: Performances and Limitations	119
	D. Tournier, P. Bevilacqua, P. Brosselard, D. Planson, B. Allard, Université de Lyon, Ampere-Lab, Villeurbanne, France	
4.2	Normally-On SiC JFETs in Power Converters: Gate Driver and Safe Operation	125
	D. Bergogne, D. Risaletto, F. Dubois, A. Hammoud, H. Morel, P. Bevilacqua, B. Allard, Ampere-Lab, Villeurbanne; R. Meuret, S. Dhokkar, Hispano-Suiza SAFRAN group, Moissy Cramaye; O. Berry, S. Raël, F. Meibody Tabar, GREEN ENSEM 2, Vandoeuvre les Nancy, France	
4.3	Insulating IGBT Driver with PCB Integrated Capacitive Coupling Elements	131
	S. Zeltner, Fraunhofer Institute IISB, Erlangen, Germany	

Session 5: Dialog Session – Poster

Chairmen: M. Stoisiek, University of Erlangen, Germany; G. Busatto, University of Cassino, Italy;
I. Omura, Kyushu Institute Technology, Japan; G. M. Martin, Valeo Créteil, France

P 1	MOS-Gated GTO: A New Functionally Integrated Device Suitable for High Voltage Power Applications	137
	C. Ronsisvalle, V. Enea, ST Microelectronics, Catania; C. Abbate, G. Busatto, A. Sanseverino, University of Cassino, Italy	
P 2	Importance of Boundary Conditions for Optimizing the Thermal Dimensioning of PCB Traces	143
	L. Coppola, B. Agostini, R. Schmidt, R. Faria Barcelos, ABB Switzerland Ltd., Baden, Switzerland	
P 3	Integrable Semiconductor Current Balancer for Paralleled Fluorescent Lamps	149
	R. Weger, NMB-Minebea GmbH, Odelzhausen, Germany	

P 4	Mechanical Characterisation of an Au-Ge Solder Alloy for High Temperature Electronic Devices	155
	S. Msolli, O. Dalverny, J. Alexis, M. Karama, University of Toulouse, Tarbes, France	
P 5	Evaluation of Commercial SOI Driver Performances while Operated in Extreme Conditions (150 °C – 200 °C)	161
	K. El Falahi, B. Allard, D. Tournier, D. Bergogne, Ampere-Lab, Villeurbanne, France	
P 6	Integrated Rectenna Circuit for Microwave Power Scavenging	165
	B. Merabet, H. Takhedmit, B. Allard, L. Cirio, F. Costa, O. Picon, C. Vollaire, Ampere-Lab, Villeurbanne, France	
P 7	Fast Extraction of Dynamic Thermal Impedance for Multi-Chip Power Modules	171
	P. Evans, C. M. Johnson, University of Nottingham, United Kingdom	
P 8	Inductive Parasitics in Power Semiconductor Modules subject to Multi-Objective Optimisation	177
	S. Förster, A. Lindemann, Otto-von-Guericke-University Magdeburg, Germany	
P 9	Normally-Off AlGaN/GaN HFET with P-Type GaN Gate and AlGaN Buffer	185
	O. Hilt, A. Knauer, F. Brunner, E. Bahat-Treidel, J. Würfl, Ferdinand-Braun-Institut, Berlin, Germany	
P 10	High Temperature Electronics for High Power Density DC-DC Converters and Motor Drives	189
	P. Delatte, V. Dessard, A. Saib, N. Pequignot, G. Picún, L. Demeûs, J. C. Doucet; T. Krebs, CISSOID S. A., Mont-Saint-Guibert, Belgium	
P 11	Preliminary Study for the Integrated Design of an Electro-Mechanical Wing De-Icing System	195
	F. Abdesselam, L. Boissy, Zodiac Aerospace, Paris, France; A. Castellazzi, T. Wijekoon, P. Wheeler, M. Johnson, University of Nottingham, United Kingdom	
P 12	Thermoelectric Cooling for Power Density Maximisation of Power Electronics Converters	201
	J. Biela, J.W. Kolar, Power Electronic Systems Laboratory, ETH Zurich, Switzerland	
P 13	Design of a Multi-Cell, DCM PFC-Rectifier for a 1mm Thick, 200W Off-Line Power Supply	207
	C. Marxgut, J. Biela, J.W. Kolar, ETH Zurich, Power Electronic Systems Laboratory, Switzerland	
P 14	Knowledge Matrix for Power Electronics – The Approach of the ZVEI Working Group ‘High Temperature and Power Electronics’	213
	M. Rittner, Robert Bosch GmbH, Schwieberdingen; A. Roth, Fraunhofer IISB, Nuremberg, Germany	
P 15	1200 V 6 A SiC BJTs with very Low VCESAT and Fast Switching	215
	A. Lindgren, M. Domeij, Transic, Kista, Sweden	
P 16	System based Optimisation of the Chip Size and the Thermal Path for Si and SiC Semiconductors	221
	T. Köneke, A. Merkert, A. Mertens, Leibnitz University Hannover, Germany	

Session 6: Power Electronics Applications

Chairmen: D. Boroyevich, CPES, USA; J.-H. Fabian, ABB Switzerland Ltd., Baden-Daettwil, Switzerland

- 6.1 Power Electronics System Integration for Electric and Hybrid Vehicles (Invited paper) 227**
M. März, A. Schletz, B. Eckardt, S. Egelkraut, H. Rauh, Fraunhofer Institute of Integrated Systems and Devices, Erlangen, Germany
- 6.2 Solar Power Inverters (Invited paper) 237**
R. Mallwitz, B. Engel, SMA Solar Technology AG, Niestetal, Germany
- 6.3 Fault Tolerant Drives for Aerospace Applications (Invited paper) 245**
G. J. Atkinson, J.W. Bennet, B.C. Mecrow, D.J. Atkinson, A.G. Jack, V. Pickert, University of Newcastle, United Kingdom

Session 7: Power Modules

Chairman: M. Bakran, Siemens AG, Nuremberg, Germany

- 7.1 Dynamic Paralleling Problems in IGBT Module Construction and Application 253**
U. Schlapbach, ABB Switzerland Ltd. Semiconductor, Lenzburg, Switzerland
- 7.2 Non Destructive SOA Testing of Power Modules (Invited paper) 261**
G. Busatto, C. Abbate, F. Iannuzzo, University of Cassino, Italy
- 7.3 Active Reduction of Common Mode Current in Power Modules 267**
J.-L. Schanen, T. De Oliveira, J.-M. Guichon, G2Elab, Grenoble;
S. Mandray, A. Bouzourene, Thales AES, Paris, France
- 7.4 Power Module with Additional Low Inductive Current Path 273**
M. Frisch, Vincotech GmbH, Unterhaching, Germany; T. Ernö, Vincotech Kft, Bicske, Hungary
- 7.5 Power Circuit Design for Clean Switching 279**
R. Bayerer, D. Domes, Infineon Technologies AG, Warstein, Germany

Session 8: Power Electronics

Chairman: M. Meinhardt, SMA, Niestetal, Germany

- 8.1 Development of a Mid-Power Core (35 kW) Dedicated to Inverters for Aerospace Applications 285**
R. De Maglie, G. Osvald, A. Mashaly, S. Liebig, J. Engstler, A. Engler, Liebherr Elektronik GmbH, Lindau, Germany
- 8.2 Evaluation of Power Density of a Reduced Switch Count Five-Level Three-Phase PWM Rectifier for Aircraft Applications 291**
J. Itoh, Y. Noge, Nagaoka University of Technology, Nagaoka, Niigata, Japan
- 8.3 Development of a Highly Compact and Efficient Solar Inverter with Silicon Carbide Transistors 297**
C. Wilhelm, D. Kranzer, B. Burger, Fraunhofer Institute for Solar Energy System, Freiburg, Germany
- 8.4 Mixed Switched Mode and Linear Lithium Ion Battery Tester for High Power and Large Bandwidth 303**
M. Fischnaller, J. Melbert, Ruhr-Universität Bochum, Germany

- 8.5 A Linear 10 kV Power Amplifier for Piezo Actuators 309**
T. Horn, J. Melbert, Ruhr-Universität Bochum, Germany

Session 9: DC/DC Converters

Chairmen: J. A. Cobos, UPM, Spain; A. Mertens, Technical University of Hannover, Germany

- 9.1 Three-Stage DC-DC Converter Solutions for SMPS Applications in Comparison 315**
U. Schwalbe, M. Scherf, T. Reimann, ISLE GmbH, Ilmenau, Germany

- 9.2 Fast Control Technique for High Frequency (5MHz) DC/DC Integrated Converter 321**
M. del Viejo, P. Alou, J. A. Oliver, O. García, J. A. Cobos, Universidad Politécnica de Madrid, Spain

Session 10: Packaging

Chairmen: F. P. McCluskey, University of Maryland, College Park, United States; D. Silber, University Bremen, Germany

- 10.1 Low Temperature Sinter Technology Die Attachment for Power Electronic Applications 327**
C. Göbl, J. Faltenbacher, Semikron Elektronik GmbH Co. KG, Nuremberg, Germany

- 10.2 Pure Low Temperature Joining Technique Power Module for Automotive Production Needs 333**
E. Schulze, C. Mertens, Volkswagen AG, Wolfsburg; A. Lindemann, Otto-von-Guericke-Universität, Magdeburg, Germany

- 10.3 Power Semiconductor Joining through Sintering of Silver Nanoparticles: Evaluation of Influence of Parameters Time, Temperature and Pressure on Density, Strength and Reliability 339**
M. Knoerr, A. Schletz, Fraunhofer Institute for Integrated Systems and Devices Technology (IISB), Nuremberg, Germany

- 10.4 Sintering Technology Used for Interconnection of Large Areas: Potential and Limitation for Power Modules 345**
T. Licht, R. Speckels, M. Thoben, Infineon Technologies AG, Warstein, Germany

- 10.5 Novel Silver Contact Paste; Lead Free Solution for Die Attach 351**
W. Schmitt, W. C. Heraeus GmbH, Hanau, Germany

Session 11: Materials

Chairmen: D. L. Saums, DS & A LLC, USA; M. Schneider-Ramelow, Fraunhofer Institute IZM, Berlin, Germany

- 11.1 Direct Bonded Aluminum on Aluminum Nitride Substrates via a Transient Liquid Phase and its Application 357**
Y. Kuromitsu, Y. Nagatomo, H. Tonomura, K. Akiyama, Mitsubishi Materials Corp., Naka, Ibaraki; C. M. Montesa. N. Shibata, Y. Ikuhara, The University of Tokyo, Japan

- 11.2 Evaluation of Insulation Material in Advanced High Power IGBT Modules with Extended Operation Temperature 363**
L. Feller, S. Hartmann, D. Schneider, ABB Semiconductors, Lenzburg; D. Granata, Swiss Federal Institute of Technology, Zurich; B. Behzadi, ABB Forschungszentrum Daettwil, Switzerland

- 11.3 Innovative Materials of Automotive Power Packaging 369**
 K. L. Tan, L. Vivet, J. M. Morelle, Valeo VEES; B. Pierre, Griset, Villiers Saint Paul;
 Y. Bienvenu, A. Kaabi, Armines, Evry, France
- 11.4 Application of Phase Change Materials for Low Duty Cycle High Peak Load Power
 Supplies 377**
 A. Stupar, U. Drofenik, J. W. Kolar, Power Electronic Systems Laboratory, ETH Zurich,
 Switzerland

Session 12: Prognostics – Thermal Management

Chairmen: F. P. McCluskey, University of Maryland, College Park, United States; J.-H. Fabian, ABB
 Switzerland Ltd., Baden-Daettwil, Switzerland

- 12.1 Current Status of Pronostics Techniques and Application to Power Electronics
 (Invited paper) 389**
 C. Bailey, C. Yin, H. Liu, The University of Greenwich; M. Musallam, C. M. Johnson,
 The University of Nottingham, United Kingdom
- 12.2 Validation of a Fast Loss and Temperature Simulation Method for Power Converters 395**
 A. Bryant, N-A. Parker-Allotey, I. R. Swan, D. P. Hamilton, P. A. Mawby, University of Warwick,
 Coventry, United Kingdom; T. Ueta, T. Nisijima, K. Hamada, Toyota Motor Corporation, Aichi,
 Japan
- 12.3 Thermal Pre-Dimensioning Methodology based on Thermal Impedance 401**
 P. Dubus, Powerlogy, Saint Forget; R. Leon, D. Le Guyader, L. Caves, Valeo, Créteil, France
- 12.4 A MATLAB Based Approach for Electro-Thermal Design of Power Converters 407**
 P. Cova, M. Bernardoni, University of Parma, Italy
- 12.5 Fast and Accurate Simulation of Time-Variant Air-Cooling Systems 413**
 T. Gradinger, Y. Liu, ABB Switzerland Ltd., Baden-Dättwil, Switzerland

Session 13: EMI & Cooling

Chairmen: J.-L. Schanen, G2Elab, Grenoble, France; E. Hoene, Fraunhofer Institute IZM, Berlin, Germany

- 13.1 Thermo-Mechanical Stress Analysis for a Multilayer SMT Manufacturing Technology 419**
 I. Josifovic, J. Popovic-Gerber, J. A. Ferreira, Delft University of Technology, The Netherlands
- 13.2 Investigation and PEEC Based Simulation of Radiated Emissions Produced by Power
 Electric Converters 425**
 A. Domurat-Linde, E. Hoene, Fraunhofer Institute IZM, Berlin, Germany
- 13.3 PEEC-Models for EMC Filter Layout Optimization 431**
 T. De Oliveira, J. M. Guichon, J.-L. Schanen, L. Gerbaud, G2ELab, Saint Martin d'Hères, France
- 13.4 Evaluation of Cooling Methods for a HVAC Drive System**
 F. P. McCluskey, V. Jha, R. Zimmermann, P. Hansen, University of Maryland, College Park, MD,
 United States
Paper not available
- 13.5 Vaporizable Dielectric Fluid Cooling for IGBT Power Semiconductors 437**
 D. L. Saums, DS & A LLC, Amesbury, United States

Session 14: Future Perspectives

Chairmen: J. D. van Wyck, University of Johannesburg, South Africa; P. Friedrichs, SICED GmbH & Co. KG., Erlangen, Germany

- 14.1 New Semiconductor Technologies Challenge Package and System Setup (Invited paper) 445**
G. Miller, Infineon Technologies AG, Neubiberg am Campeon, Germany

- 14.2 Future Role of Power Electronics (Invited paper) 451**
I. Omura, Kyushu Institute of Technology, Kitakyushu, Japan

- 14.3 Keynote: Is it the End of the Road for Silicon in Power Conversion? 461**
A. Lidow, Efficient Power Conversion Corporation, El Segundo, United States